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CHANGES IN THE SPATIAL RELATIONSHIPS OF SELECTED BIRDS IN THE DANUBIAN AREA INFLUENCED BY THE GABCIKOVO DAM

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ABSTRACT

The aim of the study is to analyse the spatial relationship of selected bird species in the Danubian region (the inundation area of the Danube and the channel of Gabčikovo's dam) influenced by the Gabčikovo dam operation.

Data was obtained by the line method on the transects along an artifical channel of the dam, the main flow of the Danube and in the branch system.

Data was used which has been obtained in the same way every year from 1985 to 1993 for comparison with the year 1994 (the year after the start of the dam operation).

The occurrence and spatial relationships of water birds in the inundation area directly depends on the water regime and its dynamics. Changes in the regime since the start of the dam operation have manifested themselves in the presence of some bird species and their preference of habitats (respective sites). Significant differences were noted in the preference of sites during seasonal cycles. In the sites with increased human contact some species reacted by limiting their flight distances.

INTRODUCTION

During the past, the river Danube has created by its sediments a dynamic system of branches, continually changing itself under the influence of the water flow. There existed in the area a mosaic of aquatic, terrestrial and semiterrestrial habitats. Their diversity and carrying capacity manifested themselves in the species diversity occuring in this ecosystem, which also served as an

important corridor and gathering place of migrant species. Because of its unique and particular surviving functions this area is recorded as a site of Important Bird Areas of the Slovak Republic, and since 1993 has been in the list of important wetlands of the Ramsar Convention as well. Through historical times, there have been changes in the ecosystem of the investigated area, which have been proportionate with the rising technical possibilities of man. Flood control, the adaptation of the river for shipping and later, excessive dredging of gravel led to changes in the river's character and a significant loss of branch system dynamics. Forestry gradually replaced the majority of the natural flood plain forests by managed forests with a different structure. Lastly, and may be the most important human impact was the construction and operation of the Gabcikovo Barrage System (GBS). Data about the biota status existed before the start of construction, creating the opportunity to compare the new status with the past. Birds of aquatic habitats were selected as indicators for the evaluation of changes. We investigated their spatial relationships and habitat preferences.

CHARACTERIZATION OF SITES AND METHODS

Sites were selected as being representative of the landscape as it was known before the start of the GBS construction and its operation (the main river Danube and the branch system) and the diversion channel of the GBS.

The main river Danube

Constant water flow is characteristic of this site. Along the full length of the river, the banks are almost completely made up of large quarry stone, with the occassional shallow gravel bank. After the main river was dammed near the village of Gabcikovo, the current declined to approx. 1/7 - 1/5 of the primary. The water level proportionately declined and the river narrowed itself. Gravel banks were revealed along the majority of the affected river section. Some of these revealed areas that were more than one hundred meter wide.

The branch system

During the 20th century the branches were isolated from the main river, primarily the inflow mouths. As the river bed eroded, the water flow through the branches gradually dwindled so that in the years immediately preceeding the start - up of the GBS, the water in the branches was mostly stagnant. Seasonal floods and minimal water level dynamics existed because of the river natural regime. The seasonal cycles of the spatial relationships of the biota also adapted themselves. Branch banks are forested by shrubs and trees of willow (*Salix sp.*), poplars (*Populus sp.*), and in certain areas, a growing reed (*Phragmites communis*). Submerged macrophytes were rare in the past because of the dynamic water regime. Shallow gravel or mud banks were exposed during times of low water levels.

The diversion channel of the GBS

The channel is an artificially constructed water route flowing at a higher level than the surrounding landscape. It serves for shipping and water leading to a hydro - electric power plant. Banks have been created by asphalted gravel dams. Along the top of these dams is an asphalt road.

Data was obtained by the line method from January to August 1994. Data was used which had been obtained in the same way every year from 1985 to 1993 for comparison purpose with the year 1994 (the year after the start of the dam operation). The investigated section of main Danube river was delineated by river marking from 1821 - 1835 kilometers in a total lenght of 14 km. Within the branch system transects led through newly constructed small dams. The total lenght of the transect was 5 km. In the diversion channel we obtained data from the top of its dam, the full channel lenght is 17 km.

RESULTS

During the investigation we recorded 52 bird species of aquatic habitats (**Table 1**). From this number we selected 8 easily identifyable regularly occuring species. Their minimal and maximal relative numbers in the investigated sites are tabulated (**Table 2**). In comparing the spatial

relationships of the selected species to the natural landscape sites and the artificial channel, it was found that the *Phalacrocorax carbo*, *Egretta alba* and *Haliäeetus albicilla* species were most closely dependendent upon the main river and branch system of the Danube.

Table 1: List of observed bird species in investigated sites

Species	GBS	D	Species	GBS	D
Gavia stellata (Pontopp.)	+	-	*Mergus merganser L.*	-	+
Podiceps nigricollis Brehm	+	-	*Somateria molissima (L.)*	+	-
Podiceps cristatus (L.)	+	+	*Circus aeruginosus (L.)*	-	+
Podiceps ruficollis (Pall.)	+	+	*Milvus migrans (Bodd.)*	+	+
Phalacrocorax carbo (L.)	-	+	*Haliäeetus albicilla (L.)*	-	+
Ardea cinerea L.	+	+	*Pandion haliaetus (L.)*	-	+
Ardea purpurea L.	-	+	*Fulica atra L.*	+	+
Egretta alba (L.)	-	+	*Gallinula chloropus (L.)*	-	+
Egretta garzetta (L.)	-	+	*Charadrius dubius Scop.*	-	+
Nycticorax nycticorax (L.)	-	+	*Numenus arquata (L.)*	-	+
Ixobrychus minutus (L.)	-	+	*Actitis hypoleucos (L.)*	-	+
Platalea leucorodia (L.)	-	+	*Tringa ochropus L.*	-	+
Ciconia ciconia (L.)	-	+	*Tringa nebularia (Gunn.)*	-	+
C. nigra (L.)	-	+	*Tringa totanus (L.)*	-	+
Cygnus olor (Gm.)	+	+	*Philomachus pugnax (L.)*	-	+
Anser sp. Briss.	-	+	*Vanellus vanellus (L.)*	-	+
Anas platyrhynchos L.	+	+	*Recurvirostra avosetta L.*	-	+
Anas penelope L.	-	+	*Larus canus L.*	+	+
Anas stepera L.	-	+	*Larus argentatus Pontopp.*	+	+
Anas acuta L.	-	+	*Larus ridibundus L.*	+	+
Anas querquedula L.	+	+	*Larus minutus Pall.*	-	+
Anas crecca L.	+	+	*Sterna hirundo L.*	-	+
Aythya ferina (L.)	+	+	*Chlidonias nigra (L.)*	-	+
Aythya nyroca (Ghld.)	-	+	*Alcedo atthis (L.)*	-	+
Aythya fuligula (L.)	+	+	*Bucephala clangula (L.)*	+	+
Clangula hyemalis (L.)	+	-	*Mergus albellus L.*	-	+

D - main river and branch system of the Danube; GBS - the Gabcikovo Barrage System

\+ presence , - absence

Table 2: Occurence of selected bird species in investigated sites

Species		Jan.	Feb.	March	Apr.	May	June	July	Aug.
Phalacrocorax carbo L.	D	0.2-1.1	0.3-18.3	1.1-3.7	3.6-9.2	3.9-9.7	0.3-26.3	0.6-1.9	6.3-26.8
	GBS	0	0	0	0	0	0	0	0
Ardea cinerea L.	D	0.2-1.2	0.1-0.5	0.1-0.5	0.8-1.5	0.1-1.3	0.1-1.3	0.2-1.6	0.9-3.9
	GBS	0.3	0	0	0.1	0.1-0.9	0	0	0.1-0.4
Egretta alba L.	D	0.8-2.2	1.2-1.9	0.8-1.3	1.1-2.5	0.3-0.6	0.1	0.1-0.2	2.2-7.5
	GBS	0	0	0	0	0	0	0	0
Anas platyrhynchos	D	12.4-39.5	11.5-21	4.2-15.8	0.3-6.4	0.8-5.3	0.4-1.3	0.8-4.5	10.3-15.6
	GBS	56-289.1	1.8-88.2	3.2-4.5	0.2-1.3	0.2-0.7	2.1-12.9	0.7-2.5	7.1-13.5
Cygnus olor Gm.	D	0.1-0.5	0.1-1.5	1.2-2.9	1.3-2.9	0.3-0.5	0.1-0.3	0.1-0.2	0.1-0.3
	GBS	0.8	0	0.4-0.9	0.4	0	0	0	0
Larus ridibundus L.	D	0.3-1.4	1.8	0.2-0.3	0.2-0.5	0.6-1.9	0.6-6.4	0.6-2.1	1-4.3
	GBS	0.4-5.6	0.3	0.8-5.4	1-1.2	0.2-0.5	0.5-0.5	0.1-0.7	0.7-5.6
Fulica atra L.	D	1.7	0.3-4.2	0.3-2.6	0.3	0.1	0	0.1-0.3	0.6-0.9
	GBS	0.4-10.2	0.4	0.9-3.5	0.2	0	0	0.1-0.2	0
Haliäeetus albicilla L.	D	0.1-0.4	0.1-0.4	0.1-0.2	0.1	0.1	0	0	0.1
	GBS	0	0	0	0	0	0	0	0

D - main river and branch system of the Danube; GBS - the Gabcikovo Barrage System

During the winter of 1994, the species of genus *Anas* and *Fulica atra* prefered the open water and asphalt banks of the artifitial derivation channel. During the breeding season these species migrated and lived in the branch system until the juvenils became independent. The diversion channel of the GBS attracted birds mostly during the winter, it does not have conditions for breeding.

DISCUSSION

Through the comparison of the present results with our own data and published data from the period preceeding GBS function we have noted several significant changes. In contrast to the past (Bohus, unpubl. data) we have noted an increase of the *Fulica atra*, *Gallinula chloropus* (*L.*) and *Podiceps ruficollis* (*Pall.*) breeding populations within the branch system. This phenomenon could be attributed to population trends, but is more likely connected with the stabilized water level which is enabling successful breeding, as well as with phytocenological changes (submerged macrophytes developing). Again, in contrast to the past (Bohus, unpubl. data) during the summer of

1994 and 1993 more adults of *Ardea purpurea L.* were recorded in the branch system. An abundance of this species rose to approximately 20 specimens after the juvenals became independent. Not long ago (Balát, 1963; Balis, 1952; Matousek, 1961 and Kux, Randik 1961 in Hudec *et al.*, 1972) this species nested on the Slovak side of the Danube, but as a result of destruction and the changed character of the breeding sites, nesting now takes place only on the Hungarian side of the river. During the investigated period this species utilized the area only as a trophic base. According to our records from recent period, shallowed branches during low water levels were an important trophic base mostly during post breeding translocations and migration of *Ciconia nigra*, *Ardea cinerea* and *Egretta alba*. In 1993, this important function did not occur due to the stabilized water regime which was accomplished through water supplied to the branches by the GBS. As a result, the above mentioned species did not group themselves in common gatherings but occured only singly. During the summer of 1994 abnormal reduction in the branch system water supply caused partial to absolute emptyig of the lower branch system section, in which 142 *Egretta alba*, 70 *Ardea cinerea* and 68 *Ciconia nigra* gathered during August 1994. Notable changes in the spatial relationships of *Phalacrocorax carbo* were recorded. After the damming of Danube and emptying of its branch system during the winter of 1992/93, species were concentrated in the reduced main river Danube (Bohus, unpubl. data). Following the rise in the fish population in the storage lake of the GBS, this lake is now the prefered feeding area of the species. A certain area of Slovak section of the branch system has re-evolved as a night resting place for this species after a ten year hiatus. In the case of the *Haliäeetus albicilla* we recorded a significant preference for the least frequented sites of the branch system and the main river of the Danube, where, at this time, there were no finished reinforced roads unlike the majority of the area. During our investigated period we recorded an unusual rise in the abundance of *Cygnus olor*. During the fifties, this species was not considered as an avifauna member of the area (Balát, 1963; Balis, 1952). The phenomenon is most probably connected with species population trends. Part of this population has probably been artificially translocated from old gravel pits in the city of Bratislava. Some of the records that we investigated should be compared with the status of Danubian inundation area of the Hungarian section. There are strong indications, that the changes noted by us are connected with alternations in the water regime in the Hungarian Danube area, but we have not had the opportunity to judge or follow their impact in this area.

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