

## *Ornithogalum boucheanum* (Asparagaceae) in Eastern Europe: Native and synanthropic range, habitat conditions and state of population

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The geographical distribution, ecological and coenotic features of the place of growth and age structure of *Ornithogalum boucheanum* populations in Ukraine have been studied. In total, during the entire period of floristic research in Ukraine, 263 native sites of this species were recorded in 13 administrative regions (oblasts). Mostly these sites are concentrated in the Steppe zone, where the main part of the Eastern European fragment of the general natural range of *O. boucheanum* is represented. For other regions of Ukraine isolated reports of the species are known. It is noted that in addition to reduction in the number of natural habitats of *O. boucheanum* within the Forest-Steppe and in the southern part of Ukraine Polissya, a secondary adventive natural habitat of the species is formed, where it is part of the immigration group of foreign taxa. It was found that the natural habitats of *O. boucheanum* are characterized by a certain stenotopy, as the species needs some moisture and is more common in valley and balka landscapes most often in large river basins, which are not prone to drying out and can be favourable ecological corridors for long-distance migration. Favourable conditions for *O. boucheanum* habitats exist in floodplain and riparian forests, which have sufficient moisture, little competition from other species of grass and a sufficient amount of light in the spring. In addition, *O. boucheanum* can successfully master artificial and synanthropic groups of tree species, in particular being widespread in the Forest-Steppe and Steppe *Robinia* plantations. It was found that populations of *O. boucheanum* in Ukraine have different numbers: with an area of 4–6 hectares, in which there are tens and hundreds of thousands of individuals, to small populations on the northern border of distribution, in Kirovohrad and Kharkiv oblasts, which have a young invasive character. It is possible that modern conditions have been favourable for the spread of *O. boucheanum* in the transition zone between the Forest-Steppe and Steppe, and that the process of forming new populations of *O. boucheanum* is taking place here.

**Keywords:** flora of Ukraine; rare species; alien species; ergasiophygyte; geographical distribution; habitats; naturalization.

### Introduction

Nowadays, excessive anthropic pressure on natural ecosystems and global warming contribute to rapid changes in the taxonomic structure of natural biodiversity (Corlett, 2016; Baranovski et al., 2020; Baquero et al., 2021). This negative process is accelerated due to the active introduction of plants outside their natural habitats and subsequent naturalization in a new environment (Keller et al., 2011; Burda, 2018). Such processes are especially active for ornamental plants grown in botanical or private gardens and other places of cultivation (Shynder & Nehrash, 2020; Májeková et al., 2021; Pyšek et al., 2022). Sometimes naturalized ergasiophytes become dangerous invasive plants that displace local plant species (Protopopova & Shevera, 2019; Strgulc Krajšek et al., 2020; Vojik et al., 2020). At the same time, some of the alien plants have a protective status in the natural environment (Chukhno & Alekhin, 2001). The identification of new localities of such species is relevant for improving the protection of natural biodiversity and monitoring phytodiversity (Jackowiak et al., 2017).

*Ornithogalum boucheanum* (Kunth) Asch. (Asparagaceae) is a Mediterranean species, located in Eastern Europe on the northeastern border of the natural range. The range of this species covers the south of Central Europe, the Balkans, the western part of Asia Minor and the area north of the Black Sea (Meriç et al., 2011; Stoyanov & Raycheva, 2020; www.plantsoftheworldonline.org). To this day, new information about the natural area of this species continues to appear (Purger et al., 2017). In Central and Southern Europe, due to its widespread use in gardens, *O. boucheanum* has been successfully naturalized and formed a secondary

(synanthropic) range (Agapova, 1979; Răduțoiu, 2020). In the Red Data Book of Ukraine, the species is assigned the zoological category “invaluable” (<https://zakon.rada.gov.ua/laws/show/z0370-21#Text>).

In Ukraine, *O. boucheanum* is distributed in Transcarpathia, the southern zone of the Forest-Steppe, the continental part of the Steppe and is known from the Crimea, and most of its known locations were concentrated in the lower Dnieper region and South-Eastern Ukraine (Bordzilovskiy, 1950; Shynder & Konakh, 2023). But recently the information about the distribution of *O. boucheanum* has been significantly enriched, in particular, various researchers have identified many new locations of the species, mainly in the lower Dnieper region (Sheleheda & Sheleheda, 2001; Baranovskiy & Tarasov, 2010; Petrochenko, 2017) and other areas (Popova, 2002; Loienko, 2018; Shynder & Saidakhmedova, 2018). In addition, localities of *O. boucheanum* outside its natural range have been recorded, and new information on the number and structure of populations has appeared. Given the conservation status of the species, the generalization of information about its current species ranges in Ukraine, ecological and coenotic conditions of its habitats and the state of its populations is relevant.

### Materials and methods

The geographical range of *O. boucheanum* was studied according to the literature, the results of our own research and materials from the numerous herbariums of Ukraine: Donetsk Botanical Garden of the National Academy of Sciences of Ukraine (DNZ), Kryvyi Rih Botanical Garden of the National Academy of Sciences of Ukraine (KRW), M. H. Kholodny

the Institute of Botany of the National Academy of Sciences of Ukraine (KW), M. M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine (KWHA), Taras Shevchenko National University of Kyiv (KWU), Luhansk National Agrarian University (LNAU), State Natural History Museum of the National Academy of Sciences of Ukraine (LWS), I. I. Mechnikov Odesa State University (MSUD), Botanical Garden of Uzhhorod National University (UU), – and databases of naturalists' observations: iNaturalist (www.inaturalist.org), UkrBIN (https://ukrbin.com) and Plantarium (www.plantarium.ru). Dissertations in free access were also used: O. K. Halahan (Antropohenna transformatsiia fitiobioty mista Krementsia ta okolys (Ukraina) za 200 rokiv (vid Bessera do nashykh dniv [Anthropogenic transformation of the phytobiota of the city of Kremenets and its surroundings (Ukraine) over 200 years (from Besser to the present day)], Kremenets, 2010; M. M. Perehym (Ridkisini ta znykaiuchi vydy flory Donetskoho Kriazhu [Rare and endangered species of flora of Donetsk Ridge], Kyiv, 2006); S. P. Petrik (Synantropna flora morskyykh portiv Pivnichno-Zakhidnoho Prychomomoria [Synanthropic flora of the seaports of the North-Western Black Sea region], Odesa, 1992); O. F. Shcherbakova (Raryetnyi florofond Kodymo-Yelanetskoho Pobuzhzhia [Rare flora fund of Kodymo-Yelanetsky Pobuzhye, Kyiv, 2008]; D. Y. Shevchenko (Flora ta populatsii ridkisykh vydiv Kreminskoho lisovoho masyvu (Luhanska oblast) [Flora and populations of rare species of Kreminka forest (Luhanska region)], Kyiv, 2006); O. R. Khananova (Flora, roslynist ta sozolochna tsinnist rehionalnoho landshaftnoho parku "Hadiatskyi" [Flora, vegetation and zoological value of the regional landscape park "Gadyatskyi"], Kyiv, 2018).

All known localities of the *O. boucheanum* were consolidated into a single checklist.

The map chart of the range of *O. boucheanum* was created by the point method for the south of Eastern Europe, where the species is aboriginal, namely: the territories of Ukraine, Moldova and the Rostov oblast of Russia.

Administrative raions of Ukraine are given under the new administrative division (the names existing after 2020 areas underlined), and within them are presented former administrative raions (the names of old raions are given in square brackets). For the left-bank part of Moldova, the districts are shown in square brackets because they are not officially recognized, but are units of Administrative-Territorial Units of the Left Bank of the Dniester.

## Results

*Checklist of Ornithogalum boucheanum locations in Eastern Europe (Ukraine, Moldova & Russia).* The following abbreviations are used in the geographic distribution: the mark "(\*)" refers to synanthropic (secondary) locations, the mark "(–)" refers to extinct locations).

### Ukraine

#### Mixed forest zone (polissya)

Kyiv City. (\*) near Svyatoshyino, in the woods, 15.05.1973, leg. V. H. Sobko (KWHA).

#### Deciduous forest zone

Khmelnitsky Oblast. Kamyansky-Podilskyi Raion: (\*) Demshyn village – on the meadows, sub *O. nutans* (Makowiecki, 1939).

[Former Chemerivtsi Raion] (\*) Ivakhnivtsi village, several individuals, sub *O. nutans* (Makowiecki, 1939; Bordzilovskiy, 1950).

Khmelnitsky Raion: [Former Letychiv Raion] (\*) Medzhybizh – along the Southern Buh, sub *O. nutans* (Eichwald, 1830).

Temopil Oblast. Kremenets: (\*) in meadows, fields, stadiums, very rarely (Halahan, 2010) [note: this is an obvious synanthropic habitat but not specified in a cited source].

#### Forest-steppe zone

Cherkasy Oblast. (\*) Cherkasy Raion: Korsun-Shevchenkivskiy – often on the territory of the landscape park (Loienko, 2018).

[Former Smila Raion] Huliahorodok village (Montezor, 1898).

Chernihiv Oblast. Pryluky Raion: (\*) near the Okhinky village (Konakh, 2019).

Kharkiv Oblast. Bohodukhiv Raion: near Valky town (Oksner, 1935).

Chuhuiv Raion: [Former Zmiiv Raion] (–) near Zadonetske village – "Homilsha Woods" National Nature Park, Khomutka tract (Onyshchenko & Andrienko, 2012b).

Kharkiv City: (Chernyaev, 1859); (\*) Kharkiv Botanical Garden – wild, in both territories, abundantly reproduces (Druleva & Alehin, 2010); (\*) on the territory of the medical complex near the Nemyshlia river, more than 2000 generative individuals in an area of about 7 hectares, 2016 (Turchynova & Bengus, 2017; Bengus & Volkova, 2021);

Kirovohrad Oblast. Holovanivsk Raion: near Holovanivsk, deciduous forest, 16.05.2011, leg. V. Malyboh (Plantarium).

[Former Blahovishchenske Raion] Synytsivka village – S, valley of the Synytsia river, "Synytsivskiy" reserve, 3 loci, 17 individuals (Holovko, 2014).

[Former Novoarkhanhelsk Raion] Synyukha village, 48.171955°, 30.813006°, 12.05.2021 (Lavrinenko et al., 2023); Ternivka village – between the rocks, 10.04.1902 (Finn, 1922).

Oleksandriia Raion: [Former Onufriivka Raion] near Onufriivka – NW, Maihorove reserve, ravine slope (Andriyenko, 1999); Pavlysh village (Oksner, 1935).

[Former Svitlovodsk Raion] between Pavlivka and Revivka villages – in the ravine in the grove, locally, quite numerous (Pachosky, 1914).

Kyiv City. (\*) O. V. Fomin Botanical Garden of Kyiv University – among spontaneous grasses, but does not spread (Malyshytska, 1948); O. V. Fomin Botanical Garden, under the fence of Komintern Street, 09.05.1954, leg. L. F. Kucheriava (electronic catalog of the KWU); M. M. Gryshko National Botanical Garden: (\*) "Central Asia" plot, spontaneously in a stand, invasive colony, more than 20 generative individuals, 7.05.2020, leg. Y. M. Nehrash & O. I. Shnyder (Shnyder, Negrash, 2022); (\*) M. M. Gryshko NBG, "Maple oak" plot, on the edge of the forest, young invasive group, 22.04.2020, leg. O. I. Shnyder (Shnyder & Konakh, 2023).

Mykolaiv Oblast. Pervomaik Raion: [Former Kryve Ozero Raion] Krasnenke village – in the shade near the rocks in the valley of the Southern Buh, sub *O. nutans* (Andrzejewski, 1823); Onyskove village – western surroundings, quarter No 4 of the Berezkyvske forestry, floodplain oak forest on the right bank of the Southern Buh, in an area of several hectares, about 5,000 generative individuals, 21.05.2018, leg. O. Shnyder (KWHA) (Shnyder & Konakh, 2023).

Odesa Oblast. Podilsk Raion: [Former Balta Raion] Kozatske village – Lisnychyvske forestry, quarter No 65 (site No 15), Labushne Forest, a natural monument "Dibrova Labushna" (Popova, 2012).

### Poltava Oblast

Kremenchuk Raion: Horishni Plavni – W, landscape reserve "Lisovy ozero" (Bayrak & Stetsyuk, 2005); Dmytrivka village – S, landscape reserve "Zaplava Psla" (Bayrak & Stetsyuk, 2005); Kamiani Potoky village – S, reserve "Dovhorakivskiy", Kryukivskiy forestry, quarters No. 46–49 (Bayrak & Stetsyuk, 2005).

Lubny Raion: (\*) Khorol town, in Botanical Garden, spontaneous colony, more than 40 generative individuals, 49.777292° N, 33.262384° E, 8.05.2022, V. Krasovskiy, O. Shnyder, V. Kolomiychuk (iNaturalist).

Myrhorod Raion: [Former Hadiach Raion] the valley of the Hrun river (Bayrak & Stetsyuk, 2005; Khannanova, 2018: Fig. 3.16).

Poltava Raion: Poltava City: former Rybtsi village, 2.05.1914, leg. M. Mykolaiev (Illichevskiy, 1928); Zintsi village, 26.04.1921, leg. O. Kapeller (Illichevskiy, 1928); near Kopyly village – Tryby tract, "lower forest near the road", 05.1924, leg. S. O. Illichevskiy (KW).

Vinnytsia Oblast. Kholmilnyk Raion: [Kalynivka Raion] (\*) near Holendra village – on the steppes, between bushes, sub *O. nutans*, leg. A. Andzheiovskiy (Rogovich, 1869).

Vinnytsia City: (\*) NW, Pyatnychansky Forest, run wild, *O. nutans*, 05.1925, leg. Yankovskiy (herbarium of Vinnytsia M. Kotsiubynskiy State Pedagogical University).

### Steppe zone

Dnipropetrovsk Oblast. Dnipro City: (Baranovskiy & Tarasov, 2010); "Ihren" residential area, Pankratieva Balka, 2007, leg. Tarasov (Baranovskiy & Tarasov, 2010); without specification, 48.438342° N, 35.008526° E, 02.05.2018 (UkrBIN); without specification, 48.459915° N, 35.003984° E, 01.05.2020 (UkrBIN).

Dnipro Raion: Dniprovsko-Orilskyi Nature Reserve, 2000, leg. Baranovskiy (Baranovskiy & Tarasov, 2010).

Kamianske Raion: Domotkan River Basin, Shyroka gully, 48.580806° N, 34.039778° E, 20 fl. plants, 14.04.2021 (Baranets et al., 2023).

[Former Piatykhatty Raion] Zelena station, 1905 (Baranovskiy & Tarasov, 2010).

[Former Verkhnodniprovsk Raion] Zarichchia village – a floodplain of the Domotkan river (Kucherevskiy, 2001).

Kryvyi Rih Raion: Kryvyi Rih City: Pryvorotna Balka (Kucherevskiy, 2001); Inhulets district: “Zelene” residential area – meadow along the Inhulets river, Riabkov (Pachosky, 1914; Bordzilovskiy, 1950); geological natural monument “Slantsevi skeli”, 27.04.2000, leg. Kucherevskiy, Shol & Krasova (KRW) (Lysohor, 2017); “Skeli MODRu” geological natural monument, 4.05.2006, leg. Kucherevskiy, Provozhenko & Baranets (KRW) (Lysohor, 2017); “North Red Balka” nature reserve – at the foot of the north-eastern slope exposition, in the ecotone between shrub vegetation and steppe meadows, 24.05.2012, leg. O. O. Krasova (Lysohor, 2017).

[Former Apostolove Raion] Tokivske village – waterfall on the Kam-yanka river (left bank, granites), 29.05.2001, leg. Kucherevskiy, Shol, Krasova & Provozhenko (KRW) (Lysohor, 2017).

[Former Shyroka Raion] near Mykhailivka village, 1998 (Tarasov, 2012); near Shestirnia village – Kobylina Balka, robinia plantation, 4.05.1998, leg. Krasova (KRW) (Baranovskiy & Tarasov, 2010; Lysohor, 2017).

[Former Sofiiivka Raion] Makorty village, 6.05.1936, leg. Artemchuk (KW); near Novooleksiivka village, 1997, leg. Tarasov (Baranovskiy & Tarasov, 2010).

Nikopol Raion: near Kamianske village – Puhachova Balka, in two places, among shrub vegetation (Lysohor, 2017); between Semenivka and Borysivka villages, Vesela Dolyna Raion, 2005 (Baranovskiy & Tarasov, 2010).

[Former Tomakivka Raion] near Hrusheve village, 1972, leg. Buryak (Baranovskiy & Tarasov, 2010).

Novomoskovsk Raion: near Novomoskovsk (Antonyuk et al., 1982); near Andriivka village (Baranovskiy & Tarasov, 2010); between Vasyliivka and Kocherezhky villages, 5 local populations in the oak groves of the Samara forest (Borsukeyevych, 2018); near Orlivshchyna village, 2005, leg. Rublevskaia (Baranovskiy & Tarasov, 2010); Ivano-Mykhailivka village, 2010, leg. Baranovskiy (Baranovskiy & Tarasov, 2010); Popasne village – S, riparian forest near the right tributary of the Samara river, 2.05.2010, leg. T. Horelova (Plantarium).

[Former Mahdalynivka Raion] between the Hupalivka and Chemechchyna villages, floodplain meadows near the Kozachyi lyman lake (48.118480° N, 34.751745° E), 5.05.2008 (Vovk et al., 2019).

Pavlohrad Raion: Pavlohrad – NW, Bohuslavskiy Reserve, floodplain of the Samara river (Baranovskiy, 2006); Bulakhivka village, 1982, leg. Tarasov (Baranovskiy & Tarasov, 2010); near Kocherezhky village, 1982, leg. Tarasov (Tarasov, 2012).

[Former Yuriivka Raion] the Vyazovok river, 2007, leg. Baranovskiy (Baranovskiy & Tarasov, 2010).

Donetsk Oblast. Bakhmut Raion: near Vershyna village (“Verkhovka”), 697 km of the route Moscow – Rostov, oak forest, 30.05.1979, leg. Sykura Y. Y. & Antonyuk N. E. (KWA); Dronivka village – “Lily of the valley” botanical reserve (Ostapko, 2010); Ilyinka village (Ostapko & Hnatiuk, 2012); Klynove village, Markiv Yar tract, in the gully, 13.05.1991, leg. R. I. Burda et al. (DNZ), cited: (Perehrym, 2006); near Olkhovatkha – Skeleva Balka landscape reserve (Ostapko & Hnatiuk, 2012); Serebryanka – NE, “Marina Mountain” botanical monument of nature (Ostapko, 2010).

Donetsk Raion: [Former Amvrosiivka Raion] Kalynove village – “Forest on the river Krynkha” landscape reserve (Ostapko, 2010; Ostapko & Hnatiuk, 2012); Sadove village (formerly Novopetrivske) (Ostapko & Hnatiuk, 2012).

Donetsk City: Budyonovsk Municipality – near Laryne village, Larynsky landscape reserve (Ostapko, 2010).

Khartsyzk Municipality: near Zuivka urban-type settlements – forest on the slope of the Krynkha river, 24.05.1929, leg. A. Lavrenko (KW); Mykolayivka village, 8.06.1969, leg. Kharkhota (DNZ), cited: (Perehrym, Diss., 2006).

[Former Yasynuvata Raion] Grachev forest, thalweg of the ravine oak grove, 30.04.1991, leg. R. I. Burda, L. V. Vladymyrova et al. (DNZ), cited: (Perehrym, 2006); Yasynuvata (Oksner, 1935; Bordzilovskiy, 1950); near Karlivka village – steppe on tertiary sands, 9.05.2007, leg. A. Bronskov (Plantarium).

Horlivka Raion: Horlivka – the bank of the Sadka river, “Urochyshe Sofiiivske” forest reserve (Ostapko, 2010; Ostapko & Hnatiuk, 2012); Yenakiieve, “Urochyshe Ploske” forest reserve (Ostapko & Hnatiuk, 2012).

[Former Shakhtarsk Raion] near Nikishine village – “Kruhlyk” entomological reserve (Ostapko, 2010).

Kramatorsk Raion: [Former Lyman Raion] Zakitne village – “Chalk Flora” Nature Reserve (Onyshchenko & Andriienko, 2012a).

[Former Slovyansk Raion] “23 km from the town of Izyum on the route to the Sviatohirsk town” (formerly Slovyanogirsk), deciduous forest of different ages, 04.05.1985, leg. Beliaev A. A. & Antonyuk N. E. (KWA) [note: obviously this place is in the eastern outskirts of the Bohorodychne village]; Maiaky village – many (Onyshchenko & Andriienko, 2012b); in the former “Artem Hory” reserve, lower part of the forested slope, meadow near the road, 06.05.1985, leg. Kharkevych S. S. (KWA); in the former “Artem Hory” reserve, the lower part of the slope, deciduous forest, 22.05.1967, leg. N. E. Antonyuk (KWA); Holy Mountains National Nature Park, leg. Shiryayev & Lavrenko (Bordzilovskiy, 1950).

Sloviansk Municipality: Svyatogirsk – on the edges, 04.1935, leg. Sokolovskiy & Lypa (KW); about Svyatogirsk (formerly Slovyanogirsk), meadow near the road, 6.05.1985, leg. Beliaev A. A. & Antonyuk N. E. (KWA).

Mariupol Raion: [Former Mangush Raion] near Yalta (Kolomyichuk, 2012).

Mariupol City: meadows along the Kalmius river, 10.05.1926, leg. Kliestov (KW).

[Former Nikolske Raion] near Nazariivka village – Kamyany Mohyly Nature Reserve, 19.05.1954, leg. Klymentov, Kuznetsova (KW); *ibid.*, 15.05.1955, leg. H. Kuznetsova (KW); Kamyany Mohyly Nature Reserve, eastern ridge, 13.05.1958, leg. L. Panova, V. Osychniuk (KW); *ibid.* (Onyshchenko & Andriienko, 2012a); near Maloyanisol village – near the former Kiriakovka small village, on the rocks above the Western Kalchik river (LNAU).

Pokrovsk Raion: [Former Dobropillia Raion] near Nikanorivka village – “Nikanorivsky forest” reserve tract (Ostapko, 2010).

Volnovakha Raion: [Former Velyka Novosilka Raion] near Novomayorske village – “Oak Plantations” natural monument (Ostapko, 2010). Kharkiv Oblast.

Izyum Raion: near Dovhenke village – in the ravine forest, leg. Y. O. Yatsiuk & S. H. Viter (Shynder & Saidakhmedova, 2018); near Dovhenke village, 49.035646° N, 37.349871° E, 2012, leg. Y. O. Yatsiuk (iNaturalist); *ibid.*, 49.064535° N, 37.333315° E, 7.05.2012, leg. Y. O. Yatsiuk (iNaturalist); “Iziumska Luka” Regional Landscape Park – in the floodplain forest, leg. O. Y. Akulov (Shynder & Saidakhmedova, 2018); Oskil village, leg. Shiryayev & Lavrenko (Bordzilovskiy, 1950); Between Gorokhovatka village of the Borivka Raion and Senkove village of the Kupyansk Raion – deciduous forest, on the right bank of the Chervonooskil reservoir, 13.05.1915, leg. M. Klovov (KW).

[Former Balakliia Raion] Borshchivka village – S, in the gully, along a bottom of the furrow on the south-facing slope, locally, 49.471361° N, 36.970133° E, 19.04.2016, leg. O. I. Shynder (KWA) (Shynder & Saidakhmedova, 2018); near Chepil village – in the valley of the Chepil river, leg. S. Maslak (Shynder & Saidakhmedova, 2018).

[Former Barvinkove Raion] near Kurulka village – in the ravine forest, leg. Y. O. Yatsiuk & S. H. Viter (Shynder & Saidakhmedova, 2018); near Kurulka village, 48.942362° N, 37.194149° E, 5.05.2012, leg. Y. Yatsiuk (iNaturalist); near Kurulka village, 48.919604° N, 37.30185° E, and 48.959837° N, 37.29972° E, and 37.299239° N, 6.05.2012° E, leg. Y. Yatsiuk (iNaturalist).

[Former Borivka Raion] Gorokhovatka village, leg. Shiryayev & Lavrenko (Bordzilovskiy, 1950).

Krasnohrad Raion: near Sakhnovshchyna urban-type settlement, “Strukova Tsilyna” tract (Shiryayev, 1912).

Lozova Raion: Lozova – S, Druzhba Park, along gully, 05.05.2020, leg. A. Hryhorenko (KW).

Kherson Oblast. Beryslav Raion: Kachkarivka village (Pachosky, 1890, 1914); Kachkarivka village – W, near former Sofiyivka village (now flooded) (Pachosky, 1914); Mylove village (Pachosky, 1890, 1914); near Tyahynka village – along the thalweg of the gully (Pachosky, 1914).

[Former Novovorontsovska Raion] near Novovorontsovska urban-type settlement – along gully, 23.04.1906, leg. Vasiliev (KW); Zolota Balka village – N, Hyrly tract (former Hyrly village, now flooded) (Pachosky, 1914); Mikhailivka village (Pachosky, 1914).

[Former Velykooleksandriivka Raion] near Krasnolyubetskiy village – right bank of the Inhulets river (Pachosky, 1914).

Kakhovka Raion: [Former Chaplynka Raion] F. Falz-Fein Askania-Nova Biosphere Reserve – in the arboretum, in several blocks (Havrylenko et al., 2008).

Skadovsk Raion: [Former Hola Prystan Raion] Rybalche village, sands of the lower Dnieper, leg. Ilyichevsky (Bordzilovskiy, 1950); the Black Sea Biosphere Reserve – Ivano-Rybachalska dacha, in the grove, 21.05.1961, leg. H. Kuznetsova, V. Protopopova (KW); the Black Sea Biosphere Reserve – areas of Ivano-Rybalchanska and Solonoozerna, often (Onyshchenko & Andriienko, 2012a); the Black Sea Biosphere Reserve, Yavorlytskiy Kut area, 27.04.1970, leg. unknown, det. 21.01.2016, M. Perehrym (KW 117372, 117373, 117375, 117376).

[Former Kalanchak Raion] Khorly village (Pachosky, 1890).

Kherson Raion: [Former Bilozerka Raion] Darivka village (Pachosky, 1914); between Sadove (former Falieievka) village and Antonivka township (Pachosky, 1914); Sadove village, 15.06.1928 (LNAU).

Kherson City: (Pachosky, 1890, 1914); without clarification, 46.654033° N, 32.557363° E, 11.04.2010, leg. R. Mishustin (UkrBIN); Dimitrova Park, grove grove by the river, 11.04.2010, leg. R. Mishustin (Plantarium).

Henichesk Raion: [Former Novotroitske Raion] Sofiyivka village (Pachosky, 1890).

Kirovohrad Oblast. Kropyvnytskiy Raion: Kropyvnytskiy City: surroundings, in meadows and bushes (Lindemann, 1882); Zlodiiska Balka tract, on a bushy slope, 10.06.1918, leg. A. Oksner (KW); near Kropyvnytskiy – SW, between the granite boulders on the left bank of the Suhokliia river near the Novopavlovsky quarry, not many (Arkushyna & Popova, 2002); City Garden, on the outskirts, among the scattered bushes, not infrequently, 01.05.1918, leg. A. Oksner (KW); City Garden, Suhokliia river valley, 23.04.1920, leg. A. Oksner (KW).

[Former Ustynivka Raion] Zavturove village – Monasteryshche tract, among the bushes, 29.06.1991, leg. M. Y. Melnyk (electronic catalog KWU).

Oleksandriia Raion: surroundings of the Oleksandriia town, granite rocks along the Inhulets river, in the shade, rarely, 6.05.1908, leg. I. Paczosky (Paczosky, 1914; Bordzilovskiy, 1950).

[Former Onufriivka Raion] Popivka village – S, “Buzove” reserve, in the gully, ravine forests at the top of the balka (Andriienko, 1999).

Luhansk Oblast. Alchevsk Raion: Brianka City, former Zamkivka settlements, in the ravine forest, rarely, 08.05.1970, leg. A. Derypova (KW); near former Lozova-Pavlivka village (now part of the Brianka), 8.05.1972, leg. Derypova (Perehrym, 2006).

Holubivka town (formerly Kirovsk): Zozulyna Balka tract, near the stream, 9.03.2013, leg. E. Pakhomov (Plantarium).

Zymohiria hromada: near Kryvorizhzhya settlement, at the bottom of a dry stony balka, rare, 04.05.1967, leg. Darynova A. I. (KWA).

[Former Perevatsk Raion] Seleznivka village, in valley of the Bila river, 48.399114° N, 38.787638° E, 1.05.2020, leg. S. Lychanyi (iNaturalist).

Dovzhansk Raion: near Provallya village – Provallya Steppe Nature Reserve, 21.05.1969, leg. D. S. Ivashyn (DNZ), cited: (Perehrym, 2006); *ibid.*, 20.05.1980, leg. T. T. Chupryna (DNZ), cited: (Perehrym, 2006); Provallya Steppe Nature Reserve (Onyshchenko & Andriienko, 2012a).

Luhansk Raion: Metalist village – in Shyshkivska Balka, 2008, leg. Y. V. Konakh (Shynder & Konakh, 2023).

Luhansk City: western part, Gorky Park, 400 m from the Luhan river, on the right bank, in a park stand, a young progressive population (Sokolov et al., 2008); NE neighborhood of the Luhansk, Chervonyi Yar villa-

ge, ravine oak near the rest house “Zelena Roshcha”, 13.05.1982, leg. Burda, Kucherevskiy & Horlachov (DNZ), cited: (Perehrym, 2006).

[Former Lutuhyn Raion] near Rozkishne village, outskirts of the Ploska Balka tract, 14.04.2004, leg. M. Perehrym (Perehrym, 2006); *ibid.*, 5.05.2004, leg. M. Perehrym & N. Zhuravel (KW, KWHA), cited: (Perehrym, 2006); near Rozkishne village – near the Ploska Balka in the ravine forest, botanical natural monument, 5.05.2004, leg. Perehrym M. M. (KWHA); Ploska Balka, on the right bank of the Siverskiy Donets river, 05.2008, leg. Y. V. Konakh (Shynder & Konakh, 2023).

Rovenky Raion: [Former Anratsyt Raion] Malomykolaivka village – N 3 km, in the ravine forest, 21.04.2004, leg. Perehrym M. (KWHA) (Perehrym, 2006).

Shchastia Raion: [Former Novoaidar Raion] Muratove village – S, in the forest on the slopes of the Siverskiy Donets river, leg. Taliiev (Bordzilovskiy, 1950); near Trokhizbenka village – “Trokhizbenka Steppe” department of the Luhansk Nature Reserve (Onyshchenko & Andriienko, 2012a).

[Former Stanytsia-Luhanska Raion] Valuyske village (Burda et al., 1992); near Pishchane village – “Stanytsia-Luhanska” Nature Reserve department (Onyshchenko & Andriienko, 2012a).

Sievierodonetsk Raion: [Former Kreminna Raion] Kreminna – in the meadows and in the forest, leg. Kotov & Klokov (Bordzilovskiy, 1950); Kreminna – southern surroundings, Kreminna forests, Serebrianske forestry, the outskirts of Zymovne and Kleshnia lakes, near the border Prelypchanskiy (Shevchenko, 2006); Kreminna Forest, near the Chernikove Lake, in the meadow, 27.05.2003, leg. D. Y. Shevchenko (KWHA); Kreminna forests, 49.026446° N, 38.247944° E, 2021 (Honcharova & Kushnerova, 2023).

Mykolaiv Oblast. Bashtanka Raion: Arkhangelsk village – in the valley of the Hromokliia river (Pachosky, 1914); between Pisky and Khrystoforivka villages (Kritskaya & Novosad, 2001); near Pryvilne village (Kritskaya & Novosad, 2001).

[Former Novyi Buh Raion] near Pelaheivka village – Kalamerzova gully to the right bank of the Inhul river, “Pelaheivka” tract (Drohobych et al., 1992); near Pelaheivka village – steppe shrubs, 08.05.2014, leg. S. M. Voronova, O. F. Shcherbakova & L. I. Krytska (KW 081750).

Mykolaiv Raion: Halysynove village – W, Starohalysynivska natural monument, left slope of the Southern Buh (Kritskaya & Novosad, 2005–2007).

Mykolaiv City: the valley of the Southern Buh (Eichwald, 1830); Lisky tract (Pachosky, 1890, 1914); surroundings of the city, 1909, leg. A. S. Doich & A. A. Yanata (KW); behind a French factory, between bushes, 16.04.1899, P. Karasev (LWS).

[Former Ochakiv Raion] the right bank of the Southern Buh between the Zavodsky Raion of Mykolayiv city (former Velyka Korenykha village) and Parutyn village (Pachosky, 1914); Kinburnska Kosa – Ivory Coast of Sviatoslav National Nature Park (Onyshchenko & Andriienko, 2012b); The Black Sea Biosphere Reserve, Volzhyn Forest area, 07.04.1970, leg. unknown, det. 21.01.2016, M. Perehrym (KW 117378); Volzhyn Forest area (Onyshchenko & Andriienko, 2012a).

Pervomaisk Raion: Hrushivka village – in the bushes on the slope of the Southern Buh (Pachosky, 1914); near Kuripchyne village, 47.999467° N, 30.994445° E, 07.05.2020, N. Sytschak (UkrBIN); Myhiia village – on the slope of the Southern Buh, in the bushes, rarely (Pachosky, 1914); Myhiia village – S (Shcherbakova, 2008: 602, map); Romanova Balka village – E, the right bank of the Southern Buh (opposite the Semenivka village), in the bushes (Pachosky, 1914); the same “ad Hypon. Siemionowka distr. Elizabeth.”, 09.05.1909, I. Pachosky (MSUD).

[Former Arbutynka Raion] Kostiantynivka village – in a bush, 28.04.1968, leg. V. Sobko (KW; KWHA); between Ivanivka and Semenivka villages – the left bank of the Southern Buh river (Shcherbakova, 2008).

[Former Bereznehuvatka Raion] near Velyke Artakove village – Naidenova Balka, side ravine with thickets of bushes, 03.05.2005, leg. Krasova (KRW); Yakovlivka village – S, the valley of the Vysun river (Pachosky, 1914).

Voznesensk Raion: Trykraty village – Labirynt tract, 47.705882° N, 31.41258° E, 3.05.2020, leg. Anna (iNaturalist).

[Former Domanivka Raion] Bohdanivka village – on an island in the Southern Buh (Pachosky, 1914); Prybuzhzhia village (former Ak-Mechet) (Pachosky, 1914); between Bohdanivka and Vynohradnyi Sad villages – coastal shrubs, 05.05.2004, leg. L. Krytska, O. Shcherbakova & V. Novosad (KW 081657); Bohdanivka village – on the slope to the Southern Buh river, among the bushes, 23.05.1979, leg. M. M. Bortniak (electronic catalog KWU).

[Former Nova Odesa Raion] N surrounding of the Mykhaylivka village, Mykhaylivka branch of the Yelanets Steppe Nature Reserve, 47.40811° N, 31.6210824° E, 11.05.2021 (Buhay, 2023).

[Former Yelanets Raion] Bohodarivka village – Bohodarivka reserve (Voronova, 2008); near Kalynivka village – Yelanets Steppe Nature Reserve, Prusakova Balka (Onyshchenko & Andriienko, 2012a).

Odesa Oblast. Berezivka Raion: near Zbrozhivka village, 47.214197° N, 30.861753° E, 01.05.2015, leg. E. Kalashnik (UkrBIN); between Raukhivka and Zavodivka villages – in Chyhyrnska gully (Popova & Rogozin, 2016); Riasnopil village (Korytnianska & Tovstukha, 2012).

[Former Mykolayivka Raion] in gully, 47.519348° N, 30.375894° E, 02.05.2019, leg. Nikolay (UkrBIN).

Bilhorod-Dnistrovskiy Raion: Tuzly Lagoons National Nature Park (Popova, 2012).

Bolhrad Raion: Bolhrad (Lipskij, 1889).

[Former Tarutyno Raion] near Borodino, Borodino gully, 16.04.2006, leg. Melnyk V. I., Didenko S. Y. & Rak O. O. (KWHa); Lisne village – in an artificial forest of *Caragana arboreascens*, quarter No. 3, 14.06.1952, leg. M. Kotov & H. Kuznetsova (KW).

Izmail Raion: near Vylkove town, Danube Biosphere Reserve (Popova, 2002; Onyshchenko & Andriienko, 2012a).

Reni, leg. Hahman (Lipskij, 1889).

Odesa Raion: the coast of the Kuyalnyk estuary (Kozitskaya et al., 1988).

[Former Lyman Raion] recreation center near Tiligul estuary, 1988–1989 (MSUD); Hvardiiske village, 1989, leg. T. I. Derevinskaya (MSUD); Kurisove village (former village Petrivka) – on the slopes of the Tylihul estuary, 24.04.2012 (Korytnianska & Tovstukha, 2012); near Kairy village, slope on the hill, 16.04.2006, leg. Melnyk V. I., Didenko S. Y. & Rak O. O. (KWHa); *ibid.*, near Kairy village (Popova, 2002); Kairy village – E, Kosa Strilka reserve (Popova, 2012); near Kalynivka village – Kalynivka reserve, Labushna oak forest (Popova, 2012); Koshary village (Popova, 2002); Nova Dofynivka village (Pachosky, 1914); Ranzheve village, 18.04.2012 (Korytnianska & Tovstukha, 2012); Sychavka village, 1987–1989, leg. unknown (MSUD); Soloviove village (Popova, 2002).

Odesa City: near the Small Fountain, 1912, leg. Shesterykov, cited: (Petrik, 1992); on the slopes (Petrik, 1992); Luzanivka Hydropark (former Kotovsky Park), 26.04.2012 (Korytnianska & Tovstukha, 2012); (\*) Botanical Garden of Odesa University: spontaneously in the grass of arboretums (Derevinskaya et al., 1998).

[Former Ovidiopol Raion] slopes of the Dniester estuary (Bondarenko, 2009); Sukhyi estuary, circa 1980, leg. students of Odesa University (MSUD) (Popova, 2002); Velykodolynske township (former Hros-Libental), leg. Shesterikov (Pachosky, 1914).

Poltava Oblast. Poltava Raion: near Karlivka town, leg. Tsinher & Bordzilovskiy (Bordzilovskiy, 1950).

[Former Kobeliaky Raion] near Luchky village, on the edge of the forest along the gully, 10.04.1897, leg. N. Tsynher (KW); near Luchky – “Luchkivskiy” landscape reserve (Bayrak & Stetsyuk, 2005); Luchky village – NE, meadows on the right bank of the Vorskla river, several loci, 2008, Y. V. Konakh; Lishchynivka village – shaded raw ravine in the forest, 05.05.1959, leg. Vasylenko (electronic catalog KWU).

[Former Novi Sanzhary Raion] near Butenky village – Drabynivka Botanical Reserve (Bayrak & Stetsyuk, 2005); Nekhvoposhcha village – SE, 49.14578° N, 34.75955° E (Vovk et al., 2019); near Sobkivka village – Novosanzharsky Landscape Reserve (Bayrak & Stetsyuk, 2005).

Zaporizhzhia Oblast. Berdiansk Raion: [Former Chemihivka Raion] Verkhni Tokmak village (Sheleheda & Sheleheda, 2001).

Melitopol Raion: [Former Yakymivka Raion] (\*) Yakymivka township – in the Garden of Tamovskiy, rarely, 22.04.1888 (Lukashev, 1890); Atmanai, leg. Sivashyuk, 46.345386° N, 35.126433° E, 05.05.2007, A. Zhakov (UkrBIN).

Polohy Raion: [Former Orikhiv Raion] Tavriya village (formerly Kirov) (Sheleheda & Sheleheda, 2001).

[Former Tokmak Raion] Zamozhne village (Sheleheda & Sheleheda, 2001); Molochansk town (Oksner, 1935); Shevchenko village – in the gully, 47.28087° N, 35.61505° E, leg. O. Vasyliuk (iNaturalist).

Vasylivka Raion: Dniprorudne town (Sheleheda & Sheleheda, 2001); Mayachka village – in a floodplain forest on the left bank of the Kakhovka Reservoir, on an area of about 4.5 hectares (Sheleheda & Sheleheda, 2001); “Velykyi Luh” National Nature Park, Mayachanska gully, 47.436475° N, 35.065019° E, 04.05.2018 (Shevchenko, 2023); Skelky village (Sheleheda & Sheleheda, 2001); near Vasylivka town – floodplain forests of the left bank of the Kakhovka Reservoir, on an area of about 4.5 hectares (Sheleheda & Sheleheda, 2001).

Zaporizhzhia Raion: Baburka village (Sheleheda & Sheleheda, 2001); near Vodiane village (Petrochenko, 2017); near Dolynske village (Petrochenko, 2017); near Malyshevka village (Petrochenko, 2017); Lower Khortytzia village (Sheleheda & Sheleheda, 2001); near New Zaporizhia village (Petrochenko, 2017); near Pryvilne village (Petrochenko, 2017); near Pryvitne village (Petrochenko, 2017); near Smoliane village (Petrochenko, 2017); near Stepne village – Duma gully, in herbaceous steppe, 04.23.2017, leg. S. Odynets (Plantarium); Soniachne Village (Sheleheda & Sheleheda, 2001); Fedorivka village (Sheleheda & Sheleheda, 2001); near Chervonodniprovka village (Petrochenko, 2017); near Shyroke village (Petrochenko, 2017).

Zaporizhzhia City: (Bieberstein, 1819); Khortytzia Island – throughout the territory (Sheleheda & Sheleheda, 2001); Khortytzia Island, 47.820267° N, 35.087563° E, 30.04.2020, leg. M. Mulyenko (iNaturalist); right bank of the Dnieper, “Raion Khortyttsky” residential area (Sheleheda & Sheleheda, 2001); Upper Khortytzia (Sheleheda & Sheleheda, 2001); Vyrva tract (Petrochenko, 2017); in a gully between the “Space” residential area and the Experimental Station, under the trees, near the road, 30.04.2017, leg. S. Odynets (Plantarium); Partyzanska gully, ruderal habitat, 01.05.2013, leg. S. Odimets (Plantarium); Shchhaveleva gully, lowland, in the grass, 08.05.2017, leg. S. Odynets (Plantarium); Voznesensky Raion of the city, 47.820267° N, 35.087563° E, 30.04.2020, leg. M. Mulyenko (iNaturalist); Kommunarsky Raion of the city, 47.755722° N, 35.175445° E, 24.04.2020, leg. V. Lysenko (iNaturalist).

### **Carpathians**

Zakarattia Oblast. Mukachevo Raion: near Mukachevo (Zerov, 1965); Seme village – on wet meadows, 1933, leg. Margittai (Margittai, 2010: 199).

Tyachiv Raion: Rivne village – surroundings, near the railway, leg. Margittai (Bordzilovskiy, 1950).

Uzhhorod Raion: Rativtsi village, in meadows, 3.05.1961, leg. Fodor (UU).

Uzhhorod City: former Donanivtsi village, 11.05.1958, leg. S. S. Fodor (UU).

### **Crimean peninsula**

Autonomous Republic of Crimea. (\*) Simferopol – Salhirka Park (former estate of K. K. Steven), leg. Kuznetsov (Wulff, 1930) [note: may have an introductory origin (Agapova, 1979)].

### **Moldova**

#### **Left bank Transnistria**

Administrative-Territorial Units of the Left Bank of the Dniester. [Hryhoriopol Raion] near Butor village – in a robinia plantation (Zhilkina, 2002).

[Rybnitsa Raion] near Biloch village (Duca, 2015).

[Slobodzia Raion] Karahash village – in the gardens, often, Riabkov (Pachosky, 1914); northern outskirts of Kitskani village, Kitskan forest, a little, 2020 (Timina & Chavdar, 2021); between Parkany and Bychok villages – in the lower part of the high left bank of the Dniester, on the old fallow, quite densely (Rushchuk, 2001); Ternivka village – in the floodplain forest on the banks of the Dniester, a lot (Rushchuk, 2009).

#### **Bessarabia**

Anenii Noi District: Delacau village – in the thickets on the slope of the Dniester, May 11, 1897, sub *O. nutans* (Paczoski, 1899).

Cahul District: Giurgiuilesti village (Duca, 2015); Cîșlița-Prut village (Duca, 2015).

Cantemir District: Capaclia village (Duca, 2015).

Chisinau city, leg. Lindeman (Lipskij, 1889).  
Cimişlia District: near Zloţi village, sub *O. nutans* (Kononov & Shanovna, 1978).  
Criuleni District: Zolonceni village (Duca, 2015).  
Dubăsari District: Ustia village, 1899, leg. I. Paczosky (MSUD).  
Orhei District: Brăneşti village (Duca, 2015).  
Taraclia District: Plague village (Duca, 2015).  
Vadul lui Vodă town (Duca, 2015).

#### Russia

##### Mixed forest zone (Upper Volga)

Moscow City. (\*) Petrovsky Park, 55.7925° N, 37.556056° E, 30.05.2020, J. Shner (iNaturalist).

##### Steppe zone (Lower Don)

Rostov Oblast. (Fedyaeva, 2014).

Kamensky Raion: Khotobok small village; Anikin small village.

Krasny Sulin Raion: Nizhniaia Kovalovka small village – Hrushevskaya Balka.

Ust-Donetsk Raion: Topilin small village – Topilin Forest; Pukhliakovskii small village; Razdorska stanitsa; Kanyhin small village – Avila Mountains tract.

*Features of the O. boucheanum habitat in Ukraine and neighbouring countries.* The formation of ideas about the location of *Ornithogalum boucheanum* in the flora of Ukraine had a difficult path and was associated not only with the accumulation of chorological information. Scientists of the XIX century more often cited the studied species under the name of a close southern Balkan species *O. nutans* L., which does not grow naturally in Ukraine. I. K. Paczosky drew attention to the problem of distinguishing between the two species, writing that it was H. Zapalovych who correctly redefined the specimen of a sprout from Bessarabia, originally attributed by the scientist to *O. nutans* (Paczosky, 1914). Following this, I. K. Paczosky doubted whether the indigenous species *O. nutans* was found in Eastern Europe at all, however, the latter species is cultivated and was collected in the rewildening state in the village Verba in Volyn (Paczosky, 1914). The inertia of the inaccurate information about *O. boucheanum* under the wrong name was so great that Y. I. Bordzilovskiy, included *O. nutans* in the flora of Ukraine, although he noted: “The researcher is convinced that *O. nutans* L. in the USSR, at least in the rewildening state, there is none” (Bordzilovskiy, 1950). Nowadays, it is well established that in the flora of Ukraine and neighbouring countries only *O. boucheanum* (Wulff, 1930; Zahariadi, 1966; Agapova, 1979) is naturally distributed. It should be noted that the typical *O. nutans* is among the Crimean specimens of the herbarium P. S. Pallas, but the exact location of their collection is not specified (Wulff, 1930). Perhaps these are cultivated plants.

In the South Polissya, a synanthropic location of *O. boucheanum* was recorded in the western suburbs of Kyiv (1973, KWHA). In the Deciduous Forest zone spontaneously growing plants of *O. boucheanum* (or as *O. nutans*) are known from Western Podillya. In Khmelnytsky Oblast three unconfirmed sites of *O. nutans* (Eichwald, 1830; Makowiecki, 1939) have been reported for all time, which probably belong to *O. boucheanum*, but in any case are not aboriginal. All these sites are too far from the natural habitat of *O. boucheanum*, outlined by confirmed guidelines, and belong to areas that have long been inhabited, and where the local cultural flora was diverse and was the source of new adventitious plants. Thus, from the village Ivakhnivtsi S. Makovetsky in addition to *O. boucheanum* the wild *Solidago canadensis* L. (Makowiecki, 1939) was cited. Probably the same origin and habitat from Medzhybozh – an ancient town, which has long been a major administrative and economic center. Therefore, we are inclined to think that all localities of *O. boucheanum* from the territory of Khmelnytsky Oblast have an introduced origin. In Ternopil Oblast *O. boucheanum* is represented in the urban flora of Kremenets (according to information O. K. Halahan) and the nature of its habitat (“in the meadows, in the fields, in the stadium”) indicates that this species belongs to the category alien. It should be noted that the taxonomic affiliation of these plants from Khmelnytsky Oblast remains unclear. In the cited researches they are presented as *O. nutans*, but we consider them here as *O. boucheanum*. Thus, Y. I. Bordzilovskiy noted that all samples of “*O. nutans*” from Ukraine, which he saw, actually belong to *O. boucheanum* (Bordzilovskiy, 1950). It should be noted here that these

both species are really difficult to distinguish, and now even the existence of spontaneous hybrid *O. boucheanum* × *O. nutans* is observed, such as in places of their joint cultivation in Poland (Czarna, 2016).

Relatively few localities of *O. boucheanum* have been recorded in the right-bank Forest-Steppe, moreover, the real native settlements are located only in the southern Forest-Steppe. In the northern part of the region *O. nutans* and *O. boucheanum* were listed within the Dnieper Upland. Locations from the outskirts of Vinnytsia and the village Holendra in the north of Vinnytsia Oblast, as well as the Western Podillya localities, are isolated and also probably related to the plant’s introduction. Thus, the settlement “Hollenderskie Karczmy” was founded on both sides of the railway, and its first inhabitants were probably of Dutch origin and engaged in trade. From the outskirts of this village A. Andzheiovskiy cited such obvious ergasiophytes as *Anthericum liliago* L. and *Hesperis matronalis* L. (Rogovich, 1869). Therefore, it is quite to be expected that *O. boucheanum* (or *O. nutans*) could have been brought by the villagers together with other ornamental and flower crops. There is a spontaneous population of the species along the edge of the O. V. Fomin Botanical Garden of Kyiv University (Malyushytska, 1948), and now in the M. M. Gryshko National Botanical Garden there are several young invasive populations *O. boucheanum*, within which there is an active seed reproduction of the species. The secondary locality of *O. boucheanum* in Korsun-Shevchenkivskiy is probably secondary, as many florists who worked here did not notice this species, and locality in the park indicates a high probability of plant introduction.

Reliable localities of *O. boucheanum* on the Dnieper Upland are known from the raions of Kirovohrad Oblast adjacent to the Dnieper and the Kremenchuh Raion of Poltava Oblast (Pachosky, 1914; Oksner, 1935; Bayrak & Stetsyuk, 2005). Another locality from Smila Raion of Cherkasy Oblast was mentioned at the end of the XIX century (Montrezor, 1898) and nowadays has not been confirmed. This last locality in the past was probably part of a large linear population of the species, which stretched along the right bank of the Dnieper and the lower part of the valley of the Tyasmyn river, but was flooded during the filling of the Kremenchuh Reservoir. The area of the species probably did not reach the northern mouth of the Ros river in historical times.

In the southern part of the Middle Pobuzhia, *O. boucheanum* with multiple localities in Odessa, Kirovohrad and Mykolaiv Oblasts (Andrzejowski, 1823; Finn, 1924; Holovko, 2014). In 2018, one of the researchers discovered the location of the species in this region in a floodplain oak stand of Bereziv forestry, on the right bank of the Southern Buh river. In addition, two Eastern Podillya areas of the species are indicated from the left bank of the Dniester in Hryhoripol and Rybnitsya Raions of Moldova (Zhilkina, 2002; Duca, 2015). Together these locations outline the reliable natural border of the *O. boucheanum* area. The territory of East Podillya is known for dubious indication of *O. boucheanum* in the southern part of the former Haisyn Raion (Baranovski & Tarasov, 2010), which belongs to O. Savostianov. This researcher in his work cited *O. nutans* “with silver-grey flowers” among steppe plant species (such as: *Adonis vernalis* L., *Crocus reticulatus* Steven ex Adam, *Leopoldia tenuiflora* (Tausch) Heldr. etc.) (Savostianov, 1925). Judging by this characteristic, the author presumably cited the area of *Ornithogalum kochii* Parl. under the wrong name, from the Korostiv reserve in the Haisyn Raion. Thus, in the southern zone of the right-bank Forest-Steppe there are indigenous localities of *O. boucheanum*, which delineate the northern limit of species’ introduction in this part of the area, and the reports given at different times from the north, which has already been noted for *O. boucheanum* in other countries.

In the left-bank Forest-Steppe, the locations of *O. boucheanum* are also represented in the southern zone of the region and are mainly concentrated in the linear localities confined to the Vorskla, Psel, and the Siverskyi Donets basins. In the northern part of Poltava Oblast there is an isolated area from Hadiach Raion (Bayrak & Stetsyuk, 2005). As in the case of similar localities in Podillya, we tend to consider this location probably secondary. A recently discovered settlement in the southern part of the Chemihiv Oblast is also certainly synanthropic.

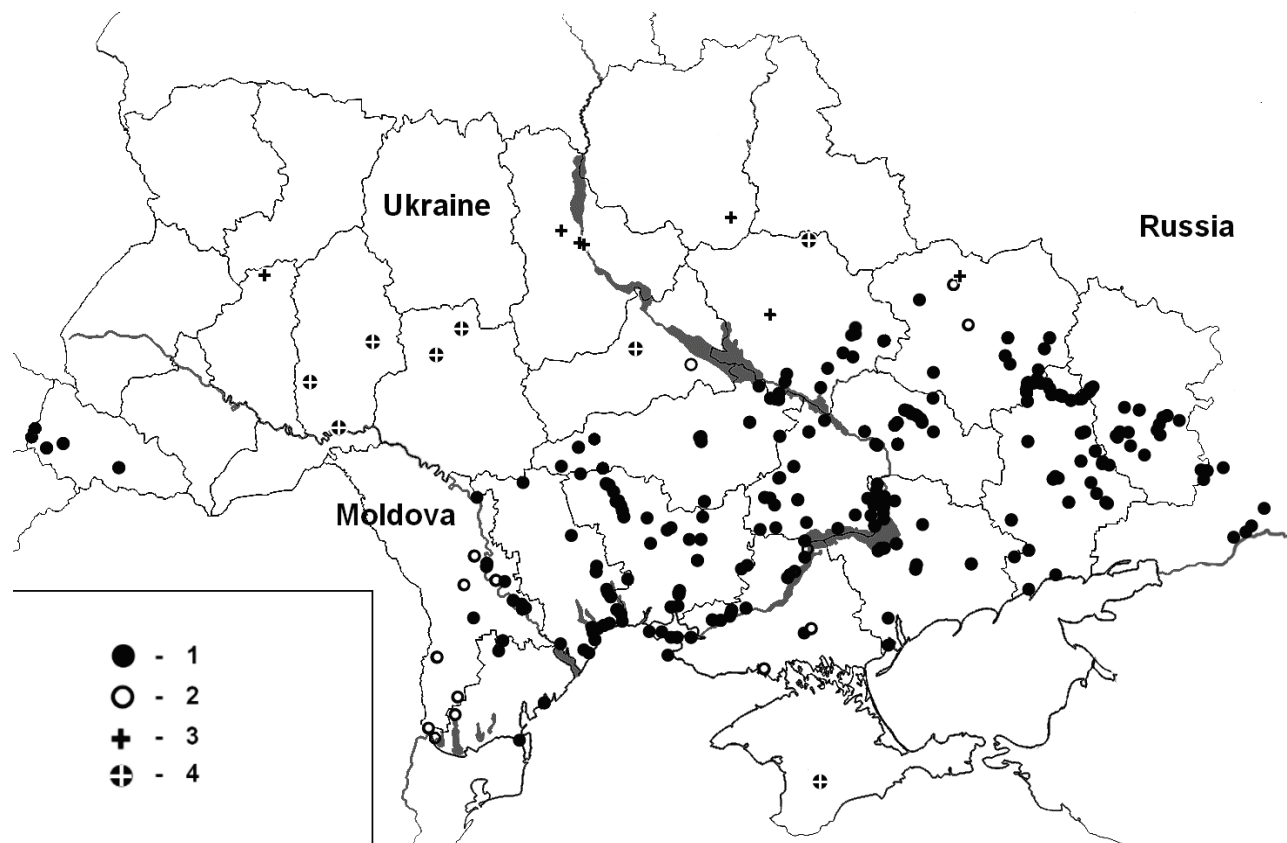
In Kharkiv there are several locations of *O. boucheanum* of different origin. V. M. Chernyaev cited the studied species for the outskirts of the city in the middle of the XIX century (Chernyaev, 1859) and, apparently,

it was a border-area locality. Spontaneous populations of *O. boucheanum* of plant introduction origin are now known in both territories of the Kharkiv Botanical Garden, as well as from the territory of a medical institution in the Nemyshlia river basin (Turchynova & Bengus, 2017). Scientists noted that the views of experts on the origin of this population differ and support the idea of its indigenous nature, although in the description of habitat *O. boucheanum* is mainly a ruderal species, so the population of this species is probably non-native.

Thus, the nature of the introduction of *O. boucheanum* in the left-bank Forest-Steppe is similar to that on the right bank: reliable locations of the species quite clearly delineate its northern boundary of the area, and locations far beyond it are probably secondary.

As already mentioned, most of the *O. boucheanum* sites within Ukraine are concentrated in the Steppe zone. They are mostly evenly located

in most areas and only in the extreme south of the Black Sea lowlands become much rarer, and on the southern spurs of the Middle Uplands within Luhansk Oblast and in the steppe part of the Crimea *O. boucheanum* was not recorded at all. A large number of localities of the studied species are clustered as part of linear metapopulations in the basins of large rivers of the Steppe zone: the Danube, Southern Bug, Ingul, Ingulets, Dnieper, Samara, Siverskyi Donets, Oskol, Molochna, etc. Similarly, the location of *O. boucheanum* is confined to the Lower Dniester in Moldova and the lower reaches of the Don in the Rostov Oblast of Russia (Fig. 1). On the north-western Black Sea coast, the species under study is often found along the shores of estuaries, especially the Tylihul'skyi. This nature of the *O. boucheanum* introduction allows us to consider it as an meadow-forest thermophilic species of river floodplains.



**Fig. 1.** Habitat of *Ornithogalum boucheanum* in Eastern Europe: 1 – localities listed after 1900, 2 – missing localities and listed before 1900, 3 – synanthropic localities, 4 – presumably synanthropic localities

It should be noted that most of the known locations of *O. boucheanum* in the Steppe zone of Ukraine were discovered in the second half of the XX century. In recent times there has been a particularly large amount of updated information about new *O. boucheanum* finds in Zaporizhia Oblast (Sheleheda & Sheleheda, 2001; Petrochenko, 2017) and some other oblasts of Ukraine (Popova, 2002; Baranovski & Tarasov, 2010). The confinement of the habitats of this species to shoreline ecosystems causes the threat of their extinction by the creation of reservoirs. Thus, the partial destruction of *O. boucheanum* populations occurred during the filling of the Oleksandrivka Reservoir in the Southern Bug river. Apparently, some of the localities of the species were cited by Y. K. Paczosky from the banks of the Southern Buh and the Dnieper.

The location of *O. boucheanum* on the banks of the Siverskyi Donets along the edge of the Donetsk ridge forms the natural boundary of the range, which reaches the Lower Don. The easternmost localities in the range of the species are known in the Rostov Oblast of Russia, where they are concentrated in the eastern part of the Donetsk ridge and on the right bank of the Lower Don (Fedyeva, 2014). The growth of *O. boucheanum* in the Caucasus remains unclear. A. A. Grossgejm noted that in the herbarium of LE there are specimens of this species with the label “Caucasus” and its location is possible in the northern part of the Caucasus

(Grossgejm, 1940). However, in most floristic collections, the Caucasus region is usually omitted from the chorology of this species.

In the north-western Black Sea coast region, the border of the *O. boucheanum* range encircles the Lower Transnistria within Moldova and reaches the Lower Prut. Then the Black Sea fragment of the species range covers the southern regions of Romania: Dobruzha, Multeniia and Olteniia – and passes to the Balkan Peninsula. It is noteworthy that most localities of *O. boucheanum* in Southern Bessarabia have disappeared or been unconfirmed for a long time. In fact, during the last historical period, a disjunction was formed between the Pontic and Balkan fragments of the *O. boucheanum* range.

In the Ukrainian Carpathians, three locations of *O. boucheanum* in the Zakarpattia Oblast are known. They are within the border-range in the Central European fragment of the species range and are geographically related to the locations of the studied species in Transylvania and the Panonian Plain. It should be noted that, as in Ukraine, in Romania there are two fragments of the range of *O. boucheanum*, separated by the Carpathian ridge – the Balkan-Black Sea area and Central European area (Zahariadi, 1966).

In the mountain Crimea for all time only one locality of *O. boucheanum* was given – found by Kuznetsov in the former estate of K. K. Steven

in Simferopol (Wulff, 1930). The nature of the finding indicates the probable introductory origin of this habitat (Agapova, 1979). Thus, *O. boucheanum* is not an aboriginal species of flora of the Crimean peninsula.

As for the true *O. nutans*, this plant grows wild in the south of the Balkan Peninsula and is widely cultivated in Western Europe. In Eastern Europe, *O. nutans* is very uncommon in culture, although it was often cited in older works. Synanthropic habitats of this plant are reliably known for the Verbka village, Kovel Raion, Volyn Oblast (Pachosky, 1914) and O. V. Fomin Botanical Garden in Kyiv (Malyushytska, 1948). In addition, the typical *O. nutans* is among the Crimean plants in the herbarium of P. S. Pallas, but the exact location of their collection is not specified (Wulff, 1930), probably these are cultivated plants.

*Ecological and coenotic characteristics of O. boucheanum habitats in Ukraine.* The habitat conditions of *O. boucheanum* in Ukraine are described very fragmentarily. The species is generally found in meadow and meadow-steppe grasslands, shrubs, ravines and floodplains, and in some places *Robinia* forests. In the lower part of the Southern Bug basin according to O. F. Shcherbakova (Shcherbakova, 2008) the habitat of *O. boucheanum* confined to shady wet areas mainly under the canopy of stands from *Acer tataricum* L., *Quercus robur* L., *Pyrus pyrastrer* (L.) Bursgd., *Ulmus* spp. The population of *O. boucheanum* found in Berezkyvske forestry is confined to the floodplain oak forest formed by *Quercus robur* with the participation of *Acer campestre* L., *Fraxinus excelsior* L. and *Tilia cordata* Mill. In more neighbouring forest areas – lower, covered with *Alnus glutinosa* L. and an elevated sandy terrace covered with *Pinus sylvestris* L. *O. boucheanum* was not detected. In Zaporizhia Oblast, the largest populations of the studied species were found on the left bank of the Kakhovka Reservoir as part of forest crops from *Fraxinus* spp., *Quercus robur* and *Robinia pseudoacacia* L. (Shelehed & Shelehed, 2001). In Kharkiv in the valley of the River Nemyshlia loci with populations of *O. boucheanum* are confined to the artificial stand of *Acer platanoides* and *Fraxinus pennsylvanica* (crown closure 70%) and felling of the poplar stand, and partially – in the area covered by *Parthenocissus vitacea* (Knerr) Hitchc. (Turchynova & Bengus, 2017). The grass cover in these areas is formed mainly by ruderal species. In Chernihiv Oblast, the synanthropic habitat of *O. boucheanum* was recorded along the edge of shrubs of species of the genus *Crataegus* (Konakh, 2019). In the M. M. Gryshko National Botanical Garden synanthropic habitats of *O. boucheanum* are confined to shaded park stands with very sparse or no grass cover in the lower tier.

In forest habitats, grass cover with *O. boucheanum* is represented mainly by ephemeroïds and shade-tolerant species that do not form sod cover. In some locations from the Steppe zone *O. boucheanum* is found in the meadow-steppe flora complex (Montrezor, 1898; Kritskaya & Novosad, 2001). In the suburbs of the village Borshchivka in Kharkiv Oblast the habitat of *O. boucheanum* was found along the thalweg basin on the balka slope, as part of meadow grass (100% coverage), which is formed by *Thinopyrum intermedium* (Host) Barkworth, D. R. Dewey and *Poa pratensis* L. with the participation of some other meso- and mesoxerophytic species (Shynder & Saidakhmedova, 2018).

*Population size and structure of O. boucheanum in Eastern Europe.* Information on the state and characteristics of *O. boucheanum* populations within Ukraine is very fragmentary and often general. In the middle part of the Southern Bug basin in the population on the border of the area near the village Synytsivka in the western part of Kirovohrad Oblast, 17 individuals were observed in three loci (Holovko, 2014). This is probably a young population of the invasive type. In the same Oblast, we found a large population of *O. boucheanum* in Berezkyvske forestry on the right bank of the Southern Buh. The area of this population is over 6 hectares. The spatial arrangement of generative individuals is quite uniform, but with a low density – up to 5–7 individuals per 1 m<sup>2</sup>. The total number of generative individuals in this population can be up to 10 thousand.

In the lower part of the Southern Bug basin the population of *O. boucheanum* has a high number and left-handed age spectra. Population density is 5–20 individuals/m<sup>2</sup> (Shcherbakova, 2008). The spatial arrangement of individuals has a diffuse or compact-diffuse type. In Kropyvnytskyi on the left bank of the Suhakleia river, a population of *O. boucheanum* with a population of 16 individuals was found (Arkushyna & Popova, 2002). In Dnipropetrovsk Oblast, populations of *O. bou-*

*cheanum* in natural forests are numerous (Baranovski & Tarasov, 2010). In Zaporizhia Oblast, large populations of the species were found on the left steep bank of the Kakhovka Reservoir near the villages Vasylivka and Maiachka, which have an area of 4.5 hectares and number – tens and hundreds of thousands of individuals, and the density in some areas – up to 600–700 individuals/m<sup>2</sup> (Shelehed & Shelehed, 2001).

In the basin of the Siverskyi Donets in the north of the Steppe, we found a local type population of the species in the suburbs of the village Borshchivka (Kharkiv Oblast). It has the form of a zone measuring about 30 × 0.5 m at the bottom of the basin on the slope of the ravine of the southern exposure. In total, about 80 generative individuals of *O. boucheanum* and more than 100 – pregenerative ones have been recorded here. This population is probably young. In Rostov Oblast, Russia, populations of *O. boucheanum* in the land types of Avilov Mountain and Hrushivska Balka are large, have an area of 0.17–0.20 hectares and a number of more than 55 thousand individuals of different ages, the average proportion of generative individuals of the species is 12–15% (Fedyeva, 2014).

Information on the number of synanthropic populations of *O. boucheanum* is almost absent. A large population of *O. boucheanum* with an area of about 7 hectares in Kharkiv in the valley of the Nemyshlia river may have a very introductory origin (Turchynova & Bengus, 2017). This population consists of two loci, and the total number of generative individuals of *O. boucheanum* is several thousand, the number of pregenerative individuals exceeded 10 thousand. In the western part of Balaklia (Kharkiv Oblast) in the valley of the Liakhova river we observed *O. boucheanum* in homesteads and flower beds, where it abundantly reproduces, as well as several small loci of introductory origin on the banks of the old Siverskyi Donets, where the species is also scattered. In the M. M. Gryshko National Botanical Garden authors recorded two young populations of *O. boucheanum* in 2020, within which 7 and 18 generative individuals of the species were noted and near them several dozen adult non-flowering individuals and more than a hundred young individuals. In the Chernihiv Oblast, the invasive population of *O. boucheanum* included about 200 individuals, of which only a few were generative (Kritskaya & Novosad, 2001).

## Discussion

During the investigation of locations of *O. boucheanum*, according to our data, it has been established that over the entire time of floristic research in Ukraine, 263 of its natural locations in 13 administrative oblasts were recorded in Ukraine. Most locations of the species are concentrated in the Steppe zone, where the main part of the Eastern European (pynthic) fragment of the general area (Fig. 1) is presented. For other regions of Ukraine are well-known indication of the species.

Consequently, based on the generalization of the public information, the northern boundary of the pynthic fragment of the natural range of *O. boucheanum* passes through the settlements: [Romania] Braila – [Moldova] Giurgiulești – Capaclia – Chișinău – Brănești – Beloci – [Ukraine] Kozatske – Holovanivsk – Pervomaisk – Kropyvnytskyi – Huliahorodok – Pavlivka – Dmytrivka – Poltava – Valky – Kharkiv – Borshchivka – Senkove – Sviatohirsk – Kreminna – Metalist – Pishchane – Valuiske – Provallia – [Russia] Kamensk-Shakhtynskyi – Ust-Donetskyi. The southern boundary of the natural habitat of *O. boucheanum* is through the south-eastern regions of Luhansk and Donetsk oblasts, South of Kherson Oblast and on the littoral zone of the Northwest Black Sea up to the mouth of the Danube. In connection with the fact that some locations of the species have not been confirmed for a long time, the modern area of the species in the Black Sea region, represented by aboriginal populations, slightly decreased in South-Western Bessarabia and in the southern lane of the Forest-Steppe in the area of the lower stream line of the Tiasmyn and the upper stream line of the Siverskyi Donets.

On the other hand, in addition to reduction in the number of natural habitats of *O. boucheanum* within the Forest-Steppe and in the southern part of Polissia of Ukraine, a secondary adventive range of the species is formed, where it is part of the immigration group of foreign taxa – ergasio-phygophytes. *O. boucheanum* is often used in many European countries in landscape gardening and its tendency to naturalization and rewildening



in cultivated areas has been repeatedly noted (Pachosky, 1914; Bordzilovskiy, 1950; Agapova, 1979). Thus, the secondary habitat of the species in Ukraine, as in Central Europe, covers more humid and cooler areas located north of the natural habitat. The northernmost synanthropic habitat of *O. boucheanum* in Eastern Europe was recorded in Russia in Moscow and is also associated with wild plants. Thus, this species north of its natural habitat is in the stage of early naturalization. We assume that due to global warming its synanthropic range will increase.

Currently, in the Ukrainian part of its minor habitat *O. boucheanum* is assigned to an unstable flora element and is an ergasiophytophyte (running wild near the cultivation places), colonophyte (forms local populations in the places of the diaspore) or ephemerophyte (which has occasionally been brought to, and appears temporarily in the flora of a given country or area). There are significant reasons to assume that the potential minor range of the species covers the entire northern and western part of Ukraine and one can expect to identify new invasive effective breeding populations, especially in valleys near large cities.

Natural habitats of *O. boucheanum* are characterized by a certain stenotopy, as the species requires some moisture and is more common in valley and balka landscapes most often in the basins of large rivers, which are not susceptible to drying out and can be favourable eco-corridors for long-distance migration. Favourable conditions for *O. boucheanum* habitats exist in floodplain and riparian forests, which have sufficient moisture, little competition from other species of grass and a sufficient amount of light in the spring. In addition, *O. boucheanum* can successfully master artificial and synanthropic groups of trees, in particular, widespread in the Forest-Steppe and Steppe *Robinia* plantations. Another close species – *O. nutans* – in Western Europe in some places has become an annoying weed (Paczosky, 1914).

*O. boucheanum* populations in Ukraine differ in numbers. In the middle part of the Southern Bug basin and in the valley of the Lower Dnieper there are large populations of 4–6 hectares, in which there are tens and hundreds of thousands of individuals. At the same time, on the northern border of distribution, in Kirovohrad and Kharkiv oblasts small populations of the species are observed, which have a young invasive character. It is possible that modern conditions have been favourable for the *O. boucheanum* distribution in the transition zone between the Forest-Steppe and Steppe and there is a process of formation of new populations of *O. boucheanum*. It is noted that under favourable conditions (in park-type stands and shrubs if there is absence of competition) plants in populations of *O. boucheanum* abundantly reproduce, and the number of individuals may increase rapidly.

Due to the stenotopic nature of the species natural habitats, they need to be protected, especially on the periphery of the natural habitat. The formation and observance of a protected regime, in particular in the shoreline areas of large rivers, may be a favourable factor for increasing the number of existing *O. boucheanum* populations and its further distribution. However, it should be noted that due to the emergence of synanthropic populations of the studied species, they need to be monitored for species expansion outside their natural habitat.

## Conclusion

The natural habitat of *O. boucheanum* in Eastern Europe includes two fragments. The Black Sea area, which covers the South Ukraine, the Northern Pryazovia of Russia, the left bank Transnistria and the south of the Bessarabian part of Moldova; as well as the Central European area, which covers Transcarpathia. Among these three countries, the largest number of localities of *O. boucheanum* was recorded in Ukraine – a total of 263 natural sites, which are concentrated mainly in the Steppe zone, less often in the southern strip of the Forest-Steppe, as well as in Transcarpathia.

Based on the inventory data of known locations of the species, the limits of its natural habitat in Ukraine, Russia and Moldova were drawn. It is noted that in continental Ukraine in the Forest-Steppe and Polissya the minor adventitious natural habitat of *O. boucheanum* is formed, and island synanthropic locations of this species were found in other regions of Eastern Europe. The distribution of this species outside the natural habitat is facilitated by the plant introduction and cultivation. Thus, the researched

species is an example of a rare plant protected in the Red Book of Ukraine (Decree, 2021), but which at the same time expands its synanthropic habitat. In this case, global warming is the basis for assuming that the climatic optimum of *O. boucheanum* is shifting in a northern direction and this will increase the number of its introduced spontaneous colonies in the Forest-Steppe and the Forest zones.

Habitats of *O. boucheanum* are marked by a certain stenotopy and are confined to floodplain, less often riparian forest and meadow groups, in addition, this species successfully masters artificial forest and park plantations and synanthropized forest and shrub groups. Populations of *O. boucheanum* in Ukraine have different numbers, the largest of which are known in the middle part of the Southern Bug basin and lower Dnieper and have an area of 4–6 hectares or more and include tens and hundreds of thousands of individuals, but natural populations on the northern border and invasive populations are mostly local and small. Currently, aboriginal populations of *O. boucheanum* need protection, but outside their natural habitat, it is desirable to control the synanthropic habitats of this species due to the prospects of phytovasions.

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