

## Plant species richness records in Ukrainian steppes

### Rekorde des Pflanzenartenreichtums in ukrainischen Steppen

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## Abstract

We compiled a list of the known maxima of vascular plant species richness in the steppe zone of Ukraine at different sampling scales (0.0001–100 m<sup>2</sup>) and compared them with the world records. Detailed information on each of the identified species-rich grassland plots is provided, including site descriptions, plot characteristics, coordinates, and species lists. Most of the small-scale records (up to 0.1 m<sup>2</sup>) were found in mesic grasslands in southern Ukraine (Kherson region) with a high abundance of annual grasses and forbs: 9 and 11 vascular plant species in 0.0001 m<sup>2</sup> and 0.001 m<sup>2</sup>, respectively, in the steppe depression Chorna Dolyna, and 26 species in 0.1 m<sup>2</sup> in a mesic psammophytic grassland in the Dzharylhach National Nature Park. Most of the records at larger scales were made in the northern part of the steppe zone, in forb-rich and forb-grass steppes: 15, 39, 73, and 107 species in 0.01, 1, 10, and 100 m<sup>2</sup>, respectively. All richness records were characterised by neutral to slightly alkaline substrates (soil pH 7.0–7.7) and low-intensity management. These characteristics are consistent with the known patterns from world records of species richness. Our inventory provides baseline knowledge for studies on the high species richness in the steppe zone and can stimulate the further investigation of identified species-rich grasslands, as well as the search for new ones. Since we did not specifically search for species-rich sites, and our dataset includes only a relatively small number of plots compared to similar studies in other regions, we expect that more species-rich vegetation will be found with further research. This study highlights the importance of steppe grasslands as global biodiversity hotspots and draws attention to their protection in the context of land-use changes and the consequences of the war in Ukraine.

**Keywords:** alpha diversity, biodiversity, grassland, maximum, spatial scale, species richness, steppe, Ukraine, vascular plant, vegetation plot.

**Erweiterte deutsche Zusammenfassung am Ende des Artikels**

## 1. Introduction

Temperate grasslands in Europe are known for their high species diversity, including most of the known world records for grain sizes below 100 m<sup>2</sup> (Zobel 1992, Wilson et al. 2012, Chytrý et al. 2015). Studies of maximum species richness provide valuable insights into the diversity, distribution, and conservation of grassland ecosystems, as well as into the ecological theory of fine-scale species coexistence and the maintenance of high species diversity (Chytrý et al. 2015, Biurrun et al. 2021). Factors such as soil properties, climate, and land-use practices are thought to play a crucial role in shaping the richness records (Roleček et al. 2014, Palpurina et al. 2015).

Almost all of the known species richness maxima represent meso-xeric and mesic grassland communities in Central Europe, such as the grasslands of the White Carpathians in the Czech Republic and Slovakia (Chytrý et al. 2015), Romanian Transylvania (Dengler et al. 2012, Turtureanu et al. 2014, Roleček et al. 2021), and western Ukraine (Roleček et al. 2014). These regions represent the westernmost part of the forest-steppe in Europe and its transition to the nemoral zone. These regions have been studied for a long time by many experienced botanists, which can increase the probability of finding new records (Chytrý et al. 2015, Hájek et al. 2020). Species richness values close to these maxima described above were also reported from Estonia (Kull & Zobel 1991, Sammul et al. 2003), Sweden, and northern Germany, where intensive vegetation sampling has been carried out and a large number of high-quality plots are available.

There are only a few reports of outstanding plant species richness from the steppe biome in Eastern Europe, most of them stemming from the forest-steppe regions with meadow-steppe vegetation. For example, 77, 87, and 88 species in 1 m<sup>2</sup> and 110 and 130 species in

100 m<sup>2</sup> were reported from the central chernozem steppe in the Kursk region (van der Maarel & Titlyanova 1989, Vasilevich 2009), but without species composition data or precise coordinates. The world's richness record of 119 species at 16 m<sup>2</sup> was recorded in the meadow steppes near the Spaska village in Chernivtsi region, Ukraine (Roleček et al. 2019). Well-documented richness records at different grain sizes from the Eurasian steppe biome have been reported from the EDGG Field Workshops in the forest-steppe zone in Central Podolia, Ukraine (Kuzemko et al. 2016), and in the transition between the forest-steppe and steppe zones in Khakassia, Siberia (Polyakova et al. 2016). However, most of the steppe biome is not yet covered by systematic vegetation sampling, which significantly complicates the search for and documentation of species richness records.

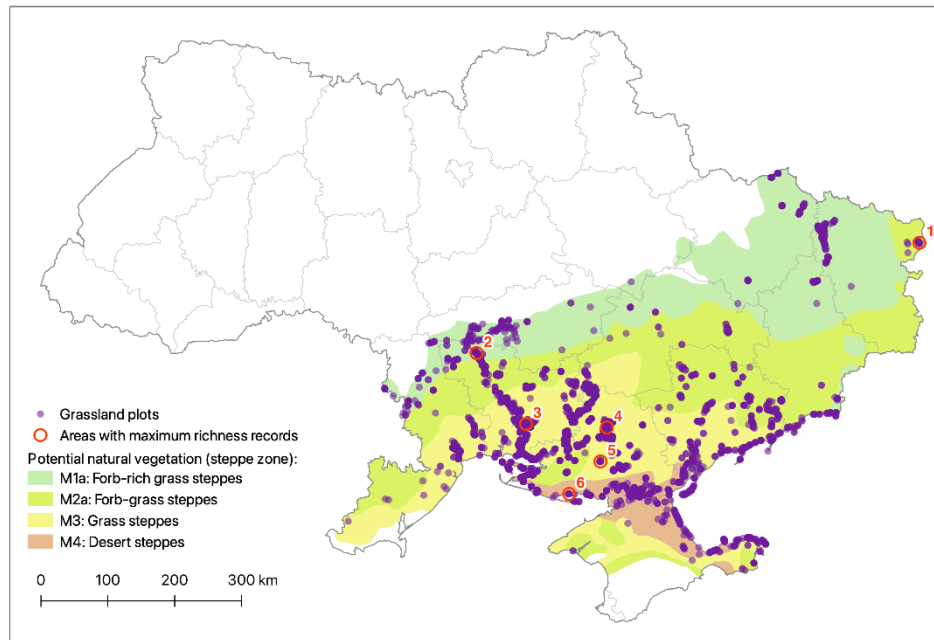
To help fill this knowledge gap, we compiled hitherto scattered or unpublished data on plant species richness in the steppe zone of Ukraine at different scales. Specifically, we aimed to reveal where and under which conditions particular species-rich grasslands occur and how their diversity compares to the known records from other regions.

## 2. Methods

In our study, we searched for species-rich plots of grassland vegetation in the steppe zone of Ukraine. We collected all available data on the vascular species richness of grassland habitats, including data from vegetation databases, literature, and our own fieldwork. We limited the selection of relevés to those with coordinates, a specified plot size, and species composition data (list of vascular plant species recorded). We considered data from all grassland habitats that occur in the steppe zone (Kuzemko et al. 2022). The resulting dataset contained 7781 plots (Fig. 1), including 4309 plots that were sampled by our team in 2005–2023, mainly in the western part of the steppe zone in Ukraine (Kherson, Mykolaiv, and Odesa regions). All of these plots were delimited with a tape measure. To obtain nested series data, we used the standard EDGG methodology (Dengler et al. 2016, 2021) with seven grain sizes ranging between 0.0001 and 100 m<sup>2</sup> nested within each other, thus resulting in a total of 183 nested plot series with species richness data at seven different scales. The species occurrences within each plot of the nested series were assessed by shoot presence. A further 3472 vegetation plots (size range: 0.5–100 m<sup>2</sup>; sampled in 1953–2020) were obtained from the following three phytosociological databases: the Eastern European Steppe Database (EU-00-030; Vynokurov et al. 2020), the Ukrainian Grassland Database (EU-UA-001; Kuzemko 2012), and the Vegetation Database of Ukraine and Adjacent Parts of Russia (EU-UA-006). The method and accuracy of measurement was unknown for most of the data from these databases. In addition to the vegetation plots from sources which were already included in the databases, we also searched for relevant data published in PhD theses which focus on the vegetation of the steppe zone in Ukraine, as well as articles in the archives of the Ukrainian Botanical Journal (<https://ukrbotj.co.ua/archive>), Chornomorski Botanical Journal (<https://cbj.kspu.edu/index.php/en/main>), and in Google Scholar using the following search string in English: 'species richness' & ('grassland' / 'steppe' / 'steppe zone') & 'Ukraine'; and in the Ukrainian language: ('видове багатство' / 'видова насиченість') & ('луки' / 'степи' / 'степова зона') & 'Україна'.

Species richness (number of species) was counted for vascular plants only. Records of the same species in different layers (e.g. seedling, juvenile, shrub) were merged. The nomenclature of vascular plants followed the Ukrainian checklist (Mosyakin & Fedoronchuk 1999). For the plots with maximum richness records, we also checked whether the number of species differed when following the Euro+Med nomenclature (Euro+Med PlantBase; <http://ww2.bgbm.org/EuroPlusMed/>, accessed 2023-10-15).

For the inventory and documentation of the record plots, we followed the approach by Chytrý et al. (2015). For each of the identified species-rich grassland plots, we provided the following information: site descriptions, plot characteristics, coordinates, and species lists. This way of presenting information about the plots allows for future verification and clarification of the plots, and also facilitates further analysis and the comparison of species richness records in different regions.



**Fig. 1.** Locations of analysed grassland plots (dots) and potential natural vegetation for the steppe zone in Ukraine according to Bohn et al. (2000) (background colours). Locations with a high density of sampled plots are indicated by darker points. Areas 1–6 and their richness records are described in the Results.

**Abb. 1.** Orte der untersuchten Grasländer (Punkte) und potenzielle natürliche Vegetation der Steppenzone der Ukraine nach Bohn et al. (2000) (Hintergrundfarben). Standorte mit einer hohen Dichte an Probeflächen sind durch dunklere Punkte gekennzeichnet. Die Gebiete 1–6 mit Rekorden des Artenreichtums sind im Ergebnis teil beschrieben.

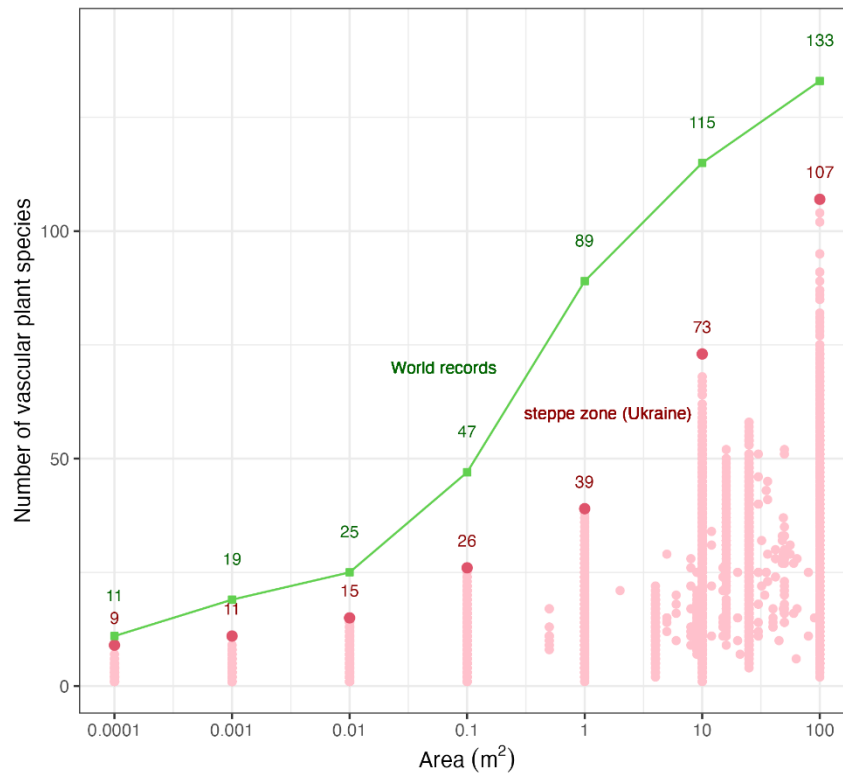
To compare our results to the world richness records, we compiled an updated list of the published world records of species richness in grasslands based on the following literature sources: for the 0.0001 m<sup>2</sup> grain size – 11 species (Biurrun et al. 2021), 0.001 m<sup>2</sup> – 19 species (meso-xeric grassland in Spain; mentioned in Dengler et al. 2016, 2020), 0.01 m<sup>2</sup> – 25 species (wooded meadow in Estonia, Kull & Zobel 1991), 0.1 m<sup>2</sup> – 47 species (meso-xeric grassland in Switzerland; 47 species for 0.09 m<sup>2</sup> published in Riedel et al. 2023), 1 m<sup>2</sup> – 89 species (mountain grassland in Argentina, Cantero et al. 1999), 10 m<sup>2</sup> – 115 species (Romania, Roleček et al. 2021), and 100 m<sup>2</sup> – 133 species (Czech Republic, Chytrý et al. 2015). All the listed world records of species richness are from grasslands located in Europe, except for the 1-m<sup>2</sup> record of 89 species from Argentinian grasslands. For Europe, the maximum species richness on 1 m<sup>2</sup> is 82 species, as reported in the White Carpathians by Hájek et al. (2020).

We also considered the distribution of richness records in the four different steppe subzones, using the map of the potential natural vegetation of Europe (Bohn et al. 2000): forb-rich (originally referred to as “herb-rich” in Bohn et al. 2000) grass steppes (M1a), forb-grass (originally referred to as “herb-grass”) steppes (M2a), grass steppes (M3), and desert steppes (M4) (Fig. 1).

### 3. Results

The highest species richness values in the steppe zone of Ukraine and its subzones are shown in Figure 2, Table 1, and Supplement E1. Most of the plots in the dataset were represented by the following seven grain sizes: 0.0001, 0.001, 0.01, 0.1, 1, 10, and 100 m<sup>2</sup>. In Figure 2, the maximum richness values for each of these plot sizes in Ukraine are compared with the known world richness records. Since plots with a size other than the standard ones listed above had lower maximum richness values than their nearest neighbour standard plots, e.g. plots of 16 and 25 m<sup>2</sup> had lower richness maxima than standard 10-m<sup>2</sup> plots, we do not list these plots in this paper.

Mean richness values (Table 1) differed only slightly between the different steppe subzones at the smallest scales (up to 0.1 m<sup>2</sup>). At the largest scales (from 1 to 100 m<sup>2</sup>), a strong trend of decreasing species richness was observed between the highest values in northern forb-rich steppes (M1a) and the lowest values in the southern desert steppes (M4). The calculated means could be affected by unequal representation of different habitat types in different subzones or by unequal sampling effort.



**Fig. 2.** Counts of vascular plant species recorded in grassland vegetation plots of different size from the steppe zone in Ukraine (in red) compared with the known world records for grasslands (in green). Maximum counts for Ukrainian steppes and world records are shown as numbers.

**Abb. 2.** Artenzahlen von Gefäßpflanzen des Graslands der Steppenzone der Ukraine (in rot) im Vergleich zu den im Grasland bekannten Weltrekorden (in grün) für verschiedene Flächengrößen. Die Zahlen stellen die Maximalwerte dar.

**Table 1.** Maximum vascular plant species richness, mean vascular plant species richness, and number of analysed plots for each subzone of potential natural vegetation (according to the map in Fig. 1) and plot size. Maximum records of species richness in the steppe zone across all subzones are underlined.

**Tabelle 1.** Maximaler und mittlerer Artenreichtum der Gefäßpflanzen für verschiedene Parzellengrößen sowie Anzahl der untersuchten Parzellen unterschieden nach Unterzonen der potenziellen natürlichen Vegetation (gemäß der Karte in Abb. 1). Der maximale Artenreichtum über alle Steppen-Unterzonen ist unterstrichen.

	Richness	Plot area (m <sup>2</sup> )						
		0.0001	0.001	0.01	0.1	1	10	100
M1a   forb-rich steppe	<b>max</b>	<b>5</b>	<b>9</b>	<u><b>15</b></u>	<b>24</b>	<u><b>39</b></u>	<u><b>73</b></u>	<b>104</b>
	mean	2.2	3.6	6.7	12.3	20.0	30.1	38.9
	n	63	63	63	63	68	455	106
M2a   forb-grass steppe	<b>max</b>	<b>5</b>	<b>8</b>	<b>13</b>	<b>22</b>	<b>36</b>	<b>59</b>	<u><b>107</b></u>
	mean	1.9	2.9	6.1	11.7	15.6	28.0	31.5
	n	54	54	54	54	56	240	541
M3   grass steppe	<b>max</b>	<u><b>9</b></u>	<u><b>11</b></u>	<b>13</b>	<b>25</b>	<u><b>39</b></u>	<b>65</b>	<b>93</b>
	mean	2.1	3.5	6.3	12.2	15.3	26.9	23.5
	n	170	170	170	170	1165	569	1067
M4   desert steppe	<b>max</b>	<b>6</b>	<b>9</b>	<b>14</b>	<u><b>26</b></u>	<b>34</b>	<b>49</b>	<b>68</b>
	mean	2.1	3.4	5.8	10.3	13.5	23.4	20.4
	n	80	80	80	80	80	139	444

### 3.1 Comparison of maximum richness values with the known records

The species richness record at the smallest scale, 9 vascular plant species on 0.0001 m<sup>2</sup>, is similar to the published world record. Including bryophyte species, the Ukrainian record coincides with the published world record of 11 species (Moysiyenko et al. 2022). The maximum difference was observed at 1 m<sup>2</sup>: 89 species in the world record vs. 39 species in the steppe zone in Ukraine (-56%), and at 0.001 m<sup>2</sup>: 11 species vs. 19 species (-42%). At 10 m<sup>2</sup>, the difference was also quite large: 115 species compared to 73 species (-37%). At 100 m<sup>2</sup>, the record from Ukrainian steppe zone (107 species) was closer (-20%) to the previously published world record in grasslands (133 species) than the records at 1 and 10 m<sup>2</sup>.

Compared to the maximum richness counts from the transition between forest-steppe and steppe zone in Khakassia (Polyakova et al. 2016), our records of species richness were higher at the scales of 0.0001 m<sup>2</sup> (9 species in steppe Ukraine vs. 5 species in Khakassia), 0.001 m<sup>2</sup> (11 vs. 9 species), 10 m<sup>2</sup> (73 vs. 72 species), and 100 m<sup>2</sup> (104 vs. 94 species). However, the records at the following intermediate scales were lower in Ukraine: 0.01 m<sup>2</sup> (15 vs. 18 species), 0.1 m<sup>2</sup> (26 vs. 28 species) and 1 m<sup>2</sup> (39 vs. 52 species).

### 3.2 Description of the sites with species richness records

Most of the records at larger scales (1–100 m<sup>2</sup>) were recorded in the northern part of the steppe zone. The “Striltsivskyi steppe” compartment of the Luhansk Nature Reserve in Eastern Ukraine, Luhansk Region (Fig. 1, area 1; Fig. 3a, b), is known for its rich forb-bunchgrass steppe dominated by *Festuca rupicola*, *Stipa tirsia*, *S. zaleskii* and forbs such as *Aster amellus*, *Filipendula vulgaris*, *Fragaria viridis*, and *Salvia nutans*. The most species-rich plots were sampled by Larysa Borovyk for her dissertation in the 2000s (Supplement E1: records 36 and 41), including the richness record for the steppe zone – 107 species in 100 m<sup>2</sup> (Fig. 3a). The most species-rich plot represented forb-rich steppe with

low steppe shrubs, such as *Amygdalus nana*, *Caragana frutex*, and *Chamaecytisus ruthenicus*. However, plots smaller than 100 m<sup>2</sup> were not sampled in this area. According to the latest available data from the Luhansk Nature Reserve (fieldwork by L. Borovyk in 2021), the grasslands are gradually degrading due to the absence of necessary management, causing the spread of invasive and expansive species. Currently, further field studies in the reserve are not possible due to the war.

Forb-rich meso-xeric steppes in the northern part of the steppe zone in the Dnipro Uplands (Mykolaiv and Kirovohrad regions) account for most of the records at larger scales. The natural vegetation of the region is characterised by a patchwork of dry grasslands, steppic shrubs, rocky outcrops, and thermophilous forests. During our fieldwork in the Buzkyi Gard National Nature Park in the Mykolaiv region (Fig. 1, area 2; Fig. 3c, d), we found most of the species richness maxima at the larger scales. In particular, several records were sampled in 2021 during a survey of newly established monitoring plots: 104, 102, and 94 species in 100 m<sup>2</sup>; 73 and 68 species in 10 m<sup>2</sup>; 39 species in 1 m<sup>2</sup>; 24 and 23 species in 0.1 m<sup>2</sup>; and 15 species in 0.01 m<sup>2</sup> (Supplement E1: records 7, 20, 25, 27, 32, 37, 38, and 39). The results were recorded in forb-rich grasslands with initial stages of shrub encroachment and low-intensity grazing. During the last years before sampling, the grazing intensity in this area had gradually decreased. The dominant species among the grasses were *Festuca rupicola*, *Stipa dasyphylla*, and *Koeleria macrantha*; and among the forbs *Ferulago galbanifera*, *Fragaria viridis*, *Jurinea arachnoidea*, *Potentilla incana*, *Salvia nutans*, *Teucrium polium*, etc. Woody species were represented by steppe shrubs, saplings, and seedlings: *Caragana mollis*, *Chamaecytisus austriacus*, *Crataegus monogyna*, *Pyrus communis*, *Rhamnus cathartica*, and others. The presence of *Alyssum murale*, *Scleranthus annuus*, and *Sempervivum ruthenicum* indicated nearby rock outcrops. The pH of the soil ranged from neutral to slightly alkaline (7.0–7.4).

The lower reaches of the Dnipro, Southern Buh, and Ingul rivers are characterised by numerous steppe ravines with complex topography and outcrops of Sarmatian limestone. Species-rich grasslands were found in extra-zonal meso-xeric forb-grass steppes and zonal grass steppes. In the Kamianska Sich National Nature Park in the Kherson Region (Fig. 1, area 4; Fig. 3e, f), we sampled plots with 38 species in 1 m<sup>2</sup>, 59 species in 10 m<sup>2</sup>, and 95 and 87 species in 100 m<sup>2</sup> (Supplement E1: records 28, 34, 40, and 42). In the lower reaches of the Southern Buh and Inhul Rivers (Fig. 1, area 3; Fig. 4a, b), we recorded 25 species in 0.1 m<sup>2</sup>, 39 species in 1 m<sup>2</sup> (Supplement E1: records 18 and 26), and 65 species in 10 m<sup>2</sup> (Supplement E1: record 33). The surveyed sites with high species richness were located on gentle slopes with NE and NW exposure, in some cases on shallow soils with limestone outcrops covered by closed grassland vegetation. The vegetation was rich in both grasses (*Bromopsis riparia*, *Koeleria macrantha*, *Stipa lessingiana*) and forbs (*Euphorbia stepposa*, *Inula oculus-christi*, *Nepeta parviflora*, *Phlomis pungens*, *Salvia nemorosa*, *Teucrium polium*). The land use in most cases was low-intensity grazing.

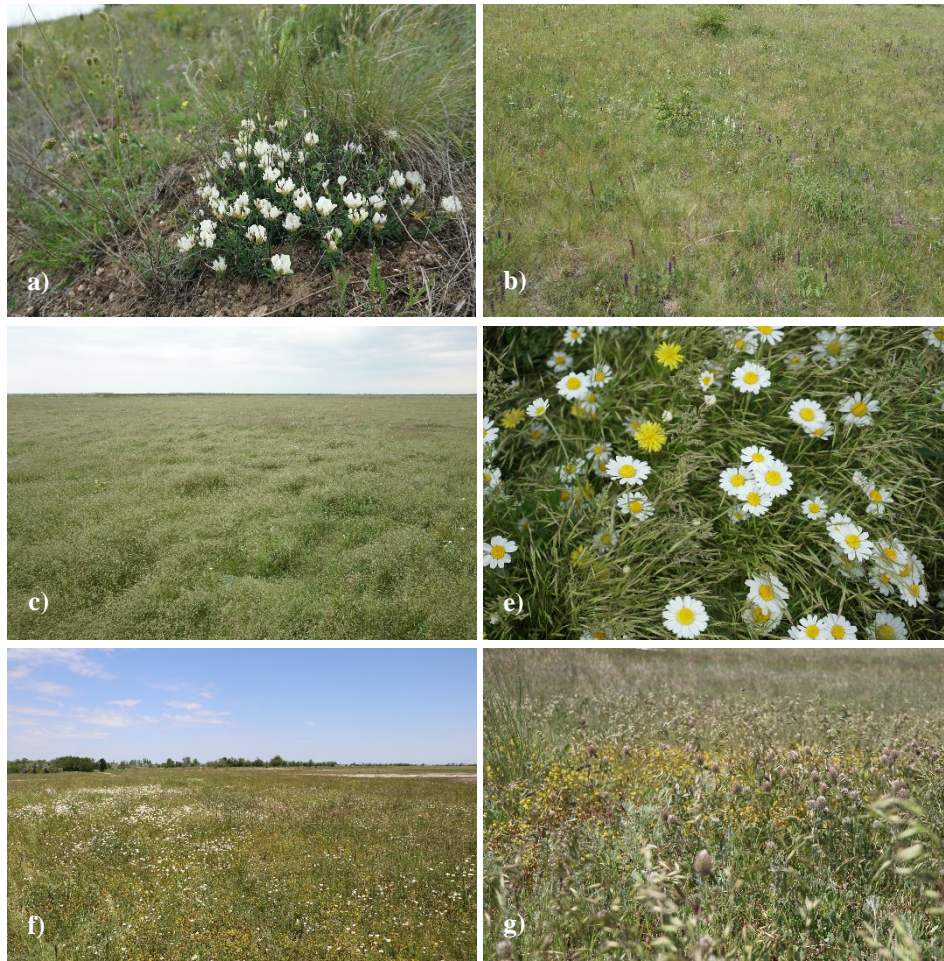
Mesic steppe depressions and mesic psammophytic grasslands in Southern Ukraine (Kherson Region: Fig. 1, areas 5 and 6) hosted most of the small-scale maxima. In the steppe depression “Chorna Dolyna” (Fig. 1, area 5; Fig. 4c, d), we sampled 9 species in 0.0001 m<sup>2</sup> and 11 species in 0.001 m<sup>2</sup> (Supplement E1: records 1 and 3). The site is a mesic grassland on slightly alkaline soil (pH = 7.7), grazed and mown once a year. The vegetation is dominated by the annual grass *Ventemata dubia* and rich in annual forbs such as *Anthemis ruthenica*, *Cerastium glutinosum*, *Erophila verna*, *Lotus angustissimus*, and *Scleranthus verticillatus*. Perennial graminoids are also abundant, including *Carex melanostachya*,



**Fig. 3.** Species-rich grassland communities at grain sizes of 1–100 m<sup>2</sup>: **a)** forb-rich steppe with low steppe shrubs in the Luhansk Nature Reserve (Supplement E1: record 36); **b)** forb-bunchgrass steppe in the Luhansk Nature Reserve (Supplement E1: record 41); **c)** forb-rich steppe in the Buzkyi Gard National Nature Park (Supplement E1: record 30); **d)** forb-rich steppe with shrub encroachment in the Buzkyi Gard National Nature Park (Supplement E1: records 5, 8, 9, 20, and 39); **e–f)** extra-zonal forb-rich steppe with shrub encroachment in the Kamianska Sich National Nature Park (Supplement E1: record 40) (Photos: a) G. Gouz, June 2008, b) L. Borovyk, May 2008; c, d, e) D. Borovyk, June 2020; f) I. Moysiienko, June 2020).

**Abb. 3.** Besonders artenreiche Graslandgesellschaften auf Flächengrößen von 1 bis 100 m<sup>2</sup>: **a)** krautreiche Steppe mit niedrigen Steppensträuchern im Naturschutzgebiet Luhansk (Anhang E1: Vegetationsaufnahme 36); **b)** Kraut-Horstgras-Steppe im Naturschutzgebiet Luhansk (Anhang E1: Aufnahme 41); **c)** krautreiche Steppe im Nationalen Naturpark Buzkyi Gard (Anhang E1: Aufnahme 30); **d)** krautreiche Steppe mit Gehölzaufkommen im Nationalen Naturpark Buzkyi Gard (Anhang E1: Aufnahmen 5, 8, 9, 20, and 39); **e–f)** extrazonale krautreiche Steppe mit Gehölzaufkommen im Nationalen Naturpark Kamianska Sich (Beilage E1: Aufnahme 40) (Fotos: a) G. Gouz, Juni 2008, b) L. Borovyk, Mai 2008; c, d, e) D. Borovyk, Juni 2020; f) I. Moysiienko, Juni 2020).





**Fig. 4.** Species-rich grassland communities at sampling scales 0.0001–10 m<sup>2</sup>: **a)** extra-zonal forb-grass steppe on Sarmatian limestone outcrops in lower reaches of the Inhul River (Supplement E1: record 33); **b)** bunchgrass steppe in lower reaches of the Southern Buh River (Supplement E1: record 18); **c–d)** mesic steppe depression “Chorna Dolyna” (Supplement E1: records 1 and 3); **e–f)** mesic psammophytic grassland in the Dzharylhach National Nature Park (Supplement E1: records 13 and 19) (Photos: a and b) D. Borovyk, June 2020; c and d) D. Borovyk, May 2021; e) O. Kucher, May 2020; f) A. Kuzemko, May 2020).

**Abb. 4.** Besonders artenreiche Graslandgesellschaften auf Flächengrößen von 0.0001 bis 10 m<sup>2</sup>: **a)** extrazonale Kraut-Gras-Steppe über sarmatischem Kalkstein im Unterlauf des Inhul (Anhang E1: Vegetationsaufnahme 33); **b)** Horstgras-Steppe im Unterlauf des Südlichen Bug (Anhang E1: Aufnahme 18); **c–d)** mesische Graslandvegetation in der Steppensenke “Chorna Dolyna” (Anhang E1: Aufnahmen 1 und 3); **e–f)** mesische Sandrasen im Nationalen Naturpark Dzharylhach (Anhang E1: Aufnahmen 13 und 19) (Fotos: a und b) D. Borovyk, Juni 2020; c und d) D. Borovyk, Mai 2021; e) O. Kucher, Mai 2020; f) A. Kuzemko, Mai 2020).

*Elytrigia pseudocaesia*, and *Poa angustifolia*. This particular vegetation represents grasslands unique to the steppe zone known as steppe depressions or ‘pody’ (Shapoval & Kuzemko 2021). In a grazed mesic psammophytic grassland on neutral soil (soil pH = 7.1) near Skadovsk in the Dzharylhach National Nature Park (Fig. 1, area 6; Fig. 4e, f), we recorded 26 species in 0.1 m<sup>2</sup> (Supplement E1: record 17). The vegetation of this species-rich mesic site is also remarkable for the large number of annuals.

#### 4. Discussion

Species-rich grasslands in the steppe zone in Ukraine resemble patterns previously evidenced from the other regions. Almost all of the known species richness records and near-maximum richness values for scales below 100 m<sup>2</sup> were found in meso-xeric grassland communities across Europe (Chytrý et al. 2015, Dengler et al. 2020, Hájek et al. 2020, Riedel et al. 2023). All identified records from the steppe zone represent meso-xeric and, at small scales, mesic grasslands. At the smallest scales (up to 0.1 m<sup>2</sup>), our records were found in a specific type of mesic grassland with a large number of annuals. The small size of annual plants may allow them to occupy tiny niches within the plots, increasing the species richness found at these grain sizes. However, these plots were recorded as shoot presence, so overlap between plants in different sub-layers also could play a role. For example, low-growing annuals could overlap with the stems of perennials above.

The initial stages of forest and shrub encroachment create favourable conditions for increasing small-scale heterogeneity. This is known from Estonian wooded meadows (Kull & Zobel 1991) and confirmed in the case of grasslands with shrub encroachment in the steppe zone of Buzkyi Gard and Kamianska Sich National Nature Parks in Ukraine. Landscape diversity and the historical persistence of landscapes and land use are known factors that positively influence species richness (Pärtel et al. 1999, Gazol et al. 2012). The landscapes that surround the grasslands in both Buzkyi Gard and Kamianska Sich National Nature Parks represent a mosaic of dry grasslands, steppic shrubs, rocky outcrops, and, in the case of Buzky Gard, thermophilous forests. Such landscape heterogeneity could increase the regional species pool. In general, most of our records we found in protected areas which are large complexes of natural landscapes, usually with a long history of continuous and stable land-use conditions.

Some of the known world records come from regions that have been intensively studied over long time periods by experienced teams of botanists. The identification of the most species-rich plots below 1 m<sup>2</sup> is not always associated with a specific area’s size, and is strongly limited by the availability of data from certain regions, such as data from long-term monitoring experiments that have accumulated thousands of plots over decades (Chytrý et al. 2015) or intensive fine-scale sampling in regions with diverse and species-rich vegetation (Dengler et al. 2012). It should be noted that revisiting previously known species-rich sites may reveal an even higher species richness than previously recorded. This occurred with the known richness records at larger scales (10–100 m<sup>2</sup>) in the White Carpathians and Romania (Chytrý et al. 2015, Hájek et al. 2020, Roleček et al. 2021).

Until recently, vegetation sampling in the Ukrainian steppe zone was mostly episodic, lacking targeted searches for species-rich plots and in many cases without the use of accurate measurement methods. In addition, the dominant approach to vegetation classification traditionally used in Ukraine during the 20<sup>th</sup> century did not require a very precise sampling procedure. Most of the species richness maxima in the analysed dataset were recorded

during the last 15 years, using the standard EDGG methodology with seven grain sizes between 0.0001 and 100 m<sup>2</sup> (Dengler et al. 2016, 2021). Other regional maxima for 100 m<sup>2</sup> have also recently been recorded during sampling of fixed monitoring plots in protected areas. Thus, we assume that the accumulation of information on species richness records in the Ukrainian steppe zone has only just begun.

The ongoing war as a result of the Russian invasion of the southern and eastern regions of Ukraine has severely limited current and future opportunities for conducting further vegetation research. Almost the entire steppe zone is affected by this military action. Except for the right bank of the Dnipro, the steppe zone is either within the front line or temporarily occupied. This increases the risk of destruction or possible extinction for certain vegetation types and plant species, including the small-scale richness hotspots in steppe depressions and meso-xeric species-rich grasslands in the Kherson region that have been surveyed (Skobel et al. 2023).

In addition, the war has exacerbated existing problems with grassland management in Ukraine, particularly in nature conservation areas. Most records were found in areas of low management intensity, highlighting the importance of moderate disturbance in maintaining species-rich grasslands. A few records from the Luhansk Nature Reserve and the Buzkyi Gard National Nature Park were found in the areas that had previously been intensively grazed, but where grazing had gradually decreased over the last decade prior to sampling. Therefore, at the time of fieldwork, these areas were in the process of successional change. However, further continuation of this succession may lead to the complete overgrowth of grasslands with shrubs. This problem is linked to the rapid decrease of traditional pasture and hay meadow use since the 1990s due to the decline of rural areas and traditional farming. At the same time, nature conservation areas in Ukraine do not have the legal and financial means to organise subsidies for grassland management. Since most of the grasslands in Ukraine are small fragments in the transformed agricultural landscape and do not represent a complete steppe ecosystem (e.g. including steppe animals), their long-term existence remains questionable without appropriate management. Appropriate management is particularly critical for grasslands in the northern part of the steppe zone, since they produce more biomass and are more sensitive to shrub encroachment.

## 5. Conclusions

The steppe zone is characterised by a continental dry climate which creates harsher environmental conditions for the vegetation compared to the forest-steppe zone. Our data suggest that local topography, landscape heterogeneity, and low-intensity management provide the basis for the existence of species-rich grasslands in the steppe zone. We hope that our contemporary overview will stimulate further studies investigating these biodiversity hotspots and identifying new ones. Since 2022, military action in southern Ukraine has limited current and future opportunities for conducting additional research and conservation and management activities in the steppe zone. Documentation of the pre-war biodiversity (see also Skobel et al. 2023) is therefore an important task, since it provides a basis for future estimates of biodiversity change and restoration.

## Erweiterte deutsche Zusammenfassung

**Einleitung** – Das Verständnis der Muster von außergewöhnlichem Artenreichtum ist wichtig für die Kenntnis von Ökosystemen und deren Erhaltung (Chytrý et al. 2015, Biurrun et al. 2021). Existierende Berichte über einen hohen Artenreichtum auf Flächen von weniger als 100 m<sup>2</sup> stammen hauptsächlich von gemäßigten meso-xerischen und mesischen Grasländern in Mitteleuropa (Zobel 1992, Wilson et al. 2012, Chytrý et al. 2015), die nach dem europäischen Naturschutzrecht zu den prioritären Lebensraumtypen gehören. Es gibt nur wenige Berichte über herausragenden Pflanzenartenreichtum aus dem Steppenbiom Osteuropas, die meisten davon stammen aus Wiesensteppenvegetation in den Waldsteppengebieten. Um einen Beitrag zur Schließung dieser Wissenslücke zu leisten, haben wir die bisher verstreuten oder unveröffentlichten Daten zum Pflanzenartenreichtum der Steppenzone der Ukraine auf verschiedenen räumlichen Skalen zusammengetragen.

**Methoden** – Wir sammelten alle verfügbaren Daten zum Gefäßpflanzenartenreichtum von Graslandlebensräumen, einschließlich eigener Daten, aus Vegetationsdatenbanken und der Literatur. Wir analysierten 6826 Vegetationsaufnahmen unterschiedlicher Größe, um den Artenreichtum auf verschiedenen Skalen zu untersuchen und verglichen diese Ergebnisse mit bekannten globalen Maxima. Wir untersuchten auch die Verteilung der Artenreichtumsrekorde in den vier Teilzonen der Steppenzone, basierend auf der Karte der potentiellen natürlichen Vegetation Europas (Bohn et al. 2000).

**Ergebnisse** – Die meisten kleinflächigen Nachweise (bis 0,1 m<sup>2</sup>) wurden in mesischen Graslandgesellschaften mit einem hohen Anteil an einjährigen Gräsern und Kräutern in der südlichen Ukraine (Region Kherson) gefunden: 9 bzw. 11 Gefäßpflanzenarten auf 0,0001 m<sup>2</sup> bzw. 0,001 m<sup>2</sup> in der Steppensenke Chorna Dolyna bzw. 26 Arten auf 0,1 m<sup>2</sup> in einem mesischen psammophytischen Grasland im Nationalen Naturpark Dzharylhach. Bei der kleinsten Flächengröße (0,0001 m<sup>2</sup>) lag unser Ergebnis nahe am Weltrekord (9 vs. 11 Arten). Die meisten Maxima auf größeren Flächen wurden im nördlichen Teil der Steppenzone, in den krautreichen Steppen, gefunden: 15, 39, 73 und 107 Arten auf 0,01, 1, 10 bzw. 100 m<sup>2</sup>. Alle Rekorde des Artenreichtums waren durch neutrale bis leicht alkalische Substrate (Boden-pH 7,0–7,7) und eine wenig intensive Bewirtschaftung gekennzeichnet.

**Diskussion** – Wir diskutieren, dass Faktoren wie Landschaftsheterogenität und extensive Bewirtschaftung zum Artenreichtum des Graslands beitragen. Der anhaltende militärische Konflikt in der Ukraine schränkt hier jedoch aktuelle und zukünftige Forschungsmöglichkeiten in der Steppenzone ein. Umso wichtiger ist, dass die Biodiversität von vor dem Krieg dokumentiert wird, um später ihre Veränderungen bewerten und sie in Zukunft wiederherstellen zu können.

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## Author contributions

DB conceived the idea, performed data collection and analyses, and led the writing. ID, JD, RG, AK, KL, IM, NS, and DV revised the initial version of the manuscript. All authors contributed data and checked the final version of the manuscript.

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## Supplements

**Additional supporting information may be found in the online version of this article.**

**Zusätzliche unterstützende Information ist in der Online-Version dieses Artikels zu finden.**

**Supplement E1.** Data of extraordinarily species-rich plots in the steppe zone in Ukraine.

**Anhang E1.** Daten der außerordentlich artenreichen Vegetationsaufnahmen in der Ukraine.

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**Supplement E1.** Data of extraordinarily species-rich plots in the steppe zone in Ukraine.

**Anhang E1.** Daten der außerordentlich artenreichen Vegetationsaufnahmen in der Ukraine.

Vegetation plots with richness records sampled in the steppe zone in Ukraine. Plots with maximum richness for all grain sizes (0.0001–100 m<sup>2</sup>) and other plots with a similar number of species (close to maximum) are given. In cases where several plots with a similar number of species at the same sampling scale were located close together (closely located monitoring plots, plots in different corners of the same nested plot series), only one plot with the maximum number of species is listed. For each of the identified species-rich grassland plots, we provide the following complete information: descriptions of sites, plot characteristics, coordinates, and species lists. Records of one species in different layers (e.g. seedling, juvenile, shrub) are merged into one.

**(1) 9 vascular plants species (11 species complete vegetation) / 0.0001 m<sup>2</sup> (1 cm × 1 cm) (maximum for the steppe zone)** – mesic meadow in steppe depression Chorna Dolyna, near Chorna Dolyna village, Kherson Region, coordinates 46.5547N, 33.4796E (recorded using GPS in smartphone), elevation 24 m a.s.l., flat area; land use: pastured in the summer, mown once per year. Plot size measured with a wooden ruler, species recorded as shoot presence, 24.05.2021, authors: Ivan Moysiienko, Jürgen Dengler, Iwona Dembicz, Oksana Kucher; nested plot series UAS03NW.

1. <i>Arenaria serpyllifolia</i> subsp. <i>glutinosa</i>	6. <i>Scleranthus verticillatus</i>
2. <i>Cerastium glutinosum</i>	7. <i>Trifolium retusum</i>
3. <i>Erophila verna</i>	8. <i>Ventenata dubia</i>
4. <i>Lotus angustissimus</i>	9. <i>Vicia hirsuta</i>
5. <i>Potentilla argentea</i>	

Bryophytes: *Ptychostomum rubens*, *Tortula truncata*.

**(2) 7 vascular plants species (7 species complete vegetation) / 0.0001 m<sup>2</sup> (1 cm × 1 cm)** – bunchgrass steppe, Kamianska ravine near Novokairy village, Kamianska Sich National Nature Park, Kherson Region, coordinates: 47.04559N, 33.58326E (recorded using GPS), elevation 29 m a.s.l., aspect 180°, slope 5°, relief position: middle slope; land use: low-intensity grazing, occasionally burned. Plot size measured with a wooden ruler, species recorded as shoot presence, 07.05.2016, authors: Iwona Dembicz, Lukasz Kozub; nested plot series CHB01NW.

1. <i>Arenaria serpyllifolia</i>	5. <i>Kochia prostrata</i>
2. <i>Bromus squarrosus</i>	6. <i>Myosotis stricta</i>
3. <i>Carex supina</i>	7. <i>Poa bulbosa</i>
4. <i>Helichrysum arenarium</i>	

**(3) 11 vascular plant species (14 species complete vegetation) / 0.001 m<sup>2</sup> (3 cm × 3 cm) (maximum for the steppe zone)** – the same nested plot series as record #1 (UAS03NW).

1. <i>Anthemis ruthenica</i>	7. <i>Potentilla argentea</i>
2. <i>Arenaria serpyllifolia</i> subsp. <i>glutinosa</i>	8. <i>Scleranthus verticillatus</i>
3. <i>Cerastium glutinosum</i>	9. <i>Trifolium retusum</i>
4. <i>Erophila verna</i>	10. <i>Ventenata dubia</i>
5. <i>Lotus angustissimus</i>	11. <i>Vicia hirsuta</i>
6. <i>Poa angustifolia</i>	

Bryophytes: *Bryum* sp., *Ptychostomum rubens*, *Tortula truncata*.

**(4) 9 vascular plants species (11 species complete vegetation) / 0.001 m<sup>2</sup> (3 cm × 3 cm)** – bunchgrass steppe, Falz-Fein Biosphere Reserve Askania Nova, Kherson Region, coordinates: 46.47478N, 33.913E (recorded using GPS), elevation 24 m a.s.l., flat area; land use: mown once per year. Plot size measured with a wooden ruler, species recorded as shoot presence, 15.05.2017, authors: Iwona Dembicz, Ivan Moysiienko, Victor Shapoval; nested plot series CHP08SE.

1. <i>Arenaria serpyllifolia</i>	6. <i>Iris pumila</i>
2. <i>Carex stenophylla</i>	7. <i>Myosotis stricta</i>
3. <i>Cruciata pedemontana</i>	8. <i>Taraxacum erythrospermum</i>
4. <i>Euphorbia seguieriana</i>	9. <i>Viola kitaibeliana</i>
5. <i>Festuca valesiaca</i>	

Bryophytes and lichens: *Cladonia* sp., *Listkowata zielona*.



(5) **9 vascular plants species (9 species complete vegetation) / 0.001 m<sup>2</sup> (3 cm × 3 cm)** – forb-rich meso-xeric steppe, shadowed slope, near Myhiia village, Mykolaiv Region, coordinates: 48.01138N, 30.98688E (recorded using GPS in smartphone), aspect 285°, slope 15°; land use: abandonment. Plot size measured with a wooden ruler, species recorded as shoot presence, 17.06.2021, authors: Dariia Borovyk, Ganna Kolomiets, Jana Ovsienko, Denys Vynokurov; nested plot series SB2105SE.

- |                                |                            |
|--------------------------------|----------------------------|
| 1. <i>Allium paczoskianum</i>  | 6. <i>Galium verum</i>     |
| 2. <i>Elytrigia intermedia</i> | 7. <i>Phlomis tuberosa</i> |
| 3. <i>Ferulago galbanifera</i> | 8. <i>Poa angustifolia</i> |
| 4. <i>Festuca rupicola</i>     | 9. <i>Vinca herbacea</i>   |
| 5. <i>Fragaria viridis</i>     |                            |

(6) **9 vascular plants species (9 species complete vegetation) / 0.001 m<sup>2</sup> (3 cm × 3 cm)** – bunchgrass steppe, shore of Syvash Lake, near Druzheliubivka village, Kherson Region, coordinates 46.13223N, 34.03916E (recorded using GPS in smartphone), elevation 3 m a.s.l., flat area; land use: abandonment. Plot size measured with a wooden ruler, species recorded as shoot presence, 26.05.2021, authors: Ivan Moysienko, Jürgen Dengler, Iwona Dembiczy, Oksana Kucher; nested plot series UAS13NW.

- |                                   |  |
|-----------------------------------|--|
| 1. <i>Artemisia austriaca</i>     | 6. <i>Tanacetum cf. achilleifolium</i> |
| 2. <i>Crepis sancta</i>           | 7. <i>Valerianella sp.</i>             |
| 3. <i>Cruciata pedemontana</i>    | 8. <i>Veronica arvensis</i>            |
| 4. <i>Euphorbia leptocaula</i>    | 9. <i>Viola kitaibeliana</i>           |
| 5. <i>Festuca valesiaca</i> aggr. |  |

(7) **15 vascular plant species (15 species complete vegetation) / 0.01 m<sup>2</sup> (10 cm × 10 cm) (maximum for the steppe zone)** – forb-rich meso-xeric steppe, pasture with shrub encroachment, near Kuripchyne village, Mykolaiv Region, coordinates: 48.00023N, 31.0053E (recorded using GPS in smartphone), aspect 240°, slope 5°; land use: low-intensity grazing. Plot size measured with a wooden ruler, species recorded as shoot presence, 16.06.2021, authors: Dariia Borovyk, Ganna Kolomiets, Ivan Moysienko, Denys Vynokurov; nested plot series SB2103NW.

- |                                  |                                     |
|----------------------------------|-------------------------------------|
| 1. <i>Alyssum murale</i>         | 9. <i>Pilosella echioides</i>       |
| 2. <i>Arenaria serpyllifolia</i> | 10. <i>Poa angustifolia</i>         |
| 3. <i>Bromus squarrosus</i>      | 11. <i>Poa bulbosa</i>              |
| 4. <i>Caragana mollis</i>        | 12. <i>Pulsatilla pratensis</i>     |
| 5. <i>Festuca rupicola</i>       | 13. <i>Salvia nutans</i>            |
| 6. <i>Fragaria viridis</i>       | 14. <i>Taraxacum erythrospermum</i> |
| 7. <i>Jurinea arachnoidea</i>    | 15. <i>Veronica steppacea</i>       |
| 8. <i>Koeleria macrantha</i>     |                                     |

(8) **14 vascular plant species (16 species complete vegetation) / 0.01 m<sup>2</sup> (10 cm × 10 cm)** – forb-rich meso-xeric steppe, shadowed slope, near Myhiia village, Mykolaiv Region, coordinates: 48.01133N, 30.98698E (recorded using GPS in smartphone), aspect 285°, slope 15°; land use: abandonment. Plot size measured with a wooden ruler, species recorded as shoot presence, 29.06.2020, authors: Dariia Borovyk, Ganna Kolomiets, Ivan Moysienko, Denys Vynokurov; nested plot series SB2105NW.

- |                                    |                                      |
|------------------------------------|--------------------------------------|
| 1. <i>Arenaria serpyllifolia</i>   | 8. <i>Myosotis sparsiflora</i>       |
| 2. <i>Carex praecox</i>            | 9. <i>Ranunculus illyricus</i>       |
| 3. <i>Chamaecytisus austriacus</i> | 10. <i>Trifolium arvense</i>         |
| 4. <i>Ferulago galbanifera</i>     | 11. <i>Valerianella sp.</i>          |
| 5. <i>Festuca rupicola</i>         | 12. <i>Vinca herbacea</i>            |
| 6. <i>Filipendula vulgaris</i>     | 13. <i>Viola kitaibeliana</i>        |
| 7. <i>Linaria biebersteinii</i>    | 14. <i>Robinia pseudoacacia</i> juv. |

Bryophytes: *Brachythecium albicans*, *Rhynchostegium sp.*

(9) **14 vascular plant species (14 species complete vegetation) / 0.01 m<sup>2</sup> (10 cm × 10 cm)** – the same nested plot series as record #5 (SB2105SE).

- |                                |                                 |
|--------------------------------|---------------------------------|
| 1. <i>Allium paczoskianum</i>  | 8. <i>Lamium amplexicaule</i>   |
| 2. <i>Caragana mollis</i>      | 9. <i>Myosotis arvensis</i>     |
| 3. <i>Elytrigia intermedia</i> | 10. <i>Phlomis tuberosa</i>     |
| 4. <i>Ferulago galbanifera</i> | 11. <i>Poa angustifolia</i>     |
| 5. <i>Festuca rupicola</i>     | 12. <i>Verbascum phoeniceum</i> |
| 6. <i>Fragaria viridis</i>     | 13. <i>Vinca herbacea</i>       |
| 7. <i>Galium verum</i>         | 14. <i>Viola arvensis</i>       |

(10) **14 vascular plants species (14 species complete vegetation) / 0.01 m<sup>2</sup> (10 cm × 10 cm)**: bunchgrass steppe, Churiuk Island, Azovo-Syvash National Nature Park, coordinates: 46.09856N, 34.2422E (recorded using GPS in smartphone), elevation 2 m a.s.l., flat area; land use: abandonment, natural disturbance by rodents. Plot size measured with a wooden ruler, species recorded as shoot presence, 25.05.2021, authors: Ivan Moysienko, Jürgen Dengler, Iwona Dembiczy, Oksana Kucher; nested plot series UAS04NW.

- |                                   |                                  |
|-----------------------------------|----------------------------------|
| 1. <i>Androsace elongata</i>      | 8. <i>Galium spurium</i>         |
| 2. <i>Anisantha tectorum</i>      | 9. <i>Galium verum s.l.</i>      |
| 3. <i>Arabidopsis thaliana</i>    | 10. <i>Geranium pusillum</i>     |
| 4. <i>Cruciata pedemontana</i>    | 11. <i>Myosotis stricta</i>      |
| 5. <i>Falcaria vulgaris</i>       | 12. <i>Potentilla recta</i>      |
| 6. <i>Festuca valesiaca aggr.</i> | 13. <i>Pterotheca sancta</i>     |
| 7. <i>Galatella villosa</i>       | 14. <i>Sisymbrium altissimum</i> |

**(11) 14 vascular plants species (16 species complete vegetation) / 0.01 m<sup>2</sup> (10 cm × 10 cm)** – meso-xeric bunchgrass steppe, Khorly Peninsula, near Khorly, Kherson Region, coordinates: 46.097025, 33.281713 (recorded using GPS in smartphone), elevation 1 m a.s.l., aspect 50°, slope 20°; land use: low-intensity grazing. Plot size measured with a wooden ruler, species recorded as shoot presence, 27.05.2021, authors: Dariia Borovyk, Anna Kuzemko, Olha Chusova, Kateryna Kalashnik; nested plot series UAS19NW.

- |   |   |
|---|---|
| 1. <i>Cruciata pedemontana</i>                    | 8. <i>Ephedra distachya</i>             |
| 2. <i>Festuca valesiaca aggr.</i>                 | 9. <i>Medicago minima</i>               |
| 3. <i>Galium spurium</i>                          | 10. <i>Serratula erucifolia</i>         |
| 4. <i>Pterotheca sancta</i>                       | 11. <i>Tanacetum cf. achilleifolium</i> |
| 5. <i>Arenaria serpyllifolia subsp. glutinosa</i> | 12. <i>Trigonella monspeliaca</i>       |
| 6. <i>Agropyron pectinatum</i>                    | 13. <i>Veronica verna</i>               |
| 7. <i>Artemisia taurica</i>                       | 14. <i>Vicia angustifolia</i>           |

Lichens: *Cladonia furcata*, *Cladonia rangiformis*.

**(12) 13 vascular plants species (16 species complete vegetation) / 0.01 m<sup>2</sup> (10 cm × 10 cm)** – the same nested plot series as record #1 (UAS03NW).

- |                                  |                                      |
|----------------------------------|--------------------------------------|
| 1. <i>Anthemis ruthenica</i>     | 8. <i>Poa angustifolia</i>           |
| 2. <i>Arenaria serpyllifolia</i> | 9. <i>Potentilla argentea</i>        |
| 3. <i>Cerastium glutinosum</i>   | 10. <i>Scleranthus verticillatus</i> |
| 4. <i>Draba verna</i>            | 11. <i>Trifolium retusum</i>         |
| 5. <i>Gratiola officinalis</i>   | 12. <i>Ventenata dubia</i>           |
| 6. <i>Inula britannica</i>       | 13. <i>Vicia hirsuta</i>             |
| 7. <i>Lotus angustissimus</i>    |                                      |

Bryophytes: *Bryum sp.*, *Ptychostomum rubens*, *Tortula truncata*.

**(13) 13 vascular plants species (15 species complete vegetation) / 0.01 m<sup>2</sup> (10 cm × 10 cm)** – xero-mesic hemipsammophytic grassland, near Skadovsk and Ozerne village, Dzharylhach National Nature Park, coordinates: 46.116N, 32.85609E (recorded using GPS in smartphone), elevation 1 m a.s.l., flat area. Plot size measured with a wooden ruler, species recorded as shoot presence, 28.05.2021, authors: Dariia Borovyk, Jürgen Dengler, Iwona Dembicz, Oksana Kucher; nested plot series UAS21SE.

- |                                   |                                |
|-----------------------------------|--------------------------------|
| 1. <i>Agropyron cristatum</i>     | 8. <i>Iris pumila</i>          |
| 2. <i>Anthemis ruthenica</i>      | 9. <i>Koeleria macrantha</i>   |
| 3. <i>Artemisia santonicum</i>    | 10. <i>Trifolium arvense</i>   |
| 4. <i>Cerastium semidecandrum</i> | 11. <i>Trifolium campestre</i> |
| 5. <i>Cynodon dactylon</i>        | 12. <i>Veronica arvensis</i>   |
| 6. <i>Erophila verna</i>          | 13. <i>Vicia lathyroides</i>   |
| 7. <i>Festuca valesiaca aggr.</i> |                                |

Bryophytes: *Brachythecium albicans*, *Syntrichia ruralis*.

**(14) 13 vascular plants species (14 species complete vegetation) / 0.01 m<sup>2</sup> (10 cm × 10 cm)** – bunchgrass steppe, Falz-Fein Biosphere Reserve Askania Nova, Kherson Region, coordinates: 46.45737N, 33.88661E (recorded using GPS), elevation 25 m a.s.l., flat area; land use: mown once per year. Plot size measured with a wooden ruler, species recorded as shoot presence, 15.05.2017, authors: Iwona Dembicz, Victor Shapoval, Ivan Moysienco; nested plot series CHP07SE.

- |                                |                               |
|--------------------------------|-------------------------------|
| 1. <i>Androsace elongata</i>   | 8. <i>Poa bulbosa</i>         |
| 2. <i>Carex stenophylla</i>    | 9. <i>Stipa capillata</i>     |
| 3. <i>Cerastium ucrainicum</i> | 10. <i>Stipa ucrainica</i>    |
| 4. <i>Cruciata pedemontana</i> | 11. <i>Ventenata dubia</i>    |
| 5. <i>Erophila verna</i>       | 12. <i>Veronica verna</i>     |
| 6. <i>Lactuca serriola</i>     | 13. <i>Viola kitaibeliana</i> |
| 7. <i>Linum austriacum</i>     |                               |

Bryophytes: *Tortula sp.*

**(15) 13 vascular plants species (13 species complete vegetation) / 0.01 m<sup>2</sup> (10 cm × 10 cm)** – bunchgrass steppe, Hlyboka Prystan (archaeological site) near Shyroka Balka village, Kherson Region, coordinates: 46.58631N, 32.23106E (recorded using GPS), elevation 16 m a.s.l., aspect 130°, slope 10°, relief position: middle slope; land use: low-intensity grazing. Plot size measured with a wooden ruler, species recorded as shoot presence, 24.05.2017, authors: Maryna Zakharova, Ivan Moysiienko; nested plot series CHG04NW.

- |                                  |                                |
|----------------------------------|--------------------------------|
| 1. <i>Agropyron pectinatum</i>   | 8. <i>Ferula caspica</i>       |
| 2. <i>Arabidopsis thaliana</i>   | 9. <i>Kochia prostrata</i>     |
| 3. <i>Arenaria serpyllifolia</i> | 10. <i>Lactuca serriola</i>    |
| 4. <i>Bromus squarrosus</i>      | 11. <i>Lamium amplexicaule</i> |
| 5. <i>Carex stenophylla</i>      | 12. <i>Senecio vernalis</i>    |
| 6. <i>Dianthus carbonatus</i>    | 13. <i>Veronica arvensis</i>   |
| 7. <i>Falcaria vulgaris</i>      |                                |

**(16) 13 vascular plants species (13 species complete vegetation) / 0.01 m<sup>2</sup> (10 cm × 10 cm)** – bunchgrass steppe, near Tiahynka village, Kherson Region, coordinates: 46.7618N, 33.05814E (recorded using GPS), elevation 7 m a.s.l., aspect 315°, slope 5°, relief position: middle slope; land use: grazing, occasionally burned. Plot size measured with a wooden ruler, species recorded as shoot presence, 22.05.2017, authors: Maryna Zakharova, Ivan Moysiienko, Barbara Sudnik-Wójcikowska; nested plot series CHG06SE.

- |                                   |                                   |
|-----------------------------------|-----------------------------------|
| 1. <i>Arabidopsis thaliana</i>    | 8. <i>Poa bulbosa</i>             |
| 2. <i>Astragalus ucrainicus</i>   | 9. <i>Potentilla astracanicus</i> |
| 3. <i>Bromus squarrosus</i>       | 10. <i>Tanacetum millefolium</i>  |
| 4. <i>Cerastium ucrainicum</i>    | 11. <i>Trigonella monspeliaca</i> |
| 5. <i>Festuca valesiaca</i> aggr. | 12. <i>Veronica praecox</i>       |
| 6. <i>Hyacinthella leucophaea</i> | 13. <i>Xeranthemum annum</i>      |
| 7. <i>Medicago falcata</i>        |                                   |

**(17) 26 vascular plants species (28 species complete vegetation) / 0.1 m<sup>2</sup> (32 cm × 32 cm) (maximum for the steppe zone)** – the same nested plot series as record #13 (UAS21SE).

- |  |                                  |
|--|----------------------------------|
| 1. <i>Agropyron pectinatum</i>                           | 14. <i>Iris pumila</i>           |
| 2. <i>Anthemis ruthenica</i>                             | 15. <i>Koeleria macrantha</i>    |
| 3. <i>Apera maritima</i>                                 | 16. <i>Limonium gmelinii</i>     |
| 4. <i>Arenaria serpyllifolia</i> subsp. <i>glutinosa</i> | 17. <i>Ornithogalum kochii</i>   |
| 5. <i>Artemisia santonica</i>                            | 18. <i>Poa bulbosa</i>           |
| 6. <i>Bromus squarrosus</i>                              | 19. <i>Trifolium arvensis</i>    |
| 7. <i>Cerastium glutinosum</i>                           | 20. <i>Trifolium campestre</i>   |
| 8. <i>Cerastium semidecandrum</i>                        | 21. <i>Trifolium diffusum</i>    |
| 9. <i>Cynodon dactylon</i>                               | 22. <i>Valerianella carinata</i> |
| 10. <i>Erodium cicutarium</i>                            | 23. <i>Ventenata dubia</i>       |
| 11. <i>Erophila verna</i>                                | 24. <i>Veronica arvensis</i>     |
| 12. <i>Festuca valesiaca</i> aggr.                       | 25. <i>Vicia angustifolia</i>    |
| 13. <i>Galium spurium</i>                                | 26. <i>Vicia lathyroides</i>     |

Bryophytes: *Brachythecium albicans*, *Syntrichia ruralis*

**(18) 25 vascular plants species (28 species complete vegetation) / 0.1 m<sup>2</sup> (32 cm × 32 cm)**: – forb-rich meso-xeric steppe, Mykolaiv region, near Trykhaty village, coordinates: 47.11046N, 31.8481E (recorded using GPS), aspect 20°, slope 10°; relief position: middle slope; land use: low-intensity grazing. Plot size measured with a wooden ruler, species recorded as shoot presence, 06.06.2020, authors: Dariia Borovyk, Denys Vynokurov, Olha Chusova; nested plot series SB20101SW.

- |                                   |                                      |
|-----------------------------------|--------------------------------------|
| 1. <i>Arenaria serpyllifolia</i>  | 14. <i>Pilosella echioides</i> aggr. |
| 2. <i>Carex praecox</i>           | 15. <i>Potentilla laciniata</i>      |
| 3. <i>Cerastium semidecandrum</i> | 16. <i>Salvia nemorosa</i>           |
| 4. <i>Crepis ramosissima</i>      | 17. <i>Silene bupleuroides</i>       |
| 5. <i>Dianthus carbonatus</i>     | 18. <i>Stipa capillata</i>           |
| 6. <i>Erophila verna</i>          | 19. <i>Thymus marschallianus</i>     |
| 7. <i>Euphorbia agraria</i>       | 20. <i>Tragopogon major</i>          |
| 8. <i>Euphorbia seguieriana</i>   | 21. <i>Trifolium arvense</i>         |
| 9. <i>Festuca valesiaca</i> aggr. | 22. <i>Veronica arvensis</i>         |
| 10. <i>Galium octonarium</i>      | 23. <i>Veronica gryniata</i>         |
| 11. <i>Galium verum</i>           | 24. <i>Veronica verna</i>            |
| 12. <i>Helichrysum arenarium</i>  | 25. <i>Viola kitaibeliana</i>        |
| 13. <i>Jurinea arachnoidea</i>    |                                      |

Bryophytes: *Bryum subapiculatum*, *Pleuridium subulatum*, *Weissia longifolia*.

**(19) 24 vascular plants species (27 species complete vegetation) / 0.1 m<sup>2</sup> (32 cm × 32 cm):** xero-mesic hemipsammophytic grassland, near Skadovsk and Ozerne village, Dzharylhach National Nature Park, coordinates: 46.11609N, 32.85595E (recorded using GPS in smartphone), elevation 1 m a.s.l., flat area. Plot size measured with a wooden ruler, species recorded as shoot presence, 28.05.2021, authors: Daria Borovyk, Jürgen Dengler, Iwona Dembicz, Oksana Kucher; nested plot series UAS21NW.

- |  |                                    |
|--|------------------------------------|
| 1. <i>Anthemis ruthenica</i>                             | 13. <i>Medicago minima</i>         |
| 2. <i>Apera maritima</i>                                 | 14. <i>Myosotis stricta</i>        |
| 3. <i>Arenaria serpyllifolia</i> subsp. <i>glutinosa</i> | 15. <i>Ornithogalum kochii</i>     |
| 4. <i>Artemisia santonica</i>                            | 16. <i>Pleconax subconica</i>      |
| 5. <i>Bromus mollis</i>                                  | 17. <i>Poa bulbosa</i>             |
| 6. <i>Cerastium glutinosum</i>                           | 18. <i>Saxifraga tridactylites</i> |
| 7. <i>Cerastium semidecandrum</i>                        | 19. <i>Senecio vernalis</i>        |
| 8. <i>Cynodon dactylon</i>                               | 20. <i>Trifolium arvensis</i>      |
| 9. <i>Erodium cicutarium</i>                             | 21. <i>Trifolium campestre</i>     |
| 10. <i>Euphorbia seguieriana</i>                         | 22. <i>Veronica arvensis</i>       |
| 11. <i>Festuca valesiaca</i> aggr.                       | 23. <i>Vicia hirsuta</i>           |
| 12. <i>Koeleria macrantha</i>                            | 24. <i>Vicia lathyroides</i>       |

Bryophytes and lichens: *Brachythecium albicans*, *Leptodictium riparium*, *Syntrichia ruralis*.

**(20) 24 vascular plants species (24 species complete vegetation) / 0.1 m<sup>2</sup> (32 cm × 32 cm)** – the same nested plot series as record #5 (SB2105SE).

- |                                 |                                      |
|---------------------------------|--------------------------------------|
| 1. <i>Allium paczoskianum</i>   | 13. <i>Lamium amplexicaule</i>       |
| 2. <i>Anisantha sterilis</i>    | 14. <i>Lamium purpureum</i>          |
| 3. <i>Artemisia austriaca</i>   | 15. <i>Myosotis arvensis</i>         |
| 4. <i>Caragana mollis</i>       | 16. <i>Phlomis tuberosa</i>          |
| 5. <i>Elytrigia intermedia</i>  | 17. <i>Poa angustifolia</i>          |
| 6. <i>Eryngium campestre</i>    | 18. <i>Ranunculus illyricus</i>      |
| 7. <i>Ferulago galbanifera</i>  | 19. <i>Trifolium arvense</i>         |
| 8. <i>Festuca rupicola</i>      | 20. <i>Valerianella</i> sp.          |
| 9. <i>Filipendula vulgaris</i>  | 21. <i>Verbascum phoeniceum</i>      |
| 10. <i>Fragaria viridis</i>     | 22. <i>Veronica arvensis</i>         |
| 11. <i>Galium verum</i>         | 23. <i>Vinca herbacea</i>            |
| 12. <i>Hypericum perforatum</i> | 24. <i>Viola</i> cf. <i>arvensis</i> |

**(21) 24 vascular plants species (24 species complete vegetation) / 0.1 m<sup>2</sup> (32 cm × 32 cm)** – the same nested plot series as record #10 (UAS04NW).

- |                                   |                                  |
|-----------------------------------|----------------------------------|
| 1. <i>Androsace elongata</i>      | 13. <i>Geranium pusillum</i>     |
| 2. <i>Anisantha tectorum</i>      | 14. <i>Lamium amplexicaule</i>   |
| 3. <i>Arabidopsis thaliana</i>    | 15. <i>Leymus ramosus</i>        |
| 4. <i>Artemisia austriaca</i>     | 16. <i>Myosotis stricta</i>      |
| 5. <i>Atriplex</i> sp.            | 17. <i>Potentilla recta</i>      |
| 6. <i>Carduus uncinatus</i>       | 18. <i>Pterotheca sancta</i>     |
| 7. <i>Cruciata pedemontana</i>    | 19. <i>Senecio vernalis</i>      |
| 8. <i>Falcaria vulgaris</i>       | 20. <i>Sisymbrium altissimum</i> |
| 9. <i>Festuca valesiaca</i> aggr. | 21. <i>Stipa ucrainica</i>       |
| 10. <i>Galatella villosa</i>      | 22. <i>Trifolium arvensis</i>    |
| 11. <i>Galium spurium</i>         | 23. <i>Vicia hirsuta</i>         |
| 12. <i>Galium verum</i>           | 24. <i>Viola arvensis</i>        |

**(22) 22 vascular plants species (25 species complete vegetation) / 0.1 m<sup>2</sup> (32 cm × 32 cm)** – bunchgrass steppe, Falz-Fein Biosphere Reserve Askania Nova, Kherson Region, coordinates: 46.44763N, 33.89643E (recorded using GPS), elevation 24 m a.s.l., aspect 225°, slope 0.5°, flat area; land use: mown once per year. Plot size measured with a wooden ruler, species recorded as shoot presence, 14.05.2017, authors: Iwona Dembicz, Ivan Moysiynko, Victor Shapoval; nested plot series CHP05NW.

- |                                |                                     |
|--------------------------------|-------------------------------------|
| 1. <i>Androsace elongata</i>   | 12. <i>Koeleria macrantha</i>       |
| 2. <i>Arabidopsis thaliana</i> | 13. <i>Myosotis stricta</i>         |
| 3. <i>Artemisia austriaca</i>  | 14. <i>Poa angustifolia</i>         |
| 4. <i>Carex stenophylla</i>    | 15. <i>Poa bulbosa</i>              |
| 5. <i>Crepis tectorum</i>      | 16. <i>Potentilla semilaciniosa</i> |
| 6. <i>Cruciata pedemontana</i> | 17. <i>Stipa ucrainica</i>          |
| 7. <i>Dianthus lanceolatus</i> | 18. <i>Tanacetum millefolium</i>    |
| 8. <i>Erophila verna</i>       | 19. <i>Taraxacum erythrospermum</i> |
| 9. <i>Eryngium campestre</i>   | 20. <i>Veronica arvensis</i>        |
| 10. <i>Festuca valesiaca</i>   | 21. <i>Vicia lathyroides</i>        |
| 11. <i>Galium ruthenicum</i>   | 22. <i>Viola kitaibeliana</i>       |

Bryophytes: *Bryum* sp., *Tortula* sp., *Weissia* sp.

**(23) 22 vascular plants species (24 species complete vegetation) / 0.1 m<sup>2</sup> (32 cm × 32 cm)** – bunchgrass steppe, Falz-Fein Biosphere Reserve Askania Nova, Kherson Region, coordinates: 46.4753N, 33.9673E (recorded using GPS), elevation 27 m a.s.l., flat area; land use: abandonment. Plot size measured with a wooden ruler, species recorded as shoot presence, 18.05.2017, authors: Iwona Dembicz, Maria Zachwatowicz; nested plot series CHP10SE.

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|----------------------------------|----------------------------------|
| 1. <i>Androsace elongata</i>     | 12. <i>Lactuca serriola</i>      |
| 2. <i>Arenaria serpyllifolia</i> | 13. <i>Leymus ramosus</i>        |
| 3. <i>Cerastium ucrainicum</i>   | 14. <i>Myosotis stricta</i>      |
| 4. <i>Conyza canadensis</i>      | 15. <i>Poa angustifolia</i>      |
| 5. <i>Cruciata pedemontana</i>   | 16. <i>Ranunculus scythicus</i>  |
| 6. <i>Eryngium campestre</i>     | 17. <i>Stipa capillata</i>       |
| 7. <i>Falcaria vulgaris</i>      | 18. <i>Stipa ucrainica</i>       |
| 8. <i>Festuca valesiaca</i>      | 19. <i>Valerianella carinata</i> |
| 9. <i>Filago arvensis</i>        | 20. <i>Verbascum phoeniceum</i>  |
| 10. <i>Galium ruthenicum</i>     | 21. <i>Veronica triphyllos</i>   |
| 11. <i>Koeleria macrantha</i>    | 22. <i>Viola kitaibeliana</i>    |

Bryophytes and lichens: *Moss sp. 1*, *Moss sp. 2* (not identified).

**(24) 22 vascular plants species (22 species complete vegetation) / 0.1 m<sup>2</sup> (32 cm × 32 cm)** – bunchgrass steppe, Falz-Fein Biosphere Reserve Askania Nova, Kherson Region, coordinates: 46.47538N, 33.96717E (recorded using GPS), elevation 27 m a.s.l., flat area; land use: abandonment. Plot size measured with a wooden ruler, species recorded as shoot presence, 18.05.2017, authors: Iwona Dembicz, Ivan Moysiienko, Victor Shapoval; nested plot series CHP10NW.

- |                                 |                                  |
|---------------------------------|----------------------------------|
| 1. <i>Androsace elongata</i>    | 12. <i>Lactuca serriola</i>      |
| 2. <i>Artemisia austriaca</i>   | 13. <i>Leymus ramosus</i>        |
| 3. <i>Carex stenophylla</i>     | 14. <i>Linaria biebersteinii</i> |
| 4. <i>Cerastium ucrainicum</i>  | 15. <i>Myosotis stricta</i>      |
| 5. <i>Cruciata pedemontana</i>  | 16. <i>Phlomis hybrida</i>       |
| 6. <i>Euphorbia seguieriana</i> | 17. <i>Poa angustifolia</i>      |
| 7. <i>Falcaria vulgaris</i>     | 18. <i>Pterotheca sancta</i>     |
| 8. <i>Festuca valesiaca</i>     | 19. <i>Ranunculus scythicus</i>  |
| 9. <i>Galium ruthenicum</i>     | 20. <i>Valerianella carinata</i> |
| 10. <i>Galium spurium</i>       | 21. <i>Veronica arvensis</i>     |
| 11. <i>Koeleria macrantha</i>   | 22. <i>Viola kitaibeliana</i>    |

**(25) 39 vascular plant species (44 species complete vegetation) / 1 m<sup>2</sup> (1 m × 1 m) (maximum for the steppe zone)** – the same nested plot series as record #7 (SB2103NW).

- |  |                                      |
|--|--------------------------------------|
| 1. <i>Allium paczoskianum</i>          | 21. <i>Linaria biebersteinii</i>     |
| 2. <i>Anisantha sterilis</i>           | 22. <i>Melica transsilvanica</i>     |
| 3. <i>Arenaria serpyllifolia</i>       | 23. <i>Myosotis arvensis</i>         |
| 4. <i>Asyneuma canescens</i>           | 24. <i>Myosotis sparsiflora</i>      |
| 5. <i>Campanula bononiensis</i>        | 25. <i>Papaver dubium</i>            |
| 6. <i>Carex praecox</i>                | 26. <i>Poa angustifolia</i>          |
| 7. <i>Chamaecytisus austriacus</i>     | 27. <i>Prunus stepposa</i>           |
| 8. <i>Echinops sphaerocephalon</i>     | 28. <i>Ranunculus illyricus</i>      |
| 9. <i>Crataegus monogyna juv.</i>      | 29. <i>Robinia pseudoacacia juv.</i> |
| 10. <i>Elytrigia intermedia</i>        | 30. <i>Teucrium chamaedrys</i>       |
| 11. <i>Eryngium campestre</i>          | 31. <i>Thlaspi perfoliatum</i>       |
| 12. <i>Falcaria vulgaris</i>           | 32. <i>Trifolium arvense</i>         |
| 13. <i>Ferulago galbanifera</i>        | 33. <i>Trifolium montanum</i>        |
| 14. <i>Festuca rupicola</i>            | 34. <i>Valerianella sp.</i>          |
| 15. <i>Filipendula vulgaris</i>        | 35. <i>Verbascum phoeniceum</i>      |
| 16. <i>Fragaria viridis</i>            | 36. <i>Veronica arvensis</i>         |
| 17. <i>Hylotelephium maximum aggr.</i> | 37. <i>Vinca herbacea</i>            |
| 18. <i>Hypericum perforatum</i>        | 38. <i>Viola kitaibeliana</i>        |
| 19. <i>Lamium amplexicaule</i>         | 39. <i>Viola matutina</i>            |
| 20. <i>Lamium purpureum</i>            |                                      |

Bryophytes: *Brachythecium albicans*, *Ceratodon purpureus*, *Eurhynchium hians*, *Rhynchostegium sp.*, *Weissia longifolia*

**(26) 39 vascular plant species (42 species complete vegetation) / 1 m<sup>2</sup> (1 m × 1 m) (maximum for the steppe zone)** – forb-grass meso-xeric steppe, Mykolaiv region, near Trykhaty village, coordinates: 47.11055N, 31.84829E (recorded using GPS), aspect 20°, slope 10°, relief position: middle slope; land use: low-intensity grazing. Plot size measured with a wooden ruler, species recorded as shoot presence, 06.06.2020, Dariia Borovyk, Denys Vynokurov, Olha Chusova; nested plot series SB20101NE.

1.	<i>Achillea setacea</i>	21.	<i>Phleum phleoides</i>
2.	<i>Arenaria serpyllifolia</i>	22.	<i>Pilosella echiooides</i> aggr.
3.	<i>Artemisia austriaca</i>	23.	<i>Potentilla argentea</i>
4.	<i>Bromopsis riparia</i>	24.	<i>Potentilla laciniosa</i>
5.	<i>Carex praecox</i>	25.	<i>Ranunculus illyricus</i>
6.	<i>Carex supina</i>	26.	<i>Salvia nemorosa</i>
7.	<i>Cerastium semidecandrum</i>	27.	<i>Scabiosa ochroleuca</i>
8.	<i>Convolvulus arvensis</i>	28.	<i>Scorzonera mollis</i>
9.	<i>Crataegus monogyna</i> juv.	29.	<i>Silene bupleuroides</i>
10.	<i>Dianthus andrzejowskianus</i>	30.	<i>Stipa capillata</i>
11.	<i>Dianthus carbonatus</i>	31.	<i>Stipa ucrainica</i>
12.	<i>Eryngium campestre</i>	32.	<i>Teucrium polium</i>
13.	<i>Euphorbia seguieriana</i>	33.	<i>Thesium arvense</i>
14.	<i>Falcaria vulgaris</i>	34.	<i>Thymus marschallianus</i>
15.	<i>Festuca valesiaca</i> aggr.	35.	<i>Trifolium arvense</i>
16.	<i>Galium verum</i>	36.	<i>Verbascum phoeniceum</i>
17.	<i>Helichrysum arenarium</i>	37.	<i>Veronica arvensis</i>
18.	<i>Holosteum umbellatum</i>	38.	<i>Veronica gryniana</i>
19.	<i>Jurinea arachnoidea</i>	39.	<i>Veronica prostrata</i>
20.	<i>Koeleria macrantha</i>		

Bryophytes: *Bryum subapiculatum*, *Phascum cuspidatum*, *Tortula* cf. *lanceola*.

(27) **39 vascular plant species (41 species complete vegetation) / 1 m<sup>2</sup> (1 m × 1 m) (maximum for the steppe zone)** – the same nested plot series as record #6 (nested plot series SB2105NW).

1.	<i>Acinos arvensis</i>	21.	<i>Linum austriacum</i>
2.	<i>Alyssum murale</i>	22.	<i>Medicago falcata</i>
3.	<i>Arenaria serpyllifolia</i>	23.	<i>Muscari neglectum</i>
4.	<i>Astragalus onobrychis</i>	24.	<i>Otites chersonensis</i>
5.	<i>Bromus squarrosus</i>	25.	<i>Pilosella echiooides</i>
6.	<i>Camelina microcarpa</i>	26.	<i>Plantago lanceolata</i>
7.	<i>Caragana mollis</i>	27.	<i>Poa angustifolia</i>
8.	<i>Cleistogenes bulgarica</i>	28.	<i>Poa bulbosa</i>
9.	<i>Crataegus monogyna</i> juv.	29.	<i>Potentilla humifusa</i>
10.	<i>Dianthus carbonatus</i>	30.	<i>Potentilla incana</i>
11.	<i>Eryngium campestre</i>	31.	<i>Poterium sanguisorba</i>
12.	<i>Euphorbia agraria</i>	32.	<i>Pulsatilla pratensis</i>
13.	<i>Festuca rupicola</i>	33.	<i>Salvia nutans</i>
14.	<i>Fragaria viridis</i>	34.	<i>Senecio jacobaea</i>
15.	<i>Galatella villosa</i>	35.	<i>Taraxacum erythrospermum</i>
16.	<i>Holosteum umbellatum</i>	36.	<i>Teucrium polium</i>
17.	<i>Iris pumila</i>	37.	<i>Thlaspi praecox</i>
18.	<i>Jurinea arachnoidea</i>	38.	<i>Verbascum phoeniceum</i>
19.	<i>Koeleria macrantha</i>	39.	<i>Veronica steppacea</i>
20.	<i>Kohlrauschia prolifera</i>		

Bryophytes: *Brachythecium* sp., *Weissia longifolia*.

(28) **38 vascular plants species (41 species complete vegetation) / 1 m<sup>2</sup> (1 m × 1 m)** – forb-bunchgrass steppe, ravine between Zmiivka and Chervonyi Maiak villages, Kherson Region, coordinates: 46.92916N, 33.58462E (recorded using GPS), elevation 27 m a.s.l., aspect 90°, slope 18°, relief position: middle slope. Plot size measured with a wooden ruler, species recorded as shoot presence, 10.05.2016, authors: Lukasz Kozub, Victoria Dzerkal; nested plot series CHB06SE.

1.	<i>Arenaria serpyllifolia</i>	19.	<i>Linum austriacum</i>
2.	<i>Artemisia austriaca</i>	20.	<i>Myosotis stricta</i>
3.	<i>Asperula montana</i>	21.	<i>Onobrychis gracilis</i>
4.	<i>Astragalus ucrainicus</i>	22.	<i>Poa bulbosa</i>
5.	<i>Astragalus varius</i>	23.	<i>Potentilla recta</i>
6.	<i>Buglossoides arvensis</i>	24.	<i>Pterotheca sancta</i>
7.	<i>Carduus uncinatus</i>	25.	<i>Salvia nemorosa</i>
8.	<i>Convolvulus arvensis</i>	26.	<i>Salvia nutans</i>
9.	<i>Ephedra distachya</i>	27.	<i>Scorzonera mollis</i>
10.	<i>Erophila verna</i>	28.	<i>Senecio vernalis</i>
11.	<i>Festuca rupicola</i>	29.	<i>Sisymbrium polymorphum</i>
12.	<i>Festuca valesiaca</i>	30.	<i>Stipa capillata</i>
13.	<i>Helichrysum arenarium</i>	31.	<i>Teucrium polium</i>
14.	<i>Herniaria besseri</i>	32.	<i>Verbascum phoeniceum</i>
15.	<i>Holosteum umbellatum</i>	33.	<i>Veronica arvensis</i>
16.	<i>Iris pumila</i>	34.	<i>Veronica spicata</i>
17.	<i>Koeleria macrantha</i>	35.	<i>Veronica triphyllos</i>
18.	<i>Lamium amplexicaule</i>	36.	<i>Veronica verna</i>

Bryophytes and lichens: *Barbula unguiculata*, *Tortula acaulon*, *Weissia longifolia*.

**(29) 38 vascular plants species (39 species complete vegetation) / 1 m<sup>2</sup> (1 m × 1 m)** – forb-rich steppe, pasture with shrub encroachment, near Myhiia village, Mykolaiv Region, coordinates: 48.01165N, 30.97917E (recorded using GPS in smartphone), aspect 205°, slope 15°, land use: low-intensity grazing. Plot size delimited by a measuring tape, species recorded as shoot presence, 15.06.2021, authors: Dariia Borovyk, Ganna Kolomiets, Denys Vynokurov; nested plot series SB2102SE.

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|-----------------------------------|---------------------------------------|
| 1. <i>Acinos arvensis</i>         | 20. <i>Linum austriacum</i>           |
| 2. <i>Arenaria serpyllifolia</i>  | 21. <i>Medicago falcata</i>           |
| 3. <i>Asperula species</i>        | 22. <i>Muscari neglectum</i>          |
| 4. <i>Astragalus albidus</i>      | 23. <i>Nonea rossica</i>              |
| 5. <i>Astragalus austriacus</i>   | 24. <i>Otites chersonensis</i>        |
| 6. <i>Astragalus dasyanthus</i>   | 25. <i>Plantago media</i>             |
| 7. <i>Astragalus onobrychis</i>   | 26. <i>Poa angustifolia</i>           |
| 8. <i>Bromopsis riparia</i>       | 27. <i>Rosa corymbifera</i> juv.      |
| 9. <i>Caragana frutex</i>         | 28. <i>Salvia nutans</i>              |
| 10. <i>Cleistogenes bulgarica</i> | 29. <i>Scorzonera mollis</i>          |
| 11. <i>Crataegus monogyna</i> S   | 30. <i>Senecio jacobaea</i>           |
| 12. <i>Eryngium campestre</i>     | 31. <i>Senecio vernalis</i>           |
| 13. <i>Euphorbia stepposa</i>     | 32. <i>Stipa capillata</i>            |
| 14. <i>Festuca rupicola</i>       | 33. <i>Teucrium chamaedrys</i>        |
| 15. <i>Herniaria besseri</i>      | 34. <i>Teucrium polium</i>            |
| 16. <i>Hypericum elegans</i>      | 35. <i>Thesium arvense</i>            |
| 17. <i>Iris pumila</i>            | 36. <i>Verbascum pseudophoeniceum</i> |
| 18. <i>Koeleria macrantha</i>     | 37. <i>Veronica steppacea</i>         |
| 19. <i>Lactuca serriola</i>       | 38. <i>Viola ambigua</i>              |

Bryophytes: *Weissia longifolia*.

**(30) 36 vascular plants species (38 species complete vegetation) / 1 m<sup>2</sup> (1 m × 1 m)** – forb-rich meso-xeric steppe, gully near Lviv village, Buzkyi Gard National Nature Park, Mykolaiv Region, coordinates: 47.88969N, 31.09888E (recorded using GPS in smartphone), aspect 325°, slope 22°, relief position: middle slope; land use: abandonment. Plot size delimited by a measuring tape, species recorded as shoot presence, 02.07.2020, authors: Dariia Borovyk, Ganna Kolomiets, Denys Vynokurov, Ivan Moysiienko; nested plot series SB20122NW.

- |                                   |                                   |
|-----------------------------------|-----------------------------------|
| 1. <i>Acer tataricum</i> juv.     | 19. <i>Poa compressa</i>          |
| 2. <i>Adonis vernalis</i>         | 20. <i>Potentilla patula</i>      |
| 3. <i>Alyssum murale</i>          | 21. <i>Pulsatilla pratensis</i>   |
| 4. <i>Asperula cynanchica</i>     | 22. <i>Salvia nutans</i>          |
| 5. <i>Campanula glomerata</i>     | 23. <i>Securigera varia</i>       |
| 6. <i>Cephalaria uralensis</i>    | 24. <i>Sempervivum ruthenicum</i> |
| 7. <i>Cleistogenes bulgarica</i>  | 25. <i>Seseli pallasii</i>        |
| 8. <i>Crataegus monogyna</i> juv. | 26. <i>Silene nutans</i>          |
| 9. <i>Euphorbia seguieriana</i>   | 27. <i>Stipa pennata</i>          |
| 10. <i>Festuca rupicola</i>       | 28. <i>Stipa tirsia</i>           |
| 11. <i>Filipendula vulgaris</i>   | 29. <i>Teucrium chamaedrys</i>    |
| 12. <i>Fragaria viridis</i>       | 30. <i>Teucrium polium</i>        |
| 13. <i>Galatella linosyris</i>    | 31. <i>Thlaspi praecox</i>        |
| 14. <i>Galium verum</i>           | 32. <i>Trifolium alpestre</i>     |
| 15. <i>Hieracium umbellatum</i>   | 33. <i>Trifolium montanum</i>     |
| 16. <i>Peucedanum ruthenicum</i>  | 34. <i>Veronica spicata</i> aggr. |
| 17. <i>Pilosella echioides</i>    | 35. <i>Viola ambigua</i>          |
| 18. <i>Poa angustifolia</i>       | 36. <i>Viscaria vulgaris</i>      |

Bryophytes and lichens: *Cladonia pyxidata*, *Homalothecium lutescens*.

**(31) 35 vascular plants species (36 species complete vegetation) / 1 m<sup>2</sup> (1 m × 1 m)** – forb-rich bunchgrass steppe, near Tiahynka village, Kherson Region, burning a few years ago, coordinates: 46.76701N, 33.04039E (recorded using GPS in smartphone), elevation 15 m a.s.l., aspect 45°, slope 1°, relief position: upper part of the slope, relatively flat area; land use: low-intensity grazing. Plot size measured with a wooden ruler, species recorded as shoot presence, 17.05.2016, author: Victoria Dzerkal; nested plot series CHB09SE.

- |                                |                                      |
|--------------------------------|--------------------------------------|
| 1. <i>Anthemis ruthenica</i>   | 9. <i>Cymbopachasma borysthenica</i> |
| 2. <i>Artemisia austriaca</i>  | 10. <i>Elytrigia repens</i>          |
| 3. <i>Asperula montana</i>     | 11. <i>Euphorbia agraria</i>         |
| 4. <i>Bromus squarrosus</i>    | 12. <i>Falcaria vulgaris</i>         |
| 5. <i>Cerastium ucrainicum</i> | 13. <i>Festuca valesiaca</i>         |
| 6. <i>Consolida paniculata</i> | 14. <i>Galatella villosa</i>         |
| 7. <i>Convolvulus arvensis</i> | 15. <i>Galium humifusum</i>          |
| 8. <i>Crepis ramosissima</i>   | 16. <i>Geranium pusillum</i>         |

- |                                     |                                   |
|-------------------------------------|-----------------------------------|
| 17. <i>Holosteum umbellatum</i>     | 27. <i>Salvia nutans</i>          |
| 18. <i>Kochia prostrata</i>         | 28. <i>Serratula erucifolia</i>   |
| 19. <i>Marrubium praecox</i>        | 29. <i>Seseli tortuosum</i>       |
| 20. <i>Medicago falcata</i>         | 30. <i>Stipa capillata</i>        |
| 21. <i>Myosotis stricta</i>         | 31. <i>Teucrium polium</i>        |
| 22. <i>Poa angustifolia</i>         | 32. <i>Trigonella monspeliaca</i> |
| 23. <i>Poa bulbosa</i>              | 33. <i>Verbascum phoeniceum</i>   |
| 24. <i>Polygonum novoascanicum</i>  | 34. <i>Veronica spicata</i>       |
| 25. <i>Potentilla semilaciniosa</i> | 35. <i>Veronica triphyllos</i>    |
| 26. <i>Pterotheca sancta</i>        |                                   |

Bryophytes and lichens: *Tortula acaulon*.

**(32) 73 vascular plant species (77 species complete vegetation) / 10 m<sup>2</sup> (3.16 m × 3.16 m) (maximum for the steppe zone)** – forb-rich meso-xeric steppe, pasture with shrub encroachment, near Kuripchyne village, Mykolaiv Region, coordinates: 48.00023N, 31.0053E (recorded using GPS in smartphone), aspect 240°, slope 5°; land use: low-intensity grazing. Plot size delimited by a measuring tape, species recorded as shoot presence, species covers are given in percentages, 16.06.2021, authors: Daria Borovyk, Ganna Kolomiets, Ivan Moysienko, Denys Vynokurov; nested plot series SB2103NW.

1. <i>Acinos arvensis</i>	0.01	38. <i>Medicago minima</i>	0.5
2. <i>Allium paczoskianum</i>	0.001	39. <i>Muscari neglectum</i>	0.1
3. <i>Alyssum murale</i>	0.2	40. <i>Nigella arvensis</i>	0.2
4. <i>Arenaria serpyllifolia</i>	2	41. <i>Otites chersonensis</i>	0.2
5. <i>Astragalus albidus</i>	0.2	42. <i>Phleum phleoides</i>	0.1
6. <i>Astragalus onobrychis</i>	1	43. <i>Phlomis pungens</i>	1.5
7. <i>Botriochloa ischaemum</i>	0.3	44. <i>Pilosella echioides</i>	5
8. <i>Bromus squarrosus</i>	0.5	45. <i>Plantago lanceolata</i>	0.1
9. <i>Buglossoides arvensis</i>	0.2	46. <i>Plantago media</i>	0.3
10. <i>Camelina microcarpa</i>	0.01	47. <i>Poa angustifolia</i>	1
11. <i>Campanula bononiensis</i>	0.2	48. <i>Poa bulbosa</i>	2
12. <i>Caragana mollis</i>	3	49. <i>Potentilla humifusa</i>	1
13. <i>Carex supina</i>	0.01	50. <i>Potentilla incana</i>	5
14. <i>Cerastium semidecandrum</i>	0.001	51. <i>Potentilla recta</i>	0.5
15. <i>Cleistogenes bulgarica</i>	1	52. <i>Poterium sanguisorba</i>	0.01
16. <i>Crataegus monogyna S</i>	4	53. <i>Pulsatilla pratensis</i>	3
17. <i>Dianthus carbonatus</i>	0.01	54. <i>Ranunculus illyricus</i>	0.1
18. <i>Eryngium campestre</i>	1	55. <i>Rhamnus cathartica juv.</i>	0.2
19. <i>Euphorbia agraria</i>	0.2	56. <i>Salvia nemorosa</i>	0.1
20. <i>Euphorbia stepposa</i>	0.1	57. <i>Salvia nutans</i>	10
21. <i>Festuca rupicola</i>	20	58. <i>Scleranthus annuus</i>	0.001
22. <i>Fragaria viridis</i>	15	59. <i>Sempervivum ruthenicum</i>	0.2
23. <i>Gagea sp.</i>	0.001	60. <i>Senecio jacobaea</i>	0.2
24. <i>Galatella villosa</i>	0.1	61. <i>Seseli tortuosum</i>	0.2
25. <i>Galium verum</i>	0.2	62. <i>Stipa capillata</i>	0.2
26. <i>Helichrysum arenarium</i>	0.5	63. <i>Stipa dasyphylla</i>	7
27. <i>Herniaria besseri</i>	0.3	64. <i>Taraxacum erythrospermum</i>	0.001
28. <i>Holosteum umbellatum</i>	0.01	65. <i>Teucrium polium</i>	1
29. <i>Hyacinthella leucophaea</i>	0.2	66. <i>Thlaspi praecox</i>	0.2
30. <i>Hypericum elegans</i>	0.01	67. <i>Thymus × dimorphus</i>	1
31. <i>Iris pumila</i>	0.2	68. <i>Tragopogon major</i>	0.2
32. <i>Jurinea arachnoidea</i>	5	69. <i>Trigonella monspeliaca</i>	0.1
33. <i>Koeleria macrantha</i>	1	70. <i>Verbascum phoeniceum</i>	2
34. <i>Kohlruschia prolifera</i>	0.1	71. <i>Veronica steppacea</i>	2
35. <i>Lactuca serriola</i>	0.01	72. <i>Viola ambigua</i>	0.01
36. <i>Linum austriacum</i>	0.1	73. <i>Xeranthemum annuum</i>	0.001
37. <i>Medicago falcata</i>	4		

Bryophytes and lichens: *Brachythecium sp.* 5, *Cladonia foliacea* 0.2, *Syntrichia ruralis* 1, *Weissia longifolia* 2.

**(33) 65 vascular plant species (68 species complete vegetation) / 10 m<sup>2</sup> (3.16 m × 3.16 m)** – forb-bunchgrass steppe on limestone outcrops, pasture, eroded slope, gully near Kapustyne village, Mykolaiv region, coordinates: 47.08989N, 32.03446E (recorded using GPS), aspect 340°, slope 30°, relief position: down slope; land use: grazing. Plot size delimited by a measuring tape, species recorded as shoot presence, species covers are given in percentages, 04.06.2020, authors: Daria Borovyk, Olha Chusova; plot SB20065.

1. <i>Achillea setacea</i>	0.01	9. <i>Botriochloa ischaemum</i>	2
2. <i>Aegilops cylindrica</i>	0.1	10. <i>Bromopsis riparia</i>	3
3. <i>Agropyron pectinatum</i>	3	11. <i>Bromus squarrosus</i>	0.1
4. <i>Arenaria serpyllifolia</i>	0.01	12. <i>Bufonia tenuifolia</i>	0.05
5. <i>Artemisia austriaca</i>	0.2	13. <i>Buglossoides arvensis</i>	0.01
6. <i>Asperula cynanchica</i>	0.2	14. <i>Camelina microcarpa</i>	0.01
7. <i>Astragalus ponticus</i>	0.5	15. <i>Caragana frutex</i>	0.5
8. <i>Astragalus ucrainicus</i>	0.5	16. <i>Centaurea diffusa</i>	0.3



17.	<i>Convolvulus arvensis</i>	0.5	42.	<i>Nigella arvensis</i>	0.1
18.	<i>Cota tinctoria</i>	0.7	43.	<i>Onobrychis arenaria</i>	2
19.	<i>Cytisus graniticus</i>	3	44.	<i>Phlomis pungens</i>	3
20.	<i>Dianthus pseudarmeria</i>	0.2	45.	<i>Poa angustifolia</i>	2
21.	<i>Erophila verna</i>	0.001	46.	<i>Poa bulbosa</i>	5
22.	<i>Eryngium campestre</i>	0.5	47.	<i>Poa compressa</i>	10
23.	<i>Erysimum diffusum</i>	1	48.	<i>Potentilla incana</i>	1
24.	<i>Euphorbia seguieriana</i>	0.3	49.	<i>Potentilla recta</i>	1
25.	<i>Euphorbia stepposa</i>	2	50.	<i>Poterium polygamum</i>	0.2
26.	<i>Grindelia squarrosa</i>	0.001	51.	<i>Salvia nemorosa</i>	7
27.	<i>Holosteum umbellatum</i>	0.01	52.	<i>Securigera varia</i>	0.2
28.	<i>Inula oculus-christi</i>	3	53.	<i>Seseli tortuosum</i>	1
29.	<i>Kochia prostrata</i>	1	54.	<i>Sideritis comosa</i>	0.01
30.	<i>Koeleria brevis</i>	1.5	55.	<i>Silene bupleuroides</i>	0.5
31.	<i>Koeleria macrantha</i>	5	56.	<i>Stipa capillata</i>	1
32.	<i>Lappula squarrosa</i>	0.01	57.	<i>Stipa lessingiana</i>	10
33.	<i>Lavatera thuringiaca</i>	0.5	58.	<i>Teucrium polium</i>	2
34.	<i>Linaria genistifolia</i>	0.5	59.	<i>Thlaspi perfoliatum</i>	0.1
35.	<i>Linum austriacum</i>	0.1	60.	<i>Thymus dimorphus</i>	0.5
36.	<i>Marrubium praecox</i>	0.5	61.	<i>Veronica arvensis</i>	0.01
37.	<i>Medicago falcata</i>	0.5	62.	<i>Viola ambigua</i>	0.5
38.	<i>Medicago minima</i>	0.1	63.	<i>Viola arvensis</i>	0.01
39.	<i>Meniocus linifolius</i>	0.1	64.	<i>Viola kitaibeliana</i>	0.01
40.	<i>Minuartia hybrida</i>	0.01	65.	<i>Xeranthemum annuum</i>	0.01
41.	<i>Nepeta parviflora</i>	1			

Bryophytes and lichens: *Collema tenax* 0.5, *Syntrichia ruralis* 0.5, *Weissia* sp. 1.

**(34) 59 vascular plants species (62 species complete vegetation) / 10 m<sup>2</sup> (3.16 m × 3.16 m)** – forb-bunchgrass steppe, ravine between Zmiivka and Chervonyi Maiak villages, Kherson Region, coordinates: 46.92916N, 33.58462E (recorded using GPS), elevation 27 m a.s.l., aspect 90°, slope 18°, relief position: middle slope. Plot size delimited by a measuring tape, species recorded as shoot presence, species covers are given in percentages, 10.05.2016, authors: Lukasz Kozub, Victoria Dzerkal; nested plot series CHB06SE.

1.	<i>Agropyron pectinatum</i>	0.5	31.	<i>Koeleria macrantha</i>	0.5
2.	<i>Alyssum desertorum</i>	0.01	32.	<i>Lamium amplexicaule</i>	0.3
3.	<i>Arenaria serpyllifolia</i>	0.1	33.	<i>Linum austriacum</i>	10
4.	<i>Artemisia austriaca</i>	3	34.	<i>Myosotis stricta</i>	0.1
5.	<i>Asperula montana</i>	0.1	35.	<i>Onobrychis gracilis</i>	0.5
6.	<i>Astragalus dasyanthus</i>	0.2	36.	<i>Pilosella echioides</i>	0.3
7.	<i>Astragalus ucrainicus</i>	0.1	37.	<i>Poa bulbosa</i>	10
8.	<i>Astragalus varius</i>	1	38.	<i>Potentilla recta</i>	0.5
9.	<i>Bromus squarrosus</i>	0.01	39.	<i>Potentilla semilaciniosa</i>	0.2
10.	<i>Buglossoides arvensis</i>	0.3	40.	<i>Pterotheca sancta</i>	0.3
11.	<i>Carduus uncinatus</i>	0.5	41.	<i>Salvia nemorosa</i>	1
12.	<i>Carex stenophylla</i>	0.5	42.	<i>Salvia nutans</i>	20
13.	<i>Carex supina</i>	0.5	43.	<i>Scorzonera mollis</i>	0.1
14.	<i>Chondrilla juncea</i>	0.1	44.	<i>Senecio vernalis</i>	1
15.	<i>Convolvulus arvensis</i>	0.2	45.	<i>Seseli tortuosum</i>	0.5
16.	<i>Ephedra distachya</i>	3	46.	<i>Sisymbrium polymorphum</i>	0.2
17.	<i>Erophila verna</i>	0.01	47.	<i>Stipa capillata</i>	25
18.	<i>Eryngium campestre</i>	0.5	48.	<i>Teucrium polium</i>	1
19.	<i>Euphorbia leptocaula</i>	0.1	49.	<i>Thymus dimorphus</i>	0.1
20.	<i>Euphorbia seguieriana</i>	0.1	50.	<i>Tragopogon major</i>	0.3
21.	<i>Festuca rupicola</i>	1	51.	<i>Trigonella monspeliaca</i>	0.1
22.	<i>Festuca valesiaca</i>	25	52.	<i>Valerianella carinata</i>	0.01
23.	<i>Galatella villosa</i>	1.5	53.	<i>Verbascum phoeniceum</i>	0.5
24.	<i>Geranium pusillum</i>	0.1	54.	<i>Veronica arvensis</i>	0.1
25.	<i>Goniolimon besserianum</i>	0.3	55.	<i>Veronica spicata</i>	1
26.	<i>Helichrysum arenarium</i>	0.01	56.	<i>Veronica triphyllos</i>	0.05
27.	<i>Herniaria besseri</i>	0.1	57.	<i>Veronica verna</i>	0.5
28.	<i>Holosteum umbellatum</i>	0.1	58.	<i>Viola kitaibeliana</i>	0.5
29.	<i>Iris pumila</i>	2	59.	<i>Xanthium albinum</i>	0.1
30.	<i>Jurinea arachnoidea</i>	0.5			

Bryophytes: *Barbula unguiculata* 0.3, *Tortula acaulon* 0.3, *Weissia longifolia* 0.5.

**(35) 57 vascular plants species (58 species complete vegetation) / 10 m<sup>2</sup> (3.16 m × 3.16 m)** – forb-rich bunchgrass steppe, near Tiahynka village, Kherson Region, burning a few years ago, coordinates: 46.76701N, 33.04039E (recorded using GPS in smartphone), elevation 15 m a.s.l., aspect 45°, slope 1°, relief position: upper slope, relatively flat area; land use: low-intensity grazing. Plot size delimited by a measuring tape, species recorded as shoot presence, species covers are given in percentages, 17.05.2016, author: Victoria Dzerkal; nested plot series CHB09SE.

1.	<i>Ajuga chia</i>	1	30.	<i>Hyacinthella leucophaea</i>	0.5
2.	<i>Anthemis ruthenica</i>	0.01	31.	<i>Inula oculus-christi</i>	5
3.	<i>Artemisia austriaca</i>	15	32.	<i>Kochia prostrata</i>	5
4.	<i>Artemisia lerchiana</i>	2	33.	<i>Koeleria macrantha</i>	3
5.	<i>Asperula montana</i>	0.5	34.	<i>Marrubium praecox</i>	0.5
6.	<i>Bromopsis heterophylla</i>	10	35.	<i>Medicago falcata</i>	1
7.	<i>Bromopsis inermis</i>	15	36.	<i>Myosotis stricta</i>	0.1
8.	<i>Bromus squarrosus</i>	2	37.	<i>Poa angustifolia</i>	10
9.	<i>Carduus uncinatus</i>	2	38.	<i>Poa bulbosa</i>	5
10.	<i>Centaurea salonitana</i>	5	39.	<i>Polygonum novoascanicum</i>	0.1
11.	<i>Cerastium ucrainicum</i>	0.1	40.	<i>Potentilla semilaciniosa</i>	1
12.	<i>Consolida paniculata</i>	0.01	41.	<i>Pterotheca sancta</i>	1
13.	<i>Convolvulus arvensis</i>	1	42.	<i>Salvia nutans</i>	5
14.	<i>Conyza canadensis</i>	0.5	43.	<i>Scorzonera mollis</i>	0.1
15.	<i>Crepis ramosissima</i>	0.5	44.	<i>Securigera varia</i>	5
16.	<i>Cymbophasma borysthonica</i>	1	45.	<i>Serratula erucifolia</i>	0.5
17.	<i>Elytrigia repens</i>	0.01	46.	<i>Seseli tortuosum</i>	0.5
18.	<i>Ephedra distachya</i>	2	47.	<i>Stipa capillata</i>	1
19.	<i>Erophila verna</i>	0.01	48.	<i>Taraxacum erythrospermum</i>	1
20.	<i>Eryngium campestre</i>	0.5	49.	<i>Teucrium polium</i>	3
21.	<i>Euphorbia agraria</i>	2	50.	<i>Thesium arvense</i>	0.01
22.	<i>Euphorbia seguieriana</i>	0.01	51.	<i>Tragopogon major</i>	0.1
23.	<i>Falcaria vulgaris</i>	1	52.	<i>Trigonella monspeliaca</i>	1
24.	<i>Festuca valesiaca</i>	25	53.	<i>Verbascum phoeniceum</i>	0.7
25.	<i>Galatella villosa</i>	0.01	54.	<i>Veronica arvensis</i>	0.5
26.	<i>Galium humifusum</i>	1	55.	<i>Veronica prostrata</i>	0.5
27.	<i>Geranium pusillum</i>	0.5	56.	<i>Veronica spicata</i>	0.5
28.	<i>Goniolimon besserianum</i>	3	57.	<i>Veronica triphyllos</i>	0.01
29.	<i>Holosteum umbellatum</i>	0.1			

Bryophytes: *Tortula acaulon* 0.5.

**(36) 107 vascular plant species / 100 m<sup>2</sup> (10 m × 10 m) (maximum for the steppe zone)** – forb-rich meso-xeric steppe, abandoned pasture, Luhansk Nature Reserve, between Krynychne and Zhuravske villages, Luhansk Region, coordinates: 49.27908N, 40.07653E (recorded using GPS), elevation 168 m a.s.l., aspect 180°, slope 5°, land use: abandonment, previously used as intensive pasture – in 1990 still intensive grazing, then intensity decreased, in 1994 abandoned. Plot size delimited by a measuring tape, species recorded as root presence, species covers are given in percentages (less than 1% – as +), 20.06.2000, author: Larysa Borovyk; plot number 13 (2000).

1.	<i>Achillea nobilis</i>	+	34.	<i>Eryngium planum</i>	+
2.	<i>Achillea pannonica</i>	+	35.	<i>Erysimum diffusum</i>	+
3.	<i>Adonis wolgensis</i>	+	36.	<i>Erysimum strictum</i>	+
4.	<i>Allium paczoscianum</i>	+	37.	<i>Euphorbia leptocaula</i>	+
5.	<i>Allium sphaerocephalon</i>	+	38.	<i>Euphorbia seguierana</i>	+
6.	<i>Amygdalus nana</i>	4	39.	<i>Falcaria vulgaris</i>	+
7.	<i>Artemisia austriaca</i>	+	40.	<i>Ferulago galbanifera</i>	+
8.	<i>Artemisia marschalliana</i>	+	41.	<i>Festuca rupicola</i>	10
9.	<i>Bellevalia sarmatica</i>	+	42.	<i>Festuca valesiaca</i>	+
10.	<i>Berteroa incana</i>	+	43.	<i>Filipendula vulgaris</i>	10
11.	<i>Bromopsis riparia</i>	1	44.	<i>Galium octonarum</i>	+
12.	<i>Bulbocodium versicolor</i>	+	45.	<i>Galium ruthenicum</i>	+
13.	<i>Bupleurum falcatum</i>	+	46.	<i>Galium verum</i>	+
14.	<i>Campanula altaica</i>	+	47.	<i>Helichrysum arenarium</i>	+
15.	<i>Campanula bononiensis</i>	+	48.	<i>Helictotrichon schellianum</i>	+
16.	<i>Campanula glomerata</i>	+	49.	<i>Hieracium virosum</i>	+
17.	<i>Campanula sibirica</i>	+	50.	<i>Hypericum perforatum</i>	+
18.	<i>Caragana frutex</i>	5	51.	<i>Inula aspera</i>	+
19.	<i>Carex supina</i>	+	52.	<i>Inula germanica</i>	+
20.	<i>Centaurea carbonata</i>	1	53.	<i>Inula hirta</i>	+
21.	<i>Centaurea orientalis</i>	+	54.	<i>Inula oculus-christi</i>	+
22.	<i>Centaurea pseudomaculosa</i>	+	55.	<i>Iris pumila</i>	+
23.	<i>Centaurea ruthenica</i>	+	56.	<i>Jurinea arachnoidea</i>	+
24.	<i>Centaurea trichocephala</i>	+	57.	<i>Jurinea centauroides</i>	+
25.	<i>Cephalaria uralensis</i>	3	58.	<i>Koeleria macrantha</i>	+
26.	<i>Chamaecytisus ruthenicus</i>	+	59.	<i>Linaria maetotica</i>	+
27.	<i>Dianthus campestris</i>	+	60.	<i>Medicago romanica</i>	+
28.	<i>Draba nemorosa</i>	+	61.	<i>Nonea rossica</i>	+
29.	<i>Elytrigia repens</i>	+	62.	<i>Odontites luteus</i>	+
30.	<i>Eremogone bibersteinii</i>	+	63.	<i>Ornithogalum kochii</i>	+
31.	<i>Eremogone longifolia</i>	+	64.	<i>Peucedanum ruthenicum</i>	+
32.	<i>Erophila verna</i>	+	65.	<i>Phleum phleoides</i>	+
33.	<i>Eryngium campestre</i>	+	66.	<i>Phlomis pungens</i>	+

67.	<i>Phlomis tuberosa</i>	+	88.	<i>Stipa dasyphylla</i>	+
68.	<i>Pilosella echioidea</i>	+	89.	<i>Stipa lessingiana</i>	+
69.	<i>Plantago lanceolata</i>	+	90.	<i>Stipa pennata</i>	+
70.	<i>Plantago urvillei</i>	+	91.	<i>Stipa tirsia</i>	+
71.	<i>Poa angustifolia</i>	+	92.	<i>Stipa zalesskii</i>	+
72.	<i>Poa bulbosa</i>	+	93.	<i>Taraxacum sp.</i>	+
73.	<i>Polygala podolica</i>	+	94.	<i>Thalictrum minus</i>	+
74.	<i>Potentilla argentea</i>	+	95.	<i>Thesium arvense</i>	+
75.	<i>Potentilla obscura</i>	+	96.	<i>Thlaspi perfoliatum</i>	+
76.	<i>Potentilla schurii</i>	1	97.	<i>Thymus marschallianus</i>	10
77.	<i>Pulsatilla patens</i>	6	98.	<i>Trifolium alpestre</i>	+
78.	<i>Pulsatilla pratensis</i>	1	99.	<i>Trifolium montanum</i>	+
79.	<i>Salvia nutans</i>	1	100.	<i>Trinia multicaulis</i>	+
80.	<i>Scabiosa ochroleuca</i>	+	101.	<i>Valeriana tuberosa</i>	+
81.	<i>Securigera varia</i>	+	102.	<i>Verbascum marschallianum</i>	+
82.	<i>Senecio grandidentatus</i>	+	103.	<i>Verbascum phoeniceum</i>	+
83.	<i>Seseli campestre</i>	+	104.	<i>Veronica prostrata</i>	+
84.	<i>Sisymbrium polymorphum</i>	+	105.	<i>Veronica sclerophylla</i>	+
85.	<i>Stachys recta</i>	+	106.	<i>Veronica spicata</i>	+
86.	<i>Stellaria hippoctora</i>	+	107.	<i>Viola ambigua</i>	+
87.	<i>Stipa capillata</i>	+			

(37) **104 vascular plant species (109 species complete vegetation) / 100 m<sup>2</sup> (10 m × 10 m)** – forb-rich meso-xeric steppe, pasture with shrub encroachment, near Kuripchyne village, Mykolaiv Region, coordinates: 48.00023N, 31.0053E (recorded using GPS in smartphone), aspect 240°, slope 5°, land use: low-intensity grazing. Plot size delimited by a measuring tape, species recorded as shoot presence, species covers are given in percentages, 16.06.2021, authors: Dariia Borovyk, Ganna Kolomiets, Ivan Moysienko, Denys Vynokurov; nested plot series SB2103.

1.	<i>Achillea setacea</i>	0.05	46.	<i>Medicago falcata</i>	3
2.	<i>Acinos arvensis</i>	0.005	47.	<i>Medicago minima</i>	0.5
3.	<i>Allium paczoskianum</i>	0.001	48.	<i>Melica transsilvanica</i>	1
4.	<i>Alyssum calycinum</i>	0.001	49.	<i>Milium vernale</i>	0.005
5.	<i>Alyssum murale</i>	10	50.	<i>Muscari neglectum</i>	0.05
6.	<i>Arenaria serpyllifolia</i>	1	51.	<i>Myosotis stricta</i>	0.001
7.	<i>Astragalus albidus</i>	0.1	52.	<i>Nigella arvensis</i>	0.1
8.	<i>Astragalus onobrychis</i>	1.5	53.	<i>Nonea rossica</i>	0.5
9.	<i>Botriochloa ischaemum</i>	0.1	54.	<i>Otites chersonensis</i>	0.6
10.	<i>Bromopsis inermis</i>	1	55.	<i>Papaver dubium</i>	0.001
11.	<i>Bromus squarrosus</i>	1.25	56.	<i>Phleum phleoides</i>	0.05
12.	<i>Buglossoides arvensis</i>	0.2	57.	<i>Phlomis pungens</i>	1.25
13.	<i>Camelina microcarpa</i>	0.005	58.	<i>Pilosella echioidea</i>	2.5
14.	<i>Campanula bononiensis</i>	0.1	59.	<i>Plantago lanceolata</i>	0.05
15.	<i>Caragana mollis</i>	3	60.	<i>Plantago media</i>	0.4
16.	<i>Carex supina</i>	0.005	61.	<i>Poa angustifolia</i>	5
17.	<i>Cerastium semidecandrum</i>	0.001	62.	<i>Poa bulbosa</i>	1.5
18.	<i>Cleistogenes bulgarica</i>	5	63.	<i>Poa compressa</i>	0.005
19.	<i>Crataegus monogyna S</i>	11	64.	<i>Potentilla argentea</i>	0.001
20.	<i>Crepis rhoeadifolia</i>	0.01	65.	<i>Potentilla humifusa</i>	0.5
21.	<i>Cynoglossum officinale</i>	0.01	66.	<i>Potentilla incana</i>	2.5
22.	<i>Dianthus carbonatus</i>	0.1	67.	<i>Potentilla recta</i>	0.5
23.	<i>Elytrigia intermedia</i>	1	68.	<i>Poterium sanguisorba</i>	0.005
24.	<i>Eryngium campestre</i>	0.75	69.	<i>Prunus sp. juv.</i>	0.005
25.	<i>Erysimum diffusum</i>	0.25	70.	<i>Pulsatilla pratensis</i>	2
26.	<i>Euphorbia agraria</i>	0.1	71.	<i>Pyrus communis juv.</i>	0.5
27.	<i>Euphorbia stepposa</i>	0.3	72.	<i>Quercus robur juv.</i>	0.001
28.	<i>Falcaria vulgaris</i>	0.75	73.	<i>Ranunculus illyricus</i>	0.05
29.	<i>Festuca rupicola</i>	17.5	74.	<i>Rhamnus cathartica juv.</i>	0.1
30.	<i>Fragaria viridis</i>	15	75.	<i>Rosa sp. juv.</i>	0.01
31.	<i>Gagea sp.</i>	0.001	76.	<i>Salvia nemorosa</i>	0.5
32.	<i>Galatella villosa</i>	0.05	77.	<i>Salvia nutans</i>	7
33.	<i>Galium spurium</i>	0.05	78.	<i>Scleranthus annuus</i>	0.001
34.	<i>Galium verum</i>	0.15	79.	<i>Scorzonera taurica</i>	0.1
35.	<i>Helichrysum arenarium</i>	0.25	80.	<i>Securigera varia</i>	1
36.	<i>Herniaria besseri</i>	0.2	81.	<i>Sempervivum ruthenicum</i>	0.1
37.	<i>Holosteum umbellatum</i>	0.005	82.	<i>Senecio jacobaea</i>	0.5
38.	<i>Hyacinthella leucophaea</i>	0.1	83.	<i>Senecio vernalis</i>	0.005
39.	<i>Hypericum elegans</i>	0.05	84.	<i>Seseli tortuosum</i>	0.1
40.	<i>Iris pumila</i>	0.1	85.	<i>Silene bupleuroides</i>	0.01
41.	<i>Jurinea arachnoidea</i>	5	86.	<i>Stipa capillata</i>	0.1
42.	<i>Koeleria macrantha</i>	3	87.	<i>Stipa dasyphylla</i>	5
43.	<i>Kohlruschia prolifera</i>	0.05	88.	<i>Taraxacum erythrospermum</i>	0.001
44.	<i>Lactuca serriola</i>	0.1	89.	<i>Taraxacum serotinum</i>	0.05
45.	<i>Linum austriacum</i>	0.1	90.	<i>Teucrium polium</i>	0.5

91.	<i>Thesium arvense</i>	0.001	98.	<i>Verbascum phoeniceum</i>	2
92.	<i>Thlaspi arvense</i>	0.001	99.	<i>Veronica arvensis</i>	0.001
93.	<i>Thlaspi perfoliatum</i>	0.005	100.	<i>Veronica steppacea</i>	5
94.	<i>Thlaspi praecox</i>	0.1	101.	<i>Vincetoxicum hirundinaria</i>	0.2
95.	<i>Thymus × dimorphus</i>	1.5	102.	<i>Viola ambigua</i>	0.05
96.	<i>Tragopogon major</i>	0.1	103.	<i>Viola arvensis</i>	0.001
97.	<i>Trigonella monspeliaca</i>	0.1	104.	<i>Xeranthemum annuum</i>	0.05

Bryophytes: *Brachythecium albicans* 2.5, *Cladonia foliacea* 0.1, *Homolothecium lutescens* 0.2, *Syntrichia ruralis* 0.5, *Weissia longifolia* 1.5.

**(38) 102 vascular plant species (105 species complete vegetation) / 100 m<sup>2</sup> (10 m × 10 m)** – forb-rich meso-xeric steppe, pasture with shrub encroachment, near Kuriphyne village, Mykolaiv Region, coordinates: 48.000175, 31.005117 (recorded using GPS in smartphone), aspect 240°, slope 5°, land use: low-intensity grazing. Plot size delimited by a measuring tape, species recorded as shoot presence, species covers are given in percentages, 16.06.2021, authors: Daria Borovyk, Ganna Kolomiets, Ivan Moysienko, Denys Vynokurov; nested plot series SB2104.

1.	<i>Acer tataricum</i> juv.	2	52.	<i>Melica transsilvanica</i>	1.5
2.	<i>Achillea setacea</i>	0.005	53.	<i>Milium vernale</i>	2.5
3.	<i>Acinos arvensis</i>	0.2	54.	<i>Muscari neglectum</i>	0.1
4.	<i>Agrimonia eupatoria</i>	0.8	55.	<i>Myosotis stricta</i>	0.001
5.	<i>Alyssum calycinum</i>	0.001	56.	<i>Nigella arvensis</i>	1
6.	<i>Alyssum murale</i>	5	57.	<i>Nonea rossica</i>	0.6
7.	<i>Anthemis ruthenica</i>	0.001	58.	<i>Otites chersonensis</i>	1
8.	<i>Anthriscus cerefolium</i>	0.001	59.	<i>Papaver dubium</i>	0.1
9.	<i>Arenaria serpyllifolia</i>	0.3	60.	<i>Phleum phleoides</i>	0.01
10.	<i>Astragalus corniculatus</i>	0.01	61.	<i>Phlomis pungens</i>	0.2
11.	<i>Astragalus onobrychis</i>	0.05	62.	<i>Pilosella echioides</i>	0.2
12.	<i>Asyneuma canescens</i>	0.08	63.	<i>Plantago lanceolata</i>	0.1
13.	<i>Bromopsis inermis</i>	5	64.	<i>Plantago media</i>	0.2
14.	<i>Bromus squarrosus</i>	7	65.	<i>Poa angustifolia</i>	2.5
15.	<i>Buglossoides arvensis</i>	0.1	66.	<i>Poa bulbosa</i>	2.5
16.	<i>Camelina microcarpa</i>	0.2	67.	<i>Poa compressa</i>	0.1
17.	<i>Campanula bononiensis</i>	0.1	68.	<i>Polygonatum odoratum</i>	0.001
18.	<i>Caragana mollis</i>	0.05	69.	<i>Potentilla humifusa</i>	0.3
19.	<i>Celtis occidentalis</i> juv.	0.001	70.	<i>Potentilla recta</i>	0.2
20.	<i>Cleistogenes bulgarica</i>	2.5	71.	<i>Poterium sanguisorba</i>	0.2
21.	<i>Crataegus monogyna</i> S	15	72.	<i>Prunus stepposa</i> S	0.5
22.	<i>Crepis rhoeadifolia</i>	0.05	73.	<i>Pulsatilla pratensis</i>	3
23.	<i>Elytrigia intermedia</i>	1.5	74.	<i>Pyrus communis</i> juv.	0.1
24.	<i>Eryngium campestre</i>	0.8	75.	<i>Rosa corymbifera</i> S	0.5
25.	<i>Erysimum diffusum</i>	0.2	76.	<i>Salvia nutans</i>	17
26.	<i>Euphorbia agraria</i>	0.1	77.	<i>Scorzonera taurica</i>	4
27.	<i>Euphorbia seguieriana</i>	0.005	78.	<i>Securigera varia</i>	0.5
28.	<i>Euphorbia stepposa</i>	0.4	79.	<i>Senecio jacobaea</i>	0.5
29.	<i>Falcaria vulgaris</i>	1.5	80.	<i>Senecio vernalis</i>	0.05
30.	<i>Festuca rupicola</i>	2	81.	<i>Seseli pallasii</i>	0.01
31.	<i>Filipendula vulgaris</i>	0.5	82.	<i>Seseli tortuosum</i>	0.1
32.	<i>Fragaria viridis</i>	3.5	83.	<i>Silene bupleuroides</i>	0.01
33.	<i>Gagea</i> sp.	0.001	84.	<i>Sisymbrium loeselii</i>	0.05
34.	<i>Galatella villosa</i>	0.05	85.	<i>Stipa capillata</i>	0.5
35.	<i>Galium aparine</i>	0.05	86.	<i>Stipa dasyphylla</i>	20
36.	<i>Galium verum</i>	0.005	87.	<i>Taraxacum erythrospermum</i>	0.01
37.	<i>Helichrysum arenarium</i>	0.05	88.	<i>Teucrium chamaedrys</i>	1
38.	<i>Hyacinthella leucophaea</i>	0.001	89.	<i>Teucrium polium</i>	0.6
39.	<i>Hypericum elegans</i>	0.02	90.	<i>Thesium arvense</i>	0.001
40.	<i>Hypericum perforatum</i>	0.01	91.	<i>Thlaspi arvense</i>	0.1
41.	<i>Iris pumila</i>	0.001	92.	<i>Thlaspi perfoliatum</i>	0.1
42.	<i>Jurinea arachnoidea</i>	1.5	93.	<i>Thlaspi praecox</i>	0.2
43.	<i>Koeleria macrantha</i>	1.5	94.	<i>Thymus × dimorphus</i>	0.1
44.	<i>Kohlruschia prolifera</i>	1	95.	<i>Tragopogon major</i>	0.05
45.	<i>Lactuca serriola</i>	0.6	96.	<i>Verbascum phoeniceum</i>	1.5
46.	<i>Ligustrum vulgare</i> juv.	0.5	97.	<i>Veronica steppacea</i>	3
47.	<i>Linum austriacum</i>	0.5	98.	<i>Veronica spuria</i>	1.5
48.	<i>Lonicera tatarica</i>	1	99.	<i>Vincetoxicum hirundinaria</i>	0.05
49.	<i>Marrubium praecox</i>	0.01	100.	<i>Viola ambigua</i>	0.5
50.	<i>Medicago falcata</i>	10	101.	<i>Viola kitaibeliana</i>	0.2
51.	<i>Medicago minima</i>	1	102.	<i>Xeranthemum annuum</i>	0.5

Bryophytes: *Brachythecium* sp. 1.5, *Syntrichia ruralis* 0.3, *Weissia longifolia* 2.

**(39) 94 vascular plant species (101 species complete vegetation) / 100 m<sup>2</sup> (10 m × 10 m)** – forb-rich meso-xeric steppe, shadowed slope, near Myhiia village, Mykolaiv Region, coordinates: 48.01133N, 30.98698E (recorded using GPS in smartphone), aspect 285°, slope 15°; land use: abandonment. Plot size delimited by a measuring tape, species recorded as shoot presence, species covers are given in percentages, 29.06.2020, authors: Dariia Borovyk, Ganna Kolomiets, Ivan Moysiienko, Denys Vynokurov; nested plot series SB2105.

1. <i>Acer tataricum</i> S	0.5	48. <i>Melica transsilvanica</i>	0.8
2. <i>Achillea setacea</i>	1.5	49. <i>Muscari neglectum</i>	0.05
3. <i>Agrimonia eupatoria</i>	0.3	50. <i>Myosotis arvensis</i>	4
4. <i>Allium paczoskianum</i>	0.01	51. <i>Myosotis sparsiflora</i>	1
5. <i>Allium rotundum</i>	0.001	52. <i>Papaver dubium</i>	0.001
6. <i>Alyssum calycinum</i>	0.001	53. <i>Phleum phleoides</i>	0.5
7. <i>Alyssum murale</i>	0.3	54. <i>Phlomis tuberosa</i>	7.5
8. <i>Amygdalus nana</i>	0.5	55. <i>Pilosella echioides</i>	0.4
9. <i>Anisantha sterilis</i>	0.2	56. <i>Plantago media</i>	0.1
10. <i>Anthriscus cerefolium</i>	0.4	57. <i>Poa angustifolia</i>	2.5
11. <i>Arabidopsis thaliana</i>	0.001	58. <i>Poa compressa</i>	0.1
12. <i>Arenaria serpyllifolia</i>	0.05	59. <i>Prunus stepposa</i> S	0.5
13. <i>Artemisia austriaca</i>	0.1	60. <i>Pulsatilla pratensis</i>	0.2
14. <i>Asyneuma canescens</i>	3	61. <i>Pyrethrum corymbosum</i>	0.1
15. <i>Bromus squarrosus</i>	0.01	62. <i>Pyrus communis</i> S	0.5
16. <i>Buglossoides arvensis</i>	0.01	63. <i>Quercus robur</i> T	2.5
17. <i>Campanula bononiensis</i>	0.05	64. <i>Ranunculus illyricus</i>	0.3
18. <i>Campanula rapunculus</i>	0.5	65. <i>Rhamnus cathartica</i> juv.	0.001
19. <i>Caragana arborescens</i> S	0.5	66. <i>Robinia pseudoacacia</i> juv.	1
20. <i>Caragana mollis</i>	0.5	67. <i>Rosa canina</i> juv.	0.5
21. <i>Carex praecox</i>	0.5	68. <i>Rosa</i> sp. juv.	0.5
22. <i>Carex supina</i>	0.2	69. <i>Salvia nemorosa</i>	0.1
23. <i>Chamaecytisus austriacus</i>	5	70. <i>Securigera varia</i>	0.1
24. <i>Echinops sphaerocephalus</i>	0.05	71. <i>Senecio vernalis</i>	0.005
25. <i>Crataegus monogyna</i> S	1	72. <i>Serratula radiata</i>	0.1
26. <i>Elytrigia intermedia</i>	2.5	73. <i>Spiraea crenata</i>	0.5
27. <i>Eryngium campestre</i>	0.7	74. <i>Stipa capillata</i>	0.1
28. <i>Falcaria vulgaris</i>	0.5	75. <i>Stipa dasyphylla</i>	2
29. <i>Fallopia</i> sp.	0.001	76. <i>Stipa pennata</i>	2
30. <i>Ferulago galbanifera</i>	13	77. <i>Stipa tirsia</i>	0.5
31. <i>Festuca rupicola</i>	18	78. <i>Swida sanguinea</i> juv.	0.1
32. <i>Filipendula vulgaris</i>	13	79. <i>Taraxacum</i> sp.	0.001
33. <i>Fragaria viridis</i>	5	80. <i>Teucrium chamaedrys</i>	1
34. <i>Fraxinus excelsior</i> S	1.5	81. <i>Thalictrum minus</i>	1
35. <i>Galium aparine</i>	10	82. <i>Thlaspi perfoliatum</i>	0.005
36. <i>Galium verum</i>	0.5	83. <i>Trifolium alpestre</i>	2
37. <i>Geranium</i> sp.	0.001	84. <i>Trifolium arvense</i>	0.1
38. <i>Holosteum umbellatum</i>	0.001	85. <i>Trifolium montanum</i>	2
39. <i>Hylotelephium maximum</i> aggr.	0.1	86. <i>Ulmus minor</i> juv.	0.01
40. <i>Hypericum perforatum</i>	0.1	87. <i>Valerianella</i> sp.	0.2
41. <i>Inula germanica</i>	0.5	88. <i>Verbascum austriacum</i>	0.01
42. <i>Lactuca chaixii</i>	0.1	89. <i>Verbascum phoeniceum</i>	0.05
43. <i>Lactuca serriola</i>	0.02	90. <i>Veronica arvensis</i>	0.02
44. <i>Lamium amplexicaule</i>	0.01	91. <i>Vinca herbacea</i>	5
45. <i>Lamium purpureum</i>	0.2	92. <i>Viola</i> cf. <i>arvensis</i>	0.05
46. <i>Linaria biebersteinii</i>	0.1	93. <i>Viola kitaibeliana</i>	0.1
47. <i>Medicago falcata</i>	0.8	94. <i>Viola matutina</i>	0.02

Bryophytes: *Brachythecium albicans* 1, *Bryum* sp. 2, *Ceratodon purpureus* 0.2, *Eurhynchium hians* 0.5, *Homolothecium lutescens* 1, *Rhynchostegium* sp. 5, *Weissia longifolia* 0.2.

**(40) 93 vascular plants species (95 species complete vegetation) / 100 m<sup>2</sup> (10 m × 10 m)** – meadow steppe, Kamianska Sich National Nature Park, Kherson Region, coordinates: 47.013059, 33.610412 (recorded using GPS in smartphone), elevation 41 m a.s.l., aspect 305°, slope 30°, relief position: down slope; land use: abandonment. Plot size delimited by a measuring tape, species recorded as shoot presence, species covers are given in percentages, 04.06.2021, authors: Dariia Borovyk, Ivan Moysiienko, Denys Vynokurov; nested plot series UA2D8 (C08).

1. <i>Achillea setacea</i>	1	12. <i>Bromopsis riparia</i>	0.25
2. <i>Agrimonia eupatoria</i>	0.01	13. <i>Bromus squarrosus</i>	0.2
3. <i>Anisantha sterilis</i>	0.1	14. <i>Buglossoides arvensis</i>	0.01
4. <i>Arabidopsis thaliana</i>	0.01	15. <i>Campanula bononiensis</i>	0.2
5. <i>Arenaria serpyllifolia</i>	0.1	16. <i>Campanula rapunculoides</i>	0.3
6. <i>Artemisia austriaca</i>	2	17. <i>Carex melanostachya</i>	1
7. <i>Asparagus officinalis</i>	0.1	18. <i>Carex praecox</i>	14
8. <i>Asparagus verticillatus</i>	0.3	19. <i>Cerastium semidecandrum</i>	0.01
9. <i>Asperula cynanchica</i>	0.01	20. <i>Cleistogenes bulgarica</i>	3
10. <i>Astragalus onobrychis</i>	0.5	21. <i>Convolvulus arvensis</i>	0.01
11. <i>Bothriochloa ischaemum</i>	0.5	22. <i>Crataegus monogyna</i> S	3

23.	<i>Descurainia sophia</i>	0.01	59.	<i>Potentilla recta</i>	0.01
24.	<i>Dianthus carbonatus</i>	0.01	60.	<i>Prunus stepposa</i> juv.	0.01
25.	<i>Elytrigia intermedia</i>	15	61.	<i>Pyrus communis</i> juv.	1.5
26.	<i>Eryngium campestre</i>	0.5	62.	<i>Rhamnus cathartica</i> juv.	0.5
27.	<i>Erysimum diffusum</i>	0.01	63.	<i>Salvia nemorosa</i>	0.5
28.	<i>Euphorbia stepposa</i>	1	64.	<i>Salvia nutans</i>	15
29.	<i>Falcaria vulgaris</i>	0.3	65.	<i>Senecio jacobaea</i>	0.5
30.	<i>Festuca rupicola</i>	20	66.	<i>Silene bupleuroides</i>	0.5
31.	<i>Festuca valesiaca</i>	3.5	67.	<i>Stachys recta</i>	1
32.	<i>Filipendula vulgaris</i>	0.5	68.	<i>Stipa capillata</i>	1
33.	<i>Galium humifusum</i>	0.1	69.	<i>Stipa pulcherrima</i>	1
34.	<i>Galium spurium</i>	0.001	70.	<i>Stipa ucrainica</i>	0.5
35.	<i>Glechoma hederacea</i>	0.001	71.	<i>Tanacetum millefolium</i>	0.01
36.	<i>Haplophyllum suavelons</i>	0.5	72.	<i>Taraxacum erythrospermum</i>	0.01
37.	<i>Herniaria besseri</i>	0.02	73.	<i>Teucrium chamaedrys</i>	3
38.	<i>Hieracium echinoides</i>	0.3	74.	<i>Teucrium polium</i>	2
39.	<i>Holosteum umbellatum</i>	0.001	75.	<i>Thalictrum minus</i>	5
40.	<i>Hylotelephium stepposum</i>	0.2	76.	<i>Thesium arvense</i>	0.01
41.	<i>Hypericum elegans</i>	0.01	77.	<i>Thlaspi perfoliatum</i>	1
42.	<i>Koeleria macrantha</i>	3	78.	<i>Thymus dimorphus</i>	0.2
43.	<i>Lamium amplexicaule</i>	0.01	79.	<i>Tragopogon major</i>	0.01
44.	<i>Limonium bungei</i>	0.05	80.	<i>Trifolium diffusum</i>	0.01
45.	<i>Marrubium praecox</i>	0.5	81.	<i>Valerianella carinata</i>	0.01
46.	<i>Medicago falcata</i>	1	82.	<i>Verbascum austriacum</i>	0.2
47.	<i>Medicago minima</i>	0.1	83.	<i>Verbascum phoeniceum</i>	0.5
48.	<i>Myosotis arvensis</i>	0.1	84.	<i>Veronica arvensis</i>	1
49.	<i>Myosotis stricta</i>	0.001	85.	<i>Veronica austriaca</i>	0.5
50.	<i>Myosotis sparsiflora</i>	0.1	86.	<i>Veronica polita</i>	0.001
51.	<i>Nigella arvensis</i>	0.05	87.	<i>Veronica steppacea</i>	0.3
52.	<i>Onobrychis</i> sp.	0.3	88.	<i>Vinca herbacea</i>	4
53.	<i>Phleum phleoides</i>	20	89.	<i>Vincetoxicum minus</i>	0.001
54.	<i>Plantago urvillei</i>	7	90.	<i>Viola hirta</i>	0.01
55.	<i>Poa angustifolia</i>	1	91.	<i>Viola kitaibeliana</i>	0.1
56.	<i>Poa bulbosa</i>	0.001	92.	<i>Viola matutita</i>	0.8
57.	<i>Poa compressa</i>	0.25	93.	<i>Xeranthemum annuum</i>	0.01
58.	<i>Potentilla argentea</i>	0.5			

Bryophytes and lichens: *Brachythecium* sp., *Syntrichia ruralis*.

**(41) 89 vascular plant species / 100 m<sup>2</sup> (10 m × 10 m)** – forb-rich meso-xeric steppe, abandoned pasture, Luhansk Nature Reserve, between Krynychne and Zhuravske villages, Luhansk Region, coordinates: 49.2926N, 40.07893E (recorded using GPS), elevation 156 m a.s.l., aspect 315°, slope 5°; land use: irregular mowing (until 1995 mown once per three years, then irregularly mown). Plot size delimited by a measuring tape, species recorded as root presence, species covers are given in percentages (less than 1% – as +), 15.06.2001, author: Larysa Borovyk; plot number 1 (2001).

1.	<i>Achillea pannonica</i>	1	29.	<i>Festuca valesiaca</i>	+
2.	<i>Adonis wolgensis</i>	+	30.	<i>Filipendula vulgaris</i>	5
3.	<i>Allium paczoscianum</i>	+	31.	<i>Gagea erubescens</i>	+
4.	<i>Artemisia austriaca</i>	+	32.	<i>Galatella villosa</i>	8
5.	<i>Artemisia pontica</i>	+	33.	<i>Galium octonarium</i>	+
6.	<i>Aster amellus</i>	+	34.	<i>Galium ruthenicum</i>	+
7.	<i>Astragalus olgianus</i>	+	35.	<i>Helictotrichon schellianum</i>	4
8.	<i>Bellevalia sarmatica</i>	+	36.	<i>Hesperis tristis</i>	+
9.	<i>Bromopsis riparia</i>	5	37.	<i>Hypericum perforatum</i>	+
10.	<i>Bupleurum falcatum</i>	+	38.	<i>Inula aspera</i>	+
11.	<i>Caragana frutex</i>	+	39.	<i>Inula hirta</i>	+
12.	<i>Carex praecox</i>	+	40.	<i>Jurinea arachnoidea</i>	+
13.	<i>Carex supina</i>	+	41.	<i>Koeleria macrantha</i>	+
14.	<i>Centaurea carbonata</i>	+	42.	<i>Limonium platyphyllum</i>	+
15.	<i>Centaurea trichocephala</i>	+	43.	<i>Linaria maeotica</i>	+
16.	<i>Cephalaria uralensis</i>	+	44.	<i>Medicago romanica</i>	1
17.	<i>Dianthus elongatus</i>	+	45.	<i>Myosotis popovii</i>	+
18.	<i>Echium russicum</i>	1	46.	<i>Odontites luteus</i>	+
19.	<i>Elisanthe viscosa</i>	+	47.	<i>Ornithogalum kochii</i>	+
20.	<i>Elytrigia intermedia</i>	+	48.	<i>Orobanche alba</i>	+
21.	<i>Elytrigia stipifolia</i>	1	49.	<i>Otitus wolgensis</i>	+
22.	<i>Eremogone bibersteinii</i>	+	50.	<i>Oxytropis pilosa</i>	+
23.	<i>Eremogone longifolia</i>	+	51.	<i>Pedicularis kaufmanii</i>	+
24.	<i>Eryngium campestre</i>	+	52.	<i>Peucedanum alsaticum</i>	+
25.	<i>Erysimum diffusum</i>	+	53.	<i>Peucedanum ruthenicum</i>	+
26.	<i>Erysimum strictum</i>	+	54.	<i>Phleum phleoides</i>	+
27.	<i>Falcaria vulgaris</i>	+	55.	<i>Phlomis pungens</i>	+
28.	<i>Festuca rupicola</i>	3	56.	<i>Phlomis tuberosa</i>	3

57. <i>Pilosella echioides</i>	+	74. <i>Stipa capillata</i>	+
58. <i>Plantago urvillei</i>	1	75. <i>Stipa pennata</i>	+
59. <i>Poa angustifolia</i>	+	76. <i>Stipa tirsia</i>	3
60. <i>Polygala podolica</i>	+	77. <i>Stipa zalesskii</i>	10
61. <i>Potentilla schurii</i>	+	78. <i>Taraxacum</i> sp.	+
62. <i>Pulsatilla patens</i>	+	79. <i>Thesium arvense</i>	+
63. <i>Ranunculus scythicus</i>	+	80. <i>Thymus marschallianus</i>	+
64. <i>Salvia nutans</i>	10	81. <i>Thymus pseudopannonicus</i>	+
65. <i>Salvia stepposa</i>	+	82. <i>Trinia multicaulis</i>	+
66. <i>Scabiosa ochroleuca</i>	+	83. <i>Turritis glabra</i>	+
67. <i>Securigera varia</i>	+	84. <i>Verbascum marschallianum</i>	+
68. <i>Senecio jacobea</i>	+	85. <i>Verbascum phoeniceum</i>	+
69. <i>Seseli campestre</i>	+	86. <i>Veronica sclerophylla</i>	+
70. <i>Silene chlorantha</i>	+	87. <i>Veronica spicata</i>	+
71. <i>Sisymbrium polymorphum</i>	+	88. <i>Vicia tenuifolia</i>	3
72. <i>Stachys recta</i>	+	89. <i>Viola ambigua</i>	+
73. <i>Stellaria hippoctora</i>	+		

(42) **87 vascular plants species (93 species complete vegetation) / 100 m<sup>2</sup> (10 m × 10 m)** – forb-rich bunchgrass steppe, near Tiahynka village, Kherson Region, burning a few years ago, coordinates: 46.76701N, 33.04039E (recorded using GPS in smartphone), elevation 15 m a.s.l., aspect 45°, slope 1°, relief position: upper slope, relatively flat area; land use: low-intensity grazing. Plot size delimited by a measuring tape, species recorded as shoot presence, species covers are given in percentages, 17.05.2016, author: Victoria Dzerkal; nested plot series CHB09.

1. <i>Agropyron pectinatum</i>	1	45. <i>Jurinea arachnoidea</i>	0.5
2. <i>Ajuga chia</i>	0.5	46. <i>Kochia prostrata</i>	2.5
3. <i>Allium guttatum</i>	1	47. <i>Koeleria brevis</i>	1
4. <i>Anthemis ruthenica</i>	0.005	48. <i>Koeleria macrantha</i>	2
5. <i>Arenaria serpyllifolia</i>	1	49. <i>Lactuca serriola</i>	0.5
6. <i>Artemisia austriaca</i>	8	50. <i>Lycopsis orientalis</i>	1
7. <i>Artemisia lerchiana</i>	1	51. <i>Marrubium praecox</i>	0.25
8. <i>Asperula montana</i>	0.75	52. <i>Medicago falcata</i>	0.5
9. <i>Bromopsis heterophylla</i>	5	53. <i>Medicago minima</i>	0.5
10. <i>Bromopsis inermis</i>	7.5	54. <i>Minuartia hybrida</i>	0.5
11. <i>Bromopsis riparia</i>	1	55. <i>Myosotis stricta</i>	0.5
12. <i>Bromus hordeaceus</i>	1	56. <i>Otitus hellmannii</i>	0.5
13. <i>Bromus squarrosus</i>	1.5	57. <i>Pilosella echioides</i>	1
14. <i>Carduus uncinatus</i>	1	58. <i>Plantago lanceolata</i>	1
15. <i>Carex stenophylla</i>	1	59. <i>Poa angustifolia</i>	5
16. <i>Centaurea salomitanana</i>	2.5	60. <i>Poa bulbosa</i>	3
17. <i>Cerastium ucrainicum</i>	0.5	61. <i>Polygonum novoascanicum</i>	0.05
18. <i>Consolida paniculata</i>	0.005	62. <i>Potentilla astracana</i>	1
19. <i>Convolvulus arvensis</i>	0.5	63. <i>Potentilla recta</i>	0.5
20. <i>Conyza canadensis</i>	0.2	64. <i>Potentilla semilaciniosa</i>	0.5
21. <i>Crepis ramosissima</i>	0.2	65. <i>Pterotheca sancta</i>	1
22. <i>Cymbochasma borysthena</i>	1	66. <i>Ranunculus oxyspermus</i>	1
23. <i>Dianthus lanceolatus</i>	1	67. <i>Salvia nutans</i>	3
24. <i>Elytrigia repens</i>	0.01	68. <i>Scorzonera mollis</i>	0.05
25. <i>Ephedra distachya</i>	1.5	69. <i>Scorzonera stricta</i>	1
26. <i>Erodium cicutarium</i>	1	70. <i>Securigera varia</i>	3
27. <i>Erophila verna</i>	0.005	71. <i>Senecio erucifolius</i>	1
28. <i>Eryngium campestre</i>	0.3	72. <i>Serratula erucifolia</i>	0.3
29. <i>Euphorbia agraria</i>	1	73. <i>Seseli tortuosum</i>	0.5
30. <i>Euphorbia glareosa</i>	0.5	74. <i>Stipa capillata</i>	1
31. <i>Euphorbia seguieriana</i>	0.005	75. <i>Taraxacum erythrospermum</i>	1
32. <i>Falcaria vulgaris</i>	0.5	76. <i>Teucrium polium</i>	2
33. <i>Festuca valesiaca</i>	13	77. <i>Thesium arvense</i>	0.005
34. <i>Galatella villosa</i>	0.01	78. <i>Thymus dimorphus</i>	1
35. <i>Galium humifusum</i>	0.5	79. <i>Tragopogon major</i>	0.05
36. <i>Galium spurium</i>	1	80. <i>Trigonella monspeliaca</i>	0.5
37. <i>Geranium pusillum</i>	0.2	81. <i>Verbascum phoeniceum</i>	1
38. <i>Goniolimon besserianum</i>	1.5	82. <i>Veronica arvensis</i>	0.2
39. <i>Haplophyllum suaveolens</i>	1	83. <i>Veronica prostrata</i>	0.2
40. <i>Helichrysum arenarium</i>	0.5	84. <i>Veronica spicata</i>	0.8
41. <i>Holosteum umbellatum</i>	0.05	85. <i>Veronica triphyllos</i>	0.005
42. <i>Hyacinthella leucophaea</i>	0.8	86. <i>Veronica verna</i>	1
43. <i>Hypericum elegans</i>	1	87. <i>Xeranthemum annuum</i>	1
44. <i>Inula oculus-christi</i>	2.5		

Bryophytes and lichens: *Bryum caespiticium* 0.5, *Ceratodon purpureus* 0.5, *Pseudocrossidium hornschurchianum* 0.5, *Syntrichia ruraliformis* 0.5, *Tortula acaulon* 0.25, *Weissia longifolia* 0.5

(43) **85 vascular plants species (87 species complete vegetation) / 100 m<sup>2</sup> (10 m × 10 m)** – bunchgrass steppe, Kostyrska ravine, near Zmiivka village, Kherson Region, coordinates: 46.88785N, 33.57762E (recorded using GPS in smartphone), elevation 31.5 m a.s.l., aspect 40°, slope 18°, relief position: middle slope; land use: low-intensity grazing, burned last winter. Plot size delimited by a measuring tape, species recorded as shoot presence, species covers are given in percentages, 09.05.2016, authors: Ivan Moysiienko, Victoria Dzerkal, Iwona Dembicz, nested plot series CHB03.

1. <i>Achillea setacea</i>	0.1	44. <i>Linum austriacum</i>	0.1
2. <i>Anthemis ruthenica</i>	0.01	45. <i>Medicago falcata</i>	1
3. <i>Arabidopsis thaliana</i>	0.05	46. <i>Medicago minima</i>	1
4. <i>Arenaria serpyllifolia</i>	0.01	47. <i>Myosotis stricta</i>	0.3
5. <i>Artemisia austriaca</i>	1	48. <i>Onobrychis gracilis</i>	0.3
6. <i>Astragalus ucrainicus</i>	1	49. <i>Pilosella echiooides</i>	1
7. <i>Botriochloa ishaemum</i>	0.01	50. <i>Plantago lanceolata</i>	0.3
8. <i>Bromus squarrosus</i>	0.2	51. <i>Poa angustifolia</i>	2
9. <i>Buglossoides arvensis</i>	1	52. <i>Poa bulbosa</i>	0.5
10. <i>Carduus uncinatus</i>	0.2	53. <i>Poa compressa</i>	0.1
11. <i>Carex praecox</i>	0.5	54. <i>Potentilla argentea</i>	0.1
12. <i>Carex stenophylla</i>	1.5	55. <i>Potentilla semilaciniosa</i>	1
13. <i>Carex supina</i>	10	56. <i>Pterotheca sancta</i>	0.1
14. <i>Centaurea salomitanica</i>	0.005	57. <i>Ranunculus scythicus</i>	0.5
15. <i>Cerastium sp.</i>	0.1	58. <i>Salvia nemorosa</i>	0.1
16. <i>Cerastium ucrainicum</i>	0.2	59. <i>Salvia nutans</i>	0.005
17. <i>Chondrilla juncea</i>	5	60. <i>Scorzonera mollis</i>	0.5
18. <i>Cleistogenes bulgarica</i>	1	61. <i>Securigera varia</i>	0.005
19. <i>Consolida paniculata</i>	0.005	62. <i>Senecio erucifolius</i>	0.5
20. <i>Crataegus monogyna juv.</i>	0.1	63. <i>Senecio vernalis</i>	1
21. <i>Crepis ramosissima</i>	0.05	64. <i>Seseli tortuosum</i>	0.3
22. <i>Dianthus pseudoarmeria</i>	0.1	65. <i>Silene bupleuroides</i>	0.1
23. <i>Ephedra distachya</i>	1	66. <i>Sisymbrium polymorphum</i>	1
24. <i>Erophila verna</i>	0.01	67. <i>Stachys recta</i>	1
25. <i>Eryngium campestre</i>	1	68. <i>Stipa capillata</i>	0.5
26. <i>Euphorbia agraria</i>	0.05	69. <i>Stipa ucrainica</i>	0.1
27. <i>Euphorbia seguieriana</i>	0.2	70. <i>Taraxacum erythrospermum</i>	0.05
28. <i>Festuca rupicola</i>	2.5	71. <i>Taraxacum serotinum</i>	0.1
29. <i>Festuca valesiaca</i>	11	72. <i>Teucrium polium</i>	0.5
30. <i>Gagea pusilla</i>	1	73. <i>Thesium arvense</i>	0.01
31. <i>Galatella villosa</i>	18	74. <i>Tragopogon major</i>	0.01
32. <i>Galium humifusum</i>	0.5	75. <i>Trifolium arvense</i>	0.05
33. <i>Galium spurium</i>	1	76. <i>Trifolium diffusum</i>	0.01
34. <i>Herniaria besseri</i>	0.3	77. <i>Trigonella monspeliaca</i>	1
35. <i>Holosteum umbellatum</i>	0.05	78. <i>Verbascum phoeniceum</i>	0.5
36. <i>Hyacinthella leucophaea</i>	1	79. <i>Veronica arvensis</i>	0.2
37. <i>Hypericum elegans</i>	0.3	80. <i>Veronica prostrata</i>	0.05
38. <i>Jurinea arachnoidea</i>	0.5	81. <i>Veronica spicata</i>	0.3
39. <i>Kochia prostrata</i>	0.3	82. <i>Veronica triphyllos</i>	0.2
40. <i>Koeleria macrantha</i>	0.5	83. <i>Veronica verna</i>	1
41. <i>Lamium amplexicaule</i>	0.01	84. <i>Viola kitaibeliana</i>	0.3
42. <i>Leontodon hispidus</i>	0.05	85. <i>Xeranthemum annuum</i>	
43. <i>Limonium bungei</i>	0.5		

Bryophytes and lichens: *Bryum sp.* 0.5, *Weissia longifolia* 0.01.