Wulfenia **29** (2022): 35–46

Wulfenia
Mitteilungen des
Kärntner Botanikzentrums
Klagenfurt

Jovibarba globifera (L.) J. Parn. (Crassulaceae) in Ukraine: Population status and ecological-coenotic description

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Summary: Ecological and coenotic features as well as the current state of the population of *Jovibarba globifera* (L.) J. Parn. (Crassulaceae), a rare boreal species within Ukraine and on its extreme areal border at the northern border of the Forest-Steppe zone in the landscape reserve of local significance, 'Chernechyi lis' of the Boyarka Forest Research Station (Kyiv region), have been studied.

Phytocommunities are distributed over its entire area in sparse pine forests, partially felled and burned. The studied phytocoenoses of this rare species, which is included in the Red Data Book of Ukraine, are assigned to a new provisional association: *Jovibarbo globiferi-Pinetum sylvestris* V. Konishchuk et I. Solomakha ass. nova prov., which, based on the affiliation of most woody, shrubby and herbaceous plants to the existing diagnostic species, is assigned to the class *Pyrolo-Pinetea sylvestris* Korneck 1974 (alliance *Koelerio glaucae-Pinion sylvestris* Ermakov 1999, order *Koelerio glaucae-Pinetalia sylvestris* Ermakov 1999).

Populations of this species show a rather good ecological condition and a considerable quantity of its individuals are in the optimal vegetative state at different stages of ontogenesis and occupy a total area of up to 2 hectares. *Jovibarba globifera* also grows in the western and north-western part outside an archaeological site, but in young and dense pine stands in this area, the distribution of the species becomes sparse and insignificant.

Keywords: *Jovibarba globifera*, nature reserve 'Chernechyi lis', association *Jovibarbo globiferi-Pinetum sylvestris*, Ukraine

Jovibarba globifera (L.) J. Parn. from Crassulaceae J. St.-Hil. is a rare European boreal species on the southern border of its growth area.

This species is widespread in Northern and Central Europe, less often in Eastern Europe on the border with Asia (Upper Volga, Volga-Kama regions). Natural habitats are found in Austria, Estonia, Lithuania, Latvia, Russia (Central European part), the Czech Republic, Slovakia, Germany, Poland and Ukraine. The species was introduced in Scandinavia (Sweden), Karelia and the extreme northern European part of the Russian Federation. It grows on rocks or on dry, sandy or stony ground ('t Hart et al. 2003).

In Ukraine it occurs mainly in Polissya, singly in the northern part of the Forest-Steppe. The species is distributed in light dry pine forests, on sandy places in the communities of the alliances *Dicrano-Pinion sylvestris* (Libbert 1933) W. Matuszkiewicz 1962 nom. conserv. propos. and *Koelerion glaucae* Volk 1931 in the northern part of Polissya (Volyn, Rivne, Zhytomyr, Kyiv, Chernihiv and Sumy regions). It is a mesoxerophytic and succulent plant (Andrienko et al. 2009). Habitats in the northern Forest-Steppe (Lviv and Kyiv regions) are also known. *Jovibarba globifera* is cultivated and often escapes from culture.

There are two species in the natural populations of Ukraine: *Jovibarba globifera* and *J. hirta* (L.) Opiz (*J. preissiana* (Domin) Omelczuk et Czopik), which are included in the Red Data Book of Ukraine (Approved by the Order of the Ministry of Environmental Protection and Natural Resources of Ukraine on February 15, 2021 No. 111). *Jovibarba globifera* is regionally rare in some cases, but widespread (from Polissya to the Steppe) in contrast to *Sempervivum ruthenicum* Schnittsp. et C.B. Lehm.

Jovibarba globifera (= *J. sobolifera*) is included in the regional red lists of Lviv (2015), Zhytomyr (2010), Sumy (2001) regions and is protected in most regions of the European part of the Russian Federation (Evstigneev et al. 2004; Varlygin et al. 2008), Czech Republic (Grulich 2012) and Poland (Kirpluk & Bomaniwska 2008; Grzegorz & Zbigniew 2010; Bomanowska et al. 2014).

According to the humidification regime, the species belongs to a xerophytic ecological group, the main ecotopes are green-moss pine forests, less often rock outcrops of mainly southern exposure, granite outcrops of the Ukrainian Crystalline Massif. We have identified and studied in detail a new habitat of the rare boreal European species *Jovibarba globifera*, which is widespread in Ukraine on the southern border of its range, for the first time.

Study area

The occurence of *Jovibarba globifera*, discovered by us, is located within the archaeological monument 'Khodosivska Archaeological Complex', a multi-layered settlement from the 6th millennium BC to the 18th century AD. This complex is located south of Kyiv and includes sites from different time periods up to the newest (Gotun 2011).

According to the materials of forest management, the identified habitats of the studied species are located within the quarter 237 of the Boyarka Forest of the SS NUBiP of Ukraine ('Boyarka Forest

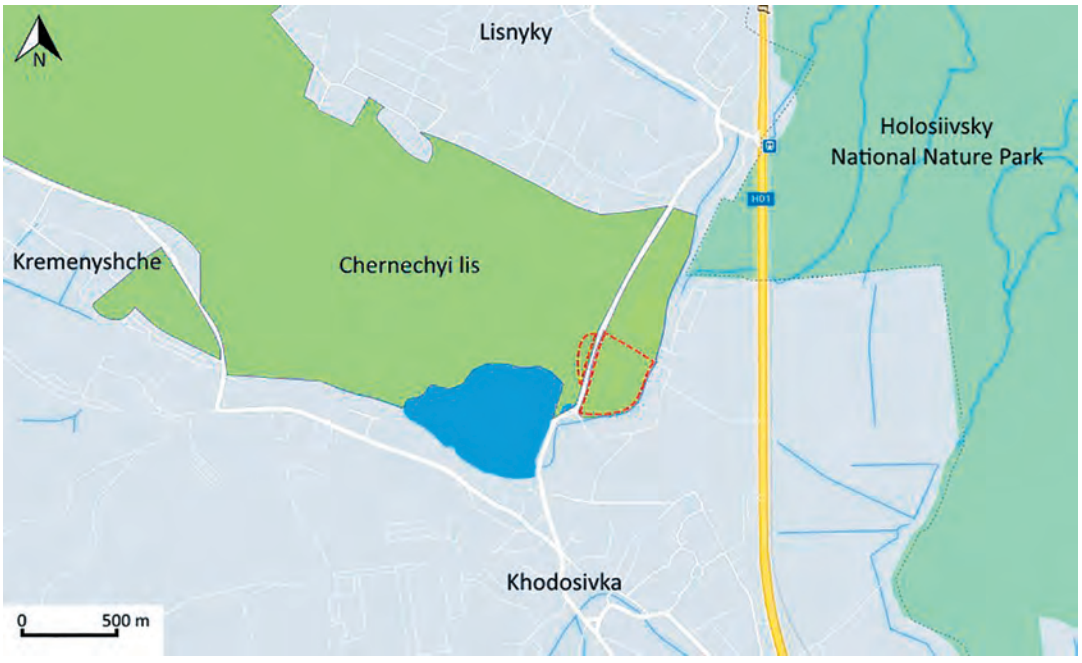

Figure 1. Location of the population *Jovibarba globifera* (landscape reserve 'Chernechyi lis').

Research Station') within the landscape reserve of local significance 'Chernechyi lis' (Prekrasna 2018; Decision of the Kyiv Regional Council No. 409-21-VII dated April 27, 2018) (Fig. 1). The reserve was created on an area of 442.0 ha to preserve the ancient oaks of Kyiv region. The area is part of the Emerald Network (Pryirpinnya and Chernechyi Forest No. UA0000338, site area 6094.7 ha) within the Pan-European Ecological Network.

It is located on the north side near the village of Lisnyky and the villages of Kremenyshche and Khodosivka in the south, within the administrative boundaries of Khotiv, Lisnyky and Khodosivska village councils of Kyiv-Sviatoshynskyi district of Kyiv region.

The territory of the reserve belongs to the European deciduous forest region and is located on the border of two natural-geographical regions: Ukrainian Polissya (south of Kyiv Polissya) and Forest-Steppe of Ukraine (northern part of the Kyiv plateau). Oak-pine forests (*Quercus robur* L., *Pinus sylvestris* L.) predominate, often admixed with linden (*Tilia cordata* Mill.), maple (*Acer platanoides* L.) and hornbeam (*Carpinus betulus* L.). The soil cover is formed mainly by sod-slightly-podzolic clay-sandy soils on fluvioglacial and alluvial deposits in the central part of the seabed. Near the eastern part of the reserve there is a swampy floodplain of the Vita river.

The region is characterized by a relatively mild climate with fairly high average annual temperatures (+ 6.7°C) and significant rainfall. Maximum temperatures reaching + 36°C occur in July and August, minimum (– 33°C) mainly in February. The absolute amplitude of temperature fluctuations reaches 70°C, which is typical of the predominant part of the northern Right Bank and testifies to the insignificant continentality of the climate. Growing season lasts 182 days (from April 9 to October 15), frost-free period on average 180–187 days.

The amount of precipitation is very irregular and ranges from 400 to 800 mm, 578 mm falls per year on average, the most in summer and the least in winter. On average, 380 mm of precipitation falls during the growing season or 65% of the total rainfall per year.

In winter, 145–155 mm of precipitation falls in the form of snow, but a stable snow cover is not formed every year. In open places, the height of snow cover is 9 cm on average and in forest plantations up to 20 cm. In light snow winters during severe frosts, deep soil freezing occurs, which sometimes reaches 151 cm, the average depth of freezing is 85 cm, the lowest is 22 cm. Snow lies 112 days on average with a deviation of 98 to 142 days. The prevailing winds in the region are northwest and west with an average speed of 3.3 ms^{-1}.

Geomorphologically, the district is located at the watershed of the Dnipro and Irpin rivers, in the area of Kyiv Polissya. However, there are areas that are typical wash plains of Polissya as well as clearly eroded landforms characteristic of the Forest-Steppe. On the territory of the forest research station, one type of soil was identified for the species under study: sod-slightly-podzolic.

The landscape reserve 'Chernechyi lis' is one of the key areas of the regional ecological network and is part of the Dnipro ecological corridor of national importance. It also has a significant phytosociological value. Thus, such rare species as *Neottia nidus-avis* (L.) Rich. and *Lilium martagon* L. occur in the reserve (Didukh 2009). Regionally rare species protected in the Kyiv region were also identified (*Potentilla alba* L., *Digitalis grandiflora* Mill.). The area included in the reserve is valuable in terms of fauna, as the old-aged *Quercus robur* trees are home of rare insects listed in the Red Data Book of Ukraine (Didukh 2009) as *Lucanus cervus* (Linnaeus, 1758), *Cucujus cinnaberinus* (Scopoli, 1763), *Aromia moschata* (Linnaeus, 1758), *Osmoderma barnabita*

(Motschulsky, 1845), *Callimorpha dominula* (Linnaeus, 1758) and *Catocala fraxini* (Linnaeus, 1758). Their habitats are confined to deciduous forests.

Materials and methods

Investigations were carried out by the route method on 03.08.2020 in the landscape reserve 'Chernechyi lis'. Taxonomic names are given according to IPNI (2022) and Hassler (2019). Collection of herbarium specimens and their processing was carried out according to standard classical methods. Description of the forest vegetation was performed and processed according to the methodology of the Braun-Blanquet school (Mirkin et al. 2001). To find out the features of *Jovibarba globifera* growth, forest research plots (20 × 25 m) with a tree 60–70 years of age were established. Seven geobotanical descriptions were conducted in the plots, processed by phytocoenological methods. A modified Mirkin scale was used to estimate the projective coverage of the species: +–: < 1%, 1: 1–5%, 2: 6–15%, 3: 16–25%, 4: 26–50%, 5: > 50% (Mirkin et al. 2001).

After the names of the species of trees and shrubs, the layer is given: a – the upper tree layer; b – shrub layer and undergrowth of trees; c – seedlings of tree species (grass layer).

Data on the distribution of *Jovibarba globifera* are given according to our own and literature data (Bordzilovskyi 1953; Andrienko 2006; Andrienko & Konishchuk 2008; Andrienko et al. 2009; Kuzmishyna et al. 2015; Panchenko & Ivanets 2019) and according to the National Herbarium of Ukraine [KW].

Results and discussion

Jovibarba globifera is quite polymorphic and insufficiently studied. It is considered a synonym for: *Diopogon globifer* (L.) Leute, *D. hirtus* subsp. *borealis* H. Huber, *D. soboliferum* (Sims) Gand., *J. globiferum* (L.) Tjaden, *J. hirta* subsp. *borealis* (H. Huber) Soó, *J. sobolifera* (J. Sims) Opiz, *Sempervivum soboliferum* Sims.

According to the updated information (IPNI 2022; Hassler 2019), the name *Jovibarba globifera* is synonymous to *Sempervivum globiferum* L. (Status Accepted), basionym *Sempervivum globiferum* L.

In the Flora of UkrSSR, *Jovibarba globifera* (= *Jovibarba sobolifera*) is marked as a species that "can be confidently indicated only for Polissya" with locations in Kyiv and Chernihiv regions (Bordzilovskyi 1953). According to the Identification Key of Higher Plants of Ukraine, the species rarely occurs in the Kyiv, Rivne and Volyn regions. Official sources are usually used for the distribution of *Jovibarba sobolifera* (Didukh 2009), where it is indicated that populations cover small areas, but with a large number of individuals, often consisting of several loci. The largest known is the population in the Desniansko-Starogutsky National Nature Park, which occupies several hectares with several loci (Panchenko & Ivanets 2019). However, our additional research indicates that the largest populations are in the Volyn region and in the south of Kyiv.

We noted the morphological features of *Jovibarba globifera* in different physical and geographical regions and their edaphic conditions. On petrophilic substrates and granites flowering stem is sloping, lying. In Polissya and in the Forest-Steppe, the stem is erect and tall, in more fertile edaphotopes the habit of individuals is stronger, but on poor sod-podzolic soils of Western Polissya the flower is larger and more open.

Recently, natural localities from different regions have been revealed on the territory of Ukraine: **Volyn region (12 localities)**: villages Volia Kovelska, Uhly (Kovel district), Pozhoh (Lyubeshiv district), Horodok, Zamostia, Karasyn, Krasnovolia (Manevychi district), Tsumanska Pushcha, south of the town of Ratne, Cheremskyi Nature Reserve, national nature parks Shatskyi and Prypiat-Stokhid; **Zhytomyr region (3)**: villages Skochyshche (Brusyliv district), Vysoka Pich near Zhytomyr, Drevlyansky Nature Reserve; **Kyiv region (5)**: pine-forest stands near the Kyiv reservoir (Vyshhorod district), Chornobyl Radiation and Ecological Biosphere Reserve, Piskivka village (Teterivsky forestry), Lisnyky Reserve (Lisnyky, Kyiv-Sviatoshyn district), reserve 'Chernechyi lis' (Khodosivka, Kyiv-Sviatoshyn district); **Lviv region (2)**: villages Zhulychi, Yelykhovychi (Zolochiv district); **Rivne region (4)**: Klevan city (Novostav), regional landscape parks Prypiat-Stokhid and Nadsluchanskyi, reserve Bryshche, Rivne Nature Reserve; **Sumy region (3)**: in the north of the region, villages Ulytsia, Novovasylivka, Desniansko-Starogutsky National Nature Park; **Chernihiv region (3)**: between the Dnipro and Desna rivers, Ripky (Ripkynsky and Kozeletsky district) (Fig. 2).

Data on the distribution of *Jovibarba globifera* are given from own and literature data (Bordzilovskyi 1953; Andrienko 2006; Andrienko & Konishchuk 2008; Andrienko et al. 2009; Kuzmishyna et al. 2015; Panchenko & Ivanets 2019).

Within the Forest-Steppe of Ukraine, the habitats of *Jovibarba globifera* are mentioned only in two sources: Kyiv region, Lisnyky reserve, Fitsailo T.V., 8.08.1997 [KW], today it is the territory of the Holosiivskyi National Nature Park, and for the Lviv region (Yurechko 2017). There is no information about the distribution of this species even further east and south in the Forest-Steppe zone, so the habitat in a pine forest near the village of Khodosivka, Kyiv-Sviatoshyn district, Kyiv region is the most south-eastern point and is actually the northern part of the Forest-Steppe zone on the border with Polissya.

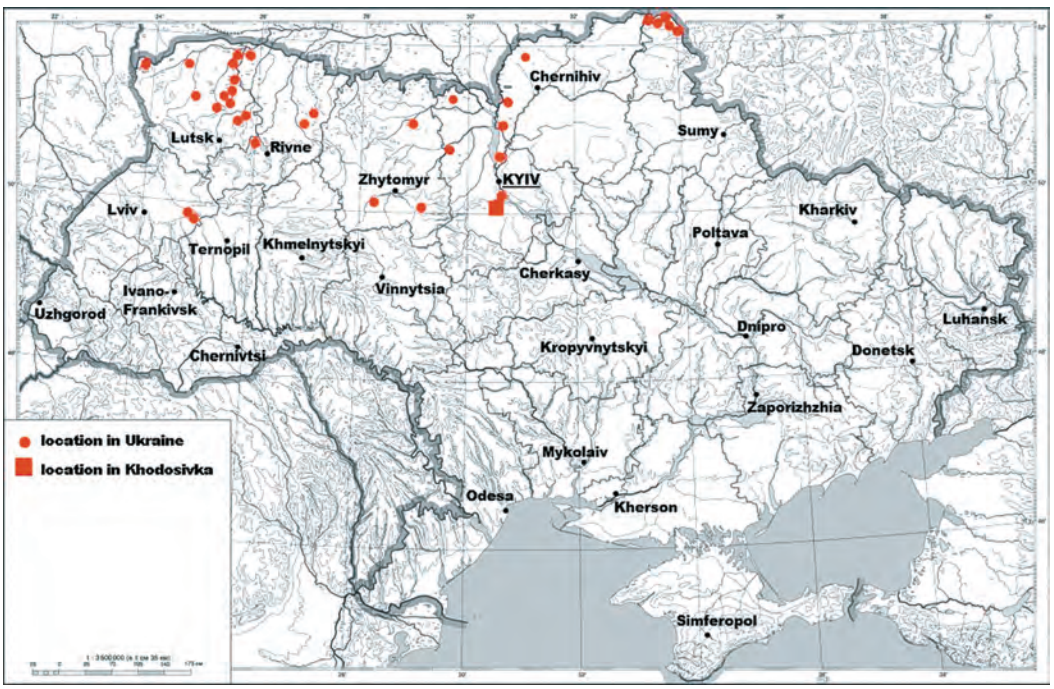

Figure 2. Distribution of *Jovibarba globifera* in Ukraine.

Only two wild species of *Jovibarba globifera* and *Sempervivum ruthenicum* occur in Polissya, other species are represented in mountainous regions. Silicious sod-podzolic soils of West Polissya always have an acidic reaction due to the presence of humic acids, so *Jovibarba globifera* can be considered as acidophilic species. *Sempervivum ruthenicum* grows best on humus-rich, sandy and sod soils, so its range in Ukraine is much larger and more southern.

The habitat conditions of *Jovibarba globifera* are somewhat specific. It grows on the periphery of dry low-grass meadows, near trampled paths, on sandy places of meadows and edges (Fig. 3) in light pine forests of Polissya. It grows in alliances PIC-03A *Dicrano-Pinion sylvestris* (Libbert 1933) W. Matuszkiewicz 1962 nom. conserv. propos., class PIC *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. et al. 1939, COR-01B *Koelerion glaucae* and class COR *Koelerio-Corynephoretea canescentis* Klika in Klika et Novák 1941 (Didukh 2009). The detection and protection of new populations of the species are necessary. Excavation and habitat disturbance have to be prohibited.

In the southern and central part of the study area (plot 1, area 9.0 ha), a plantation of *Pinus sylvestris* grows (about 80 years old, average diameter 28 cm, average height within the site 22–24 m). The forest area is characterized by thinned forest stands with a density of 0.4–0.5 and by uneven location of trees in the area. The plantation showed signs of lowland forest fires of previous years (traces of burning on the bark of tree trunks) mainly in the southern, central and eastern parts of the site. Dead pine wood is available on the site. In the southern part, one dead, broken tree and a lying fragment of this tree of class II destruction were found. In the central part of the site, there are several dead trees of class I destruction. In the western part we found single dead and felled trees of *Pinus sylvestris* (classes I–II of destruction) with an approximate stock of 5–7 m^3 / ha; in the eastern part, the stock of dead wood is large and up to 10 m^3 / ha, formed mainly by dead trees of class I destruction. In the area we recognized natural regeneration of tree

Figure 3. *Jovibarba globifera* in light pine forests of Polissia, Volyn. Photo: Konishchuk V.

species: *Pinus sylvestris*, *Quercus robur*, *Q. rubra* L., *Betula pendula* Roth., *Robinia pseudoacacia* L. and others. *Pinus sylvestris* is renewed by groves, in small groups and singly. On the hill in the south-eastern part of the site, a grove of undergrowth of this tree species aged about 15 years was found. In small groups (5–10 individuals) or singly, natural regeneration of *Pinus sylvestris* occurs in well-lit areas, where there a fall of pine trees of the main stand took place, in the whole study area (three to six years old, height 0.4–0.8 m). There is also a single 1–2-year renewal of this tree species. Natural renewal of *Quercus robur* was found mainly in the western part of the site, in the lowerings, mostly solitary, although oak undergrowth is also found in its central part. In the western part of the site, there are also young oak trees up to 10 m tall. The regrowth of *Betula pendula* is represented by only a few young trees that grow singly, mainly in the central part of the plot (height 2.0–3.0 m). Renewal of other tree species (*Quercus rubra*, *Robinia pseudoacacia*) was found singly in the western part of the site, adjacent to the road.

In the northern part of the study area (plot 2, area about 1.5 ha) pinewood plantations of *Pinus sylvestris* (about 55–60 years old) grow. The average diameter is about 20 cm, stocking degree – about 0.8. Natural renewal of *Pinus sylvestris* was not detected. Dead wood was found only singly in the form of individual dead trees.

Single localities of *Jovibarba globifera* were also found east of plots 1 and 2 and in the neighbouring forest areas adjacent to the north-eastern side of Khodosivka lake. The plantation of *Pinus sylvestris* (about 60 old) years grows in the specified territory. The average diameter of the trees is 22 cm, its stocking degree is about 0.7. Dead wood is found only singly in the form of individual dead trees. The approximate distribution square of *Jovibarba globifera* in this area is about 1.5–2.0 ha.

As a result of the phytocoenotic study 7 geobotanical descriptions were performed (Table 1) containing following characteristics.

After analyzing communities data, we assigned them to the class PYR *Pyrolo-Pinetea sylvestris* Korneck 1974 based on the affiliation of most woody, shrubby and herbaceous plants to the diagnostic block of species of this class and then to the alliance PYR-03A *Koelerio glaucae-Pinion sylvestris* Ermakov 1999, order PYR-03 *Koelerio glaucae-Pinetalia sylvestris* Ermakov 1999 (Mucina et al. 2016) (Fig. 4).

Based on geobotanical descriptions, we have described a new provisional association according to the Braun-Blanquet ecological-floristic classification:

Association. *Jovibarbo globiferi-Pinetum sylvestris* V. Konishchuk et I. Solomakha ass. nova prov.

Diagnostic species. *Pinus sylvestris* (dom.), *Jovibarba globifera* (dom.), *Calamagrostis epigeios* (dom.), *Festuca ovina* (dom.), *Chamaecytisus ruthenicus*, *Sedum ruprechtii*.

The provisional association was found in the reserve 'Chernechyi lis' on the pine terrace of the Dnipro river.The studied phytocoenoses grow in the upper part and slopes of water-glacial dunes in sparse suppressed plantations of *Pinus sylvestris* (height 22–24 m, up to 80 years old).

We have analyzed some results of European research. For Slovakia, an association with *Jovibarba globifera* is provided: *Jovibarbo-Sedetum albi* (all. SED-04A *Alysso alyssoidis-Sedion* Oberd. et T. Müller in T. Müller 1961, cl. SED *Sedo-Scleranthetea* Br.-Bl. 1955). This association represents an open thermophilous pioneer plant community developed on dry calcareous bedrock on shallow soils, dominated mainly by *Jovibarba globifera* (Kochjarová et al. 2015).

Table 1. Phytocenotic characteristics of the association *Jovibarbo globiferi-Pinetum sylvestris*.

Description number	Mnemocode of classes*	1	2	3	4	5	6	7
Density of the stand of trees		0.5	0.4	0.4	0.5	0.6	0.5	0.4
Density of the shrub layer		0.1	0.1	0.1	0.1	0.1	0.1	0.1
Projective coverage of herb layer		60	60	20	30	20	15	25
Jovibarba globifera	PYR	1	2	3	3	2	2	3
Pinus sylvestris (a)	ERI, PIC, PYR	4	3	3	4	4	4	3
Pinus sylvestris (b)	ERI, PIC, PYR	+	+	1	+	+	1	1
Calamagrostis epigeios	ART	+	5	+	1	-	+	+
Festuca ovina	COR	5	1	+	1	1	-	+
Chamaecytisus ruthenicus	-	1	1	-	1	+	-	-
Sedum ruprechtii	-	+	+	+	+	+	+	-
Potentilla argentea	PYR, SED	+	-	-	+	+	-	-
Quercus robur (b)	QUE	+	+	-	+	2	1	-
Jasione montana	COR	+	+	-	+	-	-	-
Koeleria glauca	COR, PYR	1	+	-	-	+	+	+
Artemisia annua	SIS	1	-	-	+	-	-	-
Linaria vulgaris	ART	+	-	+	+	-	-	-
Veronica chamaedrys	BRA,HER, MOL	+	-	+	-	-	-	-
Dianthus borbasii	COR, PYR	+	-	-	-	-	-	-
Hieracium umbellatum	QUE, FES	-	1	-	+	+	-	-
Solidago virgaurea	BRA, HER, RHA	-	+	-	+	-	+	-
Agrostis canescens	-	-	-	+	-	+	-	-
Otites borysthenica	-	-	-	+	+	+	-	+
Carex ericetorum	ERI, PYR	-	-	-	+	+	-	-
Centaurea sumensis	PYR	-	-	-	1	-	-	-
Sempervivum ruthenicum	FES, PYR	-	-	-	-	1	1	-
Sorbus aucuparia (b)	BRA, RHA	-	-	-	+	+	-	-
Thymus serpylium	COR, SED	-	-	-	+	+	-	-
Polygonatum odoratum	BRA, HER	-	-	-	+	+	+	-
Dicranum polysetum	PIC	-	-	-	1	1	4	-
Senecio vulgaris	PAR	-	-	-	-	+	+	+
Quercus rubra (b)	FAG	-	-	-	-	+	+	-
Veronica spicata	PYR	-	-	-	-	+	-	-

Species that occur occasionally: *Anisantha tectorum* (1 +), *Campanula sibirica* (5 +), *Erigeron canadensis* (1 +), *Pilosella officinarium* (4 +), *Rumex acetosella* (3 +), *Setaria viridis* (1 +), *Vincetoxicum hirundinaria* (5 +).

Note. Legends to descriptions in Table 1: Reserve 'Chernechyi lis', pine-forest terrace of the Dnipro river (50.284355 N 30.520615 E), 13.07.2020. Authors: Konishchuk V.V., Solomakha I.V.

1. Levelled area on the dune: pine is depressed, restoration present, description area 20 × 10 m.
2. Ridge-top slope of western exposition: steepness – 10°, description area 25 × 25 m.
3. Slight slope of western exposition: steepness – 5°, partially bare, hilly-pitted, description area 15 × 15 m. ▶

Figure 4. Ecotope and flowering of *Jovibarba globifera* (Khodosivka village, reserve 'Chernechyi lis', Kyiv region). Photo: Konishchuk V.

In Latvia, *Jovibarba globifera* is listed as a rare species for habitats such as: 6110 (E.1.3) Rupicolous calcareous or basophilic grasslands of the *Alysso-Sedion albi* (all. SED-04A *Alysso alyssoidis-Sedion*); 6120 (E.1.1, E.1.2) Xeric sand calcareous grasslands (all. COR-01B *Koelerion glaucae*, all. COR-01D *Armerion elongatae* Pötsch 1962, cl. COR *Koelerio-Corynephoretea canescentis*) (Auniņš 2013). So, in the above-mentioned works, *Sempervivum globiferum* was presented in 2 classes of psammophytic vegetation, and we studied its habitat as a part of forest vegetation, although it also grows on sands.

Conclusions

The studied species is protected at the state level. Protection requires identification and protection of new populations of *Jovibarba globifera*. Therefore, one of the important aspects of species conservation is its comprehensive study.

The initial selection of plant species for the Red Data Book of Ukraine (Didukh 2009) for *Jovibarba globifera* is characterized by the following criteria: chorological (species on the southern border of the range), criterion of limited number (few large populations), taxonomic (one of the five species of the genus in the flora of Ukraine), biological and morphological (a species of

4. Ridge-top of the dune section of western exposition: steepness – 1°, description area 15 × 15 m.
5. Ridge-top of a slight slope of northwestern exposition: steepness – 1°, description area 30 × 10 m.
6. Slight slope of southwestern exposition: steepness – 3°, description area 30 × 10 m.
7. Ridge-top of a slight slope of southwestern exposition: steepness – 3°, 20 × 10 m.

Mnemocode of classes* (Mucina et al. 2016): **ART** *Artemisietea vulgaris* Lohmeyer et al. in Tx. ex von Rochow 1951; **BRA** *Brachypodio pinnati-Betuletea pendulae* Ermakov et al. 1991; **COR** *Koelerio-Corynephoretea canescentis* Klika in Klika et Novák 1941; **ERI** *Erico-Pinetea* Horvat 1959; **FES** *Festuco-Brometea* Br.-Bl. et Tx. ex Soó 1947; **HER** *Salicetea herbaceae* Br.-Bl. 1948; **PIC** *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. et al. 1939; **PUB** *Quercetea pubescentis* Doing-Kraft ex Scamoni et Passarge 1959; **PYR** *Pyrolo-Pinetea sylvestris* Korneck 1974; **QUE** *Quercetea robori-petraeae* Br.-Bl. et Tx. ex Oberd. 1957; **RHA** *Crataego-Prunetea* Tx. 1962 nom. conserv. propos.; **SED** *Sedo-Scleranthetea* Br.-Bl. 1955.

xerophyte succulent biomorph, rare in the flora of Ukraine and with a complex reproductive cycle), aesthetic value (decorative species), population-dynamic (population reduction), threat of habitat loss (destruction of stenotopic ecotopes and direct destruction of individuals through excavation for transplantation).

It should be noted that flowering and fruiting of *Jovibarba globifera* is not frequent. The species is acidophilic and usually occupies the pioneer areas of sandy dry ecotopes, or it is confined to ancient pine forests on fluvio-glacial landforms formed in the period after the Dnipro glaciation.

Probably the optimum development of *Jovibarba globifera* populations and its maximum distribution in the Forest-Steppe of Ukraine took place during the interstadials of the Würm period (80–15 thousand years ago), when there was a fairly active aeolian process at a temperature much lower than nowadays, higher humidity and precipitation (Rosly 1986). The intensity of wind activity could contribute to the dissemination of this anemochorous taxon and the lack of competition with many types of herbs as well as the effectiveness of the reproductive process. Some habitats of this generally coenophobic species were observed at the outcrops of crystalline granite rocks of the Ukrainian Crystalline Massif and in pine forests on loamy forest deposits in the northern part of the Forest-Steppe of Ukraine and sandy alluvial deposits in Polissya obviously represent disjunctions that formed as a result of changes in vegetation already in the Holocene. So, this species is logically interpreted as a relic of the last (Würmian) glaciation of the plains of Europe.

According to long-term research results, it is proved that the species reproduces mostly vegetatively (by runners), seed germination is very rare, and young individuals are weakly competitive, so the primary criterion for its protection is the preservation of intact natural habitats.

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