

SPECIES DIVERSITY OF BREEDING WATERBIRDS OF OXBOW LAKES ON THE FLOOD TERRACE OF THE VISTULA RIVER BETWEEN CIECHOCINEK AND SOLEC KUJAWSKI

TOMASZ BRAUZE

Department of Vertebrate Zoology, Institute of Ecology and Environment
Protection, N. Copernicus University, Gagarina 9, 87-100 Toruń, Poland;
e-mail: brauze@biol.uni.torun.pl

Abstract. Qualitative studies of waterbird fauna, conducted in 2000 in 9 complexes of oxbow lakes of the total area of the water surface 41.9 ha, revealed occurrence of 17 breeding species. Low species diversity was associated with a limited and variable area of the water surface, a lack or only a very narrow strip of rush, poorly developed submerged vegetation, small depth of oxbow lakes, a lack of islands, an easy access to banks allowing for human penetration and predation pressure. Compared with birds of other waterbodies in Poland, the avian fauna of oxbow lakes was the most similar to that observed on dam reservoirs. Distinct similarity of these waterbird communities was associated with great changes of the water level, characteristic for both biotopes, which limited occurrence of reedbeds and other potential foraging and nesting sites.

keywords: species diversity, breeding waterbirds, oxbow lakes

INTRODUCTION

After regulation of large rivers of Europe vast areas of flood terraces were turned to arable land of high productivity (TOMIAŁOJĆ and DYRCZ, 1993). This process, done at the price of disappearance of many rare plant and animal species (NILSSON et al., 1991; KAJAK, 1993; DOMBROWSKI et al., 1994; NILSSON and DYNESIUS, 1994; WITKOWSKI, 1995; WARKENTIN and REED, 1999), implies the necessity to protect best preserved fragments of flood areas of large rivers. For

efficiency of conservation measures multi-directional studies are required to understand functioning of subsequent elements of this unique environment.

Oxbow lakes are the one of the least changed elements of natural environment of flood terraces. A lack of qualitative studies of breeding bird fauna of such waterbodies was the reason to undertake studies aimed at understand of species composition and an attempt to explain the character of factors that influence on species diversity of breeding bird communities of oxbow lakes in a flood terrace of a large river.

STUDY AREA

The survey covered 58 oxbow lakes on the flood terrace of the Vistula river between Ciechocinek and Solec Kujawski (723-755 km of the river course), assembled in 9 complexes of a total area of 41.9 ha of the water surface. The size of a single waterbody fell in range from 0.06 to 2.31 ha (0.72 ha on an average), the size of entire complexes was from 1 to 8.5 ha, the depth rarely exceeded 1.5 m (the level in mid-May 2000). The oxbow lakes strictly depended on the water regime of the Vistula river and presented great dynamics of water level during a year. With the progress of the breeding season the area of the water surface and the depth of studied waterbodies decreased gradually so that some shallow oxbow lakes were drying.

The most frequent syntaxon of freshwater vegetation, noted on almost all oxbow lakes, was the community of freshwater macrophytes *Nupharo-Nymphaeetum alba* and *Lymno-Spirodeletum polyrrhizae* community. Rush vegetation from the class *Phragmitetea* formed a narrow strip growing only along minor part of banks of oxbow lakes and rarely formed dense patches (maximally 5000 and 8500 m²). The limited area covered by rush (in particular by reedbed) was caused by great yearly changes of the water level (KORDAKOW, 1974). Relatively the largest area was covered by reedbed *Phragmitetum communis*, while other rushes - reedmace rush *Typhetum angustifoliae*, greater reed-mace rush *Typhetum latifolia*, sweet flag rush *Acoretum calami* and swamp horsetail rush *Equisetetum limosi* formed smaller patches. The *Magnocaricion* sedge occurring in drier places was represented by association *Phalaridetum arundinaceae* with canary reed-grass *Phalaris arundinacea*.

The major part of banks of oxbow lakes was surrounded by several- or over ten-meter strip of initial stages of a willow-poplar carr *Salici - Populetum albae*, more rarely - by mature tree stands. In the remaining lakeside areas crop fields, green crops and herbaceous vegetation dominated. Human penetration, the most intensive on oxbow lakes in the region of Toruń, was connected mainly with the presence of anglers.

MATERIAL AND METHODS

Qualitative studies of breeding waterbirds, an ecological group distinguished according to the paper of JAKUBIEC (1978), were conducted in 9 complexes of oxbow lakes from the beginning of April to the end of June 2000. Birds were observed within the waterbodies and their rush vegetation. Due to the

gradual reduction of the water surface observations covered also exposed bottoms of oxbow lakes and their rushes. In each complex a minimum of 3 morning and one evening controls were done. During an evening control the following species were stimulated by tape recorder: Little Grebe *Tachybaptus ruficollis*, Little Crake *Porzana parva*, Spotted Crake *Porzana porzana*, Water Rail *Rallus aquaticus* and Moorhen *Gallinula chloropus*. Criteria of nesting for waterbirds *Non-Passeriformes* distinguished according to based on methodological assumptions of BOROWIEC et al. (1981), considering later up-dates of RANOSZEK (1983), CEMPULIK (1985) and KOT (1986). For waterbirds from the order *Passeriformes* observations from a potential migration period, i.e. 10 days following the first record of a species during frequent field visits, were not considered.

The description of oxbow lakes includes: the area of the water surface (ha) of the whole complex and single oxbow lakes, the distribution and type of rush vegetation and size of larger patches (m²), the vegetation cover of lakes' banks and their direct vicinity, the level of water surface reduction (%) between mid-May and the end of June, the level of anthropopressure. Each complex of oxbow lakes is marked with two-letter symbols, listed in Table 1.

RESULTS AND DISCUSSION

On all studied oxbow lakes in 2000 only 17 species of breeding waterbirds were observed (Table 1). In addition, single broods of the Bittern *Botaurus stellaris*, Common Gull *Larus canus* and Goosander *Mergus merganser* were recorded in 1998-1999. The number of breeding species on the oxbow lakes was low in comparison with species diversity of birds from this group observed in Poland on small mid-field ponds - 24 species (SURMACKI, 1998), fishponds - 36 (KOT, 1986), flow lakes of the Gwda river - 43 (KARWACKI, 1991), an overgrowing eutrophic lake - 44 (BERESZYŃSKI and OGRODOWCZYK, 1995) and coastal lakes - 59 species (GÓRSKI et al., 1991).

Small surface of reedbeds, in the effect of great changes of the water level, was one of reasons for the low number of breeding species. This is suggested by studies of KOSIŃSKI (1999) which revealed a positive relation between species richness of waterbirds and the size of a reedbed. Low number of species recorded on oxbow lakes could be also caused by relatively high coverage of reed-mace rush and sedge, which are poorer in species than reedbeds as shown by the study of BUKACIŃSKI and JABŁOŃSKI (1992). The influence of the described environmental factors on the number of waterbirds is confirmed by results of the present study. The greatest species richness was recorded in complexes of oxbow lakes with the lowest level of the water surface reduction (below 20 %), the largest area of rushes and a significant participation of reedbeds (GR, PR, PJ; Table 1). The lowest number of breeding species was stated on waterbodies which dried almost entirely and on oxbow lakes with low percentage of rushes, completely lacking reedbeds (JK, DB, BT). Gradual draining of oxbow lakes and intensive putrefaction processes could lead to high deficit of oxygen that reduced the occurrence of water invertebrates and fish being food base of some waterbird species.

Table 1

Occurrence of waterbirds breeding species (+) and their frequency (%) of oxbow lakes on the flood terrace of the Vistula river between Cieclocinek and Solec Kujawski

SPECIES	SYMBOLS OF COMPLEXES OF OXBOW LAKES									%
	JK	BT	DB	DG	BP	JS	PJ	PR	GR	
Mallard <i>Anas platyrhynchos</i>	+	+	+	+	+	+	+	+	+	100.0
Coot <i>Fulica atra</i>	+	+		+	+	+	+	+	+	88.8
Reed Warbler <i>Acrocephalus scirpaceus</i>						+	+	+	+	55.5
Moorhen <i>Gallinula chloropus</i>						+		+	+	44.4
Gadwall <i>Anas strepera</i>	+		+			+				33.3
Water Rail <i>Rallus aquaticus</i>							+	+	+	33.3
Lapwing <i>Vanellus vanellus</i>			+					+	+	33.3
Kingfisher <i>Alcedo atthis</i>			+	+	+					33.3
Sedge Warbler <i>Acrocephalus schoenobaenus</i>						+	+		+	33.3
Great Reed Warbler <i>Acrocephalus arundinaceus</i>							+	+	+	33.3
Little Grebe <i>Tachybaptus ruficollis</i>								+	+	22.2
Mute Swan <i>Cygnus olor</i>								+	+	22.2
Garganey <i>Anas querquedula</i>									+	22.2
Little Ringed Plover <i>Charadrius dubius</i>			+		+					22.2
Tufted Duck <i>Aythya fuligula</i>					+					11.1
Marsh Harrier <i>Circus aeruginosus</i>									+	11.1
Savi's Warbler <i>Locustella luscinioides</i>									+	11.1
NUMBER OF SPECIES	3	4	4	4	6	6	7	8	13	
SIZE OF COMPLEXES OF OXBOW LAKES (ha)	1.65	4.90	8.47	3.98	7.77	0.98	4.57	2.04	7.51	

Small water surface and limited depth of studied oxbow lakes was the reason that among species from the family *Podicipedidae* only the Little Grebe was recorded (PR and GR). This can be explained by the fact that it this species builds nests on the shallowest waters (0.25-0.5 m of depth) in comparison with other species of grebes, as described by GOTZMAN (1965). DOBROWOLSKI (1973) proved that small area of the water surface causes a lack of species from this family on a waterbody. Strong dependence of the Great Crested Grebe *Podiceps cristatus* occurrence on the water surface area was shown by studies of JĘDRASZKO-DĄBROWSKA and CYGAN (1995). They stated the occurrence of this species in large (over 5 ha) waterbodies in Warsaw, having an oxbow lake character, while it was absent in 1-3 ha lakes. The studied oxbow lakes fell in the latter range.

An important factor limiting the occurrence of waterbirds on studied oxbow lakes was a lack of islands covered by rush. Such islands provide secure breeding places for waterbirds due to reduced accessibility for terrestrial predators (GÓRSKI, 1991). They also influence on the type of distribution and numbers of some waterbird species (JANKOWSKI, 1983; GÓRSKI, 1991; BALDI and KISBENEDEK, 1998).

An easy access to banks, allowing for human penetration and strong predation pressure was probably an additional reason of low species diversity in the described area. This assumption is partly supported by studies of BUKACIŃSKI and BUKACIŃSKA (1991), which show that decrease of anthropopressure in fishponds in Raszyn within ten years allowed for appearance of several new breeding species.

The most frequent species of waterbirds on oxbow lakes were the Mallard and Coot (Table). Only the Mallard occurred in all studied complexes, which was

probably associated with its large tolerance for varied environmental conditions. This is supported by studies of WIATR (1992), who stated great plasticity of females of this species in selection of nesting places on lakes of the Western Pomerania. Frequent occurrence of the Coot on oxbow lakes seems to be typical for flood terraces of large rivers. An attempt of typological classification of the river Saône and its tributaries in France into ornithological zones done by ROCHE and FROCHOT (1993) showed that this species is characteristic for low sections of rivers. The biotope element that distinguished these areas were the oxbow lakes.

The least frequent bird species on studied oxbow lakes were: the Tufted Duck, Marsh Harrier and Savi's Warbler (Table 1). A limiting factor for occurrence in studied complexes of the Tufted Duck, a species increasing in numbers in Central Europe (GORBAŃ, 1992; DOMBROWSKI et al., 1994; KOZULIN et al., 1998), was probably a lack of islands. This is suggested by the study of GÓRSKI (1991) which showed that in the region of the Southern Baltic coastal lakes Tufted Ducks occupied mainly waterbodies with islands. The reasons for low frequency of the Marsh Harriers in the studied oxbow lakes were its avoidance of narrow strips of rush (BALDI, 1999) and the fact that it feeds on eggs and nestlings of waterbirds (CRAMP and SIMMONS, 1980). Both limiting factors had the lowest effect in the GR complex (largest patches of dense reedbed and highest species richness of waterbirds; Table 1) and the only there the Marsh Harrier was recorded. Preferences of this bird of prey for this type of habitat were confirmed by CHMIELEWSKI et al. (1998), who stated association of this species with oxbow lakes overgrowing by reed and clumpy willows along the lower part of the Pilica river. Occurrence of the Savi's Warbler was also limited to the complex of oxbow lakes GR because this species, similarly as in the case of the Marsh Harrier, requires large areas of reedbeds (KUPCZYK, 1987; KOSTRYKO, 1989).

Statistically significant and distinct relations between the number of species and the size of complexes of studied oxbow lakes were not stated ($r = 0.25$; $P = 0.52$). This result can be interpreted if we assume that significant differences among studies bird communities did not occur due to a generally small range of the water surface area of the lakes. A lack of a distinct relation between the size of waterbodies and the number of species of waterfowl and birds breeding in rushes and littoral vegetation was stated also by KOSIŃSKI (1999), and with respect to the Reed Warbler (KOSTRYKO, 1989).

According to the ornithological classification of waterbodies in Poland presented by BOROWIEC (1981), the whole bird fauna of the studied oxbow lakes resembled the most the avian fauna of dam reservoirs, where a similar number of species (12-19) breeds. Dominants are: the Great Crested Grebe, Mallard, Coot and typical ones are: the Little Grebe, Lapwing and Little Ringed Plover. Among the listed species, only the Great Crested Grebe was not recorded on the oxbow lakes, as this species requires larger surface of open water. Distinct similarity of breeding bird communities of oxbow lakes and dam reservoirs was connected with large variation of the water level characteristic for both biotopes. This factor limits occurrence of reedbeds and a littoral zone (WIŚNIEWSKI, 1998),

which discourages many species of waterbirds. Great changes of the water level can be also a kind of an ecological trap for many bird species. CHMIELEWSKI (1997) stated that on the Sulejowski Reservoir high water levels took place in spring when birds start breeding. Then water level gradually decreased and birds abandoned nests that became connected to the mainland. An analogous situation probably took place on studied oxbow lakes. However, it should be emphasised that not all dam reservoirs in Poland meet the criteria of the ornithological typology presented by BOROWIEC (1981), and factors like e.g. location, size and the year of establishing are decisive for their distinction (STAWARCZYK and KARNAŚ, 1992; JANISZEWSKI et al., 1998).

ZRÓŻNICOWANIE GATUNKOWE WODNO-BŁOTNEJ AWIFAUNY LĘGOWEJ STARORZECZY NA TERASIE ZALEWOWEJ WISŁY MIĘDZY CIECHOCINKIEM A SOLCEM KUJAWSKIM

STRESZCZENIE

Badania jakościowe awifauny wodno-błotnej przeprowadzono od początku kwietnia do końca czerwca 2000 r. na 58 starorzeczach, zgrupowanych w 9 kompleksach o łącznej powierzchni 41,9 ha lustra wody. Na każdym kompleksie wykonano minimum 3 kontrole przedpołudniowe i jedną wieczorną połączoną ze stymulacją magnetofonową perkozka oraz chruścieli *Rallidae*. Stwierdzono występowanie 17 gatunków ptaków wodno-błotnych, spośród których najwyższą frekwencję odnotowano dla krzyżówki (100,0%) oraz łyski (88,8%). Mała liczba gatunków lęgowych związana była z niewielką i zmienną powierzchnią lustra wody, brakiem lub bardzo wąskim pasem szuwaru, słabo wykształconą roślinnością zanurzoną, małą głębokością starorzeczy, nieobecnością wysp oraz łatwym dostępem do brzegów ułatwiającym penetrację ludzką i presję drapieżników. O podobieństwie bogactwa gatunkowego na poszczególnych kompleksach starorzeczy decydowały głównie stopień redukcji powierzchni lustra wody i obecność trzcinowisk. Awifauna starorzeczy, porównywana z innymi zbiornikami wodnymi w kraju była najbardziej zbliżona do awifauny zbiorników zaporowych. Wyraźne podobieństwo tych zespołów ptaków wiązało się z charakterystycznymi dla obu środowisk dużymi wahaniami poziomu lustra wody, ograniczającymi występowanie trzcinowisk oraz innych, potencjalnych żerowisk i miejsc do zakładania gniazd.

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