

Current resources of the population of *Adonis vernalis* L. in the Niecka Nidziańska basin

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Summary

The population of *Adonis vernalis* in the Niecka Nidziańska basin has been described. The distribution of its resources, habitat requirements, threats and possibilities of protection are discussed. The occurrence of the species at 73 localities is confirmed. The development and persistence of the entire population depend on the dynamics of natural phytocoenoses in which grows. Resources, surface areas and development dynamics differ in individual subpopulations. Guidelines for collecting *Adonis vernalis* herb as a pharmacological material are given. Despite the number of the localities, the plant is under threat by overgrowing with bushes and resulting changes in light conditions as well as by frequent and excessive burning of xerothermic grasslands.

Key words: *Adonis vernalis*, resources, protected plant, medicinal plant, threatened plant, xerothermic grasslands, overgrowing of grasslands

INTRODUCTION

Adonis vernalis, a protected medicinal species, is a rare element of the Polish flora. It is phytosociologically associated with xerothermic grasslands of the *Festuco-Brometea* class. Its ecological requirements are consistent with the types of habitats and plant communities in which it grows. It is thought to be a steppe relict in the Polish flora. The species is geographically classified as a Pontic element [1].

Its main distribution area ranges from the eastern part of middle Europe through east and southeast Europe, western Siberia to eastern Siberia reaching the Jenissei region [2-4]. In the middle and southwest Europe the area is disjunct with some isolated growth places in mainly azonal habitats scattered from southeast Sweden to southeast Spain. In its main range, *A. vernalis* grows in colline to montane altitudes, at elevations from sea level to 500 m, e.g. in Italy between 50–300 m, in the Ukraine at altitudes of 50–800 m, in Romania at 50–600 m, and in the Valais (Switzerland) at 400–600 m [5-8]. To the southwest and southeast, the species reaches higher altitudes: in Bulgaria up to 1100 m, in the Causses (Cevennes, France) up to 850–1100 m, whereas in Spain it is found exclusively between 600 and 1600 m.

A. vernalis is the element of different primary or secondary subcontinental to continental grassland communities. These plant communities are dominated by slow-growing, perennial, herbaceous plants and semishrubs. *A. vernalis* is also capable of growing in open stands of wood, light woods as well as in pine and steppe-forests. It prefers summer-warm, sunny places or, at most, semi-shaded ones, where the soil can warm up easily enabling the plant to emerge early in spring. According to Melnik [8], *A. vernalis* stands are normally found on well-drained but sufficiently moistured soils, on loose loam soils, loess soils or chernozems.

The species' habitat requirements are best met in the three main biotope-types in which *A. vernalis* is generally found within its distributional range, primary grassland communities in the Eurasian steppe zone in East Europe and Asia. This zone is characterized by dry, continental climate, cold winters, hot summers, and average annual precipitation of less than 500 mm [9]. Here, *A. vernalis* grows in the forest-steppe and meadow-steppe preferably on calcareous chernozem, meadow chernozem and gray-wooded soils. Semi-natural and secondary steppe communities in the Pannonic and Danubian region of middle and southeast Europe (southern and eastern Romania, northern Bulgaria, Pannonic Basin, Czech Republic, Slovakia, Croatia, and eastern Austria). Extrazonal steppe communities and secondary grassland communities occur at dry sites in middle Europe (among other in Poland). Natural steppe grasslands occur only in areas with dry continental climate, cold winters, hot summers, and average annual precipitation less than 500 mm and are most extensively developed in southeast Europe. Semi-natural dry grasslands, maintained above all by grazing, are now mostly widespread in the Pannonic regions and central Europe. Both natural and semi-natural grasslands in central and eastern Europe are under threat in most parts of their distributional range.

The localities of *Adonis vernalis* in Poland are mostly concentrated in two centres in the Wyżyna Lubelska upland and Wyżyna Małopolska upland and in considerably smaller centres on the lower Vistula and Oder rivers. The biology and structure of the plant's population in the Niecka Nidziańska basin are discussed in many studies which compliment one another and contribute to the knowledge on the resources of *Adonis vernalis* (e.g. [2, 10-16]).

The aim of the study was to determine the resources of *Adonis vernalis* in the Niecka Nidziańska basin and to identify and verify its localities. Biocoenotic and habitat preferences of *Adonis vernalis* as well as threats posed to the species in area study were also assessed.

MATERIAL AND METHODS

Adonis vernalis had been observed in the Niecka Nidziańska basin for a period of over 20 years. Due to the plant's syntaxonomic and geobotanical value, all localities were documented as phytosociological relevés using the commonly known Braun-Blanquet method and mapped in the ATPOL grid [17]. All potential habitats where the species could be expected to occur were included in the study. The size of subpopulations was assessed at each locality, the type of the plant community was identified and the threat degree resulting from the community dynamics, pasturing or wild-plant gathering was assessed. Soil samples were collected at selected localities and a chemical analysis was conducted to determine the plant's edaphic requirements.

RESULTS

The occurrence of *Adonis vernalis* at 73 localities was recorded during long-term observations in the Niecka Nidziańska basin. The area surface, spatial structure, frequency and subpopulation dynamics differ at individual localities (tab. 1). Subpopulation frequency ranges from a few tufts, e.g. in the Lubcza reserve, to a few thousands in the Krzyżanowice, Pełczyńska and Winiary Zagojskie reserves.

Table 1.

List of *Adonis vernalis* localities in the Niecka Nidziańska basin

number of square in ATPOL net	locality	number of specimens	plant association	threat	last publications
FD 29	Biała Góra Res.	-	-	-	[18]
FE 03	Skowronno Górne	over a dozen	<i>Adonido-Brachypodietum</i>	overgrowing of grassland with shrubs and trees	[11]
FE 03	Skowronno Res.	several hundred	<i>Adonido-Brachypodietum</i> , <i>Thalictro-Salvietum</i> , <i>Sisymbrio-Stipetum</i> , <i>Ligustro-Prunetum</i>	burning and overgrowing of grasslands	[11]
FE 04	Borków	over a dozen	<i>Adonido-Brachypodietum</i>	excessive pasture	[11]
FE 04	Stawiany	several hundred	<i>Adonido-Brachypodietum</i> , <i>Sisymbrio-Stipetum</i>	excessive pasture	[11]
FE 12	Lubcza Res.	over a dozen	<i>Adonido-Brachypodietum</i>	overgrowing of grassland with shrubs with trees	[11]

number of square in ATPOL net	locality	number of specimens	plant association	threat	last publications
FE 13	Pińczów	several hundred	<i>Inuletum ensifoliae, Thalictrio-Salvietum, Prunetum fruticosae</i>	overgrowing of grassland with shrubs and treading	[11]
FE 13	Polana Polichno Res.	several dozen	<i>Thalictrio-Salvietum</i>	overgrowing of grassland with shrubs	[11]
FE 14	Grabowiec Res.	several dozen	<i>Prunetum fruticosae</i>	overgrowing of grasslands with shrubs and trees, treading	[11]
FE 14	Krzyżanowice Res.	several hundred	<i>Adonido-Brachypodietum, Thalictrio-Salvietum, Inuletum ensifoliae, Sisymbrio-Stipetum</i>	overgrowing of grasslands	[11]
FE 15	Busko Zdrój	several dozen	<i>Thalictrio-Salvietum</i>	overgrowing of grassland with shrubs	[11]
FE 15	Łagiewniki	several hundred	<i>Adonido-Brachypodietum, Thalictrio-Salvietum, Inuletum ensifoliae, Seslerio-Scorzoneretum</i>	overgrowing of grasslands with shrubs	[11]
FE 15	Podkamieniec	several dozen	<i>Adonido-Brachypodietum</i>	burning of grasslands, excessive pasture	[11]
FE 15	Szaniec	several dozen	<i>Adonido-Brachypodietum</i>	overgrowing of grassland with shrubs	[11]
FE 15	Welecz	several dozen	<i>Adonido-Brachypodietum</i>	excessive pasture	[11]
FE 15	Wymysłów	several dozen	<i>Adonido-Brachypodietum, Sisymbrio-Stipetum</i>	excessive pasture, overgrowing of grassland with shrubs	[11]
FE 15	Zwierzyniec	several hundred	<i>Thalictrio-Salvietum</i>	overgrowing of grassland with shrubs	[11]
FE 20	Strzeżów	several dozen	<i>Inuletum ensifoliae</i>	overgrowing of grassland with shrubs	[18]
FE 23	Kozubów	several dozen	<i>Thalictrio-Salvietum</i>	overgrowing of grassland with shrubs and trees	[11]
FE 23	Odrzywół	several dozen	<i>Adonido-Brachypodietum</i>	overgrowing of grassland with shrubs and trees	[11]
FE 23	Wola Chrobberska	several hundred	<i>Thalictrio-Salvietum</i>	overgrowing of grassland with shrubs	[11]
FE 24	Gacki	several hundred	<i>Adonido-Brachypodietum, Inuletum ensifoliae, Carici flacca-Tetragonolobum maritimi, Koelerio-Festucetum</i>	treading, picking flowers	[11]
FE 24	Skorocice Res.	several hundred	<i>Adonido-Brachypodietum, Thalictrio-Salvietum, Seslerio-Scorzoneretum, Sisymbrio-Stipetum, Koelerio-Festucetum</i>	overgrowing of grasslands with shrubs and trees, treading	[11]
FE 24	Skotniki Górne Res.	several hundred	<i>Adonido-Brachypodietum, Inuletum ensifoliae</i>	-	[11]
FE 24	Winiary Zagojskie	several dozen	<i>Adonido-Brachypodietum, Inuletum ensifoliae</i>	overgrowing of grassland with shrubs, picking of flowers	[11]

number of square in ATPOL net	locality	number of specimens	plant association	threat	last publications
FE 24	Winiary Zagojskie Res.	above thousand	<i>Inuletum ensifoliae</i> , <i>Thalictro-Salvietum</i> , <i>Seslerio-Scorzoneretum</i> , <i>Carici flacca-Tetragonolobum maritimi</i>	overgrowing of grassland with shrubs	[11]
FE 24	Wola Zagojska	several hundred	<i>Adonido-Brachypodietum</i> , <i>Sisymbrio-Stipetum</i>	-	[11]
FE 25	Chotelek Zielony	several dozen	<i>Thalictro-Salvietum</i>	-	[11]
FE 25	Góry Wschodnie Res.	several hundred	<i>Adonido-Brachypodietum</i> , <i>Thalictro-Salvietum</i>	treading, picking flowers	[11]
FE 25	Ostra Góra	several hundred	<i>Adonido-Brachypodietum</i> , <i>Inuletum ensifoliae</i>	setting trees	[11]
FE 25	Prześlin Res.	several dozen	<i>Inuletum ensifoliae</i> , <i>Adonido-Brachypodietum</i> , <i>Thalictro-Salvietum</i>	overgrowing of grassland with shrubs and treading	[11]
FE 25	Skotniki Małe	several dozen	<i>Adonido-Brachypodietum</i>	overgrowing of grassland with shrubs	[11]
FE 25	Szczaworyż	several dozen	<i>Adonido-Brachypodietum</i> , <i>Inuletum ensifoliae</i>	overgrowing of grassland with shrubs	[11]
FE 26	Czesławice	several dozen	<i>Seslerio-Scorzoneretum</i>	setting trees	[11]
FE 26	Sułkowice	several dozen	<i>Inuletum ensifoliae</i> , <i>Carici flacca-Tetragonolobum maritimi</i>	overgrowing of grassland with shrubs and trees	[11]
FE 26	Żerniki Górne	several dozen	<i>Inuletum ensifoliae</i>	overgrowing of grassland with shrubs, setting trees	[11]
FE 26	Stopnica	several dozen	<i>Adonido-Brachypodietum</i>	overgrowing of grassland with shrubs	[18]
FE 30	Złota Góra Res.	several dozen	<i>Inuletum ensifoliae</i>	overgrowing of grassland with shrubs	[18]
FE 30	Kaczmarowe Doły near Szczepanowice	several dozen	<i>Inuletum ensifoliae</i>	overgrowing of grassland with shrubs	[11]
FE 30	Binek	over a dozen	<i>Inuletum ensifoliae</i>	overgrowing of grasslands with shrubs	[19]
FE 30	Pojalowice	over a dozen	<i>Sisymbrio-Stipetum</i>	overgrowing of grassland with shrubs	[19]
FE 30	Szczepanowice	several dozen	<i>Thalictro-Salvietum</i> , <i>Inuletum ensifoliae</i>	overgrowing of grassland with shrubs	[19]
FE 30	Miechów	-	-	-	[18]
FE 30	Parkoszowice	-	-	-	[18]
FE 30	Sławice Duchowne	several dozen	<i>Inuletum ensifoliae</i>	overgrowing of grassland with shrubs	[18]
FE 30	Zarogów	-	-	-	[18]
FE 31	Wrocimowice	several hundred	<i>Inuletum ensifoliae</i>	overgrowing of grasslands with shrubs and trees	[20]
FE 31	Dąbie Res.	several dozen	<i>Inuletum ensifoliae</i> , <i>Thalictro-Salvietum</i>	overgrowing of grasslands with shrubs and trees	[15]

number of square in ATPOL net	locality	number of specimens	plant association	threat	last publications
FE 31	Janowiczki	several dozen	<i>Thalictro-Salvietum</i>	overgrowing of grasslands with shrubs and trees, treading	[15]
FE 31	Wały Res.	several hundred	<i>Inuletum ensifoliae</i>	overgrowing of grassland with shrubs and trees	[15]
FE 31	Raclawice	several dozen	<i>Adonido-Brachypodietum</i>	overgrowing of grassland with shrubs	[19]
FE 31	Klonów	several dozen	<i>Inuletum ensifoliae</i>	overgrowing of grasslands with shrubs	[18]
FE 31	Marchocice	-	-	-	[18]
FE 31	Opalonki Res.	several dozen	<i>Inuletum ensifoliae</i> , <i>Thalictro-Salvietum</i>	overgrowing of grassland with shrubs and trees	[18]
FE 31	Sterczów Ścianka Res.	several dozen	<i>Inuletum ensifoliae</i>	overgrowing of grassland with shrubs and trees	[18]
FE 32	Łopaty	several hundred	<i>Inuletum ensifoliae</i>	-	[20]
FE 32	Szczotkowice	over a dozen	<i>Thalictro-Salvietum</i>	-	[20]
FE 33	Gościnniec	several dozen	<i>Thalictro-Salvietum</i>	-	[20]
FE 34	Pełczyńska	above thousand	<i>Adonido-Brachypodietum</i> , <i>Thalictro-Salvietum</i> , <i>Inuletum ensifoliae</i>	burning of grasslands, excessive pasture, overgrowing of grassland with shrubs	[11]
FE 35	Wiślica	several dozen	<i>Adonido-Brachypodietum</i>	overgrowing of grassland with shrubs	[11]
FE 41	Kąty	several dozen	<i>Inuletum ensifoliae</i>	-	[20]
FE 41	Lelowice	several hundred	<i>Inuletum ensifoliae</i>	overgrowing of grassland with shrubs	[20]
FE 41	Piotrkowice Wielkie	several hundred	<i>Thalictro-Salvietum</i>	-	[20]
FE 41	Muniaczkowice	several dozen	<i>Thalictro-Salvietum</i>	overgrowing of grassland	[15]
FE 41	Przemęczanki	several dozen	<i>Thalictro-Salvietum</i>	overgrowing of grassland	[15]
FE 42	Gniazdowice	over a dozen	<i>Sisymbrio-Stipetum</i>	-	[19]
FE 44	Among Łubinówka and Byców	several hundred	<i>Thalictro-Salvietum</i>	-	[20]
FE 44	Grodowice	several hundred	<i>Thalictro-Salvietum</i>	-	[20]
FE 44	Kaczkowice	several dozen	<i>Inuletum ensifoliae</i>	-	[20]
FE 44	Kazimierza Mała	several dozen	<i>Thalictro-Salvietum</i>	-	[20]
FE 44	Łubinówka	several hundred	<i>Thalictro-Salvietum</i>	-	[20]
FE 51	Gnatowice	several dozen	<i>Thalictro-Salvietum</i> , <i>Inuletum ensifoliae</i>	-	[15]
FE 53	Modrzany	several dozen	<i>Thalictro-Salvietum</i>	-	[21]

Adonis vernalis is a light-demanding thermophilous species that mostly occurs in communities of the *Cirsio-Brachypodion* alliance. It reaches the optimum of its de-

velopment in *Adonido-Brachypodietum* where the greatest constancy and quantity are recorded. It also penetrates other related communities belonging to *Inuletum ensifoliae* and *Thalictro-Salvietum* in which its frequency and quantity are considerably lower. It is also occasionally observed in extremely thermophilous and dry patches of *Sisymbrio-Stipetum* and *Koelerio-Festucetum* as well as in mesic and fresh *Seslerio-Scorzoneretum* phytocoenoses, and even in *Carici glaucae-Tetragonolobetum maritimi*. *Adonis vernalis* retreats in patches of overgrowing grasslands and its occurrence is possible only in low-height or low-density blackthorn scrub where the light reaches the bottom of the scrub. It was also recorded in the initial *Ligustro-Prunetum* scrub and cleared, loose patches of *Prunetum fruticosae* [10, 11]. When the cover density of the scrub becomes high, *Adonis vernalis* undergoes etiolation and dies. This takes place more frequently in the study area as cultivation forms of xerothermic grasslands change and the rate of secondary succession processes intensifies.

Adonis vernalis prefers soils rich in calcium carbonate. It grows mostly on deep and medium deep chernozemic rendzinas (*typic rendolls*), brown rendzinas (*eutrochreptic rendolls*) and pararendzinas formed from limestone, marl, loess, Miocene gypsum and sandstones. These soils are usually mineral-humus with a high content of calcimorphic mull humus. The A_1 horizons contain from 2.8 to 16.85% of organic substances while deeper horizons $A_1(B)C$ or A_1C from 0.64 to 4.92% of humus. The pH reaction in H_2O ranges from 7.1 to 7.6 in the top horizons and from 7.3 to 7.7 in bottom horizons. These soils contain considerable amounts of available P_2O_5 and K_2O forms. On the other hand, the $CaCO_3$ content ranges from 4.36 to 55.87%, depending on the soil horizon. These soils are characterised not only by a high or very high $CaCO_3$ content, but also are rich in CaO, Na_2O , MgO and usually have a trace content of total N, which indicates a rapid process of organic matter mineralisation. They are classified as dry or fresh soils regarding to water content in the soil.

Adonis vernalis has been strictly protected in Poland since 1946. Species protection addresses the threat posed by plant gathering. Some localities of *Adonis vernalis* in the Niecka Nidziańska basin are protected within reserves. At present, biocoenoses where *Adonis vernalis* occurs are protected in 16 steppe and floristic reserves in the study area.

Threats posed to *Adonis vernalis* mostly result from changes in cultivation forms of xerothermic grasslands in Poland. Social and economic transformations of the late 1980s and the early 1990s brought about a complete economic reorientation of rural communities and led to the abandonment of small-sized arable lands whose biocoenotic profile changed as they lay fallow. Unpastured xerothermic grasslands began to overgrow rapidly with dense scrub. Excessive shading of light-demanding plants, such as *Adonis vernalis*, results in a reduction in or lack of blossoming and fruiting, which subsequently leads to the disappearance of their localities. Active *in situ* protection of entire biocoenoses of xerothermic grasslands prevents unfavourable succession processes. A return to moderate pasturing of domestic animals that naturally regulate the dynamics and species composition of

grassland communities would be an optimum variant. Pasturing is favourable for the development of *Adonis vernalis* populations. The plant's poisonous shoots are usually not grazed by herbivorous domestic animals and the species has greater chances of spreading. This is observed in sites traditionally pastured and in reserves where the ban on pasturing is not observed, e.g. in the Krzyżanowice reserve. Populations of *Adonis vernalis* at such localities are represented by individuals of all developmental stages. Tuft density reaches from a few to fewer than 20 per 1 m²; areas colonised by *Adonis vernalis* cover a few hundred square meters.

CONCLUSIONS

Adonis vernalis is widespread in the Niecka Nidziańska basin. Its population is strong and regenerates naturally, and its demographic structure is normal. The localities of the species are associated with xerothermic habitats with S, SW and similar exposures, on deep and medium deep soils rich in humus and CaCO₃. The species reaches the optimum development in open communities in grasslands of the *Cirsio-Brachypodium* alliance. Major threats to it result from changes in the cultivation structure of xerothermic grasslands, secondary succession and excessively frequent burning of litter and dry plant shoots in spring periods.

Promotion and popularisation of *Adonis vernalis* cultivation should be an important method of preventing the degradation of the plant's populations in the area. Studies by Gawłowska [2] clearly show that natural resources of *Adonis vernalis* could be protected by semi-natural cultivation. To our regret, this form of cultivation has now been forgotten.

Resources of *Adonis vernalis* change dynamically. Some localities, e.g. in the Grabowiec and Lubcza reserves, have been disappearing due to overgrowing by scrub. There are many similar sites where secondary succession of grasslands contributes to a reduction in the area of occurrence of the plant, e.g. in the Polana Polichno, Skorocice or Winiary Zagojskie reserves, to name a few. Protection of the species in 16 reserves fails as it is only passive. All plant communities where *Adonis vernalis* occurs should be actively protected *in situ*, which requires special individual protection plans and financial resources.

Adonis vernalis herb used for medicinal purposes should by no means be collected from natural sites. However, natural climatic and habitat conditions in the Niecka Nidziańska basin are excellent for its cultivation and the plant should be acquired as pharmacological material from such sources. Therefore, guidelines on the cultivation size for planters and herb collection methods by pharmaceutical companies should be devised.

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AKTUALNE ZASOBY POPULACJI *ADONIS VERNALIS* L. W NIECCE NIDZIAŃSKIEJ

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Streszczenie

Artykuł opisuje populację *Adonis vernalis* w Niecce Nidziańskiej. Gatunek ten został scharakteryzowany pod względem rozmieszczenia zasobów, wymagań siedliskowych, zagrożeń i możliwości ochrony. Rezultatem badań było stwierdzenie występowania tego gatunku na 73 stanowiskach. Rozwój i przetrwanie całej populacji miłka wiosennego w wysokim stopniu jest zależne od dynamiki naturalnych fitocenozy, w których ten gatunek egzystuje. Poszczególne subpopulacje wykazują zróżnicowane zasoby, powierzchnie, dynamikę rozwoju. Pomimo dużej liczby stanowisk istnieje realna groźba zanikania tej rośliny. Zagrożenie wynika z zarastania krzewami i zmiany stosunków świetlnych, a także z nadmiernego i zbyt częstego wypalania muraw kserotermicznych. Ponadto przedstawiono zasady pozyskiwania ziela *Adonis vernalis* jako surowca farmakologicznego.

Słowa kluczowe: *Adonis vernalis*, zasoby, roślina chroniona, roślina lecznicza, roślina zagrożona, murawy kserotermiczne, zarastanie muraw