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DISTRIBUTION AND PHYTOCOENOTIC CHARACTERISTICS OF *STREPTOPUS AMPLEXIFOLIUS* (L.) DC (LILIACEAE) NATURAL HABITATS IN THE ŻYWIEC BASIN (WESTERN CARPATHIANS)

Wilczek Z., Zarzycki W., Pasko I. **Rozmieszczenie i charakterystyka fitocenotyczna naturalnych siedlisk *Streptopus amplexifolius* (L.) DC (Liliaceae) w Kotlinie Żywieckiej (Karpaty Zachodnie).** *Streptopus amplexifolius* to gatunek górski, szeroko rozpowszechniony w polskich górach. Poza tym, jest znany z kilku stanowisk na obszarze wyżyn i nizin Polski. Mimo że rozmieszczenie tego gatunku w Polsce jest dość dobrze rozpoznane, to brak jest danych na temat jego występowania na obszarze kotlin górskich (basenów strukturalnych) w Karpatach. W artykule przedstawiono informacje na temat rozmieszczenia, charakterystyki fitosocjologicznej i liczebności populacji *S. amplexifolius* na siedliskach naturalnych na terenie Kotliny Żywieckiej, gdzie stwierdzono nowe stanowiska tej rośliny. Omawiany gatunek występował tam w następujących typach zbiorowisk roślinnych: *Tilio-Carpinetum stachyetosum*, *T.-C. typicum*, *T.-C. caricetosum*, *T.-C. holceetosum*, *Fraxino-Alnetum* i *Arunco-Doronicetum*. Stwierdzona liczebność populacji gatunku na badanym obszarze wynosi około 1130 osobników.

Вильчек З., Зажицки В. Паско И., 2016. **Распространение и фитосоциологическая характеристика естественной среды обитания *Streptopus amplexifolius* (L.) DC (Liliaceae) в Живецком бассейне (Западные Карпаты).** *Streptopus amplexifolius* – горный вид широко распространенный в польских горах. Имеется также в нескольких точках польских возвышенностей и низин. Несмотря на то, что распределение этого вида в Польше довольно хорошо известно, нет данных о его наличии в чертах структурных бассейнов Карпат. Данная статья содержит информацию по распределению, фитосоциологической характеристике среды обитания и численности популяции *S. amplexifolius* в Живецком Бассейне (Kotlina Żywiecka), где было обнаружено новое расположение этого растения. *S. amplexifolius* был обнаружен там в следующих типах растительных сообществ: *Tilio-Carpinetum stachyetosum*, *T.-C. caricetosum T.-C. caricetosum*, *T.-C. holceetosum*, *Fraxino-Alnetum* и *Arunco-Doronicetum*. Выявлено, что здесь имеется около 1 130 экземпляров данного растения.

Key words: *Streptopus amplexifolius*, twistedstalk, Żywiec Basin, Western Carpathians, phytosociology, mountain species
Słowa kluczowe: *Streptopus amplexifolius*, liczydło górskie, Kotlina Żywiecka, Karpaty Zachodnie, fitosocjologia, gatunki górskie
Ключевые слова: *Streptopus amplexifolius*, стрептопус стеблеобъемлющий, Живецкий бассейн, Западные Карпаты, фитоценология, горные виды

Abstract

Streptopus amplexifolius is a mountain species widespread in Polish mountains. Moreover, it has several localities in Polish highlands and lowlands. Although distribution of this species in Poland is quite well recognized, there is a lack of data about its occurrence in the area of structural basins in the Carpathians. This paper presents data on distribution, and phytosociological and ecological spectrum of *S. amplexifolius* occurring in the area of the Żywiec Basin (Kotlina Żywiecka), where the new location of this plant was discovered. *Streptopus amplexifolius* was found in the following types of vegetation: *Tilio-Carpinetum stachyetosum*, *T.-C. typicum*, *T.-C. caricetosum*, *T.-C. holceetosum*, *Fraxino-Alnetum* and *Arunco-Doronicetum*. The whole population of the species in the area studied counts about 1130 individuals.

INTRODUCTION

Twistedstalk (*Streptopus amplexifolius*) was strictly protected plant species to 2014 year in Poland (*Regulation…*, 2012). This taxon is not threatened in a scale of the all country but its relict lowland localities are potentially endangered. Confirmation of this is that some local Red Lists and Red Books include the species. In Łódź Province (northern range of the species) and Silesian Province *S. amplexifolius* was categorized

as vulnerable (VU) (KUROWSKI, HEREŹNIAK, 2011; PARUSEL, URBISZ, 2012). In two other regions – Opole Province and the Małopolska Upland – the species is considered to be critically endangered (CR category) (NOWAK A., NOWAK S., SPAŁEK, 2008; BRÓŻ, PRZEMYSKI, 2009).

Streptopus amplexifolius (photo 1) is the mountain species with many localities in highlands and even lowland areas of Poland (HEREŹNIAK, 1982; ZAJĄC, 1996; ZAJĄC A., ZAJĄC M., 2001; PARUSEL, 2009; NOWAK et al., 2011), and in the last years there were found new of them (ROK, HENEL, 2001; PIWOWARSKI, PACIOREK, 2011; BŁOŃSKA, BOSEK, 2012). Nearest mountain sites of the species are located on slope of Klimczok (1 111 m a.s.l.) in the Silesian Beskid (WILCZEK, 1995), and on Jaworzyna Mount (890 m a.s.l.) in the Little Beskid (PELC, 1958). The second one was not confirmed in the later researches (KOTOŃSKA, 1991).

Although, the distribution of *Streptopus amplexifolius* in Polish mountain ranges is well recognized, there is a lack of data about its occurrence in the area of structural basins in the Carpathians such as Żywiec Basin (HEREŹNIAK, 1982; ZAJĄC A., ZAJĄC M., 2001). The Żywiec Basin is an example of the region unexplored for occurrence of the twistedstalk, although the species was found in the surrounding mountain ranges. *S. amplexifolius* was found there for the first time between 2008–2013 (WILCZEK, ZARZYCKI, in press).

The aims of the studies were (I) to investigate the distribution of *Streptopus amplexifolius* in the Żywiec Basin, and (II) to determine its phytocoenological spectrum and habitat characteristics.

Photo 1. Fruiting specimen of *Streptopus amplexifolius* (phot. by Z. Wilczek, 16 July 2013)
Fot. 1. Owocujący okaz *Streptopus amplexifolius* (fot. Z. Wilczek, 16.07.2013)
Фот. 1. Плодоносный экземпляр *Streptopus amplexifolius* (фот.: З. Вильчек, 16.07.2013)

STUDY AREA

The Żywiec Basin according to the division of Poland into physical-geographical regions (KONDRACKI, 2002), is a mesoregion in the subprovince called the Outer Eastern Carpathians. The Żywiec Basin (photo 2) is a tectonic window bounded by the Silesian Beskid in the west, the Little Beskid in the north, and the Maków Beskid in the east (KLIMASZEWSKI, STARKEL, 1972; FÖLDVARY, 1988; KONDRACKI, 2002). It is also the contact zone of a number of tectonic units, being parts of the Carpathian flysch (PAUL, RYŁKO, TOMAŚ, 1996). Characteristic aspect of the Żywiec Basin is its harsh climate with the temperature inversions. The average year temperature is 7.3°C but in the winter temperature can fall even into -40°C. The average annual rainfall reaches 1000 mm (BAJGIER-KOWALSKA et al., 1998).

Sites of *S. amplexifolius* in the area of the Żywiec Basin are localized in two parts of the mesoregion: the Ślemień Gate in the eastern part of the Basin (photo 3), and the Wilkowice Gate in northern edge of it (photo 4). First of them is located between Żywiec Beskid and Maków Beskid. The Wilkowice Gate divides the Silesian Beskid and the Little Beskid (ZIĘTARA, 1986).

The new locations of *Streptopus amplexifolius* with regard to the 10 km ATPOL cartogram (ZAJĄC A., ZAJĄC M., 2001) are situated in DG 03 (Wilkowice) and DG 05 (Ślemień) Atpol.

Photo 2. Panorama of the Żywiec Basin (phot. by Z. Wilczek, 28 October 2015)
Fot. 2. Panorama Kotliny Żywieckiej (fot. Z. Wilczek, 28.10.2015)
Фот. 2. Живецкий бассейн – общий вид (фот.: З. Вильчек, 28.10.2015)

Photo 3. View for the Ślemień Gate from the Silesian Beskid (phot. by Z. Wilczek, 13 February 2015)
Fot. 3. Widok na Bramę Ślemieńską z Beskidu Śląskiego (fot. Z. Wilczek, 13.02.2015)
Фот. 3. Вид из Силезского Бескида на Слеменьские ворота (фот.: З. Вильчек, 13.02.2015)

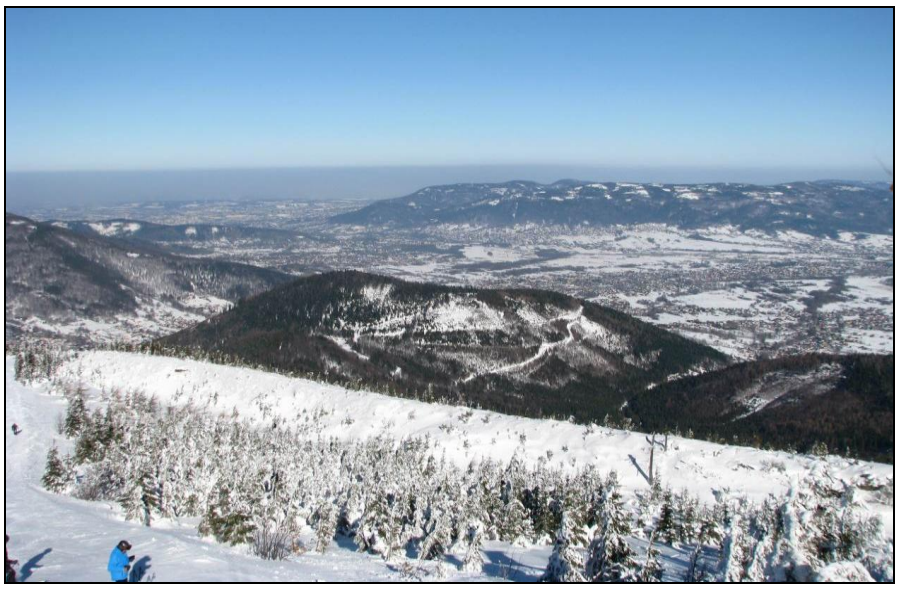

Photo 4. View for the Wilkowice Gate from the Silesian Beskid (phot. by Z. Wilczek, 13 February 2015)
Fot. 4. Widok na Bramę Wilkowicką z Beskidu Śląskiego (fot. Z. Wilczek, 13.02.2015)
Фот. 4. Вид из Силезского Бескида на Вильковицкие ворота (фот.: З. Вильчек, 13.02.2015)

MATERIAL AND METHODS

Floristic and phytosociological research were carried out in 2008–2013 to characterize newly found population of *Streptopus amplexifolius*. The collected material consisted of 14 relevés made according to BRAUN-BLANQUET (1964) method. They were next classified into syntaxonomical units on the basis of "Guide for recognition of plant communities" (MATUSZKIEWICZ, 2008). Ecological differentiation in terms of light, temperature, continentality, humidity, and fertility of these localities, where *Streptopus amplexifolius* was found, was defined with the application of Ellenberg indicator values. Habitat preferences of *Streptopus amplexifolius* in studied sites in terms of light, temperature, continentality, humidity, and fertility factors were defined according to Ellenberg indicator values (ELLENBERG, LEUSCHNER, 2010) what was carried out for both sites The calculations were based on the list of vascular species occurring in phytocoenoses with twistedstalk recorded in the new localities. The names of vascular plants follow MIREK et al. (2002) and mosses – OCHYRA, ŻARNOWIEC, BEDNAREK-OCHYRA (2003). The names of syntaxa and phytosociological affiliation of species follow MATUSZKIEWICZ (2008).

RESULTS

In the Żywiec Basin two localities of *Streptopus amplexifolius* were noted. The first is located in the valley of the Sikorz Creek in Ślemień (County Żywiec, Silesian Province) in the altitude range of 450–500 m a.s.l. (fig. 1). The stream is a one km long, right tributary of the Młynszczanka Creek, which flows into the Łękawka River. Deciduous forests are the main type of vegetation in the valley. The valley is surrounded by *Larix decidua* monocultures. *S. amplexifolius* occurs mainly in the southern part of the area where number of specimens is about 720, while in the northwestern it is approximately 350. The size of the whole population in this locality is therefore 1100. Most specimens were browsed because of strong pressure of the herbivores, ungulates in particular.

Streptopus amplexifolius in Ślemień was noted in patches of two associations: *Tilio-Carpinetum* and *Arunco-Doronicetum austriaci* (table 1). Despite the

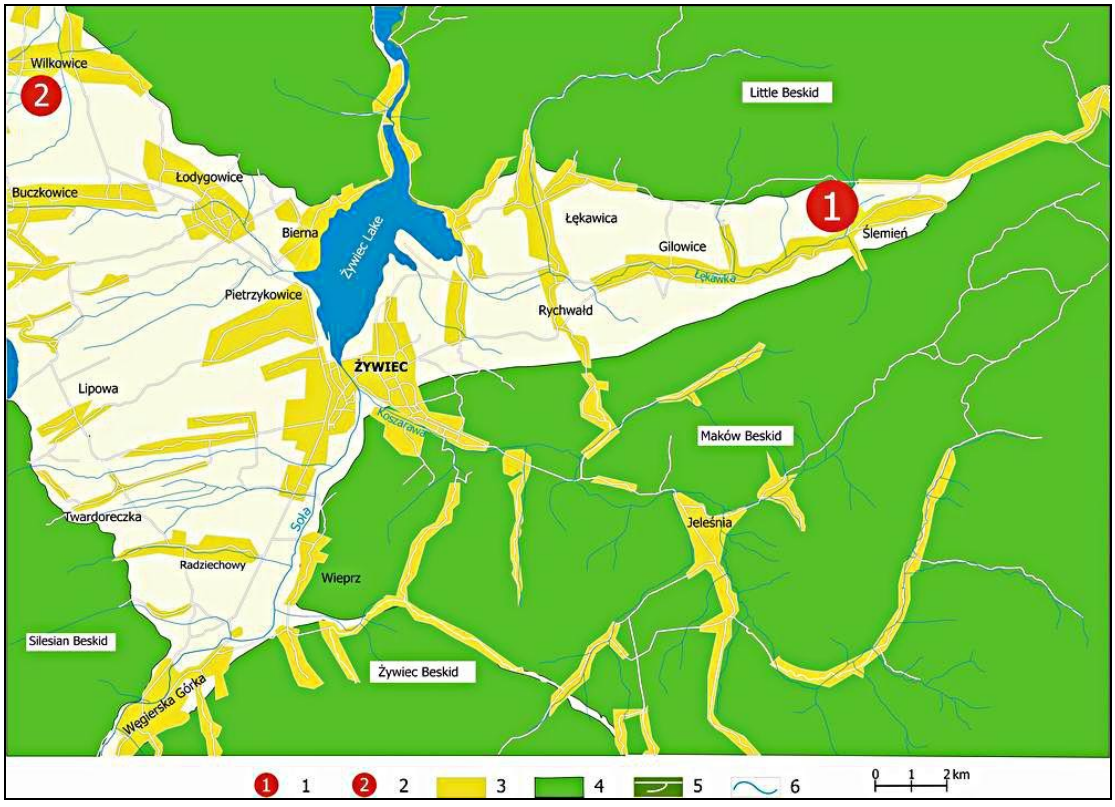

Fig. 1. Localities of *Streptopus amplexifolius* sites:
1 – site in Ślemień, 2 – site in Wilkowice, 3 – built-up areas, 4 – mountain ranges, 5 – roads, 6 – rivers
Rys. 1. Lokalizacja stanowisk *Streptopus amplexifolius*:
1 – stanowisko w Ślemieniu, 2 – stanowisko w Wilkowicach, 3 – tereny zabudowane, 4 – pasma górskie, 5 – drogi, 6 – rzeki
Рис. 1. Локализация исследовательских точек *Streptopus amplexifolius*:
исследовательские точки: 1 – Слемень, 2 – Вильковице; 3 – застроенные территории, 4 – горные хребты, 5 – дороги, 6 – реки

small area of the valley, phytocoenoses of *Tilio-Carpinetum* are syntaxonomically varied. *S. amplexifolius* is the most often found in patches of wet oak-linden-hornbeam forest *Tilio-Carpinetum stachyetosum* (table 1, relevés 1–4). The tree layer of this sub-association is dominated by *Acer pseudoplatanus* and *Carpinus betulus*, and its cover reaches about 90%. Cover of shrubs reaches maximum 80%. *Coryllus avellana* is the main component of this layer. It is accompanied by *Padus avium* and other species. The herb layer, which covers between 60 and 90% is primarily composed by species representing the *Querco-Fagetea* class, such as: *Anemone nemorosa*, *Aegopodium podagraria*, *Polygonatum multiflorum*, and *Paris quadrifolia*. The presence of character species for the riparian forest: *Padus avium*, *Stachys sylvatica* and *Circaea lutetiana*, is the main reason for the classification of these phytocoenoses into the sub-association *Tilio-Carpinetum stachyetosum*. The main bryophyte component of the community is *Polytrichastrum formosum*.

Table 1. Phytocoenoses with *Streptopus amplexifolius* occurring in the area of the Żywiec Basin
Tabela 1. Fitocenozy ze *Streptopus amplexifolius* na obszarze Kotliny Żywieckiej
Таблица 1. Фитоценозы с *Streptopus amplexifolius* в чертах Живецкого Бассейна
(A – *Tilio-Carpinetum*: A1 – *-stachyetosum*, A2 – *-typicum*, A3 – *-caricetosum*, A4 – *-holceetosum*; B – *Fraxino-Alnetum*; C – *Arunco-Doronicetum*)

Relevé numer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Date	29.08.09	31.07.09	23.08.09	16.09.09	13.06.09	05.07.08	29.08.09	31.07.09	09.09.09	05.07.08	10.05.13	16.07.13	16.07.13	15.07.09	
Locality	Ślemień	Ślemień	Ślemień	Ślemień	Ślemień	Ślemień	Ślemień	Ślemień	Ślemień	Ślemień	Wilkowice	Wilkowice	Wilkowice	Ślemień	
Exposition	E	SE	E	E	NW	S	E	NE	SE	SW	-	-	-	W	Constancy
Slope [°]	5	30	30	30	40	-	5	30	10	35	-	-	-	40	
Altitude [m]	450	500	450	500	460	500	480	480	500	450	413	430	414	480	
Cover of the tree layer [%]	90	90	44	90	30	70	100	60	70	80	70	70	90	-	
Cover of the shrub layer [%]	70	70	60	80	70	50	40	80	80	60	70	20	80	-	
Cover of the herb layer [%]	80	90	70	60	70	80	70	80	90	30	50	100	80	80	
Cover of the moss layer [%]	1	1	1	1	1	1	1	1	-	5	1	-	-	50	
Area of relevé [m²]	100	100	100	100	100	100	100	100	100	100	200	100	100	100	
No. of species	18	16	18	17	31	20	18	13	14	37	30	21	25	25	
Type of the community	A1				A2				A3	A4	B			C	
Streptopus amplexifolius	r	+	r	2	+	1	r	+	r	+	+	+	+	+	V
*Ch. *Tilio-Carpinetum* + Ch. *Carpinion betuli*:															
Carpinus betulus a	2	3	3	.	.	3	4	.	.	.	.	.	.	.	III
Carpinus betulus c	+	.	.	.	.	.	+	.	.	+	.	.	.	1	
**Carex pilosa*	.	.	.	+	.	5	.	.	.	.	.	.	.	.	I
Prunus avium	.	.	.	.	+	.	.	.	.	.	.	.	1	.	I
**Galium schultesii*	.	.	.	.	3	.	.	.	.	.	.	.	.	.	I
*D. *Fraxino-Alnetum* + Ch. *Alno-Ulmion*															
Padus avium a	.	.	.	.	.	1	.	.	.	.	.	.	.	.	
Padus avium b	.	2	2	.	.	.	.	.	.	.	3	2	1	.	III
Padus avium c	.	.	.	.	.	+	.	.	.	.	2	2	.	.	
Festuca gigantea	.	.	.	.	1	.	.	.	.	.	+	.	1	.	II
Circaea lutetiana	.	.	.	1	.	.	.	+	+	.	.	.	.	.	II
**Frangula alnus*	.	.	.	.	.	.	.	.	.	+	.	.	4	.	I

Sporadic species: *Ribes spicatum* 11; *Rumex sanguineus* 12; *Stellaria nemorum* 5.

Ch. *Fagetalia*															
Polygonatum multiflorum	1	.	1	+	+	+	+	.	1	+	+	.	+	.	IV
Paris quadrifolia	.	1	1	r	+	.	.	.	.	.	.	.	.	+	II
Carex sylvatica	1	.	.	.	+	.	2	.	.	.	.	.	.	+	II
Impatiens noli-tangere	.	1	1		.	.	.	.	.	.	3	.	.	.	II
Gaelobdolon luteum	.	.	.	.	+	1	.	.	.	.	.	.	.	+	II
Symphytum tuberosum	.	+	+	.	+	.	.	.	.	.	.	.	.	.	II
Dryopteris filix-mas	1	.	1	.		.	.	.	.	.	.	.	.	.	I
Asarum europaeum	.	.	.	.	+	.	.	.	.	.	.	.	+	.	I
Stachys sylvatica	1	r	.	.	.	.	.	.	.	.	.	.	.	.	I
Atrichum undulatum d	.	.	.	+	+	.	.	.	.	+	.	.	.	1	II

Sporadic species: *Galium odoratum* 4 (r); *Fagus sylvatica* 10; *Primula elatio*r14; *Ranunculus lanuginosus* 5; *Viola reichenbachiana* 5.

Ch. *Querco-Fagetea*															
Acer pseudoplatanus a	4	4	4	5	1	2	2	2	.	1	.	.	.	.	
Acer pseudoplatanus b	.	1	.	.	.	.	.	1	.	.	2	.	1	.	V
Acer pseudoplatanus c	.	.	+	+	+	+	1	r	+	+	+	.	.	.	
Corylus avellana b	4	4	3	4	4	3	3	4	4	4	.	.	.	.	IV
Corylus avellana c	.	.	.	+	+	+	r	+	.	+	.	.	.	1	
Anemone nemorosa	.	3	3	.	.	.	.	+	.	.	.	2	.	3	II
Aegopodium podagraria	.	2	2	.	2	.	.	.	.	.	.	.	2	+	II
Acer platanoides	+	.	.	.	+	+	.	.	.	+	.	.	.	.	II
Fraxinus excelsior a	.	.	.	.	.	.	.	.	.	.	3	.	.	.	
Fraxinus excelsior b	.	.	.	.	.	.	.	.	.	.	.	.	1	.	II
Fraxinus excelsior c	.	.	.	.	.	.	.	.	.	+	.	.	.	.	
Poa nemoralis	.	1	.	.	.	.	.	.	.	+	.	.	.	+	II
Galeobdolon luteum	.	.	.	.	.	.	.	.	.	.	.	+	2	.	I
Brachypodium sylvaticum	.	.	.	.	+	.	1	.	.	.	.	.	.	.	I

Sporadic species: *Campanula trachelium* 6; *Salvia glutinosa* 8.

Ch. *Arunco-Doronicetum austriaci*															
Aruncus sylvestris	.	.	.	.	+	.	.	.	.	.	.	.	.	3	I
Ch. *Betulo-Adenostyletea*															
Rosa pendulina	.	.	.	.	.	.	.	.	.	.	.	.	.	3	I
Phyteuma spicatum	.	.	.	.	+	.	.	.	.	.	.	.	.	1	I
Others:															
Alnus glutinosa a	.	.	.	.	.	.	.	.	.	.	3	4	5	.	II
Alnus glutinosa c	.	.	.	.	.	.	.	.	.	.	+	.	.	.	
Athyrium filix-femina	.	+	+	2	+	+	2	2	+	+	1	2	1	.	V
Oxalis acetosella	2	.	.	1	1	2	2	1	1	.	.	3	3	1	IV
Dryopteris dilatata	.	.	+	1	.	+	+	.	+	+	+	1	+	+	IV
Maianthemum bifolium	1	r	r	.	+	2	1	1	.	1	.	.	.	+	IV

Sorbus aucuparia a	.	2	.	.	.	.	.	.	.	+	.	.	.	.	
Sorbus aucuparia b	.	.	2	.	.	.	.	.	.		+	2	1	.	III
Sorbus aucuparia c	1	.	+	.	.	.	+	.	.	+	+	.	.	.	
Sambucus nigra b	2	.	.		.	.	1	1	.		1	1	1	.	III
Sambucus nigra c	1	.	.	.	.	+	r	+	.	+	.	.	.	.	
Melandrium rubrum	r	+	1	1	.	+	1	.	r	+	.	.	.	.	III
Rubus hirtus	2	.	.	+	+	+	3	.	2	+	1	.	2	.	III
Quercus robur a	.	.	.	.	3	3	.	3	4	5	1	.	.	.	
Quercus robur b	.	.	.	.	.	.	+	.	.	+	.	.	.	.	III
Quercus robur c	.	.	.	.	.	.	.	.	.	.	+	.	.	+	
Crataegus monogyna a	.	.	.	.	.	.	.	1	.	.	.	.	.	.	
Crataegus monogyna b	.	.	.	1	.	1	.	.	1	.	.	.	.	.	II
Crataegus monogyna c	.	.	.	+	.	+	.	.	.	.	.	.	.	.	
Impatiens parviflora	+	.	.	1	.	.	+	.	.	.	.	.	3	.	II
Rubus idaeus	.	.	.	.	.	.	.	.	.	.	.	+	1	+	I
Carex brizoides	3	.	.	.	2	.	.	.	5	.	.	.	.	.	II
Gentiana asclepiadea	.	.	.	.	+	.	.	.	.	.	+	.	.	1	II
Dryopteris carthusiana	.	.	.	.	.	+	.	.	.	+	.	.	.	+	II
Padus serotina b	.	.	.	.	.	.	.	.	.	.	1	.	.	.	I
Padus serotina c	.	.	.	.	.	.	.	.	.	.	+	.	+	.	
Picea abies b	.	.	.	.	.	.	.	.	.	.	1	.	.	.	I
Picea abies c	.	.	.	.	.	.	.	.	.	+	+	.	.	.	
Betula pendula a	.	.	.	.	.	.	2	.	.	.	1	.	.	.	I
Salix fragilis a	.	.	.	.	.	.	.	.	.	.	.	1	1	.	I
Impatiens glandulifera	.	.	.	.	.	.	.	.	.	.	.	4	+	.	I
Reynoutria japonica	.	.	.	.	.	.	.	.	.	.	.	2	1	.	I
Equisetum sylvaticum	.	.	.	.	.	.	.	.	.	.	1	+	.	.	I
Deschampsia caespitosa	.	.	.	.	.	.	.	.	.	.	1	+	.	.	I
Galeopsis speciosa	.	.	.	.	.	.	.	.	.	.	+	+	.	.	I
Gymnocarpium robertianum	.	.	.	.	.	.	.	.	.	+	.	.	.	+	I
Hieracium murorum	.	.	.	.	+	.	.	.	.	+	.	.	.	.	I
Phegopteris connectilis	.	.	.	.	.	.	.	.	.	.	+	.	+	.	I
Epilobium montanum	.	.	.	.	.	.	.	.	+	.	.	.	.	+	I
Polytrichastrum formosum d	1	.	+	1	.	.	.		.	1	.	.	.	3	II

Sporadic species: *Agrostis capillaris* 10 (1); *Alliaria petiolata* 11; *Angelica sylvestris* 11; *Blechnum spicant* 8 (r); *Brachythecium rivulare* d 11; *B. rutabulum* d 4; *Calamagrostis villosa* 12 (1); *Cardamine pratensis* 11 (r); *C. pallescens* 10; *Carex pilulifera* 10; *Dactylis glomerata* 10 (r); *Dryopteris affinis* 12; *Festuca ovina* 9; *Geum urbanum* 13; *Holcus mollis* 10 (1); *Jucus effusus* 10; *J. tenuis* 10; *Luzula luzulina* 14 (1); *L. pilosa* 10 (2); *Moehringia trinervia* 11; *Oreopteris limbosperma* 10; *Poa pratensis* 10; *Populus tremula* 6 (r); *Rosa canina* 5 (r); *Sambucus racemosa* b 11 (1); *Scirpus sylvaticus* 12 (1); *Vaccinium myrtillus* 10 (2); *Veronica officinalis* 10.

The most common associations in the area of the Sikorz Creek valley is oak-hornbeam forest *Tilio-Carpinetum typicum* (table 1, relevés 5–8) with abundant occurrence in a tree layer (cover 30–100%) of two or three the following tree species: *Quercus robur*, *Acer pseudoplatanus*, *Carpinus betulus*, and *Corylus avellana* in a shrub layer with cover 40–80%. The most important species in the herb layer are: *Athyrium filix-femina*, *Maianthemum bifolium*, *Oxalis acetosella*, *Carex pilosa*, *Galium schultesii*, *Carex sylvatica* and *Aegopodium podagraria.* Their cover reaches maximum 90%. Mosses are insignificant in the community.

On the first site *Streptopus amplexifolius* occurs in two patches of dry oak-hornbeam forest representing *Tilio-Carpinetum caricetosum brizoidis* and *Tilio-Carpinetum holceetosum mollis* sub-associations (table 1, relevés 9–10). Tree layers of both phytocoenoses are dominated by *Quercus robur*, and their covers are about 70–80%.*Carpinus betulus* was not recorded in the stand. Like in the other sub-associations, the shrub layer is dominated by *Corylus avellana*.

Carex brizoides is the most abundant species in *T.-C. caricetosum brizoidis* covering there the herb layer in 90%. The mosses are absent in this community. The herb layer of *T.-C. holceetosum* is outstanding from the others by slight cover (30%) and presence of the following species: *Holcus mollis*, *Frangula alnus*, *Festuca ovina*, *Luzula pilosa*, *Vaccinium myrtillus*. Because of the composition of the herb layer and the dominance of *Quercus robur* in the sub-association approximates the communities belonging to the *Quercetea robori-petraeae* class. The bryophyte layer of the community consists of *Polytrichastrum formosum* and *Atrichum undulatum*, and its cover reaches amounts in 5%.

The phytocoenosis of *Arunco-Doronicetum austriaci* (photo 5) with the occurrence of *Streptopus amplexifolius* (table 1, relevé 14) is located on a steep, western slope of the Sikorz valley. The herb layer covers about 80%, and its dominant components are *Aruncus sylvestris* and *Rosa pendulina*. other abundantly occuring species are: *Anemone nemorosa*, *Phyteuma spicatum*, *Oxalis acetosella*, *Luzula luzulina*, and *Gentiana asclepiadea*. What is also worth emphasizing, the bryophyte layer is lush and its cover reaches 50% *Atrichum undulatum* and *Polytrichastrum formosum* occur abundantly.

Photo 5. The phytocoenosis of *Arunco-Doronicetum austriaci* (phot. by Z. Wilczek, 15 July 2009)
Fot. 5. Fitocenoza *Arunco-Doronicetum austriaci* (fot. Z. Wilczek, 15.07.2009)
Фот. 5. Фитоценоз *Arunco-Doronicetum austriaci* (фот.: З. Вильчек, 15.07.2009)

The second locality of *Streptopus amplexifolius* is located in the Wilkowice Wood ("Lasek Wilkowicki") which is a part of Wilkowice commune (photo 6) (Bielsko County, Silesian Province) (fig. 1). The area of the Wilkowice Wood is crossed by many streams. The most important of them is Mesznianka with springs on slopes of the Klimczok Mount in the Silesian Beskid. This is the left-bank tributary of the Biała River. Given the extensive river network, terrain is slightly rolling with the riparian forest *Fraxino-Alnetum* (photo 7) along the streams, and alder forests *Ribeso nigri-Alnetum* in local mires. The site is located in patches of first one at the altitude 404–415 m a.s.l., and the number of individuals amounts in 30.

The *Fraxino-Alnetum* canopy is dominated by *Alnus glutinosa* with an admixture of *Salix fragilis* and *Betula pendula* (table 1, relevés 11–13). A sub-dominant could be also *Fraxinus excelsior* (table 1, relevé 11). The shrub layer is a mixture of *Padus avium*, *Acer pseudoplatanus*, *Sorbus aucuparia*, *Sambucus nigra* and *Frangula alnus*, with lack of the undergrowth of *Alnus glutinosa*. The herb layer reaches 50–100% of cover and its most important components are: *Athyrium filix-femina*, *Oxalis acetosella*, *Dryopteris dilatata*, *Padus avium*,

Photo 6. Panorama of Wilkowice commune (phot. by Z. Wilczek, 26 April 2013)
Fot. 6. Panorama gminy Wilkowice (fot. Z. Wilczek, 26.04.2013)
Фот. 6. Гмина Вильковице – общий вид (фот.: З. Вильчек, 26.04.2013)

Photo 7. *Streptopus amplexifolius* in *Fraxino-Alnetum* phytocoenosis (phot. by Z. Wilczek, 14 May 2013)
Fot. 7. *Streptopus amplexifolius* w płacie *Fraxino-Alnetum* (fot. Z. Wilczek, 14.05.2013)
Фот. 7. *Streptopus amplexifolius* в фитоценозе *Fraxino-Alnetum* (фот.: З. Вильчек, 14.05.2013)

gula alnus, with lack of the undergrowth of *Alnus glutinosa*. The herb layer reaches 50–100% of cover and its most important components are: *Athyrium filix-femina*, *Oxalis acetosella*, *Dryopteris dilatata*, *Padus avium*, *Aegopodium podagraria*, *Anemone nemorosa*, and some invasive species: *Reynoutria japonica*, *Impatiens glandulifera* and *I. parviflora*. Mosses are insignificant in the community.

The occurrence of invasive species seems to be a serious threat to the *Streptopus amplexifolius* locality.

Phytosociological researches were also supported by the studies on *Streptopus amplexifolius* habitats using Ellenberg indicator values. In both sites average values are similar (fig. 2). Light (L) and temperature (T) values are distributed almost the same in both sites. The first one ranges primarily from 4 to 6, what means semi-shade plants, while the average T value close to 5 mean moderate temperatures. Values distributions for continentality (K) and nitrogen (N) are a bit different in both sites. For K medians are dissimilar, while arithmetic means are coincided and close to 4 (suboceanic characteristics). Conversely, medians for the nitrogen value are the same (6 – intermediate fertility), and their means differ. The most varied value is the moisture (F). In Wilkowice the average value is higher than in Ślemień, but they are still in the range of moist-site indicator or intermediate between moist sites and damps.

DISCUSSION

Streptopus amplexifolius is usually considered to be a characteristic species for the *Betulo-Adenostyletea* class (MATUSZKIEWICZ, 2008). Moreover, in the Carpathians the species is also common in spruce forests, and in lowlands in riparian forests: *Fraxino-Alnetum* and *Ca-*

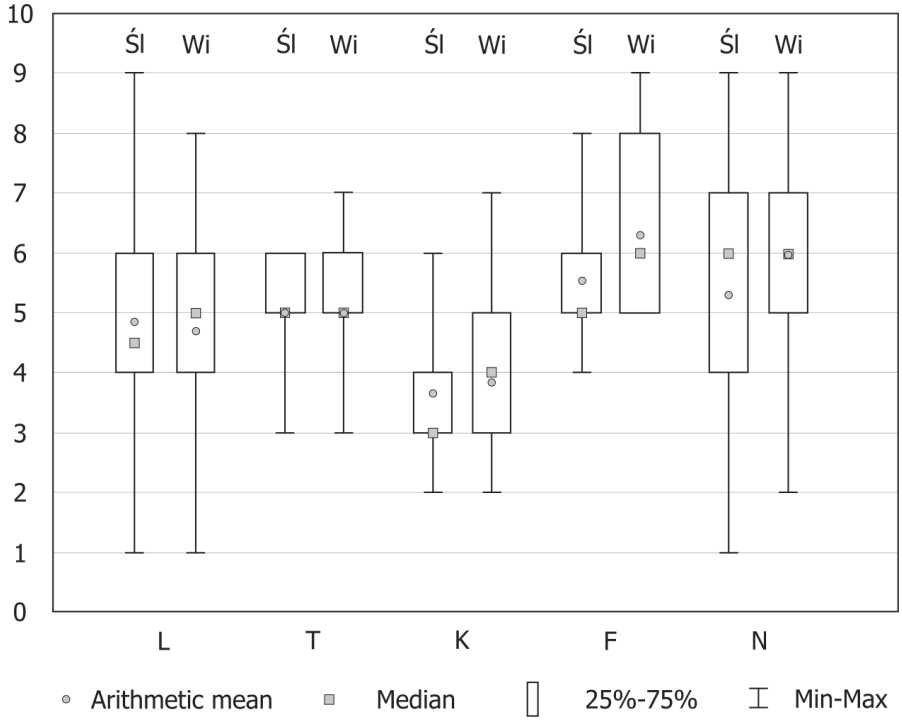

Fig. 2. The Ellenberg indicator values for: light (L), temperature (T), continentality (K), moisture (F) and nitrogen (N); Śl – Ślemień; Wi – Wilkowice

Rys. 2. Rozkład wartości liczb wskaźnikowych Ellenberga dla: światła (L), temperatury (T), kontynentalizmu (K), wilgotności (F) oraz zawartości azotu (N); Śl – Ślemień; Wi – Wilkowice

Рис. 2. Распределение чисел индекса Элленберга для: света (L), температуры (T), континентализма (C), влажности (F), содержания азота (N); Śl – Слемень; Wi – Вильковице

rici remotae-Fraxinetum (HEREŹNIAK, 1982), just like in the site of the Wilkowice Wood. In the northern range (Łódź Province) *S. amplexifolius* is most common in patches of the alder forest *Ribeso nigri-Alnetum* similar to *Tilio-Carpinetum stachyetosum* (PIWOWARSKI, PACIOREK, 2011). The occurrence of the species in the *Carpinion* oak-hornbeam forests is occasional in the area of all Polish range (HEREŹNIAK, 1982; NOWAK et al., 2011; PIWOWARSKI, PACIOREK, 2011; BŁOŃSKA, BOSEK, 2012). In contrast in the Żywiec Basin *Tilio-Carpinetum* phytocoenoses are the main habitat of *S. amplexifolius*. Moreover, the species occurrs in different habitat types of oak-hornbeam forest – from wet *T.-C. stachyetosum* (similar to riparian forest) by typical *T.-C. typicum*, to occurring in drier soils high oak-hornbeam forests *T.-C caricetosum* and *T.-C. holceetosum*. Despite the fact that the Żywiec Basin is a part of the Carpathians, and it is surrounded by mountains, *S. amplexifolius* habitats are closer to highland and lowland phytocoenoses with share of this species.

It is worth emphasizing that *Streptopus amplexifolius* was found in the patches of mountain herb community *Arunco-Doronicetum austriaci*. So far it was observed in this association only in the Bieszczady Mountains, the Gorce Mountains and the Silesian Beskids (HEREŹNIAK, 1982; WILCZEK, 2006).

The herbivore pressure on *Streptopus amplexifolius* specimens was observed in the Ślemień locality. However, the population of the species is numerous – it reaches about 1 100. It could be effect of deer grazing which stimulates the vegetative reproduction. Ramets that suffer high level of herbivory can allocate more resources to vegetative propagation than to sexual reproduction. There are evidences for such reaction also for other species (BIAŁY, 1996; KNIGHT, 2004; BERMINGHAM, 2010).

In spite of the specific climate of the Żywiec Basin, with frequent temperature inversions and heavy frosts (BAJGIER-KOWALSKA et al., 1998), *Streptopus amplexifolius* is not accompanied by many species preferring low temperature, but there is also a lack of thermophilous species. In both localities average values for light, temperature, continentality, and fertility are similar. These localities varied only in terms of moisture. Despite differences in the types of plant communities in both localities, the compositions of accompanying species are similar. The moisture is the main factor which differs habitats of *Tilio-Carpinetum* from *Fraxino-Alnetum*.

Despite the fact that the population of *Streptopus amplexifolius* in the Żywiec Basin is about 1 100, the species should be considered as locally threatened. *S. amplexifolius* is especially endangered in the area of the Wilkowice Wood, where were counted only several dozen of specimens. *Reynoutria japonica* invasion in the vicinity of the species causes that this population is under strong pressure (photo 8). *Impatiens glandulifera*, and *I. parviflora* – species regarded as invasive – also can become a threat when are spreading (TOKARSKA-GUZIK et al., 2012).

There is no anthropopressure on location in Ślemień at present, however it is located in an isolated natural-forest island, not bigger than 8 ha. In order to protect this location the nature reserve should be

Photo 8. Invasion of *Reynoutria japonica* in the Wilkowice Wood (phot. by Z. Wilczek, 12 August 2015)
Fot. 8. Inwazja *Reynoutria japonica* w Lasku Wilkowickim (fot. Z. Wilczek, 12.08.2015)
Фот. 8. Нашествие *Reynoutria japonica* в Вилькowицком Лесу (фот.: З. Вильчек, 12.08.2015)

founded. According to Nature Conservation Act (*Law of 16th April...*, 2004), creating of the reserve would ensure regular monitoring and preservation adequate to current threats and state of vegetation. Due to main purpose of a conservation, which is protection the population of *S. amplexifolius*, the new reserve should have floristic character, and due to the main ecosystem type it should be a fo-rest reserve. According to the *Regulation of the Minister of Environment* (2005) it should have the following code: L/PFlrzk/ELlgp.

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