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# The relevance of captive flamingos to meeting the four aims of the modern zoo

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## Abstract

Flamingos are popular inhabitants of zoological collections around the world and are one of the most commonly-seen zoo species. The modern zoo has four aims: Conservation, education, research and recreation. Meeting each of these aims adds value to the animal collection and allows zoos to explain their wider work to their visitors and guests. As many zoos are reliant on gate entry and return visitation as their main source of income, the animal collection must maintain visitor interest and be engaging. The income from visitors is used by zoos to uphold their education, conservation and research programmes, and the way in which animals are displayed to the visitor helps to define educational strategies and impart relevant information on a species, its ecosystem, ecology and conservation value. As zoos move towards encouraging behaviour change in their visitors, stories on climate change and human impacts can be emphasised by using particular species within the animal collection to tell such stories. Iconic or eye-catching species can have a particular role in encouraging visitors to remember stories on human impacts and their effects on the planet. This paper outlines the ways in which zoo-housed flamingos can be utilised to emphasis the main roles of the modern zoo and provides a discussion of the relevance of zoo-housed birds to meeting the wider aims of the zoo (both in terms of its work with other zoos and that with the wild world).

## Resumen

Los flamencos son habitantes populares de colecciones zoológicas de todo el mundo y son una de las especies de zoológicos más vistas. El zoológico moderno tiene cuatro objetivos: conservación, educación, investigación y recreación. Cumplir con cada uno de estos objetivos agrega valor a la colección de animales y permite a los zoológicos explicar su trabajo más amplio a sus visitantes e invitados. Como muchos zoológicos dependen de la recaudación de las entradas y de las visitas repetidas como su principal fuente de ingresos, la colección de animales debe mantener el interés del visitante y ser atractiva. Los zoológicos utilizan los ingresos de los visitantes para justificar sus programas de educación, conservación e investigación, y la forma en que se muestran los animales al visitante ayuda a definir estrategias educativas e imparte información relevante sobre una especie, su ecosistema, ecología y valor de conservación. A medida que los zoológicos fomentan el cambio de comportamiento en sus visitantes, la información sobre cambio climático y los impactos humanos se pueden enfatizar utilizando especies particulares dentro de la colección de animales para contar cuentos. Las especies icónicas o llamativas pueden tener un papel particular en recordar a los visitantes las historias sobre los impactos humanos y sus efectos en el planeta. Este trabajo describe las formas en que los flamencos albergados en zoológicos pueden utilizarse para enfatizar las funciones principales del zoológico moderno y proporciona una discusión sobre la relevancia de las aves alojadas en zoológicos para cumplir con los objetivos más amplios del zoológico (tanto en términos de su trabajo con otros zoológicos y con el mundo silvestre).

**Résumé**

Les flamants roses sont des oiseaux populaires dans les collections zoologiques du monde entier et font partie des espèces de zoo les plus fréquemment observées. Le zoo moderne a quatre objectifs : la conservation, l'éducation, la recherche et les loisirs. La réalisation de chacun de ces objectifs ajoute de la valeur à la collection zoologique et permet aux zoos d'expliquer les objectifs plus larges de leur travail aux visiteurs et invités. Étant donné que de nombreux zoos dépendent principalement des entrées et des visites répétées, la collection zoologique doit susciter l'intérêt du visiteur et être attrayante. Les revenus des visiteurs sont utilisés par les zoos pour soutenir leurs programmes d'éducation, de conservation et de recherche. La manière dont les animaux sont présentés au visiteur aide à définir des stratégies éducatives et à communiquer des informations pertinentes sur une espèce, son écosystème, son écologie et sa valeur de conservation. Au fur et à mesure que les zoos encouragent le changement de comportement de leurs visiteurs, les effets du changement climatique et les impacts de l'homme peuvent être soulignés en mettant certaines espèces au cœur d'histoires sensibilisant à ces enjeux. Les espèces emblématiques ou attractives peuvent jouer un rôle particulier en encourageant les visiteurs à se souvenir d'histoires marquantes sur les impacts de l'homme et leurs effets sur la planète. Cet article décrit les différentes manières d'utiliser les flamants roses hébergés dans les zoos pour souligner les rôles du zoo moderne et fournit une discussion sur la pertinence des oiseaux hébergés dans les zoos pour atteindre les objectifs plus larges du zoo (tant pour son travail avec d'autres zoos qu'avec le monde sauvage).

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## Introduction

The modern zoo's four aims of conservation, education, research and recreation (Fernandez et al., 2009) are seemingly well-understood by zoo professionals, and the successful fulfilment of these roles depends on the exhibition, display and interpretation of the zoo's animal collection. Flamingos are incredibly population captive subjects, with species360 currently stating nearly 20,500 birds residing in Zoological Information Management System (ZIMS)-registered zoos globally (species360, 2018). This ubiquitous presence in captivity explains, in part, why they are such a familiar and easy-to-identify species with the general public. As such, zoo flamingos can have a large role to play in explaining key conservation messages and be used for story telling of a zoo's educational or scientific goals.

Of the six extant flamingo species, four are of conservation concern (BirdLife International, 2016a, 2016b, 2016c, 2016d); whilst only one of these four (the Chilean flamingo, *Phoenicopterus chilensis*) is commonly seen in zoos, as flamingos (as a whole) live in similar habitats, feed on similar food items, breed in the same way, and are affected by the same anthropogenic environmental changes those more familiar captive-held species can highlight the struggles faced by all flamingos species out in the wild.

The life history strategy of flamingos means that (for most of their range) they breed in huge flocks, producing large numbers of chicks at irregular intervals (Johnson & Cézilly, 2009). Changes to favoured environments, such as disturbance at a specific breeding lake (Johnson, 1997; Tebbs et al., 2013) or pollution (Hill et al., 2013) can have dramatic, negative impacts on the future growth or stability of a flamingo population. Adult flamingos can live for a long time (Rose, Croft, et al., 2014), therefore the impact of past negative events (such as disturbance, egg harvesting or hunting pressures) can manifest as future population fluctuations many years after the threat has been mitigated (BirdLife International, 2016b, 2016c, 2016d). A decline due to past poorer breeding events will only become apparent as adult flamingos die

without the same number of young birds around to replace them. Zoos flamingos are perfectly placed to bring to life the unique ecology of these species, and why they may need more of our attention in the wild.

Based on current species360 (2018) data, global zoo populations consist of c7400 greater flamingos *(P. roseus)*, Least Concern, c6200 Caribbean flamingos *(P. ruber)* and c5600 Chilean flamingos. Both greater and Caribbean flamingos are deemed "Least Concern" (BirdLife International, 2016e, 2017) but this does not mean they are of lower value than the rarer species when to comes to their role in the zoo. These species could still be at risk from the same threats that have caused declines to Andean *(Phoenicoparrus andinus)*, James'/puna *(P. jamesi)* and lesser *(Phoeniconaias minor)* flamingo populations, and so they can help focus attention on the wider plight of flamingos globally whilst being managed in a sustainable fashion within zoological collections. This is principle is well explained by the World Association of Zoos and Aquariums (WAZA) on the "Virtual zoo" section of its website: (WAZA, 2018b):

*"The Andean flamingo is only rarely kept by zoos and if so, either for educational purposes, e.g. for demonstrating speciation within the flamingo family, or for scientific interest. As a matter of principle, flamingos are also excellent ambassador species for wetland conservation but this role could as well be taken on by the more common Chilean flamingo"* (WAZA, 2018a).

The aim of this article is to provide examples of exactly how zoo flamingos are these excellent ambassadors for their wild cousins and for the wetlands they live in.

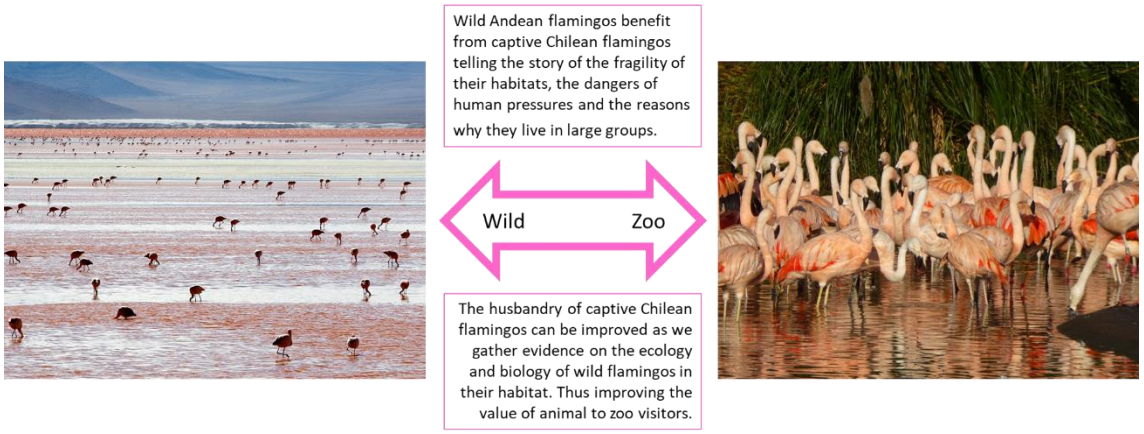


*Figure 1: Some flamingo species are best managed and conserved out in their natural habitat (left) but zoo-housed birds (right) can play a part in promoting key aspects of flamingo ecology and natural history to make the wider public more aware of the unique ecosystem that flamingos inhabit and the threats it faces. Photo credits: Wikimedia Commons and P. Rose / WWT.*

**Conservation**

Captive flamingos can play a relevant role in promoting wild world conservation initiatives or being directly involved in metapopulation management ideas related to the IUCN's One Plan Approach to conservation (CBSG, 2015). Such ideas were broached at the 2014 International Flamingo Symposium, hosted by SeaWorld San Diego, for the lesser flamingo. With delegates discussing how an integrated approach to the conservation of this species could benefit by including work on free-living and captive birds assimilated into an overall future strategy for the protection of this flamingo species. Lesser flamingos are less common in captivity than the three *Phoenicopterus* species, with 1183 individuals listed on ZIMS as of October 2018, but promotion of this bird's biology and behaviour, and its specific ecosystem can be undertaken with other species, especially the greater flamingo, which occurs alongside of

the lesser flamingo in some parts of its range (Bartholomew & Pennycuick, 1973; Kumssa & Bekele, 2014; Woodworth et al., 1997).

Managed breeding of captive flamingos also has a role to play in the conservation of wild populations. Harvesting of wild birds for the ornamental bird trade, or to increase the size of captive populations is detrimental to the health and productivity of free-living flocks (Kear, 1987). By working together, and moving individuals between institutions, zoos can establish larger flocks and assist with each zoological collection achieving the minimum number of birds (40) that best increases the chance of flamingos nesting in captivity (Pickering et al., 1992).

Translocation of flamingos between zoos helps to keep captive populations sustainable. And interventions with a breeding flock to hand-rear chicks as part of a specific population management plan have been successful; for example the hand-rearing of greater flamingos at the Wildfowl & Wetlands Trust (WWT) Slimbridge centre for export to Auckland Zoo, New Zealand as the nucleus for a new breeding flock (Batty et al., 2006) has resulted in a colony of these birds now breeding and rearing their own chicks (Auckland Zoo, 2018), and is the only breeding flamingo flock in Australasia.

**Education**

The flamingo's appearance has a great deal to lend to zoo education programmes (Figure 2). Eye-catching plumage, highly-obvious courtship displays, loud vocalisations and a unique way of feeding all fit into stories that explain evolution, animal behaviour, ecology and biodiversity conservation. The familiar one-legged posture of flamingos is an example of thermoregulation, weight-bearing and anatomical structures. Commonly observed in captive birds, this way of standing can be explained to human audiences via active participation ("how long can you stand on one leg for?") as well as by interpretation of the flamingo's skeletal system.

And the many human elements to their behaviour patterns, such as feeding their young on (crop) milk and using a crèche to keep their chicks safe whilst parents go and feed all add relatability to animal behaviour when explained to a human audience. The unique mud nest mounds of a flamingo, evolved to protect eggs and chicks from flooding and high ground temperatures can be scaled up to human-size as an interactive way of describing parental care and environmental pressures on behavioural evolution.


*Figure 2: Flamingo biology and natural history explained in interactive signage at the Copenhagen Zoo. Photo credit: P. Rose.*

Using flamingos to highlight the wider of effects of climate change is something that can have benefits to all biodiversity and to humans too. Flooding of coastal areas is an oft cited symptom of climate change that will affect where humans will be able to live in future (McGranahan et al., 2007). Hydrological changes to the wetlands

favoured by flamingos are known to influence their distribution and abundance (Ndetei & Muhandiki, 2005; Schagerl & Oduor, 2008). Further changes to water chemistry caused by climate change-inducing flooding could reduce suitable available habitat further. Therefore, explaining the global influence of climate change, using the flamingo as familiar and easy-to-comprehend example species is a way of zoos activity promoting pro-conservation behaviours and sustainable activities in their visitors. As an example, flamingos featured heavily in an exhibition at Chester Zoo (Figure 3), originally conceived by the Monterey Bay Aquarium, on the effects of climate change and how small changes can make a big difference to reduce negative human pressures on the natural world (Harrison, 2014). Flamingos were the "poster boys" for this event, not the main feature. Stories about recycling, re-using and reducing your impact on the planet were centred around what can happen to the world around us if we live in an unsustainable manner. The flamingo's colour, their eye-catching appearance and the play on words of hot pink (colour and temperature) help to emphasise the birds' role in grabbing zoo visitors' attentions, encouraging them to look around the exhibition and hopefully to engage with pro-sustainability behaviours by having a better take-home message on the long-term effects of climate change.


*Figure 3: Examples of directional signage at Chester Zoo, UK, where visitors could engage with a "Hot Pink Flamingos" exhibition about the wider effects of climate change on people and on wildlife. As well as information signage about the benefits of recycling with the same "Hot Pink Flamingos" theme. Photo credit: A. Moss / Chester Zoo.*

**Research**

Zoo flamingos can tell us a great deal about their wild counterparts (King, 2000) by allowing scientists to answer behavioural, ecological and evolutionary questions that may be tricky in wild flocks in inhospitable wetland habitats. Large flock sizes in zoos, with individual birds ringed for identification, means captive flamingos make excellent sample populations for behavioural research. Collaborations between academic institutions and zoological collections can bring many benefits, such as the sharing of resources and the development of projects that dissertation/thesis students can help collect data for (Fernandez & Timberlake, 2008; Hosey, 1997; Rose, Evans, et al., 2014). Such projects then provide evidence for best practice captive care. Captive flamingos enable good quality science to be conducted in zoos that can be lacking when other species are studied; large sample sizes improve statistical validity and replication across zoos is easy as the same species of flamingo are commonly housed in similar conditions.

Several zoo organisations, such as the Association of British & Irish Wild Animal Keepers (ABWAK) actively runs workshops to engage flamingo keepers with the latest developments in flamingo science (Rose, Walls, et al., 2016) and zoo accrediting bodies like the British & Irish Association of Zoos and Aquariums (BIAZA) within whose organisational structure are various taxon working groups (such as the Bird Working Group) that encourage the dissemination of evidence-based practice between keepers (BIAZA, 2018). The output of such meetings

can be collated and presented as ways of changing how flamingos are cared for to promote good welfare, or to enhance husbandry so that birds experience similar beneficial conditions to those within a wild habitat, or for developing ways of providing environmental enrichment for flamingos to enhance natural activity patterns (Rose, Brereton, et al., 2016).

**Recreation**

Recent research has documented that out of the twenty most charismatic species as categorised by the general public, all except two are mammals (Albert et al., 2018) and zoo visitors do not always consider birds to be amongst the most exciting thing to see on their visit (Carr, 2016a). However, in spite of the small number of respondents that chose flamingo as their favourite animal at the zoo, Carr (2016a)'s survey shows that flamingos are the most popular of all birds with visitors to this specific animal collection. And of a wider survey of zoo visitors on their "most wanted to see zoo animal" flamingos score third out of all birds after penguins and parrots (Carr, 2016b). Flamingos clearly have a lot to offer zoos in a way of capturing visitors' attention and increasing dwell time at an enclosure to allow for a wider or deeper educational message to be conveyed and taken away.

Recent research from Skibins et al. (2017) shows that whilst zoos have often tried to connect their visitors to conservation work via charismatic, mammalian megafauna as flagships, pro-conservation outcomes can be achieved by using other species too. Figure 4 clearly illustrates the attention-grabbing nature of flamingos with visitors to WWT centres that are nearly as popular as a highly charismatic mammal, the otter. Therefore, zoos should give more consideration to how they display and use their birds to increase dwell time and provide a biologically-relevant message to their visitors based on this evident popularity.


*Figure 4: "Word cloud" produced from responses to the question "what was your favourite area of the centre?" for visitors across all nine WWT centres. Size of each word is an indication of number of responses (and hence popularity). This survey ran in August 2016 and shows that flamingo/flamingos/flamingoes were second only in popularity to otter exhibits. Reproduced with permission from WWT. Whilst the number of overall responses used to create the figure is unknown, the relative scale of the words against each other, coupled with the large number of descriptions that appear in the figure suggests a large number of responses that gives a true reflection of the frequency that flamingos were mentioned by WWT visitors.*

**Discussion and conclusions**

This article has shown that flamingos are an excellent asset to the modern zoological collection and can uphold the key aims of the zoo in a variety of ways. Captive flamingos are highly-relevant ambassadors for wild birds and can tell the story of fragile wetland habitats. The public's familiarity with them and their eye-catching appearance makes flamingos easy to notice and their "crowd-pulling" potential can be used to facilitate engagement with topics such as climate change, sustainability and ecosystem health. Table 1 summarises some key points that define what value a zoo flamingo has to the aims of the modern zoo and suggests areas that zoos could consider when displaying and exhibiting their birds.

*Table 1: Summary of how flamingos can promote the aims of the modern zoo.*

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|---|---|
| **Conservation**<br>- Promote the threats to wild birds.<br>- Support wild-world conservation initiatives with fund raising events.<br>- Ambassador birds: common flamingo species tell the story of rarer, more specialised wild cousins. | **Education**<br>- A good flagship for climate change and global biodiversity issues.<br>- Excellent examples of selection, speciation, ecological niches and evolutionary biology.<br>- Nesting behaviour, parenting actions and unipedal resting are easy to demonstrate to zoo visitors. |
| **Research**<br>- Large study populations that can provide quality scientific data.<br>- Easy replication across zoos.<br>- Application of captive bird data to wild bird management and vice versa. | **Recreation**<br>- Evident popularity with zoo-going public.<br>- Extend visitor dwell time by encouraging "participation" in flamingo behaviours.<br>- A long-lifespan means adoption schemes can follow the same bird for many years. |

Flamingos are intrinsically linked to their wider environment; their colour comes from their diet and they only breed successfully when habitats can support large flocks. There are clear messages here that can resound in the human world- diet is important to health and wellbeing and all of our actions combined can affect the planet and therefore influence where we, and other species can live. All zoos that house flamingos can promote the objectives of the Flamingo Specialist Group (FSG) on their signage and can direct their visitors to the FSG's webpage and social media outlets.

Finally, we should remember that flamingos can be sensitive to disturbance around them; whilst captive birds have been shown to not negatively change behaviour based on increases to visitor number (Rose et al., 2018), wild flamingos can be easily disturbed by the activities of people (Galicia & Baldassarre, 1997). Care should therefore be taken to display flamingos in a manner that allows them to move away from disturbance if needed. Wild flamingos however can generate income from ecotourism revenues (Galicia et al., 2018), illustrating the benefits of correctly managed flamingo watching. Here is further scope for zoos to link to *in situ* populations to help raise awareness of the world of the wild flamingo- watching flamingos in the zoo generates conservation funding in a similar way that wild flamingo

ecotourism can help protect wetlands and their wildlife too.

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