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Responding to the amphibian crisis: too little, too late?

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Before the First World Herpetological Congress in Kent, UK, in September 1989, amphibians were nowhere on the conservation radar screen. But at this first gathering of the world's herpetologists there was an opportunity for scientists to compare notes from different parts of the world. They quickly discovered that what had been thought of as strange, local phenomena were being replicated in places as far apart as Australia, Costa Rica, Ecuador, Puerto Rico and the United States. Amphibians were disappearing in seemingly pristine environments, and often the declines were dramatic. In several cases, whole species could no longer be found, perhaps most notably the Gastric-brooding Frogs (*Rheobatrachus* spp.) in Australia, the Golden Toad (*Incilius periglenes*) of the Monteverde Cloud Forest in Costa Rica, and the Web-footed Coqui *Eleutherodactylus karlschmidti* in Puerto Rico.

I was present at that seminal congress in 1989. Looking back on it, the most glaringly obvious thing is how monumentally unprepared both the research and conservation communities were. The first reports of declining amphibian populations that I can find are that of the Yosemite Toad (*Anaxyrus canorus*) in 1970, though this was not published until 1993 (Kagarise Sherman & Morton, 1993). And this was a recurring problem. Very little was published in the peer-reviewed literature on amphibian declines prior to 1989, despite reports of disappearances coming from several sites in Australia, Costa Rica, Chile, Brazil, Ecuador, Venezuela, Puerto Rico, Jamaica, the United States, and elsewhere. Some of the earlier published reports which have received too little attention were those of Dubois (1980) on the extinction of *Scutiger occidentalis* in the Himalayan region of Ladakh and of Heyer et al. (1988) on declines and extinctions in southern Brazil. There was a 19-year period between the first reports of something very strange going on, and the beginning of some recognition that amphibian declines were a global phenomenon. After 1989, the publication rate of peer-reviewed papers on amphibian declines exploded. As stated by Stuart et al. (2004), the scientific community "initially received the reports of declines with some scepticism, because

amphibian populations often fluctuate widely'' (Pechmann & Wilbur, 1994), but tests of probabilistic null models showed that the declines were far more widespread and severe than would be expected under normal conditions of demographic variation (Pounds et al., 1997). This finding, in addition to many further reports of declines in the 1990s (e.g., Laurance et al., 1996; Young et al., 2001), was pivotal in convincing most herpetologists that amphibian declines are non-random unidirectional events''.

One year after Pounds et al. (1997) demonstrated that amphibian declines were a real global phenomenon, a previously unknown chytrid fungus was discovered as a causal agent implicated in many declines (Berger et al., 1998) and named as *Batrachochytrium dendrobatidis* the following year (Longcore et al., 1999). So to summarize, it took 19 years for the global alarm to go up after the first enigmatic amphibian declines were reported; another eight years for reasonable global consensus to be reached that this was a genuine phenomenon; and another two years for the proximate causal agent implicated in several of the enigmatic declines to be named (though there is still an active area of research on other factors and synergies associated with enigmatic declines, especially climate change, but few would now contest the importance of chytridiomycosis, at least as a proximate driver of the particular type of rapid declines within suitable habitats that have sometimes been described as "enigmatic''). This has to be close to a record in terms of slowness of scientific response in the face of a global crisis.

Going back to 1989, some people realised that there was already enough evidence to justify a global response without waiting for all the scientific confirmation to come trickling in. A workshop entitled "Declining amphibian populations – a global phenomenon?'' was convened in Irvine, California, in February 1990, and presented findings and recommendations (Wake et al., 1991; Tyler, 1991), and the participants to this workshop were the basis for the creation, within the IUCN Species Survival Commission (SSC), of the Declining Amphibian Populations Task Force (DAPTF) by George Rabb, then the Chair of the SSC. The DAPTF became the informal, but generally accepted, focal coordinating body advancing research on amphibian declines during the 1990s and beyond. Without the DAPTF, the delay in the scientific response would in my view have been much longer.

The SSC realised that research on its own was not sufficient to address the problem. Our understanding of the status of amphibians globally was still largely anecdotal, and so in 2001 the Global Amphibian Assessment (GAA) was launched, during which the conservation status of all of the world's amphibian species was documented. When the GAA reported in 2004 (Stuart et al., 2004), it showed quite a complex picture. The global level of threat to amphibians was clearly very high, with nearly one-third falling into one of the IUCN threatened categories. The chytrid fungus was indeed implicated in rapid declines of hundreds of species, and in some extinctions. But overall, habitat loss was impacting more species, and because so many amphibians have tiny ranges, there were many instances of species on the edge of survival due to loss of habitat, especially forests. Water pollution was also an important factor, and in East Asia most declines were driven by over-harvesting, especially for human consumption.

The Global Amphibian Assessment placed the amphibian crisis front-and-centre on the conservation agenda. For example, in 2005 a global inter-institutional initiative identified 595 Alliance for Zero Extinction (AZE) sites worldwide that most urgently need conservation if

species are to avoid extinction (RICKETTS et al., 2005). Over half the trigger species for identifying these AZE sites were amphibians (408 out of 794 species), all of them highly threatened endemic species with tiny global ranges. However, because of the phenomenon of enigmatic declines, it was recognized that site conservation alone, though essential, was not sufficient to prevent amphibian extinctions. And so in September 2005, about 100 amphibian scientists and conservationists convened in Washington DC for the Global Amphibian Summit. The main output of the Summit was the Amphibian Conservation Action Plan (ACAP), published in 2007 (MENDELSON et al., 2006; GASCON et al., 2007). The ACAP gave a clear agenda for addressing the amphibian crisis, with a price tag of US$ 409 million. Some important progress has been made in the implementation of the ACAP, for example the field projects being implemented through the IUCN SSC Amphibian Specialist Group (< http://www.amphibians.org/ASG/Projects.html>), and the work of Amphibian Ark to stimulate *ex situ* conservation for species that cannot at the moment be saved in the wild (<http://www.amphibianark.org/>). The GAA amphibian data (now in the IUCN Red List of Threatened Species) have also been used to support policy-making. For example, these data are an important component of the Resource Allocation Framework (now System for Transparent Allocation of Resources), which decides how much funding each country will receive from the Global Environment Facility. Many countries have also used the data to decide which species to protect in their national legislation, for example the Philippines.

However, the overall feeling in the conservation community has been disappointment at the slowness of the response, especially from donors. Accordingly, in August 2009 an Amphibian Mini-Summit was convened by IUCN SSC in London. This meeting prioritized the sections of the ACAP to do with habitat conservation (especially in AZE sites) and with research on chytridiomycosis aimed at coming up with *in situ* mitigation measures. These prioritized portions of ACAP have a budget of approximately US$ 30 million to implement, considered to be a more immediately achievable target than the full cost of the ACAP. Perhaps most importantly, the Mini-Summit decided to form an inter-institutional Amphibian Survival Alliance (ASA) to push ahead ACAP implementation, and the ASA Executive Director and Chief Scientist are now appointed, thanks to annual contributions of about US$ 270,000 committed by seven institutions and/or individuals. It is my hope that the ASA will soon become the major player in driving amphibian conservation forward. It is desperately needed if the amphibian crisis is not to become an amphibian catastrophe.

But in closing I return to the 29-year delay in facing up to the amphibian crisis as a scientific fact. I know of no better example of the imperative for strong, global scientific collaboration than this. Perhaps in our internet age in which conservation biology is now a more respected academic discipline, such a delay would not now happen. Perhaps. But perhaps also we are not open-minded enough to explore new phenomena as they are reported. For sure, it would take us down a few blind allies. But surely that would have been better than the last 40 years of amphibian declines and extinctions.

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