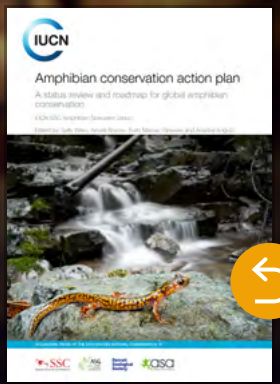
Chapter 2



Access complete book here

The Table Mountain ghost frog (*Heleophryne rosei*) is classified as Critically Endangered due to its small range and ongoing threats, which include altered stream flow from water management and alien vegetation. A collaborative group of organisations are working together to implement a species action plan addressing the threats, to ensure the survival of this species. © Joshua Weeber

Chapter 2

Common themes and challenges

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Abstract

In this chapter, we provide a brief overview of the importance of taxonomy, extinction risk assessments and evidence-based decision-making for conservation work, highlighting key developments in each of these subjects, and suggested approaches to help address some of the current challenges. It is important to bear in mind that, while working on specific amphibian conservation problems, we as a community also strive to make advances in these common themes, which are necessary for effective action worldwide.

Introduction

Taxonomy, extinction risk assessments, and evidence-based decision-making are key to informing virtually every aspect of conservation work. In previous versions of ACAP there were stand-alone chapters for assessments on The IUCN Red List of Threatened Species™ (Red List), that is, assessment of extinction risk (Chapter 9, Gascon et al., 2007) and taxonomy and systematics (Chapter 10, Gascon et al., 2007). However, since these subjects underpin all conservation actions, instead of having dedicated chapters in this document, we briefly present them in this introductory chapter.

In terms of challenges, much of what is in this chapter was inspired by responses to a question asked to IUCN SSC Amphibian Specialist Group (ASG) members when signing up to join the ASG in 2013–2016 and 2017–2020: "Other than funding, what is the single largest factor limiting effective conservation strategies for amphibians at global and regional levels?" (Note that we have included a section on 'resourcing amphibian conservation' later in this chapter to address the question of funding.) These expert perceptions highlighted a number of obstacles which are almost ubiquitous to those working in amphibian conservation, including lack of coordination and collaboration, lack of government support, amphibians not being prioritised, and a lack of knowledge of species biology/ecology.

Taxonomy

The capacity to effect changes through conservation action is underpinned by accurately identified and delineated species (Angulo & Icochea, 2010). The discipline of taxonomy thus plays a fundamental role in species conservation (Mace, 2004 and references therein), and has a bearing on everything from surveys and monitoring, extinction risk assessments, prioritisation approaches (e.g. Evolutionarily Distinct and Globally Endangered (EDGE) rankings, Alliance for Zero Extinction (AZE) sites and Key Biodiversity Areas (KBA)), funding acquisition, and species conservation planning and implementation.

Taxonomy, however, is not static; and theoretical, conceptual, and methodological developments have led to changes in the understanding of what species are and their respective delineation. There are ongoing discussions on the effects of the application of specific species concepts and associated methodologies, in some instances leading to what has been termed 'taxonomic inflation', the elevation of subspecies to species due to use of phylogenetic species concepts (Isaac, Mallet & Mace, 2004) and overreliance on a relatively limited number of mitochondrial or nuclear-encoding genes (Dufresnes & Jablonski, 2022) – here acknowledging that access to funding and the availability of specific tools is highly variable. However, the rate of newly described amphibian species as the result of new discoveries, rather than hierarchical taxonomic changes, is high (Padial & De la Riva, 2006). In terms of overreliance on specific datasets, integrative taxonomy, where all sources of evidence are combined to assess the taxonomic status of species (Padial et al., 2009), is increasingly and effectively being used in amphibian taxonomy. As a consequence, taxonomic resolution is ongoing, resulting in changes to species names and new species descriptions. Taxonomic change does not appear to have a consistent effect on conservation, although splitting taxa could lead to greater extinction risk and increased protection (Morrison III et al., 2009). Amphibian taxonomy has seen significant changes over the last two decades, both in terms of efforts to align higher-level taxonomic hierarchy with phylogenetic hypotheses (Dubois, Ohler & Pyron, 2021; Frost et al., 2006; Pyron & Wiens, 2011), and in terms of new species descriptions, which have been occurring at a rate of about 100-150 species/year (Frost, 2022; Streicher, Sadler & Loader, 2020; Tapley et al., 2018). Amphibians as a clade still have many undescribed species and, while it is unclear exactly how many, conservative estimates by Giam et al. (2012) placed the number at over 3000 undescribed species when the study was published. This suggests there are approximately 900 additional species still left to be described at this time, and up to half of them could be threatened (Liu et al., 2022).

A limitation for conservation is that species are the basis for conservation assessments and species management (Mace, 2004), and undescribed species cannot be assessed for extinction risk, although in principle conservation action should not be prevented. Taxonomic uncertainty around the delineation of a biological entity, such as cryptic taxa, will impact a species' true extinction risk (e.g. see Angulo & Icochea, 2010). Taxonomic splits often result in range reduction, which can increase the impact of threats. On the other hand, species whose taxonomic validity is in question (for example, due to unknown provenance, lost type specimens, etc.) are typically assessed as Data Deficient, and as a result receive lower conservation attention.

Species are described primarily by taxonomists, and where there are few taxonomists and few resources to undertake taxonomic studies, species descriptions will likely lag behind, having a direct impact on our ability to identify threatened species in a timely manner. The term 'taxonomic impediment' has come to be associated with this phenomenon (Raposo et al., 2021), with a suite of multi-faceted reasons accounting for this situation (see Engel et al., 2021).

Some suggestions that could be implemented to help advance both amphibian taxonomy and conservation include:

- **Taxonomic clarity list(s)**: there are many cases of species where taxonomy is a major issue to an adequate extinction risk assessment and subsequent decision-making. It would thus be helpful to identify, contribute to and maintain a list of those instances where taxonomic clarity is specifically

Box 2.1: Taxonomic clarification of a clade of the *Onychodactylus* clawed salamanders prompts conservation action

Salamander conservation in the extreme south-eastern tip of the Korean Peninsula has been a tense issue for the last decade, without any change in legislation or habitat protection despite legal and citizen-led actions. However, following the description of *Onychodactylus sillanus,* the Yangsan clawed salamander (*see* ACAP cover; Borzée et al., 2022), several workshops including government representatives have been organised around the protection of this species and *Hynobius yangi.* As a result, the city council of Yangsan (eponymous city of the species) now supports its conservation; a memorandum of understanding is being finalised between the city and conservation groups, workshops with landowners are being initiated, a national regulation on conservation is being reworked, and a dedicated ecological school is being set up.

needed for conservation decision-making, in particular, instances of species listed as Data Deficient due to taxonomic uncertainty (currently 288 of 8011 species based on the Red List; ~3.6%). This is something that could be led by the taxonomic community.

- **Awareness-raising**: obtaining funding for taxonomic work is extremely difficult, in certain instances perhaps even more so than obtaining funding for conservation. It is therefore important to raise awareness about the importance of taxonomy for conservation among funding entities, conservation organisations and the general public, and, where possible and relevant, include both aspects in fundraising efforts. Both taxonomists and conservationists could join forces in this endeavour.

- **Increase collaborations**: certain parts of the world have a dearth of taxonomists and resources relative to their respective species richness. Creating a network to strengthen international collaborations may help advance taxonomic studies in these regions. This could be led from the amphibian taxonomic community, with support from the conservation community (for example, establishing such a network within the ASG).

Updating Red List assessments

The process and task of assessing the extinction risk of amphibians for the Red List has changed over time. The first Global Amphibian Assessment (GAA) comprised the assessment of the then-known 5,743 species between 2001–2004 (Stuart et al., 2004). Each species was evaluated against the IUCN Red List Categories and Criteria (IUCN, 2012) through a series of regional workshops. Updates to the Red List in 2006 and 2008 added new species and some re-assessments. Key challenges of the GAA included convening the global herpetological community to undertake a comprehensive assessment for the first time, and maintaining consistency in the application of the extinction risk methodology across all regions. More information on the early GAA process is available on the ASG website (www.iucn-amphibians.org/wp-content/uploads/2019/03/Amphibians-Initiative-2008-webcontent-Downloaded-27Nov2018-1.pdf).

The ASG's Amphibian Red List Authority (ARLA) was established in 2009 to regularly reassess all species and continue the work of adding newly described species to the Red List each year. By that time, more than 6,000 species had been described. The appointment of Regional ARLA Coordinators began in 2010 to support and guide this work, which was undertaken by short-term volunteers. After six years of continuous effort, the ARLA found that a large backlog of new species and out-of-date GAA assessments had accumulated. The strategy for maintaining the amphibian data on the Red List was reviewed at that time and several persistent challenges were identified, including the increasing rate of taxonomic changes; the emergence and development of threats faced by amphibians; and the ARLA's reliance on volunteers. The amphibian assessments on the Red List were becoming outdated faster than the ARLA could update them.

In response to these challenges, the ARLA launched the second Global Amphibian Assessment (GAA2) in 2015. Replicating the approach of the first GAA, funding was gradually raised to employ a core global ARLA team to coordinate assessment projects for each ASG region in collaboration with Regional ARLA Coordinators, ASG Regional Chairs, and key experts in amphibian conservation and research. Completed in 2022, the GAA2 synthesises 18 years' worth of data, and has assessed the extinction risk of more than 8,000 species (~ 95% of currently known species) through a combination of in-person and virtual workshops of different sizes, internships and consultant contracts, and collaborations with national Red List processes. In addition to the challenges mentioned above, the GAA2 built the case for a second assessment process to donors and partners; tackled the increasing data requirements for Red Listing; incorporated successive versions of the IUCN Red List Guidelines (e.g. IUCN Standards and Petitions Committee, 2022) which required changes to methods such as the calculation of extent of occurrence (EOO); and shifted to an entirely virtual workshop process in 2020 due to the emergence of the COVID-19 pandemic.

A new strategy has been developed building on the first two GAAs. Among the goals are improvements in efficiency to prevent delays to first-time assessments, and increased uptake of the assessment data into planning efforts and active conservation programs at national and regional levels. Some key points of the new strategy are:

- **Each GAA cycle will last for five years. The GAA3 will run from 2024-2028, and the GAA4 from 2029-2033.**
- **Threatened species will be assessed each GAA cycle (5 years), and non-threatened species will be assessed at least every second GAA cycle (10 years).**
- **Ideally new species will be assessed within two years of being described.**
- **As much as possible, GAAs will collaborate with national and regional-level assessment processes, such as national red lists.**
- **Global, regional and national partnerships will be established to facilitate the uptake of assessment data into local conservation efforts.**

The ARLA invites interested parties to provide information to the GAA3, collaborating on the following priorities:

- **Publishing data** relevant to Red List assessments in species descriptions and survey and expedition reports, where possible. Of particular interest is information regarding ecological traits that increase a species' vulnerability to specific threats; past and present habitat quality; current population status, and past/present/future threatening processes.
- **Contacting the ARLA when a species urgently requires assessment or reassessment** in light of significant emerging threats, and where new adequate information is available for the assessment of newly described Not Evaluated (NE) and Data Deficient (DD) species. In such instances the ARLA will endeavour to prioritise their extinction risk assessment in a timely manner.
- **Improving the quality of distribution maps**, including historical ranges.
- **Increasing the consistency and accuracy with which certain threats are evaluated**, including emerging diseases, habitat loss, over-harvesting, and climate change.
- **Undertaking Green Status of Species assessments** alongside Red List assessments, where data is sufficient.
- **Broadening participation** in the assessment process to include the knowledge and experience of indigenous peoples, citizen science initiatives, managers of conservation projects, zoo and aquarium staff, members of governmental agencies, donors, etc.
- **Strengthening linkages** with national Red List processes.

- **Encouraging the use of Red List data** – both the category and supporting information – in conservation planning, collaboration, and action at global and national levels.

Limited understanding of species ecology and biology

In an ideal scenario we would be able to gather and access the basic data that are needed to understand the extinction risk and needs of all species. As this is not the case, we need to make conservation decisions based on existing information, which is often imperfect and incomplete. Following a precautionary approach, the IUCN Red List Categories and Criteria (IUCN, 2012) allows the use of a variety of types of data quality, including observed, estimated, projected, inferred, and suspected. Furthermore, the Red List process provides guidance on dealing with uncertainty (IUCN Standards and Petitions Committee, 2022). In addition, the Red List differentiates between required and recommended data to facilitate assessments in data-poor situations. These approaches enable the assessment of the extinction risk of species that have different types and amounts of data and different levels of data uncertainty. While Red List assessments are robust to missing data (Maes et al., 2015), the data needed to accurately assess all species against all the Red List Criteria are currently crucially missing or too uncertain for 11% of amphibians listed as DD, which is lower than the 14% DD mammals (IUCN, 2023). This is especially relevant as estimates of the number of amphibian species currently listed as DD that are likely to be threatened are high, ranging from 50% (González-del-Pliego et al., 2019) to 85 % of DD species (Borgelt et al., 2022).

The data that are used to inform extinction risk assessments include geographic range, population status, population trend, habitat and ecology, threats, use and trade, and conservation actions in place and required. These are covered on the Red List website (IUCN, 2023; see https://www.iucnredlist.org/assessment/supporting-information). The Amphibian Ark Conservation Needs Assessment (CNA) compiles additional and complementary information derived from 26 questions, seeking to determine the conservation needs of any species (Johnson et al., 2020; https://www.conservationneeds.org/Help/EN/QuestionsAnswers.htm). Together, these resources list data that, if all available, would allow a comprehensive picture of the extinction risk and conservation needs of a species. However, not all types of data are equally available, and some are more resource-intensive and thus not as easy to obtain. Where extinction risk is concerned, the most commonly missing information is that relating to population status, trends, species-specific life history (much information is inferred from known congeners and used as a proxy for the lesser-known species), certain types of threats, their synergies, and their relative contributions to any observed declines.

Only a fraction of these types of data are available for even the most studied species (Nori, Villalobos & Loyola, 2018). Furthermore, once a species is assessed, additional knowledge is required to plan appropriate conservation interventions, and understand and remedy the original causes of decline. This not only encompasses the target species, but also the habitats in which it thrives, the behaviours that need to be expressed and the ecological requirements to ensure that the environment provided is adequate for the conservation of the species (Conde et al., 2019).

The reasons behind the lack and paucity of data can be as varied as they are subtle. As can be seen in the Resourcing amphibian conservation section (*below*), a lack of resources is certainly a challenge; however, there are also other important reasons to consider. There are not many papers that cover this subject, so we offer some reflections based on our own collective experiences, some of the references that we could find, as well as some recommendations:

- **Geographic and thematic realities and biases**: the highest amphibian species richness can be found in tropical regions, where there is still an undetermined number of undescribed species (Moura & Jetz, 2021). Taxonomy is thus a priority for many tropical herpetologists, who tend to develop their skills in this field. The distribution of threatened species also coincides with many amphibian species richness hotspots, so in a

way threatened species compete for attention with the undescribed species. Data-deficiency also causes regionally biased priorities (Borgelt et al., 2022). In addition, there are geographic and cultural aspects that may play a role, such as the availability of professional opportunities and the support, or lack thereof, to publish scientific papers (Urbina-Cardona, 2008; Young et al., 2001). Understanding what these realities are within an amphibian biologist's own region and community, as well as increasing international collaborations to advance amphibian taxonomy in regions with few taxonomists and resources to undertake taxonomic studies (*see* Taxonomy section), may help to take further steps to change the status quo.

- **Scope of work**: Population data are key to understanding the effects of threats and potential conservation interventions, thus helping with decision-making processes, however, population studies with a focus on explicitly informing wildlife management are perhaps not all that common. Increasing collaborations between academics and wildlife managers would help better understand wildlife management data needs and in turn, inform conservation actions.

- **Data ownership and data sharing**: use of unpublished data can be a sensitive issue, especially among certain disciplines, career stages, cultural perspectives, and stakeholders (e.g. consulting firms involved in environmental impact assessments; von May et al., 2008). At the opposite end of the spectrum, some types of information that don't pertain to the immediate field of interest may not be prioritised for use (e.g. information on threats in a taxonomically focused programme). Consideration of data sharing among the multiple stakeholders would be a valuable development for increased access to data and knowledge, as would developing and improving policies on how data would be used and contributors acknowledged (Tapley et al., 2018).

- **Data quality**: where data are available there are sometimes questions regarding how they are collected. This is especially the case when the data are not published in peer-reviewed journals (e.g. see von May et al., 2008). In some instances and under certain conditions, it may be preferable to use some types of data (e.g. occurrence data with specialist identification) over others (e.g. survey data that require standardised methodologies). Citizen science projects, such as the Amphibian BioBlitz run by the iNaturalist.org platform (https://www.inaturalist.org/projects/global-amphibian-bioblitz), FrogID in Australia (https://www.frogid.net.au), or the International Bornean Frog Race (http://www.internationalborneanfrograce.com/) have the potential to provide important occurrence data and in this way, help bridge some knowledge gaps in light of the number of participants and data (more than 220,000 participants contributed data for more than 4,900 species in the iNaturalist Amphibian BioBlitz).

- **Capacity to fundraise**: the ability to bring in financial resources for project work can be limited by the lack of familiarity with the process of writing and applying for grants, which may preclude amphibian biologists from applying or from presenting competitive proposals. Furthermore, limited fluency in English may be another constraint in countries that speak languages other than English, as most calls for proposals are in English. More training opportunities in fundraising would help build capacity in this regard, while multicultural collaborations could help with proposal development in the English language (*see the section below* on Resourcing amphibian conservation for more information). In addition, grant providers could also help overcome this issue by accepting applications in languages other than English.

- **Synthesis**: new studies are constantly being published; however, the scientific literature tends to be dispersed across many journals, making it difficult to get an overview of the 'big picture'. Thus, there is a need for studies that bring together the various sources of information into a cohesive body of work that may allow for a quicker identification of knowledge and gaps, which can in turn help inform what kind of data are

still needed. Research communities would be well positioned to lead these sorts of studies.

- **Coordination**: individual amphibian biologists are often comfortable working within their established sites and their networks, but in order to address knowledge gaps more effectively at a country or regional level, higher-level coordination is needed. Coordination requires dedicated effort and time, and unfortunately it is rarely contemplated outside of a specific project or organisation; yet, it is absolutely essential to increasing efficiencies and filling knowledge gaps. Because of this, higher-level coordination efforts would be best led by institutions such as government agencies, museums, NGOs and herpetological societies, and/or (depending on the scope) the ASG, Amphibian Survival Alliance (ASA) or groups such as the Atelopus Survival Initiative (ASI) when appropriately resourced.

Evidence-based conservation action

Over the past two decades there has been a growing push for evidence-based conservation action, based on the example of evidence-based reforms in medicine and public health (Pullin & Knight, 2001). The aim of such initiatives is to close the gap between scientific knowledge and conservation action (Sutherland et al., 2004), avoid repetition of unsuccessful interventions, and more effectively use the limited funding that is available to achieve the biggest conservation impact.

However, making conservation decisions based on evidence relies on the relevant evidence being available to those making the decisions. Specifically, it requires monitoring and evaluation of conservation actions (Pullin & Knight, 2001) and reporting of what is found (both successes and failures) in a format that is freely available to others involved in conservation decision-making. This requires that the information be available in a language that can be understood by the decision-makers (Amano et al., 2021), and that there is not a significant delay in publishing relevant evidence, which needs to be available in a timely manner to have maximum impact on conservation action (Christie et al., 2021). Furthermore, some evidence will clearly help in making better decisions, particularly where the benefits of a specific approach have been well assessed, such as the removal of an invasive fish which preys on a threatened amphibian species (Sutherland et al., 2021). However, it may be more complex to apply evidence-based thinking to multi-dimensional issues, operating in context-specific situations, where directly relevant evidence is unavailable (Adams & Sandbrook, 2013).

While there has been an increase in effort to make results more freely available, for example the establishment and growth of the Conservation Evidence information resource (www.conservation-evidence.com) and associated open access journal Conservation Evidence (Sutherland et al., 2004, 2019), there are still significant biases in reported results. For instance, Christie et al. (2020), found that approximately 90% of the published evidence on amphibian conservation interventions in the Conservation Evidence journal is based on studies from North America, Western Europe and Australia. Furthermore, taxonomic bias was also clear, with only a single study on Gymnophiona. As such, extrapolating results to different taxa in tropical climates and habitats may not be appropriate. In addition, negative results are often underreported for a variety of reasons, such as difficulty to publish such results in peer-reviewed journals, and potential stigma when applying for future funding.

In order to increase the use of available evidence in amphibian conservation, with the wider aim of improving conservation outcomes, we encourage researchers and implementers to:

- **Review existing evidence-based resources**: when planning conservation interventions, consult the available evidence-based literature and broader resources to inform your decision-making process. Some important resources include the Conservation Evidence website (www.conservationevidence.com), which currently gathers ca. 130 actions for amphibians, and the publication *Amphibian Conservation: Evidence for the effects of interventions* (Smith & Sutherland, 2014) and *What Works in Conservation* (Sutherland et al, 2021).

- **Plan up front to report results**: methodically record results of interventions that you are undertaking, so that you can report whether or not the action was successful.

- **Report your findings**: communicate your results in a timely manner, and preferably in a stable format (e.g. a recurring publication) freely available to others. This may be in an Open Access journal, or could be within a newsletter, bulletin, or magazine, such as the amphibian conservation community's publication, FrogLog (https://www.iucn-amphibians.org/resources/froglog/). Also consider if it may be more useful to report your findings in a specific language, or multiple languages.

- **Strategically fill gaps in the current evidence-base**: aim to specifically report on effectiveness of conservation actions outside Western Europe and North America, and with better representation of all taxa. This may be via publication of information already gathered, or strategically aiming to fill known gaps.

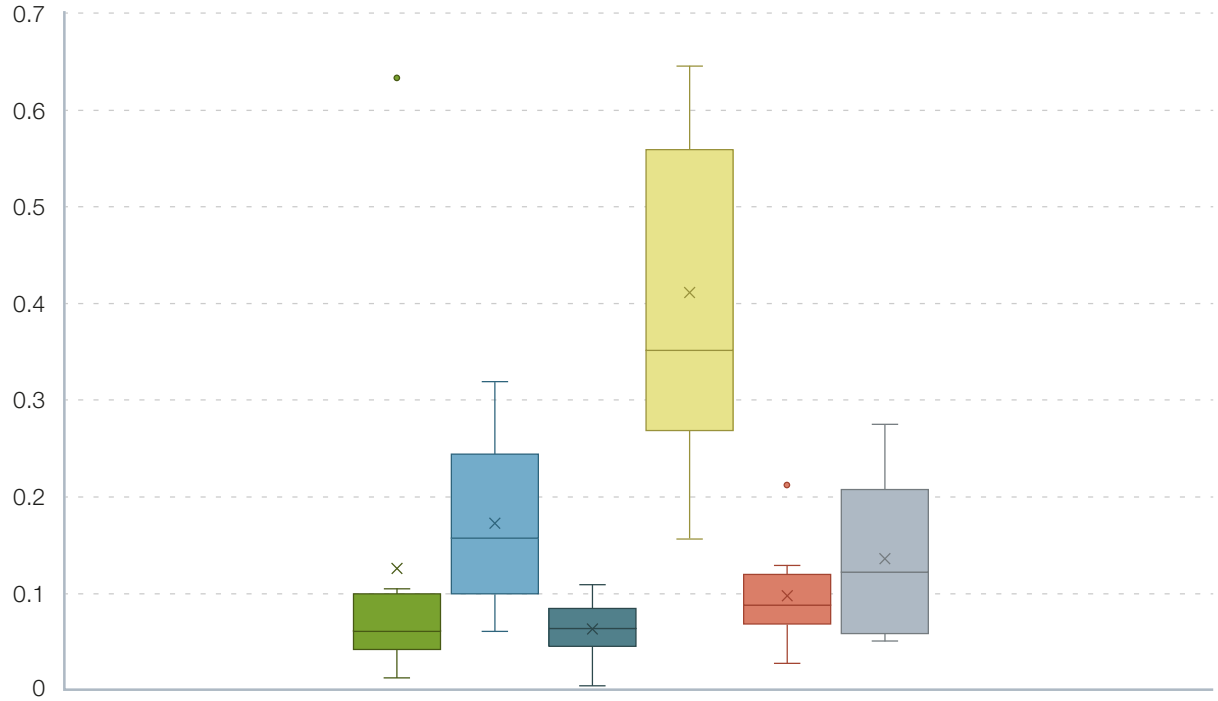
Resourcing amphibian conservation

Amphibians are the most threatened vertebrate class (IUCN, 2023; Luedtke et al., 2023), yet the level of global investment in amphibian conservation has not been commensurate with the amphibian extinction crisis, which has been known and publicised for several decades. Even within the often financially constrained world of conservation, chronic and severe underfunding has been a persistent issue (Bishop et al., 2012). Informed by the findings of the first GAA, a group of amphibian experts were convened to the 2005 Amphibian Conservation Summit in Washington, DC, USA to develop the first ACAP. It was estimated that implementing ACAP would cost over US$ 400 million over a period of five years (2006–2010; Gascon et al., 2007). As global fundraising for amphibians was not tracked, it is unclear how much of these funds were raised; however, our collective experience suggests that it was nowhere near that target. There aren't many studies that examine amphibian conservation spending, but we know, for example, that in the United States amphibians receive just one-quarter of the Endangered Species Act (ESA) compared with funding for other vertebrate classes (Gratwicke, Lovejoy & Wildt, 2012). There are also documented instances of lost support. For example, the United States Fish and Wildlife Service (USFWS) managed the Amphibians in Decline Fund, which supported conservation efforts in 25 countries from 2010–2016. Unfortunately, the programme ended once funding dried up (Scott, 2021). The collective experience of amphibian-focused groups and organisations, including ASG, are very much in line with this finding.

This scenario, and the continuing difficulties in supporting amphibian conservation at a global scale, begs a couple of questions: **1)** why is it so difficult to fundraise for amphibian conservation, and **2)** when fundraising is successful, how much has been raised?

The first question is more complex as there are likely many aspects at play. To begin with, as a generality, amphibians are not part of the charismatic megafauna that often get the most attention. It has been shown that factors such as charisma are often more important than ecological information or in driving individuals' willingness to pay for biodiversity conservation efforts, and that individuals often have preferences for species more similar to humans (Colléony et al., 2017; Martín-López, Montes & Benayas, 2007). The second question, however, is something that we can investigate more easily, especially when referring to project funding. In order to better understand the international financial support received by amphibian projects we wrote to established non-taxonomically focused biodiversity conservation funds, supporting organisations and donors. We approached twenty organisations that regularly provide grants, awards and materials for projects that support general biodiversity conservation and asked them about patterns of applications and funding for different taxa as well as perspectives on what changes may be needed. Separately, we also reviewed the information available to prospective grantees on the websites of thirty-three organisations that have either provided grants to local or national amphibian conservation projects in the past, or are listed on the ASG's webpage of potential funders of amphibian conservation. Where the data were available, we collated: **1)** how many grants out of the total per year or since foundation had been

a) Focal taxa by proportion of funded projects



b) Focal taxa by proportion of total dollar investment

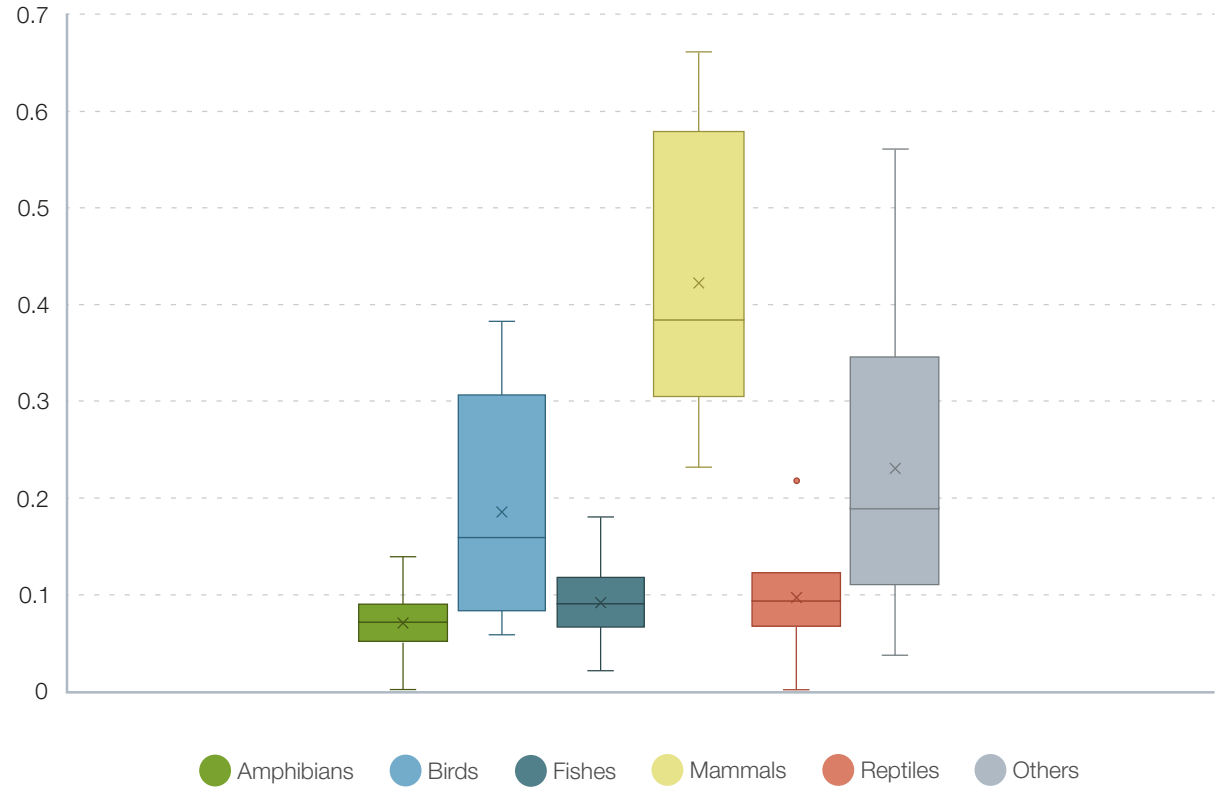


Figure 2.1: A sample of funding for amphibian conservation compared with other taxa, for which data were available; **a)** Focal taxa by proportion of funded projects (n = 9 funders), and **b)** Focal taxa by proportion of total dollar investment (n = 8 funders). Note: The 'others' category encompasses projects for plants, fungi and invertebrates, and those which are not taxon-specific. Source: A. Angulo & S. Wren, unpublished data.

explicitly allocated to amphibian conservation, **2)** the languages that an application would be accepted, **3)** whether core costs, salaries or overheads could be funded, **4)** the maximum size of grant offered, and **5)** whether renewal was possible. Not all organisations had all information available on their websites, and it must be noted that not all funders list all grantees on their website.

In our survey, of the twenty organisations contacted, twelve replied. However, because of the focus of some of these organisations or how they organised their project support (for example, not explicitly by taxonomic group, or with different groupings), not all of the responses could be used in the same way. A summary for those organisations that did record the number of grants awarded by taxonomic group is provided in Figure 2.1. It is important to note that the data provided covered different timeframes or specific programmes, so we used proportions of what was reported to account for these differences. Several organisations funded multi-taxa projects or projects without a taxonomic focus (e.g. habitat-based), which may have been beneficial to amphibians. Most of the organisations surveyed have been providing grants for amphibian conservation for a decade or more.

One organisation had a grant programme specifically for amphibians, so over 60% of projects funded had amphibians as the focal taxon (*seen* as an outlier in Figure 2.1a). For the remainder of respondents, the proportion of funded proposals and proportion of dollar spending that focus on amphibian projects were relatively small, particularly when compared with those for birds and mammals. Mean dollar investment in amphibians was lower than that for all other vertebrate taxa.

Of those organisations that did keep track of accepted and submitted proposals, the proportions of amphibian applications that were funded were comparable to or higher than other taxonomic groups in their respective grant periods (14.3%–29%). Most organisations did not have a policy for funding a specific number, proportion, or dollar amount for any given taxa; however, several responded that they do take into account, for example, the high proportion of threatened amphibian species, when reviewing applications.

While it is true that, of the data assessed, amphibian proposals receive less funding relative to their tetrapod counterparts, there are a few new pieces of information that can help us understand the funding shortfall in a different light and adjust our collective fundraising approach accordingly. To begin with, based on our limited survey figures and some of the feedback received, amphibian proposals seem to be submitted less frequently than those of other vertebrate groups, so it stands to reason that allocated funding would reflect this. Potential causes could be simply because the pool of prospective applicants is smaller relative to other taxonomic groups due to amphibians' perceived lack of charisma, or the lack of prestige in working on this taxon (Urbina-Cardona, 2008), or because of limited language or technical capacities, all of which result in a broad lack of capacity in amphibian conservation. This suggests that increased applications for amphibian-focused projects could result in increased funding being allocated to amphibian conservation. However, several organisations would like to see proposals that have a high degree of collaboration (for example, some organisations receive projects that are similar to each other and that would benefit from working together), that focus more on specific approaches (e.g. threat mitigation, instead of mostly collecting baseline data) or coming from locally-based parties in particular regions (e.g. Africa and Asia), so it is important that as a community we understand what are the priorities of funding organisations and that we address them accordingly.

Reviewing the information available on the thirty-three amphibian conservation funders' websites also revealed several areas that could be addressed to increase support for amphibian conservation from the side of funders and donors. Similar to the survey, we found that the level of support for amphibian conservation (based on projects listed on funders' websites) was disproportionately low relative to the threat the taxon is facing. The largest funders (those offering US$ 40,000 or more) supported a very low proportion of projects that mentioned amphibians in their project summaries (about 3% of total projects funded that

listed this information). It is also worth noting that most of these funders did not specify the size of the grant offered, so 3% of total projects funded does not necessarily equate to 3% of total grant funding. For example, the Darwin Initiative offers grants between approximately US$ 11,000 and US$ 5,600,000, but the largest grant found offered to an amphibian-focused project was approximately US$ 12,700.

Medium-scale funders (those offering US$ 10,000 to US$ 25,000) offered substantially more amphibian-focused grants as part of their portfolios, an average of about 11% of projects that listed this information. In addition, there are several small-scale funders, offering around US$ 5,000 that are amphibian or herpetological-specific in their scope, which regularly provide critical support for amphibian conservation organisations on the ground. Despite the strong support from medium- and small-scale funders, the size of grants offered by these groups is generally insufficient to allow organisations to scale or develop ambitious conservation interventions. When this is combined with the fact that only a third of funding organisations indicated on their websites that they welcomed renewal or repeat applications, it is clear that the funding accessible to most organisations is simply not stable, and it is deeply challenging to diversify income. Compounding this further, only nine organisations indicated that they would consider at least partially supporting core costs, salaries or overheads. These restrictions make it extremely challenging for grantees to develop strong organisational structures and retain staff, which will inevitably have an impact on conservation action. Finally, over half of funders (17 organisations) only accepted applications in English. This is a huge barrier to many conservation organisations and does not reflect the dominant languages spoken in areas where amphibians are facing greatest threats and areas of highest species richness.

Given our improved understanding of the nuances involved in resourcing amphibian conservation through projects, we suggest the following:

- **Increasing capacity for grant-writing and fundraising**: there is a need for more high-quality amphibian proposals to be considered in the various granting mechanisms that are available to biodiversity conservation. Investing in developing this capacity should result in a higher number of quality applications and therefore in more amphibian conservation projects getting funded. The ASG has its Grant Writing Mentorship Programme, which pairs an experienced reviewer with an up-and-coming amphibian conservationist so that a proposal can be assessed prior to being submitted. Scaling up the programme, in addition to putting together resources that can complement it, should help increase grant-writing capacity.

- **Expanding approaches**: obviously baseline data are essential to inform conservation action but these data alone may not be sufficient to qualify for a conservation grant. Most amphibian conservationists are formally trained researchers but are not necessarily trained in implementing conservation action, so a reassessment of scope would be advisable for applicants. Projects implementing actions aimed at mitigating a specific threat might have a higher chance of securing a grant.

- **Increasing collaborations and coordination**: to reduce duplicity and internal competition within the amphibian conservation community it is important that researchers and conservationists who work on similar systems within the same geographic and thematic areas collaborate. In order to achieve this regional or national-level coordination is necessary. With appropriate resources, ASG would be well positioned to support this coordination via its Regional Groups, as would ASA and ASI via their respective partners.

Collaborations

Collaboration is key to conservation. When asked "Other than funding, what is the single largest factor limiting effective conservation strategies for amphibians at global and regional levels?", lack of coordination and collaboration within the amphibian conservation community was the third most common response among ASG members in both the

2013–2016 and 2017–2020 IUCN quadrennia. There are many forms of collaboration, and multiple forms are often needed to maximise conservation success.

In amphibian conservation, perhaps the first and most obvious form of collaboration is between the persons implementing conservation projects and those conducting research. Interdisciplinary collaboration is vital to conservation success, as there is a vast diversity in competencies required for modern conservation, as is described in the chapters of this ACAP. In practical application, no one action described in the following chapters can be isolated from the others in terms of achieving successful conservation of amphibians. This explains the deliberate overlap of ACAP's chapters and why ASG highly recommends that collaborations be applied to conservation action. While collaboration may seem intuitive, interdisciplinary collaboration can be a challenge to execute, especially due to the modest funding generally available for amphibian conservation, with challenges in communication and increases in complexity and length of projects (Lanterman & Blithe, 2019; Pannell et al., 2019). Many modern universities are promoting interdisciplinary training in the new generation of conservation implementers, but often their administrations have not yet determined how to effectively overcome the separation of disciplines and do not fully appreciate that this can take more time and effort to execute than single-discipline research (Andrade et al., 2014; Lanterman & Blithe, 2019; Pannell et al., 2019). The benefits of interdisciplinary action outweigh the challenges, and can be overcome by remaining open-minded, using frequent communication among all stakeholders, and promoting collaborations as outputs to funding sources and administrators (Andrade et al., 2014; Lanterman & Blithe, 2019; Pannell et al., 2019). In addition to collaborations across conservation disciplines, partnering with others of the same discipline is encouraged for increased efficiency. Often several researchers in separate institutions will work in tandem on the same conservation goal and find themselves competing for funding and resources.

A second form of collaboration to emphasise is interdisciplinary collaboration with individuals who have skillsets outside of the conservation sciences (Aziz et al., 2013). Conservation is too often placed exclusively in the hands of scientists, and while science and research are paramount to understanding conservation needs and actions, participation from disciplines outside of conservation sciences is crucial to implement conservation. In the face of the extinction crisis and climate change, the urgent need for novel solutions and radical changes to how we live requires the engagement of all sectors in the conservation of nature. This means all skillsets are needed in the field of conservation. While this demand for collaborators with varied skill sets is recognised by many conservation scientists, it is still an area of great need.

The third form of collaboration, and most important for true conservation success, requires the collaboration of the community, may it be through non-governmental or governmental organisations. A community can be as small as a neighbourhood, or can be as large as the global community. While this is the most important form of collaboration, it can also be the most challenging to achieve and measure. Collaboration with local communities can lead to impacts such as habitat protection (O'Brien et al., 2021; Roach, Urbina-Cardona & Lacher, 2020) and increase in positive behaviours toward species (Perry-Hill et al., 2014). Examples of collaboration in global amphibian conservation include not only the work of the ASG but also that of AArk and the ASA, which catalyse action by linking up partners with common or complementary interests and skills, respectively. Likewise, the ASI does this at a regional level for the genus *Atelopus*, seeking to nurture coordinated collaborative efforts (Valencia & Fonte, 2022).

Improving governance

There are multiple international conventions relevant to amphibian conservation – the Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Convention concerning the Protection of the World's Cultural and Natural Heritage, and the United Nations Framework Convention on Climate

Change (UNFCCC), to mention a few. The United Nations Sustainable Development Goals (SDGs) provide a key framework in which to incorporate amphibian conservation in broader sustainability efforts. In addition, the CBD Kunming-Montreal Global Biodiversity Framework (GBF) has four broad global goals and 23 targets for 2030 to conserve nature; many of these targets are relevant to amphibians, and in particular, Target 4 (Threatened species are recovering, genetic diversity is being maintained and human-wildlife conflict is being managed; CBD, 2022). However, inadequate governance – encompassing lack of legal support, lack of political will, and lack of enforcement of existing laws – is one of the obstacles to implementing amphibian conservation most frequently cited by ASG members (mentioned by 23% of respondents in 2013 and 34% of respondents in 2019, for the 2017-2020 quadrennium).

Even where obligations for implementation of such conventions are relatively clear, we have failed to meet targets, and in particular, the Aichi targets (Butchart et al., 2010, 2015; Harrop & Pritchard, 2011). While there was criticism that targets were unachievable given the timeframe (Collen et al., 2013), and could be framed better to support necessary actions (Butchart, Di Marco & Watson, 2016; Green et al., 2019), there seems to be a disconnect between governments' commitments to biodiversity conservation on the global stage, and implementation of the practical local-scale action through national regulatory frameworks required to achieve those goals (Atisa, 2020; Collen et al., 2013). It is clear that transformative change is required if we are to reverse the current trajectory of declines (Díaz et al., 2019; Leclère et al., 2020; Mace et al., 2018; Tickner et al., 2020). The new GBF, with its four goals and 23 targets for 2030 and 2050 (CBD, 2022), provide one last and urgent opportunity to reverse current trends.

Lack of government support, specifically for amphibian conservation actions, may also be linked to the reasons amphibians are often not prioritised compared with other taxa (*see above*). Nevertheless, most countries are parties to numerous international conventions and therefore have an obligation to act to reverse biodiversity declines, so how can we better increase governmental support – at a national and local level – for amphibian conservation action?

Rogalla von Bieberstein et al. (2019) suggest the following actions that can be taken to engage governments and contribute to improving implementation of policy:

- **Establish a science-policy platform** to promote and facilitate the generation and use of best available knowledge.
- **Improve data gathering, reporting and monitoring**, including building more effective mechanisms for managing, sharing and using data.
- **Develop indicators** that adequately support implementation of national plans and strategies that can be used across all the biodiversity-related conventions.
- **Provide recommendations** based on results accompanied with evidence for successful approaches and making biodiversity data more accessible for policy makers.

Changes to conservation in the face of global catastrophe

Since the beginning of 2020 the global COVID-19 pandemic has had enormous consequences on just about every facet of human activity, including biodiversity conservation, and has been a lesson in the need to be prepared for all types of potential global disruption. In the early days of the initial mass lockdowns, there were many questions and few answers on the impacts of COVID. Shortly after the onset of these lockdowns we started seeing images of a variety of wildlife in decidedly urban settings throughout the world, and there was a sense that the compulsory collective pause of much of human activity had been good news for nature. We began to see blogs, editorials and letters that wondered about conservation in the face of COVID (e.g. Evans et al., 2020; Pearson et al., 2020), and

while there appeared to be some good news for the short term (such as reduction in noise, pollution and greenhouse gases; Corlett et al., 2020), there were also enormous and immediate negative impacts (reduced funding, cancellation of physical meetings and field work and classes, increase in waste and illegal harvesting, slowing the deployment of renewable energy, massive losses in ecotourism revenue critical to conservation, to mention a few). Years have now passed since those first lockdowns, and while we now have a better understanding of some of their most immediate impacts, it will take us some more time (and perhaps in some cases, never) to get a better sense of their reach. Furthermore, some human activities continue to be impacted while others have resumed and/or been adapted; and modified lockdowns have continued to take place as a result of subsequent COVID waves, so the pandemic may still affect parts of the world in the foreseeable future.

The number of papers and editorials documenting the impact of this global pandemic on conservation is increasing at a steady pace, so this writing is by necessity a snapshot in time.

Perhaps the most obvious impacts have been: restrictions on global movement affecting the ability to undertake on the ground conservation, carry out research, and conduct meetings for decision-making (from the scale of intergovernmental policies and international agreements, to smaller scale workshops for conservation planning); the hiatus in activities such as patrolling, enforcement, containment, treatment, and eradication of invasive species, which led to an increase in deforestation, logging, poaching, mining and diseases (Bang & Khadakkar, 2020); severely reduced financial resources for both operational costs and project work, causing conservation organisations and government departments to cut hours, furlough, or let staff go altogether, while initiatives whose business models relied on ecotourism saw their primary source of income dry up overnight; and effects on education and research from disruption of teaching, which may have been even greater in areas where internet access is not reliable or fully available.

The pandemic originated at the interface between wildlife, domestic animals and humans, and there was a rapid agreement at the international level that wildlife trade is among the vectors that enabled the pandemic. Some countries took the positive step to restrict or even ban the wildlife trade of some specific species, most notably mammals (Borzée et al., 2020). However, no such change was brought to the amphibian trade, despite the panzootics already impacting amphibians, and where the importance of human activities in its spread is not debated. Amphibian populations harvested for trade, and especially those exported to western countries or dedicated to high-end consumption would benefit from an update of amphibian trade regulation, and the COVID pandemic could be a trigger (Borzée et al., 2021).

It is important to note that while some COVID-driven changes may appear to have had a positive impact on conservation, and solutions have been found to some of the hurdles (e.g. virtual meetings have allowed for small- to medium-sized groups to effectively collaborate, and some donor organisations have allowed for proposals to cover operational costs), the overall impact is likely to be highly detrimental to conservation as a whole (e.g. *see* Lindsey et al., 2020). Given the points highlighted above, it is clear that there are major structural cracks that need to be addressed to help conservation through the pandemic crisis, and to be prepared for future global catastrophes, with a view to longer-term changes leading to a more robust and sustainable system. Thurstan et al. (2021) identify the following opportunities for building conservation resiliency:

- **Collaborations**: enhancing collaborations and partnerships at the local level
- **Diversified engagement**: increasing cross-sectoral engagement
- **Investment**: increasing local investment and developing local capacity in leadership
- **Institutional change**: increasing government and public engagement and support in favour of more equitable and sustainable socio-economic practices

A concerted collective effort by the conservation community is needed to re-think how conservation is done and funded, to engage other sectors where environmental stewardship is a priority, and to be flexible but also plan strategically. The time to do so is now.

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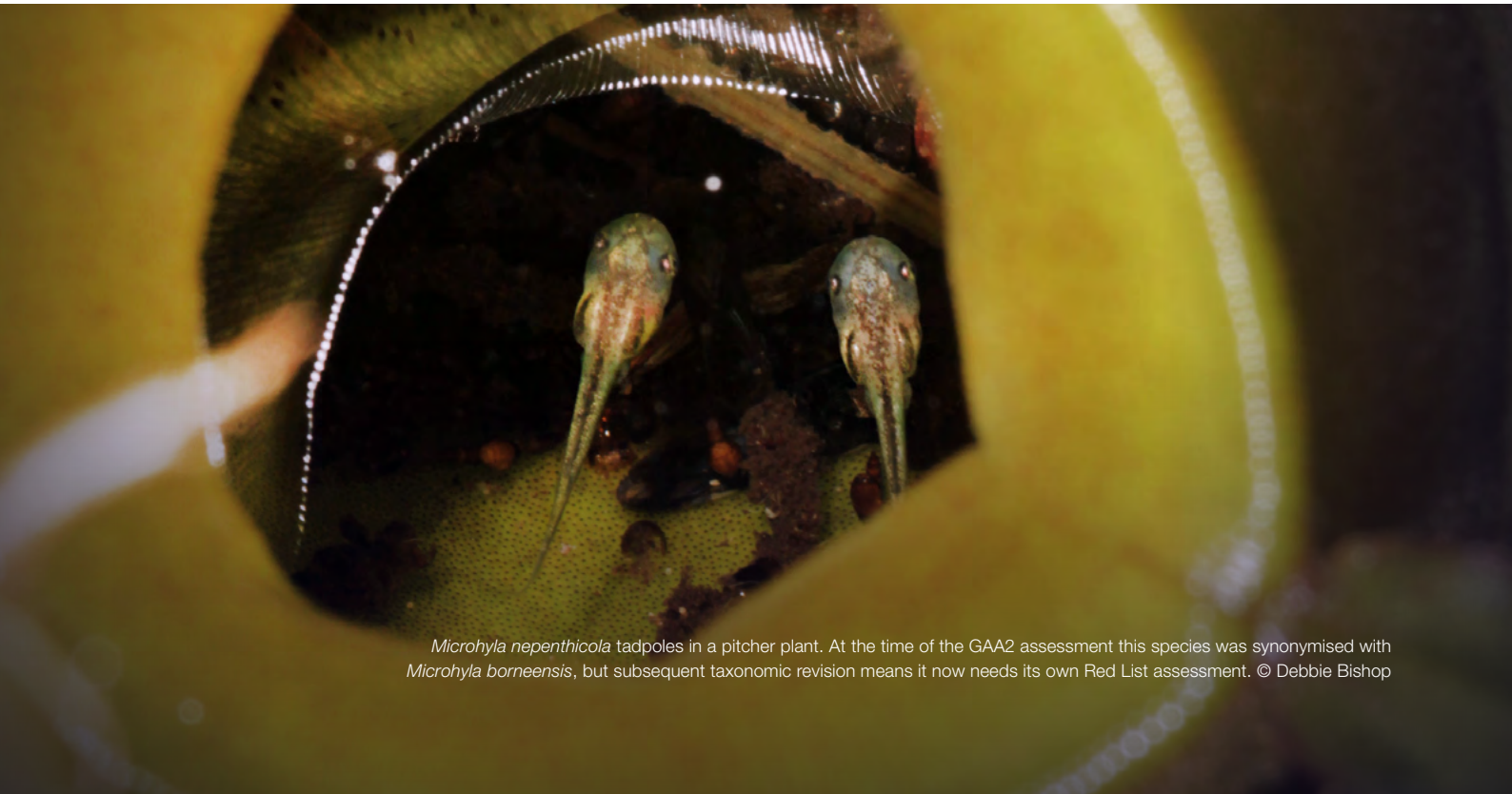

Microhyla nepenthicola tadpoles in a pitcher plant. At the time of the GAA2 assessment this species was synonymised with *Microhyla borneensis*, but subsequent taxonomic revision means it now needs its own Red List assessment. © Debbie Bishop

Stakeholders met in El Valle de Anton, Panama, in November 2013, for a multi-participatory IUCN golden frog conservation planning workshop. The workshop output was an action plan for two Critically Endangered frogs: *Atelopus zeteki* and *A. varius*. © Brian Gratwicke