the Pontifical Academy of Sciences

Zoo-led science and the global conservation of species

Mark Pilgrim[*]

During the last few decades, progressive European zoos that are part of the European Association of Zoos and Aquariums (EAZA) have evolved from menageries to conservation centres. Science and the application of scientific techniques has been key to this change. In this essay I will explain how zoos use a scientific approach to the global conservation of species using case studies. Four key topics are covered: 1) the 'one plan approach' using the Eastern black rhinoceros as the example, 2) the importance of working with local communities, 3) zoo science in conservation, and 4) using science to evaluate whether zoo visitors have a better understanding of biodiversity and positive actions they could take to protect it following a zoo visit.

The 'One plan approach' came from the International Union for the Conservation of Nature's Conservation Planning Specialist Group (IUCN/CPSG). It is defined as: "Integrated species conservation planning that considers all populations of the species (inside and outside the natural range) under all conditions of management and engages all responsible parties and resources from the start of the conservation planning initiative" (Barongi et al., 2015, p. 18). That means bringing together everyone interested in conserving a species and considers all of the populations of that species, those in the wild and those under human care.

The Eastern black rhinoceros is a good illustration of the how the one plan approach works. Since the 19th century the Easter black rhino population as a whole has declined from several hundred thousand individuals to just over 5000 (Emslie et al., 2016). The Eastern black rhino is listed as Critically Endangered on the IUCN Redlist (Emslie, 2011) and the rarest subspecies of black rhino with around 740 remaining in East Africa (Emslie et al., 2016) and 92 in European Zoos (Biddle & Pilgrim, 2017). This zoo population is extremely important as it makes up 12% of the total global population. More than this, as these rhinos were collected and sent to Europe in the 1960s and 70s before the major poaching crisis, it is very likely that the zoo population contains genes that no longer occur in the population in Africa.

To successfully manage this European Zoo population takes a great deal of cooperation between the zoos and some rules to follow to ensure the population achieves its goals. These goals are:

1) Ensure a healthy and sustainable population to fulfil the needs of EAZA zoos,

2) Manage the population to achieve a >5% growth rate per year. (This is based on the Kenyan Wildlife Service's growth target for free ranging black rhinos),

3) Maintain 90% gene diversity from 41 founders for 100 years,

4) Work closely with the African Rhino Specialist Group and Governments to make Eastern black rhino available for return to Africa to supplement populations where needed.

To be successful the EAZA Ex-situ Programme (EEP) is managed by a single coordinator who makes transfer and breeding recommendations for all the zoos holding this species. These recommendations are reviewed and approved by the Species Committee which is made up from a subset of the zoos keeping Black rhinos. Animals are not allowed to be bought or sold and the participating zoos must follow the recommendations. Excellent record keeping and scientific analysis of the studbook is essential, and zoos use computer software to do this. ZIMS is the global record keeping system, SPARKS is the studbook keeping system and PMx does the population analysis. PMx allows us to scientifically select individual males and females and test how genetically compatible they are. It helps us manage the population in a way that ensures we will lose as little as possible of the genetic diversity. Once we know which rhinos are best to breed with one another we need to keep them well and healthy. We also have to understand the best time to introduce them to each other. Black rhinos are solitary for most of the time. They gather together at night around waterholes and the females will only remain with a male when in oestrous as at this time the male is far less likely to be aggressive. Science also helps us here. Some zoos have endocrinology laboratories that can test the faeces or urine of animals to determine what stage of the oestrous cycle a female animal is in. It can also show a pregnancy but importantly it allows us to anticipate the time to introduce males and females together to have the best chance of them not fighting and injuring each other and a successful pregnancy.

The one plan approach also means that zoos are supporting wild Black rhino populations. Many zoos have been giving financial support to assist with rhino monitoring and anti-poaching activities. These include funding additional front-line rangers and the equipment and infrastructure they need to work in the field. In Africa, the Eastern Black rhino now occurs in highly fragmented isolated populations. The science developed to manage zoo populations is now being applied to the small isolated populations in Kenya's National Parks.

It is of course also important for zoos to promote their work in the media, both to raise public awareness of the crisis facing biodiversity but also to show that there is hope of saving these magnificent animals and that zoos are part of the solution.

There is much more to what zoos do than breeding rare animals. Elephants, for instance, are incredibly popular animals in zoos. This gives zoos a unique opportunity to turn these positive feeling about an animal, into positive action to protect them. People are inspired by them. However, not all communities that come into close contact with them appreciate elephants. In Assam, northern India, the growing human population and its needs are squeezing the elephant population into ever-smaller areas. This leads to elephants leaving the forests and raiding the villagers' crops and damaging their property and injuring or even killing people. The communities retaliate with violence. Through support from our visitors and a Darwin Initiative grant, we work to help local communities mitigate this conflict. This requires understanding the species ecology and the communities' livelihoods.

This work requires three areas of focus: 1) interventions – to restore safety, 2) livelihoods – to offset economic risk, and 3) education – to build capacity for the future.

It is vitally important that intervention techniques are thoroughly researched and appropriate for the community. Assan is famed for growing hot chillies. Elephants will avoid the simple fences covered in chilli paste. The smoke from burning chillies also acts as a deterrent to elephants raiding crops. We have been working with local communities in Assam since 2005. Since that time, crop losses to elephants have been reduced by up to 78%. In the same timescale property damage from elephants has been reduced by up to 95% (Davies *et al.,* 2011). This is good for people and elephants. The next stage of the project is to share these techniques across a landscape of villages. In addition to helping to mitigate conflict with elephants, we have worked with local communities to develop alternative livelihoods. Zoo staff deliver training on running sustainable businesses, domestic animal husbandry workshops and plant care for farmers to increase their produce outputs in a sustainable way.

It is not only the large megafauna that zoos work to protect. The Golden mantella frog is only found in tiny patches of forest in Eastern Madagascar. It is about the size of your thumbnail. It is critically endangered due to habitat loss for expanding agricultural practices and uncontrolled collection of the Western pet trade.

To save any species from extinction it is crucial that the basic biology ecology of the species is well understood. Keeping the Golden mantella frog in our zoos allowed us to develop fluorescent markers without causing harm to the frog. By using this marking technique, we have been able to safely mark wild living frogs. This allows us to understand, for example, which of the forest ponds are most important for breeding, where the frogs go in the dry season, how long they live and so much more. This information allows us to set up and fund a conservation action plan for this species. We also train members of the local communities and staff from the Malagasy NGO that we partner with, called Madagaskara Vorkaji, to be able to continue this work of marking and studying this species. Taking our Golden mantella mascot into the local towns and villages causes a great deal of excitement, especially but not only from the children. Understanding this little frog and inspiring conservationists of the future is key to its long-term survival.

My last example of zoo-led science and the global conservation of species comes from the evaluation of zoo visitors. European zoos attract around 140 million visits a year (EAZA website, eaza.net). Many of these visitors come to the zoo for a day out, often with their children. They do not come primarily to be educated. A study was set out to test whether zoos, through the experiences and messages they give, can improve the general public's understanding of biodiversity and more importantly identify pro-biodiversity action that they can achieve at an individual level. This was a five-year research project (2012-2017) in collaboration with the World Association of Zoos and Aquariums, Warwick University, and the Convention of Biological Diversity (Moss *et al*., 2014). It is the largest study of its kind in the literature. The overarching idea was to assess whether zoos and aquariums can contribute to global biodiversity targets that were adopted by the Convention on Biological Diversity (CBD) at its Nagoya conference. These targets are known as the Aichi targets of which there are 20. The target that this research aligns to is Aichi target 1 which states: "By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably" (CBD, n.d.). In both global surveys, we found small but significant differences between pre- and post-visit measures in both of our independent

variables, thus showing that indeed a visit to a zoo improved the understanding of biodiversity and how to take action to protect it.

Bibliography

Barongi, R., Fisken, F.A., Parker, M. & Gusset, M. (eds.) 2015. Committing to Conservation: The World Zoo and Aquarium Conservation Strategy. WAZA Executive Office: Gland, Switzerland. Last accessed on November 18, 2019.

Biddle, B. & Pilgrim, M.A. 2017. Eastern Black Rhino EEP Annual Report 2017. EAZA.

CBD. n.d. Quick guide to the Aichi Biodiversity Targets: Awareness increased. Last accessed on November 11, 2019.

Emslie, R. 2011. Diceros bicornis ssp. michaeli. The IUCN Red List of Threatened Species 2011: e.T39320A10198874. http://dx.doi.org/10.2305/IUCN.UK.2011-2.RLTS.T39320A10198874.en

Emslie, R.H., Milliken, T., Talukdar, B., Ellis, S., Adcock, K. & Knight, M.H. 2016. African and Asian Rhinoceroses – Status, Conservation and Trade – A report from the IUCN Species Survival commission (IUCN SSC) African Rino Specialist Groups and Traffic to the CITES Secretariat pursuant to Resolution conf. 9.14 (Rev CoP15). Report to CITES 16th meeting Johannesburg 2016.

Moss, A., Jenson, E. & Gusset, M. Evaluating the contribution of zoos and aquariums to Aichi Biodiversity Target 1. 2014. Conservation Biology, Volume 29, Issue2, 525-536.

Wilson, S., Davies, T.E., Hazarika, N. & Zimmermann, A. (2013) Understanding Patterns of Human-Elephant Conflict in Assam: An Analysis to Inform Mitigation Strategies. Oryx.

Davies, T.E., Wilson, S., Hazarika, N., Chakrabarty, J., Das, D., Hodgson, D.J. & Zimmermann, A. (2011), Effectiveness of intervention methods against crop-raiding elephants. Conservation Letters. 4: 346-354.

END NOTES

[*] Vice-Chair EAZA and Chester Zoo CEO.