

European beaver (*Castor fiber* L., 1758) population in the Augustowska Primeval Forest

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■ **Abstract**

The study on the distribution and abundance of beaver families in the Augustowska Primeval Forest was conducted in the years 2000 -2003. It embraced all seven Forest Inspectorates administering the Forest. The study consisted in the penetration of banks along watercourses, lakes and drainage ditches. Lodges, bank dens, dams and the length of the banks colonized by beaver families were plotted on maps. Habitat types contained within the territories of individual beaver families were established on the basis of the maps obtained from Forest Inspectorates. The percentage of bank utilisation by beavers in various types of water bodies was determined. The number of beaver lodges and bank dens, as well as their number per family were established. Also, habitat preferences of beavers in individual water bodies were verified. The presented study has the form of a report which can be used for further monitoring of beaver populations in the Augustowska Primeval Forest.

■ **Key words**

beavers, Augustów Primeval Forest, habitat use

North-eastern Poland is the region of the greatest concentration of beavers. After the Second World War, it was the only location of a few refuges of these animals in Poland. At present, beavers can be found almost in every part of Poland as a result of natural migration and reintroduction actions.

In the years 2000–2003, the studies were started on beaver population in the Augustowska Primeval Forest, the greatest forest complex in the north-eastern region of the country. The Augustowska Primeval Forest is administered by seven forest inspectorates. The Wigry National Park is part of the Forest where the beaver population was examined earlier*.

The hydrographical network of the Augustowska Primeval Forest was divided into five categories: the greatest river Czarna Hańcza, the Augustowski Channel, the remaining smaller watercourses, the lakes and the existing drainage ditches. The same research method was applied to each of these five bodies of water. The fieldworks consisted in bank penetration, positioning and projection on the map of all beaver lodges, bank dens and dams (on watercourses and drainage ditches). Also, the territories occupied by beaver families along the banks, *i.e.* their home ranges, were determined on the basis of the existing foraging areas, bank dens and dams. Forest habitat type ranges were established for a family territory using habitat maps obtained from forest inspectorates. The territorial range of a family frequently comprised several types of forest habitats. The length of banks and shorelines for individual types of watercourses and bodies of water was calculated using 1 : 25000 topographic maps. This allowed to determine the level of bank utilisation by beavers.

Table 1 contains the number of beaver families in individual forest inspectorates. 290 beaver families were identified in the area under study together with drainage ditches.

TABLE 1
The number of beaver families in forest inspectorates

Forest Inspectorate	Number of families
Pomorze	58
Głęboki Bród	17
Szczebra	33
Suwałki	16
Augustów	27
Białobrzegi	81
Płaska	58
Total	290

The differences in the number of families between forest inspectorates result from a number of factors. The size of a forest inspectorate is one of them. The second one is a more or less diversified hydrographical network. The third is the penetration of watercourses by water-sports fans (yachting), particularly of the Czarna Hańcza river and the Augustowski Channel. Numerous camping sites, bivouacs, yacht and boat harbours frighten the beavers.

* Aulak W. 2000. Populacja bobrów (*Castor fiber* L. 1758) w Wigierskim Parku Narodowym. Parki Nar. i Rezerw. Przyr. 19, 2: 35–66.

The greatest number of beaver families were found in the territory administered by the Białobrzegi Forest Inspectorate, the smallest – in the Głębokki Bród Forest Inspectorate and in the only Forest District of the Suwałki Forest Inspectorate subject to study.

The collected data on the abundance of beaver families concerned not only forestland but also drainage ditches. The level of bank colonisation by beavers on different types of watercourses (Table 2) varies between forest inspectorates. This is dependent on the surrounding (forest, meadows, fields) of a watercourse, and hence on food availability. The aforementioned bank penetration by water tourists also exerts a great impact on the foraging behaviour of beavers. The Czarna Hańcza banks are most frequently used by beavers in the territory of the Pomorze Forest Inspectorate (41.3%), least frequently – in the Głębokki Bród Forest Inspectorate (27.0%). Beavers utilise the banks of this river in 32.9% on average.

TABLE 2
Bank colonisation: 1 – Czarna Hańcza river, 2 – Augustowski Channel, 3 – other rivers, 4 – lakes

Forest Inspectorate		1	2	3	4	Σ
Pomorze	D	11500	-	37080	30200	78780
	Z	4750	-	14020	6320	25090
	%	41.3	-	37.8	20.9	31.8
Głębokki Bród	D	13500	-	5050	7950	26500
	Z	3650	-	1950	1390	6990
	%	27.0	-	38.6	17.5	22.6
Szczecza	D	-	3300	40100	61800	105200
	Z	-	-	27100	27000	54100
	%	-	-	67.6	43.7	51.4
Suwałki	D	-	-	8335	1680	10015
	Z	-	-	500	1360	1860
	%	-	-	6.0	81.0	18.6
Augustów	D	-	9100	9800	32300	51200
	Z	-	2900	7800	171100	27800
	%	-	31.9	79.6	52.9	54.3
Białobrzegi	D	-	19300	35375	41600	96275
	Z	-	14600	6450	6730	27780
	%	-	75.6	18.0	16.2	28.8
Płaska	D	15000	19625	61430	21025	117080
	Z	4750	5880	18450	7185	36265
	%	31.7	30.0	30.0	34.2	31.0
Total	D	40000	51325	197170	196555	485050
	Z	13150	23380	76270	67085	179885
	%	32.9	45.4	38.7	34.1	37.1

D – total bank length (in m)

Z – length of banks occupied by beavers (in m)

% – percent of bank colonisation

The Augustowski Channel is colonised by beavers in the greatest degree in the Białobrzegi Forest Inspectorate (75.6%) which is due to the high density of beaver families in the lower section of the Channel running from the Augustowska Primeval Forest to the river Biebrza. This section is unattractive for water tourism, as it runs through non-forested areas. So, beavers find a quiet refuge there where they are not disturbed by people. The Channel is used by the animals in 45.4%.

The category “other rivers” comprises only those watercourses which are suitable for colonisation by beavers, *i.e.* sections adequately deep and capable of retaining water during drought periods. The highest densities of the animals from this category of rivers were detected in the territory of the Augustów Forest Inspectorate (79.6%) in which water tourism is concentrated first and foremost on large lakes in the surroundings of Augustów. Small rivers can be safely colonised by beavers. The banks under this category are utilised by beavers in 38.7% on average.

The use of lakeshores by beavers is highly variable, ranging from 16.2% to 81.0%. The average bank colonisation in the Augustowska Primeval Forest is 34.1%. The “lakes” category comprises water bodies of different size, from large lakes to small ponds. The family territory on large lakes extends along one bank, while on small water bodies beavers penetrate the opposite banks as well. There is a paucity of lakes in the Suwałki District under study; the lakes are small, hence the density of beavers colonising the banks is high. The bank colonisation of all types of water bodies in the entire Augustowska Primeval Forest is 37.1% on average. It does not necessarily mean that over 60% of banks can be additionally colonised by beavers. Unoccupied are the banks lacking food resources, areas with high tourist pressure and gaps between individual family territories. There are large variations in the average length of bank colonisation by a single beaver family ranging from 105 m to 2900 m (Table 3).

TABLE 3
Average length of a bank section per one family
1 – Czarna Hańcza river, 2 – Augustowski Channel, 3 – other rivers, 4 – lakes

Forest Inspectorate	Number of families				Σ	Length of bank section				
	1	2	3	4		1	2	3	4	average
Pomorze	10	-	32	15	57	475	-	438	420	440
Głęboki Bród	6	-	5	6	17	608	-	390	232	411
Szczebra	-	-	15	18	33	-	-	1807	1500	1639
Suwałki	-	-	1	13	14	-	-	500	105	133
Augustów	-	1	5	10	16	-	2900	1560	1710	1738
Białobrzegi	-	24	29	12	65	-	608	219	561	426
Płaska	7	8	27	11	53	679	735	683	653	684
Total	23	33	114	85	255	572	708	669	789	705

The watercourses or lakes whose banks are overgrown by pines or spruces are an unattractive food resource for beavers, so the animals must penetrate longer bank sections in search of food. In wetland habitats abounding in willows, poplars, aspens and similar floodplain species, beavers find sufficient food along shorter bank sections. Food resources in floodplain habitats and alder carrs extend some distance from the bank, so beavers can find a sufficiently rich food base penetrating further into the forest interior, being not confined to the bank area only. Water tourism and bivouacking have a considerable impact on the size of beaver territories; the animals establish their home ranges only in areas far from tourists. Except for extreme cases, the average length of beaver territories oscillates between 572 m and 789 m, depending on the type of a water body.

The share of forest habitat types in beaver territories is wide-ranging (Table 4), however, the dominance of some habitats is apparent. Pine and spruce forests growing on poor soils are the prevailing habitats in the Augustowska Primeval Forest; such banks are use less for beavers because they cannot provide a sufficient food resource. Beavers often stay away from them. Other habitats are sparse, these are usually small bank sections within

TABLE 4
Percentage of habitats occupied by beavers
1 – Czarna Hańcza river, 2 – Augustowski Channel, 3 – other rivers, 4 – lakes

Habitat	1	2	3	4	Σ
Bsw	-	-	1.1	1.6	0.9
Bw	-	-	-	-	-
Bb	28.9	54.5	31.9	29.6	35.5
BMsw	-	2.2	1.1	6.1	2.4
BMw	-	-	7.3	2.5	3.7
BMb	-	-	2.0	-	0.9
LMsw	36.6	-	4.2	12.9	9.7
LMw	-	3.3	1.2	4.4	2.2
LMb	6.2	12.2	9.8	22.1	12.7
Lsw	3.6	5.1	-	-	1.6
Lw	-	-	4.5	-	1.9
Lb	-	-	-	-	-
OI	22.4	22.7	29.1	17.0	24.0
OJ	2.3	-	7.8	3.8	4.5
Total	100.00	100.00	100.00	100.00	100.00

Bsw – Fresh coniferous forest, Bw – Moist coniferous forest, Bb – Bog coniferous forest, BMsw – fresh mixed coniferous forest, BMw – wet mixed broadleaved forest, BMb – Mixed bog coniferous forest, LMsw – fresh mixed broadleaved forest, LMw – Wet mixed broadleaved forest, LMb – Bog mixed broadleaved forest, Lsw – fresh broadleaved forest, Lw – wet broadleaved forest, Lb – Bog broadleaved forest, OI – alder carr, OJ – alder-ash forest

territorial ranges. The habitat type reflects the richness of food resources. The percentage of fertility classes in beaver territories is given in Table 5. The high percentage of coniferous forest habitats can be surprising. However, the comparison of these data with the data from Table 4 shows that these are mainly peatbogs and marshy habitats with high moisture content. Other wetlands or semi-bog biotopes e.g. alder carrs are plentiful. Other habitats are in minority. The table shows the share of habitat classes in beaver territories illustrating, to a certain extent, the habitat share in the entire Augustowska Primeval Forest.

TABLE 5
Percentage of habitats by fertility class
Czarna Hańcza river, 2 – Augustowski Channel, 3 – other rivers, 4 – lakes

Habitats	1	2	3	4	Σ
Coniferous forests	28.9	54.5	32.9	31.2	36.5
Mixed coniferous forests	-	2.2	10.5	6.6	6.9
Mixed broadleaved forests	42.8	15.5	15.2	39.4	24.6
Broadleaved forests	3.6	5.1	4.5	-	3.5
Alder carrs	24.7	22.7	36.9	20.8	28.5
Total	100.00	100.00	100.00	100.00	100.00

Beavers prefer wet environments, *i.e.* boggy habitats and alder carrs (Table 6). The high proportion of fresh forest habitats with low moisture content on the Czarna Hańcza floodplain is due to the fact that these are largely the areas situated in river sections with high, steep banks above the scarp covered by pinewoods. Wet environments constitute nearly 80% of all habitats.

TABLE 6
Percentage of habitats by moisture class
1 – Czarna Hańcza river, 2 – Augustowski Channel, 3 – other rivers, 4 – lakes

Habitats	1	2	3	4	Σ
Fresh	40.2	7.3	6.5	20.6	14.5
Wet	-	3.3	13.0	6.9	7.8
Boggy	35.1	66.7	43.7	51.7	49.2
Alder carrs	24.7	22.7	36.8	20.8	28.5
Total	100.00	100.00	100.00	100.00	100.00

Beavers nest either in lodges or in bank dens, or sometimes in lodge-dens. The dominating nest type are bank dens (180), lodges are less numerous (113) (Table 7). The nest type (lodge, den) depends on the bank configuration within the family territory. Where banks are high, beavers dig holes in the bank often extending under the ground surface. Where banks are flat and waterlogged, beavers build lodges. Bank dens dominate in the majority of watercourses. The lodge-den ratio differs between individual forest inspec-

rates depending on the prevailing bank type, flat or high. An additional reason for which bank dens dominate in certain water reservoirs is the ease of hiding them from people. The number of dens is given in Table 7. Shallow dens used as temporary shelters against potential threats have not been taken into consideration.

TABLE 7
Number of lodges, bank dens and nests
1 – Czarna Hańcza river, 2 – Augustowski Channel, 3 – other rivers, 4 – lakes

Forest Inspectorate		1	2	3	4	Σ
Pomorze	Z	1	-	14	9	24
	N	10	-	21	6	37
	G	11	-	35	15	61
Głęboki Bród	Z	4	-	6	6	16
	N	5	-	-	1	6
	G	9	-	6	7	22
Szczebra	Z	-	-	8	5	13
	N	-	-	17	13	30
	G	-	-	25	18	43
Suwałki	Z	-	-	1	10	11
	N	-	-	-	3	3
	G	-	-	1	13	14
Augustów	Z	-	-	3	3	6
	N	-	1	12	16	29
	G	-	1	15	19	35
Białobrzegi	Z	-	-	-	10	10
	N	-	24	29	2	55
	G	-	24	29	12	65
Płaska	Z	5	5	22	1	33
	N	2	3	5	10	20
	G	7	8	27	11	53
Total	Z	10	5	54	44	113
	N	17	28	84	51	180
	G	27	33	138	95	293

Z – lodges

N – bank dens

G – nests

A single beaver family typically builds one bank den. However, under some circumstances they build a series of dens. One of the reasons is a high number of the young in a family, two or three-year old juveniles, which one den cannot accommodate. The other one can be a seasonal use (winter, summer) of different bank dens depending on their pro-

ximity to resources and winter food caches. The length of a shoreline may also determine the number of bank dens. A long shoreline occupied by beavers can force them to create halfway dens within their territories.

The number of bank dens or lodges vary between both forest inspectorates and water reservoir types (Table 8). The average number of dens per beaver family in the Augustowska Primeval Forest is 1.1, while in the Augustów Forest Inspectorate this figure is higher (1.9 and 3.0) depending on the type of water body. The average number of dens for all types of water bodies were detected in the Augustów, Szczzerba and Głębokki Bród Forest Inspectorates.

TABLE 8
Number of lodges, bank dens and nests per 1 family
1 – Czarna Hańcza river, 2 – Augustowski Channel, 3 – other rivers, 4 – lakes

Forest Inspectorate		1	2	3	4	Σ
Pomorze	Z	0.1	-	0.4	0.6	0.4
	N	1.0	-	0.7	0.4	0.6
	G	1.1	-	1.1	1.0	1.0
Głębokki Bród	Z	0.7	-	1.2	1.0	0.9
	N	0.8	-	-	0.2	0.4
	G	1.5	-	1.2	1.2	1.3
Szczzerba	Z	-	-	0.5	0.3	0.4
	N	-	-	1.1	0.7	0.9
	G	-	-	1.6	1.0	1.3
Suwałki	Z	-	-	1.0	0.8	0.8
	N	-	-	-	0.2	0.2
	G	-	-	1.0	1.0	1.0
Augustów	Z	-	-	0.6	0.3	0.4
	N	-	1.0	2.4	1.6	1.8
	G	-	1.0	3.0	1.9	2.2
Białobrzegi	Z	-	-	-	0.8	0.2
	N	-	1.0	1.0	0.2	0.8
	G	-	1.0	1.0	1.0	1.0
Płaska	Z	0.7	0.6	0.8	0.1	0.6
	N	0.3	0.4	0.2	0.9	0.4
	G	1.0	1.0	1.0	1.0	1.0
On average	Z	0.4	0.2	0.5	0.5	0.4
	N	0.7	0.8	0.7	0.6	0.7
	G	1.1	1.0	1.2	1.1	1.1

Z – lodges

N – bank dens

G – nests

In addition to mid-forest water bodies, beavers also colonize drainage ditches on drained lands. The studies covered only the drained areas in villages situated within the territory of the Augustowska Primeval Forest and on its peripheries, yet bordering with forests. Of the entire network of drainage ditches in this area, only those in which the presence of beavers was detected were subject to analysis. The majority of them were close to forest borderline.

In the territory of Forest Inspectorates (Augustów and Białobrzegi) in which the number of beaver families was high, the colonization of banks ranged from 42.1% to 68.1% (Table 9). The Szczebra and Głęboki Bród Forest Inspectorates lacked a mid-forest and close-to-forest drained areas. In forest inspectorates in which the number of beavers is high, the length of a bank section per one family oscillated between 500 m to more than 1500 m. The differences in the length of beaver territories for the whole Augustowska Primeval Forest was attributed to the bank type of ditches. The territorial range was longer when banks were lacking vegetation, e.g. willow thickets, and the availability of food was scarce.

TABLE 9
Bank colonisation of drainage ditches

Forest Inspectorate	Length of banks in m		% bank colonisation	Length of bank per 1 family
	Total	Occupied		
Pomorze	530	450	84.9	450
Głęboki Bród	-	-	-	-
Szczebra	-	-	-	-
Suwałki	1155	150	13.0	75
Augustów	25100	17100	68.1	1555
Białobrzegi	22390	9430	42.1	589
Płaska	13075	2575	19.7	515
Total	62250	29705	47.7	849

The analysis of nest on drained areas and in forests shows the prevalence of bank dens over nests (Table 10). The number of nests per a single family exceeded 1.0 (1.9) only in the territory of the Augustów Forest Inspectorate. It is understandable, as the average size of a family territory there was greater than 1500 m. One nest would not be sufficient for the safety of a beaver family.

Alder carrs and fens are the dominating types of forest habitats adjoining drainage ditches (Table 11). The explanation of a high percentage of coniferous forests is the same as for the mid-forest water bodies. The habitat analyses for moisture content showed that the habitats are mainly boggy coniferous forests. Boggy habitats, alder carrs and typical bogs account for more than 90% of all the habitats.

The beaver locations are unevenly distributed in the Augustowska Primeval Forest. The majority of beaver locations are close to the riverside and their tributaries, as well as around lakes. There are frequently quite large fragments of the Forest lacking watercourses or lakes, hence the absence of beavers there.

Table 10
Number of lodges, bank dens and nests on drainage ditches

Forest Inspectorate	Lodges	Bank dens	Nests	Number of families	Number of nests per 1 family
Pomorze	-	1	1	1	1.0
Głęboki Bród	-	-	-	-	-
Szczebra	-	-	-	-	-
Suwałki	2	-	2	2	1.0
Augustów	8	13	21	11	1.9
Białobrzegi	2	14	16	16	1.0
Płaska	2	3	5	5	1.0
Total	14	31	45	35	1.3

Table 11
Habitat types occupied by beavers on drainage ditches by fertility and moisture content

Habitat type by fertility	Habitat type by moisture content		%
Coniferous forests	35.2%		
Mixed coniferous forests	4.0%	fresh	4.2%
Mixed deciduous forests	11.3%	wet	4.8%
Deciduous forests	-	boggy	41.5%
Alder carrs and bogs	49.5%	alder carrs and bogs	49.5%
Total	100.00%		100.00%

Today, it is difficult to establish if beaver densities in the Augustowska Primeval Forest is sufficient. It seems that all environments suitable for beavers are already occupied. Further population growth and deficiency of resources, may force beavers to migrate through the Czarna Hańcza river to the east and through the Augustowski Channel – to the south.

■ Acknowledgements

It would not have been possible to carry out research on such a large territory without the assistance of degree students in the Department of Forest Zoology and Game Management and foresters from the Augustowska Primeval Forest Inspectorates. I would like to express my gratitude to all of them for their commitment and fieldwork.

■ Streszczenie (Summary)

Populacja bobrów (*Castor fiber* L., 1758) w Puszczy Augustowskiej

W latach 2000–2003 prowadzono badania nad populacją bobrów w Puszczy Augustowskiej. Ogółem w 7 nadleśnictwach stwierdzono 290 rodzin (Tab. 1). Analizowano 5 typów akwenów: rzeka Czarna Hańcza, Kanał Augustowski, inne rzeki, jeziora i rowy melioracyjne. Największe zagęszczenie bobrów w Puszczy stwierdzono przy ciekach i jeziorach. Z ogólnej liczby 290 rodzin ujawniono 35 rodzin na rowach melioracyjnych.

W każdym typie akwenów analizą objęto: położenie żeremi, nor, długość arealów rodzin i wybiórczość siedlisk. Określono w % wykorzystanie brzegów akwenów (Tab. 2) oraz długość brzegu zajętego przez jedną rodzinę (Tab. 3), wybiórczość siedlisk przez bobry (Tab. 4, 5, 6). Ponadto określono liczbę żeremi, nor i gniazd łącznie w różnych akwenach w poszczególnych nadleśnictwach (Tab. 7), a także ich liczbę przypadającą na jedną rodzinę (Tab. 8). Dane dotyczące rodzin na rowach melioracyjnych przedstawiono w tabelach 9–11.

Received on September 21, 2007