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POSSIBLE WAYS OF DEVELOPMENT OF THE BREEDING BIRD COMMUNITIES OF THE LOWER DNIPRO

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Possible Ways of Development of the Breeding Bird Communities of the Lower Dnipro. Busel, V. A. — Anthropogenic and natural factors of transformation of breeding bird communities of the Lower Dnipro affect mainly the territory of the Kakhovka Reservoir. Transformation processes of natural systems will result in a decrease of numbers and even the disappearance of some species of nesting birds of Ciconiiformes and Anseriformes. Podicipediformes and Charadriiformes birds remain less vulnerable, especially species that nest on the overwater vegetation. The birds nesting in hollows and in trees and shrub plantations are among the most successful. It is also possible to predict that some species would change their priorities from rock to tree-nesting. The wetlands below Nova Kakhovka will remain a natural sanctuary for the nesting birds of the forest and wetland natural complexes of the floodplain of the Lower Dnipro. Any changes in this area can occur in case of further human activity in the floodplain of the Dnipro lowland. Key words: breeding, bird colonies, Kakhovka Reservoir, shallow water, avifauna, population, transformation.

Introduction

In terms of growth of anthropogenic pressure and large-scale natural complexes transformations in the South of Ukraine the study of wildlife conservation is of particular relevance. Hydraulic engineering, land reclamation, forestation and intensive use of natural resources lead to changes in habitat of the number of animals and in particular nesting birds. The study of these processes is necessary for the establishing methods for the protection of rare and endangered species at the regional and global level and to protect their habitats. Floodplain of the Lower Dnipro is very revealing in this regard, since the construction of the Kakhovka hydroelectric power plant led to the flooding of vast areas, which significantly affected the change in the species composition of birds as well as numbers and spatial distribution of many species. Regulation of flow and the construction of dams on small rivers are leading to irreversible processes, turning the lower reaches of the Dnipro River in a cascade of slowly flowing but huge reservoirs. Flood plain forest and meadows were almost completely destroyed in a short period of time.

The first forecasts of the avifauna development of the newly constructed Kakhovka reservoir are given in the paper of O. B. Kistyakovskiy (1957) at the end of 1950. By analyzing the development of the breeding bird communities in the area, we can predict changes in the breeding avifauna under the influence of anthropogenic and natural factors.

First to make such forecasts of the development of avifauna of the newly created Kakhovka Reservoir at the end of 1950 was O. B. Kistyakovskiy (1957). But he mainly focused on forest and wetland species. Analysis of a new material is of great theoretical and practical scientific interest in the study of this issue.

Material and methods

The material which is the basis of research was collected by the author during 24 field seasons in 1992–2016. In 1992–1998, it was focused on man-made forests and floodplain forests of the left bank of the Kakhovka Reservoir, as well as the islands of Velyki and Mali Kuchugury (upper Kakhovka Reservoir) and the right bank from the city of Zaporozhzhya to Verhnetarasovka village of Dnipropetrovsk Region. In 1999–2004 field research covered the right bank of the Kakhovka Reservoir within the Dnipropetrovsk Region and marshes below the city of Nova Kakhovka. In 2005–2012 research have been carried out in the lower reaches of the river estuary Belozerka (Zaporozhzhya Region), flooded areas of the island Khortytsya, and the bottom of the Kakhovka Reservoir. Also in 1992–2016 the breeding avifauna of the lower reaches of tributaries of the Dnipro have been studied, namely Konkak, Karachekrak, Belozerka (Zaporozhzhya Region), Bazavluk, Tomakivka

(Dnipropetrovsk Region) and the Great Chortomlyk (Kherson Region).

Following the agreement with the I. I. Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine joint field researches have been carried out on the ornithological research center "Belozerk" (located on the territory of the National Park "Great Meadow"). This allowed us to collect large amounts of data on number shifts of nesting birds of wetlands and meadow natural systems.

Colonial water birds were surveyed with the help of water transport. Thus we were able to observe both islands and several bays of the Kakhovka Reservoir. The total route traveled by water transport was about 400 km. Air transport (helicopter MI-2) was used in 1998 and 2011 to explore the colonial settlements of birds on the islands of the Kakhovka Reservoir. This made it possible to find out the number of birds and the boundaries of large colonies of Pelecaniformes and Ciconiiformes. 22 flight hours were spent on carrying out observations. Car routes were used to survey the coastline of both the Kakhovka Reservoir and natural bank beneath the city of Nova Kakhovka. The total length of road routes during the study was about 13,000 km.

In 1999–2016 absolute count of waterfowl birds was conducted from observation spots and on routes. In total 330 km of routes in terrestrial habitats and 60 km² of reservoir's area were surveyed. In 2001–2010 the survey of birds of prey were carried out covering total area of over 100 km². In 2006–2012 in the most typical biotopes monitoring plots were chosen to calculate number and density of breeding birds. This enables to study large areas with the help of limited number of plots (Rogacheva, 1963; Gudina, 1999).

Results and discussion

Currently, nesting avifauna of the floodplain of the Lower Dnipro can be divided into two regions, which are fundamentally different both in its development and further formation. The first area we refer is the Kakhovka Reservoir, which is a relatively new large artificial reservoir of plain type in the process of "maturation" that influence on the future path of the breeding avifauna development in the region. The second area is the marshes below the city of Nova Kakhovka represented mainly by trees and shrubs and wetland natural complexes. The area is ecologically less dependent on the negative factors of the hydrological regime of the Kakhovka Reservoir. As a result of artificial regulation of water level, small islands are sometimes flooded.

The Kakhovka Reservoir was created in 1955–1957 and flooded former Konka-Bazavluk and Gavrilovka wetlands. At the present time it is at the stage of "stabilization and maturation", which usually begins in this type of reservoirs in 15–20 years after the flooding of the river valley. At this time, it is characterized by relatively stable bird communities which differ from those that existed before creation of the reservoir. They consist of wetland and semi-aquatic birds, which are dominated by species with high ecological plasticity (Klestov, 1983 a, b, 1991; Landau, 2004).

Active coastal erosion is one of the primary factors that affect the further development of the Kakhovka Reservoir (fig. 1). Its main reason is the relative shallow water and large areas of the reservoir, as well as the geological structure of the bank. Seasonal storms change topography and structure of the coastal strip, which limits nesting possibilities for birds. Currently, in some areas there is a tendency for the relative stabilization and the completion of these processes, but such portions comprise at least 10 % of the total reservoir coastal line.

Shallowing due to intense beach erosion on large bays of Kakhovka Reservoir will affect the future formation of semi-aquatic vegetation. Coastal lowlands overgrow with reeds leading to water logging (Zhadin, 1937; Korsakov, 1968; Zerov, 1976; Landau, 2004). According to our observations, area occupied by reed beds has increased by several times in some bays of Kakhovka Reservoir (Vasilevsky, Belozersky, Chortomlyk and Kair) in the last 15–20 years.

In the course of the further formation of the reed and the disappearance of other species of overwater vegetation in shallow water, as well as flushing the benthos as a result of wave erosion, there will be depletion of food resources mainly for Anseriformes and Charadriiformes. But these same processes will contribute to the invasion of water birds associated with the succession of reeds and aquatic landscapes: *Podiceps cristatus* (Linnaeus, 1758), *Botaurus stellaris* (Linnaeus, 1758), *Ixobrychus minutus* (Linnaeus, 1766), *Ardea alba* Linnaeus, 1758, *Ardea cinerea* Linnaeus, 1758, *Ardea purpurea* Linnaeus, 1766, *Cygnus olor*



Fig. 1. The active coastal erosion and the initial stage of formation of the sandy beach (the upper reaches of the Kakhovka Reservoir, 2012).

(Gmelin, 1789), *Circus aeruginosus* (Linnaeus, 1758), *Gallinula chloropus* (Linnaeus, 1758), *Fulica atra* Linnaeus, 1758. The expansion of reed beds will be attractive for some Passeriformes: *Locustella luscinioides* (Savi, 1824), *Acrocephalus scirpaceus* (Hermann, 1804), *Acrocephalus arundinaceus* (Linnaeus, 1758), *Panurus biarmicus* (Linnaeus, 1758), *Emberiza schoeniclus* Linnaeus, 1758.

Further shall owing of coastal areas would result in accumulation of sediments. This would create vegetation with high number of species composition. In turn it would strongly affect avifauna, both quantitatively and qualitatively (table 1). Such trend is already ongoing in places with abundant accumulation of bottom sludge. Similar processes are observed for all types of plain reservoirs (Zhuravel, 1934; Zhadin, 1937; Landau, 2004). We have observed these processes from the beginning of 2000 in shallow waters of bays in the upper reaches of the Kakhovka Reservoir. Extension of areas with such nesting conditions are attractive to *Podiceps nigricollis* Brehm, 1831, *Podiceps grisegena* (Boddaert, 1783), *Larus ridibundus* Linnaeus, 1766, *Chlidonias niger* (Linnaeus, 1758), *Chlidonias leucopterus* (Temminck, 1815), *Chlidonias hybrida* (Pallas, 1811), *Sterna hirundo* Linnaeus, 1758.

Stabilization of the coastal line and the cessation of active beach erosion will create favorable conditions for the species, nesting on the slopes and coastal cliffs. Due to the active destruction of the coast in the spring and summertime such localities remain unpopulated by birds. Termination or slowing down of these processes will create favorable conditions for colonial nesting species: *Merops apiaster* Linnaeus, 1758, *Riparia riparia* (Linnaeus, 1758), and solitary nesting birds: *Falco tinnunculus* Linnaeus, 1758, *Athene noctua* (Scopoli 1769), *Coracias garrulus* Linnaeus, 1758, *Alcedo atthis* (Linnaeus, 1758), *Oenanthe oenanthe* (Linnaeus, 1758), *Oenanthe pleschanka* (Lepechin, 1770). Further overgrowing of slopes and coastal cliffs with trees, shrubs and grass vegetation will lead to a gradual transformation of the natural complex. Such processes can already be seen on Zaporozhzhya Reservoir — one of the oldest reservoirs in the cascade of the Dnipro. Large colonies of burrowing birds were observed here in the 1990-s in the coastal cliffs of closed bays. During 2013–2016 we noted transformation of the cliffs into gentle slopes with trees and shrubs. Noteworthy, due to increase of shrub vegetation on the cliffs of the left bank of the Kakhovka Reservoir *A. noctua* and *C. garrulus* started nesting on trees instead of rocks

Table 1. The population density of breeding birds in reeds of floodplain of the Lower Dnipro (materials plots 2006–2016)

Species	The number of breeding pairs / 10 ha			
	Continuous reed beds		Reeds with overwater vegetation	
	1	2	1	2
<i>Podiceps grisegena</i>	≥ 0.5	2.0–2.5	≥ 0.5	3.0–4.0
<i>P. cristatus</i>	3.5–19.0	5.5–7.0	27.0–32.0	7.0–10.0
<i>Botaurus stellaris</i>	≥ 0.5	1.5–2.0	0.5–1.5	1.5–2.5
<i>Ixobrychus minutus</i>	1.5–3.0	1.5–2.5	1.5–3.0	2.0–3.5
<i>Egretta alba</i>	≥ 0.5	≥ 0.5	2.0	0.5–1.5
<i>Ardea cinerea</i>	1.5–3.0	2.0–3.0	1.5–3.0	2.5–4.0
<i>A. purpurea</i>	≥ 0.5	2.0–3.0	1.0–1.5	2.5–4.0
<i>Anas platyrhynchos</i>	≥ 0.5	≥ 0.5	1.5–2.0	0.5–1.5
<i>A. querquedula</i>	≥ 0.5	2.0–2.5	1.0–1.5	3.0–3.5
<i>Aythya ferina</i>	≥ 0.5	3.5–4.0	3.5–7.0	5.0–7.5
<i>Circus aeruginosus</i>	≥ 0.5	1.5–2.0	2.0–4.5	2.0–3.5
<i>Porzana parva</i>	≥ 0.5	≥ 0.5	0.5–1.0	≥ 0.5
<i>Gallinula chloropus</i>	2.5–3.0	2.5–3.5	1.0–7.5	2.5–4.5
<i>Fulica atra</i>	7.5–14.0	7.5–8.5	10.0–16.0	10.0–12.5
<i>Chlidonias niger</i>	≥ 0.5	0.5–2.5	≥ 0.5	3.5–5.0
<i>C. hybrida</i>	≥ 0.5	0.5–3.5	0.5–3.5	1.0–5.0
<i>Locustella luscinioides</i>	8.5–13.0	3.0–5.5	6.5–16.0	5.0–8.5
<i>Acrocephalus schoenobaenus</i>	≥ 0.5	2.0–3.5	0.5–3.0	3.0–6.0
<i>A. agricola</i>	≥ 0.5	1.0–2.0	1.5–4.0	1.5–2.5
<i>A. palustris</i>	–	≥ 0.5	3.5–7.0	1.0–2.0
<i>A. scirpaceus</i>	≥ 0.5	2.5–3.0	1.0–3.0	3.5–4.5
<i>A. arundinaceus</i>	12.5–18.0	7.5–10.0	21.5–27.0	8.0–12.0
<i>Panurus biarmicus</i>	–	0.5–1.5	1.0–3.0	1.0–2.5
<i>Emberiza schoeniclus</i>	≥ 0.5	0.5–1.0	1.5–4.5	0.5–2.0

Note. 1 — Bays of Kakhovka Reservoir; 2 — Floodplains below the City of Nova Kakhovka.

(Busel, 2014).

The accumulation of soil and sand in the coastal part of the reservoir leads to the formation of underwater shoals, which protect the coast from erosion and storms. Thus, wet meadows spread in large tertiary ravines and depressions. Formation of these natural systems is already observed in the coastal area of Kamenskiy Pod (Kamenka-Dniprovka District, Zaporizhzhya Region). This allows further distribution and expansion of Charadriiformes: *Charadrius dubius* Scopoli, 1786, *Vanellus vanellus* (Linnaeus, 1758), *Himantopus himantopus* (Linnaeus, 1758), *Tringa totanus* (Linnaeus, 1758), and some species of Passeriformes: *Motacilla flava* Linnaeus, 1758, *Motacilla feldegg* Michahelles, 1830, *Saxicola rubetra* (Linnaeus, 1758), *Saxicola torquata* (Linnaeus, 1766), *Emberiza calandra* Linnaeus, 1758.

Further reduction of the islands in the upper reaches of the Kakhovka Reservoir will affect numbers of nesting Ciconiiformes, Anseriformes, and Charadriiformes birds. Thus they would have to abandon preferred habitats and migrate to floodplains of small rivers that could lead to reduction or disappearance of some rare species: *Ardeola ralloides* (Scopoli, 1769), *Egretta garzetta* (Linnaeus, 1766), *Platalea leucorodia* Linnaeus, 1758, *Plegadis falcinellus* (Linnaeus, 1766), *Anser anser* (Linnaeus, 1758), *Anas strepera* Linnaeus, 1758, *Larus ichthyaetus* Pallas, 1773. We observed similar process on the island of Mali

Kuchugury (Kakhovka Reservoir). In the early 2000-s shrubs were removed during a spring freeze-up on the entire area of the island inhabited by one of the largest poly specific colonies of Ciconiiformes in the region. Number of stray animals of these species significantly increased in 2001–2003 in the floodplains of small rivers (Konka, Karachekrak, Kamenka, Rogachik). In subsequent years there has been an increase in the number of nesting birds in the existing colonies on the islands of the reservoir and even new small nesting colonies appeared in the floodplains of small rivers.

Birds nesting in trees and shrubs would be affected as well due to ongoing aging of both artificial and natural forests. This would impact most of all those species which are hollow-nesting. For example, lack of large hollows makes it impossible for *Strix aluco* Linnaeus, 1758 to nest in large floodplain forests. Noteworthy, it was a common nesting species of Konka-Bazavluk floodplains before 1950-s. Also some other bird species could benefit from aging of forests: *Bucephala clangula* (Linnaeus, 1758), *Otus scops* (Linnaeus, 1758), *Upupa epops* Linnaeus, 1758, *Jynx torquilla* (Linnaeus, 1758), *Ficedula albicollis* (Temminck, 1815), *Phoenicurus phoenicurus* (Linnaeus, 1758), *Parus caeruleus* Linnaeus, 1758, *Parus major* Linnaeus, 1758.

Dnieper floodplains below the city of Nova Kakhovka served as a refuge for tree and shrubs and wetland birds along the construction of Kakhovka Dam. These events were discussed in the works of V. V. Shevchenko (1940), P. P. Orlov (1959) and A. S. Liseckiy (1954, 1955, 1959).

In the future, the flooded part of the floodplain of the Lower Dnipro River will remain relatively stable. Breeding avifauna here could be affected only by the human activity in the Dnipro lowlands, such as constructions in coastal area, felling of floodplain forest, seasonal burning of reeds and poaching. These reasons over the past decade have led to a decrease in numbers of many colonial species, mostly Ciconiiformes and Charadriiformes: *A. ralloides*, *E. garzetta*, *P. falcinellus*, *C. leucopterus*, *Sterna albifrons* Pallas, 1764.

This part of the preserved floodplain of the Lower Dnieper will remain a sanctuary for birds nesting in trees and shrubs, meadows and wetlands. In its further development natural bird complexes of floodplains below the city of Nova Kakhovka are very important for conservation of some endangered species: *Aythya nyroca* (Guldenstadt, 1770), *B. clangula*, *Milvus migrans* (Boddaert, 1783), *Haliaeetus albicilla* (Linnaeus, 1758).

Conclusions

Birds of Kakhovka Reservoir would be most affected by ongoing transformations of natural complexes of the Lower Dnipro. This will lead to a reduction in number and disappearance of some species of nesting birds of Ciconiiformes and Anseriiformes. Species that nest on the overwater vegetation (Podicipediformes and Charadriiformes) would remain less vulnerable. Hollow-nesting birds and those nesting on trees and shrubs would be among the most successful. It is also possible to predict the transition of some rock-nesting birds (*A. noctua*, *C. garrulus*) to nesting on trees. Wetlands below the city of Nova Kakhovka will continue to act as a natural reserve for the nesting birds of the forest and wetland natural complexes. Any changes in this area can only happen with the continued human activity in the floodplain of the Dnipro Lowland (coastal buildings, floodplain forest cutting, seasonal burn of reeds and poaching).

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