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



SPECIAL EDITION

Tim Halliday: Amphibian Ambassador

Rediscovering Hope for the Longnose
Harlequin Frog

Why We Need More Amphibian-Focused
Protected Areas

Pseudophilautus hallidayi. Photo: Nayana Wijayathilaka.

... and so much more!

FrogLog

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Editorial

Dear friends,

It gives me great pleasure to write the editorial of this very special edition of *FrogLog*. Tim Halliday's name is synonymous with a number of terms—you might immediately think of “*FrogLog*”, or “DAPTF”, while others pair Tim's name with “amphibian declines” and “newt courtship”, and as you'll read about in this edition, still others link his name to “extinction biologist” or “red shoes” or even “I'm sorry I missed your talk”! Whatever your reason for being familiar with the name Tim Halliday, it is without doubt that he has made a massive contribution to amphibian behaviour and amphibian conservation—he is the leading champion and ambassador for all things amphibian.

I first became aware of the name T. R. Halliday through a shared passion—toads! As many of you will know I have an inordinate fondness for toads, mainly in the genus *Bufo*, but several other genera such as *Ansonia*, *Atelopus*, *Melanophryniscus*, *Rhinella* are some of my favourites too! My Ph.D. on frog behaviour was dedicated to my ‘familiar’, a stunning *Bufo bufo* (aka Gertrude), who accompanied me on many field trips for nearly 15 years. Tim's seminal paper entitled “Deep croaks and fighting assessment in toads *Bufo bufo*” published in *Nature* in 1978 made me realise that my early career in tropical parasitology was misguided, and my true desire was to be like Tim and study the behaviour of toads. I do not exactly remember when I first met Tim, but our paths have crossed many times and in many different places around the globe, at the First World Congress of Herpetology in Canterbury; in South Africa where I did my Ph.D. on frog behaviour; in New Zealand and more recently, several visits to his house in Oxford. Through good fortune in 1980 I ended up studying frog behavioural ecology in Neville Passmore's lab in South Africa and shortly after hearing what Tim and others were saying at the 1st World Congress of Herpetology in Canterbury 9 years later, I felt the need to investigate potential amphibian declines in southern Africa so I initiated the Southern African Frog Atlas Project.

Fast forward to 2011 when I was appointed as the Chief Scientist of the then newly formed Amphibian Survival Alliance (ASA) and Tim was one of the first people I felt I needed to consult with to get a really good grasp on the global amphibian conservation crisis. Over the intervening years I have had the privilege to visit Tim and his lovely wife Carolyn, marvel at Tim's amazing artwork (many pieces now adorn the walls of my home and office), share some great meals, wine and even some TOAD gin (TOAD stands for The Oxford Artisan Distillery—Oxford's first ever gin and it seems so appropriate that Tim has a gin called TOAD in his very own home town, spiritoftoad.com)!

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Phil Bishop

*Co-Chair, IUCN SSC Amphibian Specialist Group
Chief Scientist, Amphibian Survival Alliance*

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Tim Halliday(left) and Phil Bishop (right). Photo: Phil Bishop.



Tim Halliday attending the Society for Research on Amphibians and Reptiles (SRARNZ) meeting hosted in Dunedin, New Zealand by Phil Bishop in 2007. Photo: Phil Bishop.



Reflections on the DAPTF

By Tim Halliday

If only we had called ourselves TOAD (Task Force on Amphibian Declines), I would not have had to spend several years of my life apologizing for having the worst acronym in the conservation world. Our lack of imagination may have contributed to the fact that it took some time to establish the Declining Amphibian Populations Task Force's (DAPTF) identity.

For most of my career, I had studied sex and violence in amphibians: the extraordinary courtship of European newts and the way male toads resolve very lengthy but quite harmless disputes over females. I well remember spending an afternoon at my office desk, drafting an application for funds to do a project on whether female newts, who mate with several males, have last- or first-male paternity. As I added up what at that time was a huge budget I totted up how many people in the world might be interested in the answer. The list came to three. More importantly, I checked again how many newts I was planning to sacrifice. A glance at my office wall showed me one of Michael and Patricia Fogden's wonderful images of Golden Toads, which had just gone extinct. I resolved never to kill, or even toe-clip, another amphibian.

Fund-raising is not my forte and the DAPTF always struggled for money. We sought to maximize the value of what money we had by awarding small Seed Grants of around \$2000, primarily to young researchers. Between 1992 and 2006 we awarded nearly \$300,000 in 155 grants to applicants in 46 countries. I was amazed by the ability of our grant recipients to produce useful results on such meager resources; most produced at least one paper in a refereed journal.

Surely the biggest change that has taken place in the world of amphibians is in the sheer number of species that we now know

about. In 1986 when I published *The Encyclopedia of Reptiles and Amphibians* with Kraig Adler there were 4015 known species. As I write, AmphibiaWeb lists 7,941, a figure that increases almost every day. Recently I was given the opportunity to mine this treasure trove, when asked to write *The Book of Frogs*, a fat tome containing detailed accounts of 600 species. This brought home to me how little I actually knew about the strange, complex habits of many of the world's amphibians. It also suggested to me that there is something individuals like me can do to alert the world to the plight of frogs and other amphibians. I have also tried to do the same through my art, which entered a new phase very recently. Under treatment





group that they once were, they still face the enormous challenge of habitat loss. A neighbor recently moved away, leaving a tiny garden pond in which, over some 20 years, a small breeding population of frogs had established itself. One afternoon a fat man on a tiny bulldozer arrived and the pond had vanished in 20 minutes. Amphibians characteristically live in small ponds and streams, habitats that, unlike lakes and rivers cannot be protected by local laws and international agreement. Such habitats are so easily destroyed by carelessness, mindless vandalism and a simple lack of regard for nature. They are also, in terms of diversity, one of the richest habitats, so that working to protect amphibians also enhances the prospects of countless plants, insects and other creatures.

In *FrogLog* 69 (2005) I upset some people by describing myself as an extinction biologist rather than a conservationist. I was being too depressing and defeatist. My views on this remain much the same, however. The vast scale and momentum of the decline in all forms of life is beyond our ability to do little more than save the occasional species. I believe our primary objective as amphibian biologists is to discover, describe and record as much as we can about these wonderful creatures before they vanish forever.

Artwork by Tim Halliday. To view more, and to purchase prints and cards, please visit <http://www.hallidayfarndon.co.uk/amphibians.html>.



for a rare form of lymphoma, I found myself obsessively painting, especially the most colorful frogs I could find. The steroids that are part of many cancer treatments are known to induce 'steroid euphoria', defined as a sense of wellbeing that is 'inappropriate' to improvements in physical health. We have recently exhibited these pictures and raised a surprisingly large amount of money for research into lymphoma.

For many years, I tried to persuade the BBC to make a programme about amphibians, only to be told that the viewing public did not find them attractive. Eventually, David Attenborough embarked on his series *Life on Earth* and had to include a program on amphibians, for which I was a consultant. It was, of course, a huge success; very few people had any idea that salamanders and frogs were so interesting and so beautiful.

While books, TV programs, websites and art have done much to ensure that amphibians are no longer the neglected and ignored

Newt Scientist

By Richard A. Griffiths¹

The first proper scientific article on amphibians that I ever read was written by Tim Halliday. It was a Friday afternoon in 1974, and I was in our school library trying to write a particularly tedious essay for our English master. Seeking distractions, my eyes wandered to the rack of journals that the library had received that week and fell upon a particularly fetching photo of a Smooth Newt that was adorning the cover of *New Scientist* magazine. As a budding herpetologist that, until then, had been raised on the works of Malcolm Smith, Alfred Leutscher and Maxwell Knight, I was intrigued and turned the pages. Inside was an article entitled “The profligate private life of the newt” by a young researcher from Oxford University by the name of Tim Halliday. I was hooked. The article showed that there was clearly a lot more to the curious chasing and tail fanning that I had been puzzling over in the newts that I had netted from the local pond and was now observing in a tank in my bedroom.

Roll the clock forward several years, and through a series of fortuitous breaks I was now carrying out research on amphibian behavior myself. I found that I was increasingly drawing on the research outputs from Tim and his flourishing group of students. Indeed, Tim was instrumental in founding the TRITURUS network of newt researchers. This informal group met several times during the 1980s to exchange news and ideas about anything to do with newt research. These meetings were always at delightful locations with a strong social programme fuelled by good beer and wine. Friendships and collaborations were formed at those meetings that still endure today. Like many other scientists who started their careers doing academic research, by the 1990s Tim was becoming increasingly concerned about the conservation status of amphibians. As a global leader in the field, he was therefore, well-positioned to help found the first global initiative to tackle the issue—the Declining Amphibian Population Task Force (DAPTF). With limited resources, DAPTF punched well above its weight in drawing the disparate network of amphibian conservation researchers together through its newsletter, *FrogLog*, and its associated small grants scheme. Indeed, without DAPTF, we would not have the Amphibian Survival Alliance or the Amphibian Specialist Group today. Pragmatism has always been a hallmark of Tim’s research, and he often argued that in trying to do amphibian conservation we were often failing to learn the lessons from declining populations. We had a duty to learn from past mistakes, and controversially, he suggested that the term ‘extinctionist’ would be



a better term than ‘conservation biologist’ as the field was effectively about researching the process of extinction.

There is another reason why I can so vividly recall Tim’s article, and that is because it got me into trouble. Noticing that I had made little progress with my essay, my English master inspected the source of my distraction. Whilst musing on the contents of Tim’s article, I had doodled on the cover of the magazine, and ‘New Scientist’ had now become ‘Newt Scientist’. I was reprimanded for defacing school property, ordered to purchase a replacement copy, and told in no uncertain terms that I would never make a career studying newts. However, there is little doubt that Tim’s research helped propel me to become an amphibian biologist, and the ‘modified’ copy of the magazine founded my now extensive collection of papers on newts.

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Tim Halliday—The Red-Shoed Amphibian Professor

By Jean-Marc Hero^{1,2}



Jean-Marc Hero, Tim Halliday and Carolyn Halliday in the Halliday's garden July 2017. Photo: Jean-Marc Hero.

It is an absolute pleasure to write about my good friend and colleague Professor Tim Halliday who dedicates his life to promoting and supporting amphibian conservation efforts around the world.

I will always remember our first meeting—he was (and still is) the Professor in *Red Shoes*—as that is how I always saw him, wandering around the corridors of the World Congress of Herpetology or other scientific meetings enthusiastically talking about amphibian conservation wherever he went.

In 1994 he became the Executive Director of the Declining Amphibian Task Force sharing knowledge and supporting amphibian scientists and providing Seed Grants for students around the world.

An extraordinary dedication is Tim's listing of amphibian research publications that he had read and listed each month since the 1990's. This meant that whenever he met you at a conference or at his home he would quiz you on your recent papers and what they meant for amphibian biology and conservation. It started as "Publications of Interest" in the DAPTF *FrogLog*, and continued as a monthly reference list on the AmphibiaWeb site until July 2018—and remains as an invaluable resource for amphibian biologists around the world. That is, a monthly commitment for over 20 years, and an excellent example of how Tim has always demonstrated a genuine culture of inclusion to collaborate with, foster, mentor and support those who enter his wide circle of influence. Academic competition is not considered, as scientific research that contributes towards our understanding of amphibian biology and the conservation of amphibians has always been his undeterred goal, and through this dedication, he has attained the respect of herpetologists around the world. I am one of many who is sup-

ported and enriched by Tim's generosity.

Tim has authored numerous books that will inspire amphibian and reptile enthusiasts for decades to come. The breadth and depth of knowledge is astounding, covering whole taxa (Birds, Reptiles and Amphibians) and entire fields of biological research including books on Natural Selection, and Animal Behaviour. More recently his focus has been on amphibians with an Encyclopedia of Reptiles and Amphibians, followed by *The Book of Frogs* profiling 600 species of frogs! Tim is one of few dedicated amphibian biologists who lives, writes, draws, paints, and breathes frogs.

A simple measure of his character is the dedication to conserving amphibians and conserving our planet. Tim regularly attended WCH and other scientific meetings until he decided he could no longer justify burning the carbon required to fly around the world; so he stopped!

Recently he has bunkered down in his Oxford home, surrounded by frogs in the garden ponds and a range of fascinating frogs in aquaria, producing a constant stream of amphibian legacies including his latest series of drawings and paintings that epitomize the color and beauty of the Class Amphibia. Behind many great men is a great woman, and Tim has always been strongly supported by his beautiful wife Carolyn who always welcomed us with delicious home cooked food and a glass of good wine to wash it down, followed by long discussions in the garden.

A big thank you to Tim who continues to inspire amphibian scientists through his research, artwork, books, and intellect. It has been a great honor to share the decades of your success and to prosper from your prodigious contributions to amphibian research and conservation.

Artwork by Tim Halliday. To view more, and to purchase prints and cards, please visit <http://www.hallidayfarndon.co.uk/amphibians.html>.



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Bringing Worldwide Amphibian Declines into the Public Domain

By Mandy Dyson

I first met Tim at the First World Congress of Herpetology in Canterbury in 1989, almost 30 years ago. It was my first international conference and to meet Tim was to meet a hero. I had just finished writing my Ph.D. on sexual selection and social behavior in the Painted Reed Frog (*Hyperolius marmoratus*) and my research had been hugely influenced both by Tim's ideas about sexual selection and, more specifically, by an article he wrote for *Nature*, titled "Do frogs and toads choose their mates?" Meeting Tim was great fun: right from the start, it was obvious that he was unpretentious, deeply iconoclastic, insightful, and with a great appreciation of the humorous. He also had the ability—first seen then but subsequently frequently corroborated—to seemingly sleep through a talk only to rouse himself and ask a disconcertingly penetrating question.

At Tim's invitation, I worked with him and Sarah Bush (now at the University of Missouri) on mate choice in Mallorcan Midwife Toads at the Open University (the breeding program at the OU was part of the Mallorcan Midwife Toad Recovery Program). Following this, I moved to England in 1995 to take up a position in the Biology Department at the Open University, and so, ended up not only as a good friend and collaborator but also as a colleague of Tim's.

Tim first came to South Africa with me in 1995 to participate in a season-long project on mate choice in small Reed Frog choruses. As this work was conducted on a backyard, suburban population, directed from a veranda, it offered an ideal opportunity to mix empirical work with pleasurable and wide-ranging conversation, a

hallmark of working with Tim. Besides being genuinely interested in the theoretical issues surrounding the evolution of behavior and communication in amphibians (and other animals), Tim has always been delighted to see and handle the animals—I can still see him peering over the top of his glasses to get a good look at whatever frog he was holding.

Tim subsequently visited South Africa on a number of occasions. On one trip, we went to Kruger National Park and decided one night to look for Foam Nest Frogs (*Chiromantis xerampelina*). We were told that the best places to see them were at the rubbish dumps at the campsite. So off we went to find the frogs breeding like mad and really kicking up the foam. We had a great time watching them until a hyena sniffed my leg and I took off at a million miles an hour back to the car. Tim was phlegmatically British and wanted to go back out to watch the frogs, but I wouldn't budge. We also spent time successfully looking for African Bullfrogs (*Pyxicephalus adspersus*) just outside Johannesburg, and down in the southern Cape, accommodating his interest in Ghost Frogs (*Heleophryne*) and visiting his daughter Jo, who was helping out on a baboon project at the De Hoop Nature Reserve.

After the 1st World Congress, it was becoming evident that amphibians were declining at an alarming rate worldwide. DAPTF (The IUCN Declining Amphibian Task Force) was established and Tim became its International Director, serving from 1993 until 2005. During that time, and subsequently, in addition to running the task force, he produced scientific papers on amphibian disease

and declines, published articles in newspapers, and has been repeatedly interviewed. In so doing, he has really brought the problem of the worldwide amphibian declines into the public domain. Tim has also written a number of books, and book chapters, on amphibian behavior, evolution, and the threats facing amphibians. His latest book, *The Book of Frogs*, celebrates the diversity of these irreplaceable animals. The book is a testament to Tim's deep appreciation and fascination with the astonishing array of forms, behaviors, and adaptations that can be found, not only in amphibians, but in the natural world.



Tim Halliday holding an African bullfrog (*Pyxicephalus adspersus*). Photo: Mandy Dyson.

Of Newts and Frogs

By John Baker

I first met Tim when I applied for a post-graduate research position at the Open University. The University is based in Milton Keynes, yet my interview was at an Oxford address. My preparatory research revealed that the Open University also had some premises in Oxford—and it was here that I presumed I was heading. I was puzzled when my journey took me to the mellow, brick homes of north Oxford. I'd obviously got the wrong address, so when the door opened I asked uncertainly, 'I'm looking for Tim Halliday?' A dapper figure with a booming voice replied, 'You'd better come in then'. Still wondering whether I had the right address and who this man was, I entered the beautiful home of Tim Halliday and the start of ten years working together.

The Open University pioneered distance-learning and was established with the aim of extending educational opportunities beyond the conventional higher education system. Tim very much supports those educational values and used his excellent written communication skills to produce highly effective course materials covering ecology, evolution and behaviour. He also headed a vibrant research group pursuing a shared interest in amphibians and sexual selection. Co-workers he brought in to the Open University included Begoña Arano, Peter Henzi, Sarah Bush, Marion Petrie and David Sever. Tim encourages communication among academics and at conferences took care to introduce his students to his extensive network of international contacts.

It is well-known that Tim, along with Kraig Adler, was instrumental in organizing the First World Congress of Herpetology, held in Canterbury, England, in 1989. But the World Congress was not the only conference Tim established. Earlier in the 1980s he set up the *Triturus* biennial conferences. These were aimed at networking those working on the European newts (which prior to more recent taxonomic changes belonged to a single genus of eight species). The *Triturus* conferences were specially aimed at new researchers, not only allowing them to share ideas but also creating a friendly environment where they could gain experience of presenting their work to an audience. The European-wide distribution of the newts meant that we were hosted in some beautiful locations including the mountains of Calabria, Italy, and Segovia, Spain, the Dombes wetlands of France and a castle in Austria.

Returning to the First World Congress, my more minor role was to produce the conference abstracts volume, with another of Tim's students, Lottie Hosie. (Somewhere in there is a submission tracking the herpes virus—we advised the researcher of his error but kept the submission for entertainment value. Does no one read these things?). The World Congress itself had consequences for my further work with Tim. I was inspired by a presentation by Per Sjögren, which introduced me to the concept of metapopulation ecology, exemplified by his studies of Pool Frogs *Pelophylax lessonae* at the northern limits of their range in Sweden. It sounds naïve to



Triturus IV at Valsain, Spain. Photo: John Baker.

admit this, but the work of amphibian ecologists I had met up to that point was focussed on their single study ponds, largely overlooking the influences that neighbouring populations might have. With this insight Tim and I investigated ponds newly created on agricultural land, looking at the factors affecting amphibian colonisation, especially the inter-pond distances that could be covered by amphibians to ensure movement between sub-populations.

The First World Congress is where experiences of amphibian declines were compared and from this the Declining Amphibian Populations Task Force was established. This, too, had consequences for me—as, several years later, the Task Force office was moved from the USA to the UK at the same time as our work on farm ponds was ending, so I fell into the job of DAPTF coordinator, working with Tim until 1996.

It was during my time working with Tim that I began monitoring amphibian populations. The Open University was built around an existing building, Walton Hall, a 17th century manor house. Between the modern library building and a Church that presumably belonged to the manor house was a large pond supporting Great Crested Newts. I had read the work of Torkel Hagström, from Sweden, who had photographed the patterning on the underside of newts to identify individuals, enabling him to study their population ecology. I wanted to have a go at this myself. I didn't have any research questions—I was simply intrigued by the possibility that individual amphibians could be identified this way. The University's estates department was less enthusiastic. Any proposal that included plans to 'trap' animals raised concerns about animal welfare and how such activity might be regarded by other well-meaning University employees. Tim not only fought my corner but gave me the flexibility to pursue the monitoring when I should, more strictly, have been doing other things.

Long-term population monitoring does not mesh well with a typical research program. Most (all?) research funding covers only a few years—insufficient time to get a meaningful handle on population change. In a recent conversation with Tim we were both amused by the irony that even with the perseverance needed for the long run, data return per year is likely to result in a publication rate so low as to be disastrous to a conventional, competitive academic career. In spite of this, we both recognize that long-term studies are critically important to assessing conservation status (e.g. analyses of time-series from the Living Planet Index).

Several things have come full circle for me. I have been fortunate enough to pursue my passion for amphibian field work—for the past 14 years I have been monitoring a population of Pool Frogs as part of the program to reintroduce the species to England. The donor population was from Sweden, where Per Sjögren studied their metapopulation

ecology. And I use essentially the same individual identification techniques as I did for the Great Crested Newts at Walton Hall (although back then, prior to compact digital cameras, I used to record ventral patterns on the departmental photocopier—preferably early in the morning to avoid any queues). I have very fond memories of my time at the Open University and working with Tim. The departmental buildings were modern and utilitarian but Tim had put his personal stamp on his office. He joked about the choice of a tidy mind or a tidy office, and opted for the latter, with an uncluttered desk, extensive but tidy bookshelves and a highly organised reprint collection housed in numbered box files—a resource he generously shared with co-workers. He had trained a Bougainvillea over much of the window so that sunlight entered the room through a living canopy. I am sure that Tim's other co-workers will agree that he created a comfortable research environment, epitomising its best values of collegiality, communication and stimulation.

Artwork by Tim Halliday. To view more, and to purchase prints and cards, please visit <http://www.hallidayfarndon.co.uk/amphibians.html>.



Professor Tim Halliday: Amphibians' Best Friend

By James B. Murphy¹



When amphibian biologists began comparing notes about mysterious declines in their study populations at the First World Conference of Herpetology in Canterbury UK in 1989, there was a consensus that something needed to be done to identify the causes. Some herpetologists believed that these changes were due to normal population fluctuations while others were concerned that something sinister was happening. Tim Halliday was at the forefront in helping to guide the community to be proactive in identifying and solving the causes. And so the Declining Amphibian Populations Task Force (DAPTF) was formed under the umbrella of the IUCN Species Survival Commission; Tim and I were asked to be on the board and we were involved for 16 years until the organization morphed into the scientific arm of Amphibian Survival Alliance (ASA).

Tim's commitment to protecting amphibians was extraordinary, evidenced by being chosen to be the DAPTF International Coordinator. The office was housed at Open University in Milton Keynes UK where he was a professor. His output was impressive. He oversaw the highly successful DAPTF Seed Grants program to assist researchers, especially in developing countries. He was proud that each grant generated up to twenty times the amount in outside grants by using the DAPTF involvement as a selling point. Tim also produced *FrogLog*, instrumental in alerting the world to the worldwide challenges faced by amphibians.



Pseudophilautus hallidayi. Photo: Nayana Wijayathilaka.

His scientific output has been most productive and there have been important books and papers. Examples are books entitled *The Encyclopedia of Reptiles and Amphibians* (with Kraig Adler), *The Book of Frogs: A Life-Size Guide to Six Hundred Species from around the World*, and *Smithsonian Handbooks: Reptiles and Amphibians*. He is a skilled artist.

As the situation for amphibians deteriorated, many herpetologists believed that the end was near and the planet was facing a Sixth Mass Extinction event. I remember an evening when Tim and I were having a few beers and he said that he was no longer an amphibian biologist but had become an extinction herpetologist. Another colleague, Joe Mendelson, now calls himself a "forensic herpetologist."

When Tim and I met each year at the DAPTF Board meeting, we were disappointed that our fundraising efforts were so paltry—the DAPTF barely survived monetarily and we were confused that amphibian conservation was rarely mentioned or supported by institutional and private funding agencies. Some funds, however, were acquired through the zoo and aquarium community and private contributions. One example was the annual provision of funds by Detroit Zoological Institute to produce *FrogLog*. An anonymous private benefactor supported the bulk of our operating expenses; when the DAPTF was closing down, the operation was in the red for \$100,000 US and declaring bankruptcy was a real possibility. Tim contacted our benefactor and pleaded that it would be horrible if our organization ended, unable to pay its debts; Tim was successful and we were all relieved when the check arrived.

Halliday was instrumental in broadening the scope of amphibian research to investigate disease, climate changes, chemical contaminants, human destruction and alteration of habitats, ultraviolet radiation, and a host of other deleterious factors. Now almost all new books on amphibians include a chapter on conservation.

In 2005, Madhava Meegaskumbura and Kelum Manamendra-Arachchi published a paper entitled "Description of eight new species of Shrub Frogs (Ranidae: Rhacophorinae: *Philautus*) from Sri Lanka." In it, *Pseudophilautus hallidayi* was described [The Raffles Bulletin of Zoology 2005 Supplement No. 12: 305–338] —In the Etymology paragraph – "The species name, in the Latin genitive singular, is a patronym honouring Timothy Richard Halliday (b. England, 1945), since 1994 International Director of the IUCN/ SSC Task Force on Declining Amphibian Populations (DAPTF), recognizing also his three decades of research on amphibians and his exceptional commitment to advancing our understanding of the global amphibian decline crisis."

The biological and conservation communities hold Tim in high esteem. He is a valued colleague and friend and I am pleased to recognize his accomplishments in this public way.

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Researchers attending the 1986 Triturus Newt Conference at Ambleuse, France; and exploring local ponds along the coast for amphibians. Tim is in the bright blue shirt to the right. Photo: C.J. Raxworthy.

Tim Halliday's Love of Amphibians

By Christopher J. Raxworthy

Tim Halliday has always been passionate about amphibians. When I first met Tim in 1985, he had already devoted all of his professional career to studying the behavioral biology of newts and salamanders, and had written many influential scientific papers about them. At this time, I was just starting my PhD research, being advised by him at the Open University at Milton Keynes. His lab was an incredibly exciting place to be, and one of few places in the UK where Herpetology was taken seriously. We had rooms packed with aquaria filled with beautiful displaying newts, and Tim and his research group of technicians, students, and postdocs were always ready to discuss any aspect of amphibian behavior or the very latest exciting theoretical developments. And yet Tim also had two other passions with amphibians. One was the way they looked, and he loved drawing and photographing them. But secondly, he was becoming more and more concerned about their long-term survival. In his office, he had prominently displayed a picture of the Golden Toad (*Incilius periglenes*). This, of course, is a beautiful frog with striking sexual dimorphism in coloration, and I remember talking to Tim at length about this feature. But by 1989 his biggest interest was in their survival, and he was becoming increasingly concerned about the reported decline in the single known population, and then the complete lack of observations. We now know that the species would never be seen again after 1989, and indeed is now considered extinct. This was also during a gloomy time when many other tropical frogs were disappearing, often mysteriously in apparently pristine habitats; and more locally in the U.K., when ponds were still being lost, and amphibians were in obvious decline.

At this time during the early 1990s, it would have been so easy for Tim to have simply continued working only on amphibian behavior and biology. But instead, he put a big part of his passion and energy into understanding and solving the global amphibian crisis. Looking back now, it is obvious to see Tim as a true visionary for

the growing amphibian conservation movement during these early years. He became the International Director of the Declining Amphibian Populations Task Force (which became based at the Open University), and with the help of John Baker and then John Wilkinson serving as International Coordinators, published *FrogLog* and coordinated conservation efforts during many critical years.

Although Tim has studied and worked tirelessly to conserve amphibians over his entire career, he has also managed to maintain his unique and infectious enthusiasm for them. Whether it is describing the delicate beauty of a male newt tail fanning, or his excitement of discovering that there are frogs that brood eggs in hip-pockets (*Assa darlingtoni*), he has always been so good at communicating and motivating people to take conservation action for amphibians. His hard work has given so much back to the amphibians that he loves.



Artwork by Tim Halliday. To view more, and to purchase prints and cards, please visit <http://www.hallidayfarndon.co.uk/amphibians.html>.



“There once was a frog from Sri Lanka...”

By Jeanne McKay

I first met Tim when I was interviewed for the position of International Coordinator for the Declining Amphibian Population Task Force (DAPTF). His reputation for offering unvarnished opinions on any subject and not suffering fools preceded him. As a recent DICE postgraduate, I was prepared for an intense herpetological reckoning. Instead, I found myself engaged in an erudite conversation with a most charming individual, wearing a jaunty pair of red shoes—which I later learned he resolutely wore for all occasions, including up an enormous sand dune in South Africa.

Tim’s office was filled with plants and various drafts of his deft illustrations of countless amphibian species which graced the covers of DAPTF’s esteemed newsletter *FrogLog*, that to this day I still miss producing ‘old school’ with him. We also contributed to various other publications together; the seminal *Amphibian Conservation Action Plan* and *Threatened Amphibian Species of the World*—even one on Mallorcan Midwife toads for the “Handbuch de Reptilien und Amphibien Europas” that he assured me with a characteristic twinkle in his eye was well received. Working with Tim was both educational and inspirational. When it came to the DAPTF Tim was as much a champion of young researchers (who were often applying for their first grant and had never written a research article until doing so in *FrogLog*) as he was for supporting well-established researchers—all working in countries around the world where the quick distribution of seed funds could go a long way to support ongoing and often groundbreaking amphibian research.

Although more of an aquatic salamander aficionado, at the 5th World Congress for Herpetology in Stellenbosch, South Africa, Tim introduced me to the marvels of *Breviceps*. Upon being presented with my first live specimen, I expertly blurted out, “It looks just like a cranky meatball!” Pretty soon the moniker ‘meatball frog’ spread, and we began receiving all kinds of imagery of the species arranged in ‘artistic’ positions with numerous types of pasta—all to Tim’s delight—especially considering his particular research interests. He later had a strikingly life-like one made for me as a parting gift when I left to help transition the DAPTF into the newly forming IUCN Amphibian Specialist Group.

Christmas parties with the Hallidays were unrivaled. I still remember arriving at his gracious Oxford home with my (now) husband. Tim’s charming wife Carolyn opened the front door widely and wearing a strand of (lit) Christmas lights draped elegantly across her neck, beamed at the two strangers standing awkwardly on her doorstep as if she had known us for ages. The following year, we found ourselves convivially gathered in their kitchen attempting to create a limerick to go with his recently bestowed honor of having had a newly described species named after him, *Philautus hallidayi* (<https://www.amphibians.org/wp-content/uploads/2011/08/Froglog70.pdf>). It went something like, ‘There once was a frog from Sri Lanka, named after a right old...’ we stopped there. Tim of course, did not. It remains my great honor to have Tim both as a mentor and a friend.

Leading by Example

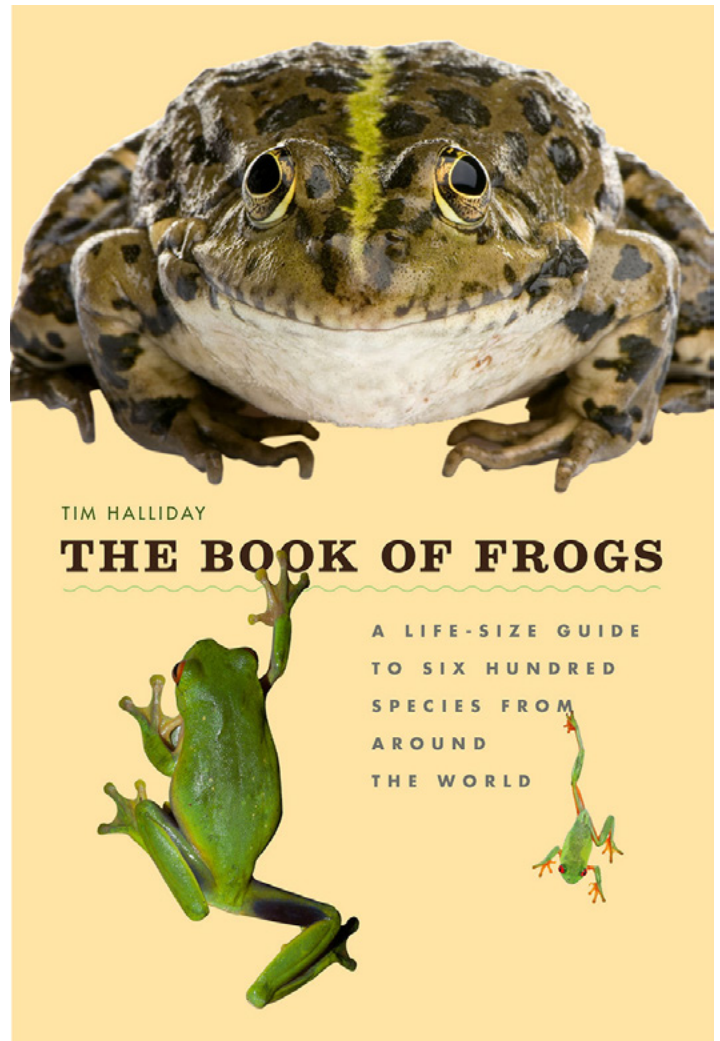
By Mike Lannoo

It was around 1981—37 years ago—that I first corresponded with Tim Halliday. I was looking for Ph.D. mentors and Tim was featured prominently in the Animal Behaviour Society’s guide to graduate programs. It’s funny to me today that I don’t remember actually meeting Tim—it was natural—but it must have been around 15 years later, at one of the many amphibian decline conferences held at that time. Maybe our most memorable meeting was when Tony Gamble hosted Tim in Minnesota, and their trip to the infamous Ney Pond aligned with a sampling visit Dan Sutherland, Josh Kapfer, and I had arranged as a component of our state-wide survey of the hottest of Minnesota’s malformed frog hotspots. Cindy Reinitz, the schoolteacher whose class had discovered the malformed frogs at this pond, met us there.

After we analyzed our survey data, Sutherland, a classically trained parasitologist, and I were able to show that Minnesota’s frog malformations had many causes—including both the direct and indirect effects of pesticide and nutrient contaminants found in agricultural runoff. We also showed that in almost every case, the host wetland was altered—either it was an artificial construction, or it was natural but had been severely degraded through human activities. We suggested that to fix the frogs you had to fix the habitat, and we offered the best way to fix the habitat was to control agricultural runoff. But, of course, the malformed frog problem was in fact, a malformed frog phenomenon—a social issue as much as it was a science issue. Everybody wanted a silver bullet: journalists wanted a “the single cause” story that would sell; scientists wanted a “the single cause” story that was fundable. Nobody wanted a habitat story; habitat is not sexy.

Except Tim.

Tim didn’t mind *not sexy*. He understood habitat and immediately grasped our data, bought our conclusions, and understood why others did not. As the rancor around malformed frogs increased, then fizzled (because, indeed, there was no silver bullet), Tim and I transformed from acquaintances into colleagues. We once spent a wonderful afternoon at the Cosmos Club in DC, just talking and laughing. A few years ago, I consulted during the early stages of



Tim’s *Book of Frogs* project, and we’ve recently co-authored a paper (1). I have a drawer full of his amphibian art cards, which I save for special occasions. Tim’s imagery is so beautiful and so unique that the recipient immediately understands how special I consider the occasion, and how much I care for them.

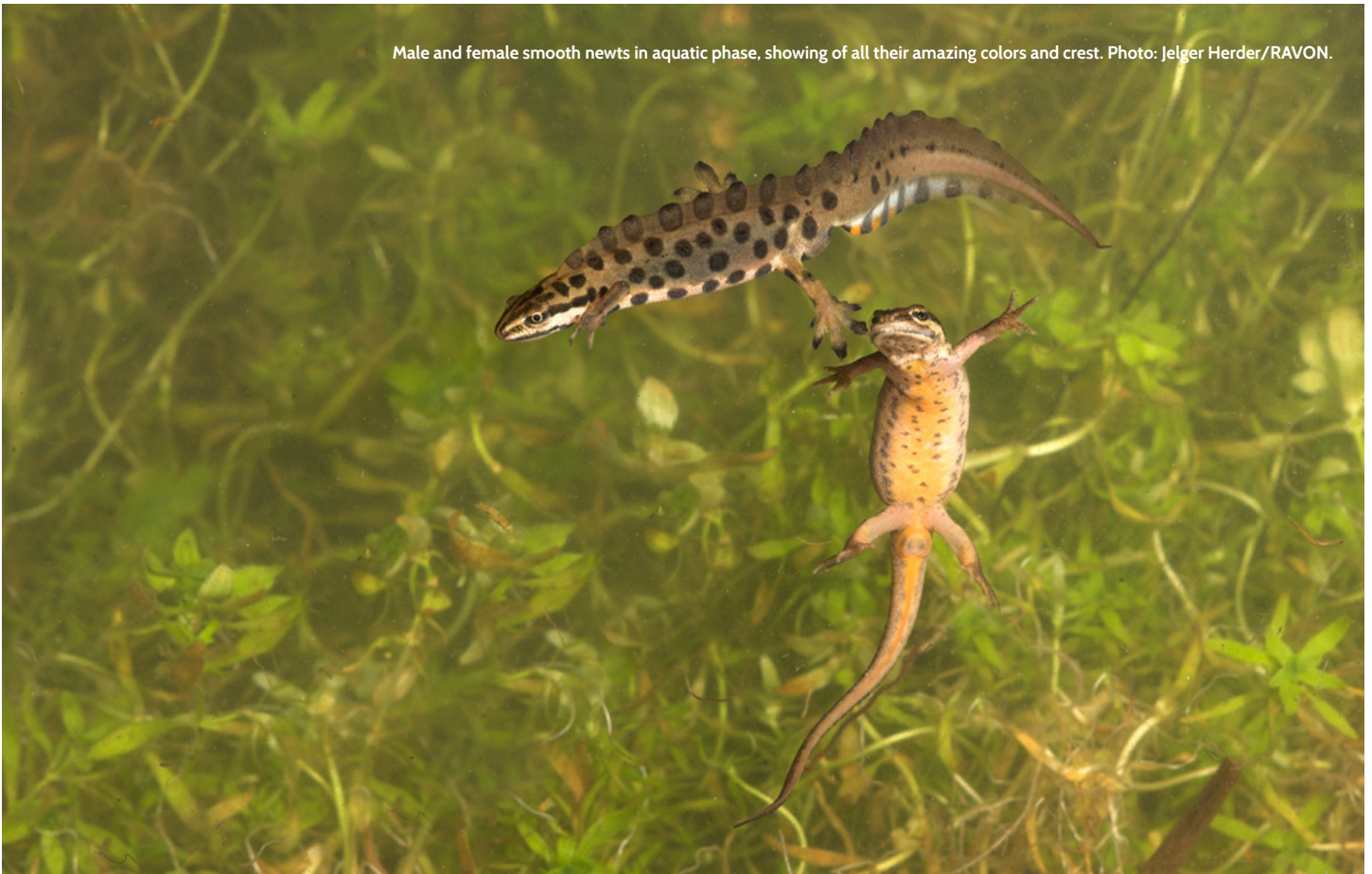
I can’t send one of Tim’s card to Tim, but I hope he understands this sentiment. I don’t know how many times I’ve come to depend on him, both as a scientist and a confidant. He has always led by example, and through his experiences and insight, has shown us amphibian biologists the way. As for me, when the shitheads start to circle over here, just across the pond, over there, I know I can always depend on the perspectives and wisdom of Tim Halliday.

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Tim Halliday, Cindy Reinitz, and Mike Lannoo at Ney Pond, ca. 2000. Photo: Mike Lannoo.



Fish Became Newts...

By Paul Verrell¹

I joined Tim's lab at the Open University in 1979, with no exposure to amphibians beyond pickled specimens in undergraduate zoology labs. I wanted to study reproductive physiology and behavior, and Tim was looking for a grad student who was interested in these topics in fish. But the Fates conspired! Fish became newts, physiology got dropped, and behavior became the influence of sexual selection on the evolution of courtship. Tim is a wonderful artist, of course. I shall not forget how he described my own drawings of courting newts – slugs! Despite that, I stayed with Tim until 1986, completing a postdoc after getting my Ph.D. Tim's lab was never big during my time with him: me, Julie, Verina, Andrew and, for a while, Claudine.

As a postdoc Tim and I worked at a breeding site for Smooth Newts, Crested Newts, and common frogs and toads. We published one of the first detailed studies of the reproductive ecology of Crested Newts, which were fast becoming a species of conservation concern. That postdoc was my introduction to hard-core fieldwork and issues in amphibian conservation. Actually, the fieldwork needn't have been so hard-core if I had learned to drive a car. But I hadn't, and so, when it was my turn to check the drift-fence, off I went to the pond by bus! Who knows what my fellow passengers thought of this strange person carrying buckets and dip-nets!

I left England in 1986 for the U.S. to work as a postdoc at the University of Chicago, where I explored the relationship between sexual behavior and speciation in a group of plethodontid salamanders.

This research used the tools of ethology that I had developed earlier under Tim's tutelage, but it wasn't explicitly conservation-related. That said, our increased understanding of species boundaries did have some relevance to conservation.

Since joining Washington State University in 1993, the main focus of our research continues to be the function and evolution of reproductive behavior, and we have added frogs, spiders, and lizards to the ever-present salamanders. I like to think of the 15 graduate students who have worked with me so far as Tim's academic grandchildren.

Tim's work in conservation continues to affect my own work in two ways. First, I am in my 25th year of teaching an undergraduate class on conservation. I remain inspired by Tim's intensive efforts to educate professionals and lay-people alike, although I have to remind myself often that the class is not specifically about amphibian conservation! Second, we are studying the effects of pesticide contamination on the susceptibility of salamander larvae to their predators. Our earliest forays into behavioral toxicology were funded by a small grant from the Declining Amphibians Population Task Force, of which Tim was a founding member (later it became part of the IUCN Amphibian Specialist Group).

Tim's impacts on research and education in amphibian conservation are immense. And his impacts on my students and I continue to be considerable. It is with great pleasure that I offer him my thanks and very best regards.

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An International Ambassador for Amphibians

By Trevor Beebee

I first became aware of Tim’s work during the 1970s, a time when awareness of Britain’s amphibians and reptiles and the problems they faced was increasingly on the conservation agenda. Tim’s groundbreaking research on the reproductive behavior of newts and toads raised the profile of widespread species while other herpetologists, including me, were preoccupied with the rare Natterjack Toad. These divergent strands coalesced to some extent during the 1980s, halcyon days for amphibian research and conservation. Annual amphibian ecology meetings brought us together at a time when funding was relatively lavish compared with today and several research groups, including Tim’s, were active in the UK. From that time on we met at irregular intervals, mostly at scientific meetings of one sort or another—I never formally collaborated with Tim, but it was always a pleasure to hear about his latest projects.

As the years went by he spread his wings far beyond British shores, with collaborations that I recall in Spain, South Africa, and the USA. With the emergence of global amphibian declines, Tim became a kind of international ambassador promoting research into causes of the decline and strategies to ameliorate the impending disaster. In this role, he became, among other things, Director of the Declining Amphibian Populations Task Force (DAPTF). I

have no doubt that Tim’s energy and ability have been of huge benefit to the ongoing struggle to conserve the world’s remaining, much depleted amphibian fauna. My personal recollections of Tim at meetings were of a sharp intellect and ready wit. A particular memory, at the 1997 World Congress of Herpetology in Prague, was his badge proclaiming “Sorry I didn’t go to your talk.” Always forthright, Tim’s clarity of vision has generated valuable contributions to our knowledge of amphibian biology and also emboldened effective lobbying for their future protection.

Artwork by Tim Halliday. To view more, and to purchase prints and cards, please visit <http://www.hallidayfarndon.co.uk/amphibians.html>.



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Pseudophilautus hallidayi. Photo: Nayana Wijayathilaka.

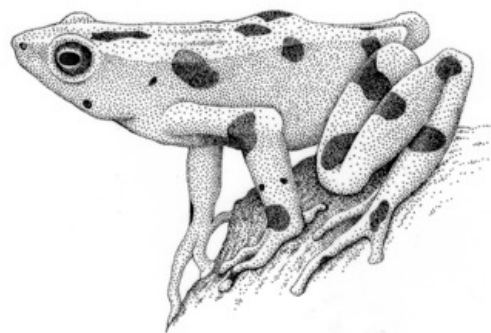
“I’m sorry I missed your talk...”

By John W. Wilkinson

I worked with Tim from 1996 to 2004, leaving my job as International Coordinator of the (then) Declining Amphibian Populations Task Force (DAPTF) to begin a Ph.D. (on toads, of course!). By deciding to employ me, Tim gave me my first real “career break” in the world of amphibian conservation – which is where I wanted to be.

I have very fond memories of attending DAPTF meetings, conferences, workshops etc. with Tim, and particularly remember the home-made pin badge he used to wear, proclaiming “I’m sorry I missed your talk”, which never failed to make me chuckle (on one occasion I wore one saying “I’m sorry Tim missed your talk”!). Despite this, Tim could appear to spend the entirety of a Plenary by some eminent Emeritus Professor fast asleep, and then spring to life and ask the most incisive and relevant question... he didn’t miss much, in truth!

Editing *FrogLog* and gaining insight into the conservation world was a real privilege for me, developing skills I use to this day working for UK charity *Amphibian and Reptile Conservation Trust*. Thanks to Tim, I also learned a lot about working with academics(!) and the seminal questions in amphibian conservation (remembering particularly the day that we were told someone had discovered an odd fungus that was responsible for catastrophic frog declines in Central America and Australia...). For some reason, I also seemed to pick up quite a lot of knowledge on the sexual proclivities of the smaller newts.....



Artwork by Tim Halliday. To view more, and to purchase prints and

Tim Halliday and AmphibiaWeb

By David B. Wake¹



I first met Tim Halliday in the Spring of 1975, when Marvalee and I were on sabbatical in London. Tim welcomed us to Oxford, where he lived, introduced us to its great university, and hosted us for lunch. Since that time our lives have intersected in many ways, the common thread being amphibian biology and conservation. In response to the general alarm over the declines and disappearances of amphibians in the late 1980's, George Rabb and I organized the Task Force on Declining Amphibian Populations (DAPTF) in 1991. Tim was an early and active member. Initially DAPTF was located in Corvallis, Oregon. Organization was rather informal; I served as Chair of DAPTF and built a Board that included Tim. Jim Vial retired from the University of Tulsa and moved to Corvallis to become Coordinator. When he stepped down, about two years later, Tim Halliday came forward with suggestions for a modified organization, which the Board of DAPTF gladly ac-

cepted. In 1994 the office of DAPTF was moved to the Open University in Milton Keynes, England, with Tim leading the operation as International Director. He selected John Baker as International Coordinator. The successful move ushered in a decade of progress. Grant programs were initiated, a succession of board chairs engaged in fundraising, and the visibility of the entire operation was significantly raised. Importantly, *FrogLog* was published regularly, mainly distributing news about amphibian declines and activities of the DAPTF and other organizations, and including a section on recent literature. Delightful "cartoons" of amphibians, pen and ink drawings done by the multi-talented Tim appeared regularly.

The late 1990s saw both excitement and confusion with respect to amphibian declines. Thanks to the publicity generated, ever increasing numbers of high profile publications, and new money, including grants from DAPTF, going into amphibian field studies, more and more talented investigators turned their attention to amphibian declines. Then, the chytrid fungus, new to science, was discovered to be causal for mysterious amphibian deaths in Australia and Central America. This was a true game-changer, and the new century witnessed a vast increase in the numbers and diversity of publications.

AmphibiaWeb went live in February, 2000. I spoke several times with Tim and the then Chair of DAPTF, Ron Heyer, about how we could effectively interact. This was a time of great activity and we witnessed the appearance of new organizations, such as ASA and ASG, which eventually incorporated and then superseded DAPTF. Tim was personally monitoring the literature on amphibian declines, and with the changes in *FrogLog* and the success of AmphibiaWeb, he joined our team. Starting in 2004, Tim prepared a monthly literature update, which became a

popular AmphibiaWeb feature. Tim not only cited the prominent literature, but he scoured journals not ordinarily seen by naturalists and conservation biologists for important but somewhat obscure publications. The updates appeared promptly on the first day of the month, and until late summer, 2018, the community benefitted from Tim's dedicated and effective service.

We thank Tim sincerely for his long-continued involvement with AmphibiaWeb, but more than that, we thank him for nearly three decades of dedicated service in the interests of amphibian conservation biology and its practitioners. Tim, we wish you the very best as you face new challenges in life, and we will always remember what you have done for us and meant to us.

Artwork by Tim Halliday. To view more, and to purchase prints and cards, please visit <http://www.hallidayfarndon.co.uk/amphibians.html>.

¹Founding Chairman, DAPTF. Director, AmphibiaWeb.

Tim Halliday at dinner together with Cristina Giacomina and Marco Bologna, future vice-President of the Italian Herpetological Society. Photo: Sandro Tripepi.



Tim Halliday and the Conservation of Italian Newts

By Cristina Giacomina¹, Emilio Balletto¹ & Sandro Tripepi²

I (Christina Giacomina) first came to meet Tim Halliday back in 1975, while reading his seminal papers on the Smooth Newt's (*Triturus vulgaris*) courtship behavior (1, 2) and I must admit that trying to squeeze the Italian Crested Newt's (*Triturus cristatus*) displays into his description of the courtship of such a phylogenetically removed species was rather a challenge. When I got my first job at the University of Calabria (Cosenza), in the south of Italy, I 'discovered' the Italian Newt, and found that matching what I was observing with Tim's descriptions was now easier, although to some extent. Just at that moment, Tim came out with one of his far-reaching initiatives and organized the first meeting of what later became known as the 'Triturus group', which he wanted to be freely open to all researchers who were studying newts. This offered me the first chance to meet him in person and to figure out differences between species, as well as to profit from the experience of a number of other colleagues.

The first 'Triturus' meeting was the starting point of a network that grew with time, and which came to involve also salamander specialists like Steve Arnold and Lynne Houck. Sharing our experience and data, allowed us to piece together a better understanding of the evolution of newt biology and behavior, and was very exciting for all of us. Thanks to the interdisciplinary scenario that we were now sharing under Tim's benevolent guide, we increased the scientific depth of our results, and Tim put together an illuminating synthesis (3, 4).

Together with Sandro Tripepi, we hosted the "1988 meeting of the *Triturus* group" at San Benedetto Ullano and Tim Halliday, together with many other researchers from all over Europe, had to travel to the deep South of the long Italian peninsula. Jan Willem Arntzen and Annie Zuiderwijk came all the way from Holland, Dag Dolmen from Norway, Henrik Bringsoe from Denmark, Claude Miaud from France, Robert Schabetsberger from Austria, Simon Tonge from Jersey, while a number of colleagues came with Tim from England, including Andrew Green, Richard Griffiths,

Lottie Hosie, Chris Raxworthy and Julie Roberts. It was a very productive meeting even if very special: local authorities were very interested to see all these strangers coming to this small village in the mountains just because there were two ponds with newts. Locals had just discovered that they also had a third species, the Alpine Newt, and now all these persons coming. For this reason, the first day we were not able to start talking about science for quite a while, because the mayor of San Benedetto Ullano wanted to let us know that they are an Albanian minority cultural heritage and that they want to help newts if we think that was important, then was the turn of the president of the local "Comunità Montana" telling about their developmental goals that he thought compatible with newts' existence; then the delegates of the shooting association expressed their willingness to establish a reserve to preserve the newts; then the Eparca (Albanian religious authority) wanted to manifest his conservation-friendly attitudes; then came the local health authorities, and the mayor of a nearby village, and even the vice-president of Comunità montana, and finally the delegates of the local University. After this quite special opening, work run well and we took advantage of the warm hospitality of the villagers, tasting local specialties and joining traditional dances at night. We thought that there was an excess of local involvement but in fact this was another important goal that Tim managed to reach: the lakelet is still there with its three species of newts and local communities are still involved in conservation of the area.

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Tim Halliday – Amphibian Champion

By Nick Davies

I first met Tim in the mid 1970's when we were fellow graduate students in the Zoology department at Oxford. My passion was bird watching and I spent my days in the woods and meadows studying their foraging and territorial behaviour. Tim's obsession was amphibians (he had painted a large frog on the outside wall of his house, which brightened up the whole street) and I learned from him that they could be just as captivating as birds.

I remember being inspired back then by a talk Tim gave on his studies of the courtship behaviour of European newts, *Triturus vulgaris*, where the female has to pick up, through her cloaca, a spermatophore that the male deposits just ahead of her path as she walks on the bottom of the pond. This seemed rather a haphazard way of mating, but Tim's elegant experiments showed how success was achieved through a sequence of carefully coordinated manoeuvres, a courtship dance in which the pair hardly touched one other.

During those early years of Behavioural Ecology there was renewed interest in sexual selection, particularly mating conflicts both within and between the sexes. I joined Tim in a study of mating competition in common toads, *Bufo bufo*, an "explosive breeder" where spawning takes place in just a few nights each spring, leading to intense struggles among males for mates. Many toads, some already paired in amplexus, had to risk crossing busy roads to reach the safety of the breeding ponds and we spent long nights



A male great crested newt in aquatic phase. Photo: Jelger Herder.



collecting them in buckets to help them on their way. It began to dawn on us that ours would be the last generation to take the natural world for granted.

A few hundred years ago, the button-like fossilised teeth of some Jurassic fish were believed to be "toadstones", mythical gems from inside the heads of toads that served as antidotes to their own poison and which had magical healing powers for humans. Norman MacCaig's lovely poem "Toad" needs no such myth to celebrate them:

"A jewel in your head? Toad,
you've put one in mine,
a tiny radiance in a dark place."

Amphibians could not have had a better champion. Tim's unique combination of scientific study, popular writings and brilliant artwork has helped to bring them to the forefront of conservation concern. It's a privilege to salute him.

Artwork by Tim Halliday. To view more, and to purchase prints and cards, please visit <http://www.hallidayfarndon.co.uk/amphibians.html>.

Singing *hallidayi*'s...!



Pseudophilautus hallidayi. Photo: Nayana Wijayathilaka.

By Nayana Wijayathilaka

Halliday's Shrub Frogs are permanent residents in our garden and frequently found on the walls inside our house, sometimes in rooms. I really love to see them and listen to them in and around my home. I cannot avoid their songs during almost all nights, except a few months in a year where dry conditions prevail. These little frog friends have to play with the kids whether they like or not. Now the kids are experts in spotting and catching them without hurting them. They are lucky to have a threatened endemic species as their pets, and more importantly the pet is honoured by sharing its name with the eminent herpetologist Professor Tim Halliday.

Pseudophilautus hallidayi was first discovered from Kandy in 2005 by Meegaskumbura and Manamendra-Arachchi. They are mostly found on boulders close to streams and forest habitats with large moist rocks, and are fairly uncommon where they occur. Their call is loud and vigorous when competing with rivals, and they have several call types. Their call is unique and only similar to their sister species, *Pseudophilautus fergusonianus*. Dusk and dawn are the peak calling times, and these are also the best times to spot them. They are experts in camouflaging, and these frogs do not depend on water to breed but instead lay eggs on wet soil.

"Trick. trick... triiik.... triiick..." listen to them, they are so cute and amazing!



Pseudophilautus hallidayi. Photo: Nayana Wijayathilaka.

¹Department of Zoology, University of Sri Jayewardenepura, Sri Lanka

A Voice of Encouragement – Thank you Tim!

By Helen Meredith¹

When I was a zoology undergraduate, I got involved in an expedition to French Guiana, aiming to conduct some amphibian inventories in a small reserve and, in particular, search for poison dart frogs. At this time in my life, I had a very equal-opportunities attitude to species conservation. I was, of course, deeply fond of amphibians, but they were not my defining vertebrate Class. I knew very little about their conservation and biology, and even less about how to catch and identify them. I was advised to phone someone called Professor Tim Halliday at the Declining Amphibian Populations Task Force. Yikes, I thought, he's not going to want to speak to me. He sounds like he has much more important things to do than tutor me through my bungling attempts at organizing a university expedition to fart around with frogs during my Summer holidays. Well, obviously I was wrong. Tim took the time to talk me through the importance of contributing to amphibian conservation and was very encouraging of my efforts. When people take you seriously at this stage in your life it has huge repercussions for the development of your self-esteem and, ultimately, your career choices. I had experienced a great



many dismissive responses from people I admired in the world of conservation, and these flattened my hopes and stifled my dreams (not to sound melodramatic, although I was a teenager). Tim's approach spurred me on, and our expedition miraculously landed in French Guiana a few short and stressful months later.

The expedition was challenging, not least because I was savaged by biting insects of every kind and came down with dengue fever midway through (turns out this is a specialty of mine). However, so began a much deeper appreciation of amphibians and a huge affection for their beauty, diversity, stealth, and cunning. My first tentative attempts to catch frogs using my latex-gloved hands were somewhat pathetic. A mere two months later I was leaping over fallen trees and returning with a (generally) small brown frog in each hand. I have never forgotten the majesty of the rainforest, nor the incredible variety of amphibians I encountered. And I have never forgotten Tim's voice down the phone telling me that amphibians were worth caring about. It turns out I did make my career in amphibian conservation. Something that I would never have thought possible as a 19-year-old struggling to find a way forward. Reading the articles that have been contributed to this *Special Edition of FrogLog* as been a wonderful experience. I feel humbled by Tim's achievements in the study and conservation of amphibians. And, just as importantly, I feel inspired by the approach he has taken. An approach of inclusivity, kindness, and good humor, and a genuine passion for all amphibians—their diversity, their behaviors, and their beauty. Like many others, I follow in his footsteps and I will always encourage others to do the same.

Thank you Tim!

¹Executive Director, Amphibian Survival Alliance

Funding Metamorphoses Amphibian Red Listing: An Update From the Amphibian RLA

By Jennifer Luedtke^{1,2}, Kelsey Neam^{1,2} & Louise Hobin¹

The Amphibian Red List Authority (ARLA) is pleased to report that 2017 was its most productive year since its establishment in 2009. A total of 805 assessments were submitted for publication on the [IUCN Red List](#) from 17 of the 21 regions we worked on during the calendar year, representing a 43% increase in submissions since 2016 (Fig. 1). We are proud of the high degree of quality and consistency of these assessments, and that they have been brought into compliance with the current version of the [Guidelines for Using the IUCN Red List Categories and Criteria](#). We are also immensely grateful for the time and energy our colleagues worldwide continue to volunteer to this important effort.

This encouraging achievement is in no small part thanks to the generous financial support we received in 2017 from Global Wildlife Conservation, Rainforest Trust, and Synchronicity Earth. In addition to equipping the ARLA with a full-time Global Coordinator and two full-time Programme Officers, we were granted US\$29.6k of project funding. This boost enabled the ARLA to conduct five “mini” workshops to assess the extinction risk of amphibians from the Philippines, Indonesia, Malaysia, Peru, and the Guiana Shield (Figs. 2–3), and attend the herpetology conferences of Argentina, Australia, Europe, and Latin America. Since 2012, the gradual increase in project funds raised (US\$60,947 over six years) has had a positive cumulative impact on our productivity (Fig. 4) and we hope to continue this trend of high submission rates until the 2004 Global Amphibian Assessment (GAA) is updated.

In 2018, the ARLA will continue to work region-by-region with our network of Regional Coordinators and experts. To deliver a fully updated GAA we must finish updating the remaining 3,982 species from 2004–2008 and submit first-time assessments for 1,176 Not Evaluated species since 2004. However, we have begun the year without project funding for workshops, internships, or consultancies and are interested in partnering with institutions working on species in Bolivia, Venezuela, Brazil, Caribbean, Mesoamerica, Mexico, USA, Europe, India, Sri Lanka, China, New Guinea, and West and Central Asia.

As we seek ways to clear the funding shortfall, we are also working to identify solutions to procedural roadblocks; to ensure data on the Red List feed more seamlessly into [Key Biodiversity Area](#) identification; increase collaboration with Amphibian Ark on [Con-](#)

[servation Needs Assessments](#); provide feedback into the development of the [IUCN “Green List of Species”](#); and improve how the cycle of Red List assessments informs and catalyses species action planning.



Fig. 2: Participants of the Red List assessment workshop for Indonesian amphibians at Bogor Agricultural University in Bogor, Indonesia. Photo: Jennifer Luedtke.



Fig. 3: Participants of the joint Red List and Conservation Needs Assessments workshop for Malaysian amphibians at Universiti Sains Malaysia in Penang, Malaysia. Photo: Kelsey Neam.



Fig. 1: ARLA regions with Red List submissions in 2017.

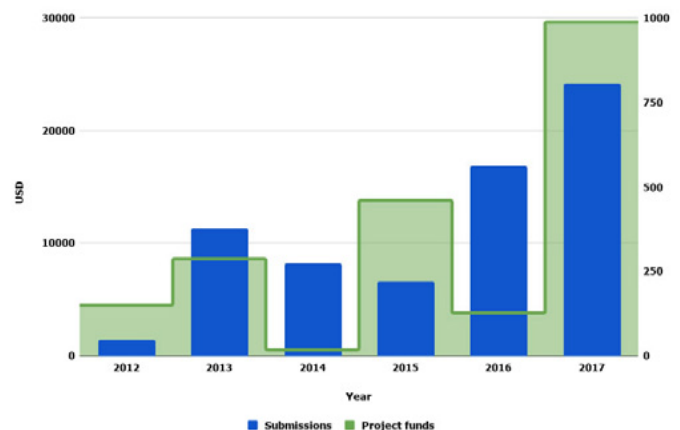


Fig. 4: Project funds raised by the ARLA and number of submitted assessments from 2012–2017.

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²Global Wildlife Conservation, Austin, TX, USA.

Photographing **FROGS**

and Other Amphibians

By Robin Hoskyns

With contributions from:

Ariadne Angulo, Candace Hansen-Hendrikx, Clay Bolt,
Phil Bishop, Robin Moore and Brian Gratwicke



A guide to facilitating engagement in amphibian conservation through compelling images



Photographing Frogs and Other Amphibians” Ebook

Designed for researchers and conservationists working with amphibians, the “[Photographing Frogs and Other Amphibians](#)” ebook by Robin Hoskyns, aims to provide an overview of techniques that can be used to create engaging images and demonstrate how these images can be utilized to tell the stories of amphibians and amphibian conservation.

“When most people think of charismatic animals, frogs are not usually the first ones that come to mind. This lack of general appeal can often have negative results when decisions are being made about their conservation. Robin’s ebook is a fantastic “How to get the best photograph!” guide which will enable people who encounter frogs to portray them in an engaging and professional way. Not only is this book incredibly useful for people wanting to get better shots of frogs, but also for people who are interested in photographing wildlife. Frogs are very good subjects for nature and macro photography and this ebook will ensure that people can portray frogs in their true form - as wonderfully endearing, charismatic animals who deserve our full attention to ensure they do not disappear in the near future.” *Phil Bishop, Co-Chair, IUCN SSC Amphibian Specialist Group and Chief Scientist, Amphibian Survival Alliance*

The ebook does not delve too deep into the technicalities of each approach, but will hopefully stimulate further learning for those that wish to take their photography and communication skills to the next level.

“This ebook is a great resource for all who wish to start or upgrade their storytelling about the world of amphibians. Let’s keep these weird and wonderful animals alive in our imaginations and in our lives. Happy snapping!” *Jennifer Luedtke Global Coordinator - Amphibian Red List Authority IUCN SSC Amphibian Specialist Group*

Although the title and text make greater reference to frogs, most techniques can be applied interchangeably between frogs, toads, newts, salamanders and caecilians. Any bias towards frogs is purely due to the availability of frog images and approachability of the word ‘frog’.

“The Amphibian Specialist Group and the Amphibian Survival Alliance are proud to launch the “Photographing Frogs and Other Amphibians” ebook. Exquisitely illustrated and with practical advice on amphibian and habitat photography offered in an accessible and easy to understand format, Photographing Frogs is a guide that is bound to become a go-to source for using compelling photography for amphibian conservation. We encourage everyone to download this freely accessible resource to help inform and build their amphibian photography and visual story-telling skills.” *Ariadne Angulo, Co-Chair, IUCN SSC Amphibian Specialist Group and Interim Executive Director, Amphibian Survival Alliance*

You can download your free copy [HERE](#).

ASG Brazil Restructuring Process and Current Activities

By Luis Fernando Marin da Fonte^{1,2}, Cybele Sabino Lisboa^{1,3}, Iberê Farina Machado^{1,4}, Lucas Ferrante^{1,5} & Débora Leite Silvano^{1,6}



Art: Luis Fernando Marin da Fonte.

Brazil has the greatest amphibian species richness on earth, currently comprising 1,080 species (1). The regional branch of the IUCN SSC Amphibian Specialist Group for Brazil (ASG Brazil) was officially established in 2006, and its first official meeting was held in July 2007, during the 3rd Brazilian Congress of Herpetology (BCH) held in Belém, Brazil. In August 2008, during the 6th World Congress of Herpetology held in Manaus, Brazil, the Group took part in the Amphibian Conservation symposium, presenting its achievements up until that moment. The following meeting was held only in July 2013, during the 6th BCH held in Salvador, Brazil. Over the course of these years, ASG Brazil contributed to developing the Brazilian Amphibian Conservation Action Plan (BACAP) (2), helped with the national conservation status assessment of Brazilian amphibian species (3), and organized the symposiums *Regional experiences of amphibian conservation in Brazil and the role of ASG Brazil (IUCN) in the conservation of amphibians: actions in progress and new directions* during the 7th and 8th BCH, held in Gramado and Campo Grande, in September 2015, and August 2017, respectively.

From 2014 onwards new members joined the ASG Brazil team, and a restructuring process was undertaken at the beginning of 2016. The ASG Brazil regional secretariat now consists of two Regional Co-Chairs and three Regional Programme Officers. Since May 2016, regular online meetings are held to discuss important issues, and to decide the next steps towards the development of the Group and its future activities.

In order to lead the execution of BACAP we believe that it is very important to identify the stakeholders involved in amphibian conservation in Brazil. Considering the continental dimensions of the country, this is not as simple a task as it may seem. With the objective of contacting researchers and people interested in amphibian conservation, the first result of our restructuring process was the development and launch of the official ASG Brazil [website](#), [e-mail](#) and [fan page](#). Since our target audience is the Brazilian community,

the main language of communication is Portuguese.

The next step in expanding our activities was to undertake a massive review of the conservation actions involving amphibians that are currently being conducted in Brazil (*i.e.*, research, population monitoring, extinction risk assessment, environmental education, etc.). To this end we developed an online questionnaire to find out *Who, Where, How* and *With Which Species* these activities are being carried out. The survey was launched in December 2016 and collected responses until March 2017.

From the analysis of this review (still in progress), we were able to identify almost 400 people who, in one way or another, are involved in the conservation of amphibians in Brazil. We now have a better understanding of the activities performed and identified the gaps in knowledge and action. Based on this, our next step is to hold an event with the goal of bringing these people together.

The *Amphibians in Focus* (ANFoCO) will be a space for connection and presentation of the main researches, actions and programs of amphibian conservation in Brazil. We intend it to be an open space for the presentation of successful experiences that can be replicated and, above all, an opportunity for the discussion and proposition of new ideas. We believe that working together is the best way to accomplish difficult tasks, and we hope that this event will be an important step to unite those involved with amphibian conservation in Brazil.

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Symposium *Regional Experiences of Amphibian Conservation in Brazil* (2015). Photo: CBH Archive.

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Brazil, ⁴Instituto Boitatá de Etnobiologia e Conservação da Fauna, Brazil,

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Brasília, Brazil.

Business in Key Biodiversity Areas: Minimizing the Risk to Nature

By Lindsay Renick Mayer

The Key Biodiversity Area Partnership involving 12 of the world's leading conservation organizations, including Amphibian Survival Alliance, in April issued a roadmap for businesses operating in, or impacting, some of the most biologically significant places on the planet. This includes those places that are especially critical for amphibians.

The report, [Guidelines on Business and KBAs: Managing Risk to Biodiversity](#), outlines steps that businesses can take to actively safeguard biodiversity and avoid contributing to its loss. It recommends businesses of all sizes and across all sectors adopt 15 guidelines to better manage their direct, indirect and cumulative impacts on places deemed critical for the conservation of species and ecosystems worldwide, known as [Key Biodiversity Areas](#) (KBAs). It addresses issues such as avoidance of impacts, limits to biodiversity offsets, as well as financial guarantees and corporate reporting. It guides businesses in managing the potential losses and other risks associated with their negative impact on biodiversity, including potential impacts on access to financing and increased company exposure to negative press.

"KBAs play a vital and global role in the overall health of our planet, so businesses need to take extra caution when planning or undertaking commercial activities in or near these sites and some activities should be avoided altogether," said Penny Langhammer, director of Key Biodiversity Areas for Global Wildlife Conservation. "The tiny ranges and specialized ecological requirements of many amphibian species make them highly vulnerable to habitat loss and degradation. Ensuring that important sites where they occur do not suffer from environmentally harmful business activities is critical for recovering and safeguarding amphibian populations."

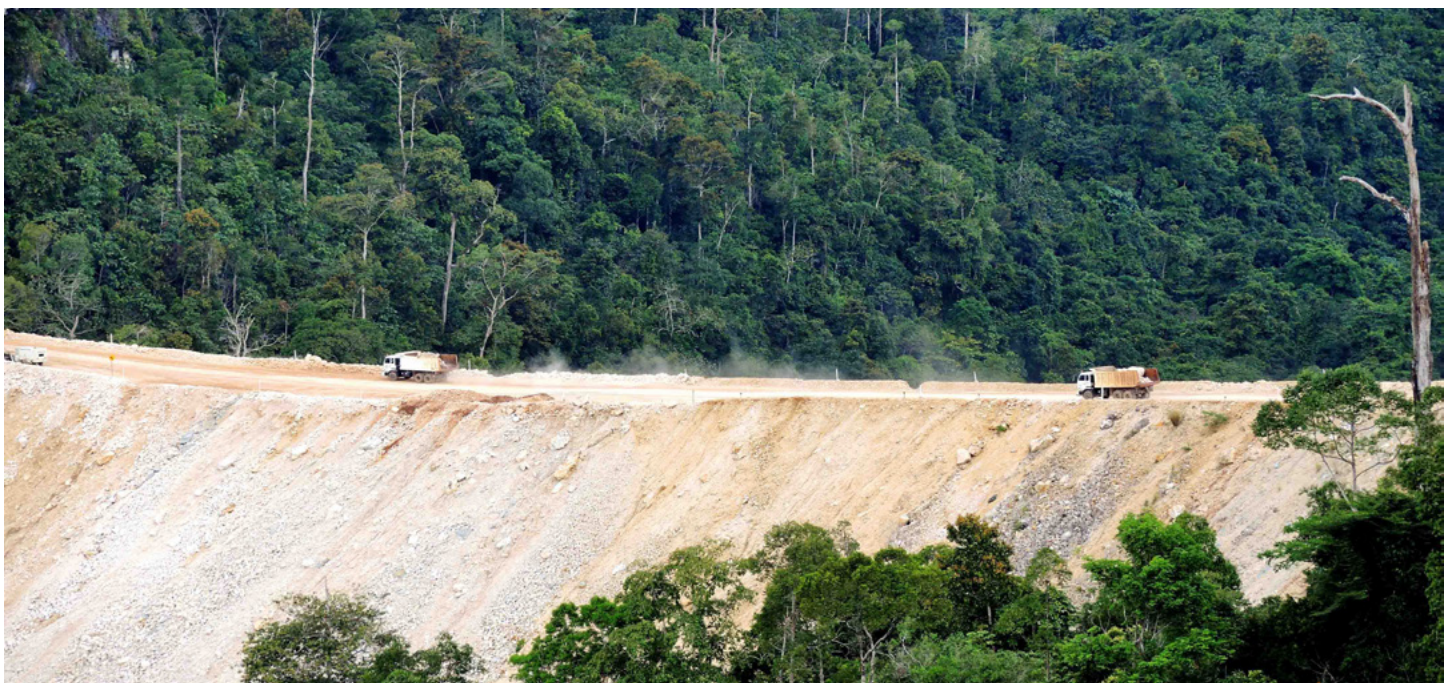
The report and [associated website](#) aims to help businesses demonstrate good environmental practice and compliance with

voluntary sustainability standards or certification schemes. It also explains how companies operating in KBAs can make a positive contribution to biodiversity by investing in conservation actions and sharing relevant information about the KBAs, including data collected in Environmental Impact Assessments, baseline studies and monitoring activities, with the KBA Partners. Its aim is to assist governments in authorization decisions related to business operations.

"These new guidelines will help businesses protect the most important natural places on our planet, and so preserve the natural resources they so strongly depend on," said Inger Andersen, IUCN director general. "By managing their impacts on nature, businesses deliver positive conservation results, helping address the escalating crisis of biodiversity loss."

Following the adoption in 2016 of a global standard for the identification of KBAs, the KBA Partnership was created to map, monitor and conserve the areas. More than 15,000 KBAs have been identified so far, many of which currently support commercial activities, such as farming, fisheries, forestry and mining. Although the global KBA network does not yet cover all geographical regions or species groups, the KBA Partnership is working to fill these gaps.

"The Tiffany & Co. Foundation is proud to support IUCN in this important effort to protect some of the world's most biologically rich and diverse places," said Anisa Kamadoli Costa, chairman and president of The Tiffany & Co. Foundation, which funded the project. "These guidelines provide an important roadmap for businesses committed to advancing the long-term preservation and stewardship of the Earth's natural resources, which all of society depends on."



A quarry in tropical forest. Photo: B. Barov/BirdLife.

Amphibians in Focus (ANFoCO): Brazilian Symposium on Amphibian Conservation

By Luis Fernando Marin da Fonte^{1,2}, Cybele Sabino Lisboa^{1,3}, Iberê Farina Machado^{1,4}, Lucas Ferrante^{1,5} & Débora Leite Silvano^{1,6}

Recently, the Amphibian Specialist Group for Brazil (ASG Brazil) conducted a massive review of the conservation actions involving amphibians in the country (unpublished data). The main objective of this diagnosis was to identify the people (and their work) involved with the subject, with the aim of connecting them and devising adequate strategies to improve amphibian conservation in Brazil.

From the analysis of this diagnosis, we developed the idea of organizing meetings to bring these people together, promoting debates that *effectively* contribute to the conservation of amphibians in our country. In this way was born the *Amphibians in Focus* (ANFoCO), a name that will be used for all the events organized by ASG Brazil from now on. In this first edition, it will be organized in a symposium format, but future events can have the structure of courses, workshops, etc.

The *I ANFoCO: Brazilian Symposium on Amphibian Conservation* will be held on August 4 and 5, 2018 at the São Paulo Zoo (São Paulo, Brazil), with the purpose of being a *propositional* event, and not merely an *expository* event. We want it to be a space for the presentation of successful ideas, so that they can be replicated in other places, with other species, and in other contexts. We intend it to be a space for the discussion of the difficulties faced, with the consequent proposition of practical actions aimed at overcoming the problems and correcting the flaws pointed out. We want it to be an inclusive space, stimulating the participation of people who are normally on the sidelines of the Brazilian scientific and academic worlds. We want it to be an innovative space, stimulating the shifting of paradigms and a new way of thinking about conservation. The principles of ANFoCO are:

Unite: we believe that unity and collective work are fundamental to advancing and consolidating conservation actions with amphibians in Brazil. Therefore, we intend to create an environment that facilitates and favors the intimacy and the exchange of ideas between participants. Thus, our event will be structured in a way that all people can attend all the lectures and spend most of their time together, without concomitant talks and with the existence of social spaces and activities that facilitate the contact between the attendees.

Propose: merely expository lectures, although important to present work results, very rarely stimulate changes. We consider that there are already other meetings in the Brazilian herpetological calendar for the exhibition of works; so we intend to structure our symposium in a way that all the talks presented are *propositive*, in order to influence the thinking of the participants, generating reflection and the impetus to put into practice the ideas proposed.

Include and Encourage: in our diagnosis, we identified some groups that, unfortunately, are still on the sidelines of scientific and academic worlds and, consequently, of the execution and decision-making processes of conservation activities. The groups



in question are women, young people, undergraduate students, and people from the North, Northeast and Center-West regions of Brazil. In our event, we intend to make room for their participation, stimulating their engagement by proposing quotas of attendance, and offering discounts and awards in recognition of their work.

Innovate: we want the event to be innovative not only in its inclusive and propositional format but also for new ideas and approaches to be presented. We intend to discuss new conservation concepts; to present new technologies which may replace outdated scientific techniques; to propose and stimulate the application of strategies that work very well in other countries, but are rarely applied in Brazil; and, above all, to make room for new names to present and discuss their ideas.

Produce: we hope that, at the end of the event, materials will be produced and disseminated, making the event's results accessible to all those interested in the theme. To do so, we will encourage the creation and publication of products (articles, reports, lists, maps, videos, etc.) in the period after the event.

The target audience of the *I ANFoCO* is all people interested in the conservation of amphibians in Brazil, including members of academic and scientific circles, governmental and non-governmental organizations, and civil society. The *Brazilian Symposium on Amphibian Conservation* is an event designed by ASG Brazil and co-organized in partnership with the São Paulo Zoo, where it will be held, and the Brazilian Society of Herpetology (SBH). The symposium will take place in the Dom Pedro Space at the Zoo, a 300 m² lounge with an outdoor area with balconies built and decorated in colonial style. It is located inside the Fontes do Ipiranga State Park, providing the participants with warmth and inspiration on a beautiful background of Atlantic Rainforest.

At the end of the *I ANFoCO*, we hope that the successful experiences presented at the meeting can be replicated in other places; that contacts made during the symposium result in future collaborations; that new ideas emerge; and that people who usually have no voice will be heard and valued. We want our event to be the catalyst that was needed to organize, connect and boost the conservation actions of amphibians throughout Brazil.

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Brazil, ⁴Instituto Boitatá de Etnobiologia e Conservação da Fauna, Brazil,

⁵Instituto Nacional de Pesquisas da Amazônia, Brazil, ⁶Instituto Federal de

Brasília, Brazil.



Southern Corroboree Frog. Photo: Tiffany Kosch.

Queensland Lab Turns to Chytrid-Fighting Genes to Save Species on the Brink

By Lindsay Renick Mayer

Australia's most iconic amphibian, the Southern Corroboree Frog (*Pseudophryne corroboree*), may soon be famous for more than its unusual and brilliant yellow and black color combo. One Health Research Group lab at James Cook University in Queensland is investigating two innovative methods to genetically bolster the species' immunity to the fungal disease chytridiomycosis, with the aim of essentially creating the first amphibian species with the superpowers to ward off the deadly foe.

"The zoos that we work with put a lot of money and resources into raising Southern Corroboree Frogs in captivity and releasing more than 1,000 eggs every year back into the wild," says Dr. Tiffany Kosch, an adjunct research fellow at James Cook University, who is leading the new genetics research along with Drs. Lee Skerratt and Lee Berger. "We want to make sure that these efforts are truly effective, and the only way that we can do that is by re-introducing frogs that are no longer susceptible to chytrid, which is still in the environment and still a primary threat. We are trying to develop a sustainable solution where the frogs can be released and we don't ever have to worry about them again."

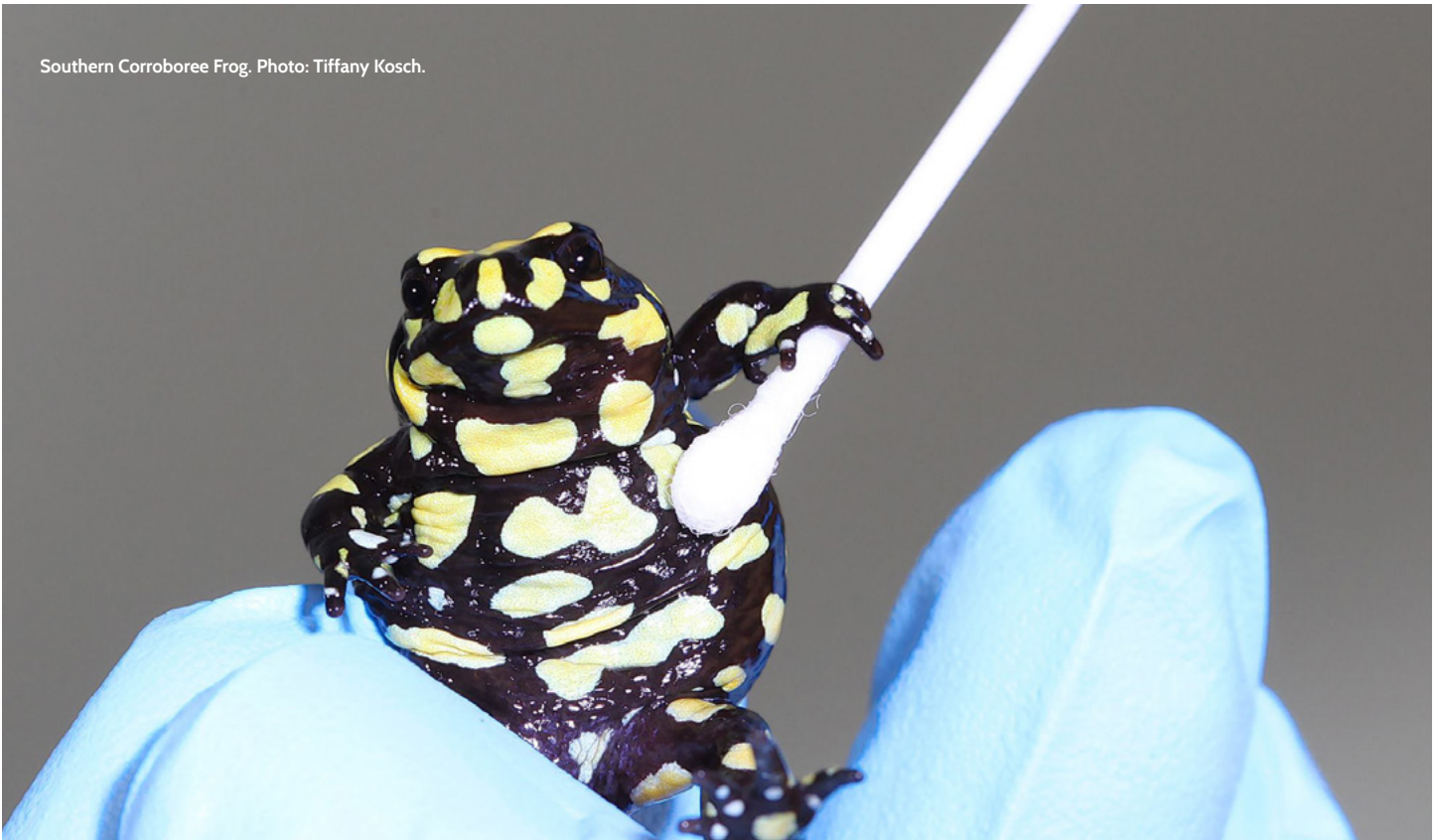
Ultimately Dr. Kosch and her colleagues will be looking at two possible methods for improving chytrid resistance in Southern Corroboree Frogs that have been captive-bred in Australian Zoos,

including the Taronga Zoo and the Melbourne Zoo: selective breeding and genetic engineering. Selective breeding would involve scoring the frogs on their likely ability to fight chytrid based on their genetic make-up, and then pairing frogs likely to pass on resistance to their offspring.

The other method, which has a science fiction overtone to it but is entirely possible with new tools, is to use the cutting-edge genome editing technology CRISPR-Cas9 to take multiple genes related to chytrid immunity and "knock" them into frog eggs immediately after they've been fertilized. While researchers haven't yet tried this method in Corroboree Frogs, it has been done successfully in pigs, fish and even other frog species, including the African Clawed Frog (*Xenopus laevis*) and the Tropical Clawed Frog (*Silurana tropicalis*).

"No one method of disease mitigation is likely to be the silver bullet for all species in all cases, so it makes sense to explore multiple methods to ensure we have a number of approaches in the tool box," said Reid Harris, a professor of biology at James Madison University and the Amphibian Survival Alliance's director of international disease mitigation. "Vaccinations and probiotics have had mixed success, and we're eager now to see the results of Tiffany's approach to use some cutting-edge genetic techniques to impart resistance to chytrid."

Southern Corroboree Frog. Photo: Tiffany Kosch.



Which of the techniques will work best will depend on the answer to one of a number of basic questions Kosch's team needs to answer first: How many genes are involved in providing resistance to chytrid? If just a handful, genetic engineering will be the likely candidate. If the number is too high for current gene knock-in technology, selective breeding will be the better solution. The team also aims to answer: Which specific genes are involved in providing resistance? How likely are the effects of these to be passed on to offspring?

The researchers did a pilot study with 70 frogs to start to answer these questions, but will be expanding that work to a much larger study of about 1,000 frogs from captive breeding programs at partner zoos in Australia. The answers to these questions will provide the first comprehensive understanding of amphibian resistance to chytrid. Once the researchers have these answers, which Kosch

predicts will take no longer than a year, they will start the genotyping process, providing the first sequenced genome of an Australian frog, and the fourth-ever sequenced genome of any frog species.

Chytrid was first introduced in Australia in 1978 and reached Southern Corroboree Frog habitat around 1984. Biologists predict that today there are likely fewer than 50 individuals of the Critically Endangered species left in the wild. The Southern Gastric Brooding Frog and five other Australian species have gone extinct—and many others have suffered precipitous declines—primarily as the result of chytrid. If Kosch is successful, other conservationists may be able to use these tools on species threatened not only in Australia, but in Central and South America, where chytrid has also hit amphibians hard.

"We're hoping that the same genes that confer resistance in the Corroboree Frogs would confer resistance in other species," Kosch says. "What makes this project so ideal is that this approach could be used to save amphibians threatened by chytrid or even other emerging diseases. We still have lots of work ahead of us before we get there, but we are hopeful that this path leads to the return of the beloved and charismatic Southern Corroboree Frog to the wild."

This research has been published in pre-print: Kosch, T.A., Silva, C.N.S., Brannelly, L.A., Roberts, A., Lau, Q., Berger, L. & Skerratt, L.F. (2018). Genetic potential for disease resistance in a critically endangered frog decimated by chytridiomycosis. bioRxiv. DOI: 10.1101/247999

This work was funded by the [experiment.com](https://www.experiment.com) crowdfunding campaign "Can we stop amphibian extinction by increasing immunity to the frog chytrid fungus?" and Australian Research Council grants.



Southern Corroboree Frog. Photo: Tiffany Kosch.



Some caecilians are as small as earthworms, while others can grow up to 1.5 meters (or 5 feet.) Caecilians don't have arms or legs, but they do have a backbone like us. They also have a strong, pointy skull which allows them to burrow into mud and dirt.

New Children's Books by Amphibian Ark

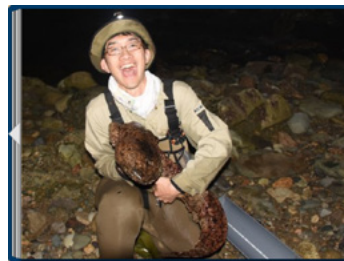
By Amphibian Ark

The Unite for Literacy team works with its partners to develop a wide range of free, online children's books, narrated in multiple languages, to celebrate language, culture and a love of reading. These short books feature wonderful images, and short pieces of text on each page, and along with the narration, help children and their families who are learning to speak English, or other languages.

Amphibian Ark's Community Education Officer, Rachel Rommel-Crump, developed the text for five books about amphibians, which are beautifully illustrated with photos from our photo competition, and others which have been generously supplied by some of our partners. The first five books can be found on AArk's "bookshelf" on the Unite for Literacy page, www.uniteforliteracy.com/aark/arkbooks. The new books are:

Amazing Amphibians – Introduces these amazing animals, providing some basic biological information, and encouraging readers to "Bring a map as you explore your neighbourhood and mark the places where amphibians might live".

Fantastic Frogs – Shares information about frogs from different countries, and different breeding strategies, suggesting that you can "Visit a pond and look for tadpoles swimming close to the edge, or frogs sitting in the water."



Hopping over to Japan, heroes like Yuki and friends work to save the Japanese Giant Salamander. These are among the largest amphibians in the world. They need clear, cold, fast-flowing rivers with large rocks to hide under.

Super Salamanders – Explains where salamanders live and how they can regrow damaged limbs and recommending that you "Learn the name of a salamander or frog that lives near you."

Secret Caecilians – Introduces these lesser-known amphibians and suggests that children can "Lie on your stomach, put your arms against your body, and try to move like a caecilian."

Amphibian Heroes – Talks about the threats facing amphibians, and how amphibian heroes in Madagascar, Argentina, Japan and the US are helping to save them. It also recommends that you "Join an effort to protect wildlife habitat in your community, or start one with your friends."

These books include English narration, and Spanish will be available soon. We hope you enjoy them!

Special thanks to Amphibian Ark's Anne Baker, Luis Carrillo and Kevin Johnson who provided creative and editorial support throughout project. Thanks to Paul Crump and Joe Mendelson for reviewing the final books and providing helpful comments. Also, thanks to Andy Gluesenkamp and Tariq Stark for confirming factual information about some specific species.

We would not have had such engaging photographs to share with children if it wasn't for the generosity of Todd Pierson, Dave Huth, Candace Hansen-Hendrikk, Arturo Muñoz, Ben Tapley, Paul Crump, Brian Gratwicke, Norhayati Ahmad, Federico Kacoloris, Melina Velasco, Aiko Taguchi, Devin Edmonds, Cassidy Johnson, Wikicommons contributors, and the AArk calendar contest photo entry participants. Finally, thanks to Unite for Literacy staff member Holly Hartman for her expertise, and who made creating the books such a fun and easy process.





Why We Need More Amphibian-Focused Protected Areas

By Alyssa Wiltse-Ahmad

Of the five major categories of vertebrates, amphibians are the most threatened, according to the International Union for Conservation of Nature (IUCN) Red List of Species. That isn't only bad news for all the frogs, toads and salamanders of the world, but also for all the rest of the living creatures on Earth, because amphibians are the bellwethers of change in our environment - the metaphorical "canaries in the coal mine" of our pollutive and destructive lifestyles. Most amphibians have thin, moist skin through which they breath, making them highly sensitive to any changes that occur in their environment, whether that be a small change in average temperatures or a new chemical introduced into the ecosystem. And as their populations continue to face extensive dangers in some parts of the world, it won't be long before the repercussions are felt by all of us.

Not only are they the most threatened of the vertebrates, but amphibians are also one of the most dependent upon their environment. Most require very specific conditions from their habitats—a clean water source for juveniles' development, as well as safe terrestrial habitats for adults, which results in extremely range-restricted populations. This is showcased well by one of Rainforest Trust's newest protected areas: the [Onepone Endangered Species Refuge](#) in Ghana.

Although this refuge protects many endangered species, the primary species targeted for the protected area was the Critically Endangered Togo Slippery Frog. When the IUCN conducted the first Global Amphibian Assessment (GAA) in 2004, this species was identified as being on the verge of extinction. Now, with the establishment of this new refuge, likely the largest population of the Togo Slippery Frog is being safeguarded. But the protections don't end there. The refuge is also safeguarding numerous other threatened or endemic species like Critically Endangered Hooded Vultures, Vulnerable Black-bellied and White-bellied Pangolins, a plethora of endemic butterfly species and additional amphibian species.

This refuge may only be 847 acres—an area likely too small to afford much protection to a much larger animal species like the African Elephant that also roams through Ghana—but it is exactly the right protected area for this habitat and the species that call it home. Within this rainforest, a forest stream flows, giving life to amphibians and local communities alike. And while this stream had been traditionally used as a source of drinking and bathing water, causing high levels of degradation to the amphibian populations, the two local communities understood this to be unsustainable. These communities came together with each giving up part of their ancestral lands to make this designation a reality. In return, the communities will receive a much safer source of freshwater from two solar-powered, underground water wells.

Another great example of amphibian-focused reserves impacting other threatened species and humans is the [Cerro Chucantí Nature Reserve](#) in Panama. This project, on which Rainforest Trust is currently working with local partner ADOPTA to expand by 127 acres, protects numerous endemic and threatened amphibian species, in particular some that are new to science and expected to be listed as critically endangered when the IUCN completes its assessment. The reserve also affords protection to Endangered Great Green Macaws and Baird's Tapirs, Vulnerable Giant Anteaters and Great Curassows and iconic animals such as Mountain Lions and Harpy Eagles.

In all, Rainforest Trust has completed projects that safeguard the habitats of 19 percent of all amphibian species on Earth, while future project sites will increase this protection to an additional six percent of amphibian species. Amphibian-focused protected areas are a necessity for ensuring both land and aquatic ecosystems are safeguarded from human activities that can and do have negative impacts on the rest of the planet. More evidence of this will likely be front and center at the second GAA that is expected to be released by 2020, depending on the availability of necessary resources.



No Pain, No Gain in the Search for this Lost Frog

By Lindsay Renick Mayer

If you're biologist Mauricio Akmentins, your first thought when you hear the call of a lovely little frog lost to science for the last 25 years is not "holy \$#@%, I think I just rediscovered the long-lost Baritú's Marsupial Frog!" Instead, your first thought is that somebody is playing a less-than-funny practical joke on you, adding insult to an adventure that has left you freezing and soaking wet in the center of Baritú National Park, home to one of Argentina's largest Jaguar populations.

"I started to yell at my colleague Martín Boullhesen, who sometimes tries to trick me by playing back frog calls on a recorder when we're in the field," Akmentins says. "When I remembered that Martín had already gone far ahead of me, out of range, I dropped my backpack and stood perfectly still, the adrenaline rushing through me. I knew right then what this moment meant."

Akmentins spent the next few hours in Argentina's Baritú National Park at the center of an overpowering chorus of Baritú's Marsupial Frogs, calling from bromeliads, holes in trees, the ground and rock crevices, and some calling as close as six feet away. Akmentins recorded the calls and took photos of two of the small gold-and-brown mottled frogs, enough to confirm the rediscovery of a frog that Akmentins and others have not been able to find despite concerted efforts since the 1990s. The August rediscovery was [announced in September](#) in Argentina's Cuadernos de Herpetología.

"The Baritú's Marsupial Frog's name means 'spotted with gold' because they have beautiful little golden spots," Akmentins says.

"They are the most beautiful marsupial frogs in Argentina. They are just precious, and their rediscovery gives us hope for other lost species."

RIGHT PLACE, RIGHT TIME, RIGHT FROG

There's an important lesson in the rediscovery of the Baritú's Marsupial Frog for our [Search for Lost Species](#) program: sometimes finding a lost species requires a little bit (or a lot!) of luck. On this trip, Akmentins was not specifically looking for the frog in Baritú National Park, but there to help a friend set up camera traps for a project on mammals.

He might not have found the frog if the temperature that day hadn't dropped precipitously, an environmental change that seemed to trigger the noisy breeding chorus the same day Akmentins happened to be there.

"The frogs are exactly where we would expect to find them—and where we've looked before without success," Akmentins says. "This species is active only a few times a year, so it wasn't about the place, but about the time. Previously we'd go to the field when it would start to rain, so it seems we've been a day too late every time we tried to find them over the last 10 years."

The Baritú's Marsupial Frog is the second lost Argentinian marsupial frog that Akmentins can now add to his list of rediscoveries. His first find was the La Banderita Marsupial Frog (*Gastrotheca gracilis*), which Akmentins and team rediscovered in 2011. The third and final marsupial frog on his dream list, Calilegua's Marsupial



Frog (*Gastrotheca cristiani*), is one of our Search for Lost Species program's **most wanted lost amphibians**—and he and Boullhesen are **already on that case**.

FIT FOR A FROG: ARGENTINA'S FINAL FRONTIER

In the 1990s, Argentina's marsupial frogs seemingly suddenly vanished. While biologists are still trying to piece together the puzzle of what happened to the frogs, they suspect a complex combination of threats that has devastated amphibians across

the Neotropics, including habitat loss, the deadly amphibian disease chytridiomycosis, and climate change. The **IUCN Red List of Threatened Species** classifies the Baritú's Marsupial Frog as Vulnerable, though that status is currently under revision. Nationally the species is considered Endangered.

For now Baritú National Park is home to the largest variety of wildlife in Argentina and a safe haven for Baritú's Marsupial Frog and the other wildlife that live there. It is **nearly impossible to access the park**—visitors have to enter through Bolivia—and outside of a rush to clear cut the forest in the '50s, the area has remained pristine. But extreme cuts to Argentina's science and environmental ministry could mean fewer scientists in the field and fewer funds for effective habitat protection, threatening both the park and the frog's future.

"Sometimes in these situations, the government will allow the creation of a road in the park," says Kelsey Neam, GWC's program officer of IUCN Red List assessments. "The reason Baritú is so well protected is because it's very difficult to access. But the minute you build roads, that protection is compromised."

Despite the budgetary challenges, Akmentins aims to do what he can to help ensure the protection of the threatened amphibian. He will return with a team in November to search the frog's breeding sites, determine the size of its population, and swab the skin of additional individual frogs to test for disease.

"I didn't brave the rain and the cold and the Jaguars only to lose this species again," Akmentins says. "Just as we were hopeful we could find it, we're hopeful that it has a future."



Biologists Martín Boullhesen and Mauricio Akmentins at Baritú National Park. Photo: Martín Boullhesen.



ACSAM2 participants who helped develop the New Sahonagasy Action Plan. Photo: ACSAM2.

A Conservation Strategy for the Amphibians of Madagascar: Where are we now?

By Serge Ndriantsoa, Andolalao Rakotoarison, Tsanta Rakotonanahary, Franco Andreone, Angelica Crottini & Jeff Dawson

Researchers have been working to protect the amphibians of Madagascar for a number of decades though often independently and with no formal coordination. Following the development of the global Amphibian Conservation Action Plan in 2006 the IUCN Species Survival Commission Amphibian Specialist Group Madagascar was formed. Shortly after, a first meeting to develop A Conservation Strategy for the Amphibians of Madagascar (ACSAM) was held in Antananarivo. Bringing together experts from across the country and globally, the first national amphibian action plan, the Sahonagasy Action Plan was developed and accepted by the Malagasy authorities and several the proposed actions have been implemented contributing to the effective conservation of this vulnerable biodiversity.

Six years later in 2014 a second ACSAM meeting was held in Ranomafana to review the progress of the first action plan and produce an updated one: the [New Sahonagasy Action Plan 2016-2020](#) (NSAP). Since the publication of the first action plan many progresses has been made. Those include the establishment of the country's first amphibian captive breeding centre at Andasibe; the formation of the national Chytrid Emergency Cell and the establishment of the pre-emptive national chytrid monitoring programme, among others. However, despite the many improvements and investment by several international NGOs and conservation funders the conservation situation for Madagascar's amphibians remains critical.

Following the indications of the NSAP a multitude of different activities have been promoted by the Amphibian Specialist Group (ASG)-Madagascar in the last two years. Both local and international groups, agreed that a lack of coordination and local capacity is limited the implementation of the first Action Plan. To address this lack of national coordination the Amphibian Survival Alliance together with Durrell Wildlife Conservation Trust, IUCN Amphibian Specialist Group Madagascar and Global Wildlife Conservation secured a three year grant from the Critical Ecosystem Partnership

Fund (CEPF), with the project entitled "Building a Future for the Amphibians of Madagascar". This has enabled the hiring until mid-2019 of two Malagasy staff: Tsanta Rakotonanahary (Amphibian Programme Lead, APL) and Serge H. Ndriantsoa (Amphibian Programme Officer, APO).

These two roles principle aim is to act focal point for amphibian conservation activities in Madagascar, and to coordinate the overall implementation of the main themes of the NSAP 2016-2020 which are:

Theme 1: Coordination of research and conservation activities. Overall delivery of the action plan including coordination, communication and fundraising. It also includes many crosscutting actions such as education and awareness-raising relating to amphibians; collection and export permits; in-country molecular laboratory development and in-country amphibian museum collections.

Theme 2: Monitoring Madagascar's amphibians and their environment. Includes identifying and monitoring key species and sites; developing monitoring capacity within Madagascar and climate change research to improve our knowledge of amphibians in Madagascar, their environment and threats, monitoring the spread and impacts of invasive Asian toad

Theme 3: Emerging infectious diseases. Includes monitoring and research into disease threats; strategic planning for mitigating potential future disease outbreaks and disease-specific education, awareness-raising and communication.

Theme 4: Site management for the conservation of amphibians. Includes developing new Protected Areas and Key Biodiversity Areas for amphibians and integrating amphibian conservation more into existing Protected Area management plans.

Theme 5: Harvesting and trade of amphibians. Relates to the research and monitoring of amphibian species within both the international and domestic trade.

Theme 6: Captive breeding and zoo actions. Relates to the captive breeding of Malagasy amphibians' in-country and overseas

and includes captive capacity development in Madagascar and associated captive breeding awareness raising and research.

In collaboration with national government agencies, national and international NGOs, and researchers, the APL and APO have been working to facilitate the achievement of some important key actions including:

- facilitating the implementation of the National Chytrid Monitoring Program;
- facilitating expeditions and surveys for amphibians and *Bd*-chytrid research;
- identifying potential new Protected Areas for amphibians in the country;
- producing draft biosecurity and reporting protocols for people;
- producing draft response plan in the event of mass mortality events;
- producing draft instructions for amphibian monitoring protocols and standardized recording sheets.

Within these activities, strengthening the capacity of coordination and contact in the conservation community in Madagascar is a key component of the CEPF funded work, so as to aid the implementation of the NSAP. Work began on identifying and developing national network of groups and organization engaged in amphibian conservation, with the aim of increase their amphibian conservation effectiveness through identifying capacity development needs, promoting their stories and assisting in identifying funds to support their work. Over the last year the APL and APO have provided assistance to Vondron'Ivon'ny Fampanandrosoana (VIF) in funding applications and capacity assessment activities for the implementation of conservation activities on the Ankaratra Massif. They have also supported Madakasikara Voakajy and Centre Val-Bio, with funding from Rainforest Trust, in identifying sites with high species richness in amphibians that are located outside protected areas for future conservation work.

The 2018 work plan has identified a number of key objectives to be achieved this year including:

Increase the development of national networks for amphibian conservation and identify a strategy to synergise their work to promote the identification of capacity development areas and engage other groups in amphibian conservation;

Continue supporting the Chytrid Emergency Cell in implementing their actions to maximize results including national monitoring programme and finalising various protocols;

Develop and provide environmental education, information and awareness campaigns to Malagasy society on issues related to amphibian conservation and disseminate information on amphibians in Madagascar and their conservation to national and international audiences.

Madagascar is one of the only countries to have both a national amphibian action plan and positions to help coordinate delivery of it in place. The NSAP represents a unique opportunity for driving forward amphibian conservation at a national level in one of the world most important and threatened amphibian regions. To ensure amphibians of Madagascar have a bright future requires proactive engagement from both the national and international communities. If you are interested in engaging in amphibian conservation activities in Madagascar or want to know more contact Tsanta or Serge at trakotonanhary@amphibians.org and sndriantsoa@amphibians.org or the ASG-Madagascar co-chairs Franco Andreone (franco.andreone@gmail.com) and Andolalao Rakotoarison (andomailaka@gmail.com)



VIF members undertaking knowledge. Photo: Serge Ndriantsoa.



Fig. 1. The Asian Black-spined Toad *Duttaphrynus melanostictus* (right) and the superficially similar Cane Toad *Rhinella marina* (left). Photos: Matthew Mo.

Keeping Asian Black-spined Toads *Duttaphrynus melanostictus* out of Australia

By Matthew Mo

Everyday Australians are no strangers to toads, despite there being no native species. In a country where the economic impacts of invasive species may cost up to \$740 million per annum (1), biosecurity is a major focus of both primary industries protection and biodiversity conservation in Australia. In recent times, new and emerging pests are increasingly comprised of herpetofauna, owing to accidental stowaways (2,3) and the illegal pet trade (4-6). Historically, one amphibian species has served as a prominent example for the importance of protecting Australia's biosecurity; the Cane Toad *Rhinella marina* was captive bred from imports from Hawaii, where an existing invasion should have been a

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lesson to learn, and liberated in Queensland, northern Australia, in 1935 (7). In less than 100 years, the Cane Toad spread rapidly, leaping across the borders of the Northern Territory, Western Australia and New South Wales (8,9). Such a noticeable invasion front and reports of native animal mortalities from ingesting their venom have led to widespread disfavouring of toads amongst members of the general public.

A similar anuran, the Asian Black-spined Toad *Duttaphrynus melanostictus* is a common amphibian of lowland habitats across much of Asia. Its natural distribution ranges from the Indian Subcontinent and southern China to southeast Asia. Here, the species is well known to local people, being one of the most prolific amphibians in suitable habitats (10). Interestingly, Australian military



Fig. 2. Locations where three free-living Asian Black-spined Toads *Duttaphrynus melanostictus* have been detected in Australia: A. Sunbury, Victoria, April 2014; B. Belrose, New South Wales, March 2015; C. Cloverdale, Western Australia, November 2017.

personnel noticing the toad's invasion of Timor Leste in 1999 mistook them for Cane Toads (11). The Asian Black-spined Toad is after all superficially similar to the Cane Toad and also exudes venom from the parotoid glands (Fig. 1). The first quarantine inspectors finding Asian Black-spined Toads stowed away in shipping containers also identified them as Cane Toads (7). Only when these preserved specimens were re-examined was identification corrected. The acute awareness Australians have that exotic toads are bad for local biodiversity can be beneficial for keeping at least the Asian Black-spined Toad out.

Anurans are routinely discovered in airports and seaports by government agencies. This is no surprise considering they seek shelter in artificial items and some function as human commensals. Such habits proliferate the likelihood of anurans becoming nestled in shipping containers, international vessels and luggage (6). The Asian Black-spined Toad has already proven to be a successful invader. Although the earliest known invasion, one on the island

of Mauritius prior to 1837, appeared to have dissolved by 1914 (12), the toads went on to successfully colonise new ground in the Maldives, the Andaman and Nicobar Islands, Bali, Sulawesi, West Papua, Borneo, Lombok, Sumbawa, the Maluku Islands, Timor Leste and most recently, Madagascar (6,11,13). The exact timing of many of these invasions is not known due to the continuous stream of trade and transportation and lack of quarantine protocols.

Prior to 1999, only one Asian Black-spined Toad was known to have been intercepted at the Australian border (6). This animal was discovered at Darwin airport in 1988. Since 1999, more than 110 Asian Black-spined Toads have been intercepted at airports and seaports and most are alive at the time of detection. The majority are stowaways from Indonesia and Thailand, some curiously gaining media interest from being carried over in people's shoes (13). At seaports, shipping containers carrying mining equipment have turned up a number of toads (7,13), indicating these transportations require particular attention.

Fortunately, there are currently no known established populations of the Asian Black-spined Toad in Australia. Climatic modelling has been undertaken to assess whether this species could survive in Australian environments. One model suggested that large expanses of northern Australia were a moderate to high match compared with locations in Asia where the species occurs (14). Interestingly, a separate model suggested instead that southeastern Australia was a better match for these toads (6). Irrespective of the different approaches taken and the varying results, both models agree that the Asian Black-spined Toad could establish in Australia. The more recent model shows an alarming prospect of this second toad species colonising parts of Australia not reached by the Cane Toad.

At the border, the invasion front is largely fended off by government officials, although increased awareness amongst travellers would definitely benefit. When toads breach unnoticed, the battle to remove free-living specimens lies mainly with members of the public. In 2009, works found a number of toads in a shipping container in Melbourne, sparking fears of an invasion because the container had been opened for some time prior to the toads' discovery. Authorities investigated collaboratively with amphibian experts from the University of Melbourne, finding no escaped toads in the vicinity (13).

The case of the opened shipper container was a close call, but closer calls have occurred. Three examples of free-living Asian Black-spined Toads have so far been documented (Fig. 2). The first

occurred in the Melbourne suburb of Sunbury in April 2014. Local residents discovered a toad in their dog's water bowl, prompting authorities to conduct a surveillance operation, which resulted in no further finds. To date, no further reports of toads have arisen from this location.

In March 2015, a second incursion occurred in Belrose, a suburb in Sydney's north. Staff of the Belrose Veterinary Hospital discovered the toad in the garden and brought it to local government staff. It was taken to the Taronga Wildlife Hospital for species identification and necropsy. An examination found that the toad was a female with over 1,000 unfertilised eggs. Authorities conducted visual and call surveys along a stream in nearby bushland and did not find any further toads. It was later known that new residents adjacent to the veterinary hospital had recently moved from Singapore, which provides explanation for the toad being a stowaway.

Most recently, in November 2017, a resident in Cloverdale, Perth found a toad in a ground hole beneath a fence stump. The resident alerted authorities by contacting a phone number advertised by Western Australian authorities for reporting Cane Toad sightings. The animal was placed in a sealed bucket awaiting authorities to collect it, after which formal identification was made. Again, surveillance efforts did not find any further toads in the vicinity.

In the above cases, the first actions in containing the toads were taken by non-government individuals. While ultimately the surveillance operations that followed each report were the responsibility of government authorities, these operations are limited because of the reduced detectability of animals at low numbers (15). More effective surveillance lies in the capability of a 'toad-savvy' population to recognise Asian Black-spined Toads and report them. After all, these animals are more likely to be discovered by members of the public rather than government officials, especially on private land. Community awareness and educational campaigns therefore play a role in encouraging reporting of any future free-living toads (16); though fortunately, it seems the long-running saga of the Cane Toad in Australia has prepared the vast majority of the general public to take action on sightings of either species.

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Photo: Matthew Mo.



Photo: Matthew Mo.

Comments on the Swabbing of Anuran Tadpoles for the Detection of Infectious Diseases

By Steven J. R. Allain

Over the past few months I've presented some research at a couple of conferences on the disease monitoring of a non-native amphibian species here in the UK (see *FrogLog* 119). Whilst presenting my methods and data, one thing has consistently confused the audience – the swabbing of tadpoles for the detection of infectious disease. The routine swabbing of amphibians is an important practise for both the detection and monitoring of diseases. Previous studies such as (1), describe a slightly dated method for the swabbing of anuran tadpoles with the use of toothpicks. Modern day amphibian infectious disease studies use surgical cotton swabs (e.g. Medical Wire MW-100) to test for the presence or absence of a particular disease, such as the amphibian chytrid fungus (*Batrachochytrium dendrobatidis*; hereafter *Bd*). The method outlined by (1) can still be used as it involves the sampling of the tadpole's mouthparts which is important as this is the area that *Bd* infects in the earlier Gosner stages (2).

Some of this confusion may be due to a lack of familiar protocols for the swabbing of larvae as most researchers will be used to sampling post-metamorphic individuals. Therefore I intend to put more emphasis on the methods used to collect a swab from a tadpole to help raise awareness of this widespread yet uncommon practise. Many studies have included tadpoles in their sampling for infectious diseases and thanks to the confined nature of larvae; they are restricted to ponds and can easily be captured in nets. Confusion may stem from the fact that most studies clearly use the correct technique yet only give a passing comment on the methods used, for example (3) states "To swab tadpoles, we made five swipes across the mouthparts."

Although technically correct, it doesn't help in terms of replicability due to a number of factors which will shortly be discussed. Confusion may also come from the fact that anurans are usually swabbed between their limbs and digits, yet tadpoles don't develop these until their later Gosner stages (4). When swabbing post-metamorphic amphibians, between ten and fifteen strokes are made with the in areas where infection is suspected. With tadpoles

there doesn't appear to be a set number within the literature although between five and ten swipes should suffice.

Unfortunately not all tadpoles encountered can be swabbed; this is particularly true of smaller individuals due to the fact that their mouthparts are too diminutive. The limiting factor here is the size of the swab used, which may unfortunately mean that diseases such as *Bd* are not detected in a population if only the larger individuals are swabbed, due to disproportionate sampling. Care also has to be taken, as noted by (1), as vigorous swabbing can lead to damage of labial teeth in tadpoles which may make such infections more likely to develop. It's not currently clear if over-zealous swabbing can lead to future facial deformities in tadpoles. Due to size and metamorphosis, it is important to try to sample tadpoles between Gosner stages 26 and 39.

The facial structure of anuran tadpoles is not equal among species; some species have an elaborate oral disc which is usually specialised for feeding (5). For species such as this, the oral disc can be artificially extended by giving the tadpoles a gentle squeeze. Again, care has to be taken not to cause any lasting damage. Swabs should then be placed within the oral disc itself and spun between the thumb and index finger whilst moving through the delicate structure. When handling tadpoles, desiccation is a risk so sampling times should be minimised as much as possible with tadpoles being released at the point of capture after swabs have been taken. It is not clear whether or not this same swabbing technique can be used for urodelean larvae, this is an area where further research is needed. When handling larvae, it's important to keep handling time to a minimum while taking samples.

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Photo: Steven J. R. Allain.

Conservation Needs Assessments for Malaysian Amphibians

By Kevin Johnson

Malaysia is home to 265 species of amphibians, with 144 of these being endemic to the country, 46 species previously listed as threatened (3 Critically Endangered, 10 Endangered and 33 Vulnerable), 30 species listed as Data Deficient and 61 species not previously assessed for the Red List. In 2012, 169 Malaysian amphibian species were assessed for their conservation needs, however these assessments were made using an early version of the assessment process, which was not as reliable as the current version, and were in need of re-assessment.

In January this year, seven Malaysian amphibian experts met with Programme Officers from the IUCN Amphibian Red List Authority and Amphibian Ark, to undertake Red List Assessments and Conservation Needs Assessments for these species. This joint assessment workshop was a great opportunity for both organizations to see each other's processes, as well as the outcomes from each set of assessments, and to make the best use of resources, and of course, the participants' time. Red List assessments (www.iucn-redlist.org) determine the relative risk of extinction, to highlight those species that are facing a high risk of extinction, while the Conservation Needs Assessments (www.conservationneeds.org) produce prioritized recommendations for a range of conservation actions, which will hopefully help to prevent further extinctions.

The workshop was hosted by the School of Biological Sciences, Universiti Sains Malaysia, in Penang, and was funded by Rainforest Trust and Amphibian Ark. We worked in two groups, split geographically, with one group focussing on species from Peninsular Malaysia, and the other group working on species from Malaysian Borneo. The focal species were those which either had not previously been Red Listed, or species whose Red List assessments were

quite out of date, or those where significant changes had occurred in the wild populations since the last Red List Assessment was made.

This joint approach to assessments was very successful, and the participants were happy to see recommendations being made for future conservation actions. Some of the assessments require additional input from experts who were not present during the workshop, and this will hopefully be completed within the next couple of months. The Red List Assessments will be reviewed within the next few months, with the final Red List category being determined, and the assessment information being published online. The Conservation Needs Assessments will also be reviewed, and once approved, will also be available online.

Collectively, we managed to complete 126 Conservation Needs Assessments, with another 41 assessment which require some additional input from other experts currently being reviewed and updated. Since the meeting, we have reviewed all the assessments, corrected any grammatical issues, and hopefully, corrected any spelling mistakes. The 126 completed assessments are now available on the Conservation Needs Assessment web site (www.ConservationNeeds.org), and the assessment data is also available in all reports on the site.

Of the 126 assessments completed so far, four threatened species were recommended for urgent *ex situ* rescue (*Leptotalax kecil*, *Ingerophrynus kumquat*, *Ansonia smeagol* and *Abavorana nazgul*). Three of these species have never been held in captivity before and more common, but related analog species have been recommended that can be used to develop husbandry and breeding protocols prior to the threatened species being brought into captivity. AArk staff

will work with our colleagues in Malaysia to investigate potential captive programs for these species, however additional field work is required to determine the suitability of establishing rescue programs for these species.

We hope that the Amphibian Red List Authority and AArk staff have the opportunity to follow this joint approach to assessments in the future, and both groups are currently reviewing their priority countries and regions to determine potential overlap with future assessments.



A group of experts in the field of Malaysian amphibians gathered in Penang in January to carry out Red List and Conservation Needs Assessments for Malaysian amphibians. Photo: Kevin Johnson.

A European Early Warning System for a Deadly Salamander Pathogen

By Tariq Stark, An Martel, Frank Pasmans, Valarie Thomas, Maarten Gilbert & Annemarieke Spitzen

The chytrid fungus *Batrachochytrium salamandrivorans* (*Bsal*) was described in 2013 after the rapid decline of a Fire Salamander population (*Salamandra salamandra*) in the south of the Netherlands (1, 2). This population experienced a 99.9% decline over a seven-year period with no signs of recovery. Soon after the description of *Bsal* more outbreak sites with massive population crashes were discovered in Belgium, Germany and in additional sites in the Netherlands (3, 4). In most cases Fire Salamander populations were affected but Alpine Newts (*Ichthyosaura alpestris*) and Smooth Newts (*Lissotriton vulgaris*) also suffered mortalities (4, 5). In 2017 *Bsal* was also detected in Great Crested Newts (*Triturus cristatus*) and Palmate Newts (*Lissotriton helveticus*) in Germany (5) but without obvious clinical signs. *Bsal* is deadly to nearly all European urodelans and poses a massive threat to European urodelan diversity (6).

Bsal originated in Asia and likely arrived in Europe via the trade in Asian salamanders and certain Asian anurans (6-9). From these vectors, it is believed *Bsal* spilled over to European salamanders and newts, which are naive to the pathogen, and most die soon after being infected. Recently Stegen *et al.*, (2017) found that Alpine Newts with low *Bsal* infection intensity may persist with the fungus, and even clear the infection. This means that these newts can vector the fungus, as can some anuran species. *Bsal* has also been detected in populations of captive urodelans in the Germany, the Netherlands, Spain and the United Kingdom (10-14).

Legislation has anticipated on halting the spread of the fungus via trade. The USA has banned the interstate transport and import of salamanders and newts in 2016, Switzerland has banned the import as has Hungary and the EU has recently announced animal health protection measures for intra-Union trade in salamanders

in order to prevent further introduction of *Bsal* (<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018D0320&from=NL>).

The current knowledge of the distribution of *Bsal* outside of its native range is incomplete. It might be present in more European countries than currently known. Early detection of *Bsal* induced population declines is therefore very important. Especially urodelans with small ranges and/or small population sizes are at risk. In order to stem the tide of amphibian population declines and prevent mass extinctions, the European Commission (EC) issued the tender ENV.B.3/SER/2016/0028, Mitigating a new infectious disease in salamanders to counteract the loss of European biodiversity).

GENERAL OBJECTIVES

Bsal has devastating effects on European urodelans and measures to protect them from these are of the utmost importance. The general objectives of this project can be summarized as followed:

- Delineate the current range of *Bsal* in Europe
- Create an Early Warning System which allows the rapid detection of novel *Bsal* outbreaks
- Development of an emergency action plan (short term)
- Provide proof of concepts for sustainable long-term mitigation measures

This article focusses mostly on the first and second objective. More on the [third](#) and [fourth](#) objective can be found on www.Bsal-Europe.com.

EARLY WARNING SYSTEM

Website: We created an online platform BsalEurope.com (Fig. 1) in order to educate the European public on *Bsal*, with the aim to detect novel *Bsal* outbreaks throughout Europe. This website replaces the previous website (<https://bsalinfoeurope.wixsite.com/eubsalmitigation2017>). The site BsalEurope provides [general information](#) on *Bsal*, from pathogen characteristics, clinical signs and hosts, to the European distribution of *Bsal*, options for treatment and prevention. The map of the current known distribution of *Bsal* in Europe will be kept up to date. In addition, several [public awareness materials](#) were created which aid in the early detection of *Bsal* outbreaks. Reporting dead- and moribund animals is very important, therefore [regional hotlines](#) and [Bsal diagnostic centres](#) are listed on BsalEurope. Comprehensive lists of [scientific and popular scientific papers](#) can also be found on the website in addition to more helpful resources. BsalEurope will be updated on a regular basis, so be sure to bookmark it!

Public awareness materials: On BsalEurope several public awareness materials can be found that were specifically created for this project: three videos and several informative leaflets. The [first](#) of the animated videos show where *Bsal* originates from, outlines its effect on European urodelans and where you can report dead- and moribund animals. The [second animation](#) outlines best practices for captive populations: biosecurity measures, quarantining of newly acquired specimens and a call to report dead- and

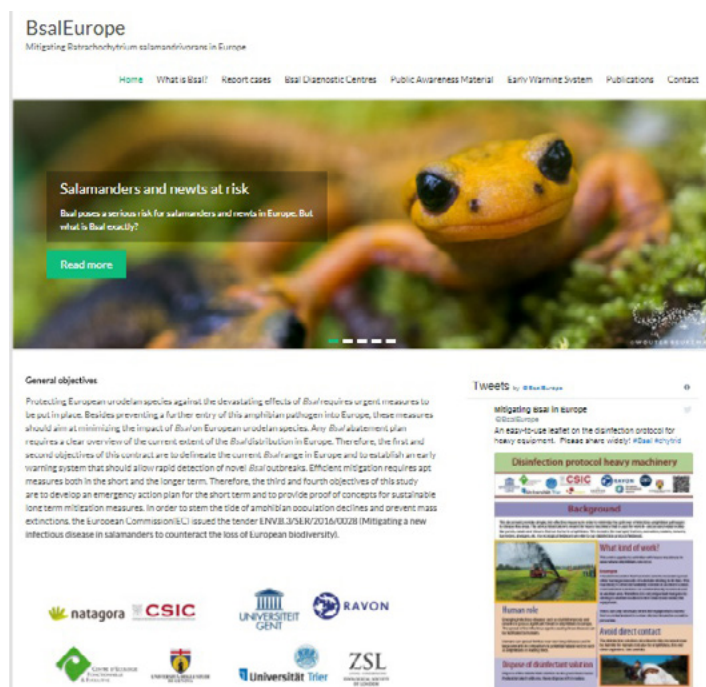


Fig. 1: Homepage of BsalEurope (www.BsalEurope.com)

moribund animals (Fig. 2). The **third video** stresses the importance of adherence to a field hygiene protocol in order to reduce the risk of human-mediated pathogen dispersal. Both animated clips have subtitles in 16 European languages in order to reach a large (European) audience. The clips can be found on the **YouTube Channel** of Reptile, Amphibian and Fish Conservation Netherlands. The other public awareness materials are three easy-to-use leaflets on **recognition of Bsal in urodelans** (including FAQ's for fieldwork and captive collections), disinfection protocols for **fieldwork** and **heavy machinery** (Fig. 3).

Report cases: In order to detect Bsal outbreaks and hence delineate the current range of the pathogen in Europe an Early Warning System is of the essence. If you have found a salamander or newt that is not the obvious victim of traffic or predation, then please report it to your nearest **regional hotline**. Now, eight hotlines have been established in eight EU countries. The network of **diagnostics centres** in the EU currently consists of 14 laboratories in 11 countries. Ghent University centralizes all data on Bsal outbreak and monitoring.

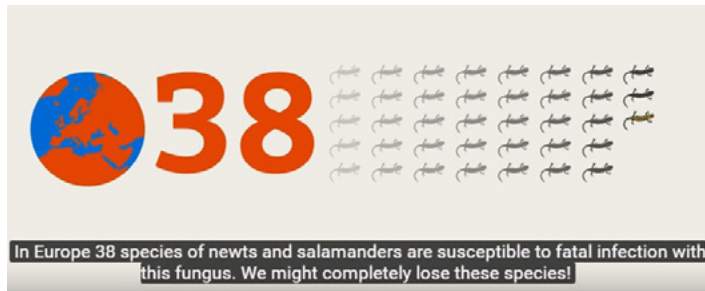


Fig. 2: Screenshot of one of the animated videos.



Fig. 3: Example of one of the leaflets on hygiene protocols.

In addition, a European network of stakeholders that will report urodelan population declines is being developed.

When you notice suspicious deaths or sick animals, please take the following steps:

- Do not handle sick or dead amphibians with your bare hands
- Use your mobile phone or other device to take multiple photos of the animal (from all sides).
- Be sure to include photos of any obvious lesions which you notice on its body.
- Make a note of the location, date, time, number of animals which are sick or dead.
- In Europe, it is prohibited to collect wildlife (alive or dead) from the environment. Therefore, please contact the relevant hotline listed below as soon as possible for further action.

Monitoring: The detection of disease induced population declines relies heavily on long-term monitoring schemes. Several European NGO's developed programs where individual amphibian species, populations and communities are followed in long-term monitoring schemes. Long-term studies are extremely valuable to assess population trends and can act as an Early Warning System when populations are declining (especially rapid declines). Sharp declines can be a sign of the involvement of a pathogen, like *Bsal*, and follow-up research can quickly be deployed. Interested in participating in such a program? Please contact one of the regional hotlines.

Contact and follow us: An Early Warning System only works when many organisations, professionals and volunteers work together. Questions about this project can be directed to Prof. Dr. An Martel of Ghent University via email (An.Martel@ugent.be) or via the **contact form**. The project also has it's very own Facebook- (@B.salamandrivorans) and Twitter accounts (@BsalEurope). Be sure to follow us!

Partners: This project is a collaboration of Ghent University (Belgium: Flanders), Natagora (Belgium Walloon), The Spanish National Research Council (Spain), Reptile, Amphibian and Fish Conservation Netherlands (the Netherlands), Centre d'Ecologie Fonctionnelle et Evolutive (France), Genoa University (Italy), Trier University (Germany), Zoological Society of London (United Kingdom). This tender (ENV.B.3/SER/2016/0028 (Mitigating a new infectious disease in salamanders to counteract the loss of European biodiversity) was issued by the European Commission.

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In Search of the Giant of the Pampas: Gathering Conservation Efforts in Argentina, Brazil and Uruguay

By Camila Deutsch^{1,9}, Luis Fernando Marin da Fonte^{2,3}, Raúl Maneyro⁴, Andreas Kindel^{5,6}, Natália Dallagnol Vargas⁷, Marcelo Duarte Freire⁷ & Gabriela Agostini^{1,8}

The Ornate Horned Frog (*Ceratophrys ornata*) is a threatened amphibian species that occurs in the South American temperate grasslands (Figs. 1-4). The historical distribution included the Pampean Region of Argentina, San José and Rocha Departments in Uruguay, and Rio Grande do Sul State in Brazil (1). However, this large range could actually be smaller considering that local populations from Argentina have apparently declined and the species has not been recorded in Uruguay and Brazil for the last 35 years. Until 2016, published occurrence data in Argentina based on field surveys undertaken over the last 30 years were scarce, representing only a few localities in the Pampean Region (2,3,4). On the other hand, the most important herpetological collections of Argentina hold an important number of specimens collected between 1898 and 1980 from areas where the species is currently rare. In Uruguay, *C. ornata* was collected for the last time in Valizas (in 1982) and the species also occurred in two additional localities: Barra de Santa Lucía (specimens collected in 1970) and La Coronilla (specimens collected in 1972) (5). In Brazil, records are also scarce, obtained at the southern end of the Brazilian coast in Santa Vitória do Palmar (in 1974, 1976 and 1977) and Rio Grande (in 1979 and 1980) (6,7).

Our knowledge of the biology and natural history of *C. ornata* is deficient and mostly based on observations. It is a voracious flesh eater, feeding on arthropods and small vertebrates (including amphibians) (8) and there are some reports of cannibalism. During the dry season it remains underground, encased in a keratinous cocoon. After staying in this latent condition for a long time, it suddenly becomes active after storms or floods (9). This period of activity is short and hard to predict, making the species difficult to sample and monitor in the field.

CONSERVATION STATUS AND THREATS

Its global conservation status is Near Threatened (10), while it is considered as Vulnerable in Argentina (11) and Uruguay (5), Near Threatened (approaching Endangered) in Brazil (12) and Critically Endangered in Rio Grande do Sul State (13).

The major threats to the species seem to be habitat loss from agriculture and housing developments. Water and soil pollution from agriculture, industry, and human settlements have also been suggested as factors causing population declines (10). In this regard, it is important to highlight that *C. ornata* occurs in the Campos and Pampas of South America which represent one of the most productive agricultural areas of the world (14). Native grasslands

throughout this ecoregion were gradually turned into agro-ecosystems over the past two centuries, leaving almost no pristine grassland areas (15). The introduction of GMO glyphosate-resistant crops and the use of no-till technologies have promoted an unprecedented growth of the agricultural frontier (16). The last remaining patches of semi-natural habitats are small and isolated, frequently



Fig. 1: Map of the estimated range of *Ceratophrys ornata*.



Fig. 2: *Ceratophrys ornata* in Argentina. Photo: Gabriela Agostini.



Fig. 3: Male *Ceratophrys ornata* still calling after caught. Photo: Gabriela Agostini.

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Fig. 4: *Ceratophrys ornata* in Argentina. Photo: Pablo Saibene.

in unproductive or marginal locations, like roadsides, train lines or around lakes (17).

C. ornata is often persecuted because of unfounded beliefs that it is a venomous species. In Argentina, a survey to understand local perceptions of the species was carried out in rural communities and indicated that 80% of encounters end with the death of the frog (18). In the Pampean region of Argentina, it is also collected for the domestic pet market and for scientific purposes at the national level. There is no knowledge of the species being exported, not even illegally, neither for Argentina nor for Uruguay (18, 19).

Given the threats mentioned above, the current lack of records and the replacement of virtually all suitable habitat by agricultural and urban landscapes, the scientific and conservation communities have warned of the imperative to initiate conservation actions.

THE ORIGIN OF OUR WORK

For several years, scientists from Buenos Aires University and the CoAnA Initiative (Amphibian Conservation in Agro-ecosystems) have been studying amphibians from the Argentinean Pampas grasslands and investigating some proposed factors for the global amphibian decline (habitat loss, pesticide impacts, chytrid fungus diseases and abnormalities) (3, 20). That extensive fieldwork generated novel data for *C. ornata* based on studies conducted in natural populations (21). Most of the data were obtained working together with farmers living in rural areas where *C. ornata* occurs (Figs. 5, 6). In 2015, CoAnA established the conservation initiative “The Giant of the Pampas”, which the first objective was to gather occurrence data in order to better define areas where the species still occurs, and then develop conservation and management actions in Argentina. Given the challenges in expanding the knowledge of the species’ distribution and considering that *C. ornata* is an iconic and unique species, the potential benefits of employing a citizen science approach in rural communities as a complement to traditional field surveys were assessed.

THE CITIZEN SCIENCE PROGRAM IN ARGENTINA

In a conservation strategy framework, the CoAnA team set up a citizen science program (CSP) to obtain occurrence data as a complement to field research using online surveys and direct interviews (21). Additionally, the CSP included an exhaustive outreach campaign intended primarily to encourage people to collect and report occurrence data. Because this program was developed within a comprehensive conservation strategy framework, the outreach campaign was also designed to promote and raise awareness of *C. ornata*, the threats it is facing, and other conservation issues. This program successfully increased by nine times the number of records obtained during ten years of field surveys. It was also possible to define the potential distribution and determine two priority conservation areas for this species in Argentina (Atlantic Coast of Buenos Aires and northwestern Pampean Region) (21). This extensive work allowed us to maintain contact with farmers who are still reporting occurrence data for the species, playing an important role for future monitoring studies needed to set up conservation actions and their outcomes.



Fig. 5: Field work: DNA sampling. Photo: Gabriela Agostini.

EXPANDING THE BORDERS: THE INTERNATIONAL STRATEGY

The experience in Argentina indicated that well-designed citizen science methods can provide a cost-effective approach to collect occurrence data for *C. ornata*, in addition to conventional field surveys. Based on this successful experience, we are creating an international strategy aiming to expand activities into Brazil and Uruguay, encompassing the species' global distribution. Although the Giant of the Pampas has not been found in these countries for over 35 years now, specialists agree that the absence of recent records might be linked to its burrowing habits and the lack of targeted searches in the field.

In Brazil, we intend to replicate the CSP combined with targeted field sampling in localities with confirmed and potential records. We aim to: (i) rediscover the species in Brazil and Uruguay, adding new localities, mapping and improving the description of its Area of Occupancy (AOO) and Extent of Occurrence (EOO), as defined in (22); (ii) identify and describe the main threats to the species; (iii) create and establish a protocol in Portuguese to apply CSP as a useful tool for the study of rare and threatened species; (iv) contribute towards other conservation actions currently underway, like the creation of a new protected area close to the Brazil-Uruguay border near the coast, and the identification of other priority areas for the conservation of the Pampa biome in Brazil; and (v) develop a National Action Plan for the species' conservation.

This is the first international conservation initiative for an anuran species developed by South American institutions and it involves extensive efforts, working together with NGOs, Universities and Government Agencies. With this multinational cooperation, we hope to better understand the global geographic distribution of the species, its natural history and the major threats affecting populations. Combining the results obtained in the three countries, we intend to create a global strategy to guarantee the frog's conservation and to promote the Giant of the Pampas as a flagship species for the conservation of the South American grasslands.

HOW CAN YOU HELP?

Have you ever seen the Giant of the Pampas? If you were so lucky, please complete this brief survey and do not forget to add pictures or any additional information to validate your recording.

- Spanish: <https://goo.gl/forms/EkJB9rzoE5iz9NIS2>
- Portuguese: <https://goo.gl/forms/3xr0qPH7Vt06f8PY2>
- Or contact us: gigantedelaspampas@gmail.com



Fig. 6: Working in rural communities. Photo: Gabriela Agostini.

MYTHS AND LEGENDS

It is NOT a poisonous species. NO skin substance has been found that could cause injury or death from poisoning on humans or domestic animals.

The Ornate Horned Frog DOES NOT attack. Sometimes these animals can be aggressive if they feel threatened. If an individual is disturbed or removed from its cave, it can open its mouth and inflate the body. This is just a defense signal.

Its bite DOES NOT inoculate venom. These animals have no teeth or poisonous glands. Under stress, they open their big mouths and emit a characteristic sound that represents just another defensive behavior.

In case we were not clear...this amazing creature IS NOT dangerous.

Acknowledgments

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The Variable Harlequin Frog in all its golden-hued glory. Photo: Cori Richards-Zawacki.

Against the Odds: Panama's Lost Frogs Cling to Life in *Bd*'s Wake

By Lindsay Renick Mayer

Hope can arrive in all different shapes and sizes. For biologists Dr. Cori Richards-Zawacki and Dr. Jamie Voyles, in 2012 hope came in the shape of a small black and golden



The deadly amphibian pathogen chytridiomycosis has wiped out frogs in the Neotropics, Australia and the Western United States since the 1980s. Photo: Jamie Voyles.

frog sitting atop a mossy boulder, a species that had become so rare over the previous decade that scientists feared that it had vanished from Panama entirely.

Richards-Zawacki and Voyles never gave up hope that small remnant populations of this species—the Variable Harlequin Frog (*Atelopus varius*)—and others that had been decimated throughout the Neotropics by the deadly amphibian chytrid fungus *Batrachochytrium dendrobatidis* (*Bd*), might still be holding on. That rediscovery of the Variable Harlequin Frog launched Richards-Zawacki and Voyles on a quest over the next few years that resulted in confirmation that eight additional Panamanian frog species hit hardest by *Bd* were somehow surviving. This work culminated recently in the release of a [much-anticipated study](#) that finds that though the pathogen has not changed, the frogs have started to evolve better defenses against it.

The biologists' determination is a testament to the vital research and conservation action that can result when scientists refuse to give up on those species that others have declared hopeless cases.

"We had heard one too many times that these frogs were gone, but we hadn't heard of anyone actually going out there and look-

ing for them,” Richards-Zawacki says. “It’s certainly no small task because these frogs live in the mountainous parts of these subtropical and tropical regions—places that are very hard to get to. But we knew we had to make the effort to get out there, or we would never truly know if the worst had happened.”

THE FIGHT FOR A FUTURE

In March of this year, Voyles received a heartening message from the father of a local Panamanian family that has been helping with surveys of one population of the Variable Harlequin Frog in El Copé: a photo of the same individual frog that the biologists had spotted with the family’s help in 2013, still alive in 2018.

“Not only are these frogs as a population limping along and doing okay, but individuals are surviving in this *Bd*-environment for many years,” Richards-Zawacki says. “That has really surprised us.”

According to the study, published in *Science* March 30, some of the frog species that were once more susceptible to *Bd* have developed better defenses to fight the disease. Scientists aren’t sure whether those defenses are related to a change in the antimicrobial peptides in their mucus, the bacterial communities on the frogs’ skin, or the “turning on” of specific genes related to the animals’ immune systems. Whatever the mechanism, they suspect that this is natural selection at its strongest—some variation probably already existed in the populations that gave some of the animals a way to survive, and those are the individuals that went on to breed.

Although this is certainly a cause for celebration, the paper’s authors warn that these species still face a great threat and are not yet firmly on the road to recovery. In addition, the researchers have found these species in very small numbers and have evidence of

only nine of the 47 species in Panama’s El Copé that have seemingly all but vanished as the result of *Bd*, or that the IUCN Red List of Threatened Species has classified as Data Deficient.

“It’s not the case that everything is back to normal in Panama,” Voyles says. “If anything, this really underscores the importance of continuing to monitor areas where we thought amphibians had disappeared so we understand how things move forward from here. And the need to conserve these species’ habitats is vital to ensure that they truly have a second chance.”

LOOKING AHEAD

Although the new study has helped answer many previous questions, according to Voyles, there are even more questions now than before the team started its work.

“There are so many different questions to pursue, including why, exactly, these frogs have been able to resist *Bd*,” Voyles says. “What we’re looking at is probably only one piece of a pretty complex puzzle. We have some amazing collaborators who are already on it, looking at the genetics of the frogs, figuring out how we’re going to maintain a monitoring program for these different populations, better understanding why some of these species are doing better than others, even getting a sense of the seasonal dynamics of the infection patterns.”

They are also planning to use environmental DNA techniques to help monitor these species—and look for others still considered missing—in Panama’s wilds. They’ve already successfully used this tool for harlequin frogs in the area. “We’re happy to have any tools that will help us find these little needles in a haystack,” Richards-Zawacki says.



Richards-Zawacki in historic Golden Frog habitat. Photo: Brian Gratwicke, Smithsonian Conservation Biology Institute.



When Dr. Cori Richards-Zawacki and Dr. Jamie Voyles discovered the individual Variable Harlequin Frog pictured here, biologists had thought the species was extirpated in Panama. Photo: Jamie Voyles.

The paper’s authors are also hoping that these insights will help researchers studying infectious diseases in other wildlife species, such as white-nose syndrome in bats. The severity of many diseases seems to subside and together these groups may be able to determine the mechanisms of how that works, Voyles says.

Today Richards-Zawacki and Voyles’ lives look different than they did when they were doing fieldwork in Panama for their graduate studies, Richards-Zawacki on golden frogs (including the Variable Harlequin Frog and Panamanian Golden Frog) and Voyles on emerging wildlife diseases. They spend less time in the field—Richards-Zawacki is associate professor at the University of Pittsburgh and Voyles is assistant professor at the University of Nevada, Reno—and are grateful to their paper co-authors and lab mates who have helped collect the data, picking up where they left off in the field.

But one thing remains the same: Neither have given up hope on any of the other species presumed extirpated in Panama or extinct in the wild, including the country’s national animal, the Panamanian Golden Frog (*Atelopus zeteki*), the sister species to the Variable Harlequin Frog. Which brings the two back to that moment of re-discovery in 2012.

“We were overjoyed,” Voyles and Richards-Zawacki write in the [blog of the Panamanian Amphibian Rescue and Conservation Project](#). “One small frog in the wild suggests that there are at least some surviving populations out there. And if there is even one small population holding on, there is hope—not just for that population,

or even for the species, but for the whole genus. Having evidence to support that hope, in the form of that single, small and beautiful frog, is something even better than holding a winning lottery ticket with his picture on it.”

The paper’s other authors are: Douglas C. Woodhams and Molly C. Bletz, University of Massachusetts-Boston; Veronica Saenz, University of Pittsburgh; Allison Q. Byrne and Erica Bree Rosenblum, University of California, Berkeley; Rachel Perez, New Mexico Institute of Mining and Technology; Gabriela Rios-Sotelo Mason J. Ryan, University of Reno, Nevada; Florence Ann Sobell, Shawna McLetchie, Laura Reinert and Louise A. Rollins-Smith, Vanderbilt University School of Medicine; Roberto Ibáñez and Heidi Ross, Smithsonian Tropical Research Institute; Julie M. Ray, La Mica Biological Station; Edgardo J. Griffith, Fundación Centro de Conservación de Anfibios.



Anjana Parandhaman collecting a water sample to be tested for frog eDNA. Photo: Patrick Kleeman.

Occurrence of California Red-Legged (*Rana draytonii*) and Northern Red-Legged (*Rana aurora*) Frogs in Timberlands of Mendocino County, California, Examined with Environmental DNA

Brian J. Halstead, Patrick M. Kleeman, Caren S. Goldberg, Mallory Bedwell, Robert B. Douglas & David W. Ulrich

Effective species management requires knowledge of species distributions, but surveys for cryptic species near the boundaries of their geographical ranges can be difficult. We used environmental DNA (eDNA) and occupancy modeling to examine the distribution of Northern Red-legged Frogs (*Rana aurora*) and federally threatened California Red-legged Frogs (*Rana draytonii*) in a sample of 60 forested stream sites near where their ranges meet in southern Mendocino County, California, USA. For both species, the probability of occurrence (ψ) in forest streams in our study area was very low: California Red-legged Frog ψ was <0.01 (95% credible interval $=<0.01-0.05$), and Northern Red-legged Frog ψ was 0.07 ($0.02-0.15$). DNA from both species was found at 1 pond site, suggesting either co-occurrence or introgression. Our results suggest that abundance, stream use, or both are very low for red-legged frogs in forested streams in southern Mendocino County.

B. J. Halstead, P. M. Kleeman, C. S. Goldberg, M. Bedwell, R. B. Douglas, D. W. Ulrich, *Northwestern Naturalist*, 99(1), 9–20 (2018).

Evaluation of conspecific attraction as a management tool across several species of anurans

Valerie L. Buxton, Michael P. Ward & Jinelle H. Sperry

Amphibian populations are declining worldwide, with habitat loss and alteration being a primary driver of many declines. Management strategies to mitigate these declines include translocation and creation or restoration of breeding habitats, yet these techniques are not always effective. We examined whether conspecific attraction—a management tool frequently used in avian conservation—would be similarly valuable in management and conservation of anuran amphibians (i.e., frogs and toads). We broadcast conspecific chorus sounds at unoccupied, artificial breeding ponds for six anuran species across three field sites. We documented when frogs arrived at each pool and when eggs were laid. We compared differences in number of pools found with adults and egg masses between playback and control pools and examined latency to first colonization. We found that Mexican spadefoots colonized playback ponds faster and more often than control ponds, while Cope’s Gray Treefrogs, Arizona Treefrogs, Green Frogs, Spring Peepers, and Wood Frogs exhibited weak or non-existent responses. We discuss why breeding ecology may influence tendency to exhibit conspecific attraction and how this behavior could be used in amphibian management and conservation.

V. L. Buxton, M. P. Ward, J. H. Sperry, *Diversity*, 10 (2018).

Increasing connectivity between metapopulation ecology and landscape ecology

Paige E. Howell, Erin Muths, Blake R. Hossack, Brent H. Sigafus & Richard B. Chandler

The fields of metapopulation and landscape ecology aim to understand how spatial structure influences ecological processes, yet the two disciplines address the problem using fundamentally different approaches. Whereas most metapopulation models ignore environmental heterogeneity between habitat patches, models used in landscape ecology include detailed descriptions of landscape structure and its effects on movement. The simplistic view of landscape structure used in metapopulation models has been defended as necessary to maintain connections to classical theories of population dynamics. We present a framework for unifying these disciplines

by incorporating landscape structure into spatially explicit metapopulation models that allow for inference on landscape resistance to movement. We demonstrate the approach by fitting models to 11 years of data from a study of *Lithobates chiricahuensis* (Chiricahua Leopard Frog) metapopulation dynamics on the Buenos Aires National Wildlife Refuge in Arizona, USA. Results suggest colonization dynamics were influenced by patch hydroperiod and landscape topography. Ponds that held water permanently or semi-permanently contributed substantially more than intermittent ponds to the colonization of neighboring ponds. Colonization rate was lower among patches that were separated by areas of high elevation. Pond-level extinction rate was highest for ponds that only held water intermittently throughout the year. The relative importance of patch and landscape variables in governing ecological processes may be species- and system-specific, which emphasizes the need for statistical models such as ours that are based on theory and generalizable to multiple systems.

P. E. Howell, E. Muths, B. R. Hossack, B. H. Sigafus, R. B. Chandler, *Ecology*. (In Press).



The Manaus Slender-legged Tree Frog (*Osteocephalus taurinus*). The nocturnal species inhabits lowland rainforest in South America. Photo: Walter Jetz, Yale Tropical Field Ecology Course Ecuador, 2017.

The interplay of past diversification and evolutionary isolation with present imperilment across the amphibian tree of life

Walter Jetz & R. Alexander Pyron

Human activities continue to erode the tree of life, requiring us to prioritize research and conservation. Amphibians represent key victims and bellwethers of global change, and the need for action to conserve them is drastically outpacing knowledge. We provide a phylogeny incorporating nearly all extant amphibians (7,238 species). Current amphibian diversity is composed of both older, depauperate lineages and extensive, more recent tropical

radiations found in select clades. Frog and salamander diversification increased strongly after the Cretaceous–Palaeogene boundary, preceded by a potential mass-extinction event in salamanders. Diversification rates of subterranean caecilians varied little over time. Biogeographically, the Afro- and Neotropics harbour a particularly high proportion of Gondwanan relicts, comprising species with high evolutionary distinctiveness (ED). These high-ED species represent a large portion of the branches in the present tree: around 28% of all phylogenetic diversity comes from species in the top 10% of ED. The association between ED and imperilment is weak, but many species with high ED are now imperilled or lack formal threat status, suggesting opportunities for integrating evolutionary position and phylogenetic heritage in addressing the current extinction crisis. By providing a phylogenetic estimate for extant amphibians and identifying their threats and ED, we offer a preliminary basis for a quantitatively informed global approach to conserving the amphibian tree of life.

W. Jetz, R. A. Pyron, *Nature Ecol., Evol.* 10.1038/s41559-018-0515-5 (2018).



Pyrenean Brook Newt, *Calotriton asper*, endemic amphibian from the Pyrenees mountain range and one of the threatened species by introduced fish. Photo: Alexandre Miró.

Large negative effect of non-native trout and minnows on Pyrenean lake amphibians

Alexandre Miró, Ibor Sabás & Marc Ventura

High mountain lakes are mostly naturally fishless ecosystems that have received numerous trout introductions over the world. Extensive studies mostly developed in west North America have shown a large negative effect of these introductions on amphibians, although no extensive studies are available from other continents such as Europe. Fish were also introduced extensively in the Pyrenees (southern Europe), mainly trout for angling and minnows for their use as live bait for fishing trout. We studied the effect of non-native trout and minnows on the

occurrence of amphibian species inhabiting Pyrenean lentic habitats. Chi-square tests and Generalized Additive Models were applied on a dataset of 12 environmental descriptors from 1739 water bodies surveyed from 2006 to 2016. After accounting for environmental characteristics we found a large negative effect of non-native trout and minnows on Pyrenean amphibians. Trout was negatively associated with four of the six studied species. Since minnows were only introduced in trout present lakes, they were only significant for *Rana temporaria*, the most distributed amphibian in the area. None of the palatable amphibians have been able to recolonise the lakes where minnow remain as the only fish species indicating a strong negative effect. Minnow is the non-native fish with a higher introduction rate in the mountain range indicating that it might be a threat for other species in the future. Therefore, the control of trout stocking and minnow release in high mountain lakes is necessary to preserve European and worldwide amphibian populations in these ecosystems.

A. Miró, I. Sabás, M. Ventura. *Biol. Conserv.* 218, 144–153 (2018). <https://www.sciencedirect.com/science/article/pii/S0006320717311400>



A pair of *R. temporaria* in amplexus amongst spawn at a typical UK garden pond. Photo: Lewis Campbell.

A novel approach to wildlife transcriptomics provides evidence of disease-mediated differential expression and changes to the microbiome of amphibian populations

Lewis J. Campbell, Stewart A. Hammond, Stephen J. Price, Manmohan D. Sharma, Trenton W. J. Garner, Inanc Birol, Caren C. Helbing, Lena Wilfert & Amber G. F. Griffiths

Ranaviruses are responsible for a lethal, emerging infectious disease in amphibians and threaten their populations throughout the world. Despite this, little is known about how amphibian populations respond to ranaviral infection. In the United Kingdom, ranaviruses impact the common frog (*Rana temporaria*). Extensive public engagement in the study of ranaviruses in the UK has led to the formation of a unique system of field sites containing frog populations of known ranaviral disease history. Within this unique natural field

system, we used RNA sequencing (RNA-Seq) to compare the gene expression profiles of *R. temporaria* populations with a history of ranaviral disease and those without. We have applied a RNA read-filtering protocol that incorporates Bloom filters, previously used in clinical settings, to limit the potential for contamination that comes with the use of RNA-Seq in nonlaboratory systems. We have identified a suite of 407 transcripts that are differentially expressed between populations of different ranaviral disease history. This suite contains genes with functions related to immunity, development, protein transport and olfactory reception among others. A large proportion of potential noncoding RNA transcripts present in our differentially expressed set provide first evidence of a possible role for long noncoding RNA (lncRNA) in amphibian response to viruses. Our read-filtering approach also removed significantly more bacterial reads from sequence datasets generated from positive disease history populations. Subsequent analysis revealed these bacterial read sets to represent distinct communities of bacterial species, which is suggestive of an interaction between ranaviruses and the host microbiome in wild amphibians.

L. J. Campbell, S. A. Hammond, S. J. Price, *et al.* *Mol Ecol.* 2018 <https://doi.org/10.1111/mec.14528>



Kudopi rocky plateau habitat. Photo: T.R. Lewis.

Micro-habitat distribution drives patch quality for sub-tropical rocky plateau amphibians in the northern Western Ghats, India

Christopher J. Thorpe, Todd R. Lewis, Siddharth Kulkarni, Aparna Watve, Nikhil Gaitonde, David Pryce, Lewis Davies, David T. Bilton & Mairi E. Knight

The importance of patch quality for amphibians is frequently overlooked in distribution models. Here we demonstrate that it is highly important for the persistence of endemic and endangered amphibians found in the threatened and fragile ecosystems that are the rocky plateaus in Western Maharashtra, India. These plateaus are ferricretes of laterite and characterise the northern section of the Western Ghats/

Sri Lanka Biodiversity Hotspot, the eighth most important global hotspot and one of the three most threatened by population growth. We present statistically supported habitat associations for endangered and data deficient Indian amphibians, demonstrating significant relationships between individual species and their microhabitats. Data were collected during early monsoon across two seasons. Twenty-one amphibian taxa were identified from 14 lateritic plateaus between 67 and 1179m above sea level. Twelve of the study taxa had significant associations with microhabitats using a stepwise analysis of the AICc subroutine (distLM, Primer-e, v7). Generalist taxa were associated with increased numbers of microhabitat types. Non-significant associations are reported for the remaining 9 taxa. Microhabitat distribution was spatially structured and driven by climate and human activity. Woody plants were associated with 44% of high-elevation taxa. Of the 8 low-elevation taxa 63% related to water bodies and 60% of those were associated with pools. Rock size and abundance were important for 33% of high elevation specialists. Three of the 4 caecilians were associated with rocks in addition to soil and stream presence. We conclude the plateaus are individualistic patches whose habitat quality is defined by their microhabitats within climatic zones.

C. J. Thorpe *et al.* *PLoS ONE* 13(3): e0194810. <https://doi.org/10.1371/journal.pone.0194810> (2018).



Photos provided courtesy of Lee Grismer (*S. malayana*), California Academy of Sciences (*S. roberti*, *S. lacrima*), Dave Kizirian (*S. annamitica*), Bryan L. Stuart (*S. montosa*, *S. nigrovittata*, *S. faber*), A. Rujirawan (*S. mortenseni*).

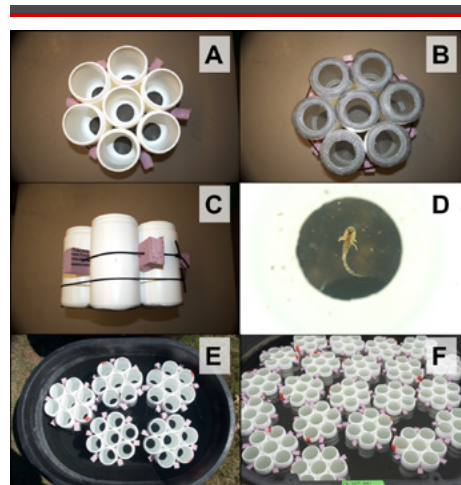
Hidden species diversity in *Sylvirana nigrovittata* (Amphibia: Ranidae) highlights the importance of taxonomic revisions in biodiversity conservation

Jennifer A. Sheridan & Bryan L. Stuart

Accurately delimiting species and their geographic ranges is imperative for conservation, especially in areas experiencing rapid habitat loss. Southeast Asia currently

has one of the highest rates of deforestation in the world, is home to multiple biodiversity hotspots, and the majority of its countries have developing economies with limited resources for biodiversity conservation. Thus, accurately delimiting species and their ranges is particularly important in this region. We examined genetic and morphological variation in the widespread frog species *Sylvirana nigrovittata* (and its long-treated junior synonym *S. mortenseni*) with the goal of clarifying its taxonomic content and geographic range boundaries for conservation. We present evidence that the current concept of *S. nigrovittata* contains at least eight species, two of which are each known from only two localities, but that *S. mortenseni* is more geographically widespread than currently realized. Five of these species are described as new to science.

J. A. Sheridan, B. L. Stuart, *PLoS ONE* 13(3), e0192766 (2018).



The salamander daisy rearing method as viewed from the top (A), bottom (B), and side (C). Note that a salamander daisy can house seven salamanders, each in a separate chamber. Screens are attached with silicone caulk to the bottom of each chamber in B, and bungee cord straps and insulation sheathing floats are visible in C. (D) depicts a small larval Tiger Salamander, *Ambystoma tigrinum*, in a chamber. (E) A small rearing system using an oval stock tank (about 200 L) and five salamander daisies (chambers for 35 salamanders). (F) large rearing system using a larger stock tank (about 1,200 L) and 21 salamander daisies (chambers for 147 salamanders). Photos: Brian J Tornabene.

The salamander daisy: a novel captive rearing method for cannibalistic salamander larvae

Brian J. Tornabene & Jason T. Hoverman

Salamanders are often reared in captivity to support reintroduction efforts and laboratory experiments. However, larval salamanders can experience intense competition and cannibalism in captive environments that can influence survival, morphological traits, and developmental

rates. Collectively, these outcomes can reduce the effectiveness and success of conservation and research efforts. Herein, we present a novel captive rearing method for cannibalistic salamanders, the salamander daisy. Our method houses salamanders in individual chambers floating in shared water, compared to traditional methods that house salamanders either communally or in individual containers. Additionally, we compared differences in survival and body size after rearing 21 Tiger Salamanders (*Ambystoma tigrinum*) using a traditional method compared to salamander daisy method. Survival of *A. tigrinum* reared using the salamander daisy method was 2.5 times higher (95%) than using the traditional method (38%). Therefore, more animals could be available for experiments or reintroductions using our novel method. We observed no difference in mean snout-vent length (SVL) or mass between methods. However, we found that variance in SVL and mass in the traditional method was > 31 times higher than when using the salamander daisy method. Our method is simple to construct, minimizes cannibalism, and makes animal husbandry more tractable. By using our method, we hope that investigators can attain more animals that have limited variation and are standardized in morphology. Moreover, this might maximize the efficiency and success of future experiments and reintroductions of imperiled salamanders.

B. J. Tornabene and J. T. Hoverman. *Herpetol Conserv Bio*, 13:167–174 (2018).

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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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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Journals/Periodicals

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

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Published Online Only

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Web site

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

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