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RESEARCH ARTICLE

Distribution of *Trifolium rubens* in Ukraine and the current state of its populations in Zakarpattia

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Abstract

Trifolium rubens is a Central European forest-steppe plant species reaching its eastern distribution limit in Ukraine and listed in the Red Book of Ukraine (2009).

Our study was carried out in 2016–2020 and aimed to analyze the distribution of *T. rubens* in Ukraine, to identify the composition of phytocoenoses with *T. rubens*, and to evaluate the current state of its populations in the Zakarpattia region of Ukraine. The distribution of this species was analyzed based on data obtained from the field surveys, literature, online resources, and herbaria. In total, 78 localities of *T. rubens* were analyzed. *Trifolium rubens* was found to be distributed in Zakarpattia, Lviv, Ivano-Frankivsk, Ternopil, Rivne, Khmelnytskyi, Chernivtsi, and Vinnytsia regions of Ukraine. Two of these regions (Khmelnytskyi and Chernivtsi) were not mentioned before in the Red Book of Ukraine. The presence of *T. rubens* in Volyn, Zhytomyr, Cherkasy, and Kyiv regions is doubtful and not confirmed by recent data. Most localities of this species are known from Zakarpattia and Lviv regions.

Three new localities were found in the Beregovo district of the Zakarpattia region in the foothills of the Volcanic Carpathians. The floristic compositions of the plant communities and ontogenetic structure of *T. rubens* populations in Beregovo and Mukachevo districts of the Zakarpattia region were investigated. Investigated populations are isolated with a dispersed disposition of plants on large areas. *Trifolium rubens* occurs here in meadow-steppe and meadow areas, on hillsides, and also participate in mesoxerophilous secondary (semi-natural) shrub communities in anthropogenically transformed areas. Often such populations are situated along pathways, on forest edges and fallow lands, and associated with ecotones of *Trifolio-Geranietea sanguinei* class. All studied populations were incomplete with the domination of generative shoots.

Keywords: *Trifolium rubens*, chorology, populations, Ukraine

Authors' contributions: Gnatiuk A. and Gaponenko M. conceived the investigation and its main conceptual ideas, designed the study, and analyzed the data. Loya V. and Gnatiuk A. collected the data from the herbaria, and made a map. Gnatiuk A., Gaponenko M., Loya V., and Gaponenko A. realized the field research, collected data, took photos, collected herbarium, identified plant samples, composed species lists, and realized a final approval of the manuscript. Gnatiuk A., Gaponenko M., and Loya V. wrote the manuscript and worked on its critical revisions.

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Introduction

Trifolium rubens L. is a Central European forest-steppe plant species. It is also present in Southern Europe, including southern Spain, Italy, and Eastern Europe. Some species' findings were reported from Belarus (Meusel & Jäger, 1992). Also, a few localities are known from the Baltic region (Rašomavičius, 2007) and the south of Thrace (Meusel & Jäger, 1992).

In Ukraine, *T. rubens* is a rare species (Didukh, 2009), reaching its eastern distribution limits. It is mostly distributed in the right-bank part of Ukraine, where it occurs on dry meadows, meadow-steppes, forest edges, and growths among shrubs. Didukh (2009) indicated that *T. rubens* occurs in Zakarpattia and Volyno-Podilia of Ukraine only. However, the preliminary chorological research showed that it probably has a broader distribution range.

In Ukraine, *T. rubens* mainly participates in the plant communities Festuco-Brometea Br.-Bl. et Tx. ex Soó 1947, Molinio-Arrhenatheretea Tx. 1937, and Trifolio-Geranietea sanguinei T. Müller 1961. It is also a diagnostic species for association Primulo veris-Agrostietum capillaris Uhliarová et Janišová 2014. Beside this, *T. rubens* participates in the thermophilic communities of ecotones, forest edges, and shrubby association Antherico ramosi-Geranietalia sanguinei Julve 1993 (Didukh, 2009; Dubyna et al., 2019).

In the adjacent countries, *T. rubens* is associated with some more communities. For example, in Poland it is listed for the order Quercetalia pubescentis Br.-Bl. (1931) 1932 (Matuszkiewicz, 2001). *Trifolium rubens* is also mentioned as an indicator of thermophilic Trifolio-Geranietea communities in Slovakia (Ružičková et al., 1996).

Usually, the populations of *T. rubens* in Ukraine are small, with sporadically distributed or joined in small groups (from a few individuals to several dozens) plants. These populations are mainly situated on the slopes of the southern and south-eastern exposures (Ralo, 2002; Onyshchenko & Andrienko 2012; Dmytrash, 2015; Dmytrash-Vatseba & Shumska, 2016; Konishchuk et al., 2017).

This study was aimed to clarify the distribution of *T. rubens* in Ukraine and its participation in plant communities. It also aimed to evaluate the current state of

T. rubens populations in the Zakarpattia region of Ukraine.

Material and methods

The study was carried out in 2016–2020. *Trifolium rubens* distribution analysis was based on the data from the field surveys, literature, Internet resources, and examination of the herbarium vouchers from UU, KW, LWS, KWHA, CHER, MW, MNR, MSUD, UPU, SOF, UM, KWHU, KWU (see Thiers (2016) for acronyms), and KW-museum (herbarium of the National Museum of Natural History of the NAS of Ukraine, Kyiv).

Populations were studied in the Zakarpattia region in June (flowering period) and August (fruiting period). In particular, the populations in the low mountain range of the Beregovo volcanic hills and on the mountain Lovachka were investigated in the following localities: 1) Beregovo; 2) Zatyshne 3) Muzhievo, and 4) Mukachevo (Figs. 1 & 2).

Trifolium rubens is a herbaceous perennial polycarpic. Shoot system of *T. rubens* is represented by elongated monocyclic shoots. The degree of development and number of shoots reflect individuals' state and prospects of seed reproduction in the population. Establishing the real age structure of *T. rubens* populations in natural habitats, as in some other perennial species, is difficult. It is impossible to do this without damaging plants and soil surface, especially in dense communities. Such damage is unacceptable for studying rare plant species. In this case, a ratio of the number of generative and vegetative shoots may be a key for population monitoring (Kagalo et al., 2012). Hence, in each locus, the shoots of four age stages: virginal, generative, subsenile, and senile (Gnatiuk et al., 2020), were registered and investigated.

In each population, the vegetation composition was evaluated following Braun-Blaquet (1964). The scientific names of the plants are provided according to POWO (2021), the names of the vegetation communities – according to Dubyna et al. (2019) and Solomakha (2008).

Revised specimens

Vynnytsia region. Nemyriv district: Antsypolivka, 08.06.2009, Vashenyak (KW), (Didukh et al., 2010).



Figure 1. *Trifolium rubens* in Beregovo (A), Zatyshne (B), Muzhievo (C), and Mukachevo (D) populations.

Volyn region. Volodymyr-Volynskiy ([Visjulina, 1954](#)).

Zakarpattia region. *Beregovo district:* Beregovo, 15.06.1947, Bilyk (UU), ([Visjulina, 1954](#)); 16.06.1953, Tovt, (UU); Beregovo, Zolota mountain, 16.06.1968, Chopyk (KW); Muzhiyivsk, 11.06.1957, Uliganets (UU); Bene, Chillagash Tetev mountain, 15.07.1960, Tovt (UU); Kuklabanya, 09.06.1948, Malynovskiy (LWS); *Velykoberezhnyanskiy district:* MalyBerezny, 07.07.1956, Khymynets (UU); Uzhok, Kinchyk mountain, 26.08.1955, Chopyk (KW); Maly Berezny, Dilok mountain, 25.06.1954, Rudenko, (UU); *Vynohradiv district:* Kholmovets, 12.06.1956, Chubirko (UU); Chopyk, 16.07.1963 (KWA); *Mukachevo district:* Mukachevo, near the monastery 11.06.1947, Grin (KW), ([Visjulina, 1954](#)); Mukachevo vicinity, Lovachka mountain, ([Margittai, 1911](#)); 11.07.2018, Loya (KWA); Mukachevo, Galish mountain, 21.05.2020, Loya (KWA); *Perechyn district:* Plishka mountain, 04.08.1955 (Chopyk-KW); 09.07.1954, Tovt (UU); 05.06.1956, Tovt (UU); 03.08.1958, Tovt (UU); 25.07.1958, Simchera (UU); Sinatoria, 03.07.1956, Chopyk (KW); *Rakhiv district:* Dilove, Polonskaya, 03.07.1956, Tovt (UU); Rakhiv vicinity, Lysa Gora mountain, 26.06.1995, Kucheryava (KWU); *Uzhhorod district:* Kholmountainsi, 11.06.1947, Bilyk (KW); 06.03.1947, ? (UU), ([Visjulina, 1954](#)); 23.07.1958, Kovalenko (UU); 29.06.1956, Tovt (UU); 28.07.1987, Tasenkevych (LWS); Antalovetska Polyana mountain, 24.07.1958, Ilnytska (UU); Antalovtsi, 25.06.1955, Tovt (UU); Nevytsky castle, 24.07.1958, Zotyky (UU); Onokivtsi, 01.07.1968, Bartok (UU); Hlyboke, 08.07.1960, Karaeva (MW).

Ivano-Frankivsk region. *Halytskyi district:* Bovshev, Kasova Hora mountain, 13.7.1973, Kukovytsya; 49.226342, 24.696633, 23.06.2015, N. Sytschak ([UkrBIN, 2021](#)); 10.06.1969, Shelyag-Sosonko, Kukovytsya (KW), ([Shumska & Dmytrash, 2012](#)); 08.06.2000, Kuzyarin (LWS); Tyaziv, 04.1960, Doroshenko (CHER); *Rohatyn district:* Velyki Goldy (Luchyntsi) ([Shumska & Dmytrash, 2012](#)); *Tysmenytsia district:* Uzin, urochysche Zhdymyr ([Shumska & Dmytrash, 2012](#)); Kolodiyivka, urochysche Pidgoroddy (Shumska & Dmytrash, 2012); urochysche Simlin ([Shumska & Dmytrash, 2012](#)); urochysche Hareva ([Shumska & Dmytrash, 2012](#)); urochysche Gorozhanka ([Shumska & Dmytrash, 2012](#)).

Lviv region. Lviv city, place Kryvchytsi (former village of Kryvchytsi), 07.1856, Łobazewski (LWS); Lviv city, park Znesinnya, 49.847987, 24.076442, 20.07.2020, Voityk ([UkrBIN, 2021](#)); north-eastern vicinity of Lviv city, urochysche Khomets, 20.06.1986, Zelenchuk (LW); *Brody district:* Buchyna, Makitra mountain, 13.07.1997, Kuzyarin (LWS); 49.967495, 25.189118 ([Batochenko, 2019](#)); 50.035774 25.264379, 30.08.2019, Yurechko ([Yurechko, 2020](#); [UkrBIN, 2021](#)); Ponykovytsya, Makitra mountain, 15.08.1954, Shelest (KWA), 05.07.1987 (KW); Boratyn, Krugla mountain, 11.07.1987, Zelenchuk (LW, MW); 50.002236, 25.147742, 30.07.2019, Yurechko ([Yurechko, 2020](#); [UkrBIN, 2021](#)); Vydra urochysche, 49.970372 25.180636, 04.08.2017, Yurechko ([UkrBIN, 2021](#)); Tetylkivtsi, 49.959404, 25.361032 ([Batochenko, 2019](#)); Verbivchyk, 49.893272, 25.283389 ([Batochenko, 2019](#)); *Zolochiv district:* Chervone, Lysa Gora mountain,

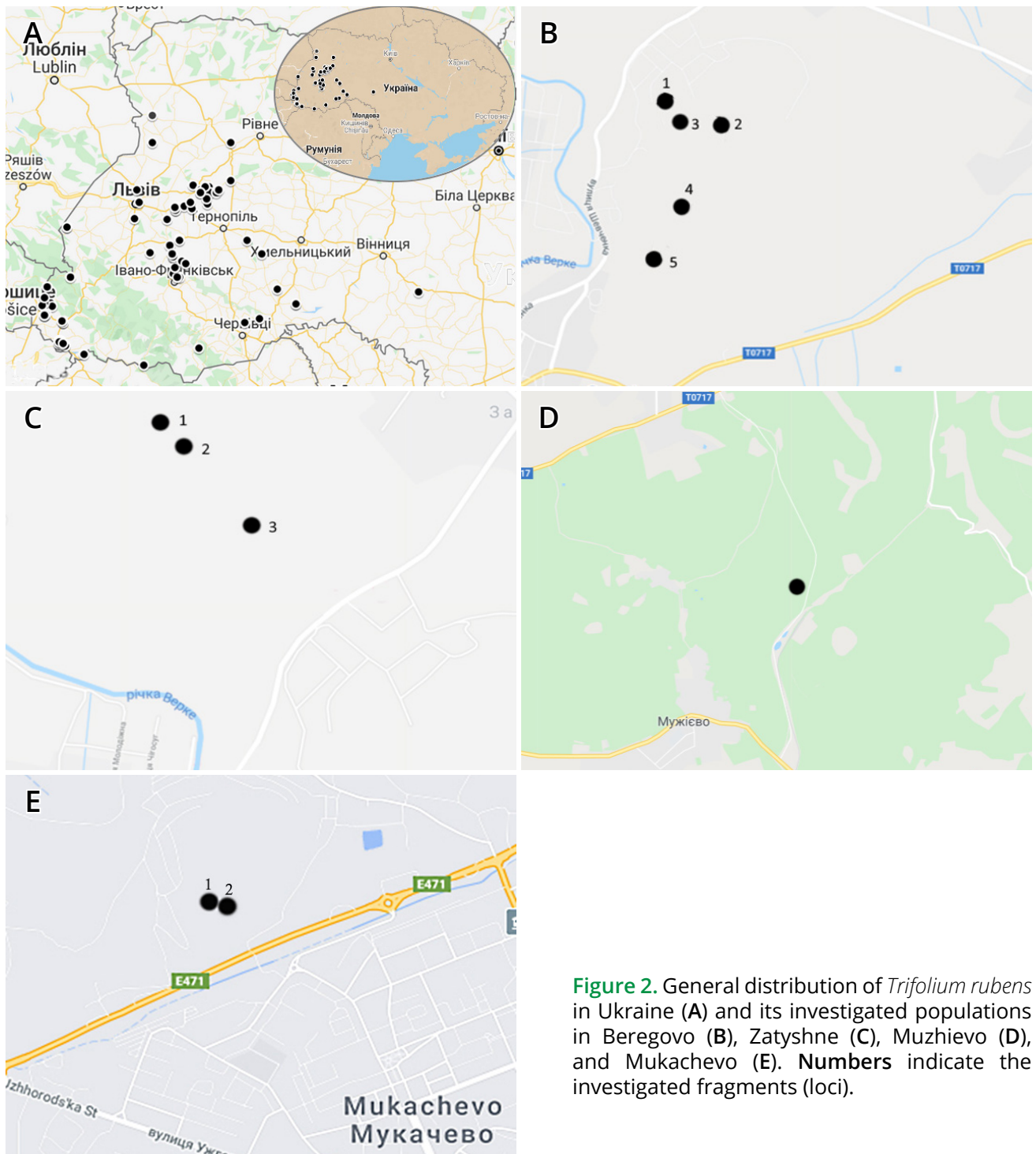


Figure 2. General distribution of *Trifolium rubens* in Ukraine (A) and its investigated populations in Beregovo (B), Zatyshne (C), Muzhievo (D), and Mukachevo (E). Numbers indicate the investigated fragments (loci).

18.06.1956, Bukhalo (KW); 49.800963, 24.714529 (Batochenko, 2019); Tserkovna mountain, 07.07.1974, Shelyag-Sosonko, Kukovytsya, Didukh (KW); Stinka, 49.771803, 24.738519 (Batochenko, 2019); Khmelevo (Ralo, 2002); 19.07.1988, Iljinska (KW); Zolochiv, "nad Kraglem" 12.07.1938, Mađalski (LWS); Derevyanky urochysche, 49.824592, 25.062689, 10.07.2020, Yurechko (UkrBIN, 2021); Luka urochysche, 49.794502, 25.01998, 27.09.2017, Yurechko (Ralo & Yurechko, 2019; UkrBIN, 2021); Zhovkva district: Mervychi, Kamin mountain, 30.06.1999, Kuzyarin (LWS); Zhydachiv district: Zhuravno, 1857, Łobarzewski (LWS); 29.07.1936, Mađalski (LWS); Peremyshlyany district: Borschiv, 16.07.1933, ?, (LWS); Pustomyty district: Derevach 06.1855; 1857, Łobarzewski

(LWS); Sokal district: ?, 1911, Szafer (LWS); Skomorokhy, 1869, Rehmann (LWS); Staryi Sambir district: Dobromyl, Meznetska mountain, 27.05.1967, Boyko (LWS).

Rivne region. Radyvyl district: Druzhba, 1859; 1858, Gomolinski (LWS); Berezne district: "Nadsluchanska Shveytsariya", the right bank of the river Sluch, Andriyenko (KW). Mlyniv district: Vladyslavivka, urochysche Hraboveshchyna (Didukh et al., 2010; Lohvynenko, 2012); Kurylykha, 50.562694, 25.7545 (Shtogryn et al., 2020). Shumsk district: 50.142583, 26.159583; 50.126444, 26.066889 (Shtogryn et al., 2020).

Ternopil region. Berezhanly district: Kuryany, Holytsya mountain, 27.06.1976, Zaverukha (KW), (Yavorivskiyi &

Stakhurska, 2017); *Kremenets district*: Pidlisne, urochysche Vakatsy, 20.07.2007, 18.06.2009, 24.07.2010, Hlinska (KWA), 30.06.2014, Krytska, Novosad, Shcherbakova (KW-museum); Novosilky, 29.06.1958, Klokov (KW); Raslavka, 49.958393, 25.465275 (Batochenko, 2019); Maslyatyn mountain, 2006, Pronyuk, Oliyars (MNR); 50.137694, 26.092528 (Shtogryn et al., 2020); Pochayiv [?] (Visjulina, 1954); *Zboriv district*: Ratyshchi, Ratyska mountain, 1875, Schauer (LWS).

Khmelnyskyi region. *Kamyanets-Podilskyi district*: urochysche Sovyi Yar, 06.07.1949, Kuznetsova (KW), (Visjulina, 1954); Nizhyn, 13.07.1964, Krutskevych (KWA); Sataniv (Visjulina, 1954).

Chernivtsi region. *Khotyn district*: Polyana, 26.06.1958, Kozak (CHER); *Vyzhnytsa district*: urochysche Velyki Luzhky, 15.07.1977, Shterma (CHER).

Results and discussion

Distribution of *Trifolium rubens* in Ukraine

Basing on the analysis of herbarium material and published data, we have confirmed that *T. rubens* is distributed only in the right-bank part of Ukraine (Fig. 2 A). It is registered from Vinnytsia, Zakarpattia, Ivano-Frankivsk, Lviv, Rivne, Ternopil, Khmelnytsky, and Chernivtsi regions. Although according to the Red Book of Ukraine (Didukh, 2009), *T. rubens* is not mentioned for the Khmelnytsky and Chernivtsi regions. Most locations are known from the Zakarpattia and Lviv regions. The current presence of *T. rubens* in the Volyn, Zhytomyr, Cherkasy, and Kyiv regions is doubtful and/or has no recent confirmation. For example, there is no recent confirmation of the presence of *T. rubens* in the Kyiv region. The herbarium voucher “Zhytomyr region. Novograd-Volynskyi district, village Mala Tsvilya, June 13, 2000, Orlov” deposited at the KW was re-identified by Y.P. Didukh as *T. medium* L., and we agree with that new identification. The report of *T. rubens* from Uman (Visjulina, 1954) was not confirmed too – there are no herbarium vouchers from this region yet.

Populations of *Trifolium rubens* in Zakarpattia region

In the investigated areas, the fragments of oak forests and shrubs occurred. The slopes were partially terraced and planted with vineyards, gardens or used as arable fields or pastures.

Population 1. The population of *T. rubens* in Beregovo (Figs. 1 & 2) was confined to a plant community with rich floristic composition and mosaic structure. In this population, five fragments (loci) were studied (Table 1). The population was numerous, with about 300 plants. Monodominant fragments of the community were formed mainly by *Calamagrostis*, *Trifolium*, *Coronilla*, and *Rubus* species. Plants of *T. rubens* occurred on the slopes of the western and north-western exposures, and the relatively flat upper part of the hills. Some individuals grew on the northern slope among trees and shrubs, and some – along the trail. The herb layer was 30–60 cm high and has 80–90 % of the projective cover. The shrub layer reaches up to 2 m high. Sometimes *Quercus petraea* Liebl., *Populus tremula* L., *Castanea sativa* Mill. overgrew between shrubs of *Cornus sanguinea* L., *Prunus spinosa* L., *Chamaecytisus supinus* (L.) Link, *C. austriacus* L., *Rhamnus cathartica* L., *Rosa canina* L. agg., and *Rubus* species (Table 2).

Shoots were concentrated in the groups (clumps) by 5–50. Each clump occupied an area of about 0.5–2.0 m². The average density of shoots was 28.4±1.3 per 1 m². In particular, 5.2±1.0 per 1 m² – for virginal shoots, 21.2±1.4 per 1 m² – for generative, 0.4±0.4 per 1 m² – for subsenile, and 3.6±1.0 per 1 m² – for senile. Like all others, this population was incomplete. Shoots in the generative state predominated (Table 1). There were also some separate generative plants at a distance 20–25 m from each other. Neither seedlings nor juvenile plants were found.

Plants were scattered irregularly on the territory. Occasionally, *T. rubens* plants co-dominated there together with *Rubus fruticosus* L. agg., *Coronilla varia* L., *Lotus corniculatus* L., and *Clinopodium vulgare* L.

According to the diagnostic species (*Agrimonia eupatoria* L., *Campanula persicifolia* L., *Clinopodium vulgare*, *Geranium sanguineum* L., *Melampyrum nemorosum* L., *Origanum vulgare* L., *Peucedanum cervaria* (L.) Lap., *Trifolium medium*, *Vincetoxicum hirundinaria* Medik., and others – see Table 2), communities with the participation of *T. rubens* should be attributed to the order *Origanetalia* Th. Müller 1962 class *Trifolio-Geranietea sanguinei* Th. Müller 1961 (Solomakha, 2008).

Table 1. Characteristics of investigated *Trifolium rubens* populations.

Population	Number of shoots per 1 m ²				Total
	Virginal	Generative	Subsenile	Senile	
1. Beregovo					
locus 1	4±0.5	17±1.3	5±1.2	0.0	26
locus 2	6±0.9	10±1.3	4±1.1	2±0.1	22
locus 3	10±1.3	45±1.5	3±1.0	0.0	58
locus 4	4±0.5	16±1.3	0.0	0.0	20
locus 5	2±0.1	8±1.5	6±1.0	0.0	16
Mean±SD	5.2±1.0	19.2±1.4	3.6±1.0	0.4±0.4	28.4±1.3
Total (%)	26 (18.3)	96 (67.6)	18 (12.7)	2 (1.4)	142 (100.0)
2. Zatyshne					
locus 1	3±0.5	9±1.5	2±0.1	0.0	14
locus 2	1±0.1	26±1.4	4±0.6	0.0	31
locus 3	0.0	16±0.5	1±0.1	0.0	17
Mean±SD	1.3±0.3	17.0±1.7	2.3±0.4	0.0	20.6±0.6
Total (%)	4 (6.3)	51 (82.5)	7 (11.2)	0 (0.0)	41 (100.0)
3. Muzhieve					
locus 1	13±0.0	75±0.0	3±0.0	0.0	91
locus 2	8±0.0	62±0.0	4±0.0	0.0	74
Mean±SD	10.5±0.0	68.5±0.0	3.5±0.0	0.0	82.5±0.0
Total (%)	21 (12.7)	137 (83.0)	7 (4.3)	0 (0.0)	165 (100.0)
4. Lovachka mountain					
locus 1	13.1±0.4	20±1.1	0.0	0.0	33
locus 2	16.3±1.3	11.1±0.9	0.0	0.0	27
Mean±SD	14.4±0.9	15.6±1.0	0.0	0.0	30.2±0.0
Total (%)	29 (48.7)	31 (51.5)	0 (0.0)	0 (0.0)	60 (100.0)

Population 2. Near the village Zatyshne, *T. rubens* occurred on gentle slopes of southeastern and northern exposures with an inclination of about 20–30° among shrubs, along paths, and, sometimes, in the 10–15-meter ecotone of the oak forest. A rich floral composition characterized this community due to the penetration of species from adjacent plant communities with the formation of mosaic complexes and due to the lack of shading. The community consisted of deciduous shrubs with significant participation of xerothermic species. The shrub layer was up to 2 m high. The herb layer's height was 30–60 cm, and its projective cover reached 80–100%. *Calamagrostis epigejos* (L.) Roth, *C. arundinacea* (L.) Roth, *Trifolium*

rubens, *T. medium*, *Melampyrum nemorosum*, *Clinopodium vulgare*, *Inula salicina* L., and *Vicia cracca* L. predominated here (Table 2).

Plants of *T. rubens* were represented by small dense clumps (1–3 m²). In each clump were 2–8 generative individuals. An average density of shoots was 31 per 1 m². In this population, only three loci were found with 41 shoots (Table 1).

Population 3. In *T. rubens* population near the village Muzhievo, two clumps formed by generative shoots were found. The population situated in the upper part of the gentle slope of the eastern exposure near thickets of shrubs with *Robinia pseudoacacia* L., *Rosa canina* agg., *Rubus fruticosus* agg., and *Vitis vinifera* L.

Table 2. Floristic composition of the plant communities in studied populations of *Trifolium rubens*.

Population	1	2	3	4	Population	1	2	3	4
Tree layer					Tree layer				
<i>Castanea sativa</i> Mill.	+	.	.	+	<i>Echium vulgare</i> L.	+	.	.	.
<i>Populus tremula</i> L.	1	+	.	.	<i>Elymus repens</i> (L.) Gould	1	1	1	.
<i>Prunus avium</i> (L.) L.	.	+	.	.	<i>Erigeron annuus</i> (L.) Pers.	1	1	1	+
<i>Prunus cerasus</i> L.	.	+	.	.	<i>Euphorbia cyparissias</i> L.	.	.	.	+
<i>Quercus petraea</i> (Matt.) Liebl.	+	+	.	1	<i>Festuca ovina</i> L.	+	.	.	.
<i>Robinia pseudoacacia</i> L.	.	.	+	+	<i>Festuca pratensis</i> Huds	.	.	+	.
Shrub layer					Shrub layer				
<i>Cornus sanguinea</i> L.	1	1	.	.	<i>Filago arvensis</i> L.	+	.	.	.
<i>Prunus spinosa</i> L.	+	+	.	.	<i>Fragaria vesca</i> L.	+	.	.	.
<i>Rhamnus cathartica</i> L.	+	.	.	.	<i>Galatella linosyris</i> (L.) Rchb.f.	.	+	.	.
<i>Rosa canina</i> s.l.	2	1	+	.	<i>Galium mollugo</i> L.	+	+	.	.
<i>Rubus fruticosus</i> s.l.	.	2	+	.	<i>Galium verum</i> L.	+	.	.	+
<i>Sambucus ebulus</i> L.	.	1	.	.	<i>Genista tinctoria</i> L.	+	+	.	+
<i>Vitis vinifera</i> L.	.	.	+	.	<i>Geranium sanguineum</i> L.	+	.	.	.
Herb layer					Herb layer				
<i>Achillea millefolium</i> L.	1	1	.	.	<i>Geum urbanum</i> L.	+	+	.	.
<i>Agrimonia eupatoria</i> L.	+	+	.	.	<i>Hypericum perforatum</i> L.	+	+	.	.
<i>Ajuga reptans</i> L.	.	.	.	+	<i>Inula acuminata</i> DC.	+	+	.	.
<i>Allium oleraceum</i> L.	1	.	.	.	<i>Lamium galeobdolon</i> (L.) L.	+	.	.	.
<i>Allium scorodoprasum</i> L.	+	+	.	.	<i>Lathyrus niger</i> (L.) Bernh.	.	.	.	1
<i>Anthericum ramosum</i> L.	.	.	.	+	<i>Lathyrus pratensis</i> L.	1	+	.	.
<i>Artemisia absinthium</i> L.	+	.	.	+	<i>Lathyrus sylvestris</i> L.	+	.	.	.
<i>Astragalus glycyphyllos</i> L.	1	+	.	.	<i>Lathyrus tuberosus</i> L.	+	.	.	.
<i>Berteroa incana</i> (L.) DC.	.	+	.	.	<i>Leucanthemum vulgare</i> Lam.	.	1	.	.
<i>Betonica officinalis</i> L.	.	+	.	.	<i>Lotus corniculatus</i> L.	2	2	1	.
<i>Calamagrostis arundinacea</i> (L.) Roth	1	2	.	.	<i>Medicago falcata</i> L.
<i>Calamagrostis epigejos</i> (L.) Roth	1	1	2	2	<i>Medicago lupulina</i> L.	.	1	.	.
<i>Campanula bononiensis</i> L.	+	.	.	.	<i>Melampyrum nemorosum</i> L.	+	1	.	.
<i>Campanula cervicaria</i> L.	.	+	.	.	<i>Melica transsilvanica</i> Schur	+	.	.	.
<i>Campanula glomerata</i> L.	.	+	.	.	<i>Melilotus albus</i> Medik.	+	.	.	.
<i>Campanula persicifolia</i> L.	+	.	.	.	<i>Melilotus officinalis</i> (L.) Lam.	.	+	.	.
<i>Chamaecytisus austriacus</i> (L.) Link	+	.	.	.	<i>Origanum vulgare</i> L.	+	1	.	+
<i>Chamaecytisus supinus</i> (L.) Link	+	.	.	.	<i>Pentanema germanicum</i> (L.) D. Gut. Larr. et al.	+	.	.	+
<i>Clinopodium vulgare</i> L.	2	1	.	1	<i>Pentanema hirtum</i> (L.) D. Gut. Larr. et al.	+	.	.	.
<i>Cota tinctoria</i> (L.) J. Gay	.	.	.	+	<i>Peucedanum cervaria</i> (L.) Lap.	1	.	.	.
<i>Dactylis glomerata</i> L.	1	1	.	1	<i>Plantago media</i> L.	.	1	.	.
<i>Dianthus carthusianorum</i> L.	1	+	.	.	<i>Potentilla inclinata</i> Vill.	+	.	.	.
<i>Digitalis grandiflora</i> Mill.	+	+	.	.	<i>Potentilla recta</i> L.	.	1	.	.
					<i>Ranunculus acris</i> L.	+	.	.	.
					<i>Rumex confertus</i> Willd.	.	1	1	.

Table 2. Continued.

Population	1	2	3	4
<i>Securigera varia</i> (L.) Lassen	2	2	.	.
<i>Sedum maximum</i> (L.) Suter	+	.	.	.
<i>Silene latifolia</i> Poir.	+	.	.	.
<i>Stachys annua</i> (L.) L.	+	1	.	.
<i>Symphytum officinale</i> L.	.	+	.	.
<i>Tanacetum corymbosum</i> (L.) Sch. Bip.	+	1	.	.
<i>Tanacetum vulgare</i> L.	+	1	.	.
<i>Teucrium chamaedrys</i> L.	.	+	.	.
<i>Torilis japonica</i> (Houtt.) DC.	+	.	.	.
<i>Trifolium arvense</i> L.	+	1	.	.
<i>Trifolium dubium</i> Sibth.	1	.	.	.
<i>Trifolium medium</i> L.	1	2	.	+
<i>Trifolium montanum</i> L.	+	1	.	+
<i>Trifolium pannonicum</i> Jacq.	.	+	.	.
<i>Trifolium pratense</i> L.	+	.	.	.
<i>Trifolium repens</i> L.	.	1	.	.
<i>Trifolium rubens</i> L.	1	1	1	1
<i>Verbascum lychnitis</i> L.	1	.	.	.
<i>Veronica spicata</i> L.	+	1	.	.
<i>Vicia cracca</i> L.	2	2	1	.
<i>Vicia lathyroides</i> L.	+	.	.	.
<i>Vicia villosa</i> Roth	.	+	1	.
<i>Vincetoxicum hirsutinaria</i> Medik.	.	.	.	+
<i>Viola arvensis</i> Murr.	+	.	.	.
<i>Viscaria vulgaris</i> Röhl.	1	.	.	.

participation (Table 2). *Lotus corniculatus*, *Calamagrostis epigeos*, and *Erigeron annuus* (L.) Pers were co-dominants of the herb layer together with *T. rubens*. In this population, the smallest number of clumps and the highest density of shoots were registered. The clumps area did not exceed 1 m².

Population 4. The population from the top of Lovachka mountain is located along the trail at the edge of the oak forest at the 295 m a.s.l. on a slope with an inclination of about 30°. The tree layer formed by *Quercus petraea* (Matt.) Liebl., *Robinia pseudoacacia*, and *Castanea sativa*. *Calamagrostis epigejos*, *Dactylis* L., *Trifolium rubens*, *Clinopodium vulgare*, and

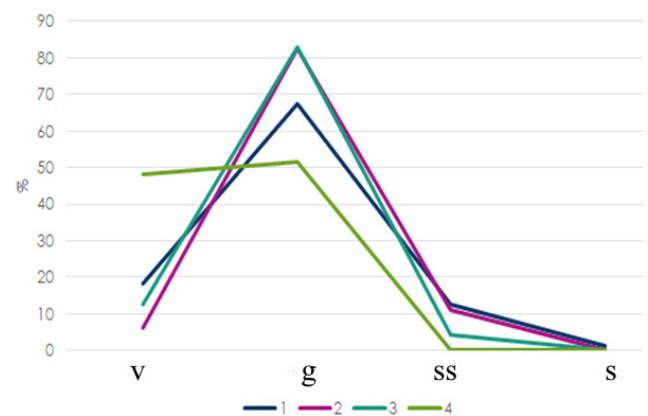


Figure 3. The ontogenetic spectrum of *Trifolium rubens* populations. 1–4 –populations' numbers; v – virginal, g – generative, ss – sub-senile, and s – senile shoots.

Lathyrus niger (L.) Bernh dominated in the herb layer, the projective cover of which reached about 50%. Two loci of this population were studied. Only generative and virginal shoots were found in clumps. Totally, 145 shoots were recorded in this population. The average density was 28.4 ± 5.0 shoots per 1 m²; in particular, 27 ± 3.6 vegetative and 26.8 ± 2.9 generative shoots per 1 m². Neither senile nor sub-senile shoots were detected.

Hence, the density of virginal shoots in the studied populations varied from 1 to 8 per 1 m². The most abundant were generative shoots (17–68 per 1 m² on average). The number of sub-senile shoots was 0–3 per 1 m², and senile – 0–2 per 1 m² (Fig. 3). The total number of shoots in the studied loci ranged from 41 to 165 per 1 m².

Conclusions

Trifolium rubens is distributed only in the right-bank part of Ukraine. There are 78 confirmed localities of this species in Ukraine. The presence of *T. rubens* in Volyn, Zhytomyr, Cherkasy and Kyiv regions is doubtful and has no recent confirmations.

Studied populations in Zakarpattia region were associated with meadow-steppe areas with the participation of shrubs. They were often located on slopes and associated with xerophile semi-natural shrub communities in areas with anthropogenic impact. They were often situated along pathways, on forest

edges, and associated with ecotones between forest or shrubs and herb communities from the class *Trifolio-Geranietea sanguinei*. In studied localities, *T. rubens* participated in communities with *Rubus fruticosus* agg., *Coronilla varia*, *Lotus corniculatus*, *Clinopodium vulgare*, *Trifolium medium*, *Melampyrum nemorosum*, *Inula salicina*, *Vicia cracca*, and *Calamagrostis* species.

Apparently, metapopulational structure with the dispersed disposition of plants on the large areas is characteristic for the *T. rubens* populations. The distances between loci in populations varied from 10 to 100 m. All studied populations were incomplete with the advantage of generative shoots (17–68 shoots per 1 m² or 51.7–82.5% from the total number of shoots). The absence of senile shoots evidences normal populations' conditions.

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Поширення *Trifolium rubens* в Україні та сучасний стан популяцій у Закарпатській області

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Trifolium rubens – це центральноєвропейський лісостеповий вид рослин, який в Україні знаходиться на східній межі поширення і включений до Червоної книги України (2009).

Дослідження проводили протягом 2016–2020 років. Метою дослідження було проаналізувати поширення цього виду в Україні, описати умови місцезростань та оцінити сучасний стан його популяцій у Закарпатській області. Для вивчення поширення виду було використано результати польових досліджень, дані з літературних та онлайн джерел, а також відомості з гербаріїв. Загалом було проаналізовано 78 місцезнаходжень *T. rubens* в Україні. В результаті чого було встановлено, що *T. rubens* трапляється в Закарпатській, Львівській, Івано-Франківській, Тернопільській, Хмельницькій, Рівненській, Чернівецькій та Вінницькій областях. Дві з цих областей (Хмельницька і Чернівецька) не наводилися раніше у Червоній книзі України. Присутність природних популяцій *T. rubens* у Волинській, Житомирській, Черкаській та Київській областях є сумнівним і не має сучасного підтвердження. Найбільше місцезнаходжень цього виду відомо з Закарпатської та Львівської областей.

Виявлено три нові місцезнаходження *T. rubens* у Вулканічних Карпатах та їхньому передгір'ї. Зокрема, описано флористичний склад фітоценозів та оцінено онтогенетичний стан популяцій у Берегівському та Мукачівському районах Закарпатської області. Ці популяції ізольовані з дисперсним розташуванням особин на великих площах. *Trifolium rubens* трапляється тут на лучно-степових і лучних ділянках, на схилах пагорбів, а також у складі мезоксерофільних вторинних (напівприродних) чагарникових угруповань на антропогенно трансформованих ділянках. Часто популяції цього виду розташовані вздовж стежок, на узліссях, перелогах у формаціях класу *Trifolio-Geranietea sanguinei*. Усі досліджені популяції неповностанові з переважанням генеративних пагонів.

Ключові слова: *Trifolium rubens*, хорологія, популяції, Україна