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froglog

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Sub-Saharan Africa

Regional updates and latests research.

Leptopelis barbouri
photo taken at Udzungwa Mountains, Tanzania
photographer: Michele Menegon

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Sub-Sahara Africa is a focus for this issue of Froglog. In April I had a chance to visit Tanzania to meet with members of Conservation International's Tropical Ecology Assessment and Monitoring Network from across the world. In particular, there were African site managers from Cameroon, Democratic Republic of Congo, Kenya, Madagascar, South Africa, Tanzania, and Uganda. It was a privilege to be with researchers and conservation area managers who invest time and energy every day to gather the information needed to manage wisely Africa's natural resources. Coincidentally, the 12 July 2011 issue of Nature also highlights Africa, where so much of the continent's biology is still waiting to be discovered. I hope that you will enjoy all of the stories and reports in this Froglog issue, but in particular those from our colleagues in Africa.

A report on the 2011 Sabin Award honorees is an especially bright spot in this issue. Alonso Quevedo and Jonh Jairo Mueses Cisneros have invested time and energy to advance amphibian research and conservation in Colombia. Their pioneering work bridges the gap between science and conservation with the aim of protecting some of the most threatened species and habitats in the world. There is a lot that we can all learn from the deep commitment that these two investigators have made to understand the causes of global amphibian decline and extinction while also helping to conserve the most endangered species.

Finally, here are a few thoughts on Froglog itself. Froglog began as the newsletter of the Declining Amphibians Population Task Force (DAPTF). The newsletter was started by DAPTF's Board of Directors to keep our community informed regarding the most recent work on amphibian research and conservation. The goal was not to be another peer-reviewed publication. The current editorial group endorses this mission. We are interested in news, views, reports, and any other messages you feel will foster amphibian research, conservation, outreach, and the ASG network. We feel that this particular issue of Froglog begins to strike the balance we want of some international/ general articles with most focusing on the work of regional groups. While we edit submissions for content and presentation, we do not submit them to the rigorous peer review typical of our best scientific publications.

Froglog is your newsletter, so please send us your articles and your ideas for stories, reports, or news items that you would like to see covered in future editions.

James P. Collins
ASG Co-Chair

Froglog

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The Amphibian Survival Alliance

By Jaime Garcia-Moreno and Phil Bishop.

The Amphibian Survival Alliance (ASA) is a new initiative set-up by the International Union for the Conservation of Nature (IUCN) to coordinate and magnify conservation efforts to stop and reverse the ongoing crisis of global amphibian declines.

The first release of the Global Amphibian Assessment (GAA) in late 2004 led to an immediate response by the conservation community. By September 2005 the IUCN-SSC and Conservation International had convened an Amphibian Conservation Summit to determine the best way forward. Two main results of the Summit were (i) the creation of the Amphibian Specialist Group of the IUCN-SSC (www.amphibians.org) and (ii) the publication of a well-formulated Amphibian Conservation Action Plan in 2007 (ACAP, http://www.amphibians.org/ASG/Publications), which outlines the steps needed to understand, halt, and control this crisis. The ACAP, which has a 5-year price tag of over US$ 400 million, highlights eleven thematic areas relevant to amphibian conservation and provides guidance for implementing conservation actions and research initiatives at all scales, from local to global. Unfortunately, in spite of such an excellent road map, progress has been slow and intermittent, and a shortage of funds dedicated to amphibian conservation has made the implementation of the ACAP extremely difficult. However, progress has been made to some extent for both *in situ* and *ex situ* conservation by the Amphibian Specialist Group and the Amphibian Ark respectively. Meanwhile, between the first GAA in 2004 and the most recent update, the number of species thought to be extinct increased from 122 to 168, the number of declining populations continues to increase and the threats to habitats preferred by amphibians continue unabated.

In 2009, a coalition of organisations agreed to set up an inter-institutional Amphibian Survival Alliance to oversee the implementation of ACAP – focusing initially on habitat destruction and climate change, the fungal disease chytridiomycosis, and over-harvesting. This is expected to promote synergies and facilitate communications both within the amphibian community and with all the relevant stakeholders. IUCN has recently appointed Dr. Jaime García-Moreno M and Dr. Phil Bishop to serve, respectively, as Executive Director and Chief Scientist of the Amphibian Survival Alliance. They will oversee the formation and coordination of a global network of partner organizations to facilitate implementation of research, conservation and assessment programs as outlined in the ACAP.

The ASA is supported by and will be working in collaboration with organizations such as Conservation International, the Zoological Society of London, the Detroit Zoological Society, the North of England Zoological Society, Wildlife Conservation Society and Frankfurt Zoo, as well as related initiatives such as the Amphibian Ark and the Amphibian Specialists Group. Jaime Garcia-Moreno will work from his office at EAZA (European Association of Zoos and Aquaria) and is based in the Netherlands, closely collaborating with the Zoological Society of London and other partners of the Alliance. Phil Bishop will remain based at the University of Otago in Dunedin, New Zealand. To contact them directly please email them at the following addresses: Jaime.GarciaMoreno@iucn.org and Phil.Bishop@iucn.org.

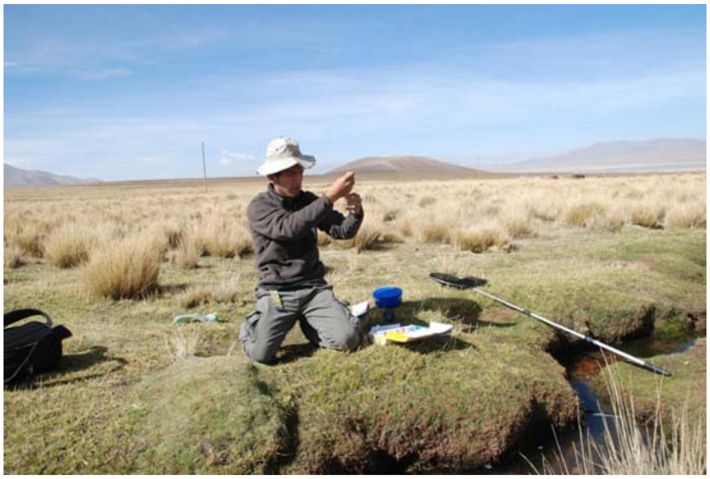
ASG International Seed Grant Award Winners 2011

We are pleased to announce the first round of recipients of the 2011 ASG International Seed Grants. The Seed Grant program, founded by the Declining Amphibian Populations Task Force, continues to be a hugely popular mechanism for kick-starting research and conservation programs that often develop into larger or longer-term projects. As always, the quality of submissions was extremely high with a wide range of projects spread across all continents on which amphibians occur. A thread running through the recipients of this round of Seed Grants is bridging the gap between research and conservation. As amphibians continue to decline and go extinct it is important that we apply our knowledge to their protection, and it is hugely encouraging to see such an interest from the research community in spearheading efforts to conserve amphibians.

Bolivian Amphibian Initiative

By Arturo Muñoz Saravia

Bolivia is considered one of the megadiverse countries that harbors a high number of species due to the different ecosystems present in the country; talking about Bolivian amphibians, there are more than 260 species, 60 are endemic and 54 are endangered. This high diversity and singularity contrasts with the poor knowledge and lack of conservation action to protect them. For this reason the Bolivian Amphibian Initiative is a project aimed to generate information about Bolivian amphibian distribution, population status of endangered species, to assess the situation of Chytrid fungus in Bolivia and also to monitor and protect Bolivian endangered species, focusing on high Andean species.



This project has four components: **Research**; providing data about amphibian diversity, population status, ecology, natural history and is trying to assess the real situation of Chytrid fungus in Bolivia. **Capacity building**; training a number of people from local communities, park rangers and young biologists in herpetological methods so to that will learn about amphibian their conservation situation and will acquire skills to work in amphibian conservation in a near future. **Education;** raising awareness about the amphibians and their diversity, situation and conservation work we are developing to protect them, and carrying out different activities designed for local communities, kids from schools and protected areas staff. **Captive breeding** of endangered amphibians; we are working mainly with the high Andean species of the genus Telmatobius with the purpose to increase knowledge about these species and also for conservation and education purposes.

This project will have a major impact on conservation in Bolivia by establishing the priorities of amphibian conservation regarding species and areas, and developing the knowledge, training and capacity to act on the priorities.

Understanding immunity to chytridiomycosis to improve reintroduction success

By Laura Grogan, Scott Cashins, Lee Skerratt, Lee Berger, Rick Speare & Erica Rosenblum

The goal of this project is to start to address the critical need for new, effective and sustainable management strategies to prevent continued amphibian declines and extinctions due to the key threat of chytridiomycosis. Our aim is to start to understand mechanisms of immunologic resistance and their potential for use in management to improve reintroduction success. We will do this by performing in vitro laboratory experiments on captively-raised Alpine Tree frogs (*Litoria verreauxii alpina*) which involve exposure to the fungus *Batrachochytrium dendrobatidis* (Bd). The project will compare immune mechanisms using metabolomics methods (not previously applied to the study of chytridiomycosis) as part of a larger existing collaborative project involving government, conservation agencies and universities. Metabolite expression will be compared between populations and experimental groups of Alpine Tree frogs with differential susceptibility and differing Bd exposure histories. This will allow us to develop an understanding of how metabolite profiles differ between 1) infected and control frogs, 2) populations of frogs exhibiting differences in innate immunity (naive and long-infected populations), and possibly 3) frogs exhibiting adaptive immunity (vaccination via live exposure and treatment) with those exposed to chytrid fungus for the first time. Metabolite data will be compared between experimental groups, and correlated with clinical evidence of infection status (via quantitative PCR zoospore equivalent swab results) to yield important information not only about basic biochemical pathways operating within the skin of both infected and control frogs, and also identify potential immune mechanisms which may play important roles in resistance to chytridiomycosis.

Rediscovery of one of the world's top 10 most wanted 'Lost Frogs', *Ansonia latidisca*, the Bornean Rainbow Toad, on Gunung Penrissen, Western Sarawak, Borneo

By Pui Yong Min, Ong Jia Jet and Indraneil Das

Ansonia latidisca, is an endangered species of tropical bufonid (Inger et al. 2004), currently known from two locations in the northwestern corner of Borneo. Prior to our discovery, this species was known from only three individuals. The holotype, an adult male, was collected by Johann Gottfried Hallier (1868–1932), a botanical assistant at the Buitenzorg (at present Bogor) Herbarium, from the summit of Gunung Damus (Kalimantan, Indonesia), the paratype, a female, taken by Robert Walter Campbell Shelford (1872–1912), entomologist with the Sarawak Museum, from Gunung Penrissen (Sarawak, Malaysia), in addition to a third specimen from the latter locality, collected by Eric Georg Mjöberg (1882–1938), Curator of the Sarawak Museum. Listed as one of the 'World's Top 10 Most Wanted Lost Frogs' by the IUCN/SSC Global Amphibian Specialist Group and Conservation International, A. latidisca has not been sighted since the late 1920s (see Inger 1966; Inger et al. 2004). The only published literature is the original description of Inger (1966), who referred to it as a montane species, with the holotype collected at about 1,200 m asl and the paratype at 1,300 m asl. The species is considered valid (see Manthey and Grossmann 1997; Matsui et al. 2009), and is listed as Endangered in Stuart et al. (2008) "in view of its extent of occurrence of less than 5,000 km^2 and area of occupancy of less than 500 km^2, with all individuals in fewer than five locations, and a continuing decline in the extent and quality of its habitat".

The 1,329 m Gunung Penrissen (Fig. 1) dominates western Sarawak, and forms the boundary between Malaysia's Sarawak State and Indonesia's Kalimantan Barat Province, and is drained mainly by Sungei Semadang and the headwaters of the Batang Kayan. The geology of this sandstone massif has been investigated by Wilford and Kho (1965), and comprises a matrix of sandstone and karst features, rising to the rugged ridges of the Penrissen range. The first and till now only multitaxic biotic inventory was conducted by Robert Shelford, on behalf of the Sarawak Museum, starting 5 May 1899 (described in Shelford 1916). Although Shelford's own interest was entomology (see Shelford 1901b), significant herpetological material was collected, which formed the basis of a couple of papers (Shelford 1901a; 1905), and others appear in list of material examined (e.g., Smith 1925; Inger 1966). Early collections of Shelford and his successors continue to form the mainstay in terms of material for research on various taxonomic groups of plants and animals of Gunung Penrissen.

Penrissen lies outside the protected area system of Sarawak, but is listed among the Important Bird Areas of the world by BirdLife International (www.birdlife.org). Threats to the area include resort development, poaching and habitat fragmentation (Anon. 2010a). The area has a long history of agriculture, especially rice, although rubber and pepper are also grown in all except the steepest terrain. Extraction of metallic and non-metallic minerals may also comprise a threat to the landscape in the future. Major development projects commenced in the Gunung Penrissen area in the last decade, with the view of promoting ecotourism and golf-tourism, the environmental effects of which remain largely unstudied. The 2,071 hectare resort, now operational close to the summit (at ca. 1,000 m asl), was planned by a Hawaii-based consortium (Tongg Clarke & McCelvey), and included an ambitious plan of development, including removal of most of the native vegetation, which was replaced largely with an 18-hole golf course and a 25 acre area of 'flower garden and theme parks' (Anon. 2010b). Baseline information on Penrissen's biodiversity is, however, meagre, the existing information stemming from Shelford's collection based on a single visit to these mountains (described in Shelford 1899).

We have initiated field work on Gunung Penrissen since August 2010, in a project initiated by The Search for Lost Frogs' campaign (see www.conservation.org/campaigns/lost_frogs/Pages/search_

Figure 1. View of summit of Gunung Penrissen, Sarawak, type locality of *Ansonia latidisca*.

Figure 2. Body in lateral view of adult female *Ansonia latidisca.*

for_lost_amphibians.aspx), to discover populations of *Ansonia latidisca*, employing standard inventory techniques appropriate for forest-dwelling bufonids. We have located three individuals of *A. latidisca* on three different mature trees (ca. 2 m above ground) near forest trails (Figs 2–3). Prior to this, no photograph of live *A. latidisca* was available.

Of the three *A. latidisca* encountered, OJJ-0009 is a juvenile, measuring 30.14 mm in snout-vent length (SVL). OJJ-0010 and OJJ-0011 are male (SVL 42.6 mm) and female (SVL 51.8 mm), respectively. The single male found show a distinctive vocal sac and developed testes. The female carries unripe ova, suggestive of reproduction later in the year. The description by Inger (1966) of *A. latidisca* match our specimens, with the male being smaller with a vocal sac and nuptial pads not visible. Our sample agrees further with the original description in showing large body size (in the female), exposed tympanum, dilated finger tips, elongate limbs and lack of tarsal fold. We consequently announce the rediscovery of *Ansonia latidisca* after its last collection in 1924.

In a recently published molecular phylogeny of the genus *Ansonia* (see Matsui et al. 2010), we did not include *A. latidisca* for lack of genetic material. However, an examination of its morphology indicates that the relation of this taxon may ultimately lie with another group of bufonids (including the bright dorsal pigmentation, elongate limbs, spatulate digit tips, and arboreal habits). Another Bornean bufonid, *Ansonia anotis* Inger, Tan, and Yambun 2001 and *Pedostibes maculatus* (Mocquard 1890), have been shown to be the same biological species, and has been allocated to a new genus- *Sabahphrynus* Matsui et al. (2007). *Ansonia latidisca* shares may characters with this taxon, differing in showing a tympanic annulus. Thus warrant further systematic work, including reevaluation of both its generic assignment (*Ansonia*) and consequently, of its suggested common English name ("stream toad").

Figure 3. Head in lateral view of adult female *Ansonia latidisca.*

Prior to the establishment of the Borneo Highlands Hornbill Golf & Jungle Club in 2000, the low and mid-elevation of Gunung Penrissen was extensively logged, restricting intact vegetation largely to the upper montane habitats. Although these forests have since been maintained as a reserve and as catchment area, habitat fragmentation may threaten the long-term survival of *A. latidisca*. The species is listed as Endangered in the IUCN Red List (see Inger et al. 2004), but is not protected under the Sarawak Wildlife Ordinance 1998. We refrain from divulging the exact site of observation, owing to the intense demand for brightly-coloured amphibians by collectors who supply the pet trade, locally and internationally (see Stuart et al. 2006 for justification).

Acknowledgments

Funding support for field research came from the "Lost Frogs" campaign of Conservation International, in partnership with the IUCN Global Amphibian Specialist Group and the Global Wildlife Conservation, as well as a grant from Shell Chair (SRC/05/2010[01]), administered by the Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak. We are grateful to Robin Moore, Don Church, and Nicolette Roach for support. For institutional support, we thank the Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, and our Director, Andrew Alek Tuen. Bernard Tiang, Cynthia Baring-Gould and Ramona Ngalih, of the Borneo Highlands Hornbill Golf & Jungle Club, provided us logistic support. We also thank David J. Gower for images and data associated with the long-preserved BMNH specimens of "Ansonia" latidisca. Finally, we thank the Sarawak Forest Department and Sarawak Forestry Corporation for permission (no. NCCD.907.4.4(V)-202) to conduct research.

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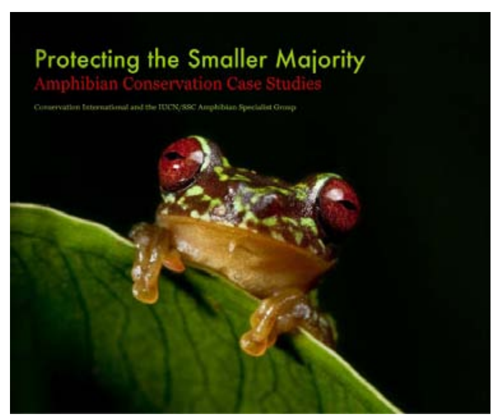
Five Years of Habitat Protection for Amphibians: New Book and Sabin Award for Amphibian Conservation 2011

Robin D. Moore

Since the ASG released the Amphibian Conservation Action Plan (ACAP) in 2006 as a blueprint for tackling the more pressing threats to amphibians worldwide, we have been working to address one of the most pressing long-term threats to the survival of many species: habitat loss. Amphibians, with their typically small home ranges, fall through the gaps in protected area coverage and are under huge pressure from the unabated destruction and alteration of habitat worldwide. With the generous support of Andrew Sabin and the Sabin Family Foundation, George Meyer and Maria Semple, we have been able to work with partners to enable the creation of some 14 new protected areas for amphibians in Latin America, Africa and Asia, home to at least 55 Threatened or endemic amphibians. To celebrate the successes of the past five years we have compiled a book called "Protecting the Smaller Majority: Amphibian Conservation Case Studies" that can be viewed (and purchased) online at: http://www.blurb.com/bookstore/detail/2244755.

We recognize that we have a long way to go, and welcome you to join us by supporting the work of the ASG in protecting critical habitats for amphibians around the world.

In addition to his support for the creation of new Protected Areas for amphibians, Andrew Sabin has, for the past four years, supported an annual award for amphibian conservation. The prestigious award was launched to support individuals or groups deemed to have made a particularly significant contribution to amphibian research and/or conservation and each year attracts an increasingly impressive and diverse suite of nominations. We are delighted to announce the recipients of the fourth annual Sabin Award for Amphibian Conservation. On June 27 in New York, Alonso Quevedo and Jonh Jairo Mueses Cisneros received their award from Andrew Sabin for their contribution to the conservation of amphibians in Colombia.



ARMI Seed Grant Award 2011

Historical disease prevalence, and current survival rates of a threatened amphibian (*Anaxyrus canorus*) with respect to chytrid infection intensity – team project awarded in 2011.

Call for applications:

The Amphibian Research and Monitoring Initiative Seed Grant Awards

Apply Now!

We are pleased to announce a new round of ARMI Seed Grants. ARMI Seed Grants are intended as one-time awards of between $500 and $2000 for the support or initiation of research that furthers the Amphibian Specialists Group's mission to conserve biological diversity by stimulating, developing and executing practical programs to conserve amphibians around the world, in addition to determining the nature, extent and causes of amphibian population declines.

The criterion for these awards is that the proposed work should be done on species or issues of concern in the USA. ARMI is particularly interested in funding research on potential stressors of amphibian populations. Please do not hesitate to contact Robin Moore if you need clarification or advice. Proposals of no more than 4 pages should be addressed to: Robin Moore, Programs Offcer, ASG at rdmoore@amphibians.org.

Read about the latest award winners in the ASG bimonthly publication - FrogLog.
View online at
http://issuu.com/amphibiansdotorg/docs/froglog96
or download from
http://www.amphibians.org/ASG/Publications

Maxwell B. Joseph - Award Winner 2011 - The legacy of an emerging disease: post-epizootic pathogen persistence in alpine lakes.

Sub-Saharan Africa

To help ASG members around to world keep up-to-date with the activities of regional ASG's, each edition of FrogLog focuses on one of the six geographical areas as outlined in FrogLog 96 (pg 6-7). This provides local ASG's with an opportunity to showcase their conservation efforts and publicize issues of concern. In this edition we focus on Sub-Saharan Africa, a zone consisting of four ASG groups; East Africa, West and Central Africa, Southern Africa and Madagascar.

East Africa

Amphibian research in the East African region is still in an exploration and discovery phase. Many new species continue to be found and described annually.

Much of the fieldwork has been in montane forests on the Eastern Arc Mountains and Albertine Rift. It is here that some of the most unusual discoveries have been made. In the past 10 years researchers have discovered over 40 new species, some of which are yet to be described. Emerging patterns reveal a high incidence of extreme local endemism, with some species restricted to a single valley. This further highlights the conservation importance of this archipelago of forest patches in Kenya and Tanzania, and has revealed a species diversity rivaling the much larger forests of the Albertine Rift.

Two species of caecelians, not seen since the type specimens were collected over 35 yeas ago, have been re-discovered, during CEPF funded fieldwork in the Taita Hills of Kenya. Local scientists and conservationists are working to restore habitat there for the Sagalla caecelian (see http://www.edgeofexistence.org/amphibian_conservation/sagalla_caecilian.php).

Two CEPF funded books documenting much of the research and discovery in the Eastern Arc are available online for free download at www.cepf.net/Documents/bilingual_field_guide_eacf.pdf and at http://africanamphibians.lifedesks.org/files/africanamphibians/Measey_et_al_2009_56-66_taita.pdf

Efforts continue in the region to map the distribution of the Chytrid fungus, *Batrachochytrium dendrobatidis*, but the extent and impact of chytridiomycosis on amphibian populations has not yet been determined. However, detrimental effects on vulnerable local populations have been observed in the dramatic decline and extinction in the wild of the Kihansi Spray Toad, *Nectophrynoides asperginus*. Ex-situ conservation efforts for this species continue in the US and Tanzania, and captive breeding facilities have been set up at the University of Dar es Salaam and the Kihansi Gorge. An attempt at reintroduction of this iconic species back into the wild will take place.

Even as new species are documented and long-lost ones re-discovered, threats to their are mounting. Human population pressure Eastern Arc Albertine Rift montane forests is huge. Habitat destruction through clearance of forests and understory for farming continues in many places and artisanal mining poses a growing threat to drainage systems and wetlands even in the most remote parts of the Albertine Rift forests.

David Moyer (Chair), East Africa Amphibian Specialist Group.

The Sagalla caecilian, *Boulengerula neideni*

The Sagalla caecilian, *Boulengerula neideni,* is listed as 'Critically Endangered' on the IUCN Red List of Threatened Species™. Only discovered in 2004, this species inhabits areas of rich, fertile soil within 30 km2 of Sagalla Hill, an isolated mountain in southeast Kenya. Subterranean, rarely encountered and regularly mistaken as an earthworm, the Sagalla caecilian is one of the most threatened amphibians on the planet.

Conversion of much of the indigenous forest to Eucalyptus plantation has led to a loss of habitat over most of its range. In remaining areas soil erosion due to poor farming practices has seen the disappearance of this species from an increasing area of otherwise suitable terrain.

This is an EDGE focal species and current projects aim to replant indigenous forest and remove alien Eucalyptus. Farmers are being taught better agricultural practice and there is real hope that active conservation of this species will benefit all inhabitants of this Eastern Arc Mountain biodiversity hotspot.

Rwanda - On a recent visit to Rwanda I was disturbed to see the impact habitat modification has had, particularly on the fragile Eastern Albertine Rift ecosystem.

The Gishwati forest in north-western Rwanda – a vast extent of endangered highland rainforest second in size only to the Nyungwe forest - was hastily settled by refugees after the genocide. Every single tree was cut down for firewood or building materials within the space of a year. The land was hastily partitioned to grow crops, and now widespread erosion washes away millions of tons of topsoil with every rain. Villages in the region are particularly prone to landslides and fields, roads and houses are suffocated by tons of silt.

Siltation is a major problem with all streams and rivers outside of Nyungwe forest. It has been suggested that siltation is a contributory factor in the decline of stream-dwelling frogs such as the Kloof Frog *Natalobatrachus bonebergi* in South Africa (Kok & Seaman 1989). In the western highlands of Rwanda several species of *Phrynobatrachus, Afrana* and *Hyperolius* occupy the same habitat, or have similar modes of oviposition, and my expectation is that they are now extinct outside of Nyungwe. Lake Karago, which was once pretty enough for the president of Rwanda to have his holiday home there, is now a muddy puddle, two thirds its original size due to the great silt delta that threatens eventually to choke it to death. Lake Karago is the type locality for *Ptychadena chrysogaster*.

Another chronic problem is that of overpopulation, with over 9 million people, the vast majority of whom follow a rural way of life, occupying a country the size of Wales. Because land is at a premium, even the uppermost slopes and crests of the mountains have been planted. The result of this homogenization of the environment is a gradual replacement of specialised amphibian species by 'generalised', highly-adaptive and generally wide-ranging forms.

Although the last president decreed a tree-planting day once a month, this was to provide for practical needs for building timber and firewood – not ecological replenishment. The trees are Australian bluegum (*Eucalyptus*) and conifers, which grow faster than indigenous species. They have no ecological value, but in replacing the indigenous species they are positively detrimental to ecological diversity, since their vegetation is unpalatable to African animals and very few plant species can coexist with them. Indigenous forests and stands of bamboo have been lost, and now probably only exist in their natural state in Nyungwe forest. The effects on species such as *Callixalus pictus* (which was described from Lutshiro in Rwanda) must be devastating.

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Martin Pickersgill, East Africa Amphibian Specialist Group.

West and Central Africa

After extended periods, where amphibian research in West and Central Africa was conducted by a few researchers only, it is very enjoyable to see that this has changed. Although this region comprises many of the poorest countries of the World, often being afflicted with civil wars, more and more herpetologists become aware of the lack of knowledge, and thus likewise the huge scientific potential in this region. It is even more enjoyable to see that this interest not only arouses in researchers and students from overseas, but likewise within the countries scientific communities.

A variety of research groups and individuals are now filling the many faunistic and taxonomic gaps and investigate the phylogeny and biogeography of western African amphibians. The same and other researchers, however, also start investigating amphibians from a conservation point of view. For instance the Nigerians A. Onadeko (University of Lagos) and M. Aisien (University of Benin) are exploring the influence of habitat (vegetation zones) and anthropgenic habitat alteration on amphibian communities. Similarly C. Boateng and G. Adum, both from the University of Kumasi in Ghana, compare the effect of fragmentation on amphibians in different forest types and the recovery potential of leaf litter frog assemblages after selective logging. Several groups also started to search for *Bd*, with very different results. However, it seems that chytrid is not (yet) a pressing problem in this part of the continent. Even a mass mortality event of a Cameroonian frog, *Xenopus longipes*, endemic to one mountain volcanic lake, showed no sign of *Bd* being involved. The last species and the viviparous Nimba Toads (investigated by T. Doherty-Bone and L. Sandberger, respectively), are the only two anuran species for which more comprehensive research programs, with a species specific conservation goal, has been established in the region.

Whereas some species, i.e. *Hyperolius nimbae*, could be retraced during the recent "Search for the lost frogs" program, others couldn't. The by far largest threat to western African amphibians is habitat degradation and conversion (in most West African countries less than 10% of the original forest cover still exists and many mountainous regions are currently explored for mining), probably resulting in the loss of many species before these have been even documented scientifically. More research programs, basic and applied ones, and more national and international funding initiatives thus are urgently needed.

Mark-Oliver Rödel (Chair), West and Central Africa Amphibian Specialist Group. Email: mo.roedel@mfn-berlin.de

Southern Africa

A meeting of the region's amphibian specialists in December 2009 led to the re-assessment of South Africa's threatened amphibians by the South African Frog Re-assessment Group (SA-FRoG) and IUCN SSC Amphibian Specialist Group. FrogLog (95:6-7) featured an article on this new Red List and a strategy document which outlines conservation research for the next five years in South Africa (Measey 2011: download a pdf for free at www.sanbi.org). Ongoing Red List work focuses on updating the database for South Africa's Least Concern species, and extending the Red List update to the rest of the southern Africa region (Namibia, Mozambique, Botswana, Zambia, Zimbabwe, Angola and Malawi). This will certainly be a more demanding task as the ASG is currently lacking any incountry southern African members from outside of South Africa.

Anyone interested should please contact the chair!

The response to the strategy document from South African stakeholders has led to some important developments. In Kwa-Zulu Natal, North-West University's amphibian researchers have teamed up with the Provincial nature authority (Ezemvelo KZN Wildlife) to investigate all occupied areas and threats to the Province's Critically Endangered Pickersgill's reed frog (*Hyperolius pickersgilli*), together with the other threatened species. New role players have also emerged, such as the Endangered Wildlife Trust (EWT, a local NGO) which is currently putting together an active conservation plan for amphibians in the region. In the Western Cape, South African National Parks have teamed up with SANBI and CapeNature to provide a multi-stakeholder approach to some of the most threatened amphibians there (see Turner et al this issue; Measey & Davies, this issue).

ASG members are also active with amphibian monitoring (e.g. the Endangered Hewitt's Ghost Frog: see Conradie, this issue) especially in relation to disease, with researchers from North-West University at the fore-front of assessing the status of the fungal disease, chytridiomycosis. Two academic meetings in South Africa in the past 12 months have seen southern African members of the ASG congregating with the inevitable benefits gained by the shared knowledge. In June 2010, the 10th African Amphibian Working Group (AAWG) met in Cape Town and in January 2011, at the biannual conference of the Herpetological Association of Africa. The next AAWG will be in Trento, Italy (28th May - 31st May) 2012 (details will be posted on www.africanherpetology.org), where we look forward to meeting all those interested in African amphibians.

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John Measey, Southern Africa Amphibian Specialist Group.

Mozambique - In January 2012 I will be undertaking a herpetological survey of the Zambezia highlands of north-western Mozambique as part of an international team of herpetologists. We will be building on work on the butterflies and flora of the region by Timberlake, Bayliss and others who regard this as a unique ecoregion, inclusive of Mount Mulanje to the west. Our aim is to catalogue the species richness of the area, the extent of gene flow between the isolated highlands, and the effect of habitat modification on species assemblages.

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Martin Pickersgill, East Africa Amphibian Specialist Group.

Madagascar

Madagascar is a country well-known for its biodiversity (Thompson et al., 2011) and especially for its amphibian's of which nearly 278 species are found nowhere else in the world (99.6 %) and 150 species are still waiting to be described (Vietes et al, 2009).

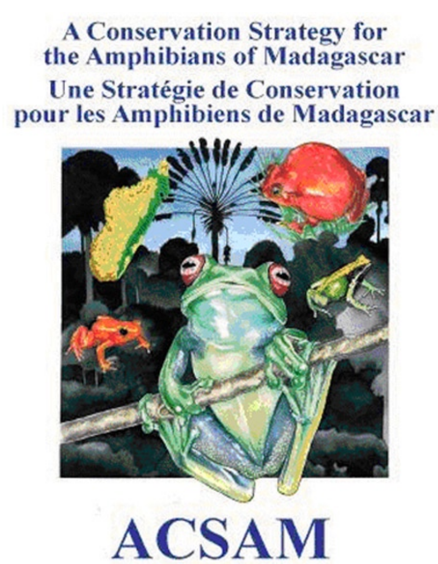

Figure 1. ACSAM's logo. Credit Franco Andreone.

This high number of amphibians has lead to a particular interest in the scientific community, as evident in the large number of papers published in the recent years and to a rapid succession of field-

Figure 2. Sahonagasy action plan booklet. Credit Franco Andreone.

guides produced (Glaw & Vences, 1992, 1994, 2007). The interest in amphibian conservation was driven by the Declining Amphibian Populations Task Force (DAPTF), transformed into IUCN/SSC Amphibian Specialist Group in 2007. Two of us (HR, FA) were designated as the Chairs of the DAPTF/ASG for Madagascar with the responsibility of coordinating major activities, and promoting general awareness of amphibian conservation related issues.

Following the Amphibian Conservation Action Plan meeting held in Washington DC in 2005 (Gascon et al., 2007), it was decided to start with a more-in-depth project to boost amphibian conservation efforts in Madagascar. To achieve these results, a specific workshop entitled "A Conservation Strategy for the Amphibians of Madagascar" was organized in Antananarivo 18-21 September 2006 (Fig. 1), to discuss and take actions for amphibian conservation. After this workshop, an initiative (ACSAM) was pursued by the ASG, in order to

Figure 3. Critically endangered amphibian species from Madagascar *Cophyla berara, Mantella mylotympanum, M. aurantiaca, M. cowani, Boophis williamsi* and *Mantidactylus pauliani*. Credit: Franco Andreone.

prepare and put in practice the action plan. ASG Madagascar strives to raise amphibian conservation to the next level by stimulating, developing, and executing practical programs to conserve amphibians and their habitats in Madagascar with all Malagasy stakeholders and foreigners who work with amphibians and biodiversity by avoiding or mitigating threats affecting amphibian populations. In particular, regarding the Madagascar species:

By conserving Malagasy amphibians over the long-term through raising public awareness and set aside areas specifically dedicated to protecting amphibians;

Figure 4. Distribution map of the seven Critically Endangered amphibian species from Madagascar (Conservation International, Madagascar)

Promoting the implementation of the Sahonagasy Action Plan (SAP, Fig. 2), one of the products of ACSAM initiative (A Conservation Strategy for the amphibians of Madagascar).

The SAP outlines the following strategic directions for amphibian conservation in Madagascar (for details see www. Sahomagasy.org):

- Coordination of research and conservation activities;
- Monitoring Madagascar's amphibians;
- Managing emerging amphibian diseases;
- Climate change and amphibians;
- Management of focal amphibian sites for conservation;
- Harvesting and trade of amphibians;
- Captive breeding and other zoo actions;
- Development of a unified herpetological collection.

Since the launching of the amphibian program in 2008 at Parc Botanique et Zoologique de Tsimbazaza (PBZT, Antananarivo), many actions have been achieved especially on focal areas of amphibians, but more work is needed especially on captive breeding projects, chytrid programs, climate change, and herpetological collections.

With close collaboration between ASG Madagascar and its partners, such as MATE (Man and the Environment), MAVOA (Madagasikara Voakajy), Conservation International, Madagascar National Park and VIF (Vondron' Ivon'ny Fampandrosoana, a Community Development based- group), all of the six critically endangered amphibian species from Madagascar are either under Protected Areas (*Stumpffia helenae, Cophyla berara*) or Temporary Protected areas (*Mantella mylotympanum, M. aurantiaca, M. cowani*) or in new protected area in progress (*Boophis williamsi, Mantidactylus pauliani)* (Fig. 3).

The programs working with ASG Madagascar are listed below with a map showing distribution (Fig. 4):

- Fohisokina project to conserve *Mantella cowani* with local population participation
- Mangabe project to conserve *Mantella aurantiaca*
- Corridor Ankeniheny-Zahamena for *Mantella mylotympanum*
- Ankaratra project for *Boophis williamsi* and *Mantidactylus pauliani*
- Sahamalaza New protected area for *Cophyla berara*
- Ambohitantely Special Reserve for *Stumpffia helenae*
- Start with Captive breeding in Andasibe with Mitsinjo Association
- Chytrid program with Emergent Cell Team
- Village tomato frogs for *Discophus*

antongili monitoring and conservation

The role of the ASG is to check if theses amphibian programs fit with Sahonagasy action plan and coordinate all activities related to amphibians by organizing meeting, disseminating information by mail groups or websites, such as www.Sahonagasy.org, working with all stakeholders and helping to fundraise for all activities identified during ACSAM.

Acknowledgements
Thanks to the Parc Botanique et Zoologique de Tsimbazaza, Département de Biologie Animale, Madagascar National Parks, and the Direction des Eaux et Forêts for permissions to work in Madagascar. Fieldwork was financially supported by several organisations and groups, such as Acquario di Genova, Amphibian Specialist Group, Andy Sabin Family Foundation, Conservation International, Declining Amphibian Population Task Force, Disney Wildlife Conservation Fund, European Association of Zoos and Aquaria, Gondwana Conservation and Research, IUCN Small Ecosystem Project Grant, Madagascar Fauna Group, Madagascar Institut pour la Conservations des Ecosystèmes Tropicaux, Mohammed bin Zayed Species Conservation Fund, Nando Peretti Foundation, the National Science Foundation, Van Thienhoven Foundation, World Association of Zoos and Aquariums, and Wildcare Institute. Among the many people with whom we repeatedly discussed about the effectiveness of amphibian conservation in Madagascar and whom we thank for their insights are O. Behra, Ch.P. Blanc, A. Bollen, N. Cox, K. Freeman, F, Glaw, J. Glos, V. Mercurio, J. Noël, R. A. Nussbaum, F. Rabemananjara, J. E. Randrianirina, G. M. Rosa, A. Sarovy, S. N. Stuart, and M. Vences.

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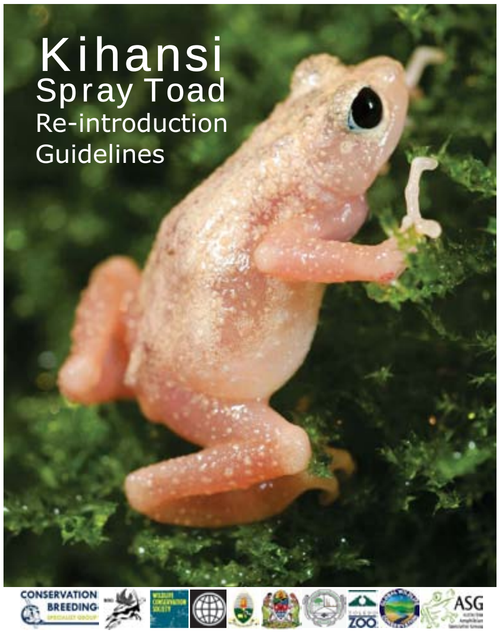
India - Chalazodes Bubble-nest Frog (*Raorchestes chalazodes*) © SD Biju

Kihansi Spray Toad Re-introduction Guidelines

By Don Church

In June, 2011, the Lower Kihansi Environmental Management Program of Tanzania's National Environment Management Council and the IUCN/SSC Amphibian Specialist Group published the Kihansi Spray Toad Re-introduction Guidelines (http://www.amphibians.org/ASG/Publications_files/KST%20reintro%20guide.pdf). Contributors included representatives from several agencies within the Tanzanian government, universities, NGOs, and zoological institutions.



The Kihansi Spray Toad, Nectophrynoides asperginis, is endemic to 2.0 hectares Kihansi Gorge of south-central Tanzania. The toad was believed to be extirpated from the area in 2003 and was declared Extinct in the Wild by the IUCN in October 2009. The decline of the species followed dam construction from 1996–2000 and coincided with the emergence of the amphibian chytrid fungus in the population, and the flushing of sediments into the gorge in June 2003. At the invitation of the Tanzanian Government, 499 toads were collected and transferred to the Bronx Zoo to initiate a captive breeding program in 2000. Currently, over 6,000 toads are housed by Bronx and Toledo Zoos in the USA, and at a captive breeding facility at the University of Dar es Salaam.

A Population and Habitat Viability Assessment (PHVA) workshop held in Bagamoyo Tanzania in May 2007. One of the primary challenges addressed during the 2007 PHVA meeting was increasing the size of the captive population. Since this meeting, the captive population has grown, providing a large enough stock maintained in biosecure facilities to return approximately 2,000 animals to Tanzania annually.

The recently published Kihansi Spray Toad Re-introduction Guidelines makes specific recommendations for the re-introduction of the species to the Kihansi Gorge, taking into account the current situation of a large captive population and new information about the state of the Kihansi Gorge's environment. The guidelines resulted from the Kihansi Spray Toad Re-introduction Workshop that was held in Dar es Salaam in February 2010. The workshop was facilitated by Cuthbert Nahonyo from the University of Dar es Salaam and attended by over 76 people. Several Tanzanian governmental and nongovernmental entities were represented including the Lower Kihansi Environment Management Project (LKEMP) and other programs within the National Environment Management Council (NEMC), Tanzania Wildlife Research Institute (TAWIRI), Division of Wildlife, TANESCO, University of Dar es Salaam, and Sokoine University. International participants included representatives from WCS-Bronx Zoo, Toledo Zoo, San Diego Zoo, Amphibian Ark, Museo Tridentino di Scienze Naturali, North West University, IUCN/SSC Re-introduction Specialist Group, IUCN/SSC Amphibian Specialist Group, State University of New York, USGS Patuxent Wildlife Research Center, and the World Bank.

Biogeography of West African amphibian assemblages

By Johannes Penner, Martin Wegmann, Annika Hillers, Michael Schmidt & Mark-Oliver Rödel

The West African fauna is often considered a subset of Central Africa, instead of being distinct. We used data on 120 amphibian assemblages from all over sub-Saharan Africa to test whether West Africa may be regarded an own bioregion. Our results showed that West Africa is indeed an own bioregion, at least concerning amphibians. West African savanna and forest amphibian assemblages grouped together, hence, sharing more similarities in species composition than e.g. West and Central African forest assemblages. The border between West and Central African assemblages is the Cross River in eastern Nigeria.

Within West Africa we detected several sub-regions which are mainly explained by the presence of major rivers. One possible explanation for the observed pattern in species assemblages may be differences in the evolutionary history of West African rivers compared to Central Africa ones. The former are believed to have persisted over time and therefore provided consistent barriers, savanna and forest assemblages evolving together. Central African rivers are thought to have been less stable and hence being porous barriers.

For more details see: Penner, J., Wegmann, M., Hillers, A., Schmidt, M., & Rödel, M.-O. (2011). A hotspot revisited - a biogeographical analysis of West African amphibians. Diversity & Distributions. DOI: 10.1111/j.1472-4642.2011.00801.x.

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The green heart of Africa is a blind spot in herpetology

By Jos Kielgast & Stefan Lötters

The world's second largest continuous tropical rain forest is found in the Congo Basin. It comprises a vast river drainage area intriguingly similar to that of the Amazon and includes more than 15 of the global WWF terrestrial ecoregions (Olson et al. 2001; de Wasseige et al. 2009). Fascinatingly, this notable area for tropical biodiversity harbours one of the least known herpetofaunas on our planet (Schiøtz 2006; Andreone et al. 2008). Most of the available knowledge derives from expeditions in the beginning of last century and a few prominent collections during the colonial regimes (e.g. Boulenger 1919; Noble 1924; Ahl 1931; Laurent 1943, 1950, 1972). Comparing the accumulated number of described species through time from the DRC with that of Brazil (The majority of the Congo and Amazon basins respectively) provide an illustration of this (fig. 1). A clearly exponential increase in species numbers since the fifties as observed for Brazil (as well as on global scale) has failed to appear in the DRC. This distinct stagnation in the rate of new species described may be interpreted as actually having described everything there. However, a more plausible explanation is that the region has simply been out of reach for science due to poor infrastructure and an unpredictable security situation. Further considering the Congo basin in the context of all current knowledge of amphibian biodiversity it stands out as a rather evident research gap in Afrotropical biodiversity (Fig.2).

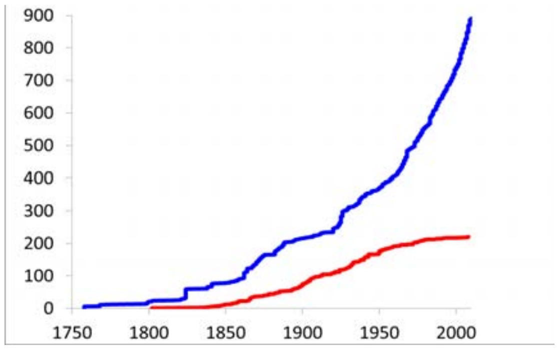

Fig. 1, Accumulated number of species described from Brazil (blue) and what is today The Democratic Republic of the Congo (red)

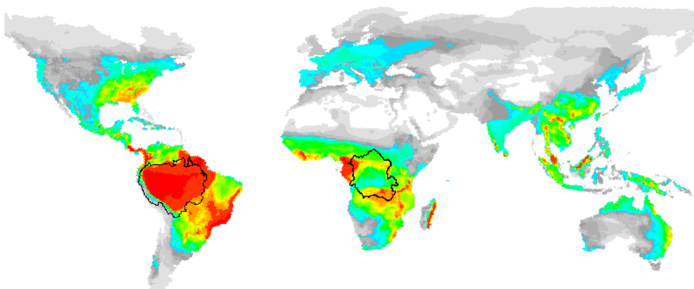

Fig. 2 Amphibian species richness according to the Global Amphibian Assessment (IUCN). Warmer colours indicate higher number of species. The Amazon and Congo river drainages are outlined in black.

For a few years now we have aimed to contribute towards filling this blind spot - improving the understanding of the evolution, ecology and systematics of amphibians in the Congo Basin. We have been involved in different projects in cooperation with a number of African and European institutions including the Belgian Royal Institute of Science, the Belgian Royal Museum for Central Africa, Museum Alexander Koenig and Max Planck Institute for Evolutionary Anthropology (Germany), Centre de Recherche en Sciences Naturelles (DRC), and Universities of Libreville (Gabon), Kisangani and Kinshasa (DRC). We regard faunistic surveys a basic step towards any other question. So far we have been engaged in collecting and identifying species in Monts Cristal (Gabon), the Ruwenzori Mountains (Uganda), Salonga National Park and a stretch of more than 350km of the Congo River (DRC). One of our focal groups is reed frogs, genus *Hyperolius*. Strictly employing an integrative taxonomic approach has revealed several conspicuous new species for the area as *H. veithi* (Fig. 3) from central DRC (Schick et al. 2010), among others yet un-described (Fig.4). However, a major part of working in this region consists of understanding names coined with poor descriptions based on single or few specimens only ever seen in preservation. An example is *Hyperolius sankuruensis* (Froglog 95, p.15) which we have now collected on multiple localities. A recent finding of this taxon initially led to the believe

Fig. 3 *Hyperolius veithi.* Photo: Jos Kielgast

Fig. 4 *Hyperolius* sp. Photo: Jos Kielgast

that it was new to science (Schiøtz 2006) until 2 specimens collected more than 50 years ago (Laurent 1979) were examined in the Royal Museum for Central Africa and the identity clarified. In other species all type material has presumably been lost and the difficult decision remains of coining new names or designating neotypes based on poor descriptions. *Hyperolius* cf. *brachiofasciatus* (fig 5) may be considered such an example. Strikingly this species appear to be both common and widespread in the entire Congo Basin - rather thought-provoking that this is the first ever published photograph of such a distinct species although it is calling loudly to be noticed all along the Congo River.

Fig. 5 *Hyperolius* cf. *brachiofasciatus*. Photo: Jos Kielgast

We call for a collaborative effort in exploring this neglected spot in global herpetological biodiversity. Even the most basic of knowledge is missing and the first steps towards understanding the fauna of the region are difficult. However, the exploration of patterns and processes of amphibian speciation, biogeography and ecology in the Congo Basin is sure to provide important insights and novel understanding of the African herpetofauna.

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Amphibians as indicators for the restoration of degraded tropical forests

By Noor de Laat

The Upper Guinean forests in West Africa are known for their high number of endemic animal and plant species (Brooks et al. 2001), but face ongoing biodiversity-loss through land conversion and forest degradation (Poorter et al. 2004; Ernst & Rödel 2005; Ernst et al. 2006; McCullough et al. 2007; Hillers et al. 2008). Except for combating continued forest loss, we should not forget that many plant and animal species will return to regenerating forests at some stage. In a review of 39 published studies, Dunn (2004) concluded that after shifting cultivation it takes 20-40 years for species richness to recover. Unfortunately most studies have been carried out at small spatial and temporal scales and they often lack replication (Gardner, 2010). This situation restricts our ability to make predictions about species richness recovery and species conservation in secondary forests.

Amphibians are very sensitive to habitat degradation (e.g., Wake 1991; Blaustein et al. 1994; Ernst et al. 2006). Many endemic and range-restricted forest frogs are for example unable to persist in logged or fragmented forests (Ernst & Rödel, 2005). Therefore, amphibians could serve as meaningful indicators for the restoration of degraded forests and could be a crucial part of a biodiversity monitoring program, providing important directions for conservation.

To gather information on recovery of the species assemblage in secondary forests, I designed a monitoring program for plants and amphibians. A first evaluation of the system was conducted in the Ashanti Region of Ghana (West Africa). This project was conducted in collaboration with FORM Ghana Ltd, a company that started reforestation projects on a previously highly degraded Forest Reserve seven years ago. Together with local employees of FORM Ghana I extensively searched along small rivers and in swampy areas for frog and toad specimens. We visited nine such possible microhabitats during one week in November 2010, at the end of the raining season. I assumed that differences in results caused by variation in sampling technique and effort between collectors were smoothed out over time.

Many highly degraded forest reserves are expected to change in the long run, and monitoring of the amphibians will be conducted in the course of at least a few consecutive years. Therefore it is very important to document vegetation succession since amphibian species composition is expected to change simultaneously. After sufficient sampling in the field, a species accumulation curve can give insight into the total number of species present. When using short-term sampling methods one has to be aware that the results are highly dependent on collecting methods, collectors' experience, level of sampling effort, weather prior to and during sampling (think of rain, dry season) and habitat of the amphibian species. Before comparisons can be made of one site at different times, any effect of these variables must be controlled for as much as possible. Practically, this can be done by the use of a clearly described method, a fixed number of people doing the sampling, a fixed planning and a fixed amount of sampling time.

Fig. 12 Frogs and toads found within Asubima Forest reserve (Ghana); 1. *Hyperolius nitidulus* (in dry season); 2. *Hyperolius concolor* (male); 3. *Kassina senegalensis*; 4. *Hyperolius concolor* (female); 5. *Phrynobatrachus calcaratus*, 6. *Ptychadena aff. aequiplicata* (juvenile; aff. because the real aequiplicata - which is morphologically identical - is restricted to Central Africa, the West African populations is currently being described as a new species); 7. *Leptopelis spiritusnoctis*; 8. *Phrynobatrachus gutturosus*; 9. *Arthroleptis cf. oecilonotus*; 10.*Hyperolius fusciventris burtoni* (juvenile); 11. *Amnirana albolabris* (juvenile);12. *Hyperolius guttulatus* (juvenile); 13. *Amietophrynus maculates*; 14. *Arthroleptis* spp.; 15. *Phrynobatrachus plicatus*; 16. *Afrixalus dorsalis*; 17. warty *Arthroleptis* (identification very uncertain); 18. *Hyperolius picturatus*; 19. *Hoplobatrachus occipitalis*; 20. *Phrynobatrachus latifrons*. (©Photo's by John Eckly and Noor de Laat)

Nineteen anuran species were found in our study. As expected, a mayority (63%) of the species represent a degraded forest ecosystem (e.g, *Afrixalus dorsalis, Phrynobatrachus latifrons, Amietophrynus maculatus*). Two species were unidentified (11%). Only the more densely vegetated parts of the reserve with closed canopy harbored species that are typically found in mature forests (e.g. *Leptopelis spiritusnoctis, Phrynobatrachus gutturosus, Phrynobatrachus plicatus*). These represent 26% of the species found. In the future, when the canopy closes, a shift in species composition is likely to be observed. Adjacent buffer zones, consisting of mature riparian forests, could therefore not only serve as core habitat but also as a corridor for species to move in and out of the area. Concluding, I think that anuran assemblages are a good indicator for environmental health since frogs and toads are sensitive to changes and they are responding strongly to vegetation development. Comparative studies in undisturbed forest and fine-tuning of the proposed method will eventually allow us to make predictions about biodiversity recovery after habitat degradation.

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Life-bearing toads on a misty mountain

By Laura Sandberger, Joseph Doumbia, Annika Hillers & Mark-Oliver Rödel

The bulk of the Nimba Mountains can be seen already from far off, very green in the rainy season and its head in the clouds. The mountain chain is situated in the triangle, Guinea-Ivory Coast-Liberia and comprises a large variety of habitats, ranging from lowland savanna and forests, mountainous forests along creeks, to high altitude grasslands. Extensive field work by French scientists in the 1940ties and 50ties revealed a very diverse fauna and flora, and the highest diversity of amphibians in West Africa (> 60 species). This also includes the World's only truly viviparous amphibian species, the endemic Nimba toads (*Nimbaphrynoides occidentalis*; Sandberger et al. 2010). Despite being the best known West African herpetofauna, recently two new species from there were described (Rödel et al. 2009, 2010) and one species was re-discovered during the "Search for the lost frogs" program (*Hyperolius nimbae* by N.G. Kouamé: http://www.conservation.org/learn/biodiversity/species/profiles/amphibians/Pages/hyperolius_nimbae.aspx).

Because of their uniqueness the Guinean and Ivorian parts of the Nimba Mountains were declared a World Heritage Site in 1981 and 1982 respectively, excluding the Liberian part where open cast mining took place from 1963 to 1992. Exploration for iron ore has occurred on-and-off since the late 1960s in the north of the Guinean Nimba Mountains.

Figure 1. Misty mountain grasslands on Mount Nimba, the habitat of the Nimba Toad.

Figure 2. A pregnant female of the viviparous Nimba Toad, *Nimbaphrynoides occidentalis*.

Funded by DAPTF, we undertook a re-assessment of the Nimba Toads and the forest amphibians in 2006 (Hillers et al. 2008). These data formed the bases of a monitoring program of the Nimba Toads and the riparian amphibian assemblages along the whole Guinean portion of the mountain range, funded from 2007 to present by the "Société des Mines de Fer de Guinée". The monitoring aims to detect potential population declines of the respective target anuran species; due to both natural and anthropogenic induced changes of the mountainous environment. Currently, the Nimba Toads are confined to only a few patches of the mountain grasslands, where according to older reports they seemed to be more widespread in the past. An in-depth study of the toads' current and past ranges, habitat requirements and their population genetics is hoped to help preserve these unique anurans in the face of pressures like mineral exploration and frequent savanna fires.

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Unravelling the mysteries of Lake Oku, where the frog is "Fon" (king)

By Thomas Doherty-Bone

Lake Oku is a crater lake at *c.* 2200 m a.s.l. in the catchment of Mount Oku, North West Cameroon, home to an endemic, aquatic frog, *Xenopus longipes* (Anura: Pipidae; IUCN: Critically Endangered). This frog is the most dominant vertebrate in the lake and it is proposed to fill the ecological niche normally occupied by fish. Lake Oku has no specific protection but is surrounded by montane forest, with a thin belt protected as a government "Plantlife Sanctuary", the rest of the forest under community-based management. There are no settlements around the lake. Surprisingly few ecological studies have been made on this lake. The first mention of Lake Oku by outsiders was by a German colonial explorer in the 19th Century who mentioned the lake, with buffalo and elephants in the area (Koloss 2000), all of which have become locally extirpated (Maisels et al. 2001). The 1984 International Council for Bird Preservation expedition spent six days camped above Lake Oku, and observed a *Xenopus* species dwelling in abundance in the lake (Gartshore 1986). In the wake of the Lake Nyos disaster, the basic limnology of Lake Oku was assessed, particularly it's potential to produce a potentially lethal limnic eruption (Kling 1988). Only in 1991 was *Xenopus longipes* described following an expedition to the region by Catherine Loumont who, following up the report of Gartshore (1986), sampled *Xenopus* throughout North West Region, but only found *X. longipes* in Lake Oku (Loumont & Kobel 1991). In 2004 *X. longipes* was assessed to be Critically Endangered by the IUCN due to its highly restricted range (Lake Oku is only 243 ha) and the threat of fish introduction first identified by Gartshore (1986) (Tinsely & Measey 2004). This assessment had no updated information since the original description of this species. Brief observations on Lake Oku were made by herpetologists in 2003, 2004 and 2006, the final year coinciding with observations of unexpected numbers of sick and dead *X. longipes* (Blackburn et al. 2010).

The "disease outbreak" at Lake Oku also coincided with our expedition to Mount Oku in June 2006, which aimed to rectify the general lack of data on amphibian conservation in Africa (e.g. Lawson & Klemens 2001) through sampling at least one region of high amphibian conservation value. The initial aim was not to make any specific study on Lake Oku, but on the whole amphibian assemblage across farmland and forests. However, when my team visited Lake Oku with the mere intention to see this unusual frog, the numbers of dead and dying frogs warranted further investigation, unaware of this also being observed by Blackburn et al. till after that field season. Work on Lake Oku started as an improvised weekly mark-recapture study over four visits to the lake. This made use of time-constrained dip-netting of frogs and batch-specific toe-clipping to try to assess how many frogs were surviving between visits and make a preliminary population estimate for future assessments. Over 700 frogs were marked for recapture, and many were surviving between sampling events. The cause of the disease remained unknown, even by Blackburn et al (2010) who analysed clinical specimens and postulated that environmental factors may have caused the mortalities, though like our own initial work was only a preliminary assessment.

Clockwise from top: Lake Oku, North West Region, Cameroon, a crater lake of 243 ha, at 2200 meters above sea level, surrounded by mountain forest that has been greatly reduced and fragmented; the critically endangered Lake Oku Clawed Frog (*Xenopus longipes*) is endemic to Lake Oku, Cameroon; the endangered frog *Astylosternus ranoides*, occurs around the lake with its tadpoles found in the shallow waters.

In 2008, funding was secured to return to Cameroon to focus on Lake Oku and *Xenopus longipes* with the aim to determine if this unexpected outbreak of disease had an impact on the population, decipher it's cause and to make a broader ecological study of the lake. This time more than one sample site at the lake was used, and the lake was sampled continuously for one month from October to November. A trapping survey was used as it was slightly more standardised (less susceptible to surveyor bias) than using a dip net survey, particularly as the frogs were found to be a lot less active during day-time that year. Water chemistry measurements were made to assess environmental factors in the lake such as pH, water temperature, ammonia concentration, nitrate concentration. Over 1000 *X. longipes* were captured at the three sample sites during the study period with recaptures from 2006. In May 2009, Lake Oku was surveyed again with over 250 *X. longipes* captured. Lake Oku was also very briefly revisited in September 2010 (see below). Sick and dead frogs are still being observed, with clinical samples deposited and examined at the Institute of Zoology, London. Final analyses and

Trained technicians from the local community monitor Lake Oku on a monthly basis to understand seasonal fluctuations of the frogs at the lake, and to assess changes to the lake in the long term.

publication are still pending, though at present conclusions are still uncertain. So far, amphibian chytrid fungus (*Batrachochytrium dendrobatidis*) has not been detected from any samples collected from Mount Oku, especially from sick *X. longipes* (Doherty-Bone et al. 2008, Blackburn et al. 2010). Due to this uncertainty for the viability of *X. longipes in-situ*, a captive assurance colony of *X. longipes* was successfully exported to Europe in 2008 in collaboration with Amphibian Ark, the Royal Zoological Society of Antwerp and the Zoological Society of London, with a Taxon Management Plan drafted for those colonies (Browne et al 2009).

However, the source of the uncertainty in the future of Lake Oku lies with the paucity of ecological knowledge on this ecosystem and its organisms, particularly its endemic frog. The subsequent field work has attempted to address this. At the end of the 2008 field season, a monthly monitoring programme was established at Lake Oku, supported by the Royal Zoological Society of Scotland, where a trained local technician would conduct a trapping survey and measure environmental parameters. This has provided seasonal data on the fluctuations in abundance of frogs at Lake Oku for over two years now, enabling contextualization of past, present and future observations at the lake. The monitoring programme has been timely in assessing the role of a recent "eruption" (possibly a limnic eruption – an explosion of gas from the bottom of the lake) at Lake Oku in the persistence of *Xenopus longipes* and wider ecology of the lake. So far, nothing unusual has appeared in the anuran abundance or chemical data since the reported eruption of gas from Lake Oku in April 2011, suggesting these frogs are adapted and thus resilient to such phenomenon.

The lack of life history and population data on *X. longipes* has been especially troubling for conservation assessments and planning. In-roads have been made on assessing the demography of *X. longipes* through first quantitatively assessing sexual dimorphism, then assessing sex ratio in the population, which appears to be female biased. Male *X. longipes* were found more often to dwell in deeper water amongst aquatic weeds. This observation has confirmed the suspicions of managers of captive *X. longipes* colonies, which are generally female biased too. This knowledge led to the export of a further ten male *X. longipes* to Antwerp Zoo in 2010. Underwater vocalizations have been recorded from Lake Oku that appear to be from pipid frogs, though isolation of male *X. longipes* have not yielded vocalizations but have only taken place during small time periods. These vocalizations are always audible in water that is deep enough to accommodate long stems of aquatic plants, where male frogs have predominately been captured. Live tadpoles of *X. longipes* have not been observed, though a few dead tadpoles have been washed up at the lake shore. These observations have unfortunately been restricted to the exterior of the lake waters, sampling in the interior of the lake so far un-attempted for safety and funding limitations, but is planned for the upcoming field season. It is hoped that the co-ordinated *ex situ* colony of *X. longipes* will yield insights into the life history and behavioural ecology of this species.

Extended study of the ecology of Lake Oku is being planned to assess the significance of this ecosystem to determine its true value and sustained protection, with work already underway. Lake Oku is a habitat for other threatened anuran species, such as *Phrynobatrachus steindachneri* (Petropedetidae, IUCN: Vulnerable), *Astylosternus ranoides* (Asytlosternidae, IUCN: Endangered), with a *Cardioglossa oreas* (Arthroleptidae, IUCN: Endangered) recently recorded at the lake during dry season. Samples of aquatic invertebrates and plants have been collected and deposited in relevant collections to allow future studies on the biogeography and food web of the lake – understanding the function of this ecosystem will allow us to understand the ecological significance of this frog. Plans are underway to sample other lakes in the North West and South West Regions of Cameroon to firstly make sure no other populations of *Xenopus longipes* occur as suggested by Loumont & Kobel (1991); and secondly to make ecological comparisons between the different lakes that will explain why Lake Oku is so special. Questions such as why fish do not occur in Lake Oku may be answered through this work.

An inventory of the other organisms is taking place at Lake Oku, including arthropods such as this water scorpion (Nepidae) that probably preys upon frogs. This inventory will enable future studies on the food web of Lake Oku, including the role frogs play in it.

This work has always been conducted with consideration and collaboration of local communities. Lake Oku has cultural significance to at least three ethnic communities in the region: the Oku, the Kom and the Kijem (Shanklin 1989, Koloss 2000). To the Oku, the lake is the resting place of a traditional god, the "Mawes", which is also the Oku noun for the lake itself. Traditional stories for the Kom discuss the lake as a landmark during an exodus of that community to their current territory. To the Kijem, Lake Oku engulfed their previous village, killing many of its people due to the wrath of the god "Mawes", the modern day settlement now significantly further away from the lake. Oku people have explained that the route of occasional present-day antagonism with a member of the Kijem community stems back to this divine catastrophe. Despite the cultural value of the lake, it is surprising that frogs at Lake Oku feature so little in traditional stories, in comparison to soil dwelling vertebrates such as caecilians (*i.e.* Doherty-Bone et al. In Press). During the return to Oku in 2008, the traditional head of the Oku community, the Fon ("king") of Oku decided upon reading the project proposal to provide a traditional title to the project co-ordinator. This unexpected title was "Fai Mawes", which means "notable of the Lake". The motives of the Fon were not clear, but this did raise awareness about the work taking place on the lake among the Oku elders and create a stronger connection between the project and the community. Instilling awareness of identity in traditional heritage of members of the Oku also seems to be a concern of the traditional authorities in Oku, and is supported by this project. Local communities are always kept informed of the work through public meetings, reports submitted to local libraries, and educational leaflets. An information board bilingual in English and Oku is planned for erection at Lake Oku to inform visitors and locals alike.

Lake Oku has great cultural value to surrounding communities, especially the Oku community, who are always consulted during fieldwork and engaged the principle researcher with a traditional ceremony (above).

The lack of understanding of the biological importance of Lake Oku now threatens this ecosystem in a nation desperate to improve the food security and well being of its people. The fears of introduction of fish by Gartshore and subsequent observers on Lake Oku are justified as aquaculture expands in Cameroon, and other high elevation crater lakes are stocked with foreign fish. In Oku, I am frequently asked by local entrepreneurs whether fish can survive in the lake. A pond that rears fish occurs less than a kilometre from the lake. I was told that introduction was held back after a herpetologist explained the risk to the Fon, but whether this abstinence can be sustained is uncertain. Other threats to the lake include the general degradation of the forest fragment surrounding the lake, incursions of livestock into the forest, of unsustainable tourism, of increased development and traffic on the road that goes through the forest and passes Lake Oku. It is still unknown if disease is affecting the population of *X. longipes*. This year a campaign has been made for funds to enable a participatory community initiative to ensure the protection Lake Oku and other critical amphibian habitats on Mount Oku. Decisions for funding are still pending. Other amphibian species restricted to lakes include the Mexican Axolotl (*Ambystoma mexicanum*) endemic to Lake Xochimilco and the Lake Titicaca Frog (*Telmatobius culeus*) endemic to Lake Titicaca. Both these species are also Critically Endangered, with *X. longipes* in a comparatively enviable position of being in a far more pristine ecosystem. Whether this enviable position will be sustained in a modernizing Cameroon is another issue.

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Adaptation or extinction – anurans along altitudinal and degradation gradients in south-western Cameroon

By Mareike Hirschfeld, Matthias Dahmen & Mark-Oliver Rödel

Among the threatened amphibian species; especially those in forested tropical highlands have to cope with dramatic climate alterations and man-made habitat degradation (Williams et al. 2003; Stuart et al. 2004). This calls for studies, allowing predicting the capability of species to survive in habitats, and environments that are likely to change in the future. Our research aims unrevealing links between survival probability and species specific habitat needs and life-history traits. We selected three anuran genera: *Cardioglossa*, *Arthroleptis* and *Phrynobatrachus*. *Cardioglossa* and *Arthroleptis* are closely related (family Arthroleptidae) but differ in their biology; e.g. *Arthroleptis* are direct developers; in contrast *Phrynobatrachus* (Phrynobatrachidae) and *Cardioglossa* have free swimming and feeding tadpoles. Our research focuses on two regions in south-western Cameroon; Mount Manengouba and the Ebo Forest Reserve and adjacent areas. All three genera comprise several species along the altitudinal (lowland to 2400 m asl) and habitat (pristine forest to farmland) gradients; hence, allowing to search for correlations between the range of selected habitats and particular life-history traits. We hope to identify phylogentically independent life-history traits which facilitate and / or constrain species' adaptation capacity to current or future habitat and climate alterations. Such linkages between particular traits and the use of specific habitats may be potentially applicable to other anuran species in comparable ecosystems.

Figure 1. *Cardioglossa pulchra* occurs in a wide range of habitats and altitudes in mountainous western Cameroon and adjacent Nigeria.

Figure 2. *Cardioglossa trifasciata* is an endemic species of Mount Manengouba, where it is restricted to forests in higher altitude.

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Re-Visiting the Frogs and Toads of Zimbabwe

By Rob Hopkins

During the past four decades, Zimbabwe has undergone major changes in social and environmental conditions. These changes have bye and large affected research negatively. The bush war, precluded field trips, and research halted for that period. Social changes have also impacted seriously on these functions.

The political climate prevailing has precluded funding for research, and Government has assigned research funding to the back burner. Museums have little fiscal ability for field trips. Vehicles are in a bad state of disrepair, and are mostly stagnant wrecks. It therefore falls upon the individuals to finance their own projects.

The ecosystem is largely compromised by the discovery of diamonds and new gold fields, these activities are under the auspices of Russian and Chinese organisations, who have little or no interest in ecological preservation. Unfortunately, the activities are in a particularly fragile area, the eastern border with Mozambique.

In May 2010, Doctor Don Broadley and I, re-visited the Inyanga area, we were in search of Amieta *Inyangae* Poynton, 1966 (the Inyanga River Frog). This was because of a request by Professor Alan Channing. Don had located the holo type at the base of Mount Inyangani, some fifty odd years previously and last recorded in 1974. We relied on my private sedan motor vehicle to take us to the site. However, we broke down, and walked some thirty odd kilometres to Inyangani, and back. After some searching, we were only able to locate a number of Strongylopus *fasciatus* tadpoles. Search of the original site revealed no sign of

Amieta Inyangae. We had reluctantly to report our failure to Alan Channing.

In late August, early September 2010, Alan and his wife Jenny came up to Zimbabwe in their Landrover, and we again went to the original site, but again we were unable to locate Amieta Inyangae. We then tried to locate this species at the Ntarazi Falls, a location that had previously borne results; this river empties into the Pungwe River, the main river that eventually feeds water to the City of Beira in Mozambique. This river is showing serious signs of siltation. We located a number of Amietophrynus *garmini* Meek, 1897 tadpoles; they had to depart without having accomplished their main objective.

In September 2010, Don and I were part of a field trip to locate the missing frogs; we went to the John Meikle Forestry Station. A site where probreviceps *rhodesianus* Poynton & Broadley, 1967 (Zimbabwe Forest Rain Frog), had been located. That find was in November 1966, here we found that the environment had been affected adversely, we encounter a number of vehicles driven by Chinese personnel. We at no time heard the calls of bush babies (Galago *crassicaudatus*), but only found one of their tails; the animal obviously had been caught in the numerous snares. The Crowned eagle (Stephanoaetus coronatus), the bush babies' main predator, was also not heard or seen. I walked to the Nyamwarara river, now showing serious siltation, and was able to find Xenopus *laevis* Daudin, 1802 (Common Platanna), these had previously not been recorded in this river, preferring less fresh habitats the siltation obviously attracts them.

Our next stop was at Chimanimani, here we wanted to locate Strongylopus *rhodesianus* Hewitt, 1933 (Chimanimani stream frog) and Arthroleptis *troglodytes* Poynton, 1963 (Cave Squeaker), neither of which were located. We had been joined by a group from South Africans led by Mike Cummings; they did find a new Strongylopus, which Mike is in the process of describing.

As can be seen there is an urgent need for more fieldwork, but we are hampered by the lack of transport and funds, I have been able to recruit a number of personnel in various parts of the country, who are sending in observations. It is worth mentioning that Pyxiecephalus is in dire need of conservation, their numbers particularly of *adspersus* is diminishing every year, of the fifty-six known species, only thirty-nine have been recorded in the last two years. It is obvious that our endemics are particularly at risk, and it is almost assumed that they may have gone extinct, hopefully not. ***But our search goes on.***

Rob Hopkins is a Research Associate with the National Museums of Zimbabwe.

Amatola Toad AWOL: Thirteen years of futile searches

By Werner Conradie & Jeanne Tarrant

South Africa has rich amphibian diversity for an arid country with 118 known species. Although 18% of the species assessed in 2010 were classified as threatened, no species has yet been regarded as extinct. That is until now. The Amatola toad (*Vandijkophrynus amatolicus*) is a small toad species, restricted to the montane grassland of the Winterberg and Amatola mountains. Over the last two decades the species status has changed from Restricted (1988), to Vulnerable (2000), to Endangered (2004), and was most recently raised to Critically Endangered (2010). It was also recognized as having high priority by Amphibian Ark and was recommended for a full *ex situ* rescue plan.

The last sighting of this species was in 1998 and since then more than ten searches in optimal breeding conditions by recognized herpetologists have proved frogless. The latest effort was during Conservation International's 'Lost Frog' campaign. A team of seven researchers, led by Werner Conradie, went to known localities to search for the toad in September 2010, but with no success. Is it already too late for this species? The Eastern Cape Province of South Africa has been experiencing a major drought cycle for the last eight years and this may be a contributing reason for the difficulty in finding this little frog. This species might possibly be extinct, but more searches are planned for the coming breeding season.

In addition to drought, the species is affected by several threats especially the loss of habitat as a result of utilisation for forestry. Much of the key habitat of the Amatola toad is now overrun by pine plantations. These not only cause a reduction in water levels, but mismanagement of forestry causes a loss of suitable breeding habitat through placement of trees into wetland areas and incorrect burning regimes. Other threats include dam construction, overgrazing and other agricultural activities in the area.

Amatola toad (*Vandijkophrynus amatolicus*). Photo: Vincent Carruthers

As with other species of amphibians that are now considered extinct (such as the Golden toad), the Amatola toad used to gather in very large numbers to breed and was thus relatively easy to detect. That such congregations have not been witnessed for 13 years must beg the question as to the existence of the species. Although researchers are not giving up, this species may represent the first to completely disappear from South Africa.

Atypical breeding patterns observed in the Okavango Delta

By Ché Weldon & Marleen le Roux

Globally, there is a generalised reproductive pattern among anurans that involves short, annual mating episodes; followed by spawning during which time eggs are laid and left unattended; and finally the hatching and development of aquatic larvae. However, universal statements about the reproductive patterns of anurans are not possible since individual species show great variation and diversity in the reproductive strategies they employ.

Ptychadena guibei. Photo: Ché Weldon

Ptychadena subpunctata. Photo: Ché Weldon

The reproductive activity of temperate species seems to be seasonal and short-lived, and driven by both rainfall and temperature (Duellman & Trueb, 1994) The Okavango Delta falls within the transitional complex, in the largest zoogeographical unit of southern Africa amphibian diversity, called the central tropical transitional fauna (Poynton, 1964). It contains species from the tropical West African fauna to the north, as well as species from the temperate fauna to the south (Auerbach, 1987). Therefore, broadly speaking, it follows that reproductive patterns of amphibians in the Okavango Delta would be consistent with that of the seasonably dry tropics, where reproduction is closely linked to the rainy season; as well as the subtropical/temperate regions, where reproduction commences with the arrival of seasonal rainfall.

The weather pattern of the Okavango Delta can be divided into two seasons; the summer (November to February) is the rainy season and coincides with low flood levels (the minor flood), and the dry winter season (March to October) which coincides with the major flood when water levels are highest. We investigated how the hydrology of the ecosystem influences the breeding behaviour of amphibians in the Okavango Delta.

We assumed that the breeding behaviour of the 28 species encountered during our investigation would be dominated by explosive breeders (58% of species), and the rest of the species equally split between prolonged summer breeders and continuous breeders. The results of observations spanning two years, proved considerably different from what was expected, with the explosive breeding class decreasing substantially, the prolonged summer breeding class falling away completely, and the number of species in the continuous breeding class more than doubling from the expected number. The only species that exhibited explosive breeding behaviour consistent with populations outside of the Delta included *Hemisus* (2 species), *Pyxicephalus* (2 species), *Kassina senegalensis, Breviceps adspersus, Chiromantis xerampelina, Tomopterna cryptotis* and *Phrynomantis bifasciatus*. The genus *Ptychadena* (7 species) was reclassified from explosive to continuous breeders (e.g. continued to breed in the dry season). *Amietophrynus* (4 species) was reclassified from prolonged summer breeders to continuous breeders (e.g. peak acoustic activity in June and larvae present). So too, was *Xenopus* (2 species). For all three continuous breeder genera, breeding was evident in the summer rainy season, as expected, but breeding was not restricted to these months. The breeding behaviour of the remaining species *Phrynobatrachus* (3 species) and *Hyperolius* (3 species) did not differ from their known classification as continuous breeders.

The results imply that there exists more than one breeding peak for these genera over the course of a year, and that these peaks are not consistently associated with rainfall. It appears as though these genera are opportunistic breeders, utilising other environmental variables for the commencement of breeding activity. We believe this rather unique shift in breeding strategy for many of the species within the natural boundaries of the Delta can be explained within the context of the flood pulsed nature of the Okavango Delta ecosystem. Two wet seasons with high biological productivity occur in the Okavango Delta; the first of which starts with the summer rain, and the second occurs in winter and results from the annual major flood. It appears that this breeding strategy has evolved in the frog populations inhabiting this region to exploit the higher biological production resulting from the flood pulse in winter.

It can therefore be concluded that the breeding activity of some amphibian species occurring in the Okavango Delta is controlled not only by rainfall (as is the case for the majority of southern African taxa occurring in summer rainfall areas), but also an additional mechanism related to the flood pulse that results in opportunistic breeding in winter.

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Eight years of Giant Bullfrog (*Pyxicephalus adspersus*) research revealed

By Caroline A. Yetman

The Giant (African) Bullfrog (*Pyxicephalus adspersus*) (Figure 1) could be regarded as one of sub-Saharan Africa's "Big 5" anurans along with the Goliath Frog (*Conraua goliath*), the Maluti River Frog (*Amietia umbraculata*), the Hairy Frog (*Trichobatrachus robustus*) and the Leopard Toad (*Amietiophrynus pardalis*). Adult male Giant Bullfrogs (~ 400 - 1 000 g) weigh up to ten times more than females (~ 90 - 300 g; Cook, 1996), and are known to consume animals as large as young chickens (Branch, 1976). Giant Bullfrog breeding has been described as a rare example of amphibian "lekking" (Emlen and Oring, 1977), and when males fight over favoured oviposition sites, they often injure each other with the large canine-like projections on their lower jaw (Grobler, 1972).

Figure 1. A male Giant (African) Bullfrog (*Pyxicephalus adspersus*) in Gauteng Province, South Africa. Photo: C. A. Yetman.

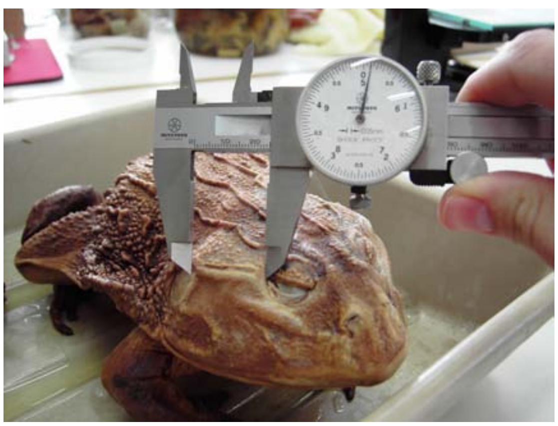

Figure 2. Giant Bullfrog museum specimens were carefully examined prior to inclusion of their locality information in a model used to predict this species' geographic range in southern Africa. Photo: C. A. Yetman.

Giant Bullfrogs reportedly occur across most of southern and in parts of East Africa (Channing, 2001) and therefore, are not globally threatened (IUCN, 2008). In South Africa, however, the species is considered Near-Threatened (Minter et al., 2004) due to estimated population declines of between 50 and 80% caused mainly by habitat loss in Gauteng Province (Harrison et al., 2001), Africa's economic epicentre (GDACE, 2004). Unfortunately, effective conservation management of this species has been hampered by a lack of field-based research and monitoring of populations. To tackle this problem, in 2003 I commenced with a doctorate on various aspects of the ecology and conservation biology of the Giant Bullfrog. Here follows a brief description of research involved in this eight-year project, which is now near completion.

An ecological niche model was used to predict the Giant Bullfrog's geographic range in southern Africa at a quarter degree grid scale. The Giant Bullfrog's geographic range has been difficult to accurately assess due to the sporadic activity and superficial morphological similarity of species in this genus (Poynton and Broadley, 1985). The model was created in Maxent 3.3.2. (Phillips et al., 2006) using several hundred carefully screened occurrence records (Figure 2), and a selection of environmental predictors including various bioclimatic variables, altitude, soil and vegetation types. The model predicted that the Giant Bullfrog occurs across most of South Africa, Namibia, southern Botswana, and the central highlands of Zimbabwe, but not in Mozambique. A pan-African taxonomic revision of the genus is currently underway, and will contain accurate actual and predicted distribution maps for all species therein.

As a step towards identifying Giant Bullfrog conservation management units, genetic structure and gene flow for populations from 30 localities on the South African Highveld was quantified using mitochondrial DNA (Figure 3). Effective population size estimates indicated that Giant Bullfrogs were common on the Highveld but may have declined by > 90% in certain areas. Genetic differentiation on the Highveld (F_{ST} = 0.60) was reflected by limited gene flow between populations ~ 200 km apart. Giant Bullfrogs in the Free State Province represent an evolutionary significant unit and require improved conservation. Lack of correlation between genetic and geographic distance of samples suggested that genetic differentiation between populations in Gauteng Province (F_{ST} = 0.26) may be due to genetic drift following population isolation caused by human transformation of habitat. Since habitat may no longer be available to establish movement corridors between isolated populations in Gauteng, the feasibility of translocation as a Giant Bullfrog conservation tool urgently needs to be tested. This is the focus of a M.Sc. project currently being conducted by Chris De Beer from the National Zoological Gardens of South Africa (De Beer et al., 2011).

Figure 3. A population genetics study of Giant Bullfrogs on the South African Highveld involved many samples obtained from road kill. Photo: C. A. Yetman.

To better understand the Giant Bullfrog's unpredictable activity, spawning by a population was monitored during five summers (Figure 4) and examined in relation to meteorological variables (Yetman and Ferguson, 2011a). Annually 6 ± 1 spawning events occurred, and numbers of annual spawning events were positively correlated with total summer rainfall. Spawning occurred most frequently, in descending order, during December, January, and November, and was triggered by 40 ±

Figure 4. Spawning by a Giant Bullfrog population was monitored during five summers. Photo: C. A. Yetman.

16 mm rain in 24 h. Spawning events lasted 2 ± 1 days but were prolonged around full moon. Numbers of males at spawning events were positively correlated with the previous day's rainfall, and varied between 30 and 500 males. Long-term counts (exceeding 10 years) are clearly necessary to detect real population trends. Due to the unpredictable activity of adults, however, it may be more practical to monitor tadpoles or numbers of sites where breeding occurs for improved conservation management of Giant Bullfrogs.

To investigate the poorly understood terrestrial behaviour and habitat requirements of Giant Bullfrogs, 70 adult frogs were radio- or spool-tracked during five summers around a breeding site (Figure 5; Yetman and Ferguson, 2011b). Spool-tracking revealed that animals moved directly between their burrows and the breeding site, and often followed roads and human-created footpaths. On average, radio-tracked animals used one "home" burrow in a summer. Female burrows were situated almost four times further (mean = 446.8 m) from the breeding site than those of males (mean = 131.0 m). This might be explained by resource competition because female body condition was significantly positively correlated with distance of their burrows from the breeding site ($r_s = 0.77$). A 950 – 1 000 m wide buffer around the breeding site would be necessary to protect the burrows of all the radio-tracked animals. Adult bullfrogs appear to be philopatric; therefore juvenile dispersal is predicted to be mainly responsible for gene flow among populations.

Figure 5. Thirty adult Giant Bullfrogs were implanted with radio-transmitters and their movements tracked around a breeding site. Photo: Fourways Review.

Captive Giant Bullfrogs have reached 45 years (Channing, 2001) but nothing is known about the age of wild specimens. The age, body size and condition of adult bullfrogs caught during spawning events at three peri-urban breeding sites in Gauteng, was therefore compared (Figure 6 ; Yetman et al., in press). Age was estimated from lines of arrested growth (LAG) counted in cross-sections of animal phalanges. Males and females from the three sites possessed 3 - 16 and 3 - 11 LAG, respectively. There was no significant difference in the LAG counts of same-sex animals between the three sites. However, male body length, mass, and condition were significantly lower at Bullfrog Pan, where pollution is problematic. Male Giant Bullfrogs probably reach ≥ 20 years in the wild, but at peri-urban breeding sites adult life expectancy and body size are possibly declining. Juvenile bullfrogs are most threatened by terrestrial habitat loss because they take ≥ 3 years to mature, during which period they may disperse far from their natal site.

A recent assessment of IUCN Red List amphibians occurring in South Africa indicates that the conservation of many species is hindered by a deficiency of knowledge on their biology (Measey, 2011). In this regard the Giant Bullfrog shall hopefully be an exception following the past eight years of dedicated research ranging from individual age assessment to species distribution modelling. Certainly the main conservation priority for the Giant Bullfrog in South Africa is the protection of terrestrial habitat for adult foraging and aestivation around, and for juvenile dispersal and gene flow between, breeding sites. In Gauteng Province the conservation of a viable meta-population is critical. In the Free State Province populations deserve improved protection given their genetic and purported ecological uniqueness. At local spatial scales specific threats must be ameliorated (e.g., pollution at Bullfrog Pan) and long-term monitoring programmes should be implemented to detect real trends in important populations.

Figure 6. Giant Bullfrogs caught during spawning events were measured, weighed, photographed and toe-clipped for skeletochronological age assessment. Photo: C. A. Yetman.

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Struggling against domestic exotics at the southern end of Africa

By G. J. Measey & S. J. Davies

Globally, there are relatively few well-known alien amphibian invaders, in comparison with other groups such as mammals and birds. The handful of frogs which have been deliberately moved all over the world (cane toad *Rhinella marina*, American bullfrog *Lithobates catesbeianus*, and African clawed frog *Xenopus laevis*) are relatively easily identified as 'foreign exotics', at least by those familiar with the local fauna. However, recognition of alien frogs by members of the public is problematic as many are unable to distinguish them from native species (Somaweera et al., 2010). There are added complications with 'domestic exotic' fauna which expand their ranges rapidly within their native country. The presence of these species outside their natural ranges is often viewed with curiosity rather than concern. On a practical level, when the American bullfrog was introduced from the eastern United States to California and other western states there was confusion over its status as it appeared in field guides to the indigenous United States fauna.

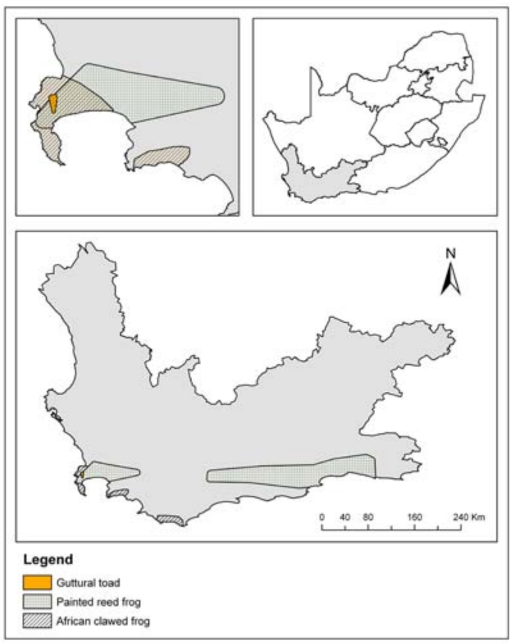

Figure 1: The distribution of domestic exotics (bottom panel, with detail of the Cape Metropolitan Area; top left panel) in South Africa's Western Cape Province (top right panel). The painted reed frog and guttural toad were probably introduced with the horticultural trade, and now have growing extralimital distributions in the Western Cape. The African clawed frog is being introduced and spreading naturally into disturbed water bodies within the range of the Cape platanna (distribution shown) further threatening this Endangered species.

South Africa is one of the world's megadiverse countries (1 221 037 km^2), covering five biomes and with three internationally recognised biodiversity hotspots and an endemic floral kingdom. It has no indigenous amphibians in the orders Caudata or Gymnophiona, but a rich and diverse anuran fauna exists with endemic and range-restricted species concentrated in two centres in the north and east (Maputuland-Albany hotspot) and south-west (Fynbos hotspot) of the country. The south-west centre has a particularly high concentration of endemic species, associated with topographic heterogeneity and climatic and hydrological stability of the Cape Fold Mountain system (Poynton 1964), while species richness is highest in the north-east, partly due to the intrusion of tropical species into this part of the country (Alexander *et al.* 2004). Concerns related to invasive amphibians in South Africa include hybridization, trophic cascade effects, competition with indigenous species and transmission of novel or existing pathogens (Van Rensburg *et al.* 2011).

A recent review found that the number of domestic exotics is generally underestimated as many are regularly considered 'native'. We ignore these species at our peril as we show in these amphibian examples from the Western Cape Province of South Africa. Further, domestic exotics are likely to increase, because the drivers of their introduction and spread are becoming more prominent, among them the pet and cargo/nursery trades (Kraus 2009), extensive landscape change and climate change. While national and international legal instruments such as CITES and biosecurity conventions exist to control or prevent international movements, few regional (within country) mechanisms are available. South Africa's National Environmental Management: Biodiversity Act and provincial ordinances aim to control within country movement of animals and plants, including herpetofauna. However, our findings suggest that there is a gap between legislation and enforcement.

Currently invading the Cape

The painted (or marbled) reed frog *Hyperolius marmoratus*

This small, brightly-coloured reed or tree frog provides an interesting example of within country range expansion. Its expansion into the Western Cape occurred when the South African Frog Atlas Project was in full swing, and thus it was recorded at an early stage (Minter *et al* 2004). Prior to 1997, there were no records of these handsome, vocal frogs west of 23°E in the province. The single record prior to 1997 was found to be a misidentified arum lily frog (*H. horstockii*) when the museum specimen was examined in 2010 (S.J. Davies and A.A. Turner, unpublished data). The westward travel of the painted reed frog was first detected by A.A. Turner in 2001. By 2006, the species was widespread in the province, and today it is found in farm

Figure 2: South African domestic exotic painted reed frog (*Hyperolius marmoratus*) underwent multiple introductions to the Western Cape and is now in broad sympatry with cogener, the arum lily frog (*H. horstocki*) inset.

dams and garden ponds across all but the most mountainous and driest parts of the Western Cape. Choruses of up to 400 males can be heard during the summer breeding season - at about 103 dB, its penetrating whistle is louder than a pneumatic jackhammer two meters away and is therefore easily noticeable.

The painted reed frog is now sympatric with its congenor, the arum lily frog (*H. horstockii*), which is endemic to the Fynbos biome (Fig. 2). The impacts of the presence of a closely related species sharing a similar feeding niche are unknown at present.

In 2008, Tolley et al. (2008) reported that the genetic 'signature' of Western Cape painted reed frogs could be traced back to ancestral stamping grounds in northern and central KwaZulu-Natal, the Eastern Cape and the southern Cape. The frogs introduced from these regions could easily have travelled with fresh produce or nursery plants which are known vectors of amphibians (Kraus 2009) or on cars, boats, caravans and building materials. Given its widespread distribution in the Western Cape it is unlikely that control or eradication of the painted reed frog is feasible, except in very localized areas. However, ongoing work will clarify the current species distribution and model the potential future distribution of the species in the Western Cape.

The guttural toad *Amietophrynus gutturalis*

In January 2000, the distinctive call of the male guttural toad was heard by a keen local naturalist coming from a large residence in the Constantia Valley, Cape Town. The toads were of unknown origin, but are presumed to have been accidentally introduced from another part of South Africa (possibly Durban), making this another domestic exotic. The first guttural toad visitors to the Western Cape may have arrived as eggs or tadpoles with a consignment of aquatic plants (de Villiers 2006) ordered by a home owner in Cape Town. This area is within the range of the Endangered western leopard toad (*Amietophrynus pantherinus*), raising concerns about the effects of the invasion on this species. In 2006 the toads were restricted to an area of less than 2 km^2 around the presumed site of introduction. An attempt was made to eradicate this population in 2003, and 30 adult toads were removed from the site, but the operation floundered due to a lack of resources and sustained effort.

By 2008, the guttural toad population was still spreading and a decision was made by the CAPE Invasive Alien Animal Working Group (CAPE-IAA) to mount a sustained eradication campaign. By the end of 2009, some 652 guttural toads (plus eggs and tadpoles) had been captured and euthanized. Calls and sightings revealed that the distribution covered approximately 10 km^2 of the Cape Peninsula (City of Cape Town Biodiversity Management, unpublished data). The CAPE-IAA has secured funding to continue this campaign and to date 1 835 guttural toads, plus eggs and tadpoles, have been collected. The ongoing work is challenging, as almost all of the breeding sites are garden ponds on private property in a low density, high income residential area. Home owners are sometimes unwilling to allow removal of guttural toads from their gardens.

The African clawed frog, *Xenopus laevis*

Unlike the previous examples, in which the original distribution of the species was well-known, we have little idea of the pre-anthropic distribution of *Xenopus laevis*. It was described in 1802 by Daudin with no type locality information, but other specimens collected during this period were labelled 'Cape of Good Hope' or simply 'Cape' (see Frost 2011). So why does it deserve to be called a domestic exotic?

The collection of specimens occurred more than 200 years after the colonization of the Cape when there was already extensive farming: vineyards and orchards were established, along with appropriate agricultural infrastructure including irrigation and impoundments such as farm dams. Our knowledge of *X. laevis* today suggests that it is capable of spreading rapidly over land (Lobos & Jaksic 2005, Measey & Tinsley 1998), prefers nutrient-rich or eutrophic waters and is quick to colonise new and disturbed water bodies, where it can rapidly build to high population densities (Measey & Channing 2003, Van Dijk 1977). Therefore it is probable that by the early 19th century, *X. laevis* was already invading farming areas of the Cape.

In contrast, *Xenopus gilli* is endemic to a small area of the southwestern Cape and adapted to the most acidic black water streams and pools (Picker 1993). Its distribution follows acid

Figure 3: The guttural toad (*Amietophrynus gutturalis*) has been rapidly expanding its range after introduction to Cape Town and is within the range of cogener the Endangered western leopard toad (*A. pantherinus*; inset).

fynbos vegetation, a habitat that is already highly transformed and is under ongoing threat (Driver *et al.* 2005). Invasion of disturbed *X. gilli* habitat by *X. laevis* is well-documented, and has led to conservation actions to prevent hybridisation between these species (Picker 1985, Picker & De Villiers 1989). Ongoing habitat destruction and hybridisation has meant this species is considered to be Endangered (SA-FRoG & IUCN 2011).

Xenopus gilli and *X. laevis* are thought to have originally occurred in sympatry (Picker & De Villiers 1989), probably separated by different types of water bodies. The introduction of *X. laevis* to the Cape Point section of Table Mountain National Park has been documented at least once (Picker & De Villiers 1989), but has probably occurred repeatedly when ethically misguided individuals 'rescued' animals by placing them in conservation areas. Despite repeated conservation efforts to remove *X. laevis* from this area (Picker & De Villiers 1989), surveys in 2010 revealed high densities within this protected area.

Figure 4: The African clawed frog (*Xenopus laevis*) is probably native to the South African Cape, but readily invades disturbed water bodies further threatening it's cogener the Endangered Cape platanna (*X. gilli*).

In March 2011, a team from South African National Parks (SANParks) and the South African National Biodiversity Institute (SANBI) seined areas with standing water in Cape Point, removing 848 *X. laevis* (93% of which were juveniles), including gravid females. This exercise has served to underline the importance of the nature of a long-term management commitment toward alien invasive species. Happily, the management authority, SANParks, is committed to sustaining regular trapping and seining events to control the invasion of *X. laevis*.

Perspective

Our examples highlight the problem of domestic exotic amphibians in a megadiverse country, which contains many biomes. Two of the three domestic exotics described here have been moved from a different biome, probably by the nursery trade. The third has been facilitated by a mixture of opportunistic use of anthropogenically altered habitats (with farming), deliberate movement as fishing bait and release by well-meaning individuals. Despite national legislation that covers each of these issues, invasions are ongoing.

Early Detection and Rapid Response (EDRR) is likely to be the most cost effective way to manage domestic exotics, but our examples show that EDRR policy must be supported by sufficient resources and sustained long-term commitment from managing authorities. The wealth of biodiversity in the Western Cape carries with it the cost of removing invasive species that threaten this diversity. Representative committees, such as the CAPE-IAA play a pivotal role in EDRR by bringing multiple stakeholders and their resources together in a collaborative approach to management. The painted reed frog may be beyond the reach of eradication, but ongoing studies will continue to generate insight into the effects of this invasion. We are hopeful that the spread of the guttural toad and African clawed frog can be managed or halted to preserve South Africa's endemic amphibian fauna.

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The CAPE-IAA contains representatives from the City of Cape Town, SANParks, CapeNature, SANBI, the Centre for Invasion Biology (C·I·B) and UCT. We acknowledge the importance of the combined efforts of many individuals from each of these organisations in tackling ongoing invasions of domestic exotics in the Western Cape.

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Monitoring of the endangered Hewitt's ghost frog

By Werner Conradie & Che Weldon

Hewitt's ghost frog (*Heleophryne hewitti*) has some of the most limited and fragmented distribution of any South African frog. It is restricted to only four streams in the Elandsberg range near Port Elizabeth and all these streams are situated in forestry plantations and thus not in any formal protected area. The aim of the project is to develop a long-term monitoring program, gather data regarding the current habitat state and how to improve it, as well as threat assessment, e.g. incidence and epidemiology of amphibian chytrid. This project has been funded by the Evolutionary Distinct and Global Endangered (EDGE), ZSL program since 2009 and is ongoing.

Monitoring of Hewitt's ghost frog tadpole numbers for the last 24 months revealed that this species is doing exceptionally well and is at no immediate risk of becoming extinct as long as current conservation action by Forestry continues. Amphibian chytrid has a very high prevalence (80%) in this population, but does not affect larval survival. We have moved on to the next phase of the project, namely to monitor the tadpoles for the next 24 months in an experimental plot that has been cleared of all alien vegetation.

Hewitt's ghost frog (*Heleophryne hewitti*). Photo: Werner Conradie

Frog Monitoring in the Western Cape

By Andrew Turner, Atherton de Villiers & John Measey

The Western Cape Province of South Africa is home to two biodiversity hotspots, the Fynbos and Succulent Karoo biomes which are well known for their floral wealth but the province also sports an interesting amphibian fauna with a large percentage (more than 50%) of endemic frog species.

CapeNature, the provincial conservation body for the Western Cape Province, is responsible for the biodiversity of the area and with its partner organisations the South African Biodiversity Institute (SANBI) - responsible for biodiversity of South Africa, and South African National Parks (SANParks), monitor and manage threatened frog populations.

Threatened lowland frogs

There is a suite of frogs occurring on the low-lying seaboard of the Western Cape from Cape point to Cape Agulhas that have lost much of their historical distribution to development of this attractive coastline. This suite comprises the micro frog (*Microbatrachella capensis*) CR, cape platanna (*Xenopus gilli*) EN and the western leopard toad (*Amietophrynus pantherinus*) EN.

Micro Frog

The Critically Endangered micro frog (*Microbatrachella capensis*) is one of the most threatened lowland amphibians in South Africa. It has a restricted and fragmented distribution comprising four subpopulations, with a total area of occupancy of less than 10 km². This frog has specialized habitat requirements and is endemic to certain fynbos wetlands in the coastal lowlands between Cape Town and Cape Agulhas. Although more than 80% of its original habitat has been destroyed through development and associated threats, most of this disappeared prior to the 1970s. Monitoring by CapeNature is based on the estimated number of calling males at key breeding sites and reviewing habitat threats. Despite ongoing habitat loss and degradation, this species survives in relatively high population densities and, during recent years, there has been an increase in the extent of breeding habitat included in protected natural areas.

Cape Platanna

The Endangered Cape Platanna (*Xenopus gilli*) has a fragmented distribution that spans a distance of about 160 km in the coastal region extending from the Cape Peninsula to the Agulhas Plain. Although the majority of its recorded acid black-water localities have been destroyed or degraded through development and associated threats (Picker & De Villiers 1989), large populations occur in the Cape Point area of the Cape Peninsula and on the Agulhas Plain. These are the two strongholds of this species, on either side of its distribution range, and fall within protected natural areas. However, published genetic studies indicate an ancient division between these populations (Evans *et al.* 2004), and ongoing genetic and morphological studies suggest that these populations represent distinct species. The Cape Peninsula populations fall within the Table Mountain National Park, where they face threats from hybridisation (see Measey & Davies, this issue). A monitoring program is being developed by SANParks officials in conjunction with CapeNature and the South African National Biodiversity Institute. CapeNature also periodically monitors other populations across its distribution range, with populations on private land facing ongoing threats from invasive vegetation and hybridisation.

Western Leopard Toad

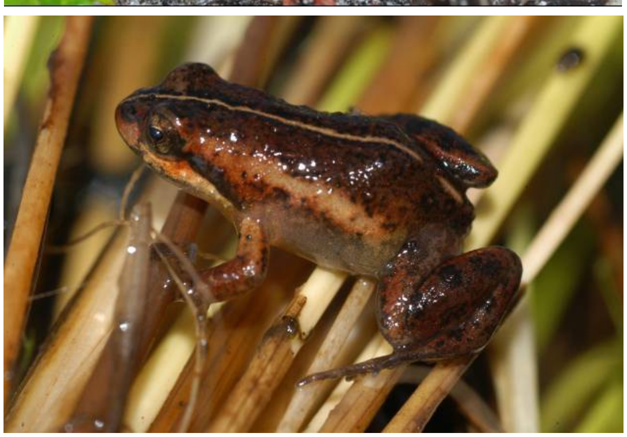
The Endangered western leopard toad (*Amietophrynus pantherinus*) is endemic to the coastal lowlands of the south-western Cape. Although the distribution range of this species extends from Cape Town to the Agulhas Plain, its range is very fragmented and is threatened by development and habitat degradation. There are no recent records of this species from the central parts of its distribution, where it is now thought to be extinct (Measey & Tolley 2011). These toads spend most of their time away from water, frequently venturing into suburban gardens, but are seldom found more than a few kilometres from their breeding habitat. The Western Leopard Toad Conservation Committee (WLT-CC) is a multi-stakeholder group (including volunteer groups, SANParks, City of Cape Town, CapeNature and SANBI) which overseas the conservation of this species. In particular, volunteer groups help toads across busy roads in the Cape Metropolitan Region when they migrate to and from breeding sites. Public awareness is probably the key to reducing threats to this species and the work of the WLT-CC has succeeded in generating a growing awareness of the ways in which this species can be helped, particularly in the peri-urban areas of Cape Town. This species also faces threats from a growing invasive population of guttural toads (*A. gutturalis*; see Measey & Davies, this issue).

Threatened upland frogs

There are also a number of threatened upland frogs in the Cape Fold Mountains. Many of these are monitored through CapeNature's Long-term Frog Monitoring Project (see below) but two species deserve special attention: the Table Mountain Ghost frog and the Rough Moss Frog.

Table Mountain Ghost Frog

The Table Mountain Ghost Frog *Heleophryne rosei* occupies a very restricted range on the iconic Table Mountain in Cape Town. Its tiny range in the midst of a highly urbanized area contributes to its Critically Endangered threat status. It is dependent on perennially flowing mountain streams in which to breed since ghost frog tadpoles take more than a year to complete metamorphosis. Although this species is threatened by ongoing habitat degradation and loss, its entire habitat is situated within a protected natural environment. The adults of this species are difficult to monitor as they are highly secretive and at least 70% of their habitat includes steep, rugged, inaccessible terrain. Monitoring by CapeNature is therefore focused on their distinctive tadpoles and habitat threats. The threats include invasive alien vegetation, erosion and water abstraction. Monitoring commenced in 1997 and is undertaken annually during late summer when stream levels are at their lowest, making it easier to observe and count the tadpoles more accurately. In general, tadpole populations have been fairly stable at the monitoring sites



Top left: The Endangered cape platanna (*Xenopus gilli*). Top right: A Western Leopard Toad during its brief reproductive period. Credit: Andrew Turner. Lower Left: The Critically Endangered Micro Frog (*Microbatrachella capensis*). Credit: Marius Burger. Lower right: The tiny but Critically Endangered Rough Moss Frog. Credit: Andrew Turner.

during the past few years, but reduced rainfall since April 2010 has reduced the extent of stream habitat available for breeding.

The Rough Moss Frog

Invasive alien plants are a major threat to natural ecosystems in the Western Cape. They consume more water than local plants, often from very dense stands that exclude local plants and provide very high fuel loads that lead to hotter fires. Invasive species threaten 37.1% of South Africa's frogs, which is considerably higher than the global average (15.7%; Angulo et al 2011). Both the micro frog and the cape platanna (see above) face substantial threats from reduction in the sizes of their breeding sites from alien invasive plants, but for some species the problem is acute. The recently described Rough Moss Frog occurs on a single mountain in a sea of cultivated lands. The Rough Moss Frog's habitat is severely invaded by alien plants, impinging yet further on an extremely small range. A concerted effort by local landowners and provincial bodies is required to secure the habitat (which includes numerous threatened plant species) of this frog.

Long-term Frog Monitoring

CapeNature began a Long-term Frog monitoring project in the austral winter of 2002. This monitoring project uses frog species presence and abundance categories to monitor amphibian responses to climate change and other factors which may affect frog populations. Although conclusions on the effects of climate with only nine years of weather data are premature, a number of interesting observations have been made. Thus far, the most dramatic effects on population numbers have been as a result of fire and there is an ongoing effort to quantify the effect of fire on various species with a particular focus on recolonisation of breeding sites. It will be crucial to determine dispersal distance and recolonisation success to properly evaluate risk of extinction for Threatened species in the fire-prone Fynbos vegetation.

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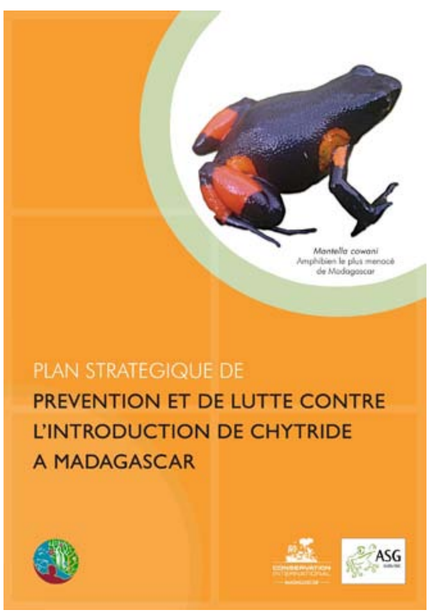
Madagascar and Chytrid news: Needed an urgent action and close collaboration between stakeholders

Falitiana Rabemananjara, Franco Andreone & Nirhy Rabibisoa

The Amphibian disease chytridiomycosis caused by the fungus *Batrachochytrium dendrobatidis* is actually the subject of intensive exploration for the conservation of this taxonomic group, and is included in the Sahonagasy Action Plan. Two workshops have been held in Madagascar to avoid its introduction (in April 2010 with Malagasy stakeholders and October 2010 with international expert) and a Proactive Detection Action Plan has been produced. Furthermore a detection program has been conducted by Ché Weldon and Louis Dupré from the North-West University, Potchefstroom in South Africa, in collaboration with the University of Antananarivo since 2005.



Currently Madagascar has a control structure represented by the "Emergency Cell" of the prevention of the disease *Chytridiomycosis* and is running a detection program until the end of 2010.

Although Madagascar has been reportedly free of the disease during the past six last years, a recent expedition during December 2010 identified the presence of the fungus at Makay in the South-West part of the Island. Further, more intensive, expeditions will be required to confirmation the extent of occurrence within this area. This recent contamination has been detected on *Mantidactylus betsileanus*, in just one of six localities.

Efforts are currently underway to establish the strain of the fungus and identify how it has been introduced to this area that is completely isolated from human activities.

ASG Madagascar hope that the entire Amphibian team, National and International will help to fight against this disease and to prevent the massive extinction of the high diversity of amphibian of the fourth largest Island in the world.

Acknowledgments

We thank Conservation International for their commitment to the conservation of the Amphibians of Madagascar since the launching of the Sahonagasy Action Plan in 2008 and in particular fighting against Chytrid since 2005.

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Association Mitsinjo: Captive breeding program

By Devin Edmonds

The community-run conservation organization Mitsinjo, based out of Andasibe in east-central Madagascar, is currently developing a biosecure captive breeding and husbandry research facility for local amphibian species. This project will ensure the survival of threatened frog species in the area through captive assurance populations, and will build local capacity to manage a potential future epidemic of the amphibian chytrid fungus. As of May 2011, five Mitsinjo technicians are training in amphibian husbandry techniques using four locally common frog species, and are breeding live foods in large numbers to feed these first frogs. This is the first project of its kind in Madagascar and is of great importance, serving as an example for other organizations and institutions in country to develop similar programs.

The project is supported by the Association of Zoos and Aquariums, Amphibian Ark, the Cleveland Metroparks Zoo and Cleveland Zoological Society, and the Woodland Park Zoo, and recently by Conservation International.

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Figures. Top left: Mitsinjo Facility, in March 2011 construction finished. Top right: Mitsinjo technicians construct terraria. Bottom left: Cricket breeding setup. Bottom right: Terraria for husbandry training. Credit: Devin Edmonds.

Overview of the implementation of Sahonagasy Action plan by Madagascar Fauna Group (MFG)

By An Bollen

The Madagascar Fauna Group has worked more intensively on amphibians since our 2004 collaborations with Franco Andreone and Gonçalo Rosa. Initially we focused on documenting Betampona Natural Reserve's amphibian biodiversity, work that produced a confirmed list of 77 frog species including several that are newly described and endemic to Betampona. Current research is directed at developing ecological descriptions and analyses of spatio-temporal distribution patterns for certain priority species to help guide plans for their conservation.

At Parc Ivoloina, the MFG's amphibian inventories have resulted in a list of 34 species. In October 2010, we hosted an international workshop on chytridiomycosis at the Parc which was organized by Durrell Wildlife Conservation Trust. Responding to the potential introduction of chytrid into Madagascar, Ivoloina and several other sites were identified for regular screening. In April 2011, we began our chytrid screenings at Ivoloina on 3 species: *Mantidactylus betsileanus, Ptychadena mascariensis* and *Boophis tephraeomystax.*

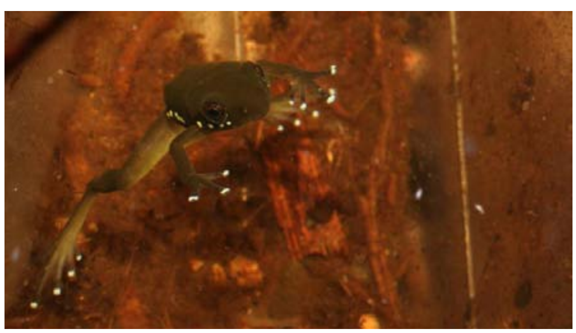

Figure 1: *Blommersia angolafa,* new species from Betampona (MFG)

Figure 2. *Boophis tephraemystax* in cage at Ivoloina Park (MFG)

Based on the recommendations of ACSAM, MFG invested in one and renovated another outdoor enclosure for captive breeding frogs at the Ivoloina Zoo. We already displayed *Dyscophus antongilii* but in April 2009, and following advice from Franco Andreone, 10 tomato frogs were collected in Maroansetra and transferred to the new enclosure. Despite excellent husbandry advice from Franco and other experts, we have not yet succeeded in breeding this species. At the October 2010

Figure 3 : The Participants receiving certificate during Chytrid training in October 2011, at Ivoloina Conservation Training Centre, Toamasina.

workshop MFG was identified as one of the institutions for captive breeding an 'analog' frog species to gain more experience. *Boophis tephraeomystax* was selected as the species and in March 2011 5 individuals were captured in Parc Ivoloina for placement in our renovated enclosure.

MFG is committed to continue working with its partners on amphibian conservation in both Betampona and Ivoloina in the future.

MFG is grateful for the support of the Wildcare Institution of the Saint Louis Zoo and EAZA for their funding and support with regards to our amphibian conservation efforts.

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Species Conservation Strategy for the Golden Mantella Launched in Madagascar

By Richard K. B. Jenkins & Roma Randrianavelona

The golden mantella frog is a Critically Endangered species that is endemic to a small area in eastern Madagascar (Randrianavelona et al. 2010). It used to be traded in large numbers but improvements in management procedures for CITES species in Madagascar, and the availability of captive bred individuals, has led to a decline in exports over the last decade. The golden mantella frog breeds in ephemeral ponds in humid forests and the main threat to this species nowadays is the destruction of these habitats. A conservation project was launched in 2008 to provide protected area status for the Mangabe Forest, which contained over 50% of the known breeding ponds for the species. Other breeding ponds for this species occur in sites that are managed by international NGOs, national NGOs and a large mining company. Whilst progress was made in obtaining provisional protected area status for the Mangabe Forest, it became clear that the species needed a single conservation plan to weave the different stakeholders together to promote coordinated actions for the benefit of the frog.

Critically Endangered Golden Mantella frog - in a battle to survive in the wild. Credit: R. Randrianavelona/ Madagasikara Voakajy.

Madagasikara Voakajy and the Amphibian Specialist Group, supported by key partners, produced a Species Conservation Strategy for the golden mantella frog in 2010. The approach followed the IUCN guidelines on Species Planning (www.cbsg.org/cbsg/content/files/scptf_handbook.pdf) and included the participation of all stakeholders in a workshop and a clear set of goals-objectives-actions. With a varied stakeholder community, including CITES authorities, community based organizations, NGOs and the extraction industry, it was extremely useful to generate a consensual strategy and set of actions for a five year period. A similar approach would certainly be useful for conserving some of Madagascar's other CR amphibian species. The final Species Conservation Strategy was launched by the Minister of Environments and Forests in February 2011.

The availability of a Species Conservation Strategy alone does of course not confer a significant impact on conservation because success depends on its implementation. Some of the key actions in the golden mantella Species Conservation Strategy are now being implemented at Mangabe thanks to support from donors including the Rufford Foundation and the BBC Wildlife Fund. In the last two years there has been a major increase in illegal gold mining in the forests inhabited by the golden frogs. The artisanal mines cause serious damage to rivers, ponds and the forest and are often situated in the same localities as the golden mantella breeding ponds.

Support from Conservation International has enabled Madagasikara Voakajy and the authorities concerned to provide additional assistance to communities in Mangabe, including regular patrols by armed gendarmes. The results so far are encouraging but limited; on the positive side the communities in the forest are grateful for the patrols and these have led to an overall reduction in illegal mining in Mangabe, but on the negative side, lucrative gold mining is worth the risk for the miners and they usually return to the same site, or move to another after the patrols have passed. Three ponds were destroyed by illegal miners in Mangabe between November 2010 and February 2011 and with no more than 50 golden mantella ponds known in Madagascar, a continued conservation presence is essential for the survival of the species. This is especially pertinent given the planned extraction of nickel at the Ambatovy mine near Moramanga where a number of breeding ponds are scheduled to be heavily impacted. Continued conservation by communities new protected areas, reinvigourated law enforcement at Mangabe and an ambitious mitigation strategy at the Ambatovy mine will go a long way to conserving the golden mantella frog in the wild.

Ankarahabe: golden mantella breeding pond in Mangabe forest that was destroyed by gold miners in 2010. Credit: R. Randrianavelona/Madagasikara Voakajy.

Acknowledgements
Funding for the workshops that led to the Species Conservation Strategy was kindly provided by the IUCN Netherlands, Rufford Foundation, Disney Wildlife Conservation Fund and the Cheyenne Mountain Zoo. Funding for conserving the golden mantella frog in the Mangabe forest was kindly provided by IUCN Netherlands (2008-2010), Rufford Foundation (2008-present), Disney Wildlife Conservation Fund (2009-2010), Conservation International (2011), Mr. Mark Pilgrim (2009) and the BBC Wildlife Fund (2011-2012). We are grateful to the Ministry of Environment and Forests for supporting and authorising conservation and research projects on the golden mantella frogs. We also thank the Department of Animal Biology, University of Antananarivo and the IUCN/SSC Amphibian Specialist Group for their continued support.

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Ankaratra massif: Highland focal amphibian site for conservation.

By H. Rahantalisoa, M. Rakotomalala, Falitiana C. E. Rabemananjara, J. Rahantamalala & N. Rabibisoa

The Ankaratra massif is a high mountain region situated at the central highland of Madagascar (Fig. 1). This massif has two types of forest, rainforest (Fig. 2) and *Pinus* forest. It is an area that has been included in the State's Forestry Station system since 1960 for its importance to water sources and biodiversity. Due to the presence of the critically endangered amphibian species, *Mantidatylus pauliani* and *Boophis williamsi*, this region is one of the high priorities for conservation in the new System of Protected Areas in Madagascar and lead to its classification into the Alliance of Zero Extinction (Langaha, 2010). In addition, this area is the only remaining forest within the high central mountain zone of Madagascar with a unique ecosystem and water resource, and is home to treasures like *Lydodactylus mirabilis*, a critically endangered gecko endemic to the area (Glaw and Vences, 2007). Thus, the preservation of the site and associated species recovery plans are being implementation through a management plan produced by VIF (Vondrona Ivon'ny Fampandrosoana, association focusing on the community development) with Conservation International last year.

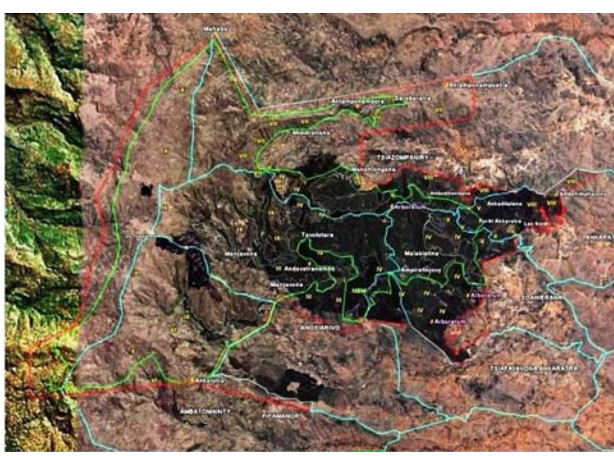

Figure 1: Ankaratra map

It is evidence nowadays that climate change can modify the distribution of upper slope montane species (Rabibisoa et al., 2008, Raxworthy et al., 2007). This bad reality is reinforced and accentuated by political events in Madagascar during the last three years resulting in degradation of the Ankaratra massif by illegal exploitation of wood for charcoal and bush fire. This habitat loss is resulting in erosion, leading to an increased need for the conservation of the area with particular focus on amphibian associated habitats and their breeding sites in the valley. A red alert action has been undertaken this year by all stakeholders lead by Conservation International and ASG Madagascar with local partners such as VIF association, Lalona Association, community based, regional and local authorities. This red alert aims to reinforce the patrol, to protect the water source, to monitor the two CR amphibian species, and to recover the exotic forest by establishing a nursery.

Figure 2: Ankaratra natural forest

Figure 3: Public consultation to local population for the management strategy, at Ankaratra Massif

Figure 4. Example of Management transfer ceremony at Ankaratra

Currently the VIF Association, working under the financial umbrella of Conservation International with technical assistance from the Amphibian Specialist Group-Madagascar, is implementing the management plan validated by stakeholders last year during a public consultation in Ambatolampy (Fig. 3).

The overall aim of this plan for the next three years is to insure that no extinction or population declines of *Mantidactylus pauliani* and *Boophis williamsi* occur in Ankaratra.

Current efforts are focusing on starting the implementation of the new protected area through the transfer of management to the VOI (local community-based) (Fig. 4), implementation of the new protected area, continuation of regular monitoring for both critically endangered amphibian species, continued improvement of patrols, undertaking habitat restoration and improving the social livelihoods of the community-based around the massif.

Acknowledgments
We are grateful to Conservation International, the Amphibian Specialist Group Madagascar for their help during the last three years, and to the MacArthur Foundation which currently supporting activities through an IUCN/SSC ASG proposal.

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Brief note on the most threatened Amphibian species from Madagascar: *Boophis williamsi* (CR) and *Mantidactylus pauliani* (CR) in Ankaratra massif, Madagascar

By F. C. E. Rabemananjara, J. Randrianirina, M. Randriambahiniarime, H. Randrianasolo, T. J. Razafindrabe, F. Andreone, & N. Rabibisoa

Figure 1: *Boophis wiliamsi* (left) (Mantellidae) and *Mantidactylus pauliani* (right) (Mantellidae) Photo: F. Rabemananjara.

The amphibians of Madagascar, with 277 recognized species and 150 still waiting to describe 99.6 % are endemic of Madagascar (Vietes et al, 2009). However, these unique treasures are currently threatened by habitat loss, bush fires and slash and burn practices for agriculture. Among the 7 critically endangered amphibian species encountered in Madagascar, two are locally endemic in Ankaratra massif, namely *Boophis williamsi* and *Mantidactylus pauliani* (Glaw and Vences, 2007) (Fig. 1) which are sympatric species and restricted between the range 2000- 2400 m a.s.l elevation, representing less than 4,000 ha of area of occupancy (Langaha, 2010). They inhabit the high montane with fast flowing streams both in open savannah area and in rainforest area (Fig. 2).

During the last three years these areas have undergone Pine plantation's fires and bush fires leading to the denudation of all the crests and slopes (Fig. 3) that have resulted in water pollution in the valley, the habits of both CR species, during the heavy rain.

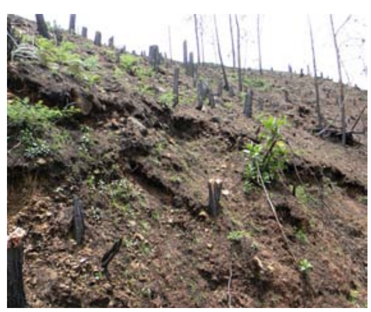

Figure 2: Habitat of *Mantidactylus pauliani* and *Boophis williamsi* in high mountain natural forest habitat (a) and at the high mountain savannah habitat (b) (F. Rabemananjara)
Figure 3: Habitat erosion and degradation by fire (F. Rabemananjara)

Regular monitoring undertaken since 2001 by various research teams (Vences' expedition, Langaha association, Biotope association) demonstrate that *Boophis williamsi* is very rare with less than 10 adult individuals found per 400 m to 1000 m of stream transect during surveys conducted over a ~15 day period (Langaha 2010). The two types of habitat most critical for survival of the species, are the high savannah which is inhabited by the mature adults and the adjacent forest stream used for breeding in which the majority of tadpoles and juveniles have been recorded.

Monitoring in 2010 for *Mantidactylus pauliani* showed a density of 78 individuals by 100m of transects. The current survey by Langaha Association demonstrates that this species is not yet declining. The preferred habitat of this species is the natural forest however it has also been recorded in high mountain savannah.

In May 2011, training of local agents for the continual monitoring and a formation in conservation of the Amphibians and in population sensitizing for the local authorities and associations around the Forestry Station are done by Langaha with ASG technical help.

Currently, the continual survey of these critically endangered species will be undertaken by VIF Association in collaboration with the Animal Biology Department at the University of Antananarivo.

To implement the engagement of Madagascar in the Alliance for Zero Extinction (AZE), the strategy is to protect the water sources by restoring the crest's and slope's flora at the process of New Protected Area instauration.

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Fohisokina project: Implementation of *Mantella cowani* action plan

By Mamy Andriananja, Ramandimbison & Nirhy Rabibisoa

Fohisokina is an area that was probably once covered with forest, the preferred habitat of the *Mantella cowani* (Rabibisoa et al., 2009), however due to regular burning to create pastures the area is now predominately savannah with some relict riverine plants, and small eucalyptus plantations in place.

A small population of *Mantella cowanii* (Fig. 1) have been able to survive thanks to their adaptability and despite the destruction of their natural forest habitat. The two main direct threat to this population are the previously mentioned fires and the hunting of crayfish along the rivers that the *Mantella cowanii* utilize. Faced with this situation, the Amphibian Specialist Group and Conservation International are working with MATE (Man and the Environment) and the VOI FOMISAME (local community association involved in this site since 2009) to implement the *Mantella cowanii* action plan (Rabibisoa, 2008). The first activity completed was to establish a land use plan (Fig. 2) that created a core area to protect the *Mantella cowani* in which native trees have been planted (Fig. 3). This area includes a buffer zone where production of fruit trees and aromatic species are allowed.

In 2010, activities supported by Conservation International started with a one hectare fish pond being created by the local population (Fig. 4). Fish production has two objectives: to improve the quality of life of local people by providing a new source of protein and provide for operating costs of the association through the sale of fish. The creation of this pond also had a positive but unintended consequence: wild ducks came, such as *Anas erythrorhyncha* and *Tachybaptus pelzelnii* (VU). We regularly observe at least a dozen individuals.

With regard to restoration, the members of the VOI have planted 10,000 seedlings of native species in an area covering 10 hectares. In addition 500 plants of *Eucalyptus citriodora* were also planted and 1,000 other plants of *Cinnamosma fragrans* for the production of essential oils.

Figure 1: *Mantella cowani* (Mantellidae) (MATE)

Acknowledgments

We thank Conservation International and the IUCN/SSC Amphibian Specialist Group of Madagascar for their close collaboration in funding and providing technical assistance to smooth this project .

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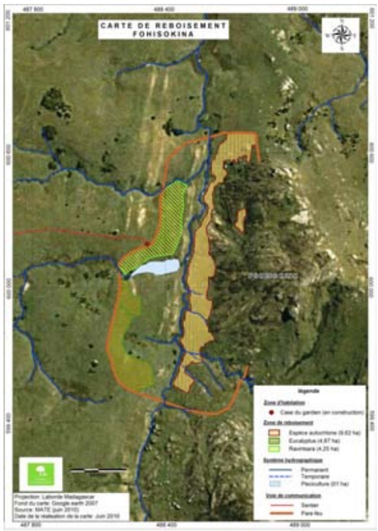

Figure 2: Map of conservation area and management plan for restoration at Fohisokina
Figure 3: Example of native plant planted by VOI FOMISAME
Figure 4: Valley bottom transformed into fishpond area for local population income.

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Discovering Ecuador's five-hundredth Amphibian

By Alejandro Arteaga

500 species of amphibians may seem like too much for a country roughly the size of the state of Colorado. However, 500 may be just half the number of species that actually exist in Ecuador. That missing half needs to be described; otherwise, thousands of wonderful amphibians, which are the most threatened group of vertebrates on the planet, may go extinct before we even find out about their existence.

In this sense, the story of the newest addition to Ecuador's list of frogs may prove helpful, as it may hold the clues to discover those frogs yet unknown to science, and therefore foster interest in their conservation.

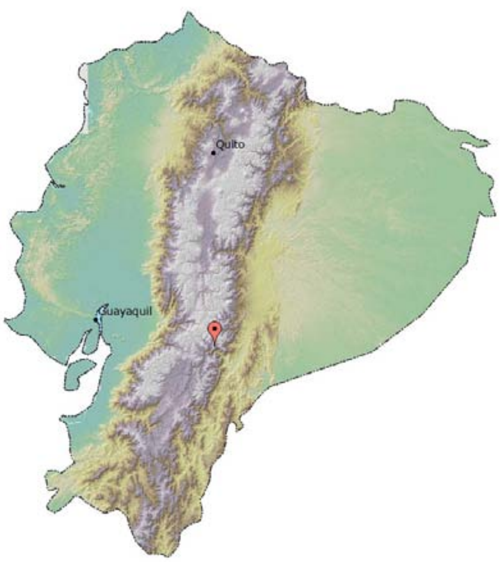

Figure 2. Distribution of *Pristimantis bambu* in Ecuador. The dot indicates the type locality, the only locality where the species is known to date.

Naming a single species is a small step, but it's the first one towards the long-term conservation of that species, so how is it done? Let's look at the example of Ecuador's five-hundredth described amphibian: the **Bamboo Rain-Peeper** (*Pristimantis bambu*).

Figure 1. The new species resembles many other Ecuadorian frogs but the black-bordered yellow spots on the groin are pretty unique.

Finding the **Bamboo Rain-Peeper** was like discovering a secret, a deeply held secret. It all started in February 2008, when me, and my family, were kindly invited by Stuart White and his wife, Patricia to stay at their hacienda (actually a protected area called the Mazar Reserve) at the southern portion of the Sangay National Park.

From the very first moment, I became fascinated with the landscape at Stu's property: it was a combination of pristine montane forest, green pastures and alpacas. Even better, the place looked promising for amphibians (with moist, well-conserved forests). I recognized its potential right away, because I knew that most of Ecuador's unknown amphibians were still hidden in isolated forests in the Andes; specially in the southern Andes, a region in which topographic and ecological complexity has favored speciation, particularly among **Rain-Peepers** of the genus *Pristimantis*.

Unfortunately, the weekend was soon over, and I did not get the chance to prove whether Stu's forests were home to new species.

But they were indeed, and that's what I found out on May 2009, during a second visit to Stu's lands. This time, I was enthusiastically supported by Catherine Schloegel from Fundación Cordillera Tropical (the NGO that manages the Mazar Reserve) and I was on a mission: to document all of the reptiles and amphibians living on those forests. With this in mind, I revised all of the available literature about the herpetofauna of the southeastern Ecuadorian Andes.

This was a critical step in recognizing whether the found species were potentially new or not. It also was the step that led me towards the investigator Martín Bustamente from Finding Species, whose support and previous work in the Mazar paved the road towards the description of the **Bamboo Rain-Peeper**. The next step was to get field assistance and to

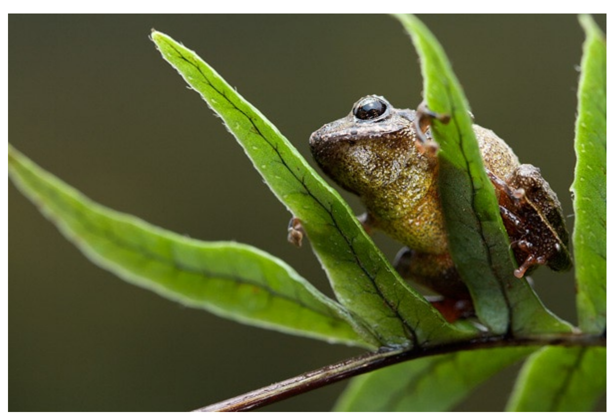

Figure 3. Valuable colors, such as the yellowish tinge on the belly of this Bamboo Rain-Peeper (*Pristimantis bambu*) were recorded in the field before preserving the specimens.

Figure 4. Every single frog encounter is different. Therefore, a detailed data sheet with geographic, ecological, morphological and taxonomic info was filled for each.

implement surveys among local people; the former, to improve searching success; and the latter, to gather info about rare species or about historical records.

In regard to field assistance, the discovery of *Pristimantis bambu* would not have been possible without the help and companionship of Jesse Lewis, Seth Adams and all of the enthusiastic people involved in the Round River Conservation Studies programs at the Mazar Reserve during 2009 and 2010. If all expeditions counted with such a fantastic team, discovering all of Ecuador's missing species would be a piece of cake.

Well, being honest, discovering a species new to science is not an easy task, but in the right place, with the right info, and with the right assistance, the task becomes much easier, even fun. For us, it involved staying up until very late while searching for tiny creatures with the aid of a headlamp, or during day, by turning logs over or by raking the leaf-litter. The result was that many seemingly identical frogs appeared during the following days. I grouped all of these under the same species, but later realized some of them sang differently. Moreover, some of them had different markings; pigmentation; and proportions.

Leaving apart the other easily diagnosable species (i.e., those with salient features such as big-size, brilliant colors, horn-like protuberances, marked patterns, etc.) all the little, brownish and inconspicuous toads were initially identified as **Mountaineer Rain-Peepers** (*Pristimantis orestes*). I knew though, that frogs grouped based on phenotypic resemblance often are erroneously identified as just one species; a masquerading effect for cryptic diversity.

To elucidate this enigma. I had to gather data and analyze it side by side. First, individual frogs were documented through drawings and photographs; and second, data about ecological preferences, timing, location, and physical traits was obtained for each of the populations.

The data was Raw, but it gave me the hint I needed: those frogs that had a different song also were restricted to only those patches of forest where the bamboo species (*Chusquea* sp.) was dominant; the other seemingly identical population was instead distributed on old-growth montane forests and paramos. Neither habitats, nor songs overlapped.

I also realized that taking into consideration this speciation pattern (in which two amphibian populations replace one another altitudinally or ecologically) had been the logic behind many other frog discoveries. I therefore concluded that many wide-ranging species (including the **Mountaineer Rain-Peeper**) were, as a matter of fact, a complex of many more.

But the situation warranted a second opinion. So I came back to Quito, and met Dr. Juan Guayasamin from the Universidad Indoamérica, which in my opinion is Ecuador's ultimate *Pristimantis* expert. As he has done many times in the past, Dr. Guayasamin, recognized the incipient **Bamboo Rain-Peeper** as a potentially new species right away, and consequently gave me the advice and support to gather the evidence needed to properly name the new species.

Evidence, in taxonomy terms, means voucher specimens, tissue samples, sound recordings, pictures in life and associated data. Once equipped with the tools (i.e. collecting permits, plastic containers, a sound recorder and many data sheets) to gather the needed evidence, I went back to search for the awaiting new frogs.

There they were, exactly where I left them. Hundreds of **Bamboo-Rain Peepers** were active that night, making it possible to collect a reasonably diverse sample of individuals, including singing males (for which the calling was recorded), foraging females, perching juveniles, etc. These were going to be the type collection for the **Bamboo-Rain Peeper**. That is to say, the group of specimens on which the original description of the species was to be based. It was therefore important that the sample was representative; otherwise, different morphological variations and developmental stages could have been confused with another species.

But the above scenario was not a problem because genetic data was taken from each of the voucher specimens. This was done by taking samples from at least three different types of tissues (skin, muscle and liver) per specimen, and storing those in alcohol-filled Eppendorf tubes. Of course, this procedure had to be performed after the frogs were euthanized, and before they were fixed in 10% formaldehyde and

Figure 5. These specimens are called paratypes. That is to say, the scientific vouchers other than the holotype (which is the main one) used for naming *Pristimantis bambu* as a valid species.

Figure 6. Whenever possible, tissue samples were taken from voucher specimens in the field. In order to preserve those samples for subsequent analysis, these little plastic containers, called Eppendorf tubes, were used.

stored, each with a specific ID number, in 70% ethanol.

The field phase was over, and the specimens were deposited in the QCAZ museum of herpetology. The lab phase was next.

First, morphological measurements (such as total length, hand length, weight, etc.) were gathered using digital calipers and electronic scales. Second, radiographies were obtained using X-ray generators. Third, data about morphological traits (such as number and disposition of skin protuberances, body shapes and color patterns) was gathered for each of the specimens. The goal was to obtain information to perform a complete cross-species comparison that would support assigning the new frog to the genus *Pristimantis*, and to prove the validity of the new taxon; essentially by distinguishing it from the other known frogs that belong to the same genus.

The data set was compared to that of other species housed in museum collections and to all the available literature. The **Bamboo Rain-Peeper** appeared to be undescribed. But this had to be confirmed through a phylogenetic analysis to determine if *Pristimantis bambu* was indeed genetically different from other closely related frogs, and by comparing the new species' song to that of others. The **Bamboo Rain-Peeper** was unique in both respects, confirming thus the initial assumption.

Now, it was time to tell the world what both Dr. Guayasamin and I knew, that Ecuador had yet another new frog, and had therefore reached 500 species of amphibians. To do this, however, all of our supporting data had to be published in a scientific journal, which in turn involves writing a fully detailed article explaining methods, a systematic description, natural history, and a discussion justifying the new addition. We also had the honor to name the new frog, following of course the guidelines of the International Code of Zoological Nomenclature. The chosen name was *Pristimantis bambu*, as an allusion to the new species' preference for bamboo-dominated montane forests (*Chusquea* sp.).

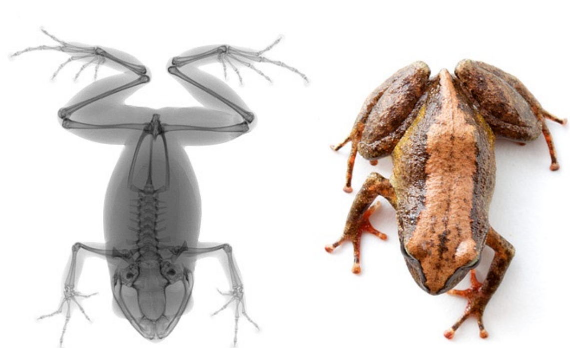

Figure 7. Here's *Pristimantis bambu*, internally and externally. Both views were useful for diagnosis.

In May 2011, almost two years after the initial finding, the article has been aproved, revised and published in the prestigious journal Zootaxa, therefore validating the inclusion of *Pristimantis bambu* in the list of Ecuador's frogs.

A new species has been born! But the race is still on. We, as humanity, need to find what other unknown creatures are still out there so they too, as the **Bamboo Rain-Peeper**, hold a chance to be saved before it's too late.

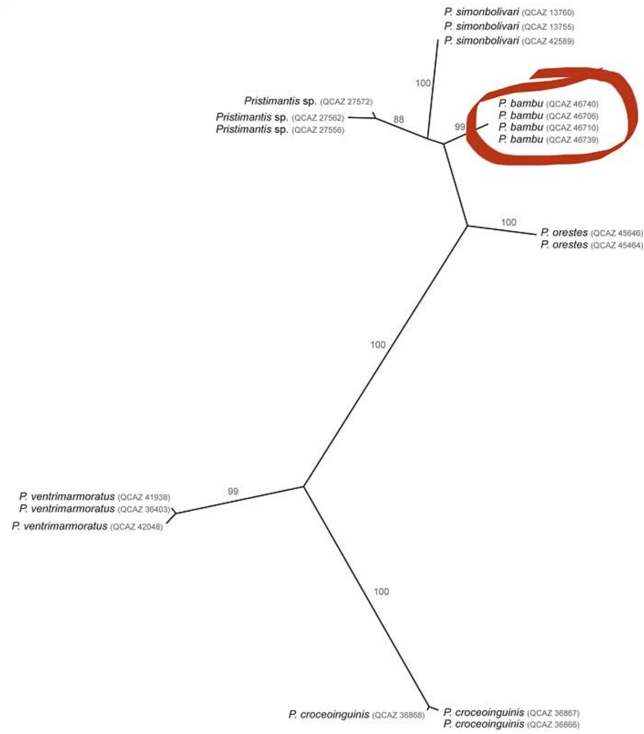

Figure 8. The decisive cladogram for the new species. This diagram, which illustrates genetic relatedness, clearly shows that *Pristimantis bambu* is essentially different from other closely related frogs, including *Pristimantis orestes*.

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Abc Taxa as a highway to the build-up of taxonomic capacity

By Yves Samyn, Didier Vanden Spiegel & Jérôme Degreef (Editorial team of *Abc Taxa*)

The last couple of decades the species *Homo sapiens* has altered biodiversity patterns with an unprecedented speed, causing not only the deterioration of habitats, the hollowing of ecosystem services (on which he ultimately depends), but also provoking the irreversible loss of species. To restore and conserve the natural balance, accurate taxonomic information, such as what species live where and why, and in what abundance, is urgently needed. Yet, paradoxically, in the 21st century, more then 250 years after the start of the so-called Linnean enterprise, *H. sapiens* knows disappointingly little on the taxa with which he cohabits.

It is estimated that today at least some 10 to 30 million species populate Earth. A mere 1.9 to 2 million of these have been (validly) named, and it is estimated that less than 20,000 new species are described annually. This is a surprising low number given the advance of sampling, investigation, description and publication techniques. Clearly taxonomic productivity needs to be boosted, especially in mega-diverse countries, with particular focus on little-explored habitats such as the deep sea, underground water reservoirs or tropical forest canopies and on taxa that are very poorly known or that are indicative of global change, such as frogs. The Belgian National Focal Point to the Global Taxonomy Initiative (GTI) has installed a capacity building program to accelerate the build up of taxonomic capacity. The flagship product of that program is called *Abc Taxa*. It is a high quality series of manuals that aims to be a toll-free taxonomic information highway between experts and novices.

Since 2006, 10 volumes have been published, two of these dealt specifically with the taxonomy and collection management of amphibians. Diaz & Cadiz (2008) produced a stunning tome on the Cuban amphibians, detailing not only good practices in amphibian taxonomic research, but also providing detailed descriptions of adults, tadpoles, eggs and advertisement calls (audio files also provided) of nearly all Cuban species. The same year Kok & Kalamandeen repeated this exercise, but this time in English, treating the amphibians of the Kaieteur National Park in Guyana. Both books have in common that they make it possible to easily identify the species, thus driving conservation action for instance through Red List Assessment using IUCN criteria and categories.

Next to these two volumes, *Abc Taxa* has also released a 652 pages thick manual that details field recording techniques and protocols for biodiversity inventory and monitoring. Chapters such as the one on the planning of large scale inventories, or the one on the standardization of taxonomic records and associated data, or the one on bioacoustics, or the one on DNA-based methods, and certainly the one on herpetological inventory techniques are certainly also of interest to herpetologists.

Hard copies of volumes of *Abc Taxa* are distributed through the GTI and CHM (Clearing-House Mechanism) network of the CDB, through privileged contacts with the authors and their local networks and through library exchange-systems. Researchers or institutions from developing countries can obtain a free copy of a particular book when they send a motivated demand to the editorial office of *Abc Taxa*. For the interested public of non-developing countries, copies are charged at publication and distribution cost. Each volume can of course also freely be downloaded on the journal's website.

At present we have not published a digest that covers the taxonomy of sub-Saharan amphibians. However, because quite a few central African countries (notably the DR Congo) belong to the privileged partners of the Belgian Development Cooperation, the sponsor of *Abc Taxa*, we are open to investigate with attention project proposals

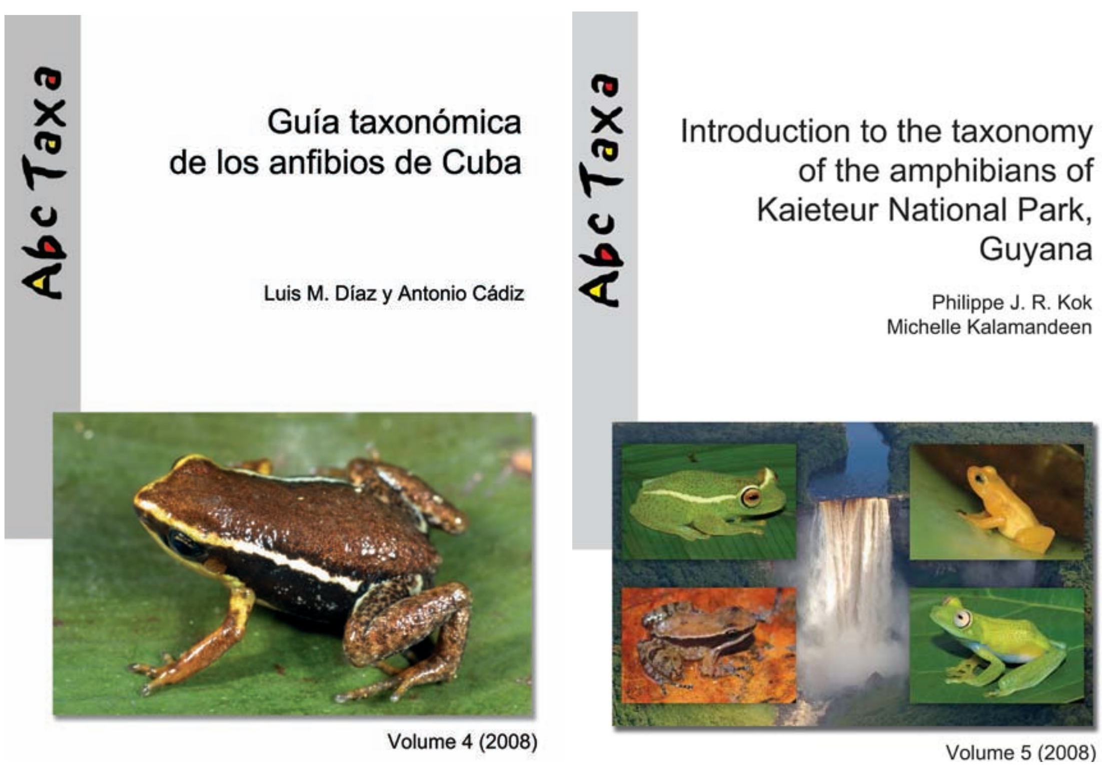

Figure 1. Front covers of the two volumes on amphibian taxonomy released so far.

that would treat amphibian taxonomy in central Africa, preferentially the DR Congo. Next to the usual prerequisites (for more info see our website), we would only expect such volume to be written in French so that there's minimum overlap with volume 4 written in Spanish and volume 5 written in English.

The editorial board of *Abc Taxa* invites you to its website (http://www.abctaxa.be) for further information. More *ad hoc* information on the series can also be obtained by mailing the editorial board (abctaxa@naturalsciences.be).

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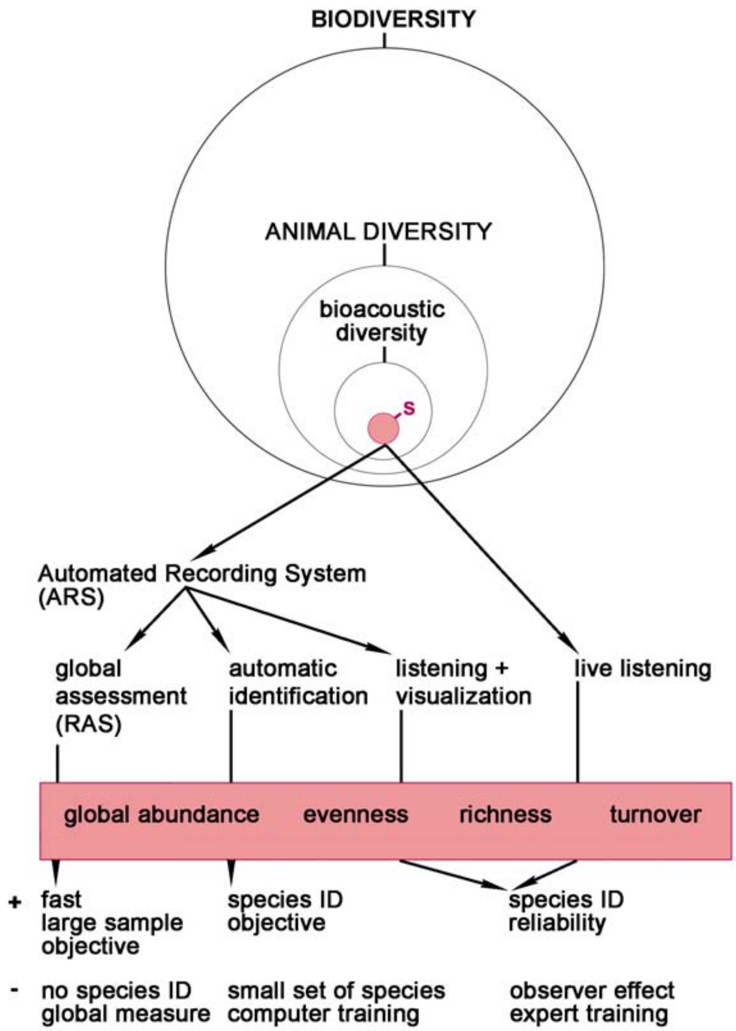
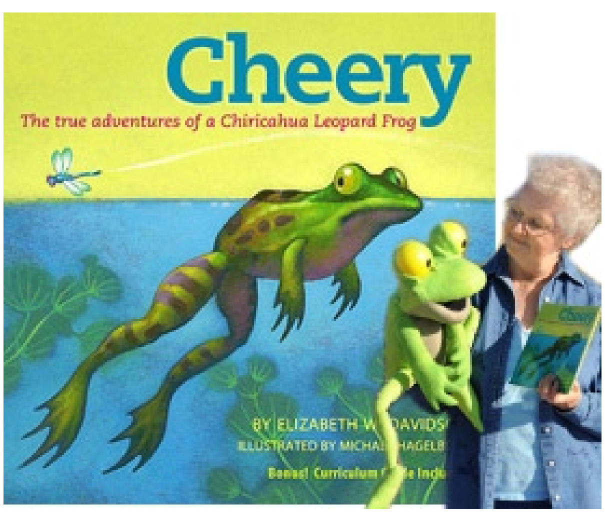


Figure 2. Illustration taken from the chapter on bioacoustics in volume 8 of the series *Abc Taxa*.

Cheery, the true adventures of a Chiricahua Leopard frog

By Elizabeth W. Davidson

Cheery, the true adventures of a Chiricahua Leopard frog introduces children to the exciting and frightening adventures of a frog in the wild. Cheery's story begins when he hatches from the egg in a quiet pond, where he soon experiences many adventures, including hiding from introduced crayfish and bullfrogs. One night he is captured and finds himself at a zoo, where he and his companions make many more Chiricahua Leopard frogs. In the end, Cheery and his offspring are reintroduced back to their home pond when it has been freed of the dangerous invaders.



Cover image by: Michael Hagelberg. Photo:Tim Trumble

Cheery, the true adventures of a Chiricahua Leopard frog, is designed to introduce children in grades 2-5 to the life cycle, habitat, and hazards of an endangered species while inspiring the children to care about these important amphibians. Understandable science is included at the end of the book, along with a curriculum guide. The website www.CheeryAFrogsTale.com contains the actual calls of the Chiricahua frogs. The book is written by Elizabeth W. Davidson, Arizona State University, who has worked for several years on amphibian diseases in Arizona, and is illustrated by Michael Hagelberg from Flagstaff, Arizona.

Coastal sand-dune habitats, frog-bromeliad relationship and conservation in Rio de Janeiro, Brazil

By Helio Ricardo da Silva, André Luiz Gomes de Carvalho, & Gabriela Bueno Bittencourt-Silva

The Brazilian coast is marked by a unique habitat that results from historical and ecological interactions between species of the Atlantic forest and oceanic sand plains, locally called restinga (Scarano, 2002). During the late Pleistocene and early Holocene, variations in sea level resulting from glaciations and interglacial periods (global warming) caused changes in the design of coastal areas (Suguio & Tessler, 1984). Amongst the most outstanding features resulting from these modifications, we verify the formation of lagoons (Figure 1), which represent the imprisonment of ancient small to medium size bays or coves, and lines of sand dunes parallel to the coast, caused by falls in sea level towards the present level. The first and most interior dune results from a see drop that occurred about five thousand years ago, and the second one, which is closer to the ocean, resulted from a see drop that occurred about three thousand years (Suguio & Tessler, 1984). At least in the state of Rio de Janeiro, restingas have a configuration that includes, from the interior towards the ocean, a flatland at the margin of a lagoon, the first dune, another flatland between dunes, a second dune, and the ocean.

The area between the lagoons and the ocean is occupied by vegetation (Silva & Oliveira, 1989), at least in part, adapted to xeric conditions (Figure 2), apparently as a response to the lower capacity of the sandy soil to retain water, which acts synergistically with the effects of salty sprays from the ocean. These two typical elements of the restinga environment may result in deficit of water to plants (Lacerda & Ray, 1982) even with elevated rainfall, which is higher than 1100 mm a year (Mantovani & Iglesias 2001). The vegetation varies in the size of the plants, but is in general organized in scrubs, forming a patchy distribution (Figure 2). Besides cacti, bromeliads are characteristic in these habitats. In Rio de Janeiro, the bromeliad *Neoregelia cruenta* (R. Graham) L. B. Smith is common growing on the sand dunes of several restingas (Araujo & Henriques, 1984).

Figure 1. View of the littoral of the State of Rio de Janeiro, Brazil, showing (in blue) the lagoons resulting from sea level drop in the past and the location of some of the restinga habitats (oceanic margin of the lagoon and the study site in Restinga de Maricá).

Because of their location, restingas are prime land for real estate investments. As a result, in states like Rio de Janeiro, these habitats and the fauna and flora that thrive on them are extremely endangered. In the Municipality of Rio de Janeiro, its almost 50 Km of coast was once dominated by restingas which have almost completely disappeared. In the state, however, several fragmented remnants still exist, but their conservation status varies tremendously (Rocha *et al.*, 2007) and their conservation future is still uncertain. Therefore, studies that can serve as the bases for the understanding of these restingas are urgent and necessary so as to support conservation efforts.

Restingas harbor a peculiar community of frogs (Carvalho-e-Silva *et al.*, 2000; Rocha *et al.*, 2008), with some of the species endemic to this habitat, *e.g.*, *Leptodactylus marambaiae* (Izecksohn & Carvalho-e-Silva, 2001) and *Rhinella pygmaea* (Carvalho-e-Silva *et al.*, 2000). Some of the most distinctive species of the Atlantic forest are also restinga inhabitants, and bromeliad users in different levels of dependency. Examples of the frog diversity include the exquisite casque-headed hylid frog *Aparasphenodon brunoi* (Figure 3), *Xenohyla truncata* (Figure 4), which is the only species known to include fruits

Figure 2. Detail of sand dune (closer to the lagoon) in Restinga de Maricá showing scrub and patchy vegetation.

Figue 3. Juvenile *Aparasphenodon brunoi* (Hylidae)

in its diet (Silva *et al*, 1989; Silva & Britto-Pereira, 2009), and *Scinax littoreus* (Figure 5) that belongs to a group specialized in reproducing in bromeliads (Alves-Silva & Silva, 2009).

Our study of the frogs in the Restinga de Maricá, State of Rio de Janeiro, published at Biotropica (Silva *et al.*, 2011), was designed to answer some basic questions regarding the use of the most abundant bromeliad, *Neoregelia cruenta* (Figure 6), by frogs. We aimed to (1) describe how many frog species in the area used these plants, (2) if bromeliads were used differently by different species of frogs, and (3) if some of the physical characteristics of the bromeliads were somehow selected by the species of frogs when searching for a place to hide. Based on our findings we discuss and reinforce the need to conserve bromeliads as microhabitats for frogs.

Our results confirm a morphological plasticity trend in which bromeliads exposed directly to the sun are different from those that grow in the shade, protected from direct sun light by the covering of other plants in the interior of scrubs (Cogliatti-Carvalho & Rocha, 1999). Bromeliads that grew exposed to direct sun light are bulkier, shorter, have narrower and lighter green leaves and their thorns are stronger and more spaced. Bromeliads that grew on the shade have longer, darker green leaves, and less water storage capabilities. It is also reported that, as a result of having a higher degree of deposition of organic debris inside their tanks, bromeliads growing in shaded areas, within the scrubs, have a different and possibly less hospitable water storage to anurans than those directly in the sun. The chemistry of the water stored is significantly different (Guimarães-Souza *et al.*, 2006), which may affect the physiology of the anurans, including their respiration, and influence the process of plant selection for sheltering.

We discovered that frogs are more common in bromeliads growing exposed to direct sunlight, where dissolved oxygen levels are proved to be higher and ammonia and dissolved organic carbon lower (Guimarães-Souza *et al.*, 2006). Therefore we hypothesize that frogs choose among bromeliads based on the quality of their stored water, rather than their morphology, which may be harder for a frog to detect. Considering the high frequency of bromeliads used by anurans during the whole year, our data reinforce the importance of protecting these plants. We demonstrate the importance of bromeliads as biodiversity amplifiers for anurans and the importance of these plants for their conservation.

Figure 4. Female *Xenohyla truncata* (Hylidae)

Figure 5. *Scinax littoreus* (Hylidae)

Figure 6. *Neoregelia cruenta* (Bromeliacea)

Acknowledgments

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Invasive plants and amphibians: a cryptic connection

By James I Watling, Caleb R Hickman & John L Orrock

The negative effects of invasive species on biodiversity have been documented repeatedly around the world and across levels of biological organization. However, most research on invasive species focuses on invasives that either compete with or prey upon native organisms. Relatively little work has focused on the ability of invasive species to change the environment in ways that impact native organisms. Recent research by James Watling (University of Florida), Caleb Hickman and John Orrock (both at the University of Wisconsin) suggests that an invasive plant may create changes in both aquatic and terrestrial environments that can influence amphibian survival, development and distribution. In one paper (Watling et al., 2011a) the authors report on a laboratory study in which tadpoles of four species were reared in extracts of native leaf litter, extracts of leaf litter from the invasive Amur Honeysuckle (*Lonicera maackii*), or dechlorinated water. Although there were no differences in survival of tapoles reared in the two types of leaf litter extracts for three species, one species (the American toad, *Anaxyrus americanus*) experienced much greater mortality in *L. maackii* leaf extracts than in extracts of leaves from native species. In another experiment, the authors wanted to see if tadpoles of *A. americanus* were also affected by *L. maackii* under more natural conditions (Watling et al. 2011b). They created small depressions in the ground that were allowed to fill with rainwater, simulating the ephemeral pools used as breeding habitat by many amphibians. Half of the pools were located in areas with high densities of *L. maackii* shrubs, and the other half were located in areas with very few or no *L. maackii*. To differentiate effects of the shrub itself (i.e., shading) from effects of the leaf litter from the shrub and soil from invaded areas, the authors lined half of the pools in uninvaded areas with soil and leaf litter from invaded areas, and vice versa. All pools were stocked with the same number of tadpoles. After a month, the remaining tadpoles were collected, counted, and scored for developmental stage (pools were monitored during the experiment to ensure that metamorphosing individuals were not escaping from pools). Survival of tadpoles was lower in pools where predatory beetle larvae were observed than in pools where beetle larvae were not observed—a result that is not surprising given the important role of aquatic invertebrates as tadpole predators. Survival did not differ between pools located in invaded or uninvaded areas, or between pools with soil and leaf litter from invaded forest, in contrast to the dramatic mortality associated with *L. maackii* extracts in the laboratory study. However, more tadpoles in pools lined with soil and leaf litter from invaded areas reached an advanced developmental stage than individuals in pools with native leaf litter and soil. Thus, tadpoles appear to have been accelerating the trajectory to metamorphosis, a common response to suboptimal conditions in the aquatic environment. In a final paper (Watling et al. 2011c), the authors investigate how *L. maackii* affects the distribution of post-metamorphic amphibians, sampling in forest invaded or not by the shrub. They found that invaded areas had fewer species and more simplified amphibian communities than uninvaded areas. However, one species (the Green frog, *Lithobates clamitans*) actually increased in density in invaded plots, where high *L. maackii* density reduced both daily mean and daily maximum temperatures on the forest floor compared with uninvaded areas. It appears that different species respond to different components of the environmental changes associated with plant invasion: some responding to plant-mediated changes in the aquatic environment, some respond to changes in the terrestrial environment caused by exotic plants, and some are unaffected by plant invasion. Additional research is starting to shed light on these non-intuitive interactions (Martin & Murray 2011; Maerz et al. 2009), and it appears there is much still to learn about the patterns and mechanisms underlying the effects of invasive plants on amphibians.

Figure 1. Amphibian breeding pond in forest invaded by the Amur Honeysuckle, *Lonicera maackii*. Credit: Caleb R. Hickman.

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Global Amphibian BioBlitz

Find every one...

By Scott R. Loarie, Ted R. Kahn, Brian Gratwicke, Kevin Johnson, Michelle Koo, Giovanni A. Chaves Portilla, Benjamin Tapley & Ken-ichi Ueda

Saving amphibians represents one of the most precarious fronts in the struggle to conserve biodiversity. Scientists suspect that more than 200 amphibians have gone extinct in the last two decades and at least one third of the planet's nearly 7,000 species are at risk of extinction. Action to prevent extinction requires a basic understanding of where amphibians persist and where they are no longer found, and what factors are involved with these disappearances. But with scarce conservation resources, the flow of this fundamental information on species occurrence cannot keep pace with the scale of the challenge. Many amphibian species have not been seen in years. Are they extinct? Others are known from only one or two specimens. Are there new ways to acquire information that we can harness?

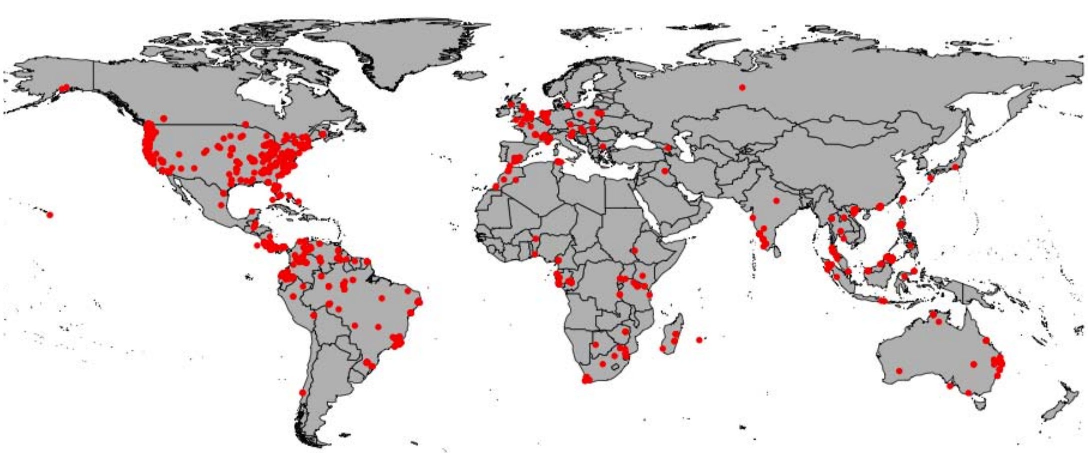
Good, scalable information can transform conservation. Consider forest cover conservation in the Brazilian Amazon. A few decades ago, while it was well known that the Amazon was rapidly disappearing, the only evidence to support this trickled in from isolated local reports. Regional scale trends were largely anecdotal, and coordinating local partners was difficult. In 2000, the Brazilian space agency began using remote sensing technology from the Landsat 5 satellite to track the location and number of hectares lost to deforestation. Such tangible indices are as powerful as they are rare in conservation. They are benchmarks from which to chart progress, rallying cries to galvanize support for broad policies, and blueprints from which to launch focused conservation efforts.

Where is our 'satellite' for amphibian conservation? Sadly, satellites can't tell us where frogs persist. We have noticed that something exciting, however, is happening on the Internet. People are sharing information on biodiversity – photos of frogs posted to Facebook and Flickr pages, trip reports on herping adventures on forums, and growing checklists from eco-lodges around the world. Can we harness the power of social networks and citizen scientists to produce data streams that are useful for amphibian conservation and accepted by the scientific community? The potential is compelling and one we are exploring with the Global Amphibian BioBlitz (www.inaturalist.org/projects/global-amphibian-bioblitz).

The goal set by the Global Amphibian BioBlitz is at once simple and ambitious – to gather *in situ* observations of every species of amphibian in the world. In the first month, over 200 volunteer participants worked together to upload over 1,000 observations of more than 500 distinct species of amphibian. While this only represents about 8% of amphibians globally, 84% of families and 37% of genera have been 'checked-in' from dozens of countries across the planet. In addition to being well distributed across the amphibian tree and across the continents, these species also represent an interesting cross-section of threatened species. Of the first 624 species observed by participants in the Global Amphibian BioBlitz, the IUCN Red List of Threatened Species considers 75 as Near Threatened (NT), 46 as Vulnerable (V), 42 as Endangered (EN), five as Critically Endangered (CR), and one 'Extinct' (EX). The 'Extinct' species is Holdridge's Toad (*Incilius holdridgei*), which was declared Extinct by the IUCN Red List of Threatened Species since it had not been seen since 1986. In 2009, it was rediscovered, making it one of a short list of 'Lazarus species' raised from the dead that surely represent some of the most threatened species on the planet.

Keeping a watchful eye on these threatened species is especially important for setting conservation priorities, making policy decisions and ultimately conserving species. Many species such as the Andean Marsupial Frog (*Gastrotheca riobambae*) were once widespread but have declined precipitously in recent years. A contribution from May 21st of this year is a welcome sign that this species persists, however tenuously.

What can information like this tell us? First, we wish to know whether each species of amphibian still persists, and where they are surviving. We are certain that many species no longer persist. The IUCN

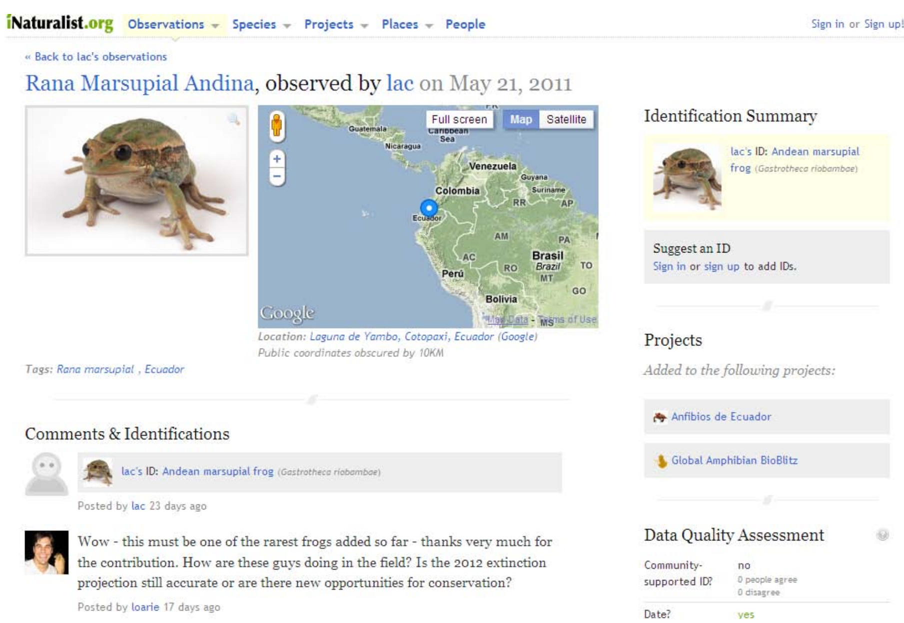


A map of contributions to the Global Amphibian BioBlitz. 85% of the world's amphibian species have been checked-in so far representing 38% of genera and 9% of species.

Species Survival Commission Amphibian Specialist Group's Lost Frog campaign selected 100 amphibian species that appear very likely to have gone extinct in recent decades and targeted them with field expeditions. That only a few of these species were located despite a great deal of support for the effort tells us that we may be too late for many in this subset and perhaps a broader survey across all amphibians is required. By comparing the rate and number of 'check ins' to the Global Amphibian BioBlitz we hope to develop a useful metric for identifying amphibians that require special attention before they are lost forever.

After just one month, the vast majority of amphibian species haven't yet checked-in to the Global Amphibian BioBlitz. But as new contributions continue to fill in the amphibian tree of life with confirmed sightings, our attention will be increasingly drawn to gaps in the tree. We can already see this happening in the BioBlitz in several well-surveyed areas with relatively small numbers of amphibian species including some countries in Europe. For example, of the twenty species of amphibians found in Austria, all have been posted on the BioBlitz to date except one salamander and one newt: the Alpine Salamander (*Salamandra atra*) and the Italian Crested Newt (*Triturus carnifex*). We are by no means suggesting that these amphibians are rare or have gone extinct – in fact both are quite well-studied and considered common – only that by being the last two amphibians awaiting confirmation in Austria our attention is focused on them, and we can better visualize - and indeed in a sense quantify - rarity among an often bewildering diversity of amphibians. The absence of data is still useful, and in the BioBlitz this is certainly the case. If in a year or two the BioBlitz succeeds in observing a substantial proportion of the world's amphibians, surely the missing fraction will be a focal point for conservation and science.

Another application of these data is the refinement of coarse species distribution maps. Many distributions are informed only by the species' type locality. Out of range observations greatly increase our understanding of where these amphibians are found, and what ecological niches they occupy, which provides more information to prioritize areas in need of conservation. Even our knowledge of broadly distributed amphibians benefits from more observations. For example, the Lemon-yellow Tree Frog (*Hyla savignyi*) is known to occur in a relatively broad swath across much of Turkey, Iran and several other Middle Eastern countries. However, a contribution from a US National Guard sergeant stationed in Iraq of a Lemon-yellow Tree Frog found in a latrine on Joint Base Balad near Al Bakr is well outside of the IUCN range map, a common online reference for amphibian distributions, and all the museum records for the species searchable through the Global Biodiversity Information Facility (GBIF). Especially in places like Iraq that may be inaccessible to herpetologists, every observation counts.



An observation of the endangered Andian Marsupial Frog (*Gastrotheca riobambae*) contributed to the Global Amphibian BioBlitz.

It's foreseeable that the Amphibian BioBlitz may highlight some unresolved branches of amphibian taxonomy. Several species posted have unresolved placement in the amphibian tree of life. While species should never be described solely from photographs, observations of amphibians that don't seem to resemble any known species might warrant further investigation. There are about thirty observations in the BioBlitz that have not been identified to the species level. While attention from local experts, or a better photograph of certain characters might key some of them to species, it is possible that they might represent undescribed species that justify further taxonomic investigation.

Engaging citizen scientists, amateur naturalists, and the conservation community at large by connecting them with amphibian specialists is clearly advantageous for amphibian conservation. People only conserve what they understand and care about, and it is our belief that helping people to learn about and share information on these unique animals is good for conservation. We've tried to make the BioBlitz entertaining through friendly competition. Users can see who has observed the most species and how many species have been 'ticked-off' from each country, and indeed the BioBlitz 'leader board' has a lively and competitive short history. These statistics not only give incentive to the public to participate, but reward those submitting data.

Of course, making public the flow of information raises concerns that must be considered carefully. The first concern is whether observations made by amateurs are credible enough for scientific purposes. The success of efforts to mobilize the amateur bird watching community for science has shown that amateurs can be a reliable source of data. And unlike birds, amphibians are comparably easy to photograph. These photographs serve as tangible evidence upon which the scientific community can judge the veracity of a contribution. Many photos are too poor and many species too cryptic to identify from photos, but the vast majority can be identified to at least genus level. The

The ghost glass frog (*Sachatamia ilex*) from Panama. Photo: Brian Gratwicke

BioBlitz has a group of volunteer curators who help verify contentious identifications. www.iNaturalist.org, the social network that powers the BioBlitz, facilitates communication between amateurs and specialists that can help follow up on controversial observations. Direct communication between those who post and the curators lends further veracity to observations among peers.

A second concern is that commercial and hobby amphibian collectors might use distribution information to further endanger rare populations of amphibians. This is a real concern and something we have taken several steps to address. First, the public locations of threatened taxa are automatically obscured by ten kilometers. Second, users can choose to obscure the locations of any contribution by ten kilometers or completely. We have asked participants to make the private locations of their observations accessible to the curators of the BioBlitz and to scientists with legitimate research needs. As a result we are in the process of putting together a panel to review requests to access the database for scientific purposes.

The BioBlitz was launched through a partnership between the IUCN Amphibian Specialist Group, the Smithsonian Conservation Biology Institute, AmphibiaWeb, the Center for Biological Diversity, Amphibian Ark, and the Neotropical Conservation Foundation. Because of these partners' early participation in the BioBlitz, activity has thus far been concentrated in certain areas more so than others. For example, an emphasis on the tropics means that many salamanders have been underrepresented – especially salamanders from mainland Asia and several from Mesoamerica. As we grow, by partnering with established forums like www.Caudata.org, we hope for more activity on these branches. Activity is likewise geographically varied. Panama, for example has been well represented with 32% of species being reported, largely because of Smithsonian scientists' emphasis on the region. By contrast, only 2% of Madagascar's amphibians have been checked in. Another new partnership with the Sahonagasy effort in Madagascar will hopefully increase reports from that area. We hope that communities will work together to complete their countries' checklists, and perhaps find solidarity by competing in a friendly manner with other countries. We'd also like to better engage reserves with geographically focused but well-studied amphibian faunas. The success of the BioBlitz so far – over 624 species at the time of this writing – reveals that this approach has real potential. However, the effort has a long way to go before we can realize the true extent of its utility.

We encourage you to visit the Global Amphibian Blitz to check on the progress and to upload your own amphibian photos and observations. The site can be found at www.inaturalist.org/projects/global-amphibian-bioblitz.

Please join in and help amphibian scientists and conservationists around the world to Find every one...

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Planning Amphibian Conservation in Mexico

By Leticia M. Ochoa-Ochoa, Nicolás Urbina-Cardona & Oscar A. Flores-Villela.

It is well known that Mesoamerican cultures were aware of the amphibian diversity living in the area. This, however, is not surprising, due to the large amphibian diversity that has been documented for this part of the world. As part of the Mesoamerican transition zone where the biotas of northern and southern America overlap, Mexico is considered one of the megadiverse countries in the world (Mittermeier *et al.*, 1999), and the proportion of endemics is known to reach more than 60% (372 species; Flores-Villela, 1993; Flores-Villela & Canseco, 2004; Frías *et al.*, 2010). Despite of its vast richness, Mexico is in an early stage of amphibian ecology and taxonomy knowledge (Frías *et al.*, 2010). For example, in the decade between 1993 and 2003, 26 frog and 31 salamanders species were described as new taxa from the country (Flores-Villela & Canseco, 2004).

Neotropical amphibians are considered highly threatened by deforestation, and recent data from Mexico and Guatemala shows the critical situation of the plethodontids (Rovito *et al.*, 2009). Moreover, it has been recognized that for some threatened species of Hylids the "core" distribution it is not represented within the natural protected areas system in Mesoamerica (Urbina-Cardona & Loyola, 2008).

The need to establish more areas targeting amphibian conservation has been clear since the first analyses showed that most areas of high endemism are not being preserved (Ochoa-Ochoa & Flores-Villela, 2006). In 2006, we performed a series of analyses for a GAP analysis of Mexico (CONABIO *et al.*, 2007), using different search algorithms heuristic, metaheuristic, optimum (Marxan, ResNet and Cplex, respectively) and targets (set per species and based upon expert workshops; and 10% target of representation for rare, common and all species) for selecting areas for conservation. Although we found variation in the results depending on the algorithms and targets, we also find that there are some places that were always selected. Due to their emergent importance for conservation we named them "highly priority sites" (Figure 1).

Figure 1. Priority sites selection for amphibian conservation using different goals and algorithms (Marxan, ResNet and Cplex). Highly priority sites were always selected. Figure modified from (Conabio-Conanp, 2011)

While doing this research we had the opportunity to collaborate with The Nature Conservancy Mexico, developing the spatial databases of different conservation instruments for the country. This was the connection that gave birth to our article "The effects of governmental protected areas and social initiatives for land protection on the conservation of Mexican amphibians" (Ochoa-Ochoa *et al.,* 2009). In that article we focussed on the importance of social initiatives in conservation (SICs) promoting a new perspective for analysis. Social initiatives in conservation include all of the efforts that society implements to conserve biodiversity, such as land protection from private reserves to community zoning plans some of which have generated community-protected areas. This was the first attempt to analyze the status of conservation in Latin America when some of these social initiatives are included. We used a niche model approach to map the potential and real geographical distribution (extracting the transformed areas) of the endemic amphibians. Based on remnant distribution, all the endemics had at that moment suffered some degree of loss, but 36 species have lost more than 50% of their potential distribution. We found that most of the species have some proportion of their potential ecological niche distribution protected, but 20% were not protected at all within governmental PAs. A percentage of 73% of endemic and 26% of microendemic amphibians were represented within SICs. However, 30 micro-endemic species were not represented within either governmental PAs or SICs. This study showed how the role of land conservation through social initiatives was becoming a crucial element for an important number of species not protected by governmental PAs (Ochoa-Ochoa *et al.,* 2009).

Another analyses using distribution models for 222 amphibian and 371 reptile species (49% endemics and 27% threatened) showed that high priority areas for conserving Mexican amphibiofauna (total) are not congruent with high priority areas for threatened species and endemic species. Furthermore these prioritized areas significantly differ from other groups, such as mammals (Urbina-Cardona & Flores-Villela, 2010). This study also showed that pine and oak forests, tropical evergreen forest, low deciduous forest, and montane cloud forests support a high proportion of endemic and threatened species and should therefore be given priority over other types of vegetation for inclusion in the system of protected areas for south-eastern Mexico. Conservation areas prioritized for amphibians could focus efforts in conducting expeditions searching for new amphibian species. It is also important to determine the status of amphibian populations in these areas, and their genetic variability in determining vulnerability to extinction by anthropogenic factors.

Recently we proposed a triage tool to prioritize sites for conservation based on micro-endemic Mexican amphibian (Ochoa-Ochoa *et al.*, *submitted*). This tool is base on the ground reality of limited resources and high speed of land use change, assessing current potential threat abatement responses derived from existing policy instruments and social initiatives. To prioritize the amphibian micro-endemic areas we used existing and newly compiled spatial databases of territorial conservation instruments, threats, and amphibian range distributions for Mexico. We identified 50% of Mexican micro-endemic amphibians as requiring urgent actions. We developed a conservation strategy for the majority of these species. However, almost 25% urgently need field-base verification to confirm their persistence due to the small percentage of remnant natural vegetation within their areas of distribution.

Prioritization exercises as presented in this paper can help local experts make good policy decisions. Nevertheless, multicriteria analyses including socioeconomic variables are needed to refine conservation area networks and ensure that the final proposal satisfies divergent socioeconomic criteria and to identify natural hazards, vulnerability, and conservation goals of stakeholders involving different institutions and individuals. An efficient solution for a particular conservation problem can be performed only if it is supported by local communities who could potentially be affected by conservation actions implemented to achieve the goals.

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ARMI (Amphibian Research and Monitoring Initiative): Founded Locally; Engaging Globally

As a consequence of the global amphibian decline first discussed at the 1st World Congress of Herpetology in 1989, the United States Congress established and funded the Amphibian Research and Monitoring Initiative (ARMI) within the United States Geological Survey in 2000. ARMI's overarching goals are to evaluate the status of amphibians on Federal lands across the United States, conduct research on the causes of those declines, and develop and test potential options for conservation. Though developed to focus on amphibian populations in the United States, ARMI scientists have been involved with amphibian conservation around the globe.

Estimation of individual survival or population abundance is usually impractical at the large scales at which many ecologists conduct research. As a practical alternative to estimate the status of amphibian populations, ARMI pre-doctoral student Darryl MacKenzie designed inference methods for occupancy data known as "Proportion of Area Occupied" (MacKenzie et al. 2006). Because occupancy methodology has no taxonomic constraints, it has gained wide use across the globe for many taxa (Pellet and Schmidt 2005; Louiselli 2006; Penmian et al. 2008; Karanth et al. 2011). The freely available occupancy estimation software (http://www.mbr-pwrc.usgs.gov/software/presence.shtml; http://warnercnr.colostate.edu/~gwhite/mark/mark.htm), and classes offered by MacKenzie and USGS scientists have contributed to its international adoption. In another arena is ARMI's work on filtering methods to detect amphibian chytrid (*Batrachochytrium dendrobatidis*; Bd) DNA in water and sediments (Kirshtein et al. 2007). The USGS microbiology lab in Reston has processed swabs and water filters from researchers across various countries and provided technical assistance to other labs.

ARMI scientists have also collaborated directly with colleagues across the globe via research projects (e.g. Australia, Canada, China, Denmark, Guam, Italy, Mexico, Switzerland, Taiwan) and participation in workshops and meetings (e.g., Australia, Brazil, Czech Republic, South Africa, Taiwan, Tanzania) yielding dozens of publications including Scalera et al. (2008); Muths et al. (2009); Shoo et al. (2011); Wan-Yi et al. (2011); and Woodhams et al. (2011). While ARMI's primary mission is to assist US Federal land managers, the findings of ARMI scientists contribute to the worldwide discussion and learning about how to reverse the global amphibian crisis.

More information on ARMI availiable at http://armi.usgs.gov/

Photo: Gary Fellers and colleagues, Yeong-Choy Kam, Wan-Tso Hsu in Central Taiwan; 2010.

Photo: Erin Muths and colleagues at the global "Bd mitigation workshop"; Zurich, Switzerland, 2010

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Recent Publications

Conservation and Ecology

A Power Analysis for the Use of Counts of Egg Masses to Monitor Wood Frog (*Lithobates sylvaticus*) Populations

Rick D. Scherer & Jeff A. Tracey

Reports of declines in amphibian populations has led to the development of many monitoring programs. Population monitoring is the repeated measurement over time of some attribute (a state variable) that is informative of a population's status. In many cases, the purpose of the monitoring program is to detect a declining trend in the state variable, so that action can be taken to prevent unacceptable losses or extinction. Annual counts of the number of egg masses has been promoted as a valid state variable for monitoring wood frog (*Lithobates sylvaticus*) populations, and the objective of this project was to assess the statistical power of this approach. In this context, power is defined as the probability of detecting a negative trend when the abundance of egg masses is actually declining over time. We addressed the following questions: How many years of count data will be required to have high power (≥ 0.80) to detect negative trends of various magnitudes in the abundance of wood frog egg masses? How does variation in detection probability of wood frog egg masses and the number of surveyors conducting surveys affect the number of years required to achieve high power? What effect does increasing Type I error rate, α, have on the number of years to achieve high power? We used computer simulation to address these questions.

Under the poorest conditions for detecting a decline in the abundance of the number of egg masses (i.e., small rate of decline in egg mass abundance across time, low detection probability of egg masses, one surveyor, and low α), more than 30 years were required to achieve high power. Under the best conditions (i.e., high rate of decline, high detection probability, three surveyors, and high α), nine years of count data were required to achieve high power. Improving the proportion of egg masses that were counted each year (by increasing detection probability and/or the number of surveyors) resulted in small reductions in the number of years to achieve high power. Increasing α resulted in larger reductions in the number of years to achieve high power but, of course, was accompanied by a higher probability of detecting a declining trend when the number of egg masses was not decreasing over time.

A common cause of failure in monitoring programs is insufficient duration of financial and institutional support. Therefore, a power analysis should be a central component in the evaluation of a proposed monitoring program's survey design and state variable. Though this study was focused on counts of egg masses in wood frog populations, we suspect the results are more broadly applicable to other amphibian species and counts of other life stages.

Full article: Scherer, R.D., & Tracey, J.A. (2011) A power analysis for the use of counts of egg masses to monitor wood frog (*Lithobates sylvaticus*) populations. Herpetological Conservation and Biology 6:89-98.

New population record and conservation assessment of *Colostethus ruthveni* in Colombia

José F. González-Maya, Mauricio González, Diego Zárrate-Charry, Fidela Charry, Amancay A. Cepeda & Sergio A. Balaguera-Reina

Colombia possesses important amphibian species richness but it is also heavily threatened by several factors threatening this richness. The country, in general, is poorly studied and several areas requires more intensive surveys to document species' presence and richness, and to understand the current status of numerous amphibian species and to gather basic information regarding distribution, ecology and general natural history. Here we report a new population of the Santa Marta Poison Arrow Frog, *Colostethus ruthveni*, an Endangered and endemic species from Sierra Nevada de Santa Marta mountain range, Colombia. During intensive surveys across Námaku Reserve, 22 *C. ruthveni* individuals (mean abundance 0.28 ± 0.09 ind/km) were observed along creeks between 737 and 923m above sea level near downtown Minca. This record represents a new locality for the species, increasing the number of known sites and expanding its extent of occurrence. We suggest the reassessment of the conservation status of the species from EN B1ab(iii) to VU B1ab(iii), due to this and other recent findings. Currently, the species is present in three protected areas; this new record represents another reserve area where the species is distributed, ensuring the habitat and reducing some of its most important threats such as habitat loss and degradation from agricultural activities, logging, pollution and infrastructure development. This finding represents new critical information for the species and defines the needs to understand the real status of its populations for future conservation strategies in the region, and also, it provides hope for several species that have potentially larger distributions but intensive and extensive surveys are needed to provide with accurate conservation status information.

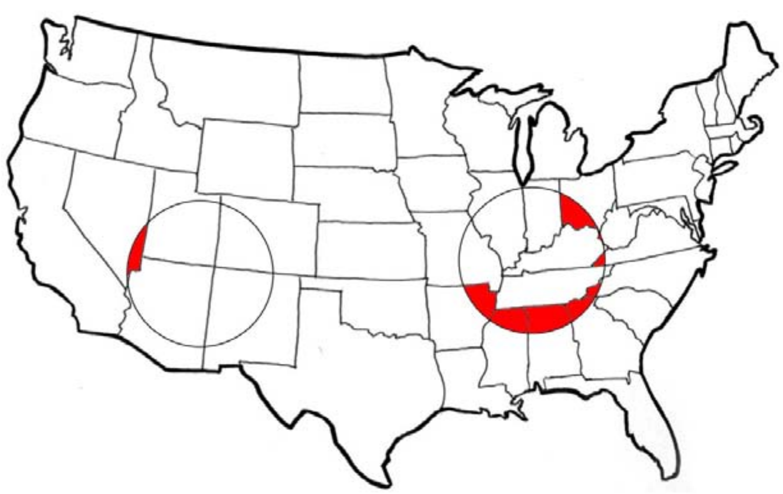
Full article: González-Maya, J.F., González M., Zárrate-Charry D., Charry F., Cepeda A.A. & S.A. Balaguera-Reina (2011). A new population record and conservation assessment of the Santa Marta Poison Arrow Frog *Colostethus ruthveni* Kaplan, 1997 (Anura: Dendrobatidae) from Sierra Nevada de Santa Marta, Colombia. Journal of Threatened Taxa 3(3): 1633-1636.

Individual of *C. ruthveni* observed at Námaku reserve in Sierra Nevada de Santa Marta. Credit: ProCAT Colombia 2010.

Biases in the protection of peripheral anuran populations in the United States.

Ryan P. O'Donnell & Andrew P. Rayburn

Many governments maintain lists of species of conservation concern. Governments at the edges of species' ranges can help prevent declines of species by protecting edge populations, where declines often begin. However, patterns in the sizes of political units may bias where species are likely to have their edges protected (see figure). We used simulations of hypothetical species ranges to determine whether the geographic pattern in sizes of U.S. states had the potential to bias the proportion of frogs and toads listed for protection at the state level. Then, we investigated whether the bias found in the simulations was evident as a bias in state listing decisions. The distribution of state sizes resulted in a pattern of more peripheral occurrences predicted in the eastern states than central or western states for typical ranges. Despite this pattern, edges of species ranges were more often protected in the western states. Western states also contained more species that were endangered range-wide, which could help explain this pattern. However, even after statistically controlling for the number of species that are endangered range-wide occurring in each state, there was still a pattern of western states protecting more species edges. Thus, despite being predicted to have more edge occurrences because of their small size, eastern and central states list a lower proportion of species edges than western states. Similar patterns in the sizes of political units elsewhere could bias our global preparedness to detect shifting ranges of species and to respond to those shifts in the face of climate change.



Two hypothetical circular species ranges are mapped on the United States. Edges of the species' ranges that might be protected by states are highlighted in red. By randomly applying ranges such as these across the United States, we found that species are predicted to have more of their range edges protected in the east, where states are smaller, than in the west. (Map created by Ryan P. O'Donnell.)

Full article: O'Donnell, R. P. & A. P. Rayburn. (2011). Biases in the protection of peripheral anuran populations in the United States. Herpetological Conservation and Biology 6: 91-98. (www.herpconbio.org)

A New Rapid Assessment Technique for Amphibians: Introduction of the Species List Technique from San José de Payamino, Ecuador

Anna P. Muir & Martin C. A. Muir

The urgent need for baseline amphibian data in light of global population declines has led to a call for accurate and robust rapid assessment techniques for amphibian assemblages. This is especially pertinent in areas such as wet tropical rainforest where there is a scarcity of data, often a result of the logistical problems of conducting research in such areas. Therefore, amphibian rapid assessment techniques specifically designed for work in the difficult tropical rainforest environment are required. The aim of this paper is to introduce the Species List Technique (SLT) as a rapid assessment technique for inventorying amphibian assemblages in tropical rainforest environments. We discuss the suitability of this technique to assess species richness and species accumulation based on field work in the lowland tropical rainforest territory of the Kichwa community San José de Payamino, Orellana Province, Ecuador.

The Species List Technique facilitates rapid species inventorying alongside richness estimation, allowing standardised comparisons between areas. Originally designed for rapid assessment of avifauna in tropical rainforest environments, this straight forward technique provides an index of effort for opportunistic encounters, meaning no data are excluded from analysis. This standardisation makes the SLT much more valuable for species assemblage comparisons between studies and sites than species inventories alone. To allow comparisons between richness estimations, we propose a standard species list length of five. The time efficiency of the method, low environmental impact and low cost lends itself for use in a rapid assessment setting. We therefore recommend the Species List Technique for the rapid assessment of amphibian assemblages in rainforest environments.

Full article: Muir, A. P. & Muir, M. C. A. (2011) A New Rapid Assessment Technique for Amphibians: Introduction of the Species List Technique from San José de Payamino, Ecuador. Herpetological Review: 42; 149- 151.

No Retreat, Baby, No Surrender.

Michael J. Lannoo

As amphibian biologists bearing witness to the sixth mass extinction, we have to be careful not to lock ourselves down into some form of pre-clinical post-traumatic stress disorder. The world, whether it realizes it or not, needs us. The trick in all this is to not lament the loss, but to get on with it, and to find energy; and rather than mourn what is no longer, try to celebrate those things that are or were. Easier said than done, and for people in certain sub-professions of our field this can be more than difficult. My friends who work in zoos and aquariums, especially those who run captive breeding programs, are particularly vulnerable. Their jobs are high stress—they fail to succeed and there are forever consequences. I understand their loss of hope, which can sometimes descend deeper, into a place that is much darker and from where it is more difficult to rise. These are people who, if they drink, drink faster and more than your average herpetologist, which is saying something. What our friends need to understand is that the problem does not lie with them; it lies within the situation they find themselves in. If roles were reversed it would be us on the floor next to that barstool. We are asking them to be on the front lines of the sixth mass extinction, and we're not giving them the financial or emotional support they need. They are frazzled and fraying. It is easy for them to think they're alone, and following a loss, it's easy for them to despair. But their fight is our fight, and they need our help. Why wouldn't we expect burnout and despair, and the sorts of behaviors in bars typically reserved for returning soldiers and off-shift firefighters? These are people that need to know they're not alone, and that they have our support. Bruce Springsteen understood when he wrote:

"Yes, we made a promise we swore we'd always remember.
No retreat, baby, no surrender."
Blood brothers in the stormy night a vow to defend.
No retreat, baby, no surrender."

Columbia Records, 1984

Full article: Lannoo, M.J. 2011. No Retreat, Baby, No Surrender. Herpetological Review 42:142–145.

Molecular phylogenetics of *Boulengerula* (Amphibia: Gymnophiona: Caeciliidae) and implications for taxonomy, biogeography and conservation

Simon P. Loader, Mark Wilkinson, James A. Cotton, G. John Measey, Michele Menegon, Kim M. Howell, Hendrik Müller & David J. Gower

The African caecilians of the genus Boulengerula are almost entirely confined to the Lowland coastal and Eastern Afromontane region but little is known of their evolutionary history. Phylogenetic relationships of the East African caeciliid Boulengerula were investigated using mitochondrial sequence data from Kenya and Tanzania. The phylogenetic tree supports a formerly proposed bipartition of the genus, and differs significantly from recent morphological analyses. Our analysis identified genetic differences between several mtDNA groups that potentially represent undescribed species – populations isolated on mountain fragments. If substantiated, taxonomic revision will be necessary with implications for conservation assessments. The two sampled lowland, coastal individuals are nested within primarily montane clades. Molecular clock estimates suggest some temporally congruent divergences in Boulengerula, perhaps suggesting regional causal events. However, other divergences happened at different times and over a long period, perhaps extending back to the Oligocene/Eocene. Our results for Boulengerula suggest a role for relative long-term environmental stability in the origins of the Eastern Arc Mountains biodiversity hotspot.

Full article: Loader, SP, Wilkinson, M., Cotton, J., Measey, G.J., Menegon, M., Howell, KM., Müller, H. Gower, DJ. 2011. Molecular phylogenetics of *Boulengerula* (Amphibia: Gymnophiona: Caeciliidae) and implications for taxonomy, biogeography and conservation. Herpetological Journal, 21: 5-16.

Boulengerula. Photo: Michele Menegon

Metamorphic (top) and paedomorphic (bottom) Oklahoma salamanders (*Eurycea tynerensis*). Images by Samuel D. Martin.

Considering alternative life history modes and genetic divergence in conservation: a case study of the Oklahoma salamander

Sarah L. Emel & Ronald M. Bonett

Alternative life history strategies can provide important variation for the long-term persistence of a species. However, conservation of such lineages can be complicated because each life history mode may have different habitat requirements and may be vulnerable to different environmental perturbations. The need to identify and conserve divergent intraspecific genetic lineages of amphibians is well recognized, but conservation of alternative life history modes has been underemphasized. The Oklahoma salamander (*Eurycea tynerensis*) is endemic to the Ozark Plateau of North America, and has two discrete life history modes, metamorphic and paedomorphic. Until recently, these modes were considered separate species and conservation attention focused only on paedomorphic populations. We perform phylogenetic analyses of mitochondrial and nuclear genes to assess patterns of historical isolation in *E. tynerensis*, and test whether life history mode is randomly distributed with respect to the phylogeny and geography. We find three divergent mitochondrial lineages and significant shifts in allele frequencies of a nuclear gene between the eastern, western, and southwestern portions of the distribution. Life history mode varies extensively, but paedomorphosis is largely restricted to the widespread western clade. Therefore, the two most divergent and narrowly distributed clades (southwestern and eastern) were previously overlooked due to their metamorphic life history. Paedomorphosis has allowed *E. tynerensis* to drastically increase its niche breadth and distribution size. Nevertheless, metamorphosis is also an important attribute, and metamorphic populations are the ultimate source for paedomorphic evolution. Preservation of divergent genetic lineages, and regions that include adjacent habitat for both life history modes, may be the most effective way to maintain historical and adaptive variation and provide gateways for ongoing life history evolution.

Full article: Emel, S. L., and R. M. Bonett. 2011. Considering alternative life history modes and genetic divergence in conservation: a case study of the Oklahoma salamander. *Conservation Genetics*. DOI 10.1007/s10592-011-0226-9

Conservation genetics of endangered southern California mountain yellow-legged frogs, *Rana muscosa*

Sean. D. Schoville, Tate S. Tunstall, Vance T. Vredenburg, Adam R. Backlin, Elizabeth Gallegos, Dustin A. Wood & Robert N. Fisher

Mountain yellow-legged frogs, *Rana muscosa*, have been listed as a federally endangered distinct population segment in southern California since 2002. Surveys indicate that populations are now extinct at >99% of historical sites in the San Gabriel, San Bernardino, San Jacinto and Cuyamaca mountain ranges, with only nine small populations remaining. The small size of these populations makes them prone to unpredictable environmental events, as was recently demonstrated when a catastrophic wildfire, followed by flooding and heavy stream erosion, impacted the San Bernardino population. Recently, the San Diego Zoo Institute for Conservation Research established a captive breeding program from tadpoles salvaged in the San Jacinto Mountains during a drought year. To facilitate conservation and recovery of *R. muscosa*, we examined patterns of genetic variation, historical population connectivity, and declines in genetic variability using mitochondrial and microsatellite data. Levels of genetic variation are low in all remaining southern California populations and there is strong evidence of recent genetic bottlenecks. At the same time, genetic variation among populations is quite high, suggesting a high degree of historical isolation within and between mountain ranges. We fit the observed data to a biogeographic model and estimate that these populations diverged during glacial episodes of the Pleistocene, with little gene flow occurring during or following population divergence. Hence, our results demonstrate that unique evolutionary lineages of *R. muscosa* occupy each mountain range in southern California and should be managed separately. We also show that some genetic variation has been lost in the establishment of the captive population, suggesting that recruitment of additional breeding frogs may be necessary. However, the initial stages of the captive breeding program have been promising, with the first reintroduction occurring this year in April.

Full article: Schoville, S.D., T.S. Tunstall, V.T. Vredenburg, A. R. Backlin, E. Gallegos, D.A. Wood, and R.N. Fisher. 2011. Conservation of evolutionary lineages of the endangered mountain yellow-legged frog, *Rana muscosa* (Amphibia: Ranidae), in southern California. *Biological Conservation* 144: 2031-2040.

Adult *Rana muscosa* from Riverside County, California. Photo taken by Adam Backlin.

Population Status of the Eastern Hellbender (*Cryptobranchus alleganiensis alleganiensis*) in Indiana

Nicholas G. Burgmeier, Shem D. Unger, Trent M. Sutton & Rod N. Williams

To better understand the conservation status of imperiled wildlife species, rigorous examinations of current and historical population densities need to be conducted. Eastern Hellbender (*Cryptobranchus alleganiensis alleganiensis*) populations have drastically declined throughout much of their range during the past few decades. This study documents the decline of the Eastern Hellbender over the previous 25 years in the only known remaining Indiana population. Mark-recapture surveys were conducted from June 2008 – October 2008 and July 2009 – September 2009 at 35 southern Indiana sites. Despite considerably higher survey efforts than previous studies, we documented fewer total captures and extremely low population densities. Density was estimated at 0.06 individuals/100 m^2 with a catch per unit effort of 0.05 individuals/person hour. These results fall well below estimates from other parts of the species range and highlight a significant decline from historical surveys in the study area. Sex ratios were male biased (2.6 males: 1 female), no sub-adult age classes were found, and only two nests were located. The population's bias towards older age classes combined with low population densities will likely negate the effects any natural breeding efforts would have on long-term population survival.

Full article: Burgmeier, N. et al. (2011). Population Status of the Eastern Hellbender (*Cryptobranchus alleganiensis alleganiensis*) in Indiana. J. Herp 45(2): 195-201.

Effects of urbanization on occupancy of stream salamanders

Steven J. Price, Kristen K. Cecala, Robert A. Browne & Michael E. Dorcas

Urban development is the most common form of land conversion in the United States. Using a before–after control-impact study design, we investigated the effects of urbanization on larval and adult stages of southern two-lined salamanders (*Eurycea cirrigera*) and northern dusky salamanders (*Desmognathus fuscus*). Over 5 years, we estimated changes in occupancy and probabilities of colonization and survival in 13 stream catchments after urbanization and in 17 catchments that were not urbanized. We also examined effects of proportion of urbanized area in a catchment and distance of the salamander population to the nearest stream on probabilities of colonization and survival. Before urbanization, adult and larval stages of the two salamander species occupied nearly all surveyed streams, with occupancy estimates ranging from 1.0 to 0.78. Four years after urbanization mean occupancy of larval and adult two-lined salamanders had decreased from 0.87 and 0.78 to 0.57 and 0.39, respectively. Estimates of mean occupancy of larval northern dusky salamanders decreased from 1.0 to 0.57 in urban streams 4 years after urbanization; however, adult northern dusky salamander occupancy remained close to 1.0 in urban streams over 5 years. Occupancy estimates in control streams were similar for each species and stage over 5 years. Urbanization was associated with decreases in survival probabilities of adult and larval two-lined salamanders and decreases in colonization probabilities of larval dusky salamanders. Nevertheless, proportion of impervious surface and distance to nearest stream had little effect on probabilities of survival and colonization. Our results imply that in the evaluation of the effects of urbanization on species, such as amphibians, with complex life cycles, consideration of the effects of urbanization on both adult and larval stages is required.

Full article: Price, S.J., K.K. Cecala, R.A. Browne, and M.E. Dorcas. 2011. Effects of urbanization on occupancy of stream salamanders. Conservation Biology 25: 547-555.

Amphibian pond loss as a function of landscape change - A case study over three decades in an agricultural area of northern France

Nuno Curado, Tibor Hartel & Jan W. Arntzen

Agricultural reform and infrastructural development are among the major drivers of biodiversity loss and landscape homogenization worldwide. Ponds, as other small stagnant water bodies, have a significant importance on regional-scale biodiversity; yet, they are particularly vulnerable to destruction and increased isolation caused by human induced landscape change. In this study we investigated for a set of 199 ponds if pond persistence (n = 86, 43%) or disappearance (n = 113, 57%) was related to wider changes in the landscape over the period 1975–2006 in an agricultural area in north-western France, and determined to what extent pond loss affects the local amphibian species' breeding possibilities. Landscape data was obtained from the classification of aerial photographs (1963) and two satellite images (2001 and 2003), complemented with field observations (1975 and 2006). Land use around the ponds was described and compared over concentric circles with five different radii in the 100–1000 m range. Overall, pond disappearance was associated with a decrease in grassland and an increase in arable fields and, in a lesser extent, urban areas around the ponds. We found that the small, man-made cattle ponds, with either natural substrate or concrete drinking troughs, were more often affected than the larger, semi-natural ponds. Since the cattle ponds are regularly used for amphibian reproduction, their massive destruction had a strong effect of local amphibian richness and breeding sites' availability, therewith weakening the population network and putting the local occurrence of some of the rarer species at risk. The creation of spatial pond persistence models allowed the identification of areas most at risk of further pond loss. We suggest that local amphibian conservation efforts will be the most effective if the focus is on the marshes and dune areas and on cattle-pond preservation in the remaining grasslands.

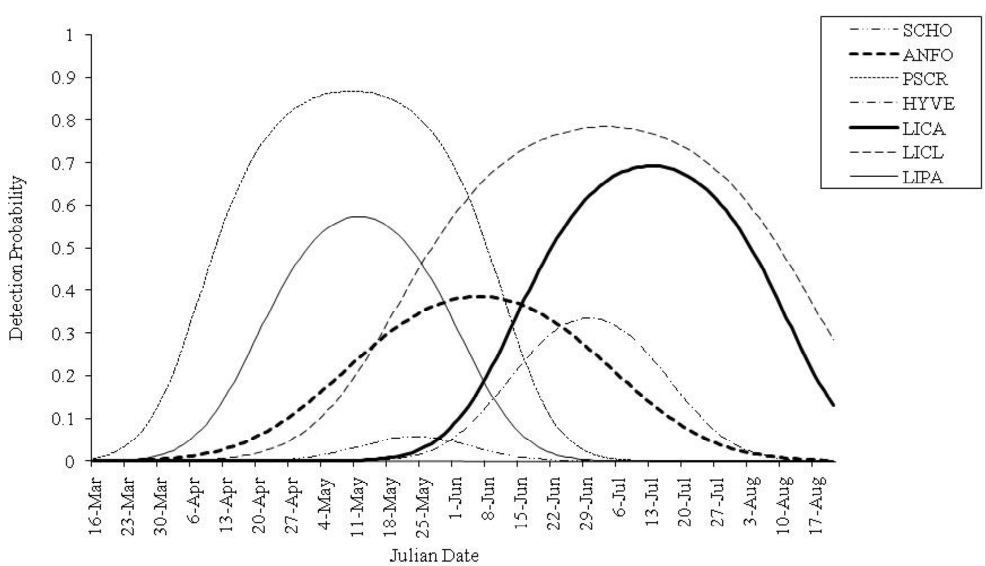
Full article: Curado N., Hartel T., Arntzen J.W. (2011). Amphibian pond loss as a function of landscape change – A case study over three decades in an agricultural area of northern France. Biological Conservation 144 (5): 1610–1618

Effects Of Temperature And Temporal Factors On Anuran Detection Probabilities At Cape Cod National Seashore, Massachusetts, Usa: Implications For Long-Term Monitoring

Robert P. Cook, Todd A. Tupper, Peter W.C. Paton & Brad C. Timm

To evaluate the efficacy of calling surveys, we studied effects of temperature and temporal factors (diel, seasonal, annual) on detection probabilities for anurans of southeastern Massachusetts, USA. We used automated recording systems (ARS) to quantify diel chronology during one field season, and conducted calling surveys to investigate seasonal and annual variation in calling at 103 wetlands over six years at Cape Cod National Seashore. Five species detected with ARS called primarily between sunset and midnight, with mean calling time of *Anaxyrus fowleri* and *Lithobates sylvaticus* nearer to sunset than *Pseudacris crucifer*, *Lithobates catesbeianus*, or *Lithobates clamitans*. Of eight species recorded during calling surveys (the preceding five plus *Scaphiopus holbrookii*, *Hyla versicolor*, and *Lithobates palustris*), detection probabilities of all but *Scaphiopus holbrookii* and *Lithobates sylvaticus* varied seasonally. Peak detection periods ranged from 11 to 33 days and peak period detection probabilities ranged from 0.06 for *Scaphiopus holbrookii* to 0.84 for *Pseudacris crucifer*. There was strong to moderate support for models with annual variation for all species except *Hyla versicolor*. Detectability was affected more by surface water temperature than by air temperature, but models with both received greater support in five species. For six species, models with temperature and seasonal effect received the greatest support, indicating that detectability is a function of both temperature and day of year. Durations of peak calling periods were long enough and detection probabilities high enough to effectively monitor six of the eight species with calling surveys.

Full article: Cook, R.P., T. Tupper, P.W.C. Paton, and B. Timm. 2011. Effects of temperature and temporal factors on anuran detection probabilities at Cape Cod National Seashore: Implications for Long-Term Monitoring. Herpetological Conservation and Biology 6(2):25-39.



Seasonal variation in detection probabilities of calling anurans during 5-minute calling surveys at Cape Cod National Seashore, based on model $\psi(.),\gamma(.),\varepsilon(.), p(julian+julian^2)$ in Appendix Table 1. SCHO = *Scaphiopus holbrookii*, ANFO = *Anaxyrus fowleri*, HYVE = *Hyla versicolor*, PSCR = *Pseudacris crucifer*, LICA = *Lithobates catesbeianus*, LICL = *L. clamitans*, LIPA = *L. palustris*.

Diseases and Toxicology

Critical windows of disease risk: amphibian pathology driven by developmental changes in host resistance and tolerance

Pieter T. J. Johnson, Esra Kellermanns & Jay Bowerman

Critical developmental windows are particularly important for infections that alter host development. Here, we test the influence of host developmental stage on the risk of mortality and the types of malformations produced in Pacific chorus frogs (*Pseudacris regilla*) following exposure to trematode (*Ribeiroia ondatrae*) parasite infection.

Consistent with a critical window of vulnerability, host mortality and malformations were greatest among animals exposed during pre-limb and early limb development (15–90%) and decreased to <5% with progressive development. Early stage animals exhibited a higher frequency of missing limbs, whereas extra limbs and limb elements developed predominantly among tadpoles exposed after limb development was initiated. Hosts infected later in limb development were normal or exhibited only minor abnormalities.

Increases in host tolerance rather than host resistance largely explained the observed changes in pathology. Prior to host metamorphosis, parasites exhibited comparable success invading host tissue, but the amount of resulting damage differed significantly as a function of host size and developmental stage. Following metamorphosis hosts were significantly more resistant to infections.

These findings highlight the importance of critical developmental windows for infectious diseases and underscore the role of developmental changes in host tolerance in controlling this process.

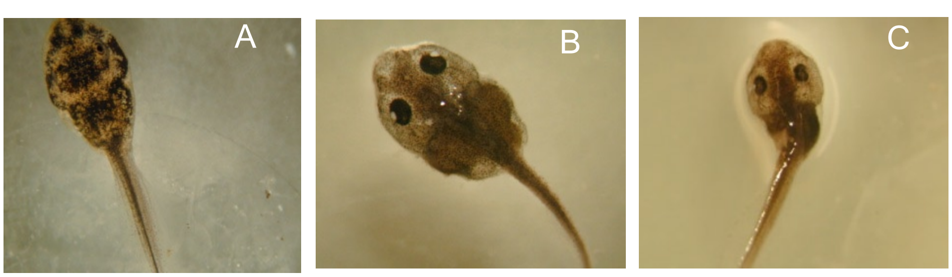
Full article: Johnson, P. T. J., E. Kellermanns, and J. Bowerman. (2011). Critical windows of disease risk: amphibian pathology driven by developmental changes in host resistance and tolerance. Functional Ecology 25: 726-734.

Effects of three explosive compounds on developing bullfrog (*Rana catesbeiana*) tadpoles

Norka E. Paden, Ernest E. Smith, Jonathan D. Maul & Ronald J. Kendall

The use of explosive compounds has resulted in contamination of terrestrial and aquatic ecosystems and is currently a serious concern in the United States, Germany, and Canada. In the United States both 2,4,6-trinitrotoluene (TNT) and 2,4-dinitrotoluene (DNT) have been detected in vicinity of munitions facilities and waste water from TNT manufacturing plants. Little is known regarding the effects of chronic exposure of TNT and DNT in early developmental stages of North American species, such as the bullfrog. Chronic aqueous exposures were conducted using bullfrog (*Rana catesbeiana*) tadpoles (8 d old) exposed to TNT, 2,4-DNT, and 2,6-DNT for 90 d. Survival, growth, gross morphology, incidence of abnormal swimming and morphological abnormalities were evaluated. Survival of tadpoles was significantly reduced at all concentrations tested. Only 2,4-DNT did not have a significant effect on body mass or SVL, but all three compounds tested had significant effects on survival. Our study suggests that long-term continuous exposure to these compounds at concentrations of 0.25 mg/L could lead to significant changes in growth and survival of larval amphibians.

Full article: Effects of chronic 2,4,6,-trinitrotoluene, 2,4-dinitrotoluene, and 2,6-dinitrotoluene exposure on developing bullfrog (*Rana catesbeiana*) tadpoles. 2011. Ecotoxicology and Environmental Safety (74): 924–928

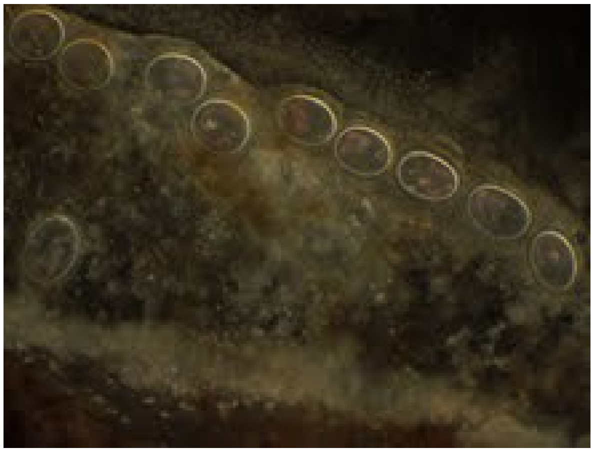


Control bullfrog tadpole after two weeks (A). Mild abdominal edema in tadpole exposed to 2,6-DNT (8 mg/L) for one week (B). Tail flexure in tadpole exposed to 1mg/L of TNT for one week (C).

Effects of wetland vs. landscape variables on parasite communities of *Rana pipiens*: links to anthropogenic factors

Anna M. Schotthoefer, Jason R. Rohr, Rebecca A. Cole, Anson V. Koehler, Catherine M. Johnson, Lucinda B. Johnson & Val R. Beasley

Infectious diseases have emerged as important factors in the declines of many amphibian populations. Helminths, in particular, are common parasites of frogs and evidence suggests that at least some species (e.g., *Ribeiroia ondatrae*, *Echinostoma trivolvis*) may have detrimental effects on the growth and survival of larval and juvenile frogs. In addition, previous studies have suggested that wetland pollution and loss of native habitats in the landscapes surrounding wetlands may influence the transmission of these parasites in frog populations; however, a complete understanding of the contributions of wetland versus landscape factors on helminth transmission is lacking. To better understand the interplay between wetland and landscape factors and to identify specific environmental factors and spatial scales associated with helminth infections, we examined the mean abundances, richness and diversity of helminth taxa in 18 populations of juvenile northern leopard frogs (*Rana pipiens*) in relation to wetland and landscape variables quantified at 1 km (local) and 10 km (regional) spatial extents in Minnesota (USA). Regression analyses and variance partitioning techniques revealed that variation in the abundances of parasite taxa that are found as larvae in frogs (larval trematodes) were influenced primarily by wetland (R^2_{adj} = 29.1%) and local landscape (R^2_{adj} = 28.0%) variables, whereas the abundances of parasite taxa found as adults in frogs (adult trematodes and nematodes) were significantly associated with regional landscape variables (R^2_{adj} = 60.6%). The particular variables identified as important for larval trematodes were the concentrations of atrazine and phosphorus in wetland water (positive associations), the percentage of forest habitats in the local landscapes (positive association) and size of open water habitats in the local landscapes (negative association). Large patches of woody wetland habitats in the regional landscapes were identified as important for adult parasite taxa. Forest and woody wetland habitats in surrounding landscapes were also identified as important for maintaining parasite taxa richness and diversity. In summary, our data emphasize the influence of multiple spatial scales on helminth transmission in frogs and suggest that anthropogenic activities that have resulted in the loss of the availability and connectivity of native habitats in landscapes surrounding wetlands are associated



Metacericae of *Echinostoma trivolvis* infecting the kidney of a frog. This larval trematode species was the most common parasite observed in juvenile northern leopard frogs in Minnesota and has been implicated in causing tadpole death and reduced growth in laboratory studies. Credit: Jason R. Rohr.

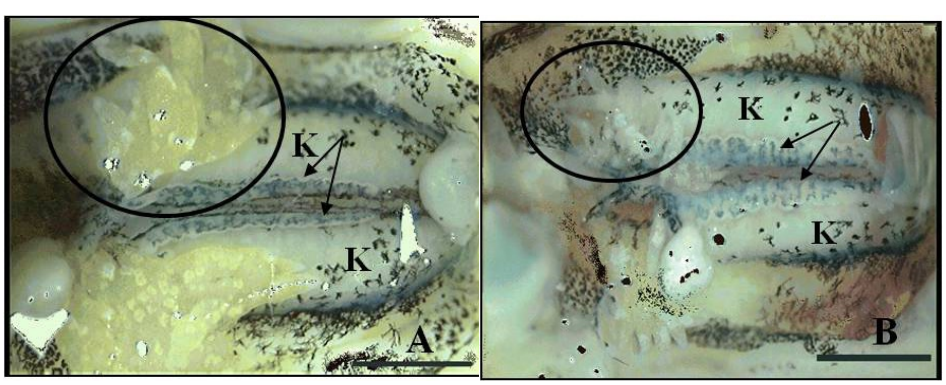
with declines in helminth richness and abundance, but that alteration of wetland water quality through eutrophication or pesticide contamination may facilitate the transmission of certain parasite taxa. Reducing inputs of agrochemicals into wetlands may be particularly important for limiting the effects of larval trematode infections on frog populations.

Full article: Schotthoefer et al. (2011) Effects of wetland vs. landscape variables on parasite communities of *Rana pipiens*: links to anthropogenic factors. Ecological Applications: 21; 1257-1271. Schotthoefer.Anna@mcrf.mfldclin.edu

Atrazine exposure affects growth, body condition and liver health in *Xenopus laevis* tadpoles

Renee M. Zaya, Zakariya Amini, Ashley S. Whitaker, Steven L. Kohler & Charles F. Ide

Six studies were performed regarding the effects of atrazine, the most frequently detected pesticide in fresh water in the US, on developing *Xenopus laevis* tadpoles exposed 5 days post-hatch through Nieuwkoop Faber Stage 62. The levels of atrazine tested included those potentially found in puddles, vernal ponds and runoff soon after application (200 and 400 µg/L) and a low level studied by a number of other investigators (25 µg/L). During all exposures, mortality, growth, metamorphosis, sex ratio, fat body (a lipid storage organ) size and liver weights, both relative to body weight, were evaluated. In certain studies, feeding behavior was recorded, livers and fat bodies were histologically evaluated, liver glycogen and lipid content were determined by image analysis, and immunohistochemical detection of activated caspase-3 in hepatocytes was performed. No effects were noted at 25 µg/L. None of the exposure levels changed sex ratios nor were intersex gonads noted, however, no definitive histological evaluation of the gonads was performed. Exposure to 400 µg/L atrazine did not increase mortality versus controls. Although a marginal increase in mortality at the 200 µg/L level was noted, it was not statistically significant. At the 400 µg/L level, tadpoles were smaller than controls by 72 hours of exposure and remained smaller for the rest of the exposure. Appetite was not decreased at any exposure level. Slowed metamorphosis was noted only at 400 µg/L in two of five studies. No pathological changes or differences in glycogen or lipid stores were noted in the livers of exposed tadpoles. However, in one study, livers were significantly smaller after exposure to both 200 and 400 µg/L. In another study, livers from 400 µg/L exposed tadpoles had higher numbers of activated caspase-3 immunopositive cells suggesting increased rates of apoptosis. Fat body size decreased significantly after exposure to 200 and 400 µg/L although they still contained some lipid and lacked any pathology. Since this effect was noted across all studies, it was considered the most sensitive indicator of atrazine exposure measured. The changes noted in body and organ size at 200 and 400 µg/L atrazine indicated chronic developmental exposure negatively affected the tadpoles. Significant reductions in fat body size could potentially lessen their ability to survive metamorphosis or diminish reproductive fitness as frogs rely on stored lipids for these processes.



Exposure to 200 and 400 µg/L atrazine throughout development significantly decreased fat body size in Xenopus laevis tadpoles ($p \leq 0.05$). Fat bodies (circled) from control (A) and 400 µg/L atrazine exposed (B) stage 62 tadpoles. Arrows: ovaries, K: Kidneys, Bar = 1 mm.

Full article: Zaya, R.M. et al (2011) Atrazine exposure affects growth, body condition and liver health in Xenopus laevis tadpoles Aquatic Toxicology 104; 243-253.

Agricultural intensity in ovo affects growth, metamorphic development and sexual differentiation in the common toad (*Bufo bufo*)

F. Orton & E. J. Routledge

Pollution was cited by the Global Amphibian Assessment to be the second most important cause of amphibian decline worldwide, however, the effects of the agricultural environment on amphibians are not well understood. In this study, spawn from *Bufo bufo* was taken from four sites in England and Wales with varying intensities of arable agriculture. Spawn was either placed in tanks containing aged tap water (*ex-situ*, 5 replicates) or in cages at the native site (caged, 4 replicates). Hatching success, abnormal tadpoles, and forelimb emergence were recorded during the larval stage. Individuals were also sampled at five time points during development (5-, 7-, 9-, 12-, 15-weeks post-hatch) and analysed for morphological parameters. The thyroids (TP2) and the gonads (TP3,4,5) were also analysed histologically. With the exception of the thyroid histopathology, all analysed endpoints were significantly different between *ex-situ* individuals reared under identical conditions from the different sites. In addition, intensity of arable agriculture had a negative effect on growth and development. At one site, despite distinct rearing conditions, a high level of intersex (up to 42%) and similar sex ratios were observed in both *ex-situ* and caged indiviuals. Taken together, these data suggest that maternal exposure and/or events *in ovo* had a much larger effect on growth, metamorphic development, and sexual differentiation in *Bufo bufo* than the ambient environment. This could have important implications for traditional exposure scenarios that typically begin at the larval stage. Intersex is reported for the first time in European amphibians *in situ*, highlighting the potential use of distinct populations of amphibians in fundamental research into the aetiology of specific developmental effects in wild amphibians.

Full article: Orton, F. & Routledge, E. (2011) Agricultural intensity in ovo affects growth, metamorphic development and sexual differentiation in the common toad (*Bufo bufo*). Ecotoxicology: 20; 901-911.

Combined effects of virus, pesticide, and predator cue on the larval tiger salamander (*Ambystoma tigrinum*)

Jacob L. Kerby, Alison J. Hart & Andrew Storfer

Both emerging infectious diseases and environmental contamination are known to impact amphibian survival in a wide variety of studies. While there are clear instances of epizootics occurring in pristine environments, many species of amphibians are regularly exposed to pollutants such as pesticides. Despite this being well known, few studies have examined the influence of contaminants on disease susceptibility, and even fewer have also incorporated the role of natural stressors such as predation. This experimental study investigates the interaction of the insecticide carbaryl, dragonfly predator cue, and the emerging pathogen Ambystoma tigrinum virus (ATV) on fitness correlates and disease susceptibility in tiger salamander larvae. Four week old larvae were exposed for 22 days in a 2 (0, 500 µg/l carbaryl) × 2 (control, predator cue water) × 2 (0, 1 × 10^4 pfu ATV) factorial designed laboratory study. In this study, predator cue strongly exacerbated disease-driven mortality. There was a clear pattern of reduced survival with the addition of stressors, with those where all three stressors were present exhibiting the worst effects: a decrease in survival from 93% in controls to 60% with all three stressors present. For the surviving larvae, there were several sub-lethal impacts in mass, SVL, and development. Predator cue and pesticide treatments significantly reduced both SVL and mass while virus and predator treatments significantly slowed development. These results highlight the importance of examining combined natural and introduced stressors to understand potential impacts on amphibian survival and development. Experiments focused on single stressors might be drastically underestimating actual effects. In particular, runoff from agricultural areas might contribute to the emergence of ATV in particular regions, raising concerns about the influence of pesticides on disease emergence in general.

Full article:Kerby et al. (2011) Combined effects of virus, pesticide, and predator cue on the larval tiger salamander (*Ambystoma tigrinum*) Ecohealth DOI: 10.1007/s10393-011-0682-1

First Detection of Ranavirus in *Lithobates pipiens* in Quebec.

By Linda J. Paetow, Bruce D. Pauli, J. Daniel McLaughlin, Julie Bidulka & David J. Marcogliese

Ranaviral disease has been implicated in mortality of wild and captive amphibians. It is caused by members of the genus *Ranavirus* and was recently listed as a notifiable disease by the World Organization for Animal Health. In Canada, amphibian die-offs associated with ranavirus infection have occurred in Saskatchewan, Manitoba, Ontario and New Brunswick and we recently reported the first incidence of ranaviral infection in amphibians from Quebec. The infection was found in juveniles of *Lithobates pipiens* captured in a privately-owned wildlife preserve in Boucherville, Quebec (45.6477°N, 73.4350°W). DNA sequences suggested that the Quebec material was related to Frog Virus 3 (FV3). Wild caught froglets exhibited high rates of mortality in the laboratory that was accompanied by erythema, ulceration of the limbs, pupillary constriction, excessive shedding of the skin and loss of the righting reflex. The rapid onset of symptoms suggests that this form of ranaviral infection may be highly lethal to frogs that are exposed to additional stressors such as transport and capture. We also observed an unusually high rate of unilateral anophthalmia (0.8%) in the frog population. Possible links into ocular malformations and ranaviral infections warrant future investigation, given a recent publication that associated reduced eye size in an adult of *Lithobates catesbeianus* with infection by FV3.

Full article: Paetow, L. J. et al. (2011) First Detection of Ranavirus in *Lithobates pipiens* in Quebec. Herpetol. Review: 42(2); 211-214. (linda.paetow@gmail.com)

Bd is widespread in aquatic Appalachian salamanders, but prevalence rates are low.

Brian Gratwicke, Matthew Evans, Evan H. Campbell Grant, Joe Greathouse, William J. McShea, Nancy Rotzel & Rob C. Fleischer.

Bd is present in salamanders at very low prevalence rates (>2.1%) in Warren County, Va. We calculated *Bd* prevalence at >2.1% in a multispecies survey of 200 terrestrial and aquatic salamanders. *Bd* was detected only on *Desmognathus monticola*. Other studies testing for *Bd* on salamanders in the Appalachians found very low occurrences and the actual level of threat that *Bd* poses to wild Appalachian salamander populations remains an unresolved question. Our observations in Virginia are consistent with observations elsewhere in the Appalachian region, where others have found that though *Bd* appears to be widely distributed it is found at low prevalence rates and is predominantly found in aquatic salamanders.

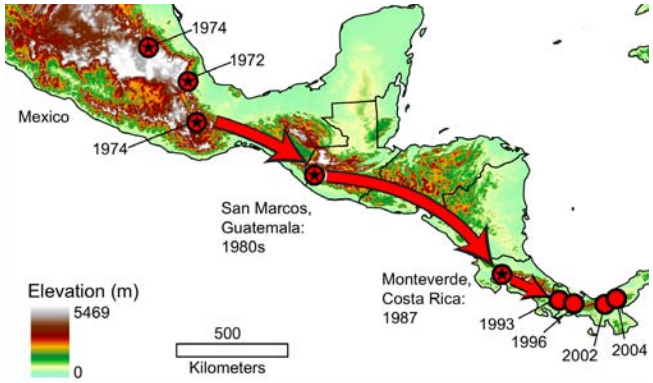
Full article: B Gratwicke, M Evans, E H Campbell Grant, J Greathouse, W J McShea, N Rotzel, RC Fleischer. Low prevalence of *Batrachochytrium dendrobatidis* detected in aquatic Appalachian salamanders from Warren County, Virginia, USA. Herpetological Review, 2011, 42(2), 217–219.

Museum specimens link the emergence of the chytrid fungus, *Batrachochytrium dendrobatidis*, with the decline of neotropical amphibians

Tina L. Cheng, Sean M. Rovito, David B. Wake & Vance T. Vredenburg

Engimatic declines have come to characterize the majority of decline events documented within the global amphibian crisis in the past 40 years. The infectious fungal pathogen, *Batrachochytrium dendrobatidis* (*Bd*), has now been implicated in many of these declines. However, since *Bd* was only recently described in 1999, the impact of *Bd* on historical amphibian declines remains unclear. We investigated the role of *Bd* outbreak in two cases of enigmatic decline: (1) the disappearance of 40% of anurans from Monteverde, Costa Rica, and (2) the decline of plethodontid salamanders in Mexico and Guatemala. We first prove the reliability of a molecular technique to detect *Bd* in formalin-preserved specimens. We swabbed, extracted, and ran qPCR for 38 specimens that had previously been examined using histology, and found these molecular techniques to be successful in detecting *Bd* in specimens with 83-90% accuracy in comparison to histological results. Using this molecular technique, we sampled over 1000 specimens collected from Mexico, Guatemala, and Costa Rica from the 1960s to 2000s. We found a strong pattern of the absence of *Bd* over multiple years, species, and localities followed by *Bd* emergence coincident with decline at all localities. Furthermore, our data supports the hypothesis that *Bd* is a novel

Spatial-temporal spread of *Bd* found from museum sampling, including "*Bd*-wave" from Lips *et al.* (2008). Map by Sean M. Rovito



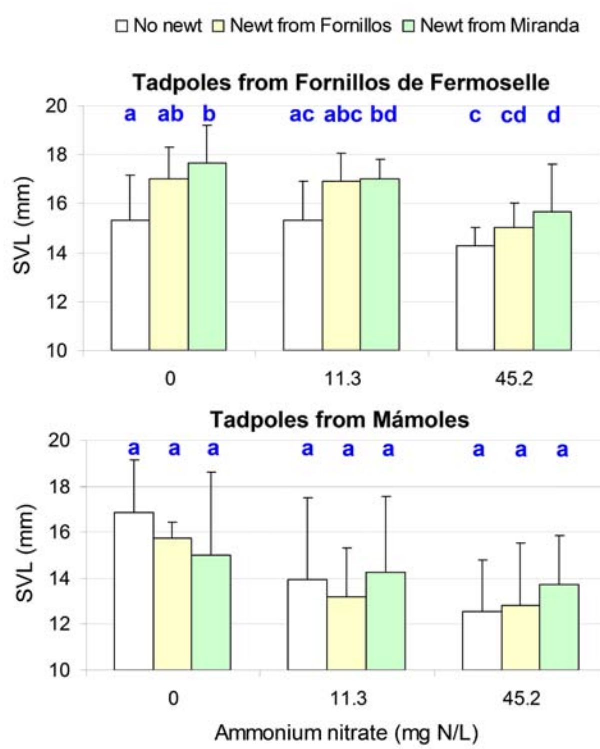
spreading pathogen. Our results show that *Bd* emerged in Mexico in the early 1970s and subsequently spread south to Guatemala by the 1980s/1990s and finally to Monteverde, Costa Rica by 1987. We also show lethality in two species of plethodontid salamanders (*Bolitoglossa rufescens*, *Pseudoeurycea leprosa*) and resistance in a Mexican frog, *Plectrohyla matudai*, which could potentially be one of the many carrier hosts spreading *Bd* from aquatic habitats to terrestrial environments. This study highlights the potential use of museum specimens to answer questions regarding *Bd* emergence and spread in the scope of amphibian decline, and further contributes to the complex ecology of *Bd* by describing its impact in a group of terrestrial amphibians, plethodontid salamanders.

Full article: Cheng TL, Rovito SM, Wake DB, Vredenburg VT (2011) Coincident mass extirpation of neotropical amphibians with the emergence of the infectious pathogen, *Batrachochytrium dendrobatidis*. *Proceedings of the National Academy of Sciences USA* 108(23):9502-9507.

Responses of toad tadpoles to ammonium nitrate fertilizer and predatory stress: Differences between populations on a local scale

Manuel E. Ortiz-Santaliestra, María J. Fernández-Benéitez, Miguel Lizana & Adolfo Marco

Agriculture-related pollution is undoubtedly a major risk for many amphibian populations, but even within a small area, diffuse agricultural pollution does not affect all aquatic environments equally, which could account for local differences in amphibians' sensitivity to agrochemicals. Furthermore, ecological stressors to which amphibians are exposed in the field, such as predation pressure, can make agrochemicals far more deadly that when acting in isolation. We examined the combined effects of ammonium nitrate fertilizer and predator stress on larval Western Spadefoot toad (*Pelobates cultripes*) from two nearby locations from Western Spain, using adult caged male marbled newts (*Triturus marmoratus*) as predators. Local differences were detected in terms of larval growth, which was affected by the combination of stressors in one of the two populations tested. Whereas tadpoles exposed to 45.2 mg N-NH4+/L were 7 % smaller than controls, the presence of predators from a foreign community resulted in animals 15 % larger than without predators. Interestingly, predators from the same community as the tadpoles did not affect larval growth. The length of the tadpoles from a nearby locality was unaffected after exposure to ammonium nitrate and predatory stress.



Snout-vent length (SVL) of larvae from two *Pelobates cultripes* populations exposed to ammonium nitrate and predatory marbled newts. Lowercase letters indicate homogeneous groups defined by Tukey post-hoc tests.

Full article: Ortiz-Santaliestra, M.E. et al. (2011) Responses of toad tadpoles to ammonium nitrate fertilizer and predatory stress: Differences between populations on a local scale. Environmental Toxicology and Chemistry 30: 1440-1446.

Effects of copper, zinc and dragonfly kairomone on growth rate and induced morphology of *Bufo arabicus* tadpoles

Michael J Barry

Tadpoles use chemical signals to detect predators such as dragonfly larvae and respond by changing their body and tail shape. The new phenotype gives them greater protection from predation. There is concern that pollutants such as metals and pesticides may affect the ability of tadpoles to respond to the naturally occurring chemical signals from predators. Elevated concentrations of metals such as copper and zinc are often found in natural ecosystems. The aim of this study was to measure the effects of increasing concentrations of these metals on the response of tadpoles to chemical signals from dragonfly larvae. The study used tadpoles of the Arabian toad (*Bufo arabicus*) and exposed them to low levels of copper and zinc in water that had previously contained dragonfly larvae (*Crocothemis erythrea*) that were fed tadpoles, or water that had contained only tadpoles. Tadpoles that received the predator-water, developed deeper bodies and slightly longer tail fins than controls. But when tadpoles were grown in predator-water plus 35 µg/L copper they reverted to close to the control phenotype. The copper appears to have either inhibited the development of the protective phenotype or has prevented the tadpoles from detecting the dragonfly smell. On the other hand zinc did not have any effect on the tadpoles at the low concentrations used in this study. The study shows that metallic pollutants such as copper may affect indirect interactions between species in ways that we did not previously suspect.

Full article: Barry, M.J. (2011) Effects of copper, zinc and dragonfly kairomone on growth rate and induced morphology of *Bufo arabicus* tadpoles. Ecotoxicology and Environmental Safety 74:4 918-923

Larval fitness and immunogenetic diversity in chytrid-infected and uninfected natterjack toad (*Bufo calamita*) populations

Shoshanna May, Inga Zeisset & Trevor J.C. Beebee

Chytrid fungus *Batrachochytrium dendrobatidis* (Bd) was first detected in Britain in 2004 and since that time has achieved high prevalence in many natterjack toad (*Bufo calamita*) populations, indeed consistently higher than in any other British amphibian species so far. We quantified aspects of larval fitness, adaptive (major histocompatibility complex) diversity and neutral (microsatellite) diversity in natterjack populations in two regions of north-west England. Toads in region one had no evidence of chytrid infection whereas in region two there was a substantial prevalence of Bd. Larval fitness (growth rate, time to metamorphosis and survival) of *B. calamita* did not differ between the regions. Genetic diversity at microsatellite loci was much higher in the infected than in the uninfected region but the converse was true of MHC diversity, indicating that genetic drift was unlikely to explain the differences in MHC between the regions. Furthermore, MHC allele frequencies varied significantly between Bd- infected and uninfected populations. Microsatellite diversity was not a robust indicator of larval fitness in these toad populations while MHC genotype frequencies varied in a way that was consistent with directional selection in response to pathogen prevalence. The acquired immune defences may therefore play an important role in determining the susceptibility of amphibians to chytridiomycosis although this requires much wider investigation both in other natterjack populations and in a range of other species. Thus far there is no evidence of decline in any of the infected natterjack toad populations, providing some hope that this species might prove resistant to the pathogen.

Full article: Conservation Genetics 12, 805-811 (2012)

Exposure to Atrazine affects the expression of key genes in metabolic pathways integral to energy homeostasis in *Xenopus laevis* tadpoles

Renee M. Zaya, Zakariya Amini, Ashley S. Whitaker & Charles F. Ide

In our laboratory, *Xenopus laevis* tadpoles exposed throughout development to 200 or 400 µg/L atrazine, concentrations reported to periodically occur in puddles, vernal ponds and runoff soon after application, were smaller and had smaller fat bodies than controls. These changes were hypothesized to be due to atrazine-related perturbations of energy homeostasis. Selected metabolic responses to exposure at the transcriptional and biochemical levels in atrazine-exposed tadpoles were measured to investigate this hypothesis. DNA microarray assays determined which metabolic pathways were affected after developmental exposure to 400 µg/L atrazine. Representative genes from the affected pathways were selected for quantitative real time polymerase chain reaction (qRT-PCR) assay to measure changes in their expression during a two-week exposure to 400 µg/L. Finally, tadpole ATP levels were measured early in and at the end of exposure. Microarray analysis showed significant differential gene expression in pathways involved with energy homeostasis. Pathways with increased transcription were associated with the conversion of lipids and proteins into energy. Pathways with decreased transcription were associated with carbohydrate metabolism, fat storage, and protein synthesis. Changes in gene expression indicative of an early stress response to atrazine were noted in the qRT-PCR assays. After 24 hours, exposed tadpoles had significant decreases in acyl-CoA dehydrogenase (AD) and glucocorticoid receptor protein (GR) mRNA ($p \leq 0.04$), and slight increases ($p = 0.07$) in peroxisome proliferator-activated receptor β (PPar-β) mRNA by 72 hours. Decreases in AD suggested reduction in fatty acid β-oxidation while decreases in GR could have been a receptor desensitization response to a glucocorticoid surge. Involvement of PPar-β, an energy homeostasis regulatory molecule, also suggested fluctuations in energy status. Despite, or possibly because of, these early gene changes, there were no differences in either absolute ATP levels or ADP:ATP ratios early in the exposure. However, livers from animals exposed to 200 µg/L atrazine had slight increases ($p = 0.06$) in ADP:ATP ratios at the end of exposure. This suggests exposed tadpoles may have had difficulty maintaining energy homeostasis. Perturbations in the expression of genes regulating energy metabolism by 24 hours into exposure to 400 µg/L atrazine was noteworthy, especially since these tadpoles were significantly smaller than controls by 72 hours of exposure.

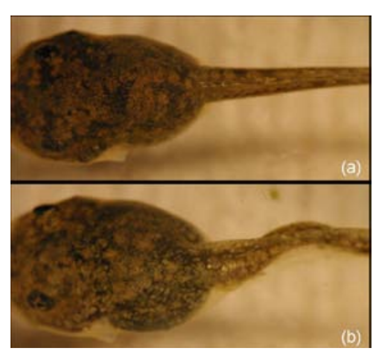
Full article: Zaya, R.M. et al (2011) Exposure to Atrazine affects the expression of key genes in metabolic pathways integral to energy homeostasis in *Xenopus laevis* tadpoles Aquatic Toxicology 104; 254-262.

Consequences of an amphibian malformity for development and fitness in complex environments

Matt J. Michel & Stephanie Burke

In natural habitats, the development and fitness consequences of amphibian malformities may depend on many different environmental factors. We examined if predation risk, increased competition, and structural complexity affected the development of scoliosis, a lateral curvature of a tadpole's tail (see figure). We also determined if scoliosis affected tadpole burst swim speed and survival from predation. Predation risk decreased the frequency of scoliosis in both low and high competition treatments, and this effect was greater at low competition. Behavioral observations suggested that reductions in activity by tadpoles induced by the presence of the predator may have mediated this response. Less activity would decrease cumulative exposure to ultraviolet-B radiation, which is known to cause scoliosis in tadpoles. Scoliosis substantially affected tadpole fitness as scoliotic tadpoles suffered a 14% reduction in burst swim speed and were twice as likely to be killed by predators. Our results highlight the importance of environmental context in determining the development and lethality of amphibian malformities.

Fill article: Michel, M. J. & S. Burke (2011) Consequences of an amphibian malformity for development and fitness in complex environments. Freshwater Biology 56:1417-1425. Doi: 10.1111/j.1365-2427.2011.02580.x.



(a) Non-scoliotic and (b) scoliotic tadpoles. Photo: Matt J. Michel

This reference list is compiled by Professor Tim Halliday (formerly DAPTF International Director) (tim.halliday@homecall.co.uk). It lists papers on amphibian declines and their causes and papers on amphibian conservation, with an emphasis on those that describe methods for monitoring and conserving amphibian populations. Tim is always delighted to receive details of forthcoming papers from their authors.

AmphibiaWeb: Information on amphibian biology and conservation. [web application]. 2011. Berkeley, California: AmphibiaWeb. Available: http://amphibiaweb.org/. (Accessed: July 18, 2011).

May 2011

Austin, J. D. *et al.* (2011) Assessing fine-scale genetic structure and relatedness in the micro-endemic Florida bog frog. *Conservation Genetics:* **12;** 833-838. (austinj@ufl.edu)

Barry, M. J. (2011) Effects of copper, zinc and dragonfly kairomone on growth rate and induced morphology of *Bufo arabicus* tadpoles. *Ecotoxicology & Envtl. Safety:* 74; 918-923. (mjbarry@squ.edu.om)

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Call for data!

Data are required for a collaborative BioFresh (European Framework 7 Project) paper seeking to quantify the global status, distribution and population trends of freshwater megafauna. This paper builds on a successful pilot project, which suggested that, on average, global freshwater megafaunal populations have declined by 44% since 1970. Aside from identifying these species as being amongst the most imperilled worldwide, it is hoped that quantifying their plight may help garner support for freshwater conservation.

The authors welcome any information regarding the life-history characteristics and long-term population time-series data for both *Andrias davidianus* (Chinese Giant Salamander) and *Andrias japonicus* (Japanese Giant Salamander). We are happy to accept population time-series data in any form (e.g. counts, densities, indices etc.).

If you feel you can contribute any relevant data or expertise, or have questions about the project, please contact the lead author via email (see below). All data providers will be referenced in the paper.

Contact: Jon David; jon.david@ouce.ox.ac.uk

TRENTO 2012 African Amphibian Working Group Announcement

AAWG15 will be held in Trento, Italy from Monday 28 to Thursday 31 May, 2012.

The meeting will be informal, but every delegate will be expected to make a presentation (a talk or poster). The program will include an opening speech and dinner on monday evening, followed by a poster session and talks over Tuesday and Wednesday, with Thursday left to wrap up any further business or a 'social trip' in the surrounding Dolomiti Mountains. Furthermore, we plan between 4th to the 9th of June to update the assessment of the African amphibian species (collaboration between IUCN, CI, MTSN). Both meetings will be held at Museo Tridentino di Scienze Naturali.

The conference program will cover the topics including African amphibian biogeography, taxonomy and conservation. We encourage talks to cover these topics/themes. Furthermore we will be celebrating Professor John Poynton's contribution to African Herpetology. Please contact Dr Simon Loader (simon.p.loader@gmail.com) and Michele Menegon (mmenegon@gmail.com) for further details. http://www.mtsn.tn.it/inglese/AAWG15/

Keep In touch

If you would like to be added to the ASG mailing list, please send an email to froglog@amphibians.org with the subject heading "add me to mailing list".

Also follow us on Facebook for regular updates on the herpetological community and the latest news from the ASG.

http://www.facebook.com/AmphibiansDotOrg

Upcoming Meetings & Workshops

July

Joint Meeting of Ichthyologists and Herpetologists Minneapolis, USA, 6-11 July 2011. Details at http://www.dce.k-state.edu/conf/jointmeeting/.

IX Latin American Congress of Herpetology Curitiba, Brasil, 17-22 July 2011. http://www.seh-cc.org/blogs/blog2.php/2010/11/11/ix-latinamerican-congress-of-herpetology

August

Midwest Partners in Amphibian and Reptile Conservation Annual Meeting, Lesterville, MO. August 5-7, 2011.

Northeast Partners in Amphibian and Reptile Conservation Annual Meeting, Arlington Echo Outdoor Education Center, Millersville, Maryland. August 17 - 18, 2011

Partners in Amphibian and Reptile Conservation (SW PARC) and Current Research on Herpetofauna of the Sonoran Desert V (CRHSD V) Tucson, Arizona. August 10 - 16, 2011.

September

SEH-Conservation Committee Herpetofauna monitoring course Luxembourg, 24-25 September 2011. Details at http://www.seh-cc.org.

16th European Congress of Herpetology and 47. Deutscher Herpetologentag (DGHT) Luxembourg and Trier, 25-29 September 2011. Details at http://www.symposium.lu/herpetology/.

October

Conservation Needs Assessment workshop Singapore. October 17-18, 2011.

Amphibian husbandry/conservation workshop Singapore. October 19-21, 2011.

Internships & Employment

The following information can be found at http://www.parcplace.org/jobs.html. Herp jobs are posted as a service to the herpetological community. If you would like to list a job opening for your organization, please send the announcement to herpjob@parcplace.org

Crew Leader Position - Effects of Forest Management on Reptiles and Amphibians - West Plains, MO

Technician Positions - Effects of Forest Management on Reptiles and Amphibians -West Plains, MO

Timber Rattlesnake Field Technician - Purdue University - Yellowwood and Morgan-Monroe State Forests, Indiana

Authorized Desert Tortoise Biologist/Monitor (On Call) - SWCA Environmental Consultants - Las Vegas, NV

Authorized Desert Tortoise Biologist - SWCA Environmental Consultants - Las Vegas, NV

Intern Positions (2) - Florida Sand Skink Research - Archbold Biological Station, Lake Placid, FL

Research Assistant/Telemetry - San Diego Zoo Institute for Conservation Research - Las Vegas, NV

Government Affairs Associate - The Wildlife Society Conservation Biologist, EDGE of Existence Programme - London, UK

M.S. or Ph.D. Assistantship - Salamander Conservation - Virginia Tech - Blacksburg, VA and Eglin Airforce Base, Niceville, FL

Desert Tortoise Monitoring Positions - EPG Inc. - Phoenix, AZ

Assistant/Associate Curator of Herpetology - The Natural History Museum of Los Angeles County - Los Angeles, CA

Marine Turtle Position - Joint Institute for Marine and Atmospheric Research - Honolulu, HI

Wildlife Research Administrator - Ohio Division of Wildlife - Franklin Co., OH

Postdoctoral Position - University of Alabama - Tuscaloosa, AL

Senior Wildlife Biologist - EPG Inc. - Salt Lake City, UT

USGS Desert Tortoise Research Technician - Henderson, NV

Wildlife Biologist and Assistant Wildlife Biologist Positions at the University of Arizona - Tucson, AZ

Director of Conservation Economics and Finance - Defenders of Wildlife - Washington D.C.

Director of Conservation Planning - Defenders of Wildlife - Washington D.C.

WRD Program Manager - Georgia Wildlife Resources Division - Brunswick, GA

Herpetology Field Technician - Green Diamond Resource Company - Korbel, CA

Amphibian field Technicians (3) - Northwestern Oregon

Field Herpetology Technicians/ Research Associate - Swaim Biological, Inc. - San Francisco Bay Area, California

Research Technician - Blandings Turtle Research - Massachusetts

MS Position with Aquatic Herps/Spotted Turtles in Managed Forests - Clemson University, SC

Biodiversity Paid Internship - Amphibian Assisted Reproduction - The Memphis Zoo, Memphis, TN

Field Assistants (2-3) - behavior and ecology of the lizards - Great Abaco Island, Bahamas

Summer Herpetological Internship Opportunity - Lower Michigan

Postdoc position - Amphibian pathogens and their impact on biodiversity - Station d'Ecologie Experimentale, Moulis, France

Field Assistant - Canopy research on herpetofauna - Singapore and the Philippines (Southeast Asia)

Volunteer/Intern Herpetological (Glass Lizard) Field Technician - College of Charleston, Charleston, SC

Graduate RA Positions - Lizard Behavior and Physiology - Indiana State University

Student Research Opportunities - Indiana-Purdue University Fort Wayne - Fort Wayne, IN

Master's Student Opportunities - Garter Snake Ecology - University of Texas at Tyler - Tyler, TX

Graduate Research Studies in Sustaining Hardwood Ecosystems, Purdue University - West Layfayette, Indiana

Postdoctoral Researcher in Evolutionary Biology and Behavioral Ecology - Florida State University - Tallahassee, FL

If you have any upcoming events, internships, employment opportunities or recent publications that you would like announced in FrogLog, please send details to James Lewis at jplewis@amphibians.org.

Amphibian Declines Teaching Module Available from Free Download

Now available, via the Network of Conservation Educators & Practitioners (NCEP; a program of The American Museum of Natural History) is an outreach teaching module reviewing all aspects of the global crisis of amphibian declines and extinctions. Module includes a thoroughly annotated and illustrated PowerPoint presentation, an overview Synthesis monograph with extensive literature citations, as well as proposed in-class teaching exercises and solutions. The module is aimed toward university-level students (e.g., Conservation Biology, or Herpetology, courses) but it is open-format so it can be edited and customized to any particular need or audience. A sample panel appears below.

Citation and link for free download:

Mendelson, J. R., III, and R. Donnelly. 2011. The Crisis of Global Amphibian Declines: Causes, Consequences, and Solutions. Network for Conservation Educators and Practitioners, American Museum of Natural History. CD-ROM. System requirements: IBM PC or Mac compatible. Windows 98 or higher. Also available electronically at: (PowerPoint Teaching Tutorial, plus associated pedagogical materials) 97+ pp. http://research.amnh.org/biodiversity/ncep

The authors also are actively seeking K–12 and other educators to collaborate to prepare versions of this module appropriate for non-university students and public audiences. For more information, or copies of these materials, please contact Joe Mendelson: jmendelson@zooatlanta.org

NOTES

Recall the importance of water and humidity to the survival and reproduction of amphibians. Even subtle changes in local vegetation, level or timing of water flow in a creek, or water temperatures can negatively impact amphibians. Realize that the "land-use change" may involve more than just alteration of vegetation (e.g., deforestation) or soils (e.g., plowing), but may be accompanied by chemicals (e.g., herbicides on a farm) or streetlights that make amphibians more visible to predators. A few amphibians appear to be very tolerant of habitat alteration around them and may persist even in environments as degraded as a vacant lot in a major city or a golf course.

We are pleased to announce, in partnership with Partners in Amphibian and Reptile Conservation (PARC; wwwparcplace.org) a new round of ARMI Seed Grants. Please see page 42 for more details.

Funds for habitat Protection -- The ASG supports organizations working to protect critical amphibian habitat worldwide. This fund is specifically for direct conservation action, not research (although some funds can be earmarked for survey work if this is an integral component of the overall project). Criteria and examples of funded projects can be found at http://www.amphibians.org/ASG/Funding.html .

The conservation leadership Programs website provides a comprehensive overview of a large array of funding available http://www.conservationleadershipprogramme.org/OtherFundingOptions.asp

The following information is kindly provided by the Terra Viva Grants Directory, for more information please visit: http://www.terravivagrants.org/.

July 2011

Asia-Pacific Network for Global Change Research -- Call for Proposals 2011. APN's Annual Regional Call for Proposals (ARCP) supports research on physical, biological, and human dimensions of change in the Earth's systems. APN's CAPaBLE program focuses on training, awareness raising, and partnerships in these themes. Eligible countries are Australia, Bangladesh, Bhutan, Cambodia, China, Fiji, India, Indonesia, Japan, Laos, Malaysia, Mongolia, Nepal, New Zealand, Pacific Island States, Pakistan, Philippines, Russia, Singapore, South Korea, Sri Lanka, Thailand, USA, and Vietnam. In the previous year, grant awards were approximately US$45 thousand for ARCP research projects, and US$40 thousand for CAPaBLE projects. Advisory services (voluntary) are available if letters of intent are submitted before 24 June 2011. Summary proposals are due 29 July 2011.

Chicago Zoological Society -- CBOT Endangered Species Fund. The Chicago Zoological Society administers conservation grants funded by the Chicago Board of Trade (CBOT). Grants are for research projects that will: (i) help protect populations of threatened and endangered species; or (ii) protect a specific habitat of high biological value, or that is substantially threatened, using IUCN's definitions. The Fund supports small projects, usually up to US$5 thousand. Grants are open to chairs and officers in IUCN's SSC Specialist Group; chairs and officers in AZA/WAZA; and all interested researchers. The next application deadline is 15 July 2011.

European Commission (EC) -- Environmental Awareness in Central Asia. The EU will support actions to raise the awareness of key stakeholders in Central Asia on environmental sustainability and sustainable management of natural resources. Funded actions will also enhance public participation in the regulatory frameworks for natural resources. Activities can take place in Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, and cross-border situations. Eligible applicants are nonprofit organizations in the EU; the EU candidate countries; the European Economic Area; and the Central Asian countries -- in addition to inter-governmental organizations. Reference 131463/L/ACT/RSC. Concept notes are due 01 July 2011.

Peoples Trust for Endangered Species -- Worldwide Small Grants and Continuation Grants. The PTES supports conservationists and researchers that aim for the preservation of endangered species, either through research or practical field work. Small grants are between £2 thousand and £8 thousand for projects of up to two years. Continuation grants are between £10 thousand and £25 thousand for projects of two and five years that build from previous PTES small grants (i.e., not available to first-time applicants). The closing dates for submissions are 15 June 2011 for small grants, and 20 July 2011 for continuation grants.

U.S. Agency for International Development -- Biodiversity Conservation in the Brazilian Amazon. USAID-Brasilia intends to make one grant of US$6 million over two years for biodiversity conservation on public lands in the western Amazon region of Brazil. Eligibility is open to nonprofit organizations (and businesses willing to forego profits) in the U.S. and other countries (Brazil). Funding Opportunity RFA-512-11-000003. The application deadline is 18 July 2011.

U.S. Agency for International Development -- Forests and Land Use in AmaZONAS Andinas. USAID, in collaboration with other U.S. government agencies and the Moore Foundation, will fund projects on sustainable forest management and land use in Ecuador, Colombia, and Peru. The objective is to reduce greenhouse gas emissions through forest monitoring, demonstration projects, and capacity strengthening. Grants are up to US$5 million. Applications are invited from U.S. institutions of higher education, nonprofit organizations, and regional NGOs in Latin America and the Caribbean. Funding Opportunity USAID-W-OAA-GRO-11-00603. The due date for the first round of applications is 08 July 2011.

August 2011

African-Eurasian Waterbird Agreement -- Small Grants 2011. AEWA's Small Grants Fund supports waterbird conservation projects in African countries. Proposals for projects up to two years are invited from national governments and NGOs concerned with the conservation of migratory waterbirds and/or their habitats. Grants are up to €25 thousand for AEWA contracting parties, and up to €15 thousand for non-contracting parties. The application deadline is 01 August 2011.

Future for Nature Foundation -- Future for Nature Award 2012. The Future for Nature Award recognizes internationally outstanding efforts to conserve wild animals and plants. Work related to endangered species (IUCN's Red List) is a priority. Award winners receive €50 thousand and a sculpture. Candidates should be no older than age 35. Nominations are accepted through 31 August 2011.

Open Meadows Foundation -- Grants for Leadership of Women and Girls. Open Meadows offers grants up to US$2 thousand to encourage leadership in women and girls, particularly in vulnerable communities. Grants are to tax-exempt charitable organizations in the USA and developing countries (i.e., through a U.S. fiscal sponsor). Environmental justice is among several inter-connected themes. Annual deadlines for applications are 15 February and 15 August.

V. Kann Rasmussen Foundation -- Environmental Grants 2011. The Foundation makes grants in

several themes of environment and sustainable development, especially favoring projects that have international significance and perspective. Areas for funding include sustainable economic framework; post-fossil fuel science and practices; ecosystems protection and restoration; and communication and leadership. The deadline for letters of intent is 01 August 2011.

September 2011

Ford Motor Company in the Middle East -- Grants for Conservation and Environment 2011. Ford Middle East, in partnership with UNESCO, announce grants for non-profit conservation initiatives in the Middle East. Categories are conservation engineering; protection of the natural environment; and environmental education. The grants are open to individuals as well as groups. Applications are due no later than 10 September 2011.

Ornithological Society of the Middle East -- Grants 2011. The OSME's Conservation and Research Fund makes grants to support bird research in the Middle East, Caucasus, and Central Asia. Grants average about £500. Submission deadlines are 31 January; 31 May; and 30 September.

Yves Rocher Foundation -- "Women of the Earth" 2011-2012. The Foundation annually honors women for achievements in environmental awareness, conservation, and solidarity. The countries eligible for participation in 2011-2012 are Canada, France, Germany, Morocco, Portugal, Russia, Switzerland, and Ukraine. The awards are made for actions in any part of the world, including in the developing countries. Prizes range from €2 thousand to €10 thousand. The closing date is 30 September 2011.

October 2011

Birdfair/RSPB Research Fund for Endangered Birds – Applications 2011. The British Bird watching Fair (Birdfair) and the Royal Society for the Protection of Birds (RSPB) jointly provide grants of up to US$2 thousand for research on endangered birds (IUCN's red list). Priority is for researchers working in their own countries, particularly in collaboration with BirdLife's partners. The closing date for applications is 31 October 2011.

Lemelson Foundation -- Lemelson-MIT Award for Global Innovation 2012. The annual Award provides US$100 thousand to inventors whose products or processes contribute to improving the lives of impoverished people in the developing world. Areas of innovation may include work in energy, agriculture, air quality, water, soil, ecosystem management, and other themes. The application deadline is 04 October 2011.

November 2011

American Museum of Natural History -- Chapman Grants for Research in Ornithology 2011. The Frank M. Chapman Memorial Fund supports ornithological research anywhere in the world. There is one competition per year for fellowships and two categories of grants. Most grants range from US$500 to US$2 thousand. Fellowships are for 1-2 years of research in avian systematics, evolution, and biogeography in residence at the American Museum of Natural History. The application deadline is 15 November each year.

Royal Geographic Society -- Grants with Deadlines in November 2011. The RGS makes grants for geographical research, fieldwork, and teaching that include the following awards: Ralph Brown Expedition Award; Peter Fleming Award; Thesiger-Oman International Research Fellowships; Hong Kong Research Grant; Postgraduate Research Grants; Geographical Club Award. The application deadline for each of these programs is 25 November 2011.

U.S. Fish and Wildlife Service -- Neotropical Migratory Bird Conservation, Proposals 2012. The USA's Neotropical Migratory Bird Conservation Account funds projects in the USA, Canada, and Latin America and the Caribbean to promote the long-term conservation of neotropical migratory birds and their habitats. For projects in 2012, the application deadline is 01 November 2011.

If you have any funding opportunities that you would like announced in FrogLog, please send details to James Lewis at jplewis@amphibians.org

Instructions to Authors

FrogLog publishes a range of articles on any research, discoveries or conservation news relating to amphibians. We encourage authors describing original research to first make submissions to a refereed journal and then, if appropriate, to publish a synopsis in FrogLog. Submissions to FrogLog should be in English, in the region of 1000 words, unless previously discussed with the editorial team, and follow the format of FrogLog 83 and above.

All graphics supplied for publishing should be submitted as separate files, ideally in original jpg format or alternative commonly used graphical format. Please ensure that the highest quality image is sent to allow for optimal reproduction.

Tables and charts may be included at the end of a word document with clear indication as to the appropriate title/legend.

All titles and legends should be listed one after the other, as part of the text document, separate from the figure files. Please do not write a legend below each figure.

Submission must include all authors first and surname which will be printed at the beginning of the published document.

Each submission will be referenced as follows at the back of the edition:

Tingley, R., Phillips, B. L. & Shine, R. (2011) Alien amphibians challenge Darwin's naturalization hypothesis. *FrogLog* 95. Author Contact: reid.tingley@gmail.com.

If you require further information on author affiliations, provide directly under this reference.

Examples of submissions can be found in previous editions of FrogLog and include:

- News and Comments
- Correspondence
- Obituaries
- Opinion
- Futures
- News & Views
- Insights, Reviews and Perspectives
- Upcoming meetings
- Recent Publications
- Books Releases
- Careers

Submission should be sent to froglog@amphibians.org.

Please name all files as follows, first author surname_ brief title description_content i.e. tingle_darwins naturalization_paper, tingle_darwins naturalization_ figure 1.

Students

The ASG has a particular interest in highlighting the vast amount of work being undertaken by students around the world and we invite students to submit synopsis of their thesis where appropriate.

Coming up in FrogLog Vol. 98

Mainland Asia Special

Mainland Asia ASG Update

More International Seed Grant award winners

Recent Publications

and much more..........

Photo: Don Church

September 2011