IUCN SSC Amphibian Specialist Group

Amphibian Conservation Action Plan April 2015

Edited by Sally Wren, Ariadne Angulo, Helen Meredith, Jos Kielgast, Leida Dos Santos & Phil Bishop

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2015 Online Amphibian Conservation Action Plan

The Amphibian Conservation Action Plan (ACAP), the first taxonomic class-level plan of its kind, was first published in 2007 and then updated as a digital resource in 2015, moving to an online 'living document' format, with the aim of updating it in real time.

This document provides a record of that 2015 ACAP, which has since been updated (back to a pdf version, after consultation with the amphibian conservation community) as the 2024 ACAP, which can be found on the ASG website.

Note: While there is a 2007 ACAP chapter dedicated to amphibian extinction risk assessments, please note that the Amphibian Red List Authority (Amphibian RLA) is responsible for all Red List matters, so a working group was not established for this subject.

Contents

1. Reintroductions

Because the identification and neutralization of threats are such fundamental first steps in species recovery, reintroduction can be risky without a full understanding of these issues. Although this problem is particularly acute in parts of the world where there are high levels of amphibian diversity but a poor understanding of their natural history, some well-researched species in Europe and North America continue to pose challenges in this respect.

Group Co-Chairs: Richard Griffiths and Gemma Harding

ASG Secretariat Lead Contact: Sally Wren (swren[at]amphibians.org)

Vision

Amphibian species surviving in self-sustaining populations so that reintroductions are no longer required.

Goals

Threats understood and either neutralised, mitigated or managed for priority species and habitats.

Reintroductions undertaken for priority species.

Monitoring data show that reintroductions have established viable populations in the wild, or are on a trajectory towards viability.

Improved understanding of how to carry out successful amphibian translocations and post release monitoring, including improving methods and understanding the biology behind these reintroductions.

Publication and dissemination of results from both successful and unsuccessful reintroductions.

Key variables linked to reintroduction success identified, disseminated and incorporated into reintroduction planning.

Challenges

Insufficient resources

Although there are now more resources being invested in amphibian conservation than ever before, compared to other taxa amphibians remain grossly underfunded. Funding for reintroductions comes from a diversity of sources but is often piecemeal and localised. In addition to fundamental resources for the design and execution of reintroductions, there also needs to be improved analysis, documentation and dissemination of results on a global scale.

Insufficient technical expertise

As several analyses have shown, most conservation effort is carried out by experts working on non-priority species in areas that are not globally important for biodiversity. Although there are local and regional initiatives to rectify this imbalance, there remain significant challenges in building the capacity and technical expertise required for reintroductions in those parts of the world where it is most needed.

Current threats not understood

Although our understanding of the threats that amphibians face has increased considerably over the past two decades, significant barriers remain. As the identification and neutralisation of threats is a fundamental first step in species recovery, reintroduction can be risky without a full understanding of these issues. Although this problem is particularly acute in parts of the world where there are high

levels of amphibian species richness but a poor understanding of their natural history, some well-researched species in Europe and North America continue to pose challenges in this respect.

New threats emerging

Even if they are well-understood in themselves, climate and environmental change may result in conditions under which new threats can emerge and thrive. Novel pathogens and invasive species pose a particular problem here. Reintroduction may therefore involve releasing animals into an environment that is very different from that which the source animals originally came.

Lack of robust field data on population status

Amphibians are often small, cryptic and highly seasonal and these characteristics pose challenges for reliable population assessment. Establishing the baseline population status for monitoring programmes is an essential precursor for a reintroduction and appropriate methods and protocols need to be in place to facilitate this.

Lack of field data on population biology and life history

Unless the data can shed light on wider problems, single species projects focusing on basic life history information (i.e. survival, fecundity, population size) are becoming increasingly unfashionable within research and funding agendas. However, such life history information is essential for providing a template for identifying and designing interventions such as reintroductions.

Ex-situ management produces maladapted amphibians

Some amphibians fail to thrive and breed in in captivity. The husbandry requirements of amphibians are more complex than previously thought and there is a danger or producing maladapted amphibians in *ex situ* breeding programmes which may not be suitable for reintroduction.

Risk of novel pathogens in ex situ facilities

Ideally, conservation breeding facilities should be located within the range or former distributional range of a species to minimise the risk of individuals in such programmes becoming exposed to novel pathogens. Capacity may be lacking in some regions, as a result facilities may need to be located outside of the target species range state and there is a risk that such populations of amphibians will become exposed to novel pathogens.

National, regional or local conservation authorities unsupportive

Conservation priorities depend on the scale of operation. A regionally threatened species may not be a national or global priority, and vice versa. This can result in different priorities within organisations operating at different scales. Equally, the level of support provided will depend on the political motivations of the authorities concerned.

Lack of appropriate and protected release sites for some species

Even with Critically Endangered species, all of the favourable habitat that is available may be already occupied by the species. Identifying, creating, restoring and managing release sites may therefore be problematical.

Lack of knowledge on the best way to reintroduce some species

This aspect of amphibian reintroduction has developed in recent years, and we now have a better understanding of such issues as identifying appropriate life stages for release, timing of releases, mechanisms for releases etc. There remain gaps in terms of assessment of fitness of release stock, behaviour following release, and 'soft' versus 'hard' releases.

Lack of sufficient numbers or genetic diversity for founding populations

Genetic analysis is expensive and the resources and expertise are not available to determine the genetic viability of many populations that would benefit from it. Consequently, when they are carried out they are often part of a wider research project.

Postponing management actions until founder populations have become dangerously low

Shifting and conflicting conservation priorities often means that interventions are not actioned until a population has reached a dangerously low level. By this time, the species may already be in an 'extinction vortex', and the remaining habitat may be unable to support a viable population.

Inadequate pre-release health screening

Some amphibian pathogens are difficult to screen for both ante and post mortem. Animals destined for reintroduction may have subclinical infections that are not detectable with current pathogen screening techniques. This may pose a threat to sympatric amphibians at the release site.

Difficulties with post release monitoring

Reintroductions should be followed up with appropriate post release monitoring so that the success of the reintroduction can be evaluated and future conservation actions determined. Many amphibian species are often small, cryptic and highly seasonal and these characteristics pose challenges for post release monitoring. Funding for longitudinal post release monitoring should be identified prior to any reintroduction.

Current Priority Actions

Constraint / Action	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
Identification of long-term protection for and restoration of reintroduction sites	National and local governments have effective instruments in place for protection and restoration of reintroduction sites	Increase the urgency within national and local governments for the identification and protection of sites that are important for amphibians
Fundraising to carry out reintroductions and appropriate post-release monitoring	High priority reintroduction programmes funded	Recruit entrepreneurial 'amphibian champions' to identify and access sources of funding
Training and capacity building in regions/agencies short of expertise	i. All areas of the world that have high levels of amphibian species richness will have had a training and capacity building programme delivered regionally; ii. All relevant expertise in	i. Support and develop initiatives with existing training providers (e.g. Durrell Wildlife); ii. Identify gaps in training and capacity building coverage

Constraint / Action	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
	the key regions will have been identified and trained	
Identify most appropriate reintroduction methods	Produce reintroduction guidelines for amphibians to complement current IUCN SSC guidelines	i. Establish central open-access database for amphibian reintroductions; ii. Carry out systematic evidence review/meta-analysis of factors affecting reintroduction success; iii. On the basis of the review identify research shortfalls and most appropriate methods; iv. Refine protocols for amphibian reintroductions
Research to identify threats and mitigate threats	Threat neutralization, mitigation and management plans in place for newly identified threats	Continue to carry out, support and disseminate research aimed at identifying threats, such as novel pathogens and invasive species
Identify and prioritise species appropriate for reintroduction	Delivery of prioritised list of reintroduceable amphibian species and projects	Assessment – The AARK prioritisation process has already made a start on this issue through its regional assessment workshops. However, some amphibians may not require a captive component for reintroduction. 'Reintroduceability' of species needs to be assessed on the basis of data on (1) current population status; (2) potential for threat neutralization; (3) available habitat; (4) national and local stakeholder support; (5) availability of stock for release; (6) viability of reintroduced population; (7) inability of the species to respond to alternative interventions (e.g. habitat restoration); (8) Life history characteristics, particularly generation time; fecundity and mode of reproduction.
Formulation of appropriate survey protocols to assess	Establish appropriate population and habitat survey protocols for all	i. Continue to work with biostatisticians to ensure that new developments in statistical modelling are embraced within survey design and analysis protocols; ii. Continue to develop novel tools for the

Constraint / Action	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
population status and habitat assessment	priority species for reintroduction	assessment of populations (e.g. environmental DNA); iii. Continue to utilise new tools in GIS and spatial and landscape ecology to identify and assess habitats.
Inadequate pre-release health screening	Continue to work with wildlife specialists to ensure that the disease screening protocols are up to date and of the highest possible standard	
Difficulties with post release monitoring	Continue to develop novel tools for the assessment of individuals and populations	

2007 ACAP Related Chapters: Chapter 8. Reintroductions (R. Griffiths, K. Buhlmann, J. McKay, and T. Tuberville).

2. Habitat Protection

Habitat loss and degradation are well recognized as the largest threat to amphibian populations around the world.

Group Co-Chairs: Jeanne Tarrant and Timo Paasikunnas

ASG Secretariat Lead Contact: Ariadne Angulo (aangulo[at]amphibians.org)

Current Priority Actions

The following are immediate priorities identified by the Habitat Protection Working Group. These actions are expected to change as progress is made in addressing the underlying issues. Certain issues may not have been addressed in the current planning process and therefore some actions might be currently omitted from this list.

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
SCIENCE		
Limited understanding of species ecology/biology/taxonomy: – No clear evidence on what should be studied (although the Synopsis on Conservation Evidence for Amphibians (2014) should be a useful tool to help guide research and actions) – Limited taxonomic expertise – Few incentives and limited funding to undertake studies	i. Coordinate conservation research with habitat protection needs – Improve/develop relationships with relevant role-players ii. Coordinate citizen science projects: – Develop field guides with academic institutes/museums/experts including habitat, not only species – Develop communication strategies for attracting more students and citizen scientists to participate in amphibian research	i. Prioritise research questions relevant to needs and resources and distribute research questions to universities, relevant research institutes and citizen science groups ii. Identify candidate species or groups which need improved understanding of their taxonomy iii. Support local/native graduate students studying not only species but doing environmental studies as well iv. Develop practical guide for citizen science contributions
Lack of support/understanding from local governments and public to conduct relevant research	i. Incorporate amphibian habitat into conservation planning at municipal (or other relevant levels)	i. Improve communication at all levels

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
	ii. Develop innovative ways of garnering funding	ii. Development of specific conservation plans
CONSERVATION		
Limited comprehensive understanding of Critical Habitat for amphibians: – Contact points unknown – Inconsistent information on sites – Available data not easily accessed – Unclear definition of Critical Habitat	Develop "Amphibian Critical Habitat" key to identify priority sites: – "Important Amphibian Areas" etc – Align with Alliance for Zero Extinction (AZE) sites	i. Refine definition of "Critical Habitat" ii. Develop list of standards for identification of important sites for Critical Habitat and key biodiversity areas: – Develop relationships with key role-players iii. Use different keys to identify different areas and develop means for aligning these: – KBA, when ready (Key Biodiversity Area) – IBA (Important Bird and Biodiversity Area) – IPA (Important Plant Area)
Need improved collaboration/learning exchange possibilities between different countries/groups	See below under "policy"	
Limited methods for the selection of conservation areas	i. Develop computer algorithms to identify systems and protection needs of priority sites ii. Coordinate with conservation organizations/government etc	Test models that are currently in use

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
	to incorporate amphibian data into overall conservation plans	
Limited understanding by local communities of habitat protection and importance of amphibians in ecosystem	Develop easy and understandable report form for local communities to report changes in habitat (e.g. use frogs as indicators)	Initiate pilot projects and develop and test reporting formats
Ecotourism related to amphibians or other ectotherms	Develop standards for safe ecotourism concerning amphibians (including biodiversity and habitat)	Start some small-scale pilot projects: – guided tours – identification courses – field guides/booklets/educational posters
Need for improved cooperation from zoos and *ex situ* organisations field conservation	Develop standards for zoos that encourage increased participation in field (*in situ*) activities conservation	Strengthen relationships with local zoos, aquaria and other ex situ organizations
Lack of support from large NGOs	Build national/international network with conservation specialists from large NGOs	Being a part of ecological restoration projects and encourage addition of amphibians to overall conservation plans
POLICY		
Disconnect between scientists, conservationists, naturalists, funders and governments	Build relationships at local level initially: – Convene international workshop	Design national workshop and develop cooperation model further with different partners at national level:

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
	– Improved capacity for learning exchange	– Convene politicians, naturalists, scientists, conservationists, photographers, hunters, poachers, industry, agriculture (timber, sugar, etc.) – Panel discussion
No effective communication channel	i. Develop communications strategy ii. Design web-based model and possibly carry out surveys to estimate sites level – Using questionnaire – Need key first for estimate Critical Habitat	Design model for web-based interactive groups – Facebook groups (Completed)
Amphibian data/habitat protection needs are not incorporated into national/local conservation policy	Amphibian conservation plans to be incorporated into higher-level conservation planning	

2007 ACAP related chapters:

Designing a Network of Conservation Sites for Amphibians—Key Biodiversity Areas (D. Silvano, A. Angulo, A.C.O.Q. Carnaval and R. Pethiyagoda).

Freshwater Resources and Associated Terrestrial Landscapes (M. Lannoo, C. Funk, M. Gadd, T. Halliday and J. Mitchell).

3. Infectious diseases

Emerging infectious diseases are major threats to amphibian biodiversity. *Bd* has caused massive extinctions in various parts of the world, and it has just been found in Madagascar, which has a highly diverse, endemic amphibian fauna. *Bsal* has just been described, which could devastate salamander species in Europe and the Americas. New viruses have been described in Europe that are highly virulent and have caused population extinctions.

Group Co-Chairs: Penny Langhammer and Reid Harris

Group Members: Matt Becker, Molly Bletz, Jesse Brunner, Evan Brus, Patricia Burrowes, Alessandro Catenazzi, Jim Collins, Mat Fisher, Jake Kerby, An Martel, Nicholas Massimo, Frank Pasmans, Angela Picco, Alan Pressier, Falitiana Rabemananjara, Tsanta Rakotonanahary, Lee Skerratt, Jenny Urbina, Vance Vredenburg, Doug Woodhams

ASG Secretariat Lead Contact: Phil Bishop (pbishop[at]amphibians.org)

Current Priority Actions

The following are immediate priorities identified by the Infectious Diseases Working Group. These actions are expected to change as progress is made in addressing the issues.

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
SCIENCE		
Critical gaps and needs in basic knowledge, such as: – Knowledge of worldwide diversity and distribution of amphibian pathogens – Developing baseline population data and monitoring methods to identify infection-related population declines – Preventing pathogen spread to naive populations – Biological determinants underpinning variation in pathogen lineages associated with amphibian population decline/extinction – Transmission processes of main disease threats across spatial	Update research priorities annually (target=graduate students, post-docs)	Report on research priorities in ASA-AmphibiaWeb Science Zone, disseminate on social media, and highlight in FrogLog

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
scales and via non-amphibian vectors, and persistence of pathogens in the environment – Factors (e.g. genetic, immunological) that distinguish amphibian species, populations and individuals that resist or tolerate infections – Interaction of infections with contaminants, climate, other stressors – Variation in susceptibility across life stages – Ecosystem impacts of amphibian declines and extirpations resulting from infectious disease – Effect of temperature variation (human and natural) on pathogen-host dynamics – Role of trade in spread of Bd/Bsal in US and internationally		
Develop fund for grants to high caliber doctoral students filling critical research gaps (model=NSF Doctoral Dissertation Improvement Grants)	i. Identify potential donors for a fund ii. Develop concept note for doctoral grants fund	
i. Coordinate volunteer effort by the professional community (academic, government, commercial entities) to sample salamanders, frogs, and caecilians for emerging threats (Bsal and emerging viruses such as BNV) in nature and in trade	i. Invite and publish articles by Bsal and BNV researchers on the urgency of a global sampling effort with specific recommendations ii. Support academic partners (e.g. Imperial College London and others) to develop a website	

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
ii. Coordinate strain typing and mapping of the distribution of strains of RV and Bsal as has been done for Bd	like http://www.bd-maps.net for Bsal and ranavirus and promote it using ASA communications channels including ASA-AmphibiaWeb Science Zone	
i. Conduct surveys of infectious disease prevalence in areas not surveyed or thought to be negative for Bd, Bsal and ranavirus ii. Encourage development of a cheaper alternative to the qPCR detection method iii. Develop policy statement to encourage local authorities to expedite permits for collecting samples for PCR analysis	i. Identify priority areas and species for surveys of infectious disease prevalence ii. Facilitate collaborations between researchers, local and international universities, protected area managers and other Alliance members to undertake disease and population monitoring in priority areas (e.g. Madagascar's Chytrid Emergency Cell). iii. Support a citizen science project that encourages pet owners to swab their pet amphibians for Bsal iv. Identify labs that analyze swabs for Bd/Bsal	
i. Conduct surveys of amphibian defenses (e.g. mucosome assays, resistant alleles) in areas not surveyed or thought to be negative for Bd/Bsal and assess susceptibility of priority species ii. Coordinate comparative studies of species/population susceptibility (tolerance/resistance) in key species in particular regions using common experimental design	i. Convene experts to identify priority areas and species for surveys of amphibian defenses ii. Facilitate collaborations between researchers, protected area managers, zoos and other captive breeding facilities, and other Alliance members to undertake disease and population monitoring in priority areas	

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
	iii. Conduct Bsal susceptibility experiments on priority species that represent a wide taxonomic range to determine the extent of the threat	
CONSERVATION		
Limited evidence for conservation practitioners on effective mitigation measures, including: – Probiotics – Chemotherapeutics – Vaccinations – Micropredators – Artificial selection – Head-starting/reintroduction – Habitat modification – Managed relocation to new habitats as in NZ – Other tools to help limit pathogen spread	i. Trial probiotics with additional species, life stages and ecosystems with the aim of finding effective probiotics that persist on host species ii. Encourage collaborations between natural park personnel and scientists in order to promote mesocosm-type studies to evaluate the potential impact of mitigation strategies with native species in their own environment	i. Identify high-priority candidate species for probiotic trials from ecosystems not yet represented in probiotics research ii. Support local graduate students and protected area managers to implement trials
Support targeted reintroductions of surplus captive amphibians within an experimental framework	i. Convene an expert working group/workshop to identify barriers to the reintroduction of surplus captive amphibians and make recommendations . Include partners such as AArk and Panama Amphibian Rescue and Conservation Project ii. Co-author a policy piece for a high profile journal with the	

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
	recommendations from this working group	
Evaluate efficacy of other disease mitigation measures such as vaccination, micropredators, habitat modification and artificial selection	Convene a meeting over Skype with experts to explore the state of the art and encourage additional brainstorming and collaboration. Encourage research with an ASA seed grant category for this topic.	
Facilitate integration and data sharing by academics, NGOs, government agencies, wildlife managers to encourage consistent and better application of successful methods to mitigate impact of disease	Consider a web-based interactive solution hosted by amphibians.org or an appropriate partner with relevant tabs such as Bd/Bsal maps, funding opportunities, mitigation research updates and project plans for brainstorming by the larger group	
A large number of species on the brink of extinction	Prioritize field interventions using data on ongoing declines and extinction risk (including amphibian defenses)	Undertake the identification of Important Amphibian Areas globally, starting in regions of ongoing decline, and ensure that information on threats from infectious disease is incorporated into the documentation
Support rescue pods for species with no other options	Facilitate input of disease experts into the existing priority-setting processes of AArk, AZA and other institutions involved in amphibian rescues	
Develop an emergency fund for highly threatened species where no other funding exists	i. Identify potential donors	

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
	ii. Develop concept note for highly threatened species fund	
Convene meeting to brainstorm outside the box conservation strategies	Design meeting, identify participants, secure resources	
Raise public awareness about amphibian diseases	i. Expand and strengthen social media campaigns to reach a broader audience ii. Engage education graduate students to develop curriculum module at various grade levels	
POLICY		
Lack of appropriate policies (mostly at a national or regional level), or insufficient policy implementation (mostly at an international level), to reduce threats to amphibians from infectious disease	i. Establish guidelines for screening and interpreting results for amphibian pathogens in trade, ranaculture, and other important settings. ii. Encourage regulatory officials to establish a testing program for amphibian pathogens. iii. Promote development of a multi-pathogen screening tool. iv. Explore efficient, effective quarantine options as part of a clean trade program	Immediate priority — Work with ASA partners to convince regulatory authorities of relevant countries (e.g. USFWS) to implement a moratorium on importation of salamanders until a testing program for Bsal is in place
Encourage grassroots testing, treatment and disease risk minimization measures for the pet, food, bait, and science uses of amphibians	Work with Associations and major importers and stores in the US to encourage testing, treatment, and disease risk	

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
	minimization (e.g., Petco, Petsmart, AZA, and AARK)	
Evaluate potential threats of disease spread into novel environments via ecotourism and communicate data to government agencies to educate the public and promote appropriate regulations		

Diagnostic Laboratories

This is a list of laboratories around the world that perform a variety of diagnostic tests for amphibian diseases.

Laboratories that have participated in a round robin validation run are marked with an asterisk (*). For more information visit Bsal Task Force.

For further information on sampling, biosecurity, diagnostic methods and more please contact the laboratory directly that will be screening your samples before you collect them.

Lab	State/ Province/ City	Country	Contact Name	Contact email(s)
*Animal Health Centre, BC Ministry of Agriculture	BC	Canada	Heindrich Snyman & Tomy Joseph	Heindrich.Snyman@gov.bc.ca & Tomy.Joseph@gov.bc.ca
*Animal Health Laboratory, University of Guelp	ON	Canada	Hugh Cai	hcai@uoguelph.ca
*Florida International University	FL	USA	Alessandro Catenazzi	acatenaz@fiu.edu

Imperial College Schoool of Public Health	London	UK	Matthew Fisher	matthew.fisher@imperial.ac.uk
*Laurentian University	ON	Canada	David Lesbarreres	dlesbarreres@laurentian.ca
*Pisces Molecular	CO	USA	John Wood	jwood@pisces-molecular.com
*Southeastern Cooperative Wildlife Disease Study	GA	USA	Nicole Nemeth	nmnemeth@uga.edu
*University of Massachusetts, Boston	MA	USA	Doug Woodhams	dwoodhams@gmail.com
University of South Dakota	SD	USA	Jacob Kerby	jacob.kerby@usd.edu
*USGS-NWHC	WI	USA	Dan Grear	nwhc-epi@usgs.gov (for submissions); dgrear@usgs.gov (for questions)
*Wildlife Epidemiology Lab	IL	USA	Matt Allender	mcallend@illinois.edu

ACAP related chapters

Infectious Diseases (P. Daszak, K. Lips, R. Alford, C. Carey, J.P. Collins, A. Cunningham, R. Harris and S. Ron).

4. Ecotoxicology

Although contaminants are not necessarily playing a singular role in amphibian population declines on their own, it is likely that they are an important cofactor in many declines. A number of studies have shown that exposure to low environmental concentrations of contaminants such as pesticides can make amphibians more susceptible to disease.

Group Co-Chairs: Michelle Boone & Jessica Hua

ASG Secretariat Lead Contact: Phil Bishop (pbishop[at]amphibians.org)

Current Priority Actions

The following are immediate priorities identified by the Ecotoxicology Working Group. These actions are expected to change as progress is made in addressing the issues.

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
SCIENCE		
Movement of pesticides/contaminants into amphibian habitats	i. Identify key factors that may interact with contaminant exposure to increase susceptibility to declines, e. g. disease ii. Identify ways to mitigate pesticide exposure (i.e. reduce runoff) through terrestrial buffers or other means	i. Rank species according to threat level in The IUCN Red List of Threatened Species and prioritize by habitats ii. Classify the scope of impact (individual, population, community, or landscape level)
Insufficient information on ecotoxicological links between amphibian and human health	i. Develop funds to promote future toxicological studies on amphibians in the field ii. Develop regionally-focused social marketing campaigns against the use of pesticides with positive ideas and solutions for people	i. Identify potential donors and funding mechanisms, reach out to prospective donors ii. Encourage research institutions to focus on increasing capacity in toxicological studies on amphibians, use of more relevant methods to field situations, e g. mesocosms iii. Explore the opportunities to directly link human welfare with amphibian welfare
Insufficient work on translational research on	Increase dialogue between amphibian conservation	Raise awareness of the lack of conservation evidence on pollution-

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
ecotoxicology and amphibian conservation	scientists, practitioners and environmental chemists and ecotoxicologists on pollution-related threats to ensure mitigation efforts are guided by the best science, and that science meets the needs of conservation practice	related threat mitigation and encourage publication of these studies through www.conservationevidence.com and other journals
Geographic and species biases in studies	i. Raise awareness of geographical and taxonomic gaps ii. Identify chemicals that are banned in some countries but not others, and rationale for the chemicals being banned in certain regions (and use that for lobbying)	i. Review and collate information on both geographical and taxonomic gaps as well as assess the vulnerabilities related to life history and effects of contaminants across different life stages ii. Identify areas/species where there is very little knowledge on the effects of pollution iii. Chemicals are usually tested on Xenopus as a model organism, encourage identification and use of ecologically relevant species for testing
An overwhelming number of chemicals in the environment, making targeted studies of all potentially damaging chemicals and their interactions challenging	i. Promote and facilitate the study of representative contaminants by "chemical class" to evaluate risks ii. Support the evaluation of potential for key mixtures or interactions with other factors like disease or habitat change	i. Target persistent pesticides (e.g., atrazine or DDT) and contaminants (e.g., Hg) ii. Target pesticides/contaminants that are known to be endocrine disruptors
Lack of use of native amphibians in standard ecotoxicological testing	Promote and lobby for the testing of amphibians as part of routine	Determine adequate models (e.g., northern leopard frogs in US) and standards for standard toxicity tests

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
	toxicological screening—currently fish and birds are the surrogate for aquatic and terrestrial amphibians, respectively	
Lack of information on key endpoints for studies	Promote and support studies that seek to determine population-level significance of cellular and reproductive changes (for instance, do reductions in fertility have population-level impacts)	Evaluate impacts on breeding behavior, reproductive development and function, and fecundity; biomarkers (e.g., changes in thyroid responsive genes); impacts on survival
Life cycle studies largely missing	Promote and support studies of exposure across the life cycle of amphibians to improve our ability to predict population-level consequences	
CONSERVATION		
Limited alternatives on the use of pesticides and limited interaction with communities that use these alternatives	i. Develop fund to allow for research on use of alternative pesticides ii. Establish long-term partnerships with organic agriculture organizations	i. Identify and contact potential donors to the fund ii. Identify and contact representatives of the organic agriculture movement to explore potential partnerships
Citizen science initiatives to educate young people on the issues surrounding pollutants and amphibians	i. Integration into school curricula ii. Develop a database of environmental educators	i. Develop materials in several languages to disseminate to students (make available to educators) ii. Identify and contact environmental educators who can act as focal points for the initiatives

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
Lack of communication and coordination between law enforcement and the research on ecotoxicology	i. Establish communication channels between both communities ii. Work with authorities to change attitudes and eventually legislation	i. Identify and contact proactive and communicative members who would be willing to act as focal points/moderators for these communities, create an online network and invite members of both communities to join ii. Identify relevant authorities in amphibian rich countries iii. Develop clear and informative documentation in various languages (perhaps IUCN's three official languages to begin with) to help explain the current situation on some of the effects of pesticides
Insufficient independent funding mechanisms for routine toxicity testing in the lab or in more natural environments	Establish funding for toxicological studies on key categories of contaminants or key contaminants of interest to generate the needed data	
POLICY		
Conflict of interest (COI) with industry-funded research being used in regulatory assessment	i. Promote and lobby for the creation of a third-party funding agency that can separate funding from industry to conduct tests from the research analysis and interpretation ii. Lobby for changes in US legislation to mitigate issues of financial COI in research and to use more of the available data to make evidence-based decisions	Identify and contact receptive members of governmental agencies to lobby for change in approach at key regulatory agencies

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
Lack of knowledge on harmful pesticides	Develop an open database compiling evidence-based information on all pesticides that affect amphibians	Enlist volunteers to identify and review commonly used pesticides that are harmful to amphibians
Wetland protection	Promote and support the protection and use of terrestrial buffers for ephemeral and small wetlands through legislation (as many streams and rivers have)	i. Identify amphibian-occupied aquatic habitats that are most vulnerable to pesticide runoff ii. Establish vegetative buffer zones around these aquatic habitats in areas of concern to filter out pesticide runoff
SITE LEVEL STAKEHOLDERS		
Insufficient information on the effects of pollutants on human welfare (for local stakeholders, e.g. farmers)	Social marketing of the issue, establish links with grassroots organizations	Identify target locations and develop outreach material (in appropriate language) on the effects of locally applied pollutants on amphibian and human health

ACAP related chapter: Chapter 6. Evaluating the Role of Environmental Contamination in Amphibian Population Declines (M. D. Boone, D. Cowman, C. Davidson, T. Hayes, W. Hopkins, R. Relyea, L. Schiesari, R. Semlitsch).

5. Communications and Education

Communication and education are both key to grow and sustain support for biodiversity conservation. Through communication and education, we identify threats to biodiversity at local and regional scales and also bring about the learning needed across groups to mitigate these threats.

Group Co-Chairs: Rachel Rommel and Candace Hansen-Hendrikx

ASG Secretariat Lead Contact: Marcileida Dos Santos (ldossantos[at]amphibians.org)

Vision

Secure the world's endangered amphibians and their habitats through empowered communities that are motivated to act on behalf of biodiversity conservation.

Goals

Communication and education, along with other strategies for public engagement*, are key to catalyzing and sustaining action for biodiversity conservation. These social strategies should be informed by the best available science and practice, just like the biological aspects of conservation management. We must identify threats to amphibian diversity at local, regional, and global scales, bringing about the learning and collaboration needed to facilitate change and address these challenges. Critical to our success, this work will require renewed and expanded dedication to the cooperation and exchange of information across academic and professional disciplines, as well as with diverse stakeholders and partners. Lastly, we must harness the expertise and passion of our global community to facilitate nature based experiences and active participation in amphibian and habitat conservation.

Our working goals

1. Increase collaboration across disciplines, professions, and stakeholder groups to find sustainable solutions to amphibian declines.

2. Build capacity and provide resources to plan, implement, and evaluate effective public engagement* programs.

3. Identify, engage, and empower target audiences to take action to monitor and protect amphibians and habitats.

4.Using amphibians as ambassadors, increase experiential learning opportunities in communities across the globe to inspire deeper connections with nature.

5. Continue to raise awareness and knowledge of the ecological, cultural, and intrinsic value of amphibians and their habitats.

*We define public engagement throughout this plan as a broad term to encompass social strategies such as social marketing, communications, environmental education, capacity building, citizen science, advocacy, and community outreach.

Current Priority Actions

The following are immediate priorities identified by the Communications and Education Working Group. These actions are expected to change as progress is made in addressing the issues.

Major Constraints To Effective Conservation	Mid-term Priorities	Short-term Targets
1. SCIENTISTS & PRACTITIONERS		
1.1 Need for more interdisciplinary communication & collaboration to inform research & conservation	i. Continued involvement of interdisciplinary experts via working group, task force, or consultation on special projects. ii. Develop communication plan to engage with scientific community (social & biological sciences). iii. Engage social scientists/other professional experts in research/practice (e.g. human dimensions, conservation psychologists, anthropologists, policy/governance, social marketing, environmental educators, community engagement experts, etc.) iv. Develop partnerships with NGOs & businesses that can add to interdisciplinary breadth & expand public impact (e.g. watershed conservation, water security/health, other biodiversity groups, sustainable product certification, etc.). v. Share community & citizen-science based conservation program examples that include interdisciplinary research teams & diverse stakeholders (e.g. NGOs, agencies, businesses, landowners, indigenous groups, policy makers, etc.) through social media, publications, and conference sessions.	i. Identify areas where scientists/practitioners would benefit from interdisciplinary expertise to help inform conservation planning & programs. ii. Reach out to specialists/advisors to see if there is interdisciplinary interest or overlap in issues which directly or indirectly affect amphibians & humans (e.g. social science working groups, etc.).

Major Constraints To Effective Conservation	Mid-term Priorities	Short-term Targets
1.2 A need for training and capacity building opportunities for: a) developing effective public engagement* programs, b) evaluation strategies to monitor impact.	i. Identify and include related presentations and workshops at global, regional, and local amphibian conference(s). ii. Continued identification of opportunities to communicate need & transfer skills for public engagement. iii. Acquire and/or partner for funding to provide opportunities to hold capacity building workshops on relevant & underrepresented topics related to public engagement & evaluation. iv. Develop training webinars on diverse topics related to planning, implementing and evaluating public engagement programs. v. Include public engagement discussion panels/working group meeting at amphibian related conferences or symposia. vi. Continue to use diversity of media for sharing knowledge within our community (e.g. amphibians.org website, social media (FB, Twitter, Instagram, etc.), video, photography, and publications).	i. Conduct a pilot survey for practitioners on current practices and needs related to public engagement & program evaluation. ii. Add an "Action Planning" section to the ASG/ASA websites and add links to existing resources & papers. iii. Raise awareness for free online courses & webinars which focus on relevant training content through social media and popular amphibian publications (e.g. Froglog). iv. Share literature and best practices related to public engagement & program evaluation with scientists/practitioners through social media & popular publications.
1.3 Lack of support & forum for scientists and practitioners to: a) acquire & retain innovative scientists & practitioners,	i. Identify other areas for building capacity (e.g. navigating & understanding global/regional policy/legislation which impacts amphibians). Communicate with other working groups to identify these.	i. Increase availability and accessibility of seed grants to help with general capacity building initiatives. ii. Develop a list of organizations working towards general capacity

Major Constraints To Effective Conservation	Mid-term Priorities	Short-term Targets
b) share knowledge, successes, and challenges.	ii. Develop existing communication tools (FrogLog, blog, newsletter and social media) in multiple languages to overcome existing language barriers. iii. Practitioners should partner with organizations that provide comprehensive leadership training and support to established and emerging conservation leaders. iv. Dedicate Froglog article(s) to raise awareness in subject areas where we need to build capacity & share resources that are available. v. FB admins should monitor thematic pages to make sure that posted content stays relevant & retains engaged followers. a) Monitor engagement & topics b) Ask members for topics they would like to see	building for the amphibian community to promote within our network. iii. Expand and develop amphibians.org blog to share experiences, successes & challenges. iv. Increase the number of and diversity of the background of amphibians.org bloggers to stay relevant to target subject areas. v. Create online Facebook communities for sharing and discussing ideas and research based on predetermined thematic areas.
2. PRIORITY TARGET AUDIENCES		
2.1 Identify & communicate with priority target audiences* more strategically at global, regional, and local levels. (*audiences who have an impact on the success/failure of	Global/Regional/Local: i. Strategically link desired conservation outcomes and engagement with target audiences, continue to evaluate & reassess programs. ii. Conduct focus groups, surveys, literature reviews to identify topics & messaging that resonate with different target audiences.	i. Identify resources and training opportunities for strategically targeting & engaging audiences (e.g. community-based social marketing). ii. Identify audiences that we should engage more (e.g. product consumers, landowners, businesses, captive breeding community, resource users, etc.).

Major Constraints To Effective Conservation	Mid-term Priorities	Short-term Targets
desired conservation outcomes)	iii. Work with zoos/aquaria/museums to develop surveys to collect public information to help better inform action based messages for urban/suburban conservation-minded audiences. iv. Develop media (e.g. short film) etc. that targets audiences for action/behavior change. v. To better inform programs, work with local stakeholders & target audiences to understand: – Root conflicts, drivers of decline – Social norms – Values, attitudes, beliefs – Knowledge, skill, resource needs – Motivators and/or incentives – Barriers	iii. Convene discussions to identify target audiences for a pilot behavior change/action campaign which links to a driver of amphibian declines. iv. Identify target audiences for resource development/capacity building (landowners, natural resource managers, etc.).
2.2 Lack of focus on actions/changes in behavior needed to help address root causes of amphibian declines. (i.e. awareness -> action)	i. Pilot coordinated programs for targeted audiences to adopt a specific behavior/action. Evaluate, adapt, and repeat. ii. Continue to highlight ecological, cultural and intrinsic values of amphibians and/or habitats and link to specific actions needed. Make sure we know our target audiences and what incentives/messages motivate them. iii. Work with zoos/aquaria/museums to develop action-based infographs/media kits that can help inform public interpretation & exhibits. iv. Identify conservation commerce projects (e.g. cultural crafts, recycled items) which benefit people	i. Develop lists of specific actions & behavior change needed that links to priority conservation outcomes (see related "identify target audiences"). ii. Build more diverse partnerships with organizations who focus on other biodiversity or human wellness issues (e.g. sustainable certification programs, other taxonomic groups (birds, inverts), watershed conservation/water security, eco-agriculture, etc.) but which also impact amphibians & habitat.

Major Constraints To Effective Conservation	Mid-term Priorities	Short-term Targets
	& wildlife in amphibian hot spot areas that we can promote. Target zoos & museums who may sell these products in their gift shops. v. Develop amphibian friendly "take action" graphics/resources to be shared through partner networks. vi. Highlight amphibian friendly communities and programs. vii. Storytelling through captivating media (photography, video) that demonstrates collective action which benefits amphibians/habitat.	
3. SOCIETAL LEVEL CHANGE "SEED PLANTING"		
3.1 More "experiential learning" needed, especially through: – participation in citizen science – environmental education – field experiences with amphibian enthusiasts	i. Coordinated efforts needed to synthesize and communicate findings from citizen science data back to the amphibian community & with those who participate. ii. Highlight/celebrate volunteers who participate in model citizen science programs. iii. Develop relationships with national environmental education associations to incorporate amphibian related topics into wetland/water quality or other curricula. iv. Continue to highlight ecological, cultural and intrinsic value of amphibians and their habitats.	i. Continue to identify & promote amphibian related citizen science initiatives to families & wildlife enthusiasts. ii. Share "best practices" for citizen science and other public participation programs. iii. Coordinate a global day(s) whereby amphibian enthusiasts commit to offer field/nature based experiences for the public. Share activities & reach. iv. Share examples of how biologists have involved innovative hands-on public participation in their research or conservation activities via peer-review, grey literature, social media, and conference symposia.

Major Constraints To Effective Conservation	Mid-term Priorities	Short-term Targets
	v. Tie environmental education programs to local habitats, watersheds, & bioregions which are more connectable to individuals & communities. vi. Continue to seek opportunities to share knowledge and passion in local nature based experiences. Partner with new and diverse organizations (e.g. general outdoor recreationists, health organizations, local businesses, church groups, etc.) vii. Partner with other taxonomic conservation groups (e.g. birds, bats, invertebrates) to include amphibian expertise in local public engagement programs & biological inventories. viii. Identify and promote opportunities for ecotourism which includes experiences with local herpetofauna.	v. Develop/implement methods to measure attitudinal/behavourial change
3.2 Lack of engagement with youth who are increasingly disconnected from nature.	i. Use amphibians as ambassadors for hands-on nature based experiences & learning. ii. Identify and develop partnerships with local & global organizations that focus on youth recreation programs, nature engagement, service learning & citizen science. iii. Long-term collaboration needed between local NGOs and education institutions for accurate & effective lessons about amphibian declines. iv. Build educator capacity through: a) workshops/professional	i. Publish an annual edition of Froglog Jr. to engage with families and youth. ii. Develop Science Zone on amphibians.org with amphibian education resources. Make sure this is widely communicated to scientists/practitioners to make resources available. iii. Highlight global amphibian programs & research that engage youth via social media & amphibian publications.

Major Constraints To Effective Conservation	Mid-term Priorities	Short-term Targets
	development opportunities b) developed curricula linked to national or local standards c) service learning projects (e.g. habitat restoration, research, citizen science) d) provide comprehensive online amphibian resources for educators e) partnership with zoos, aquaria, parks & museums education & interpretation programs v. Use Media/technology to engage youth in amphibian conservation, partnering with other biodiversity groups to highlight "uncharismatic" animals & expand our reach.	iv. Develop graphics highlighting tangible ways urban youth can take action for amphibians. Distribute through partnership networks. v. Develop/share experiential learning method best practices. vi. Develop "teach the teacher"/educator training courses. vii. Share best practices in regards to educator engagement.

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6. Species Conservation Planning

Basic information on amphibian distributions, ranges, population sizes, conservation status and threats for many species and regions is still lacking, and many priority amphibian species or biodiverse priority regions have no conservation strategies in place.

Group Co-Chairs: Anne Baker & Sally Wren

ASG Secretariat Lead Contact: Helen Meredith (hmeredith[at]amphibians.org)

Vision

A world in which the conservation status of all described amphibian species is known, and effective conservation strategies are in place for all threatened species.

Goals

1. To ensure all threatened amphibian species are covered by either national or range-wide conservation strategies, or conservation strategies at the level of biogeographic region;

2. To develop the means/indicators by which the effectiveness of conservation strategies can be assessed;

3. To ensure that all conservation strategies are developed using the established methods of the community of practice, to ensure attainment of desired conservation outcomes.

Inputs or assumptions

1. That the ranges and conservation status of all amphibian species are accurately and currently known;

2. That important amphibian biodiversity areas are identified;

3. That priority areas in terms of increasing or novel threats are known.

Obstacles

1. Basic information on distributions, ranges, population sizes, conservation status and threats for many species and regions is still lacking;

2. The extent of uptake and effectiveness of existing conservation strategies need further assessment;

3. Many priority amphibian species or biodiverse priority regions have no conservation strategies either for individual species or for their amphibian fauna;

4. Increased pressure on natural resources (i.e. habitat destruction, fragmentation, accidental kills);

5. Lack of funds, institutions, and trained staff.

Necessary actions

1. Develop a small working group membership of those with global coverage of amphibian range, and regional representation;

2. Map existing strategies to global amphibian knowledge and conservation priorities, hence identifying priority species / countries / regions where conservation strategies are missing;

3. Contact relevant parties in priority countries / regions to promote the benefits of conservation planning for amphibian species, offering technical assistance on planning process and content for using established best practice;

4. Involve the growing community of amphibian captive breeders and pet traders.

Current Priority Actions

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
1. KNOWLEDGE		
1.1 Use existing information sources to identify priority species (IUCN Red List of Threatened Species, AZE, Amphibian Ark Conservation Needs Assessment tool etc.) that need a species conservation strategy	Refine priority species lists in terms of geographic coverage, national action plans etc	i. Identify top priorities for SCS using current information sources, using endangerment as standard criterion; ii. Use all existing bodies, regional groups etc. to achieve this
1.2 Develop and apply prioritisation criteria based on more than level of species endangerment	Apply criteria to supplement 1.1	Develop criteria
1.3 Develop an open-source online database that aggregates all existing strategies and plans in one place	Continue activities from short-term	Use SCS WG members and any others to build up collection of existing amphibian SCS
1.5 Assess existing Action Plan successes and failures, and analyse causation	Quantify and review amphibian action plan successes and failures and publish in an open-source document	Develop a questionnaire designed to assess the successes and failures of Action Plan implementation, and send out to ASG members and other relevant stakeholders, using very simple template of

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
		questions, building on work underway
1.6 Promote local knowledge and awareness of amphibian species and their conservation needs and opportunities	Accumulate cases and ensure lessons as models are proactively disseminated to other potential amphibian conservation parties	Identify opportunities as in 5.5 and 5.6, to develop model cases of data acquisition at local level
1.7 Ensure climate change is included in conservation planning, and that its impact on defining conservation sites is well-recognised and heeded in all planning	Collate case histories and lessons learned over amphibian conservation planning and climate change	Build on existing assessment of amphibian vulnerability to climate change through engagement with the Climate Change Specialist Group, the Species Conservation Planning Sub-committee and others
1.8. Develop and improve the evidence-base for amphibian conservation interventions.	Disseminate summarised amphibian conservation evidence (Amphibian Synopsis: Smith & Sutherland 2014) to all ASG members, raising awareness of justifications for evidence-based conservation, and the need for conservation scientists and practitioners to collaborate to publish conservation evidence studies. Request that members review the current list of publications collated in the Amphibian Synopsis, and contribute any evidence studies that have been missed (in any language). Highlight interventions/areas particularly in need of attention, and encourage ASG members to submit any	Coordinate a Conservation Evidence sub-group to: recruit willing ASG members to promote the publication and dissemination of conservation evidence across the ASG, by region and/or specialist topic; assist the Conservation Evidence team at Cambridge University (www.ConservationEvidence.com) to regularly update the Amphibian Synopsis by contributing appropriate studies from ASG members and their colleagues; and support the development of conservation evidence research projects on a regional basis, especially in the tropics.

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
	unpublished evidence to the online Conservation Evidence journal and other publications. Amphibian Synopsis: Smith, R. K., and W. J. Sutherland. 2014. Amphibian conservation: Global evidence for the effects of interventions. Exeter, Pelagic Publishing. Available at: www.conservationevidence.com/synopsis/download/13	
2. ACCESS AND PARTICIPATION		
2.1 Develop the ASG Species Conservation Strategy Working group into an effective, active team	Build on short-term activities	i. Develop the Species Conservation strategy Working Group membership, ii. Develop SCSWG membership into national / regional groups, iii. Proactively increase awareness of the WG within ASG and other amphibian bodies
2.2 Widen the global audience of persons and institutions able and willing to participate in amphibian species conservation	Continue with short-term activities	i. Build on 2.1 to promote awareness of SCS WG activities amongst non-amphibian specialists or interested parties, both inside and outside IUCN, and

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
		assist and welcome their involvement; develop citizen-science opportunities

ii. Stimulate and encourage local-level initiatives |
2.3 Provide technical knowledge and assistance to any party keen to help with amphibian conservation planning	Continue with short-term activities	Match species planning priorities with identified suitable and keen local parties
3. PROCESS		
3.1 Provide a model species conservation planning process	Use amphibian species planning activities to contribute to developing SSC guidance on species planning,	Ensure SSC Species Conservation Planning Sub-committee (SCPSC) planning approach is known and available
3.2 Encourage uptake of amphibian planning opportunities by diverse parties	Undertake at least 5 amphibian planning exercises annually from 2015	Use SCPSC methodology in at least two amphibian planning exercises
3.3 Demystify amphibian conservation planning for non-specialists	Continue and build on short-term activities	i. Assist citizen groups, non-exclusively amphibian interest groups / NGOs with expertise and encouragement to plan

ii. Promote planning approaches that are appropriate to each situation, are common-sense, resource-light but |

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
		based on good information and rigorous thinking
3.4 Overcome lack of engagement and increase support from local stakeholders in the conservation of amphibians	i. Promote participatory approaches in the development of species and site action plans, to elicit buy-in from local stakeholders from the start. ii. Build capacity of local conservationists to conduct simple 'stakeholder mapping' to understand their perspectives, interests, potential contribution, etc., and provide guidance on outreach and conflict resolution	In the analysis of action plan failures/ successes above, ensure questions address how the plan addressed stakeholders
4. CAPACITY AND RESOURCES		
4.1 Using an internet-based system, develop a website for SCS WG to which any/all interested parties, in and outside IUCN, can be invited to join in the interest of species conservation planning	Develop this skills and capacity resource base for coverage around all amphibians of conservation concern	Use SCS WG members to identify organisations and individuals to develop species strategies based on priory species (above)
4.2 Improve collaboration between the various communities involved	Establish a network with representatives from the different disciplines	Identify and assign focal points for each technical discipline required in conservation planning for amphibians

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
4.3 Make available knowledge of potential resources for species planning that are not taxon specific, e.g. Species Conservation Strategy Handbook, and others	Continue development of resource base, including contributing to the development of amphibian-specific planning techniques	Raise awareness of available resources and support networks through articles in FrogLog and on the amphibians.org website, referring to the dedicated website (above), and targeting amphibian conservation parties both inside and outside IUCN
4.4 Increase availability and access to technical support to develop conservation plans to conservationists and amphibian researchers	Develop user-friendly guidelines on how to develop an amphibian species action plan; provide/ fund access to action plan facilitators and other technical advice to aid project design and implementation	Collate and review existing tools for developing species action plans and managing conservation projects
4.5 Increase funding and other resources for the conservation of amphibian species and sites	Demonstrate that more amphibian conservation work has been funded, with funding from what sources, and the effectiveness of low-cost, local actions	i. Include this activity within 6.1; ii. Demonstrate through model projects that much effective amphibian conservation can be done at low-cost
4.6 Promote awareness of funding opportunities and assist with proposal preparation	Ensure all species action plans contain budgets and identify funding sources	Collate and provide a checklist of funding sources for amphibian conservation
5. CONSERVATION		

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
5.1 Increase management monitoring tools for amphibian sites conservation	Develop a 'how to' kit for species and site monitoring for amphibians	Develop and improve efficiency management tools for amphibian sites conservation, using good practice
5.2 Expand active Long-Term Ecological Monitoring of amphibian populations and communities (similar to LTER in USA)	Develop a network of amphibian LTEM sites worldwide	i. Identify existing long-term studies and locations suitable for LTEM ii. Design and agree on protocols, data sharing etc.
5.3 Promote planning and conservation actions in areas / protected areas that are important for amphibians but are of lesser priority on other criteria or for other taxa	Develop simple information packs for PA managers on the importance of amphibians and provide guidance on integrating amphibian conservation into the management of protected areas (including how to find out which threatened species are in their areas)	Ensure staff from relevant protected areas are invited to participate in the development of species action plans
5.4 Promote and assist with effective long-term actions for amphibian conservation at national, local and community levels	Continue short-term actions	Identify amphibian conservation opportunities and strategies where those responsible / keen to take action need assistance
5.5 Promote research and collection of basic information on amphibian species, especially in the tropics	Continue short-term actions, and ensure knowledge arising is stored and disseminated effectively	Encourage research on lesser known species

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
6. POLICY AND PUBLIC RELATIONS		
6.1 Increase awareness amongst publics, governments, policy-makers etc. of the ecological importance of amphibians and their habitats for human well-being, and hence increase support for their conservation	Develop materials to educate decision makers on the importance of conservation strategies and seek access to them through strategic mediators	i. Identify and enlist strategic partners that can act as mediators between ASA and decision-makers ii. Develop documentation on the importance of species conservation strategies in different languages (perhaps start with IUCN's three official languages)
6.2 Increase communication capability to effectively propose and implement a strategic plan and consequent amphibian conservation	Build amphibian scientists' capacity to communicate ideas and convey the need for conservation initiatives in simple and convincing ways, using expertise from others sectors as necessary	Identify good communicators in the amphibian scientific community and ask to develop guidance documents on how to be an effective communicator
6.3 Increase awareness of areas of outstanding importance for amphibians	Continue short-term activities; consider merit of concept of 'Important Amphibian Areas'	Identify and promote protected areas of outstanding importance for amphibians
6.4 Ensure information on the species and context for implementation of the conservation strategy is available to stakeholders and local communities in any amphibian conservation effort, to ensure lasting collaboration	Develop outreach programmes for each species / site as desirable	Develop standard presentations and outreach materials that can later be adapted to suit specific species/sites, based on the analysis in 3.4

7. Taxonomy and Systematics

Taxonomy is often the basis of priority action in conservation yet the complexities associated with amphibian taxonomy frequently result in unanswered questions and challenges when addressing conservation issues.

ASG Secretariat Lead Contact: Ariadne Angulo (aangulo[at]amphibians.org)

These actions were developed by the ASG Secretariat with input from Darrel Frost, Rachunliu Kamei and Stephen Mahony.

Current Priority Actions

The following are immediate priorities identified for Taxonomy and Systematics. The actions are expected to change as progress is made in addressing the issues.

In addition to the constraints in the table below, a number of additional issues were identified, including: an unquantified number of new, undescribed species and their impact on existing species concepts; complex and sometimes intractable taxonomic issues; taxonomic flux; and different opinions by different taxonomic authorities on nomenclature. Individuals and organisations working on this topic should be aware of these factors as they will have an effect on implementation of priority actions.

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
SCIENCE		
Insufficient taxonomic expertise	Develop funds to train future taxonomists in coordination with taxonomists in academic positions	Identify potential donors and funding mechanisms, reach out to prospective donors
Lack of employment opportunities in the taxonomic field	Develop an outreach campaign targeting both the general public and decision makers to stress the importance of taxonomy and taxonomic work	Together with taxonomists and communicators, develop documentation (presentations, brochures and webpage) on the importance of taxonomy in several languages (perhaps start off with IUCN's three official languages)
Museum misidentifications and outdated nomenclature	Develop funds to allow for expert taxonomic revisions in museums with large amphibian collections and for museum database updates	Identify potential donors and funding mechanisms, reach out to prospective donors

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
Geographic biases in the distribution of taxonomic expertise	Develop capacity in regions with gaps in taxonomic expertise	i. Conduct surveys among the ASG membership to identify regions in need of taxonomic expertise ii. Contact off-site experts where available to enquire about potential local sources of future taxonomists iii. Match established taxonomists with potentially new taxonomists in gap regions via the new ASG mentorship programme
Lack of access to modern technologies in amphibian rich regions	i. Enlist local institutions willing to share existing technologies (e.g. molecular laboratories in academic and health care institutions) ii. Invite new institutions with the ability to house new technologies to partner up with institutions where these technologies are already available and create agreements to facilitate cooperation between them	i. Identify and contact institutions with existing facilities and those able to house and maintain modern equipment ii. Identify funding mechanisms to facilitate transfer of technologies between existing and potential laboratories with modern technologies
CONSERVATION		
Insufficient capacity to keep up with level of taxonomic flux	Develop funds to allow for extinction risk assessments of species with taxonomic changes	Identify and approach sources of funding that would be amenable to specifically fund extinction risk assessments resulting from taxonomic flux
Lack of coordination between taxonomy and conservation communities	Establish communication channels between both communities and encourage collaborative projects	i. ASA to lead in the identification and contact of proactive and communicative members in both taxonomy and conservation

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
		communities who would be willing to act as focal points/moderators for these communities, create an online network and invite members of both communities to join ii. Seek to increase ASG membership with taxonomic expertise
Taxonomic uncertainty precluding conservation action	Increasing awareness of the need for conservation action in spite of taxonomic uncertainty, whilst not denying the importance of taxonomy in the long term	Identify cases of taxonomic uncertainty (this could be done at a regional level)
POLICY		
Legislation hampering the use of modern technologies (stringent requirements to access "genetic resources")	Where possible, work with authorities to change attitudes and eventually legislation	i. Identify receptive and responsive relevant authorities in amphibian rich countries where legislation may be an issue in the use of modern technologies ii. Develop clear and informative amphibian-specific documentation in various languages (perhaps IUCN's three official languages to begin with) to help explain the need for modern technologies in amphibian taxonomy and how these differ from a commercial application in relation to genetic resources iii. Identify good communicators in the amphibian community who would be in a position to effectively and successfully communicate the need for modern technologies with targeted receptive authorities

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
International conservation mechanisms not keeping up with taxonomic changes	i. Notify representatives of international mechanisms of nomenclatural discrepancies and notify them of any further changes ii. Facilitate identification of amphibian species listed in CITES by law enforcement officers through the development of a pictorial guide	i. Identify any major discrepancies in amphibian nomenclature in international mechanisms (e.g. CITES) ii. Identify key and receptive representatives of these mechanisms and the processes needed to effect nomenclatural changes iii. Recruit volunteers to identify all amphibians listed in CITES, determine how many have photos, request access to use photos, and in consultation with taxonomic experts, mount a pictorial guide of CITES amphibians
SITE LEVEL STAKEHOLDERS		
Insufficient resources to help local stakeholders in identifications	i. Develop materials to help in species identifications (e.g. field guides) ii. Establish a fund specifically designed to publish field guides	i. Identify those instances where there are local stakeholders who are committed to amphibian work and contact experts on that particular fauna to request expert contribution towards a field guide ii. Identify and approach potential sources of funding for a field guide development fund

2007 ACAP related chapter: Systematics and Conservation (G. Parra, R. Brown, J. Hanken, B. Hedges, R. Heyer, S. Kuzmin, E. Lavilla, S. Lötters, B. Pimenta, S. Richards, M.O. Rödel, R.O. de Sá and D. Wake).

8. Trade & Policy

A lack of information on global amphibian trade is significantly hampering effective response to emerging diseases and contributing to the unsustainable harvesting of some amphibian species.

Group Chair: Jonathan Kolby

ASG Secretariat Lead Contact: Ariadne Angulo (aangulo[at]amphibians.org)

Current Priority Actions

The following are immediate priorities identified by the Trade & Policy Working Group. These actions are expected to change as progress is made in addressing the underlying issues.

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
SCIENCE		
Critical gaps in basic knowledge about traded amphibians, such as: – Methods to differentiate amphibians that were collected from the wild versus those that were bred in captivity – In wild populations, methods to differentiate different morphs (to ensure that morphs from elsewhere are not being illegally traded) – Monitoring the magnitude and impact of current trade volumes on amphibians collected from the wild – The effect of disease events on wild populations of traded amphibians – Presence of emerging pathogens in the international amphibian trade – Precise points of origin for wild amphibians in trade	Update research priorities annually	Develop section of amphibians.org where research priorities can be presented to the public and a listserv to facilitate discussion of priorities among group members

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
– Trade routes (animals may be smuggled illegally from one country to another then legally exported elsewhere from second country) – Species have not been identified for CITES listings – The additive effects of trade on populations that are experiencing population declines due to other factors (e.g. disease)		
Facilitate development of resources (e.g. pictorial guides) that can help law enforcement officers identify whether trade policies have been violated	Identify potential subject matter experts	
Develop fund to support emergency pathogen surveillance in traded amphibians	Identify potential donors for fund	
Identify species that warrant targeted disease surveillance to evaluate the presence of specific emerging pathogens in traded amphibians	i. Facilitate collaborations between researchers, the public, government, and policy-makers ii. Produce a list of high priority species for targeted disease surveillance and their trade routes	
Assess whether trade restrictions intended to prevent population declines via unsustainable harvest have led to population recovery (and/or identify whether data exists)	i. Identify amphibian species previously subject to high trade volumes that were subsequently governed by specific trade quotas	

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
	ii. Identify and contact experts on the species above to assess whether there are recent field population data	
Evaluate the life history and/or reproductive traits of commonly traded "captive bred" species to determine whether commercial-scale breeding is likely	i. Identify amphibian species commonly traded in high volumes as "bred in captivity" ii. Identify species that are more likely to be wild-harvested and monitor trade iii. Identify and contact husbandry experts on the above species to enquire about their life histories being conducive to commercial-scale breeding	
Produce a database with known and documented points of origin (collection localities) for all species listed in CITES	Research available publications and trade documentation and compile an initial list of species and points of origin	
Identify those genera and species listed in CITES which could potentially comprise species complexes and engage with taxonomists specializing in these groups to assess the potential distribution of cryptic forms and whether they would be at risk from trade	i. Identify and contact taxonomic experts on species listed in CITES and work to produce a list of potential target species ii. Of the target species, assess whether there are particular areas of their distribution that may contain forms which could be most vulnerable to trade (via points of origin collections) and may be at risk of extirpation	
Engage with local experts to investigate whether commercial collection may contribute towards the extirpation or	Identify regions where amphibian disease events have contributed to	

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
extinction of amphibians already in decline from other pressures (e.g. Fire salamanders and *B*sal)	population decline, but commercial harvest may be occurring	
TRADE		
Lack of supporting documentation for the effect of trade volumes on wild populations, specifically: – Quota systems for "sustainable" harvest are issued following the identification of "unsustainable" harvest – Quota systems being voluntary in nature and not informed by science – CITES listings being applied to species level (App I or App II)	Support the development of amphibian species proposals for CITES CoP 17 and prepare documentation to request that quotas are supported by science	Convene a meeting with international amphibian experts to identify species that may warrant proposal for CITES listing at the next CoP
Facilitate integration and data sharing by academics, NGOs, government agencies and wildlife managers actively working to mitigate the spread of infectious disease through amphibian trade through a dedicated symposium or workshop	Assist ASA's urgent effort to prevent the introduction of Bsal into the USA through the salamander import trade by encouraging the USFWS to establish an import moratorium	
Lack of industry & public awareness for the need to: – Employ biosecurity measures in trade facilities to mitigate the spread of disease	i. Develop outreach material to provide to amphibian traders and buyers and also amphibian collectors	Facilitate input of disease experts into the development of best management practices

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
– Encourage captive breeding of amphibians to relieve pressure on wild populations – Prevent release of exotic amphibians into the wild – Prevent the untreated disposal of amphibian husbandry waste from households into the environment – Educate local communities and other stakeholders on the impact of trade on their local amphibian populations	ii. Work with responsible and legitimate amphibian breeders to disseminate awareness-raising materials related to biosecurity, ethical sourcing of amphibians and conservation priorities	
POLICY		
Absence of international data recording mechanisms which leads to lack of data necessary to evaluate threats to amphibians from unsustainable trade (trade in non-protected species is only recorded by the USA)	Encourage countries to record and report trade volumes in non-CITES-listed amphibian species	Engage in discussion with World Customs Organization to create codes specific to amphibians
Lack of regulations to mitigate pathogen introduction to the USA and elsewhere via amphibian importation	Facilitate data sharing and brainstorming between academics, NGOs, the World Organization for Animal Health (OIE), and government agencies to develop amphibian health certification platforms and disease risk analysis and surveillance systems for potential application to the amphibian trade through a dedicated symposium or workshop	Engage in discussions with USFWS regarding the need for policies that reduce the threat of pathogen introduction via the international amphibian trade

2007 ACAP related chapter: Chapter 5. Over-harvesting (A. I. Carpenter, H. Dublin, M. Lau, G. Syed, J. E. McKay and R. D. Moore).

9. Surveys and Monitoring

With the threat of emerging infectious amphibian diseases such as *Bd*, *Bsal* and Ranavirus, the lack of screening for these diseases in biodiversity surveys poses a significant threat to amphibians around the world. Ensuring that the integration of disease monitoring is a standard part of all surveys is of critical importance in areas such as Madagascar (*Bd*),the Americas (*Bsal*) and Europe (Ranavirus).

Group Chair: Ross Alford

ASG Secretariat Lead Contact: Ariadne Angulo (aangulo[at]amphibians.org)

Current Priority Actions

The following are immediate priorities identified by the Surveys and Monitoring Working Group. These actions are expected to change as progress is made in addressing the issues.

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
SCIENCE		
Limitations of traditional survey and collection approaches to monitor certain threatened, rare and/or cryptic species, possible advantages of more novel monitoring techniques (e.g. environmental DNA, automated recording devices)	i. Development of best practice techniques for collection and interpretation of environmental DNA (eDNA) data ii. Support the development of remote monitoring devices, including call recording and effective automated call identification; support capacity building on remote monitoring device management by local communities that have immediate access to sites of interest	i. Literature survey and consultation with experts on the use of eDNA; working document subject to continual revision ii. Literature review and survey of individuals working in the field of passive acoustic monitoring (PAM) iii. Matching of expertise with students or others interested in PAM as part of ASG or academic projects
Survey efforts not standardized, making comparisons and sometimes achievement of goals difficult	i. Development of guidelines for optimization of survey effort and techniques to meet particular goals ii. Development of criteria for choosing types of monitoring	Literature surveys and consultation with experts; working document subject to continual revision: – Develop guidelines for choosing state variables in monitoring programs and surveys (i.e. should we measure species richness,

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
	techniques and localities for monitoring	occupancy, abundance, occurrence of reproduction (tadpoles), life history traits, etc.) – Develop guidelines for ancillary data (predators, competitors, pathogens, environmental features, possible contaminants, etc.) to be collected in surveys
Lost survey opportunities and/or improper collection of scientific specimens	i. Harness citizen science and local stakeholder participation by developing guidelines for basic population monitoring techniques that would allow for relatively inexperienced individuals or community groups to conduct regular surveys ii. Develop guidelines for collection of voucher specimens and genetic samples	i. Following from the above item, develop a simplified protocol for adoption and application by citizen science ii. Identify and contact citizen science initiatives that would be interested in partnering up for amphibian surveys and monitoring iii. Survey museums and researchers to determine their field collections guidelines and integrate into best-practice document
Lack of integration between field data and available spatial (GIS) data	i. Develop a better understanding of which GIS data are available and relevant for amphibians (depends on spatial scale), inclusive of literature review and experimentation with GIS (more experimental use of GIS, i.e. making and testing predictions, revising when they prove inaccurate, repeat) ii. Develop guidelines for how to analyze and interpret spatial data collected in surveys.	i. Recruit volunteers to do a literature and web review for existing GIS resources that can be applied to amphibians ii. Identify and approach ASA and/or ASG members with GIS expertise who may be willing to do some pilot testing of GIS data against field data

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
	Requires preliminary gap-filling science, though guidelines could be developed and promoted with continual review and revision	
Misidentifications in the field leading to inaccurate conclusions	i. Development of keys or databases for reliable species identification, either using traditional or DNA barcoding techniques (to be carried out by individuals working with regional faunas and/or surveys. Some potential for using Genbank, but much misidentification at present at least for some faunas). ii. When there is ongoing monitoring with stakeholder participation, develop targeted keys specific to the monitored fauna that are easy to use and reliable for non-experts	Recruit volunteers to collate existing keys by regions; develop lists of keys for taxa/areas to identify existing resources; reach out to taxonomic experts to assess quality and usefulness of keys
Knowledge gaps on the impact and significance of amphibians in community and ecosystem dynamics	Long-term, monitoring and experimental ecology as needed to answer questions arising from literature review(s)	Review of relevant literature for amphibians in terrestrial and aquatic systems
Knowledge gaps on how amphibian-specific conservation sites contribute to the delivery of ecosystem goods and services	Medium-term, planners and ecologists to establish and test hypotheses	Recruit volunteers to review existing literature on amphibians and ecosystem services
CONSERVATION		

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
Lack of screening for emerging infectious diseases (EIDs such as Bd/Bs and ranavirus) in biodiversity surveys	i. Support the integration of Bd/Bs and ranavirus surveys into all biodiversity survey work. This is an immediate priority in areas such as Madagascar (Bd) and the Americas (Bsal) ii. Collaborate with disease experts to incorporate disease and pathogen detection into monitoring programs. This is an urgent priority in regions where particular diseases are presently thought to be absent, and should be a high priority in other regions	Disease and monitoring working groups to exchange documents and cross-fertilise membership
Mismatch between modelled species ranges and ranges on the ground	Develop resources (funds, citizen science initiatives) that would allow for ground truthing and border expansion of presently understood species ranges. This can be prioritized by the conservation status of species, e.g., Least Concern species are low priority unless they are disease carriers	i. Evaluate and select some potential case studies that could be tested in areas where there are already ongoing survey and monitoring efforts ii. Identify and contact potential donors
Lack of collaboration and coordination in survey and monitoring efforts	i. Better coordination among basic biodiversity surveys, to ensure that geographic or taxonomic gaps are filled—website/database with at least names, contacts, regions working ii. Provide resources for and promote collaboration between those working on	i. Recruit volunteers to develop tailor-made questionnaire for ASG members to complete; develop a database/online resource with this information and make it available to all ASG members ii. Use ASA as a clearinghouse where students looking for graduate projects at universities are matched to ASG priorities

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
	biodiversity identification, pathogen and parasite ecology, skin microbiota, the effects of environmental contaminants, and habitat alteration and climate change	iii. ASA and ASG can help with integration/collaboration via cross-fertilization of working groups and compilation of needs
POLICY		
Governmental agencies sometimes requiring lengthy and involved application processes to conduct surveys	Where possible, work with receptive authorities to simplify application processes	i. Develop clear documentation to help explain the need for surveys and monitoring ii. Recruit good communicators in the amphibian community to act as mediators with authorities
SITE LEVEL STAKEHOLDERS		
Lack of information and buy-in on survey and monitoring initiatives (and thus on amphibian and habitat conservation)	Promote community and authority engagement by developing outreach materials	Recruit amphibian educators and communicators to develop outreach materials in several languages (perhaps the three official IUCN languages to begin with) and make them available to all ASG members that go to the field

10. Genome Resources

Amphibian genome resources impact many aspects of amphibian conservation including: infectious diseases, trade and policy, climate change, ecotoxicology, assessing the success of species conservation strategies, reintroductions, management, habitat loss and restoration, invasive alien species, surveys and monitoring, taxonomy and systematics, education and awareness and even politics.

Group Facilitators: Caren Helbing & Craig Hassapakis

ASG Secretariat Lead Contact: Jos Kielgast (jkielgast[at]amphibians.org)

Vision

To create a historically permanent record and resource (publicly accessible in sustainable repositories) of bioinformatics and tissue for amphibian species conservation and research.*

Target Areas

A) Bioinformatics of amphibian genomes: Sequence, assemble, and annotate representative nuclear genomes from each family of Amphibia and make them publicly available in curated databases.

B) Biodiversity preservation of tissues representing all amphibian species: Cryopreserve tissues. Promote assisted reproductive technologies. Develop and use cell/tissue culture in amphibian species, particularly those in immediate danger of being lost.

Goals

Part A. Bioinformatics of amphibian genomes

1. **Nuclear Genomes**: Sequence, assemble, and annotate representative genomes from each family of Amphibia (Anura: 55, Caudata: 10, Gymnophiona: 10)—total 75, to enable initiatives such as evaluation of biological responses to pollutants, infectious diseases, climate change, habitat stress/loss using transcriptomics, proteomics, and metabolomics approaches, identification of antimicrobial peptides, etc. Promote the development of non-lethal molecular health assessment tools.

2. **Resource Accessibility**: Promote the deposition of genome, microbiome, and related data into curated public databases to facilitate their widespread accessibility and use.

Part B. Preservation of amphibian tissues

1. **Collection and Discoverability**: Determine existing worldwide amphibian genome, tissue, and cell culture resource availability and making these resources known and accessible. Collect (germ, somatic cells and other tissues), cataloging, and cryodeposition in publically accessible repositories, first, representing all genera of amphibians (Anura: 445 genera (6,630 sp.); Caudata: 68 genera (682 sp.); Gymnophiona: 33 genera (205 sp.)—total: 546, and the completion of all species worldwide within 10 years (7,517 sp.: March 4, 2016, AmphibiaWeb).

1. **Priorities**: Collect, store, and catalogue cryobanked tissues of all amphibian species, but most importantly, those in immediate danger of being lost forever. Facilitate Assisted Reproductive Technologies (ART) and development of cell/tissue culture techniques and resources.

1. **Education and Standards**: Generate and integrate operating ethics and standards for cryopreservation of tissue, proper storage, and depositing in publicly accessible venues practices routine. Promote the use of standard procedures.

Current Priority Actions

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
Part A. Critical gaps in basic knowledge, funding, and resources		
Knowledge: Genetic diversity of amphibian species; linkage of genetic makeup, physiology, and phenotype at various life stages; impact of pollutants, toxicants, infectious disease, climate change; role of microbiomes in amphibian health and disease.	**Support:** Facilitate and support large scale efforts to sequence, assemble, and annotate high quality amphibian genomes that will be made publicly available. Support initiatives using genomic (including microbiomes), transcriptomics, proteomics, and/or metabolomics-based approaches.	**Priorities:** Motivate a synergistic community effort towards transparency, communication and coordination among large scale sequencing projects. Create prioritized list of target species for genome sequencing. Engage appropriate sequencing and bioinformatics partners.
Tools: Lack of conservation-friendly, minimally invasive tools to determine amphibian health and reliable distribution and estimated population sizes of species.	**Training:** Invest in the training and support of students and highly qualified personnel in creating and using molecular resources/tools and bioinformatics.	**Support:** Support funding initiatives, formation and interactions of research consortia aimed at amphibian genome sequencing, assembly, and annotation as well as developing and using these molecular tools and approaches.
	Education: Promote data acquisition and dissemination relevant to environmental regulatory agencies e.g., linking molecular indicators to deleterious outcomes.	**Infrastructure & Policy:** Identify sustainable informatics structure for providing public access to genome information.
	Dissemination: Encourage the scientific community to take data-based recommendations	**Education & Financial:** Identify and interact with potential donors

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
	for reducing threats to amphibians to policy makers, industry, and the public at international, national, regional, and local levels.	and funding partners. Set up funding structures.
	Research & Development: Promote and support the development of high quality minimally invasive molecular assays for animal health and population distribution assessments (e.g., eDNA from water samples; swab or biopsy techniques followed by biomolecular assays).	
Part B. Critical gaps in basic knowledge, funding, and agreement within the amphibian conservation community		
Knowledge: Lack of technical ability for female gamete cryopreservation and specific parameters for male gamete cryopreservation conditions for all known amphibian species.	**Support:** Facilitate and support large scale efforts to collect, store, and catalogue cryopreserved amphibian tissues, assistive reproduction technologies, and development of cell/tissue culture techniques and resources for research, experimentation, and conservation purposes.	**Priorities:** Create prioritized list of species and areas for tissue collection and cryopreservation (determine types of tissue collected: somatic, reproductive, blood, etc.) taking action before it is too late for certain areas and species.
Agreement: Shortfall in understanding and agreement within the amphibian conservation community of how to best protect and preserve	**Training:** Invest in the training and support of students and highly qualified personnel for amphibian tissue cryopreservation collection, storage, and maintenance.	**Activities:** Support funding initiatives, formation, and interactions of research consortia (e.g., Global Genome Biodiversity Network [GGBN]) aimed specifically at amphibian tissue

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
amphibian species worldwide.		collection, cryopreservation, and cataloging.
Stakeholder Challenges: National politics; intellectual property rights agreement; lack of curation infrastructure for tissue collection and storage; lack of complete support and agreement (e.g., MOUs, collecting permits) for effective cooperation toward amphibian cryopreservation goals; and lack of funding to develop and implement urgent action(s).	**Financial:** Develop long term financial and institutional support specific for amphibian tissue cryopreservation technology and development.	**Funding:** Identify and interact with potential donors and funding partners specific to further amphibian tissue cryopreservation worldwide.
	Education & Publication: Development of technical manuals, protocols, hands on training, and public awareness campaigns for amphibian tissue acquisition and storage in multiply conservation specific countries, areas, and languages.	**Research:** Construct a list of research topics which urgently need to be addressed (e.g., female gamete cryopreservation technology and development, bioinformatics, reproductive technologies) and actively promote participation within educational systems (M.Sc., Ph.D., and Postdoctoral programs) worldwide.
		Education/Agreement: Sign MOUs with stakeholders.

2007 ACAP Related Chapter: Chapter 11. Bioresource Banking Efforts in Support of Amphibian Conservation (O.A. Ryder).

This resource impacts many aspects of amphibian conservation including infectious diseases, trade & policy, climate change, ecotoxicology, assessing the success of species conservation strategies, reintroductions, & management, habitat loss & restoration, invasive alien species, surveys &

monitoring, taxonomy & systematics, education & awareness, and politics. Ongoing promotion of integration genome resources into larger initiatives encompassing broader organismal groups e.g., mammals, reptiles, microorganisms, plants, etc. is essential.

11. Climate Change

A better understanding of the potential impacts that climate change has on amphibians is needed. By improving our understanding of the species to be most affected by any changes in climatic conditions and how those particular species will likely be impacted we are better able to direct the conservation prioritization and planning processes for range restricted and threatened species.

Group Co-Chairs: Guin Wogan and Johannes Penner

ASG Secretariat Lead Contact: Phil Bishop (pbishop[at]amphibians.org)

Vision

Amphibian habitats and populations sufficiently robust and adaptable to adapt to current and future climate change

Goal

All key amphibian habitats and populations restored or maintained to a healthy state, encompassing ecosystem diversity and adaptability, population dynamism and genetic diversity. Amphibian population management to be informed by adaptive models incorporating climate change and populations through close cooperation between amphibian researchers and modelling researchers.

Issues

Environmental changes affecting all regions the world and influence all organisms. Amphibians are one of the most sensitive groups to change, whether that is caused by habitat loss, invasive species, disease, trade or climate change. Nearly 33% of the amphibian species of the world are categorized as threatened on the Red List. Furthermore, given their complex life cycles and other traits, amphibians are often recognized as indicators of ecosystem health.

The vulnerability of tropical forests to climate variability and change has been highlighted (Condit 1998, IPPCC 2002, CBD 2003). However, these habitats are of particular importance for amphibian conservation due to the high amphibian diversity and also many endemic species they support. Other habitats may have an overall lower amphibian diversity but may be of global evolutionary significance, or regional or local importance for biodiversity. The continued delivery of many important ecosystem services is dependent upon the maintenance of biological diversity within these ecosystems. Thus, climate change impacts need to be considered for all ecosystems supporting amphibians.

At a habitat level actions are needed to maximize the resilience of natural systems, including ensuring habitat connectivity towards potential habitats suitable in the future (Julius and West 2008). Resilience is being compromised by climate change and uncertainty over future climate makes management plans difficult. Nevertheless, management needs to be flexible and diverse approaches will be required (Millar *et al.* 2007). The most immediate priority is to reduce short-term threats to achieve a vision of long-term adaptation (Perez *et al* 2005), in many cases the most immediate issue will be habitat alteration and fragmentation. Given the scale of the problems there is a need to prioritise species and ecosystems for conservation management. In addition certain overarching research issues need to be addressed before fully robust plans can be devised. Our ability to identify priorities and actions is limited by data availability on the precise climate change threats the diverse amphibian species face and on the most effective actions that can be taken. Data are needed on key habitats, sites and populations, on individual species vulnerabilities, the nature of present threats and on likely future threats. More complex issues also need to be investigated such as the synergies between threat

factors, for example habitat alteration and fragmentation may reduce climate adaptability, or climate stress may be increasing amphibians' susceptibility to disease. These are logical interactions but largely speculative at present.

Current Priority Actions

The following are immediate priorities identified by the Climate Change Working Group. These actions are expected to change as progress is made in addressing the issues. Certain issues may not have been addressed in the current planning process and therefore some actions might be currently omitted from this list.

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
SCIENCE		
We do not know which species of amphibian are most likely to be affected by climate change	Identify climate change vulnerabilities: i. Assess the climate change vulnerability of each amphibian species ii. Develop global and regional lists of taxa threatened by climate change iii. Identify Key Areas for Amphibians Conservation at regional level with local involvement in prioritization. This should identify key ecosystems, sites and amphibian populations iv. Produce a list of sites requiring immediate protection and/or restoration	Identify set of high priority species & model the impacts under existing scenarios and future climate change models: i. Identify a set of characteristics which make amphibians vulnerable to climate change iii. Superimpose these characteristics to range restricted and or already threatened species to identify priority species
The threats amphibians face from climate change are not well understood.	i. Review the data on the threats amphibians face from climate change in order to identify data gaps. ii. Fill the identified data gaps through facilitation of research on the priority issues by universities, NGOs and local groups and ensuring	i. Summarise direct threats ii. Identify possible synergistic threats needing research iii. Outline possible threats

Major Constraints To Effective Conservation	Mid-term Priorities (1–5 years)	Short-term Targets (6–12 months)
	open-access data sharing of this research.	
We don't have evidence-based solutions to counter the effects of climate change for amphibians	Identify potential solutions to the effects of climate change	Identify any clear solutions to the effects of climate change and outline possibilities for further investigation
CONSERVATION		
It is likely that many amphibian-rich areas will be affected by climate change resulting in potential species extinction.	Protect and manage the identified key sites and species, addressing the vulnerabilities identified	
Climate change is likely affecting amphibian species quicker than we can find solutions to this issue.	Establish ex-situ breeding programmes of priority species likely to lose suitable habitat before effective climate change mediation can be implemented	Develop list of most vulnerable species (see Science section above)
The effects of climate change need to be widely understood to gain support for action.	Communication of the issues to the amphibian community and wider pubic will be necessary to publicise the issues and the need for action through the identified solutions.	Develop communication tools to engage individuals in amphibian climate change issues

2007 ACAP related chapter: Climate Change, Biodiversity Loss, and Amphibian Declines (A. Pounds, A.C.O.Q. Carnaval and S. Corn).

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12. Captive Breeding

The captive breeding community must be able to respond to new threats as they emerge, emerging infectious diseases in particular. There is currently limited captive breeding capacity and more species in need of conservation breeding programs than there are programs established. As new threats emerge and more species become threatened, there is a risk that the captive breeding community will be unable to respond.

Group Co-Chairs: Ben Tapley and Kevin Johnson

ASG Secretariat Lead Contact: Sally Wren (swren[at]amphibians.org)

Vision

All amphibian species assessed by AArk Conservation Needs Assessments or other nationally-recognized organizations that are recommended as priorities for conservation breeding, are established in genetically and demographically viable and financially stable *ex situ* programs. Where possible, programs should be within the indigenous range, with program outlines which identify short, medium and long term goals for the program and an exit strategy.

Goals

Identify species that are both priorities for *ex situ* conservation action and are appropriate candidates for such action.

Leverage the resources required to ensure that all species identified for urgent rescue can be brought into effectively managed facilities.

Ensure that effective program planning, including methods of evaluating the success or failure of the program and its goals, and an exit strategy is developed for each new conservation program, before the program is actually implemented.

Ensure that resources are used as transparently, efficiently and responsibly as possible.

Maintain genetically and demographically viable populations in captivity while threats are either better understood or mitigated in the wild.

Provide fit, healthy animals for release that are capable of establishing self-sustaining populations in the wild once threats have been correctly identified and removed or sufficiently reduced (released animals should not provide a disease risk to other individuals / species at the release site) .

All breeding programs will endeavour to the best of their ability to comply with all national and international requirements on activities involving specimens in captive breeding colonies.

Provide high quality training / capacity building and long term support in regions where captive breeding programs are required but there is not currently sufficient expertise.

Foster / contribute to partnerships and collaborations that facilitate positive conservation outcomes, funding and political support.

Foster scientific research on captive colonies to generate information relevant for amphibian conservation.

The effective management of disease in captive populations.

Provide best practice recommendations to the community for screening animals prior to release in order to mitigate unintentional transfer of disease or disease strains.

A community that can respond to new demands and challenges as they emerge.

Captive amphibians on public display are used to effectively convey conservation messages to the visiting public, in order to develop a feeling of responsibility for amphibian conservation.

An Amphibian Ark staff member in every amphibian-rich country of the world, reviewing and updating the conservation needs assessments, organising and delivering training, lobbying for habitat protection, raising funds and managing and supervising species programs.

Share and communicate results and network with the amphibian conservation community.

Challenges

Insufficient funding / resources

Although there are now more resources being invested in amphibian conservation than ever before, relative to other taxa amphibians remain grossly underfunded. Funding for captive breeding comes from a diversity of sources but is often piecemeal, localised and short-term. Captive breeding programs require long term investment and take time to establish, this often results in project fatigue. There is also an issue with sourcing specialist equipment in some range states which has the potential to undermine programs once they have been established.

Insufficient technical expertise and a lack of species champions

Amphibian captive husbandry expertise is sometimes lacking in the countries which support the greatest amphibian biodiversity, this is compounded by the fact that usually, the countries with the highest amphibian diversity are also the countries where the greatest proportion of amphibians are threatened. Although attempts have been made to address this balance the lack of technical expertise remains a problem. It can be difficult to train the appropriate people, there is high staff turnover and once training has occurred there are no mechanisms in place to ensure that the knowledge gained through training workshops is put into practice and disseminated to others. This last issue is due, at least in part, to a lack of species champions to develop and formally manage programs for target species. Some captive husbandry practitioners also have difficulty accessing scientific literature on amphibian husbandry. The expertise underpinning many programs is based on short training experience and some programs may lack the longer term experience required to adapt to the problems in husbandry.

Identifying suitable candidate species that require captive breeding programs

Not all amphibians are suitable candidates for captive breeding programs. The threats for some species are not currently reversible, or may not ever be reversible. Deciding which species should be established in captivity can be problematic and needs to take into account the geo-political context and likelihood that the captive breeding program will succeed.

Failing to act and acting too late

Captive breeding programs are often seen as a measure of last resort and the establishment of a captive breeding program is often postponed until numbers in the wild are dangerously low. This can greatly reduce the chances of establishing a viable captive breeding program due to the issues inherent with small population sizes and the time potentially required to develop species-specific husbandry techniques. There is a choice to be made between prioritising small populations or larger, rapidly

declining populations; in the one case extinction may be imminent, but programs may fail, while in the other case there is still time for *in situ* only intervention.

Lack of field data on species biology and reliance on non–evidence based husbandry practices

Data on life history and environmental parameters are lacking for many species and life stages. This paucity of information has the potential to undermine programs for species which are established where little to nothing is known about the species biology, ecology and habitat / microhabitat requirements. There is a prevalence of anecdote-based husbandry over evidence-based approaches. There is a need to engage with field biologists, the scientific literature and the application of a methodical approach to changing husbandry. Engagement with industry / technical expertise may facilitate the design of better captive facilities to provide appropriate conditions.

New threats and limited capacity

The captive breeding community must be able to respond to new threats as they emerge, in particular emerging infectious disease. There is already limited captive breeding capacity and more species in need of conservation breeding programs than there are programs established. As new threats emerge and more species become threatened there is a risk that the captive breeding community will be unable to respond. Working with field biologists to conduct health surveillance of wild populations is crucial.

Ex situ management can produce maladapted amphibians

Some amphibians fail to thrive and breed in captivity under the conditions currently provided to them. The husbandry requirements of amphibians are more complex than previously thought and for many species that require captive breeding programs, the husbandry requirements are unknown. There is a danger of not producing any captive bred offspring or producing maladapted amphibians in captive breeding programs which may not be suitable for reintroduction, especially if captive conditions differ greatly from field conditions.

Risk of novel pathogens in ex situ facilities

Conservation breeding facilities should be located within the indigenous range of a species to minimise the risk of individuals in such programs becoming exposed to novel pathogens, or bringing pathogens into existing captive populations. Doing so may also simplify the provision of some environmental and climatic variables that may be important for successful husbandry. Capacity may be lacking in some regions, and as a result facilities may need to be located outside of the range state and / or distributional range of the target species and there is a risk that such populations of amphibians will become exposed to novel pathogens. This is especially an issue if hosting organisations maintain cosmopolitan animal collections. Many pathogens of concern (e.g. ranaviruses) cannot currently be effectively screened for and this has the potential to undermine programs and put sympatric species at release sites at risk.

National, regional or local conservation authorities are / become unsupportive

Conservation priorities depend on the scale of operation. A regionally threatened species may not be a national or global priority, and vice versa. This can result in different priorities within organisations operating at different scales. Equally, the level of support provided will depend on the political motivations of the authorities concerned. State support is likely to improve with appropriate engagement with in-country parties.

Lack of sufficient numbers or genetic diversity for founding populations

Genetic analysis is expensive and the resources and expertise are not available to determine the genetic viability of many populations both in the field and in captivity that would benefit from it. Currently, some studbooks are not well implemented in existing *ex situ* programs.

Lack of post release monitoring

Inadequate post-release monitoring does not allow captive breeding practitioners to assess the success of their programs. Poor survival and / or breeding of captive bred animals following their release to the wild needs to be identified as quickly as possible so that husbandry changes aimed at improving success can be identified and implemented.

Conflict of interests

Whilst conservation research has an important role in developing new husbandry techniques, disease mitigation and for developing reintroduction strategies, there is a risk that producing animals for research becomes the priority to the detriment of the captive population. The practical benefits of using captive bred offspring for research rather than release need to be critically assessed on a case-by-case basis.

Current Priority Actions

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (3–10 years)	Short-term Targets (1–3 years)
Actions From ACAP		
Operating in response to recommendations from local biologists, national governments, and the various ACAP research branches, rapid-response teams would travel to sites predicted to suffer catastrophic losses to implement pre-emptive collections of animals that will form the basis of captive programs. A prototype of such a program has been used effectively to rescue the frog fauna of a site in Panama (see www.saveafrog.org)	i. Assess countries for their conservation needs ii. Reassess all countries for their conservation needs every 4-5 years (Ongoing)	i. Ensure that conservation needs assessments for countries with high amphibian biodiversity are completed (Partially completed) ii. Collate as much species data as possible while the animals are still in the wild iii. Develop and regularly update emergency response plans for various situations (to

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (3–10 years)	Short-term Targets (1–3 years)
		help avoid the issue of poor planning) iv. Collect environmental / habitat data during emergency collection trips to start informing husbandry and equipment kits held by AArk for deployment with each rapid response team
Central to the long-term success of a captive program is the establishment of captive operations as close to the indigenous range as practically possible	i. Establish captive programs as close to the indigenous of a species as practically possible ii. Facilities established outside of range states only when species extinctions are imminent before range country programs can be effectively achieved iii. Set up external panel to ensure the risks posed by establishing programs outside of range states are assessed iv. Sufficient funding and resources secured for each *ex situ* programs	Identify the areas in which there is the most need for amphibian husbandry capacity building (Partially completed)
Local biologists or citizens must quickly be identified, hired, and trained and trained in amphibian biology and husbandry	i. Ongoing training and support to be provided for early career husbandry practitioners	Update list of people with conservation husbandry experience (Underway, but needs more resources)

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (3–10 years)	Short-term Targets (1–3 years)
	ii. All staff working in facilities are trained in amphibian biology and husbandry topics and have the knowledge base to allow them manipulate captive parameters to achieve program success	
A steady program of internships in established amphibian facilities in other countries will be critical to maintaining intellectual and practical capacity at range-country facilities	i. Identify programs where internships would be beneficial ii. Internships underway; supporting staff in newly established facilities	Identify list of institutions willing to host interns. Obtain funding for internship programs
Close contact and communication among all facilities in the network must be maintained by a global supervisory staff	i. An Amphibian Ark staff member in every amphibian-rich country of the world, reviewing and updating the conservation needs assessments, organising and delivering training, lobbying for habitat protection, raising funds, managing and supervising species programs ii. Establish an information exchange network that is available for all to access (e.g. FB etc not accessible in	i. Global supervisory staff established – Amphibian Ark ii. Update list of facilities and practitioners

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (3–10 years)	Short-term Targets (1–3 years)
	China, and AArk's online *Ex Situ*Program Progress resource)	
Range-country programs will operate in native languages, and will be aimed to ensure that operational protocols are matched to local conditions, culture, and infrastructure	All guidance documents are available in the first language of each country with an operational amphibian captive breeding program	Identify people willing to translate guidance documents
Ensure captive colonies are maintained in at least two different facilities to reduce the likelihood of catastrophic loss or threat of loss from disease		
Provide the capacity and facilities for research and implementation of cryobanking of gametes of threatened species, thereby serving as an additional safeguard for species and specific genetic lineages	Viable cell cultures / tissue samples for all threatened amphibians held in captivity are accessioned into the frozen ark	Frozen ark protocols disseminated to all facilities housing amphibians
The captive colonies will produce the animals needed to meet long-term research needs and to provide animals for the ultimate goal of reintroduction to natural habitats	i. Regular publications each on captive husbandry / amphibian conservation, available in many different languages ii. Ensure sufficient resources are available to produce the required numbers of animals for both reintroduction and research purposes, and to widely disseminate all relevant captive breeding program and research findings in a timely fashion	Research needs identified in advance for each program species

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (3–10 years)	Short-term Targets (1–3 years)
New Actions		
Identify species that are both priorities for *ex situ* conservation action and are appropriate candidates for such action to ensure that limited funding is allocated to projects that will generate tangible conservation outputs	i. Ensure that recommendations for *ex situ* programs arising from national conservation needs assessments are disseminated appropriately and are readily available to all stakeholders ii. Encourage low priority species to be phased out of collections and replaced with higher priority species (where appropriate)	Continue to assess and prioritize species on a national level for their *ex situ* conservation actions. (Underway)
Protocols for dealing with new threats are developed so that conservation responses can be timely	Committee meets annually and recommendations disseminated to all stakeholders	Establish advisory committee that can update captive breeding community on how to respond to new threats
Evaluate the likely success of captive husbandry for the species involved – are the knowledge and skill sets, as well as the resources, available to keep animals alive and breeding?		Update program implementation tool
Improve the success of future programs, particularly focusing on the need to keep animals fit and healthy, produce healthy offspring beyond F1, and to understand and control breeding triggers		Identify major medical, nutrition, husbandry concerns/gaps for amphibian programs and prioritize research efforts

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (3–10 years)	Short-term Targets (1–3 years)
Work with species where we have the greatest chance of success and thus ensure that our limited funding is allocated to projects that will generate tangible conservation outputs	i. Work with *ex situ* program managers to ensure that appropriate recommendations arising from conservation needs assessments are followed ii. Encourage low priority species to be phased out of collections and replaced with species identified for urgent rescue or research (where appropriate) iii. Evaluate genetic management of populations to make sure enough resources are available to match desired outcomes (i.e. is there capacity to manage 5 different "populations" from separate stream systems, or only enough space to manage one long-term?)	Update program implementation tool
Cater for changes in management strategies, conservation needs and technological advances with development and specification of *ex situ* facilities		i. Develop reference library hosted on AArk website (Underway) ii. Identify list of potential trouble-shooters who would be able to advise husbandry practitioners on how to implement

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (3–10 years)	Short-term Targets (1–3 years)
		changes in management strategies (Underway)
Training programs and internships must continuously update to ensure that the most recent advances in husbandry are communicated (e.g. UVB provision, nutrition), feeding in from the action to generate evidence-based husbandry protocols	Content of training courses updated annually to reflect advances in husbandry and knowledge of disease and population management	i. Update course content ii. Ensure all institutions providing internships are employing current best practice protocols and husbandry standards
Ensure that biosecurity measures are included as an important component of any captive program	Ensure that biosecurity aspects of training programs are reviewed annually and updated as required	i. Update manual for control of diseases in amphibian assurance colonies and reintroduction programs on AArk website ii. Specific aspects of biosecurity outlined in the program implementation tool iii. Ensure that program managers and staff understand the importance of biosecurity and how to implement relevant protocols iv. Ensure that new information / protocols

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (3–10 years)	Short-term Targets (1–3 years)
		are widely distributed as they become available
Identify country champions/coordinators to closely monitor progress and deal with barriers and challenge for the program (or programs within the country)	Develop a system to ensure that there is a champion / coordinator in every country hosting one or more amphibian captive breeding programs and that vacancies are filled in a timely fashion	Champions identified and promoted on AArk website and newsletters
Ensure that funding plans must be in place to secure the long term future of projects intended to safeguard both living and cryopreserved populations of a species		Publicise Frog MatchMaker and the *Ex Situ* Programs Needing Support page through social networking on ASA, AArk and ASA / AArk partner / supporter pages
Put together a reference library (even if only titles/abstracts) around major amphibian husbandry themes	Reference library updated on a monthly basis	FrogLog provides updates; Reference library hosted on AArk website (Underway and ongoing)
Develop an open access online 'journal' of amphibian husbandry which publishes tips, techniques, advances etc as well as short papers on husbandry. Freely and continually share information / experience with one another and encourage programs to publish, or at least write up informally, their experiences		Generate and promote evidence-based husbandry protocols through the establishment of an online open access journal on amphibian husbandry
Maintain genetically and demographically viable populations in captivity while threats are mitigated in the wild		i. Circulate / update amphibian population management guidelines

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (3–10 years)	Short-term Targets (1–3 years)
		ii. Ensure captive breeding program managers understand how to properly manage the amphibian populations they are responsible for; provide support as required
Facilities which are having husbandry issues / failing to breed species are visited by captive husbandry specialists to offer support a 'fresh pair of eyes' and constructive feedback	Ensure that all facilities are aware of specialist panel and that they are able to contact the panel for advice and trouble shooting	i. Identify panel of specialists and secure funding. (Underway – AArk's AVOP program) ii. Country champions liaise with panel via monthly / quarterly reports highlighting any issues and identifying areas where increased support / capacity building is needed
Captive programs have partnerships with relevant field biologists	Ensure that all captive programs are linked with field programs and information is shared freely between field biologists and husbandry practitioners	Approach regional working groups to identify field biologists
Effective management of disease in captive populations	i. Ensure that all known diseases that pose a risk to amphibians have risk	i. Approach veterinarians and wildlife epidemiologists to ensure that new methods / techniques

Actions To Respond To Major Constraints To Effective Conservation	Mid-term Priorities (3–10 years)	Short-term Targets (1–3 years)
	assessments and these are updated annually	are filtered down to husbandry practitioners
	ii. Ensure that the disease control manual is reviewed annually and updated as required	ii. Update manual for control of diseases in amphibian assurance colonies and reintroduction programs on AArk website
		iii. Have a plan of action in place for diseases where there is no reliable screening and / or treatment, should there be an outbreak
		iv. Develop and disseminate disease risk assessments for known amphibian diseases which have the potential to undermine captive breeding programs

2007 ACAP related chapter: Chapter 7: Captive Programs (J.R. Mendelson III, R. Gagliardo, F. Andreone, K.R. Buley, L. Coloma, G. Garcia, R. Gibson, R. Lacy, M.W. Lau, J. Murphy, R. Pethiyagoda, K. Pelican, B.S. Pukazhenthi, G. Rabb, J. Raffaelli, B. Weissgold, D. Wildt and Xie Feng).

Appendix 1: Gamete Banking (B.S. Pukazhenthi, K. Pelican and D. Wildt).