Flora of Vladimir Oblast, Russia: an updated grid dataset (1867-2020)

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Abstract

Background

The dataset covers wild tracheophytes (native species, naturalised aliens and casuals) of Vladimir Oblast, Russia. It includes only one occurrence per species per grid square, thereby recently confirmed earlier records are not duplicated. Georeferences are based on the WGS84 grid scheme with 342 squares with areas ranging from 94.7 km² in the northernmost part to 98.2 km² on the southern boundary (5’ lat. × 10’ long.). Each occurrence is linked to the corresponding grid square centroid, therefore actual coordinates, habitat details and voucher information are unavailable. In late 2011, the earlier version of the dataset was used for the production of grid maps in the standard "Flora of Vladimir Oblast: checklist and atlas". Additional records, obtained during field excursions of 2012 and 2013, were fully included in the "Flora of Vladimir Oblast: grid data analysis". The stable version of the dataset with 123,054 grid records (as of 1867–2013) was published in GBIF in 2017.

New information

Data obtained in the field during 2014–2020, as well as those extracted from recently published sources, were digitised, structured and finally published in GBIF in April 2021.
The last update added 7,000 new grid records. Currently, "Flora of Vladimir Oblast, Russia: an updated grid dataset (1867–2020)" contains 130,054 unique occurrences of 1,465 vascular plant taxa (species, hybrids, species aggregates) from Vladimir Oblast and tiny parts of the adjacent areas. The average number of grid records has grown over the seven years from 363 to 380 species. The grid occurrences are largely based on the field studies by the author, performed during 1999–2020 (121,737 records), as well as on data extracted from the relevant literature, unpublished sources, herbarium collections and citizen science projects (8,317 records). The taxonomic backbone of the occurrence grid dataset follows the accompanying checklist dataset to ensure correct cross-linking of the names. As of April 2021, the dataset on the Vladimir Oblast flora represents the fourth largest dataset on vascular plants of Russia published in GBIF.

Keywords
vascular plants, dataset, flora, Vladimir Oblast, Russia, occurrence

Introduction
Since 1999, the author has been working on the grid mapping of the Vladimir Oblast flora. The region covers an area of 29,074 km². The oblast was divided into 342 grid squares measuring 5’ lat. x 10’ long. or ca. 9.2 x 10.4 km. Thus, the area of the grid cells slightly increases southwards from 94.7 to 98.2 km² (Fig. 1). Cyrillic letters were used to designate 21 rows from north to south, while numbers were used to indicate the squares within the rows from west to east. The northern border of the northernmost row А follows 56°50’S, while the southern border of the southernmost row Х follows 55°05’S, the western border of the squares Г and Д follows 38°10’E, while the eastern border of the square 328 follows 43°00’E. The grid is available as a supplementary *.kml file (Suppl. material 1) with a copy on Zenodo (https://doi.org/10.5281/zenodo.4724913). The grid is visualised on Google Maps at https://maps.google.com/maps/ms?msid=200284766630468455543.000462414ec0fd70a9c6f&msa=0

Every year, data obtained by the author in the field were imported into the distribution database on the Vladimir Oblast flora (MS Excel spreadsheet). The earlier version of the database supplemented by all available records from the literature and herbarium collections was used to produce maps for the standard "Flora of Vladimir Oblast: checklist and atlas" (Seregin 2012). At the time of map production for the flora in November 2011, the database contained 118,231 records. In 2012–2013, the author continued the grid mapping of the Vladimir Oblast flora. By the end of 2013, the regional flora included 1,399 species of vascular plants (Seregin 2014). The stable version of the dataset with 123,054 grid records (as of 1867–2013) was published in GBIF in November 2017 (Seregin 2021b).
In line with the call for data papers describing datasets from Russia by GBIF, we completely revised the dataset and made the following improvements and amendments:

1. Field data obtained by the author during 2014–2020 and new data published recently in various references were fully integrated into the dataset. New field data were obtained by the author during 77 standard one-day grid square surveys, as well as dozens of occasional field excursions focused on specific plant habitats, communities or species.

2. This update added 7,000 new grid records into the dataset, including records of 26 new species. For at least 11,190 grid records, the date of the last record was updated to show current presence of the species.

3. Three new grid squares were added on the fringes of Vladimir Oblast. The average number of grid records increased within seven years from 363 to 380 species (Table 1).

4. The taxonomic backbone of this occurrence dataset follows Seregin (2014), available in GBIF as a checklist dataset (Seregin 2021c) to ensure correct cross-linking of the names.

5. An aggregation of the records by standard grid square surveys was performed using the "eventID" field of the DarwinCore.

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**Figure 1.** The grid scheme with 342 squares currently used for the floristic surveillance of Vladimir Oblast, Russia (5° lat. x 10° long.).

There were 335 grid squares in the initial scheme (white squares). Subsequently, Seregin (2012) added Л0 and С0, whereas Seregin (2014) added А0 and Д0. In 2018, three grid squares (Б0, Л25 and М22) were included for the better curation of some small areas of Vladimir Oblast outside the regular grid. The squares added during 2011–2018 are shown here in grey.
We amended the dataset on 29 Apr 2021 after a thorough data audit, performed by Dr Robert Mesibov (https://www.datafix.com.au) in line with preparation of the data paper.

As of 19 April 2021, the Vladimir Oblast occurrence dataset on the flora makes the seventh largest dataset on biodiversity of Russia published in GBIF (Table 2) and the fourth largest for vascular plants after Ueda (2021), Seregin (2021a) and Artemov and Egorova (2021). This is the only complete grid dataset for the first-level administrative divisions across Russia, although there are at least three GBIF-mediated datasets based on grid surveys of specific second-level administrative units in Tver, Saratov and Yaroslavl Oblasts of European Russia (Abramova and Volkova 2018, Frontova 2019, Pashkina 2019).

Table 1.
The growth of the dataset during 2011–2020.
The earlier version of the dataset with 118,231 grid records (as of late 2011) was used for the map production in the standard flora (Seregin 2012).

| End of the year | Number of records | Number of grid squares | Average number of records per grid square |
|-----------------|-------------------|------------------------|------------------------------------------|
| 2011            | 118,231           | 337                    | 350.8                                    |
| 2012            | 120,854           | 337                    | 358.6                                    |
| 2013            | 123,049           | 339                    | 363.0                                    |
| 2014            | 124,100           | 339                    | 366.1                                    |
| 2015            | 126,682           | 339                    | 373.7                                    |
| 2016            | 127,245           | 339                    | 375.4                                    |
| 2017            | 127,415           | 339                    | 375.9                                    |
| 2018            | 128,966           | 342                    | 377.1                                    |
| 2020            | 130,073           | 342                    | 380.3                                    |

Table 2.
Top-10 datasets by the number of records on the biodiversity of Russia published in GBIF (as of 19 April 2021).

| Rank | Dataset                                                      | Reference                | Number of records |
|------|-------------------------------------------------------------|--------------------------|-------------------|
| 1    | iNaturalist Research-grade Observations                      | Ueda (2021)              | 1,247,040         |
| 2    | Moscow University Herbarium (MW)                            | Seregin (2021a)          | 659,565           |
| 3    | RU-BIRDS.RU, Birds observations database from Russia and neighbouring regions | Ukolov et al. (2019)  | 433,635           |
| 4    | EOD - eBird Observation Dataset                             | Levatich and Ligocki (2020) | 282,227         |
Amongst the datasets published by the Russian institutions, this occurrence dataset on the flora makes the fourth largest dataset available in GBIF (Table 3*1) and the third largest dataset for vascular plant diversity after Seregin (2021a) and Artemov and Egorova (2021).

Table 3.
Top-10 datasets by the number of records published in GBIF by the Russian institutions (as of 19 April 2021).
Rank | Dataset                           | Reference                              | Number of records |
-----|-----------------------------------|----------------------------------------|-------------------|
9    | Birds and Mammals Collections of the Zoological Museum of M.V. Lomonosov Moscow State University | Lomonosov Moscow State University (2018) | 54,120            |
10   | CRIS dataset                      | Community of CRIS and Melechin (2019)  | 54,054            |

**Project description**

**Title:** Grid mapping of the Vladimir Oblast flora

**Personnel:** Alexey P. Seregin

**Study area description:** Vladimir Oblast is located in Russia, specifically, in the central part of the East European Plain, ca. 100–400 km east of Moscow. It spans ca. 190 km from north to south and ca. 290 km from west to east, covering an area of 29,084 km². The area is situated within the Volga River Basin with altitudes ranging from 67 to 271 m a.s.l.

**Climate:** The mean January temperature is −8.5°C, the mean July temperature is +18.7°C and the mean annual temperature is +4.7°C in the City of Vladimir. The mean annual precipitation level is 555 mm (ranging from 322 mm in 1967 to 783 mm in 2013) with the most precipitation occurring from June to November. Usually, snowcover lasts for 144 days from November to March with an average maximum snowdepth of 41 cm (Anonymous 2021). Continentality is more pronounced along the eastern border of Vladimir Oblast. According to the phenological data for the adjacent Moscow Oblast, the climatic conditions of which are similar to those in Vladimir Oblast, *Tussilago farfara* L. starts blooming on April 13 on average, superseded by *Alnus incana* (L.) Moench, *Daphne mezereum* L. and *Corylus avellana* L. from 16-18 April (Strizhev 1973). However, in the last decades, spring phenological events have been shown to begin earlier as compared to the long-term average values. For instance, *T. farfara* now starts blooming 21 days earlier than a century ago in the City of Kirov (Soloviev 2007).

**Vegetation and floristic divisions:** Vladimir Oblast is situated in the ecotone zone between boreal coniferous and temperate broadleaf (hardwood) forests. Distribution of the forest types within the region is clearly determined by the soil conditions. Both boreal coniferous forests dominated by *Pinus sylvestris* L. and *Picea abies* (L.) H. Karst. on various nutrient-poor substrata and temperate broadleaf forests with *Quercus robur* L., *Tilia cordata* L. and *Ulmus glabra* Huds. on loamy eutrophic soils being the main components of the original (pre-man) vegetation.

Other native plant communities of Vladimir Oblast are peat bogs, xeric meadows on steep slopes and alder stands along smaller streams, as well as meadows, marshes and willow thickets on flood plains. Currently, 29.9% of land is used for agriculture, while 55% is covered by forests (official data).
Floristic divisions of Vladimir Oblast are based on UPGMA cluster analysis of grid data (Fig. 2) (Seregin 2014). This scheme corresponds, to some extent, to landscape divisions. Balakhna Lowland is the most distinct Region with Pyrolo–Pinetea forests and Oxycocco–Sphagnetea peat bogs. Three spatially-separated divisions (Meshchera Lowlands, Nerl District and Lower Oka District) have similar flora and vegetation consisting of Vaccinio–Piceetea boreal coniferous woods and various wetland vegetation.

In contrast, the Oka-Tsna Ridge with similar boreal forests typically lacks species from wetland habitats due to the proximity of limestone. The Klin-Dmitrov Ridge has the most eutrophic conditions and is characterised by the Querco–Fagetea and Galio–Urticetea classes, while, in the adjacent Opolye Querco–Fagetea, woodlands are framed by Trifolio–Geranietea sanguinei communities. The Gorokhovets Ridge and the Oka Plain are covered by Querco–Fagetea woods and xeric meadows with some diagnostic species of the Festuco–Brometea class. The Sudogda Upland is the only Region where both Querco–Fagetea and Vaccinio–Piceetea communities are equally present.
Sampling methods

Study extent: The dataset combines two types of records, namely, field records by the author and data from other sources. The field records collected by the author (121,737 occurrences) were obtained during 594 standard grid surveys. Typically, two surveys were performed in each grid square: (1) a summer survey (between June and September) and an additional (2) spring survey (late April to May). The numbers of grid records, obtained during the most comprehensive one-day standard grid surveys, are given on the map (Fig. 3).

Data extracted from the relevant literature, unpublished sources, herbarium collections and citizen science projects are not massive (8,317 records), since the dataset comprises only the latest records per grid for each species. A short historical overview of the most important sources was published in Russian in Seregin (2012) and Seregin (2014). Additionally, we integrated data from the citizen science project "Flora of Vladimir Oblast" (https://www.inaturalist.org/projects/vladimir-oblast-flora), initiated by the author on iNaturalist as part of the "Flora of Russia" initiative (Seregin et al. 2020). Surprisingly, the number of new grid records from the community was fairly modest. Only 959 occurrences out of 19,239 (as of 29 March 2021) were identified as new grid records, whereas another 200 occurrences accounted for recent confirmations of historical records.

Sampling description: A standard one-day survey began with the preparation of the route using satellite images. It was designed to link known localities of rare species and areas of potential interest. Route planning helps to avoid various delays and fruitless searches. Plants that are difficult to identify in the field were collected for further examination as herbarium specimens. Previously-known localities of rare species were to be revisited.
Usually, a floristic survey of a grid square took one day (6–9 h, sometimes up to 12 h). The track was permanently controlled using GPS in the field. Before 2018, the author used a printed spreadsheet in a field notebook with a list of the most common plants, which comprised about half of the regional flora (Fig. 4). Rarer plants were placed at the end of the list, whereas both species not identified with certainty and those of interest were collected. In 2019 and 2020, field documentation of the flora was performed using a smartphone in line with the "Flora of Russia" initiative (Seregin et al. 2020).

Quality control: During field surveys, we kept a record of 680 most widely distributed species on printed spreadsheets to avoid omissions of common species. Nonetheless, a
map of omissions of the top-100 most recorded species (Fig. 5) suggests that some grid squares were likely under-surveyed. One can see some under-surveyed grid squares on the fringes of Vladimir Oblast (i.e. on the borders of the Region), as well as a few poorly sampled grid squares across the area. A group of red squares on the north-eastern corner shows the Balakhna Lowland (Fig. 2) with unfavourable conditions of nutrient-poor acid habitats, such as extremely dry pine forests on alluvial sands.

**Geographic coverage**

**Description:** Vladimir Oblast, Russia, in its administrative borders and some records from adjacent parts of the grid squares, which are only partly within the Vladimir Oblast borders. During 21 years, the area was evenly sampled, thus the number of recorded species across grid squares gives a good overview of natural patterns, rather than sampling efforts (Fig. 6). Spatial data on the vascular plant flora of Vladimir Oblast were published earlier in the form of 1,370 species distributional maps (Seregin 2012).

![Figure 6](image_url)

Number of records per grid (equalling the number of taxa).

The second book of the series (Seregin 2014) included an analytical part of the survey. A quantitative spatial assessment at various scales, an overview of distributional patterns for common and rare species and spatial analysis of grid distributions led to recognition of the regional chorotypes (i.e. distributional species groups within the Region) and confirmed the presence of ten floristic divisions (Fig. 2).

**Coordinates:** 55 and 57 Latitude; 38 and 43 Longitude.
**Taxonomic coverage**

**Description:** A total of 1,465 vascular plant taxa—largely species, but also hybrids, microspecies, undivided genera and some uncertain species. Table 4 shows the top-100 most widely-distributed species across the grid squares, giving a general overview of the common plant species and communities. The flora of Vladimir Oblast is a typical temperate European flora dominated by some forest, meadow and ruderal species. *Erigeron canadensis* L. with 327 grid records is the most widespread alien species.

Table 4.
Top-100 most recorded species of Vladimir Oblast flora (318+ grid records).

| Rank | Species                                      | Number of grid squares |
|------|----------------------------------------------|------------------------|
| 1    | *Betula pendula* Roth                       | 342                    |
| 2    | *Chamaenerion angustifolium* (L.) Scop.      | 342                    |
| 3    | *Hieracium umbellatum* L.                   | 342                    |
| 4    | *Lysimachia vulgaris* L.                    | 342                    |
| 5    | *Plantago major* L.                         | 342                    |
| 6    | *Populus tremula* L.                        | 342                    |
| 7    | *Sorbus aucuparia* L.                       | 342                    |
| 8    | *Achillea millefolium* L.                   | 341                    |
| 9    | *Calamagrostis epigejos* (L.) Roth           | 341                    |
| 10   | *Deschampsia cespitosa* (L.) P. Beauv.      | 341                    |
| 11   | *Tanacetum vulgare* L.                      | 341                    |
| 12   | *Artemisia vulgaris* L.                     | 340                    |
| 13   | *Polygonum aviculare* L. agg.               | 340                    |
| 14   | *Ranunculus repens* L.                      | 340                    |
| 15   | *Salix cinerea* L.                          | 340                    |
| 16   | *Trifolium repens* L.                       | 340                    |
| 17   | *Angelica sylvestris* L.                    | 339                    |
| 18   | *Equisetum arvense* L.                      | 339                    |
| 19   | *Solidago virgaurea* L.                     | 339                    |
| 20   | *Urtica dioica* L.                          | 339                    |
| 21   | *Galium mollugo* L.                         | 338                    |
| 22   | *Phleum pratense* L.                        | 338                    |
| Rank | Species                              | Number of grid squares |
|------|-------------------------------------|------------------------|
| 23   | *Pinus sylvestris* L.               | 338                    |
| 24   | *Potentilla argentea* L.            | 338                    |
| 25   | *Rubus idaeus* L.                  | 338                    |
| 26   | *Dryopteris carthusiana* (Vill.) H.P. Fuchs | 337                  |
| 27   | *Pimpinella saxifraga* L.           | 337                    |
| 28   | *Poa annua* L.                      | 337                    |
| 29   | *Salix caprea* L.                   | 337                    |
| 30   | *Taraxacum officinale* Wigg. agg.  | 337                    |
| 31   | *Trifolium pratense* L.             | 337                    |
| 32   | *Veronica chamaedrys* L.            | 337                    |
| 33   | *Vicia cracca* L.                   | 337                    |
| 34   | *Chenopodium album* L. agg.        | 336                    |
| 35   | *Convallaria majalis* L.            | 336                    |
| 36   | *Linaria vulgaris* Mill.            | 336                    |
| 37   | *Bromopsis inermis* (Leyss.) Holub  | 335                    |
| 38   | *Festuca rubra* L.                  | 335                    |
| 39   | *Fragaria vesca* L.                | 335                    |
| 40   | *Frangula alnus* Mill.              | 335                    |
| 41   | *Prunella vulgaris* L.              | 335                    |
| 42   | *Cirsium setosum* (Willd.) Besser  | 334                    |
| 43   | *Galium palustre* L.                | 334                    |
| 44   | *Potentilla anserina* L.            | 334                    |
| 45   | *Cerastium holostoides* Fr.         | 333                    |
| 46   | *Knautia arvensis* (L.) Coul.       | 333                    |
| 47   | *Leontodon autumnalis* L.           | 333                    |
| 48   | *Quercus robur* L.                  | 333                    |
| 49   | *Stellaria graminea* L.             | 333                    |
| 50   | *Alisma plantago-aquatica* L.       | 332                    |
| 51   | *Athyrium filix-femina* (L.) Roth   | 331                    |
| 52   | *Hypericum maculatum* Crantz        | 331                    |
| Rank | Species                                      | Number of grid squares |
|------|---------------------------------------------|------------------------|
| 53   | Hypericum perforatum L.                     | 331                    |
| 54   | Elytrigia repens (L.) Desv. ex Nevski       | 330                    |
| 55   | Equisetum sylvaticum L.                     | 330                    |
| 56   | Picea abies (L.) H. Karst.                  | 330                    |
| 57   | Trifolium medium L.                         | 330                    |
| 58   | Tussilago farfara L.                        | 330                    |
| 59   | Anthoxanthum odoratum L.                    | 329                    |
| 60   | Dactylis glomerata L.                       | 329                    |
| 61   | Lemna minor L.                              | 329                    |
| 62   | Rubus saxatilis L.                          | 329                    |
| 63   | Tripleurospermum inodorum (L.) Sch. Bip.    | 329                    |
| 64   | Campanula patula L.                         | 328                    |
| 65   | Scirpus sylvaticus L.                       | 328                    |
| 66   | Anthriscus sylvestris (L.) Hoffm.           | 327                    |
| 67   | Artemisia absinthium L.                     | 327                    |
| 68   | Bidens tripartita L.                        | 327                    |
| 69   | Erigeron canadensis L.                      | 327                    |
| 70   | Filipendula denudata (J. Presl et C. Presl) Fritsch | 327          |
| 71   | Phalaroides arundinacea (L.) Rausch.        | 327                    |
| 72   | Viburnum opulus L.                          | 327                    |
| 73   | Agrostis capillaris L.                      | 326                    |
| 74   | Centaurea jacea L.                          | 325                    |
| 75   | Glechoma hederacea L.                       | 325                    |
| 76   | Heracleum sibiricum L.                      | 325                    |
| 77   | Juncus tenuis Willd.                        | 325                    |
| 78   | Mentha arvensis L.                          | 325                    |
| 79   | Juncus bufonius L.                          | 324                    |
| 80   | Arctium tomentosum Mill.                    | 323                    |
| 81   | Leucanthemum vulgare Lam.                   | 323                    |
| 82   | Poa angustifolia L.                         | 323                    |
| Rank | Species                                  | Number of grid squares |
|------|------------------------------------------|------------------------|
| 83   | *Ranunculus acris* L.                    | 323                    |
| 84   | *Aegopodium podagraria* L.               | 322                    |
| 85   | *Capsella bursa-pastoris* (L.) Medik.    | 322                    |
| 86   | *Malus domestica* Borkh.                 | 322                    |
| 87   | *Prunus padus* L.                        | 322                    |
| 88   | *Rorippa palustris* (L.) Besser         | 322                    |
| 89   | *Viola canina* L.                        | 322                    |
| 90   | *Salix myrsinfolia* Salisb.              | 321                    |
| 91   | *Typha latifolia* L.                     | 321                    |
| 92   | *Alchemilla* L. (multiple species)       | 319                    |
| 93   | *Cirsium vulgare* (Savi) Ten.            | 319                    |
| 94   | *Juncus effusus* L.                      | 319                    |
| 95   | *Lycopus europaeus* L.                   | 319                    |
| 96   | *Vicia sepium* L.                        | 319                    |
| 97   | *Glyceria fluitans* (L.) R. Br.          | 318                    |
| 98   | *Salix triandra* L.                      | 318                    |
| 99   | *Schedonorus pratensis* (Huds.) P. Beauv.| 318                    |
| 100  | *Silene pratensis* (Rafn) Godr. et Gren.| 318                    |

**Taxa included:**

| Rank | Scientific Name   |
|------|-------------------|
|      | phylum            |
|      | Tracheophyta      |

**Temporal coverage**

**Notes:** 01-01-1867 through to 31-01-2021.

The year of observation is clearly indicated in 113,578 grid records (87.3%). Undated records resulted from digitisation of old references and specimen records, as well as from earlier surveys during which an interval instead of a specific date was indicated. As we include only the latest grid records for each species, the number of undated records is permanently decreasing. Merely all dated records (i.e. 112,992) were made during 2000–2020. In 2009, 21,220 grid records were added into the dataset (Fig. 7).
Table 5.
Growth in the number of grid records during the last three years (2017 vs. 2020) across Vladimir Oblast.

Presumable causes of the data growth include true expansion of the alien species across the region; earlier under-recording of species from some habitats (such as alder forests, nutrient-poor meadows, flood plains etc.); life cycle of some orchids when they can be abundant or completely invisible from year to year; or short life cycle of spring plants.

| Species                                      | Cause of the data growth | Records by the end of 2017 | Records by the end of 2020 | New grid records (2017 vs. 2020) |
|----------------------------------------------|--------------------------|----------------------------|----------------------------|----------------------------------|
| *Erigeron septentrionalis* (Fernald et Wiegand) Holub | expansion                | 217                        | 232                        | 15                               |
| *Platanthera bifolia* (L.) Rich.             | orchid’s life cycle      | 185                        | 197                        | 12                               |
| *Epilobium tetragonum* L. agg.               | expansion                | 110                        | 122                        | 12                               |
| *Oenothera biennis* L.                       | expansion                | 31                         | 43                         | 12                               |
| *Anisantha tectorum* (L.) Nevski             | expansion                | 26                         | 38                         | 12                               |
| *Jacobaea vulgaris* Gaertn.                  | expansion                | 223                        | 234                        | 11                               |
| *Cardamine dentata* Schult.                  | earlier under-recording  | 71                         | 82                         | 11                               |
| *Paris quadrifolia* L.                       | earlier under-recording  | 200                        | 210                        | 10                               |
| *Dactylorhiza fuchsii* (Druce) Soó            | orchid’s life cycle      | 161                        | 171                        | 10                               |
| *Dianthus barbatus* L.                       | expansion                | 76                         | 86                         | 10                               |
| *Corydalis solida* (L.) Clairv.              | short life cycle         | 70                         | 80                         | 10                               |
| *Impatiens glandulifera* Royle               | expansion                | 41                         | 51                         | 10                               |
| *Rumex thrysiflorus* Fingerh.                | earlier under-recording  | 271                        | 280                        | 9                                |
| *Sagittaria sagittifolia* L.                 | earlier under-recording  | 172                        | 181                        | 9                                |
| *Lamium album* L.                            | expansion                | 32                         | 41                         | 9                                |
| *Myosotis sylvatica* Ehrh. ex Hoffm.         | expansion                | 13                         | 22                         | 9                                |
Carex elongata L. (Cyperaceae) is used here as an example of a previously under-recorded species to show the recent progress in data collection (Fig. 8). This species was reported from 79 grid squares in the standard flora (Fig. 8a) (Seregin 2012). In Vladimir Oblast, C. elongata is a typical plant of Alnetea glutinosae communities (alder forests), which are extremely inhospitable for a researcher during the spring and summer seasons due to mosquitoes and boggy ground. Therefore, the data on this species were far from complete. Further focused surveying of this habitat during the last decade and expertise in identification of this sedge without fruits helped us to double the number of the known records published in this dataset (Fig. 8f).

By the end of 2017, many biased maps of species grid distributions were updated as a result of extensive field surveys. Thereby, the data collected during the last three years (2018 to 2020) clearly indicate further expansion of invasive or potentially invasive species (Seregin 2010, Seregin 2015). For instance, *Erigeron septentrionalis* (Fernald et Wiegand) Holub, *Epilobium tetragonum* L. agg., *Oenothera biennis* L., *Anisantha tectorum* (L.) Nevski and *Jacobaea vulgaris* Gaertn. are the most rapidly expanding aliens in the last three years (Table 5). Surprisingly, a steady growth of the grid records for common orchids like *Platanthera bifolia* (L.) Rich. and *Dactylorhiza fuchsii* (Druce) Soó is noticeable as well.

Usage licence

**Usage licence:** Other

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Data resources

**Data package title:** Flora of Vladimir Oblast, Russia: an updated grid dataset (1867-2020)

**Resource link:** [https://www.gbif.org/dataset/7af26e9-aad6-47cb-a5bf-de49dc7597a4](https://www.gbif.org/dataset/7af26e9-aad6-47cb-a5bf-de49dc7597a4)
Figure 8.
Progress in the documentation of Carex elongata L. (Cyperaceae) across Vladimir Oblast in the last decade. This is an example of a species from under-recorded habitats with a short flowering/fruiting period.

a: By the end of 2011 (79 grid records). Same data as published in the standard flora (Seregin 2012) [doi]
b: By the end of 2012 (97 grid records) [doi]
c: By the end of 2014 (112 grid records) [doi]
d: By the end of 2015 (130 grid records) [doi]
e: By the end of 2017 (133 grid records) [doi]
f: By the end of 2020 (140 grid records). Current dataset [doi]
Data set name: Flora of Vladimir Oblast, Russia: an updated grid dataset (1867-2020)

Data format: Darwin Core

Description: "Flora of Vladimir Oblast, Russia: an updated grid dataset (1867–2020)" contains 130,054 unique occurrences of 1,465 vascular plant taxa (species, hybrids, aggregates) from Vladimir Oblast and tiny parts of the adjacent areas. The average number of grid records increased in seven years from 363 to 380 species (Seregin 2021b).

The grid occurrences are largely based on the field studies by the author performed in 1999–2020 (121,737 records), as well as on the data extracted from relevant literature, manuscripts, herbarium collections and citizen science projects (8,317 records). An aggregation of the grid records by 342 grid squares was performed using "Event ID" field of the DarwinCore. Taxonomic backbone of the occurrence grid dataset is following Seregin (2014) which is available in GBIF as a checklist dataset (Seregin 2021c) to ensure smooth cross-linking of the names.

As of April 2021, "Flora of Vladimir Oblast, Russia: an updated grid dataset (1867–2020)" is the fourth largest dataset on vascular plants of Russia published via GBIF.

| Column label      | Column description                                                                                                                                                                                                 |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| occurrenceID      | An identifier for the occurrence. A variable constructed from a combination of two identifiers (datasetID and catalogNumber). For example, "urn:lsid:biocol.org:col:15550:02:000001".                                                                 |
| dcterms:type      | The nature or genre of the resource. A constant ("Dataset").                                                                                                                                                           |
| dcterms:modified  | The most recent date-time on which the resource was changed. A constant ("2021-04-16").                                                                                                                                 |
| dcterms:language  | A language of the resource. A constant ("en" = English)                                                                                                                                                                |
| dcterms:license   | A legal document giving official permission to do something with the resource. A constant ("http://creativecommons.org/licenses/by/4.0/legalcode").                                                                     |
| dcterms:rightsHolder | A person or organisation owning or managing rights over the resource. A constant ("Moscow State University").                                                                                                         |
| dcterms:accessRights | Information about who can access the resource or an indication of its security status. A constant ("Use under CC BY 4.0").                                                                                  |
| institutionID     | An identifier for the institution having custody of the object(s) or information referred to in the record. A constant ("http://grbio.org/institution/moscow-state-university" for the Moscow Sate University).                                      |
| collectionID      | An identifier for the collection or dataset from which the record was derived. A constant ("urn:lsid:biocol.org:col:15550" for the Moscow University Herbarium).                                                    |
| datasetID          | An identifier for the set of data. May be a global unique identifier or an identifier specific to a collection or institution. A constant ("urn:lsid:biocol.org:col:15550:02"). |
|-------------------|--------------------------------------------------------------------------------------------------|
| institutionCode   | The name (or acronym) in use by the institution having custody of the object(s) or information referred to in the record. A constant ("Moscow State University"). |
| collectionCode    | The name, acronym, coden or initialism identifying the collection or dataset from which the record was derived. A constant ("MW" for the Moscow University Herbarium). |
| datasetName       | The name identifying the dataset from which the record was derived. A constant ("Flora of Vladimir Oblast, Russia: an updated grid dataset (1867-2020)"). |
| ownerInstitutionCode | The name (or acronym) in use by the institution having ownership of the object(s) or information referred to in the record. A constant ("Moscow State University"). |
| basisOfRecord     | The specific nature of the data record - a subtype of the dcterms:type. A variable (three terms: "Literature", "PreservedSpecimen", "HumanObservation" before translation). "Literature" was translated as "HumanObservation" following Darwin Core Type Vocabulary. |
| informationWithheld | Additional information that exists, but that has not been shared in the given record. A constant ("Occurrence is placed in the grid square centroid; real coordinates, habitat details and voucher information (if present) are obscured.") |
| dataGeneralizations | Actions taken to make the shared data less specific or complete than in its original form. A constant ("Occurrence is placed in the grid square (5.0′ lat. x 10.0′ long.) centroid. Only one record per grid per taxon is included in the dataset (normally, the latest one."). |
| catalogNumber     | An identifier (preferably unique) for the record within the dataset or collection. A variable. For example, "000001". |
| recordedBy        | A list (concatenated and separated) of names of people, groups or organisations responsible for recording the original occurrence. A variable. |
| occurrenceStatus  | A statement about the presence or absence of a taxon at a location. A constant ("present"). |
| associatedReferences | A list (concatenated and separated) of identifiers (publication, bibliographic reference, global unique identifier, URI) of literature associated with the Occurrence. A constant ("Seregin, A.P. assisted by Borovichev, E.A., Glazunova, K.P., Kokoshnikova, Y.S. and Sennikov, A.N. (2012): Flora of Vladimir Oblast, Russia: checklist and atlas. Tula. Grif i K. 620 pp. (in Russian, with English abstract). http://dx.doi.org/10.13140/RG.2.1.4544.5122/1"). |
| eventID           | An identifier for the set of information associated with an event. A variable constructed from a combination of three identifiers (grid square index from verbatimLocality, eventDate and initials of the recordedBy person). For example, "H3/2004-10-23/APS". |
| **year** | The four-digit year in which the event occurred, according to the Common Era Calendar. A variable. |
| **month** | The ordinal month in which the event occurred. A variable. |
| **day** | The integer day of the month on which the event occurred. A variable. |
| **eventDate** | The date or interval during which an event occurred. For occurrences, this is the date when the event was recorded. A variable. |
| **eventRemarks** | Comments or notes about the event. A variable (three options: "Standard survey period 1867-1949", "Standard survey period 1950-1999", "Standard survey period 2000-2020"). |
| **higherGeography** | A list (concatenated and separated) of geographic names less specific than the information captured in the locality term. A constant ("Europe | Russian Federation | Vladimir Oblast"). |
| **continent** | The name of the continent in which the location occurs. A constant ("Europe"). |
| **country** | The name of the country or major administrative unit in which the location occurs. A constant ("Russian Federation"). |
| **countryCode** | The standard code for the country in which the location occurs. A constant ("RU"). |
| **stateProvince** | The name of the next smaller administrative region than country (state, province, canton, department, region etc.) in which the location occurs. A constant ("Vladimir Oblast"). |
| **verbatimLocality** | The original textual description of the place. A variable with grid square index. For example, "Grid square E17". |
| **locationAccordingTo** | Information about the source of this location information. Could be a publication (gazetteer), institution or team of individuals. A constant ("Seregin, A.P. assisted by Borovichev, E.A., Glazunova, K.P., Kokoshnikova, Y.S. and Sennikov, A.N. (2012): Flora of Vladimir Oblast, Russia: checklist and atlas. Tula. Grif i K. 620 pp. (in Russian, with English abstract). http://dx.doi.org/10.13140/RG.2.1.4544.5122/1"). |
| **decimalLatitude** | The geographic latitude (in decimal degrees, using the spatial reference system given in geodeticDatum) of the geographic centre of a location. A variable (latitude of a grid square centroid). |
| **decimalLongitude** | The geographic longitude (in decimal degrees, using the spatial reference system given in geodeticDatum) of the geographic centre of a location. A variable (longitude of a grid square centroid). |
| **geodeticDatum** | The ellipsoid, geodetic datum or spatial reference system (SRS) upon which the geographic coordinates given in decimalLatitude and decimalLongitude are based. A constant ("WGS84"). |
coordinateUncertaintyInMeters  The horizontal distance (in metres) from the given decimalLatitude and
decimalLongitude describing the smallest circle containing the whole of the
location. A constant ("7000" or an average distance between a grid square centroid
and a grid square corner).

georeferencedBy  A list (concatenated and separated) of names of people, groups or organisations
who determined the georeference (spatial representation) of the location. A
constant ("Alexey P. Seregin").

identifiedBy  A list (concatenated and separated) of names of people, groups or organisations
who assigned the Taxon to the subject. A variable (for example, "Alexey P.
Seregin").

scientificName  The full scientific name, with authorship and date information, if known. A variable
(for example, "Diphasiastrum complanatum (L.) Holub").

kingdom  The full scientific name of the kingdom in which the taxon is classified. A constant
("Plantae").

phylum  The full scientific name of the phylum or division in which the taxon is classified. A
constant ("Tracheophyta").

genus  The full scientific name of the genus in which the taxon is classified. A variable (for
example, "Diphasiastrum").

taxonRank  The taxonomic rank of the most specific name in the scientificName. A variable
(three options: "Species", "Genus", "Variety").

nomenclaturalCode  The nomenclatural code (or codes in the case of an ambiregnal name) under
which the scientificName is constructed. A constant ("International Code of
Nomenclature for algae, fungi and plants").

taxonomicStatus  The status of the use of the scientificName as a label for a taxon. A constant
("accepted"). The taxonomy is linked to a checklist dataset (https://doi.org/
10.15468/7zk2y5) that defines the concept.

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Author contributions

All stages of the work were performed by Dr. A.P. Seregin.
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Supplementary material

Suppl. material 1: A grid scheme used for "Flora of Vladimir Oblast, Russia" dataset

Authors: A.P. Seregin
Data type: shapefile of the grid (*.kml)
Brief description: A grid scheme (*.kml file) used for georeferences in the "Flora of Vladimir Oblast, Russia: an updated grid dataset (1867–2020)" (https://doi.org/10.15468/hoafrr). It is based on the WGS84 datum with 342 squares with areas ranging from 94.7 km² in the northernmost part to 98.2 km² on the southern boundary (5' lat. × 10' long.). Each occurrence is linked to the corresponding grid square centroid. Cyrillic letters were used to designate 21 rows from north to south, while numbers were used to indicate the squares within the rows from west to east. The northern border of the northernmost row А follows 56°50'N, while the southern border of the southernmost row Х follows 55°05'N, the western border of the squares Г1 and Д0 follows 38°10'E, while the eastern border of the square З28 follows 43°00'E.
This file is also available on Zenodo (https://doi.org/10.5281/zenodo.4724913).
An earlier version of the grid is available on Google Maps as a kml file at https://maps.google.com/maps/ms?msid=200284766630468455543.000462414ec0fd70a9c6f&msa=0
Download file (188.60 kb)

Endnotes

*1 eBird dataset (Levatch and Ligocki 2020) partly attributed to Russia is excluded.