Short Communication

The IUCN Technical Guidelines on the Management of *Ex Situ* Populations for Conservation: reflecting major changes in the application of *ex situ* conservation

Mike Maunder and Onnie Byers

Abstract The recently revised *IUCN Technical Guidelines on the Management of* Ex Situ *Populations for Conservation* represent an attempt to synthesize current thinking on the strategic application of *ex situ* conservation for the maximum benefit of both threatened species and habitats. We review this document as a means of assessing major changes in the application of *ex situ* conservation. We identify a number of major themes. These include the need for the integrated management of wild and captive populations, expansion of *ex situ* capacity in terms of institutional facilities and breadth of taxonomic experience, an important emphasis to be given to the need for in-country conservation initiatives, and the need to comply with national and international legal structures, most notably the Convention on Biological Diversity.

Keywords Convention on Biological Diversity, *ex situ* conservation, *in situ*, IUCN Technical Guidelines, species recovery.

In December 2002 the Species Survival Commission (SSC) approved an update of the IUCN Policy Statement on Captive Breeding (IUCN, 2002). This Statement reflects an evolution in the strategic application of *ex situ* techniques, with emphasis given to the absolute priority of *in situ* conservation. The definition of *ex situ* conservation follows the Convention on Biological Diversity: 'the conservation of components of biological diversity outside their natural habitats' (Glowka *et al.*, 1994). While acknowledging that debate on the effective deployment of *ex situ* management is continuing (Ebenhard, 1995; Snyder *et al.*, 1996; Gippoliti & Carpaneto, 1997; Guerrant *et al.*, 2004), these revised guidelines reflect the importance of the broad portfolio of services that *ex situ* facilities and techniques can provide to support the conservation of wild populations and habitats.

Ex situ facilities for wild species conservation, encompassing zoos, botanic gardens, aquariums, gene banks and research facilities, represent a large financial investment in conservation. The effective utilization of this diverse range of facilities and their associated resources will continue to be an important part of any attempt to retain current levels of biological diversity. Since the original IUCN Policy Statement on Captive Breeding (IUCN, 1987) the science and practice of *ex situ* conservation has developed considerably. A number of important changes, including new policy and legal instruments, have profoundly altered the working context and objectives for *ex situ* conservation.

There has been a fundamental shift from the traditional 'ark' paradigm (Soulé *et al.*, 1986) towards using *ex situ* conservation as a set of techniques supporting the conservation and recovery of wild populations and habitats, with the *ex situ* population management undertaken in close collaboration with land managers. A model for this approach is the Center for Plant Conservation in the US (Kennedy, 2004), where regional *ex situ* institutions work on locally threatened plant species in close association with land management agencies. There has been expansion of national and global networks of *ex situ* practitioners that are developing skills in both species management and collaborative working with a wide variety of conservation agencies and stakeholders (Westley & Miller, 2003). This can be demonstrated through two examples: (1) the growth of national and regional botanic garden networks, and (2) the extending influence of regional groups of the Conservation Breeding Specialist Group (CBSG) in Latin America, South Africa and Asia. *Ex situ* conservation, and associated display and educational activities, is utilized as a tool to lever political, financial and scientific support for the

Mike Maunder (Corresponding author) Fairchild Tropical Botanic Garden, 10901 Old Cutler Road, Coral Gables, Miami, FL 33156, USA. E-mail mmaunder@fairchildgarden.org

Onnie Byers Conservation Breeding Specialist Group, Species Survival Commission /IUCN, 12101 Johnny Cake Ridge Road, Apple Valley, MN 55124, USA.

Received 27 October 2003. Revision requested 5 March 2004. Accepted 12 August 2004.

conservation of important habitat areas and ecosystem services. In addition there have been major new institutional investments. Notable botanical examples include the Millennium Seed Bank of the Royal Botanic Gardens, Kew, UK, and conservation biology laboratories at Kings Park and Botanic Garden, Perth, Australia, and Chicago Botanic Garden, USA, all providing both new facilities and intellectual investment. The scientific tools for *ex situ* conservation have advanced, particularly with regard to information systems, collection planning, genetic assessment, gamete and zygote storage, and controlled reproduction. For example, the Center for Plant Conservation, USA, has developed practical guidelines for the *ex situ* management of threatened plants (Guerrant *et al.*, 2004). The liabilities and risks of *ex situ* conservation have been clearly identified with regard to deleterious modifications to *ex situ* stocks (Joron & Brakefield, 2003; Husband & Campbell, 2004), the transmission of pathogens, and the risk of invasive species escaping from *ex situ* holdings (Reichard & White, 2001). More work is, however, needed on the practical management of pathogen risks for *ex situ* collections.

The absolute need for *ex situ* capacity has been demonstrated through successful captive breeding and reintroduction projects that have ultimately established new populations, such as the reintroduction of Californian condor *Gymnogyps californianus* to California and Arizona (Cade *et al.*, 2004) and the reintroduction of Arabian oryx *Oryx leucoryx* to the Middle East (Mésochina *et al.*, 2003). At the same time there is the recognition that some species may not be returned to the wild for the foreseeable future, and face long-term and probably inter-generational *ex situ* management (Maunder *et al.*, 2000). It is also increasingly clear that *ex situ* conservation must be responsive to unexpected challenges. For instance, until recently the Asian *Gyps* vultures would have been low on any list of captive breeding priorities, but as a result of rapid and catastrophic declines in wild populations (Lindsay Oaks *et al.*, 2004) captive breeding may be a vital component in any conservation response. In addition, *ex situ* expertise has expanded to encompass those groups of perceived lower display value that may not have received attention in institutions focused on popular charismatic species; examples include threatened molluscs (Mace *et al.*, 1998) and bryophytes (Pence, 2004).

Above all, the legal and political context for *ex situ* conservation has changed profoundly since 1987. A number of strategic documents from *ex situ* networks (IUDZG/CBSG IUCN/SSC, 1993; BGCI, 2001) and multilateral environmental agreements now recognize *ex situ* conservation as a valid tool. Amongst the latter, two of the most important are the Convention on Biological Diversity and the associated Global Strategy for Plant Conservation. Linked with the changes in legal context is the recognition that not all *ex situ* conservation will take place within developed world institutions and that in-country *ex situ* conservation will be an increasingly appropriate and cost-effective option for species in regions of high biodiversity (Maunder *et al.*, 2002).

The *IUCN Technical Guidelines on the Management of* Ex Situ *Populations for Conservation* (IUCN, 2002) were drafted by a team established by the CBSG, with working groups convened at the 1999 and 2000 CBSG Annual Meetings. This group then worked with a wide range of stakeholders to ensure the document reflected policy amongst as wide range of *ex situ* practitioners as possible. The botanical liaison was conducted via the Plant Conservation Committee of the SSC and the zoological liaison undertaken by CBSG. The final version was adopted following extensive review within the wider SSC Network. The document was designed to: (1) Provide a set of guidelines that establishes the core values and policies for *ex situ* practitioners dealing with any taxonomic group, both within and external to the range country. (2) Clearly state the increasingly valuable role of *ex situ* conservation within the context of *in situ* conservation, particularly ecosystem and habitat conservation, and the ecological services that can only be provided by *in situ* conservation. (3) Reflect the increasingly sophisticated role of *ex situ* institutions in directly supporting and funding in-country and *in situ* conservation activities. (4) Reflect existing strategic and scientific frameworks for *ex situ* conservation, established through international legislation (e.g. the Convention on Biological Diversity and the Global Plant Conservation Strategy), international agencies (International Plant Genetic Resources Institute and the Food and Agriculture Organisation) and *ex situ* networks (e.g. American Zoo and Aquarium Association, Botanic Gardens Conservation International, Conservation Breeding Specialist Group, Center for Plant Conservation).

The Technical Guidelines state 'the primary objective of maintaining *ex situ* populations is to help support the conservation of a threatened taxon, its genetic diversity, and its habitat.' Key areas of the guidelines encompass the selection of priority species, the need for developing *ex situ* protocols, and the need to manage the risk of natural catastrophe, disease or political upheaval on *ex situ* programmes.

The preamble emphasizes the IUCN goal of 'the maintenance of existing genetic diversity and viable populations of all taxa in the wild in order to maintain biological interactions, ecological processes and function', and recognizes the support role of *ex situ* efforts. It is clearly stated that '*ex situ* conservation should be considered as a tool to ensure the survival of the wild population' and 'only as an alternative to the imperative

of *in situ* management in exceptional circumstances', and 'effective integration between *in situ* and *ex situ* approaches should be sought wherever possible.'

The Technical Guidelines request that those responsible for managing *ex situ* plant and animal populations and facilities 'use all resources and means at their disposal to maximize the conservation and utilitarian values of these populations', including: (1) increasing public and political awareness and understanding of important conservation issues and the significance of extinction, (2) coordinated genetic and demographic population management of the threatened taxa, (3) reintroduction of and support to wild populations, (4) habitat restoration and management, (5) long-term gene and bio-material banking, (6) institutional strengthening and professional capacity building, (7) appropriate benefit sharing, (8) research on biological and ecological questions relevant to *in situ* conservation and (9) fundraising to support all of the above. *Ex situ* agencies and institutions must follow national and international obligations with regard to access and benefit sharing (as outlined in the Convention on Biological Diversity) and other legally binding instruments, such as CITES, to ensure full collaboration with all range states.

These guidelines reflect a scenario whereby stocks are managed in tandem with wild populations and that the period of *ex situ* intervention is minimized in terms of both time and any deleterious genetic or demographic impacts. This reflects the increasing investments by *ex situ* institutions in habitat conservation (Cohn, 2000; Stanley Price *et al.*, 2004). Examples include zoo support for Brazilian Atlantic rainforest using primates as flagship species (Holst, 2003) and the political lobbying by the European Association of Zoos and Aquaria against bushmeat trading (Stanley Price *et al.*, 2004). Botanic garden examples include support from the Royal Botanic Gardens, Kew and Missouri Botanical Gardens for *ex situ* facilities and protected areas in Mauritius and Madagascar, respectively, and the Utrecht Botanic Garden supporting *in situ* reserves in French Guyana. The recently established African Botanic Garden Network has placed a strong emphasis on habitat conservation, retention of traditional knowledge and the challenge of poverty alleviation as well as a 'traditional' focus on conserving threatened or endemic species (Anon., 2004).

The effective utilization of *ex situ* facilities and their associated resources as a support to the conservation of wild populations and habitats will be an important part of any attempt to retain current levels of biological diversity. The *IUCN Technical Guidelines on the Management of* Ex Situ *Populations for Conservation* will, we believe, help to strengthen the beneficial impacts of *ex situ* facilities, reduce some of the inherent problems of *ex situ* management, and increase acceptance of *ex situ* efforts as an integral component of biodiversity conservation.

Acknowledgements

This paper is dedicated to the memory of Dr Ulie Seal (1929–2003), Chairman of the Conservation Breeding Specialist Group and leading player in the formulation of these IUCN Technical Guidelines. Many thanks to David Brackett, David Bramwell, Bill Conway, Fred Daman, Susie Ellis, Nate Flesness, Jo Gipps, David Given, Ed Guerrant, Kay Havens, Toby Hodgkins, John Knowles, Alan Lieberman, Georgina Mace, Sue Mainka, Jeremy Mallinson, Jerry Millhon, Oliver Ryder, Mark Stanley Price, Wendy Strahm, Simon Stuart, Peter Wyse Jackson, and Dave Wildt, and others who helped to shape the Technical Guidelines and to see the document through the review process.

References

Anon. (2004) Strategic framework and action plan for the African Botanic Garden Network 2002–2010. *Southern African Botanical Diversity Network Report*, **22**, 59–67.

Botanic Garden Conservation International (2001) *Botanic Garden Agenda for Conservation*. Botanic Gardens Conservation International, London, UK.

Cade, T.J., Osborn, S.A.H., Grainger Hunt, W. & Woods, C.P. (2004) Commentary on released Californian condors *Gymnogyps californianus* in Arizona. In *Raptors Worldwide. Proceedings of the VI World Conference on Birds of Prey and Owls* (eds R.D. Chancellor & B.U. Meyburg), pp. 11–25. World Working Group on Birds of Prey and Owls/MME-Birdlife, Budapest, Hungary.

Cohn, J.P. (2000) Working outside the box: zoos and aquariums are shifting the focus of their conservation efforts to the wild. *BioScience*, **50**, 564–569.

Ebenhard, T. (1995) Conservation breeding as a tool for saving animal species from extinction. *Trends in Ecology and Evolution*, **10**, 438–443.

Gippoliti, S. & Carpaneto, G.M. (1997) Captive breeding, zoos, and good sense. *Conservation Biology*, **11**, 806–807.

Glowka, L., Burhenne-Guilman, F., Synge, H., McNeely, J.A. & Gündling, L. (1994) *A Guide to the Convention on Biological Diversity*. Environment Policy and Law paper No. 30. IUCN, Gland, Switzerland.

Guerrant, E.O., Havens, K. & Maunder, M. (eds) (2004) Ex Situ *Plant Conservation: Tools for Conserving Wild Populations*. Island Press, Washington, DC, USA.

Holst, B. (2003) European zoos support the Atlantic Rainforest. *Oryx*, **37**, 14–15.

Husband, B.C. & Campbell, L.G. (2004) Population responses to novel environments: implications for *ex situ* plant conservation. In Ex Situ *Plant Conservation: Tools for Conserving Wild Populations* (eds E.O. Guerrant, K. Havens & M. Maunder), pp. 231–266. Island Press, Washington, DC, USA.

IUCN (1987) *Captive Breeding Policy. IUCN Policy Document*. IUCN, Gland, Switzerland [http://www.iucn.org/themes/ssc/pubs/pubs/policy/capte.htm, accessed 18 August 2004].

IUCN (2002) *IUCN Technical Guidelines on the Management of* Ex Situ *Populations for Conservation.* IUCN, Gland, Switzerland [http://www.iucn.org/themes/ssc/pubs/policy/exsituen.htm, accessed 18 August 2004].

IUDZG/CBSG IUCN/SSC (1993) *The World Zoo Conservation Strategy: The Role of Zoos and Aquaria of the World in Global Conservation*. Chicago Zoological Society, Brookfield, USA.

Joron, M. & Brakefield, P.M. (2003) Captivity masks inbreeding effects on male mating success in butterflies. *Nature*, **424**, 191–194.

Kennedy, K.L. (2004) The role of federal guidance and federal partnerships in *ex situ* plant conservation in the United States. In Ex Situ *Plant Conservation: Tools for Conserving Wild Populations* (eds E.O. Guerrant, K. Havens & M. Maunder), pp. 67–83. Island Press, Washington, DC, USA.

Lindsay Oaks, J., Gilbert, M., Virani, M.Z., Watson, R.T., Meteyer, C.U., Rideout, B.A., Shivaprasad, H.L., Ahmed, S., Chaudhry, M.J.I., Arshad, M., Mahmood, S., Ali, A. & Khan, A.A. (2004) Diclofenac residues as the cause of vulture population decline in Pakistan. *Nature*, **427**, 630–633.

Mace, G.M., Pearce Kelly, P. & Clarke, D. (1998) An integrated conservation program for the tree snails (Partulidae) of Polynesia: a review of captive and wild elements. *Journal of Conchology*, **S2**, 89–96.

Maunder, M., Culham, A., Alden, B., Zizka, G., Orliac, C., Lobin, W., Bordeu, A., Ramirez, J.M. & Glissmann-Gough, S. (2000) Conservation of the Toromiro tree: case study in the management of a plant extinct in the wild. *Conservation Biology*, **14**, 1341–1350.

Maunder, M., Stanley Price, M.R., Soorae, P. & Mashuari, S. (2002) The role of tropical botanic gardens in supporting species and habitat recovery: East African opportunities. In *Plant Conservation in the Tropics: Principles and Experiences* (eds M. Maunder, C. Hankamer, C. Clubbe & M. Groves), pp. 115–134. Royal Botanic Gardens, Kew, UK.

Mésochina, P., Bedin, E. & Ostrowski, S. (2003) Reintroducing antelopes into arid areas: lessons learnt from the oryx in Saudi Arabia. *Comptes Rendus Académie des Sciences de Paris – Biologies*, **326**, 158–165.

Pence, V.C. (2004) *Ex situ* conservation methods for bryophytes and pteridophytes. In Ex Situ *Plant Conservation: Tools for Conserving Wild Populations* (eds E.O. Guerrant, K. Havens & M. Maunder), pp. 206–227. Island Press, Washington, DC, USA.

Reichard, S.H. & White, P.S. (2001) Horticulture as a pathway of invasive plant introductions in the United States. *BioScience*, **51**, 103–113.

Snyder, N.F.R., Derrickson, S.R., Beissenger, J.W., Wiley, T.B., Smith, W.D., Toone, W.T. & Miller, B. (1996) Limitations of captive breeding in endangered species recovery. *Conservation Biology*, **10**, 338–348.

Soulé, M.E., Gilpin, M., Conway, W. & Foose, T.J. (1986) The millennium ark: how long a voyage, how many staterooms, how many passengers? *Zoo Biology*, **5**, 101–113.

Stanley Price, M.R., Maunder, M. & Soorae, P.S. (2004) *Ex situ* support to the conservation of wild populations and habitats: lessons from zoos and opportunities for botanic gardens. In Ex Situ *Plant Conservation: Tools for Conserving Wild Populations* (eds E.O. Guerrant, K. Havens & M. Maunder), pp. 84–110. Island Press, Washington, DC, USA.

Westley, F.R. & Miller, P.S. (eds) (2003) *Experiments in Consilience: Integrating Social and Scientific Responses to Save Endangered Species*. Island Press, Washington, DC, USA.

Biographical sketches

Mike Maunder is co-chair of the IUCN/Species Survival Commission Plant Conservation Committee and a Strategic Associate of the CBSG. He has a particular interest in the conservation of island floras and the strategic application of *ex situ* conservation.

Onnie Byers is Executive Officer for CBSG, with a particular interest in conservation planning and species recovery. She is responsible for organization, design and facilitation of CBSG's Population and Habitat Viability Assessment, and Conservation Assessment and Management Plan workshops.