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FrogLog

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Promoting Conservation, Research and Education for the World's Amphibians

Protecting the Lower Kinabatangan Floodplains

Using Story Maps to Increase Awareness and Promote Conservation

Recent Publications

And Much More!

The Yellow bush frog (*Philautus neelanethrus*). Photo: Angad Achappa.

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FrogLog

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Editorial

Dear FrogLoggers,

The *FrogLog* family is continuing to grow! Please join me in welcoming the newest member of our Editorial team: Lindsay Renick Mayer. Lindsay has been an amphibian fanatic from a young age, learning to love our little friends from her home in Wisconsin. She has worked for The Nature Conservancy and the Smithsonian's National Zoo, where she led the communications efforts for the Panama Amphibian Rescue and Conservation Project and is particularly passionate about using colorful stories to inspire conservation action.

FrogLog itself is also evolving, with Lindsay, Craig, Laurence and myself working hard throughout the upcoming months to develop its new look and expanded focus.

Inside the pages of this edition you will learn how research on microhabitat differentiation between two treefrog species may actually reveal the cause of population declines in the Endangered *Hyla suweonensis* in Korea. You can also read about how a multi-institutional effort stopped the construction of a hydroelectric power plant that threatened the Critically Endangered Red-belly toad in Brazil. And you can even learn how to use a simple tool called a story map to increase awareness and promote amphibian conservation efforts.

As the ASA continues to drive forward, it is scaling up funding for amphibian conservation, research and education, including the recent launch of the new ASA Seed Grant program. Seed Grants are normally provided in amounts ranging from USD $500-$1,000 and are designed to help kick start projects or allow teams to try new innovative approaches to address amphibian conservation, research and education challenges. We accept and review Seed Grants all year, however grants are announced only four times a year in *FrogLog*. As such, we are excited to announce the winners of the first round of ASA Seed Grants on page 4 and another open call for Seed Grant applications. Full details and an online application form can be found on www.amphibians.org/seedgrants.

The ASA is also spearheading response to combat the spread of the chytrid fungus (*Batrachochytrium dendrobatidis*, *Bd*) and ensure a future for the frogs of Madagascar is the ASA. The strategy involves pursuing the most promising techniques for mitigating the fungus in the wild. Probiotic disease mitigation for wildlife is a new conservation frontier and amphibians are at the leading edge of this novel research. Don't miss the update on progress so far found on page 7.

But for let's now turn the page and hop right in!

Candace M. Hansen-Hendrikx
Editor-in-Chief

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FrogLog

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The Alliance—Scaling up Funding for Amphibian Conservation, Research and Education

In the last edition of the Amphibian Survival Alliance's magazine, *The Alliance*, we provided for the first time a set of metrics to help our supporters and partners track our progress. The metrics presented were: Hectares Protected (5,860), Grants Awarded (10), USD Invested (318,510.22) and Priority Species Supported (11). If you would like to learn more about the work we have supported to date please download and share the latest edition of *The Alliance*, which highlights in a compelling narrative the incredible impact that we can have as a community dedicated to saving amphibians worldwide.

Since publication of the first edition of *The Alliance* we have dispersed a further $60,000 in 4 grants. The bulk of this funding has gone to supporting important work to mitigate and monitor the impact of the deadly amphibian chytrid fungus, *Bd* in Madagascar, where the fungus was only recently detected for the first time. Later this year a workshop is being convened to develop a strategy for collaborative conservation of amphibians in Madagascar. We have helped to secure over USD$30,000 to date and welcome inquiries from anyone interested in supporting this extremely important meeting.

As the Alliance continues to grow we hope to build upon our fundraising successes and diversify the projects that we are able to support. Our first funding mechanism is the Leapfrog Conservation Fund (LCF). LFC is a major step forward for the conservation of critical habitat for amphibians and has already supported five projects working towards the protection of over 50,000 hectares of important amphibian habitat.

We have secured funding for a Seed Grants program to support coordinated research and provide small travel grants. We have long had our sights on developing such a program, as we feel this type of funding facilitates the development of innovative approaches to amphibian conservation and often leads to leveraged funding and long-term programs. Our Seed Grants will typically be awarded at the USD$500–1,000 level.

We expect to receive far more Seed Grant applications than we can fund. In order to help connect unsuccessful, but strong, proposals, with potential donors and partners we will be developing a simple online map to showcase all the project proposals that we receive, with further information on each project. Visit the Seed Grants page to learn more about this initiative and apply for funding.

Do you think Seed Grants are important for the future of amphibian conservation, research and education? Are you interested in supporting a Seed Grant or establishing a fund to support these activities? Send us an email and we can arrange a time to talk.

We are now thrilled to be able to announce the winners of the first round of ASA Seed Grants:

1. Habitat restoration of Centrolenidae at Itapoa Tropical Rainforest Reserve
2. Enhancing amphibian survival through education, awareness and forest rehabilitation in Kitobo Forest, Taita County, Kenya
3. Environmental education for the conservation of amphibians and its habitat in 5 rural communities in Nayarit, Western Mexico

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amphibian survival alliance

Habitat Restoration of Centrolenidae at Itapoa Tropical Rainforest Reserve

By Nick Pezzote

Ecuador is one of the most important countries of the world for research and conservation of amphibians because of its exceptional diversity and high levels of endemism (527 species of amphibians described, plus about 200–250 species awaiting descriptions, 207 endemic species, 41% of endemism). Diversity of amphibians in Ecuador represents about 7.4% of the world's amphibian diversity. Despite this high diversity, amphibians have been affected by numerous threats, which have resulted in the possible extinction of at least 15 species and drastic declines of no less than 155 species. However, this figure may be underestimated because for many species (153) the data is insufficient.

One of the extreme examples of amphibian declines is thought to be due to chytrid fungus, climate change and trout. Also, predictions suggest that, in Ecuador, almost half of the habitats suitable for glassfrog species have been deforested (Cisneros-Heredia, 2008). For example, in Ecuador, at Yanayacu Biological Station, only three individuals of *Centrolene buckleyi* were found after an intensive 3-year inventory effort by our colleague Juan Manuel Guayasamin, suggesting that this species is quite rare at this locality (Guayasamin *et al.*, 2006). Elsewhere in Ecuador (e.g., Pilaló, Cashca Totoras, Zamorahaico) other species were formerly abundant; however, it is now nearly absent or absent from these localities (Bustamante *et al.*, 2005; J.M. Guayasamin, pers. comm. 2008). Further investigation indicates the presence of *Bd* specially affects this species as it inhabits higher altitudes.

Our project aims to save from extinction several extant species of glass frog Centrolenidae in Ecuador, inhabiting different areas of the Itapoa Tropical Rainforest Reserve, through i*n situ* breeding and management. The species included are: *Espadarana prosoblepon*, *Sachatamia albomaculata*, *Sachatamia ilex*, *Cochranella mache*, *Teratohyla spinosa*, as well as some possible other species currently not described yet to science.

The extant populations of these species are facing deforestation through all of their distribution. Given the threats these species face, *in situ* management is an urgently needed proactive solution to save the extant populations from extinction. Previous efforts to monitor breeding of *Centronelidae* have been relatively minor and unsuccessful. Thus, our objectives and activities are directed at finding additional founder breeding locations, adequately equipping the *in situ* locations (fauna monitoring, planting, if necessary, water quality testing in streams) and continually document all concepts utilized and successes obtained. With this project we will expect to see an increase in reproduction, monitor that reproduction, monitor declines and disappearances, if any, and record data that will help us better understand the overall breeding behaviors of these species.

A variety a glassfrogs inhabiting Itapoa Rainforest Reserve. From top to bottom: *Sachatamia ilex*, *Sachatamia albomaculata* and *Hyalinobatrachium colymbiphyllum*. Photo: Raul Nieto.

Enhancing Amphibian Survival Through Education, Awareness and Forest Rehabilitation in Kitobo Forest, Taita County, Kenya

By Rogers K. Makau and Dr. Patrick K. Malonza

Kitobo Forest is a ground water forest located about 10 km South-East of Taveta town in the Taita- Taveta County, Coast Province, Kenya. It is approximately 250 km inland from the coast and on the extreme lowland North-East of the Tanzanian Eastern Arc Mountain block of North Pare Mountains near the Kenya-Tanzania border. It covers an area of about 160 ha at an altitude of about 730 m above sea level.

The forest described as an "island" in a "sea" of arid lands, acts as a refuge for diverse wildlife species. It harbors 12 amphibian species belonging to four families. The *Hyperolius puncticulatus* classified as Endangered under the IUCN Red data list is the key amphibian flagship species for Kitobo forest. Other wildlife species include 29 reptiles and over 160 bird species. There are a modest variety of mammals in and around the forest considering its small size. These include; Monkeys,Wild pigs, Bushbuck, Hippopotamus and Leopard. For a long time, Kitobo Forest has provided fundamental ecosystem benefits to the surrounding communities such as fuel wood, timber, water, medicinal plants among others. However, the forest is increasingly threatened by human encroachment, illegal logging, forest fires and livestock grazing owing to escalating human population. These anthropogenic activities pose a great threat to the survival of amphibian species hence the urgent need for conservation action.

Communities living adjacent forests are the primary users of the forest resources. Therefore, their contribution to sustainable management and conservation of forest biodiversity is paramount. In this project we seek to promote the survival of amphibians by empowering the local communities to actively participate in conservation and management of the Kitobo Forest. Our objectives are to: strengthen the skills and abilities of Kenya Forest Service (KFS) staff and community scouts in monitoring of Kitobo forest, create awareness among the local people on the importance of amphibians and

other forest biodiversity in ecosystem balance and rehabilitate the degraded areas within Kitobo forest through reforestation.

Continued degradation of Kitobo forest will negatively impact conservation of amphibians hence the need to regularly monitor the forest to stop further destruction. KFS staff and community scouts will be trained on application of Management Effectiveness Tracking Tool (METT). The tool will enable the community and other stakeholders to identify needs, constraints and priority actions to improve the effectiveness of managing Kitobo forest.

Educational and awareness campaign will be conducted to raise awareness on amphibian conservation among the local community. Increased conservation awareness will lead to reduction in pressure on Kitobo Forest thus helping to maintain a suitable habitat for amphibian species

Rehabilitation of the forest will help to increase the forest habitat important for amphibian survival as such; we aim to plant at least 1,000 seedlings of indigenous trees.

Hyperolius puncticulatus, **the flagship species for Kitobo forest. Photo: Patrick Malonza.**

Environmental Education for the Conservation of Amphibians and its Habitat in Five Rural Communities in Nayarit, Western Mexico

By Dr. Víctor Hugo Luja Molina

Cora girls trying to capture tadpoles and frogs in Santa Teresa, Municipality of Del Nayar, Nayarit en the Sierra Madre Occidental. Photo: V. H. Luja.

Amphibians in Nayarit, Western Mexico, have been little studied. Three years ago I started a project to understand the amphibian diversity and collect both biological and ecological data of its species. During the fieldwork in rural communities (some of them have a high percentage of indigenous people) I spoke with local people about amphibians, showing pictures for visual identification and asking them about their common names, etc. The common response was fear and/or repulsion toward these animals. They only knew a few species and their knowledge about the ecology and requirements of these amphibians was scarce.

The main goal of this project is to realize activities of environmental education with local people of selected sites in Nayarit in order to increase their knowledge and awareness about the importance of amphibian conservation and the habitats needed for their survival. To further our endeavors I will work with local NGO's (Ecologizate al 100, Scout Group 1 and others) to design printed educational materials which we will use to spread the message of conservation throughout these Mexican communities.

On each site the activities will include: a photographic exposition of species of amphibians of Nayarit, audiovisual presentations inviting all individuals to participate, searching for amphibians at night with the help of local people, cleaning and habitat restoration activities and the collocation of signage *in situ*. Our expectations are that at least 150 people from each of the five localities will receive information and be involved in these conservation activities.

"In the end, we will conserve only what we love, we will love only what we understand, and we will understand only what we are taught." (Baba Dioum, Senegalese Conservationist).

Disease Mitigation Update

With a recent report of the lethal chytrid fungus *Bd* found on several frogs exported from Madagascar in the pet trade (*2*), it becomes even more imperative to search for mitigation strategies in a timely fashion. Mitigating the chytrid fungus through the use of skin probiotics is a promising conservation strategy. Amphibians house anti-*Bd* bacteria on their skins, and our approach is to identify these bacteria and treat at-risk amphibian species with locally occurring anti-*Bd* bacteria to help protect them.

Recently, a project led by Molly Bletz (Technische Universitat Braunschweig) was launched in collaboration with Reid Harris (Director of International Disease Mitigation, Amphibian Survival Alliance) and the Chytrid Emergency Cell in Madagascar to search for effective probiotics to protect frogs in Madagascar from the devastating effects of *Bd* using a selection protocol (*1*).

Jill Myers worked with Molly Bletz at James Madison University to determination which bacterial isolates from Malagasy frogs inhibit *Bd*. Photo by: Molly Bletz.

With funding from the Mohamed bin Zayed Species Conservation Fund and the Chester Zoo, two sampling trips to Madagascar have been completed to collect skin bacteria specimens and identify potential probiotics. With the assistance of in-country collaborators and students at the University of Antananarivo, more than 1,000 individuals of 120 species at 15 different locations across Madagascar have been sampled (phase 1 of the selection protocol). Back in the lab, Molly and a team of lab assistants isolated 3,506 bacterial isolates, which have been challenged against the *Bd* in laboratory assays to determine if they inhibit the pathogen (phase 2). Approximately 520 isolates from a range of frog species and locations can inhibit the growth of *Bd* by more than 95%. These isolates are excellent probiotic candidates. Currently, all isolates are being identified using molecular techniques.

With funding from the ASA, the next step is to partner with zoos in Europe and in the United States to treat Malagasy frogs with probiotic candidates in order to determine which isolates successfully colonize and persist on the frogs (phase 3). Molly has plans to begin persistence trials in collaboration with the Paris Zoo in early 2015. Plans are being made to expand these trials to other zoos. Anti-*Bd* bacteria that persist on Malagasy frogs will be excellent candidates for probiotic therapy.

References:

1. Bletz, M. C., Loudon, A. H., Becker, M. H., Bell, S. C., Woodhams, D. C., Minbiole, K. P., & Harris, R. N., Mitigating amphibian chytridiomycosis with bioaugmentation: characteristics of effective probiotics and strategies for their selection and use. *Ecology Letters*, 16(**6**), 807-820 (2013).
2. Kolby, J. E.,. Presence of the Amphibian Chytrid Fungus *Batrachochytrium dendrobatidis* in Native Amphibians Exported from Madagascar. *PLOS One*, 9(**3**), e89660 (2014).

Leapfrog Conservation Fund

The Leapfrog Conservation Fund has been created specifically to support the creation of new reserves for important amphibian habitat, or the expansion of existing reserves through local organizations. If your organization is working toward the protection of critical habitat for threatened amphibian species, we would love to hear from you.

Please visit http://www.amphibians.org/leapfrog-conservation-fund/ for more information about the fund or contact Robin Moore at rdmoore@amphibians.org with any questions.

leapfrog CONSERVATION FUND

Announcing the Creation of the Chamicero de Perijá Nature Reserve, Colombia

Cañon del Perija. Photo by: Rainforest Trust.

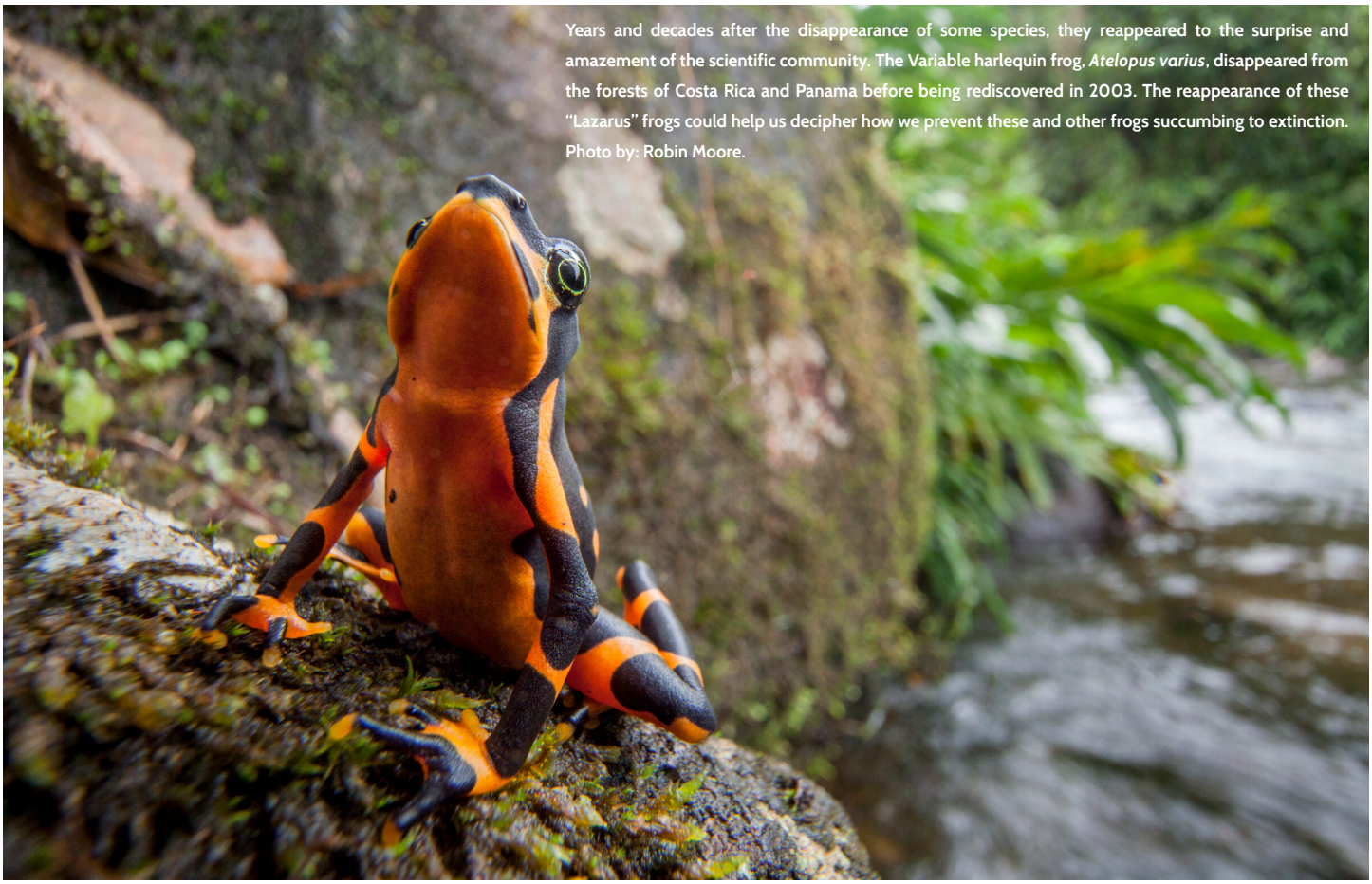
A coalition of conservation groups, including the Amphibian Survival Alliance, Rainforest Trust and Global Wildlife Conservation have joined forces to enable local partner ProAves to establish the Chamicero de Perijá Nature Reserve, the first protected area in northern Colombia's Serranía de Perijá mountain range.

In response to the looming threat of losing prime habitat for birds and amphibians—only five percent of rainforest is left on the Colombian side of the Serranía de Perijá mountain range—ProAves swiftly acquired 11 properties to establish the new 1,850-acre reserve. The reserve protects a pristine cloud forest environment that includes critical habitat for threatened wildlife. "Without this reserve, the chances are high that within a few years nothing would be left of the spectacular forests that once covered Colombia's Serranía de Perijá," said Dr. Paul Salaman, CEO of Rainforest Trust.

Due to a history of difficulties conducting research in the area, the Serranía de Perijá remains one of the least-known natural environments in the Northern Andes. Field research by ProAves has confirmed its importance as a stronghold for many endemic and rapidly declining species, including three endangered and endemic species of birds. "The new reserve is globally important, as it is recognized as an Alliance for Zero Extinction site. The incredible fauna and flora include many species found nowhere else in the world," said Dr. Wes Sechrest, Chief Scientist and CEO of Global Wildlife Conservation.

The Chamicero de Perijá Nature Reserve will protect one of the best-preserved tracts of forest remaining in Colombia's Serranía de Perijá. It also protects two watersheds that are vital for the city of Valledupar and several towns in the otherwise arid Cesar Department. "This reserve is a win for everyone. Not only is it going to be a permanent lifeline for the region's many endemic species that have nowhere else to go, but it is also a major victory for nearby cities and towns that will benefit for years from the water it provides," said Dr. Salaman.

Recurve-billed bushbird from the Serranía de Perijá. Photo by: Alejandro Grajales/ ProAves.

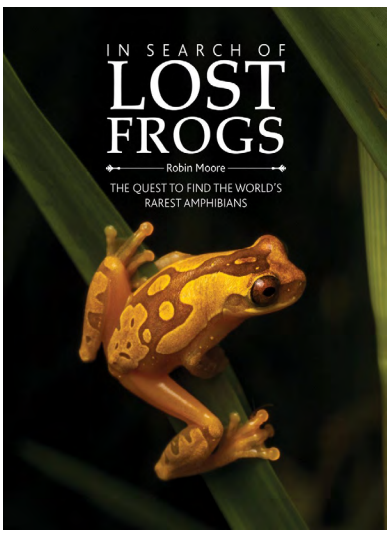


Years and decades after the disappearance of some species, they reappeared to the surprise and amazement of the scientific community. The Variable harlequin frog, ***Atelopus varius***, disappeared from the forests of Costa Rica and Panama before being rediscovered in 2003. The reappearance of these "Lazarus" frogs could help us decipher how we prevent these and other frogs succumbing to extinction. Photo by: Robin Moore.

Book Review: In Search of Lost Frogs, by Robin Moore

By Wendy Townsend

Please don't mistake Robin Moore's *In Search of Lost Frogs* for just another beautiful coffee table book. The photos and writing tell a big story—one that engages, inviting us to follow. It is a culmination of a life's work driven by passion for amphibians, and for where they live, which is just about everywhere. Portraits of amphibians show us that each frog, each salamander, is a non-human *being*. Who could not help but smile, looking at the Green rain frog, with her fingers laced and expression that's so open, or the Giant palm salamander, peering into the camera lens as though asking, "Who are you?"



Of childhood summers spent searching for frogs and their kin, Moore says, "... each year the heartbeat of the wild, untamed land pulses through me a little stronger and the belief grows that, for those who are willing to stop and listen, the amphibians have something important to say."

Indeed, they do, and with *Lost Frogs*, Moore gives them a voice.

To read this book and look at the photographs is to understand that the author's passion extends to life on earth, for we are all part of the biosphere, and everyone is affected by what happens to animals and nature. It makes perfect sense that Moore's Ph.D. is in biodiversity conservation.

Told in first person, present tense, *Lost Frogs* is a story that takes us to places where amphibians live—or not. In the United States, we ride a day and a half on horseback, into the Sierra Nevada to lakes where Mountain yellow-legged frogs are dying—where clouds of mosquitoes make head nets essential—and where one biologist has been working for nearly two decades to find out why. In Colombia we follow a stream through a steamy tropical forest to see pale green, near transparent Glass frogs, deep red Poison dart frogs, and then, a new species. In Ecuador we hike high into the Andes where the cold wind doesn't let up and the air is thin—yet humid—to spend hours following another stream, searching for the lime-green Harlequin frog.

Not only do we get to meet amphibians, but people, too, like biologists and journalists who are sometimes funny, mostly eccentric, and always utterly dedicated to their work. Photos capture joy and excitement in discovery—in a frog clinging to eyeglasses—concern and dedication—injecting a microchip to track a frog—satisfaction and pride—in discovery of a new species—and deep sadness in looking out across a land where frogs once thrived.

Perfectly woven into the story of the search, the author gives an overview of each region's natural and human history that enables a better understanding of how ecosystems have been and continue to be, impacted by human expansion, conflict, politics, and economics.

We see more clearly what happened to Haiti's environment, why parts of the Colombian forest have stayed protected, but are now threatened, and why, in Israel, a vast, beautiful lake was drained.

The sudden disappearance of frogs got people talking about amphibians as "canaries in a coal mine," but not really understanding how and why. Moore affirms that there is no "silver bullet" cure, and what's happening to frogs is a "lethal cocktail" of "habitat loss, disease and climate change," with stress as a factor in weakening immune systems, thereby decreasing the ability to fight infectious diseases like the chytrid fungus. Thus, it's clear that conservation of biodiversity is important, because it is the bio-diverse ecosystem that is best able to survive disease.

Moore's discussion of the lethal cocktail and the tenacity of fungi lets us see how we could be affected. Bats, bees, coral reefs and snakes are also dying from fungal infection. It is a solid wake-up call. But because of the positive tone and clarity of the writing, we don't feel helpless; we are inspired and ask *what can we do?*

For starters, Moore proposes a shift in attitude toward wildlife. Of a species in question, he speaks about our tendency "to ask first, 'what good is it?' before deciding whether it is worth saving."

We need to see that wild animals have the right to live for their own sakes, regardless of any value to us. Terry Tempest Williams says, "To honor wildlands and wild lives that we may never see, much less understand, is to acknowledge the world does not revolve around us."

It is a shift in attitude we can create that will energize us and make the actual work of conservation and habitat restoration totally doable. The work of conservation is going on around the world. Frame of Mind, co-founded by Moore, is one program that connects young people to their environment through photography and storytelling. It is a success story that's growing.

Perhaps the big take-away question comes from a twelve-year old Haitian girl, a participant in the Frame of Mind program who asks the Environment Minister, "What is your reforestation policy for Parc La Visite?"

Children come into the world with inherent curiosity, ready to explore. The discovery of a pond, a stream, a bit of forest—a frog, turtle, dragonfly—a squirrel in the park—fills a child with wonder, and that is a gift. It is a gift Moore wants present and future generations to have. With *Lost Frogs*, Moore opens the dialogue to us, inviting us to join the conversation and the efforts to save these delightful creatures—and ourselves.

To find out more about *In Search of Lost Frogs* or to snag your own copy, please visit www.insearchoflostfrogs.com

The La Hotte glanded frog, *Eleutherodactylus glandulifer*, is one of six frogs rediscovered after close to two decades in southwest Haiti. The frogs are a flagship of hope for the preservation of fragmented cloud forests. Photo by: Robin Moore.

Male Mountain chicken calling on a rock. Photo: Sarah-Louise Adams.

Amphibian Survival Alliance Q&A With Durrel Wildlife Conservation Trust

By [1]Jeff Dawson

Amphibians the world over are facing probably the world's most serious extinction crisis. What are your thoughts on the future prospects for amphibian conservation and preventing further extinctions?

With threats such as habitat loss continuing at rapid rates and diseases such as chytridiomysosis and ranavirus devastating local populations, amphibians are on a precipice and increased, coordinated action is required now to prevent them falling off. The level of attention given to amphibians by the global zoo and conservation communities in relation to other species groups such as mammals and birds is still very low, though I believe this is changing, albeit slowly, for the better. Durrell has been responsible for saving at least six birds and reptiles from extinction and I believe that if the global conservation community comes together and commits to amphibians then in 50 years we will be talking about successfully averting a conservation crisis.

Why did you join the Amphibian Survival Alliance?

The importance of amphibian conservation has languished for too long within the global political and conservation processes. It is vital that the profile and urgency of amphibian conservation is raised at a global level, with effective partnerships developed and the necessary resources made available. The Alliance represents a fantastic way for organisations to raise the profile of their work, to promote collaborations and new partnerships and attract the all-important funds necessary to carry out amphibian conservation. We are really pleased and excited to have joined the Allianceand work with them in our goal of preventing the amphibian crisis from becoming a catastrophe.

What are youdoing to help protect amphibians?

This year Durrell has launched our first dedicated single taxonomic programme, *Saving Amphibians From Extinction* or SAFE (www.durrell.org/safe). SAFE's mission is to secure the survival of amphibian species at 10 sites across four of the world's highest priority regions for amphibian conservation by 2020. To achieve this we will utilize Durrell's wealth of experience in field conservation, captive management and training, all underpinned and guided by the best science.

At each site we will progress through four stages—first we must understand the situation of the species in the wild (applying SAFE-checks), which will inform our conservation actions including any captive breeding needs (establishing SAFEhavens). To ensure long term sustainability and success we will develop key skills in local partners (building SAFEguards) and galvanize support and col-

[1]Amphibian Program Officer, Durrell Wildlife Conservation Trust

laboration from the international community (promoting SAFEty in numbers).

We have kicked off SAFE with a programme of work in Madagascar focussing on the chytridiomycosis threat to the country's amphibian fauna—undertaking chytrid monitoring at high-priority sites and facilitating the development of in-country captive breeding capacity, alongside our long-standing work on the Mountain chicken (*Leptodactylus fallax*) in Montserrat through the Mountain Chicken Recovery Program. We are also in the process of developing projects with local partners in the Dominican Republic, Haiti and the Tropical Andes.

One of the most important events that Durrell is co-organizing and part funding is the upcoming *A Conservation Strategy for the Amphibians of Madagascar* meeting—ACSAM2. This crucial meeting will bring together more than 70 national and international experts to review conservation efforts, gather new proposals and identify targets and actions for amphibian conservation in Madagascar over the forthcoming years.

What do you think are some of the most promising developments in the fight to prevent further amphibian population declines?

Rightly, a lot of attention is being given to trying to solve chytridiomycosis. Probiotics is a very exciting area and Durrell is pleased to be helping with this research in Madagascar. Looking at ways to manage chytrid *in situ*, such as environmental manipulation, is an important area and something we are looking to explore as part of the next stages in our mountain chicken work. Habitat loss is still the biggest threat facing amphibians globally and effective local engagement remains key.

Captive breeding training at Mitsinjo. Photo: Devin Edmonds.

What can the average person, as well as the private sector, do to tangibly and actively participate in amphibian conservation?

There are a number of ways that people and organizations can help. Firstly, by promoting amphibians—their beauty, weirdness, importance, plight—so more people know about them, understand them and come to care for them. Volunteering with local or charitable organizations engaged in amphibian conservation is a great way of actively making a contribution. Carrying out fundraising activities, donating or financially supporting project activities is probably the most tangible way that people can help, and more information can be found at www.durrell.org/Support.

Radio-tracking Mountain chickens in Montserrat. Photo: Sarah-Louise Adams.

Monitoring for chytid at Ankaratra. Photo: Jeff Dawson.

Eleutherodactylus abbotti in Dominican Republic. Photo: Jeff Dawson.

Cardamom bush frog *(Philautus cardamonus)*. Photo: Jeremy Holden/FFI.

Fauna & Flora International Joins the Amphibian Survival Alliance

It's not easy being green—in fact with nearly one-third of the world's amphibian species threatened with extinction, it's never been harder.

Amphibian conservation is proving to be one of the most important conservation challenges of this century, with alarming implications for the health of ecosystems globally.

It is well known that amphibians are indicators of environmental change and biological health. Their permeable skin absorbs toxic chemicals, which makes them more susceptible to environmental disturbances on land and in water. Breathing through their skin means they are more directly affected by chemical changes present in our polluted world—so the health of amphibians such as frogs is thought to be indicative of the health of the biosphere as a whole.

Frogs have survived in more or less their current form for 250 million years—250 million years of asteroid crashes, countless ice ages and myriad other environmental disasters and disturbances. Frogs have a natural extinction rate of about one species every 500 years, but since 1980, up to 200 species have completely disappeared.

Fauna & Flora International (FFI) has joined the Amphibian Survival Alliance (ASA)—the world's largest partnership for amphibian conservation—agreeing to support conservation actions and research to address the global amphibian extinction crisis.

"We are delighted to have Flora & Fauna International join the ASA. FFI's long tradition of achieving conservation impact in the field is exactly what amphibians need now," said Don Church, Executive Director of the ASA.

Using a priority-actions framework provided by the IUCN SSC Amphibian Specialist Group, ASA partners facilitate the implementation of conservation initiatives at all scales, from global to local.

Aldrin Mallari, FFI's Philippines Country Director, commented, "We are very happy to have found allies in ASA, to jointly address the issues of such excellent ambassador species for fragile ecosystems."

Hop on over to www.amphibians.org to learn more about how organisations like FFI and others around the world are working together within the ASA for amphibians, the environment and for people.

FAUNA & FLORA INTERNATIONAL

The ASA Jumps on Board #GivingTuesday to Raise Support for Amphibians

Giving Tuesday is a movement created to celebrate *giving* on the Tuesday following Black Friday and Cyber Monday. This third annual #GivingTuesday is on December 2, 2014 and was established by the UN Foundation and 92Y. In addition to being celebrated in the U.S., the day is celebrated in countries worldwide.

The day inspires personal philanthropy and encourages bigger, better and smarter charitable giving during the holiday season, showing that the world truly gives as good as it gets. It is a day where charities, companies and individuals like yourself join together to share commitments, rally for favorite causes and think about others.

The Amphibian Survival Alliance is the world's largest partnership for amphibian conservation. By focusing on amphibians and the sites and habitats upon which they depend, we are working with our partners to improve the quality of life for amphibians, for other wildlife and for people around the world.

On this day of giving back, the amphibians around the world need YOUR HELP too!

Why do we need to save amphibians? Because …

- they play an integral part in the food chain, acting as both as prey and predator;
- they have substances in their skin that can protect them and they could be used in treatments for a variety of human diseases such as cancer, Alzheimer's and AIDs;
- they eat pest insects which in turn benefits agriculture and may help to minimize the spread of diseases such as malaria;
- they are sensitive to environmental changes, they act as an ecological "canary in the coalmine" for humans, telling us when something is wrong in the environment around us;
- they're here today;
- they depend on us;
- they are beautiful;
- life's more fun with frogs; and because
- #FrogsNeedFriends too!

How can you help?

#GivingTuesday is about ordinary people coming together doing extraordinary things. It is the perfect time for the world to come together and show how powerful humanity can be when we unite to give on one day and feel great giving. So what can YOU do to help?

Visit http://www.amphibians.org/givingtuesday/to find out how to participate.

How do your donations make a difference?

With the help of people like yourself since 2012 the ASA has helped to protect over 5,000 hectares of critical amphibian habitat in 5 countries. We have done this through 10 Grants targeted at 8 Priority Species investing over USD$300,000 in amphibian conservation, research and education!

Fabled Frog Soap Joins the World's Largest Partnership for Amphibian Conservation

Fabled Frog Soap, a company that provides socially and environmentally responsible soap and skin products, has a keen interest in frogs—and that goes beyond the company's amphibian-themed name. As a company deeply committed to amphibians, Fabled Frog Soap has joined the Amphibian Survival Alliance (ASA) in preventing extinctions of threatened amphibians around the globe. Fabled Frog Soap donates 15 percent of its sales to the restoration and preservation of critical habitat.

Fabled Frog Soap makes vegan, palm-oil free soap and ensures that every ingredient that goes into its products requires the least amount of processing necessary. The company is steadfast in ensuring its products don't negatively impact habitat that is important to frogs and the species that share their ecosystems. As part of this commitment, Fabled Frog Soap sells deforestation-free products and seeks fair trade vendors when possible. The company's vision and the name "Fabled Frog Soap" are the work of founder Kimberly Merenz.

"The idea for the frogs came from my experience as a biologist, but likely started long before I knew what an ecosystem was," Merenz said. "While growing up at a small lake in Pennsylvania, I saw the impacts of our actions directly on the lake we played in and around. Each septic system for each house around the lake was draining into the lake. As the lake became polluted, the call of the bullfrogs on hot summer nights nearly disappeared. The lake now has a sewer system and the lake has recovered, but I wonder if the frogs have."

Like the ASA, Merenz, too, believes that frogs are the canary in the coal mine.

"What we do to our water systems we do to ourselves and future generations," Merenz said. "The frogs are the first to tell us when we have polluted our water. Without clean water, all life will cease to exist as we know it."

Each product on the Fabled Frog Soap website is paired with a featured frog, giving shoppers the chance to learn more about amphibians. The Basics Bar, for example, includes information not just about the product, but about the Riggenbach's reed frog (*Hyperolius riggenbachi*), which is found in Cameroon and Nigeria and is classified as Vulnerable by the IUCN. The company's vegan skin care products promote the *Nymphargus rosadus*, a species found in Columbia and classified as Vulnerable.

Companies such as Fabled Frog Soap make it possible for eco-minded consumers to find eco-friendly alternatives. The ASA is benefitting from Fabled Frog Soap's commitment to amphibians. When consumers support Fabled Frog Soap, they support the ASA.

Red-belly toads *(Melanophryniscus admirabilis)* at the only locality known for the species, Perau de Janeiro, municipality of Arvorezinha, Rio Grande do Sul, Brazil. Photo by: Michelle Abadie.

II Simpósio Gaúcho de Herpetologia: An Integrative Approach to Address the Challenges of Amphibian and Reptile Conservation in Southern South America

By [1,2,4]Valentina Caorsi, [2,3]Patrick Colombo, [2]Alexandre Krob, [2]Caroline Zank, [1,2]Michelle Abadie, [2]Pedro Luz, [1]Márcio Borges-Martins and [1]Laura Verrastro

Brazil has the largest number of amphibian species in the world, with 1,026 species (*1*) and counting, and the second largest number of reptiles, about 790 species (*2*), which highlights the country's extremely rich biodiversity. The southernmost Brazilian State, Rio Grande do Sul, is exceptional for the existence of two biomes, Pampa and Atlantic Forest. Many of the species from these biomes are seriously threatened by uncontrolled human activities. Losing part of our fauna could bring untold damage to many ecosystems and also potentially impact their environmental services (*3*).

One of the biggest challenges for conservation action for these groups in Brazil is the absence of integration and coordination between different areas of studies and society. The lack of a knowledge network makes the elaboration of conservation strategies for species difficult.

Aiming to integrate academy, environmental agencies, NGOs, environmental consultants and herp enthusiasts, the *Núcleo de Conservação de Anfíbios e Répteis* (NuCAR), a partnership between the NGO Instituto Curicaca and the Laboratory of Herpetology of the Universidade Federal do Rio Grande do Sul (UFRGS), organized the *II Simpósio Gaúcho de Herpetologia* (II SGH). This event is a biannual meeting of the southern South American herpetologists that are a part of the knowledge network on herpetology of Rio Grande do Sul, and it addresses the need for conservation actions. It took place from September 24th-26th, 2014 at Campus do Vale, UFRGS, in Porto Alegre.

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II SGH participants gathered at the closing ceremony. Photo by: Ariadne Angulo.

During the three-day event—with more 150 attendees—presentations on many subjects were offered, including opportunities and herpetological research scopes from several educational institutions of Rio Grande do Sul. The aim of the II SGH was to highlight ongoing projects, new information and discussions about current conservation policies for amphibians and reptiles in the state, country and the world (*4*,*5*).

The II SGH was opened with a presentation by Dr. Ariadne Angulo, currently the IUCN SSC Amphibian Red List Authority (RLA) Coordinator and Co-Chair of the IUCN SSC Amphibian Specialist Group (ASG). Her presentation provided an overview of the tools, challenges and perspectives of global amphibian and reptile conservation. In addition, the institutions involved in herpetological issues participated in a series of roundtables on environmental and conservation policies related to amphibians and reptiles. Participants emphasized the need for biologists and institutions to engage in actions to protect these groups of vertebrates. The interaction between herpetological researchers and managers of conservation units was one of the subjects discussed. Another roundtable focused the importance and richness of some herpetological collections and challenges in their care. Furthermore, during the first day of II SGH, six short courses were offered, including various topics: tadpole identification, biology of turtles, distribution modelling, alligator handling, anuran calling, methods of studies for diet analysis and photo identification in herpetology.

At the end of the II SGH the attendees approved a letter addressed to the executive, legislative and judiciary members and other regional public and private institutions committed to biodiversity conservation. This letter summarizes the reflections and discussions evoked during the event and the concerns of the participants involved with the care and protection of amphibians and reptiles of southern South America.

Additionally, attendees participated in a field trip September 27th through 28th to search for the Critically Endangered (CR) South American Red-bellied toad (*Melanophryniscus admirabilis*), an endemic species of the Atlantic Forest of Rio Grande do Sul, Brazil, at the locality of Perau de Janeiro. Representatives from UFRGS, Instituto Curicaca, Instituto Chico Mendes de Conservação da Biodiversidade and the IUCN SSC Amphibian Specialist Group partook in this trip. Following this field trip, a workshop (on September 29th) was promoted by the Laboratory of Herpetology of UFRGS and Instituto Curicaca and included several environmental networks and organizations, including the IUCN SSC Amphibian Specialist Group, Centro Nacional de Pesquisa e Conservação de Répteis e Anfíbios do Instituto Chico Mendes de Conservação da Biodiversidade (RAN-ICMBio), Secretaria Estadual do Meio Ambiente do Rio Grande do Sul (SEMA/RS), Instituto Boitatá and Fundação Zoobotânica do Rio Grande do Sul (FZB-RS). The main goal of this meeting was to create the first conservation plan for *M. admirabilis* focusing on the main threats to the species, the specific conservation actions and the organization responsible for them.

Acknowledgements

We thank the many institutions and colleagues who generously donated their valuable time to make the II SGH possible and encourage other herpetologists and students to include conservation as part of their research and conservation focus. This event was funded by Fundação de Amparo à Pesquisa do Estado do Rio Grande do Sul – FAPERGS (Procs. 1155-2551/14-2) and Programa de Pós-Graduação em Biologia Animal, UFRGS. We also thank the support of the Instituto de Biociências, Pró-Reitoria de Extensão and Instituto de Informática, UFRGS.

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The Times they are a-Changing: How a Multi-Institutional Effort Stopped the Construction of a Hydroelectric Power Plant that Threatened a Critically Endangered Red-Belly Toad in Southern Brazil

By Luis Fernando Marin da Fonte, Michelle Abadie, Thayná Mendes, Caroline Zank and Márcio Borges Martins

Brazil has today the world's richest amphibian fauna, with 1,026 species recorded (*1*). In spite of this, the cumulative tendencies suggest that richness is highly underestimated and many species are yet to be discovered. Describing this diversity is a monumental task and, for this reason, most biological aspects are still unknown. Brazil still holds large extensions of original landscapes; however, some Brazilian biomes, such as the Atlantic Forest, were reduced to a small fraction of their original distributions. As one of the world's current emerging markets, Brazil has faced recent economic acceleration with increased spatial and energetic requirements of all sorts. This new economic reality has resulted in increased exploitation of natural resources, in addition to the historical threats to the country's biodiversity.

With a largely unknown or poorly understood fauna, with many species still in the process of description, and increasing pressures on natural resources, the conservation of amphibians in Brazil is an overwhelming challenge. However, collaborative efforts between academia, government and non-governmental organizations have proven that it is not an impossible task. The case of the South-American Red-belly-toad, *Melanophryniscus admirabilis* Di-Bernardo, Maneyro & Grillo, 2006, is an emblematic example in many ways, and we believe that it can serve as a potential model for other groups involved with the conservation of amphibians.

The genus *Melanophryniscus* Gallardo, 1961 comprises 26 species distributed in South America. Most species have restricted ranges and are considered to be threatened at regional or global levels (*2*). *Melanophryniscus admirabilis* (Fig. 1) is a microendemic species known only from its type locality. It occurs exclusively along 700 meters of the Forqueta River, in a forested environment with steep slopes in the southern Brazilian Atlantic Forest (Fig. 2), in the Municipality of Arvorezinha, State of Rio Grande do Sul. Its explosive reproduction takes place in small and shallow puddles on exposed rocks of the river margins and when individuals are not reproducing, they probably inhabit the contiguous riparian forest, where they are rarely seen. Due to its restricted range (ca. 0.035 km^2), the ongoing loss of habitat quality, and because it was severely threatened by the possible construction of a hydroelectric power plant (HPP), the species is listed as "Critically Endangered" in The IUCN Red List of Threatened Species.

Melanophryniscus admirabilis was only recently discovered and described and, to date, only one population is known. In August 2010, the regional environmental agency had granted a preliminary authorization (the first of three) for the construction of a HPP in the same river, just 500 meters upstream of the only site of occurrence of the species. Although the consequences of implementation of the HPP were not fully understood at the time, we considered that they would be rather harmful for the single population of *M. admirabilis*. Until that moment, however, almost nothing was known about its natural history and its conservation status.

Therefore, in October 2010 the Laboratório de Herpetologia da Universidade Federal do Rio Grande do Sul (UFRGS) initiated a series of applied studies (Fig. 3) aiming to evaluate the potential threats to *M. admirabilis* and to assess its conservation status. We have searched for other populations in the nearby areas, totaling about seven km of forested river environments, including upstream and downstream portions within the Forqueta River. We also analyzed databases from numerous environmental studies conducted over past years in other rivers in the region, especially in the same river basin. However, despite our extensive search, we were not able to find new populations or similar locations suitable for the occurrence of the species. Funding from the Boticário Group Foundation for Nature Protection was essential in this stage.

We also carried out additional research (and we are still studying some important topics) on the natural history, genetics and ecology of *M. admirabilis*, such as diet, reproductive biology, next-generation population genetics (RADSeq) and estimation of population size (by both mark-and-recapture and genetic methods). Since the toad is a globally threatened species, we have always attempted to use less invasive methods for individual recognition (photo-identification) and DNA sampling (buccal swab).

In October 2011 we were invited to participate in the planning workshop for the "Action Plan for the conservation of amphibians and reptiles threatened with extinction in southern Brazil", organized by the National Center for Research and Conservation of Reptiles and Amphibians of the Brazilian Ministry of Environment (RAN/ICMBio). On this occasion, we were able to present the case

Fig. 1: *Melanophryniscus admirabilis* in its natural environment. Photo: Márcio Borges Martins.

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of *M. admirabilis* and to share ideas and insights with other Brazilian experts. Besides the RAN/ICMBio team, our subject matter attracted the attention of the NGO Instituto Curicaca, a long-time active organization working on conservation issues in Southern Brazil. The definition of several "actions" involving academia (UFRGS), the government (RAN/ICMBio) and the NGO (Instituto Curicaca) was the ultimate seed for the process that culminated in the suspension of the HPP license.

About one and a half years after starting our research studies, we were finally able to assess the extinction risk of the species at the regional, national and global levels (all listed as "Critically Endangered" as per the IUCN Red List Categories and Criteria). The global assessment was published first, appearing in the IUCN Red List of Threatened Species (*3*). The regional list (Rio Grande do Sul's Red List) was published in September 2013 (*4*), and the national (Brazilian Red List) still awaits publication.

Besides our scientific activities, with the strong support of the NGO Instituto Curicaca and RAN/ICMBio, we decided to jointly act also at the political level against the implementation of the HPP. The NGO played, and still plays, a very important role in these activities, once they have plenty of experience in conservation issues. The Instituto Curicaca helped to coordinate meetings and workshops to discuss matters between the scientific community, the environmental agencies (both regional and national), local prosecutors and the entrepreneurs who wanted to build the HPP.

A significant milestone during this process was the broadcasting of the struggle "frog against HPP" in the regional media. A series of reports against the frog were published in the biggest South Brazilian media, probably intending to lobby the regional environmental agency to grant the implementation license (the second of three, but the one that allows for construction). Newspapers, radio and television focused on the subject of "a small frog hindering the construction of HPP" for over a week. They emphasised that an animal "without importance" could harm the region's economic development (*5*), despite the HPP in question being a relatively small project (it would produce only about 1 MW in a reservoir with 9,4 ha surface area). Although most of what was said was against the toad, this event was very important because it brought about public awareness to this issue.

A decisive stage in this process was a Technical Meeting (May, 2014) organized by RAN/ICMBio at UFRGS, with the presence of the entrepreneurs, the environmental state agency (FEPAM), Instituto Curicaca and the Public Prosecutor's Office (Fig. 4). All arguments, in favour and against the construction of the HPP, were exposed and debated. A relevant argument against the HPP was a neglected study, conducted by the environmental agency itself, recommending the exclusion of HPPs in the area (high Forqueta River included) to preserve the river headwaters. Additionally, the

Fig. 2: Reproductive site of *Melanophryniscus admirabilis* in Perau de Janeiro, Arvorezinha, State of Rio Grande do Sul, Brazil. Photo: Michelle Abadie.

Fig. 3: Team during fieldwork searching for individuals of *Melanophryniscus admirabilis*. Photo: Márcio Borges Martins.

mitigation strategies presented by the entrepreneurs were not satisfactory. Finally, the absence of robust risk assessment analyses for the HPP installation and the serious threats imposed to the species became clearer.

So, almost four years after we decided to embark in this conservation battle, the environmental agency finally decided against granting the license, considering that the HPP's energy-generating capacity was too small and there were better and less harmful alternatives (e.g., wind turbines); the area of the HPP project is inside the region intended to preserve the Taquari-Antas River basin headwaters, and the HPP's implementation could be very harmful to the only known population of a Critically Endangered species and could lead to its extinction. Thus, in mid-2014, the implementation license was officially denied.

The whole process, from the beginning of our studies to the official decision to deny the license application, was laborious and slow. But now that we have achieved it, we can identify some crucial aspects of the process: (i) our scientific studies, prioritizing to unveil the most relevant issues for conservation, were very important to better understand the species' relations with the environment and to allow for its extinction risk assessment; (ii) the publication of its assessment as "Critically Endangered" was a key step, especially the global one, published by The IUCN Red List of Threatened Species; (iii) the involvement of the NGO Instituto Curicaca was crucial, once they have experience not only with conservation matters but also with political issues; (iv) the governmental support provided by the National Center for Research and Conservation of Reptiles and Amphibians of the Brazilian Ministry of Environment (RAN/ICMBio) was fundamental; (v) the meetings and workshops conducted had great value to discuss and to bring ideas together; (vi) the broadcasting of the problem in the regional media brought public awareness to the issue; and (vii) the involvement of a multi-institutional and committed team, combining young and experienced people, dreamers and down-to-earth minds, scientists and politically experienced practitioners was more than vital for the good progress and success of our work.

However, despite the fact that the results achieved so far are undeniably relevant to the conservation of the South-American-Red-belly-toad, all our effort is not much more than a "running to stand still" situation. To effectively conserve this rare and beautiful species, we still need to move forward. We are now exploring the possibility of creating a conservation unit encompassing the whole range of *M. admirabilis*, as well as its surroundings. Given that the area is currently used for tourist activities and that the nearby region presents farming and livestock activities, our research is now directed to better quantify the additional threats identified to the species, such as habitat loss and fragmentation, use of agrochemicals, illegal collection and other impacts imposed by the tourists, as well as the possible occurrence of diseases (e.g., chytridiomycosis). To this end, we are once again working in the same way, bringing together our team with old (NGO Instituto Curicaca and RAN/ICMBio) and new partners, such as the Amphibian Specialist Group (ASG). Nevertheless, we still have many questions on how to achieve our objectives. For instance, which is the best type of

protected area to be implemented? Who should ideally manage the area, assuming that it can be formally protected? If it can't, what are the alternatives? Furthermore, another important question is how to deal with the surrounding neighbours, who are humble and poor small-scale farmers who have always lived in that area. What could be feasible economical alternatives for them, to make it a part of the solution for the toad's conservation?

Lastly, another crucial issue that arises is how to carry out efficient environmental education without exposing the species to smuggling. Since *M. admirabilis* has a very beautiful and colorful morphological pattern, it is rare worldwide (but locally abundant in its tiny range) and it inhabits an unprotected area with easy access to tourists, we are concerned about unnecessarily exposing the species. For instance, local reports indicate that individuals were recently collected illegally, since the media reports were broadcasted in the regional press. Therefore, the main question that arises is: does the knowledge acquired from environmental education improve conservation or can lead to illegal collection? We still do not know how to answer properly all of these questions, but we expect that sharing ideas and experiences with other experts can enormously improve our ability to decide. At this time we are celebrating the fact that, this time, and through multi-institutional and collaborative efforts, the conservation of a threatened species was prioritized over unsustainable development. We hope that sharing our experience may encourage actions like this throughout the world.

Acknowledgments

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Fig. 4: Technical Meeting (May, 2013) organized by RAN/ICMBio at UFRGS to discuss the impacts of the HPP. Photo: Márcio Borges Martins.

Frog Communities in Fire-Disturbed Forests of the Peruvian Amazon

By [1,5]Eleanor Warren-Thomas, [1,2]Mary Menton, [5]Jusmell Huamán, [5]Ruth Frisancho Vargas, [1]Emma Wadley, [1]Nicholas Price and [4]Jan Christoph Axmacher

Madre de Dios, a region of Peru within the Amazon Basin, sits in one of the 25 global "biodiversity hotspots" (*1*, Fig. 1). The region contains an incredible richness of amphibian species: although it covers only 1% of the Amazon Basin by area, it is estimated to support 30% of known Amazonian herpetofauna, including 114 amphibian species (*2,3*). This area of the Amazon was hit by widespread forest fires in 2005, due to the combination of unusually low rainfall, the building of a highway, and the use of fire to clear land (*4-6*). Forest structure can be dramatically altered by fire, as large trees die and fast-growing pioneer species establish themselves (*7,8*). Such changes may affect amphibians through alterations to habitat structure, microclimate and plant species composition (*9,10*). Although this is a growing problem in moist tropical lowland rainforests (*7,8*), very few studies have assessed the effect of fire on amphibian communities in the Amazon. The aim of this study was to make a preliminary assessment of amphibian species richness, abundance and community composition in forests affected by fire during the 2005 drought, and to compare these data to nearby non-impacted forests (*11*).

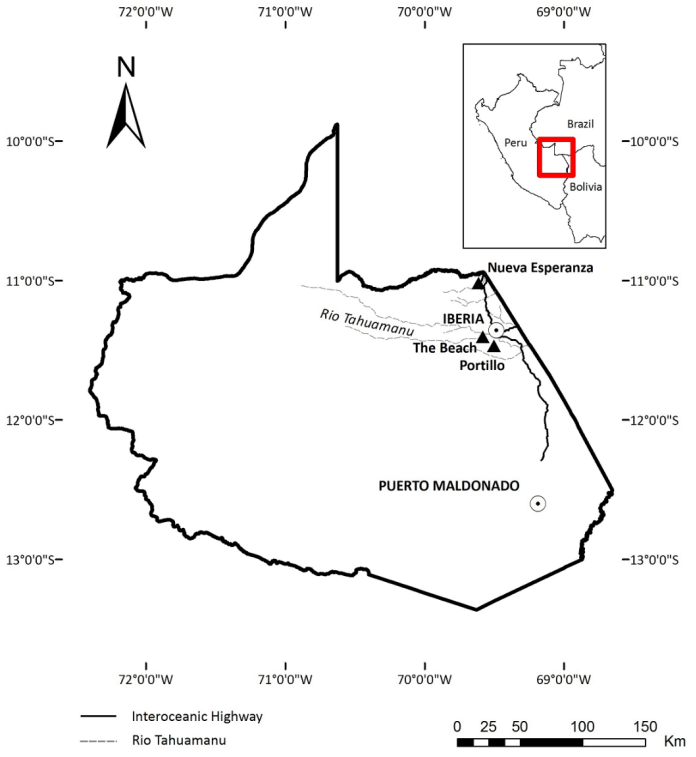

Fig. 1: Study area in the context of the tri-national border (inset) and the study sites in relation to the Inter-Oceanic Highway (shown on map as completed in 2009; subsequently extended to Puerto Maldonado).

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METHODS

We surveyed amphibians from July to August 2009, along transects and opportunistically, within burned and unburned areas of three study sites (Fig. 1; burned areas identified using satellite imagery). Four major forest types are found in this region, each supporting differing amphibian assemblages that contribute to the very high richness of species found at the landscape scale (*12*). We surveyed within two of these: two study sites were within closed-canopy terra-firme forest, and one was within bamboo forest. We also recorded a number of habitat structure variables, including the density of living and standing dead trees, the density of tree saplings, and the density of bamboo (*11*). The study sites lay outside any protected areas.

To analyze the findings we compared burned and unburned areas within each forest type (terra-firme or bamboo) in terms of: 1) species richness of amphibians, 2) the expected species richness that would be reached with further sampling, using a Jacknife species richness estimator, and 3) abundance of amphibians.

FINDINGS

We recorded 254 anuran individuals comprising 33 species along transects, and a further 39 individuals comprising 17 species opportunistically (Table 1, (see footnote regarding species nomenclature)). No individuals from other amphibian orders were encountered. Fourteen species were only found in unburned forests, while nine were only recorded in burned forest. A species accumulation curve for all anurans collected on transects does not show any levelling off, indicating that more species would be found with further sampling (*11*).

The density of living large trees was lower in burned areas of terra-firme forest (statistically significant reduction, $p < 0.05$), while there was no difference in bamboo forest. The density of standing dead trees within burned areas was higher in both forest types.

The total number of recorded anuran individuals was higher in bamboo forest than in terra-firme forest (statistically significant difference, $p < 0.05$), and within both forest types, more individuals were recorded in unburned areas than burned areas *(Fig. 2)*, although these differences were not statistically significant.

Anuran species richness was higher in unburned areas of both forest types (*Fig. 3*) but these differences were not statistically significant. No correlation could be found between recorded or estimated anuran species richness and any of the measured vegetation variables.

We found interesting differences in amphibian community composition among forest types: the majority of individuals sampled in bamboo forest were from the Hylidae (75%), while in terra-firme forest Hylidae comprised only 38%, with other families including Strabomantidae (22%), Leptodactylidae (17%), Dendrobatidae (16%) and Bufonidae (5%) comprising the remainder (Table 1). These families contain species with varying life history characteristics (*Fig. 4*). *Pristimantis peruvianus* (Strabomantidae, *Fig. 5*) was found in higher numbers in terra-firme forest (n = 15) compared to bamboo forest (n = 4), while the two Hylidae species *Hypsiboas fasciatus* (n = 61 in bamboo forest, n = 4 in terra-firme) and *Scinax icteri-*

Table 1: Species list of amphibians recorded during the study, showing the number of individuals found in each forest type. Sampling methods: O = opportunistic, T = transect, Both = individuals found both on transects and opportunistically.

Species	Bamboo (n)		Terra firme (n)		Sampling method
	Burn	Unburn	Burn	Unburn	
Allobates conspicuus	0	0	0	1	O
Ameerega hahneli	1	6	1	0	T
Ameerega petersi	0	1	0	0	T
Ameerega trivittata	0	0	4	2	Both
Chiasmocleis bassleri	0	0	1	1	Both
Chiasmocleis ventrimaculata	1	0	0	0	T
Teratohyla midas	0	1	0	0	O
Dendropsophus acreanus	0	0	0	1	O
Dendropsophus allenorum	1	0	0	0	T
Dendropsophus koechlini	1	2	0	0	T
Dendropsophus leali	0	2	0	0	T
Dendropsophus leucophyllatus	0	1	0	1	T
Dendropsophus parviceps	0	5	1	3	T
Dendropsophus schubarti	2	3	0	0	T
Dendropsophus xapuriensis	0	0	0	1	T
Elachistocleis bicolor	6	1	1	0	Both
Eleutherodactylus sp.	1	0	0	0	T
Engystomops petersi	0	0	0	1	O
Hamptophryne boliviana	0	9	0	0	T
Hypsiboas fasciatus	31	37	3	1	Both
Hypsiboas lanciformis	0	0	1	0	O
Hypsiboas sp.	0	1	0	0	T
Leptodactylus andreae	4	0	0	10	Both
Leptodactylus cf. *petersii*	0	1	0	0	T
Leptodactylus lineatus	0	0	2	0	T
Leptodactylus rhodonotus	0	1	0	0	O
Leptodactylus sp.	1	0	0	0	T
Oreobates quixensis	0	0	1	0	T
Osteocephalus cabrerai	0	0	0	1	T
Osteocephalus leprieurii	0	0	3	1	T
Osteocephalus sp.	0	0	4	2	Both
Phyllomedusa palliata	1	2	0	1	T
Pristimantis peruvianus	1	3	6	17	Both
Ranitomeya cf ventrimaculata	0	0	0	3	T
Rhinella margaritifera	0	5	3	0	T
Scarthyla cf. *goinorum*	1	0	0	0	O
Scinax garbei	3	2	0	0	T
Scinax ictericus	16	15	1	1	Both
Scinax pedromedinae	0	1	0	0	T
Scinax ruber	1	1	0	0	T
Trachycephalus venulosus	1	0	0	0	O

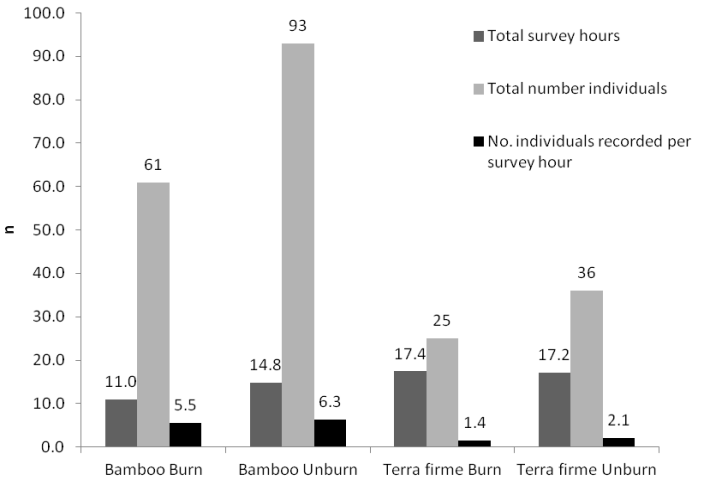

Fig. 2: Anuran abundance: three bars represent the number of survey hours in each forest type, the number of individuals encountered in each forest type (sum of all surveys) and the number of individuals recorded by survey hour.

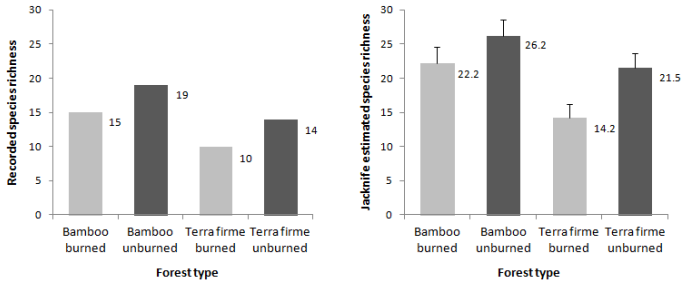

Fig. 3: Anuran species richness: the recorded species richness is shown in the left panel, and the Jacknife estimated species richness in the right panel, for each forest type. The error bar on Jacknife estimated species richness represents the calculated standard deviation.

cus (n = 26 in bamboo forest, n = 1 in terra-firme) were much more abundant in the bamboo forest. These two species represented a substantial proportion of the total individuals in the bamboo forest and contributed considerably to the difference in species composition between the forest types (Table 1).

IMPLICATIONS

Although we found that burned areas of both forest types supported lower species richness and abundance of anurans, these differences were not statistically significant. However, our data analysis suggests that actual amphibian diversity at these sites may be higher than we recorded. This is supported by long-term studies within protected areas of Madre de Dios that found up to 67 anuran species at a single site (*2*); in this context, our list of 42 species recorded in such a short sampling period highlights the exceptional species richness at our study sites, even after disturbance events such as the 2005 fires.

All of the species we found are known to be tolerant to habitat modification, and even in unburned areas, we found no primary forest specialist species. This suggests that our study sites might lay within transition zones, rather than within core areas of burned and unburned forest. We also recorded some highly generalistic species, such as *Elachistocleis bicolor*, a species we found only in bamboo forests and more often in burned areas. This species has previously been recorded in burned and grazed savannah habitats

Fig. 4: Anuran families recorded during sampling, with representative species: a) Bufonidae – the true toads b) Dendrobatidae – poison dart frogs c) Strabomantidae – diverse group, all species thought to be direct-developing d) Hylidae – tree frogs and allies e) Leptodactylidae and f) Microhylidae – large and diverse groups containing many different guilds. Photos: Eleanor Warren-Thomas.

(*13*) so might act as an indicator for habitat modification.

We suggest that to fully assess the impact of forest fire on amphibian communities, particularly on primary forest specialists, more extensive sampling over a wider spatial scale between unburned and burned areas stretching over a large number of survey nights is required. We suggest that differences in species richness and community composition may become clearer with a study extended in this way.

Our results support previous work (*12*) that highlights the importance of identifying distinct forest types when conducting amphibian studies in this region. We also highlight the conservation value of forests degraded by a burn event, and of associated transition zones, as even in this short study a large proportion of anuran species known within the region were recorded. This is of particular interest for those species that have so far only been recorded outside of protected areas in Madre de Dios, such as *Ranitomeya* cf *ventrimaculata* and *Osteocephalus buckleyi* (*14*).

In summary, we hope to highlight the value of burned and degraded forests for species richness in this exceptional place, and hope to stimulate further interest in surveying amphibians outside of protected areas in Madre de Dios.

Acknowledgments:

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Community (Antonio & family) and Villa Primavera Community (Vanesa Sharmelly & family) who allowed us to live and work in their homes, to Mercedes for liaising with the communities on our behalf, Rina Grifa Juriuchi for providing exceptional support in the field, and the many others who helped us in Iberia and Iñapari. We gratefully acknowledge the work and expertise of Jorge Rios del Aguila from Iberia, who identified the local names of all of the trees and saplings for this study (full details in RGS report), and Moises Barbosa de Souza from Universidade Federal do Acre, who assisted with the identification of some difficult anuran species.

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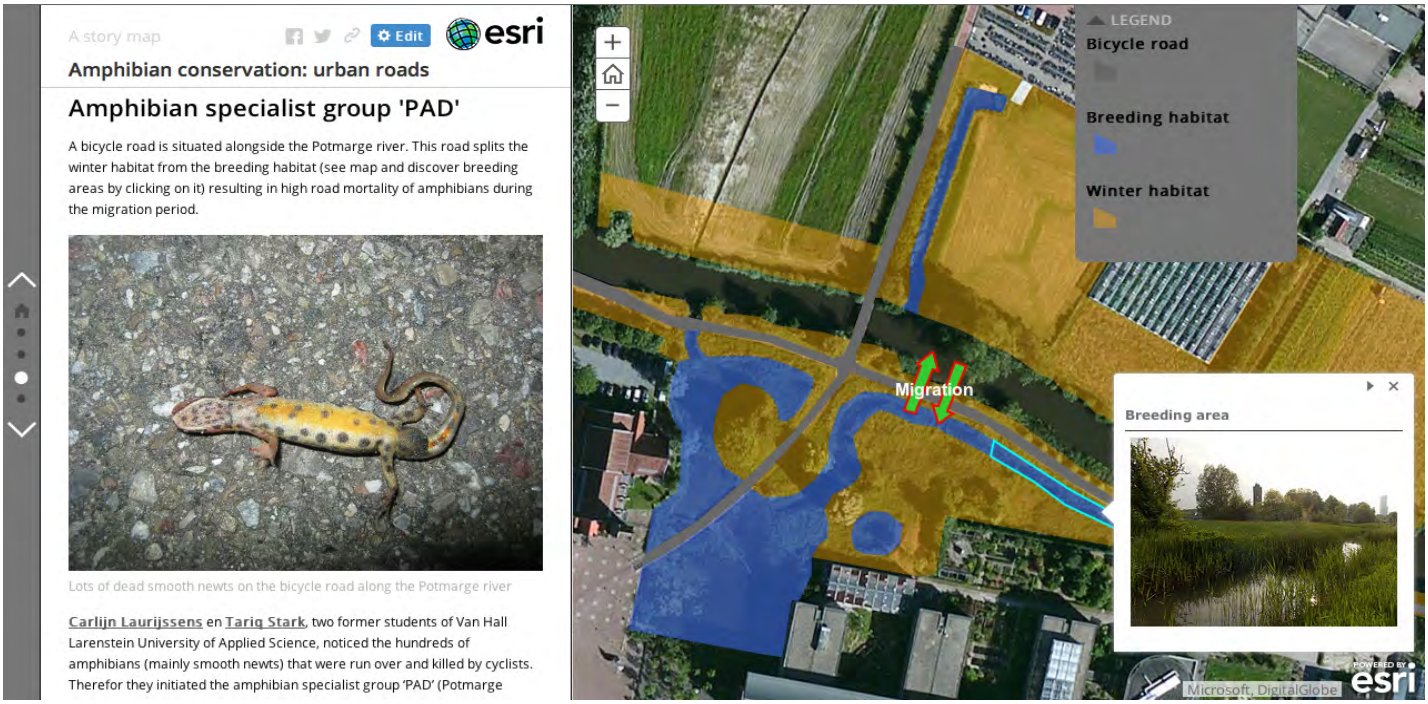
Footnote:
Species and family names in this article were cross-referenced with the Amphibian Species of the World Database in 2009, and have not been updated to reflect recent taxonomic changes (i.e., Frost, 2014)(*15*), to reflect the findings as published in *Herpetological Bulletin* (*11*). Key differences in nomenclature relative to Frost (2014) include the use of the family Strabomantidae, which is now considered part of the family Craugastoridae, and the identification of an unknown *Eleutherodactylus* species, a genus name that is no longer used in the study region. *Leptodactylus andreae* and *Leptodactylus lineatus* are also now considered to be synonyms.

Fig. 5: *Pristimantis peruvianus*, found chiefly in terra-firme forest. Photo: Eleanor Warren-Thomas.

Using Story Maps to Increase Awareness and Promote Conservation

By Koen van Lieshout



There are now approximately 7 billion people living on our planet. While that number is still rapidly increasing, biodiversity is declining at a seemingly unstoppable rate. It is now more important than ever that people understand the problems that the world is facing. There are many tools conservationists can use to generate awareness among the general public: articles, newspapers, magazines, workshops and outreach programs. While these have traditionally helped inform the general public, a new tool that combines science and the art of storytelling is effectively helping conservationists inform people about the problems threatening the world and the projects that aim to save this wonderful planet and everything on it.

My name is Koen van Lieshout and I have a Bachelor's of Science in wildlife management. GIS, herpetology, human-wildlife conflicts and natural resource management are among my main interests. GIS (Geographical Information System) is a powerful tool that uses visual maps to solve spatial problems and to clarify complex situations. Combine these maps with the craft of storytelling and you have a perfect new tool for conservation. ESRI, the leading company in GIS software, developed this concept. They created different applications that allow users to tell a story that combines text with ArcGIS online web maps, photos and videos. They call the results "story maps."

On July 3, 2014 ESRI launched a new story map application called "Map Journal." I used this application to tell a story about the connection between urban environments and high numbers of amphibian road kills. For this story I used the Amphibian Survival Alliance partner Potmarge Amphibian Connectivity Project (PAD), which transfers amphibians from one side of the road to the other to prevent road kills and organizes education programs for families and students (*1*,*2*).

In my story map a user can click on the name of a species in the text and will be directed to a webpage with additional information about that species. Or a user can click on a word in the text to view a distribution range of a species in the Netherlands, which appears in the main frame and in the same tab. Pop-ups in the map also makesit possible to view photos of the project area and breeding areas of amphibians. You can check out the result of my story here.

The map journal is an interactive tool that includes a main frame and a side frame with multiple tabs. You can add text, photos and videos in the side frame. You can also use the tabs to separate different topics and link the topics to a specific ArcGIS Online web map, photo, video or webpage in the main frame. An ArcGIS online web map can contain features with information that pops up when clicked on. It is also possible to link words in the text to webpages or web maps. You can build a map journal by downloading the template or through an online interactive builder. The interactive builder is user friendly and very straightforward—you don't need to have any knowledge about script writing to make one.

The story maps can be a great contribution to conservation. I challenge others to make similar story maps about their projects. These story maps give readers a better understanding of the problems and conservation actions that we're undertaking and will hopefully make them more aware of the serious issues that our planet is facing.

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Giants in the Anthropocene Part Two of Two: Hell-Bent on Surviving

By Matthew Charnock

Hellbenders (*Cryptobranchus alleganiensis*) are the largest amphibian found in North America, tipping the scales at nearly three kilograms. Photo: Brian Gratwicke.

Denoting an animal with a secular name often invokes feelings of divinity—or satanic thoughts. For example, the Green basilisk lizard (*Basiliscus plumifrons)* is commonly referred to as the "Jesus Christ lizard." And how did a mid-sized ectotherm garner such a name—it can literally walk across water via its highly motile, somewhat buoyant feet. But Hellbenders can't perform such spiritual acts of meniscus-aided acrobatics—they're completely aquatic. But aside from their pores, frilled exterior, these completely aquatic amphibians aren't demonic. They're not viscous, "hell-raising" creatures from the slow-moving shallows. And they sure aren't summoning demons to your next potluck. But they are victimized—and endangered. Let's part a bit of mercy on these salamanders, shall we?

The Hellbender (*Cryptobranchus alleganiensis*) is a giant salamander found in the eastern half of the United States, ranging from southern New York to northern Georgia. To date, the Cryptobranchus genus is comprised of two genetically divergent populations, the Eastern hellbender (*Cryptobranchus alleganiensis alleganiensis*), and the Critically Endangered subspecies, the Ozark hellbender (*Cryptobranchus alleganiensis bishop*). And while the Eastern hellbender is considered to be a "Near Threatened" species by the IUCN throughout its endemic range, the Ozark hellbender only occurs in the small, threatened Ozarks of southern Missouri and northern Arkansas, yet to be designated a conservation status (*1,2*).

Whether you refer to them as "snot otters," "mud devils" or by any other vernacular, there's no discrepancy in one anatomical attribute—they're enormous. And they were born that way. Straight from their yoke-laden egg sac, neonatal hellbenders can measure in excess of thirty centimeters, eventually reaching upwards of one meter by the end of their thirty or so year lifespan. In fact, the only other genus of salamanders that can eclipse these "Allegheny alligator"—my favorite common name for hellbenders, personally—are the Asiatic giants belonging to the Andrias genus, the Chinese and Japanese giant salamanders (*Andrias davidianus* and *Andrias japonicas*).

But just like their Godzilla brethren, man's shadow has quickly eclipsed their noticeable presence—and population counts. Because of our anthropogenic practices, hellbenders could become the next "EX" on the IUCN Red List. Between the acidifying, estrogen-laden waterways these animals call home and man's ever-encroaching infrastructure, the hellbender may very well be on its way toward a shared, phylogenetic purgatory—remember that celestial body I alluded to in the last segment? And we haven't even factored in the animal's high susceptibility to chytridiomycosis

But fear not, ecocentic individual—that augmenting asteroid may be pushed toward a benign trajectory. The St. Louis Zoo, located

in the state of Missouri, has successfully bred the critically endangered Ozark hellbender since 2011. This conservation milestone is a first for both species, solidifying the captive rearing and reintroduction programs to come. And with less than 600 of these animals remaining in the world, every larva reared counts. As of today, the zoo's efforts have produced in excess of 1,000 larval salamanders (3). Once these captive bred larvas begin to mature at three or so years of age, they can then be reintroduced into their endemic waterways. And with a given 15-year window for reversible, sustainable population growth, the clock is ticking—and loudly.

In this age of human-catalyzed extinction, it's imperative that we, the 7 billion or so *Homo sapiens* that inhabit this biosphere, conceptualize one sobering factoid—we're destroying our planetary home. But more importantly—we're capable of repairing it. It's the small, seemingly insignificant carbon-heavy practices that engorge our wasteful presence. If you're within earshot of a destination, walk. That plastic coffee cup you're about to mindlessly dump, recyle it. And when someone in your near vicinity commits environmental libel, lead by example—educate and correct their malpractice. In order for our children's generation to experience these gargantuan, unique amphibians, we have to cognitively change our ways. We have to shift our moral compass. And by not doing so would rob a future demographic of these evolutionary marvels. Our planet is a shared one—and the aquatic "Godzillas" or our waterways are "bell-bent" on peering through their rocky lairs from the year 2025.

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Hellbenders are adorned with what many call one of the most charismatic anatomical traits found anywhere in the animal kingdom–four to five "fingered" feet. The front forelimbs each have four stubby, quirky, seemingly insignificant toes, while the hindlimbs each contain five toes. These "toes" give the aquatic giant the ability to grasp onto its submerged landscape when the waters become a bit more turbulent. They've also been known to excavate burrows, using these anatomical assets. Photo: Brian Gratwicke.

Pictured here are three juvenile Ozark hellbenders. The species, like most aquatic salamanders, often take refuge under underlining rocks and other submerged materials. Photo: Brian Gratwicke.

Hellbenders feed on small crustacean, fish and other passing animals that are within consumable size–even their own kin. Temperature also appears to play a big hand in the animal's feeding routines–temperatures above twenty-seven or below seven degrees Celsius appear to negate any feeding response (*4*). Photo: Brian Gratwicke.

Because of their aquatic lifestyle, searching for "snot otters" requires both diligence and creativity. Field biologists often find themselves peering through the plastic lenses of marine goggles for hours, hoping to catch a glimpse of one, curiously peering out from its rocky dwellings. Photo: US Fish and Wildlife Service Southeast Region.

Red eft (*Notophthalmus viridescens*). Photo: Matt Ellerbeck.

The Salamanders of Ontario

By Matt Ellerbeck

The province of Ontario is not exactly known for its diversity of reptiles and amphibians. That being said, the region is still home to a dozen different salamander species. This makes Ontario the most salamander-diverse province in Canada. Luckily for me, I have seen (almost) all of the province's different species in the wild.

The most common species in most locations throughout the province is the Red-backed salamander (*Plethodon cinereus*). These small, lungless salamanders are common inhabitants of woodland areas. In some areas I have seen up to 100 of them during just an hour of searching. Numerous studies have found densities of these salamanders to be around 1,000 individuals per acre. Aside from being prolific, these salamanders have extremely varied colouration and patterns. Salamanders in the typical red-back phase have a red, orange or even yellow stripe running down their back. Salamanders in the lead-back phase do not have stripes down their backs. Some even seem purplish. In most regions the red-phased individuals are the most common form. However, I have visited several woodlands along the Saint Lawrence River where the lead-phased salamanders were predominant. Twice, I have even had the extreme pleasure of observing all-white (leucistic) or all-red (erythristic) forms.

I have also frequently observed the Four-toed salamander (*Hemidactylium scutatum*), another species of small lungless salamander. These salamanders are brownish or grey in color and have white underbellies speckled with black flecks. I usually encounter these salamanders in forests that are flush with various mosses, or areas adjacent to bogs or forested ponds. However, I have seen them a few times in leaf litter in wooded areas, more typical of Red-backed salamander habitat. Once I found two at the forest's edge under a piece of discarded floor laminate. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC), considers the Four-toed salamander to be rare, or at least rarely seen. This makes my numerous sightings of these diminutive salamanders that much more rewarding!

Four-toed salamander (*Hemidactylium scutatum*). Photo: Matt Ellerbeck.

Another type of small lungless salamander is the Two-lined salamander (*Eurycea bislineata*). Two-lined salamanders are a beautiful goldish yellow color with black lines running down their backs, as their name suggests. These salamanders live in or next to forested streams. In the same area where I observed many Leadbacked salamanders, there are also historical records of Two-lined salamanders. However, I have yet to see one in the wild. Given that the records are quite old, I suspect they may be extirpated from this

area. However, I did observe lots of these salamanders in an area northwest of Algonquin Provincial Park.

Two subspecies of the small Eastern newt (*Notophthalmus viridescens*) also call Ontario home: the Eastern newt and the Central newt. The Eastern newt is not a lungless salamander like the others, but belongs to the *Salamandridae* family. Most people see Eastern newts while they are juveniles and live on land, a stage called red eft. Red efts are bright orange with red spots. Many of the newts I have seen have been efts, often in damp forested areas near wetlands or ponds. Most of the adult newts I have seen were also on land, under cover close to water. During one trip to an area near the Niagara Escarpment, I came across a pond full of adult newts. They were resting and swimming along the muddy bottom amongst the vegetation. As adults, the orange colour of their red-eft stage has turned to green and they have bright yellow bellies. The red spots from the eft stage remain against the green. Their tails also become more paddle-like to facilitate swimming in this aquatic stage.

The province is also home to several species of mole salamanders, or *Ambystomatid*. Compared to the *Plethodons* and newts, these salamanders seem like giants! One of the most commonly encountered of these is the Blue-spotted salamander (*Ambystoma laterale*). These salamanders are dark in color and covered with blue speckles. I have encountered legions of Blue-spotted salamanders of times, usually under pieces of bark or fallen logs in cool forests. One campground I visited seemed to be teaming with them. I found them under door mats, tent covers, and in wood piles.

Another common mole salamander is the Yellow-spotted salamander (*Ambystoma maculatum*). This is the largest terrestrial salamander in Ontario, measuring up to 20 to 25 cm long as adults. They are dark in color with bright yellow polka dots. The number and size of the spots can range considerably. Some individuals may even have several orange spots, though I have only observed this in captive specimens from America. I have observed Yellow-spotted salamanders as frequently as Blue-spotteds. These too were often found under cover (logs, rocks, etc), next to forested ponds and wetlands.

Blue-spotted salamander (*Ambystoma laterale*). Photo: Matt Ellerbeck.

Yellow-spotted salamander (*Ambystoma maculatum*). Photo: Matt Ellerbeck.

Jefferson salamanders (*Ambystoma jeffersonianum*) are one of the province's rarest species. They are listed as Threatened by COSEWIC. Although complex forms of the Jefferson and Blue-spotted salamanders are more widespread, the true Jeffersons have a small range, only occurring in portions of southern Ontario. During one trip to the Niagara Escarpment, I had the extreme pleasure of observing 14 of these salamanders! I even often found more than one under the same cover object.

The Small-mouth salamander (*Ambystoma texanum*) is the rarest salamander species in Canada, found only on Pelee Island, Ontario, the southern-most point of the country. As the result of the species' small range and population declines, COSEWIC lists the Small-mouthed salamander as Endangered. To observe these salamanders I had to embark on a nine-hour road trip, and then board a ferry and trek another hour and a half across the water to reach the island. I was, however, rewarded by seeing six of these amazing and infrequent salamanders! Small-mouth salamanders on the island are either pure *A. texanum* or complex form with blue-spotted salamanders. I was able to see both forms.

The largest salamander species in Ontario is the Mudpuppy (*Necturus maculosus*). These amphibians can reach lengths of close to 20 inches! While most salamander species are aquatic as juveniles and terrestrial as adults, Mudpuppies are the only completely aquatic salamander in Canada. Mudpuppies are extremely cold-hardy animals, active in the cool winter waters, even under ice. One night I observed more than 100 of these salamanders as I wandered through the shallow waters of a cold stream with a flashlight. Despite their large size and their superficial resemblance to the Axoltol (*Ambystoma mexicanum*), Mudpuppies are not a species of *Ambystomatid*; instead, they belong to the *Proteidae* family.

There are only two salamander species in Ontario that I have not seen in the wild and both are Dusky salamanders (genus *Desmognathus*). The two forms in the province are the Northern dusky (*D. fuscus*) and the Allegheny Mountain dusky (*D. ochrophaeus*). Both forms only occur in small areas along the Niagara Gorge. According to COSEWIC, both salamanders are Endangered. Like the Two-lined salamander, Duskys are often found in or near streams. Although I have not seen them in Ontario, I have seen several different forms of *Desmognathus* in the southern Appalachian region. I hope to one day observe them in my native Ontario.

Ontario is home to many beautiful and interesting salamander species that comprise several different families. Each time I encounter one of these salamanders, it is a tremendous pleasure and privilege. Despite the number of species that exist here, during outreach events in Ontario, I often hear from people who attest to the fact that they had no idea that salamanders occurred here. Because people will not be supportive of conserving animals they don't even know exist, it is imperative that we bring attention to these species before they vanish altogether.

Herpetological Information Center: A Bibliographic Collection to Strengthen Research in the Mexican Axolotl

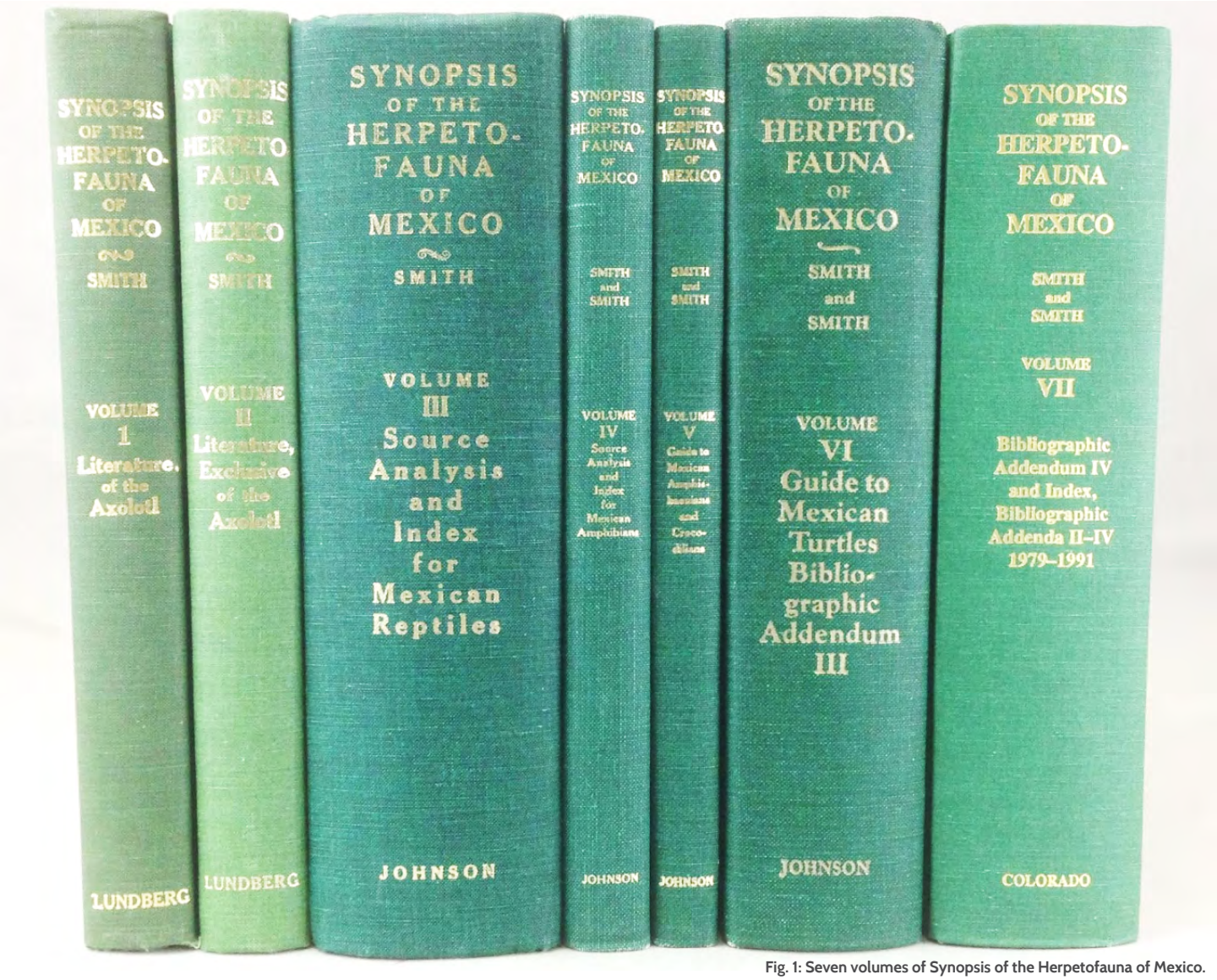

Fig. 1: Seven volumes of Synopsis of the Herpetofauna of Mexico.

By Miguel Ángel Vieyra Guzmán & Layla Michán Aguirre

The Axolotl, *Ambystoma mexicanum* (*1*), endemic to the basin of Mexico, constitutes a unique component of the natural biodiversity of the country. It has a life cycle with an inducible neotenic condition, uncommon among vertebrates. It is also part of the cultural biodiversity of Mexico being a valuable animal in the Nahuatl cosmogony as a representation of the god Xolotl, embodied in legends and being used as a theme in different expressions of traditional art (*2*).

The natural range of this species is in the valley of Mexico and it's now occupied by one of the most densely populated cities in the world. The species is in serious danger of extinction, caused by pollution of its natural habitat with sewage, drainage and filling of some channels to be used as farmland, the introduction of exotic flora and fauna and the uncontrolled capture for traditional medicine, food or as exotic pet (*3*).

It is recorded in Appendix II of the Convention on International Trade in Endangered Species, CITES (1975) which protects international trade and reduces pressure on wild populations (*4*).

The Mexican axolotl has been recorded as Critically Endangered (CR) in the International Union for the Conservation of Nature (IUCN) Red List since 2006 because it is still collected and there is increased risk of becoming Extinct in the wild due to its endemic and restricted distribution (*5*).

In the Mexican Official Norm NOM-059-SEMARNAT-2010 the species has been enlisted under category P (Endangered) since 1994 (*6*).

Similarly, the Zoological Society of London (ZSL) considers this species to be the seventh amphibian within the EDGE species i.e., in major risk of extinction and evolutionarily distinct (with fewer

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sister taxa and unusual in appearance, natural history and behavior) (*7*).

These reasons make it one of the most used species in scientific research (*8*). Proof of this includes the results of the work of the American herpetologist Hobart Muir Smith, who devoted himself to the study of amphibians and reptiles in North America, making fundamental contributions in taxonomic and ecological studies (*9*). Moreover, he has been one of the most productive herpetologists of all time, reaching a total of 1,600 works of his authorship in 2006 (*10*), noting that he has named more than 300 species and subspecies throughout his life (*11*).

One of his most important contributions to the study and knowledge of the herpetological biodiversity of Mexico is the paper he published with his wife Rozella Smith, in seven volumes under the title Synopsis of the Herpetofauna of Mexico, where they gathered all existing herpetological bibliography for Mexico until 1971 (*12*) (Fig. 1).

In particular, Volume I entitled *Analysis of the Literature on the Mexican Axolotl*, was published in 1971 and reflects his deep interest in this species as it accumulates 37.5% of all the citations contained in seven volumes. Additionally less than 2% of the literature refers to any other species, so that it is not duplicated in any of the other volumes (*13*).

On September 26th 2012, as part of the celebration of Hobart M. Smith`s 100 anniversary, the Information System of the Faculty of Sciences UNAM paid tribute to him with the opening of the Herpetological Information Center, which contains two major collections: 1) Catalog of the Library of Hobart M. Smith (a collection of literature specialized in herpetology, donated by Hobart M. Smith to the National University of Mexico in 2006) and 2) Synopsis of the Herpetofauna of Mexico. The purpose of this collection is to preserve, organize, spread, share and analyze the bibliographic records of the Synopsis of the Herpetofauna of Mexico online and conduct a general bibliometric analysis to establish its peculiarities.

These bibliographic collections are defined as a set of scientific publications systematized in a database that contains the data and metadata records of documents produced by formal scientific research. Records are stored in relational tables with a precise and standardized order, whose purpose is to collect them in an orderly fashion to facilitate storage, processing and retrieval of information. Their main advantages are: accumulation of information in little space, easy access by using search engines, submitting the results according to the user´s requirements, processing the data both qualitatively and quantitatively, and easy update by using the appropriate software (*14*).

The importance systematizing this information within the collections is that the literature is the main input or output of information for researchers and also the way that scientific knowledge is communicated, shared and evaluated. The expansion of information technologies such as computers, since the late twentieth century, followed by the digital format and Internet, have modernized the way to track, manage, organize, publish, spread and use scientific literature.

LITERATURE ON AXOLOTL IN THE INFORMATION SYSTEM OF THE SCIENCES FACULTY, UNAM

The 3,312 bibliographic records contained in Volume I of Synopsis of the Herpetofauna of Mexico are complete, standardized and available online in the Herpetological Information Center at the Information System of the Faculty of Sciences, UNAM (repositorio.fciencias.unam.mx:8080/xmlui). This collection consists entirely of articles and books published on the Axolotl *Ambystoma mexicanum* from 1615 to 1970, according to the work of Dr. Smith (Fig. 2).

BIBLIOMETRIC ANALYSIS OF THE COLLECTION

1,945 authors were identified, from which:

- 634 (32.59% of all authors) are considered core authors and have more than one publication; their contribution corresponds to 67.19% of all publications.
- 10 (5.65% of all authors) are the primary core authors and have more than five publications; together account for 31.28 % of the publications.
- The highest proportion (67.4% of authors) have a single publication.

For the analysis of the years of publication, a series of graphs were drawn. The first comprises four centuries (Fig. 3), then, in order to facilitate visualization there were drawn graphics for the nineteenth and twentieth century.

In the seventeenth century, it is possible to identify the beginning of publications on *Ambystoma mexicanum*. It is worth mentioning that even if the first reference corresponds to 1615 by Francisco Ximénez, this is the translation of a work written long ago by Francisco Hernandez de Toledo, based on his expeditions in central Mexico between 1570 and 1587 being the first scientific work of natural history in America that refers to amphibians and reptiles.

In the nineteenth century, the number of publications is 600.

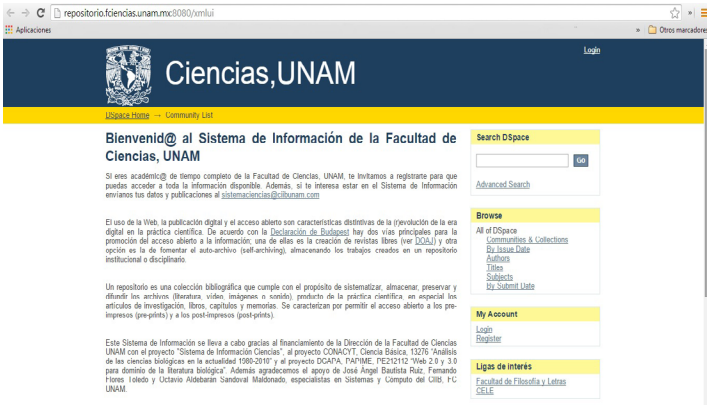

Fig. 2: First record from Volume I Analysis of the literature on the Mexican axolotl available online in the Herpetological Information Center at the Information System of the Faculty of Sciences, UNAM.

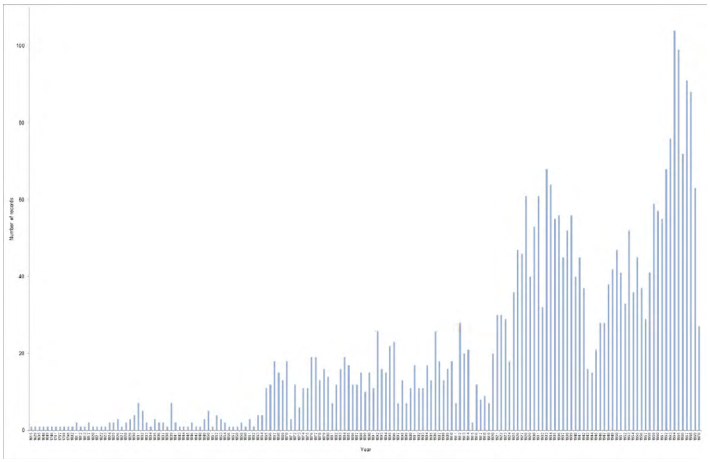

Fig. 3: Years from 1615 to 1970, in which at least one work on Mexican axolotl was published, according to Smith & Smith (1971).

Starting from 1820, there are reports for all years except 1840, 1842 and 1855. The minimum number of publications in one year is one and the maximum is 26 (in 1892). In 1863 the first shipment of live specimens to the Museum of Natural History in Paris, triggered an important rise of publications, which continued until 1970, at the end of the temporal coverage of this volume (Fig. 4).

In the twentieth century, the total number of publications is 2,703. Publications exist for every single year; the minimum number of publications per year is one in 1915 and the maximum is 104 in 1964. Effects of the First and Second World Wars (1914–1918 and 1939–1945) are very evident in publishing in general, which is reflected in the literature on the axolotl. Finally, the most widely used language in these records is English, followed by German and French (Fig. 5).

Based on the above results, it is undeniable that the Volume I of *Synopsis of the Herpetofauna of Mexico* in the Herpetological Information Center, is the most complete, open, historical collection of literature on *Ambystoma mexicanum* online, until 1970. This collection also has the widest temporary coverage (355 years), spanning four centuries, contributing significantly with more literature to the knowledge about *Ambystoma mexicanum* than any other database available nowadays.

In this work, the records were enriched during the capture process with identifiers such as the number of volumes to which they belong, allowing to recognize records found in any of the other volumes, integrated in the Herpetological Information Center. Similarly the reference number assigned by Smith and Smith in the book was included.

For some records, the link to the full text document was included in Portable Document Format (PDF).

For the study of the herpetofauna of Mexico it is imperative to strengthen scientific research through unconventional methods including bibliometric research. This one provides resources as well as systematized, organized and accessible information to determine the status of the research to generate new knowledge about the species of amphibians and reptiles.

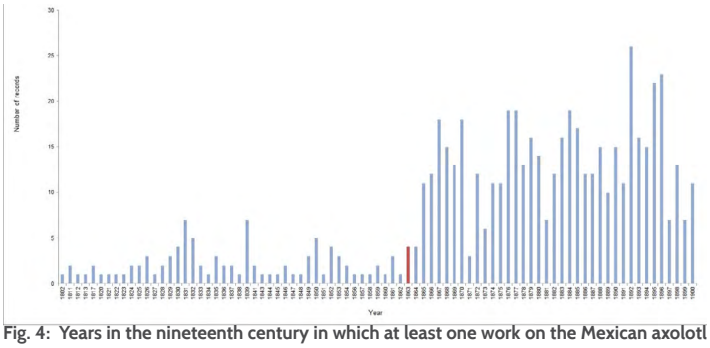

Fig. 4: Years in the nineteenth century in which at least one work on the Mexican axolotl was published, according to Smith & Smith (1971). In red, the year of arrival of live specimens to the Natural History Museum of Paris.

Fig. 5: Years in the twentieth century in which at least one work on Mexican axolotl was published according to Smith & Smith (1971). In black, the beginning years of the First and Second World War.

Achieving this involves knowledge, applies and generates the most suitable technologies for the use of bibliographic collections such as the training of professionals specialized in its use.

Acknowledgments:

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2014 Year of the Salamander

Salamander News

No. 10 October 2014

www.yearofthesalamander.org

Partnerships for Conservation: It Takes a Village

By Lindsay Renick Mayer, The Nature Conservancy

The Nature Conservancy and the Maryland Department of Natural Resources joined forces to protect tiger salamander habitat in Maryland. The population is rebounding. Photo by Brian Gratwicke, Smithsonian Conservation Biology Institute.

It had all of the trappings of a devastating conservation tale: a population of the state-rare Eastern Tiger Salamander (*Ambystoma tigrinum tigrinum*) had plummeted after human disruption to critical breeding habitat in Maryland. The Maryland Department of Natural Resources couldn't move quickly enough to purchase the property when it went on market. And while The Nature Conservancy's Maryland/DC chapter could move fast, the private organization didn't have the herpetological expertise to ensure population recovery.

It was only by working together that the DNR and The Nature Conservancy turned the story around. The Nature Conservancy purchased the land and held it for the state until the DNR could purchase it. Because the property was adjacent to state-owned property, the DNR had site-specific management expertise and removed invasive trees and herbaceous species from the wetland basin. That was nearly 20 years ago. Today the success of that partnership is evident. Last winter the DNR counted more tiger salamander egg masses than the state agency had surveyed since 1990.

The Nature Conservancy has a long history of partnering with both public and private organizations to most effectively protect animal and plant species, habitat, and even whole ecosystems. The Conservancy's Maryland/DC and Virginia chapters have been protecting habitat in both the Chesapeake Bay and Appalachia, which is home to the most biodiverse community of salamanders in the world. Nearly 14 percent of the world's

continued on p. 5

The Newt that Crossed the Road

By Tariq Stark

What happens in spring when a small, fragile creature like a newt crosses the road to reach its breeding pond? You may have guessed it: this tiny amphibian does not mix well with cars, scooters, mopeds, or even bikes. Still, the newt has no choice other than to cross it if it is to participate in that year's breeding season. In that annual effort, lots of

A male Common Newt making its way across the road to its breeding water. Photo: Tariq Stark.

continued on p. 4

Inside:

sponsored by PARC - Partners in Amphibian and Reptile Conservation

Get Your October Photo Contest Calendar - Free!

Is that really a salamander? Yes, it's an **Everglades Dwarf Siren** (***Pseudobranchus axanthus belli***), found by this month's winning photographer, **Josh Young**. Take a closer look and see our sticky but charming runner-up, go to **http://www.parcplace.org/images/stories/YOSal/YoSalCalendarOctober.pdf.**

Call for Photos for the 2014 Year of the Salamander Calendar Photo Contest

We are seeking close-up, digital photos of salamanders, preferably in their natural habitats or within an educational or conservation context. One winner will be selected each month to be the featured photo as part of the Year of the Salamander online calendar. Runner-up photos will also be included in the calendar. In addition, all submitted images will be considered for use in the Year of the Salamander monthly newsletter and website as well as other Year of the Salamander-related conservation, outreach, and educational efforts. Give us your best shot! For more information and for entry details, please visit **http://www.parcplace.org/images/stories/YOSal/YOSphotocontest.pdf**.

Year of the Salamander Podcasts Coming Soon!

Podcasts will soon be posted on the Year of the Salamander webpage (**www.yearofthesalamander.org**). Check the site for details in September.

Get your Year of the Salamander 2014 Gear!

Go online to the PARCStore (**http://www.cafepress.com/parcstore**).

Ready to gear up for Year of the Salamander? We've got you covered!

At the Café Press PARCStore, you can find just about any style of t-shirt, sweatshirt, or hoodie, for men, women, or children. But don't stop there - you'll find a messenger bag, field bag, aluminum water bottle, even a beach towel (in case you want to join the salamanders crawling out of that primeval sea).

And take a look at the beautiful **Year of the Salamander Wall Calendar**, full of fantastic salamander photos for every month of your year!

Proceeds from sales go to the Year of the Salamander Conservation grant, managed by Amphibian and Reptile Conservancy, a not-for-profit organization that helps support PARC activities, such as public education, publications, and research.

September Newsletter Content Coordinator: Candace M. Hansen-Hendrikx, Amphibians.org
Design and layout: Kathryn Ronnenberg, U.S. Forest Service, Pacific Northwest Research Station
Salamander News Facilitator: Tom Gorman, Virginia Tech
Year of the Salamander Committee Chair: Mary Beth Kolozsvary, Siena College

Year of the Salamander Collaborating Partners

The Year of the Salamander Planning Team is pleased to welcome the following organizations to our growing list of collaborating partners:

The Nature Conservancy
Protecting nature. Preserving life.®
www.nature.org

The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends. We achieve this mission through the dedicated efforts of our diverse staff, including more than 600 scientists, located in all 50 U.S. states and more than 35 countries; with the help of our many partners, from individuals and governments to local nonprofits and corporations; and by using a non-confrontational, collaborative approach and staying true to our five unique core values.

Crawford Park District www.crawfordparkdistrict.org

The Crawford Park District, located in north-central Ohio, is focused on preservation through education. We seek to raise awareness and appreciation for the environment by offering programs to people of all ages. Education today.....Preservation tomorrow.

New Jersey Audubon www.njaudubon.org

The New Jersey Audubon Society is a privately supported, not-for profit, statewide membership organization. Founded in 1897, and one of the oldest independent Audubon societies, New Jersey Audubon has no connection with the National Audubon Society. New Jersey Audubon fosters environmental awareness and a conservation ethic among New Jersey's citizens; protects New Jersey's birds, mammals, amphibians, reptiles, other animals, and plants, especially endangered and threatened species; and promotes preservation of New Jersey's valuable natural habitats. New Jersey Audubon Education department has been coordinating Amphibian crossing with other partners since 2003 and New Jersey Audubon Stewardship Department performs and/or assists with large-scale habitat restorations on private and public lands for a variety of wildlife including enhancing and /or restoration vernal pool and other wetland/woodland habitats across NJ. Salamander species that benefit from these restorations include Spotted, Jefferson, Long-tailed, Marbled, Eastern Tiger, and Blue-spotted Salamander.

The Friends of the Cache River Watershed http://friendsofcache.org/

The Friends of the Cache River Watershed is a non-profit citizens' group that promotes natural resource conservation throughout the Cache River Watershed in southern Illinois. We work together with landowners and members of the Joint Venture Partnership, which includes Ducks Unlimited, Inc., Illinois Department of Natural Resources, Natural Resource Conservation Service, The Nature Conservancy and the U.S. Fish and Wildlife Service. Together we share a common goal to protect and restore 60,000 acres along a 50-mile corridor of the Cache River.

Nature Abounds
www.natureabounds.org

Nature Abounds is a national 501c3 non-profit organization that's focus is bringing people together for the planet, specifically through environmental volunteerism and stewardship. Among Nature Abounds' programs are IceWatch USA, Watch the Wild, the Senior Environment Corps, Turtle Ambassadors, Climate Change Ambassadors, and Knitters for Nature's Critters.

Alaska Herpetological Society
www.akherpsociety.org

The Alaska Herpetological Society is a nonprofit organization dedicated to advancing the field of Herpetology in the State of Alaska. Our mission is to promote sound research and management of amphibians and reptiles in the North, to foster responsible pet ownership and to provide opportunities in outreach, education, and citizen science for individuals who are interested in these species.

Reptile, Amphibian and Fish Conservation Netherlands (RAVON)
http://www.ravon.nl/En/tabid/376/Default.aspx
http://www.sosvuursalamander.nl/en-us/home.aspx

The aim of RAVON is to increase the number of sustainable populations of amphibians, reptiles and freshwater fish in the Netherlands. Our work is based on research and uses best conservation practices. As an independent NGO, we also influence regional and national policy to achieve this goal. We collaborate closely with universities and other NGOs and we are supported by more than 2,000 volunteers in collecting long-term population data.

We are still recruiting partners! If you are interested in contributing to the Year of the Salamander efforts, please send an email to **yearofthesalamander@gmail.com** with a brief description of your organization and its efforts. Our full list of partners can be found at **http://www.parcplace.org/news-a-events/2014-year-of-the-salamander/68-uncategorised/281-year-of-the-salamander-partners.html**

Follow all of the Year of the Salamander news and happenings on Facebook (https://www.facebook.com/YearOfTheSalamander2014) and Twitter (@YOSal2014).

The Newt that Crossed the Road, *cont. from p. 1*

newts lose their lives or are severely injured by vehicles whose drivers do not notice them. Both Old- and New-world newts and salamanders face this challenge every year (sometimes even twice, when they migrate to their summer habitat, but usually with fewer casualties). The case for newts in the Netherlands, a country riddled with roads, is no different.

Carlijn Laurijssens checking a pitfall trap for newts and other amphibians. Photo: Tariq Stark.

Since 2012, a small but dedicated group of conservationists have been helping four anuran species and one newt species to cross a busy bicycle path during their spring migration in a very urban environment the North of the Netherlands (Leeuwarden). The project was initiated in the spring of 2011, when two of the project founders, Carlijn Laurijssens and Tariq Stark, discovered up to 20 Common (Smooth) Newts (*Lissotriton vulgaris*) a night DOR on the path [DOR means 'dead on road']. The death of these newts kick-started this project.

To help the newts, frogs, and toads cross the road, a screen and pitfall traps are placed on both sides of the road. The screens function as an obstacle for the animals and guide them toward and into the pitfalls. These are emptied twice a day (in the morning and evening), and the animals are placed in the water, safe and sound. After the breeding season, we look for larvae from June until the end of August to check up on their breeding success.

Happy and healthy larvae of *Lissotriton vulgaris*.

Common Newts and Common Toads (*Bufo bufo*) make up the majority of the total number of individual amphibians captured every year. In the three years that the project has existed, a whopping total of 1015 newts have been safely transferred to their breeding waters! Plans are already in the making to continue our efforts in 2015.

People make the project. This project revolves around the people involved! Student volunteers, people from the neighbourhood,

local kids, the Van Hall Larenstein University of Applied Sciences, and the Municipality of Leeuwarden all come together to make this project happen year after year. This year there were special lessons revolving around the local amphibians, their environment and conservation, for young children (6-12 years/old) and older kids (13-15 years/old).

Participation is key – hop to it!

The good people of the Leeuwarden municipality helping out with setting up the transect. Photo: Tariq Stark.

It Takes a Village, *cont. from p. 1*

salamander species live in Appalachia, which **extends from southern New York, down to South Carolina and over to Mississippi [1]**. *[If reading this newsletter in hardcopy or offline, see p. 4 for links.]*

In addition to helping the U.S. Forest Service acquire land in the 1970s around Mt. Rogers, which is home to several globally rare salamanders, The Nature Conservancy's Virginia chapter has helped protect more than 35,000 acres of critical natural habitat in the **Clinch Valley [2]** in southwest Virginia.

The Eastern Hellbender (*Cryptobranchus alleganiensis alleganiensis*), North America's largest salamander, lives in cooler creeks and streams in southwest Virginia. With partners such as the Virginia Dept. of Game and Inland Fisheries and the Virginia Department of Conservation and Recreation, The Nature Conservancy is managing Clinch River tributaries and land to ensure premium water quality for the hellbender and other species living downstream. Protected land in the Clinch is also providing important landscape connectivity for the high-elevation, rare Green Salamander (*Aneides aeneus*).

While The Nature Conservancy's work with partners to protect habitat throughout the Appalachian region has been an important component of conserving salamanders, so, too, are partner efforts to promote these colorful little jewels. On Earth Day this year, The Nature Conservancy and The Smithsonian Conservation Biology Institute took a public radio reporter out to **Finzel Swamp [3]**, a TNC-owned preserve and "frost pocket" in the Appalachian highlands of western Maryland.

The group spent the day catching salamanders—Eastern (Red-spotted) Newts (*Notophthalmus viridescens*), Spotted Salamanders (*Ambystoma maculatum*) and the majestic Long-tailed Salamander (*Eurycea longicauda longicauda*). While the SCBI scientist was able to talk about the specific species, The Nature Conservancy's conservation ecologist could talk about the quality of habitat for amphibians. It was a terrific partnership that told a full story, resulting in a **blog post [4]** and colorful **radio spot [5]**.

Over the next 100 years, Appalachia is expected to see an overall temperature increase between 3 and 11 degrees Fahrenheit as the result of climate change, which is bad news for animals that live in cold, fast-flowing water. The Nature Conservancy will continue working with key partners to identify and protect key components of landscapes to make them more resilient in the face of climate change.

Links:
[1] **http://www.arc.gov/appalachian_region/MapofAppalachia.asp**
[2] **http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/virginia/placesweprotect/clinch-valley-program-1.xml**
[3] **http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/maryland_dc/placesweprotect/finzel-swamp.xml**
[4] **http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/maryland_dc/explore/year-of-the-salamander.xml**
[5] **http://wamu.org/programs/metro_connection/14/04/25/searching_for_salamanders_in_appalachia**

The Nature Conservancy and the Smithsonian Conservation Biology Institute took a public radio reporter out to the Conservancy's Finzel Swamp Preserve to find salamanders, including the long-tailed salamander. Photo by Lauren Ludi, The Nature Conservancy.

Conservation Partnerships on the Coast of Ecuador

By Ryan L. Lynch

While it is true that the Amazon is experiencing some of the world's most severe deforestation, it has gone relatively unnoticed that the coast of Ecuador has one of the highest rates of deforestation in South America. The coast of Ecuador is frequently recognized as one of the areas most at risk of biological extinction on the planet due to a massive loss of forest cover (Fig. 1; Dodson & Gentry 1991). It is currently estimated that only 2-4% of native forest cover still remains along the coast of Ecuador (Dodson & Gentry 1991). The importance of immediate action and conservation partnerships along the coast of Ecuador cannot be overstated. High levels of species diversity combined with low levels of existing protection make the central coast of Ecuador one of the most critical conservation priorities in the country (Lessmann et al. 2014).

In the central coastal province of Manabi a network of conservation organizations are joining forces to protect some of the last remnants of Pacific Equatorial Forest in the Tumbes-Chocó-Magdalena Biodiversity Hotspot. This partnership, made up of Third Millennium Alliance, The Biodiversity Group, and Ceiba Foundation for Tropical Conservation, are working together to protect the threatened forests of coastal Ecuador, to reforest what has already

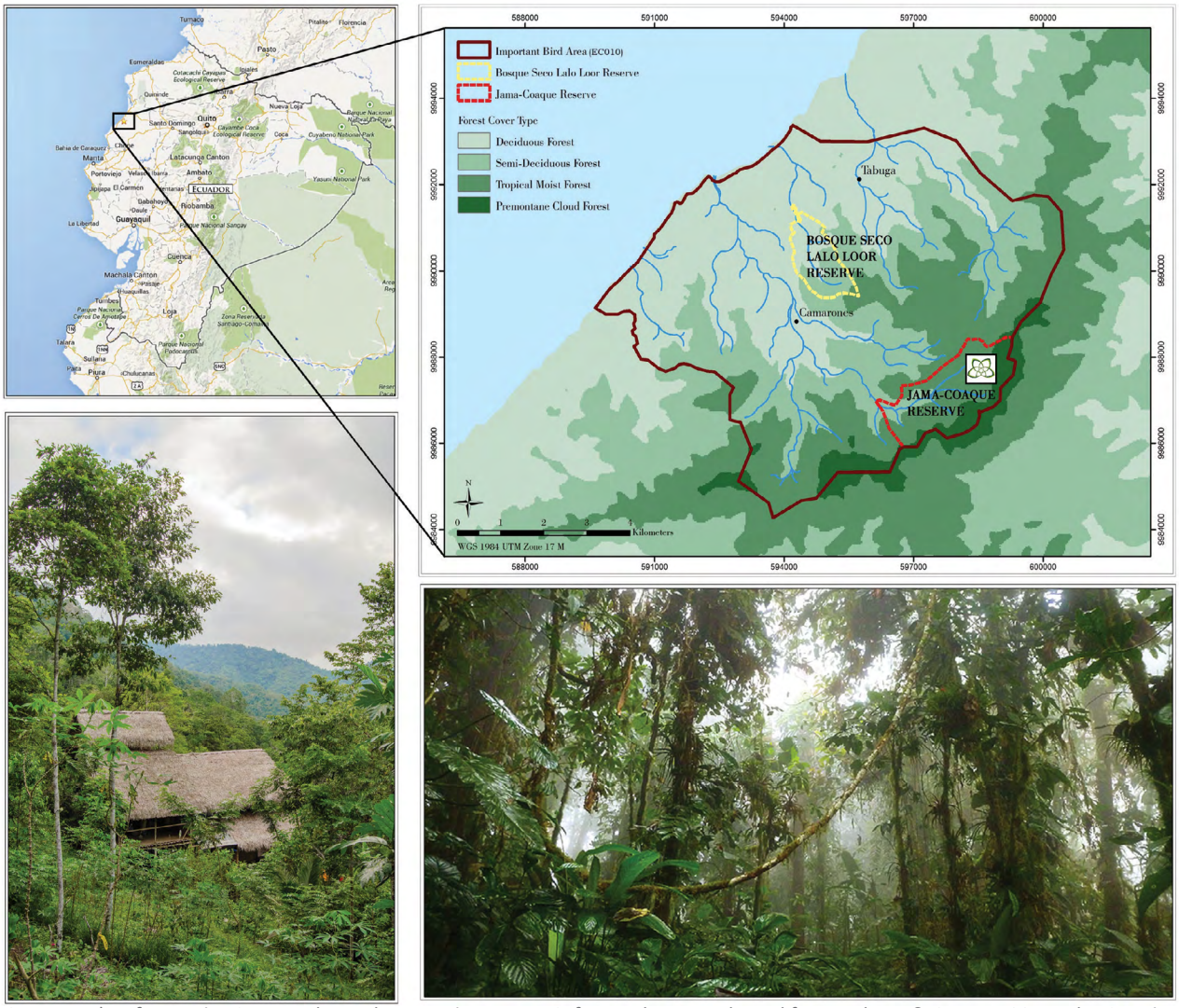

Figure 1. A.) Deforestation in coastal Ecuador over time; green is forested areas; adapted from Dobson & Gentry 1991 under Creative Commons License. B.) Aerial photography of clear-cut deforestation near the Jama-Coaque Reserve. C.) Complete deforestation and aridification of landscape immediately neighboring the Jama-Coaque Reserve.

been lost, and to collect important biological data that supports their conservation missions. At the center of their conservation efforts are two protected reserves: Bosque Seco Lalo Loor and Jama-Coaque Ecological Reserve. Together the two neighboring reserves protect roughly 1,515 acres of tropical dry forest, semi-deciduous forest, tropical moist forest, and pre-montane cloud forest (Fig. 2).

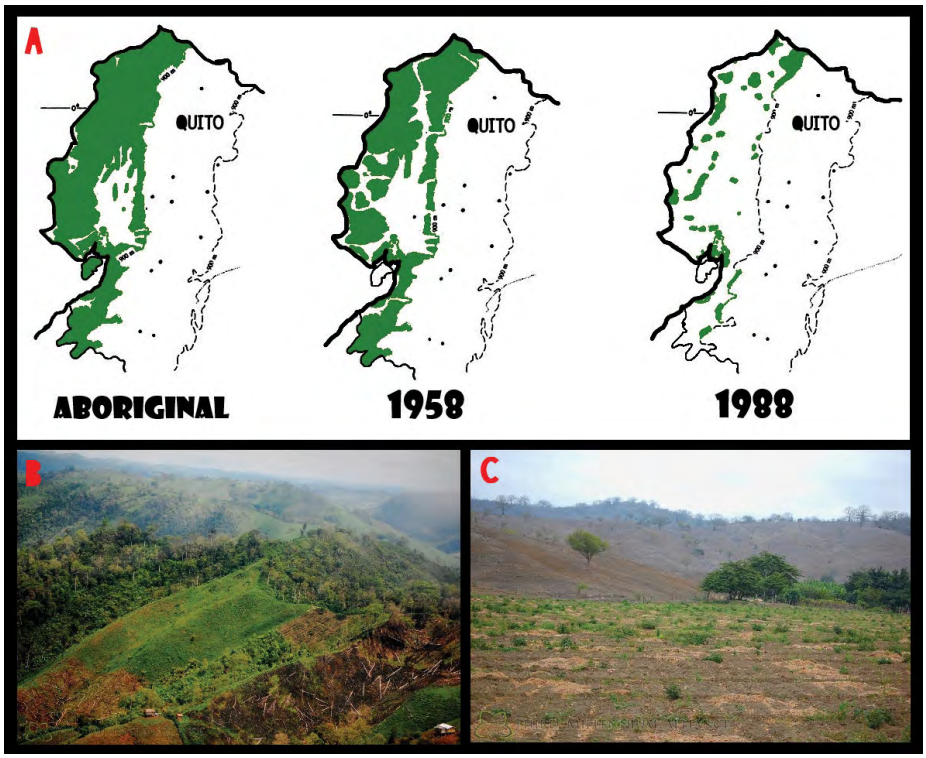

Figure 2. Location of the Jama-Coaque Reserve and Bosque Seco Lalo Loor with details and photos of surrounding forest types and the Jama-Coaque Research Station.

Population surveys of the amphibians and reptiles of Bosque Seco Lalo Loor and Jama-Coaque Ecological Reserve have been ongoing since 2009. To date 28 species of amphibian and 43 species of reptile have been documented between the two reserves. Of the 71 species recorded between the two reserves, one of the most special discoveries due to their rarity has been the observation of numerous *Bolitoglossa* salamanders. *Bolitoglossa* salamanders are a unique and understudied neotropical genus that are infrequently found in the coastal forests of Ecuador. Individuals found in the Jama-Coaque Reserve have been identified as *B. chica*, aptly named for its small body size relative to other species in the genus, and a second larger species that has yet to be identified with 100% certainty (Fig. 3). The observation of *Bolitoglossa* salamanders in these forests is just one of many reasons why it is important that local organizations continue to work together to protect the coastal forests of Ecuador before they are gone forever.

A free full-color PDF field guide to the amphibians of the Jama-Coaque Reserve is available for download at: Amphibians.org.

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Figure 3. *Bolitoglossa* salamanders of the Jama-Coaque Reserve: A.) *Bolitoglossa chica*; B.) *Bolitoglossa* sp.

Competition for Habitat

By Matthew Evans—Smithsonian Conservation Biology Institute, National Zoological Park, and Eric Dallalio—US Geological Survey, North East Amphibian Monitoring and Research Initiative

The Appalachian Region is the global epicenter of salamander diversity. The Appalachian Mountains contain 76 salamander species representing more than a dozen genera, with nearly half of those species endemic to the area. The status of these salamanders remains relatively uncertain due to a multitude of environmental threats, in addition to the difficulties in sampling individuals and estimating populations.

A collaborative effort by the USGS and the Smithsonian Conservation Biology Institute are addressing some of these uncertainties by focusing research on two species of Plethodontid salamanders, the Eastern Red-backed Salamander (*Plethodon cinereus*) and the Shenandoah Salamander (*Plethodon shenandoah*). The Shenandoah Salamander is a federally endangered species found only within the boundaries of Shenandoah National Park, Virginia. This terrestrial salamander is isolated to approximately 6 km² of dry talus slopes at high elevations in the park (above 800 m). Results of previous research suggest that *Plethodon shenandoah* is competitively excluded to suboptimal talus habitats by the Eastern Red-backed Salamander, and have implicated competition as the dominant driver of extinction risk for this species. However, recent occupancy analysis suggests that climate change appears to be the dominant driver of extinction risk for *P. shenandoah*, and that the risk may be further exacerbated when climate change interacts with competition.

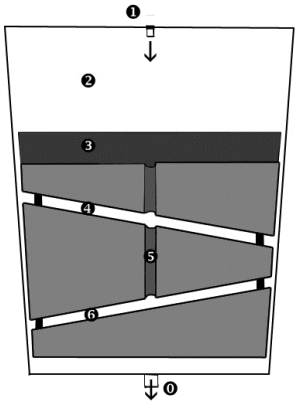

Fig. 1. Cross-sectional view of the microcosm design, this design allows for optimal observation of natural behaviors including competition.

Fig. 2. One of many metal shelving units holding over a dozen microcosms.

Climate change models predict a warming (2-6°C), an increase in the severity of rain events and prolonged drought, and importantly, more variable temperatures throughout Appalachia over the next century. The Smithsonian and USGS came together to look at how the effects of temperature and humidity influence both the potential to limit distributions of one or both species, and change the nature of the interaction between the species. The research design investigates these relationships by using innovative three-dimensional microcosms to examine growth and behavior differences in response to climate and competition treatments (Fig. 1). We designed this experiment to directly test *P. shenandoah*'s response to competition under realistic climate conditions.

Fig. 3. Eric and crew conducting observations.

In order to focus on the effect of competition together with climate, we designed a unique experimental chamber with habitat and climate conditions that mimic reality by: (1) developing a 3-dimensional space that looks and feels like the high-elevation talus habitats; and (2) creating realistic environmental conditions in the chambers. We constructed 60 of these chambers to house 2 adult male salamanders in each, paired for intra- and interspecific competition treatments (Fig. 2,3,4). We are looking at two response variables: (1) behavior in terms of surface frequency; and (2) fitness as measured by body condition. Surface frequency has implications for effective monitoring in that it will provide information on how competition under climate change affects surface detection probability. Body condition allows us to measure the impact of climate and competition stressors on the experimental salamanders. The *P. shenandoah* study results are currently under analysis, but preliminarily our behavioral observations and body condition scale do show that *P. shenandoah* is not out-competed by *P. cinereus* under various environmental treatments within our microcosm design.

Fig. 4. Microcosm with Eastern Red-backed Salamander.

Evidence-based Salamander Conservation

By Helen Meredith, PhD candidate, Durrell Institute of Conservation and Ecology, University of Kent, Institute of Zoology, Zoological Society of London, Amphibian Specialist Group Programme Officer

An important resource for conservation decision-makers was published this year – "*Amphibian Conservation: Evidence for the Effects of Interventions*" (Smith & Sutherland 2014). Also known as the *Amphibian Synopsis*, it collates and summarises scientific knowledge about what works and does not work in amphibian conservation. Currently, it comprises evidence from over 400 publications across a comprehensive list of 129 conservation actions, compiled by an expert advisory board. It is freely available as a searchable database or as a pdf to download, and can also be purchased as a book, all through: **www.ConservationEvidence.com**

A Golden Alpine Salamander, *Salamandra atra aurorae*, one of many species whose conservation might be given more attention.

"Conservation evidence" describes any study that quantitatively tests the effect of an intervention used by conservation practitioners to protect species. The use of evidence to support conservation decision-making can alert practitioners to better methods and highlight interventions that are ineffective (Sutherland et al. 2004). A concerted move towards the practice of evidence-based conservation has huge potential to improve results and generate more successful outcomes in the management of species and habitats.

A Great Crested Newt, *Triturus cristatus*, the best-represented species in studies of conservation effectiveness.

The Amphibian Synopsis features 220 amphibian species from 36 countries. However, in honour of the Year of the Salamander, we shall put frogs, toads, and caecilians to one side for now and focus on what the Amphibian Synopsis can tell us about caudate conservation. Fifty-nine species of salamander from 16 countries are included to date, and although salamanders only account for around 9% of extant amphibians, they represent 27% of the species listed in the synopsis. Relevant conservation interventions span a wide variety of actions from habitat and species management, to the removal of invasive species and awareness-raising activities. Certain key interventions feature evidence summarised solely for the purpose of salamander conservation, including pond creation, translocation, and captive breeding. The majority of evidence so far accumulated focuses on interventions that support habitat conservation and restoration. Given that over 95% of salamander species listed by the IUCN are threatened by the loss, degradation, and fragmentation of their habitat, it is perhaps reassuring that these interventions take precedence.

Although a body of evidence clearly exists that can help inform conservation decision-making, a great deal more is required. Only around 10% of all salamander species currently appear in the synopsis, and over half of all evidence records refer to just five species—in descending order: Great Crested Newt (*Triturus cristatus*); Spotted Salamander (*Ambystoma maculatum*); Smooth Newt (*Lissotriton vulgaris*); Eastern Red-backed Salamander (*Plethodon cinereus*); and Mountain Dusky Salamander (*Desmognathus ochrophaeus*). Only one of the 16 range countries mentioned is in the tropics (Mexico), and 80% of species so far included in the synopsis are listed as not threatened (Least Concern or Near Threatened) by the IUCN Red List of Threatened Species (**www.iucnredlist.org**), whereas nearly half of all salamander species are listed as threatened globally. Perils such as invasive species, disease, climate change, exploitation, and pollution are heavily under-represented by available evidence supporting the use of interventions to mitigate these threats.

The salamanders therefore need your help! The synopsis is currently undergoing a rigorous assessment, which will place all interventions into effectiveness categories based expert appraisal of the existing evidence. The results will be

Helen Meredith with a Critically Endangered Chinese Giant Salamander, *Andrias davidianus* (left), and a Near Threatened Japanese Giant Salamander, *Andrias japonicus* (right), two cryptobranchids whose conservation needs urgent attention in the face of declining populations.

published in an annual '*What works in conservation? Lessons from conservation evidence*' in due course. Accumulating and summarising this evidence is therefore very much a dynamic and ongoing process, and new or omitted studies will be reviewed for inclusion on an annual basis. We therefore urge you to publish and disseminate any studies that may contribute to this endeavour, either through **www.ConservationEvidence.com** or other journals and publications. Let's continue to work together to do the right thing for these amazing species!

References:

Smith, R.K. and Sutherland, W.J. (2014) *Amphibian conservation: Global evidence for the effects of interventions*. Exeter, Pelagic Publishing.

Sutherland, W.J., Pullin, A.S., Dolman, P.M. & T.M. Knight (2004) The need for evidence-based conservation. *Trends in Ecology and Evolution*, 19, 305-308.

Priority Amphibian and Reptile Conservation Areas (PARCAs): Creative Uses for Conservation - a free webinar

Thursday, October 16, 2014 10:30 am

Presented by: Dr. Joseph J. Apodaca of Warren Wilson College & Dr. Stephen Spear of The Orianne Society

As the threats facing our natural resources continue to increase at an exponential rate, conservation organizations must quickly evolve to meet these challenges. **An effective approach to preserving biodiversity is the protection of viable populations of priority species and areas that contain viable populations for a high number of species.**

Members of the Orianne Society, Warren Wilson College, Partners for Amphibian and Reptile Conservation (PARC), and the South Atlantic Landscape Conservation Cooperative (SALCC) have worked collaboratively to develop model criteria for designating Priority Amphibian and Reptile Conservation Areas (PARCAs) for the southeastern United States.

The PARCA idea is loosely based on the Important Bird Areas (IBAs) movement. IBAs target areas essential to bird conservation and have arguably been one of the most successful conservation programs in the world. The southeastern PARCA project is expected to raise the profile of high priority species or areas, increase public awareness of locally important conservation areas, and elevate the importance of proper management at these sites.

In this webinar hosted by NCSU Extension Forestry, **the presenters will discuss the development of PARCAs, areas of the southeastern United States likely to be designated as PARCAs, and how state and federal agencies can use PARCAs to conserve amphibians, reptiles, and their habitats.** Please visit the following site for further information on ongoing PARCA projects: **http://parcplace.org/publications/parcasprioritya mphibianandreptileconservationareas. html**

For link to join the webinar, see **http://separc.wordpress.com/2014/09/04/creative-uses-for-conservation-a-webinar-on-priority-amphibian-and-reptile-conservation-areas-parcas/**

From Beneath the Concrete Jungle—Amphibian Crossings

By, Matthew Charnock

Traffic signs, like the example pictured above, give drivers, bikers, etc. time to not only slow their current speed, but to simultaneously become mindful of the amphibians they may or may not encounter as well. Photo by Javier Montero.

As any well-practiced "herper" knows, one of the most "concrete"—and yes, pun intended—ways of spotting nocturnal, ectothermic organisms is to drive slowly down a country road, aiming a glaring spotlight over the passing asphalt. But this clever use of our ever-growing infrastructure highlights the dangers posed at amphibians attempting to seek new dwellings. "Frogger" isn't just a fictional, pixilated game anymore—it's right in front of your headlamps.

Amphibians are temporal, highly migratory creatures by the nature of their being. It's this characteristic that places, more than so often, the oblivious anuran underneath the tire path of a passing automobile. And this dismal factoid is no more prevalent than during an amphibian's breeding season. "Why did the frog cross the road—to partake in some amplexing, of course?"

But never doubt the will-power of ecocentric individuals. From developing traffic signs stating that amphibians are near to constructing subterranean tunnels that bypass the problem completely, countless animals are now safe—and mating. But let's focus on the latter, shall we?

Studies have shown the effective use of subterranean culverts and tunnels to bypass heavily-trafficked roads and other infrastructural dangers. So effective, in fact, that those populations where road crossings were prevalent saw, on average, a 50% drop in asphalt-affiliated deaths. But it also needs to be noted that the benefit of these tunnels came down to mainly two variables—design and location.

Rest easy, Kermit. You don't have to play "Frogger" anymore—just take the tunnel. And bring your friends.

Upcoming Meetings & Events

Traveling Year of the Salamander Art Exhibit, September 14-October 19, City of Austin's Beverly Sheffield Education Center at Barton Springs, Austin, TX. Opening reception September 14, 6 pm.

Save the Frogs! Wetland Construction Workshops, with Tom Biebighauser and Kerry Kriger.
October 13: Ben Lomond, CA
October 14: Shingle Springs, CA, east of Sacramento
October 15 &16: San Francisco Bay area, CA
See **http://savethefrogs.com/ponds/workshops.html** for more info & registration.

Creative Uses for Conservation: a Webinar on Priority Amphibian And Reptile Conservation Areas (PARCAs), October 16, 10:30 am EDT, presented by SEPARC. **http://separc.wordpress.com/2014/09/04/creative-uses-for-conservation-a-webinar-on-priority-amphibian-and-reptile-conservation-areas-parcas/**

Mid-Atlantic Vernal Pool Mapping Workshop, October 24, Aquatic Resources Education Center, Smyrna, DE. Full info at: **http://northatlanticlcc.org/projects/vernal-pools/mid-atlantic-vernal-pool-mapping-workshop**. To register, contact Dan Lambert at **dan@highbranchconservation.com** by Oct. 10.

The Wildlife Society annual meeting, October 25-30, David Lawrence Convention Center, Pittsburgh, PA. **http://wildlifesociety.org/schedule-at-a-glance/**

PARC symposium "15 and Forward: Reflections on 15 Years of Successes, and the Future of Partners in Amphibian and Reptile Conservation", October 28, 1:30-5:30 pm, as part of TWS annual meeting, Pittsburgh, PA.

PARC and ARC* reception, October 28, 6-8:00 pm, as part of TWS annual meeting, Pittsburgh, PA.

*ARC - Amphibian and Reptile Conservancy

Family of the Month: Hynobiidae

The Japanese Clawed Salamander, *Onychodactylus japonicus*, an Asiatic salamander in family Hynobiidae, is found in only two places in the world - the islands of Honshu and Shikoku in Japan. Japanese Clawed Salamanders occupy moist, cool, shady mountain habitats near springs or waterfalls, and are usually found beneath rocks, tree roots, or down wood. They breed down within the substrate of clear, cold streams. At first glance, this salamander appears to be similar to many others, as it is relatively small and slim, 4 to 8 inches (10 to 20 cm) total length, the larvae are aquatic, and the adults are terrestrial. However, this salamander is highly unusual in that it has palatine teeth and "amphibian claws." These claws, which are keratinized features at the tips of the toes, are present in larvae, and breeding adults have them only during the breeding season. Larvae also have external gills that are replaced by fully developed lungs by the time they reach adulthood.

A Japanese Clawed Salamander, *Onychodactylus japonicus*. Photo by Danté Fenolio, Year of the Salamander Photo Contest.

Ongoing taxonomic work is still teasing out species relationships in this family, and several new species have been recently recognized. In addition, there are a large number of threatened species (Vulnerable, Endangered, or Critically Endangered, as classified by the IUCN Red List, www.iucnredlist.org) in this family, including 15 species in the genus *Hynobius*, more than 40% of its members. Even among Hynobius that are not yet considered threatened, many more species are decreasing in population. Many hynobiid species have very limited distributions, which renders them vulnerable to even small losses of habitat or populations. Approximately half of hynobiids are endemic to Japan, often to only a small area of a single island.

Family: Hynobiidae

Also known as:	Asiatic Salamanders
Number of Species:	66 species in 10 genera, most in *Hynobius* (35 spp.) and *Onychodactylus* (10 spp.)
Region / Habitat:	- distributed across Asia, from European Russia to Japan
Physical Characteristics:	- relatively small, ranging from 4 inches to 8 inches in length - the have "amphibian claws" or keratinization in their toes - Presence of palatine teeth arranged in a V-shape - the larvae have external gills while most adults have well-developed lungs (except for two lungless species)
Behavior / Development	- nocturnal - external fertilization (spawning); females lay eggs on spermatophores in water - some males guard the egg sacks
Fun Fact:	There are no Asian salamanders in the fossil record.

Spotted tree frog (*Nyctixalus pictus*). Near Threatened.

Protecting the Lower Kinabatangan Floodplains, Borneo

By Robin Moore

The Amphibian Survival Alliance recently supported an appeal by the World Land Trust to raise $1.7 million to enable local partners HUTAN to purchase and protect critical rainforest habitat in the Lower Kinabatangan floodplain of Sabah, Borneo. "The rapid expansion of palm oil plantations in Borneo has resulted in an unprecedented destruction of the island's unique and rich tropical rainforests, putting the future of the Bornean Orang-utan [and many other species] in serious jeopardy," said Dr. Paul Salaman, CEO of Rainforest Trust, who played a pivotal role in organizing and raising support for the project.

Two corridors totaling 894 acres (362 hectares) have been purchased as a result of the appeal, protecting a wide variety of habitats including mangroves, swamps, oxbow lakes, dipterocarp forest and limestone outcrops. The diversity of these habitats undoubtedly contributes to the region's exceptional biodiversity. Hutan and the University of Melbourne recently conducted a survey of amphibians in the area, recording a total of 29 frog species from 5 families, among which at least 12 species are endemic to Borneo. One of the most striking species in the area is the beautiful Spotted tree frog, *Nyctixalus pictus*, currently listed on the IUCN Red List as Near Threatened.

The lead researcher, Dr. Gillespie, has stated that Bornean populations of the non-endemic species are likely to eventually be taxonomically split from others after in-depth molecular biology studies. Importantly, three previously undescribed arboreal frog species were discovered, one of which, belonging to the genus *Chiromantis*, is the first and only member of this genus in Borneo. The other undescribed species of frog (both belonging to the genus *Philautus*) were also located in the wider corridor within Keruak VJR. Specimens have been collected and sent to the Sabah Museum to be formally described and named.

Many other species will also benefit from this project, including the endangered Orang-utan, Bornean pygmy elephant, Malayan sun bear and Proboscis monkey, in addition to 300 species of birds. The project site is also vitally important for local people who depend on tourism for their livelihoods through provision of accommodation and guiding services. The ultimate goal for all of the properties within the corridor is to include them as part of the existing Lower Kinabatangan Wildlife Sanctuary to protect a mosaic of habitats in perpetuity.

asa
amphibian survival alliance

Helen's flying frog (*Rhacophorus helenae*) from Vietnam, recently assessed for the first time on The IUCN Red List of Threatened Species as Endangered. The species is only known from two patches of forest separated by agricultural land - both of which are under continued threat from habitat loss and modification due to livestock grazing and collection of forest products, as well as habitat isolation. Collection for the pet trade is also a concern. Photo: Jodi Rowley/Australian Museum.

Update From the Mainland Southeast Asia Amphibian Red List Authority (RLA) Team

By [1]Jodi Rowley

The IUCN Red List extinction risk assessments for the amphibians of Southeast Asia are out of date. While a few species accounts have been updated in recent years, most species haven't been updated since the Global Amphibian Assessment in 2004. In a region where our knowledge of amphibian species is rapidly expanding, and new species are being discovered on a regular basis, a decade-long lag in assessment is a huge problem, particularly in the face of habitat loss and other great threats. Without an updated list that more accurately reflects the current conservation status of amphibians in the region, our limited conservation resources may be directed towards species that don't need it or that don't need it as urgently, at the expense of those that do.

Vampire flying frog *(Rhacophorus vampyrus)*, listed for the first time on The IUCN Red List of Threatened Species as Endangered. The primary threat to the Vampire flying frog is habitat loss and modification due to aquaculture, agriculture (primarily coffee), road development, and harvest of both timber and non-timber forest products. Photo: Jodi Rowley/Australian Museum.

Enter the mainland Southeast Asia working group (WG) of the IUCN Species Survival Commission (SSC) Amphibian Red List Authority (RLA). We like to shorten our title somewhat in conversations, though! Our job is to ensure that the Red List assessments for the amphibian species in Cambodia, Laos, Myanmar, Thailand and Vietnam are as accurate and up to date as possible, and that new species are assessed as soon after their description as possible. That's no easy task, particularly when it's all on a volunteer basis.

The team consists of five experts in amphibians from each of the countries in the region, five interns and myself. A large number of generous amphibian researchers also donate their time and expertise on a regular basis, providing us with vital unpublished information on the distribution, abundance, habitat requirements and threats facing each species.

Our initial focus has been to work on 50 or so species that had been relatively recently described and not yet assessed. This year, we've added two newly discovered species to the Red List: the Vampire flying frog *Rhacophorus vampyrus* and Helen's flying frog *Rhacophorus helenae* (both species assessed as Endangered). We have also reassessed one species that was identified as urgently needing updating (the now Endangered Lao Salamander, *Laotriton laoensis*).

Our job has only just begun, and it's a lot of work, but we all believe in the importance of the IUCN Red List in helping us prioritize amphibian conservation in Southeast Asia and beyond.

[1]Australian Museum Research Institute; Tier I Member, Amphibian Red List Authority; Co-Chair, Mainland Southeast Asia, IUCN SSC Amphibian Specialist Group

Research on Microhabitat Differentiation Between Two Treefrog Species May Reveal the Cause of Population Decline in the Endangered *Hyla suweonensis* in Korea

By [1]Yikweon Jang & [2]Amaël Borzée

Two treefrog species occur on the Korean peninsula, *Hyla suweonensis* and *H. japonica* (*1*). The distribution of *H. japonica* is widespread across East Asia, ranging from Mongolia to Japan and from Manchuria to southern China (*2*). In contrast, *H. suweonensis* is an endangered species (*3,4*) that is almost exclusively restricted to the underdeveloped large coastal plains northwest of the Republic of Korea (*5*). The distribution of *H. suweonensis* is completely within that of *H. japonica*. These two species are mor-phologically similar, albeit not identical (*6, 7*). The latest genetic data suggests that these two species diverged during the late Miocene, 7.1 mya (*8, 9*).

These two treefrog species are mostly found in rice paddies in the Republic of Korea, as the natural habitats for these species have now almost disappeared. The spatiotemporal distributions, discovered through a citizen science project in 2012, of the two treefrog species, showed that the calling activity of *H. japonica* was constantly vigorous throughout the breeding season, but that of *H. suweonensis* was generally weak (*10*). This study took advantage of the differences in the advertisement calls of two treefrog species for species identification. That is, the calls of *H. suweonensis* are lower in note repetition rate and higher in dominant frequency than those of *H. japonica* (*11*). Compared to the localities where *H. japonica* occurs alone, the localities where both treefrog species are heard were generally dominated by the rice-paddy fields with little urban areas nearby (*10*).

Although the two treefrog species are similar in morphology and ecology, their fates seem to be going in opposite directions. In fact, *H. japonica* is abundant even in seemingly unusual environments, such as high mountains, coastal pools and rice paddies in the middle of urban settings. This fact suggests that any hypothesis that may explain the population decline of *H. suweonensis* should also explain the ubiquitousness of *H. japonica*. One hypothesis is that the two treefrog species compete with each other and *H. suweonensis* is on the losing end. Another hypothesis is species reversal in which *H. japonica* is replacing *H. suweonensis* and we may be seeing the last scene of this process under our own noses. These two hypotheses may not be mutually exclusive with each other.

According to the competition hypothesis, two species that occupy the same habitat at the same time compete with each other reproductively or ecologically. However, the competition is nothing new to these two species, and it may have always existed since their divergence, millions of years ago. Because these two species have lived together for the last several millions of years, there may be several ways that they coexist. Microhabitat differentiation in the phase of reproduction may eliminate hybridization between sympatric species or may, at least, minimize its reproductive costs, such as male signaling or female searching.

Although there is no report on hybrids between *H. suweonensis* and *H. japonica* in the field yet, these two species can produce hybrids under laboratory conditions (Kuramoto 1984). Thus, we tested the possibility of microhabitat differentiation for the calling location between the two species in rice paddies. We examined microhabitat differentiation at the level of the individual rice paddy or within a rice-paddy complex, where many similar rice paddies are typically grouped together. A treefrog could simply avoid calling heterospecifics by selecting another unoccupied rice paddy within the same rice-paddy complex. We examined microhabitat differentiation for the calling location in a rice paddy by conducting acoustic monitoring in 16 rice paddies across six rice-paddy complexes (Fig. 1). Then, the location of a calling individual within a rice paddy was noted. We examined microhabitat differentiation for the calling location within a complex of rice paddies by documenting calling individuals in all rice paddies in four complexes of rice paddies. The experiments were conducted in the city of Paju, near the demilitarized zone, which holds one of the few major remaining populations of *H. suweonensis*.

The results of acoustic monitoring revealed microhabitat differentiation in calling location within a rice paddy: *H. japonica* called from the edges, but *H. suweonensis* called from the center of the rice paddy. In the rice paddies where both species were heard calling, the average difference between the calling site of *H. japonica* and *H. suweonensis* was 8.1 ± 3.9 m (mean ± standard deviation). We did not find any evidence of microhabitat differentiation within rice-paddy complexes. In fact, some rice paddies within a rice-paddy complex seemed to be preferred by both treefrog species, and others seemed to be avoided by both treefrog species. The spatial separation within a rice paddy may create an effective premating barrier between the two species, because amplexus occurs where calling takes place.

Fig.1: Acoustic monitoring was conducted in rice paddies to determine microhabitat differentiation in calling location within a rice paddy and within a rice-paddy complex between two treefrog species, *H. suweonensis* and *H. japonica*. LED markers were deployed on two adjacent banks of the rice paddy every three or five meters to measure distances. Photo: Amaël Borzée.

The spatial arrangement between two treefrog species may pose a threat to species integrity for the central species. When females arrive at a rice paddy for mating, they are likely to be encountered

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Fig. 2: *H. suweonensis* is calling from the center of rice paddies, and rarely in the water but hanging on rice seedlings, while *H. japonica* is usually calling from the banks of rice paddies, sitting on the substrate. Photo: Yikweon Jang..

by males of the edge species. Thus, hybridization, if it occurs, may be directional with males of the edge species and females of the central species. In fact, we did anecdotally observe amplexuses between female *H. suweonensis* and male *H. japonica* in the field, although not confirmed through DNA sequencing. Furthermore, the numerical advantage of *H. japonica* over *H. suweonensis* may aggravate the unidirectional hybridization between two treefrog species.

The most distinctive behavioral characteristic of two treefrog species is their calling postures. During call production, males of *H. suweonensis* are "holding" onto vegetation, whereas males of *H. japonica* are "sitting" on the substrate (Fig. 2). It may not be a coincidence that body postures of two treefrog species are different during the production of advertisement calls. *H. suweonensis* males are calling from the center of the rice paddy where they cannot sit on any hard substrate, but must hold onto rice seedlings to produce calls. In contrast, males *H. japonica* are calling mainly from the banks of rice paddies, where it is possible to sit on a substrate during the production of advertisement calls. The holding posture of *H. suweonensis* may be an adaptation to calling from the center of a rice paddy, displaced from males of *H. japonica* calling on or near the bank.

Microhabitat differentiation can also occur during non-reproductive phases. For example, co-occurring species may utilize prey of different sizes, reflected by differences in body size. Males of *H. suweonensis* are about 5% smaller in SVL than males of *H. japonica* (Borzée et al, 2013), suggesting a possibility of differential habitat use for feeding. Thus, we studied differential habitat use of these two treefrog species using harmonic direction finding, which relied on a microwave emitter and light-weight reflectors (Fig. 3). We tracked 42 individuals of *H. japonica* and seven individuals of *H. suweonensis* every 65.99 ± 113.30 min (mean ± standard deviation) for a maximum of 72 h. Field tracking was conducted in four localities in the city of Paju between June 17 and July 3, 2013, which was the breeding season of two treefrog species.

We identified five microhabitats in diel cycles of these two treefrog species during the breeding season: rice paddy, ground, buried, grass, and tree. Buried was noted when a treefrog was found below the ground level, regardless of the depth or the substrate consisting of soil or decaying vegetation. Males of both *H. suweonensis* and *H. japonica* occurred in all five microhabitats. However, these two species might still exhibit differentiation in use of microhabitats in diel activities during the breeding season. Males of *H. japonica* were likely to be found on the grass or trees when resting, whereas males of *H. suweonensis* were mostly found on the grass. This difference in use of microhabitats during resting was also reflected by the height at which male treefrogs were found. Males of *H. suweonensis* were invariably found on the ground level or close to it, 20.00 ± 6.49 cm high (mean ± standard deviation), even when under trees. In contrast, males of *H. japonica* climbed on an average of 124.23 ± 103.51 cm when resting on trees.

The general pattern of movements is as follows. Males of both treefrog species moved to rice paddies between late afternoon and dusk. Then males produced advertisement calls in rice paddies. Between dawn and early in the morning, males moved to grasses or trees adjacent to rice paddies, where they spent the day. Based on the result of Markov-chain analysis, the movement patterns of the two treefrog species were not different from each other. However, the abiotic conditions of movements were different between the two treefrog species. In all five microhabitats, males of *H. suweonensis* moved earlier than did males *H. japonica*. For example, movement toward rice paddies occurred in the late afternoon for *H. suweonensis* males, but at dusk for *H. japonica* males. Movement out of rice paddies occurred before dawn in *H. suweonensis*, but after dawn in *H. japonica*. Because *H. suweonensis* preceded *H. japonica* in movements across the microhabitats, the temperatures of microhabitats at which individuals of *H. suweonensis* were found were generally higher than those for *H. japonica*.

Although microhabitat differentiations for calling location and resting may minimize the competition between the two treefrog species, it's unclear whether these differentiations are sufficient for the coexistence of the two species. One of the most important findings in our studies is that the banks of rice paddies, which are often covered with grasses, are critical for resting and feeding during the breeding season of *H. suweonensis*. Anecdotal observations show that individuals of *H. suweonensis* are still on the edges of rice paddies during the non-breeding season in the fall, while individuals of *H. japonica* are typically found in the forest at that time of the year.

Unfortunately, the dependency of the grass microhabitat adjacent to rice paddies may contribute to population decline of *H. suweonensis*, due to modern farming practice. The banks of rice paddies are getting narrower in modern days, often covered with less grasses than it used to be or with no grass at all. Furthermore, the banks are often sprayed with herbicide and are mowed down to the ground level, leaving no shelter for *H. suweonensis* during the breeding season. In the fall, the tops of the trees in the forest are not harvested, while the environment used by *H. suweonensis* is subject to mechanical harvest. Thus, there is a possibility that modern farming practice may tip the balance on the coexistence of the two treefrog species in rice paddies in Korea.

The situation of *H. suweonensis* is bleak with an estimate of 260 calling males remaining in 2012 according to one study (*5*). Our results of microhabitat differentiation and tracking provide useful information for the conservation of *H. suweonensis*. First of all, the banks of rice paddies should be maintained in a way that grasses occur throughout the growing period. Second, natural ditches are preferred to concrete ditches. Traditionally, natural ditches with running water adjacent to rice paddies are available for the community of anurans as shelters or feeding grounds. Third, the water in rice paddies should be maintained at a certain level throughout the breeding season of the two treefrog species. Farmers drain the water in rice paddies early July, detrimental to tadpoles of many amphibian species in Korea. Fourth, the use of pesticides and herbicides should be limited, as these chemical are deadly for tadpoles of both treefrog species. Fifth, the wintering habitat, which is different from the one used by *H. japonica* and seems to be situated close to the breeding site, should be protected for *H. suweonensis*.

Fig. 3: We used harmonic direction finding, which relied on a microwave emitter and light-weight reflectors, to study the diel cycles of microhabitat use during the breeding season in two treefrog species. The student in the picture tried to locate an individual treefrog by listening to the pinging sound uttered when a microwave reflected from the reflector that was belted on the treefrog was returned to the emitter.

Finally, and most importantly, areas where healthy populations of *H. suweonensis* still remain, must be designated as refugia for amphibian species.

Acknowledgment

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A pair of *Bombina orientalis*. Photo: Jungbae Park.

Evaluating the Reliability of Diagnostic Methods for Chytridiomycosis

By Jaehyub Shin and Bruce Waldman

The amphibian chytrid fungus (*Batrachochytrium dendrobatidis*—denoted *Bd*—causes morbidity and mortality in amphibians by interfering with electrolyte balance and osmoregulation (*1*,*2*) and disrupting adaptive immune responses (*3*). The pathogen's effects can be devastating, especially upon first contact with naïve host populations that may lack evolved defenses.

Bd was first reported in Asia in 2008 (*4*), nine years after its discovery in Australia and Central America (*5*). While *Bd* is considered to be one of the main causes of global amphibian population declines, researchers have not yet recorded population die-offs as the result of chytridiomycosis (the disease caused by *Bd*) in Asia. Throughout the continent, amphibians typically bear low *Bd* infection loads (Thailand (*6*), South Korea (*7*), Vietnam and Cambodia (*8*)). *Bd* appears to have been introduced only recently via the animal trade into countries that were thought to be *Bd*-free (e.g., Hong Kong (*9*); Singapore (*10*)).

Diagnosing *Bd*-infected amphibians and determining their infection intensities is especially problematic in regions of the world where individuals bear low *Bd* loads. If swabbing is not completely effective at detecting *Bd* from infected animals, individuals easily may be misdiagnosed as disease-free when in actuality they carry low *Bd* loads. Other testing protocols may therefore be necessary to detect *Bd* and evaluate its effects on endemic species.

Initially chytridiomycosis was diagnosed by histological and immunohistological methods. Subsequently, methods based on the polymerase chain reaction (PCR) were developed to detect *Bd* on swabs taken from individuals in the lab and the field. Besides the initial PCR methods designed to amplify *Bd* DNA, more sensitive procedures, including quantitative PCR (qPCR) and nested PCR, have been rapidly adapted to diagnose chytridomycosis (Fig. 1). These methods detect *Bd* DNA quickly with very high sensitivity, making possible the rapid screening of large numbers of samples. However, despite their advantages, PCR-based methods can sometimes yield false results. One frequently hears accounts of non-

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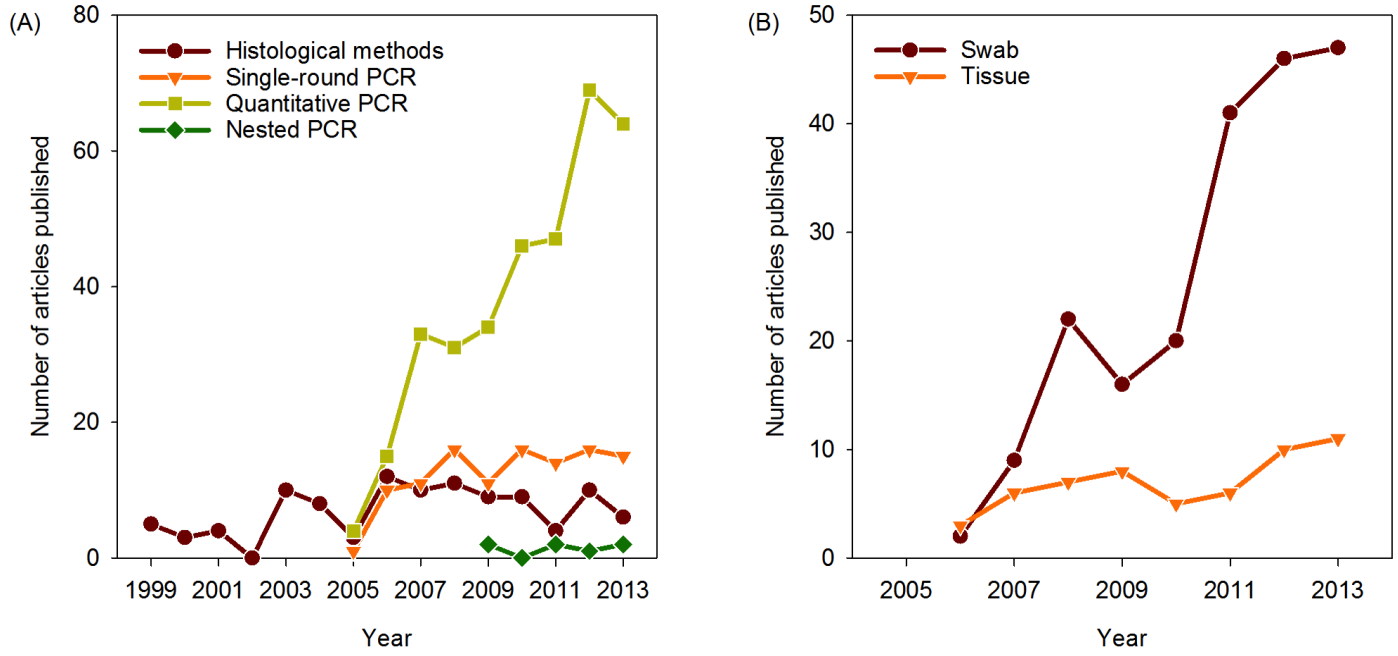

Fig. 1: ***Bd*** **diagnostic methods have changed over time. (A) Initial histological and immunohistological approaches have rapidly given way to PCR methods, especially qPCR. (B) At first,** ***Bd*** **was diagnosed by collecting toe clips, sloughed skin and other tissues. Assaying** ***Bd*** **infection by swabbing began in 2006 and quickly became the predominant sampling method. Publication data from Science Citation Index, Zoological Record and Google Scholar. Reproduced from (*11*).**

repeatability of results when visiting laboratories, although these details rarely make their way into publications. So we decided to conduct a study to specifically look at the reliability of results generated by different methods of sampling and diagnosis.

First, we compared results from conventional swabbing with those obtained by allowing subjects to release zoospores into a container of water and then testing the filtrate for *Bd* using various PCR methods (*11*). As test subjects, we used Oriental fire-bellied toads (*Bombina orientalis*) in our laboratory and in the field. To obtain *Bd* filtrate, we held individuals in a container with 150 ml of water, so that 90 percent of the frog's body was submerged, for 24 hours. Then we filtered 50 mL water using a 0.2 µm syringe filter that collected zoospores.

The filtering method revealed that many subjects that tested negative for *Bd* by swab analysis were in fact releasing zoospores. Using two different DNA extraction procedures, we found that *Bd* infection intensity borne by subjects, measured in zoospore equivalents, was between 33 and 51 times higher based on the filtrate than by swabbing. Based on these results, we determined that *Bd* prevalence values (22.8 percent) in the field were higher than those previously measured in the same species across South Korea using swab samples (16.7 percent).

We also studied how individuals release zoospores over time using the filtering method. We found that subjects discharged zoospores from zoosporangia intermittently over a five-day period. On some days, individuals known to be infected released no zoospores. Thus we recommend that subjects should be tested at least twice, several days apart, to be confident of their infection status.

Current knowledge of the worldwide distribution of the amphibian chytrid fungus is based almost entirely on quantitative PCR analyses of DNA collected from swabbed animals. Our study suggests that *Bd* distribution maps (*12*) may miss some infected regions, especially where infection loads are low. The methods we propose here for *Bd* sampling can assess infection status more precisely by directly targeting DNA of zoospores released from infected animals. Accurate determinations of *Bd* infection status may prove crucial for the rapid implementation of intervention actions to protect global amphibian populations.

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Defensive display of Fire-bellied toad to a predator. Photo: Jungbae Park.

In the Spotlight: Yellow Bush Frog

The Yellow bush frog (*Philautus neelanethrus*)–formerly known as the Blue-eyed bush frog because of the distinctive blue ring around its eye –is a species endemic to the Western Ghats in India. These tiny frogs are usually between 2.5 and 3 cms long from snout to vent. The IUCN Red List considers the Yellow bush frog Endangered (EN) due to habitat loss from dam construction and the conversion of forest land for agricultural uses. Photo: Angad Achappa.

Frogging: Where Researchers, Students and Photographers Get Together

By Ashish GB

Photo: Bamboo Rustles

It wasn't until July of this year that we started to see more substantial monsoons over peninsular India, leaving us to wonder whether a weaker monsoon season was impacting amphibians' reproductive cycle—and survival rates?

Like last year, nature camp Bamboo Rustles this year conducted an amphibian camp at Honey Valley in the Kodagu district of Karnataka, India, over the first week of July. By comparing the findings between the two years, we hoped to find our answer. With the support of Dr. KV Gururaja, we were once again able to learn about the amazing world of amphibians: species diversity, their behavior, their adaptations, their reproduction methods, how to identify different species and much more.

The team departed from Bangalore on a drizzling early morning June 4, 2014. The vehicle became more and more crowded as we picked people up from various locations. We stopped for breakfast en route to Mysore, where the vehicle was finally full after two final participants came on board the bus. This year's group was larger than last year's (13 members) and included many more experts. The highly experienced and very knowledgeable Dr. David Bickford shared stories about the amazing life of amphibians and his experiences in New Guinea and Borneo. For example, did you know that some species of frogs there eat their eggs if predators come too close?

Ramya Badrinath and Seshadri KS, who are studying frogs and have tremendous knowledge about amphibians, also shared their insights with the group members.

The first observation of a change from last year it seemed, was made by Dr. Gururaja who noted that the roads had actually become longer. It was an illusion—the result of our mid-day hunger. So two jeeps took us up to our dens at Chingara, where we met the three other participants who had already arrived. We feasted on a delicious lunch and settled in our rooms before Dr. Gururaja's presentations on the secret life of frogs began. Snacks, tea and coffee refilled our batteries for the night frogging session.

There was no sign of rain our first night and we went out around Chingara to observe and identify calling frogs. The sounds were so loud even though the frogs making the sounds were so tiny! It was amazing to see the amount of energy these frogs were spending. We saw some species low on the shrubs (*e.g.* the Knob-handed shrub frog) and others higher up in the canopy (*e.g.* the Glandular bush

frog). We even observed the belly of the brightly coloured Malabar torrent toad.

Soon we took a break for dinner, before some members ventured back out to continue their amphibian observations late into the night!!

Most of us slept late into the morning, awakening to breakfast, followed by presentations by Dr. KV Gururaja, Dr. David Bickford and Seshadri KS.

That night we planned to leave earlier in the evening to get to higher elevations. After a fun and scenic jeep ride, we reached the point where we would start the walk. The habitat was a mix of disturbed grasslands and forest patches. On the way we all heard some frogs calling, but despite searching for them for an hour, not a single one of us saw the animals. What were they? We decided we'd come back a bit later in the night.

At this elevation we observed few different species and even saw a particularly small *Nyctibatrachus* sp. (the adult was smaller than 10 mm). After an amazing night, the jeeps took us back to Chingara for a late dinner.

This was our last night. Here's the breakdown of what we saw:

In July 2013 we saw a total of 18 species of amphibians. During the same time in July 2014, we saw 11 of those same species. In July 2014, we observed a total of 16 species, of which five were new observations. Between the two years, we have observed 23 species in total at Honey Valley.

We are hopeful that next July when we conduct the workshop again, we'll be able to add more species to the database to increase our understanding of the frogs at Honey Valley.

Bamboo Rustles is an organization based in Bangalore that organizes camps, workshops, etc., for interested individuals to understand, appreciate, and enjoy the natural world.

You can find additional information one our Facebook page: https://www.facebook.com/BambooRustles

July 2013	July 2014
Duttaphrynus melanostictus – Asian common toad	
	Ghatophryne ornate – Malabar torrent toad
Nyctibatrachus grandis - Wayanad night frog	
	Nyctibatrachus sp. – Night frog species (smaller than a Rs. 5 coin)
Nyctibatrachus sp. Night frog species which was quite large	
Raorchestes luteolus – Coorg yellow bush frog	
Raorchestes charius – Seshachar's bush frog	
Raorchestes chromasynchysi – Confusing coloured bush frog	
Raorchestes tuberohumerus – Knob handed shrub frog	
Raorchestes glandulosus – Glandular bush frog	
Raorchestes ponmudi – Ponmudi bush frog	
	Raorchestes wynaadensis – Wyanaad bush frog
Pseudophilautus kani – Kani bush frog	
Rhacophorus malabaricus – Malabar gliding frog	
Zakerana caperata – Wrinkled zakerana	
Zakerana cf. *granosa*	
	Zakerana mudduraja – Muddu raja zakerana
Micrixalus elegans – Elegant torrent frog	
Micrxalus saxicola – Small torrent frog	
	Micrixalus specca – Spotted dancing frog
Indirana semipalmata – Small handed frog	
Hylarana aurantiaca – Golden Ffog	
	Hylarana temporalis – Bronze frog

Conservation and Ecology

Phyllomedusa palliata **photographed in Madre de Dios, Peru. Photo: Eleanor Warren-Thomas.**

Frog communities in fire-disturbed forests of the Peruvian Amazon

Eleanor Warren-Thomas, Mary Menton, Jusmell Huamán, Ruth Frisancho Vargas, Emma Wadley, Nicholas Price & Jan Christoph Axmacher

Amphibian declines are a pressing global concern. The lowland rainforests of the southeastern Amazon harbour exceptionally high amphibian diversity, but also face a range of threats including habitat modification caused by forest fires. In this study, we sampled amphibians in areas of forest in Madre de Dios, Peru, that were affected by anthropogenic fires following severe drought in 2005. Two forest types, bamboo and terra-firme, were assessed. Forty-two anuran species were recorded in 22 survey nights. Amphibian diversity and abundance were not significantly different in burned areas of either forest type, and amphibian community composition did not change significantly between burned and unburned forests within any forest type, while bamboo forest was found to support a distinctly different amphibian assemblage to terra-firme forest. Our results suggest that further sampling over wider spatial and temporal scales to encompass a greater range of fire impacts could consolidate insights into the effects of fire on anuran communities in this region, and help to highlight the conservation value of these disturbed forests. These preliminary results are novel and enhance our understanding of how tropical forest fires may affect amphibian communities. The data also highlight the conservation value of forests affected by a fire event, as they harboured large numbers of anuran species known in the region. This is of particular interest for those species that have so far only been recorded outside of protected areas in Madre de Dios, such as Ranitomeya cf. ventrimaculata and Osteocephalus buckleyi.

Warren-Thomas, E., Menton, M., Huamán, J., Frisancho Vargas, R., Wadley, E., *et al.*, *Herpetol. Bulletin*. **126**, 14-24. (2013).

Characterizing the width of amphibian movements during postbreeding migration

Stephanie S. Coster, Jessica S. Veysey Powell, Kimberly J. Babbitt

Habitat linkages can help maintain connectivity of animal populations in developed landscapes. However, the lack of empirical data on the width of lateral movements (i.e., the zigzagging of individuals as they move from one point to another point) makes determining the width of such linkages challenging. We used radiotracking data from wood frogs (Lithobates sylvaticus) and spotted salamanders (Ambystoma maculatum) in a managed forest in Maine (U.S.A.) to characterize movement patterns of populations and thus inform planning for the width of wildlife corridors. For each individual, we calculated the polar coordinates of all locations, estimated the vector sum of the polar coordinates, and measured the distance from each location to the vector sum. By fitting a Gaussian distribution over a histogram of these distances, we created a population-level probability density function and estimated the 50th and 95th percentiles to determine the width of lateral movement as individuals progressed from the pond to upland habitat. For spotted salamanders 50% of lateral movements were ≤13 m wide and 95% of movements were ≤39 m wide. For wood frogs, 50% of lateral movements were ≤17 m wide and 95% of movements were ≤ 51 m wide. For both species, those individuals that traveled the farthest from the pond also displayed the greatest lateral movement. Our results serve as a foundation for spatially explicit conservation planning for pond-breeding amphibians in areas undergoing development. Our technique can also be applied to movement data from other taxa to aid in designing habitat linkages.

S. S. Coster, J. S. Veysey Powell, K. J. Babbitt, *Conserv. Biol.* **28**, 3 (2014).

Macroecological patterns of amphibian assemblages in the Western Palaearctic: implications for conservation

Daniel Escoriza & Albert Ruhí

Unveiling the patterns of amphibian phylogenetic diversity across broad spatial scales is extremely timely, given the need to optimize conservation strategies for this group. Here we analysed the distributions of 51 amphibians in the Western Palaearctic, and we explored the variation in phylogenetic structure and beta diversity across space. We predicted that the incidence of phylogenetic clustering in local assemblages would follow a latitudinal gradient, explained by the fact that only a few families would be able to occupy most of the available climate space, whereas many families would be restricted to the mid-latitudinal range. For the same reason, we predicted that a latitudinal pattern would be observed when analysing the relative contributions of the two components of overall beta diversity, namely turnover and nestedness. At both geographic extremes we observed a decline in species richness, with these areas presenting relatively higher levels of phylogenetic clustering. As expected, a few families (Bufonidae, Ranidae, and Salamandridae) occupied one or both extremes, whereas the rest were confined to the mesothermal belt. Also as predicted, the nestedness mechanism prevailed in explaining overall beta diversity in both the northern and southernmost regions of the ecozone, but not in the temperate regions. From these results we suggest the existence of a conservation challenge: in northern Europe and the arid regions of Northern Africa, the relatively high contribution of nestedness to overall beta diversity allows conservation efforts to prioritize the few areas that host the greatest species richness. However, in southern Europe and the mesic regions of Northern Africa this pattern does not hold, hence conservation efforts should be focused on identifying areas of high phylogenetic diversity rather than focusing on high species-richness sites.

D. Escoriza, A. Ruhí, *Biol. Cons.* **176**, 252-261 (2014).

To breed or not to breed: past reproductive status and environmental cues drive current breeding decisions in a long-lived amphibian

Hugo Cayuela, Aurélien Besnard, Eric Bonnaire, Haize Perret, Justine Rivoalen, Claude Miaud & Pierre Joly

Iteroparity is an adaptive response to uncertainty in reproductive success. However, spreading reproductive success over multiple reproduction events during a lifetime is constrained by adult mortality and the stochasticity associated with interactions between external factors and physiological states. The acquisition of information about environmental conditions during the growth of progeny and sufficient resources during the non-reproductive period are key factors for breeding success. Consequently, we hypothesized that long-lived animals may skip a breeding opportunity when information about unfavourable

environmental conditions is available. In addition, nutritional constraints could prevent an animal from replenishing its reserves sufficiently to invest in the current breeding period. We investigated these questions using capture–recapture data from a 5-year study on a large population of yellow-bellied toads in a forest in north-eastern France. We took advantage of various advances in multi-state capture–recapture models (e.g. unobservable states and mixture models) to test our hypotheses. Our results show that the combined effects of rainfall deficit and the breeding/non-breeding state of individuals during the past breeding season affect breeding probability during the following breeding opportunity. We also found that females breed less frequently than males, suggesting that the overall energy cost of reproduction differs between genders. Finally, the results indicate that toad survival appears to be negatively influenced by rainfall deficits. We discuss the yellow-bellied toad's reproductive behaviour in term of bet-hedging strategy and life history trait evolution.

Cayuela *et al.*, *Oecologia*, **176(**1), 107-116.

Yellow-bellied toad *(Bombina variegata)*. Photo: Lucas Cottereau.

The efficiency of indicator groups for the conservation of amphibians in the Brazilian Atlantic Forest

Felipe S. Campos, Joaquim Trindade-Filho, Daniel Brito, Gustavo A. Llorente & Mirco Solé

The adequate selection of indicator groups of biodiversity is an important aspect of the systematic conservation planning. However, these assessments differ in the spatial scales, in the methods used and in the groups considered to accomplish this task, which generally produces contradictory results. The quantification of the spatial congruence between species richness and complementarity among different taxonomic groups is a fundamental step to identify potential indicator groups. Using a constructive approach, the main purposes of this study were to evaluate the performance and efficiency of eight potential indicator groups representing amphibian diversity in the Brazilian Atlantic Forest. Data on the geographic range of amphibian species that occur in the Brazilian Atlantic Forest were overlapped to the full geographic extent of the biome, which was divided into a regular equal-area grid. Optimization routines based on the concept of complementarily were applied to verify the performance of each indicator group selected in relation to the representativeness of the amphibians in the Brazilian Atlantic Forest as a whole, which were solved by the algorithm "simulated annealing," through the use of the software MARXAN. Some indicator groups were substantially more effective than others in regard to the representation of the taxonomic groups assessed, which was confirmed by the high significance of the data ($F = 312.76$; $P < 0.01$). Leiuperidae was considered as the best indicator group among the families analyzed, as it showed a good performance, representing 71% of amphibian species in the Brazilian Atlantic Forest (i.e., 290 species), which may be associated with the diffuse geographic distribution of their species. In this sense, this study promotes understanding of how the diversity standards of amphibians can be informative for systematic conservation planning on a regional scale.

F.S.Campos, J. Trindade-Filho, D. Brito, G. A. Llorente, M. Solé, *Ecol. Evol.* **4(12),** 2505–2514 (2014).

Amphibian diversity on floating meadows in flooded forests of the Peruvian Amazon

Upton, K., Warren-Thomas, E., Rogers, I. & Docherty, E.

Floating meadows are often associated with Amazonian white-water flooded forests (varzea), where they grow between the tree line and open-water. Floating meadows consist of herbaceous water plants that begin growing at the end of the low water period. The importance and diversity of floating meadows has been highlighted for several taxa, yet studies focusing on amphibian use of floating meadows are relatively scarce. This study was conducted in the Samiria River basin of the Pacaya-Samiria National Reserve, Loreto, Peru (-4.893256°S, -74.355526°W). The floating meadows surveyed were located in the Samiria River basin at PV1 Shiringal, PV2 Tacshacocha, Huishto Cocha and PV3 Hungurahui. Nineteen amphibian species and 1090 individuals were recorded on the floating meadow habitat representing four families. Six species have not been previously recorded on floating meadows. Most of the species recorded on floating meadows were hylids. The median height in which amphibians were found and the most commonly used (over 50% of encounters) plant species are presented for all species observed. Hylids may potentially be using floating meadows for breeding, as calling males, gravid females, egg masses and newly metamorphosed juveniles of twelve species were observed.

Upton, K. E. Warren-Thomas, I. Rogers, E. Docherty. *Herpetol. Rev.* 45(2), 209-212 (2014).

***Hypsiboas punctatus* one of the most commonly encountered species on the floating meadows. Photo: Katy Upton.**

Plateau salamander (*Eurycea tonkawae*). Photo: N. F. Bendik.

Effect of Urbanization on Abundance of Jollyville Plateau Salamanders (*Eurycea tonkawae*)

Nathan F. Bendik, Blake N. Sissel, Jacqueline R. Fields, Lisa J. O'Donnell & Mark S. Sanders

Urbanization causes havoc to native ecosystems, resulting in population declines or extirpation of sensitive taxa. This can be devastating to narrow-range endemics whose distributions overlap or are enveloped by urban development. Jollyville Plateau Salamanders (*Eurycea tonkawae*) are aquatic neotenes restricted to karst-associated waters in a small, highly urbanized area of central Texas. *Eurycea tonkawae* was recently listed as threatened

under the U.S. Endangered Species Act due to threats from urbanization, although the published literature on their population status is limited to a single, short-term study. Here, we attempt to remedy this dearth of knowledge by summarizing population survey data from sites that span the breadth of *E. tonkawae*'s range. We analyzed count data using Bayesian inference and generalized linear models, first to determine trends in abundance at eight sites from 1996–2011. Secondly, we examined differences in salamander density at these and an additional nine sites (n = 17) among urbanized and non-urbanized catchments from 2009–2012. Study sites occurred in catchments that ranged from undeveloped to completely built-out, from no-change in development to > 20% increases in development. Accounting for climatic variation, we found that counts of *E. tonkawae* declined in areas that had the largest increases in residential development (a metric of urbanization) over a 15-y period. Additionally, densities of *E. tonkawae* were negatively correlated with residential development across their range. We discuss several possible mechanisms responsible for declines of *E. tonkawae* and highlight likely causes and potential areas of future research to aid in conservation efforts for this and other central Texas *Eurycea* salamanders.

N.F. Bendik, B.N. Sissel, J.R. Fields, L.J. O'Donnell, M.S. Sanders, *Herpetol. Conserv. Biol*. **9**, 1 (2014).

Bob Inger's Bush frog (*Raorchestes bobingeri)* can be severely impacted by loss of canopy cover. Photo: Seshadri KS.

Effects of Historical Selective Logging on Anuran Communities in a Wet Evergreen Forest, South India

Seshadri K S

Logging of tropical forests continues to be a threat for biodiversity conservation. Large expanses of evergreen and rainforests forests were logged in the past and many areas continue to be logged. Determining impacts of the logging activity on amphibians is not fully understood. Selective logging, where particular, commercially important trees are logged is often considered to be less impactful and is widely followed. However, such activities appear to have severe impacts. This paper examines the impacts of selective logging on anuran communities in a wet evergreen forest in south India. Assemblages of anurans in unlogged forests were compared with those in selectively logged forests. Forty sampling units measuring 10 m by 10 m were established in forests, riparian zones, and streams of both unlogged and selectively logged forests. Night time visual encounter surveys were carried out over four months in 2010-2011. The anuran species richness did not appear to be affected by logging as it was comparable in both logged and unlogged areas. Anuran density however, appeared to be significantly impacted and was 42 percent lower in selectively logged forests when compared to unlogged forests. Anuran densities, measured in three micro-habitats viz., streams, riparian and forests also varied significantly. Streams supported the highest density followed by riparian and forests. This is indicative of stream and riparian areas serving as important refugia. Examining the niche breadth and overlap provided further insights as niche breadth and overlaps were altered for several species in logged areas. Canonical correspondence analysis accounted for 95 percent of variation in species assemblage across both selectively logged and unlogged forests. Litter thickness and water depth had the highest influence on the assemblage in both areas. Findings indicate that even after ca. 40 yr. since logging, anuran assemblages appear to be affected. Further studies and long term monitoring would be necessary to track the recovery process.

K S. Seshadri, *Biotropica* **46**(5), 615-623 (2014).

Field observation of an adult Lesser treefrog *Dendropsophus minutus* (Anura: Hylidae) being consumed by a neotropical *Lethocerus* sp. (Hemiptera: Belostomatidae) nymph

Ricardo Rocha, Thaís Almeida & Adrià López-Baucells

Amphibians constitute important items in the diet of many predators. Giant water bugs have been reported to feed on several species of amphibians; however, there is still a poor understanding of the complexity of their food webs. Here, we report the consumption of an adult *Dendropsophus minutus* (Anura: Hylidae) by a *Lethocerus* sp. (Hemiptera: Belostomatidae) nymph, in Central Amazon, Brazil. This represents the first observation of thropic interaction between *Lethocerus* sp. and *D. minutus* and the first report of a neotropical *Lethocerus* sp. nymph feeding upon an adult vertebrate.

Rocha *et al*., *Alytes*. **31**, 1-2 (2014).

Juvenile Hurter's spadefoot. Photo: Donald Brown.

Potential impacts of a high severity wildfire on abundance, movement, and diversity of herpetofauna in the Lost Pines ecoregion of Texas

Donald J. Brown, Adam Duarte, Ivana Mali, Melissa C. Jones & Michael R. J. Forstner

In September and October 2011, a high severity wildfire burned 39% of the 34,400 ha Lost Pines ecoregion in Bastrop County, Texas, USA. We assessed potential impacts of the wildfire on abundance, movement, and diversity of herpetofauna using drift fence array trap data collected prior to and after the wildfire, and anuran call survey data collected after the fire, on the 1,948 ha Griffith League Ranch. A capture-recapture analysis indicated that movement rates were higher in the wildfire zone for Hurter's Spadefoot (*Scaphiopus hurterii*) the following spring. Based on the trap data, herpetofaunal species composition was not significantly different shortly after the fire or subsequently, during the following spring. However, the anuran call survey data indicated that anuran species richness was higher in the wildfire zone. Overall, we did not find reduced abundance or diversity of herpetofauna after the fire, a positive result for conservation in this ecoregion. In addition, our study indicated that investigations focused on fire impacts to ground-dwelling wildlife should consider detection probability when drawing inferences concerning abundances, particularly when differences in ground structure are apparent. Few other studies have examined the effects of intense fires on herpetofauna and our study indicates that herpetofaunal communities can emerge from intense fires without detrimental changes.

D. J. Brown, A. Duarte, I. Mali, M. C. Jones, M. R. J. Forstner, *Herp. Con. Bio.* **9**, 192-205 (2014).

Egg mass and adult Dusky gopher frog (*Lithobates sevosus*). Photos: Stephen Richter.

Survival to metamorphosis is positively related to genetic variability in a critically endangered amphibian species

Stephen C. Richter & Schyler O. Nunziata

Isolated small populations typically have reduced genetic variation and are more susceptible to local extinction. Examining the relationship between genetic variability and survival is important for conservation because it provides insight on evolutionary potential and population viability. We studied genetic associations of survival from egg to metamorphosis in the largest population of critically endangered dusky gopher frogs Lithobates sevosus. This approach allowed us to examine whether heterozygosity-fitness correlations (HFCs) existed in a selected species with large effect size, whereas previous research on HFCs has largely focused on k-selected species often with low effect sizes. Our objectives were to determine if genetic-fitness associations exist, if associations are a result of inbreeding and if natural selection against inbreeding has occurred. Specifically, we examined averaged population responses and HFC in relation to (1) mortality within egg clutches and (2) differential survival of offspring through metamorphosis. To do so, we used eight microsatellite DNA markers to compare genotypes across three life-history stages from a single year in the following temporal order: adults, eggs and metamorphs. We discovered a strong genetic association with survival in early life stages. In terms of average population responses, we documented a within-cohort decrease in FIS with life-history stage progression (adults: FIS = 0.067; eggs: FIS = 0.063; metamorphs: FIS = −0.134), high FST between eggs and metamorphs (FST = 0.113), and a locus that had larger than expected FST. We found positive genetic-fitness associations for survival of egg clutches and for survival to metamorphosis. We believe that inbreeding is the primary cause; however, we also found evidence suggesting existence of purging selection against a deleterious mutant linked to a microsatellite locus. Survival of individuals with greater genetic variability should prolong persistence of this isolated population. Our study underscores the importance of species management focused on preservation of genetic diversity.

S.C. Richter, S.O. Nunziata, *Anim. Conserv.* **17**, 265 (2014).

Natural History Museum of the University of Oporto. Photo: L. Ceríaco.

Catalogue of the amphibian and reptile type specimens of the Museu de História Natural da Universidade do Porto in Portugal, with some comments on problematic taxa

Luis M. P. Ceríaco, David C. Blackburn, Mariana P. Marques & Francisco M. Calado

We present an annotated catalog of the type specimens of amphibians and reptiles in the collections of the Museu de História Natural da Universidade do Porto in Portugal. These specimens, all from present-day Angola, formed the basis of taxonomic descriptions by both José Júlio Bethencourt Ferreira and José Vicente Barbosa du Bocage in the latest 19th and early 20th century. We provide details for all type specimens and summarize the history and taxonomy for each species. Specimens of *Rappia bocagei* var. *maculata* and *Typhlops bocagei* could not be located during our survey, and we believe these to be lost. The collections at the University of Porto contain type specimens of one snake, *Typhlops boulengeri*, and eight frogs, *Arthroleptis carquejai*, *Hylambates bocagei* var. *leucopunctata*, *Rappia platyceps* var. *angolensis*, *Rappia bivittata*, *Rappia fasciata*, *Rappia nobrei*, *Rappia osorioi*, and *Rappia seabrai*. Of these, only two are currently recognized: *Afrixalus osorioi* and *Arthroleptis carquejai*.

Ceríaco *et al.*, *Alytes.* **31**, 1-2 (2014).

Aplastodiscus callipygius, a species whose type locality is within the study site, the Serra da Bocaina National Park, in the Serra do Mar. Photo: D. B. Provete.

Broad-scale spatial patterns of canopy cover and pond morphology affect the structure of a Neotropical amphibian metacommunity

Diogo B. Provete, Thiago Gonçalves-Souza, Michel V. Garey, Itamar A. Martins & Denise de C. Rossa-Feres.

Both spatial and environmental processes influence species composition at distinct scales. Previous studies suggested that the distribution of larval anurans at the landscape-scale is influenced by environmental gradients related to adult breeding site selection, such as pond canopy cover, but not by water chemistry. However, none study so far have analyzed the combined effects of spatial, pond morphology, and water chemistry variables on metacommunity structure of larval anurans. We used a partial redundancy analysis and variation partitioning to test the relative influence of pond morphology (e.g., depth, area, and aquatic vegetation), water chemistry (e.g., pH, Dissolved Oxygen, Temperature, and conductivity), pond canopy cover, and spatial variables on a metacommunity of larval anurans from southeastern Brazil. The spatial variables were generated by a multi-scale method called distance-based Moran Eigenvector Maps (dbMEM) that allows the incorporation of multiple spatial scales in the analysis. We predict that pond morphology and canopy cover will influence the metacommunity at broad spatial scales, while water chemistry would play a larger role at finer scales. However, we found that broad-scale spatial patterns of pond canopy cover and pond morphology strongly influenced metacommunity structure, with water chemistry being not significant. These two sets of variables were spatially autocorrelated at broad spatial scales and explained the first dbMEMs. Conversely, species composition was spatially autocorrelated at short distances. However, the biological causes of such pattern could

not be sorted out, since it could be related to both adult dispersal limitation (a pure spatial process) and species response to spatially-structured environmental gradients (a niche-based process), or a combination of both. We suggest that the reproductive behavior of adult anurans is driving tadpole metacommunity dynamics, since pond morphology, but not water chemistry affects breeding site selection by adults. Our results contribute to the understanding of amphibian species diversity in tropical wetlands.

D. B. Provete, T. Gonçalves-Souza, M. V. Garey, I. A. Martins, D. C. Rossa-Feres, *Hydrobiologia*. **734,** 69 (2014).

Yinggeling treefrog *(Rhacophorus yinggelingensis)* in its native habitat. Photo: Bosco P.L. Chan.

Altitudinal range and reproduction of the Hainan endemic treefrog, *Rhacophorus yinggelingensis*

C.l. Liao, Bosco P. L. Chan, Yik-Hei Sung & H.s. Wang

Hainan Island, China, is part of the Indo-Burma biodiversity hotspot with high rates of biodiversity and endemism. Today, 90% of the 12 endemic amphibian species is considered threatened by the IUCN Red List. The Yinggeling treefrog *Rhacophorus yinggelingensis* was described as late as 2007 and is known only from Yinggeling Nature Reserve. Our understanding of the ecology of this highly restricted species is extremely limited. The objectives of this study were to investigate the altitudinal range and reproductive seasonality of Yinggeling treefrog so as to provide baseline information for future population monitoring and conservation plans. Transect survey was conducted to search for the presence of treefrog and its breeding site over a 18-month period, which covered over 100 km in length and an elevation range from 900m asl to the summit of Yinggeling at 1,812m asl. Our results show that the species is restricted to and breed in high-elevation old-growth forest above 1,200m, and the species breeds prior to the onset of the rainy season from March to June, with March being its activity peak. This is of particular conservation concern in the face of climatic change, as it indicates that the species may be susceptible to global warming, which has been linked to the decline of other montane amphibian species. Notably, over 40 % of breeding pools identified were above 1,500 m asl; with the highest peak reaching a mere 1,812 m, the room for upslope migration in the face of climate change for this species is very limited. All identified breeding pools and sightings of adults were located in mature tropical montane rainforests, suggesting that well-preserved forest is essential for successful reproduction and survival of *R. yinggelingensis*. In Hainan, there has been extensive forest degradation, with less than 5 % of the original forest cover remaining. This may be one of the possible reasons for its extremely narrow geographic distribution. One important observation is that *R. yinggelingensis* appears to only breed in pools that are maintained by the wallowing activity of large ungulates, such as sambar deer (*Rusa unicolor*) and wild boar (*Sus scrofa*), and there is a possibility that the availability of breeding pools for *R. yinggelingensis* is limited by mammal activities. This warrants quantitative studies on the relationship between mammal activities and reproduction of *R. yinggelingensis* to understand this potential commensalism between mammals and amphibians.

Liao, C.L., B.P.L. Chan, Y.H. Sung, H.S. Wang, 2007. *Herpetozoa*. **27** (1/2): 91-94

Desert Anuran Occurrence and Detection in Artificial Breeding Habitats

Nicole M. Harings & Wiebke J. Boeing

One-third of known amphibian populations have become extinct, with habitat loss and degradation being the leading causes in the United States. Site occupancy has been suggested as one of the most effective state variables in describing population declines. The objectives of this study were to determine occupancy estimates of five southwestern desert anurans, accounting for imperfect detection, and to determine the main factors impacting detection. We conducted call and visual surveys on three consecutive nights after rain events at 21 breeding sites for Mexican Spadefoot (*Spea multiplicata*), Plains Spadefoot (*Spea bombifrons*), Couch's Spadefoot (*Scaphiopus couchii*), Great Plains Toad (*Anaxyrus cognatus*), and Green Toad (*Anaxyrus debilis*). We used occupancy modeling to estimate the proportion of sites occupied for all species detected during the sampling period. *Spea multiplicata* and *A. debilis* were most prevalent, followed by *A. cognatus*, *Sp. bombifrons*, and *Sc. couchii*, respectively. In addition to the inclusion of repeated site surveys to decrease bias, incorporating visual surveys greatly improved occupancy estimates for southwestern desert anurans. Detection was highest on survey night one for *Sp. multiplicata, Sp. bombifrons*, *Sc. couchii*, and *A. debilis* (72.2–100%); warmer air temperature improved detection of *A. cognatus*. Sky conditions did not significantly influence desert anuran detectability. Immediate survey after rain events and the combination of call and visual surveys are critical to increase accuracy when studying desert anurans.

N.M. Harings, W.J. Boeing, Herpetologica **70**, 123-134 (2014) http://dx.doi.org/10.1655/herpetologica-d-12-00077

Tadpole of Iberian waterfrog (*Pelohylax perezi)* at a breeding pond. Photo: Anssi Laurila.

Rapid evolution of constitutive and inducible defences against an invasive predator

Ana L. Nunes, Germán Orizaola, Anssi Laurila & Rui Rebelo

The expansion of species outside their distribution range due to human activities is currently one of the most serious threats to biodiversity worldwide. Invasive alien predators are considered one of the major causes of population declines and extinctions in nature. Moreover, exotic predators can also impose strong selection on native prey populations and induce rapid evolutionary change in the invaded communities. Many amphibians have been negatively impacted by the expansion of invasive predators and their larval stages provide an ideal model for examining the evolution of anti-predator defences against invasive predators. In this study, we examined the effect of coexistence time with an invasive predator, the red-swamp crayfish (*Procambarus clarkii*), on the development of anti-predator defences of the Iberian waterfrog (*Pelophylax perezi*). We selected five *P. perezi* populations in Southern Portugal that differ in coexistence time with *P. clarkii*: two populations have been in contact with the exotic predator for ca. 30 years, one population has been invaded by the crayfish more recently (ca. 20 years ago) and two populations come from an area that has not been invaded by

the crayfish. Eggs of *P. perezi* were collected at each location and transferred to the laboratory, where tadpoles were reared. Half of the tadpoles of each population were exposed to the nonlethal presence of crayfish, whereas the other half was reared without predators. We examined the behavioural and morphological response of tadpoles to crayfish presence. Tadpoles from populations with longer coexistence time with the crayfish had extremely low activity rates, even in the absence of the predator, suggesting that the exotic predator has selected for constitutively low activity level. The other populations exhibited plastic behavioural responses, having high activity in the absence of the crayfish, but reducing movement in its presence. Tadpoles from one of the long-coexistence populations also showed plastic morphological responses, increasing tail surface when reared in the presence of the crayfish. Larger tails likely increase tadpole survival as they attract predator attacks to less vulnerable parts of their body. This study shows that evolutionary responses to exotic predators can be rapid and quantitatively different from those shown by naïve populations. In order to study long-term impacts of invasive predators to natural communities more studies examining multiple populations distributed across a range of coexistence time are needed.

A.L. Nunes, G. Orizaola, A. Laurila, R. Rebelo, *Ecology* **95**, 1520-1530 (2014). http://dx.doi.org/10.1890/13-1380.1

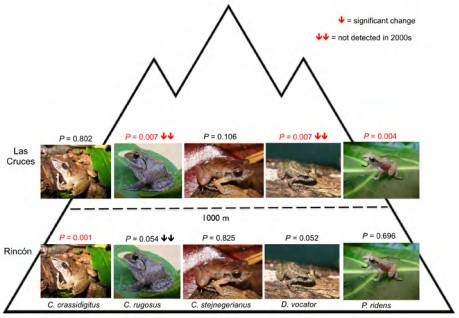
The Golden frog (*Hylarana aurantiaca*). Photo: Rachakonda Sreekar.

Drivers of reptile and amphibian assemblages outside the protected areas of Western Ghats, India

Divya Balaji, Rachakonda Sreekar & Siddharth Rao

Biodiversity conservation in forested landscapes outside protected areas is important to sustain populations of species with restricted ranges. However, such habitats face many anthropogenic threats, including logging, extraction of firewood and leaf-litter for mulch in plantations. In this study, we determined the effects of forest degradation on amphibians and reptiles in forests outside protected areas by measuring their species richness and community composition across a disturbance gradient from near pristine to highly degraded forests in Agumbe, Western Ghats, India. Twenty-one strip 15 m × 150 m transects were laid across the disturbance gradient and diurnal visual encounter surveys were conducted. Sampling was repeated three times per transect covering the dry, intermediate and wet seasons. Amphibian and reptile communities were affected by the decrease in canopy cover and leaf litter volume, respectively. Our results indicate that the collection of firewood and leaf-litter can severely affect amphibian and reptile populations. Structured conservation planning outside of protected areas is therefore imperative.

D. Balaji, R. Sreekar, S. Rao, *J. Nat. Conserv.* **22**, 337-341 (2014).



Changes in detection of the five species between the two sites. The site-specific logistic regression P-values and direction of relative detection changes between sampling periods and elevation for each species. Upper row is LCBS and lower row is Rincón.

Individualistic population responses of five frog species in two changing tropical environments over time

Mason J. Ryan, Michael M Fuller, Norman J. Scott, Joseph A. Cook, Steven Poe, Beatriz Willink & Gerardo Chaves Federico Bolaños

Roughly 40% of amphibian species are in decline with habitat loss, disease, and climate change being the most cited threats. Heterogeneity of extrinsic (e.g. climate) and intrinsic (e.g. local adaptations) factors across a species' range should influence population response to climate change and other threats. Here we examine relative detectability changes for five direct-developing leaf litter frogs between 42-year sampling periods at one Lowland Tropical Forest site (51 m.a.s.l.) and one Premontane Wet Forest site (1100 m.a.s.l.) in southwest Costa Rica. We identify individualistic changes in relative detectability among populations between sampling periods at different elevations. Both common and rare species showed site-specific declines, and no species exhibited significant declines at both sites. Detection changes are correlated with changes in temperature, dry season rainfall, and leaf litter depth since 1969. Our study species share Least Concern conservation status, life history traits, and close phylogenetic relationship, yet their populations changed individualistically both within and among species. These results counter current views of the uniformity or predictability of amphibian decline response and suggest additional complexity for conservation decisions.

M.J. Ryan, M.M. Fuller, N.J. Scott, J.A. Cook, S. Poe, *et al*. *PLoS One* **9**(5): e98351 doi:10.1371/journal.pone.0098351 (2014)

Cryptic Diversity and Conservation of Gopher Frogs across the Southeastern United States

Stephen C. Richter, Eric M. O'Neill, Schyler O. Nunziata, Andrew Rumments, Emily S. Gustin, Jeanne E. Young & Brian I. Crother

Identifying cryptic biodiversity is fundamental to evolutionary biology and to conservation efforts. This study investigated range-wide genetic diversity of Gopher Frogs, Lithobates capito, across the southeastern United States coastal plain to determine implications for taxonomy and conservation. We collected data for two mtDNA regions in 21 populations to identify genetic structure across the geographic distribution of the species. Based on population genetic, phylogenetic, and genealogical analyses, we recovered three reciprocally monophyletic mtDNA lineages corresponding to mainland coastal plain populations and two lineages within peninsular Florida. Breakpoints for these lineages did not occur in previously identified hotspots of amphibian phylogeographic breaks and did not follow currently recognized subspecies designations. We recommend these lineages be recognized as separate distinct population segments and be considered separately by the U.S. Fish and Wildlife Service for listing under the Endangered Species Act. Additionally, we propose an evolutionary hotspot for amphibians that deserves further attention.

S.C. Richter *et al*., *Copiea* 2014, **231** (2014).

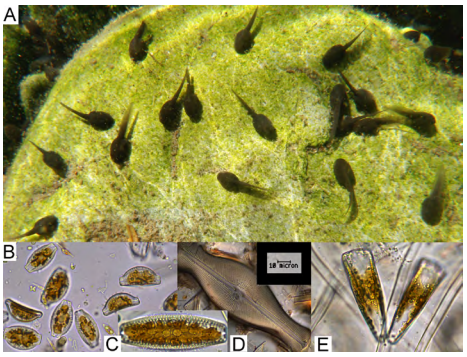
Identifying priority areas for conservation of spadefoot toad, *Pelobates fuscus insubricus* using a maximum entropy approach

Andrea Giovannini, Daniele Seglie, & Cristina Giacoma

In this study, we used a maximum entropy (MaxEnt) approach to model the distribution of the rare European amphibian *Pelobates fuscus insubricus*, with

the final goal of identifying suitable areas for its conservation. We generated the model starting from a dataset of all locations where this species' presence was confirmed for the region of piedmont in 2004–2010, which consisted of only 15 occurrence records. To verify the working hypothesis that population survival is higher in areas where Maxent identifies higher distribution probability values, we used suitability indexes generated by the model to compare the "historical" (before 1980) and "recent" (1980–1996) distributions of *P. f. insubricus* populations in the piedmont region. The average area-under-the-curve value (0.878, s = 0.075) of the Maxent model proved significantly informative. Using the Bonferroni confidence interval, we demonstrated that surviving populations occupy geographic areas characterized by significantly higher potential suitability ($p < 0.05$), and we selected areas accordingly. We therefore conclude that, in our case study, modelling the distribution of rare species may represent a useful strategy to select areas where these species are likely to persist. To further evaluate this approach, we suggest testing it on the study of other rare species.

A. Giovannini, D. Seglie, C. Giacoma, *Biodiversity Conserv.* **23**, 1427–1439 (2014).



(A): Tadpoles of the foothill yellow legged frog (*Rana boylii)* grazing on periphyton. Photo: A. Catenazzi. (B-E): Periphyton with different nutritional value and grazeability, such as diatoms that are protein rich (*Epithemia* species, B, C), or mucilaginous (*Didymosphenia geminata*, D, and *Gomphoneis* with stalk material in the background , E). (B-E Photos: P.C. Furey).

The perils of unpalatable periphyton: *Didymosphenia* and other mucilaginous stalked diatoms as food for tadpoles

Paula C. Furey, Sarah J. Kupferberg & Amy J. Lind

Proliferations of the diatom *Didymosphenia geminata* are becoming prevalent in rivers around the globe, sometimes covering stream bed surfaces with a nuisance build-up of extracellular stalk material. In the Sierra Nevada of California, *Didymosphenia* and other taxa that produce mucopolysaccharide stalks (e.g. *Gomphoneis*, *Gomphonema*, *Cymbella*) can dominate benthic environments downstream of dams that alter hydrologic and thermal regimes. Releases of water from the depths of upstream reservoirs can create conditions several degrees C cooler than would occur naturally. We compared the prevalence of stalked diatoms in paired river reaches, one free-flowing and the other regulated, within two Sierran river systems, the American and Feather Rivers. In the regulated reaches, short-term power generation caused daily flow fluctuations and periphyton biovolume was dominated by either *Didymosphenia* (where hypolimnetic releases created cool summer temperatures) or other stalked diatom taxa (where temperatures were warm). Periphyton assemblages from the unregulated sites were significantly different from the regulated reaches based on biovolume, with *Gomphonema* being the genus at unregulated sites contributing to the dissimilarities after accounting for the stalked genera from the regulated reaches.

We evaluated the consequences of these differences in the prevalence of mucopolysaccharide producing diatoms for a large-bodied grazer, tadpoles of the foothill yellow-legged frog (*Rana boylii*). These frogs which are endemic to rivers of California and southern Oregon, rely on diets dominated by other protein rich diatom taxa which contain N_2- fixing spheroid bodies (e.g. *Epithemia*) to enhance larval development and growth. In a factorial experiment manipulating diet and thermal regime, we found that at 16.6°C mean daily temperature, tadpoles lost weight (72 h relative change of −16.1 ± 7.2%) when grazing on periphyton from a *Didymosphenia*-dominated site. At 19.9°C (similar to unregulated river conditions), tadpoles grazed *Didymosphenia* at a rate similar to tadpoles consuming higher protein control periphyton, but the former tadpoles did not grow (relative change of 4.3 ± 5.4% vs 30.7 ± 3.4% for control periphyton). When tadpoles were fed periphyton dominated by mucilaginous stalked diatoms other than *Didymosphenia*, tadpole weight loss was 21.0 ± 9.2% (cool) and 16.6 ± 5.6% (warm). These results illustrate that hydrologically or thermally mediated shifts in periphyton composition can have significant implications for the energy transferred to grazers. Because foothill yellow legged frogs are missing from more than half of historically occupied sites, and are more commonly absent downstream of large dams, these findings highlight the importance of a holistic approach to conservation.

P. C. Furey, S. J. Kupferberg, A. J. Lind, *Diatom Research*, **29**, 267-280 (2014).

Adult female of *Duttaphrynus hololius*. Photo: S. R. Chandramouli.

Description of the larvae of Günther's toad *Duttaphrynus hololius* (Günther, 1876) (Anura: Bufonidae) with notes on development and oral ultra-structure

S. R. Chandramouli & Ayuthavel Kalaimani

Morphology of tadpoles of the little known, Peninsular Indian endemic bufonid *Duttaphrynus hololius* (Günther, 1876) is described across different stages in detail, with observations on natural history. The oral apparatus of these benthic feeding tadpoles was examined using scanning electron microscopy and the ultra-structure is illustrated and described in detail. These larvae have a labial tooth row formula of 2(2)/2(2), with about 99 and 97 denticles on the anterior and posterior labia respectively. Novel information on the time taken for its ontogenetic development in the advanced stages is presented.

S. R. Chandramouli, Ayuthavel Kalaimani, *Alytes*. **31**, 1-2 (2014).

Diseases and Toxicology

Impacts of UVB provision and dietary calcium content on serum vitamin D_3, growth rates, skeletal structure and coloration in captive oriental fire-bellied toads (*Bombina orientalis*)

Christopher J. Michaels, Rachael E. Antwis & Richard F. Preziosi

Many amphibian species are dependent on *ex situ* conservation interventions for their long-term persistence. However, projects have been jeopardized by husbandry issues involving poor calcium metabolism and nutritional metabolic bone disease (NMBD). Healthy calcium metabolism requires appropriate dietary calcium content and access to vitamin D3. In many animals, vitamin D3 can be photobiosynthesized in skin exposed to UVB radiation, as well as extracted from the diet, but the extent of vitamin D3 photobiosynthesis in amphibians is poorly known. Additionally, prey insects for captive amphibians are deficient in calcium

and calcium content must be artificially increased, but the effects of different levels of augmentation and their interaction with UVB exposure are also little understood. We fed captive fire-bellied toads (*Bombina orientalis*) with crickets augmented to contain 5% and 10% calcium and housed them with and without UVB exposure. Despite additional dietary vitamin D3 supplementation, we found that toads exposed to UVB radiation exhibited significantly higher serum vitamin D3 levels, indicating that this species may partly rely on photobiosynthesis sources of vitamin D3. These data are the first to show a direct link between UVB exposure and serum vitamin D3 in an amphibian. We found significant positive effects of UVB exposure and 10% dietary calcium content on skeletal structure, as well as complex interactions between treatments. We also found UVB radiation exposure resulted in more rapid natural coloration acquisition. Together, this indicates that standard calcium plus vitamin D3 supplementation methods may not fully substitute for UVB exposure and for increased feeder insect calcium content. This may have implications for the success of *ex situ* amphibian conservation, as well as for the welfare of captive amphibians in general. Our data lend support for the provision of UVB radiation for captive, basking amphibians.

Michaels CJ, Antwis RE, Preziosi RF, *J. Anim. Physiol. An. N.*, DOI: 10.1111/jpn.12203 (2014).

Tagging frogs with passive integrated transponders causes disruption of the cutaneous bacterial community and proliferation of opportunistic fungi

Rachael E. Antwis, Gerardo Garcia, Andrea L. Fidgett & Richard F. Preziosi

Symbiotic bacterial communities play a key role in protecting amphibians from infectious diseases including chytridiomycosis, caused by the pathogenic fungus *Batrachochytrium dendrobatidis*. Events that lead to the disruption of the bacterial community may have implications for the susceptibility of amphibians to such diseases. Amphibians are often marked both in the wild and in captivity for a variety of reasons, and although existing literature indicates that marking techniques have few negative effects, the response of cutaneous microbial communities has not yet been investigated. Here we determine the effects of passive integrated transponder (PIT) tagging on culturable cutaneous microbial communities of captive Morelet's tree frogs (*Agalychnis moreletii*) and assess the isolated bacterial strains for anti-*B. dendrobatidis* activity in vitro. We find that PIT tagging causes a major disruption to the bacterial community associated with the skin of frogs (12-fold increase in abundance), as well as a concurrent proliferation in resident fungi (up to 200-fold increase). Handling also caused a disruption the bacterial community, although to a lesser extent than PIT tagging. However, the effects of both tagging and handling were temporary, and after 2 weeks, the bacterial communities were similar to their original compositions. We also identify two bacterial strains that inhibit *B. dendrobatidis*, one of which increased in abundance on PIT-tagged frogs at 1 day postmarking, while the other was unaffected. These results show that PIT tagging has previously unobserved consequences for cutaneous microbial communities of frogs and may be particularly relevant for studies that intend to use PIT tagging to identify individuals involved in trials to develop probiotic treatments.

Antwis RE, Garcia G, Fidgett AL, Preziosi RF, *Appl Environ Microbiol.* **80**, 4779-4784 (2014).

Synergy between glyphosate- and cypermethrin-based pesticides during acute exposures in tadpoles of the common south american toad *Rhinella arenarum*

Julie C. Brodeur, M. Belen Poliserpi, M. Florencia D´Andrea & Marisol Sanchez

The herbicide glyphosate and the insecticide cypermethrin are key pesticides of modern management in soy and corn cultures. Although these pesticides are likely to co-occur in ephemeral ponds or aquatic systems supporting amphibian wildlife, the toxicological interactions prevailing in mixtures of these two pesticides have been little studied. The current study evaluated the toxicity of equitoxic and non-equitoxic binary mixtures of glyphosate- and cypermethrin-based pesticide formulations to tadpoles of the common South American toad, Rhinella arenarum. Two different combinations of commercial products were tested: glyphosate Atanor® + cypermethrin Xiper® and glyphosate Glifoglex® + cypermethrin Glextrin®. When tested individually, the formulations presented the following 96h-LC50s: Glifosato Atanor® 19.4 mg ea/L and Glifoglex 72.8 mg ae/L , Xiper® 6.8 mg/L and Glextrin® 30.2 mg/L. Equitoxic and non-equitoxic mixtures were significantly synergic in both combinations of commercial products tested. The magnitude of the synergy (factor by which toxicity differed from concentration addition) was constant at around twofold for all tested proportions of the glyphosate Glifoglex® + cypermethrin Glextrin® mixture; whereas the magnitude of the synergy varied between 4 to 9 times in the glyphosate Glifosato Atanor® + cypermethrin Xiper® mixture. These results highlight the importance of mixture toxicity testing, and call for more research to be undertaken in order to understand the mechanisms and evaluate the environmental impacts of the synergy observed.

Brodeur, J.C., Poliserpi, M.B., D`Andrea, M.F., Sanchez, M. *Chemosphere*. **112**, 70-76 (2014).

Effects of different UV and calcium provisioning on health and fitness traits of red-eyed tree frogs (*Agalychnis callidryas*)

Rachael E. Antwis, Richard F. Preziosi & Andrea L. Fidgett

In response to global amphibian declines and extinctions, the IUCN has recommended the establishment of *ex situ* conservation breeding programs. However, there are a limited number of studies that scientifically assess amphibian husbandry practices, even at a basic level of nutrition and lighting. One component of captive husbandry that is increasingly discussed is the provision of ultraviolet radiation (UVR), which is required for the synthesis of vitamin D3 and subsequent assimilation of calcium and phosphorous from the diet. Here we used two methods of UV provision ("background UV" and "background UV with UV boost") and two calcium gut-loading diets (5% and 10%) to assess the effects on a range of fitness measures in the Red-eyed tree frog (*Agalychnis callidryas*). We found no effects of either UV treatment or calcium diet on growth, body condition or cutaneous bacterial communities of frogs, although subsequent to the UV boost, frogs had a significantly greater fungal load in comparison to frogs that were not UV-boosted. There were negligible differences in the breeding success of females according to UV exposure. Provision of the UV boost was not demonstrated to provide any real advantages for *A. callidryas* in terms of growth or breeding success. In addition, there were no benefits of a 10% calcium diet over a 5% calcium diet (in conjunction with regular dusting). Further studies that investigate the UV requirements of other amphibian species and ecotypes are required, particularly in conjunction with naturalistic cricket gut-loading diets.

Antwis RE, Preziosi RF, Fidgett AL. *Journal of Zoo and Aquarium Research*. **2**, 69-76 (2014).

Ampibiocystidium infection in *Lissotriton vulgaris*. Photo: Tariq Stark.

Amphibiocystidium infections in the Netherlands

Tariq Stark & Gaston-Denis Guex

Diseases are important drivers of declines in amphibians and fishes. Relatively well known diseases in amphibians are chytridiomycosis and ranavirosis, however fungal-like organisms from the orders Dermocystida and Ichthyophonida may have a large potential impact as well. Species from the genus Amphibiocystidium infect amphibians and cause lesions on the skin and infect liver and kidneys. Amphibians infected with species from the genus Ichtyophonus display lesions on the skin and swelling of the axial muscles due to replacement of muscle tissue by spores of the parasite causing an increased risk of predation due to problems in locomotion. Dermocystidium infections cause lesions and infection on skin, fi ns and gills of fi sh and destruction of the internal organs, hart and muscles. These parasites have a broad host spectrum, spores that are long lived, mobile and highly contagious. Possible vectors are humans and animals like birds. Infections by these parasites are know in Dutch amphibians and fi sh. This article calls on people in the fi eld to report infected animals in order to get a better picture of the distribution and host range of this disease in the Netherlands.

Stark, T., Guex G.D., *RAVON*. **54**, 54-56 (2014).

Cool temperatures reduce antifungal activity of symbiotic bacteria of threatened amphibians—implications for disease management and patterns of decline

Joshua H. Daskin, Sara C. Bell, Lin Schwarzkopf & Ross A. Alford

Chytridiomycosis, caused by the fungus *Batrachochytrium dendrobatidis* (*Bd*), is a widespread disease of amphibians responsible for population declines and extinctions. Some bacteria from amphibians' skins produce antimicrobial substances active against *Bd*. Supplementing populations of these cutaneous antifungal bacteria might help manage chytridiomycosis in wild amphibians. However, the activity of protective bacteria may depend upon environmental conditions. Biocontrol of *Bd* in nature thus requires knowledge of how environmental conditions affect their anti-*Bd* activity. For example, *Bd*-driven amphibian declines have often occurred at temperatures below *Bd*'s optimum range. It is possible these declines occurred due to reduced anti-*Bd* activity of bacterial symbionts at cool temperatures. Better understanding of the effects of temperature on chytridiomycosis development could also improve risk evaluation for amphibian populations yet to encounter *Bd*. We characterized, at a range of temperatures approximating natural seasonal variation, the anti-*Bd* activity of bacterial symbionts from the skins of three species of rainforest tree frogs (*Litoria nannotis*, *Litoria rheocola*, and *Litoria serrata*). All three species declined during chytridiomycosis outbreaks in the late 1980s and early 1990s and have subsequently recovered to differing extents. We collected anti-*Bd* bacterial symbionts from frogs and cultured the bacteria at constant temperatures from 8°C to 33°C. Using a spectrophotometric assay, we monitored *Bd* growth in cell-free supernatants (CFSs) from each temperature treatment. CFSs from 11 of 24 bacteria showed reduced anti-*Bd* activity *in vitro* when they were produced at cool temperatures similar to those encountered by the host species during population declines. Reduced anti-*Bd* activity of metabolites produced at low temperatures may, therefore, partially explain the association between *Bd*-driven declines and cool temperatures. We show that to avoid inconsistent antifungal activity, bacteria evaluated for use in chytridiomycosis biocontrol should be tested over a range of environmental temperatures spanning those likely to be encountered in the field.

Daskin, J. H., S. C. Bell, L. Schwarzkopf, and R. A. Alford, *PLoS ONE*. **9**:e100378 (2014)

Manipulation of the calcium content of insectivore diets through supplementary dusting

Christopher J. Michaels, Rachael E. Antwis & Richard F. Preziosi

Insects fed to captive insectivores are deficient in calcium with inverse calcium to phosphorous ratios (Ca:P), and supplementation is required to avoid nutritional metabolic bone disease (NMBD). One method of improving the nutritional value of feeder insects is by "dusting" with powdered supplements, although it is often suggested that these are rapidly shed from prey insects. Here we analysed the calcium content of hatchling, second, fourth and adult instars of black field crickets and silent crickets at increasing time intervals after dusting, as well as comparing three commercially available brands of supplement in fourth instar black field crickets. Our data show these brands do not differ from one another in terms of calcium delivery, despite differences in calcium content. We also show that dusting can be used to increase Ca:P ratios above 1:1 in crickets up to 5.5 hours after dusting, with the exception of adult black field crickets, and thus dusting is a useful method of calcium supplementation.

Michaels CJ, Antwis RE, Preziosi RF, *Journal of Zoo and Aquarium Research*. **2**, 77-81 (2014).

Call for recent publication abstracts

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.

General Announcements

Events

The following information can be found at: http://www.parcplace.org/news-a-events/meeting-and-events-calendar.html

October 2014

25 - 30 - The Wildlife Society Annual Meeting - Pittsburgh, PA

28 - Join us for the PARC Symposium "15 and Forward: Reflections on 15 Years of Successes, and the Future of PARC."

Internships & Employment

Wildlife Biologist, Western Arctic National Parklands

Kotzebue, AK (Posted to PARC 10/03/14, Closing October 10, 2014)

Research Zoologist, Smithsonian Institution

Washington D.C. (Posted to PARC 10/03/14, Closing October 27, 2014)

Supervisory Biologist, Patuxent Wildlife Research Center

Laurel, Maryland (Posted to PARC 10/03/14, Closing November 3, 2014)

Biological Internship Opportunity, University of Florida Fort Lauderdale Research and Education Center

South Florida (Posted to PARC 09/29/14, Closing October 3, 2014)

Wildlife Specialist III (Garter Snake Project Coordinator), Arizona Fish and Game Department

Phoenix (Posted to PARC 09/29/14, Closing October 3, 2014)

Social Media Intern (Unpaid), Partners in Amphibian and Reptile Conservation, Joint National Steering Committee

Telecommute / Remote Position (Posted to PARC 09/16/14, Closing October 15, 2014)

Biologist I / Brown Tree Snake Biologist, Cherokee Services Group

Guam, USA (Posted to PARC 09/01/14, Closing October 15, 2014)

Wildlife Specialist / Project Evaluation Specialist, Arizona Fish and Game Department

Phoenix, AZ (Posted to PARC 08/11/14, Closing August 22, 2014)

Interdisciplinary, Historian/ Anthropologist/Archaeologist/Biologist/ Ecologist, GS-13/14, National Park Service

Lincoln, NE (Posted to PARC 07/25/14, Closing August 06, 2014)

Wildlife & Fisheries Data Coordinator (At-Risk Species), Wildlife Management Institute (WMI)and the Southeastern Association of Fish and Wildlife Agencies (SEAFWA)

Atlanta, GA / Negotiable (Posted to PARC 07/14/14, Closing July 15, 2014)

Interdisciplinary, Archaeologist/ Historian/Biologist/Ecologist (CESU Research Coordinator)

Panama City, FL (Posted to PARC 06/27/14, Closing July 3, 2014)

Fisheries & Wildlife Technician, Florida Fish & Wildlife Conservation Commission (FWC)

Panama City, FL (Posted to PARC 06/25/14, Closing July 7, 2014)

Wildlife Biologist (Flatwoods Salamander Conservation), U.S. Geological Survey

Gainesville, FL (Posted to PARC 06/25/14, Closing July 9, 2014)

Association of Fish and Wildlife Agencies

Washington, D.C. (Posted to PARC 06/18/14, Closing July 3, 2014)

Reptile and Amphibian Conservation Coordinator, Florida Wildlife Commission

Tallahassee, Florida (Posted to PARC 06/13/14, Closing June 23, 2014)

Research Manager, Brown Treesnake Research Project

Guam, Mariana Islands (Posted to PARC 06/05/14, Open Until Filled)

Center Director - USGS Patuxent Wildlife Research Center

Laurel, MD (Posted to PARC 06/05/14; Closing July 11, 2014)

Research Administrator II, Florida Fish and Wildlife Commission, Gainesville Wildlife Research Laboratory

Gainesville, FL (Posted to PARC 06/03/14; Closing June 23, 2014)

Communications Internship (Unpaid), Partners in Amphibian and Reptile Conservation, Joint National Steering Committee

Remote / Telecommute (Posted to PARC 06/03/14; Closing June 30, 2014)

Unpaid Herpetological Researcher/ Educator Internship Opportunities (2) Midewin National Tallgrass Prairie,

Wilmington, IL (Posted to PARC 01/8/2014, Closing 4/1/2014)

Unpaid Volunteer Ornate Box Turtle Telemetry Technician Nachusa Grasslands

Franklin Grove, IL (Posted to PARC 01/8/2014, Closing 4/30/2014)

Funding Opportunities

The Amphibian Survival Alliance is pleased to announce an open call for seed grant applications. Seed grants are normally provided in amounts ranging from USD $500-$1,000 and are designed to help kick start projects or allow teams to try new innovative approaches to address conservation, research and education challenges. **Link**

The Leapfrog Conservation Fund has been created specifically to support the creation of new reserves for important amphibian habitat, or the expansion of existing reserves through local organizations. If your organization is working toward the protection of critical habitat for threatened amphibian species, we would love to hear from you. **Link**

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

November

Explorers Club -- Grants for Student Exploration and Field Research 2015. 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. There are no nationality restrictions. Grants in both categories range from US$500 to US$5,000. The application deadline is 01 November 2014. **Link**

Field Museum -- Visiting Scholarships 2014. The Field Museum (Chicago, USA) supports basic research on its collections by interested students and scholars throughout the world. The Museum offers a modest number of grants and fellowships, including funding for short-term visits of up to three months for collection-based research studies. Grants to examine specimens in the Museum's collections are open on a competitive basis to all individuals in the national and international scholarly community working on problems related to natural history. The deadline to apply for the visiting scholarships is 01 November 2014. **Link**

Trust for Mutual Understanding -- Second Grants Cycle 2014. 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. Priorities in the environment program are ecosystem and habitat conservation; land-use planning; activities that facilitate effective international contact between environmental organizations; measures to preserve biodiversity; and efforts to encourage environmental sustainability. The Trust accepts initial inquiries twice a year. The deadline for the second cycle of initial inquiries is 01 November 2014. **Link**

Cleveland Metroparks Zoo -- Africa Seed Grants and Asia Seed Grants 2015. 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 (both programs) is 03 November 2014. **Link**

East-West Center -- Fellowships for Graduate Students. The East-West Center provides graduate students from Asia, the Pacific, and the USA with funding for up to two years for masters and doctoral studies. Participants engage in the educational, residential, and leadership development programs at the East-West Center while pursuing graduate study at the University of Hawai'i. The university's graduate programs include ecology and conservation; biology and marine biology; tropical plant and soil sciences; ocean policy; and several other disciplines related to environmental sciences. The deadline for applications is 03 November 2014. **Link**

African Water Facility (AWF) -- Water and Climate in Africa. The AWF invites eligible African organizations to submit proposals for water projects aimed at building resilience to climate change in Africa AWF will prioritize projects focused on the preparation of investment programs or projects that show strong emphasis on climate and water adaptation and/or mitigation. The program will also consider components focused on improving water governance in the context of climate change, and on capturing and disseminating climate and water information and knowledge. Grants will range from €1 million to € 3 million. The application deadline is 14 November 2014. **Link**

German Federal Ministry of Education and Research -- Graduate Studies in Germany on Water Management 2015. Germany's Federal Ministry of Education and Research (BMBF) offers graduate research grants on themes of water management for qualified young scientists from Cambodia, Indonesia, Iran, Jordan, Kazakhstan, Kyrgyzstan, Laos, Mongolia, Myanmar, Tajikistan, Thailand, Turkmenistan, Uzbekistan and Vietnam. Financial support is available for 31 months in masters programs, and 43 months in doctoral programs. The deadline for applications is 14 November 2014. **Link**

Schlumberger Foundation -- Funding for Women in PhD and Post-Doctoral Studies 2015-2016. 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 deadline for applications is 14 November 2014. **Link**

Aspen Institute -- New Voices Fellowship 2015. The New Voices Fellowship is a year-long program in media skills, communication, and leadership for top development professionals in the developing world. Fellows are expected to have both a record of significant professional achievement and a desire to share their perspectives on global development with a broader international audience. The Aspen Institute aims to select 12 fellows who will write opinion articles, participate in interviews with local and international media, and speak at international conferences. Applications are welcome from all developing countries, and from subject areas including all those relevant in the Terra Viva Grants Directory. The deadline for nominations is 15 November 2014. **Link**

Morris Animal Foundation -- Wildlife Health and Welfare 2015. The Morris Animal Foundation supports research on animal health and welfare, including wildlife/exotics. The Foundation invites proposals in several categories (i.e., established investigator; first award; fellowship training; pilot study). The application deadline for wildlife/exotics is 19 November 2014. *(Note: The Foundation also manages a wildlife rapid response fund that has no calendar deadlines.)* **Link**

U.S. Fish and Wildlife Service (USFWS) -- Conservation of Neotropical Birds.

The United States Neotropical Migratory Bird Conservation Act supports an annual grants program to promote the conservation of neotropical migratory birds and their habitats in the USA, Canada, Latin America, and the Caribbean. Since 2002, the program has funded 451 projects in 36 countries. Projects are for one or two years. Projects of one year are limited to a grant request of US$100 thousand. The deadline for proposals is 20 November 2014. Link

Islamic Development Bank (IDB) -- Prize for Women's Contribution to Development in Water Resources. The annual IDB Prize for Women's Contribution to Development draws international attention to the vital role women play in developing their communities and the world. The theme for the 1436H/2015G Prize is "Women's Contribution to Water Resources Management." The Prize consists of US$50 thousand for a woman or group of women, and US$100 thousand for an organization. Applications can be submitted in Arabic or English before 30 November 2014. **Link**

December

East-West Center -- Asia Pacific Leadership Program 2015-2016. The APLP invites professionals from Asia-Pacific countries to apply for a 9-month program of leadership training and professional development on emerging issues facing the Asia-Pacific region. Inter-disciplinary interests at the East-West Center include climate change, land use, water and energy demands, etc. -- among other social and environmental themes. Fellowships of US$15 thousand cover the majority of costs. Applicants who request funding should complete their applications by the priority deadline of 01 December 2014. **Link**

UK Commonwealth Scholarship Commission (CSC) -- Commonwealth Scholarships 2015. The UK Department

for International Development (DFID) funds the Commonwealth Scholarships for master's and PhD studies in the UK for citizens of developing Commonwealth countries. Approximately 300 scholarships are awarded annually across all subjects, with priority for applications that demonstrate strong relevance to development. There is a nominating agency for Commonwealth Scholarships in each Commonwealth country, with contact details provided in the announcement. Inquiries about the scholarships should be directed to this agency. The application deadline is 03 December 2014. **Link**

Australia Awards for Africa -- Scholarships and Fellowships for Africans 2015. Australia Awards funds qualified African candidates for masters studies in Australia in priority subjects that include agriculture and food security; natural resource management (including mining and mining governance); public policy; health; and water and sanitation. Additionally, the program offers short-term fellowships for professional training in Africa and/or Australia. The announcement identifies the eligible countries and application deadlines, most of which are 12 December 2014 or 16 January 2015 -- verify for your country. **Link**

Society for the Study of Amphibians and Reptiles (SSAR) -- Herpetology Grants 2015. The SSAR makes grants of US$500 to deserving individuals and organizations for herpetological research, education, and conservation. Projects should focus on endangered or threatened species. Some of the grant categories are restricted to SSAR members and students. The application period is 15 September 2014 through 15 December 2014. **Link**

U.S. Environmental Protection Agency -- Grants to U.S. University Students for Research on Global Sustainability 2015. The EPA's 12th annual P3 Awards (People, Prosperity, and the Planet) will fund research projects in energy, built environment, urban green water, and clean cookstoves. Grants are up to US$15 thousand for one year (Phase I); winners in Phase I will be eligible to apply for larger grants to follow. The competition is open to U.S. institutions of higher education to support teams of undergraduate and/or graduate students. The application deadline is 16 December 2014. **Link**

January

World Wide Fund For Nature (WWF) -- Prince Bernhard Scholarships for Nature Conservation 2015. 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; Asia and Pacific; Latin America and Caribbean; Eastern Europe; and the Middle East -- including WWF staff, or candidates working as partners with WWF. The maximum grant is CHF 10 thousand for studies or training lasting one year or less. The deadline for applications (English, French, Spanish) is 11 January 2015. **Link**

International Institute for Applied Systems Analysis (IIASA) -- Young Scientists Summer Program 2015. IIASA invites doctoral students worldwide to participate in its Young Scientists Summer Program held at IIASA's headquarters in Laxenburg, Austria. The selected participants work with IIASA's senior scientists in research on energy, ecosystem services, water, risk policy and vulnerability, and other topics. Scholarships are available from IIASA's national member organizations. A limited number of scholarships are available from other sources. The application period is 01 October 2014 through 12 January 2015. **Link**

Harvard University -- Environmental Fellows 2015. Harvard University's Center for the Environment will award approximately six fellowships for the 2015 cohort. The Environmental Fellows work for two years with Harvard faculty members in any school or department. Candidates with a doctorate or equivalent in any field are eligible, and they may propose research projects in any discipline. Applicants without a PhD may apply if they have studied in fields where the Ph.D. is not the typical terminal degree. Candidates may have received their degrees at any university in the world. The Center strongly encourages applications from women and minorities. The application deadline is 14 January 2015. **Link**

Inter-American Foundation -- Research in Grassroots Development 2015-2016. The Inter-American Foundation supports PhD research in Latin America and the Caribbean (LAC) on themes related to grassroots development. Past projects have included topics in agriculture, watershed management, and climate change (among others). The competition is open to citizens of the USA and citizens of independent Latin American and Caribbean countries (except Cuba) who are PhD candidates at universities in the USA. The deadline for applications in the 2015-2016 cycle is 20 January 2015. **Link**

Garden Club of America – Support for Tropical Botany and Horticulture. The GCA offers several grants, prizes, and fellowships for students enrolled at universities in the USA, including some awards that have a tropical focus. The GCA Awards in Tropical Botany are open to PhD candidates (application deadline is 15 January). The Lou McCandless Marks Scholarship in Tropical Horticulture is restricted to U.S. citizens who are graduate students or advanced undergraduate students (deadline is 15 January). The Anne Chatham Fellowship in Medicinal Botany is open to PhD students and recent PhD graduates (deadline is 01 February). Applicants should review all programs, criteria, and deadlines. **Link**

American Society of Primatologists (ASP) -- Conservation Grants and Awards 2015. ASP supports students and young researchers from habitat countries who are engaged in primate conservation. (i) The Conservation Small Grants of up to US$1,500 support conservation research or related projects, including conservation education. (ii) The Conservation Award of US$750 recognizes students and young investigators in habitat countries who demonstrate potential for making significant and continuing contributions to primate conservation. Applications for grants will be accepted 01 through 31 January 2015; nominations for the awards need to be submitted by 31 March 2015. **Link**

February

Nacey Maggioncalda Foundation -- Grants for Doctoral Students in Primatology. The Nacey Maggioncalda Foundation annually awards the James F. Nacey Fellowships to doctoral students working in the areas of primate paleontology, evolution, ecology, behavior, and/or conservation. Applications are invited from researchers associated with colleges, universities, and non-profit organizations in the USA. Awards are up to US$3,500. The next application deadline is 01 February 2015. Link

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 quarterly 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/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

Candace M. Hansen: cmhansen@amphibians.org

Editorial Committee

Candace M. Hansen
Craig Hassapakis
Laurence Jarvis

Additional reviewers will be requested as required.

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 froglog@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 Standard US English. For example, "colour" should be spelled "color."

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).

SPECIAL NOTE: Use only one space after all punctuation marks (this includes only one space after "periods" at the end of sentences).

Further examples and details can be found on our web site at: www.amphibians.org/froglog/guidelines/

Coming up in *FrogLog* 113

Special Edition: Amphibian Diseases & Mitigation Techniques

Recent Publications

Grants

and Much More...

January 2014

Tell Us Your Story!

Golden Mantella (*Mantella aurantiaca*). Photo: Robin Moore.