

**NEW LOCALITY OF *TROLLIUS EUROPAEUS* L. AND *GLADIOLUS IMBRICATUS* L. NEAR
SOCHOCIN BY PŁOŃSK (CENTRAL POLAND)**

DEMBICZ IWONA¹, KAPLER ADAM², KOZUB ŁUKASZ³, ZANIEWSKI PIOTR⁴

¹ Department of Plant Ecology and Environmental Protection, Warsaw University,
Al. Ujazdowskie 4, 00-478 Warsaw, Poland; e-mail: i.dembicz@biol.uw.edu.pl

² National Seed Bank, Department of Plant Diversity Evaluation and Protection,
Polish Academy of Science – Center for Biological Diversity Conservation in Powsin
ul. Prawdziwka 2, 02-973 Warsaw – Powsin, Poland; e-mail: adam.kapler@obpan.pl

³ Department of Plant Ecology and Environmental Protection, Warsaw University,
Al. Ujazdowskie 4, 00-478 Warsaw, Poland; e-mail: l.kozub@biol.uw.edu.pl

⁴ Department of Molecular Plant Physiology, Warsaw University
ul. Miecznikowa 1, 02-096 Warsaw, Poland; e-mail: piotrzaniewski@biol.uw.edu.pl

ABSTRACT: *Trollius europaeus* L. and *Gladiolus imbricatus* L. are both threatened plant species in lowland Poland, occurring in extensively managed litter meadows. Due to changes in cultivation methods species typical for those ecosystems became rare. The locality of considered species populations lies within the region of which our chorological knowledge is still very limited. This fact increases the significance of that finding. Both species grow on an extensively used meadow located on the southern edge of the Wkra river valley in the north of Mazovia region. We investigated the flora of that particular meadow during three visits in the vegetation season 2010. The meadow area is about 0,15 ha but it is inhabited by 72 vascular plant species including, apart from *T. europaeus* and *G. imbricatus*, such species as *Dactylorhiza incarnata*, *D. majalis*, *Listera ovata*, *Campanula glomerata* and *Filipendula vulgaris*. The population of the *T. europaeus* consists of 6 clumps with many flowering shoots. *G. imbricatus* was represented by 152 flowering individuals. Apart from the suitable management of the meadow we connect the threatened species occurrence with the geochemical features of the site which is fed by calcium rich groundwater. This may lead to strong limitation of primary production by the lack of available phosphorus. Such conditions are beneficial for mentioned species. The locality is not threatened at present, however both abandonment or agriculture intensification is visible in adjacent areas and may affect this valuable meadow in the near future.

KEY WORDS: *Trollius europaeus*, *Gladiolus imbricatus*, Mazovia Voievodship, Wysocyzna Płońska

Introduction

Trollius europaeus L. is a 10-60 (80) cm tall perennial plant from to the *Ranunculaceae* family, flowering mainly from May to June, insect-pollinated, anemochoric (Nowak 2002, Hitchmough 2003). During many years, individuals of that species form a polycormones of vegetative rosettes and generative shoots, hence it is regarded as hemicryptophyte according to Raunkiaer or typical caulophyte according to Tarant (1997). Although *Trollius europaeus* become very rare at the Polish Lowlands, it remains quite common species in the mountains and at Polish Highlands: the Wyżyna Miechowska upland and the Wyżyna Krakowsko-Częstochowska upland (Szafer et al. 1986, Tarant 1997, Zając M. and Zając A. 2009). From the phytosociological point of view this species is characteristic for *Molinietalia* order and *Polygono bistortae-Trollietum* association (Matuszkiewicz 2001). Many sites of this strictly protected species disappeared after drainage of wet meadows, changing them into arable fields or carp ponds (Nowak 2002, Nowak et al. 2008). It is protected *ex situ* in the field collections of Polish flora and National Seed Bank at Botanical Garden in Powsin (Muranyi 2003).

Gladiolus imbricatus L. belongs to *Iridaceae* family. It is a strictly protected, Eastern-Central European bulbo-tuber geophyte, 30-80 cm tall, flowering from June to July, pollinated by *Hymenoptera*, with wind-dispersed seeds (Grabowska 1978; Rutkowski 2004). In the past it was very common in Poland, growing in termophilous oak forests *Potentillo albae-Quercetum*, humid lowland meadows from the *Molinion* alliance (Piękoś-Mirkowa and Mirek 2006), occurring as a weed in the oats and barley fields (Stecki 1979, Michalik 1989, Kropač and Mochnacký 2009), being also a co-dominant plant species in many types of mountain pastures and meadows (Pawłowski et al. 1960, Kornaś and Medwecka-Kornaś 1967). Nowadays this plant become threatened at Polish Lowlands (Falkowski 2002) and gradually becomes more and more rare in the Polish mountains (Nowak and Antonin 2006). It can also be found in some anthropogenic habitats, eg. *Calamagrostis epigejos*- and *Carex brizoides*-phytocoenoses (Falkowski 2002). From the phytosociological point of view *Gladiolus imbricatus* is a taxon characteristic for *Molinion caeruleae* alliance and *Triglochino-Glaucetum* association (Kornaś and Medwecka-Kornaś 1967). National Seed Bank staff tried to secure the seeds of *Gladiolus imbricatus* by cryopreservation but it were not able to ensure optimal methods of breaking the seed dormancy (Muranyi and Wróbel 2006).

Both species are enlisted in the regional “red lists” (RRL) of vascular plant species. Although *Gladiolus imbricatus* was not included in the “Red List of the vascular plants in Poland” (Zarzycki and Szelağ 2006), this plant is threatened in entire Eastern and Central Europe (Schnittler and Günther 1999). *Gladiolus imbricatus* is considered:

- critically endangered (CR) in Opole Province (Nowak et al. 2008),
- critically endangered (CR) at the Nizina Południowopodlaska plain, in eastern parts of the modern Mazovia Voivodeship (Głowacki et al. 2003),

- endangered (EN) in Wielkopolska province (Żukowski and Jackowiak 1995, Jackowiak et al. 2007),
- vulnerable (VU) in Central Poland (Jakubowska-Gabara and Kucharski 1999),
- vulnerable (VU) in Lower Silesia (Kącki et al. 2003),
- low risk (LR) taxon in Silesian Voievodship as a whole, vulnerable (VU) outside mountainous regions of Silesian Voievodship (Bernacki et al. 2000).

Trollius europaeus is also threatened species, considered:

- critically endangered (CR) in Opole Province (Nowak et al. 2008),
- endangered (EN) in the Nizina Południowopodlaska plain, in eastern parts of the modern Mazovia Voivodeship (Głowacki et al. 2003),
- vulnerable (VU) in Central Poland (Jakubowska-Gabara and Kucharski 1999),
- vulnerable (VU) in Silesian Voievodship (Bernacki et al. 2000),
- vulnerable (VU) in Lower Silesia (Kącki et al. 2003),
- vulnerable (VU) in Wielkopolska and Pomorze Zachodnie Voievodships (Żukowski and Jackowiak 1995; Jackowiak et al. 2007),
- low risk (LR) species in south-eastern Poland: in Wyżyna Lubelska upland, Roztocze highland, Wołyń Zachodni upland and Polesie Lubelskie plain regions (Kucharczyk and Wójciak 1995).

Trollius europaeus as well as *Gladiolus imbricatus* are associated with the litter meadows (of the *Molinion* alliance) – low productive, unfertilized meadows, typical for extensive farming with only one hay cut every year, giving low quality hay used only as litter for cattle, not as fodder (Grabowska 1978, Matuszkiewicz 2001). Few decades ago such low-productive, litter-giving meadows used to be very common in Poland (Bernacki and Butwiłowska 1997, Babczyńska-Sendek et al. 2003). Due to the changes in agricultural landscape such habitats became very rare. Intensification of farming by fertilization and drainage of meadows, sowing more effective pasture grass species and on the other hand meadow abandonment threaten existence of litter meadows. Therefore, plant species associated with this kind of meadows belong to the one of most endangered in modern Europe (Hitchmough 2003, Mari et al. 2007, Jõgar and Mari 2008).

Great part of Mazovia Voivodship, including the environs of Płońsk, is among the least explored by botanists areas of Poland (Nowak 1972, Mowszowicz 1978). The “Góra Napoleona” hill is located in the Płońsk powiat (district) in the Sochocin commune, about 1 km SW from the Sochocin village. It is the part of the Wysoczyzna Płońska postglacial plain, near its borders with the Wysoczyzna Ciechanowska and Równina Raciąska plains (Kondracki 2010). Examined object is located on the slope of the plateau, which is descending towards the north to the Wkra river valley (Fig. 1). The height of the slope is about ten meters. A visible area of groundwater seepage occurs in the middle of it. Most of the slope is covered by *Alnus glutinosa* woodland, however a part of it is used as extensively managed meadow. According to our own observation as well as the interview with land owner, this meadow is usually mowed once a year and sometimes also grazed by cattle. Few years ago this area was more immense, but local farmers planted alders in most swampy places. Edges of this plateau were then mown meadows and pastures, with only some small areas totally abandoned, but meadows in the Wkra valley become lately intensively managed pastures or greenhouse areas.

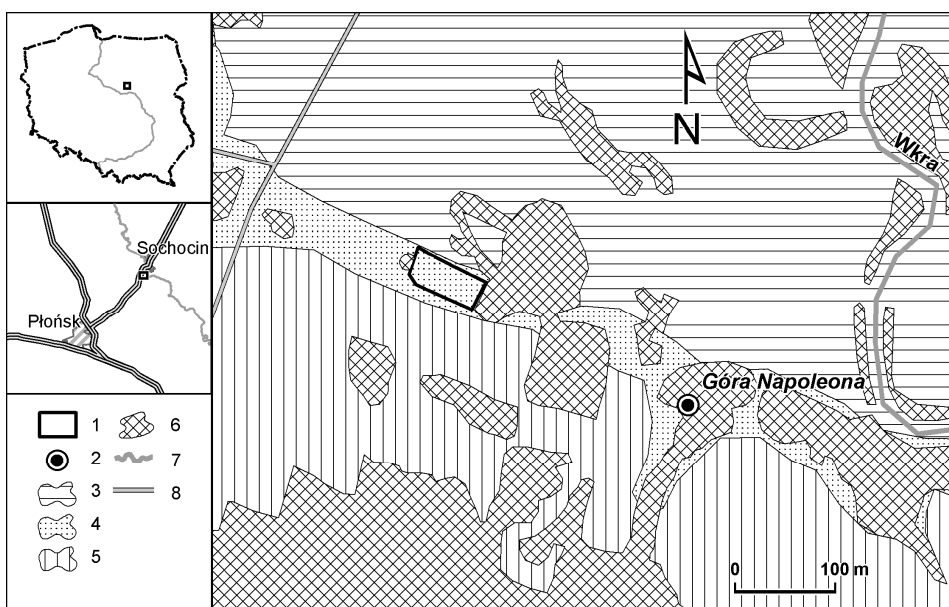


Fig. 1. New stands of *Trollius europaeus* and *Gladiolus imbricatus*. 1 – meadow with the stand of rare species, 2- old settlement, 3 – valley of Wkra river, 4 – plateau slope, 5 – Wysoczyzna Płońska plateau, 6 – woods, 7 – river, 8 – roads

Methods

Vascular plant species inventories have been made on 30-th April, 1-st July and 23-rd August 2010. Three relevés (due to a noticeable humidity gradient) of 16 m² were made using Braun-Blanquet (1964) scale. Plant names follow Mirek et al (2002). The content of organic matter in soil samples was estimated by burning the sample of soil in temperature 550 °C for 90 minutes. Conductivity, pH and calcium content was measured in water samples taken from the seepage. Total amount of Ca in water was determined by flame photometry.

Results

Part of examined area, used as extensive meadow with vegetation from *Molinietalia* order is the refugee for many botanical peculiarities, rare in the Mazovia Voievodship. The most noteworthy plants of this grassland are six clumps of the *Trollius europaeus* located in the western part of the meadow. Each cluster of this species consist of a dozen-or-so shoots. Very interesting and worth protection are also 152 flowering sprouts of the *Gladiolus imbricatus*, in the upper zone of the slope (Fig. 2). Worth mentioning are also three orchid species recorded there: *Listera ovata*, *Dactylorhiza incarnata* and *Dactylorhiza majalis*. Other plant peculiarities noted are: *Primula veris*, *Ononis arvensis*, *Betonica officinalis*, *Campanula glomerata* and *Filipendula vulgaris*. Remarkable is the coexistence of the wetland species (like both *Dactylorhiza* species)

with the species typical for xerothermic grasslands (like *Campanula glomerata*) at the same spot. Such phenomenon is a characteristic feature of the litter meadows, from the *Molinion* alliance, responsible for their high species richness.

Relevé 1:

Area: 16 m², inclination (slope) - 20%, exposition – north, density: A – 0%, B – 0%, C – 95%, D – 30%. Molinion: *Gladiolus imbricatus* +, *Molinia caerulea* +, Filipendulion: *Filipendula ulmaria* 3, Calthion: *Cirsium oleraceum* 4, *Crepis paludosa* +, *Scirpus sylvaticus* 1, *Juncus effusus* 1, Molinieta: *Deschampsia caespitosa* 1, *Equisetum palustre* 1, *Angelica sylvestris* +, Arrhenatherion: *Arrhenatherum elatius* 1, Arrhenatheretalia: *Dactylis glomerata* +, *Achillea millefolium* +, *Leucanthemum vulgare* 1, *Lotus corniculatus* +, Trifolio-Agrostietalia: *Carex hirta* +, Molinio-Arrhenatheretea: *Centaurea jacea* +, *Holcus lanatus* +, *Lathyrus pratensis* +, *Plantago lanceolata* +, *Ranunculus acris* +, *Rumex acetosa* +, *Trifolium pratense* +, Festuco-Brometea: *Campanula glomerata* +, *Filipendula vulgaris* +, Other species: *Aegopodium podagraria* +, *Agrostis capillaris* +, *Anthoxanthum odoratum* +, *Carex nigra* +, *Carex spicata* +, *Cirsium vulgare* r, *Cynosurus cristatus* +, *Dactylorhiza incarnata* r, *Epilobium hirsutum* r, *Galium palustre* 1, *Galium verum* 1, *Geum rivale* +, *Hypericum perforatum* +, *Juncus articulatus* +, *Listera ovata* r, *Melampyrum pratense* r, *Stellaria graminea* 1, *Taraxacum officinale* +, *Veronica chamaedrys* 2.

Relevé 2:

Area: 16 m², inclination (slope) - 20%, exposition – north, density: A – 0%, B – 0%, C – 95%, D – 40%. Molinion: *Galium boreale* 1, *Gladiolus imbricatus* r, *Molinia caerulea* 1, Filipendulion: *Filipendula ulmaria* 4, Calthion: *Cirsium oleraceum* 3, *Crepis paludosa* +, *Scirpus sylvaticus* 2, Molinieta: *Equisetum palustre* 2, *Lotus uliginosus* 2, *Trollius europaeus* 1, Arrhenatherion: *Arrhenatherum elatius* 1, *Geranium pratense* +, Trifolio-Agrostietalia: *Carex hirta* +, *Elymus repens* +, *Lysimachia nummularia* 1, Molinio-Arrhenatheretea: *Lathyrus pratensis* +, *Phleum pratense* r, *Rumex acetosa* +, Other species: *Aegopodium podagraria* +, *Dactylorhiza incarnata* +, *Dactylorhiza majalis* r, *Galium palustre* 1, *Galium verum* 1, *Geum rivale* +, *Taraxacum officinale* 1.

Relevé 3:

Area: 16 m², inclination (slope) - 20%, exposition – north, density: A – 0%, B – 0%, C – 95%, D – 30%. Molinion: *Betonica officinalis* 4, *Galium boreale*, 1, *Gladiolus imbricatus* 1, *Molinia caerulea* 2, Filipendulion: *Filipendula ulmaria* +, Calthion: *Cirsium oleraceum* 2, *Crepis paludosa* r, Molinieta: *Deschampsia caespitosa* +, *Equisetum palustre* +, Arrhenatherion: *Arrhenatherum elatius* +, Arrhenatheretalia: *Dactylis glomerata* +, *Achillea millefolium* 1, *Leucanthemum vulgare* 1, Trifolio-Agrostietalia: *Carex hirta* +, Molinio-Arrhenatheretea: *Centaurea jacea* 3, *Festuca pratensis* r, *Holcus lanatus* +, *Lathyrus pratensis* +, *Phleum pratense* +, *Poa trivialis* +, *Prunella vulgaris* r, *Ranunculus acris* 1, *Rumex acetosa* +, Festuco-Brometea: *Filipendula vulgaris* r, Other species: *Aegopodium podagraria* +, *Dactylorhiza incarnata* +, *Dactylorhiza majalis* r, *Galium verum* 2, *Ononis arvensis* +, *Stellaria graminea* +.

Apart from the species listed in presented relevés, the following species were also found: *Alnus glutinosa*, *Anemone ranunculoides*, *Calamagrostis canescens*, *Campanula patula*, *Cardamine pratensis*, *Chrysosplenium alternifolium*, *Galium uliginosum*, *Heracleum sphondylium*, *Knautia arvensis*, *Lychnis flos-cuculi*, *Ononis arvensis*, *Paris quadrifolia*, *Pimpinella saxifraga*, *Rhinanthus serotinus*, *Salix cinerea*, *Vicia cracca*.

Calcium concentration in the seepage waters of this area reached 60-70 mg Ca/l, with average conductivity circa 500-600 $\mu\text{S}/\text{cm}$. pH of the examined water was relatively high, varying from 6,9 to 7,3. Content of organic matter in soil samples from the examined meadow was 15%. Material from the soil samples foams when mixed with HCl which indicates high calcium concentration.

Discussion

Described grassland located near “Góra Napoleona” hill is very rich in rare vascular plant species thanks to unique hydrogeology of this site (rare in Mazovia), but probably also due to the high concentration of groundwater Calcium. Measured values are comparable with concentrations observed by Pawlikowski and Wołkowycki (2010) on locality with *Swertia perenniss* L. subsp. *perennis* (a highly calciphilous species) and those commonly recorded in rich fens of north-western Poland by Wołejko (2002). The relatively high organic matter content of the soil indicates slow decomposition rate resulting from high watertable which, at least periodically, causes anoxia. Such combination of local water and soil chemistry can restrict the primary production at the examined site, which maintains the persistence of competitively weak, calciphilous plant species like *Trollius europaeus* and *Gladiolus imbricatus* (Wallis de Vries et al. 2002, Wassen et al. 2005).

Owing to relatively fast process of *Trollius europaeus* and *Gladiolus imbricatus* extinction in Poland, conservation of the new site near “Góra Napoleona” is necessary. Especially prevention of drainage and secondary succession is needed. Nowadays this unique, species-rich meadow is not threatened due to maintaining its extensive, agricultural use. It is important that farmers realize that a complete abandonment of these areas will be detrimental to *Trollius europaeus* and *Gladiolus imbricatus* and other botanical peculiarities. For the remnant populations of those species intensification of land use in the environs of “Góra Napoleona” hill would be equally dangerous, especially fertilizing with organic and mineral fertilizers, intensive mowing and sowing with more effective, highly productive grass species. Such effects have been observed on similar meadows and pastures in Central Europe (Loster 1991, Uziębło and Wika 1993, Nowak 2005, Nowak A. and Nowak S. 2005, Mari et al. 2007, Babczyńska-Sendek 2009).

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Fig. 2. Clump of *Trollius europaeus* and *Gladiolus imbricatus* at Góra Napoleona