

COMMENTARY

A Horizon Scan for Species Conservation by Zoos and Aquariums

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We conducted the first horizon scan for zoos and aquariums to identify the 10 most important emerging issues for species conservation. This involved input from more than 100 experts from both the wider conservation community and the world zoo and aquarium community. Some of the issues are globally important: diseases, zoonoses, and biosecurity issues; new (communication) technologies; global water shortage and food insecurity; developing economies and markets for wildlife consumption; changes in wildlife population dynamics; and political instability and conflicts. Other issues are more specific to zoos and aquariums: need for extractive reserves; space shortage in zoos and aquariums; need for metapopulation management; and demand for caring of more species in zoos and aquariums. We also identified some broad approaches to these issues. Addressing the emerging issues identified in our horizon scan will further increase the contribution of the world zoo and aquarium community to global biodiversity conservation. *Zoo Biol.* 33:375–380, 2014. © 2014 Wiley Periodicals, Inc.

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INTRODUCTION

Reducing the threat of human-induced extinctions requires action to address the direct and indirect drivers of

change [Pullin et al., 2013]. For most known threatened species, the most appropriate actions entail protecting the sites where they are found, combating particular threats, building local capacity, and/or conservation outside of the

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species' natural habitat [e.g. in zoos and aquariums; Fa et al., 2011]. For species facing a real risk of extinction, zoos and aquariums can play a significant role [Dick and Gusset, 2010; Conde et al., 2011; Gusset and Dick, 2012]. However, there is a lack of more focused discussion to assess how progress toward effective species conservation can be achieved by zoos and aquariums.

Policy makers and practitioners in most fields, including the zoo and aquarium industry, often make decisions based on insufficient evidence. One reason for this is that issues appear unexpectedly, when with hindsight, many of them were foreseeable. A solution to the problem of being insufficiently prepared is routine horizon scanning, described as the systematic search for potential threats and opportunities that are currently poorly recognized [Sutherland and Woodroof, 2009]. Horizon scanning is a technique for detecting early signs of potentially important developments. An important objective is to explore new and unexpected issues as well as persistent problems and trends, including matters at the margins of current thinking that challenge past assumptions.

The importance of horizon scanning is increasingly recognized by governments and commercial organizations, as having a major contribution to make to strategic planning, risk management, and policy making. It can also inform research prioritization. For policy makers and practitioners to make informed decisions, they require an evidence base on potential effects, and an assessment of the options for remedial policy and action responses. Policy makers and practitioners also need to articulate the issues for which they lack relevant information for ensuring future conservation success [Sutherland et al., 2012]. A solid "scan of the horizon" can provide the background to develop strategies for anticipating future developments and thereby gain lead-time.

Building on similar previous exercises [reviewed in Sutherland et al., 2011], our aim here was to engage with the wider conservation community as well as the world zoo and aquarium community. Together, we identified emerging issues with potential to impact upon threatened species conservation by 2020, in a manner important to policy makers and practitioners in zoos and aquariums. This serves to align their conservation activities with Aichi Biodiversity Target 12 of the United Nations Strategic Plan for Biodiversity 2011–2020 (<http://www.cbd.int/sp/targets/>). This target states that "by 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained." Thus, this exercise focused on species conservation and not on other roles that zoos and aquariums may play.

IDENTIFICATION OF EMERGING ISSUES

Emerging issues were identified adopting methods used in previous horizon scans [Sutherland et al., 2011]. Seventy-one international experts with wide interests across the conservation community (academia, non-governmental

organizations, and inter-governmental organizations) were contacted electronically in August 2013. These experts were encouraged to consult their network of peers for input [up to an estimated six peers per person; Sutherland et al., 2011]. Additionally, 51 experts from the world zoo and aquarium community attended a workshop held in conjunction with the annual meeting of the Conservation Breeding Specialist Group of the Species Survival Commission (SSC) of the International Union for Conservation of Nature (IUCN) at Orlando, FL (USA) in October 2013. All involved were asked to identify, from the perspective of zoos and aquariums worldwide, emerging issues that can potentially impact threatened species conservation by 2020.

A total of 130 emerging issues were identified prior to the workshop and a further 82 during the workshop, resulting in 212 emerging issues for further consideration by workshop participants. Workshop participants reduced this list to 43 different emerging issues that were considered a priority. Emerging and priority issues were consecutively identified in five concurrent discussion groups using a participatory process. Workshop participants then voted on each priority issue in plenary to identify the 10 most important ones (closely related topics were grouped under common themes). Following the workshop, all involved were asked to elaborate on these top-10 emerging issues by providing suggestions electronically regarding how to, in broad terms, approach each issue.

THE EMERGING ISSUES

This horizon scanning exercise resulted in the following list of emerging issues for species conservation of particular relevance to the world zoo and aquarium community (Table 1).

Diseases, Zoonoses, and Biosecurity Issues

Description. There is a growing risk of disease transmission and virulence as well as increasing threats to the health of

TABLE 1. The 10 most important emerging issues with potential to impact upon threatened species conservation by 2020 from the perspective of zoos and aquariums worldwide

Emerging issues
Diseases, zoonoses, and biosecurity issues
New (communication) technologies
Global water shortage and food insecurity
Developing economies and markets for wildlife consumption
Changes in wildlife population dynamics
Need for extractive reserves
Space shortage in zoos and aquariums
Need for metapopulation management
Political instability and conflicts
Demand for caring of more species in zoos and aquariums

wildlife, people, and livestock as the interface of interaction expands. Wildlife health problems are exacerbated by anthropogenic pressures, such as bushmeat hunting, (illegal) wildlife trade, human settlements, roads, ecotourism, climate change, habitat loss, and population decline.

Approach. Invest in, capitalize on, and create links between zoological institutions' resources, expertise (including the International Species Information System), and facilities (e.g. veterinary units) in wildlife diseases, visitor engagement, and community outreach. Train customs officials in detecting cross-border wildlife disease issues. Strengthen collaboration between zoological institutions, their associations, and governments in wildlife disease issues. Invest in strategically located diagnostic laboratories, and corresponding capacity building, in developing countries. Incorporate wildlife disease issues into conservation planning.

New (Communication) Technologies

Description. New technologies are evolving and spreading at a faster pace than ever. Recent developments in communication technology, for example, lead to improved information sharing via social media and data systems for educational and management purposes. Individuals, communities, governments, and businesses are immersed into the virtual world to a much greater extent than before. Digital media and virtual communications allow people to form new connections, understandings, and values through multiple and diverse channels.

Approach. Invest in and capitalize on zoological institutions' expertise in visitor engagement and community outreach, requiring better incorporation of social science methods. Establish a committee, or think-tank, to monitor emergence of new technologies and how they can be harnessed, to stay abreast of and communicate upcoming threats and opportunities. Conduct more research on behavior change communication tools that work throughout different cultures and ethnic groups. Assure that visiting zoological institutions is understood as an act of conservation and that each visit contributes to conservation in the wild.

Global Water Shortage and Food Insecurity

Description. Climate change and human population growth lead to a growing demand for, and conflict over, water and food that negatively affect ecosystems and conservation efforts. This also leads to a growing demand for bushmeat in the developing world and a global shift to other unsustainable forms of food production.

Approach. Invest in and capitalize on zoological institutions' expertise in visitor engagement, community outreach,

field conservation, and, importantly, political advocacy. Establish trial sites to explore innovative solutions. Work with the corporate sector to reduce waste and increase efficiency. Work with the public to make sustainable choices. Provide an avenue for the public to demonstrate to governments that action is desired and required. Conduct more research on behavior change communication tools that work throughout different cultures and ethnic groups. Incorporate water and food issues into conservation planning.

Developing Economies and Markets for Wildlife Consumption

Description. Developing economies put additional anthropogenic pressures on the environment, especially resource use, and lead to a market-driving growing demand for wildlife products (including bushmeat). The (illegal) wildlife trade is becoming a lucrative business where it is more profitable for communities to capture and sell wildlife rather than use it for local consumption.

Approach. Invest in and capitalize on zoological institutions' expertise in visitor engagement, community outreach, (community-based) field conservation, research, and political advocacy. Engage with agencies to effectively track markets, stem demand, and reduce opportunities for poachers as well as providing viable livelihood alternatives. Focus on messages and campaigns that address reducing demand. Link with governments and embark on joint campaigns within their countries.

Changes in Wildlife Population Dynamics

Description. Increasing threats, such as invasive species, hybridization, pollution, habitat loss, and species range shifts induced by climate change, lead to changes in the dynamics of wildlife populations. This trend is exacerbated by population declines due to "by-catch" from bushmeat hunting and the (illegal) wildlife trade.

Approach. Invest in and capitalize on zoological institutions' expertise in (community-based) field conservation and research to best understand and predict likely changes, and flow-on impacts, to provide remedial actions. Invest in regional conservation genetics laboratories, and corresponding capacity building, to understand consequences. Embed work with local governments to ensure that recommendations are disseminated and likely to be adopted. Invest in collection planning and intensive population management to accommodate affected species. Incorporate predicted likely changes into conservation planning.

Need for Extractive Reserves

Description. Growing concerns about the long-term sustainability of wild animal populations in human care lead to a greater need for exploring the potential of extractive reserves to sustainably and ethically remove animals from the wild. Local communities would gain development and an improved standard of living that would result from setting up a reserve by a consortium of zoological institutions. In turn, these zoological institutions would gain a base for conservation, education, and research as well as a sustainable and ethical source of certain species.

Approach. Invest in feasibility studies, either individually or in partnership with other zoological institutions. Develop a model agreement with a country. Lobby authorities to facilitate cross-border animal transfers and address restrictive legislation. Invest in capacity building for intensive population management, both in human care and in the wild. Develop a selection process which species to extract from the wild. Incorporate extractive reserves into conservation planning.

Space Shortage in Zoos and Aquariums

Description. Limitations in space availability lead to a greater need for exploring alternative options of sustainably managing wild animal populations in human care, such as off-site breeding centers, metapopulation management, extractive reserves, global population management (including inter-regional animal transfers), and advanced molecular genetics tools (including genetic engineering and genome resource banking). The role of populations in human care can vary from little interaction with wild populations to populations with extensive gene flow in both directions.

Approach. Invest in feasibility studies and set up model programs by zoological institutions. Lobby authorities to facilitate cross-border animal transfers and address restrictive legislation. Screen collection plans and develop a selection process which species to keep. Look into partnership agreements with private animal holders. Invest in molecular genetics technology. Address design, management, and husbandry concerns linked to space shortage, especially for social species. Incorporate space shortage into conservation planning.

Need for Metapopulation Management

Description. Growing concerns about the long-term sustainability of wild animal populations in human care lead to a greater need for sustainably managing populations both in human care and in the wild together as metapopulations.

Metapopulation management involves managing a set of interacting populations, in human care and in the wild, under a common conservation goal. Possibly, this ought to be done within geographical clusters. When populations in the wild are becoming small, they too will need to be curated (managed reserves).

Approach. Invest in feasibility studies and set up model programs by zoological institutions. Probe interactive exchanges of animals (or gametes) between populations in the wild and in human care for mutual reinforcement. Lobby authorities to facilitate cross-border animal transfers and address restrictive legislation. Invest in breeding programs, especially to meet social species' behavioral needs. Invest in coherent care of species, whether in human care or in the wild, as part of a single conservation plan.

Political Instability and Conflicts

Description. Political instability and conflicts, which climate change will greatly exacerbate, negatively affect conservation efforts and lead to the displacement of people (often to the last remaining wild lands). This also leads to lawlessness that facilitates bushmeat hunting and the illegal wildlife trade. Lack of governance leads to paralysis and to global environmental bodies not functioning effectively.

Approach. Invest in and capitalize on zoological institutions' expertise in visitor engagement, community outreach, security, (community-based) field conservation, and political advocacy. Invest in-country resources and build capacity as well as trust to perform an advisory role in developing countries. Incorporate political issues into conservation planning.

Demand for Caring of More Species in Zoos and Aquariums

Description. Growing demand to take in wild animals in response to conservation crises, for rehabilitation, or from confiscations affects collection planning and wider strategic conservation planning. Rising pressures from illegal activities and political or environmental instability lead to an influx of wild animals to zoological institutions, which will greatly exceed available capacity and resources. This trend is exacerbated by a growing number of species for which long-term persistence in the wild is unlikely (e.g. due to climate change or inescapable habitat loss). Existing collection planning and species threat-evaluation processes are not sufficiently prepared for this.

Approach. Invest in evaluation of demand, feasibility studies, public understanding, conservation planning, animal

husbandry, and political advocacy by zoological institutions. Expand collaboration with, and support from, IUCN SSC specialist groups to agree on unified positions. Invest in large-scale multi-species exhibits, managed reserves, and integrated species conservation. Develop an international (business) model to achieve population management in the wild.

DISCUSSION

Any expert elicitation exercise, such as this, faces bias from the range of participants and the potential influence of particular individuals. This bias was reduced by including a wide range of participants with broad expertise to cover the subject's diversity and by using a democratic process. The novel output comprises a list of emerging issues for species conservation of particular relevance to the world zoo and aquarium community. This list will be distributed within the network of the World Association of Zoos and Aquariums (WAZA). These zoological institutions collectively reach more than 700 million visitors annually and are among the main providers of conservation funding globally, spending more than US\$350 million on wildlife conservation every year [Gusset and Dick, 2011a]. Actively disseminating this list will afford zoos and aquariums the opportunity to prepare in time for forthcoming potential threats and opportunities in species conservation.

Some of the emerging issues, while identified as being of particular relevance to zoos and aquariums, are equally important to the wider conservation community [Sutherland et al., 2009; Dick and Gusset, 2013]: diseases, zoonoses, and biosecurity issues; new (communication) technologies; global water shortage and food insecurity; developing economies and markets for wildlife consumption; changes in wildlife population dynamics; and political instability and conflicts. However, there is relatively little overlap between the annual horizon scans of global conservation issues [e.g. Sutherland et al., 2014] and the (fairly broad) list of emerging issues for species conservation identified here. Recent priority issues globally include emerging diseases, the ecological role of microbiota, nonrenewable and renewable energy, and under-recognized effects of human activities on the marine environment. This calls for better integration of the world zoo and aquarium community into the wider conservation community.

Other emerging issues are more specific to zoos and aquariums: need for extractive reserves; space shortage in zoos and aquariums; need for metapopulation management; and demand for caring of more species in zoos and aquariums. These issues closely relate to two of the currently major conservation themes in the world zoo and aquarium community, namely finding ways to ensure the long-term sustainability of populations both in human care and in the wild [Lees and Wilcken, 2009; Gusset and Dick, 2011b] and moving toward integrated species conservation [Pritchard et al., 2012; Redford et al., 2012; Gusset and Dick, 2013].

Under this new paradigm, conservation holistically refers to activities aimed at sustaining biodiversity, whether conducted in or out of a species' natural habitat, integrated across the conservation community.

In addition to advancing tools for the behavioral, reproductive, genetic, and health-related management of intensively managed populations [Ballou et al., 2010; Asa et al., 2011; Leus et al., 2011; Penfold et al., 2014], innovative approaches—such as those identified here—are needed to enhance our capacity to sustain viable populations both in human care and in the wild [Conway, 2011; Conde et al., 2013; Lacy, 2013]. Realizing that most species are to some extent conservation-dependent [Redford et al., 2011], integrated conservation works along a continuum of management intensity, including hardly any human intervention in wild populations to intensively managed populations in human care. Both of these novel approaches aim at, and rely on, closer integration of the wider conservation community (e.g. IUCN SSC specialist groups) and the world zoo and aquarium community.

The suggestions provided regarding how to approach the emerging issues, while broad in nature, imply that concrete actions taken by zoos and aquariums to help species conservation should focus on visitor engagement, community outreach, capacity building, political advocacy, and international collaboration, in addition to focusing on improving a population's status both in human care and in the wild. In this regard, the growing trend toward evidence-based conservation [Sutherland et al., 2004] urges all practitioners, including those involved with zoos and aquariums, to provide evidence for their conservation impact [Gusset and Dick, 2010; Fa et al., 2014; Gusset and Lowry, 2014], specifically by initiating multi-institutional cooperative research trials and model programs on the emerging issues. This should, and demonstrably can [e.g. Müller et al., 2011; Conde et al., 2013; Moss et al., 2014], be done in collaboration with the academic and wider conservation community.

CONCLUSIONS

Innovation in species conservation needs to be promoted strategically. Addressing the emerging issues identified in our horizon scan will further increase the contribution of the world zoo and aquarium community to achieving Aichi Biodiversity Target 12—to prevent the extinction of threatened species and improve their conservation status by 2020. Many of the issues will be influenced by public perception of operating practices, so the public's response to these issues and practices should be considered. WAZA, together with other international conservation bodies, is a partner of IUCN's "Friends of Target 12" coalition (<http://www.iucn.org/friendsoftarget12/>), which supports the United Nations Convention on Biological Diversity to achieve this crucial target at the core of global biodiversity conservation. Based on our horizon scan, we

call upon the world zoo and aquarium community and the wider conservation community to act together for species conservation.

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