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# Zoos Can Lead the Way with *Ex Situ* Conservation


## Summary

Zoos can play a key role in the management of threatened species that require the support of captive breeding for their survival. In this sense, it is important to have an accounting of how many at-risk species are already represented in zoos, which can inform future prioritisation efforts. We used data from ISIS and the IUCN Red List of Threatened Species to assess the conservation status and population size of terrestrial vertebrates in ISIS member institutions. Our results show that 15% of described species classified as threatened are represented in ISIS zoos. Zoos already hold important populations for certain threatened species, especially for mammals. However, the number of threatened birds and their population sizes are much lower, which is even more dramatic for amphibians, although almost one-quarter of their populations are above 250 individuals. The implementation of cooperative captive breeding programmes across large numbers of institutions is one of the more demanding actions where zoos as a global network could play a key role to support the conservation of some of the most threatened species.


## Introduction

Zoos and aquariums face a major task if they are to be effective in preventing the extinction of some species. Habitat loss, overhunting and predation and competition from invasive species are some of the pressures that are driving species to extinction. Moreover, it is expected that these pressures will be exacerbated by future climate change. As a result, although the ultimate goal must be conservation in the species' natural habitat, captive breeding programmes may be the only short-term solution to avoid the extinction of those species whose populations are highly threatened. In fact, captive breeding played a major role in the recovery of 13 of the 68 species that had improved their conservation status in the last assessment (Hoffmann *et al.* 2010; Conde *et al.* 2011b). Thus, it is clear that while captive breeding is not a conservation goal in itself, it can be an important conservation tool.

Zoos can potentially lead the way with *ex situ* conservation efforts since they hold a large number of threatened species and employ staff with extensive experience of captive breeding techniques. However, without knowledge of which species, and how many individuals per species, zoos hold, it is difficult for the conservation community to appreciate the status of their "insurance populations". In this article, we outline the findings from our recent publication (Conde *et al.* 2011a), where we carried out a detailed accounting of zoo species using the freely available data from the International Species Information System (ISIS) and the Red List of Threatened Species published by the International Union for Conservation of Nature (IUCN).

ISIS is an organisation that holds the most extensive information on zoo animals, with more than 2.6 million individuals across more than 800 member institutions. Although ISIS does not represent all of the world's zoos, it has the best data available to estimate the representation of the planet's biodiversity in captivity. In Conde *et al.* (2011a), we matched the species-level data in ISIS zoos with the latest IUCN Red List data. The taxonomic matching was done at the species level for terrestrial vertebrates (i.e. mammals, birds, reptiles and amphibians). Where the ISIS and IUCN taxonomic names differed, we used the Catalogue of Life for taxonomic synonyms. The ISIS data were then mapped to obtain the distribution of threatened species across ISIS zoos.


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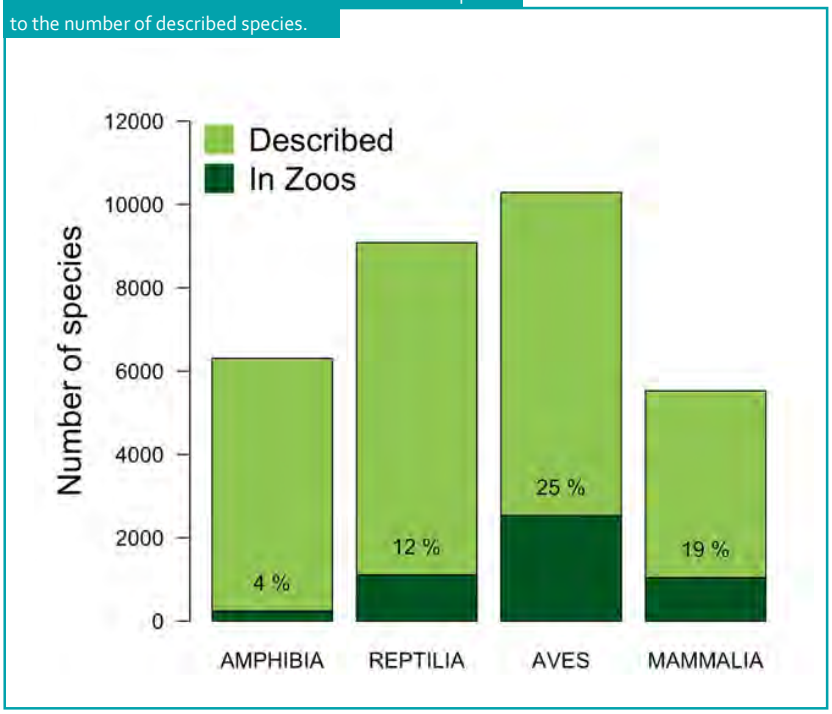
## Terrestrial Vertebrates in ISIS Zoos

Conde *et al.* (2011a) found that one-quarter of the world's described bird species and almost 20% of its mammal species are represented in ISIS zoos. In contrast, the representation of reptiles and amphibians is considerably lower with just 12% and 4%, respectively (Fig. 1). The picture is slightly different when we focus solely on threatened species. Mammals have the highest representation, with 24%, 23% and 19% of species classified as Vulnerable, Endangered and Critically Endangered, respectively (Fig. 2). Although the bird collections account for one-quarter of all known species, the representation of threatened species is lower (Vulnerable = 17%, Endangered = 17%, Critically Endangered = 9%). However, the lowest representation of threatened species is for amphibians, with only 4%, 2% and 3% of species classified as Vulnerable, Endangered and Critically Endangered, respectively (41% of amphibian species are threatened and ISIS zoos hold only 4% of all described amphibian species). IUCN has so far only assessed the conservation status of 1,672 of the 9,205 described reptile species. From this incomplete survey, zoos hold 37%, 28% and 51% of species classified as Vulnerable, Endangered and Critically Endangered, respectively. As a whole, roughly one in seven threatened species of terrestrial vertebrates (15%) are represented in ISIS zoos.

Although individual zoos usually do not hold large numbers of individuals of particular species of conservation concern, zoos as a global network hold important populations for some of the more highly threatened species. For example, almost one-quarter of the amphibian populations and 21% of the mammal populations include more than 250 individuals worldwide (Fig. 2). The figure is smaller for bird and reptile populations; only 8% and 6%, respectively, exceed 250 individuals.

The distribution of threatened species among the world's ISIS zoos does not coincide with the distribution of threatened species in the wild (Fig. 3). Zoos that hold most threatened species are concentrated in Europe and North America, while most of the wild populations of threatened species are concentrated in the tropics. However, it is important to emphasise that this map only shows species richness and does not account for the number of individuals per species. Consequently, zoos that hold a large number of species, albeit populations consisting of few individuals, would rank higher (brighter on this map) than zoos having small numbers of species with large population sizes. In this sense, Fig. 3 only shows the distribution of threatened species across zoos and it should not be seen as a measure of how zoos contribute to conservation.

**Fig. 1**
The number of terrestrial vertebrates in ISIS zoos compared to the number of described species.



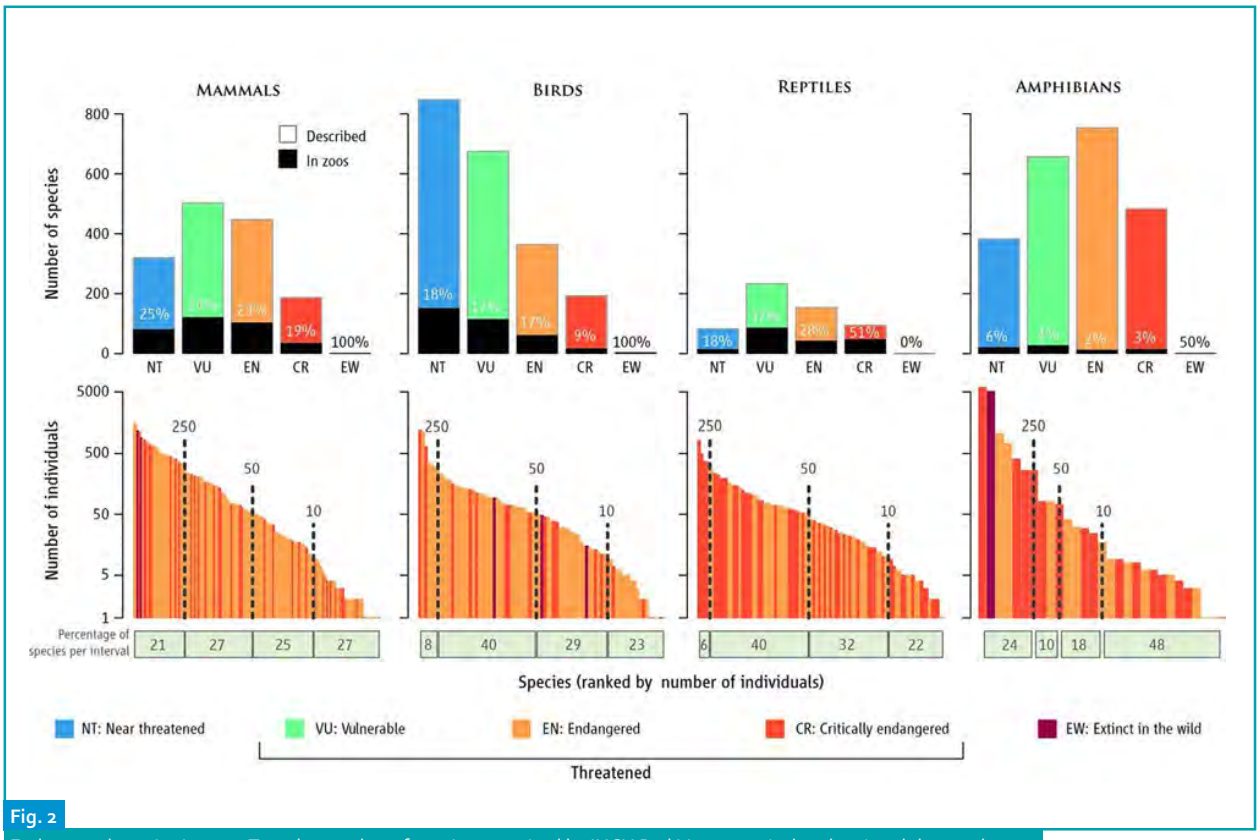



**Fig. 2**
Endangered species in zoos. Top: the number of species organised by IUCN Red List status (colour bars) and the number of those species that are in ISIS zoos (black bars). Bottom: the number of individuals for all species represented in ISIS zoos. The vertical broken lines show the boundaries by 250, 50 and 10 individuals. The large numbers of species classified as Vulnerable and Near Threatened are omitted for clarity (modified from Conde *et al.* 2011a).

## Discussion

Zoos already hold important populations for certain threatened species; this is especially so for mammals. However, zoos are rethinking the way they should manage their collections if they want to maximise efforts for *ex situ* conservation. For birds, for example, the total number of threatened species is low and it is even lower considering the number of individuals in highly threatened categories, with only 8% of them above 250 individuals; the figure is similar for reptiles. Although zoos have significantly increased their collection holdings for amphibians, as a result of the amphibian crisis, they can focus on further increasing these collections. As well it may be advisable for particular zoos to specialise their collections on a smaller number of at-risk taxa rather than aiming to increase diversity, since it has been shown that specialisation increases breeding success (Conway 2011).

Zoos' contribution to conservation is not limited to captive breeding, but as well is growing towards research, education and the financing of *in situ* conservation projects. For example, members of the WAZA network collectively are the third largest contributor to field conservation projects worldwide after The Nature Conservancy and the WWF global network. As a global network, WAZA zoos and aquariums contribute approximately US$ 350 million per year (Gusset & Dick 2011). However, zoos' contribution towards conservation could extend further. The accumulated knowledge and data that the zoo community has collected on the ISIS network could provide key data for species for which we lack such information from the wild, especially since adequate data from natural environments are often unavailable for threatened species. For example, demographic data such as average litter size, interval between successive litters and age at maturity could be used to fill knowledge gaps for the development of population viability analyses. Of course, if these data are used it should be with caution, since zoo conditions and the management of the populations do not mimic the conditions in the wild. Furthermore, the data accumulated by the zoo network in ISIS can be used to assess selection pressures on the species in captivity; this could inform which of these pressures may hamper the

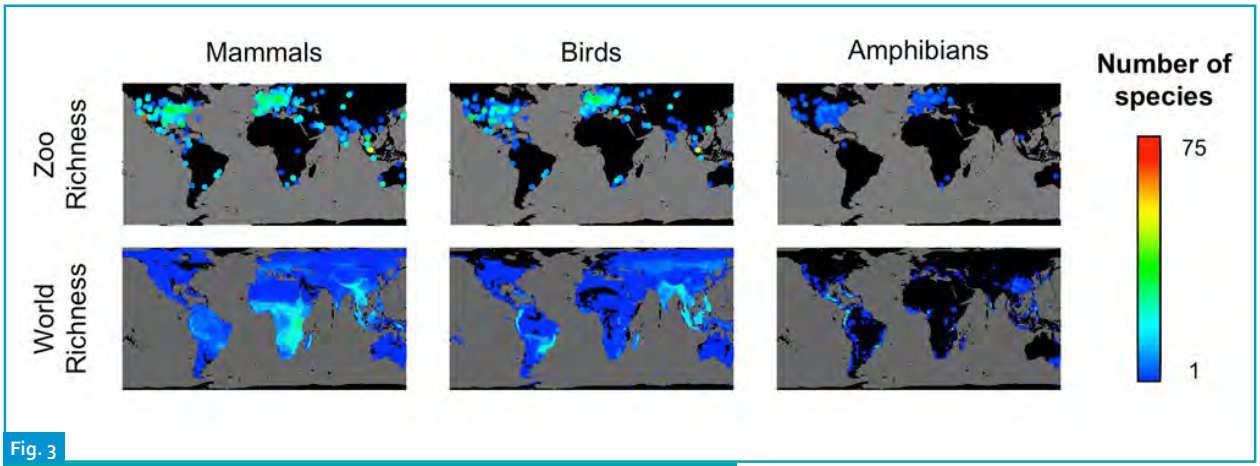



**Fig. 3**
Species richness map for threatened mammals, birds and amphibians within ISIS zoos (top) and in their natural ranges (bottom; modified from Grenyer *et al.* 2006). Zoo species richness is represented by points coloured to indicate the number of species within individual zoos; global species richness corresponds to the number of species occurring within a 1° latitude by 1° longitude cell. Reptiles are omitted because the IUCN Red List assessment is still incomplete (modified from Conde *et al.* 2011a).

success of their reintroductions into the wild (Pelletier *et al.* 2009). In this sense, studbook keepers have an important responsibility and a key role to play since the data they collect cannot only be helpful for the management of the species in their institutions but also for the development of conservation and management programmes, such as the reintroduction of threatened species into the wild.

The implementation of cooperative captive breeding programmes across large numbers of institutions, which are also referred as Intensively Managed Populations (IMPs), is one of the more demanding actions where zoos as a global network could play a key role. There are many challenges that must be overcome in order to further develop these programmes. For example, one of the first issues will be to identify which species will need the assistance of captive breeding before it is too late to successfully implement it. The Conservation Breeding Specialist Group (CBSG) of the IUCN Species Survival Commission (SSC) is currently working on guidelines to identifying those species. Another challenge is to estimate the capacity of zoos, both in terms of space and monetary funds, to manage sustainable IMPs that could be reintroduced into the wild over the long term. For this reason, accurate data on at-risk species will be essential for the prioritisation and management of IMPs. In the future, organisations such as ISIS will certainly play an active role in providing critical information support for IMP programmes among member zoos across the world; therefore, there is a need for more institutions to become part of this global network, in particular for zoos in countries that are located in areas with high biodiversity and high threat, but which are under-represented in ISIS. Zoos are at the forefront of global conservation efforts and, with their combined efforts, their network has the potential to make a huge difference.

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