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froglog

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Conservation news for the herpetological community

Regional Focus
Asia, Russia and Oceania

INSIDE

Rhacophorus rhodopus of Hainan Island, a beautiful treeforg from Indochina that needs intact rainforest to survive. Photo credit: Bosco Chan@KCC.

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FrogLog

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Editorial

Welcome to the first quarterly edition of *FrogLog*. As ever, this edition is packed full of news from the ASG and broad community concerned with amphibian conservation. Highlights from this edition include the announcement of a new partnership between the ASG and the International Society for the Study and Conservation of the Amphibians, updates from the Amphibian Survival Alliance, including a summary of events from this year's Herp Congress and the IUCN World Congress. We are also very excited to announce the 2012 Sabin Award winner and provide an update on the Metamorphosis campaign that has recently won a prestigious international photography award.

As usual we have tried to highlight some potential partnerships and opportunities that readers might want to become involved in. These include the BIOFRAG Index, a new metric that can quantify the net biological impact of forest fragmentation on biodiversity at the levels of individual species and ecological communities and a call from Helen Meredith who is currently conducting a survey to assess what people view as success in amphibian conservation.

The edition focuses on Asia, Russia and Oceania with articles provided from China, the Philippines, Thailand, India, Vietnam, Korea, Malaysia and two recent publications from Borneo. The articles in this edition complement those published last year well with many new contributions from regions previously not highlighted in *FrogLog*.

Finally, we would like to welcome on board a new member to the *FrogLog* editorial team. Candace M. Hansen from the Sticky Tongue Project will be bringing with her a wealth of knowledge and experience in both amphibian conservation and communication, which is fantastic timing with the January edition of *FrogLog* focusing specifically on education initiatives related to amphibian conservation.

The ASG Executive Committee

Froglog

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Karen Lips Winner of the 2012 Sabin Award for Amphibian Conservation

We are delighted to feature the 2012 winner of the Sabin Award for Amphibian Conservation as Dr. Karen Lips. Dr. Lips of the University of Maryland, who I am sure for many of you needs little introduction, is a genuine ground breaker. Much of our understanding of the underlying causes of amphibian declines and extinctions can be attributed to her work. Add to this her considerable effort in basic tropical ecology and systematics, and you have a broad-based world leader in tropical biology, a ground-breaking leader on research into amphibian declines, and also a leader in conservation policy making.

Building on her early efforts to determine the underlying causes of amphibian declines, Dr. Lips is now involved in some truly cutting-edge collaborative work to investigate the genetic basis of amphibian responses to chytrid infections and the genetics of the chytrid fungi themselves. In addition to her research, Karen has co-led efforts to conceptualize, fund and realize the RANA network - a network of Neotropical amphibian specialists that has been extraordinarily influential and successful cross-disciplinary and international framework of collaboration and data sharing.

Dr. Lips was recently accepted as a Fellow into the rather exclusive Aldo Leopold Leadership Program and continues to be an inspirational leader for amphibian research and conservation and beyond.

This year we produced a book to showcase the seven Sabin award winners from the last five years. You can view a copy of the book at: http://www.blurb.com/bookstore/invited/2797520/1be331d3c0178bd5fb6c3f4a1d3dda6698e1f66d

Metamorphosis – Campaigning for Amphibians

By Robin Moore

Last week, a series of amphibian images took first place in the Natural World Portfolio category of the prestigious FotoWeek DC International Photo Contest. The image series, called Metamorphosis, forms part of a visual initiative inspired by amphibians and led by ASG Program Officer, Robin Moore, in collaboration with conservationist Gabby Wild. In order to depict our connection with amphibians, Academy Award-winning makeup artist Brian Sipe transformed Wild into several unique amphibians. Moore then photographed Wild with the live amphibians she represents in order to create a composite of photographs. Each photograph and an associated caption embodies a metaphor that captures and promotes the mission of the ASG and the newly formed Amphibian Survival Alliance.

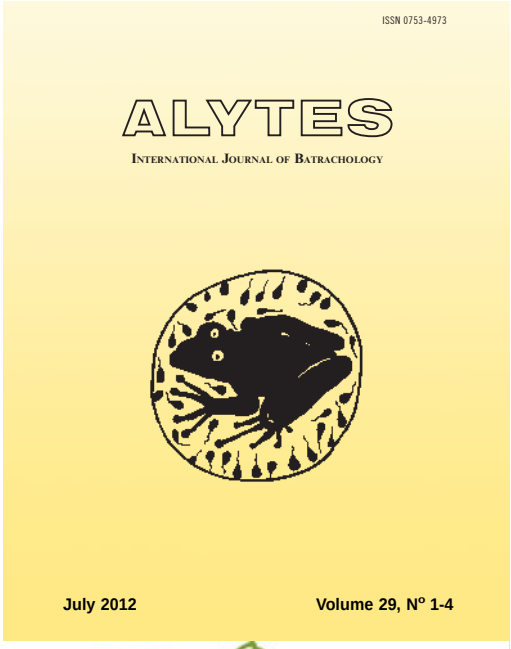
The long term goals of Metamorphosis are two-fold. First, in order to scale up amphibian conservation efforts globally we need to inspire people to care about our fragile friends. Let's face it, amphibians don't always get a good rep and are often overshadowed by the more charismatic megafauna when it comes to conservation. We believe that it is time to promote amphibians to take their place among this august group of charismatic creatures. We hope metamorphosis can aid this transformation in the mindsets of people through a celebration of the beauty, diversity and importance of frogs, toads, newts and salamanders in the cultural fabric of societies around the world. Secondly, metamorphosis aims to raise and leverage funds to support the *in situ* conservation of amphibians through the production of a book, calendars, exhibits and auctions.

We have given metamorphosis its own page within the ASG website (www.amphibians.org/our-work/metamorphosis) and look forward to posting more images from the series over the coming weeks, and to using these images to engage and inspire people to care about, and protect amphibians. With a book, calendar and exhibits planned, we hope you will spread the word and help support metamorphosis achieve its goals.

A Joint Collaboration between the ASG and ISSCA

By Franco Andreone & James Lewis

The recent special issue of *Alytes*, aimed at bridging the gap between amphibian conservation and policy (*1*), marked an important and successful partnership between the IUCN SSC ASG (Amphibian Specialist Group) and ISSCA (International Society for the Study and Conservation of the Amphibians). The ISSCA is an international scientific and academic society created in 1982 to promote the study and conservation of amphibians and their habitats through the publication of journals and monographs, together with congresses and workshops. The ISSCA publishes two journals, *Circalytes*, the internal member's bulletin, and *Alytes*, an international scientific journal. The topics of *Alytes* touch all the aspects of research on amphibians, in particular systematics, evolution, development, ecology and conservation. Shortly after being established the ISSCA established a partnership with the ASG (at that time known as Declining Amphibian Populations Task Force, DAPTF) by assuring the distribution of the first issues of *FrogLog* to ISSCA members and by promoting a general awareness of the threats affecting amphibian populations around the world. For example, Dubois (*2, 3*) addressed issues relating to the consumption of frog legs from alien frog species. The contributions obtained from the Irvine meeting held in 1990 were published in *Alytes*, thus giving origin to the DAPTF (*4, 5*). Over the past 30 years *Alytes* and ISSCA have contributed extensively to the knowledge of taxonomy and diversity of amphibians around the world. In such a context, it is evident that the ASG and ISSCA followed two convergent paths, having common and shared objectives. It was therefore time and a logical next step to identify common objectives and collaborate to achieve them.



The need for a coordinated response to promote better knowledge and conservation of amphibians has been the basis of the recent MoU established between the ASG and ISSCA signed by respective representatives from each group. The collaboration is to provide a basis for scientific and popular publications through the production of a peer reviewed publication (*Alytes*) and non-peer reviewed publication (*FrogLog*). The ISSCA and ASG will actively pursue a sharing of content for both publications through their respective editorial teams. *Alytes* is also in the process of modernizing its appearance and format to meet the needs of the ISSCA membership. Together with *FrogLog* this partnership will actively promote the distribution of information and knowledge on amphibians. With this new partnership we are pleased to announce that the ISSCA has made available for download from the ASG web site four contributions published in the special issue, notably the forewords by Angulo and Andreone (*1*) and by Stuart (*5*), and two full papers (*6, 7*) (papers available at http://www.amphibians.org). We sincerely hope that this will be the start of a renewed and constructive collaboration.

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2. A. Dubois, *Alytes* **2**, 69 (1983).
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4. M. J. Tyler, *Alytes*, **9**, 43 (1991).
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ASA News

The Amphibian Survival Alliance is continuing its quest towards creating a united community focused on amphibian conservation. The ASA's mandate as it was born was to coordinate the comprehensive implementation of IUCN SSC's Amphibian Conservation Action Plan, and to promote amphibian conservation and thus magnify the response to the ongoing amphibian crisis. The ASA, is not a replacement for ongoing initiatives like Amphibian Ark or the Amphibian Specialist Group, but rather sets such initiatives in a proper context as one of the many elements in a concerted response to a complex problem, and it has already grown fourfold - from its original six supporting institutions to 25. We envision that the ASA, speaking as one voice on behalf of the entire amphibian conservation community, will be able to engage with partners from different sectors of society that are needed for successful conservation, and will also be able to represent the interests of amphibians—which

are also those of many other species—at the negotiation table: attending amphibian needs would help advance sixteen of the twenty targets that the member countries of the CBD committed to fulfil by 2020. We will be reporting on advances of the Alliance regularly through these pages.

ASA in Vancouver

Phil Bishop (ASA Chief Scientist) presented an update on the ASA in the session entitled *Conservation: Recovery and restoration* at the 7th World Congress of Herpetology hosted by the University of British Columbia in August. The talk highlighted the achievements of the ASA so far and the primary efforts that the ASA will concentrate on for the remainder of the year. In summary these are Fundraising; Web site completion and updating (amphibiansurvivalalliance.org); coordinating the communication between people interested in different areas of the ACAP; and jointly coordinating (with Jim Collins, Co-Chair of the ASG) a global translational mini-summit on chytrids.

In addition, Phil reminded the audience of the importance of their input to the ASG and briefly discussed their four year strategic vision. He also introduced the Amphibian Conservation Evidence project and called for people to help by sending their own lists of amphibian conservation interventions to Rebecca Smith (r.k.smith@zoo.cam.ac.uk) who was also at the conference.

During the conference Phil met with Christine Bishop, Rick Relyea and some of the speakers from the *Amphibian and Reptile Ecotoxicology* symposium and discussed ways that the ASA can assist the group with some of their aims.

ASA in Jeju

Amphibian Conservation Workshop at the WCC

ASA was present at IUCN's World Conservation Congress in Jeju where, together with IUCN Korea and the Korean ASG, hosted the only amphibian focused activity of the entire forum, namely the workshop "Addressing the Global Amphibian Crisis by Integrating Policy, Planning, and Research." The event counted with the participation of Sathyabhama Das Biju (University of Delhi), Bruce Waldman (Seoul National University), Rafe Brown (Kansas University), David Bickford (University of Singapore), Jae-Hwa Su (National Institute of Environmental Research), Mathieu Tolian (Veolia Water), and Jaime García-Moreno (Amphibian Survival Alliance) and explored different aspects of the ACAP that require interactions well beyond the herpetological community for successful conservation. The discussion centred on building a united multidisciplinary community responding in a coordinated fashion to combat the amphibian crisis.

Bioacoustic brainstorming session

Responding to an invitation from the Alexander König Museum in Bonn, ASA participated in brainstorming sessions on acoustic monitoring. Through the discussion it was confirmed that bioacoustic monitoring provides an excellent opportunity for automated and flexible monitoring—in fact, Island Conservation (www.islandconservation.org) is already making use of it on bird conservation projects on small islands. The ASA pointed out the urgent need for continuous monitoring of a high number of Critically Endangered species, and during the session it was pointed out that European institutions are highly interested in the development of streamlined biodiversity monitoring protocols. Participants came to the conclusion that better cooperation is needed in order to bring together fragmented monitoring initiatives and build broader networks. Common protocols on recording, data storage and exchange could add value to the existing data sets. All people taking place in the session agreed with ASA's suggestion that AZE sites would be a good starting point for testing the method, as there is often a very clear target species or set of species in a relatively small area that can be covered with few recording units. A workshop is being prepared for June 2013 to bring together the engineer specialists with the users in order to address some of the challenges to promote the use of this tool. We want to start identifying those of you that are already using bioacoustic monitoring, as this subset of ASG members could quickly become the backbone that facilitates the establishment of an acoustic monitoring network.

Amphibian conservation motion

Finally, the ASA was active working for the submission to the assembly of a motion to call on all stakeholders to increase the priority given to prevent amphibian extinctions and support the ongoing initiatives—including the ASA itself. The motion was submitted by 15 member institutions and approved with the amendments that were proposed by ASA and partners. A copy of the motion can be found on page 8.

The Amphibian Extinction Crisis - S.A.P.I.EN.S Article

The following is an abstract of a paper recently published in a special issue of S.A.P.I.EN.S which was dedicated to the work of IUCN, International Union for Conservation of Nature, and its commissions. The entire journal can be accessed online at http://sapiens.revues.org/1248 .

IUCN SSC's Amphibian Conservation Action Plan (ACAP) was published in 2007, following an Amphibian Conservation Summit held in 2005. The ACAP identified the key issues that require attention in order to curb this crisis, and provided the framework for interventions. While there have been significant efforts in the last five years, the response to the crisis has not progressed across all areas of the action plan at a scale sufficient to halt the crisis. As a direct result, species continue to decline and go extinct. This paper has been complied by members of the recently formed Amphibian Survival Alliance (ASA), an Alliance formed to mobilize a motivated and effective consortium of organizations working together to stem the rapid losses of amphibian populations and species worldwide. The Alliance brings focus, coordination, and leadership in addressing one of the world's most serious extinction crises. Its goal is the restoration of all threatened native amphibian species to their natural roles and population levels in ecosystems worldwide. The Alliance will address the multiple ACAP issues with several new initiatives, including creating a web-based 'living' version of ACAP and driving the implementation of the ACAP themes in a more progressive and collaborative manner than ever before, thereby stemming the loss of an important part of the biological diversity of our planet. The paper summarizes the major causes of amphibian declines and what global actions have been taken to stop the crisis to date. The paper ends with a look at future perspectives and a call to engage with communities beyond the amphibian research and conservation community in order to ensure that amphibians become embedded in broader conservation efforts.

Further Steps to Combat the Amphibian Crisis

RECALLING Resolution 4.017 *Stopping the Amphibian Crisis* adopted by the 4th IUCN World Conservation Congress (Barcelona, 2008);

AWARE that the concerns that gave rise to Resolution 4.017, and which are explained in its preamble, remain just as valid, if not more valid, today, and that the global status of amphibians is continuing to deteriorate rapidly;

APPRECIATING the steps taken by the IUCN Species Survival Commission (SSC) and key IUCN Members and partners to address the amphibian crisis, most notably through the formation of the inter-institutional Amphibian Survival Alliance (ASA) in 2011, which is providing strategic direction and coordination to the amphibian conservation work being carried out by the SSC Amphibian Specialist Group (ASG), by Amphibian Ark (an *ex situ* programme under the umbrella of SSC and the World Association of Zoos and Aquaria), and by a number of other institutions;

CONCERNED that despite this progress, the funding for amphibian conservation in general, and the ASA in particular, remains woefully inadequate and outside the priorities of many donors and institutions that otherwise support biodiversity conservation;

CONVINCED that unless greater priority is given to amphibian conservation, many species will become extinct in the coming decades;

ENCOURAGED, nevertheless, that despite the meagre resources available, concerted efforts by the amphibian conservation community over the last five years have resulted in over 22,000 hectares of vital habitat being secured to provide for the survival of 55 Threatened amphibian species, as well as nearly 100 globally Threatened species now being maintained in captive breeding programmes;

AWARE that despite these welcome gains, progress is very small in relation to the huge dimensions of the crisis;

ALSO AWARE that the ASA has recently identified the sites which, if securely protected, would safeguard the largest number of Threatened amphibian species, noting that conserving the top 25 sites, all of which have also been identified by the Alliance for Zero Extinction, would benefit over 500 globally Threatened species, 150 of which are listed as Critically Endangered on the *IUCN Red List of Threatened Species*; and

CONCERNED that the majority of amphibian species on the *IUCN Red List of Threatened Species* were last assessed in 2004, making their reassessment a matter of urgency in order to understand the change in status of amphibians, and the success of conservation efforts;

The World Conservation Congress, at its session in Jeju, Republic of Korea, 6–15 September 2012:

CALLS ON governments, non-governmental conservation organizations, and donors to:

Increase the priority given to preventing amphibian extinctions and bringing about their recovery, in particular through the conservation of the top priority sites that are being identified by the Amphibian Survival Alliance (ASA);

Develop, support and maintain adequate captive breeding programmes in biosecure facilities for those species that are declining rapidly and which may go extinct before the threats in the wild (in particular imminent habitat loss and the fungal pandemic chytridiomycosis and its associated synergies) can be combated successfully; and

Promote the regulation and monitoring of trade in live and dead amphibians and their parts and derivatives, including efforts to enable and facilitate monitoring of international commercial transactions through established mechanisms like CITES and the World Customs Organisation, and

Provide sustainable support to the operations of the ASA to enable it to provide its essential role of coordination and leadership to amphibian conservation efforts worldwide;

URGES the scientific community, as a matter of urgency, to carry out the research necessary in order to make it possible to develop practical and realistic measures to combat the deadly effects of the chytrid fungus *Batrachochytrium dendrobatidis* in the wild; and

REQUESTS the Director General and the IUCN Species Survival Commission to take the necessary steps to ensure that all amphibians last assessed for the *IUCN Red List of Threatened Species* in 2004 during the Global Amphibian Assessment be updated by 2014, and calls on donors to provide the necessary funding to make this possible.

Sponsor:
Stiftelsen Nordens Ark
Co-sponsors:
Chicago Zoological Society, USA
Conservation International, USA
European Association of Zoo and Aquaria, Netherlands
North of England Zoological Society (Chester Zoo), United Kingdom
Reptile Amfibieën Vissen Onderzoek Nederland, Netherlands
Wildlife Conservation Society, USA
World Association of Zoos and Aquariums, Switzerland
Zoological Society of London, United Kingdom
Zoologische Gesellschaft Frankfurt von 1858—Hilfe für die bedrohte Tierwelt
Zoologisk Have København, Denmark
Naturhistoriska Riksmuseet, Sweden
Sociedad Audubon de Panamá
NatureServe
ANCON—Asociación Nacional para la Conservación de la Naturaleza de Panama

Amphibian Academy

Serving Amphibians

Developing Amphibian Conservation Expertise

Amphibian Ark (AArk) announces a new capacity building program with a novel and holistic approach to amphibian conservation training for both *in-situ* and *ex-situ* program development. This new program is called *Amphibian Academy*: a broad perspective training opportunity that will benefit people from diverse backgrounds who desire to help save amphibians. A key difference between this effort and earlier endeavors is that the emphasis is on the individual student so that graduates will be poised to address the needs of threatened amphibians. Our mission is simple: train amphibian conservation biologists so that they can best *Serve Amphibians*.

The *Amphibian Academy* has been developed under the umbrella of the Amphibian Ark and the Toledo Zoological Society. It will be a week-long course with robust conservation emphases. The school is scheduled for 20–28 April 2013 at the Toledo Zoo, Toledo, Ohio USA. The amphibian conservation and breeding programs at the Toledo Zoo are internationally known and the collection is extremely diverse—an ideal environment for training amphibian conservationists. Local field opportunities will be utilized for teaching purposes. Centrally located, Toledo is a friendly city with reasonably priced accommodations and food. Costs to attend will not be excessive.

The course includes lectures, hands-on practical exercises, and fieldwork. Most of all there will be ample opportunities for students to be personally mentored by globally recognized and successful amphibian conservationists to help them address their specific program's focus and needs. The students can rely on the faculty members to remain as their mentors and professional contacts throughout their careers. The hands-on activities are designed for students to "learn by doing" in small groups with an instructor, thus providing an optimal learning opportunity. The faculty for the course includes leaders in the fields of amphibian husbandry, medicine, research, reintroduction and conservation. As amphibian decline knows no borders and is a significant global concern, we invite a diverse group of students from all countries. The vision for this training course is to *Serve Amphibians*. If this motto is in alignment with your conservation interests, this course will provide you with a unique opportunity to develop the appropriate skills for making a difference. Some scholarship opportunities will be available for deserving individuals with limited resources. There will also be a few short-term internships available to qualified students after the course. Registration will be open in October 2012. Tuition costs 750USD and the process for obtaining financial support and internship opportunities will be announced shortly.

For registration information and process, contact AArk Education Officer, Rachel Rommel (Rachel@AmphibianArk.org), or Ron Gagliardo (Ron@AmphibianArk.org) and Andy Odum (RAOdum@aol.com).

Amphibian Academy Trainers

- Kent Bekker
- John Chastain
- Ron Gagliardo
- Timothy Herman
- Robert Hill
- Robert Johnson
- Mike Lannoo
- Joe Mendelson
- R. Andrew Odum
- Allan Pessier
- Jennifer Pramuk
- Rachel Rommel
- Kevin Zippel

FrogLog Schedule

January – Special Topical Edition
April – The Americas
July – Africa, West Asia, Madagascar, Mediterranean and Europe
October – Asia, Russia and Oceania


Robin Moore / iLCP

BIOFRAG - Call for Datasets to Test New Biodiversity Change Metric

BIOFRAG http://biofrag.wordpress.com

Quantifying Biodiversity Response to Forest Fragmentation

The BIOFRAG project at Rob Ewer's Forest Ecology Group (Imperial College London) is calling for datasets to test their BIOFRAG index, a new metric that can quantify the net biological impact of forest fragmentation on biodiversity at the levels of individual species and ecological communities.

The BIOFRAG index was taken up by the 2010 Biodiversity Indicators Partnership and could be utilized to monitor Aichi Targets (2011 – 2020) of the Convention on Biological Diversity.

We would like to include your data in our analyses. All collaborators will become part of the BIOFRAG community and if data are used in any publication will be acknowledged accordingly.

Would you like more details on the index?

Please contact us (m.pfeifer@imperial.ac.uk; r.ewers@imperial.ac.uk) at Imperial College London and browse our BIOFRAG homepage: http://biofrag.wordpress.com/. Some publications discussing the method have been published (BIP 2010, Ewers *et al.*, 2010, Lafortezza *et al.*, 2010). We look forward to hearing from you.

Would you like to collaborate?

We have been analysing data recorded for communities of understory herbs, trees, beetles, butterflies, frogs, reptiles, birds and bats in fragmented forested landscapes of Africa, Brazil Canada, Europe and New Zealand. We would like to extend our analyses to further datasets (for as many different regions and taxa as possible) to test the general applicability of the index and improve it.

Would you be happy to share your data for this BIOFRAG estimation?

Did you record your data in a fragmented forested landscape? Did you measure abundance or presence/absence of single species or many species in a community (e.g., all frog species) in the plots? Do you have the geographic coordinates for your plots?

- Biodiversity Indicators Partnership. 2010. Forest Fragmentation: Identifying a biodiversity-relevant indicator. Cambridge, UK. Download from BIOFRAG webpage.
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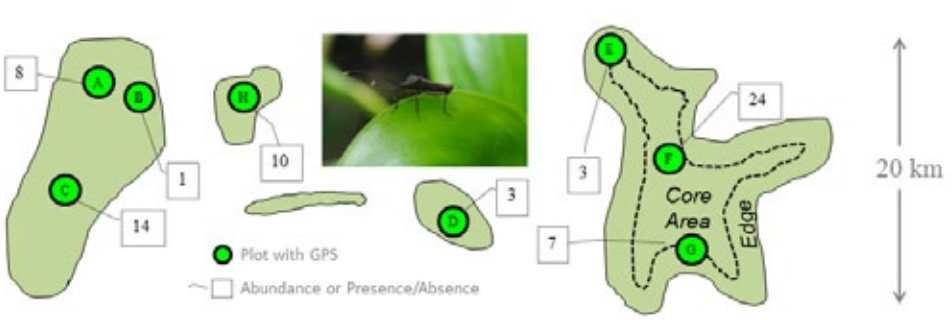
- Lafortezza R, Coomes DA, Kapos V, Ewers RM. 2010. Assessing the impacts of fragmentation on plant communities in New Zealand: scaling from survey plots to landscapes. *Global Ecology and Biogeography*, 19, 741-754.

Dr. Marion Pfeifer, Imperial College London, Silwood Park Campus, Buckhurst Road, Ascot, Berkshire, SL5 7PY, UK; Tel.: Skype name: marion_allie

Dr. Rob Ewers, Imperial College London, Silwood Park Campus, Buckhurst Road, Ascot, Berkshire, SL5 7PY, UK

Follow us at: Stability of Altered Forest Ecosystems Project (S.A.F.E.): Homepage: http://imperial.academia.edu/MarionPfeifer/ Environmental change blog: http://marionpfeifer.wordpress.com/



Example of a fragmented landscape consisting of forest patches separated by different habitat. Abundance was recorded in plots (green dots) located in some of the forest patches.

The Herpetologists' League EE Williams Research Grant

The Herpetologists' League is pleased to announce competitive grants for graduate student research for 2013. These awards are named in honor of the late Ernest E. Williams, the first Distinguished Herpetologist of The Herpetologists' League.

Overview

1. An award ($1000.00 maximum amount) will be presented to one winner in each category:

Behavior
Conservation
Ecology
Physiology
Morphology/Systematics

2. See HL web site for application form, complete rules and details: http://www.herpetologistsleague.org/dox/eewilliamsgrant.pdf.
3. Entries must be received by 5 PM Mountain Time on 15 December 2012.
4. Send complete application (cover page, proposal, budget, CV,) as a single PDF electronically to: Ann Paterson at apaterson@wbcoll.edu. Please put "EE Williams Research Grant" in subject line.
5. One letter of support should be sent, preferably by e-mail, directly by the supporter.
6. Proposals will be reviewed by at least two professional scientists, who will provide written feedback by April 2013.
7. Funding dispersed in April 2013 and winners announced at the Herpetologists' League Business Meeting in Albuquerque, New Mexico, 2013.

Rules – please read, the rules have changed from last year

1. The applicant must be a member in good standing of The Herpetologists' League.
2. The applicant must be registered and in good standing in a degree-granting program (M.S. and Ph.D. candidates eligible).
3. One proposal per applicant per year.
4. Project must be original work, authored and conducted by the applicant.
5. Projects that are already fully supported by other sources are not eligible.
6. The proposal category must be clearly designated. However, HL reserves the right to judge proposals under a category different from that requested based on evaluation of the subject matter and the number of proposals received in each category.
7. Previous winners are NOT eligible for the award in subsequent years.
8. A short report (2 pg) summarizing the results of the project and a reprint or .pdf of any publication arising from the project is due to secretary of HL when available.

Photo: David Herasimtschuk.

Preparation guidelines (see web site for more details)

1. Word limit: 1200 words not including citations, budget, cover page or CV.
2. Double spaced, 12 pt font.
3. Margins: 1 inch.
4. Include the cover page provided at the HL website.
5. Include a detailed budget, as well as sources and amounts of current and pending support.
6. Clearly designate the proposal category on the cover page.
7. Arrange in advance for one letter of support to be sent separately by the supporter.
8. Include a two-page CV that includes telephone, e-mail and mailing addresses.

What is Success in Amphibian Conservation?

By Helen Meredith

Please visit the following survey to give your views on what "success" means in amphibian conservation: www.zsl.org/helenmeredith (Direct link: https://www.surveymonkey.com/s/LZJCT6Z)

Following five years coordinating the Zoological Society of London's EDGE Amphibians Program (www.edgeofexistence.org), I started a Ph.D. in 2011 with the aim of investigating ways of improving the impact of amphibian conservation programmes. Developing and optimizing strategies to mitigate extinctions of amphibian species presents many opportunities for improving current and future initiatives. I aim to address two key areas currently impeding effective interventions within and across international amphibian conservation programmes, namely: (i.) Investigating the relationship between perceived "success" in species recovery programmes and scientific research on those species, and (ii.) Evaluating the degree to which current conservation programmes have been effective in reducing threats and extinctions.

I am therefore investigating perceptions of success in conservation among people involved in amphibian research and conservation practice, with the aim of trying to understand how scientists and practitioners view conservation success around the world. Since these perceptions influence the development of conservation programmes, as well as their funding and political support, I feel it is very important to gain a better idea of what these perceptions are in order to improve the overall impact of amphibian conservation programmes. This information will also lead into a subsequent study where I use project evaluation tools to assess the performance of a sample of amphibian conservation programmes, looking for predictors of success in terms of project management, components and outcomes. I will later contrast the notions of success from the survey results with these objective assessments to see how well they align.

In the following short survey, you can give your views on what we, as a community of amphibian researchers and conservationists, regard as success in conservation. Understanding better how scientists and practitioners view conservation success around the world will hopefully help to improve the development of conservation programmes and their long-term impact. All responses to this survey will be treated with complete confidence, and anonymously for the purposes of all analysis.

DO YOU WANT TO TAKE THE SURVEY?

CLICK HERE:

https://www.surveymonkey.com/s/LZJCT6Z

This survey will be available until 30th November 2012

Helen Meredith, Ph.D. Candidate, E-mail: helen.meredith@zsl.org ; Durrell Institute of Conservation and Ecology (University of Kent), Institute of Zoology (Zoological Society of London), Primary Supervisor: Professor Richard Griffiths Ph.D.: "I***mproving the impact of amphibian conservation programmes***" Main Address: Institute of Zoology, Zoological Society of London, Regent's Park, London NW1 4RY. Tel: +44 (0) 207 449 6556

Hemiphractus fasciatus, Banded horned tree frog. Photo: George Sunter.

Conservation Leadership Programme

Call for Applications: 2013 Conservation Leadership Programme Awards

Deadline: 9th November 2012

The Conservation Leadership Programme (CLP) is now accepting funding applications from early-career conservationists for projects focused on conserving threatened species and sites in Africa, Asia, East/South-East Europe, the Middle East, the Pacific, Latin America and the Caribbean. To find out whether your project is eligible and to download application guidelines and forms visit www.conservationleadershipprogramme.org/ApplyNow.asp

In recent years the CLP has supported a number of excellent amphibian projects which have resulted in the discovery of new species of amphibians in Colombia and the Western Ghats of India, important research into the effects of climate change and chytrid fungus, contributions to help draft the first Amphibian Conservation Action Plan for Ghana and awareness raising campaigns for little-known species such as the Moustache toad in China.

There are three awards categories:

- **Future Conservationist Awards:** Approximately 20 awards of up to $15,000 each
- **Conservation Follow-up Awards:** Approximately 6 awards of up to $25,000 each (available only to previous CLP award winners)
- **Conservation Leadership Awards:** 1 award of $50,000 each (available only to previous CLP award winners)

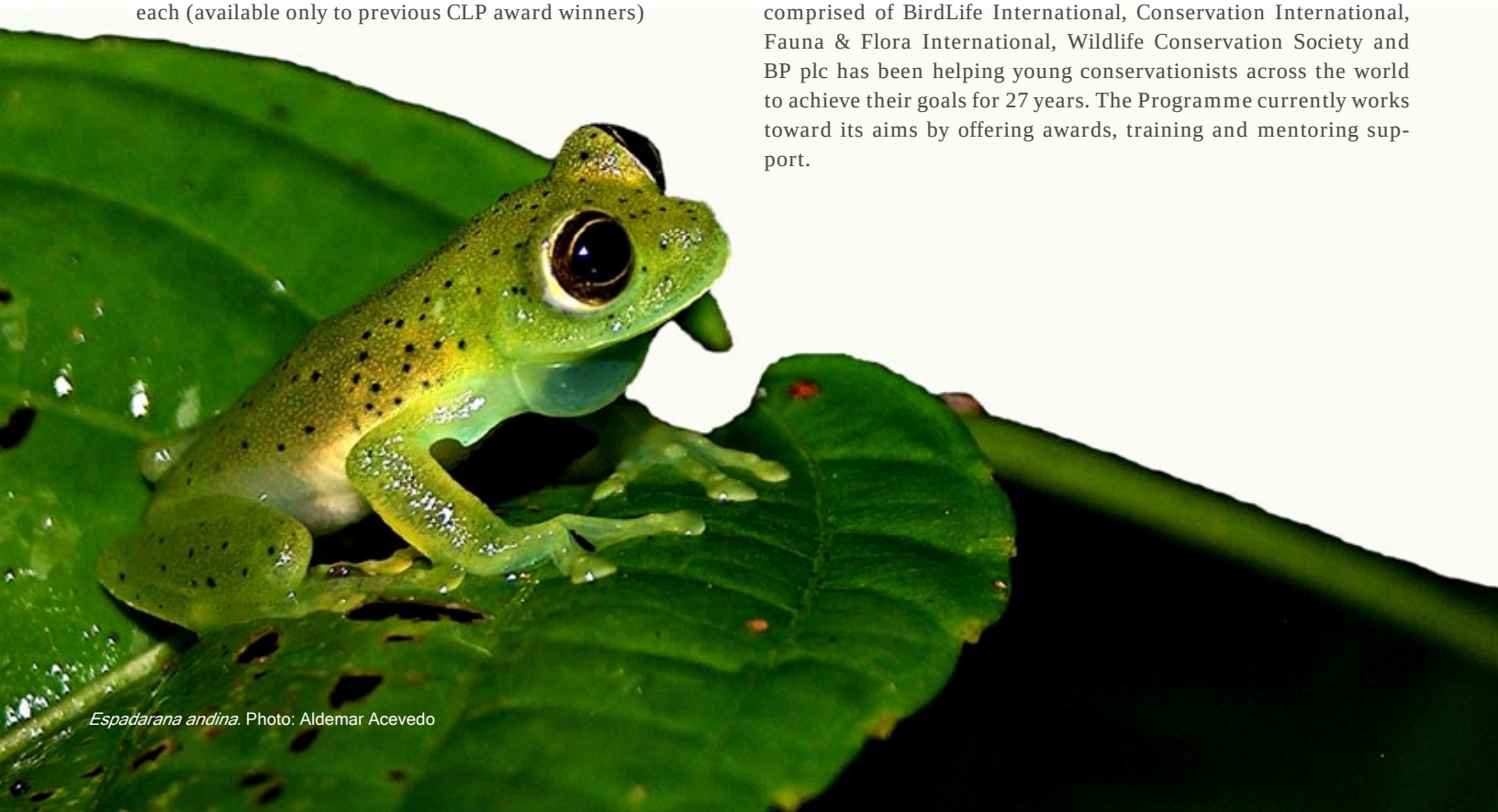
The application deadline for full proposals is 9th November 2012 for ALL applications. Those applying for a **Conservation Follow-up or Conservation Leadership Award** must submit a logical framework to the CLP by 1st October 2012. Awards will be announced in April 2013.

Successful applicants will: 1.) Develop the knowledge, skills and abilities of team members; 2.) Implement a focused, high-priority conservation project combining research and action; and 3.) Contribute to the long-term success of local conservation efforts. A representative from each award-winning team will be invited to attend an international training event in June/July 2013 organized by the CLP to share ideas and develop skills, knowledge and contacts. Additionally, winning teams are able to network with experts from within each of the partner organizations and past winners.

For further information visit www.conservationleadershipprogramme.org/ApplyNow.asp or email clp@birdlife.org

About the Conservation Leadership Programme

The CLP aims to contribute to long-term conservation in priority areas by encouraging and engaging potential leaders in biodiversity conservation and providing opportunities for individuals to gain practical skills and experience. This partnership initiative comprised of BirdLife International, Conservation International, Fauna & Flora International, Wildlife Conservation Society and BP plc has been helping young conservationists across the world to achieve their goals for 27 years. The Programme currently works toward its aims by offering awards, training and mentoring support.



Espadarana andina. Photo: Aldemar Acevedo

Amphibian Declines Teaching Module Spanish-language version Available for Free Download

Now available is a full Spanish translation version of this popular teaching module, 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 to the right.

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*

For more information, or copies of these materials, please contact Joe Mendelson: *jmendelson@zooatlanta.org*

New Field Guide - Anfíbios

By Fábio Maffei, Flávio Kulaif Ubaid & Jorge Jim

Front cover and plates from the recently published full color Portuguese language guide to the amphibians of Fazenda Rio Claro, in the county of Lençóis Paulista in the state of São Paulo, Brazil.

Written by Fábio Maffei, Flávio Kulaif Ubaid and Jorge Jim, Anfíbios is a recently published full color Portuguese language guide to the amphibians of Fazenda Rio Claro, in the county of Lençóis Paulista in the state of São Paulo, Brazil. Covering 40 species of anurans in seven families, this guide merges beautiful photography with a visually pleasing approach to each species account. As the plate to the left shows, each species account includes the Latin name and author, the Portuguese name and a note on the biology of the species including vocalization. Each species account also includes graphical representation of the months of activity, locations the species has been recorded at, an indication of body size and habitat preference. The layout and content of this guide make it a useful tool for residents and tourists alike even for those who do not speak Portuguese.

To purchase a copy of Anfíbios ($20) please contact first author Fábio Maffei at maffei.fabio@gmail.com

www.savethesalamanders.com
Striving to Contribute to Salamander Conservation

By Matt Ellerbeck

Salamanders are among the world's most endangered animal groups, with around half of all the world's species being listed as Threatened by the International Union for Conservation of Nature (IUCN). These species are all facing a high risk of extinction. Unfortunately, salamanders often get far less attention from conservationist then other threatened species. It is due to this high level of decline, that I have decided to focus my conservation efforts on salamanders.

"Some inquisitive participants of one of my educational salamander conservation talks meets a Marbled Salamander (*Ambystoma opacum*). Photo: Clint Fulsom.

I focus mainly on outreach education, visiting class rooms, kid's clubs, national parks and conservation areas. I have educated students at every academic level, giving presentations or talks to pre-schools, elementary schools, high schools and colleges/universities. I believe that all ages and all walks of life need to be taught an appreciation for salamanders. During these educational lectures I highlight the threats that salamanders face and ways in which individuals can aid in their recovery and participate in their conservation. I strongly promote land stewardship/habitat management activities as one way to help salamanders. I also inform landowners about the useful roles that salamanders play in eco-systems (i.e., natural pest controllers as they prey heavily on various arthropods and invertebrates). I hope that when people learn about the benefits that salamanders provide, they will be more inclined to protect them.

My presentations also allow for people to get an up close look at live salamanders, as captive-bred and adopted specimens are brought with me. This allows people to see these secretive and cryptic creatures and develop a sense of empathy and concern for them. To further bring my message of conservation to the public, I often appear in the media, giving radio and newspaper interviews. Many of my presentations also draw attention from the local media, allowing for more people to be reached and educated on conserving salamanders. Alongside these activities, I am also an avid salamander observer. During the spring, summer, and autumn months I spend much time out in the field gathering observational records of salamanders. These are sent to the Natural Heritage Information Centre to help gain a better understanding of salamander populations, habitats, ranges and behaviors across the province of Ontario. Over the past summer I have viewed hundreds of salamanders in their natural habitat. I sincerely hope my efforts to educate and raise awareness will have a positive impact on salamanders and their populations, and that is why I am committed to continuing with my endeavors to help them.

One of the endeavors I am most proud of though is creating a salamander sanctuary. This came about after a visit to the Mazinaw Lakeside Resort Campground. I was set to do a presentation as part of their grand opening. After the presentation I went to explore the grounds and was pleased to find an area on the property rich in salamanders, both in terms of species and in the numbers seen. I was intrigued about the numerous sightings of salamanders that occurred within a short time. I was also filled with a sense of concern about the prospect that their habitat would be under threat from the development of the campground as there had been talks about expanding certain areas that were still in their natural state. I sat down with the owners and discussed why I felt it was important to leave these (salamander) areas untouched and undeveloped - not always an easy pitch to new business owners! However, my enthusiasm for preserving the salamanders habitat must of worked, as they agreed. I returned to the area the following weekend. My assistant and I marked off the area which would be designated as the sanctuary, and put up signs to inform visitors to stay off to prevent habitat degradation. I regularly do presentations at the campground and continually monitor the sanctuary.

FrogLog Digital Archive Now Online

As many of you know, for the last year we have been hunting high and low for old copies of *FrogLog* in order to create an online digital archive. I am pleased to announce that thanks to the help of devoted readers and past editors we have now successfully posted online all 104 editions of *FrogLog* at www.amphibians.org/froglog. While pulling these together I was constantly reminded of the dedicated following that *FrogLog* has built up over the years and the impact it has had in sharing information and provoking conversation. In light of this and to celebrate the new online archive we thought it would be interesting to hear from some of the past editors about their time working on *FrogLog*. We hope you enjoy!

The changing faces of FrogLog. From the first edition to 100th FrogLog continues to evolve while remaining true to its role as a newsletter for the amphibian community written by the amphibian community.

John Baker

My involvement with *FrogLog* was serendipitous. I was finishing a research project with Tim Halliday at a time when the Declining Amphibian Populations Task Force (DAPTF) wanted to move its offices outside the US to broaden its international scope. As a member of the DAPTF's Board of Directors Tim agreed to host the office at the Open University in Milton Keynes, England. Loralei Saylor flew over from the US with a shipment of more paperwork than was humanly possible to deal with and I ended up editing *FrogLog* from 1994 to 1996. Although the transatlantic hop meant a shift from US letter to A4 size paper, we tried to maintain some continuity by keeping the overall appearance of *FrogLog*—three columns, green ink and a pen-and-ink line drawing of two frogs. We were also fortunate to receive continued financial support from Frog's Leap Winery, California.

With technical assistance from colleagues at the Open University we gave the DAPTF a web site where we published *FrogLog*, although paper copy was still predominant—it took several days to stuff paper copies into air mail envelopes.

John Baker hard at work on FrogLog in the DAPTF Office based at the Open University in Milton Keynes, England.

Today's *FrogLog* looks fantastic and the changes over the last 15 years enabled by developments in information technology are astonishing. But it was still an exciting time, then, working with the support of DAPTF's board of directors, and especially Chair Ron Heyer, and other amphibian ecologists from around the world. I was struck by the long reach of *FrogLog* when one of my team mates from a local sports club returned from a hiking holiday with a surprising story. He told me that in a remote, mountainous area of Central Europe he had bumped into someone who turned out to be surveying ponds for amphibians. The amphibian surveyor spotted the words "Milton Keynes" (*FrogLog*'s home town at the time) on my friend's sports shirt and wanted to know if he knew John Baker.

John Wilkinson

I was the Declining Amphibian Task Force (DAPTF) International Coordinator from 1996 to 2004 and remember editing *FrogLog* with particular fondness. It was during this time that "bespoke" drawings began to feature on the cover—mainly from the inimitable pen of Tim Halliday but supplemented by humble efforts from myself and others from around the world who volunteered sketches of their favourite study animals! I used to anticipate eagerly the diverse missives on exotic amphibia from all over the world, as well as hearing the latest news from our various Working Groups!

All in all, however, it mustn't be forgotten that two major events in the (then) esoteric world of amphibian declines took place during that period... I can't claim to have influenced either of them, though *FrogLog* might have! First, the scientific community at large seemed to start to really accept the fact that amphibian decline phenomena were really happening, there having been mutterings of denial from many quarters, and second, the chytrid fungus was "outed" as one of the contributing factors to declines. It's odd, with hindsight, that it seemed such a battle at the time—now we know that other taxa (freshwater organisms, reptilia, invertebrates etc. etc.) are probably declining at least as much as are amphibians and that chytridiomycosis is just one of many emerging infectious diseases we're fighting against! So, now to convince the deniers that climate change is really happening...

The reach and potential influence of *FrogLog* was brought home in 1997 when it featured in Mayra Montero's celebrated Caribbean novel "In the Palm of Darkness"... a scientist searching for the rare (but fictitious) blood frog *Eleutherodactylus sanguineus* (if memory serves) in Haiti returns from a field trip to find copies of *FrogLog* burning on his camp fire!!! An interesting read, if you like voodoo!

The DAPTF's frog mascot 'BJ' graduates to become the ASG mascot at the Durrell Institute of Conservation and Ecology (left to right: Professor Richard Griffiths, Jeanne McKay, Brett Lewis and Matt Linkie).

Jeanne E. McKay

As the International Coordinator for the Declining Amphibian Task Force (DAPTF) from 2004 to 2009, I had the immense pleasure of editing 17 editions of *FrogLog*. From the first, I was aware of its loyal following and wide reach and later came to know it as a unique newsletter; a relatively small but an incredibly potent amalgamation of information that both celebrated the successes and documented the challenges faced by a wide range of amphibian researchers, conservationists and enthusiasts from around the world.

Times change and I remember that when we discontinued printing hard copies in favor of becoming exclusively web-based, it was met with both eagerness (lower costs and environmentally friendly) and some regret (from those who looked forward to receiving their hard copies in the post and being among the first to see which of Tim Halliday's hand drawn illustrations had 'jumped' onto the front page for that particular issue). In fact, long after we discontinued the printed editions, I still carried on mailing several hard copies to those who had subscribed to *FrogLog* for over a decade and thus would not have it any other way!

In 2006, after nearly 15 years since its inception, I assisted in another auspicious change, the transitioning of DAPTF and *FrogLog* to the Amphibian Specialist Group. However, as with all things which must end before they can begin again, the nostalgia of what once was and those that had come before, did not go unheeded. So, when *FrogLog's* current Editor, James Lewis, contacted me in Sumatra asking if I had happened to keep copies of 26 earlier editions in order to complete the electronic archive he was producing, I was delighted to tell him that I had—even more so because his request came just a few days before I was returning to the UK on holiday. Whilst climbing around in my attic in Canterbury was a far cry from the Sumatran rainforest, locating that box of printed treasure was no less satisfying as it reminded me once again of what an honor it was to meet an incredible array of people and be inspired by their work through its pages whether they are printed or electronic.

Robin D. Moore

My stint as *FrogLog* editor spanned from 2007, when I took the reigns from Jeanne McKay, until I passed the baton to James Lewis early last year. I didn't actually realize how long my stint lasted until now! As editor, time seemed to quicken and two months was a very short time indeed—no sooner had one edition gone out than it was time to gather content and start organizing the next!

Prior to becoming editor I had always enjoyed *FrogLog* for my amphibious updates. I made occasional contributions in the form of drawings for the cover or written articles. It was always a thrill to see your drawing adorning the cover. *FrogLog* was, for as long as I can remember, a fantastic source of news, updates and short articles from the amphibian community. And even though it was always a newsletter, over time it grew into a trusted and reliable source of information—so much so that it started being cited alongside peer-reviewed publications in scientific journals—including in a paper that I co-authored in PloS Biology on the challenge of conserving amphibian megadiversity. It's rapid turnaround meant it was often the first source of new information, and I had written about our workshop in Madagascar in *FrogLog* long before the findings appeared in a scientific journal.

As editor I enjoyed the direct contact with the contributors—the people out doing amazing work around the world. It was inspiring. The biggest change that I made when I took over was making it a full-color publication. It was somewhat harrowing to lose the drawings that had become a *FrogLog* Trademark, but the challenges of sourcing a new drawing every two months ushered in a new look and feel for *FrogLog*. I started to invite authors to supply color images to bring their stories from the field to life; and the response was good. The switch to color was also an indication of changes in the ways *FrogLog* was distributed and read; it had become a digital publication and, freed from the prohibitive costs of printing in color, I could see no good reason not to start including color images to accompany the articles. And so, *FrogLog* got a new banner and the full-color *FrogLog* was spawned.

Jeanne McKay, Don Church and Robin Moore. The ASG Team that brought FrogLog into full color.

There is a "before and after" as an editor of *FrogLog*, and I definitely read the publication with different eyes now. The content is king of course, but I now find myself thinking "this must have been a lot of work to pull together!" Having been editor for a stint gives me an appreciation and an admiration for all that goes into each edition. *FrogLog* has really ballooned in just the past year, and while it is so rich in content that it straddles the line between newsletter and journal, it retains the essence of what it has always been; a newsletter for the amphibian community by the amphibian community.

Decreased *Triturus cristatus* Breeding Site Number as a Consequence of *Perccottus glenii* Range Expansion

By Andrey Reshetnikov

The invasive alien fish Rotan *Perccottus glenii* (family Odontobutidae) originates from the Far East regions of Asia (*1*). Now its new invaded range covers more then 100 geographical degrees east to west (*2*). Rotan were recorded in water bodies of Poland, Slovakia, Hungary, Bulgaria, Romania, Serbia, Croatia, Moldova and other countries (*3*). After its appearance in ponds and lakes in the province of Moscow, Russia (1950), *P. glenii* quickly established itself in most of the regions permanent ponds. Although amphibian eggs are not edible to Rotan due to their protective jelly coating (*4*), the larvae of many amphibian species are highly vulnerable to Rotan predation. Rotan effectively eliminate newt and frog tadpoles from shallow ponds however noxious larvae of the Common toad *Bufo bufo* can develop in water bodies with Rotan (*5, 6*). In some districts, only temporary water bodies are still available for reproduction of the Great crested newt *Triturus cristatus*. This dramatically transformed spatial structure of newt metapopulations (*7*).

The invasive alien fish Rotan *Perccottus glenii* (family Odontobutidae) originates from the Far East regions of Asia. Photo: Andrey Reshetnikov.

Ecosystem monitoring of aquatic habitats has been carried out since 1994 in the region of Lake Glubokoe (55°45'N, 36°30'E) located 50 km west of Moscow, Russia. The lake and the surroundings are part of the Lake Glubokoe Reserve. Small aquatic habitats (village ponds, roadside ditches, old tractor ruts, a coal pit, a high bog, etc.) were studied in this region within an area of approximately 50 km^2. Waterbodies were inspected annually with faunal and general limnological data being recorded. The aquatic fauna was sampled using a dip-net. Approximately 2 m^3 of water were filtered in each waterbody at different places along the shoreline. Breeding success (of vertebrates only) was recorded along with species richness, relative abundance of particular species and overall abundance of macroinvertebrates, vertebrates (*6*).

Attempts of *T. cristatus* to use some temporary water bodies with suboptimal characteristics were recorded, however such water bodies can not provide stable conditions for newt reproduction annually. By 2011, 40 aquatic sites had been monitored, only one of which was used by Great crested newts for reproduction. The relative abundance of *T. cristatus* larvae was pretty low in this aquatic site (0.5 larvae per 1 m^3 of water). The last breeding site of *T. cristatus* does not have optimal characteristics. It is too shallow and too overgrown by submerged and floating aquatic vegetation. No successful breeding of *T. cristatus* was recorded in 2012 in monitored water bodies. This negative tendency confirms that expansion of Rotan may result in severe decreasing of *T. cristatus* breeding sites. Occupation of the favorable newt breeding sites by this introduced fish may be a reason for local extinction of *T. cristatus* over large areas.

Western Europe is climatically suitable for Rotan (*3*). There are no geographical barriers between already colonized territories of the Eastern Europe and yet unoccupied Western European countries. Further distribution of Rotan is a threat for native European amphibians, including *Triturus* species and other rare amphibians.

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Endemic and Rare Amphibians of Hainan Island, China

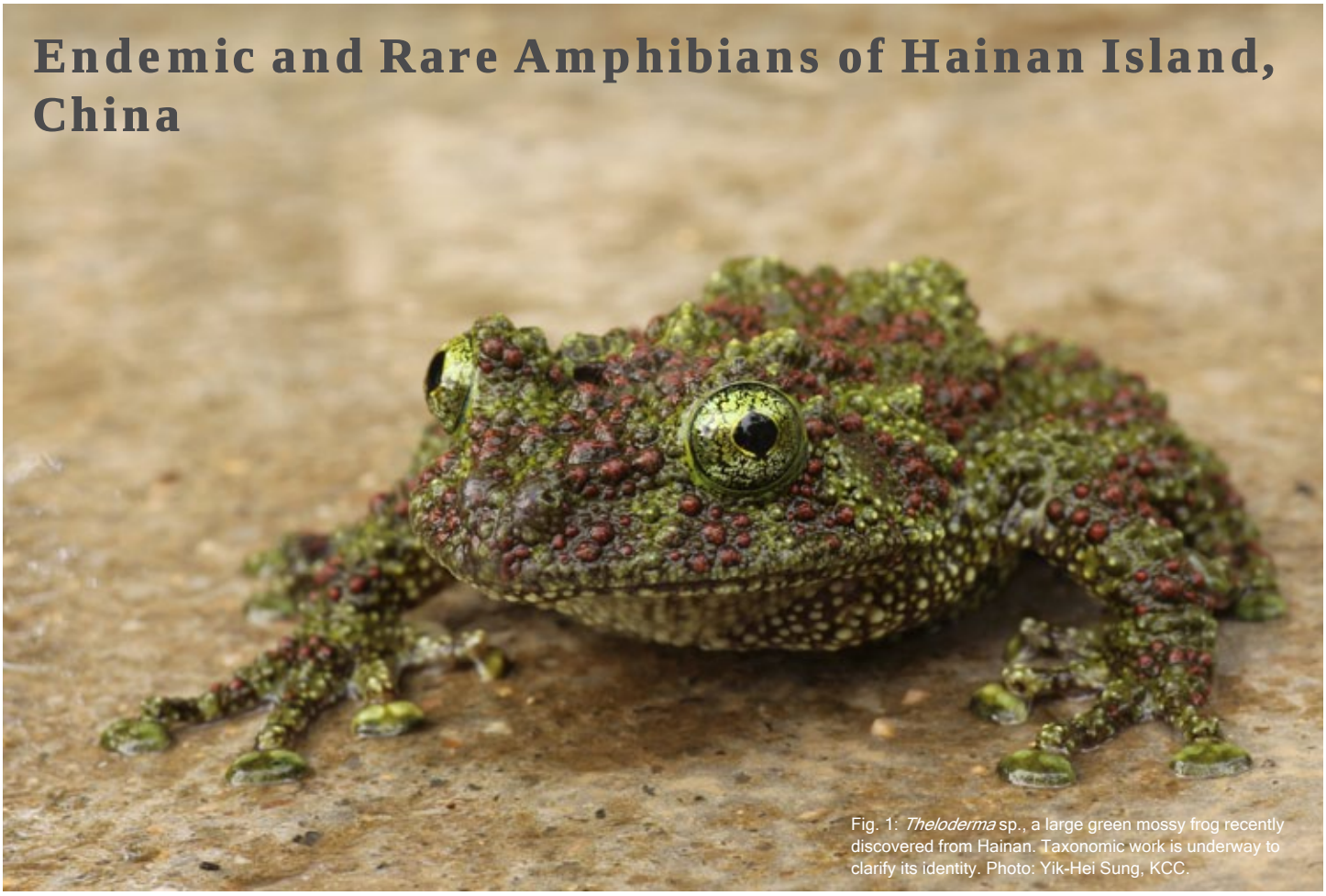

Fig. 1: *Theloderma* sp., a large green mossy frog recently discovered from Hainan. Taxonomic work is underway to clarify its identity. Photo: Yik-Hei Sung, KCC.

By [1,2]Bosco P. L. Chan & [1]Yik-Hei Sung

Hainan at the southern tip of China is a tropical island within the Indo-Burma biodiversity hotspot. With forest-clad mountains and limited road access to the interior, new records and even new species of amphibians are still being discovered. So far, a total of 44 amphibian species have been recorded from the 33,000 km^2 island, including 13 endemic species. In addition, interesting taxa are being added on the Hainan checklist; for example two species of the forest-dwelling *Theloderma* mossy frog (Fig. 1 & 2), as well as the miniature *Micryletta inornata* (Fig. 3) have recently been recorded from remote forests (*1-3*).

The bright green Yinggeling treefrog *Rhacophorus yinggelingensis* is arguably Hainan's amphibian celebrity (Fig. 4). Since its discovery in 2007, virtually nothing is known about its ecology except it occurs in high-altitude primary rainforest within Yinggeling Nature Reserve (18^{0}49'–19^{0}06'N; 109^{0}11'–109^{0}34'E). Globally there have been marked declines and extinctions of populations of montane frog species (*4-6*) there is therefore an urgent need to understand the ecology, status and distribution of the species to ensure its long-term survival. We are working with research staff of Yinggeling Nature Reserve to study the ecology and distribution of this rare gem and results will be published soon.

Among the Hainan endemics, 80% are listed as Threatened by the IUCN Red List of Threatened Species™. However, effective conservation measures are hampered by a lack of understanding on their ecology and status. Basic ecological information for most, if not all, endemic or newly-discovered species, such as *Tylototriton hainanensis* (Fig. 5), *Parapelophryne scalpta* (Fig. 6) and *Leptobrachium hainanense* (Fig. 7) remains poorly understood. Many of them share the high-altitude forest habitat (over 900 m above sea level) with *R. yinggelingensis*, and therefore are also susceptible to climate change and deforestation. It is thus imperative more efforts should be put into studying the basic ecology of Hainan's amphibians.

Fig. 2: *Theloderma asperum*, a new member on the Hainan amphibian checklist. Photo: Philip Lo, KCC.

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[2]Yinggeling Nature Reserve, Baisha 572800, Hainan, China.

On the positive side, the majority of upland forests in Hainan are now protected as nature reserves, giving legislative protection to the habitats of all endemic species. Yinggeling, with altitudes spanning across elevation of 200 m to the summit of Mt. Yinggeling at 1812 m, and extensive forest covering most of the reserve, it has exceptional value in the conservation of amphibian diversity of Hainan. Our surveys so far recorded 39 amphibian species (89% of the known amphibian fauna), including 11 out of the 13 known endemic species. It is a genuine amphibian hotspot and the ecosystem must therefore be properly protected to ensure its irreplaceable conservation value.

Acknowledgments

We would like to thank the Hainan Wildlife Conservation Bureau of Hainan Provincial Forestry Department for their permission and support for amphibian research. We thank all the nature reserves, particularly Yinggeling and their hard-working wardens for their assistance in surveys and logistic arrangement.

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Fig. 3: (Top) *Micryletta inornata*, the elusive habits make it difficult to detect unless breeding sites are located. Photo: Pak Ho Wan, KCC. Fig. 4: (Middle left) *Rhacophorus yinggelingensis*, an amphibian gem of Hainan. Photo: Lu Gang, KCC. Fig. 5: (Middle right) *Tylototriton hainanensis*, the only tailed amphibian of Hainan. Photo: Bosco Chan, KCC. Fig. 6: (Lower left) *Parapelophryne scalpta*, a little-known toadlet of the Hainan upland forest. Photo: Pak Ho Wan, KCC. Fig. 7: (Lower right) *Leptobrachium hainanense*, tadpoles are common in forest hillstreams but adults are difficult to find in their forest home. Photo: Bosco Chan, KCC.

Amphibian Research and Conservation in Vietnam

By Truong Quang Nguyen & Thomas Ziegler

Vietnam has one of the richest amphibian faunas in the world with nearly 200 species being recognized from this country (*1-10*). However, many amphibian populations and species are facing declines as a result of habitat loss and degradation, over-harvesting for food consumption, traditional medicine and pet trade (*11-13*). Currently, 32 Vietnamese amphibian species (approximately 16% of the total species number known for Vietnam) are listed in the IUCN Red List (*14*) at different categories: three species are listed as Endangered, 13 as Vulnerable and 16 as Near Threatened. To counteract the biodiversity decline in tropical forests in Southeast Asia, numerous research and conservation programs have been undertaken in Vietnam during recent decades (*15, 16*). We herein provide a brief overview about recent amphibian research and conservation efforts in Vietnam.

Rhacophorus robertingeri, a newly described species from central Vietnam. Photo: T.Q. Nguyen.

Research activities

Since 1998, a series of herpetofaunistic studies has been conducted in different regions of Vietnam with the focus on unexplored forests such as Hoang Lien Mountains in the Northwest; Ngan Son and Bac Son karst formations or Viet Bac and Dong Trieu granitic formations in the Northeast; Truong Son range and Central Highlands (e.g., Kon Tum, Dak Lak, Langbian, Di Linh plateaus); as well as on some offshore islands (e.g., Bai Tu Long, Cat Ba, Con Dao and Phu Quoc). As result of recent herpetological exploration, the knowledge about species richness of amphibians in Vietnam has remarkably increased, from 82 species in 1996 to 181 in 2010, and currently, the species number has reached 194 (*1-10, 17*). In the past two years, 11 new amphibian species have been described from Vietnam and two new records have been reported from this country as well. In addition, taxonomic reviews have been provided for some groups based on morphological and molecular data, namely *Gracixalus* (*3*), *Ichthyophis* (*8*), *Leptolalax* (*9*), *Rhacophorus* and *Theloderma* (*4, 10*). Ongoing investigations of the amphibian fauna are being carried out in Dien Bien, Son La, Cao Bang, Ha Giang, Thanh Hoa and Lam Dong provinces.

Ichthyophis nguyenorum, a newly described species from central Vietnam. Photo: T.Q. Nguyen.

In contrast to the surge of herpetofauna diversity surveys, the research on the natural history of Vietnamese amphibians is still limited. However, information about the specific adaptations (ecology) and population status is crucial for subsequent, suitable conservation measures. In times of the global amphibian crisis, and to be prepared for proper conservation breeding action, necessitated by the hazardous amphibian chytrid fungus (which is responsible for the amphibian disease chytridiomycosis), one of the major interests here is related to the reproductive biology of threatened or poorly known species. Some larval descriptions, larval staging and in part breeding reports of salamanders, bufonids, megophryids, microhylids, ranids and rhacophorids have been recently published (*2-4, 9, 10, 18-26*). Call descriptions for some species of several anuran groups from Vietnam were also provided, amongst others, by Anderson *et al.*, (*27*), Ziegler (*28*), Rowley *et al.*, (*3, 6*) and Wildenhues *et al.*, (*21*).

Currently, a comprehensive study on the distribution, population size and ecology of the Vietnamese newt genus *Tylototriton* and salamander genus *Paramesotriton* is taking place in northern Vietnam (e.g., *29*).

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Larvae of Vietnam newt *Tylototriton vietnamensis* at the Amphibian Breeding Station in Hanoi. Photo: T. Ziegler.

In order to build up or maintain populations in captivity, the Institute of Ecology and Biological Resources (IEBR), together with the Cologne Zoo, have decided to promote the *ex situ* research and conservation of amphibian species in Vietnam since 2007 (see *31, 32, 33*). The first phase has been successfully carried out at the Breeding Station on the outskirts of Hanoi, with already 14 bred amphibian species (*34*). Some results already have been published as service for other breeding stations / conservation projects / natural history research on tadpoles (*21, 25*), further data in particular concerning rearing, tadpole morphology and staging of rhacophorids (*Rhacophorus*, *Theloderma*) are currently assessed by Vietnamese and German students of our working group and prepared for subsequent publication. For disease control, selected breeding groups have been tested for the amphibian chytrid fungus *Batrachochytrium dendrobatidis* and since recently also for *Ranavirus*, but fortunately there has been no infection documented in Vietnamese amphibians at the station so far.

Conservation activities

An amphibian conservation needs assessment for the species of the Indochina region was held in Hanoi by the Amphibian Ark in March 2012. During this five-day workshop, the conservation status of 65 species from Cambodia, 110 species from Laos and 176 species from Vietnam was evaluated. According to the assessment results, conservation actions for the Vietnamese amphibians include: 80 species of *in situ* conservation, 105 species of *in situ* research, five species of *ex situ* research, 73 species of conservation education and 21 species that do not require any conservation action at this point of time (*30*).

However, because of the land re-allocation and the current conditions at the Breeding Station in Hanoi, IEBR and Cologne Zoo are planning to implement the second phase of the *ex situ* research / conservation, but this time combined with *in situ* and education activities at the Me Linh Station for Biodiversity, bordering the famous Tam Dao National Park in Vinh Phuc Province, northern Vietnam. The Me Linh Station was established by the Vietnam Academy of Science and Technology in 1999 with the total area of 170.3 hectares. This station is directly located in forest environment, and therefore, it creates easier conditions for *in situ* conservation and research approaches as well as environmental

(Top left) Herpetological field work of European / Vietnamese working group in the lowland forest of Yen Tu, northern Vietnam. (Top right) Examination of abiotic parameters in the habitat of the endemic *Tylototriton vietnamensis*. (Lower left) One of the amphibian breeding facilities at the IEBR Breeding Station at Hanoi. (Lower right) Rhacophorid tadpoles at the Hanoi Breeding Station. Photo: T. Ziegler.

Cologne Zoo staff constructing indoor amphibian terraria and introducing the Me Linh Station staff into amphibian husbandry management. Photo: T. Ziegler.

The Me Linh Station for Biodiversity, located directly in forested environment. Photo: T. Ziegler.

education. The objectives at Me Linh are to monitor the local biodiversity, to protect the native species and their natural habitat, to rescue confiscated animals, to keep and breed selected threatened / poorly known species, with a special focus on amphibians (including husbandry analogue species, as was decided during the AArk amphibian assessment in March 2012) and finally to provide services for conservation education for visitors and students.

Several initial activities have already been done at the Me Linh Station in May 2010 during a five-day visit of the latter author together with Cologne Zoo staff. This first administrative assistance included amongst others the beginning of the build up of an indoor amphibian facility, the setting of a quarantine station, the building of facilities for Tiger geckos (*Goniurosaurus* spp.) and Vietnamese crocodile lizards (*Shinisaurus crocodilurus*), the improvement and enrichment of a macaque facility, and the improvement of existing as well as construction of new turtle enclosures (*35*). Further building activities, in particular regarding the indoor amphibian facility and the construction of outdoor amphibian facilities, together with labeling and a keeper training conducted by the Cologne Zoo team on husbandry and captive breeding are planned to take place at the Me Linh Station in spring 2013, but still outstanding funds need to be acquired first. Besides such capacity strengthening aspects we also intend to continue with public awareness such as implementation of school visits and compiling a bilingual brochure, as it was already done by our team for the Yen Tu Nature Reserve, which houses the endemic Vietnam newt *Tylototriton vietnamensis* (see http://www.eaza.net/campaigns/Documents/Brochure Tay Yen Tu Nature Reserve 2010.pdf).

Acknowledgments

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Integration of Species Distribution Modeling with *In Situ* Research for the Conservation of the Endemic Vietnamese Crocodile Newt (*Tylototriton vietnamensis*)

By [1]Marta Bernardes, [2]Dennis Rödder, [3]Cuong The Pham, [1,3] Truong Quang Nguyen & [4]Thomas Ziegler

The need to engage in biological conservation actions in Vietnam has long been recognized as a global priority. The country is included in the 25 biodiversity hotspots (*1*) and identified as one of the most biologically distinct ecoregions on the planet (*2*), in addition to having one of the lowest percentages of remaining primary forest in Southeast Asia (*3*).

Still evidences of new species are gathered every year in Vietnam (*4*). In 2005 Böhme *et al.* (*5*) discovered a new species of amphibian, the Vietnamese crocodile newt, *Tylototriton vietnamensis* (Fig. 1). This species is currently known from only three localities in northern Vietnam: Yen Tu Mountain in Bac Giang (type locality), Quang Ninh provinces, Mau Son Mountain in Lang Son Province, and Xuan Son National Park in Phu Tho Province (*6*). *Tylototriton vietnamensis* inhabits forested areas and its reproduction seems dependent on the occurrence of small muddy pools in the shadow of trees (Fig. 2), possibly indicating that it cannot tolerate extensive deforestation. Due to the extent of occurrence of this species its range is probably not larger than 20,000 km^2 (*7*). *T. vietnamensis* is therefore listed as Endangered in the Vietnam Red Book (2007) (*8*) and as Near Threatened in the IUCN Red List of Threatened Species™ (2012) (*9*).

Fig. 1: Life stages of the Vietnamese crocodile newt: A) female on top of eggs; B) larva; C) juvenile in land. Photos respectively: Marta Bernardes, Thomas Ziegler & Cuong The Pham.

In 2010 we developed the first natural history research focused on *T. vietnamensis*. Besides gathering ecological information about pond occupancy in the type locality we created, based on Species Distribution Modeling (SDM), a predictive map showing the additional distribution of suitable habitats for the species in northern Vietnam (*10*). This information was subsequently intersected with existing protected areas to help assessing high priority regions for conservation. Natural habitats of *T. vietnamensis* belong to some of the remaining lowland evergreen forests from the northeastern region of the country (*11*). This region is severely fragmented and vulnerable to further degradation by deforestation (*10*), in what is known to be one of the highest densely populated countries in mainland Southeast Asia (*12*).

Based on our SDM results we are carrying out field surveys this year in regions with high probability of supporting new populations of the Vietnamese crocodile newt. A part of these potential habitats are occupied by the Black knobby newt, *Tylototriton asperrimus*, and others by the Vietnamese salamander, *Paramesotriton deloustali*, wherein the latter species is also endemic for northern Vietnam. While the taxonomy of these species is unquestioned, there are still phylogenetic, biogeographic and in particular ecological questions to be answered concerning *T. vietnamensis* that will be addressed

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Fig. 2: Searching for adults of *T. vietnamensis* inside of a breeding pond. Photo: Cuong The Pham.

in our research. We do not only verify the actual distribution of *T. vietnamensis* and the other aforementioned salamander species in northern Vietnam, comparing the various ecological aspects of each habitat, but also assess their extent, quality and degree of protection. The updated occurrences of *T. vietnamensis* will be used in the future to develop more accurate distribution models that should be projected to the neighboring countries. Additionally we will raise awareness to new potentially highly biodiverse areas, creating an opportunity to additionally protect other sympatric and Threatened amphibian species, such as the IUCN listed Vulnerable anuran species *Quasipaa spinosa* and *Rhacophorus kio*, which were recorded at the type locality of *T. vietnamensis* (*13*).

Since the status of *T. vietnamensis* is still poorly known we also aim to study population size, structure and threats, while investigating possible phylogenetic variations among populations from different regions. Furthermore, we intend to gather information about the natural history of the species for potential future conservation breeding action.

Being a densely populated and developing country it is expected that in Vietnam the pressure on natural ecosystems will continue to increase. Recognizing the importance of ecological research subsequent to the discovery of new species will be essential for the implementation of adequate conservation measures.

Acknowledgments

Research and conservation of the Vietnamese crocodile newt is supported by the Institute of Ecology and Biological Resources (IEBR), the Cologne Zoo, the European Association of Zoos and Aquaria (EAZA), the Hans-Schiemenz-Fonds of the Deutsche Gesellschaft für Herpetologie und Terrarienkunde (DGHT) and the Idea Wild. SERA kindly provided water tests.

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Restarting Amphibian Studies in Southern Vietnam

By Huy Duc Hoang and Duong Thi Thuy Le

The amphibian and reptile research program at the Lab of Zoology of the University of Science–Ho Chi Minh City was initiated in 2008 through collaboration with the Australian Museum (Australia) and the North Carolina Museum of Natural Sciences (USA). Our goal is to document the diversity, biology and conservation status of the herpetofauna of Southern Vietnam—a region that is biologically diverse, poorly known, and facing great human pressures.

Fig. 1: Montane forest in Bidoup-Nui Ba National Park, Lam Dong Province, Vietnam. Photo: Le Thi Thuy Duong.

Our amphibian and reptile surveys were initially concentrated on the Langbian Plateau in Southern Vietnam, a region that had been neglected by herpetologists since the pioneering work of Malcolm A. Smith in the early 1900's. We continue to focus on the Langbian Plateau, but have expanded to conduct amphibian research throughout Vietnam, particularly in montane evergreen forests from 700–2600 m elevation.

Because the true amphibian diversity of Vietnam is unknown, much of our research involves documenting and discovering amphibian diversity, and our research group has discovered seven new

Fig. 2: Vampire tree frog *Rhacophorus vampyrus* female at Bidoup-Nui Ba National Park, Lam Dong Province, Vietnam. Photo: Le Thi Thuy Duong.

Fig. 3: Cloaked moss frog *Theloderma palliatum*, *in situ* with diurnal colouration. Photo: Le Thi Thuy Duong.

amphibian species to date. The most famous of our discoveries so far is the Vampire flying frog (*Rhacophorus vampyrus*) found in Bidoup-Nui Ba National Park on the Langbian Plateau. This species is not only a beautiful tree frog, but is also unique in that tadpoles of the species have strange, fang-like structures in their mouth (*1*). Other species that we have described so far are *Leptobrachium leucops*, *Leptolalax bidoupensis*, *Leptolalax croceus*, *Leptolalax firthi*, *Theloderma nebulosum* and *Theloderma palliatum* (*2–6*). All these species are distributed in montane forests at least partially inside national parks or nature reserves in Southern and Central Vietnam. Our discoveries have contributed towards a more complete understanding of Vietnamese herpetofauna.

Fig. 4: Members of the amphibian research group of University of Science-Ho Chi Minh City in the field at Chu Yang Sin National Park, Dak Lak Province, Vietnam. Photo: Hoang Duc Huy.

In addition to documenting and describing the amphibian diversity of Vietnam, we also conduct ecological and conservation studies. As part of our amphibian surveys, we have sampled amphibians for the potentially devastating pathogen, the amphibian chytrid fungus *Batrachochytrium dendrobatidis*. The amphibian chytrid fungus was recorded at low infection prevalence and intensity in amphibians at one of our sites, but to date, we have not observed any associated morbidity, mortality or population declines (*7*). To further assess amphibian population trends at this site, we have initiated amphibian population monitoring in Bidoup-Nui Ba National Park.

Our lab plans to continue investigating the diversity of Vietnamese amphibians and monitoring amphibian populations at select sites, along with expanding our research to focus on the ecology of threatened Vietnamese amphibian species.

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Overview of Current Research on Amphibian Ecology and Conservation of the Amphibian and Reptile Ecology Laboratory, Kasetsart University, Thailand

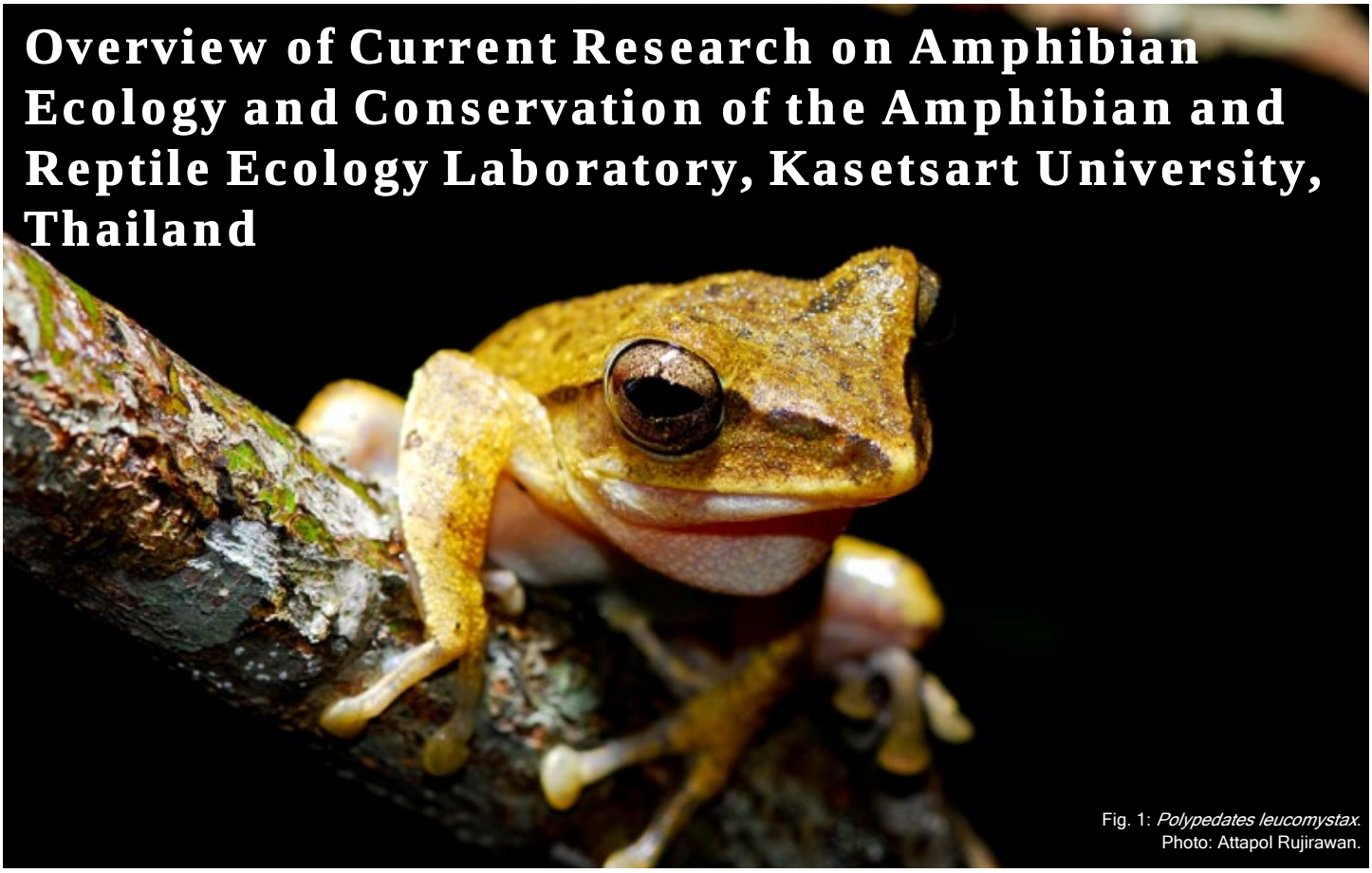

Fig. 1: *Polypedates leucomystax*. Photo: Attapol Rujirawan.

By Anchalee Aowphol

Thailand is a biodiversity hotspot with a diverse amphibian fauna comprising 169 species (*1*). Unfortunately, amphibians in Thailand face conservation crisis due to habitat loss and overharvesting for food and the pet trade. Only 12 species are nationally listed as protected species. The diversity and distributions of amphibians in Thailand are reasonably well studied compared to some other Southeast Asian countries (*2*); however, little is known on amphibian ecology, hindering conservation action. Among the academic institutions that are conducting research on amphibians and reptiles in Thailand, the Amphibian and Reptile Ecology Laboratory (AREL), Kasetsart University, Bangkok, recently initiated studies on amphibian ecology and conservation. This article presents an overview of the activities and current research in the AREL.

The AREL is one of the laboratories in the Animal Systematics and Ecology Research Unit at Department of Zoology, Faculty of Science, Kasetsart University. The laboratory was established in 2010 and specimens and tissues from our research are deposited in the herpetological collection, Zoological Museum, Kasetsart University. The AREL research group consists of Professor Anchalee Aowphol and her graduate students from Thailand and Laos, in collaboration with Thai and foreign herpetologists, e.g., Dr. Kumthorn Thirakhupt (Chulalongkhorn University), Tanya Chan-ard and Dr. Yodchaiy Chuaynkern (National Science Museum, Thailand), Dr. Bryan Stuart (North Carolina Museum of Natural Sciences), Dr. Harold Voris (Field Museum of Natural History) and Dr. David McLeod (University of Kansas).

One of our research goals is to provide basic knowledge on amphibian systematics and ecology in Thailand that can be used for implementing conservation action. We have been focused on the systematics, ecology and conservation of threatened species and cryptic species complexes using morphology, advertisement calls and genetics. Graduate students in the AREL have been active in this research. Attapol Rujirawan is a M.Sc. student focusing on the geographic variation of calls of widely distributed rhacophorid frog species. Siriporn Yodthong is a M.Sc. student analyzing the population genetics of species in the rhacophorid frog genus *Chiromantis*. Natee Ampai is a M.Sc. student who aims to study the population ecology of the ranids *Odorrana chloronota* and *O. aureola*, the latter of which is endemic to Thailand. Finally, Somphouthone Phimmachak is a Ph.D. student from Laos who is working in the lab on the systematics and ecology of knobby newts (genus *Tylototriton*) in Laos and Thailand. We hope that knowledge from our laboratory's studies will provide the basic biology information that is needed for conservation of amphibians in Thailand and adjacent countries. For more information of the AREL see: http://pirun.ku.ac.th/~fsciacl/Anchalee_Aowphol/Welcome.html

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Fig. 2: *Chiromantis vittatus*. Photo: Attapol Rujirawan.

Fig. 3: *Tylototriton verrucosus*. Photo: Attapol Rujirawan.

Toxic Effects of Pesticides: Empirical Trials Provide some Indication of the Imminent Threats to Amphibians

By Mayuri R. Wijesinghe

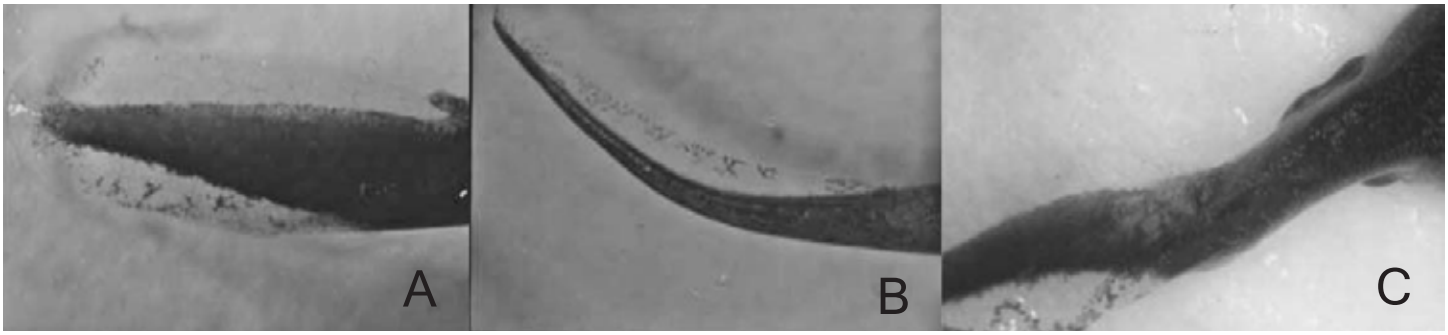

Fig. 1: (A) normal tail in an untreated tadpole and (B) and (C) abnormal curved and bent tails of tadpoles exposed to diazinon. Source: Sumanadasa *et al.,* (*1*).

Pollution of freshwater bodies in Sri Lanka has reached alarming proportions, threatening the well being of many a species of aquatic biota. Toxicity induced by aquatic pollutants on fauna is frequently assessed through empirical trials using a variety of test organisms. Amphibians have been found to be ideal indicators of the levels of pollutants in water bodies because of their highly permeable skin. They are also particularly favored by ecotoxiciologists because they could be raised and handled with ease and because larval growth and development, which occurs within a relatively brief time frame, could be easily observed and monitored. Additionally, they lay a large clutch of eggs that could be observed and collected without much of a problem. In this article I highlight some of the findings of the toxicity tests that were conducted at the Department of Zoology, Faculty of Science, University of Colombo, Sri Lanka, in an attempt to assess the toxicological effects of four selected pesticides on tadpoles. In a series of empirical exposure trials, tadpoles of two species of amphibians were continuously exposed, for two weeks or more, to widely used commercial grade organophosphates, a carbamate and a herbicide. Toxicity was assessed using several end points such as survival, growth, development, activity and histopathological alterations.

Evidence from empirical trials

One of our initial exposure trials involved diazinon and tadpoles of the Asian common toad *Duttaphrynus melanostictus* with findings reported in Sumanadasa *et al.* (*1*). In this study tadpoles of two stages (the gill stage - Gosner stages 21 and 22 and gill-atrophy stage - Gosner stages 24 and 25) were continuously exposed to environmentally relevant levels of diazinon for 30 days. Significant elevations in mortality, growth retardation and reduced activity were noted at concentrations of 10 mgl^{-1}. Tadpoles exposed to 10 mgl^{-1} were actually less than half the size of the untreated larvae. Another noteworthy fact was that behavioral (slanted swimming) and morphological (tail curvature) abnormalities were also detected (Fig. 1). This was followed by another study, working with the Common hour glass frog *Polypedates cruciger*, where we examined the effects of a chronic exposure (52 days) to gramaxone (paraquat) which was intended to simulate long term exposure in a low dilution environment (*2*). It was evident from this trial that gramazone also has the capacity to considerably enhance the levels of mortality in tadpoles of this species. It was demonstrated that long term exposure to gramaxone at low levels of 32 μgl^{-1} induced growth retardation and delayed development in this species. Some malformations such as the lack of a hind limb were observed in the tadpoles and the emerging froglets. We have also reported similar toxicities for tadpoles of *D. melanostictus* with chlorpyrifos (*3*).

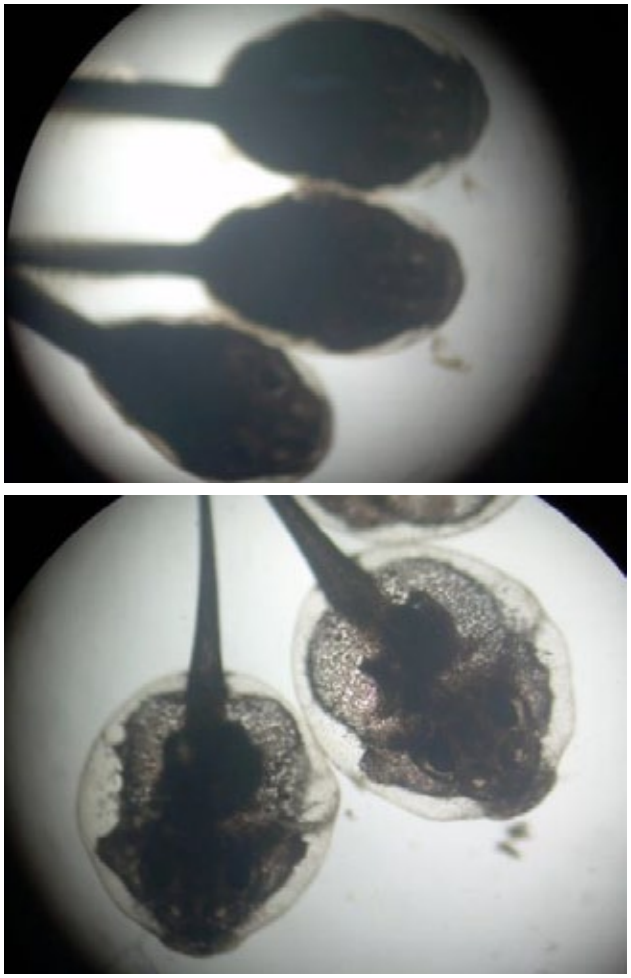

Fig. 2: The normal head and body of tadpoles and the swelled head and body region and the enclosing capsule in *D. melanostictus* tadpoles exposed to of carbofuran. Source: Jayatillake *et al.,* (*4*).

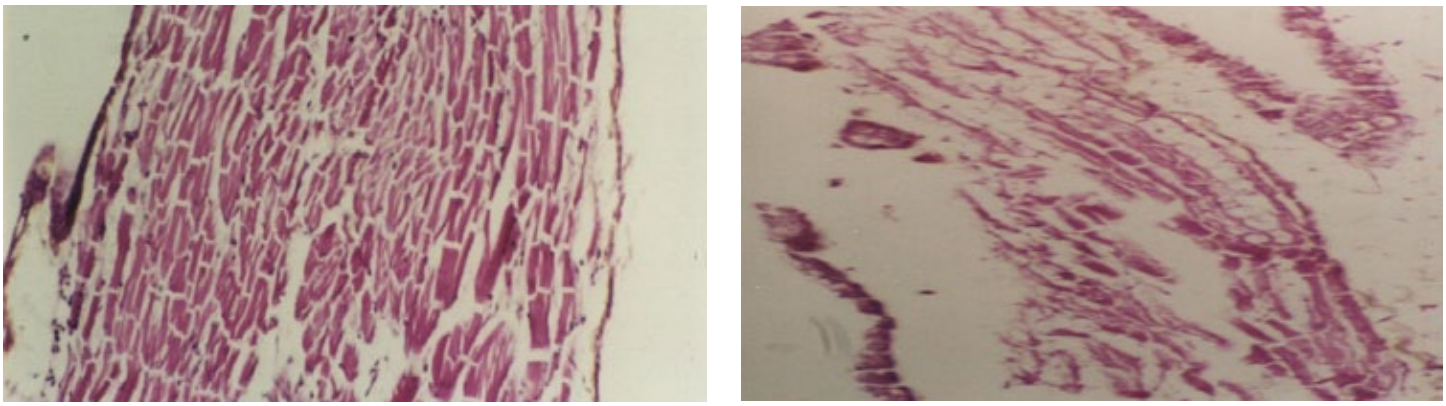

Fig. 3: Normal tail muscles in untreated tadpoles and disintegrated tail muscles in D. melanostictus tadpoles exposed to carbofuran. Source: *Jayatillake et al.,* (4).

Here the tadpoles which were exposed for 14 days to concentrations of 1000 μl^{-1} suffered marked elevations in mortality, while those exposed to 500 $\mu g\ l^{-1}$ showed growth defects and reduced activity. Metamorphosis was also delayed, with only around 10% of the tadpoles completing metamorphosis. Deformities in tails and abnormal swimming behavior were also observed. A fourth study focused on the effects of carbofuran on the larvae of *D. melanostictus* and the results are reported in Jayatilleke *et al.* (*4*). As with the other three pesticides, mortality levels were considerably higher than that of the controls at levels of 50 $\mu g\ l^{-1}$. Surprisingly, in this case, the impact on growth and activity was only transient. Another unusual response was the fact that the adverse effects at mid doses were greater than at the higher doses, a phenomenon known as the hormetic response. Abnormalities such as the swelling of the head and body were also noted (Fig. 2).

It was demonstrated through these trials that pesticides also have the capability of inducing many histolopathological effects in vital organs and tissues of the tadpoles. The potential to induce structural changes in gills such as a considerable loss of primary and secondary gill lamellae, the loss of cellular integrity and nuclear fragmentation in hepatocytes, and the disintegration of the tail muscle tissues (Fig. 3) of the tadpoles were observed with chlorpyrifos (*5*) and carbofuran (*6*).

Consequences of the observed adverse impacts

Increased mortality will directly lead to a decline in populations and probably to range reductions. Indirect undesirable impacts will be brought about by decreased growth and delays in metamorphosis of tadpoles. For instance, tadpoles that are smaller in size will face greater risks of predation or be less competitive than larger ones at obtaining food resources (*7*). Also smaller individuals will produce a lesser number of viable offspring than would larger ones. A number of other factors such as the rate of sexual maturation and mate-selection ability will be negatively affected by a reduction in body size. A factor that was noted was that retarded swimming affected the feeding intensity of the tadpoles. Such adverse impacts, may in the long run, lead to local extinction. As demonstrated in other countries, the disappearance of amphibians will have ramifications on other species as well as through entire ecosystems.

Do results of empirical trials provide evidence for detrimental impacts in the field?

The investigations using controlled exposure trials clearly demonstrate that pesticides have the capacity to harm amphibians. But, to what extent would these findings simulate what actually occurs in the field? A point to note in this regard is that the recommended application levels of the pesticides, at least for rice paddies in Sri Lanka, far exceed the test concentrations used in the empirical trials. Thus the impacts observed in the laboratory could be expected to worsen under natural conditions. Furthermore, due to synergistic effects, when pesticides are applied in conjunction with other herbicides and fertilizers, the manifested impacts are often aggravated (*8*).

A few surveys in Sri Lanka [e.g., (*9*)] have noted morphological abnormalities in frogs occurring in increasing numbers than a decade ago. Nevertheless, there is a severe paucity of systematic field studies that have examined the effects of pollutants on amphibians both in this country and elsewhere. One of the fundamental reasons for this is the difficulty in identifying abnormal conditions and relating them to likely causes. Xenobiotic stressors in aquatic ecosystems may include a mixture of agrochemicals, industrial chemicals and heavy metals. There is also no quantitative data on the levels of pesticides found in the water bodies within the country, which makes it difficult to select realistic levels of exposure for toxicity tests. On the positive side, recovery was also demonstrated in our studies where damage is repaired during the intermittent periods of non-exposure. Additionally, factors such as sunlight and turbidity may also modify the expected trends (*10*), sometimes reducing or increasing the potency of the harmful substances. Nonetheless, under these circumstances, standard exposure trials would, without doubt, provide a strong basis for predicting the toxicity of various contaminants on non-target organisms such as the amphibians.

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A Brief Note on the Extensive Inter-state Trade in the Indian Bullfrog (*Hoplobatrachus tigerinus* formerly *Rana tigrina*) Between the Nagaland and Assam States in North-East India

By Abrar Ahmed

In some cultures—notably Asian, Greek, and Roman—frog meat has been considered a delicacy for centuries. The export of frog legs from India was started in the early sixties and it was evident that this would be harmful to agriculture. In 1987, based on a pioneering study on the export of frog legs from India by the Bombay Natural History Society coupled with a robust campaign by Beauty Without Cruelty, the government of India decided to ban the export of frog legs. As a consequence of unsustainable exploitation, in 1985, the Indian bullfrog (*Hoplobatrachus tigerinus*) was listed in Appendix II of CITES. Consequently fresh water frogs (*Rana* spp.) were listed in Schedule IV of the Wild Life (Protection) Act, 1972. Local illegal collection, trade and utilization takes place unabated in some Indian states such as Assam and Nagaland in North-East India. In many parts of India, frogs, especially the Indian bullfrog, is exploited for vivisections (*1*).

Frogs sold by local vendors at the super market in Dimapur, Nagaland. Photo: Abrar Ahmed / TRAFFIC India.

According to a recent report frogs are collected for subsistence or local consumption in many countries across Asia, Africa and Latin America (*2*). Some of these same countries are engaged in the commercial trade of frogs and frog products—including frogs' legs—supplying markets in the European Union (EU) and the United States of America (USA), where native frog populations have been in serious decline.

Frogs and toads are amphibians. They belong to the order Anura, the largest subdivision with the most diverse set of species in the class amphibia. About 216 species of frog and toads, representing 6 families are presently known in India (*3*).

The Indian bullfrog, *Hoplobatrachus tigerinus*, is undoubtedly the most prominent species among Indian amphibians represented in trade. The species can be identified by their large size and prominent folds of skin on the dorsum and spots on the skin. They also have a broad white-yellow vertebral stripe. The breeding males turn bright lemon yellow (*3*). The Indian bullfrog is found in India, Sri Lanka, Nepal, Bangladesh and Pakistan (*3*). It is found in a wide range of habitats—from sea level to above 2000 m above sea level. It is, however more often found in hills inhabiting rice plantations, irrigation channels, ponds and stream edges.

In some regions of India, frogs are called "jumping chickens," as their taste is similar to chicken. The palatability of frogs for humans is the reason for billions of frogs being consumed annually (2, 4). India was as a major exporter of frog legs until the blanket ban in 1987. Each year three to four thousand tons of frog legs were exported from India (*5*). The Indian bullfrog being the largest frog (in fact largest Indian amphibian), was in the greatest demand for the frog leg trade. For food purposes there is heavy commercial exploitation of this species (*6*). The other frog species in trade were *Holobatrachus crassus* (*5*). Despite of the ban on trade in India, locally the Indian bullfrog continues to be harvested in large numbers for food trade in Assam other N E States of India, especially Nagaland. Local utilization of frogs has been reported from Goa, Kerala, Gujarat, West Bengal, Tamil Nadu and Andhra Pradesh (*5*).

As part of the bird trade survey, I visited various localities where wildlife was sold for food in Nagaland state. The main surveys were undertaken in a New Market and Super Market in Dimapur and vegetable market in Kohima. Two week long visits were made in July 2008 and another visit was made in August 2011. On average about 2,500 to 3,000 frogs were counted on sale per day in the above markets, including other small makeshift markets. On each occasion there were about 15—20 stalls in Dimapur and about six stalls in Kohima vegetable markets selling frogs (*7*). The small-size (up to 50—60 mm) live frogs were sold in packets of 30—40 frogs enclosed in plastic bags or in open tubs priced between INR 100–150 per packet. Large-size (about 150 mm) frogs that were displayed were in bunch of three to six individuals tied by their bellies with jute strings and sold at a price of INR 100 per cluster com-

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prised of three frogs. The preference and value was most for frogs of about 15 cm. Based on interviews with the local vendors it was found that on average about 1,000 full-sized frogs were sold a day. The approximate net sale of large frogs was INR 35,000 and about INR 8,000 to 10,000 for about 2,000 small-sized frogs. Unlike the previous export oriented demand for frogs' legs, in Nagaland the consumption of entire frogs was the prevailing practice.

Kohima vegetable market, Nagaland where large number of frogs are openly displayed for sale. Photo: Abrar Ahmed / TRAFFIC India.

Apart from the practice of restricting live frogs in plastic bags or with their bellies tied, another very cruel practice was noticed during the early morning hours. The bones of the hind legs were broken at two joints each so that the frog, even when kept in open dishes, could not jump away. The practice of cutting the frogs' legs was not recorded here but live frogs were restrained by breaking their hind legs.

I was told categorically by several people dealing in frogs that the animals were caught and transported from the neighboring state of Assam. Certain trappers from Cachar and Garo districts catch and bring frogs by passenger trains or night buses to Dimapur, where they are further sent to Kohima and other small markets. Most of the retail trade is handled by women whereas most of the catching is done by men. Up to 10% mortality was noticed in all survey days. Hence, the practice of selling dried frogs preserved with oil was also common.

The buyers of frogs range from all strata and religions. In Nagaland, the frog's meat is not only considered a delicacy, but frog meat is attributed to have medicinal properties that heal body ache, joint pain and is a body revitalizer. The frogs are cooked by making a small cut in the belly and removing some internal body organs.

The collection of frogs from Assam and the organized interstate trade between Nagaland needs to be investigated in detail in order to document the impact on their population *in situ*. On two occasions during my visit, I recorded people of Assam bringing sacks full of frogs to Nagaland.

Some recent seizures point to the collections of frogs in Assam where speculation was made that the catch was meant for foreign markets, but it seems after TRAFFIC conducted recent surveys that it was meant to be sold in Nagaland. For instance, in September 2007, 3,000 Indian bullfrogs were seized in 14 jute bags on a highway near the Kaziranga National Park. Earlier that year, 85 Indian bullfrogs concealed in a container were seized (*8*). In April 2007, 71 frogs were seized in Guwahati Railway station (*9*). Apart from Assam, there has been a recent seizure of 40 Indian bullfrogs in Goa (*10*).

Frogs play an important role in the ecosystem as predators and prey. Therefore, they play a key role in trophic interactions in aquatic ecosystems. As prey, frogs contribute to the diet of many species. An absence of frogs in an ecosystem may boost the presence of agricultural pests and mosquitoes (*5*) given their important role as predators.

The trends and volume of trade in frogs needs further study to determine the impact of trade in Nagaland from Assam. The open trade in frogs and other wildlife need strict control measures with awareness about the illegality of the whole business. The cruelty involved in breaking of bone joints in live frogs until they are sold and killed is very gruesome and there seems to be little awareness about utilization of wildlife in this barbaric manner.

Acknowledgements

This article is based on field data collected during the bird trade survey funded by TRAFFIC India / WWF-India. I am extremely grateful to Mr. Ravi Singh, Secretary General & CEO WWF-India and Mr. Samir Sinha, ex-Head TRAFFIC India for allowing me to undertake the surveys. I am thankful to Dr. Asad R. Rahmani, Director, BNHS and Dr. Karthikeyan Vasudevan, Scientist, Wildlife Institute of India for their technical inputs. I would also like to acknowledge my TRAFFIC colleagues especially Ms. Dilpreet Chhabra, M.K.S. Pasha and Mr. Shubhobroto Ghosh for all their support and help on this article.

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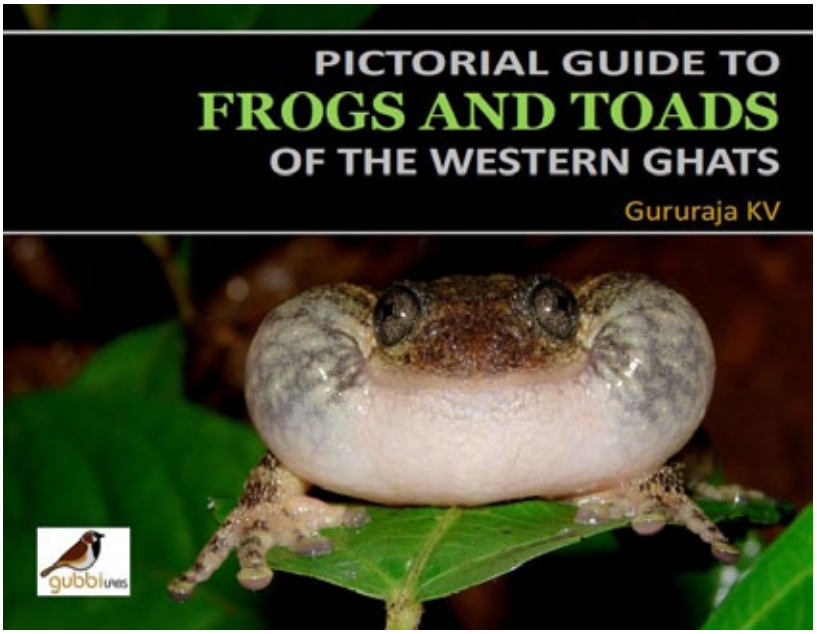
Pictorial Guide to Frogs and Toads of the Western Ghats



The amphibian fauna of India is represented by all three living orders (Salamander, caecilians, frogs and toads). So far about 280 species have been described and many new species are yet to be published. Hence, in view of recent developments in the form of new discoveries, taxonomic revisions and studies related to ecology and natural history in the last fifteen years, Indian herpetology is metamorphosing very fast. If we think of the post independence era, Indian herpetology was overlooked except for a few studies by numerous researchers and scientists across the country. Most of the historical information on Indian herpetofauna was in the form of scientific publications or reports—which were beyond the reach of many stakeholders including new researchers, Forest Department officials, amateurs, serious naturalists and nature photographers. During 2002, Mr. J. C. Daniel of the Bombay Natural History Society published the revised edition of his book *"The Book of Indian Amphibians and Reptiles"* and this publication was a pioneering effort to bridge this gap. The amphibian section of this book was mainly based the series of four papers published by him in the *Journal of the Bombay Natural History Society* from 1963 to 1989. In the book he covered some common and endemic species of Indian amphibians and provided basic (but good) information about their identification, distribution and natural history to some extent along with photographs of live individuals of respective species. Later Dr. R. J. R. Daniels published a book, *Amphibians of Peninsular India* in 2005, which was also considerably noteworthy. *Amphibians of Peninsular India* was a step forward however it was a large format textbook style publication more text, fewer images and utilized old scientific names. In subsequent years there were many new publications pertaining to new species descriptions and taxonomic revisions. For effective conservation measures scientific information like this should be accessible to the masses and to overcome this hurdle there was a great need of good field guides to the amphibians of India.

India harbors a rich diversity of amphibians, which are more concentrated in the Western Ghats and North-east India, many of them are endemic and facing dire consequences. In recent years in India there has been a large influx of amphibian enthusiasts and researchers, amateur, serious naturalists and nature photographers who visit various places to document the wide variety of herpetological fauna. Often amphibian species they encounter and photograph in the field are unidentified or misidentified. Further, the amphibians are not considered under various management and conservation programs formulated by the Forest Departments of Government of India. Therefore, such documentation will create amphibian awareness among people and assist in the conservation of these fascinating animals.

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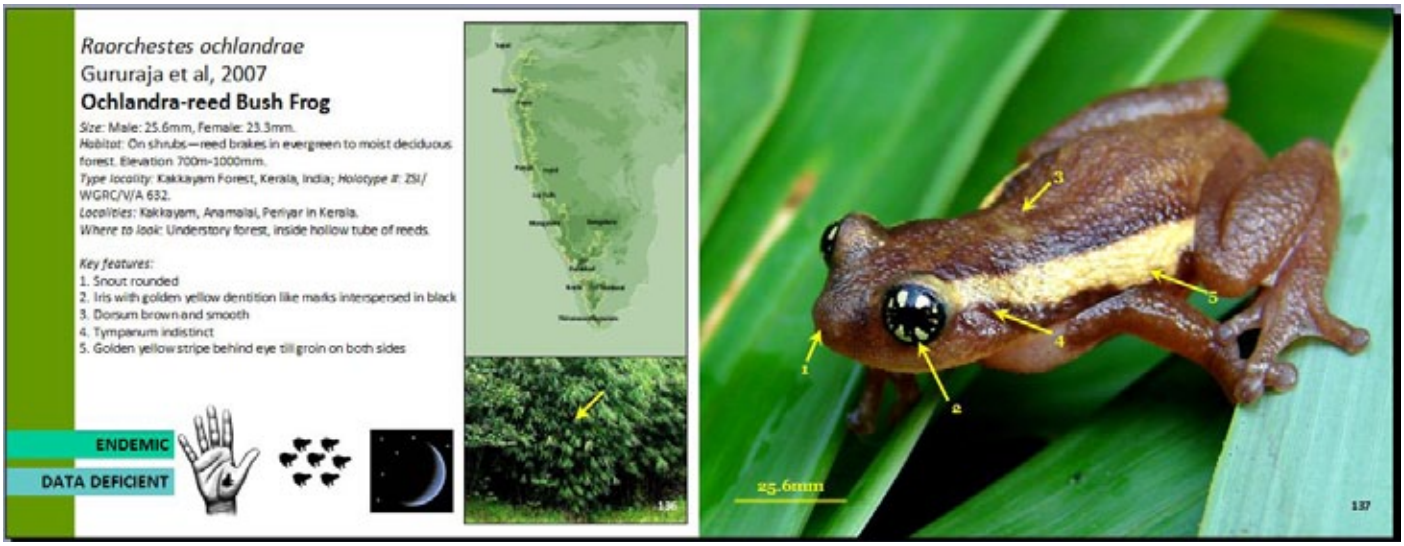

The recent book, *Pictorial Guide to the Frogs and Toads of the Western Ghats* is a much needed relief. The compact size, content, layout and price of this book are appreciable and affordable. This pocket book can be easily carried to the field as it will fit in any field bag or a big waist pouch. In this field guide the author has attempted to provide most of the general information about frogs and toads, such as, how to differentiate and identify them, why we need them, what problems they face and why we need to conserve them. The author has given a photographic representation of general morphological features (skin texture, eye and vocal sac). The content provided along with each species is concise, clear and precise, which is a result of the author's long term association with amphibians of the Western Ghats in the field and the lab. The information about type locality, location of types, habitat and microhabitat, their overall distribution, five prominent key features, IUCN conservation status, endemic or non-endemic status, size, group size, diurnal or nocturnal habit and distribution map is of great importance to everyone. There may be some "arguments" regarding this content, especially distribution and key features, but the information provided here is for a general understanding targeting layman and for further details, one can refer to respective scientific publications.

Isn't my balloon interesting?" Calling male individual of Yellow bush frog (*Raorchestes luteolus*). Photo: Gururaja KV.

The layout of this book is very professionally done and deserves appreciation. In this book one can easily browse amphibians of the Western Ghats based on their habitats mainly divided into four groups, Terrestrial/Burrowing, Semi-aquatic/Terrestrial, Aquatic and Arboreal, which are color coded for easy access. Layout for each species is in a double spread of which one page has an image/s and the other with content for that respective species. The images are sharp, representing most of the key characters, with proper colors and taken in their respective habitat. It is noteworthy that the author has made an attempt to collect these images from researchers and naturalists with some basic understanding of frog identification. The scale provided at the left corner of every image gives a general idea about the size of the species. The five key features mentioned in the content are numbered and they are respectively represented by arrows on the images, which provide a lay user with an understanding about morphological characters. Finally, the cost of this field guide is quite reasonable for the amount of effort and quality of the information provided. I hope in future, someone will publish a book on field guide to all the amphibians of Western Ghats of India. However, presently this tiny pictorial pocket book should be considered as the best to know about frogs of the Western Ghats of India.

Pictorial Guide to Frogs and Toads of the Western Ghats. K. V. Gururaja (Author), Publisher: Gubbi Labs LLP, #2-182, II Cross Extension, Gubbi-572216, Karnataka, India. http://www.gubbilabs.in; 153pp. Price: Rs. 300/-; US$ 20.

Kotambylu Vasudeva Gururaja (b.1977) holds Ph.D. from Kuvempu University on Amphibian Ecology. He did his Postdoc at Centre for Ecological Sciences, Indian Institute of Science, Bangalore. He is credited with describing two new species of anurans from the Western Ghats and a novel reproductive mode in frogs from the region. At present he is with CiSTUP, IISc, Bangalore.

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Busy Year for the Korean Amphibian Specialist Group

By Daesik Park, Robert H. Kaplan and Bruce Waldman

IUCN World Conservation Congress on Jeju Island in September

As its names suggests, the IUCN is a *union* of diverse organizations, of which the ASG, one of more than 120 specialist groups that comprise the Species Survival Commission, is only a small part. Every four years, the IUCN holds a World Conservation Congress in which leaders from government, the public sector, non-governmental organizations, business, UN agencies and social organizations meet to discuss, debate and deliberate solutions to the world's most pressing environmental and developmental issues. Conservationists cannot achieve their goals without engaging these other sectors, which gives rise to the IUCN's challenging mission.

This year the Congress was held in Jeju, Korea, in September, with approximately 10,000 people attending. To ensure that the problems facing amphibians were considered by the Congress, members of the Korean Amphibian Specialist Group and the Korean Research Society of Herpetologists joined with the Amphibian Survival Alliance to organize a workshop "Addressing the Global Amphibian Crisis by Integrating Policy, Planning, and Research." The workshop had dual goals of highlighting problems faced by amphibians in a global context and focusing attention on protecting amphibians in Asia, a continent that faces unprecedented demands on its environment, yet is exceptionally rich in biodiversity, much of which still remains to be discovered and described.

Welcoming the audience, Bruce Waldman (Seoul National University) introduced problems that have given rise to the amphibian crisis, and highlighted the need for different groups to work together, consistent with the objectives of the IUCN One Program Charter. To illustrate, he cited specific examples of successful and unsuccessful collaborations among scientists, government, industry and NGOs. Next, Sathyabhama Das Biju (University of Delhi) outlined anthropogenic threats to amphibians, and spoke of his efforts to raise public and political awareness to document and protect amphibian species diversity in India. David Bickford (National University of Singapore) discussed how amphibians were adapting in unexpected ways to cope with climate change, with the likely outcome that frogs will mature at smaller sizes as the planet warms. Rafe Brown (University of Kansas) stressed the importance of protecting species diversity in biological hotspots and described how molecular, morphological, ecological and behavioral data can be used to assess biodiversity. Next, from the perspective of the private sector, Mathieu Tolian (Veolia Water) discussed how a sustainable business model needs to incorporate ecosystem services and surveys of biodiversity.

Focusing on Korea, Jae-Hwa Suh reviewed governmental environmental policy, noting that the main threats to amphibians have been the strong political focus on industrialization and economic development, together with a lack of understanding of the importance of biological resources. Yet, Korean wildlife is protected by robust legislation, and the political mood is improving as the

Daesik Park (Co-Chair KASG), Division of Science Education, Kangwon National University, E-mail: parkda@kangwon.ac.kr Robert H. Kaplan (Co-Chair KASG), Dept. Biology, Reed College, Portland, OR 97239, E-mail: Robert.Kaplan@reed.edu Bruce Waldman, School of Biological Sciences, Seoul National University, Seoul 151-747, South Korea, E-mail: waldman@snu.ac.kr (For past news see last year's issue of FrogLog Sept. 2011 Vol. 98; www.amphibians.org/wp-content/uploads/2011/09/Froglog98.pdf)

Addressing the Global Amphibian Crisis by Integrating Policy, Planning, and Research

Tuesday, 11 Sep 2012; 14:30 - 16:30; Room: Halla A

INTRODUCTORY TALKS

1. **Welcome and introductory remarks.** Bruce Waldman (Seoul National University; Korean IUCN SSC Amphibian Specialist Group)
2. **Halting human induced amphibian extinction.** Sathyabhama Das Biju (University of Delhi)
3. **Impacts of climate change on Asian amphibians.** David Bickford (National University of Singapore)
4. **Assessing biodiversity hotspots.** Rafe Brown (University of Kansas)
5. **Addressing the global amphibian crisis by integrating policy, planning, and research: a business perspective from a water service provider.** Mathieu Tolian (Veolia Water)
6. **Environmental policy for conservation of Korean amphibians.** Jaehwa Suh (Nature Conservation Research Division, National Institute of Environmental Research Korea)
7. **The Amphibian Conservation Action Plan (ACAP) and the role of the Amphibian Survival Alliance.** Jaime Garcia Moreno (Amphibian Survival Alliance)

BRAINSTORMING AND DELIBERATIONS

1. **Climate change/Habitat management/Urbanization.** Led by: David Bickford (National University of Singapore), Emily Fountain (Lincoln University)
2. **Wildlife trade/ Disease ecology.** Led by: Jonathan Fong (Seoul National University), Arnaud Bataille (Seoul National University), KS Cheung (Agriculture, Fisheries, Conservation Department, Hong Kong)
3. **Policy/Communication among groups.** Led by: Jaime Garcia-Moreno (Amphibian Survival Alliance), Bruce Waldman (Seoul National University), Mathieu Tolian (Veolia Water)
4. **Population monitoring/Long-term management.** Led by: Jaehwa Suh (National Institute of Environmental Research Korea), Tatjana Dujsebayeva (Ministry of Education and Sciences, Kazakhstan)
5. **Preserving biodiversity.** Led by: Rafe Brown (University of Kansas), Sathyabhama Das Biju (University of Delhi), Mi-Sook Min (Seoul National University)

Korean organizers and invited participants in the WCC workshop (from left to right): Jonathan Fong (Seoul National University), Jae-Young Song (National Park Service, Korea), Hoan-Jin Jang (National Institute of Environmental Research, Korea), Mi-Sook Min (Seoul National University), Sathyabhama Das Biju (University of Delhi), Bruce Waldman (Seoul National University), Rafe Brown (University of Kansas), David Bickford (National University of Singapore) and Jae-Hwa Suh (National Institute of Environmental Research, Korea).

conservation budget has increased from 50 million dollars ten years ago to 340 million dollars today. To conclude, Jaime Garcia Moreno, executive director of the Amphibian Survival Alliance group (ASA), suggested that the ASA intends to promote, coordinate, and magnify implementation of the Amphibian Conservation Action Plan (ACAP) by working closely with other organizations and institutions. The initial goals of the ASA are to prioritize plans for habitat conservation, *ex situ* management and mitigation of the threat posed by amphibian chytrid fungus.

Following the talks, audience members discussed ideas and concerns with the panel of speakers. We concluded that successful implementation of the ACAP in Asia requires effective networking among all stakeholders. We need to actively work to support training programs that will establish expertise within each country. We should interact with and encourage citizen involvement at every level. We can encourage local people to participate in amphibian conservation programs by working together with grassroots organizations. This, in turn, will enhance educational programs and serve as the seed for further political action to drive needed policy changes.

We thank the Korean IUCN Organizing Committee, the Brain Korea 21 program, and Seoul National University for generously funding the workshop.

The workshop was covered by the international news media, including the Guardian (http://gu.com/p/3acgx/em).

7th World Congress of Herpetology in Vancouver

Korean researchers presented three studies at the 7th World Congress of Herpetology in Vancouver:

a) Bruce Waldman, Moonsuk Cha, Arnaud Bataille, Jonathan Fong, Hae Jun Baek, Hang Lee, and Mi-Sook Min. Haplotype diversity and distribution of *Batrachochytrium dendrobatidis* in South Korea.

b) Daesik Park and Ja-Kyung Kim. Arginine vasotocin (AVT) induces the courtship behavior of male *Hynobius leechii* (Urodela, Amphibia) without external stimuli.

c) Jaehyub Shin. Effects of amphibian chytrid fungus (*Batrachochytrium dendrobatidis*) on reproduction of the Oriental fire-bellied toad (*Bombina orientalis*).

Herpetological society

We held our 5th annual conference of the Korean Research Society of Herpetologists (http://www.krsh.co.kr/rb/) between July 7—9 at Jangsoo-Gun and published the third issue of Korean Journal of Herpetology.

Web site development

We are updating our all Korean Language website at:
http://academic.reed.edu/biology/korea_asg/

Conservation of Amphibians in Korea

A chapter is soon to be published entitled Conservation of Amphibians in Korea by Daesik Park, Mi-Sook Min, Kelly C. Lasater, Jae-Young Song, Jae-Hwa Suh, Sang-Ho Son and Robert H. Kaplan in "Status of Amphibian Decline and Conservation," Volume 11 in "Amphibian Biology," edited by Harold Heatwole and Indraneil Das." (Contact Bob Kaplan for more information).

Attendees of the 5th annual conference of the Korean Research Society of Herpetologists.

Climate Change Research in the Philippine Biodiversity Hotspot

By Brett R. Scheffers

The Philippine Archipelago and Pillars of Climate Change Research

The Philippine biodiversity hotspot has an exceptionally rich endemic fauna (*1*). Almost 84% of its amphibians are found nowhere else. However, because the majority of these species are forest-dependent, they are highly threatened by habitat loss—primary forest cover, particularly in the lowlands, has been reduced by almost two-thirds during the 20th century (*2*). The little high-quality forested habitat that remains is confined to mountains and even these habitats are now being removed (*3*).

But what threats may exist in the remaining areas of high quality rainforests? According to emissions scenarios, the Philippine archipelago may warm by 2.9 ˚C (low emissions scenario) to 6.2 ˚C (high emissions scenario) over the next century (*4*). This average warming may be confounded by extreme, above-average temperatures that are capable of causing rapid population declines (*5*). Many species will be affected from this warming, especially ectothermic amphibians whose physiology and health are governed by climate. Climate warming may dramatically impact Southeast Asian amphibians within the next 50 years because adaptation to heat will likely occur at a slower rate than current warming trends (*6*). Here I reintroduce thermal *sensitivity*, and current and predicted *exposure* to heat (*7*) as important pillars to conservation in a warming world—these two important considerations in identifying climate vulnerability are all but absent from the herpetological literature in Southeast Asia, especially the Philippines.

Thermal sensitivites are defined as the minimum and maximum temperature that an animal can tolerate. These sensitivites are therefore criticial to understand before speculating on how a species may respond to increasing temperature through climate change. Globally, the thermal minima for frogs range between -4 ˚C to 11 ˚C and maxima range between 29 ˚C to 43 ˚C (*8*). Sunday et al.'s study (*8*) is based on 30 frog species which is not a comprehensive sample. I suspect however that 43 ˚C is close to the thermal ceiling in Southeast Asian amphibians—it may be closer to 46 ˚C. The temperature that animals will experience (i.e., exposure) while fulfilling their life cycle must remain above the temperature minimums and fall below the temperature maximums in order for a species to remain physiologically functional. At first glance, maximum sensitivies of 40 plus degrees celcius is far higher than most maximum temperatures in the tropics, suggesting that many species will be safe from climate warming. Amphibians however typically have optimum temperatures far below thermal maximas and therefore will alter their behavior to reduce exposure far before maximum temperature is reached. This trade-off between reducing foraging time and altering behavior to remain at optimum temperatures has already been shown to have devastating impacts on tropical ecototherms (*9*, *10*).

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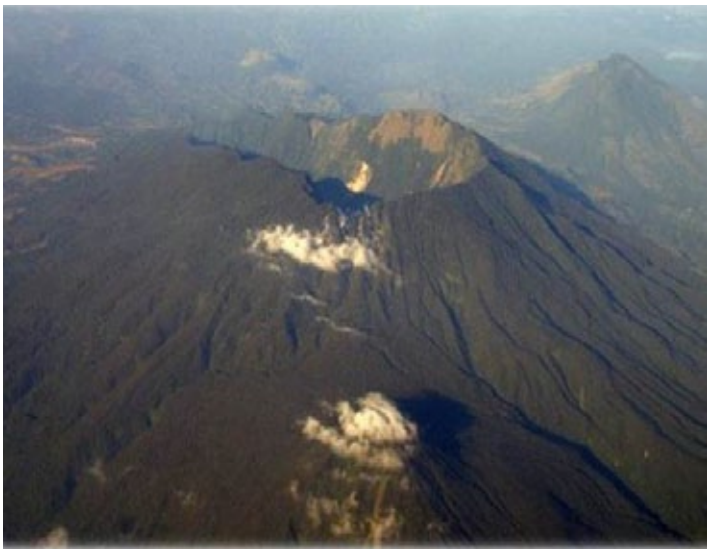

Fig. 1. Mt. Banahaw is an extinct cone volcano. As it is completely isolated from other mountain ranges, more than five species (possibly several more pending genetic analyses) are local endemics to the mountain. Extensive habitat loss in the surrounding lowlands limits forest-dwelling amphibian's ability to evade climate warming through dispersal. Therefore, protecting the rainforest within this forest preserve is essential for future climate mitigation. Photo: pinoymountaineer.com

In 2011, colleagues from the National Museum of the Philippines and I began examining the thermal sensitivity and exposure of amphibians on a montane rainforest preserve, Mt. Banahaw, in southern Luzon (Fig. 1). Forest clearing on Mt. Banahaw is limited so the main threats that face the fauna of Mt. Banahaw are overexploitation (*11*) and climate change (*6*).

Research on Climate Refuges

Mt. Banahaw is an extinct volcanic cone, of limited area (approximately 10,000 ha), that is isolated from other mountain ranges found in the Philippines (e.g., Sierra Madres in northern Philippines). Because of this isolation, a unique endemic fauna, most of which are montane species, evolved. Drastic increases in temperature or severe drought could threaten more than five endemic frog species in this single locality.

Our research is focused on identifying the sensitivity and exposure of the frog communities on Mt. Banahaw (Fig. 2). We conducted numerous experiments to identify thermal sensitivites of frogs and closely montiored temperature of various habitats across the mountain gradient. As amphibians have complex life-cycles that include multiple life-history stages, we explored the capacity of breeding habitats to buffer temperature. The two primary breeding strategies of amphibians are aquatic free swimming tadpoles and direct-developing eggs (i.e., larvae that develop within a terrestrial egg). Species in the genus *Platymantis* are the primary direct-developers on Mt. Banahaw. Commonly used breeding habitats are epiphytes and arboreal habitats by *P. luzonensis* and *P. banahao*, leaf habitats used by *P. montanus* (eggs laid directly on top of leaf), and terrestrial ground habitats used by *P. dorsalis* and *P. naomi* (Fig. 2). Species that lay aquatic eggs that develop into free swim-

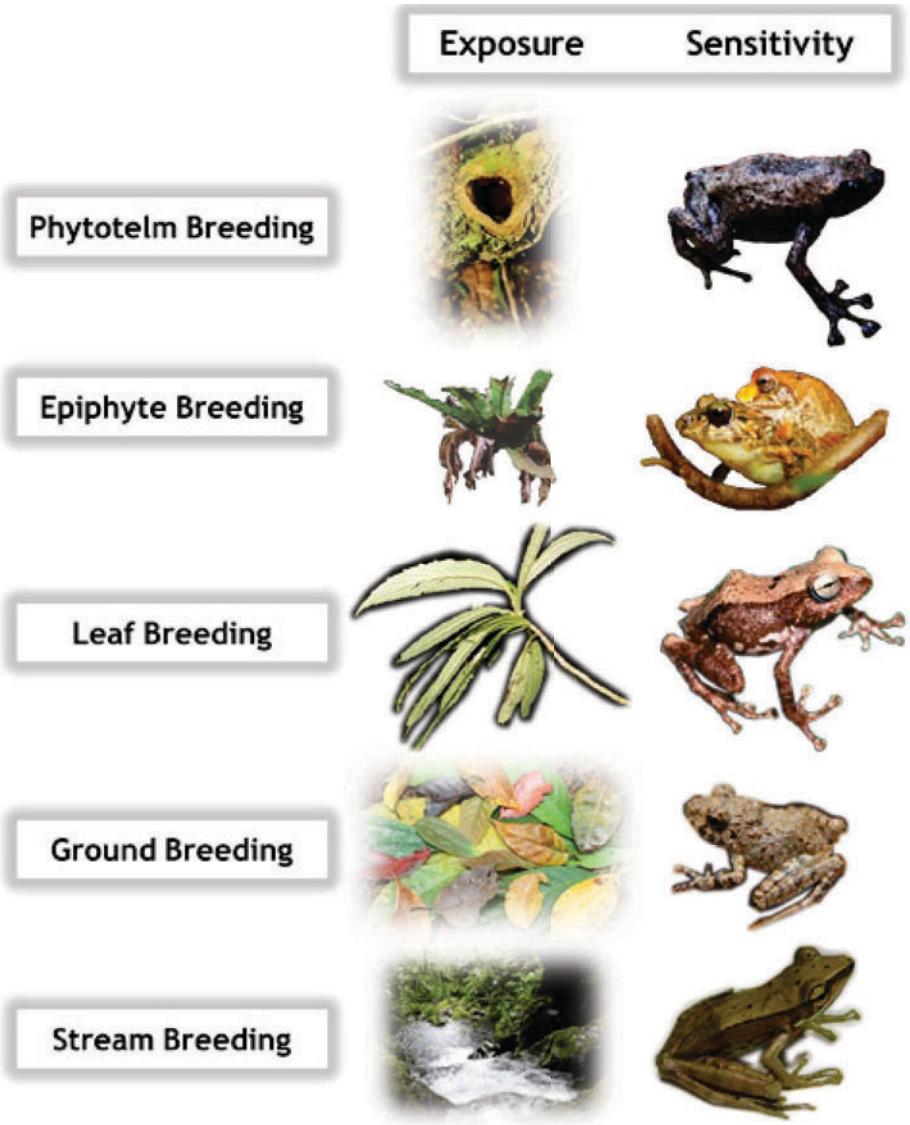

Fig. 2. Climate vulnerability of frogs on Mt. Banahaw will depend on how well breeding habitats buffer hostile temperatures (i.e., exposure) in a warmer and sporadically drier climate as well as species sensitivity to hot temperatures. Species (top to bottom): *Kaloula kalingensis, Platymantis luzonensis, P. montanus, P. dorsalis*, and *Rana erythraea*. Photo: Brett Scheffers, Rebecca Brunner, and Rafe Brown.

ming tadpoles are those such as *Rana luzonensis* and *R. erythraea* and phytotelm breeders such as *Kaloula kalingensis* who rear tadpoles in tree-hole phytotelmata (Fig. 2). All species in our system are strictly dependent on these habitats with few alternatives.

Exposure is directly tied to habitat (*12*). Primary rainforests are structurally complex with numerous microhabitats (e.g., epiphytes) that are capable of buffering temperature by reducing maximums, increasing minimums and eliminating variation (*13*). The problem is that the structure itself is under threat. Rampant illegal logging in protected areas throughout the Philippines threatens the structural integrity of remaining rainforest environments. Disturbances and tree removal could increase understory light levels, reduce organic loads that cover the ground and eliminate phytotelmata and epiphyte habitats—weakening their utility as climate refuges. Lastly, even if habitats remain undisturbed, many breeding habitats such as trees, broad-leaf plants and epiphytes have their own set of moisture and temperature requirements. The distribution of these habitats will certainly shift with climate change. The fate of Filipino frogs will likely depend on their ability to withstand direct warming and whether they are capable of following distributional shifts in their habitats.

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Amphibian Conservation in the Philippines

Fig. 1: A substantial portion (~30-40%) of the total amphibian diversity of the Philippines may still be undescribed. Spectacular discoveries like this stream frog (*Sanguirana aurantipunctata*) are regular occurrences in recent years (*16*). Photo: Rafe M. Brown.

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The relatively small island archipelago of the Philippines shares only with Madagascar the distinction of being both a megadiverse nation and also a global conservation hotspot. This combination of high concentrations of biodiversity, coupled with exceptionally high rates of forest loss and soaring human population, places the country at the top of regional and global lists for conservation urgency and action. Among the top priorities for land vertebrate conservation in the Philippines are the country's strikingly diverse and highly endemic radiations of amphibians (*1–4*).

Philippine amphibians

The vast majority of Philippine amphibians occur nowhere else in the world. Because they are found in an archipelago of more than 7,100 small islands, many Philippine amphibians have naturally restricted geographic ranges. This becomes a particular challenge when assessing both amphibian species diversity and conservation status. With very small natural ranges (many endemic species occur on small islands, single mountain peaks, isolated limestone outcrops, etc.), Philippine species can be difficult to detect unless researchers visit the right place, at exactly the right time of year, when atmospheric conditions are perfect. Because so many species have restricted ranges and reproductive patterns that are tightly coupled to local microclimates, many secretive species are poorly known—even to the most determined of field biologists.

Linnaean and Wallacean shortfalls

The challenge of unknown Philippine amphibians is exemplified by terminology developed to describe our lack of understanding of biodiversity at a global level (*5*). The Linnaean shortfall (referring to our lack of knowledge of the existence of some species) in the Philippine amphibians is represented in our sense that the country's amphibian fauna may be underestimated by as much as a third of the total species diversity. The Wallacean shortfall (our lack of knowledge of species distributions) is evident in our woefully incomplete understanding of distributions of Philippine frogs, toads, and caecilians. Both deficiencies represent major stumbling blocks for effective conservation.

A Philippine amphibian systematic and biogeographic agenda

The amphibian fauna is composed of caecilians (three species in two genera and one family) and anurans (with approximately 110 species in 23 native genera in eight families). We now recognize a total of 110 native taxa, with exceptionally high endemism (85% of the native fauna)— the highest of endemism estimates of the Indo-

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Fig. 2: Chytrid studies in the lab and field: (left) student participants at a recent WCSP chytridiomycosis workshop learn proper swabbing technique with preserved museum specimens. (right) Vance Vredenburg, Viscente Yngente, and Jason Fernandez screen Laguna Province species (*Rhacophorus pardalis, R. appendiculatus, Limnonectes woodworthi, L. macrocephalus,* and *Occidozyga laevis*) for chytrid fungus in 2012. Photos: Rafe M. Brown.

malayan realm (*2*). Efforts to arrive at a total, comprehensive estimate of Philippine amphibian diversity have gone through several discrete historical stages of species accumulation in the archipelago (*4, 6, 7*), corresponding to the European age of Discovery (1800s), the works of E. H. Taylor (early 1900s), R. F. Inger (1950s), W. C. Brown and A. C. Alcala (1960s–1990s) and our current effort (*3, 8– 10*). Species accumulation curves (plots of species discovery against the year of publication; *3, 10, unpublished data*) now indicate that the current rate of species discovery is higher than at any earlier period (Fig. 1). Still, with so few workers describing Philippine species, and the threat of wide scale chytridiomycosis outbreaks, climate change and habitat destruction-induced extinctions looming, we are collectively experiencing a growing sense of urgency to document species diversity and distributions before they are lost and degraded beyond recognition. Aside from the continuing need for field surveys and systematic studies, a number of targeted, threat-specific, taxon-specific and site-specific conservation efforts are now underway. We summarize some of these, below.

Philippine chytrid fungus research

Over the past five years, together with colleagues Vance Vredenburg and Andrea Swei (San Francisco State University) we have screened Philippine amphibians for the infections of *Batrachochytrium dendrobatidis* throughout the archipelago. With the first published announcement of widespread occurrence of chytrid fungus in the country (*11, 12*), the myriad of new questions and concerns raised public concern among the country's growing environmentally aware population. This concern resulted in this year's well attended training workshop, held in conjunction with the annual Wildlife Conservation Society of the Philippines (WCSP) meetings (April 2012), where we developed the first outline of a national strategy for documenting, studying, and hopefully mitigating the effects of the emerging infectious disease (Fig. 2). Topics now (or soon to be) under study include the dynamics of infection (Fig. 3), Philippine chytrid strain genetic diversity, the possible natural resistance in some Philippine species, as well as the possibility of older, initial, infections that may have entered the archipelago years or decades ago. This last topic underscores the value of historical amphibian legacy collections (which can now be screened for chytrid fungus) at several museums around the world. Despite this progress, we are left with the burning and, as of yet, unanswered question: are any Philippine frog populations in decline?

Fig. 3: Understanding the dynamics of chytridiomycosis necessitates an intimate knowledge of the natural history of each species. These Philippine *Rhacophorus pardalis* spend much of the year in trees where they may not come in contact with other species or environmental vectors for the spread of chytrid fungus. These individuals may have already been infected by chytrid fungus after they descended from the forest canopy to breed in ephemeral forest pools. Photo: Rafe M. Brown.

Species of particular concern

Several Philippine species represent particular conservation challenges. First, a persistent portion (~15%) of the country's species remains Data Deficient (*13*), largely because the species have not been studied since the original date of collection (*9*), are known from inaccessible portions of the archipelago, or are so secretive that they cannot be studied (*6*). The

Fig. 4: (Top row) “Critically Endangered” Philippine taxa, recently back from the apparent brink as a result of extensive field surveys that demonstrate they are reasonably common, abundant and widespread (left: *Platymantis speleaus*; right: *P. polillensis*). (Lower left) Given declines in the New World, cool, high elevation anuran communities are of particular concern. This flooded forest (1800 m, Mt. Palali, Nueva Vizcaya Province, Luzon Island) is typical habitat for six species of tree frogs and four stream frogs, including the newly discovered *Sanguirana aurantipunctata* (*16*). (Right) Follow-up surveys at Pasonanca Natural Park in the southwestern Philippines resulted in rediscoveries and important new natural history information critical for conservation of Leyte swamp frogs (*Limnonectes leytensis*, middle right) and McGregori’s river toads (*Ansonia mcgregori*, lower right); this site was first surveyed by E. H. Taylor nearly 100 years ago and had not been revisited by biologists until being resurveyed by the authors in 2009. Photos: Rafe M. Brown.

numbers of species classified at some elevated level of conservation threat (~45%)(*13*) is a cause for concern in each case, although our sense is that many species' conservation statuses are in dire need of revision and, in some instances, downgrading given newly available information on their distributions and habitat requirements (*14*). Recent field studies of taxa of particular concern have returned the reassuring news that several previously considered Critically Endangered species (the Negros cave frog *Platymantis speleaus* and the Polillo forest frog, *P. polillensis*) are actually much more common, abundant and widely distributed than previously appreciated (Fig. 4). The "severely fragmented" (*13*) nature of many species' distributions (which, in hindsight, is the norm for natural occurrence in an island archipelago) is no longer considered as dire as it once was. These developments, in our opinion, should be considered good news for long-term Philippine conservation efforts. Still, with several key species limited to tiny island (*15*) or mountain top (*16*) habitats, the prospects for long-term survival are tenuous given recent land-use changes and scenarios of climate change (*17*).

Resurveys of megadiverse amphibian areas

One final focus of research and conservation efforts has involved a recent, multi-institution effort of partnership to resurvey regions of the archipelago long recognized as megadiverse amphibian areas (Fig. 4). Several islands or mountain ranges that were the subjects of early survey efforts by E. H. Taylor (central and western Mindanao), W. C. Brown and A. C. Alcala (Negros Island, eastern Mindanao, central Palawan) are now recognized as having supported the most diverse amphibian communities in the country—and yet many have not been revisited in the intervening years since the initial survey. Now, 30, 40 or 100 years later, the largest lowland forests have been removed and the onset of climate change may have begun. These areas are ripe for "before-and-after" surveys (Fig. 4) aimed at determining what effects human land use and climate change may have on long-term survival of viable amphibian populations (*14*).

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Decreasing Population Size of the Philippine Limestone Frog, *Platymantis insulatus*

By [1]A. C. Alcala, [1]A. A. Bucol, [1]E. L. Alcala and [2]R. M. Brown

The endemic Philippine limestone frog, *Platymantis insulatus* (Brown and Alcala 1970), is considered Critically Endangered (*1*) and is known to be restricted to the Gigantes group of Islands, off northeast Panay Island, Province of Iloilo, the Philippines (*2, 3*). Its microhabitats are limestone caves, rock crevices and rock fissures. In the present paper, we report our observations on the population density of this frog prior to and during the course of the El Niño Southern Oscillation (ENSO) Event in 2009-2010.

Philippine limestone frog *Platymantis insulatus* in life. Photo: Abner Bucol.

The two main islands of the Gigantes and the small associated islets were explored for amphibians, reptiles, birds and mammals by the authors in 2004, 2005, 2009 and 2010 (30 April, 1 May, 6-8 September 2004; 3, 4, 5 March 2005; 13-19 December 2009; and 13-20 January, 21-28 February, 14 April, 15 May 2010). A total of 17 small caves (ca. 1.0 m-6.5 m wide and 2.0 m-35.0 m long) on the two larger islands were visited. These caves have been mined for their guano deposits and the forest cover has been reduced by the expanding human population, altering the microhabitats of the frog.

The years 2009 and 2010 were El Niño Southern Oscillation (ENSO) Events (*4*), characterized by reduced precipitation (5.2-33 mm) in the entire Western Visayas Region from December 2009 to March 2010.

One data set gathered by us was population density of the Limestone frog. Visual counts were made in 100 m^2 quadrats during daytime. The counts made at night included the number of calling males multiplied by two as part of the estimate of the number of individuals in a quadrat. A total of 42 quadrats were established during the entire survey duration in both islands in 2009-2010. The team also collected data on ambient air temperatures and relative humidity in the microhabitats of the frog on 13, 14, 15, 18 and 19 December 2009 and on 13 January 2010. Air temperature readings in cave entrances using a mercury thermometer ranged from 26-28 °C (27.44±0.20 S.E.), while relative humidity as measured by a sling psychrometer ranged from 75-92% (87.44±1.08 S.E.). The inner cave ambient temperatures, ranging from 25-28 °C (26.5±0.21 S.E.), were slightly lower than the temperature readings at the cave entrances. Some of the caves were observed to be drying up in 2009-2010. None of the caves had running water inside during the whole observation period.

The population density mostly outside caves for 2004-2005 was 400-638 individuals per hectare (*2*). In the El Niño years 2009-2010, the population density estimate outside caves was 5.0-6.7 individuals per 100 m^2 (S.E.= ±.48-0.67) or 50-67 individuals per hectare. However, the density estimate inside caves was 1.0-4.30 individuals per 100 m^2 (S.E.= ±0.33-1.86) or 100-430 individuals per hectare. Assuming that the density estimate for 2004-2005 is correct, the population density outside the caves would appear to have substantially decreased in a time span of five years. The occurrence of the El Niño in 2004-2005 and the disturbance of the habitat by humans could explain the population decline. It appears that the density inside the caves was higher than that outside caves, which probably was due to the more equable conditions (cooler and more humid) inside caves, although the effect of guano mining cannot be discounted.

We also observed some aspects of the ecology of the frog, which was generally found in moist and cooler portions of the caves, particularly near the entrance and in moist rock crevices. Except for the Harpa Cave which showed no frog signs, despite having the lowest temperature and highest humidity readings, the rest of the wet caves were observed to be inhabited by the species. We think the species' absence in this cave might be due to the frequent human disturbance resulting from diggings for supposed treasure-hunting. Conversely, we generally did not observe the species in dry caves with high temperature readings (e.g., Elepante Cave) and in a heavily disturbed cave (Langub Cave). In addition, one of the authors (AB) visited three caves in the adjacent islet of Cabugao Daku in February 2010 and observed only three *P. insulatus* individuals occurring in a single dry cave, indicating a small population of the species on this islet due to the dry condition of the cave.

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In Pawikan Cave, we observed at least 18 individuals congregating inside a small hole measuring ca. 15 cm x 10 cm on 15 May 2010. The mean temperature at that time was about 27-28 °C, with a humidity reading of 70-80%. The hole was devoid of water but had high moisture content. This is the first time that this congregating behavior has been observed in this species. This behavior is probably associated with group survival through reduction of moisture loss during times of prolonged dry season, and may also be a form of social interaction in this species.

We observed at least five gravid females in Pawikan Cave in May 2010. The presence of gravid females inside the cave indicates that the species utilize caves for egg-laying and that the reproduction of *Platymantis insulatus* is not or little affected by dry spells during an ENSO Event. However, the reproductive biology of the *P. insulatus* requires more study. The species is most likely a direct developer like any other Philippine species of *Platymantis*.

Although no eggs of *P. insulatus* were found inside any of the caves we visited, we encountered juveniles near the vegetated cave entrances in Danao-danao and Pawikan caves in Gigane Sur Island on 13 December 2009. The following month, we also observed froglets (with snout-vent length of ca. 10 mm) on the moist forest floor outside the caves. We suspect that the juveniles and the froglets were hatched either inside the caves or in deep rock crevices and went outside to feed, similar to an earlier observation by A. Alcala & E. Alcala on the froglets of another limestone cave species, *P. spelaeus*, on Negros Island (*2*). The ability of limestone-associated frog species to survive during dry season can very well be explained by the fact that they live in cooler microhabitats (such as caves and rock crevices) that retain moisture for long periods of time under tropical forest conditions. Limestone cave habitats if left intact and unspoiled could ensure the survival of the species over prolonged dry seasons.

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The Status of Philippine Caecilians (Amphibia: Ichthyophiidae)

By Arvin C. Diesmos

As with other regions in Southeast Asia, Philippine caecilians are among the least studied terrestrial vertebrates. Basic information on the distribution, biology and natural history of these generally subterranean amphibians is highly limited primarily because of their cryptic habits (*1, 2*). There are three species of caecilians in the Philippines, all are endemic to the region (*3*). The true level of species diversity within this group, however, remains obfuscated by the lack of museum specimens that are necessary for taxonomic investigations. In fact, current knowledge on the distribution of two of the three known species is still based on information associated with type specimens.

Fig. 1: Adult male *Ichthyophis mindanaoensis* from Mt. Kitanglad Range Natural Park, Mindanao, taken from a shallow pool of a mountain stream at 600 m elevation. Various populations of this species across Mindanao Island may eventually prove to be distinct taxa. Photo: A. C. Diesmos.

Between 1919 and 1961, the eminent herpetologist E. H. Taylor described all three recognized species of Philippine caecilians: *Caudacaecilia weberi* is endemic to Palawan Island, *Ichthyophis glandulosus* is known from Basilan Island and from a single locality on Mindanao Island, and *Ichthyophis mindanaoensis* is restricted to Mindanao Island (*4*). Herpetologists last recorded *C. weberi* in Iwahig, Palawan, in 1961. The type locality of *I. glandulosus* on Basilan has not been visited by herpetologists since 1921 while the record (of *I. glandulosus*) from Mindanao remains tentative. Only *I. mindanaoensis* has been collected fairly recently from several areas on Mindanao.

With initial support from the Declining Amphibian Populations Task Force (DAPTF), I conducted field surveys of several forested localities on Mindanao and Palawan including visits to type localities. The study aims to provide insights on current conservation status of species based on updated information on distribution, habitat and perceived threats (*5*). Field methods include timed-searches in specific habitats where caecilians may be found by probing and digging the forest floor (upturning debris, logs and rocks) and streams, and ethno-biological interviews. This brief report summarizes results of fieldwork undertaken between 2003 and 2010.

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Current status

Ichthyophis mindanaoensis remains extant at the type locality on Todaya, Mt. Apo National Park and is also known from several other other forested sites within this mountain range (on Mt. McKinley and the Philippine National Oil Company forest reserve). A population of the species is still found on Mt. Malindang (another volcanic mountain some 200 km north west of Mt. Apo) but we failed to find the species in the area of Dapitan Peak where it was first recorded from this mountain range (based on historical records in 1959). New distributional records of *I. mindanaoensis* include Mt. Kitanglad Range Natural Park (Bukidnon Province), Malagos Watershed Area (Davao City), Cotabato Cordillera (provinces of South Cotabato and Davao del Sur), Layawan River (Misamis Occidental Province), Mt. Magdiwata (Agusan del Sur Province) and Pasonanca Natural Park (Zamboanga City).

Ichthyophis mindanaoensis inhabits primary and secondary forest at elevations between 100 to 900 m. We found a few individuals in agricultural plantations and flooded rice fields that are adjacent to remnant natural forest patches. We did not find caecilians in areas where the natural vegetation has been completely removed. A total of 20 individuals were captured during this study, more than half were found ensconced under rocks, decayed logs and other forest debris in shallow water pools and on dry bed of mountain streams. A few were dug up in soil beside irrigation ditches. The species may be more widely distributed than is currently known. Major threats observed include habitat conversion, slash-and-burn farming and run-off from mine tailings and agro-chemicals. *Ichthyophis mindanaoensis* is occasionally seen inside built structures such as concrete cisterns erected beside streams, and is sometimes caught in indigenous fish traps that are laid across creeks and rivers. Results of interviews with local residents from several areas suggest that caecilians are often killed becase they are mistaken for snakes. Stomach contents of voucher specimens examined (deposited at the National Museum of the Philippines) consists of ants, water beetles and other arthropods.

The security situation on Basilan during the study period did not permit for visits to the island, no new information on the status of *I. glandulosus* is forthcoming. We failed to find the species in Marata Bogan, Lanao del Norte Province (Mindanao) where a lar-

Fig. 2: Distribution of *Caudacaecilia weberi* (Taylor, 1920) [black circle and star], *Ichthyophis glandulosus* Taylor, 1923 (blue circle and star) and *Ichthyophis mindanaoensis* Taylor, 1960 (red circles and star). Stars indicate the approximate position of the type locality of each species.

val specimen was collected in 1940. Much of the site has already been stripped of its natural vegetation. The status of *I. glandulosus*, therefore, remains unresolved and much of the current knowledge on the species continues to be based on the original information.

Caudacaecilia weberi was last recorded on Palawan in 1961. Our field surveys (conducted between 2003 and 2005) of five different forested sites across Palawan failed to record the species. *Caudacaecilia weberi* is known from riverine habitats in lowland forest and has been recorded only from two localities on Palawan [forest of Iwahig and in "Malatgan" (=Malatgao) River]. Either this species is truly rare or there is a need to utilize a combination of sampling methods in order to find this species. Potential threats to the species are slash-and-burn farming, mining and habitat conversion for agriculture. At present, there are no indications that the burgeoning illegal wildlife trade on Palawan has a direct impact on the species.

Suitable habitats for both *I. mindanaoensis* and *C. weberi* remain on Mindanao and Palawan, respectively. Populations of these species also occur inside protected areas. The greatest threat to Philippine caecilians is habitat destruction, particularly of lowland forests. Forest clearing for agriculture and human settlements appears to have already claimed some populations of *I. mindanaoensis* and *I. glandulosus*. Deforestation also results in degradation of streams and creeks, which are the primary habitats of caecilians.

Future needs

A sustained research program on Philippine caecilians needs to be developed. Basic ecological studies and distributional studies are warranted and utilizing a combination of multiple sampling methods may yield optimum results (*2*). Field studies should be complemented with public awareness programs that, apart from centering on the biological importance of these animals, must promote caecilians as beneficial and harmless animals. This will help curb needless killing of caecilians by rural peoples.

The possibility of discovering new species of caecilians in the Philippines remains high. Much of the remaining forested areas on Mindanao and Palawan are still biologically unexplored (*3, 6*). Previous studies have demonstrated that the complex geological history and isolation of many Philippine islands are the prime generators of the region's high levels of diversity and endemism (*3, 7*). Our examination of specimens of various populations of *I. mindanaoensis* indicates significant morphological differences among populations. In-depth taxonomic studies (applying a combination of morphological and molecular techniques) will likely reveal presence of cryptic species within this taxon (*7*).

Acknowledgements

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Detecting the Distribution of the Chytrid Fungus in the Philippines

By [1*]Mae Lowe L. Diesmos, [2]Arvin C. Diesmos, [3]Cameron D. Siler, [4*]Vance T. Vredenburg, [3]Rafe M. Brown

Globally over 30% of the 6,000+ amphibians species are currently threatened with extinction (*1*). Amphibian biologists have recorded over 150 species of frogs that have vanished from many parts of the world particularly in North, Central, and South America, Europe and in Australia. Chytridiomycosis, an emerging infectious disease specific to amphibians and is caused by the chytrid fungus, *Batrachochytrium dendrobatidis* (*Bd*), has been directly associated with these extinction events (*2–4*). Mass amphibian mortalities were recorded in areas where evidence of high *Bd* spore counts are known, most especially in closed fresh water ecosystems. Chytridiomycosis is also known to interact with other environmental factors such as habitat destruction and climate change, triggering massive declines of amphibian populations in countries where the pathogenic disease is known (*5, 6*).

In 2008, we detected the first case of *Bd* infection in an assemblage of frogs at two localities on the island of Luzon: on Mts. Palaypalay-Mataas Na Gulod in Cavite Province and on Mt. Labo in Camarines Norte Province (*7*). We subsequently found chytrid-positive frog populations from our surveys of other areas across the country (*8, 9*). Here we summarize information on the status and distribution of this emerging infectious disease in the Philippines covering the period from 2004 to 2011.

Our sampling sites include natural forested areas (primary and secondary forest from near sea level to over 1,000 m elevation) and man-modified environments (second-growth, agricultural areas, and gardens). During the course of the study, we sampled over 3,000 frogs belonging to at least 30 species via standardized swabbing protocol (five strokes each on inner thighs of hind legs, on webbing of each foot, and on abdomen). A drop of 95% ethyl alcohol was added to each swab, air-dried, and the swabs were placed inside individually labeled micro-centrifuge tubes. Samples were analyzed using Real-Time PCR (Polymerase Chain Reaction) assay (*9, 10*). To estimate prevalence and infection intensity, we calculated a measure of the number of *Bd* zoospores found on each swab that we refer to as zoospore equivalents. To calculate for prevalence, samples were categorized as *Bd*-positive when zoospore equivalents were ≥ 1 and *Bd*-negative when zoospore equivalents were < 1 (*9*).

Chytrid fungus in Philippine frogs

From an initial two localities, we detected *Bd*-infected frog assemblages in 15 other sites on the major islands of Luzon, Negros and Mindanao. We further expect to find an increasing trend in the number of chytrid-positive localities with the completion of our analyses of additional materials from multiple sampling sites across the archipelago.

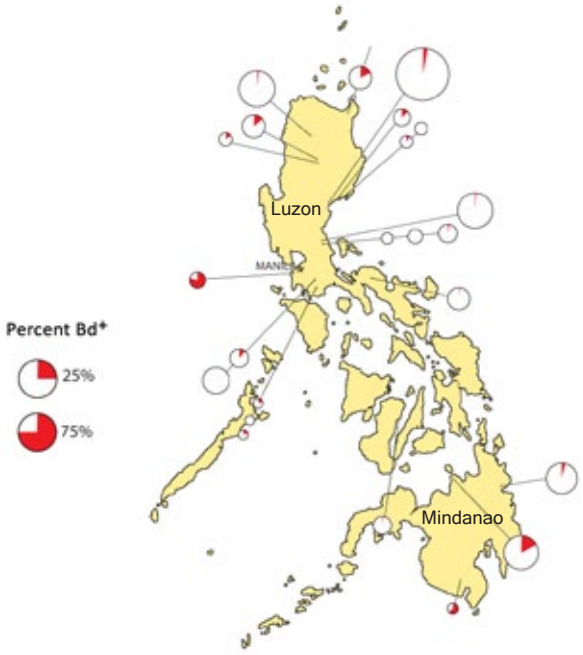

Fig. 1: The chytrid fungus *Batrachochytrium dendrobatidis* (*Bd*) is now found in at least 17 localities on three major islands across the Philippines. Thus far, highest prevalence of *Bd*-infection (with over 60% of samples) were detected from two localities.

At least seven species of frogs were infected with *Bd*, these are *Limnonectes macrocephalus* (Inger, 1954), *L. magnus* (Stejneger, 1910), *L. woodworthi* (Taylor, 1923), *Occidozyga laevis* (Günther, 1858), *Hylarana grandocula* (Taylor, 1920), *H. similis* (Günther, 1873) and *Sanguirana luzonensis* (Boulenger, 1896). These species are associated with aquatic environments and are typically found in clear, fast-flowing mountain streams and rivers (*11*). Except for *O. laevis*, all of these species are endemic to the Philippines. None of our samples of alien invasive frog species known from the Philippines (*12*), such as *Rhinella marina* (Linnaeus, 1758), *Hoplobatrachus rugulosus* (Wiegmann, 1834) and *Hylarana erythraea* (Schlegel, 1837), were positive for chytrid fungus.

Infection levels were found to be generally low and ranged from 3–10% of our samples. However, we detected high levels of infection (> 10%) from two localities, Mts. Palaypalay-Mataas Na Gulod on Luzon Island and Cotabato Cordillera in South Cotabato Province on Mindanao Island. This level of infection, based on studies from several regions in Central and South America, is known to result in amphibian declines or the extinction of affected populations (*9, 10*).

Research Priorities

Results of our ongoing field surveys demonstrate that *Bd* is widespread in the Philippines. Thus far, evidence of mass die-offs or local extinction of amphibian populations is yet to be detected. This

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Fig. 2: Among the species that we found to be infected with *Bd* include *Limnonectes macrocephalus* (Fig. 2A), *L. magnus* (Fig. 2B), *L. woodworthi* (Fig. 2C), *Occidozyga laevis* (Fig. 2D) (Dicroglossidae), *Hylarana grandocula* (Fig. 2E), *H. similis*, (Fig. 2F) and *Sanguirana luzonensis* (Fig. 2G) (Ranidae). Nearly all of these species are endemic to the Philippines. Photos: A. C. Diesmos.

is an issue that must be considered as top research priority in the region. *Bd* has the potential to infect numerous Philippine amphibian species and may cause large-scale species extinctions, given the high levels of richness and species endemicity among Philippine amphibians and the extent to which numerous critical habitats are already being degraded (*2, 8, 12*).

Based on initial results of our studies, we recommend that: (1) a comprehensive and sustained field surveys be undertaken to cover as many islands and localities as possible and to sample various habitats; (2) there is a need to perform ecological experiments that will examine the effects of *Bd* on both infected and unexposed species and assemblages, and (3) a long-term monitoring and research program need to be established, which may prove to be more effective through partnerships among government agencies, research and academic institutions and conservation groups.

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Peninsular Malaysia Revealed

By [1]Chan Kin Onn, [2]Norhayati Ahmad & [3]Lee Grismer

Fig. 1: Titiwangsa Mountain Range. Photo: Chan Kin Onn.

Fig. 2: *Gastrophrynoides immaculatus* from Gunung Besar Hantu, Negeri Sembilan. Photo: Norhayati Ahmad.

Despite having a rich and relatively long history of herpetological research, Peninsular Malaysia's amphibian diversity continues to grow at a robust pace with a recent surge over the past decade or so. Since the year 2000, 20 new species have been described and this number shows no sign of tapering off. Much of this has been made possible through collaborations between international research institutions in the United States (La Sierra University, California; University of Kansas), Japan (Kyoto University) and local universities (Universiti Kebangsaan Malaysia, Universiti Sains Malaysia, Universiti Malaya), which have changed the face of amphibian research in this region through the usage of integrative taxonomy. As such, the amphibian diversity of Peninsular Malaysia has increased by 19% since the year 2000 and now harbors 111 species of amphibians (*1-3*).

Peninsular Malaysia is a continuation of the Malay Peninsula (or Thai-Malay Peninsula), which is considered by some to be the longest peninsula in the world and extends from the Isthmus of Kra to the southerly state of Johor. Three major mountain ranges trisect Peninsular Malaysia longitudinally, producing a myriad of diverse ecosystems from upland cloud forests to peat swamps, dramatic karst formations to archipelagos littering its seas, remnants of ancient mountaintops (Fig. 1). Systematic surveys to previously unexplored or inaccessible areas have greatly contributed to the discovery of many new species. One of the most interesting discoveries was made by a tribe of indigenous people living atop Gunung Besar Hantu (translated as Big Ghost Mountain) while collecting wild bamboo in the forest. A presumably bamboo breeding microhylid was found in water-filled bamboo cuts and was later descbribed as *Gastrophrynoides immaculatus*, only the second known species in the previously monotypic genus (*4*; Fig. 2). Almost nothing is known about this enigmatic species save of the conditions in which it was found in. In the highlands of the Titiwangsa Mountain Range (Peninsular Malaysia's most extensive mountain range), another new species of microhylid was discovered in the mossy, cloud forest of Cameron Highlands, Pahang (*5*). Unique characters of this species include a humeral spine and conspicuous, white spines on the dorsal side of the male's hands (Fig. 3).

Fig. 3: *Kalophrynus yongi*, endemic to the mossy forest of Cameron Highlands, Pahang. Photo: Daicus Belabut.

Not all discoveries were born from novel explorations. Peninsular Malaysia's oldest endemic species, *Ansonia penangensis* was described in 1870 from the island of Penang off the northwest coast and last seen in 1898. One hundred and thirteen years later, renewed effort and repeated sampling over different seasons by local herpetologists bore fruit as four specimens were found along with six tadpoles (Fig. 4). Additionally, a new locality was recorded for this species, thereby expanding the distribution range of this endemic, insular species (*6*). Revision of existing species complexes have also resulted in the discovery of new species' such as *Kalophrynus tiomanensis*, another insular endemic from Tioman Island, *K. booliati* from the the *Kalophrynus pleurostigma* complex and *Rhacophorus norhayatii* from the *R. reinwardtii* complex (Fig. 5).

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Fig. 4: *Ansonia penangensis*, endemic to Penang Island, rediscovered after 113 years. Photo: Lee Grismer.

Fig. 5: *Rhacophorus norhayatii*. Photo: Lee Grismer.

As with many other tropical countries, Malaysia's biodiversity is under threat primarily through deforestation either from logging or land conversion for agriculture. The situation is exacerbated in the highlands that houses many endemic species, most of which cannot survive in warmer, dryer climates. *Kalophrynus yongi* from the mossy forest of Cameron Highlands, Pahang is one such species under threat as deforestation continues to plague its highlands which is a popular tourist destination known for its agricultural produce (Fig. 6). Conversion of large forest areas into vegetable farms and tea plantations encroach ominously upon the fragile habitat of this species. Unfortunately, this isn't an isolated event as other upland areas suffer from similar events. Larut Hills in Perak is the type locality for eight species of amphibians and is now under threat from the construction of a cable car system, which stands to change the idyllic cloud forest into a bustling tourist destination (*7*; Fig. 7).

Researches on amphibians in Peninsular Malaysia have taken on interests of multi stakeholders, including private sectors, civil society and academics. All agree that tropical deforestation is caused by multiple drivers such as conversion of natural forest areas to agricultural areas, logging and infrastructure development. As far as the worldwide REDD projects (Reduced Emissions from Deforestation and Forest Degradation) are concerned, Malaysia does not receive full support from any technical and advisory bodies of the UN-REDD secretariat. Thus, this program is not under the national strategy of the Malaysian government. Because of this, the program cannot be implemented around the country by government agencies and non-governmental organizations (NGOs). Another huge initiative is underway, known as SAFE or Stability if Altered Forest Ecosystems, which aims to understand how the impacts of forest modification ramify through the web of life. Various fields of re-

Fig. 6: Huge areas of forest are cut down for tea plantations and other agricultural produce at Cameron Highlands, Pahang. Photo: Chan Kin Onn.

search are involved, namely biodiversity, physiology, species interactions, ecosystem processes, microclimate and others. Two scientists are working on the amphibians; Aisyah Faruk and her team from University of London have just completed her work on species composition of amphibian communities, while Ulmar Graffe from the University of Brunei is working on the beta diversity of the amphibians. The System of Rice Intensification Project in Malaysia is currently undergoing a major transformation across paddy fields in Peninsular Malaysia with many successful trial plots. Studies on rice production and effectiveness of organic farming have been successful. Work is underway to assess the biodiversity aspects of the SRI projects initiated by Universiti Kebangsaan Malaysia, especially on amphibians.

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Fig. 7: The fragile and diverse cloud forest of Bukit Larut, Perak is under threat by the construction of a cable car system for tourism. Photo: Chan Kin Onn.

Conservation of Amphibians in Borneo: Relative Value of Secondary Tropical Forest and Non-Forest Habitats

By Graeme R. Gillespie, Eddie Ahmad, Berjaya Elahan, Alice Evans, Marc Ancrenaz, Benoit Goossens & Michael P. Scroggie

The lowlands of Southeast Asia have been grossly altered by timber harvesting and conversion to agriculture, in particular, oil palm plantations. The impacts on amphibians are poorly known. We assessed the relative value of secondary forests, oil palm plantations and other non-forest habitats for amphibian conservation, by examining amphibian species richness and assemblage composition in secondary lowland forests, compared with oil palm plantations and other non-forest habitats, along the Lower Kinabatangan River, eastern Sabah, Malaysia. We located 31 frog species from five families. Estimation of species richness for the study area from the species accumulation rate indicated that most species likely to occur in the area were detected. Projected maximum species richness was similar to the total number of species known to occur in similar primary forest habitats elsewhere in Sabah, suggesting that the secondary forests along the Lower Kinabatangan River may have retained a large proportion of their original frog species richness despite extensive alteration from past timber harvesting. We found 29 species in forested habitats, 12 in plantations, and 14 in other non-forest habitats. Of the 13 endemic species detected, only 3 were found in non-forest habitats. We also found strong differentiation between the species assemblages in forest, non-forest and plantation habitats. No microhylid species and few arboreal species were found in oil palm plantations, which were dominated by habitat generalist and human commensal species. Our findings suggest that, despite a recent history of extensive human disturbance and degradation, remnant secondary forests play an important role in conserving amphibian diversity in Southeast Asia. In contrast, oil palm plantations have comparatively low conservation value for amphibians. In view of the extent of conversion of forests to plantations and other agricultural production across Southeast Asia, the conservation status of many amphibians restricted to lowlands in this region may be underestimated. Our findings highlight the value of setting aside adequate areas of representative forest habitats within agricultural landscapes in order to conserve biodiversity, even when those remnants have a history of prior disturbance.

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Kalophrynus pleurostigma. Photo: Graeme R. Gillespie.

The Conservation Breeding of Two Foot-Flagging Frog Species from Borneo, *Staurois Parvus* and *Staurois Guttatus*

A male of *Staurois parvus* displaying the white interdigital webbing during foot-flagging behavior. The visual signals are mainly employed during male-male agonistic interactions. Photo: D. Preininger.

By Doris Preininger, Anton Weissenbacher, Thomas Wampula & Walter Hödl

The Bornean frogs of the genus *Staurois* live exclusively along fast-flowing, clear water rainforest streams, and are famous for displaying a variety of visual signals, including foot-flagging. Their precarious existence, mainly due to forest clearance, and extraordinary behavior make *Staurios* target species for captive breeding and behavioral research. Vienna Zoo has pioneered the development of a research and conservation project for *S. parvus* and *S. guttatus*. We implemented two breeding and research models offering an artificial waterfall and different options for egg deposition. Two months after introducing the *Staurois*, we observed amplectant pairs and the first tadpoles of both *S. parvus* and *S. guttatus*. We were the first zoo to succeed in breeding foot-flagging frog species to produce over 900 tadpoles and more than 470 juveniles. One of our most striking observations was the use of foot-flagging signals in recently metamorphosed *S. parvus* suggesting that "foot flagging" is employed as intraspecific spacing mechanism no just for reproductive territoriality. The breeding success of two *Staurois* species at Vienna Zoo increases the technical knowledge necessary for successful Conservation Breeding Programs for tropical stream-dwelling, and other stream dwelling anurans. We have also shown that major contributions to our knowledge of anuran behavior, ie. the role of "foot flagging" as a visual signal component in anuran communication, can be made during captive breeding programs.

Juvenile *Staurois parvus*. Photo: D. Zupanc.

Tadpoles of *Staurois guttatus*. Photo: N. Potensky.

D. Preininger , A. Weissenbacher, T. Wampula, W. Hödl. *Amphibian and Reptile Conservation* **5**, 45 (e51) (2012). Read the full paper at http://www.redlist-arc.org/Current-Issues/

Recent Publications

Conservation and Ecology

Using ecological niche modeling to predict the distributions of two endangered amphibian species in aquatic breeding sites

By Lior Blank & Leon Blaustein

Amphibians are among the most threatened taxonomic groups worldwide. A fundamental step in species conservation is identifying the habitat requirements of the target species. However this determination can often be problematic in endangered species because, by definition, they often only occupy a very limited number of sites. Moreover, when found, they are often in low abundance and thus detectability is low, yielding false "absence" data. Maximum entropy niche modeling of species' geographic distributions provides a tool using only presence data to predict potential habitat distributions of endangered species whose distributions have become highly limited. We provide two examples in the current study for the Fire salamander, *Salamandra infraimmaculata*, and the Green toad, *Bufo viridis*. *S. infraimmaculata* is considered endangered in Israel and near endangered worldwide. *B. viridis* is classified as locally endangered in Israel. Soil type was the most important predictor of the distribution of *S. infraimmaculata* and, to a lesser extent, also predicted the distribution of *B. viridis*. In addition, *S. infraimmaculata* larvae were also associated with high elevation areas. *Bufo viridis* was negatively associated with distance to urban areas and low solar radiation level. The potential distribution maps determined for *S. infraimmaculata* and *B. viridis* can help in planning future wetland use management around its existing populations, discovering new populations, identifying top-priority survey sites, or set priorities to restore its natural habitat for more effective conservation.

The Green toad, *Bufo viridis*, is classified as locally endangered in Israel. Habitat suitability mapping can identify areas in need of restoration or preservation, and identify candidate areas for species reintroduction or for construction of artificial breeding pools. Photo: Meital Golstein.

L. Blank, L. Blaustein, *Hydrobiologia* **693**, 157 (2012). http://www.springerlink.com/content/71794868u2mku411/

Using a species-specific habitat model helps identify unprotected populations of the federally threatened Red Hills salamander (*Phaeognathus hubrichti*)

By Joseph J. Apodaca, Jessica Homyack & Leslie J. Rissler

The Red Hills salamander (*Phaeognathus hubrichti)* is a rare fossorial species endemic to only six counties in southern Alabama (USA). In 1976 the species was listed as a Threatened species by the USFWS due to concerns of local herpetologists regarding the impact of habitat degradation on the few known populations at the time. The federal listing has provided a degree of protection against the effects of timber harvest in the form of habitat conservation plans (HCPs), administered by USFWS with large landholders. Because the majority of *P. hubrichti* habitat is managed for timber production, HCPs are an essential component for species persistence. However, for conservation efforts to expand, extant populations of *P. hubrichti* must be identified. Due to the fossorial life history and patchy distribution of the species, identifying populations outside of known localities is a challenging task. In this paper, we created a species-specific habitat model to identify areas that may harbor unidentified populations of *P. hubrichti*. We evaluated the utility of this model by surveying 24 sites where the species had not been documented. Our field survey confirmed that our modeling technique was practical and effective for identifying previously undiscovered populations. In total we found new populations in 13 out of the 16 areas where prediction probabilities were highest, 1 out of 4 in habitat with modest prediction probabilities, and no new populations where the model indicated there was a low probability of occurrence. In total, these findings increase the total range size of *P. hubrichti* by roughly 15%. These results indicate that creating fine-scale species-specific models can be a useful approach for identifying areas that harbor unidentified populations of imperiled amphibians. The future persistence of *P. hubrichti* is dependent on the cooperation of land managers. However, proper precautions aimed at safeguarding habitat cannot be taken if populations remain unidentified.

Red Hills salamander (*Phaeognathus hubrichti*). Photo: J. J. Apobaca.

J. J. Apodaca, J. Homyack, L. J. Rissler, *Herpetol. Rev.* **43**, 230 (2012).

Population structure and gene flow in a heavily disturbed habitat: Implications for the management of the imperiled Red Hills salamander (*Phaeognathus hubrichti*)

By Joseph J. Apodaca, Leslie J. Rissler & James C. Godwin

Estimating levels of gene flow and assessing levels of population connectivity are of critical importance to the field of conservation genetics, especially for imperiled species. Many factors can influence dispersal and therefore gene-flow patterns across a natural landscape. These patterns can be substantially altered by the impacts of habitat modification by humans or natural phenomena. Landscape-genetic studies that address both historical and contemporary influences on gene flow can be critical to demonstrating whether isolated populations with low levels of genetic variation are typical of the species or a result of strong negative effects of such modification. We used 10 microsatellite markers to investigate the spatial genetic patterns of the Red Hills salamander (*Phaeognathus hubrichti*), a federally listed species. Bayesian clustering revealed five well-supported demes within the range of *P. hubrichti*. Gene-flow analysis suggested that overall migration levels for *P. hubrichti* are low, but coalescent methods indicate that migration levels were significantly higher before habitat modification by humans. By accounting for history and species characteristics, our results suggest that loss and fragmentation of habitat have strongly negatively affected *P. hubrichti* by reducing migration, increasing bottlenecks, and promoting high levels of inbreeding.

J. J. Apodaca, L. J. Rissler, J. C. Godwin, *Conserv. Genet.* **13**, 913 (2012).

Can patterns of spatial autocorrelation reveal population processes? An analysis with the Fire salamander

By Gentile Francesco Ficetola, Raoul Manenti, Fiorenza De Bernardi & Emilio Padoa-Schioppa

Spatial autocorrelation (SAC) occurs when nearby localities have similar values for a given parameter. For instance, adjacent wetlands are often occupied by the same species of amphibians. SAC can be caused by exogenous factors affecting species distribution (e.g., nearby localities have similar habitat), or by endogenous population processes determining clustering, such as dispersal. We evaluated whether the analysis of SAC can actually reveal the scale at which amphibian dispersal takes action, by comparing SAC analyses with more traditional measures of dispersal, obtained through capture-recapture. Our analysis focused on the Fire salamander *Salamandra salamandra*, a stream-breeding amphibian for which dispersal has been measured using multiple approaches. We reviewed available studies measuring salamander movements; we also surveyed 565 streams to obtain species distribution data; for each stream, we recorded landscape and microhabitat features known to affect the species. We compared multiple statistical approaches for the analysis of SAC.

In studies using traditional approaches, 98% of individuals moved 500 m or less. Multiple analyses of distribution data identified 500 m as the distance at which endogenous autocorrelation is most likely to occur. For instance, the residuals of logistic regression relating the species to environmental variables were autocorrelated at distances up to 500 m. The concordance between SAC data and traditional measures of movements was striking, suggesting that 500 m is the scale at which dispersal connects breeding localities, increasing probability of occurrence. The analysis of SAC can provide important insights on endogenous population processes, such as the flow of individuals, and can be effort-effective if compared with traditional or genetic approaches. SAC analysis can also provide important information for conservation, as the existence of metapopulations or population networks is essential for long-term persistence of amphibians.

Female Fire salamander *Salamandra salamandra*. Photo: G.F. Ficetola.

G.F. Ficetola, R. Manenti, F. De Bernardi, E. Padoa-Schioppa, *Ecography* **35**, 693 (2012).

Complex impact of an invasive crayfish on freshwater food webs

By Gentile Francesco Ficetola, Matteo E. Siesa, Fiorenza De Bernardi & Emilio Padoa-Schioppa

Invasive alien species can have complex effects on native ecosystems, and interact with multiple components of food webs, making it difficult a comprehensive quantification of their direct and indirect effects. We evaluated the relationships between the invasive crayfish, *Procambarus clarkii*, amphibian larvae and predatory insects, to quantify crayfish impacts on multiple levels of food webs. The crayfish can prey on both amphibian larvae and their predatory insects: we tested whether amphibian larvae can take advantage by the reduction of their native predators (mesopredator release). We used pipe sampling to assess the abundance of crayfish, amphibian larvae and their major predators (dragonfly larvae, Ditiscidae and Notonectidae) in invaded and uninvaded ponds within a human dominated landscape. We disentangled the multivariate effects of *P. clarkii* on different components of food web through a series of constrained redundancy analyses. The crayfish had a negative, direct impact on both amphibian communities and their predators. Amphibian abundance was negatively related to predatory insects. However, the negative, direct effects of crayfish on amphibians were much stronger than predation by insects, therefore amphibians did not take advantage by the reduction of native predators. Our results suggest that this crayfish impacts multiple levels of food webs, disrupting natural prey-predator relationships.

A juvenile Italian agile frog *Rana latastei*. The tadpoles of this frog are heavily predated by the invasive crayfish *Procambarus clarkii*. Photo: G. F. Ficetola.

G. F. Ficetola, M. E. Siesa, F. De Bernardi, E. Padoa-Schioppa, *Biodivers. Conserv.* **21**, 2641 (2012).

Pipe refuge occupancy by herpetofauna in the Amazonia/ Cerrado ecotone

By Eduardo Ferreira, Rita G. Rocha, Adriana Malvasio & Carlos Fonseca

We evaluated the usefulness of arboreal pipe refuges for studying Neotropical herpetofauna, by quantifying the effects of microhabitat variables and pipe coloration on pipe occupancy rates. We used 55 sets of refuges that each comprised three pipes with different colors (white, grey and black). We recorded 122 occupancy events by four hylid and one scincid species. Refuge color did not significantly affect occupancy rates. Environmental data explained a significant portion (10.6%) of the total variance of occupancy, with vegetation type and height of opening being most important.

E. Ferreira, R.G. Rocha, A. Malvasio, C. Fonseca, *Herpetol. J.* **22**, 59 (2012).

Arboreal pipe refuges used for studying Neotropical herpetofauna. Photo: E. Ferreira.

The reproductive biology of the invasive *Lithobates catesbeianus* (Amphibia: Anura)

By Peterson T. Leivas, Maurício O. Moura & Luis F. Fávaro

The American *bullfrog*, *Lithobates catesbeianus* (Shaw 1802) is an invasive anuran introduced in Brazil that can affect population and community dynamics of native frogs. However, the mechanisms

The American Bullfrog in natural habitat in Brazil. Photo: Peterson T. Leivas.

that allow the establishment of this species in non-native areas are not known. Considering that reproduction is a key feature in the dynamics and establishment of an invasive species in a new environment, this study investigated the reproductive biology of *L. catesbeianus* in a subtropical area of southern Brazil. One-hundred and four females and 79 males were collected during monthly sampling from June 2008 to May 2009 in the State of Paraná, Brazil. In the laboratory, sex determination and macroscopic determination of the gonad development stage of each specimen were carried out. Subsequently, the gonads were removed and mass was determined to obtain an individual gonadosomatic index (GSI) for each specimen. We also processed a sub-sample of gonadal tissue for histological analysis. Five stages of ovarian development and four stages of testicular development were determined by microscopic analysis. The maturation curve, using the mean monthly variation of the GSI for females and males, showed that reproductive activity was more intense during spring and summer. The maturation curve of females revealed two reproductive peaks during the study period; one from August to November and another in February. There was little variation in the mean monthly GSI values obtained for males, but with greater values from August to February. The snout–vent length (SVL) of the first maturation (shortest SVL at which 50% of individuals are reproductively active [Vazzoler, 1996]) was estimated for females as 84.5 mm. The SVL of the smallest reproducing male was 76.0 mm.

P. T. Leivas, M. O. Moura, L. F. Fávaro, *J. Herpetol.* **46,** 153 (2012)

Urbanization interferes with the use of amphibians as indicators of ecological integrity of wetlands

By Jacquelyn C. Guzy, Earl D. McCoy, Anna C. Deyle, Shannon M. Gonzalez, Neal Halstead & Henry R. Mushinsky

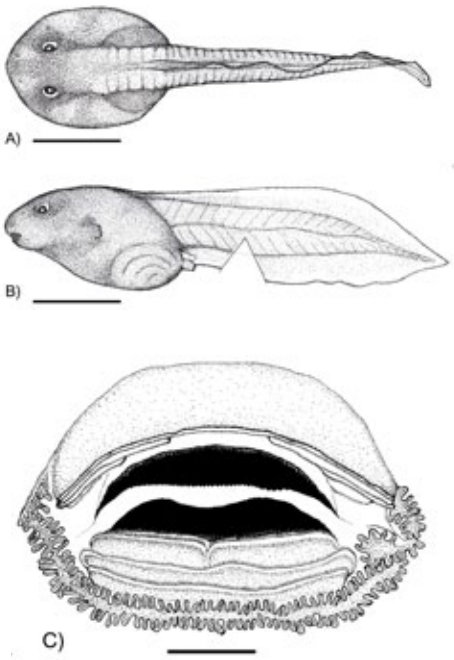
Wetlands are ecologically and economically important ecosystems but are threatened globally by many forms of human disturbance. Understanding the responses of wetland species to human disturbance is essential for effective wetland management and conservation. We undertook a study to determine whether anurans can be used effectively to assess the ecological integrity of wetlands affected by groundwater withdrawal and, if so, what effect increasing urbanization might have on the utility of anurans as wetland indicators. We monitored the intensity of anuran calls at 42 wetlands in southwestern Florida throughout 2001–2002 and 2005–2009. We first validated the use of anurans to assess wetland integrity using a small group of wetlands by comparing anuran calling and subsequent tadpole development with an established index employing vegetation composition and structure. We then verified that the results could be expanded to a variety of sites throughout the region. Finally, we focused on urbanized wetlands to determine whether urbanization could interfere with the use of anurans to assess wetland integrity. We used PRESENCE to estimate occupancy and detection probabilities and to examine the relationship between occupancy and five covariates expected to influence individual species occurrence. We used FRAGSTATS to calculate the mean proximity index for urbanized wetlands, which assesses the size and distribution of land use types within a specified area. Our results indicate that the group of species including Oak toad (*Anaxyrus quercicus*), Southern cricket frog (*Acris gryllus*), Pinewoods treefrog (*Hyla femoralis*), Barking treefrog (*Hyla gratiosa*) and Little grass frog (*Pseudacris ocularis*) is a reliable indicator of wetland integrity. However, this same group of species, which is sensitive to wetland health, is selectively excluded from urbanized wetlands. Although anurans are effective indicators of wetland health, the usefulness of this group for monitoring the ecological integrity of wetlands can be substantially reduced, or eliminated, as a consequence of urbanization. We urge for careful consideration of confounding factors in any studies examining the utility of indicator species.

J. Guzy, E.D. McCoy, A.C. Deyle, S.M. Gonzalez, N. Halstead, H.R. Mushinsky, *J. Appl. Ecol.* **49**, 941 (2012).

Larval morphology of two species of the genus *Theloderma* (Tschudi, 1838) from Vietnam (Anura: Rhacophoridae: Rhacophorinae)

By Anna Gawor, Simone Chapuis, Cuong The Pham, Truong Quang Nguyen, Andreas Schmitz & Thomas Ziegler

The rhacophorid genus *Theloderma* has a wide distribution range from north-eastern India and Sri Lanka through Myanmar, Thailand, Laos, and Cambodia to southern China and Indochina to Malaya and Sumatra. Currently, there are 23 species recognized, of which 16 species are recorded from Vietnam: *T. asperum* (Boulenger, 1886), *T. bambusicolum* Orlov, Poyarkov, Vassillieva, Ananjeva, Nguyen, Nguyen & Geissler, 2012, *T. bicolor* (Bourret, 1937), *T. chuyangsinense* Orlov, Poyarkov, Vassillieva, Ananjeva, Nguyen, Nguyen & Geissler, 2012, *T. corticale* (Boulenger, 1903), *T. gordoni* Taylor, 1962, *T. kwangsiense* Liu & Hu, 1962, *T. laeve* (Smith, 1924), *T. lateriticum* Bain, Nguyen & Doan, 2009, *T. licin* McLeod & Ahmad, 2007, *T. nebulosum* Rowley, Le, Hoang, Dau & Cao, 2011, *T. palliatum* Rowley, Le, Hoang, Dau & Cao, 2011, *T. rhododiscus* (Liu & Hu, 1962), *T. ryabovi* Orlov, Dutta, Ghate & Kent, 2006, *T. stellatum* Taylor, 1962 and *T. truongsonense* (Orlov & Ho, 2005). However, first records of *T. kwangsiense* and *T. licin* for Vietnam were recently published by Orlov *et al.* (2012) without collection and locality information, and thus still need reconfirmation. Of the 16 *Theloderma* species currently recorded from Vietnam, eight species are known as Data Deficient, one species is listed as Endangered, three species are listed as Near Threatened and four are Least Concern species. In general, ecological and morphological data for species of the genus *Theloderma* (both for adults and tadpoles) are incomplete. Concerning tadpole morphology, larval descriptions are only available for seven of the 23 recognized species, namely *T. asperum*, *T. bambusicolum*, *T. horridum*, *T. moloch*, *T. nebulosum*, *T. palliatum* and *T. stellatum*. Since 2006, the Amphibian Breeding Station of the Institute of Ecology and Biological Resources (IEBR) in Hanoi (Vietnam) is investing in amphibian (conservation) breeding and respective research with the aim to fill these gaps, in particular for Rhacophoridae such as the genus *Theloderma*. In the present paper, we provide for the first time detailed descriptions of the external larval morphology of two *Theloderma* species, namely *T. bicolor* and *T. corticale* from northern Vietnam based on larvae bred at the IEBR Amphibian Breeding Station, and subsequently additionally identified by



Drawings of the preserved tadpole of *Theloderma corticale* (stage 32) from the Amphibian Breeding Station (Hanoi, Vietnam). Drawings: A. Gawor.

DNA barcoding. Larvae of both species are generalized exotrophic lentic arboreal forms of Orton's type IV with a slightly depressed to round-bellied body shape and uniform dark brown, greyish or black in colour. The tadpoles of *T. asperum*, *T. bicolor*, *T. corticale*, *T. horridum*, *T. moloch*, *T. nebulosum*, *T. palliatum* and *T. stellatum* share a similar colour pattern (uniform dark brown, greyish or black bodies) whereas the larva of *T. bambusicolum* is unpigmented, semi-transparent and whitish on dorsum. The oral discs of the larvae of *T. bicolor* and *T. corticale* exhibit a wide medial gap of marginal papillae on the upper labium and short papillae on the lower labium. In general, the tadpoles of *T. bicolor* and *T. corticale* can be distinguished from the remaining known *Theloderma* larvae by having different numbers of keratodont rows which are 3(2-3)/3 in *T. bicolor* and 4(2–4)/3(1) in *T. corticale*.

A. Gawor *et al.*, *Zootaxa* **3395**, 59 (2012).

Parasite transmission in complex communities: Predators and alternative hosts alter pathogenic infections in amphibians

By Sarah A. Orlofske, Robert C. Jadin, Daniel L. Preston & Pieter T.J. Johnson

Host-parasite interactions occur within the wider community context, including alternative hosts and predators. These other species have the potential to influence parasite transmission through the "dilution effect," which describes how more diverse communities can reduce disease risk. However, the mechanisms for these effects may differ based on the specific interactions of the component species. Here, we used data from natural wetlands and laboratory experiments to investigate how alternative hosts and predators effect transmission of the pathogenic trematode *Ribeiroia ondatrae* to its focal amphibian host, the Pacific chorus frog (*Pseudacris regilla*). Predation bioassays conducted in the laboratory revealed that among a variety of taxa including molluscs, zooplankton, fish, insect nymphs, or larval newts (*Taricha torosa*), 4 of 7 species removed 62–93% of parasite free-living infectious stages. Subsequent bioassays indicated that predators continued to consume parasites even when provided with alternative prey. For experiments where *P. regilla* tadpoles were exposed to *R. ondatrae* in the presence of damselfly nymphs (predators) or newt larvae (alternative hosts) we observed a reduction in transmission by ~50%. However, the presence of mosquitofish (potential predators and alternative hosts) did not significantly effect transmission. Infection intensities in wild populations of newts and *P. regilla* were similar, supporting our laboratory results identifying them as alternative hosts, despite their differences in palatability to other hosts required to complete the parasite life cycle. Mosquitofish collected from the field had very low infection intensities suggesting that they are unlikely to serve as natural hosts. Taken together, our results demonstrate the importance of including the broader community in our studies of host-parasite interactions and linking predation, biodiversity and disease ecology.

S. A. Orlofske, R. C. Jadin, D. L. Preston, Pieter T. J. Johnson, *Ecology* **93**, 1247 (2012).

Co-occurring larval amphibians, Pacific chorus frogs (*Pseudacris regilla*) and California newts (*Taricha torosa*) interact in natural wetlands by serving as hosts for the complex life cycle trematode *Ribeiroia ondatrae*. Photos: Sarah Orlofske.

Genetic variability in geographic populations of the Natterjack toad (*Bufo calamita*)

By Neus Oromi, Alex Richter-Boix, Delfi Sanuy & Joan Fibla

Across altitudinal and latitudinal gradients, the proportion of suitable habitats varies, influencing the individual dispersal that ultimately can produce differentiation among populations. The Natterjack toad (*Bufo calamita*) is

A reproductive male individual of the Natterjack toad *Bufo calamita*, in the studied zone of Sierra de Gredos (Spain). Photo: Neus Oromi.

distributed across a wide geographic range that qualifies the species as interesting for a geographic analysis of its genetic variability. Five populations of *B. calamita* in the Sierra de Gredos (Spain) were studied in an altitudinal gradient ranging from 750 to 2270 m using microsatellite markers. In addition, we analyzed the latitudinal genetic variation in *B. calamita* within a global European distribution using genetic diversity parameters (mean number of alleles per locus [M_a] and expected heterozygosity [H_E]) obtained from our results and those published in the literature. The low level of genetic differentiation found between populations of *B. calamita* (F_{st} ranging from 0.0115 to 0.1018) and the decreases in genetic diversity with altitude (M_a from 13.6 to 8.3, H_E from 0.82 to 0.74) can be interpreted by the combined effects of discontinuous habitat, produced mainly by the high slopes barriers and geographic distance. In the latitudinal gradient, genetic diversity decreases from south to north as a consequence of the colonization of the species from the Pleistocene refugium. We conclude that the genetic variability in *B. calamita* along its wide altitudinal and latitudinal geographic distribution mainly reflects the colonization history of the species after the last glacial period.

N. Oromi, A. Richter-Boix, D. Sanuy, J. Fibla, *Ecol. Evol.* **2**, 2018 (2012).

Community ecology of invasions: Direct and indirect effects of multiple invasive species on aquatic communities

By Daniel L. Preston, Jeremy S. Henderson & Pieter T. J. Johnson

The spread of nonnative species around the globe represents a major driver of ecosystem change and a pressing conservation challenge. Among ecosystems, freshwater wetlands are of particular concern because they are the most imperiled habitat type in the United States and they frequently support multiple nonnative species. We combined wetland surveys in the San Francisco Bay Area of California with a mesocosm experiment to examine the individual and combined effects of nonnative fish predators and nonnative bullfrogs on native communities. Among 139 wetlands, nonnative fish (bass, sunfish and mosquitofish) negatively influenced the probability of occupancy of Pacific treefrogs (*Pseudacris regilla*), but neither invader had strong effects on occupancy of California newts (*Taricha torosa*), Western toads (*Anaxyrus boreas*) or Red-legged frogs (*Rana draytonii*). In mesocosms, mosquitofish dramatically reduced the abundance of zooplankton and palatable amphibian larvae (*P. regilla* and *T. torosa*), leading to increases in nutrient concentrations and phytoplankton (through loss of zooplankton), and rapid growth of unpalatable toad larvae (through competitive release). Bullfrog larvae reduced the growth of native anurans but had no effect on survival. Improving our understanding of the complex interactions among native and nonnative species will help inform wetland management decisions and improve our capacity to conserve threatened wetland biota.

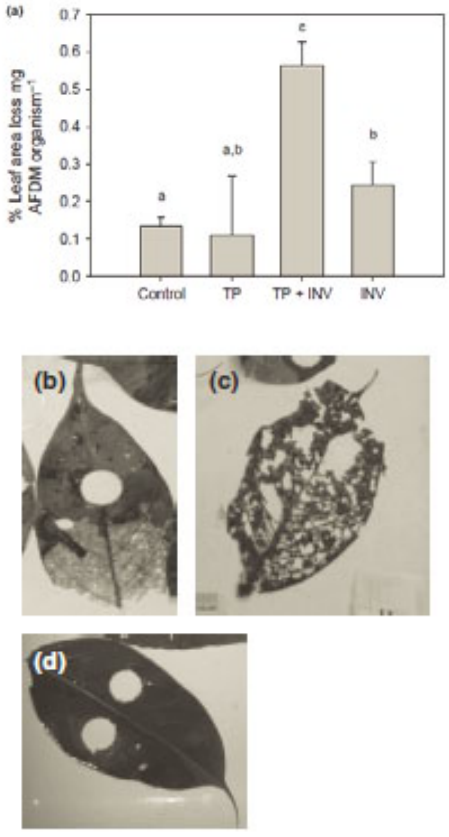
D. L. Preston, J. S. Henderson, P. T. J. Johnson, *Ecology* **93**, 1254 (2012).

The contents of seine net haul from a northern California wetland are dominated by invasive Bullfrogs (*Lithobates catesbeianus*) and Western mosquitofish (*Gambusia affinis*). The same wetland supports breeding populations of three native amphibians. Photo: Jeremy Monroe/Freshwaters Illustrated.

Tadpoles enhance microbial activity and leaf decomposition in a neotropical headwater stream

By Amanda T. Rugenski, Cesc Múrria & Matt R. Whiles

Relationships between biodiversity and ecosystem function are of increasing interest, particularly in freshwater ecosystems where species losses are occurring at unprecedented rates. Amphibian declines have been associated with a loss of ecosystem function in neotropical streams, but little is known of the potential roles of stream-dwelling tadpoles in leaf decomposition. Leaf litter is an important energy source to streams, and the breakdown of this material to fine particulate organic matter (FPOM) is a key ecosystem function. We used mesocosms in a natural stream setting to quantify the effects of grazing tadpoles, shredding macroinvertebrates and a combination of the two on leaf decomposition and associated microbial activity. We measured respiration rates of decomposing leaves, particulate organic matter (POM) and leaf biofilm biomass and C : N : P ratios, and leaf area loss in 4 treatments: Control, tadpole only (TP), tadpole and shredding macroinvertebrates (TP + INV) and shredding macroinvertebrates only (INV). We hypothesized that tadpoles would enhance leaf decomposition by changing nutrient availability and stimulating microbial activity. Respiration rates ranged from 3.1 to 6.0 mg O_2 dry mass $^{-1}h^{-1}$ and were significantly higher in the TP and TP + INV treatments than in the control. The TP + INV treatment had significantly higher POM in chambers than the control and INV treatments. The TP treatment had significantly lower leaf biofilm biomass than the control and INV treatments. Tadpoles influenced the elemental balance of C and N in POM and leaf biofilm. In contrast to our prediction, molar C : N ratios were higher in the TP + INV treatment than in the control. Mean molar N : P ratios in POM were higher in the TP + INV treatment than in any other treatment. Leaf biofilm followed a similar pattern, but both TP and TP + INV had significantly higher N : P ratios than the control and INV treatments. Leaf area loss was greatest when tadpoles and invertebrates were together (TP + INV = 0.6% leaf area loss per mg organism) than separate (TP = 0.1%, INV = 3%), indicating facilitation. Tadpoles indirectly affected leaf decomposition by influencing microbial communities and macroinvertebrate feeding. As such, ongoing amphibian declines may adversely affect a critical ecosystem function in freshwater habitats.



Leaf area loss by tadpoles and shredding macroinvertebrates Figure 4.

A. Rugenski, C. Múrria, M. R. Whiles, *Freshwater Biol.* **57**, 1904 (2012).

Response of stream-breeding salamander larvae to sediment deposition in southern Appalachian (U.S.A.) headwater streams

By S. Conor Keitzer & Reuben R. Goforth

Sedimentation degrades freshwater habitats and is a major threat to stream biodiversity. Stream-breeding salamanders are negatively impacted by sedimentation, but the bi-phasic life history of these organisms (i.e., aquatic larvae and terrestrial adults) makes it difficult to determine if salamanders are threatened by in-stream sedimentation *per se*, or the terrestrial land use practices that are often responsible for sedimentation (e.g., timber harvesting, road construction, etc.). Management efforts designed to protect stream ecosystems often focus on reducing sediment inputs to streams through the use of riparian buffers, although the recommended buffer widths are often too limited to protect the forested areas used by adult and dispersing salamanders. While these practices may help to protect larvae and eggs, they may fail to adequately protect stream-breeding salamander populations if it is the terrestrial stage, rather than the aquatic, that is most impacted by sedimentation processes. We conducted

in situ experiments and surveys of larval salamanders in headwater streams in an effort to separate in-stream sedimentation effects from the land uses that cause sedimentation.

We found limited evidence for a negative effect of increased sedimentation on the larvae of the Blue Ridge two-lined salamander (*Eurycea wilderae*) or the Black-bellied salamander (*Desmognathus quadramaculatus*). This is not to suggest that sedimentation has no affect on salamander populations, for example, eggs may be impacted independently of larvae or it is possible that increased turbidity may negatively affect salamanders. Additionally, this study was conducted at relatively small spatial and temporal scales and it is therefore possible that larger scale effects might occur.

Stream-breeding salamanders are abundant predators in headwater streams and their loss from these ecosystems may have cascading effects on important ecosystem processes. Our results suggest that current management efforts designed to decrease the input of sediment to streams may fail to adequately protect salamander populations. Consideration of terrestrial habitat use is therefore needed to protect stream-breeding salamanders and preserve their potential vital function in headwater streams.

S. C. Keitzer, R. R. Goforth, *Freshwater Biol.* **57**, 1535 (2012).

Is prevention of water pollution and eutrophication the best option to ensure Axolotl survival in its natural environment?

By José M. Serrano

Amphibian conservation programs have traditionally procured pristine and innocuous conditions to ensure optimal captivity and the success of reintroduction plans. Furthermore, biologists and conservationists ignore many of the interactions between the target species and their natural habitats. One of those species is the long-known Axolotl *Ambystoma mexicanum*, which has been cultivated and studied under laboratory conditions for embryology, genetics, ecotoxicology and many others disciplines. Unfortunately, this species has almost disappeared from its natural habitat, the Lake of Xochimilco in Mexico City, where several factors (pollution, introduced species and overexploitation) are probably acting in synergy. For this reason, I carried out a research at a research center beside Axolotl's natural habitat for understanding how the survival and growth of embryos and hatchlings are modified regarding the captivity conditions under which they spend the first six weeks of development, which included a treatment with water from a canal of the Lake of Xochimilco. Surprisingly, water from the natural habitat showed a better survivor rate for embryos and hatchlings as well as better growth results in weight and size of hatchlings than both potable water and water treated with antibiotics. This is an unexpected result, especially since the pollution of water from the canal includes heavy metals, fertilizers and organic substances. In other words, it is an invitation to understand the interactions with the natural environment in the first place, rather than its level of damage, before defining and implementing priority measures in conservation programs.

J. M. Serrano, *Salamandra* **47**, 45 (2011).

Improved detection of an alien invasive species through environmental DNA barcoding: The example of the American bullfrog *Lithobates catesbeianus*

By Tony Dejean, Alice Valentini, Christian Miquel, Pierre Taberlet, Eva Bellemain & Claude Miaud

Alien invasive species (AIS) are one of the major causes of biodiversity loss and global homogenization. Once an AIS becomes established, costs of control can be extremely high and complete eradication is not always achieved. The ability to detect a species at a low density greatly improves the success of eradication and decreases both the costs of control and the impact on ecosystems.

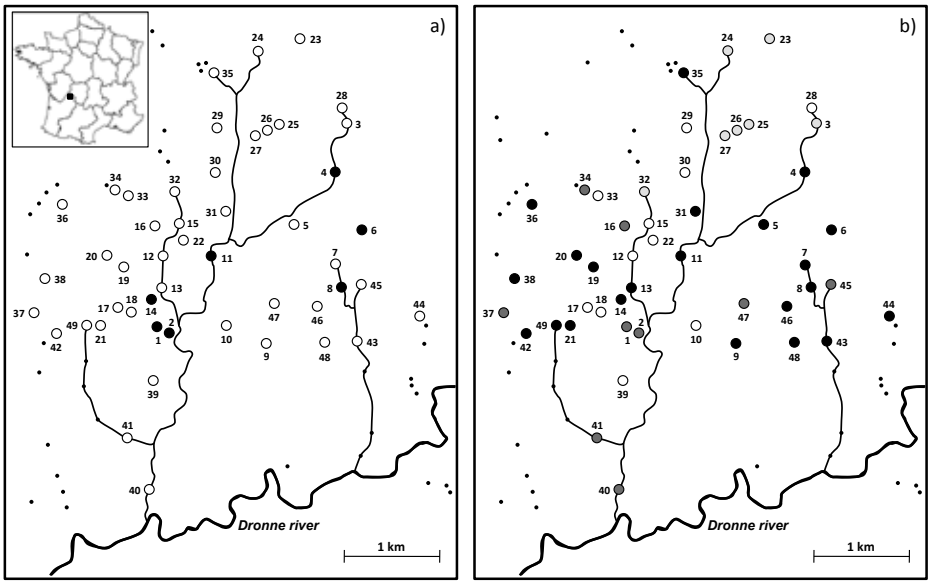
In this study, we compare the sensitivity of traditional field methods, based on auditory and visual encounter surveys, with an environmental DNA (eDNA) survey for the detection of the American bullfrog *Rana catesbeiana* = *Lithobates catesbeianus*, which is invasive in south-western France.

We demonstrate that the eDNA method is valuable for species detection and surpasses traditional amphibian survey methods in terms of sensitivity and sampling effort. The bullfrog was detected in 38 sites using the molecular method, compared with seven sites using the diurnal and nocturnal surveys, suggesting that traditional field surveys have strongly underestimated the distribution of the American bullfrog.

Synthesis and applications

The environmental DNA approach permits the early detection of alien invasive species (AIS), at very low densities and at any life stage, which is particularly important for the detection of rare and/or secretive aquatic species. This method can also be used to confirm the sensitivity of control operations and to better identify the distributions of vulnerable species, making this a very relevant tool for species inventory and management.

T. Dejean, A. Valentini, C. Miquel, P. Taberlet, E. Bellemain, C. Miaud, *J. Appl. Ecol.* **49**, 953 (2012).



Distribution of bullfrog with traditional surveys (a) filled circles represent the ponds where the American bullfrog was detected, and open circles represent the pond where the species was not detected. Distribution of bullfrog with environmental DNA (eDNA) survey (b) filled light grey circles represent the ponds where the American bullfrog was detected in one of the three water samples, filled dark grey circles represent the ponds where it was detected in two of the three water samples, filled black circles represent the ponds where it was detected in all the water samples and open circles represent the pond where the species was not detected. Dots represent the ponds that were not surveyed.

Restricted natural hybridization between two species of litter frogs on a threatened landscape in southwestern Brazilian Amazonia.

By Pedro I. Simões, Albertina P. Lima & Izeni P. Farias

Hydropower corresponds to approximately 75% of the energy generated in Brazil, most power plants having been settled across rivers near populated areas in the country's southern and eastern regions. Following economic growth projections and saturation of river systems by dams in these areas, current developmental projects now reach the Amazon basin. Among these, the Santo Antônio and Jirau dams (settled on the upper course of the muddy Madeira River) were the first to raise environmental concern, as the scientific community produced multiple reports on how their reservoirs would affect local biodiversity and the dynamics of the surrounding ecosystem.

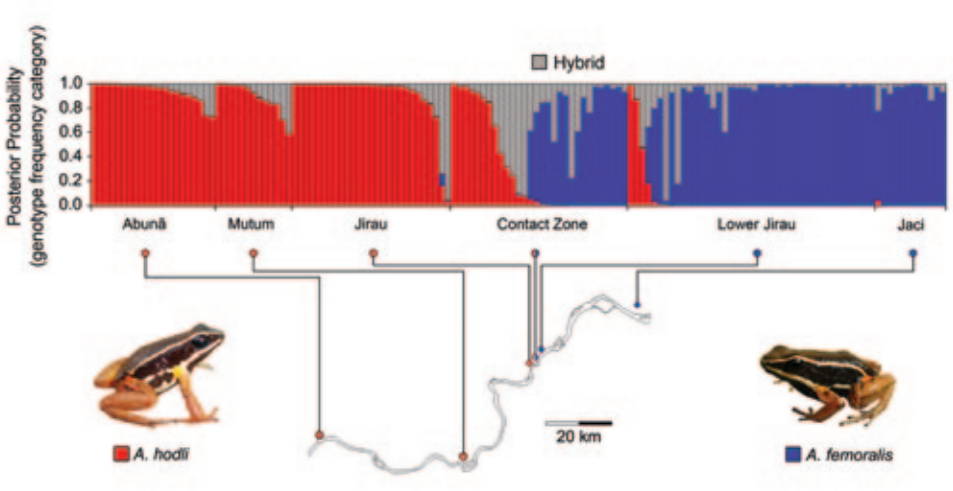
In accordance with Brazilian environmental licensing regulations, studies were carried out in order to characterize the fauna of areas potentially impacted by both dams. However, most of them overlooked ecological and evolutionary processes that might be of paramount scientific interest. In this study, we provided a thorough genetic characterization of a contact zone between two species of diurnal litter frogs, *Allobates femoralis* and *Allobates hodli*, located in an area of *terra-firme* rainforest on the western bank of the Madeira River, a few kilometers upstream of the construction site of the Jirau dam. This contact zone is apparently coincident with a geomorphological boundary and, to our knowledge, was the first to be described for anuran species within the Brazilian Amazon.

Using a combination of genetic markers (mitochondrial DNA sequences and microsatellite loci) obtained from over 200 samples collected across this system, we conducted frequency based and Bayesian inference analyses in order to estimate genetic diversity and genetic structure parameters, as well as the occurrence of genetic admixture between the two species.

The results confirmed the existence of hybrids between the two lineages. However, hybridization and genetic introgression is geographically restricted, the frequency of potential hybrids decaying abruptly about one kilometer upstream and downstream of the contact zone's core area. Observed patterns of reduced heterozygosity and haplotype diversity in sampling sites immediately adjacent to the core area of the contact zone suggest the existence of selection against hybrids, probably mediated by post-zygotic mechanisms of reproductive isolation, or outbreeding depression.

The *A. femoralis*/*A. hodli* contact zone currently conforms to a tension zone model, its width apparently regulated by selection. The genetic snapshot of this evolutionary system previous to settlement of Santo Antônio and Jirau reservoirs provides a rich background for monitoring the effects of human-induced environmental changes on hybridization dynamics.

P. I. Simões, A. P. Lima, I. P. Farias, *Conserv. Genet.* **13**, 1145 (2012).



Genetic characterization of the contact zone between *Allobates femoralis* and *Allobates hodli* on the left bank of the upper Madeira River, in Rondônia, Brazil. Photo: Pedro Ivo Simões & Walter Hödl.

Effects of road deicer (NaCl) and amphibian grazers on detritus processing in pond mesocosms

By Robin J. Van Meter, Christopher M. Swan & Carrie A. Trossen

Road deicers have been identified as potential stressors in aquatic habitats throughout the United States, but we know little regarding associated impacts to ecosystem function. A critical component of ecosystem function that has not previously been evaluated with respect to freshwater salinization is the impact on organic matter breakdown. The purpose of this study was to evaluate cumulative effects of road deicers and tadpole grazers on leaf litter breakdown rate (g d^{-1}) and microbial respiration (mg O^2 g $leaf^{-1}$ h^{-1}). To test this interaction, in May 2008 the authors added dry leaf litter (*Quercus* spp.) to forty 600-L pond mesocosms and inoculated each with algae and zooplankton. In a full-factorial design, they manipulated a realistic level of road salt (ambient or elevated at 645 mg L^{-1} Cl^-) and tadpole (*Hyla versicolor*) presence or absence. The elevated chloride treatment reduced microbial respiration by 24% in the presence of tadpoles. The breakdown of leaf litter by tadpoles occurred 9.7% faster under ambient chloride conditions relative to the elevated chloride treatment. Results of the present study suggest that the microbial community is directly impacted by road deicers and heavy tadpole grazing under ambient conditions limits microbial capacity to process detritus. Road salts and tadpoles interact to limit microbial respiration, but to a lesser extent leaf mass loss rate, thereby potentially restricting energy flow from detrital sources in pond ecosystems.

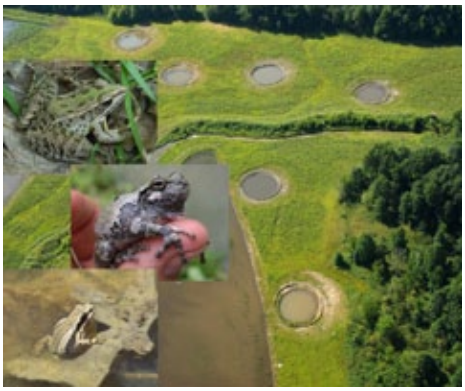
R. J. Van Meter, C. M. Swan, C. A. Trossen, *Environ. Toxicol. Chem.* DOI: 10.1002/etc.1949 (2012).

Gray treefrogs (*Hyla versicolor*) are commonly found breeding in semipermanent ponds throughout the northeastern United States. Developing tadpoles play an important role as grazers in pond food webs. Photo: Robin Van Meter.

Testing wetland features to increase amphibian reproductive success and species richness for mitigation and restoration

By Christopher D. Shulse, Raymond D. Semlitsch, Kathleen M. Trauth & James E. Gardner

Aquatic habitat features can directly influence the abundance, species richness and quality of juvenile amphibians recruited into adult populations. We examined the influences of within-wetland slope, vegetation cover and stocked western Mosquito fish (*Gambusia affinis*) on amphibian metamorph production and species richness during the first two years post-construction at 18 experimental wetlands in northeast Missouri (USA) grassland conservation areas. We used an information theoretic approach (AICc) to rank regression models representing total amphibian metamorph production, individual amphibian species metamorph production, and larval amphibian species richness. During the first year, total amphibian metamorph production was greatest in shallow-sloped wetlands that did not contain Mosquito fish. However, during the second year post-construction, shallow-sloped wetlands with high vegetation cover were best. Species richness was negatively associated with Mosquito fish and positively associated with vegetation cover in both survey years. Leopard frog (*Rana blairi/sphenocephala* complex) metamorph quality, based on average metamorph size, was influenced by slope and the number of cohorts in the wetland. However, the tested variables had little influence on the size of American toads (*Bufo americanus*) or Boreal chorus frogs (*Pseudacris maculata*). Our results indicate that wetlands intended to serve as functional reproductive habitat for amphibians should incorporate shallows, high amounts of planted or naturally established vegetation cover and should not contain *Gambusia* or other fish species that are detrimental to amphibians.



The design features of constructed wetlands have direct effects on the production of metamorphosing juveniles and species composition of amphibian communities. We tested the effects of slope, vegetation, and the introduction of mosquitofish on amphibian responses in small replicated pools shown here at our Pinkston site. Three representative species found in constructed pools in central Missouri include: [inset photos from top to bottom] Leopard frog, Gray treefrog and Chorus frog. Aerial photo courtesy Cathy Morrison, Missouri Dept. of Transportation.

C. D. Shulse, R. D. Semlitsch, K. M. Trauth, J. E. Gardner, *Ecol. Appl.* **22**, 1675 (2012).

Integrating museum and GIS data to identify changes in species distributions driven by a disturbance-induced invasion

By Laura V. Milko

Two topics of great importance to conservation biologists and managers are the impact of habitat degradation on species' distributions and the effects of invasive species on the decline of other species. I evaluate the interaction of these threats by comparing the impact of a native invasive amphibian species on a formerly allotopic amphibian species in disturbed versus undisturbed habitat. Fowler's toad (*Anaxyrus fowleri*) historically thrived in a range of habitats including urban and suburban areas in the mid-twentieth century, but has recently undergone a range contraction concurrent with the spread of the Coastal plain toad (*Incilius nebulifer*) into recently disturbed habitat. Contemporary surveys of historical collection sites obtained from museum records of vouchered specimens were used to document changes in the distribution of both species over the past half-century. Temporal changes in habitat disturbance at collection sites were detected by comparing historical aerial photographs with current remote sensing data. Analysis of species' distribution in different disturbance levels showed that *A. fowleri* is unaffected by disturbance in areas where *I. nebulifer* is absent, but at sites where the species are sympatric the distribution of *A. fowleri* in degraded habitat contracted while the expansion of *I. nebulifer* increased substantially. This study demonstrates that anthropogenic habitat alteration can facilitate dispersal and colonization by an invasive species, resulting in the significant decline of a native species that is otherwise tolerant of disturbance.

Both (A) "current" and (B) "historic" sites are in the same geographic location. (A) is plotted on a 2004 DOQQ and (B) is plotted on a historical aerial photograph that has been georeferenced and rectified.

L. V. Milko, *Copeia*. **2012**, 308 (2012).

Control of invasive American bullfrog *Lithobates catesbeianus* in small shallow water bodies

By Gerald Louette, Sander Devisscher & Tim Adriaens

Setting up cost-efficient control programs for alien invasive species requires the development of adequate removal methods in combination with insights in population size and dynamics. American bullfrog *Lithobates catesbeianus* is an alien invasive species, which is suspected to cause substantial ecological damage around the globe. However, control of bullfrog populations is difficult, as no conclusive management measures have yet been determined. We investigated how double fyke nets could contribute to bullfrog management by assessing the tadpole population size in 10 permanent small shallow water bodies. Two population size estimate methods were applied, being the catch-depletion and mark-recapture method. Catchability of bullfrog tadpoles proved to be very consistent over ponds and methods, with one catch per unit of effort (one double fyke net for 24 h) retaining on average 6% of the tadpole population. Population density varied considerably among ponds, ranging from 950 to 120,804 larger tadpole individuals/ha. Using these insights in developing a cost-efficient eradication program for the species, we projected the number of catch efforts needed to reduce tadpole numbers to a threshold that more than likely affects final bullfrog population size. Predictions indicated that for the specified thresholds

the use of eight double fyke nets at a time is most cost-efficient in high abundance populations, while using five double fyke nets seems most suitable in low abundance populations. What the exact threshold number of remaining tadpole individuals should be is uncertain, but forecasts demonstrate that only half of the budget would be needed when aiming at a drop to fewer than 100 remaining tadpoles than when a decrease to fewer than 10 remaining tadpoles is pursued. Given the fairly limited cost of bullfrog management with double fyke nets, however, it may be worthwhile to fully reduce the tadpole population.

Control of invasive American bullfrog using double fyke nets in small shallow fish ponds. Photo: INVEXO.

G. Louette, S. Devisscher, T. Adriaens, *Eur. J. Wildl. Res.* DOI 10.1007/s10344-012-0655-x. Open access (2012).

Effects of terrestrial buffer zones on amphibians on golf courses

By Holly J. Puglis & Michelle D. Boone

A major cause of amphibian declines worldwide is habitat destruction or alteration. Public green spaces, such as golf courses and parks, could serve as safe havens to curb the effects of habitat loss if managed in ways to bolster local amphibian communities. We reared larval Blanchard's cricket frogs (*Acris blanchardi*) and Green frogs (*Rana clamitans*) in golf course ponds with and without 1 m terrestrial buffer zones, and released marked Cricket frog metamorphs at the golf course ponds they were reared in. Larval survival of both species was affected by the presence of a buffer zone, with increased survival for Cricket frogs and decreased survival for Green frogs when reared in ponds with buffer zones. No marked Cricket frog juveniles were recovered at any golf course pond in the following year, suggesting that most animals died or migrated. In a separate study, we released Cricket frogs in a terrestrial pen and allowed them to choose between mown and unmown grass. Cricket frogs had a greater probability of using unmown versus mown grass. Our results suggest that incorporating buffer zones around ponds can offer suitable habitat for some amphibian species and can improve the quality of the aquatic environment for some sensitive local amphibians.

H. Puglis, M. Boone, *PLoS ONE* **7**, 6 (2012).

The disappearing Northern leopard frog (*Lithobates pipiens*): Conservation genetics and implications for remnant populations in western Nevada

By Serena D. Rogers & Mary M. Peacock

Many species that were once widespread are now experiencing declines either in part of or across their historic range. This is especially true for amphibians. The Northern leopard frog (*Rana* [*Lithobates*] *pipiens*] has undergone significant declines particularly in the western United States and Canada. Leopard frog population losses in Nevada are largely due to habitat fragmentation and the introduction of non-native fish, amphibian and plant species. Only two populations remain in the Truckee and Carson River watersheds of western Nevada which represents the western boundary of this species range. We used sequence data for an 812 base pair fragment of the mitochondrial NADH dehydrogenase 1 (ND1) gene to support a native origin for western Nevada populations. All frogs had a single haplotype (W07) from the distinct western North America ND1 haplotype clade. Data from seven polymorphic microsatellite loci show that Truckee and Carson River populations are highly differentiated from each other and from leopard frogs collected from eastern Nevada sites by Hitchcock (2001). Lack of gene flow among and distinct color morphs among the western Nevada populations likely predates the current geographical isolation. Restoration of leopard frog populations in these watersheds will be challenging given well entrenched non-native bullfrog populations and major changes to riparian zone over the past century. Declines of once common amphibian species has become a major conservation concern. Contemporary isolation of populations on a species range periphery such as the leopard frog populations in the Truckee and Carson rivers further exacerbate extirpation risk as these populations are likely to have fewer genetic resources to adaptively respond to rapidly changing biotic and abiotic environments.

S. D. Rogers, M. M. Peacock, *Ecol. Evol.* **2**, 2040 (2012).

Amphibian community richness in cropland and grassland playas in the Southern High Plains, USA

By Louise S. Venne, Jo-szu Tsai, Stephen B. Cox, Loren M. Smith & Scott T. McMurry

On the Southern High Plains, USA, intensive farming causes habitat loss via cultivation and, subsequently, sedimentation of playa wetlands. To look at the effects of sedimentation and land use around playas, we used local and landscape factors (e.g., hydroperiod, vegetative cover, wetland volume loss due to sediment, playa density and density of edges within three km of each playa) shown to influence amphibian species richness in other regions. We sampled amphibian species richness in 80 playas over two years, sampling an equal number of playas with cropland and native grassland watersheds. Hydroperiod strongly influenced amphibian species richness where playas with longer hydroperiods (typically these have less sediment) had more amphibian species than playas with shorter hydroperiods (typically these have more sediment). Percent vegetative cover and amphibian species richness were also positively related. Erosion and runoff in the Southern High Plains result in sedimentation of playas, causing a reduction of hydroperiod length. This also diminishes the number of playas available to amphibians for breeding. Shorter hydroperiods in playas negatively affect reproductive success of amphibian species, particularly those with long larval development periods [e.g., Barred tiger salamander (*Ambystoma tigrinum mavortium*), American bullfrog (*Rana catesbeiana*)], thereby limiting amphibian species richness over multiple generations. Efforts aimed at conservation of amphibian species richness on the Southern High Plains should focus on reducing sedimentation of playa wetlands and maintaining appropriate vegetative cover.

L. S. Venne, J. S. Tsai, C. B. Cox, L. M. Smith, S. T. McMurry, *Wetlands* **32**, 619 (2012).

Comparative assessment of different methods for using land-cover variables for distribution modelling of *Salamandra salamandra longirostris*

By David Romero, Jesús Olivero & Raimundo Real

Use of distribution models to find out environmental variables that explain the location of a species is becoming more frequent. Land-cover variables are usually used together with other types of environmental variables. Land-cover variables can be used in different formats for distribution modelling. Each of these formats may involve considering different information on the relationships between species and landscape. Our aim was to evaluate whether the explanatory power of the models is altered when different approaches to the use of land-cover variables are considered in the construction of a favourability model. We used a case study based on the distribution of *Salamandra salamandra longirostris*, an endangered amphibian subspecies in the south of the Iberian Peninsula. A set of 28 land-cover classes was considered in combination with another 42 environmental variables. We built four different models. Three models used a unique type of land-cover variable: either the presence of each class, the surface area of each class or the distance to each class. For the fourth model the three variable types were jointly entered. All models obtained acceptable scores according to a set of assessment criteria; however most of the assessment parameters computed indicated a better performance of the models using either the surface area of land classes or the distance to them. Moreover, the whole set of assessment parameters conferred the best scores on the model that combined different types of land-cover variables, which may constitute a result applicable to other areas and species beyond our case study. This model described three environments stand out in the models as important to *S. s. longirostris* in our study area: areas not far from oak (either forests or partially forested scrubland); areas either far from or lacking herbaceous crops; and areas where pastures do not predominate. Also, this model suggested that the oak forest fragmentation in favour of herbaceous crops and pastures may have negative effects on the distribution of *S. s. longirostris*. This was only partially suggested by the first three models, which considered a single type of land-cover variable, demonstrating the importance of considering a multi-variable analysis for conservation planning.

Salamandra salamandra longirostris in a natural habitat of Cadiz (South of Spain). Thus, *S. s. longirostris* is the southernmost salamander of Spain. This subspecies of salamander is catalogued as Vulnerable to extinction according to the International Union for the Conservation Nature (IUCN). Photo: David Romero.

D. Romero, J. Olivero, R. Real, *Environ. Conserv*. (2012). DOI: http://dx.doi.org/10.1017/S0376892912000227

Landscape resistance to movement of the poison frog, *Oophaga pumilio*, in the lowlands of northeastern Costa Rica

By A. Justin Nowakowski , Beatriz Otero Jiménez , Melanie Allen , Melissa Diaz-Escobar & Maureen A. Donnelly

Conversion of forests to agricultural land or pastures is occurring at a rapid rate in many tropical regions. Amphibians may be particularly susceptible to changes in landscape composition and connectivity because of their physiological characteristics and complex life cycles. We experimentally assessed landscape resistance for the dart-poison frog, *Oophaga pumilio*, associated with two prevalent land-cover types, secondary forest and pasture, in the northeastern lowlands of Costa Rica. We measured recapture rates of individuals displaced into forest and into pasture, the effects of microclimate on the movement performance of individuals and the influence of land-cover type and displacement distance on orientation ability of *O. pumilio*. Results showed a significant interaction between displacement distance and land-cover type indicating greater resistance to movement experienced by individuals displaced into pasture compared to frogs displaced into forest. Microclimatic conditions in pasture appear to have a detrimental effect on the movement performance of *O. pumilio* and initial orientation was both distance and habitat dependent. Understanding the magnitude of resistance presented by different land uses to amphibian dispersal is important for the development of successful conservation strategies in human-altered landscapes.

A. J. Nowakowski, B. Otero Jiménez, M. Allen, M. Diaz-Escobar and M. A. Donnelly. *Anim. Cons.* (2012). DOI: 10.1111.

Divergent landscape effects on population connectivity in two co-occurring amphibian species

By Jonathan L. Richardson

The physical and environmental attributes of landscapes often shape patterns of population connectivity by influencing dispersal and gene flow. Landscape effects on movement are typically evaluated for single species. However, inferences from multiple species are required for multi-species management strategies increasingly being applied in conservation. In this study, I compared the spatial genetic patterns of two amphibian species across the northeastern U.S. and estimated the influence of specific landscape features on

Occurring throughout northeastern North America, Wood frogs and Spotted salamanders share many ecological attributes, including habitat use and phenology. However, each species is affected by the landscape in very different ways, with Spotted salamander exhibiting less connectivity between populations and greater genetic structuring than Wood frog populations throughout the northeastern United States. Photo: J. Richardson.

observed genetic patterns. The Spotted salamander (*Ambystoma maculatum*) and Wood frog (*Rana sylvatica*) share many ecological attributes related to habitat use, phenology and site fidelity. However, I hypothesized that important differences in their movement patterns and life history would create distinct genetic patterns for each species. Using 14 microsatellite loci, I tested for differences in the level of genetic differentiation between the two species across 22 breeding ponds. The effects of eight landscape features were also estimated by evaluating 32 landscape resistance models. Spotted salamanders exhibited significantly higher genetic differentiation than wood frogs. Different landscape features were also identified as potential drivers of the genetic patterns in each species, with little overlap in model support between species. Collectively, these results provide strong evidence that these two amphibian species interact with the landscape in measurably different ways. The distinct genetic patterns observed are consistent with key differences in movement ability and life history between *A. maculatum* and *R. sylvatica*. These results highlight the importance of considering more than one species when assessing the impacts of the landscape matrix on population connectivity, even for ecologically similar species within the same habitats.

J. L. Richardson, *Mol. Ecol.* **21**, 4437 (2012).

Diseases and Toxicology

Ribeiroia ondatrae causes limb abnormalities in a Canadian amphibian community

By Corey D. Roberts & Thomas E. Dickinson

A parasitic flatworm, *Ribeiroia ondatrae*, is known to cause severe limb abnormalities and high mortality levels in American amphibian populations. The distributional pattern of this parasite—its main dispersal agent being birds—correlates with the boundaries of migratory flyways in the USA. Yet thus far, *R. ondatrae* have not been found in Canadian amphibians, which is surprising, considering that said flyways extend well into northern Canada. In this study we report on a lake in British Columbia where abnormal amphibians have been consistently observed. To determine if *R. ondatrae* were present and if they were the cause of the observed abnormalities, we collected and necropsied Columbia spotted frog (*Rana luteiventris*) and Pacific chorus frog (*Pseudacris regilla*) metamorphs. In addition, to more strongly determine causality, we manipulated exposure of tadpoles to *R. ondatrae* through the use of on-site field enclosures. Abnormality levels were high in both species (>20%), with the vast majority being found in close proximity to the metacercariae of *R. ondatrae*. Moreover, the types of abnormalities closely matched those produced by *R. ondatrae* in previous experiments. Finally, and most conclusively, tadpoles that developed in the same lake, but with reduced exposure to *R. ondatrae*, did not develop abnormalities. Collectively, our paper documents the first occurrence of *R. ondatrae* in Canadian amphibians, and more importantly the first time this parasite has caused higher than expected levels of abnormalities in amphibians outside the USA.

C. D. Roberts, T. E. Dickinson, *Can. Journ. Zool.* **90,** 808 (2012).

Pacific chorus frog (*Pseudacris regilla*) with extra limb (polymelia). Over 50% of chorus frogs at our site had extra limbs, which previous lab experiments have shown can be induced by the parasitic-flatworm *Ribeiroia ondatrae*. Photo: Corey Roberts.

Unlikely remedy: Fungicide Ccears infection from pathogenic fungus in larval Southern leopard frogs (*Lithobates sphenocephalus*)

By Shane M. Hanlon, Jacob L. Kerby & Matthew J. Parris

Amphibians are often exposed to a wide variety of perturbations. Two of these, pesticides and pathogens, are linked to declines in both amphibian health and population viability. Many studies have examined the separate effects of such perturbations; however, few have examined the effects of simultaneous exposure of both to amphibians. In this study, we exposed larval Southern leopard frog tadpoles (*Lithobates sphenocephalus*) to the chytrid fungus *Batrachochytrium dendrobatidis* and the fungicide thiophanate-methyl (TM) at 0.6 mg/L under laboratory conditions. The experiment was continued until all larvae completed metamorphosis or died. Overall, TM facilitated increases in tadpole mass and length. Additionally, individuals exposed to both TM and *Bd* were heavier and larger, compared to all other treatments. TM also cleared *Bd* in infected larvae. We conclude that TM affects larval anurans to facilitate growth and development while clearing *Bd* infection. Our findings highlight the need for more research into multiple perturbations, specifically pesticides and disease, to further promote amphibian heath.

S. M. Hanlon, J. L. Kerby, M. J. Parris, *PLoS ONE* **7**: e43573. Doi:10.1371/journal.pone.0043573 (2012)

Chloramphenicol with fluid and electrolyte therapy cures terminally ill Green tree frogs (*Litoria caerulea*) with chytridiomyscosis

By Sam Young, Rick Speare, Lee Berger & Lee F. Skerratt

Terminal changes in frogs infected with the amphibian fungal pathogen *Batrachochytrium dendrobatidis (Bd)* include epidermal degeneration leading to inhibited epidermal electrolyte transport, systemic electrolyte disturbances and asystolic cardiac arrest. There are few reports of successful treatment of chytridiomycosis and none that include curing amphibians with severe disease. Three terminally ill Green tree frogs (*Litoria caerulea*) with heavy *Bd* infections were cured using a combination of continuous shallow immersion in 20 mg/L chloramphenicol solution for 14 days, parenteral isotonic electrolyte fluid therapy for six days, and increased ambient temperature to 28 °C for 14 days. All terminally ill frogs recovered rapidly to normal activity levels and appetite within five days of commencing treatment. In contrast, five untreated terminally ill *L. caerulea* with heavy *Bd* infections died within 24–48 hr of becoming moribund. Subclinical infections in 15 experimentally infected *L. caerulea* were cured within 28 days by continuous shallow immersion in 20 mg/L chloramphenicol solution without adverse effects. This is the first known report of a clinical treatment protocol for curing terminally ill *Bd*-infected frogs.

S. Young, R. Speare, L. Berger, L. F. Skerratt, *J. Zoo Wildl. Med.* **43**, 330 (2012).

Soil bioaugmentation with amphibian cutaneous bacteria protects amphibian hosts from infection by *Batrachochytrium dendrobatidis*

By Carly R. Muletz, Jillian M. Myers, Rickie J. Domangue, James B. Herrick & Reid N. Harris

Conservationists are challenged with developing implementable strategies to combat emerging infectious diseases that threaten wildlife biodiversity. The amphibian disease chytridiomycosis has caused a dramatic loss of amphibian biodiversity and is of particular interest in this study. Infection by the fungal pathogen *Batrachochytrium dendrobatidis* (*Bd*) causes chytridiomycosis, and targeting methods to reduce or eliminate *Bd* infection is essential for disease mitigation. One plausible method to do so is the use of probiotic anti-*Bd* bacteria (bioaugmentation). In this study, we examined the use of soil bioaugmentation in the mitigation of chytridiomycosis in a laboratory experiment. Specifically, we sought to determine if the anti-*Bd* bacterial species *Janthinobacterium lividum* could be successfully introduced into natural soil, if the introduced bacteria could then be transmitted to the skin of the amphibian species *Plethodon cinereus* and if the environmental transmission of *J. lividum* could reduce *Bd* infection on *P. cinereus*. We demonstrated that *J. lividum* can be successfully introduced into soil and can be environmentally transmitted to *P. cinereus* skin. We found that the environmental transmission of *J. lividum* inhibited colonization by *Bd* on the skins of *P. cinereus* five days post-*Bd* exposure. Assuming no or minimal effects on non-target species, as suggested by other studies, soil bioaugmentation may be a feasible conservation strategy that could protect amphibians susceptible to chytridiomycosis from declines driven by the disease.

C. R. Muletz, J. M. Myers, R. J. Domangue, J. B. Herrick, R. N. Harris, *Biol. Conserv.* **152**, 119 (2012).

Prevalence of infection by *Batrachochytrium dendrobatidis* and *ranavirus* in Eastern hellbenders (*Cryptobranchus alleganiensis alleganiensis*) in eastern Tennessee

By Marcy J. Souza, Matthew J. Gray, Phillip Colclough & Debra L. Miller

Hellbenders (n=97) were collected from the Little and Hiwassee Rivers in eastern Tennessee, USA, during 2009 and 2010. Location and morphometrics for each animal were recorded, and nonlethal tissue samples were collected to estimate the prevalence of infection with *Batrachochytrium dendrobatidis* (*Bd*) and *Ranavirus* in each watershed and year. Real-time polymerase chain reaction was performed on skin swabs for *Bd* and on tail clips for ranaviruses. Overall prevalences of DNA of *Bd*, *Ranavirus*, and coinfections (i.e., detectable DNA of both pathogens in the same individual) were 26%, 19%, and 5%, respectively. Differences in infection prevalence were detected between watersheds and years. Gross lesions were observed in 31 animals (32%), but the types of lesions were not consistent with chytridiomycosis or ranaviral disease. This is the first report of infection of eastern hellbenders with *Bd* and *Ranavirus*. Despite infection by both pathogens, it is unclear whether chytridiomycosis or ranaviral disease develops in wild populations of Hellbenders. More research is needed to determine the susceptibility of Hellbenders to *Bd* and ranaviruses and their role in the epidemiology of these pathogens.

M. J. Souza, M. J. Gray, P. Colclough, D. L. Miller, *J. Wildl. Dis.* **48**, 560 (2012).

Physiological effects and tissue residues from exposure of leopard frogs to commercial naphthenic acids

By Judit E.G. Smits, Blair D. Hersikorn, Rozlyn F. Young & Phillip M. Fedorak

Naphthenic acids (NAs) are considered to be one of the main causes of the toxicity related to oil sands process-affected materials originating from the extraction of bitumen from the oil sands in northeastern Alberta, Canada. Our laboratory studies aimed to determine whether exposure to commercial NAs (Refined Merichem) caused NAs to accumulate in Northern leopard frogs (*Lithobates pipiens*), and whether this exposure would produce clinical or subclinical toxicity. Frogs were kept in NAs solutions for 28 days under saline conditions comparable to those on reclaimed wetlands in the Athabasca oil sands region. The exposure waters contained NAs acids concentrations of 0, 20 or 40 mg/L. As a result of these exposures, NAs were found in the frog muscle tissue. The NAs concentrations found in the muscle were dependent upon the exposure concentration of NAs. Physiological parameters that were studied included innate immune function, thyroid hormones levels and hepatic detoxification enzyme induction. Although, body mass did increase in both the salt- and NA-exposed animals, none of the other physiological parameters differed in response to increased exposures or tissue concentrations of NAs. The increase in body mass was likely related to osmotic pressure and uptake of water through the skin. We concluded that commercial NAs are absorbed and deposited in muscle tissue, yet there are minimal toxicological or other negative effects on the frogs.

J. E. G. Smits, B. D. Hersikorn, R. F. Young, P. M. Fedorak, *Sci. Total Environ.* **437**, 36 (2012).

Truly enigmatic declines in terrestrial salamander populations in Great Smoky Mountains National Park

By Nicholas M. Caruso & Karen R. Lips

Highton (2005) demonstrated that populations of woodland salamanders (genus: *Plethodon*) declined throughout the Eastern United States by the mid-1980s. Because declines were synchronous and widespread, we hypothesized that these losses were consistent with the fungal pathogen *Batrachochytrium dendrobatidis* (*Bd*) and we resurveyed historic collecting sites and searched for *Bd* in current populations. Between March and November 2009, we surveyed 35 sites 2–4 times, determined community composition and abundance of 72 populations of six species and three hybrids of *Plethodon* salamanders, and analyzed 665 skin swabs for the presence of *Bd*. At 22 of the sites we were unable to find one or more historic species. *Plethodon glutinosus* and *P. teyahalee* and their hybrids were less abundant than historically, *P. jordani x metcalfi* and *P. ventralis* were significantly more abundant, and the remaining three species fluctuated but showed no significant net change. *Bd* was present, but at low prevalence, only 1 of 665 salamanders was positive despite high environmental suitability predicted by Maxent models. Declines were associated with higher elevations (z=-3.023; P=0.003), cooler temperatures (z=3.066; P=0.002), and areas that received higher precipitation

Plethodon teyahalee is a large terrestrial salamander found in the Southern Appalachian Mountains. This species was absent from the majority of the resurveyed populations. Photo: Nicholas M. Caruso.

(z=-3.453; P=0.001). Based on patterns in population declines, we concluded that over collecting, logging and acid rain were unlikely to have caused these population declines, but we were unable to rule out disease or climate change as contributing factors. Population declines of *Plethodon* salamanders in the Great Smoky Mountains National Park are real and have persisted for 30 years. Determining the cause and the extent of these declines is important for managing this area of global salamander biodiversity.

N. M. Caruso, K. R. Lips, *Diversity Distrib.* (2012). DOI: 10.1111/j.1472-4642.2012.00938.x

Novel and pandemic lineages of amphibian chytridiomycosis associated with the North American bullfrog trade

By Lisa M. Schloegel, Luís Felipe Toledo, Joyce E. Longcore, Sasha E. Greenspan, Conrado Augusto Vieira, Maria Lee, Serena Zhao, Catherine Wangen, Claudia Maris Ferreira, Márcio Hipolito, Angela J. Davies, Christina A. Cuomo, Peter Daszak & Timothy Y. James

The emerging fungal pathogen *Batrachochytrium dendrobatidis* (*Bd*) has been linked to amphibian declines globally. Populations susceptible to the onset of disease (known as chytridiomycosis) when infected with *Bd* have, until recently, been associated with the presence of a single *Bd* genotype group (GPL). In the current study, we investigated the role of the global trade in *Lithobates catesbeianus* (North American bullfrog) in spreading *Bd*. Through genotypic comparisons of 45 isolates, including those associated with *L. catesbeianus* and a global panel, we identified the GPL genotype as the main source of infections. However, we also detected a novel, highly divergent *Bd* genotype from a live bullfrog on sale for human consumption in a US market in Michigan. Subsequent investigations led to the isolation of the novel genotype from native anurans in the Brazilian Atlantic Forest. Comparative analyses of ITS (internal transcribed spacer) rRNA sequences from the novel genotypes to sequences from native and introduced amphibians in Japan suggests the lineage also exists in Asia, and may have been introduced through the importation of live *L. catesbeianus*. A single isolate obtained from a frog in the Brazilian Atlantic Forest possessed a hybrid genotype between the GPL and novel lineages. The existence of a hybrid is the first conclusive evidence of sexual reproduction in *Bd*. These data add to our growing understanding of *Bd* genotype diversity, which includes multiple genetic lineages. *Bd* has been previously reported in live amphibians in the food and pet trades, in markets and on farms throughout the US, South America and Asia. The finding that *Bd* can undergo sexual reproduction emphasizes the risk of transporting live amphibians and their associated infections as a source of additional *Bd* epidemics due to hybridization.

L. M. Schloegel *et al.*, *Mol. Ecol.* (in press).

Bd on the Beach: High Prevalence of *Batrachochytrium dendrobatidis* in the Lowland Forests of Gorgona Island (Colombia, South America)

By Sandra Victoria Flechas, Carolina Sarmiento & Adolfo Amézquita

The amphibian chytrid fungus, *Batrachochytrium dendrobatidis*, *Bd*, has been implicated in the decimation and extinction of many amphibian populations worldwide, especially at mid and high elevations. Recent studies have demonstrated the presence of the pathogen in the lowlands from Australia and Central America. We extend here its elevational range by demonstrating its presence at the sea level, in the lowland forests of Gorgona Island, off the Pacific coast of Colombia. We conducted two field surveys, separated by four years, and diagnosed *Bd* by performing polymerase chain reaction (PCR) on swab samples from the skin of five amphibian species. All species, including the Critically Endangered *Atelopus elegans*, tested positive for the pathogen, with prevalences between 3.9% in *A. elegans* (in 2010) and 52% in *Pristimantis achatinus*. Clinical signs of chytridiomycosis were not detected in any species. To our knowledge, this is the first report of *B. dendrobatidis* in tropical lowlands at sea level, where temperatures may exceed optimal growth temperatures of this pathogen. This finding highlights the need to understand the mechanisms allowing the interaction between frogs and pathogen in lowland ecosystems.

S. V. Flechas, C. Sarmiento, A. Amézquita, *EcoHealth* (2012). DOI: 10.1007/s10393-012-0771-9

Population estimates of *Dendrobates tinctorius* (Anura: Dendrobatidae) at three sites in French Guiana and first record of chytrid infection

By Elodie A. Courtois, Kevin Pineau, Benoit Villette, Dirk S. Schmeller & Philippe Gaucher

One of the main challenges in assessing the population status of species is setting up efficient protocols for the evaluation of demographic parameters.

Adult of *Dendrobates tinctorius* from Favard Mountain, French Guiana. Photo: Jean-Pierre Vacher.

Neotropical amphibians are especially diverse but few data are currently available to assess their conservation status. In this study, we used Capture-Mark-Recapture (CMR) protocol to make robust estimations of the population size of the poison frog *Dendrobates tinctorius* in three populations (Tresor, Favard and Nouragues) in French Guiana. In two populations (Favard and Nouragues), we also determined the prevalence of pathogen fungal *Batrachochytrium dendrobatidis* (*Bd* hereafter). We determined that, for this species, 25 encounter occasions can be sufficient for a confident estimation of the population size if these captures are concentrated in time. We also found out that density estimates varies greatly across sites with 4.67 individuals/100 m² for Tresor, 8.43 individuals/100 m² for Favard and 4.28 individuals/100 m² for Nouragues. This study provides a baseline for population densities of *D. tinctorius* in French Guiana against which future population estimates can be compared and propose a protocol for population monitoring of *Dendrobates tinctorius*. We also report the first mention of chytrid infection in the two sampled sites (Favard and Nouragues) with a *Bd* prevalence of 9.4 percent for the Favard population (2009 = 1.96%; 2010 = 40.0%) and 22.0 percent for the Nouragues population (2009 = 23.1%; 2010 = 20.0%).

E. A. Courtois, K. Pineau, B. Villette, D. S. Schmeller, P. Gaucher, *Phyllomedusa* **11**, 63 (2012).

Contaminant Residues and Declines of the Cascades Frog (*Rana cascadae*) in the California Cascades, USA

By Carlos Davidson, Kerri Stanley and Staci M. Simonich

Populations of Cascades frogs (*Rana cascadae*) have declined precipitously in the Mount Lassen area, but remain abundant in the other half of their California range in the Klamath Mountains. To evaluate the role of contaminants

in Cascade frog declines, we sampled sediment and frog tadpole tissue at 31 sites where Cascades frogs had disappeared and sites where Cascades frogs are still present across the Lassen and Klamath regions. We tested and used Pacific chorus frogs (*Pseudacris regilla*) as surrogates for residue concentrations in Cascades frogs. We analyzed a total of 79 tadpole samples for 73 semi-volatile contaminants including pesticides, PCBs and PAHs. The most frequently detected residue was endosulfan sulfate, followed by dacthal, chlorpyrifos, PCB 187, endosulfan II, *trans*-chlordane and *trans*-nonachlor. Chorus frogs had similar residue concentrations as Cascades frogs for most but not all chemicals, indicating that chorus frogs can serve as a reasonable proxy for chemical concentrations in Cascades frogs. None of the contaminants in tissue or sediment had significantly higher concentrations at sites where Cascades frogs have disappeared than at sites where Cascades frogs are still present. We found no evidence to support the hypothesis that the contaminants we analyzed have contributed to the decline of Cascades frogs in northern California, although we were able to analyze only a handful of the over three hundred pesticides currently used in the area.

C. Davidson, K. Stanley, S. Simonich, *Env. Tox. Chem*. **31**, 1895 (2012).

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If you would like to include an abstract from a recent publication in this section of *FrogLog* please email froglog@amphibians.org. We also encourage all authors of recent publications to inform Professor Tim Halliday (formerly DAPTF International Director) (tim.r.halliday@gmail.com) of their publication in order for it to be referenced on the AmpibiaWeb latest papers page. The full list of latest papers from AmphibiaWeb is also included in every edition of *FrogLog* following the recent publications abstract section.

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This reference list is compiled by Professor Tim Halliday (formerly DAPTF International Director; tim.r.halliday@gmail.com). It lists papers on amphibian declines and their causes and 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.

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General Announcements

Upcoming Meetings & Workshops

October

9 — 13, Modeling Patterns and Dynamics of Species Occurrence Workshop - Swiss Ornithological Institute, Sempach, Switzerland.

21 — 25, Association of Reptilian and Amphibian Veterinarians 19th Annual Conference, Oakland, California.

24 — 27, Southwest Partners in Amphibian and Reptile Conservation (SWPARC) Annual Meeting - Las Vegas, NV

November

2 — 4, Kansas Herpetological Society (KHS) Annual Meeting - Fort Hays State University and Sternberg Museum of Natural History - KS2012

Internships & Employment

The following information can be found at http://www.parcplace.org/resources/job-listings.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

MS Assistantship – Population Ecology of the Chiricahua Leopard Frog (Montana State University) Bozeman, MT (Closing 10/15/2012)

Tenure Track Position in Conservation Biology - Davidson College Davidson, NC (Closing 10/15/2012)

PhD Position: Genetic Assessment of Amphibian Source-Sink Dynamics (University of Missouri) Columbia, MO (Closing 12/15/2012)

Biologist (Invasive Species, GS-0401-11/12) Honolulu, HI (Closing 9/06/12)

Part-Time Desert Tortoise Biologist/ Monitors Las Vegas, NV (Posted 8/28/12)

Biologists & Construction Monitors, Biological Resources Team Las Vegas, NV (Posted 8/28/12)

Staff Environmental Scientist, California Department of Fish and Game Sacramento, CA (Posted 8/14/12)

Ph.D. Assistantship, Wildlife Ecology - Clemson University Clemson, SC (Fall 2012 - Open Until Filled)

Assistant Professor - Wildlife Ecology and Management - Purdue University. West Lafayette, IN (8/21/12)

Assistant Professor - Wildlife Management - University of Georgia. Athens, Georgia (8/10/12)

Ph.D. Assistantship, Larval Amphibian

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 conservation community and the latest news from the ASG.
http://www.facebook.com/AmphibiansDotOrg

Ecology - University of Hong Kong, China. Hong Kong, China (8/7/12)

Ph.D. Research Assistantship, Turtle Ecology and Conservation, University of Rhode Island. Kingston, RI (8/5/12)

Crew Leader - Forest Management and Reptiles and Amphibians in the Ozarks. Missouri (8/2/12)

Field Technicians - Forest Management and Reptiles and Amphibians in the Ozarks. Missouri (8/2/12)

Desert Tortoise Research Technician, U.S. Geological Survey. Henderson, NV (7/30/12)

OPS Wildlife Field Biologist, Florida Fish and Wildlife Conservation Commission. Pamana City, FL (7/30/12)

Curator of Herpetology and Assistant Professor of Biology, Sam Noble Museum and Department of Biology, the University of Oklahoma, Norman. Norman, OK (7/30/12)

Threatened & Endangered Species Field Technician, Florida Fish and Wildlife Conservation Commission. Holt, FL (7/27/12)

Biologist I - Brown Tree Snake Researcher (Two Openings Available)Guam (7/23/12)

Michigan Herpetological Internship. Throughout Michigan and Surrounding States (6/13/12)

MS Assistantship – University of Wyoming - Wyoming Toad Conservation. Laramie, Wyoming (5/31/12)

Communications Specialist - The Orianne Society. Clayton, GA (5/15/12)

MS Assistantship - Clemson University - Wetland Herpetofauna Research. Clemson, SC (5/8/12)

Desert Tortoise Telemetry Technician. Las Vegas, NV (5/3/12)

Gopher Tortoise Seasonal Field Technician. Southern GA (4/25/12)

Copperhead Research Assistant - Ball State University. South-Central Indiana (4/22/12)

Herpetofaunal Research Intern - Alabama A&M University. Bankhead National Forest, northern AL (4/21/12)

Research Associate - Florida Fish and Wildlife Conservation Commission. Gainesville, FL (4/18/12)

Research Manager - Brown Treesnake Research. Guam (4/11/12)

Volunteer Field Assistants - Ornate Tree Lizard Research. Southeast, AZ (4/3/12)

MS or PhD Graduate Research Assistantship - Oregon State University. Corvallus, OR (4/3/12)

Biological Technician - Reptile and Amphibian Research. Snake River Field Station, Biose, ID (4/1/12)

Zoo Keeper - Herpetology - Houston Zoo. Houston, TX (3/30/12)

Funding Opportunities

October 2012

Asian Waterbirds Conservation Fund – Annual Call for Applications. The Fund supports the conservation of migratory waterbirds and their wetland habitats in the East Asian – Australasian flyway, as well as projects which bring socio-economic benefits to local communities. The maximum grant size is US$5 thousand. The Fund issues a single call for applications each year, with a deadline of 31 October.

Buckminster Fuller Institute — Buckminster Fuller Challenge. The Challenge is an annual prize of US$100 thousand to invite ideas to radically advance human well-being and ecosystem health. Entries in prior years include several in energy, water, agriculture, natural disasters, etc., in developing countries. In 2011, the deadline for submissions was 24 October *(monitor for changes 2012)*.

Critical Ecosystem Partnership Fund — Eastern Afromontane Biodiversity, First Call for Proposals. The CEPF announces its first call for proposals in the period 2012-2017 to support biodiversity conservation in the Eastern Afromontane "hot spot," stretching over a large region from Saudi Arabia to Mozambique. The program is open to NGOs, community groups, private enterprises, universities, and other applicants from civil society. Grants are likely to average US$100 thousand for projects of 1-2 years that focus on priorities identified in the announcement. The deadline for letters of inquiry (English or French) is 19 October 2012.

European Commission (EC) — Sustainable Environment and Natural Resources for Development in South Africa. The EU Delegation in South Africa calls for proposals to support healthy ecosystems and sustainable use of natural resources in South Africa. The aim is to facilitate South Africa's resilience to climate change, a lower-carbon economy, job creation, poverty reduction, and sustainable livelihoods. The program is open to organizations in the EU, the European Economic Area, South Africa, and selected other developing countries. Partnerships are strongly encouraged. Grants are up to €1.5 million, varying by cost shares. Reference EuropeAid/133370/L/ACT/ZA. The closing date for concept notes is 23 October 2012.

Global Spatial Data Infrastructure Association. GSDI makes small grants in cash and services to assist developing and emerging countries with infrastructure for access to spatial data. Grants can be awarded to SDI (Spatial Data Infrastructure) coordinating bodies and GIS user groups. In 2011, the closing date for applications was 31 October *(monitor for changes 2012)*.

Mohamed bin Zayed Species ConservationFund—NextApplication Deadline October 2012. The Mohamed bin Zayed Species Conservation Fund makes grants to individuals, communities, and organizations for the conservation of animal, bird, plant, and fungi species worldwide. Small grants are up to US$5 thousand; larger grants of up to US$25 thousand require approval by the Fund's board. Applications (in English) received before 31 October 2012 will be reviewed before the end of December.

Oklahoma City Zoo & Botanical Garden — Conservation Grants 2013. The OKC Zoo (USA) manages "Conservation Action Now" as a program of small grants for conservation education, scientific research, and species preservation. Grants are up to US$2,500 for projects worldwide. The application deadline is 18 October 2012.

Smithsonian Tropical Research Institute — Research in Forest Plots. The CTFS Grants Program at

STI supports forest research by senior researchers, postdoctoral fellows, and graduate students. Social scientists and natural scientists of all nationalities are eligible. In 2011, the application deadline was 01 October *(monitor for changes 2012)*.

TED Fellows Program — Global Fellows 2013. TED aims to help support the next generation of innovators to positively affect the world. TED particularly encourages applications from persons aged 21-40 in Africa, Asia-Pacific, the Middle East, Latin America, and the Caribbean. Fellows represent all fields of endeavor — including environment, biodiversity, energy, and agriculture and food supply. The individuals selected by TED are offered conference attendance and international networking opportunities. The application period for TEDGlobal (i.e., the more international of the programs) is 10 September 2012 through 22 October 2012.

Whitley Fund for Nature — Whitley Awards 2013. The Whitley Fund for Nature (WFN) offers the "Whitley Awards" to outstanding wildlife conservation leaders around the world. The Whitley Awards are £35 thousand over one year as an international profile prize and a form of project funding. Grants are to nationals of developing countries or regions who lead pragmatic grassroots projects that combine conservation and long-term sustainability. Eligibility criteria are explained in full on WFN's website. The application deadline is 31 October 2012.

November 2012

Cleveland Metroparks Zoo — Africa Seed Grants and Asia Seed Grants. Both programs make grants for wildlife conservation and research in their respective regions. The priority is for projects focusing on wildlife and habitat protection, human-wildlife conflict, sustainable environmental practices, capacity building, and conservation biology. There are no application restrictions by nationality. In both programs, the seed grants range from US$1,000 to US$3,500. The deadline for pre-proposals is 05 November 2012.

Conservation Leadership Program (CLP) — Conservation Awards 2013. The CLP makes grants to advance the leadership capacity of early-career conservationists in the developing world. Grants combine research with conservation. CLP provides support to small teams of at least three individuals. Future Conservationist Awards are up to US$15 thousand. Follow-Up Awards and Leadership Awards are up to US$25 thousand and US$50 thousand, respectively. The deadline for applications is 09 November 2012.

EarthCorps — International Program 2013. EarthCorps invites applications from emerging environmental leaders around the world to participate in an environmental service program in the USA. Participants take part in field projects such as tree planting, trail construction, stream restoration, and removal of invasive plants. Projects are located throughout the state of Washington (i.e., not Washington, DC). International participants receive a monthly stipend, health insurance, accommodations with host families, and possible reimbursement of air fares. Applicants should be 18-28 years of age, with a university degree in an environmental field (or equivalent work experience), and speak conversational English. The application deadline is 30 November 2012.

EC Erasmus Mundus — Forest and Nature for Society, FONASO 2013. The EC's Erasmus Mundus includes the program Forest and Nature for Society (FONASO), jointly administered by seven European universities. FONASO annually funds 8 -10 fellowships in its doctoral program for candidates worldwide. Research in FONASO includes several projects on themes relevant in the developing world, e.g., tropical forest ecology, paying for ecosystem services, assessing the contribution of forests to poverty alleviation, increasing the value chains of non-timber forest products, and several others. The application deadline is 01 November 2012.

Explorers Club — Grants for Student Exploration and Field Research 2013. The Explorers Club makes grants to students for international field projects, including projects focusing on environment and natural resources. The Youth Activity Fund is for high school students and university undergraduates. The Exploration Fund is for graduate and post-graduate students, including early-career post-doctoral students. Grants in both categories are typically from US$500 to US$1,500. The application deadline is 01 November 2012.

Field Museum — Grants and Fellowships 2012-2013. The Field Museum (Chicago, USA) offers grants and fellowships to visiting scientists and students for research and training on its scientific collections in anthropology, botany, geology, and zoology. The deadline for visiting scientists is 01 November 2012; the deadline for graduate fellowships is 25 January 2013. The museum posts other categories for internships and residency programs.

IDRC — Doctoral Field Research in Developing Countries 2012. Canada's International Development Research Center (IDRC) offers doctoral research awards twice a year (April and November) in priority themes that include agriculture and environment (among others). The program is open to Canadians, permanent residents of Canada, and nationals of developing countries who are pursuing doctoral studies at Canadian universities. IDRC funds research in all developing countries, with a few exceptions. The award covers expenses for field research up to CA$20 thousand a year. The next deadline is 01 November 2012.

Lawrence Foundation — Grants for Environment. The Lawrence Foundation makes grants to nonprofit organizations in the USA for projects in environment, education, and other themes. There is no restriction on the geographical area where grant activities can be implemented. Average grant size is over US$10 thousand. The two deadlines for applications are 30 April and 01 November of each year.

Lemelson Foundation — Lemelson-MIT Award for Global Innovation. 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. Eligibility is restricted to U.S. citizens, permanent residents, and other nationals working legally in the USA. The deadline for nominations is 02 November 2012.

Morris Animal Foundation — Wildlife Health and Welfare 2013. The Morris Animal Foundation supports research on animal health and welfare, including wildlife/exotics. The Foundation invites proposals in several categories: Established Investigator; First Award; Fellowship Training; and Pilot Studies (small grants). The application deadline for wildlife/exotics is 14 November 2012.*(Note: The Foundation also manages a wildlife rapid response fund that has no calendar deadlines.)*

Prince Albert II Foundation — Pre-Applications in 2012. The Prince Albert II of Monaco Foundation makes grants for global environmental stability in themes of climate change, biodiversity, access to water, and the fight against desertification. Its geographical priorities are the Mediterranean Basin, the Polar Regions, and the Least-Developed Countries.

The next round of pre-applications for grants will be 15 October 2012 through 16 November 2012.

Royal Geographic Society — Grants with Deadlines in November 2012. 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; Postgraduate Research Grants; and Geographical Club Award. The application deadline for each of these programs is 23 November 2012

Schlumberger Foundation — Funding for Women in PhD and Post-Doctoral Studies 2013-2014. Schlumberger Foundation's "Faculty of the Future" supports women in developing and emerging economies to pursue PhD and post-doctoral studies at the international level. Grants are in the physical sciences, engineering, and related fields — including past grants in subjects such as ecology and environment. The application period for online submissions is 10 September 2012 through 16 November 2012.

Trust for Mutual Understanding — Professional Exchanges in Environment 2013. The Trust for Mutual Understanding makes grants to nonprofit organizations in the USA for environmental projects in collaboration with partners in Russia, Central Asia, and Eastern and Southern Europe. Initial inquiries may be made by individuals and institutions in any of the countries in which TMU is active. However, final proposals must be submitted by U.S. tax-exempt nonprofit organizations (i.e., in their role as hosts and/or partners). For projects beginning July 2013 and later, initial inquiries are due 01 November 2012.

Turtle Conservation Fund – Grants 2012. The Turtle Conservation Fund makes grants to organizations and individuals worldwide for conservation and research of endangered and critically endangered tortoises and freshwater turtles. Most grants are US$2 thousand to US$5 thousand per project. Application deadlines are 01 May and 01 November each year.

U.S. Fish and Wildlife Service — Gabon Conservation 2013. The USFWS program "Wildlife Without Borders" includes a regional component for Africa. The 2013 call for applications is restricted to initiatives that strengthen conservation actions in Gabon. Grant size and eligibility vary according to each of eight conservation priorities. Applications are invited from government agencies, NGOs, institutions of higher education, and individuals. The application deadline is 01 November 2012.

U.S. Fish and Wildlife Service — Grants for Species Conservation 2012. As part of its program "Wildlife Without Borders," the USFWS makes grants for the conservation of selected wildlife species. Grants are for applied research, training, conservation management, community outreach, law enforcement, decreased human-wildlife conflicts, and other activities in conservation. Preference is for proposals that request less than US$50 thousand. Eligibility extends worldwide to qualified and relevant government agencies, other organizations, multi-national secretariats, and individuals. Programs that have deadlines on 01 November are: African elephants; Asian elephants; rhinos and tigers; and great apes. *(Note: Some of these programs have another deadline on 01 April).*

United States-India Educational Foundation (USIEF) — Obama-Singh 21st Century Knowledge Initiative 2013. The USIEF supports partnerships between U.S. and Indian institutions of higher education for exchange activities in the following fields: agricultural sciences and food security; energy; sustainable development; climate change; environmental studies; and several other themes. The maximum grant is US$250 thousand. The closing date for applications is 01 November 2012.

Worldwide Universities Network — Research Development Fund 2012. The Worldwide Universities Network comprises 18 research universities on six continents to develop leaders prepared to address the challenges and opportunities of the rapidly changing world. WUN's Research Development Fund is an annual competitive fund to bring together researchers to undertake research that addresses global challenges. One of these challenges is "Adapting to Climate Change." For the competition 2012, the Fund offers grants of up to £15 thousand. Applications are open only to researchers from WUN member institutions. The application deadline is 01 November 2012.

December 2012

Academy of Sciences for the Developing World (TWAS) – Grants for International Scientific Meetings in Developing Countries. TWAS makes grants in support of conferences, workshops, symposia, and special meetings in developing countries. Requests are submitted by the organizers of the meetings (i.e., not by individual participants). Grants are intended for air tickets, and do not normally exceed US$5 thousand. Application deadlines are 01 June and 01 December each year.

Austrian Development Cooperation — Partnerships in Higher Education & Research for Development. The Austrian Partnership Program in Higher Education & Research for Development (APPEAR) aims to strengthen institutional capacities in higher education, research, and management. Thematic areas include water supply and sanitation, rural development, energy, environment, and natural resources (among others). Partnerships are prepared collaboratively between institutions in Austria with institutions in selected developing countries. In 2011, the deadline for submissions was 31 December *(monitor for changes 2012)*.

Both ENDS — JWH Initiative to Promote Leadership of Young Environmentalists. The Joke Waller-Hunter Initiative offers grants to advance the leadership and learning of junior persons working for — or affiliated with — environmental civil society organizations in developing and emerging countries. JWH especially encourages the nomination of young women and local community leaders. Grants can be applied for a wide range of activities, but candidates should have a clear idea of how they intend to use the grant. The grants range from €2,500 to €10,000 each. The nomination deadlines are 01 June and 01 December.

Fonds Eremitage — CSRS Award 2013. The Swiss Center for Scientific Research (CSRS), with financial support from Fonds Eremitage (Switzerland), makes an award every two years to honor research in Cote d'Ivoire and other countries of West Africa in trans-disciplinary themes that include biodiversity and ecology, food security and nutrition, climate change, and others. The prize is CHF 15 thousand for a team of at least two researchers North-South or South-South. The deadline for applications (French or English) is 31 December 2012.

French Global Environment Facility (FFEM) — Small Grants, Phase 3. Phase 3 (2011-2013) of FFEM's Small-Scale Initiatives makes grants for biodiversity conservation in West and Central Africa, Madagascar, and Mozambique. Grants are a maximum of€50 thousand — subject to co-financing requirements — for NGO conservation organizations in eligible countries. For NGOs meeting the relevant criteria, pre-proposals can be submitted at any time before 31 December 2012.

Keidanren Nature Conservation Fund. The Fund supports field projects in environment, biodiversity, and natural resources in Japan and developing

countries, with an emphasis on the Asia-Pacific region. Grants are to nonprofit NGOs. The average grant size is about 3 million yen for one year. Keidanren supports about 60 projects per year, mainly outside of Japan. In 2011, the application deadline was 09 December *(monitor for changes 2012)*.

Phoenix Zoo — Grants for Conservation and Science. The Phoenix Zoo (Arizona, USA) makes small grants to support wildlife conservation and science worldwide. First-year grants are limited to US$3 thousand. Priority is for practical projects that help build capacity, and that involve local communities. The application period is 01 November through 01 December each year.

Rainforest Alliance — Kleinhans Fellowship. The Kleinhans Fellowship supports research to understand and improve how the harvesting and marketing of non-timber forest products affects rural livelihoods and tropical forest ecosystems in Latin America. The fellowship provides US$16 thousand per year, for two years. Applicants should have at least a master's degree (doctoral candidates and post-doctoral researchers are preferred) and/or relevant experience. There are no restrictions by nationality. The application deadline is 31 December 2012.

Safari Club International Foundation – Grants 2013. SCI makes grants for wildlife conservation and research in Africa, Asia, and North America. Applications for small grants can be submitted any time, but applications for grants over US$5 thousand should be submitted by 31 December for consideration in the following year.

SeaWorld and Busch Gardens — Conservation Fund. The Conservation Fund makes grants for wildlife conservation, research, and education. Most grants are US$5 thousand to US$25 thousand for one year. Applications are accepted from U.S. non-profit organizations, non-profit organizations in other countries, governmental entities, accredited universities and research centers, and institutions accredited by AZA or AMMPA. Applications for projects starting in 2013 are due no later than 01 December 2012.

Society for the Study of Amphibians and Reptiles (SSAR) -- Herpetology Grants 2013. The SSAR makes grants of US$500 to deserving individuals and organizations for herpetological research, education, and conservation. Conservation projects should focus on endangered or threatened species. Some grant categories are restricted to SSAR members and students. The application period is 15 September 2012 through 15 December 2012.

U.S. Agency for International Development (USAID) and U.S. National Science Foundation (NSF) -- PEER Science, 2nd Cycle. USAID and the NSF jointly support Partnerships for Enhanced Engagement in Research (PEER) Science. PEER Science invites scientists in 87 eligible developing countries to apply for funds to support research and capacity-building of importance to USAID, and conducted in partnership with NSF-funded collaborators. Topic areas include food security, climate change, disaster mitigation, biodiversity, water, renewable energy, and others. Grants are US$30 thousand to US$60 thousand per year for projects of 1-3 years. Larger grants are available for projects across several institutions and/or countries. The deadline for proposals is 04 December 2012.

January 2013

Action for Nature — Young Eco-Hero Awards. This program honors the work of young people between the ages of 8 and 16 who have completed successful projects in environmental advocacy, environmental health, research, or protection of the natural world. The selected individuals are awarded a cash prize and certificate, as well as public recognition. The annual competition is open internationally. In 2012, the application deadline was 15 January *(monitor for changes 2013)*.

AgMIP. The Agricultural Model Intercomparison and Improvement Project (AgMIP) supports interdisciplinary teams to conduct collaborative research on climate impacts in the agricultural sector. In 2012, the deadlines for proposals were 31 January 2012 for Sub-Saharan Africa, and 29 February 2012 for South Asia *(monitor for changes 2013)*.

Animal Behavior Society — Grants and Awards. The ABS offers five types of grants and awards, including the Developing Nations Research Grant; the Latin America Travel Award, and other grants and awards open internationally. In 2012, the deadline for applications was 06 January *(monitor for changes 2013)*.

Association of Avian Veterinarians — Research Grants. The AAV makes grants for research addressing clinical aspects of exotic and wild birds — including diagnostic tests, drug doses, practice management, and conservation. Grants are up to US$10 thousand for individual projects of one year. The AAV usually makes 1-2 grants per year. In 2012, the deadline for pre-proposals was 15 January *(monitor for changes 2013)*.

Blue Earth Alliance — Support for Photography Projects 2012-2013. Blue Earth sponsors photography projects that educate the public about threatened cultures, endangered environments, and other social concerns. Blue Earth provides assistance with organization, fund raising, publishing, and publicity. However, it does not make direct grants to sponsored projects. The next deadlines for proposals are 20 August 2012; 20 January 2013; and 20 July 2013.

Conservation, Food, and Health Foundation — Concept Applications 2012-2013. The CFH Foundation makes grants to nonprofit organizations for projects in conservation, sustainable agriculture, and health in developing countries. Most grants range from US$15 thousand to US$30 thousand. Concept applications are accepted twice a year, with deadlines of 01 January and 01 July.

Earthwatch — Field Research. Earthwatch supports scientific field projects in topics of ecosystems and biodiversity in several world regions. Applicants to lead these field projects can be of any nationality. Earthwatch invites projects that have a strong rationale for requiring non-specialists (volunteers) to aid with data collection, scientific observation, or other research tasks. In 2012, the deadline for concept notes was 27 January *(monitor for changes 2013)*.

Field Museum — Grants and Fellowships 2012-2013. The Field Museum (Chicago, USA) offers grants and fellowships to visiting scientists and students for research and training on its scientific collections in anthropology, botany, geology, and zoology. The deadline for visiting scientists is 01 November 2012; the deadline for graduate fellowships is 25 January 2013. The museum posts other categories for internships and residency programs.

Grantham Prize for Excellence in Reporting on the Environment. The annual Grantham Prize for Excellence in Reporting on the Environment recognizes outstanding non-fiction journalism on subjects related to environment and natural resources. Entries must have been aired or published within the U.S. or Canada. However, there are no nationality requirements, and previous prizes have included several of international scope. In 2012, the application deadlines were 09 January 2012 for books, and 30 January for other types of entries *(monitor for changes 2013)*.

Japan Fund for Global Environment — Conservation Grants. The Fund

makes grants for projects in environmental conservation conducted by NGOs in Japan and developing countries. In 2012, the application deadline was 25 January *(monitor for changes 2013)*.

Royal Geographical Society with the Institute of British Geographers — Awards with Deadlines in January-February 2013. The RGS-IBG offers a number of grants for graduate and post-graduate geography research in an international context. Grants range from £500 to £15,000. Many awards are restricted to nationals of the UK and EU, and/or students at UK universities. The next deadline for the Geographical Fieldwork Grants, Small Research Grants, Henrietta Hutton Research Grants, and Monica Cole Research Grants is 18 January 2013. The Dudley Stamp Memorial Award, Slawson Awards, Frederick Soddy Postgraduate Award, and International Congress Award have a deadline on 22 February 2013.

Smithsonian Tropical Research Institute — Fellowships. The STRI offers grant support for university and postdoctoral research at its facilities in Panama in several disciplines of biology, ecology, soils sciences, anthropology, and others. Fellowships and internships are awarded to researchers from the USA and Latin America in several program areas. Research projects are carried out in collaboration with STRI's scientific staff. Deadline for the Earl S. Tupper post-doctoral grant is 15 January of every year. Other programs have deadlines in March, May, August, and November.

UK Field Studies Council — Darwin Scholarship Program. The UK's Field Studies Council (FSC) annually sponsors intensive training in the UK to make "better naturalists" in honor of the work of Charles Darwin. The FSC offers partial direct funding support, as well as assistance to successful applicants to find additional financial aid. In 2012, the closing date for applications was 06 January *(monitor for changes 2013)*.

UNESCO — Michael Batisse Award for Biosphere Reserve Management. The United Nations Educational, Scientific and Cultural Organization (UNESCO) sponsors this award for outstanding achievements in biosphere reserve management. In 2012, applications were due 15 January *(monitor for changes 2013)*.

University of California at Berkeley — Beahrs Environmental Leadership Program. The Beahrs ELP sponsors an annual three-week certificate course in environmental science, policy, management, and leadership at UC Berkeley. The ELP invites applications from mid-career professionals around the world. Workshops and field trips draw on the strengths of UC Berkeley and the greater San Francisco Bay Area of California. Course participants continue their learning and networking through the Berkeley ELP Alumni Network. In 2012, the application deadline was 09 January *(monitor for changes 2013)*.

University of Texas, Austin -- Dell Social Innovation Challenge 2013. The Dell Social Innovation Challenge (DSIC) invites university students worldwide to submit their best ideas for changing the world through social and environmental innovation. Categories include agriculture and food security; renewable energy; environment; and economic development (among others). Proposed projects can be charitable, profit-oriented, or a blend of both. The Dell Social Innovation Challenge gives out over US$350 thousand annually in cash and in-kind prizes. Online submissions (in English) are due no later than 28 January 2013.

Volvo Adventure Competition — Youth Projects in Environment 2013. Volvo Adventure is an educational program that makes grants for community environmental projects by youth worldwide, aged 13 to 16. Applications are submitted by small teams. Volvo invites the finalists to Sweden to compete for cash prizes. The first prize is US$10 thousand. The closing date for applications is 31 January 2013.

Volvo Environment Prize — Nominations 2013. The Volvo Environment Prize is for innovations which in broad terms fall within the environmental field. The Volvo Environment Prize Foundation invites universities, research institutes, scientists, engineers, as well as other individuals and organizations to submit nominations. Priority is given to an individual or to a group of named individuals. Past laureates have included leaders in fields such as global change, biodiversity, energy efficiency, and others. The deadline is 10 January 2013.

Wildlife Conservation Network — Partnership Applications. The WCN supports wildlife projects worldwide, with emphasis on Latin America, Africa, and Asia. WCN invites letters of inquiry from registered nonprofit organizations engaged in wildlife conservation or animal welfare to apply for partnerships. In 2012, letters of inquiry were accepted through 15 January *(monitor for changes 2013)*.

World Wide Fund For Nature (WWF) — Prince Bernhard Scholarships for Nature Conservation 2013. WWF supports professional training and formal studies of individuals working in disciplines directly relevant to nature conservation. Eligibility extends to mid-career nationals from Africa (including Madagascar); Asia and Pacific; Latin America and Caribbean; Eastern Europe; the Middle East; and North Africa/Mediterranean. WWF gives priority to applicants seeking support for studies or training in their own countries or regions. Grants are for a maximum of one year; the maximum grant amount is CHF 10 thousand. Applications are due 11 January 2013.

Zoological Society of London — Erasmus Darwin Barlow Expedition Grant. The Erasmus Darwin Barlow Expedition Grant Fund provides support for short field expeditions to address a field conservation question outside of Western Europe and North America. The grants are for teams of persons led by a UK resident, or by an individual registered at a UK university or college. Priority is for collaboration with individuals at institutions in the destination country of the expedition. In 2012, the application deadline was 31 January *(monitor for changes 2013)*.

Instructions to Authors

Background

FrogLog has been one of the leading amphibian conservation community newsletters since the early 1990's. Over the years it has been affiliated with different groups but has always strived to help inform the community. In 2005 *FrogLog* became the official newsletter of the IUCN SSC Amphibian Specialist Group and is produced on a bimonthly basis.

As the ASG's newsletter members are encouraged to contribute to *FrogLog*'s content and direction. To aid in this process each edition of *FrogLog* focuses on one of the six broad geographical zones identified by the ASG. The publication schedule is as follows:

- January — Special Topical Edition
- April — The Americas
- July — Africa, West Asia, Madagascar, Mediterranean, and Europe
- October — Asia, Russia, and Oceania

FrogLog invites contributions of research, reviews on current management and conservation issues, methods or techniques papers and, editorials. We also actively encourage submissions describing the current activities relating to projects and academic institutions in order to help inform the community as to the general state of current research and conservation activities.

Publication

FrogLog is published online at www.amphibians.org and is open access.

Review

All contributions should ideally be channeled through Regional ASG Chairs, the details for which can be found at http://www.amphibians.org/resources/asg-members/. If for some reason this cannot be done, contributions will be reviewed by at least one individual within the ASG. *FrogLog* is not a peer reviewed publication and the onus for submitting accurate information remains with the authors.

Production Editor

James P. Lewis (jplewis@amphibians.org)

Editorial Committee

James P. Collins (ASG Co-Chair)
Claude Gascon (ASG Co-Chair)
Phillip J. Bishop (ASG Deputy Chair)
Robin D. Moore (ASG Program Officer)
Craig Hassapakis (Co-editor, Amphibian and Reptile Conservation)
Additional reviewers will be requested as require

Submission of Manuscripts

Manuscripts can only be received as electronic files. Text should be submitted in MS Word format and may contain tables, but figures should be sent as a separate attachment where possible. All documents should be sent to James Lewis at jplewis@amphibians.org. Each file should be labeled in a style that illustrates clear association, i.e., authors_name_ms and authors_name _figure1.

Guidelines for Authors

All manuscripts must be written in English.

Title

Titles should ideally be no more than 15 words.

Authors

Authors names should be written in full as follows: By James P. Lewis & Robin D. Moore

Main body of text

Use Georgia 11-point font. Genus and species names should be in italics as should the abbreviation for *Batrachochytrium dendrobatidis*, *Bd*. Suggested headings include Acknowledgements, Author Details, and References and Notes.

Author details

Author details may be provided including affiliations and contact details.

Figures

Figures should be numbered and include brief, concise legends. Where photographs or illustrations are used please state whom the image should be credited to, e.g., Photo: James P. Lewis. Graphics should preferably be submitted in tiff or jpeg format in the highest possible quality. Resolution should be at least 300 dpi at the final size.

Tables

Tables may be included within the text file and should be numbered and include brief, precise legends.

Citation of literature

FrogLog uses a numbering system for references and notes. This allows explanatory or more detailed notes to be included with the references. Journal names are abbreviated using common abbreviations to save space.

Journals/Periodicals

1. E. Recuero, J. Cruzado-Cortés, G. Parra-Olea, K. R. Zamundio, *Ann. Zool. Fenn.* **47**, 223 (2010).

Books

2. J.Gupta, N. van der Grijp, Eds., Mainstreaming Climate Change in Development Cooperation (Cambrdige Univ. Press, Cambridge, UK, 2010).

Technical reports

3. G. B. Shaw, Practical uses of litmus paper in Möbius strips (Tech. Rep. CUCS-29-82, Columbia Univ., New York, 1982).

Paper presented at a meeting

4. M. Konishi, paper presented at the 14th Annual Meeting of the Society for Neuroscience, Anaheim, CA, 10 October 1984.

Published Online Only

5. N. H. Sleep, Geochem. Geophys. Geosyst., 10, Q11010 (2009), doi:10.1029/2009GC002702.

Web site

6. National Oceanic and Atmospheric Administration, Beaufort Wind Scale, http://www.spc.noaa.gov/faq/tornado/beaufort.html (2012)

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