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Spread of *Veronica filiformis* (Scrophulariaceae) in the Sudetes

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Abstract: *Veronica filiformis* is an alien plant species widely distributed, across Central and Western Europe. The first observation of the species in the Sudetes was reported in 1942. Until 2000, only a few scattered sites were known in south-western Poland. During the last decade, *V. filiformis* was observed more frequently in many ranges of the Sudetes. In 2007, field works intended to discover new sites of the species were conducted as well as a critical revision of herbarium specimens stored in WRSL was performed. The number of known localities totals 37. Almost 65% of them were discovered during the last decade. The data are now summarized to bring up to date the known distribution and invasion scale of *V. filiformis* in the Polish part of the Sudetes.

Key words: *Veronica filiformis*, plant invasion, alien plants, the Sudetes

1. Introduction

The native range of the slender speedwell *Veronica filiformis* Sm. was limited to the Caucasus Mountains and Asia Minor (Müller & Sukopp 1993). It was brought to Europe as an ornamental plant at the end of the nineteenth century. Its expansion in Europe began in 1930s. *V. filiformis* successfully spread in areas of mountain and Atlantic climates becoming an invasive species (Pietras 1970; Tokarska-Guzik 2005). It was recorded in Great Britain, Slovakia, Hungary, Austria, Belgium, the Czech Republic, Denmark, Germany, Holland, Estonia, Slovenia, Ukraine, Romania, Russia, France, Spain, Switzerland, Italy and the southern part of Scandinavia (Bangerter & Kent 1957, 1962, 1965; Blažková 1984; Peniašteková & Zlinská 1995; Kuusk *et al.* 1996; Fremstad & Elven 1997; Hämet-Ahti *et al.* 1998; Jehlík 1998; Fischer 1999; Elenevskii 2001; Pyšek *et al.* 2002; Oprea 2005; Walter *et al.* 2005; Király 2006; Walker 2007; Williamson *et al.* 2009), and also outside Europe, at the eastern and western ends of the United States, in Canada (Uva *et al.* 1997), New Zealand (Esler 1987) and Iran (Saedi-Mehrvarz & Assadi 2003).

In Poland, *V. filiformis* was for the first time listed in Sopot and near Janowice Wielkie (Lehman 1942). After the Second World War, the first records of the species came from the Bieszczady Mountains (Kornaś & Kuc 1953). Modern literature data indicate that the species is common only in the south-eastern Poland. Particularly numerous and rich localities were observed in the Polish part of the Bieszczady (Pietras 1970; Zemanek & Winnicki 1999; Mirek & Piękoś-Mirkowa 2008). It was also observed in the vicinity of Szczecinek and Gdańsk (Żukowski 1958; Zając & Zając 2001).

In the Sudetes, the first localities of *V. filiformis* were listed by Lehman (1942) in the area of Jelenia Góra and Janowice Wielkie. In the post-war period, it could be found in an arboretum in Wojsławice (Ciaciura 1965) and again in the vicinity of Janowice Wielkie (Kwiatkowski 1997). During this period, slender speedwell was already quite widespread in the Czech part of the Sudetes (por. Pietras 1970). In the last decade, there was a significant increase in the frequency of listings of slender speedwell in south-western Poland. It was reported from the Massif of the Śnieżnik Mountain (Szeląg 2000), Jelenia Góra-Cieplice (Pielech 2002), Kaczawskie Mountains (Kwiatkowski 2006) and Staniszów (Pielech 2008), and repeatedly observed in other ranges of the Sudetes and their foreland.

Slender speedwell is an invasive species which, in many parts of Europe, dominated grass lawns and semi-natural habitats. The increase in the number of

its sites in the Sudeten Mountains and their foreland implies the need for observation of the condition of its population and influence on the abundance of the communities which it permeates. The purpose of this paper is to present the current distribution and expansion scale of *V. filiformis* in the Sudetes and Sudeten Foreland region.

2. Materials and methods

The study covered the area of the Sudetes, including the Sudeten Foreland, in accordance with the regionalisation proposed by Kondracki (2000). The work began with a preliminary research on available sources, containing published information about the localities of *V. filiformis*.

As some researchers draw attention to the possibility of confusing slender speedwell with other species of the *Veronica* genus (e.g. Kornaś & Kuc 1953), a critical review of the specimens was conducted in the herbarium of the Museum of Natural History, Wrocław University (WRSL). Literature data and information from the labels of the herbarium specimens were introduced into the GIS database by assigning geographic coordinates to each site, using the currently recommended methods of georeferencing (Chapman & Wieczorek 2006). In 2006-2007, in April, field works were conducted which were focused on finding new localities of *V. filiformis*. New sites were sought in spa parks and lawns of a dozen or so towns located in the Sudetes, also the largest complexes of pastures and meadows in their area were explored. The localities of the species, included in the database, were assigned square indexes of the ATPOL grid (Zając 1978); also a detailed list and a map of the current distribution were prepared.

3. Results

The analysis of literature data and unpublished, up to then, observations of the species provided information on 20 localities of *V. filiformis* in the Sudetes and their foreland. The revision of herbarium specimens provided a source of information concerning other sites. A specimen that was incorrectly labeled as *Veronica persica* was collected in 1970 in Boleslawiec (*leg. A. Wójcikiewicz-Klim*). The field exploration carried out in 2006-2007 resulted in finding 16 consecutive, previously unknown localities of slender speedwell. All newly discovered sites were found on lawns in towns across the Kłodzko Valley and the surrounding mountain ranges. However, despite thorough examination, the localities of the species were not found in the north-western part of Central Sudetes (Stone Mountains, Wałbrzyskie Mountains, Owl Mountains, Brama Lubawska).

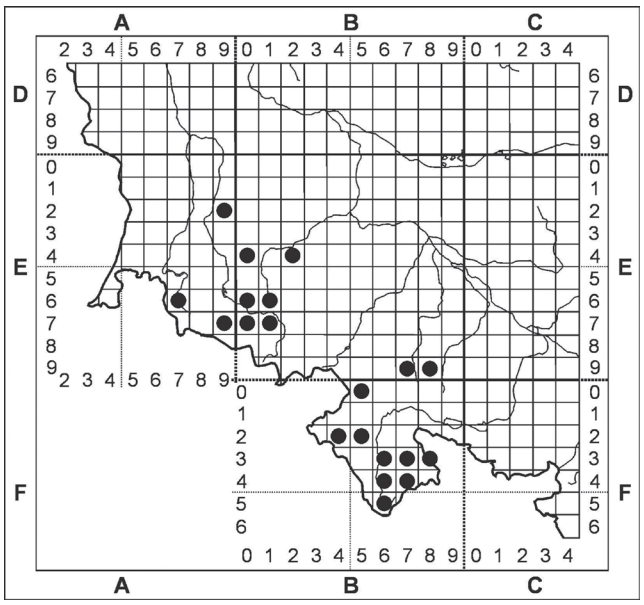

Fig. 1. Distribution map of *Veronica filiformis* in south-western Poland

The total number of *V. filiformis* localities known up to then was 37, out of which 24 (64.86%) were observed for the first time in the last decade.

The list of positions with the square index of ATPOL, source data and year of observation was placed at the end of the paper (Appendix 1). Figure 1 shows the distribution of slender speedwell in the Sudetes and their foreland compared to the ATPOL grid.

4. Discussion

Over the past several years, there was a significant increase in the frequency of records of *Veronica filiformis* in the Sudetes which confirms the earlier predictions related to the expansion of this species. The emphasized, by some authors, resemblance to a different species of speedwell – *V. persica* might suggest that it could have been ignored during field observations, and its spread had occurred earlier. The verification of the herbarium material collected in WRSL partially confirmed it. On the other hand, in many regions of the Sudetes, in recent decades regular floristic research was carried out, and it is unlikely that this species was systematically overlooked. Moreover, most of the currently known positions in the Sudetes are located on lawns in parks, especially in spas. These items were the subject of detailed floristic research (Weretelnik 1990) which did not reveal the presence of *V. filiformis*. It has to be, therefore, assumed that the expansion of slender speedwell occurred in the last several years, and previously only few, scattered localities of the species were known.

The map of the slender speedwell distribution in the Sudetes indicates two major centres of its occurrence. These are Kłodzko and Jelenia Góra Valleys, together

with the surrounding mountain ranges, and individual positions are located in the Kaczawskie Foothills and the Niemczańsko-Strzelińskie Hills. The lowest site is situated in the vicinity of Rzymówka in the Kaczawskie Foothills (155 m), and the highest at the edge of the Bear Cave Nature Reserve, in the Massif of the Śnieżnik Mountain (800 m). The vast majority of the localities (89.47%) are located between the altitudes 225 and 545 m a.s.l.

Sledner speedwell is an invasive species and it easily spreads in the grass communities within the areas of mountain and sub-Atlantic climates. The specimens observed in Europe, apart from one known exception (Kornaś & Kuc 1953), do not develop seeds. The species reproduces vegetatively, and huge regeneration possibilities enable its effective expansion (Šerá 2012). In the nodes of detached parts of the plant, only after four days, adventitious roots were formed (Harris & Lovell 1980a). They gave rise to new individuals and their vigorous growth allowed for covering of inhabited ecosystems (Harris & Lovell 1980b). Both mowing and raking of lawns, as well as grazing of animals cause the fragmentation of *V. filiformis* specimens, accelerating its spreading. The species can get to the adjacent areas on hooves of grazing animals or with the mown material from the meadows and lawns. Some authors also emphasize the importance of allelopathy, which is characteristic for slender speedwell, as a method of competition in grassland communities (Sankey, www site).

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Appendix 1. List of localities of *Veronica filiformis* in south-western Poland

AE29: Bolesławiec, *leg. A. Wójcikiewicz-Klim*, 1970 (WRSL); AE67: Czerniawa Zdrój, lawn near the pump room, *leg. M. Malicki*, 2005 (WRSL); AE79: Jelenia Góra-Cieplice, ul. Krośnieńska (Pielech 2002) – not confirmed during last years; Jelenia Góra-Cieplice, Park Norweski, lawn next to the Museum of Natural History, *obs. K. Zając*, 2002; BE40: between Skorzynice and Czaple (Kwiatkowski 2006); Nowa Wieś Grodziska (Kwiatkowski 2006); BE42: Rzymówka (Kwiatkowski 2006); BE60: Jelenia Góra (Hirschberg) (Lehman 1942); Jelenia Góra-Zabobrze, lawn within a housing estate, *obs. M. Malicki & K. Zając*, 2003; BE61: Mysłów (Kwiatkowski 2006); between Różanka and Kaczorów (Kwiatkowski 2006); BE70: Staniszów, lawn in the rural park, obs. K. Zając, 2003 (Pielech 2008); BE71: Janowice (Janowitz) (Lehman 1942); Janowice Wielkie/Janowice Stare (Kwiatkowski 1997); BE97: Wojsławice, lawn in the arboretum (Ciaciura 1965) – confirmed locality, *obs. R. Pielech,* 2003; BE98: within a patch of grassland vegetation in the park in Henryków, *obs. K. Pender*, 2006; BF05: Nowa Ruda, in the vicinity of garden plots, at the foot of. Góra św. Anny Mt., *obs. C. Harasimowicz, K. Pender*, 1980; BF24: Duszniki Zdrój, lawn next to the Centrum of Culture and Sport and near the banks of the Bystrzyca Dusznicka river, *leg. R. Pielech*, 2007 (WRSL); Duszniki Zdrój, lawn at Wojska Polskiego street *obs. R. Pielech*, 2007; Duszniki Zdrój, lawn in the spa park, *obs. R. Pielech*, 2007; BF25: Polanica Zdrój, lawn next to the football pitch at Kamienna street, *leg. R. Pielech*, 2007 (WRSL); BF36: 4 localities in the vicinity of Piotrowice, Stary Waliszów and Nowy Waliszów (Szeląg 2000); BF37: Lądek Zdrój, lawn at M. Konopnicka street, *obs. K. Zając*, 2006; Lądek Zdrój, lawn in the park on the Rudawka river, *obs. K. Zając*, 2006; Lądek Zdrój, lawn by the Biała Lądecka river, at T. Kościuszki street, obs. K. Zając, 2007; Lądek Zdrój, lawn in the Park Tysiąclecia, obs. K. Zając, 2007; Lądek Zdrój, lawn on Ogrodowa street, *obs. R. Pielech*, 2007; Stronie Śląskie, lawn in the park at Kościuszki street, *leg. R. Pielech*, 2007 (WRSL); Konradów, lawn next to the church and nearby buildings, *leg. R. Pielech*, 2007 (WRSL); Konradów, wet pasture in the valley of the Konradka river, *obs. R. Pielech*, 2007; BF38: Lądek Zdrój, lawn on the bank of the Grodzki Potok river, *obs. K. Zając*, 2007; BF46: Długopole Zdrój, lawn in the spa park, *leg. R. Pielech*, 2007 (WRSL); Długopole Zdrój, lawn next to buildings at Zdrojowa street, *leg. R. Pielech*, 2007 (WRSL); BF47: on the forest track near the border of the Jaskinia Niedźwiedzia nature reserve, *obs. K. Pender*, 2000 – not confirmed in 2008; BF56: Międzylesie, lawn near the palace, *leg. R. Pielech*, 2007 (WRSL).