Captive Breeding, Reintroduction, and the Conservation of Amphibians

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Abstract: The global amphibian crisis has resulted in renewed interest in captive breeding as a conservation tool for amphibians. Although captive breeding and reintroduction are controversial management actions, amphibians possess a number of attributes that make them potentially good models for such programs. We reviewed the extent and effectiveness of captive breeding and reintroduction programs for amphibians through an analysis of data from the Global Amphibian Assessment and other sources. Most captive breeding and reintroduction programs for amphibians have focused on threatened species from industrialized countries with relatively low amphibian diversity. Out of 110 species in such programs, 52 were in programs with no plans for reintroduction that had conservation research or conservation education as their main purpose. A further 39 species were in programs that entailed captive breeding and reintroduction or combined captive breeding with relocations of wild animals. Nineteen species were in programs with relocations of wild animals only. Eighteen out of 58 reintroduced species have subsequently bred successfully in the wild, and 13 of these species have established self-sustaining populations. As with threatened amphibians generally, amphibians in captive breeding or reintroduction programs face multiple threats, with habitat loss being the most important. Nevertheless, only 18 out of 58 reintroduced species faced threats that are all potentially reversible. When selecting species for captive programs, dilemmas may emerge between choosing species that have a good chance of surviving after reintroduction because their threats are reversible and those that are doomed to extinction in the wild as a result of irreversible threats. Captive breeding and reintroduction programs for amphibians require long-term commitments to ensure success, and different management strategies may be needed for species earmarked for reintroduction and species used for conservation research and education.

Keywords: amphibian declines, captive breeding, ex situ conservation, species reintroduction, species translocation

Reproducción en Cautiverio, Reintroducción y la Conservación de Anfibios

Resumen: La crisis global de los anfibios ha resultado en el renovado interés por la reproducción en cautiverio como una herramienta de conservación para los anfibios. Aunque la reproducción en cautiverio y la reintroducción son acciones de manejo controvertidas, los anfibios poseen un número de atributos que los hacen modelos potencialmente buenos para tales programas. Revisamos la extensión y efectividad de programas de reproducción en cautiverio y reintroducción de anfibios mediante el análisis de datos de la Evaluación Global de Anfibios y otras fuentes. La mayoría de los programas de reproducción en cautiverio y reintroducción de anfibios se han concentrado en especies amenazadas en países industrializados con una diversidad de anfibios relativamente baja. De 110 especies en esos programas, 52 estaban en programas sin planes de reintroducción y que tenían como objetivo principal la investigación y/o educación para la conservación. Treinta y nueve especies más estaban en programas que implicaban la reproducción en cautiverio y la reintroducción o combinaban la reproducción en cautiverio con reacomodo de animales silvestres. Dieciocho de 58 especies reintroducidas se han reproducido con éxito en el medio silvestre, y 13 de esas especies ban
established populations autosustentables. Como en los anfibios amenazados en general, los anfibios en programas de reproducción en cautiverio o de reintroducción enfrentan amenazas múltiples, de las cuales la pérdida de hábitat es la más importante. Sin embargo, sólo 18 de 58 especies reintroducidas enfrentaron amenazas que son potencialmente reversibles. Al seleccionar especies para programas en cautiverio, pueden surgir dilemas entre seleccionar especies que tienen una buena probabilidad de sobrevivir después de la reintroducción porque sus amenazas son reversibles y especies que están condenadas a la extinción en el medio silvestre como resultado de amenazas irreversibles. Los programas de reproducción en cautiverio y reintroducción de anfibios requieren compromisos a largo plazo para asegurar el éxito, y se pueden requerir diferentes estrategias de manejo para especies destinadas a la reintroducción y para especies usadas para investigación y educación de conservación.

**Palabras Clave:** conservación ex situ, declinaciones de anfibios, reintroducción de especies, reproducción en cautiverio, translocación de especies

**Introduction**

The captive breeding of threatened species has used increasingly sophisticated technologies and protocols in recent years. Although this has blurred the dichotomy between in situ and ex situ species management, the value of captive breeding as a conservation tool remains controversial (e.g., Snyder et al. 1996; Hodder & Bullock 1997; Ebenhard 1998; Fischer & Lindenmayer 2000). The problems associated with small founder populations—inhbreeding depression, removal of natural selection, and rapid adaptation to captivity—pose considerable challenges for managers of captive populations of threatened species (e.g., Miller & Hedrick 1993; Woodworth et al. 2002; Gilligan & Frankham 2003). Equally, reintroduction of captive-bred stock to the wild may require implementation of rigorous protocols that embrace acclimation, pre- and postrelease training, health screening, genetic management, long-term monitoring, and involvement of local stakeholders (e.g., Beck et al. 1994; Cunningham 1996; Reading et al. 1997). Shortfalls in implementing such protocols may jeopardize the likelihood of achieving success. In addition, the resource implications and cost-effectiveness of ex situ conservation relative to in situ conservation has been frequently called into question (Snyder et al. 1996; Balmford et al. 1996; Dodd 2005).

Amphibians possess several life-history traits that make them potentially model organisms for captive breeding and reintroduction programs (Bloxam & Tonge 1995; Jones 2002). Breeding programs often use the repeated breeding and high fecundity of amphibians to build up captive populations quickly, and their small body size and low maintenance requirements mean that viable populations can be managed much more cost-effectively than many larger-bodied vertebrate species (Balmford et al. 1996). Unlike higher vertebrates that possess a high degree of learned behaviors that may ill-equip them for life in the wild, the hard-wired physiology and behavior of amphibians means that some reintroduction protocols—such as pre- and postrelease training—may be circumvented. Despite these advantages, amphibians are among those taxa that are generally neglected within zoo-based conservation programs (Balmford et al. 1996).

Counterarguments have focused on the fact there is apparently little published evidence of success in amphibian breeding and release programs, and reintroductions of amphibians appear to have been carried out without sufficient attention to researching and neutralizing the threats that originally caused the decline (Dodd & Seigel 1991; Seigel & Dodd 2002; Dodd 2005). Despite this ongoing debate, results of the Global Amphibian Assessment (GAA) highlight the urgent need for imaginative tools to address the global amphibian crisis (Stuart et al. 2004). With some 32% of species threatened with extinction, and complex, often synergistic, threats as putative agents of decline, actions to address the problem are difficult to perceive. This left Stuart et al. (2004) to surmise: “For a species facing an ‘enigmatic’ decline, the only conservation option currently available is captive breeding…” Indeed, captive breeding and reintroduction form 2 out of the 11 priority actions for amphibian conservation and research within the recently published Amphibian Conservation Action Plan (Gascon et al. 2007). A reappraisal of the effectiveness of captive breeding and reintroduction as a conservation tool for addressing the amphibian crisis is therefore urgently needed.

Previous reviews of animal translocations and reintroductions contain little information that is relevant to amphibians (Griffith et al. 1989; Wolf et al. 1996; Fischer & Lindenmayer 2000; Seddon et al. 2007). Therefore, we reviewed how captive breeding and reintroduction have contributed to the conservation of amphibians to date. In particular, we addressed the following questions: (1) For how many amphibian species has captive breeding been used as a conservation tool? (2) Has captive breeding focused on species and regions of major conservation concern? (3) How many species have been reintroduced successfully to the wild after captive breeding or relocations of wild amphibians? (4) What types of threats are faced by amphibians in captive breeding and
reintroduction programs? We addressed these questions by interrogating the GAA database and integrating the emergent data with that from other published and unpublished sources.

Methods

Sources of Data

We assembled data on amphibian captive breeding programs and reintroductions from a variety of sources, the major one being the GAA. The GAA is the most complete review of the conservation status of all 5918 species of amphibian known at time of review, and it was undertaken by 520 scientists from over 60 countries over a 3-year period. The original GAA was completed in 2004 and updated in 2006 (IUCN et al. 2006). We drew other data from the on-line document compiled by Zippel (2004), which contains data on 37 amphibian species that have been the subject of zoo-based conservation programs.

If there was insufficient information contained within the GAA or Zippel (2004), we conducted further searches for data with the species name in conjunction with the keywords captive breeding, reintroduction, and translocation in Web of Science, Google, and JSTOR. The time frame for these on-line searches was not explicit, but was constrained by Web of Science, which contains literature published from 1970 onward. When necessary, we followed this up with an email to the appropriate personnel to request clarification of details for some of the species concerned (e.g., whether a species held in a captive program was used for breeding, research, or education). The review therefore included all data published in peer-reviewed journals since 1970 and data from nontechnical documents and reports available on the Internet or supplied to us directly by conservation practitioners. Data were not included unless the practitioners concerned gave us permission to use it in the analyses. A full bibliography of the literature sources consulted is available from http://www.kent.ac.uk/anthropology/dice/dicestaff/richard.html.

Data Collection

We initially determined whether or not each amphibian species was the subject of a captive breeding or reintroduction program for conservation. We excluded those species that were bred in captivity solely for commercial or biomedical purposes and those in programs that lacked a clear connection to conservation. We also excluded releases that were carried out solely to resolve human–wildlife conflict issues (e.g., relocations of animals from sites scheduled for development) and releases that seemed motivated by an excess of captive stock. These criteria meant that the majority of programs involving releases met the World Conservation Union [IUCN] (1998) definition of reintroduction. Nevertheless, because there is inconsistent use of the IUCN categories in the literature, in a few cases it was difficult to identify the explicit type of release that was carried out.

We classified species into 3 main groups. (1) The captive breeding only group (CB) contained species held in captive programs but for which there were no reintroductions currently planned. (2) The captive breeding and reintroductions group (CB&R) contained species with both captive breeding and reintroductions. This category included species that were bred in captivity and for which reintroductions were carried out or are planned for the future. It also included species in programs in which captive breeding complemented relocations of wild animals (in these programs, captive-bred stock may or may not have been released). (3) The relocation of wild animals group (R) contained species in programs that did not have a captive breeding component, but may have involved head starting of wild animals. In addition to assessing which species had reintroduction as a reason for captive breeding, we also collated information on other reasons for captive breeding or reintroductions and classified these under the headings of conservation research and conservation education because these are areas in which collection-based institutions (i.e., zoos, aquaria, and museums) can make potentially significant contributions (e.g., Miller et al. 2004; Griffiths & Kuzmin 2008). The full list of species classified into the CB, CB&R, and R categories is available from http://www.kent.ac.uk/anthropology/dice/dicestaff/richard.html.

We collated data on threats that each species faced in the wild and classified them into 2 groups: irreversible and reversible threats. Irreversible threats comprised those that cannot currently be ameliorated by management actions. These included widespread or total habitat loss or disturbance, emerging infectious diseases, climate change, and widespread or highly invasive species. Reversible threats were those that could be—or had the potential to be—ameliorated by management actions. These comprised local or small-scale habitat disturbance or pollution, manageable invasive species, and collection for human use. We then classified amphibian species into 1 of 4 categories: (1) no threats reversible, (2) some threats reversible, (3) all threats reversible, or (4) unknown (in which either the threats were unknown or the potential for reversibility of the threats was unclear). We classified species into IUCN (2006) threat categories and then compared the number of threatened species in captive breeding and reintroduction programs with the number of threatened species outside such programs.

We examined all species for linkage to in situ conservation programs. We classified all species that had been released into the wild and had clearly bred successfully for several generations—or had otherwise displayed
evidence of self-sustaining populations—into a high-success category. We classified those that had reproduced in the wild but had not yet yielded evidence of self-sustaining populations into a partial-success category. We classified species that had been released and survived but lacked evidence of breeding into the low-success category.

**Results**

**Number of Species in Programs**

Eighty-three species of frogs and toads (order: Salientia) and 27 species of salamanders (order: Caudata) were involved in captive breeding or reintroduction programs. The number of frogs and toads in these programs outnumbered the number of salamanders by about 3 to 1. Given that the number of extant species of frogs and toads outnumbers that of salamanders by about 10:1, there was a disproportionately high number of salamanders within the programs when they were compared with numbers of all other amphibian species ($\chi^2 = 34.9, df = 2, p < 0.001$). Although caecilians (order: Gymnophiona) are kept and bred in captivity, we could find no information about these species being used in programs related to conservation.

Of the 110 species in captive breeding or reintroduction programs, just under half (52 species) were in programs that had not involved releases into the wild and for which there were no immediate reintroduction plans (CB). A further 39 species were in programs that had both captive breeding and reintroductions (CB&R), and 19 species had been reintroduced with relocation of wild animals only (R). Of the 91 species in the CB and CB&R categories, 50 were used for conservation research and 26 for conservation education. Research—rather than reintroduction—was therefore the most frequent reason for captive breeding. Consequently, research and education were the principle justifications for breeding species for which there were no immediate release plans. Species from 45 countries were involved in captive breeding or reintroduction programs. There was an overall bias toward species from temperate countries with relatively low amphibian diversity in the industrialized world; North America was particularly well represented (Fig. 1).

The programs for all 59 species in the CB&R group and for 41 out of the 52 species in the CB group had links to in situ conservation initiatives. The conservation of protected areas was the activity to which most species were

![Figure 1. Representation of amphibian species from different countries in captive-breeding and reintroduction programs (CB, captive breeding only; CB&R, captive breeding and reintroduction; R, reintroductions using wild-wild relocations).](image-url)
Threats and Threat Status

Habitat loss was the most common threat to species in captive breeding and reintroduction programs and to all other species (Fig. 2). Nevertheless, a disproportionate number of species within the programs were also threatened by invasive species, human use, and climate change, whereas those not suffering from major threats were underrepresented ($\chi^2 = 56.7$, df = 6, $p < 0.001$).

Over half (57 species) of the species in captive breeding or reintroduction programs were classified in the 4 highest IUCN threat categories (i.e., vulnerable, endangered, critically endangered, and extinct in the wild). The rest of the species were classified as near threatened or of least concern with only one species in the data-deficient category. When the distribution of species in captive breeding or reintroduction programs between the IUCN threat categories was compared with the distribution of all other amphibians in the same categories (excluding the extinct in the wild category), there was a significant association between species in these programs and the higher threat categories ($\chi^2 = 54.6$, df = 5, $p < 0.001$). Nevertheless, this result may be influenced by the very high proportion of data-deficient species within amphibians that were not in captive breeding or reintroduction programs. When the data-deficient species were excluded, the relationship still held ($\chi^2 = 16.7$, df = 4, $p < 0.01$), indicating that the species of least concern were underrepresented in captive breeding or reintroduction programs. Thus, these programs for amphibians tended to focus on species that were most threatened. Indeed, some of the species that were classified as near threatened or of least concern may be of conservation concern locally if not globally.

Amphibians face complex and often synergistic threats. For most of the reintroduced species (i.e., 36 out of 58), some of the threats they face are potentially reversible. Nevertheless, only 18 of 58 reintroduced species faced threats that were all potentially reversible, and 3 reintroduced species faced irreversible threats. The reversibility of threats was unknown for the one remaining species.

Success in Captive Breeding and Reintroduction Programs

Some programs in the CB&R category combined captive breeding with relocations and/or captive rearing (head starting) of wild stock, so it is difficult to distinguish
between the relative success rates of captive breeding, relocations of wild animals, and head starting as tools for population management. Nevertheless, we obtained data on outcome for the 58 species in the CB&R and R categories (Fig. 4). An assessment of the level of success was possible for 21 species that had been reintroduced to the wild (Table 1). Of these, 13 species displayed evidence of breeding in the wild for multiple generations (high success), 5 species displayed some evidence of breeding (partial success), and 3 species displayed evidence of surviving following release (low success). This does not mean that the other programs were unsuccessful. The outcome of the majority may be currently unknown, it may be too early to determine success, or the program may not yet have reached a stage in which reintroduction is possible.

Discussion

In Situ and Ex Situ Population Management

About 1.9% of all amphibian species—and 3% of all threatened amphibian species—have been used in captive breeding or reintroduction programs for conservation. Twice as many programs involving reintroductions (or planned future reintroductions) to the wild have had a captive component than those that have involved population manipulations using only wild stock (0.7% and 0.3% of all species, respectively). Nevertheless, it is difficult to compare the success of reintroductions of captive-bred stock with that of relocations of wild animals because many of the reintroduction programs have combined both approaches. For example, species in the CB&R category that were successfully reintroduced to the wild include those derived almost exclusively from captive stock (e.g., Alytes muletensis, Chiraxalus romeri) and those involved mainly with relocations of wild animals.
Table 1. Summary of amphibian species that have been successfully reintroduced to the wild.

<table>
<thead>
<tr>
<th>Captive breeding and reintroduction*</th>
<th>High success (self-sustaining populations established in the wild)</th>
<th>Partial success (evidence of successful breeding in the wild)</th>
<th>Low success (evidence of survival in the wild)</th>
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<tbody>
<tr>
<td>Alytes muletensis</td>
<td>Bombina bombina</td>
<td>Bufo viridis</td>
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<td>Bufo calamita</td>
<td>Bufo baxteri</td>
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<td>Chirixalus romeri</td>
<td>Bufo lemur</td>
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<td>Hyla arborea</td>
<td>Rana dalmatina</td>
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<td>Leiopelma pakeka</td>
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<td>Triturus cristatus</td>
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<td>T. vulgaris</td>
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<tr>
<td>Relocation of wild animals only</td>
<td>Bufo bufo</td>
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<td>L. hamiltoni</td>
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<td>Pseudacris crucifer</td>
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<tr>
<td>R. subaquavocalis</td>
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<td>R. sylvatica</td>
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<td>R. temporaria</td>
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*Some programs may have combined captive breeding with relocation of wild animals.

may have been supported by a captive breeding program (e.g., Bufo calamita). Equally, some species in the R category without captive breeding may have had a head-starting component that was performed under ex situ conditions (e.g., Rana subaquavocalis). This underlines how management protocols of in situ and ex situ species have become increasingly integrated in recent years.

Just under half the species in the programs assessed did not have reintroductions as a primary goal. Research—rather than reintroduction—was therefore the most frequent reason for captive breeding or reintroduction programs. Nevertheless, reintroductions can be carried out with research—rather than establishment of a viable population—as the primary goal. For example, a reintroduction of yellow-legged frogs (R. mucosa) was carried out to determine whether the threats that led to the original demise of the population were still present (Fellers et al. 2007). Indeed, such pilot releases are good conservation practice (Caughley 1994). Despite this pattern, there has been rather little published research emerging from captive breeding or reintroduction programs that is relevant to conservation (Pavajeau 2005; Griffiths & Kuzmin 2008). We are also aware of some amphibian captive breeding and reintroduction programs that we could not include in this study because of a lack of reliable or accessible documentation.

Success of Reintroductions

With the possible exception of the natterjack toad (B. calamita), Dodd (2005) argues that there is little evidence from the published literature to suggest that any other amphibian reintroductions had been successful. Our survey was more optimistic because it revealed that 13 species derived from programs that had a captive breeding component had founded self-sustaining populations (e.g., Zvirgzds et al. 1995; Buley & García 1997; Buley & Gonzalez-Villavicencio 2000; Kinne 2004). Equally, there was good evidence that some population manipulation exercises that did not have a captive breeding component also have been successful (e.g., Cooke & Oldham 1995; Bell et al. 2004; Tocher & Pledger 2005). Successful programs all ran for a decade or more before success could be confirmed, which indicates the long-term commitment required in captive breeding and reintroduction programs. Many projects have been running for a shorter period, and it may therefore be too early to realistically assess their level of success. The list of successful amphibian reintroduction projects is therefore likely to grow in the coming years.

Global and Taxonomic Patterns

The distribution of captive breeding and reintroduction programs between countries conforms to an oft-repeated pattern for conservation effort—most effort and expertise is being channeled into regions that have the most expertise rather than the most biodiversity (e.g., Fischer & Lindenmayer 2000). This is unsurprising, given that conservation breeding programs can be demanding in terms of resources and facilities, commodities that may be in short supply in some countries rich in amphibian species. Clearly, there are opportunities here for building capacity through the transfer of expertise in such countries.

A further bias within the data was the disproportionately high number of salamanders in captive breeding or reintroduction programs. At the global level proportionally more salamanders are threatened (47%) than frogs and toads (31%). This trend may therefore be a function of the disproportionate focus of captive breeding and reintroduction programs on threatened amphibian species. Alternatively, the pattern may be a result of collection-based institutions striving to display as wide a variety of amphibian diversity as possible. Nevertheless, caecilians.
remain underrepresented in captive breeding and reintroduction programs for conservation.

Seigel and Dodd (2002) and Dodd (2005) argue that a major problem for amphibian population manipulations is the fact that addressing the threats that led to declines in the first place is rarely addressed before reintroductions take place. Caughley (1994) discusses the wider implications of this issue and argues that identification and neutralization of threats is an essential precursor to any reintroduction. As is the case for threatened amphibians generally, most of the species in captive breeding or reintroduction programs face multiple threats. Although habitat loss is the main threat to amphibians generally and to those in captive breeding or reintroduction programs in particular, a disproportionate number of species in the latter category suffer because of invasive species, exploitation for human use, and climate change. For some amphibians at least, it is likely that threats associated with invasive species and human use may be more readily addressed and neutralized than those associated with climate change and disease, at least at a local scale and within the short to medium term. The reintroduction potential of a species, then, may be higher if it faces simple, potentially reversible threats such as invasive species and human use, rather than those threats linked to climate change and disease.

It may be possible to obtain some degree of success in reintroduction without complete neutralization of threats. For example, the endemic midwife toad of Mallorca (A. muletensis) has been very successfully reintroduced to some sites on the island without eradication of one of its main threats—introduced snakes. This has been achieved by identifying the habitat preferences of both predator and prey and carrying out releases where the habitat is suboptimal for snakes and by protecting vulnerable sites from snakes through habitat management and physical barriers (Moore et al. 2004). Nevertheless, if reintroduction is the ultimate goal of conservation breeding programs, then it may be wise to focus on those species with simple, localized, and potentially reversible threats rather than those suffering from threats of a more global nature, such as those linked to climate change. For these reasons, amphibian reintroductions programs may be easier to execute for those threatened species that inhabit islands.

The Role of Zoos and Aquaria

The role of zoos, aquaria, and botanical gardens in global conservation has changed considerably in recent decades, with less emphasis placed on maintaining safety-net type collections of threatened species and more emphasis on embracing ex situ conservation issues and conservation science and education (e.g., Hutchins et al. 1995; Conway 2003; Hutchins 2003; Miller et al. 2004). It is reassuring that captive breeding and reintroduction programs for amphibians are tending to focus on threatened species, and this pattern is consistent with a general trend for coordinated breeding programs within zoos over the past 10 years (Leader-Williams et al. 2007). Nevertheless, the current amphibian crisis—and the threat of disease in particular—pose new challenges to current ideas about which species should be selected for captive breeding. For example, chytridiomycosis has undoubtedly caused extinctions of amphibians in several parts of the world (Daszak et al. 2003) and may continue to do so as the disease reaches new areas and infects new species (Lips et al. 2006). For those species with restricted geographical ranges that lie in the path of a chytrid epidemic, the only way to prevent their extinction may be to bring them into captivity.

In terms of assessing which amphibian species should be selected for captive breeding, amphibian conservationists may face something of a dilemma. Should the emphasis be on those species suffering from simple, reversible threats that have a realistic chance of reintroduction or on those species that will otherwise go extinct as a result of threats that are—at present—irreversible? Perhaps there should be a balance between the two approaches. In the short term, conservation programs that focus on neutralizing simple threats as a precursor to reintroduction may be cost-effective. In the long term, it may become possible to reintroduce animals to an area where they were formerly wiped out by chytridiomycosis, once the disease has run its course or has been eliminated by some other means.

Conclusions

There have been some successful captive breeding and reintroduction programs for amphibians in recent years. Although captive rearing, head starting, or relocations of wild animals may be the easiest and most cost-effective population manipulation method for many species (Griffiths & Kuzmin 2008), there may be strategic, ecological, or logistical reasons for breeding amphibians in captivity for conservation purposes. Nevertheless, if captive breeding is to play a significant role in the future conservation of amphibians, then traditional practices and protocols may need reviewing. Likewise, the diversity and scale of both in situ and ex situ actions will need to be increased with engagement of a much wider range of stakeholders than has occurred in the past (Mendelson et al. 2006). If the principal goal of a captive breeding program is reintroduction, then biosecure, single-species isolation containers with rigorous health management and climate control will be needed (as pioneered by the Amphibian Research Centre in Australia and recommended by Mendelson et al. [2007]). On the other hand, facilities that are designed for education and raising awareness will...
need to engage and immerse visitors, and this may involve displaying a diversity of species in an imaginative setting that may compromise rigorous population management. Equally, the individual-based tools currently used within the zoo community to manage breeding programs for mammals and birds may be inappropriate for many amphibian species (Griffiths & Kuzmin 2008).

Fortunately, the conservation community has not been slow to take action. In 2006 the Amphibian Ark (AArk) was formed as part of a collaborative initiative between the World Association of Zoos and Aquariums (WAZA), the IUCN Species Survival Commission (IUCN/SSC) Conservation Breeding Specialist Group (CBSG), and the Amphibian Specialist Group (ASG). The role of the AArk is to assist zoos, aquariums, and botanical gardens by carrying out those aspects of the Amphibian Conservation Action Plan that have an ex situ component (Gascon et al. 2007). These actions may go well beyond captive breeding and will embrace global coordination, technical guidance and training, fund raising, capacity building, and campaigning. To this end, 2008 has been designated the Year of the Frog, and AArk will be supporting a public awareness campaign coordinated through collection-based institutions throughout the world.

Captive breeding for conservation is no panacea, and should not detract from efforts to achieve natural species recovery via threat mitigation and habitat management. Whether captive breeding is oversold as a conservation tool will no doubt continue to be debated (e.g., Pounds et al. 2006), but with the current amphibian crisis likely to deepen, it is a tool that we cannot afford to exclude from the toolbox.

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Literature Cited


