

REVIEW



Current status of the Dalmatian pelican and the great white pelican populations of the Black Sea/Mediterranean flyway

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ABSTRACT: The Dalmatian pelican (DP) *Pelecanus crispus* and the great white pelican (GWP) *Pelecanus onocrotalus* are listed as 'Vulnerable' and 'Least Concern', respectively, in the IUCN Red List. We present an updated estimation of the Black Sea/Mediterranean flyway population status of both species, based on data provided by experts working in all 7 countries of the region where pelicans breed and/or overwinter, who came together at the 1st Workshop on Pelican Research and Conservation in Prespa, Greece. The DP breeding population in the Black Sea and Mediterranean countries increased from 1730–2105 pairs in the years 2000–2010 to 2154–2437 pairs in 2011–2012. Approximately 40% of the Palaearctic breeding population of GWP occurred in Southeast Europe and Turkey. In 2011–2012 the GWP population in this region was estimated to be 4702–5175 pairs, and has remained more or less stable during the last decade. Although all the breeding sites for both species are in protected areas, disturbance at nesting places was considered to be the main threat. Direct persecution and electric power lines still cause occasional problems. In deltaic lagoons, erosion and inundation of nesting sites cause breeding failures in DPs, while in inland wetlands large water level fluctuations are a widespread problem. Decrease of fish stocks is a threat, especially in coastal areas. Many stop-over wetlands along GWP migration routes between Southeast Europe and Africa have been seriously degraded or have disappeared, resulting in serious implications for their populations. Conservation needs are listed, but further research is recommended for both species.

KEY WORDS: Black Sea/Mediterranean flyway · Conservation status · Dalmatian pelican · Great white pelican · *Pelecanus crispus* · *Pelecanus onocrotalus* · Pelicans

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INTRODUCTION

In the last century both the Dalmatian pelican *Pelecanus crispus* Bruch, 1832 (DP) and great white pelican *Pelecanus onocrotalus* L., 1758 (GWP) were relatively widespread breeding species in many wetlands in the western Palaearctic. During the 1960s and 1970s many colonies of both species vanished, mainly due to drainage of wetlands, disturbance, persecution, overexploitation of fish stocks, pesticides and electric power lines (Crivelli & Vizi 1981, Crivelli & Schreiber 1984, Crivelli et al. 1991a, 2000, Crivelli 1996, Handrinos & Akriotis 1997, Onmuş et al. 2011).

The DP is currently a species of global conservation concern, listed as 'Vulnerable' (VU) in the IUCN Red List of threatened Species (IUCN 2014). Its geographic distribution is limited to the Palaearctic Region, from Europe to Mongolia. It occurs in 3 relatively distinct flyways: (1) Black Sea/Mediterranean, (2) Southwest Asia and South Asia, and (3) East Asia. The Black Sea/Mediterranean flyway (BirdLife International fact sheet available at www.birdlife.org/datazone/userfiles/file/sowb/flyways/5_Mediterranean_Black_Sea_Factsheet.pdf, Boere & Stroud 2006) consists of breeding colonies in Albania, Bulgaria, Greece, Montenegro, Romania, Turkey and the Ukraine. All these birds winter close to their breeding colonies in the eastern Mediterranean (Onmuş et al. 2011), while breeding birds in Russia and Southwest and South Asia winter in Iran, Iraq and on the Indian subcontinent (Crivelli 1994). In 2004 the world population of DP was estimated to be between 10 400 and 13 850 individuals, with 4350–4800 individuals in the Black Sea/Mediterranean flyway, 6000–9000 individuals in Southwest and South Asia and 50 individuals in East Asia (Delany & Scott 2006). These numbers have been used in subsequent efforts to estimate the global population (BirdLife International 2012a). As they come from compilations of data from various sources and for different time periods, they should be considered rough approximations, especially as information about the Southwest Asian populations is scant. However, almost half of the estimated pairs of DP, numbering between 1700 and 2100 individuals, breed in Southeast Europe (Barov & Derhé 2011). Recently, the DP breeding population has increased in Southeast Europe, particularly at Lake Mikri Prespa in Greece and in the surrounding countries, following the implementation of conservation measures (Barov & Derhé 2011, Onmuş et al. 2011, BirdLife International 2012a).

The GWP is listed in the IUCN Red List as 'Least Concern' (LC) (IUCN 2014) and has a very large dis-

tribution extending from Southeast Europe through Asia and Africa. In the Palaearctic, GWPs are long-distance migrants from Southeast Europe to East Africa (Crivelli et al. 1991a,b). In the Black Sea/Mediterranean region the most important breeding countries for this species were: Romania, with an estimated 3000–3500 breeding pairs; Turkey, with 250–400 pairs; and Greece, with 50–100 pairs (Crivelli et al. 2000). However, there is much uncertainty regarding the size of the global GWP population (BirdLife International 2012b).

The small population sizes and existing threats render both species vulnerable in many parts of the world; therefore, formal protected status is a necessary prerequisite for their conservation. As a result, they are protected under a plethora of international agreements, conventions and other supra-national legislation. Nevertheless, law enforcement is poor in most countries in their range, and the species still face a range of anthropogenic threats, possibly exacerbated by global climate change (Barov & Derhé 2011).

The latest published information about the population and conservation status of both species in the Palaearctic is already outdated (Crivelli et al. 2000) or uses a mixture of old and more recent data (Barov & Derhé 2011). The aim of the present paper is to provide up-to-date information about the current population sizes and the conservation status of the 2 pelican species occurring in the Black Sea/Mediterranean flyway.

MATERIALS AND METHODS

The 1st International Workshop on Pelican Research and Conservation in Southeast Europe was held on 1–2 May 2012, in Prespa, Greece. The workshop goals were to assess the population status and trends of the 2 pelican species in the region, identify the threats and suggest appropriate conservation measures that would effectively address the key threats to these birds. Data on breeding, wintering and migration numbers (in 2011 and 2012) of DP and GWP were compiled from the presentations at the workshop by national experts from Albania, Bulgaria, Greece, Israel, Montenegro, Romania, Turkey, and the Ukraine—all countries in the Black Sea/Mediterranean flyway—as well as from workshop discussions and fora. Census methods to estimate nesting population sizes varied between countries and local ecological conditions, but were all focussed on direct counts of 'apparently occupied nests' for

colonial waterbirds and seabirds (Bibby et al. 1992). These are defined as nests where the birds are apparently incubating or brooding, well-built nests that contain eggs or young, and empty nests that were apparently used that breeding season. Censuses were generally carried out during visits to the nesting sites, through surveys from aircraft or from vantage points with the aid of telescopes, or combinations of these methods. Surveys from aircraft (Romania) were carried out once during the breeding period. Visits to nesting islands were carried out at least twice in most cases to cover asynchronous nesting (Crivelli et al. 1998). At Lake Mikri Prespa (Greece), in order to avoid researcher disturbance in a very large and dense colony, censuses of DPs were carried out through a combination of counts from a vantage point at a distance from the colony and an on-site visit after the fledging of all young to cover non-visible sites. At the same site, GWP nests were estimated indirectly from a combination of counts from vantage points, an on-site visit after fledging of young and, mainly, from direct counts of juveniles ca. 2 wk before fledging. From this latter number a back-calculation was made assuming a breeding success of 0.65 fledged young per pair, a value close to the average observed for the species from detailed studies during the period 1983–1996 (Hatzilacou 1992, Crivelli et al. 1997). In the case of Mikri Prespa, this was shown to be the most effective and least invasive way of monitoring a breeding colony of GWP.

Threats to species were classified using the IUCN/Conservation Measures Partnership (CMP) threats classification scheme (Salafsky et al. 2008), and threat scores were calculated according to how many discrete colonies were reported to be threatened by a particular issue. The effectiveness of conservation measures addressing the key threats observed in the Black Sea/Mediterranean flyway was also discussed at the workshop, and a summary of the main recommendations for conservation, research and monitoring agreed upon by the participants appears in the 'Discussion'. Data were presented in terms of political boundaries (i.e. per country), mainly to facilitate comparison with previously published information which was also presented in this way. The direction of current population trends was coded as: increasing, stable, fluctuating, decreasing and unknown (Croxall et al. 2012). The trend for each species was estimated by country, comparing the available values for the range of population sizes during the years 2011 and 2012 with those from the most recent period with available data. Trend evaluation is a tricky

endeavour; however, because not all the available data are of the same accuracy, there are differences in methods and terminology and gaps in time-series, meaning that it is not possible to apply very robust methods.

RESULTS

The most recent information about the nesting population sizes of both DP and GWP is summarised in Tables 1 & 2. The population development of pelican populations is presented below, successively for each country for which information was available.

Dalmatian pelican breeding data

In Albania, since at least 1906 (Lodge 1908), DPs have bred at the Karavasta (Fig. 1) coastal lagoon (Peja et al. 1996). They also bred at Malik and Terbuf Lakes, from at least the 1930s, but disappeared after drainage in the late 1950s. The maximum known number of breeding pairs at Karavasta was 225 in 1962; since then they have steadily declined. Between 2006 and 2011 colony size varied between 27 and 30 pairs. Breeding success in 2009 was 0.45 fledglings per pair (Kallfa & Bino 2010).

Drainage, alteration of the water regime, pollution and disturbance have caused the disappearance of DPs from at least 3 nesting sites in Bulgaria. Today, they breed only at Lake Srebarna (Fig. 1) within the Srebarna Biosphere Reserve, averaging 80–150 pairs over the last 5 yr. Large variations in nesting numbers are related to unusual fluctuations in water level, disturbance by wild animals and/or direct persecution (shooting).

In Greece, until the first half of the 20th century DPs nested at over 10 wetlands throughout the mainland (Handrinos & Akriotis 1997). They currently breed at Lake Kerkini (7–120 pairs between 2007 and 2012; T. Naziridis & A. J. Crivelli pers. comm.), at the lagoons of Amvrakikos (140–145 pairs in the years 2007–2012; D. Hatzilacou & A. J. Crivelli pers. comm., G. Catsadorakis pers. comm.), at Lake Mikri Prespa (1150–1530 pairs in 2008–2012; G. Catsadorakis pers. comm.), and recently they started nesting at the Mesolonghi Lagoons (6–8 pairs in 2011 and 11–13 in 2012; G. Roussopoulos pers. comm.; Fig. 1). In 2012, 1 pair successfully raised 2 young at the Karla Reservoir (Fig. 1).

In Montenegro, DPs breed only at Lake Skadar (Fig. 1), where 29 and 20 breeding pairs were first

Table 1. Breeding populations of the Dalmatian pelican *Pelecanus crispus* in the Black Sea/Mediterranean flyway in 2011–2012. Population trends are derived by evaluating all available published data on each country's breeding population size for the period 1990–2010. Data for 1990–2000 appear in Crivelli et al. (2000) and data for 2000–2010 are a combination of input from Barov & Derhé (2011) and unpublished data presented by the authors of the present study at the Prespa workshop (see 'Materials and methods'). Population trends—increasing: clear positive difference between range of population values between the 2 periods; stable: no clear difference; unknown: not enough data to assess trend. No. of pairs refers to dates in 'Year' column

Country	Year	No. of colonies	No. of pairs	Population trend	Previous period estimation (for no. of pairs) ^h	Census method used
Albania ^a	2011	1	27	Stable	2005–2007: 27	Nest counts via on-site visits
Bulgaria ^b	2011/2012	1	102/106	Stable	1990–2009: 14–150	Nest counts from hide and on-site visit
Greece ^c	2011/2012	4/5	1315/1476	Increasing	2004–2010: 1165–1710	Counts from vantage point and double-check and count nests on-site after fledging
Montenegro ^d	2011/2012	1	16/22	Stable	2000–2010: 5–14	Counts from vantage point and double-check via on-site visits
Romania ^e	2011	5	300–350	Stable	2009: 312–330	Counts from aircraft
Turkey ^f	2011/2012	6	390/440	Increasing	2000–2010: 220–270	Nest counts via on-site visits
Ukraine ^g	2010–2012	1	4–16	Unknown	1994–2009: 0–14	Nest counts via on-site visits
Total SE Europe and Turkey		19–20	2154–2437	Increasing	1730–2105	

^aS. Shumka (pers. comm.); ^bT. Michev (pers. comm.); ^cH. Nikolaou, A. J. Crivelli, T. Naziridis, D. Hatzilacou, G. Roussopoulos (unpubl.); ^dD. Saveljic (pers. comm.); ^eS. Bugariu (pers. comm.); ^fO. Onmuş, M. Sıkı, O. Gül (unpubl.); ^gA. Rudenko, G. Molodan (pers. comm.); ^hBarov & Derhé (2011)

Table 2. Breeding populations of the great white pelican *Pelecanus onocrotalus* in the Black Sea/Mediterranean flyway in 2011–2012. Population trends—stable: no clear difference; decreasing: clear negative difference; fluctuating: very large inter-annual fluctuations make trend assessment impossible; unknown: not enough data to assess trend; BS: breeding success. No. of pairs refers to dates in 'Year' column

Country	Year	No. of colonies	No. of pairs	Population trend	Previous period estimation (for no. of pairs)	Census method used
Greece ^a	2011/2012	1	532/464	Stable	2000–2010: 258–806	Count of fledged young and back-calculation of nests using average BS of last years
Romania ^b	2009	1	4100–4480	Unknown	2001–2002: 3590–4160 1999–2001: 460–1700 ^f	Nest counts from aircraft
Turkey ^c	2011/2012	2	110/140	Decreasing	1990–2000: 180–420 ^e	Nest counts via on-site visits on colonies
Ukraine ^d	2011/2012	1	190/210	Fluctuating	1990–2000: 3–343 ^f 2008–2010: 348–550	Nest counts via on-site visits
Total		5	4702–5175	Stable		

^aH. Nikolaou (pers. comm.); ^bS. Bugariu (pers. comm.); ^cO. Onmuş, M. Sıkı, O. Gül (unpubl.); ^dA. Rudenko, Z. Petrovych (pers. comm.); ^eKılıç & Eken (2004); ^fSchogolev et al. (2005)

reported in 1894 and 1896, respectively (Führer 1894, Reiser & Führer 1896). There is a lack of information about breeding between 1896 and 1965. From 1965 to 1992 the number of breeding pairs varied from 0 to 52, peaking in 1977 (Saveljic et al. 2004). At this site, DPs nest on islands of peat, rhizomes and dead vegetation and, since 2012, also on artificial platforms.

Breeding success varied from 0 to 1.4 fledglings per nest, and due to human disturbance there was no breeding between 1993 and 2001 (Saveljic et al. 2004). At least 16 pairs were recorded in both 2011 and 2012, but all failed to fledge young, mainly due to flooding caused by a sudden rise in water level following heavy rainfall.

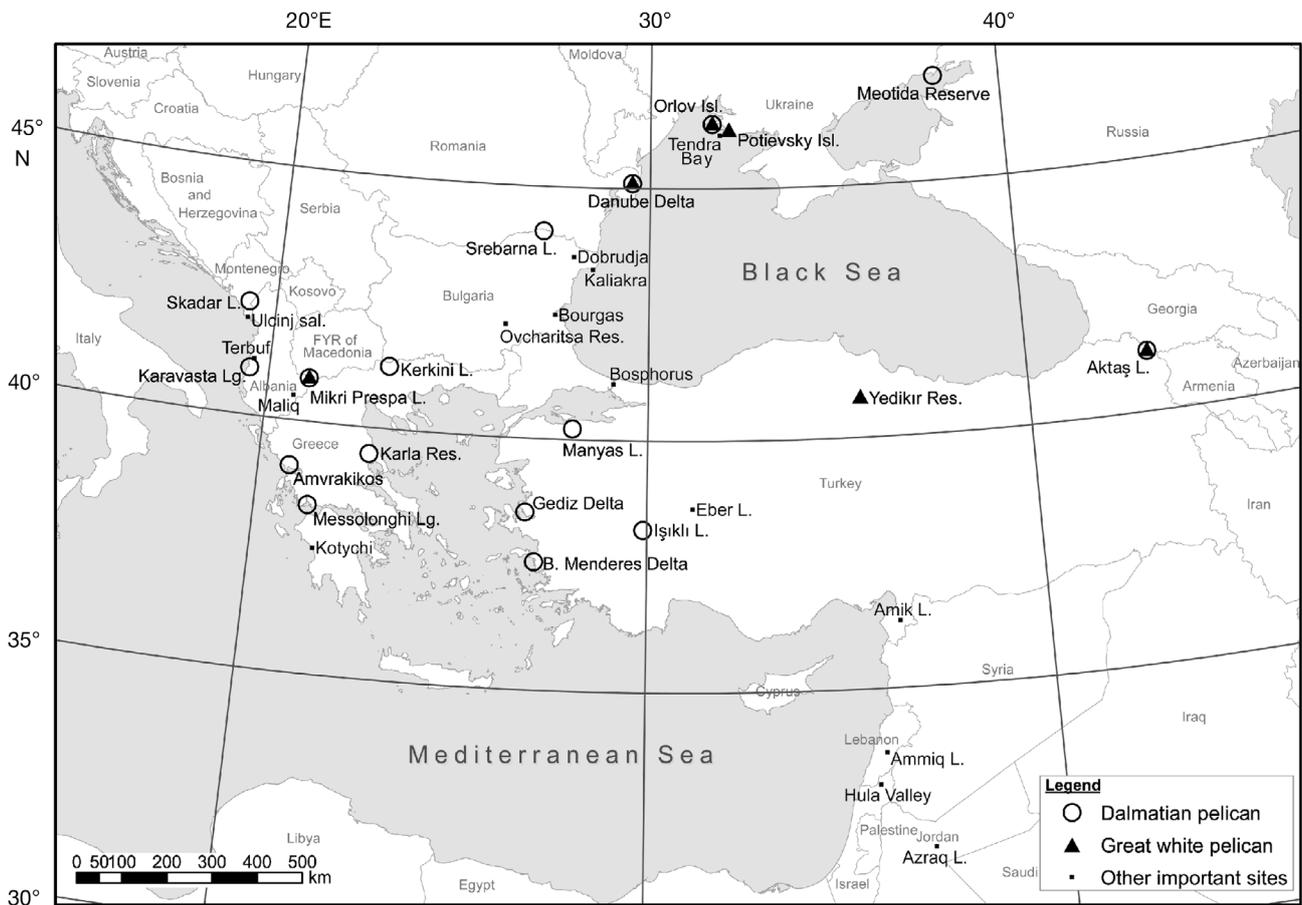


Fig. 1. Breeding distribution of the Dalmatian pelican *Pelecanus crispus* and the great white pelican *Pelecanus onocrotalus*, within the Black Sea/Mediterranean flyway in 2011

In Romania, Hodek (1882) reported 'a minimum of 2500 breeding pairs' of DPs at the end of the 19th century. In the past, most colonies were located on the lower Danube River and in the Danube Delta. The severe decline of the species in the first half of the 20th century was mainly due to the loss of nesting areas and to persecution. Currently, DPs nest only in the Danube Delta and the adjacent lagoons to the south. In the last decades of the 20th century estimates of breeding pairs did not exceed 200 (Weber et al. 1994), although in 2001–2003 Platteeuw et al. (2004, 2006) reported 450 pairs. Recent estimates (2006–2011) are around 300–350 pairs in 4–5 colonies (Bugariu & Fântân 2008).

In Turkey the DP also used to be a widespread breeder. Until the 1990s, 473–763 pairs were breeding at 20–25 sites. Many of these sites have been lost to drainage and direct persecution or both, as well as to water level increase (Onmuş et al. 2011). Since 2000, the breeding numbers have increased moder-

ately from 220–250 to 277–341 pairs (Onmuş et al. 2011). DPs currently breed at Lakes Manyas, Aktaş and Işıklı and the Gediz and Büyük Menderes Deltas. The Işıklı colony was discovered in 2010 and comprises only 6 pairs. A few DP pairs (1–5) might have bred in Lake Eber in 2011.

A small number of DPs occasionally attempt to breed on the north coast of the Black Sea (Ardamatskaya & Rudenko 1996), and a few have nested sporadically in the Ukrainian part of the Danube Delta (Zhud 2009). Since 2009, 4–15 pairs have nested every year in the National Natural Park 'Meotida' (G. Molodan pers. comm.).

Great white pelican breeding data

In Greece, GWPBs breed only at Lake Mikri Prespa, with estimated numbers of breeding pairs ranging between 258 and 806 in 2000–2010 (A. J. Crivelli

unpubl. data, Society for the Protection of Prespa unpubl. data; Table 2). These numbers are only the best approximations produced by a combination of 3 complementary methods (see 'Materials and methods').

In Romania, the largest numbers of colonies were seen at the beginning of the 20th century. Since then, however, they have declined dramatically, mainly due to the loss of breeding areas and to persecution (Linția 1955, Cătuneanu 1958, Cătuneanu et al. 1978, Munteanu 2008). At present GWPs breed only on 2 lakes in the Danube Delta, in 1 mixed colony with DPs. In 2001–2002 the breeding population was estimated to be 3590–4160 pairs (Platteeuw et al. 2004). The most recent complete aerial survey of the breeding colony in 2009 resulted in an estimate of 4100–4480 pairs (S. Bugariu pers. comm.). The real trend is unknown, but the population is considered to be stable, with a potential slight increase (since the 1990s). Since 2009, due to the difficulty in accessing colonies, censuses in the vast Danube Delta have been carried out by aerial survey. However, in aerial surveys it is not always possible to distinguish between resting and nesting birds, so the results are only the best approximations available (Schogolev et al. 2005).

The GWP used to be a widespread breeding species with 8–13 colonies in different wetlands in the central and eastern parts of Turkey (Kumerloev 1963, 1964, Ertan et al. 1989, Yarar & Magnin 1997). In the 1960s, some colonies disappeared, mainly due to drainage for agricultural purposes (Kumerloev 1964), and the decline continued in the 1970s and 1980s (Crivelli et al. 1991b). During these 2 decades the population was estimated at 300–420 pairs (Ertan et al. 1989, Yarar & Magnin 1997). Up until a few years ago, Lake Aktaş was the only known remaining breeding site for GWPs, although a new breeding site has since been discovered in Yedikır Dam (Nature Research Society 2011, S. Toker unpubl. photo at www.panoramio.com/photo/30386269). The species may have also bred at Lake Eber in 2011 (0–30 pairs).

In the Ukraine, GWPs were considered rare visitors in spring and summer from the 1950s to the early 1980s in the south of the country. At the end of the 1980s and in the early 1990s, numbers on the northern coast of the Black Sea increased to 500–600 individuals. Between 1995 and 1998, 3–41 pairs of GWPs nested unsuccessfully on the islands of Tendra Bay, located within the Black Sea Biosphere Reserve. The pelicans bred on the 28 ha continental Orlov Island and the 4 ha alluvial Potievsky and New Islands, with 1999 being the first year in which breeding was suc-

cessful. In 2000 there were 343 pairs, declining to 50–150 between 2001 and 2006, with no breeding in 2007; there were 348–550 nests between 2008 and 2010, which declined to 190 nests in 2011 and 210 in 2012. Breeding success was 0.03–0.2 young per pair in the 1990s, rising to 0.7–0.9 in the 2000s.

Dalmatian pelican movements, migration and wintering

In Albania, wintering DP numbers in recent years have comprised around 150 individuals (range: 100–200). In Montenegro they overwinter only at the Ulcinj Salines (Saveljic & Rubinic 2005), where numbers have increased recently to almost 100 individuals (range: 0–96). Colour-ring re-sightings have shown that outside the breeding season DPs breeding in Amvrakikos and Messolonghi seem to move on a north–south axis along the coastal wetlands, from the southerly Kotychi Lagoon in Greece up to the Karavasta Lagoon in Albania and Lake Skadar and Ulcinj Lagoon in Montenegro in the north (Saveljic & Rubinic 2005).

In Bulgaria, the total number of wintering DPs fluctuated strongly in the period 1977–2010, reaching a maximum of 1140 individuals in 2009. The main wintering sites for DPs are the Bourgas Wetlands, the Ovcharitsa Reservoir and the Danube Delta (Romania). Each year an average of ca. 200 DPs migrate over the Bourgas wetlands heading south (Michev et al. 2011), while individuals marked in Srebarna in Bulgaria have been observed in the Danube Delta (Romania) colonies, Kerkini and Porto Lago (Greece), and the Gediz Delta (Turkey). Birds from Greece and Romania have also been observed in Srebarna.

In Romania, non-breeders use sites along the lower Danube, both during and outside the breeding season, but they are difficult to census. The main wintering sites are also along the lower Danube.

In Greece, during the last decade (2003–2012) numbers of wintering DPs have varied between 1500 and 2000, in contrast with an average of 421 birds in 1982–1992 (Hellenic Ornithological Society unpubl. data). The main wintering sites for the birds of Prespa and Kerkini Lakes are the wetlands of north and northeast Greece and western Turkey. Similar to Greece, wintering DPs in Turkey increased from 352 in 2000 to 2344 within 10 yr (Onmuş et al. 2011). Large parts of the wintering population in western Anatolia are comprised of birds from Greece, Bulgaria and Romania (Crivelli et al. 1991a).

Great white pelican movements, migration and wintering

On average, fewer than 20 GWPs overwinter in Greece. In Bulgaria the GWP is a passage migrant. According to Michev et al. (2011), the Bourgas wetlands are a key stop-over site during post-breeding dispersal and during spring and autumn migrations along the western Black Sea coast. Unexpectedly, 61 705 migrating GWPs were counted in the autumn of 2011 by the International Soaring Bird Counts scheme at Bourgas Bay, while for the period 1978–2003 the average number had been 20 946 birds with a maximum of 37 703 in 1996. GWPs migrating through Turkey converge and pass through Israel in large numbers. The autumn migration of GWPs has been monitored there since 1966. Between 1999 and 2010 the average annual number of pelicans passing through the Hula Valley in Israel was $39\,395 \pm 8201$ (Nature & Parks Authority unpubl. data). In the 1980s the majority of migrants were recorded in October and November, but, during recent years, they have been passing through mainly in September and October. It takes about 70 d on average for all GWPs to pass through Israel.

Threats

The frequencies of the main threats to pelican populations as identified by the workshop participants are shown in Fig. 2. Direct anthropogenic threats in

the form of disturbance (by fishermen, poachers, tourists and photographers) and persecution are more frequent than all others, followed by alterations in the hydrological regime, especially those resulting in abrupt and major changes in water levels. These occur mostly in natural or artificial wetlands used partly or solely as reservoirs. In contrast, nesting islands in coastal wetlands suffer from erosion and degradation mainly associated with natural sediment regime alterations, soiling of the islands by the birds, eradication of vegetation for nest building and the effects of extreme weather, such as storms, possibly aggravated by climate change. Mortality due to collisions with power lines is a serious problem in only 2 wetlands. Reedbed fires are often set for management reasons, but they frequently get out of control and can destroy pelican islands, rendering them unsuitable for nesting or causing abandonment.

The occasional disturbance and predation by golden jackals *Canis aureus* and wild boar *Sus scrofa* observed at the Lake Srebarna colony in Bulgaria, as well as cases of predation by other land predators when pelican islands become accessible by land, are probably linked to drought events and should not be considered permanent threats. Wind parks along pelican migration and regional movement routes are considered a potential threat for both species. So far, there is no evidence of worryingly consistent mortality incidents or other effects, but only a few monitoring schemes cover this issue. The recent deployment of many wind parks in the Dobrudja and Kaliakra areas between the Danube Delta and the Bourgas

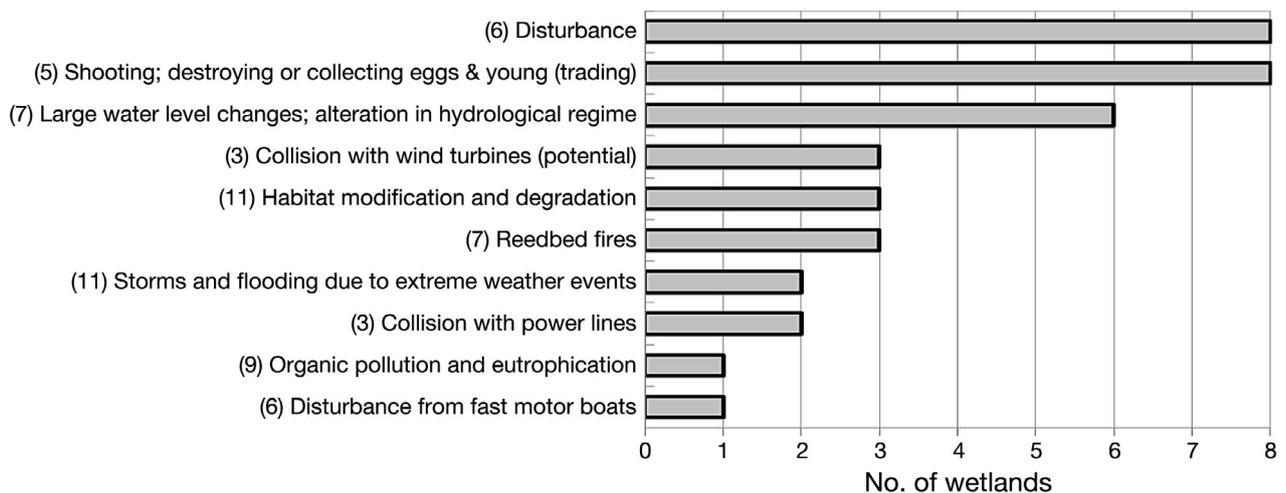


Fig. 2. Frequency (number of wetlands where each threat occurs) of main threats to breeding and non-breeding pelican populations summed for all the countries of the Black Sea/Mediterranean flyway examined. Numbers in parentheses preceding threat description correspond to the code for groups of threats according to Salafsky et al. (2008) — 3: energy production and mining; 5: biological resource use; 6: human intrusions and disturbance; 7: natural system modifications; 9: pollution; 11: climate change and severe weather

wetlands (Fig. 2) may pose a threat to both pelican species on migration. In Turkey, Lake Manyas, the most important site for wintering DPs and the most important stop-over site for migrating GWPs, is surrounded by wind farms and high-voltage power lines which threaten all soaring birds.

An important issue which is not considered in Fig. 2 but which was emphasised by the participants for at least 7 colonies (Skadar, Karavasta, Messolonghi, Meotida, Büyük Menderes, Aktas and Işıklı) was the potentially negative effect of the very small size of the colonies; this, however, should not be considered a threat in itself but an inherent property of the sub-populations. Thus, the small size of these populations amplifies the effects of existing threats.

In Albania, disturbance and the destruction of eggs and nests are regular occurrences, despite the fact that Karavasta was designated a Ramsar Site in 1994 and the DP was listed in 2007 as a critically endangered (CR) species in the National Red List.

DISCUSSION

Distribution and populations

In the late 1990s the world population of the DP was estimated to be 4031–5196 breeding pairs, with more than half of this number in Kazakhstan and 20% in Southeast Europe and the Black Sea/Turkey (Crivelli et al. 2000). The estimate of the breeding population of DPs in the latter region has risen by ca. 20%, increasing from 1730–2105 pairs in the years 2000–2010 (Barov & Derhé 2011) to 2154–2437 pairs in 2011–2012. Unfortunately, the current world population of the DP cannot be estimated because the most recent data for Azerbaijan, Russia, Iran, Turkmenistan and Uzbekistan are those provided by Crivelli et al. (2000), and there is only incidental information on some colonies in Kazakhstan (Morimoto et al. 2005, Schielzeth et al. 2008). Thus, for all these countries the most recent available information pertains to the 1980s–1990s (Krivenko et al. 1994).

All the evidence clearly implies that the 4 breeding DP colonies situated in the coastal wetlands along the Adriatic and Ionian coasts (Skadar, Karavasta, Amvrakikos, Messolonghi) form a meta-population which is demographically separated from the eastern meta-population which consists of the other colonies in Greece, Bulgaria, Romania and Turkey (A. J. Crivelli pers. comm.). The 2 meta-populations are geographically separated by the Pindus mountain range, similar to the case of American white pelicans *Pele-*

canus erythrorhynchos, which are separated into 2 meta-populations by the North American Continental Divide (Anderson & King 2005). The 2 meta-populations (Adriatic-Ionian and Eastern) should be treated as 2 separate large-scale management units. The former suffers from higher anthropogenic pressures, with the first 2 colonies dwindling for decades to around 20 pairs and Amvrakikos forming a 'source' colony. The eastern meta-population is larger and more secure.

The Palaearctic breeding population of GWPs was estimated in the late 1990s to be 6703–10964 pairs, with ca. 40% (3303–4014) in Southeast Europe and Turkey (Crivelli et al. 2000). In 2011–2012 (but in 2009 for Romania), the latter population was estimated at 4702–5175 pairs. For the last 5 yr reliable, consistent monitoring has been carried out only in Greece, Turkey and the Ukraine, but not in Romania where the majority of GWPs in Southeast Europe occur, due to logistical difficulties with censuses. Despite the lack of quality data and local inter-annual fluctuations, overall numbers of GWPs in the above countries seem to have been stable over the last decade. The very high numbers of birds migrating through the Bourgas area imply that birds on migration from breeding colonies further north and/or east of the Ukraine also follow the west coast of the Black Sea. Knowledge of their migration routes is still rudimentary. As for the DP, recent data on the numbers and distribution of GWPs in Russia and the countries of Southwest and West Asia are lacking. The data of Crivelli (1994), which pertain to the 1980s and 1990s and are the only values available, are now outdated.

Conservation

Although both species are protected and all the breeding sites of both species are in protected areas, law enforcement is poor across almost their entire range. National Species Action Plans exist only for the DP and only in Bulgaria, Montenegro and Romania, but even in these countries the implementation of the plans leaves much to be desired.

Besides the recently observed and potential future impacts of climate change on pelicans (Doxa et al. 2010, 2012a,b), the list of threats to these 2 species has remained almost unaltered for the last 30–40 yr (see Crivelli et al. 1991c, Barov & Derhé 2011), and only their relative importance has changed: disturbance at nesting colonies, direct and indirect persecution, mortality from collisions with structures, wetland and habitat degradation and shrinkage. Two

recurrent issues underlie pelican conservation in all places where pelicans occur: the fisheries–pelican conflict, which has not been permanently resolved in most cases (del Hoyo et al. 1992, King 2005) and the increasing difficulty most pelican species have in finding undisturbed sites for nesting (Anderson et al. 1976, Bunnell et al. 1981, del Hoyo et al. 1992, Barter et al. 2008). The 2 pelican species in the Black Sea/Mediterranean region are strictly management dependent, and as soon as wardening or other management measures are curtailed for any reason, populations will most likely suffer. The official state conservation institutions, services and schemes in the countries of the region are not, as a rule, able to provide consistent monitoring and conservation management on a long-term basis; thus, to secure pelican conservation it will not only be essential to ensure law enforcement, but also to maintain it long term. It is clear that when financial and human resources are available, a combination of wardening and local awareness campaigning can prove very successful. The increasing trend for DP numbers in Greece is attributed to conservation efforts (Kirby et al. 2004, Barov & Derhé 2011, BirdLife International 2012a). At Lake Mikri Prespa and the Amvrakikos Wetlands, local public awareness efforts were used in combination with wardening to stop disturbance. An effect of the increase of the size of these 2 colonies was the establishment of 3 new DP colonies in Greece (Kerkini, Messolonghi and Karla), as well as an overall increase in breeding pairs — and colonies — in Turkey. At Lake Kerkini, pelicans were successfully encouraged to breed when platforms were erected to avoid the flooding of their nests, an effort which was combined with wardening to prevent disturbance. However, conservation measures are not ensured anywhere in Greece. As soon as wardening is curtailed the ensuing disturbance immediately poses serious problems to pelican populations, as has been the case at Amvrakikos since 2010. Similarly, nesting numbers in Srebarna seem to have benefited from direct protection and management measures, such as the hydrological connection to the Danube River, the cessation of fishing and reed cutting, the building of a protective fence around the colony and the erection of artificial wooden nest platforms (Michev & Kambourova 2012). In Albania, there is currently a project to establish a scheme for the conservation and sustainable use of the expanded Divjake-Karavasta National Park (5000–22 000 ha) based on a management plan and the active participation of local governments and stakeholders. In Montenegro, all the conservation measures which have been taken to elimi-

nate disturbance over the last 20 yr have proved ineffective, while the flooding of colonies due to sudden rises in water level has still not been countered. In Romania, the practical protection of breeding colonies is insufficient. Successful conservation measures were recently taken at various sites under a LIFE-Nature project; these included as underwater wooden fences around breeding islands to prevent erosion, the erection of fixed nesting platforms, the wardening of nesting colonies, reed bed management, the construction of solid fences to prevent access by land predators (wild boar, as well as domestic animals) and the marking of problematic sections of electric power lines. In Turkey, full monitoring of all breeding and wintering DPs and the implementation of conservation measures, particularly against disturbance and persecution, are currently being pursued by a project which will run until the end of 2015.

The hydrological regime of lakes and reservoirs in the region has been altered by humans, and large fluctuations in water levels negatively affect the breeding performance of pelicans or even prevent them from nesting. Primarily as a response to this threat, 4 DP colonies in the region already depend on artificial nesting platforms (Srebarna, Skadar, Kerkini and Manyas). Though there is an increasing interest in building artificial platforms in new areas, either to attract or to support pelicans already nesting, the erection of platforms is only occasionally really necessary and should be decided upon only after very careful planning. In general, the conservation of pelicans should be carried out within the framework of integrated ecosystem approaches, as far as possible, and preferably with as little human intervention as possible.

The dramatic loss of wetlands in areas where the GWP used to stop over during migration (such as Lake Amik and other central Anatolian lakes in Turkey, Lake Ammiq in Lebanon, Lake Hula in Israel and the Azraq Wetlands in Jordan [Fig. 1]; Kumerloev 1963, 1964, Ashkenazi 2004, Onmuş et al. 2011) has had a variety of negative effects. Almost a quarter of the migrating GWPs arrive in Israel in poor physical condition; thus, they exert a high level of pressure on the extensive fish farms in the area. This has triggered problems between pelicans and the financially important aquaculture industry. In search of food the birds move by day and night from one water body to another. These movements also pose a high risk to flight safety, and, in addition, ca. 50 pelicans collide with power lines annually. As a management measure to address these problems the Nature and Parks Authority began in 1989 to provide non-com-

mercial fish (mainly Zill's tilapia *Tilapia zillii*) to GWPs. The goal was to enable them to feed up as quickly as possible, and thus to become physically able to complete the rest of the migration journey and so shorten the stop-over period in Israel and reduce pressure on the aquaculture sites. In 2012 a total of 270 tons of fish were supplied to ca. 40 000 GWPs at 3 feeding sites (O. Hatzofe pers. comm.). The measure proved successful and has also gradually reduced the number of wintering GWPs to an average of 250 individuals for the period 2000–2013 compared to an average of 1200 in 1980–1999, with a peak of 3500 in 1981 (Nature and Parks Authority unpubl. data), and in great contrast to 57 individuals in 1966.

Recommendations

Although the DP is a short-distance migrant, the 2 DP meta-populations in Southeast Europe and Turkey, require well-coordinated trans-boundary cooperation to achieve conservation results, because populations of the species use several wetlands in different countries to fulfil their needs throughout the annual cycle.

Similarly, the conservation of the GWP—a long-distance migrant—is critically dependent upon the conditions encountered along migration routes and in wintering areas. It is well known that a large proportion of the GWP populations nesting in the western Palearctic, and certainly in Romania and the Ukraine, migrate along the west coast of the Black Sea through the Bosphorus and Turkey to Syria and Israel and thence to Africa. Well-coordinated, trans-boundary conservation efforts should clearly focus on maintaining the good conservation status of a chain of stop-over, 'stepping-stone' wetlands along the way, from the northern parts of the flyway down to Africa. The rehabilitation and restoration of drained and/or degraded wetlands should be given priority, especially in Turkey.

There are evident difficulties and restrictions in working with these threatened colonial species without putting them at risk, and this is reflected in the low number of scientific publications on these 2 species. In spite of the fact that in Southeast Europe more effort has been invested in studying and monitoring pelicans—particularly DPs—than elsewhere in the world, even in this region more research is urgently needed, especially that which is conservation oriented.

The workshop participants recognised the need for further research and monitoring work on pelicans in the region, in order to: (1) improve understanding of

the ecology, dispersal and distribution patterns of DP non-breeders across the Black Sea/Mediterranean flyway, with an emphasis on Greece, Turkey and the lower Danube, where the highest concentrations of these birds occur; (2) assess, through intensive monitoring, the potential impacts of wind farms on pelican movements and migration ecology, especially mortality and route deviations; (3) determine the genetic characteristics and degree of genetic separation of the various geographic divisions of the DP, ultimately to better define 'evolutionarily significant units' for conservation; (4) study the movements and genetic exchange between various colonies; (5) study the phylogenetic relationships between GWP populations in Europe, Asia and Africa; (6) shed more light on the movement patterns and migration ecology of GWPs between Southeast Europe, Turkey and Israel, particularly in respect to wetland loss, degradation and change; (6) acquire basic information about DP populations in Russia and the countries of West and Southwest Asia; and, last but not least, (7) ensure that pelican populations are monitored consistently each year at all the major sites where they occur during breeding, migration and winter, following standardised census and monitoring methods.

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