

Mammalian activity in the vicinities of beaver dams in the fall-winter season

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Abstract

European beavers, being so-called "keystone species", transform their habitat according to their own needs while also creating favorable living conditions for other animals. The research aimed to find out how different species of mammals use beaver dams and the area directly adjacent to the watercourse, in the place where the dam was built, in the autumn and winter period. In the investigated areas the activity of 13 different mammal species was recorded, most often using the beaver dams as river crossing, either on or close to the dam itself. Between September-February the activity of mammals was evenly distributed over each month with a slight increase in November. The study confirmed the great role of the European beaver in increasing the diversity of the local mammal species.

Keywords: *Castor fiber*, biodiversity, mammals, shoreline

Introduction

The most characteristic and terraforming evidence of local beaver activity is the dams created across river beds, which are used to slow down the current and increase the water level (Jones et al., 1994). This in turn leads to the emergence of swamps that retail large amounts of water. In water ponds that can be multiple in the course of one river, the beaver keeps a water level high enough to cover the entrances of their habitats, to ensure secure mobility over the coastal area (Collen & Gibbon, 2001; Janiszewski & Misiukiewicz, 2012). The creation of dams and lodges also contributes to the well-being of other mammals. Those contributions can be different, for example, hide-outs in deserted lodges or holes, finding shelter in areas created due to beaver activity, carnivorous and herbivorous food gathering in beaver ponds and/or their vicinities, hunting around beaver inhabited locations, etc. (Ciechanowski et al., 2011; Janiszewski et al., 2014). Scientific literature concerning

the diverse role of the beaver as an ecosystem transforming animal is quite extensive, however, some topics are less touched upon (Bashinskiy, 2008; Dalbeck et al., 2007). For example, there is little information concerning not only which but how various animals are benefitting from the areas close to beaver dams. The study aimed to analyze the usage of areas transformed by beaver activity in the fall-winter seasons by other animal species.

Material and methods

The subjects of the study were two beaver dams, around 10m across and 1.5m in height constructed over a water canal 7m across. The locations of the dams were as follows: dam no. 1 - N 53° 48' 28", E 20° 35' 26"; dam no. 2 - N 53° 48' 30", E 20° 35' 22". The distance between monitored dams was ca. 650 m. The canal on which the beavers built the dams used in the experiment flows mostly through a forest area, in a small ravine with seasonally marshy meadows. An about 30-meter zone immediately adjacent to the shoreline is mainly populated by deciduous trees (eg alder, birch, hazel). The subject location is one of the oldest recorded to be inhabited by the European beaver in Poland, its existence is estimated to have started over 50 years ago (Janiszewski & Misiukiewicz, 2012). The canal on which the surveilled dams are located has been created by the beavers ca 5 years prior (word of mouth).

At each investigated dam two EREAGLE E1B camera traps have been placed, each recording a two-minute full-HD (1920x1080 30 fps) video sequence after being triggered by a motion detector. The cameras are equipped with IR lights enabling recording at night time. One of the camera traps was recording the area around the dam from the incoming water current side, the other was recording the side of the current leaving the dam. In total the surveilled area was estimated to be ca 30m in front and 30m after each dam. No special permits were required for this investigation from the local environmental authorities. Each recording containing the activity of various mammalian species was investigated. In total 2074 such recordings were gathered. Consecutive recordings containing the same animal or animal group were regarded as one activity recording.

The investigation started on Sep 1st, 2019, and ended on Feb 29th, 2020. During that period the activity at the two beaver dams was continuously investigated and the following characteristics were analyzed:

- animal species,
- activity type,
- date of activity occurrence.

The type of activity was classified as one of the six following categories:

- 1) preying/food gathering - the gathering of food or hunting by carnivorous species on or in the vicinity of the monitored dam,
- 2) water uptake (drinking) - drinking of water by the animal from the dam or the area close to the dam while being in the water,
- 3) transport across the dam - walking or running over the top side of the dam over the surface of the water,
- 4) crossing/swimming across the water canal in the vicinity of the dam - crossing the river across or along the water in the surveilled area,

5) transport along the coast of the river close to the dam - walking or running along the coast of the surveilled area,

6) other - any activity not classified as any of the above,

The complete data for each species has been presented in form of tables. Statistical analyses were performed using ANOVA in non-orthogonal design using the Tukey HSD test.

Results

From the gathered recordings a total of 1056 different mammalian activities have been characterized in the two investigated areas. The analysis showed that the subjects of the activities in or close to the dams were from one of 13 mammalian species (Table 1). The most recorded activity was due to transportation over the dam, followed by walking or swimming across the river close to the dam. It is worth noting that during the surveillance period the face of the water was covered by seasonal ice only three times, each time no longer than over five consecutive days, which did not significantly affect the results from the entire period. The least occurring activity was the one due to using the water close to the dam as a drinking source. From the activities classified as "other", the most frequent occurrences were ones due to fecal excretion by foxes, raccoon dogs, and American minks, as acts of territory marking. Activities recorded for the beaver species were mostly due to fixing the dam construction and were recorded 14 times. The various activities occurred with different frequencies in the investigated months over the fall-winter seasons (table 2).

As can be seen in table 2 preying and food gathering on the shorelines of the investigated areas were most frequent in the fall months, peaking in October. In the same month, the area in the vicinity of the dam was used as a source of drinking water. In November and over the winter months the animals used the beaver dams as a means of crossing the river. Walking and swimming across the water close to the dams occurred with uniform frequency over the entire surveillance period. In summary, taking all mammalian activities into account in every month of the recording period there were no significant statistical differences, although the months of greatest animal activity were November and February.

Table 1. Mammalian species and numbers of activities performed by each species in the investigated areas.

Species	Type of activity*						Total
	1	2	3	4	5	6	
Moose <i>Alces alces</i>	3	12	0	21	9	0	45
Red deer <i>Cervus elaphus</i>	6	9	0	33	11	0	59
Roe deer <i>Capreolus capreolus</i>	11	6	14	3	13	0	47
Wild boar <i>Sus scrofa</i>	8	0	25	43	23	0	99
Fox <i>Vulpes vulpes</i>	0	4	112	0	11	16	143
Raccoon dog <i>Nyctereutes procyonoides</i>	19	0	39	0	13	2	73
European badger <i>Meles meles</i>	11	0	16	0	9	0	36

American mink <i>Neovison vison</i>	23	0	119	6	92	9	249
European beaver <i>Castor fiber</i>	14	0	44	91	2	14	165
Eurasian otter <i>Lutra lutra</i>	41	0	14	51	6	2	114
Red squirrel <i>Sciurus vulgaris</i>	0	7	3	0	9	0	19
Yellow-necked mouse <i>Apodemus flavicollis</i>	0	0	0	0	5	0	5
Domestic cat <i>Felis catus domestica</i>	0	0	0	0	0	2	2
Total	136	38	386	248	203	45	1056

*1. preying/food gathering, 2. drinking, 3. dam crossing 4. crossing/swimming over the river close to the dam, 5. transport along the coast close to the dam, 6. other

Table 2. Frequency of occurrence of each activity during each month of the study period.

Type of activity*	Months					
	IX	X	XI	XII	I	II
1	24 ^b	49 ^{Ab}	21 ^b	10 ^B	11 ^B	21 ^b
2	7 ^b	12 ^{Aa}	5 ^b	3 ^B	5 ^b	6 ^b
3	49 ^b	24 ^B	93 ^{Aa}	87	66	67
4	37 ^b	56 ^a	44	33 ^b	29 ^b	49
5	23	24	39	41	28	48
6	11	1 ^B	2 ^B	11	14A ^a	6 ^b
Total	151	166	204	185	153	197

*1. preying/food gathering, 2. drinking, 3. dam crossing 4. crossing/swimming over the river close to the dam, 5. transport along the coast close to the dam, 6. other; (A, B – $p \leq 0,01$; a,b – $p \leq 0,05$)

Discussion

The European beaver *Castor fiber* has been classified as a keystone species, meaning one that has a significant impact on the lives of other animals in a given biotope, mammals being among them (Paine, 1995; Pliūraitė & Kesminas, 2012). The coexistence of the European beaver and the Nevison has been previously shown in scientific literature based on proprietary studies. As an example, there have been claims from the Bialovieska Forest in the mid 20th century stating that the population density of otters and American mink is positively correlated with the numbers of local European beaver habitats (Żurowski & Kammer, 1988; Sidorovich et al., 1996). Just as in the case of minks, the territories inhabited by otters are often overlapping with beaver territories. Those carnivores, similarly to minks, prey on small mammals, fish, crayfish, and other amphibians in the water reservoirs created by beaver activity. Moreover, otters rest on beaver dams and beaver impoundments. In the wintertime, they also use the ventilation holes made by beavers in the ice cover. Otters utilize beaver holes and dams, as well as hunt in their vicinity (Romanowski et al., 2010). The Canadian otters also utilize the beaver terraformed coastal areas as shelter during

wintertime. In the state of Idaho, 38% of the otter shelter area was recorded to be in dens dug by beavers. It is assumed that the increase in the beaver population in Poland had a positive impact on the number of otter populations. Also, earlier records from Latvia show a relation between the improvement of otter and beaver populations (Ozolins & Rantins, 1992).

Two interesting cases of coexistence of the beaver and another carnivorous mammal - the pine marten have been recorded in Norway (Rosell & Hovde, 1998). In one of them, two males and a female marten have been seen using the beaver dam due to its thermal isolation properties. In the wintertime, the temperature inside the dam lair is always higher than the outside ambient temperature. Being in a higher temperature area allowed the marten to more easily retain body temperature and conserve the energy otherwise used to keep this temperature up. In the second case, a hole in the snow cover on a beaver dam was noted leading down to the dam lair. Marten feces was found near the hole. It was later found that beaver hair and claw remains were found in the fecal matter. Based on the size of beaver remains it was established that a marten must have eaten a ca. One-year-old beaver. Additionally, all tracks found in the snow hinted that the beaver was not captured while being outside. The marten must have entered the dam lair through the ventilation shaft and hunted down the beaver inside. One occurrence of a beaver being hunted by a fox has also been recorded (Kile et al., 1996). Beaver habitats also attract other carnivorous species preying on other lesser animals. Among them is the raccoon (*Procyon lotor*), whose activity is noted increasingly more often on the territory of our country. Other carnivores use abandoned dams or lairs as their shelter. Those are for example badgers (*Meles meles*), martens (*Martes martes*), or even foxes (*Vulpes vulpes*) (Rosell et al., 2005).

Areas close to beaver dams are often characterized by luscious floral, bush, and tree vegetation. It is a rich food basis for wild herbivore animals, for example, roe deer, red deer, or moose. Studies have been conducted on the relation between beaver and moose activity in areas close to beaver habitats. Food competition has been noted between those species in such areas (Brzuski & Kulczycka, 1999). It was stated that a beaver colony residing in a certain area was quick to destroy the density of aspen trees growing in the area. This in turn resulted in the growth of bush and shrub vegetation, which were an attractive food source for moose. However, given a large enough moose population, there was a risk of them eating up all the lowly growing shrubs and trees before reaching a certain height, thus depriving the beaver population of food. Hence, a coexistence of the two species is only possible if the numbers of both populations are not too high (Brzuski & Kulczycka, 1999). According to information presented by Misiukiewicz et al. (2016), there is no food competition between beavers and other species in the aquatic areas, while on the coastal areas competition can arise with hoofed mammals such as roe, deer, and moose. The analysis of the degree of competition has shown that the hoofed animals did not pose as a significant food competitor for the beaver.

Sidorov et al. (2011) stated that beavers face competition from species that forage on stalks and shoots of aquatic plants and chew on herbaceous plants, shrubs, and trees growing on land at the distance of 100-150 m from the shore. In winter, significant competition may be observed in areas characterized by low food supply and high density of some semiaquatic species, including muskrats (*Ondatra zibethicus*) and water voles (*Arvicola amphibius*). In fall, winter, and early spring, European hares (*Lepus europaeus*) and mountain hares (*Lepus timidus*) feed on the branches of trees cut by beavers. Those species compete for food only in periods when their populations are particularly high. In special areas, significant competition could be posed by elks and red deer. The

first ones forage on willows in the shoreline zones. Their competitive influence is most strongly felt by beavers in late fall and winter. Red deer feed on the bark and shoots of woody plants, and in winter, they chew on the bark of trees cut by beavers. Beaver areas (dams or lodges) can be attractive for other small semiaquatic animals, including muskrats and water voles. The relationship between beavers and muskrats is an example of commensalisms (where one species benefits from the other without affecting the latter) that exists in sites transformed by beavers (Janiszewski et al., 2014). Such a relationship was not noted during the own research. However, it should be noted that the number of muskrat in north-eastern Poland (research area) is very low. In Germany, it was observed that as many as 14 out of 20 examined beaver positions were visited by wild boars. These animals burrowed in the dry parts of the beaver pond, mainly looking for waterlily and reed rhizomes. In addition, they used muddy and floating pond fragments as places for mud baths. In these places, created by the activity of beavers, the wild boars could both cool down and get rid of external parasites that haunt them (Ciechanowski et al., 2011). The activities of wild boars, consisting of the passage of a watercourse along the dam or near it (categories 3-5), were noted quite numerous in our research.

Conclusions

The described studies have shown and confirmed the important role of the European beaver in increasing the local biodiversity of mammals. During the fall-winter period, many other species of mammals use beaver dams and their vicinities to pass watercourses or as places to get food. Beaver dams are therefore a very important element of animal migration routes, as well as feeding grounds.

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