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6. Post-Breeding Dispersion and Migratory Routes of Dalmatian Pelican (Pelecanus Crispus), Great Cormorant (Phalacrocorax Carbo) and Eurasian Spoonbill (Platalea Leucorodia) from the North of Sinoe Lagoon (Danube Delta)

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Abstract: In the period 2003-2006, a series of bird markings were performed in nesting colonies from the northern part of the Sinoie lagoon in the Danube Delta Biosphere Reserve. We marked with colour plastic and metal rings nestlings of breeding species as Dalmatian Pelican (*Pelecanus crispus* Bruch, 1832), Great Cormorant (*Phalacrocorax carbo* Linnaeus, 1758) and the Eurasian Spoonbill (*Platalea leucorodia* Linnaeus, 1758). We already published a series of preliminary results for Great Cormorant and the Eurasian Spoonbill (Kiss *et al.*, 2007; Sándor *et al.*, 2009), here we follow the publishing of recoveries received after 2009. This paper contains the results obtained after this date, integrating the information obtained from the other marked species, the Dalmatian Pelican, which was not previously discussed. At the same time, for a better interpretation of the results, a brief summary of the results from the previous phase is made.
Keywords: dispersal, colonial birds, migration, wintering, wetland, Danube Delta

INTRODUCTION

In the period 2003-2006, our team carried out a series of expedition in order to mark nestlings of colonial birds in the Danube Delta Biosphere Reserve, in the northern part of the Sinoie lagoon. Nestlings of several species were marked with plastic colour (PVC and Darvic) and metallic rings (alloy and aluminium) of Dalmatian Pelicans (*Pelecanus crispus*), Great Cormorants (*Phalacrocorax carbo*) and Eurasian Spoonbills (*Platalea leucorodia*). In that period, the numbers of these species within the reserve were estimated at 420-460 pairs of Dalmatian Pelicans, some 12,800-17,400 pairs of Great Cormorants and 160-220 pairs for Eurasian Spoonbill (Platteeuw *et al.*, 2004; 2006). These activities were not part of a project specifically designated for this purpose but were the collateral results of other studies, involving a significant part of the offspring of these species. Preliminary results were presented in several earlier publications for Great Cormorant and Eurasian Spoonbills (Kiss *et al.*, 2007; Sándor *et al.*, 2009, 2011), but without any interpretations in the case of pelicans. Hereby we present unpublished data for 29 sightings, 6 for Great Cormorants and 9 for Eurasian Spoonbills. At the same time, in order to better understand the phenomenon of seasonal movements in the case of the species discussed, the information obtained in the first phase was also re-evaluated.

MATERIALS AND METHODS

For all three target species have been used dedicated colour plastic rings produced within the international ringing programs. Most recoveries have been reported through official correspondence from specialist group responsible. Exceptions are the data for one Dalmatian Pelican (Figure1), and one Eurasian Spoonbill that have been collected from media sources (***** 2011, ***** 2011a)
All colour marking was performed in breeding colonies of three colonial birds in the southern part of the Danube Delta Biosphere Reserve (SE Romania). The topography of the Danube delta is mainly lowland terrain, with a mean height of 0.52 m asl, with 83.2% of the total area is permanently under

water. The climate is temperate continental with pontic influences. The January average temperature is -1 °C, with 22 ºC in June and an annual average of 11 ºC. The annual precipitation is 400-450 mm in the western regions and 300-350 mm in the shore and lagoon regions (south). The vegetation cover consists mainly of reed beds covering approximately 199,000 hectares, periodically forming floating islands (plaur). A total of 16% of the area is covered by woody vegetation; the predominant species being poplar and willow, with oak appearing on two large sand islands. (Gâştescu and Ştiucă, 2010; Hanganu *et al.*, 2002; Munteanu 2005). The flora and fauna are extremely varied, with birds alone encompassing 362 species. The breeding colonies where the birds were ringed are located in the lagoon system of the Razim – Sinoe lakes, located in the south of the delta, with a total area of ca. 863 km². All the visited breeding colonies lay on small islands inside Lake Sinoie (135 km² and a depth of no more than 1.6 meters). The three islets that shelter the colonies are made up of fixed sand sections, 0.7-2.6 km from the nearest shoreline. Together their reed cover has a size of approx. 130 x 70 m, with some open portions and sand deposits. These colonies were visited on several occasions and nestlings were individually ringed.

Here we analyse the recoveries from 133 Dalmatian Pelicans, 215 Great Cormorants and 219 European Spoonbills, a total of 567 birds individually marked with colour rings. Initial results of colour ring resightings of 26 Great Cormorants, and 24 Eurasian Spoonbills were published (Kiss *et al.,* 2007; Sándor *et. al.,* 2011), while here we present data regarding 29 Dalmatian Pelicans, 2 Great Cormorants and 9 Eurasian Spoonbill new recoveries, completing our previous survey and analysing the whole picture of geographical trends in migratory movements and wintering of these bird species. Only recoveries of positively identified birds are reported here, with sightings were the birds were not identified unambiguously were excluded. Also here we intend to correct a previous error published (Kiss *et al.,* 2007).

Here we list all known details for each individual resighting, with coordinates, dates, and distance covered by individual birds from the geographical location of initial ringing. Distances were calculated using great-circle (orthodromic) from ringing place and each following individual encounter.

RESULTS AND DISCUSSIONS

Dalmatian Pelican

All the phenologic observations of Dalmatian Pelicans justify the classification of this species into a short-distance migrant, dispersing over small to medium distances (Crivelli 1996). This species belongs to the western subpopulation, which follows the Pontic-Mediterranean migration route (Catsadorakis and Portolu, 2016) to the Eastern Mediterranean, wintering particularly in Turkey (Catsadorakis, 2002, 2016; Doxa *et al.*, 2012), specifically in the Menderes Delta and the Bafa Lake in western Anatolia (Crivelli *et al.*, 1991, Onmuș *et al*., 2011), some reaching Israel (Jiguet *et al.*, 2008) and the Nile Delta. In particular, the young birds are trying to overwinter in the Danube Delta, Lower Danube and Bulgaria (Catsadorakis *et al.*, 2015). In Romania, at the beginning of the last century, the species arrived to the breeding colonies in the first decade of March and generally left in the middle of November (Lintia, 1955), as later to find a gap with arrivals in the middle of March and some delays until October (Cătuneanu *et al.*, 1978). Shortening of the period spent in winter quarters was estimated to two weeks for two decades (Doxa *et al.*, 2012). Nowadays, Dalmatian Pelican is present in a small number in the studied area even during the winter period, and the reproduction can start in late winter (on 25th February 2000, full clutches found in the Sinoie North colony or small nestlings are to be found in mid-to-late March (Kiss, 2000; Kiss *et al.,* 2016). Some authors note that the Dalmatian Pelican is also an indicator species that adapted to recent changes in the climate and local food availability (Niculina *and* Smölcke, 2015). Data from old metal ring recoveries is scanty, limited to eight records. One marked in the north of the delta in 1927 was shot, in the same year, in Călăraşi. From a group of 93 birds marked with metal rings in 1958, a number of 7 individuals were recovered locally. Data is not relevant, retrieval occurred at max. 2 months after marking and at distances of less than 5 km to the place of the colony (Cătuneanu, 1999).

In the present material, we point out the recoveries of plastic coloured rings applied to nestlings in the period 2003-2005, with 133 fledglings being marked in the northern part of the Sinoie lagoon. Except for one shot in the cold season at a distance of approx. 60 km of the colony (Figure 1), and one juvenile at 6 km, a total of 15 subadults (51.72%) remained at least about another two months after

ringing in or near the colony (max. 5 km distance). The situation is similar to those of the seven young pelicans described above (Cătuneanu, 1999). There is a remarkable territorial fidelity of the species, adults using the same nesting colony for decades. Among the marked birds, resightings were realised for two individuals in the second and third years respectively (6.99%), and 6 (20.68%) in the fourth. Recovery locations highlight the importance of protecting the colonies' location against human disturbance, to which the nesting islands are particularly sensitive.

Figure 1. Mutilated Dalmatian Pelican (*Pelecanus crispus*) with colour ring. (Foto: Iliuță Goean In *****, 2011a)

Great Cormorant

Causes of the Great Cormorant dispersion have a complex set of determinants, starting with the genetic basis of birds and habitat availability, as well climate factors (Bregnballe *et al.*, 1997; Campos and Lekuona, 1994).

In the past only one recovery from a group of 29 birds ringed in Danube Delta Great Cormorant (from the Danube Delta) recoveries were rare, with only one recovered from a group of 29 birds ringed. This individual was recovered after almost five years in Turkey in the middle of winter (Cătuneanu *et al.*, 1978). Species with numerous populations and with an obvious impact on fishery resources already require pan-European implementation of managerial measures. In this respect, the insufficiency of information regarding the post-breeding movements of cormorants breeding in Romania expressly involved the research of this phenomenon. Our previous studies (Ridiche and Kiss, 2011; Sándor *et. al.,* 2009, 2011) present the identification data by retrieving or reading cormorant rings of 26 cases, out of which nine coloured plastic rings, applied during 2003-2006 on nestlings. The rest refers to Great Cormorants ringed with metal or plastic rings in other countries and identified in Romania. Great Cormorants ringed as nestling in the Danube Delta were resighted in 4 countries: 4 in Bulgaria, 3 in Romania and one each in the United Kingdom and Turkey. Romanian recoveries were made close to the ringing sites (within a radius of less than 15 km around the colony where the birds were marked), with only one exception, a bird which moved 70 km. Most of the resightings in other countries document the autumn and spring movements of cormorant in the north-south direction towards Bulgaria, the maximum distance reached by the birds recovered in Turkey being approx. 750 km. In this context, a case found after 615 days in the UK at the beginning of autumn does not fit, suggesting leaving the area of origin erratic movement by the bird for reproduction elsewhere up to a distance of 2200 km. For the above data series, the longest retrieval time was 2118 days.

In the last five years, 6 new cases of recoveries were realised, with 4 in Romania, at distances from 14 km to 70 km from the place of the ringing, after intervals of 1149-2180 days. It was atypical to find birds in the central part of the country at Apata (Brasov County), ca. 300 km distance and 2305 days after marking. Among other countries, a Great Cormorant reached Belarus (920 km, 2180 days) and another reached Hungary (855 km, 3335 days). All three cases involved birds which abandoned the classic north-south direction of movements and opted for dispersion in NW and NE direction. This remarkable spatial dynamic may be one of the determining factors of the Great Cormorant's territorial expansions found in the past decades (Newson *et al.*, 2004).

The recovery rate of Great Cormorants ringed in Romania is low, with only 15 birds recovered out of 215 ringed (6.97 %) and this rate is extremely low, if we consider a large-bodied birds species, which is regularly hunted all over its range. Comparing for example with the 48% recovery rate of coloured rings applied in Denmark (Bregnballe *et al.*, 1999), suggests an explanation of the theory that the chances of retrieval depend not only on bird size and numbers ringed, but also on the social and material level of the possible recovery area, the local communication infrastructure and others (Underhill *et al.*, 1999). Great Cormorants in Denmark mostly move to the Central European and Mediterranean countries (Bregnballe *et al.*, 1999; Campos and Lekuona, 1994; Voisin and Posse 2005; Yésou, 1995), a region with high density distribution of ornithologists, while Great Cormorants breeding in Romania disperse primarily in the Balkans and Turkey (Van Eerden, et al. 1995) In the case of Great Cormorants there is a remarkable territorial fidelity to the places (Yésou, 1995), a phenomenon not yet documented in the country. Earlier recoveries showed a clear north/north-east to south/south-west migratory trend, with Greta Cormorants observed in Romania originating from Ukraine - 10 cases (38.46%), followed by Estonia - 2 (7.69%), Denmark and Russia with one each (3.84%). These (together with one from Romania) have moved southwards from considerable distances of 1400-1600 km. The recapture of a bird, ringed as adult in Sfântu Gheorghe, recovered breeding in Ukraine (80 km distance) after 1066 days suggest a meta-population like a structure of Great Cormorants breeding in the region of the Danube mouths.

Eurasian Spoonbill

Romania overlies in the nominate subspecies range that includes Western, Central and Southeastern Europe. Within this range, two metapopulations are often regarded as the Atlantic and Central/Southeast European, differing in their distribution and ecology, in particular during the migration and the breeding season (Cramp and Simmons, 1977; Hagemeijer and Blair, 1997; Lok *et al.*, 2015; Wetlands International, 2012, Triplet et al.2008). Regarding the migration, Western European populations follow the Atlantic coasts with stops at the mouths of large rivers such as Somme, Seine, Loire, Gironde, Guadalquivir, passing through Gibraltar to Moroccan Atlantic wetlands and tropical North Africa, especially at Banc d'Arguin, Mauritania, some continuing S to winter in Senegal and Guinea-Bissau (Overdijk *et al.,*2001; Lok *et al.,* 2011; Porter, 1982; Smart *et al.*, 2007). Detailed studies have documented species dynamics and ecology in stopping over areas (Banchau *et al.*, 1998; 1997; Galarza, 1986; Isenmann *et al*.,2010; Navedo *et al.*, 2010), as well as the use of habitats in winter quarters (Navedo *et al.*, 2010; Porter, 1982; Triplet *et al.*, 2006, Lok *et al*., 2015).

Danube basin, northern Italy, Greece, the Black Sea region and Anatolia holds the Central and Southeastern European breeding populations. Birds from Central European breeding colonies migrate through the Apennine peninsula, then crossing the Mediterranean, wintering in the Tunisian and Libyan lagoons. Small numbers are recorded to winter in the Sahel wetlands. (Azafzaf *et al.*, 2006; Bauer and Berthold, 1996; Lelkes, 1996;, Pigniczki and Karcza, 2006; Triplet *et al.,* 2006; Triplet *et al.*, 2008).

Birds from the Southeast Europe migrate along the eastern Mediterranean coast to winter either along the Nile, as far south as Sudan, or in Israel, Syria and Iraq, with a few reaching the Gulf. Some western birds may however also go to the Nile, while eastern breeders may winter in the Maghreb.(Cramp and Simmons, 1977; Hagemeijer and Blair, 1997; Lok *et al.*, 2015; Wetlands International, 2012, Triplet et al.2008). It is assumed that individuals from Southeast and Central Europe populations are not changing their nesting areas (AZAFZAF et al. 2006, BAUER *et* GUTZ 1966, OVERDIJK *et* ZWART 2003, PIGNICZKI *et* KARCZA, SMART *et al*. 2007).

Only a small number of metal ring recoveries are known for Eurasian Spoonbills breeding in Romania. Between the world wars period one bird ringed in the SE part of the country was recovered in Sudan, while two more in Central Egypt, one in Kenya and a case of short distance movement is observed in Moldova, a few tens of km from the place of the markings (Cătuneanu, 1999; Smart *et al.*, 2007). In our previous study (Kiss *et al.,* 2007) we analysed data of 24 birds. Following the marking of 219 birds, recoveries were noted in 11 countries, showing an irregular polygon between Hungary, Tunisia, Oman and Ukraine. Two observations, (Oman and Tunisia) stand out from the known pattern, with deviations to East and West from the known wintering areas. More than a third of the recoveries are reported from Israel (9 cases, 37.5%), followed by Tunisia (3 cases, 12.5%), Italy and Romania (2-2 cases (8.33 %), other countries: Cyprus, Croatia, Hungary, Oman, Turkey, Ukraine, each has one observation. With new information available from successive recoveries in the surveyed areas, we have to omit two recoveries published before, respectively Nigeria and Spain (Kiss *et al.*, 2007), as invalid (both records have been reconsidered and based on the particular circumstances should be regarded as ring reading errors - personal communication Pigniczki Cs.). All these observations refer to individual birds, multiple successive observations in the same place are not taken into account. The longest recovery has 1839 days elapsed between ringing and resighting, while the maximum distance from the place of marking, 3814 km, was registered in the case of the bird seen in Oman.

In the period 2007 - 2018 are 17 new recoveries, with most birds seen in Romania (7), followed by Israel and Tunisia (2 in each country), Bulgaria and Ukraine (one each, see Table 1., positions 17-20, 22, 24, 26-34. and Figure 2.).

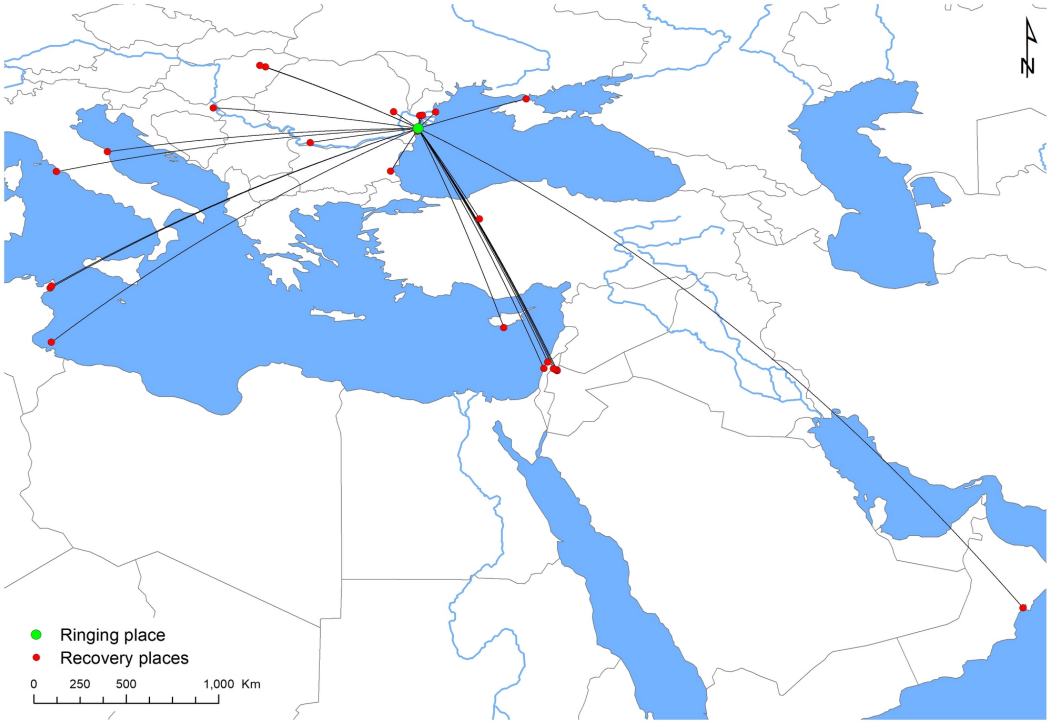

Figure 2. Map showing the geographical distribution of Eurasian Spoonbill *Platelea leucorodia*) movements.

The recoveries from Romania were primarily made close to the colony area where the birds were ringed (less than 15 km). There is only one more distant recovery, the bird was observed in a feeding flock at a distance of 75 km from its ringing place. These results show a remarkable territorial fidelity, that seems it grows with aging, according to data of the phenomenon described in other populations (Lok *et al.*, 2011; Pigniczki and Végvári , 2015). The plastic rings have been worn for a period of between 1838 and 3651 days. These new records complete our knowledge on Eurasian Spoonbill post-breeding dispersal and show a fairly complex pattern of migratory routes and wintering areas. To exemplify these, hereby we present the individual history of a few birds. A bird ringed in 2005 was first seen in Cyprus in 2006, later found in 2010 in Israel. We have to mention, that Cyprus is an important

migratory stop-over and wintering area for Eurasian Spoonbills from the East European population. Another bird was seen in six occasions in the same area in Israel in 2004, however in 2006 appears in Cyprus, and in 2010 once again is reported from Israel.

The most complex, however, seems to be the case of another bird ringed in Danube Delta, which first time was wintering in Tunisia in 2005, seen in the same area three times, and in 2007 it appears in late April and early September in Hungary, with the possibility of nesting in the area. This bird was observed once again in Tunisia in 2012.

These data confirm that individual birds from Danube Delta may use the Adriatic flyway and even possibly breed in Central Europe (ex. Hungary). The extent of these exchange is unknown yet, while populations considered to be divided by distant wintering and/or breeding areas may mix at certain stop-over or wintering areas. Moreover, the presence of an adult bird from the Danube Delta population in breeding period in Hungary may indicate possible gene-flow between Southeast and Central European populations. Further genetic investigations may bring more information on this topic and a better understanding of the phenomenon.

Table 1. Recovery details of Eurasian Spoonbills (*Platelea leucorodia*) ringed as nestlings in the Danube Delta Biosphere Reserve

Nr. crt.	**No. ring Metal, plastic**	**Ringing place**	**Ringing date**	**Age, sex**	**Recuperation place**	**Finding date**	**Elapsed time**	**Distance** (Km)	**Metod**
1	4 ex. obs., with CR ring	RO, Prundu cu Păsări, 44° 37'N 28° 43'E	16.06.2003	Nestling	**Romania**, Istria, Sinoie, 44° 37' N 28° 43' E	27.07.2003	41 days	5	Visual obs. CR read
2	B 6718, R-KE B-KE	RO, Prundu cu Păsări, 44° 37'N 28° 43'E	03.07.2003	Nestling	**Ucraina**, NE from Vilkovo 45° 31' N 28° 35' E	End of Sept. 2003	± 80 days	≈ 130	Shot
3	B 6722, R-PJ B-PJ	RO, Prundu cu Păsări, 44° 37'N 28° 43'E	03.07.2003	Nestling	**Israel**, Kibbouts Maagan Michael 32 ° 55' N 35° 26' E	29.09.2003	88 days	1408	Visual obs. CR read
4	B 6715, R-PE B-PE	RO, Prundu cu Păsări, 44° 37'N 28° 43'E	03.07.2003	Nestling	**Israel**, Kibbouts Maagan Michael 32° 55' N 35° 26' E	05.10.2003	94 days	1408	Visual obs. CR read
5	B 6711, R-KH B-KH	RO, Prundu cu Păsări, 44° 37'N 28° 43'E	03.07.2003	Nestling	**Oman**, Barr al Hikman lagoons, 20° 37' N 58° 26' E	29.12.2003	179 days	3814	Visual obs. CR read
6	1 ex. obs., with CR ring	RO, Prundu cu Păsări, 44° 37'N 28° 43'E	03.07.2003	Nestling	**Turkey**, Samsun, Sariyar Baraji, 41° 52'N 35° 52' E	07.02.2004	219 days	654	Visual obs. CR read
7	H 000165 R-SX B- SX	RO, Prundu cu Păsări, 44° 37'N 28° 43'E	16.06.2003	Nestling	**Israel**, Bet Shean 32° 55'N 35 ° 26'E	04.03.2004	262 days	1423	Visual obs. CR read
8	B 6729 R-JN	RO, Prundu	03.07.2003	Nestling	**Israel**, Kefar Ruppin fishponds	26.09.2004	451 days	1477	Visual obs. CR

	B-JN	cu Păsări, 44° 37'N 28° 43'E			32° 27'N 35° 33'E				read
9	H 000812 L-TZ L-TZ	RO, Prundu cu Păsări, 44° 37'N 28° 43'E	10.06.2004	Nestling	**Israel**, Maoz Haim fishponds 32° 27'N 35° 33'E	03.10.2004	115 days	1470	Visual obs. CR read
10	B 6727 R-KB B-KB	RO, Prundu cu Păsări, 44° 37'N 28 °43'E	03.07.2003	Nestling	**Italia**, Grosseto Laguna di Orbetello 42° 26'N 11° 12'E	31.05.2005	698 days	1429	Visual obs. CR read
11	H 000814 R-DS B-DS	RO, Prundu cu Păsări, 44° 37'N 28° 43'E	01.06.2004	Nestling	**Israel**, Bet Shean 32° 31' N 35° 30' E	26.01.2005 14.04.2005 16.04.2005 17.04.2005 29.09.2005 04.10.2005	239 317 319 320 485 490 days	1423	Visual obs. CR read
12	H 000148 R-YO B-YO	RO, Prundu cu Păsări, 44°37'N 28°43'E	16.06.2003	Nestling	**Italia**, Scossici, Porto Recanati, Macerata 43° 28' N 13° 28' E	28.05.2005	712 days	1210	Visual obs. CR read
13	B 6708 R-XH B-XH	RO, Prundu cu Păsări, 44°37'N 28°43'E	03.07.2003	Nestling	**Tunisia**, Tun Korba Lagoons 36°42' N 10°56' E	18.08.2005	777 days	1734	Visual obs. CR read
14	B 6708 R-XH B-XH	RO, Prundu cu Păsări, 44°37'N 28°43'E	03.07.2003	Nestling	**Tunisia**, Tun Oued Lebna reservoir 36°42' N 10°56' E	21-24.08.2005	780, 783 days	1733	Visual obs. CR read
15	B 6708 R-XH B-XH	RO, Prundu cu Păsări, 44°37'N 28°43'E	03.07.2003	Nestling	**Hungary**, Balmazújváros Virágoskúti fishponds 47°40'N 21°21' E	08.09.2007	1528 days	670	Visual obs. CR read
16	H000824 L-VZ L-VZ	RO, Prundu cu Păsări, 44°37'N 28°43'E	10.06.2004	Nestling	**Croatia,** Podunavlje fishponds 46°04' N 19°56' E	07-18.10.2005	484-495 days	783	Visual obs. CR read
17	H 00151 R-DA B-DA	RO, Prundu cu Păsări, 44°37'N 28°43' E	15.06.2003	Nestling	**Hungary,** Békés Biharugrai fishpond 46°55' N 21°33' E	26.09.2005	834 days	609	Visual obs. CR read
18	H 000814 L-DS L-DS	RO, Prundu cu Păsări, 44°37'N 28°43' E	01.06.2004	Nestling	**Cyprus,** Thira, Akrotiri 34°52' N 33°56' E	15.04.2006	683 days	941	Visual obs. CR read
19	B 6708 R-XH B-XH	RO, Prundu cu Păsări, 44°37'N 28°43' E	03.07.2003	Nestling	**Hungary,** Dinnyés lapos 47°43' N 21°06' E	23.04.2007	1390 days	834	Visual obs. CR read
20	B 6708 R-XH B-XH	RO, Prundu cu Păsări,	03.07.2003	Nestling	**Hungary,** Balmazújváros 47°39' N	08.09.2007	1528 days	667	Visual obs. CR read

		44°37'N 28°43' E			21°21' E				
21	H 001113 R-ZK B-ZK	RO, Prundu cu Păsări, 44°37'N 28°43' E	15.06.2003	Nestling	**Bulgaria**, Burgas, Poda 42°26'N 21°20'E	14.07.2008 15.07.2008	1856 days 1857 days	263 263	Visual obs. CR read
22	H 000824 L-VZ L-VZ	RO, Prundu cu Păsări, 44°37'N 28°43' E	10.06.2004	Nestling	**Romania,** Vadu 44°29'N 28°45'E	14.05.2009	1799 days	12	Visual obs. CR read
23	L 001883 R-LR B-LR	RO, Prundu cu Păsări, 44°37'N 28°43' E	01.06.2004	Nestling	**Ukraina,** Krim 47°40'N 35°06'E	03.09.2009	1920 days	440?	Visual obs. CR read
24	H 000814 L-DS L-DS	RO, Prundu cu Păsări, 44°37'N 28°43' E	01.06.2004	Nestling	**Israel** Ein Harod fishponds 32°32'N 35°24'E	01.02.2010	2071 days	1459	Visual obs. CR read
25	H 000105 R-XC B-XC	RO, Prundu cu Păsări, 44°37'N 28°43' E	03.07.2003	Nestling	**Romania**, Grindul Lupilor 44°37' N 28°43' E	15.06.2010	2539 days	10	Visual obs. Pictures
26	B 6708 R-XH B-XH	RO, Prundu cu Păsări, 44°37'N 28°43' E	03.07.2003	Nestling	**Tunisia**, Meninx, Djerba Island, 33°42'N 10°56'E	22.01.2012	3125 days	1958	Visual obs. CR read
27	B 6708 R-XH B-XH	RO, Prundu cu Păsări, 44°37'N 28°43' E	15.06.2003	Nestling	**Romania,** Gr. Lupilor 44°63' N, 28°84' E	23.06.2010	2565 days	5,7	Visual obs. CR read
28	B 6708 R-XH B-XH	RO, Prundu cu Păsări, 44°37'N 28°43'E	03.07.2003	Nestling	**Romania** ,Tulcea 45°15' N 28°59' E	01.04.2017	5021	75	Visual obs. Pictures
29	H 00102 R-BR B-BR	RO, Prundu cu Păsări, 44°37'N 28°43' E	15.06.2003	Nestling	**Romania,** Gr. Lupilor 44°63' N, 28°84' E	23.VI.2010	2565 days	5,7	Visual obs. CR read
30	ROB L 001847 L-LX L-LX	RO, Prundu cu Păsări, 44°37'N 28°43'E	01.06.2004	Nestling	**Israel** Kfar Masarik fishponds, 32°53'N 35°06'E	16.09.2012	3029 days	1413	Visual obs. CR read
31	B 6708 R-XH B-XH	RO, Prundu cu Păsări, 44°37'N 28°43'E	15.06.2003	Nestling	**Tunisia**, Meninx, Djerba Island 33°42'N 10°56'E	10.01.2014	3862 days	1959	Visual obs. CR read
32	H 000802 L-UX L-UX	RO, Prundu cu Păsări, 44°37'N 28°43'E	10.05.2004	Nestling	**Romania,** Tulcea 45°15' N 28°57' E	10.05.2014 05.05.2017 06.06.2017	3652 4743 4775	75	Visual obs. Pictures

Analysing all the data of marked birds, from the 143 colour rings applied in 2003, we have 9 cases (6.3%) when birds moved westwards, reaching the most westerly points in Tunisia, or at least visiting Hungary, Croatia and Italy. We mention that the inverse of the phenomenon (birds from Central European Flyway migrating towards East and reaching the Pontic route) is rare, with only one known recent case (0.9%). In addition, from the 272 European Spoonbills marked with colour rings in the Pannonian area of Croatia only of 0.37% were observed to migrate to East (Kralj *et al.*, 2012), while only 19 birds out of the 3343 marked in Hungary were found to migrate towards east since the beginning of last century, reaching eastwards to Turkey and south to Sudan (Pigniczki and Karcza, 2013).

CONCLUSIONS

Recoveries of colour ringed nestling of Dalmatian Pelicans, Great Cormorants and Eurasian Spoonbills breeding in the Danube Delta area were analysed in order to identify patterns of post-breeding movements.

Dalmatian Pelicans showed a remarkable territorial fidelity, both for young birds and adults, which require the application of special efforts to protect the nesting area. Both adults and young birds showed short distance movements, with no records coming from large distances.

Great Cormorants breeding in the Danube Delta have a tendency to show wide range movements, without a clear migratory direction to be noted. The autumn and winter recoveries of a third of the rings were found in Bulgaria and Turkey documenting the fact that some individuals left the area, and the flocks observed in the winter mostly belong to the vicarious northern populations.

While some Eurasian Spoonbills migrate to SW (6.3%), the bulk of the breeding population uses the Eastern Mediterranean Flyway to reach wintering areas in the eastern part of the Mediterranean Basin. During the migration and at the wintering areas, the East European populations may partially mix with the Central European ones, which may result in certain individuals to be able to switch even breeding territories.

In order to better understand the spatial and temporal dynamics of the three species, as well to improve the management measures, it is important to continue colour marking of these large water birds, as colour ring-resightings may bring valuable information on post-breeding habitat use and distribution of these bird species.

Our findings are also important for generating hypotheses for future research about the migratory connectivity of these species populations.

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REFERENCES

*****, 2011 https://peterlengyel.wordpress.com/2011/11/09/grindul-lupilor/

*****, 2011a. GALERIE FOTO Aşa arată moartea adusă de vânători în Delta Dunării! Cotidianul Adevarul.https://adevarul.ro/locale/tulcea/galerie-foto--asa-arata-moartea-adusa-vanatori-delta-dunarii-1_50ad6bb57c42d5a66394d1ce/index.pdf

Banchau V., Horn H., Overdijk O., 1998. Survival of Spoonbills on Wadden Sea islands. *Journal of Avian Biology*. 29, pp. 177-182.

Bauer H.G., & Berthold P., 1996. *Die Brutvogel Mitteleuropas*. AULA Verlag, Wiesbaden. pp. 48-49.

Bauer K.M., & Gutz Von Blotzheim U.N., 1966. *Handbuch der Vögel Mitteleuropas*. Akad. Verlag, Frankfurt am Main, vol. 1, pp. 428-441.

Bezzel E., 1985. *Kompendium der Vögel Mitteleuropas*. *Nonpasseriformes*. AULA Verlag, Wiesbaden. pp. 100-102.

Bregnballe T., Morten F., Gregersen J., 1997. Seasonal distribution and timing of migration of Cormorants *Phalacrocorax carbo sinensis* breeding in Denmark. *Bird Study*. 44, pp. 257-276.

Campos F., & Lekuona J.M. 1994. La población invernante de Cormorán Grande (*Phalacrocorax carbo*) en el norte de España y suroeste de Francia. *Ardeola*. 41. 13-18.

Catsadorakis G., 2002. The book of pelicans. The Society from the Protection Of Prespa. Pp. 9-179.

Catsadorakis G., & Crivelli A.J., 2001. Nesting habitat characteristics and breeding performance of Dalmatian Pelicans in Lake Mikri Prespa, NW Greece. *Waterbirds.* pp. 386-393.

Catsadorakis G., 2016. An update of the two *Pelecanus* species in the Mediterranean - Black Sea region. In: Yésou P., Sultana J., Walmsley J., Azafzaf H. (Eds.). Proceedings of the UNEP-RAC/SPA symposium, Hammamet – Tunisia, 20-22 February 2015. pp. 47-52.

Catsadorakis G., & Portolou D., 2016. 1st Draft Status Report for the Dalmatian Pelican *(Pelecanus crispus)*. Report of Action A6 under the framework of Project LIFE EuroSAP (LIFE14 PRE/UK/002). Hellenic Ornithological Society and Society for the Protection of Prespa. pp. 2-27.

Catsadorakis G., Onmuş O., Bugariu S., Sarigül G., Hatzilacou D., Hatzofe O., Rudenko A., 2015. Current status of the Dalmatian pelican and the great white pelican populations of the Black Sea/Mediterranean flyway. *Endangered Species Research*, 27. pp. 119-130.

Cătuneanu I.I., Korodi-Gál I., Munteanu D., Paşcovschi S., Vespremeanu E., 1978. *Fauna R.S.R. Aves*. Ed. Academiei R.S.R., Bucureşti. Vol. 15, fasc.1, pp.267 – 275, 281-286.

Cătuneanu, I.I., 1999. Istoricul cercetărilor efectuate pe teritoriul României asupra migraţiei păsărilor prin metoda inelărilor, până la înfiinţarea Centralei Ornitologice Române, şi fazele acesteia de dezvoltare în perioada 1939-1970. Publicaţiile Societăţii Ornitologice Române. 8, pp. 25, 56, 63-65, 74-75.

Cramp S.C.Y.K., & Simmons L.E., (eds.), 1977. Handbook of the Birds of Europe, Milddle East, and North Africa: the Birds of the Western Paleartic. Vol. 1 Oxford University Press, London.

Crivelli A. J., 1996. Action plan for the Dalmatian pelican *(Pelecanus crispus)* in Europe. Globally Threatened Birds in Europe: Action Plans. Council of Europe Publishing, Strasbourg. Pp. 53-66.

Crivelli A.J., Catsadorakis G., Hatzilacou D., Naziridis, T., 1997. *Pelecanus crispus* Dalmatian Pelican. Birds of the Western Palearctic (BWP) Update. Vol.1, pp. 149-153.

Crivelli A.J., Hatzilacou D., Catsadorakis G., 1998. The breeding biology of the Dalmatian Pelican Pelecanus crispus. *Ibis*. 140, pp. 472-481.

Crivelli A.J., Mitchev T., Catsadorakis G., Pomakov V. 1991. Preliminary results on the wintering of the Dalmatian Pelican, *Pelecanus crispus*, in Turkey. *Zoology in the Middle East*. *5*(1), pp. 11-20.

Doxa A., Robert A., Crivelli A., Catsadorakis G., Naziridis T., Nikolaou H., Theodorou K., 2012. Shifts in breeding phenology as a response to population size and climatic change: a comparison between short-and long-distance migrant species. The Auk. 129, pp. 753-762.

Galarza A., 1986. Migración de la Espátula (*Platalea leucorodia* (Linn.) por la Península Ibérica. *Ardeola.* 33, pp. 195-201.

Gîştescu P. & Ştiucă R., 2010. Delta Dunării, Rezervaţie a biosferei. Editura CD Press, Bucureşti. pp. 1-400.

Hanganu J., Dubiyna D., Zhmud E., Grigoraş I., Menke U., Drost H., Ştefan N., Sărbu I.O., 2002. Vegetation of Biosphere reserve “Danube Delta”. RIZA rapport 2002.049. 88 p.

Isenmann P., Benmergui M., Browne P. Ba A.D., Diagana C.H., Diawara Y. & El Abidine ould Sidaty Z., 2010**.** Birds of Mauritania/Oiseaux de Mauritanie.Société d’Études Ornithologiques de France, Paris.

Kiss J.B., 2000. Erdélyi Nimród hirek. A borzas gödények korai fészkelése. Erdélyi Nimród. 2: 23.

Kiss J.B., Sándor D.A., Marinov E.M., Overdijk O., 2007. New data regarding the migration of Spoonbills (*Platalea leucorodia*) in the Danube Delta, based on color ring resightings. *Scientific Annals of the Danube Delta Institute, Tulcea*. 13, pp. 45-49.

Kiss J.B., 2010. Pelikánlesen, R337. National Geographic. 12, pp. 94.

Kiss B.J., Alexe, V., Doroşencu A.C., Ceico T., Kiss N.B., Marinov M.E. 2016. Recent data on the Danube Delta (Romania) avifauna from the 2014 and 2015 summer seasons. *Acrocephalus*. 37, pp. 85-92.

Kralj J., Žuljević A., Mikuska A., Overdijk O.T., 2012. Movements of Immature Eurasian Spoonbills *Platalea leucorodia* from the Breeding Grounds of the Eastern Metapopulation in the Pannonian Basin. Waterbirds. 35, pp. 239-247.

Lelkes A., 1996. Populations of Spoonbill (*Platalea leucorodia*) in Central Eastern Europe. IN: Duncan A., Hoogstaden P., (eds.) Management of coastal aquatic habitats for the Spoonbill on migration and other associated waders. Proceeding of the 23rd Eurosite Nature Management Workshop, Rochefort, France, pp. 19-24.

Linţia D., 1955. Păsările din R.P.R. Editura Academiei R.P.R. Vol. 3., pp. 171-173.

Lok T., Overdijk O., Piersma T., 2015. The cost of migration: spoonbills suffer higher mortality during trans-Saharan spring migrations only. Biology Letters. 11, Issue 1

Lok T., Overdijk O., Tinbergen J.M., Piersma T., 2011. The paradox of spoonbill migration: most birds travel to where survival rates are lowest. Animal Behaviour. 82, pp. 837-844.

Munteanu I., 2005. Soils of the Romanian Danube Delta Biosphere Reserve. RIZA nota n. 96.070. p. 172.

Navedo J.G., Masero J.A., Overdijk O., Orizaola G., Sánchez-Guzmán J.M., 2010. Assessing the role of multiple environmental factors on Eurasian Spoonbill departure decisions from stopover sites. *Ardea*. 98(1), pp. 3-13.

Navedo J.G., Orizaola G., Masero J.A., Overdijk O., Sánchez-Guzmán J.M., 2010. Long-distance travellers stopover for longer: a case study with spoonbills staying in North Iberia. Journal of Ornithology. 151, pp. 915-921.

Newson S.E., Hughes B., Russell I.C., Ekins G.R., Sellers R.M. 2004. Sub-specific differentiation and distribution of Great Cormorants *Phalacrocorax carbo* in Europe. *Ardea.* 92, pp. 3-10.

Nikulina E.A., & Schmölcke U., 2015. First archaeogenetic results verify the mid Holocene occurrence of Dalmatian pelican *Pelecanus crispus* far out of present range. Journal of Avian Biology. 46, pp. 344-351.

Onmuș O., Siki, M., Saragül G., Crivelli A.J., 2011 - Status and development of the population of the globaly threatened Dalmatian Pelican, *Pelecanus crispus*, in Turkey. Zoology in the Middle East. 54pp. 3-17.

Overdijk O., de le Court C. & Gueye A., 2001 Spoonbill count on the Banc d'Arguin, Mauritania, January 2000. *WIWO-report* 70

Overdijk O. & Zwart F., 2003. The actual state of the Spoonbill in Europe. In: Veen J. & Stepanova O. (eds.): Wetland management for Spoonbills and associated waterbirds. pp 7−8. EUROSITE, Tilburg.

Pigniczki Cs, 2010 Magyarországi kanalasgémek (*Platalea leucorodia*) kóborlása és vonulása fémgyűrűs megkerülések alapján. Aquila. 116-117: pp. 17-32.

Pigniczki Cs., Végvári, Zs., 2015. Dispersal and migration of Spoonbills (Platalea leucorodia) ringed in Hungary. Unpublished PhD Thesis, University of Debrecen, pp. 8-142.

Pigniczki Cs. & Karcza Zs., 2006. First results of spoonbill colour-ringing project in Hungary (2003-2005). In: EUROSITE Spoonbill Workinggroup Newsletter. 4, pp. 8-9.

Pigniczki Cs. & Karcza Zs., 2013. Movements of Eurasian spoonbill based on metal-and colour-ringing recoveries between 1908 and 2012 in Hungary. In: Navedo J.G. (Ed.): Proceedings Eurosite VII Spoonbill Workshop, pp. 59-65. Cantabria. Spain.

Pigniczki Cs., Kralj J., Volponi S., Žuljević A., Dakhli M.A., Mikuska T., Azafzaf H., Végvári Zs., 2016. Migration routes and stopover sites of the Eurasian Spoonbill (*Platalea leucorodia*) between the Carpathian Basin and wintering areas. Ornis Hungarica. 24, pp. 128-149.

Pigniczki Cs., & Karcza Zs., 2015. Dispersal of the Central European Population of the Eurasian Spoonbill *Platalea leucorodia. Ardeola.* 62, pp. 219-236.

Platteeuw M., Kiss J.B., Sadoul N., Zhmud M.Y., 2004*. Colonial Waterbirds and their habitat use in the Danube Delta.* RIZA Report 2004.002. ISBN 90.369.5658.7. pp. 3 – 168.

Platteeuw M., Kiss J.B., Sadoul N., Zhmud M.Y., 2006. Large colonial waterbirds in the Romanian and Ukrainian Danube Delta: a complete survey in 2001/2002. Scientific Annals of the Danube Delta Institute, Tulcea. 12, pp. 103-108.

Porter E.P.R., 1982. Migration et dispersion des Spatules néerlandaises. Oiseau et R. F. O. vol. 52, pp. 305-334.

Ridiche M.S. & Kiss J.B., 2011. The species of ringed birds found within the Danube's meadow in-between Calafat and the River Jiu (Dolj county, Romania). Journal of Wetlands Biodiversity, Istros. 1, pp. 119-126.

Sándor D.A., Kiss J.B., Alexe V., Marinov M., Domşa C., 2011. The Danube Delta at the crossroads of migrating Great Cormorants *Phalacrocorax carbo*. Cormorant Research Group Bulletin. 7, pp. 26-32.

Sándor D.A., Kiss J.B., Domşa C., 2009. The importance of Northern Dobrogea in the migration of Great (*Phalacrocorax carbo*). Scientific Annals of the Danube Delta Institute, Tulcea. 15, pp. 41-46.

Schneider-Jacoby M., 2008. How many birds migrate over the Adriatic Sea? *Acrocephalus*. 29, pp. 1-3.

Smart M., Azafzaf H., Dlensi H., 2007. The 'Eurasian' Spoonbill (*Platalea leucorodia*) in Africa. Ostrich. 78(2), pp. 495-500.

Triplet P., Diop I., Schricke V., Leray G., 2006. Origin of the spoonbills wintering in the Senegal Delta. Eurosite Spoonbill Workinggroup Newsletter. 4, pp. 8-9.

Triplet P., Overdijk O., Smart M., Nagy S., Schneider-Jacoby M., Karauz SE.K., Navedo J.G. 2008. International single species action plan for the conservation of the Eurasian Spoonbill Platalea leucorodia. AEWA Technical Series 35. Bonn, Germany.

Underhill L.G., Tree A.J., Oschadleus H.D., Parker V., 1999. Review of ring recoveries of waterbirds in southern Africa. Avian Demography Unit. pp. 103–106.

Van Eerden M.R., Koffijberg K., Platteeuw M., 1995. Riding on the crest of the wave: possibilities and limitations for a thriving population of migratory cormorants *Phalacrocorax carbo* in man-dominated wetlands. *Ardea*. 83, pp. 1-9.

Voisin R. & Posse B., 2005. Le passage automnal du Grand Cormoran *Phalacrocorax carbo* à travers les Alpes, à partir de la basse vallée du Rhône (Vaud/Valais). Nos Oiseaux. 52, pp. 3-16.

Wetlands International, 2012. Waterbird Population Estimates, Fifth Edition. Summary Report. Wetlands International, Wageningen, The Netherlands.

Yésou P., 1995. Individual migration strategies in cormorants *Phalacrocorax carbo* passing through or wintering in western France. *Ardea*. 83, pp. 267-274.

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