amphibian ark

Keeping threatened amphibian species afloat

Newsletter

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Joint amphibian assessment workshop in Honduras

Luis Carrillo and Kevin Johnson, Amphibian Ark; Louise Hobin, Jennifer Luedtke and Kelsey Neam, Amphibian Red List Authority

Amphibians are the most threatened group of vertebrates globally, with 41% of species at risk of extinction. Most of these species are threatened by human activities and can be effectively protected through well-informed strategic conservation. It is therefore of the utmost importance to continue identifying the most highly threatened amphibian species through the IUCN Red List of Threatened Species and prioritizing the conservation actions critical to their survival.

The Amphibian Red List Authority

The International Union for Conservation of Nature (IUCN) is the world's oldest and largest global environmental organisation, with more than 1,300 government and NGO members worldwide. The Species Survival Commission (SSC) is the largest of IUCN's commissions with a global membership of over 8,000 voluntary experts. Under the guidance of the IUCN SSC, the Amphibian Specialist Group (ASG) is the world's leading body of scientific and practical management expertise on the status and conservation of all amphibian species. The ASG Amphibian Red List Authority (ARLA) is the group responsible for maintaining the amphibian data on the IUCN Red List.

The overall aim of the ASG is to promote the long-term conservation of these species and their environments worldwide, and the recovery or restoration of populations and ecosystems where feasible. Our mission is to provide the scientific foundation for effective conservation action worldwide.

The IUCN Red List

The IUCN Red List of Threatened Species is the global authority on the conservation status of species and is critical to a wide range of conservation applications. For example, its data are used to identify Key Biodiversity Areas (KBAs) for conservation and to inform policies and international agreements, such as the Convention on International Trade in Endangered Species (CITES). It is also used to guide scientific research priorities and track the impact of conservation action.

The Global Amphibian Assessment (GAA), completed in 2004, was the first comprehensive study of the conservation status of all known amphibian species in the world. The second Global Amphibian Assessment is now underway and the ARLA is working to ensure all 8,000+ species of amphibians have an up-to-date extinction risk assessment on the IUCN Red List.

The Amphibian Ark

The Amphibian Ark (AArk) is a joint effort of three principal partners: the World Association of Zoos and Aquariums (WAZA), the IUCN SSC Conservation Planning Specialist Group (CPSG), and the ASG. AArk is a partner in the Amphibian Survival Alliance (ASA), and we were formed to address the *ex situ* (captive) components of the Amphibian Conservation Action Plan.

Our vision is *the world's amphibians safe in nature*, and our mission is *ensuring the survival and diversity of amphibian species focusing on those that cannot currently be safe-guarded in their natural environments*.

Conservation Needs Assessments

With limited conservation resources and thousands of threatened species in need of help, the Conservation Needs Assessment (CNA) process, managed by the AArk, seeks to objectively and consistently identify priority species and their immediate conservation needs.

Using a transparent, logical and objective method, the CNA process uses current knowledge of species in the wild to determine those with the most pressing conservation needs and provide a foundation for the development of holistic conservation action plans that combine *in situ* and *ex situ* actions, as appropriate. Conservation Needs Assessments generate national prioritized lists of species recommended for one or more conservation action. These can subsequently be used to assist in the development of species recovery plans and national action plans, or to better inform national conservation priorities.

The subsequent assessments and recommendations for conservation actions can then be used as the basis for the development of a national amphibian action plan. Assessors from a wide variety of backgrounds are identified, and may include ASG members, academics, field biologists and researchers, university students, animal husbandry experts, and members of national, local, or regional wildlife agencies.

Joint Red List and Conservation Needs Assessments

Most often, national or regional ASG Chairs help to coordinate both the Red List and Conservation Needs Assessments for all amphibian species in their country,

A very successful amphibian symposium was held at the Universidad Nacional Autónoma de Honduras prior to the assessment workshop, with speakers giving a range of excellent presentations relating to amphibian conservation in Honduras.
Photo: Franklin Castañeda.

On the first day of the workshop participants were introduced to the two different assessment processes, and how they would be integrated during the workshop. Photo: Kevin Johnson.

and historically, these two independent assessment processes have been managed separately, and at different times, despite the same expertise generally being required to complete the assessments. Over the past two years, in an effort to reduce the duplication of effort, workshop costs, and the time required by experts to complete the assessments, the ARLA and AArk have joined forces by assembling experts of overlapping priority countries for a single workshop to complete both sets of assessments in parallel. The first joint assessment workshop using this method was held in Malaysia in early 2018, with the recent workshop in Honduras using a similar approach.

Honduras

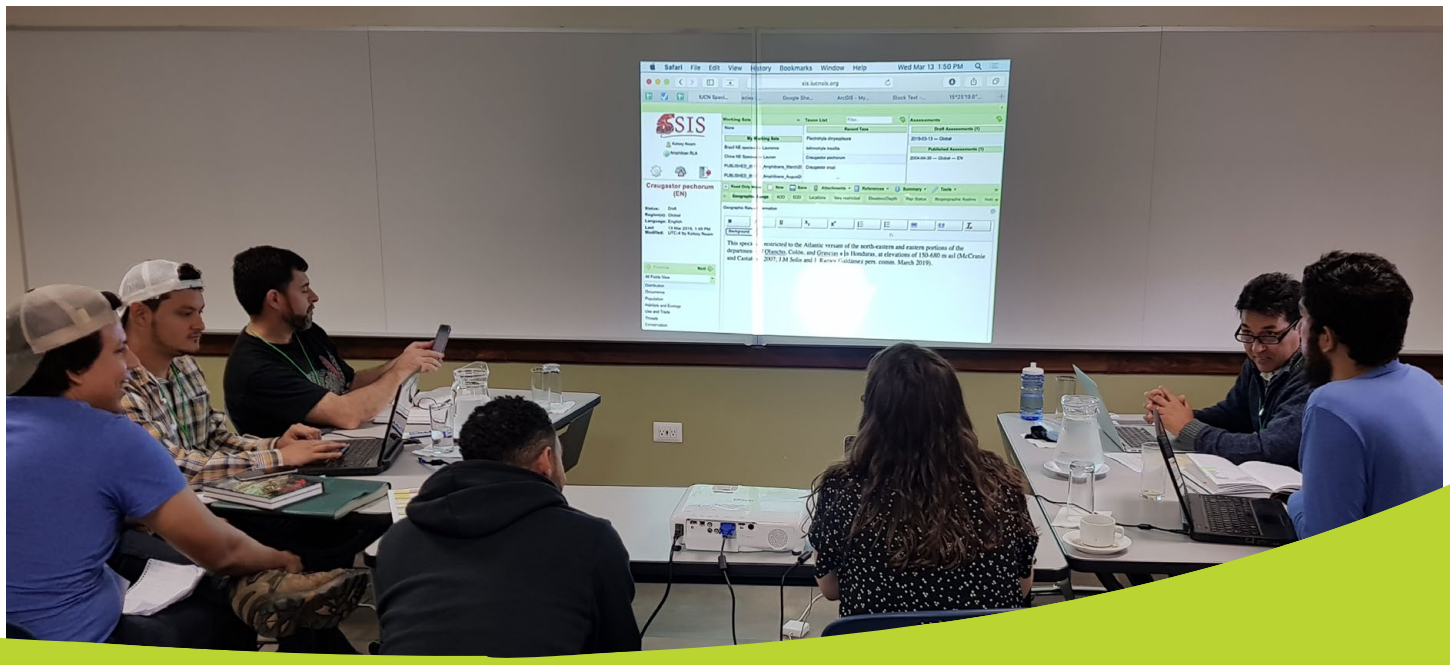
The results of the 2004 Global Amphibian Assessment highlighted that, of all the countries in the Neotropics, the situation facing Honduran amphibians was dire, with approximately half of its species at risk of extinction (Stuart et al. 2004). This realization spawned a number of conservation and research initiatives, which resulted in large amounts of new data and more than fifteen species descriptions, thereby raising the number of known species in Honduras to nearly 150. The extinction risk of the newly described species has never been assessed for the IUCN Red List, and the original GAA data are now more than a decade old and in need of update.

With a relatively high proportion of endemic (39%) and threatened (~50%) amphibian species, Honduras was considered to be a high priority country by the AArk to complete CNAs.

Amphibian symposium

Immediately preceding the assessment workshop, a very successful amphibian symposium was held at the Universidad Nacional Autónoma de Honduras (National Autonomous University of Honduras), in Tegucigalpa. The symposium, entitled *Conservation of the Amphibians of Honduras: the last decade*, attracted a very large audience, and included a range of excellent presenta-

Twelve experts were split into two working groups to complete 146 Red List and 89 Conservation Needs Assessments, over a three and a half-day period. Photo: Kevin Johnson.



tions relating to amphibian conservation in Honduras:

- Assess, plan, act! The role of the IUCN Red List in the conservation cycle. Jennifer Luedtke, IUCN Amphibian Specialist Group / Global Wildlife Conservation
- An overview of the amphibians of Honduras. Mario Solis, Universidad Nacional Autónoma de Honduras
- Informing *ex situ* conservation: Amphibian Ark's Conservation Needs Assessment program. Luis Carrillo and Kevin Johnson, Amphibian Ark
- Rescuing the amphibians of Cusuco National Park. Jonathan Kolby, IUCN Amphibian Specialist Group / Honduras Amphibian Rescue and Conservation Center
- Endemic amphibians receiving protection through Jaguar corridors. Franklin Castañeda, Panthera
- Amphibian diversity and climate change at Sierra Lenca and Cordillera Nombre de Dios. Joe Townsend, Indiana University of Pennsylvania
- When the world falls in love: case study of one small frog going global. Chris Jordan, Global Wildlife Conservation

These inspiring presentations provided an excellent background to the issues facing amphibian populations, both in Honduras, and globally, and also informed the audience about what actions are being taken, both inside and outside the country, to save amphibians. Several representatives of the Honduran government were present, some of who shared their perspectives and priorities related to amphibian and habitat conservation.

The assessments

The primary aim of the workshop was to update the existing 116 species assessments on the IUCN Red List and conduct first-time assessments for the approximately twenty-five species that have been described since the 2004 GAA.

Twelve experts, from a range of institutions both within Honduras and from overseas contributed to the assessments, along with three facilitators from the ARLA and two facilitators from the AArk. On the first day, participants were introduced to the two different assessment processes, and how they would be integrated during the workshop. Several species were assessed during a plenary session during the first day, then the participants were split into two groups for the subsequent workshop days.

During the workshop, a great amount of unpublished data were readily shared and recorded within the assessments. The level of cooperation and camaraderie between participants was admirable and showed a true and genuine concern for the future of amphibian conservation in Honduras. It was also inspiring to see an excellent representation of local university students, well on their way to becoming the next generation of Honduran herpetologists. Most, if not all of these experts will play a crucial role in implementing the conservation actions arising from the workshop and helping to protect amphibian habitats throughout the country.

All 146 species occurring in Honduras, including those both previously assessed and all newly described species to date, were assessed for the IUCN Red List. While some assessments still need to go through the external review process prior to being published on the Red List, preliminary results indicate that Honduras continues to have a high proportion of threatened endemic species, with

Workshop facilitators, Honduran amphibian experts, and representatives from various government wildlife departments, NGOs and local academics all participated in a five-day assessment and conservation planning workshop in Honduras in March. Photo: Franklin Castañeda.

nearly 90% of species assessed as Vulnerable (VU) (2), Endangered (EN) (15) and Critically Endangered (CR) (34). As for the other 10% of endemics, one species has been assessed as Near Threatened (NT), one as Least Concern (LC), and two as Data Deficient (DD). Unfortunately, two species (*Craugastor anciano* and *Craugastor omoaensis*) were declared Extinct (EX), most likely due to the combined effects of chytridiomycosis and habitat loss. While these assessments are tragic and alarming, we must commemorate the tireless efforts and dedication of the researchers who exhaustively searched for these species. All non-endemic species still require input from other regional groups before final categories can be assigned, which is set to take place later this year. Finally, several species were removed from the country list, as a result of taxonomic changes, with Honduran records being assigned to other species.

During the workshop, eighty-nine species were assessed using the CNA process. To expedite the assessment process, it is usual not to assess species listed as Least Concern on the Red List, unless those species have been recommended as potential husbandry analog species for more threatened, related species. The summary numbers of recommended conservation actions for the assessments are:

- *In situ* conservation – 71 species
- *In situ* research – 62 species
- *Ex situ* rescue – 18 species
- *Ex situ* research / analog – 15 species
- Conservation education – 28 species
- Supplementation – 1 species
- Biobanking – 18 species
- No conservation actions required – 2 species

It should be noted that each species can be recommended for one or more different conservation actions, hence the total number of actions recommended above is higher than the 89 species assessed. Definitions of the conservation actions above can be found in the help pages on the Conservation Needs Assessment web site.

The highest priority species recommended for *ex situ* rescue are *Craugastor anciano*, *Bolitoglossa cataguana*, *Nototriton mime*, *Craugastor chrysozetetes*, *Duellmanohyla salvavida*, *Craugastor fecundus* and *Craugastor coffeus*. Of these, three species (*Nototriton mime*, *Craugastor chrysozetetes* and *Craugastor fecundus*) are probably or possibly extinct, and *Craugastor anciano* was assessed as Extinct. The remainder continue to be threatened by habitat loss due to logging, small-scale agriculture, landslides, small-scale palm oil plantations and human settlements. The experts who contributed to these assessments consider that if these species have not yet become extinct, it is likely that they will face extinction before the threats they face can be mitigated, and that *ex situ* rescue programs are required to ensure their persistence.

Planning session

On the last day of the assessment workshop, a conservation planning session took place involving the Honduran amphibian experts, representatives from various government wildlife departments, NGOs and local academics, including key organizations, such as Detroit Zoological Society, Global Wildlife Conservation, the Honduras Amphibian Rescue & Conservation Center, Instituto de Conservación Forestal, and Universidad Nacional Autonoma de Honduras. The purpose of this session was to identify and prioritize the research and conservation actions necessary to safeguard Honduran amphibians and define some critical next steps that the workshop participants and the wider conservation community can take to achieve these actions. This planning exercise was therefore a natural extension of the prior days of the symposium and workshop.

After a summary of both the Red List and CNA results, an open discussion forum took place, expertly facilitated by Franklin Castañeda from Panthera - Honduras. The discussion covered topics, such as the development of a national amphibian conservation action plan, including identifying an individual to lead the action planning process; reviewing existing national legislation affecting wildlife and environmental protection; and widespread dissemination of additional scientific publications. All participants were completely engaged with the discussions and eager to participate in future actions.

A timetable of activities over the coming year was developed, with various individuals identified to lead the development of those activities, including scientific publications, a national action plan, and fundraising for specific conservation and research priorities that emerged during the assessment workshop.

Sponsors

The joint assessment and amphibian conservation planning workshop was made possible by the generous support of the Detroit Zoological Society, Global Wildlife Conservation, Synchronicity Earth, Amphibian Ark, Panthera and Escuela de Biología de la Universidad Nacional Autónoma de Honduras.

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A collaborative effort for conservation management of the Green Toad in the Cologne area

Thomas Ziegler, Zoologischer Garten Köln, Germany; Miguel Vences, Technische Universität, Braunschweig, Germany; Elmar Schmidt, NABU Naturschutzstation Leverkusen-Köln, Germany; Ruth Dieckmann, Christian Niggemann and Anna Rauhaus, Zoologischer Garten Köln, Germany

The Green Toad (*Bufotes viridis*) is a pioneer colonizer, found in sunny areas with sparse vegetation. For spawning it requires water bodies that heat up quickly, without the presence of fish. This predominantly continental species reaches its northwestern distribution range in Germany, specifically in the state of North Rhine-Westphalia (Günther & Podloucky 1996). In this region, the Green Toad only occurs in the Bay of Cologne, where it has been reported for many years (Glaw & Vences 1989, Vences et al. 2003, 2011).

In the past, distinct population declines have been observed both in the city of Cologne and in the whole Bay of Cologne. Vences et al. (2003) recorded definite extinction events in North Rhine-Westphalia, in particular at its peripheral area. The Europe-wide strictly protected species, listed as Vulnerable in Germany, is therefore considered to be Endangered in North Rhine-Westphalia. Most of the remaining occurrences in Cologne consist of small subpopulations only. Predominantly due to habitat destruction, particularly in the sites where reproduction is known to occur, the species has moved to secondary habitats such as gravel pits or other areas with sparse vegetation, like fields and meadows, which have suitable water bodies (Schmidt & Simon 2017). However, a number of such habitats have already been lost due to advancing development of settlements. Remaining habitats are often separated from each other by urbanized areas and roads, thus precluding genetic exchange. Suitable habitats must also be maintained to prevent them becoming overgrown, which sometimes is problematic at sites destined for other use.

To help conserve this species, the Nature and Biodiversity Conservation Union (NABU) Nature Conservation Station Leverkusen-Köln, together with the University of Technology at Brunswick (TU Braunschweig) and the Cologne Zoo have been jointly engaged in conservation management of the Green Toad in the Cologne area since 2016. Elmar Schmidt from the NABU Nature Conservation Station is responsible for developing conservation actions at specific sites. At Cologne Zoo, Thomas Ziegler and his terrarium team are in charge of the project and at TU Braunschweig, the laboratory of Miguel Vences supports the project with genetic analyses and providing long-term expertise in amphibian surveys and mapping in Cologne. Recently, the urban dewatering company in Cologne (Stadtentwässerungsbetriebe Köln, AöR, (StEB Köln) have joined the team and also supports Green Toad conservation in Cologne.

A Green Toad (*Bufotes viridis*) in the exhibit and rearing station at the Cologne Zoo, Germany. Photo: Thomas Ziegler.

Field work and creation of protection concepts

Using various *in situ* conservation measures we help to preserve and promote the remaining subpopulations of the Green Toad in Cologne and enable expansion of the species by the creation of connected stepping-stone biotopes. Since 2014, more than forty reproduction sites have been or are being established by the NABU Nature Conservation Station in Cologne. With their responsibility for clean water, the StEB Köln take care of the streams in Cologne and fifteen ponds in the urban parks, they not only ensure the water quality, but are also restoring sections of streams, protecting their drainage capability, and rehabilitating park ponds. They also directly collaborate with the NABU Nature Conservation Station in creating new habitat for resettlement with captive-raised Green Toads. The goal of our *in situ* activities is preservation, habitat conservation and extension, finally resulting in increasing the existing subpopulations.

The Natural habitat of the Green Toad in Cologne which is threatened by habitat destruction.
Photo: Thomas Ziegler.

Research into causes for decline as a basis for risk assessment and establishment of protection measures

As a first measure we have begun to systematically record the remaining occurrences of Green Toads in Cologne. For an effective inventory we have involved students from the University of Cologne within the scope of practical courses or student theses. During these surveys we have collected skin and saliva swabs for subsequent analyses of potential pathogen infection, and of genetic structure and variation of the toad subpopulations in the Cologne area. By doing so, we hope to receive further information on the causes of decline. Logistics and supervision was performed in close collaboration between TU Braunschweig, Cologne Zoo and NABU Nature Conservation Station. The first Bachelor thesis dealing with the population status and threat potential of the Green Toad in Cologne was completed in 2016. Subsequently, further theses were completed at the University of Cologne in 2017-2018, dealing with the characterization of reproductive sites, conservation genetics, and prevalence of fungal pathogens such as chytrid fungus (*Batrachochytrium dendrobatidis*).

This research is used as a basis for improved threat assessment, and subsequently for fine-tuning suitable conservation measures. Results received in the frame of the population analyses, risk assessment, genetic structure and habitat constitution and availability are helping to optimize the protection concept. The first research results will be published shortly, dealing with the development of new microsatellite markers for the Green Toad, and the assessment of the population structure in the Cologne area (Vences et al. in press). Another project will cover the results of the chytrid screening, not only for the Green Toad but also syntopic amphibians.

Green Toad exhibit and rearing station

The Cologne Zoo, together with StEB Köln, has established an exhibit illustrating the biology of and threats to the Green Toad in Cologne. This facility also provides space for keeping and rearing tadpoles and froglets under protected conditions. At the beginning of the breeding season, staff from the NABU Nature Conservation Station deliver larvae to the rearing station, where they are reared under optimal conditions. Subsequently, at the end of the Summer, the young captive-reared toads are released in Cologne to stabilize and restock declining natural subpopulations.

The Green Toad exhibit and rearing station at the Cologne Zoo, where visitors can also see behind the scenes activities through a large viewing window. Photo: Thomas. Ziegler.

Restocking sites are either small, threatened natural occurrences or the reared toads are released at newly-created ponds. Such inoculation measures help to initiate populations in stepping-stone biotopes, as a contribution to developing the biotope network. The rearing station also has sufficient space for housing and rearing tadpoles salvaged from drying ponds which would not stand a chance of survival under natural conditions. These rescued Green Toads can also be used at a later stage for release or relocation events. For example, in the project initiation phase in 2016, in total of 179 young toads could have been released in Cologne after having been reared in the Cologne Zoo, which at that time were still behind the scenes of the terrarium section. In addition, in the same year we provided temporary housing for approximately 550 tadpoles that would have died as a result of drying-out of their natural water bodies, and which subsequently were released at other sites in Cologne.

The Green Toad exhibit, which was opened in May this year, is located on the upper floor of Cologne Zoo's Aqua-Terrarium building. In two 100 cm long x 60 cm deep x 40 cm high aqua-terraria, different development stages can be seen during the activity period of the toad and adults are housed in a 100 cm long x 60 cm wide x 75 cm high terrarium. Zoo visitors can also see behind the scenes activities through a large window, e.g. seeing a separate rearing rack with nine 45-liter tanks which house larger groups of tadpoles, and another shelf with four 60 cm x 38 cm x 36 cm terraria for rearing metamorphosed toads. This allows Zoo visitors to gain further insights into the work of the amphibian keepers and into the functionality of an amphibian rearing station. This is a great opportunity to demonstrate the efforts and logistics of several of Cologne Zoo's Aqua-Terrarium off-display rearing projects. Ambassadors of the exhibit and rearing station are congenial cartoon characters of Green Toads in all life stages, created by animal keeper Christian Niggemann, and these help to increase the originality of the exhibit. Together with section keeper Anna Rauhaus and the remaining terrarium keepers, the team also cares for rearing the tadpoles and young toads. The exhibit is accompanied by a display dealing with the topics of conserving the Green Toad and its environment, as well as water protection. In addition, we have developed a fact sheet which also is part of Cologne Zoo's species conservation leaflet.

The poster "Together for the Green Toad", developed for the Green Toad exhibit and rearing station at Cologne Zoo, showing cartoon character of the Green Toad in front of the pinnacles of the famous Cologne cathedral.
Credit: Christian Niggemann.

UN Decade on Biodiversity award

During the official opening of the Green Toad exhibit and rearing station in May, the corporate project Conservation of the Green Toad in Cologne being undertaken jointly by the NABU Nature Conservation Station, Cologne Zoo (together with StEB Köln) and TU Braunschweig, was presented with an award as an official project of the UN Decade on Biodiversity (CBD, Convention on Biological Diversity). The awarding ceremony was performed by Karl-Heinz Erdmann from the Federal Agency for Nature Conservation, Bonn, and the ambassador of the UN Decade on Biodiversity, TV anchorman Ralph Caspers.

Outlook

In North Rhine-Westphalia the Green Toad has a core area of occurrence in Cologne and thus bears the status of a flagship species for local biological diversity. A number of co-occurring species will benefit from the Green Toad conservation measures, and thus biodiversity in Cologne in general is supported. Population genetic analyses to identify potential genetic depletion and isolation, and investigation of pathogen infection prevalence and intensity, contribute to a better understanding of declines and help to improve the protection concept. This collaborative project is a good example how research, along with *in situ* and *ex situ* conservation measures can effectively promote local preservation of a threatened amphibian species. This approach is another successful example of the “One Plan Approach”, supported by the International Union for Conservation of Nature (IUCN). This term describes activities targeting the intensified development of integrative strategies to protect threatened animal species and advancing cooperative concurrence of *in situ* and *ex situ* measures and expert groups.

Acknowledgements

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Green Toad tadpoles in the exhibit at the Cologne Zoo. Photo: Thomas Ziegler.

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The opening of the Green Toad exhibit and rearing station in May, which included an award ceremony. From left to right: Christopher Landsberg (Chief Financial Officer, Cologne Zoo), Otto Schaaf (Chief Executive Officer StEB Köln), Ralph Caspers (TV anchorman and prominent UN Decade ambassador), Prof. Theo B. Pagel (Director, Cologne Zoo), Prof. Dr. Karl Heinz Erdmann (Federal Agency for Nature Conservation, Bonn), Elmar Schmidt (NABU Nature Conservation Station), Ruth Dieckmann (Educationist, Cologne Zoo), Prof. Dr. Thomas Ziegler (Curator, Cologne Zoo). Photo: Anna Rauhaus.

Amphibian Ark Conservation Grants

AArk has offered grants since 2009, and in the past ten years, we have provided funding totalling just over US$166,000 to thirty-five projects in eighteen countries. We offer a range of grants, including start-up grants, which provide initial funding to help newly-launched projects get started at the very beginning of their life; start-up grant extensions, which are additional funds, available to provide continued support for AArk seed or start-up grant projects that have met their stated objectives over the previous year; workshop attendance grants providing partial funding to assist attendance at *ex situ* amphibian conservation-related workshops; and mentorship grants, which support organizations that 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. Details of all of our grants, including guidelines and deadlines for lodging applications, can be found on the Conservation Grants page of the AArk web site.

This year, we changed the application process a little, requiring all potential applicants to lodge a 200-word Project Outline, prior to submitting their full application. The outline is required to summarize the proposed outcomes of the project, provide brief details on the species, its conservation status, and other funding sources. All project outlines are reviewed by our Grant Review Committee, with the principal investigators of approved outlines then invited to submit a full application. Feedback received from the Review Committee is provided to the applicants, which can then be considered when full applications are being written. We received sixteen project outlines this year, with eleven of them resulting in full applications. Overall, the quality of the applications received this year was much higher than in previous years – no doubt the result of initial feedback and suggestions being factored into the applications.

Of the eleven applications received, we are excited to announce that we are able to fund four of them, with each project receiving US$5,000 (or very close to it). The successful projects this year are:

- Using radio-telemetry to track survival and disease outcomes in the Mountain-Yellow-legged Frog (*Rana muscosa*) to inform *ex situ* management. Institute for Conservation Research, USA
- Project Palaka, Phase II - *Platymantis insulatus ex situ* program. Project Palaka, Philippines
- First steps towards the conservation of the Darwin's Blackish Toad (*Melanophryniscus nigricans*). National University of the Centre of Buenos Aires Province, Argentina
- Start-up grant for the Lake Patzcuaro Salamander (*Ambystoma dumerilii*), Zacango Ecological Park - CEPANAF, Mexico

Using radio-telemetry to track survival and disease outcomes in the Mountain Yellow-legged Frog (*Rana muscosa*) to inform *ex situ* management. *Tali Hammond, Institute for Conservation Research, USA*

The Mountain Yellow-legged Frog (*Rana muscosa*) is an IUCN Red List, federal, and state Endangered species, native to central and southern California, USA. Declines of Mountain Yellow-legged Frogs in the mid-20th century were primarily caused by habitat loss, invasive species, and disease. One of the main conservation challenges currently faced by this species is the small number of remaining populations, all of which are impacted by chytrid fungus and are subject to continued anthropogenic impacts (e.g. climate change induced extreme weather events, habitat loss, invasive species introduction).

We are working to re-establish new populations of Mountain Yellow-legged Frog through *ex situ* conservation breeding and reintroduction. For these efforts to be effective, it is critical to evaluate post-release success of reintroduced frogs; only through a better understanding of how frogs behave and survive after release can we optimize management actions in captivity. However, monitoring in this species has proved challenging due to camouflaging patterning and cryptic behavior. We propose to use radiotelemetry to track reintroduced frogs.

Telemetry would allow us to better quantify survival rates, to gain a better understanding of habitat use across seasons, and to test how habitat use and pre-release treatments (e.g. microbiome augmentation) affect survival and disease (chytridiomycosis) prevalence. This information is critical for assessing and improving future management actions.

We currently do not have funds to purchase radio-transmitters. An investment from Amphibian Ark would jump-start this project, allowing us to purchase radio-transmitters that last more than six months. The proposed work will address top priority recovery actions designated in the Recovery Plan for this species (e.g. reintroductions and post-release monitoring to assess survival, disease surveillance, characterizing role of microbiome in disease dynamics). It also aligns with Amphibian Ark priorities of optimizing preservation and management of endangered amphibian species in *ex situ* programs.

The Institute for Conservation Research, USA is working to re-establish new populations of Mountain Yellow-legged Frog (*Rana muscosa*) through *ex situ* conservation breeding and reintroduction.

Project Palaka, Phase II - *Platymantis insulatus ex situ* program. *Norman Greenhawk Schuyler, Project Palaka, Philippines*

The target species for this grant is the Gigantes Forest Frog (*Platymantis insulatus*). This species occurs in the remote Gigantes Islands in the Philippines, in karst/limestone forests/caves which are threatened by logging and tourism. Critically Endangered, population dynamics of the Gigantes Forest Frog are unknown, owing to the remote location of the species and the time it takes to get to Gigantes. There is a possibility that the species might be extinct in the wild, and more fieldwork

is required to properly assess the population. According to the Philippines Red List Assessment Workshop (May 2017), field surveys in 2014 found the species to be more abundant than previously thought, however, due to ongoing decline in the extent and quality of habitat, the population is suspected to be decreasing.

A team of six, including Project Palaka staff and students from the University of the Philippines, Los Baños (UPLB) will travel to Gigantes in October/November 2019 for one week to search for the species, conduct thorough population counts and habitat assessments, and collect individuals for housing at Project Palaka, on the UPLB campus, in Laguna province. Project Palaka Phase I allowed us to develop protocols for maintaining and breeding *Platymantis* species in captivity; these will be used to initiate a breeding program for Gigantes Forest Frogs. We will conduct another population survey in April/May 2020, and thereafter continue population monitoring every six months, on an October/November and April/May schedule. If the breeding program is successful, we anticipate releasing the first of the captive-bred offspring into the wild in the summer of 2020 (on a special trip). We then intend to keep breeding Gigantes Forest Frogs and conduct yearly releases in addition to twice-yearly monitoring.

For threat mitigation, we intend to better assess current threats to the species on the October/November trip this year. Assuming that logging is still the largest threat, we will work with reforestation groups in the Philippines to determine the feasibility of starting a reforestation/regeneration project on Gigantes. However, it is likely that such a project will not be started until at least 2021- the permitting and organization of such projects takes time in the Philippines.

The Gigantes Forest Frog (*Platymantis insulatus*). Photo: Pierre Fidenci, Creative Commons. https://it.wikipedia.org/wiki/File:Platymantis_insulatus01.jpeg

First steps towards the conservation of the Darwin's Blackish Toad (*Melanophryniscus nigricans*). *Igor Berkunsky, National University of the Centre of Buenos Aires Province, Argentina*

The Darwin's Blackish Toad (*Melanophryniscus nigricans*) is a threatened, recently-described species, found in highland grassland along the Tandilia Mountain System, in the south-east of the Province of Buenos Aires, Argentina. In the past, this species was considered as an unnamed taxon belonging to the *Melanophryniscus stelzneri* group, however since 2004, most researchers consider it a separated unnamed species.

Since the 1970s, the wild populations of this species have dramatically declined by more than seventy percent, with at least two well-known populations becoming extinct, and a third one is probably extinct. The remnant populations are facing a combination of threats which include habitat loss from forestry, invasive woody species, quarries, overgrazing and trampling by livestock, chytrid fungus, and desiccation caused by climate change.

The Darwin's Blackish Toad (*Melanophryniscus nigricans*) is a threatened, recently-described species, found in the south-east of the Province of Buenos Aires, Argentina. Photo: Gabriela Soler.

In 2017, we started a conservation initiative aimed at identifying the main threats and exploring effective conservation actions to recover the populations of the Darwin's Blackish Toad. Currently, only one protected area (the Sierra del Tigre Natural Reserve) is effective at guarding a wild population of this toad, and the managers of the reserve initiated a habitat restoration project aimed at providing additional habitat for the Darwin's Blackish Toad. However, natural recolonization by the species is unlikely due to current fragmentation and the lack of corridors between remnant highland grassland habitats.

This project is aimed at increasing the area of occupancy of Darwin's Blackish Toad. We will build *ex situ* breeding facilities at the Universidad Nacional del Centro de la Provincia de Buenos Aires campus and we will establish a survival colony. We will also include head-starting from eggs - we will collect some clutches from wild breeding sites and will maintain them in captivity until they reach juvenile or adult stage. All individuals produced in captivity will be translocated to restored and protected habitats in the Sierra del Tigre Natural Reserve and selected surrounding areas.

This project will result in the first effective conservation activities for the Darwin's Blackish Toad, connecting the current populations, and increasing the species' viability.

Start-up grant for the Lake Patzcuaro Salamander (*Ambystoma dumerilii*). *Margarita Ruiz Flores, Zacango Ecological Park - CEPANAF, Mexico*

There are 659 known species of salamander, and of these, seventeen species are endemic to Mexico and four of them are kept in a neotenic state (the retention of some juvenile traits). The Lake Patzcuaro Salamander (*Ambystoma dumerilii*) is a commercially-harvested species, with catches registered in tons from 1987 to 1991.

In the Purepecha culture, this species, which is known as the Achoque, is part of traditional medicine and is used by local people as a food source.

Due to the contamination of Lake Pátzcuaro and the overexploitation of the species, by 2011 the Achoque was partially extinct from the lake. In 2019, the Michoacán University of San Nicolás de Hidalgo (UMSNH), conducted an investigation on the possible extinction of the Achoque in Lake Pátzcuaro, discovering a considerably large population of Achoque *in situ*. This discovery gives us a window of opportunity to save the species.

A considerable number of local people in Pátzcuaro, Michoacán, are engaged in fishing, and it has been identified that while dragging their fishing nets in the lake, Achoque eggs are collected, which are not returned to the lake, causing them to die. The project aims to save at least fifty percent of the eggs which are collected accidentally during the months of oviposition. All eggs that are recovered will be hatched in captivity and the specimens will be released after completing the development of their four limbs (feet and hands).

The species is listed in the IUCN Red List of Threatened Species as Critically Endangered, is listed as CITES Appendix II, and locally is listed as NOM-059- SEMARNAT-2010: (Pr) Subject to Special Protection by the Secretariat of Environment and Natural Resources in Mexico. It is important for conservation work to be undertaken with the population to attempt to recovery this species in its natural habitat. The project addresses one of the main causes of extinction: by-catch of eggs.

We propose to create a technical manual for the *ex situ* breeding and rearing of Achoque larvae, which allows us to standardize an adequate methodology for the development and subsequent release of the Axolotls; reference bibliography for intensive periods of wildlife management (farms or facilities that manage wildlife in a confined form, outside of their natural habitat, for the purpose of controlled reproduction of species or populations for commercial use, without the purpose of recovering species or populations for their subsequent reintegration into the wild); and units of management for wildlife conservation established.

The Lake Patzcuaro Salamander (*Ambystoma dumerilii*) is part of traditional medicine and is used by local people of Lake Patzcuaro as a food source.

We will recover the eggs that are collected incidentally in fishing nets, transfer them to the laboratory where they can be hatching and reared, and then release the hatched specimens to Lake Pátzcuaro. We also hope to work with local fishermen to mitigate the incidental exploitation of the species.

AArk Husbandry Document library

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. A new search engine has recently been installed on the Husbandry Documents page, which can now search for particular words or phrases within all pdf files. This results in much more accurate results when searching the document library for particular topics.

Four new documents have been added recently:

Husbandry Guidelines, *Aromobates duranti* (Spanish)
Author: Enrique La Marca
Publication: May 2019

www.amphibianark.org/wp-content/uploads/2019/06/Pautas-de-Manejo-Ex-situ-Aromobates-duranti.pdf

Species Action Plan for *Aromobates duranti* (Spanish)
Author: Enrique La Marca, Universidad de Los Andes, Mérida, Venezuela.
Publication: May 2019
www.amphibianark.org/wp-content/uploads/2019/06/Plan-de-Acci%C3%B3n-para-Aromobates-duranti.pdf

Recovery Plan for the Southern California Distinct Population Segment of the Mountain Yellow-legged Frog (*Rana muscosa*) (English)
This document presents the U.S. Fish and Wildlife Service's (Service) plan for the conservation and recovery of the southern California distinct population segment of mountain yellow-legged frog (*Rana muscosa*). The goal of this recovery plan is to provide guidance on how to control or ameliorate impacts from current threats to the southern *Rana muscosa* such that the taxon no longer requires protections afforded by the Act and therefore, warrants delisting.
Author: U.S. Fish and Wildlife Service
Publication: 2018
www.amphibianark.org/wp-content/uploads/2019/06/Southern-CA-MYLF-Recovery-Plan.pdf

Recovery Implementation Strategy for the Southern California Distinct Population Segment of the Mountain Yellow-legged Frog (*Rana muscosa*) (English)
This Recovery Implementation Strategy specifies the activities necessary to fully implement the recovery actions that are specified in the Recovery Plan for the Southern California Distinct Population Segment of the Mountain Yellow-legged Frog (*Rana muscosa*) (U.S. Fish and Wildlife Service (Service) 2018).
Author: U.S. Fish and Wildlife Service
Publication: 2018
www.amphibianark.org/wp-content/uploads/2019/06/Southern-CA-MYLF-Recovery-Implementation-Strategy.pdf

Amphibian Advocates

Our Amphibian Advocate for this Newsletter is Carlos Andrés Galvis Rizo, Head of Animal Collection Department at Cali Zoo in Colombia. Carlos and his team at the Amphibian Reproduction Center at Cali Zoo are currently involved with the conservation of the Golden Poison Frog (*Phyllobates terribilis*), and the Lehman Poison Frog (*Oophaga lehmanni*). We hope you enjoy reading about his amphibian conservation activities.

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!

Carlos Andrés Galvis Rizo, Head of Animal Collection Department, Cali Zoo, Colombia

Ever since I was a child and for as long I can remember, I have been passionate about all animals. My father was also a lover of nature and motivated me tremendously to become a biologist. He often gave me books and video documentaries about animals as gifts which further inspired my fascination about fauna, and especially amphibians and reptiles. I was very fortunate to be born and grow up in a tropical country like Colombia, and frequently I made trips to rural areas with my father, during which time my enthusiasm grew increasingly to someday pursue university studies enabling me to become a biologist.

Shortly after beginning my studies at the university, I started working as Curator of the reference collection of amphibians and reptiles at the Universidad del Valle where I remained throughout the length of my time as a student. During this same period I was also connected with the Conservation Research Center (CREA) of Cali Zoo where I led some of the research and conservation programs pertaining to amphibians and reptiles. After completing my studies I was appointed as Biologist of the Cali Zoo, where I was able to continue my conservation activities. It was then that I assumed the responsibility as head of the animal collection department. In 2008, I received a grant from the Durrell Wildlife Conservation Trust to continue my studies in the United Kingdom. It was there that I obtained an Honors degree in Management of Threatened Species Conservation from the University of Kent. From the knowledge I acquired, I had a much clearer understanding about the important role of zoos in conservation and the appropriate strategies necessary to help save species from extinction. A few years later, I was awarded a scholarship by the Zoo Conservation Outreach Group (ZCOG) to pursue coursework in biology and management and conservation of amphibians in Toledo, Ohio. It was there that I acquired knowledge on amphibian management techniques in captivity and other aspects related to amphibian conservation. Throughout this period the Cali Zoo had continually supported my training efforts as a scientist and my initiatives to promote the conservation of natural resources.

From the start of my affiliation with the Cali Zoo in 1999, I initiated a snake conservation program which had allowed me to generate important associations within the rural communities of Colombia. These connections enabled me to access many areas of our country that were often difficult for many other scientists. It can be said that it was because of my work with the snakes that many doors had been opened for me; enabling me to contribute to the conservation of other animals, especially amphibians.

During one of my field expeditions in which I was working with snakes in the Colombian Pacific rainforest, I unexpectedly found a new population of Golden Poison Frog (*Phyllobates terribilis*). This discovery was very significant because it extended the range of distribution of these animals 60 km north from its known distribution location. From this sighting and with the support of Wildlife Conservation Society (WCS, USA), the Zurich Zoo in Switzerland, and the Universidad del Valle, studies are now being conducted

that will inform us much more extensively about their conservation status and the development of new strategies to prevent their extinction.

From the studies conducted by the scientific community pertaining to endangered species of Colombia and a prioritization workshop conducted at the Cali Zoo and guided by Amphibian Ark, which brought together many amphibian experts, it had been determined that the Lehman Poison Frog (*Oophaga lehmanni*) is also a Critically Endangered species that required a breeding program for reintroduction and population supplementation. Consequentially, with my encouragement and guidance, we recently initiated a breeding program at the Amphibian Reproduction Center at the Cali Zoo for this species.

Recapitulating these events in my life has enabled me to see how fortunate I am to watch how my childhood dreams became a reality. To be able to share my life's work and passion of conservation of our natural resources with others brings me an enormous sense of personal satisfaction.

Currently we are continuing our studies with regard to the conservation of the Golden Poison Frog from the newly discovered population, at our Amphibian Reproduction Center. We have also continued our efforts on the current conservation needs of the Lehman Poison Frog. We have an extraordinary team of knowledgeable and dedicated veterinarians, biologists, curators and keepers at the Cali Zoo. Going forward, we hope to continue generating contributions to the awareness and conservation of other amphibian species in our country.

Observation on the impact of nutrition and feed presentation on leg development in the Pickersgill's Reed Frog

Cassandra A. Becker, Nutritionist; Ian du Plessis, Curator: Reptiles, Fish and Amphibians; Piet Malepa, Animal Welfare Manager; and Timothy Netsianda, Keeper: Reptiles, Fish and Amphibians, Johannesburg City Parks and Zoo, South Africa

Background

The Amphibian Research Project of the Johannesburg Zoological Gardens in South Africa, was initiated in 2006 to assist with the conservation of endangered South African amphibian species as a result of the outbreak of chytrid fungus in South America. The outbreak necessitates South Africa to start plans to prevent the spread of chytrid fungus and also develop new ways of dealing with this outbreak. The project then focused on the species of national concern, Pickersgill's Reed Frog (*Hyperolius pickersgilli*) which was classified on the IUCN Red List as Critically Endangered because of the small area of occurrence which is severely fragmented, and the decline of suitable habitat (IUCN, 2016). The Pickersgill's Reed Frog is a small reed frog endemic to KwaZulu-Natal in South Africa, with males measuring up to 22 mm and females, 28 mm in length (Raw, 1982). In KwaZulu-Natal the species can be found in a few ponds which are all located within 20 km of the coast. While KwaZulu-Natal is 2,303 km^2, the area of occurrence of the Pickersgill's Reed Frog is calculated to be only 9 km^2 (Measey, 2011). Because the Pickersgill's Reed Frog's environmental requirements, feeding and breeding behaviour were unknown, the project started with a more common, related species, the Painted Reed Frog (*Hyperolius marmoratus*) to establish the baseline requirements for the subsequent successful breeding of the species in captivity.

The project successfully bred thirty-one Painted Reed Frogs and gathered valuable information and insight on the species. The lessons learnt from this exercise were used to breed more than one hundred Pickersgill's Reed Frogs, from which additional breeding groups have been established. This has culminated in the reintroduction of 200 frogs in 2018 and fifty frogs in 2019 back to their natural habitat in KwaZulu-Natal. One of the aspects for successful breeding and release of frogs is an in-depth understanding of the nutritional and dietary requirements of the species. This includes the correct balance and amount of nutrients (Ferrie et al., 2014). Also critical is the correct presentation of food items to encourage consumption (Livingston et al., 2014) (e.g. live vs dead food items), and the presentation of a wide variety of foods so the animals are best equipped to take advantage of prey in a natural environment and recognize a number of prey items as such. The purpose of this article is to share some new insights observed on the impact nutrition and feed presentation had on leg development of the Pickersgill's Reed Frog.

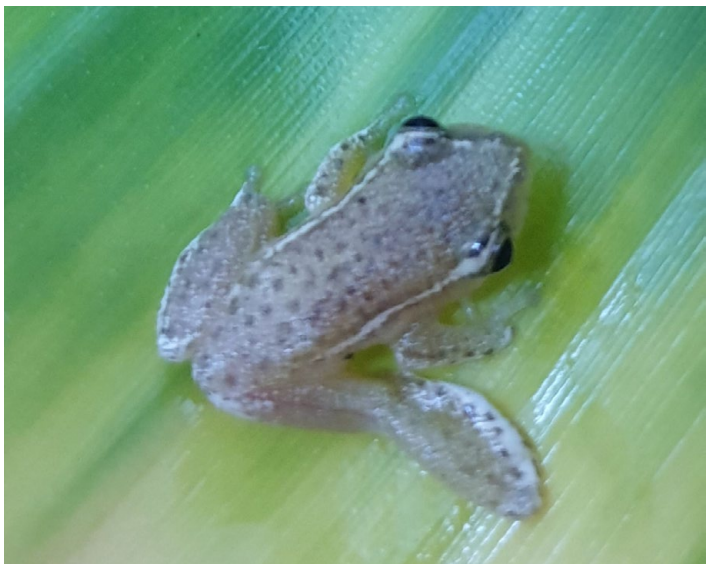
Nutritional management of Pickersgill's Reed Frogs

Observations of the development of the Pickersgill's Reed Frog led to the classification of seven distinct life stages which were used for feeding and housing management purposes. These were: eggs, tadpoles, developing tadpoles, developing froglets, froglets, young adults and adults. At the tadpole stage, the frogs were kept in Exoterra Natural Terraniums® measuring (60 cm long x 45 cm wide x 60 cm high) as shown on the next page.

From the beginning the zoo offered the tadpoles a mixture of fish flakes, spirulina tablets and blanched romaine lettuce. Later spirulina powder was introduced to the diets in place of tablets. The tadpoles then received a mixture of spirulina powder and fish-flakes, with blanched romaine lettuce introduced at the developing tadpole phase. However, there was an eight-week period in 2018, when there was no romaine lettuce available. The absence of romaine lettuce coincided with a group of tadpoles developing from tadpoles to adults while only being fed the spirulina/fish-flake mixture.

Observations

When the frogs fed spirulina/fish-flake mixture developed to adult phase, two significant things were observed: their ability to jump long distances and stronger hind limbs. Firstly the froglets were able to jump from one side of the exhibit to the other, while still having a tail. This was observed during routine maintenance, while the glass was being wiped down. This was in stark contrast to the previous groups which had been fed spirulina/fish-flakes with romaine lettuce, that did not jump strongly and were unwilling or unable to do so while still possessing a tail. Initially the tadpoles fed spirulina/fish-flakes with romaine lettuce were only able to walk or crawl. It was only after their tails had been resorbed



Left: Example of hind limb deformity observed in Pickersgill's Reed Frog (*Hyperolius pickersgilli*). Right: Proper development of hind limbs. Photos: Ian du Plessis.

that the adult frogs started making small jumps across the terraria. This was observed in 250 individuals. However, the new batch of frogs fed with only the spirulina and fish flakes were able to clear the whole distance (the entire distance of the terrarium – 45 cm), even while still in the froglet stage. The greater jumping ability was observed in all of the new group which consisted of 150 individuals.

The second observation was that the frogs which had been fed only the spirulina/fish-flake mixture had noticeably stronger hind legs with well-developed muscling on their femurs. It had been observed in tadpoles which were fed spirulina/fish-flakes with romaine lettuce that there was a low incidence of poor hind leg development (see photos on previous page). Obvious deformities were visible in five out of 250 animals (incidence of 2%). There were no deformities observed in the tadpoles fed only the spirulina/fish-flake mixture.

Exoterra Natural Terrarium Medium/Tall 60 cm long x 45 cm wide x 60 cm high. Image sourced from www.exo-terra.com.

Conclusions

The observations made may be attributed to several factors. It could be that the romaine lettuce was not nutritionally balanced enough to offer the proper nutrients during development of the limbs, or the tadpoles could not consume enough to meet their requirements for growth or the difference in the presentation of the feed induced different feeding behaviour in the tadpoles.

The values in Table 1 show that the spirulina is far higher in all values except for water content, total lipid and calcium. The higher water content in lettuce basically dilutes the nutrients available to the tadpoles. The spirulina also provides more of all the nutrients required for growth and enhanced activity compared to the romaine lettuce which can explain the better muscle development and ability to jump observed.

Another possibility is that the large size of the lettuce offered at feeding means that it remains stationary while the tadpoles are feeding on it, with little energy being required to feed on it. However, the tadpoles feeding on spirulina powder have to actively 'pursue' the food across the water surface in order to feed. This continued 'exercise' of the developing limbs forces them to become stronger and leads to the changes observed.

In both cases, a proper in-depth study will need to be conducted in order to determine which of the factors (if any) was responsible for the observed changes. In the meantime, the zoo has adapted its feeding protocol to simply spirulina and fish flakes and has not fed romaine lettuce since the discovery.

Nutrient	Romaine Lettuce Value per 1000 g	Spirulina Powder Value per 1000 g
Water	946.10 g	N/A
Energy	711.28 (170) kJ (kcal)	19 037.20 (4550) kJ (kcal)
Protein	12.30 g	606.10 g
Total lipid (fat)	3.00 g	0.00 g
Carbohydrate, by difference	32.90 g	303.00 g
Calcium, Ca	330 mg	0 mg
Iron, Fe	9.70 mg	436.40 mg
Sodium, Na	80 mg	10610 mg
Vitamin B-12	0.00 µg	3454.50 µg
Vitamin A, IU	87100 IU	3333330 IU

Table 1. The nutritional composition of romaine lettuce and spirulina powder as indicated by the manufacturers were compared. Retrieved from USDA Branded Food Products Database: https://ndb.nal.usda.gov.

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AArk-lead Amphibian Translocation (Reintroduction and Reinforcement) for Conservation Symposium, September–October 2019

Luis Carrillo, Training Officer, AArk

Many amphibian populations have been decimated in the wild and many others are severely fragmented, meaning that re-colonizing suitable habitat is almost impossible. Reintroduction and reinforcement are two of the tools in the conservation translocation toolkit, and often require the help of captive breeding programs as a source of animals. It has become more relevant to amphibians due to the continued population declines for many species. However, we still need to better understand the different factors that affect the success of amphibian reintroduction programs.

Reintroduction in conjunction with threat mitigation and habitat protection should be one of the major goals of almost any comprehensive amphibian conservation program. To be successful, program managers should properly plan reintroduction programs. The IUCN has produced guidelines for animal species reintroduction and the Reintroduction Working Group of the Amphibian Specialist Group has drafted specific guidelines for amphibians.

Target audience: Amphibian conservation program managers - the people who are managing programs at different stages of progress. The symposium is especially intended for programs that have produced surplus animals, potentially as candidates for reintroduction programs, but with no clear reintroduction strategy in place. It also is intended to be helpful for managers and institutions interested in setting-up amphibian conservation programs with a clear exit strategy focused on reintroduction.

Format: This free symposium will be online-based, avoiding the cost of transportation and attendance fees. The symposium will be divided into themes, and most of the themes will be covered over three days each week, during two-hour talks. Each theme will be covered within a week. Talks will be delivered using GoToMeeting. The symposium is planned to be delivered between September 23rd and October 18th, 2019. Major themes to be covered include theoretical framework, habitat management and restoration, reintroduction examples, and post-release monitoring.

In 2010 the Institute for Conservation Research at San Diego Zoo released 300 Mountain Yellow-legged Frog eggs into a stream on the University of California's James San Jacinto Mountains Reserve near Idyllwild, California. Photo: Ken Bohn, San Diego Zoo.

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. Photo: Federico Kacoliris.

Speakers: Experienced program managers with previous experience in amphibian reintroductions, amphibian disease risk assessment, habitat management and restoration, threat management, and post-release monitoring will share their successes and failures. Other speakers will include small-population managers, amphibian conservationists and general reintroduction specialists.

Registration and information: Although this is an online-based symposium, there will be a maximum number of participants at the same time in a given session. There are 100 spots opened for participants in each session. If you are interested in participating or receiving more information please contact Luis Carrillo – luis@amphibianark.org.

Learning from each other's successes and failures will allow symposium participants to gather new and unpublished information and project experiences that could be helpful to better design their reintroduction protocols; avoid unsuccessful practices or strategies; and connect with amphibian management experts and other program managers from different regions of the world.

Trade and efforts for the conservation of the Titicaca Water Frog

Arturo Muñoz, Patricia Mendoza, Gabriel Callapa, Jaime Salamanca and Dan Lay, Bolivian Amphibian Initiative; and Andrea Morales, Ivan Rodriguez, Luis Beltran, Daniela Morales and Diego Maldonado, Zoológico Municipal Vesty Pakos, La Paz, Bolivia

The Titicaca Water Frog (*Telmatobius culeus*) is a species listed as Critically Endangered in the IUCN Red List of Threatened Species, with pollution, introduced exotic fish species and human consumption being some of the factors which have caused its drastic decline in the last few decades. It is also recommended for an urgent captive conservation program in the Conservation Needs Assessments. Human consumption has been increasing during recent years, mainly in Peruvian towns, as frogs are collected and sold in markets for 'frog shakes', and thousands of frogs are caught monthly. The liquidized frogs are offered as an unproven cure for a number of different human health issues. It appears that this recent use of the species as a pseudo-medicine is increasing not only in numbers but also geographically. It is not the first time that the species has been used for human consumption: in the 1980s frogs were used mainly in restaurants for frog legs, where large numbers of frogs were collected at different locations in the lake to be sold in the main markets or directly in restaurants. Bolivian and Peruvian projects even tried to produce frog legs on a commercial scale from wild and captive frogs.

On the Bolivian side of the lake, selling the frogs has been increasing during recent years and the main markets are for frog shakes, restaurants, pets in national markets and from time to time local communities report Asian people travelling to different towns to buy large frogs. This trade has seen a number of frogs dying in markets or confiscated frogs that eventually die because of the poor conditions and lack of knowledge about how to take care of them.

To help improve husbandry skills, the Bolivian Amphibian Initiative has started a capacity-building program to train people and institutions working with confiscated Titicaca Water Frogs, and is collaborating with institutions to provide them with the skills to work with confiscated frogs. One of the activities was the coordination of the amphibian conservation and husbandry course carried out with the Zoológico Municipal Vesty Pakos in La Paz, the closest city to the lake. Together, we have been working to train staff and set up the first aquariums to hold confiscated frogs that would otherwise die. Now, after some months of this effort, the zoo holds a number of frogs that have recovered their body condition and are now being well-managed. Some individuals are being exhibited to zoo visitors in an effort to raise awareness about the situation facing this unique species. In this way, approximately 450,000 people who visit the zoo annually, can see this wonderful species in a different way. We can provide the visitors with an experience where they don't see only the trade problems of the frog, but all the other issues that are affecting the wild populations and the

Confiscated Titicaca Water Frogs (*Telmatobius culeus*) which are being collected for the food and pet trade, can now be taken care of at institutions such as Zoológico Municipal Vesty Pakos in La Paz. Photo: Zoologico Municipal Vesty Pakos.

different efforts that together, we are trying to achieve.

As we continue to build on the success of our projects, we would love to hear from other international organizations who might be interested in helping us - please feel free to contact us. More information is available on Bolivian Amphibian Initiative web site, www.bolivianamphibian.org.

After some months of training staff and setting up aquariums to hold confiscated Titicaca Water Frogs, Zoológico Municipal Vesty Pakos holds a number of frogs that have recovered their body condition. Photo: Fabricio Claure.

Participants at the amphibian conservation and husbandry course, learning how to build aquariums.
Photo: Arturo Muñoz, Bolivian Amphibian Initiative.

Participants at a recent amphibian conservation and husbandry course at Zoológico Municipal Vesty Pakos, learning how to drill aquarium glass. Photo: Gabriel Callapa, Bolivian Amphibian Initiative.

Update on the status of the Frosted Flatwoods Salamander

Victoria Gould, Communications Intern and Mark Mandica, Executive Director, Amphibian Foundation, USA

The Amphibian Foundation's logo says a lot about its priority project. The graphic is a stylized depiction of a larval Frosted Flatwoods Salamander (*Ambystoma cingulatum*), and currently, we hold the only captive colony of this species in the world - although we are hoping to change that in the not too distant future.

Since 2000, the wild populations of Flatwoods Salamanders have declined by 90% and are at imminent risk of extinction. There are only three known populations to exist: Two in Florida, USA (Apalachicola National Forest and St. Marks National Wildlife Refuge) and one in Eastern Georgia, USA on the Fort Stewart Army Base. The Florida and Georgia populations are genetically distinct from each other and are referred to by the recovery team as the 'Atlantic' and 'Gulf Coast' clades.

Frosted Flatwoods Salamanders require open Longleaf Pine/ Wiregrass Savannas to thrive. In the Summer, lightning strikes would cause wildfires to naturally manage the open habitat which these amphibians use to live and breed. At present, 97% of Frosted Flatwoods Salamander habitats are gone and while these amphibians can withstand natural fire cycles, they cannot withstand habitat loss. Without these natural fire cycles, dense clusters of trees shade out the wetlands so the necessary grasses of the habitat can't grow. The trees drink up the water, which shorten the hydroperiod. This increases the chance the ponds will dry before the Flatwoods Salamanders can complete metamorphosis.

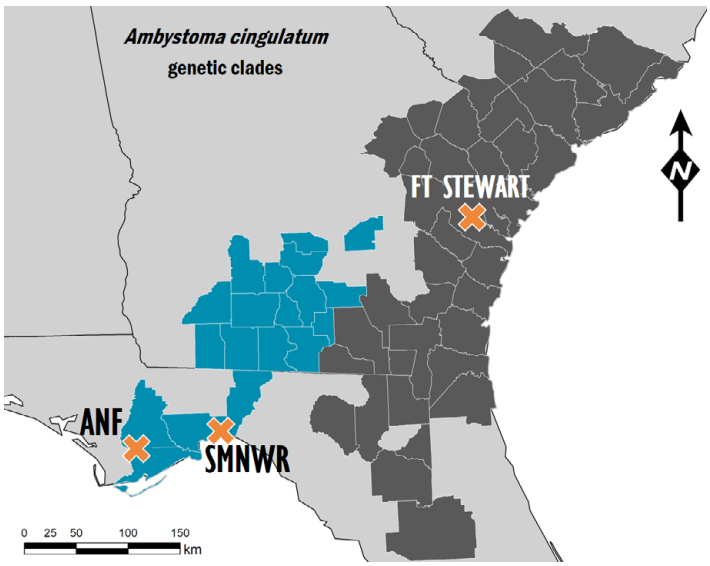
Roy King, a biologist on the Fort Stewart base, has been working on mimicking the summer burns in these habitats. Over the last several years, Roy and his team have been able to clear a lot of trees and open up the habitat for necessary vegetation to grow. On our first trip this year to survey these amphibians, the pond was full of seasonal rains. By the time we surveyed fifty percent of the pond we had detected twenty-one Frosted Flatwoods Salamander larvae! During our second trip, we brought some of our students from the Biology of Amphibians class at Agnes Scott College in Georgia, along with staff from Fort Stewart and U.S Fish and Wildlife Service. Twenty additional Frosted Flatwoods Salamander larvae had been detected. Forty salamanders were brought back to the Amphibian Foundation in Atlanta to rear them in a miniature Longleaf Pine ecosystem, where they will hopefully produce healthy offspring to release back into protected habitat. For perspective, since 2012 when staff from the Amphibian Foundation first started conducting field surveys on Fort Stewart, only six Frosted Flatwoods Salamanders had been collected for the captive propagation program, so in one year we have greatly increased our chances of success with this clade of "Frostys".

Three larval Frosted Flatwoods Salamanders (*Ambystoma cingulatum*) detected in 2019 at Fort Stewart Army Base, Liberty County, Georgia USA. The wetland within which these animals were found might represent that last known breeding site in the entire Atlantic clade for the species. Photo: Amphibian Foundation

While the vast majority of the captive propagation colony of Frosted Flatwoods Salamanders are housed at the Amphibian Foundation in outdoor tri-phasic mesocosms (experimentally controllable breeding habitats with upland, wetland, and ecotone), we are developing a method to rear and potentially breed these Atlantic clade Georgia animals in a manner that will allow for more rigorous monitoring of the health of the captive populations.

Currently, we are building an indoor rain chamber/mesocosm for the Frosted Flatwoods Salamanders collected during these trips to Fort Stewart. This will be an indoor rearing and breeding enclosure mimicking the natural habitat of the Coastal Plain. The climatic parameters will be fully controllable to allow healthy growth and optimal breeding conditions for the Frosted Flatwoods Salamanders. The rain chamber/mesocosm contains vegetation from the Coastal Plain known to be selected by salamanders for nesting sites. Native plants were collected in Georgia by staff from the Amphibian Foundation and US Fish and Wildlife Service, and in Florida by the Florida Fish and Wildlife Conservation Commission. Hopefully, these young salamanders will have everything they need to grow into healthy adults and produce offspring. Any potential offspring would be candidates for release back into the wild and for building redundant captive propagation colonies at other institutions throughout the south-eastern US.

All of this was made possible by our partners at the Amphibian and Reptile Conservancy who funded the 2019 trips to Fort Stewart. Our partners at Zilla and the Joyce Tillman Trust were a huge help in donating the indoor system which will house and care for this critically imperilled species, and our partners who provided vital assistance in the field such as Georgia Department of Natural Resources, US Fish and Wildlife Service, United States Geological Survey, Florida Fish and Wildlife Conservation Commission and the Orianne Society.



Clade map of the Frosted Flatwoods Salamander. The grey area represents the Atlantic clade, and the blue area denotes the Gulf Coast clade. The orange "x's" represent known breeding sites. This map shows Fort Stewart as the last known breeding site for the entire Atlantic clade.
Figure: Katie O'Donnell, United States Geological Survey.

1st International Symposium on Amphibian Conservation, Cuenca, Ecuador

Luis Carrillo, Training Coordinator, Amphibian Ark

Between April 30 and May 2, the First International Symposium on Amphibian Conservation was held in Cuenca, Ecuador. It was organized by the Ministry of the Environment of Ecuador, the Ikiam Regional University, the Amaru Biopark and Etapa EP.

The symposium brought together experts from Ecuador and other countries such as Argentina, Mexico, the United States and Puerto Rico, who shared their knowledge and experiences on issues such as field monitoring, *ex situ* conservation, *ex situ* reproduction, habitat management, biosecurity in *ex situ* amphibian husbandry, environmental education, community participation and reintroduction among others. Two hundred participants, representing more than thirty institutions attended the symposium.

The Amphibian Ark participated during the symposium, delivering a presentation called *Biosecurity and quarantine issues in the management of* ex situ *conservation programs of threatened amphibians*.

We also had the opportunity to visit the Amphibian Conservation Center (CCA) at the Biopark Amaru. Here, biologists and veterinarians work in the conservation of threatened endemic species such as *Atelopus nanay*, Azuay Stubfoot Toad (*Atelopus bomolochos*), *Gastrotheca cuencana*, *Atelopus exiguus*, the Rio Pescado Stubfoot Toad (*Atelopus balios*), Boulenger's Rocket Frog (*Hyloxalus vertebralis*) and others, in three dedicated facilities. During the visit, suggestions were made on management and medical care to improve the maintenance of these species in the CCA.

Apart from conserving and exhibiting amphibians, the CCA also dedicates space to raising awareness among its visitors about the importance of amphibians and the protection of their ecosystems.

It should be noted that a recent donation made through the Amphibian Ark is currently being used to remodel and improve the *Atelopus* management area and to buy a reverse osmosis filter to improve the water quality used within the amphibian facilities.

Our profitable visit also included a walk through El Paraíso Park, where the Yanuncay and Tomebamba rivers run, and where the Municipality of Cuenca, along with six other sites, has built an artificial habitat to encourage reproduction, and therefore the repopulation of native species of the Azuay region. In these artificial ponds people of the city of Cuenca and elsewhere can observe and appreciate the native amphibian fauna.

The Amphibian Conservation Center dedicates space to raising awareness among its visitors about the importance of amphibians and the protection of their ecosystems. Photos: Luis Carrillo.

A section of El Paraíso Park, where artificial habitats have been built to encourage reproduction, and therefore the repopulation of native species of the Azuay region.
Photo: Luis Carrillo.

Participants at the First International Symposium on Amphibian Conservation in Ecuador visited the Amphibian Conservation Center at the Biopark Amaru. Photo: Luis Carrillo.

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