New record of *Goodyera repens* (L.) R. Br. (Orchidaceae) on Przedborska Upland (Poland)

Andrzej Grzyl [1], Agnieszka Rewicz [2], Spyros Tsiftsis [3]

[1,2] Department of Geobotany and Plant Ecology, Faculty of Biology and Environmental Protection, University of Łódź, Banacha 12/16, 90-237 Łódź, Poland
[3] Department of Botany, School of Biology, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece
stefa@biol.uni.odz.pl

Abstract: *Goodyera repens* in Poland occur mainly in the northern and north-eastern parts of the country, as well as in the Carpathians and the Sudeten Mountains. In central Poland it could be considered as a rare species which has been found only in a limited number of sites with a small number of individuals. In Poland it is characterized as a critically endangered species which faces the danger of extinction in many of its sites. A new site of *G. repen* has been found in central Poland hosting a relatively large number of individuals. Data about its habitat, its population size as well as its spatial structure are provided.
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1. Introduction

Goodyera repens (L.) R. Br. (Creeping Lady's Tresses) is a circumboreal species that mainly occurs in Central, North and East Europe, Caucasus, North and East Asia, the Himalayas and North America (Hulten and Fries, 1986; Adamowski, 2000; Delforge, 2006; Foley and Clarke, 2005). In Europe extends northwards to northern Scandinavia and Murmansk Region (northwestern Russia), the British Isles, while southwards it reaches Spanish and French Pyrenees, central Italy and north Greece (Füller, 1984; Tsiftsis et al., 2012).

In Poland it occurs mainly on the northern and north-eastern part of the country, as well as the Carpathians and the Sudeten mountains where it grows within the upper altitudinal vegetation zone (Zając and Zając, 2001; Piękoś-Mirkowa and Mirek, 2006; Mirek et al., 2002; Mirek and Zarzycki, 2006) (Figure 1). Although it seems to be widespread in Poland, it is actually a rare and legally preserved species (Kolon et al., 1990). Its most frequent populations occur in the Baltic coast zone, the Masurian Lake District as well as to the Podlasie, Karpaty and Sudety Mountains. Populations in other parts of Poland are highly dispersed, scarce (Bernacki, 1999), while most of the them have only a few to several individuals (Witosławskia and Stefaniak, 2011).

Its thread category has been determined both at regional scale and at the country scale. In detail, it is regarded as critically endangered (CR) in central and western Poland (Jackowiak et al., 2007; Urbisz, 2008; Witosławski and Stefaniak, 2011; Stefaniak et al., 2013), as well as in south-east Poland (Kucharczyk and Wójciak, 1995), while according to Bróż and Przemyski (2009) in western Poland it is regarded as vulnerable (V) and in northern Poland (Gdańsk Pomerania) is considered as near threatened (NT) (Markowski and Buliński, 2004). At the country level, the application of the IUCN criteria by Zarzycki and Szeląg (2006) showed that *Goodyera repens* is a declining and critically endangered species which is on the verge of extinction. This is due to the fact that at its isolated localities, which are situated beyond the main area of occurrence, it faces an extremely high risk of extinction.

The present paper reports a new and very important finding of *G. repens* on the terrain of Przedborska Upland (central Poland). The main goals of this study were: a) to provide currently known distribution data of *G. repens* and b) to determine its habitat preferences and its population size in its new site.

2. Materials and methods

In July 26th of 2013, during floristic study, shoots of the orchid *G. repens* were found at the Dołki village (Przedborska Upland; central Poland). The identification and the nomenclature were made according to Delforge (2006) and a voucher specimen of *G. repens* is deposited in the *Herbarium* database of the University of Lodz.

The distribution of *G. repens* in Poland was presented on a grid map with squares of 10 km × 10 km using the ATPOL grid system [which is majorly used for mapping the distribution of the plant species in Poland (Zając and Zając, 2001)].

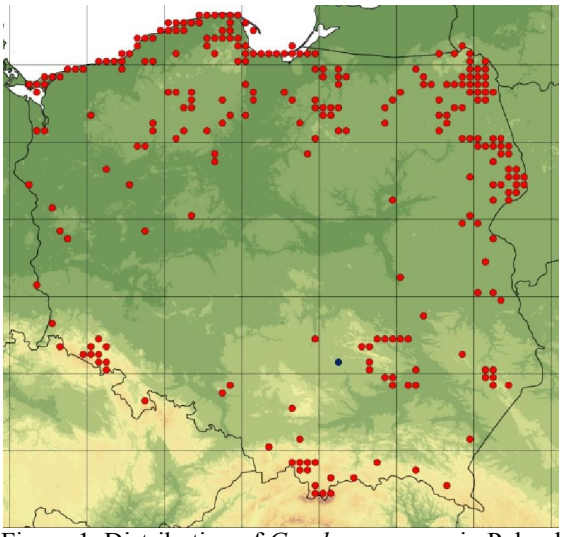

Figure 1. Distribution of *Goodyera repens* in Poland (red dots: known distribution; blue dot: new location)

3. Results and discussion

The discovered site is located in the southern part of the Przedborsko-Małogoskie Range (Świętokrzyskie). The geological substrate of the site consists of limestones of the Upper Jurassic and sandstones of the Cretaceous. In the wider area depressions with aeolian sands exist which occasionally are exploited for the construction industry. *Goodyera repens* was found on the base of the wooded hill Brogowica which southwards is adjacent to a settlement called Dołki and is part of the village Bocheniec. The site of *G. repens* is situated within square DE82 (50°48'18.04" N, 20°18'30.38" E) of the ATPOL square grid system (Zając, 1978).

The examined site is situated almost 200 meters from the sand mining heading to the south-east and about 100 meters to the west from the forest boarder and the wide valley of the meandering river Łososina (Wierna Rzeka) at an altitude of c. 240 m a.s.l. *Goodyera repens* occurs on an area of c. 45 square meters, within which eight groups of plants were found. The area occupied by the eight groups of plants was about eight square meters. In total, 123 inflorescences were counted, all of them at the time of research in the initial shedding blossom stage. The finding of *G. repens* in this area could be characterized as very important because although it was found again on the terrain of Przedborska Upland and specifically in one site within the reserve Jawora (Witosławski, 2003) it was restricted in an area of about 2 square meters having only a few individuals. We could consider the newly discovered site as the only site in the wider area of the Przedborsko-Małogoskie Range (Świętokrzyskie) in central Poland where *G. repens* has such a population size.

In Poland, *G. repens* is a characteristic species of the spruce-fir coniferous forests classified in the order *Vaccinio-Piceetalia* and of the Baltic dune Scots pine woods (Ass. Empetro nigri-Pinetum) (Matuszkiewicz, 2001). On the site in Dołki, G. repens grows in an uneven-aged pine forest where the forest stratum is not distinctly marked and the density within trees crowns reaches 50% (Figure 2). Moreover, bushes stratum is underdeveloped, while herbaceous stratum has inconsiderable density (about 10%). Herbaceous stratum is mainly constituted of *Quercus robur, Q. petraea, Betula pendula, Frangula alnus, Corylus avellana* and *Juniperus communis*, and less frequently by *Acer platanoides, Berberis vulgaris* and *Cornus sanguinea*. Apart from the above tree species which appear in the herbaceous stratum, other 21 herbaceous species occur. Among those, some are characteristic of the class *Vaccinio-Piceetea* and order *Vaccinio-Piceetalia* (e.g. *Pyrola minor, Melampyrum nemorosum, Orthilia secunda* and *Trientalis europaea*), while others are characteristic of the alliance *Dicrano-Pinion* (e.g. *Platanthera chlorantha, Chimaphila umbellata* and *Monotropa hypopitys*).

In total, the site where *G. repens* has been found hosts 35 plant species. Apart from the typical for the coniferous forests floristic elements also species occurring in broadleaved forests and mainly of *Quercus robur* and *Quercus petraea* can be found. Such species composition makes, from a phytosociological point of view, the classification of the site difficult. This fact indicates that *G. repens* can also be found in other plant communities and not exclusively in spruce-fir or Scots pine forests.

In Poland *G. repens* sites are scarce and they constitute out of several individuals (Witosławski and Stefaniak, 2011). The discovered site discussed in the present study is situated beyond its range in Poland both chorologically and ecologically. However, we may conclude that *G. repens* occur also in other sites of untypical for it habitats but the expected number of its individuals is not expected to be large. Isolated sites are many in Poland (Zarzycki and Szeląg, 2006) and the reasons causing the disappearance of *G. repens* from such sites are its low competitiveness, the unfavorable habitat eutrophication and the forest felling (Baumann et al., 2010; Sępioł, 2009). Moreover, although the distribution of *G. repens* was expanded during - having colonies of many individuals - the last 100 years mainly in anthropogenic habitats (Adamowski, 2000), the habitats it prefers could be characterized as early successional. As a result, it may decline from areas where it is common due to the natural vegetation succession. The consequences of vegetation succession on the distribution of *G. repens* should be

monitored in order to determine potential future management actions that will promote its future persistence.

Figure 2. Habitat and localization of *Goodyera repens* in Dołki (fot. A. Grzyl)

Corresponding Author:
M.Sc. Agnieszka Rewicz
Department of Geobotany and Plant Ecology, Faculty of Biology and Environmental Protection, University of Łódź, Poland
E-mail: stefa@biol.uni.odz.pl

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