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Turkey as a crossroad for Greater Flamingos *Phoenicopterus roseus*: evidence from population trends and ring-resightings (Aves: Phoenicopteridae)

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Turkey as a crossroad for Greater Flamingos *Phoenicopterus roseus*: evidence from population trends and ring-resightings (Aves: Phoenicopteridae)

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The Greater Flamingo *Phoenicopterus roseus* is a waterbird commonly found in saline and brackish lagoons throughout the Mediterranean Region. We have gathered existing data on Greater Flamingos in Turkey and carried out field surveys to present the most up to date information on wintering (1999–2014) and breeding (1969–2014). The wintering population of flamingos shows an increasing trend with 54,947±20,794 individuals mainly concentrated in the Gediz, Büyük Menderes and Çukurova deltas, respectively. Breeding attempts were recorded in at least seven wetlands in Turkey in the past, yet after 1999 most of the colonies were abandoned due to basin scale intensive water management practices in Central Anatolia. Currently, only Tuz Lake and Gediz Delta are used as regular breeding sites, while breeding has been recorded sporadically in Acıgöl and Akşehir Lakes. The breeding colony of Tuz Lake is of prime importance at the Mediterranean scale, with the number of young chicks in 2011, 2012 and 2013 accounting for the highest number of fledglings in the Mediterranean Region and West Africa (18,418, 20,274 and 20,292 respectively). Finally, building upon the previous findings about Turkey and the western Mediterranean metapopulation links, recent resightings of Turkish flamingos (despite the limited numbers) confirm post-fledging and natal dispersal reaching the western Mediterranean Basin and West Africa. Flamingos from Turkey were also found to disperse to Israel and to a region outside the known flyways of the western Mediterranean and West African flamingos (i.e. to Israel and UAE). Thus, Turkey, due to its geographic position, appears to be a crossroad between the western and eastern Mediterranean Region and southwest Asia.

Keywords: Conservation; Greater Flamingo; ringing; resighting; Turkey; dispersal; metapopulation

Introduction

The Greater Flamingo *Phoenicopterus roseus* is a partially migratory, dispersing and at times nomadic species, found widely distributed in the shallow brackish or saline lagoons of the Mediterranean Basin, West, East and South Africa, and South and Southwest Asia. The world population is estimated to range from 545,000 to 682,000 individ-

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uals and the Mediterranean population is estimated between 100,000 and 165,000 individuals (Childress, 2005).

The population trend of flamingos in the Mediterranean Region appears to be increasing (BirdLife International, 2004). Yet, breeding may not occur every year due to human disturbances and natural fluctuations of water levels (Béchet et al., 2012), which characterize saline lakes of tropical and sub-tropical regions, as well as many parts of the Mediterranean Region (Nager, Johnson, Boy, Rendon-Martos, Calderon, & Cézilly, 1996).

Recent reports suggest that Turkey could host one of the largest flamingo populations in the Mediterranean Region, with up to 15,000-16,000 breeding pairs, and from 20,000 to 50,000 wintering individuals (Eken, Bozdoğan, İsfendiyaroğlu, Kılıç, & Lise, 2006; Kılıç & Eken, 2004; Kirwan et al., 2008). Despite these high numbers, flamingos remain classified as “Endangered” in the Turkish national red list (IUCN criteria A3c: reduction in population size of $\geq 80\%$ suspected to occur within the next 10 years, based on a decline in distribution range, extent of occurrence and/or quality of habitat; Eken et al., 2006; IUCN, 2001; Kılıç & Eken, 2004). This criterion was retained mainly because the majority of sites used by flamingos in Turkey face serious threats ranging from water regime changes to pollution. Since 1999, all colonies in Central Anatolia – except Tuz Lake – were abandoned due to mismanagement of water resources at the basin scale (i.e. intensified agricultural production with high water demand causing drastic decreases in surface and underground water levels at a large scale (Demircan, 2003; Eken & Magnin, 1999; Eken et al., 2006; Kılıç & Eken, 2004).

To gain a better understanding of the species, flamingos have been ringed with PVC rings since 1977 in France, 1986 in Spain, 1994 in Italy, 1997 in Sardinia, 1999 in Iran (only once), 2005 in United Arab Emirates (UAE) and 2006 in Algeria (www.flamingoatlas.org). About 10% of the chicks have been ringed with a metal and a plastic ring bearing a unique alphanumeric code readable from up to 300 metres (Johnson & Cézilly, 2007), thus enabling assessing individual breeding status. Long-term resighting studies have proved that birds ringed in France, Spain, Italy and Algeria breed at different colonies along the western and eastern Mediterranean, including Turkey (in Gediz Delta; Balkız et al., 2007; Balkız et al., 2010; Bouchecker et al., 2011). Recent phylogenetic studies comparing the mitochondrial DNAs and microsatellite markers among 8 different Mediterranean colonies (in France, Spain, Italy, Algeria and Turkey) also supported the presence of significant exchanges among colonies (Geraci et al., 2012). Yet, analyses of flamingo ring resightings from southwest Asia (Iran and Kazakhstan) suggested the presence of a different flyway in southwest Asia, with movements reaching Turkey (Balkız et al., 2007) and weak connections to the western Mediterranean (Behrouzi-Rad, 1992). Turkey, located at the intersection of these two semi-isolated flyways (Balkız et al., 2007), can constitute an important crossroad for flamingos. Therefore it is of importance to gain a better understanding of the population status and the movements of flamingos to and from Turkish colonies.

In this paper we aimed to (i) present a complete synthesis of the distribution and status of wintering and breeding populations of flamingos in Turkey, (ii) map the dispersal of flamingos born in Turkey, and (iii) update our knowledge on the role of Turkey in the population dynamics of the species in the Mediterranean Region.

Material and Methods

Wintering Population (1999-2014). We surveyed wintering flamingo populations in Turkey during the month of January from 2003 until 2005 at 10 to 15 different sites along the Aegean and Mediterranean coasts. Each site was surveyed with the collaboration of birdwatchers and local conservation authorities. We compiled the figures from grey literature, the World Birds Database

of Turkey (www.kusbank.org), publications on the wintering population of flamingos in Turkey and used the Turkish Midwinter Waterfowl Counts database to assess the wintering population size of flamingos in Turkey for years outside our field survey period (from 1999 to 2003, and 2005 onwards; references listed in Akarsu & Balkız, 2010; Erciyas Yavuz & Kartal, 2011; Erciyas Yavuz & Isfendiyaroğlu, 2013; Erciyas Yavuz & Boyla, 2013; International Waterbird Census, unpublished data, 2014). Since the coverage of surveyed areas in the framework of Midwinter Waterfowl Counts was very limited prior to 1999, we did not take into account the outcomes of these counts.

Breeding Population (1969-2014). We carried out breeding censuses between 2003 and 2014 by regularly visiting the two known colony sites, namely Tuz Lake and the Gediz Delta (from April to July in Tuz Lake and from May to August in the Gediz Delta). As the breeding colony of Tuz Lake is located in a remote area difficult to access (>17 km away from the lake shore), we could not approach the colony by land, and therefore could not make any ring resightings. However, we conducted aerial censuses: twice in 2003, three times in 2004 and 2005, then once a year between 2006 and 2014. Incubating birds and chicks (in the crèche) on digitalized photographs were counted manually or using the Flamingo Software (Descamps, Béchet, Descombes, Arnaud, & Zerubia, 2011).

Aerial flights could not be carried out in Gediz Delta – except in 2010 and 2011 – because of lengthy legal permit acquisition process, given the proximity of the colony to a military zone. Therefore breeding population size was estimated mainly by ground counts. Intensive field surveys were carried out from 2003 to 2005; three ground surveys in 2003 and 2004, each lasting at least 3 days, and 6 field surveys in 2005, each lasting for at least one day (a total of 33 days and 163 hours of observation). Regular, yet less intensive censuses were carried out to estimate breeding population size from 2006 to 2014. In these censuses, the number of breeding flamingo pairs (i.e. the number of actively used nests) was determined by visiting the breeding colony site after all the chicks left the colony. Other potential breeding locations in the Gediz Delta were also controlled during this time period. In 2012 an S-shaped artificial breeding island (6,400 m²) was built on the existing colony ground to cope with the erosion of breeding islands (approx. 700m²/year) and to enhance the breeding success of flamingos at the site. Existing old nests were preserved while building the island as a measure to attract the flamingo colony. Since 2012, more intensive field efforts were dedicated to control the use of this new breeding island by flamingos.

We have also evaluated the data available in the literature (since 1968). In the literature, breeding population records were generally produced through punctual individual or institutional surveys, where time-series were often discontinued and the kind of data reported was diverse, e.g.: (i) number of breeding pairs in the colony from the beginning of reproduction to mid-season, (ii) number of nests, from mid-season to the end of the breeding season, (iii) number of chicks at the time of crèche formation. For the sake of homogenizing this information, we estimated the breeding population size as the number of breeding pairs, and if not given, as the number of nests or of chicks. Finally, in some years the only information that was available was that breeding had occurred without any estimates.

Ringing and resighting. A total of 1,180 young flamingos born at the Gediz Delta colony were ringed between 2002 and 2009 (200 on 17.viii.2003, 247 on 1.viii.2004, 270 on 31.vii.2005, 216 on 29.vii.2007 and 247 on 16.viii.2009). All young were ringed with both a metal and a plastic ring with unique alphanumeric codes. From 2003 to 2005, one to three weeks after each ringing session, we counted the number of ringed young flamingos on a sample of chicks controlled in the crèche. Then using an improved Lincoln Peterson method (Bailey, 1951), we estimated the total number of chicks born in the area. On these surveys we made several counts to account for the number of chicks, and among the estimates obtained by the Lincoln Peterson method, we selected the one within the limits of our ground survey estimates. In the following years, ground survey outcomes were employed as the sole estimate of the chicks born in the Gediz Delta.

To assess the presence and breeding status of individuals ringed in Turkey and elsewhere, we carried out resightings at the breeding colony of the Gediz Delta between March and August (from 2003 to 2014). A bird was considered breeding when it was observed incubating an egg, attending a young, or when it was observed on the same nest for more than 24 hours (Johnson & Cézily, 2007). Because Tuz Lake could not be accessed from land, flamingo ring resighting efforts were restricted to the Gediz Delta in Turkey.

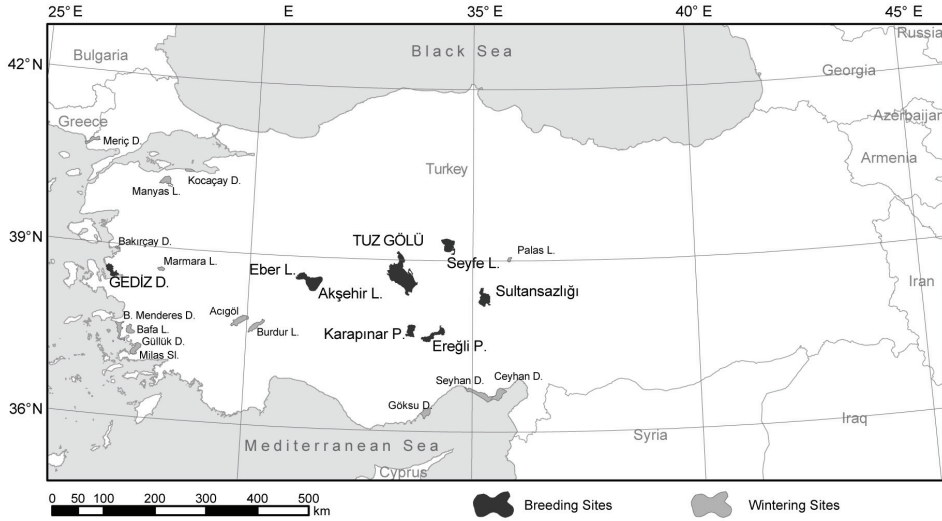


Figure 1. The wintering and breeding sites of flamingos in Turkey. Black-coloured sites are current and former breeding grounds and the grey-coloured sites correspond to regular wintering grounds.

Results

Wintering Population

Flamingos are widespread throughout Turkey, ranging from the Aegean, Mediterranean, Central and Eastern Anatolian wetlands to the Thrace Region (Figure 1). Wintering occurs mainly along the Aegean and Mediterranean coasts. Central and Eastern Anatolia region are generally abandoned during this period due to the harsh weather conditions (Kirwan et al., 2008). We have observed that the wintering population of flamingos in Turkey shows an increasing trend, with numbers ranging from 36,459 to 98,687 individuals in up to 56 different sites between 1999 and 2014 (average $54,947 \pm 20,794$ individuals; Figure 2). In our field surveys, flamingos concentrated mainly on three wetland systems during winter: the Gediz, Büyük Menderes and Çukurova deltas (composed of Akyatan Lake, Ağyatan Lake, Yumurtalık Lagoon and Tuzla Çukurova) in the order of importance. This same pattern was also reported for the Midwinter Waterfowl Counts (Figure 3).

Breeding Population

From 1969 to 1998, flamingos have bred in up to 7 sites in Turkey, namely Tuz Lake, Seyfe Lake, Ereğli Marshes, Sultan Marshes, Karapınar Plain, Gediz Delta and Acıgöl (Sıkı, 1985; Kılıç, 1988; Magnin & Yarar, 1994; Figures 1 & 4, Appendix 1). Five of these sites are located in the Central Anatolian Region (Tuz Lake, Seyfe Lake, Ereğli Marshes, Sultan Marshes and Karapınar Plain). In sites other than Tuz Lake, breeding (including unconfirmed attempts) took place sporadically. After 1999, most of these colonies were abandoned due to intensive water management practices at the water catchment scale. In 2009, a colony with 163 nests was found in the Akyatan Lagoons located along the Mediterranean coast (S. Ekşioğlu; Nature Research Society, pers. comm.). However the past and present use of this colony site was never ascertained. Nowadays, the only regular breeding sites are in Tuz Lake and the Gediz Delta. Two other sites are still used sporadically, namely Acıgöl (Johnson & Bennets, 2000; Sıkı,

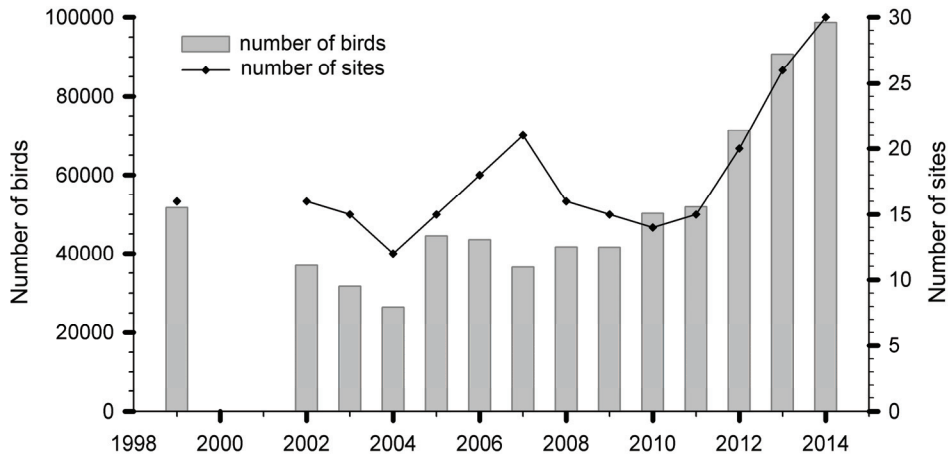


Figure 2. Wintering population size estimates of flamingos in Turkey. The years without any data on the figure represent the years without Midwinter Waterfowl counts, except years 2003, 2004 and 2005, where our field survey results were used to infer the size of the wintering flamingo population.

2002) and Akşehir Lake (a newly discovered colony). It is unknown if earlier breeding attempts were made in these sites without being noticed or if previous breeding was not possible due to adverse ecological conditions.

Tuz Lake. Since the discovery of a colony in an archipelago of 13 islands in 1969 (38°34'N 33°29'E; Lehmann, 1974; Warncke, 1971), irregular observations were carried out in Tuz Lake. With the exception of 2008 and 2014, Tuz Lake has hosted the largest flamingo colony in Turkey ($\geq 50\%$ of the flamingo breeding population). The onset of egg-laying is suspected to occur between the end of March and early April (Warncke, 1971). From 2003 to 2014 a minimum of 1,610 chicks (in 2008) and a maximum of 20,292 chicks (in 2013) fledged in Tuz Lake (Figure 5; Appendix 1). The number of young chicks in Tuz Lake in 2011, 2012 and 2013 accounted for the highest number of fledglings in the Mediterranean Region and West Africa (18,418 chicks in 2011 corresponding to 27%, 20,274 in 2012 corresponding to 67%, 20,292 in 2013 corresponding to 29% of Mediterranean chicks: Greater Flamingo Network, *unpublished data*). However the number of fledglings in Tuz Lake dropped sharply to 2,893 in 2014.

Gediz Delta. The breeding colony of flamingos in the Gediz Delta is located in the middle of the saltpans of Çamaltı Salina, where active salt production takes place (38°32'N, 26°52'E; Magnin & Yazar, 1997; Onmuş et. al., 2009). Until the end of 1990s, Gediz Delta was an irregular breeding site holding only a few hundred breeding pairs of flamingos (Sıkı, 1985), with successful breeding occurring on average every other year ($N=8$ over date range; $< 50\%$). However, after 2000, the site has become a regular and important breeding ground for flamingos in Turkey.

In the Gediz Delta, the onset of egg-laying generally occurs later than that at Tuz Lake (between mid-April and early May). In 2003, between 2,500 and 3,000 young were counted from the ground and 2,542 nests on the island (the low number of nests might be due to flooding of the nests at the border of the breeding island). After a ringing operation, four ring resighting sessions were made using the Lincoln-Peterson method; we estimated the crèche size as $3,100 \pm 625$ chicks. In 2004, ca 3,250 chicks were counted from the ground, and a total of 3,619 nests were counted on the breeding

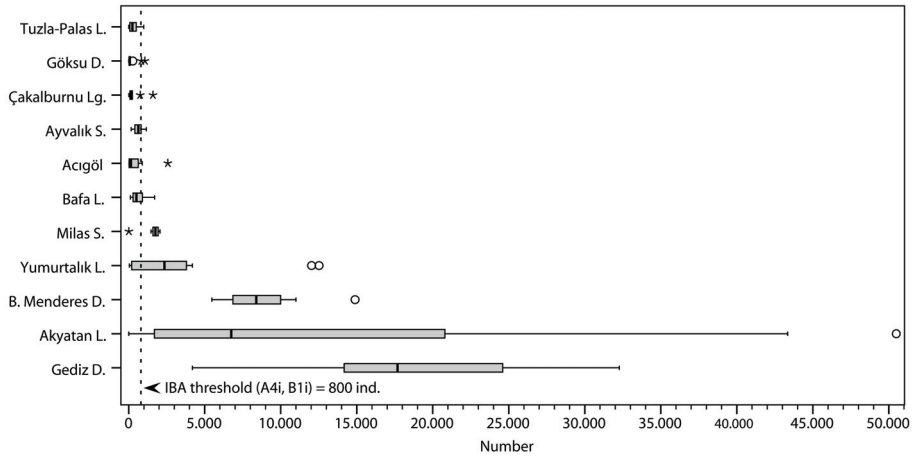


Figure 3. The number of wintering flamingos in sites with internationally significant numbers (exceeding IBA threshold) observed (D: Delta, L: Lake, Lg: Lagoon and S: Salina). The centre lines represent the median, the boxes the lower 25% and upper 75% limits and error limits, point represent maximum values exceeding outliers and star represent extreme values.

islands. After the ringing operation, only one ring control was carried out, which gave an estimate outside the limits of our ground survey results (9,633 chicks). We thus decided to discard this estimate. In 2005, between 4,000 and 4,500 chicks were counted in the crèche and a total of 7,407 nests were counted on the breeding islands right after the island was evacuated. We made 7 ring controls corresponding to an estimate of $4,025 \pm 1,122$ chicks. As a result of the ground surveys in the colony between 2006 and 2008, we observed a maximum of 10,743 breeding pairs of flamingos and 7,143 chicks (Appendix 1). However, between 2009 and 2011, a negative trend prevailed mainly due to the erosion of the breeding islands and disturbance by stray dogs, with a complete breeding failure observed in 2011. The same year, flamingos bred successfully for the first time on islands of the nearby Homa Lagoon at the beginning in July (approximately 5 km from the traditional breeding site). This was much later than the regular breeding season, with the incubation period continuing through October and in December adults were observed still feeding the juveniles. This site was used successfully by flamingos between 2011 and 2013. In 2011, 1,100 breeding pairs and 1,000 chicks were counted from the ground and in 2012, 2,750 breeding pairs and 1,600 chicks were observed (Figure 6). In 2013, approximately 3,000 breeding pairs started to breed on the islands of the Homa Lagoon, but due to strong and unusual storms during incubation and chick raising, most of the nests were flooded and many chicks died. As a result only approximately 135 chicks survived. The new artificial island constructed in 2012 at the traditional breeding site at the Çamaltı Salina was used by flamingos for the first time in 2014, following unsuccessful attempts in 2012 and 2013. The 2014 breeding corresponds to the highest number of breeding pairs ever observed in the Gediz Delta, with 10,812 breeding pairs and approximately 7,000 chicks. Finally, despite the aerial surveys carried out in 2010 and 2011, the poor quality of the photographs prevented their use for breeding population estimates.

Acıgöl and Akşehir Lake. The sites of Acıgöl ($37^{\circ}49'N$ $29^{\circ}51'E$) and Akşehir Lake ($38^{\circ}30'N$ $31^{\circ}24'E$) have been periodically used for breeding flamingos in Turkey. Breeding at Acıgöl, located in the Mediterranean Region, was recorded for the first time

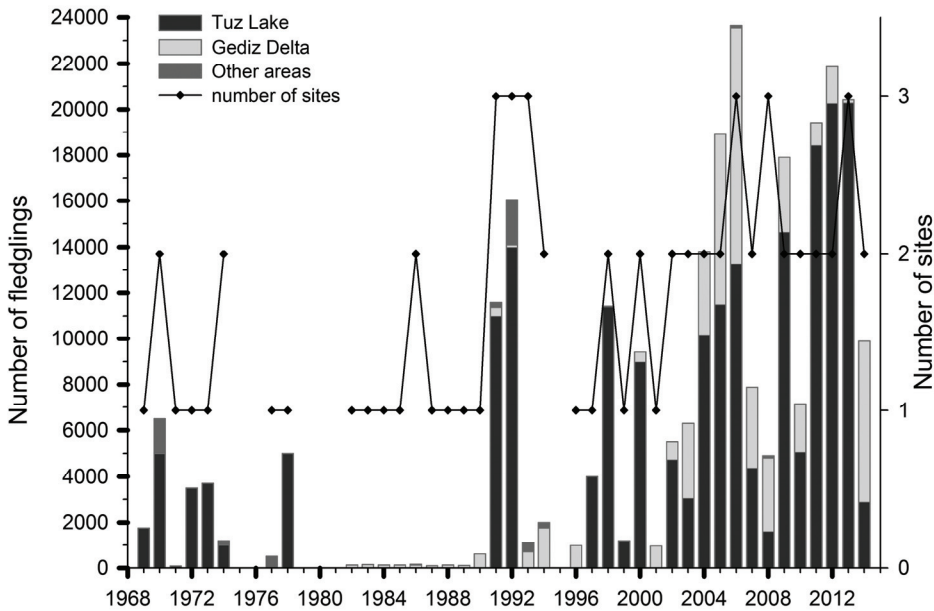


Figure 4. Breeding population size estimates of flamingos in Turkey, with number of sites where breeding occurred in the given year. Other areas in the figure correspond to breeding population size estimates summed up for Seyfe Lake, Ereğli Marshes, Sultan Marshes, Acıgöl, Akşehir Lake and Karapınar Marshes. Years without any information are years with no surveys. As in 2003 in the Gediz Delta the nest counts were not reliable, the estimate presented is the number of fledglings. The colony size information in the Gediz Delta is from Çamaltı Salina except between years 2011 and 2013 (from Homa Lagoon). When present, primarily data on the number of fledglings was given in the figure, and if absent, the number of breeding pairs and number of nests were employed.

in 1964 with approximately 50 young observed and 1968 with approximately 10 young (Dijksen & Kasperek, 1986; Warncke, 1971). In 1993, a colony of up to 100 breeding pairs was observed (Magnin & Yazar, 1997) and in 2006, 100 juveniles - not yet fledged - were observed in the area (O. Turan & R. Çetiner, pers. comm.; www.kusbank.org). However during regular observations of local birdwatchers and our surveys to the area, the nesting ground of flamingos could not be located.

Breeding at Akşehir Lake in Central Anatolia was recorded for the first time in 2008, when approximately 100 chicks were found dead on the completely dried lake (R. Gül, pers. comm.). Nesting grounds in the lake could not be found, but as the dead chicks had not yet fledged, it was evident that flamingo breeding did take place there. In 2013, during our field surveys to the site, a nesting ground of between 2,950 and 3,200 nests with a large number of eggs and a few dead chicks were located in the lake, but the colony was estimated to be abandoned app. 2-3 weeks prior to our visit (start of June) and no chicks were observed.

Other breeding locations. Seyfe Lake (39°11'N 34°25'E), a shallow and brackish lake located in Central Anatolia, used to be one of the former breeding grounds of flamingos in Turkey. Breeding was suspected as early as 1970 when nests were observed on two small islands (Husband & Kasperek, 1984; Turan, 1970). In 1992, a total of 1,947 nests were counted at the lake (Magnin & Yazar, 1994) and several hundreds of nests were observed in 1993 (Kirwan et al., 2008). The last recorded breeding attempt was in 1994 when 240 chicks were counted in the lake (Johnson, 1995).

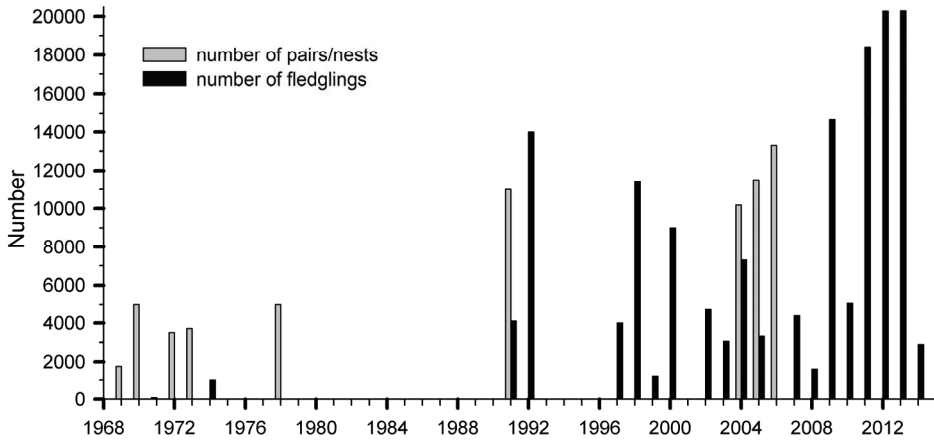


Figure 5. Breeding population size estimates of Tuz Lake. Years without any information in the figure refer to the absence of surveys.

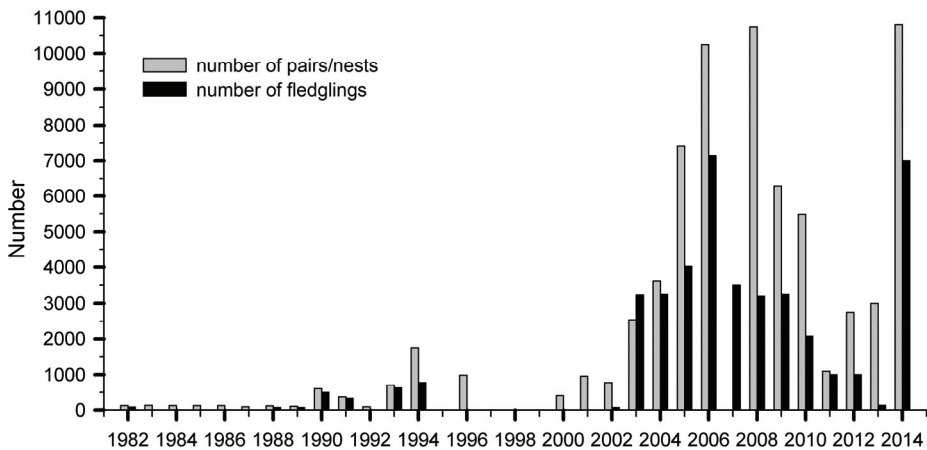


Figure 6. Breeding population estimates of the Gediz Delta. Years without any information in the figure correspond to years without any breeding attempt. The colony size information in the Gediz Delta is from Çamaltı Salina except between years 2011 and 2013 (from Homa Lagoon).

Ereğli Marshes ($37^{\circ}31'N$ $33^{\circ}47'E$), which used to be a large wetland ecosystem in Central Anatolia, has dried up drastically in the second half of 1990s (Eken et al., 2006). For the first time in 1986, approximately 35 flamingo nests were observed in the site and in 1991, 217 nests were counted on three islands located on the lake (68 of which contained eggs) (Kılıç, 1988; Kasparek, 1992; Kirwan, 1992). The observations of 300 pairs in 1993 and 20 pairs in 1998 were the last official records of breeding encountered in the site (Eken & Magnin, 1999; Magnin & Yarar, 1994).

The Sultan Marshes ($38^{\circ}19'N$ $35^{\circ}17'E$) were one of the most important wetland ecosystems in Turkey holding both freshwater and saline lakes. Similar to other lakes in Central Anatolia, big dam projects and the use of underground water for irrigation in agriculture, caused the Sultan Marshes to almost completely dry out. Recent projects and management efforts are currently being put in practice for the restoration of the

ecosystem (Eken et al., 2006). The site hosted breeding flamingos in 1970, when 1,500-2,000 pairs were observed breeding in the saline lake Yay Gölü (Warncke, 1971; Kasparek, 1985).

The Karapınar Plain (37°47'N 33°38'E) located in Central Anatolia is made up of a freshwater lake and the mudflats surrounding the lake. The plain has completely dried due to basin scale hydraulic projects (Eken et al., 2006). Observations suggested the presence of a flamingo colony in 1976 or 1977. Up to 1,000 individuals were observed, but the breeding was never confirmed (Kılıç, 1988; Kasparek, 1992).

Dispersal of Flamingos Born in Turkey

Between 2003 and 2014, a total of 2,125 resightings were made from 525 flamingos ringed in Turkey as chicks (45% of the 1,180 birds ringed in Turkey). These birds were observed in 16 countries along the western and eastern Mediterranean Basin and West Africa (namely Italy, Turkey, France, Greece, Algeria, Tunisia, Spain, Portugal, Israel, UAE, Libya, Cyprus, Montenegro, Mauritania, Slovenia and Saudi Arabia, in the order of importance; Figure 7, Appendix 2). These constitute proof to dispersal movements of flamingos from Turkey, including post-fledging and natal dispersal. The observations were collected throughout the year, without any major differences among seasons.

The first time a ringed Turkish flamingo was observed breeding in a colony was in 2007 in the Gediz Delta. A bird born and ringed in 2003 was observed breeding at the same colony site (Appendix 3). The first natal dispersal movements were recorded in 2009 in two colonies; four birds born and ringed in 2004 in the Gediz Delta were observed breeding in the Garaet Ezzemoul colony in Algeria and one bird born and ringed in 2005 was observed breeding in the Saline di Comacchio in Italy (Appendix 3). Observations on natal dispersal of Turkish flamingos continued in the following years and birds have been observed breeding successfully in two colonies in Italy, one colony in Algeria and one in France. In total, 24 flamingos born and ringed in the Gediz Delta colony were observed 25 times as breeders in colonies in Turkey and elsewhere (Appendix 3). Prior to 2014, we did not observe any breeding dispersal movements (i.e. birds changing breeding locations from one year to the other).

Discussions and Conclusions

Conservation of flamingos in Turkey - Gediz Delta

Until the end of 1990s, Gediz Delta only hosted a few hundred flamingos during the breeding season, with a low breeding success. This was partially due to (i) insufficient and/or fluctuating water levels during salt production activities, allowing predation by foxes and disturbance by stray dogs, (ii) regular maintenance work to repair the borders of the salt pans causing disturbance to the colony, (iii) high water levels causing nests to flood (M. Siki, unpubl.). Towards these threats, effective conservation measures were set up with the collaboration of academicians, local and national conservation authorities, salt production company (formerly state-owned and now privatized), NGOs and birdwatchers. Some of the actions included establishing a wire door to prevent the entrance of stray dogs, stopping salt production maintenance work at the onset of colony formation, regulating water levels according to the needs of flamingos and the restoration of the flamingo breeding island. Today the site has become a regular and successful breeding ground. Yet the flamingo colony is still under severe threat due to urbanization, pollution and disturbance from stray dogs present in the Delta (Eken et al., 2006; Magnin & Yarar, 1997; Onmuş & Siki, 2011, 2013). Conservation efforts in the Gediz Delta should be oriented to reduce these threats in order to ensure successful breeding in the future.

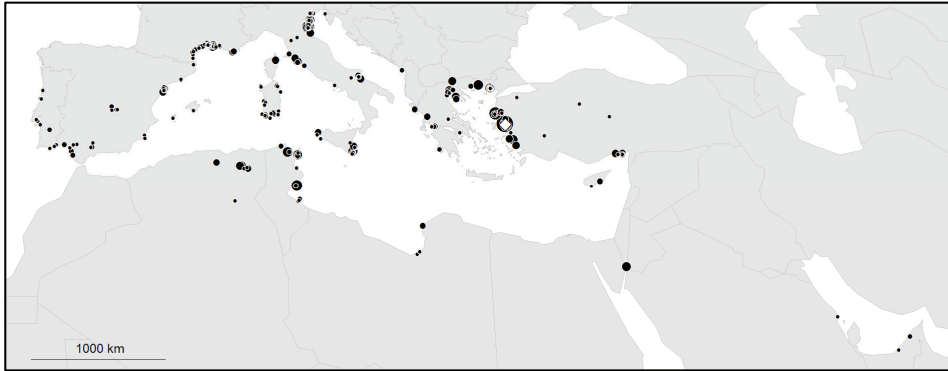


Figure 7. Resighting range of flamingos born and ringed in the Gediz Delta (diamond) between August 18, 2003 and June 10, 2014. The sizes of the circles are proportional to the number of resighting records. One resighting record from Mauritania is not presented on the map.

Conservation of flamingos in Turkey – Tuz Lake

Large-scale water management projects implemented in the Central Anatolian Basin to irrigate vast areas of agricultural lands, along with possible results of decreased rainfall due to climate change, caused a sharp decrease of water levels in many wetlands including Tuz Lake and other former breeding flamingo colony sites (Demircan, 2003; Eken & Magnin, 1999; Eken et al., 2006; Kılıç & Eken, 2004). Considering that successful breeding depends on sufficiently high water levels at both the colony site and the surrounding feeding grounds (Cézilly et al., 1995; Johnson, 1997), Tuz Lake has become the only feasible breeding grounds in Central Anatolia since 1999. However, sharp and ongoing decreases in surface and underground water levels in the past 40 years are threatening the colony site drastically (Demircan, 2003; Eken & Magnin, 1999; Eken et al., 2006; Kılıç & Eken, 2004; Magnin & Yarar, 1997; Onmuş et al., 2011). Due to continued reduction of water levels, the breeding success of flamingos and survival of flamingo chicks in Tuz Lake is now primarily dependant on rainfall. The droughts in 2007 and 2014 (State Meteorology Service numbers) are prime examples to the deterioration of the breeding colony at the Tuz Lake in the absence of rainfall. In 2007, hundreds of flamingo chicks were found dead before fledging due to the almost complete drying out of the lake. In 2014, the flamingo colony showed a drastic decrease in size as compared with 2011, 2012 and 2013 when Tuz Lake held the largest colony in the Mediterranean and West African basins. Therefore it is of critical importance to restore the surface and underground water levels of the lake for the survival of the Tuz Lake colony in the long term. The quantity of water is not only important, but the quality of water is also degraded as the lake is fed by the drainage channels of Konya, collecting untreated drainage waters from farmlands and domestic waste waters of Konya city. On the other hand, conservation actions focused only at the Tuz Lake scale would not suffice for the conservation of the flamingo population; past surveys indicated strong interactions between Tuz Lake and the small satellite lakes around it (Bijlsma & Roder, 1986; Husband & Kasparek, 1984; Johnson, 1992, 1995; Kasparek, 1987; Lensink, 1987). These satellite lakes serve as feeding grounds for flamingos breeding at the Tuz Lake colony. Aerial surveys also suggested that the lake was used very rarely or not at all by foraging flamingos (Johnson, 1997). As a result, conservation planning should not only focus on Tuz Lake, but should also ensure the sustainability of the network of satellite lakes present within the basin.

Given the inaccessibility of the colony site from land, we were not able to make any ring resightings to infer the use and thus importance of Tuz Lake for flamingos born elsewhere. However in 1992, near a former breeding site, namely Seyfe Lake, two flamingos ringed in France and one flamingo ringed in Spain were observed (Johnson, 1992). These records are of importance as they are the only flamingo resightings carried out in the Central Anatolian lakes. Resightings around the satellite lakes around Tuz Lake are also important to provide information about birds possibly breeding at the Tuz Lake colony.

Gediz Delta – Tuz Lake Link

The annual fluctuations in the breeding population size of Tuz Lake and Gediz Delta colonies indicate an interaction between these two colonies. After 2008, the Gediz Delta colony size decreased sharply while Tuz Lake colony showed an unprecedented increase. In this period, the number of chicks in Tuz Lake corresponded to the highest number of flamingo chicks fledged in Turkey and in the Mediterranean and West African basins (namely in 2011, 2012 and 2013). It can be hypothesized that following an unsuccessful breeding season in the Gediz Delta, flamingos disperse to Tuz Lake for the following breeding season. It can also be argued that this sharp increase in the number of breeders in Tuz Lake originates from colonies elsewhere (e.g. Lake Uromiyeh in Iran). On the other hand, despite the successful breeding in 2013, the severe drought around Tuz Lake in 2014 caused a drastic decline in reproduction. That same year, the record numbers of breeding pairs of flamingos were observed in the Gediz Delta. Given the time lapse between the onsets of breeding at these two sites, movements in the same breeding season can also be suspected. To conclude, in order to better understand inter-colonial dynamics of flamingos in Turkey, in the eastern Mediterranean Basin and in southwest Asia, it is crucial to have simultaneous field survey efforts in each of the locations. This is especially important for the flamingo population in Iran, where monitoring data is very limited, if not absent.

Acıgöl and Akşehir Lake

There is very little information available on these two wetlands used sporadically by flamingos. Previous efforts have failed to locate the breeding colony ground in Acıgöl. It is therefore a priority to carry out detailed surveys in the area in order to confirm the location of the colony. As for Akşehir Lake, the reason why the colony was abandoned by flamingos in 2013 cannot be ascertained. No signs of predation and/or direct persecution were observed during field surveys. Decreases in water levels (about 30-40 cm in May as reported by a local farmer) and frequent microlight flights (Gökhavacılık, 2013) – if carried out in low altitudes – could be the causes for the colony to abandon the site. Therefore it is important to put in place a flamingo monitoring scheme in both lakes to observe how regularly these sites are being used, the breeding success at the lakes and threats acting on the flamingo colonies. Finally, given that flamingos are dispersive, special efforts should also be dedicated to survey previous flamingo breeding grounds in Turkey and to observe their use during each breeding season. If resources are available, it could be highly valuable to have conservation actions not only at Tuz Lake and in the Gediz Delta colonies, but also secure other alternative breeding grounds in order to conserve the species at the national and regional scale.

Dispersal from Turkey

Turkey, due to its geographic position, acts as a crossroad between the Mediterranean Region and southwest Asia. The ring resighting studies carried out in the last decade demonstrated that (i) throughout the year, Turkey hosts flamingos from the western

Mediterranean Basin and southwest Asia, more specifically birds born and ringed in France, Spain, Italy, Algeria and Iran were observed in Turkey, (ii) breeding dispersal from western Mediterranean colonies to Turkey successfully take place, and (iii) the Gediz Delta can serve as a site for the recruitment of flamingos born in the western Mediterranean Basin (Balkız et al., 2007; Bouchecker et al., 2011). These studies have indicated that the western Mediterranean metapopulation extends as far as Turkey. However, information on breeding movements of Turkish birds to western Mediterranean countries and West Africa are lacking. This limits our understanding on the extent of the metapopulation and Turkey's role in supporting it. In this study, we were able to confirm that flamingos ringed as chicks in Turkey do breed in colonies in the western Mediterranean Region. While the genetic comparisons of Mediterranean flamingos made by Geraci et al. (2012) points at a metapopulation covering Turkey, the current data on post-fledging and natal dispersal limits the conclusions that can be made about the use of the Mediterranean colonies by Turkish flamingos. Longer term resighting data is a prerequisite to better assess this relationship.

Among the post-fledging and natal dispersal of flamingos born in Turkey between 2003 and 2014, the highest number of observations were carried out in Italy, Turkey, France, Greece, Algeria, Tunisia and Spain. This can be due to multiple factors including the proximity of these countries and the high intensity of resighting efforts rather than a geographic structure in dispersal. On the other hand, observations of Turkish flamingos in Israel and UAE are also important. At the time of writing this article, with the exception of one Spanish individual, none of the flamingos ringed in the western Mediterranean colonies were observed in these countries. Yet, 3 birds ringed in Iran were recovered in Israel (Behrouzi-Rad, 1992) and 17 flamingos ringed in Turkey were resighted and/or recovered in Israel since 2004. Furthermore 3 birds from Turkey have been observed regularly in UAE since 2007. Building upon the findings of Balkız et al. (2007), recent resightings also confirm that flamingos from Turkey disperse to a region outside the known flyways of the western Mediterranean and West African flamingos.

Future ringing and resighting studies in Turkey and especially in southwest Asia can deepen our knowledge about the population dynamics of flamingos and can permit us to develop sound conservation measures for the species. Therefore it is essential to increase the intensity of resighting efforts in Turkey and to share ring readings with the Mediterranean Flamingo Network.

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Disclosure Statement

No potential conflict of interest was reported by the authors.

Supplementary Material

The Supplementary Annexes are available via the “Supplementary” tab on the articles online page (<http://dx.doi.org/10.1080/09397140.2015.1058452>).

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