amphibian ark

Keeping threatened amphibian species afloat

Newsletter

Number 43
June 2018

In this issue...

Amphibian Ark
c/o Conservation Planning Specialist Group
12101 Johnny Cake Ridge Road
Apple Valley MN 55124-8151
USA

www.amphibianark.org

Phone: +1 952 997 9800
Fax: +1 952 997 9803

Reintroduction of the Northern Pool Frog to the UK - Progress Report, April 2018

Karen Haysom, Species Programmes Manager; Yvette Martin, Amphibian Conservation Officer; and Jim Foster, Conservation Director, Amphibian and Reptile Conservation Trust, UK

Introduction

The Northern Pool Frog (*Pelophylax lessonae*) became nationally extinct in the UK in 1995, largely because of outright habitat loss and the degradation and fragmentation of its remaining habitats. The species had often been considered an introduced species until the late 20th century, unfortunately therefore escaping conservation attention. A reintroduction program initiated by the Amphibian and Reptile Conservation (ARC) Trust and partners in 2005 has restored one population to a specially prepared UK site using wild-to-wild translocation of Swedish founders. Whilst that intervention appears to have been successful to date, the result is that the UK has had only a single population of Northern Pool Frogs in recent years. This is clearly a perilous situation: should any harm come to that population, the species would again risk being extirpated from the UK.

The ARC Trust is now working to establish a second population to increase the resilience of the species in the UK, countering the risks inherent in having only a single population. The current project plan (Baker & Foster, 2015), aims to establish this second population using a head-starting approach, taking spawn from the first population and then releasing well-grown larvae and metamorphs at the second reintroduction site.

An Amphibian Ark Seed Grant, awarded in May 2017 is supporting the ARC in working towards two primary outcomes: 1) the UK conservation status of the Northern Pool Frog is considerably improved, via the establishment of a second viable population; and 2) head-starting methods for Northern Pool Frogs are deployed and evaluated, with the results documented in the literature in order to assist with reintroduction efforts for this species and other amphibians with a similar life history.

This progress report summarises work undertaken between July 2017 and April 2018.

Design, construction and equipping of *ex situ* facility

Work began in June 2017 to investigate established amphibian head-starting facilities across the world, to inform the design of a facility for pool frogs. The Amphibian Pods page on the Amphibian Ark web site (www.amphibianark.org/amphibian-pods/) provided a basis for the research. Following this desk-study we had discussions with Chelsea Tomas of the Atlanta Botanical Gardens, USA and Chris Michaels of London Zoo, UK. A design specification for an appropriately equipped 20 ft shipping container was drafted and used as the basis for soliciting quotes from three sources, two of which responded.

In addition to scoping the equipment needed to set up a biosecure unit e.g. air conditioning, lighting etc., we also investigated the cost and type of equipment needed for amphibian housing and husbandry. Advice on best practice for amphibian husbandry and equipment needed was sought from London Zoo. A fully costed plan was developed, covering both the capital costs of establishing the unit and its subsequent running costs, including the salary of a dedicated ecologist to run the facility.

Fundraising has remained the major priority throughout 2017 and 2018 and a description of fundraising activities is provided below. The level of funding achieved as of April 2018 was unfortunately not sufficient to make progress with the purchase and equipping of a head-starting unit meaning that translocations have had to be postponed until 2019. Fundraising will remain a priority throughout 2018 and until enough money has been secured to set up the head-starting facility.

The northern clade pool frog (*Pelophylax lessonae*) is much darker in colour than its southern counterparts.
Photo: Yvette Martin.

Amphibian and Reptile Conservation Trust members, along with Zoological Society of London staff and Phil and Debbie Bishop during a field trip to study of water quality at the first reintroduction site of the Northern Pool Frog (*Pelophylax lessonae*) in the UK. Photo: Yvette Martin.

Advice on habitat management

The ARC instigated and chaired two meetings of the Pool Frog Working Group (an advisory panel of experts set up prior to the initial reintroduction project in 2005), one in September 2017 and another in February 2018. In September the group visited the first reintroduction site with the newly appointed Reserve Manager for Norfolk Wildlife Trust at Thompson Common, Jonathan Preston. The aim of the site visit was to discuss priorities for habitat management over the coming winter season and to provide insight for the new reserve manager into pool frog habitat management. A revised three-year habitat management plan is being produced for the first reintroduction site. This will take into account recommendations from experts in the species, recent research on characteristics of breeding ponds, as well as advice from Professor Phil Bishop of the University of Otago in New Zealand and Amphibian Survival Alliance, who undertook studies of water quality at the first reintroduction site during Summer 2017. The management plan will focus on works deigned to increase habitat quality for pool frogs and encourage their spread across the site. Results from monitoring of the implementation of this plan will then be used to refine habitat management plans for the second reintroduction site.

Project management

Project management is an ongoing task. The ARC has been working with a professional fundraiser to expand the ways in which we look to raise funds; this now includes grant applications, letters of interest and most recently ARC has created a new web page which allows individuals or organisations to make donations to individual species or to support a particular cause. In April 2017 postage stamps featuring the pool frog were launched by the UK's national postal service, following consultation with the ARC (www.arc-trust.org/news/sand-lizard-and-pool-frog-stamps). This event was used as an opportunity to raise awareness of the pool frog reintroduction work.

Species surveillance data (recording counts of adults, juveniles, spawning events and metamorphs at both of the reintroduction sites) for the 2017 field season was collated between August and September 2017.

Detailed data analysis was carried out between October 2017 and February 2018. Mark recapture analysis was undertaken to produce a population estimate for the pool frogs at the first reintroduction site (fifty-five adults). At the second reintroduction site, where Amphibian Ark funds are being used to develop head-starting efforts, it was encouraging to find pool frogs resulting from an experimental head-starting release in 2016, with evidence of attempted breeding. Numbers of pool frogs were, as expected, rather low, reinforcing the need for further releases.

In April 2017 postage stamps featuring the pool frog were launched by the UK's national postal service as an opportunity to raise awareness of the pool frog reintroduction work.

Disease risk management advice

Consultation with the Institute of Zoology, UK is ongoing. A Disease Risk Management protocol was produced in May 2017 and a management protocol for collecting, transporting and releasing spawn was produced in collaboration between ARC and London Zoo.

Captive management advice

Further consultation with London Zoo led to the production of amphibian husbandry guidelines, these have been designed to aid ARC staff in monitoring the species while in captivity and managing environmental parameters within the head-starting facility. The head-starting guidelines provide advice on housing, environmental management, feeding, monitoring development, dealing with ill health and metamorphosing tadpoles. Consultation with London Zoo is ongoing. London Zoo has offered staff time 'in kind' to advise on amphibian husbandry prior to and once the unit is established.

More information about the project can be found on our web site, www.arc-trust.org/breaking-new-ground.

Establishment of a captive breeding program for the Kroombit Tinkerfrog

Harry Hines, Senior Conservation Officer, Queensland Parks and Wildlife Service, Australia

The Department of Environment and Science's Queensland Parks and Wildlife Service, Australia, and Currumbin Wildlife Sanctuary, Australia, have commenced a collaborative project to undertake captive breeding of the Critically Endangered Kroombit Tinkerfrog (*Taudactylus pleione*). This comes on the back of a successful captive breeding trial using the closely related Eungella Tinkerfrog (*T. liemi*), by Professor Jean-Marc Hero (formerly of Griffith University), Dr Ed Meyer (consultant ecologist) and Currumbin Wildlife Sanctuary.

In early February 2018, Ed Meyer and Harry Hines undertook a field trip to Kroombit Tops National Park, Australia, to collect a small number of tinkerfrogs for captive breeding. We focused our efforts on finding an adult female but were unable to locate one (due in part to the very wet, cold and windy conditions prevailing at this time). We did however locate and collect an indeterminate, possibly sub-adult female and an adult male on this trip. A subsequent collecting trip in March 2018, with Saskia Lafebre and Kimberly Revelly from Currumbin Wildlife Sanctuary, Harry Hines and Ben Revelly (a Queensland Parks and Wildlife Service volunteer), resulted in the collection of a second indeterminate individual and a partially gravid adult female. Animals collected from the wild were carefully transported back to a dedicated husbandry

A male Kroombit Tinkerfrog (*Taudactylus pleione*) in the wild at Kroombit Tops National Park. Photo: Ed Meyer.

The partially gravid female Kroombit Tinkerfog at Currumbin Wildlife Sanctuary.
Photo: Michael Vella.

A male Kroombit Tinkerfrog, receiving its first treatment for amphibian chytridiomycosis (a ten-minute bath in an antifungal solution). Photo: Ed Meyer.

facility at Currumbin within forty-eight hours of capture. They have all settled into their new home and are eating well. We are hopeful that the adult female will develop a full complement of eggs over the coming months with a view to breeding in Spring.

Amphibian chytridiomycosis, a fungal disease responsible for declines and disappearances of frogs across the globe, is a major threat to the tinkerfrog species both in the wild and in captivity. The preceding work with the captive population of Eungella Tinkerfrogs at Currumbin Wildlife Sanctuary developed safe treatment protocols to rid adult and subadult tinkerfrogs of amphibian chytrid fungus. In keeping with these protocols, treatment of Kroombit Tinkerfrogs for chytrid commenced in the field, twelve hours after capture. Pre-treatment chytrid infection status was assessed by carefully swabbing the flanks and ventral surfaces of the frogs and subsequent DNA analyses. After swabbing, each frog was treated with a ten-minute bath in an antifungal solution. This same treatment was repeated every twenty-four hours for ten days after capture. Analysis of skin swabs of the frogs immediately post-treatment and in subsequent weeks, has shown that all four animals collected from the wild are now chytrid free.

Depending on the sex of the sub-adults collected in February and March, additional animals may be collected from the wild this Spring. The Kroombit Tinkerfrog husbandry team will regularly assess the progress of captive frogs and evaluate the need for additional animals as required. In the longer term, we hope to release captive-bred animals back to the wild.

The Fitzroy Basin Association helped finance this important project and have supported survey and monitoring of threatened frogs at Kroombit Tops National Park over many years. Their ongoing support of this project and other conservation work at the park (in particular, feral animal control) is critical to the continued survival of the Kroombit Tinkerfrog. Other important contributors to this project include present and former staff of Currumbin Wildlife Sanctuary, including Michael Vella, Saskia Lafebre, Natalie Hill and Matt Hingley. Department of Environment and Science staff (past and present) and numerous volunteers have also contributed over many years to our understanding of the distribution and abundance of the Kroombit Tinkerfrog, its status, and the need for captive breeding. Thanks are also owed to the local Queensland Parks and Wildlife Service staff for use of the barracks (warm, dry and mostly leech free!) and their ongoing efforts in controlling feral animals at Kroombit.

The captive breeding facility at Currumbin Wildlife Sanctuary.
Photo: Saskia Lafebre.

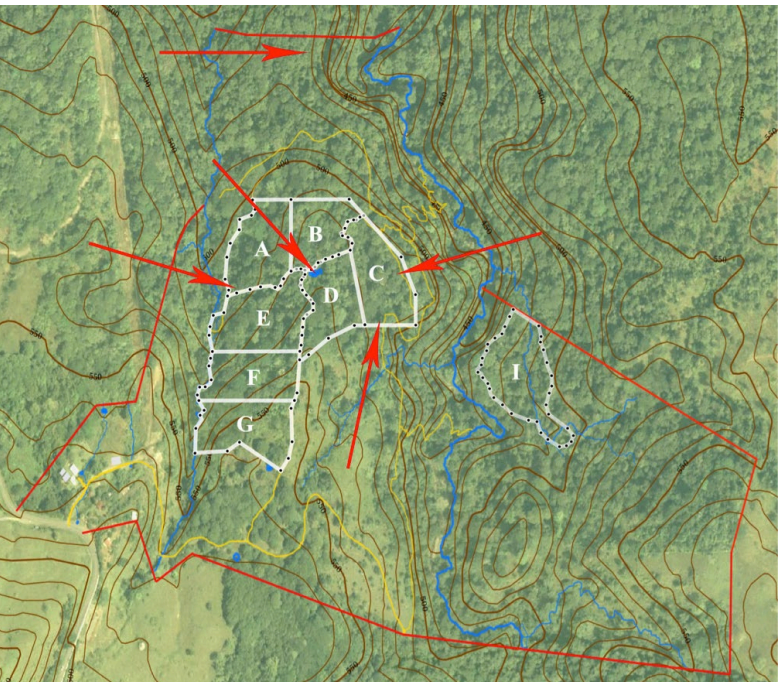
In situ conservation of the Lemur Leaf Frog through habitat improvement and forest management practices in the Guayacán Rainforest Reserve in Costa Rica

Brian Kubicki, Costa Rica Amphibian Research Center

In 2002 Brian Kubicki established the Costa Rica Amphibian Research Center (CRARC). The CRARC is a small private and family-operated biological research project that is dedicated to studying, understanding, and conserving one of the most ecologically important faunal groups of Costa Rica's humid forest ecosystems, that of the amphibians. The CRARC owns and operates two private reserves in the mega-diverse forests along the Caribbean slopes of Costa Rica's Talamancan mountains, the Guayacán Rainforest Reserve (50 hectares), and the Río Vereh Cloud Forest Reserve (44 hectares); together, these two reserves are currently known to be home to seventy species of amphibians, but following further studies, especially in the Río Vereh Cloud Forest Reserve, this number could likely surpass eighty.

Since 2002, the CRARC has proven to be a pioneer with establishing novel and successful *in situ* conservation methodologies for a variety of amphibian taxa within its reserves. One example of a species-specific *in situ* conservation project that has been very successful is with the Critically Endangered Lemur Leaf Frog (*Agalychnis lemur*). Through the creation of artificial and semi-natural breeding sites in the Guayacán Rainforest Reserve, the CRARC has been able to greatly increase the size of an initially small reintroduced population of this species. Not only has the population of Lemur Leaf Frogs within the Guayacán Rainforest Reserve greatly increased, but numerous breeding metapopulations have now been observed extending into neighboring properties. Based on the great successes that the CRARC has had for more than fifteen years with various *in situ* conservation projects focused on several amphibian taxa it is a very important to emphasize that *in situ* conservation practices should be considered as a priority and one of the most effective ways to potentially achieve long-term conservation goals with species of special concern.

Populations of the Critically Endangered Lemur Leaf Frog (*Agalychnis lemur*) in the Guayacán Rainforest Reserve have greatly increased, thanks to an experimental "Forest Management Project" being undertaken by the Costa Rica Amphibian Research Center. Photo: Brian Kubicki.



Red arrows indicating sites within the Guayacán Rainforest Reserve in Costa Rica where Lemur Leaf Frogs (*Agalychnis lemur*) are known to be actively breeding. White lettered sections represent the eight forest management areas. Photo: Brian Kubicki.

Within the Guayacán Rainforest Reserve there are five sites where Lemur Leaf Frogs are known to be actively breeding, and four are concentrated near the center of the reserve, in a section that is dominated by early to mid-staged secondary forest. Unfortunately, secondary forest can become dominated by undesirable plant species that impede with the regeneration and overall health of the forest and its understory. This dominance of undesirable plant species within the core area where the metapopulations of leaf frogs are found within the Guayacán Rainforest Reserve has given rise to the development and implementation of an experimental "Forest Management Project", which received a boost late in 2017, with a donation from a private donor, via the Amphibian Ark.

An area of approximately seven hectares in the center of the reserve, in addition to an area approximately one hectare in size, east of the Siquirres River have been designated as candidate forest for this pioneering project, one that aims to try to drastically shift the dominance of the understory vegetation from undesirable species to those that directly benefit not only a wide variety of vertebrates and invertebrates, but will also result in a higher rate of regeneration and growth of the overall forest. The designated areas within the reserve have been divided into eight sections, each measuring roughly one hectare in size. On the map, each of the eight sections are highlighted and given a specific letter. Within the proposed Forest Management Areas three principal plant types have been determined as undesirable and targeted for removal: assorted vine species, a vining fern and a creeping terrestrial and epiphytic fern.

The forest management methodology involves several phases. The first phase is to go into the selected section and physically cut all undesirable vine species with machetes, after which they will quickly wither and die up in the canopy. The second phase involves going in and removing

A section of forest prior to being cleared, showing the dominance of undesirable ferns and vines. Photo: Brian Kubicki.

Another section of forest in the Forest Management Project; this section is in the third phase of management, when creeping terrestrial ferns and their rhizomes are being removed. Photo: Brian Kubicki.

the creeping ferns that grow up the trunks of trees. The third phase, which is the most physically demanding and time-consuming, involves eliminating the creeping terrestrial ferns and their rhizomes that dominate the understory in the Forest Management Areas. In order to weaken the undesirable terrestrial ferns, it is necessary to chop their vegetation two to three times with approximately one month between each round of chopping. The repeated removal of the energy producing vegetation of the terrestrial ferns drastically weakens the plants. Once the ferns have been drastically weakened after several rounds of cutting their fronds, the surviving plants will be removed. The fourth phase is to go back in approximately six months after the initial cutting (phase one) and remove the dead rotting vines hanging from the trees and canopy that can be reached and safely pulled down. Once the undesirable plants have apparently been removed, the final or fifth phase is to monitor in each section for a period of roughly four years. During the four-year monitoring process any re-emerging undesirable plants are quickly identified and removed.

The Forest Management Project was initiated more than three years ago, and the observable results thus far have more than surpassed expectations. The Forest Management Project is not only benefiting numerous taxa of flora and fauna within the Guayacán Rainforest Reserve, but it has also provided vital economic support to some local families through paid manual labor.

The Forest Management Project has been made possible through the financial support of four institutions; the CRARC, which has invested more than US$3,000; the Manchester Museum, which donated US$1,000; the Bristol Zoo, which donated US$1,250; and a private donor (via the Amphibian Ark), who donated US$2,500. The CRARC would like to extend a very special thanks to the Amphibian Ark, Manchester Museum, and Bristol Zoo for their support with the Forest Management Project.

CURSO DE BIOLOGÍA

MANEJO Y CONSERVACIÓN DE ANFIBIOS NEOTROPICALES

El Arca de Anfibios y el Departamento de Biología de la Universidad del Valle de Guatemala invitan al curso teórico-práctico de Biología, Manejo y Conservación de Anfibios Neotropicales dirigido a biólogos y otros profesionales con interés en la conservación *ex situ* de anfibios.

Lugar: Universidad del Valle de Guatemala
Fecha: Del 27 al 31 de agosto del 2018
Costos: Sesión teórica (3 días) - Q.300
Sesión práctica (2 días) - Q.150 - Cupo limitado

Información para inscripciones:
Luis Carillo - luis@amphibianark.org

amphibian ark

Departamento de Biología
UNIVERSIDAD DEL VALLE DE GUATEMALA

UVG
UNIVERSIDAD DEL VALLE DE GUATEMALA

Manchester Metropolitan University

Donation provides for equipment upgrades within the Biogeos Foundation facilities, at the Rescue of Endangered Venezuelan Amphibians program in Venezuela

Enrique La Marca, Rescue of Endangered Venezuelan Amphibians Program, Biogeos Foundation, Venezuela

Late in 2017 a private donation was made to us via the Amphibian Ark, and our plans for these funds were:

To improve climate and feeding conditions:
- Automated water and air cooling system
- Timer, thermo-hygrometer, UV roof lamp, plastic pipes
- Materials for live invertebrate cultures (plastic containers, food, prey-aspirators, forks, gloves, masks, gauze, water sprinklers).

To purchase and install additional terraria and larvaria:
- 12 Exo-Terra terrariums
- Materials for water pump and filters
- Materials for twenty enclosures for raising tadpoles.

Summary of investment

The funds were allocated to condition a cool room and an adjacent temperate room, to keep medium (1,700-2,400 meters above sea level) and high (2,400-2,900 meters above sea level) elevation amphibians. This altitudinal range includes humid and cloud forests at middle elevations, to high montane cloud forests. In this sense, these are the only facilities in Venezuela devoted to keeping middle to high montane amphibians in captivity. All previous *ex situ* amphibian programs (one, active in CCRAAV, Merida, Venezuela, with lower montane frogs from the Merida Andes; and another, no longer running at the Universidad Central de Venezuela, with the late Dr. Cesar Molina in charge, kept lower montane frogs from the Venezuelan Coastal Range) covered lower montane to coastal elevation conditions. The new facilities are used to teach and to introduce university students to amphibian captive husbandry and breeding knowledge and techniques.

The cool room was recently improved through the installation of an air conditioner and a freezer that allows for the circulation of cold air and water, and currently houses an *ex situ* program for Mucuchíes' Frog (*Aromobates zippeli*). Photo: Enrique La Marca.

Cool room

The cool room was improved through the installation of an air conditioner and a freezer that allows for the circulation of cold air and water. The water is mobilized through a water pump connected through plastic pipes to go in and out of the freezer and maintain cold water for containers keeping tadpoles ("larvaria"). Mean daily temperatures in the cool room are 12-14º C for air and 10º C for water. The room is mainly intended for endangered skunk frogs (*Aromobates* spp.) and harlequin frogs (*Atelopus* spp.), and it currently houses an *ex situ* program for Mucuchíes' Frog (*Aromobates zippeli*). The cool room has also been used to temporarily keep specimens of an undescribed paramo lizard of the genus *Anadia* found at an elevation of 2,900m in the southern Venezuelan Andes, to obtain data before the species is formally described.

The temperate room is used to keep adults and tadpoles of the endangered frog *Mannophryne cordilleriana*.
Photo: Enrique La Marca.

Temperate room

The temperate room has been used to keep adults and larva of the endangered frog *Mannophryne cordilleriana*. The first generation of tadpoles raised to metamorphosis have already been released in the field, and were the basis for an undergraduate biology thesis by Michelle Castellanos at the Central University of Venezuela, that deserved an honorific degree recognition. This research tested a tadpole´s food (see separate article in this edition of the Amphibian Ark Newsletter).

Invertebrate cultures (mealworms, ants, fruit flies, weevils, moths) are kept in an adjacent warm room. The next cultures will be crickets and earthworms.

New AArk Conservation Grants program, and call for applications

Since 2009, Amphibian Ark has provided over US$127,000 in seed grants to twenty-six *ex situ* conservation programs for threatened amphibian species, in sixteen different countries. A complete list of the programs that have received these grants is available on our web site (www.amphibianark.org/seed-grant-winners/). Most of these programs have subsequently raised additional funding so the programs can develop and expand, with some of them now maintaining very successful captive breeding programs, working with their colleagues in the field to mitigate threats, and reintroducing captive-bred animals into repatriated and protected habitats in the wild.

We have recently updated and expanded our grants program, to include a range of additional granting opportunities, including scholarships for workshop attendance, multi-year project grants, mentorship for existing captive programs, and start-up grants for new projects.

Applications due 1 August 2018!

We are now accepting applications for the following types of grants:

- **Start-up grants** - initial funding to help newly-launched projects get started at the very beginning of their life, to help them attract larger and/or long-term funding for the duration of the program. We will not fund projects that are already well-established or have significant funding, although we will consider projects with funding in place for complementary components (such as fieldwork or education). One-time grants of up to US$5,000 are available. Recipients are able to apply for second and third year extension grants.
- **Start-up grant extensions** - additional funds are available to provide continued support for AArk seed or start-up grant projects that a) have met their stated objectives for year one, and b) can demonstrate that additional supplemental funds have been secured for years two and three. Recipients of funding from the AArk in 2016 and 2017 are eligible to apply for these extensions. Grants of up to US$4,000 for year two and US$3,000 for year three are available.

Local school children were involved with the first release of captive-bred Valcheta's Frogs (*Pleurodema somuncurense*) into restored and protected habitat in Argentina. This very successful program received an AArk Seed Grant in 2014.
Photo: Melina Velasco.

- **Workshop attendance** - partial funding to assist attendance at *ex situ* amphibian conservation-related workshops, especially those which focus on amphibian husbandry, planning and reintroduction. Applicants must have already secured partial funding to attend the workshop. You must already be actively involved in an amphibian conservation project or have well-developed plans and funding in place to implement a new program. Grants of up to US$750 are available.
- **Mentorship grants** - support for organizations which have previously received an AArk seed or start-up grant, to bring in a designated outside expert to assist with an aspect of their amphibian conservation efforts (e.g. veterinary training, environmental control etc.). Grants up to US$1,500 are available.
- **Emergency grants** - limited funding is available for past recipients of AArk grants throughout the year for emergency situations such as emergency rescue of wild populations facing imminent threat of extinction, unanticipated major equipment failure in existing *ex situ* programs etc. Please contact grants@amphibianark.org at any time to discuss an emergency grant.

Our grants are intended to support conservation projects for amphibian species that cannot currently be saved in the wild, with a focus on *ex situ* actions, and in partnership with appropriate field activities. Preference will be given to projects for species which have been assessed as in need of *ex situ* rescue or research work, either as a recommendation from a Conservation Needs Assessment (www.conservationneeds.org) or a similar, national assessment process.

The deadline for applications for 2018 is 1 August.

Please follow the guidelines carefully, as applications that do not adhere to the guidelines may not be accepted. Several past grant recipients have offered to act as mentors to help new applicants – if you'd like us to put you in contact with one of them, please let us know at grants@amphibianark.org. We strongly suggest that you send us your application a week or so prior to the deadline so we can check it for you - **several proposals have been rejected in the past** due to issues that could have been prevented!

More details about the new AArk Conservation Grants program, and guidelines for applications are available on the AArk web site at www.amphibianark.org/conservation-grants/. We look forward to receiving your applications. Please contact grants@amphibianark.org if you have any questions.

Amphibian Advocates

Our Amphibian Advocates for this edition are José Alfredo Hernández Díaz from Africam Safari in Mexico and Dr. Phil Bishop, who is the IUCN SSC Amphibian Specialist Group's (ASG) representative on the AArk's Executive Committee. Both Alfredo and Phil have worked with amphibians throughout their careers, with both of them gaining a love amphibians in their childhood.

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!

José Alfredo Hernández Díaz, Africam Safari, Mexico

Since I was a child, I loved animals, especially reptiles and amphibians. When I was young, my parents used to take my brother and I to the countryside; we usually collected some tadpoles, raised them and then put the frogs or toads in the garden. I liked to hear them calling on rainy days. Then I grew up and decided to become a biologist.

While I was studying my Biology degree, I created a student organization with some friends. We built a small herp collection at the university and tried to teach people about their important role in the ecosystem as well as change people's misconceptions regarding reptiles and amphibians. During that time, I was also a volunteer in the Education Department at Africam Safari Zoo in Puebla, Mexico.

After finishing my degree, I got the opportunity to work as a volunteer for Shawn McCracken's TADPOLE Organization on its Canopy Amphibian Project in Ecuador. The project aimed to test the negative effects of pollution by oil companies on amphibian diversity in the Amazon. I witnessed the great richness of amphibians in the most diverse terrestrial ecosystem on Earth, and I definitely decided to focus my career on amphibian conservation. Then, I did my Master's degree in Colombia where I worked with poison dart frogs. We had a small collection at the university lab and there I learned more about amphibian husbandry.

In 2012, I came back to Africam Safari Zoo as the Curator of Reptiles and Amphibians, where I became responsible for the Large-crested Toad (*Incilius cristatus*) Conservation Program - a Critically Endangered amphibian which is endemic to Mexico. I had participated in the beginning of that program while I still was a volunteer at the zoo. I collaborated in the field work when the founders of the colony were collected. Unfortunately, when I got the position, the toads were still in quarantine boxes, but that gave me the opportunity to design their enclosures and form two breeding groups. Six months later, we had the first breeding event of the species in captivity. That event was a huge learning experience for me, because I was able to see the toads laying eggs, and the tadpole development from the beginning.

Since that day, we have had eight breeding events in the captive colony, which have allowed us to gather important information on the species breeding and developmental biology. We have collected additional tadpoles to enrich the gene pool of the colony and we have released more than 1,000 captive-bred toads on five different occasions between 2013 and 2017. Also, during those five years we established a toad population monitoring program. We found an increase in the abundance of the species during the breeding season - from 23 to 120 in a single night.

In addition to the Large-crested Toad, I started a new project in 2015 with support from the Zoological Society of London's Edge of Existence Program. This project consisted of determining the status of the Taylor's Salamander (*Ambystoma taylori*) population, where it is endemic to a single crater lake in Mexico. After two years working on that project, I developed a conservation strategy to implement protective actions in the salamander's habitat, and to create an assurance colony for the species, and at the end of last year, I received the "For the Love of Mexico Award" from Volkswagen. The award included funding to continue habitat protection work for the Taylor's Salamander through actions such as the creation of a protected area around the lake, the reforestation of the crater with 2,500 native trees, and the engagement of local people and visitors in actions to reduce pollution in the lake.

I hope my efforts can improve the conservation status of the species I work with. In addition, I hope I am able to work for the conservation of other endangered Mexican amphibians in the future. Amphibians are not usually among the most important species for national conservation priorities in many countries, however, they are an outstanding group of animals due to their beauty, their different life histories and the role they play in the ecosystems.

Amphibians deserve our protection.

Dr. Phil Bishop, Co-Chair IUCN SSC ASG, Chief Scientist Amphibian Survival Alliance and Professor of Zoology at the University of Otago, New Zealand

People often ask me "Why frogs?" and this has been an extremely difficult question for me to answer. I have been passionate about amphibians for as long as I can remember, I don't know why, I just simply love amphibians, especially toads! When I look back at my childhood over half a century ago, I remember finding my first amphibian, it was a beautiful female brick red Common Toad (*Bufo bufo*). I was four or five years old at the time, and she just sat patiently, filling up my small hand, smiling at me – from that time on I was hooked!

Like many amphibian conservationists, I ended up with a garden filled with frogs, toads, newts and snakes and my path was set to become a herpetologist. I studied Zoology at Cardiff University and went on to do a Master's degree in tropical medicine and parasitology. However, near the end of my Master's my eminent parasitologist of a supervisor gave me some great advice, he came into my lab (which housed thirty-two species of amphibians in twenty different aquaria, none of which were relevant to my thesis) and said to me "I think you should be working on amphibians!". So, I took his advice and was fortunate enough to get a PhD scholarship to study anuran communication and social behaviour under the tutelage of Prof Neville Passmore in South Africa. Going to South Africa to study frogs made me feel like a kid in a candy shop, so many amazing frogs and toads, beautiful colours and sounds, so many weird and wonderful behaviours, a fantastic place to be to study amphibians.

Towards the end of my PhD I was fortunate to be able to attend the First World Congress of Herpetology and of course it was at this conference that we started to realise that global amphibian declines were well under way and we needed to be concerned. On my return to South Africa I felt that we were in a good position as there was no evidence of any declines, but I also felt it was very important to take a snapshot in time and conduct an inventory of how many species we had, where they lived and how they were doing. So, I started the Southern African Frog Atlas Project and tried to convince all the 4x4, tree-hugging birders, that 'birding' is old hat and if they really wanted to be cool they would go frogging with their tape recorders! To cut a long story short, with hundreds of volunteers and recordings it took ten years to complete the "Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland" which provided the accurate distribution and population status of every species of frog in the southern African region. This was the first time that such a project had been attempted at such a large multi-national level.

At the end of the 1990s I moved to New Zealand to study the incredibly unusual and archaic *Leiopelma* species. New Zealand has a raft of unusual species like the tuatara, and flightless birds like the kiwi and kakapo and I was concerned when I first arrived to see that the birds were attracting all the conservation funds and the frogs, that were more threatened, seemed to have been forgotten about. So, I began a crusade to raise awareness about the plight of New Zealand's native frogs and in so doing became more and more involved in global amphibian conservation. I became acutely aware that we needed a global campaign and I

attended the planning meeting for the Year of the Frog in Rotterdam and later became the Year of the Frog Ambassador for New Zealand (it's time we had another campaign like this!). As more and more amphibian declines were being reported it was becoming clearer that we weren't winning the battle and many scientists felt there was the need to form a global coordinating body which would have oversight of global amphibian conservation. With generous financial contributions from several institutions and the late George Rabb the Amphibian Survival Alliance was formed in 2011 and I was appointed as their Chief Scientist (a position I still hold today). In 2013 I was also appointed as the Co-Chair (along with Ariadne Angulo) of the IUCN SSC Amphibian Specialist Group, and in these two positions I strive to help coordinate global amphibian conservation to ensure that our children, grandchildren and great grandchildren, will still have amphibians in their lives.

Amphibians have been very kind to me, I have worked on amphibian conservation projects in many parts of the world, like Africa, Borneo, Australia, Chile, Madagascar and the UK and amphibians have introduced me to some amazing people (some of them my childhood heroes) like Sir David Attenborough, Dr Dame Jane Goodall, Xena Princess Warrior, Prince Charles and Camilla, and the great late George Rabb.

We must do everything in our power to save amphibians, we should be working hard to protect them - like our lives depend on them, because it does!

AArk Newsletter - Instructions for authors

The Amphibian Ark Newsletter publishes articles on amphibian conservation programs, with a focus on *ex situ* programs for threatened species. Four editions are produced each year, in March, June, September and December.

Types of article

Feature articles, short updates, advertisements for non-commercial amphibian conservation-related activities etc. are welcome.

Themes for articles

- Progress reports on amphibian conservation or management initiatives
- Amphibian husbandry techniques, successes and failures
- Live food production
- Habitat restoration and protection in preparation for release or translocation
- Forthcoming or recent amphibian conservation conferences or captive management courses
- Education and community engagement
- Other relevant articles related to *ex situ* amphibian conservation

Word limit

Maximum 2,000 words including references and all information in figures and tables (and their captions). As a guide to article length, there are approximately 500 words per printed page.

Photos

Photos are encouraged, especially close-up photos of amphibians, and people working within the amphibian programs. Photos should be sent as separate files (i.e. not included within the Word document) and should be the highest resolution possible.

If photos are included, please suggest a caption for each photo, approximately 25-30 words), along with the name of the photographer.

Figures

Please embed all figures (maps, tables and diagrams) in the text. Full colour is acceptable.

Language

Please submit articles in English or Spanish.

Layout

Include the title (bold, sentence case) followed by the author names, and then their affiliations and countries.

First level headings should be sentence case and bold. Second level headings should be sentence case and underlined.

Please use Arial font size 12. Left align all paragraphs with single line spacing.

Please use the species' common name and scientific name when first referred to in the text; i.e. Titicaca Water Frog (*Telmatobius culeus*) and format the scientific name in parentheses and in italics. Refer to the species by its common name thereafter.

Please use SI units throughout (i.e. metric measurements).

Layout (tables and figures)

Please provide a label for each table and a caption for each figure. Label all tables and figures consecutively (i.e. Table 1, Figure 1 etc.). Ensure that all tables and figures are referred to in the text.

Editorial

The editors reserve the right to make typographical, spelling and grammatical corrections without author consultation.

Inappropriately or overly-formatted articles may be sent back to the authors for editing to the required layout.

Authors are required to proof-read and spell-check their own submissions.

Submission

Please email articles in English or Spanish to newsletter@amphibianark.org.

Articles will be considered for publication throughout the year, but the deadlines for each edition are March 1st, June 1st, September 1st and December 1st.

A private donation helps the Valcheta Frog program in Argentina

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

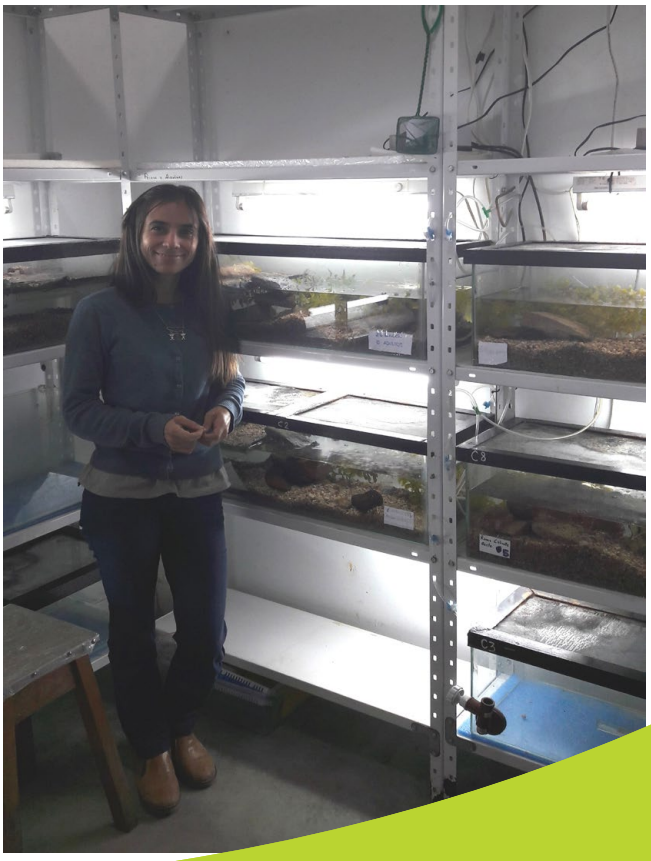
Since 2013 we have been working on the conservation of the IUCN Critically Endangered Valcheta Frog (*Pleurodema somuncurense*), integrating *ex situ* and *in situ* conservation approaches. In 2014 we received an Amphibian Ark seed grant that was key for us to build the first amphibian rescue center in Argentina, and the AArk then helped us through a training workshop conducted in Cochabamba, Bolivia, that was of great importance to learn how to maintain healthy amphibians in *ex situ* facilities. In 2015, we established a survival colony of twenty pairs of the Valcheta Frog, and after several attempts, during 2016 we successfully achieved reproduction of the species in terrariums. At the same time, we continued working in the field, alleviating threats and restoring wild habitats where the species used to be common but where it became locally extinct after some high disturbing human-related activities. In March of 2017, with one wild habitat fully recovered, we conducted the first reintroduction of captive-bred animals of this species, that was also the first amphibian reintroduction program (and still the only one) working in Argentina.

Over the past five years we have gathered a lot of data related to the natural history and reproductive ecology of this frog and this helped us to discover some specific features of key relevance to improve the current conditions in the assurance colony. One of these features is that this species shows a scramble competition reproductive behavior. This means that reproduction mostly occurs when several males interact with one female. Thus, it is key to have several individuals in the same terrariums in order to increase the chances of producing fertilized eggs. However, when several individuals share the same terrarium, this must be bigger enough to provide sufficient space, ensuring their health status. Late last year we received a donation from a private donor, via the AArk, which has allowed us to build two new terrariums, which are significantly larger than those we had previously used. We expect to move frogs to these new terrariums before September 2018, which will be the next reproductive season. These terrariums will help us to greatly improve the reproductive habitat for captive Valcheta Frogs and will give individuals more space for their daily activities.

In 2018, we also conducted the second reintroduction campaign aimed at strengthening the previous reintroduced population of Valcheta Frogs. This time we released fifty frogs that were captive-bred in the *ex situ* facilities during 2017. Our goal is to achieve the establishment of a healthy, self-sustaining population of the species in this site, with individuals of several different age groups.

Almost two years after the first reintroduction, we expect to see the first clutches in this wild site during the next reproductive season. This would be a key indication that the local population has been successfully established. After that, the next step of the reintroduction program is aimed at recovering other local population of the species that became extinct from the wild. For the second reintroduction campaign, we received additional financial support from the AArk that was key to cover the transportation of the fifty released individuals and related fieldwork activities.

Two new and larger terrariums (above) compared with the older and smaller terrariums (below) for Valcheta Frogs (*Pleurodema somuncurense*), which were built with the support of a donation provided via the Amphibian Ark. Photos: Federico Kacoliris.



The second reintroduction of captive-bred Valcheta Frogs, with participation of children from a local school in March of 2018 which we have been able to accomplish thanks to a recent donation. Photos: Federico Kacoliris.

A rich food formula to raise tadpoles in captivity

Enrique La Marca and Michelle Castellanos, Rescue of Endangered Venezuelan Amphibians Program, Biogeos Foundation, Venezuela

Although tadpoles may resemble fishes and some may even be confused with them, they have different food requirements. There are some commercial formulas available to feed tadpoles, but keepers generally use products manufactured for fishes. They are not only expensive but are also inappropriate because they are intended for animals with a carnivorous diet.

Tadpoles are mostly vegetarians, feeding mainly on algae attached to different substrata. Their intestinal tracts are long simple tubes with a rudimentary stomach and large coiled intestines that are better suited for digestion of plant material. Nonetheless, tadpoles also need proteins for growth but they obtain them from sources other than meat or its derivatives.

At early stages of amphibian development, embryos rely on the proteins provided by their egg's yolk reserve. Once they are free-moving larvae, they start to feed on green matter (which is rich in carbohydrates). The lack of inhibitory feeding controls allows them to feed continuously to maximize growth. Once back legs grow, they need rich-protein sources to finish development, and calcium to fortify their developing bones. To replicate these feeding requirements under captive conditions, we need to take a close look at the actual natural needs of the species we are concerned with. This could be a difficult and time-consuming task, given the different species' requirements. In spite of this, we can still produce a relatively low-cost lab food that satisfies most of these requirements. Before we proceed to an explanation, let´s review some basic facts.

The diet of a tadpole in natural conditions has a wide spectrum of food items. Some kinds of food are more important at one stage of development than in others but, in general, at early stages they tend to eat more algae (particularly euglenophytes and chlorophytes), accompanied by diatoms, protozoans, amoebas, rotifers, micro-crustaceans, and even some fungal material. When larvae grow back legs, they need more proteins to go through a faster and healthier metamorphosis. Some sources of proteins at this stage are nematodes, invertebrate eggs and also invertebrate remains. Vegetation debris can also be found at all stages, just indicating that tadpoles scrape the surface of aquatic plants. Through scraping submerged surfaces (like rocks and plant material) in the aquatic environment, tadpoles may also ingest their inhabitants, usually a complex mixture of algae, protozoans, cyanobacteria, and heterotrophic microbes, that complement their nutrient intake.

To imitate the food items consumed by tadpoles in nature, keepers have relied on different plant sources. Lettuce and romaine leaves, carrots, cucumber and zucchini, among a few others, have been used. Unfortunately, they do not provide a wide variety of nutrients, and this is the reason why we do not recommend them as single sources of food. Hard-boiled egg yolks and baby food have been used as sole food source or to complement a diet, since they are excellent sources of nutrients. We avoid those since they are messy and tend to make the water turbid.

Tadpoles in early stages of development have small mouths better suited to scrape and ingest small particles mostly of vegetable origin. In later stages, the mouth openings become larger which allows for the consumption of larger prey items (for example, small water fleas and invertebrate remains), which means a richer intake of proteins. Consumption of protozoans, amoebas, and rotifers constitutes an important source of proteins for amphibian larvae too, although more research is needed to fully understand their importance in tadpole development and metamorphosis.

After several trials with different food components, we came up with a formula that is a rich mixture of phytonutrients, vitamins and minerals, trying to imitate the early-stage tadpole´s feeding in nature. It contains two green vegetables, peas (*Pisum sativum*) and smooth-leaf spinach (*Spinacia oleracea*), as well as commercial oat flakes (*Avena sativa*).

To prepare the tadpole food, the fresh green vegetables are washed thoroughly and cooked until they are soft, and then mixed with the raw oat flakes in a blender. The resulting paste is then dried out. Place the paste as a thin coat on a non-sticky surface such as wax paper, if intended to be dried out under natural sunshine (as we have been forced to do during times of gas shortages), or on aluminum foil if using a regular oven (in the latter case, the paste tends to stick to the foil but if frozen a while it will tend to detach easier). The resulting dried film is broken down into tiny pieces that resemble flakes. This is your tadpole's food! They are heavier than usual fish flake food, which is an advantage since they sink faster to the bottom of the aquarium, and last longer without rotting when submerged. Additionally, they can be stored in a dry place for more than a year. It is important to keep the food dry and to not touch it with wet hands, to prevent mold growth.

After several trials with different food components, the Rescue of Endangered Venezuelan Amphibians Program in Venezuela has come up with a formula that is a rich mixture of phytonutrients, vitamins and minerals, trying to imitate the early-stage tadpole´s feeding in nature. Photo: Enrique La Marca.

Because of its three main ingredients (peas, spinach and oats), these flakes have a rich nutritional value, according to data gathered mainly from the USDA Food Composition Databases (https://ndb.nal.usda.gov/ndb/) and the USDA National Nutrient Database for Standard Reference (https://www.ars.usda.gov/).

Our flakes have a rich array of minerals. Calcium, magnesium, phosphorus and potassium are important for bone and muscle development and tissue maintenance; iron constitutes the hemoglobin responsible for transporting oxygen to organs; while manganese, copper, selenium, chromium, molybdenum, zinc, selenium and sodium participate in

Tadpoles feeding on the new dried flake food.
Photo: Enrique La Marca.

many other processes in the body that are important for development, growth and metabolism.

Flakes provide vitamins A, B1, B2, B3, B5, B6, B7, B12, C, D, E and K, which are important to synthesize and metabolize proteins, carbohydrates and fat, influence cell and membrane growth, muscle and bone mass building, among other benefits. Flakes contain eighteen amino acids (alanine, arginine, aspartic acid, cysteine, glutamic acid, glycine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, proline, serine, threonine, tyrosine, tryptophan and valine) that have important roles in biosynthesis, neurotransmission and other important life-supporting processes.

Other chemical compounds found in the flakes are folate (one of the B-complex vitamins required for DNA synthesis inside the cell), carotene and lutein-zeaxanthin (phytonutrients involved in vision processes), and betaine (for protection against osmotic stress, drought, high concentration of salts, or high temperature). Oats in the flakes also provide large amounts of beta-glucan, a type of soluble fiber that increases growth of beneficial bacteria in the digestive tract.

Flakes are given to the tadpoles in small amounts once a day. You will know how much is enough by looking at how quickly all the food is consumed or what is left the next day. If the container where you keep the tadpoles has leftover food it will start to get dirty, meaning that you are feeding them too much at one time. Be careful also to avoid underfeeding conditions such as scarcity of food arising in crowded confined conditions, because tadpoles will start preying upon each other.

Our flakes have been proven successful in raising some dendrobatid larvae (*Aromobates meridensis*, *A. zippeli*, *Mannophryne collaris*, *M. cordilleriana*), hylid larvae (*Boana xerophyla*, *Hyloscirtus platydactylus*) and the tadpole of one *Leptodactylus* species, all from the Venezuelan Andes, to the end of metamorphosis.

Tadpoles in late stages of development, usually after they grow their back legs, need more protein. Nutritional analyses of commercially bred insects suggest they are excellent sources of most nutrients including minerals, amino acids, fatty acids, and vitamins. We are starting to test a richer protein formula, based mainly on the preceding flakes, to which insects are added, to provide more protein to the amphibian larvae in late stages to accelerate their development.

The additional source of protein we use is meal worms (*Tenebrio molitor*). These beetles are raised normally until they reach the stage of late instar larva, when they are collected and put in a closed plastic container into the freezer at temperatures below 5º C (less than 20° F) for a couple of days. Then, frozen meal worms can be boiled for five minutes, drained and dehydrated either by direct sunshine or in the oven at about 90° C (200° F). The same can be achieved using a microwave oven but pay attention not to put aluminum foil in the microwave, to avoid electric discharges within the microwave oven. The worms are ready to use when you can crush them to a rough brown powder (it could be a little oily due to the rich larval fat contents). Add this powder to the above formula when mixing all the ingredients together in the blender to produce flakes as indicated earlier.

Meal worms can be substituted by (or complemented with) crickets (late instar *Acheta domestica* nymphs), which provide a natural source roughly constituted by 60% protein. Although both insects appear to be a good source for most of the essential amino acids, only crickets contain detectable amounts of taurine, an organic compound essential for development and function of the central nervous system and skeletal muscle. Also, crickets have more than twice the amount of calcium than mealworms, although with a still relatively low content. Phosphorus contents are much higher than calcium levels in both species, albeit phosphorus is likely to be more readily available, which may compensate for the slightly low levels. It has been suggested that the nutrient content of insects might be improved by modifying their diet while they are actively growing. This is especially true when using insects alone as live food, but unnecessary if the processed dry crickets are mixed with plant material to produce flakes as indicated here.

Tadpoles that feed on a richer protein diet grow faster and are healthier. Once they develop their front legs, they start modifying their mouth parts and from this stage on, until they finish metamorphosis, they will rely on re-absorbing their tails and will not be feeding orally. At the end of metamorphosis, the resulting froglets may then start feeding on small live invertebrates.

Vibicaria Conservation Program: creation of an *ex situ* model for a rediscovered species in Costa Rica

Gilbert Alvarado, Laboratory of Experimental and Comparative Pathology, School of Biology, University of Costa Rica

Since the end of the eighties, Costa Rica has been part of one of the world's centers of discussion on population declines of amphibians. Its most emblematic species, the endemic Golden Toad (*Incilius periglenes*) disappeared suddenly from the Monteverde Cloud Forest and was later declared extinct in 2004. Today it is one of the symbols of the extinction of vertebrates in the world. Unfortunately, along with this species, at the beginning of the nineties, many of Costa Rica's species began to disappear, especially those that belonged to altitudinal zones above 1,000 meters above sea level.

A male *Lithobates vibicarius* from the Juan Castro Blanco National Park in Costa Rica. Photo: Pedro Murillo Rodrigues.

During the first decade of 2000, the reappearance of some populations of species that had not been observed for more than a decade began to be noticed. Some of these include *Craugastor rugulosus*, the Golfito Robber Frog (*Craugastor taurus*), Holdridge's Toad (*Incilius holdridgei*), the Lemur Leaf Frog (*Agalychnis lemur*), the Blue-sided Leaf Frog (*Agalychnis annae*), the Harlequin Frog (*Atelopus varius*) and *Lithobates vibicarius*. A great deal of effort has been made in recent years to generate information on these species on the status of their populations in the wild and their health profile in relation to the presence of chytrid fungus (*Batrachochytrium dendrobatidis* (*Bd*)) and Ranavirus. However we have been limited to working just in the field since currently we don't have a biosecurity space that comply with animal welfare standards required for maintaining amphibians in ex situ conditions.

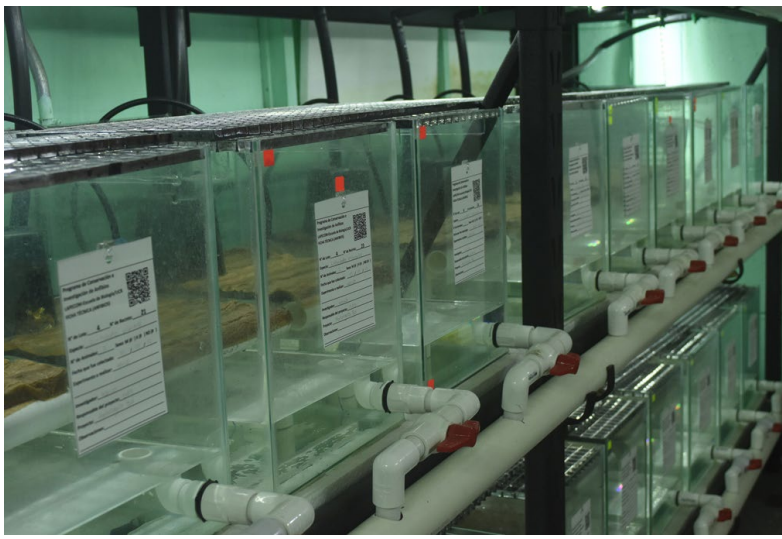
Within these species, *Lithobates vibicarius* is one of the most representative. In the last six years that we have been monitoring the wild population, we have seen that one of its main reproduction lagoons which is in the middle of a small human settlement, now has domestic animals around it. The other lagoons that are around the Juan Castro Blanco National Park run the same risk, since they are in the middle of land dedicated to agriculture and livestock. So it is not possible to completely rule out the disappearance of these reproductive centers at any time. In the 70's, one of the last high altitude wetlands of our country was drained for grazing use, being perhaps at that time also the main reproductive center for Vibicaria. For all these reasons we believe that together with the fact of living with potential pathogens such as *Bd*, this population has a series of threats that could end up decimating their numbers critically. This is on top of the fact that the reproductive cycle of this species is likely to be further affected by changing patterns of rain and temperature that have occurred in the area.

Creation of the first facilities of the conservation program

Thanks to the need created by the Vibicaria Program, the School of Biology at the University of Costa Rica provided a space where we developed the first prototype of the laboratory that we are now building. This space gave birth to the Laboratory of Experimental and Comparative Pathology (LAPECOM) with a section of Experimental Biology where the experiments to support the conservation and reproduction of rediscovered Costa Rican amphibian species were developed. Over the last fourteen months four functional units have been created; each of them consists of a module of twenty-four enclosures. Each enclosure is a tank 25 cm x 50 cm x 35 cm, with three levels (water at the bottom, a platform with substrate and a shelter that generates a space on it). Each enclosure has its own water supply, a drain that allows individual isolation and its corresponding automatic water sprinkler programmed accordingly. Each enclosure also has its identification with a QR code that provides access to the animals' individual records. Currently the animals remain in excellent condition and we have extremely low death rates. A water treatment and distribution system was also installed to the enclosures. Each unit has its own light/dark cycle duly programmed to work automatically. All the installation processes were carried out with the participation of the lab work team, and we are currently working on the construction of two spaces with adequate noise and vibration insulation, with better devices for temperature and humidity management.

Creation of the first feeding unit

We designed and built the first feeding unit that allows us to easily supply a group of 100 adult frogs. This feeding unit consists of a space for eight plastic containers placed in pairs in a vertical arrangement. Two main containers (40 cm x 50 cm x 25 cm) are



Primary enclosures in the amphibian center at the University of Costa Rica, showing identification labels for each one, which include QR codes, linking to individual animal's records.
Photo: Gilbert Alvarado.

used as incubation and growth vessels. The remaining six containers (45 cm x 65 cm x 40 cm) are spaces for maintenance and reproduction. So far the laboratory team has managed to develop the skills and abilities for the reproduction and maintenance of crickets (*Acheta domestica*), cockroaches (*Nauphoeta cinerea*) and collembola (species to be defined).

Units for individual protection equipment and standardized operating protocols

We have installed devices for the organization and supply of individual protection equipment for use in two spaces for different experimental purposes, and we are also consolidating and formalizing the laboratory's operating processes. This equipment is used for cleaning and disinfecting a room or live food containers and for more elaborate experimental procedures performed in the laboratory such as anesthesia of animals or taking blood samples to perform clinical analyses.

Information generated about *Lithobates vibicarius*

In conjunction with our work creating the facilities and establishment of protocols, we have already established the reference blood parameters of the animals, the base behavior under laboratory conditions, the establishment of an anesthesia protocol, marking of individuals with PIT-tags, chytrid treatment protocol with Itraconazole, sampling protocol and molecular diagnosis for Bd among other procedures. We currently have information from the field on the characteristics for selection of microhabitat by females for the placement of their eggs, which we are working to imitate in the best way in our captive facilities. The stages in which the females lay eggs and the generation of conditions that favor the metamorphosis of animals have been overcome. It highlights the doctoral work that Randall Jiménez is doing regarding the microbiome of this species and the contribution of Jilma Alemán in several aspects related to biotherapy and animal welfare. Randall and Jilma are both founding members of the Vibicaria program.

Multidisciplinary work increases the success of conservation

From the moment of its creation, LAPECOM has based its success on multidisciplinary work. So far the team has been made up of biologists, wildlife managers, veterinarians, audiovisual producers, photographers, graphic designers, architects and engineers. All come together in this project with the goal of generating direct actions that favor the conservation of amphibians. It is also important to highlight the many and varied collaborations with different centers of the University of Costa Rica and others at an international level.

Part of the work team of the Laboratory of Experimental and Comparative Pathology of the School of Biology of the University of Costa Rica, with international guests in the Juan Castro Blanco National Water Park. Photo: Gilbert Alvarado.

Lithobates vibicarius metamorph bred in the laboratory
Photo: Pedro Murillo Rodrigues.

The local community in the conservation of Vibicaria

One of the biggest advantages that the Vibicaria in situ program has had is the support of the Juan Castro Blanco National Park Development Association (APANAJUCA), which has made an important effort in the delimitation of the boundary of the National Park and the creation of effective mechanisms for the purchase of land for conservation purposes in the National Park. Since January 2016, there has been an inter-institutional cooperation agreement between the University of Costa Rica and APANAJUCA.

It was also possible to turn *Lithobates vibicarius* into the emblem of the 25th anniversary of the Juan Castro Blanco National Water Park (PNAJCB) through the creation of a postage stamp made by Correos de Costa Rica. This stamp was presented as part of a public commemoration in the northern zone of Costa Rica.

The participation of students from the region has become increasingly common in the development of the conservation program.

Obtaining blood samples to perform clinical analyses. Photo: Pedro Murillo Rodrigues.

Looking to the future

The University of Costa Rica has already authorized the use of space in the Alfredo Volio Mata Experimental Station for the establishment of new facilities, with better conditions and more space to improve the reproduction of animals and their food, as well as experiments and necessary procedures to help guarantee the existence of them in the coming years. We have already built the foundations of what in the future will be a building with characteristics consistent with environmental sustainability. The process is being directed by architects Karina Aguilar and Laura Phillips. In addition, communication platforms for the conservation program have been created with the collaboration of graphic designer Jorge Delgado.

Reproduction of *Dendropsophus padreluna* at the Santacruz Zoological Foundation, Colombia

Susan Paola Castillo Vega, Project and Collection Coordinator; Guiomara Reyes Barrera, Project Biologist; Haydy Monsalve Redwan, Executive Director; and Kelly Paola Prieto Avila, Keeper, Santacruz Zoological Foundation, Colombia

Dendropsophus padreluna (Kaplan-Ruiz, 1997) from the family Hylidae, is a species of frog reported only in Cundinamarca in Colombia, between 1,880-2,400 meters above sea level in the Sub-Andean and Andean Forests of the Central region on the western slope of the Eastern Cordillera. There is little information about the species although it is listed as Least Concern in the IUCN Red List.

It is characterized by yellow or brown dorsal coloration, with dark spots or irregular dorsolateral spots, and smooth back skin, while the skin of the abdomen appears thick and granular, and the chest and throat weakly granular. It has a robust body, the membrane of the eyelid does not have pigmentation except on the upper border and it has a medial sub-vocal vocal sac and vocal grooves extending from the lateral regions of the tongue towards the angles of the mandible. It has a cordiform tongue (heart shape). It presents sexual dimorphism observed in body size, which is slightly higher in females than in males.

Amphibian conservation and reproduction project in the Tequendama region

The Santacruz Zoological Foundation manages a group of *Dendropsophus padreluna* along with other species of amphibians such as the Palm Rocket Frog (*Rheobates palmatus*), *Pristimantis renjiforum* and *Pristimantis susaguae*, for several years. We started with a pilot laboratory and an arthropod animal feeding facility, developed ecological, ethological, nutritional and medicine research guidelines in order to standardize management and reproduction under controlled conditions (establishing management protocol and biosecurity), in addition to helping to complement the great knowledge gap that exists with these species.

The results of these investigations allowed the Foundation to open an exhibition area with these species that seeks to educate the general public and at the same time has generated the implementation of educational programs through work with the school community and surrounding population. The hard work of the personnel involved, helped by experts, professionals, students and volunteers has achieved good adaptation and reproduction results not only in the laboratory but also in the exhibition.

Reproduction on display

Earlier this year two matings were observed, one month apart, in one of the aquariums in the exhibition, which holds five animals. The parents moved the eggs several times, as part of the parental care of the species, looking for dark places. Ten to fifteen days after the eggs were laid the tadpoles began to emerge. Approximately thirty tadpoles resulted from the first mating and they were left in the exhibition to provide almost natural development of the cycle. The tadpoles were fed fish food and lettuce or spinach cut into small pieces. To date, most of the tadpoles have metamorphosed into frogs. Twenty individuals were produced from the second mating, and these were moved to the laboratory.

Reproduction in the laboratory

The twenty tadpoles from the second mating were moved to the laboratory and separated into two groups (A and B). They were placed in glass aquariums with water and a small amount of gravel as the substrate. 75% of the water in each aquarium is changed once every eight days, and tests are done to determine nitrites, nitrates and pH. The temperature is between 8-20º C and the environmental humidity is between 70-85%. These tadpoles are fed with fish food and lettuce or spinach cut into small pieces. Each group receives a different type of water movement, which helps them in their development. The first froglets have started to appear in this group.

Dendropsophus padreluna was recently bred at the Santacruz Zoological Foundation in Colombia. Photo: Kelly Prieto.

Once they reach their final stage the frogs will be moved to the humid zone in transition aquariums with gravel, and rocks or trunks that protrude from the water, to help them settle down. Once they have completely metamorphosed they will be moved to fixed aquariums, either in the laboratory or in the exhibition. The complete development process is being monitored and documented so we can standardize times in the life cycle, parental behavior, morphology, among others.

Expectations

We hope to eventually obtain specific and usable data from these breeding events for the description of the life cycle of the species *Dendropsophus padreluna*. As a Foundation we continue to be motivated towards conservation and developing research that contributes to the management and care of different species of amphibians and to contribute with reintroduction in the wild.

When bad ideas turn out well…

Natalie Calatayud PhD, Post-doctoral Fellow, San Diego Zoo's Institute for Conservation Research, USA

Isn't it funny how there are moments you remember as life shifting. I've had a few of those, most of them admittedly have been spur of the moment "yup! I'm doing it!" kind of decisions. And while people tell you that you should think things through, take your time and look at the options rationally, sometimes those inner impulses that drive, what seem to be at the time, ridiculous decisions, end up turning out to be the best.

On New Year's Day 2016, my father and I were visiting some cousins in the small rural town of Coatepec de las Harinas, a small municipality in the state of Mexico (Estado de Mexico) about two hours from Mexico City. My cousin lives in a small brick house on the edge of bushland, a small manicured grassy garden separates her front door from a tangled mesh of vegetation that forms a thick wall around the front of her house. As we prepared to leave for the day, we stepped outside and, in the distance heard the cries and howling of a dog, deep within the mess of vegetation. My cousin, Pilar, pointed out that she had heard these cries for a couple of nights now but could not pinpoint the source of the howling. Little could I know as I tore through the vegetation that I was about to inherit an extra mouth to feed! There in the middle of a thicket trapped in a small concrete dike stood a scared and confused mother with her pup. Freeing a terrified mother from the predicament she found herself in left me with this adorable, skinny flea ridden scruff of a mutt that, the vet estimated later, could not have been more than eight or nine weeks old. A lot happened in the freeing of mother and pup from their situation, but the point is, as I stated in the beginning of this article, I was left with what seemed at the time to be the most logical of "on the spot" decisions. Three days later we were on a train, the pacific surf liner from Los Angeles to San Diego, a world away from Coatepec de las Harinas, Mexico.

Learning to read each other, and to notice even small changes in behavior are really important aspects of working with specialty-trained dogs. Photo: Janet Wilhelm.

That is the very short version of how Luna became a member of the Calatayud pack. This story is more about how this Coatepec terrier (as my father proclaimed her), who was twenty-four hours away from starving to death, came to be so much more than a pet. My time working in the US these last four years has been as a post-doctoral fellow for the San Diego Zoo's Mountain Yellow-legged Frog (*Rana muscosa*) conservation breeding and reintroduction program.

Operation Save the Mountain Yellow-legged Frog began in 2005. Twelve years in it has diversified into an ecological and biotechnological machine. From a captive perspective, the Mountain Yellow-legged Frog program set out to breed animals for reintroduction, but now it deals with much more than the development and optimization of husbandry. Research encompasses nutrition, reproduction, microbiology, mate choice studies, embryological development, assisted reproductive technologies and single nucleotide polymorphism (SNP) technology-based genetic management protocols.

Initially, I joined the program as a reproductive biologist, assisting with increasing the breeding and health of the captive population. However, in time I found myself overwhelmed as I transversed multiple disciplines. I even broke out of the warmth and

Releasing year-old Mountain Yellow-legged Froglets (*Rana muscosa*).
Photo: Dr. Debra Shier.

Luna was rescued as a puppy and eventually became trained to find Critically Endangered Mountain Yellow-legged Frogs in the wild, as part of San Diego Zoo's conservation breeding and reintroduction program. Photo: Natalie Calatayud.

safety of a lab to challenge my physical prowess and join my fellow froggers, Dr. Debra Shier, Nicole Gardner and Michelle Curtis, in the field. I now own clothes that dry in minutes, and boots that shield my ankles from the rocking and rolling of loose terrain. Heck, I even own a Camelback. But the more time I spent studying the species, the more I became convinced that there were a number of tools, not commonly utilized in conservation, that warranted further exploration.

Since 2015, the program has accomplished three major tadpole and metamorph introductions, but as all amphibian enthusiasts know, reintroduction of healthy, viable animals is by no means indicative of a program's success. Surveying techniques for amphibians are variable and their success dependent on the species. How Mountain Yellow-legged Frogs move in the wild or how they survive post reintroduction, has not been the subject of any reliable scientific documentation, particularly for the populations that we work on. Typically, surveys of this species have been based on sightings during hikes through sites presumed to have or were historically known to have been inhabited by frogs. Although we are scientists, gifted with common sense and logic, carrying equipment for reading variables like light, wind speed, distance, tree cover, temperature, pH, etc., we are still human. Humans are greatly limited by our underdeveloped senses so despite our technology, looking for cryptic species is still a major hurdle we have not been able to overcome. This makes amphibians often frustratingly invisible, sometimes even when they are basking on a rock a foot away from you.

So, what is the best method of detecting a creature that is cryptic? The answer is there no one, all encompassing, great tool. Monitoring and finding animals in the wild is often a multi-manned endeavor that requires many approaches. But perhaps, as so many have already been realizing over the years, detecting animals in the wild may best be achieved by using another animal; animals, that have not lost the acuity of their senses. Case in point, Luna the "Coatepec terrier", before her Jessie the Bordercollie from North-West University, South Africa and Scarlett from the University of Maryland, USA, Conservation Canines at the University of Washington, USA and Maya with Detection Dogs for Conservation, USC, Australia. This is not a novel concept yet is one that for some reason is still met with hesitation and has not been widely accepted by the wider ecological community. There are many approaches to training a dog and the best approach will depend on the breed and its temperament. What breed is best or what method is best for training is up for debate.

I am not an expert, but I can honestly say that if you and your dog are not having fun doing it then you're doing it wrong. Much of the scepticism behind using dogs for conservation is the investment in time, money and energy. In my opinion, as long as K9's are used as a tool in the tool box and not the only tool, then there is no reason why they cannot become invaluable to the work we do. Luna was trained on gauze and swabs that had been rubbed on the skin of a live frog. Because Mountain Yellow-legged Frogs are a Critically Endangered species, initially, I was only allowed to train on scent. Once the signature scent was identified and she understood what she was looking for, it was time to challenge her in ways that more resembled the environment. Scent was hidden in all manner of receptacles, in the ground, in sand and water, buried or hidden in bushes and trees or under rocks. After a year Luna could find multiple scents in the environment and distinguish them from controls with no scent. At this point we were ready to proceed to a proper search, or were we?

Now, I've described the training in just a few sentences and that is not by any stretch of the imagination as straight forward as it gets. I quickly began to realize why people charge money to train dogs for these jobs. During our training I learned a lot about my dog and about myself. I also think Luna learned that her mother is not as bright as she may have once believed. The dog is truly limited by its handler and shy of actually speaking to you, you quickly learn to read the quirky little body changes that your dog undergoes when she/he is working. When Luna is very focused I think I can honestly see her concentrating, her eyes are wide, she snorts the air taking in large breaths of air and has a relaxed but very rigid and motivated gate while she searches. When she finds her mark her tail starts to wag, her body softens, and she regains the usual goofy playful look she normally has when she is not in work mode. So that is what comes first, learning how to read each other.

In August-September of 2017, Luna and the Mountain Yellow-legged Frog crew embarked on their first K9 accompanied surveys. What happened next? You overconfidently think you know how to read your dog, so you set off into the wilderness. Mountain Yellow-legged Frogs inhabit the high altitude, rocky forest streams and pools of southern California. At worst bouldering and climbing can happen at best you have a tough hike through very rocky country. So, second exercise is learning patience (yours and the dogs) and building trust. Forget looking for frogs, sometimes just navigating the terrain requires practice. Luna and I transversed one site about six times before we even started looking for frogs.

It was actually September 2017 almost twenty months from the very first training session with our trainer Janet Wilhlem, a search and rescue pro, that Luna found her first frog. Unfortunately, it would be her last Mountain Yellow-legged Frog. My post-doctoral fellowship was coming to an end and it was time to return home. In science, there just never seems to be enough time to do all the projects you want to do. In December, Luna, Sancho (my other dog) and I touched down in Australia, home. Luna and I have since joined up with our new team. The newly launched Canine Ecological team comprised of Kip, and handler Naomi Hodgens, Luna and myself (yes this is shameless pitch!) are now open for business.

Promising news for the Large-crested Toad: the number of mature individuals has increased!

José Alfredo Hernández Díaz, MSc., Curator of Reptiles and Amphibians, Africam Safari, Mexico

It has been almost five years since we released the first group of captive-bred Large-crested Toads (*Incilius cristatus*) in Mexico. We have had eight breeding events in our colony and we have released 1,070 captive-bred toads, however the most challenging part of the project has been monitoring the toads we have released in the wild. The Large-crested Toad has a very cryptic coloration; adults are active only at night and they are scattered throughout the forest for most of the year. There is only one week between late October and early November when the toads concentrate on the riverside during the breeding explosion and that is the best time to find them.

We began monitoring animals in the wild only three months after releasing the first group of 140 toads in 2013. It took us eight days to find only eight toads, and only one of these was from the captive-bred group. It was a bit disappointing to such a small number of toads, however, the only captive-bred toad found in that trip gave us a great hope because it had increased its weigh from 0.5 to 14 grams, showing an excellent adaptation to living in the wild. In that trip, we did not find any adults breeding in the river.

In 2014 we carried out the second monitoring survey, but we tried during the rainy season to see if we were able to find more individuals. However, we had the same bad luck as in the previous year - we only found eight toads, but none of them were animals that we had released. We were wondering if the released toads had not survived or if we had just not been able to find them. Over the next year we released two more groups of toads, one of forty-four adults and another of 440 toadlets. During that year, we were not able to do any monitoring.

After having released more than 500 toads, we decided to increase our monitoring efforts and improve our methods. In 2016 we did more monitoring in summer again, with much better luck. We found twenty-one individuals, but again, none of them were the previously released animals. We tried again in November, when we were finally able to find toads breeding in the river, but we arrived a bit late because we only found twenty-three adults. The best news was that one of them, an adult male, was marked and belonged to the first group which had been released in 2013.

Finally, last year we released another group of 170 toads at the end of October and we also did more monitoring. We found toads breeding in the river again, however, this time we recorded the highest number of mature adults breeding at the same time. We saw 120 toads in a single night and two of them were from the captive-bred group! I have to say that we were not able to check many of the animals because they were in amplexus, laying eggs. This record was even higher than the first census from 2009 when seventy-two individuals were found at the breeding site.

Five years after releasing the first group of captive-bred toads, we have seen the first results of our work. The evidence shows that captive-bred Large-crested Toads are able to adapt, survive and breed when released into the wild. We have improved our knowledge regarding the species' biology and we have found the best time to track them in the wild. Our results really support the conservation potential of *ex situ* programs, especially when they are combined with *in situ* actions.

Adult Large-crested Toads (*Incilius cristatus*) were found in amplexus and laying eggs in the river during a field trip to monitor the progress of released toads. Photo: José Alfredo Hernández Díaz.

José Alfredo Hernández Díaz has been managing an *ex situ* breeding program for Large-crested Toads at Africam Safari in Mexico, with over 1,000 captive-bred toads released into the wild in the past five years. Photo: José Alfredo Hernández Díaz.

Two pairs of Large-crested Toads in amplexus. Photo: José Alfredo Hernández Díaz.

The Amphibian Foundation's Metamorphosis Meadow, a salamander community

Lacey Avery, Communications Lead, and Mark Mandica, Executive Director, Amphibian Foundation, USA

Frosted Flatwoods Salamanders (*Ambystoma cingulatum*) have suffered a 90% population loss since 1999. The Amphibian Foundation plans to breed these salamanders in our new conservation resource, nicknamed Metamorphosis Meadow. Photo: Mark Mandica.

The Amphibian Foundation, USA, recently made tremendous progress towards our comprehensive recovery plan for one of our priority species—the endangered Frosted Flatwoods Salamander (*Ambystoma cingulatum*). We hold the world's only captive population, and now they live in a one-of-a-kind conservation resource, nicknamed Metamorphosis Meadow.

Metamorphosis Meadow is an outdoor area of the preserve that holds twenty aquatic mesocosms that mimic the natural environment under controlled conditions. More specifically, we are mimicking ephemeral wetlands because Flatwoods Salamanders breed in fish-less wetlands that dry out periodically throughout the year.

The mesocosms will assist more than 400 salamanders with metamorphosis and head-starting these endangered species past the sensitive larval stage, where amphibians are particularly vulnerable to predation. These tiny endangered animals are hungry all the time, and the self-contained system will have all the substrate of a natural ephemeral wetland to help them thrive as they grow.

Raising amphibians in captivity

The Amphibian Foundation works with partners like the Amphibian Ark to save amphibians from extinction by raising awareness and leading one-of-a-kind conservation and research activities. A large part of this work focuses on Frosted Flatwoods Salamanders, which have suffered a 90% loss in population since 2000. Our captive breeding program allows us to raise these amphibians in captivity and produce offspring that can be released into protected habitat in the wild.

In 2017, we received these salamanders as water-stressed eggs collected from Florida. They are endemic to the Long Leaf Pine ecosystem in the lower Southeastern Coastal Plain of the USA, which has been reduced to three percent of its original range in the southeastern USA coastal plain. Consistent with recent years, there was not enough rain to fill the ponds holding the eggs.

We successfully hatched nearly ninety of these larvae in our Atlanta salamander lab. Later in 2017, we received and hatched around 340 eggs. The salamanders started out in our biosecure lab, in enclosures with grasses and water from where they were collected. The imperiled amphibian species will be reared, bred, and experimentally released into protected habitat in partnership with Georgia Department of Natural Resources and the US Fish and Wildlife Service.

Recovery plans for Georgia's rarest amphibians

Frosted Flatwoods Salamanders are at imminent risk of extinction. The ultimate goal of this work is that the Flatwoods Salamanders will no longer need the protection of the Endangered Species Act. But for now, the salamanders will live in our outdoor field research center for breeding when they are older, and their offspring will be released back into protected habitat in the wild.

The Amphibian Foundation works towards comprehensive recovery plans for three of the four endangered amphibians native to Georgia. In addition to the Flatwoods Salamander, we are working with the Gopher Frog (*Lithobates capito*), Georgia's rarest frog, and the Striped Newt (*Notophthalmus perstriatus*), a federally threatened species. We and many partners across the globe are putting in a lot of time, effort, and hope into this work, and setting up Metamorphosis Meadow is a huge piece of putting the puzzle together.

For updates on these projects and more, sign up for the Amphibian Foundation mailing list: www.StayInformed.amphibianfoundation.org.

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. Seven new documents have been added recently:

Action Plan for Zippel's Frog (*Aromobates zippeli*) (Spanish)

Author: Enrique La Marca, Universidad de Los Andes, Mérida, Venezuela.
Publication: February 2018

www.amphibianark.org/pdf/Species-Action-Plan-Aromobates-zippeli.pdf

Amphibian Ark Amphibian Population Management Guidelines (English)

Created at an Amphibian Ark amphibian population management workshop held on 10-11 December 2007 at San Diego Zoo, San Diego, California, USA sponsored by the Amphibian Ark. Updated January 2018 with Appendix C: Applying Molecular Genetics to Captive Amphibian Populations.

Author: Amphibian Ark, Schad, K (ed)
Publication: December 2007

www.amphibianark.org/pdf/AArk-Amphibian-Population-Management-Guidelines.pdf

Development of in-country live food production for amphibian conservation: The Mountain Chicken Frog (*Leptodactylus fallax*) on Dominica, West Indies (English)

Here, we describe the establishment of live food cultures for the Critically Endangered Mountain Chicken Frog (*Leptodactylus fallax*) at a conservation breeding facility on the Caribbean island of Dominica. Not all invertebrate species were suitable for long-term culture and several species were rejected by captive *L. fallax*, making them unsuitable as food items. Despite the CBP being established within a range state, it was not possible to provide a diet of comparable variety to that of wild *L. fallax*. Our experiences may provide guidance for the establishment of live food culture systems for other conservation breeding programs elsewhere.

Author: Daniel J. Nicholson, Benjamin Tapley, Stephanie Jayson, James Dale, Luke Harding, Jenny Spencer, Machel Sulton, Stephen Durand, and Andrew A. Cunningham
Publication: Amphibian & Reptile Conservation 11(2) [General Section]: 59–68 (e149). 2017.

www.amphibianark.org/pdf/Nicholson-et-al-2017-In-country-live-food-production-Dominica.pdf

Native frog (*Leiopelma* spp.) recovery plan, 2013–2018 (English)

The Native Frog Recovery Group prepared this plan in conjunction with people interested in or affected by this plan, or with an expert knowledge of these species. Drafts have been sent to relevant DOC regions for comment and to people or organisations with an interest in conservation management of native frogs. Changes to the plan were made as a result of that consultation. The Recovery Group will review progress in implementation of this plan and will recommend to managers any changes that may be required in management.

Author: Phillip J. Bishop, Lisa A. Daglish, Amanda J.M. Haigh, Leigh J. Marshall, Mandy D. Tocher and Kate L. McKenzie
Publication: Department of Conservation, December 2013

www.amphibianark.org/pdf/Native-Frog-Leiopelma-spp-Recovery-Plan-2013-2018.pdf

Species Conservation Strategy for *Mantella aurantiaca* (The Golden Mantella Frog), 2011-2015 (English)

Madagasikara Voakajy initiated a conservation and sustainable management programme for *Mantella aurantiaca* and its habitats, which started with a scientific study in 2007 (Randrianavelona et al. 2010). Following a workshop with the participation of all relevant stakeholders and a few work post-workshops sessions, the final product consists of: a complete review of *M. aurantiaca* status, a vision, five main goals, twelve specific goals, seven objectives, sixteen specific objectives and fifty actions to be undertaken over the next five years.

Author: Randrianavelona R., Randrianantoandro J. C., Rabibisoa N., Randrianasolo H., Rabesihanaka S., Randriamahaleo S. and Jenkins R. K. B.
Publication: Ministère de l'Environnement et des Forêts, 2011

www.amphibianark.org/pdf/Mantella-aurantiaca-conservation-straegy-English.pdf

Lake Titicaca's Frog (*Telmatobius culeus*) Conservation Strategy Workshop (English)

The Denver Zoo has been committed, through its conservation program, to establishing a program that is to include field work, captivity handling, and environmental education about the Titicaca Water Frog. With this aim, a workshop was promoted and held from December 13-15, 2010, at the Bioscience School of Universidad Nacional del Altiplano, in Puno, Peru. This workshop was actively attended by 39 people representing 15 institutions and organizations of Peru, Bolivia, the United States, and Costa Rica. The workshop was facilitated by Yolanda Matamoros of the Conservation Breeding Specialist Group, of the Species Survival Commission of IUCN.

Author: Reading, R.R., T.J. Weaver, J.R. Garcia, R. Elias Piperis, M.T. Herbert, C. Cortez, A. Muñoz, J.E. Rodríguez & Y. Matamoros (Eds.)
Publication: December 13-15, 2010, Conservation Breeding Specialist Group CBSG/(SSC/IUCN) Mesoamerica.

www.amphibianark.org/pdf/Conservation-strategy-of-the-lake-titicaca-frog-EN.pdf

Evaluating the role of zoos and *ex situ* conservation in global amphibian recovery (English)

I examine the conservation value of captive collections. I find that collections do not reflect the species of likeliest greatest concern in the future but that non-traditional zoos and conservation-focused breeding programs are bolstering the representation of threatened amphibians held *ex situ*. Next, I examine the reproductive success of captive breeding programs in relation to species' biological traits and extrinsic traits of the program. Based on 285 programs, I find that not all species are breeding in captivity, yet success is not correlated to the suite of tested predictors. Overall, *ex situ* approaches are playing a potentially important role in amphibian conservation, but we must work to improve the representation of threatened amphibians in zoos and husbandry expertise.

Author: Alannah Biega
Publication: MSc. Thesis, Simon Fraser University, 2017

www.amphibianark.org/pdf/alannah-biega-msc-thesis.pdf

Amphibian Ark donors, January 2017 - June 2018

The work of AArk is possible due to the generous support of the following individuals and institutions:

Up to $60,000

Bernard & Nancy Karwick

George Rabb, in honor of Mary Sughrue Rabb

Up to $10,000

Anne Baker & Robert Lacy in memory of George Rabb

Louis Schauer

Up to $5,000

Cleveland Metroparks Zoo
Ronna Erickson
Kansas City Zoo
Nordens Ark
Omaha's Henry Doorly Zoo
Paignton Zoo
Philadelphia Zoo
Raymond Picciano
Potawatomi Zoo
Sedgwick County Zoo
Singapore Zoological Gardens
Taipei Zoo
Kate Woodle, The Kuehlthau Family Foundation
Zoo de Barcelona

Up to $1,000

Abilene Zoological Gardens
Don Arnold & Sue O'Brien
Beastly Threads
El Paso Zoo
Chandra Jessee
Lee Richardson Zoo
Minnesota Zoo
Rosamond Gifford Zoo
Sacramento Zoo
Alistair Ward
Woodland Park Zoo

Up to $500

Casimir Borowski Jr.
Buffalo Zoo
Charles Burnette
Fahim Dhalla
Douglas Fraser
Lee Hall
Traci Hartsell
Julia Hertl
Carol Judd, in memory of Matias Sosa-Wheelock
Jens Felix Knoth
Katherine Madin
Margaret B. Marshall
Helen Medley
Midnight Sun AAZK
Michelle Rand
Crystal Robertson
Andrew Smith
Georgette Taylor
David & Marvalee Wake
Doug Widener
Brett Williams
Tait Wilson

Up to $100

John Adams
Anonymous
Roman Bodinek
Eithan Dudnik
Monique Canonico
Michael Christie
Fantasia Crystals
Ramona Fenner
Maria Ferrante
Marvin Goldberg
Brian Gratwicke, in memory of George Rabb
Susan Handa
Chloe Harris
Da-Shih Hu
Chris Johnson
Eric Johnson
James King
Tomas Kraus
Ron Lane
John Liuzzi, in memory of Matias Sosa-Wheelock
Kevin Mitchell
Matt Neff
Philomath High School
Claire Pritchard
Sara Rex
Andrea Ross, in honor of George & Mary Rabb
Gregory Shchepanek
UEAF
James Valiant
Lori G. Van Allen
Benjamin Winterbourne
Lore Wymetal
Donna Yannazzone

Up to $50

Chris Carvalho
Sarah Cuypers
Valrie Fingerman & Stephen Hirsch
James Hanken
Vivienne Holm
Alyce Hopko
Adam Kosloff, in memory of Matias Sosa-Wheelock
Max McBarron
Thomas Miskovsky, in honor of George Rabb
Ella Rowan
Adam & Erin Scimone
Suzanne Sharp Johnson, in memory of George Rabb
Ceil Slauson
Barbara Trautner
Alethe Vassay
Stuart Weeks
Georgeanne Wilcox

Up to $25

Kade Ariani
Sami Asad
Amiran Berman
McKay Caruthers
Stephanie Davis
Elise Diesslin
Stephen C. Durand
Rafael Pardo Espejel
David Etzkorn
Alex Foster
Samantha Haddon
Matthew Hecht
Adrienne Hulf
Douglas Hull
Brandon Kong
Chris Linnell, in honor of George Rabb
James McIntosh
Nikki Metcalfe
Austin Mohr
Ryan Toso

Up to $10

Paul Babicki Babicki
Jason Define
Brayden Diehl
Alicia Loeza
LW
Carina Lerch
Tam Ly
Rebekah McFarland
Don Smith
Lucy Smith
Miho Takayama