



Critically endangered Panamanian Golden Frogs (*Atelopus zeteki*) are thought to bring good luck and fertility.

CONSERVATION ALERT

Beyond 2008 “Year of the Frog”: The Challenges Facing Amphibians and the Amphibian Ark

Ron Gagliardo

AmphibianArk.org

The Global Amphibian Crisis

As stated in no uncertain terms in many recent publications, television documentaries, and internet sources, amphibians are in serious trouble. The potential consequences of this unprecedented loss of biodiversity occurring in our lifetimes cannot be emphasized enough. The statistics speak for themselves: (1) Over one third of the 6,000 extant amphibian species are threatened and over one half are experiencing population declines; (2) This figure represents more endangered amphibians (frogs, salamanders, and caecilians) than birds, fishes, or mammals, making them the most threatened class of vertebrates on the planet; and (3) In the past few decades, over 122

species have been declared extinct in the wild, and all experts involved recognize this as a very conservative estimate.

Amphibian declines are not necessarily new. Based on information streaming in from many sources, changes in amphibian populations in different parts of the world have been documented since the 1980s. Monitoring the changes was difficult but, clearly, something was amiss. We needed a “head count.” In 2004, the International Union for the Conservation of Nature and Natural Resources (IUCN, 2008) compiled the first Global Amphibian Assessment, gathering data from scientists worldwide in an effort to develop an accurate picture of how amphibians were faring. The news was not



Despite the attention given to emerging infectious diseases, habitat loss is the leading threat to amphibian populations worldwide. Preserving pristine riparian habitats such as this stream in Panama is crucial to the future of amphibians in nature.



www.exo-terra.com

Proud sponsor of the IRCF and this centerfold

BRAD WILSON

A Horned Marsupial Frog (*Gastrotheca cornuta*) with hatchlings. This species has disappeared from much of its historical range from Costa Rica to Ecuador. Breeding programs may provide a stopgap for this amazing species before it disappears forever.

good. Over one third of all amphibian species were found to be in serious decline. Another 23% were considered “data deficient,” and presumed threatened. That brings the number to nearly 50% of amphibian species that are threatened with extinction. In addition, over 100 species were declared extinct, and hundreds more are so critically endangered that we could lose them in our lifetimes.

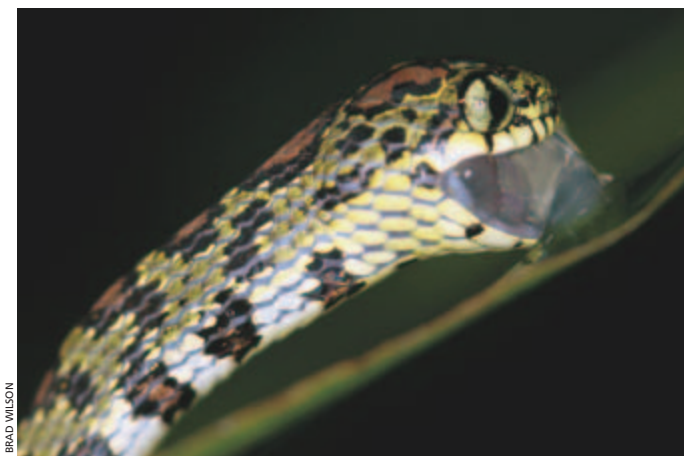
Why Should We Care?

With this grim picture documenting the loss of a huge part of an entire vertebrate class, the inevitable question arises: Why should we care? The answer is complex and eye opening. Amphibians serve as environmental barometers (proverbial canaries in coal mines), responding to signals that we are mistreating the planet in ways that surely will affect us in the future. We are seeing more and more reports revealing that commonly used agrochemicals, such as the herbicide atrazine, occur in our environment at levels hundreds of times higher than those needed to induce hermaphrodites and cause other mutations in amphibians (Hayes et al. 2003). Fertilizer runoff has been linked to nutrient spikes that lead to increased snail populations. These snails support parasites that interfere with proper development in amphibian larvae, resulting in deformities (Johnon and Chase, 2004). Surely, we should pay very close attention to these trends. In addition to the interactions amphibians have with agriculture, they also play a significant role in human cultures. Frogs, such as the critically endangered Panamanian Golden Frog (*Atelopus zeteki*), are thought to bring good luck and fertility. Frogs also have filtered into modern society in commercial branding for cereals, as protagonists in video games, and even in the form of an infamous bullfrog promoting adult beverages. No frog, however, is better known and revered than our friend “Kermit,” who has already hopped up to the plate and taken a stand against the extinction of his class.

“It seems to me that if you wait until the frogs and toads have croaked their last to take some action, you’ve missed the point.”

Kermit the Frog

Amphibians are not only barometers and cultural icons; they are crucial to the well being of the planet, human society, and individual lifestyles. Their roles are multifold. As critical links in global food webs,



Although snakes in the genus *Sibon* are usually thought of as snail-eaters, many rely on frog eggs at least seasonally. Snakes and other predators that rely on frogs to varying degrees are sure to find food supplies more scarce following the disappearance of amphibians from their habitat.

amphibians consume millions of tons of invertebrates annually and themselves become prey for larger predators. The effects are best illustrated by examining situations resulting from the removal of amphibians from ecosystems. In areas where amphibian populations have been decimated, we are just beginning to appreciate the impact. For example, in streams where amphibians and their grazing larvae have disappeared, mats of algae grow, water quality has declined (Connelly 2008) and snakes that normally eat frogs or their eggs literally starve to death (Whiles et al. 2006). The next step in this domino effect is difficult to predict, but I doubt that it will be pretty.

We have much to lose with the disappearance of amphibians. As pharmaceutical treasure chests, amphibians have already supplied human medicine with many useful and important chemicals. From antibiotics and analgesics to compounds that block the transmission of HIV, the thin skin of amphibians has produced many exciting biomedically active products — but both the amphibians themselves and their chemicals are disappearing. Many species have already gone extinct before we could determine what possible biomedical contributions they might have made. Certainly, keeping amphibians on the planet is in everyone’s best interest.

What We Can Do: Conservation Action

In response to the IUCN Global Amphibian Assessment and the need for immediate action to curb pending amphibian extinctions, the Amphibian Conservation Summit was held in 2005 to develop a solution. This historic meeting brought together scientists, policy makers, conservationists, and other interested parties, and led to the Amphibian Conservation Action Plan (ACAP), a \$400-million bailout for amphibians (Gascon et al. 2007). The plan, perhaps the most ambitious of its kind for any conservation action, contains directives and action plans to mitigate major known threats to amphibians. The ACAP specifically outlines work to protect key habitats and areas of biodiversity, addresses issues such as disease, climate change, and pollution, and continues to promote assessments and emergency response activities to prevent extinctions. Conducting this work will require not only scientific expertise and funding but also an effort on the part of each of us to improve environments for amphibians by lessening our impact on the planet. Implementation of the ACAP has not been easy, especially since funding for the initiative is relatively scarce and the necessary global coordination is a monumental task.

The Amphibian Ark

The Amphibian Ark (AArk), an organization formed by the Captive Breeding Specialist Group (CBSG), World Association of Zoos and Aquariums (WAZA), and the IUCN/SSC Amphibian Specialist Group (ASG), has been tasked with implementing the *ex situ* portion of the ACAP (Zippel et al. 2006). Amphibian Ark’s vision is to assure that amphibians are safe in nature for the long term. The organization’s strategy is to safeguard those species that are threatened in nature via global partnerships that establish short-term *ex situ* breeding programs until those threats can be mitigated. In fulfilling its mission to protect amphibians, AArk encourages, facilitates, and helps fund practical delivery of *ex situ* programs through partnerships involving AArk members, national governments, and regulatory authorities. This process requires global coordination, species prioritization, and training in addition to fundraising (to facilitate range-country programs, for example) and outreach (raising global aware-



ness of the amphibian crisis through the 2008 “Year of the Frog” campaign). The organization is small, has only a limited staff and depends on many volunteers. Oversight comes from an executive committee of leaders from each of its three parent organizations. Additional assistance comes from a steering committee with representatives from zoos, aquariums, botanical gardens, and academia. This diverse group helps AArk sustain a more holistic approach to amphibian conservation as it pertains to environmental stewardship, research, and global strategies. Currently the AArk organization has five employees: Program Officer (Dr. Kevin Zippel), two Taxon Officers (Dr. Richard Gibson and Dr. Kevin Johnson), one Training Officer (Ron Gagliardo), and one Research Officer (Dr. Robert Browne).

AArk emphasizes *ex situ* programs in the range countries of the species with solid links to *in situ* activities that promote the protection and restoration of species in natural habitats. Developing these programs is challenging. When lack of staff, funds, or expertise stand in the way of progress in range countries, AArk attempts to fill the gaps. AArk assists with species evaluations and selection in range countries (or regions) through workshops that use a prioritization tool developed collaboratively by AArk partners around the world. Once the range country has a list of *ex situ* priorities, it moves to the next step of identifying local participants, out-of-country partners, and other resources needed to carry out *ex situ* activities. AArk helps provide partners, husbandry training, and other resources to get things moving. In some cases, a lack of basic natural history information creates challenges to managing populations under *ex situ* conditions. How do we successfully manage a species in captivity for restoration work if we do not know how it lives in nature and data on how to maintain or breed these taxa are unavailable? Using related species as surrogates, we can gain valuable husbandry experience to apply in programs involving their critically endangered counterparts. For example, AArk members at the Atlanta Botanical Garden have

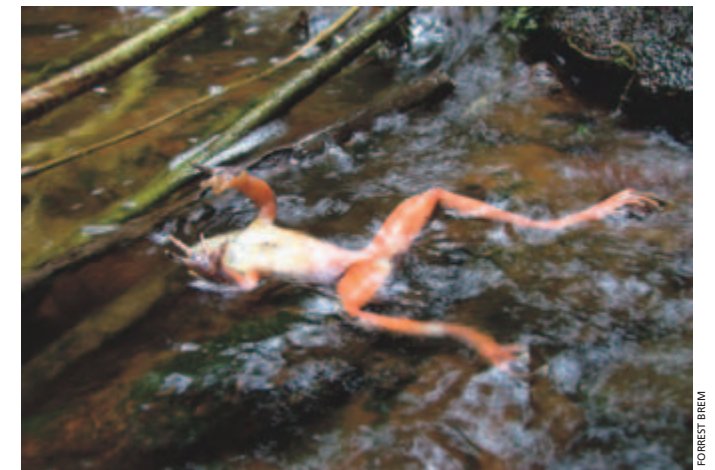


A laboratory in a modified shipping container at the Atlanta Botanical Garden helps scientists manage *ex situ* populations under strict biosecurity outside of their range countries.

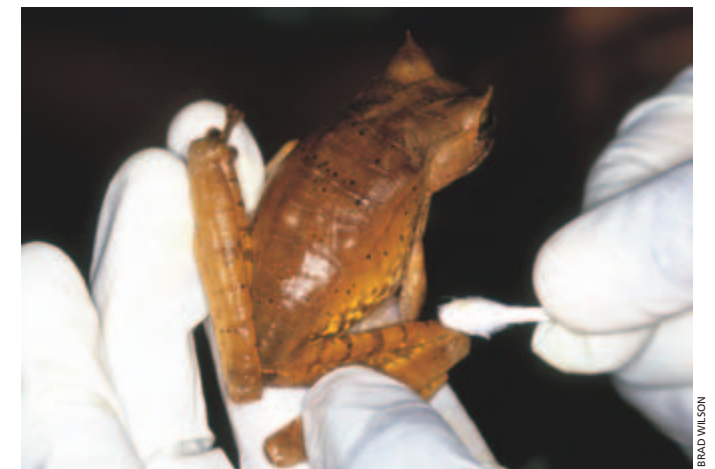
worked out protocols for maintaining and breeding common species of centrolenids (glass frogs) that are used by range country partners in Panama to advance their programs. In a similar collaborative venture, Project Golden Frog, *ex situ* partners in several U.S. zoos worked out care and breeding guidelines for the critically endangered Harlequin Frog (*Atelopus zeteki*) and have provided this information to range country researchers working with other species of *Atelopus*.

2008 Year of the Frog: What We Accomplished

A global publicity and fundraising campaign, “2008 Year of the Frog,” was launched to increase global awareness of the issues that threaten amphibians and to help raise funds for responding to the crisis. Although the educational aspects were global, the capital campaign was managed largely on a local level for more regional programs. Corporate partners, such as Clorox and the Discovery Channel, helped immensely. The campaign was fronted by world-renowned celebrities that included Sir David Attenborough, Jean-Michel Cousteau, and Jeff Corwin, all of whom emphasized the urgency of this crisis to the public. Some of the accomplishments of the campaign and of AArk to date include:



Amphibian chytridiomycosis decimates amphibian populations in natural habitats quickly and is currently unstoppable in nature.



Surveying for the fungus that causes amphibian chytridiomycosis is possible with a cotton swab and a molecular assay in a laboratory. Here a Horned Marsupial Frog (*Gastrotheca cornuta*) is swabbed for subsequent testing.



Centrolenids or Glass Frogs, such as this *Hyalinobatrachium vireovittatum* from Panama, are highly susceptible to chytridiomycosis due in part to their association with riparian habitats.

- AArk conducted 11 prioritization and three training workshops.
- AArk partners currently are working with over 40 species in various capacities.
- 85 rescue populations have been established.
- \$1 million in advertising equivalents have been raised.
- \$4.4 million have been spent on *ex situ* programs.
- \$868,000 has been spent on *in situ* programs.
- 15 biosecure facilities have been added.
- Over half a million website visits have been clocked.
- Over \$12 million have been pledged over the next five years to support amphibian conservation worldwide.

The Future of Amphibian Ark

Many challenges remain for amphibians and their habitats despite an ever-increasing awareness and appreciation of their plight. With nearly 500 species on the verge of extinction, AArk has much to do. AArk would be thrilled to work its way out of a job by conquering the threats currently facing amphibians.

What AArk hopes to accomplish is to save hundreds of species from extinction, develop capacity in institutions globally to provide amphibian species with care and protection as needed, and form true partnerships between *ex situ* and *in situ* components of conservation. If successful, AArk will have created a model framework for responding to future conservation crises and demonstrated to the world that zoos and aquariums are essential conservation organizations. These efforts will require continued fundraising on both grassroots and corporate levels. Of over 1,200 zoological institutions in the world, only a fraction is capable of saving even one species. In the best-case scenario, the current global capacity is 50 species. Clearly, more resources (funds,

facilities, trained staff) will be required to see this to the next level. AArk will work incrementally to increase these numbers and involve more people. Although AArk is small in terms of staff and advisors, the potential amount of effort capable of being put forth by our partners around the world is huge — but ongoing support of local zoos and other institutions is critical if human societies are to rise and meet the challenges of conservation and environmental stewardship.

Amphibian Ark currently is a global network comprised of zoos, aquariums, botanical gardens, and other such institutions, but hopes to metamorphose into a membership-based organization that anyone can join, from a 3rd-grader concerned about the frogs in the creek that runs through her backyard to school classes in Colombia fearful of losing national natural treasures, and presidents and other heads-of-state. Because we all, knowingly or not, have a vested interest in amphibians and their environments, “we are ALL part of Amphibian Ark!” (Zippel 2008).

Amphibians hold a special place in the hearts and lives of many of us. Nearly everyone can relate to amphibians, especially frogs. Few children have grown up without chasing frogs or falling asleep to a melodic (or sometimes raucous) nighttime chorus. From the Frog Prince and Kermit to the Panamanian Golden Frog, frogs are deeply embedded in our collective psyche. Beyond cultural icons, their importance as environmental indicators, critical parts of the global food web, and sources of medicines should not be underestimated. Amphibians have survived on this planet for millions of years — and now, largely as a consequence of human activities, they are threatened with extinction. The amphibians are telling us that our environment



Everyone can be part of the Amphibian Ark, including upcoming young authors like Laura Elizabeth Seydel, whose recent book, *Our Friends, the Frogs*, details the amphibian crisis from a new perspective.



Although most of the news about amphibians in trouble deals with those in tropical areas, temperate-zone species such as the Chiricahua Leopard Frog (*Rana chiricahuensis*) also are threatened with extinction.

has some serious problems and, if we don't act quickly, not only the frogs will go extinct!

References

- Connelly, S., C.M. Pringle, R.J. Bixby, R. Brenes, M.R. Whiles, K.R. Lips, S. Kilham, and A.D. Huryn. 2009. Changes in stream primary producer communities resulting from large-scale catastrophic amphibian declines: Can small-scale experiments predict effects of tadpole loss? *Ecosystems* 11:1262–1276.
- Gascon, C., J.P. Collins, R.D. Moore, D.R. Church, J.E. McKay, and J.R. Mendelson III (eds.). 2007. *Amphibian Conservation Action Plan*. IUCN/SSC Amphibian Specialist Group. Gland, Switzerland, and Cambridge, United Kingdom.
- Hayes, T., K. Haston, M. Tsui, A. Hoang, C. Haeffle, and A. Vonk. 2003. Atrazine-induced hermaphroditism at 0.1 ppb in American leopard frogs. *Environmental Health Perspectives* 111:568–575.



The natural history and biochemical properties of many amphibians, such as this Tropical Climbing Salamander (*Bolitoglossa* sp.) from Panama, are not fully known and many could become extinct before such properties are elucidated.

IUCN (International Union for the Conservation of Nature and Natural Resources). 2008. 2008 IUCN Red List of Threatened Species. <www.iucnredlist.org>.

Johnson, P.T.J. and J.M. Chase. 2004. Parasites in the food web: Linking amphibian malformations and aquatic eutrophication. *Ecology Letters* 7:521–526.

Whiles, M.R., K.R. Lips, C.M. Pringle, S.S. Kilham, R.J. Bixby, R. Brenes, S. Connelly, J.C. Colon-Gaud, M. Hunte-Brown, A.D. Huryn, C. Montgomery, and S. Peterson. 2006. The effects of amphibian population declines on the structure and function of Neo-tropical stream ecosystems. *Frontiers in Ecology and the Environment* 4:27–34.

Zippel, K.C. and J.R. Mendelson III. 2008. The amphibian extinction crisis: A call to action. *Herpetological Review* 33:23–29.

Zippel, K.C., R. Lacy, and O. Byers (eds.). 2006. CBSG/WAZA Amphibian *ex situ* Conservation Planning Workshop Final Report. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, Minnesota.



Endangered Horned Marsupial Frogs (*Gastrotheca cornuta*) breed by direct development; females carry fertilized eggs in pouches on their backs and eggs hatch fully-developed froglets.