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Amphibian Conservation Needs Assessments for Madagascar

Kevin Johnson, Taxon Officer, Amphibian Ark

Amphibian Ark staff help coordinate *ex situ* (captive) amphibian conservation programs implemented by partners around the world and we assist AArk partners in identifying priority species for *in situ* (in nature) and *ex situ* conservation work. An initial part of this process involves evaluating species, to help conservation managers maximize the impact of their limited conservation resources, by identifying which amphibian species are most in need of particular types of conservation action. These Conservation Needs Assessments are usually undertaken by a similar team of experts to that which led the original 2004 Global Amphibian Assessment, and who also undertake IUCN Red List assessments (www.redlist.org). The Conservation Needs Assessments however have a goal of updating the information and separating out and assessing all taxa to determine the best conservation actions to help ensure their ultimate survival in the wild. The assessments result in a series of reports for nine different conservation actions. Species are listed according to their priority for the particular conservation action, and the supporting documentation provided by the experts gives a guide for those species which have the most chance of benefiting from the prescribed conservation action(s).

Since 2007, AArk staff and our partners have facilitated Conservation Needs Assessments for over 2,600 (31%) of the 7,530 currently-known amphibian species through twenty-six national or regional workshops. In early 2015, the assessment process was migrated to an online format (www.ConservationNeeds.org), allowing for more inclusive access for assessors, with concurrent national assessments being made at the same time. This new online program has considerable cost savings, as funding for each assessment workshop varies between \$10,000-\$30,000.

In early 2015, as the development of the online program was nearing completion, we contacted several people who were working with frogs in Madagascar, and asked if they would be willing to complete some assessments, and to provide feedback on the new online program before it was formally launched. Initially, four assessors used the program, and provided some great feedback, most of which was incorporated into the final design of the program. Over the next twelve months, an additional twelve assessors contributed their expertise, with a total of 282 assessments being completed. These assessments resulted in 564 recommended conservation actions (more than one conservation action can be recommended for each species):

- **Rescue** (20 species) - A species that is in imminent danger of extinction (locally or globally) and requires *ex situ* management, as part of an integrated program, to ensure its survival.
- **In Situ Conservation** (166 species) - A species for which mitigation of threats in the wild may still bring about its' successful conservation.
- **In Situ Research** (202 species) - A species that for one or more reasons requires further *in situ* research to be carried out as part of the conservation action for the species. One or more critical pieces of information is not known at this time.
- **Ex Situ Research** (78 species) - A species currently undergoing, or proposed for specific applied research that directly contributes to the conservation of that species, or a related species, in the wild (this includes clearly defined 'model' or 'surrogate' species).
- **Mass production in captivity** (4 species) - A species threatened through wild collection (e.g. as a food resource), which could be or is currently being bred in captivity – normally in-country, *ex situ* - to replace a demand for specimens collected from the wild. This category generally excludes the captive-breeding of pet and hobbyist species, except in exceptional circumstances where coordinated, managed breeding programs can demonstrably reduce wild collection of a threatened species.
- **Conservation Education** (62 species) - A species that is specifically selected for management – primarily in zoos and aquariums - to inspire and increase knowledge in visitors, in order to promote positive behavioral change. For example, when a species is used to raise financial or other support for field conservation projects (this would include clearly defined 'flagship' or 'ambassador' species).
- **Biobanking** (20 species) - A species for which the long-term storage of sperm or cells to perpetuate their genetic variation is urgently recommended, due to the serious threat of extinction of the species.
- **No Conservation Action** (12 species) - Species that do not require any conservation action at this point in time. This list may also contain species that were not evaluated during the workshop due to a lack of data being available.



The Red Rain Frog (*Scaphiophryne gottlebei*) has been widely collected for the international pet trade - over-collection could be a significant threat to this species. Creation of insurance colonies may be a strategy to help preserving wild populations, although there is still a lack of knowledge on how to breed the species, with successful breeding only being achieved through the use of hormones.
Photo: Devin Edmonds.



Boettger's Grainy Frog (*Gephyromantis horridus*) is a rare species from Madagascar, which is difficult to find because of its secretive life style. It is severely threatened by habitat loss and has been recommended as a high priority species for *ex situ* rescue, *in situ* research, conservation education and biobanking.
Photo: Devin Edmonds.



There are twenty-seven amphibian species in Madagascar which have not yet been assessed.

The recommendations arising from these assessments will help to guide future amphibian conservation in Madagascar, as part of the *Conservation Strategy for the Amphibians of Madagascar* (ACSAM, www.sahonagasy.org/acsam). The ACSAM initiative was produced as a result of a workshop which was held in Antananarivo, Madagascar in September 2006 to discuss and decide priorities for amphibian conservation in Madagascar. The plan was subsequently updated during a second meeting of over sixty experts from Madagascar and around the world in Ranomafana, Madagascar in November 2014, resulting in *The New Sahonagasy Action Plan 2016 - 2020* (www.amphibians.org/news/nsap2016-2020/).

The benefits of the Conservation Needs Assessment process are clear – we assemble the leading amphibian field experts in each region, to collectively determine the best course of conservation actions to help prevent the extinctions of threatened amphibian species in the wild. These actions include habitat restoration and preservation, threat mitigation, captive breeding for release and community awareness and involvement. Without immediate captive management as a stopgap component of an integrated conservation effort, hundreds of species could become extinct. Because *ex situ* resources are limited, the Amphibian Ark and our partners must try to identify which species require *ex situ* management most urgently.



Mantidactylus pauliani is only known to occur in a single area, which is probably less than 10 km², and its forest habitat is severely declining. This is probably the most threatened frog species in Madagascar, and it has been recommended as a high priority for *ex situ* rescue, *in situ* conservation, further *in situ* research and biobanking.
Photo: Devin Edmonds.

2017 Amphibian Ark Seed Grant announcement and guidelines

Amphibian Ark is pleased to announce the 9th annual call for proposals for its Seed Grant program!

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

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

We would like to acknowledge the generous support of the Andrew Sabin Family Foundation, Naples Zoo, Josie Lowman, Ronna Erickson, Woodland Park Zoo (www.zoo.org), the European Association of Zoos and Aquariums (www.eaza.net), and the other AArk supporters (www.amphibianark.org/our-funders/) who helped establish this grant. Inquiries can be directed to Kevin Johnson, Taxon Officer KevinJ@amphibianark.org.

Important dates:

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

This grant is NOT intended to fund workshops, educational exhibits, project overhead or indirect costs.

Please read the Seed Grant page on the AArk web site, www.amphibianark.org/aark-seed-grant/ and download the application guidelines, www.amphibianark.org/pdf/AArk-Seed-Grant-2017.pdf - **all applications must follow these guidelines**.

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



The Biology, Management and Conservation of North American Salamanders - A training course

Location: The course will be held at Zoo Atlanta, Georgia, USA.

Dates: September 18th – 22nd, 2017

Amphibian Ark and Zoo Atlanta are pleased to announce the second Biology, Management and Conservation of North American Salamanders training course.

The planned course will consist of five days of intensive training, including lectures, hands-on practical exercises, and fieldwork. Topics covered during the course will include: salamander biology, conservation and management; enclosure design and construction; captive breeding techniques; biosecurity and disease control; monitoring and surveys of wild and captive populations; education and scientific engagement. Globally recognized amphibian biologists, veterinarians, and conservationists will comprise course's faculty, and the course is limited to twenty students.

Registration and payment for this course can be made via the AArk web site, www.amphibianark.org/salamander-husbandry-course/. For further information please contact Luis Carrillo, Training Officer, luis@amphibianark.org.

Yellow-eyed Ensatine, (*Ensatina eschscholtzii platensis*). Photo: Robert Hansen.



Red-backed Salamander (*Plethodon cinereus*).
Photo: Daniel Hocking.



The greatest success for the Large Crested Toad conservation program

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

The Large Crested Toad (*Incilius cristatus*) is a Critically Endangered amphibian, endemic to Mexico and restricted to some patches of cloud forest in the southern highlands of the Sierra Madre Oriental. Since December 2012, when we achieved the first breeding event for the species in captivity at Africam Safari, Mexico, we have been working very hard. We have focused a lot of effort in engaging the local community in the conservation of the species and its habitat, which is also the most endangered terrestrial ecosystem in Mexico.

Over the last four years we have achieved seven breeding events with the Large Crested Toad in our facilities. Two years ago we raised the first clutch from the first group of toads hatched in our facilities and last year we collected a new group of tadpoles from the wild, which are now being reared to become the new founders of our captive colony and enrich the gene pool. We have also released more than 800 captive-bred toads, mostly as toadlets, on four different occasions. The releases have always been with the participation of the local community, who are committed to preserve the toads and their forest.

However after all that work, there were two big questions that we needed to answer in order to be able to evaluate the success of our efforts: 1) are the captive-bred toads able to survive after being released in the wild and 2) are the released toads able to breed in the wild. The first question might be very obvious but the second one needs additional information to be understood, so I

am going to explain why we were asking that question.

Xocoyolo, where our toads come from is a huge rift about 400 m deep, covered with dense forest and with a fast-flowing river at the bottom. As adults, the toads are spread in the forest, we have found them at different elevations in the rift including at the top. This species is not social, and they spend the entire year hiding in the forest, except for the breeding season. For a few days, not more than a week, all the adult toads come to a small area on the riverside where the rocks stop the current and form shallow ponds, which are ideal for the toads' eggs and tadpole development. What exactly motivates the toads to come to the river to breed and how they find the exact same spot each year is a mystery, at least to us. This is why we wondered if our toads, hatched in captivity, were able to find the right time and place to breed.

The answer to the first question came very quickly. Three months after we released the first group of toads we visited Xocoyolo to look for them and to see if they had survived. The weather was really bad on that trip and we only found eight toads, and only one of those had been marked. One out of eight was not a bad number, and the best news was that he had increased his weight 28 times, from 0.5 g when released, to 14 g when recaptured. This finding gave us the answer to our first question. Our toads were able to survive after being released, and they were able to adapt really well!



Xocoyolo Rift, the habitat of the Large Crested Toad (*Incilius cristatus*) is a huge rift about 400 m deep, covered with a dense forest with a fast flowing river at the bottom. Photo: José Alfredo Hernández Díaz.



The first Large Crested Toad that we recaptured, in October 2013. This frog had increased his weight 28 times, from 0.5 g when released, to 14 g when recaptured.
Photo: José Alfredo Hernández Díaz.

But it took us three more years to find the answer to the second question. It wasn't until last November when we were finally able to coincide with the toads' breeding season in the wild, after many attempts. We walked all the way down to the river before sunset and arrived there while there was still some daylight. After walking along the area where the toads usually lay eggs, we found some clutches as well as some evidence of toads predated by raccoons. We thought it was too late, that all the toads had already come to the river to lay their eggs, but we decided to wait until the evening. Once the light was gone, the male toads started coming out from under the rocks and females came from the forest. We were there for two nights, walking along the river side and catching all the toads we saw, looking for markings. We found a total of twenty-one toads, but it was not until the second night when we found a marked toad. It was the last individual we saw - an adult male with a clipped toe from the right hind limb, looking for a female. It was a very exciting moment because we have checked many toads without success, it was getting late and it was pouring with rain. But we finally made it! We had the answer to the second question, our released toads are able to find the right time and place to breed. Because of his size and marking, this toad belongs to the first group of 140 toads we released in 2013 which means that he has survived for more than three years in the rift.

Perhaps two individuals recaptured after three years might seem like a very low number. However the detectability of this species is very low, they are very cryptic and they live in a very difficult place to work in. That is why we are convinced that these great findings are good indicators of how successful captive-bred toads can be when released back to the wild. Also these findings give us the hope and the motivation we need to continue with our work. It has been challenging work but it has been worthwhile. There is still much to do, but the future looks promising for the Large Crested Toad.



The second toad that we recaptured in November 2016. We could clearly see the marking on the middle toe of the left back limb.
Photo: José Alfredo Hernández Díaz.



A pair of Large Crested Toads mating in the wild.
Photo: José Alfredo Hernández Díaz.

Guatemalan Amphibian Biology, Management and Conservation Training Course

Luis Carrillo, Training Officer, Amphibian Ark

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

Amphibian Ark and the Universidad del Valle de Guatemala (UVG) have joined forces to offer a training course at the School of Biology of UVG in November 2017.

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

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

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

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

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



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

Plectrohyla sagorum. Photo: Alejandra Zamora.



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



Mitsinjo's new education center and frog exhibit in Andasibe seeks funding opportunities

Justin Claude Rakotoarisoa, Director of Amphibian Conservation; Rainer Dolch, Coordinator of Mitsinjo's Scientific Activities; and Sebastian Wolf, Manager, Mantella Breeding Program, Association Mitsinjo, Madagascar

Association Mitsinjo, a local NGO in Andasibe, central eastern Madagascar, is involved in a range of different environmental, educational, and developmental activities, among others one mainstay of our nature work is conservation breeding of local, threatened frogs. Over 100 species occur within a few kilometer radius of Andasibe and we carry out ecological research on these in the surrounding habitats.

We also know that teaching environmental issues to the local residents is very important, and in fact some recently emerging threats such as the occurrence of chytrid fungus in this mega-diverse location, and the latent danger of the arrival of Asian toads, are issues that are poorly-known among local residents and environmentalists and most visitors who come to Mitsinjo. Delivery and availability of information is crucial in these times, more than ever before. We are bringing together all kinds of people to highlight these dangers and other issues, and the idea of a facility that should serve educational purposes was born some time ago. Work has already begun on our new education center and a live animal exhibit has been included, because our amphibian breeding center is biosecure and therefore cannot be visited by the public. In the near future, we plan to hold meetings with different local stakeholders to raise awareness about chytrid fungus and appropriate measures that can be taken to prevent its spread.

Construction on the new education facilities began in November 2014. The building contains three rooms: a large one for education courses where volunteers created a beautiful mural with a local nature theme, a frog exhibit and a small entrance room. After the basic foundations and necessary infrastructure was installed, construction of terraria began. At the moment the frog exhibit contains three



Work has begun on a new education center at Association Mitsinjo, a local NGO in Andasibe, Madagascar, and a live animal exhibit has been included. Photo: Sebastian Wolf.



mid-sized, natural looking terraria and two aquariums showing the development of tadpoles. A small terrarium was built into the outer wall so it can be viewed from outside the building.

Since May 2016, four species have been kept here. Three species were bred in our frog center: *Boophis pyrrhus*, the Golden Mantella (*Mantella aurantiaca*) and the Betsileo Madagascar Frog (*Mantidactylus betsileanus*), and we are also displaying some large Sambava Tomato Frogs (*Dyscophus guineti*) which were seized by local authorities. Although the tomato frogs do not inhabit the surrounding forests, the responsible authorities asked for Mitsinjo's help with these seized animals because there are very limited possibilities in Madagascar to accommodate illegally-traded animals and Mitsinjo has the trust of local stakeholders to be able to provide proper conditions for these beautiful frogs.

We are currently hoping to develop an ongoing partnership with a sponsoring institution to continue our work in the education centre. We are hoping to find \$1,500 for the first year and \$1,200 each year after that to cover all ongoing costs and expenses, including:

- a staff of four people (guard, receptionist, environmental teacher, and amphibian keeper)
- operating expenses
- completion of construction, then ongoing maintenance and repairs
- purchase of furniture
- education materials (e.g. posters for promotion, flyers for distribution of information).

If you would like any further information, or to offer your support, please contact either Justin Claude Rakotoarisoa (Director of Amphibian Conservation): babakotokely@gmail.com, Rainer Dolch (Coordinator of Mitsinjo's Scientific Activities): rdolch@gmx.de or Sebastian Wolf (Manager, Mantella Breeding Program): sebamwolf@gmail.com.

Association Mitsinjo in central eastern Madagascar is involved in a range of different environmental, educational, and developmental activities, and the new education centre will help with teaching environmental issues to local residents and visitors. Photo: Sebastian Wolf.



A number of frog species have been kept at Association Mitsinjo, including the Critically Endangered Golden Mantella (*Mantella aurantiaca*). Photo: Devin Edmonds.

New planning document templates available

Kevin Johnson, Taxon Officer, Amphibian Ark

Amphibian Ark staff have developed two new documents to assist with amphibian conservation planning efforts. The first is a species-level action plan which documents all aspects of planning and carrying out activities to save a threatened amphibian species. The second is a template for developing a national amphibian action plan, to give an overview of planned conservation actions for all threatened species in a particular country. Both documents are available in English and in Spanish.

The **Species Action Plan** template (www.amphibianark.org/pdf/Species-Action-Plan-template-EN.docx) has been developed as a guide to assist authors who are writing an action plan for a single amphibian species. It includes a range of suggested sections and sub-sections, along with a brief definition of what should be included in each section. Each country will likely have different needs, and may decide to exclude some of these sections and/or add additional sections. This template is quite comprehensive, and possibly includes more information than is necessary for a basic plan. The first version of a species action plan does not need to be as detailed - additional information can be added as the plan develops.

It is important to have representation from all of the relevant stakeholder groups who have an interest in the species being managed, and this can be achieved by the formation of a Taxon Management Group. Forming a management group will ensure that all stakeholders' needs are met, that expertise is available on all aspects of managing the program, and that the management processes are transparent. Typical membership of a Taxon Management Group should include representatives from each of the institutions that will house the animals (zoos, aquariums, museums, private holders etc.), amphibian husbandry experts, veterinarians, educators, researchers, population biologists, State or National wildlife agency representatives, private landowners and local people. Ideally, the group members would meet, at least during the establishment of the program, to discuss the overall aims of the program, to document any specific needs for the program or the species, and perhaps to draft a Taxon Management Plan.

There are a number of IUCN Species Survival Commission protocols and guidelines available which will be very useful during the development of a species action plan: *Strategic Planning for Species Conservation: A Handbook* (<https://portals.iucn.org/library/sites/library/files/documents/2008-047.pdf>); *Guidelines on the Use of Ex Situ Management for Species Conservation* (<https://portals.iucn.org/library/sites/library/files/documents/2014-064.pdf>); and *Guidelines for Reintroductions and Other Conservation Translocations* (<https://portals.iucn.org/library/sites/library/files/documents/2013-009.pdf>).

A number of species action plans can be found on the Amphibian Ark web site (www.amphibianark.org/species-action-plans/).

The **National Amphibian Action Plan** template (www.amphibianark.org/pdf/National-Action-Plan-template-EN.docx) has been developed as a guide to assist authors who are writing a national amphibian action plan. It suggested sections and sub-sections, with a definition of what should be included in each section. Each country will likely have different needs, and may decide to exclude some of these sections and/or add additional sections. This is a very comprehensive template, and like the Species Action Plan, probably includes more information than is necessary for a basic plan. The first version of a national action plan does not need to be as detailed - additional information can be added as the plan develops.

Representatives from all of the relevant stakeholder groups who have an interest in the species being managed should contribute to the plan, and this can be achieved by the formation of a planning group, to ensure that all stakeholders' needs are met, that expertise is available on all aspects of managing the plan, and that the management processes are transparent. Typical membership of a planning group is described above.

Some example national amphibian action plans (in English and Spanish) are available as further guides on the Amphibian Ark web site, www.amphibianark.org/national-action-plans/.

An update from the Association of Zoos & Aquariums

Shelly Grow, Director of Conservation Programs, Association of Zoos & Aquariums, USA

AZA is a Partner in Amphibian and Reptile Conservation

AZA (Association of Zoos & Aquariums) is a member of Partners in Amphibian and Reptile Conservation (PARC), a group whose mission is "forging proactive partnerships to conserve amphibians, reptiles, and the places they live." PARC has released its 2016 Annual Report (www.parcplace.org/parcplace/images/stories/documents/2016-PARC-Annual-Report.pdf), highlighting how partners, including the AZA community, are putting into practice PARC's Core Values. PARC's Core Values include inclusivity and collaboration; proactive, responsive, and adaptive approaches; scientific integrity; biodiversity; and optimism.

PARC is a network of representatives of government, industry, nongovernmental organizations (NGOs), zoos and aquariums, private consultants, private citizens, and academia and extends from western Canada throughout the continental US and into the Caribbean. In 2016, Shelly Grow, Director of Conservation Programs for AZA, replaced Steve Olson, AZA's VP of Federal Relations, as the zoo and aquarium member of the Joint National Steering Committee. Several AZA members are leaders and active at the regional level. Learn more about PARC at www.parcplace.org.



Creating a functional housing and breeding setup for Panamanian Golden Frogs

Kayleigh Kisner, Jason Provow and Darcy Richardson, Kansas City Zoo, USA

In 2015, the Kansas City Zoo's newly formed Passion and Action for Wildlife (PAW) Conservation Program awarded funding to eight conservation grant proposals. Four of the eight projects were dedicated to amphibians: participation in the Amphibian Allies program; monitoring for chytrid fungus in local frogs and toads; assisting in the breeding and reintroduction of the Wyoming toad (*Bufo baxteri*) back into its native environment; and the rearing and research of Titicaca Water Frogs (*Telmatobius culeus*) in Bolivia. This year, a small group of zoo keepers saw an opportunity to expand on the Zoo's commitment to amphibian conservation, and that opportunity lies in a closet.

In the lower level of the Zoo's kid-friendly Discovery Barn, nestled within a busy play area, is a small 7' x 7.5' closet. Dusty and half-filled with supplies, this limited space did not seem to hold many possibilities outside of a storage area. But for amphibians, limited spaces can hold a world of potential. Entire populations of endangered frogs and toads can live and breed in less space than is required to care for just a single member of a Zoo's more alluring megafauna. And with the current amphibian extinction crisis sweeping the planet, arguably no other group of animals stands more to gain from zoo conservation than amphibians. With this knowledge, our dusty closet had a vision of becoming more.

A small team of keepers at the Kansas City Zoo, USA, has been gaining skills breeding other species of amphibians in preparation for attempting to breed Panamanian Golden Frogs (*Atelopus zeteki*) later this year. Photo courtesy of Kansas City Zoo.

It became the ideal location to set up a breeding program for our beautiful Panamanian Golden Frogs (*Atelopus zeteki*).

The Panamanian Golden Frog is the national animal of Panama and for good reason. They are a brilliant golden color, thought to bring good luck, and not only live in wet rain forests, but also in the dry cloud forests of the Cordilleran Mountains of Panama. They secrete toxins that are so potent and unique that scientists have defined the Panamanian Golden Frog as a distinct species. Unfortunately for the Panamanian Golden Frog, the species is now considered to be extinct in the wild. There have been many contributing factors to this frog's demise, including illegal pet trade and habitat destruction, but the spread of chytrid fungus is what ultimately destroyed the wild populations of the Panamanian Golden Frog.

The Kansas City Zoo has been housing male and female Panamanian Golden Frogs since 2014, and is now beginning a breeding program. A team of keepers received funding through the Kansas City Zoo Conservation Grant Committee to build a housing and breeding facility for the four pairs of frogs currently housed on grounds at the Zoo. With luck and preparation, the team is optimistic that the number of frogs will increase dramatically. And with each success, and realistically some failures, the team is confident that the increased knowledge and skill sets will grow to the level needed to breed and maintain the species.

The small team of keepers mostly specializes in the training and husbandry of domestic hoofstock, birds, and small mammals. But



seeing the need to develop the amphibian collection and husbandry in meaningful ways, the team has started preparing for breeding Panamanian Golden Frogs. Currently, the team is learning how to rear a few other species of amphibians in the collection, and with multiple successes. The team's Green and Black Poison Dart Frogs (*Dendrobates auratus*) have been breeding regularly, and enough tadpoles have been raised to froglets that at this point, the breeding and rearing has become routine. More recently, the team has been experimenting with water quality and setup for raising Amazon Milk Frog (*Trachycephalus resinifictrix*) tadpoles. The team is hopeful that the knowledge gained about the husbandry of these species will positively impact the breeding attempts with the Panamanian Golden Frogs.

The first goal of the new program is to have the tanks setup and operational with high water quality maintained for breeding by the end of September. The second goal is to be fully prepared for the targeted November-December breeding season. The team is looking forward to updating with news of Panamanian Golden Frog tadpoles by the end of the year!



The Kansas City Zoo has been housing male and female Panamanian Golden Frogs since 2014, and is now beginning a breeding program. Photo courtesy of Kansas City Zoo.



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The Amphibians of Puebla project needs a few more votes to win the grant, which will be used to manage programs for the Large Crested Toad (*Incilius cristatus*) and Taylor's Salamander (*Ambystoma taylori*) in Pueblo, Mexico.

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Denver Zoo supports the Lake Titicaca Frog in Peru

Tom Weaver, Assistant Curator—Reptiles and Fish, Denver Zoological Foundation, USA

Denver Zoo, in Colorado USA, along with international and local partners, is involved in ongoing research and outreach focused on the Lake Titicaca Frog (*Telmatobius culeus*). The *Telmatobius* Captive Breeding Program and Laboratory was established at the Universidad Peruana Cayetano Heredia (UPCH) in Lima, Peru, along with a breeding population at the Parque Zoológico Huachipa (Huachipa Zoo) in Lima. These laboratories will help biologists learn more about the frogs' husbandry requirements and potentially build a future assurance population for this Critically Endangered species.

Last year Denver Zoo was successful in their collaborative effort to bring together various local Peruvian partners to conserve the Lake Titicaca Frog and expand their efforts to include the Junin Frog (*Telmatobius macrostomus*) and the Amable Maria Frog (*Telmatobius brachdactylus*); Critically Endangered species that are found in and around Lake Chinchaycocha, in Junin Province, about 150 miles north-east of Lima. Continued collaborations included working with the Puno Reserve Team and Junin Reserve Team in Peru and the Museo de Historia Natural Alcide d'Orbigny team in Bolivia.

In November 2013, Denver Zoo and the IUCN's Conservation Breeding Specialist Group (CBSG) supported a conservation strategy planning workshop for all parties interested in working to conserve this species. The three-day workshop, facilitated by the CBSG, reviewed current knowledge of the species and had participants working in small groups and larger plenary sessions to draft a conservation action plan with specific recommendations for actions focused on recovering the species. Outcomes of the conservation strategy planning workshop were: Junin National Reserve staff was trained in techniques of capture and restraint of frogs, biometrics, sampling and necropsy. The Bolivian team provided valuable expertise on frog research, and progress was made in agreements with the regional government of Puno (the state where Lake Titicaca is located, in south-eastern Peru), that resulted in the signing of a memorandum of understanding to work together on issues such as tourism, environmental education and research in areas outside the Titicaca National Reserve.

In addition to the development of new partnerships and capacity building, Huachipa Zoo successfully sent twenty second-generation captive-bred Lake Titicaca Frogs to Denver Zoo. This frog population and exhibit is very important to Denver Zoo for increasing awareness to Zoo visitors, and in demonstrating the Zoo's commitment to amphibian conservation. As of February 2017, Denver Zoo successfully reproduced third generation captive-bred frogs and staff are currently raising the tadpoles. This is potentially the first captive-breeding of the species outside of Peru and Bolivia.

The biggest event that occurred in October last year was the die-off of more than 10,000 frogs in a 30-mile stretch near the end of the Coata River, a tributary leading into Lake Titicaca. There were also die-offs of birds, fish and livestock. The main cause of the deaths is unknown, however multiple sources are suspected, such as human waste, livestock waste and contamination from mining. The zone was undergoing a scraping operation that appears to have exposed the area and released contaminants. During this time of year this zone receives lots of rain and it is believed that high runoff contributed to the exposure to the contaminated area. There was no explanation for this event nor was anyone held responsible for their actions. It was an unfortunate event that occurred prior to our conservation strategy planning workshop in November.

The recent frog mortalities opened up a much broader discussion at the workshop on what is the current and future state of the lake. Illegal harvesting of the frog for consumption is still a major concern but now we have come to the realization that protection of the lake should be the main focus to help preserve the frog. This creates a situation where we need to focus on the Peruvian Government and be prepared to collect data from these die-off events to present to the correct officials. We feel that Denver Zoo's role should focus on supporting the Lake Titicaca National Reserve (RNT) that includes our frog team and potentially supporting the team from El Servicio Nacional de Áreas Naturales Protegidas por el Estado (The National Service of Natural Areas Protected by the State) with equipment to collect water quality data and be able to respond to future die-offs with a rapid response protocol. The RNT team has really improved on their ability to dive in the lake and conduct their surveys. In 2016 they became certified PADI divers and showed great progress in their ability to do the surveys. This was observed during our trip in November. The efficiency in their methods and safety was impressive. Moving into 2017 we would like to be prepared to support these teams with the ability to collect good samples from these contaminations and die-offs, assuming that these occurrences continue in Peru and Bolivia.

After our visit in November we received news that the Peruvian President, Pedro Pablo Kuczynski, announced that ten waste-water treatment plants will be built to decontaminate Lake Titicaca, located at about 3,800 m above sea level and sharing its country with Bolivia. The Peruvian president visited the Southern Andean city of Puno, located on the shores of Lake Titicaca and in a statement said, "We are going to do this cleaning project of the lake with ten treatment plants in the mouths of the rivers that flow here, and in the drainage, so that the most beautiful lake in the world is the cleanest lake in the world".

Denver Zoo understands that the well-being of wildlife goes hand in hand with the well-being of people. Community engagement, education and capacity-building are key components in the pursuit to save Lake Titicaca Frogs. While in Puno, Denver Zoo staff members made several radio and



In February 2017, Denver Zoo successfully reproduced third generation captive-bred Titicaca Water Frogs (*Telmatobius culeus*) and are currently raising the tadpoles. Photo: James Garcia.



Denver Zoo, in Colorado USA, along with international and local partners, is involved in ongoing research and outreach focused on the Lake Titicaca Frog (*Telmatobius culeus*). Photo: Tom Weaver.

television appearances to talk about the plight of the species. During these appearances Zoo staff, along with various Peruvian partners, conveyed Denver Zoo's commitment to help save the frog. One important message the team shared through media appearances is the success of the Lake Titicaca project's result in influencing the Regional Government of Puno to issue an ordinance declaring the Lake Titicaca Frog a species of interest to tourism and economic development.

Working under the accordance with the Regional Government of Puno's decree, Denver Zoo, in partnership with Huachipa Zoo, hosted the first annual Dia de La Rana (Day of the Frog) in Puno. More than 1,000 local community members and tourists in Puno took part in various frog-related educational activities, where they learned about the biology and ecology of the Lake Titicaca Frog, threats to the species and what people in Puno can do to protect the frogs. Denver Zoo is also supporting the printing of two children's books that tell the story of "Telma", a Lake Titicaca Frog, and her adventures. The first book tells the story of Telma's life cycle at the Huachipa Zoo. In the second book, Telma ventures from her zoo home to visit Lake Titicaca, where she discovers what is happening to her cousins in the wild, and the conserva-

tion efforts that Denver Zoo and others are doing to save Lake Titicaca Frogs. More than 300 books were distributed to children that attended Frog Day in Puno. The children's books caught the attention of Puno's Department of Education, and Huachipa Zoo signed an agreement with the Department of Education of Puno to provide more than 200 elementary school libraries with copies of the Telma series of children's books. A third book is now being produced, which will tell the story of her visit to Lake Titicaca and the habitat of her wild cousins.

Lastly, Denver Zoo worked closely with a group of local Peruvian women to form a Ccori Amapar; a women's collective that makes a variety of frog-related handicrafts that they sell to community members and tourists. The collective currently includes more than thirty women who create hand-knitted crafts which provide an alternative source of income to harvesting the Lake Titicaca Frog. In partnership with Denver Zoo's concessionaire, SSA, the women's handicrafts are now available for purchase within Denver Zoo's Kibongi Market gift shop. This partnership has led to a successful opportunity to build the collective's capacity while spreading awareness about the importance of conserving the Lake Titicaca Frog.

Relating natural climate and phenology to captive husbandry in two midwife toads from different climatic zones

Christopher J. Michaels, Luke Harding, Zoe Bryant, Joseph-Smilely Capon-Doyle, Iri Gill and Benjamin Tapley, Zoological Society of London, UK; and Michael Fahrbach, Criesbach, Germany

With over 500 amphibian species thought to require urgent *ex situ* intervention, it is important that husbandry practices are optimised. Unfortunately, many amphibian species have not been maintained in captivity before and initial attempts may be partly or wholly unsuccessful. Amphibians, like all organisms, exhibit adaptations in physiology, ecology, behaviour and phenology to their natural habitat. Moreover, amphibians are typically highly sensitive to their immediate environment and often have highly specific requirements for survival and reproduction. Therefore it has been suggested that, from observations of the wild habitat, inferences can be made about the captive husbandry needs of amphibians. This concept has been further extended to suggest that in the absence of field data on a focal species, observations of a closely-related, or 'analog', species may be used as a proxy. Caveats concerning the selection of analog species are frequently overlooked, however, and the importance of understanding similarities and differences between focal and candidate analog species may be forgotten. Despite frequent practical application, there have been few investigations that explore the linked concepts of field data informed captive husbandry and analog species in practice.

In a paper published in the journal *Alytes*, we present observations from two species of midwife toads, the Common Midwife Toad (*Alytes obstetricans*) and the Iberian Midwife Toad (*Alytes cisternasii*), relating wild micro- and macro-climate observations to the development of successful captive husbandry practice in these two closely-related, but ecologically disparate, species. We also use them to illustrate the dangers of using poorly-considered analog species.

The temperature of two refugia used by the Common Midwife Toad during the reproductive season was measured from May-July in garden habitat in south-west Germany. The presence of toads was noted and temperatures were taken immediately adjacent to, or in the absence of toads on the positions where they had previously been discovered. Due largely to the fossorial and therefore inaccessible behaviour of Iberian Midwife Toad, field data from the micro-habitat of this species were not available. However, general climatic data for the Algarve region were used alongside observations of the natural history of the species to inform captive husbandry parameters.

Our captive colony of Common Midwife Toads originated from the French Pyrenees and our Iberian Midwife Toad colony originated from the Algarve, Portugal. All enclosures were held within climate-controlled facilities. The Common Midwife Toads were maintained in several different enclosure types throughout the year according to husbandry requirements. Throughout the autumn and spring, up to twelve toads were maintained in 45 cm x 45 cm x 45 cm vivaria following the European Association of Zoos and Aquaria's best practice guidelines for the species.

During the winter, toads were moved to small plastic boxes (38 cm x 25 cm x 15 cm) with a substrate dampened with water. Stacks tile were provided as shelter and a small shallow water dish was present. The Common Midwife Toad is found in regions where winter temperatures fall below freezing, but toads are not frost resistant and use hibernacula where they are protected from freezing. We held these boxes in a refrigerated unit between 0.5-3°C and they became entirely torpid at these temperatures. Toads were brumated (held in a hibernation-like state) over the winter period for 57-65 days. After the brumation period, temperatures were increased over 24 hours to 10-12°C and toads returned to autumn/spring enclosures. Half the males and half the females were housed as a group with a 60 W spot light, providing a thermal gradient from 31°C on the exposed surface of upper tiles, to 18-21°C in substrate under tiles and crevices. Temperatures between these two extremes were available. This replicated the temperatures measured in nature. Toads maintained without access to these lamps were held at the same ambient temperature of 18-21°C.

The Iberian Midwife Toad is a fossorial species native to a more Mediterranean climate with milder winters. In winter, this species



The captive colony of Common Midwife Toads (*Alytes obstetricans*) at ZSL London Zoo in the UK originated from the French Pyrenees. Photo: Courtesy of ZSL.

was therefore exposed to minimum temperatures of 10-12°C and in summer moved to enclosures identical to those used for Common Midwife Toads at this time of year, except with deeper substrate (10 cm). Water dishes were provided in summer enclosures for soaking and tadpole deposition. All toads were fed twice weekly on small insects. Prey items were gut-loaded and dusted with Nutrobal immediately before being offered to toads.

In the field, Common Midwife Toads were no longer present in focal refugia once temperatures climbed consistently above 40°C. At this point, the substrate beneath refugia had also become increasingly dry. Macro-climate data for the range of Iberian Midwife Toads shows a typical Mediterranean climate with hot, dry summers and mild, wet winters. In captivity, Iberian Midwife Toads reproduced following a drop in temperature at the end of summer and continued to reproduce throughout the autumn, winter and spring. Common Midwife Toads reproduced after an increase in temperature to values within the range measured in the field, and reproduced throughout the early summer. Common Midwife Toads of the same number and sex ratio maintained without the thermal gradient generated by the incandescent lamp did not breed. In both species, calling and first reproduction occurred within twenty-four hours of the temperature change.

Alytes species can be roughly split into two ecological groups: those whose reproductive period in nature is defined mainly by



hydroperiod and those with a reproductive period defined mainly by temperature.

Based on observations of reproduction in the field, Common Midwife Toads belong to the latter and Iberian Midwife Toads to the former.

Although our animals originated from a different part of the range from where field data were collected, these data are still informative as to the microclimate preferences of this wide-ranging species and proved useful in successful captive breeding. In the field, toads only abandoned the focal refugia when temperature climbed consistently above 40°C and the substrate became increasingly dry. We chose to use a thermal gradient reaching lower temperatures to avoid inadvertently reaching critical thermal maximum for animals that, in captivity, are more limited in their ability to behaviourally regulate their immediate external, and therefore internal, environment.

The Iberian Midwife Toad (*Alytes cisternasii*) is a fossorial species native to a more Mediterranean climate with milder winters. Photo: Courtesy of ZSL.

Neither Common Midwife Toads nor Iberian Midwife Toads are commonly maintained in captivity, but where they are, Common Midwife Toads rarely, if ever, breed in indoor enclosures in captivity, whereas Iberian Midwife Toads are frequently

reproduced in vivaria. Most breeders of Common Midwife Toads only report success in outdoor enclosures and greenhouses. Keepers usually maintain this species without thermal gradients indoors and it is likely that the use of lamps to generate such gradients is necessary for successful captive reproduction in this species. However, further investigation with more replicates and the inclusion of additional localities of Common Midwife Toads from across their range would be useful in determining this.

This comparison underscores the importance of caution when applying the analog species concept, that is, the use of a common relative of a rare species to develop captive husbandry protocols. Even closely-related congeners may have very different requirements to stimulate reproduction, but understanding the native climate and microhabitat selection can provide clues as to how to select appropriate analogs and to maintain amphibian species in captivity.

These observations highlight the importance of understanding wild biology and phenology and replicating wild seasonality to stimulate breeding in captive amphibians, and potentially in choosing appropriate analog species for the development of captive husbandry. In the case of Common Midwife Toads they also highlight the utility of even simple field data in informing captive husbandry.

The reference for the full article is: Michaels, C.J., Fahrbach, M., Harding, L., Bryant, Z., Capon-Doyle, J.S., Grant, S., Gill, I. and Tapley, B., Relating natural climate and phenology to captive husbandry in two midwife toads (*Alytes obstetricans* and *A. cisternasii*) from different climatic zones. *Alytes* 33, 2-11.

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