

Urban Beavers *Castor fiber* L., 1758 (Rodentia: Castoridae) in Warsaw, Central Poland

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Abstract: Beavers, *Castor fiber* L., were first observed on Vistula River banks near the city of Warsaw in 1997. From 15.12.2015 to 27.02.2016, field surveys for fresh signs of beaver activity were performed along 20 km long urban section of the Vistula River. Other aquatic habitats in Warsaw were surveyed in March and April 2016, and re-surveyed in February and March 2017. Altogether, nine beaver families were recorded in the city section of Vistula and six families in the remaining urban aquatic habitats. Since there have been no earlier reintroductions of beavers in the area of Warsaw, the animals are considered to have been migrated from reintroduction sites in the Vistula catchment area. The dispersion was facilitated by high cohesion of riparian and forest habitats in the Vistula Valley. The lower density of beavers in the urban section of Vistula (app. 4.5 families/10 km) in comparison to semi-natural river habitats north of Warsaw can be explained by infrastructure development and removal of riparian forest in the city.

Key words: synurbization, urban fauna, Vistula River

Introduction

The Eurasian Beaver, *Castor fiber* L., 1758 (Rodentia: Castoridae) was widespread in Poland until the 13th century. However, due to anthropogenic pressure, its numbers decreased, leading to extinction in the entire Vistula River catchment in Poland after 1850 (PUCEK 1984). The recovery of the species in central Poland was initiated with the release of 232 individuals in the Vistula basin in 1975-1985 (ŻUROWSKI & KASPERCZYK 1988). The reintroductions were supported by natural dispersions of beavers that resulted in the current presence of the species along the middle Vistula River (ROMANOWSKI et al. 2008). In the last three decades, the presence of beavers was recorded on the river banks and several other locations in Warsaw. Even though beavers living in proximity to humans attracted the attention of city residents and were often portrayed in the media, no single study of this urban population was conducted so far. Therefore, the present study aims at the census of the urban beaver population within the area of Warsaw.

Materials and Methods

We examined the beaver population in the frames of the city of Warsaw, the capital of Poland. Warsaw is the largest city of Poland, situated on the Vistula River on the Masovian Plain in east-central Poland. The city limits cover 520 km², while the metropolitan area covers over 6000 km². Almost a quarter of the city area consists of parks and green areas, many with aquatic habitats. The Vistula is one of the largest semi-natural rivers in Central and Western Europe. Diverse riparian vegetation between the dykes and forests located inside the river valley provides important refuge for fauna and flora and makes up an ecological corridor recognized in the European Ecological Network EECNET (KAJAK 1993, LIRO et al. 1995, ROMANOWSKI 2007). Almost the entire banks of the urban section of the Vistula are protected by willow bundles and rocky windrows. The vegetation of the river banks and the accumulation terrace consists of herbaceous plants, shrubs and trees, including fragments of riparian *Salici-Populetum* forests. Only 5 km long section of

left bank in the city centre is developed into boulevards and reinforced with stone and concrete walls. Comprehensive hydro-technical measures consist of concrete wing-dams (groynes) to force the re-alignment of the Vistula in the city into narrow channel. The 20 km long urban section of the river is defined in the north by Gdański Bridge (52°18'23.2"N, 20°56'58.1"E) and in the south by Siekierkowski Bridge (52°12'51.9"N, 21°05'29.3"E). To perform the first inventory of beavers, both sides of this river section were surveyed from 15.12.2015 to 27.02.2016. The remaining aquatic habitats in the whole city (channels, oxbows, park ponds) were surveyed in March and April 2016, and re-surveyed in February and March 2017. During surveys, fresh signs of beaver activity (feeding signs, food caches, tracks, lodges and burrows) were searched and their locations were registered with their GPS coordinates.

To evaluate urban population, we followed the recommendations of the "beaver monitoring methods" manual (ZAJĄC et al. 2015). More specifically, the census of the beaver families was conducted in the winter period when animals concentrated their activity within a group territory near a family shelter (lodge or burrow). Presence of food storages and fresh feeding signs was used as a main criterion of site occupancy. Food storages, fresh feeding sites and shelters located on one river bank within the distance of 1 km were considered as belonging to one family. Average size of beaver family $N=3.7$ individuals was adopted after the field study by ŻUROWSKI & KASPERCZYK (1988).

Results

The presence of signs of beavers was detected on both banks of urban section of Vistula River, except of 5 km long left, reinforced bank in the city centre. Altogether 17 food catches floating in the river were detected and nine beaver families were recorded. Two families were present on 6.5 km long section of Żerański Channel in the north of Warsaw. Single beaver families were detected in four urban locations (Bródnowski Channel, Skaryszewski Park, Czerniakowskie Lake and Wilanowskie Lake). In several places (Targówek, Paluch), only signs of temporal beaver presence were noted; these sites were abandoned by the beavers during winter study periods. The inventory results indicate that the area of Warsaw is populated by a total of 15 beaver families (approximately 55 individuals). Continuous signs of beaver presence were also recorded along suburban banks of Vistula River, indicating the density of 4-5 families per 5 km of river length (MISIUKIEWICZ and ROMANOWSKI, unpublished data).

The total beaver population in the Warsaw agglomeration can be thus evaluated at about 25 families (approximately 93 individuals).

Discussion

Beavers were first observed in the Warsaw agglomeration in 1997, when the signs of their presence were noted on Vistula River banks near the northern and southern city limits (J. MATUSIAK, unpublished data). There have been no reintroductions of beavers in the area of Warsaw, suggesting that they migrated from the neighbouring areas. The nearest reintroductions occurred in Kampinos National Park in 1980, Wilga River and Rawka River in 1982-1983 (ŻUROWSKI & KASPERCZYK 1988). According to ROMANOWSKI (2007) who analyzed the corridor function of the valley of Vistula, the high spatial cohesion of habitats in the valley facilitates dispersion of riparian and forest mammals. The dispersal of beavers through Vistula catchment followed the general pattern of expanding population in river valleys, i.e. colonization first in the optimal forest areas (ŻUROWSKI & KASPERCZYK 1988, SOUTH et al. 2001, JOHN et al. 2010). More disturbed agricultural and urban areas were colonized later. Urban populations of beavers developed recently in several cities in Poland, e.g. Kraków (since 1997, HĘDRZAK et al. 2011), Gdańsk, Szczecin and Lublin (CZYŻOWSKI et al. 2011) as well in other large cities in Europe, e.g. Berlin (D. MUELLER, unpublished data), Frankfurt (M. HARTHUN, unpublished data) and Bratislava (PACHINGER & HULIK 1999). Development of urban populations of beavers confirms the high ecological plasticity of this species that adapted to living in close proximity to humans.

The density of beavers on the urban section of Vistula (app. 4.5 families/10 km) is lower in comparison to population numbers on 95 km long semi-natural section of Vistula River between Warsaw and Płock, where the field census in November 2013 revealed average density of 10 families/10 km (MISIUKIEWICZ, unpublished data). Lower density of beavers on urban section of Vistula is not surprising, since infrastructure development and removal of riparian forest in the valley, characteristic for city landscape, were earlier recognized as the major threats to viability of beaver populations (ROMANOWSKI et al. 2008).

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