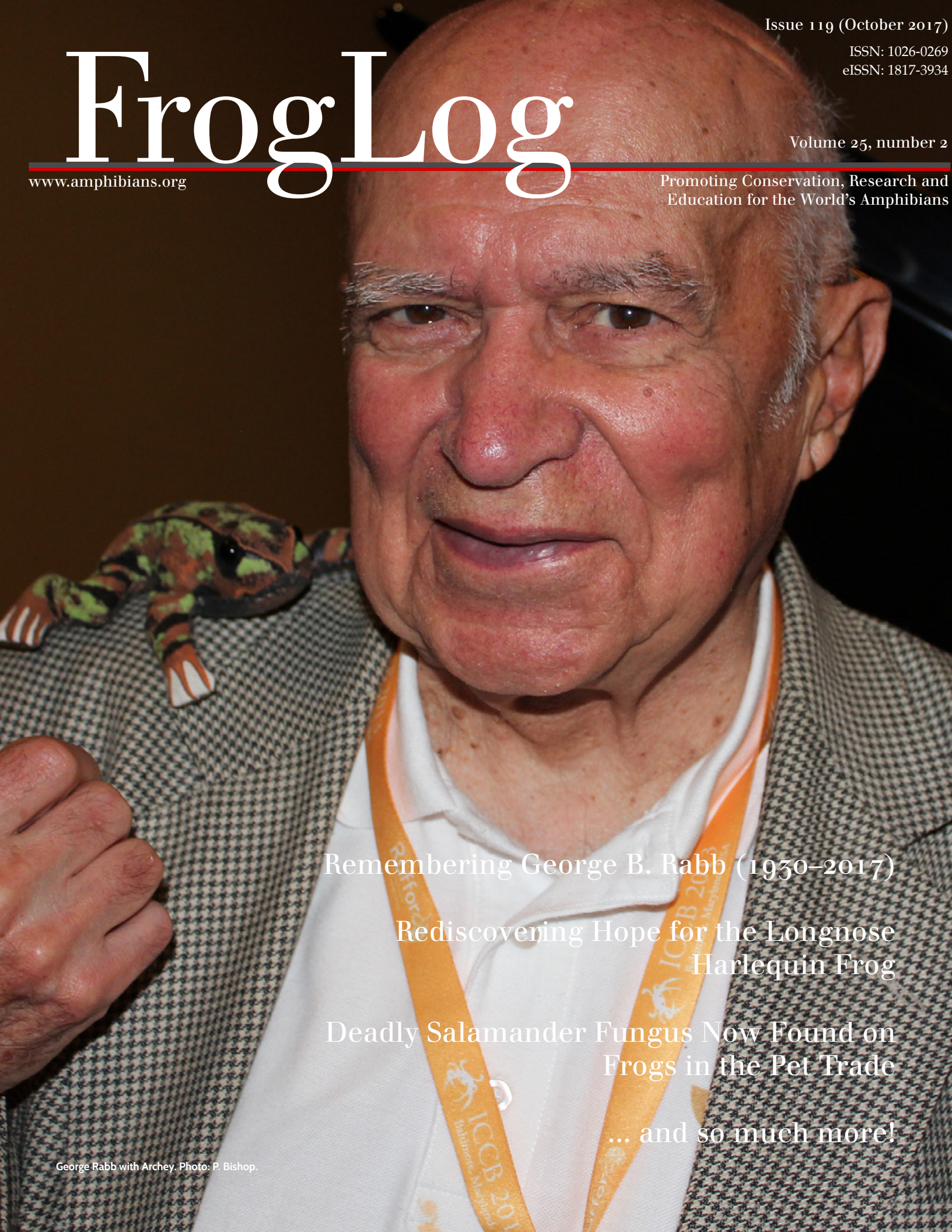


FrogLog

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



Remembering George B. Rabb (1930–2017)

Rediscovering Hope for the Longnose
Harlequin Frog

Deadly Salamander Fungus Now Found on
Frogs in the Pet Trade

... and so much more!

FrogLog

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Editorial

Dear friends,

Heartbroken. This is how members of the global amphibian conservation community, including the Amphibian Survival Alliance (ASA) and IUCN SSC Amphibian Specialist Group (ASG), have been since learning that our dear mentor and supporter George Rabb has died.

George was a passionate, committed and highly respected global conservationist, having significantly influenced zoos and a wide breadth of conservation issues covering many taxonomic groups. However, when it comes to amphibians, George has left a larger-than-life footprint. It was George's vision that there be an international entity to address amphibian declines, which led to the creation of the Declining Amphibian Population Task Force (DAPTF) during his tenure as IUCN Species Survival Commission Chair. The DAPTF later amalgamated with the Global Amphibian Specialist Group (GASG) to form today's ASG.

An early proponent and architect of the Amphibian Survival Alliance, George has been absolutely instrumental in the development of the ASA from its inception to its current form, where he was a key member of the ASA's Global Council. We would not be where we are today in global amphibian conservation had it not been for George.

Characterized not only by his sharpness and brilliance, but also by his modest and unassuming disposition, his generosity, and his complete and utter devotion and concern for the well-being of amphibians, George was an example to all of us.

Although George is no longer among us, he is not lost to us. We will remember George, and his legacy will continue through the efforts of each and every individual whose lives he touched. That theme is evident in the outpouring of responses from those in the conservation community—including in the reflections in this edition of *FrogLog*. It is up to us to ensure that his life's work and his legacy continue beyond our own lifetime, and that when future generations hear about George Rabb, may a sense of awe and gratitude grace their own days and inspire them to continue in his footsteps.

Ariadne Angulo

*Co-Chair, IUCN SSC Amphibian Specialist Group
Interim Executive Director, Amphibian Survival Alliance*

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George Rabb with Archey. Photo: P. Bishop.

Carrying on the Legacy of Amphibian Conservation Pioneer George Rabb

By Phil Bishop

The amphibian conservation community is deeply saddened by the loss of one of its greatest and most supportive pioneers. Dr. George Rabb, with his focus on amphibians, stands equal in our conservation world among other “giants” such as Jane Goodall and David Attenborough.

George felt very honored to have an amazing species of frog named after him (and his late wife, Mary): Rabbs’ Fringe-limbed treefrog (*Ecnomiophyla rabborum*). George was very dismayed when the last remaining specimen (named “Toughie”) died in 2016 in captivity—it was probably the last one of the species—just as George was the last one of a kind.

On hearing about the frog’s death, George ensured me that the body was quickly transferred to the Frozen Zoo at San Diego Zoo and asked me to convey his thanks to Joe Mendelson and his co-authors Jay Savage, Edgardo Griffith, Heidi Ross, Brian Kubicki, and Ron Gagliardo for naming this species for George and Mary in their wonderfully illustrated description of the species in the *Journal of Herpetology* in 2008. They named this frog in respect of all the efforts that George and Mary made to conserve the thousands of species of frogs and salamanders threatened mainly by the active negligence of our own species.

During his career, George was a pioneer and worked hard to change zoos from natural history collections to holistically engaged conservation centers. He was instrumental in leading the challenge to stop amphibian declines and was active in amphibian conservation from the time that serious declines were first observed in the late 1980s until shortly before his death.

On a personal note, while I read a lot of George’s papers during my Ph.D. studies, I only got to know him in the last 10 years. When I visited him in Chicago in 2011 I was very impressed that at the age of 81 he collected me from the airport in his own car, lined up the large American beast of a car so that the center line was in the middle of the hood (bonnet), and off we went through the Chicago traffic! George had a very quiet, unassuming personality but he was incredibly sharp and always knew the exact time to make the most significant point during a meeting.

The amphibians have lost a champion, the strongest champion they have ever had, and it’s up to us to carry on in the legacy of the Great Dr. George Rabb.

George Rabb: Founder and “Spiritual” Leader of the Amphibian Conservation Movement

By Simon Stuart

I first met George Rabb at Royal Botanic Gardens, Kew, in October 1985 when I was interviewed by an intimidating panel of four men and one woman for the position of Species Programme Officer at IUCN headquarters in Gland, Switzerland. George was on the panel – I don’t remember much of the interview, except that I got the job, and IUCN has defined my career ever since. At the IUCN World Conservation Congress in Honolulu in September 2016, 31 years later, at the goodbye party to mark the end of my 8 years as SSC Chair, George gave the final speech and, in addition to saying some kind words about me, told those present: “I hired Simon!”, underlying his constant presence to me beginning with that 1985 interview.

George was already a dominant force on the SSC Steering Committee (SC) by the time I joined IUCN. I attended my first Steering Committee meeting in March 1986, and that was when I really started to get to know George, with the first of our many one-to-one in-depth conversations. His extraordinary intellect, his deep ethical commitment to conservation, and his breadth of interests marked him as an influential force to be reckoned with. Soon after, Wayne King resigned as the SSC Deputy Chair, and George was appointed

to take his place. When Gren Lucas resigned as SSC Chair in August 1989, George became Chair, and served until 1996. George assumed his leadership of the SSC while Martin Holdgate was Director General of IUCN. The two men were similar in some respects – very sharp intellects, huge knowledge and commitment, and also both to some extent a little traditional in their mannerisms. They clearly had great respect for each other, and the SSC’s standing within the wider IUCN family grew enormously under George’s leadership. George brought about many changes during his time as SSC Chair. He brought many new and younger people from across the world on to the Steering Committee, improved its gender balance, and established many new Specialist Groups. Some of the most active SGs in SSC today, such as the Shark, Iguana and Invasive Species SGs, were established under George’s leadership.

George was not a typical leader. In many ways he was a shy and self-effacing man. He never sought to be the center of attention and always gave great credit to others. But when a topic arose about which he cared passionately, he could speak with passion and conviction. George endeared himself to SSC members across the globe by his straightforward, uncomplicated commitment to saving the



George Rabb, Jane Smart and Simon Stuart. Photo: S. Stuart.

world's species and natural places. George became the unofficial leader of the zoo community within IUCN. He was a pioneer of the movement to bringing zoos more fully into conservation, working closely alongside the likes of Bill Conway, Ulysses Seal and David Jones. George used to go to the IUCN Congress having collected a large number of proxy votes from across the zoo community. In the days before IUCN introduced electronic voting, George became famous for holding up a fistful of ballot papers whenever a vote was taken! But although he played the IUCN political game, George was never a politician in a scheming or tactical sense. He avoided other people's controversies and was reluctant to trade votes to get his own way. George was more of a conviction politician, fighting for things he believed to be morally right and opposing things that he believed to be wrong. He also had courage. A classic example arose in 1995 when some of the US Government's most important conservation funding mechanisms were under serious threat of being reduced, or even closed. George invited the then Speaker of the House of Representatives, Newt Gingrich, to Brookfield Zoo, and the resulting meeting led to the Speaker adopting a pro-conservation stance and defending and saving these funding streams.

George knew that his effectiveness grew from surrounding himself with top-caliber people. Compared with any SSC Chair before him, George built up a significant support team at the Brookfield Zoo, composed of people such as Tim Sullivan, Susan Tressler, Elizabeth McCance, Mena Boulanger, Maria Sadowski and Craig Pugh. This was made possible by the generous support of the Chicago Zoological Society, a recognition of the global importance of the conservation work that George was leading. George and his team worked in seamless unity with the IUCN Secretariat Species Programme team that I was leading at the time. A few weeks after George took over as SSC Chair, the great Sir Peter Scott, also a former SSC Chair, passed away. Sir Peter's friend, Sultan Qaboos of Oman, decided to give USD 1.5 million to SSC in Sir Peter's honor. George and his team used the Sir Peter Scott Fund to provide highly strategic grants to SSC SGs focused especially on action planning, thus starting the process to make the SGs much more proactive, as we see today.

During his tenure as SSC Chair, George typically visited Switzerland at least twice a year on IUCN business. He often stayed with my family and me, and we enjoyed the evenings together, as he unwound from the affairs of IUCN by playing with my little daughter Claire. He often brought her soft toy animals from the Brookfield Zoo shop. I often wondered how much sadness George and Mary might have felt at not having children of their own. But as we all know, George was a very private person and avoided talking about himself. George and I shared a love for classical music. He once took me and some of his SSC team to a Chicago Symphony Orchestra concert. And he gave me many classical CDs over the years; one by Alfred Deller conducting choral music by Purcell stands out (George noted how a recording from the 1950s could have sound quality just as good as modern digital recordings if the producer knew how to position the microphones properly – an example of George's broad interests and knowledge!). I also remember in one conversation when George and I had a meeting of minds in agreeing that the greatest piece of music ever written by a teenager is Mendelssohn's Octet!

George pursued many conservation passions during his long life. He loved the Okapi, and this led to an abiding interest in the Democratic Republic of the Congo (DRC) and the research station at Epulu. When all the captive animals at the station were killed in

2012 during the terrible civil strife in that suffering country, George was heartbroken, but characteristically also took the initiative in generating a constructive response. He got a late emergency motion on the Okapi submitted and adopted at the 2012 IUCN Congress, calling for urgent assistance for Okapi conservation. The publication of the SSC Okapi Action Plan in 2016, a joint initiative with the DRC Government, followed on from this call. George became great friends with the long-term head of conservation in the DRC, Dr Mankoto ma Mbalele. It was heart-warming to witness them meeting each again at the IUCN Congress in 2012 after many years. George was also heavily involved in the SSC Conservation Breeding SG. He was a close advisor and supporter of Ulie Seal, CBSG's founding chair. Most significantly George recruited the leading population geneticist, Bob Lacy, to work at Brookfield Zoo, and made him available to the CBSG. Bob wrote the Population and Habitat Viability Analysis (PHVA) software, Vortex, which became the basis for the CBSG's many PHVA workshops held in many parts of the world, and is still widely used today. Bob later became CBSG Chair following Ulie's death. George was also involved in other organizations. He was a board member of the Center for Humans and Nature, Defenders of Wildlife, and many others. He was a prime mover of the Chicago Wilderness initiative, showing his ability to focus on both the local and the global. His earlier natural history exploits have faded with time, but remain remarkable. For example, he discovered several species of salamander in Mexico in the 1950s, published a paper on wolf social behavior in 1967, and was one of the last people to see Bachman's Warbler in the field. He had an abiding interest in environmental ethics and was heavily involved in the IUCN World Commission on Environmental Law's Ethics Specialist Group. He was a major contributor to the Draft International Covenant on Environment and Development. And in the past few years he was part of the movement to establish a "World Organization on the Environment."

Despite all of these interests and achievements, George's largest single contribution was to amphibian conservation. It is no exaggeration to say that George was the founder of the amphibian conservation movement. As noted above, George was already working on amphibians back in the 1950s. But things suddenly changed at the First World Herpetological Congress in 1989, when the alarm bell of unexplained and dramatic amphibian declines and extinctions taking place around the world was first sounded. This could have resulted in a shocked scientific world with no follow-up action. However, George had the vision and leadership to turn the alarm bell into a clarion call to mobilize action for amphibian conservation and research. As a direct result, the global amphibian conservation movement started to develop, focused on both understanding the science and the scale of the problem, and then working on conservation solutions. The very first step was the formation of the Declining Amphibian Populations Task Force (DAPTF) within IUCN SSC, and everything followed from that. The DAPTF demonstrated conclusively that amphibian declines were real phenomena, and eventually the underlying cause of many of these declines, a fungal pathogen, was discovered. George was involved in all of the major steps that subsequently took place: the Global Amphibian Assessment in 2004 (which I was privileged to lead and showed the global extent of the crisis); the founding of Amphibian Ark in 2005 which started the mobilization of zoos to give high priority to *ex situ* amphibian conservation; the Amphibian Conservation Summit in 2005 (and subsequent mini-summit in 2009); the transformation of the DAPTF into the SSC Amphib-

ian SG (2005), the Amphibian Conservation Action Plan (2006 and subsequently updated); and the founding of the Amphibian Survival Alliance (2010) which has become the umbrella body for amphibian conservation. Nobody else was involved at every stage in the way that George was. He was without doubt the founder and “spiritual” leader of the amphibian conservation movement. It is for this reason that an Amphibian Conservation Fund will soon be launched in George’s honor, something that George agreed to in his usual self-deprecatory manner shortly before his last illness.

What is less widely known is that as well as being the driving force behind the initial establishment of Amphibian Ark and the Amphibian Survival Alliance, he was also a major and faithful donor to both of them, but characteristically had no interest in having this to be widely known. Although George died knowing that the amphibian crisis was far from solved, I hope that he was able to draw some pleasure from the rapid growth of amphibian conservation globally as civil society and academia respond to the crisis. I believe that this would not have happened without George’s initial leadership.

Another remarkable characteristic of George was his ability to stay on top of the scientific literature, right up until the end. He was constantly looking forward to the next challenges, and always pushed the Amphibian Survival Alliance to be proactive and ready for the next change. In the last few months of his life he became a strong advocate of exploring the potential of new genetic technology to develop solutions in the fight against amphibian disease. As Phil Bishop wrote recently, he was always ahead of his time. While George was Director at Brookfield Zoo, his wife Mary worked in the zoo’s library. She systematically made photocopies of all the scientific papers that she thought he should be reading, and this enabled him to stay current. Later on after his retirement from the zoo, Mary’s health started to deteriorate and George devoted more and more of his life to being her career. As a result, he had much less time for his conservation activities. When she passed away he was devastated and I, along with many others, wondered how he would cope. But instead he threw himself headlong into a whole range of activities in all the organizations named above. He was perhaps the most faithful contributor to the monthly conference calls of the Amphibian Survival Alliance’s Global Council. He was scheduled to come to Canterbury in June this year to take part in the annual meeting of the Global Council but had to cancel. But when he did not show up to participate remotely, his close friend Anne Baker from Amphibian Ark and I knew that this was very uncharacteristic and that something was seriously wrong. Unfortunately, we were right. Over the subsequent weeks, George’s faithful office team kept us updated. Sometimes we were more hopeful; other times not. When the news we were all dreading finally came there was much sadness all across the world from the thousands of people whose lives had been touched by George.

George was always a generous man and this showed itself in many ways. He would frequently send well-chosen scientific papers to his many acolytes to make sure that we were focusing on what

he saw as the key issues. And whenever a group of people went out for a meal, there was an unstated and unnegotiable rule that George would pay! In 2009 the SSC SC decided to establish the George Rabb Award for Conservation Innovation. George immediately decided to fund the award at USD5,000 per recipient. There have been four recipients to date: Bob Lacy; Resit Akcakaya; Penny Langhammer; and Mike Hoffmann.

Probably more people would describe George as their mentor than anyone else I can imagine. I am proud to be one of them. But strangely enough, I don’t think George ever set out to be an intentional mentor of anyone. He just became a mentor by his example, his ethics, his commitment, his constant challenging of us, and his kindness. George was not always easy on his mentees. He could be irascible and impatient at times, but it was all for the greater conservation course. Despite being a very private person, he became close to many of us. I certainly did not agree with him on everything, but on the fundamental conservation issues we were of one mind. It is hard to imagine life now without George. He is irreplaceable, but he also leaves a tremendous legacy.

Thank you George for being there for me every step of the way these past 32 years. I will miss you hugely but count myself as hugely blessed by having you as part of my life.



George with Toughie, the last remaining Rabbs' Fringe-limbed Treefrog (*Ecnomiohyla rabborum*) which died in 2016.

ASG at the 2017 Latin American Congress of Herpetology

By Cybele S. Lisboa, Esteban Lavilla, Arturo Muñoz, Nicolás Urbina-Cardona, Andrés Merino-Viteri, Carlos Vásquez-Almazán & Ariadne Angulo

Earlier this winter (24-28 July 2017) the XI Latin American Congress of Herpetology was held in Quito, Ecuador. This is one of the most important events in herpetology worldwide and takes place every three years in different Latin American countries. This year, around 500 herpetologists attended the congress at the Pontificia Universidad Católica del Ecuador facilities in Quito.

The IUCN SSC Amphibian Specialist Group (ASG) seized the opportunity to convene Latin American regional chairs to attend the symposium “Joining efforts for amphibian conservation in Latin America.”

Because Latin America as a region holds the greatest amphibian species richness on the planet and many amphibian species in the region are at risk of extinction, among other reasons, it is very important to strengthen relations between ASG regional groups.

Taking into account the socioeconomic, cultural and scientific similarity that Latin American countries present, as well as the amphibian species, this symposium aimed to provide a forum to disseminate the main amphibian-targeted conservation measures that are underway in Latin American countries, seeking to share successful experiences, strengths, challenges and limitations.

Argentina, Bolivia, Brazil, Colombia, Ecuador, Guatemala and Peru were represented by their respective regional chairs or co-chairs. In addition to regional ASG leaders the symposium had presentations from different organizations such as NGOs, zoos, universities, herpetological societies and others, sharing various amphibian conservation initiatives. A total of 15 presentations representing 10 countries (those mentioned above plus Chile, Costa Rica and Mexico) covered diverse subjects such as public policies, *ex situ* actions, environmental education, action plans, population monitoring, protection of priority areas, *in situ* research, diseases, etc.

After the symposium ASG regional leaders held a side meeting with Jennifer Luedtke (Amphibian Red List Authority Coordinator)

and David Diaz (Key Biodiversity Areas partner BirdLife) to discuss how to link global priorities (update of IUCN Red List assessments, identifying Key Biodiversity Areas, advancing the Amphibian Conservation Action Plan) with regional priorities and activities. Over the course of the meeting Regional chairs presented ideas of how bottom-up or up-bottom mechanisms may be adopted in order to share information and to promote results of local actions contributing to the global ACAP.

We hope that this first meeting is just the beginning in the development of a more integrated Latin American amphibian conservation network, where we can work together to develop action planning for amphibian conservation in-region and with amphibian conservation priorities for each country.

Acknowledgements

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From left to right: ASG Bolivia Co-Chair Arturo Muñoz, Amphibian Red List Authority Coordinator Jennifer Luedtke, ASG Ecuador Chair Andrés Merino-Viteri, ASG Co-Chair and ASG Peru Co-Chair Ariadne Angulo, ASG Chair Guatemala & Belize Carlos Vásquez-Almazán, ASG Colombia Chair Nicolás Urbina-Cardona, ASG Argentina Chair Esteban Lavilla and ASG Brazil Co-Chair Cybele Lisboa. Photo: D. Díaz.



Researchers swabbing an Emperor newt at the Smithsonian National Zoological Park. Photo: Brian Gratwicke.

New Study Reveals Deadly Pathogen Not Present in Pet Salamanders in the United States

By Lindsay Renick Mayer

A recent rule put in place in 2016 restricting the international import of 201 salamander species into the United States aimed to prevent the newly discovered deadly salamander fungal disease, *Batrachochytrium salamandrivorans* (*Bsal*), from entering the country. In a new study published Oct. 13 in *Scientific Reports* based on help from the Amphibian Survival Alliance (ASA), Smithsonian Institution scientists reveal that the moratorium seemingly has a chance to do its job effectively.

“When the moratorium went into effect, we did not know if *Bsal* was already in the United States in pet salamanders and whether we were closing the barn door only after the horse had already escaped,” said Brian Gratwicke, ASA global council member, Smithsonian Conservation Biology Institute amphibian conservation biologist and paper senior author. “Our study did not find the pathogen in pet salamander populations in the United States, which is good news for native salamanders, especially the Appalachian region—a salamander biodiversity hotspot. It also means that we must continue to be vigilant and prevent the disease from entering the United States.”

The study marks the first general survey for *Bsal* in pet salamanders in the United States. The researchers worked with the ASA to mail out sampling kits to salamander pet owners. In return the team received skin swab samples from 639 salamanders belonging to 65 species, many of which are potential carriers of *Bsal*. None of the samples came back with evidence of *Bsal*, according to tests conducted in SCBI’s Center for Conservation Genomics. The *Scientific Reports* study complements SCBI’s ongoing tests of salamanders in the wild, which have also come back negative for *Bsal*.

The Lacey Act was used to list 201 species of salamanders that the United States Fish and Wildlife Service judged as “injurious wildlife” (those shown to be carriers or to be lethally affected by *Bsal*). As a result, these species cannot be imported from other countries with a permit for research or conservation use. According to the paper, the Lacey Act decision reduced the number of salamanders imported to the United States from 2015 to 2016 by 98.4 percent.

Bsal has been detected in the wild in the Netherlands, Belgium, Germany and Vietnam, and in captive individuals in the United Kingdom and Germany. An [article published this month](#) in the journal *Amphibia-Reptilia* reports that *Bsal* has also been found on frogs in the pet trade in Germany. The study found *Bsal* on Small-webbed bell toads, which are closely related to the Oriental fire-bellied toad, a species traded in massive numbers with more than 3.5 million specimens traded in the United States between 2001 and 2009.

The discovery of this new potential disease carrier has spurred the ASA to join other organizations in [urging the USFWS to place a moratorium on amphibian imports](#) until a system is in place to ensure imports are free of *Bsal* and other diseases.

“Preventing *Bsal* from entering North America is currently the only viable strategy we have to protect native amphibians and amphibian captive populations from *Bsal*,” said Reid Harris, ASA director of international disease mitigation and professor of biology (emeritus) at James Madison University. “The finding of no *Bsal* among a sample of salamander pet owners is welcome news, and we need to do whatever we can to continue to protect our 190 native species of salamanders.”

Bsal was discovered after populations of fire salamanders in the Netherlands experienced catastrophic declines from the disease, which was likely introduced from Asia, the source of most international exports of salamander species for the pet trade. *Bsal* is similar to a lethal fungus called *Batrachochytrium dendrobatidis* (*Bd*), which has been a major driver of global amphibian declines and extinctions.

The *Scientific Reports* paper’s additional authors are Blake Klocke, Matthew Becker, Robert Fleischer and Carly Muletz-Wolz, Smithsonian Conservation Biology Institute; James Lewis, Rainforest Trust; and Larry Rockwood and A. Alonso Aguirre, George Mason University.

Combining Agroecological Production, Wildlife Conservation and Rescue of Food Culture in the Amazonian Rainforest

By Lucas Ferrante^{1,2,5,5} & Carlos Alexandre Demeterco^{5,4}

Allying food production and biodiversity conservation is one of humanity's greatest challenges (1). The expansion of agricultural crops occurs mainly in the tropical and subtropical regions, expanding on the most biodiverse forests of the planet due to the climate favorable to diversified agriculture (2). Agriculture and aquaculture is the current greatest threat to vertebrates (3), in this scenario amphibians are the most threatened group (4). Agricultural crops as sugar cane and pastures for cattle affect the forest structure and the amphibian assemblages (5). The agribusiness is not just the villain for wildlife, but in regions such as the Amazonian Rainforest the agribusiness leads the indices of slave labor (6), incorrect and excessive use of agrochemicals (7) and deforestation (8,9,10).

The current model of food production has affect the human life and the fauna, but it is not only the wildlife that is disappearing due to the current model of agricultural production. Many traditional and native food of threatened biomes are also disappearing, directly impacting food culture and loss of food diversity (11). In order to meet the demand of production of good, clean and fair food for the Amazon region in Brazil, valuing the conservation of biodiversity in the production chain the Brazilian Amphibian Specialist Group (ASG Brazil) has joined forces with the Slow Food movement of the state of Amazonas. The Slow Food is an activist movement present in more than 150 countries that support the production of good, clean and fair food and rescue of traditional food culture, besides that advocating in favor of food consumption with that characteristics. In the Slow Food document entitled "The Central Role of Food," mentions the importance of conserving the biodiversity for the production of good, clean and fair food, "Biodiversity offers us services that we cannot reproduce in any other way and which we cannot do without. To cite only the most glaring, a system with a high degree of biodiversity is capable of responding adequately to climate change and performing a very important function in climate regulation by keeping conditions constant, alleviating global warming and protecting very broad areas of the planet from the risk of hydrogeological upheaval. And let us not forget that the value of biodiversity is also aesthetic (hence economic, since much of our tourism, for example, owes its existence to our agrarian landscapes) and spiritual (hence protective of collective health) and that, last but not least, it performs a regenerating function. It is no coincidence, in fact, that the areas with a high level of biodiversity are the ones in which soil regeneration is highest and fastest, and in which the impact of polluting agents artificially released by human activity is mildest. Biodiversity is important not only with regard to animal and plant species, but also to an infinity of human activities (cooking, craft food production and other craft activities, traditional medicine, rituals, festivals and so on) incapable of surviving

the standardization of crops and production and processing techniques. A production system that puts the survival of the planet at risk has to be countered by Slow Food and Terra Madre's vision of food: it cannot and must not become a threat to biodiversity. Paradoxical but true, today we are living through a moment in history in which the main threat to the life of so many species is precisely the production of food, the element indispensable for life," Slow Food Congress Paper The Central Role of Food (12).

The Slow Food and ASG Brazil, with the aim of divulging the importance of the ecological role of amphibians, wildlife as a whole and sustainable food production, have developed environmental education activities aiming to involve conservationist practices in the model of food production in a traditional community located in the edge of the largest city amidst the Amazon Rainforest, Manaus, in the Amazonas state, Brazil. In these activities were addressed topics as: 1) How to produce food in a sustainable way and without harming the environment or human health; 2) The rescue of traditional food; 3) Sustainable food production and its interaction with the fauna; 4) the diversity of Amazonian anurans; 5) the bioindicator function of amphibians for water quality; 6) the medical importance of chemical compounds in anurans' skin; 7) the role of anurans in natural pest control and their interaction with agriculture; 8) the importance of conservation of other animals groups for agriculture, as snakes in the natural control of rodents and invertebrates and their role in pollination and fruit generation. This activity integrates the project "Good, clean and fair food: enlargement and qualification of the participation of family farmer in Slow Food movement." This project is a result from a partnership between Slow Food Brazil and the Federal Government of Brazil, by means of the Special Secretary for Family Agriculture and Agrarian Development, that actuates directly with the family and traditional farmers in the five regions of the country. The National Institute for Research in the Amazon (INPA) integrates a university network led by Federal University of Santa Catarina, an important part of this project, that approximate the rural population from the scientific and practical actions from these institutions. The lectures were held at the National Institute for Research in the Amazon (INPA) (Fig. 1 and 2), with the community Raios de Sol that is in the process of implementing a Presidia (Project within the Slow Food that aims to accompany the production chain of a food, ensuring safety in your production chain) for the cultivation and protection of the Amazonian fruit traditional named cubiu (*Solanum sessiliflorum*).

The cubiu fruit (Fig. 3), is a solanaceae that can be used in typical sweet or savory dishes, such as jellies, sauces, breads and even juice (Fig. 4). The activity ended with a delicious coffee break with foods produced with the cubiu fruit (Fig. 5). In the Raios de Sol community was also carried out the implementation of vegetable-gardens in form of mandala (Fig. 6). In the vegetable-garden among the land patches, were included small canals that accumulates water for the natural irrigation, these canals attract anurans with generalist habits that can control pests in the plantation. In the region, also was stimulated the conservation of the water bodies, habitat for many amphibians and where the community captures water for

¹IUCN SSC Brazilian Amphibian Specialist Group, South America, Brazil. ²National Institute for Research in the Amazon - (INPA), Ecology Graduate Program, 69060-001 - Manaus, AM - Brazil. ³Slow Food Brazil North Region (Occidental Amazon), 69060-808 - Manaus, AM - Brazil. ⁴National Institute for Research in the Amazon - (INPA), Agriculture on Humid Tropic, 69060-001 - Manaus, AM - Brazil. ⁵E-mail: lucasferrante@hotmail.com

consumption and agriculture. These water bodies harbor a variety of species of anurans such as this leaf frog of only 1 cm *Anomaloglossus* sp. (Fig. 7).

As a result of the experience, we can conclude that activities of popularization of science and fauna with rural workers, arouse interest in conservation, this was evident in conversation with members of the Raios de Sol community. According to the woman community leader, she did not even imagine what kinds of research activities were being developed at INPA and that these activities ranged from research on animal diversity in the Amazon to the native fruits of the Forest. She complements, "It is a pleasure to be in such a renowned research institute and receiving this kind of information. I did not know that frogs were harmless and could help to control pests that affect our plantations and can cause diseases for humans, knowing these animals, I understand their role in nature and the importance of preserving them.". Other community members said they now understand that every animal has its role in nature, and that it is important to conserve these animals. Due to these results, we can say how transformative is the environmental education to improve the man's way of life in the field and transform agriculturists in conservation agent. In addition, we conclude that few people actually know the role of the applicability of research developed in research institutes such as INPA and do not understand how much the human being is dependent on the conservation of natural resources, ecological services and the fauna. This warns from the importance of the science popularization, from opening the doors of research institutes for the society and integrating conservation research and ethnobiology with the society through environmental education. This is the way to change how the Brazilian population views the agricultural production, linking the conservation practices to produce good, clean and fair food.

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Fig. 1: Carlos Alexandre Demeterco coordinator of Slow Food in Occidental Amazonian ministering a lecture about actions of Slow Food movement and the importance of rescue of food culture. Photo: Ligia Maria.



Fig. 2: Lucas Ferrante, Program Officer for the IUCN SSC Amphibian Specialist Group, giving a lecture about the role of amphibians as natural pests control. Photo: Carlos A. Demeterco.



Fig. 3: Cubiu fruit, *Solanum sessiliflorum*. Photo: Carlos A. Demeterco.



Fig. 4: Jellies, salad and breads produced with cubiu, in the center of the dish a cubiu fruit. Photo: Carlos A. Demeterco.



Fig. 5: Coffee break with the Raios de Sol Community. Photo: Lucas Ferrante.



Fig. 6: Vegetable-gardens in the form of mandalas in the Raios de Sol community. Photo: Lucas Ferrante.



Fig. 7: Probably a new species of genus *Anomaloglossus* not described by science and observed in the Raios de Sol community. Photo: Lucas Ferrante.



Longnose Harlequin frog. Photo: Gustavo Pazmiño.

Rediscovering Hope for the Longnose Harlequin Frog

By Lindsay Renick Mayer

A miracle. That's how Ecuadorian herpetologist Dr. Luis Coloma describes his team's rediscovery of a striking yellow-spotted frog, the Longnose Harlequin frog, which had been lost to science since 1989 and feared extinct.

The species, which is endemic to Ecuador, was once abundant in an area above about 1,550 km². In the late '80s the Longnose Harlequin frog suddenly and mysteriously vanished, along with nearly a dozen other Ecuadorian amphibian species. Without the knowledge or tools necessary to try to combat the invisible threat, Coloma, like other conservation biologists across the Neotropics at the time, was forced to bear witness to an unfolding ecological tragedy.

"In those years, I held more than 10 frog species in my hands right before they went disappeared," Coloma, now a batrachologist at the NGO [Fundación Otonga](#), says. "I was lucky in a sense—some of the younger generations have never even seen some of these animals. But it was devastating. When I was a kid, harlequin frogs were my brothers, my sisters, my family. I didn't need to find them in a book or encyclopedia, they were just there. They were abundant. Suddenly I couldn't do anything to save these animals that had survived in these lands undisturbed for millions of years."

Fast forward nearly 30 years to the end of March of 2016 and that tragedy is unexpectedly upended with a twist. During a four-day amphibian survey of Ecuador's remote and biodiverse Intag region, funded by [Defensa y Conservación Ecológica de Intag](#) (DECOIN),

three biologists working with Coloma rediscovered four adult Longnose Harlequin frogs—little living, breathing parcels of hope.

"It's a feeling that there are no words to describe," says Elicio Tapia, a biologist who grew up in the jungle, a veritable frog whisperer who used his keen hunting senses to unearth two Longnose Harlequin frogs the first night of the survey, and two more in subsequent days. Tapia is the first author on the [paper the team published in May in Neotropical Biodiversity](#) about the rediscovery. "You want to cry, you want to scream. Suddenly they're not just this image in your mind, but they're real. You can see them, you can touch them, you can study them. Finding hope has been the biggest surprise of this rediscovery."

With the rediscovery, however, comes some difficult decisions, a tough path ahead, and a team of conservationists grappling with duel emotions and wavering between celebrating a dream come true and fearing a nightmare on repeat.

"After you rediscover a species like this, you calm down and realize you have a new reality," Coloma says. "With that new reality comes a tremendous responsibility. Do you leave the animals in the wild, where they face even more threats today? Or do you take them to the lab to try to breed them? This is a beautiful story of hope, but we can't stop there. What happens next is even more important."

One of the first steps is for the International Union for Conservation of Nature (IUCN) to now change the classification of the Long-

nose Harlequin frog from Extinct to Critically Endangered on the [Red List of Threatened Species](#).

"We are thrilled that another amphibian species has been found again," says Jennifer Luedtke, [Global Wildlife Conservation's](#) manager of IUCN Red List assessments. "It's an incredible message of hope that some species are showing signs of being able to recover and gives us an even more urgent mandate to protect their habitats."

The threats to the Longnose Harlequin frogs in their natural habitat seem insurmountable, and growing. Chytrid—the fungal disease that is responsible, in part, for the steep declines of amphibian populations in the '80s and '90s—is still present in the area, though these individuals tested negative for the pathogen. Climate change and the expansion of cattle ranching, agriculture and illegal logging is permanently altering the frogs' home, threatening to continue the devastation where chytrid left off.

The largest immediate threat to these frogs, however, is a large-scale open-pit copper mining project that's already in the advance phase of development. This is not uncommon throughout Ecuador, where the government is allowing these projects throughout the country, including in some of its protected areas.

"In no uncertain terms, the mine will be the end of the Longnose Harlequin Frog, unless it is discovered somewhere else on Earth," Carlos Zorrilla, director of DECOIN, says. "It also means heavily impacting the habitat of more than 10 species of animals facing extinction; in addition to relocation of not less than four communities. We are talking of so much deforestation that it would lead to climate change at the local level, stripping of thousands of hectares of primary cloud forests; contamination of rivers and streams with lead, arsenic, cadmium and chromium."

So it didn't take Coloma and team long to make a decision. The team brought all four frogs, two males and two females, to the [Jambatu Research and Conservation Center](#), which has extensive experience developing technologies for captive breeding programs for frog species on the edge of extinction, including harlequin frogs. Jambatu's Arca de los Sapos, or frog arc, is supported by Ecuador's Ministerio de Ambiente and the Saint Louis Zoo.

One of the Longnose Harlequin frogs died for undetermined reasons in the lab, replaced by a fifth frog discovered months later in the field. Although four animals aren't enough to ensure a genetically healthy captive population—and harlequin frogs have been notoriously difficult to breed, with few exceptions—Coloma says conservationists are much better equipped today to give the frogs at least a chance at a future.

"In the past we'd bring the animals into the lab and they'd die," Coloma says. "That has changed. Now we treat chytrid, we quarantine the new arrivals, a veterinarian does parasite analyses, we know what to feed them, and we just know more generally. The technology has improved. We're in a good place now to at least try to do something to save them. And then if we're successful keeping them alive, we'll try to breed them and maybe someday return them to the wild."

But the dream of someday, somehow returning the Longnose Harlequin frog to the wild means that there must be a wild to return them to.

Ecuador's Intag region is a partly mountainous area that includes sub-tropical rainforests in the Andes. According to DECOIN, every year Ecuador loses another 2.3 percent of its forests, giving it the distinction of having the highest deforestation rate in South America.

Nearly the entire area known as Intag is being set aside for mining, according to Zorrilla, including the last remaining primary cloud forests. In the 4,965 hectare mining concession threatening the Longnose Harlequin frog's habitat, a local conservation organization identified the presence of more than 100 species of amphibians, birds and mammals facing extinction, including the Critically Endangered Brown-faced Spider monkey and the Vulnerable Andean bear.

This threat was among the reasons Coloma's team decided to survey the area for amphibians, pulling together evidence that is now being leveraged in the fight against the mining project. In total, the scientists recorded the presence of 16 amphibian species in the area, nine of which are listed on Ecuador's Red List as facing extinction.

Now the Longnose Harlequin frog is becoming the symbol of a rallying cry against open-pit mining and other development in the area. According to Zorrilla, the combination of the area's steep topography, biology, climate, mineralogy and seismic risks, the mining concession would be one of the world's most destructive, threatening more species facing extinction than any other mine project on the planet.

"I know firsthand how precious, threatened and scarce these biological jewels are," says Zorrilla, who has called the Intag area home since 1978. "We can definitely use the rediscovery to not only draw attention to the importance of protecting this vanishing habitat, but more importantly, to use the species to uphold the Constitutional Rights of Nature—as guaranteed in Ecuador's 2008 Constitution. This case is more likely to succeed in the courts precisely because the frog has only been found in one locality, which is now threatened by mining."

While DECOIN fights the good fight in the courts and by raising the alarm, Coloma and team are urgently encouraging the expansion of the Junín Community Reserve and the restoration of forest clearings. They will continue to survey the area and other sites where the Longnose Harlequin frog could still exist, looking for more frogs, including tadpoles, so the conservationists can continue to build their insurance population. They'll study the species' biology, behavior and reproductive physiology in the lab. And eventually they'll try to figure out how the species has somehow managed to survive chytrid, even if barely, while other harlequin frog species have been wiped out completely.

For Tapia—the first person to see a Longnose Harlequin Frog in nearly 30 years—all of these efforts come back to a miracle, not just the miracle of rediscovery, but the miracle of life itself.

"We lose too much even when we lose a single species of mite or fly," Tapia says. "One animal that took millions of years to evolve into its own species is a miracle. How can we even imagine destroying this miracle? Especially a frog, which is complex like us with eyes, a nose, a stomach, skin, legs, a mouth, a tongue, everything. We would be so foolish to let that happen. We must save it. That's the only choice there is."

Want to help ensure a future for the Longnose Harlequin Frog and other rare amphibian species? [Make a donation today](#) to the Jambatu Research and Conservation Center.



Andean Toad Thought to be Extinct, Rediscovered in the Andes of Ecuador

By Diego Cisneros-Heredia

Ecuatorian and British scientists have rediscovered one of the rarest amphibians of Ecuador, thought to have gone extinct more than three decades ago, the Carchi Andean toad *Rhaebo colomai*.

The Carchi Andean toad inhabits a small region in the border area between Ecuador and Colombia. The last time a specimen was observed in Ecuador was in 1984.

An expedition in July 2017 found a small population in the Dracula Reserve, in the northwestern Andes of Ecuador. The expedition was carried out by scientists from the Laboratory of Terrestrial Zoology of University San Francisco de Quito USFQ, the Natural History Museum of London, and the Instituto Nacional de Biodiversidad INABIO.

“We found these little toads near streams of crystal clear water with lush surrounding vegetation. When we saw the first individual, we immediately knew that we were in front of a species thought extinct,” said Carolina Reyes-Puig, professor and researcher at University of San Francisco de Quito USFQ.

The Dracula Reserve is the only protected area in Ecuador that could maintain populations of this threatened species today. This reserve is managed by the Ecominga Foundation and is key for the conservation of not only amphibians but also other rare and threatened biodiversity, such as Dracula and Lepanthes orchids and Spectacled Bear.

According to The IUCN Red List of Threatened Species, a global inventory with information on the risk of extinction of biodiversity, the Carchi Andean toad was possibly extinct in Ecuador due to the absence of records for more than 30 years and the serious destruc-

tion and fragmentation of the native forests where the species lives. In 2005, it was recorded in Colombia, but the situation in Ecuador was uncertain. This rediscovery will be reflected in the updated IUCN Red List assessment to be produced this year.

“This discovery is an incredible message of hope that some species are persisting even in the face of growing threats to their survival and confirms our mandate to protect their habitats and plan for their long-term future,” said Jennifer Luedtke, Global Coordinator of the IUCN Amphibian Red List Authority.

At the global level, amphibians face a high risk of extinction due to intense human pressure. In Ecuador only, hundreds of species are on the brink of disappearing. Causes include deforestation, environmental pollution, infectious diseases and local, regional and global climate change.

“We must remember the importance of amphibians to the planet and humans. Amphibians feed on a large number of insects and in turn are prey to birds, snakes and mammals, thus having a significant impact on ecosystem nutrient cycles. Many of those insects are pests of agricultural crops, so amphibians provide an environmental service to humans. Amphibians are important indicators of environmental health,” said Diego F. Cisneros-Heredia, director of the Laboratory of Terrestrial Zoology of the University San Francisco de Quito USFQ.

The next steps following rediscovery include the development of a monitoring program to improve knowledge of the populations status of the Carchi Andean toad in the Dracula Reserve and the search for other populations that may have survived in small patches of forest in surrounding areas.



One of the large tunnels used in this study. Photo: Froglife.

How did the Newt Cross the Road?

By Jenny Tse-Leon

Researchers from Froglife, The University of Hull and The Open University are discovering how endangered amphibians use man-made tunnels to cross roads. Their [work, published in the open access journal PeerJ](#) is the first published research on the effectiveness of these tunnels for our most spectacular amphibian, the protected great crested newt.

Amphibians can roam around on land but need to return to water to breed. And, for such small animals, they have remarkable homing instincts, many travelling long distances to the ponds of their birth. They can also travel long distances between ponds in order to find mates, thereby adding fresh blood into new populations. But developments like new roads and houses can get in the way of these migrations. One of the ways that developers try and reduce the impact on amphibians is by building tunnels under roads for them to migrate through. And while this sounds like a great idea, and has been shown to work for some bigger animals, we know very little about whether tunnels really work for amphibians and almost nothing specifically about newts. In Britain, we have a significant proportion of Europe's Great Crested newts but they are threatened because habitat loss reduces and fragments their populations. They are also vulnerable to being killed on roads by vehicles and pollutants like road salt.

The team of scientists set out to find out how effective road tunnels are. Using 5 years of monitoring data from a major road mitigation scheme, they provided the first hard evidence that newts use tunnels to move between feeding and breeding sites. This means that road tunnels may help connect populations of newts and other small species across fragmented landscapes, by allowing animals to move between ponds and maintain genetic exchange. Small, isolated populations are otherwise very prone to extinction. But it wasn't all good news. Writing in the journal *PeerJ*, they showed that females made much more use of tunnels than males, potentially risking imbalances in the sexes over the long term. And, rather

than tunnels connecting newts to ponds as they migrate to breed in spring, most of the action happened in autumn, meaning that tunnels might help newts find their way to their feeding and hibernating sites better than to their breeding ponds. Tunnels are usually accompanied by fences which stop newts wandering onto the road and direct them towards the tunnels. But most of the newts that contact the fences don't reach tunnel entrances, and of those that do, few attempt to cross. The researchers suggest that maximising the number of tunnels, putting ponds close to tunnel entrances, and on both sides of roads might help resolve these problems.

Dr Silviu Petrovan, a trustee from Froglife, who led the work said: "This is the first study that has shown that even very long road tunnels, from a newt's perspective, were used by newts and as such they can be a very important solution for mitigating fragmentation of populations. This is very positive as there is no published data on tunnel use despite the fact that many developments in the UK and elsewhere have employed tunnels as a mitigation measure."

Cátia Matos, a PhD researcher from The University of Hull who carried out the study, said, "An important finding from our work was that tunnel crossing rates varied substantially between years. Populations are usually monitored for five years after a development has finished, but it is likely that this is not enough time to assess whether mitigation measures have been effective."

Dr Phil Wheeler from the Open University said, "Even though our work has shown that newts use tunnels, we need much longer monitoring data and from many more sites before we can be confident that tunnels stop fragmented populations dying out. It is essential to know that the resources being committed to wildlife mitigation are being spent in a way which best benefits the target species. Our work is starting to show that, but there is much more to learn."

Diaries of Frog Research Adventures in Wau Creek Research Station, Papua New Guinea.

By Deborah S. Bower, Simon Clulow, Yolarnie Amepou, Arthur Georges

We left through a haze of white mist over Cairns in Tropical Northern Australia and flew over lush rainforest, interspersed with large houses, nestled in the canopy of the forest. Yachts dotted the coast but soon became obscured by the white cloak of cloud. I looked down some twenty minutes later to see a translucent blue ocean, surrounding a stepping stone of small islets, each unique in size and shape but almost all a mixture of browns and yellows with an edge of brilliant aqua extending along some area of the coast, most often on the northern side.

The Torres Strait melted into a winding network of brown rivers that met an ocean rippled like a marble around the New Guinea mainland. The river network cut through the land forming countless islands of green vegetation below us. Before long I had spied a village, marked by a handful of buildings lost in the muddled maze. The islands grew larger as the rivers merged, seemingly more organized in their collective arrangement. The dense canopy of the forest made it difficult to decipher the vegetation communities blanketed below us but as we descended into Moro, I could discern the intricate shadows of mountains and a road pathed yellow through the forest, a scar on the otherwise intact landscape.

From Moro we flew to Gobi and drove 4x4 to Kopi where we took an hour speed-boat trip to Kikori. We met Frank John at the boat, the local landowner and creator of a research station at Wau Creek where we would be working. He piled us into a fiber-glass river boat with a large outboard at its rear and we waved to villagers as the boat motor putted us away from Kikori station, out into the large, murky river.

We drove upstream as the river changed from a wide murky expanse to an intimate series of tight meandering bends, hugged by limestone cliffs with overhanging forest like a hidden gorge. The water was a clear, deep lagoon green and we sped past two Papuan crocodiles, which were making the most of the unseasonably consistent sunshine. Hornbills flew across the canopy as I tapped Simon's knee in uncontrollable excitement. The Kikori River turned into the Sire and we began to pass small beaches of sand, covered with tracks. Perfectly parallel sets of tire-like flipper tracks emerging from the waters edge marking Pig-nose turtle nesting routes to the highest spots available. The last section of the journey we pushed the boat up the shallow stream, moving against the current and trying to keep up with the locals.



Photo: Arthur Georges.

THE RESEARCH STATION

We pulled up on a raised stretch of river bank with pebble substrate and the field assistants tied the boat to a large snag. There I noticed a railing guiding a path up three discrete step ladders to a 5 x 18 m traditional house that was to be our research station for our two week trip to Wau Creek. Built and owned by Frank John and his family, we were the first visitors to his recently protected patch of forest. Tree trunks provided the frame to the station, which is divided into a sheltered verandah, large room for sleeping quarters and a kitchen area for food preparation. The roofing was made from long, dried Nipa Palm leaves and walls were weaved mats from Sago Palm leaf. The floor of Black Palm bark was aligned neatly on top of the tree trunk foundation and delicate windows propped open with sticks allowed streaks of sun light into the main compartment. Frank had even built tables and bench seats on the verandah and kitchen and put a sink and benches in for convenience. It was built off the ground, providing an undercover area where the baby 'Nena-hiho' could be left to swing in the shade of her miniature hammock and where scorpions could torment me during my frantic forays to catch rogue escapee wildlife during our photography and data collecting sessions.

Outside the building, a path had been constructed from pebbles, bordered by larger rocks collected from the river below. The path passed a water tank, through a garden of beans and banana trees and looped around the house up a small incline to a hut where a handmade door swung open to reveal a box with a toilet lid decorated with a floral design, perched on top.



Photo: Arthur Georges.

FROG SURVEYS

We were visiting Wau Creek Nature reserve to survey frogs and with 6% of the world's frog species in less than 1% of its land surface area, we knew we were in for a treat.

As twilight greeted us eagerly, I handed out plastic bags to everyone with instructions to invert them as they capture the frogs so that I could test for the presence of a fungal pathogen on their skin, without contamination. Before I'd finished handing them out, then my head torch detected the characteristic dull green eye shine of a frog from across the camp. I went over to a small plant and bending down, I used my bag to pluck a small delicate frog from a leaf and popped it inside the bag to keep it safely secured, as people gathered round to observe. I picked up some leaf litter from the ground and sealed in inside the bag, using a marker to record its GPS location and habitat details. We then marched off in a conga line including Frank's small children, our field assistants and cooks.

I'd only taken a couple of steps when I saw another frog on the path. This one was larger and sat up higher with red markings on its legs and a bulbous head. No sooner than I had captured it in its own plastic bag and I was on to the next. The frogs surrounded us

as we walked down the path collecting more and more every few steps until the transect had changed to a low, lying grassy based forest. It became quieter as I fell behind the group and I caught some blazing red eye shine from up in a tree. I edged closer thinking it was a mouse but soon realized it was something else entirely. With a black and white striped face like a possum and a thin, prehensile tail a Feathertail or Pentail Possum (*Distoechurus pennatus*) glared back at me. "It flies" a local hunter Mikey told us. It's the Angel rat. "Very powerful", he added. "Keep remains of it in your pocket and you can enter a meeting place or houses undetected."

On the way back, just off the path I lost my breath in surprise and excitement as my light fell onto the characteristic shape of a forest dragon clutching a tree. This was no Australian forest dragon though, it was huge with red eye liner and striking long spines lying down the length of his head and body. I braced for its reaction as I went to catch it but it remained motionless as my eyes grew wide in disbelief and delight. Papua New Guinea is Cape York on acid I decided and practically skipped back to camp because I was so excited to show the others. Bounding up to the verandah I gave Arthur a bag with a dragon tail hanging out of the top, betraying the surprise. He was an Indonesian Forest dragon, the first of three that we would find that trip.



Distoechurus pennatus. Photo: Arthur Georges.



Lophosaurus dilophus. Photo: Arthur Georges.

OUR CATCH

Each day we sat down and spent hours taking detailed descriptive notes and measurements of the frogs we had caught the night before, as well as specimens for the museum. With a field guide developed largely from museum specimens, it was a complex and slow task to identify the 164 individuals of 26 species of frogs we sampled during our trip. As Australian's we appreciated the novelty of the Ranids, dominant and obvious in the larger creeks but as biologists, we marveled at the diversification of Microhylids, which accounted for the majority of our sample. They have radiated to occupy every niche imaginable from burrowing *Xenorhina* to a largely aquatic *Austrochaperina* and every arboreal *Oreophryne*, terrestrial *Callulops* and pointed nosed *Sphenophryne* possibility in between.

A lack of rain transpired into some quiet nights during the middle of our trip but several downpours a few days before we left meant that the last night we went out at Wau Creek was a ripper. The *Litoria* materialized from the forest canopy to places we could see and catch them and as we were walking down a transect, we heard a soft staccato moan that grew louder and more intense each time it released a call. On the fourteenth note it would climax in a high-pitched release and then rest a while before starting again. We crept upon the sound, local research assistants and biologists alike, puzzled at the absurdity of such a crescendo and after recording it, we dug a frog up from a small nest it had made in the ground. The frog looked no less ridiculous than its call with a tiny head and giant body, we marveled at the spectacular animal that we so nearly missed seeing. How many more amazing creatures lay hidden in the forest of Kikori and beyond?

FUTURE CONSERVATION

Frank John's Research Station is now functioning as a base where scientists can stay during research trips. The research station comes complete with food, fresh from the forest and the help of the 'Piku Warriors' - the research assistants that know the local area and have been trained to assist in researching pig nosed turtles and, more recently, frog surveys. The petroleum industry has funded pig-nosed turtle research, which has been used as an excellent model for out-

reach and education of sustainable harvest, invasive species, pollution and general conservation issues in the Kikori Region. In the future we hope Frank can build the capacity of the research station as more researchers visit and the value of Wau Creek biodiversity is recognized. Our baseline surveys for frogs served as a first step towards documenting frog biology at Wau Creek and we hope to build on this in the future. People that are interested in the station can contact Arthur Georges (georges@aerg.canberra.edu.au) for more information.

Acknowledgments

Funded by the Petroleum Industry with thanks to Frank John, the Rupahai clan and the Piku Warriors for logistical support.



Sphenophryne cornuta. Photo: Arthur Georges.



Hylophorbis rufescens. Photo: Arthur Georges.



Oreophryne oviprotector. Photo: Arthur Georges.



Litoria aff. *genimaculata*. Photo: Arthur Georges.



Austrochaperina derongo. Photo: Arthur Georges.



Callulops omnistriatus. Photo: Arthur Georges.



Callulops doriae. Photo: Arthur Georges.



Austrochaperina palmipes. Photo: Arthur Georges.



Trinidad Golden Treefrog. Photo: Paul Hoskisson.

eDNA Provides Potential New Lease on Life for Trinidad Golden Frog

By Lindsay Renick Mayer

The whole world seems to be conspiring against the Trinidad Golden treefrog, says University of Strathclyde microbiologist Paul Hoskisson.

“The treefrog is Critically Endangered, it lives its life rather reclusively in an endangered plant, and climate change is leaving it nowhere to go,” Hoskisson says. “Not to mention that the only way to find the frogs has been to chop down this endangered bromeliad, their only home, and rip it apart.”

If the whole world is against the Trinidad Golden treefrog, the universe has found a formidable foe in Hoskisson and a team of microbiologists and zoologists that have gone to great lengths for the underfrog, scaling steep, rain-drenched hills riddled with the venomous fer-de-lance for hours on end. In a [study published in February in PLOS ONE](#), the researchers became the first-ever to use environmental DNA, or eDNA, to look for clues left behind by Trinidad Golden Treefrogs, providing valuable information about the population without the destruction of a single bromeliad or the surrounding flora.

To collect the eDNA samples, the researchers took mucus tubes that hospitals use to aspirate lungs and jerry-rigged a device to suck water samples from the bromeliads, which contain treasure troves of DNA in frog fecal matter, eggs and shed skin. Sampling more than 140 bromeliads over the course of two field seasons, the scientists found evidence of frogs in 9 percent of the bromeliads, which matched the occupancy rate that the most recent destructive survey in 2012 had found, proving that the eDNA technique works.

“This is truly minimal intervention,” Hoskisson says. “You put a tube the size of the end of a pen into the bromeliad and leave it there for only 10 seconds while you take a sample. There is no damage at all, but you still end up with the vital data we need to help conserve the species.”

Not only can the collection of eDNA tell scientists about the population of Trinidad Golden treefrogs, but eDNA can also shed light on the little-understood ecosystem in which the frog lives, says Sarah Brozio, lead author of the study and a PhD student. It can also reveal the presence of chytridiomycosis, the fungal pathogen that has wreaked havoc on populations of frogs elsewhere in the world, especially in the neotropics.

“eDNA is a powerful tool for understanding what these frogs need to survive,” Brozio says. “We can see if levels of particular groups of bacteria that repeatedly occur start to suddenly drop, in-

dicating a massive change that could impact the higher-level organisms, like the frogs. We can also really start delving into if there are antibiotics or antifungals in the environment that are different to those we already know about.”

Although eDNA is the key to protecting the habitat of the Trinidad Golden Treefrog during surveys, it means that researchers won’t likely have opportunities to catch sight of the unique-looking species firsthand. Mark S. Greener, a PhD student at Ghent University and co-author on the paper, was among the last people to see a Trinidad Golden treefrog in the flesh during the 2012 survey, and he calls it a “phenomenal-looking” frog. But he adds that even though it was an exhilarating experience, he much prefers the eDNA method.

“When you have more of an ecosystem view, you get a much better appreciation for the fact that the bromeliad is that frog’s entire life,” Greener says. “It’s not just a plant. It’s where the frog lives, it’s where it breeds. So you have to protect the plant, too. You can’t just protect the frog and not give it anywhere to live.”

The paper’s authors next hope to do a more extensive survey over a longer period using the eDNA technique to determine whether the population is rising or falling—and if it’s falling, to try to determine why. They will also use the technique to sample at another site that historically had bromeliads to see if there’s a remnant population of the treefrog holding on there. And they’re sharing their methodology with other scientists and conservationists who can use eDNA to better study other elusive, arboreal amphibian species.

The data collected in this survey will help the Trinidad government best ensure that the small range where the treefrog lives is protected from collectors and from deforestation. Climate change presents a particularly challenging threat to mitigate—because the treefrogs live at such a high altitude already, above 700 meters, there will be nowhere for them to move in a warming climate.

“We know so little about the ecology of the Trinidad Golden Treefrog, but eDNA is giving us a chance to learn more not only about the species, but about how we might be able to best protect them,” Brozio said. “The effects of climate change in particular are going to provide an uphill battle. But we’re still hopeful—if doing these surveys in treacherous conditions proved anything, it’s that we like a good hill climb.”

Seeking Conservation Heroes!

Do you know of an inspiring wildlife conservationist who is making a lasting difference in their home country? If so, we'd love to hear from them!

The Whitley Awards 2018 is now open for applications! We are looking for dynamic grassroots conservation leaders from middle to low income countries working with project teams to deliver game-changing conservation for wildlife and people.

Since 2001, WFN's Patron, HRH The Princess Royal has presented our internationally recognised Awards – often referred to as the 'Green Oscars' - at an annual Ceremony in London attended by 500 guests and our Trustee, Sir David Attenborough, kindly narrates winner films.

The Charity has supported four Award winners conserving amphibians and would be keen to find more, particularly those that are working on the [Amphibian Conservation Action Plan \(ACAP\)](#) priorities in their home countries. In 2016, Gilbert Adum from Ghana promoted the giant squeaker frog as a means of conserving the Sui Forest Reserve, whilst the 2015 Gold Award winner Dino Martin's work on pollinators and pesticides benefits amphibians in his home country of Kenya and more broadly through his work with The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). In another region, Carlos Vasquez Almazan, following his 2012 Award, now has further funding to extend his amphibian conservation work in Guatemala. Focusing on a different threat, in 2007 Mirza Kusri from Indonesia tackled the frog leg trade and increased awareness about amphibians

more generally in her country. If you are a successful amphibian conservationist looking to scale-up or replicate action to safeguard an important ecosystem with help from the local community in a resource-poor country – we'd love to hear from you!

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Save The Date: Salamander Saturday, 5 May 2018

Salamander Saturday is an initiative started by Foundation for the Conservation of Salamanders (FCSal) to raise awareness about salamanders, their habitats and their role in the ecosystem. We are encouraging organizations around the world to hold an event on this day and to share their events with FCSal through social media, thereby promoting global unity in the effort to protect salamanders.

Interested in hosting an event?

Your Salamander Saturday event should be catered to your organizations strengths and schedules; it can be as simple as hosting an education table, or as involved as a fundraising event. FCSal will be partnering with AAZK, PARC and ASA to reach a broad audience of amphibian lovers and to make Salamander Saturday a success!

You can help by creating a day for international salamander awareness. If you would like to participate in Salamander Saturday, please contact info@fcsal.org and share your plans with us. Make sure to send us the event title/program name, organization hosting, location/time, and website (if applicable).

All Salamander Saturday events will be promoted via FCSal.org and our Facebook page, so please take pictures and have fun spreading the word about salamander conservation! If you would like to host a fundraiser for FCSal, we would be happy to supply you with necessary materials including our Chopsticks for Salamanders stainless steel chopsticks.

Please see our website for more information and for downloadable education materials. www.FCSal.org



Green Salamander. Photo: Tom Mann.



Fig 1. Atlantic Forest fragments immersed in sugar cane crops for biofuel production. Photo: Lucas Ferrante.

The Matrix Effect on Amphibians of the Atlantic Rainforest, Brazil

By Lucas Ferrante^{1,2} & Ariadne Angulo²

The loss and fragmentation of natural habitats is the most pervasive threat to biodiversity, affecting over 40% of species listed on The IUCN Red List of Threatened Species (1). Amphibians are no exception to this phenomenon: in 2008 over 63% of all amphibians were considered to be impacted by some form of habitat loss (2). Despite this, the processes through which habitat loss affects amphibian populations have been relatively understudied. Agriculture and aquaculture are the greatest drivers of habitat loss for amphibians (3). In the case of forests, their loss and fragmentation is driven by land use change in favour of crops for food and biofuel production, livestock or human settlement use (Fig. 1). Under this scenario, forest patches are often surrounded by an inhospitable matrix, a situation which has increased in frequency, but whose effects on local biodiversity are not well understood. In a fragmented landscape of semideciduous Atlantic Rainforest in south-eastern Brazil, we assessed which of the predominant landscapes matrix types (coffee, sugar cane, pastures, heterogeneous landscapes and landscapes with cattle that accessed the fragment interior) were more likely to impact the internal structure of forest fragments and consequently amphibian composition, species richness and number of individuals. The study's results show that there is a strong link between agricultural matrices that facilitate forest fragment exposure to the elements and a decrease in forest integrity within the fragment, which is reflected in a loss of strict forest anuran species (Fig. 2). Those matrices that allow for greater exposure of forest fragments also appear to favour their occupation by habitat generalists. Given that these matrices influence forest fragment integrity, there is a turnover from forest specialists to

generalists, suggesting a decline in forest specialists due not only to habitat loss, habitat split and disease, but also due to the influence of structural changes in the landscape components comprised of agricultural matrices (4). Many species are forest-dependent, such as *Aplastodiscus leucopygius* (a tree frog that uses riparian vegetation for vocalization sites, Fig. 3), *Proceratophrys boiei* (a terrestrial species breeding in temporary pools, Fig. 4) and *Haddadus binotatus* (a species with terrestrial development in leaf litter, Fig. 5). Although these species have completely different natural histories and reproductive modes, they all rely on the integrity of the vegetation structure within forest fragments. These results are reported in detail in Ferrante *et al.* (2017) and suggest the need for new management approaches for conservation of species in fragmented landscapes.

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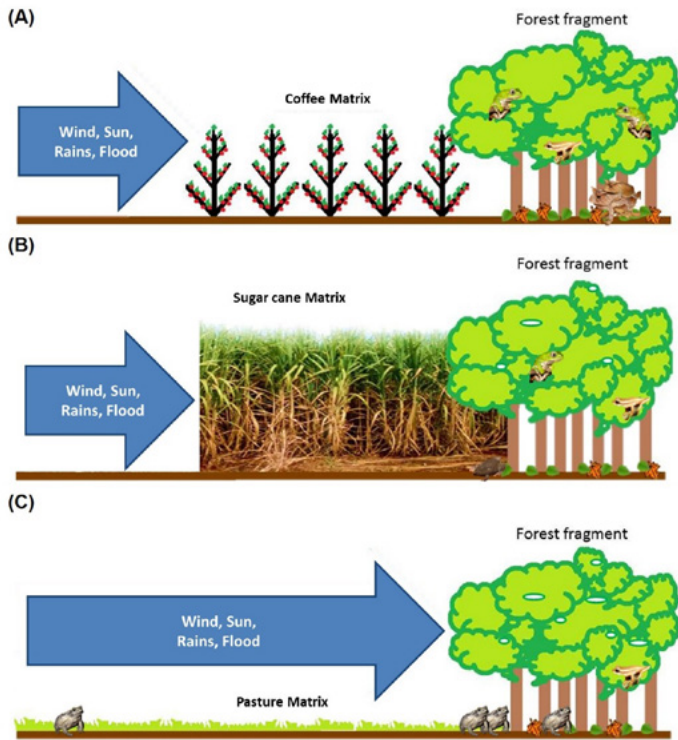


Fig 4. *Proceratophrys boiei amplexus* in a temporary pool after rainfall. Photo: Lucas Ferrante.



Fig 5. *Haddadus binotatus*. Photo: Lucas Ferrante.

Fig 2. (A) Coffee crops are the most perennial matrix in this landscape; in comparison with other agricultural crops coffee helps maintain the structure of forest fragments and thus the composition, species richness and number of individuals of strict forest species. (B) Sugar cane is a seasonal crop, exposing forest fragments to external effects and hence affecting the structure of forest fragments and amphibian assemblages. (C) Pastures expose forest fragments to several external effects leading to vegetation degradation and loss of forest species; however, the degradation of forest fragments favours generalist species that colonize the degraded fragments.



Fig 3. *Aplastodiscus leucopygiu*. Photo: Lucas Ferrante.

Recent Field Assessment for the Endangered St. Vincent Frog *Pristimantis shrevei*

By Roger Sweeney



Fig. 1: Map of survey sites St. Vincent with indication of where *Bd* was detected.



Fig. 2: St. Vincent frog *P. shrevei* photographed during surveys. Photo: Cornelius Richards.

The St. Vincent frog *Pristimantis shrevei* is endemic to the island of St. Vincent and is listed as Endangered under IUCN Red list criteria. This assessment was made because its Extent of Occurrence is less than 5,000 km², with a continuing decline in the extent and quality of its habitat (1). No updated assessment had been done for this species for several years, with the last survey work having taken place in 2006. The need for more current assessment of threatened endemic species in St. Vincent has increased in recent years following several severe weather events that have caused significant damaged to some forest reserve areas.

In addition, the impact of the invasive Johnstone's Whistling frog *Eleutherodactylus johnstonei* on the island needs more assessment for impacts on *P. shrevei*, either from direct competition or as a vector for infectious disease. The amphibian chytrid fungus *Batrachochytrium dendrobatidis* (*Bd*) is known to be present in *E. johnstonei* populations on other nearby islands, including the neighboring island of Grenada to the South of St. Vincent (C Berg, Milwaukee County Zoo, pers. comm.). The biogeography of *P. shrevei* populations further elevates conservation concerns because these frogs are only known to exist in isolated higher-elevation "sky islands" of habitat, surrounded at lower elevations by dense populations of *E. johnstonei*, which occur in warmer lower-elevation habitat areas, which could increase the risk of *Bd* infection for *P. shrevei*. For these reasons, we conducted field surveys for *P. shrevei* in June 2015 and included surveillance testing for the presence *Bd*, which led to the first documentation of the fungus in St. Vincent (2).

METHODS

St. Vincent and the Grenadines is a eastern Caribbean nation comprising a main island, St. Vincent, and a chain of smaller ones. The main island of Saint Vincent measures 26 km long, 15 km in width and 344 km² in area. The island of Saint Vincent is volcanic and includes little level ground. The St. Vincent Forestry Department staff were involved in all survey work and ensured that legal permission and permits were obtained for all aspects of our work on the island as well as for export of biological samples to the Amphibian Disease Lab at San Diego Zoo for surveillance for the presence of *Bd*.

The last formal survey work for the St. Vincent Frog was con-



Fig. 3: St. Vincent frog *P. shrevei* photographed during surveys. Photo: Cornelius Richards.

ducted in 2006 when a joint team from the University of Puerto Rico, Avila University and the Milwaukee County Zoo surveyed five locations on St. Vincent (3). We worked with the Forestry Department staff to select seven locations for survey from across the island. We replicated the same transect methods that were used in 2006 to allow for possible trend comparison, but we also added additional survey sites of higher-elevation cool, dense forest within the historical range of the *P. shrevei* to increase data collection for the target species. One of the additional sites was also selected to represent an area of forest plantation that was extensively disturbed by storm damage in 2011 and which is now in regeneration.

We conducted visual encounter surveys along timed straight line transects. Surveys took place between the hours of 1800–2100 hours over 7 consecutive nights, 5–11 June 2015. This replicated the same survey methods as the previous 2006 field work for trend comparison. When a frog was detected, the stop watch was paused while we examined the frog, confirmed identification and swabbed for *Bd* (2). Biosecurity practices were practiced between field survey sites, particularly when more than one transect was visited on the same day. Disposable gloves and footwear covers were used as well as disinfection protocols (4) to prevent human-mediated *Bd* transmission.

All Samples were sent to the Amphibian Disease Lab of the San Diego Zoo, California, USA for testing in June 2015, where the samples were analyzed by polymerase chain reaction testing (5).



Fig. 4: Forestry officers helping to set up transect line. Photo: Roger Sweeney.



Fig. 5: Example of transect line through typical frog habitat. Photo: Roger Sweeney.



Fig. 6: Frog habitat at La Soufriere trail field site. Photo: Roger Sweeney.

RESULTS

The majority of our sites were selected to favor finding *P. shrevei* over *E. johnstonei*, although we did specifically include the Perseverance forest area of disturbed forest damaged by storms in 2011 to assess whether *P. shrevei* can adapt when its habitat is disturbed with significant damage to canopy cover. We encountered a total of 25 *E. johnstonei* and 114 *P. shrevei* during surveys. We found *E. johnstonei* at higher-elevations and deeper inside cooler dense forest that we had originally expected. The survey results from the Vermont nature trail site, which had good populations of *P. shrevei* in 2006, had now become dominated by *E. johnstonei* during 2015 survey, increases concern about the hypothesized ability of *E. johnstonei* to displace *P. shrevei*. We did find good populations of *P. shrevei* in the disturbed forest site at Perseverance forest where dramatic flooding in 2011 has caused extensive damage and significantly reduced forest canopy cover. *P. shrevei* still remains abundant there even after a period of significant disturbance to the habitat. Our surveillance for *Bd* produced positive results from two different sites on the island (2).

DISCUSSION

We encountered good populations of *P. shrevei* in each of the survey sites visited except the Vermont Nature Trail, where this species was previously numerous but we now found *E. johnstonei* dominating the area. The hermitage forest site had high density of both species in near even population numbers in June 2015 and we intended to continue to survey this site to assess whether *E. johnstonei* will eventually displace *P. shrevei* over time.

Strong population density of *P. shrevei* in the disturbed forest landscape of the Perseverance forest area was a positive sign. We had hypothesized that the more open forest canopy with greater sunlight penetration would have increased ambient temperature and decreased humidity, favoring the invasive *E. johnstonei*, but our results showed *P. shrevei* to be abundant even after significant habitat disturbance four years earlier.

The invasive *E. johnstonei* does seem to test some of the elevation barrier assumptions that we had previously held. We found high density of *E. johnstonei* populations in hermitage forest at 1548 ft and also found *E. johnstonei* in more open agricultural land as high as 1700 ft. If the range of *E. johnstonei* continues to extend further into the higher-altitude, cooler forest habitat of *P. shrevei* that may



Fig. 7: South Rivers forest field site showing frog habitat. Photo: Roger Sweeney.



Fig. 8: Author and Wildlife Officer Glenroy Gaymes working transect line in Montreal forest. Photo: Cornelius Richards.

further threatened the endangered endemic species.

Finding positive results for the presence of *Bd* on the island was a significant finding. Now that the organism has been identified on the island we intend to design a follow up study to collect more information about prevalence and to assess whether or not there are disease effects on native and nonnative anuran populations.

Acknowledgements

The author is extremely grateful to the Forestry department on St. Vincent for accommodating this project with such enthusiasm and facilitating the involvement of as many staff members as possible. All fieldwork was conducting with the forestry department staff, who participated in every element of this project. The Sacramento Zoological Society provided financial support for this project through its Conservation small grants fund, with the remaining funding coming from Virginia Zoo. San Diego Zoo Amphibian Disease lab conducted the Chytrid test work for this project. Craig Berg, from the Milwaukee county Zoo, advised on the design of this project and also supplied information about the 2006 survey work on St. Vincent as well as similar work with whistling frogs on Grenada.

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Fig. 9: St. Vincent frog *P. shrevei* in hand for confirmation of identification. Photo: Cornelius Richards.

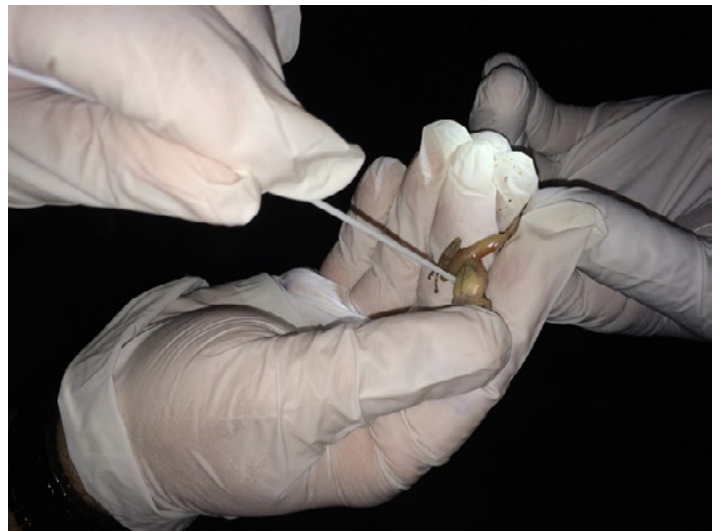


Fig. 10: Swabbing of a St. Vincent frog *P. shrevei* for chytrid surveillance. Photo: Cornelius Richards.

Multiple Strategies for Revealing the Amazonian Amphibians: Environmental Education and Conservation Actions in Amazonian Forest

By Lucas Ferrante^{1,2,5}, Luciana Frazão⁵, Igor Luis Kaefer^{2,4}

Frogs are the most threatened vertebrates and their largest diversity is found in the Amazon region (1,2). This region faces many anthropic threats such as deforestation, fragmentation, hydroelectric dams, mining and climate changes (3). In addition, the population of central Amazonia views the anurans as grotesque animals and exhibits fear of the frogs (4). In this dangerous scenario faced by amphibians, environmental education acts as an important tool to help increase awareness of conservation of these animals (5). Successful conservation actions involving amphibians must integrate several parts of the society and different age groups to construct a society with higher environmental awareness (6).

Through environmental education we seek to bring greater knowledge about the biology, ecology and threats that amphibians have faced for the population inserted in the major city in the middle of the Amazon Forest, the city of Manaus in the Amazonas state, Brazil. In Manaus, we broadcast a series of documentaries showing Amazonian anurans diversity, reproduction habits and threats in a TV and YouTube show called Wild Manaus (Fig. 1) (<https://www.youtube.com/watch?v=jkk0HS5KT9Y&t=159s>) (in Portuguese “Manaus Selvagem”). We also organized the second edition of the Save the Frogs Day in the Brazilian Amazonian region (Fig. 2). This event happened in April, 27th of this year at Amazonas Federal University (UFAM) (Fig. 3), this university is located in an urban Amazonian fragment with large anuran diversity and emblematic species of the Amazonian Forest. We showed living animals in terrariums that occur in the area as *Phyllomedusa bicolor*, *Boana lanciformis*, *Boana cinerascens*, *Scinax ruber*, *Leptodactylus fuscus* and *Adenomera andreae* (Fig. 4), also played some videos about reproduction and behaviour of the Amazonian frogs. The event was attended by people from different age groups and many questions were raised to the staff (Fig. 5 and 6).

Acknowledgments

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Fig. 1: Images of the Wild Manaus program where we showed the diversity, identification and medical importance of Amazonian Phyllomedusas. Photo: YouTube image.



Fig. 2: Coordinators of Save The Frogs Day in Manaus, from left to right: Igor Kaefer, Luciana Frazão and Lucas Ferrante. Photo: Dr. Igor Kaefer.

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Fig. 3: Irmão Mazela Band vocalizing in the Save The Frogs Day Manaus with a rock and roll call for attracting the public. Photo: Luciana Frazão.



Fig. 4: *Phyllomedusa bicolor*, Monkey treefrog of medicine importance and used in traditional medicine by Amazonian indigenous. Photo: Lucas Ferrante.



Fig. 6: Participation of elementary school students and integration of the "human tadpoles" in the academic center. Photo: Luciana Frazão.



Fig. 5: Students participation in the Save The Frogs Day Manaus activities. Photo: Dr. Igor Kaefer.



The Oriental fire-bellied toad (*Bombina orientalis*). Photo: Laurent Lebois.

Deadly Salamander Fungus Now Found on Frogs in the Pet Trade

By Reid Harris

The recently discovered pathogen *Batrachochytrium salamandrivorans* (*Bsal*) has decimated fire salamander populations in Europe and has been shown in laboratory trials to lethally affect salamanders found in North America, such as species of newts in the eastern and western sections of North America. An [article published in the journal *Amphibia-Reptilia*](#) reports that the lethal amphibian pathogen *Bsal* was found on frogs in the pet trade in Germany. So far, *Bsal* appears to be absent in North America, so it is important to try to keep it out since no mitigation options are currently available to fight it in nature. Should it arrive in North America, it is likely that many salamander species will be decimated.

The article found *Bsal* on the frog species *Bombina microdeladigitata*. The authors conclude that, “the closely related *Bombina orientalis* is traded in massive numbers with over 3.5 million specimens traded in the USA between 2001-2009 ... posing a potentially significant threat of disease introduction.” For mitigating the disease threat of *Bsal* to *Bsal* naïve regions, the Amphibian Survival Alliance (ASA) therefore calls for the installment of proper sanitary measures (quarantine, entry controls) in the live amphibian trade from Asia, not only pertaining to urodeles, but also including anurans. Moreover, installing such measures for the trade in wildlife could reduce the risk of pathogen spillover to native fauna, livestock and even humans. The ASA supports these conclusions.

Until such protections are in place, the ASA supports a moratorium on imports of all amphibian species from areas where *Bsal* has been found in nature (Europe and Asia) or on any species of amphibian on which *Bsal* has been found regardless of country of origin. For maximum protection and until a clean trade program is in place, we support a moratorium on amphibian imports into North America.

In addition, a group of scientists, conservation organizations and professional societies [urged the US Fish and Wildlife Service](#) to institute a moratorium on amphibian imports until a system is in place to ensure imports are free of *Bsal* and other diseases.



Eastern newt (*Notophthalmus viridescens*). Photo: Paul St. Clair.



Multi-species chytridiomycosis mortalities from Lac Arlet. Photo: Mat Fisher.

Long Term Analysis of an Outbreak of Chytridiomycosis in the Western Pyrenees

By Kieran Bates¹, Jennifer Shelton¹, Jaime Bosch², Dirk Schmeller³, Trenton W. J. Garner⁴ and Matthew C. Fisher¹

For over a decade a collaborative project led by Imperial College London and the Zoological Society of London has been monitoring the emergence of *Batrachochytrium dendrobatidis* (*Bd*) in amphibians from the Western Pyrenean mountain range, spanning the borders of France and Spain. The Pyrenees is rich in biodiversity and is home to a wide range of amphibians, including the endemic Pyrenean Brook salamander, *Calotriton asper* and Pyrenean frog *Rana pyrenaica*.

A great deal of work has focussed on infection dynamics in a highly susceptible species, the Common Midwife toad *Alytes obstetricans*, with key manuscripts being submitted in 2016 (1). Importantly, the emergence of infection across study sites has been tracked which has enabled temporal and spatial patterns of disease to be generated. Findings show marked variation in both infection prevalence and intensity across populations, with spread of infection being observed and severe declines in population abundance being common. To address the putative mechanisms underlying

the heterogeneity of infection, research themes encompassing the biology of *Bd*, its host, and their interactive effect with the environment have been developed.

The 2015 field season saw continued surveillance of infection and a field microbiome study in which the dermal bacterial communities of *A. obstetricans* were classified using 16S metabarcoding. It is hoped that the data generated will enable potential relationships between the microbiome and *Bd* infection to be identified, thus paving the way for more targeted microbiome-*Bd* studies across this system. Alongside our scientific activities we also continued stakeholder engagement with the Pyrenean National Park, and also hosted a visit to film our activities by Barbara Réthoré and Julien Chapuis from ConservAction.

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Jennifer Shelton sampling *Alytes obstetricans* tadpoles in Ibon Acherito. Photo: Mat Fisher.

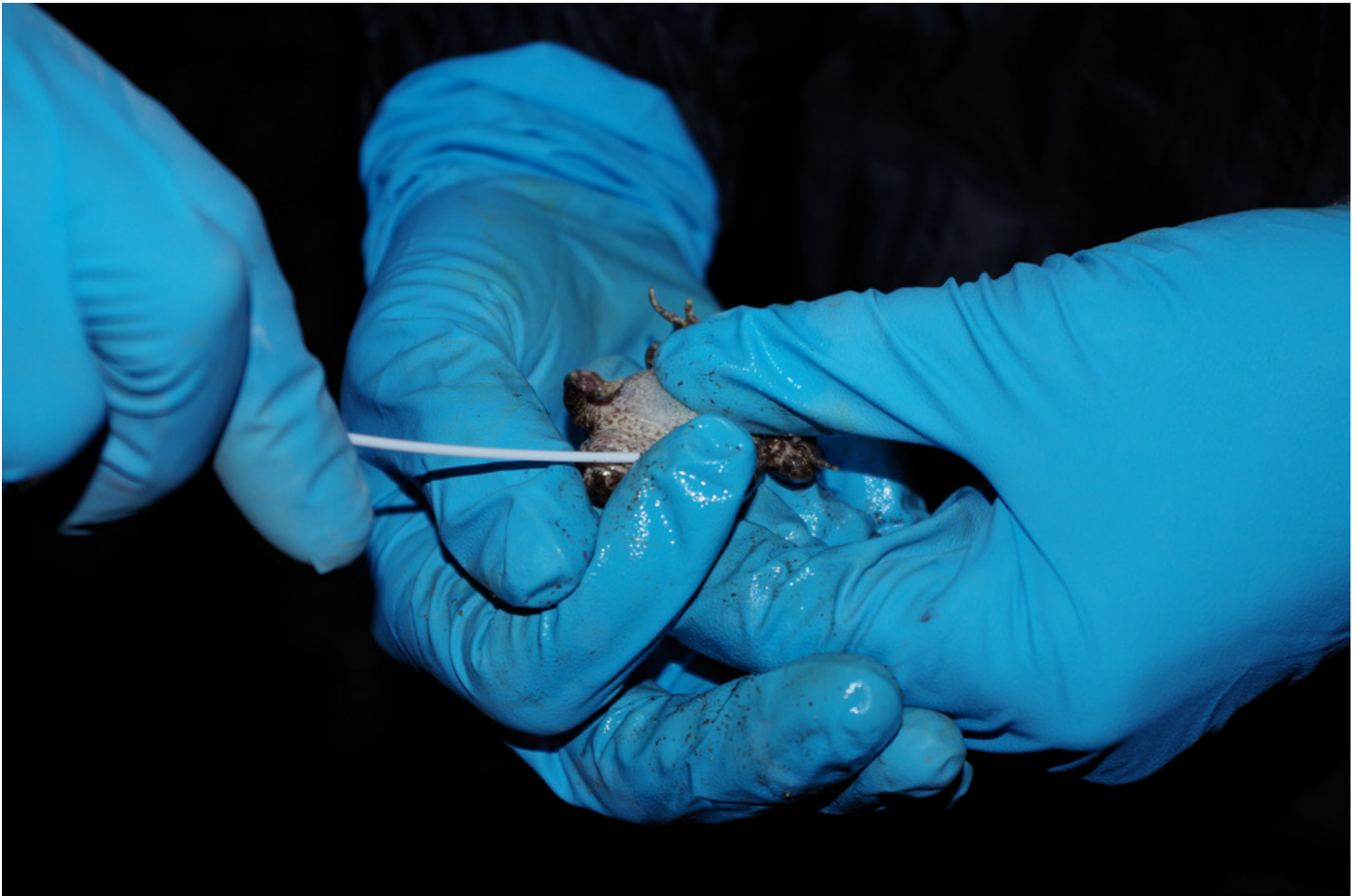


Lac Arlet and *Alytes obstetricans* metamorph sampling. Photo: Mat Fisher.



Jennifer Shelton sampling *Alytes obstetricans* tadpoles in Ibon Acherito. Photo: Mat Fisher.





Monitoring a Non-native Amphibian in Cambridge, UK

By Steven J. R. Allain & Mark J. Goodman

In 2015 we were able to confirm the presence of a population of the non-native Common Midwife toad (*Alytes obstetricans*) in central Cambridge, UK. The population has persisted for at least a decade and we have developed a novel method to be able to locate the toads (1). The toads are currently restricted to the back gardens of a row or parallel Victorian-aged terraced houses (2). Their dispersal is limited due to the fact that the population is surrounded by walls and roads – isolating them unless somebody decides to move them. We've actively networked with the local community to be able to gain access to the gardens the toads inhabit, when the conditions are right to survey. This has led to a small level of community engagement which we hope to build on in future years. Since the early months of 2017, the project has grown with leaps and bounds with more residents allowing us access to their gardens to survey for midwife toads. This is something that we didn't expect!

As a non-native species it's not known what threats the species poses to our native amphibians, this is an area of research which needs to be explored more. Due to the nature of their vastly different life history it is unlikely they'll pose a problem in terms of competition with the local amphibian species. We've found them happily living and breeding (Fig. 1) alongside *Bufo bufo*, *Rana temporaria*, *Lissotriton helveticus* and *L. vulgaris*. The only threat we feel the midwife toads may pose to the native and naive amphibian populations is as a disease vector (3). Since 2016, we've been actively swabbing the midwife toads in an effort to screen them for

the amphibian chytrid fungus (*Batrachochytrium dendrobatidis*). Preventing the spread of disease to native species may be impossible as *A. obstetricans* are the most numerous amphibian species within the study area. This may be due to the fact that they are able to exploit the opportunities better and due to their cryptic nature are less likely to be predated on by cats or other predators.

One of the main aims of the project is to develop a baseline population estimate of *A. obstetricans* as we are currently unaware as to how big the population is, although our current estimates are between 50-100 sexually mature individuals. The initial method of introduction or the size of the founding population is still not known and is another area we wish to investigate further once we've screened more individuals. So far from a limited number of samples we've had analysed the results have been negative for *B. dendrobatidis*. This is encouraging news but a larger sample size is needed to be sure that the toads are not acting as a vector of disease. We'd like to thank the Amphibian and Reptile Groups UK for supporting the analysis of the initial batch through the 100% Fund.

We've also been working to collect morphometric data on the midwife toads to gain a better understanding of their population dynamics. Each individual encountered has also been photographed in order to create a reference database of the population. This method has been used before to re-identify *Alytes* tadpoles (4) and it's hoped we will be able to use this method to count repeat encounters, therefore creating a more accurate prediction of the population size. For the first time this season we were able to identify one



Fig. 1: Common Midwife toad (*Alytes obstetricans*). Photo: Steven J. R. Allain.

of breeding ponds and locate Midwife toad tadpoles of differing age classes (Fig. 2). We plan to swab the tadpoles in the coming months as it's likely now that they will overwinter in the pond.

Another risk the Midwife toads may pose is as a vector of *Rana-virus* (5), although the mass die-offs usually associated with the disease (as well as chytridiomycosis) have not yet been observed. If such die-offs are observed, then samples will be collected for further analysis although at this moment in time it is not a high priority. This is partly down to the fact that we are lacking funds, especially for additional levels of analysis, and there is a lack of evidence for the disease being present. We are hopeful that the toads will be free from chytrid as well but as their origins are not known, they are being screened as a safety precaution.

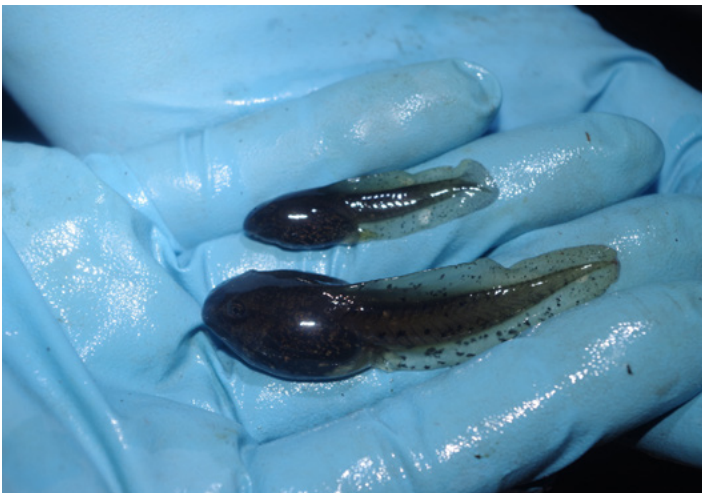


Fig 2: Midwife toad tadpoles. Photo: Steven J. R. Allain.

We successfully crowdfunded the funded needed to sustain the project as it is being increasingly difficult to find grants that are willing to support such a project. This may be due to the uncertain and uneasy global political and economic climate we are currently experiencing, or it may just be bad timing on our part. Our target was \$1500 but we successfully raised \$1706. We'd like to thank all of our backers for their support in this project. With the success of of crowdfunding campaign, all of the samples taken from this year have been sent to the lab for analysis and we are currently awaiting the results.

Keep an eye out for future updates as the project is only just getting started—it has evolved so much over the past two years and may continue to do so.

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Progress in Biobanking Amphibian Species Worldwide for Conservation

By Craig Hassapakis & Howard O. Clark, Jr.

There is no question that cells preserved from endangered animals (somatic and reproductive) will play an ever increasing role in the future of species conservation through proper cryopreservation; as well as providing and documenting species diversity for future generations (1,2). The movement and assembly of these vital resources within collections worldwide are urgently needed. Efforts are under way to initiate programs to collect the world's amphibian species which are threatened with extinction (see Amphibian Survival Alliance and Amphibian Specialist Group, Genome Resources Working Group, Target Areas, Bioinformatics of amphibian genomes and biodiversity preservation of tissues representing all amphibian species: <http://www.amphibians.org/asg/workinggroups/genome-resources/>). The goal is to create a historically permanent record and resource (publicly accessible in sustainable repositories) of bioinformatics and tissue for amphibian species conservation and research. Although research continues in the development of cryopreservation protocols in various laboratories worldwide (3,4) there still is no coordinated effort (5), between research institutions and governing bodies, to undertake the massive task of bringing together plant, animal tissue and cell bio banks at a global scale. A current and excellent review of the state of the world's amphibians can be found here (6) and an accomplished review of current practices, programmatic development and future

directions for cryopreservation of gametes, embryos and larvae of aquatic species can be found here (7).

One developing advancement in biobanking animals is the effort to collect an entire class of vertebrate species. *Amphibia Bank*, is planned to be a network of cell culture and tissue repositories with the goal of collecting cell samples (blood, cell cultures, tissues, spermatozoa, eggs and embryos) representing every amphibian species on earth. An initial pilot project of this effort is the collection of all North American salamander species. Other strategies are being considered for reptiles as well (8).

It is hoped that the scientific community will come together to make these collection efforts a reality and a permanent record of life on earth used for the future benefit of all. It is envisioned that collection and deposition of cell samples worldwide will become routine among researchers, particularly herpetologists, and those with access to specimens (especially those working in the field).

The ambitious task of collecting amphibian genetic material in various forms is finally becoming a priority for the biobanking community. Collection coordinators will need to be assigned to all countries, geographic areas and species groups. If you would like to be involved with these collection efforts or are a leader in biobanking amphibians, please contact us at: genome.resources@gmail.com.



Hydromantes platycephalus. Photo: Howard O. Clark, Jr.



Pseudacris sierra. Photo: Howard O. Clark, Jr.

Acknowledgments

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Ecotoxicological Studies as a Tool on Amphibians' Disease Risk Assessment

By Sara Costa¹ & Isabel Lopes¹

Global environmental changes are having profound impacts on ecological systems (1). The number of species is declining, infectious diseases are emerging and other perturbations as pollution or global warming, are adversely affecting the ecosystems. Amphibians are being severely affected by these changes. However, infectious diseases are the more concerning threat that amphibians are facing nowadays (2). The scientific community is trying to understand which factors could interact to increase this tendency. The risk of disease depends on host's susceptibility and pathogen pathogenicity (3). In fact, environmental changes can contribute to suppress amphibian's immune system, making them more susceptible to disease (4,5). Additionally, pathogenic agents can also be affected and lose their infection ability. Disease emergence depends on which of the intervenient (host or pathogen) is more susceptible to the environmental changes (3,6).

Ecotoxicology can be used as a tool to understand the response of organisms after exposure to a certain stressor. It is a fast way to obtain answers about what is happening and what could happen, allowing to construct case scenarios that could be useful to conservation or for a fast and effective mitigation response in wild.

The project "Ecotoxicological studies as a tool on amphibians' disease risk assessment" aims at use *Pelophylax perezi* as a model organism to understand the risk of disease under metal contamination and salinization scenarios.

One of the specific objectives of this study was to understand the effects that environmental changes may cause on amphibian pathogens. Ecotoxicological assays were performed with the pathogenic agent, *Saprolegnia australis* (Fig. 1), which was exposed to different levels of NaCl, seawater and acid mine drainage (AMD). Radial growth, biomass production, extracellular enzymatic activity and mycelium chemical composition were assessed under control and contaminated conditions.

RESULTS SO FAR

Exposure to NaCl did not affect the radial growth but decreased the biomass production at the highest tested concentrations, though it improved the proteolytic activity. In general, seawater increased the biomass production and enzymatic activity, maybe due to the presence of higher concentration of nutrients. Finally, AMD exerted a strong effect on growth and biomass of the mold (Fig. 2), but did not affect the enzymatic activity. The FTIR-ATR analysis reported, in general, a trend consistent with a decrease in protein, lipids and polysaccharides with increasing concentration of the environmental stressor (e.g. fragile hypha resulting on less production of protein, lipids and polysaccharides).

These results suggest that the tolerance of pathogens to environmental alterations, such as salinization and metals contamination, should be better understood. Since, even if the growth of the pathogen is affected, it may maintain its capacity of tissue degradation in the host, thus keeping its capacity of infection.

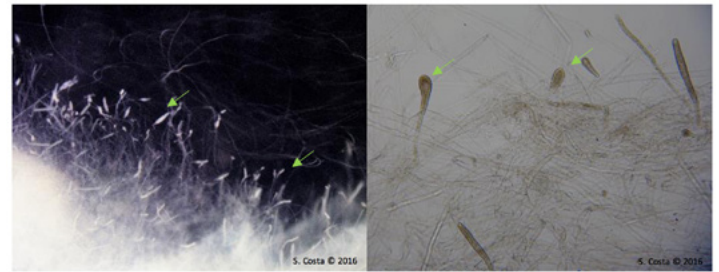


Figure 1: *Saprolegnia australis* mycelium, showing the characteristic whitish cotton like aspect. Green arrows indicate reproductive structures with spores. In a low nutrient condition and under an environmental stressor, this organism releases motile spores.

Photo: Sara Costa.

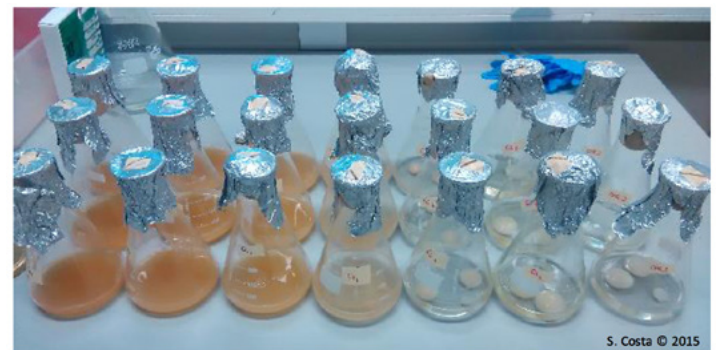


Figure 2: *Saprolegnia australis* biomass assay, under exposure to different dilutions of acid mining drainage (AMD). Photo: Sara Costa.

NEXT STEPS

An Amphibian Survival Alliance Seed Grant was a fundamental starting point, which allowed us to begin the study and embrace a more detailed research that is still on going. Research is now focused to gather a collection of bacteria capable to inhibit *S. australis* and understand if they keep this ability in a contamination scenario.

Acknowledgements

Thanks are also due to FCT/MEC through national funds and FEDER, within the PT2020 Partnership Agreement and Compete 2020 (UID/AMB/50017; PTDC/BIA-BIC/3488/2012; IF/00475/2013; PD/BD/113605/2015)

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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.

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.

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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.

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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.

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