Diversity

Recent Captive-Breeding Proposals and the Return of the Ark Concept to Global Species Conservation

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Introduction

Captive breeding for reintroduction is a much discussed tool in the management of endangered species. Although a number of high-profile case studies illustrate the critical role captive breeding can play in preventing species extinction (e.g., Stanley Price 1989; Kleiman & Rylands 2002; Cade & Burnham 2003), the available historical evidence indicates most reintroduction attempts failed (Griffith et al. 1989; Wolf et al. 1996). Over the past decade, the number of reintroduction programs and the body of scientific literature documenting these efforts has increased dramatically (Seddon et al. 2007), but the role of captive breeding remains controversial (e.g., Jule et al. 2008) despite well-documented successes.

In its simplest form, the role of captive breeding and reintroduction in conservation is analogous to Noah's ark. Species threatened with extinction are maintained in captivity, as if aboard an ark escaping the flood, until those factors threatening their existence are removed and they can be returned to the wild. This analogy has been widely used in the popular and scientific literature (Durrell 1976; Soulé et al. 1986; Balmford et al. 1995).

Here I focus on the extent to which the importance of captive breeding and reintroduction as a conservation strategy is reflected in planning and policy, particularly by the world's zoos and aquaria. I tracked policy and opinion in the zoo and conservation biology literature and found a general decline in emphasis on captive breeding since the early 1990s until the recent recommendations for large-scale captive breeding pertaining to hundreds of species from certain taxonomic groups. It is worth considering whether these new proposals are open to the same criticisms as their predecessors and whether they are justified by the increasing severity of the biodiversity crisis.

Captive Breeding in the Early 1990s

By the early 1990s, captive breeding had gained widespread recognition as a conservation strategy from conservationists and the general public. Captive-breeding practitioners had a clear mandate from the conservation community in the form of The World Conservation Union policy statement on captive breeding (IUCN 1987). In addition, a sound theoretical basis for genetic and demographic population management and an impressive global organizational structure had emerged (summarized in Ebenhard 1995).

Zoos and aquaria were to play a key role in conservation by maintaining populations of threatened species ex situ. These institutions were seen as pre-adapted to the role by their long tradition of keeping, breeding, and transporting animals (Conway 1986, 1995). This role was popularized by Tudge (1992) and formalized by the first World Zoo Conservation Strategy (IUDZG/CBSG 1993).

With this foundation, recommendations for captive-breeding programs proliferated. Through a series of Global Captive Action Plans (later Global Captive Action Recommendations), the IUCN Conservation Breeding Specialist Group (CBSG) recommended hundreds of taxa for captive breeding. For example, Seal et al. (1993) recommended captive breeding for 1192 vertebrate taxa out of 3550 examined. Local and national conservation authorities also envisaged a major role. Tear et al. (1993) reviewed 314 approved recovery plans for endangered

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species in the United States and found 64% recommended captive breeding.

Limitations of Captive Breeding

Following the grand visions for captive breeding of the early 1990s, concerned biologists responded in the conservation literature (Rahbek 1993; Rabinowitz 1995; Oates 1999). Rahbek (1993) questioned the utility of captive breeding given the tiny proportion of biodiversity that such techniques are relevant to, even though zoos had long recognized their limited capacity in terms of the number of species to be maintained (Conway 1986).

Snyder et al. (1996) provided a comprehensive summary of the limitations of captive breeding as an approach to the recovery of endangered species. Some of these limitations are essentially practical ones for which the solutions may appear with time. For instance, the difficulty in establishing self-sustaining captive populations and poor success in reintroduction could potentially be overcome given increased resources and improved methods.

Other limiting factors identified by Snyder et al. (1996) are of a more fundamental nature, in particular the high costs involved in captive breeding and the pre-emption of other conservation activities. Balmford et al. (1995) in a direct comparison found that the costs of conserving mammals ex situ often exceeded in situ costs even with intensive protection. Other critical and cost-effective conservation activities can be delayed or overlooked when captive breeding and reintroduction are recommended or undertaken. Potential examples of this occurring are given by Snyder et al. (1996) and Rabinowitz (1995), and similar fears were apparently behind the recent rejection of a captive-breeding proposal for the Grenada Dove (*Leptotila wellsi*) (Bruslund Jensen & Meier 2008). Funding for captive breeding, however, is not necessarily transferable to field conservation (Conway 1995).

Of particular concern to skeptics of captive breeding is the idea that hundreds of species could be maintained in captivity for perhaps centuries and eventually returned to the wild. Tudge (1992: 53) envisaged species held in captivity forming the nucleus of a restored global fauna following a “demographic winter” in which human populations were greatly reduced. This long-term plan for large numbers of species has been labeled the “ark paradigm” (Hutchins et al. 1995; Snyder et al. 1996). Several of the limitations to captive breeding noted by Snyder et al. (1996), such as domestication and administrative continuity, would be particularly difficult to overcome in this scenario. More seriously, the ecosystems for which these species are adapted may change dramatically in the interim between the establishment of a captive-breeding program and eventual reintroduction.

I suggest that in the early years of this century the enthusiasm for captive breeding as a conservation strategy waned due to the growing recognition of its limitations. This is highlighted when one compares the coverage given to population management in the first World Zoo Conservation Strategy (IUDZG/CBSG 1993) and in the second (WAZA 2005). The first document does not mention the in situ conservation role of zoos other than reintroduction, which it describes as “the ultimate goal of *ex situ* conservation.” The second document outlines a much broader conservation role for zoos as suggested by various authors in the 1990s, including monitoring, research, and education programs. Similarly, the notion of global captive-breeding plans was largely abandoned in the mid-1990s—the most recent Global Captive Action Recommendations available on the CBSG Web site were published in 1996 (CBSG 2008). Collection planning by regional zoo associations considers many reasons for maintaining species in captivity, including education and research, rather than focusing on those species considered in need of reintroduction (EAZA 2008).

Despite the limitations, most authors agree that captive breeding for reintroduction can be a useful and necessary conservation method given the appropriate circumstances. Therefore, much of the current debate revolves around when ex situ efforts are warranted. Some proponents advocate the technique for hundreds or even thousands of species, whereas others argue for a much more judicious and limited application.

Return of the Ark(s)

In recent years the captive-breeding ark has made a return in name and concept. The Turtle Survival Alliance was formed as a partnership between the IUCN Tortoise and Freshwater Turtle Specialist Group and CBSG with the aim of establishing captive populations of threatened species following the recognition of the Asian turtle crisis (The Turtle Survival Alliance 2008). These breeding programs are known as “assurance colonies” and are an integral part of a global action plan for these species (Turtle Conservation Fund 2002). In 2004 the European Association of Zoos and Aquaria recommended that similar, safety-net populations (“turtle arks”) be established for 36 chelonian species in European zoos (EAZA Executive Office 2006).

The biggest challenge to face the captive-breeding community, however, is the result of the ongoing global amphibian crisis (Global Amphibian Assessment 2008). The Amphibian Conservation Action Plan (Gascon et al. 2007) outlines an extensive ex situ conservation program to be implemented by the Amphibian Ark, a coalition of the World Association of Zoos and Aquariums, the CBSG, and the IUCN/SSC Amphibian Specialist Group. The number of amphibian species requiring captive breeding is estimated to be at least 500 (Amphibian Ark 2008).

These proposals run contrary to the general recommendation of Snyder et al. (1996: 345) that captive breeding "should not normally be recommended or initiated...before careful field studies have been completed and a comprehensive determination has been made that preferable conservation alternatives are not available and that captive breeding is essential for near-term survival of a species." Although such field studies are recommended for chelonians and amphibians, it is presumably believed that captive breeding should be initiated as a matter of urgency to avoid risking extinctions while research is still underway.

In considering whether these latest proposals are open to the same criticisms as their predecessors, three potential justifications come to mind. First, the plans for turtles and amphibians have achieved a broad consensus of approval from the relevant global conservation bodies, something not necessarily achieved for previous proposals (Oates 1999; 216 pp). Second, these particular species may be more amenable to captive husbandry than various other taxa. Amphibians have been proposed previously as good candidate species for captive breeding and reintroduction (Bloxham & Tonge 1995). Third, and perhaps most importantly, many of these species are subject to threats in their native habitats that are unlikely to be removed or controlled in the short term (e.g., chytrid fungus in the case of many amphibians). In these cases justification comes not simply from the degree of endangerment, but also from the perceived nature of the threats identified in documented declines and extinctions (Turtle Conservation Fund 2002; Hawkins et al. 2006 [mammalian example]; Gascon et al. 2007).

It could be argued that these most recent ark proposals have arisen under the sort of exceptional circumstances that can justify captive breeding. Nevertheless, these circumstances are likely to become less and less exceptional as the current biodiversity crisis unfolds. Perhaps previous global recommendations will need to be reexamined in the light of future survey data. Certainly, there are other taxonomic groups for which captive breeding is likely to be critical, including Lake Victoria cichlids (Fiumera et al. 2000) and perhaps Asian vultures (Green et al. 2004).

Although many zoos had been involved in field conservation for a considerable time by the 1990s (Gould 1996), recent years have seen a tremendous increase in the capacity of zoos to contribute directly to in situ conservation (Zimmermann & Wilkinson 2007). Although this has allowed zoos to expand their conservation programs beyond management of captive populations there has also been a parallel increase in assisted-reproduction technology, which allows zoos to further their roles as arks by, for instance, transferring gametes instead of animals between zoos (Bainbridge & Jabbour 1998) or through the long-term storage of genetic material (Zhang & Rawson 2007). Therefore, discussion over when captive breeding is warranted remains relevant as managers of zoos and other captive-breeding organizations now have to balance ex situ management of threatened species directly with in situ conservation programs to achieve optimum conservation success.

Captive breeding and reintroduction are but minor parts of the conservation response to ongoing population declines and extinctions caused by human activities. Nevertheless, whether the ark will be required to carry hundreds of passengers for the duration of the flood or a relative few at any one time, it is clear that recognizing and overcoming the limitations of captive breeding will be crucial to the conservation of a growing number of species. Ignoring lessons from the past concerning how and when to employ captive breeding in species conservation risks the failure of recovery programs and, ultimately, the loss of species.

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