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CONTRIBUTION TO THE KNOWLEDGE OF WOODS PREFERENCES OF EUROPEAN BEAVER (*CASTOR FIBER* L. 1758) IN BANK VEGETATION ON NON-FOREST LAND IN THE FOREST DISTRICT SOUTOK (CZECH REPUBLIC)

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Abstract

URBAN, J., SUCHOMEL, J., DVOŘÁK, J.: *Contribution to the knowledge of woods preferences of European beaver (Castor fiber L. 1758) in bank vegetation on non-forest land in the forest district Soutok (Czech Republic).* Acta univ. agric. et silvic. Mendel. Brun., 2008, LVI, No. 4, pp. 298–294

From 2003 to 2005, this work studied the preference of tree species on non-forest land in the forest district Soutok (Southern Moravia, Czech Republic) in order to evaluate the suitability of the area for the development and the its importance in relation to the decrease of damage in neighbouring production forests. The diet included the total of 14 tree species with diameter interval reaching from 1–10 cm to 191–200 cm. The most preferred species was Common Ash (*Fraxinus excelsior*) (40.5 %) with the diameter 1–10 cm and willow (*Salix* spp.) (31.7 %) with the diameter 11–20 cm – both species with good ability to regenerate. Activities of European beaver negatively influenced the population of European white elm (*Ulmus laevis*), which belongs to the endangered species. Significant is the low ratio of poplars *Populus* spp. (7.9 %) caused by the forest management. Maintaining the suitable tree composition and a sufficiently high percentage of individual tree species – in favour of willows and poplars – can result in the needed decrease of stress caused by the population of beaver on the adjacent forest stands and in the decrease of possible damage.

European Beaver, *Castor fiber*, woods preferences, non-forest land

European Beaver (*Castor fiber*) is one of the protected mammal species with its numbers boosting in Europe, including the Czech Republic, over the recent years (HALLEY et ROSELL, 2002). Increasing numbers mean also enlarging its inhabited area; beaver expands to areas with suitable biotopes such as bank areas along streams, water reservoirs or wetlands, as long as there is enough food i.e. soft broad–leaved species and herbs (ANDĚRA et HORÁČEK, 1982; DJAKOV, 1975; DZIECIOLOWSKI, 1996). The present landscape in Central Europe is of anthropogenic origin which leads inevitably to conflicts between expanding beaver and man. These conflicts relate to similar life strategy of both species considering the ability to change its environment (KOSTKAN, 2000; MÜLLER-SCHWARZE et SUN, 2003; VOREL, 2005; ROSELL et al, 2005). An important role also plays the fact that many sites – being of anthropogenic origin – provide beaver with good living conditions and therefore beaver population thrives also in non-typical biotopes (KOSTKAN, 2000). From the perspective of the forest management beaver is important mainly because of its close dependence on tree species (KOSTKAN, 2000; DOUCET et BALL, 1994; DONKOR et FRYXELL, 1999) with up to 80 species making-up his diet (KOSTKAN, 2000). Therefore, beaver is closely observed in production forest stands (NETÍK, 2005; HOŘENÍ, 2004). Apart from the issue of the damage considered from the point if view of forestry, it is the aforementioned legal protection that has to be taken into account when considering the population on their sites.

According to Act No. 144/1992 Coll., on Nature and Environment Protection and the Degree No. 395/1992

Coll. the European Beaver is critically endangered species in the Czech Republic. Beaver is also included in Annex 1 (species requiring the designation of special area of conservation) and in Annex 4 (species requiring conservation) of the Council Directive 92/43/EEC of May 21, 1992 on the conservation of natural habitats and of wild fauna and flora that, in the Czech Republic, became a biding piece of legislation after the accession to the European Union.

It is necessary on one hand to tackle the issue of the damage caused to production forest stands and on the other hand to provide for a long-term prosperity of beaver population on selected sites also out of the protected areas. Non-forest land, where no actual damage is inflicted and therefore feasible as refugium for beaver populations, appears to be essential. The importance of such sites is still undervalued. Our work focuses on the importance of selected non-forest plots within the model area of Soutok in the South Moravia (Czech Republic) from the prospective of the offer of species insignificant for the forest management to the local populations of European Beaver.

MATERIAL AND METHODS

In the area of interest, the type and extend of damage inflicted by the European Beaver (tree species, diameter and circumference of a damaged tree at 0.5 m above the ground and type of damage) was monitored during the period from 2003 to 2005. The following degree of damage was recorded:

1. Trees without any damage
2. mirrors – only the bark nibbled off the trees
3. trees nibbled to max. 1/3 of tree diameter
4. trees nibbled to more than 1/3 of tree diameter
5. felled trees.

I: *Area of selected sites*

Site No.	Area of site (km^2)	Circumference of site (km)
I	0.087	1.413
IIa	0.113	3.443
IIb	0.157	2.880
III	0.209	4.080
IV	0.093	1.728
V	0.091	2.200
VI	0.690	4.701
VII	0.423	4.145
VIII	0.275	4.092
IX	0.863	6.490
X	0.420	6.082
Σ	3.421	41.254

The research included the total of 701 damaged trees.

Individual observations were recorded in the form made according to the monitoring methodics for beaver populations (KOSTKAN, 2000; HAMŠÍKOVÁ, 2003).

The monitored plots were marked by numbers I–X (Tab. I) and were situated on the bank of the river Dyje and on its cut-offs or on the bank parts of small water channels and ditches. One plot was situated near to a water reservoir.

CHARACTERISTICS OF THE MONITORED AREA

The monitored area includes alluvial plains of the rivers Morava and Dyje and it is situated in the most southern part of Moravia, on the border with Austrian and Slovakia, with the total area of 605 km^2. The bioregion comprises of vast river flood plains of the first vegetation zone with clear relation to the Pannonian province. Despite the disturbed water regime due to water management many species and communities are still of the most representative distribution within the whole Czech Republic (CULEK, 1995).

Plains are located mainly on sands and gravel sands with 2–5 m thick layer of alluvial soil and partly buried dunes of blown sand emerging on several sites particularly in southern parts. In 1970's and 1980's the dynamics of alluvial plains was disrupted by stream control and building of the Nové Mlýny Water Reservoir that changed greatly the original water regime of rivers, particularly of the river Dyje.

Alluvial plains are like flatlands with the elevation from 2 to 10 m. The altitude of the area of junction of the rivers Dyje and Morava is 148 m (CULEK, 1995).

In the area the weather is according to QUITT (1971) substantially warm with the average temperature from 9 to 9.5 °C. The precipitation reaches from 495 to 585 mm.

Flood-plain forests are the potential dominant vegetation. The hard flood-plain forest comprises of class *Ulmenion*, mainly of associations *Ficario-Ulmetum campestris* and *Fraxino pannonicae-Ulmetum* that change rarely to types close to Pannonian *Primulo versi-Carpinetum* and possibly up to thermopile oak forests. Primarily unstocked forest land developed on wetland (inland delta, dead river channels) with vegetation of alliance *Phragmition communis, Caricidae gracilit* that change in water to various types of alliance *Hydrocharition, Nymphaeion albe, Potamion lucentis, Potamion pusilli* and *Batriachion aquatilis*.

Hydrophilous and xerophilous flora includes numerous species bound to alluviums of lower reach of rivers, e.g. *Fraxinus angustifolia, Tithymalus palustri, Thalictrum flavum, Cnidium dubinum, Cruciata pedemontana, Asarum evropaeum, Dentaria bulbifera*.

The following most important species are present here: oak (*Quercus robur*), horn beam (*Carpinus betulus*), white poplar (*Populus alba*), black poplar (*Populus nigra*), tree-of-heaven (*Ailanthus altissima*), black walnut (*Juglans nigra*), lime (*Tilia* spp.), European white elm (*Ulmus laevis*), etc. (CULEK, 1995).

RESULTS AND DISCUSSION

According to our results, the following soft broad-leaved species were present and damaged: white poplar (*Populus alba*), aspen (*Populus tremula*), willow (*Salix* sp.) and ash (*Fraxinus excelsior*). These tree species regenerate significantly, therefore dying or decreased stability of such forest stands does not cause problems. On the monitored plots the most common species include ash and willow with the total of 72 % (Table II).

On the monitored sites the mostly preferred diameter reached from 1–10 cm; ash of such diameter was the mostly damaged species (Table III) with the perfect browsing amounting up to 91.3 % (Tab. IV). The perfect browsing was the most common damage inflicted on all tree species present on the monitored site amounting up to 77 %. As for ash and willow – when compared to other monitored tree species – the perfect browsing amounted to 89.4 % and 72.1%, respectively (Tab. V). Other authors also conclude that beaver prefers tree species of smaller diameter, e.g. according to HENRY et BOOKHOUT (1970) 90 % of trees felled by beavers are of diameter below 8 cm, and trees of diameter over 25 cm are felled only rarely. DROBNÁ et JEŽEKOVÁ (2000) found that three quarters of used trees are of diameter below 10 cm and browsing on trees over 45 cm occurs only seldom; however, sometimes trees of exceptional diameters are damaged. On our monitored site a goat willow with 195 cm in diameter nibbled to more than 1/3 of the diameter was found (Table III).

II: *Percentage of tree species on the whole area of interest (plot I–IX)*

Tree species	Total of tree trunks	in %
Salix spp.	222	31.7
Populus spp.	55	7.9
Populus alba	8	1.1
Fraxinus spp.	284	40.5
Fraxinus angustifolia	2	0.3
Acer negundo	35	5
Acer campestre	9	1.3
Ulmus spp.	61	8.8
Quercus spp.	1	0.1
Robinia spp.	3	0.4
Tilia spp.	1	0.1
Crataegus monogyna	8	1.1
Sambucus nigra	4	0.6
Prunus spinosa	8	1.1
Σ	701	100

III: *Percentage of diameters of damaged tree species on the whole area of interest*

Diameter in cm (from to)	Σ	% within the interval	Dominant tree species	% of dom. species
0–10	358	51.1	*Fraxinus* spp.	62
11–20	181	25.8	*Salix* spp.	41.4
21–30	76	10.8	*Salix* spp.	60.5
31–40	41	5.8	*Salix* spp.	46.3
41–50	19	2.7	*Salix* spp.	52.6
51–60	10	1.4	*Populus* spp.	50
61–70	5	0.8	*Salix* spp.	60
71–80	3	0.4	*Salix* spp.	100
81–90	5	0.8	*Populus* spp.	60
101–110	1	0.1	*Salix* spp.	100
131–140	1	0.1	*Salix* spp.	100
191–200	1	0.1	*Salix* spp.	100
Σ	701	100	-	-

The sampling plots (I–X) differed in the preference of individual tree species according to the level of their cultivation by man. Interesting is the preference of various diameter intervals of tree species influenced probably by the age of the given forest stand; however, it proves beaver's ability to fell trees of any diameter. For example, on the plot I, willow was the most attractive tree species (82.3 %) for beaver with its diameter reaching from 11 to 20 cm. On the plot IIa, it was the box elder (77.2 %) with its diameter from 1 to 10 cm; on the plot IIb, it was the willow (100 %) with its diameter from 31 to 40 cm; on the plot III, it was the ahs (57.1 %) with its diameter from 1 to 10 cm; on the plot IV, it was the white poplar (100 %) with its diameter from 61 to 70 cm and from 81–90 cm; on the plot V, it was the European

IV: *Degree of damage within the mostly preferred interval of diameters*

Diameter (from to)	Degree of damage	Σ Pc.	Σ %	W %	P %	JM %	EL %	AC %	1 %	2 %	3 %	4 %	5 %	6 %	Σ
0–10	0	22	6.2	1.1	0.8	0.6	1.7	0.3	0.3	0.6	0	0.8	0	0	6.2
	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	+	9	2.5	0.3	0	0.3	1.7	0	0	0	0.3	0	0	0	2.6
	x	327	91.3	14.8	2.5	4.4	58.6	0.3	4.7	1.6	0	1.4	2	0.8	91.2
Σ		358	100	16.2	3.3	5.3	62	0.6	5	2.2	0.3	2.2	2	0.8	100

Key: W – willow, P – poplar, AS – ash, EL – elm, AC – acacia

Key of the degree of damage:
partly nibbled, only mirrors 0
tree nibbled to max. 1/3 of tree diameter ..... –
tree nibbled to more than 1/3 of tree diameter ..... +
tree felled completely (perfect browsing) x
1 – box elder (Acer negundo L.)
2 – blackthorn (Prunus spinosa L.)
3 – narrow-leaved ash (Fraxinus angustifolia L.)
4 – field maple (Acer campestre L.)
5 – common hawthorn (Crataegus monogyna L.)
6 – common elder (Sambucus nigra L.)

V: *Degree of damage of the mostly preferred tree species*

Degree of damage	Σ pc.	Σ %	JS pc.	JS %	VR pc.	VR %
0	107	15.3	17	6	42	18.9
–	3	0.4	0	0	2	0.9
+	51	7.3	13	4.6	18	8.1
x	540	77	254	89.4	160	72.1
Σ	701	100	284	100	222	100

white elm (57.1 %) with its diameter from 11 to 20 cm; the last plot, where the activity of beaver – felling and damaging trees – was established, is the plot IX with field maple being the mostly preferred tree species (26.5 %) and its diameter reaching from 1 to 10 cm. So, it can be concluded that on the whole area the most attractive tree species for beaver is ash (40.5 %) with its diameter reaching from 1 to 10 cm; the second most attractive tree species is the willow (31.7 %) (Tab. II). Willow and poplar – that was not so often present on the monitored plots – belong to the most important tree species from the point of view of the diet preference (MÜLLER-SCHWARZE et SUN, 2003) and therefore, it is desirable to plant them in the areas of occurrence of beaver, which can then result in lower damage inflicted on valuable, commercial tree species (KOSTKAN, 2000). Alder (*Alnus glutinosa*) is one of the commercially unimportant tree species that is the least preferred food source and that is felled only as material for construction (BRYANT et KUROPĚT, 1980; PINKOWSKI, 1983 in NOLET, 1994). On the other hand (NOLET, 1994) found that on the monitored site in the Netherlands no construction work was carried out, therefore alder and other minor species were felled and served as food source. In case of lack of poplars and willows beaver also feed on birch (BRYANT et KUROPĚT, 1980).

Apart from ash and willow, the species damaged to a lower extent was the elm (*Ulmus* sp.) that does not occur on the site so often and damaging helps to eradicate it. Following tree species were also damaged: blackthorn (*Prunus spinosa*) and common hawthorn (*Crataegus monogyna*); according to other sources, damage on other tree species is recorded on these sites e.g. on common walnut (*Juglans regia*) (NETÍK, 2005) and on whole range of hard tree species such as oak or ash (NETÍK, 2004). The tree species preference relates both to their digestibility that differs from species to species as established by FRYXELL et al. (1994) and DOUCET et FRYXELL (1993) and to their use as construction material (DOUCET et BALL, 1994).

Beavers are active and take in food for the whole year and only during the toughest periods of frost fall into lethargy and live from their fat reserves. In order to be able to digest cellulose, making up – mainly in winter – a large part of their diet, its appendix consists of three folds where micro-organisms decomposing cellulose are living (SYROVÁTKOVÁ, 1998). Concerning the speed individual tree species are di-

gested with, DOUCET et FRYXELL (1993), DOUCET et BALL (1994), FRYXELL et al. (1994) described that beaver digest e.g. poplar (*Populus tremuloides*) 2.3 to 2.7 times faster than alder (*Alnus rugusa*) and 2.6 to 3 times faster than maple (*Acer rubrum*). DOUCET et FRYXELL (1993) established that the energy is derived from food in the same order. Poplar is the best diet from the point of view of the strategy of deriving energy from food. The ration of herbs and tree species in the diet depends on the time of the year (SYROVÁTKOVÁ, 1998).

Tree species comprise the diet mainly in winter and herbs mainly in spring (MÜLLER-SCHWARZE et SUN, 2003; HAARBERG et ROSELL, 2006). European beaver uses the plant food component to make winter reserves. These reserves can be significant with the volume per animal amounting up to 10 cubic meters of wood. Approx. 10–15 % of animals do not make any reserves (ZEJDA et al., 2002).

CONCLUSION

On the base of the afore mentioned it can be concluded that due to the presence of willow, ash and poplar are the monitored non-forest plots – considering the food offer – a suitable area for the population of the European beaver. Preserving a suitable tree species composition and a sufficient percentage of individual tree species – in favour of willow and poplar – can help to achieve the desirable decrease of the stress caused by beaver to the adjacent production forest stands and of the possible damage.

SOUHRN

Příspěvek k poznání preference dřevin bobrem evropským (*Castor fiber* L., 1758) v břehových porostech nelesních půd v oblasti Soutok (Česká republika)

V práci byla studována preference dřevin na nelesních plochách na polesí Soutok (jižní Morava) v letech 2003 až 2005, s cílem posoudit vhodnost území pro rozvoj populace bobra evropského a posoudit význam ve vztahu ke snižování škod v okolních hospodářských lesích. Celkem bylo využíváno 14 druhů dřevin o průměrech v intervalech od 0–10 cm do 191–200 cm. Nejvíce bobr preferoval jasan ztepilý (*Fraxinus excelsior*) (40,5 %), s průměrem v intervalu 0–10 cm a vrbu (*Salix* spp.) s 31,7 %, v tloušťkovém intervalu 11–20 cm, tedy dobře zmlazující dřeviny. Jeho činnost naopak negativně ovlivnila populaci jilmu (*Ulmus laevis*), který je ohroženou dřevinou. Významné je nízké zastoupení topolů *Populus* spp. (7,9 %), ovlivněné lesnickým hospodařením. Při udržování vhodné dřevinné skladby a dostatečného procentického zastoupení jednotlivých druhů dřevin (ve prospěch vrb a topolů) lze dosáhnout potřebného zmírnění tlaku bobří populace na okolní hospodářské lesní porosty a tím i snížení potenciálních škod.

bobr evropský, *Castor fiber*, preference dřevin, nelesní půda

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