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Editorial

Welcome to the third instalment of Flamingo, the e-version of the FSG’s popular annual journal. We are pleased to continue to bring you a new volume of Flamingo after its relaunch in 2018. It’s especially pleasing that, in this difficult year of so much uncertainty and upheaval, people all around the world have still found the time to observe flamingos, to collect information on them, to manage and protect their habitats, and to write about their work for this newsletter.

The global Covid-19 pandemic has impacted greatly upon the lives of those who work in conservation, education and research that involve animals. Many zoological collections, who do important work towards fighting the rising tide of extinction, have been closed and many dedicated animal care and conservation professionals have been furloughed or found themselves out of employment. It is important that, in such difficult times, the conservation community comes together to support each other and ensure that vital work to understand more about flamingos and their unique homes can continue.

We see some great papers in Flamingo 2020 that discuss how flamingos are being monitored out in the wild; to gain a better understanding of their population numbers and dynamics. Articles on coordinated surveying across huge areas of flamingo habitat show the importance of working together for a common goal. We also see how local people can successfully mobilise lobbying and action to protect their local wetlands from development, which would have meant the loss of an incredible “pink bird spectacle” so loved by many.

Flamingo 2020 also highlights the excellent work of the zoo community in its constant efforts to develop improved management practices for flamingo population under human care. Papers cover everything from checking foot health using novel methods, to hand rearing protocols and enclosure modifications to improve breeding. We even see an article that explains how this ex situ flamingo knowledge can be take out to the field and directly applied to a major conservation crisis; a situation that needed the expertise of those working in all areas of flamingo science and management to bring about a positive ending.

In 2020 the FSG was sad to hear of the death of one of the greatest champions of flamingo research, Dr Adelheid Studer-Thiersch, who added so much information on flamingo behaviour to the available literature, thanks to her long-running observations at Basel Zoo in Switzerland. Adelheid’s work fed into numerous areas of flamingo management and husbandry practice; it encouraged those housing flamingos in ex situ flocks to always consider the bird’s behaviour and what they need to do to keep them healthy and breeding well. Thank you, Adelheid for so many years of valuable contributions to flamingo science and we send out best wishes to Adelheid’s family.

We are also saddened by the death of Dr Bhavbhuti Mukundray Parasharya in October, due to Covid-19. An accomplished ornithologist and long-time member of the Flamingo Specialist Group, Bhavbhuti conducted extensive research on the ecology, distribution and conservation of flamingos in Gujarat, in western India. He will be sadly missed by all whose lives he has touched.

We are accepting articles for Flamingo e4, due out in December 2021. Given that flamingo habitats worldwide are threatened, it is critical that we compile and disseminate research and studies on flamingos to the widest audience. Long or short reports, original research or descriptive pieces are welcome. Guidelines for publishing can be found on the FSG’s website (http://www.flamingo- sg.org/journal/) and at the back of this volume.
I think my colleagues Cathy King (co-chair of the FSG), Dr Felicity Arengo and Dr Arnaud Bechet for their assistance with translations for this edition. And I take this opportunity to warmly welcome Dr Maria Cecilia Chiale to the Flamingo team, to thank her for her work promoting the FSG on Twitter and helping with the abstracts for this volume. Finally, the FSG is grateful to the efforts of Enver Ortiz Lopez who has been volunteering to post information in Spanish on the FSG’s Facebook page, to increase accessibility and diversity in our outreach. Thank you, Enver.

With very best wishes for this holiday season.

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American flamingos in Florida: Updates on sightings, distributions and conservation efforts

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Abstract

The status of the American flamingo (Phoenicopterus ruber) in Florida has been misunderstood and controversial for nearly a century, leaving them without legal protection at state level in Florida or conservation planning for the entire United States. However, flamingo sightings in the early 2000s made biologists consider the origins and history of the species in the state. In 2018, a comprehensive review of the American flamingo’s history in Florida was published. Here, we summarise the main findings of this review and provide an update on observations, conservation considerations and management attention following that original publication.

Resumen

El estatus del flamenco americano (Phoenicopterus ruber) en Florida, EE.UU. ha sido mal comprendido y controvertido durante casi un siglo, dejándolo sin protección legal a nivel estatal en Florida y sin plan de conservación para todo el país. Sin embargo, los avistamientos de flamencos a principios de la década de 2000 hicieron que los biólogos consideraran los orígenes y la historia de la especie en el estado. En 2018, se publicó una revisión exhaustiva de la historia del flamenco americano en Florida. Aquí, resumimos los principales hallazgos de esta revisión y proveemos una actualización sobre las observaciones, las consideraciones de conservación y la atención de la gestión después de esa publicación original.

Résumé

Le statut du flamant des Caraïbes (Phoenicopterus ruber) en Floride a été mal compris et controversé pendant près d'un siècle, laissant cette espèce sans protection juridique au niveau de l'État de Floride et sans plan de conservation aux États-Unis. Cependant, les observations de flamants roses au début des années 2000 ont amené les biologistes à réfléchir aux origines et à l'histoire de l'espèce dans l'État. En 2018, un examen complet de l'histoire du flamant des Caraïbes en Floride a été publié. Ici, nous résumons les principales conclusions de cette revue et fournissons une mise à jour des observations, des enjeux de conservation et de gestion suite à cette publication originale.

Introduction

The American or Caribbean flamingo (Phoenicopterus ruber), hereafter “flamingo”, has been a well-known icon of Florida for decades (Price, 2000). Many visitors to, and residents of, the state have been greeted by flamingo images on advertising, souvenirs, and logos (Irvine and Arluke, 2017). One of the most popular sites for bird watchers and recreation in Everglades National Park is the Flamingo Visitor Center, located in Monroe
County. Despite the cultural association of flamingos in Florida, their natural history in the state has been misunderstood and debated for a century (Howell, 1932; Allen, 1956).

Many reports of flamingo sightings in the 20th century have been discounted as escapees from nearby captive facilities (Bailey, 1932; Allen, 1956; Stevenson and Anderson, 1994). The Florida Fish and Wildlife Conservation Commission (FWC) has considered the flamingo a non-native species, disqualifying it for protection under state wildlife laws (Millsap et al., 1990). However, flamingo sightings have appeared to increase within the past decade, bringing up many questions, including—what is the status of the flamingo in Florida?

In 2018, review, “Status and trends of American Flamingos (Phoenicopterus ruber) in Florida, USA” was published (Whitfield et al., 2018). This review was the first paper to discuss the presence and natural history of flamingos in Florida since a report by Allen (1956). Some of the major ideas the publication brought forward included, but not limited to:

- Narrative accounts of flamingo observations from the 1800s to early 1900s provide robust evidence for a historical population hunted to extinction by humans

- Digitised records of museum egg specimens collected from Florida in the 1800s suggest that the historical population nested within Florida

- Analysis of contemporary trends from 1950 to 2016 show increasing numbers of flamingos in each decade

- Rather than being listed as a non-native species, flamingos should receive conservation and management attention, and may be suitable for listing under state or federal endangered species laws

**Efforts to gain legal protections**

The 2018 review of flamingos in Florida has brought the need for flamingo conservation to the attention of many people, agencies, and non-profit organizations. With articles from various media sources discussing the long-lost history of flamingos in Florida, many people have become supportive and interested in helping them gain protective status.

In June 2018, several agencies partnered together once again to draft a petition to FWC citing over 60 sources on why the flamingo should be protected as a native species that is either designated as a “species of special concern” or “threatened”. The petition was supported by three local Audubon Societies (Tropical Audubon, Audubon of the Everglades, and Florida Keys Audubon). In October 2019, FWC biologists approved the petition to move forward to the Biological Review Group to review the status of the species against state ranking criteria.

Commissioners from the FWC are likely to make a final decision on the status of flamingos in late 2020 or early 2021, and a formal listing under Florida’s threatened species laws would lead to increased protections or conservation actions for the Florida population.

**Natural dispersal of Flamingos in 2000s**

Since banded birds from Yucatan, Mexico were seen in the early 2000s, biologists have pondered the natural dispersal of flamingos in this region. Banded birds “DFJV” and “HRTJ” were observed in Everglades National Park during 2002 and 2012, respectively (Whitfield, et al., 2018). Both birds were observed with other individuals in small groups (three to six birds). These observations provided incontrovertible evidence that natural dispersal occurs and not all flamingos in Florida are escapes of captive origin. On 23rd October 2019, a third banded flamingo (coded “DPDA”) was observed in the Calusa Keys in Florida Bay (Figure 1). Banding records reveal that this individual was banded in August 2016.
in Ría Lagartos Biosphere Reserve, México (M. Lopez, personal communication). This bird has not been observed since 2019, but a small group of flamingos was observed south of Florida Bay in the Lower Keys in June 2020. Similarly, a small group of six birds was seen at Big Torch Key. Given the 2019 banded flamingo sighting as well as banded bird sightings mentioned in 2002 and 2012, there is a distinct possibility that these individuals could also be migrants from other regions such as Mexico. (Galvez et al., 2016).

**Figure 1: Banded "DPDA" in Calusa Keys on 23rd October 2019 (photo credit: Bryan White).**

While most of the sightings are centred around Everglades National Park and Florida Bay, birds have started to appear in new areas such as Cape Canaveral, Fort Myers, and the panhandle region. Sightings in such new areas have mainly consisted of a singular bird. However, larger groups have been seen since 2010 as well (Table 1). Florida Bay, Everglades National Park, and surrounding southeast Florida areas have seen the largest flocks (Figure 3). More study is needed to determine if these larger flocks correlate with the habitat characteristics of the areas that flamingos are selecting in Florida.

**Table 1: Largest flamingo flocks in Florida since 1st January 2020 (asterisk represents flock in flight).**

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th># Birds</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/12/2010</td>
<td>Florida Bay</td>
<td>31</td>
</tr>
<tr>
<td>09/11/2011</td>
<td>Florida Bay</td>
<td>20</td>
</tr>
<tr>
<td>01/06/2013</td>
<td>Garfield Bight</td>
<td>32</td>
</tr>
<tr>
<td>22/06/2013</td>
<td>Matheson Hammock Channel</td>
<td>45*</td>
</tr>
<tr>
<td>06/05/2014</td>
<td>Stormwater Treatment Area 2</td>
<td>147</td>
</tr>
<tr>
<td>03/05/2014</td>
<td>Stormwater Treatment Area 3/4</td>
<td>20</td>
</tr>
<tr>
<td>07/05/2014</td>
<td>Stormwater Treatment Area 2</td>
<td>87</td>
</tr>
<tr>
<td>01/07/2015</td>
<td>Soldier Key</td>
<td>20</td>
</tr>
</tbody>
</table>

**Discussion of current trends**

Since 2018, flamingos have continued to appear in Florida. On 16th May 2018, 84 flamingos were observed flying over the turnpike in Miami. On that same day, about 24 flamingos were seen in Biscayne Bay and Snake Bight in Everglades National Park. A month later, on 13th June, about 90 flamingos were observed flying over Miami. As shown in Figure 2, flamingo sightings expanded to a larger area of Florida during the 2010s, with sightings in nearly every region of Florida.

**Figure 2: Map of flamingo sightings in Florida from the 1970s to August 2020. Map created by A. Mauro (QGIS 3.14 16-Pi).**

2018 flamingos have continued to appear in Florida. On 16th May 2018, 84 flamingos were observed flying over the turnpike in Miami. On that same day, about 24 flamingos were seen in Biscayne Bay and Snake Bight in Everglades National Park. A month later, on 13th June, about 90 flamingos were observed flying over Miami. As shown in Figure 2, flamingo sightings expanded to a larger area of Florida during the 2010s, with sightings in nearly every region of Florida.
As discovered by Baldassarre & Arengo (2000), flamingos in Yucatan, Mexico selected foraging habitats with water no deeper than 60 cm. The foraging patches selected were dominated by either plant or invertebrate structures. Flamingos sampled in Uaymitun and Celestun, Mexico selected deeper water, ranging from 30 to 50 cm. Only one group of flamingos was seen foraging in waters less than 2 cm deep (Arengo & Baldassarre, 1999).

In 1859, Bryant found that flamingos in Great Inagua, Bahamas foraged in Lake Windsor, which varied from depths of 25.4 cm to 91.44 cm (Allen, 1956). This water level is deeper than the preference for most Florida wading birds, which favour depths around 10 cm (Gawlik & Crozier 2007; Lantz et al., 2011). This could also help explain why large groups of flamingos appeared in the Everglades during years that were not optimal conditions for smaller wading bird species (Cook, 2014; Cook & Baranski, 2017). The years 2014 and 2016 had relatively poor foraging conditions for smaller wading birds due to wetter than average dry seasons or rain events that produced water level reversals during the dry season (Cook 2014, Cook & Baranski, 2017). While those rain events were not favourable for smaller wading bird foraging conditions, they may have provided high quality food and habitat normally unavailable to flamingos.

Contrastingly, a few groups of flamingos were observed in wetland habitat (Snake Bight and Biscayne Bay) during 2018, a year optimal for smaller foraging and nesting wading birds. This year resulted in historically significant wading bird nesting numbers throughout the Everglades (Cook & Baranski, 2019). Preceding the 2018 nesting season were two tropical storms and Hurricane Irma, which led to above-ground wet conditions for a long period. Slightly higher elevation marshes that are normally over-drained were able to sustain adequate water levels for the production and survival of prey species populations. The following dry season in 2018 was dryer than average, allowing a continuous drop in water levels that created a greater amount of foraging habitat that is not normally available for birds (Cook & Baranski, 2019). This increase in available habitat may have been beneficial for the flocks of flamingos observed flying in the area (Table 1).

While we do not yet fully understand the cause behind the increased flamingo sightings in Florida, it is likely that flamingos are returning to Florida because the population of American flamingos throughout the Caribbean have grown at many nesting sites, and birds are starting to naturally disperse.
from their breeding grounds (Allen, 1956) (Wiley and Wiley, 1979). According to the latest evaluation by the IUCN in September 2018, the species is currently at 330,000 individuals and is increasing (BirdLife International, 2018).

While estimates for individual nesting colonies are decades-old or not available, there is evidence that shows the species has recovered in total population numbers from hunting pressures in the late 19th century and early 20th centuries. In 1955, Allen reported that there were 21,500 individuals in the Caribbean (Allen, 1956). Sprunt (1975) estimated that there were 57,410 to 65,610 individuals across the Caribbean in 1972. Legal protections and management practices have helped in leading several breeding populations to recovery in several Caribbean regions as well. Breeding populations in the Yucatan, Cuba, Great Inagua, and Venezuela have all increased (Baldassare & Arengo, 2000; Espinoza et al. 2000; Johnson 2000).

One noteworthy occurrence of flamingo sightings has occurred in St. Mark’s National Wildlife Refuge (St. Mark’s NWF) in Wakulla, Florida. Since 31st October 2018, a lone flamingo has been observed at the refuge. It has been seen year-round, except for the months of August and September. The flamingo arrived after Hurricane Michael in 2018. Using eBird data (Sullivan et al., 2009), observations of the flamingo from November 2018 to August 2020 were mapped by season in Figure 4. Since 2018, the flamingo has been observed on 15 days during autumn (October and November), 98 days in the winter (December to February), 109 days in the spring (March to May) and 30 days in the summer (June and July). Despite the bias in citizen science data, the occurrence of this bird (and others) indicates that there is suitable, year-round, habitat for flamingos in various locations throughout the state of Florida.

![Figure 4: Map of flamingo sightings in St. Mark’s National Wildlife Refuge from 1st November 1 2018 to August 2020 by season on land cover as categorized by National Land Cover Database 2016. Map created by A. Mauro (QGIS 3.14 16-Pi).](image)

An interesting aspect of the sighting at St. Mark’s NWR was the habitat the flamingo was using. Most flamingo habitat consists of remote, desolate areas with minimal flora or fauna diversity (Allen, 1956; Chandler, 1988; Espino-Barros & Baldassarre, 1989; Brown & King, 2005). Early naturalists and biologists often remarked at how shocked they were to find that much of the habitat had a “virtual absence of visible life” (Allen, 1956). St. Mark’s NWR is a popular destination for tourists and is easily accessible via a paved
road that travels through the managed impoundment habitat the flamingo was using (Burnett, 2013). The impoundment is also adjacent to salt marsh and freshwater marsh habitat. The salt marsh is dominated by various emergent plant species such as black needle rush (*Juncus roemerianus*), smooth cordgrass (*Spartina alterniflora*), and saltmeadow cordgrass (*Spartina patens*). The freshwater marsh habitat is dominated by emergent herbaceous plants and sparse woody shrubs or small trees (Burnett, 2013).

Many flamingo habitats are also consistent with high salinity lagoons or vast, shallow waters. (Allen, 1956; Baldassarre & Arengo, 2000; Herrera-Silveira et al., 2001). Allen’s (1956) report recorded flamingos using habitats with salinity ranging from 27.5 parts per million (ppm) in Rio Cauto, Cuba to 181.4 ppm in Yucatan, Mexico. In 2000, high-salinity ponds in Yucatan were reported with a higher range of salinity reaching 205 ppm (Baldassarre & Arengo, 2000). In 2008, bottom salinity at St. Marks estuary was 28 to 30 ppm and surface salinity was 18 to 20 ppm, comparable to the lower range of salinity recorded in 1956.

Under a projected sea level rise of 0.85 m, the surface salinity ranges from 24 to 25 ppm and the bottom salinity increases to 33 ppm (Xiao et al., 2014). It is quite possible that as sea levels rise, salinity will increase to concentrations in which flamingos thrive. More research is needed to study the effects of sea level rise on habitat salinity requirements with the American flamingo throughout its range.

**Conclusions**

The 2018 review of American (Caribbean) flamingos in Florida catalysed an interest in this species and this story for the public, organisations and agencies. While we await for the results of the petition in 2021, we continue to see flamingos using a variety of habitat types throughout Florida. More study is needed to better understand the natural history and current trends of flamingos in the state, including, but not limited to foraging patch selection, salinity significance, and geographic origins. State of Florida legal protection of the species would be instrumental to future research and management activities.

**References**


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Monitoring populations on non-breeding and breeding flamingos at Los Olivitos Wildlife Refuge and Fishing Reserve, Zulia, Venezuela

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Abstract

In 2020, we carried out a non-systematic evaluation of Caribbean flamingo (Phoenicopterus ruber) populations at Olivitos Wildlife Refuge and Fishing Reserve in western Venezuela, estimating a total of 71200 non-breeding and 7480 breeding flamingos on June and 92685 non-breeding and 10200 breeding flamingos in August. Total young fledged were 7000 (June) and 8000 (August). Censuses at nearby solar salt works (2013-2019) were higher in February, showing the importance of the site as feeding alternative for flamingos from the refuge during dry season. Natural disturbance due to cyclical weather factors destroyed, in 2019, significant sections of the breeding islands. However, in February 2020, flamingos built another successful nesting island. Revision of the history of nest numbers built by flamingos across several nesting islands between 1999 and 2020 gave a total of 57981 nest mounds.

Resumen

En el año 2020, se realizó una evaluación no sistemática de la población de flamencos en los sitios de alimentación y de reproducción en el Refugio de Fauna Silvestre y Reserva de Pesca Ciénaga de Los Olivitos. En el mes de junio se estimaron un total de 71.200 flamencos no reproductores y 7.480 en reproducción y en agosto 92.685 flamencos no reproductores y 10.200 flamencos en reproducción. Se contaron 7.000 flamencos juveniles volantones en junio y 8.000 en agosto. El Concentrador 1 de la compañía Produsal censado entre 2013 y 2019, tuvo números más altos de flamencos en febrero, ratificando la importancia de este cuerpo de agua artificial permanente como sitio de alimentación alternativo y seguro para los flamencos, principalmente en el periodo seco. Las lluvias excesivas y mareas entre septiembre y octubre inundaron y destruyeron una gran sección de las isletas con nidos en 2019. No obstante, en febrero 2020, los flamencos construyeron una isla de nidos exitosa. La revisión de registros del número de nidos construidos por flamencos en diferentes islas de nidificación entre 1999 y 2020, dio un total de 57.981 nidos.

Résumé

En 2020, nous avons effectué une évaluation non systématique des populations de flamants des Caraïbes (Phoenicopterus ruber) au refuge de faune et de pêche d'Olivitos dans l'ouest de la Venezuela, estimant un total de 71200 flamants non reproducteurs et 7480 reproducteurs en juin et 92685 non reproducteurs et 10200 flamants en août. Le nombre total de jeunes à l'envol était de 7 000 (juin) et 8 000 (août). Les recensements des salines solaires à proximité (2013-2019) étaient plus élevés en février, montrant l'importance du site comme alternative pour l'alimentation des flamants du refuge pendant la saison sèche. Les perturbations naturelles dues à des facteurs climatiques cycliques ont détruit, en 2019,
des sections importantes des îles de reproduction. Cependant, en février 2020, les flamants des Caraïbes ont construit une nouvelle île de nidification. La révision de l'historique du nombre de nids construits par les flamants roses sur plusieurs îles de nidification entre 1999 et 2020 a donné un total de 57981 nids.

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**Introduction**

The Olivitos Wildlife Refuge and Fishing Reserve (the refuge), is the most important breeding site for the southern population of Caribbean (American) flamingo (*Phoenicopterus ruber*), nesting yearly and successfully from 1999 to the present time (Espinoza and Perozo, 2006, 2008; Espinoza and Torres 2012, 2019). Since then, flamingos have showed an expanding trend in the numbers of breeding birds, mainly because the breeding site is located in a protected area, isolated from anthropogenic disturbances and the presence of an alternative and secure feeding habitat at Concentrator 1 at the solar salt works of Produsal (Casler and Esté 2000).

Therefore, breeding flamingos do not need to migrate during the dry season to search for food on the wetlands from western Zulia (Pirela, 2000). Currently, we estimate these flamingo populations to number around 170000 birds, distributed 155000 on the coast of Venezuela and offshore islands, 8000 in Bonaire (Frank Van Slobbe, pers.com.) and 7000 at Peninsula de la Guajira, Colombia (Franke-Ante et al. 2013). These expanding populations enhance the recovery of flamingo numbers on several lagoons at Margarita Island, in state of Nueva Esparta, where flamingos were absent for more than two decades, but started to return since 2006. In the last decade flamingos have been reported breeding (Sanz D’Angelo, 2019) at Laguna Las Marites, National Park, where a colony has been active since 2017 (Marcano et al. unpublished data).

Field surveys carried out in June and August 2020 present the most recent information on the population trend of non-breeding and breeding Caribbean flamingos at Olivitos Wildlife Refuge and Fishing Reserve.

**Methods**

**Study Area**

The Olivitos Wildlife Refuge and Fishing Reserve is located on the eastern coast of El Tablazo Bay, western Venezuela (10°52’08” N71°24’22” W). The refuge is an estuarine system covering 24000 ha characterised by a mangrove forest (4800 ha), shallow open water (10000 ha), sandy beaches (1800 ha) and several channels, Oribor, Perejil, Nuevo, Viejo, through which tidal brackish water enters the system from El Tablazo Bay and the Gulf of Venezuela. While fresh water is supplied by the Palmar River (Casler et al. 1994).

The refuge is bounded on the southeast by the solar salt works of Produsal (Productora de Sal, C.A., a subsidiary of Cargil de Venezuela), a man-made aquatic habitat covering 3028 ha. (Casler and Este, 2000), see Figure 1. Rainfall averages 500mm/year and is bimodal, with a low peak in May and the highest peak in October (Figure 2).
Survey techniques

On 14th June and 23rd August 2020, we counted non-breeding flamingos in groups of 500 to 1000 individuals (when they were close to the observers) and in groups of 1000 when foraging at a greater distance. At the breeding site, we observed flamingos from a distance of 300 to 350m, estimating the numbers of flamingos sitting on nests, the numbers of chicks around nests and young fledged out in the crèche. We interviewed local fisherman about the flamingo’s previous breeding activity.

To measure the importance of the solar salt works nearby as feeding alternative for flamingos, we analysed census data from 2009-2019 of the Neotropical Waterbirds Census of Venezuela (Sainz Borgo et al. 2019), carried out on in February and July at Concentrator 1, Produsal. We used a 15x60 spotting telescope, 8x40 binoculars and electronic camera (lenses 500-1000mm) to record flamingo numbers and behaviour.

Results

We learned from interviewing fisherman that breeding activity has been observed since
2019 and that flamingos have built a new breeding site in February 2020. This was confirmed when we arrived at the breeding area located in the Los Corianos sector. The new breeding island measured approximately 350 to 400m in length and 50m wide. The previous nesting site that had been monitored until May 2019 (Espinoza and Torres 2019) was partially destroyed by rising water levels during the peak rains (September to October), tides and eruption of water from the Gulf of Venezuela, through channel Oribor (local fisherman pers. com). However, there was still a large tract of island remaining with a group of approximately 2250 breeding flamingos, located about 250m behind the new 2020 colony. Location of the new colony and the islet remaining from 2019 where marked on an aerial picture (Figure 3) from 2018 (Espinoza and Torres 2019). It is important to mention, that the nesting islands on the right side of the picture, are no longer there, since sites were washed out by the flooding.

![Figure 3: Location of the 2020 breeding islands in relation to previous breeding sites](image)

![Figure 4: Counting nest mounds in 2014 at Olivitos Wildlife Refuge](image)

**Nest counts**

Evaluation of the nesting island at Los Olivitos is usually carried out when breeding season is over, and the island is empty of birds (Figure 4). However, after the last count of nest made in 2014, flamingos have always been present during our visits, impeding entering the isles. Therefore, in order to evaluate the breeding site, we used data from the peak numbers of flamingos estimated nesting in 2017 and 2020, as indicators of nest number and compare with previous years (Table 1).
Table 1: Number of nests at four different nesting islands from 1999 to 2020

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of nests</th>
<th>Island ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>1111</td>
<td>One</td>
</tr>
<tr>
<td>2004</td>
<td>4800</td>
<td>Two</td>
</tr>
<tr>
<td>2009</td>
<td>10968</td>
<td>Three</td>
</tr>
<tr>
<td>2013</td>
<td>7257</td>
<td>Three</td>
</tr>
<tr>
<td>2014</td>
<td>10645</td>
<td>Three</td>
</tr>
<tr>
<td>2017</td>
<td>13000</td>
<td>Three</td>
</tr>
<tr>
<td>2020</td>
<td>10200</td>
<td>Four</td>
</tr>
</tbody>
</table>

In December 2017, the numbers of nest increased 2355 units with respect to 2014 and 2032 units in relation to the year 2009. In 2020, we estimated 10200 nests in the new colony, meaning 2800 fewer nests compared to 2017. However, when the numbers of nests from 2020 is combined with the 2250 nests counted on the remaining island from 2019, the total numbers of both nesting sites in August 2020 accounted for 12450 nest mounds. This is equivalent to just 550 fewer nests than the peak number of nests estimated in December 2017.

Numbers of non-breeding flamingos

Although we could observe the flamingo feeding areas by boat, we could not always approach the birds closely due to shallow waters. Numbers of non-breeding flamingos (Figure 5) were higher in August (rainfall 79mm), probably due to improving weather condition than in June (60mm).

Breeding flamingos

In June, we estimated 7480 flamingos sitting on nests (incubation and brooding); nine weeks later numbers of breeding flamingos reached 10200 birds (Figure 6). We observed chicks about two to three weeks old located around the nests and edges of the island, whilst others were already grouped in several crèches close to the colony. Numbers of chicks estimated in both months increased almost at the same rate as breeding pairs did between counts. Estimated numbers of young fledged in June and August were very similar (Figure 6).

Figure 5: Estimated numbers of non-breeding flamingos at Olivitos Wildlife Refuge
We estimated that young fledged in June were approximately 11 to 13 weeks old, suggesting that hatching may have started sometime between March and February. Other groups of young located further from the breeding site were perhaps 14 to 16 weeks old were all hatched in January and December 2019. Young fledged in August were grouped into differences age classes, some 11 to 13 weeks old and groups located away from the breeding site perhaps 16 to 20 weeks old.

We also estimated the number of flamingos performing courtship behaviour, about 1.5 km from the breeding site, and these flocks numbered 800 (June) and two groups of 700 and 1200 in August 2020.

Flamingos feeding at Produsal

A total of 16 censuses (2009-2019), totalling 60541 flamingos were carried out at Concentrator 1, a man-made aquatic habitat (674 ha), located at the solar salt works, at Produsal (Figure 7). Numbers of flamingos were distributed 63.5% in July and 36.5% in February, with peak numbers observed in July 2010 (1615 flamingos/ha) and February 2017 (1038 Flamingos/ha). However, the lowest numbers of flamingos were usually found in February, even though water level at Concentrator 1 remains constant all year.

Discussion

This study shows that whilst we did not carry out a systematic survey, we have gathered useful data through field surveys to present the most current information on population trends of non-breeding and breeding Caribbean flamingos at Olivitos Wildlife Refuge. Flamingo populations are unpredictable due to their constant movements, but we have managed to
estimate numbers of non-breeding flamingos on the western shoreline of the refuge at Los Corianos sector, showed a difference of 21485 birds between counts. Nevertheless, this gap could be closer since we did not survey flamingos in July. Increasing numbers of non-breeding flamingo in the refuge are correlated with hydrological factors at the onset of the wet season during May (Espinoza and Torres 2019; Espinoza and Perozo 2008). This period of the year is characterised by an abundance of brine shrimp (*Artemia* sp.), brine fly (*Ephydra* sp.), chrysalids, copepods and amphipods (Este et al. 2012; Este and Casler 2000). These plentiful food resources also coincide with the arrival of the flamingos, which are expected to return to Los Olivitos around June to July. These birds are flying back from the western wetlands of Gran Eneal (25km) (Pirela, 2000) and even from the Caribbean coast (150km), at Peninsula de la Guajira, Colombia. The main groups of flamingos (perhaps the majority hatched at the refuge), settle down, increasing the non-breeding and breeding populations at the refuge, while some transient groups may stay feeding for days and latter departure to the wetlands on the western coast the state of Falcon, the island of Bonaire and the eastern coast of Venezuela and offshore islands.

The fledged young observed on 15th June were estimated 11 to 12 weeks old, suggesting hatching dates for this group of birds in March. However, since the new nesting island was supposing to be built on early February, other groups of fledged young over 13 weeks’ old may have hatched in February, January and even December 2019 (on the nesting island that remained after the flooding). Whilst many young fledged in August, would have been hatched at either nesting island. It is worth mentioning that all fledged young observed at both visits looked in very good physical condition.

**Disturbing factors at the colony**

Unlike flamingo colonies located at Inagua (Bahamas), Río Máximo (Cuba) and Yucatan (Mexico), the Olivitos colony (as well as Bonaire), is out of the hurricane season path that is responsible for destroying breeding sites in the aforementioned countries. Natural disturbance (rise of water level) has caused nest losses and chick’s mortality (Caler et al. 1994, Pirela, 2000) and anthropogenic (Pirela, 2000), induce disturbance (military artillery practice, eggs and chicks collecting), it is not a recurrent event.

In 2019, we monitored the breeding colony until May (Espinoza and Torres, 2019), reporting disturbing factors such erosion of nest and section of some isles washed out by water. However, a few months later during the peak rains, an unexpected intrusion of water from the Gulf of Venezuela entered the refuge and flooded a large section of the nesting site, washing away thousands of nests mounds. However, in 2020 a group of flamingos was observed nesting on the islands left by the flooding, located on the same bank of soil where the new breeding island was built up for flamingos on early February 2020.

Overall, both nesting islands, during the month of August 2020, contained a total of 12450 nest mounds, equivalent to just 550 fewer nests than the peak numbers estimated on the nesting colony on December 2017. This showed the great abilities of resilience for flamingos in the face of adversity.

The breeding island from 2020 became the sixth nesting site built since reproduction has been reported at Olivitos (Casler et al. 1994; Pirela, 2000; Espinoza, 2003; Espinoza and Perozo, 2006, 2008; Espinoza and Torres 2019) and the fourth breeding site founded for flamingos on the same area at Los Corianos sector.

**Produsal**

Overall, the censuses from 2009 to 2019 confirmed the importance of the salt works as alternative feeding sites for Caribbean
flamingos at the refuge. However, when treating the number of flamingos feeding at Concentrator 1 as a segment of the total population estimated at the refuge using data from the census done on the same months (total numbers of non-breeding and breeding flamingos), from 2013 to 2019 (Espinoza and Torres 2019), the results (Table 2) are quite different. These results show that feeding activity (column 1) is higher in February than in July. On the other hand, when assuming that all feeding flamingos at Concentrator 1 correspond only to the segment of the breeding population from the refuge, results point out a higher percentage of breeding flamingos feeding on February (dry period) at Concentrator 1, coinciding with the lowest water level available at the refuge.

Table 2: Flamingos from Olivitos Wildlife Refuge, feeding at Concentrator 1

<table>
<thead>
<tr>
<th>Date</th>
<th>% total</th>
<th>% breeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 Jul 2013</td>
<td>1.98</td>
<td>36.27</td>
</tr>
<tr>
<td>19 Feb 2015</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>17 Jul 2015</td>
<td>4</td>
<td>14.72</td>
</tr>
<tr>
<td>14 Jul 2016</td>
<td>0</td>
<td>10.84</td>
</tr>
<tr>
<td>13 Feb 2017</td>
<td>10.41</td>
<td>46.05</td>
</tr>
<tr>
<td>12 Feb 2018</td>
<td>3.95</td>
<td>31.5</td>
</tr>
<tr>
<td>13 Feb 2019</td>
<td>0.44</td>
<td>21.05</td>
</tr>
</tbody>
</table>

In previous research, Casler and Este (2000) made 29 censuses of non-breeding flamingos (October 1996 to June 1998) at Concentrator 1, counting 7874 birds, but only estimated 1.6% flamingos feeding on February 1997, and none in July (1997 and 1998). According to these authors, Concentrator 1 contrasts with the natural conditions of the Los Olivitos Wildlife Refuge and Fishing Reserve, where water and salinity regimes fluctuate seasonally, sometimes widely. At the Concentrator 1, brine fly larvae and pupae, and brine shrimp, also appear to be the main source of food for flamingos (Este 1997; Este et al. 2012).

Adult breeding greater flamingos (P. roseus) in Europe have been reported to fly from the breeding site during incubation and early chick rearing to forage in heterogeneous and complex habitat patches with varying salinity gradients and hydro periods (Bechet et al., 2009). Flamingos breeding at Pekelmeer (Bonaire), fly daily to the wetlands (100-120km) of the eastern coast of Falcon near Chichiriviche, Venezuela to feed (Rooth, 1976). However, breeding flamingos at the Olivitos Wildlife Refuge only needs to fly 4 km from the breeding site to feed on Concentrator 1. The constant water levels maintained all year in Concentrator 1 is a vital alternative, not only for breeding flamingos but also for other waterbirds, that use the solar salt works as a staging habitat for feeding and roosting specially for migratory shorebirds. For these reasons, the solar salt works at Prodsusal, was recently declared a Western Hemisphere Shorebird Reserve Network.

Conclusions

Negative impact of weather (e.g. flooding) significantly reduced the nesting islands available for the flamingos at Olivitos in late 2019. However, the flamingo’s resilience permitted the building of a new breeding island for the birds in early 2020, and by late August they had recuperated a total 12450 nest mounds, equivalent to just 550 less nests than the peak numbers estimated on the nesting colony destroyed by stormy weather in 2019. Historical numbers of nests estimated in several breeding colonies at Los Olivitos between 1999 to 2020 totalled 57981 nest mounds.

The Concentrator 1 at Prodsusal offers a safe and available alternative feeding site for these flamingos all year around, especially during the dry season. Flamingo research at Olivitos Wildlife Refuge needs support from international organisations to help cover expenses and equipment costs and to enable the researchers to spend more time in the field, estimating more precisely the breeding success of the birds. Such resources could also allow for investigation on different ecological
fields, as well re-start the banding program that was suspended in 2002. Such activities would improve conservation and management of the Caribbean flamingo at the regional level.

Acknowledgements

We would like to express particular thanks to Francis Perozo, Luis Loyo, Albéniz Avila (Macho), from ONG-Mangle. Helimenes Perozo (Pepe) and Teobaldo Torreblanca from Ministerio de Ecosocialismo. Emiliano Rujano and Juan Parra from Produsal. We also would like to thank the people from El Ancon de Iturre, for caring so much about the conservation of La Ciénaga de los Olivitos Wildlife Refuge and Fishing Reserve.

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Comments on the population status of Chilean flamingos at Lagoa do Peixe National Park, Southern Brazil

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Abstract

In South America, the Chilean flamingo (Phoenicopterus chilensis) is distributed from south of the Equator to southern Argentina, passing by the Brazilian coast. One of the locations where this species is present in southern Brazil is the Lagoa do Peixe National Park, between the cities of Mostardas and Tavares, in Rio Grande do Sul state. This area is a natural reserve implemented to conserve both coastal biodiversity and the many species of migratory birds that use the area in contranuptial periods. Although the flamingo is well known in the region, there is a lack, in scientific literature, of information about the population of flamingos living inside the park. In this paper, we comment on the current population and conservation status of Chilean flamingos in the Lagoa do Peixe National Park, bringing attention to the necessities to protect the park from political pressures and to increase research activity on these birds in this area.

Resumen

En América del Sur, el flamenco austral (Phoenicopterus chilensis) se distribuye desde el sur del Ecuador hasta el sur de Argentina, pasando por la costa brasileña. Uno de los lugares donde esta especie está presente en el sur de Brasil es el Lagoa do Peixe, entre las ciudades de Mostardas y Tavares, en el estado de Rio Grande do Sul. Esta área es una reserva natural implementada para conservar tanto la biodiversidad costera como las muchas especies de aves migratorias que utilizan el área en períodos contranupciales. Aunque el flamenco es muy conocido en la región, existe una falta de información sobre la población de flamencos que viven dentro del parque en la literatura científica. En este trabajo, comentamos sobre la población actual y el estado de conservación de los flamencos australes en el Parque Nacional Lagoa do Peixe, llamando la atención sobre las necesidades de proteger el parque de las presiones políticas y aumentar la actividad de investigación de estas aves en esta área.

Résumé

En Amérique du Sud, le flamant du Chili (Phoenicopterus chilensis) est réparti du sud de l’équateur au sud de l’Argentine, en passant par la côte brésilienne. L’un des endroits où cette espèce est présente dans le sud du Brésil est le parc national de Lagoa do Peixe, entre les villes de Mostardas et Tavares, dans l’État de Rio Grande do Sul. Cette zone est une réserve naturelle établie pour conserver à la fois la biodiversité côtière et les nombreuses espèces d’oiseaux migrateurs qui l’utilisent pendant les périodes inter-nuptiales. Même si le flamant est bien connu dans la région, il y a un manque, dans la littérature scientifique, d’informations sur la population de flamants vivants à l’intérieur du parc. Dans cet article, nous documentons l’état de la population actuelle et l’état de conservation des flamants du Chili dans le parc national de Lagoa do Peixe, en attirant
l'attention sur la nécessité de protéger le parc des pressions politiques et d'augmenter l'activité de recherche sur ces oiseaux dans cette zone.

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**Introduction**

Flamingos (Phoenicopteriformes) are known for their distinctive morphology and uniquely shaped bill adapted for filtering small particles (Mascitti and Kravetz, 2002). These birds live in salt lakes, lagoons, or coastal areas, feeding on microalgae and aquatic invertebrates (del Hoyo et al., 2017). The Chilean flamingo (*Phoenicopterus chilensis*) is one of the four flamingo species currently distributed in South America, from central Ecuador to Southern Chile (Derlindati et al., 2014). It breeds during the summer in central and northern Argentina, establishing colonies of thousands of individuals, and migrates, during winter, to humid areas of lower altitudes (Caziani et al., 2007), mainly in the eastern coast, reaching Uruguay and Southern Brazil outside of the breeding season (Antas, 1994).

In Brazil, the Chilean flamingo is seen in large and recurrent flocks at Lagoa do Peixe (31°29’S, 50°46’W); a coastal lagoon in the Lagoa do Peixe National Park (Knak, 1999), a 344.4 km² federal conservation area situated on the coastal plain in Rio Grande do Sul state. The Lagoa do Peixe National Park is the only place in Brazil where flocks of Chilean flamingo can be seen all year round (Antas, 1994; Somenzari et al. 2018). However, there is no existing research evaluating the current population or conservation status of the Chilean flamingos inside this reserve. Consequently, the goals of this paper are to discuss and comment on both the historic and current population records of the Chilean flamingo at the Lagoa do Peixe lagoon and propose strategies to contribute to the conservation of this bird and its habitat in Brazil.

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**Evaluation**

The Lagoa do Peixe is a shallow lagoon (mean depth of 30 cm) with a regular width of 1 km, and an extension of about 35 km surrounded by representative ecosystems from this region, such as dunes, sandbanks, fresh waters lagoons, beaches, and salt marshes (Knak, 1999), see Figure 1. The National Park, with the same name as the lagoon, was established in 1986 to protect migratory birds that use this area as a breeding site or as a staging post outside of the breeding season (mainly for feeding and resting), such as the royal tern (*Thalasseus maximus*) and red knot (*Calidris canutus*) (Bencke et al., 2010; Grimm, 2013).

Flamingo ecology in this national park

Currently, in the Lagoa do Peixe National Park, Chilean flamingos are recorded in large numbers, especially between April and September, when these individuals fly out to spend the winter on the South American east coast (Antas, 1994). According to Somenzari et al. (2018), the Chilean flamingo colony in the park is made up of wintering birds coming from large populations in Mar Chiquita Lake in Argentina, seeking environments not affected by winter temperatures (Caziani et al., 2007), and who fly back to Argentina when the season changes (Antas, 1994). Despite this, it is possible to observe a resident colony of Chilean flamingos throughout the year in the Lagoa do Peixe National Park (FZBRS 2013; Somenzari et al., 2018; pers. obs. by the authors).
Figure 1: The location and dimension of Lagoa do Peixe National Park, between the cities of Mostardas and Tavares, in the Rio Grande do Sul state, southern Brazil. The three main locations of flamingos in the park are: the Figueira Trail (yellow), the Flamingo trail (red) and the Barra (orange). Figure provided by Oscar M. Aldana-Ardila.

Historical records of the Chilean flamingo in the Lagoa do Peixe reports its presence at least since 1970. Belton (1984) and Resende and Leeuwenberg (1987) listed more than 500 individuals between 1972 and 1981 and mentioned that a large number of individuals were observed in the spring. The Chilean flamingo colony in the park shows a high variation of individuals during the seasons, due to the park colony receiving a large number of other individuals from colonies elsewhere (Somenzari et al., 2018). But the lack of ringing of these birds makes it impossible to certify the origin or the route made by these birds. There is also still no evidence of breeding activity of Chilean flamingos in the park, leading to the inference that the population is formed mainly by young animals and non-reproductive males (FZBRS, 2013). Despite that, we also observed behaviours usually reported during the breeding season, like synchronized wing-salutes, head flagging and other group rituals that lead us to believe that some breeding behaviours are possible in or near to the protected park area (Delfino and Carlos, in preparation), see Figure 2.

The colony of Chilean flamingos in the Lagoa do Peixe National Park offers a significant opportunity to know the population situation of these birds, but also represents a great challenge. Activities like capture and ringing of these birds can help to identify and to determine the sex and age of the individuals (Anderson and Green, 2011). Nevertheless, this methodology requires trained and qualified field biologists (Lakhani, 1985).
Figure 2: The Lagoa do Peixe National Park supports a dynamic population of Chilean flamingos, mainly in the Barra area, with flocks that vary from tens to hundreds of individuals. On the left, a flock of Chilean flamingos performing ritualistic behaviours like head-flagging at the Barra; on the right, three individuals, of different ages (photo credit: Oscar M. Aldana-Ardila).

Pressures on this flamingo population

Currently, birdwatchers, tourists and ornithologists can observe Chilean flamingos when visiting three places in the park: the Figueiras Trail, the Flamingo Trail, and the Barra, the most visited place among these (Figure 1). The region of the Barra is where the communication between the lagoon and the sea occurs (Knak, 1999; ICMBio, 2020). This region is possibly one of the richest places for flamingo numbers and other migratory bird diversity due to high food availability (Knak, 1999).

In addition, the Barra is seasonally used by local shrimp fishers, and apparently, the usual behaviour of Chilean flamingos seems to be unaffected by their presence. However, the increased presence of human activities in the park, such as tourism, illegal agriculture and livestock presence (Almudi and Kalinoski, 2009), threatens the stability of the Chilean flamingo colony in this protected area. Despite the absence of a periodic census of the Chilean flamingo colony, reports by park rangers and tourist guides have related a potential decrease in Chilean flamingo numbers over the last years.

Due to changes in the environmental policy of the current Brazilian federal government, environmental and conservation laws are softening, allowing the transformation of integral protected areas such as National Parks into Environmental Protection Areas, which consent human occupation and sustainable use of natural resources, placing the Lagoa do Peixe National Park (as well as other National Parks) in the middle of a controversy between government and conservationists, biologists and activists (Moraes, 2009; Fruet and Heurich, 2019; Kervalt, 2019; Wenzel, 2019; Wenzel 2020).

The execution of economic activities such as tourism, agriculture, and fishing could become a threat to the great diversity of resident and migratory birds that coexist in the park, including the flamingos (Almudi and Kalinoski, 2009).

The absence of a reliable and periodic census obstructs any action to know the real state of conservation of this bird, and that is why the Chilean flamingo is not considered an endangered species in Brazil (FZBRS, 2013; ICMBio, 2013). Despite a considerable amount of evidence that indicates the threat of the Chilean flamingo population, it is necessary to carry out direct actions that will allow the execution of a conservation plan for this species, and this must begin with knowledge of the real state of its population as well as protection of its habitat.
Conclusions

The Chilean flamingo population in South America is about 300,000 individuals, according to the IUCN Red List (BirdLife International, 2018). These numbers have decreased over the past 20 years, mainly due to habitat loss by human activity, such as increasing tourism pressures and extensive farming.

The Lagoa do Peixe National Park is the only non-reproductive area where the Chilean flamingo is seen throughout the year in Brazil, so it is imperative to know the real population status of these birds in the park area to ensure successful habitat management and conservation action can be implemented.

It is necessary to join forces between park rangers, researchers, and Brazilian wildlife protection authorities to create a conservation plan for this bird that includes a year-long monitoring and research program, surveys, and course the protection and preservation of their park habitat. Finally, environmental education programs should be focused on responsible tourism, promoting respect for wildlife, and the conscious use of their habitats.

Acknowledgments

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References


Fight of the flamingos for survival in the Navi Mumbai wetlands

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Abstract
Tens of thousands of flamingos congregate annually in Talawe Wetlands, in Navi Mumbai on India's west coast. These annual visitors comprise of lesser and greater flamingos, the two species that migrate within India. With India's coronavirus lockdown, this year saw a 25% increase in numbers of these migratory birds. Bombay Natural History Society (BNHS), a pan-India wildlife research organisation, estimated that numbers this year may be more than 150000 birds compared to the 134000 counted last year. Unfortunately, these wetlands, the habitat of the flamingos, are in danger of being taken over for development for a residential complex and a golf course by the City and Industrial Development Corporation (CIDCO). Citizens of the area and city have been fighting to protect the wetlands.

Resumen
Decenas de miles de flamencos se congregan anualmente en los humedales de Talawe, Navi Mumbai, en la costa oeste de la India. Estos visitantes anuales son las especies flamenco común (Phoenicopterus roseus) y flamenco enano, (Phoeniconaias minor) las dos especies que migran a la India. Con el encierro por coronavirus en India, este año se registró un aumento del 25% en el número de estas aves migratorias. La Sociedad de Historia Natural de Bombay (BNHS), una organización de investigación de la vida silvestre de la India, estimó que los números de este año pueden ser más de 150.000 en comparación con los 134.000 contados el año pasado. Pero estos humedales, el hábitat de los flamencos, están en peligro de ser tomados para el desarrollo de un complejo residencial y un campo de golf por la Corporación de Desarrollo Industrial y Municipal (CIDCO). Los ciudadanos de la zona y la ciudad han estado luchando para protegerlos.

Résumé
Des dizaines de milliers de flamants roses se rassemblent chaque année dans les zones humides de Talawe, à Navi Mumbai, sur la côte ouest de l'Inde. Ces visiteurs annuels comprennent des flamants nain et rose, les deux espèces qui migrent en Inde. Avec le confinement dû au coronavirus en Inde, cette année a vu une augmentation de 25% du nombre de ces oiseaux migrateurs. La Bombay Natural History Society (BNHS), une organisation pan-indienne de recherche sur la faune, a estimé que les chiffres de cette année pourraient être supérieurs à 150000 par rapport aux 134000 recensés l'année dernière. Mais ces zones humides, l'héritage des flamants, risquent d'être détruites pour l'aménagement d'un complexe résidentiel et d'un terrain de golf par la City and Industrial Development Corporation (CIDCO). Les citoyens de la région et de la ville se battent pour les protéger.

Introduction
The wetland areas around Navi Mumba, on India’s west coast, attract huge flocks of
flamingos, both lesser (*Phoeniconaias minor*) and greater (*Phoenicopterus roseus*), see Figure 1. During the 2020 Covid-19 pandemic, with people at home and remaining more in their local area, it appeared as if the birds were more evident to those living and working around these wetlands. Flamingo numbers also increased during the Covid-19 lockdown, to around 150,000 birds according to census by the BNHS, suggesting that a lack of human activity has been beneficial to the habits of the flamingos around Navi Mumbai. Whilst this spectacle was enjoyed by many, behind the scenes, work and activism by a dedicated community of flamingo-lovers and environmentalists is attempting to conserve this spectacle of birds from long-term damage to the wetlands that are so important for them.

![Figure 1: Flamingo flocks in the wetlands that exist around the city of Navi Mumbai](image)

**The threat**

It was in the summer of 2016 when a group of workers descended overnight to begin hacking mangroves when people living in the vicinity approached them to stop work and started filming the activities, they immediately stopped the work but refused to tell the people who had assigned them on the task. Alarm bells went up and citizens of the area Sunil and Shruti Agarwal filed a complaint at the nearest police station of NRI Coastal Police Station, Navi Mumbai. Everything went silent, no arrests were made, but one morning in October 2017 everyone was shocked to see excavator machines digging and creating a boundary and fences around the mangrove habitats. The concerned citizens in the vicinity came together to fight for the environment.

The group members started sharing pictures and videos of these activities from the towers around the area. It became clear that the intention was to destroy the 800 trees. On further digging, the residents found out that they had a letter stating that they are soil testing but for that as well the permission was not in place. But in the name of soil testing, they were creating havoc. The residents also found out that the government had, without consulting the adjoining communities, gotten permission to change the land use from a no-development zone to a regional park zone and residential zone.

Complaints were filed with the wetland committee as well as with the local police station, and various other authorities and the destruction was halted. These aware citizens stood victorious, but unsatisfied as a lot of damage had already been done. The soil dumped in the wetland had not been removed.
Court battle

In March 2018, Sunil Agarwal filed a Public Interest Litigation in the Bombay High Court. The Court ordered the removal of the dumped soil and in November 2018, the final High Court order came in favour of the citizens and directed the state government to protect and preserve mangroves, wetlands and lakes of the city.

The Court also said that the destruction of water bodies and mangroves will be a violation of fundamental rights under Article 21 of the Constitution of India. This victory instilled confidence in the local community, who began to increasingly spread awareness about mangroves and wetlands. "We are delighted with this decision, but our fight doesn't end here. People need to be vigilant, report destruction and question authorities without shying away or being scared. Permissions must be challenged if they are violative of environmental laws" said Sunil Agarwal.

Community involvement

People took note of any further act of destruction and systematic burning of mangroves and reported them to authorities. There were events such as marathons, nature trails and awareness walks to expand this community of aware citizens, extending it beyond the immediate locality. The citizens continued to fight and work towards a more permanent solution to prevent destructive incidences in the future, while on the legal front, the Supreme court is now hearing the case and it will determine who will win, CIDCO or the flamingos and the citizens fighting for the good of the natural environment.

An affidavit submitted by Maharashtra Coastal Zone Management Authority (MCZMA) in court had revealed that what enabled the approval of this project of residential towers and golf course was a statement by The City and Industrial Development Corporation (CIDCO) that there are no wetlands in the area. “Public money and time are being drained in these futile battles of land grab under the garb of development. And what are the consequences faced by those responsible for this? Stringent action must be taken to dissuade other authorities from indulging in such lies in the future” said Shruti Agarwal.

Proposed flamingo sanctuary

There is a simple solution, a proposed flamingo sanctuary, in the interest of the birds, the people and the wider environment of the area. Despite a promise made by the state environment minister in January 2020, and follow-up emails from many concerned citizens and environmentalists, such as Bittu Sehgal and Sunjoy Monga, there has been no action from the CIDCO MD. Observations of the birds by ornithologists, environmentalists and local people have shown the diverse array of behaviours performed by the flamingos in these wetlands, including group courtship display (Figure 2). Consequently, the wetlands provide an important habitat for the flamingos, being of good enough quality to facilitate the performance of numerous behaviours important to the flamingo annual cycle and life history stages.
Figure 2: Displaying lesser flamingos in the Navi Mumbai wetlands. The performance of this group courtship display highlights the importance of these wetlands to the birds’ annual cycle.

Consequences

But why is it so important to save this parcel of land? Why go to all these lengths? Not only are these 80 ha of wetlands and mangroves a habitat to rich biodiversity, but they also play a crucial role in protecting our shoreline from floods. While the infamous Mumbai floods wash away the city, these mangroves stand guarding Navi Mumbai and ensuring a peaceful night’s sleep for its residents.

The mangroves also play an important role in carbon removal as they are the most carbon-dense ecosystems in the world. If protected, mangroves act as long-term carbon sinks to this world otherwise awash with carbon emissions.

Another very important concern is that of passenger safety. A report by BNHS shows that if the birds lose their habitat, they will possibly move north. Moving North means going closer to the new airport that is coming up. This poses a huge risk to flights and passenger safety and must not be overlooked.

A step towards victory

The site of the proposed golf course was sold to a private company by a state agency, the CIDCO of Maharashtra, after assuring the coastal zone management authority that it was not a wetland. On 18th June 2020, the Maharashtra Forest Department approved and published an official document showing six ecologically sensitive areas in the Mumbai Metropolitan Region (MMR) as wetlands. This includes Training Ship Chanakya (13 ha) and NRI Complex (19 ha) in Navi Mumbai, the site of the proposed golf course and residential project.

The areas have been listed as 'satellite wetlands that need to be protected within a 50km radius of Thane Creek Flamingo Sanctuary (TCFS).’ This is the first time the state has also officially declared its intent to protect these sites as conservation reserves.

"Protecting these wetlands will help us achieve our sustainable development goals and commitments to the global community on Central Asian Flyway that the Prime Minister had announced during the Convention on the Conservation of Migratory Species (CMS COP 13) in Gandhinagar in February” said Deepak Apte, director, BNHS to the Hindustani Times.

"They are vital migratory bird habitats and their protection is crucial from the air safety point of view for the Navi Mumbai International Airport." This development shakes the basis of approval of the project as it now sits on an untruth that these areas are not wetlands. It exposes the truth that the citizen activists of this area have been promoting for so many years: these are important wetlands that must be protected, for flamingos, for other wildlife and for people too.
Enclosure alterations for improved lesser flamingo health and welfare at the Oregon Zoo

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Abstract

Flamingos in captivity are prone to pathological changes to foot health and condition, commonly identified as pododermatitis (“bumblefoot”). Lesser flamingos at the Oregon Zoo experienced fluctuations in foot health between winter and summer, with severe changes over winter that showed limited improvement in the summer. The zoo embarked on an enclosure alteration project, changing substrates and heating the water of the flamingos’ pool. These changes have markedly improved the health and condition of the birds’ feet, as evidenced by regular monitoring and documentation of foot scores. This article outlines the changes that were undertaken to improve flamingo welfare and explains how the enclosure and the birds are managed to keep a check on their foot condition.

Resumen

Los flamencos en cautiverio son propensos a condiciones patológicas en la salud y el estado de las patas, comúnmente identificadas como pododermatitis (dermatitis plantar). Los flamencos enanos (Phoeniconaias minor) en el Zoológico de Oregon, EE.UU. experimentaron fluctuaciones en la salud de las patas entre el invierno y el verano, con cambios severos durante el invierno que mostraron una mejora limitada en el verano. El zoológico se embarcó en un proyecto de modificación del recinto, cambiando sustratos y calentando el agua de la piscina de los flamencos. Estos cambios han mejorado notablemente la salud y el estado de las patas de las aves, demostrado en el seguimiento y la documentación regular de las puntuaciones de la planta del pie. Este artículo describe los cambios que se llevaron a cabo para mejorar el bienestar de los flamencos y explica cómo se maneja el recinto y las aves para controlar el estado de sus patas.

Résumé

Les flamants en captivité sont sujets à des changements pathologiques de la santé et de l'état de leurs pattes au niveau des palmures, communément nommés pododermatites («bumblefoot»). Les flamants nains du zoo de l'Oregon ont connu des fluctuations de la santé de leurs pattes entre l'hiver et l'été, avec de graves détériorations pendant l'hiver qui ont montré une amélioration limitée en été. Le zoo s'est lancé dans un projet de modification de l'enclos, en changeant les substrats et en chauffant l'eau de la piscine des flamants. Ces changements ont nettement amélioré la santé et l'état des pattes des oiseaux, comme en témoigne le suivi régulier et la documentation de l'état des pattes. Cet article décrit les changements qui ont été entrepris pour améliorer le bien-être des flamants et explique comment la gestion de l'enclos et des oiseaux a permis de contrôler l'état de leurs pattes.
Introduction

At the Oregon Zoo, we care for a small flock of lesser flamingos, ranging in age from 29 to 39 years old. When I joined the team in 2018, we were monitoring their feet closely and taking regular photos for documentation and study. As with many flamingo flocks in cooler climate zoos, we struggled to maintain good foot health.

By 2019, the bird care team, together with zoo veterinarian, Dr. Carlos Sanchez, had discussed several papers with extensive data on pododermatitis and different types of foot bumbles and the correlation of occurrence with various substrates and climates (Nielsen, 2010, 2012; Wyss 2014). Our flamingo area was a dirt and grass habitat with a medium-textured concrete pool (Figure 1).

![Figure 1: The lesser flamingo enclosure at the Oregon Zoo before alterations (note, these are not some of the actual flamingos...). Photo credit: B. Suhn.](image1)

We tried retrofitting the edge of the pool with Nomad mats, and then with artificial grass (soft, not Astroturf). We also treated the birds’ feet in the winter with a combination topical cream made up of mostly A&D ointment (for good skin health) and DMSO (Dimethylsulfoxide). Each winter, however, the birds’ feet would get worse, and in the summers, improvement was limited. We decided that major steps were needed to improve the foot health of our flock.

Changes to the enclosure for better welfare

We sampled several types of sand and ultimately selected Oregon Dune sand. We ordered enough to completely cover the concrete of the pool, as well as create a sandy beach.

![Figure 2: Sanded area in front of the flamingo’s pool, covering the concrete edges (photo credit: B. Suhn).](image2)
We also worked with our Life Support Systems team to install a heater that would pull water and heat it to 21°C (70°F) before returning it to the pool, providing a gradient of heat all year long and ensuring the pool would never freeze. This also allowed us to let the birds stay outside in colder temperatures than before, which meant less time spent indoors, where the floors were concrete. Lastly, we modified our holding pool to have a smooth river rock aggregate floor, so even when the birds were inside, they would not be standing in a flat, rough or spongy pool (Figure 3). According to the papers we studied, the best solid flooring for our birds’ feet was a smooth but uneven surface.

Post-planning and after finalising logistics, the project was organized, and in May 2019, installation of sand, heating and the new holding pool were completed. We kept most of the sand away from the lowest point of the pool to keep our drain system (and Life Support Systems team!) happy. The pool is deep enough at one end so that the lesser flamingos cannot touch the bottom when the pool is full, so leaving this part mostly bare of sand had no effect on the birds’ feet but did encourage swimming, which is a natural behaviour for this species.

Monitoring and evaluation

We continued to take regular photos to continue the close monitoring of their feet. In a year, the improvement in all types of bumble is marked. The photos on the left were taken May 2019, and the ones on the right were taken July 2020. We still take regular photographs of the birds’ feet, but we have cut back from bi-monthly to semi-annually.
We continue to work on sand maintenance and have had the sand removed and replaced in August 2020. Most likely we will need to continue to replace the old sand once a year. We also continue to modify our drain setup to ensure as little sand as possible ends up in our drain and filtration system. We added some sand to our indoor rooms to cover the concrete flooring around the holding pool as well.

**Conclusion**

While the project was labour intensive and takes some effort to maintain to ensure all enclosure features remain in working order and keep their benefits for the birds, the results are well worth it. In August 2019, we added five juvenile greater flamingos to the exhibit, and as of July 2020 they had not developed any signs of pododermatitis or unnatural changes to foot condition (Figure 5).

*Figure 4: Examples of changes to foot health and condition pre-enclosure change (left) and after the enclosure changes (right). Photo credit: B. Suhn.*

*Figure 5: Photo condition of a juvenile greater flamingo, living in the altered enclosure and showing evidence that the enclosure enables maintenance of excellent foot health (photo credit: B. Suhn).*
References


Substrate influence on the prevalence of bumblefoot in captive Chilean flamingos: Assessing the use of infrared thermography as a diagnostic screening tool

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Abstract

Flamingos are a commonly kept species in zoological collections due to their charismatic appearance and popularity with visitors. One of the comments of concerns for those keeping captive flamingos is their susceptibility to “bumblefoot” (ulcerative pododermatitis). Previous studies have found nutrition, abnormal weight bearing, poor sanitation and suboptimal substrates to be the major influencing factors in disease progression. Early diagnosis of bumblefoot is essential for improvement of welfare in affected flamingos. The main objective of this study was to determine whether substrate type influences the prevalence of bumblefoot. This study also tested the effectiveness of thermal imaging as a diagnostic tool for subclinical identification of bumblefoot and assessed its use as a potential long-term diagnostic method. Fourteen captive Chilean flamingos (Phoenicopterus chilensis), housed at Harewood Bird Garden were used for this study. Rubber matting was used as a trial substrate based on recommendations from published literature, and for ease of cleaning and sanitation. Bumblefoot severity was measured prior to and after substrate change in accordance to Nielsen’s severity scores. Thermal images and photographs were also taken prior and post substrate change. Average temperatures of each digit per foot (three per foot) were measured using FLIR software. Results of the study showed a 12.6% increase in bumblefoot severity with the implementation of rubber matting. No significant correlation was found between bumblefoot severity level and thermographic screening. The results identify that substrate may influence susceptibility to bumblefoot development. However, the effectiveness of infra-red thermography in the sub-clinical identification of bumblefoot needs to be further investigated, as data variation and subsequent limitations did not allow for solid conclusions to be formed.

Resumen

Los flamencos son una especie comúnmente mantenida en colecciones zoológicas debido a su apariencia carismática y popularidad entre los visitantes. Una de las condiciones que preocupan a quienes mantienen a los flamencos en cautiverio es su susceptibilidad a la dermatitis plantar (pododermatitis ulcerosa). Estudios anteriores han encontrado que la nutrición, el soporte de peso anormal, el saneamiento deficiente y los sustratos subóptimos son los principales factores que influyen en la progresión de la enfermedad. El diagnóstico temprano de dermatitis plantar es esencial para mejorar el bienestar de los flamencos afectados. El principal objetivo de este estudio fue determinar si el tipo de sustrato influye en la prevalencia de la patología dermatitis planter. Este estudio también probó la efectividad de la imagen térmica como una herramienta de diagnóstico para la identificación subclínica de dermatitis plantar y evaluó su uso como un posible método de diagnóstico a largo plazo. Para este estudio se utilizaron catorce flamencos australes (Phoenicopterus chilensis) en cautiverio, alojados en Harewood Bird Garden. La alfombra de goma se utilizó como sustrato de prueba según las recomendaciones de la literatura publicada y para facilitar la limpieza y el saneamiento. Se midió la gravedad la pododermatitis antes y después del cambio de sustrato de acuerdo con las puntuaciones...
de Nielsen. También se tomaron imágenes térmicas y fotografías antes y después del cambio de sustrato. Las temperaturas promedio de cada dígito por pie (tres por pie) se midieron utilizando el software FLIR. Los resultados del estudio mostraron un aumento del 12,6% en la gravedad de la pata con la implementación de alfombras de goma. No se encontró una correlación significativa entre el nivel de gravedad de la pata y la evaluación termográfica. Los resultados identifican que el sustrato puede influir en la susceptibilidad al desarrollo de pododermatitis en la pata. Sin embargo, la efectividad de la termografía infrarroja en la identificación subclínica de la pododermatitis debe investigarse más a fondo, ya que la variación en los datos y las limitaciones posteriores no permitieron establecer conclusiones sólidas.

Résumé

Les flamants sont une espèce couramment conservée dans les collections zoologiques en raison de leur apparence charismatique et de leur popularité auprès des visiteurs. L’un des commentaires préoccupants pour ceux qui gardent des flamants en captivité est leur susceptibilité aux pododermatites ulcéreuses. Des études antérieures ont montré que la nutrition, une mise en charge anormale, un mauvais assainissement et des substrats sous- optimaux étaient les principaux facteurs influençant la progression de la maladie. Un diagnostic précoce est essentiel pour améliorer le bien-être des flamants affectés. Le principal objectif de cette étude était de déterminer si le type de substrat influence la prévalence de cette pathologie. Cette étude a également testé l’efficacité de l’imagerie thermique en tant qu’outil de diagnostic pour l’identification subclinique de la pododermatite et évalué son utilisation en tant que méthode de diagnostic potentielle à long terme. Quatorze flamants du Chili captifs, logés au Harewood Bird Garden, ont été utilisés pour cette étude. Des tapis en caoutchouc ont été utilisés comme substrat d’essai sur la base des recommandations de la littérature publiée et pour faciliter le nettoyage et l’assainissement. La sévérité de la pododermatite a été mesurée avant et après le changement de substrat conformément aux scores de sévérité de Neilson. Des images thermiques et des photographies ont également été prises avant et après le changement de substrat. Les températures moyennes de chaque doigt (trois par pied) ont été mesurées à l’aide du logiciel FLIR. Les résultats de l’étude ont montré une augmentation de 12,6% de la gravité des pododermatites avec les tapis en caoutchouc. Aucune corrélation significative n’a été trouvée entre le niveau de gravité de la pathologie et le dépistage thermographique. Les résultats indiquent que le substrat peut influer la sensibilité au développement des pododermatites. Cependant, l’efficacité de la thermographie infrarouge dans l’identification subclinique de cette pathologie doit être étudiée plus avant, car la variation des données et les limitations ultérieures n’ont pas permis de tirer des conclusions solides.

Introduction

Flamingos (Phoenicopteridae) are commonly kept avian species in zoos, arguably one of the most ubiquitous (Rose et al., 2014). In 2010, it was reported that a total of 8837 flamingos were held in captivity; three of the most common species being the Chilean flamingo (Phoenicopterus chilensis), the greater flamingo (P. roseus) and the Caribbean flamingo (P. ruber) (King and Bračko, 2013).
susceptible to poor welfare due to lack of knowledge on their needs and gaps in the research present on what their requirements are (Fidgett and Gardner, 2014).

A common disease of captive birds, predominantly found in wading, domestic and raptor species, is bumblefoot (ulcerative pododermatitis) (Stransky et al., 2016). The cause of the disease can be bacterial, with infection found to occur through breakages in the plantar surface of the metatarsal pad (Tolpinrud et al., 2017). Nielsen et al. (2010) established that 100% of sampled flamingos within a captive population showed varied levels of foot change in comparison to wild counterparts. Wyss et al. (2015) further found that bumblefoot was the primary cause or secondary cause for 95% of euthanasia cases of captive flamingos. Despite the high prevalence of bumblefoot in captivity, there is limited literature present whether this is a disease occurring in wild populations (Tolpinrud et al., 2017). Consequently, complete disease aetiology is still unknown, although the requirement for preventative measures to be undertaken for zoo-housed birds are increasing (Tolpinrud et al., 2017).

Methods

To understand potential causative factors of bumblefoot and to determine a non-invasive way of detecting pathological changes to flamingo foot health, a 10-month study was undertaken on 14 captive Chilean flamingos held at Harewood Bird Garden, Leeds. The flock was comprised of eight males and six females, with a median age of 37.8 years old.

The aim of the investigation was to determine whether substrate type influences the prevalence of bumble foot in flamingo’s to aid in the discovery of preventative measures for the future, and to investigate the effectiveness of thermal imaging as a diagnostic tool for the sub-clinical identification of bumble foot and to assess its use as a potential long-term diagnostic method.

Tolpinrud et al. (2017) tested the use of thermal imaging as a diagnostic tool for birds and found a statistically significant difference between regions of the plantar surface that contained nodules, and those that did not. Despite the difference, the success of the tool as a non-invasive diagnostic screening method was still limited due to variations in flamingo foot temperature between each foot and overlapping temperature between sound and abnormal feet (Tolpinrud et al., 2017).

A baseline assessment of bumblefoot severity was first recorded. Photographs of each foot of each flamingo were taken using a smartphone camera and a handheld FLIR (Forward Looking InfraRed) E60BX thermography camera (Figure 1). The duration of the investigation (10 months) allowed for sufficient time for changes in foot health to occur. Foot assessments occurred three times over the duration of the study period (November 2016, February 2017 and November 2017) to reduce stress and prevent disturbance during any potential breeding event. Due to high variation and inconsistency in temperature readings however, the findings of the second foot assessment were discounted from the analysis. A comparison of data was drawn between the original substrate (concrete) and the implemented substrate (rubber matting). Analyses of thermal images occurred using FLIR software, provided with the camera (Figure 2).
Evaluation

Despite Hall (2008), Muir and King (2013) and Fiorello (2017) recommending the use of rubber matting as a substrate in both seabirds and wading birds, the results of this study were inconsistent, with a 12.6% increase in bumblefoot severity post implementation of the rubber matting. Various causative factors eliciting the negative result could have included where the matting was placed, with matting only distributed around the indoor pool due to keeper recommendations. Natural rubber has increased thermal conductivity in comparison to concrete and this may increase the potential for disease organisms to survive (Hernández et al., 2012; Aguilar-Bolados et al., 2016). Enclosure usage may also influence these results, with the flock being provided with access to natural environments (access to lake and pasture) during the warmer months.
Thermal readings were inhibited due to atmospheric temperatures; something that potentially combined with the flamingo’s behavioural adaption to thermal regulation (the raising of one leg close to the body) (Anderson and Williams, 2009), causing fluctuations in heat signatures detected by the FLIR camera. Variation in temperature could have also occurred between hyperkeratosis and papillomatous growths due to proliferation of the epithelial tissue and the increased distance between the epithelial surface and deeper vasculature tissue (Tolpinrud et al., 2017). The state of the bumblefoot lesion (active or dormant) and subsequent inflammation would also have influenced the readings taken by the FLIR camera (Marques et al., 2009).

An area not investigated for this study was the effect of nutrition. Flamingos in captivity are generally provided with formulated pellets, of breeding or maintained types. Influences of diet on bird health, body mass and exercise could be considered alongside of environmental factors that affect foot condition. Furthermore, although thermal images throughout the study showed highlighted heat signatures where bumblefoot susceptibility is high, due to data variation and subsequent study limitations, a definitive conclusion could not be drawn on the efficacy of this recording method.

Conclusion

The results of this study, although formally uncertain, highlights the importance of substrate type and where the substrate is located to flamingo management and health. Currently, although diagnostic methods for bumblefoot, both traditional scoring and infrared thermography are invasive, a combination of both methods could be more accurate in confirming disease presence and monitoring progression, if other environmental influences and individual bird health status is considered and measured too.

Acknowledgements

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References


Pink birds and baseball stars... renovations of the flamingo enclosure at the Birmingham Zoo, Alabama, USA

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Abstract

Flamingos at the Birmingham Zoo, Alabama were provided with changes to their habitat to encourage nesting and breeding activity within the flock. A fundraising effort provided the money for improvements to the birds’ pool and surrounding land areas, including removing unwanted vegetation and re-designing the edges around the pool to improve access for the birds. A donation of infield clay by a local baseball team was instrumental in enabling the bird team at the Zoo to make important alterations to the flamingos’ nesting island. This article discusses the changes made to the flamingo habitat and the timescale for the development and reintroduction of the birds, as well as the importance of relationships with organisations external to the Zoo, which are so helpful to the completion of projects of this nature.

Resumen

Los flamencos del Zoológico de Birmingham, Alabama, EE.UU. recibieron cambios en su hábitat para fomentar la actividad de anidación y reproducción en la bandada. Un esfuerzo de recaudación de fondos proporcionó el dinero para mejorar la piscina de las aves y las áreas circundantes, incluyendo la eliminación de vegetación no deseada y el rediseño de los bordes alrededor de la piscina para mejorar el acceso de las aves. Una donación de arcilla de cancha por parte de un equipo de béisbol local fue fundamental para permitir que el equipo de aves del zoológico hiciera modificaciones importantes en la isla de anidación de los flamencos. En este artículo se analizan los cambios realizados en el hábitat de los flamencos y el cronograma para el desarrollo y reintroducción de las aves, así como la importancia de las relaciones con organizaciones externas al Zoológico, tan útiles para la realización de proyectos de esta naturaleza.

Résumé

Au zoo de Birmingham, Alabama, des flamants, ont bénéficié de modifications de leur habitat pour encourager les activités de nidification et de reproduction. Un effort de collecte de fonds a permis d’améliorer le bassin d’oiseaux et ses pourtours, notamment en supprimant la végétation indésirable et en remodelant les bords du bassin pour améliorer l’accès des oiseaux. Un don d’argile fait par une équipe de baseball locale a permis à l’équipe de soigneurs des oiseaux du zoo d’apporter des modifications importantes à l’ilot de nidification des flamants. Cet article traite des changements apportés à l’habitat des flamants et du calendrier du développement et de la réintroduction des oiseaux, ainsi que de l’importance des relations avec les organisations extérieures au zoo, qui sont si utiles à la réalisation de projets de cette nature.

The Birmingham Zoo in Alabama houses a flock of 21 American / Caribbean flamingos (*Phoenicopterus ruber*), 12 males and nine females, with a median age of 18 years of age. The flamingos were originally brought in as eggs in June 2002 and hand reared by Zoo
staff. These birds live in the “Flamingo Lagoon” exhibit. The pool, yard and holding building were originally opened in 1955, and were originally constructed for capybara (*Hydrochoerus hydrochaeris*) and waterfowl before being updated in subsequent years for flamingos. Pre-renovation (Figure 1), the exhibit had a large lagoon (with a depth ranging between 1.2m at its deepest to 5cm at its shallowest) with steeply inclined walls, an island covered in pampas grass as a visual barrier, a small usable land space (the majority of the land being covered in decorative ivy) and a concrete cinderblock building with a single large holding stall with a sloping floor that could be partially flooded to create a pool for the birds and a small keeper space for cleaning and supply storage.

![Figure 1: The original flamingo exhibit at the Birmingham Zoo, prior to the refurbishment (photo credit: Birmingham Zoo).](image)

After many decades of planning and consultation and a robust fundraising effort, the Zoo raised $120,000 for the complete make-over of the flamingos’ home. It took a total of three months from the time the birds were corralled off exhibit and relocated to the Zoo’s health centre (Figure 2) in September 2019 to the completion of the project in December 2019, when the birds were reintroduced to the renovated and enhanced exhibit.

![Figure 2: Flamingos are moved to the health centre at the Birmingham Zoo before renovation and landscaping works commence in and around their exhibit. Soft turf is provided as the substrate in the temporary housing to protect the bird’s feet (photo credit: Birmingham Zoo).](image)
Renovations included clearing out much of the vegetation and many of the old-growth trees, which presented potential falling hazards to the birds and to zoo guests, installing new metal fencing to replace an old wooden fence, increasing the overall footprint of the habitat, removing an old wooden boardwalk (used by guests) that contoured the shallower end of the pool, installing a breeding area with sand and clay on the island portion of the habitat, and resurfacing the sides of the pool to allow easier access for the flamingos to and from the pool. The flamingos were reintroduced in December (Figure 3) and they have been monitored by animal care staff, who have seen that the birds have been doing well since their move into their renewed home. Although the flamingos regularly built nest mounds in the original exhibit, eggs have only been produced once (in 2017) and were infertile. The parents did not tend to the nest and trail cameras placed overnight revealed that the entire flock would move from their nesting area to the pool for most of the night. These exhibit renovations will allow for better husbandry and management regimes to be provided for the flamingos, as well as enhanced opportunities for the birds to successful nest within the exhibit.

A local baseball team, the Birmingham Barons, donated a load of infield clay to the new exhibit, in the hope of encouraging successful breeding. Clay was needed for the nesting area and makes an excellent substrate for flamingo nest building. In May 2020, members of the baseball team assisted Zoo staff in moving this clay into the exhibit, as well as incorporating it into the habitat overall and the bird’s nesting area (Figure 4).
The donation of clay by the baseball team provided an excellent media opportunity to show the links that can be forged between zoos and the wider community within which they operate (Figure 5); telling an excellent story of public and corporate engagement that benefits animal welfare and promotes the conservation outcomes of the Zoo and its animals.

Figure 5: Media coverage of the Birmingham Baron’s donation of infield clay to enhance the American flamingo exhibit (and chances of nesting) at the Birmingham Zoo, showing the links between the animal collection, conservation outcomes and local patronage. Article from: https://www.villagelivingonline.com/news/zoo-receives-special-gift-from-birmingham-barons/

The author of this article was not an employee of the Birmingham Zoo at the time of the renovations. Further information on the Caribbean flamingos at the Birmingham Zoo should be addressed to the contact information on the Zoo’s website www.birminghamzoo.com/about-us/contact-us
Hand rearing Chilean flamingo chicks at Belfast Zoo

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Abstract

This article explains how Belfast Zoological Gardens hand-reared two Chilean flamingo chicks for the first time in the Zoo’s 86-year history. The article describes the background to the hand rearing intervention and the methods used, as well as the housing and management of the young flamingos and their behaviour when introduced into the main flock. As to be expected, we learnt a lot with our first chick (“Popcorn”) therefore, we were better prepared and had more knowledge of what needed to be done with future chicks (“Peanut” who arrived two weeks later). This was a worthwhile experience, though challenging in the chick’s first week, it has assisted in strengthening the population of Chilean flamingos at the Zoo and it has increased capacity for hand-rearing of birds within the team of animal care staff.

Resumen

Este artículo explica cómo los Jardines Zoológicos de Belfast criaron a mano dos polluelos de flamenco austral (Phoenicopterus chilensis) por primera vez en los 86 años de historia del zoológico. El artículo describe los antecedentes de la intervención de cría a mano y los métodos utilizados, así como el alojamiento y manejo de los flamencos juveniles y su comportamiento cuando se introducen en la bandada principal. Como era de esperar, aprendimos mucho con nuestro primer polluelo ("Popcorn") por lo tanto, estábamos mejor preparados y teníamos más conocimiento de lo que había que hacer con los futuros polluelos ("Peanut" que llegó dos semanas después). Esta fue una experiencia valiosa, aunque desafiante en la primera semana del polluelo, ha ayudado a fortalecer la población de flamencos australes en el zoológico y ha aumentado la capacidad de cría manual de aves dentro del equipo de personal de cuidado animal.

Résumé

Cet article explique comment les jardins zoologiques de Belfast ont élevé manuellement deux poussins de flamants du Chili pour la première fois en 86 ans d’histoire du zoo. L’article décrit le contexte de l’élevage manuel et les méthodes utilisées, ainsi que l’hébergement et la gestion des jeunes flamants et leur comportement lorsqu’ils ont été relâchés avec le reste des oiseaux. Comme on pouvait s’y attendre, nous avons beaucoup appris avec notre premier poussin (‘Popcorn’) donc, nous étions mieux préparés et avions plus de connaissances sur ce qu’il fallait faire avec le second poussin (‘Peanut’ qui est arrivé deux semaines plus tard). Ce fut une expérience intéressante, bien que difficile au cours de la première semaine du poussin, elle a aidé à renforcer la population de flamants du Chili du zoo et elle a augmenté la capacité d’élevage manuel des oiseaux au sein de l’équipe de soins aux animaux.

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Introduction

Belfast Zoological Gardens is home to a flock of 42 Chilean flamingos (Phoenicopterus chilensis). Over a quarter of the Zoo’s flock is 20 to 22 years of age, and over half are eight to nine years of age. The flock now includes
two new chicks, which are the subject of this paper. This is the first time that the Zoo has hatched Chilean flamingo eggs, after many years of encouraging the flock to nest and breed.

“Popcorn” hatched on Monday 17th September 2018 (Chick 1) and “Peanut” hatched on Friday 5th October (Chick 2) the same year. The decision to lift the chicks was a difficult one, but the inclement weather caused by “Storm Helene” in September and “Storm Callum” in October meant that the chick’s chances of surviving the night were extremely low. This article is a personal story of involvement with the process of hand rearing, being the parent to two new flamingos, and watching them develop into adult birds.

**Meeting the chicks**

I remember when I first heard about being asked to hand rear a flamingo chick. My curator came in and told me that I was a “mummy”, which brought about confusion in my head. Later that morning he brought up an incubator containing this small ball of white fluff which looked like a cotton ball. I instantly fell in love with it. I didn’t know that something so small could take over my life so quickly. When our second chick arrived, two weeks after, I could not believe I was responsible for two of them, excitement took over. Looking back and comparing the size of the two, the chicks grew so much in the first two weeks. Since the day of their hatching, I have been there for every milestone and still, on occasion, pop over to the flamingo lake to check up on them. I hope that over the years Popcorn and Peanut themselves will become parents. That would be the icing on the cake.

**Diet**

From day one the chicks were weighed before being fed (Figure 1), which occurred every three hours; the temperature of the incubator was recorded at time too. Initially on the day of their hatching, a small dose of glutalyte (electrolytes and easily absorbable carbohydrates) was given to the chick for nutritional purposes. Over the next three days this was decreased as formula and water increased. The formula, as suggested by WWT Slimbridge and Chester Zoo, was made up of sprats (heads and fins removed), soaked and blended flamingo breeder pellets, hard-boiled egg yolk, calcium carbonate powder, vitamin supplement and Nutrabol (Vetark).

![Figure 1: Each chick was weighed before being syringe fed (photo credit: G. Murphy).](image)

There was the occasional time when we tried to increase the formula percentage, but the consistency was too thick, and the chick was not ready to accept it. Around Day 8 I would have a syringe of water as well as the formula and go between the two. Soaked flamingo breeder pellets were introduced at two weeks of age alongside of the formula that the two chicks were still receiving. With the chick consuming 90% formula on Day 18, the amount of water the chick was drinking from the syringe was also recorded at each feed. Tables 1 and 2 show how the time period that the amount of formula was increased for each chick during the hand rearing process.
Table 1: Chick 1, Popcorn, feeding regime

<table>
<thead>
<tr>
<th>Day</th>
<th>% formula</th>
<th>% water</th>
<th>ml consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>25 (+ 25% glutalyte)</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>40 (+ 20% glutalyte)</td>
<td>40</td>
<td>4 – 5.5</td>
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<td>4</td>
<td>50</td>
<td>50</td>
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<tr>
<td>7</td>
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<td>40</td>
<td>9 – 10</td>
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<tr>
<td>10</td>
<td>70</td>
<td>30</td>
<td>9 - 11</td>
</tr>
<tr>
<td>16</td>
<td>80</td>
<td>20</td>
<td>8 – 12</td>
</tr>
<tr>
<td>18</td>
<td>90</td>
<td>10</td>
<td>11 - 14</td>
</tr>
<tr>
<td>22</td>
<td>100</td>
<td>0</td>
<td>15 +</td>
</tr>
</tbody>
</table>

The variation in ml depends on the time of the feed, if the chick was hungry or not.

Table 2: Chick 2, Peanut, feeding regime

<table>
<thead>
<tr>
<th>Day</th>
<th>% formula</th>
<th>% water</th>
<th>ml consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>25 (+ 25% glutalyte)</td>
<td>50</td>
<td>4 - 5</td>
</tr>
<tr>
<td>3</td>
<td>30 (+ 40% glutalyte)</td>
<td>30</td>
<td>5 - 6</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
<td>60</td>
<td>7 - 9</td>
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<tr>
<td>5</td>
<td>50</td>
<td>50</td>
<td>6 – 7</td>
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<td>7</td>
<td>60</td>
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<tr>
<td>10</td>
<td>70</td>
<td>30</td>
<td>9 - 11</td>
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<td>18</td>
<td>90</td>
<td>10</td>
<td>10 – 13</td>
</tr>
<tr>
<td>21</td>
<td>100</td>
<td>0</td>
<td>15 +</td>
</tr>
</tbody>
</table>

The reason for the variation in ml is the same as for Table 1.

Once we had the chick on 100% formula, the millilitres each day increased from 14mls – 35mls over 22 days. The number of syringe feeds per day decreased gradually as dry and wet flamingo breeder pellets were introduced. By Day 27 there were five syringe feeds; from Day 35 this was reduced to four feeds; Day 37, three feeds included morning, midday and night-time; Day 40 was two feeds, first thing in the morning and last thing at night. Finally, at Days 42 and 43 there was a morning feed only. With the decrease of formula being offered to the chick, this meant consummation of pellets increased during the day and overnight.

Physical development

The beginning of Day 3 saw the first kinds of movement from the chick, by the end of the day they were standing more, beginning to walk and even standing to feed. Around a week old, the skin was starting to peel from the chick’s legs changing them from bright orange to a salmon pink colour. At twenty days old, the beak of the chick was starting to curve at the front, similar to that of their parents, and over the next week it was getting noticeably sharper as well. A month old and the skin was peeling on the feet and legs again, this time going from pink to grey.

The feathers of the chick didn’t start changing until around seven weeks, when dark white/grey feathers started to appear. The first sign of black primary feathers being visible occurred around week 8 to 9 and pink feathers started developing around nine months.

Between nine months and two years of age, the chicks started to look like adult flamingos, with their legs getting longer, necks becoming slimmer, plus beaks curving, sharpening and changing colour. During this same period, their adult pink and orange feathers came through. Even with this, the chicks were still identifiable due to their grey neck and head feathers, which was gradually disappearing.

Flamingo behaviour

When hand rearing any animal you are concerned that they may not develop traits specific for their species; in the case of flamingos, feeding with their head upside down, stomping their feet in water to release food to the surface or even how to communicate with other flamingos (important for when the time comes to introduce them back to their counterparts).
Day 3 was, for both flamingo chicks, when they started to stand and walk around for the first time; it was noticeable that Peanut (chick two) moved a lot more as he had the advantage of hearing a real flamingo chick communicating. At around a week old I wanted to get the chicks used to a range of surfaces and substrates, not just wood or towels, in case there may be issues later in life with a fear of something new, i.e. grass. Another anxiety concerned whether the chicks would understand the vocalisations of other flamingos. To ensure that they did, I played flamingo sounds on the internet while they were getting fed plus recorded the chicks themselves and played it back, which they responded to. During the same time there was improvement of standing on one leg, even if they were a bit shaky.

By two weeks old, we offered soaked pellets, which were broken into very small pieces (Figure 2). The chicks were showing signs of pecking at the ground and foraging so I thought it would be an ideal time to try them on pellets. As expected, they were becoming more inquisitive and interacted more with objects around them, biting objects within reach, including their feeding syringe.

At three weeks the chicks were beginning to explore more and enjoyed walking around after each feed; this had the added benefit of exercise and strengthening their legs. With the benefit of their newly found freedom, a small tray of water was introduced. It took a few days for the chicks to become accustomed to it but in the days that followed they became more inquisitive and started stomping their feet in the water, sitting down in it, turning their head upside down to try and feed and even preening in the tray too.

At one month old the chicks’ confidence was growing in all behaviours; standing on one leg (Figure 3), preening, walking in water and even sleeping while standing on one leg. As the weeks passed both chicks were developing more complex behaviours, for example, filter feeding and drinking from water and they also communicated to each other frequently. The final behaviour yet to see was attempts at flying. This occurred around seven weeks old when they started jumping and flapping their tiny wings- an amusing site and one that will never be forgotten!

Figure 2: Flamingo Breeder pellet was offered dry and soaked throughout the day (photo credit: G. Murphy).
Figure 3: The two chicks “behaving like flamingos”, resting whilst standing on one leg (photo credit: G. Murphy).

Housing

During the first two weeks, the chicks were housed in an incubator unit. This would be placed in the vet room during the working day as it was warmer, then taken home each evening. While Chick 2 was in the incubator, chick one was placed in cardboard box with a heat lamp overhead. Two weeks later, both chicks were placed into a specially designed crèche during the day, but still taken home each night. The crèche was divided with each chick having their own half. Each section contained a sleeping area, plus a bowl for food and water. During the day, when possible, the chicks were provided with paddling pools for wading in, a different size for each one.

Thursday 17th November was the first night that the chicks stayed over at the Zoo, a nerve wrecking time for their foster mummy. From this day on, the chicks were together during the day and should fighting occur, we were there to separate them if necessary. We need to remember that at this stage Chick 2 is only five weeks old and so still very small. We wanted the chicks to bond as we felt that this friendship would help them when it came to them being introduced to the adult birds.

News of the hand reared chicks had now hit social media and they were proving very popular. By the end of November (29th) the chicks were located to a different building to start preparing them for being outdoor birds. This enclosure had more room for them to move around as they were getting bigger, a heat lamp if necessary during the winter months, windows so the public could see them, plus it was a lower overall ambient temperature (again preparation for life outdoors). The chicks spent their winter and spring here before being moved in April 2019 for one final time.

Meeting the rest of the flock

The 12th April was when the chicks saw other flamingos for the first time. We fenced off part of the flamingo paddock for the chicks and added a heat lamp to their shed for particularly cold nights. Initially, the chicks were locked in overnight as we wanted them to get used to the shed and become accustomed to any sounds they may hear for the first time. Over time we noticed that the adult flamingos would come up to the fence, sleep beside it and even communicate with the chicks. We knew this positive behaviour would definitely make it easier when the chicks joined the adults. We wanted to wait until both chicks had turned one year old before letting them join the adults. On 16th October, we introduced the chicks to the flock and everything went as planned. The chicks kept to the outside initially or sometimes standing further up the paddock where their section used to be. Within a few weeks the only way to spot the chicks was by their grey head and neck, as they had completely bonded with the adults. As foster mummy I stayed away during this time as the chicks needed to get to know the adult birds and fully integrate with the flock overall.

Conclusion

Throughout the whole hand rearing process, our own veterinary team were heavily involved. The vets would see the chicks on a daily basis until they were a few months old. Gradually, health checks on the chicks became monthly to ensure they maintained the
correct weight and that physical development and behaviour were both normal and species appropriate.

Overtime, Popcorn and Peanut, who already had developed strong personalities, bonded with the whole group but would still come over if I called them. The younger of the two always had another chick with him from hatching, but the older never had that luxury. Even today, a couple of years later, Popcorn (Chick 1) will still come when called but Peanut (Chick 2) is not so sure. It is great to see that both flamingos, now turning two, are more and more difficult to pick out from their flock mates as each day passes. A successful hand rearing intervention and smooth transition into the rest of the flock.

Acknowledgements

Thank you to flamingo experts at WWT Slimbridge and Chester Zoo for their assistance with the hand rearing process.
Breeding events of greater flamingos in southern Spain during 1865–1926

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Abstract

During 1865-1926 there were at least 19 breeding events of greater flamingos in southern Spain, of which at least 12 had not been previously reported in the ornithological literature. The evidence of breeding for such unreported events is based on the presence of eggshells in the collections of some natural history museums.

Resumen

Durante 1863-1926 hubo al menos 19 eventos de reproducción de flamenco común (Phoenicopterus roseus) en el sur de España, de los cuales al menos 12 no habían sido reportados en la bibliografía ornitológica. La evidencia de esos casos de reproducción está basada en la presencia de cascarones de huevos en las colecciones de algunos museos de historia natural.

Résumé

De 1863 à 1926, il y a eu au moins 19 tentatives de reproduction de flamants roses dans le sud de l'Espagne, dont au moins 12 n'avaient pas été signalées dans la littérature ornithologique. La preuve de ces cas de reproduction est basée sur la présence de coquilles d'œufs dans les collections de certains musées d'histoire naturelle.

Introduction

In Spain, the greater flamingo (Phoenicopterus roseus) forms part of a metapopulation that spreads across the Mediterranean and NW Africa (Balkiz et al., 2007). There are many breeding records of the greater flamingo in Spain from 1958 onwards (e.g. Vargas Yáñez et al., 1983; Johnson & Cézilly, 2007), indicating that the species is, nowadays, a regular breeder, which has even occupied new breeding sites in the last two decades (de Juana & García, 2015).

The main habitats of the greater flamingo are shallow brackish and saline wetlands, which are characterised by seasonal and annual variations in water depth depending on rainfall. The transformation of many of such wetlands in salt pans and fish farms has likely facilitated regular nesting of the species during the last decades, as water levels are managed and remain more or less stable throughout the year (Béchet & Johnson, 2008). Indeed, greater flamingos commute regularly during the chick provisioning period to salt pans and fish farms, which in Spain may be located up to 400 km from the main breeding site (Amat et al., 2005).
Before such habitat transformations, the breeding of greater flamingos around the Mediterranean was triggered by rainfall during months preceding breeding, which determined the water levels in natural wetlands used as foraging sites during chick provisioning, and ultimately affected breeding success (Rendón-Martos, 1996; Máñez et al., 2009). The reliance on rainfall for breeding, likely determined that breeding by greater flamingos was an irregular event during the past, and this may have determined that many breeding attempts in Spain have remained undocumented.

Riddell (1945) reported three breeding events of greater flamingos in the marshes of the Guadalquivir (SW Spain) in which the eggs hatched, namely in 1935, 1941 and 1945. Bernis & Valverde (1954) compiled information, based on game keepers, on breeding events of the greater flamingo in the marshes of the Guadalquivir during the first half of the 20th Century, and concluded that the species bred in only three occasions, which were the same as reported by Riddell (1945). However, some years later Valverde (1960) reported ten breeding events in the marshes of the Guadalquivir between 1870 and 1947, three of which had already been reported by British ornithologists (Lilford, 1880; Chapman & Buck, 1893). Bernis & Valverde (1954) also stated that there were more than one hundred eggshells of greater flamingos in natural history museums in the United Kingdom and Germany, which had been collected in Spain.

In this article, we report on at least 12 breeding events of greater flamingos in Spain that were not previously documented in the ornithological literature.

Methodology

We relied on the occurrence of eggshells in natural history museums as evidence of greater flamingo breeding. Some natural history museums have databases of their collections accessible through Internet. These databases are usually available in North American museums, but not so in European museums (at least in the most important ones). In two North American museums there are eggshells of greater flamingos that were collected in Spain (see Table 1). In addition, we requested information from the Natural History Museum (Tring, UK) and the Zoologisches Forschungsmuseum Alexander Koenig (Bonn, Germany), of which only the Natural History Museum holds greater flamingo eggshells collected in Spain.

Lastly, we reviewed the ornithological literature for cases of breeding of greater flamingos in Spain during the late 19th and early 20th Centuries. We did not consider later years because the breeding events from 1930 onwards have been reported (Riddell, 1945; Valverde, 1960; Vargas Yáñez et al., 1983; Johnson & Cézilly, 2007; de Juana & Garcia, 2015).

Results

In the ornithological literature there are seven nesting records of greater flamingos occurring in Spain during 1865-1926 (Table 1). Moreover, and based on the occurrence of eggshells in the collections of natural history museums, it is clear that flamingos also bred in Spain on at least 12 additional occasions during that period (Table 1). The date of collection of an eggshell in the collection of the Natural History Museum is not accurate, as in on its card the date is indicated as “c. 1869” (Table 1). If such eggshell was not collected in 1870, when the flamingos certainly bred (Lilford, 1880), then there would now be 13 previously unreported breeding events in southern Spain. Most of the eggs in the museums where collected in the marshes of the Guadalquivir (Table 1). We assumed that in two occasions (1892 and 1904) the flamingos bred in Fuente de Piedra lake (southern Spain), as the locality of collection was “Malaga province”. On two occasions it was indicated that the eggs were collected in southern Spain, without any other specification.
Table 1: Breeding events of greater flamingos in southern Spain from 1865-1926, according to the presence of eggshells in the collections of museums and records in bibliographic sources. NHM= Natural History Museum, UK; AMNH= American Museum of Natural History, USA; WFVZ= Western Foundation of Vertebrate Zoology, USA.

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<th>Year</th>
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<tr>
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</tr>
</tbody>
</table>

Discussion

There are prehistoric paintings of greater flamingos in caves of southern Spain (Gurney, 1921; Topper & Topper, 1998), which were made about 5000 BC, indicating that the species is a component of the avifauna of the country from thousands of years ago. Thus, breeding may have been occurring from prehistoric times, although it was not reported until British ornithologists started to visit southern Spain in the 19th Century (e.g. Lilford, 1880). Chapman & Buck (1893) tried to look for greater flamingo colonies in the marshes of the Guadalquivir during several years, before finding one in 1883. Although the time they took in finding a colony might have been due to the difficult access to this,
by then, remote area, Chapman and Buck (1910) recognized that this could also have been due to the irregular nesting of greater flamingos in southern Spain. Indeed, these authors estimated that the species only bred after rainy winters, in two out of every five.

Even much less often than in the marshes of the Guadalquivir, the greater flamingo should have bred in Fuente de Piedra during the 19th Century. By then, the only sites for flamingo nesting in Fuente de Piedra lake were a few natural islets (called Canchones del Suroeste) that provided sufficient isolation only in years with exceptionally high water levels (Rendón-Martos & Johnson, 1996), otherwise the site was easily accessible to mammalian predators. However, in the late 19th Century a French company acquired the lake and constructed many dykes to exploit its salt content commercially. These dykes have allowed a more regular nesting pattern of the greater flamingo in Fuente de Piedra after the salt extraction and the disturbances ceased, and have been the main nesting sites of this flamingo in this area from 1950 onwards (Valverde, 1963; Vargas Yáñez et al., 1983; Rendón-Martos, 1996).

In the late 19th and early 20th Centuries the nesting colonies of greater flamingos were rarely successful in the marshes of the Guadalquivir, mainly because of eggs being taken by local people, who sold the eggs for human consumption (Lilford, 1880; Chapman & Buck, 1893). This practice likely facilitated the egg collectors that were visiting southern Spain, and who purchased eggs in the markets of villages surrounding the Guadalquivir marshes (e.g., Coria del Río, La Puebla del Río, Santiponce, Sanlúcar de Barrameda), as inferred after examining the cards of these eggshells. In other cases, the eggs could have been retrieved directly from nests by egg collectors themselves, as there are descriptions of nests and the characteristics of the associated breeding colonies on the eggshells’ cards.

Although our sample of museum is limited, two of these museums are hold the most important eggshells collections in the world, (Natural History Museum and Western Foundation of Vertebrate Zoology), we show the importance of museum egg collections to filling in gaps in our knowledge of species natural history. We provide a method for others to follow so that additional breeding events may be reported in the future when the collections of more museums are considered. The examination of eggshells collections may complement the cases reported in the literature to gain insights into the frequency of historic breeding events of greater flamingos.

Acknowledgements

With thanks to Dr Douglas G.D. Russell and Dr Till Töpfer who kindly replied to our queries on the occurrence of greater flamingo eggshells in the collections of the Natural History Museum, Tring (UK) and Zoologisches Forschungsmuseum Alexander Koenig (Germany), respectively.

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A successful first flight for International Flamingo Day, 26th April 2020

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Abstract

The Flamingo Specialist Group (FSG) is always looking for new ways to engage with its audiences, be they in person or online. A prominent standing on social media, a website used as a hub for key information and a yearly newsletter containing scientific and technical articles on all aspects of flamingo ecology and management are successful ways for the FSG to meet its objectives. Missing from these ways of information sharing and engagement was an international day to bring focus on to flamingos for everyone to share in, wherever they are in the world. As no official day celebrating the six species of flamingo currently existed, the FSG decided upon 26th April as the new International Flamingo Day (IFD). The creation of a new logo for this venture, along with the production of educational materials (free to download from the FSG website) and a schedule of social media events throughout the weekend of 25th and 26th April 2020, saw IFD reach a large audience and successfully meet its aims of explaining the beauty and wonder of flamingos and their wetland homes to a wide and diverse audience. IFD will return for 2021 and beyond, and it is the hope of the FSG that it becomes a fixture in the yearly calendar of “animal themed dates”.

Resumen

El Grupo de Especialistas en Flamencos, Flamingo Specialist Group (FSG), siempre está buscando nuevas formas de interactuar con su público, ya presencial o por internet. Una posición destacada en las redes sociales, un sitio web utilizado como centro de información clave y un boletín anual que contiene artículos científicos y técnicos sobre todos los aspectos de la ecología y el manejo de los flamencos son formas exitosas para que la FSG cumpla sus objetivos. En estas formas de intercambio de información y participación, faltaba un día internacional para centrar la atención en los flamencos para que todos pudieran compartir, en cualquier lugar del mundo. Como en la actualidad no existía un día oficial para celebrar las seis especies de flamencos, la FSG decidió el 26 de abril como el nuevo Día Internacional del Flamenco (International Flamingo Day, IFD). La creación de un nuevo logotipo para esta iniciativa, junto con la producción de materiales educativos (descarga gratuita desde el sitio web de la FSG) y un calendario de eventos en las redes sociales durante el fin de semana del 25 y 26 de abril de 2020, hicieron que IFD llegara a un público numeroso y cumpliera con éxito sus objetivos de explicar la belleza y la maravilla de los flamencos y sus ambientes en los humedales a una audiencia amplia y diversa. IFD regresará en 2021 y más allá, y la FSG espera que se convierta en un elemento fijo en el calendario anual de “fechas con temas de animales”.

Résumé

Le groupe de spécialistes flamants (FSG) est toujours à la recherche de nouvelles façons de dialoguer avec son public, que ce soit en personne ou en ligne. Une position de premier plan sur les médias sociaux, un site internet utilisé comme un centre d’informations clés
et une newsletter annuelle contenant des articles scientifiques et techniques sur tous les aspects de l’écologie et de la gestion des flamants roses sont des moyens efficaces pour le FSG d'atteindre ses objectifs. Il manquait à ces moyens de partage d'informations et d'engagement une journée internationale pour mettre l’accent sur les flamants roses, pour que tout le monde puisse les partager, où qu’ils soient dans le monde. Comme aucune journée officielle célébrant les six espèces de flamants roses n’existait jusqu’alors, le FSG a choisi le 26 avril pour en faire la nouvelle Journée internationale des flamants roses (IFD). La création d’un nouveau logo pour cette initiative, ainsi que la production de matériel pédagogique (téléchargeable gratuitement sur le site internet du FSG) et un calendrier d'événements sur les réseaux sociaux tout au long du week-end des 25 et 26 avril 2020, ont permis à l'IFD d’atteindre un large public et d’atteindre avec succès ses objectifs d'expliquer la beauté et les merveilles des flamants et des zones humides qu’ils habitent à un public large et diversifié. L’IFD sera de retour en 2021 et au-delà, et le FSG espère qu'il deviendra un incontournable du calendrier annuel des «dates à thème animales ».

Introduction

The FSG has a strong reach on social media, its Facebook page now has over 6000 likes and nearly 6500 followers (as of November 2020). This strong social media presence was useful for the launch and running of the first International Flamingo Day (IFD), launched by the FSG in the new year of 2020, IFD aims to celebrate the exceptional nature of flamingos, their behaviour, appearance and colour, as well as the beauty, fragility and uniqueness of their wetland habitats.

The FSG has been engaging with scientists, and flamingo experts as well as non-technical flamingo audiences for from its inception; successfully educating and informing audiences via its newsletter, website and social media pages. However, no “official” date existed as a focal point for attention on flamingos for all audiences globally. Numerous species and habitats have a global date designed to focus attention, awareness and advocacy for their cause.

World Wetlands Day (2nd February) and World Migratory Bird Day (9th May or 10th October) are just two examples of annual dates that celebrate key environmental features. In some case, such as World Giraffe Day (21st June) from the Giraffe Conservation Foundation, a species-specific date has proven extremely effective in garnering tangible support for conservation action and educational activity.

The steering committee of the FSG decided upon a suitably ornithologically-centred, flamingo-focussed date to be named as IFD, settling on the birthday of that pioneer of flamingo advertising, John James Audubon (1785-1851). The ornithologist and painter who produced the, now unique, life-size picture of the American (Caribbean) flamingo for his book “The Birds of America” (started in 1827). Audubon’s role in bringing flamingos to the public’s attention meant that his birthday of 26th April seemed a fitting date for IFD to run on.

To ensure IFD had real presence and branding, a logo competition was launched on the FSG’s Facebook page in the new year 2020, asking the flamingo-loving online audience to design a logo specifically for IFD, featuring the name of the date and the date, and to take some inspiration in the logo design from Audubon’s original flamingo design. The winning design, chosen by the co-chairs of the FSG was by produced by 8-year-old Logan. The launch of the logo, one week before IFD itself, received 132 likes and was shared 30 times, getting an overall reach of 4200 people.
The American flamingo, from Audubon’s “The Birds of America”, painted 1838.

Although wild flamingos can be remote, and not always accessible, flamingos are common and easy to see in zoos and wildlife parks—making them excellent ambassadors for their wild cousins and one of the best ways of explaining and enthusing the story of the wild flamingo and its wetland home. It was heartening to see the number of zoological institutions that came on board for IFD, promoting the many features of flamingos to their visitors; utilising the event as a way of celebrating not only their flamingos and flamingos out in the wild, but also the wetlands habitats that flamingos call home.

Due to the global Covid-19 pandemic, IFD was hosted as an online event by the FSG, utilising Facebook and Twitter as means of communicating with a wide audience. To encourage engagement with this online audience, #flamingostoyourfrontroom was used to bridge the gap between the virtual world and the real world. Posts, features and stories provided by the FSG on IFD were aimed at bringing flamingos closer to the lives of the online audience interacting with the day’s events.

Downloadable information on each of the six species was created and available on the FSG website, and they are still available for download now. Two posters were produced for each species; one that that provided key facts about the flamingo (“Fast Flamingo Facts”) including its behaviour, ecology, habitat and appearance, and the other a “spotter’s guide” that outlined the distinctive features of that flamingo, and what made it different from the other flamingo species. Links to YouTube clips that illustrated key behavioural features of each species were included in the online flamingo facts poster.

The FSG also produced a “what flamingo species are you” jokey personality quiz, where participants answer several questions relating to the characters, in a humanised manner, of the each of the six flamingo species to find out which flamingo matched their choices. Again, this quiz was freely available on the dedicated IFD section of the FSG website.

A link to a special edition of the WWT Flamingo Diary was also provided, with this diary entry (written by the author of this
article) explaining all about the need for IFD and what it aims to achieve, as well as discussing the impact of the Covid-19 pandemic and the associated closure of zoological collections on flamingo-related research and conservation activities.

Posts throughout the date of 26th April engaged with audiences using photos and videos and narrated clips of the birds to explain the focus of IFD and its key aims. As of November 2020, totalling the reach for each post on IFD itself reveals 42,622 people were reached by all of the posts on that Sunday (based on Facebook analytics data). There is clearly a huge appetite for engaging with flamingos, learning more about them and sharing the work that scientists, flamingo experts and others are currently involved in with these birds.

It is the FSG’s aim to build on this solid foundation of interest in the pink birds to continue IFD into 2021 and beyond, investigating new and exciting ways of engaging our current and would-be followers in the wonderful world of the flamingo - its unique biology and behaviour, its conservation relevance and the story it can tell about its incredible wetland homes.

We hope that the readers of Flamingo 2020 will join in for IFD on the 26th April 2021 and share their stories, photos and love for the flamingos, where they are (and wherever you are) around the globe.

An example of the educational poster produced for IFD, in this case for the Andean flamingo.

Websites mentioned in this article

FSG Facebook
https://www.facebook.com/FlamingoSpecialistGroup

Twitter @flamingospecgrp

IFD section of the FSG website
http://www.flamingo-sg.org/international-flamingo-day/

What flamingo are you quiz http://www.flamingo-sg.org/what-flamingo-are-you/

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https://www.wwt.org.uk/wetland-centres/slimbridge/diaries/flamingo-diary/2020/04/20/closed-but-still-caring-on-international-flamingo-day/18774#

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World Migratory Bird Day https://www.worldmigratorybirdday.org/

World Giraffe Day https://giraffeconservation.org/world-giraffe-day/
Behavioural observations to evaluate natural instinct in hand-raised rescued lesser flamingos in South Africa

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Abstract

When an artificial dam in South Africa suddenly dried up in the middle of the lesser flamingos breeding season, a wide rescue operation was put together. It ended up with the rescue of about 1800 chicks and eggs for hand-rearing before eventual release. It brought up countless challenges, both for the people and animals involved. Such a traumatic experience could have had disastrous consequences on the birds and jeopardise their survival and their future. However, numerous observations made during the project highlight resilience within the species. These observations are documented in this article and provide important information regarding the natural behavioural development and instinct of lesser flamingos.

Resumen

Cuando una represa artificial en Sudáfrica se secó repentinamente en medio de la temporada de reproducción de flamenco enano (Phoeniconaias minor), se organizó una amplia operación de rescate. Terminó con el rescate de alrededor de 1800 polluelos y huevos para criarlos a mano antes de su eventual liberación. Planteó innumerables desafíos, tanto para las personas como para los animales involucrados. Una experiencia tan traumática podría haber tenido consecuencias desastrosas para las aves y poner en peligro su supervivencia y su futuro. Sin embargo, numerosas observaciones realizadas durante el proyecto destacan la resiliencia de la especie. Estas observaciones están documentadas en este artículo y brindan información importante sobre el desarrollo natural del comportamiento y el instinto en el flamenco enano.

Résumé

Suite à l’assèchement brutal d’un plan d’eau artificiel en Afrique du Sud en pleine période de reproduction des flamants nains, une opération de sauvetage a conduit à la récupération de 1800 œufs et poussins dans le but de les élever à la main avant de pouvoir les relâcher. L’envergure de l’opération a apporté de nombreux défis à relever, aussi bien d’un point de vue humain qu’animal. L’impact d’un tel traumatisme aurait pu fortement nuire aux oiseaux, et compromettre leur survie ainsi que leur avenir. Cependant, de nombreuses observations détaillées ici montrent une extraordinaire résilience de l’espèce, et apportent d’importantes informations quant au développement comportemental naturel et à l’instinct naturel des flamants nains.

Introduction

Kimberley, Northern Cape, South Africa - January 2019: One of the major breeding sites in Southern Africa for lesser flamingo (Phoeniconaias minor), Kamfers Dam (Anderson & Anderson 2010; del Hoyo et al., 2020), endured an unprecedented challenge. The inflow of water coming into the artificial dam from the town of Kimberley drastically decreased, leading water levels to drop.
Consequently, the area surrounding the flamingo nesting island dried up, forcing the adult birds to move further into the dam to sustain themselves. In Southern Africa, the lesser flamingo breeding season usually occurs in summer, between December and April (del Hoyo et al., 2020). This sudden, artificially induced drought of Kamfers Dam then had a major effect on the survival of hundreds of newly hatched chicks and soon-to-hatch eggs. Around 5500 youngsters, old enough to follow the flock were able to head to deeper waters and available algae. Around 1800 chicks and eggs were left behind under the burning sun.

A country-wide and international operation was then quickly set up to rescue those chicks and eggs, with the goal of hand-raising them and releasing them back into the wild. The rescued birds were sent to several facilities across South Africa, including the National Zoological Gardens (NZG) in Pretoria, where the following observations took place over three months. The NZG initially received 200 compromised chicks from the rescue project, which were only a few days old at the time. The challenge in the first two weeks after the rescue was mainly to keep them alive and safe, as they arrived physically traumatised, very weak and dehydrated.

I arrived in South Africa and was assigned to the NZG right after those two weeks, and the following observations described in this article occurred after this sensitive part of the rescue.

**Methods**

These observations were all made on a daily basis during the rescue project. Approximately 130 lesser flamingo chicks were under the care of NZG when I arrived on 12th February 2019. No adult flamingos were rescued, and the chicks were still on, or near, their respective nests when rescued. This means that they only got to see their parents’ behaviour for a few days, as lesser flamingo chicks generally stay on or near the nest until they are 5 to 12 days old (Anderson & Anderson 2010; Brown et al., 2011; Shannon 2007). There were also no adult flamingos nearby in the NZG.

The rescued birds were received at NZG two weeks before I arrived. We can thus consider that they were between two and three-and-a-half weeks old at the beginning of these observations. The birds were first kept in groups of 10 to 15 individuals, then moved to larger groups.

The daily routine started with the weighing of each individual chick. Then they were crop fed several times a day until weaning (from ten feeds a day, down to only one). They were all microchiped so they would all be identifiable. Growth (weight, size) and health of each individual were monitored to ensure that body conditions suitable for release could be eventually achieved. After their time at NZG, the birds were brought back to Kimberley for release. These NZG chick re-joined the rest of the rescued lesser flamingos raised in other facilities across South Africa. They were between four and four-and-a-half months old when the first group was released back into the wild.

**Results**

**Brooding and begging behaviour**

Early in the first weeks, the birds showed some instinctive behaviours that are usually directed toward the parents. They would be congregating together or clinging to a stuffed toy made available in the pen when sleeping, as to be brooded under a parent wing on the nest (Brown et al., 2011; Shannon 2007). Some of them also started real soon to show a begging behaviour toward other individuals: standing in front of another bird, turning their back to them, making a characteristic begging call and trying to reach some fictional crop milk while pacing in motion with the other chick.

At that time, the other chick would respond and show the expected response from the parent (Brown 1971; Brown et al., 2011). I had previously observed this behaviour between
chicks from other species of flamingo raised by their respective parents. If we assume that all six species of flamingo display similar breeding behaviours (Brown 1971; Brown et al., 2011; Conrad & Kasielke 2020; Winkler et al., 2020), then it is probably safe to say that the observation made here was not of a rescue-induced behaviour. Healthy parent-raised chicks display the same kind of behaviour, so it could mean that the rescue did not alter their natural instincts.

Strength of the bonds between individuals

Wild and captive flocks can present strong bonds between individuals (Rose & Croft 2015; Rose & Croft 2020; Shannon 2000). This has been observed during this project. During the first weeks, the chicks were kept in small groups, for easy feeding, monitoring and management. After a few weeks, they were strong enough to handle being outside for the most part of the day. It was then noticed that some of them (about a 12 birds) would desperately try to climb the wires between the enclosures or would be pacing non-stop along the fence.

At first, we assumed that those ‘climbers’ were being bullied in the group they were in, as this often happened. Consequently, they were switched to another group to provide them with a calmer environment, but it did not systematically make this behaviour disappear. A few individuals would instantly start adopting the same behaviour on the next fence, toward the next enclosure. It became clear that they were trying to reach another individual on the other side. Consequently, we decided to keep them all in one large group, in a creche-setting closer to a wild one.

It was then observed that very strong bonds existed between some of the birds. As they were not tagged with identification rings and we could only recognise a few birds, we could not be sure that they were all the exact same birds. Despite this, we noticed that within identified bonded pairs, one of the two birds would constantly follow the other one everywhere, stay very close, sometimes try to hide between its legs. It appeared more like reaching for protection or reassurance than actual interaction. This behaviour was diluted with the birds growing up but was still observed when they were three-and-a-half months old.

Bullying behaviour

In parallel of the bonding behaviour, we observed some aggressive bullying. When the chicks were kept in small groups during the first weeks of the project, they were divided according to their size to prevent such behaviour as much as possible. However, we observed that some individuals systematically displayed aggressive behaviour, even when they were smaller than the ones they were bullying. Indeed, we could notice one or two small chicks being as aggressive towards larger chicks as they were with small ones.

As a result, switching them between groups was often necessary. It would temporarily create a calmer situation, both in the group they were coming from and in the one they arrived in. The aggressive bullying behaviour started to be noticeable when the younger birds were only about three weeks old. We observed that, as the chicks grew up, this behaviour occurred more often. We attributed that to the enclosures becoming too small for the growing birds. Thanks to a non-stop collaboration with the NZG personnel, we could regularly expand the size of the enclosures. Yet, it was only when the birds were kept in the larger creche and the biggest enclosure (i.e. provided with the largest amount of space) that the bullying behaviour decreased significantly.

One-leg resting

At approximately three weeks old, the stronger chicks started to sleep less (and less directly on the ground too). Chicks were already able to stand on one leg for short periods of time. Eventually, after a few weeks we observed that they all spent most of their resting time on one leg, probably because they had gained enough strength and balance
to do so. At the same time, we noticed that they were sleeping less soundly, being more aware of their surroundings while resting, both indoors and outdoors. Such observations were reassuring concerning their physical development, which further appeared to be normal when considering their weight and size growth rates. These observations suggest that the rescue operation did not impact the natural growth of the birds.

**Additional observations regarding bird growth**

Several additional observations mainly agree with the assumption that natural flamingo growth and developed was not impacted upon by the rescue operation.

a) A few days after we opened the big enclosure and regrouped the entire creche together, a helicopter flew over the zoo and the flamingos. They immediately grouped close together, each one staying as close as possible to the others, and the entire flock moving as one bird. They then displayed the head-flagging behaviour better known in flamingos as a courtship display (O’Connell-Rodwell et al., 2004; Stevens 1991) and maybe this stressor, followed by the sudden close proximity of all birds together, stimulated the first stirrings of potential courtship activity.

b) Lesser flamingos feed exclusively on blue-green algae in deep water, but they also can find food close to the shore (Childress et al., 2008; del Hoyo et al., 2020). They mainly feed near the water surface (Brown et al., 2011) but do share the ‘stamp-feeding’ behaviour found in the other flamingo species. The birds raised during the rescue project started to display this behaviour as instinctive between five and eight weeks old. It was combined with the use of their bill for filtering the water they were stirring.

c) Almost immediately after the birds were put outside during daytime, they instinctively went towards pools of water available in the pens and cleaned themselves. They already knew how to submerge themselves, dry their down and preen themselves afterwards.

d) At the same time as the previous observation, the birds started jumping around in the enclosure, flapping their wings. This could be assigned to a natural attempt to experiment with and use their wings, test their balance and their ability to play with air. We further observed that individuals showing feather growth over their down would take off for an instant, as to try to “understand” the wind direction and speed. The growing birds got more and more agile with their wings, as they developed condition thanks to increased exercise. As a result, after a few weeks they would completely take off for a few seconds. They were then assessed to be ready for returning to Kimberley before release.

The pictures of the first release event showed the birds flying, facing wind. In the wild, they would have been encouraged to undergo the same learning process by the adults in the colony (Brown 1971).

**Feeding behaviour**

At their arrival, crop-feeding by humans was performed to feed the chicks. At about six weeks old, the birds were offered the choice between crop-feeding by humans and bowls in their enclosures with food *ad lib*. The bowls were first filled with the crop-feeding mix used since their arrival, and adult food was then gradually introduced in the mix. Supplementary crop-feeding was still given twice a day then once a day to those who did not completely sustain themselves with the food they found.

We also chose to follow their preferences when transitioning between the ‘baby diet’ and young adult food. As a result, they transitioned themselves over less than a week, and finished weaning themselves from crop-feeding over two and a half days. As the birds started feeding themselves, we observed that they filled their crops more than we would have done with artificial crop-feeding. This is directly linked to the fact that their crop capacity quickly increases during the weaning process (Conrad & Kasielke 2020). The chick growth rates remained
satisfactory and kept the same pace during the entire weaning process. The feeding strategy that we used helped to minimise the handling time of the birds and, as a consequence, lowered the risk of them being imprinted.

Discussion

It is known that artificial rearing of flamingos can disrupt their intraspecific socialisation and induce some kind of imprinting, voluntarily or not (Conrad & Kasielke 2020). We did our best to keep the handling of the birds to the bare minimum to ensure them the best chances upon their return to the wild. These rescued lesser flamingos have shown the early development of behaviours (brooding, bond between individuals, bullying, one-leg resting) typically documented in flamingo species (Brown et al., 2011; Rose & Croft 2015). Also, the wide range of behaviours observed and explained in the results section show some strong natural instincts within the birds. Their physical and cognitional development, evaluated as normal, thereby seemed to not have been affected by their rescue and captivity, although appearing as traumatic. It all seems to give evidence of a strong resilience of the birds in the growth and survival characteristics of their species. Maybe of all flamingos as the six species do share some behavioural features. Plus, most of the wild behaviours witnessed here had already been seen in captivity.

Could it mean that captivity does not affect many of a flamingo’s natural instincts? Over the years, in the course of my professional work as a bird keeper, I have noticed many behavioural patterns in flamingos that had been captive for generations, shared by three species, both adults and chicks. These species were the greater (Phoenicopterus roseus), Caribbean (P. ruber) and Chilean flamingo (P. chilensis). Not having compared these behaviours with wild individuals, I wished to understand if some of the behaviours were captive-induced, or an integral part of the birds regardless of if they were wild or captive.

I also wanted to know if they were instinctive, taught by the parents, or shared within the flock, and if they were all shared with these three other flamingo species that I have cared for in the past. This rescue operation answered some of these questions, as those birds were wild, not raised by their parents, and of another species.

Finally, as the chicks observed at NZG were always kept in groups, first small then larger, it raises another question. Is the learning potential of living within a flock higher than what comes from the parents? Is growing in a flock promoting another sort of resilience and allowing wild behaviours to develop in captive settings?

Conclusion

Over three months, the birds displayed some amazing instinctive behaviours. Many of my observations raised fascinating questions, and call for more research into: The social bonds (positive and negative) between growing flamingo chicks; a potential link between these early bonds and the strong pair-bond that makes flamingos apparently monogamous (Conrad & Kasielke 2020; Shannon 2000; Winkler et al., 2020); and as lesser flamingos are the most gregarious if not the most social (Brown 1971; Rose & Croft 2020) of flamingo, assessment of social differences between the six flamingo species.

Aside of their behaviour, the speed of the weaning was quite surprising. It would be interesting to know more about the weaning process when the birds are raised by their parents. It may be of use in the event of another large rescue elsewhere in the world and provide an additional monitoring tool for the development of flamingo chicks. The goal of releasing these flamingos back in the wild means it is essential to make sure their development is viable.

Finally, and more generally, it is clear from these observations that rescue projects such as this provide an enormous learning potential to advance our knowledge of a
species, as important pieces of information can be gathered from the observation of rescued animals. It should be strongly encouraged to study the animals’ development if such an unfortunate event were to happen again. The comparison of these gathered data to the existing information on captive and wild flamingos also could both give more credit to studies on captive birds, by advancing husbandry through a better knowledge of their needs, as sometimes flamingos can be difficult to study in the wild (King 2000).

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References


Sixth International Simultaneous Census of three flamingo species in the Southern Cone of South America: Preliminary analysis

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Abstract

The sixth International Simultaneous Census (ISC) of High Andean Flamingos carried out during the summer of 2020 covered 551 wetlands in Argentina, Bolivia, Chile and Peru. A total of 795,551 individuals of the three flamingo species were recorded: 77,949 Andean flamingos (\textit{Phoenicoparrus andinus}), 154,001 puna flamingos (\textit{P. jamesi}), and 515,530 Chilean flamingos (\textit{Phoenicopterus chilensis}). We observed a sustained increasing trend in the global abundances of the three flamingo species. The known sites that concentrate high Andean flamingos in summer were reaffirmed, highlighting the area centered on the tripartite border of Argentina, Bolivia, and Chile. By significantly expanding census coverage compared to previous years, progress was made in the identification of sites of importance for the conservation of Chilean flamingos.
**Introduction**

The Grupo Conservación Flamencos Altoandinos (GCFA) began its international activities in 1996 with simultaneous censuses of the two High Andean Flamingo species, the Andean flamingo (*Phoenicoparrus andinus*) and puna flamingo (*P. jamesi*) throughout their range in Argentina, Bolivia, Chile, and Peru. To date, six international summer censuses of broad coverage have been carried out in 1997, 1998, 2005, 2010, 2015, and 2020, and two winter censuses in 1998 and 2000. The early censuses from 1997 to 2000 allowed the GCFA to establish baseline population numbers for both species of High Andean Flamingos, as well as the conservation status of their habitats (Caziani et al., 2007). The GCFA defined a five-year census frequency to monitor population trends of both species. The third simultaneous census (2005) provided the necessary scientific information to identify priority wetlands and design a Network of Wetlands of Importance for the Conservation of High Andean Flamingos (Marconi et al., 2007). Starting in 2010, lowland wetlands were incorporated into the summer censuses (Marconi et al., 2011), resulting in greater coverage of the Chilean flamingo’s range (Romano et al., 2011). Here we report on the results of the sixth International Simultaneous Census of flamingos carried out in 2020 (ISC20) and compare it with the results of 2005, 2010, and 2015 censuses.

**Methods**

The ISC20 was carried out by 190 participants including biologists, technicians, and park rangers, with the support of 33 organisations including national and international governmental organizations, academic and non-governmental organizations, and private sector companies. Census team leaders and country coordinators planned and coordinated the ISC20 through virtual meetings.

In Argentina, Bolivia, and Peru the census was carried out from 1st to 10th February 2020, the
dates that had been established previously for this activity. In Chile, the census was carried out from 21\textsuperscript{st} to 24\textsuperscript{th} January 2020, due to climatic conditions that strongly affect regions in northern Chile.

In conjunction with the flamingo ISC, teams also carried out the First Simultaneous Census of shorebirds in the Altiplano, with special emphasis on Neotropical migratory birds, and in particular the Wilson’s phalarope (*Phalaropus tricolor*). This census was coordinated by the Western Hemisphere Shorebird Reserves Network ( WHSRN), a program of Manomet, and the GCFA. The information obtained during the shorebird census will contribute to the development of the Midcontinent Americas Shorebird Conservation Initiative (Castellino & Lesterhuis, 2020), fostering collaboration and building synergies for conservation strategies for flamingo and shorebird habitats in the Altiplano.

The results of these censuses were complemented by flamingo census data provided by several researchers carrying out the Summer Neotropical Waterbird Census and the Lowland Phalarope Census in Argentina, coordinated by the WHSRN.

For the flamingo census, the GCFA census protocol was used (Marconi, 2010). In this report we used data on adults, sub-adults, and juveniles of the three flamingo species for population estimates. All census teams contributed their data of wetlands surveyed and flamingo abundances to the GCFA shared database.

**Results**

**Wetlands censused in ISC20**

![Maps of wetlands censused in ISC20](image)

*Figure 1: Maps of wetlands censused in ISC20: Left map: Blue dots are wetlands censused up until 2015; red dots are wetlands incorporated into the census in 2020; Right map: Colour dots indicate wetlands in different elevation ranges.*
During the ISC20, 551 wetlands were censused in Argentina, Bolivia, Chile and Peru (Figure 1), including lakes, lagoons, salinas, salt flats, bogs, rivers, marshes, marine coastline, spanning an altitude range from 0-4740 m.a.s.l., of which 29% (160 wetlands) are included in the 22 priority sites of the Network of Wetlands of Importance for the Conservation of High Andean Flamingos (Figure 2).

![Figure 2: Network of Wetlands of Importance for the Conservation of High Andean Flamingos, indicating the 22 priority sites identified.](image)

The ISC20 was the census with the broadest coverage organized by the GCFA and included the entire known distribution range of the Andean and puna flamingos, and most of the range of the Chilean flamingo, expanding wetland coverage by 55% and incorporating for the first time wetlands of the Patagonia region in southern Argentina (62 wetlands).

**Overall results**

Global results obtained during the ISC20 for the three flamingo species are summarised in Table 1. Unidentified individuals correspond almost exclusively to two wetlands, Laguna de los Pozuelos (39,201) in Argentina, and Salar de Surire (8,400) in Chile. In Laguna de los Pozuelos, the difficulty in identifying species is due to the large size of the wetland and the distance between the observers and the flamingos (Moschione & Sureda, 2008, Rodríguez et al. 2011). In the Salar de Surire, the census team consisted of one individual whose optical equipment could not distinguish species from a distance.
Table 1: Global results of the International Simultaneous Census (ISC) of the three flamingo species in the Southern Cone of South America from 1997-2020.

<table>
<thead>
<tr>
<th></th>
<th>ISC97</th>
<th>ISC98</th>
<th>ISC05</th>
<th>ISC10</th>
<th>ISC15</th>
<th>ISC20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puna flamingo</td>
<td>47,619</td>
<td>64,101</td>
<td>105,647</td>
<td>106,001</td>
<td>159,946</td>
<td>154,001</td>
</tr>
<tr>
<td>Andean flamingo</td>
<td>33,918</td>
<td>27,813</td>
<td>31,962</td>
<td>38,675</td>
<td>57,821</td>
<td>77,949</td>
</tr>
<tr>
<td>Chilean flamingo</td>
<td>39,087</td>
<td>25,777</td>
<td>40,889</td>
<td>282,752</td>
<td>267,627</td>
<td>515,530</td>
</tr>
<tr>
<td>Flamingo species</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>unidentifiable</td>
<td>0</td>
<td>0</td>
<td>26,547</td>
<td>8,623</td>
<td>2,783</td>
<td>48,071</td>
</tr>
<tr>
<td>Total</td>
<td>120,624</td>
<td>117,691</td>
<td>205,045</td>
<td>436,297</td>
<td>485,394</td>
<td>795,551</td>
</tr>
<tr>
<td>Wetlands censused</td>
<td>94</td>
<td>125</td>
<td>140</td>
<td>259*</td>
<td>244**</td>
<td>551***</td>
</tr>
<tr>
<td>Wetlands with High Andean Flamingos</td>
<td>69 (73%)</td>
<td>90 (72%)</td>
<td>117 (84%)</td>
<td>157 (61%)</td>
<td>127 (52%)</td>
<td>142 (26%)</td>
</tr>
<tr>
<td>Wetlands with flamingos</td>
<td>82 (87%)</td>
<td>108 (86%)</td>
<td>121 (86%)</td>
<td>193 (75%)</td>
<td>180 (74%)</td>
<td>287 (52%)</td>
</tr>
</tbody>
</table>

* Includes 26 lowland wetlands  
** Includes 52 lowland wetlands  
*** Includes 228 lowland wetlands

When comparing censuses with similar coverage -ISC05, ISC10, ISC15, and ISC20- including all wetlands surveyed, we observe a constant increase in the two High Andean Flamingo species until 2015 (Figure 3). In 2020, Andean flamingo numbers increased by 26% compared to 2015, while puna flamingo numbers remained stable. When considering only the same wetlands censused in those four ISCs (n= 68), we observe a sustained increasing trend for both High Andean Flamingo species over the last 15 years (Figure 3). However, the high number of unidentified individuals in 2020 introduces a bias in this comparison. In the ISC20, the increase in Chilean flamingo numbers is notable.

Figure 3: (left) Total flamingo abundances by species in ISCs with broad coverage. (right) Flamingo abundances by species in the subset of wetlands surveyed in the four censuses.
Spatial distribution of the three flamingo species in CSI20

Half of the global population of puna flamingos is concentrated in five high Andean wetlands (Figure 4): Laguna Colorada (17.6%) and Khara (7%) in Bolivia, Laguna Grande (11%) and Laguna Vilama (10.5%) in Argentina, and Salar de Tara in Chile (5%). The Andean flamingo presents a similar distribution pattern (Figure 4), with 50% of the population in four wetlands: Laguna de los Pozuelos (18%) and Laguna Palar (16%) in Argentina, and Laguna Colorado (10%) and Lago Uru-Uru (8%) in Bolivia. In the lowlands, only one priority site, Mar Chiquita, contributed to the high Andean flamingo count with 67 puna flamingos and 817 Andean flamingos.

![Figure 4: Maps of distribution and abundance by species: Puna flamingo (left), Andean flamingo (middle), Chilean flamingo (right).](image)

Both High Andean Flamingo species had distribution patterns similar to the previous ISCs (Caziani et al., 2006; Caziani et al., 2007; Marconi et al., 2011; Marconi et al., 2015). The sites with higher puna flamingo abundance in summer (76% of the global population) are concentrated in three areas. The largest includes the priority sites of the region around the tripartite area: Laguna Vilama and Laguna de los Pozuelos, Argentina, Reserva Eduardo Avaroa and Los López, Bolivia, and Reserva Nacional Los Flamencos National Reserve (Salar de Tara), Chile. Adding two other areas, Laguna Grande (within the Parinas priority site), Argentina, and Surire-Sakewa, Bolivia, these three areas encompass 93% of the total puna flamingo population.

The distribution pattern is somewhat less aggregated for the Andean flamingo. The sites in the tripartite area, Laguna Vilama, Laguna de los Pozuelos, Reserva Eduarco Avaroa, Los López, and Reserva Nacional Los Flamencos (Salar de Atacama), comprise 69% of the population. Sites to the north of the tripartite area, Lago Poopó (8.45%) and Surire-Sakewa (5.75%), and Salar Huasco-Coposa (3.64%) and Laguna Negro Francisco (4.48%) to the south have intermediate abundances, between 1,000 and 3,000 individuals.

The Chilean flamingo shows a different distribution pattern, with highest abundances (81%) found in lowland wetlands such as Mar Chiquita-Dulce, Lago Epecuén (Buenos Aires Province, Argentina), Loriscota and Parinacochas (Peru), Nueva Las Tunas (Córdoba Province, Argentina), Laguna Jara (Chubut Province, Argentina), Nihuil Reservoir (Mendoza Province, Argentina) and in two wetlands in the high Andes: Laguna de los Pozuelos and Lago Popó-Uru Uru, Bolivia (10.74%), Figure 4. In 2020, high numbers of Chilean flamingos stand out in Laguna Palar.
(9.27%) of the Laguna Vilama complex, with a high proportion of juveniles (> 50%).

**Flamingo abundances by country**

When analysing the ISC20 data for the puna flamingo by country (Figure 5), we observed a decrease in numbers in Bolivia compared to 2015, accompanied by an increase in Argentina. In the case of the Andean flamingo (Figure 5) numbers fluctuate in Chile, but we observe an increase overall in Bolivia and in Argentina (where numbers have doubled compared to the 2015 Argentinian population). Most of the Chilean flamingo population was found in Argentina throughout all of the censuses, with a notable increase in CSI20 (Figure 5). This increase in 2020 is also observed in Bolivia and Peru, while in Chile, numbers in the censused areas are the lowest for this species. Part of the global increase recorded in 2020 (5%) is due to the increase in coverage of that census. Lowland wetlands were not included in ISC05; these were incorporated into the ISC in 2010.

![Figure 5: ISC results by country for Andean flamingo (left), puna flamingo (middle) and Chilean flamingo (right).](image)

**Discussion**

The ISC in the summer of 2020 was the flamingo census with the broadest coverage to date, with 551 wetlands surveyed in Argentina, Bolivia, Chile, and Peru. The addition of new lowland wetlands did not expand coverage of the High Andean Flamingo species’ range, but did so for the Chilean flamingo, especially in Argentina where wetlands in the centre and southern regions of the country were added (Figure 1).

The ISC20 incorporated 304 new wetlands, 281 in Argentina and 23 in Peru, resulting in a 5% increase (25,141 individuals) in the abundance of Chilean flamingos counted. No new wetlands were incorporated in Bolivia or Chile. We aim to increase the census coverage for the Chilean flamingo in Chile because of known records in the south of the country. These preliminary results have important implications in prioritising conservation efforts for the Chilean flamingo and in defining a Network of Wetlands of Importance for the Conservation of Flamingos that considers the three flamingo species in the Southern Cone.

Comparing the censuses with similar coverage-ISC05, ISC10, ISC15, ISC20- and including the same wetlands surveyed in these four ISCs (n= 68), a sustained increasing trend in global abundances of both species of
High Andean Flamingo species is detected over the past 15 years. In ISC20, a notable increase in Chilean Flamingos was recorded (Figure 3).

When analysing the ISC20 data for the puna flamingo by country (Figure 5), we observed a decrease in Bolivia compared to 2015, accompanied by an increase in Argentina. This trend was even more dramatic in ISC10 (Marconi et al., 2011) and reinforces the evidence for complementary use of wetlands and the relevance of the regional and transboundary approaches in the analysis of census data and conservation strategies for these species which are concentrated in the tripartite border area of Argentina, Bolivia, and Chile.

The next steps identified with respect to the conservation of High Andean Flamingos include reviewing the list of priority sites and defining the incorporation of new sites based on the inclusion criteria used to define the Network of Priority Wetlands (Marconi et al., 2007). We are also considering using a category of “priority site in recovery” for those wetlands or wetland complexes that, based on the results of the ISC20, do not meet the inclusion criteria defined for the Network, but require special management and conservation programs or ecological restoration actions. We are also going to evaluate the current degree of implementation of the Network of Wetlands of Importance for the Conservation of High Andean Flamingos, through an analysis of the conservation status of each Network site.

Conclusions
Our data show a sustained increasing trend in the global abundances of these three flamingo species. The known sites that concentrate High Andean flamingos in summer were reaffirmed, highlighting the area centered on the tripartite border of Argentina, Bolivia, and Chile. By significantly expanding census coverage in 2020, progress was made in identifying sites of importance for the conservation of Chilean flamingos. The priority sites for the conservation of the Chilean flamingo should be identified applying the same criteria as those used for the Network for High Andean Flamingos, a conservation strategy for the species should be developed, and conservation strategies among the three flamingo species should be compatible.

Finally, we propose to strengthen links among the organisations participating in the ISC20, enhance their capacities, and design a joint monitoring plan for flamingos and other aquatic birds.

Acknowledgements
We are grateful to all those who supported the ISC20, including the 190 participants and 33 organisations who made execution of the census possible. Special thanks to Rob Clay and Arne Lesterhuis of the Manomet Bird Observatory. Financial support was provided by Manomet, the Convention on Migratory Species (CMS) in Peru, and the International Flamingo Foundation and Fundación Humedales in Argentina.

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Cross-fostering as a reproductive strategy for lesser flamingos at the San Diego Zoo Safari Park.

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Abstract

In 2020, all fertile lesser flamingo (Phoeniconaias minor) eggs at the San Diego Zoo Safari Park were pulled and fostered by American (Phoenicopterus ruber) and greater (P. roseus) flamingos. After many years of limited breeding success with these lesser flamingos, this fostering method resulted in the most successful year (to date) for breeding in this flock. This paper outlines the management strategy that was used and suggests could it be modified for use in other flamingo flocks under human care in order to improve reproductive success.

Resumen

En 2020, todos los huevos fértiles de flamencos enanos (Phoeniconaias minor) pertenecientes a San Diego Zoo Safari Park fueron extraídos y criados por flamencos Americanos (Phoenicopterus ruber) y comunes (P. roseus). Después de muchos años de éxito reproductivo limitado con los flamencos enanos, este año resultó ser el más exitoso (hasta la fecha) utilizando este método de crianza para la reproducción en esta bandada. Este documento describe la estrategia de manejo que se utilizó y sugiere que aspectos podrían modificarse para su uso en otras bandadas de flamencos bajo cuidado humano con el fin de mejorar el éxito reproductivo.

Résumé

En 2020, tous les œufs fertiles de flamants nains (Phoeniconaias minor) du zoo de San Diego ont été retirés à leurs parents et ont été confiés à des flamants des Caraïbes (Phoenicopterus ruber) et à des flamants roses (P. roseus). Après de nombreuses années de succès de reproduction limité avec ces flamants nains, cette méthode d’élevage a abouti à l’année la plus réussie (à ce jour) pour la reproduction de cette espèce. Cet article décrit la stratégie utilisée et suggère qu’elle pourrait être modifiée pour être utilisée pour d’autres flamants élevés en captivité afin d’améliorer le succès de la reproduction.

Introduction

The San Diego Zoo Safari Park (SDZSP) is a 730 hectare facility that opened to the public in 1972 and focuses on the breeding, conservation and display of a wide variety of animals, many of which are threatened or endangered. The SDZSP houses three species of flamingo: greater (Phoenicopterus roseus), Chilean (P. chilensis), and lesser (Phoeniconaias minor). The aviculture team has had immense success breeding the greater flamingo (with 316 chicks hatched) but breeding the lesser flamingo has proven more challenging. The lesser flamingo flock lives in an approximately 0.4 hectare exhibit with a large natural pond comprising of four islands, three of which are specifically for nesting (Figure 1). Each year, the aviculture specialists prepare the islands with fresh soil for nesting and build starter mounds for the
flock. From 1999-2019, 59 lesser flamingo chicks hatched but only 36 survived past their first 6 months. In 2020, the aviculture team decided to attempt cross-fostering as a method to increase the breeding success for lesser flamingos.

![Figure 1: The lesser flamingo exhibit at the San Diego Zoo Safari Park showing the islands provided for nesting (photo credit: F. Lujan.).](image)

**History of breeding**

From 1999-2001, the lesser flamingo flock produced 13 chicks, with nine surviving. Between 2002 and 2009, the lesser flamingos endured a period of no breeding activity. During this time, they shared a habitat with the greater flamingo flock, and it was later determined that the greater flamingos outcompeted the lesser flamingos for nesting space. In 2010, the greater flamingos were moved to a separate habitat and lesser flamingo breeding resumed. Each year, from 2010 to 2014, at least one lesser flamingo chick either went missing or was found predated. The presumed predator was a great horned owl (*Bubo virginianus*), which nests on the SDZSP grounds. All of the predations occurred over night and the necropsy findings pointed to an avian predator. In 2015, from 5th April to 1st May, a construction project to renovate the feeding area took place in the lesser flamingo habitat. This is usually the time period when nest building begins and the extended disturbance prevented any breeding that year.

Many years of parent rearing had resulted in limited success; subsequently artificial incubation and hand-rearing was attempted in 2016. This new method proved difficult and only two chicks were fledged, far fewer than originally anticipated. The following year parent rearing was once more undertaken with increased predator deterrents installed in the form of Nite Guard Solar lights (niteguard.com). In 2017, the lesser flamingo flock was successful in fledging seven chicks with zero predation (one chick perished due to unrelated causes). In 2018, the team observed similar challenges with two of three chicks predated, so hand-rearing took place in 2019 but resulted in zero surviving chicks. Since neither parent-rearing nor hand-rearing were very successful, the SDZSP team brainstormed other potential ideas and decided to pursue a creative solution by cross-fostering. In 2020, all fertile lesser flamingo eggs were fostered under American (Caribbean) flamingos (*Phoenicopterus ruber*) at the San Diego Zoo and under greater flamingos at the SDZSP.

**Evaluation**

The lesser flamingo flock laid 23 eggs from May-July during the 2020 season. Three separate egg collections were completed. On 26th May, ten eggs were pulled and candled for fertility. Four eggs were fertile and two were too early to determine fertility. All six eggs were set in incubators to await fostering. Five lesser flamingo pairs were left on dummy eggs (replicas of real eggs) and the flock continued to lay. Hatch dates for the fertile eggs were matched up with non-recommended American flamingo pairs at the San Diego Zoo that were sitting on dummy eggs.

On 28th May, four fertile eggs were placed in a portable incubator, driven 49 km to the San Diego Zoo, and fostered under the matched pairs. Of the two eggs that were too early to determine fertility when pulled, one was proven fertile and fostered on 6th June. This egg, upon candling that morning, did not
appear very strong, but the team was optimistic that natural incubation would increase the egg’s chance of survival.

The second egg collection was conducted on 18th June. Six eggs were pulled and candled for fertility. Two eggs were fertile and fostered under American flamingos on 22nd June. Four pairs of lesser flamingos were given dummy eggs. The lesser flamingos continued to lay while the American flamingos had already finished laying. Luckily, the greater flamingo flock was still laying at the SDZSP and had several potential foster pairs. A comparison of lesser and greater flamingo chicks is shown in Figure 2.

On 22nd July, the final egg collection took place and five eggs were pulled and candled. Two eggs were fertile, and one was too early to determine fertility. All three eggs were fostered under greater flamingo pairs at the SDZSP. On 27th July, the last egg was candled again and determined to be infertile. The lesser flamingos were given three weeks to lay any additional eggs, and then on 15th August all dummy eggs were pulled. Of the nine fertile lesser flamingo eggs fostered, all hatched and eight survived, making 2020 the most successful breeding year for this species at the SDZSP (Figure 3). The chick that did not survive hatched from the egg that did not look strong on 6th June. This chick hatched on 22nd June and was found dead on the nest mound the following morning.

Acknowledgements

Thank you to all the Bird Department staff at the San Diego Zoo Safari Park and San Diego Zoo, especially Fatima Lujan and Jenna Duarte for completing endless hours of nesting observations.
Lesser flamingos of Kamfers dam: A review of the rescue and developments during lockdown

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Abstract
The lesser flamingos (Phoeniconaias minor) of Kamfers Dam in Kimberley, Northern Cape, South Africa are one of four breeding colonies in Africa and the only one situated in South Africa. This non-perennial pan was changed into a permanent wetland when the municipality started discarding treated effluent of the nearby sewage plant into the pan. A breeding island was built by a local mining company and nature conservation organisation in 2006 that brought about great breeding success, producing roughly 24000 chicks. This island flooded a few years later and the flamingos started breeding on the South Western side of the dam in 2017. This new breeding site of the lesser flamingos was in danger due to the drought of the 2018-19 breeding season and failing sewage system reducing the dam’s water levels. The result of this was a huge rescue effort by the of about 2000 chicks that made the news worldwide and had a global impact.

Resumen
Los flamencos enanos (Phoeniconaias minor) presentes en Kamfers Dam en Kimberley Northern Cape Sudáfrica conforman una de las cuatro colonias reproductoras en África y la única situada en Sudáfrica. Esta cuenca no perenne se transformó en un humedal permanente cuando el municipio comenzó a desechar en la cuenca, el efluente tratado de una planta de aguas residuales cercana. En 2006 se construyó una isla de cría por una empresa minera cercana y una organización de conservación de la naturaleza que generó un gran éxito en la cría, produciendo aproximadamente 24000 polluelos. Esta isla se inundó unos años más tarde y en 2017 los flamencos comenzaron a reproducirse en el lado suroeste de la presa. Este nuevo sitio de reproducción de los flamencos enanos estuvo en peligro debido a la sequía que ocurrió durante el período reproductivo 2018-19 y a un fallido sistema de drenaje que redujeron los niveles de agua de la presa. Como consecuencia de esto, se realizó un enorme esfuerzo de rescate de unos 2000 polluelos que fueron noticia en todo el mundo y tuvieron un impacto global.

Résumé
Les flamants nains (Phoeniconaias minor) du barrage de Kamfers à Kimberley Northern Cape en Afrique du Sud sont l'une des quatre colonies de reproduction en Afrique et la seule située en Afrique du Sud. Ce lac salé saisonnier a été transformée en zone humide permanente lorsque la municipalité a commencé à y rejeter l'effluent traité de la station d'épuration proche. Une île a été construite pour la reproduction par une société minière et une organisation de conservation de la nature à proximité en 2006. Ce projet a été un grand succès résultant en la naissance d’environ 24 000 poussins. Cette île a été inondée quelques années plus tard et les flamants nains ont commencé à se reproduire du côté sud-ouest du barrage en 2017. Ce nouveau site de reproduction des flamants nains était en danger en raison de la sécheresse pendant la saison de reproduction 2018-19 et du système d'égouts défaillant réduisant les niveaux d'eau du barrage. Cela s’est soldé par une énorme
Introduction

Kamfers Dam is an ephemeral (non-perennial) pan situated approximately 6 km outside Kimberley South Africa where three biomes, Nama Karoo, Grassland and Kalahari Savanna come together. Kamfers Dam is classified as a Highland Salt pan and is the home of about 60 000 Lessor flamingos. The pan covers between 500 to 600 ha and is on the receiving end of catchment area of roughly 160km² (Anderson 2018). This dam has an evaporation rate of around 8.5 -10mm per day in the high summer months. In 2006 this ephemeral pan changed to a permanent wetland when the pan received a steady inflow of treated sewage from the nearby sewage plant (Anderson & Anderson 2010).

Along with this change, a flamingo Island was designed and built by Ekapa Minerals and Mark Anderson along with various partners as an attempt to encourage the undisturbed breeding of the lesser flamingos visiting the pan on a regular basis. This project was completed in 2006. The island was successful for three consecutive years and roughly 24000 flamingo chicks hatched on this Island. Kamfers Dam became the fourth breeding site for Lessor flamingo’s in Southern Africa and the first breeding site in South Africa (Anderson & Anderson 2010). In 2010 the island sadly flooded which resulted in the drowning of hundreds of young chicks. However, in 2017 the flamingos started breeding on the South Western side of the dam with great success without the island. In the 2018-19 breeding season about 2000 of the 8000 breeding pairs abandoned the nests with day old chicks (Figure 1) and hatching eggs after a prolonged drought and a dysfunctional sewage work that could not deliver a constant water supply each day.

Evaluation

On 24 January 2019 the community of Kimberley initiated a rescue attempt to save roughly 2000 of the abandoned chicks and eggs from the pan. About 5500 older chicks remained behind moving into the receding water of the pan.

Figure 1: Abandoned lesser flamingo chicks at Kamfers Dam in January 2019. Photo credit: E. van der Westhuizen-Coetzer)

This was an unknown situation for the rescuers and scientists, leading to vets being called in to assist. The main problem was the logistics of how to get all these chicks rehydrated and fed as this was the first rescue attempt of its kind. Birdlife South Africa assisted by supplying a recipe for feeding the day-old chicks similar to the crop milk produced by the parents. This was an egg-based diet that was enhanced with a few other ingredients such as shrimp, vitamins and fish, and it seemed to work very effectively.

Most of the chicks were flown out by plane to various rehabilitation centres across South Africa. Philanthropists and the public opened their hearts all over South Africa and donations were made to the rehabilitation centres to assist with the rearing of these chicks. This was only the beginning of a challenging four-month period to raise the
chicks to a stage that they can self-sustain. Countless hours of feeding, cleaning of cages, washing of young adults and hours of monitoring was needed to achieve this.

Large numbers of chicks died from simply being too weak to survive the trip or as in one case an outbreak of Avian pox at one of the institutions. Chicks had to be fed every three hours through the night for a duration of between four to eight weeks. After this the birds got fed a special blend called AV + that was dissolved in water. This speciality blend was manufactured with a high content of oil that rubbed off on the bird’s feathers during preening. This high oil content influenced the bird’s waterproofing, and everyone had to be washed beforehand which allowed time to secrete their natural oils to facilitate waterproofing (especially important before eventual release into the wild). This tremendous task, of caring for all of these chicks properly, was undertaken by the team and with assistance from the experts at SANCOC from Cape Town.

Flamingos were released from May 2019 when they reached the release criteria as set out by the ecologists and vets. A decision between hard release or soft release had to be taken. The choice was made to release the first birds using a hard release approach. This approach seemed logical as a soft release would take weeks to achieve and would mean extra shelter and facilities being built at Kamfers Dam, incurring additional costs. Birds would be monitored if assistance was required after release.

Releases occurred at two specific points at Kamfers Dam. First two releases were on the eastern side of the dam and all other releases on the western side. The western side of the dam is privately owned land and the chicks could be monitored safely at various times of the day. All the birds ready to be released were ringed with a colour and a metal ring. Some birds received a backpack tracker as well (in total about 25 throughout the release process) to monitor their movements throughout Africa.

A total of 550 birds were released from May to July 2019. The last two released groups were released in winter and were closely monitored each day for about 6 to 8 weeks to make sure that the harsh Northern Cape winters did not influence the group too much with regards to food availability and inclement weather conditions. As the algae blooms in the dam returned to normal, the group became more independent and slowly integrated with the rest of the 70000 wild birds on the dam.

During the monitoring period several patrols were conducted around the dam to determine mortality of the released birds and to recover rings and capture data as accurately as possible. Mortality was due to various predators such as caracal (*Caracal caracal*), mongoose species and African fish eagles (*Haliaeetus vocifer*). Human predation also took place in some areas. Human predation was localised to an area that was managed by the Koi San. The trackers were recovered safely and could be refitted to other birds. Powerline collisions were also a big factor in mortalities. Lesser flamingos tend to travel at night in search of other food resources and then collide with the powerlines. Daily walks along the railway line was also undertaken to...
ensure that most rings and injured birds could be recovered if possible. Other causes of mortality were the harsh winter conditions and the lack of algae growth during these unfavourable months.

Human imprinting was another issue that was experienced for some birds due to the hand rearing process. However, all these birds eventually integrated with the wild birds at some stage without returning to humans. Some of the birds that were the most imprinted on humans, rehabilitated before the lesser flamingo imprinted birds.

By the end of September 2019, some of the last birds in Kimberley could be returned to the wild as they all achieved the release criteria. However about 195 birds are still in captivity at some of the rehabilitation centres and still need to be released when they are fit and able. In October 2019 the adult birds started with nest building in various areas in Kamfers Dam again. This breeding behaviour was closely monitored from a distance. The danger was that late breeders could abandon their nests, having the same outcome as the previous season, which would not be ideal. In February 2020 there was about 3000 nests on the south western side of the dam with birds sitting on them. Eggs were noticed on some nests. Around 8th March 2020 several week-old chicks were observed between the adults, finding their way in the water.

The lockdown period in South Africa was announced 22nd March 2020 and the team was unable to check up on the breeding at the dam. However, on the 1st May when the restrictions allowed it, a visit was made to the dam. Lockdown had a tremendous unexpected effect on the breeding success. About 2000 chicks varying in age from three weeks to two months old were formed into a crèche close to the shoreline. The flamingos had managed to breed with great success during a very difficult time without any human interference.

Conclusion

Lesser flamingos all over the world experience drought and other challenges during breeding season. Never before has a rescue attempt of this capacity been undertaken. However, although about 2000 chicks were rescued from the site only about 550 were released back into the wild and a number of these did not survive the winter conditions. Excluding the birds still in captivity this was a success rate of approximately 27.5%. Does the cost and effort of this rescue operation rationalise the success of the operation or should rescue operations in future rather be avoided? In the author’s opinion, the knowledge gained from the experience and the awareness created by the rescue had more value than the success rate. The lesser flamingo is classified as Near Threatened, with a declining population caused (in part) to human activity, therefore these reintroduced birds (regardless of how costly the introduction may have been) can play a vital role in helping improve the future of this species in the wild.
In memoriam: Adelheid Studer-Thiersch

Catherine King

We regretfully announce the passing of Adelheid Studer-Thiersch, a much respected and appreciated member of our flamingo community, on 18th June 2020, at 80 years of age. Adelheid was a pioneer in flamingo behavioural research, describing for the first time many ritualised behaviours important in flamingo communication and reproduction.

Adelheid's fascination with flamingos began more than 60 years ago, when she began observing them during an internship at the Basel Zoo in 1958. She received her PhD in 1966, under the supervision of Professor Konrad Lorenz, with her thesis entitled “Die zogenannte Balz der Flamingogattung Phoenicopterus, literally translated to “the so-called courtship behaviour of the flamingos (genus Phoenicopterus)”, primarily based on her study of flamingos at Basel Zoo. Several publications on ethology of flamingos, including comparative analyses of breeding behaviours, resulted from her work. Adelheid continued studying the Basel Zoo flamingos, one of the most consistently successful breeding groups of flamingos in captivity, throughout her life. Her acute observation skills, many viewing hours and her familiarity with each flamingo in the group resulted in recording numerous unusual behaviours, for example un-paired male flamingos acting as a helper in feeding the secretion normally provided only by the parents to nourish a particular chick.

Adelheid created partnerships between Basel Zoo and research facilities, leading to insights in many aspects of flamingo morphology, phylogeny, physiology and ecology. Much of our knowledge about the secretion fed by the parents to chicks is a result of investigations that she drove and participated in. More recently, observations of feeding flamingos at Basel Zoo has been used to interpret feeding strategies studied in the Camargue, and her work has clearly demonstrated how study of captive flamingos can benefit our understanding of the biology of flamingos generally.

Adaptations of flamingos to irregular breeding conditions intrigued Adelheid, and she identified many physiological and behavioural patterns in her studies at Basel Zoo that would benefit such a breeding strategy under natural conditions. For example, she observed that the nesting flamingos in captivity form smaller groups that perform breeding displays together and then nest together. Breeding synchronization has several benefits, including reducing fighting between neighbours, thereby reducing egg loss and energy expenditure. Unfortunately, Adelheid was not able to demonstrate that the small groups of greater flamingos displaying together in the wild were the same individuals that then bred together during her study of reproductive behaviour of greater flamingos nesting in Spain because of the paucity of tagged individuals. Hopefully with increased marking of flamingos in colonies in situ, someday her hypothesis will be validated.

Adelheid’s understanding of the needs of the Basel Zoo flamingos led to changes in their enclosure and their management, resulting in the high and consistent breeding success. A new enclosure, incorporating her ideas, was constructed in 1990 and the layout of this enclosure still serves as a model for other zoos wanting to house flamingos in optimal conditions. Basel Zoo has been a leader in studying the problem of foot lesions in captive flamingos, developing possibly the first lesion scoring system, and later showing unequivocally how much and how quickly lesions can be affected by substrate. Adelheid served as an active advisor to the European Association of Zoos and Aquaria (EAZA) Ciconiiformes and Phoenicopteriformes Taxon Advisory Group, and her presentations at various meetings as well as her publications have been helpful to many zoo professionals in improving captive management of flamingos.
In contrast to her work with flamboyant flamingos, Adelheid also spent much effort in recent years to protect a non-descript beetle endemic to a small site along the Basel railway. During her life she also studied a variety of other animals as well, including fairy terns in the Seychelles, and she acted as a scientific supervisor during a series of films on nature in that country. She was co-editor of the publication “Der Ornithologische Beobachter” between 1960-1975 and served as editor of the Annual reports of the Basel Ornithological Society between 1987-1998. A passionate birder, Adelheid had a habit of watching the sky rather than the path in front of her, resulting in several accidents, including a broken collar bone!

Home life for Adelheid was intertwined with Basel Zoo, as she lived next to the zoo much of her life, allowing her to pop down to observe the flamingos at will. Her husband, Dr Peter Studer, first a fellow student interning at the zoo, became curator for the aquarium and later director of the zoo. Her family was an important element in Adelheid’s life. Insightful descriptions of her two sons and later five grandchildren’s personalities were characterised by her appreciation of them and her sense of humour.

I was thrilled to finally meet Adelheid for the first time at the XXV International Ethological Conference in Vienna in 1997, as I had avidly read every one of her publications relating to flamingos that had appeared in English, and had tried to glean what I could with my rudimentary German from the others. That meeting resulted in my travelling to Basel for several years thereafter to record copulation behaviour of flamingos in the Basel colony. Adelheid and Peter shared their home and the charms of the city of Basel with me, and I will never forget their generosity and kindness in those years. I will also never forget the instructive and thought-provoking conversations we had about flamingos and I am very grateful for all the insights that Adelheid shared. She also graciously presented me with her second copy of the much coveted book “Flamingos”, published in 1975, and I think of her every time I open it.

Adelheid was a good listener, eager to hear about the ideas and observations of others who shared her passion for flamingos. She never stopped observing, learning and reinterpreting her conceptions as her knowledge grew throughout her life, and was always pleased to share her experiences if these were useful to someone. Adelheid definitely deserved her award recognizing her lifetime of dedication to flamingo conservation and research given during the last international Flamingo symposium held in 2014. It was an award richly deserved.

Anyone wishing to make a donation in her honour can select from two organizations that she chose:

Zoo Basel: Binningerstrasse 40, 4054 Basel, IBAN: CH68 0900 0000 4000 7096 0
Pro Natura Basel Gellertstrasse 29, 4052 Basel, IBAN: CH66 0900 0000 4000 2094 4
In memoriam: Bhavbhuti Mukundray Parasharya

Taej Mundkur

Dr Bhavbhuti Mukundray Parasharya was an accomplished ornithologist, having undertaken extensive research on the ecology, distribution and conservation of flamingo in Gujarat, in western India. He has been a long-time member of the Flamingo Specialist Group and had contributed articles to its newsletter. He was born on 4th July 1955 in Bhavnagar, Gujarat and to where he retired until his untimely death due to COVID 19 on 9th October 2020.

Bapu as we all called him respectfully, was a wise man of great wit with a sharp tongue. Our first meeting was in mid1984 when I joined the Department of Biosciences at the Saurashtra University, Rajkot, to start my Ph.D. This was around the time Dr Parasharya had just completed his degree, both of us did our work under the able guidance of late Prof Dr R. M. Naik. His thesis had focused on the ecology of western reef heron (*Egretta gularis*), painted stork (*Mycteria leucocephala*) and other coastal waterbirds. Dr Parasharya then served as Research scientist - 1984 to 2017 at the Gujarat Agricultural University in Anand, where his research focussed on management of birds, insect and rodent predators and conservation of birds in agricultural landscapes leading to several recommendations for both farmers and scientific community as part of the *All India Coordinated Research Project on Agricultural Ornithology* or later the *All India Network Project on Agricultural Ornithology*. Through this work, many important advances were made in understanding the positive and negative interactions of birds and insects with different agricultural crops.

Flamingos remained his special passion and he spent many years surveying potential nesting areas in the expanses of the Great and Little Rann of Kachchh under hostile weather conditions, and researching various aspects of their ecology and conservation. He published extensively on these issues and also contributed to the 2008 International Single Species Action Plan for Lesser Flamingo produced by IUCN-SSC/Wetlands International Flamingo Specialist Group, Wildfowl & Wetlands Trust, Wetlands International and BirdLife International Africa Partnership and published by the Convention on Migratory Species and African Eurasian Waterbird Agreement.

Besides birds, Dr Parasharya took great interest in all forms of flora and fauna, and he published a range of articles on insects, reptiles and mammals in English and Gujarati. He has guided four doctoral students and more than 12 masters’ students in, as well as ecology of flamingos, Indian sarus cranes (*Grus antigone*) and many other birds, as well as in agricultural entomology (specifically concerning spider, butterfly and insect diversity).

Dr Parasharya served as the state coordinator of the Asian Waterbird Census (AWC) for Gujarat for several decades and through this work got an opportunity to work with amateur birdwatchers, researchers and forest staff from across the state. As I coordinate the AWC regionally for Wetlands International during this time, we had many opportunities to discuss a range of bird identification, monitoring and conservation and I was impressed by his knowledge and understanding of local issues. Dr Parasharya had been one of the driving forces in the establishment of the Bird Conservation Society of Gujarat in 2002 and had served on the editorial board of its newsletter aptly named *Flamingo - Bulletin of Gujarat Birds*. Through his keen interest, *Flamingo* has grown to be an important publication for bird enthusiasts and ornithologists in the state and country.
Even after his retirement from the university, Dr Parasharya was active in research and conservation activities until his untimely death. He had recently discovered a new breeding location for the greater flamingo in private salt pans in the Gulf of Khambhat in Gujarat, quite some distance away from the known breeding sites for the species. Since then, he had been working with the salt pan owners to encourage them to enhance protection (including from bird photographers) and on an expansion of the nesting sites.

Bapu will be greatly remembered for his hard work and life-long dedication to the cause of bird and nature conservation. Selected publications of his, pertaining to flamingos are listed below.


Dr B.M. Parasharya (second from right) with fellow Asian Waterbird Census coordinators at the launch of the latest AWC India report during the 13th Conference of the Convention on Migratory Species Conference, Gandhinagar, India,
Flamingo-related publications 2020

Relevant publications relating to flamingos, their biology, behaviour, ecology, conservation, health and/or management.


Global flamingo population estimates (2020)

Wild populations

<table>
<thead>
<tr>
<th>Species</th>
<th>Population (max. estimate)</th>
<th>Population trend</th>
<th>IUCN Red List classification</th>
<th>Assessment date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater flamingo</td>
<td>680,000</td>
<td>Increasing</td>
<td>Least Concern</td>
<td>07/08/2018</td>
</tr>
<tr>
<td>Caribbean (American) flamingo</td>
<td>330,000</td>
<td>Increasing</td>
<td>Least Concern</td>
<td>09/08/2018</td>
</tr>
<tr>
<td>Chilean flamingo</td>
<td>300,000</td>
<td>Decreasing</td>
<td>Near Threatened (A3cd)</td>
<td>09/08/2018</td>
</tr>
<tr>
<td>Andean flamingo</td>
<td>38,675</td>
<td>Stable</td>
<td>Vulnerable (A2acd+4acd)</td>
<td>01/10/2016</td>
</tr>
<tr>
<td>Puna (James’s) flamingo</td>
<td>106,000</td>
<td>Stable</td>
<td>Near Threatened (A3cd)</td>
<td>01/10/2016</td>
</tr>
<tr>
<td>Lesser flamingo</td>
<td>3,240,000</td>
<td>Decreasing</td>
<td>Near Threatened (A2c+3c+4c)</td>
<td>07/08/2018</td>
</tr>
</tbody>
</table>

Captive populations

<table>
<thead>
<tr>
<th>Species</th>
<th>Estimated global holding* November 2019</th>
<th>Number of institutions* November 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater flamingo</td>
<td>8253 birds</td>
<td>202</td>
</tr>
<tr>
<td>Caribbean (American) flamingo</td>
<td>6333 birds</td>
<td>173</td>
</tr>
<tr>
<td>Chilean flamingo</td>
<td>5993 birds</td>
<td>188</td>
</tr>
<tr>
<td>Andean flamingo</td>
<td>32 birds</td>
<td>2</td>
</tr>
<tr>
<td>Puna (James’s) flamingo</td>
<td>7 birds</td>
<td>2</td>
</tr>
<tr>
<td>Lesser flamingo</td>
<td>1505 birds</td>
<td>65</td>
</tr>
</tbody>
</table>

* Data from zoological collections that provide information to the Zoological Information Management System database (ZIMS) from species360.

For the time period November 2019 to November 2020, the captive population of the greater flamingo increased, with 13 more holders registered on ZIMS and an increase of 357 birds across all species360 zoos. Holders of Caribbean flamingos increased by four new zoos, but the global captive population of this flamingo species decreased by 99 birds. There is no change to the number of holders of Chilean, Andean, puna and lesser flamingos. The captive Chilean flamingo population increased by 174 birds. Captive Andean flamingo and puna flamingo populations both decreased by one bird, and the captive population of lesser flamingos decreased by 42 birds.

References


**Flamingo; instructions for authors**

“Flamingo” publishes articles on all six extant flamingo species, from wild and captive populations.

**Types of article**

Experimental papers, field notes, research findings, review articles, short reports and commentaries are all welcome.

**Themes for articles**

- Conservation / status of populations
- Progress reports on conservation or management initiatives at a local or regional scale
- Biology, ecology and natural history
- Habitat management
- Bird movements, tracking, ringing and monitoring
- Behaviour and welfare
- Captive management and husbandry, and roles of flamingos in the zoo
- Education, community engagement and human-flamingo interactions

**Word limit**

Maximum 3000 words including references and citations, all information in figures and tables (and their captions), and the abstract. As a guide to article length, there are approximately 500 words per printed page. Manuscripts longer than 3000 words will be returned to the authors for shortening.

**Figures**

Please embed all figures (photos, maps, diagrams) in the text. Full colour is acceptable.

**Language**

Please submit articles in English, French or Spanish. Articles in Spanish and French should be submitted with a translation of the abstract only into English.

**Layout**

Include the title (bold, sentence case) on the first page, followed by the author names, and then their affiliations. Please align centre the title, authors and affiliations.

For all articles please supply an abstract at the start of the article.


First level headings should be sentence case and **bold**. Second level headings should be sentence case and **underlined**.

Please use Calibri font size 12. Left align all paragraphs with 1.5 line spacing.

Please use the species’ binomial name when first referred to in the text; i.e. lesser flamingo (*Phoeniconaias minor*) and format the binomial name in italics.

Please use SI units throughout.

**Layout (tables and figures)**

Label all tables and figures consecutively (i.e. Table 1, Figure 1 etc.). Please provide a label for each table (above) and a caption for each figure (below). Include the table label and figure caption in italics. Ensure that all tables are figures are referred to in the text.

**Editorial**

The editors reserve the right to make typographical, spelling and grammatical corrections without author consultation. Articles are not peer-reviewed but authors may be asked to clarify specific points. Inappropriately or overly-formatted articles may be sent back to the authors for editing to the required layout. Authors are required to proof-read and spell-check their own submissions.

**Submission**

Please email articles in English to Dr Paul Rose: p.rose@exeter.ac.uk
Please email articles in Spanish to Dr Felicity Arengo: arengo@amnh.org
Please email articles in French to Dr Arnaud Béchet: bechet@tourduvalat.org

Articles will be considered for publication throughout the year.
Flamingo; instrucciones para autores

"Flamingo" publica artículos sobre poblaciones silvestres y en cautiverio de las seis especies de flamencos.

Tipos de artículos
Se aceptan trabajos experimentales, notas de campo, resultados de investigación, artículos de síntesis, informes breves y comentarios.

Temas para artículos
- Conservación / estado de las poblaciones
- Informes de avance sobre iniciativas de conservación o gestión a escala local o regional
- Biología, ecología e historia natural
- Manejo de hábitat
- Movimientos de flamencos, seguimiento, anillado y monitoreo
- Comportamiento y cuidado animal.
- Manejo y cría en cautiverio, y el rol de los flamencos en los zoológicos
- Educación, participación comunitaria, difusión e interacciones entre personas y flamencos

Límite de palabras
Máximo 3000 palabras incluyendo referencias y citas, toda la información en figuras y tablas (y sus leyendas), y el resumen.

Como guía para la longitud del artículo, hay aproximadamente 500 palabras por página impresa.
Los manuscritos de más de 3000 palabras serán devueltos a los autores para ser acortados.

Figuras
Por favor inserte todas las figuras (fotos, mapas, diagramas) en el texto. Imágenes a todo color son aceptables.

Idioma
Por favor envíe artículos en inglés, francés o español. Los artículos en español y francés deben enviarse con una traducción del resumen en inglés.

Formato
Incluya el título (en negrita, usando mayúscula sólo al principio de la oración) en la primera página, seguido de los nombres de los autores y luego sus affiliaciones.
Alinee el título, los autores y las affiliaciones al centro. Para todos los manuscritos, proporcione un resumen al comienzo.


Presentación
- Para manuscritos más largos, utilice la siguiente estructura:

Los títulos de sección de primer nivel deben tener formato de oración (mayúscula sólo al principio) y negrita.
Los títulos de sección de segundo nivel deben tener formato de oración y subrayados.

Utilice el estilo y tamaño de letra Calibri 12. A la izquierda, alinee todos los párrafos con un espaciado de línea de 1.5.

Utilice el nombre binomial de la especie cuando se hace referencia por primera vez en el texto; es decir, flamenco enano (*Phoeniconaias minor*) usando tipografía cursiva.

Por favor use unidades SI en todo el trabajo.

Diseño (tablas y figuras)
Etiquete todas las tablas y figuras de forma consecutiva (es decir, Tabla 1, Figura 1, etc.). Proporcione una etiqueta para cada Tabla (por encima) y un título para cada Figura (por debajo). Incluya la etiqueta de la tabla y el título de la figura en tipografía cursiva.
Asegúrese de que se haga referencia a todas las tablas y figuras en el texto.

Revisión
Los editores se reservan el derecho de realizar correcciones tipográficas, ortográficas y gramaticales sin consultar a los autores.

Flamingo no es una revista con referato, sin embargo, se les puede pedir a los autores que aclaren puntos específicos.

Artículos que no tengan el formato indicado se devolverán a los autores para su edición usando el formato requerido.

Se requiere que los autores revisen y verifiquen la ortografía de sus propias presentaciones.

Envíe artículos en inglés por correo electrónico a Dr. Paul Rose: p.rose@exeter.ac.uk
Envíe artículos en español por correo electrónico a la Dra. Felicity Arengo: arengo@amnh.org
Envíe artículos en francés por correo electrónico al Dr. Arnaud Béchet: bechet@tourduvralat.org

Los artículos serán considerados para publicación durante todo el año.
Flamingo; instructions pour les auteurs

« Flamingo » publie des articles sur les six espèces de flamants existantes, provenant de populations sauvages et captives.

Types d’articles
Les articles rapportant des résultats de recherche, de suivis sur le terrain, les articles de synthèse, les rapports courts et les commentaires sont les bienvenus.

Thèmes pour articles
- Conservation / statut des populations
- Rapports d’avancement sur les initiatives de conservation ou de gestion à l’échelle locale ou régionale
- Biologie, écologie et histoire naturelle
- Gestion de l’habitat
- Mouvements d’oiseaux, baguage, suivis GPS...-
  Comportement
- Gestion en captivité et rôles des flamants dans le zoo
- Éducation, engagement communautaire et interactions homme-flamant

Limite de mots
Maximum de 3000 mots, y compris les références et les citations, toutes les informations dans les figures et les tableaux (et leurs légendes), et le résumé.
En guise de guide pour la longueur de l’article, il y a environ 500 mots par page imprimée.
Les manuscrits de plus de 3000 mots seront retournés aux auteurs pour être raccourcis.

Figures
Veuillez incorporer toutes les figures (photos, cartes, diagrammes) dans le texte. La couleur est acceptable.

La langue
Veuillez soumettre vos articles en anglais, français ou espagnol. Les articles en espagnol et en français doivent être soumis avec une traduction du résumé uniquement en anglais.

Disposition
Inclure le titre (en gras) sur la première page, suivi par les noms des auteurs, puis leurs affiliations.
Veuillez aligner le titre, les auteurs et les affiliations.
Pour tous les articles, veuillez fournir un résumé au début de l’article.

- Pour les articles courts, veuillez utiliser la structure suivante :
  - Pour les articles plus longs, utilisez la structure suivante :

Les titres de premier niveau devraient être en majuscules et en gras.
Les titres de deuxième niveau devraient être soulignés.
Veuillez utiliser la police Calibri 12.
Alignez à gauche tous les paragraphes avec un interligne de 1,5.

Veuillez utiliser le nom latin de l’espèce lorsqu’il est mentionné pour la première fois dans le texte; c’est-à-dire un flamant nain (Phoeniconaias minor) et formater le nom latin en italique.

Veuillez utiliser les unités SI partout.

Mise en page (tableaux et figures)
Étiquetez tous les tableaux et les figures consécutivement (par exemple, le tableau 1, la figure 1, etc.).
Veuillez fournir une légende pour chaque tableau (au-dessus) et une légende pour chaque figure (au-dessous). Formater l’étiquette du tableau et la légende de la figure en italique.
Assurez-vous que tous les tableaux sont référencés dans le texte.

Éditorial
Les éditeurs se réservent le droit d’effectuer des corrections typographiques, orthographiques et grammaticales sans consultation d’un auteur.
Les articles ne sont pas revus par les pairs, mais les auteurs peuvent être invités à clarifier des points spécifiques.
Des articles inappropriés ou trop formatés peuvent être renvoyés aux auteurs pour être modifiés selon la mise en page requise.
Les auteurs sont tenus de relire et d’épeler leurs propres soumissions.

Soumission
S’il vous plaît envoyer des articles en anglais à Dr Paul Rose: p.rose@exeter.ac.uk
S’il vous plaît envoyer des articles en espagnol au Dr Felicity Arengo: arengo@amnh.org
S’il vous plaît envoyer des articles en français à Dr Arnaud Béchet: bechet@tourduvalat.org
Les articles seront considérés pour publication tout au long de l’année.