Habitat distribution of breeding waterbirds of Srebarna Managed Reserve, NE Bulgaria

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Abstract: In the present study we observed the habitat distribution of breeding waterbirds in Srebarna Managed Reserve. We also estimate the influence of decrease of water depth on the number of breeding pairs and their distribution. Nest mapping was used to estimate the number of breeding pairs. The results show that in Srebarna Reserve have five very important areas for the breeding of waterbird species and the short-term changes in water depth have serious influence on the number of breeding pairs of nesting waterbirds.

Key words: Srebarna Reserve, waterbirds, habitat distribution, water level

Introduction

The world-wide loss of wetlands has significantly increased the needs to manage these types of habitats to sustain their biodiversity especially birds. Many factors determine the viability of wetlands, but the water depth proves to be the most important (Taft et al., 2002; Reitan & Sandvik, 1992). The state of other wetland parameters, like water surface area, suitable feeding sites, vegetation cover, depend on the water level and their alteration can affect bird species diversity and numbers (Fasola & Barbieri, 1978; Gec, 1983; Elmberg et al., 1994; Musil & Janda, 1997; Crivelli et al. 1998; Vogrin, 1999, Kosinski, 1999).

The Srebarna Lake is situated in northeast Bulgaria. It is a Ramsar site (1975), UNESCO biosphere reserve (1977), Monument of World Cultural and Natural Heritage (1983) and Important Bird Area (1990) due to its very rich bird fauna and particularly the breeding of the globally threatened species Dalmatian Pelican (*Pelecanus crispus*), Pygmy Cormorant (*Phalacrocorax pygmeus*) and Ferruginous Duck (*Aythya nyroca*). Many European and Bulgarian scientist were stimulated by the high bird diversity and
mainly the permanent colony of the Dalmatian Pelican and mixed heronry (Hodek, 1882; Lorenz-Liburnau, 1893; Reiser, 1894; Petrov, 1947; Patev, 1950; Petrov and Zlatanov, 1955; Mountfort and Ferguson-Lees, 1961; Geissler, 1962). Comprehensive studies on the ornithofauna of Srebarna Lake were carried out by Paspaleva-Antonova (1961a,b) and Michev (1966, 1968, 1981).

The aim of this study is firstly to describe the breeding waterbird species composition, their numbers and habitat distribution 40 years after the last studies. Secondly we tried to look for the possible influence of variations in the water level on birds’ number and distribution.

Materials and methods

The research was carried out in the Srebarna Managed Reserve (806 ha). The lake is situated at the Danube River, 18 km west of the town of Silistra, NE Bulgaria. In the northern part of the reserve is situated Komluka Island.

The observations were made during the breeding period (April-June) in 2001 and 2002. The open water areas were examined by boat. Observations were made between 8.00 and 12.00 a.m. Nest mapping was used to estimate the number and density of breeding pairs. The number of breeding pairs was based on the number of nests found and also on the number of individuals estimated at the beginning of the breeding period (April) in the open water areas, because some parts of the reserve were inaccessible with boat. We also measured the average water level in different part of the lake in the two studied years.

Four habitat types were identified in the study area according to the classification of Devilliers and Devilliers-Terschuren (1996): reed-beds habitat, mesophytic and hygromesophytic grassland habitat, White Willow (Salix alba) and White Poplar (Populus alba) habitat on Komluka Island and Water-lily (Nymphaea alba) habitat (Fig. 1).

Reed-beds habitat occupies the largest part of the reserve area and could be divided into two microhabitat types. The bottom-growing reed-beds - BgRb (285 ha) can be found in all costal parts around the Srebarna Lake. There are open water areas of variable sizes amongst the vegetation. The dominant plant species is the Common Reed
(Phragmites australis) but there are other plant species (Salix cinerea, Typha angustifolia, Typha latifolia, Schoenoplectus lacustris, and also Nymphoides peltata, Potamogeton crispus), too. We defined four patches (№ 1, 2, 3 and 4) in this microhabitat based on species concentration (Fig. 1). The patches are units of habitat that are heterogeneous when compared to the whole (Barnes, 2000).

**Fig. 1.** Habitat types and patches in Srebarna Manage Reserve (I – Reed-beds habitat; I a – Floating reed-beds microhabitat; I b – Bottom growing reed-beds microhabitat; II – White Willow and White Poplar habitat on Komluka Island; III – Mesophylic and hygromesophylic grassland habitat; IV – Water-lily (Nymphaea alba) habitat; 1, 2, 3, 4, 5, 6, 7 – patches).
The floating reed-beds - FlRb (170 ha) are clumps of floating reed-beds which can be moved by strong winds. This microhabitat is located in the central part of the Srebarna Lake and the reed-beds are surrounded by a large expanse of open water (95.5 ha). We defined three patches (№ 5, 6 and 7) in this microhabitat (Fig. 1).

Mesophylic and hygromesophylic grassland habitat - MesoHyg (111.5 ha) is a dry area where *Phragmites australis*, *Typha angustifolia*, *Typha latifolia*, *Carex pseudocyperus*, *Carex distans*, *Tanacetum vulgare* are the most common plant species.

White Willow (*Salix alba*) and White Poplar (*Populus alba*) habitat (WIWp) is present on Komluka Island and occupies an approximate area of 19 ha in the northernmost part of the reserve. Besides the dominant plant species (White Willow and White Poplar), in this habitat also presented *Ulmus minor*, *Acer pseudoplatanus* and various undergrowth represented by shrub species (*Rubus caesius*, *Rubus idaeus*).

The Water-lily (*Nymphaea alba*) habitat (WatLil) has an impermanent patchy distribution throughout the reserve.

One per breeding period we also estimated the number of arriving and leaving bird species individuals in the heronry in 2001 and 2002.

The percent participation of four trophic groups (phytophagous, zoophagous, ichthyophagous and omnivorous) was compare.

We examined the differences between number of breeding pairs in two studied years and in two microhabitats in two years according to t-test. Chi-square test ($\chi^2$) was used to compare the relative abundance of breeding pairs in 2001 and 2002. For these analyses we used STATISTICA package. Shannon’s diversity index ($H^*$) and G evenness index was used to compare the bird diversity in two studied years and in two microhabitats (Baev & Penev, 1995).

**Results**

During the two-years study period a total of 33 breeding waterbird species were established in the Srebarna Managed Reserve. They belonged to the six orders: Podicipediformes (4 species), Pelecaniformes (3 species), Ciconiiformes (9 species), Anseriformes (9 species), Gruiformes (4 species) and Charadriiformes (4 species). The
data on the bird species composition and their percent participation in the study area for 2001 and 2002 is shown in Table 1. In 2001, 30 waterbird species were found and in 2002 the established species were 33. The mean number of breeding pairs in the area in 2001 was 75 and in 2002 they were 39. The mean density in 2001 was 0.11 pairs/10 ha (range 0.00 - 0.59) and in 2002 it was 0.05 pairs/10 ha (range 0.00 - 0.51). The two years are differed from one another in number of breeding pairs \( t = 2.7; p < 0.05 \). The evaluation of Shannon’s index show no differences \( t = 1.31; p = 0.05 \) in the bird diversity between 2001 \( H^- = 2.66 \) and 2002 \( H^- = 2.71 \). The evenness index \( (G) \) for the 2001 is 0.326 and for the 2002 is 0.175. We also found that the decrease of breeding pairs were highest in the group of zoophagous than in others trophic groups (Fig. 2).

The relative species richness of the breeding waterbirds in different habitats studied in the reserve in 2001-2002 is presented in Figure 3 (the total percent is more than 100% because some species inhabiting more than one habitat). From the 33 estimated bird species 73% (24) are permanent inhabitants of the reserve (species in bold in Table 1). These species have been observed for a long period of time, since Reiser (1894), in the study area.

The prevailed waterbird species in 2001 were Cormorant (17.50%), Coot (15.50%) and Pygmy Cormorant (13.10%). In 2002 the highest percent abundance had the Cormorant (28.0%) (Table 1). Comparing the relative abundance of waterbird species it was found that there is no difference between 2001 and 2002 \( \chi^2 = 38.8; p < 0.19 \). In four bird species (12%) are concentrated 50% of the breeding pairs in the two studied years. The species from order Pelecaniformes dominated (36 % in 2001 and 41% in 2002) over the species from other orders.

**Table 1.** Number of pairs (N) and percent abundant (N%) of waterbird species on study area in 2001 and 2002.

<table>
<thead>
<tr>
<th>№</th>
<th>Species</th>
<th>2001</th>
<th>2002</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>N%</td>
</tr>
<tr>
<td>1</td>
<td><em>Podiceps nigricollis</em> Brehm (Black-necked Grebe)</td>
<td>2</td>
<td>0.09</td>
</tr>
<tr>
<td>2</td>
<td><em>Tachybaptus ruficollis</em> Pallas (Little Grebe)</td>
<td>27</td>
<td>1.18</td>
</tr>
<tr>
<td>3</td>
<td><em>Podiceps cristatus</em> L. (Great crested Grebe)</td>
<td>20</td>
<td>0.87</td>
</tr>
<tr>
<td>4</td>
<td><em>Podiceps grisegena</em> Boddaert (Red-necked Grebe)</td>
<td>1</td>
<td>0.04</td>
</tr>
</tbody>
</table>
In BgRb microhabitat were found 26 waterbird species in 2001, but in 2002 we observed another species – Ruddy Shelduck. The estimated number of breeding pairs in this microhabitat in 2001 (1573) was higher than in 2002 (644). In 2001 the Coot (21,3 %) and Pygmy Cormorant (19,1 %) constituted nearly 50 % of the pairs. But in 2002 the Coot (18,6 %), Little Egret (9,3 %), Pygmy Cormorant (9,3 %), Squacco Heron (7,8 %) and Garganey (6,5 %) formed the 50 % of the breeding pairs. A mixed heron colony is situated in the northern part of this microhabitat (patch 3, Fig. 1). The colony comprised nine waterbird species (Squacco Heron, Little Egret, Pygmy Cormorant, Night Heron, Gray Heron, Purple Heron, Great Egret, Spoonbill, and Glossy Ibis). In 2001 the colony occupied an area of 35 000 m². About 90 % of the nests were built on Gray Willow (Salix...
cinerea) trees and the rest on the reed-beds. The most abundant species here were the Pygmy Cormorant, Squacco Heron and Little Egret (Table 2). In 2001 the heronry species composed 43.4 % of the overall community and in 2002 – 23.8 %. The colonial bird species feed in the costal parts of the lake and in the nearby Romanian wetlands. The evaluation of individual’s number that leaving and arriving the heronry during the day show that the total in 2002 more birds (644) went to the Romanian wetlands than in 2001 (460). In three of the defined patches in Bottom growing reed-beds (patch 1, 2 and 4, Fig. 1) 16 waterbird species were observed. These patches are the main breeding site for the four Anas species, two Aythya species and for the Coot and Moorhen. The declining of water level by 0.75 m in 2002 lead to formation of shallow and dried up areas in the southwest part (patch 1) of the reserve (Fig. 1). In that way in the end of the breeding season (August) the area of Bottom growing reed-beds was decline by 37 ha. Because of the decrease of the area of their breeding sites, the decline of the number of pairs of some species was observed in 2002 (Coot, Ferruginous Duck, Pochard) (Table 2). In the contrast with southwest part of the reserve, in southeast part (patch 2, Fig. 1) the declining of water level cause the shallowness of 0.47 m, but the area was not dry in the end of the breeding season. This induces a decrease (50%) in breeding pairs of Coot, Moorhen, Mallard and Gadwall.

Table 2. Number of breeding pairs of permanent waterbird species in two different habitats and in seven patches in 2001-2002 in Srebarna Reserve

<table>
<thead>
<tr>
<th>№</th>
<th>Species</th>
<th>Bottom growing reed-beds</th>
<th>Floating reed-beds</th>
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</thead>
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<tr>
<td></td>
<td>2001 1 2 3 4 1 2 3 4</td>
<td>2002 5 6 7</td>
<td>2001 5 6 7 1 1</td>
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<td>Tachybaptus ruficollis</td>
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<td>Podiceps cristatus</td>
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<td>Phalacrocorax pygmeus</td>
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<td>Ixobrychus minutus</td>
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<tr>
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<td>Ardea ralloides</td>
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<td>Egretta alba</td>
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<td>Ardea cinerea</td>
<td>0  0  80 0  0  0  30 0</td>
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</table>
In FlRb microhabitat in two studied years were found 13 waterbird species. The estimated number of breeding pairs in 2001 (272) again was higher than in 2002 (227). The Dalmatian Pelican was the prevailed species in the two years (47.1 % in 2001 and 44.9 % in 2002). Furthermore, we observed that the pelicans were feeding in the lake, which is not happening before. Its colony is situated in patch 5 (Fig. 1). The patches 6 and 7 in this microhabitat were occupied by nine of the permanent waterbird species (A. strepera, A. querquedula, A. platyrhynchos, A. nyroca, Ix. minutus, T. ruficollis, P. cristatus, G. chloropus, F. atra). In 2002 we observed the overall decrease of breeding pairs of former species (Table 2).

<table>
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<tr>
<th></th>
<th>Ardea purpurea</th>
<th>Plegadis falcinellus</th>
<th>Platalea leucorodia</th>
<th>Anas platyrhynchos</th>
<th>Anas strepera</th>
<th>Anas clypeata</th>
<th>Anas querquedula</th>
<th>Aythya ferina</th>
<th>Aythya nyroca</th>
<th>Gallinula chloropus</th>
<th>Gadwall</th>
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<td>136</td>
<td>994</td>
<td>73</td>
<td>102</td>
<td>298</td>
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<td>29</td>
<td>36</td>
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</table>

![Fig. 2 The percent participation of the four trophic group in Srebarna bird community for the two years](image-url)
We observed no difference between number of breeding pairs in two studied years in BgRb ($t = -2.57; p < 0.05$) and FlRb ($t = -1.20; p < 0.05$) microhabitats (Fig. 3).

In Mesophylic and hygromesophylic grassland habitat in 2001 was not found waterbird species, but in 2002 was observed Lapwing and Little Ringed Plover.

In White Willow and White Poplar and in Water-lily habitats, which are not typical wetland areas, we found one waterbird species in each, respectively Cormorant and Whiskered Tern. The breeding colony of the Cormorant is in the eastern part of the island on the trees of White Poplar, and numbered 400 pairs in 2001 and 350 in 2002. The colony of Whiskered Tern in 2001 was situated in the western water bodies of the reserve, but in 2002 it located in the southeast part of the reserve (Fig. 1).

**Discussion**

The observed bird species composition remained almost constant (the difference is only three species) in the two studied years. The total number of breeding waterbird pairs in 2002 showed 50 % decrease of pairs compared to 2001 (Table 1). The decline of the breeding pair’s number of some species was obvious in the two microhabitats (BgRb and FlRb) and in all the seven patches there (Table 2). These differences could be probably due to variations of the water level. In May 2001 the observed water depth was 13.03 m (according to the Baltic system) and in May 2002 it was lower by almost 1 m, i.
The changes in water level obviously have an affect on the habitats and these changes influence the water bird’s number in the reserve. In BgRb the great decrease was observed in the heronry (patch 3). The declining of water depth caused the disappearance of shallow shore part of the reserve, which is the major feeding site for the heron species. As a result in 2002 the fly way of individuals to Romanian wetlands is increase by 184 individuals. In confirmation of this the percent of zoophagous, in which trophic group belong the species from the colony, was decrease (Fig. 2). Also, like us Paspaleva-Antonova (1961b) determine the reduction of the number of all species in mixed colony in comparison with the observation of Hodec (1882) and Reiser (1894). According to her this was a result from the building of a dike (in 1949) between the lake and Danube River, which interrupt the entering of Danube water in the reserve. The great role of water level for the species from the heronry was demonstrate again in 1993 (the water column in the lake was 0,20 m), when the Pygmy Cormorant and heron species (without Glossy Ibis and Spoonbill) left the colony site and bred on the Komluka Island (Hiebaum et al., 2000).

We also observed the reduction of breeding pairs of Coot, Ferruginous Duck and Mallard in patches 1, 2 and 4 in 2002 in this microhabitat. This change we associate with the facts that 1/ in 2002 the area of water bodies, which are abundant with food and nesting resources in these patches, decreased and 2/ because these species was numerous in 2001 and the decline in 2002 was very obvious. Reitan and Sandvik (1992) in Norway and Kosinski (1999) in Poland also confirmed that the water depth is a key factor for the number of pairs of Anas and Aythya species.

In FIRb microhabitat and in the patches 5, 6 and 7 we observed decrease of breeding pair’s number of duck species in 2002 in contrast with 2001 (Table 2). This alteration probably is due to the observed overall shallowness of 0,75 m in the lake. This almost not affected the number of pairs of Dalmatian Pelican, which feeding also in the reserve, not only in the Romanian wetlands. Crivelli et al. (1998) however declared that the water level and degradation of breeding islands are most important factors affecting the spatial distribution of breeding units of Dalmatian Pelican. But Stoyneva and Michev (1997) found that the Dalmatian Pelican colony in Srebarna reserve not influenced by
decreasing of depth of the water column.

The less change in the number of pairs of Cormorant colony in 2001 and 2002 in WwWp habitat is may be due to the fact that the colony is situated on the Komluka Island and the breeding is not affected by the water level fluctuation.

The lack of Lapwing and Little Ringed Plover in MesOHyg habitat in 2001 is explained with the fact that these species are rare for the reserve and they do not nest every year in the study area.

Although, we observed almost 50 % decreased of breeding pairs number in 2002, there was change in percent abundance in two years for some species, but for others there was not. This may be meant that there was alteration in distribution of breeding pairs over different species - the evenness index decreased almost 50 % (0,326 in 2001 and 0,175 in 2002), i. e. there is a bigger evenness in distribution of breeding pairs over the species in 2002.

The comparison of these data with those of Paspaleva-Antonova (1961a,b) showed that for the period of 40 years a change had come in the reserve. In 1961 she estimated 24 breeding waterbirds. We have recorded some species that have not been registered in the reserve in 1956 -1960’s study: the colony of Cormorant in Komluka Island, the Pygmy Cormorant and the Glossy Ibis (breeding in the mixed heron colony); the Red-necked Grebe, Graylag Goose, Little Ringed Plover, Black-necked Grebe. On the other hand, Paspaleva-Antonova (1961) recorded as a breeding species one of the rare diving ducks in Bulgaria, Red-crested Pochard (*Netta rufina*). Subsequently, this species was not found in the Srebarna Reserve.

Obviously, the water level is important factor for the number and distribution of waterbird species because it affected other environment factors such as the feeding sites and water surface area. If the processes of water level decreasing in Srebarna Lake continuo, which began in 2001 (Fig. 4), we may expect that many of the species in heronry will disappear and the number of pairs of some duck species will greatly decrease. But the different species have quite different response to habitat changes and it is necessary to continue monitoring the numbers of waterbirds, the fluctuation in water level and the food condition, to enable the lake to be managed in such a way that the favorable conditions for birds will be maintained.
Conclusions

The water level is a key factor for the ornithofauna for the wetland like Srebarna Reserve. The short-term changes in water depth have serious influence on the number of breeding pairs of waterbirds. But the long-term changes probably will affect not only the number of breeding pairs but and the bird species. The data also present that the water level is a key factor for the breeding of Coot, Ferruginous Duck, Pochard and the heron species in the colony.

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References


