amphibian ark

Keeping threatened amphibian species afloat

Newsletter

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Partnerships: Working together to save amphibians

In this issue...

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The Mountain Chicken Recovery Programme

Jeff Dawson, Durrell Wildlife Conservation Trust, Jersey; Machel Sulton, Ministry of Agriculture and Forestry, Commonwealth of Dominica; Lloyd Martin, Ministry of Agriculture, Land, Housing & Environment, Montserrat; Gerardo Garcia, Chester Zoo, UK; Luke Harding, Paignton Zoo, UK; Emma Nygren, Nordens Ark, Sweden; and Benjamin Tapley, ZSL-London Zoo, UK

The Mountain Chicken Frog (*Leptodactylus fallax*) is the largest native amphibian species in the Caribbean and one of the world's largest species of frog (Adams et al. 2014). The species is Critically Endangered (Fa et al., 2010) and underwent catastrophic range-wide population declines of over 85% in less than eighteen months after the emergence of chytrid, the fastest ever decline witnessed in a vertebrate species (Hudson et al., 2016). In response to these population declines, *ex situ* safety-net populations were established in 2009 at several institutions in Europe; ZSL London Zoo in the UK, Durrell Wildlife Conservation Trust's Jersey Zoo in Jersey, Chester Zoo in the UK, and Parken Zoo in Sweden and later, Nordens Ark, also in Sweden. A range-country facility was established on Dominica in the Caribbean and has housed Mountain Chickens since mid-2011 (Tapley et al., 2014). The captive populations in Europe are closely managed by an Endangered Species Programme (EEP). The aim of the EEP is to ensure a genetically viable population of Mountain Chicken Frogs is maintained for future conservation translocations; Dr Gerardo Garcia, Curator of Lower Vertebrates and Invertebrates at Chester Zoo is studbook holder for the Mountain Chicken EEP. Whilst there are small, fragmented Mountain Chicken populations on Dominica, we only know of two individuals surviving on the island of Montserrat in the Caribbean. Currently the immediate future of the species on Montserrat is uncertain with the most realistic hope being through captive breeding and release (Adams et al., 2014).

As the Mountain Chicken crisis has deepened over the last few years these partner organizations, in collaboration with the Dominican and Montserratian Governments, merged their different projects on Dominica and Montserrat respectively, into a collaborative effort to develop a more cohesive Mountain Chicken conservation project - the Mountain Chicken Recovery Programme (www.mountainchicken.org). This program is guided by a long-term recovery strategy 2104-2034 (Adams et al. 2014) which sets out a clear vision and goal for the program. The vision is "*To have healthy populations of Mountain Chickens as a flagship species for the islands' national and cultural heritage*"; and the goal "*There are healthy mountain chicken populations across their former year-2000 ranges on each of Montserrat and Dominica by 2034*." The partners include ZSL, Durrell, Chester Zoo, Norden's Ark, the Governments of Dominica and Montserrat and most recently Paignton Zoo in the UK.

The Mountain Chicken Recovery Programme is coordinated by Jeff Dawson at Durrell Wildlife Conservation Trust. Communication is essential for the program to function effectively. Monthly reports are written by the partners in the Caribbean and a summary report on the activities of all the partners is produced and disseminated every two months. There is an annual partners' meeting which is either held in Europe or the Caribbean. At these annual partners' meeting the progress on each of the recovery strategies' action points are tracked, and barriers to program implementation discussed and prioritized.

Achievements to date

- Successful rapid response to population declines attributed to the fungal disease, amphibian chytridiomycosis.
- Establishment of an ongoing biosecure population of Mountain Chickens and an EEP program.
- Established a conservation breeding facility for Mountain Chickens in Dominica.
- Developed a molecular diagnostics laboratory in Dominica.
- Capacity building in range-state countries: over twenty people have been trained in Mountain Chicken husbandry, field survey and laboratory techniques.
- Development and maintenance of a large constituency for Mountain Chicken conservation with community engagement and public outreach.
- Trialed the treatment of amphibians in the wild for chytridiomycosis for the first time.
- Conducted world-leading research into the emergence and epidemiology of chytridiomycosis in the Mountain Chicken and disease dynamics in the wild.
- Development of a twenty-year conservation action plan for the Mountain Chicken.
- Undertaken research to improve the captive husbandry and pre-release health screening of Mountain Chickens.
- Recent translocation of the last surviving female Mountain Chicken into the territory of the last surviving male on Montserrat.

ZSL London Zoo and Chester Zoo in the UK, Durrell Wildlife Conservation Trust's Jersey Zoo in Jersey, and Parken Zoo and Nordens Ark in Sweden have partnered with the governments from the Caribbean islands of Dominica and Montserrat, to save the Critically Endangered Mountain Chicken Frog (*Leptodactylus fallax*). Photo Ben Tapley.

Next steps

On Dominica we are currently monitoring several Mountain Chicken Frog populations as they show slow signs of recovery and exploring how best to protect the sites at which these populations occur as they currently receive no formal protection. The next phase of the program on Montserrat involves the construction of a semi-wild enclosure where we can test the ability of captive-bred frogs to coexist with chytrid infection through environmental manipulations to create conditions that may be suitable for the frogs but suboptimal for the fungus. This component of our work requires urgent funding. Please support our efforts by donating to this important campaign www.durrell.org/wildlife/safehaven/?gclid=CJG22Yvp-9QCFRHgGwodUeEI1Q.

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Second call for Amphibian Ark Seed Grant applications

In June 2017, two new amphibian conservation programs were awarded Amphibian Ark Seed Grants (www.amphibianark.org/news/2017-seed-grant-winners/) and Amphibian Ark is pleased to announce a call for proposals for a second round of Seed Grants in 2017.

These competitive $5,000 grants are intended to fund start-up rescue projects for species that cannot currently be saved in the wild. Successful proposals will reflect AArk values; please pay careful attention to the grant guidelines (below and also at www.amphibianark.org/aark-seed-grant/) for details on what types of projects are favored. Past grantees can be seen at the web link listed above.

A couple of changes have been made to the application and reporting requirements this year, including the addition of a species action plan and husbandry guidelines being developed as part of the reporting process for successful applicants. We are also considering programs which will initially work with a surrogate species in order to develop husbandry protocols for a more threatened species, as well as allowing for up to 20% of the funds applied for to be used to support the acquisition of founder animals, if required.

We would like to acknowledge the generous support of the Andrew Sabin Family Foundation, Ronna Erickson, Woodland Park Zoo (www.zoo.org), the European Association of Zoos and Aquariums (www.eaza.net), and the other AArk supporters (www.amphibianark.org/our-funders/) who helped establish this grant.

Inquiries can be directed to Kevin Johnson, Taxon Officer KevinJ@amphibianark.org.

Important dates:

- grant application deadline: 1 November 2017
- grant decision/notification date: 15 November 2017
- winners must provide bank details by: 21 November 2017
- grant payment date: 1 December 2017
- final progress report, species action plan and husbandry guidelines due 1 December 2018.

Priority Guidelines - please read very carefully! This grant is NOT intended to fund:

- Workshops
- Educational Exhibits
- Project Overheard or Indirect Costs

Guidelines for Seed Grant applications can be downloaded from the AArk web site (www.amphibianark.org/pdf/AArk-Seed-Grant-2017.pdf).

AArk staff are available if you need assistance in formulating your proposal. Please do not hesitate to contact us with any questions. Each year several proposals have been rejected due to issues that could have been prevented!

Amphibian program implementation tool now available in Portuguese

Kevin Johnson, Taxon Officer, Amphibian Ark

A significant challenge for *ex situ* programs relates to ensuring that all programs are adequately supported for their duration. Establishing facilities and collecting rescue populations is only the first, albeit perhaps the single greatest expense. However, it is insufficient to support only those first-year expenses without operational support for the long term, which may amount to years or even decades. In addition to financial planning, *ex situ* programs should establish at the onset a plan for working with partners to mitigate threats in the wild and, where necessary, getting animals back into the wild, as well as how to distribute the progeny of captive animals in the interim.

As part of our Conservation Needs Assessment process (www.ConservationNeeds.org), we have developed an easy to use checklist that should be utilised prior to the commencement of any *ex situ* conservation breeding program for amphibians (www.amphibianark.org/tools/Program-implementation-tool.htm). If, and only if, all of the critical program aspects can be met for a species, should a new program be implemented.

The online tool is also available in Spanish (www.amphibianark.org/tools/program_implementation_tool_es.htm) and it has recently been translated into Portuguese (www.amphibianark.org/tools/Program-implementation-tool-pt.htm).

When considering the implementation of a new *ex situ* program the species should be added to the tool, and then the twenty-one questions are answered. All questions have Yes/No answers. Before implementing a new program, it is important that most questions have Yes answers, when this is the case, the chances of a successful *ex situ* program are much greater.

When the answers to all questions are Yes, all the criteria have been met for the implementation of an *ex situ* program for that species. If the answer to any question is No, additional resources or expertise are required.

We'd like to sincerely thank volunteer William Baptista who not only generously donated his time to translate the tool, but has also translated most of newer pages on the Amphibian Ark web site (www.amphibianark.org/pt/).

Project Lemur Frog final report, July 2017

Andrew R. Gray, Curator of Herpetology, The Manchester Museum, UK

Establishing captive breeding and rearing facilities

Specific *ex situ* breeding and rearing facilities for Lemur Leaf Frogs (*Agalychnis lemur*), including rearing facilities for the prey insects, have been completed at Manchester Museum and Bristol Zoo in the UK, and at Nordens Ark in Sweden. The facility at Nordens Ark was completed in 2015, and at the beginning of 2016 an *ex situ* assurance population of Lemur Leaf Frogs, representing three different initial bloodlines, was transferred to Nordens Ark from Manchester Museum and Bristol Zoo. The aim of the transfer was to maintain a further assurance population in a biosecure manner, while maintaining the genetic integrity of the captive population overall. The facilities are custom made to meet the requirements of the species.

A cooperative breeding program for Lemur Leaf Frogs (*Agalychnis lemur*) is being managed at the Manchester Museum and Bristol Zoo in the UK, and at Nordens Ark in Sweden. As well as the captive breeding program, *in situ* habitat restoration at the Costa Rican Amphibian Research Centre, an international education program and student research opportunities are a significant component of this conservation effort. Photo: Andrew Gray.

Managing distinct blood-lines in captivity

Genetic work at Salford University in Manchester, UK, has focused on the sequencing of hereditary genes so as to allow for the identification of specific individuals and parentage following on from the genotyping of the species with primers described and characterised in 2013 (link.springer.com/article/10.1007/s12686-014-0261-1).

Building on the genetic work, breeding of founders has started. With the support of the genetic evaluations conducted by Dr Jim Labisko, and overseen by Dr Robert Jehle at Salford University, Tim Skelton at Bristol Zoo has established a new studbook for the species during the project period. He proposed the species to the European Association of Zoo and Aquaria (EAZA) on behalf of the project and the European studbook was formally approved by the EAZA Amphibian Taxon Advisory Group and the European Endangered Species Programme committee in July 2016. The new studbook includes animals from Manchester Museum, Bristol Zoo and Nordens Ark. All specimens have individual studbook numbers, and all have photograph IDs held at their holding institutions to allow for individual recognition. These specimens are all part of the official captive breeding program for the Lemur Leaf Frog established as part of the project.

Staff training

During the project period several staff exchanges have taken place between Manchester Museum and Nordens Ark in order to share knowledge between the two institutions and to increase the capacity of the staff at Nordens Ark in the care, management, and husbandry of the lemur leaf frogs. This has been essential since the species is delicate and has very specific husbandry needs. It has proved reliant on the skill set of the keepers at each institution that the species has been able to thrive in captivity.

Raising awareness of the conservation needs of the species

Over the duration of the project the project manager Andrew Gray and staff from Nordens Ark have conducted lectures at both local and international meetings, to highlight the project and to promote the species' conservation needs to the widest influential audience as possible (www.frogblogmanchester.com/2016/11/14/amphibian-ambassadors/). In 2015, Sir David Attenborough visited Manchester Museum to record and highlight the project in the BBC's TV documentary 'Fabulous Frogs' (www.bbc.co.uk/programmes/p02503rc), which was then screened worldwide.

Nordens Ark and Bristol Zoo have also each created a special page about the project on their websites: (en.nordensark.se/conservation/lemur-leaf-frog/) and (www.bristolzoo.org.uk/explore-the-zoo/lemur-leaf-frogs). A separate website is dedicated to the project (www.lemurfrog.org).

In situ habitat restoration and facilitating future research

The Costa Rican Amphibian Research Centre (CRARC) is a privately-run organization which owns and operates two biological reserves in Costa Rica, the Guayacán Rainforest Reserve, and the Río Vereh Cloud Forest Reserve. Areas within the CRARC reserve forest have been actively managed by the owner, Brian Kubicki, to support the population of Lemur Leaf Frogs and other threatened amphibians. Manchester Museum, through Project Lemur Frog, has provided funds for the clearing of ponds as well as clearing large areas of understory dominated by undesirable fern species and vines within the current forest of the CRARC reserve.

As part of the project, Nordens Ark has provided the CRARC with a small research station through funding from the Fondation Segré, which has been built in the in Rio Vereh Cloud Forest Reserve. The cabin, which was finished in April 2015, can accommodate several people and may play a vital role in

Facilities for Lemur Leaf Frogs at the Manchester Museum. Photo: Andrew Gray.

facilitating research efforts with the amphibians in the area. The Rio Vereh Cloud Forest Reserve is located in one of the most unstudied, yet biologically diverse regions in Costa Rica: the upper margin of the premontane rainforest life zone of the Caribbean slopes of the Talamancan Mountains.

Genetically identifying individuals

Genetic fingerprinting has been done on the *ex situ* assurance population and the result has provided the first genetically-informed studbook for a Critically Endangered amphibian. The aim of this aspect of the project was to genetically characterise thirty individual Lemur Leaf Frogs from collections held at Manchester Museum and Bristol Zoo, to inform the captive breeding program and to compile a studbook based on genetic information.

Individuals were genotyped with the use of nine microsatellite markers previously developed by Salford University (Petchy, et al., 2013). DNA was retrieved non-invasively using mouth swabs (twenty-seven samples) or was based on eggs (three samples). A freelance post-doctoral scientist, Dr Jim Labisko, conducted the practical work. Tim Skelton at Bristol Zoo is now using the results from the study for the continued development of the official new studbook.

International environmental education program

A new environmental education initiative, which provides resources for primary schools, three information films, and related children's activity booklets, has been created. The Ambassador of Costa Rica, His Excellency Enrique Castillo, launched this key educational aspect to the project in January 2016, at Manchester Museum (www.frogblogmanchester.com/2016/02/02/lucys-launch/).

The related education material and films were translated into Spanish for use throughout Latin America. The project also funded the delivery of associated environmental education work in Costa Rica, in collaboration with the CRARC (www.lemurfrog.org/in-situ/environmental-education-in-costa-rica/). The production of Swedish versions of the Lemur Frog films, with Swedish voiceovers, will help bring the Lemur Frog-related environmental education campaign to Swedish schoolchildren in the future. See www.manchester.ac.uk/discover/news/lucy-9-fronts-global-fight-to-save-frog-from-extinction/, www.phys.org/news/2015-12-lucy-global-frog-extinction.html and www.mancunion.com/2016/03/09/uom-supports-campaign-save-endangered-amphibian/.

International student opportunities

To support undergraduate student development and international academic collaboration in both Sweden and the UK, Andrew Gray and Professor Amanda Bamford from Manchester University visited Nordens Ark in January 2017 to discuss placement student opportunities. This has resulted in a placement student from the University of Manchester Faculty of Biology, Medicine and Health conducting a nine-month project from November 2017 to support the Lemur Frog care and the development of related environmental educational aspects at both institutions.

Future conservation of the species

The Lemur Leaf Frog has also recently been nominated and accepted as an EDGE (Evolutionarily Distinct and Globally Endangered) species. We hope this new status will encourage and provide opportunities for other conservationists to work with the species and through paid fellowships help actively support the species' future.

Manchester Museum has supported the development of recognition software for the non-invasive identification of individual animals. The software has proved to be an efficient and reliable application that would be particularly appropriate for accurately assessing wild Lemur Leaf Frog populations and facilitates non-invasive survey methods for future monitoring (https://lemurfrog.files.wordpress.com/2017/05/lemur-frog-recognition.pdf).

We will fully support future proposals by our existing *ex situ* collaborators for developing in-country initiatives relating to the monitoring of Lemur Leaf Frog populations throughout the species' known range. Whilst supporting the conservation of wild populations is a priority, full commitment to all *ex situ* aspects will continue by the partners concerned, so as to provide a secure safety net to ensuring the species never becomes extinct in the future.

In Memoriam

Anne Baker, Executive Director, Amphibian Ark

George Bernard Rabb was born on January 2, 1930 in Charleston, South Carolina, USA. He was an avid naturalist from the beginning, collecting frogs, salamanders and snakes; eventually taking over the top floor of his family's home for his herpetological menagerie. As a teenager he and several friends roamed the South Carolina low country, sometimes in the company of the Curator of the Charleston Museum of Natural History, adding to the Museums' collection of birds for a book on the avifauna of South Carolina.

George attended the College of Charleston with a McIver Scholarship, graduating with honors, and went on to attend the University of Michigan on a graduate scholarship. There he completed his Master's and PhD degrees. His PhD dissertation was on systematics and biogeography of lizards in the *Liocephalus carinatus* complex in the Bahamas, based on specimens he had collected during an expedition with the American Museum of Natural History.

Following graduation George took a job of Curator and Coordinator of Research at the Chicago Zoological Park (Brookfield Zoo) in Brookfield, Illinois, USA. George's first day at the zoo coincided with the arrival of the zoo's first Okapi (or forest giraffe), thus beginning his lifelong fascination with and study of this species. George's early research at the zoo was on the ecology and taxonomy of salamanders in eastern North America and Mexico. His work in Mexico resulted in the description of six new species of amphibians there. All of the taxa he described are still recognized today. He also began work on the behavior and reproduction of the Surinam Toad (*Pipa pipa*).

As George assumed new roles at Brookfield Zoo, first as Deputy Director, and then as Director of Brookfield Zoo and President of the Chicago Zoological Society, his interests broadened to include conservation and conservation psychology. He served as Chair of the International Union for the Conservation of Nature (IUCN) Species Survival Commission (SSC) from 1989-1996, one of his many contributions to conservation organizations. It was during his tenure as SSC Chair, at the First World Congress of Herpetology in Canterbury, England in 1989 that George and David Wake realized that amphibian declines were occurring around the globe. Following that congress, in 1990 he created the IUCN/SSC Declining Amphibian Population Task Force (DAPTF). This was followed by the Global Amphibian Assessment in 2001 and the Global Amphibian Summit in 2005. The IUCN/SSC Amphibian Specialist Group (ASG) and the Amphibian Ark (AArk) were both outgrowths of the 2005 Summit, and in 2009 George was a key founder of the Amphibian Survival Alliance (ASA). He once said that the two achievements (of his many) of which he was most proud were his influence in transforming zoos and aquaria into conservation organizations and his participation in amphibian conservation. In recognition of George's unceasing championship of amphibians, two species have been named after him, the Guatemalan Bromeliad Salamander (*Dendrotriton rabbi*) and Rabb's Fringe-limbed Treefrog (*Ecnomiohyla rabborum*). It would not be an overstatement to call George the father of amphibian conservation.

George was a shy man and one of those rare people whose focus was rarely on himself, but rather on what needed to be done for conservation. He spent more time listening than talking, and usually only spoke up when his passion for conservation over-rode his shyness. But when George spoke, people listened. Despite his shyness George had an incredible impact on people, science, and conservation. His passion for the Earth and the species that inhabit it has inspired many and multiplied his impact a hundredfold. He was a scientist, a mentor, a conservationist and a true gentleman.

George Rabb died on July 27, 2017. He was a guiding force for the Amphibian Ark, supporting our work through his knowledge, his vision, and his generous contributions of both time and money. He attended our strategic planning meetings, was there for almost every conference call, and made certain that we were tracking important issues. One of his last directives was "Don't forget about the caecilians". We promise you, George, that we won't.

Rabb's Fringe-limbed Treefrog (*Ecnomiohyla rabborum*) was formally described in 2008, and was named in honor of the conservationists and herpetologists George B. Rabb and his wife Mary. Photo: Brad Wilson.

Guatemalan Amphibian Biology, Management and Conservation Training Course

Luis Carrillo, Training Officer, Amphibian Ark

Amphibians are the most endangered group of organisms on the planet, with over one-third of the species threatened with extinction, due to threats ranging from water quality to infectious diseases. Currently Guatemala has more than 145 amphibian species with almost eighty of them threatened, mainly due to habitat lost for timber and habitat modification for crops.

Amphibian Ark and the Universidad del Valle de Guatemala (UVG) have joined forces to offer a training course (in Spanish) at the School of Biology of UVG in June 2018.

The Guatemalan Amphibian Biology, Management and Conservation Training Course will build capacity among biologists and other professionals in Guatemala and within the region, with the objectives of:

1. Providing technical skills necessary for long-term management of *ex situ* assurance populations of endangered amphibian species, from species selection to reintroductions, with a focus on husbandry, health, biosecurity and population management.
2. Building a network for practitioners to better work together in taking charge of the conservation of local species.
3. Providing guidance in the establishment of healthy assurance colonies of imperiled amphibian species.

The course will consist of five days of intensive training including lectures, hands-on practical exercises, and case studies. Topics covered during the course will include amphibian biology and management, enclosure design and construction, breeding techniques, biosecurity and disease control, and population management.

In 2010 a Conservation Needs Assessment workshop (www.conservationneeds.org) was organized in Guatemala, where thirty-four species were recommended for *ex situ* rescue (www.amphibianark.org/conservation-programs/rescue-species/); these are species that are in imminent danger of extinction and require *ex situ* management, as part of an integrated program, to ensure their survival. The next logical step is to develop and establish *ex situ* conservation programs within the country for these rescue species, but to do so, there is a need to ensure there are sufficient trained personnel to successfully manage the programs. Amphibian Ark and our partners have a history of delivering successful management and conservation training courses in the past, with sixty *ex situ* conservation training workshops in thirty countries, training almost 2,000 students.

For more information about the course and how to register please contact Luis Carrillo, Training Officer – luis@amphibianark.org.

Cloud Forest Stream Frog (*Ptychohyla euthysanota*). Photo: Alejandra Zamora.

Plectrohyla sagorum. Photo: Alejandra Zamora.

Doflein's Salamander (*Bolitoglossa dofleini*). Photo: Alejandra Zamora.

A cooperative strategy between Cali Zoo, Zurich Zoo and Wildlife Conservation Society for the conservation of Colombian amphibians

Carlos Andrés Galvis-Rizo, Head Biology Deparment, Animal Welfare Unit, Cali Zoo Foundation; German Forero, Science and Species Director, Wildlife Conservation Society, Colombia; and Martin Bauert, General Curator, Zurich Zoo, Switzerland

Colombia has one of the greatest diversities of amphibian species in the world, with approximately 809 species, however 227 of them are at some risk of extinction (Acosta Galvis, A.R. 2017). The greatest threats for amphibians in Colombia are the loss of habitat, contamination, the introduction of exotic species and the recent appearance of the chytrid fungus (*Batrachochytridium dendrobatidis*), which is affecting wild populations. Many of the amphibian populations also have limited areas of distribution, which makes them vulnerable to any process of disturbance in their environment.

In 2006, in response to the serious amphibian extinction crisis, Zoo Zurich in Switzerland and Cali Zoological Foundation in Colombia agreed to start a cooperative project to contribute to amphibian conservation. This agreement aimed to develop an integrated frog conservation strategy for Colombian frog species. The first cornerstones were building a conservation breeding facility, setting up an inter-institutional network working with universities and environmental authorities, the organization of specific workshops and the building of an amphibian exhibit at Cali Zoo for education purposes. These initial steps resulted in important achievements in the conservation of amphibians in Colombia and strengthened institutional relationships between Cali Zoo, Zoo Zurich and Wildlife Conservation Society (WCS) as well as with other organizations involved with amphibian conservation.

The initial project phase compromised three main achievements:

- Conservation centre - Established an *ex situ* conservation centre at the Cali Zoo Foundation for the management of endangered amphibian species (assurance colonies) and to provide opportunities for research in captivity.
- Conservation research - Carry out research on the status and biology of some amphibian populations and on the status of Chytridiomycosis in wild populations.
- Conservation education - Develop education and outreach programs for amphibian conservation in Cali Zoo and in local communities as well as to the visitors to the Zurich Zoo.

The endangered Golden Poison Dart Frog (*Phyllobates terribilis*) is part of a case study by Cali Zoo, Zurich Zoo and the Wildlife Conservation Society, which will identify the key conservation actions to be taken within the next years to safeguard this enigmatic species. Photo: Martin Bauert.

In 2016 Cali Zoo, Zürich Zoo and WCS signed a new, expanded agreement to further foster amphibian conservation in Colombia on a national level and taking advance of the assets developed so far. After intense discussions a twofold strategy was adopted by the three partners. Firstly we will implement a case study of the endangered Golden Poison Dart Frog (*Phyllobates terribilis*), which is a flagship species of Colombia. Our goals are to identify the key conservation actions to be taken within the coming years to safeguard this enigmatic frog species.

The second outcome is to liaise with the Colombian National Park Service to develop a holistic *in situ* and *ex situ* conservation program to safeguard at least 30% of Colombia's threatened amphibian species.

With this twofold strategy we try to make the best use our the limited financial and human resources: the case study on the Golden Poison Dart Frog helps to generate momentum in Zurich Zoo and the network "Frogs & Friends", a new communication campaign for amphibian conservation issues. Through Frogs & Friends, a video-report about the Golden Poison Dart Frog case study (www.frogs-friends.org/en/projects/colombia) is distributed not only online but also at interactive terminals in the zoos of Zurich, Vienna and Cologne. Collectively, these major European zoos have more than five million visitors per year.

Abundance estimate of a new population of Golden Poison Dart Frog in the Joaquincito indigenous village, Puerto Merizalde, Buenaventura (Valle del Cauca)

The Golden Poison Dart Frog is an endemic species of Colombia, which lives mainly in the tropical forest of the lowlands in the western mountain range of Colombia, on the Pacific coast, on the Saija river basin (Cauca Department) (Myers et al., 1978). It is a diurnal species that lives very close to the ground, on the roots of the trees of primary forests. This frog lays its eggs on the ground and the males carry the tadpoles to permanent waters (Myers et al., 1978). The secretion from their skin contains particular batracotoxins and homo batracotoxins, alcaloids steroids that are very strong. They produce large amounts of these components, which are at least twenty times more toxic than other poison frogs (Myers et al., 1978; Heike, 2005). For this reason it is considered the most poisonous verte-

Golden Poison Dart Frogs lay their eggs on the ground and the males carry the tadpoles to permanent waters. Photo: Carlos Galvis.

brate in the world. International Union for the Conservation of Nature (IUCN) information indicates that their range of distribution is less than 5,000 km^2 and there is a large reduction of the extension and quality of their habitat (Bolívar & Lötters, 2004). Consequently the species is currently categorized in the IUCN Red List as an Endangered species.

The range of Golden Poison Dart Frog is extremely restricted, however in 2005 Carlos Galvis, biologist at Cali Zoo, found a new population. In 2012 the expansion of the distribution was reported, extending its range 60 km north from previous known locations (Marquéz et al., 2012). The new population is located in the Joaquincito indigenous village in Port Merizalde. The new distribution includes dart frog populations from two departments of western of Colombia (Cauca and Valle del Cauca). The report didn't include any data related to the abundance or level of threat of the population of the species at the new location, so new field census and studies are urgently needed to determine the current conservation status of the species.

This study generated information about the population condition of Golden Poison Dart Frog, specifically in the only population reported for the Valle del Cauca department, in the Joaquincito indigenous village. The discovery of this new population is of great importance for the species, not only because it increases the number of known populations, but because it also provides an opportunity to understand population dynamics and extinction probability of this endangered species. The information we have collected about this population could lead to development of future conservation strategies for the species, based on the understanding of the ecological requirements and population dynamics of this species.

Amphibian conservation strategy in Colombia

The best way to effectively protect the biodiversity and health of amphibians in Colombia is through the development and implementation of a holistic conservation strategy, one that embraces both *in situ* conservation and *ex situ* collection management efforts. Protected areas represent the main strategy for the conservation of biodiversity worldwide and they generally contribute to reducing habitat destruction — the single most pervasive threat to species survival. Strategically located, well-managed protected areas can make a major contribution to amphibian conservation. Nonetheless, other threats that affect amphibians such as disease, invasive species and illegal wildlife traffic require complementary strategies. For some species, *ex situ* conservation and management measures are necessary to ensure that they persist within protected areas and other non-protected sites, especially as extinction is a serious threat for many of these species.

To ensure success of the *ex situ* component, Cali Zoo enhanced the laboratory and husbandry facilities to maintain captive populations of amphibians. Photo: Martin Bauert.

Conservation efforts inside protected areas must be complemented with ecological and biological research to improve baseline understanding of the group's ecology and accurately determine their conservation status, including the need or not for *ex situ* management. Most probably, for some regionally or locally endangered species, management of assurance colonies in zoos such as Cali Zoo is essential; but cannot be achieved without comprehensive professional development and capacity building efforts to train amphibian experts working in these institutions. For example, WCS curators and keepers have conducted workshops to train Cali Zoo's personnel on husbandry, enclosure design, and disease management. Today, Cali Zoo is one of the most important institutions in *ex situ* management of amphibians in Colombia, and has contributed to and led the development of husbandry capacities among other entities. Finally, the role of zoos for generating awareness among the general public of the conservation challenges associated with amphibians is crucial. The animals or offspring of the animals in the *ex situ* program can be used to educate

The Critically Endangered Lehmann´s Poison Frog (*Oophaga lehmanni*) is an endemic species that occurs in the Parque Nacional Natural Farallones de Cali. It is one of the many species that will be protected by the Amphibian Conservation Strategy in Colombia. Photo: Martin Bauert.

and inspire the public to make different choices in their lives that can help conserve these amazing creatures. Outreach and education efforts, especially around such charismatic and attractive animals as amphibians, are essential components of *ex situ* conservation action.

The *in situ* component of this project involves working in five national parks that together contain more than 30% of Colombia´s endangered amphibians. In these protected areas the team will evaluate the presence of previously reported amphibians, identify threats, including chytrid fungus, and produce monitoring protocols for some key species.

To assure success of the *ex situ* component, Cali Zoo enhanced the laboratory and husbandry facilities to maintain captive populations of amphibians, in particular to improve those aspects that have been identified in previous workshops and training sessions with international experts. These include: additional skills of personnel responsible for the maintenance of the collection, infrastructure improvements to enhance welfare of individuals and biosecurity in general, and laboratory equipment and clinical supplies among others. *Ex situ* management activities will be focused on implementing the collection plan for one particular species identified as priority, by starting a captive breeding program. This program will be based on previous experiences at the Cali Zoo, where the initial husbandry and management activities will be conducted. However, Cali Zoo will involve other partner zoos in order to develop a properly-managed captive population across the country. This activity encompasses maintenance of the laboratory and husbandry facilities for captive populations of amphibians at the Cali Zoo. Further Colombian institutions will have to be evaluated for their suitability for building up *ex situ* assurance colonies to be able to react to the continuing amphibian crisis.

Golden standard of PCR diagnostics

In July 2017 we successfully launched a molecular disease diagnostic training program for continuous amphibian health monitoring in Colombia by using the gold-standard molecular diagnostic procedure to quantify pathogen loads for two amphibian-killing agents: *Batrachochytrium dendrobatidis* (*Bd*) and ranavirus (RV). The bilingual workshop training held in Spanish and English was held in close collaboration with the Laboratroia diagnostico Veterinario of the University La Salle in Medellín. Participants learnt to analyze and interpret results and are able to contribute to the ongoing health monitoring efforts for surveillance of these diseases in Colombia.

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Amphibian Advocates

In this edition of the AArk Newsletter we're featuring Christopher Michaels from ZSL London Zoo in the UK, and Federico Kacoliris from the Wild Plateau Initiative in Argentina. Christopher and Federico are involved in amphibian projects on opposite sides of the world, but sharing the desire to include both *in situ* and *ex situ* components in their conservation programs.

The profiles of all of our Amphibian Advocates can be found on the AArk web site at www.amphibianark.org/amphibian-advocates. If you would like to nominate an Amphibian Advocate to be featured in a future edition of the AArk Newsletter, please send us an email at newsletter@amphibianark.org and we'll add your suggestion to our list!

Chris Michaels, Manager, Herpetology Team, ZSL London Zoo, England

Like so many people working in amphibian conservation, Chris Michaels started young with amphibians, pond dipping and rock flipping wherever he went and building up a collection of animals at home.

My name is Chris Michaels. I currently manage the Herpetology team at ZSL London Zoo in the UK. Like so many people in our field, I started young with amphibians, pond dipping and rock flipping wherever I went and building up a collection of animals at home. Very quickly I found that my true love was salamanders, especially salamandrid and hynobiid species from Asia.

An obsessive hobby and a Bachelor's degree from the University of Oxford landed me a government funded PhD studentship in the Preziosi lab group at the University of Manchester. Over three years I established and worked with captive populations of anurans, caudates and caecilians studying the effects of captive conditions on fitness and their implications for reintroductions. I also looked at the interplay between field and captive aspects of amphibian conservation and how they can be combined. Much of this work was published. While studying for my PhD, fellow doctoral student Rachael Antwis and I established the Amphibian Conservation Research Symposium (ACRS), an annual conference now affiliated with the Amphibian Survival Alliance (ASA) that has become an important part of the amphibian conservation calendar and with which I am still heavily involved.

During my doctoral write-up period, I accepted a job at ZSL London Zoo in the Herpetology Section. I had always been interested in working in zoos and in using captive collections to address the conservation needs of amphibians through research, education and on-the-ground conservation measures. At ZSL I currently manage the Herpetology team, which maintains a large collection of reptiles and amphibians. We work to develop exhibits that raise awareness for the conservation plight of amphibians, and to highlight conservation initiatives in which ZSL is involved. Our displays and outreach work also engage the public in amphibian and reptile conservation. Research is a key component of zoo work, and, working with colleagues, I have published on amphibian species biology, conservation strategy and taxonomy. Particular areas of interest include the role of zoos in conservation breeding programs, the application of field data to captive husbandry protocols, and the effect of captivity on the fitness of amphibians. This scientific work has been supplemented by independent peer-reviewed publications from my private collection, which still includes species I kept as a teenager!

At ZSL we currently work with several amphibian species of conservation interest, often in close association with ZSL's EDGE of Existence program (www.edgeofexistence.org) and colleagues from other areas of ZSL such as the Institute of Zoology and Conservation Programmes. These include projects with wild and captive amphibians, and also a combination of the two. Key foci for me are Mexican ambystomatid salamanders (working closely with Alfredo Hernández Díaz from Africam Safari), Cameroonian Highland endemics (with a particular focus on the Lake Oku Clawed Frog (*Xenopus longipes*)), Chinese Giant Salamanders (*Andrias davidianus*), the UK-native Pool Frog (*Pelophylax lessonae*) (as part of the reintroduction project undertaken by Amphibian and Reptile Conservation and partners), Mountain Chickens (*Leptodactylus fallax*), and *Alytes* midwife toads. The latter, while being of conservation interest in their own right, form a model system of phylogenetically close, but ecologically dissimilar, species that we use for a number of research projects concerning husbandry and amphibian biology. Alongside species-focused projects, I have also contributed to the review and implementation of the IUCN's Amphibian Conservation Action Plan and delivered husbandry training courses and support for other institutions working with amphibians.

In the future, I hope to continue working in zoos and have particular interest in ensuring that living collections reach their potential to contribute to protecting amphibians through research, education and direct conservation intervention.

Federico Kacoliris, Coordinator, Wild Plateau Initiative, La Plata Museum, Buenos Aires, Argentina

I have loved animals for as long as I can remember. When I was a child, I used to spend a lot of time lying on the ground searching for any small animal that would cross my way. I especially had a predilection towards frogs, toads, and lizards. I still remember during a summer vacation in a rural town, a combination of prime weather conditions allowed for an explosive breeding event of the Argentinian Common Toad (*Rhinella arenarum*). The ground was covered by hundreds of toads, smaller than a fingertip, and moving everywhere. From that day forward, I was fascinated by these animals. Some years later, from a pond that was drying up, I rescued a group of tadpoles that risked desiccation. I followed the entire metamorphosis process until releasing the juveniles at home in my garden. Later, during my adolescence, I started to become aware of the problem of species' extinctions. The need to help grew inside of me. Motivated by all of these experiences, at the age of eighteen I decided to study biology at La Plata University in Argentina.

During the course of my career, I participated in several projects with endangered vertebrates in Argentina and neighboring countries. It was during this time that I realized two things: one, there were too few projects focused on problems with endangered herps, and second, there was some research, but few implementing conservation activities. Although this trend changed during the course of the last decade, even today, the problems facing several native amphibians in our country are not being fully addressed. It was then that I decided to focus my efforts on the conservation of highly threatened herp species in my country.

In 2012, with this goal in my mind and together with some colleagues and friends, we decided to initiate a project aimed at conserving the Valcheta Frog (*Pleurodema somuncurense*). They are one of three amphibians in Argentina listed as Critically Endangered in the IUCN Red List. This frog is a microendemic species that only occurs at the headwaters of the Valcheta Stream - a waterway that begins at thermal springs located within the Somuncura Plateau in Argentinian Patagonia. Sadly, over the last decades, wild populations of this species have declined and some have become locally extinct. The unique habitat where they live (the headwaters of the Valcheta Stream) is rapidly degrading due to water use issues such as poor livestock management by local farmers, and also introduction of exotic trout in sites where frogs should be thriving. Chytrid fungus is also infecting wild populations of this species, and despite the absence of records of dead individuals, we do not discard a potential negative effect of this emerging disease. In order to face challenges to this species, we created the Wild Plateau Initiative and started work in *in situ* conservation management.

However, in light of the complexity of the situation faced by the Valcheta Frog, we realized in order to achieve better results in recovering wild populations, we would also need to develop a reintroduction program. Therefore, we contacted the Amphibian Ark team and they gave us support to create the first Argentinian *ex situ* facilities for threatened amphibians. It was built at La Plata Museum in the Cururu Program. In 2015, this rescue center received a survival colony of Valcheta Frogs. After an acclimation process, several pairs successfully bred. This allowed us to carry out not only the first reintroduction experience for this species, but also for amphibians in general in our country. During this project, we released 200 individuals at a site where the species had gone extinct due to habitat degradation. Reintroduction of individuals was possible after the restoration of the habitat to original conditions, incorporating a good combination of *in situ* and *ex situ* management.

We are happy with these results, yet a lot of work is still ahead of us. We will continue working with the Valcheta Frog until we can ensure its long lasting survival in the wild. In this regard, we aim to double the number of local populations of this species, and to enhance the connectivity of its habitat. I hope that our work will serve as inspiration for the development of new conservation projects of other endangered amphibians and also as a place where volunteers can be trained to become local conservation leaders.

During the course of his career, Federico Kacoliris (bottom, right) participated in several projects with endangered vertebrates in Argentina and neighboring countries, before deciding to focus his efforts on the conservation of highly threatened reptiles and amphibians in Argentina.

Droughts, floods and froglets in between: a troublesome first half of 2017 in Mitsinjo's conservation breeding center in Madagascar

Sebastian Wolf, Association Mitsinjo, Andasibe, Madagascar

Upon writing this short update, the first half of the year is already over. In retrospect, our work was often influenced by drastic events that we could neither foresee nor influence, but also yielded some nice achievements in regards to the frogs we keep and breed. The Golden Frog conservation strategy finally had a big leap forward with the release of some of our captive-bred stock back into the wild; however a separate story will provide more exciting information about this event at a later time.

A juvenile Golden Frog (*Mantella aurantiaca*) during its color change. Photo: Sebastian Wolf.

Last rainy season felt like a very hard test of our fortitude. An epic drought laid over Madagascar during the months at the beginning of the year that normally see very high rainfall. However, our frogs were rather unimpressed by this as more than a handful of species laid eggs for the first time. So soon we had to deal with froglets so tiny we feared they were even not able to devour our smallest feeder insects. They did though, and so we are happy to announce a couple of world's first breeding successes. This gives us insights into the natural history of small frogs that normally lead a rather secret life and are often hard to find ad hoc in nature.

Our assurance colonies of the Golden Frog (*Mantella aurantiaca*) also did not care too much about the unusual low humidity levels and continued with egg laying as always. However their counterparts in nature had a hard time as their breeding ponds did not refill when they should have done. After the drought, the biggest flood for almost thirty years rolled over the region in March and caused massive destruction in infrastructure and long blackouts. Luckily, our facility was not severely affected as it is situated on a hill a little bit too high for even the most severe rise of river waters.

A two-month old Malagasy Climbing Rain Frog (*Plethodontohyla mihanika*) on a finger tip. Photo: Sebastian Wolf.

Now in July, when temperatures have been falling considerably, our frogs take a resting period, so our technicians are now enjoying the tranquility of the Malagasy winter without any weather excesses. With less time needed for tadpole care and froglet feeding, we can carry out tasks that have been laid aside during other months. Some long-term behavioural studies wait to be processed and we plan new projects regarding husbandry procedures and tadpole rearing with different species. We also plan to invite volunteers from abroad to work alongside our technicians on these projects and will announce more details for interested people soon.

Recent animal husbandry documents on the AArk web site

The Husbandry Document library on the AArk web site (www.amphibianark.org/husbandry-documents/) currently has over 150 articles in it, with additional articles being added regularly. One new document has been added recently:

IUCN Guidelines for Determining When and How* Ex Situ *Management Should Be Used in Species Conservation

The Convention on Biological Diversity's target of halting extinctions by 2020 is less than a handful of years away. Captive, or *ex situ*, management has long been cited as having a potential role to play in the recovery of species, although this remains the subject of debate. IUCN's Species Survival Commission (IUCN SSC) produced guidelines to assist in identifying when *ex situ* management may contribute to species recovery in 2002. Since then, there have been considerable developments in a range of areas that may influence the design of such programs (e.g., understanding of constraints on breeding programs, development of new techniques and approaches, and strategic planning approaches to species conservation). IUCN SSC has therefore revised its guidance and proposes a five-step process: (1) compile a status review; (2) define the role(s) that *ex situ* management might play; (3) determine the precise nature of the *ex situ* population in order to meet identified role(s); (4) define resources and expertise, and appraise the feasibility and risks; and (5) make a decision that is informed based on the above analysis and transparent. These guidelines offer an objective process for considering the role of *ex situ* management in species conservation.

Authors: Philip J.K. McGowan, Kathy Traylor-Holzer, & Kristin Leus
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Partnership as a management tool: maximizing conservation efforts for Chilean amphibians

Guillermo Cubillos Torres, Chief - Unit of Conservation and Research, National Zoo of Chile; Alejandra Montalba Zalaquett, Director, National Zoo of Chile; William W. Lamar, Adjunct Professor, Department of Biology, University of Texas at Tyler, USA; and Danté B. Fenolio, Vice President, Conservation & Research, San Antonio Zoo, USA

Darwin's Frog (*Rhinoderma darwinii*) is a species native to temperate rainforest along the slopes of the Pacific versant of the Andes and in the coastal mountain ranges of Chile. Photo: Danté Fenolio.

The San Antonio Zoo, USA has had an amazing and productive relationship with the National Zoo of Chile in Santiago, which is almost a ten-year collaboration revolving around Chile's endemic amphibians. We have worked to develop captive breeding laboratories at the National Zoo, to train associated personnel, and to enact disease monitoring of wild populations of frogs. Two labs are in place at the National Zoo and another is currently in the works - bringing in new collaborators at the Austral University in Valdivia, Chile. Further, we have been able to publish a number of species conservation assessments and some other ecological findings, all contributing to the conservation of the incredible and vulnerable community of amphibians inhabiting Chile. Above all, the relationship has required clear communication and an understanding of the needs of the range country institution before any actions were taken.

From the perspective of the National Zoo of Chile in Santiago

Based on an integrative approach to conservation, the National Zoo of Chile has formed an active part of concrete conservation actions with other governmental and non-governmental institutions. This kind of strategy can be successful, and should include circumstances where *ex situ* conservation complements *in situ* conservation.

A bit of history for our project and the original focal species: Frogs of the genus *Rhinoderma* are unique amphibians that are endemic to Chile and Argentina – these are the species around which our collaboration first formed. Specifically, Darwin's Frog (*Rhinoderma darwinii*) is a species native to temperate rainforest along the slopes of the Pacific versant of the Andes and in the coastal mountain ranges of Chile. The sister species to Darwin's Frog is the Northern Darwin's Frog (*Rhinoderma rufum*) which has not been observed in well over thirty years and is presumed by many to be extinct. Because of environmental pressures, Darwin's Frog has declined in abundance over the past twenty-five years, especially in the north of its range in Chile. In 2008, the Year of the Frog, the National Zoo joined a global campaign for preventing the extinction of amphibians. Since that year, the National Zoo of Chile has sought to be a reference center for breeding and reintroduction of Darwin's Frog.

One of the captive breeding laboratories located at the National Zoo of Chile in Santiago. Photo: Danté Fenolio.

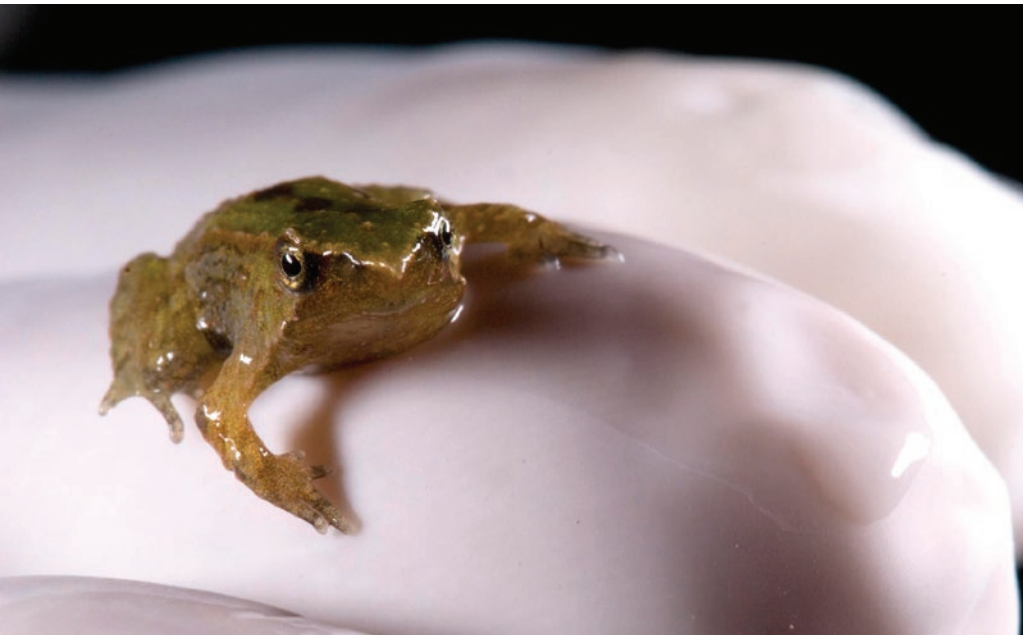
To reach this objective, the project began with the aid of the Atlanta Botanical Garden (Georgia, USA) in 2007/2008, and now is supported by the San Antonio Zoo (Texas, USA). Under this relationship, some advances in breeding and reproduction of Darwin's Frog in the first Center of Reproduction of Threatened Chilean Amphibians in Santiago (Chile) have been achieved. From this collaboration between the National Zoo of Chile and the San Antonio Zoo, a Memorandum Of Understanding was signed in 2011 with the objective of establishing lines of action and responsibilities of the two institutions. This alliance has reinforced some important aspects of the project such as training of personnel, laboratory installation, and equipment support at the Center. With this, we hope to contribute to the conservation of Chilean amphibians, providing *ex situ* reproduction and *in situ* research. Additionally, samples have been taken from a variety of Chilean frog species to try to determine the occurrence and distribution of amphibian chytrid fungus.

We hope to generate data for use in a management plan as well as population monitoring recommendations for this species. As this project began, we all agreed to extend our efforts to include other threatened and native amphibian species, broadening the impact of this collaboration.

From the perspective of the San Antonio Zoo:
From San Antonio Zoo's point of view, we love working with the competent and capable team at the National Zoo in Chile. The project allows our team in San Antonio to share some of its husbandry and facilities expertise and to install labs that will be operated by Chilean collaborators long into the future and within the range country. We might point out that when we began our project, there were not many amphibian conservation programs operating in Chile beyond some work with Darwin's Frogs. We have been monitoring dozens of species in the wild from the outset. The result is a collaboration good for Chile's amphibians and one spearheaded by a Chilean zoo.

Much has been learned through the collaborative process. For example, installing the amphibian labs at the National Zoo was a major effort where both sides learned much about implementing lab space. Having moved through the process the first time, the second lab installation at the National Zoo went much more smoothly (and involved repurposed shipping containers). We are installing a third lab at the Austral University and our collective experience in lab installation in Chile will undoubtedly come into play.

Disease monitoring of wild amphibian populations has been a regular component of the project. Photo: Tim Paine.



The first captive bred Darwin's Frog (*Rhinoderma darwinii*) at the facility at the National Zoo of Chile in Santiago. Photo: Danté Fenolio.

The emphasis of international amphibian conservation programs at the San Antonio Zoo is to develop capacity within range countries. Our collaborators in Chile have been remarkable in their dedication to the effort in Santiago and they have set an example with regard to determination and focus in Chile. The facilities remain operational and will now be networked with the lab in Valdivia. Productive collaborations are in the works wherein personnel, ideas, and supplies can be shared between the networked facilities, providing an even greater benefit to Chile's native amphibians. The San Antonio Zoo will continue to be involved and will provide whatever support is required through time to maintain functional captive breeding facilities and strong field studies.

An adult Chile Mountains False Toad (*Telmatobufo venustus*) another focal species of our project. Photo: Danté Fenolio.

Saint Louis Zoo's WildCare Institute's Ecuadorian Collaboration

Mark Wanner, Zoological Manager of Herpetology & Aquatics, Director, Ecuadorian Amphibian Collaboration, Saint Louis Zoo, USA

Amphibians are disappearing at an exponential rate and the world is facing the largest single mass vertebrate extinction in history. Ecuador ranks third in the world for amphibian diversity behind Brazil and Colombia, but is actually more diverse when you consider the number of species per unit of area. Ecuador is a small mountainous country with a variety of habitats and boasting over 578 described living species of amphibians. It is presumed that Ecuador could have over 700 species of amphibians, many still undiscovered. This small country in South America is said to have over nine percent of the world's amphibians with over 44% endemism. This means almost 258 species of amphibians are only found in Ecuador and nowhere else on the planet.

Since 2006, the Saint Louis Zoo's WildCare Institute (USA) has been supporting Dr. Luis Coloma, Director of Centro Jambatu, with his incredibly important amphibian conservation work in Ecuador. The Centro Jambatu de Investigacion y Conservation de Anfibios (Jambatu Center for Amphibian Research and Conservation) started in January 2011. The name "Jambatu" means frog or toad and is a Quichua word first mentioned by Father Juan de Velasco in 1789. Centro Jambatu's mission is to conduct research and implement the Strategic Plan for the conservation of Ecuadorian endangered amphibians. This project aims to save several endemic extant species of amphibians in Ecuador from extinction through *ex situ* (off-site conservation, away from threat) breeding and management. Given the threats amphibians face, *in situ* (on-site conservation) management is not enough to save many of these species. At this point, *ex situ* management is an urgently needed, proactive solution to save amphibians from extinction. Dr. Coloma and his staff are working around the clock to help ensure amphibians are not lost in Ecuador forever. The Saint Louis Zoo's WildCare Institute is determined to help fight this mass extinction of amphibians by supporting the Centro Jambatu with a biannual contribution of $12,500. With such a large number of amphibian species at risk, this small contribution hopes to help provide a sense of consistent security to this vital work.

Centro Jambatu is now part of Fundacion Otonga, a non-governmental organization founded in 1998 by Dr. Giovanni Onore with the mission to promote the conservation of wildlife in Ecuador. The Otonga Foundation currently manages four reserves in Ecuador (Otonga, Otongachi, Otoyacu and Otokiki) and their objectives are to foster conservation awareness in local communities through early childhood education, and provide facilities to scientists studying wildlife.

The Centro Jambatu is located in Quito, Ecuador and encompasses an area of approximately two and a half acres. This space has several small buildings utilized as amphibian and insect rearing rooms, along with outdoor breeding enclosures. Centro Jambatu currently houses thirty species of amphibians: twenty species of frogs in their conservation programs and ten species in research programs. Of the thirty species, seventeen are listed as either Critically Endangered or Endangered by the IUCN Red List.

The rediscovery and reproduction of Jambato Harlequin Frogs (*Atelopus ignescens*) is a great conservation story and one that deserves strong recognition. Photo: Luis Coloma ©.

In 2013 Dr. Coloma and Saint Louis Zoo's WildCare Institute's staff secured a United States Fish and Wildlife Center "Wildlife Without Borders" grant. The grant enabled the expansion of the Center by supporting new construction and providing a new frog building, insect rearing room, space for meetings and lab work. Since this time Centro Jambatu has added multiple amphibian pods in preparation for any immediate threats, a veterinary lab with two quarantine rooms and a full time veterinarian (Dr. Elena Naydenova) to the staff (www.anfibiosecuador.ec/index.php?as,17).

Some of Centro Jambatu's most recent accomplishments include:

The breeding of Jambato Harlequin Frogs (*Atelopus ignescens*) from specimens rediscovered in April 2016. A founder colony of Jambato Harlequin Frogs consisting of forty-five individuals and a large number of tadpoles are being maintained at the Center, safeguarding this species from extinction. The rediscovery and reproduction of this species is a great conservation story and one that deserves strong recognition. In an effort to rediscover this species the Centro Jambatu offered a $1,000 reward to anyone who could find this unique frog. A ten-year old boy, David Jalaica, accepted this challenge and found the frogs! He and his brother found them in an alfalfa field and led the Centro Jambatu team to the discovery of the forty-five founders now reproducing at the Center (www.anfibios-ecuador.ec/index.php?no).

The rediscovery of the Longnose Stubfoot Toad (*Atelopus longirostris*); this species was rediscovered in 2016. Since that time the Centro Jambatu has been housing this species and hopes to create a sustainable captive population. The Centro Jambatu is perfecting their husbandry guidelines in hopes of reproducing this species soon. As with most species, habitat destruction and fragmentation is playing a major role in their demise. Expansion of the Junin Community Reserve is needed to secure habitat for this species, but until habitat can be acquired and secured, captive propagation maybe the only hope for this species. www.tandfonline.com/doi/full/10.1080/23766808.2017.1327000.

Centro Jambatu is currently breeding and maintaining three other species of harlequin frogs; *Atelopus* sp. (*spumarius-pulcher* complex) a complex currently listed as Vulnerable by the IUCN and two Critically Endangered species, *Atelopus balios* and *Atelopus elegans*. These species are declining due to habitat loss, land-use practices and disease, and sustainable captive populations are vital for their continued existence. The reproduction of these species is a testament to the hard work, strong knowledge and perseverance of the Centro Jambatu team.

In addition to Centro Jambatu's personal success, Ecuador's amphibian community, under the umbrella of the Amphibian Ark, hosted a workshop in early 2016. The workshop was generously supported by AArk, the Philadelphia Zoo and the Saint Louis Zoo's WildCare Institute, and brought together national and international stakeholders in an effort to progress Ecuador's amphibian conservation.

Moving forward we reflect upon our over thirteen years of collaboration. Conservation is always most effective through strong collaborative efforts, and this is the case with Dr. Luis Coloma, the Centro Jambatu, and the Saint Louis Zoo's WildCare Institute. This partnership has one focus - the conservation of Ecuadorian amphibians. Now more than ever, amphibians are in need of conservation action; with twenty-five species already presumed extinct and another 140 on the brink, Ecuador is a hotspot for amphibian conservation. The St. Louis Zoo's WildCare institute looks forward to continuing this collaboration aimed at conserving Ecuador's unique amphibians.

The San Lucas Marsupial Frog (*Gastrotheca pseustes*) has been maintained and bred at Centro Jambatu in Ecuador since 2011. Photo: Mark Wanner.

The Prince Charles Stream Tree Frog (*Hyloscirtus princecharlesi*) was described as new to science by Dr. Luis Coloma et al. and named in honour of Prince Charles, recognising the Prince's work advocating rainforest conservation.
Photo: Mark Wanner.

Recent activities and advances in the high Andean Amphibian Conservation Program at the Santacruz Zoo, Colombia

Viky Johana Téllez Mendoza, Project and Collection Coordinator; Wilmer Antonio Cardona Ocampo, Head of Customer Service and Education; and Haydy Monsalve Redwan, Executive Director, Santacruz Zoological Foundation, Colombia

Historical account of the Amphibian Conservation Program

In 2006, the Amphibian Conservation Program was created within the Santacuz Zoological Foundation, in the Municipality of San Antonio del Tequendama, Cundinamarca, Colombia, because of the level of anthropism that is being carried out in the high Andean forests of the area, which has resulted in decreasing populations of fauna and flora. An amphibian conservation strategy was established, resulting in the "Amphibian Conservation Pilot Laboratory", which initially developed research projects where field trips were made to identify species of the municipality, from which three species were selected for *ex situ* work in the laboratory. These three species were *Pristimantis renjiforum* (Endangered), *Dendropsophus padreluna* (Vulnerable) and *Rheobates palmatus* (Least Concern).

Field and captive research

For the three species, an *in situ* ecological project was developed which included determining habitat status, distribution and natural diet. The project, "Identification of invertebrates and establishment of a diet based on amphibian biology" was undertaken by Ivan Ramos, Viky Téllez and Ramiro Ordoñez.

An *ex situ* program including amphibian husbandry, nutrition, adaptation and reproduction was started by Ivan Ramos, Viky Téllez, Alejandra Sepúlveda and Kelly Prieto. Positive results were obtained from both projects including new records of distribution, management with governmental entities to protect areas of influence for the three species, adaptation, successful captive breeding, and identification of diseases by species. From these results, a biosecurity protocol and detailed amphibian management guidelines have been developed, which include information compiled during the research. An amphibian exhibition area at the zoo was created for the public, and currently work is being carried out to implement specific captive diets.

A laboratory at the Santacruz Zoological Foundation in Colombia, specifically for the conservation of high Andean amphibians from the genus *Pristimantis*. Photo: Viky Tellez.

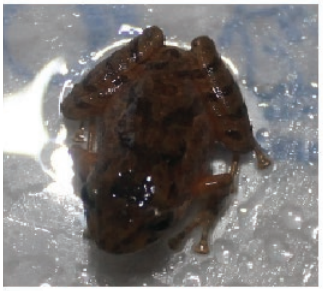
Working with new species

After working on these projects for more than ten years, we incorporated three new species from the region: *Pristimantis bogotensis* (Least Concern), *Pristimantis susaguae* (Data Deficient) and the Two-colored Robber Frog (*Pristimantis bicolor*, Vulnerable), in a project called "Rain frogs in a high Andean forest, sharing resources between four species using the knowledge gained with *Pristimantis renjiforum*" with Mayra Avellaneda and Alexandra Delgadillo. One of the purposes of the Santacruz Zoological Foundation is to be a laboratory specifically for the conservation of high Andean amphibians from the genus *Pristimantis*, which is the most abundant genus in the municipality and at the moment we know of six species.

Pristimantis bogotensis

Pristimantis susaguae

Pristimantis taeniatus



Pritimantis bicolor

Pristimantis renjiforum

Five species from the genus *Pristimantis*, which have all been maintained in the laboratory at the Santacruz Zoological Foundation. Photo: Kelly Prieto Carer.

For these anurans, on-site projects have been carried out such as current distribution and it is hoped to develop research on abundance (since it was identified that the species of the genus *Pristimantis* named in this article coexist together in the same areas and for that reason any protection developed for *Pristimantis renjiforum* will benefit the other five species, including the three in this new program). Founder animals have been collected for the captive program to start the breeding and maintenance program for *Pristimantis bogotensis*, *Pristimantis susaguae* and *Pritimantis bicolor*. We are currently forming reproductive nuclei to hopefully grow the captive population to ensure their conservation.

Conservation education program

During the course of the program we have been involved in community engagement activities to encourage community awareness of local conservation and biodiversity issues in the municipality, using amphibians as flagship species. The program has been directed primarily towards rural educational institutions, which have been fundamental components for the implementation of the educational project. The education project aims to maintain amphibian population stability in natural habitats (Sandra Gomez, Ivan Ramos, Viky Tellez, Ramiro Ordoñez and Kelly Prieto). We have worked with ten institutions obtaining results up to 80% effectiveness towards the acquisition of new knowledge and appropriation of biodiversity with amphibians. Work has also been carried out with local people to help them better understand agroforestry practices, helping to maintain and preserve the municipal ecosystems in order to reduce the loss of natural habitat by human activities we looked at in previous years (grazing, productive crops, mining, livestock, etc.). Generated by man, giving as a positive result the sensitization of community leaders for the care and protection of the environment.

As a zoo, we emphasize the importance of conserving local biodiversity, not only from the point of view of work carried out in captivity or with specialists for scientific research, but also the regional educational work involving the community. All stakeholders have the same objective - the preservation of biodiversity in favor of the conservation of high Andean amphibians, since the human population settlements are those who are directly involved in influencing positive change for these animals, and with their help, greater results are generated in less time than normal estimates of generating species conservation strategies at local, regional and global levels.

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Naturalist available on the web page: www.naturalista.com.

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