

ASG Captive Breeding Working Group

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*Denotes authorship of the updated Captive Breeding Working Group Action Plan.

Vision, Goals and Actions

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 and an exit strategy.

Goals

Species selection and responding to new threats

- Identify species that are both priorities for *ex situ* conservation action and are appropriate candidates for such action.
- A community that can respond to new demands and challenges as they emerge.
- Implement *ex situ* conservation action in accordance with the national and international legislations and agreements

Capacity building, training and mentors

- 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.
- Advise organizations on transparent, efficient and responsible use of resources.
- 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.

Program implementation

- Leverage the resources required to ensure that when high priority species are brought into captivity, they are held in 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 all necessary import and export permits are obtained for all interstate and international movements of animals, and when collecting animals from the wild.

Captive husbandry

- The effective management of disease in captive populations.
- 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 best practice recommendations to the community for screening animals prior to release in order to mitigate unintentional transfer of disease or disease strains.

Effective partnerships

- 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.
- Engage national agencies to pledge resources and support *ex situ* conservation action
- Implement actions of ACAP through nodal agencies/persons identified in different regions.

Communication

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

Aspects to address

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, as well as knowledge of specific husbandry needs and financial resources.

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.

Taxonomic uncertainty and genetic distinctiveness

Taxonomic uncertainty has the potential to undermine conservation activities. Some amphibian species may be species complexes and different populations may be genetically distinct from one another. Failing to resolve taxonomic uncertainties and / or consider the genetic distinctiveness of a population may result in animals that are unsuitable for release and / or once released reduce evolutionary potential of the species.

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 and in some cases completely absent. The focus of *ex situ* programs on species experiencing catastrophic declines and the tendency to allocate only small facilities to amphibian programmes means that numbers of founder animals may be too small in some cases, even if the animals are unrelated.

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 or develop new techniques or solve problems that arise.

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. . Ideally, a species would be brought into captivity while this *in situ* work is occurring so that species-specific husbandry techniques could be developed. If *in situ* actions fail to halt the decline, a captive conservation program could then be developed with confidence.

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

Data on basic biology and environmental/habitat parameters are lacking for many species and life stages, and this paucity of information has the potential to undermine programs. 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 apply a methodical approach to developing species-specific husbandry techniques. 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 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 which may not be suitable for reintroduction, especially if captive conditions differ greatly from field conditions.

Alternatives to full conservation breeding programs

Minimizing the time / number of generations bred in captivity reduces the risks associated with captive programs and potentially increase the likelihood of success for improving populations in the wild. Further attention to methods of headstarting, augmenting or breeding species within their natural historic range is therefore warranted. Stopping to think what we can learn from extant, albeit small in some cases, populations affected by threats could help fine tune some programs.

Risk of novel pathogens in ex situ facilities

Conservation breeding facilities should be located within the indigenous range of a species and separated from collections of non-native 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 or there may be logistical issues associated with establishing programs 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 or treated 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 scale. 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 may be affected by the political motivations of the authorities concerned. State support is likely to improve with appropriate engagement with in-country parties. Conservation programs need to learn how to work around such political issues while maintaining good relations with authorities.

Permissions

Obtaining prerequisite permission from governments and other organisations can be a slow and difficult process. Failure to secure the necessary permissions could undermine amphibian conservation programs in the long term. All necessary permits inclusive of export (and if applicable, import) permits, should be secured for all projects

Lack of post release monitoring

Inadequate post-release monitoring prevents assessment of how successful conservation breeding programs are and identification of potential problems. 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 and release methodology 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 and a clear priority to use captive-bred animals to maintain the captive population established.

Actions

Actions highlighted in **green** should be relatively quick and/or easy to implement and should be initiated as soon as possible.

Actions highlighted in **orange** are somewhat more difficult or time-consuming to implement, and might be considered once green actions are complete.

Actions highlighted in **red** are considered more time-consuming, difficult or costly, and will likely be the last actions to be implemented.

Action	Short-term actions (1-3 years)	Responsible organization(s)	Long-term actions (3-10 years)	Responsible organization(s)
Actions from the ACAP				
Close contact and communication among all facilities in the network must be maintained by a global supervisory staff.	Global supervisory staff established - Amphibian Ark. Update list of facilities and practitioners. (Underway, Ongoing)	AArk, Zoo and aquarium associations	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. Establish an information exchange network that is available for all to access (e.g. FB etc not accessible in China, and AArk's online <i>Ex Situ</i> Program Progress resource.)	AArk, Zoo and aquarium associations
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.	Identify people willing to translate guidance documents. (Underway for Spanish - other language translators required)	AArk, Zoo and aquarium associations	All guidance documents are available in the first language of each country with an operational amphibian captive breeding program. (All major AArk documents in Spanish, ongoing)	AArk, Zoo and aquarium associations, Durrell (Matt Goetz, German)
Local biologists or citizens must quickly be identified, hired, and trained and trained in amphibian	Update list of people with conservation husbandry experience. (Ongoing) www.amphibianark.org/amphibian-	AArk	Ongoing training and support to be provided for early career husbandry practitioners.	AArk, Zoo and aquarium associations

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biology and husbandry.	husbandry-experts/		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.	AArk, Zoo and aquarium associations
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.	Identify list of institutions willing to host interns. Obtain funding for internship programs. (Underway, AArk)	AArk, Zoo and aquarium associations	Identify programs where internships would be beneficial.	AArk, Zoo and aquarium associations
			Internships underway; supporting staff in newly established facilities.	AArk, Zoo and aquarium associations
Ensure captive colonies are maintained in at least two different facilities to reduce the likelihood of catastrophic loss or threat of loss from disease.				
Contribute to 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.	Genome Resources WG		Zoo and aquarium associations
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.	Research needs identified in advance for each program species and experimental designs produced to plan numbers of captive-bred animals required.	AArk, Zoo and aquarium associations, Reintroduction WG	Regular publications each on captive husbandry/amphibian conservation, available in many different languages. 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.	AArk, Zoo and aquarium associations

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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.	Identify the areas in which there is the most need for amphibian husbandry capacity building. (Underway)	AArk, ZSL (Chris Michaels and Ben Tapley), Perth Zoo (Kay Bradfield)	Establish captive programs as close to the indigenous of a species as practically possible.	All program managers
			Facilities established outside of range states only when species extinctions are imminent before range country programs can be effectively achieved.	Zoo and aquarium associations
			Set up external panel to ensure the risks posed by establishing programs outside of range states are assessed.	AArk(?), Zoo and aquarium associations, ZSL (Chris Michaels and Ben Tapley)
			Sufficient funding and resources secured for each <i>ex situ</i> programs.	ASA, AArk, Zoo and aquarium associations
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).	Ensure that conservation needs assessments for countries with high amphibian biodiversity are completed. (Underway) www.ConservationNeeds.org	AArk, National ASGs, Zoo and aquarium associations	Reassess countries for their conservation needs every 4-5 years (Underway) . www.ConservationNeeds.org	AArk, National ASGs, Zoo and aquarium associations
	Collate as much species data as possible while the animals are still in the wild. (Underway)	National ASGs, ZSL (Chris Michaels and Ben Tapley)		
	Develop and regularly update emergency response plans for various situations (to help avoid the issue of poor planning).	National ASGs, AArk		
	Collect environmental/habitat data during emergency collection trips to start informing husbandry and equipment kits for deployment with each rapid response team.	National ASGs, Zoo and aquarium associations, Perth Zoo (Kay Bradfield)		

Action	Short-term actions (1-3 years)	Responsible organization(s)	Long-term actions (3-10 years)	Responsible organization(s)
New actions				
Species selection and responding to new threats				
Identify species that are both priorities for <i>ex situ</i> conservation action and are appropriate candidates for such action to ensure that limited funding is allocated to projects that will generate tangible conservation outputs	Continue to assess and prioritize species on a national level for their <i>ex situ</i> conservation actions. (Underway, Ongoing)	AArk, Zoo and aquarium associations	Ensure that recommendations for <i>ex situ</i> programs arising from national conservation needs assessments are disseminated appropriately and are readily available to all stakeholders.	AArk, Zoo and aquarium associations
Protocols for dealing with new threats are developed so that conservation responses can be timely.	Establish advisory committee that can update captive breeding community on how to respond to new threats.	AArk, Zoo and aquarium associations, Perth Zoo (Kay Bradfield)	Committee meets annually and recommendations disseminated to all stakeholders.	AArk, Zoo and aquarium associations
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. (Underway)	AArk, Zoo and aquarium associations, Perth Zoo (Kay Bradfield), ZSL (Chris Michaels and Ben Tapley), Durrell (Matt Goetz)		
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.	Utilize the new/updated program implementation tool to ensure that programme implementation tool dove-tails with regional collection plans.	AArk with input from Zoo and aquarium associations, ZSL (Chris Michaels and Ben Tapley, Kay Bradfield)	Work with <i>ex situ</i> program managers to ensure that appropriate recommendations arising from conservation needs assessments are followed. Encourage low priority species to be phased out of collections and replaced with species identified for urgent rescue or research (where appropriate).	Zoo and aquarium associations, all organizations managing captive programs

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			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?)	
Capacity building, training and mentors				
Identify country champions/coordinators to closely monitor progress and deal with barriers and challenge for the program (or programs within the country).	Champions identified and promoted on AArk website and newsletters. (Underway)	AArk, Zoo and aquarium associations	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.	AArk, Zoo and aquarium associations
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.	Identify panel of specialists and secure funding. (Underway)	AArk, Zoo and aquarium associations	Ensure that all facilities are aware of specialist panel and that they are able to contact the panel for advice and trouble-shooting.	AArk
	Country champions liaise with panel via monthly/quarterly reports highlighting any issues and identifying areas where increased support/capacity building is needed.		Formal assessment every 3 years to ensure that failing programmes don't slip through the net.	
Ensure that funding plans are 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 <i>Ex Situ</i> Programs Needing Support page through social networking on ASA, AArk and ASA/AArk partner/supporter pages. (Ongoing)	AArk, Zoo and aquarium associations		
Captive husbandry practices				
Put together a reference library (even if only titles/abstracts/	FrogLog provides updates. Reference library hosted on AArk website,	AArk, Zoo and aquarium	Reference library updated on a monthly basis. (Ongoing)	AArk, Zoo and aquarium

Action	Short-term actions (1-3 years)	Responsible organization(s)	Long-term actions (3-10 years)	Responsible organization(s)
summary of major findings) around major amphibian husbandry themes.	www.amphibianark.org/husbandry-documents/ (Ongoing)	associations		associations
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 and document major medical, nutrition, husbandry concerns/gaps for amphibian programs and prioritize research efforts. (Underway)	AArk, Zoo and aquarium associations, ZSL (Chris Michaels and Ben Tapley), Perth Zoo (Kay Bradfield), captive program managers		
	Disseminate and implement research findings to improve husbandry. (Underway) www.amphibianark.org/husbandry-documents/	AArk, Zoo and aquarium associations, ZSL (Chris Michaels and Ben Tapley), captive program managers		
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.	Update course content. (Underway) Ensure all institutions providing internships are employing current best practice protocols and husbandry standards (Underway)	AArk, Zoo and aquarium associations, ZSL (Chris Michaels and Ben Tapley), Perth Zoo (Kay Bradfield)	Content of training courses updated annually to reflect advances in husbandry and knowledge of disease and population management.	Zoo and aquarium associations
Ensure that biosecurity measures are included as an important component of any captive program.	Update manual for control of diseases in amphibian assurance colonies and reintroduction programs on AArk website. (Underway)	ZSL (C. Michaels, B. Tapley), A. Pessier, J. Mendelson, Durrell (Matt	Ensure that biosecurity aspects of training programs are reviewed annually and updated as required.	AArk, Zoo and aquarium associations

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		Goetz)		
	Specific aspects of biosecurity outlined in the program implementation tool.	AArk, Zoo and aquarium associations, Perth Zoo (Kay Bradfield), ZSL (Ben Tapley)		
	Ensure that program managers and staff understand the importance of biosecurity and how to implement relevant protocols.	AArk, Zoo and aquarium associations, all program managers		
	Ensure that new information/protocols are widely distributed as they become available.	AArk Population Management Group, Perth Zoo (Kay Bradfield), Zoo and aquarium associations, all program managers		
Maintain genetically and demographically viable populations in captivity while threats are mitigated in the wild.	Circulate/update amphibian population management guidelines. Ensure captive breeding program managers understand how to properly manage the amphibian populations they are responsible for; provide support as required.	AArk, Zoo and aquarium associations		

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Effective management of disease in captive populations.	Approach veterinarians and wildlife epidemiologists to ensure that new methods/techniques are filtered down to husbandry practitioners.	AArk, Zoo and aquarium associations	Ensure that all known diseases that pose a risk to amphibians have risk assessments and these are updated annually.	AArk, Zoo and aquarium associations
	Update manual for control of diseases in amphibian assurance colonies and reintroduction programs on AArk website. (Underway)	ZSL (C. Michaels, B. Tapley, A. Pessier, J. Mendelson)	Ensure that the disease control manual is reviewed annually and updated as required.	
	Have a plan of action in place for diseases where there is no reliable screening and/or treatment, should there be an outbreak.			
	Develop and disseminate disease risk assessments for known amphibian diseases which have the potential to undermine captive breeding programs.	CBSG, AArk, ASA, Infectious Diseases WG		
Cater for changes in management strategies, conservation needs and technological advances with development and specification of <i>ex situ</i> facilities.	Develop reference library hosted on AArk website. (Underway) www.amphibianark.org/husbandry-documents/ Identify list of potential trouble-shooters who would be able to advise husbandry practitioners on how to implement changes in management strategies. (Underway) www.amphibianark.org/amphibian-husbandry-experts/	AArk, Zoo and aquarium associations, ZSL (Chris Michaels and Ben Tapley), Perth Zoo, Kay Bradfield		
Develop an open access online peer review 'journal' of amphibian husbandry which publishes tips, techniques, advances etc as well	Generate and promote evidence-based husbandry protocols through the establishment of an online open access journal on amphibian husbandry.	AArk, ZSL (Chris Michaels and Ben Tapley), Zoo		

Action	Short-term actions (1-3 years)	Responsible organization(s)	Long-term actions (3-10 years)	Responsible organization(s)
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.	(Underway)	and aquarium associations		
Effective partnerships				
Captive programs have partnerships with relevant field biologists.	Approach regional working groups to identify field biologists.	AArk, Zoo and aquarium associations	<p>Ensure that all captive programs are linked with field programs and information is shared freely between field biologists and husbandry practitioners.</p> <p>Ensure interests are aligned as far as possible and ensure that the benefits to both sides of collaboration are publicised through active engagement with <i>in situ</i> work.</p>	AArk, Zoo and aquarium associations