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Assessing the impact of European beaver (*Castor fiber*) on the organisation of plant communities, a case study from the lower reaches of the River Liswarta

Grzegorz Kłys[1], Justyna Naturalna[2]

[1]University of Opole, Department of Biosystematics, Oleska 22, PL 45-052 Opole, Poland gklys@uni.opole.pl
[2]Students Scientific Club of Biologists, University of Opole, Department of Biosystematics, Oleska 22, PL 45-052 Opole, Poland

Abstract: In order to study the extent to which *Castor fiber* modifies its natural habitat, we conducted observations along the lower reaches of the River Liswarta, an easterly tributary of the River Odra. To this aim, plant communities on the river banks were mapped in order to determine the existing phytocoenosis; a list of plants which constitute the beavers' diet was drawn up. Six plant associations and four plant communities were found in the section of the river studied. It has been determined that beaver activity to a great extent modifies the plant communities dominated by *Populus tremula,* and to a lesser degree such associations as *Salicetum triandro–viminalis* and *Salicetum pentandro–cinereae*. In other vegetation types, changes resulting from beaver modification are minimal. Species making up the associations *Salicetum triandro-viminalis* and *Salicetum pentandro–cinereae* characteristically have a long life-span which is why its proportion in future may rise.

Key words: *Castor fiber*, Poland, Liswarta River, Silesia, river side vegetation

Introduction

Beavers are typical herbivores. The spectrum of plant species which constitute their diet is very broad. According to Pawłowska-Indyk and Indyk (1996), it involves some 150 species, while Dzięciołowski (1996) noted 150 herbaceous and 86 arborescent species, and Czech (2000) estimated the number to be 200 herbaceous and 100 arborescent plants.

The animal eats in a „central place" – and the distance from water is a primary determinant of nutritional components (Dzięciołowski 1996; Drobná and Ježekowa 2000; Dzięciołowski and Misiukiewicz 2002). The distance, however, does not exceed 20 m (Czech 2000).

Beaver composes its own menu depending on occupied habitat (Czech 2000). If autumn starts early, beaver will eat more hard food. European aspen and willow account for the winter's nutritional basis (Tomek et al. 1978; Żurowski 1982; Żurowski and Gulewicz 1986; Jamrozy et al. 2001; Brzezowski 2002; Dzięciołowski and Misiukiewicz 2002). Beavers can then even go on 'trips' of a couple of hundred metres in order to find food (Dehnel 1949; Pawłowska-Indyk and Indyk 1996). In northern and eastern Poland, the following food items should be added: birch, black alder, ash (Dzięciołowski and Misiukiewicz 2002), as well as hazel, black ash tree (Brzozowski 2002) and lime (Jamrozy et al. 2001).

The aims of the present study were:

1. to map the flora growing on the river banks and in the river itself so as to determine the phytocoenosis of places inhabited by the European beaver;
2. to draw up a list of trees, bushes and herbaceous plants which constitute the beaver's menu;
3. to assess and evaluate the extent to which a beaver modifies its natural habitat (i.e., determine the level of changes which occur in particular plant communities);
4. to determine possible forecasts regarding the direction of changes in places inhabited by beavers.

Study area

The present study was conducted in the lower reaches of the River Liswarta, an easterly tributary of the River Odra. In the current administrative division of the Republic of Poland, this river constitutes the natural border between the provinces of Łódzkie and Śląskie (Silesia) (51º00´N, 19º00´E). The right bank, together with adjacent plots of land, belong to the village of Trzebca (province of Łódzkie, District of Pajęczno, municipality of Nowa Brzeźnica (UTM: CB 65). Further away, there are the areas of the Forest District of Kłobuck, where the Forest District of Gidle wedges in on a small distance. To the left, there is the village of Kule (province of Śląskie, District of Kłobuck, municipality of Popów) (Fig. 3).

According to Kondracki (1998), study area belongs to mesoregion 341.21 Wieluń Upland which is a part of the macroregion 341.2 Wieluń Upland.

Methods

Fieldwork was carried out between autumn 2003 till spring 2005, to obtain data on species assemblages of potential nutritional flora for *C. fiber*. Apart from that, during spring-summer seasons, phytosociological relevés were taken in order to determine actual plant communities growing in the study area, using the methodology of Braun-Blanquet (1964).

In order to mark particular species properly, the following sources were used:

„Klucz do oznaczania roślin naczyniowych Polski Niżowej" ["Determination Key of Vascular Plants of Polish Lowland"] by Rutkowski (1998), and to document plant communities, „Przewodnik do oznaczania zbiorowisk roślinnych Polski" ["A Guide to Determination of Plant Communities in Poland"] by Matuszkiewicz (2002) was used.

After mapping the actual flora, lists of trees, bushes and herbaceous plants constituting the diet of *Castor fiber* were drawn up. These data were collected between autumn 2003 and spring 2005.

In addition to summing up fallen trees, annual observations regarding nutritional activity in distinct plant communities were conducted.

Results

During the spring-summer of 2004, we took 78 phytosociological relevés in order to determine actual plant communities growing in the study area. Six plant associations and four plant communities were found in the studied river section . Employing both field and laboratory methods, it has been determined that in this section there are species typical of the following phytocoenoses:

a) river banks
- *Phalaridetum arundinaceae* association,
- *Salicetum triandro–viminalis* association, belonging to the class *Salicetea purpureae*,
- *Salicetum pentandro–cinereae* association of the class *Alnetea glutinosae*,
- a community of the class *Koelerio glaucae – Corynephoretea canescentis*,
- a community dominated by *Calamagrostis epigejos,*
- monocultural *Pinus sylvestris*,
- a community dominated by *Populus tremula,*

b) river:
- *Potametum natantis* association,
- *Elodeetum canadensis* association,
- *Spirodeletum polyrhizae* association

Communities growing on the river borders are presented in phytosociological tables (Tab. 1-7); associations found in the river itself were not taken into account as these occurred only locally; instead, they are presented on the map of the area together with remaining phytocoenoses in order to document the distribution of all communities (Fig. 4).

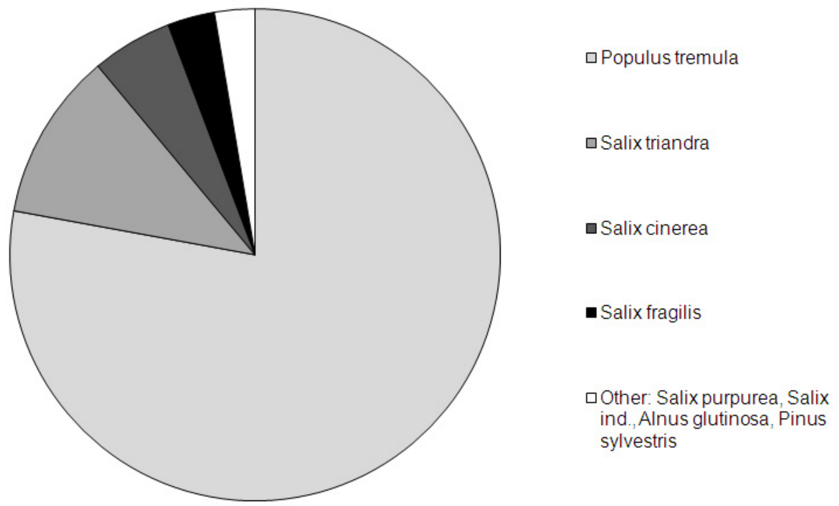

Fig. 1. Percentage incidence of tree species in an European beaver diet.

The distribution is presented in Fig. 1. It was determined that of arborescent plants the rodent is the most willing to cut European aspen (*Populus tremula),* which accounts for 78% of the total number of bitten tree stumps. In second place (considering the number of bites) is *Salix* sp. with a total of 21% of all tree items (in a descending trend: almond willow *S. triandra* 11%, grey willow *S. cinerea* 5%, crack willow *S. fragilis* 3% and purple willow *S. purpurea* 0,5%). Moreover, the cut and left-out Scots pine (*Pinus sylvestris*) was observed near the old river bed (which accounts for 0,5%), bites on wild pear (*Pyrus pyraster*) (0,5%), black alder tree (*Alnus glutinosa*) (0,5%) and tracks of incisors on hornbeam tree (*Carpinus betulus*).

In the period between 13 November and 28 March, there were no field observations and for this reason, bitemarks were classified as if made in the following periods: “winter ‘04/05” or: ”spring 2005”, after having visually assessed the time of the bite (on the basis of the degree of wood darkening). Because of the fact that all above-mentioned species of willow trees, with the exception of fragile willow (*S. fragilis*) have a bush form, the overall number of cut specimens as well as the number of bitten shoots were provided (the latter value presented in brackets). Next, the total value of bites on European aspen and willows taken from Table 4 was treated as 100% in order to assess mutual proportion of dominants. The remaining species were omitted as they account for a miniscule proportion of bites. Thus, proportion of cut-down stumps of *P. tremula* amounted 79% and the genus *Salix* spp. 21%. The proportion of all cut-down shoots of these two components were: aspen 70%, willow 30%.

We took 256 diameter measurements of cut-down stumps and shoots in order to determine preferences related to thickness. A division on the basis of size of the section was made; each category represents 1-centimetre sections. Next, the data from columns were summed up and they accounted for 6 categories with specific diameters (i.e. 0-5 cm, 5-10 cm, 10-15 cm, 15-20 cm, 20-25 cm and 25-30 cm). The data obtained are shown in Fig. 2.

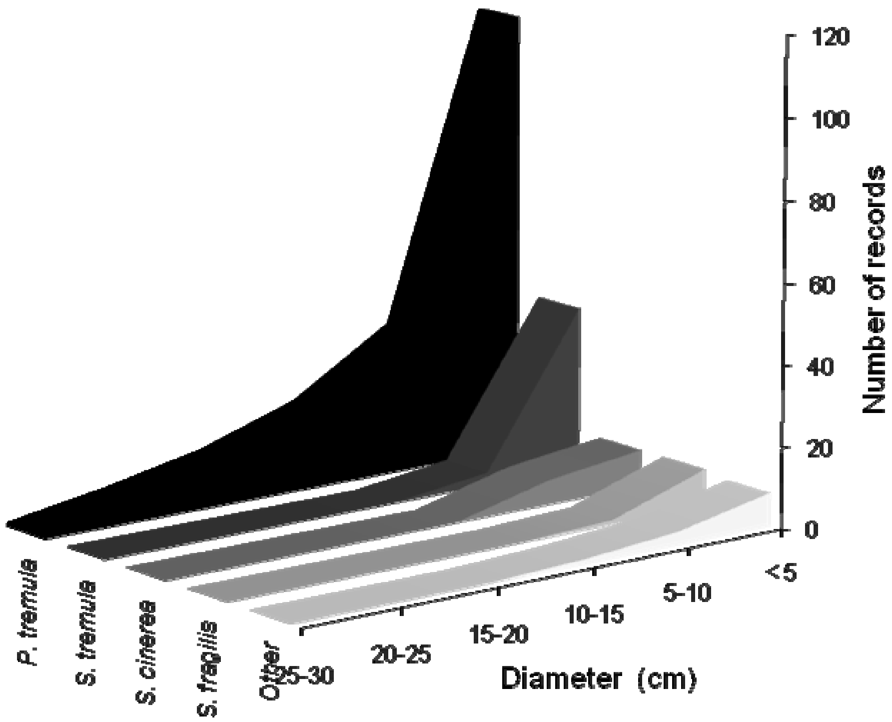

Fig. 2. Diameter of stumps and shoots of tree species cut-down by European beaver (N=256).

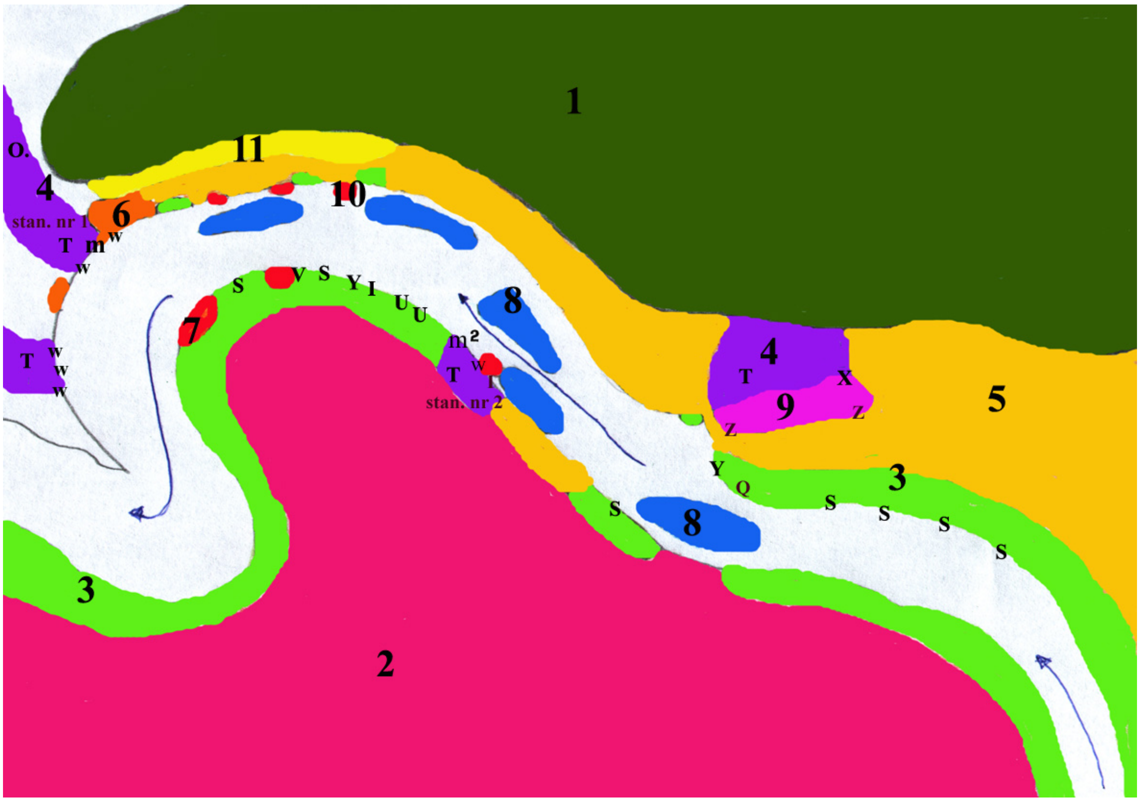

Fig. 3. Study area

LEGEND
1 - monocultural *Pinus sylvestris*,
2 – meadow with isolated *P. sylvestris* and *J. communis*,
3 – plant association *Salicetum triandro-viminalis*,
4 – tree-covered area with *Populus tremula*,
5 – plant association *Phalaridetum arundinaceae*,
6 – plant community dominated by *Calamagrostis epigejos*,
7 – class *Alnetea glutinosae*,
8 – plant association *Elodeetum canadensis*,
9 – plant association *Potametum natantis*,
10 – plant association *Spirodeletum polyrhizae*,
11 – plant community of the class *Koelerio glaucae - Corynephoretea canescentis*;

Stan. nr 1 (position no 1) and Stan. nr 2 (position no 2) – places where European aspen were cut down,
m – winter storehouse,
w – toppled exemplars of European aspens,
O. – cut-down individual of European aspen (approx. 30 metres from the river bank)

Species consumed
I - *Alisma plantago-aquatica*,
Q – *Solanum dulcamara*,
S – *Salix* (*cinerea, fragilis, purpurea, triandra*),
T – *Populus tremula*,
U – *Veronica anagallis-aquatica*,
V – *Lysimachia nummularia*,
X – *Pinus sylvestris*,
Y –*Mentha aquatica*,
Z – *Berula erecta*.

So-called ”nutritional tables” (i.e. decorticated willow shoots and left along the river banks or in the shallow water) were encountered by us in early spring 2004 on both banks of the section studied as well as upstream of it. The changes were marked in Fig. 3. After a summer break, intense activity was observed once again on 23 August 2004. At that time, the first fresh bites appeared 3 metres above site no. 2 (Fig. 4). As autumn approached, there was a considerable increase in the number of bites. In autumn (23 October 2004) there were seven cut-down branches 0,5 – 1,5 cm thick and covered with bark. During a subsequent inspection (12 November 2004), a considerable increase in “nutritional tables” was observed, which to a large extent consisted of species of the *Salicetum triandro-viminalis* association. Having penetrated 2 kilometre section of the river (along its banks starting from the old river bed upstream), numerous twigs of *Salix* sp. left and covered with bark were found.

Research conducted in spring 2005 (29 March) once again confirmed the existence of subsequent, albeit less numerous “nutritional tables”. Moreover, two winter storehouses were found – their location and position are shown in Fig. 4. It was determined that the twigs collected therein belong to the genus *Salix*.

The places where individual specimens of *P. tremula* either fell down into the river or were cut, which was due to uprooting (by digging canals or burrows along the river banks by beavers) were also recorded on the map.

It was determined that from the consumed plants the actual nutritional base accounts for the following components:

- water mint (*Mentha aquatica*),
- common water-plantain (*Alisma plantago-aquatica*),
- veronica (*Veronica anagallis-aquatica*),
- cutleaf waterparsnip *Berula erecta*,
- bittersweet nightshade (*Solanum dulcamara*),
- *Lysimachia nummularia*.

The places where beavers fed on herbaceous species were marked on the Fig. 4.

Discussion

Beavers modify their habitat both directly and indirectly. The first changes can be noted soon after the animal takes over control of a particular area.

These changes are usually the following:

- cutting down trees,
- digging burrows and canals in high river banks,
- building dams in shallow waters and constructing beaver lodges.

Indirect changes can be traced only after some time and are the result of long-term impact of direct changes, as follows: biodiversity increase, development of one type of flora (i.e. flora favouring marshy areas) at the cost of others, creation of so-called “beaver ponds”, etc.

Arborescent plants constitute the core nutritional base (supplemented with other flora) of beavers in the winter season (Dehnel 1949; Czech 2000). In other seasons (i.e. spring, summer and early autumn), the beaver’s diet is constituted mostly of herbal species, data on which are presented in the previous section.

It is worth noting that the number of bites in *P. tremula* was higher than that in willow. This discrepancy in proportions was explained in the following way: the genus *Salix* is represented in the study area by species with a bushy form. The only exception is fragile willow (*Salix fragilis*), which has a tree-form. The proportion of dominants was different when only the sum of cut-down exemplars was taken into account (in which case shoot bites made by beavers on an individual exemplar of a willow were treated as one); it was also different when each shoot was treated as a separate case. In such a situation the first alternative was more beneficial for European aspen. This would suggest that the plant community dominated by *Populus tremula* is modified more frequently than the one dominated by willows.

It is also important to remember that the data for the genus *Salix,* as presented in Table 4, may be underestimated in relation to those for *Populus tremula,* which can be ascribed to fact that all places where beavers bit the shoots are difficult to access.

Areas overgrown with osiers, which belong to the *Salicetum pentandro-cinereae* and *Salicetum triandro-viminalis* associations, constitute rather dense bush associations; located in floodland they are frequently inaccessible, especially when water level rises (location of phytocoenoses is presented in Fig. 4). Therefore, some specimens might have been omitted due to an oversight (measurements were conducted by a single person) or in fear that results could have been duplicated. Moreover, it is easier to count the exemplars which are cut at the bottom of the land than those which have only lost some branches or twigs.

Cutting down European aspen causes an increase of growth on particular tree stumps. It contributes to rejuvenation of the plant community (in this case, the one dominated by *Populus tremula)* and may increase the percentage of phytocoenosis as well as exert a considerable influence upon the number and species of fauna (Bereszyński 1991). It takes some time for a tree to reach a specific height. As a result, the illuminated (i.e. exposed to the sun) plot of land may be a favourable habitat for light-loving plants with low edaphic and humidity requirements, e.g. belonging to the class *Koelerio glaucae – Corynephoretea canescentis* (Fig. 4).

The majority of bites on *P. tremula* were made by beavers at distance not greater than 5 metres from the river bank. Generally, these animals exploit nutritional base found within a distance of 20 m along the edge of the river (Czech 2000) and only sporadically do they penetrate the terrain beyond 30 metres from that (Drobná and Ježeková 2000). Such behaviour was repeatedly confirmed during the present study; in the spring of 2005, a cut-down European aspen was found 30 metres from the edge of the river. Interestingly, it was not an individual specimen growing there, but one of numerous trees constituting a plant community dominated by *Populus tremula* (Fig. 4).

If a tree growing on the edge is cut, it falls into the river. Logically, the animals will cut the tree stump from the land side. A similar effect is observed when planting a tree in the land is disturbed as a consequence of tunnelling through the land or digging burrows in the river banks. Such actions may cause damage to the embankment and initiate landslides. If erosion of high banks overgrown with European aspen trees (Fig. 4) would occur following the above scenario, the reach of the plant community may decrease. This, in turn, would contribute to the development along the escarpment of plant communities of lower organisation levels, i.e. a phytocoenosis of the group *Koelerio glaucae – Corynephoretea canescentis*. In the study area, the soil comprises pseudo-podsols classified as poor soils. The position created secondarily would be characteristic of low humidity and a high exposure level to the sun. Plant communities belonging to one and the same class are characteristic of low floral diversity and therefore dry escarpment would be a favourable habitat, which we noted in the preceding section. A correlation would exist between direct influence on the plant community dominated by *P. tremula* and indirect impact, which was positive for the class *Koelerio glaucae – Corynephoretea canescentis*. It is necessary to bear in mind that the assumptions made above constitute propositions only and they may serve merely as predictions for future development. To date, such profound changes have not been registered in the study area.

Transformation will also occur below the level of toppled trees. In such a case, the river channel undergoes modifications, which results in a new meander. It can be noted that the outflow in the winter term prevails, with the highest value recorded for March. Fast-flowing water may additionally accelerate carving of the bottom and contribute to changing the shape of the channel. If the river bend cuts deeply into the bank, then the flow of the current may slow down. Such a situation would be an ideal solution for plant associations of the class *Lemnetea minoris* or *Potametea* (which belong to the union *Potamion*). Such conditions would constitute an optimum environment for their development.

The slowed-down current would additionally contribute to sedimentation of suspended particles and thus silt up the bottom of the river. The secondarily created position would constitute a habitat for the development of rushes, especially for the plant association *Phalaridetum arundinaceae*, which belongs to the union *Magnocaricion*. To some extent, it would also serve as a refugium for waterfowl.

Below, we present hypothetical trends in the changes of willow bushes.

The plant association *Salicetum triandro–viminalis* is made up of species which adopt easily to changing environmental conditions and may develop in places not appropriate for fragile willow (*Salix fragilis*). As such it will pave the way to development even in regions subject to destruction by ice floating down the river in spring (which is harmful to seedlings of *S. fragilis*; Sikorski and Wysoki 2002).

When beavers abandon twigs, this may contribute to a spontaneous development of such plant communities. In such a case, beavers would inhabit places dominated by flora, e.g. bog flora, which would have to recede automatically (*Phalaridetum arundinaceae* grows just next to the river and it frequently takes root in the shallow water; Fig. 4). From a floristic perspective, the plant association *Salicetum triandro–viminalis* is poor, and the level “c” covers the foundation to variable degrees (Sikorski and Wysoki 2002). *Salicetum pentandro–cinereae* also belongs to the bush formation. The analysis of data for grey willow (*Salix cinerea*) presents the low level of biting the tree. As a result, no stretches of land exposed to the sun appear, which would constitute a favourable habitat for light-loving plants. Due to extensive gnawing, a dynamic development of trees will occur, i.e. it will accelerate plant growth.

Nolet et al. (1994) assumed that the branches dangling just above the water (they account for potential nutritional base of *C. fiber)* may exert a negative influence upon the development of annual plants, perennial plants and other light-loving species. These suggestions appear plausible because even in places where beavers have not been feeding, e.g. on grey willow (*Salix cinerea)*, level “c” was very rare.

Furthermore, it is possible to attempt to explain why willow bushes (*Salix cinerea* and *Salix triandra*) dominating plant communities enjoy a strong preference over the tree form of *Salix fragilis*. The percentage (expressed in %) of particular species of willow, for which an upward tendency has been registered, is the result of nutritional optimum (Nolet et al. 1994): it is necessary to cut down the tree first in order to obtain the branches of fragile willow. Due to energy saving, the most efficient way is the exploitation of bushes such as e.g. *Salix triandra* and *S. purpurea*. One more advantage is the spatial localisation, which is not beneficial for fragile willow growing some distance away from the safe water habitat. It is also necessary to explain that the animals cut all the branches of *S. fragilis* on the toppled exemplars only.

It is accepted to treat the other species in less detail, because they were exploited to a minimum extent. What is interesting, however, is the case of cutting down one specimen of Scots pine (*Pinus sylvestris)* (Fig. 4). It is common knowledge that European beavers use this plant as construction material and for that reason do not consume it. Nevertheless, no construction was erected in the area close to the old river bed. The tree was abandoned after being cut down.

The aim of conducting measurements of diameters was to ascertain whether there are any preferences with regard to bitten tree stumps and shoots. As it follows from the analysis, the majority of cuts were noted on exemplars with a cross section of stump and shoot measuring less than 10 cm, which is presented in Chart 2. Within that range, we differentiated two divisions - a cross section between 0 - 5 cm and 5 - 10 cm. The data prove that stumps and shoots 0-5 cm thick were strongly preferred over the thicker ones. Such a preference was confirmed by earlier observations conducted by Drobná and Ježeková (2000), which is related to the fact that small diameters of stumps and trees suggest the young age of a tree.

Due to their engineering activity, European beavers may also modify the level of organisation of plant communities. A correlation exists between direct changes (digging burrows and holes) and indirect ones (succession of flora). Collapse of canals and holes and erosion of river banks contribute to the development of a bog flora.

In this context the following question arises: will the presence of beavers increase or decrease biodiversity in a particular area? Based on results of the present research, it all depends on nutritional preferences. If the selection related to tree species will lead to total elimination of particular species, then herbaceous plants associated with it may disappear. As a result, another form of plant will automatically develop instead. Therefore the influence of either progression or suspension of succession will be considerable. New stages may not develop and the level of organisation of plant communities associated and correlated with each other may not improve.

Conclusions

1. Six plant associations and four plant communities were found in the section of the river studied.

a) plant associations in the study are the following:

- on river banks:
  Phalaridetum arundinaceae,
  Salicetum triandro–viminalis, belonging to the class Salicetea purpureae,
  Salicetum pentandro-cinereae, of the class Alnetea glutinosae,
- in the actual river:
  Potametum natantis,
  Elodeetum canadensis,
  Spirodeletum polyrhizae.

b) plant communities in the study area are the following:

- a community of the class *Koelerio glaucae – Corynephoretea canescentis*,
- a community dominated by *Calamagrostis epigejos,*
- monocultural *Pinus sylvestris*,
- a community dominated by *Populus tremula,*

2. Species constituting the nutritional base for beavers (*C. fiber)* are the following:

- European aspen (aka Common Aspen/Aspen/trembling poplar (*Populus tremula),*
- grey willow (*Salix cinerea*),
- fragile willow (*Salix fragilis*),
- purple willow (*Salix purpurea*),
- almond willow (*Salix triandra*),
- black alder tree *(Alnus glutinosa)*,
- wild pear (*Pyrus pyraster*),
- water mint (*Mentha aquatica*),
- common water-plantain (*Alisma plantago-aquatica*),
- *Veronica anagallis-aquatica*,
- cutleaf waterparsnip (*Berula erecta*),
- bittersweet nightshade (*Solanum dulcamara*),
- *Lysimachia nummularia*.

3. It has been determined that beaver activity to the greatest extent modifies the plant community dominated by *Populus tremula,* which is due to extensive exploitation of the species (direct changes); only later does it modifiy plant communities such as *Salicetum triandro–viminalis* and *Salicetum pentandro–cinereae* (species constituting phytocoenosis account for nutritional base of *C. fiber*). In the remaining plant associations and communities the changes resulting from modification are minimal or non existent (Fig. 4).

4. Species making up the *Salicetum triandro-viminalis* and *Salicetum pentandro–cinereae* associations are characteristic of long life-span and this explains why its proportion may rise in future. However, they will not reach the highest stage of succession. If predictions and assumptions are confirmed in future, then due to the direct influence on European aspen, the reach of the plant community of the class *Koelerio glaucae – Corynephoretea canescentis* (indirect influence) would change.

Acknowledgement

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Tab. 1. ***Salicetum triandro-viminalis***

Successive number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Constancy
Field number of relevé	9	78	27	28	29	34	57	77	71	68	47	45	54	72	23	70	69	46	43	32	31	37	2	73	
Data	2	10	31	31	31	31	10	10	1	1	6	5	10	3	17	1	1	6	5	31	31	3	13	3	
	7	9	7	7	7	7	8	9	9	9	8	8	8	9	7	9	9	8	8	7	7	8	4	9	
	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	
Area of relevé in m²	8	15	20	50	50	30	30	30	100	40	100	35	50	40	50	50	30	40	20	35	49	30	50	20	
Cover a [%]	80	0	0	60	60	10	25	75	85	75	50	50	60	85	20	75	60	30	10	40	50	10	25	80	
Cover b [%]	0	80	10	40	40	30	0	5	60	70	40	40	10	10	40	10	10	30	30	60	10	5	20	5	
Cover c [%]	50	50	70	60	60	40	80	75	70	60	85	50	90	60	70	80	70	90	60	30	80	30	55	50	
Cover d [%]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Number of species in relevé	16	15	18	18	18	12	17	19	11	17	20	11	13	12	19	23	26	28	15	16	15	13	16	9	
Trees and shrubs																									
Rubus caesius b	r	.	.	2	3	1	+	.	1	+	1	.	1	.	.	1	.	.	1	1	1	.	1	.	III
Humulus lupulus b	r	.	.	+	1	.	.	.	2	3	.	2	1	1	.	.	1	.	2	.	+	.	.	+	III
Salix cinerea b	.	.	.	.	.	.	.	1	.	2	2	.	1	1	2	1	2	1	.	.	.	.	.	.	II
Viburnum opulus b	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	1	.	.	.	.	+	.	.	.	I
Prunus padus b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	2	1	.	.	.	I
Frangula alnus a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	I
Alnus glutinosa a	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Fraxinus pennsylvanica a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	I
Euonymus europaeus b	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Populus tremula b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	I
Alnus incana b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	I
ChAss. *Salicetum triandro-viminalis*																									
Salix triandra b	.	4	1	2	3	2	.	1	.	.	3	.	.	3	.	.	4	1	.	1	2	.	2	.	III
Salix triandra c	.	.	1	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	I
ChAll. *Salicion albae*																									
Salix viminalis b	.	+	.	.	.	.	.	.	.	3	2	.	1	.	.	.	.	1	.	.	.	.	.	.	II
Salix alba b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	I
ChAll. *Salicion eleagni*																									
Salix eleagnos b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	I

Successive number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
ChCl/O. *Salicetea purpureae*, *Salicetalia purpureae*																									
Salix fragilis a	4	.	.	3	.	.	2	3	4	.	.	3	3	2	2	3	.	.	1	.	.	.	1	4	III
Salix purpurea b	.	.	.	.	.	.	.	.	.	.	2	.	.	1	1	.	.	.	.	.	1	1	.	.	II
Accompanying species																									
Phalaris arundinacea	2	+	+	+	1	1	2	1	1	+	3	1	3	1	.	2	3	3	.	+	.	1	.	.	IV
Urtica dioica	.	.	.	1	1	+	+	+	1	.	2	2	+	1	.	1	.	.	+	+	.	.	+	.	III
Solanum dulcamara	2	.	+	+	+	+	+	+	+	1	+	.	.	.	+	1	1	+	.	.	.	.	.	.	III
Galium aparine	+	.	.	1	2	.	.	.	1	+	.	1	+	+	.	1	.	.	1	+	+	.	.	.	III
Deschampsia cespitosa	.	.	.	+	+	.	1	+	.	.	1	.	.	.	.	+	.	1	.	+	.	+	.	+	III
Fallopia dumetorum	.	.	.	.	.	+	.	+	2	2	1	+	.	.	.	2	.	.	+	.	1	.	.	.	II
Bidens frondosa	.	+	1	+	.	.	+	+	.	.	.	.	+	.	.	+	+	+	.	.	.	.	.	.	II
Stachys palustris	+	.	.	+	+	+	+	.	+	.	1	.	+	.	.	+	.	.	.	.	.	.	.	.	II
Agropyron repens	.	.	.	.	+	+	.	1	.	.	.	.	.	.	1	.	.	.	2	.	.	+	.	1	II
Polygonum persicaria	.	+	+	+	.	.	1	.	.	.	2	.	.	.	.	.	+	+	.	.	.	.	.	.	II
Epilobium palustre	.	+	.	.	.	.	+	.	.	.	1	.	+	.	.	.	+	+	.	.	.	.	.	+	II
Glechoma hederacea	.	.	.	2	.	.	.	2	.	.	.	.	.	.	2	.	.	.	+	.	4	.	1	.	II
Rorippa amphibia	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	1	2	+	.	.	.	.	2	.	II
Filipendula ulmaria	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	+	.	.	1	+		+	.	.	II
Myosoton aquaticum	.	.	+	.	.	.	.	.	.	.	.	+	.	.	+	+	+	+	.	.	.	.	.	.	II
Galium palustre	.	.	.	.	.	.	1	.	.	.	2	.	.	.	+	.	.	.	1	.	.	.	+	.	II
Polygonum hydropiper	.	+	1	.	.	.	.	+	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	II
Phleum pratense	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	1	.	+	.	+	II
Cirsium arvense	.	.	.	.	.	.	.	.	.	1	.	.	.	+	.	.	.	.	+	.	.	+	.	+	II
Lycopus europaeus	.	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	.	.	.	.	.	.	II
Conyza canadensis	.	.	.	.	r	.	.	.	.	+	.	.	.	.	.	.	.	.	.	r	+	r	.	.	II
Phragmites australis	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	1	.	.	.	.	.	.	.	1	I
Lysimachia vulgaris	.	+	.	.	.	.	.	.	.	.	1	.	2	.	.	.	.	.	.	.	.	+	.	.	I
Glyceria fluitans	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	3	.	2	.	.	.	.	.	.	I
Fallopia convolvulus	.	.	.	1	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	I
Impatiens parviflora	.	.	.	2	+	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Ranunculus repens	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	+	.	I

Successive number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Agrostis stolonifera	.	.	+	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	I
Rudbeckia laciniata	.	.	.	.	.	.	.	+	.	+	.	.	.	.	1	.	.	.	.	.	.	.	.	.	I
Rumex acetosa	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	1	.	+	.	.	I
Geum urbanum	1	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	I
Myosotis palustris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	I
Veronica anagallis-aquatica	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	I
Alisma plantago-aquatica	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	I
Echinocystis lobata	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	I
Galeopsis bifida	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+	.	.	.	.	.	.	.	.	I
Juncus bufonius	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	I
Torilis japonica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	I
Angelica sylvestris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	r	.	I
Lythrum salicaria	.	.	r	.	.	.	.	.	.	.	+	.	.	.	.	.	.	r	.	.	.	.	.	.	I
Calystegia sepium	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	1	.	.	.	.	I
Lysimachia nummularia	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I
Tanacetum vulgare	1	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Polygonum mite	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	I
Cirsium palustre	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	I
Eupatorium cannabinum	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	I
Galeopsis speciosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	I
Galeopsis tetrahit	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Holcus lanatus	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Scrophularia nodosa	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Scutellaria galericulata	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I
Epilobium parviflorum	.	.	r	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	I

Sporadic species: *Mentha pulegium* 2(2), *Poa pratensis* 1(20), *Acorus calamus* 1(18), *Equisetum pratense* 1(2), *Parmelia physodes* d 1(8), *Scirpus sylvaticus* 1(2), *Teesdalia nudicaulis* 1(17), *Xanthoria parietina* d 1(8), Batrachium *trichophyllum* +(18), *Cruciata glabra* +(22), *Deschampsia flexuosa* +(15), *Ficaria verna* +(23), *Rumex* sp.+(23), *Alopecurus pratensis* +(1), *Anthriscus sylvestris* +(16), *Artemisia vulgaris* +(5), *Bidens cernua* +(3), *Carex gracilis* +(15), *Carex* sp. +(2), *Chelidonium majus* +(1), *Conocephalum conicum* +(17), *Cuscuta epithymum* +(12), *Filaginella uliginosa* +(17), *Gnaphalium uliginosum* +(18), *Juncus articulatus* +(18), *Oenanthe*

Tab. 2. ***Phalaridetum arundinaceae***

Successive no of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	Constancy
Field number of relevé	24	35	22	55	50	52	58	61	30	51	48	49	75	60	38	41	62	76	14	53	13	36	26	8	6	18	33	44	15	
Data	24	31	17	10	6	6	10	16	31	6	6	6	10	16	3	3	16	10	7	6	6	3	24	26	26	10	31	5	7	
	7	7	7	8	8	8	8	8	7	8	8	8	9	8	8	8	8	9	7	8	7	8	7	6	6	7	7	8	7	
	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	`04	
Area of relevé in m²	35	35	70	70	20	30	50	25	10	20	10	20	20	20	8	30	25	30	10	50	30	40	25	6	10	160	10	10	4	
Cover a [%]	0	40	0	60	40	0	30	0	0	0	10	10	45	10	0	0	0	10	0	0	5	60	0	0	0	10	0	5	0	
Cover b [%]	10	10	0	0	0	0	0	5	0	20	10	0	10	5	0	10	5	0	5	5	0	40	0	0	0	10	0	10	0	
Cover c [%]	80	90	90	85	85	95	80	80	80	90	90	90	80	80	60	60	60	90	70	90	85	80	95	90	95	70	80	70	90	
Cover d [%]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Number of species in relevé	18	11	12	22	16	11	10	17	9	10	17	10	19	11	5	31	10	22	15	12	27	16	20	13	4	9	7	12	7	
Trees and shrubs																														
Salix triandra b	1	.	.	1	.	.	.	2	1	2	1	1	1	1	.	.	.	1	+	1	.	2	.	.	.	1	.	.	.	III
Salix cinerea b	.	.	.	.	2	.	2	1	.	.	1	.	.	1	.	.	.	+	.	.	.	1	.	.	.	.	.	.	.	II
Salix fragilis a	.	2	.	.	.	.	.	.	.	.	1	.	2	.	.	.	.	2	.	.	+	1	.	.	.	.	.	.	.	II
Rubus caesius b	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	2	.	.	.	+	.	1	.	I
Salix viminalis b	.	.	.	2	2	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Salix purpurea b	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	I
Humulus lupulus b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	1	.	I
Salix triandra c	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Frangula alnus b	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	I
Salix alba b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	I
Populus tremula b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Salix fragilis b	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Alnus glutinosa a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	I
Alnus incana b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Pyrus pyraster a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I
Juniperus communis b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	I

Successive no of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
ChAss. *Phalaridetum arundinaceae*																														
Phalaris arundinacea	3	3	3	3	2	4	3	2	2	2	3	4	3	3	1	2	2	3	2	3	4	3	3	4	4	3	3	3	5	V
ChAll. *Magnocaricion*																														
Galium palustre	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	.	.	.	+	+	.	.	.	.	+	.	.	+	II
Carex acutiformis	.	.	.	.	.	1	.	.	.	2	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	I
Carex acuta	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Lysimachia thyrsiflora	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Poa palustris	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Scutellaria galericulata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I
ChCl/O. *Phragmitetea, Phragmitetalia*																														
Rorippa amphibia	+	+	+	1	1	1	1	+	+	+	1	1	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	III
Alisma plantago-aquatica	+	+	+	+	+	+	+	+	+	.	.	.	.	.	1	+	.	+	.	.	.	.	.	.	.	.	.	.	.	III
Veronica anagallis-aquatica	+	.	.	+	1	1	.	.	.	1	.	+	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	II
Acorus calamus	.	.	1	.	1	1	1	.	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
Glyceria fluitans	.	.	.	+	.	+	+	+	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
Glyceria maxima	+	.	1	.	.	.	+	1	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Berula erecta	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Sparganium emersum	.	.	.	.	.	.	1	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	I
Phragmites australis	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Sagittaria sagittifolia		+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Oenanthe aquatca	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Butomus umbellatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	I
Rumex hydrolapathum	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Sparganium erectum	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I

Successive no of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
Accopmanying species																														
Myosotis palustris	+	+	+	1	1	+	+	+	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
Mentha aquatica	.	.	.	1	+	.	.	+	.	1	1	.	.	+	.	.	.	1	.	.	+	.	.	.	.	.	.	.	+	II
Ranunculus repens	+	.	.	+	+	.	.	+	.	.	.	.	.	.	+	1	.	.	+	.	1	.	.	1	.	.	.	.	.	II
Deschampsia cespitosa	.	.	.	+	1	.	.	.	+	.	.	.	1	.	.	.	.	.	+	.	1	.	+	+	+	.	.	.	.	II
Bidens frondosa	.	.	.	+	+	.	.	+	1	.	.	.	+	+	.	+	1	.	.	+	.	.	.	.	.	.	.	.	.	II
Solanum dulcamara	.	+	.	.	.	.	+	.	+	.	+	.	+	.	.	.	.	.	.	.	+	.	.	+	.	+	.	.	.	II
Urtica dioica	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	1	+	1	+	.	.	2	.	.	.	II
Polygonum persicaria	.	.	.	+	.	.	.	+	+	.	+	.	+	.	.	.	1	.	.	+	.	.	.	.	.	.	.	.	.	II
Calystegia sepium	+	.	.	.	.	.	.	+	.	.	.	.	1	.	.	.	.	2	.	1	r	.	.	.	.	.	.	.	.	II
Fallopia dumetorum	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	.	1	.	+	.	.	.	.	+	1	.	II
Agropyron repens	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	+	.	1	.	.	.	+	+	.	.	.	+	.	.	II
Lycopus europaeus	.	+	.	+	.	.	.	.	.	.	+	.	.	.	.	+	+	1	.	.	.	.	.	.	.	.	.	.	.	II
Achillea millefolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	+	+	+	.	.	.	.	.	.	II
Juncus effusus	+	.	.	+	.	.	.	+	.	.	+	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	II
Stachys palstris	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	+	.	+	+	.	+	.	.	.	.	.	.	II
Epilobium palustre	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	+	.	.	+	.	r	.	.	.	.	.	.	.	+	II
Rumex palustris	r	.	.	+	+	.	.	.	.	.	+	r	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	II
Tanacetum vulgare	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	1	.	.	.	.	2	1	.	+	.	.	I
Lysimachia vulgaris	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	.	.	.	1	.	.	+	.	.	r	.	.	.	I
Filipendula ulmaria	.	.	.	.	.		.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	+	1	.	.	+	.	.	.	I
Agrostis stolonifera	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	+	.	I
Equisetum pratense	.	.	.	1	1	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Echinocystis lobata	.	+	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	I
Cirsium arvense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	1	.	.	.	.	+	.	.	I
Galium aparine	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	+	.	I
Juncus articulatus	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Corynephorus canescens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	1	.	.	.	.	.	I
Juncus bufonius	.	.	.	.	.	.	.	1	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Rumex acetosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	+	.	.	.	.	.	.	.	.	I
Epilobium hirsutum	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	I
Eupatorium cannabinum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	+	.	.	.	.	.	.	I

Successive no of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
Oenothera biennis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+	.	.	.	.	I
Scrophularia nodosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	+	.	.	.	.	.	+	I
Glechoma hederacea	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	I
Vicia sativa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	.	.	I
Artemisia campestris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	I
Conyza canadensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	I
Cuscuta epithymum	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	I
Hieracium pilosella	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	I
Mentha x verticilata	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	I
Angelica sylvestris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	I
Cirsium palustre	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I
Filaginella uliginosa	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Rumex longifolius	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	I

Sporadic species: *Lotus corniculatus* 2(16), *Batriachium trichophyllum* 1(5), *Carex* sp. 1(16), *Galium verum* 1(16), *Trifolium repens* 1(16), *Aegopodium podagraria* 1(28), *Ranunculus flammula* 1(16), *Rumex acetosella* 1(24), *Carex hirta* +(16), *Phleum pratense* +(23), *Poa palustris* +(1), *Arrhenatherum elatius* +(21), *Carex* sp. +(21), *Fallopia convolvulus* +(23), *Galeopsis bifidum* +(18), *Geum urbanum* +(22), *Holcus lanatus* +(23), *Hypericium perforatum* +(23), *Impatiens glandulifera* +(18), *Juncus conglomeratus* +(29), *Lysimachia nummularia* +(10), *Lythrum salicaria* +(4), *Peucedanum cervaria* +(16), *Plantago major* +(4), *Polygonum hydropiper* +(13), *Rudbeckia laciniata* +(18), *Scirpus sylvaticus* +(1), *Sedum acre* +(21), *Senecio vernalis* +(21), *Taraxacum officinale* +(24), *Teesdalia nudicaulis* +(19), *Torilis japonica* +(11), *Veronica longifolia* +(22), *Viola tricolor* +(23), *Erigeron acre* r(24)

Tab. 3. *Salicetum pentandro-cinereae*

Successive number of relevé	1	2	3	4
Field number of relevé	59	63	64	67
Data	16	17	17	1
	8	8	8	9
	`04	`04	`04	`04
Area of relevé in m²	20	25	20	50
Cover a [%]	70	50	65	80
Cover b [%]	0	10	0	65
Cover c [%]	80	70	60	30
Cover d [%]	0	0	0	0
Number of species in relevé	13	11	9	15
Trees and shrubs				
Salix triandra b	1	1	.	2
Humulus lupulus b	.	.	.	3
ChAss. *Salicetum pentandro-cinereae*				
Salix cinerea b	3	2	3	3
ChCl/O/All. *Alnetea glutinosae*, *Alnetalia glutinosae*, *Alnion glutinosae*				
Salix cinerea b	3	2	3	3
Solanum dulcamara	.	.	+	2
Accompanying species				
Myosotis palustris	+	+	1	+
Phalaris arundinacea	3	1	2	.
Rorippa amphibia	1	+	+	.
Mentha aquatica	+	+	+	.
Sparganium emersum	2	1	.	.
Veronica anagallis-aquatica	.	+	1	.
Bidens frondosa	+	.	.	1
Stachys palustris	+	.	.	1
Equisetum pratense	.	+	+	.
Glyceria fluitans	.	.	.	2
Fallopia dumetorum	.	.	.	2
Glyceria maxima	2	.	.	.
Alisma plantago-aquatica	.	1	.	.
Cirsium palustre	.	.	.	1
Conyza canadensis	.	.	.	1
Urtica dioica	.	.	.	1
Galium palustre	+	.	.	.
Acorus calamus		.	+	.
Berula erecta	+	.	.	.
Deschampsia cespitosa	+	.	.	.
Oenanthe aquatica	.	+	.	.
Phragmites australis	.	.	.	+
Tanacetum vulgare	.	.	.	+

Tab. 4. Community from *Koelerio glaucae - Corynephoretea canescentis* class

Successive number of relevé	1	2	3	4
Field number of relevé	3	4	7	12
Data	11	11	26	6
	6	6	6	7
	`04	`04	`04	`04
Area of relevé in m²	20	24	16	50
Cover a [%]	20	20	0	5
Cover b [%]	0	10	5	5
Cover c [%]	50	70	70	60
Cover d [%]	5	0	0	10
Number of species in relevé	14	13	13	19
Trees and shrubs				
Populus tremula b	1	+	.	.
Juniperus communis b	.	.	+	r
Populus tremula a	.	1	.	.
Pinus sylvestris a	.	.	.	+
Quercus robur b	.	+	.	.
Salix purpurea b	.	+	.	.
ChCl/O. *Koelerio glaucae - Corynephoretea canescentis*, *Corynephoretalia canescentis*				
Corynephorus canescens	2	2	+	2
Rumex acetosella	+	1	1	.
Sedum acre	+	.	+	+
Jasione montana	+	.	.	1
Dianthus deltoides	.	1	.	r
Potentilla argentea	+	.	.	.
Scleranthus perennis	.	.	.	+
Thymus serpyllum	.	.	.	+
Spergula morisonii	.	r	.	.
Accompanyjing species				
Conyza canadensis	1	1	1	+
Hieracium pilosella	1	1	.	+
Artemisia campestris	+	1	.	+
Tanacetum vulgare	.	.	1	+
Achillea millefolium	+	.	+	.
Armeria maritima	+	.	.	+
Solanum dulcamara	.	.	.	1
Phalaris arundinacea	1	.	.	.
Amaranthus retroflexus	.	.	+	.
Arenaria serpyllifolia	.	.	+	.
Cladonia furcata d	+	.	.	.
Deschampsia cespitosa	.	.	.	+
Epilobium parviflorum	.	.	+	.
Myosoton aqaticum	.	.	+	.
Plantago lanceolata	.	.	+	.
Rumex acetosa	.		.	+

Tab. 5. Monoculture of *Pinus sylvestris*

Successive number of relevé	1	2	3	4
Field number of relevé	1	16	66	74
Data	13	7	23	3
	4	7	8	9
	`04	`04	`04	`04
Area of relevé in m²	100	100	100	100
Cover a [%]	50	60	75	60
Cover b [%]	5	5	5	5
Cover c [%]	5	95	5	10
Cover d [%]	90	0	95	95
Number of species in relevé	15	23	16	7
Trees and shrubs				
***Pinus sylvestris* a**	**3**	**3**	**3**	**3**
Juniperus communis b	1	+	1	+
Quercus petraea b	.	.	1	+
Frangula alnus b	.	.	+	+
Sorbus aucuparia b	.	.	+	+
Corylus avellana b	.	.	+	.
Frangula alnus b	.	+		.
Juniperus communis b	+	.	.	.
Quercus robur	.	+	.	.
Rubus saxatilis b	.	.	+	.
Viburnum opulus b	.	.	+	.
Pyrus pyraster	.	r	.	.
Accompanying species				
Mycelis muralis	+	r	+	.
Corynephorus canescens	1	+	.	.
Thymus serpyllum	+	+	.	.
Rumex acetosa	.	+	+	.
Taraxacum officinale	r	+	.	.
Melampyrum pratense	.	.	.	1
Moneses uniflora	.	.	1	.
Agrostis capillaris	.	.	+	.
Cladonia furcata d	+	.	.	.
Fragaria vesca		+	.	.
Luzula campestris	+	.	.	.
Agrostis capillaris	.	+	.	.
Angelica sylvestris	+	.	.	.
Anthoxanthum odoratum	+	.	.	.
Cerastium holosteoides	.	.	+	.
Galeopsis bifida	.	.	+	.
Rumex sp.	+	.	.	.
Stellaria media	.	.	+	.
Veronica officinalis	.	+	.	.
Artemisia campestris	.	r	.	.
Chimaphila umbellata	.	r	.	.
Festuca ovina	.	r	.	.
Festuca pratensis	.	r	.	.

Veronica anagallis-aquatica	.	.	+	.
Artemisia absinthium	r	.	.	.
Hypericium perforatum	.	.	.	r
Oenothera biennis	.	.	.	r
Veronica serpyllifolia	r	.	.	.

Hieracium pilosella	.	r	.	.
Poa palustris	.	r	.	.
Polygonatum multiflorum	.	r	.	.
Scleranthus perennis	.	r	.	.
Solanum dulcamara	.	r	.	.

Tab. 6. Com. with *Calamagrostis epigejos*

Successive number of relevé	1	2
Field number of relevé	5	11
Data	26	6
	6	7
	`04	`04
Area of relevé in m²	16	10
Cover a [%]	0	0
Cover b [%]	10	5
Cover c [%]	80	70
Cover d [%]	0	0
Number of species in relevé	22	9
Trees and shrubs		
Populus tremula b	1	+
Pinus sylvestris b	1	.
Betula pendula b	+	.
Rubus caesius b	.	+
Salix fragilis b	+	.
Salix purpurea b	+	.
Alnus incana b	r	.
Quercus robur b	r	.
Calamagostris epigejos	**2**	**2**
Accompanying species		
Phalaris arundinacea	2	2
Molinia caerulea	+	+
Conyza canadensis	1	.
Artemisia campestris	1	.
Senecio jacobaea	1	.
Dianthus deltoides	+	.
Rumex acetosella	+	.
Achillea millefolia	+	.
Artemisia vulgaris	.	+
Corynephorus canescens	+	.
Fallopia convolvulus	.	+
Festuca rubra	+	.
Jasione montana	+	.
Papaver argemone	.	+
Ranunculus repens	+	.
Sedum acre	+	.
Stachys palustris	+	.
Galium aparine	.	r

Tab. 7. Comm. with *Populus tremula*

Successive number of relevé	1	2	3
Field number of relevé	19	42	65
Data	16	3	23
	7	8	8
	`04	`04	`04
Area of relevé in m²	80	100	70
Cover a [%]	10	35	15
Cover b [%]	10	30	5
Cover c [%]	70	80	90
Cover d [%]	0	0	0
Number of species in relevé	36	18	24
Trees and shrubs			
***Populus tremula* b**	**2**	**2**	**4**
***Populus tremula* a**	**1**	**2**	**.**
Rubus caesius b	.	3	+
Humulus lupulus b	.	1	+
Juniperus communis b	+	.	+
Pinus sylvestris a	.	.	1
Pyrus pyraster a	.	1	.
Salix fragilis b	.	1	.
Frangula alnus b	+	.	.
Juniperus communis a	.	.	+
Prunus spinosa b	.	.	+
Quercus petraea b	+	.	.
Salix triandra b	+	.	.
Corylus avellana b	r	.	.
Pinus sylvestris b	r	.	.
Rosa arvensis b	r	.	.
Accompanying species			
Agropyron repens	+	+	2
Achillea millefolium	+	+	+
Hieracium pilosella	1	.	+
Fallopia convolvulus	+	1	.
Conyza canadensis	+	.	+
Holcus lanatus	+	+	.
Papaver argemone	+	.	+
Teesdalia nudicaulis	+	.	+
Artemisia campestris	r	.	+
Sedum acre	r	.	+
Agrostis stolonifera	.	.	4
Poa pratensis	.	2	.
Fallopia dumetorum	.	.	2
Phalaris arundinacea	.	2	.

Carex hirta	1	.	.
Deschampsia cespitosa	1	.	.
Galium mollugo	.	1	.
Glechoma hederacea	1	.	.
Trifolium pratense	.	.	1
Artemisia vulgaris	1	.	.
Oenanthe aquatica	.	1	.
Lotus corniculatus	+	.	.
Lysimachia nummularia	+	.	.
Thymus serpyllum	+	.	.
Aegopodium podagraria	.	.	+
Arenaria serpyllifolia	.	.	+
Armeria maritima	.	.	+
Cirsium arvense	.	+	.
Corynephorus canescens	+	.	.
Dactylis glomerata	.	.	+
Dianthus deltoides	.	+	.
Equisetum pratense	.	+	.
Galeopsis bifida	.	+	.
Geum urbanum	.	.	+
Pteridium aquilinum	.	.	+
Rumex acetosa	+	.	.
Rumex hydrolapathum	+	.	.
Scleranthus perennis	+	.	.
Selinum carvifolia	.	.	+
Torilis japonica	+	.	.
Veronica longifolia	+	.	.
Viola tricolor	+	.	.
Galium aparine	r	.	.
Myrrhis odorata	r	.	.
Potentilla argentea	r	.	.

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