The distribution, numbers, and breeding of terns and waders on the sand islands along the Bulgarian-Romanian section of the Danube

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Abstract. During 2011 and 2013 three complete surveys of the nesting terns and waders were conducted along the whole Bulgarian-Romanian section of the Danube River. In both years, during the spring and summer the water levels of the Danube were very low and as a result many suitable inlets and sandpits formed for the breeding of terns and waders. The total breeding numbers of all studied species during both years (2011/2013) were as follows: Common Tern (Sterna hirundo) – 428/510-550 pairs, Little Tern (Sternula albifrons) – 182/139-144 pairs, Little Ringed Plover (Charadrius dubius) - 61/16 pairs, Oystercatcher (Haematopus ostralegus) – 15/0 pairs, Avocet (Recurvirostra avosetta) - 80/2 pairs, Lapwing (Vanellus vanellus) - 7/0 pairs, and Stone Curlew (Burhinus oedicnemus) – 2/1 pairs, Black-winged Stilt (Himantopus himantopus) - 0/1 pairs. The largest colonies were concentrated east of Nikopol /Turnu Magurele, the eastern part of the studied river section. The clutches of the Common Terns consisted of 1 - 4 eggs, an average of 1.934 (SD: 0.892) (n=61). The size of the eggs from four of the colonies were: 39.5 – 43.8 mm × 28.7 – 32.8 mm, on average 41.28 (SD:1.04) × 31.02 mm (SD:0.873) (n=24). The clutches of the Little Terns consisted of 1-3 eggs and in one case – three eggs and one hatchling. The average number of the eggs was 2.5 (SD: 0.837) (n=6). Size of the eggs from one of the colonies: 30.1 -32.9 mm × 22.2-23.4 mm, on average 31.38 (SD: 1.2) x 23.12 mm.(SD: 0.46) (n=6). The main threats for the breeding terns and waders are the projects for dredging the river bed, big variations of the water levels of the Danube, and disturbance by people landing on the islands.

Key words: terns, waders, breeding, Lower Danube, threats, breeding biology.

Introduction

The breeding population numbers and breeding biology of waders and terns (order Charadriiformes) on the islands of Bulgarian-Romanian section of the Danube River are too rarely studied. For example, in Bulgaria until now all data about the breeding biology of species such as Common Tern (Sterna hirundo), Little Tern (Sternula albifrons), Avocet (Recurvirostra avosetta), Oystercatcher (Haematopus ostralegus) and Little Ringed Plover (Charadrius dubius) were collected along the Black Sea Coast (Georgiev 1976, Nankinov & Darakchiev 1978, Nankinov & Darakchiev 1980, Dalakchieva 2004) and along some of the inland rivers Maritsa and Struma (Darakchiev 1984, Darakchiev & Filipova 1986, Kotsakov & Kantardjiev 1986). In Romania colonial terns and waders have only been intensively studied in the Danube delta area and some other locations in Eastern Romania (Platteeuw et al.2004, Petrencu et al.2011).

The Danube populations of these bird species have remained beyond of the scope of such investigations probably because of the irregularity of their nesting. During 2011 and 2013 spring and summer levels of Danube were unseasonably low for the time of the year. As a result, numerous inlets, sandpits and shallow water areas formed. Providing ideal conditions for the breeding of birds of the order Charadriiformes, and these birds rapidly occupied them. A similar situation has also been observed in the past; – during the 1960 ties of 20th century when six colonies of terns were discovered along the Bulgarian-Romanian section of Danube (Spitzenberger 1966). But it is obvious that such situations happen only rarely and have never been used as an opportunity for a complete inventory and census of wader and tern colonies. We performed the research during 2011 and 2013, aiming to obtain a complete picture of the status and numbers of waders and terns nesting along the whole Bulgarian-Romanian section of Danube River.

Material and methods

We conducted three field expeditions using motor boat along the entire Bulgarian-Romanian section of Danube river from the Timok river mouth to the town of Silistra (470 km.) in the periods 20-25 May 2011, 20-25 June 2011 and 10-15 June 2013. At each sandpit or island we stopped and counted all the nesting waders and terns. During the expeditions in 2011 we studied on five of the larger islands holding significant colonies of birds for col-
lecting more precise data about the number of nests, the stage of nestings and the breeding biology of the studied birds. These colonies were found close to Persina island, at the mouth of Yantra river, at Aleko island, Kicha island and on an islet at Popina village. During the second expedition in 2011, the hatchlings from the nests in part of these larger colonies were ringed with standard metal rings.

Additional data on the status of the waders and terns on the Danube islets and sandpits in the same river section were collected also during other expeditions in 1998, 2001, 2006, 2010 and 2012. In 2006, 2010 and 2012 the expeditions were again surveyed in the whole Bulgarian-Romanian section but in these years the hydrological conditions were not suitable for nesting of waders and terns as they were in 2011 and 2013. Thus, these results have only complementary significance and were used for the discussion in the present article.

Results

Distribution and numbers

During the first expedition in May 2011, a total of 33 breeding localities of birds of the order Charadriiformes were recorded along the Bulgarian-Romanian section of the Danube. In overall 458 pairs were counted belonging to the following species: Common Tern (Sterna hirundo), Little Tern (Sternula albifrons), Little Ringed Plover (Charadrius dubius), Avocet (Recurvirostra avosetta), Oystercatcher (Haematopus ostralegus), Lapwing (Vanellus vanellus) and Stone Curlew (Burhinus oedicnemus). During the second count in June 2011, the numbers of the nesting pairs had increased significantly - the total number of the breeding localities was 35 with 778 pairs (increase of 69%). Surely a considerable part of the birds had started breeding after the end of the first count (25 May).

The total number of all detected pairs during 2011 was 792 including the following numbers by species; Common Tern - 428 pairs, Little Tern - 182 pairs, Little Ringed Plover - 61 pairs, Oystercatcher- 15 pairs, Avocet - 80 pairs, Lapwing - 7 pairs and Stone Curlew - 2 pairs. The distribution of tern colonies in 2011 is shown on Fig.1.

Black headed Gull (Chroicocephalus ridibundus) was not proved as a breeder on the studied islands and sandpits but non-breeding individuals were observed staying in the colonies of terns and waders in five occasions – in May, 2011 – between Stanovo and Dolni Tsibar – 1 pair, at Kicha island -30 individuals and between Leskovets and Ostrov – 5 ind. and in 2013 – at Kamadinu island -5 ind., at Varasti island – 10 ind.

During 2013, only seven colonies of terns and waders were detected along the same studied river section but the total numbers, especially of the terns, again were high. Additionally, further six localities of solitary pairs of Little Ringed Plover were found. The number of colonies was much lower compared to 2011 because of the higher water levels of the Danube which led to early flooding of many sandpits and islets. Despite that fact the total numbers of the Common Tern had increased by 24% - from 428 (in 2011) to 530 pairs in 2013 (average numbers). Breeding Common Terns were much more concentrated in a small number of large colonies (Fig.2). The numbers of Little Tern showed the opposite pattern and decreased by 25% - from 182 pairs in 2011 to 141 pairs in 2013. One additional breeding species was detected in 2013 – Black-winged Stilt (Himantopus himantopus) – one pair on an islet close to Batin island. Avocet was recorded only at one locality with two pairs thus showing a significant decrease compared to 2011. Another difference from 2011 was the lack of breeding pairs of Oystercatcher and Lapwing. The majority of the birds were higher on Romanian sandpits, and they were not flooded during the high water levels in 2013. In the same year, a total of 667 – 714 breeding pairs of waders and terns were counted in the studied Danube river section.

Four of the nesting localities (colonies or solitary pairs) recorded in 2013, had been occupied also in 2011 but the numbers of birds and species composition was very different. At Kicha island, close to Gorni Tsibar, the number of breeding terns in 2013 was much lower than the ones compared to 2011. From the place close to Golyama Burzina island where only one breeding pair of Common Tern was found in 2011, the largest colony of that species was recorded in 2013. It can be explained that although being a very high sand island, it was connected with Romanian shore due to lower water level in 2011 and it was separated from the shore by the higher water level in 2013. The colony at Aleko island in 2013 showed significantly higher numbers of breeding Common Terns and Little Terns, compared to 2011.

In 2013, we detected three colonies that were not occupied in 2011 - on a river barge at Vidin (only Common Terns), at Kamadinu island and at Varasti island.

List of all recorded localities with their coordinates and the numbers of all breeding birds of order Charadriiformes is presented in Table 1.
Common Tern (*Sterna hirundo*)

Common Tern is the most numerous breeding bird on the sand islands and sandpits along the Bulgarian-Romanian section of the Danube. In 2011, 138 pairs out of the total number of 438 pairs (May and June) were counted on Bulgarian islands-31.5%, 208 pairs – on Romanian islands - 47.5%, and 92 pairs were found on the islands situated on the state border – 21%. Common Terns were found at 27 localities and they were nesting colonially in 20 of them while at seven it was nesting solitary. In 2013, 510-550 pairs of Common Terns were counted at six localities, all of them nested in colonies. 59 pairs were found on Bulgarian islands (11.1%) and the rest 451–491 pairs were found on Romanian islands (88.9%).

Between the two countings conducted during May and June 2011, an increase in the nesting pairs of Common Tern with 93.6% was detected. Such considerable increase was a result of forming of six new (late) colonies and a significant increase of the numbers in the colonies already established in May. The numbers decreased from May to June only at three colonies - at Stanevo, Kopanitsa and Gradina islands. Probably that was due to temporal high levels of the rising water which caused to flooding of some of the nests.

The major part of the breeding population of

![Figure 1. Distribution of colonies of Common Tern (*Sterna hirundo*) and Little Tern (*Sternula albifrons*) along the Bulgarian-Romanian section of the Danube in 2011](image1)

![Figure 2. Distribution of colonies of Common Tern (*Sterna hirundo*) and Little Tern (*Sternula albifrons*) along the Bulgarian-Romanian section of the Danube in 2013](image2)
Table 1. Breeding localities and numbers of waders and terns along the Bulgarian-Romanian section of the Danube river in May and June 2011 and June 2013.

<table>
<thead>
<tr>
<th>Locality (in brackets - state territory - BG-Bulgarian, RO-Romanian)</th>
<th>Coordinates</th>
<th>Common Tern $Sterna hirundo$ Number of pairs</th>
<th>Little Tern $Sterna albifrons$ Number of pairs</th>
<th>Little Ringed Plover $Charadrius dubius$ Number of pairs</th>
<th>Oystercatcher, $Haematopus ostralegus$ Number of pairs</th>
<th>Avocet $Recurvirostra avosetta$ Number of pairs</th>
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<tr>
<td>Vidin (BG)</td>
<td>N43.95695 E22.87005</td>
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<td></td>
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<td>Archar-mouth of river Archar (BG)</td>
<td>N43.49.325 E22 55.767</td>
<td>1/1</td>
<td>0</td>
<td>1/1</td>
<td>0</td>
<td></td>
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<tr>
<td>Archar (BG)</td>
<td>N43.49.325 E22 55.767</td>
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<td>0/2</td>
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<td>0/2</td>
<td>0</td>
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</tr>
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<td>1/2</td>
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<td>9/37</td>
<td>11</td>
<td>2/6</td>
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<td>1/3</td>
</tr>
<tr>
<td>Kopanitsa island (BG)</td>
<td>N43.46.697 E23 47.182</td>
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<td>0</td>
<td>4/0</td>
<td>0</td>
<td>1/0</td>
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<tr>
<td>Island at the mouth of Ogosta river (RO/BG)</td>
<td>N43.45.047 E23 53.381</td>
<td>17/33</td>
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<td>6/28</td>
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<td>0/2</td>
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<tr>
<td>Leskovets-Octrov (RO)</td>
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<td>Sandpit between the mouth of Iskar river and Zagrazhdan (BG)</td>
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<tr>
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<td>Kalinovits island (RO)</td>
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<td>0</td>
<td>3/5</td>
<td>0</td>
<td>2/2</td>
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<tr>
<td>Gradina island (BG)</td>
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<td>7/3</td>
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<td>3/5</td>
<td>0</td>
<td>2/2</td>
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<tr>
<td>Laski island (BG)</td>
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<td>1/1</td>
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<td>1/5</td>
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<tr>
<td>Irika island(BG)</td>
<td>N43.42.759 E25 00.095</td>
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<td>0</td>
<td></td>
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<tr>
<td>Magaretitsa island (BG)</td>
<td>N43.43.595 E25 11.752</td>
<td>2/2</td>
<td>0</td>
<td>4/4</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Sandpit close to GolyamaBuzina island (RO)</td>
<td>N43.41.674 E25 08.765</td>
<td>1/1</td>
<td>350-380</td>
<td>55-60</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Milka island (BG)</td>
<td>N43.41.674 E25 08.765</td>
<td>1/1</td>
<td>350-380</td>
<td>55-60</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Sandpit close to the eastern part of Persina island (RO/BG)</td>
<td>N43.41.209 E25 14.007</td>
<td>42/42</td>
<td>0</td>
<td>11/11</td>
<td>0</td>
<td>2/2</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Locality (in brackets- state territory - BG-Bulgarian, RO-Romanian)</th>
<th>Coordinates</th>
<th>Common Tern Sterna hirundo Number of pairs</th>
<th>Little Tern Sterna albifrons Number of pairs</th>
<th>Little Ringed Plover Charadrius dubius Number of pairs</th>
<th>Oystercatcher Haematopus ostralegus Number of pairs</th>
<th>Avocet Recurvirostra avosetta Number of pairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vardim island (BG)</td>
<td>N43.38.945 E25.30.961</td>
<td>0/6</td>
<td>2/2</td>
<td>4/4</td>
<td>1/1</td>
<td>3/3</td>
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<tr>
<td>Guska island (RO)</td>
<td>N43.38.622 E25.33.357</td>
<td>49/49</td>
<td>28/28</td>
<td>4/4</td>
<td>1/1</td>
<td>7/7</td>
</tr>
<tr>
<td>Sandpit at the mouth of Yantra river (BG)</td>
<td>N43.40.420 E25.37.468</td>
<td>2/2</td>
<td>0/0</td>
<td>2/2</td>
<td>1/1</td>
<td>0/0</td>
</tr>
<tr>
<td>Upstream Batin island (RO)</td>
<td>N43.41.026 E25.38.560</td>
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<td>90-100</td>
<td>2/2</td>
<td>0/0</td>
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<tr>
<td>Islet close to the upper part of Batin island (RO)</td>
<td>N43.41.660 E25.40.374</td>
<td>15/15</td>
<td>8/8</td>
<td>3/3</td>
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<tr>
<td>Sandpit at Batin island (RO)</td>
<td>N43.41.634 E25.43.779</td>
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<td>8/8</td>
<td>3/3</td>
<td>1/1</td>
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<tr>
<td>Islet downstream from Batin island (RO/BG)</td>
<td>N43.44.971 E25.49.576</td>
<td>15/15</td>
<td>8/8</td>
<td>3/3</td>
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<td>0/0</td>
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<tr>
<td>Kamadinu island (RO)</td>
<td>N43.47.132 E25.52.869</td>
<td>15/15</td>
<td>8/8</td>
<td>3/3</td>
<td>1/1</td>
<td>0/0</td>
</tr>
<tr>
<td>At Brushlen (BG)</td>
<td>N43.59.014 E25.11.584</td>
<td>15/15</td>
<td>8/8</td>
<td>3/3</td>
<td>1/1</td>
<td>0/0</td>
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<tr>
<td>Other small sandpits</td>
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<td>0/0</td>
<td>6/0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td>Total</td>
<td>221/428</td>
<td>510-550</td>
<td>110/182</td>
<td>139-144</td>
<td>42/62</td>
<td>16/16</td>
</tr>
</tbody>
</table>
the Common Tern was concentrated in the eastern half of the studied Danube section - between Nikopol/ Turnu Magurele and Silistra/ Calarasi - in 2011 - 330 pairs, in 2013 - 502-542 pairs. Along the western half of the section (between Timok mouth and Nikopol/ Turnu Magurele) in 2011 there were 108 pairs and in 2013 were only 9 pairs.

In 2011, the largest and most important colonies of Common Terns were recorded at Popina (40% of the whole population), at the mouth of Yantra river (11.2% of the population) and off the lower part of Persina island (9.6% of the population). In general, 60.8% of all breeding pairs of Common Terns were recorded at these three largest colonies. In 2013, 440-480 pairs (ca. 87% of the whole population) were concentrated at two major colonies - on a sand islet close to Golyama Burzina island and on a islet close to the upper part of Batin island.

Most of the colonies of the Common Tern were mixed with Little Terns and other species of the order Charadriformes - 25 cases out of 33 (75.8%). In eight cases the Common Terns formed monospecific colonies.

In 2011, we studied 61 nests of Common Tern from five colonies (Persina island, mouth of the Yantra river, Aleko island, Kicha island and Popina). According to the building material the nests were four types: 1) nests built by wooden sticks and straws (Fig 3),
2) nests formed as a small inundation in the sand without any building material (Fig.4),
3) nests hidden in the vegetation or among other objects - stones or pieces of timber, 4) nests built by mussel shells (Fig.5). The clutches consisted of 1-4 eggs, on average 1.93 (SD: 0.892) (n=61). For the nests found in May and June the values were 1.91 (SD: 0.842) (n=33), and 1.964 (SD:0.944) (n=28), respectively. Sizes of the eggs from all four colonies were as follows: 39.5 – 43.8 mm × 28.7 –32.8 mm, on average 41.28 (SD:1.04) × 31.02 mm,(SD: 0.873) (n=24). In two nests a great variability in the coloration and form of the eggs was recorded (Fig.4). Clutches containing four eggs were found twice, in the colony close to Persina island and in the colony at Popina. In the nests on hatchling stage, the number of hatchlings varied from one to three, on average 2.0 (SD: 0.577) (n=7). All nests found in May 2011 were on egg stage or on stage of building, still without eggs. In June 2011, in most of the nests the chicks were hatched and they differed considerably by age.
Cases of recently hatched chicks in nests containing also eggs were recorded in the colonies at Popina and Aleko islands. Hatchlings of different ages including partially feathered hatchlings were recorded in these colonies at the same time. The latter together with some of the smaller hatchlings formed creches - groups consisting of 20-30 hatchlings originating from neighbouring nests.

Four specimens of four fish species were found apart from some of the nests with hatchlings on the sandpit at Popina, on 21 June 2011. These included one Pontic Anadromous Shad (Alosa kessleri pontica), 25-30 cm; one Pumpkinseed (Lepomis gibbosus); one Common roach (Rutilus rutilus) and one small Prussian carp (Carassius auratus gibelio).

Little Tern (Sternula albifrons)
In 2011 a total of 189 pairs were counted, of which 86 pairs on Bulgarian islets and sandpits, 54 pairs on Romanian and 49 pairs on the state border. Breeding of the Little Tern was recorded at 23 localities, of which 17 were in colonies and in six cases were solitary nesting pairs. In 2013, five breeding localities with 139-144 pairs were discovered. Of these, only 16 pairs were on Bulgarian islets, the rest were on Romanian side. The increase in the nesting pairs between May and June 2011 was 65.5%, which was due to an increase in the colonies already established in May. Only in three colonies there was a decrease in the numbers between May and June - at Stanevo and in two colonies at Kopanitsa island. The decrease in the number was most probably due to temporary high water levels which have led to flooding of some of the nests. On the same islands the Common Tern also decreased.

Most of the breeding pairs of the Little Tern were found in the eastern half of the studied Danube river section - between Nikopol/Turnu Magurele and Silistra/Calarasi - in 2011 - 105 pairs (55.5% of the whole population), in 2013 - 128-133 pairs (92.2%). Along the western half of the section (between Timok mouth and Nikopol/ Turnu Magurele) there were 84 pairs (44.5%) in 2011, and 11 pairs (7.8%) were recorded in 2013.

In 2011, the largest colonies were situated on sand islets at Popina (21.2% of all counted pairs), at Kicha island close to Gorni Tsibar (19.6%), at the mouth of the river Yantra (14.8%) and on sand islet at the mouth of Ogosta river (14.8%). Totally, 70% of all Little Tern nesting population in the studied river section were concentrated in these four most important colonies. In 2013, 84.5% of the entire population of the Little Tern was concentrated in two major colonies – at the sandpit close to Golyama Burzina island and on the upper part of Batin island.

In all cases of colonial breeding, the Little Tern was found in mixed colonies with the Common Tern and (or) other waders.

We studied a total of 23 nests of Little Terns, of them three colonies were studied at Popina, at the mouth of Yantra river and at island Kicha in June 2011. Little Terns were already presented in the colonies in May 2011, but nests were not built except for a few cases of well formed inundations without eggs. The clutches found in June consisted of 1-3 eggs and in one case - three eggs and one hatchling. The average number of the eggs was 2.5 (SD: 0.837, n=7). In the nests, we recorded between one and three hatchlings, on average 2.375 hatchlings (SD: 0.86, n=16). Size of the eggs from the colony at Popina: 30.1 -32.9 mm × 22.2-23.4 mm, on average 31.38 (SD: 1.2) × 23.12 mm. (SD: 0.46, n=6).

At the same time the stage of breeding in different pairs inside the colonies varied substantially. For example, on 22 June 2011 in the colony at the mouth of Yantra river we found one nest with three eggs and one hatchling, three nests with three eggs each, three nests in each with three hatchlings, two nests with two hatchlings, one nest with one egg and one hatchling (Fig.6) and one nest with one hatchling.

Little Ringed Plover (Charadrius dubius)
In 2011, a total of 62 nesting pairs were counted in 26 localities. Between the counts in May and...
June 2011, the numbers increased in 45%. Only 16 pairs were detected in 2013. Many of the recorded pairs found on islands with colonies of terns and other waders were out of these colonies. The nests of other pairs were detected inside these colonies.

In 2011, 23 pairs (37.1%) of Little Ringed Plovers were found in the western half of the studied river section (between Timok and Nikopol/Turnu Magurele) and 39 pairs in the eastern section (62.9%), from Nikopol/Turnu Magurele downstream.

Out of all 62 pairs recorded in 2011, 42 pairs were on Bulgarian islands, 13 pairs on Romanian islands and 7 pairs on the border islands.

Two nests of Little Ringed Plovers were found on 23.05.2011 on the sand island close to the eastern part of Persina island consisting one and four eggs respectively. The size of the eggs was 28.0-29.8 mm × 21.8-22.3 mm; on average - 29.00 (SD: 0.58) × 21.96 mm.(SD: 0.493, n=5). The nests were just small inundations in the sand without any bulding material. A pair with two hatchlings was observed on 23.06.2011 on a sandpit close to Kozloduy island. Close to the same location, on the Bulgarian shore one pair leading one hatchling was found. Two pairs with hatchlings were seen on 24.06.2011 on a sandpit close to Gorni Tsibar village. One pair with one hatchling was observed also on the sandpit at the mouth of the Yantra river on 22.06.2011.

Avocet (Recurvirostra avosetta)

In 2011, a total of 80 pairs of Avocets were counted in the studied river section in eight breeding localities. Solitary birds were also seen in two other localities. In 2013, only two pairs were recorded on a sand island close to Batin island. In all cases breeding of the species was colonial with numbers of the nesting pairs varying between 2 and 43. Most of the colonies were mixed with terns and other wader species. The largest colonies were located on a sand island close to Persina island (53.7% of all pairs counted in 2011), at Popina (20%) and on an island at the mouth of Yantra river (8.8%). About 82% of all recorded breeding pairs of Avocets were concentrated in these three colonies. In 2011, 14 pairs of Avocets nested on the Bulgarian islands, 21 pairs on the Romanian and 45 pairs on the border islands.

Almost the whole breeding population of Avocet in 2011 was found in the eastern part of the studied river section - between Nikopol/Turnu Magurele and Silistra/Calarasi - 75 pairs (93.7%).

A total of 16 nests from three of the colonies were investigated; at a sand island close to Persina island, on island at the mouth of Yantra river and on sand island at Popina. The size of the clutch varied between 1 and 4 eggs, on an average of 3.4 (SD:0.986) (n=15). The nests were inundations in the sand without building material or with scarce material of mussel shells or wooden sticks (Fig. 7). All recorded nests in May 2011 were in the egg stage. In June 2011, we found nests with eggs at Persina and one nest with three hatchlings (Fig. 8). Size of the eggs of the Avocet from the previously mentioned three breeding colonies: 46.3 – 50.2 X 31.8 -36.0 mm, on average 49.1 (SD:2.106) X 34.8 mm,(SD:1.447) (n=7).

Oystercatcher (Haematopus ostralegus)

In 2011, a total of 15 breeding pairs of Oystercatchers were found in 10 localities. In 2013 individuals of that species were not observed. In seven
of the localities we detected solitary pairs and in the rest three localities – groups of 2-3 pairs. In all localities except one (Kalnovats) the Oystercatchers were recorded in a colonies of terns and/or Avocets. In most of the cases, the species was present in the larger colonies.

In June 2011, the numbers of the breeding pairs of Oystercatcher increased in 53.3% compared to May 2011, which refers to a late arrival of the majority of the pairs. The most of the breeding Oystercatchers were in the eastern part of the studied river section (Nikopol/Turnu Magurele – Silistra/Calarasi) with 12 pairs (80%).

From the recorded 15 pairs, nine were on Bulgarian islands, three pairs on Romanian islands and three pairs on islands on the border line.

Oystercatcher nests were not found but two families leading hatchlings were observed. On 23.06.2011 on a sandpit at Lakut island three pairs were observed, one of them leading two hatchlings. On the same date one pair leading one hatchling was observed on the island Kicha at Gorni Tsibar village.

Discussion

The high numbers of breeding terns and waders recorded in 2011 and 2013 along the Bulgarian-Romanian section of the Danube can be compared with the very few previously reported cases. Similar significant breeding colonies of Common Terns, mixed with Little Terns, were recorded along the Bulgarian-Romanian Danube section in 20th century but they referred only to the terns (Talpeanu 1965, Spitzenberger 1966, Nankinov 1993). According to Spitzenberger (1966) in the single breeding season of 1965 six colonies of Common Terns with 211 breeding pairs were counted between Vidin and Sulina. In the same year in four of these colonies Little Terns were also found to nest –27 pairs in total. Undoubtedly, as in 2011 and 2013, that year offered optimal conditions for breeding of terns and waders. In 1979, Nankinov (1993) reported about the existence of a colony of 100 pairs of Little Terns nesting on the Danube island of Tsibar at Dolni Tsibar village. Colonies of Little Terns were later discovered on an island to the east of Nikopol, at Svishtov and at Rousse (Nankinov & Darakchiev 1980).

In all the other cases, the nesting of Common Tern, Little Tern, Avocet or Oystercatcher were of a sporadic or occasional character in very small colonies or solitary pairs and the breeding localities were highly unstable at the time. According to the most recently published sources the breeding numbers of Little Tern along the Bulgarian section of the Danube is estimated as being “up to 10 pairs” (Bedev & Dimitrov 2011). The species is mentioned as one that a breeding species along the Danube from the Romanian side between Calafat and Bechet (Petrescu 2002). We have observed this species in Danube on 30. May 1997; one individual close to Kalimok island, on 16.05.2005; one pair at a sand islet to the west of Belene town, on 14. June 2005; three pairs in the area “YozĂ” also to the west of Belene, on 17 May 2005; one pair at the mouth of the Osam river and on 22 July 2009 and one pair at Gorni Tsibar (Shurulinkov et al. 2005; Shurulinkov & Tsonev 2009; P. Shurulinkov - unpublished data). Solitary pairs of Little Terns have also been observed along the Danube at the villages Baykal and DobrĂ do during the breeding period (Paspaleva – Antonova 1961), at Svishtov (Patev 1950), at Prundu (Papadopol 1965), at Calarasi, Nedeia, Rast and Bistroc (Papadopol & Talpeanu 1987). Common Terns were recorded in many cases with low numbers during the breeding period – on a sandpit at mouth of the river Osam - two pairs in June, 2003, and at Persina island – regularly solitary pairs or groups up to 10 birds were noticed (Shurulinkov et al. 2005). About 15 pairs of Common Terns were recorded as nesting on Persina island in 1971 (Ivanov 1985). Small numbers have also been recorded from the Romanian side of the Danube – at Lake Greaca and Calarasi (Papadopol & Talpeanu 1987).

Obviously, the formation of large colonies of terns and waders along the Bulgarian-Romanian section of the Danube is a rare occasion, only happening during the spring and summer of those years with very low water levels. In other years these species do not breed along the river, or only in very low numbers. The present study showed the enormous habitat potential of the Danube river to attract high numbers of terns and waders for nesting if the hydrological conditions are favorable, and underlines the significance of the sand islands and sandpits for colonies of these birds.

We are not aware of any published data about the presence of colonies of Avocets along the Bulgarian-Romanian section of the Danube. In the first half of 20th century the species had been observed close to the Danube in the Svishtov marsh, and the species probably nested there (Flericke
1941). During the breeding season the species has also been observed along the Danube by Boetticher (1927). In the past the species was noticed only as a regular migratory bird along the Danube by most of the researchers worked in that area (Paspaleva-Antonova 1961, Talpeanu 1965). At the beginning of August 2002, Avocets were observed in Suhai lake at Zimnicea and it was noted that this wetland offers an appropriate habitat for the nesting of this species (Petrescu, Chișmărea 2003).

One pair of Avocets was observed west of the town of Belene during May and June 2005 and one adult Avocet was observed on 22 June 2006 in flooded meadows close to Slivo Pole, Rousse district very close to the Danube River (Shurulinkov et al. 2009). Recently published sources mention that along the Danube Avocets can be observed incidentally during the breeding period (Dimitrov 2011). In May – June 2010, two pairs of Avocets were found to nest in the vicinity of the Danube in flooded meadows between the villages Dabovan and Zagraždhen, in the Pleven district (Shurulinkov et al. 2013). The present study showed for the first time the existence of Avocet colonies at or close to, the course of the Danube on Bulgarian territory namely at Persina and Popina. However, it can be assumed that such colonies have existed on the Danube in the past, during years when there have been favorable hydrological conditions.

The Oystercatcher has been recorded as an irregular breeding species along the Bulgarian-Romanian section of the Danube, probably on the former Karaboaz Marsh (Nankinov 1979) and definitely proved on the island of Tsibar (Ibisha) in Gorni Tsibar village two pairs (Boev 1991) and on an island at Kozloduy two to three pairs (Tinchev 1997). Solitary individuals were observed also on 16 May 1993 at Silistra, on 20 May 2005, 4 July 2005 and 14 June 2006 to the west of Belene and on 22 June 2005 at Ryahovo village, Rousse district (Shurulinkov et al. 2009; P. Shurulinkov - unpublished data). In all these cases it is probable that solitary pairs have nested, although the total numbers of the Oystercatcher breeding population along the Bulgarian section of Danube remains unknown. According to Boev (1991), it is probable that about 10 pairs of that species bred in that area. This estimate is similar to the results obtained in the present study.

Stone Curlew has been recorded during the 1960ties as a rare breeding bird along the Danube from the Romanian side – at Bistrita, Ciuperceni et Orlea and Ciuperceni Noi (Talpeanu 1965). From the Bulgarian side of the studied river section the species was found nesting (two to three pairs) at “Yoza” area to the west of Belene town (Shurulinkov et al. 2005).

The huge significance of the Danube for the breeding and conservation of terns and waders can be understood from the numbers presented in Table 2. The population of Little Terns nesting only on the Bulgarian and border islands of the Danube reaches 61% from the maximal estimated Bulgarian breeding population of that species. For Common Tern and Oystercatcher, these are 18 and 20 percent, respectively. These results prove the need for the conservation of the sand islands along the Bulgarian-Romanian section of the Danube, including the implementation of international cooperation for that purpose.

The average clutch size of the Common Tern obtained in the present study – 1.93 eggs, is lower compared with the values obtained from “Poda” area close to Bourgas, SE Bulgaria -2.45 (Nankinov et al. 1997) and in Switzerland where that annual clutch size varies between 2.66 (April) and 2.75 (May) (Glutz von Blotzheim 1964). Nests of Common Terns containing four eggs were recorded twice during the present study. Four egg clutches have been found in two cases in the southern salt pans of Atanassovsko Lake close to Bourgas, SE Bulgaria in 2002 (Svetla Dalakchieva & Konstantin Popov – pers. communication). Clutches of up to six eggs have also very rarely been recorded in Switzerland, in the Caspian region of Russia and in the USA (Glutz von Blotzheim 1964, Shterbina 1979, Conover 1984). The clutch size of Little Terns from Bulgaria varies between one and three eggs (Nankinov & Darakhchiev 1980). Average clutch size of the Little Terns obtained in the present study – 2.5 eggs, is only slightly lower when compared to the value from the Ebro Delta in Spain - 2.66 (Oro et al. 2004) but it is much larger than the value of 1, 73 from a colony found recently in Algeria (Metalliaoui, Houhamdi 2014). The nest found at the mouth of the Yantra River, with three eggs and one nestling, is interesting because cases of four eggs have not been recorded in Bulgaria until now and rarely such cases have been reported in Russia (Zubakin 1988).

The average size of the clutch of the Avocet recorded along the Danube in 2011 (3.4 eggs) does not differ from the value registered at the Atanassovsko Lake - 3.395 eggs (n = 783) (Nanki-
Table 2. Breeding numbers of Common Tern (Sterna hirundo), Little Tern (Sternula albifrons), Avocet (Recurvirostra avosetta) and Oystercatcher (Haematopus ostralegus) on Bulgarian and border islands along the Danube in 2011 and comparison to the estimated total population numbers for Bulgaria taken from different sources.

<table>
<thead>
<tr>
<th>Species</th>
<th>Breeding numbers for Bulgaria, (Birdlife International 2004) (in pairs)</th>
<th>Breeding numbers for Bulgaria, (Nankinov et al.2004) (in pairs)</th>
<th>Breeding numbers for Bulgaria (Jankov ed. 2007) (in pairs)</th>
<th>Maximal estimated breeding population in Bulgaria (in pairs)</th>
<th>Breeding numbers of the population in Danube in 2011 (only on Bulgarian and border islands), (in pairs)</th>
<th>% of the numbers in Danube from the maximal estimated breeding population in Bulgaria (according to Iankov ed.2007)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Tern (S. hirundo)</td>
<td>180-540</td>
<td>400-500</td>
<td>500-1200</td>
<td>1200</td>
<td>220</td>
<td>18,3</td>
</tr>
<tr>
<td>Little Tern (S. albifrons)</td>
<td>60-150</td>
<td>100-150</td>
<td>100-220</td>
<td>220</td>
<td>135</td>
<td>61,4</td>
</tr>
<tr>
<td>Avocet (R. avosetta)</td>
<td>210-530</td>
<td>450-550</td>
<td>250-790</td>
<td>790</td>
<td>59</td>
<td>7,5</td>
</tr>
<tr>
<td>Oystercatcher (H. ostralegus)</td>
<td>25-50</td>
<td>30-50</td>
<td>30-50</td>
<td>50</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>

The eggs of the Little Terns measured during the present study do not differ in their length from the values published for the Bulgarian Black Sea population of the species (Nankinov et al.1997), but they are on average shorter – 23.12 mm compared with 24.4 – 25.2 mm. However, compared with the egg size of Little Terns from Greece (Makatsch 1974), the values obtained in the present study are identical, both in their length and width. Similarly, the average size of the eggs of the Avocets from the Danube islands, - 49, 24 mm (n = 7), is much closer to the values obtained from Greece - 49, 16 mm. (n = 109), but differs from the egg size of the species in Hungary - 50, 53 mm (n = 36) and Southern Bulgarian Black Sea coast - 50, 71 mm. (n = 291) (Makatsch 1974, Nankinov et al. 1997).

The breeding of Common Terns on barges has not so far been recorded in Bulgaria (Nankinov et al. 1997, Iankov, ed. 2007) but barges were identified as temporary nesting sites for Caspian Terns (Sterna caspia) in the Columbia River, USA (Collis et al. 2002).

Threats to the breeding colonies of terns and waders along the Bulgarian-Romanian section of Danube

The most serious threat for the future of the colonies of terns and waders on the islands along the Bulgarian-Romanian section of Danube are some already implemented or planned projects for dredging the riverbed with the aim of increasing the water depth in some shallow areas, and the hydrotechnical consolidation of the riverbank. These projects are connected with the river shipping and protection against the riverbank erosion. The planned and already partially implemented measures destroy the small sand islets and sandpits and thus the breeding habitat of terns and waders. Future projects for large-scale dredging in the areas around the Belene (Persina) archipelago, Vardım Island and Batin Island will negatively affect the breeding populations of terns and waders.

A further serious threat were the great variations in the water levels as a result of the heavy rainfalls in Central and SE-Europe and the artificial management of the water quantities released from the large dam lakes “Iron Gates” -1 and 2 built on the Romanian-Serbian section of Danube. In many cases the Danube water levels increased or decreased dramatically, which surely was anthropogenic in origin. Most hazardous were the rapid increases of the water level during the second half of May and in June. This lead to the flooding of many sand islands that hosted colonies and nests of terns and waders and is the reason for the loss of a considerable of the eggs and the offspring of these birds. The impact was strongest in the western part of the studied river section particularly between Timok and Oryahovo – the section closest to “Iron Gates” dam. In general, the numbers of colonies and pairs in that section was significantly lower compared with the river sections downstream, where the variations in the river levels were much smaller. Flooding of the nests is the main threat for Common Tern colonies in Venice lagoon, Italy and leading to a dramatic
decline of that population over the last 20 years (Scarton, 2010). Flooding was also the most common threat causing low productivity levels in Common Tern population on Petitt Island, USA (Palestis, Hines 2015).

A third threat was the disturbance caused by humans with boats stopping at the sand islands. On many of these islands people spend much time sunbathing or fishing, and causing considerable disturbance for the breeding terns and waders. Humans or other potential predators coming closer than 10 m to the colonies always leads to a mass takeoff of all the incubating birds. This allows some birds –mostly Hooded Crows (Corvus cornix) and Yellow-legged Gulls (Larus michahellis) to approach the unprotected colony and seize and eat some of the eggs or the hatchlings. Large gulls and the crows are mentioned as the main predators of Common Tern and Kamchatka Tern colonies in Sakhalin Island, Russia (Tsunov, Blokhin 2014) and for Avocets nesting on the German shores of Wadden Sea (Hotker, Segebage 2000). This disturbance can also lead to the overheating or cooling of the eggs the absence of the adult birds.

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