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Penetration of anthropophytes into alluvial phytocoenoses of the Skawica river valley (western Carpathians)

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Abstract: In this paper, data on penetration of anthropophytes into alluvial phytocoenoses, collected in the years 2006-2007, were analysed with reference to the level of their disturbance, community structure and localization of patches. The investigation was carried out in the whole Skawica valley (in the area comprising villages Zawoja, Skawica and Białka). On the basis of 106 phytosociological relevés, eight associations were distinguished: *Rorippo-Agrostietum, Phalarido-Petasitetum hybridi, Filipendulo ulmariae-Menthetum longifoliae, Phalaridetum arundinaceae, Glycerietum plicatae, Thyphetum latifoliae, Alnetum incanae, Salicetum albo-fragilis*. It was stated that phytocoenoses undisturbed or less disturbed are penetrated with anthropophytes in smaller degree while riparian forest associations are more threated by anthropophytes. Invasive species – *Impatiens glandulifera, Impatiens parviflora* and *Reynoutria japonica* – most frequently penetrate phytocoenoses of *Alnetum incanae, Salicetum albo-fragilis, Phalarido-Petasitetum hybridi* and *Filipendulo ulmariae-Menthetum longifoliae*. Communities which are free from penetration by anthropophytes in this area include rush associations: *Glycerietum plicatae* and *Typhetum latifoliae*.

Key words: anthropophytes, alien plants, phytocoenoses, alluvial communities

1. Introduction

Skawica is a typical montane river. Its sources are localized on the northern slopes of the Babia Góra Mt. (1726 m a.s.l.), in the area of the Babiogórski National Park and Biosphere Reserve of UNESCO (Fig. 1). In the distance of about 16 km and in altitudinal zone between 360-590 m a.s.l., its valley has various shape and diverse vegetation on the riversides. In some places, the river runs in a narrow canyon with steep slopes, where alluvial vegetation practically does not exist . In other places, a valley-floor is getting wide, forming extensive alluvial terraces covered with vegetation which reveals features of natural zonation. It is so-called "stabilization of river-bed by vegetation", which has a great importance not only in landscape formation, but also in flood protection and creation of habitats for many plant and animal species. There is widely known, that river valleys are used as migration ways not only by montane species spreading to the lowlands (and vice versa), but also by alien species (Dajdok & Kwiatkowska-Anioł 1998; Dajdok *et al.* 1998; Kasperek 2004; Tokarska-Guzik 2005; Hejda & Pyšek 2006). These latter ones

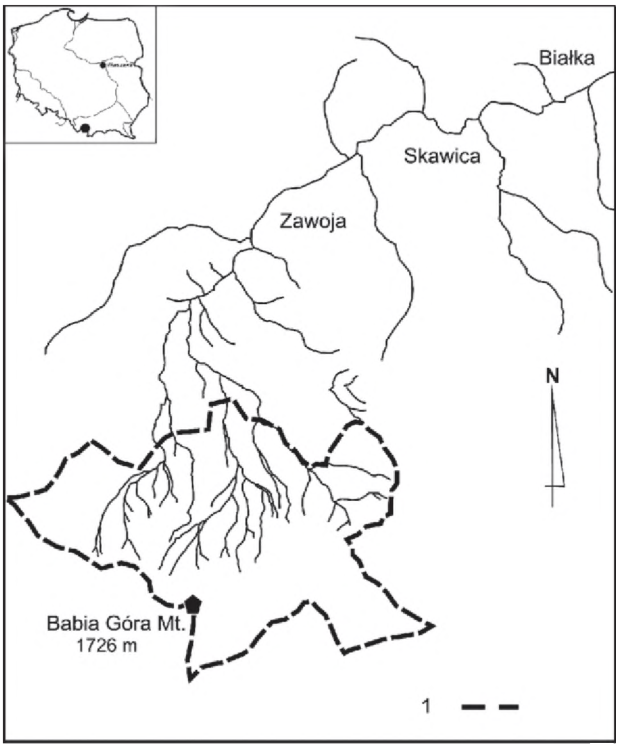

Fig. 1. Localization of investigated area
Explanation: 1 – borders of the Babiogórski National Park

settle down in phytocoenoses with the disturbed biological balance or in initial habitats, which appear after floods, in which alien species (if they are able to accept habitat conditions) profit from a lack of interspecies competition, especially in initial stages of succession. Flooding of alluvial phytocoenoses by flood waters, repeatedly carrying diaspores of foreign species, is a factor frequently connected with montane rivers, contributing to formation of riverside habitats, specific floristic composition and the structure of riparian phytocoenoses.

The aims of the present paper are: (*i*) to define which plant associations are most frequently penetrated by anthropophytes, (*ii*) to state if degree of disturbance in the phytocoenoses is significantly connected with the presence of alien species, (*iii*) to estimate if localization of phytocoenoses in proximity of a waterway (which is a carrier of alien species diaspores) has importance in connection with penetration of riparian vegetation by anthropophytes, (*iv*) to estimate the threat posed by alien species to the alluvial vegetation of the Skawica valley (which fulfils the role of an ecological corridor, adjoining an area under protection, of high ecological value).

2. Material and methods

The investigations were carried out in the years 2006-2008, in the whole valley of the Skawica river (comprising the area of three villages: Zawoja, Skawica and Białka), from the point of two source streams (Jaworzyna and Marków Stream) junction to the confluence with the Skawa river. Phytosociological relèves (Braun-Blanquet method) were taken in the riverside zone of 15-20 m in width. Only species noted in the studied patches were included in the floristic analysis. Syntaxonomical nomenclature is after Matuszkiewicz (2005) and scientific names of taxons follow Mirek *et al.* (2002).

Estimation of disturbance of analysed vegetation patches was based on the following data: (*i*) percentage of diagnostic species of a given syntaxon (*ii*) percentage of sporadic species from other syntaxons, (*iii*) proximity of synanthropic habitats (i. e. wild rubbish dumps, roads, croplands)

Anthropophytes were checked against the work of Tokarska-Guzik (2005). Statictical analysis were made with the use of MS Statistica version 6.0.

3. Results

Analysis of phytosociological data (101 relèves) allowed to separate 8 plant associations: two forest associations – *Alnetum incanae* Lüdi 1921 and *Salicetum albo-fragilis* R. Tx. 1955, two tall herbs associations – *Filipendulo ulamariae-Menthetum longifoliae* Zlinska 1989 and *Phalarido-Petasitetum hybridi* Schwick. 1933, one riverside meadow – *Rorippo-Agrostietum* (Moor 1958) Oberd. et Th. Müll. 1961 and three rush associations – *Phalaridetum arundinaceae* (Koch 1926 n.n.) Lib. 1931, *Glycerietum plicatae* (Kulcz. 1928) Oberd. 1954 and *Typhetum latifoliae* Soó 1927 (Table 1).

Table 1. A brief synoptic table of the alluvial associations with the presence of anthropophytes

	Class	R-A	Fu-Ml	PhP-h	Pha	Sa-f	Ai
Species characteristic for associations							
Agrostis stolonifera	M-A	$\mathbf{V^{7083}}$	IV^{170}	II^{13}	III^{30}	III^{342}	II^{407}
Rorippa sylvestris	M-A	$\mathbf{V^{233}}$	.	.	.	.	.
Mentha longifolia	M-A	IV^{179}	$\mathbf{V^{6000}}$	III^{131}	II^{110}	V^{454}	II^{185}
Filipendula ulmaria	M-A	.	$\mathbf{II^{16}}$	.	.	.	.
Lythrum salicaria	M-A	.	$\mathbf{II^{15}}$	.	.	.	.
Petasites hybridus	Av	.	II^{16}	$\mathbf{V^{5012}}$	III^{30}	III^{2865}	II^{1091}
Petasites kablikianus	Av	.	II^{105}	$\mathbf{IV^{3794}}$	II^{20}	IV^{1008}	$\mathbf{V^{3447}}$
Myosoton aquaticum	Av	III^{138}	III^{70}	$\mathbf{V^{244}}$	II^{20}	II^{142}	II^{353}
Angelica sylvestris	M-A	II^{17}	III^{66}	$\mathbf{III^{73}}$	.	III^{92}	II^{33}
Cirsium oleraceum	M-A	II^{13}	II^{15}	$\mathbf{II^{12}}$	.	.	II^{12}
Phalaris arundinacea	Ph	.	II^{105}	IV^{315}	$\mathbf{V^{6750}}$	V^{669}	II^{39}
Salix alba	Sp	.	.	.	.	$\mathbf{V^{2927}}$	.
Alnus incana	Q-F	.	.	.	.	.	$\mathbf{V^{5794}}$
Geranium phaeum	Q-F	.	.	.	.	.	$\mathbf{IV^{295}}$
Tussilago farfara		III^{196}	II^{15}	.	.	II^{88}	$\mathbf{II^{86}}$
Carduus personata	B-A	.	.	.	.	.	$\mathbf{II^{15}}$
Other species							
Urtica dioica	Av	IV^{27}	V^{195}	V^{1068}	V^{660}	V^{1185}	V^{1271}
Festuca gigantea	Q-F	II^{13}	III^{165}	V^{342}	II^{20}	V^{731}	V^{356}
Chaerophyllum hirsutum	B-A	II^{13}	IV^{625}	IV^{223}	III^{30}	IV^{193}	IV^{1271}
Aegopodium podagraria	Q-F	II^{9}	IV^{170}	V^{383}	III^{120}	II^{692}	V^{2039}
Salix fragilis	Sp	II^{17}	III^{108}	II^{25}	II^{4}	IV^{3735}	IV^{1797}
Galium aparine	Av	.	IV^{35}	IV^{523}	III^{30}	II^{123}	IV^{904}

Ranunculus repens	M-A	V^{800}	IV^{300}	III^{79}	II^{20}	III^{127}	II^{101}
Myosotis palustris	M-A	V^{375}	IV^{130}	II^{13}	III^{30}	III^{58}	II^{26}
Dactylis glomerata	M-A	II^{13}	IV^{166}	II^{13}	IV^{40}	II^{54}	II^{61}
Vicia cracca	M-A	II^{54}	III^{66}	II^{37}	II^{20}	III^{55}	II^{49}
Glechoma hederacea	Av	III^{21}	III^{25}	III^{62}	III^{30}	II^{81}	II^{164}
Taraxacum officinale	Av	III^{29}	IV^{170}	II^{52}	III^{14}	III^{23}	II^{10}
Galium palustre	Ph	II^{54}	III^{71}	II^{12}	III^{22}	III^{23}	II^{23}
Deschampsia caespitosa	M-A	II^{50}	III^{30}	II^{83}	IV^{380}	.	II^{170}
Impatiens glandulifera	Av	II^{13}	IV^{1075}	II^{200}	.	III^{258}	II^{34}
Rumex obtusifolius	Av	II^{17}	II^{15}	II^{37}	.	II^{12}	.
Trifolium repens	M-A	III^{96}	III^{25}	II^{46}	.	III^{127}	.
Holcus lanatus	M-A	III^{133}	III^{30}	II^{50}	.	II^{50}	.
Poa pratensis	M-A	II^{50}	II^{65}	.	III^{120}	II^{212}	.
Impatiens parviflora	Av	II^{29}	II^{16}	.	.	II^{44}	II^{46}
Elymus caninus	Q-F	.	III^{120}	III^{112}	II^{20}	II^{12}	III^{263}
Heracleum sphondylium	B-A	.	II^{15}	II^{48}	.	II^{12}	III^{75}
Lamium maculatum	Av	.	II^{15}	II^{52}	.	II^{12}	IV^{323}
Chaerophyllum aromaticum	Av	.	.	IV^{154}	II^{20}	III^{96}	V^{649}
Poa palustris	Ph	II^{17}	.	II^{33}	.	III^{224}	II^{26}
Rumex crispus	M-A	IV^{108}	II^{20}	.	III^{30}	.	.
Cardamine pratensis	M-A	II^{13}	III^{25}	.	II^{20}	.	.
Plantago major	M-A	III^{21}	III^{30}	.	.	II^{16}	.
Poa trivialis	M-A	II^{13}	IV^{80}	.	.	.	II^{73}
Veronica beccabunga	Ph	III^{96}	III^{25}	.	.	I^{8}	.
Plantago lanceolata	M-A	II^{13}	III^{25}	II^{12}	.	.	.
Tanacetum vulgare	Av	II^{13}	III^{66}	II^{67}	.	.	.
Lycopus europaeus	Al. g	III^{104}	II^{16}	.	.	II^{12}	.
Rumex caesius	M-A	II^{13}	III^{25}	.	.	.	.
Stachys sylvatica	Q-F	.	II^{20}	II^{27}	.	.	III^{139}
Athyrium filix-femina	-	.	II^{15}	II^{12}	.	.	III^{33}
Juncus effusus	M-A	.	III^{25}	.	II^{20}	.	.
Bidens tripartita	Bt	IV^{143}	.	II^{12}	.	II^{81}	.
Orobanche flava	B-A	V^{179}	.	.	.	II^{12}	II^{41}
Carduus crispus	Av	II^{13}	.	III^{37}	.	.	.
Melandrium rubrum	-	.	.	III^{60}	.	II^{85}	III^{117}
Campanula trachelium	Q-F	.	.	III^{56}	.	.	III^{29}
Rubus idaeus	Ea	.	.	.	.	II^{535}	III^{362}
Rubus caesius	Av	.	.	.	II^{20}	IV^{400}	.
Lotus uliginosus	M-A	.	III^{75}	.	.	.	.
Centaurea jacea	M-A	.	II^{57}	.	.	.	.
Lathyrus pratensis	M-A	.	III^{25}	.	.	.	.
Alopecurus pratensis	M-A	.	III^{25}	.	.	.	.
Prunella vulgaris	M-A	.	II^{20}	.	.	.	.
Bromus hordeaceus	M-A	.	II^{15}	.	.	.	.
Crepis biennis	M-A	.	II^{15}	.	.	.	.
Scutellaria galericulata	Ph	.	II^{15}	.	.	.	.
Equisetum palustre	M-A	.	II^{11}	.	.	.	.
Arctium lappa	Av	.	II^{11}	.	.	.	.
Cirsium lanceolata	-	.	II^{7}	.	.	.	.
Alopecurus geniculatus	M-A	.	.	.	III^{120}	.	.
Salix viminalis	Sp	.	.	.	.	II^{504}	.
Reynoutria japonica	-	.	.	.	.	II^{300}	.
Polygonum lapathifolium	Bt	.	.	.	.	II^{119}	.
Calystegia sepium	Av	.	.	.	.	II^{54}	.
Medicago lupulina	-	.	.	.	.	II^{43}	.
Hypericum maculatum	N-C	.	.	.	.	II^{43}	.
Typha angustifolia	Ph	.	.	.	.	I^{38}	.
Centaurea phrygia	-	.	.	.	.	II^{12}	.
Melilotus alba	Av	.	.	.	.	II^{12}	.
Sonchus arvensis	Sm	.	.	.	.	II^{12}	.
Symphytum officinale	-	.	.	.	.	II^{12}	.
Fraxinus excelsior	Q-F	.	.	.	.	.	III^{1520}
Acer pseudoplatanus	Q-F	.	.	.	.	.	III^{1017}
Sambucus nigra	Ea	.	.	.	.	.	III^{686}
Poa nemoralis	Q-F	.	.	.	.	.	III^{170}

Salvia glutinosa	Q-F	.	.	.	.	.	II^{170}
Astrantia major	Q-F	.	.	.	.	.	II^{133}
Lysimachia nemorum	Q-F	.	.	.	.	.	II^{116}
Lysimachia nummularia	M-A	.	.	.	.	.	II^{113}
Padus avium	Q-F	.	.	.	.	.	II^{111}
Rumex sanguineus	Q-F	.	.	.	.	.	II^{53}
Brachypodium sylvaticum	Q-F	.	.	.	.	.	II^{50}
Carex sylvatica	Q-F	.	.	.	.	.	II^{26}
Galeobdolon luteum	Q-F	.	.	.	.	.	II^{26}
Asarum europaeum	Q-F	.	.	.	.	.	II^{25}
Galeopsis pubescens	Av	.	.	.	.	.	II^{23}
Senecio nemorensis	B-A	.	.	.	.	.	II^{23}
Carex remota	Q-F	.	.	.	.	.	II^{11}

Explanations: Agro – *Agropyretea,* Al. g – *Alnetea glutinosae,* Av – *Artemisietea vulgaris,* B-A – *Betulo-Adenostyletea,* Bt – *Bidentetea tripartiti,* Ea – *Epilobietea angustifolii,* Fu-Ml – *Filipendulo ulmariae-Menthetum longifoliae,* M-A – *Molinio-Arrhenatheretea,* M-C – *Montio-Cardaminetea,* N-C – *Nardo-Callunetea,* Ph – *Phragmitetea,* Pha – *Phalaridetum arundinaceae,* PhP-h – *Phalarido-Petasitetum hybridi,* Q-F – *Querco-Fagetea,* R-A – *Rorippo-Agrostietum,* S-cn – *Scheuchzerio-Caricetea nigrae,* Sa-f – *Salicetum albo-fragilis,* Sm – *Stellarietea mediae,* Sp – *Salicetea purpureae,* T-Gs – *Trifolio-Geranietea sanguinei*

Analysis of flora, noted in the studied vegetation patches, proved the presence of 272 species of vascular plants, including 22 species of anthropophytes, which makes 4% of alluvial flora. The most abundant are: *Impatiens glandulifera, I. parviflora, Reynoutria japonica* and *Aster* ×*salignus* (Table 2). Analysis of distribution proved, that anthropophytes the most frequently and the most abundantly occur in the further part of the valley, in the vicinity of Białka village (Table 2).

All vegetation patches, on the basis of the proposed criteria, were divided into two groups of phytocoenoses – disturbed and undisturbed. Correctness of division of phytocoenoses was verified by discriminant analysis. It revealed that the largest importance in this differentiation has variable of percentage of diagnostic species in a given syntaxon (factor for canonical variables = 0.6). In this way, it was stated, that most of analysed patches (76%) revealed features of disturbance. The majority of disturbed patches was found in: *Salicetum albo-fragilis, Filipendulo ulamariae-Menthetum longifoliae* and *Phalaridetum arundinaceae*. Patches of associations: *Rorippo-Agrostietum, Alnetum incanae* and *Phalarido-Petasitetum hybridi* are the least disturbed.

Occurrence of anthropophytes was noted in the patches of 6 associations. Alien species were not observed in the patches of *Glycerietum plicatae* and *Thyphetum latifoliae*. It was found that anthropophytes mainly penetrate forest communities (*Alnetum incanae*

Table 2. Distribution and frequency of anthropophytes in the Skawica valley

Species	Village		
	Zawoja	Skawica	Białka
Impatiens glandulifera	+++	+++	+++
Impatiens parviflora	+++	+++	+++
Reynoutria japonica	+++	+++	+++
Aster ×salignus	++	++	++
Erigeron ramosus	++		++
Chenopodium bonus-henricus	+		
Euphorbia peplus	+		
Galinsoga ciliata	+		
Sonchus oleraceus	+		
Lamium album	+		+
Sinapis arvensis	+		+
Malva sylvestris	+	+	
Robinia pseudoacacia	+	+	
Solidago canadensis		++	++
Geranium dissectum		+	
Hesperis matronalis		+	
Matricaria maritima subsp. *inodora*		+	+
Melandrium album		+	+
Bidens frondosa			+
Bromus inermis			+
Conyza canadensis			+
Epilobium ciliatum			+
Total	13	11	15

Explanations: +– 1-4 localities, ++ – 5-13 localities, +++ – 14-34 localities

Table 3. Frequency (F) and abundance (A) of chosen anthropophytes in particular associations

Association	*Impatiens glandulifera*		*Impatiens parviflora*		*Reynoutria japonica*		*Aster ×salignus*		*Erigeron ramosus*		*Solidago canadensis*	
	F	A	F	A	F	A	F	A	F	A	F	A
Salicetum albo-fragilis	46	+-2	31	r-1	31	+-2	-	-	8	+	-	-
Filipendulo ulmariae-Menthetum longifoliae	80	+-4	30	r-+	-	-	-	-	10	+	-	-
Alnetum incanae	23	r-1	40	r-1	20	1-3	11	+-2	-	-	14	+-2
Phalarido-Petasitetum hybridi	35	+-2	27	r-1	11	+	4	+	-	-	-	-
Rorippo-Agrostietum	25	+	8	+	-	-	-	-	8	+	-	-
Phalaridetum arundinaceae	-	-	20	+	-	-	-	-	20	+	-	-

and *Salicetum albo-fragilis*) and in the smallest degree rush communities (Fig. 2). Alien species occurred in 81% of disturbed patches and only in 38% of undisturbed ones. Most of them occurred in single localities, as single specimens. Yet, a few of them (*Impatiens glandulifera, I. parviflora, Reynoutria japonica, Aster ×salignus, Erigeron ramosus* and *Solidago canadensis*) were more frequent and abundant in particular communities (Table 3). Three species, qualified as invasive ones: *Impatiens parviflora* and *I. glandulifera*, and in smaller degree *Reynoutria japonica*, are most frequent and abundant in each type of alluvial vegetation. Remaining species have been found only in some communities. *Impatiens glandulifera* and *Reynoutria japonica* reached the highest coverage in the studied patches (50-75%). Other species frequently appear as a small addition in a herb layer, or as single specimens (Table 3).

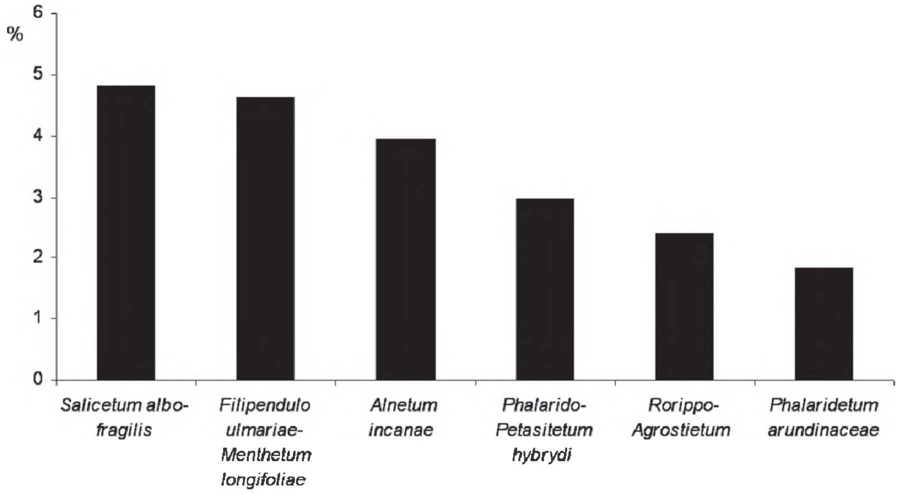

Fig. 2. Percentage of anthropophytes in particular associations

4. Discussion

There is accepted, that anthropophytes more easily penetrate riverside habitats, particularly communities revealing the disturbance of the biological balance (Faliński 1969; Dajdok & Kącki 2003; Tokarska-Guzik 2005), and obtained results seem to prove this argument. The number and percentage of anthropophytes in the disturbed phytocoenoses is clearly higher. Nonetheless, *Phalaridetum arundinaceae* should be excluded from this tendency. Although all its patches were qualified as disturbed, anthropophytes (*Impatiens parviflora*) appeared in them only sporadically.

The reason of such tendency is connected with objective indicators, which allowed to discriminate disturbed and undisturbed phytocoenoses. As it was mentioned above, percentage of characteristic species in a given syntaxon is the most important indicator in this division. The percentage of species from the *Phragmitetea* class is naturally small in the *Phalaridetum arundinaceae* because it differs from other communities in the habitat conditions. This association is the only rush community from *Phragmitetea* which is connected with alluvia, not with marshy habitats, and devoid of hydrophytes, which is characteristic for the class.

Contrary to initial expectations, an analysis of phytocoenoses, in which anthropophytes do not appear or appear sporadically, revealed that these are not forest communities which make the most hermetic barrier for alien species, but some other. The reason is probably

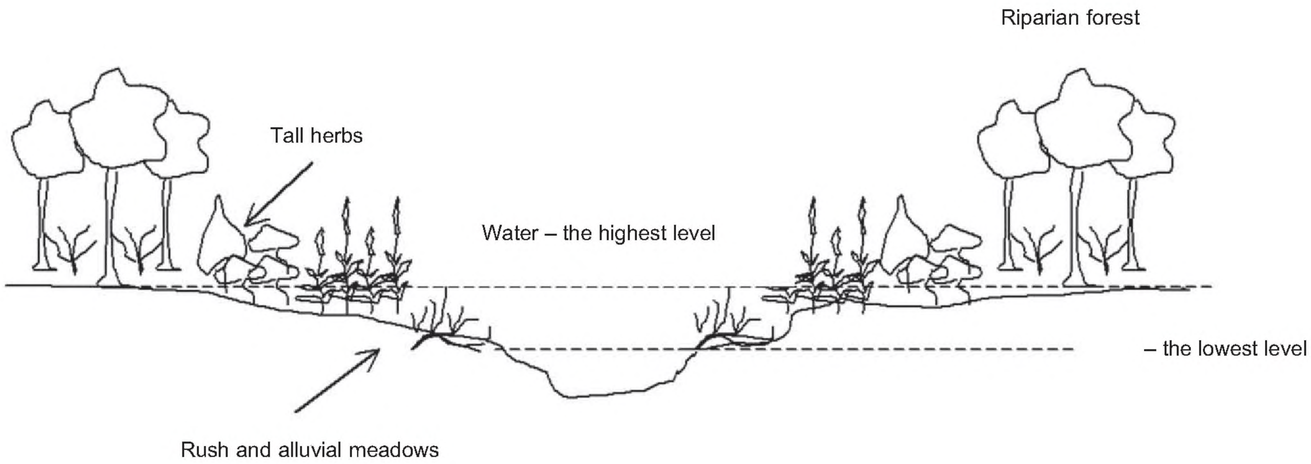

Fig. 3. Typical zonation of riparian vegetation in the Skawica river valley

the structure of these other communities, which are dominated by a dense population of one species (*Phalaris arundinacea, Agrostis stolonifera, Petasites hybridus* or *P. kablikianus*).

Moreover, none of anthropophytes occurred also in other rush communities, which are characterized by similar dominance of one species. However, it could be possibly connected with small number of their patches. Similarly like in *Phalaridetum arundinaceae,* the low percentage of anthropophytes is observed in the patches of *Phalarido-Petasitetum* and *Rorippo-Agrostietum*, where dense populations of species characterized by intensive, vegetative propagation are in dominance as well. Nonetheless, a correlation analysis between the coverage of these species and percentage of anthropophytes revealed only small, though statistically significant, correlation between the percentage of alien species and coverage of *Petasites hybridus* (0.28). The reasons of such distribution of anthropophytes could be numerous. As Gniazdowska (2005) suggests, some allelopathic interactions between species could be of some consequence and, possibly, they are stronger in floristically rich phytocoenoses. It is also possible, that some recurring combinations of habitat factors decide about the appearance of alien species during some growing seasons. It is not unlikely that distribution of anthropophytes is accidental as well, or that localization in proximity of watercourses is of significant importance.

The distribution pattern of all noted communities in the studied area is typical to alluvial vegetation (Fig. 3). Riparian forest communities are localized furthest from the river, and are most seldom flooded, only during flood-stage. Tall-herbs communities and rush community of *Phalaridetum arundinaceae* form a kind of a buffer zone or fringe vegetation for riparian forests. Nearest the water, and also most frequently disturbed by water, are alluvial meadows of *Rorippo-Agrostietum*. Patches of rush communities of *Glycerietum plicatae* and *Typhetum latifoliae* occur sporadically, far away from the river, in the further part of the valley, where small ponds originate in abandoned canals and form convenient habitats for hydrophytes. Vegetation localized nearest the river is most frequently disturbed by two groups of factors – natural (flooding by water which destroys vegetation but also transports diaspores of different species, including the alien ones), and anthropogenic (human recreation activities in summer, littering, exploitation of gravel). Riparian forests are less penetrated by humans, because they are difficult to access (dense undergrowth and herb layer frequently dominated by *Urtica dioica*), however, they are often localized in the vicinity of synanthropic habitats, which are the basic source of alien species diaspores. Because of their further localization in relation to the river, they are most seldom destroyed by water current (Zarzycki 1955). Nevertheless, riparian forests, in spite of lower number of disturbing factors, are characterized by higher percentage of patches with the disturbed biological balance and higher percentage of anthropophytes. The processes, which regulate this balance, are clearly slower in relatively stable forest community than in changeable communities, localized in the proximity of the watercourse, where succession processes are more dynamic and some species replace others, in rather short time periods. Here, near the water, new habitats ready for arrival of new species appear more frequently, but also disappear faster than in forest habitats.

It would seem that species treated as invasive (*Impatiens glandulifera, I. parviflora* and *Reynoutria japonica)* could pose some threat to alluvial vegetation and vegetation of neighboring national park, because of their wide ecological scale and penetration of practically all types of alluvial vegetation. *Impatiens parviflora* was observed on alluvia of the Skawica river already in 1954, as a sporadic species occurring in very small abundance (Stuchlikowa & Stuchlik 1962; Zarzycki 1956). Since then, it is still not abundant species, but occuring with large frequency in all types of phytocoenoses. The results of former investigations proved, that also a therophyte, *Impatiens glandulifera,* does not reveal any tendency to spread and constantly increase its abundance in penetrated localities. The number of its stands is very changeable in different seasons (Uzięblo 2007), and the species does not have the destroying influence on structure of penetrated phytocoenoses (Drescher & Prots 2003; Kasperek 2004; Hejda & Pyšek 2006). The highest threat is connected with the appearence of *Reynoutria japonica*, which reveals reductive relation to penetrated phytocoenoses (Faliński 1969) and has a tendency to eliminate other species.

Floristic richness of alluvial communities and percentage of alien species in the Skawica river valley keep on the same level for at least ten past years (Uzięblo & Ciapała 2006), and probably even longer (Stuchlikowa & Stuchlik 1962; Zarzycki 1956). However, although the location of particular localities insignificantly changes, because of destroying and transporting influence of flooding water, the state of vegetation in this period remains generally unchangeable. At present, the abundance of populations of these species and number of their localities seem not to be endangered, but further anthropopression, which will facilitate the penetration of other anthropophytes into valley, could change the condition to more alarming.

5. Conclusions

1. Obtained results proved, that alien species more frequently and in greater number penetrate disturbed phytocoenoses, and that riparian forests are types of phytocoenoses most penetrated by anthropophytes.
2. The process of penetration of alien species into alluvial phytocoenoses seems to be connected with the phytocoenoses structure, proximity of a watercourse and intensity of factors disturbing the biological balance in phytocoenoses.
3. Constant and small percentage of anthropophytes in alluvial phytocoenoses, persisting for 50 years, allows to estimate the threat to the native vegetation posed by alien species as still not large.

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