PERSICARIA NEPALENSIS (POLYGONACEAE),
A NEW POTENTIALLY INVASIVE ANTHROPOPHYTE
IN THE POLISH FLORA

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Abstract. Persicaria nepalensis (L.) Mill. is an annual herb occurring natively in South, East and Southeast Asia, having a range extending from Oceania to East Africa. Here we report the first Polish stand of this species, found in 2011 near Baligród (Western Bieszczady Mountains), followed by the discovery of two more stands in the surrounding area up to 2013. The floristic composition of vegetation impacted by P. nepalensis is presented, and the invasive potential and pathways of introduction of the species are briefly discussed.

Key words: alien species, Bieszczady Mts, Carpathians, distribution, Persicaria nepalensis, Poland

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Introduction

Persicaria (L.) Mill. (Polygonaceae) is one of the species-richest genera in the alien flora of Europe, especially in the southern part of the continent (Lamdon et al. 2008). Some of its species are distant intercontinental introductions, such as P. pensylvanica (L.) M. Gómez transferred from North America (Kubát & Jehlík 2003) and P. capitata (Buch.-Ham. ex D. Don) H. Gross originating from South Asia (Nogueira et al. 2006).

In Poland the genus Persicaria is represented by three anthropophytes [P. bungeana (Turcz.) Nakai, P. orientalis (L.) Spach.]. Persicaria wallichii Greuter & Burdet is classified as an invasive kenophyte (Mirek et al. 2002; Bartoszek et al. 2006; Tokarska-Guzik et al. 2012).

During a floristic study in the Western Bieszczady Mountains in 2011 a population of Persicaria nepalensis (Meisn.) H. Gross, a species new both to the Polish flora and to the flora of the Carpathians, was discovered.

Materials and methods

Persicaria nepalensis was discovered during floristic surveys done in 2011–2013 in the Pogórze Leskie foothills and in the northern part of the Western Bieszczady Mts (Eastern Carpathians). The researched area is bounded by the San River to the north, the Osława River to the west, the road between Rzepedź and Wołkowyja to the south, and the western shores of the Solina Reservoir to the east (Fig. 1). In each of the three P. nepalensis stands discovered we made a relevé following the Braun-Blanquet method as modified by Dzwonko (2007). The floristic relevés of the P. nepalensis habitats studied are given in Table 1. Persicaria nepalensis specimens were collected from each discovered location. Specimens are deposited in the Herbarium of the Institute of Botany of the Jagiellonian University in Kraków (KRA).

Results

Persicaria nepalensis (Meisn.) H. Gross

Bot. Jahrb. Syst. 49: 277. 1913. – Polygonum nepalense Meisn., Monogr. Gen. Polyg.: 84. 1826.

Erect, ascending or decumbent annual, 15–50 cm high. Stem usually branched, rooting at lower
nodes, round, glabrous except for whitish glandular trichomes on upper parts of internodes. Leaves alternate, 1.4–5.0 × 1.0–3.0 cm; heterophyllous: lower leaves broadly ovate or rhomboid with truncate base, petiolate, petiole 2–3 cm long, slightly to moderately winged; upper leaves oblanceolate, subsessile or subamplexicaul with auricled base. Lamina with entire and slightly scabrous margin, revolute, undulate, glabrous on adaxial surface, pubescent on veins and punctate with yellow glands on abaxial surface, apex acute (Fig. 2a–c). Ochreae tubular, truncate, 5–10 mm long, strigose proximally, brownish. Inflorescences terminal and axillary corymbose heads, 6–7 mm in diameter, subtended by sessile, subamplexicaul, ovate to lanceolate leaves (6.5–12.5 × 2.5–5.0 mm), peduncles 1–20 mm long, erect with glandular hairs below heads. Ochroleae ovate-lanceolate, acute, 3–5 × 2 mm. Flowers 2.5–4.0 × 1.0–2.0 mm, shortly pedicellate. Tepals 4(–5), 2.9–3.5 × 0.6–1.5 mm, obtuse, obovate, usually pink, sometimes white or lavender. Stamens 5(–8), filaments 0.5–1.5 mm long, anthers black-purple, elliptic, ovary biconvex or trigonous with 2(–3) unequal styles, stigmas capitulate. Fruit (nut) biconvex or trigonous, 1.0–2.0 × 1.0–1.9 mm, dull, shining, densely and minutely pitted, light or dark brown to black, enclosed in perianth (Fig. 2d). Flowering in June–September.

Description follows Qaiser (2001), Li et al. (2003), Hinds and Freeman (2005) and Yasmin (2009), modified following our own observations. *Persicaria nepalensis* is sometimes confused with the closely related *P. runcinata* (Buch.-Ham. ex D. Don) H. Gross and *P. capitata* (Buch.-Ham. ex D. Don) H. Gross of the same section *Cephalophilon*, mainly due to their capitate inflorescences and truncate ochreas (Kim & Donoghue 2008; Galasso et al. 2009).

**GENERAL DISTRIBUTION AND ECOLOGY**

*Persicaria nepalensis* is a paleotropical species. Its native geographical range span tropical and subtropical mountain regions of South, East and Southeast Asia, reaching Oceania and East Africa. In Asia it has been reported from India, Pakistan, Afghanistan, Nepal, Bhutan, Ceylon, Thailand, the Philippines, Malaysia, Indonesia, China, Japan, South Korea and Russia (Qaiser 2001; Li et al. 2003; Nogueira et al. 2006). It was also found in Papua-New Guinea (Oceania) (Li et al. 2003), Kenya, Ethiopia, Tanzania, Uganda, Zambia and Malawi (Africa) (Nogueira et al. 2006). Outside its native range, *P. nepalensis* is occasionally introduced accidentally to other regions. In favorable conditions it readily colonizes, sometimes exhibiting expansive or even invasive tendencies. *Persicaria nepalensis* was introduced accidentally to the Asian part of Turkey (Tan & Baytop 1995) and also to Europe and both Americas. In Europe it is an established anthropophyte in Italy (Pignatti-Wikus 1973, Webb et al. 1993), Great Britain (Stace 2010), Germany (Diekjobst 1994; Brandes 1995; Aboling 2008) and most likely also Belgium (Verloove 2013). It has been reported from the USA and Canada (Hinds & Freeman 2005) and Mexico (Vibrans & Hanan-Alipi 2008). In South America it has been found in Ecuador (Jørgensen & León-Yáñez 1999), Colombia and Venezuela (Meier 2006). *Persicaria nepalensis* prefers mountain slopes and river valleys, and is usually found in humid, partially shaded locations, mainly along muddy, gravelly and stony banks of mountain streams and
P. nepalensis along forest edges. Depending on the geographic location its altitude tolerance ranges from 200 to 4000 m a.s.l. (e.g., Qaiser 2001; Li et al. 2003). Since P. nepalensis is an annual herb exhibiting rapid growth, a high reproductive rate and high fertility, it is relatively resistant to disturbances in its environment. Within its natural range it often becomes an apophyte, spreading to various human-transformed habitats such as forest felling areas, fields, gardens, banks of artificial canals, roadsides and landfills.

### OCCURRENCE IN POLAND

The first stand of P. nepalensis was found in August 2011, 2 km east of Baligród in the Western Bieszczady Mountains. In July 2013 the first stand was confirmed and two more were found. All three stands are located within a few hundred meters of each other (Fig. 1). Persicaria nepalensis grew on rarely used, partly overgrown forest paths. The canopy of the first stand (no. 1 in Fig. 1) is dominated by Picea abies, Fraxinus excelsior, Acer...
Table 1. Floristic relevés of the studied *Persicaria nepalensis* (Meisn.) H. Gross. habitats.

| No. of relevé | 1 | 2 | 3 |
|---------------|---|---|---|
| **Location**  | Baligród | Baligród | Baligród |
| **Latitude [N]** | 49°20'21,1" | 49°20'12,2" | 49°20'15,7" |
| **Longitude [E]** | 22°19'12,1" | 22°19'10,1" | 22°19'09,9" |
| **Date** | 9.07.2013 | 9.07.2013 | 27.07.2013 |
| **Area of relevé [m²]** | 5 | 14 | 25 |
| **Plant cover [%]** | 50 | 40 | 95 |
| **Slope [°]** | 10 | 30 | 5 |
| **Exposition** | NE | S | E |
| **No. of species** | 27 | 33 | 27 |
| *Persicaria nepalensis* | + | 1 | 4 |
| *Achillea millefolium* L. | . | + | + |
| *Agrimonia eupatoria* L. | . | + | . |
| *Agrostis capillaris* L. | . | . | + |
| *Agrostis stolonifera* L. | + | . | . |
| *Anthemis arvensis* L. | . | + | 1 |
| *Athyrium filix-femina* (L.) Roth | + | . | . |
| *Bidens frondosa* L. | . | . | + |
| *Callitriche cophocarpa* Sandtn. | + | . | . |
| *Carex remota* L. | + | . | . |
| *Carex sylvatica* Huds. | + | + | . |
| *Centaurea cyanus* L. | . | . | + |
| *Centaurea jacea* L. | . | + | . |
| *Cerastium* sp. | + | . | . |
| *Cirsium arvense* (L.) Scop. | . | + | 1 |
| *Echinochloa crus-galli* (L.) P. Beauv. | . | . | + |
| *Elymus repens* (L.) Gould. | . | + | 2 |
| *Euphorbia serrulata* Thuill. | . | + | . |
| *Galeopsis tetrahit* L. | . | . | + |
| *Galinsoga ciliata* (Raf.) S. F. Blake | . | . | 1 |
| *Geranium* sp. | . | + | . |
| *Glechoma hederacea* L. | + | . | . |
| *Glyceria notata* Chevall. | + | + | . |
| *Hepatica nobilis* Schreb. | r | . | . |
| *Holcus mollis* L. | . | . | + |
| *Hypericum humifusum* L. | . | + | . |
| *Hypericum maculatum* Crantz | . | + | + |
| *Impatiens parviflora* DC. | 2 | + | . |
| *Juncus effusus* L. | + | + | . |
| *Juncus tenuis* Willd. | . | + | . |
| *Lapsana communis* L. | . | + | . |
| *Medicago lupulina* L. | . | + | . |
| *Mentha arvensis* L. | . | + | 1 |
| *Millium effusum* L. | + | . | . |
| *Myosotis sylvatica* Ehrh. ex Hoffm. | + | . | . |
| *Oxalis acetosella* L. | + | . | . |
| *Polygonum hydropiper* L. | 1 | + | . |
| *Polygonum lapathifolium* L. | . | . | + |
| *Phleum pretense* L. | . | + | . |
pseudoplatanus, Abies alba and Fagus sylvatica; the second stand (no. 2) is dominated by Larix decidua, Picea abies and Sambucus nigra. The third stand (no. 3) is a small field where vegetables are cultivated to be used as bait for game, near a raised blind. Persicaria nepalensis is clearly spreading from this location, following along a forest road. The first two stands comprise ca 15 individual plants; in the third one we noted ca 20,000 plants.

1. Baligród – rarely used forest path, 49°20′21.1″N/22°19′12.1″E, alt. 641 m, 14 Aug. 2011, leg. T. Kowalczyk.

2. Baligród – rarely used forest path, 49°20′12.2″N/22°19′10.1″E, alt. 626 m, 9 July 2013, leg. Sz. Drobniak & T. Kowalczyk.

3. Baligród – small field at a raised blind, 49°20′15.7″N/22°19′09.9″E, alt. 647 m, 27 July 2013, leg. T. Kowalczyk & A. Pliszko.

Table 1 presents the relevés taken from the recorded P. nepalensis stands.

**DISCUSSION**

Persicaria nepalensis occurs in Poland in human-transformed habitats. From the distribution of the discovered stands and the numbers of individual plants in the respective locations we can infer both the probable origin of these plants and the potential pathways of further expansion of the species. Since the density of the plants was highest at the third location (75% of the projective coverage in the relevé), the raised blind and the small field directly adjacent to it are the most likely points of origin, from where the plant began to expand its range along the road at the east side of the field. Persicaria nepalensis seeds probably were
accidentally transferred to the field with sowing material used to grow cultivated species. The other two stands along forest paths have much lower densities of *P. nepalensis*, which suggests their secondary origin. Although impurities in sowing material are the most likely source of seeds of this species, other explanations cannot be ruled out at this stage. The *P. nepalensis* seeds may have been brought to the studied area accidentally by tourists. Finally, the *P. nepalensis* seeds may have been transferred with seeds of other plants used as bird food – this mode of transport had already been suggested in the case of the German populations of this species (Diekjobst 1994; Aboling 2008). The much higher density of *P. nepalensis* at the third stand may also be attributable to more favorable conditions at that site.

Irrespective of the origin of *P. nepalensis* in our flora, the discovery of this species offers a rare opportunity to observe the expansion of a potentially invasive species in Poland. *Persicaria nepalensis* most likely arrived in the studied area recently and spread quickly from its original location. Its wide range of ecological tolerance suggests that it may quickly spread to new habitats. In other countries the expansion of *P. nepalensis* (especially into human-transformed habitats) has already caused serious problems. In both Americas it has been classified as an invasive species (Meier 2000; Vibrans & Hanan-Alipi 2008). In Asia it significantly affects the tea crop and in Africa it has been classified as an invasive species (Meier 2006; Vibrans & Hanan-Alipi 2008). In Poland, *Persicaria nepalensis* seeds may have been brought to the studied area accidentally by tourists. Finally, the *P. nepalensis* seeds may have been transferred with seeds of other plants used as bird food – this mode of transport had already been suggested in the case of the German populations of this species (Diekjobst 1994; Aboling 2008). The much higher density of *P. nepalensis* at the third stand may also be attributable to more favorable conditions at that site.

In the near future the further expansion of *P. nepalensis* in the studied area along roads and forest paths should be expected. Given the potential threats to the economy and nature associated with the expansion of this species, we suggest that the *P. nepalensis* population requires monitoring as well as measures to contain its expansion. Possible steps include controlling the seed material used by hunters, and mowing existing stands of *P. nepalensis*, preferably before flowering.

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