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Regular research paper

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RELATION BETWEEN INVASIVE PLANT AND SPECIES RICHNESS OF FOREST FLOOR VEGETATION: A STUDY OF *IMPATIENS PARVIFLORA* DC.

ABSTRACT: In 13 forest reserves situated in southern Poland, 68 study plots were established in two regions: the Jurassic Upland and the Silesian Upland. In these plots, size 10 m × 10 m divided into 100 subplots 1 m² each and randomly placed in various forest communities, percentage cover of all species in ground layer was recorded. Relationship between highly invasive alien plant species, Asiatic small balsam *Impatiens parviflora* DC., and indigenous species, was estimated using various indexes of species richness and diversity. They were: Hill's numbers (N_p , N_r , N_q), Shannon-Wiener's index at the level of a subplot, alpha diversity (species richness within sites), and beta diversity (species richness among sites) at level of a study plot. The subplots with a presence of *I. parviflora* were compared with those where only native resident species occurred. The study has shown that subplots with the occurrence of *I. parviflora* are characterized by higher species richness and diversity of native plants independently on vegetation type. The frequency of *I. parviflora* was negatively correlated with beta diversity of study plots but there was no association with values of alpha diversity. In oak forest, alder carrs and floodplain forests the negative correlation between percent cover of *I. parviflora* and species richness, as well as cover of the herb layer was observed. The percent cover of *I. parviflora* was positively correlated with number of native species in beech forest and with their total cover in mixed coniferous forests. However,

in natural well-preserved forest phytocoenoses *I. parviflora* avoids patches characterized by high cover of ground layer species and colonizes empty sites as an additional element of a community.

KEY WORDS: *Impatiens parviflora*, biodiversity, species richness, plant invasions, nature reserves

1. INTRODUCTION

One of the key problems of invasion ecology, apart from invasiveness of species, and invisibility of ecosystems is an impact of an invader on native and resident biota (Parker *et al.* 1999). Various works suggest that species richness makes ecosystem more invasion-resistant (Kennedy *et al.* 2002). However, other studies show that invasive plant species can use open sites, left unconsumed nutrients in ecosystems and that these open sites are an important mechanism allowing numerous species to coexist (Tilman 1997, Davis *et al.* 2000). Thus, sometimes invasion can lead to increase in local biodiversity (Meiners *et al.* 2004). Such relationship between an invader and a community Faliński (1998) classifies as a supplementary relationship. The species under this study – small balsam (*Impatiens parviflora* DC.) as an annual

plant, and SR-strategist penetrates forest habitats using loose places in herb cover, or "safe microsites for germination" as well as gaps in tree stands facilitating higher availability of light to the forest floor (Obidziński and Symonides 2000, Elemans 2004). Many authors elucidate fact that success of small balsam in invasions into natural communities depends on their former disturbance (Kujawa-Pawlaczyk 1991, Faliński 1998, Eliáš 1999, Obidziński and Symonides 2000). Extrinsic factors such as disturbance, soil fertility, and climate may create favorable conditions to reduction of invasion-resistance of plant communities (Naeem *et al.* 1999).

Impatiens parviflora is a representative of Balsaminaceae family of Central and East Asiatic origin. It was introduced to Europe in 1830s as an ornamental plant to botanical gardens. In 1850s it was observed in Poland for the first time (Berda 1859, Trepl 1984). During next 150 years its massive naturalization started. At present it is common in Northern and Central Europe, especially in mesic broad-leaved forests, forest edges, ruderal habitats (Pyšek *et al.* 1998, Tokarska-Guzik 2003). The species occurs in riparian forests, oak-hornbeam forests, beech woods, acidophilous oak forests, mixed coniferous forests; however, more rarely in pine woods. It seems that there is optimum of its occurrence in plant communities of the *Fagetalia* order (Kujawa-Pawlaczyk 1991, Eliáš 1999, Obidziński and Symonides 2000, Chmura and Orczewska 2004). In the study area this species is very frequent in woodlands of the Silesian Upland (Chmura 2004) and is very common, especially in southern part, in the Jurrasic Upland (Urbisz 2004). Small balsam poses a threat to native plant species. It is considered to be competitive with, native to Europe, *I. noli-tangere* L. (Faliński 1998) and other understorey species even perennials (Uhercikova and Eliáš 1987, Obidziński and Symonides 2000). Specific characters of small balsam like short life cycle, presence of cleistogamic and chasmogamic flowers, high production of seeds, long duration of flowering, fast growth of seedlings, high tolerance to light conditions (Coombe 1956, Csontos 1984, Perrins *et al.* 1993, Eliáš 1999) make it one of the most

ideal weed (Noble 1989, Jackowiak 1999). The role and mechanisms of establishment of this species with regard to a role of resident species in forest habitats are not fully known therefore the aims of the study was to answer the following questions: Does *I. parviflora* colonize "empty" sites in forest phytocoenoses or its establishment is a result of exclusion of other species? Does the cover of resident neighbours influence on the abundance of *I. parviflora*? Are species-rich forest communities more resistant to invasion by *I. parviflora* independently of type of vegetation?

2. STUDY SITES

The investigations were carried out in 13 forest reserves: 7 from the Jurrasic Upland and 6 from the Silesian Upland, (both being a part of the Silesian-Kraków Upland) situated in Southern Poland (Fig. 1). Forest vegetation in reserves was classified into the following vegetation units using phytosociological studies: oak-hornbeam forest *Tilio-Carpinetum* Tracz. 1962, beech forests *Dentario glandulosae-Fagetum* W. Mat. 1964 ex Guzikowa et Kornaś, *Luzulo pilosae-Fagetum* W. Mat. et A. Mat. 1973, *Fagus sylvatica-Cruciatata glabra* Michalik 1972, mixed coniferous forest *Quercus robur-Pinetum* (W. Mat. 1981) J. Mat. 1988, alder forests and alder carrs *Fraxino-Alnetum* W. Mat. 1952, communities of *Alno-Ulmion* Br.-Bl. et R.Tx. 1943, *Ribes nigri-Alnetum* Sol.-Görn. (1975) 1987, as well as 2 transient communities between *Quercus robur-Pinetum* and *Luzulo pilosae-Fagetum*, *Tilio-Carpinetum*. In the Jurrasic Upland deciduous forest associations prevail, especially species-rich beech forests *Dentario glandulosae-Fagetum* but in reserves of the Silesian Upland there are disturbed oak-hornbeam associations, poor-species beech forest, and mixed coniferous forests. Protected woodlands of the former region are mainly remnants of old-growth and ancient forests, however Silesian woodlands, within examined reserves, are usually recent forests or strongly transformed ancient forests. In both regions within forest reserves mixed coniferous forests and pinewoods are of anthropogenic origin due to pine monocultures. The occurrence of *Impatiens parviflora* was mapped and using random num-

bers methods (Łomnicki 2003) patches of communities with its presence was chosen for purposes of detailed studies. The number of study plots representing different forest communities reflect both the synecological

amplitude of *I. parviflora* and area occupancy by particular forest phytocoenoses in the study area. The essential characteristics and number of study plots established in specific forest communities are shown in Table 1.

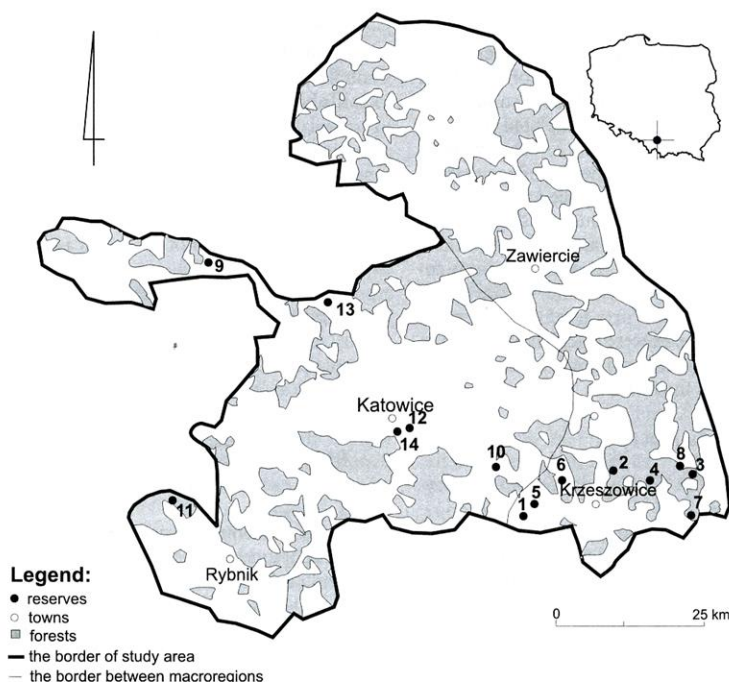


Fig. 1. Localization of the investigated nature reserves in the study area (Silesian-Kraków Upland) with two mesoregions: the Silesian Upland (on the left) and the Jurassic Upland (on the right): 1. (Bukowica), 2. (Dolina Eliaszówki), 3. (Dolina Kluczwoły), 4. (Dolina Raclawki), 5. (Lipowiec), 6. (Skała Kmity), 7. (Wąwóz Bolechowicki), 8. (Hubert), 9. (Dolina Zabnika), 10. (Łęczczok), 11. (Ochojec), 12. (Segiet), 13. (Las Murckowski). Local names are given in brackets.

Table 1. Characteristics of forest communities in study plots.

Forest communities	No. of study plots	Species richness	Tree cover (%)
<i>Tilio-Carpinetum</i>	26	24.4 $\pm$ 7.6	79.5 $\pm$ 7.8
<i>Luzulo pilosae-Fagetum</i>	7	16.6 $\pm$ 4.3	78.5 $\pm$ 10.6
<i>Fagus sylvatica-Cruciatia glabra</i>	2	29.0 $\pm$ 4.2	75 $\pm$ 7.07
<i>Dentario glandulosae-Fagetum</i>	9	23.6 $\pm$ 9.08	78.8 $\pm$ 7.8
<i>Quercu roburi-Pinetum</i>	19	19.1 $\pm$ 4.9	75 $\pm$ 7.6
Communities of <i>Alno-Ulmion</i>	3	35.0 $\pm$ 25.4	70 $\pm$ 12.6
<i>Ribes nigri-Alnetum</i>	2	22.0 $\pm$ 1.4	65.0 $\pm$ 7.07

3. METHODS

In 2004, 68 permanent study plots in both regions were randomly established in herb layer under dense and homogenous tree canopy without gaps. Each study plot covering 100 m² (10 m × 10 m) was divided into 100 subplots 1 m² each. The cover in % (10% intervals) were used to estimate abundance of vascular plant species using wooden frame in ground layer. The sampling of herb layer vegetation was carried out between June and September in 2004 and completed in spring of 2005. In order to classify forest communities of the study plots phytosociological studies, using commonly applied Braun-Blanquet method, were conducted (details about geobotanical research are given elsewhere (Chmura and Sierka, in press). Various indexes of species richness and species diversity were applied. For a level of subplot the following indexes were calculated as follows:

Shannon-Wiener index H' was calculated according to the formula:

$$H' = -\sum p_j \ln p_j \quad (1)$$

where p_j is the abundance (percent cover) of j -th species.

The so called Hill's numbers i.e. N_0 index, the N_1 richness index, and the N_2 diversity statistics (Hill 1973) were defined as:

$$N_0 = \text{number of species in a sample (subplot)} \quad (2)$$

$$N_1 = e^{H'} \quad (3)$$

where H' = Shannon-Wiener index, e = base of natural logarithm.

$$N_2 = 1 / \sum_{i=1}^S p_i^2 \quad \text{inverse Simpson index} \quad (4)$$

where p_i is the abundance (percent cover) of j -th species

Evenness (Legendre and Legendre 1988) was determined as the ratio of N_2 and N_1 :

$$E = N_2 / N_1 \quad (5)$$

In order to estimate an effect of species richness within a study plot and species diversity among subplots in a study plot on abundance of *I. parviflora* Spearman rank correlation test between alpha diversity, beta diversity indexes, S and frequency of *I. parviflora* (number of subplots occupied per a study plot) was used.

Alpha diversity was defined as the average number of plant species recorded in subplot within a study plot (Schluter and Ricklefs 1993).

$$ALPHA = \sum_{i=1}^{i=100} s / 100 \quad (6)$$

where s is number of species in a subplot

Beta diversity was defined after Schluter and Ricklefs (1993) as 1/mean number of plots (subplots) within a habitat (study plot) occupied by a species followed the formula:

$$BETA = 1 / \frac{\sum_{i=1}^{i=j} f}{j} \quad (7)$$

where f (frequency) is a number of occupied subplots by j -th species within a study plot and j is the number of species in a study plot.

Finally, species richness S was a number of species in the study plot. The comparison of means and ranges of alpha and beta diversity of particular forest communities is shown in Table 2.

As the other method of measurement of beta diversity *sensu* Whittaker (1972) Detrended Correspondence Analysis (DCA) (Hill and Gauch 1980) was used to show a differentiation of herb layer of forest patches by means of CANOCO 4.5 package (ter Braak and Šmilauer 2002). According to Dzwonko and Gawroński (1994) and literature cited there, the ranges of plots along the ordination axes are a measure of beta-diversity and floristic and ecological distance. The correlations between the DCA scores of the study plots along two first axes and frequency of *I. parviflora* were calculated using Spearman rank correlation coefficient.

The above mentioned indexes were calculated using percentage cover and number of native species excluding from the calculations *I. parviflora*.

The following hypotheses were formulated:

If *I. parviflora* colonizes sites in a community as a result of competition then sites with its presence should be characterized by smaller number and lower diversity of resident herb species compared to adjacent sites free from *I. parviflora*. According to the alternative hypothesis, establishment of *I. parviflora* is connected with colonization of open sites in a community therefore species richness and diversity of resident species should be at least equal than sites free of this species.

To test the hypothesis that species richness and abundance of its native neighbours in ground layer affects the abundance of *I. parviflora* Spearman rank correlation tests between percentage cover of small balsam and both number and percentage cover of remaining species were used. A Mann-Whitney *U* test was analyzed to assess significance of difference between values of aforementioned indexes of species richness and diversity between subplots with and without *I. parviflora* for total data and particular forest communities. The accepted level of significance was $P < 0.05$. All statistics were calculated by means of SAS 9.1 (SAS 2003). Nomenclature of plant names follows Mirek *et al.* (2002) and of plant associations were adopted after Matuszkiewicz (2001).

4. RESULTS

Altogether 27621 floristic records were noted from 6800 subplots area 1 m². Total 191 species accompanying *I. parviflora* were observed, and 171 of them co-occurred in subplots with *I. parviflora*. In 3628 subplots (on the average 53.4 per study plot) the occurrence of *I. parviflora* was recorded.

The comparison of number of native herbs between subplots with the presence of *I. parviflora* and those free of the species revealed that in the former number of resident plants is higher (N_0 index Fig. 2) but this relationship is not significant for *Cruciata glabra*-*Fagus sylvatica* community. In relation to Shannon-Wiener and N_1 indexes also subplots with *I. parviflora* showed higher values except for the communities of the *Alno-Ulmion* alliance and *Cruciata glabra*-*Fagus sylvatica* community. However, comparison of values of N_2 index indicates no significant differences only with regard to *Cruciata glabra*-*Fagus sylvatica* community (Fig. 2). Differences in evenness (*E*, Fig. 2) are significant for all forest communities except for *Ribeso nigri-Alnetum* and revealed higher values in subplots without *I. parviflora*. The results of comparison of those mentioned indexes in total are given in Table 2.

The DCA carried out on frequency of species (number of subplots occupied by a species) from all 68 study plots produced two axes with eigenvalues 0.637, 0.468 and lengths of gradients 4.456 and 3.392 respec-

Table 2. Comparison of subplots with *I. parviflora* and without in relation to native species richness and diversity indexes: H' – Shannon-Wiener index (equation 1), N_0 – number of species in a sample (equation 2), N_1 – richness index (equation 3), N_2 – diversity index (equation 4), and *E* – evenness (equation 5). Probability: * – $P < 0.05$, ** – $P < 0.01$, *** – $P < 0.001$.

Variable	Subplots				
	with <i>I. parviflora</i>		without <i>I. parviflora</i>		
	N= 3628		N= 3172		
	Mean	SD	Mean	SD	<i>P</i>
<i>H'</i>	1.12	0.51	0.87	0.61	***
<i>N</i> ₀	4.29	2.29	3.39	2.38	***
<i>N</i> ₁	3.46	1.74	2.83	1.88	***
<i>N</i> ₂	3.03	1.46	2.52	1.61	***
<i>E</i>	0.89	0.08	0.92	0.08	***

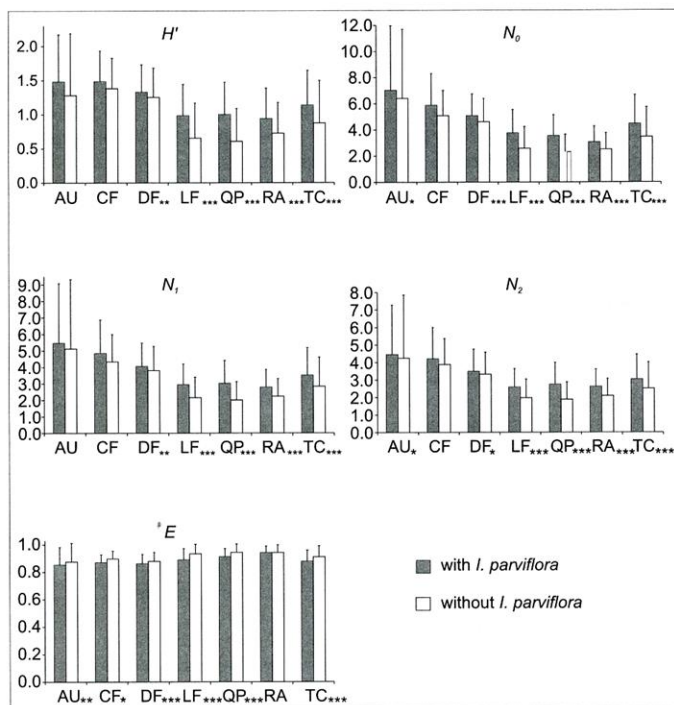


Fig. 2. Comparison of subplots with *I. parviflora* and without in relation to native species richness and diversity indexes in particular plant communities. Probability: * – $P < 0.05$, ** – $P < 0.01$, *** – $P < 0.001$. H' – Shannon-Wiener index (equation 1), N_0 – number of species in a sample (equation 2), N_1 – richness index (equation 3), N_2 – diversity index (equation 4), and E – evenness (equation 5). Abbreviations: AU – *Alno-Ulmion*, CF – *Cruciata glabra-Fagus sylvatica*, DF – *Dentario glandulosae-Fagetum*, LF – *Luzulo pilosae-Fagetum*, QP – *Quercus robur-Pinetum*, RA – *Ribes nigri-Alnetum*, TC – *Tilio-Carpinetum*.

tively (Fig. 3). They explain 7.5 (Axis 1) and 13.1 (Axis 2) percentage of variance (Fig. 3).

There are no significant relationships between frequency of *I. parviflora* and the DCA scores of the study plots with two axes (Axis 1: $r_s = -0.12$, $P = 0.36$, and Axis 2: $r_s = 0.03$, $P = 0.8$) as well as with number of native species S ($r_s = 0.04$, $P = 0.71$) and alpha diversity (Fig. 4A). However, there is negative and significant correlation between beta diversity index and frequency of *I. parviflora* (Fig. 4B).

The species richness of the herb layer built by native plants was negatively correlat-

ed with the percentage cover of *I. parviflora* (Table 4). The separate correlations made for particular communities yielded different results. There are some negative r_s coefficients for *Ribes nigri-Alnetum*, *Tilio-Carpinetum*, *Alno-Ulmion* and positive for *Luzulo pilosae-Fagetum*; other are insignificant. The relationships between percentage cover of *I. parviflora* and cover percentage of native species are negative for *Ribes nigri-Alnetum*, *Alno-Ulmion*, *Tilio-Carpinetum*, and positive but very weak for *Quercus robur-Pinetum* (Table 4). The other correlations turned out to be insignificant.

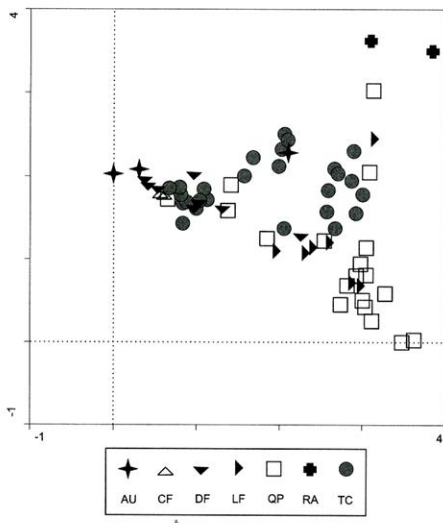


Fig. 3. Ordination of the study plots based on frequency of species of herb layer along the first two axes of DCA. Abbreviations: AU – *Alno-Ulmion*, CF – *Cruciata glabra-Fagus sylvatica*, DF – *Dentario glandulosae-Fagetum*, LF – *Luzulo pilosae-Fagetum*, QP – *Quercus robur-Pinetum*, RA – *Ribes nigrum-Alnetum*, TC – *Tilio-Carpinetum*.

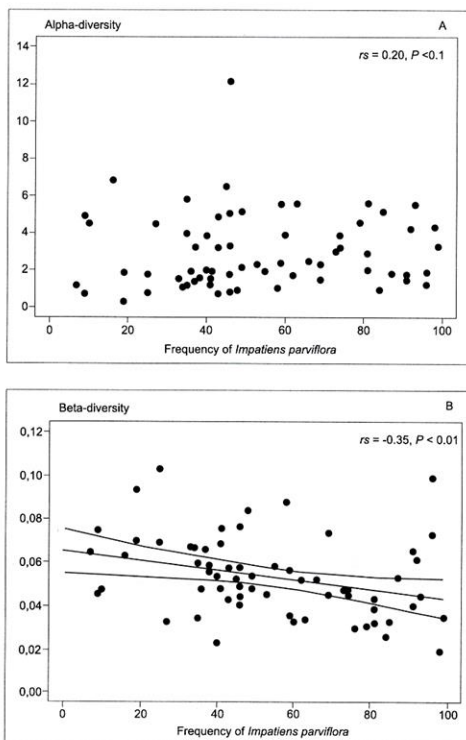


Fig. 4. Relationship between alpha-diversity (A) (equation 6), beta-diversity (B) (equation 7) and frequency of *Impatiens parviflora*.

Table 3. An overview of alpha diversity (equation 6) and beta diversity (equation 7). The means and ranges of particular forest communities are given.

Forest community	Alpha diversity		Beta diversity	
	Mean	Range	Mean	Range
Total	3.01	11.85	0.05	0.08
Communities of <i>Alno-Ulmion</i>	5.81	11.4	0.04	0.027
<i>Cruciata glabra</i> - <i>Fagus sylvatica</i>	5.67	2.31	0.06	0.016
<i>Dentario glandulosae</i> - <i>Fagetum</i>	4.00	3.85	0.05	0.043
<i>Luzulo pilosae</i> - <i>Fagetum</i>	2.40	3.4	0.05	0.065
<i>Quercus roboris</i> - <i>Pinetum</i>	1.98	4.83	0.05	0.043
<i>Ribes nigrum</i> - <i>Alnetum</i>	1.81	0.1	0.07	0.005
<i>Tilio-Carpinetum</i>	3.14	7.23	0.06	0.074

Table 4. The coefficients of Spearman rank correlation between percentage cover of *I. parviflora* and number, and percentage cover of native species in particular forest communities. Probability: * - $P < 0.05$, ** - $P < 0.01$, *** - $P < 0.001$.

Forest community	*	Number of species	Cover of species
Total		-0.26***	-0.1***
Communities of <i>Alno-Ulmion</i>		-0.32***	-0.30***
<i>Cruciata glabra</i> - <i>Fagus sylvatica</i>		ns	ns
<i>Dentario glandulosae</i> - <i>Fagetum</i>		-0.09*	ns
<i>Luzulo pilosae</i> - <i>Fagetum</i>		0.23***	ns
<i>Quercus roboris</i> - <i>Pinetum</i>		ns	0.076*
<i>Ribes nigrum</i> - <i>Alnetum</i>		-0.39***	-0.40***
<i>Tilio-Carpinetum</i>		-0.31***	-0.23***

5. DISCUSSION AND CONCLUSIONS

The results obtained confirm some earlier observations on invasion of *Impatiens parviflora* and contribute some new things. The study has shown that species richness of sites (subplots) with *I. parviflora* is higher than those ones without this species (Table 2, Fig. 2). Establishment and persistence of an invader in many cases is not a result of replacement of a resident species due to competition or disturbance but the use of open sites, available nutrients and space (Tilman 1997, 2004). Sites with *I. parviflora* were characterized by higher number of native species independently of type of vegetation (Fig. 2) and their species richness and diversity, measured by indexes of alpha and beta diversity (Table 3) as well as ranges of DCA scores. Some studies demonstrate that in-

vader success does not depend of an amount of bare ground but of size and abundance of neighbouring species. Kennedy *et al.* (2002) observed that species richness more negatively affected number of invaders than size and area covered by invader. This mechanism allows an invading species to persist at lower cover in a specific community for a long time. In phytocoenoses with the presence of *I. parviflora* but dominated by other species e.g. *Impatiens noli-tangere* small balsam produced lower phytomass and smaller plants (Uhercikova and Eliáš 1987). This phenotypical plasticity probably facilitates *I. parviflora* to coexist in phytocoenoses with many species and therefore it can occur in sites characterized by high species richness and diversity. Obidziński and Symonides (2000) reported that small balsam easily penetrates degraded and floristically

poor communities. In the present study the frequency of *I. parviflora* within study plots was not affected by local species richness (alpha-diversity) (Fig. 4A) but only by species diversity among sites (beta-diversity) (Fig. 4B). It means that the more heterogeneous and diverse, in relation to species composition, forest communities are the more invasion resistant they are. Species diversity and diversity of functional guilds present in a given community are believed as one of major factors influencing invasion resistance of ecosystems (Fargione *et al.* 2003). There are some differences concerning relations between percentage cover of small balsam and both cover and number of native species. The most negative correlations were observed in oak-hornbeam forests, alder carrs and floodplain forests (Table 4). This is congruent with the study of Obidziński and Symonides (2000) who showed a significant negative correlation between the density of small balsam and cover of native species in six phytocoenoses of the *Fageta-lia* order. Csontos (1984) also indicated dense closed herb layer as limiting factor for a penetration of this species into herb layer. Additionally we found negative correlation with respect to alder carrs *Ribes nigri-Al-netum*. This community is not an optimum for small balsam. In alder carrs of the Glubczyce Plateau (West Poland) and the Silesian Upland this species occurred very rarely and not abundantly (Chmura and Orczewska 2004, Sierka and Chmura 2004). In some poorer floristically woodlands as beech forest *Luzulo pilosae-Fagetum* with dense tree canopy there was weak, positive but significant correlation between cover of small balsam and number of accompanying species. Generally in beech forest shading is a limiting factor for the occurrence of many plants. *I. parviflora* as a shade-tolerant species is capable to exist on such conditions. Machado *et al.* (2003) found that *I. parviflora* can survive in daylight of 5%. In mixed coniferous forest *Quercus roboris-Pinetum* there is a very weak positive correlation between percent coverages of the species and native plants. Similar results were obtained in phytosociological studies on *Calamagrostis epigeios* Roth in forest communities (Sierka and Chmura 2005).

In phytocoenoses with disturbed ground layer or thinned tree stands there is a higher light intensity favoring light demanding plants and ruderal species (Brothers and Spingarn 1992). In such communities some species can become dominants e.g. *Carex brizoides* L. which hinders seedling germination and growth of other species (Dzwonko and Gawroński 2002). Like *C. brizoides* also *I. parviflora* is capable to co-occur whereas other species are outcompeted (Sierka and Chmura 2004). In our study plots this native and expansive clonal sedge also was observed the most frequently in phytocoenoses of *Quercus roboris-Pinetum*. It explains why with increasing cover of native species, abundance of *I. parviflora* increases too (Table 4). There is no much information about impact of *I. parviflora* on forests herbs in literature. Faliński (1998) treated influence of small balsam on native components of a community as a supplementary because the species is capable to outcompete with a native *Impatiens noli-tangere*. However, Kujawa-Pawlaczyk (1991) believes that this species reveals a negative influence on neighboring plants – reductive relationship *sensu* Faliński (1998). She compared number of accompanying species in two transects varied in time of establishment of *I. parviflora*. In earlier colonized transect cover of *I. parviflora* was higher and number of native species lower with the comparison of transect established later. Despite this, it is unknown whether changes in species composition, and decrease in species richness are due to competitive ability of *I. parviflora* or are caused by disturbance encouraging penetration and spread of this species. Uhercikova and Eliáš (1987) suggest that canopy development of even-aged individuals of *I. parviflora* is a factor of light-blocking and can be considered as the mechanism of competition ability of the species. They observed such phenomenon in nitrophilous fringing communities, but in conditions of forest interiors differentiation of size and age in *I. parviflora* is higher. As the disturbance is concerned, forest reserves in Silesian Upland are more frequently visited and trampled by tourists, also there are more intensive forest management activities. That leads to disturbance in forest vegetation and their impoverishment. How-

ever, not only anthropogenic factors cause disturbance but also those of natural origin as a presence of wood debris and zoopression. Piskorz and Klimko (2001) reported that *I. parviflora* colonizes fallen trees and rooted ground by wild boars. However, Obidziński and Głogowski (2005) observed equal frequency of this species in presence of dens of red fox and setts of Eurasian badger and in control sites. Therefore invasion of this species when once introduced into the forest community, is enhanced by many factors. Finally we sum up that the appearance of small balsam *I. parviflora* in woodland communities, in the absence of extrinsic factors as disturbance, does not result in a decrease of species richness. *I. parviflora* seems to be a good indicator of disturbance both of anthropogenic and natural origin. First of all it colonizes empty sites i.e. bare ground in herb layer. In natural forest phytocoenoses *I. parviflora* avoids patches characterized by high cover of herbaceous species.

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