Flamingo

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FLAMINGO SPECIALIST GROUP

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ABOUT THE GROUP

The Flamingo Specialist Group (FSG) is a global network of flamingo specialists (both scientists and non-scientists) concerned with the study, monitoring, management and conservation of the world's six flamingo species populations. Its role is to actively promote flamingo research, conservation and education worldwide by encouraging information exchange and cooperation among these specialists, and with other relevant organisations, particularly the IUCN Species Survival Commission (SSC), the Ramsar Convention on Wetlands, the Convention on Conservation of Migratory Species (CMS), the African-Eurasian Migratory Waterbird Agreement (AEWA), and BirdLife International. The group is coordinated from the Wildfowl & Wetlands Trust, Slimbridge, UK, as part of the IUCN-SSC/Wetlands International Waterbird Network.

FSG members include experts in both *in-situ* (wild) and *ex-situ* (captive) flamingo conservation, as well as in fields ranging from research surveys to breeding biology, infectious diseases, toxicology, movement tracking and data management. There are currently 286 members representing 206 organisations around the world, from India to Chile, and from France to South Africa. Further information about the FSG, its membership, the membership list serve, or this bulletin can be obtained from Brooks Childress at the address below.

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Cover photograph: Puna and Andean Flamingo chicks (*Phoenicoparrus jamesi* and *P. andinus*) being rounded up for banding at Laguna Colorada, Potosi, Bolivia. Photo provided by Omar Rocha. See Rocha *et al.* in this volume.

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Number 17, December, 2009

CONTENTS

Aim of the group and membership summary 2
In-Situ Breeding Summary 3
Ex-Situ Breeding Summary 8
In-Situ Ringing Summary 9
In-Situ Papers 11
Variation in abundance of Andean and Chilean Flamingos wintering in lowland wetlands of central Argentina in two contrasting years 11
Abundancia, reproducción y anillado de Flamencos Andinos (*Phoenicoparrus jamesi* y *P. andinus*) en Laguna Colorada, Potosí – Bolivia 16
Conteos de Flamencos y otras observaciones en la desembocadura del Río Mataquito, VII Región del Maule, Chile, 2007-2009 22
Investigating the potential connectivity of Lesser Flamingo populations by satellite-telemetry 26
Aerial census of Lesser Flamingos (*Phoeniconaias minor*) on the Rift Valley lakes of northern Tanzania, January 2002 30
Monitoring of Greater and Lesser Flamingos *Phoenicopterus ruber* and *Phoeniconaias minor* in Menabe Central Coastal Wetlands, Madagascar 34
Lateral neck-resting preferences in the Lesser Flamingo (*Phoeniconaias minor)* 37
Données récentes sur l'hivernage du Flamant rose au Maroc 40
A new breeding site for the Greater Flamingo *Phoenicopterus roseus* in Algeria 44
Mass reproduction of the Greater Flamingo at Ezzemoul, Algeria in 2009 and the need to reassess the role of North African wetlands 48
In-Situ Short Reports 54
Nesting of flamingos in India, 2009 54
Expansion of Greater Flamingo wintering range along the southeast coast of India 55
Effectiveness of traditional staked-noose lines to capture Greater Flamingos 57
Ex-Situ Papers 61
AZA efforts to develop a sustainable North American captive Lesser Flamingo population 61
Successful *ex-situ* breeding of Lesser Flamingos (*Phoeniconaias minor*) 64
News Items 68
New and expanded Ramsar sites help protect high Andes flamingo habitats 68
Flamingos suffer as several Kenyan Rift Valley lakes dry up 69
Recent Scientific Publications 70

Aim of the group and membership summary

The aim of the Flamingo Specialist Group (FSG) is to actively promote study, monitoring, management and conservation of the world's six flamingo taxa by:

- Developing and maintaining an active and comprehensive international network of *in situ* and *ex situ* flamingo conservation specialists (both scientists and non-scientists)
- Stimulating and supporting information exchange among flamingo conservation specialists
- Encouraging development and implementation of conservation action plans for the three taxa of greatest conservation concern: *P. andinus*, *P. jamesi* and *P. minor*.
- Promoting innovative conservation approaches and reconciliation of water conservation for people and for flamingos in the context of climate change and predicted water shortage
- Providing information and advice in support of the programmes of Wetlands International, IUCN - SSC, and others that promote the conservation of flamingos and their habitats

During 2008-09 membership grew 12%. Currently there are 286 members representing 206 organisations from 55 countries. 195 members are involved primarily with the conservation of flamingos in the wild (*in-situ*), while 91 are involved primarily with *ex-situ* conservation.

Country	No. Members	Country	No. Members
Algeria	6	Madagascar	2
Argentina	12	Mauritania	1
Bahamas	2	Mexico	12
Belgium	4	Morocco	2
Bolivia	1	Namibia	4
Botswana	3	Netherlands Antilles	2
Canada	1	Paraguay	3
Chile	8	Peru	3
Colombia	2	Poland	1
Cuba	2	Portugal	1
Cyprus	4	Saudi Arabia	1
Czech Republic	2	Senegal	3
Denmark	1	South Africa	8
Djibouti	1	Spain	10
Egypt	2	Suriname	1
Ecuador	1	Switzerland	2
Eritrea	1	Tanzania	6
Ethiopia	4	The Netherlands	11
Finland	1	Tunisia	2
France	8	Turkey	1
Germany	6	Turkmenistan	1
Guinea-Bissau	1	Uganda	1
India	10	United Arab Emirates	7
Iran	2	United Kingdom	50
Italy	8	Uruguay	1
Kazakhstan	1	United States	48
Kenya	6	Venezuela	1
Libya	1		

IN SITU BREEDING SUMMARY

Mediterranean & West Africa

Breeding by *P. roseus* in Mediterranean and West African countries during 2009 was reported at 17 sites. Approximately 87,500 pairs attempted to breed, based on nest counts in many instances, and an estimated 48,800 chicks were produced. In a major breeding disaster, the breeding attempt by an estimated 14,000 pairs on Etang du Fangassier in the Camargue in France was almost completely abandoned after apparent repeated disturbances during incubation, probably by foxes. The following reports were provided by Arnaud Béchet and members of the Mediterranean and West African Greater Flamingo Network.

Spain (*P. roseus*)

Breeding period: April-June

Doñana: No breeding at this site in 2009 due to low water level

Ebro Delta: 3,139 breeding pairs produced 1,107 chicks

Fuente de Piedra: ~ 10.966 breeding pairs produced 5,071 chicks

Marismas del Odiel: ~ 450 pairs attempted to breed; 346 chicks were produced

France (*P. roseus*)

Breeding period: April-June

Camargue (Etang du Fangassier): ~ 14,000 breeding pairs produced < 1,000 chicks, of which only about 377 fledged. The low hatching success was likely to have been caused by disturbance during incubation, probably by foxes.

Italy (*P. roseus*)

Breeding period: April-June

Comacchio salt pans: 1,368 nests; 1,266 chicks produced

Diaccia Botrona, Tuscany: Late breeding attempt; success unknown

Dogà, Lagoon of Venice: Breeding attempt abandoned due to disturbance

Apulia, Margherita di Savoia: 996 nests and a crèche of 600 chicks

Valle Pozzatini, North Po Delta: 70 breeding pairs; attempt failed

Sardinia (*P. roseus*)

Breeding period: April-June

Cagliari, Saline di Macchiareddu (Santa Gilla): ~ 8,800 nests; ~ 6,000 chicks produced

Turkey (*P. roseus*)

Breeding period: April-June

Acigöl: No report.

Akşehir Lake: No report

Camalti Tuzlasi saltpans (Izmir): 6,295 nests; ~3,250 chicks produced

Tuz Gölü: 14,644 chicks produced

Algeria (*P. roseus*)
Breeding period: April-August

Bazer Sakra: ~ 4,000 birds were displaying in May and some started nest building before they were disturbed (probably by humans).

El Goléa: ~ 70 breeding pairs produced 23 chicks

Garaet Ezzemoul: ~ 11,000 breeding pairs produced > 6,000 chicks.

Tunisia (*P. roseus*)
Breeding period: April-June

Salines de Thyna: 46 nests; abandonded following disturbance and high water

Sebkhet Sejoumi: 20 nests abandoned following disturbance by dogs

Mauritania (*P. roseus*)
Breeding period: March-July

Aftout es Saheli: No report

Banc d'Arguin National Park (Grande Kiaone Island): 11,623 nests; ~ 9,500 chicks

Southwest Asia & South Asia

Abu Dhabi (*P. roseus*)
Breeding period: May-June

Bu Al Syaeef: ~2,000 breeding pairs produced >800 chicks

India (*P. minor* & *P. roseus*)
Breeding period: Erratic, depending on the rains, but mainly September-November

Bela-Mowana, Great Rann of Kachchh: Estimated 70,000-80,000 Lesser Flamingo chicks in eight creches guarded by ~ 500 adults

Boru salt pans, GRK: Eggs in deserted nests, unknown numbers

"Flamingo City", GRK: No breeding

Purabcheria mud flats, Little Rann of Kachchh: ~ 5,000 deserted nests, presumed to be Lesser Flamingo nests; unkown breeding success.

Zinzuwada salt pans, LRK: No breeding

Report by B. M. Parasharya; see full report in short reports, this issue

Iran (*P. roseus*)
Breeding period: May-June

Uromiyeh Lake: No report

East Africa & southern Africa

Tanzania (*P. minor & P. roseus*)
Breeding period: Erratic, depending on the rains, but mainly November-February

Lake Natron: No report

Botswana (*P. minor & P. roseus*)
Breeding period: Erratic, depending on the rains, but mainly November-February

Sua Pan: Good breeding year with above average rainfall. An uncounted number of Lesser Flamingo breeding pairs produced about 35,500 chicks, while a total of 44,731 Greater Flamingo breeding pairs produced at least 30,550 chicks. 14,179 pairs were still nesting when the survey was conducted. (G. McCulloch, *in litt.*)

Namibia (*P. minor & P. roseus*)
Breeding period: Erratic, depending on the rains, but mainly November-February

Etosha Pan: With good rains and additional flooding from Angola, the flamingos were able to breed on Etosha again this year. Approximately 10,000 pairs of Lesser Flamingos produced >2,500 chicks and approximately 5,000 Greater Flamingo pairs produced an unknown number of chicks. (W. Versfeld, *in litt.*).

South Africa (*P. minor*)
Breeding period: Erratic, depending on the rains, but mainly November-February

Kamfers Dam: This first artificial breeding island continued to be extraordinarily successful during the 2008-09 breeding season, producing an estimated 13,000 Lesser Flamingo chicks. Because of the limited nesting space and high level of nest re-use, it is not possible to estimate the number of breeding pairs. (M. Anderson, *in litt.*)

Bahamas & Caribbean

Bahamas (*P. ruber*)
Breeding period: April-June

Lake Rosa, Great Inagua: No report

Bonaire (*P. ruber*)
Breeding period: October-March

Pekelmeer: There were 315 nests in the breeding sanctuary this year. Due to multiple reuse of the nest mounds, the number of breeding pairs is not known; ~ 690 chicks were produced (Peter Montanus, *in litt.*)

Cuba (*P. ruber*)
Breeding period: April-June

El Refugo de Fauna Rio Maximo: No report

Mexico (*P. ruber*)
Breeding period: April-September

Ría Lagartos Biosphere Reserve: Approximately 8,000 pairs nested in the La Esperanza salt pond belonging to Yucatan's Salt Industry S.A. located within the reserve, and about 5,000 chicks hatched. (X. Galvez Aguilera, *in litt*.)

Venezuela (*P. ruber*)
Breeding period: (October-March)

Refugio de Fauna Silvestre y Reserva de Pesca* (Los Olivitos Wildlife Refuge and Fishing Reserve)*: There were ~10,900 nest mounds in the breeding colony this year. Breeding began in late October 2008 and continued until June 2009. Due to multiple re-use of the nest mounds, the number of breeding pairs is not known. At least 22,000 chicks were produced. (Helimenes Perozo in personal communication to Frank Espinoza)

La Restinga National Park, Margarita Island: No report

South America

Argentina
Breeding period: December-February

There are 12 known breeding sites, two for *Phoenicoparrus andinus*, seven for *P. jamesi*, and five for *Phoenicopterus chilensis*. During 2008-2009 breeding season, we recorded for *P. jamesi* four successful, two unsuccessful events; and one new breeding site, Laguna Santa María, in Salta Province.

Laguna Pozuelos (P. chilensis): No breeding
Laguna Vilama (P. jamesi): No breeding
Laguna Honda (P. jamesi): breeding colony recorded on February 9th, 267 chicks.
Laguna Guindas (P. jamesi): breeding colony recorded on February 9th, 124 chicks.
Laguna Santa María (P. jamesi): breeding colony recorded on February 13th, 142 chicks.
Laguna Pabellón (P. jamesi): No survey
Laguna Grande (P. jamesi): breeding colony recorded on February 3rd, six groups of nests (649 active nests), two abandoned groups (300 nests). 125 grey chicks in crèche, 283 white chicks in nests. Footprints of three people towards the abandoned colonies, Two Culpeos (foxes) *Pseudalopex culpaeus* also seen in the area.
Laguna Hedionda (unidentified): 1 breeding attempt recorded, 19 abandoned nests
Laguna Aparejos (P. jamesi): No breeding
Laguna Brava (P. andinus): colony of 58 nests (26 active) in December, found abandoned in February. Vega dried with water well and new route 72, colony exposed to fox predation.
Salinas Grandes (P. chilensis): No breeding
Mar Chiquita *(P. andinus & P. chilensis):* 100 P.chilensis nests counted, not a comprehensive count.
Laguna Melincué (P. chilensis): No breeding
Laguna Llancanelo (P. chilensis): No breeding

Lago Aleusco (P. chilensis): Flamingos arrived mid-November; in late December, ~3,000 in six groups on islets in center of almost dry lake, 70% sitting on nests. Breeding success unknown.

Reported by: F. Arengo, Bucher, E., Clark, R., Derlindati, E., Harris, G., Marconi, P., Michelutti, P., Moschione, F., Romano, M., Sosa, H., Sureda, A., Torres, R.

Bolivia

Breeding period: December-February

***Laguna Catalcito (P. chilensis)*:** 170 chicks
Laguna Chiar Khota: 178 nests, 29 unidentified chicks
***Laguna Colorada* (*3 species*):** 6,964 chicks of mixed species; majority *P. andinus & P. jamesi*
Laguna Coruto (P. jamesi): 182 chicks
Laguna Guayaques (P. jamesi): 119 chicks
Laguna Khara (P. jamesi): 2,232 chicks

Reported by: O. Roca, Centro de Estudios en Biología Teórica y Aplicada - BIOTA.

Chile

Breeding period: December-February

Reserva Nacional Los Flamencos:(P. andinus, P. jamesi, P. chilensis)

- ***Salar de Atacama***
  - Laguna Barros Negros (P. andinus) 276 chicks hatched; none survived 60 d
  - Laguna Puilar (P. andinus)*:* 21 chicks hatched; none survived 60 d
  - Laguna Saladita (P. andinus) No report
- ***Salar de Pujsa (P. chilensis, P. andinus)****:* No report
- ***Salar de Tara* (*P. andinus & P. jamesi*):** ~511 chicks of each species hatched); ~350 of each species survived for 60 d

Salar de Coposa (P. andinus, P. jamesi, P. chilensis): No report
Laguna Huambune (P. chilensis): No report
Salar de Huasco (P. andinus, P. jamesi, P. chilensis): No report
***Salar de Loyoques (P. chilensis)*:** No report
El Parque Nacional Nevado de Tres Cruces

- ***Salar de Maricunga (P. andinus):*** No report
- ***Laguna Negro Francisco (P. andinus):*** No report

Nevado Tres Cruces (P. andinus, P. jamesi): No report
***Salar de Piedra Parada (P. jamesi)*:** 180 *P. jamesi* chicks hatched
Salar de Punta Negra (P. andinus)*:* No report
***Salar de Surire (3 species*):** 2,398 *P. jamesi* chicks hatched

Reports by Nelson Amando Pool, CONAF, *in litt.*

EX-SITU BREEDING SUMMARY

Three flamingo species (Greater *P. roseus*, Caribbean *P. ruber* and Chilean *P. chilensis*) breed readily in zoos and other captive facilities. The following table summarises registered captive flamingo populations and breeding success in ISIS-registered institutions worldwide from October 2008 to September 2009. Note particulalrly the 10 new Lesser Flamingos. These were hatched at Fort Worth Zoo (See separate article this volume)

Species	Registered institutions		Registered birds		No. hatched (12 months)	
	No.	Chg.	No.	Chg.	No.	Chg.
Caribbean Flamingo (*Phoenicopterus ruber*)	169	±0	4,744	+296	122	+6
Greater Flamingo (*Phoenicopterus roseus*)	131	+7	4,575	+687	124	-8
Chilean Flamingo (*P. chilensis*)	173	+2	4,686	+106	49	-22
Lesser Flamingo (*Phoeniconaias minor*)	60	+3	1,567	+425	11	+10
Andean Flamingo (*Phoenicoparrus andinus*)	1	-1	26	-3	0	±0
James's Flamingo (*Phoenicoparrus jamesi*)	1	±0	2	-1	0	±0
Unidentified flamingo species and hybrids	39	+1	148	+20	8	-4
	NA		15,728	1,530	314	-18

Source: International Species Information System (www.isis.org; date accessed: 13 Oct 2008)

Note: Figures for numbers of birds are the number of registered birds; thus increases may indicate that institutions have registered more birds with ISIS rather than obtained new birds.

Report by: R. Lee (Rebecca.Lee@wwt.org.uk)

IN SITU RINGING SUMMARY

Mediterranean & West Africa

The following reports were provided by Arnaud Béchet and members of the Mediterranean and West African Greater Flamingo Network.

Algeria (*P. roseus*)

Garaet Ezzemoul: 637 chicks were ringed on 31 July. Biometrics, blood and parasite samples were taken. Pictures on http://www.flickr.com/photos/bsamraoui

El Goléa: In June, 8 of the total 23 chicks were banded.

France (*P. roseus*)

Camargue (Etang du Fangassier): On 23 July, 367 chicks were ringed. Pictures available on: http://www.flamingoatlas.org/galeriephoto2009.php

Italy (*P. roseus*)

Comacchio salt pans: 554 *P. roseus* chicks were ringed on 14 July.

Sardinia (*P. roseus*)

Cagliari, Saline di Macchiareddu (Santa Gilla): 501 *P. roseus* chicks were ringed on 01 August.

Spain (*P. roseus*)

Fuente de Piedra: 600 chicks were ringed on 18 July. Blood samples were taken for sex determination and health screening. Pictures available on http://www.diariosur.es/multimedia/fotos/malaga/flamencos-vuelven-fuente-piedra-39860.html And a video on http://casadelaciencia.blogspot.com/

Ebro Delta: 400 chicks were ringed on 12 July. Pictures available on www.picampall.org in the section "Album de fotos".

Marismas del Odie: 341 chicks were ringed on 08 August.

Turkey (*P. roseus*)

Camalti Tuzlasi saltpans (Izmir): 247 chicks ringed on 16 August

Southwest & South Asia

No flamingo ringing reported from Southwest or South Asia in 2009.

East Africa & Southern Africa

No flamingo ringing reported from East Africa or southern Africa in 2009.

Bahamas & Caribbean

Mexico (*P. ruber*)

Breeding period: April-September

Ría Lagartos Biosphere Reserve: 519 individuaks were banded on 23 August in the La Esperanza salt pond in the reserve. Morphometric data, feathers for sex determination, and blood samples for health checks and DNA studies were taken. (X. Galvez Aguilera, *in litt*.)

Cuba (*P. ruber*)

Breeding period: April-September

Refugio de Fauna Rió Maximo: 373 chicks were banded on 16th August

South America

Bolivia (*P. andinus & P. jamesi*)

697 *P. andinus* & *P. jamesi* chicks banded at Laguna Colorada

Chile

CONAF authorities cancelled banding activity to avoid human disturbance and associated risks for chick survival due to the low reproductive success of breeding colonies. (N. Amando Pool, *in litt.*)

IN SITU PAPERS

Variation in abundance of Andean and Chilean Flamingos wintering in lowland wetlands of central Argentina in two contrasting years

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[6] Facultad de Ciencias Veterinarias, Universidad Nacional de Rosario. Casilda, Argentina.
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Abstract
In 2009 the lowland wetlands of Argentina experienced one of the most dramatic droughts recorded in the last hundred years. In August 2009, we conducted a field survey of 37 shallow brackish alkaline lakes in lowland Argentina, where we counted flamingos, identified to species. Almost half of the surveyed lakes (18) were dry. These conditions modified the patterns of distribution of Andean Flamingos (*Phoenicoparrus andinus*) as well as Chilean Flamingos (*Phoenicopterus chilensis*) when compared to a survey carried out in 2008. Some large wetlands, such as Melincué, are consistently used by Andean Flamingos, whereas smaller lakes are used depending on climatic conditions. These results show that conservation of these key lowland sites is of high priority.

Resumen
Durante el último año (2009), los humedales de zonas bajas de Argentina experimentaron una marcada sequía. En Agosto de 2009 realizamos censos de 37 lagos salados de Santa Fe en los cuales contamos los flamencos e identificamos las especies. Casi la mitad de los lagos estaban secos. Estas condiciones modificaron los patrones de distribución tanto de Flamencos Andinos (*Phoenicoparrus andinus*) como de Flamencos Australes (*Phoenicopterus chilensis*) respecto al monitoreo realizado en 2008. Algunos lagos grandes, como Melincué, son utilizados consistentemente por Flamencos Andinos, mientras que lagos más pequeños son utilizados dependiendo de las condiciones climáticas. Estos resultados demuestran que la conservación de estos humedales claves es de alta prioridad

Introduction
Lowland lakes in Argentina are key habitats for high Andean flamingos, especially during winter when some of the high-Andes lakes from Argentina, Bolivia, Chile and Peru freeze (Caziani *et al.* 2007). Previous studies have shown that flamingo abundance experiences wide annual fluctuations at some lowland wetlands (Bucher 1992; Romano *et al*. 2005). These fluctuations in flamingo numbers may be associated with inter-annual variations in climatic conditions (*e.g.* annual rainfall) that affect the lake surface area and the physical and chemical composition of these lowland wetlands.

During 2009, the lowland wetlands of Argentina experienced one of the most severe droughts recorded in the last hundred years. These climatic conditions greatly reduced the availability of suitable habitats for flamingos. In this report, we first present the results of the 2009

flamingo survey and then compare them to the survey carried out at 20 lowland lakes in August 2008 (Romano *et al*. 2008).

Study site

The study area is located in a highly agricultural region (c. 70% of the area), in the southern part of Santa Fe Province, Argentina (Figure 1). This region is known as "Pampas de las Lagunas" (Pampas of the shallow lakes) (Pasotti *et al*. 1984). Most of these lakes are moderately saline, but differ in their chemical composition (Romano *et al.* 2008). Climate is temperate, subhumid–humid (Pasotti *et al*. 1984). Mean annual temperature is 16°C, and annual precipitation averages 917 mm (period 1933–1990), concentrated in the summer–autumn (November-April) (Biasatti *et al.* 1999).

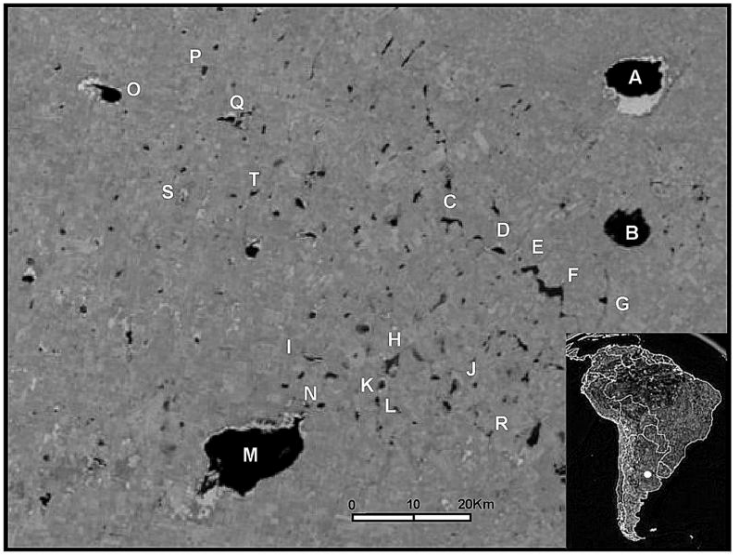

Figure 1. Satellite image of area in Santa Fe Province where wetlands were censused in August 2009. Letter code: **A** = Melincué; **B** = Quirno, **C** = MT1 (66), **D** = Encadenadas 3, **E** = Encadenadas 4, **F** = Encadenadas 5, **G** = 006, **H** = Martín García, **I** = Carmen, **J** = Morgan, **K** = Bella Vista, **L** = Santa Marta, **M** = La Picasa 3, **N** = La Picasa 2, **O** = Las Tunas, **P** = La Badenia, **Q** = Sur de Maggiolo, **R** = 005, **S** = El Retiro, **T** = M1

Methods

In August 2009, we surveyed 37 shallow brackish alkaline lakes in lowland Argentina, where we counted flamingos and identified to species, using 10x binoculars or 15/45x spotting scopes, and manual counters. We took twelve water samples to characterize physical and chemical properties at twelve lakes. These samples are currently being processed.

We calculated the coefficient of variation (CV = standard deviation/mean × 100) of the abundance of individuals of Andean and Chilean Flamingos for lakes where each species was recorded in 2008 and 2009.

Results

In the 2009 survey, almost half (18) of the surveyed lakes were dry. On the 19 lakes with water, we counted 13,625 Andean Flamingos (*Phoenicoparrus andinus*), 41,122 Chilean Flamingos (*Phoenicopterus chilensis*) and 1,400 unidentified flamingos. Andean Flamingos were recorded in eleven wetlands (Table 1). Laguna Melincué contained almost half of the total individuals recorded (6,630), whereas the rest were mainly counted in two other wetlands (Las Encadenadas

3 and 4). Chilean Flamingos were recorded in 16 lakes (Table 1). Almost 85% of the individuals were counted at four lakes (Sur de Maggiolo, La Picasa, Las Encadenadas 4 and 5).

Table 1. Number of Andean and Chilean Flamingos on wetlands censused during August 2009 in Santa Fe Province, Argentina. Only those sites where flamingos were recorded are shown.

Site	Lat.	Long.	*P. andinus*	*P. chilensis*	*P.* spp.
Lag. Melincué	33º 44.026'	61º 27.435'	6630	1321	
Las Encadenadas 3	33º 59.004'	61º 44.282'	3475	1188	700
Las Encadenadas 4	34º 01.762'	61º 40.597'	2616	7310	700
Carmen	34º 10.405'	62º 06.026'	507	642	
Sur de Maggiolo	33º 46.844'	62º 16.883'	1	14280	
Las Encadenadas 5	34º 02.828'	61º 39.101'	87	8615	
La Picasa 3	34º 15.907'	62º 09.208'	80	4822	
006	34º 04.459'	61º 32.939'	38	1466	
Bella Vista	34º 13.160'	61º 58.414'	117	348	
La Picasa 2	34º 14.945'	62º 07.796'		301	
Lag. Martín García	34º 10.186'	61º 56.930'	6	282	
Quirno	33º 56.426´	61º 28.471'	68	244	
MT1 (66)	33º 56.011'	61º 51.398'		199	
005	34º 17.187'	61º 45.764'		95	
Santa Marta	34º 14.163'	61º 50.820'		8	
Lag. Las Tunas	33º 44.544'	62º 32.636'		1	

On those ten lowland lakes where flamingo surveys were conducted in both years, our results show that the abundance of Andean Flamingos was lower in 2009 than in 2008 on all these lakes, whereas the abundance of Chilean flamingos was reduced in 2009 in most lakes except for Melincué and Sur de Maggiolo (Figure 2). It should be noted that five of these lakes where dry in 2009 (Morgan, El Retiro, La Badenia, Sancti Spiritu and Las Tunas).

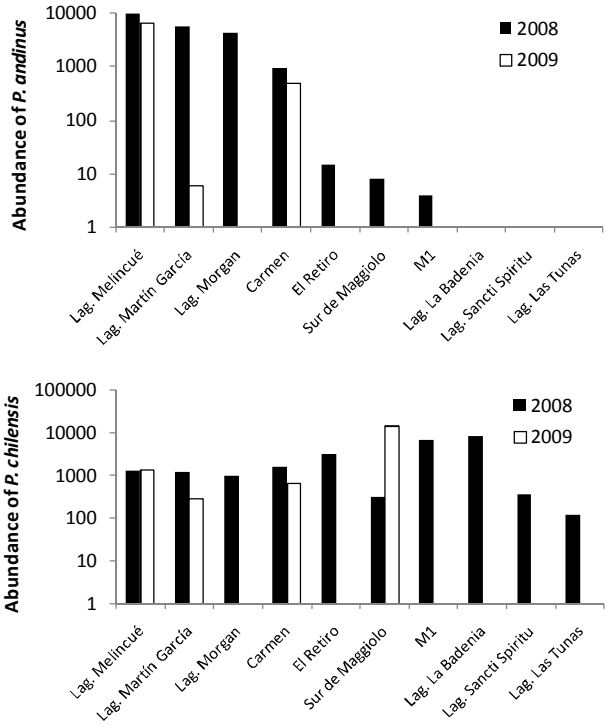

Figure 2. Abundance of Andean and Chilean flamingos (*P. andinus* and *P. chilensis*) in 2008 and 2009 on those ten lowland lakes that were surveyed in both years. Note log scale in the y axes in order to show the values of those lakes with very low numbers.

In 2009, we counted fewer Andean Flamingos, but more Chilean Flamingos than in 2008 (Table 2). In both years, Andean Flamingos were more aggregated (*i.e*. higher coefficient of variation, CV) than Chilean Flamingos (Table 2). However, the species differed in their aggregation patterns between years. Chilean Flamingos were more aggregated in 2009 than in 2008, whereas Andean Flamingos showed similar CV in both years (Table 2).

Table 2. Abundance of Andean and Chilean Flamingos (*P. andinus* and *P. chilensis*) in 2008 and 2009 and coefficient of variation (CV) of Andean and Chilean Flamingos for lakes where each species was recorded in 2008 and 2009.

	P. andinus		*P. chilensis*	
	2008	2009	2008	2009
Abundance	20,864	13,625	29,539	41,122
Coefficient of variation	211	210	129	154

Andean Flamingos used fewer of the available lakes, whereas Chilean Flamingos are less selective and thus used almost all of the lakes (Table 3). Some of the lakes used by Andean Flamingos in 2008 were dry in 2009, thus this species showed an almost complete shift in lakes used between these years, except for Melincué and Carmen (Table 3). Chilean Flamingos, despite being recorded in more lakes in both years, showed a high concentration of individuals in 2009 in just one lake (Sur de Maggiolo), which was surrounded by lakes that were important in 2008 but that were dry in 2009 (Lag. La Badenia, El Retiro; Table 3).

Table 3. Percentage of wintering Andean and Chilean flamingos (*P. andinus* and *P. chilensis*) recorded on lakes of Santa Fe, 2008 and 2009. Only lakes with more than 2% of the annual wintering population recorded at Pampa de las Lagunas are shown. Black numbers denote values higher than 3%. Dashes denote that the lake was not censused that year.

			P. andinus		*P. chilensis*	
Site	Lat.	Long.	2008	2009	2008	2009
Lag. Melincué	33º 44.026'	61º 27.435'	**47.5**	**48.7**	**4.3**	**3.2**
Lag. Martín García	34º 10.186'	61º 56.930'	**27.0**	0.0	**4.1**	0.7
Lag. Morgan	34º 13.876'	61º 52.063'	**20.8**	0.0	**3.2**	0.0
Las Encadenadas 3	33º 59.004'	61º 44.282'	**-**	**25.5**	**-**	2.9
Las Encadenadas 4	34º 01.762'	61º 40.597'	**-**	**19.2**	**-**	**17.8**
Lag. La Badenia	33º 42.479'	62º 20.895'	0.0	0.0	**29.1**	0.0
M1	33º 53.366'	62º 13.888'	0.0	0.0	**22.9**	0.0
El Retiro	33º 48.950'	62º 23.699'	0.1	0.0	**10.8**	0.0
Unnamed	33º 45.145'	62º 30.049'	0.0	**-**	**8.5**	**-**
Unnamed	33º 45.590'	62º 19.510'	0.0	**-**	**7.9**	**-**
Carmen	34º 10.405'	62º 06.026'	**4.6**	**3.7**	**5.2**	1.6
Sur de Maggiolo	33º 46.844'	62º 16.883'	0.0	0.0	1.1	**34.7**
Las Encadenadas 5	34º 02.828'	61º 39.101'	**-**	0.6	**-**	**21.0**
La Picasa 3	34º 15.907'	62º 09.208'	**-**	0.6	**-**	**11.7**

Discussion

This comprehensive winter monitoring of southern Santa Fe province has shown the importance of long-term studies. Some large wetlands, such as Melincué, are consistently used by Andean Flamingos, whereas smaller lakes are used depending on climatic conditions. In periods of severe drought, Melincué, one of the largest and deepest lakes in the area, could support large populations of Andean Flamingos and other waterbirds. The other smaller lakes in the area may act as satellites and can be used by flamingos in a complementary and alternative way. Thus, conservation of these key lowland sites is of high priority.

These new results support our previous recommendations to include the southern Santa Fe wetland complex (SSF) in the winter monitoring scheme, incorporate the complex in the "Network of Wetlands of Importance for Flamingo Conservation", and evaluate its potential as a Ramsar site.

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References

Biasatti, N., Delannoy. L., Peralta, E., Pire, E., Romano, M. and Torres, G. 1999. Cuenca Hidrográfica del Humedal de la Laguna Melincué, Provincia de Santa Fe. ProDIA, SRNyDS, Buenos Aires.

Bucher, E. H. 1992. Population and conservation status of flamingos in Mar Chiquita, Cordoba, Argentina. Colonial Waterbirds 15:179-184.

Caziani, S. M., Rocha, O., Rodríguez, E., Romano, M., Derlindati, E.J., Tálamo, A., Ricalde, D., Quiroga, C., Contreras, J. P., Valqui, M. and Sosa, H. 2007. Seasonal distribution, abundance, and nesting of Puna, Andean, and Chilean Flamingos. The Condor 109:276-287.

Romano, M. C., Barberis, I. M., Pagano, F. and Maidagan, J. I. 2005. Seasonal and interannual variation in waterbird abundance and species composition in the Melincué saline lake, Argentina. European Journal of Wildlife Research 51:1-13.

Romano, M. C., Barberis, I. M., Pagano, F., Marconi, P M. and Arengo, F. 2008. Winter monitoring of Andean and Chilean Flamingos in lowland wetlands of central Argentina. Pp: 45-47. In: Childress, B., Arengo, F. and Béchet, A. (eds.) 2008. *Flamingo*, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, No. 16.

Pasotti, P., Albert, O. and Canoba, C. 1984. Contribución al conocimiento de la laguna Melincué. Instituto de Fisiografía y Geología ''Dr. Alfredo Castellanos''. Publ 66. UNR Editora, Rosario.

Abundancia, reproducción y anillado de Flamencos Andinos (*Phoenicoparrus jamesi* y *P. andinus*) en Laguna Colorada, Potosí – Bolivia

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Summary
Here we report on high-Andes flamingo (*Phoenicoparrus jamesi* and *P. andinus*) banding in Laguna Colorada, Bolivia in 2009 and general results of the banding program in place since 2002. We have registered movements from Laguna Colorada to lakes in northern Bolivia and to lowland wetlands such as Mar Chiquita and Laguna Melincué in Argentina, with travel distances of 1,418 km. We also recorded flamingo abundance, both adults and chicks for Laguna Colorada from 1997 to 2009, showing seasonal fluctuations in abundance, with highs in the summer and lows in winter.

Resumen
Se reporta la actividad de anillado de flamencos altoandinos (*Phoenicoparrus jamesi* y *P. andinus*) 2009 en Laguna Colorada, Bolivia y los resultados generales del programa de anillado que se realiza desde el 2002. Se registran desplazamientos desde Laguna Colorada hacia lagunas en el norte del territorio boliviano y hasta tierras bajas como Mar Chiquita y Laguna Melincue en la República de Argentina, con desplazamientos de 1418 km. Se presentan datos de abundancia desde 1997 al 2009 de flamencos adultos y pichones en este humedal, que reflejan

fluctuaciones estacionales bien marcadas, con altas concentraciones en verano y bajas en invierno.

Introducción

En la región altoandina de Sudamérica, entre Argentina, Bolivia, Chile y Perú se distribuyen tres especies de flamencos; el flamenco andino (*Phoenicoparrus andinus*), el flamenco de James (*Phoenicoparrus jamesi*) y el flamenco chileno o austral (*Phoenicopterus chilensis*). Las dos primeras especies con distribuciones más restringidas se encuentran principalmente en lagunas altoandinas y salares. No obstante recientes estudios han registrado a *P. andinus* en tierras bajas principalmente en la época invernal (Caziani *et al.* 2006, 2007; Marconi *et at.* 2007). Los flamencos son considerados especies representativas y conspicuas de los salares y lagunas de los Andes centrales de Sudamérica.

El estudio de las poblaciones de flamencos en la región sudandina, es un caso complejo que requiere de esfuerzos de planificación y gestión a nivel regional, y donde aún es necesario generar información básica relacionada a la temática. En este contexto, el Grupo de Conservación de Flamencos Altoandinos -GCFA, conformado por investigadores y gestores ambientales de Argentina, Bolivia, Chile y Perú, impulsan esfuerzos conjuntos con el objeto de ordenar y sistematizar la información existente, identificar requerimientos críticos de información y ejecutar proyectos, programas y actividades relacionadas con la conservación de flamencos.

En ese contexto se desarrolla el Programa de Anillado de Flamencos del GCFA, que por octavo año consecutivo ha anillado flamencos altoandinos (*Phoenicoparrus jamesi* y *P. andinus*) en Laguna Colorada- Bolivia. En este sitio se reproducen regularmente miles de flamencos de ambas especies.

En el presente artículo se reporta la actividad de anillado del 2009 y los resultados preliminares del anillado de flamencos altoandinos realizado en Laguna Colorada desde 2002. Se presenta un análisis general de la reproducción y de la abundancia poblacional de tres especies de flamencos en este humedal.

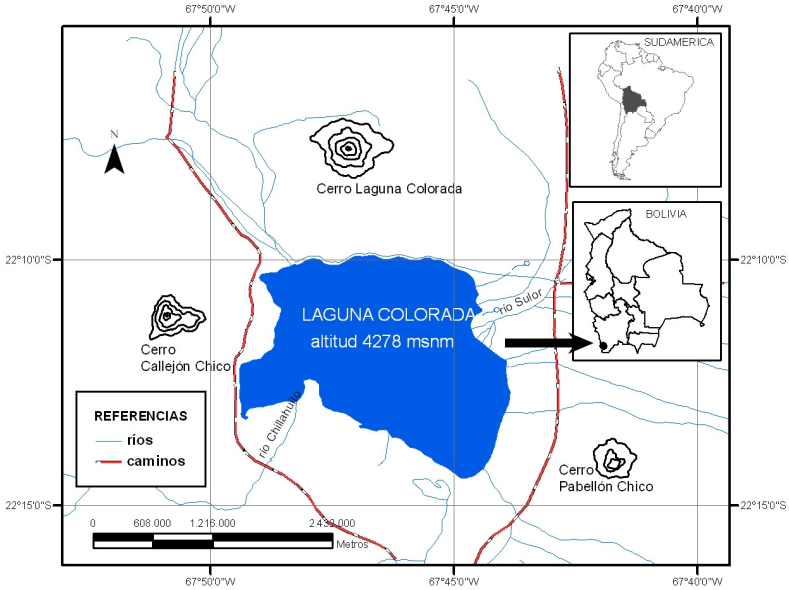

Figura. 1. Mapa de ubicación de Laguna Colorada, Potosí – Bolivia.

Área de estudio

La Laguna Colorada se encuentra en la Prov. Sud Lípez del Departamento de Potosí, Bolivia (Figura 1), en la Reserva Nacional de Fauna Andina Eduardo Avaroa, (22°15' S y 67°46' W) el espejo de agua cubre un área aproximada de 51.5 km^2. Es una laguna poco profunda (35 cm), se halla en pie de montaña, clasificándola como "altoandina-salina".

Las aguas de Laguna Colorada muestran notorias variaciones en su composición química. Se registra un elevado contenido de sales en la laguna (81 – 200 g/l, pH 8,2 – 9) y características de baja salinidad en las vertientes. Esta laguna presenta una salinidad extrema, donde predominan el catión sodio, sulfatos y cloruros. En general es un cuerpo lacustre hipereutrófico, alcalino-salino de drenaje cerrado, de tipo cloruro sódica de pH básico y valores de conductividad elevados (>100 mS/cm, Rocha 2006).

Métodos

La jornada de anillado se desarrolló el día 11 de abril de 2009 empezando a las 6:00 a.m. con el armado de la manga de captura con dos brazos de 200 metros cada uno, dispuestos en un ángulo aproximado de 60°, en cuyo ápice se construy ó un corral de mantenimiento de 10 x 15 m^2. Se logró capturar alrededor de 1500 pichones del flamenco andino en su mayoría y del flamenco de James en menor proporción, La actividad de anillado concluyó a las 15:00 horas.

A cada polluelo capturado se le coloca un anillo de plástico (PVC) de color blanco, provisto de un código de tres letras negras en la tibia derecha. Se toman medidas biométricas: longitud del ala, longitud del pico, longitud del tarso y peso.

Las anillas permiten el reconocimiento individual y a distancia de las aves marcadas cuando están posadas. Se utilizan letras puesto que son más fáciles de distinguir a distancia que los números. Estas características de los anillos permiten distinguir: 1) El lugar de anillado si sólo se ve el anillo de lejos (por el color), lo cual da información sobre desplazamientos; 2) El lugar y año de anillado si se logra distinguir la primera letra y, 3) El individuo si se lee todo el código, con lugar y año de anillado.

Desde 1997 se realiza el monitoreo de la abundancia de las tres especies de flamencos en Laguna Colorada, y desde 1993 se tienen datos parciales de pichones nacidos en este humedal (Rocha 2006). Para estimar la abundancia poblacional de flamencos de las tres especies en Laguna Colorada, desde enero 1997 hasta febrero 2009, se realizaron 14 conteos por barrido de flamencos adultos, sin embargo no se tienen datos de todos los años, se realizaron 11 conteos en la época de verano y 3 en la época de invierno. Para los pichones se realizaron 11 conteos entre 1993 al 2009. Para las observaciones se utilizaron binoculares y telescopios. Los censos fueron apoyados por contadores manuales y se realizaron mediante el doble conteo repetitivo que considera el conteo simultáneo de dos o mas censadores (Valqui *et al.* 2000, Rocha 2006, Caziani *et al*. 2007). Por la superficie de la laguna, se utilizó el orillamiento con sectorización y varios puntos de conteo. Los censos se realizaron generalmente desde los mismos puntos en cada ocasión, determinando la especie en los adultos y en el caso de los pichones el número total.

Resultados

En laguna Colorada se viene anillando desde el año 2002. Hasta el presente se tienen anillados 3044 individuos de acuerdo a los códigos que se presentan en el Cuadro 1.

El 2009 se lograron anillar 697 individuos, se tomaron medidas biométricas (ala, tarso, pico y peso) de 191 polluelos. El peso y tamaño de los juveniles capturados fue variable (1100 -2700 g), no se anillaron flamencos por debajo de este peso. Una prioridad fue liberar a los flamencos más pequeños para no causar un estrés innecesario en el grupo capturado.

Se han registrado un total de 76 avistamientos de individuos anillados en Laguna Colorada, de los cuales 65 corresponden a lagunas del norte en el altiplano central de Bolivia y este último año se obtuvieron 11 registros en tierras bajas en la república de Argentina.

En el caso boliviano el mayor número de registros se presenta en las lagunas Saquewa (402 km de distancia en línea recta desde Laguna Colorada), Macaya (420 km) y los lagos Poopó y Uru Uru (462 km), en la Argentina los registros provienen de Laguna Melincue (1418 km), Prov. Santa Fe y la albufera Mar Chiquita (1107 km), Provincia de Buenos Aires, cerca de Mar del Plata. La mayoría de los registros corresponden a los meses de junio y agosto. Todos los registros son precisos con datos de códigos, fechas y coordenadas del lugar.

Cuadro 1. Número de anillados de flamencos y código de anillos de Laguna Colorada, Potosí-Bolivia

Año	Nro flamencos anillados	Códigos de los anillos
2002	155	A y B
2003	87	A
2004	309	A y B
2005	269	D y F
2006	560	F, H y J
2007	414	L, N y P
2008	553	P, S y T
2009	697	T, V, X y Z
Total	**3,044**	

En lo que respecta a la abundancia, se realizaron 14 conteos de las tres especies de flamencos en Laguna Colorada, desde enero 1997 a febrero 2009, la especie más abundante es *P. jamesi*, con relación a las otras dos, sin embargo desde enero 2005 *P. andinus* tiene un crecimiento importante y llega en el 2008 a sobrepasar los 5.000 individuos. Los conteos más altos para *P. jamesi* coinciden con la época de reproducción (noviembre a marzo), llegan a más de 15.000 individuos en abril 1997, enero 1998, octubre 1999, marzo 2000, enero 2005 y marzo 2006 y los registros mas bajos en la época de invierno (julio – agosto) con registros menores a los 3000 ejemplares en julio 1997 y agosto 2000. La abundancia del flamenco chileno (*Phoenicopterus chilensis*) fue menor como se presenta en la Figura 2.

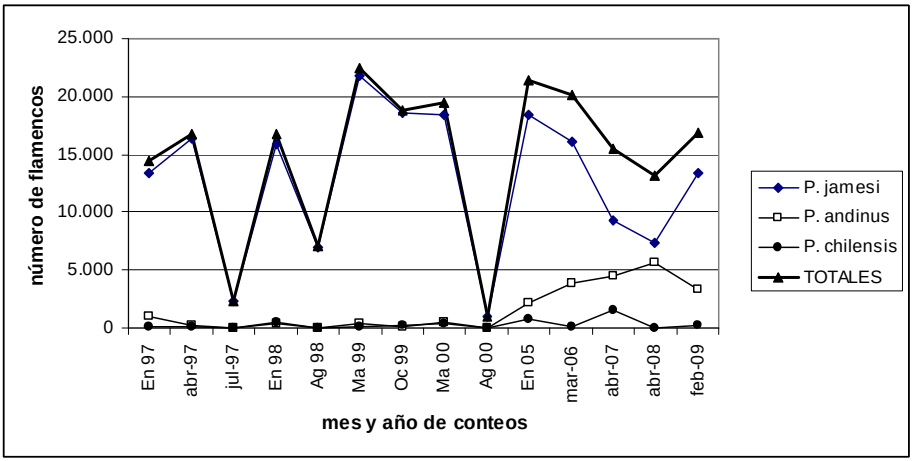

Figura 2. Abundancia de tres especies de flamencos en Laguna Colorada, Potosí, Bolivia desde 1997 a 2009.

Los sitios actuales de nidificación de flamencos son muy escasos a nivel regional (Rocha 2006) y muy pocas localidades de anidamiento son conocidas para *P. jamesi*. La principal colonia esta en Laguna Colorada, donde los pichones están en grupos numerosos (100 a 500 individuos o más) y muy compactos denominados agregaciones infantiles o "creches". Los pichones de las tres especies presentan una coloración gris del plumaje lo cual dificulta su identificación, considerando que en este humedal nidifican las tres especies aunque en diferente proporción.

Sin duda en Laguna Colorada se registran los mayores eventos reproductivos para *P. jamesi*, con registros altos como 18.465 pichones en marzo de 2000 y 8.388 pichones en marzo 2004

(Figura 3). El 2005 se han registrado más de 10.000 pichones y el 2007 más de 15.000 pichones, sin embargo parece ser que la proporción de *P, andinus* ha ido incrementándose respecto a las otras dos especies. Esta aseveración se basa en las colonias o "creches" que han sido manipuladas para las actividades de anillado.

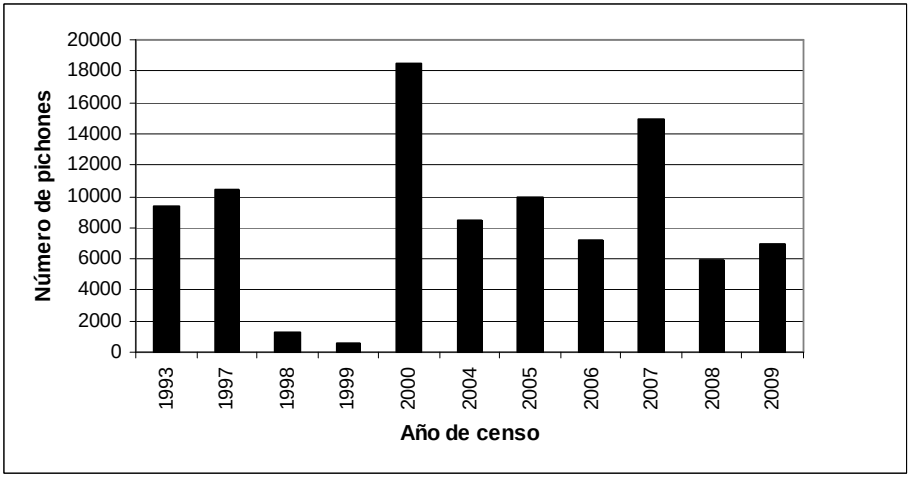

Figura 3. Datos parciales del número de pichones de flamencos, sin distinción de especie, nacidos en Laguna Colorada (1993 – 2009)

Discusión

Las anillas utilizadas de color blanco y combinaciones de tres letras en negro se pueden distinguir a distancia con cierta práctica. Las anillas permiten el reconocimiento individual y a distancia de las aves marcadas cuando están posadas. De los 76 registros solo en dos casos no se pudo distinguir las tres letras del código, lo cual demuestra que los avistamientos son bastante precisos. Estos registros representan el 2,5% del total de 3044 individuos anillados en Laguna Colorada.

La mayoría de los registros corresponden a la época de invierno altiplánico (junio–agosto), donde los espejos de agua de las lagunas del suroeste de Potosí, donde se encuentra Laguna Colorada, se congelan superficialmente, dificultando la búsqueda de alimento por parte de los flamencos, razón por la que se desplazan hacia el norte a las lagunas Saquewa y Macaya y los lagos Poopó y Uru Uru, en el departamento de Oruro – Bolivia y hacia los humedales de Melincue y Mar Chiquita en tierras bajas de Argentina, donde existen mejores condiciones de temperatura y de alimentación.

Por lo tanto nuestros resultados corroboran los estudios de Valqui *et al.* (2000), Caziani, *et al.* (2006, 2007) y Marconi *et al.* (2007), donde se establece los desplazamientos estacionales y altidudinales de los flamencos altoandinos, debido al recurso alimenticio y las condiciones climáticas extremas de frío que en invierno puede llegar a -23ºC.

En lo que respecta a los desplazamientos, la menor distancia se registra de Laguna Colorada hasta Laguna Saquewa con 402 km lineales y la mayor distancia a Laguna Melincue con 1.418 km, en este último caso se observaron individuos después de tres meses de ser anillados en Laguna Colorada, lo que demuestra una gran capacidad de desplazamiento por parte de los pichones que están sobre los tres meses de vida.

Se ha visto que la continuidad del programa en 8 años de anillado juntamente con estudios de telemetría satelital (F. Arengo com. pers.) están brindando importantes resultados para poder interpretar los desplazamientos de los flamencos altoandinos y entender mejor su ecología.

En lo que respecta a la abundancia poblacional de los flamencos altoandinos en Laguna Colorada, en general las mayores abundancias se presentan en los meses de verano (octubre a

marzo), que coincide con la época de reproducción y cuando el clima es más favorable, al contrario los registros mas bajos se sitúan en los meses de invierno (julio – agosto), donde gran parte de los espejos de agua se congelan y los flamencos se trasladan a lugares más cálidos. Por lo tanto, las variaciones de abundancia en Laguna Colorada fluctúan en relación con la época estacional, con altas concentraciones en verano y bajas en invierno.

El flamenco *P. jamesi* es la especie más abundante en Laguna Colorada, donde se concentran más de 25.000 flamencos de esta especie en la época de verano, lo que representa el 25% de toda la población de esta especie. Sin embargo en los últimos cinco años existe un incremento considerable de *P. andinus* y finalmente el flamenco chileno (*P. chilensis*) sigue siendo la especie menos abundante.

Agradecimientos

Manifestamos nuestro agradecimiento por su apoyo a la Dirección General de Biodiversidad y Áreas Protegidas (DGBAP) del Viceministerio de Medio Ambiente, Biodiversidad y Cambios Climáticos, al Centro de Estudios en Biología Teórica y Aplicada (BIOTA), al Grupo de Conservación de Flamencos Altoandinos (GCFA) y Wildlife Conservation Society (WCS-Bolivia) y al equipo de Guardaparques de la Reserva Nacional de Fauna Andina Eduardo Avaroa. Nuestro especial reconocimiento a José Salazar por su apoyo constante en el trabajo de campo y a Felicity Arengo por su permanente asesoramiento.

Bibliografía

Caziani, S. M., Rocha Olivio, O., Rodríguez Ramírez, E., Romano, M., Derlindati, E. J., Tálamo A., Ricalde, D., Quiroga, C., Contreras, J. P., Valqui, M. y Sosa, H. 2007. Seasonal distribution, abundance, and nesting of Puna, Andean, and Chilean Flamingos. The Condor 109:276-287.

Caziani, S.M., Rocha Olivio, O., Romano, M., Tálamo, A., Derlindati, E. J., Ricalde, D., Rodríguez Ramírez, E., Sosa, H y Sureda, A. L. 2006. Abundancia poblacional de flamencos altoandinos: resultados preliminares del último censo simultáneo internacional. In: Childress, B., Arengo, F., Béchet, A. and Jarrett, N (eds.) 2006. *Flamingo*, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, Nº 14, December 2006. Wildlfowl & Wetlands Trust, Slimbridge, UK.

Marconi, P., Sureda A. L., Rocha Olivio, O., Rodríguez Ramírez, E., Derlindati, E., Romano, M., Sosa, H., Amado, N. y Arengo, F. 2007. Network of Wetlands of Importance for Flamingo Conservation: Preliminary results from 2007 summer monitoring at priority sites. In: Childress, B., Arengo, F., Béchet, A. and Jarrett, N (eds.) Flamingo, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, Nº 15, December 2007. Wildlfowl & Wetlands Trust, Slimbridge, UK.

Rocha, O. 2006. Relación de la abundancia de tres especies de flamencos del suroeste del Altiplano de Bolivia con las características del hábitat. Tesis de Grado. Universidad Mayor de San Andrés, La Paz – Bolivia.

Valqui, M., Caziani, S. M., Rocha, O. y Rodríguez, E. 2000. Abundance and distribution of the South American altiplano flamingos. Pp 110-113. In: Baldassarre, G. A., Arengo, F. and Bildstein, K. L., editors. 2000. Conservation biology of flamingos. Waterbirds 23 (Special Publication 1).

Conteos de Flamencos y otras observaciones en la desembocadura del Río Mataquito, VII Región del Maule, Chile, 2007-2009

Flamingo counts and other observations in the mouth of the Mataquito River, VII Region of Maule, Chile, 2007-2009

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Resumen
Se informan los resultados de conteos de flamencos realizados en la temporada no reproductiva (Abril a Octubre) en la desembocadura del río Mataquito (Región del Maule, Chile) durante los años 2007, 2008 y 2009. Los resultados indican que el área es utilizada para la alimentación, especialmente por el Flamenco Chileno (*Phoenicopterus chilensis*), aunque durante los primeros conteos del año 2007 se detectó la presencia de un ejemplar de Flamenco Andino (*Phoenicoparrus andinus*). La agrupación de flamencos mostró un máximo de 427 ejemplares en Octubre 2007 y no detectamos flamencos luego del recuento del mes de Mayo 2008 (105 individuos) como producto de una gran crecida del río Mataquito, cuyo flujo habría impactado las áreas de alimentación del estuario. En efecto entre los meses de Junio y Octubre del año 2008 no se registró la presencia del Flamenco Chileno en el área. Los conteos del año 2009 indicaron que la condición alimentaria de la desembocadura del río Mataquito fue restablecida, registrándose nuevamente la presencia de ejemplares de Flamenco Chileno (*Phoenicopterus chilensis)* alimentándose en el área.

Abstract
This paper presents results of flamingo counts during the non-breeding season (April-September) at the mouth of the Mataquito River in the Maule Region of South Central Chile during the years 2007, 2008 and 2009. The results show that the area is used as a feeding site, especially by the Chilean Flamingo (*Phoenicopterus chilensis*), even though during the initial counts of 2007 the presence of one Andean Flamingo (*Phoenicoparrus andinus*) was also detected. We counted a maximum of 427 individuals in October 2007, but did not detect any flamingos in the May 2008 count, due to an increase in water levels that affected the feeding areas of the estuary. In fact, between the months of June and October 2008 we did not observe Chilean Flamingos in the area. Feeding conditions at the estuary returned to normal during the non-breeding season and we again observed Chilean Flamingos there.

Introducción
Se realizaron conteos de flamencos en el sector desembocadura del Río Mataquito en la VII Región del Maule durante los meses de Abril y Octubre de los años 2007, 2008 y 2009, cuyo objetivo fue evaluar el número de ejemplares de Flamenco Chileno (*Phoenicopterus chilensis*) que utiliza el área durante las estaciones de Otoño, Invierno y Primavera de cada año.

Área de Estudio
La cuenca del Río Mataquito forma parte de la VII Región del Maule y posee una extensión de 6.190 km^2. Se encuentra bajo la influencia de un bioclima mediterráneo y presenta al menos dos meses consecutivos del período estival Enero y Febrero) con déficit hídrico.

Esta cuenca hidrográfica se caracteriza por la gran cantidad de materiales aluviales aportados por los grandes ríos, sobre los cuales se ha creado una capa de suelo agrícola que proporciona los más extensos campos de cultivo del país.

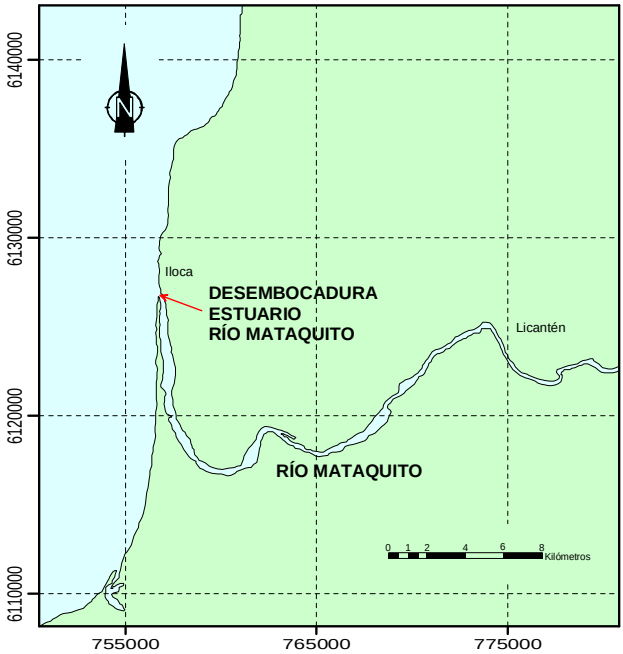

Figura 1: Desembocadura del Río Mataquito, VII Región del Maule, Chile

El área de estudio es un sector de ocupación estacional (Abril a Octubre) de Flamenco Chileno (*Phoenicopterus chilensis*), especie que muestra movimientos latitudinales y longitudinales al interior de su área de distribución regional (Perú, Bolivia, Brasil, Argentina, Uruguay, Paraguay y Chile) y nacional a lo largo y ancho del territorio Chileno (Parada, 1990c). En Chile habita en salares del norte del país (Hurlbert y Keith 1979, Parada 1985, 1988, 1990a), lagunas de agua dulce y desembocaduras de ríos del sur del territorio chileno (Soto 1990, Parada 1990a y 1990c). El número de flamencos chilenos que habitan en Chile es estacional y anualmente variable, y está determinado básicamente por las posibilidades de instalación de colonias de cría en el norte de Chile (Parada 1990b, Parada 1992) y agrupaciones en descanso invernal en el sur del país (Soto 1990). Su alimentación es omnívora y está dominada por presas animales de pequeña talla como crustaceos, nemátodos, moluscos y larvas de insectos (Parada 1990). Su conducta reproductiva es ampliamente conocida en el Norte de Chile, existiendo incluso manejos exitosos de incubación, alimentación artificial y reinserción al medio natural de polluelos de la especie.

Métodos

Los recuentos de flamencos en el área de estudio se han realizado mensualmente entre los meses de Abril y Octubre de los años 2007, 2008 y 2009 entre las 09:30 y 12:30 hrs.La observación se ha realizado mediante binoculares 10x42 y telescopio 20X-60X, y el conteo ha sido total y directo, recorriendo la ribera Este de la desembocadura del río Mataquito.

Resultados

Variación Temporal del Número de Individuos entre Junio y Octubre del 2007

El conteo total y directo realizado sobre las agrupaciones de flamencos del área de estudio mostró variaciones en el número y distribución de individuos. El mayor registro de 427 individuos se obtuvo durante el conteo de mediados de Junio, mientras que durante el conteo de fines de Octubre se registró el menor número de individuos (2), asociado esto último con la migración estacional del Flamenco Chileno hacia áreas de utilización estival.

Las variaciones en el número de individuos entre los conteos efectuados entre Junio y Agosto indicarían la existencia de movimientos frecuentes de parte de estas agrupaciones hacia y desde áreas de habitat cercanos como las desembocaduras de Reloca e Itata (tabla 1). En la misma tabla se ha incluido el resultado del conteo de Julio de la temporada invernal del año 2006.

Es destacable la presencia de un ejemplar de Flamenco Andino (*Phoenicoparrus andinus*) durante los recuentos del mes de Junio de 2007, condición anómala respecto a la distribución de la especie en territorio chileno. Este avistamiento podría estar indicando la existencia de movimientos migratorios latitudinales antes no propuestos para el Flamenco Chileno, pudiendo significar que las "poblaciones" del Norte y Sur del área de distribución estarían más conectadas de lo que hasta el momento se piensa.

Variación Temporal del Número de Individuos entre Mayo y Septiembre de 2008

El conteo total y directo realizado sobre las agrupaciones de flamencos del área de estudio mostró variaciones en el número y distribución de individuos. El único registro de individuos de la especie se obtuvo en el conteo de los días 10 y 11 de Mayo de 2008 y alcanzó a 105 ejemplares de Flamenco Chileno (*Phoenicopterus chilensis*). Durante los conteos de los meses siguientes (Junio a Septiembre) no se avistaron ejemplares de la especie (tabla 1). Lo anterior estaría relacionado con una crecida del río Mataquito observada el día 23 de Mayo del 2008, evento fluvial que habría alterado las áreas de alimentación de la especie en el sector del estuario.

Variación Temporal del Número de Individuos entre Abril y Septiembre de 2009

El conteo total y directo realizado sobre las agrupaciones de flamencos del área de estudio durante el año 2009 mostró variaciones en el número y distribución de individuos. El mayor registro de 188 individuos se obtuvo durante el conteo de mediados de Julio, mientras que durante el conteo de fines de Septiembre se registró el menor número de individuos (17), asociado esto último al inicio de la migración estacional del Flamenco Chileno hacia áreas de utilización estival hacia Argentina o el Norte de Chile.

A diferencia de lo observado el año anterior (2008), el número de flamencos en el área de estudio mantuvo el comportamiento estacional habitual y observado durante los conteos del año 2007, condición atibuible a la ausencia de eventos fluviales de alto caudal como la observada en Mayo del año 2008.

Tabla 1. Recuento total y directo de flamencos en el estuario del río Mataquito durante las temporadas 2007, 2008 y 2009.

	Otoño		Invierno			Primavera	
	Abril	**Mayo**	**Junio**	**Julio**	**Agosto**	**Sept.**	**Oct.**
2006	s/i	s/i	s/i	126	s/i	s/i	s/i
2007	s/i	s/i	427	351	154	5	2
2008	0	105	0	0	0	0	0
2009	55	97	183	188	30	17	

Conclusiones

Durante la temporada 2007 (Junio a Octubre) se observó alta ocupación del estuario del río Mataquito y no se evidenciaron signos patológicos ni comportamientos inusuales en los individuos de Flamencos del área de estudio. Se observaron maniobras de alimentación en todos los meses de observación.

Durante la temporada 2008 solo se observó ocupación del área durante el primer conteo de Mayo. Esta condición habría sido determinada por la inundación y alto flujo del río Mataquito observado el 23 de Mayo del 2008, fenómeno natural que habría afectado las áreas de alimentación invernal del Flamenco Chileno (*Phoenicopterus chilensis)* en el estuario del río.

Durante la temporada 2009 la ocupación del área del estuario retomó la condición observada en el año 2007, contabilizandose flamencos chilenos entre Abril y Septiembre, confirmando la ocupación estacional del área correspondiente al descanso reproductivo.

La observación de actividad de alimentación en los ejemplares de flamenco chileno en horarios cercanos al mediodía durante la temporada 2009 indicarían que las condiciones alimentarias para la especie del estuario del río Mataquito se han recuperado, luego de las crecidas de Invierno 2008 que provocaron el abandono del área por los flamencos durante gran parte de la temporada.

La observación de *Phoenicoparrus andinus* entre grupos de *Phoenicopterus chilensis* permite plantear la existencia de un movimiento latitudinal de esta última especie, no descartandose que flamencos chilenos observados en el sur de Chile durante los meses de descanso reproductivos correspondan a individuos provenientes del sector Norte del área de distribución y nó solo de áreas de habitat de territorio argentino. Nuestros próximos trabajos se orientarán al esclarecimiento de los movimientos migratorios estacionales del Flamenco Chileno que ocupa el Sur de Chile durante la fase de descanso reproductivo.

Referencias

Hulbert, S. y J. O Keith, 1979. Distribution and spatial patterning of flamingos in the Andean altiplano. Auk, 96: 328-342

La Prensa: El Pueblo de Licanten, sus alrrededores y el río. 23 de mayo 2008

Parada, M. 1985. Proyecto "Conservación de Flamencos en el Norte de Chile", Informe N°3 - 32 p., CONAF / CHILE.

Parada, M. 1986. Proyecto "Conservación de Flamencos en el Norte de Chile", Informe N°4 - 41 p., CONAF / CHILE.

Parada, M. 1988. "Conservación de Flamencos en el Norte de Chile, Informe Final 1985 - 1987", Informe final - 159 p., NYZS-CONAF / USA-CHILE.

Parada, M. 1990a. Flamencos en el Norte de Chile: Distribución, abundancia y fluctuaciones estacionales del número. Pp. 52-66 En: Actas del I Taller Internacional de Especialistas en Flamencos Sudamericanos. Corporación Nacional Forestal – Sociedad Zoológica de Nueva York,

Parada, M. 1990b. Reproducción de Flamencos en el Norte de Chile. Pp. 87-91 En: Actas del I Taller Internacional de Especialistas en Flamencos Sudamericanos. Corporación Nacional Forestal – Sociedad Zoológica de Nueva York. 217 pp.

Parada, M. 1990c. Flamencos en el Norte de Chile: decrementos invernales y proposición de movimientos migratorios. Pp. 101-110. En: Actas del I Taller Internacional de Especialistas en Flamencos Sudamericanos. Corporación Nacional Forestal – Sociedad Zoológica de Nueva York,

Parada, M. 1992. "Conservación de Flamencos en el Norte de Chile entre 1985 y 1990", 126 p., Corporación Nacional Forestal y Sociedad Zoológica de Nueva York.-CHILE.

Soto, D. 1990. Relationship between zooplankton biomass and Chilean flamingo population in southern Chile Patagonic lagoons. Pp. 22-26. En: Actas del I Taller Internacional de Especialistas en Flamencos Sudamericanos. Corporación Nacional Forestal – Sociedad Zoológica de Nueva York.

Investigating the potential connectivity of Lesser Flamingo populations by satellite-telemetry

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Abstract
Lesser Flamingos occur in four regional populations in western, southern and eastern Africa and in northwest India. They make many long-distance movements within these regions, but movements between regional populations are not known, with the exception of one ring recovery. The Max-Planck-Institute for Ornithology in Radolfzell, Germany, started a project to investigate the potential connectivity of the regional populations with satellite transmitters. In May and June 2009 four and 15 Lesser Flamingos were tagged with GPS transmitters in Ethiopia and Kenya respectively. Between tagging and 30 September, 2009 two of the Ethiopian birds moved about 530 km northeast to the border with Djibouti, while the other two remained in the national park where they were tagged. Most of the birds tagged in Kenya, also moved considerable distances, some of several hundred kilometres, among the soda lakes in Kenya and Tanzania. There was, however, no indication of movement towards other regional populations. As the tags are expected to last for several years, the project may confirm such movements in the future and will reveal new insights in Lesser Flamingo movement ecology.

Introduction
There are three populations of Lesser Flamingos (*Phoeniconaias minor*) in Africa (Figure 1). The world's largest concentration, with an estimated 1.5 to 2.5 million individuals, is found on the soda lakes in the East African Rift Valley (Wetlands International 2006). Another smaller regional population is found in southern Africa, with an estimated number of 55,000 to 65,000 individuals (Wetlands International 2006). This population increases during good breeding years (*e.g.* at Sua Pan in Botswana, 80,000 breeding pairs were counted in 2000 and about 85,000 individuals were counted in March 2005 [Childress 2005]). A small population of 15,000 to 25,000 Lesser Flamingos is found in West Africa (Wetlands International 2006), with the main concentrations in the Senegal delta and adjacent areas (Trolliet and Fouquet 2001), but also in northern Mauritania (Isenmann 2006) and in Guinea (Trolliet and Foquet 2001). In southern Asia, Lesser Flamingos are found at a variety of mostly coastal sites between Yemen and Bangladesh (Parasharya and Tere, 2006). A complete census has been difficult to obtain. The best current estimate is 390,000 (Wetlands International 2006).

Lesser Flamingos are not regularly migratory but rather show irregular nomadic movements. There is only one record of a movement between two regional populations: a bird which was ringed as a chick in Kenya in 1962 was found dead in the Western Sahara in 1997 (Childress and Hughes 2007). Apparent parallel fluctuations in the sizes of regional populations (*e.g.* between eastern Africa and southern Africa and between eastern Africa and India) have been discussed as an indication that there are migrations between regional populations (Borello *et al*. 1998, Parasharya and Tere 2006). On the other hand, counts revealing unexpected high numbers of Lesser Flamingos in southern Africa may be indicative that resident numbers are higher than previously thought, which could explain high breeding densities without immigration from elsewhere (Childress 2006). A recent molecular study comparing the populations of eastern and southern Africa supported the idea of restricted interchange between the two populations but nevertheless with some gene flow between them (Zaccara *et al*. 2008). However, seven Lesser Flamingos equipped with satellite transmitters in Kenya in 2002/03 and followed for up to four years (B. Childress, unpub. data) made movements of several hundred kilometres up and down the Rift Valley, but never left their regional population. Similarly, three Lesser Flamingos equipped with satellite tags in Botswana moved for distances of up to 930 km within a few days (McCulloch *et al*. 2003) but never left southern Africa.

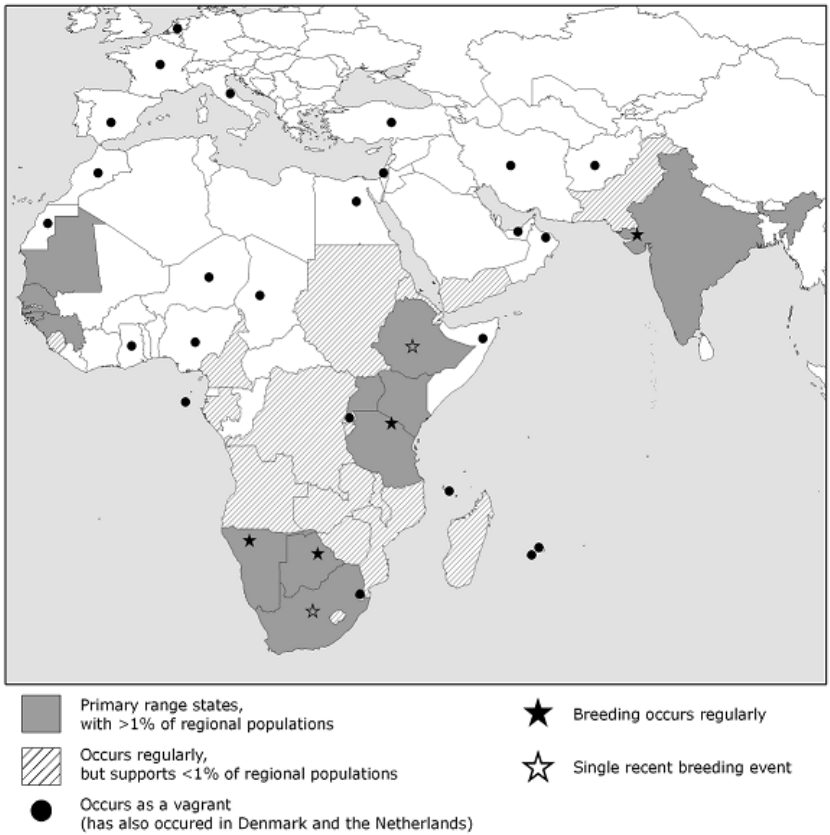

Figure 1. Lesser Flamingo distribution map. Source: Childress *et al.* 2008.

The Max-Planck-Institute for Ornithology started a project to equip Lesser Flamingos of all four regional populations with satellite-transmitters. The objectives of the study are to investigate whether there are movements connecting the four regional populations, to discover the movement routes, to detect important staging areas, to assess the importance of different staging areas and to assess threats on migration and at staging areas. Here we report the results obtained between the start of the project in eastern Africa in May-June and 30 September 2009.

Methods

Between 1st and 4th May 2009 four Lesser Flamingos were captured at Lake Abijatta in Ethiopia. Between 20 and 25 June 15 additional birds were captured at Lake Bogoria, Kenya. The head-and-bill length and the tarsus length of each captured bird were measured for sex determination (Childress *et al.* 2005). Then, a 40 g GPS Platform Transmitter Terminal (PTT, Microwave Telemetry) was attached with a 'backpack' harness consisting of 3 mm braided nylon cord inside a Teflon sleeve (Childress *et al.* 2004). The PTTs transmitted GPS data through the ARGOS-system (ARGOS, Toulouse, France).

Results

On 30 September 2009, 17 of the 19 transmitters, including all four of those attached in Ethiopia, were still sending data. Of the 15 tags applied in Kenya, one stopped transmitting after twelve days, after the respective flamingo had moved from Lake Bogoria to Lake Nakuru. A second bird was apparently preyed upon by an African Fish Eagle (*Haliaaetus vocifer*) at Lake Elmenteita. That bird had already moved from Lake Bogoria to Lake Natron and back via Lake Oloidien and died after moving to Lake Elmenteita 28 days after it was tagged.

Two of the Lesser Flamingos tagged at Lake Abijatta in Ethiopia had left the area of the Abijatta-Shalla Lakes National Park only for short trips to lakes near Debre Zeyit and to Lake Koka 135 km and 110 km north of Lake Abijatta. The other two birds moved after approximately nine and ten weeks to Lake Abbe near the Ethiopian-Djibouti border approximately 530 km to the northeast of Lake Abijatta. One of these birds was still there at the time of writing, but the second one had moved 50 km to Lake Gemeri.

Most of the birds tagged at Lake Bogoria in Kenya moved among several alkaline lakes in Kenya and Tanzania. However, three birds never left Lake Bogoria during the period considered here. The other birds moved mainly for various periods among lakes Nakuru, Elmenteita and Oloidien to the south and southeast of Lake Bogoria. One bird moved to Lake Manyara in Tanzania via Lake Natron, a distance of approximately 430 km. Another bird moved to Lake Logipi 220 km to the north before all remaining birds had returned to Lake Bogoria for about a week in early August. Since then three birds moved to the Elboitong area 20 km south of Lake Logipi two had moved to Lake Nakuru and Lake Elmenteita at the time of writing.

Discussion

During the early stages of this study, the Lesser Flamingos in Ethiopia and Kenya moved among various lakes without any consistent patterns. The birds tagged in Ethiopia may have been an exception in that all birds moved out of the vicinity of the capture site in a north-easterly direction. Whether this movement indicates a possible route to *e.g.* the Aden Wetlands in Yemen (Al-Saghier and Porter 1996) may be shown in the future.

The birds that were tagged in Kenya moved among several lakes in Kenya and Tanzania. This was already apparent from the earlier study by Childress *et al.* (2007). However, unlike the period during the previous study, Kenya and Tanzania have been experiencing a disastrous drought. Lake Nakuru hosted 500,000 – 600,000 Lesser Flamingos in April 2009 and Lake Elmenteita many thousands more. By 1st September, the latter had dried out completely; Lake Nakuru had very little water left and was possibly hypersaline (see separate report this issue). The movements of the tagged birds towards Lake Bogoria in early August may reflect a search for a good feeding site in a very demanding environment. The situation may be indicative that Lesser Flamingos are adapted to respond to local environment changes by moving elsewhere, and thus depend on a network of suitable areas (BirdLife International 2000). In Botswana three Lesser Flamingos that were equipped with satellite tags also left the area when the lake where the birds were tagged when the lake dried out (McCulloch et al. 2003).

The Lesser Flamingos previously tagged in Kenya (Childress *et al.* 2007) produced data for up to four years (B. Childress, unpub. data). Therefore, it can be expected that the Lesser Flamingos tagged within this study will also reveal data about their movements for several years. Together with birds that will be equipped with PTTs in other regional populations, they may reveal interesting insights into the movements of Lesser Flamingos which may enable the development of more sophisticated conservation strategies through a better knowledge of the movement ecology of the species.

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References

Al-Saghier, O. and Porter, R. F. 1996. The bird conservation Importance of the Aden Wetlands, Republic of Yemen. BirdLife International and the Ornithological Society of the Middle East, Aden.

BirdLife International. 2000. *Threatened birds of the world*. Barcelona and Cambridge, UK. Lynx Edicions and BirdLife.

Borello, W. D., Mundy, P.J. and Liversedge, T. N. 1998. Movements of greater and lesser flamingos in southern Africa. Pp: 201-218. In: Leshe, E., Lachman, E. and Berthold, P. (eds) Migrating Birds know no Boundaries. Torgos Publication, Tel Aviv.

Childress, B. 2005. New flamingo population estimates for Waterbird Population Estimates, Fourth edition. Pp: 18-21 In: Childress, B., Béchet, A., Arengo, F. and Jarrett, N. (eds.) 2005. Flamingo, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, No. 13, December 2005. Wildfowl & Wetlands Trust, Slimbridge, UK.

Childress, B. 2006. Important Lesser Flamingo site documented in South Africa. Flamingo. Pp: 37-38. In: Childress, B., Arengo, F., Béchet, A. and Jarrett, N. (eds.) 2006. Flamingo, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, No. 14, December 2006. Wildfowl & Wetlands Trust, Slimbridge, UK.

Childress, B., Harper, D., Hughes, B., Van den Bosche, W., Berthold, P. and Querner, U. 2004. Satellite tracking of Lesser Flamingo movements in the Rift Valley, East Africa – Pilot Study Report. Ostrich 75:57-65.

Childress, B., Harper, D., Hughes, B. and Ferris, C. 2005. Sex determination in the Lesser Flamingo (*Phoenicopterus minor*) using morphological measurements. Ostrich 76:148-153.

Childress, B. and Hughes, B. 2007. Evidence of interchange between African Lesser Flamingo populations. Proceedings of the 11th Pan-African Ornithological Congress, 2004. Ostrich 78:507.

Childress, B., Hughes, B., Harper, D., Van den Bossche, W., Berthold, P. and Querner, U. 2007. East African flyway and key site network of the Lesser Flamingo (*Phoenicopterus minor*) documented through satellite tracking. Proc. Pan African Ornithol. Congr. XI, Djerba, Tunisia, 20-25 November 2004. Ostrich 78:463-468.

Childress, B., Nagy, S. and Hughes, B. (Compilers). 2008. International Single Species Action Plan for the Conservation of the Lesser Flamingo (*Phoeniconaias minor*). CMS Technical Series No. 18, AEWA Technical Series No. 34. Bonn, Germany.

Isenmann, P. 2006. The Birds of the Banc d'Arguin. Parc National du Banc d'Arguin & FIBA, Arles, France.

McCulloch, G., Aebischer, A. and Irvine, K. 2003. Satellite tracking of flamingos in southern Africa: the importance of small wetlands for management and conservation. Oryx 37:480-483.

Parasharya, B. M. and Tere, A. 2006. *Lesser Flamingo in India: a knowledge update*. Anand Agricultural University, Anand.

Trolliet, B. and Fouquet, M. 2001. La population ouest-africaine du Flamant nain *Phoeniconaias minor*: Effectifs, réparation et isolement. Malimbus 23:87-92.

Wetlands International 2006. Waterbird Population Estimates – Fourth Edition. Wetlands International, Wageningen, The Netherlands.

Zaccara, S., Crosa, G., Childress, B., McCulloch, G. and Harper, D. M. 2008. Lesser Flamingo *Phoenicopterus minor* populations in eastern and southern Africa are not genetically isolated. Ostrich 79:165-170.

Aerial census of Lesser Flamingos (*Phoeniconaias minor*) on the Rift Valley lakes of northern Tanzania, January 2002

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Abstract
In January 2002, we conducted an aerial census of Lesser Flamingos on 13 major lakes in northern Tanzania known to be used by Lesser Flamingos. A total of 634,440 flamingos were counted, 79% (502,066) of which were on Lake Eyasi and 16% on Lake Natron. The remaining 5% were distributed in small numbers across the other 11 lakes.

Introduction
The Rift Valley lakes of East Africa are world renowned for the large number and diversity of water birds that congregate in them. Lesser Flamingos (*Phoeniconaias minor* Geoffroy Saint-Hilaire 1798) are the most numerous and conspicuous birds using the alkaline lakes, frequently colouring their shorelines pink. These alkaline lakes hold an estimated Lesser Flamingo population of between 1.5 and 2.5 million birds (Wetlands International 2006). In addition to the major lakes, Lesser Flamingos occur on many relatively small inaccessible lakes from Ethiopia to southern Tanzania, making accurate ground counts difficult and time consuming. The birds also make frequent, spontaneous, and often unpredictable movements among the lakes (Childress *et al.* 2007), meaning that multi-lake censuses need to be conducted over short periods of time in order to be accurate.

Since the first studies published by Brown (1973), the Lesser Flamingo population in the Rift Valley has been studied continuously. Brown & Root (1971) indentified Lake Natron in Tanzania as the only regular breeding site used by the large East African population. Since the 1960s, flamingo populations have been counted several times to determine their conservation status and to establish population trends (Grizmeck & Grizmeck 1960, Bartholomew & Pennycuick 1973, Tuite 1979 and Woodworth *et al.* 1997). As a census provides only a snapshot of the population at a point in time, it is necessary to repeat counts on a regular basis to establish population dynamics (Escute'-Gasulla et al, 2002). Since 1990, annual ground counts have been performed in Kenya as part of the Wetlands International African Waterbird Census (Perrenou 1991) and an important database for developing a conservation strategy has been established (Nasirwa 2000). The status of flamingo populations in Tanzania is still poorly understood. In January 2002, this aerial survey of flamingos was carried out under the auspices of the Tanzania National Wetlands Working Group (NWWG) as part of the implementation of the African-Eurasia Migratory Waterbird Agreement (AEWA) which Tanzania joined in 1999 and the Ramsar Convention on Wetlands which the country joined in 2000.

Study area
Although Lesser Flamingos are known to occur on 20 alkaline lakes and wetlands in northern Tanzania, the aerial census was conducted on the 13 major lakes: Eyasi, Natron, Manyara, Balangida Lelu, Balangida, Magadi, Lagarja, Masek, Burungi, Kitangiri, Big Momella, Small Momella and Tulusia (Figure 1).

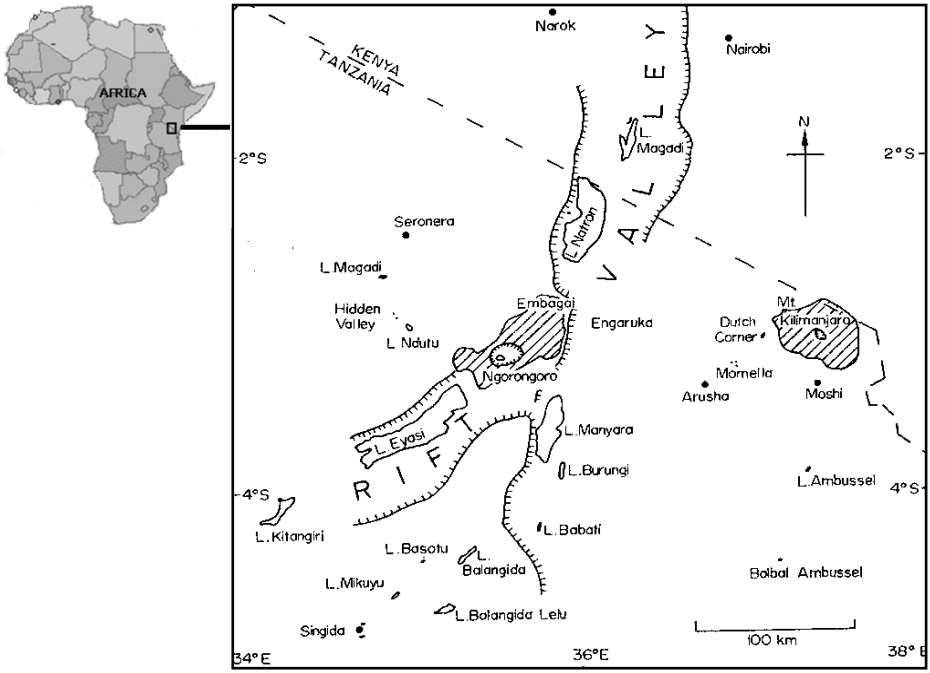

Figure 1. Rift valley lakes in Tanzania, surveyed for flamingos, January 19th and 20th 2002.

Methodology

The aerial census was conducted at eight lakes (Eyasi, Natron, Kitangiri, Magadi, the two Balangidas, Lagarja, and Masek) in two flights on 19th and 20th January 2002 using a 4-seat Cessna 182 aircraft. A hand-held Nikon F-70 camera with a 50 mm 1.8*f* lenses was used. Flight altitudes varied from 280 to 630 meters above the lake surface depending on the birds' response in each lake. Total count was used throughout the study. The crew conducted a reconnaissance flight at each lake to assess the general distribution of flamingos and to make essential visual observations prior to conducting the photographic survey. A visual estimate of water level was recorded and classified as dry (completely dry, no water), very low (<10% of lake bed covered with open water), low (11-25% water), moderate (26-75% water), high (76-90% water) and full (>90% water).

Overlapping photographs were taken of the shorelines where flamingos concentrated. At least one transect of sample photographs was flown over each lake with flamingos feeding in the pelagic areas. Where flocks were small and it was possible to count individual birds, direct estimates were made. Combining both methods, gave us a repeatable cost-effective methodology to produce a good estimate of the flamingo numbers present on each lake.

Ground counts were conducted at five lakes where the aerial survey could not be made due to poor visibility (the Momella lakes, Manyara, Burungi and Tulusia). Overlapping photographs were taken from each lakeshore, ensuring that all birds located between the shoreline and 500 m inside the lake were counted. The camera was hand held and reference points were looked established in each shot to enable flock identification when counting to avoid repetitions. The first photograph in each film was taken of a portable blackboard where location, film number and date were written.

Photographs taken were counted in order to know in advance when the film was ending. Two camera bodies were used in rotation, one person changing films and taking first photographs while another was taking photographs of the shoreline. Once back in the lab, films were

developed and absolute bird counts started. Each slide was projected with a grid and birds in each rectangle counted. Data was recorded in a specially designed sheet and later into a computer spreadsheet. Where flocks were small and it was possible to count individual birds, direct estimates were made. Colour slides were printed on A5 photographic paper and each bird in a flock was counted. It is difficult to distinguish between Lesser Flamingos and Greater Flamingos (*Phoenicopterus roseus*) using aerial photography. For the purpose of the survey, based on previous studies by Woodworth *et al.* 1997, Bennun & Nasirwa 2000, Escute'-Gasulla *et al.* 2002, we have assumed here that the Greater Flamingos represented 2% of the total counts.

Results

634,440 Lesser Flamingos were counted on the 13 lakes surveyed (Table 1). 79% of the birds were on Lake Eyasi and 16% on Lake Natron. The remaining 5% were distributed among the Momella lakes (Big and Small, Manyara, the Balangidas, Masek, Magadi, Lagarja and Burungi.

Table 1: Flamingo numbers in the Rift Valley Lakes in Tanzania, January 2002.

Lake	Aerial Count	Ground Count	Total Count	Water Level
Eyasi	502,066	-	502,066	Moderate
Natron	102,410	-	102,410	Moderate
Manyara	6,000	8,264	8,264	High
Balangida Lelu	2,000	-	2,000	Moderate
Balangida	0	-	0	High
Magadi	1,000	-	1,000	Low
Lagarja	200	-	200	Low
Masek	-	-	1,050	Low
Burungi	-	46	46	High
Kitangiri	-	-		Full
Big Momella	-	17,227	17,227	Moderate
Small Momella	-	87	87	Moderate
Tulusia	-	90	90	Moderate
Total			**634,440**	

The 2002 count total was significantly below some of the counts obtained during pervious censuses conducted between 1969 and 2000 (Figure 2).

Table 2: Flamingo numbers in Tanzania's Rift Valley lakes for the period 1969-2002.

Lake	1969	1991	1992	1994	1995	2000	2002
Eyasi	28,288	-	-	0	800,000	12,000	502,066
Natron	25,195	-	372,670	507,117	400,000	-	102,410
Manyara	1,313	1,940,000	-	78,320	1,000,000	0	8,264
Embagai	-	-	-	243,278	4,026	-	-
Balangida	3,452	-	-	-	0	-	2,000
Magadi	5,686	-	-	7,765	-	-	1,000
Lagarja	4,100	-	-	0	-	-	200
Masek	-	-	-		-	-	1,000
Burungi	-	-	-	71,030	0	-	46
Kitangiri	104	-	-	-	360,000	-	0
Momella	25	-	220,000	-	0	-	17,404
Total	**68,163**	**1,940,000**	**592,670**	**907,510**	**2,619,026**	**112,000**	**634,440**

Source: Ministry of Natural Resources and Tourism, Tanzania

Discussion

The 2002 Lesser Flamingo count for the 13 lakes (634,440) was lower than several similar previous counts by other authors. Furthermore, the results indicated that the majority of the Lesser Flamingos in East Africa were outside Tanzania at the time of the census (based on a total estimated population of 1.5-2.5 million) and that those in Tanzania were concentrated on Lake Eyasi, and to a lesser extent Lake Natron. It is known that Lesser Flamingos move among lakes depending on different environmental circumstances such the abundance of their preferred food (*Arthrospira fusiformis* and diatoms), fresh water availability, water level or disturbance. Their frequent, spontaneous and often unpredictable movements among the alkaline lakes of Tanzania and Kenya (Childress *et al.* 2007) result in distribution patterns that are continuously changing. Lesser Flamingos are adapted to respond to environmental changes by moving to other locations, and thus depend on a network of suitable sites (BirdLife International 2000). Environmental conditions (such as drought and availability of fresh water) affecting Lesser Flamingo ecology in the saline alkaline lakes are interactive, and correlated in different ways amongst themselves and with flamingo numbers. The conditions are highly variable like the flamingo numbers over time depending on the prevailing environmental conditions, whose variation results in different Lesser Flamingo utilization patterns on the lakes. The proportional utilization is not uniform and different lakes may contain almost the entire population resident at certain points in time. Each different lake has its own special role to play in the survival of the Lesser Flamingo.

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References

Bartholomew, G. A. and Pennycuik, C. J. 1973. The flamingo and pelican populations of the Rift Valley lakes in 1969-1969. East African Wildlife Journal 11: 189-198.

BirdLife International. 2000. *Threatened birds of the world*. Barcelona and Cambridge, UK. Lynx Edicions and BirdLife.

Bennun, L. and Nasirwa, O. 2000. Trends in waterbird count in the southern Rift Valley of Kenya. Ostrich 71: 220-226.

Brown, L. H. 1973. *The Mystery of the Flamingos*. East Africa Publishing House, Nairobi.

Brown, L. H. & Root, A. 1971. The breeding behaviour of the Lesser Flamingo *Phoeniconaias minor*. Ibis113:147-172.

Childress, B., Hughes, B., Harper, D., Van den Bossche, W., Berthold, P. & Querner, U. 2007. East African flyway and key site network of the Lesser Flamingo (*Phoenicopterus minor*) documented through satellite tracking. Proceedings of Pan African Ornithological Congress XI, Djerba, Tunisia, 20-25 November 2004. Ostrich 78 (2): 463-468.

Grizmeck, M and Grizmeck, B. 1960. Flamingo censuses in East Africa Using aerial photography. Journal of Wildlife Management 24: 215-217.

Escutè, G., Pèrez, M. M., Solis, L. F. and Suňè, M. G. 2002. The Lesser Flamingo expedition Kenya 2000-2001. A study on the Lesser Flamingo *Phoeniconaias minor* in Lake Bogoria, Kenya.

Perrenou, C. 1991. African Waterfowl Census 1991. Slimbridge, UK: IWRB.

Nasirwa, O. 2000. Conservation status of flamingos in Kenya. In: Baldassarre, G. A. Arengo, F. and Bildstein, K. L., editors. 2000. Conservation biology of flamingos. Waterbirds 23 (Special publication 1): 47-51

Tuite, C. H. 1979. Population size, distribution and biomass density of the Lesser Flamingo in Eastern Rift Valley. Journal of Applied Ecology 16: 765-775.

Wetlands International. 2006. *Waterbird Population Estimates - Fourth Edition.* Wetlands International. Wageningen, The Netherlands.

Woodworth B. L., Farm, B. P., Mufungo, C., Borner, M. and Ole Kuwai, J. 1997. A photographic census of flamingos in the Rift Valley lakes of Tanzania. African Journal of Ecology 35: 326-334.

Monitoring of Greater and Lesser Flamingos *Phoenicopterus ruber* and *Phoeniconaias minor* in Menabe Central Coastal Wetlands, Madagascar

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Abstract
Since 2006, the Madagascar Teal Project team of the Durrell Wildlife Conservation Trust has conducted a bi-annual waterbird census in the Menabe Central Coastal Wetlands during the wet (March) and dry (July-August) seasons, except in 2009 when the census was conducted only once in July. The wet season maximum flamingo count of 3,152 individuals (*P. ruber* and *P. minor* combined) occurred in March 2007 and the dry season maximum count of 1,256 individuals occurred in July 2009. Total maximum numbers for both species during wet and dry season are respectively: *P. ruber* 1,223 individuals in 2006 and 341 in 2007; *P. minor* 2,210 in 2007 and 985 in 2009. The numbers of individuals fluctuate from year to year, and there are differences between wet and dry season, with the highest numbers being recorded during the wet season. Based on interviews with local people, flamingos formerly bred on Ankiamena salt pan, with the last known breeding in the 1980's. Disturbance, hunting and habitat destruction constitute the main threats.

Introduction
Two species of Flamingo (*Phoenicopterus ruber* and *Phoeniconaias minor*) occur in Madagascar. They are found in the western coastal wetlands, particularly in large muddy salt pans and brackish shallow lakes behind the mangroves, lagoons flooded during the high tide and on sand islets. Menabe Central Coastal Wetlands (see map) contains a variety of these types of the wetlands and is rich in waterbirds including several endemic and threatened with extinction. The extensive Tsiribihina River favours the formation of shallow wetlands in Menabe Central and they are among to the most important sites for resident and migratory waterbirds in Madagascar. However, as with most bird species in Madagascar, the status of flamingos has not yet been well documented.

Since 2006, bi-annual monitoring of waterbirds in the Menabe Central Coastal Wetlands has been conducted by the Madagascar Teal Project team of the Durrell Wildlife Conservation Trust. This monitoring has enabled us to document the number of each species occurring in this area during wet and dry seasons.

Methods
Through collaboration with local people, all known flamingo sites in the monitoring area were visited. The census was done systematically on foot or by boat and all individual flamingos were recorded by direct count using binoculars (10x42) and telescopes (D=80mm W30x or D=60mm W22x). The monitoring was conducted twice a year (March and July-August), except in 2009, when only one visit was made in July. Visits were made between 05:30 and 10:30, and the census was conducted by one or three people recording together the data according to the size of

the site and bird settlement. During visits, some local people were interviewed for information about flamingo histories and threats in this area.

Study area

Monitoring was conducted in Menabe Central Coastal Wetlands, particularly in the Tsiribihina River Delta wetlands, located between 19°25'25.90" S and 20°07'35.04" S, and 044°25'07.90" E and 044°23'10.35" E. This area contains extensive muddy salt pans, brackish shallow lakes behind the mangroves, lagoons flooded during the high tide, and sand islets.

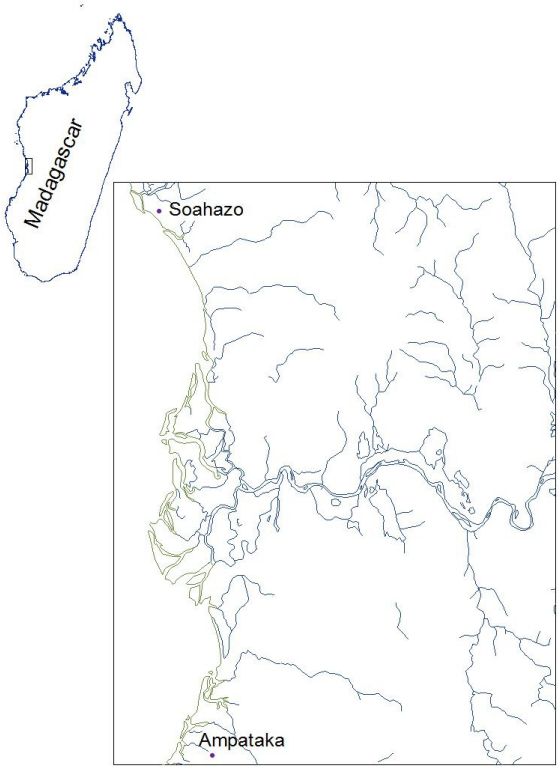

Figure 1. Map of study site

Results

Both species of flamingo occur in the western coastal wetlands throughout the year, but they are substantially more numerous during the wet season (March). Lesser Flamingos outnumber the Greater Flamingos both seasons, but there is a large variation in the numbers from year to year (Table 1).

Table 1. Number of flamingos counted in the Menabe Central Coastal Wetlands during the wet and dry seasons, 2006-2009. No wet season census in 2009.

	Lesser Flamingos		Greater Flamingos	
Year	Wet (March)	Dry (July)	Wet (March)	Dry (July)
2006	0	149	1,223	0
2007	2,210	380	942	341
2008	1,640	499	705	85
2009	-	985	-	271

Discussion

The Menabe Central Coastal Wetlands on the western coast of Madagascar regularly host both Greater and Lesser Flamingos, the numbers being higher in wet season. During the wet season, water depth increases in most of wetlands, and the flamingos move to sites with shallower water where they find adequate food. Thus, most of the flamingos are found concentrated at only a few sites. During the dry season, the flamingos disperse and are found on most of the wetlands along the coast, making them more difficult to census. This may be reason that the census numbers are consistently higher in the wet season counts.

According to local people, flamingos have bred previously in Ankiamena salt pan, and breeding of Greater Flamingos has been confirmed in south west Madagascar, especially Tsimanampetsotsa and Ihotry Lakes (Langrand, 1994). The last recorded breeding was in the 1980's. Ankiamena is a large, muddy salt pan about 18 km^2. It is private land and belongs to Aquamen, a shrimp farming company. The pan is partly flooded during the wet season with maximum depth of 70 cm, and is the biggest salt pan in this area. Large numbers of flamingos occur at this site during the wet season. However, according to local people some hunting still occurs in this area, although due to poverty, few local people have guns and most hunters are shrimp farm company employees and foreign game hunters.

Information from local people and observations of juveniles may be a sign of breeding in or near to Menabe Central Coastal Wetlands.

Although the coastal wetlands in this area are very important habitats for flamingos, they are subject to heavy anthropogenic pressures. The flamingos' habitats are also important sites for shrimp farming and salt extraction, and local people use this kind of habitat as fishing sites and places for shrimp harvesting. Hunting, disturbance and habitat destruction due to shrimp farming and salt extraction constitute the main threats of the flamingos in this area. Given that many wetlands of the same types are present along of west coast of Madagascar, visiting more sites in different regions is recommended to assess their full population size.

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Reference

Langrand, O, 1990. *Guide to the birds of Madagascar.* Delachaux & Niestlé. Neuchâtel-Paris.

Lateral neck-resting preferences in the Lesser Flamingo (*Phoeniconaias minor)*

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Abstract
When flamingos rest they lay their heads along their backs forcing their necks to curve to either the right or left of their individual center of gravity. Recent evidence (Anderson *et al.* 2009b) has suggested that Caribbean flamingos (*Phoenicopterus ruber)* display significant lateral preferences in neck-resting position, with most birds preferring to rest their necks to the right. In this report we employed Africam.com's "Flamingo Island" webcam in order to examine the neck-resting preferences of Lesser Flamingos (*Phoeniconaias minor)*. Four independent observers, whose tallies were subsequently averaged, recorded the number of birds seen resting their necks to the right and left on twelve separate instances during March 2009. A significantly greater number of Lesser Flamingos were observed resting their necks to the right than to the left, evidencing a population-level rightward lateral preference, and suggesting that this behavior may generalize across flamingo species.

Introduction
Lateral asymmetries in brain and behavior are commonly observed among vertebrate species. While the handedness displayed by humans is, of course, the most commonly cited example of laterality (*e.g*. Corballis 1989), it is hardly the only instance. Indeed, lateral asymmetries have been demonstrated in numerous species of mammals (*e.g.* Rizhova and Vershinina 2000), reptiles (*e.g.* Stancher *et al.* 2006), fish (*e.g.* Bisazza *et al*. 2000), and birds (*e.g*. Hoffman *et al.* 2006).

One can distinguish between individual-level laterality, in which an individual animal displays a consistent side preference over time (*e.g.* one person is typically either right or left-handed) and population-level laterality in which a similar side preference is seen among the majority of animals within a group (*e.g.* most people are right-handed {Corballis, 1989}). Individual-level laterality is commonly thought to function as a means by which to enhance multi-tasking ability and reduce redundancy of neurological circuits (*e.g*. Rogers 2000). Population-level asymmetries on the other hand, are more difficult to explain but may possibly serve to enhance coordination among individuals in groups (Bisazza *et al.* 2000) and general social cohesion (Rogers and Workman 1989).

In light of the possibility that population-level laterality serves a social function, we have recently attempted to demonstrate such asymmetries in the highly gregarious Caribbean flamingo (*Phoenicopterus ruber*). When flamingos rest they lay their head on their back, which forces their neck to curve to either the right or left of their individual center of gravity. Results obtained from the captive flock at the Philadelphia Zoo (Philadelphia, PA, USA) have suggested that while any one bird may rest its neck in either direction on a given day, significant individual and population-level lateral preferences are observed when individual preferences are tracked over time, with most birds preferring to rest their necks to the right (Anderson *et al.* 2009a; Anderson *et al.* 2009b). In the present report we attempted to determine whether a similar population-level behavioral preference exists in a wild population of Lesser Flamingos (*Phoeniconaias minor*).

Methods
Africam.com's "Flamingo Island" webcam was employed in order to provide a view of the behavioral preferences of wild Lesser Flamingos. The live cam streams images from the artificial breeding island at Kamfers Dam (Kimberley, South Africa) 24-hours per day, and offers great potential as a behavioral research tool.

The webcam was viewed on a Macintosh computer (OS X operating system) via the Firefox (Version 3.0.5; Mozilla Foundation) internet browser. As soon as the cam opened, the image

displayed via the live stream was captured and temporarily saved as a .TIFF file by means of Grab (Version 1.4; Apple Inc.) screen grabbing software. This enabled the image to be scored by four independent observers in a manner similar to a scan-sampling technique (Altmann 1974). Images were never reproduced, and were simply deleted following scoring by the observers.

The cam is manually operated from a remote location and occasionally focuses on single birds or individual nests. As such an image would dramatically decrease the overall number of flamingos observed, in the event that the cam was focused on a single bird at the time the live streaming feed was initially started, image capture was delayed until the camera refocused on a group of multiple birds. If this did not occur within 15 minutes of the specified observation time, no image was captured at that time.

Twelve images were collected between March 10th and 23rd, 2009. In order to obtain a wide sampling of Lesser Flamingo behavior, images were captured at four times (12 A.M., 6 A.M., 12 P.M. and 6 P.M. SAST; three images at each time point) across the observation period. Each of the images was viewed by four independent observers who counted the number of birds seen resting their necks to the left and right. The scores of the four observers were averaged for each image, and the total numbers of flamingos seen resting their necks to the right and left across all images were tallied. The total number of observations of right neck-resting was analyzed with a binomial test.

Results

The four observers viewed a total of 59.25 resting Lesser Flamingos across all images. Of these resting flamingos, a significantly greater number were seen resting their necks to the right (n=38.5) than the left (n=20.75) (z=2.31, p<.025, two-tailed).

Discussion

The results strongly suggest that the majority of Lesser Flamingos prefer to rest their necks to the right. Such a result is important for a variety of reasons. First, it suggests that a behavioral preference for rightward neck-resting may be common across flamingo species. In other avian species it has been shown that early sensory (Skiba *et al.* 2002) and motor (Casey and Martino 2000) experiences play a role in establishing behavioral and neuronal lateral asymmetries. It seems likely that some aspect of early development that is common across flamingo species serves to establish this lateral preference. Future research is needed to further explore this possibility.

An additional contribution of this research is that it offers further support for a social function of population-level laterality. Indeed, if such an explanation is correct, one should expect to obtain evidence of significant population-level lateral preferences in highly gregarious species such as the Lesser Flamingo.

Our work with captive Caribbean flamingos has suggested that those birds preferring to rest their necks to the left are more likely to be involved in aggressive encounters than those preferring the right (Anderson *et al.* 2009a). The right hemisphere is typically thought to be in control of emotion and aggression (*e.g*. Vallortigara and Rogers 2005), and as the right hemisphere would presumably also exert contra-lateral control over neck-resting behavior, these findings seem to suggest an underlying neural laterality or hemispheric dominance in Caribbean flamingos. Similar work is necessary to determine whether lateral behavior is indicative of underlying neural asymmetries in the Lesser Flamingo. Indeed, studies such as these have the potential to not only allow us to better understand flamingos, but also to gain a more complete knowledge of general behavioral and physiological processes relevant to many species.

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References

Altmann, J. 1974. Observational study of behaviour: Sampling methods. Behaviour 49: 227-63.

Anderson, M. J., Williams, S. A. and Bono, A. J. 2009a. Preferred neck resting position predicts aggression in Caribbean flamingos (*Phoenicopterus ruber*). Laterality: Asymmetries of Body, Brain and Cognition DOI: 10.1080/13576500903081814.

Anderson, M. J., Williams, S. A. and O'Brien, E. H. 2009b. Individual differences in preferred neck resting position of Caribbean flamingos (Phoenicopterus ruber). Laterality: Asymmetries of Body, Brain and Cognition 14: 66-78.

Bisazza, A., Cantalupo, C., Capocchiano, M. and Vallortigara, G. 2000. Population lateralization and social behaviour: A study with 16 species of fish. Laterality: Asymmetries of Body, Brain and Cognition 5: 269-284.

Casey, M. B. and Martino, C. M. 2000. Asymmetrical hatching behaviors influence the development of postnatal laterality in Domestic chicks (*Gallus gallus*). Developmental Psychobiology 37: 13-24.

Corballis, M. C. 1989. Laterality and human evolution. Psychological Review 96: 492-505.

Hoffman, A. M., Robakiewicz, P. E., Tuttle, E. M. and Rogers, L. J. 2006. Behavioural lateralisation in the Australian magpie (*Gymnorhina tibicen*). Laterality: Asymmetries of Body, Brain and Cognition 11: 110-121.

Rizhova, L. Y. and Vershinina, E. A. 2000. The dynamics of two different tests of laterality in rats. Laterality: Asymmetries of Body, Brain and Cognition 54: 331-350.

Rogers, L. J. 2000. Evolution of hemispheric specialization: Advantages and disadvantages. Brain and Language 73: 236-253.

Rogers, L. J. and Workman, L. 1989. Light exposure during incubation affects competitive behaviour in domestic chicks. Applied Animal Behaviour Science 23: 187-198.

Skiba, M., Diekamp, B. and Güntürkün, O. 2002. Embryonic light stimulation induces different asymmetries in visuoperceptual and visuomotor pathways of pigeons. Behavioural Brain Research 134: 149-156.

Stancher, G., Clara, E., Regolin, L. and Vallortigara, G. 2006. Lateralized righting behavior in the tortoise (*Testudo hermanni)*. Behavioural Brain Research 173: 315-319.

Vallortigara, G. and Rogers, L. J. 2005. Survival with an asymmetrical brain: Advantages and disadvantages of cerebral lateralization. Behavioral and Brain Sciences 28: 575-633.

Données récentes sur l'hivernage du Flamant rose au Maroc

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Abstract
Greater Flamingos migrate through and winter in Morocco. They formerly bred in the country, in the Iriqui Depression, but since the damming of the Oued Dr'a in 1979 this site no longer floods, even after heavy rains. The main flyways and the timing of movements are well known and we hereby present the results of the flamingo counts made in January as part of the IWC (International Waterfowl Census). Most birds are to be found on the estuaries situated along the Atlantic coast but the most important site is Lake Zima.

Résumé
Depuis que le seul site marocain de nidification du Flamant rose *Phoenicopterus roseus*, le lac temporaire de l'Iriqui, s'est définitivement asséché à la fin des années 1970, le statut phénologique de cette espèce au Maroc est réduit aux catégories 'Migrateur de passage' et 'Hivernant'. Si les voies et les dates de migration à travers le pays sont bien documentées, les effectifs et la distribution du Flamant rose au Maroc le sont beaucoup moins et demandent à être actualisés. Afin d'atteindre cet objectif, nous avons utilisé les résultats des recensements hivernaux d'oiseaux d'eau, devenus réguliers au Maroc depuis 1983. Il apparait, d'après l'analyse de ces résultats, que ce pays ne joue qu'un rôle minime dans l'hivernage de l'espèce, l'effectif national moyen de l'espèce ne représentant que 1% de son effectif régional. Les hivernants se répartissent essentiellement sur la côte atlantique, parallèle au principal axe de migration de l'espèce dans la région (voie est-atlantique) et le long de laquelle plusieurs zones humides estuariennes favorables existent. L'espèce fréquente, en outre, la Sebkha de Bou Areg sur le littoral méditerranéen et Sebkha Zima à l'intérieur des terres. Ce dernier site s'est révélé être le meilleur site d'hivernage au Maroc pour le Flamant rose, mais sa situation en zone aride et son hydrologie instable rendent sa capacité d'accueil très aléatoire.

Introduction

Le Flamant rose se reproduisait naturellement au Maroc en un seul site, le lac temporaire de l'Iriqui le long du cours moyen de l'oued Dr'a (Panouse 1958, 1965; Robin 1966, 1968), avant que cette zone humide ne soit définitivement asséchée à la fin des années 1970 suite aux travaux de construction du barrage d'Al Mansour Ad-Dahbi (mis en service en 1979) près de la ville de Ouarzazat et à ceux de dérivation de l'oued Dr'a effectués à cette occasion. Même les fortes crues de cet oued lors des années pluvieuses de 1979-80 et 1988-89 n'ont pas réussi à remettre en eau le lac d'Iriqui (DEFCS 1990).

Depuis la fin des années 1960, le Flamant rose n'est que de passage et un hivernant régulier dans le pays (Thévenot *et al.* 2003) bien qu'une petite colonie d'une dizaine de couples se reproduit actuellement en captivité dans le Parc Zoologique National de Rabat (obs. pers.)

Les oiseaux de passage au Maroc proviennent de plusieurs colonies reproductrices en Europe (Espagne, France, Italie) mais aussi de Turquie et de Russie (Johnson & Cézilly 2007); ils empruntent essentiellement la voie est-atlantique où des sites favorables sont utilisés aussi bien comme reposoirs que zones de nourrissage (Thévenot *et al*. 2003) mais ils peuvent aussi passer occasionnellement le long de la marge septentrionale du Sahara via la Tunisie et l'Algérie (Johnson & Cézilly 2007).

Les passages automnaux ont lieu de fin juillet à début novembre; ceux du printemps débutent vers la mi-février et se terminent fin mai, avec quelques retardataires qui peuvent être vus jusqu'à début juin (Thévenot *et al.* 2003).

Les voies et les dates de migration du Flamant rose de passage au Maroc sont donc assez bien connues; en revanche, les principales caractéristiques de son hivernage (effectifs et répartition) nécessitent une actualisation.

Nous utiliserons les résultats des recensements hivernaux d'oiseaux d'eau (RHOE's), coordonnés conjointement par le Centre d'Etude des Migrations d'Oiseaux (CEMO, Institut Scientifique de Rabat) et le Groupe de REcherche pour la Protection des Oiseaux au Maroc (GREPOM) afin d'analyser l'hivernage du Flamant rose au Maroc.

Nous exposerons brièvement l'évolution de la taille de la population hivernante marocaine et présenterons l'effectif moyen et la distribution des hivernants ainsi que les meilleurs sites pour le Flamant rose au Maroc.

Matériels et méthodes

Dans la présente analyse, nous avons d'abord utilisé les données recueillies de 1983 à 2000 dans la Base De Données 'Oiseaux d'Eau et Zones Humides du Maroc' gérée au niveau du CEMO afin de montrer l'évolution globale de l'effectif hivernal marocain du Flamant rose. Puis, pour une étude plus détaillée sur l'effectif moyen et la répartition des hivernants, nous avons considéré les données plus précises de la période 1996-2000 (Dakki *et al.* 2002).

L'effectif annuel des hivernants correspond à la somme des effectifs recensés au niveau des divers sites prospectés chaque année depuis 1983 dans le cadre des RHOE's; l'effectif national moyen a été obtenu en calculant la moyenne des effectifs annuels des cinq dernières années (1996-2000).

Les effectifs moyens obtenus pour cette même période (1996-2000) pour les divers sites ont été reportés sur un fond de carte du Maroc, ce qui nous a permis d'analyser la répartition des hivernants.

Résultats

Depuis 1983, date à partir de laquelle, les recensements hivernaux d'oiseaux d'eau sont devenus réguliers dans le pays, l'effectif hivernal annuel du Flamant rose au Maroc a subi globalement une évolution significative (Figure 1).

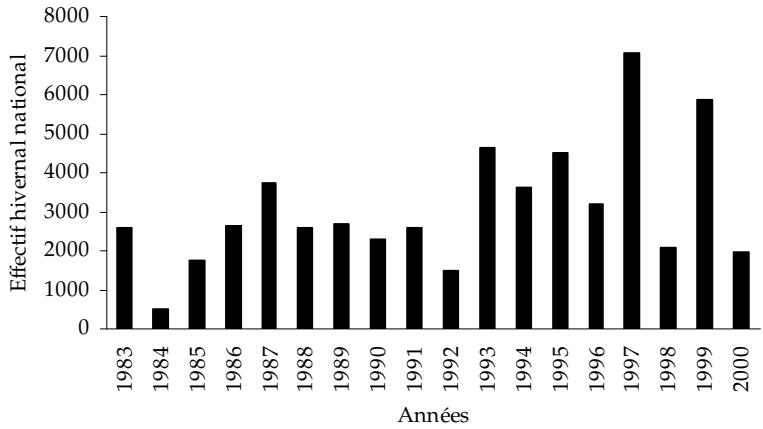

Figure 1: Evolution de l'effectif hivernal annuel du Flamant rose de 1983 à 2000.

De 1996 à 2000, cette espèce a hiverné de manière plus ou moins régulière au niveau de 34 zones humides marocaines correspondant à des lagunes et des baies marines, à des estuaires ou à des marais côtiers (de 1983 à 1995, ce nombre atteignait 52 sites). A l'intérieur des terres, le Flamant rose a fréquenté certains lacs de barrage et, surtout, un plan d'eau hyper salée, Sebkha Zima.

L'effectif moyen des hivernants marocains, environs 4250 oiseaux, a subi des fluctuations annuelles importantes au cours de la période 1996-2000; il a varié entre 7064 oiseaux recensés en 1997 et 1941 individus enregistrés en 2000.

La grande majorité des hivernants se répartit sur les sites côtiers atlantiques (Figure 2) qui abritent 57% des hivernants marocains; les plus grandes concentrations sont observées au niveau de cinq sites (Table I).

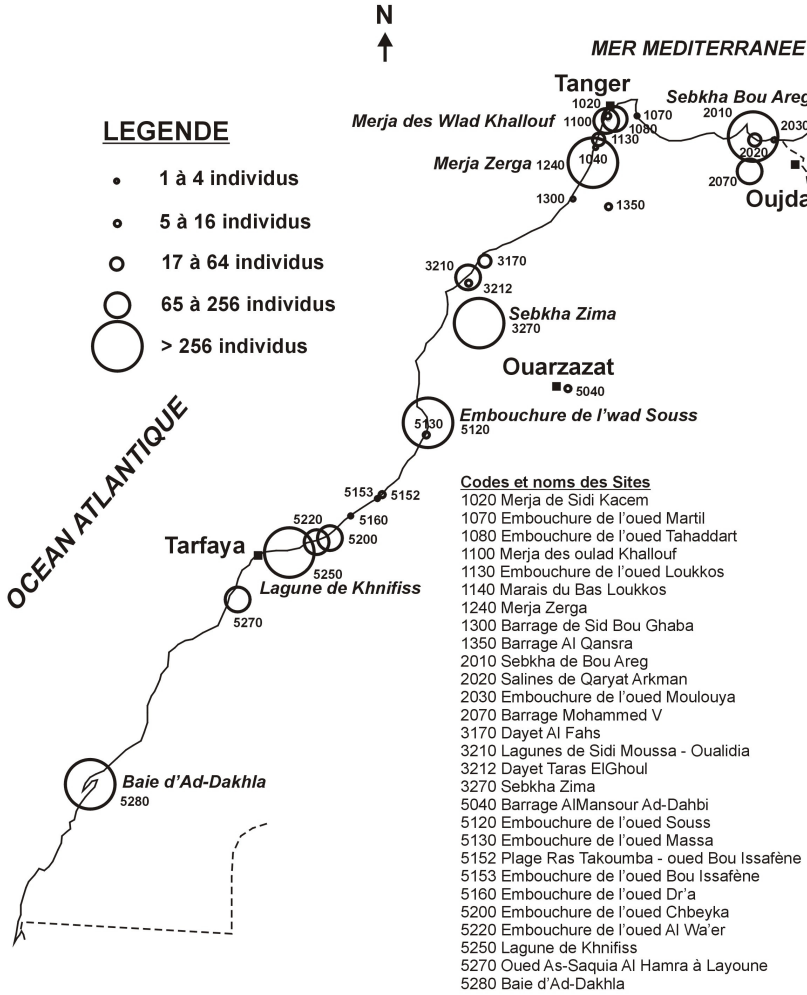

Figure 2: Carte de répartition du Flamant rose hivernant au Maroc.

Le long de la côte méditerranéenne, une seule zone humide a abrité un effectif conséquent d'hivernants, la Sebkha de Bou Areg (415 oiseaux).

A l'intérieur des terres, le site de Sebkha Zima s'est révélé être le meilleur site d'hivernage de l'espèce au Maroc en hébergeant en moyenne (1996-2000) plus de 1.100 oiseaux; remarquons, cependant, que la mise en eau de ce site dépend de la pluviométrie qui est très aléatoire dans cette région très aride du Maroc et que l'effectif élevé des hivernants dans ce site est dû essentiellement à la concentration exceptionnelle des Flamants roses (4.700 individus)

observée en 1997. En 2000 (année sèche), nous n'avons recensé à Sebkha Zima que 44 individus.

Tableau 1: Principaux sites d'hivernage au Maroc du Flamant rose d'après les résultats des recensements hivernaux d'oiseaux d'eau réalisés durant le mois de janvier entre 1996 et 2000.

Sites	Secteur	1996	1997	1998	1999	2000	Moyenne
Sebkha Bou Areg	Littoral méditerranéen	-	562	255	667	177	415
Merja des Wlad Khallouf	Littoral atlantique	-	48	650	106	450	251
Merja Zerga	Littoral atlantique	335	59	45	1010	108	311
Sebkha Zima	Continental	120	4700	586	146	44	1119
Embouchure de l'wad Souss	Littoral atlantique	17	-	49	1090	570	345
Lagune de Khnifiss	Littoral atlantique	1520	558	225	1408	211	784
Baie d'Ad-Dakhla	Littoral atlantique	360	862	-	-	114	325

Conclusions

Le Maroc ne joue qu'un rôle minime dans l'hivernage du Flamant rose puisqu'il n'héberge qu'un effectif moyen estimé à 4250 oiseaux, ce qui ne représente qu'une infime partie de la population régionale (Sud-ouest de l'Asie, Méditerranée et Afrique de l'Ouest) estimée à au moins 400000 individus (Wetlands International 2006).

Paradoxalement, au moment où l'effectif hivernal de cette espèce a connu une hausse substantielle attribuée à une plus large couverture géographique de l'activité de dénombrements hivernaux d'oiseaux d'eau (des sites aussi importants que la lagune de Khnifiss ou la baie d'Ad-Dakhla n'ont été prospectés qu'à partir de 1989), le nombre de sites fréquentés par le Flamant rose a connu une nette baisse. En effet, plusieurs zones humides marocaines qui hébergeaient des contingents plus ou moins importants durant les années 1980, ont été asséchées ou ont beaucoup perdu de leurs capacités d'accueil suite aux diverses perturbations anthropiques qui les ont affectées.

L'essentiel du contingent hivernal marocain du Flamant rose se distribue le long des sites littoraux atlantiques où la relative stabilité hydrologique des zones humides estuariennes assure à cette espèce les conditions propices à leur nourrissage et à leur repos. A l'intérieur des terres, les zones humides fragilisées pour la plupart par la succession de plusieurs années de sécheresse ainsi que par les pompages excessifs n'assurent plus de telles conditions aux divers contingents qui les fréquentaient auparavant. Seule Sebkha Zima continue à abriter, bien que de manière irrégulière, des effectifs substantiels d'hivernants.

Notons enfin que les meilleurs sites d'hivernage actuels du Flamant rose au Maroc sont inscrits sur la liste de la Convention de Ramsar comme zones humides d'importance internationale.

Remerciements

Nous tenons à remercier Messieurs A. Johnson et A. Béchet qui ont bien voulu relire ce manuscrit et nous faire part de leurs remarques et critiques. Par ailleurs, Monsieur A. Johnson a eu l'amabilité de traduire le résumé en anglais. Nous remercions également l'ensemble des observateurs, trop nombreux pour être cités ici, qui ont participé aux recensements hivernaux d'oiseaux d'eau au Maroc et sans lesquels cette synthèse n'aurait pu avoir lieu.

Bibliographie

Dakki, M., Qninba, A., El Agbani, M.A. and Benhoussa, A. 2002. Recensement hivernal d'oiseaux d'eau au Maroc : 1996-2000. *Trav. Inst. Sci., Série Zoologie,* n° 45, 28 p.

DEFCS 1990. *Projet de création du Parc National d'Iriqui*. Rapport inédit, Direction des Eaux et Fprêts et de la Conservation des Sols, 17 p.

Johnson, A. and Cézilly, F. 2007. *The Greater Flamingo*. T & AD Poyser, London UK, 328 p.

Panouse, J. B. 1958. Nidification des Flamants roses au Maroc. *C. R. séances Soc. Sci.nat. phys. Maroc* 24: 110.

Panouse, J. B. 1965. Les Flamants roses de L'Iriqi. *C. R. séances Soc. Sci. nat. phys. Maroc* 31: 4.

Robin, P. 1966. Nidifications sur l'Iriki daya temporaire du Sud marocain en 1965. *Alauda* 34: 81-101.

Robin, P. 1968. L'avifaune de l'Iriki (Sud-Marocain). Alauda 36: 237-253.

Thévenot, M., Vernon, R. and Bergier, P. 2003. *The Birds of Morocco*. British Ornithologists' Union, Checklist series n°20, Tring, UK. 594 p.

Wetlands International 2006. *Waterbird Population Estimates - Fourth Edition*. Wetlands International, Wageningen, The Netherlands.

A new breeding site for the Greater Flamingo *Phoenicopterus roseus* in Algeria

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Abstract
After two failed nesting attempts in 2007 and 2008, the Greater Flamingo managed to breed successfully at El Goléa in March-April, 2009, in the heart of the Algerian Sahara. A total of 70 pairs nested and 23 chicks fledged. This is the second Algerian site to host a Greater Flamingo breeding colony after the first recorded reproduction at Ezzemoul in 2005. Two of the breeding birds at El Goléa were ringed at Ezzemoul in 2006, suggesting that the establishment of the new colony may owe much to the successful reproduction of the older and larger colony located in the Algerian Hauts Plateaux. Eight chicks were banded as part of a study focused on factors influencing dispersal and recruitment of flamingos in the region.

Résumé
Après deux tentatives infructueuses de nidification en 2007 et 2008, le Flamant rose a réussi à se reproduire à El Goléa, au cœur du Sahara algérien. Un total de 70 couples a niché et 23 poussins ont réussi leur envol. El Goléa est le deuxième site algérien de reproduction du Flamant rose et sa découverte est le prolongement de la première reproduction documentée à Ezzemoul en 2005. Deux flamants roses nicheurs à El Goléa provenaient de la colonie d'Ezzemoul où ils ont été

bagués en 2006. Ce lien suggère un rôle potentiel de la colonie des Hauts Plateaux, plus importante en effectif et beaucoup plus ancienne, dans l'édification de nouvelles colonies, d'effectifs plus réduits, dans la région. Huit poussins ont été bagués dans le cadre de l'étude de la métapopulation régionale de flamants roses.

Introduction

Following several decades of successful breeding in the Camargue, France and at Fuente de Piedra in Spain, the Greater Flamingo, *Phoenicopterus roseus*, successfully expanded its range in southern Europe with new colonies in Spain, Italy and Turkey (Johnson and Cézilly 2007, Baccetti *et al*. 2008). Although exchanges between southern Europe and North Africa have long been known, suggesting the existence of a Greater Flamingo metapopulation in the western Mediterranean, much less is known about the role of North African breeding colonies. North African wetlands were previously believed to play a dual role as wintering quarters and act as a "kindergarten" for all European colonies (Smart *et al*. 2009). The study of North African colonies is expected to shed a new light on the dynamics of the Greater Flamingo western Mediterranean metapopulation (Balkiz *et al*. 2007).

Study area

The El Goléa salt lake (30°31.778'N, 2°56.201'E) is sandwiched between the Grand Erg Oriental in the east and the Grand Erg Occidental in the west. The site is made up of two parts: 1. An upper basin with brackish water mixed with sewage and irrigation waters from the oasis of El Goléa. The vegetation is dominated by *Phragmites australis*, *Typha angustifolia*, *Juncus acutus* and *Limoniastrum guyogonium* on the dunes surrounding the basin. 2. A lower basin with saline water and devoid of vegetation. Islets dot the salt lake supporting scattered salt-cedar trees *Tamarix* sp.

Methods

Since 2002, an ornithological survey of Algerian wetlands has been carried out to monitor breeding colonies (Samraoui and Samraoui, 2008). Recorded colonies are closely monitored to prevent disturbance and guarded to prevent vandalism, especially egg pilfering. Once hatching is under way, Darvic leg bands are read using a mobile hide (Boulkhssaim *et al*. 2006).

Results

In the second half of February 2009, a flock of 200 Greater Flamingos gathered and started displaying close to a sandy islet. They soon started nest building and egg-laying apparently started in early March, as the first chick aged 2-3 days was recorded on 8 April. The colony split into two distinct nuclei within the same islet (Figure 1). Although the display continued and the birds were seen incubating, no chicks hatched within the second nucleus. At least two nests were recorded containing two eggs and on one occasion two chicks hatched in the same nest. A good supply of the large branchiopod *Artemia salina* and dipteran larvae allowed the birds to feed mainly *in situ* with very few departing and incoming flights.

Figure 1. A view of the El Goléa colony (nucleus 1).

In May, the water level started to decline markedly and by the end of the month the area between the islet and the shore was dry. Three jackals *Canus aureus* took advantage of the land bridge and reached the colony at night. Following this raid, the flamingos deserted the islet and 40 eggs were left behind. An inspection of the colony revealed 70 nests and two corpses of chicks aged less than 5 days. A total of 23 chicks managed to flee to an area which was still holding water (Figure 2). Two Greater Flamingos banded as chicks at Ezzemoul in 2006 were recorded breeding for the first time at El Goléa in 2009. One was recorded with a chick not far from the colony whereas the second one was last seen incubating an egg.

Figure 2. Adults with chicks after they took refuge in the deeper part of the sebkha.

On 17 June, 30 volunteers herded the small crèche towards a corral. The crèche broke into two groups which made the task of steering the chicks in the right direction a difficult one. To our surprise, two of the chicks were able to fly a short distance. We managed to capture and band eight chicks. Care was taken to avoid injuries and all chicks were safely released. We monitored the crèche which quickly regrouped once the banding operation was over.

Discussion

El Goléa is the second confirmed Greater Flamingo breeding site in Algeria (Samraoui *et al*. 2009) and the successful outcome in the Sahara is due in no small part to the protective measures taken to ensure breeding sanctuaries for the Greater Flamingo in the region (Samraoui *et al*. 2009). Disturbance, whether by man or natural predators, remains the major obstacle to reproduction of the species in North Africa.

The Greater Flamingo has long been known to be present in the Sahara (Laferrère 1966), and the successful establishment of a Greater Flamingo breeding site in the Sahara (Bouzid *et al.* 2009) might lend support to the hypothesis of a link between West African and Mediterranean populations via a direct Saharan route. A record of a Greater Flamingo in Mali, 900 km inland from the Atlantic coast (Johnson and Cézilly 2007) might be an important clue to an undocumented flyway. Another hypothecated flamingo flyway is along the Saharan Atlas, at the edge of the Sahara, with movements from the Atlantic coast in southern Morocco to the eastern Algerian and Tunisian salt lakes (Johnson and Cézilly 2007).

The record of two breeding birds at El Goléa banded as chicks in 2006 in the Algerian Hauts Plateaux and the absence of a similar finding at Ezzemoul in 2009 supports the idea of newly sexually mature birds finding it easier to breed at newly established colonies, thus avoiding mature and more assertive individuals in older, larger colonies. This despotic pattern of breeding birds has been shown to be adopted by the Greater Flamingo (Rendon *et al*. 2001). Likewise, the finding highlights the role of Ezzemoul acting as a source in the establishment of new colonies in the region.

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References

Baccetti, N., Panzarin, L., Cianchi, F., Puglisi, L., Basso, M. and Arcamone, E. 2008. Two new Greater Flamingo (*Phoenicopterus roseus*) breeding sites in Italy. Pp 25-27. In: Childress, B, Arengo, F. and Béchet, A. (eds.) 2008. *Flamingo*, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, No. 16, december 2008. Wildfowl & Wetlands Trust, Slimbridge, UK.

Balkiz, Ö., Özesmi, U., Pradel, R., Germain, G., Siki, M., Amat, J.A., Rendon-Martos, M., Bacetti, N. and Béchet, A. 2007. Range of the Greater Flamingo *Phoenicopterus roseus* metapopulation in the Mediterranean: new insights from Turkey. Journal of Ornithology 148: 347-355.

Boulkhssaim, M., Houhamdi, M., Saheb, M., Samraoui, F. and Samraoui, B. 2006. Breeding and banding of Greater Flamingo *Phoenicopterus roseus* in Algeria, August 2006. Pp 21-24. In: Childress, B, Arengo, F., Béchet, A. and Jarrett, N. (eds.) 2006. *Flamingo*, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, No. 14, December 2006. Wildfowl & Wetlands Trust, Slimbridge, UK.

Bouzid, A., Yousfi, A., Boulkhssaim, M. and Samraoui, B. 2009. Première nidification réussie du Flamant rose *Phoenicopterus roseus* dans le Sahara algérien. Alauda 77:139-143.

Johnson, A. and Cézilly, F. 2007. *The Greater Flamingo*. T & A.D. Poyser, London.

Laferrère, M. 1966. Les flamants *Phoenicopterus ruber roseus* sur les chotts de la vallée de l'oued Rhir (Nord-Sahara). Alauda 34: 67-69.

Rendón, M. A., Garrido, A., Ramirez, J. M., Rendón-Martos, M. and Amat, J. A. 2001. Despotic establishment of breeding colonies of greater flamingos, *Phoenicopterus ruber*, in southern Spain. Behavioural Ecology and Sociobiology 50: 55-60.

Samraoui, B. and Samraoui, F. 2008. An ornithological survey of the wetlands of Algeria: Important Bird Areas, Ramsar sites and threatened species. Wildfowl 58: 71-98.

Samraoui, B., Boulkhssaim, M., Bouzid, A., Bensaci, E., Germain, C., Bechet, A. and Samraoui, F. 2009. Current research and conservation of the Greater Flamingo in Algeria. Pp 20-25. In: Béchet, A., Rendón-Martos, M., Amat, J., Baccetti, N. and Childress, B. (eds.) 2009. *Flamingo*, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, Special Publication 1: Proceedings of the IVth International Workshop on the Greater Flamingo in the Mediterranean region and northwest Africa, Antequera, Spain, 5-6 November, 2007. Wildfowl & Wetlands Trust, Slimbridge, UK.

Smart, M., Azafzaf, H. and Dlensi, H. 2009. Analysis of the mass of raw data on Greater Flamingos *Phoenicopterus roseus* on their wintering grounds, particularly in North Africa. Pp: 58-61. In: Béchet, A., Rendón-Martos, M., Amat, J., Baccetti, N. and Childress, B. (eds.) 2009. *Flamingo*, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, Special Publication 1: Proceedings of the IVth International Workshop on the Greater Flamingo in the Mediterranean region and northwest Africa, Antequera, Spain, 5-6 November, 2007. Wildfowl & Wetlands Trust, Slimbridge, UK.

Mass reproduction of the Greater Flamingo at Ezzemoul, Algeria in 2009 and the need to reassess the role of North African wetlands

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Abstract
For years, the Greater Flamingo *Phoenicopterus roseus* has been considered as a wintering species in Algeria, occurring with a relatively small number. It has, over the last 7 years (2003-2009), nested regularly at sebkha Ezzemoul in the northeastern Hauts Plateaux. This period witnessed seven successive nesting attempts of the species and three successful breeding events totaling over 15,000 fledged chicks. Breeding failures were linked with human intrusions and, to a lesser extent, to drought. Conservation efforts have been deployed aiming at protecting the colony and key wetlands in the area. Furthermore, in the light of our recent knowledge and pending the effects of climate changes in the area, it is crucial to reassess the role of North African wetlands for the conservation of the Greater Flamingo metapopulation in the west-Mediterranean region.

Résumé
Considéré pendant longtemps comme hivernant en Algérie avec un effectif relativement réduit, le Flamant rose *Phoenicopterus roseus* s'est reproduit de manière régulière à la sebkha d'Ezzemoul, localisée dans les Hauts Plateaux du nord-est algérien, au cours des sept dernières années (2003-2009). Cette période a vu le Flamant rose tenter de nicher à 7 reprises et réussir la reproduction à trois reprises (2005, 2006 et 2009) avec un total de plus de 15 000 poussins qui ont réussi l'envol. Les facteurs qui ont fait échouer la reproduction sont les intrusions humaines et à un degré moindre la sécheresse. Des efforts de conservation sont menées à fin de pérenniser cette colonie et les zones humides qui la supportent. A la lumière des connaissances acquises au cours des dernières années et au vu des changements climatiques prévus pour la région, il est impératif de réévaluer l'importance des zones humides nord-africaines pour la métapopulation de flamants roses de la Méditerranée occidentale.

Introduction
Whereas breeding of the Greater Flamingo in North Africa was previously believed to occur sporadically (Johnson and Cézilly 2007), the discovery of the Ezzemoul colony and its close monitoring has unveiled a new pattern: the Greater Flamingo has attempted to breed yearly at Ezzemoul over the last seven years (Samraoui *et al.* 2008). Breeding attempts at two other Algerian sites with one successful reproduction in the Sahara was also recently recorded (Bouzid *et al*. 2009). When one considers the recognized role of Tunisian wetlands for wintering (Green *et al*. 1989) and occasional breeding of flamingos (Johnson and Cézilly 2007), our recent knowledge begs the question: how important are the North African wetlands and the Ezzemoul in particular for the Greater Flamingo west-Mediterranean metapopulation?

Study area
Ezzemoul (35°53.137'N, 06°30.200'E) is a 6,000 ha h ypersaline lake (water conductivity = 145 mS/cm in May 2009) housed by the Oum El Bouaghi wetlands complex located in the northeastern Algerian Hauts Plateaux. These High Plains are sandwiched between the Saharan Atlas Mountains on the edge of the Sahara in the south and the Atlas mountains of the Tell which

overlook narrow coastal plains in the north. The ENASEL, a state-owned company exploits salt in the western part of lake which harbors two species of large branchiopods *Artemia salina* and *Branchinella spinosa* as well as dipteran larvae (Samraoui *et al.* 2006).

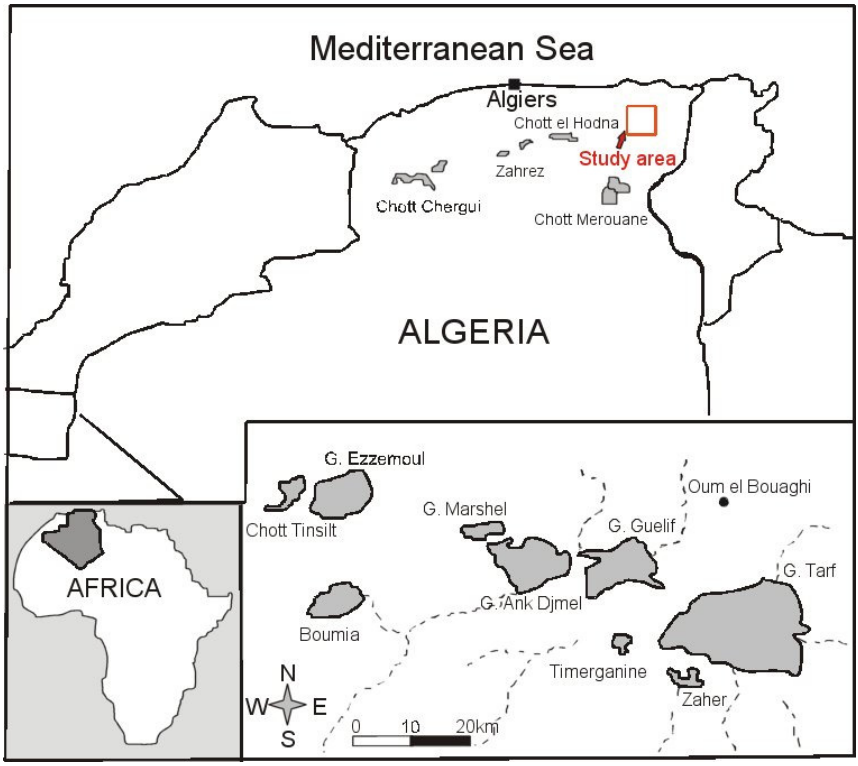

Figure 1. Wetland complex in the eastern Hauts Plateaux of Algeria containing the Great Ezzemoul breeding site.

Methods

This study is part of a long term ornithological survey of Algerian wetlands (Samraoui and Samraoui 2008). Since its discovery in 2004, the study site has been wardened during the breeding period (April-August) as disturbance had been a major cause of breeding failure (Samraoui *et al.* 2008). The colony is monitored from the shore with the help of telescopes. Once incubation is well underway and close to hatching time, the birds are approached using mobile hides to record the behavior banded flamingos. Prior to fledging, chicks have been captured and fitted with a PVC Darvic band with a specific Algerian code Ax/xx where x is an alphanumeric character (Boulkhssaim *et al.* 2006).

Results

Rainfall for the winter and spring months that preceded the breeding season at Ezzemoul was above average and the water level in April exceeded 55 cm to such extent that the surface area of the islet which hosts the colony was significantly reduced. During the first half of April, the birds started displaying close to the breeding islet which was at the time occupied by incubating Slender-billed Gulls *Larus genei*. There was a repeat of the same scenario that occurred in 2006 as the Greater Flamingos initiated nest building, they soon displaced the Slender-billed Gulls

which left the site. Incubation started on 18 April and the first egg was recorded (from the shore) on 23 April.

Heavy rainfall fell on 14 May and many peripheral nests were inundated. On the western part of the islet, many birds could not build any nest and were incubating on the ground. This low-lying part of the islet was inundated and the birds deserted it, leaving behind around 400 eggs. The weather quickly improved and, within a week, the area was again reoccupied by incubating birds. An estimated 10 000-12 000 pairs nested but only 6 069 nests were counted after the breeding was over. However, not all birds built nests and some were trampled. A large area where flamingos nested was devoid of discernible nests.

The first chick (aged 4-5 days) was recorded on 21 May and hatching went on till early-July. Because of the lengthy period of hatching, there was a marked difference in age between the chicks and the crèche was often split into two distinct groups of chicks based on age. No aerial photography of the crèche could be carried out but repeated evaluations from the ground allowed us to estimate the number of chicks to be in excess of 6 000. The impact of two Yellow-legged Gulls *Larus michahellis* and two Egyptian Vultures *Neophron percnopterus* were relatively minor. Breeding success is estimated to be over 70% with nest failures accounted for mainly by the heavy rains of May.

At least two Turkish born birds managed to breed successfully at Ezzemoul in 2009. This is the first record of Turkish-born birds breeding outside their natal site. Although, we recorded two birds banded as chicks at Ezzemoul in 2006, none attempted to breed. Flamingos from all the European colonies bred on this occasion but a full analysis of resighted birds will be carried separately.

On 31 July, a group of 120 volunteers from all walks of life (but mainly university students and locals) combined forces to coax more than 6000 chicks towards a purpose-built corral. Around a 1 000 chicks were held and the rest was allowed to escape. Six teams divided the task to band a total of 637 chicks and to collect standard measurements before all the chicks were released. The event was widely publicized in the national media.

Discussion

Conventional wisdom views North Africa as a wintering ground and a “kindergarten” for Greater Flamingos born in Europe (Smart *et al.* 2009). However, North African wetlands’ role may have been underplayed as the region is a vast expanse dotted with huge salt lakes and varied climatic conditions. Such a large area is heterogeneous, combining heavy rains and drought, patchily. Unlike Europe, North Africa remains barely investigated so we cannot be confident that no large colonies could have persisted for decades or centuries, undetected, and it is not far fetched to think that North African colonies could have in the past repeatedly replenished European colonies as these went extinct following adverse conditions (cold spells or drought). Cases of post-fledging dispersal have repeatedly been recorded in Europe, well before locally bred juveniles were able to fly, with immigrant first-year juveniles likely originating from southerly sites with precocious breeding (Johnson and Cézilly 2007).

North Africa provides a wintering haven to juveniles facing periodically an inclement weather in Europe which may severely reduce survival (Lebreton *et al*. 1992) and it may also be a cross-road for flamingo flyways providing a link between sub-populations. A preliminary analysis of bands read in North Africa suggest the occurrence of two longitudinal eastern and western flyways roughly divided by a line separating Eastern Spain, France, Italy, Tunisia and Eastern Algeria from western Spain, Portugal, Morocco, western Algeria and Mauritania. This latter route, namely the well known Atlantic flyway, links the west Mediterranean subpopulation to the west African one (Johnson and Cézilly 2007). This division is similar to the distinct Eastern and Western Spanish populations of Little Egrets *Egretta garzetta*, separated roughly by the 3° meridian, which were found to have separate breeding and post-breeding dispersal ranges (Bartolome *et al.* 1996). Another transverse flyway connects the Atlantic with easternmost Algerian and Tunisian wetlands and it runs along the Saharan Atlas at the edge of the Sahara (Johnson and Cézilly 2007). This flyway may continue eastwards towards the Middle East. Presence at Ezzemoul of Turkish-banded flamingos underlines the link with the east-Mediterranean colonies and beyond.

Despite the extensive movement of the Greater Flamingo in the region, could there be a North African resident sub-population? This hypothesis is based on a series of indices:

- Breeding at Ezzemoul in 2005 coincided with breeding failure at Fuente de Piedra due to drought and many were quick to suggest a link between the two events. However, in 2006, breeding resumed at Fuente de Piedra but Ezzemoul was dry until early May. Despite this, when rains finally arrived and filled Ezzemoul, egg-laying promptly started and breeding was successful. The reason of an influx of breeding birds originating from Fuente de Piedra at Ezzemoul in 2006 is not clear but previous accounts of a delayed effect following breeding failures at the Camargue in 1988 and 1990 with more breeding birds switching colonies the year after (Johnson and Cézilly 2007) might offer a clue. The prevalence of winds blowing in the right direction might also be instrumental in the choice of the target colony (Green *et al*. 1989). In conclusion, it is safe to state that the breeding populations of Fuente de Piedra and Ezzemoul are distinct and it suggests that a resident population was waiting for favorable conditions despite two important costs: delayed or foregone breeding.
- The sighting effort of banded flamingos in Algeria has been increasing over the last years (Samraoui *et al.* 2009) but despite a partial set of data and based on an incomplete analysis, many birds were recorded during the three breeding events of Ezzemoul suggesting that a low breeding dispersal (Nager *et al*. 1996) might also apply to North Africa. Nomadism seems to be imposed on the Greater Flamingo but the species shows high levels of plasticity by being philopatric to predictable sites.
- There is a year-round presence of a large number of Greater Flamingos in North Africa. The number may range between 60 000 and 80 000 birds. Many of these birds were ringed in southern Europe but they have never been recorded outside North Africa. They have also been breeding at Ezzemoul and were recorded at various sites in the region.

Ezzemoul is one of the 53 IBAs in Algeria (Samraoui and Samraoui 2008) and the only unprotected site where the Greater Flamingo attempted to breed over the past seven years. El Goléa, Bazer Sakra and chott Hodna are all classified under the Ramsar treaty and it is simply unacceptable that the site hosting one of the major Greater Flamingo breeding colony of the west Mediterranean remains unprotected.

Greater Flamingo breeding at Ezzemoul has not been documented before 2004 but the colony was apparently known to locals since at least the early twentyth century. Ezzemoul matches several characteristics that make it one of the important west-Mediterranean Greater Flamingo breeding colonies (Rendón Martos *et al*. 2009):

- a large surface area (6 000 ha),
- difficulty of access making it hard for terrestrial predators to disturb the birds,
- a central location within a large wetland complex.

Ezzemoul differs from North African colonies by being the only one where regular breeding attempts are carried out and from other West-Mediterranean colonies in a set of characteristics:

- It is located in the Algerian Hauts Plateaux, at an altitude of 900 m,
- it is a natural habitat with unmanaged hydroperiod and no restoration has ever been attempted to enhance breeding,
- Although wardening is carried out to prevent egg pilfering by locals or hunting, the colony is not entirely safe from wild boars or terrestrial predators if the water level is low.

Breeding success, once the human threat is controlled, is clearly closely linked to the hydroperiod (Samraoui *et al*. 2008). Because of the high rate of evaporation, water level must be sufficiently high at the start of the breeding period (40-60 cm) to allow chicks to hatch and develop before the islet comes within easy reach of terrestrial predators. In 2008, the colony disbanded at the incubation stage when water level fell below 15 cm. Tracks of wild boars were recorded around the islet but we could not ascertain whether the boars caused the disturbance. As North

African faces the challenge of demography and development, water becomes an increasingly scarce resource making hydrological changes brought by dam construction a recurring threat. Climate changes may only exacerbate an already complex issue.

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References

Bartolome, J., Fernandez-Cruz, M. and Campos, F. 1996. Band recoveries of Spanish Little Egrets, *Egretta garzetta*. Colonial Waterbirds 19: 220-225.

Boulkhssaim, M., Houhamdi, M., Saheb, M., Samraoui, F. and Samraoui, B. 2006. Breeding and banding of Greater Flamingo *Phoenicopterus roseus* in Algeria, August 2006. Pp 21-24. In: Childress, B, Arengo, F., Béchet, A. and Jarrett, N. (eds.) 2006. *Flamingo*, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, No. 14, December 2006. Wildfowl & Wetlands Trust, Slimbridge, UK.

Bouzid, A., Yousfi, A., Boulkhssaim, M. and Samraoui, B. 2009. Première nidification réussie du Flamant rose *Phoenicopterus roseus* dans le Sahara algérien. Alauda 77:139-143.

Green, R. E., Hirons, G. J. M. and Johnson, A. R. 1989. The origin of long-term cohort differences in the distribution of Greater Flamingos *Phoenicopterus ruber roseus* in winter. Journal of Animal Ecology 58: 543-55.

Johnson, A. and Cézilly, F. 2007. *The Greater Flamingo*. T & A.D. Poyser, London.

Lebreton, J. -D., Burnham, K. P., Clobert, J. and Anderson, D. R. 1992. Modeling survival and testing biological hypotheses using marked animals: a unified approach with case studies. Ecological Monographs 61: 67-118.

Nager, R. G., Johnson, A. R., Boy, V., Rendón-Martos, M., Calderon, J. and Cézilly, F. 1996. Temporal and spatial variation in dispersal in the greater flamingo (*Phoenicopterus ruber roseus*). Oecologia 107: 204-211.

Rendón-Martos, M., Garrido, A., Rendón, M. A. and Ramírez, J. M. 2009. Greater Flamingo *Phoenicopterus roseus* monitoring and conservation at Fuente de Piedra lake. Pp 1-11. In: Béchet, A., Rendón-Martos, M., Amat, J., Baccetti, N. and Childress, B. (eds.) 2009. *Flamingo*, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, Special Publication 1: Proceedings of the IVth International Workshop on the Greater Flamingo in the Mediterranean region and northwest Africa, Antequera, Spain, 5-6 November, 2007. Wildfowl & Wetlands Trust, Slimbridge, UK.

Samraoui, B. and Samraoui, F. 2008. An ornithological survey of the wetlands of Algeria: Important Bird Areas, Ramsar sites and threatened species. Wildfowl 58: 71-98.

Samraoui, B., Chakri, K. and Samraoui, F. 2006. Large branchiopods (Branchiopoda: Anostraca, Notostraca and Spinicaudata) from the salt lakes of Algeria. Journal of Limnology 65: 83-88.

Samraoui, B., Bouzid A., Boulkhssaim, M., Baaziz, N., Ouldjaoui, A. and Samraoui, B. 2008. Nesting of the Greater Flamingo *Phoenicopterus roseus* in Algeria (2003-2008). Pp 14-18. In: Childress, B, Arengo, F. and Béchet, A. (eds.) 2008. *Flamingo*, Bulletin of the IUCN-

SSC/Wetlands International Flamingo Specialist Group, No. 16, december 2008. Wildfowl & Wetlands Trust, Slimbridge, UK.

Samraoui, B., Boulkhssaim, M., Bouzid, A., Bensaci, E., Germain, C., Bechet, A. and Samraoui, F. 2009. Current research and conservation of the Greater Flamingo in Algeria. Pp 20-25. In: Béchet, A., Rendón-Martos, M., Amat, J., Baccetti, N. and Childress, B. (eds.) 2009. *Flamingo*, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, Special Publication 1: Proceedings of the IVth International Workshop on the Greater Flamingo in the Mediterranean region and northwest Africa, Antequera, Spain, 5-6 November, 2007. Wildfowl & Wetlands Trust, Slimbridge, UK.

Smart, M., Azafzaf, H. and Dlensi, H. 2009. Analysis of the mass of raw data on Greater Flamingos *Phoenicopterus roseus* on their wintering grounds, particularly in North Africa. Pp: 58-61. In: Béchet, A., Rendón-Martos, M., Amat, J., Baccetti, N. and Childress, B. (eds.) 2009. *Flamingo*, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, Special Publication 1: Proceedings of the IVth International Workshop on the Greater Flamingo in the Mediterranean region and northwest Africa, Antequera, Spain, 5-6 November, 2007. Wildfowl & Wetlands Trust, Slimbridge, UK.

IN-SITU SHORT REPORTS

Nesting of flamingos in India, 2009

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Little Rann of Kachchh:
Greater and Lesser Flamingos both nest at the following two sites in Little Rann of Kachchh, Gujarat State. Both nesting sites were visited on 8th July 2009 and 12th October 2009.

Zinzuwada salt pans: Since the monsoon had not begun on 8th July 2009, the area was not inundated and hence nesting had not started. This known nesting site was revisited on 12th October 2009 by a local resource person, but there was no evidence of nesting by either species. Overall precipitation and number of rainy days in the surrounding areas of Little Rann were very low which could be the reason behind non-occupancy of nesting site. Nesting of both species was last recorded at this site in 2006.

Purabcheria mud flats: About 5,000 deserted nest platforms and 4,000 adult Lesser Flamingos were recorded at the site on 8th July 2009. Greater Flamingos were not seen. The number of nest platforms was the highest amongst all recent records. This is the area where Lesser Flamingos congregate in very large numbers by May end/ early June (before onset of the south-west monsoon), make unsuccessful nesting attempts and later move to the interior parts of Rann with its inundation. Unlike every year, the colony remained unsuccessful. Besides egg pilferage, other possible reasons for colony failure need to be ascertained. Some pairs were still engaged in nest-building activity.

Great Rann of Kachchh:
There are three nesting sites namely Bela-Mowana, Boru salt pans and Flamingo City.

Bela-Mowana: Though we could not reach the actual nesting site due to hostile habitat, we gathered information about the exact location of nesting. On 14th October 2009, we estimated *ca.* 70,000 to 80,000 Lesser Flamingo chicks distributed in eight crèches. There were fewer than 500 adult birds around. A few adult Greater Flamingos were also seen indicating a mixed breeding colony. Probably the breeding pairs foraged ~ 50 km south in Little Rann where shallow water with low salinity was available. No adult bird foraged on north or north-western side of the sighting of crèche as its water had very high concentration of salt and probably it was devoid of food.

The area of the Rann between Adesar and Bela had dried up, but around Nandabet, 50 km south of the nesting site in the Little Rann, there were at least 250,000 Lesser Flamingos and about 10,000 Greater Flamingos feeding. There were no juveniles with this foraging group indicating that the chicks at Bela-Mowana nesting site were too young to fly with the parents. In other parts of the Little Rann (Venusar, Bajana wetland, Kuda, Purabcheria, Rupen river mouth, etc.) there were an additional approximately 200,000 Lesser Flamingos foraging.

Boru salt pans: Eggs were also found in the saltpans of Boru village on the eastern fringe of Great Rann indicating nesting attempt. However, nest number or success rate could not be determined. The area had dried and salt mining activity had started in early September. Birds were absent.

Flamingo City: Nesting of Greater Flamingos at 'Flamingo City' is not yet confirmed this year. The water around nesting site had receded in late September. Greater Flamingos were not observed in the surrounding area, or even at the distant locations of Chhari Dhandh and Shervo Dhandh, which indicated that Greater Flamingos have not bred at their traditional nesting site in 2009.

There was no confirmation of Greater Flamingo nesting at Flamingo City even during 2007 and 2008. The Greater Flamingos bred successfully at Flamingo City only during 2006-07. The nesting activity started in September 2006 continued till late April 2007.

Expansion of Greater Flamingo wintering range along the southeast coast of India

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During the 1980s and 1990s, many thousands of Greater Flamingos *Phoenicopterus roseus* frequented the major southeast coastal wetlands in India during the winter months. The two major coastal wetlands, which supported over 20,000 during the 1980s, were the Great Vedaranyam Swamp (Point Calimere) and Pulicat Lake (Balachandran, 2007). Other important southeast coastal wetlands are the Dhanuskodi Lagoon on Rameswaram Island and Kaliveli Lake. Besides the coastal wetlands, up to 2,000 Greater Flamingos also spent winter months inland in Koonthankulam Bird Sanctuary and the adjoining wetland complexes, and in Big Tank in Ramanathapuram District - an Important Bird Area. The Greater Flamingo has now extended its distribution range south to Kanyakumari on the southern most tip of India. This report is based on data generated through Bombay Natural History Society's (BNHS) recent waterbird population monitoring/ringing projects conducted from October 2008 to May 2009 in three major wetlands (Point Calimere, Koonthankulam and Kanyakumari saltpans) and the reconnaissance surveys carried out in other areas along the southeast coast of India during 2008-2009 migratory season (Figure 1).

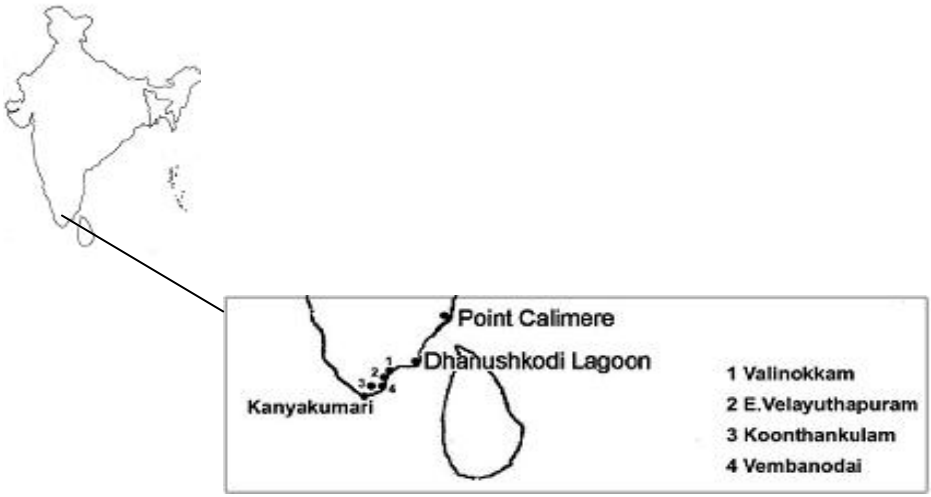

Figure 1. Wetland sites along southeast coast of India surveyed during 2008-09.

Due to heavy rain and an optimum water level in Point Calimere (Great Vedaranyam Swamp), 10,500 Greater Flamingos were recorded during January 2009 (Table 1). This is the highest number for this species in the last 10 years. Balachandran (2007) reported that there was a substantial decline in the number of Greater Flamingos wintering at Point Calimere during the last three decades. During the reconnaissance surveys in 2008-09, Greater Flamingos were recorded in four new sites along the southeast coast of India (E. Velayuthapuram saltpans, Vembanodai saltpans, Vijayanarayanam tank and Nanguneri tank). It was learned from the salt workers and local fishermen that the Greater Flamingos have frequented these two saltpans for the past 4-6 years.

Table 1. Details of the wetlands utilized by the Greater Flamingo on the southeast coast of India, 2008-09.

Wetland	Type	Location	Max count	Survey period	Maximum Recorded
E. Velayuthapuram	Saltpans	09°03′N, 78°18′E	520	Jan & Feb 2009	Feb 2009
Vembanodai	Saltpans	08°58′N, 78°12′E	1,850	Jan & Feb 2009	Feb 2009
Valinokkam	Saltpans	09° 10′N, 78° 37′E	800	Jan & Feb 2009	Feb 2009
Kanyakumari	Saltpans	08°06′N, 77°28′E	700	Sept.2008-July 2009	Jan 2009
Koonthankulam	Fresh	08°28′N, 77°43′E	160	Sept.200-June 2009	Dec 2008
Vijayanarayanam	Fresh	08°25′N, 77°46′E	300	Nov.2008-June 2009	Dec 2008
Nankuneri	Fresh	08°30′N, 77°39′E	60	Nov.2008-June 2009	Jan 2009
Great Vedaranyam Swamp (Point Calimere)	Swamp	10°18′N, 79°51′E	10,500	Oct.2008 - June 2009	Jan 2009
Dhanuskodi Lagoon (Gulf of Mannar)	Lagoon	08°40′N, 78°10′E	2,950	Dec.2008-Jan. 2009	Dec 2009

The Greater Flamingo utilizes a wide variety of habitats during the winter, ranging from freshwater ponds to highly saline saltpans and high alkaline ponds. Wetlands throughout the world, which are the main habitat for waterfowl, have been destroyed or have deteriorated in quality. However, for flamingos, their role is now being taken over by saltpans in many places of the world (Johnson and Cézilly 2007; Velasquez 1992; Britton and Johnson 1987; Dharmakumarsinhji 1973).

Though the number of Greater Flamingos wintering at traditional sites on the southeast coast of India, such as Kaliveli Tank, Pulicat Lake and Dhanuskodi Lagoon (Gulf of Mannar) is on a declining trend (Balachandran 2007), the saltpans play an important role for the Greater Flamingos by providing alternate habitat to them. It was also recorded that the saltpans are the only important habitat for a number of wintering and over-summering birds including Greater Flamingo in Kanyakumari District, where a total of 125 Greater Flamingos over-summered.

Our long-term surveys and observations along the southeast coast of India also revealed that the coastal and estuarine lagoons, which are important foraging grounds for the Greater Flamingos during winter and spring, are often influenced by the amount of winter rainfall, which fluctuate substantially from year to year. In contrast the saltpans, with seawater storage reservoirs where the seawater is directly pumped or channelled into them, guarantee the availability of foraging habitats for flamingos throughout the year. Moreover, the *Artemia* sp., the favoured prey species of Greater Flamingo, occurs abundantly in saltpans during the extreme summer as well.

References

Balachandran, S. 2007. Current status of Flamingos at major coastal wetlands along the east coast of India with special emphasis on population decline. Pp. 27-31. In: Childress, B., Arengo, F., Bechet, A. & Jarrett, N. (eds.) 2007. *Flamingo*, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, No. 15, December 2007. Wildfowl & Wetlands Trust, Slimbridge, UK.

Britton, R. H. and Johnson A. R. 1987. An ecological account of a Mediterranean salina: the Salin de Giraud, Camargue (S. France). Biological Conservation 42:185–230.

Dharmakumarsinhji, R. 1973. Migratory and resident waterfowl (Anatidae) of Bhavnagar District, Gujarat, India, Pavo 11: 33-60.

Johnson, A. R. and Cézilly, F. 2007. *The Greater Flamingo*. T & AD Poyser, London, UK.

Velásquez, C. 1992. Managing artificial saltpans as a waterbird habitat: species' responses to water level manipulation. Colonial Waterbirds 15:43-55.

Effectiveness of traditional staked-noose lines to capture Greater Flamingos

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Summary
We used staked noose lines, used by traditional Indian trappers to catch Greater Flamingos *Phoenicopterus roseus* at two wetlands in the United Arab Emirates. All together we captured 14 flamingos; five at Al Wathba Wetland Reserve in Abu Dhabi between 26-28th November 2005 and nine flamingos at Ras Al Khor Wildlife Sanctuary in Dubai on 27th February 2006 and another five birds at Al Wathba in 2007. We discuss the effectiveness of staked noose lines for the capture of greater flamingos in relation to effort and practical ease in using the staked noose lines, both for flamingos and other large wading birds.

Introduction
Greater Flamingos have been captured in the United Arab Emirates (UAE) and fitted with satellite transmitters to study their movement and migration patterns. As most of the flamingos in the UAE are winter migrants and make extensive movements between inland and coastal wetland sites, it is important to catch them as quickly as possible at the few inland wetlands sites where they occur.

Between November 2005 and January 2007, we captured flamingos at two different places in the country to attach rings and satellite transmitters for documenting their movement and migration. In this article we briefly describe the traps used and their effectiveness in catching flamingos.

Study sites
Flamingos were captured at two sites in the UAE, the Al Wathba Wetland Reserve in Abu Dhabi and Ras Al Khor Wildlife Sanctuary in Dubai (RAKWS). At both the sites, flamingos usually gather in flocks of up 100 individuals in the shallow waters. RAKWS is an inter-tidal lagoon, protected by mangrove trees, while the Al Wathba Wetland is an inland wetland. Both sites have shallow water areas, ideal for setting noose lines to capture waterbirds.

Methods

Noose lines and nooses
The noose lines we used to capture Greater Flamingos consisted of a series of nylon loops made from 45lb and 50lb test fishing line. Each noose measured approximately 20 cm in diameter when fully opened. One end of the fishing line was made into a loop while the other end was tied to a 20 x 5 cm wooden stake with pointed distal end to push in the mud (Figure 1). On average, 40-50 staked nooses were joined 10-15 cm apart to a common noose line (Figure 2).

Figure 1. Coiled noose lines

Setting the noose lines
The noose lines were set in shallow (10-15 cm) water. Potential trapping locations were identified by visiting sites a day before to know where flamingos regularly feed and rest during the day. Efforts were made to finish placement of noose lines just before sunrise, when it was still dark, to keep the disturbance to minimum (Figure 2). Usually 2-3 such lines were set at each location,one running diagonal from the shoreline, one running parallel to shore line, starting where the first line ended, and one running perpendicular to the shoreline. This allowed greater area coverage and increased the chances of capture for birds either moving towards the shore or moving away.

Results
At Al Wathba trapping efforts were undertaken three times, first for three days in November 2005, then for a day in December 2006 and finally for four days in January 2007. However at RAKWS Dubai trapping was done only on one day (Table 1). Altogether we caught 20 birds over nine days at 37 sites using 60 noose lines. On average, we caught two birds per day from approximately 10 hrs of trapping. There was only one bird injured, due to a delay in extracting it from the noose.

Figure 2. Setting the noose lines

Table 1. Details of capture operations and numbers of birds trapped on each day

Date	Locality	No. sites	No. noose lines	Total hours	No. birds caught	Staff	Approx. no. of birds
26.11.05	Al Wathba	4	3	10.0	1	3	300+
27.11.05	Al Wathba	4	5	9.5	0	3	up to 300
28.11.05	Al Wathba	5	6	9.5	4	5	300+
27.02.06	Khor Dubai	3	8	9.5	9	6	400-500
28.12.06	Al Wathba	3	5	9.5	0	3	Less than 100 birds overall
09.01.07	Al Wathba	3	6	9.5	3	3	200-2250 birds
10.01.07	Al Wathba	3	5	9.5	1	4	300-350 birds
23.01.07	Al Wathba	6	11	10.5	0	4	300-350 birds
24.01.07	Al Wathba	6	11	10.5	2	4	300-350 birds
Sum		**37**	**60**	**88**	**20**	**35**	
Mean		**4.1**	**6.6**	**9.7**	**2.2**	**3.8**	
SD		**1.2**	**2.7**	**0.4**	**2.9**	**1.0**	

Discussion

Noose lines have been used successfully to capture a range of species, including ducks, geese and cranes (Javed *et al*. 2000, Javed *et al.* 2003) and also have been used to catch flamingos in Africa and Spain (Childress and Jarrett 2005, Amat *et al.* 2005). Using staked noose lines is similar to the mesh of noose lines used by Amat *et al.* (2005) and suggested by Childress and Jarrett (2005). However, the staked noose lines used by us are easier and more portable to carry and deploy. It may be possibly require more time to deploy the noose lines, compared to the meshed noose lines used by the previous authors. However, the staked noose lines are much

lighter, can be used at any site, and can be easily transported to any other country for use. In addition, given the length of the noose line, it covers a much larger area compared to 1x1m meshed noose line. The line can be run along the main feeding areas of birds in straight line or in ziz-zag fashion or in any other manner, based on the patterns of flamingos feeding in the area and hence provide much greater operational flexibility. We recommend use of these staked noose line for catching flamingos and other large wading birds.

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References

Amat, J. A., Rendón, M. A., Rendón-Martos, M., Garrido, A. and Ramí, J. M. 2005. Ranging behaviour of greater flamingos during the breeding and post-breeding periods: Linking connectivity to biological processes. *Biological Conservation* 125: 183-192

Childress, B. and Jarrett, J. 2005. Methods of capturing and handing wild Lesser Flamingos for research. Pp: 25-31. In: Childress, B., Béchet, A., Arengo, F. & Jarrett, N. (eds.) 2005. *Flamingo*, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, No. 13, December 2005. Wildfowl & Wetlands Trust, Slimbridge, UK.

Javed, S., Higuchi, H., Nagendran. M. and Takekawa, J. Y. 2003. Satellite telemetry and wildlife studies in India: Advantages, Options and Challenges. Current Science 85: 1439-1443.

Javed, S., Takekawa, J. Y., Douglas, D. C., Rahmani, A. R., Kanai, Y., Nagendran, M., Choudhury, B. C. and Sharma, S. 2000. Tracking the spring migration of a Bar-headed Goose (Anser indicus) across the Himalaya with Satellite Telemetry. Global Environmental Research 2: 195-205.

EX-SITU PAPERS

AZA efforts to develop a sustainable North American captive Lesser Flamingo population

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Abstract
The North American captive Lesser Flamingo (*Phoeniconaias minor*) population is not self-sustaining and regular importations are required to fill the demand for birds. Since 2002, the Fort Worth Zoo has been the only zoo to consistently produce chicks. The population is genetically healthy; the majority of the population is made up of founders, but reproduction has been low. On 01 January 2009, the studbook data showed a heavily male-skewed population: 404 males, 178 females, and 41 birds of unknown sex, plus ~100 birds recently imported which have not been included. The Association of Zoos and Aquariums (2008) Ciconiiformes Regional Collection Plan (RCP) established a Population Management Plan (PMP) for the Lesser Flamingo. Implementation of this plan, which is on-going, has resulted in increased chick production within the first year.

Introduction
Caribbean (*Phoenicopterus ruber*), Chilean (*Phoenicopterus chilensis*), Greater (*Phoenicopterus roseus*), and Lesser (*Phoeniconaias minor*) Flamingos are prominent species in zoological collections around the globe. Caribbean, Greater and Chilean Flamingos are consistent breeders within the zoological community and the North American populations breed recurrently at many zoos. However, the captive Lesser Flamingo population is not self-sustaining and importations are required to fulfill the demand for birds. Tanzania is the only country that allows the capture and export of live Lesser Flamingos and the operation frequently results in high levels of mortality (Clamsen *et al* 2008), which adds to the urgency of establishing a self-sustaining captive population.

The earliest record of Lesser Flamingos in a North American zoological collection is in the late 1950's (Conrad 2007) and successful reproduction in North America did not occur until 1989 at SeaWorld San Diego. Several successful hatches have occurred at the Baltimore Zoo, San Diego Wild Animal Park, the Fort Worth Zoo, and most recently, Sylvan Heights Waterfowl Park. The Fort Worth Zoo has been the only zoo to consistently produce chicks since 2002.

The North American population is genetically healthy. The majority of the population is made up of founders, but reproduction has been low. Studbook data show a heavily male-skewed population: 404 males, 178 females, and 41 unknown sex as of 01 January 2009, plus ~100 birds recently imported which have not been included in the studbook (Conrad 2006). Birds imported from Tanzania are wild caught and are imported at the expense of the importer. The Association of Zoos and Aquariums (2008) Ciconiiformes Regional Collection Plan (RCP) has established a Population Management Plan (PMP) for the Lesser Flamingo. PMP recommendations focus on increasing the breeding success of the Lesser Flamingo in North America.

Methods
In 2006, the Lesser Flamingo Regional Studbook was analyzed by the AZA Population Management Center (PMC) at Lincoln Park Zoo. Of the 544 individuals in the captive population as of 01 January 2006, > 96% were wild-caught; there were only 21 surviving offspring. The PMC recommended the following objectives:

- Achieve 20 offspring in the coming year from pairs rating 1, 2 or 3 on MateRx mate suitability index[a]

- Identify parentage of all chicks
- Report sexes of individuals whose sex is currently unknown to allow their incorporation into breeding recommendations
- Organize a forum for discussion of husbandry and management issues to facilitate transition from import-sustained population to propagation-sustained population.

As a result of these recommendations, a Lesser Flamingo captive breeding workshop was held in conjunction with the Ciconiiformes Taxon Advisory Group meeting at the Regional AZA Conference in Denver, Colorado in 2007. Photographs of North American holding institutions and exhibits were collected and presented. Colony management including exhibit design, diet, salt versus fresh water, pinioned versus full-winged birds, breeding management, flock behavior, disturbance, and sex ratio was discussed. Also discussed were: colony size; exhibit con-specifics (some facilities house Lesser Flamingos with Chilean or Caribbean Flamingos in order to increase flock size); weather (several institutions move their colonies indoors during the winter); and feed (includes a variety of commercial pellet and powder diets, shrimp, romaine, and krill).

Interestingly, most colonies within North America display build nests and even lay eggs but achieve little success. Additional questions were raised by the group: Are we asking the birds to breed at the wrong time? Should we try winter (November) breeding? Why do some birds have such intense color and some not? Should krill and duckweed be fed for enrichment? Is the lack of breeding diet related?

The breeding husbandry questions were not answered, but it was concluded that the heavily skewed male population clearly is a significant factor in the lack of breeding for this species. Fort Worth Zoo developed an indoor “breeding barn” which is supplemented with light, heat and mirrors (B. Hazleton, pers. comm.). Chick production has been consistent since the onset of the breeding strategy (K. Unger, pers. comm.). Several action points arose from the forum:

- Extra males should be separated from breeding pairs to decrease disturbance.
- Birds from flocks < 20 individuals should be transferred to breeding situations, as recommended by the AZA Husbandry Manual.
- Supplemental lighting to increase day length to ~14 hours in locales which do not have this natural light should be investigated.
- The breeding barn model at Fort Worth Zoo should be replicated

New Population Management Plan objectives for the Lesser Flamingo were established at the 2008 AZA Regional Collection Plan meeting following the forum. These objectives were:

- Update information and add to husbandry guidelines for this species; gather information from breeding zoos
- Determine sex of all birds
- Distribute individuals to create equal sex-ratio flocks
- Increase numbers of small flocks
- Identify zoos that will develop breeding programs

All holding institutions were contacted by phone and the majority of holding institutions were willing to follow the transfer recommendations.

Results

Although shipping requirements and costs make shipping flamingos no easy task, North American zoos have been extremely cooperative and enthusiastic about moving females to equalize sex ratios. Several zoos have shared information in attempts to increase colony productivity. The majority of the unsexed birds in North America now have known sex and the population continues to be heavily skewed toward males. The following additional activities have occurred:

- Fort Worth Zoo is in discussion with Caldwell Zoo about transferring either eggs or birds to try to stimulate breeding activity in the Caldwell flock (K. Unger, pers. comm.). Caldwell will develop a breeding program.
- In 2009, Sylvan Heights Waterfowl Park imported birds and with the help of Brad Hazelton, former curator of Birds at Fort Worth Zoo, and built a breeding barn much like the breeding barn at the Fort Worth Zoo. Unfortunately, the imported birds were heavily skewed male.
- Minnesota Zoo agreed to transfer eight female Lesser Flamingos to Sylvan Heights. The Sylvan Heights colony produced a chick as a result of the Minnesota transfer and the newly built breeding facility (B. Hazleton pers. comm.).
- San Antonio Zoo determined the sex of all its birds. Only two birds of unknown sex were females; the two females will likely be transferred to the breeding colony at Fort Worth Zoo. San Antonio will be a male holding facility (J. San Miguel pers. comm.).
- Honolulu agreed to send females to the San Diego Zoo on breeding loan; no shipment has occurred to-date (L. Santos and D. Rimlinger pers. comm.).
- Busch Gardens determined the sex of all their birds and they also have a heavily male-skewed population. Future plans include splitting the colony to separate out a small breeding colony and a larger, male holding colony (P. Hillary, pers. comm.).
- SeaWorld San Diego returned its colony to the former location where breeding had occurred.
- Oakland Zoo transported six female birds to SeaWorld San Diego in exchange for three male Lesser Flamingos (on breeding loan). The SeaWorld San Diego colony produced eggs for the first time in five years, but did not produce chicks.
- Dallas Zoo imported birds and now has an even sex ratio. Dallas is in the planning phases of a breeding barn similar to Fort Worth (C. Brown, pers. comm.).
- Safari West imported ~100 Lesser Flamingos which have not been sexed (P. Lang, pers. comm.). Long term plans for this colony have not been discussed.

Discussion

The North American captive Lesser Flamingo (*Phoeniconaias minor*) population is not self-sustaining and regular importations are required to fill the demand for birds. Tanzania is the only country that allows the capture and export of live Lesser Flamingos and these operations frequently result in high levels of mortality (Clamsen *et al* 2008), which adds to the urgency of establishing a self-sustaining captive population. The AZA has been proactive in taking steps to achieve this goal. In 2006, the AZA Population Management Center analyzed the Lesser Flamingo Regional Studbook and made several substantive recommendations, including the scheduling of a special forum. This forum was held in conjunction with the AZA Ciconiiformes Taxon Advisory Group meeting at the Regional AZA Conference in Denver, Colorado in 2007. Following the forum, new Population Management Plan objectives for the Lesser Flamingo were established at the 2008 AZA Regional Collection Plan. Many North American zoos have been extremely cooperative and enthusiastic in taking the steps to implement the new Population Management Plan, but continued discussion and cooperation among zoological facilities and continued efforts to breed the Lesser Flamingo in North America are necessary to sustain this population in zoos without importation of birds.

Acknowledgements

I would like to express thanks to the curators, institutional representatives, and keepers of the holding institutions of Lesser Flamingos for willingness to share information, transfer flamingos, and work towards increasing awareness of the husbandry needs of these animals. I would like to thank Sherry Branch, Program Liaison for the Ciconiiformes TAG; Chris Brown, Ciconiiformes TAG chair; and Stephanie Costelow, SeaWorld of California Curator of Birds; for their advice and prompting. Thanks to Erin Kovencz and Amanda Newman for assistance with data entry and record keeping. Thank you to Brad Hazelton and Katie Unger for successful management and breeding success and a special thank you to the flamingo keepers turning dirt and encouraging breeding in their exhibits.

References

Association of Zoos and Aquariums. 2008. *Ciconiiformes TAG Regional Collection Plan (2008)*. Retrieved on October 15, 2009 from: http://www.aza.org/uploadedFiles/Animal_Care_and_Management/Animal_Programs/Animal_Programs_Database/Regional_Collection_Plans/RCP_CiconiiformesPhoenicopteriformes2008.pdf

Clamsen, T. E. M., Mlingwa, C. O. F and Childress, B. 2008. Size and trend of the Tanzanian export trade in wild Lesser Flamingos (*Phoeniconaias minor*). Pp: 54-57. In: Childress, B., Arengo, F., and Béchet, A. (eds.) 2008. *Flamingo*, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, No. 16, December 2008. Wildfowl & Wetlands Trust, Slimbridge, UK.

Conrad, L. 2006. Lesser Flamingo Population Management Plan. Retrieved on October 15, 2009 from: http://www.aza.org/uploadedFiles/Animal_Care_and_Management/Animal_Programs/Animal_Programs_Database/Population_Management_Plans/BreedingPMPFlamingoLesser.pdf

Conrad, L. 2007. North American Regional Studbook for Lesser Flamingos. Retrieved on October 15, 2009 from: http://www.aza.org/uploadedFiles/Animal_Care_and_Management/Animal_Programs/Animal_Programs_Database/Studbooks/FlamingoLesserStudbook.pdf

Conrad, L. and Costelow, S. 2007. Lesser Flamingos in North American Zoos. PowerPoint session presented at the meeting of the Ciconiiformes Taxon Advisory Group at the AZA Regional Meeting in Denver, CO.

[a] MateRx software (http://www.vortex9.org/materx.html) is designed and developed to be a genetic tool that will guide population management decisions. For every male/female pair in the population, MateRx calculates a single numeric index indicating the relative genetic benefit or detriment to the population of breeding that particular pair. This index, the mate suitability index (or MSI), is calculated from considering the pairs' mean kinship values, the difference in the male and females mean kinship, the inbreeding coefficient of the offspring produced, and the amount of unknown ancestry in the pair. MateRx is designed to simplify the decisions about which pairs should be bred by condensing all that we know about the genetics of a pair into a single number.

Successful *ex-situ* breeding of Lesser Flamingos (*Phoeniconaias minor*)

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Abstract
Historically in North American zoos, breeding Lesser Flamingos (*Phoeniconaias minor*) has been challenging. In 2001, an indoor breeding facility for Lesser Flamingos was constructed at the Fort Worth Zoo (FWZ). From 2002 to 2009, 59 Lesser Flamingos have hatched through the FWZ breeding program, which is the greatest number of hatchings from any North American institution. In both 2007 and 2009, three second generation chicks hatched. It is likely that the indoor

breeding facility, which increased bird density because of its size, contained mirrors, and provided security, contributed to the successful Lesser Flamingo breeding program.

Introduction

Flamingos are popular birds in zoos and have a widespread presence within the worldwide zoo community. One species of flamingo, the Lesser Flamingo (*Phoeniconaias minor*), is classified as Near Threatened in the wild (IUCN 2009). In 2009, 53 zoos around the world held Lesser Flamingos in their bird collections; 17 were North American institutions (ISIS 2009).

Historically in North American zoos, breeding Lesser Flamingos has been challenging. Maintaining self-sustaining breeding populations is important for zoos because successful programs ensure the continuance of viable populations for zoos, reduce the impact on wild populations and reduce the costs of acquiring animals (Hutchins *et al*. 1996). Like all flamingos, Lesser Flamingos are gregarious birds that naturally live in large flocks (del Hoyo *et al*. 1992). In the wild, they breed in colonies of tens of thousands or more birds and engage in synchronized group breeding displays (del Hoyo *et al.* 1992).

In captivity, flamingo breeding has been shown to be influenced by flock size. Caribbean Flamingos (*Phoenicopterus ruber*) housed in captivity engaged in more synchronized group displays and laid more eggs when flock size increased (Stevens 1991, Stevens and Pickett 1994). To simulate a larger flock, Pickering and Duverge (1992) placed a panel of mirrors in a building that housed a group of Lesser Flamingos. They found that when the birds were exposed to the mirrors, the occurrence of reproductive-related marching displays increased, as well as the number of individual birds who took part in the displays. Pickering and Duverge (1992) also noted that the marching displays lasted longer when the flock had visual access to the mirrors.

Since 1987, Lesser Flamingos have been housed at the Fort Worth Zoo, Fort Worth, Texas, USA. They were originally housed in an outdoor exhibit (approximately 21x12 m) which had available nesting areas and a large pond; however, breeding did not occur. As a result, a new breeding strategy was developed in 2001, which included a plan for an indoor breeding facility complete with mirrors to create the illusion of a large flock.

Materials and Methods

In 2001, an indoor breeding facility for Lesser Flamingos was constructed. The building was 4.7x2.4x1.7 m and consisted of a nesting area (1.8x2.4 m) and a shallow pool (2.7x2.4 m; sloping to 10.2 cm deep) which made up slightly more than 50% of the total space. Two 1.2 m fluorescent light fixtures provided light during a 14L:10D photoperiod (lights on at 07:00 hours and off at 21:00 hours). Two 61 cm radiant heaters were hung 1.7 m over the nest area to simulate a natural tropical environment. When necessary, additional 250 watt heat lamps were provided. Birds were offered a commercial diet (Mazuri® flamingo breeder) and a canthaxanin supplement once per day in the morning and allowed to free-feed throughout the day. A clay substrate was provided and was manipulated by the flamingo keepers three times per week to ensure it remained loose enough to facilitate building of nest mounds by the birds. A panel of mirrors (76.2 cm high) completely lined three of the walls, including the pool area.

To establish a breeding flock, several birds (11 males, 5 females) were moved from their outdoor exhibit to the breeding building in December 2001 and were housed inside until late spring 2002. This routine continues at present, with breeding-age adults (average sex ratio: 12 males, 8 females) moved inside the building in November/December and released to the outdoor exhibit in late spring/early summer at the end of the breeding season.

In early 2008, to meet management needs, the original breeding building was demolished and a new building was constructed in a separate location. The new breeding facility was designed similarly to the previous building: 5.3x3x2.4 m with a nesting area of 2.9x3 m and a pool that was 2.4x3 m, sloping to 15.2 cm deep. The lighting and heating regime, as well as the position of the mirrors, also remained similar to the original protocol. During the 2008-2009 breeding season, temperature and relative humidity inside the building were recorded using a HOBO data logger (Onset Computer Corporation, Bourne, Massachusetts, USA). The average daily temperature was 22°C (Range: 10°- 34°C). The average daily relative humidity inside the breeding building was 65% (Range: 37-99%).

Results

Two fertile eggs were laid in the spring of 2002. One egg either fell off or was kicked from the nest mound and destroyed. However, the other egg hatched and resulted in the first hatching of a Lesser Flamingo chick at the Fort Worth Zoo. The egg was naturally incubated by the parents. After the chick hatched the keepers observed some aggressive behavior toward the chick from other birds in the flock. As a result, the chick was removed from the parents for hand-rearing at three days of age.

Table 1. Fort Worth Zoo Lesser Flamingo (*Phoeniconaias minor*) egg and chick record, 2002-2009. In the egg record, the number in parentheses = the number of fertile eggs laid. In the chick record, the number in parentheses = the number of chicks that did not survive to fledge (3 mos.).

Year	Eggs laid	Chicks hatched	Success rate (%) [a]	Male chicks	Female chicks	Unknown sex	Survival rate (%) [b]
2002	4 (2)	1	50.0	1	0	0	100.0
2003	0	0	0.0	0	0	0	0.0
2004	15 (6)	6	100.0	3(1)	2(1)	1(1)	50.0
2005	32 (20)	14	70.0	11(5)	3(2)	0	50.0
2006	34 (19)	17	89.5	12(4)	05(2)	0	64.7
2007	28 (12)	9	75.0	3	5(1)	1(1)	77.8
2008[c]	0	0	0.0	0	0	0	0.0
2009	23 (17)	12	70.6	5	7(1)	0	91.7
Totals	**136 (76)**	**59**	**77.6**	**35(10)**	**22(7)**	**2(2)**	**72.4**

[a] Chicks hatched as percent of fertile eggs laid
[b] Percent of chicks that survived > 3 mos. (age of fledging)
[c] New breeding building under construction; birds did not have access to the facility.

In successive years, the breeding program has remained consistent in egg production and subsequent chick hatching, with the exception of 2003 and 2008 when no breeding occurred. To ensure safe development and hatching, the eggs were collected and artificially incubated after they were laid. Artificial eggs were placed on the nest mound to stimulate a continued breeding response from the birds. The chick-rearing protocol was a combination of hand-rearing and "foster parenting" (hatchlings were placed with adult pairs deemed by management to be most likely to successfully rear and fledge a chick; the chosen pairs were not necessarily the biological parents).

With each breeding season, the first egg was generally laid approximately 1.8 months after the breeding flock was moved inside the building and the last egg was typically laid after 4.5 months. The incubation period was 26-27 days, which coincides with an incubation period of 27-31 days for wild flamingos (del Hoyo *et al.* 1992).

From 2002 to 2009, 136 eggs were laid and 59 Lesser Flamingo chicks have hatched (Table 1). The sex was identified for 57 chicks; 61% were males and 39% were females. For the years that chicks hatched (n = 6), the average chick survival rate was 72.4%. In both 2007 and 2009, three second generation chicks hatched. All chicks were sired by full-flighted males.

Discussion

To date, the Fort Worth Zoo has produced the greatest number of Lesser Flamingo chicks of any North American institution. The success of the breeding program is further validated by two important factors: 1. high survival rate of chicks each year (compared to 40% fledging success in the wild; del Hoyo *et al.* 1992), and 2. hatching of second generation chicks. It is highly likely that the indoor breeding facility contributed to the successful breeding program. The smaller size of the building increased bird density when compared to the outdoor exhibit and the mirrored walls possibly succeeded in creating the illusion of a large flock. The security of the building and the provision of the large pool may also have enhanced the flamingos' willingness to breed (King 2008). In addition, full-flighted male wing condition may have contributed to successful copulation and subsequent chick production (King 2008).

In 2003, the Fort Worth Zoo's Lesser Flamingos did not breed, which could be explained by the natural, irregular breeding pattern of flamingos (del Hoyo *et al.* 1992). However, they did breed and produce eggs in succeeding years. During construction of the new breeding building in 2008, the birds did not have access to the building for breeding activity.

Successful breeding programs are important for zoos because these programs help reduce the impact on wild populations (*i.e.* less need to collect new individuals from the wild) and also indicate enhanced animal welfare (Elston and Plasse 2008). In the future, the Fort Worth Zoo will continue to play a strong role in flamingo conservation by adding new birds to the captive population and by sharing knowledge with other institutions that either have or are planning to establish flamingo breeding programs.

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References

del Hoyo, J., Elliot, A. and Sargatal, J. (eds). 1992. Order Phoenicopteriformes. Pp. 508-526. In: *Handbook of the Birds of the World. Vol. 1.* Lynx Edicions, Barcelona.

Elston, J. and Plasse, C. 2008. Bird welfare in zoos: it's not just about having fur. Pp. 69-79. In: Bettinger, T. and Bielitzki, J. (eds.) *The well-being of animals in zoo and aquarium-sponsored research: putting best practices forward.* Scientists Center for Animal Welfare, Greenbelt, MD

Hutchins, M., Wiese, R., and Willis, K. 1996. Why we need captive breeding. Pp. 77-86. In: *Proceedings of the American Zoo and Aquarium Association Central Regional Conference, New Orleans, Louisiana, February 28 - March 2, 1996.* American Zoo and Aquarium Association, Silver Spring, Maryland, USA.

ISIS 2009. International Species Information System (http://www.isis.org)

IUCN 2009. IUCN Red List of Threatened Species. Version 2009.2. <www.iucnredlist.org>. Downloaded on 07 November 2009.

King. C.E. 2008. A hypothetical husbandry point system for breeding flamingos in captivity. In: Childress, B., Arengo, F. and Bechet, A. (eds.) *Flamingo*, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, 16: 57-61. Wildfowl & Wetlands Trust, Slimbridge, UK.

Pickering, S.P.C. and Duverge, L. 1992. The influence of visual stimuli provided by mirrors on the marching displays of Lesser Flamingos, *Phoeniconais minor*. Animal Behaviour 43:1048-1050.

Stevens, E. 1991. Flamingo breeding: the role of group displays. Zoo Biology 10: 53-63.

Stevens, E. and Pickett, C. 1994. Managing the social environments of flamingos for reproductive success. Zoo Biology 13: 501-507.

NEWS ITEMS

New and expanded Ramsar sites help protect high Andes flamingo habitats

The Grupo de Conservacion Flamencos Altoandinos (GCFA), a regional initiative in South America aimed at conserving flamingos and wetlands, has been working for over 12 years, focusing research, conservation and outreach activities at priority sites for the Andean and Puna (James') Flamingos (*Phoenicoparrus andinus and P. jamesi*) throughout their range in Argentina, Bolivia, Chile and Peru. Working closely with provincial authorities and communities in Argentina and Bolivia, the GCFA lead the processes that culminated in the official recognition of Lagunas Altoandinas y Puneñas de Catamarca as the newest Wetland of International Importance under the Ramsar Convention in Argentina, and the expansion of the Laguna Colorada Ramsar site in Bolivia, designated in 1990, from 51,000 hectares to nearly 1.5 million hectares.

Figure 1. Laguna Hedionda, Los Lípez Ramsar site, Bolivia (Photo Omar Rocha) Reprinted from the Ramsar website (www.ramsar.org).

The Lagunas Altoandinas y Puneñas de Catamarca site, officially recognised on 27 April 2009, has two sub-sites totalling over 1.2 million hectares and encompasses 14 wetlands used by Andean, Puna and/or Chilean Flamingos, and includes nesting colonies of both Andean and Puna Flamingos. The expanded Laguna Colorada Ramsar site in Bolivia, now renamed "Los Lípez", is located in the Bolivian Altiplano in Potosí Department and now includes a complex of high Andean endorrheic permanent saline, hypersaline and brackish lakes, as well as "bofedales" and geothermal wetlands. The "Los Lípez" announcement was made during the 6th workshop on the Regional Strategy for the Conservation and Sustainable Use of High-Andean Wetlands (21-24 September, La Paz, Bolivia).

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Flamingos suffer as several Kenyan Rift Valley lakes dry up

During 2009, severe drought has ravaged most parts of East Africa, causing crops to fail and killing large herds of livestock, wild animals and humans through dehydration and starvation. The Rift Valley soda lakes in Kenya have been particularly hard hit. As of this writing, Lake Nakuru ($0^0$19'-$0^0$24'S, $36^0$04'-$36^0$07'E), a 4,900 ha shallow soda lake with a normal mean depth of 1.9 m and the primary Lesser Flamingo feeding lake in the country, had only 80 cm of water at its deepest point. Lake Elmenteita ($0^0$27'S, 36015'E), 1,800 ha lake near Lake Nakuru and another important feeding lake, has been almost completely dry since July, enabling salt extraction and sand mining by the local communities to increase substantially (Figure 1). Other lakes in the area have also either dried up completely or suffered major reductions in water levels, the effects of the drought being exacerbated by ground water abstraction, deforestation of the catchments, and re-direction and damming of the meager water sources. As drought happens irregularly, but not infrequently in the Rift Valley, Lesser Flamingos are adapted to respond by moving to other feeding lakes, which they appear to have done on this occasion, with hundreds of thousands moving to Lake Bogoria. However, with the large influx of flamingos at the few remaining feeding lakes, there is concern that overcrowding may result in the spread of avian diseases or toxic algae blooms that are believed to have caused mass die-offs of this species in the past.

Jackson Raini (jraini2002@yahoo.com).

Figure 1. Lake Elmenteita during drought of 2009 (J. Raini)

RECENT SCIENTIFIC PUBLICATIONS

With abstracts where available

Abu, J., Wunschmann, A., Redig, P. T. and Feeney, D. 2009. Management of a Cutaneous Squamous Cell Carcinoma in an American Flamingo (*Phoenicopterus ruber*). Journal of Avian Medicine and Surgery 23: 44-48.

A 32-year-old female American Flamingo (*Phoenicopterus ruber*) was presented with squamous cell carcinoma of the middle digit of the right foot. No clinical, hematologic, or radiologic evidence of metastasis was present. Salvage amputation of the digit resulted in complete cure, whereas previous electrosurgery and radiation therapy were unsuccessful. Three years later, another squamous cell carcinoma was diagnosed in the middle digit of the left foot. The digit was also amputated. Seven months after the second amputation, the bird did not have any recurrence or signs of metastasis.

Amat, J., Rendon, M.A., Ramirez, J. M., Hortas, F., Arroyo, G. M., Garrido, A., Rendon-Martos, M. and Perez-Hurtado, A. 2009. Hematocrit is related to age but not to nutritional condition in Greater Flamingo chicks. European Journal of Wildlife Research 55: 179-182.

We measured the hematocrit from Greater Flamingo chicks *Phoenicopterus roseus* over 4 years to test whether this blood parameter was related to the nutritional condition of chicks, as there are controversial results on whether hematocrit may be used as an index of body condition. We also tested whether hematocrit increased with chick age, as there would be an age-related increase of oxygen demand due to exercising. We found no evidences that hematocrit was related neither to the nutritional nor to the body condition of chicks. Hematocrit increased with chick age, which may be related to the increased requirements of chicks for oxygen delivery during development.

Anderson, M. J., Williams, S. A.and O'Brien, E. H. 2009. Individual differences in the preferred neck-resting position of Caribbean Flamingos (Phoenicopterus ruber). Laterality 14: 66-78.

When resting, flamingos often lay their heads along their backs. While in this position they must curve their necks to either the right or left of their midline. Observations of captive Caribbean Flamingos at the Philadelphia Zoo (Philadelphia, PA, USA) were conducted in order to determine if individual birds would display consistent preferences in neck-resting position over multiple observations. While individual birds were shown to vary greatly in regards to the strength and direction of their preferences, a significant flock-level preference towards neck resting to the right was obtained. Analysis of individual flamingos revealed that 5 out of 17 birds displayed preferences that significantly differed from chance, with each of these birds preferring to rest their necks to the right. From the present data we can conclude that flamingos display behavioural laterality of neck-resting position at both the level of the group and that of the individual.

Béchet, A., Germain, C., Sandoz, A., Hirons, G. J. M., Green, R. E., Walmsley, J. G. and Johnson, J. R. 2008. Assessment of the impacts of hydrological fluctuations and salt pans abandonment on Greater Flamingos in the Camargue, South of France. Biodiversity Conservation DOI 10.1007/s10531-008-9544-8.

Flamingos forage in both commercial salt pans and natural marshes and lagoons along the French Mediterranean coast. In order to assess the impact of changes in management of commercial salt pans and hydrological fluctuations on this flagship species, we evaluated the foraging areas of breeding flamingos using the resightings of 283 breeding flamingos marked with dye at the colony in 1987 and 1989, two years with contrasting hydrological conditions. Teams of observers searched all suitable habitats within 80 km of the colony during the four

days following marking and recorded presence of off-duty flamingos. About one-third of the birds were found within 10 km of the colony, but some were seen up to 70 km away. About 24–54% of the birds were found in permanent brackish lagoons and 18–60% in the salt pans, the two most important habitats. In 1989, a dry year with lower water levels in the natural wetlands, the proportion of breeding flamingos using salt pans was twice as high [53%, range (47–60%)] as in 1987 [26%, range (18–29%)], this habitat thus acting as a refuge. Most of the feeding areas shown to be important for flamingos breeding in the Camargue are thus susceptible to variations according to rainfall and to transformations or drying out if the salt pans are abandoned. Our results provide essential benchmarks to reconsider the conservation of this flagship species when management of commercial salt pans changes.

Bouzid, A., Yousfi, J., Boulkhssaim, M. and Samraoui, B. 2009. First successful nesting of the Greater Flamingo Phoenicopterus roseus in the Algerian Sahara. Alauda 77: 139-143.

In 2009 the Greater Flamingo *Phoenicopterus roseus* was recorded to have bred for the first time at El Golea, in the heart of the Algerian Sahara. This event is the third successful breeding record of the species in Algeria, and El Golea is the second breeding site after Ezzemoul, located in the Eastern Hauts Plateaux. Egg pilfering which provokes mass desertion has been the major cause of failure at El Golea in the past but efficient surveillance of the colony ensured its successful breeding.

Meena, R. L., Korvadia, V. T., Dave, A. B. and Joshi, P. N. 2008. A note on Greater Rann of Kachchh, Kachchh District, Gujarat with special reference to Flamingo City. Indian Forester 134: 1393-1397.

Mondal, S. P., Lucio-Martinez, B. and Buckles, E. L. 2008. Molecular characterization of a poxvirus isolated from an American Flamingo (*Phoenicopterus ruber*). Avian Diseases 52: 520-525.

An avian poxvirus from the beak scab of an American Flamingo (*Phoenicopterus ruber*) was isolated by inoculation on the chorioallantoic membrane (CAM) of specific-pathogen-free (SPF) chicken embryos. The virus produced multifocal areas of epithelial hyperplasia along with foci of inflammation in the CAM, and rare cells contained small eosinophilic intracytoplasmic bodies. Chickens inoculated with the isolated virus in the feather follicle of the leg did not develop significant lesions. Nucleotide sequence comparison of a PCR-amplified 4.5 kb HindIII fragment of the genome of flamingo poxvirus (FlPV) revealed very high homology (99.7%) with condor poxvirus (CPV), followed by approximately 92% similarity with canary poxvirus (CNPV) and Hawaiian goose poxvirus (HGPV), but less similarity (similar to 69%) to fowl poxvirus (FPV), the type species of the genus Avipoxvirus of family Poxviridae. As in the cases with CPV, CNPV, and HGPV, genetic analysis of FlPV revealed an absence of three corresponding FPV open reading frames (ORF199, 200, and 202) and an absence of any reticuloendotheliosis virus (REV) sequences in this region. There are only nine nucleotide substitutions observed between FlPV and CPV in the 4.5 kb fragment; those were clustered in the ORF201 region, which in FPV genome is a site for integration of REV sequences. Phylogenetic analysis of the predicted amino acid sequences of the ORF201-coded hypothetical protein demonstrated FlPV to be more closely related to CPV, as well as to CNPV and HGPV, than to FPV.

Ramesh, D. A. and Ramachandran, S. 2005. Factors influencing flamingo (*Phoenicopterus roseus*) distribution in the Pulicat Lagoon ecosystem, India. Wetlands Ecology and Management 13: 69-72.

The shallow (1.5 m) Pulicat Lagoon in India supports a variety of migratory birds (125 species), especially flamingos and storks. Flamingo populations in this area are dominated by *Phoenicopterus roseus*, and they are densely distributed in shallow areas and fringes of the lake where the water level is below 40 cm. Eighteen flamingo groups were distributed around the lagoon with about 750 individuals per group. Flamingo populations were greatest in

places where fish, algal, and benthic faunal biomass were highest. Physiological adaptations and morphology of flamingos are important criteria for selecting feeding locations.

Zadegan, S.S. 2006. Greater Flamingo *Phoenicopterus ruber* ringing at Lake Uromiyeh, I.R. Iran. *Waterbirds around the world.* Eds. G.C. Boere, C.A. Galbraith & D.A. Stroud. The Stationery Office, Edinburgh, UK. pp. 562-563.

NOTES

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