

NUMBER, DISTRIBUTION AND DYNAMICS OF PISCIVORE BIRD SPECIES AND THEIR INFLUENCE TO FISHES ON THE GRUŽA RESERVOIR

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ABSTRACT. Significant place among aquatic bodies in Serbia belongs to the Gruža Reservoir, which is on the Areas of National importance list and has potential for the list of internationally Important Bird Areas (IBA). Material for this study has been collected during realization of the national project “Monitoring of aquatic migratory birds for prevention of avian influenza 2005–2007” as well as through various field researches within the work of Ecological Research Association “Mladen Karaman” of Kragujevac. There were registered 184 bird species with the biggest number of the birds of aquatic habitats, which spend winters on this reservoir. Only two species have had significant number of individuals that could have an adverse effect on piscine fauna. Those are Great Cormorant *Phalacrocorax carbo* and Grey Heron *Ardea cinerea*. Quality of diet of Great Cormorant was determined based on osteological material and remains of scales of fish (found in pellets that were collected on the reservoir). There are four species of fish that these birds consume: Silver Bream *Abramis bjoerkna*, River Perch *Perca fluviatilis*, Goldfish *Carassius auratus* and Bleak *Alburnus alburnus*. Great Cormorant use types of fish that have no economic, sports and other importance for humans.

Key words: Numbers, distribution, dynamics, piscivore bird species, Gruža Reservoir

INTRODUCTION

Reservoirs, fishponds and other aquatic surfaces have got into their prime when it comes to survival of the most endangered bird species in Serbia and Europe. Marsh habitats have lost a big part of their natural values in relation to the structure and numbers of the birds of aquatic regions. Some reservoirs in Serbia are the most important concerning species which are most endangered in national and international proportions (Storks, Herons, Waders and Terns). Competition between intensive use of ichthyofauna in economic and sport purposes and presence of the rare and endangered birds is not emphasized and is mostly negligible, when the benefits from the birds that feed on the enemies of the spawn are taken into account. Only two bird species Great Cormorant and Grey Heron could be considered as larger users of fish from reservoirs, fishponds and other aquatic surfaces. Harmonization of intensive

breeding and use of fish with preservation of invaluable important bird fauna on reservoirs and fishponds has become a necessity and prime national strategy in the battle for survival of many species of birds, which are facing extinction (PUZOVIĆ, 1999).

Because of its size, spatial allocation, abundance of food and possibility for reproduction and resting of birds, fishponds in Vojvodina become main anchorage for many bird species (Tucakov *et al.* 2001). In Serbia, south from Sava and Danube River, many reservoirs, and to lesser extent fishponds, play similar role. These reservoirs are: Gruža, Međuvršje, Čelije, Zvorničko Lake, Uvačko Lake (GRUBAČ, 2001, 2003; MARINKOVIĆ, 1997; PUZOVIĆ, 1999; RAKOVIĆ & NOVAKOVIĆ, 2003; RUŽIĆ, 2002B; RUŽIĆ, 2003; STANKOVIĆ, 2000). This positive trend had influence on enlargement of population of birds of aquatic habitats in the northern Serbia, in Pannonian basin, and in the Balkan part of the Republic.

Construction of the dam on River Gruža started in 1979 and was finished in 1985. It is situated 20 km southeast of Kragujevac on altitude of 238–269 m. Length of the reservoir is about 10 km and width varies 0.2–1.5 km. Total surface covers area of 934 ha.

On the altitude of 269.2 m, two thirds of the reservoir is shallow waters (2–9 m depth) and it mostly filled the depression of Kničko field. This part of the reservoir is surrounded by agricultural land. One third of the reservoir is deeper and situated in the gorge of River Gruža (25–30 m depth) and is surrounded by woodlands and grazing land. Maximum depth is near the dam (31 m) and the average depth is 6.3 m.

This study presents numbers, distribution and seasonal changes of piscivore bird species on the Reservoir Gruža, as well as diet analysis and predatory pressure of these birds on ichthyofauna with the special emphasis on Great Cormorant and Grey Heron.

MATERIAL AND METHODS

Material for the study was collected during national project “Monitoring of aquatic birds for prevention of avian influenza 2005–2007”. Ordering party of the project was Ministry of agriculture, forestry and water management of Republic Serbia and Veterinary agency. Bearer of the project was the Institute of veterinary science. Coordinator team consisted of three ornithologists: Executive: Voislav Vasić, Coordinators: Dragan Simić and Marko Tucakov, together with 20 other ornithologists, members of the League for Ornithological Action of Serbia (LOA) of Belgrade, and Society for preservation and research of birds of Vojvodina of Novi Sad.



Fig. 1. - Pellet of Great Cormorant on the roosting place on the Reservoir Gruža
(Photo Miloš Radaković)

Moreover, the material for the study was collected during various field researches, within the activities of Ecological Research Association „Mladen Karaman” of Kragujevac.

Collection and sampling of undigested parts of fish and food leftovers – pellets (Fig. 1) from Great Cormorant was done on 30 March 2008 on locality near the dam on the Reservoir Gruža, on roosting sites of this species. Based on osteological material and scales, high diet quality was determined. The collected material was processed and the species were identified with the key (SIMONOVIĆ, 2001) in the Aquarium of the Faculty of Science in Kragujevac.

Methods that were used during field research for determining number of individuals are: Transect Method (MATVEJEV, 1950), which has been modified and adapted to the conditions of the research object, and Census method and Block Method (SIMIĆ & TUCAKOV, 2003) in accordance to the IWC Techniques Manual. For the identification of birds' binoculars 7x50, 10x50 and 12x60, and telescope 20–60x70 were used.

RESULTS AND DISCUSSION

During the survey, 184 bird species were registered (RADAKOVIĆ, 2008; 2009), with the biggest number of wintering water birds. A total of 107 new bird species were documented for the Reservoir Gruža checklist, compared to 77 previously known (BARJAKTAROV, 2004).

This study shows that the numbers of individuals and species are significantly larger on the Reservoir Gruža, compared to the rivers and other reservoirs in Central Serbia (RUŽIĆ *et al.* 2004). Reasons for this we find in habitat structure (large water surface, lesser water movements, weaker water current and macrophyte vegetation suitable for resting and nesting), plus the rich food offer.

Taken all the numbers of bird species into account, a lot of them are piscatorial and 15 can be described as predominant users of fish. This can be seen in the Table 1 in which was given an overview of all the literature and field research data about taxons with periods of their presence, status on the Reservoir Gruža, numbers and their predatory influence (Table 1).

As Table 1 shows, there are 13 species: Great Crested Grebe, Black-necked Grebe, Little Grebe, Pygmy Cormorant, Little Bittern, Black-crowned Night Heron, Great Egret, Purple Heron, Osprey, Black-headed Gull, Yellow-legged Gull and Whiskered Tern have small predatory influence on fish on the Gruža Reservoir while other species, Great Cormorant and Grey Heron stay on the lake in numbers that can be important for numbers of fish. All mentioned species are listed as natural rarities and are protected by permanent closed season on hunting (Decree of hunting season, Official Gazette of Republic of Serbia 19/02) except for Great Cormorant and Grey Heron which are protected by permanent close season in Vojvodina. The reason for this is that the numbers of these species are small in Serbia and their habitats are degraded and endangered or they are only passing during migration or wintering on the reservoir. Only two sedentary species have significant number of individuals that can have an adverse effect on piscine fauna. Those are Great Cormorant *Phalacrocorax carbo* and Grey Heron *Ardea cinerea*.

Chart 1 shows high richness of piscivore bird species on the Gruža Reservoir in April in research period (12 species), while smaller diversity was in May, June and September (5 species). This can be explained by the fact that in April was the peak of spring migration, and the number of piscivore birds is bigger than in May and June.

Table 1. - Literature and field data with period of presence, average number, and status on the reservoir, protection status and predatory influence of piscivore species.

No.	Species*	Presence observed (months)	Status on the Reservoir Gruža	Average number of individuals	The peak of one-day number of observed individuals	Estimation of predatory influence
1.	<i>Podiceps cristatus</i>	I–XII	B / W	63	123	*
2.	<i>Podiceps nigrcollis</i>	III, X	P	0–7	7	*
3.	<i>Tachybaptus ruficollis</i>	I–XII	B / W	6	13	*
4.	<i>Phalacrocorax carbo</i>	X–IV	W / P	788	1552	***
5.	<i>Phalacrocorax pygmaeus</i>	XI–III	W / P	20	396	**
6.	<i>Ixobrychus minutus</i>	IV–IX	B / P	1	2	*
7.	<i>Nycticorax nycticorax</i>	IV	P	32	45	*
8.	<i>Egretta alba</i>	X–IV	W / P	28	55	*
9.	<i>Egretta garzetta</i>	IV–X	P	3	3	*
10.	<i>Ardea cinerea</i>	I–XII	B / W / P	79	153	**
11.	<i>Ardea purpurea</i>	IV	P	1	1	*
12.	<i>Pandion haliaetus</i>	III–IV	P	1	1	*
13.	<i>Larus ridibundus</i>	X–IV	W / P	147	287	*
14.	<i>Larus cachinnans</i>	XI–II	W / P	14	23	*
15.	<i>Chlidonias hybridus</i>	IV, VII, VIII	P	24	41	*

All those species have strict legal protection in Serbia as „Natural rarities# – species that have protection of 1st degree on territory of Republic Serbia, according to the Decree of Protection of natural rarities”. Legend: Status on the Gruža Reservoir: B (breeding) – nesting bird; W (wintering) – wintering bird, birds that spends winters; P (passage) – birds passing the area on migration. Estimation of predatory influence: negligible (); small (**); average (***); big (****)

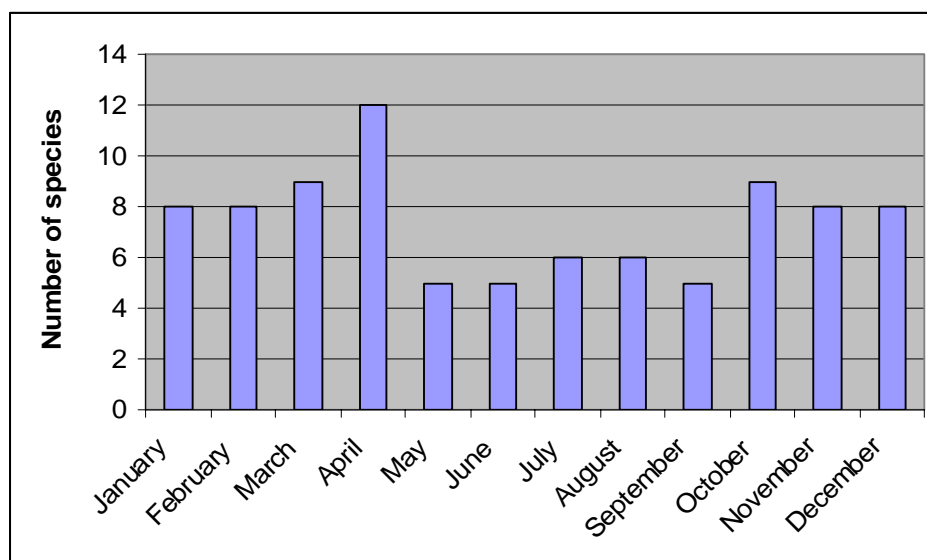


Chart 1. - Piscivore bird species per mounts in research period 2005-2007 on the Reservoir Gruža

The largest concentration of piscivore species of birds was registered in northern parts of the reservoir, where they hunt their prey, since the depth of water in that part is about 3 m. Therefore this part is more suitable for hunting than southern parts of the reservoir, where depth is 31 m and is mostly used for roosting.

In osteological material and scales (Mass 16.8 g) in 48 pellets, there was four species of fish that Great Cormorants consume: Silver Bream *Abramis bjoerkna*, River Perch *Perca fluviatilis*, Goldfish *Carassius auratus* and Bleak *Alburnus alburnus* (Table 2). In the Reservoir Gruža were registered 21 fish species (ŠORIĆ, 2005).

Table 2. - Quality of diet of Great Cormorant on the Gruža Reservoir

No.	Species	Presence in %
1.	<i>Abramis bjoerkna</i>	10
2.	<i>Perca fluviatilis</i>	20
3.	<i>Carassius auratus</i>	40
4.	<i>Alburnus alburnus</i>	30

Great Cormorants eat only fish and because of that is causing the greatest impact to fishes on fishponds all over the continent. European population of this species started to increase rapidly since 1970s and in between 1981 and 1992 they have grown from 15,000 nesting couples (28 colonies) to 81,000 (170 colonies) (TUCAKOV *et al.* 2001). Reasons for this are not completely known, but the assumption is that combination of effective protection and improved feeding had a big role. The biggest problem on waters in Serbia is causing by north-European population, mostly during migration (TUCAKOV *et al.* 2001). In the last couple of years Great Cormorants is roosting on the left bank of the reservoir in oak trees, about 500 m from the dam. There they can find much needed peace, especially in wintertime when ducks are being hunted in northern parts of the reservoir and on rivers Boračka and Gruža.

Total number in Serbia was in 1998 estimated at 980 nesting pairs in 5 colonies, which gravitate along Danube and Tisa River (PUZOVIĆ *et al.* 1999). Great Cormorant is protected as natural rarity in Serbia. On the Reservoir Gruža it doesn't have nesting sites but uses it as place for wintering and resting during migrations.

The biggest number of this species at the Gruža Reservoir was registered on 25 December 2005 with 1552 individuals (the largest number documented in all field research), while the average number on this reservoir is 778 individuals.

This, the largest, concentration was noted near the dam and roosting place in southern parts of the reservoir and in these parts Cormorants do not hunt, but use them to roost. Larger groups were seen in northern areas during hunting. Also, as places for rest they use dry trees in northern parts because there's enough light which helps them dry their feathers after hunting.

As a referent model we can take the research of diet of these species conducted on Drava River in Slovenia, during winter 1995-1996 (GOVEDIĆ & JANŽEKOVIĆ, 2003). The authors collected pellets - vomits of undigested parts of fish - of Great Cormorant on roosting places. Analysis of that material showed quality and quantity of their diet. There were found 14 fish species and four of them are the most common in their diet: European Perch *Perca fluviatilis* Linnaeus 1758, Common Nase *Chondrostoma nasus* Linnaeus 1758, Common Barbel (Linnaeus 1758) and European Chub *Leuciscus cephalus* (Linnaeus 1758). Fish with economic and sports importance that Great Cormorant eats are: Common Carp *Cyprinus carpio* (Linnaeus 1758), Northern Pike *Esox lucius* Linnaeus 1758, Common Roach *Rutilus rutilus* Linnaeus 1758 and Carp Bream *Abramis brama* Linnaeus 1758.

When these two researches are compared, they show that they are almost the same, which draws the conclusion that Great Cormorant in their diet does not use fish of economic

or sports value. It was determined that they feed in opportunistic way, with fish species which are mostly present, and in this case Goldfish *Carassius auratus*. With having the role of natural enemy these birds help in maintaining a seriously disturbed natural balance on this reservoir.

Based on their selection of prey, Grey Heron is opportunistic in nesting period. Their main food is small fish, amphibians and insects. As the proof of big ecological flexibility of the species, on couple of occasions were observed several individuals near corpses of dead domestic pigs on Zapadna Morava River downstream from Čačak (RUŽIĆ, 2004). In winter, their menu is getting filled with small rodents, which are hunted on fields around the river and in this way they are doing a favor to agriculture. On one occasion, on farming land around the river, there was seen an adult Grey Heron which carried a big Black Rat *Rattus rattus* Linnaeus 1758 in its beak. Different kinds of Herons have different eating habits, so they eat other kinds of animals besides fish, such as insects, frogs, snakes.

Geographically closest colony of Grey Herons in the vicinity of the reservoir is in the village Grabovac (Radaković, 2008). Other colonies are relatively close to this one, in Valley of Zapadna Morava River in Adrani (RADAKOVIĆ, 2003) and in Mrsac near Kraljevo (RADAKOVIĆ, 2005).

The biggest number of Grey Heron at the Reservoir Gruža was registered on 27 April with 153 individuals, while the average number was 79. The largest concentrations were observed in northern parts of the reservoir where they mostly hunt different types of amphibians and to a lesser extent, fish.

A number of them were observed in southern parts of the reservoir, near the bridge where they use a rock above the water as a place for resting and cleaning the feathers.

Taking under consideration that Great Cormorants and Grey Herons feed on the banks of the River Gruža, Boračka and Ribeš, which are tens of kilometers long, there can't be talked about overpopulation during winter. As very movable organisms, these birds easily change locations where they feed and because of that can often be seen on larger aquatic surfaces in the area. Grey Herons from the colony in Riđaga were seen 30 km to the south in Dragačevo region and about 40 km northeast of Gornji Milanovac (RUŽIĆ, 2004). Also, birds from already mentioned colony in Grabovac are often seen tens km downstream from River Gruža and upstream of the reservoir. As natural enemies and predators, all piscivore species catch and consume sick, incautious and defective have fish, which is one of the examples of natural selection and one mechanism of evolution. Furthermore, in cases of river intoxication, these birds have sanitary role, which is usually deadly for them.

CONSLUSION

Numbers of fish eating birds on the Gruža Reservoir are drastically bigger than on rivers in this part of Serbia in the research period. The biggest diversity of birds on this reservoir was in April (12 species), while the smallest is in May, June and September in the research period (5 species). Larger concentration of fish eating birds was noted in northern parts of the reservoir, where these birds hunt their prey. Number of piscivore species on Gruža was 15, but 13 species has had a negligible predatory influence on ichthyofauna. Only two species – Great Cormorant and Grey Heron were present in numbers that can have adverse influence on fishing. The largest concentration of Great Cormorant was registered near the dam on their roosting site in southern part of the reservoir and this area bird's use for resting and roosting and not for hunting. Bigger groups can be seen in northern parts of the lake during hunting. Analysis of osteological material and scale shows that Great Cormorant on this reservoir uses mostly 4 species of fish: Silver Bream *Abramis bjoerkna*, River Perch *Perca fluviatilis*, Goldfish *Carassius auratus* and Bleak *Alburnus alburnus*, what indicates

that they do not use fish of economical and sports value to the reservoir. These birds use northern parts of the reservoir for hunting because that part of reservoir is shallow and therefore it allows easy access to fish. Big concentrations of Grey Heron were observed in the north part of the lake where they usually hunt different types of amphibians and fish. Based on these results, analysis of diet and observing and monitoring diet of Grey Heron and Great Cormorant as bigger users of fish, conclusion is that fish eating bird species have small predatory influence and they do not destroy ichthyofauna in the reservoir.

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