The Role of Zoos in the 21st Century

Introduction

Collections of exotic animals, menageries, have been in existence for thousands of years; the word zoo came into common usage in the 19th century (Hosey et al, 2013). However their role as collections remained unchanged until comparatively recently. The role of some zoos moved more towards conservation after the Second World War alongside the creation of the World Association of Zoos and Aquariums (WAZA) in 1935 and the International Union for the Conservation of Nature (IUCN) in 1948 (Braverman, 2014). The introduction of the European Endangered Species Programme (EEP) in the 1970’s and Species Survival Plan (SSP) programs in the 1980’s created stronger links between zoos and conservation in Europe and North America respectively (Braverman, 2014).

The role of zoos in the 21st century has in part been determined by legislation and zoo associations. For example in 1999 the EC Zoo Directive required that all zoos in European Union (EU) member states be actively involved in conservation and education, however conservation only has to consist of one or more of research, training, captive breeding, repopulation or reintroduction and these do not have to be the primary aims of the zoo (European Union, 1999). Membership of WAZA or regional associations such as the European Association of Zoos and Aquaria (EAZA) also requires that zoos be actively involved in conservation, research and education (WAZA, 2005). However of the estimated 10,000 or so zoos in the world only around 1,200 are accredited members of such organisations, leaving many zoos that do not have to provide conservation, education or research as part of their role (Gusset and Dick, 2011; Hosey et al, 2013).

This review will look at these 3 main roles of zoos; conservation, research and education. Conservation will be broken down into ex-situ, occurring outside natural habitat e.g. in the zoo premises, and in-situ, occurring within a species natural habitat (Tribe and Booth, 2003). Suggestions for the future direction of zoos will then be made.

Conservation

Ex-situ

A key aim of conservation is to maintain biodiversity and reduce the current rate of extinction which is currently taking, place mainly as a result of human activity (Minteer and Collins, 2013). Zoos are contributing to this is by breeding threatened animals in captivity as safety populations. Conde et al (2013) found that 23% of the species in zoos which use the International Species Information System (ISIS) are classified by the IUCN as threatened. This means that 77% of species in zoos are not deemed to be threatened and it could be argued are not playing a role in conservation. Not all zoos use ISIS and some species are data deficient or yet to be classified by the IUCN, which could affect the percentages. There are currently 61 species classified as extinct in the wild, being held only in ex-situ locations including zoos (IUCN, 2014; Brooks et al, 2009). A captive population of a species needs to be over a certain size in order to maintain its long term sustainability. Lacy (2013) argues that the current zoo population management strategy of “minimising genetic decay” is not sustainable. Conde et al (2013) found that only a fraction, ranging from 9% for birds to 18% for mammals, of threatened species have a population of greater than 250, in ISIS zoos. Traill et al (2007) suggested that a minimum viable population size was 1,000, however this
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varies between taxa and species. Zoos are limited by size and finances as to how many individuals of a species they can hold so reaching a long term sustainable population size may not be possible for every species, limiting the effectiveness of the safety net (Bartos and Kelly, 1998; Tribe and Booth, 2003).

Zoos also breed for reintroduction into the wild. Hoffman et al (2010) reported that captive breeding played a large role in 17 of the 68 species of vertebrate that saw a reduction in threat level between assessments, however there is debate over the role zoos actually played in terms of supplying animals and expertise (Balmford et al, 2011). Conde et al (2011a) reported it was actually 13 species that zoos aided. Many reintroductions from captivity have been unsuccessful, however (Reading et al, 2013). For example success with carnivores has been low because of factors such as released individuals inability to hunt, competition from wild individuals, disease and also due to the threats not being removed prior to release (Jule et al, 2008). Lack of long term monitoring after reintroductions is also limiting their success. As many zoo populations are too small to be sustainable this creates problems when trying to reintroduce, such as increased inbreeding (Ewing et al. 2008) and providing enough stock.

In-situ

As well as providing animals for reintroduction a number of zoos are also involved in in-situ conservation projects. The number of projects zoos are involved in has increased greatly, for example in 1992 Association of Zoos and Aquariums (AZA) members were involved in less than 325 in-situ projects, by 1999 this had increased to 650 (Tribe and Booth, 2003) and the latest figure is now 1,970 (Minteer and Collins, 2013). The Wildlife Conservation Society of the Bronx Zoo alone supported more than 300 projects in 2003 (Conway et al, 2003). Gusset and Dick (2011) reported that zoos spent $350 million on conservation projects in 2008, making them the third largest funder behind The Nature Conservancy and the WWF global network. This was based on figures from 7 out of 12 national and regional zoo associations which the authors surveyed so is likely to be more.

Unlike ex-situ conservation which can be measured in terms of breeding success or the number of species being protected, it is more difficult to measure the success of in-situ conservation. Brooks et al (2009) found that efforts to conserve tropical biodiversity have prevented a fifth of the extinctions of birds that would have occurred. However they admit that success for other taxa and for schemes such as education of locals, providing conservation incentives and changes in policy, for which zoos are involved (Hoban and Vernesi, 2012), are less well known. Gusset and Dick (2010) carried out a review of 113 projects with zoo involvement and found that all of them are “helping to improve the conservation status” of threatened species and habitats based on Mace et al’s (2007) impact assessment of success. However Howe and Milner-Gulland (2012) criticised the robustness and consistency Mace et al’s method suggesting that more robust methods should be used in assessment.

Zoos can also link ex-situ and in-situ conservation together, for example they are playing a large role in the amphibian ark project set up to help protect amphibians, which are currently under crisis but are underrepresented in zoos (Conde et al, 2011b; Zippel et al, 2011). Species such as the mountain chicken, *Leptodactylus fallax* (Martin et al, 2007) and Lake Oku clawed frog, *Xenopus longipes* (Browne and Pereboom, 2009) have been rescued from
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The wild and are being bred in captivity with the aim of releasing them once suitable habitat is available. The amphibian ark has nearly 100 species in ex-situ programs (Zippell et al, 2011), however there are 484 critically endangered and 754 endangered species of amphibians on the IUCN redlist (Browne et al, 2011).

Research

Research undertaken by and in zoos can also contribute to conservation efforts and further knowledge of species in general. Animals can be studied more closely in zoos than in the wild, for example collection of blood and urine samples is possible allowing for the study of physiology and endocrinology. This can be used along with observations to determine reproductive physiology such as oestrus cycles, gestation length, interbirth intervals and litter size (Ryder and Feistner, 1995), which can then be used to assess populations in-situ. Zoo workers and animals can also contribute to disease research, for example zoo biologists aided in the discovery, description and developing an ex-situ treatment for chytrid fungus, which is currently affecting many amphibian species in the wild (Longcore et al, 1999; Zippel et al, 2011). Behavioural studies can also be conducted on zoo animals; many studies have been carried out on zoo primates (Worlein and Kelly, 2013), which can be carried out in more controlled conditions than in the wild and can include habitat manipulations, not usually possible in the wild (Moreira et al, 2007). However zoo animals may not behave in the same way in captivity as in the wild (Veasey et al, 1996) and the stress of being in captivity can alter animals physiology (Mason, 2010), this needs to be taken into account when making inferences about wild populations. Zoo studies also often have small sample sizes, as individual zoos often have low populations of each species. Despite this new husbandry and monitoring techniques can be developed in zoos and then used in the wild, for example bird nest boxes can be tried out to see if they would be used and the effects on reproduction, before installing in-situ protected areas. Likewise radio collars can be designed to be as non-invasive as possible, trying out various designs on zoo populations before using in-situ.

Education

The conservation and research undertaken by zoos can be used to educated the public and policy makers. Education is considered by all the major regional zoo accreditation organisations as fundamental to the role of zoos (Moss and Esson, 2013). It can be split into formal, taught and educator led, and informal, visitor led. Patrick et al. (2007) found that of the 136 American zoo mission statements they analysed more mention education (131 of 136) than conservation (118 of 136). A review of zoo education, supported by AZA, carried out by Falk et al (2007) came to the conclusion that zoos are increasing the public’s understanding of wildlife and conservation. However this study has drawn criticism by many including Marino et al (2010) who suggest their findings are methodologically limited and Dawson and Jensen (2011) who question the studies outcomes. Falk et al (2010) defended their research and “seriously question” Marino et al’s conclusion that there is no evidence that zoos impact their visitors. Moss and Esson (2013) point out that quantifying the education of zoo visitors is difficult as visitor experiences and educational impact vary greatly from person to person. They also suggested that zoo visitor studies focus too much on assuming a positive educational outcome, studies such as Jensen et al (2011) found that of 3000 school children surveyed pre and post zoo visit 13% showed a negative change in attitude towards zoos. If visitors are educated at zoos this may not led to a positive change in behaviour. Schultz (2011) and others suggest that education does not led to a change in
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behaviour and that only motivation will, however a person could be become motivated to act by visiting a zoo. Pearson et al (2013) found that there was a link between understanding of orang-utans and intentions for future conservation behaviour, however they provide no evidence that the respondents carried out these intentions.

Zoo’s can also help educate outside their walls, many in-situ projects involve educating the locals about wildlife, conservation and how to live alongside them (Hoban and Vernesi, 2012). Also zoo’s can contribute to awareness campaigns such as ‘Don’t Palm Us Off’, the aim of which was to inform the public of the plight of orang-utans and create support for compulsory labelling of palm oil products in Australia. Pearson et al (2014) claim this was a success in increasing awareness and conservation intentions, getting 160,000 people to sign a petition for palm oil labelling and reporting an increase in self-reported conservation behaviour post campaign, however there is problems with the reliability of self-reporting (Moss and Esson, 2013)

**Conclusion**

Many zoos are playing an increasing active role in conservation, both ex-situ and in-situ, however populations between zoos need to be better managed to ensure their long-term sustainability and potential for reintroduction (Conde et al, 2013). Also methods of assessing reintroductions and in-situ conservation projects need to be uniform and robust, however this can be expensive and it can be difficult to obtain sufficient data. There are a large number of species in zoos that are not threatened raising issues of their roles in collections, however education is being used as justification for keeping many of these species. Education is seen as an important role by accreditation organisations and zoos themselves. There is however debate over the effectiveness of this education and the ways in which it can and should be measured. Research in zoos has improved knowledge of many species and helped to develop husbandry and monitoring techniques that are aiding conservation of species. There is considerable overlap between these three main roles. They should be developed further and involve greater cooperation between zoos and other institutions such as non-government organisations, government bodies and universities to create a united vision and tools to help conserve more of the world’s biodiversity.

**References**


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