amphibian ark

In This Issue

Sent to you courtesy of:
The AArk Team

AArk Newsletter No. 11, June 2010

The Amphibian Ark team is pleased to send you the latest edition of our e-newsletter. We hope you enjoy reading it.

The Amphibian Ark

Amphibian Ark Seed Grant winners

Kevin Zippel, Amphibian Program Director, Amphibian Ark

Amphibian Ark is pleased to announce the winners of the 2010 Seed Grant program. These $5,000 competitive grants are designed to fund small start-up projects that are in need of seed money in order to build successful long-term programs that attract larger funding.

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We're looking for volunteer language translators!

Kevin Johnson, Webmaster, Amphibian Ark

If you have excellent translation skills from English to Spanish or German, and are able to spare a few hours to help amphibian conservation, we'd love to hear from you!

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Control of disease in living amphibian collections – a new manual

A new manual on the control of diseases in captive amphibian collections, with input provided by a global delegation of amphibian veterinarians, pathologists, biologists, and keepers.

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Amphibian Biology, Conservation and Management School graduates another class!

Ron Gagliardo, Training Officer, Amphibian Ark, and Andy Odum, Curator of Herpetology, Toledo Zoo

Since 2006, Amphibian Ark staff has partnered with AZA in conducting the week-long course Amphibian Biology, Conservation, and Management. This year, ten instructors offered up their time to share information on topics ranging from amphibian anatomy and evolution to husbandry, captive reproduction, and veterinary medicine.

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Amphibian husbandry comes to Indonesia

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New amphibian species accounts on the AArk web site

One of the new features on the new AArk web site will be a series of amphibian species accounts. We'll feature one of these species accounts in each AArk newsletter, starting with the spectacular Horned Marsupial Frog, *Gastrotheca cornuta*.

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News

Association Mitsinjo's captive breeding facility for Malagasy

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amphibians

Devin Edmonds, University of Wisconsin-Madison

Association Mitsinjo, a community-run organization founded by villagers in Andasibe, Madagascar, was the successful winner of the 2009 AArk seed grant, which is supporting the creation of a captive breeding facility for threatened Madagascar amphibians.

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Third successful attempt to culture amphibian cells

Andrea Johnson, Genetics Division, San Diego Zoo's Institute for Conservation Research

The Genetics Division at San Diego Zoo's Institute for Conservation Research recently celebrated its third successful attempt to culture amphibian cells from a tissue sample, when living fibroblasts from a White's Tree Frog were accessioned into the Frozen Zoo®.

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Betic Midwife Toad conservation project

David Garcia, Curator of Herpetology Department of Bioparc Fuengirola (Fundación Instituto del Trópico)

In 2007, following the suggestions of Amphibian Ark and ARTAG, Bioparc Fuengirola began a conservation project for the Betic Midwife Toad. This report outlines the program's progress to date.

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Tinker Frog program at Currumbin Sanctuary

Matt Hingley, Technical Advisor, Currumbin Wildlife Sanctuary

In an effort to help secure the future for the species, Currumbin Sanctuary in Queensland, Australia, obtained permits to collect breeding pairs of the Tinker Frog, which is on the verge of extinction.

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Frog 'love shack' to open at Bristol Zoo Gardens

Lucy Parkinson, PR Manager, Bristol Zoo Gardens

Bristol Zoo Gardens is due to open an amphibian breeding sanctuary within its grounds to breed two frog species on the verge of extinction. The facility will provide a safe home for some of the world's most endangered frog species - Lemur Leaf Frogs and Golden Mantella Frogs – which will be settled into their new home in the coming weeks.

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Frog MatchMaker - supporting our amphibian conservation partners

Kevin Johnson, Taxon Officer, Amphibian Ark

In this newsletter we feature three more amphibian projects from AArk's conservation project list, that are seeking support to carry out their amphibian conservation work.

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Florida women in herpetology unite to save the Coqui!

Jennifer Stabile, Amphibian Keeper, Central Florida Zoo

The Central Florida Zoo and Botanical Gardens is publishing a calendar to raise funds for conservation of the Coqui Frogs of Peurto Rico. You can support this project by helping to sponsor the calendar, or by purchasing a calendar.

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Establishing a new population of Georgia's rarest frog

Robert Hill, Amphibian Specialist, Atlanta Botanical Garden

The Atlanta Botanical Garden and the Maerz Herpetology Laboratory at the University of Georgia's Warnell Forestry School, are both involved in a head-starting program for Georgia's rarest, and most threatened anuran species, the Carolina Gopher Frog.

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An international consortium to conserve two beautiful newts from Iran

Robert Browne, Research Officer, Amphibian Ark

An international consortium based in Iran, Europe and the US is conducting a comprehensive program for the conservation of two of the most beautiful and endangered newts, the Yellow-spotted Newt (*Neurergus microspilotus*) and Kaiser's Newt (*N. kaiseri*).

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Amphibian Ark Seed Grant winners

Kevin Zippel, Amphibian Program Director, Amphibian Ark

Amphibian Ark is pleased to announce the winners of the 2010 Seed Grant program. These $5,000 competitive grants are designed to fund small start-up projects that are in need of seed money in order to build successful long-term programs that attract larger funding. We would like to acknowledge the generous support of the Wildlife Conservation Society, Chester Zoo, and the Sabin Conservation Fund in establishing these grants.

The successful projects are:

Maude Island Frog Habitat - Orana Wildlife Park, New Zealand ($3,562)

Orana Wildlife Park in Christchurch – New Zealand's only open range zoo, will develop a state-of-the-art habitat for the "Nationally Endangered" New Zealand Maud Island Frog (*Leiopelma pakeka*) in 2010. Housing these frogs will support the aims of the Department of Conservation Native Frog Recovery Plan through conservation advocacy, provision of an insurance population, research, refining husbandry techniques for the species and ultimately breeding for release to the wild.

Maude Island Frog, *Leioelma pakeka*.

The habitat will be a nocturnal display providing an insurance population of Maud Island Frogs, allow refinement of techniques to enable captive breeding of the species, and ultimately allow breed-for-release programs to supplement surviving colonies *in situ*. The refinement of these techniques is also essential to the Department of Conservation's aim of securing and breeding Hamilton's Frog (*Leiopelma hamiltonii*) in captivity and could potentially lead to breed-for-release of this species.

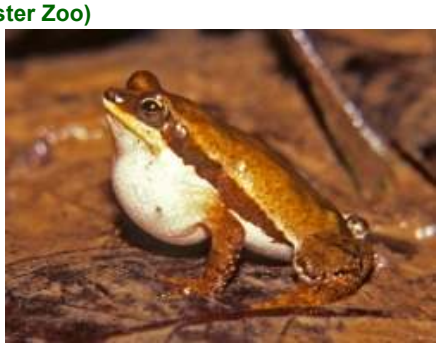
Extensive interpretation will support key messages that will outline the importance of habitat preservation, the need for controlling introduced predators and demonstrate the public's role in assisting conservation. Through holding the species, Orana will obtain more information about the management of Maud Island Frogs, helping to manage this and other species (particularly Hamilton's Frog) in captivity and in their natural habitats.

The Amphibian Ark funds are instrumental to enabling us to construct a facility that provides long term security of Maud Island Frog and potentially Hamilton's Frog.

The complete project proposal can be viewed here.

Conservation of the Cuban Long-nosed Toad ($5,000, funded by Chester Zoo)

The Cuban Long-nosed Toad (*Peltophryne longinasus*) is the first anuran species in which the chytrid fungus has been found in Cuba (Díaz et al., 2007). This species is currently evaluated as Endangered (EN), following the IUCN categories and criteria (Hedges and Díaz, 2004). The main threats are the historical loss of suitable habitats and the very limited range of distribution. No further information exists about the impact of chytrid fungus on this species and other frogs that co-exist in the same habitats.



Cuban Long-nosed Toad, *Bufo longinasus longinasus*.

Regarding the critical danger that chytrid fungus represents for amphibians, *ex situ* and *in situ* conservation efforts are strongly necessary to avoid species extinction. Preliminary experiences on the captive breeding of Peltophryne longinasus longinasus exist (Díaz and Cádiz, 2007), and may represent a good starting point for a long term captive program. This AArk Seed Grant application is intended to obtain support for the following purposes:

1. to develop a facility for *ex situ* conservation of *Peltophryne longinasus* in Cuba; and
2. to monitor wild populations of this species and co-occurring frogs, in order to assess the impact and spread of chytrid fungus, the habitat health and quality, and to gather basic information on the biology of species for long-term conservation.

This project is expected to develop first actions to protect Cuban amphibians from extinction combining *ex situ* and *in situ* strategies, particularly in this species in which chytrid fungus and habitat viability are critical threats for its survival in a period of less than ten years. New experiences derived from this project will provide the opportunity to complete a practical handbook about the biology and captive management of *P. longinasus*.

The complete project proposal can be viewed here.

Conservation actions for native and threatened amphibians of Colombian Caribbean region - Fundación Botánica y Zoológica de

Barranquilla ($3,000)

The amphibian biodiversity of Colombia's Caribbean region is rich, but most is threatened to some degree. Fundación Botánica y Zoológica de Barranquilla (Barranquilla Zoo), as the only zoo in the region, intends to contribute to the plight of amphibians via a holistic amphibian conservation project that includes an amphibian exhibition and education program, *ex situ* conservation via captive breeding programs for two local, endangered amphibians; *Allobates wayuu* (VU-UICN) from Makuira National Natural Park and *Colostethus ruthvenni* (EN-UICN) from Sierra Nevada de Santa Marta, educational activities at the zoo and at localities where endangered amphibians are found and by monitoring the health of several amphibian populations.

Wayuu Frog, *Allobates wayuu.* Photo: Luis Alberto Rueda Solano.

Both species, assessed during the Colombian-AArk species prioritization workshop in 2007, were recommended for captive breeding programs. We hope to make people aware about amphibians, the threats they are facing and the actions we can take to protect them both in wild and at the zoo.

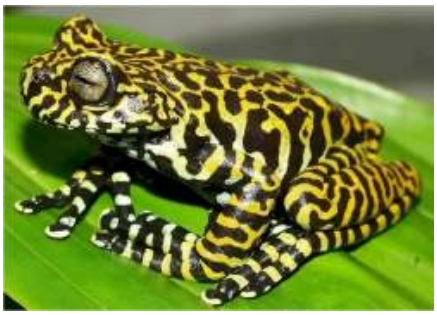
Barranquilla Zoo plans to add a second storey to it's amphibian display building to house a lab and breeding facility.

The complete project proposal can be viewed here. You can also see photos and read more information about the amphibian facility and its specific support requirements.

Frogs and toads from south-western Colombia: Jewels of nature that our grandsons should know - Jonh Jairo Mueses-Cisneros ($575)

Colombia has one of the highest amphibian diversity in the world; and south-western Colombia (with nearly 290 amphibian species) contributes to 40% of this diversity. However, in spite of this high diversity, the conservation efforts toward this imperilled group are very scarce. Since 2004, we have worked successfully on *in situ* conservation projects in the region focusing on species of special concern. At the moment, we consider that our efforts should be directed towards the implementation of responsible *ex situ* conservation programs for amphibians, accompanied by a detailed environmental education plan involving local people and the construction of legal policies to guarantee the survival of these species and their habitat.

We have prioritized forty-five species from south-western Colombia that require immediate *ex situ* conservation actions (most of these species were not prioritized for the Amphibian Ark and other Colombian institutions in 2007, due to the lack of information at the time). To help save all of the forty-five species would require an ambitious, long-term, large scale project, however, we have devised a scheme that would allow us to build facilities and have an operating program within two years in order to be able to start the breeding and reproduction phase for seven of this species.



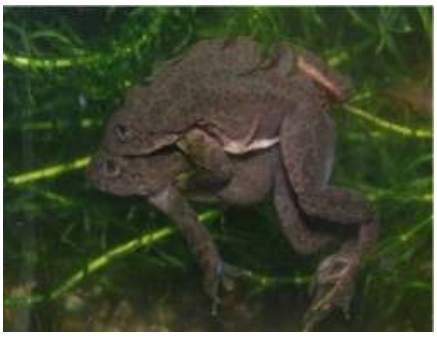
Adult female *Hyloscirtus tigrinus*. Photo: Francisco López-López and Mario Montezuma.

The funds requested from AArk will be used in:

1. Training of two members of our team on amphibian husbandry techniques and the rearing of feeder insect colonies at internationally recognized *ex situ* institutions in Ecuador, (the only facilities currently housing amphibians that are phylogenetically similar to the ones targeted in our project).
2. Environmental education for local people and environmental authorities to improve the quality of existing amphibian habitats, and
3. Engaging in policy-making efforts to enact legal actions for these species and their habitats.

The complete project proposal can be viewed here. You can also see photos and read more information about the proposal and its specific support requirements.

Bolivian amphibian initiative in search of support to protect the endangered species in Bolivia - Museo de Historia Natural Alcide d'Orbigny ($1700)



Telmatobius hintoni.

The Bolivian Amphibian Initiative has been working for a couple of years with Bolivian amphibians, and now is focusing efforts ob the high Andean species of the aquatic frogs of the genus *Telmatobius*. All species in this genus are in the IUCN Red List, some of them with very restricted distribution areas and with high levels of threat, and some include populations that have possibly already disappeared.

We are working in four main areas in this project:

1. Research - we are obtaining information about the populations, habitat, threats and requirements.
2. Capacity building - training young biologists, students, local communities and park guards in amphibian monitoring methods.
3. Increasing of awareness - Developing different educational activities, such as workshops, exhibitions in local communities, schools and in the Museum.
4. Captive breeding - The project is working with *Telmatobius hintoni* (Vulnerable) and *Telmatobius culeus* (Critically Endangered), obtaining very interesting data about their biology and also trying to breed the species.

We have recently also been working with other species for which almost nothing is known about the natural history or requirements. We are seeking additional support for this initiative because preliminary data is showing that some species are disappearing and the levels of threats are very high. We need to carry out more work in different activities of the project, specially the captive breeding aspect, where resources and equipment are needed to improve and expand the facilities that we already are using.

For more information please visit: www.bolivianamphibianinitiative.org or www.bolivianamphibianinitiative.blogspot.com or contact Arturo Muñoz hyla_art@yahoo.com

The complete project proposal can be viewed here.

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We’re looking for volunteer language translators!

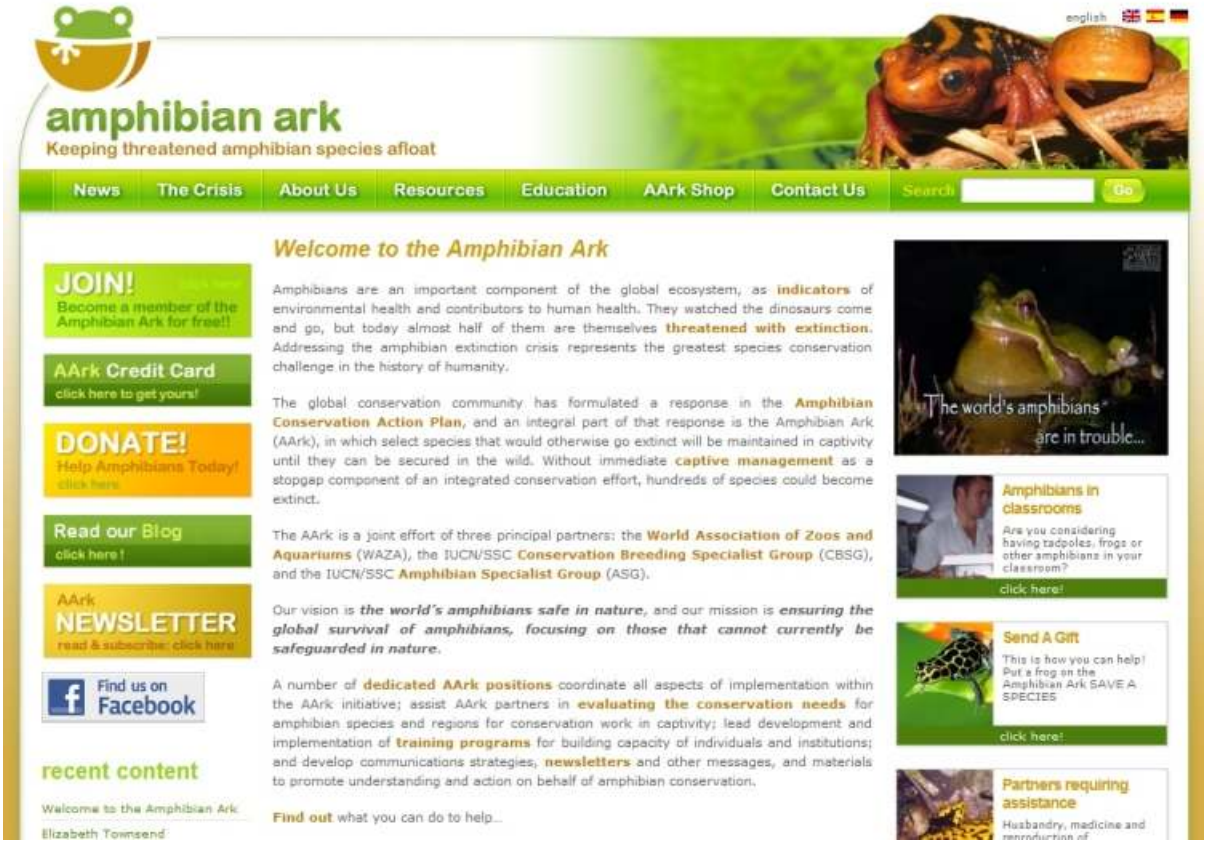
Kevin Johnson, Webmaster, Amphibian Ark

We’re excited to let you know that we have almost completed work on our new-look Amphibian Ark web site, with the official launch expected early in July. We are very grateful for the generous support from Moxie Interactive, an Atlanta-based internet marketing solutions company, who worked with us to develop the theme and templates for our new site. I’m sure you’ll agree that the new site has a fresh, vibrant new feel to it, is easier to navigate, and includes exciting new features.

The new site provides tools for easy delivery into multiple languages, and we are currently working with a couple of volunteers who are helping with Spanish and German translations. We feel that it is crucial to make information about the amphibian crisis, and the global response to it, available to as many people across the world as we can, and having the site available in local languages is one way of helping to achieve this.

If you are able to spare a few hours, and have excellent translation skills from English to Spanish or German, we’d love to hear from you, and to enlist your help with this valuable project. We’re also keen to make the site available in other languages once we have Spanish and German complete, so if you are able to help with translation into other languages, please let us know!

Please contact Kevin Johnson at kevinj@amphibianark.org if you are able to help.



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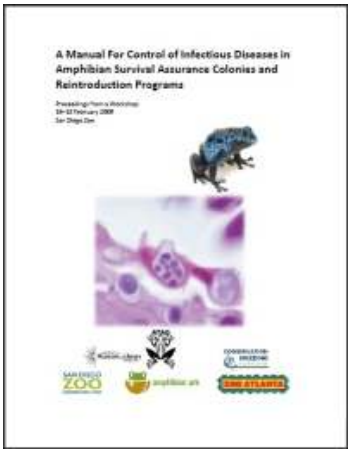
Control of disease in living amphibian collections – a new manual



Infectious diseases have become a well recognized threat to amphibians, both in the wild and in captive collections intended for any purpose including research, teaching, and conservation. With funding from Institute of Museum and Library Services (to San Diego Zoo and Zoo Atlanta) and support from the IUCN Conservation Breeding Specialist Group, a global delegation of amphibian veterinarians, pathologists, biologists, and keepers convened in 2009 to provide input and text for a basic manual on the control of diseases in such collections.

The manual includes outlines and references to the primary literature regarding recommended best-practices regarding protocols for disease diagnostics and treatment, necropsy, quarantine, routine husbandry, risk assessment, and biosecurity.

The manual is available for download, free of cost, at:
http://www.cbsg.org/cbsg/workshopreports/26/amphibian_disease_manual.pdf

PESSIER, A.P. AND J. R. MENDELSON III (Eds.). 2010. *A Manual for Control of Infectious Diseases in Amphibian Survival Assurance Colonies and Reintroduction Programs*. IUCN/SSC Conservation Breeding Specialist Group: Apple Valley, Minnesota, USA. 229pp.

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Amphibian Biology, Conservation and Management School graduates another class!

Ron Gagliardo, Training Officer, Amphibian Ark, and Andy Odum, Curator of Herpetology, Toledo Zoo

Since 2006, Amphibian Ark staff has partnered with AZA in conducting the week-long course Amphibian Biology, Conservation, and Management (ABCM). This course, first offered at the Detroit Zoo in 2004 and 2005, has since been held six times at the Toledo Zoo. It is highly recommended for folks who are just stepping into the world of keeping amphibians, but even the experts are able to pick up new techniques, information, and most of all, motivation!

ABCM's initial target audience was U.S. zoo personnel; however partnering with AArk has created opportunities for many international students. Students from Asia, Australia, Central America, South America, Europe, and Africa have attended the school and added an entirely new international perspective to amphibian conservation. This year, thanks to AZA scholarships, we were able to have students from Brazil and Colombia. Amphibian Ark helped to support students from Chile and Costa Rica and in addition, the Toledo Zoo was able to fund two students from the Dominican Republic where there are plans to establish *ex situ* conservation populations for some of the island's endangered frogs. All of these students will bring valuable knowledge and techniques back to range country programs that will benefit amphibians!

Students and instructors from this year's Amphibian Biology, Conservation, and Management course. Photo: Andy Odum.

The course is taught by a number of amphibian specialists from around the world, combining husbandry, taxonomy, ecology, and pathology, as well as several seasoned amphibian conservationists including Mike Lannoo and Bob Johnson. This year, ten instructors offered up their time to share information on topics ranging from amphibian anatomy and evolution to husbandry, captive reproduction, and veterinary medicine. To help students tie all of these disciplines together into a real "amphibian" program, they are tasked with group projects aimed at fostering teamwork and knowledge as they embark on building a multi-faceted program from assigned hypothetical circumstances. These programs encompassed not only collection plans and facilities but also how conservation education, a topic specifically addressed by ABCM instructors, comes into play. At the end of the week, these teams of newly found friends and colleagues present their programs to the entire class and instructor panel for feedback.

Maintaining amphibians in captivity can be a labor intensive, hands-on endeavor. ABCM helps students to prepare for these challenges through a good deal of hands-on demonstration and workshop-style group projects. Participants learn specific techniques involved in creating exhibits and enclosures from drilling glass and assembling plumbing, to horticultural techniques. In addition there are demonstrations of hormone-induced breeding, egg and larval development monitoring, and disease diagnostics. In the current climate of diseases and their effects on amphibians in the wild and captivity, a great deal of emphasis on biosecurity and quarantine helped students to better understand the risks in engaging in *ex situ* work and how proper planning and assessment are very important. And ABCM is not just about captive animals. To provide background in basic field techniques for amphibian censuses, the week culminates in a day-long field trip to a site in western Ohio where there is a good representation of the amphibians.

ABCM students prepare for amphibian survey work in Western Ohio. Photo: Andy Odum.

During the week-long class, students from different disciplines are able to interact with each other and instructors to fill in gaps in their knowledge and motivate each other to continue to do the best we can in developing these programs. This year, they also had two special additional opportunities to further their knowledge. Dr. George Rabb, Director Emeritus of Chicago's Brookfield Zoo was in attendance and delivered a moving presentation on the birth of the amphibian conservation movement and shared some of his vast experience working with amphibians over the last five decades! In addition Michael McFadden from Taronga Zoo in Sydney, Australia was on hand to share some of the great successes with *ex* and *in situ* projects ongoing in Australia. We were quite fortunate to have these wonderful and motivating additions to this year's ABCM.

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Amphibian husbandry comes to Indonesia

Ron Gagliardo, Training Officer, Amphibian Ark

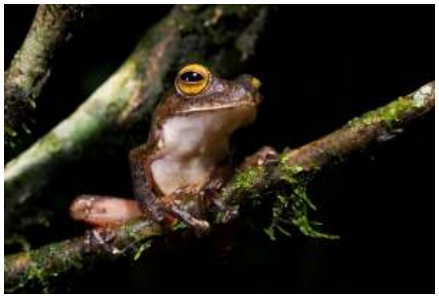
Taman Safari Indonesia in Cisarua, Bogor provided an expansive and beautiful venue for the Amphibian Ark husbandry workshop held from March 9-11. Twenty-five students attended from West Java and also neighboring Sumatra, all keen to learn more about amphibian husbandry and conservation.

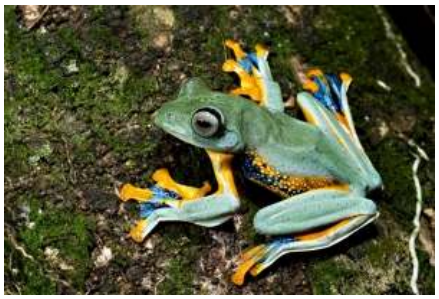
The instructor team consisted of Ron Gagliardo, Andy Odum (Toledo Zoo), Mike Ready (Sandfire Dragon Ranch) and Michael McFadden (Taronga Zoo, Australia). The course covered topics ranging from basic husbandry and water quality to captive reproduction and veterinary care. In addition, *ex situ* planning and exemplary programs were covered to help students gain a full appreciation of how these programs are initiated and carried out. Hands-on group projects and demonstrations were held outdoors which despite the rain, was not a problem as Taman Safari Indonesia staff erected a massive canopy for us within minutes!

Above: Instructor Michael McFadden supervises a tank drilling exercise.
Below: Success in the enclosure building session!
Photos: Ron Gagliardo.

For more up-close and personal interactions with amphibians, the group was divided into teams for a night hike to explore for frogs in the national forest surrounding the park. Over a dozen different taxa were encountered including *Megophrys*, *Rhacophorus* and *Bufo*.

A great deal of gratitude is owed to the in-country organizers: Dr. Mirza Kusrini (Bogor Agricultural University) and staff at Taman Safari: Mr. Jansen Manansang, (Director, Taman Safari), Sharmy Amy Prastiti, Retno Sudarwati, and Bongot H. Sirajaguguk.





(left): Javan Gliding Frog (*Rhacophorus margaritifer*), (below): Giant River Toad (*Phrynoidis aspera*), (below left): Reinwardt's Flying Frog (*Rhacophorus reinwardtii*), Photos: © Michael Ready.

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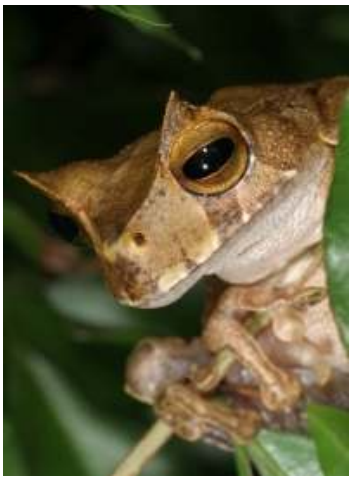
New amphibian species accounts on the AArk web site

As mentioned elsewhere in this newsletter, we're excited to be launching our new web site in July. One of the new features on the site will be a series of amphibian species accounts, which will provide information about some of the more threatened amphibian species. We'll feature one of these species accounts in each AArk newsletter, starting with the spectacular Horned Marsupial Frog, *Gastrotheca cornuta*.

Gastrotheca cornuta



Gastrotheca cornuta, Horned Marsupial Frog. Photo: Brad Wilson, Courtesy Atlanta Botanical Garden.

Species name: *Gastrotheca cornuta*

Common name: Horned Marsupial Frog

Red List status: Endangered (http://www.iucnredlist.org/apps/redlist/details/55329/0)

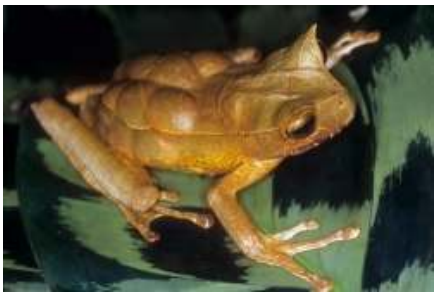
Distribution: Costa Rica, Panama, Colombia, and Ecuador

Habitat: *Gasthrotheca cornuta* is found mainly in lowland and premontane humid primary and secondary forests lacking disturbance however, there are reports of this species being found in palm oil plantations.

Threats to survival: Habitat loss, disease.

Species assessment by AArk: *Costa Rica:* Ark role – A species that is extinct in the wild (locally or globally) or which could become completely extinct without *ex situ* management.
Panama: - Rescue/Supplementation – 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 / A species for which *ex situ* management benefits the wild population through breeding for release as part of the recommended conservation action.

Reproductive behavior: This species of marsupial frog reproduces by direct development with no free-swimming tadpole stage. Eggs are fertilized externally and carried in a pouch on the back of the female. After 60-80 days, fully formed frogs emerge. Note: the eggs are the largest of any amphibian species.



Gastrotheca cornuta, Horned Marsupial Frog, showing eggs. Photo: Brad Wilson, Courtesy Atlanta Botanical Garden.

Interesting natural history notes: See Reproductive behavior.

***In situ* projects currently underway:** None at the moment.

***Ex situ* programs:** Small *ex situ* populations exist at the El Valle Amphibian Conservation Center (EVACC, www.houstonzoo.org/amphibians/) in El Valle de Anton, Panama and also at the Atlanta Botanical Garden (www.atlantabotanicalgarden.org), Atlanta, Georgia, USA.

How can we help this species? While reproduced several times in captivity in and outside of Panama, the captive born generations suffer from health problems associated with nutrition and husbandry. Supporting further research on amphibian dietary and husbandry research surely would be helpful to this species.

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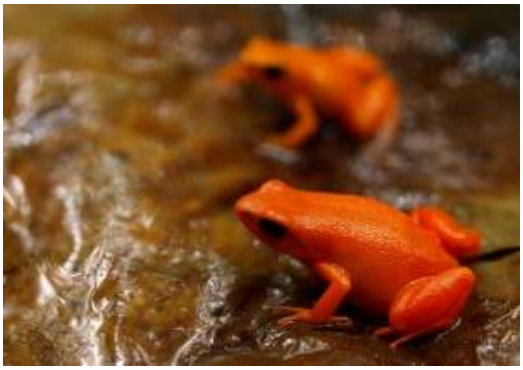
Association Mitsinjo's captive breeding facility for Malagasy amphibians

Devin Edmonds, University of Wisconsin-Madison

Few places in the world are as rich in amphibian species as the tropical forests surrounding the village of Andasibe in east-central Madagascar. Walking for an hour down the main road on a rainy night you can encounter over twenty species of frogs. Hike a little further and you reach the RAMSAR-protected Torotorofotsy Wetlands, home of the Critically Endangered and iconic Golden Mantella Frog (*Mantella aurantiaca*). Over 100 species of amphibians exist in the 30 kilometers of fragmented rainforest and rice paddies surrounding Andasibe, and it is here where the community-run NGO Association Mitsinjo is building a facility to house captive assurance colonies of local threatened frog species.

Pilot studies indicate that the amphibian chytrid fungus (Bd) has yet to reach Madagascar, so it seems for now Malagasy amphibians have been spared from this global-spreading infectious disease. This presents Association Mitsinjo with the opportunity to take a proactive response, establishing captive assurance populations and training personnel in advance of the impending Bd epidemic. Currently there are no biosecure facilities to house captive amphibians or staff trained in the husbandry of amphibians in Madagascar, so this project will be the first of its kind.



Above: Golden Mantella Frog (*Mantella aurantiaca*). Below: *Boophis pyrrhus*. Photos; Devin Edmonds.

The facility will consist of two buildings, one which houses assurance colonies of amphibians and another for educational purposes and ecotourist activities. Located adjacent to one of Madagascar's most popular national parks (Andasibe-Mantadia), the educational facility will display captive populations of frogs to tourists for a nominal fee, generating funds to maintain the facility indefinitely. Educational presentations and outreach programs will also be conducted here for the Andasibe community, thereby raising awareness within the local population to Andasibe's diverse amphibian species and their ecological importance.

Funding for building construction and assembly of vivaria has been secured through the AZA Conservation Endowment Fund and AArk Seed Grant, and construction will begin this fall. The Wildlife Conservation Society has committed resources for developing educational programs and materials. Association Mitsinjo now seeks financial support to operate the facility during the initial two years until it can become self-sufficient through revenue generated by ecotourist activities.

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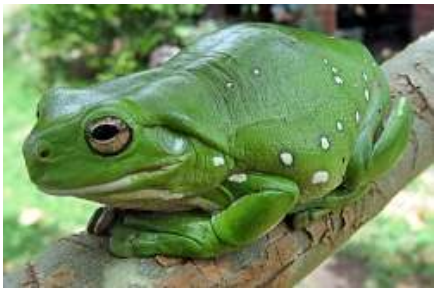
Third successful attempt to culture amphibian cells

Andrea Johnson, Genetics Division, San Diego Zoo's Institute for Conservation Research

The Genetics Division celebrated our third successful attempt to culture amphibian cells from a tissue sample this April, when living fibroblasts from a White's Tree Frog (*Litoria caerulea*) were accessioned into the Frozen Zoo®. The frog, which died at the San Diego Zoo, donated a foot to the cause. Using practices developed over decades of culturing mammal, bird, and reptile cells, technicians washed the sample thoroughly in a series of salt solutions and antibiotics and diced it with a scalpel. The tiny tissue pieces were then placed in an enzyme to digest the collagen holding the cells together. After a few hours the soupy mixture was transferred to a tissue culture flask with cell culture medium.

Usually, this would lead to a thriving carpet of fibroblast cells adhering to the bottom of the flask, which would be "fed" with fresh medium a few times a week. As the cells multiplied they would be put into larger flasks and when there were enough, they would be put in cryoprotectant liquid and frozen in one-milliliter vials. Unfortunately, there are some types of animals which always present tissue culture problems for us, and amphibians are the most difficult of all. The issues start right at the beginning when the samples are washed. The permeability of frog skin makes it much tougher to eradicate bacteria and fungus from the tissue while it's being processed. The mechanical action of washing can take most of the debris off the surface of the tissue, but after a couple of days in culture, branching fungus and tiny swimming bacteria often appear, killing any of the frog cells that may have started growing.



White's Tree Frog.

We've tried a lot of things to clean the samples, from passing the tissue through a flame, to rinsing it with various kinds of antibiotics, to soaking the sample in acetic acid. Our record is getting better, but we're still excited when we come in the next day and find a clean tissue culture flask with amphibian cells attached to the bottom.

The challenge then is to keep the cells alive and dividing. For reasons as yet unknown, amphibian cells almost always fail to thrive and eventually die. There are any number of factors involved; the temperature at which the cells are kept, the pH of the medium, the oxygen component of the air inside the cell incubator, and of course the nutrients and growth factors in the medium itself. It's entirely possible that different species of amphibian require different conditions for their cells to grow. To figure out what the cells are missing, we try varying many combinations of factors. Every once in a while a cell line just "takes off" and grows very well under certain conditions, but so far what works with these exceptional cell lines has not successfully transferred to other cell lines.

Every amphibian sample we set up without contamination is a small victory; the emergence of living cells is a bigger one. The greatest triumph is when the cells are frozen and stored in liquid nitrogen. The White's Tree Frog joins an African Clawed Frog (*Xenopus laevis*) and an African Bullfrog (*Pyxicephalus adspersus*) in the Frozen Zoo®, and differs from those two species in that it is very susceptible to infection with chytridiomycosis; in fact, the individual from which we took the sample had died from the disease. Clawed frogs and African bullfrogs, on the other hand, seem to have at least partial resistance to the fungus. So it's encouraging that infection with chytrid doesn't in itself prevent a sample from generating a viable cell line. We are glad for any good news as we continue trying to work out the complex difficulties associated with amphibian cell culture.

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Betic Midwife Toad conservation project

David Garcia, Curator of Herpetology Department of Bioparc Fuengirola (Fundación Instituto del Trópico)

In 2007, following the suggestions of Amphibian Ark and ARTAG, Bioparc Fuengirola decided to start a conservation project for the Betic Midwife Toad (*Alytes dickhilleni*). The "Alytes Project" would be the first conservation project started by the Fundación Instituto del Trópico, a foundation promoted by Bioparc Valencia and Bioparc Fuengirola to develop conservation actions. In 2008 permission to proceed was granted by the Junta de Andalucía, the regional government that has the environmental responsibilities in this area of Spain.

For two years the staff of the Herpetology Department worked with Majorcan Midwife Toad or "ferreret" (*Alytes muletensis*) as a model species to establish adequate husbandry protocols. Construction of a biosecurity room to establish an *ex situ* breeding colony was completed in Bioparc Fuengirola in late 2009.

Arrival and release of the first Betic Midwife Toad (*Alytes dickhilleni*) tadpoles in Biosecurity Room at Bioparc Fuengirola. Photo: David Garcia.

In 2010 we received a contribution of 10.135 €, from the 2008 EAZA Amphibian Campaign. In the early part of 2010, we started to sample various wild populations to detect the presence of chytrid (*Batrachochytrium dendrobatidis*), and we selected wild populations, on which we will base a year studying chytrid in our species. We are conducting this important part of the project with Dr. Jaime Bosch, form the Consejo Superior de Investigaciones Científicas (CSIC).

In April, we caught our first specimens of Betic Midwife Toad to start the *ex situ* component of the project. A total of twenty-five tadpoles were collected from an isolated population on the Málaga sierra, and we are currently investigating the possibility of collecting a new group of tadpoles from a different population, using genetic and/or ecological selection.

In April we also participated in a conference promoted by the City of Canillas de Aceituno, Malaga, on threatened fauna. This municipality in the Málaga sierra has several Betic Midwife Toad populations, some of which are infected with chytrid fungus. At the conference we spoke about our project, the conservation status of amphibians worldwide, and the actions being carried out by international institutions and organizations, such as EAZA, Amphibian Ark, etc. We strongly believe in public awareness as part of the key to succeed in this project.

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View of the Biosecurity Room at Bioparc Fuengirola. Photo: David Garcia.

Tinker Frog program at Currumbin Sanctuary

Matt Hingley, Technical Advisor, Currumbin Wildlife Sanctuary

“The work of wildlife parks and zoos to secure the future of individual species can translate into much more expansive global conservation outcomes”, Currumbin Wildlife Sanctuary Technical Advisor Matt Hingley recently told a national conference.

‘What made David Attenborough different was an early introduction to a wild creature and a mentor who taught respect for nature – these influences led to him having such an incredible impact throughout the world’, Matt said.

Those two key influences can also be delivered by zoos and aquariums every day to a new generation – it all comes down to how we do things every day and how we share it. The recent Zoo and Aquarium Association National Conference in Melbourne, hosted by Zoos Victoria, heard how individual wildlife parks and zoos could continue to complement the work of government conservation agencies through research, breeding and education programs.

In particular, recent work to save a Tinker Frog species found in the Eungella region in northern Queensland showed how the work of a single conservation program could have a significant impact. Australia had 219 species of frog, but eight of those have recently become extinct, with six of those eight from Queensland.

The Tinker Frog is one species on the brink of extinction, which is only found in the Eungella region. This unique habitat is comprised of an array of species from both the tropics and sub-tropics. In addition to this diverse mix, Eungella is home to an amazing range of endemic species (those found there and nowhere else on the planet).

In an effort to help secure the future for the species, Currumbin obtained permits to collect breeding pairs last November to be housed in Currumbin’s ‘Amphibian Ark’ – a temperature-controlled breeding facility inside a converted shipping container.

These frogs are now showing signs of breeding behaviour which is considered a world first as no captive husbandry or reproduction has been undertaken to date. The results and findings may breathe new life into the future of the remaining three Tinker Frog species.

Last year, Currumbin successfully raised more than 200 Spotted Tree Frogs, (*Litoria spenceri*), which were release into an area along Bogong Creek in the Australian Alps from which the species was confirmed extinct in 1993 – and the same success with the Tinker Frog could bring the species back from the brink of extinction.

But most important was the effort of wildlife parks and zoos to continue sharing the knowledge and success of these programs with a broad audience. ‘In the late sixties whilst man took his first step on the Moon, Attenborough was stepping through the Congo leaving muddy footprints across our living room floor, and I was having my earliest and most memorable introduction to nature in the form of a Tiny Green Frog.’

‘These are life memorable experiences that must be enthusiastically shared. Our purpose now is to secure populations for the future and to ensure that we provide an experience that will be memorable for the next generation to carry on the work that we have just started’, Matt said.

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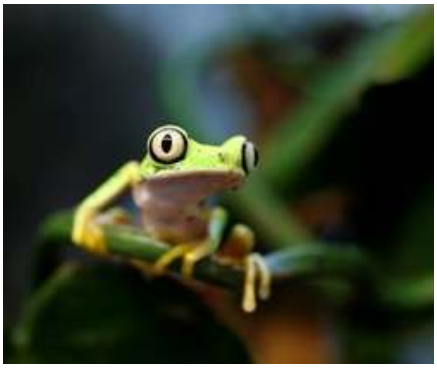
Frog ‘love shack’ to open at Bristol Zoo Gardens

Lucy Parkinson, PR Manager, Bristol Zoo Gardens

Bristol Zoo Gardens is due to open an amphibian breeding sanctuary within its grounds to breed two frog species on the verge of extinction. The facility will provide a safe home for some of the world’s most endangered frog species - Lemur Leaf Frogs and Golden Mantella Frogs – which will be settled into their new home in the coming weeks.

Called the ‘AmphiPod’, the facility will provide the perfect conditions to allow the rare frogs to breed, in an effort to help save the species from extinction. Both species are listed as Critically Endangered on the IUCN Red List of threatened species.

Tim Skelton, Bristol Zoo’s Curator of Reptiles, explains: “This high tech facility will allow us to adjust the temperature, humidity and day length to create the perfect conditions to encourage the frogs to breed.”



Lemur Leaf Frog, *Hylomantis lemur*.

He added: “We are thrilled to have been able to build this facility as it will be a vital tool in helping to save high-risk frog species from the danger of extinction – which is currently a very real and near threat.”

The extinction crisis is mainly due to man’s destruction of amphibians’ natural habitats, but in a deadly combination with pollution and climate change, they now face an even bigger and deadlier threat – chytrid fungus (chytridiomycosis). This killer fungus is steadily spreading over the world. One third to one half of all amphibian species are currently threatened with extinction, with more than 160 species thought to have been lost in recent years. The threat is so serious that the World Conservation Union (IUCN) has said that the only hope for many species is to be held in captivity until the disease can be tackled in the wild. As a result, priority amphibian species are being taken into dedicated facilities at zoos, aquariums, and other institutions around the world for safekeeping and breeding.

Tim Skelton added: ”Until a solution is found to help stop the fungus in the wild, the safekeeping and captive management of threatened amphibians is the only way to ensure their long-term survival.

“Our new AmphiPod will allow us to keep frogs in a safe, isolated environment, away from any threat of disease, as well as giving our keepers the opportunity to learn the techniques required for the specialist amphibian care we can provide in the AmphiPod. In future we will be able to provide a safe haven to other amphibian species in immediate danger of extinction.”

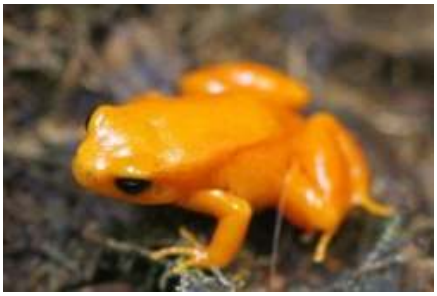
Bristol Zoo’s AmphiPod has been built following a year of fundraising by the Zoo as part of its Year of the Frog campaign in 2008. The Zoo’s fundraising efforts included proceeds from the Zoo’s Boogie for Brizzle summer event, various fundraising challenges throughout the year and the support of generous trusts.

As well as thanking members of the public who donated to the campaign, the Zoo would also like to thank a number of local companies, including Vincent Timber, for donating the roof shingles for the sanctuary.However, the Zoo is still £30,000 short of the target amount which will help pay for the continued cost of running the facility for the next three years.

The frog species which will be maintained in Bristol Zoo’s AmphiPod are:

Lemur leaf frog - *Hylomantis lemur*
This critically endangered amphibian is only found in a few places in Costa Rica and Panama; and the number of Lemur Leaf Frogs left in the wild is thought to be dangerously low.

Golden Mantella Frog - *Mantella aurantiaca*
Golden Mantella Frogs are around 2cm long and are brilliant golden-orange in color, with black eyes. The bright colors are as a result of 'aposematic coloration'. This means that they display the bright colors usually associated with toxic species to ward off predators.



Golden Mantella Frog, *Mantella aurantica*.

Golden Mantella Frogs are critically endangered and are native to the forests of Madagascar, where they live in a fragmented area of forest surrounded by degraded land. The remaining forest is under threat from subsistence agriculture, timber extraction, fires and expanding human settlements. Limits on the exportation of these animals have been imposed and the trade of these frogs has been greatly reduced as a result.

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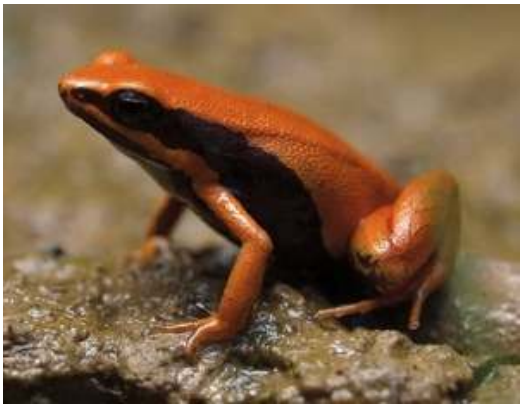
Frog MatchMaker - supporting our amphibian conservation partners

Kevin Johnson, Taxon Officer, Amphibian Ark

In the last AArk newsletter, we launched our new conservation project list, Frog MatchMaker, and we featured a couple of projects from the list. In this newsletter, we'd like to let you know about three more projects from the list, that are seeking support to carry out their amphibian conservation projects. The complete list currently contains fifty-one projects, which can be searched by genus, country, project type, or by the amount of support required.

Madagascar: Establishing a captive breeding facility for Malagasy amphibians

Association Mitsinjo in Madagascar is seeking funds and experienced amphibian keepers between 2010 and 2013 to help train caretakers from the local community in amphibian husbandry.



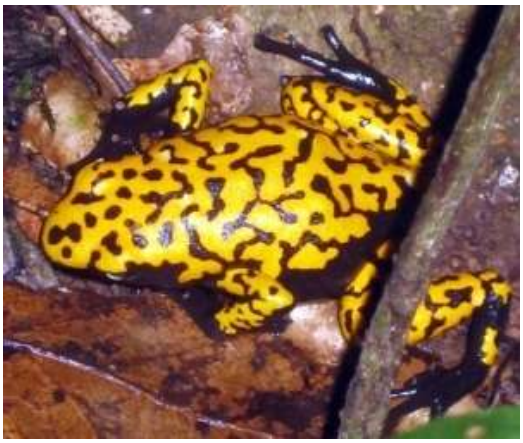
Mantella cf. milotympanum near Andriambe are found only in unprotected habitat that is under pressure from agricultural activity and logging. Photo: Devin Edmonds

Madagascar hosts some of the highest amphibian species richness in the world. Tragically, over one quarter of amphibian species in Madagascar are threatened with extinction. Association Mitsinjo in collaboration with the Wildlife Conservation Society are working to establish a captive breeding facility for threatened amphibian species. Components of the project include a facility that will support assurance colonies, as well as a separate building that will focus on education and community outreach.

This project involves captive propagation, community-based conservation, community outreach, education; establishment of assurance populations; *ex situ* conservation, and rescue.

Please contact Devin Edmonds, Project Director, devin@amphibiancare.com for further information, or visit the web page http://sites.google.com/site/mitsinjo/

Brazil: Captive husbandry, medicine and reproduction of *Brachycephalus ephippium* and a new, unknown species from Amazonia



Dendrobates cristalino. Photo: Hans Ulrich Furrer.

Zooparqe Itatiba in São Paulo, Brazil, is establishing a stable *ex situ* population of *Brachycephalus ephippium* and a new, unknown species (probably to be named *Dendrobates cristalino*), to increase knowledge about biology, and behaviour. $20,000 is required for the training of specialised amphibian keepers, and aditional, related projects and will be established later in 2010.

Additional information can be obtained from the Director, Hans Ulrich Furrer, at zooparque@zooparque.com.br

Photo: Dendrobates cristalino. Photo: Hans Ulrich Furrer.

Mexico: Captive husbandry, medicine and reproduction of the Critically Endangered axolotl

Chapultepec Zoo in Mexico City, Mexico, is working with the Biology institution of the National Autonomus University of Mexico, to develop a program for the captive husbandry, medicine and reproduction of the Critically Endangered Mexican Axolotl (*Ambystoma mexicanum*).

Mexican Axolotl *Ambystoma mexicanum.*

If you are able to assist with this project, please contact Erika Servín, the Veterinarian in charge of the axolotl colony of the Chapultepec Zoo, eservinz@hotmail.com

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Florida women in herpetology unite to save the Coqui!

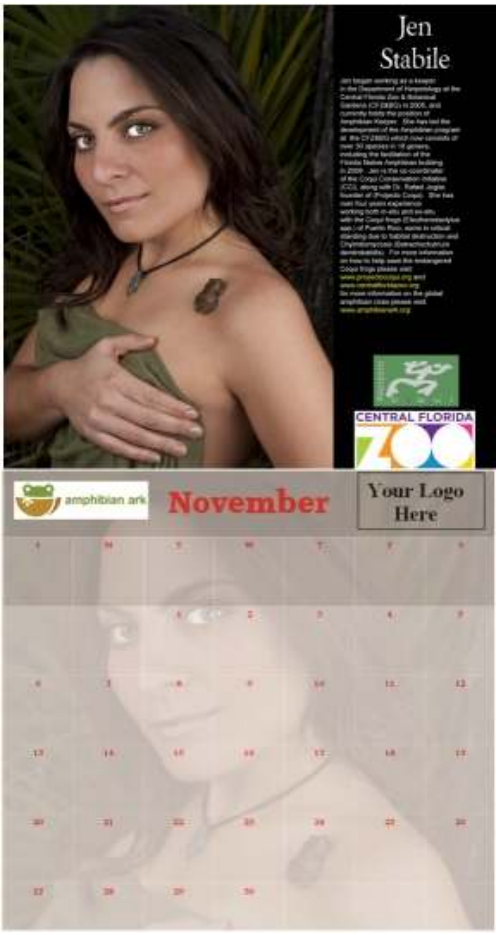
Jennifer Stabile, Amphibian Keeper, Central Florida Zoo

Eleutherodactylus coqui, Puerto Rican Coqui. Photo: Joe Milmoe.

The island of Puerto Rico is known for one of the world's most vocal amphibians, the coqui frog (*Eleutherodactylus coqui*). With its characteristic "ko-kee" call, the Coqui Frog holds a special place in the culture and history of the Puerto Rican people. The Coqui Frog's vocalization enchants the island, and is what many people say they miss most once they leave. The Coqui are an integral part of the community's folklore and legends. Cave paintings of the Coqui can be traced back to the Taino people, the first inhabitants of the island. That is how long the Coqui have been captivating Puerto Rico.

To give you a small glimpse of what the Coqui means to the Puerto Rican people, a few years ago at the Central Florida Zoo and Botanical Garden's Fiesta del Coqui a passionate guest approached us at the end of the day and described his feelings for the Coqui. "The Coqui represent the calm after the storm of a busy day. The sound both relaxes and transforms our evening into a magic time to rest and replenish our souls. The Coqui is a small frog struggling to survive in a big jungle as is Puerto Rico, but still each night he sings out loudly and with pride in what he is-and what we are. To be Puerto Rican is to be the Coqui. Thank you for bringing a piece of my island to your zoo, and for reconnecting me to Puerto Rico."

There are seventeen different species of Coqui, three of which are now extinct and eleven are listed as either Threatened or Endangered. Primary threats include habitat destruction and fragmentation, the chytrid fungus (*Batrachochytrium dendrobatidis*) and climate change. In 2006, the Central Florida Zoo and Botanical Gardens became aware of the work being done by Dr. Rafael Joglar, founder of Proyecto Coqui (UPR), to ensure the survival of this threatened group of frogs and became involved in helping with ex situ efforts aimed at helping this important amphibian. The Coqui Conservation Initiative is collaboration between Proyecto Coquí, and the Central Florida Zoo and Botanical Gardens to ensure preservation of endangered Coqui. These institutions have joined together to focus conservation efforts on the *Eleutherodactylus* of Puerto Rico, otherwise known as the Coqui Frogs. With modest funds wisely applied by dedicated staff these institutions have worked together for three years to study the species of Coqui (*Eleutherodactylus* spp.) in Puerto Rico that are of conservation concern. This collaborations mission is to integrate the best aspects of cultural respect and a diversified regional conservation initiative to help educate the public and preserve the Coqui Frogs of Puerto Rico.



Ladies in the Florida herpetology field have banded together to help the Coqui and put together an attractive and fun 2011 wall calendar, Florida Girls of Herpetology which will soon go to press! The funding received from sales of this calendar will be applied to the construction of an Amphibian Conservation Facility at the Central Florida Zoo. The Coqui facility's primary purpose will be to create a space for both Proyecto Coquí and the Central Florida Zoo and Botanical Gardens to further develop captive husbandry and reproduction requirements of Eleutherodactylus, some of which are critically endangered in Puerto Rico. The facility will also provide space for visiting students to learn and apply captive propagation techniques for projects in Puerto Rico.

The calendar will debut at the 2010 National Reptile Breeders Expo held in Daytona Beach, FL in August 2010. Calendars will also be sold at several institutions including the Central Florida Zoo and Botanical Gardens, The Reptile Discovery Center, and the St. Augustine Alligator Farm. A website dedicated to the sale of the calendar will be linked to www.centralfloridazoo.org soon, along with a Facebook page that will assist with promotion of the calendar. Don't miss this opportunity to support this unique conservation project.

For more information on sponsorship and obtaining the calendar, please contact:
Jennifer Stabile Jens@centralfloridazoo.org Ph: +1 (386) 848-5936

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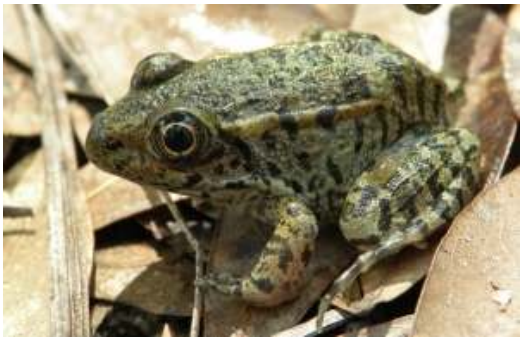
Establishing a new population of Georgia's rarest frog

Robert Hill, Amphibian Specialist, Atlanta Botanical Garden

Carolina Gopher Frogs (*Lithobates capito* formally *Rana capito*) are nearly endemic to the once-vast longleaf pine and wiregrass ecosystem of the south-eastern United States coastal plain. Largely due to the drastic loss of this ecosystem and the isolated ephemeral wetlands necessary for breeding and larval development, populations have significantly declined throughout their range. This is Georgia's rarest, and most threatened anuran species, and extant populations are currently known from only a handful of sites within the state. Because of the extremely fragmented landscape throughout the Carolina Gopher Frog's historic range, it is highly unlikely that the species will re-establish itself on restored lands without the help of repatriation efforts.

Growing to nearly four inches in length, Carolina Gopher Frogs feed mainly on insects and other frogs. The gopher epithet is earned through this anuran's habit of spending most of its life underground, most often in Gopher Tortoise (*Gopherus polyphemus*) burrows. Breeding typically takes place in late fall to early winter following heavy rains. Each egg mass may contain up to 2,000 eggs and larvae take four to six months to reach metamorphosis.



Carolina Gopher Frog (*Rana* [*Lithobates*] *capito*). Photo: Robert Hill.

Portions of several egg masses from known stable breeding sites are collected by Georgia Department of Natural Resources staff during each breeding season. These are then transferred to the Conservation Greenhouse facility at the Atlanta Botanical Garden and to the Maerz Herpetology Laboratory at the University of Georgia's Warnell Forestry School. Each egg mass portion is separated into different enclosures and the tadpoles are reared in outdoor facilities. Upon metamorphosis, each froglet is marked on the underside of one hind limb with visual implant elastomer. Following marking, tadpoles and metamorphosed froglets are released on the Williams Bluffs Preserve located in Early County, GA. This property, managed by The Nature Conservancy, contains nearly two thousand acres of suitable restored upland longleaf pine habitat along with five ephemeral limesink wetlands ideal for Carolina Gopher Frogs. After extensive surveys before the start of this project, no signs of a population of these frogs had been detected. After five consecutive years of releases, the property will be regularly monitored for the presence of adult frogs. Success will be gauged on the observation of Carolina Gopher Frog egg masses, detection of calls, and capture of marked adults in the years following releases.

Since 2007, nearly 2,000 head started late stage tadpoles and newly metamorphosed Carolina Gopher Frogs have been released at the Williams Bluffs Preserve. This year is looking to be a banner year for the project, with roughly 2,500 tadpoles nearing metamorphosis between Atlanta Botanical Garden and the Maerz Herpetology Lab. This project would not be possible without funding from the Association of Zoos and Aquarium's Amphibian Taxon Advisory Group and support from the Nature Conservancy, Georgia Department of Natural Resources, Atlanta Botanical Garden, and the University of Georgia.

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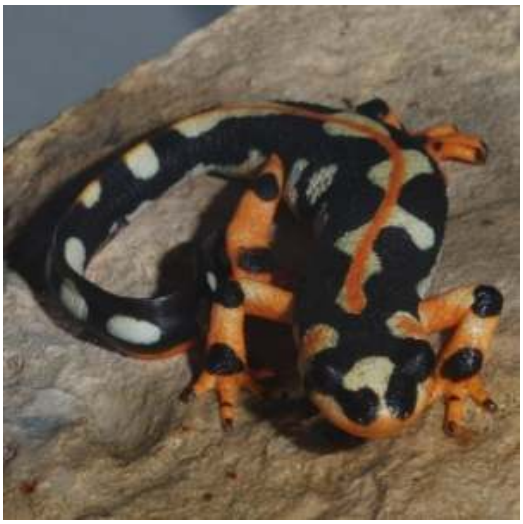
An international consortium to conserve two beautiful newts from Iran

Robert Browne, Research Officer, Amphibian Ark

Iran has one of the greatest herpetological diversities in the world, and the country is a land of geographic contrasts from snowy peaks to jungles, to the fertile valleys of the Zagros Mountains, and the parched and sun baked deserts of both the inland and coastal plains. Although Iran is particularly noted for reptiles it is also home to a fascinating range of amphibians including two of the most beautiful and endangered newts, the Yellow-spotted Newt (*Neurergus microspilotus*) and Kaiser's Newt (*N. kaiseri*).

These species are two of the most threatened in the Eurasian region and an international consortium based in Iran, Europe and the US, supported by generous grants from The Mohamed bin Zayed Species Conservation Fund, and the "EAZA Funding Conservation Support" grant from the European Association of Zoos and Aquariums (EAZA), is conducting a comprehensive program for their conservation. Within Europe, the Center for Research and Conservation, Royal Zoological Society of Antwerp in Belgium, and Parken Zoo in Sweden, have provided the administrative support to enable capacity building for both Neurergus species in their home range in Iran, and with *N. kaiseri* out of range populations in zoos and with private breeders. This program is being is being supported by private individuals from Germany and the Netherlands, and Sedgwick County Zoo, USA, with important conservation breeding initiatives and in providing expertise and capacity to guide programs in Iran.



Neurergus kaiseri. Photo: Peter Janzen.

Through its Curator of Herpetology, Nate Nelson, the Sedgwick County Zoo in Wichita, Kansas, USA, has proved a champion of *N. kaiseri* conservation, by proving a global champion in the breeding of this species and through innovative fund raising. The beautiful Kaiser's Newt, is easily kept and bred and is proving very popular with amphibian lovers. So popular in fact that it was recently listed by CITIES to prevent its excessive harvest. Now the popularity of Kaiser's Newt is being turned to support its conservation with Sedgwick County Zoo selling their surplus newts to raise funds for a conservation breeding population in Iran.

The private breeders in Europe have undertaken a census of the Kaiser's Newts in Germany, the Netherlands, Belgium, France and Austria. There are more than 1,500 adults and 3,000 juveniles, so many in fact those private breeders have slowed reproduction until enough homes can be found. One private breeder produced 1,600 eggs this year but only raised a small number of them, due to the space issues. We are hoping that improved commercial awareness, marketing, and other efforts will make Kaiser's Newts a standard pet species, both to encourage interest in amphibians, and to reduce pressure on more exotic but less attractive species. We are also relying on the government to encourage and support private breeders in their endeavors to establish a studbook for the wild-caught salamanders in their collections, and the keeping and breeding of *N. kaiseri*. Both activities are a major component of global efforts for amphibian conservation.

In Iran populations of Kaiser's Newt have suffered terribly because of previous harvesting for both the international pet trade, and for their use locally as living flowers when displayed on mass in jars during traditional ceremonies. The Yellow-spotted Newt, although beautiful and endearing, with its jet black body and bright yellow spots, is more difficult to keep than Kaiser's Newt and does not now exist outside of Iran. However, it was bred to second generation by private breeders in Germany several years ago, and has recently been reared in Iran.

Amphibian conservation breeding projects protect species and their habitat in nature, build scientific knowledge of both natural and captive populations, and establish and maintain captive populations in the species to ensure their survival in any circumstances. Fortunately, both Kaiser's, and the Yellow-spotted Newt, had champions at Razi University, Iran, with a long history of dedication to the survival of these newts. Prof. Mozafar Sharifi and Prof. Nasrullah Rastegar have a long history of field and laboratory work with both species and have agreed to manage our program from Razi University, Kermanshah, Iran. They have been joined by two very enthusiastic and dedicated masters students, Mohsen Takesh and Babak Nader, who are currently completing extensive surveys of these species, including their range, populations, ecology, and behaviour. This information together with assessments of health and genetics will be used to build genetically representative populations of both species in very high standard and secure facilities at Razi University. An important part of this program is the education of both students and the community of the importance of amphibian conservation.

Babak and Mohsen with some guests in the field, enjoyed lecturing young students about different

Support for the program to assess the genetic sub-population of these species has been offered through an advanced center in China, Kunming University, and a global consortium including the Russian Academy of Sciences, and workers from Europe, USA, and China, will assist in the development of techniques for sperm cryopreservation and gene banking. Working with a range of institutions, individuals, and cultures, has proved the perfect combination to foster and develop programs to conserve these and other amphibians, and perhaps most importantly to build international friendships and cooperation between those that want to see the Earth's natural beauty and biodiversity become our children's inheritance and not a lingering memory form the past.

aspects of the project.

More information

Amphibian Ark *ex situ* programs list: https://aark.portal.isis.org/ExSituPrograms/Lists/Ex%20situ%20programs/DispForm.aspx?ID=7

Neuergus microspilotus management plan: https://aark.portal.isis.org/Taxon%20management%20documents/Neurergus%20microspilotus%20Taxon%20Management%20Plan.pdf

Neurergus kaiseri management plan: https://aark.portal.isis.org/Taxon%20management%20documents/Neurergus%20kaiseri%20Management%20Guidelines.pdf

Private breeders and zoos:
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