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A record of *Silene viscaria* (L.) Jess. (Caryophyllaceae) with achromatic flowers in the Mordovia State Nature Reserve (Central Russia)

Introduction

Silene viscaria (L.) Jess. (syn.: *Lychnis viscaria* L., *Steris viscaria* (L.) Rafin., *Viscaria viscosa* Asch., *V. vulgaris* Rohl.) is a perennial 25–80 cm high herb: stem erect, green, not branching in lower portion, glabrous, upper portion of the upper internodes glutinous, with two to five distinct internodes (Clapham et al., 1981; Gubanov et al., 2003). It inhabits dry grasslands, open forests, forest clearings, and ledges (Kurtto, Wesenberg, 2001; Gubanov et al., 2003). *S. viscaria* is distributed in most of Europe excluding the Iberian Peninsula, Northern Scandinavia, Northern Russia, most of South Italy, and Southern Greece (Jalas, Suominen, 1986). Moreover, it is an occasional and alien garden species in eastern North America (Morton, 2005). Inflorescences are compound dichasia, lax or slightly congested. Each of them bear about 20–25 flowers. The flowers are pollinated by insects, mainly bumblebees and butterflies (Jennersten, 1988). The seeds are dispersed by gravity.

In most literature, the colour of *S. viscaria* flowers is indicated as purple, purple-red, pink, or crimson (Clapham et al., 1981; Gubanov et al., 2003; Morton, 2005; Frajman et al., 2013). Only few authors indicate cases of achromatism for *S. viscaria* flowers (Gubanov et al., 2003; Frajman et al., 2013). Moreover, there is a lack of data on differences of white-flower, and plants with normal coloured flowers. In particular, we cannot evaluate the frequency of their registering of the existence/absence of morphological differences between white- and purple-flower plants. Nevertheless, the flowers colours play a significant role both for plants and their insect pollinators (Miller et al., 2011), because insects discriminate a wide range of patterns and shapes (Dyer et al., 2008; Hempel de Ibarra et al., 2015), and entomophillous plants are highly dependent of insects.

That is why, in this study, we aimed to compare some morphological parameters of generative plants with achromatic flowers and individuals with purple ones in the same coenopopulations in conditions of the Mordovia State Nature Reserve (Central Russia).

Material and methods

The field investigations were carried out at the southern border of the Federal Protected Area, Mordovia State Nature Reserve (54°7504′N; 43°4016′E), in June 2017. Population studies were conducted according to Aleksandrova (1964) and Khapugin et al. (2014). Three study plots (1×1 m) were established in *Silene viscaria* coenopopulations where individuals with achromatic flowers were found. The composition of accompanying flora was recorded within square plots 10×10 m situated around small (1 m^2) study plots established for the study of *S. viscaria* individuals.

Assessment of the *S. viscaria* individuals status was carried out on the basis of the morphological parameters of generative plants (20 plants with achromatic flowers vs. 57 plant with normally coloured flowers): height of plants, number of whorls of lateral branches per an inflorescence, number of flowers per an inflorescence, length of an inflorescence, and the percentage of an inflorescence length from a plants height.

The nomenclature and the taxonomy of the plant taxa of the accompanying flora (Appendix 1 – Tab. 1) are presented in accordance with *The Plant List*… (2013) and *Euro+Med Plantbase* (2006–2011).

Statistical analysis was performed in MS Excel and PAST (Hammer et al., 2001). Therefore, we used Principal Component Analysis (PCA) to define the main morphometric parameters that differentiate both groups of plants in studied habitats. For interpretation of the ordination axes, values of measured morphometric parameters were plotted onto a PCA ordination diagram as supplementary environmental data.

Results and Discussion

Among the many species of colourful flowers, sometimes the specimens lacking this colour are referred to as albinotic forms. Examples of 64 species of this type of plant were reported by Czarna (2006) and others. A more detailed description of albinism in orchids was given, e.g., Griesbach (1979), Kohns and Schneider (1993), Selosse et al. (2004), and Jakubska and Schmidt (2005). Examples of albinotic plants are also mentioned by Trudell et al. (2003), and Śliwiński and Jakubska-Busse (2010). However, there has been no analysis of the albinotic population of *Silene viscaria*, which was the subject of the investigatation undertaken in this study. As a result of investigations, several records of white-flower *S. viscaria* plants were found at the south of the Mordovia State Nature Reserve (Fig. 1). They occur within the same plant communities with *S. viscaria* individuals with flowers normally coloured.

The composition of flora accompanying to *S. viscaria* in studied locations is presented by 37 species belonging to 34 genera and 22 families (Appendix 1 – Tab. 1). Of these,

Fig. 1. Examples of *Silene viscaria* (L.) Jess. flowering plants with achromatic (A) and normal flowers (B) at the southern border of the Mordovia State Nature Reserve (Photo. A.A. Khapugin)

Tab. 2. Morphological traits of *Silene viscaria* (L.) Jess. flowering plants with different colouring of flowers

Parameters	Morphological traits									
	Height of individuals [cm]		Number of whorls of lateral branches per an inflorescence		Number of flowers per an inflorescence		Length of an inflorescence [cm]		Percent of an inflorescence length to a plant height [%]	
	a	n	a	n	a	n	a	n	a	n
M	67.3	55.4	4.3	4.4	40.5	51.0	16.9	16.4	24.9	29.8
m	2.9	1.8	0.2	0.1	2.9	2.8	1.5	0.9	1.8	1.4
min	55.0	35.0	3.0	3.0	26.0	19.0	9.0	8.0	16.1	17.0
max	78.0	71.0	5.0	5.0	56.0	67.0	24.0	25.0	33.6	50.0

Notes: *M* – mean value, *m* – error of the mean, *min–max* – minimal–maximal values; a – plants with achromatic flowers; n – plants with normally coloured flowers

Poaceae (6 species), Plantaginaceae (4 species), Rosaceae (3 species), Asteraceae (3 species), and Caryophyllaceae (3 species) contain the highest numbers of representatives.

The mean values of morphological parameters were determined for *S. viscaria* flowering individuals within three study plots. As a result, we found that these parameters are similar between plants with achromatic flowers and plants with typically coloured flowers (Tab. 2). Similarly, Binkenstein and Schaefer (2015) compared flower colours of different habitats and chromatic / achromatic components of flower colours from the honeybees' point of view. They found that flower colours do not differ between closed forest and open grassland habitats in any chromatic or achromatic aspect both from the bees' perspective and without any model bias.

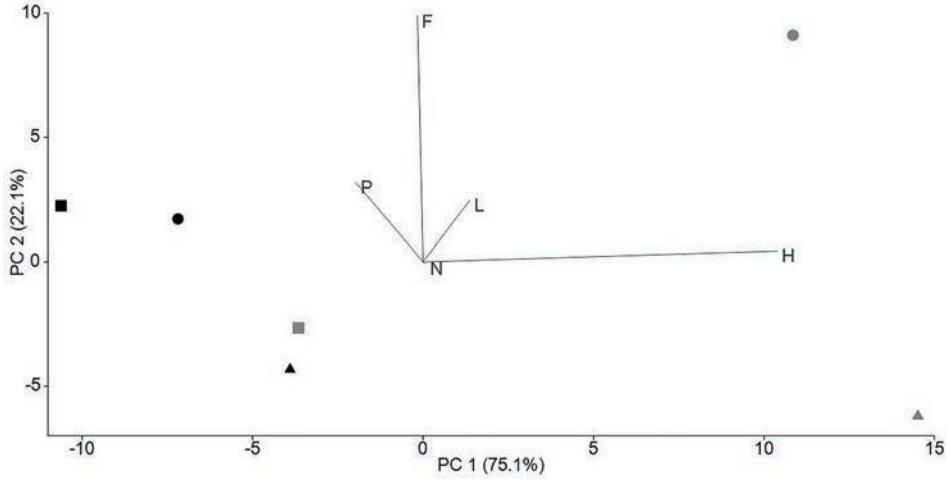

Fig. 2. Principal Component Analysis (PCA) ordination diagram of flowering *Silene viscaria* individuals with achromatic (grey symbols) and normally coloured (black symbols) flowers for first (triangles), second (circles), and third (squares) study plots; all groups are arranged in accordance to morphologic traits: H – height of individuals, N – number of whorls of lateral branches per an inflorescence, F – number of flowers per an inflorescence, L – length of an inflorescence, P – percentage of an inflorescence length from a plants height

In order to determine the presence/absence between both study plots and two groups of *S. viscaria* plants, we carried out conjoint principal component analysis (PCA) with the involvement of averaged values of all measured morphometric traits in three study plots (Fig. 2). Despite of high similarity in morphological traits, plants with achromatic flowers are slightly higher than flowering individuals of *S. viscaria* with normally coloured flowers.

Although, on the basis of all obtained results, we may conclude that there are not significant differences between *S. viscaria* plants with achromatic flowers and individuals with coloured flowers. We suggest accumulating data on a phenomenon of flowers achromatism amongst different groups of plants in different areas of the world. It will allow the understanding of the frequency of this phenomenon and, perhaps, its relationship with the biological traits of the plants.

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Appendix 1

Tab. 1. List of plant taxa growing together with *Silene viscaria* in studied plant communities at the southern border of the Mordovia State Nature Reserve

No.	Species	Family	Plot 1	Plot 2	Plot 3
1.	*Achillea millefolium* L.	Asteraceae	+	+	+
2.	*Anthoxanthum odoratum* L.	Poaceae	+	+	+
3.	*Betula pendula* Roth	Betulaceae	+	+	
4.	*Calamagrostis epigejos* (L.) Roth	Poaceae	+		
5.	*Campanula patula* L.	Campanulaceae		+	+
6.	*Convallaria majalis* L.	Asparagaceae	+		
7.	*Festuca valesiaca* Schleich. ex Gaudin	Poaceae			+
8.	*Fragaria vesca* L.	Rosaceae	+	+	
9.	*Frangula alnus* Mill.	Rhamnaceae	+		
10.	*Galium mollugo* L.	Rubiaceae	+	+	+
11.	*Hypericum perforatum* L.	Hypericaceae	+	+	+
12.	*Leucanthemum vulgare* L.	Asteraceae	+		
13.	*Linaria vulgaris* Mill.	Plantaginaceae		+	
14.	*Luzula pilosa* (L.) Willd.	Juncaceae	+	+	+
15.	*Malus domestica* Borkh.	Rosaceae			+
16.	*Melampyrum nemorosum* L.	Orobanchaceae	+		
17.	*M. pratense* L.	Orobanchaceae	+	+	+
18.	*Melica nutans* L.	Poaceae	+		+
19.	*Orthilia secunda* (L.) House	Ericaceae	+		
20.	*Phleum pratense* L.	Poaceae			+
21.	*Pilosella officinarum* Vaill.	Asteraceae	+	+	+
22.	*Pimpinella saxifraga* L.	Apiaceae	+		
23.	*Pinus sylvestris* L.	Pinaceae	+	+	+
24.	*Plantago lanceolata* L.	Plantaginaceae			+
25.	*Platanthera bifolia* (L.) Rich.	Orchidaceae			+
26.	*Poa pratensis* L.	Poaceae	+	+	
27.	*Prunella vulgaris* L.	Lamiaceae			+
28.	*Ranunculus polyanthemos* L.	Ranunculaceae			+
29.	*Rumex acetosella* L.	Polygonaceae		+	
30.	*Sorbus aucuparia* L.	Rosaceae	+		+
31.	*Stellaria graminea* L.	Caryophyllaceae	+		
32.	*S. holostea* L.	Caryophyllaceae	+		
33.	*Silene viscaria* (L.) Jess.	Caryophyllaceae	+	+	+
34.	*Veronica chamaedrys* L.	Plantaginaceae	+	+	+
35.	*V. officinalis* L.	Plantaginaceae	+		
36.	*Vicia sylvatica* L.	Fabaceae			+
37.	*Viola mirabilis* L.	Violaceae			+

Abstract

Silene viscaria (L.) Jess. is a common species of Central Russian flora. It has attractive purple, crimson, or dark-pink inflorescences. Some literature sources indicate the possibility of white-colour flowers. However, there are no reliable published evidences of these cases. In this report, a record of *S. viscaria* plants with achromatic, white, flowers at the southern border of the Mordovia State Nature Reserve is presented. Some morphological traits of flowering individuals were measured: the height of reproductive individuals, the number of whorls of lateral branches per an inflorescence, the number of flowers per an inflorescence, the length of an inflorescence, and the percentage of an inflorescence length from a flowering plants height. Data on the flora accompanying *S. viscaria* are presented. As a result, no significant differences between plants with achromatic flowers and plants with coloured flowers have been found. However, the height of white-flower individuals was slightly higher. We suggest accumulating data on a phenomenon of the flower's achromatism amongst different groups of plants in order to try to understand the frequency of this phenomenon and perhaps its impact on plants biology.

Key words: achromatism, flower colour, morphological features, plant population, Russia

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Stanowisko *Silene viscaria* (L.) Jess. (Caryophyllaceae) z kwiatami achromatycznymi w Rezerwacie Przyrody Mordovia (Rosja Centralna)

Streszczenie

Silene viscaria (L.) Jess. jest gatunkiem pospolitym we florze Centralnej Rosji. Ma atrakcyjne fioletowe, szkarłatne lub ciemnoróżowe kwiatostany. Niektóre źródła literatury wskazywały na możliwość występowania kwiatów w kolorze białym u tego gatunku. Jednak dotychczas nie było wiarygodnych opublikowanych danych na ten temat. W niniejszym opracowaniu zaprezentowano stanowisko *S. viscaria* z achromatycznymi, białymi kwiatami, zlokalizowane na południowej granicy Rezerwatu Przyrody Mordovia. W trakcie badań zmierzono niektóre cechy morfologiczne osobników kwitnących: wysokość osobników reprodukcyjnych, liczbę okółków odgałęzień bocznych na kwiatostan, liczbę kwiatów na kwiatostan, długość kwiatostanu, procent długości kwiatostanu z długości rośliny kwitnącej. Przedstawiono również dane dotyczące flory towarzyszącej *S. viscaria*. W rezultacie nie stwierdzono różnic istotnych między roślinami o achromatycznych kwiatach i roślinami o kolorowych kwiatach. Jednak długość osobników z białymi kwiatami była nieco większa. Byłoby wskazane gromadzenie dalszych danych dotyczących zjawiska achromatyzmu kwiatów wśród różnych grup roślin, aby spróbować zrozumieć częstotliwość tego zjawiska i być może jego wpływ na biologię roślin.

Słowa kluczowe: achromatyzm, kwiaty barwne, cechy morfologiczne, populacje roślin, Rosja

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