Distributions of vascular plants in the Czech Republic. Part 2

Rozšíření cévnatých rostlin v České republice. Část 2

Zdeněk Kaplan[1], Jiří Danihelka[1, 2], Jitka Štěpánková[1], Libor Ekrt[3], Jindřich Chrtek Jr.[1], Jiří Zázvorka[1], Vít Grulich[2], Radomír Řepka[4], Jan Prančl[1, 5], Michal Ducháček[6], Pavel Kúr[3], Kateřina Šumberová[1] & Josef Brůna[1]

[1]*Institute of Botany, The Czech Academy of Sciences, CZ-252 43 Průhonice, Czech Republic, e-mail: kaplan@ibot.cas.cz, stepankova@ibot.cas.cz, chrtek@ibot.cas.cz, zazvorka @ibot.cas.cz, hroudova@ibot.cas.cz, prancl@ibot.cas.cz, katerina.sumberova@ibot.cas.cz, bruna@ibot.cas.cz;* [2]*Department of Botany and Zoology, Masaryk University, Kotlářská 2, CZ-611 37 Brno, Czech Republic, e-mail: danihel@sci.muni.cz, grulich@sci.muni.cz;* [3] *Department of Botany, Faculty of Science, University of South Bohemia, Branišovská 1760, CZ-370 05 České Budějovice, Czech Republic, email: libor.ekrt@gmail.com, pavel.kur@prf.jcu.cz;* [4]*Department of Forest Botany, Dendrology and Geobiocenology, Faculty of Forestry and Wood Technology, Mendel University, Zemědělská 3, CZ-613 00 Brno, Czech Republic, e-mail: repka@mendelu.cz;* [5]*Department of Botany, Faculty of Science, Charles University in Prague, Benátská 2, CZ-128 01 Prague, Czech Republic;* [6]*Department of Botany, National Museum, Cirkusová 1740, CZ-193 00 Praha 9-Horní Počernice, Czech Republic, e-mail: duchace@seznam.cz*

Kaplan Z., Danihelka J., Štěpánková J., Ekrt L., Chrtek J. Jr., Zázvorka J., Grulich V., Řepka R., Prančl J., Ducháček M., Kúr P., Šumberová K. & Brůna J. (2016): Distributions of vascular plants in the Czech Republic. Part 2. – Preslia 88: 229–322.

The second part of the publication series on the distributions of vascular plants in the Czech Republic includes grid maps of 87 taxa of the genera *Antennaria*, *Aposeris*, *Astragalus*, *Avenula*, *Bidens*, *Carex*, *Cenchrus*, *Centunculus*, *Convallaria*, *Crocus*, *Cryptogramma*, *Cyperus*, *Dryopteris*, *Gladiolus*, *Gratiola*, *Helictochloa*, *Hierochloë*, *Lindernia*, *Maianthemum*, *Myriophyllum*, *Nothoalaena*, *Nymphoides*, *Radiola*, *Schoenoplectus*, *Sisyrinchium*, *Spergularia*, *Tillaea*, *Veratrum* and *Veronica*. The maps were produced by taxonomic experts based on all available herbarium, literature and field records. The plants studied include 56 taxa registered in the Red List of vascular plants of the Czech Republic, some of which showed remarkable declines. *Astragalus arenarius*, *Hierochloë odorata* and *H. repens*, as representatives of vegetation of inland sand dunes, are critically threatened due to conversion of their habitats to arable land, local sand mining, afforestation, changes in landscape management and eutrophication followed by succession. Each of them survives at a few localities and their populations are poor. Competitively weak wetland annuals, confined to open habitats such as exposed fishpond littorals and river beds, abandoned sand-pits and wet arable fields, have considerably declined and disappeared from large areas as a result of agriculture and fish-farming intensification, in particular fertilization and restriction of summer drainage of fishponds, and other changes in land-use. These include *Centunculus minimus*, *Cyperus flavescens*, *C. michelianus*, *Lindernia procumbens*, *Radiola linoides* and *Tillaea aquatica*. Observed recently at a few sites only, they are all classified as critically threatened. A map is for the first time provided also for *Spergularia kurkae*, a newly recognized species and a central-European endemic. *Astragalus asper*, *Schoenoplectus supinus* and *Veronica pumila* are now extirpated from the country's flora. In contrast, *Spergularia marina*, until recently confined to natural saline habitats and very rare, has been spreading along roads that are treated by de-icing salts. Examination of an old herbarium voucher showed that the only record of *Astragalus alopecuroides* in the Czech flora actually refers to the species whose correct name is *A. alopecurus*.

Further introduced casuals mapped in this paper include *Bidens pilosus*, *Cenchrus echinatus*, *Gratiola neglecta* and *Lindernia dubia*, each introduced to only a few sites. *Bidens connatus* was recorded at two dozen sites and appears to have spread as a consequence of the great floods in 2002. Typical examples of naturalized neophytes are *Veronica filiformis* and *V. peregrina*, both currently known from many parts of the country. Invasive aliens are represented by *Bidens frondosus*, which began to spread in the 1930s and now is frequent throughout the country. Spatial and temporal dynamics of individual species are shown in maps and documented by records included in the Pladias database and available in Electronic appendices. The maps are accompanied by comments, which include additional information on distribution, habitats, taxonomy and biology of the species.

K e y w o r d s: alien species, central Europe, chorology, Czech Republic, distribution atlas, distribution patterns, endangered species, endemic, flora, grid maps, herbaria, phytogeography, plant record, vascular plants

Introduction

A recent review on the Czech flora (Kaplan 2012) emphasized that no comprehensive piece of work with distribution maps in this country is available in spite of a long history of botanical research. The project of mapping plant distributions in the Czech Republic was launched two years ago with the aim to establish a modern plant record database and to prepare the first sets of distribution maps as a basis for a future complete atlas of the distribution of vascular plants in the Czech Republic. The first results of our effort were published a half year ago (Kaplan et al. 2015) within the PLADIAS project (www.pladias.org). The paper contained 75 grid distribution maps produced by taxonomic experts and based on critically evaluated and sorted records.

From September 2015 to February 2016 the plant record database has increased by ca 154,000 new records. Of these about 45,000 records resulted from critical examination of herbarium specimens by taxonomic experts. Maps of further 87 taxa, both native and alien, were finished at the beginning of February 2016 and these are published in this paper.

Current revisions of national plant diversity have brought several species new to the flora of the Czech Republic, which include both newly recognized native endemics (Kolář et al. 2015, Lepší et al. 2015) as well as recently introduced alien species (Kocián 2014, Hadinec & Lustyk 2015). Two changes in identification and nomenclature involve genera dealt with in this paper, which require an update of the checklist of vascular plants of the Czech Republic (Danihelka et al. 2012). Examination of an old herbarium voucher and the nomenclatural history of the respective plant group showed that the only record on the casual occurrence of *Astragalus alopecuroides* in the Czech flora actually refers to the species whose correct name is *A. alopecurus*. The name *Crocus albiflorus* has to be replaced by *C. vernus*, which was shown to be the correct name for the species largely known as *C. albiflorus* (Peruzzi et al. 2013).

Materials and methods

Taxonomic scope

The following groups of vascular plants are mapped: native taxa, naturalized aliens and most casuals, and selected hybrids. Distribution maps are produced for species and sub-

species, in exceptional cases also for varieties or infrageneric taxa (e.g. sections). Plants of species groups that are difficult to assign to species may be mapped as species aggregates. Field crops and plants deliberately cultivated in gardens and parks are not included in the mapping project. Nomenclature, taxonomic concepts and delimitation of species aggregates mostly follow Danihelka et al. (2012), with differences indicated where necessary. For taxa not included in that checklist, a taxonomic reference is given. Publication of maps does not follow any alphabetical or systematic order but those maps that have resulted from recent revisions are preferably printed.

Data sources

All relevant floristic data sources are used. Major national herbaria and some local and foreign collections were consulted, incl. BRA, BRNL, BRNM, BRNU, CB, CBFS, CESK, CHOM, FMM, GM, HOMP, HR, KHMS, LIM, LIT, MJ, MMI, MP, MZ, NJM, OH, OL, OLM, OMJ, OP, OSM, OSTR, OVMB, PL, PR, PRA, PRC, ROZ, SAV, SLO, SOB, SOKO, SUM, VM, VYM, W, WU and ZMT (acronyms follow Thiers 2016), as the main source of taxonomically revised records. Most records for maps of common and easy-to-identify taxa come from the recently developed Pladias database (hosted at the Institute of Botany, Průhonice; previously tentatively named CzechDistrib database), which has integrated all available records on the distribution of vascular plants in the Czech Republic. Among the most important incorporated databases are the Database of the Distribution of Vascular Plants in the Czech Republic (FLDOK), the Czech National Phytosociological Database (CNPD), plant records from the Floristic Summer Schools and other activities of the Czech Botanical Society, the Species Occurrence Database of the Nature Conservation Agency of the Czech Republic (NDOP) and the Database of Forest Typology of the Forest Management Institute of the Czech Republic (DLT). Unpublished field records previously entered into the Pladias database by the authors of maps or regional contributors were also considered.

Procedure of mapping

All records used for mapping are entered into the Pladias database and geographically sorted according to the traditionally used CEBA (Central European Basic Area) grid template (Niklfeld 1999) divided into quadrants of 5 × 3 arc minutes (corresponding to approximately 5.5 × 5.9 km). The territory of the Czech Republic is covered by 2551 quadrants, of which 2181 are completely within the border of the country. Individual records as well as the whole distribution pattern of each taxon are checked and evaluated by the author of a particular map in a web-based mapping interface of the Pladias database. Because maps of taxonomically critical groups are often highly inaccurate in distribution atlases (Gregor 2009), maps of such taxa are based solely or mainly on herbarium records revised by taxonomic experts; these cases are indicated in the text accompanying the particular map. Maps of all other taxa are based on records from databases, literature and herbaria, which were scrutinized by the authors of the respective maps. Records used for producing maps are listed in Electronic Appendices 1–87. In selected maps, native versus introduced occurrences are distinguished and corresponding records in the database classified accordingly. Draft distribution maps and the background records are released in a web-based review process for scrutiny to field botanists, regional collabora-

tors and members of the Czech Botanical Society. Their comments and additional records are collected in the database and returned to the responsible specialists for consideration before producing final distribution maps.

Final maps and comments

The treatment of each taxon consists of a grid distribution map and of an accompanying text; authors of maps are indicated in the figure captions, and they also took major part in preparing the first drafts of the respective texts. Maps are displayed using spherical Mercator projection (EPSG:3857) where meridians and parallels are shown perpendicular, and the mapping CEBA grids are thus nicely displayed. The background relief was derived from the SRTM data (http://www2.jpl.nasa.gov/srtm/, the version provided by http://srtm.csi.cgiar.org), and the river network was adapted from data provided by CENIA (www.cenia.cz). When appropriate, different symbols are used in the maps in order to distinguish one of the following attributes of the plant distribution records: (1) recent versus old records, (2) native occurrences versus introductions, or (3) records based on revised herbarium specimens versus all other records. These classifications of records are used only for those taxa where such distinction provides important information and, in addition, the amount and quality of records are sufficient. The mapping symbols used to indicate the different attributes of the records in the particular grid cell are shown in Table 1. Symbols specific to individual maps are explained in their captions. In the caption to each map, counts of occupied quadrants are indicated according to the symbols used in the map; uncertain occurrences are not included in the counts. The accompanying text includes the accepted scientific name, a brief outline of the total distribution, information on habitats occupied by the species and a description of its distribution in the Czech Republic. Where appropriate, comments on the taxonomy, biology and details of the spatial and temporal dynamics of the distribution are given.

Table 1. – The mapping symbols used in the distribution maps to indicate the different attributes of the occurrence in a particular grid cell.

Attribute distinguished	Symbol	Attribute state
None	●	all records
Time	●	recent occurrence (at least one record since 2000)
	○	old occurrence (all records before 2000, or demonstrably being extirpated from all localities after 2000, or all records undated)
Origin	●	native (at least one record)
	×	alien
Source data	●	a revised herbarium specimen (at least one record)
	▲	all other
All	?	only record(s) uncertain regarding identification and/or locality

Distribution maps and comments

Antennaria dioica (Fig. 1)

Antennaria dioica is a boreo-temperate species occurring throughout the temperate zone of Eurasia as far as Japan; in North America it is confined to the western Aleutian Islands. It is found in most of Europe except the Iberian Peninsula, southern Italy and the Balkan Peninsula, where it is scattered; it is absent from the Mediterranean islands (Meusel & Jäger 1992, Bayer 2000, Greuter 2006). In Europe *A. dioica* is a species characteristic of slightly buffered soils with pH 4.5–6.0 (van den Berg et al. 2005). In the Czech Republic it grows on nutrient-poor soils in dry pastures, heathlands, on well-drained mountain slopes and rock edges, in pine forests and other types of rather acidophilous forests with open canopy. It is distributed throughout the country from the lowlands to the mountains, where it is more frequent. In contrast, it is markedly less frequent in dry deforested parts of north-western, central and eastern Bohemia. In Moravia it is absent from the dry and warm lowlands with prevailing arable land and usually with base- and nutrient-rich soils. It has recently disappeared from many sites, particularly in lowlands, as a result of the abandonment of pastures, increasing canopy closure in forests and atmospheric deposition of sulphate and inorganic nitrogen (van den Berg et al. 2005, Chytrý 2007a). *Antennaria dioica* is classified as endangered (Grulich 2012).

Aposeris foetida (Fig. 2)

Aposeris foetida has a small distribution range situated in central and south-eastern Europe. It occurs in most of the calcareous parts of the Alps, and is scattered throughout the Carpathians and the mountains of the north-western Balkan Peninsula (Meusel & Jäger 1992). In the Czech Republic *A. foetida* usually grows in beech and oak-hornbeam forests on flysch sediments. It has been only recorded from several localities in the Bílé Karpaty Mts around the Brumov-Bylnice village where it was discovered as late as in 1922 by S. Staněk. It used to be also rarely grown as an ornamental in château parks, sometimes surviving there for a long time. It is classified as critically threatened (Grulich 2012).

Astragalus alopecurus (Fig. 3)

Astragalus alopecurus, described from the Southern Ural Mts, has a large fragmented distribution range, mainly in the mountains of the temperate zone of western and central Siberia, Kazakhstan and north-western China. It is also found in the Caucasus Mts and Anatolia, as well as in the Rodopi Mts. in Bulgaria and the Western Alps in France and Italy (Vydrina 1994, Podlech & Zarre 2013). In the Czech Republic it was collected at a single site, namely in the Prokopské údolí valley west of the village of Hlubočepy in the south-western outskirts of the city of Prague by L. J. Čelakovský in June 1872. He correctly identified the specimen as a "Russian-Siberian" plant and published his find as *A. alopecuroides* (Čelakovský 1875: 675), which was the name then in current use (see the synonymy in Podlech & Zarre 2013). More than a century later the Linnaean name *A. alopecuroides* was typified by D. Podlech (in Turland & Jarvis 1997: 463) with a specimen collected in Spain that is attributable to a different species native to south-western Europe and northern Africa. The typification remained unnoticed by Czech botanists,

and the single record from Bohemia was further referred to as *A. alopecuroides* (e.g. Pyšek et al. 2012b). We examined the voucher specimen (preserved at PR) using a modern monograph (Podlech & Zarre 2013) and confirmed Čelakovský's identification, with the correct name being now *A. alopecurus*. The specimen's label describes the habitat as "in a slope below rocks behind the mill" (we assume he referred to Dalejský mlýn). The species was either deliberately planted or sown (it was rarely cultivated due to its peculiar habit) or accidentally introduced with cereals. Čelakovský harvested the single specimen for his herbarium and, as he noted (Čelakovský 1875: 675), the plant was no longer present at the site in the following year.

Astragalus arenarius (Fig. 4)

The more or less continuous distribution range of *Astragalus arenarius* includes north-eastern Germany east of the Elbe river, Poland, Belorussia, northern Ukraine and northern-central part of the European Russia. It occurs also near the Baltic coast of Latvia and Lithuania, in southern Sweden and Finland; rather isolated occurrences are found in the Czech Republic and the German province of Bavaria (Meusel et al. 1965, Podlech & Zarre 2013). The populations in eastern, eastern-central and northern Bohemia are situated on the south-western border of its distribution range. In this area *A. arenarius* is considered a relict from late glacial or early postglacial ages and its origin is associated with the Sarmatian migration route (Kaplan 2012). Most of the Czech populations are found in open vegetation of inland sand dunes dominated by the perennial tussock-forming grass *Corynephorus canescens*, developed on acidic sand that is free of calcium carbonate (Chytrý & Sádlo 2007). At one of its sites the species temporarily colonized an edge of the gravel embankment of the adjacent railway soon after its rebuilding. *Astragalus arenarius* used to be found at 14–17 sites in the surroundings of the town of Doksy in northern Bohemia, in the Labe river basin in central and eastern Bohemia, and in the Divoká Orlice and Tichá Orlice rivers basin in eastern Bohemia. Most of these populations disappeared in late 19th century or during the first half the 20th century as a result of direct habitat destruction, including conversion to arable land, local sand mining, afforestation, abandonment of pastures and eutrophication followed by succession. Currently it survives at only 4 sites. They host poor populations, which have declined during the last decades and have consisted of one individual to several dozen individuals during recent years. It is therefore currently classified as critically threatened (Grulich 2012).

Astragalus asper (Fig. 5)

Astragalus asper is distributed in eastern Austria, south-western Slovakia, Hungary, northern Croatia, northern Serbia, Romania, Bulgaria, Ukraine and the southern part of European Russia, in the east reaching the lower Volga river (Meusel et al. 1965, Podlech & Zarre 2013). It used to be found also at two sites in the south-eastern part of the Czech Republic near the towns of Klobouky u Brna and Čejč about 35 km SE of Brno. It was discovered there by A. Makowsky in 1859 (Podlech & Zarre 2013: 1862) and last collected by J. Otruba in 1930. It may be assumed that all native populations, representing the north-westernmost outpost of the species' range, were destroyed before World War II. Based on rather general information on herbarium labels, it may have been found there in semi-ruderal dry grasslands and meadows. In 1993 *A. asper* was collected by Č. Deyl

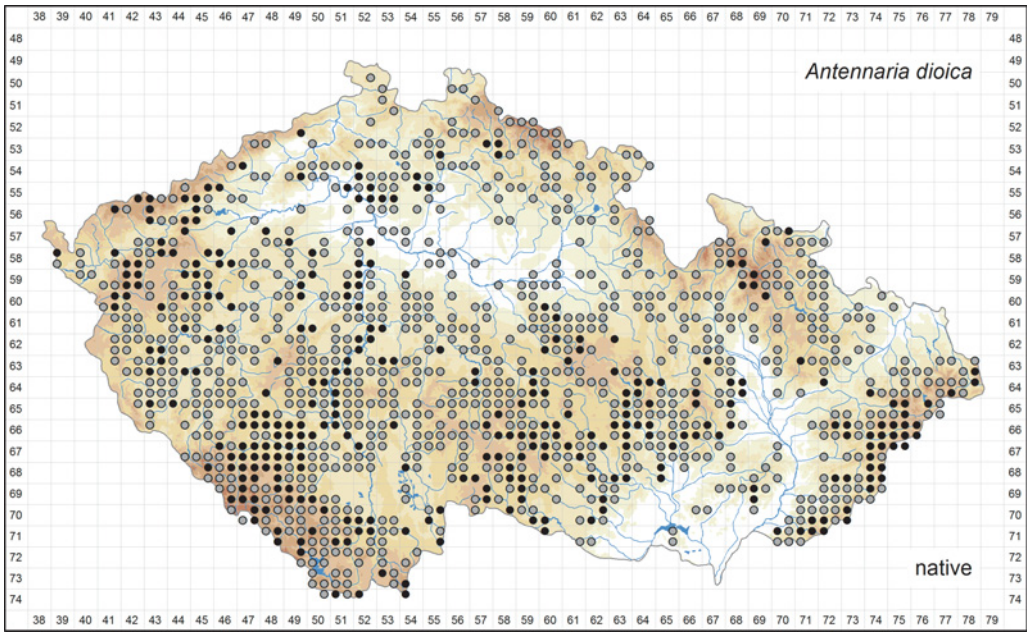


Fig. 1. – Distribution of *Antennaria dioica* in the Czech Republic: ● at least one record in 2000–2016 (319 quadrants), ● pre 2000 records only (842 quadrants). Prepared by Jitka Štěpánková.

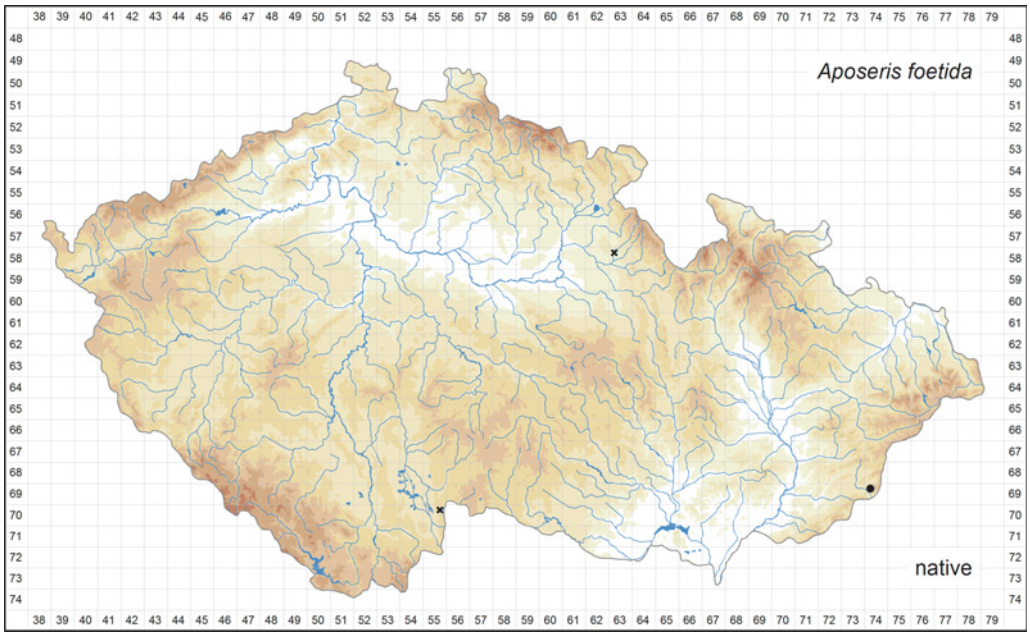


Fig. 2. – Distribution of *Aposeris foetida* in the Czech Republic: ● native (1 quadrant), × alien (2 quadrants). Prepared by Jitka Štěpánková.

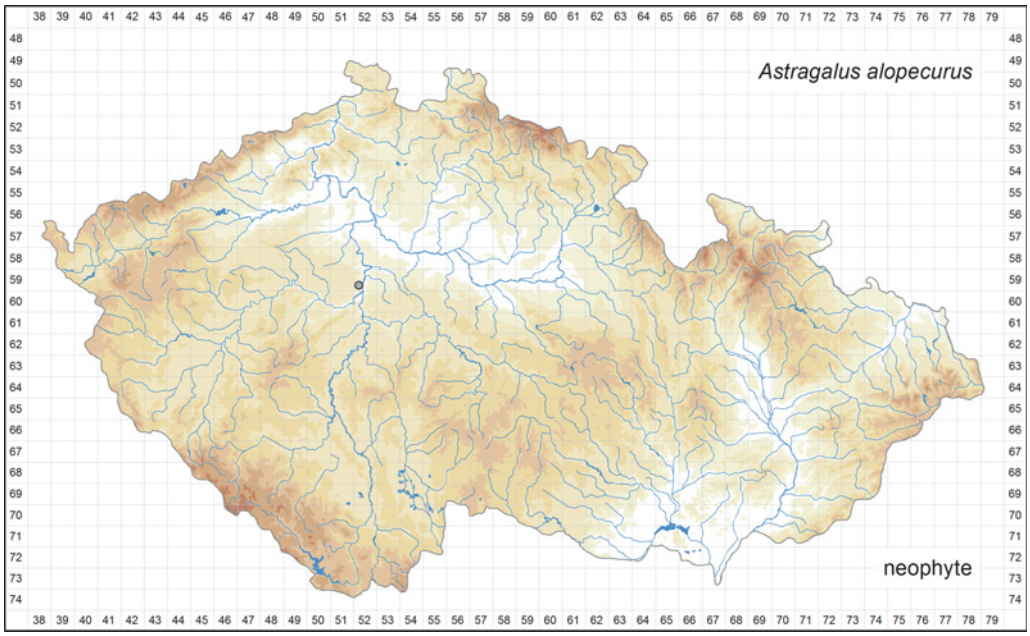


Fig. 3. – Distribution of *Astragalus alopecurus* in the Czech Republic (1 occupied quadrant). Prepared by Zdeněk Kaplan & Jiří Danihelka.

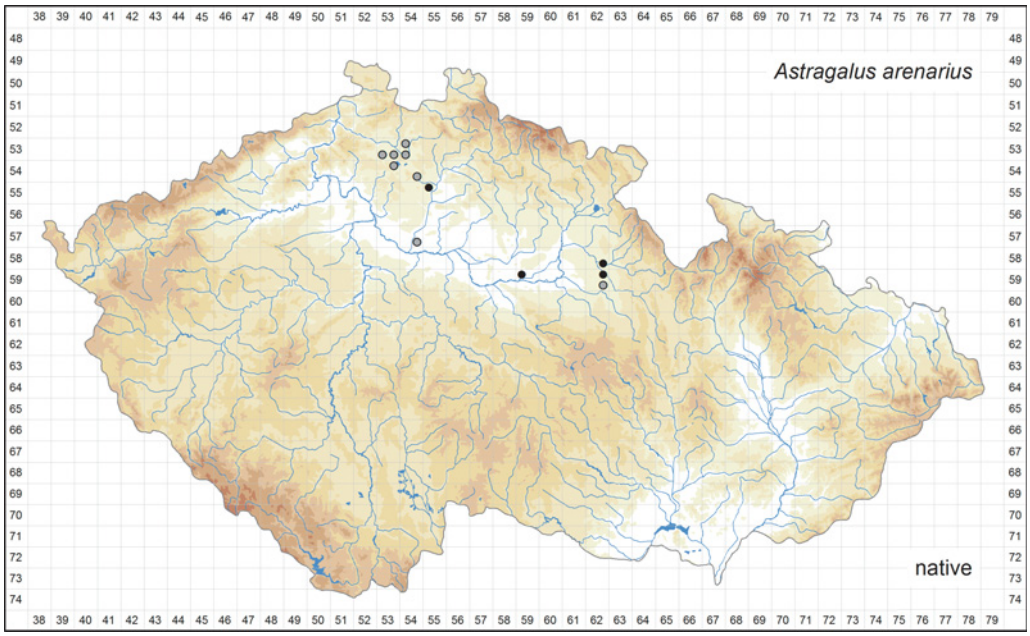


Fig. 4. – Distribution of *Astragalus arenarius* in the Czech Republic: ● at least one record in 2000–2016 (4 quadrants), ◍ pre 2000 records only (8 quadrants). Prepared by Zdeněk Kaplan & Jiří Danihelka.

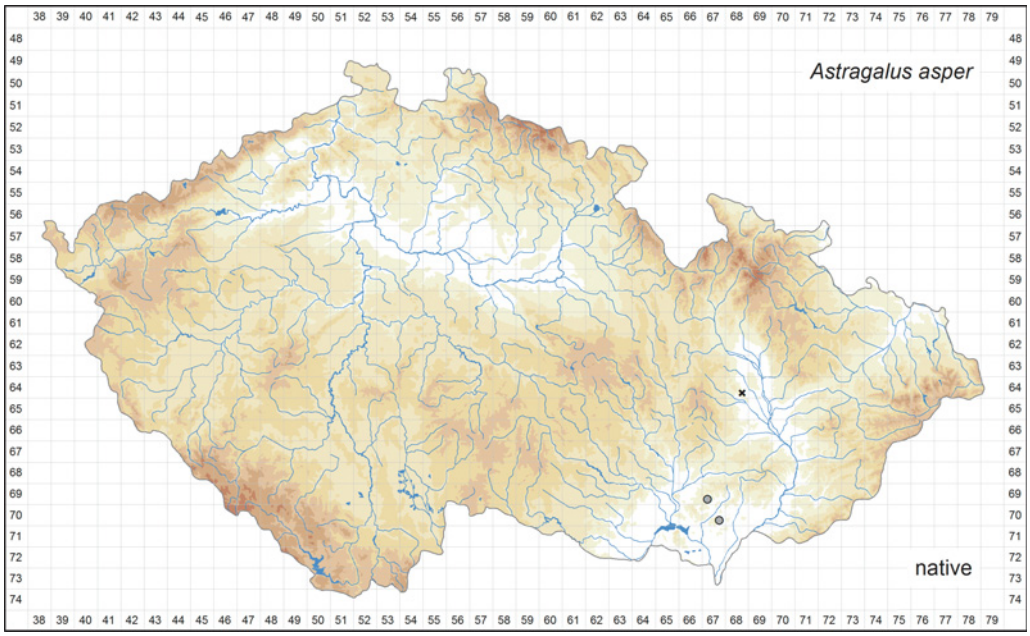


Fig. 5. – Distribution of *Astragalus asper* in the Czech Republic: ◍ pre 2000 native records (2 quadrants), × pre 2000 alien records (1 quadrant). Prepared by Zdeněk Kaplan & Jiří Danihelka.

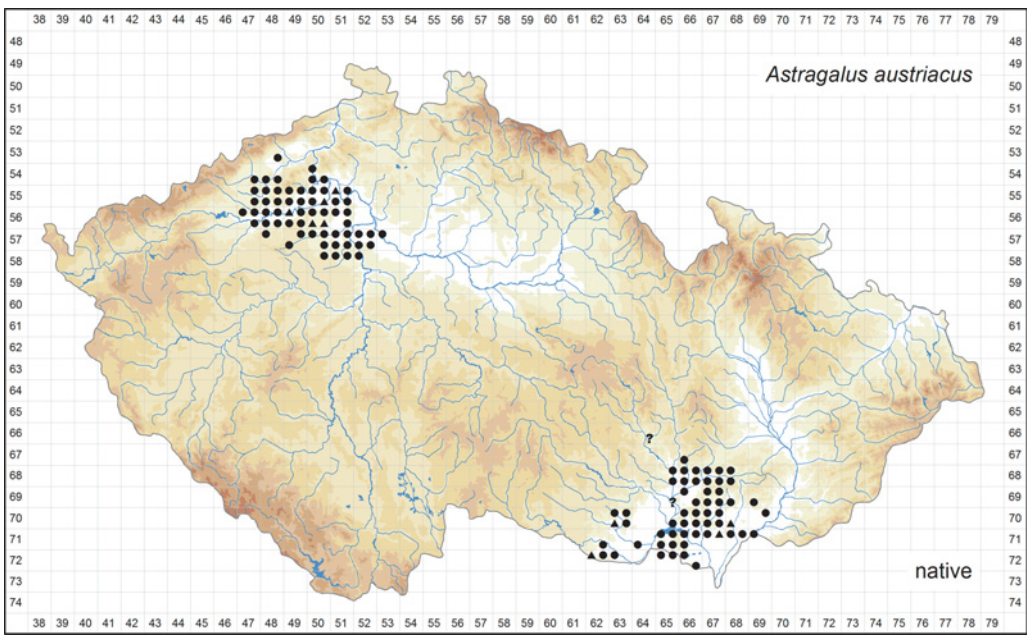


Fig. 6. – Distribution of *Astragalus austriacus* in the Czech Republic: ● occurrence documented by herbarium specimens (110 quadrants), ▲ occurrence based on other records (9 quadrants). Prepared by Zdeněk Kaplan & Jiří Danihelka.

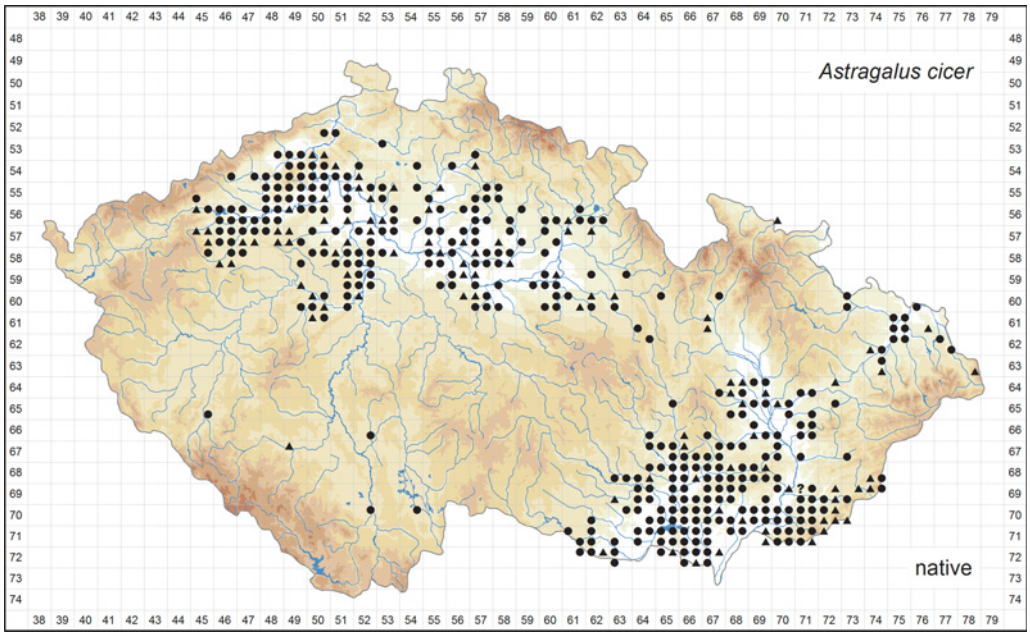


Fig. 7. – Distribution of *Astragalus cicer* in the Czech Republic: ● occurrence documented by herbarium specimens (335 quadrants), ▲ occurrence based on other records (100 quadrants). Prepared by Zdeněk Kaplan & Jiří Danihelka.

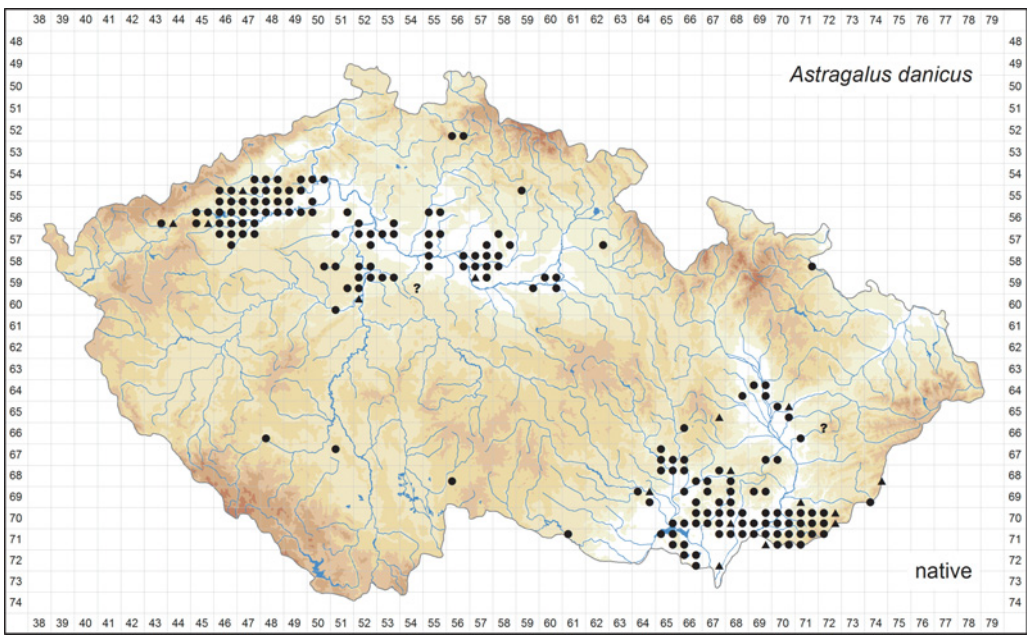


Fig. 8. – Distribution of *Astragalus danicus* in the Czech Republic: ● occurrence documented by herbarium specimens (171 quadrants), ▲ occurrence based on other records (16 quadrants). Prepared by Zdeněk Kaplan & Jiří Danihelka.

on a grassy slope above the railway near the village of Kaple in central Moravia north of the town of Prostějov. It was probably accidentally introduced to that site, and the population no longer exists. The species is currently classified as extinct (Grulich 2012).

Astragalus austriacus (Fig. 6)

Astragalus austriacus has a large distribution range including north-western Spain, south-western France, north-western Italy, large parts of central and south-eastern Europe (apart from Albania and Greece), Ukraine and the south-eastern part of European Russia in Europe, as well as the southern part of western and central Siberia and Kazakhstan in Asia (Meusel et al. 1965, Vydrina 1994, Podlech & Zarre 2013). In the Czech Republic it occurs in various types of dry grasslands; it is particularly well represented in the communities of continental steppes dominated by narrow-leaved tussock-forming grasses of the genera *Festuca* and *Stipa* (Chytrý 2007b), developed usually on base-rich and often calcareous bedrocks, including loess. It is found in the country's warmest and driest parts, i.e. in the hilly area north and north-west of Prague and in the České středohoří Mts in Bohemia, and south-west, south and south-east of Brno in Moravia. The localities in Bohemia are situated at the northern edge of the species' distribution range. Though *A. austriacus* may have somewhat declined during the last decades, it is not immediately endangered and it is therefore classified only as vulnerable (Grulich 2012).

Astragalus cicer (Fig. 7)

Astragalus cicer is native to Europe, mainly to the European Mediterranean area and south-eastern Europe, as well as Anatolia and Transcaucasia (Podlech & Zarre 2013). It has been introduced to and naturalized in the British Isles (Stace 2010), northern Europe and other parts of the World, such as North America (USDA, NRCS 2016). In the Czech Republic it is found in dry meadows and grasslands, pastures, forest fringes, road verges, railway stations, along railways and in similar semi-ruderal sites in settlements. It is fairly common in the northern half of Bohemia, southern and central Moravia south of Olomouc and scattered in the northernmost Moravia and adjacent Czech Silesia. It is difficult to distinguish between "native" and recent secondary occurrences as *A. cicer* usually grows in secondary habitats but it is quite certain that, e.g., scattered records from southern Bohemia, eastern Bohemia south-east of Pardubice and northern Moravia represent rather recent introductions (cf. Procházka 1977: 33). The species' distribution pattern clearly shows its affinity to warm and moderately warm parts of the country.

Astragalus danicus (Fig. 8)

Astragalus danicus is a species with a remarkably large distribution range, extending from Spain and the British Isles in the west over central and eastern Europe and Siberia as far as the Russian Far East; in North America it is replaced by its sibling species *A. agrestis*. The westernmost part of the distribution range is discontinuous and includes outposts in southern Scandinavia and the Caucasus Mts, but the species is absent from the Balkan Peninsula. In Asia, *A. danicus* occurs also in Kazakhstan, Kyrgyzstan, Mongolia and north-eastern China (Meusel et al. 1965, Vydrina 1994, Podlech & Zarre 2013). In the

Czech Republic *A. danicus* is found in semi-dry grasslands dominated by *Brachypodium pinnatum* or *Bromus erectus*, less frequently in continental thermophilous oak forests and various types of dry meadows, usually on deep heavy soils (but also on sand), developed on loess, marl, marlstone but also above basalt, usually well supplied with carbonates. It is almost continuously distributed in north-western Bohemia and scattered in central Bohemia. In the eastern part of the country, it is scattered in central Moravia and almost continuously distributed from the city of Brno towards the southeast, being particularly frequent in the south-western part of the Bílé Karpaty Mts. Mainly in the past *A. danicus* was accidentally introduced to other parts of the country outside its range, being able to establish viable and rather persistent populations, frequently in road verges and other secondary habitats. Numerous records found in literature, in particular those from southern and south-western Moravia, may be erroneous, based on misidentifications of *A. onobrychis*. The species is declining and currently classified as vulnerable (Grulich 2012).

Astragalus exscapus (Fig. 9)

Astragalus exscapus is a species with a discontinuous distribution range including central Germany, the Czech Republic, eastern Austria, the western Alps in Switzerland and Italy, Hungary, Romania, the Balkan Peninsula, Moldavia, southern Ukraine, southern European Russia and northern Anatolia. All central-European populations are assigned the type subspecies, while *A. exscapus* subsp. *transsilvanicus* is endemic to Romania and *A. e.* subsp. *pubiflorus* is found in south-eastern and eastern Europe (Meusel et al. 1965, Vydrina 1994, Podlech & Zarre 2013). In the Czech Republic *A. exscapus* is considered to be a postglacial relict now restricted to isolated refugia (Kaplan 2012). It is confined to vegetation of continental steppes dominated by narrow-leaved species of *Festuca* and *Stipa*; less frequently it is found in open scrub communities, both developed usually over calcareous or base-rich bedrock, such as loess, calcareous sand, sandstone or basalt on south-facing slopes. The vegetation is frequently disturbed by rabbits or landslides. Most of the sites may be considered naturally tree-less, but the species is able of colonizing secondary habitats, such as railway embankments (Dřevojan 2012). In the Czech Republic *A. exscapus* occurs in the western part of the České středohoří Mts, the adjacent hilly area south of the town of Chomutov and north of Prague in Bohemia as well as south and south-east of Brno in Moravia. The species is declining, mainly because of abandonment of former pastures, previous planting and later spread of *Robinia pseudoacacia* and vegetation succession; it is classified as endangered (Grulich 2012).

Astragalus glycyphyllos (Fig. 10)

Astragalus glycyphyllos is distributed over most of Europe, in the northern part of Anatolia, the Caucasus Mts, south-western Siberia and eastern Kazakhstan (Meusel et al. 1965, Vydrina 1994, Podlech & Zarre 2013). It has been recorded as alien in Quebec in Canada and the eastern USA (USDA, NRCS 2016). In the Czech Republic it occurs in thermophilous oak forests, oak-hornbeam forests, beech forests and their canopy openings, forest fringes, scree slopes, abandoned meadows, orchards and stone quarries, along roads and railways. It is common throughout most of the country, being absent only from its mountainous parts, such as the Krkonoše Mts and Hrubý Jeseník Mts, areas covered by plantations of coniferous trees, with arable fields as dominant land use type or

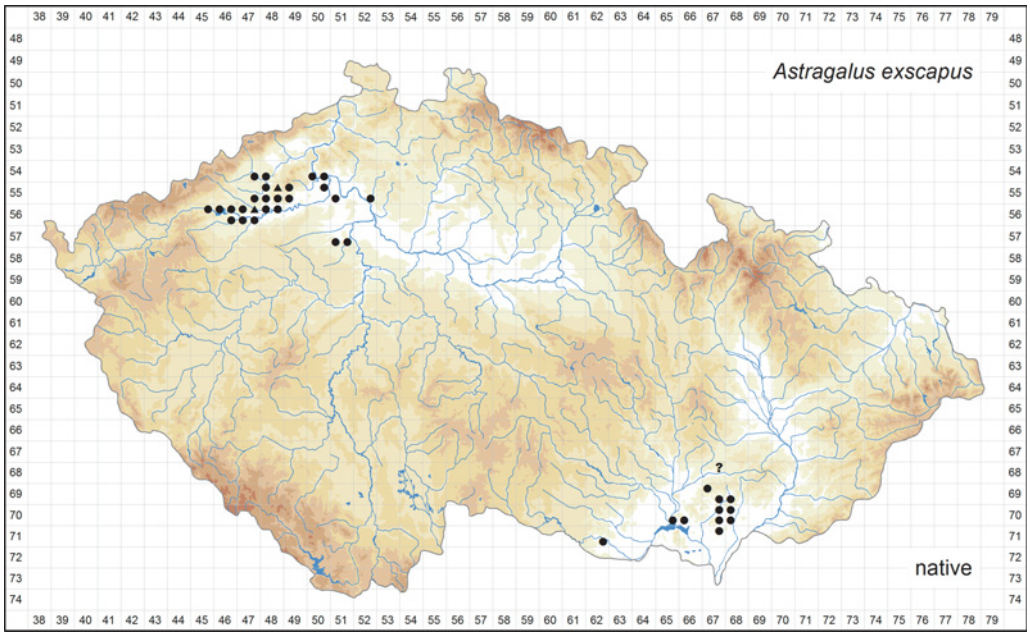


Fig. 9. – Distribution of *Astragalus exscapus* in the Czech Republic: ● occurrence documented by herbarium specimens (35 quadrants), ▲ occurrence based on other records (2 quadrants). Prepared by Zdeněk Kaplan & Jiří Danihelka.

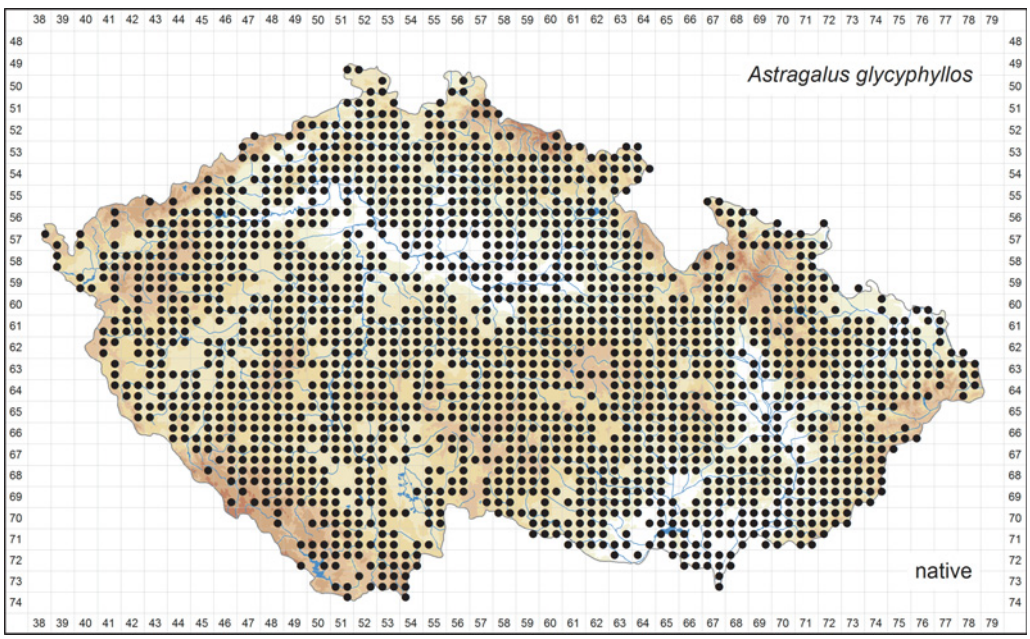


Fig. 10. – Distribution of *Astragalus glycyphyllos* in the Czech Republic (1876 occupied quadrants). Prepared by Zdeněk Kaplan & Jiří Danihelka.

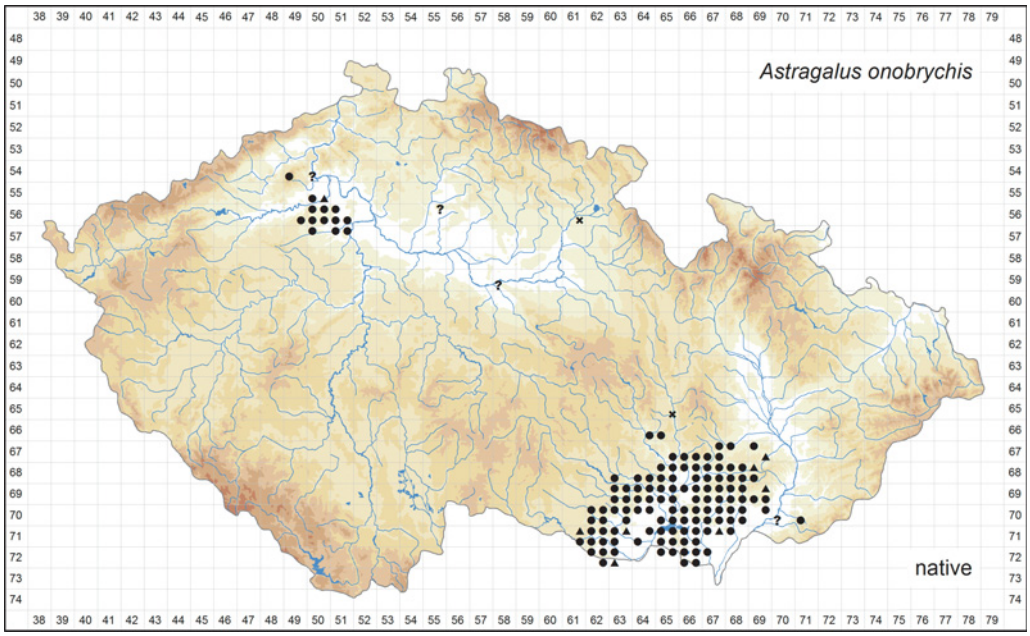


Fig. 11. – Distribution of *Astragalus onobrychis* in the Czech Republic: ● occurrence documented by herbarium specimens (123 quadrants), ▲ occurrence based on other records (8 quadrants), × alien (2 quadrants). Prepared by Zdeněk Kaplan & Jiří Danihelka.

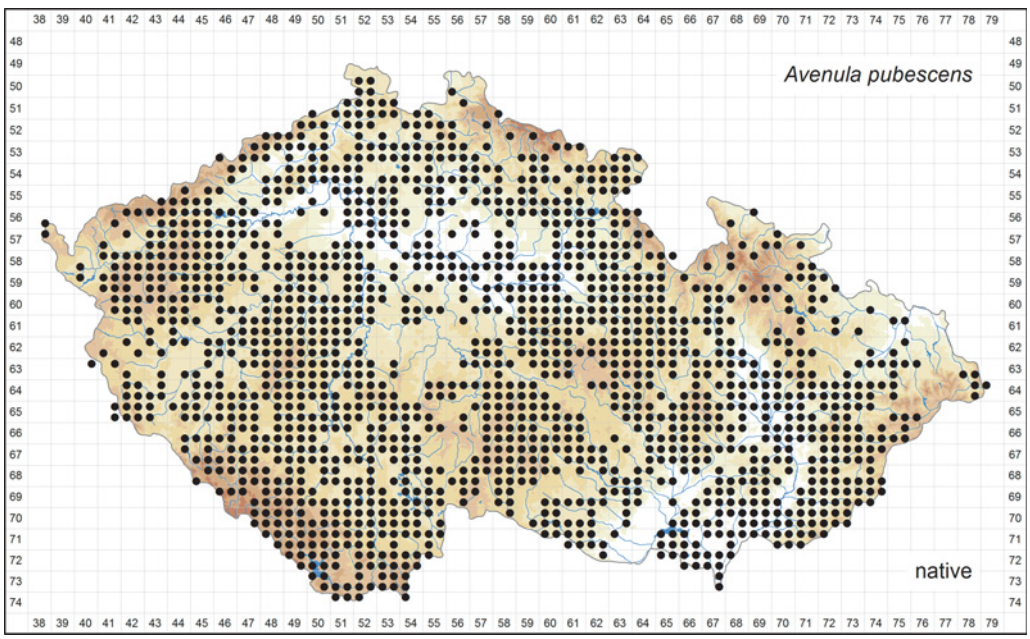


Fig. 12. – Distribution of *Avenula pubescens* in the Czech Republic (1567 occupied quadrants). Prepared by Jiří Zázvorka.

with very acidic soils, such as the Třeboňská pánev basin. Still, the gaps in the map may combine true absences with under-recording at least in warm and moderately warm parts of the country.

Astragalus onobrychis (Fig. 11)

Astragalus onobrychis is the most widespread member of *A.* sect. *Onobrychoidei*, a taxonomically difficult group of about 75 species in the Old World, with a distribution range reaching from France in the west over central, south-eastern and eastern Europe as far as western Siberia, Mongolia and Kazakhstan. It occurs also in Anatolia, the Caucasus Mts and Transcaucasia (Vydrina 1994, Podlech & Zarre 2013). As casual alien it has been introduced to Germany. In the Czech Republic *A. onobrychis* is usually found in vegetation of continental steppes dominated by narrow-leaved tussock-forming grasses of the genera *Festuca* and *Stipa* and in subcontinental semi-dry grasslands dominated by *Brachypodium pinnatum* or *Bromus erectus* (Chytrý 2007b, Novák & Chytrý 2007). The species occurs in a small area north-west of Prague with an outpost, documented by a single herbarium specimen, in the western part of the České středohoří Mts in Bohemia; in Moravia, its continuous local distribution range may be delimited by the lines connecting the city of Brno with the towns of Znojmo in the south-west and Veselí nad Moravou in the south-east, again with some outposts towards the north and east. It was accidentally introduced, probably with hay, to the garrison town of Josefov in eastern Bohemia (first recorded in 1933 and still present in 2009); in addition the northernmost occurrence Moravia north of the town of Blansko, recorded in 2014, may be due to accidental introduction. Both the Czech and Moravian localities are situated on the northern edge of the species' distribution range. The map is well supported by herbarium specimens so that most wrong records based on misidentifications of *A. danicus* have been eliminated. *Astragalus onobrychis* may have been slightly declined because of abandonment of former pastures and eutrophication, both enhancing succession by scrub vegetation. It is therefore classified as vulnerable (Grulich 2012).

Avenula pubescens (Fig. 12)

Avenula pubescens is a Euro-Siberian species with a large distribution range consisting of two separate parts. The western part extends throughout most of Europe, in Norway reaching as far as 70°N, eastwards to Ural Mts and southwards to Italy, and isolated patches are located in western Asia. The central-Asian part of its distribution range covers vast territories including the Ob and Irtysh basins, the Altai and Tian Shan Mts, central Siberia, Transbaikalia and northern Mongolia (Conert 1998). It is found in various types of grasslands, such as meadows, pastures and steppes, forest clearings, road and railway embankments, usually on dry or humid, more or less neutral soils rich in nutrients. In the Czech Republic it is scattered through the country, being rare in or absent from the highest elevation of the mountains. At lower altitudes it is less frequent in or absent from westernmost and south-eastern Bohemia as well as from western, south-western and north-eastern Moravia and adjacent Silesia. It is most frequently found at altitudes of 150–800 m, in the Krušné hory Mts reaching 1000 m and in the Šumava Mts 1150 m.

Bidens cernuus (Fig. 13)

Bidens cernuus occurs in the temperate zone of the Northern Hemisphere, from Europe eastwards through south-western Asia as far as eastern Siberia, and scattered even in China and Japan. It is widespread in the warmer part of the temperate zone of North America, towards the north reaching 60°N (Hultén & Fries 1986, Chen & Hind 2011). In Europe it is widely distributed from southern Scandinavia and the Baltic countries southwards as far as northern Spain, central Italy and southern Greece (Meusel & Jäger 1992, Greuter 2006). *Bidens cernuus* grows on nutrient-rich soils on the banks of slow-flowing rivers, canals and streams, on the shores of fishponds, oxbows and around temporary pools in meadows. It also occurs on the bottoms of summer-drained fishponds and other water reservoirs. In the Czech Republic it is abundant predominantly in the fishpond landscapes of southern Bohemia, in the Českomoravská vrchovina highlands and the Železné hory hills. It tends to be rare in or absent from the dry part of north-western Bohemia, the Krkonoše Mts, Jizerské hory Mts and Krušné hory Mts; in the Šumava Mts it occurs only along the Vltava river and in adjacent areas. In Moravia it is markedly less frequent than in Bohemia, with most localities situated in the floodplains of lowland rivers around the cities of Ostrava and Olomouc, and the towns of Břeclav and Pohořelice. It occurs at altitudes about 150–750 m, reaching its altitudinal maximum in the Žďárské vrchy Mts.

Bidens connatus (Fig. 14)

Bidens connatus is native to eastern North America, including southern Canada and the USA. It was introduced to Europe probably in 1865 (Meusel & Jäger 1992). It is now scattered in central Europe, eastwards reaching as far as Ukraine, southwards to France and Italy, and westwards to the British Isles (Greuter 2006). In the Czech Republic it inhabits banks of lowland rivers, oxbows and canals, and humid waste places. *Bidens connatus* was first collected in 1934 in Prague along the Vltava river and in Litoměřice along the Labe river. In the eastern part of the country it was first recorded in 1964 in the Silesian town of Karviná. In the last decade it has spread to many new sites, especially along the Labe and Vltava rivers, and in the vicinity of Karviná, apparently as consequence of the great floods in 2002. It is currently classified as casual neophyte (Pyšek et al. 2012b).

Bidens frondosus (Fig. 15)

Bidens frondosus is native to North America, from southern Canada southwards to the southern USA. It has been introduced to Europe (Meusel & Jäger 1992), and isolated records are known from Morocco, Lebanon, Tajikistan, China, South Korea, Japan, French Guyana, and New Zealand (Mouterde 1986, Pyke et al. 2008, Han et al. 2009, Nobis & Nowak 2011, Chen & Hind 2011). In Europe, it was first recorded as escaped in 1777 in Poland (Lhotská 1966). Today it is naturalized almost in all European countries except Scandinavia and the Baltic countries, where it is classified as casual (Greuter 2006). In the Czech Republic it grows on nutrient-rich moist soils, invading banks of rivers, streams and canals, shores of oxbows, water reservoirs and fishponds, and also has been recorded in wet waste places, road ditches, along railways, in wet depressions in arable fields and meadows. The earliest record for the Czech flora from the town of Žďár

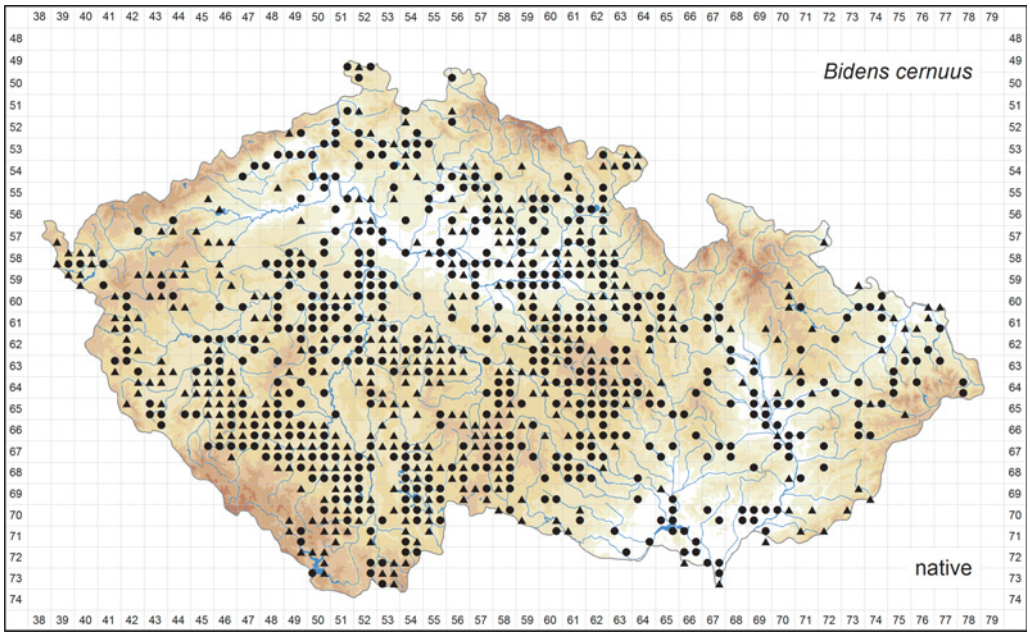


Fig. 13. – Distribution of *Bidens cernuus* in the Czech Republic: ● occurrence documented by herbarium specimens (522 quadrants), ▲ occurrence based on other records (388 quadrants). Prepared by Jitka Štěpánková.

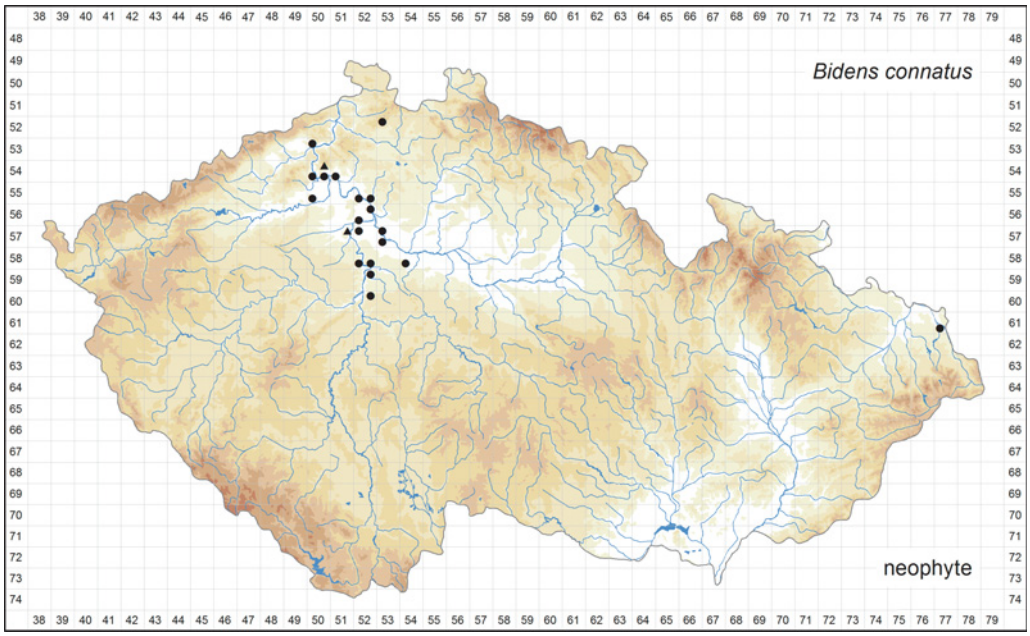


Fig. 14. – Distribution of *Bidens connatus* in the Czech Republic: ● occurrence documented by herbarium specimens (19 quadrants), ▲ occurrence based on other records (2 quadrants). Prepared by Jitka Štěpánková.

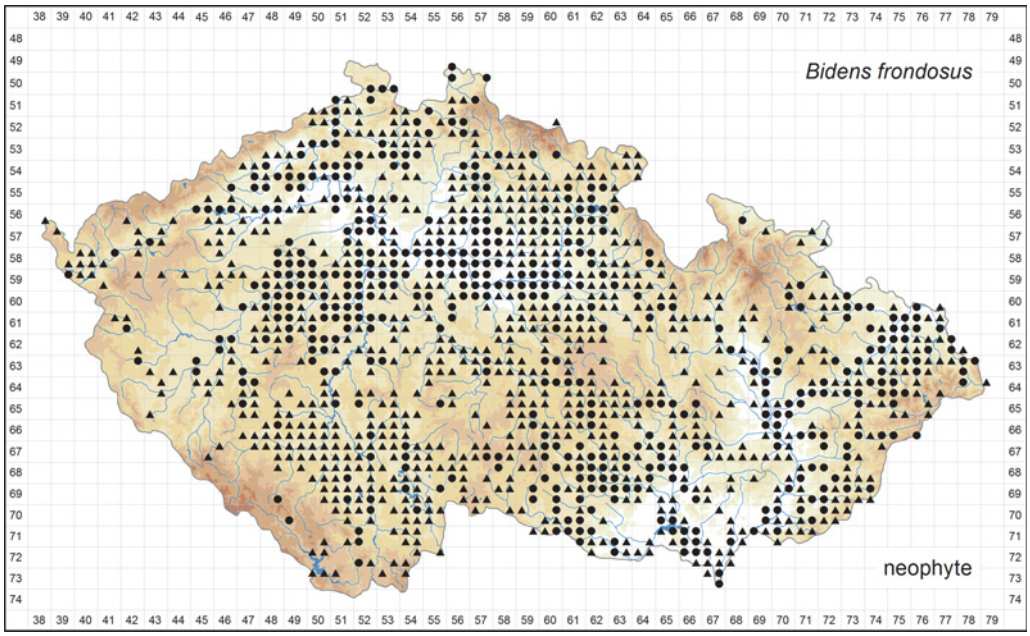


Fig. 15. – Distribution of *Bidens frondosus* in the Czech Republic: ● occurrence documented by herbarium specimens (466 quadrants), ▲ occurrence based on other records (788 quadrants). Prepared by Jitka Štěpánková.

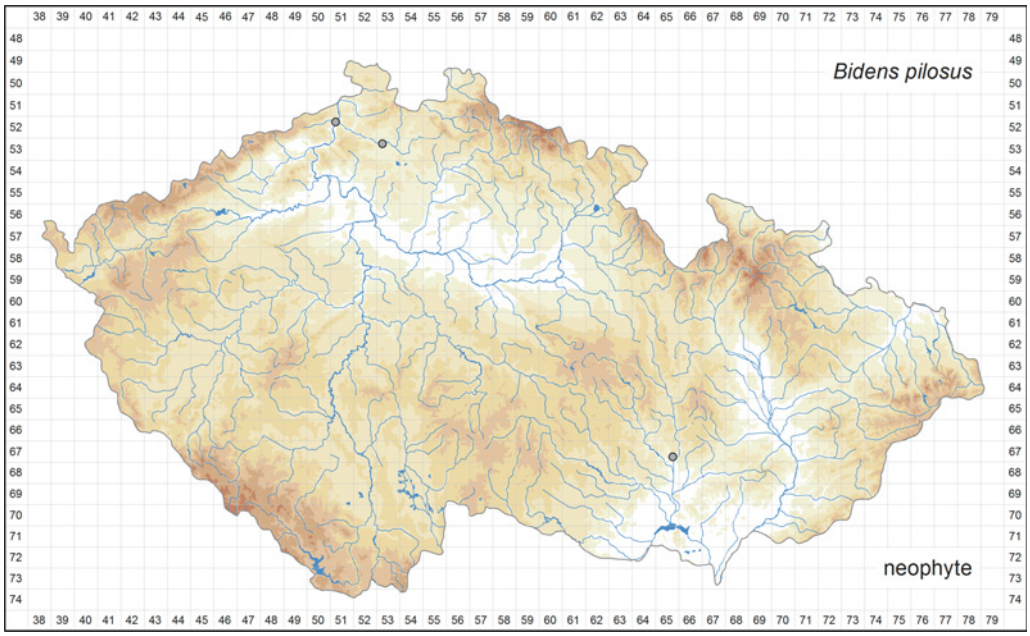


Fig. 16. – Distribution of *Bidens pilosus* in the Czech Republic (3 occupied quadrants). Prepared by Jitka Štěpánková.

nad Sázavou in Moravia dates back to 1907. The year 1894 given in Pyšek et al. (2012a, b) for the first record ever of *B. frondosus* in the Czech Republic is erroneous, relating in fact to the first record in Germany (Hegi 1925, Hejný 1948). The growing number of herbarium specimens and literature records suggests that it began to spread intensively as late as in the 1930s along the Labe and Vltava rivers. The distribution maps published by Hejný (1948) and Lhotská (1968) show records of *B. frondosus* almost exclusively from the alluvia of lowland rivers. At present it is distributed almost throughout the country. In Bohemia it is most abundant in lowlands, while being less frequent in middle altitudes, particularly in the west, and rare in or absent from the Krkonoše Mts, Jizerské hory Mts, Krušné hory Mts and Šumava Mts. It occurs frequently in most of Moravia, being rare in or absent only from the Hrubý Jeseník Mts and reaching its altitudinal maximum at 880 m in the Javorníky Mts. It is classified as an invasive neophyte (Pyšek et al. 2012b).

Bidens pilosus (Fig. 16)

Bidens pilosus is native to southern North America and South America, but now it is a noxious weed introduced to most of the tropical zone of the World, reaching occasionally the temperate zones of both hemispheres (Hadač & Hadačová 1969). In Europe *B. pilosus* occurs sparsely in its central and southern parts, northwards reaching Germany and Poland and southwards the Mediterranean area including northern Africa (Greuter 2006). It grows on mesotrophic to eutrophic neutral to basic, moist or dry soils (Hadač & Hadačová 1969). It is capable of invading various types of disturbed habitats such as railway embankments, road edges and dumping ground. The earliest herbarium record for the Czech Republic is from the town of Česká Lípa, dating back to 1913. It was further recorded in 1934 in Brno and in 1981–1983 in the railway station of Děčín-Loubí. It is classified as a casual neophyte (Pyšek et al. 2012b).

Bidens radiatus (Fig. 17)

The distribution range of *Bidens radiatus* is confined to Europe and the temperate zone of Asia (Hultén & Fries 1986, Meusel & Jäger 1992). In Europe it occurs from the Netherlands northwards to southern Scandinavia and the Baltic countries, eastwards to Ukraine and southwards to France and Italy (Greuter 2006). It grows on nutrient-rich soils on the shores of fishponds and oxbows, banks of slow-flowing rivers, canals and streams, and on the bottoms of summer-drained fishponds and other water reservoirs. In the Czech Republic it is abundant in the fishpond landscapes of southern Bohemia and in the Českomoravská vrchovina highlands. Recently, as possible results of climatic changes and the great floods in 2002, it has been spreading in central and eastern Bohemia, where it used to be rare before. In Moravia it is generally rare, occurring more frequently only in its south-western part. It is found at altitudes about 160–700 m, reaching its maximum elevation in the Žďárské vrchy Mts.

Bidens tripartitus (Fig. 18)

Bidens tripartitus is native to Europe, northern Africa and Asia, except its north and north-western part. It has been introduced to many other parts of the World, now being frequent in North America, Australia and New Zealand. In Europe it is found over the

whole of the continent, excluding its northernmost and southernmost parts. In Asia it is widespread through central and south-eastern Siberia to China, Sakhalin, the Kuril Islands, the Korean Peninsula and Japan (Hultén & Fries 1986, Meusel & Jäger 1992, Greuter 2006). It grows on nutrient-rich soils on the banks of slow-flowing rivers, canals and streams, on the shores and exposed bottoms of fishponds and oxbows and in wet depressions in grasslands and arable fields, less frequently in road ditches and humid ruderal sites in human settlements. It is distributed throughout the Czech Republic from the lowlands to middle altitudes, reaching its altitudinal maximum at 900 m in the Novohradské hory Mts. It is fairly common in central, southern and eastern Bohemia, less frequent in dry areas of western Bohemia and north-central Bohemia and rare in or absent from the highest mountains. It is abundant in Moravia, becoming less frequent in its north-western part.

Carex appropinquata (Fig. 19)

Carex appropinquata has been recorded across most of Europe, from the British Isles and southern parts of the Scandinavian Peninsula in the north-west as far as Greece in the south-east. It is also found in the Caucasus Mts, Anatolia, western and central part of southern Siberia, in the east reaching as far as Lake Baikal (Hultén & Fries 1986, Egorova 1999). It occurs over base-rich substrates (limestone, marl and serpentine) on gley or organic, slightly acidic to slightly basic soils with a high groundwater level. It is most frequent, sometimes even forming monodominant stands, in rich fens, fen and wet meadows, less frequent in alder carrs. In the Czech Republic *C. appropinquata* occurs scattered in the warm and moderately warm parts of the country, being rather rare in the mountains. In Moravia it has been known from its south-eastern and central parts, becoming rarer towards the north and missing from the Moravian part of the Carpathians. Its altitudinal range is 165–750 m. *Carex appropinquata* has been declining both in number of sites and in population size. It is particularly threatened by habitat destruction, most frequently drainage, and less so by abandonment of meadows and subsequent encroachment. It has therefore been classified as endangered (Grulich 2012). The literature records may be contaminated by misidentifications of the similar *C. paniculata*.

Carex chordorrhiza (Fig. 20)

Carex chordorrhiza is a boreal circumpolar species occurring only rarely in central and southern Europe. It has been known from central Spain, the Pyrenees, the Alps, Germany, the Czech Republic, Poland and Slovakia. It is widespread throughout the boreal zone of eastern Europe and Asia as far as Sakhalin and the Kamchatka Peninsula. In North America it grows across the north from Alaska to Newfoundland, southwards as far as the Great Lakes region (Meusel et al. 1965, Page & Rieley 1985, Hultén & Fries 1986). The Czech Republic is situated at the southern limit of the species' distribution range. *Carex chordorrhiza* is confined to transitional peat bogs. It has been found at only 15 localities in the moderately warm and cold areas. Most of its localities are situated in Bohemia; in Moravia it is found only in the Jihlavské vrchy hills and Žďárské vrchy hills. The altitudinal range of this species in the Czech Republic is 275–1210 m. The records of *C. chordorrhiza* from the Jizerské hory Mts are either doubtful or refer to the Polish part of the mountains (Plocek 1986). *Carex chordorrhiza* occurs in habitats that are prone to

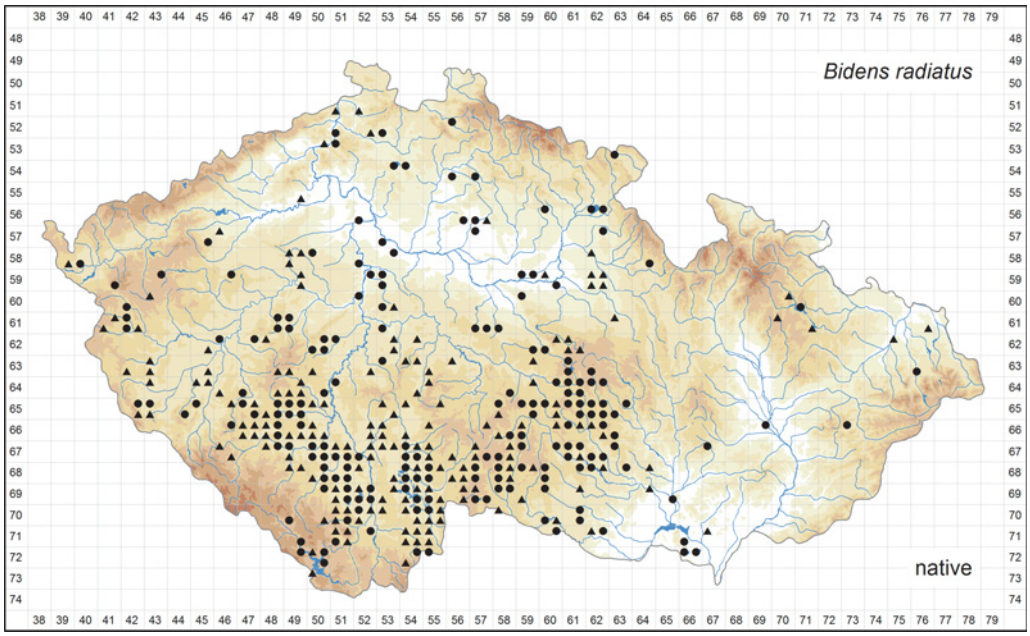


Fig. 17. – Distribution of *Bidens radiatus* in the Czech Republic: ● occurrence documented by herbarium specimens (188 quadrants), ▲ occurrence based on other records (178 quadrants). Prepared by Jitka Štěpánková.

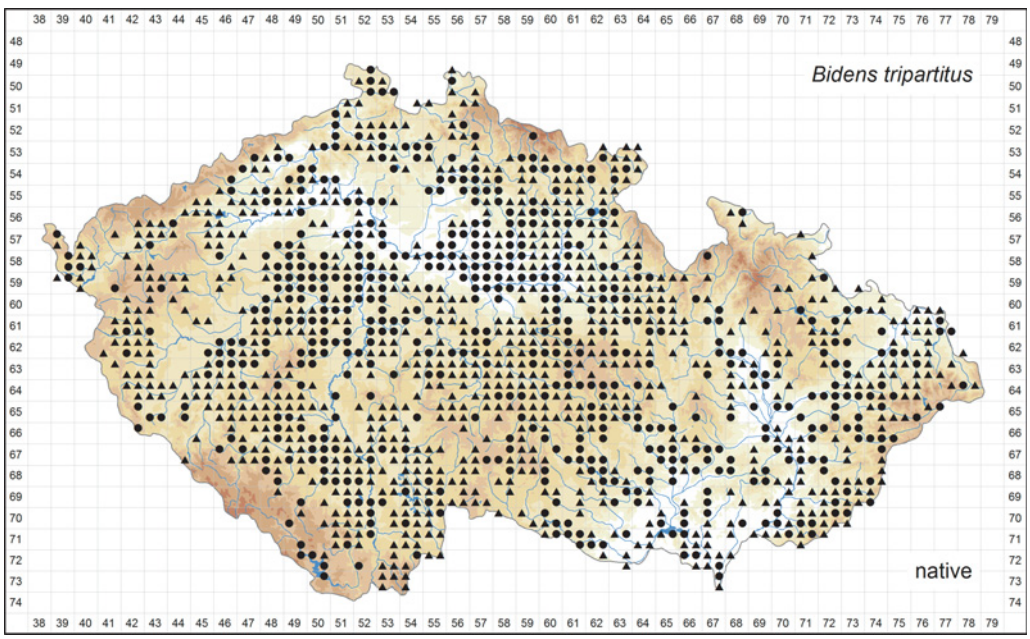


Fig. 18. – Distribution of *Bidens tripartitus* in the Czech Republic: ● occurrence documented by herbarium specimens (546 quadrants), ▲ occurrence based on other records (804 quadrants). Prepared by Jitka Štěpánková.

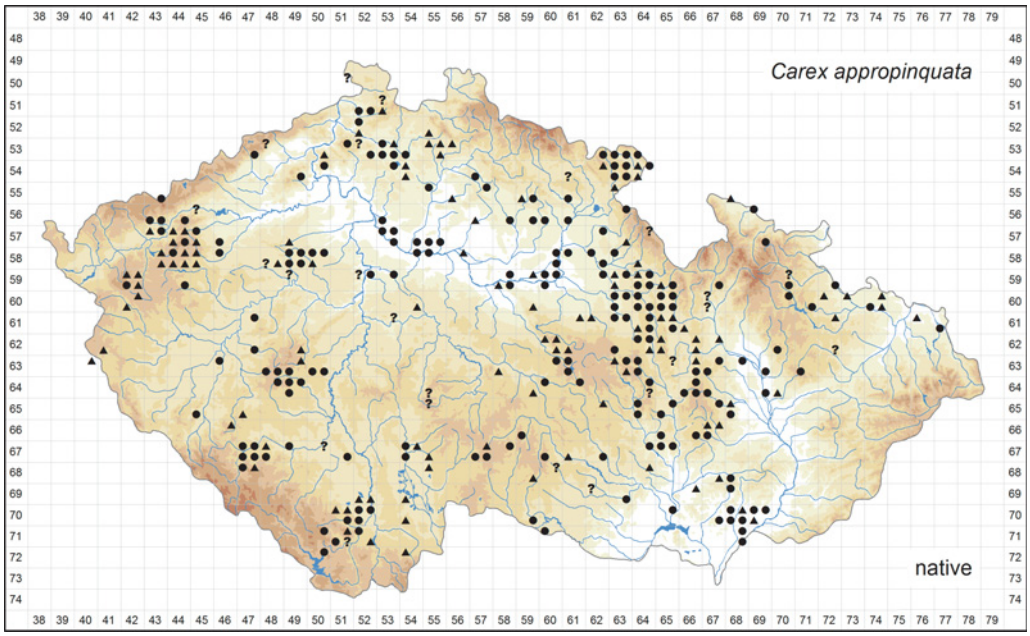


Fig. 19. – Distribution of *Carex appropinquata* in the Czech Republic: ● occurrence documented by herbarium specimens (190 quadrants), ▲ occurrence based on other records (110 quadrants). Prepared by Vít Grulich & Radomír Řepka.

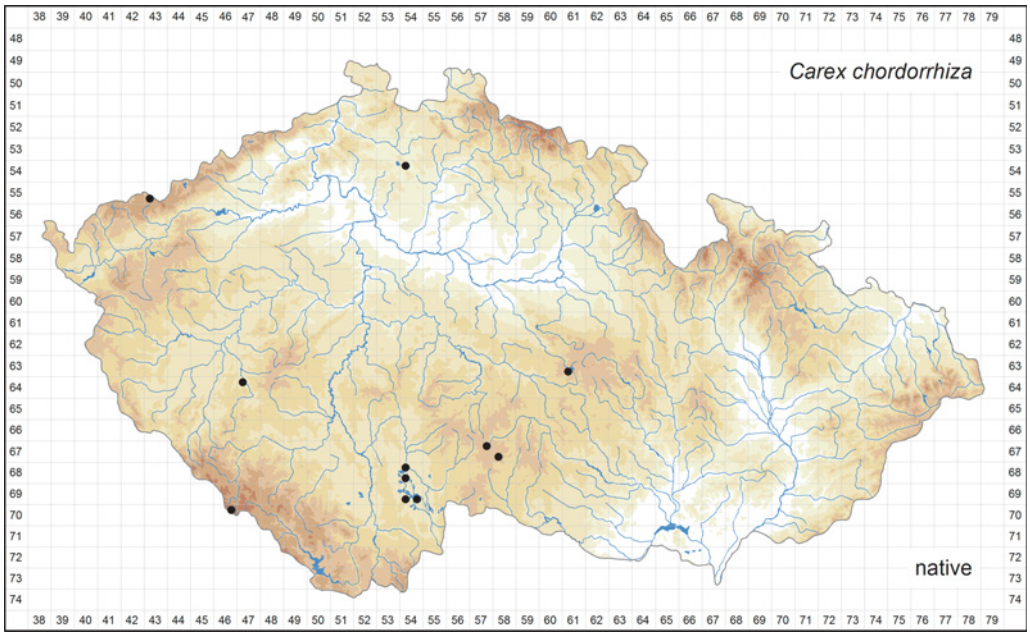


Fig. 20. – Distribution of *Carex chordorrhiza* in the Czech Republic (11 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

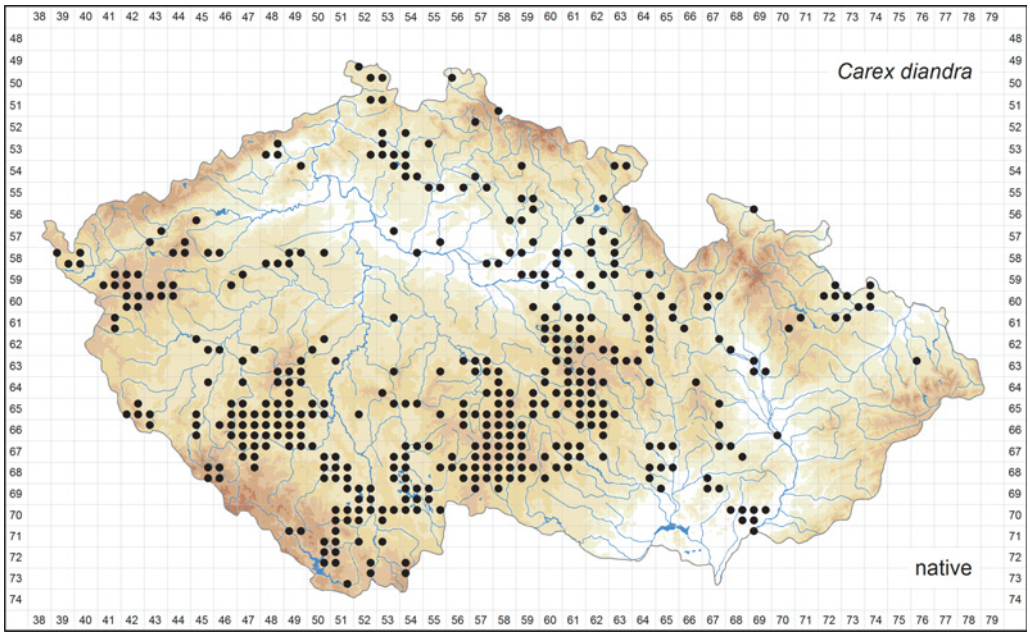


Fig. 21. – Distribution of *Carex diandra* in the Czech Republic (417 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

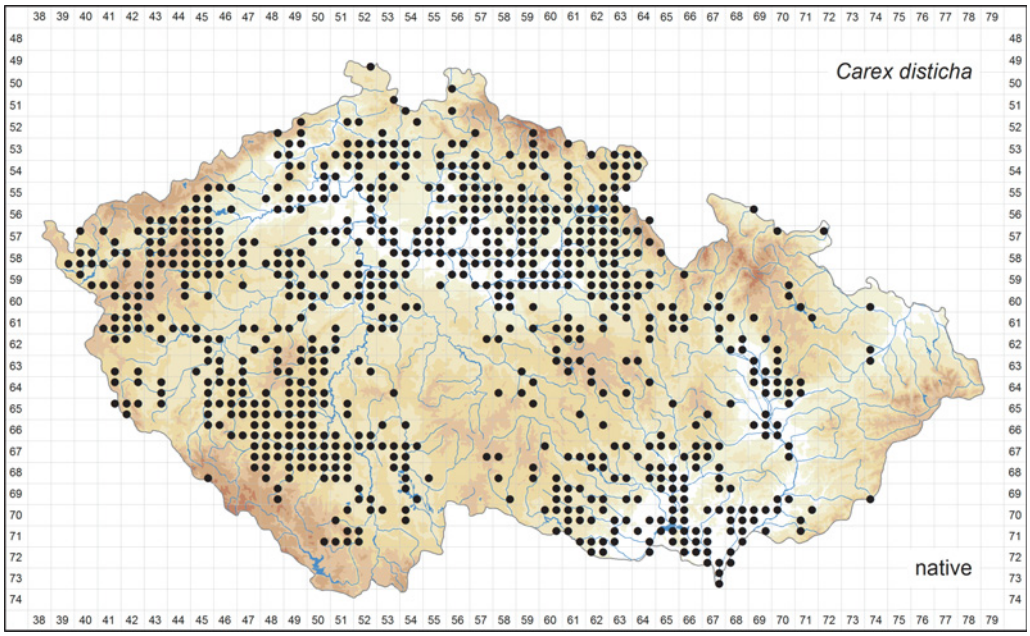


Fig. 22. – Distribution of *Carex disticha* in the Czech Republic (793 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

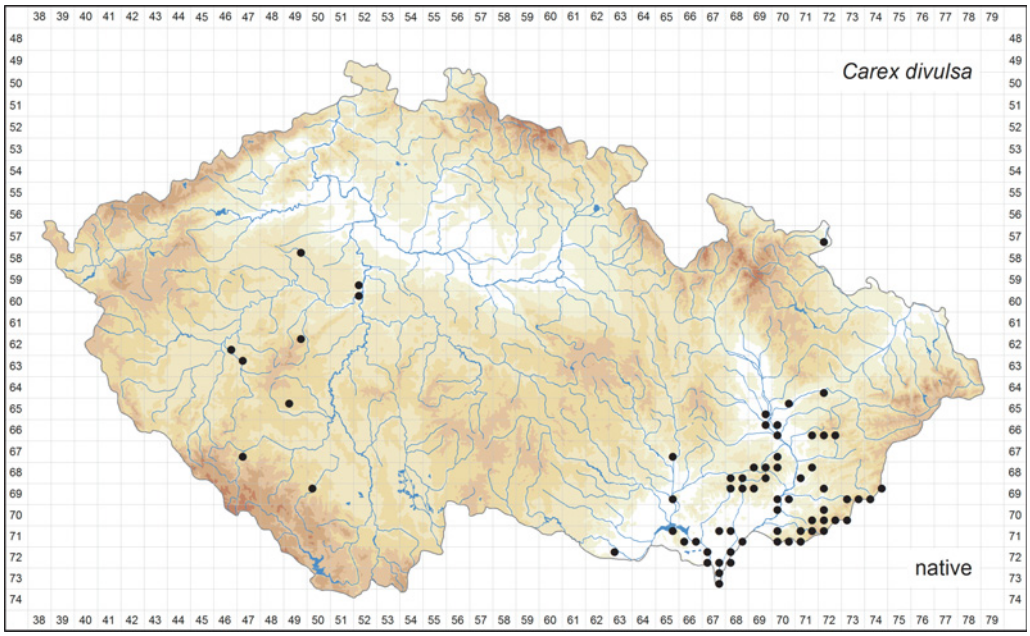


Fig. 23. – Distribution of *Carex divulsa* in the Czech Republic (67 occupied quadrants). Prepared by Radomír Řepka & Vít Grulich.

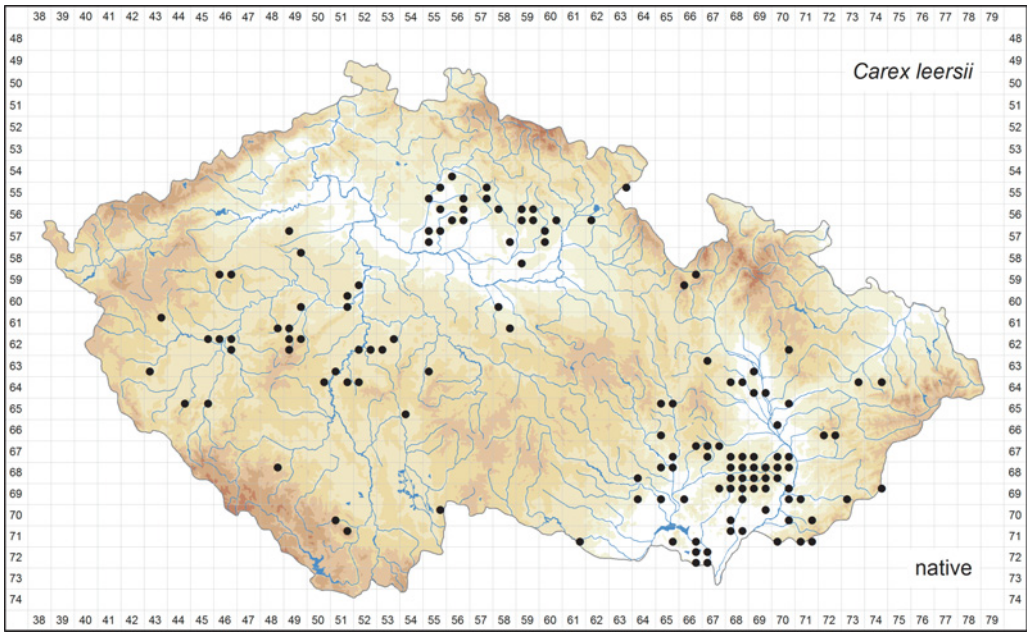


Fig. 24. – Distribution of *Carex leersii* in the Czech Republic (134 occupied quadrants). Prepared by Radomír Řepka & Vít Grulich.

damage by human intervention, such as excavation of peat and drainage. Some of the populations have been destroyed and nowadays only 6 or 7 still exist. The species is therefore classified as critically endangered (Grulich 2012).

Carex diandra (Fig. 21)

Carex diandra is a circumboreal species with a very large distribution range. It is common in northern and central Europe, towards the east reaching as far as the Far East via Siberia. Isolated occurrences are known from the Caucasus Mts, Anatolia, Kazakhstan, the Central-Asian mountains, Afghanistan and Pakistan. *Carex diandra* is common in the boreal zone of North America, extending southwards along the Rocky Mts to southern California. The records from the Canary Islands and New Zealand are erroneous (Hultén & Fries 1986, Egorova 1999). *Carex diandra* is a weak competitor very sensitive to eutrophication. It is most frequently found in poor fens, fen meadows, in marsh vegetation of tall sedges on the shores of fishponds and along ditches on fen soils with a slightly acidic to slightly alkaline pH. It is most abundant in middle altitudes, becoming less frequent towards the mountains. The species is frequent in southern Bohemia and in the Českomoravská vrchovina highlands. It is scattered in western and northern Bohemia and in parts of eastern Bohemia adjacent to Moravia. In Moravia this sedge occurs mainly in its central and northern parts, while being rare in the south. *Carex diandra* has declined considerably due to drainage and direct habitat destruction and it is now classified as endangered (Grulich 2012).

Carex disticha (Fig. 22)

The distribution range of *Carex disticha* extends from the British Isles in the west as far as the southern part of Siberia, Kazakhstan and China in the east. In Europe it occurs mainly in its central and western parts. Its southern range limit runs through northern Spain, southern France, central Italy, the countries of the former Yugoslavia and Bulgaria. There are also a few records from Anatolia and the Caucasus Mts (Meusel et al. 1965, Hultén & Fries 1986). In the Czech Republic *C. disticha* occurs in marsh vegetation of tall sedges, wet and alluvial meadows, and less frequently in fen meadows on heavy or sandy soils, usually rich in nutrients and with a high groundwater level. The species is frequent to scattered throughout the parts of the country with a warm and moderately warm climate; in contrast, it is very rare in the Českomoravská vrchovina and Drahanská vrchovina highlands, the Carpathian part of Moravia, Czech Silesia and generally in the mountains. Its altitudinal range is 150–980 m.

Carex divulsa (Fig. 23)

Carex divulsa is one of the eight taxa subsumed by Molina et al. (2008a) under *C. divulsa* agg., of which also *C. leersii* and *C. otomana* are present in central Europe. *Carex divulsa* is distributed mainly in western and central Europe from the British Isles in the west to Ukraine in the east. There are also records from southern Scandinavia and Latvia. It is common in the Carpathians. Outside Europe it is known from Anatolia, the Caucasus Mts and Turkmenistan (Molina et al. 2008a). In the Czech Republic *C. divulsa* is confined to forests with a closed or moderately closed canopy, in the same time showing rather

a strong affinity to disturbed places. It is usually found in hard-wood floodplain forests, oak-hornbeam and beech forests. It grows on soils that are rich in nutrients and humus, humid in the spring but may become dry during the summer. *Carex divulsa* is a rare species of the Czech flora. Most of its localities are found in southern and south-eastern Moravia along the Morava and Dyje rivers and in the Moravian Carpathians. The isolated occurrence in Czech Silesia is quite remote but it is situated not far from the closest localities in Poland. The dispersed records from Bohemia may relate both to indigenous populations (e.g. in the Brdy Mts) and accidental introductions (e.g. surroundings of the city of Plzeň), while status of other populations is uncertain. *Carex divulsa* was recorded at altitudes of 150–750 m. Some populations in southern and south-eastern Moravia approach *C. otomana* in morphological characters and could not be identified with certainty. Our experience from herbarium studies suggests that many literature records may be erroneous, based on misidentified specimens of *C. leersii* or *C. otomana*. That is why the distribution map is based only on revised herbarium specimens. *Carex divulsa* has been classified as endangered (Grulich 2012).

Carex leersii (Fig. 24)

Carex leersii occurs almost throughout the whole of Europe, from the British Isles in the west to the easternmost parts of Europe. It is most widespread in western and central Europe, including France, Germany and Austria. In its Mediterranean part it is replaced by *C. enokii*, in northern Europe by the recently described *C. nordica* and in south-western Europe by *C. magacis* (Molina et al. 2008a). Outside Europe it has been recorded in Anatolia. In the Czech Republic *C. leersii* grows mostly in oak-hornbeam forests, thermophilous oak forests and beech forests, usually in canopy openings, in forest edges, clearings, along forest paths and roads, in ditches and other disturbed open habitats such as road edges, railway embankments and city parks. In comparison with other species of *C.* sect. *Phaestoglochin* it seems to prefer base-rich soils developed above sandstone, limestone or marl. In the Czech Republic *C. leersii* grows mainly in eastern and eastern-central Bohemia and southern Moravia. It is rare elsewhere but may become locally abundant, for instance in the surroundings of the city of Plzeň. It is generally more frequent in Moravia, mainly in the Ždánický les, Litenčické vrchy and Chřiby hills. Its altitudinal maximum is 800 m. The distribution map is based solely on revised herbarium specimens.

Carex muricata (Fig. 25)

This species has a very large Eurasian distribution range reaching from the British Isles and Scandinavia in the west over southern Siberia as far as Mongolia and western China in the east; it is also found in the Caucasus Mts. In south-western Europe it occurs only in the Pyrenees, elsewhere being replaced by *C. pairae* and *C. omeyica*. There are further records from the Mediterranean area, where the species is confined to the mountains. Molina et al. (2008b) distinguish three subspecies, of which *C. m.* subsp. *muricata* and *C. m.* subsp. *cesanensis* are reported to occur in central Europe. However, the plants found in the Czech Republic may be assigned to any of the three subspecies based on the character states of a particular specimen; we therefore consider the subspecies to be of little taxonomic value. The most similar species is *C. pairae*, which was not distinguished from *C. muricata* in the Czech botanical literature until the late 1870s, and both species

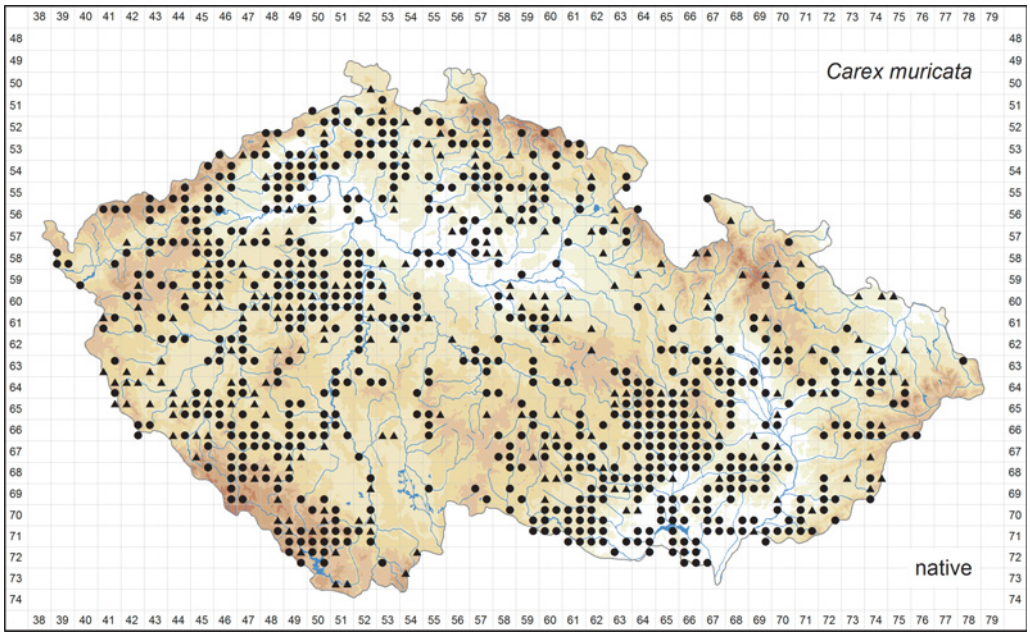


Fig. 25. – Distribution of *Carex muricata* in the Czech Republic: ● occurrence documented by herbarium specimens (672 quadrants), ▲ occurrence based on other records (217 quadrants). Prepared by Radomír Řepka & Vít Grulich.

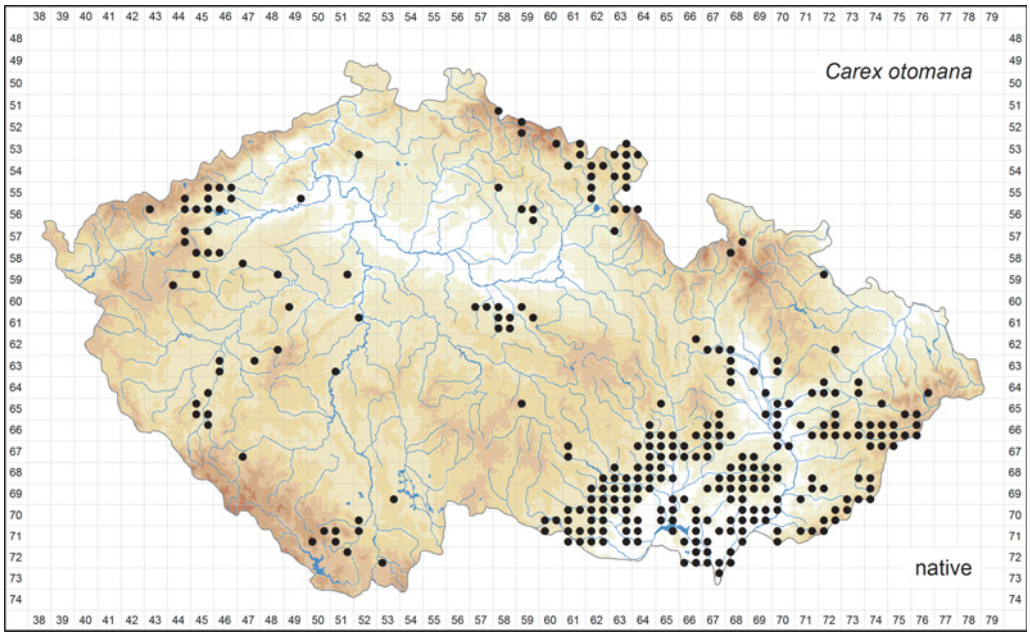


Fig. 26. – Distribution of *Carex otomana* in the Czech Republic (290 occupied quadrants). Prepared by Radomír Řepka & Vít Grulich.

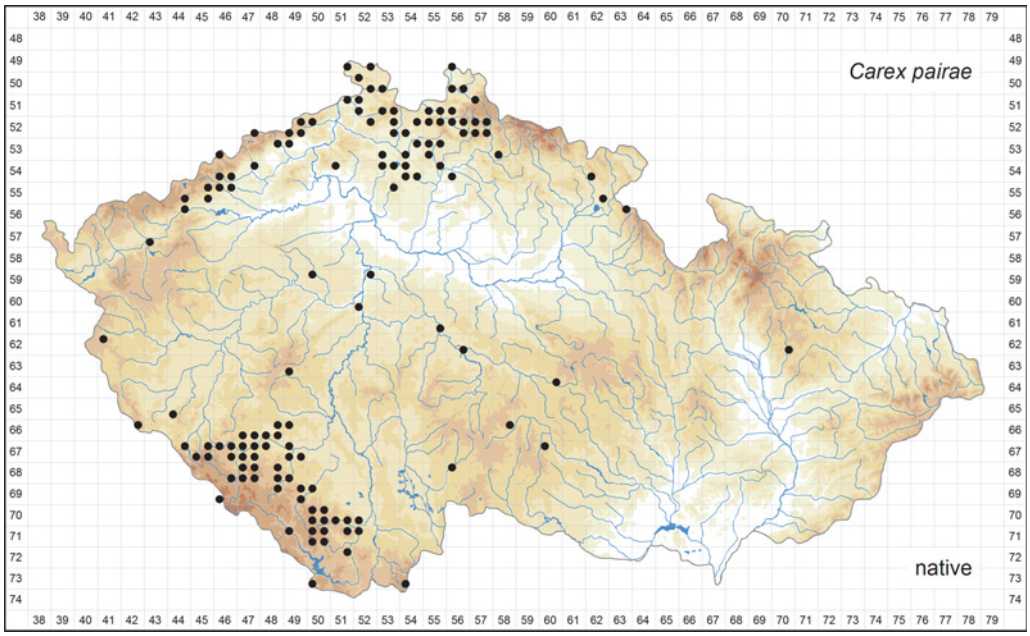


Fig. 27. – Distribution of *Carex pairae* in the Czech Republic (133 occupied quadrants). Prepared by Radomír Řepka & Vít Grulich.

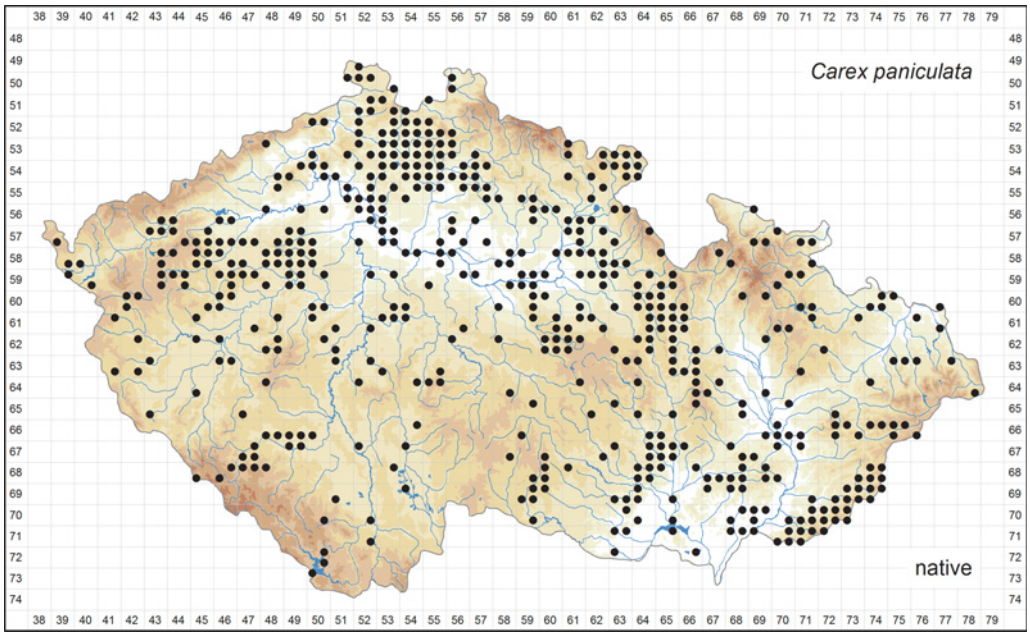


Fig. 28. – Distribution of *Carex paniculata* in the Czech Republic (539 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

were referred to under the former name. This renders all earlier literature records of little use. In the Czech Republic *C. muricata* usually occurs in oak-hornbeam and beech forests, less frequently in Norway spruce plantations, black locust groves and other types of forests. It is further found in shrubby slopes, abandoned orchards, field boundaries, pastures, meadows and rocky hillsides, only rarely also in ruderal nitrogen-rich habitats. It prefers moderately shaded places with nutrient-rich soils, mostly above basic substrates (limestone and marl, but often also above crystalline bedrock) and it does not tolerate a high groundwater level. Like other species of the section it prefers slightly disturbed sites such as clearings and edges of forest roads. In the Czech Republic *C. muricata* is quite frequent in warm and moderately warm parts of the country, while being rare in the mountains. After *C. spicata*, this is the second most common species of the *C.* sect. *Phaestoglochin* in the country. It is common in well-preserved semi-natural deciduous forests but rare elsewhere, which explains its rarity in the Českomoravská vrchovina highlands, western Bohemia and the South Bohemian pond basins. It avoids also dry deforested areas. The species' altitudinal maxima in Czech mountain ranges are 1090–1120 m.

Carex otomana (Fig. 26)

Carex otomana was described from the western part of the Tian-Shan Mts in Central Asia. It is reported to occur also in Iran, Transcaucasia, Anatolia, Greece and Bulgaria (Molina et al. 2008a). According to our own findings, it is common in central Europe, in the west probably reaching Alsace in France. Still, its distribution is not yet known in detail. Formerly the species was recognized in the Czech botanical literature as *C. chabertii* (Řepka 1988). However, this name is no longer applicable because it was typified by a specimen taxonomically corresponding to *C. leersii* (Loos 1996). *Carex otomana* is remarkably variable over its distribution range but this variation is difficult to separate from habitat modifications; for instance, specimens from shaded habitats often resemble *C. divulsa*. In the Czech Republic *C. otomana* grows most frequently in oak-hornbeam forests, dry oak forest and black locust groves. Sometimes it is found in mixed stands of Scots pine and its plantations. It prefers semi-shaded places, such as forest edges, verges of forest roads and young tree plantations in clearings. It is found on loamy or sandy soils that are well supplied with nutrients. In the Czech Republic it is almost continuously distributed in southern, central and eastern Moravia. In contrast, it is much rarer and occurs only locally in Bohemia without any clear phytogeographical pattern. It grows from the lowlands to a maximum altitude of 900 m; however, it was also collected as accidentally introduced at 1335 m a.s.l. in the Krkonoše Mts. Because of frequent misidentifications, the distribution map is based solely on revised herbarium specimens.

Carex pairae (Fig. 27)

Carex pairae occurs mainly in south-western and western Europe, including the British Isles, the Iberian Peninsula, France and the Benelux countries. It is rare in southern and central Scandinavia and scattered over central Europe, where it occurs in Germany, the Czech Republic and Poland (Molina et al. 2008b). According to these authors it is also found in a large part of the Mediterranean area and the Balkans but we have not seen any specimens from there. In the Czech literature this species had been merged with *C. muricata* until the 1870s. However, the two taxa differ by a set of morphological and

phenological characters as well as by their ecological requirements (Hylander 1966, Hartvig 1987, Řepka 2003). In the Czech Republic it most frequently grows in pastures and dry meadows, on grassy and shrubby slopes, in field boundaries, road verges and along footpaths, but not in strongly eutrophicated habitats. Less frequently it occurs also in deciduous and coniferous forests, forest edges, clearings and along forest roads. It is usually found in sunny or semi-shaded habitats on sandy or loamy acidic soils, developed above acidic rocks, rarely also above basalt or limestone. In the Czech Republic *C. pairae* has a distribution pattern typical of Subatlantic floristic elements, with localities concentrated in the moderately warm parts of the western half of Bohemia, namely in northernmost Bohemia, the Krušné hory Mts and at the foothills of the Šumava Mts. There are only individual records from other parts of the country, the easternmost one from the Nízký Jeseník hills. *Carex pairae* is found in the mountains more often than the other members of the *C. muricata* aggregate, reaching altitudinal maximum at 1065 m in the Šumava Mts. Because of frequent misidentifications, the distribution map is based solely on revised herbarium specimens.

Carex paniculata (Fig. 28)

Carex paniculata has been recorded in almost all European countries, from the British Isles in the west to the Baltic countries and the western part of European Russia in the east. In Scandinavia it reaches central Sweden and south-western Finland. It is rare in southern Europe, where it has been recorded mainly in the mountains, reaching the southern margin of its distribution range on the continent in central Italy and northern Greece, and also occurring in Anatolia and the Caucasus Mts (Meusel et al. 1965, Hultén & Fries 1986). Plants from the south-western part of the distribution range are usually treated as a separate subspecies (see Chater 1980). In the Czech Republic *C. paniculata* grows mainly in wet meadows and tall sedge communities, sometimes forming even monodominant stands. It is often found around meadow springs, on shores of reservoirs, banks of streams, rarely in willow and alder carrs and fens. It is a competitively strong species, often forming conspicuous robust tussocks. *Carex paniculata* usually grows on gley soils rich in nutrients and with neutral to slightly alkaline pH, often above carbonate bedrock, less frequently on nutrient-poor acidic soils, but always with a high groundwater level. In the Czech Republic *C. paniculata* occurs almost throughout the country, but with varying frequency. Most of its localities are situated in the moderately warm regions, while being less frequent in the areas with a warm climate and rare in cold mountains. It is abundant in northern and eastern Bohemia, the Českomoravské mezihoří highlands and in the Bílé Karpaty Mts. In contrast, *C. paniculata* is almost missing from other parts of the Czech Republic such as the Bohemian side of the Českomoravská vrchovina highlands. In the Rýchory Mts it was recorded at an altitude of 950 m, reaching there its altitudinal maximum.

Carex spicata (Fig. 29)

Carex spicata has a wide Eurasian distribution range centred in the temperate zone. It grows in almost all of Europe from the British Isles and Iceland in the west as far as Lake Baikal in Siberia. In Europe it is missing from the boreal zone north of the 64th parallel in Scandinavia and in the northern part of European Russia. It is very rare in the warmest part of the Mediterranean area and in northern Africa, where it grows only in the moun-

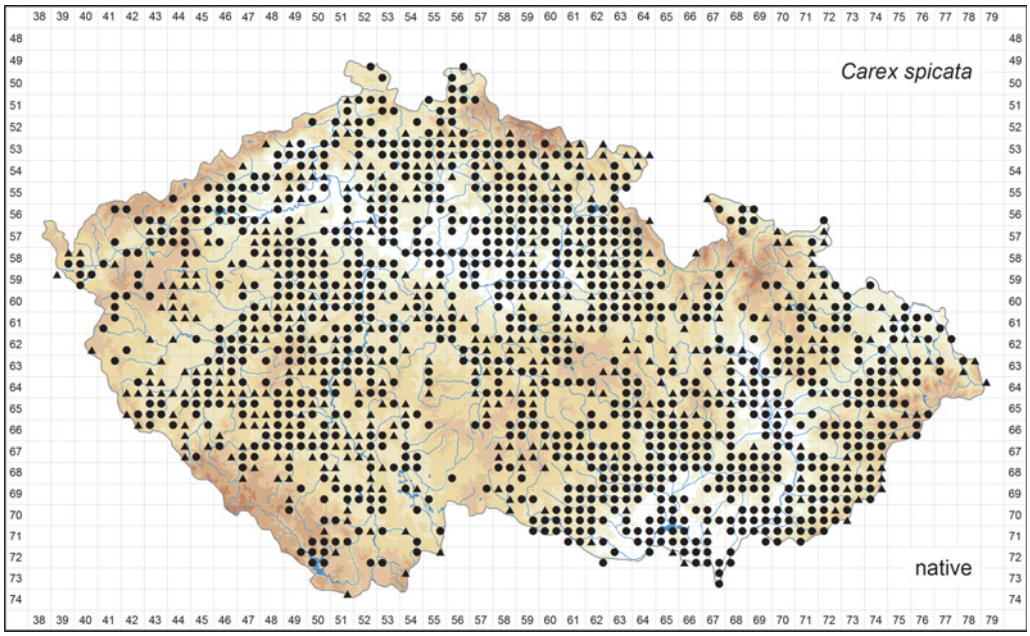


Fig. 29. – Distribution of *Carex spicata* in the Czech Republic: ● occurrence documented by herbarium specimens (1047 quadrants), ▲ occurrence based on other records (343 quadrants). Prepared by Radomír Řepka & Vít Grulich.

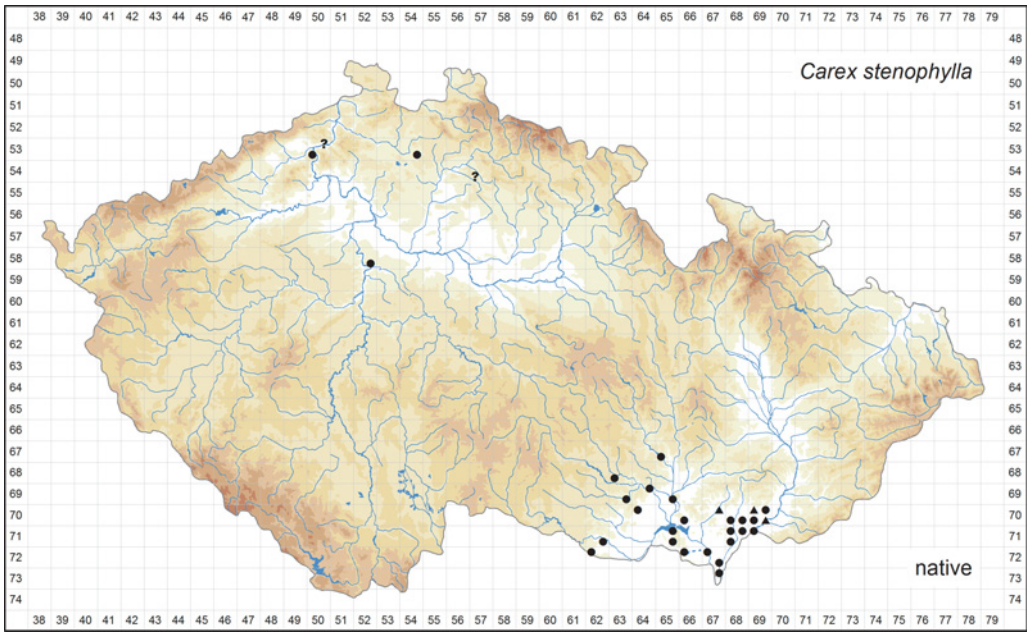


Fig. 30. – Distribution of *Carex stenophylla* in the Czech Republic: ● occurrence documented by herbarium specimens (26 quadrants), ▲ occurrence based on other records (3 quadrants). Prepared by Vít Grulich & Radomír Řepka.

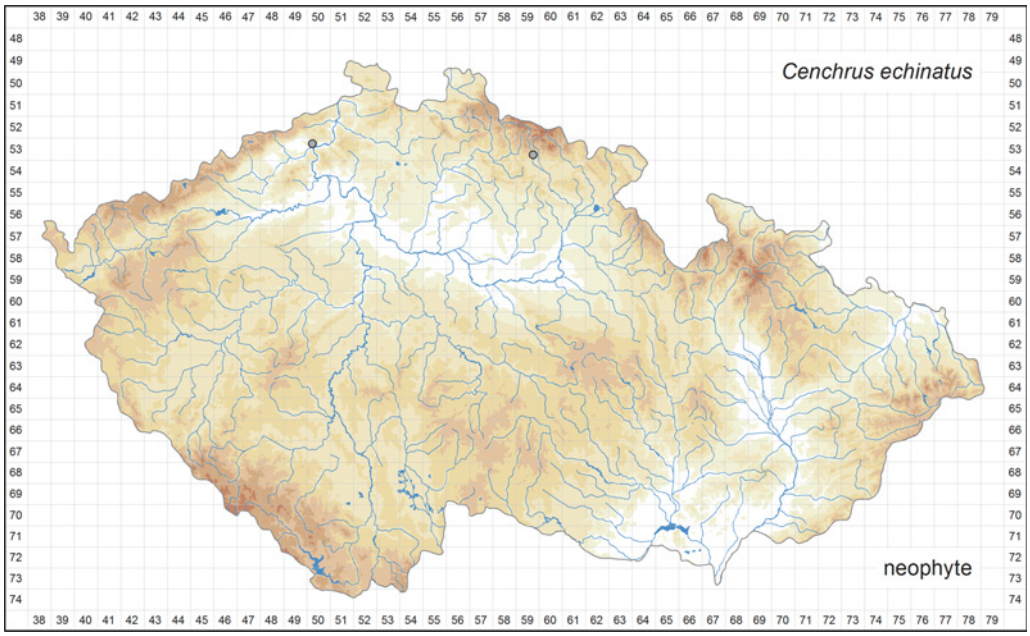


Fig. 31. – Distribution of *Cenchrus echinatus* in the Czech Republic (2 occupied quadrants). Prepared by Jitka Štěpánková.

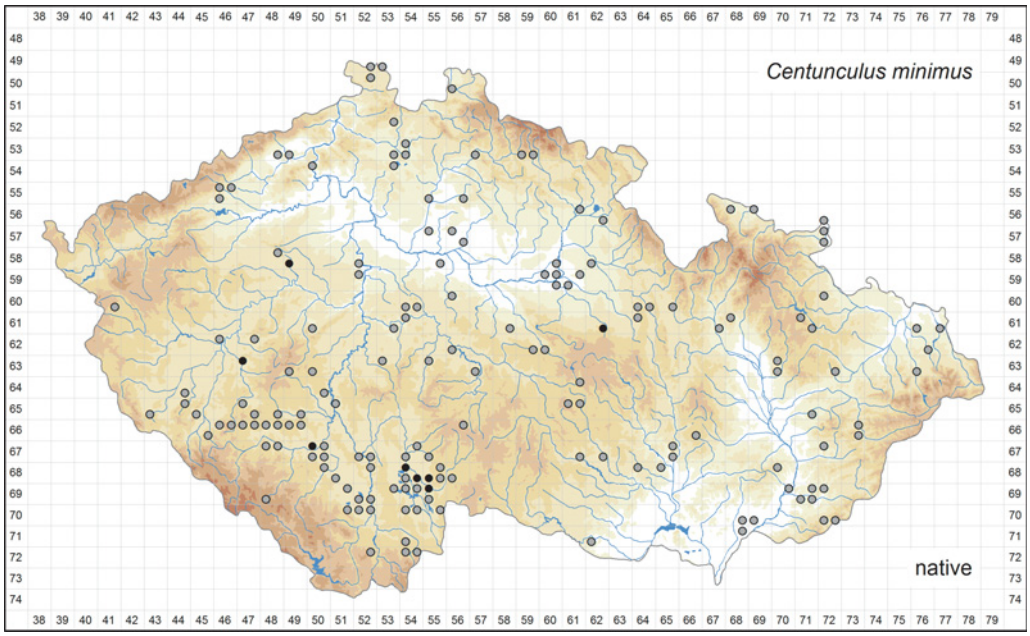


Fig. 32. – Distribution of *Centunculus minimus* in the Czech Republic: ● at least one record in 2000–2016 (8 quadrants), ◍ pre 2000 records only (156 quadrants). Prepared by Jan Prančl.

tains. In Asia the southern limit of its distribution range runs through Anatolia, the Caucasus Mts, northern Iran and Central Asia. It has also been recorded in Madeira and the Canary Islands. In Spain Molina et al. (2008b) distinguish *C. s.* subsp. *andresii*, whereas plants in the remaining part of the distribution range belong to the variable type subspecies. In the Czech Republic *C. spicata* has the widest ecological amplitude of all members of *C.* sect. *Phaestoglochin*, preferring mostly non-forest, secondary habitats and rarely occurring in semi-natural vegetation. Its most frequent habitats are ruderal sites, landfills, roadsides, railway embankments, wet, mesic and dry meadows and pastures, urban lawns, banks of ponds, clearings, black locust groves and rocky hillsides. This sedge has an obvious affinity to wet, rather warm and nutrient-rich soils, growing on soils with a high nitrogen content. Still, it also occurs on dry and sandy, sometimes even saline soils. It can withstand frequent mowing. In the Czech Republic *C. spicata* is the most common species of the *C. muricata* complex. It is widespread in warm and moderately warm parts of the country up to the altitude of 500 m, being absent from or scarce in western Bohemia and southern Bohemia east of the Vltava River; however this may be also due to underrecording. The species is missing from most of the mountains apart from (perhaps casual) introductions recorded along roads and walking paths up to a maximum altitude of 1100 m. *Carex spicata* can be easily distinguished from other species of *C.* sect. *Phaestoglochin* (Řepka 2003, Molina et al. 2008b) and we therefore accept non-documented field records for the map, being aware that some may still be erroneous.

Carex stenophylla (Fig. 30)

The *Carex stenophylla* group (Egorova 1999) includes about 5 taxa distributed in central and eastern Europe, the entire Siberian steppe zone, China, the Far East and continental North America. In Europe *C. stenophylla* occupies its continental and subcontinental parts, with the westernmost locality situated in northern Italy and Slovenia. It occurs in the Czech Republic, Austria, Slovakia, Hungary, Poland, northern part of the Balkan Peninsula, Ukraine and European Russia. In Asia it grows in Kazakhstan and the Altai Mts in western Siberia (Meusel et al. 1965, Hultén & Fries 1986, Korniak 1987). In the Czech Republic *C. stenophylla* is a facultative psammophyte growing mainly on road verges and in short lawns in human settlements. It has rarely been found also in dry grasslands over limestone and granite; formerly it also occurred in saline habitats that were partly flooded in spring. It is tolerant of mowing and other types of mechanical disturbance. In contrast, it is a weak competitor, and some populations are endangered by the encroachment of nitrophilous broad-leaved species. Its presence on gravel, sand and sandstone in Bohemia may be attributable to the Sarmatian plant migration as are the localities in Poland (Korniak 1987). In the Czech Republic *C. stenophylla* occurs only in its warmest regions, rarely elsewhere. In Bohemia it was collected in a small number of sites near the towns of Ústí nad Labem and Mimoň in northern Bohemia and in Prague, all other records being erroneous. All Bohemian populations have been extirpated. In Moravia *C. stenophylla* is found in the warmest parts of the province, being most frequent on wind-blown sands near the town of Hodonín. Its local distribution range may be roughly delimited by the lines connecting the city of Brno with the town of Znojmo in the southwest and with the town of Hodonín in the southeast, with the northernmost site situated at the northern edge of Brno. The local altitudinal maximum is at 400 m. The south

Moravian sites are situated not far from localities in Lower Austria, Slovakia and Hungary, which suggests its relationship with the Pontic-Pannonian flora (Podpěra 1930, Řepka 1983). *Carex stenophylla* is classified as endangered (Grulich 2012) but there is no immediate threat by humans as it occurs in sandy places trampled and strongly disturbed by man and no decline has been observed.

Cenchrus echinatus (Fig. 31)

Cenchrus echinatus is native to the tropical parts of both Americas and it has been introduced to most tropical countries of the World, rarely also to the warm part of the temperate zone, usually with wool shoddy, bird seeds or soya waste (DeLisle 1963). In Europe it has been recorded in the British Isles, Spain, France, Hungary and Greece (Holm et al. 1991, Greuter 2006). In the Czech Republic *C. echinatus* was first collected in 1908 in Trutnov next to a woollen factory, for the second time in 1968 in a goods railway station in Ústí nad Labem. It is classified as a casual neophyte (Pyšek et al. 2012b).

Centunculus minimus (Fig. 32)

Centunculus minimus is an amphi-atlantic species, occurring mainly in temperate zones of Europe and North America (Meusel et al. 1978, Hultén & Fries 1986). In Europe it is distributed across most of the continent, extending from Ireland and Portugal eastwards to temperate regions of European Russia, but appears to be rare in the Mediterranean area and absent from northern parts of Scandinavia, not exceeding 63°N there. It also occurs in the Azores, northernmost Africa and Ethiopia (Meusel et al. 1978), and rarely in Asia, being reported only from the Russian Far East, India and Taiwan (Tsvelev 1980, Hultén & Fries 1986, Hsu et al. 2009). It has been introduced to South America and south-eastern Australia (Zuloaga & Morrone 1999, Walsh 2003). *Centunculus minimus* is a competitively weak wetland annual, confined to open nutrient-poor habitats, mainly on sandy or gravelly substrates with acidic soil reaction (Popiela 1998). It prefers habitats such as exposed pond littorals, abandoned sand-pits, lightly managed arable fields (often stubble fields), edges of sandy tracks, disturbed sites in pastures, ditches and other wet places with sparse vegetation cover. In the Czech Republic *C. minimus* has probably never been common, although it has undoubtedly been overlooked due to its diminutive habit and late phenology. In the past it was sparsely distributed across the country, being most frequent in the fishpond landscapes of southern Bohemia. It has been recorded at altitudes 180–900 m, most frequently at middle elevations. *Centunculus minimus* has markedly declined since World War II. It has completely vanished from fishponds as a result of intensification of fish farming, especially fertilizing and restriction of summer drainage. The causes of its disappearance are probably similar to those of *Radiola linoides* (cf. Šumberová 2013c). Recently, the drainage of fishponds is not applied as systematically as in the past and most often only for a shortened period in the first half of the growing season. *Centunculus minimus* as a late growing species, flowering and fruiting mostly from July to October, is usually unable to complete its life cycle under these conditions. High amount of fertilisers and lime in fish farming causes eutrophication and supports more competitive tall growing species. The disappearance of the species from fields and pastures is associated with the decline of grazing, abandonment of lightly managed sandy crofts or their conversion to more productive cropland. *Centunculus minimus* has been

observed at only eight sites since 2000 and vanished completely from Moravia. It is currently classified as critically endangered (Grulich 2012). Several non-native populations on the sand-pits in the Třeboňská pánev basin, originating from recent rescue cultivations (A. Kučerová, in litt.), were not included in the map.

Convallaria majalis (Fig. 33)

Convallaria majalis is native to most of Europe, being absent from Iceland, northernmost Scandinavia and north-eastern Russia, and in the south from most of the Mediterranean area, Pannonian Basin and the Ukrainian and Russian steppe zone; the plants from the Crimea and Caucasus Mts are sometimes separated as *C. transcaucasica* but the variety rank seems to be more appropriate (Meusel et al. 1965, Hultén & Fries 1986, Kupriyanova 1986). In the Czech Republic *C. majalis* grows in open broadleaved and mixed forests, alluvial forests and on shrubby slopes. It is a rhizomatous geophyte preferring humid loamy soils rich in nutrients, basic to moderately acid. In dry, nutrient-poor soils and in forests with dense canopy it forms large patches of sterile plants. It is scattered or locally frequent in the wooded areas of the country, avoiding native spruce forests; above the timberline in the Krkonoše and Hrubý Jeseník Mts it is found only in glacial cirques. It occurs from the low to middle altitudes, reaching its altitudinal maximum of 1400 m in the Velká kotlina glacial cirque in the Hrubý Jeseník Mts. To the Czech Republic only *C. m.* var. *majalis* is native. However, plants cultivated in the gardens, parks and cemeteries belong to various taxa or cultivars of uncertain origin. Plants from the Caucasian region of Abkhasia were introduced in the 1970s to the garden of the Klatovy hospital in western Bohemia, became naturalized there and subsequently escaped to a nearby forest-park. They may be assigned to *C. m.* var. *transcaucasica* (Čížek & Král 2009).

Crocus heuffelianus (Fig. 34)

Crocus heuffelianus is distributed in the Carpathians, mountains of the Balkan Peninsula and very likely also in northern Italy (Harpke et al. 2015). Plants from the Western Carpathians (Slovakia, Poland and Czech Republic) are sometimes treated as a separate species, *C. discolor*. However, except for different number of chromosomes and slightly narrower leaves in the Western Carpathian plants, there is no clear line of distinction between the two variants and thus the broader species concept is adopted here. *Crocus heuffelianus* is found in regularly mown meadows, pastures, stream ash-alder woods and occasionally also in margins of mountain forests. In the Czech Republic it is native to eastern Moravia and Silesia, recently confirmed at five localities, each harbouring one to several populations. Isolated occurrences in the Orlické hory Mts and Žďárské vrchy Mts are most likely of secondary origin. In the Krkonoše Mts in north-eastern Bohemia, plants slightly different from those found in the Carpathians (but still included here in *C. heuffelianus*) have escaped from cultivation and become locally naturalized. *Crocus heuffelianus* occurs at altitudes about 320–950 m in eastern Moravia and Silesia and occasionally up to 1390 m in the Krkonoše Mts. Due to its rarity and possible habitat loss (abandonment of meadows and development of rural areas) it is classified as critically threatened (Grulich 2012).

Crocus vernus (Fig. 35)

Crocus vernus is a correct name for the species recently treated as *C. albiflorus* (Peruzzi et al. 2013). It is a European mountain species distributed in the Pyrenees, Alps, mountains in the north of the Balkan Peninsula and some adjacent uplands (Harpke et al. 2015). In the Czech Republic it reaches the northern limit of its distribution range. It may be native to the Šumava Mts and Novohradské hory Mts in southern Bohemia and in the Smolinka stream basin near the town of Valašské Klobouky in eastern Moravia. In contrast, there is reliable evidence for deliberate planting at other localities, e.g. the village of Slunečná near the town of Česká Lípa and near the town of Malá Skála in northern Bohemia. Scattered occurrences in the Krkonoše Mts in north-eastern Bohemia, mostly at meadows close to chalets and houses (the species is locally common in the easternmost part of the mountains) seem to have originated from either deliberate planting in the wild or as garden escapes. *Crocus vernus* grows in regularly mown meadows, pastures, occasionally also forest margins and shrubs at altitudes up to 1030 m. It is somewhat endangered by land-use changes, particularly by abandonment of meadows. Despite doubts about its indigenous status the species is classified as endangered (Grulich 2012).

Cryptogramma crispa (Fig. 36)

Cryptogramma crispa is an autotetraploid species distributed in high mountains of Europe eastwards to Scandinavia, the Carpathians and the Balkan Peninsula, and in adjacent western Asia, with an outpost in the Ural Mts (Hultén & Fries 1986). In the Czech Republic *C. crispa* inhabits mainly screes and crevices of siliceous rocks usually in glacial cirques in the mountains. It still occurs at several sites in the central part of the Krkonoše Mts and at the last site in the glacial cirque of the Mt Jezerní hora in the Šumava Mts. In the past *C. crispa* also occurred at several other sites in the Šumava Mts and also in the Novohradské hory Mts; an isolated occurrence was recorded in Kamenec hill near the village of Starý Šachov in the České středohoří Mts. It is classified as critically threatened (Grulich 2012).

Cyperus flavescens (Fig. 37)

Cyperus flavescens is a wetland annual species with a large but rather disjunct distribution range involving temperate to tropical zones of Eurasia, Africa, North, Central and South America and (probably secondarily) also Australia (Meusel et al. 1965, Lampe 1996). The only larger area with more or less continuous occurrence extends throughout the southern part of central Europe and central and eastern part of the Mediterranean area (Lampe 1996). High summer temperatures and moderately high precipitations (mainly from autumn to spring) are typical of areas with the occurrence of *C. flavescens*, which belongs to the thermophilous species, in central Europe not germinating before mid-May (Lampe 1996). In the Czech Republic *C. flavescens* was in the past frequently scattered in lowland and colline areas throughout the country, with the largest concentrations of localities in the Bohemian Cretaceous Basin, fishpond landscapes of southern Bohemia, and some parts of southern and central Moravia and the Carpathians. It is able to grow on a broad range of substrates, both calcareous and non-calcareous, e.g. wet sand, loam and clay (including salty type), and peaty and fen soils (Lampe 1996). The range of its potentially

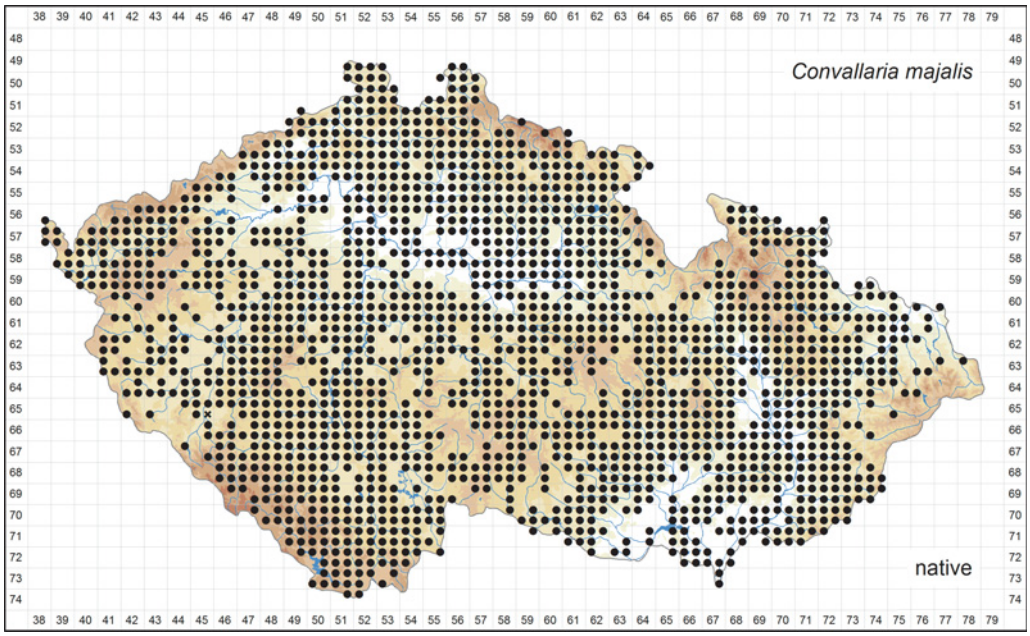


Fig. 33. – Distribution of *Convallaria majalis* in the Czech Republic: ● *C. m.* var. *majalis* (1807 quadrants), × both *C. m.* var. *majalis* and alien *C. m.* var. *transcaucasica* (1 quadrant). Prepared by Jiří Zázvorka.

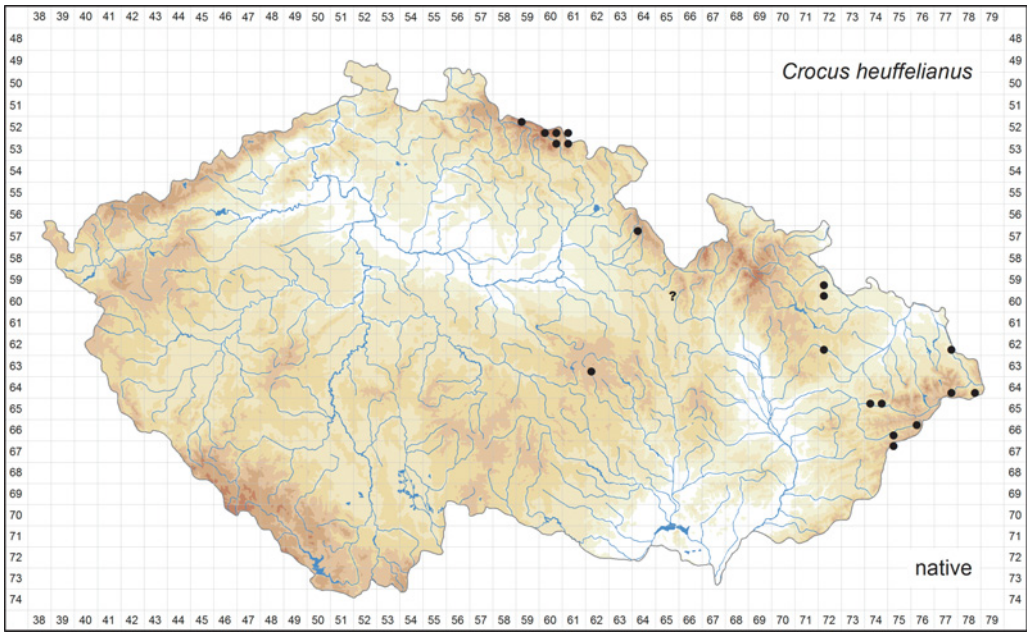


Fig. 34. – Distribution of *Crocus heuffelianus* in the Czech Republic (19 occupied quadrants). Prepared by Jindřich Chrtek Jr.

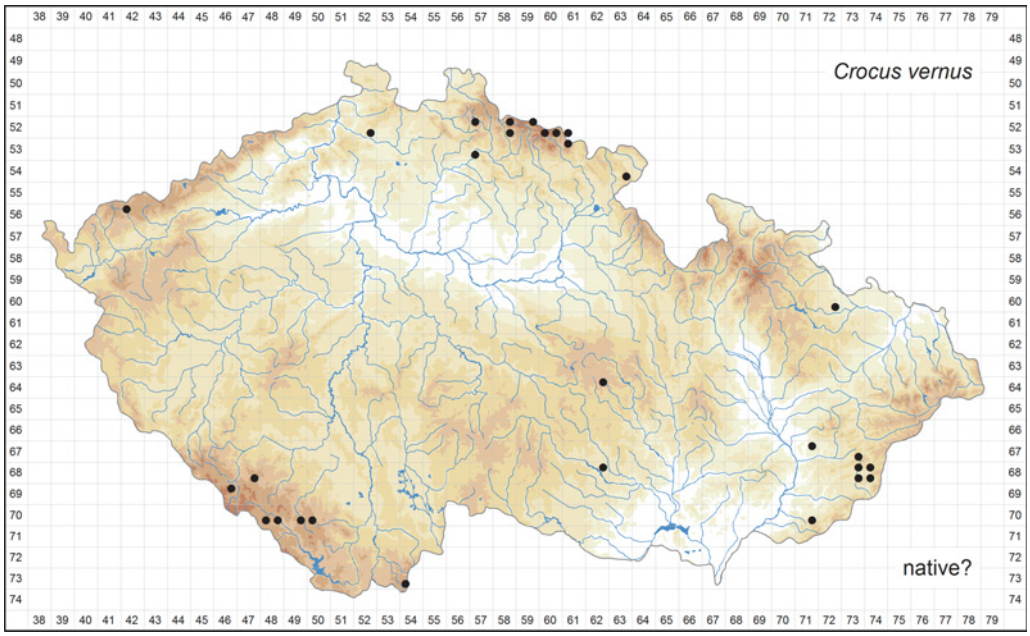


Fig. 35. – Distribution of *Crocus vernus* in the Czech Republic (29 occupied quadrants). Prepared by Jindřich Chrtek Jr.

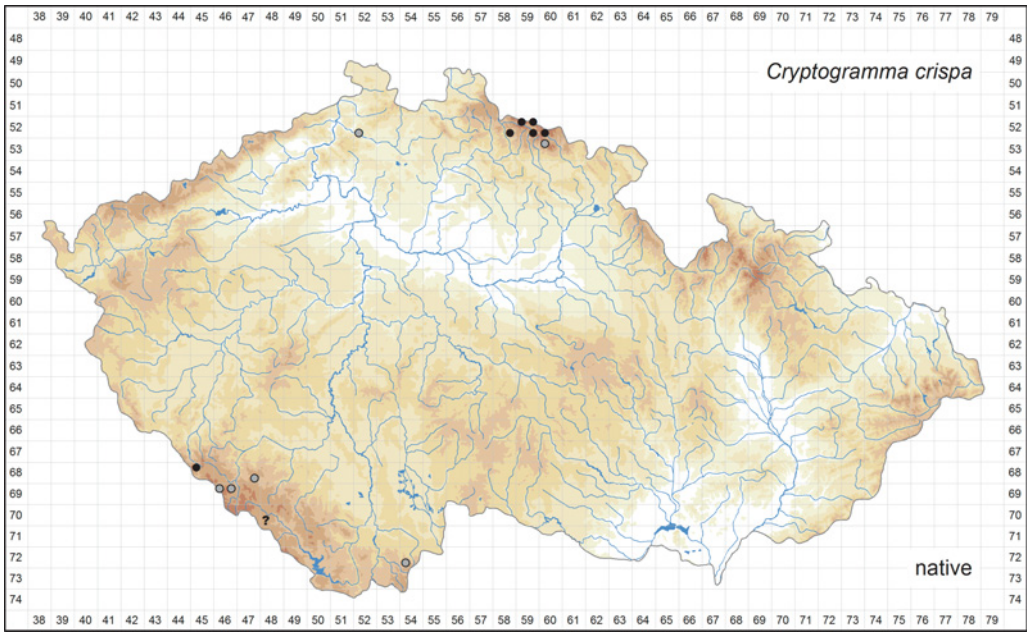


Fig. 36. – Distribution of *Cryptogramma crispa* in the Czech Republic: ● at least one record in 2000–2016 (6 quadrants), ◍ pre 2000 records only (6 quadrants). Prepared by Libor Ekrt.

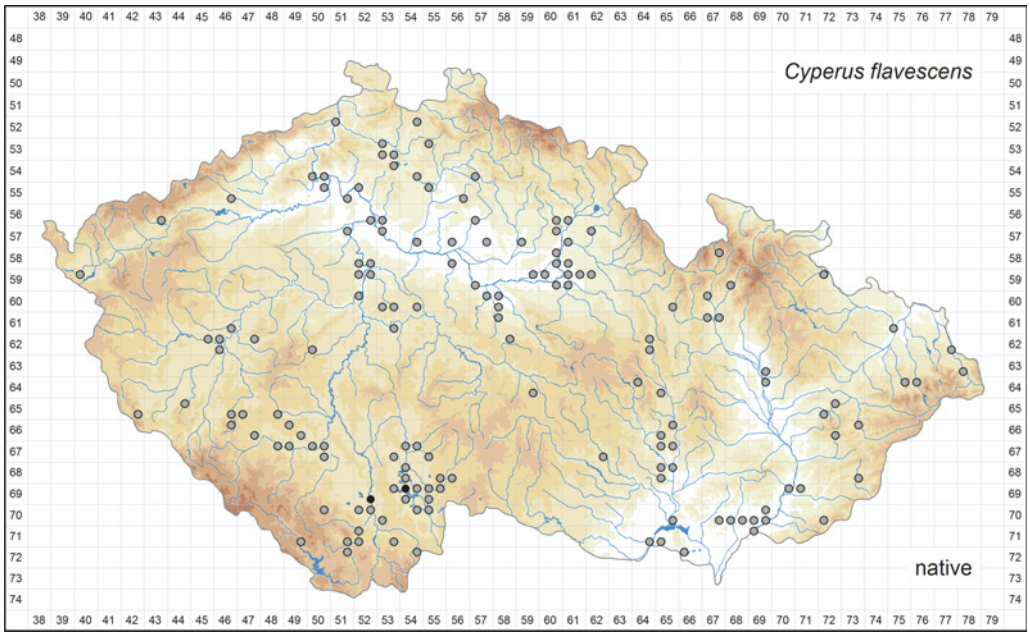


Fig. 37. – Distribution of *Cyperus flavescens* in the Czech Republic: ● at least one record in 2000–2016 (2 quadrants), ◍ pre 2000 records only (152 quadrants). Prepared by Kateřina Šumberová & Pavel Dřevojan.

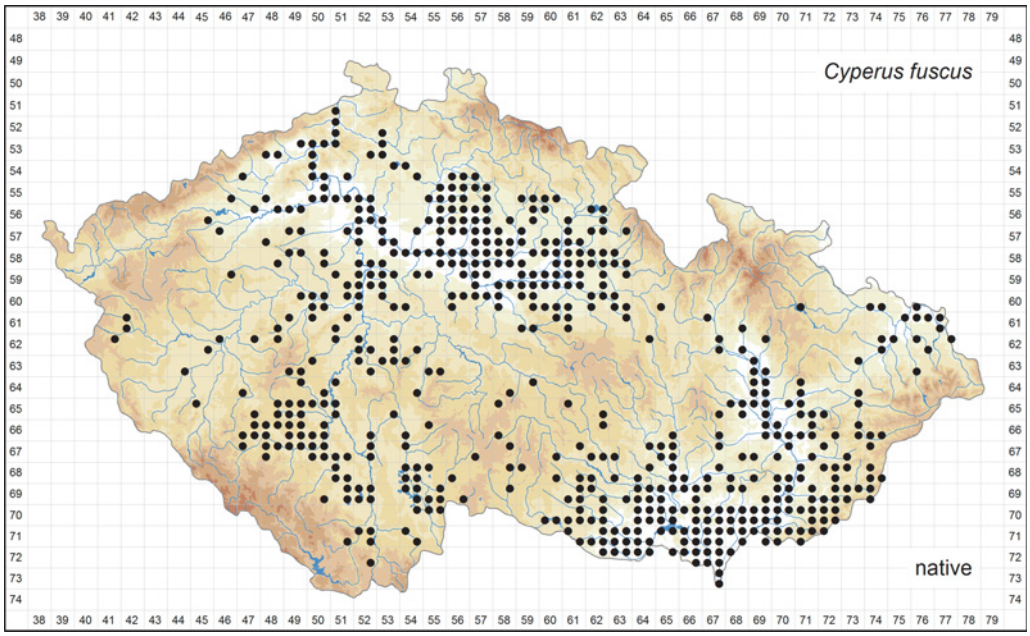


Fig. 38. – Distribution of *Cyperus fuscus* in the Czech Republic (576 occupied quadrants). Prepared by Kateřina Šumberová, Pavel Dřevojan, Zdenka Hroudová & Pavel Kúr.

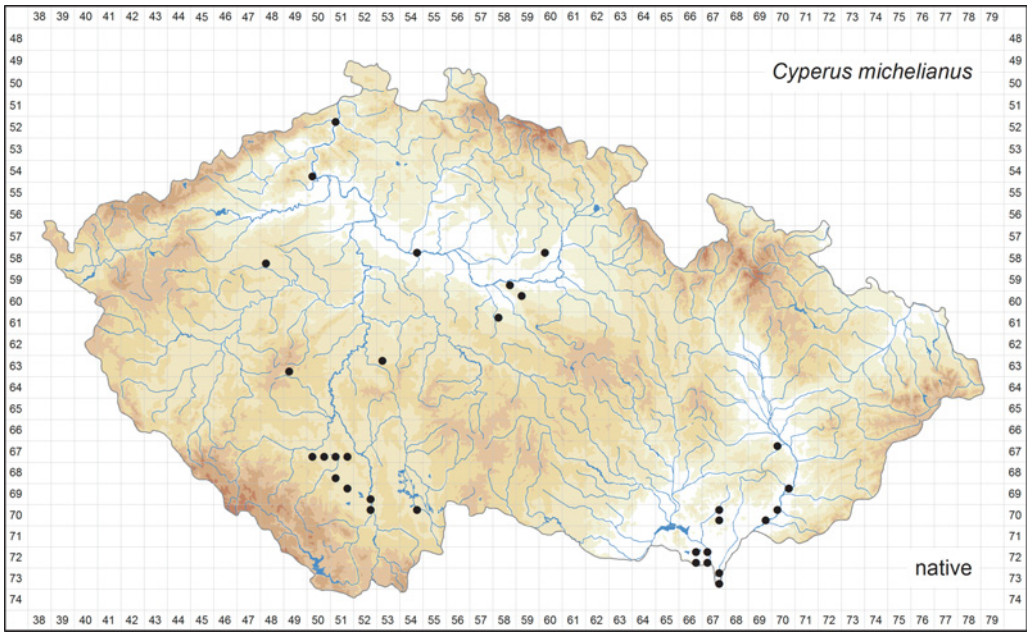


Fig. 39. – Distribution of *Cyperus michelianus* in the Czech Republic (31 occupied quadrants). Prepared by Kateřina Šumberová & Pavel Dřevojan.

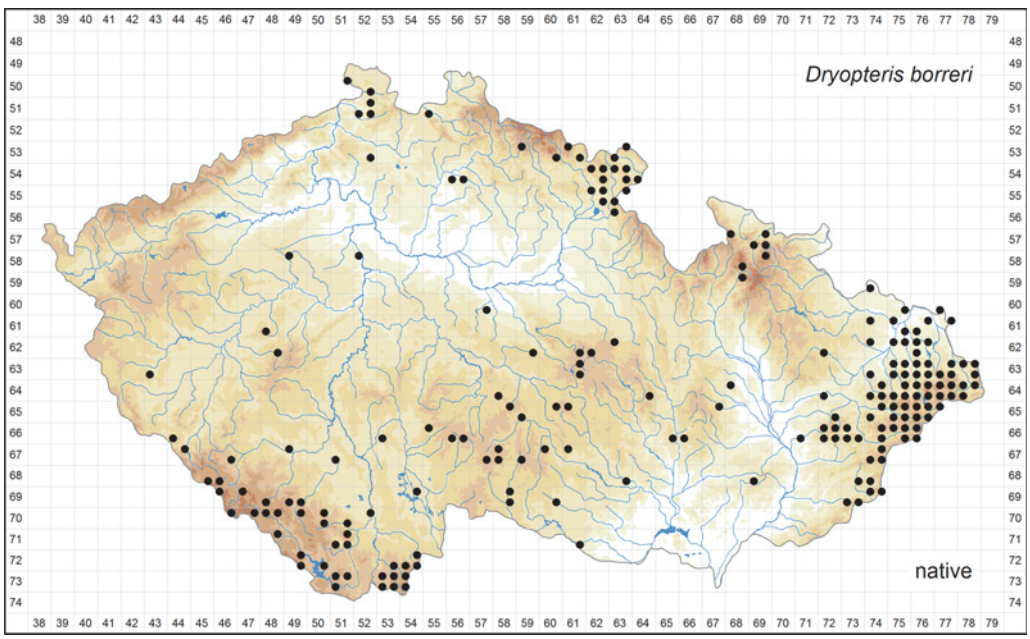


Fig. 40. – Distribution of *Dryopteris borreri* in the Czech Republic (200 occupied quadrants). Prepared by Libor Ekrt.

suitable habitats includes wet arable fields, pastures, disturbed springs and fens, fishpond margins, fish storage ponds, wet ditches, etc. Despite its large tolerance to variation of abiotic conditions, the species had already started to decrease by the late 19th century, probably as a consequence of large-scale abandonment of low-intensity grazing and overall intensification of agriculture. The last habitats in which the species managed to survive were sandy fishpond littorals, from which *C. flavescens* disappeared during the 1960s–1980s due to fish-farming intensification, in particular intensive fertilization and summer drainage restriction. Small-scale and moderate but regular disturbances are probably the key to *C. flavescens* survival in the landscape; patches without dense vegetation are indispensable for its successful germination and reproduction. Nowadays only two spontaneous populations of the species are known in the Czech Republic, both located in South Bohemian fish storage ponds. Some other populations of *C. flavescens* in the surroundings of the town of Třeboň in southern Bohemia have originated from intentional sowing in abandoned sand pits within rescue cultivations (A. Kučerová, in litt.) and they are not displayed in the map. *Cyperus flavescens* is classified as critically threatened (Grulich 2012).

Cyperus fuscus (Fig. 38)

Cyperus fuscus is a Eurasian wetland annual plant distributed mainly in warm temperate and Mediterranean parts of Europe, northern Africa and western Asia, with its northern distribution limit in southern Scandinavia. Eastwards it is scattered throughout the temperate zone of continental Asia (at high altitudes reaching the subtropical zone), being more frequent in floodplains of large rivers and around lakes. It is also known from North America where it is considered as introduced (Lampe 1996). *Cyperus fuscus* prefers mineral-rich calcareous soils, especially in northern parts of its distribution range (Hejný 1960). In the Czech Republic it is mainly confined to the Bohemian Cretaceous Basin, southern Moravia and some parts of the Carpathians (e.g. Bílé Karpaty Mts). *Cyperus fuscus* is a typical component of the vegetation of temporarily exposed bottoms of various water bodies, growing over a broad range of habitats, including fishponds, fish storage ponds, oxbows, river beds, sand pits, wet depressions in arable fields and disturbed places in wet meadows. In areas formed by acidic, mineral-poor bedrock, such as fishpond landscapes of southern Bohemia, the species was reported as rare until the 1950s, occurring mainly in eutrophic water bodies in settlements (Hejný 1960, Šumberová 2013a). As a consequence of overall eutrophication and soil chemistry changes associated with fish farming intensification, in particular combined fish and duck farming and intensive liming of some ponds, the number of records has considerably increased since then (Šumberová 2003, 2013a). Despite the loss of some populations due to habitat destruction in river alluvia, the species has recently had many hundreds of localities and is classified only as vulnerable (Grulich 2012).

Cyperus michelianus (Fig. 39)

Cyperus michelianus is a wetland annual plant with a disjunct distribution in temperate to tropical zones of Eurasia, Africa and Australia (Lampe 1996). In Europe the species reaches its northern distributional limits on the Elbe river in eastern Germany and on the Oder river in south-western Poland (Schultze-Motel 1980, Lampe 1996); however, it

meets optimal conditions in regions with warm and dry summers. *Cyperus michelianus* grows on exposed sandy or muddy substrates in river beds, oxbows, sand pits, fishponds and similar habitats, usually on mineral-rich and relatively nitrate-rich, sometimes slightly saline soils (Hejný 1960). It is able to persist in the soil seed banks and to reappear after 15–20 years, although suitable conditions usually occur several times within the given period (Lampe 1996, Hejný 1999). In the Czech Republic and elsewhere in the northern part of its geographic range, *C. michelianus* usually occurs in warm lowland and colline areas. It used to be most frequent in the wetland-rich parts of southern Bohemia and southern Moravia. During the last two decades, *C. michelianus* started to be regularly observed both in areas of its former occurrence and elsewhere. However, most of its former occurrences have not been confirmed recently. Some of them were probably temporary (e.g. in the Brdy Mts). On the one hand, the changes in land-use and landscape management, such as river regulations and elimination of fishpond drainage over the growing season, restricted the number of suitable *C. michelianus* habitats. On the other hand, the changing climate, in particular repeated summer heat waves and drought periods, support more frequent occurrence and successful species' reproduction on existing sites. The species is listed as critically threatened (Grulich 2012).

Dryopteris borreri (Fig. 40)

Dryopteris borreri is a triploid member of the *D. affinis* group (Fraser-Jenkins 2007). This solely apomictic and polyploid complex includes four species in central Europe of which triploids *D. borreri* and *D. cambrensis* are present in the Czech Republic (Ekrt et al. 2009, 2010). The closely related diploid *D. affinis* and the newly discovered triploid *D. lacunosa* are in central Europe restricted to its western and southern parts (Jessen et al. 2011). *Dryopteris affinis* has not been reliably recorded for the Czech Republic yet but it is found in Germany not far from the border with Bohemia (S. Jessen, in litt.). *Dryopteris borreri* is a polymorphic species with assumed origin from the crossing between two diploids, *D. affinis* and *D. caucasica* (Widén et al. 1996). It is a species of European sub-Atlantic and sub-Mediterranean distribution, ranging from south-western Norway to northern Africa and from Macaronesia to the coast of the Caspian Sea in Iran (Fraser-Jenkins 2007). In the Czech Republic it grows mainly in mountain beech, spruce or ravine forests, at middle altitudes being confined to humid and rather cold valleys. In many sites it occurs only in moist places along margins of forest roads. It is particularly frequent in eastern Moravia and adjacent Silesia. It is scattered in the sandstone landscapes of northern and northeastern Bohemia and the mountains of southern Bohemia, and rare elsewhere, mainly in the Českomoravská vrchovina and Drahanská vrchovina highlands (Ekrt et al. 2010). There are no records from the westernmost parts of the country. *Dryopteris borreri* was not reliably distinguished from the similar *D. filix-mas* in the past. The distribution map is based on revised herbarium specimens and a few finds documented by photographs or plants personally inspected but discarded; consequently, many new sites are likely to be discovered in the future. The species is classified as vulnerable because of its limited distribution (Grulich 2012).

Dryopteris cambrensis (Fig. 41)

Dryopteris cambrensis is a triploid member of the *D. affinis* group (see comments under *D. borreri*) with assumed origin from crossing of the diploid *D. affinis* and *D. oreades* (Widén et al. 1996). It occurs throughout the western half of Europe except for its northernmost parts, ranging from the British Isles in the west as far as Bulgaria in the east (Fraser-Jenkins 2007). The Czech Republic is situated close to the north-eastern limit of the species' distribution range, where it is rare. It usually occurs as individual plants (and not rich populations) in spruce, beech, fir or pine forests and in ditches along forest roads. *Dryopteris cambrensis* was not distinguished from similar *D. filix-mas* and *D. borreri* until recently (Ekrt et al. 2009). It appears to be a rare plant: until now it has been found in northern and southern Bohemia, the Českomoravská vrchovina highlands, Czech Silesia and (based on old herbarium specimens) also north of the city of Brno in the karst area of Moravský kras (Ekrt et al. 2010). It is certainly under-recorded and its exact distribution is a topic for further field research. Only revised herbarium specimens were included in the distribution map. *Dryopteris cambrensis* is classified as critically threatened because of its rarity (Grulich 2012).

Dryopteris carthusiana (Fig. 42)

Dryopteris carthusiana is allotetraploid, probably derived from the crossing between the diploid *D. intermedia* and an extinct or as-yet undiscovered taxon (Stein et al. 2010, Sessa et al. 2012). It is a holarctic, mostly boreal-temperate species, being frequent in Europe (except its Mediterranean part) and the adjacent western Siberia, and also occurring in the central and eastern part of North America (Hultén & Fries 1986, Rünk et al. 2012). In the Czech Republic it is most frequent in humid alder forests along streams and springs, in alder carrs, willow scrubs and birch mire forests, and less frequently in beech, spruce, oak-hornbeam and ravine forests, forest margins and open peat bogs. It is widespread throughout the country, particularly at middle and higher elevations, but it tends to be rare or even missing at low altitudes due to absence of suitable humid forest sites. Most of the gaps in the map, mainly at middle altitudes, are due to under-recording rather than true absences of the species.

Dryopteris cristata (Fig. 43)

Dryopteris cristata is allotetraploid, probably derived from the crossing between the diploid *D. ludoviciana*, endemic to the south-eastern USA, and an extinct or as-yet undiscovered species, the same putative parent as that of *D. carthusiana* (Stein et al. 2010). *Dryopteris cristata* occurs mainly in Europe (except its northernmost, westernmost and southernmost parts), in adjacent western Siberia and in the central and eastern part of North America (Hultén & Fries 1986). In the Czech Republic *D. cristata* inhabits mainly peat bogs and treeless marshes. Still, it is able to persist in various succession stages of wetland tree and scrub vegetation such as alder carrs, birch mire forests and willow scrub, or even reed beds, which usually encroach upon this type of wetlands. Most of its localities are found in the Třeboňská pánev basin in southern Bohemia and around the towns of Doksy and Česká Lípa in northern Bohemia. Several other sites are known elsewhere in Bohemia, some of which were discovered only recently. *Dryopteris cristata* is classified as critically threatened (Grulich 2012).

Dryopteris dilatata (Fig. 44)

Dryopteris dilatata is a tetraploid species of as-yet unresolved origin with possible explanations that include several polyploidization events from the diploid *D. expansa* (Juslén et al. 2011) or allopolyploidy from a hybrid of the diploid *D. intermedia* and *D. expansa* (Gibby & Walker 1977, Sessa et al. 2012). It is almost exclusively a European species, being most frequent in western, central Europe and the Carpathians, and scattered in western Russia and western foothills of the Caucasus Mts. It is absent from most of the Mediterranean area, surroundings of the Black Sea areas and central and northern Scandinavia (Hultén & Fries 1986, Rünk et al. 2012). In the Czech Republic it occurs mainly in humid spruce, beech, alder and ravine forests and moist sandstone areas, less frequently in more humid types of oak and oak-hornbeam forests. It is widespread throughout the country but tends to be rare in or missing from low altitudes due to absence of suitable forest habitats. Most of the gaps in the map, particularly those at the middle altitudes, are due to under-recording rather than true absences of the species.

Dryopteris expansa (Fig. 45)

Dryopteris expansa is a diploid species distributed in Europe particularly in Scotland, Scandinavia and the adjacent part of European Russia, and in mountain areas of western, central and eastern Europe. Outside Europe it has been recorded in the Caucasus Mts and throughout subboreal Siberia as far as the Russian Far East and and in temperate and subboreal areas of North America (Hultén & Fries 1986, Rünk et al. 2012). In the Czech Republic it is found in humid sites in beech, spruce, alder and ravine forests, in *Pinus mugo* scrub, subalpine tall-fern vegetation or gorges in sandstone areas and semi-shaded moist screes. It occurs mainly in highlands and mountains up to the subalpine vegetation belts. In low elevations it is missing or very rare, confined to suitable humid microhabitats (Ekrt et al. 2013). It is classified as lower risk – near threatened (Grulich 2012). *Dryopteris expansa* was not distinguished or was frequently misidentified in the past. The map was therefore based solely on revised specimens and is inevitably incomplete.

Dryopteris filix-mas (Fig. 46)

Dryopteris filix-mas is an allotetraploid taxon, probably derived from hybridization of the diploid *D. oreades* and *D. caucasica* (Fraser-Jenkins 1976). It is a holarctic species with a mostly boreal-temperate disjunct range in Eurasia and northern North America (Hultén & Fries 1986). In the Czech Republic *D. filix-mas* inhabits humid spruce, beech, oak-hornbeam and ravine forests, and open stony screes. It is widespread throughout the country, and particularly frequent from the uplands to the mountains. At low altitudes it tends to be rare or missing due to the absence of suitable humid forest sites.

Dryopteris remota (Fig. 47)

Dryopteris remota is a triploid apomictic species, the origin of which is still not reliably resolved (Juslén et al. 2011). *Dryopteris remota* is a subatlantic and subalpine species of the European mountains, being most frequent in the Pyrenees and the adjacent southern part of France, in the Alps and their foothills, the Carpathians and the western part of the Caucasus Mts. Northwards it extends up to Ireland and Scotland, central Germany, the

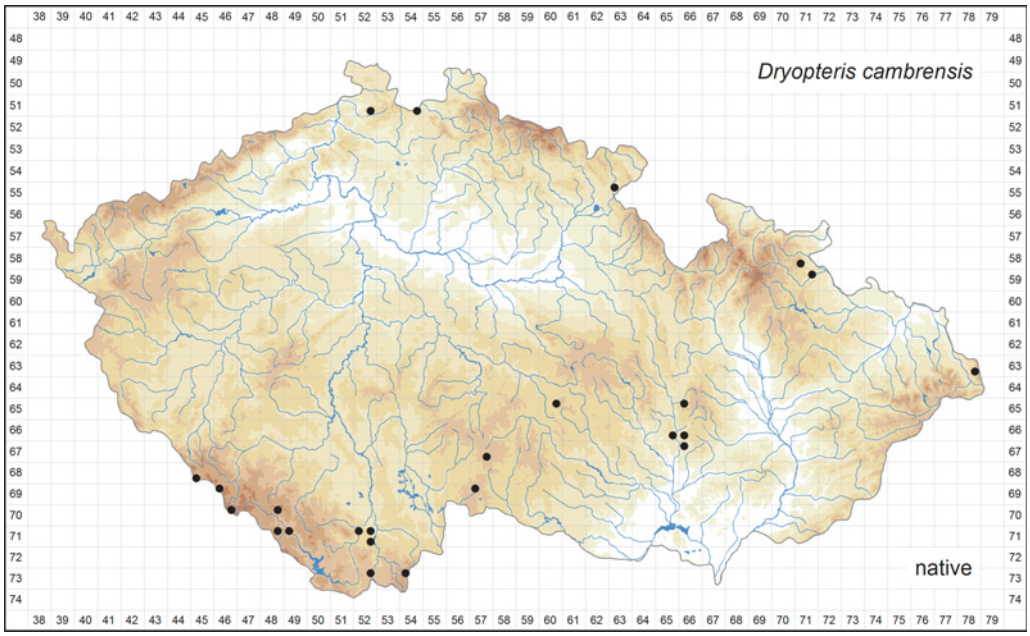


Fig. 41. – Distribution of *Dryopteris cambrensis* in the Czech Republic (24 occupied quadrants). Prepared by Libor Ekrt.

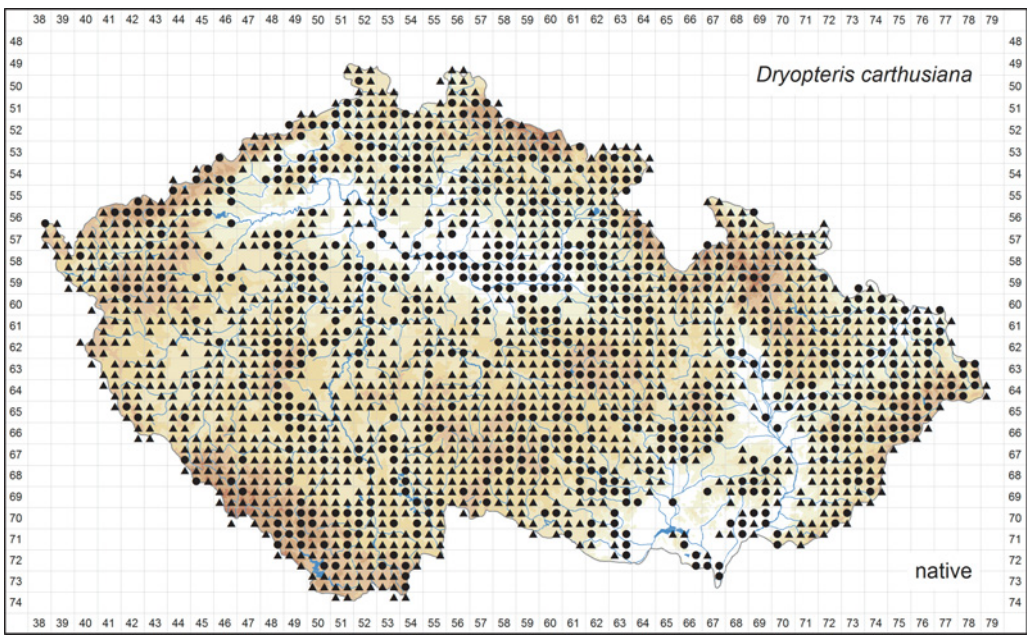


Fig. 42. – Distribution of *Dryopteris carthusiana* in the Czech Republic: ● occurrence documented by herbarium specimens (607 quadrants), ▲ occurrence based on other records (1376 quadrants). Prepared by Libor Ekrt.

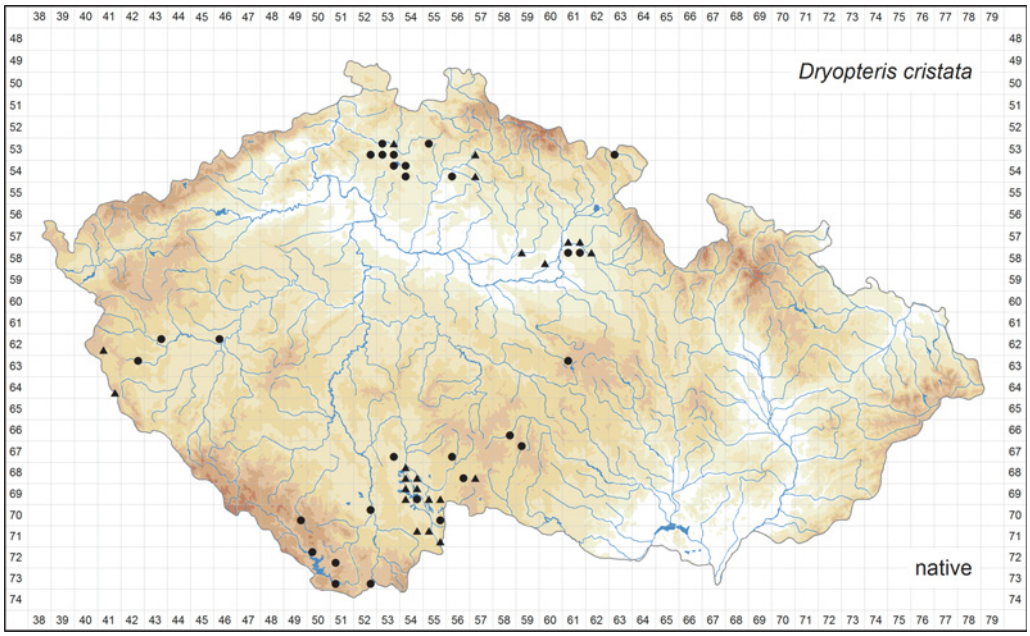


Fig. 43. – Distribution of *Dryopteris cristata* in the Czech Republic: ● occurrence documented by herbarium specimens (29 quadrants), ▲ occurrence based on other records (22 quadrants). Prepared by Libor Ekrt.

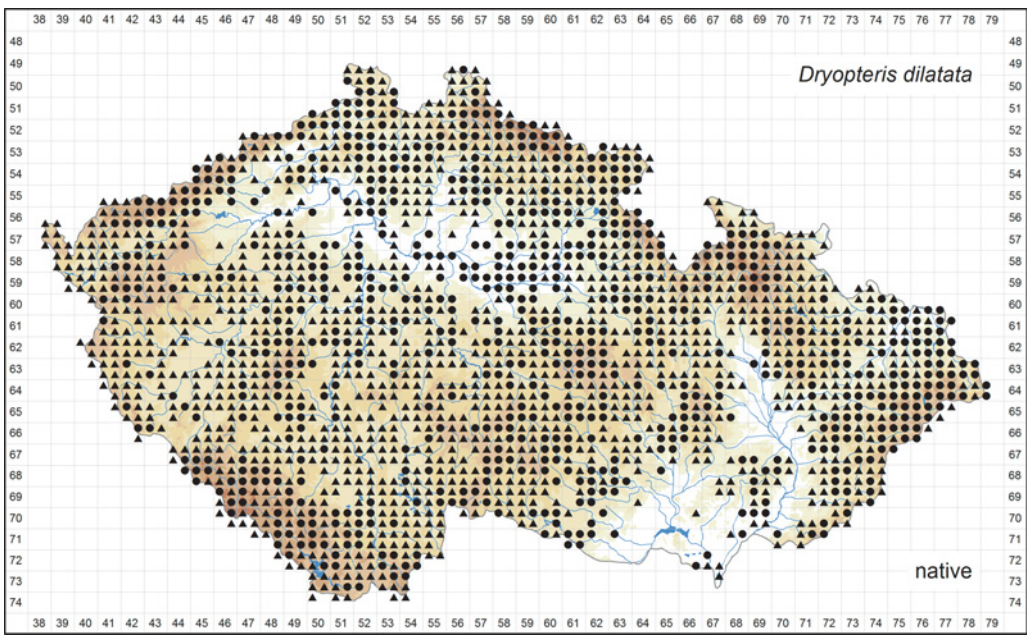


Fig. 44. – Distribution of *Dryopteris dilatata* in the Czech Republic: ● occurrence documented by herbarium specimens (752 quadrants), ▲ occurrence based on other records (1206 quadrants). Prepared by Libor Ekrt.

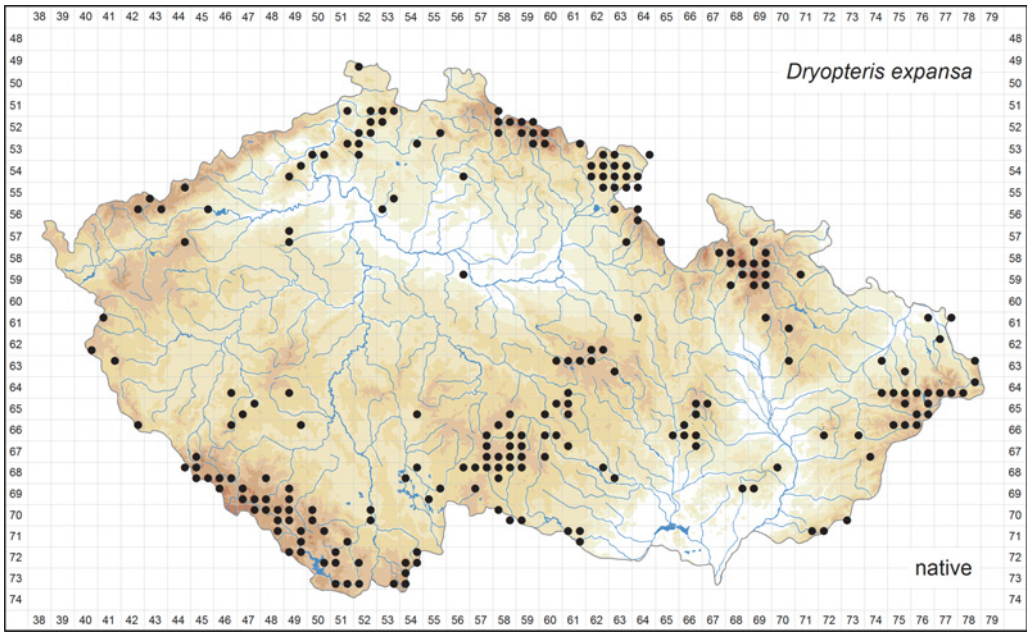


Fig. 45. – Distribution of *Dryopteris expansa* in the Czech Republic (225 occupied quadrants). Prepared by Libor Ekrt.

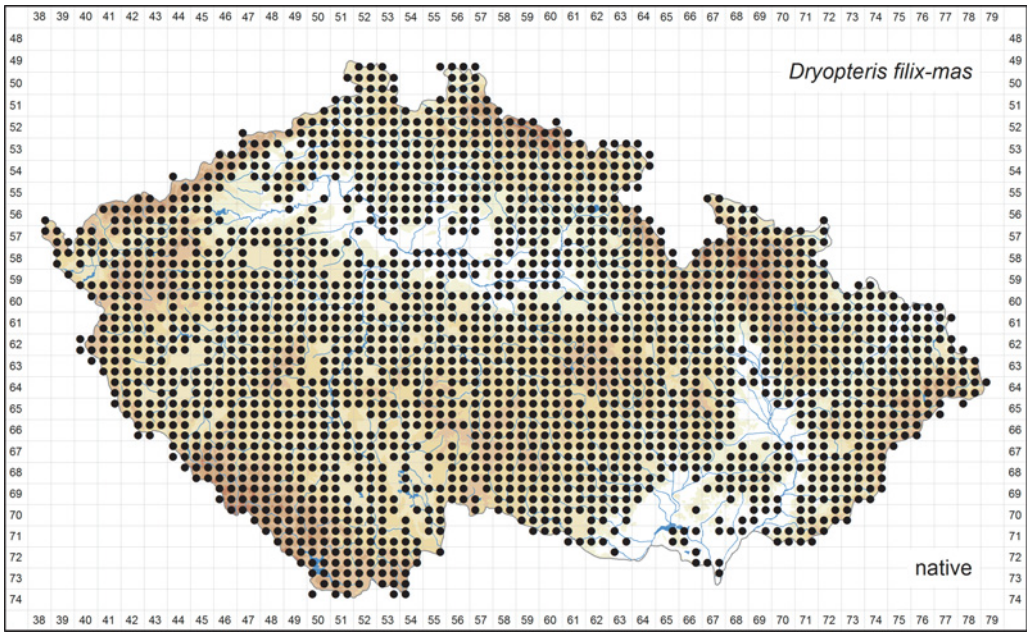


Fig. 46. – Distribution of *Dryopteris filix-mas* in the Czech Republic (2137 occupied quadrants). Prepared by Libor Ekrt.

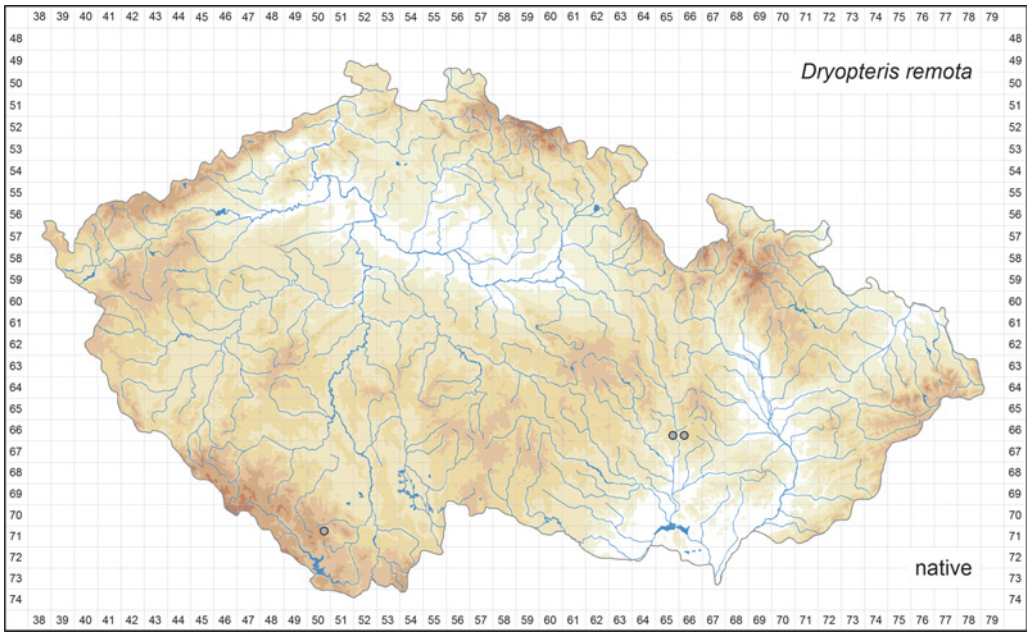


Fig. 47. – Distribution of *Dryopteris remota* in the Czech Republic (3 occupied quadrants). Prepared by Libor Ekrt.

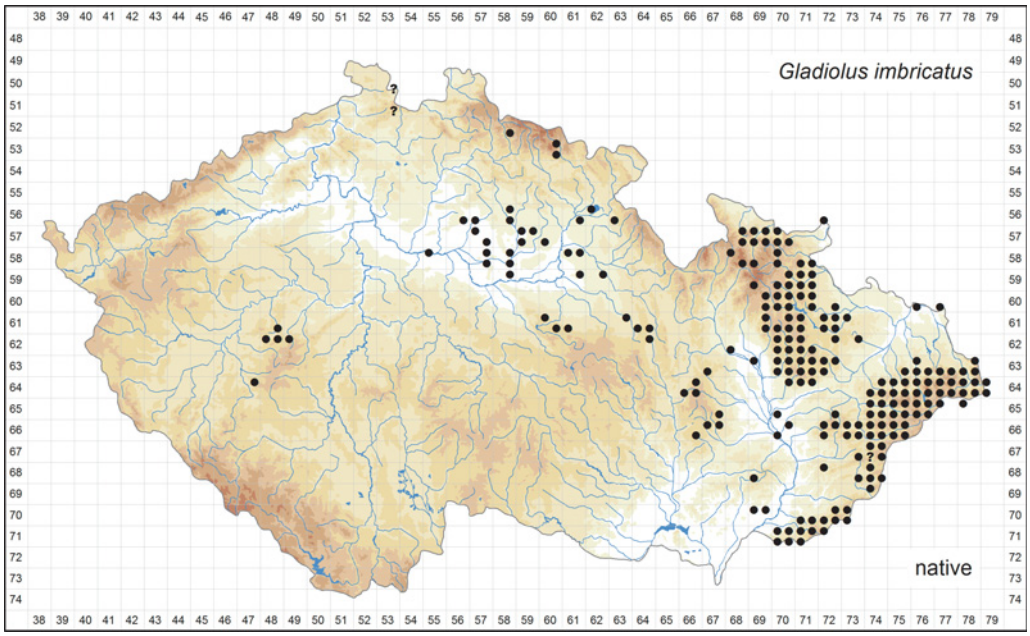


Fig. 48. – Distribution of *Gladiolus imbricatus* in the Czech Republic (211 occupied quadrants). Prepared by Jindřich Chrtek Jr.

Czech Republic, south-eastern Poland and south-western Ukraine (Ekrt et al. 2007). The Czech Republic is situated outside its continuous distribution range and *D. remota* represents there the Alpine migration element. It was discovered there in 1929 at several sites in the karst area of Moravský kras (Bílý 1931, 1937). The second find dates back to 2002 when it was found on Mt Malý Plešný near the village of Ktiš in southern Bohemia (Ekrt et al. 2007). Only a single plant was present there, growing on a rock in the ecotone between shrubs of *Ribes alpinus*, *Rosa pendulina* and *Lonicera nigra*, and open spruce-beech-fir forest. This occurrence has not been confirmed recently. All records shown in the map are based on revised herbarium specimens. Considering its rarity, the species was classified as critically threatened in the last Red List (Grulich 2012), but at present it is actually extirpated.

Gladiolus imbricatus (Fig. 48)

Gladiolus imbricatus is distributed in central and eastern Europe, reaching westwards to the French foothills of the Western Alps, and Thuringia and Lusatia in Germany, northwards to Poland and north-western Russia, southwards to Greece and eastwards as far as the Ural Mts. Outside Europe it has been recorded in western Siberia, the Caucasus Mts, Transcaucasia and Iran (Meusel et al. 1965, Hultén & Fries 1986). In the Czech Republic it inhabits mesic, intermittently wet and fen mown meadows, marshes, meadows springs, open-canopy forests; occasionally it may occur also as a weed in corn and clover fields. *Gladiolus imbricatus* is scattered throughout the Moravian Carpathians and Eastern Sudetes (Nízký Jeseník hills and lower elevations of the Hrubý Jeseník Mts), with occasional extensions to adjacent lowlands, and it is uncommon in eastern Bohemia. Isolated localities are known at foothills of the Brdy Mts near the border between south-western and central Bohemia, in central Bohemia, in the Krkonoše Mts in north-eastern Bohemia, and in the Drahanská vrchovina highlands north of Brno. It occurs at altitudes about 190–1210 m. *Gladiolus imbricatus* declined mainly during the 1950s and 1960s, mostly due to drainage of wetlands and fen meadows. Although many populations are protected in nature reserves nowadays, the species suffers from changes in land-use, mainly abandonment of meadows. It is therefore classified as endangered (Grulich 2012).

Gladiolus palustris (Fig. 49)

Gladiolus palustris is a European species with a disjunct distribution range reaching eastern France in the west, Poland and Lithuania in the north, Belarus, western Ukraine and Bulgaria in the east, and central Italy and Albania in the south (Meusel et al. 1965). In the Czech Republic *G. palustris* is found in intermittently wet meadows, semi-dry grasslands and lowland oak forests. It is very rare, confined to the south-western part of the Bílé Karpaty Mts and to the Hodonínská Dúbrava wood in south-eastern Moravia, and to several sites in the Bohemian Cretaceous basin in central and eastern Bohemia. It occurs in the planar, colline and supracolline vegetation belts with an altitudinal maximum at 430 m in the Čertoryje National Nature Reserve in the Bílé Karpaty Mts. *Gladiolus palustris* is a declining species, since 2000 only confirmed near the village of Velenka in central Bohemia and in south-eastern Moravia at a few sites in the Hodonínská Dúbrava wood and at a single site in the Čertoryje reserve in the Bílé Karpaty Mts. It is therefore classified as critically threatened (Grulich 2012).

Gratiola neglecta (Fig. 50)

Gratiola neglecta is a wetland annual species of North-American origin with the main distribution in the catchment basin of the Mississippi and Missouri rivers in the eastern USA (Pennell 1935). Since 1919 it has been recorded as an alien in various places of Europe: Alsace in France (Simon 1960, Soriano & Romero 2008), southern Finland (Suominen 1984, Soriano & Romero 2008) and north-western Germany (Raabe 2007). It is also reported from Japan (Ohwi 1965). Both in the primary and the secondary range the species colonizes muddy river beds, exposed pond and lake bottoms, wet arable fields and similar wet habitats with open vegetation (Pennell 1935, Šumberová & Ducháček 2009). In the Czech Republic *G. neglecta* was for the first time collected in 1941 near the town of Lázně Bohdaneč in eastern Bohemia but the specimen was misidentified as *G. officinalis* (Lustyk 2015). Recently it was found in fish storage ponds (probably the same site as of the find from 1941) and two small fishponds near the town of Lázně Bohdaneč in eastern Bohemia and in fish storage ponds in the town of Blatná in southern Bohemia (Šumberová & Ducháček 2009, Šumberová 2013b). Although its invasive potential in central Europe does not appear to be very high, it may persist for decades at one site. The manner of its first introduction to the Czech Republic remains unknown. Various dispersal modes, including anthropochory by means of vehicles used for fish transport or with fish-farming equipment (Šumberová et al. 2012b) are in question.

Gratiola officinalis (Fig. 51)

Gratiola officinalis is a species of mainly European distribution; isolated occurrences are also known from Anatolia, Central Asia and western Siberia (Hartl 1975, Meusel et al. 1978). In Europe it is known from the temperate and meridional zones where it follows large river floodplains (Burkart 2001), reaching its native northern distribution limit in the Baltic countries, the western limits in the Benelux countries and the Iberian Peninsula, the southern limits in Sardinia and Greece, and the eastern limits in the Volga and Kama river floodplains in Russia (Hartl 1975, Meusel et al. 1978). *Gratiola officinalis* has its optimum in lowland floodplain meadows with regular disturbances by flood, mowing and intensive fluctuations of soil moisture during the growing season (Burkart 2001). The species is able to grow also in other disturbed wet habitats such as ditches, flooded sand and gravel pits and fishpond banks. In the Czech Republic its past distribution involved lowland floodplains of large rivers, in particular of Morava, Dyje and Svratka in southern and central Moravia, and floodplains of the Labe river and its tributaries in north-western and central Bohemia. From there, the species reached lowlands in northern Moravia and Silesia and the colline belt in eastern and northern Bohemia; isolated occurrences were recorded in southern Bohemia. Old records outside the floodplains are probably due to garden escapes, related to the medical use of *G. officinalis* in the past (Skokan 1928, Hartl 1975). We accepted most of these records for the map, though some of them (mainly literature records) as uncertain. Records of plants intentionally planted outside gardens were excluded. The species has declined considerably since the beginning of the 20th century, probably as a consequence of land-use change (particularly the abandonment of low-intensity grazing) and the large-scale river regulations, in particular in the Labe river basin. During the 1960s to 1980s the drainage of meadows and their conversion to arable land, and abandonment of other wet grasslands

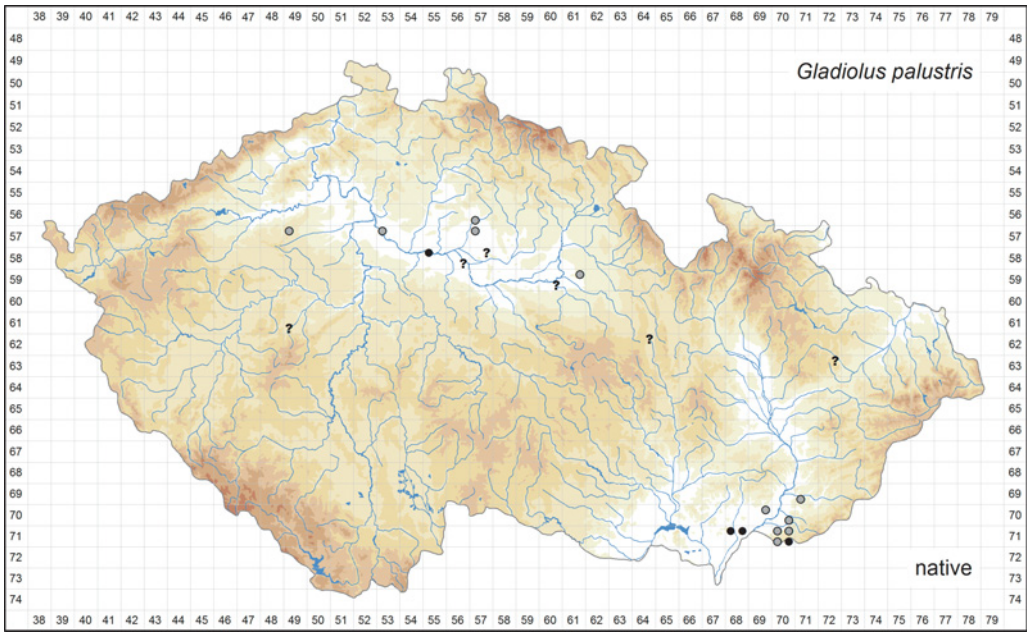


Fig. 49. – Distribution of *Gladiolus palustris* in the Czech Republic: ● at least one record in 2000–2016 (4 quadrants), ◍ pre 2000 records only (11 quadrants). Prepared by Jindřich Chrtek Jr.

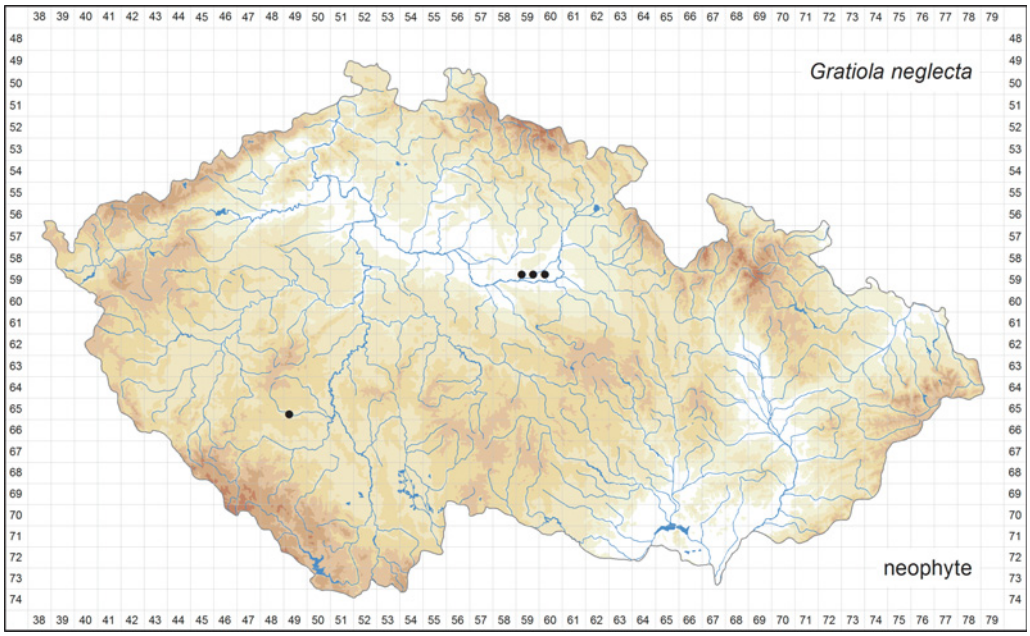


Fig. 50. – Distribution of *Gratiola neglecta* in the Czech Republic (4 occupied quadrants). Prepared by Kateřina Šumberová & Michal Ducháček.

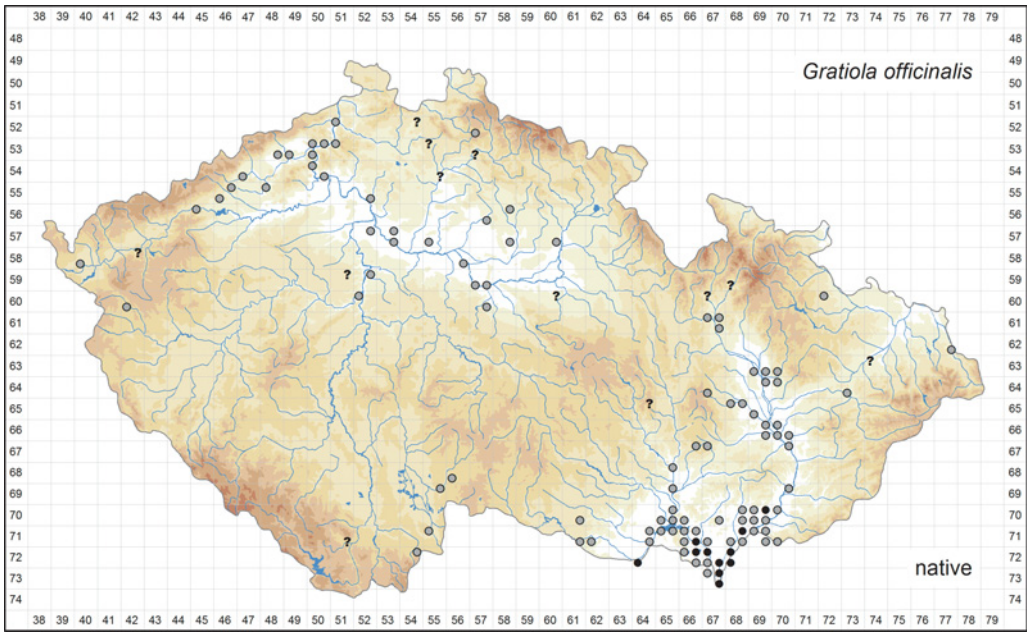


Fig. 51. – Distribution of *Gratiola officinalis* in the Czech Republic: ● at least one record in 2000–2016 (11 quadrants), ● pre 2000 records only (94 quadrants). Prepared by Kateřina Šumberová & Michal Ducháček.

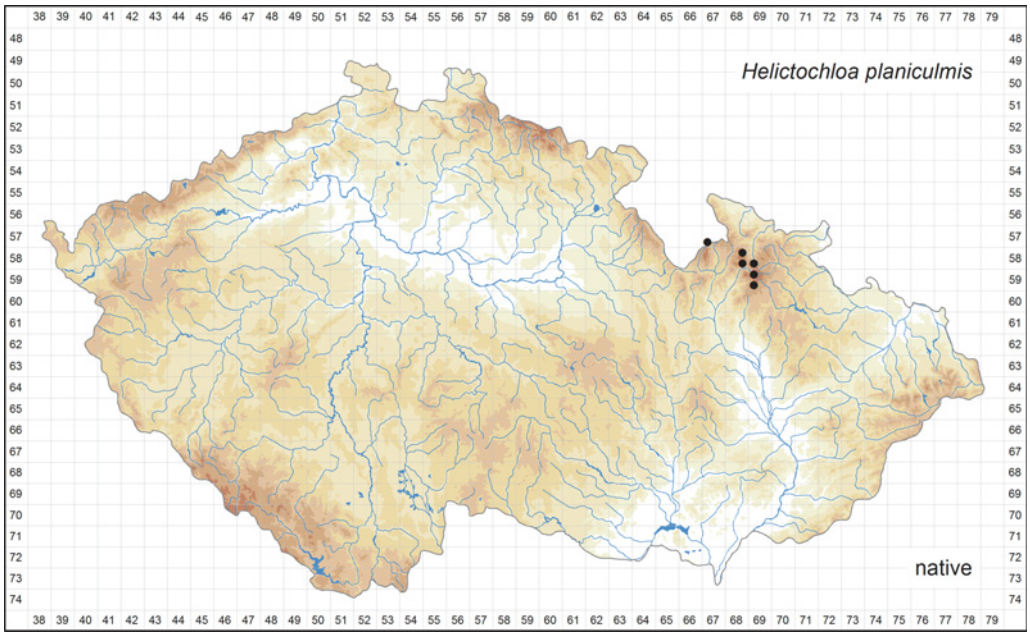


Fig. 52. – Distribution of *Helictochloa planiculmis* in the Czech Republic (6 occupied quadrants). Prepared by Jiří Zázvorka.

caused further losses of *G. officinalis* sites, in particular in Moravia. Recently the species has been recorded as a permanent resident only in the lower Morava and Dyje rivers floodplains in southernmost Moravia and it is listed as endangered (Grulich 2012).

Helictochloa planiculmis (Fig. 52)

Helictochloa planiculmis is distributed in the mountains of Europe, including the Eastern Sudetes in the Czech Republic, the Carpathians in Slovakia, Poland, Ukraine, Romania and Serbia, and Stara Planina, Vitoša, Rila and Rodopi Mts in Bulgaria. It has also been reported from central Poland from lower altitudes. Outside Europe it occurs in north-eastern Turkey (Röser 1996, Conert 1998). Two subspecies have been recognized: in the Czech Republic only the type subspecies occurs (the species was described by H. A. Schrader from Mt Králický Sněžník), while the plants from south-eastern part of the European distribution range are assigned to *H. p.* subsp. *angustior* (Romero-Zarco 2011). In the Czech Republic *H. planiculmis* is rare or locally scattered in subalpine grasslands of the Hrubý Jeseník Mts and Králický Sněžník Mts in the north-eastern part of the country. It is found in subalpine and supramontane vegetation belts at altitudes 1180–1450 m. It is classified as endangered (Grulich 2012).

Helictochloa pratensis (Fig. 53)

Helictochloa pratensis is a European sub-atlantic species, distributed mainly in western and central Europe, eastwards to south-western Finland, north-western Russia, Poland, the Czech Republic, Slovakia and Austria. In contrast, the literature records from western Ukraine, Transylvania and the Balkan Peninsula are uncertain (Conert 1998). *Helictochloa pratensis* occurs in various types of dry grasslands, meadows and pastures, rocky slopes, rarely in open pine or oak acidophilous forests, always in sunny, dry and warm habitats. It prefers acidic, neutral or slightly basic soils poor in calcium and nitrogen, usually over silicates, basaltic extrusive rocks, marlstone, serpentinite or limestone and even loess. In the Czech Republic *H. pratensis* is scattered in warm and rather dry parts of the country, predominantly at altitudes 200–500 m. It is found in north-western and central Bohemia and locally also in south-western Bohemia and in southern Bohemia between the towns of Písek and Protivín (Toman 1973, Soukup et al. 2010). In Moravia it occurs in its warmest southern and central parts east of the line connecting the towns of Třebíč and Vranov nad Dyjí, northwards almost reaching the city of Olomouc in central Moravia. In the Czech Republic two subspecies occur, differing in a few characters, but they are clearly delimited geographically. The Bohemian populations may be assigned to the type subspecies, which is replaced in Moravia by *H. p.* subsp. *hirtifolia*, present also in Slovakia and Lower Austria. *Helictochloa pratensis* is classified as lower risk – near threatened (subsp. *pratensis*) or lower risk – data deficient (subsp. *hirtifolia*) in the Czech Red List (Grulich 2012).

Helictotrichon desertorum subsp. *basalticum* (Fig. 54)

Helictotrichon desertorum is a Eurasian continental steppe plant distributed from central Europe as far as Transbaikalia in eastern Asia, and from Siberia southwards to the Altai Mts, the Pamir Mts, northern Mongolia and westernmost China. Four subspecies are

distinguished (Holub 1972): in the western part of the distribution range west of the Volga river only *H. d.* subsp. *basalticum* occurs; its distribution is discontinuous, consisting of many geographically isolated patches (Conert 1998, Holub 1958, 1962, Röser 1996). *Helictotrichon desertorum* is a perennial grass morphologically adapted to the climate of continental steppe. In the westernmost part of its distribution area it is considered a relict of early Holocene periglacial steppes. It grows on open grassy slopes of dry basalt rocks or their loess and marlstone edges, rarely on limestone (Kolbek & Boublík 2007). *Helictotrichon desertorum* reaches its western distribution limit in the Czech Republic where it is a rare species known from seven localities, six of them in the České středohoří Mts between the towns of Louny and Most in northern Bohemia and one in southern Moravia near the town of Mikulov. It occurs at altitudes from 230 m (Šibeničník hill near Mikulov) to 430 m (Oblík hill near Louny). It is classified as critically threatened (Grulich 2012).

Hierochloë australis (Fig. 55)

Hierochloë australis has a fairly small distribution range confined to Europe (Weimarck 1971). It is distributed mainly in central Europe, towards the east reaching southern Finland, Estonia, Latvia, Lithuania and Ukraine, southwards extending to northern Italy and Croatia; it is only scattered in Romania and Moldova (Meusel et al. 1965, Hultén & Fries 1986, Valdés et al. 2009). In the Czech Republic it grows usually on mineral-rich soils in habitats that are intermittently wet in the spring but dry out during the summer. It occurs mainly in thermophilous oak forests on volcanic hills of north-western Bohemia, in the Bohemian Cretaceous Basin of central and eastern Bohemia, and in deep river valleys of central and southern Bohemia and south-western Moravia. It is found at altitudes about 200–500 m, with the altitudinal maximum at about 700 m in Mt Milešovka in the České středohoří Mts. It is classified as vulnerable (Grulich 2012).

Hierochloë odorata (Fig. 56)

Hierochloë odorata is a member of the *H. odorata* aggregate, which is a widespread species complex with a circumpolar distribution (Meusel et al. 1965, Hultén & Fries 1986). In the Czech Republic two species are found: *H. odorata* growing only in Bohemia and *H. repens* limited to southern Moravia. *Hierochloë odorata* is distributed mainly in north-western Europe and north-eastern North America. In Europe it occurs from the British Isles and Netherlands northwards to Scandinavia and the Baltic countries; towards the east it reaches European Russia. In central Europe it is scattered in Germany, Poland, the Czech Republic and Switzerland, towards the south reaching south-eastern France. It has also been recorded in Iceland (Weimarck 1971). In the Czech Republic it usually grows on sandy soils in disturbed sites, such as roadsides and playgrounds, on the margins of pine woods and sandy shores of artificial lakes. Most of the localities of *H. odorata* are situated in the middle Labe river basin, particularly between the towns of Mělník and Lysá nad Labem. It is classified as critically threatened (Grulich 2012).

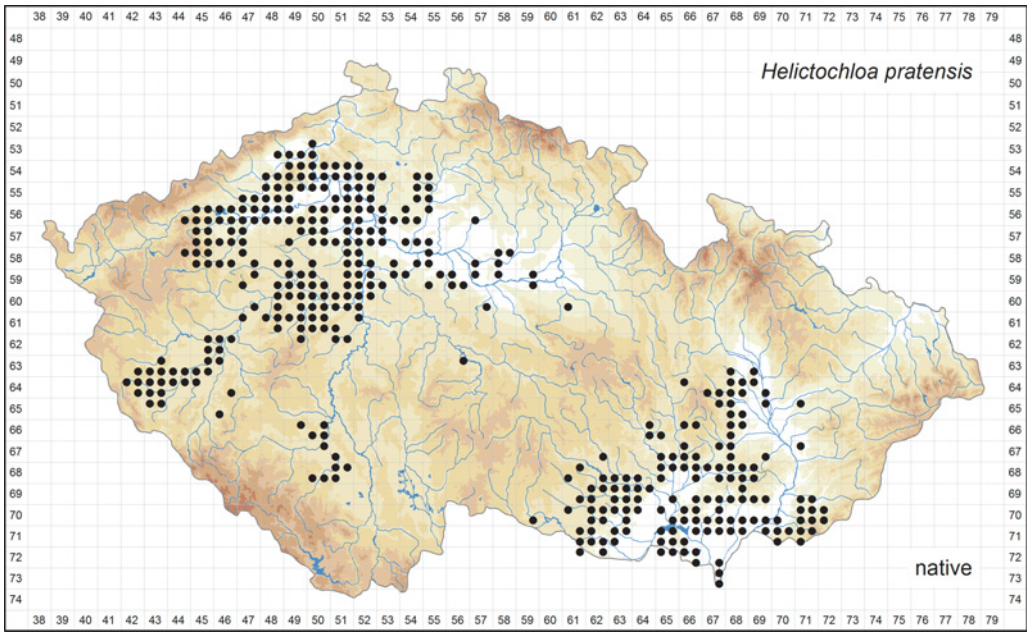


Fig. 53. – Distribution of *Helictochloa pratensis* in the Czech Republic (385 occupied quadrants). Prepared by Jiří Zázvorka.

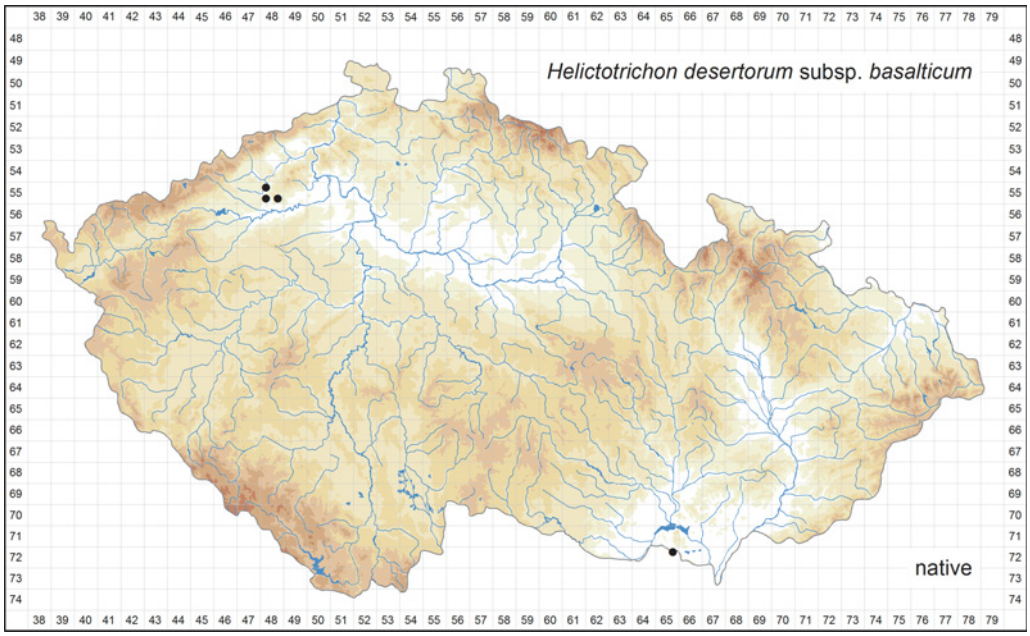


Fig. 54. – Distribution of *Helictotrichon desertorum* subsp. *basalticum* in the Czech Republic (4 occupied quadrants). Prepared by Jiří Zázvorka.

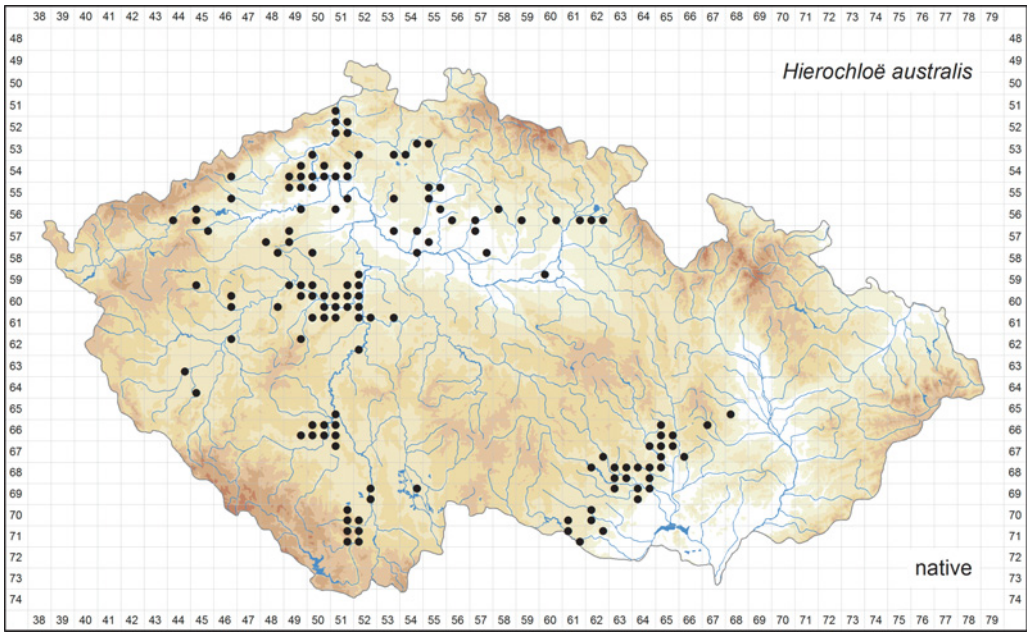


Fig. 55. – Distribution of *Hierochloë australis* in the Czech Republic (137 occupied quadrants). Prepared by Jitka Štěpánková.

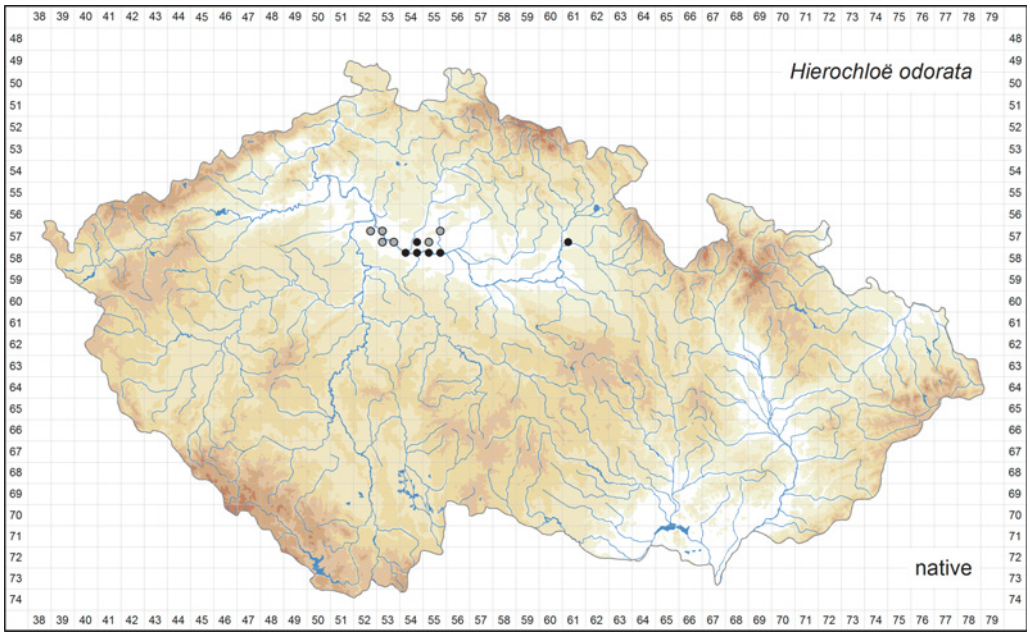


Fig. 56. – Distribution of *Hierochloë odorata* in the Czech Republic: ● at least one record in 2000–2016 (6 quadrants), ◍ pre 2000 records only (6 quadrants). Prepared by Jitka Štěpánková.

Hierochloë repens (Fig. 57)

Hierochloë repens, the other member of the *H. odorata* aggregate, is scattered throughout central and south-eastern Europe and adjacent south-western Asia. In Europe it occurs in the Czech Republic, Slovakia, Austria, Hungary, Romania, Bulgaria, Ukraine and south-eastern part of European Russia (Weimarck 1971). It grows on sandy soils in pine forests, along roads and railways; sometimes it occurs as a weed of arable fields or vineyards (Chrtek & Jirásek 1964, Weimarck 1971). In the Czech Republic it is confined to southern Moravia, where it is found in a few sandy sites south of the town of Lanžhot and between the towns of Hodonín and Veselí nad Moravou. It is classified as critically threatened (Grulich 2012).

Lindernia dubia (Fig. 58)

Lindernia dubia is a wetland annual species native to the basin of the Mississippi river in the USA; localities in other parts of the USA, Canada and South America are probably due to introductions (Pennell 1935, Meusel et al. 1978). The secondary range of the species also involves the temperate and meridional zones of Europe and temperate to tropical parts of Asia (Meusel et al. 1978). The first European records date back to the middle of the 19th century from France. Recently, the species has been reported from Spain, Portugal, Italy, Bulgaria, Romania, Slovenia, Serbia, Hungary, Slovakia, Germany, Poland, the Netherlands and Belgium, in many of the countries showing high invasive potential (Šumberová et al. 2012b, Hrivnák et al. 2016). Both in its primary and the secondary range the species grows mainly on muddy river banks, in lake and pond littorals and on exposed bottoms of water reservoirs and in ditches. In Italy and south-eastern Asia it also occurs in rice fields (Šumberová et al. 2012b). In the Czech Republic *L. dubia* was found for the first time in 1989 on the Lužnice river in southern Bohemia (Kurka 1990) and this locality was for more than a decade the only known site of the species in the country. Since 2000, a total of 11 new localities of *L. dubia* have been discovered in the basins of the Lužnice, Vltava and Otava rivers in southern Bohemia (Šumberová et al. 2012b). While the populations on the Lužnice river show a clear link to the very first record (Lepší & Douda 2005), the source of propagules for all the other localities was most probably the fish storage pond system in the town of Hluboká nad Vltavou. The species was dispersed by two ways: on rubber boots, fish farming equipment or vehicles among the individual fish-farming pond systems situated on various watercourses, and via water between the pond systems and the watercourses collecting their waters (Šumberová et al. 2012b). Further spread is very likely in already invaded catchments. In rivers the spread may remain unnoticed for a long time because suitable conditions for *L. dubia* growth occur irregularly during extremely dry summers, whereas in the years with average rainfall the species survives in the soil seed bank.

Lindernia procumbens (Fig. 59)

Lindernia procumbens is a wetland annual species with a Eurasian range. It is most frequent in eastern and south-eastern Asia with the summer monsoon climate, where the species occurs as a weed of rice fields. Outside this region, the species is scattered in floodplains of large rivers throughout the warm-temperate parts of Europe, western and

central Asia and western Siberia (Lampe 1996). In the Czech Republic *L. procumbens* colonises exposed river beds, oxbows, artificial channels, sand pits and exposed bottoms of fishponds and fish storage ponds. *Lindernia procumbens* has high temperature and moisture demands; in central Europe it germinates on wet substrates not before the end of May. Most of its localities in fishponds were lost probably due to summer drainage applied in spring and early summer which does not suit reproduction of *L. procumbens*, or due to competition of taller herbs on the fishponds with long summer drainage. *Lindernia procumbens* has been recorded in the floodplains of the Labe and Vltava rivers and their tributaries in central, northern and eastern Bohemia, the Lužnice river in southern Bohemia, the Dyje and Morava rivers in central and southern Moravia, and the Odra river in northern Moravia. Most of the extant populations are situated in fish storage ponds where tall vegetation is regularly eliminated by mowing, poultry grazing or occasional herbicide application (Šumberová et al. 2012b). The localities in river floodplains are, at least in some regions, still maintained too. Over the last few years with extraordinary hot and dry summers, i.e. in 2012 and 2015, new populations were found and its occurrence at some already known sites was confirmed (Šumberová et al. 2013). It is obvious that under favourable climatic conditions *L. procumbens* may emerge more frequently from the soil seed bank or after recent dispersal events (via water or waterfowl; Burkart 2001, Šumberová et al. 2012b). Although the species is listed as critically endangered (Grulich 2012), under recent climate conditions it has a potential to survive or even to spread to new localities (cf. Nobis et al. 2010).

Maianthemum bifolium (Fig. 60)

Maianthemum bifolium is a Eurasian boreal species with a large continental distribution range. It grows in the boreal forest zone from western Europe (but excluding most of the British Isles, where it is doubtfully native, and the Iberian Peninsula) as far as Japan in the Far East (Hultén & Fries 1986, Meusel et al. 1965). In the Czech Republic *M. bifolium* grows on humid or rather dry loamy or sandy acid soils in dense coniferous, broadleaved and mixed forests, alluvial forests, glacial cirques and mountain pine growths. It is frequent in forest-rich areas throughout the country, occurring from the planar to subalpine vegetation belts and reaching its altitudinal maximum at 1420 m in the Krkonoše Mts at the upper edge of the Kotelné jámy glacial cirque.

Myriophyllum alterniflorum (Fig. 61)

Myriophyllum alterniflorum is an amphi-atlantic species being most frequent in Atlantic western and northern Europe. It is widespread northwards to Iceland and the Scandinavian coast of the Arctic Ocean, southwards to the Portuguese Atlantic coast. It becomes rare towards the continental interior, eastwards reaching the Baltic countries, western Ukraine, central Europe, Italy and Greece (Meusel et al. 1978, Hultén & Fries 1986, Sarika-Hatzinikolaou et al. 1994). Outside Europe it occurs in northern and north-eastern parts of North America, in Greenland, the Azores, north-western Africa and China (Hultén & Fries 1986, Yu et al. 2002). In the Czech Republic it occurs predominantly in the upper reaches of rivers and bigger streams, rarely in standing water (especially in detached river arms). It prefers clear, oligo-mesotrophic to dystrophic, slightly acidic waters with sandy or gravelly bottom. The majority of *M. alterniflorum* localities in the

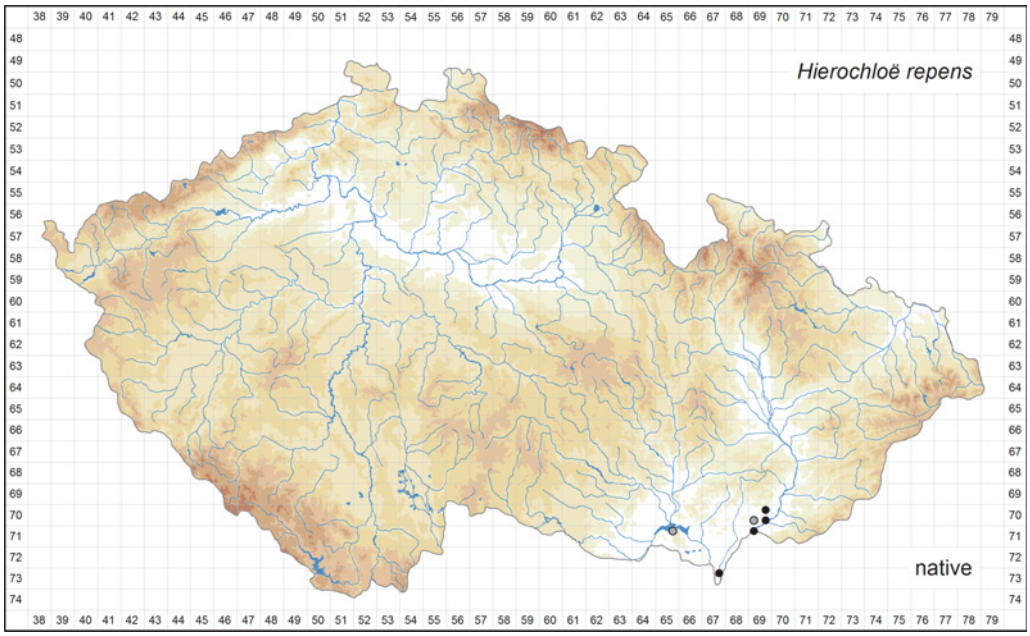


Fig. 57. – Distribution of *Hierochloë repens* in the Czech Republic: ● at least one record in 2000–2016 (4 quadrants), ● pre 2000 records only (2 quadrants). Prepared by Jitka Štěpánková.

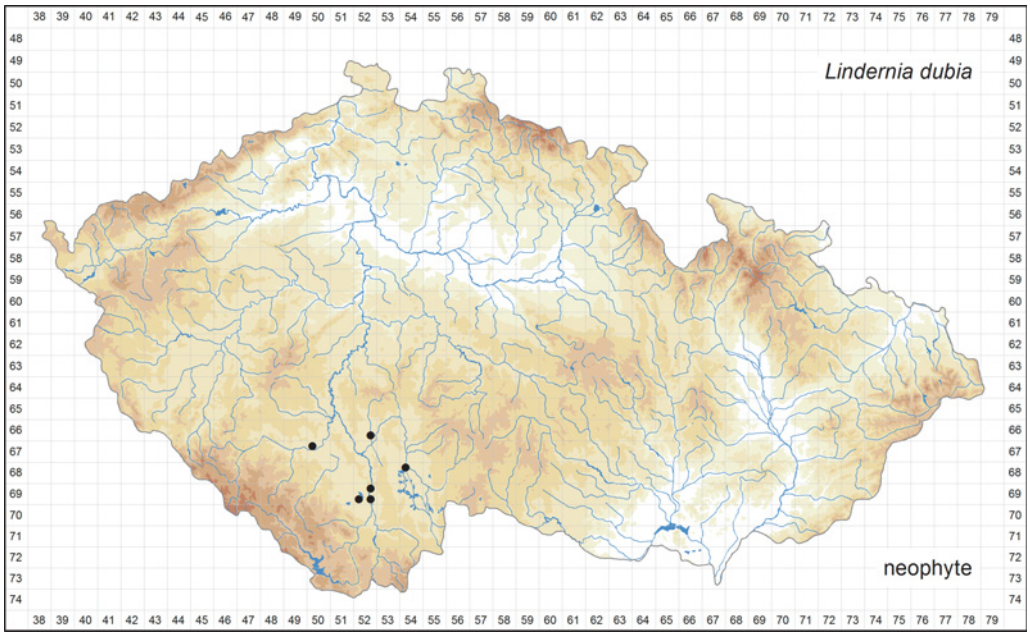


Fig. 58. – Distribution of *Lindernia dubia* in the Czech Republic (6 occupied quadrants). Prepared by Kateřina Šumberová & Michal Ducháček.

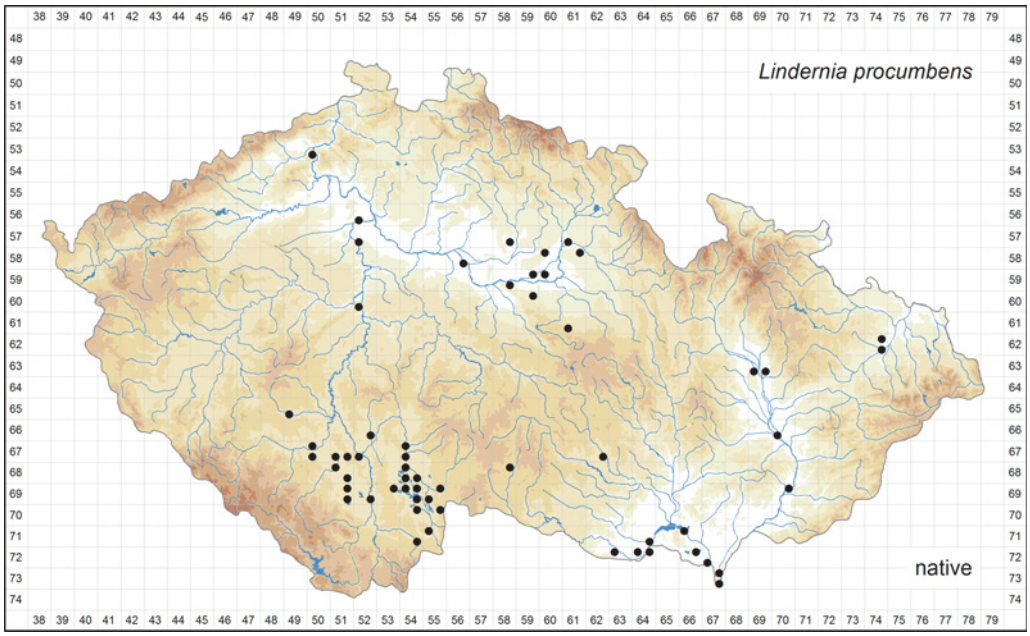


Fig. 59. – Distribution of *Lindernia procumbens* in the Czech Republic (58 occupied quadrants). Prepared by Kateřina Šumberová & Michal Ducháček.

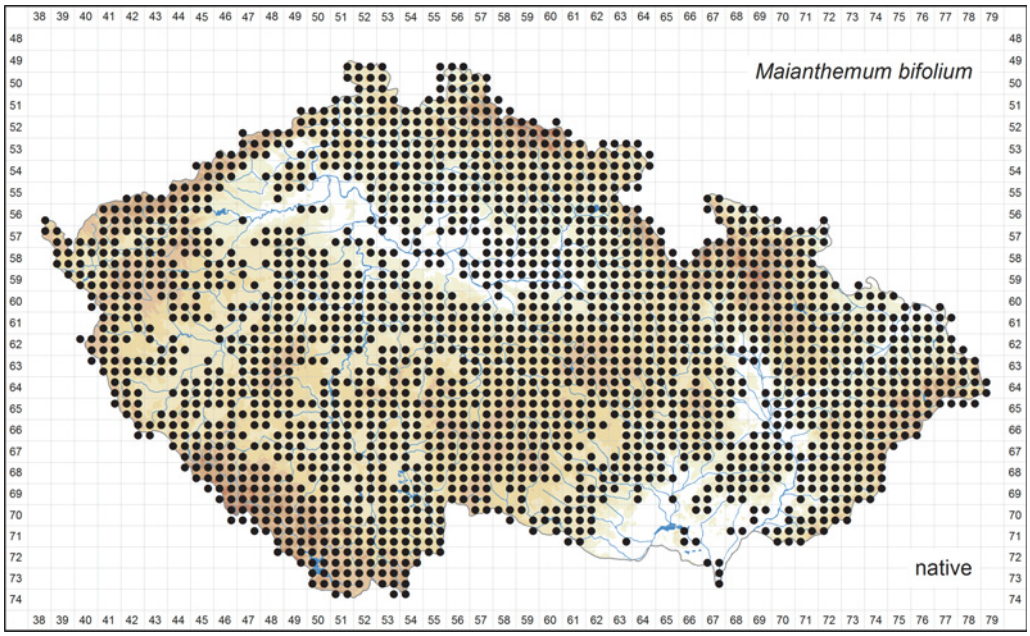


Fig. 60. – Distribution of *Maianthemum bifolium* in the Czech Republic (2064 occupied quadrants). Prepared by Jiří Zázvorka.

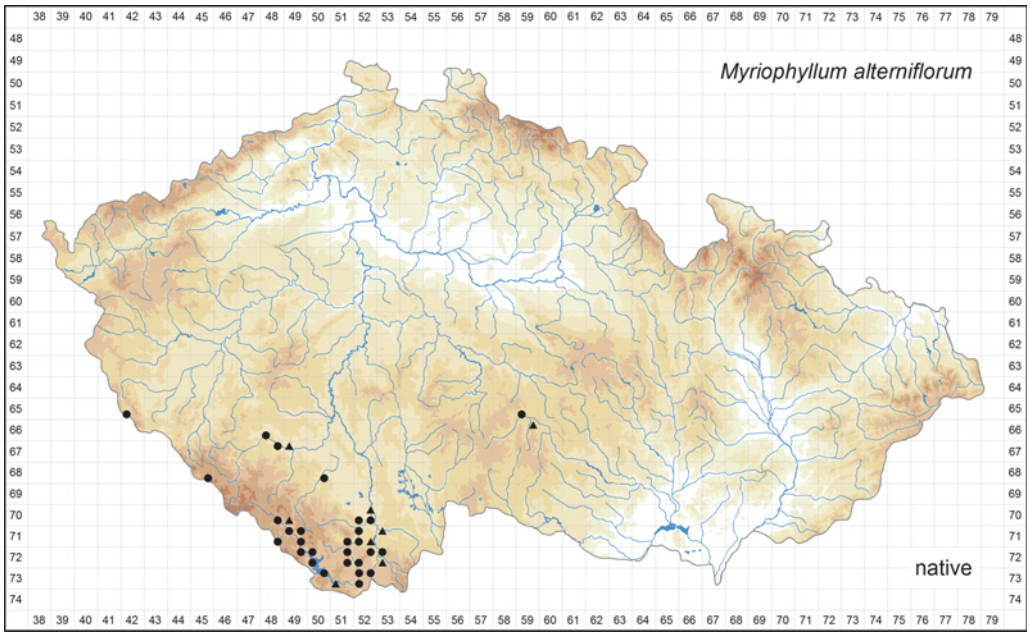


Fig. 61. – Distribution of *Myriophyllum alterniflorum* in the Czech Republic: ● occurrence documented by herbarium specimens (28 quadrants), ▲ occurrence based on other records (8 quadrants). Prepared by Jan Prančl.

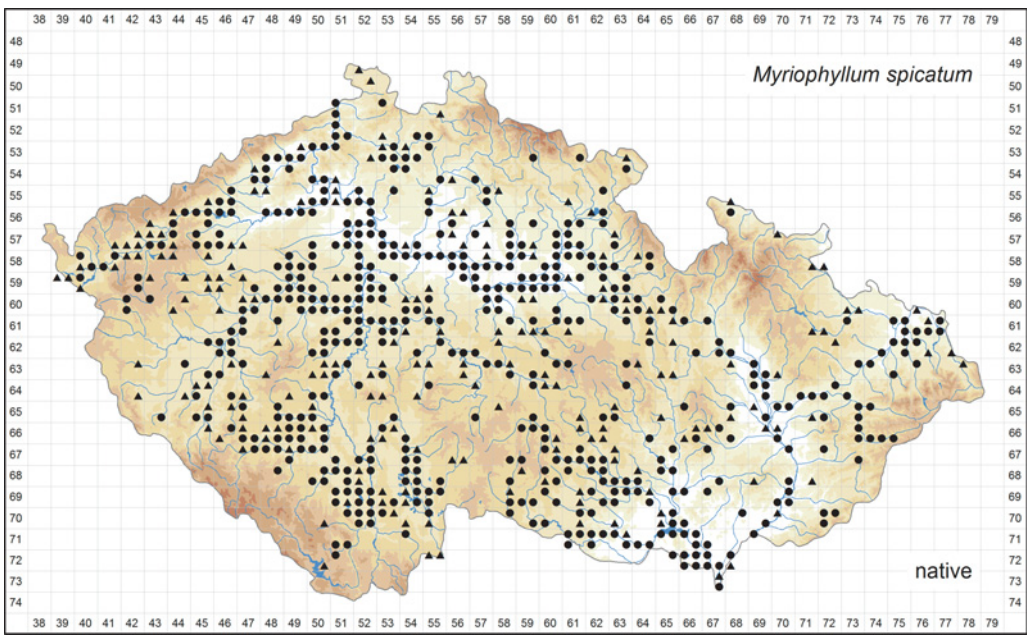


Fig. 62. – Distribution of *Myriophyllum spicatum* in the Czech Republic: ● occurrence documented by herbarium specimens (503 quadrants), ▲ occurrence based on other records (212 quadrants). Prepared by Jan Prančl.

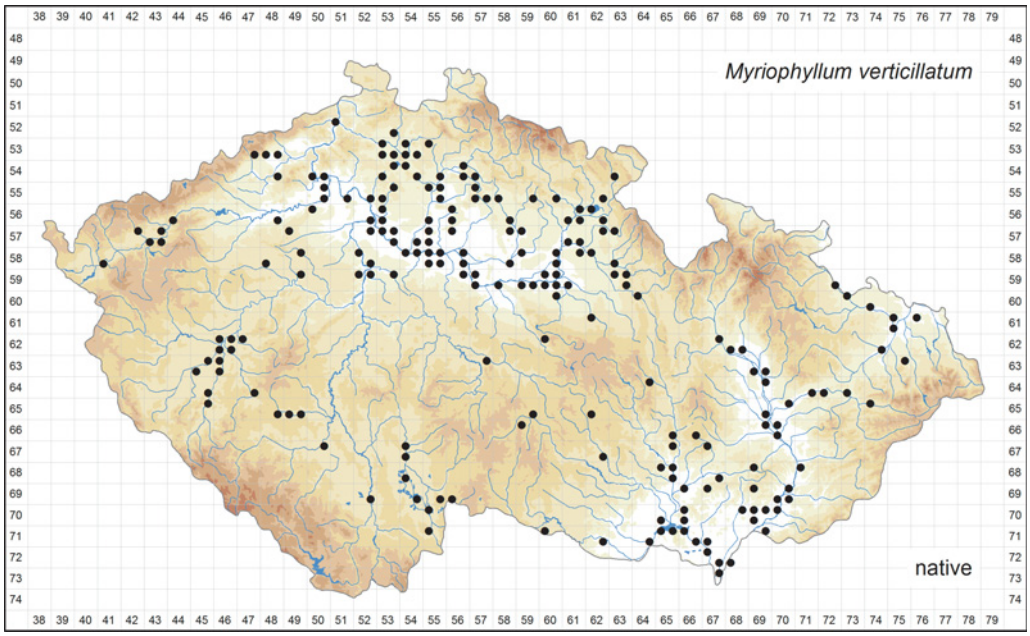


Fig. 63. – Distribution of *Myriophyllum verticillatum* in the Czech Republic (207 occupied quadrants). Prepared by Jan Prančl.

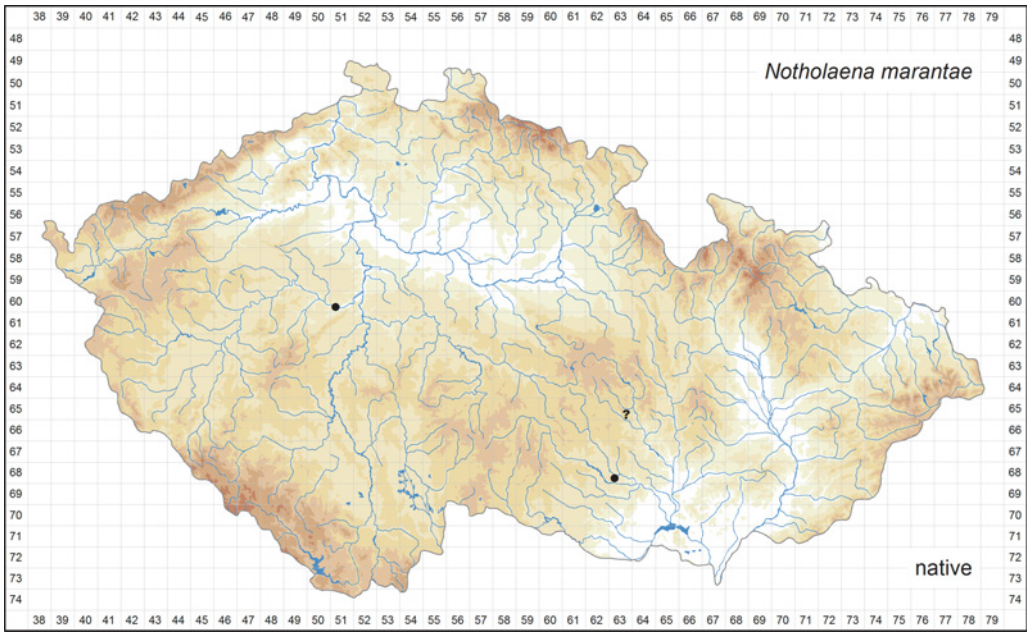


Fig. 64. – Distribution of *Notholaena marantae* in the Czech Republic (2 occupied quadrants). Prepared by Libor Ekrt.

Czech Republic are found in the Vltava river and several of its tributaries in the Šumava Mts and its foothills in southern Bohemia. It used to occur in but has vanished from other rivers in this area (Malše, Otava and Blanice) and from the Laka glacial lake. The northernmost Bohemian population in the Nemanický potok stream in the Český les Mts has been discovered only recently. The species was known to occur also in the Jihlava river in the Českomoravská vrchovina highlands (last record in 2003). *Myriophyllum alterniflorum* is a competitively weak species sensitive to water pollution and stream regulation, reaching the south-eastern limit of its local distribution in the Czech Republic. Therefore, it is classified as endangered (Grulich 2012). However, the populations in the Vltava river are abundant and not threatened.

Myriophyllum spicatum (Fig. 62)

Myriophyllum spicatum is widespread in most of Europe (although apparently rare in central and northernmost parts of Scandinavia) and the temperate regions of Asia. Eastwards it reaches Japan and the Russian Far East, southwards the Canary Islands, northern and eastern Africa, western Asia, the Himalayas, southern China and the Philippines (Meusel et al. 1978, Hultén & Fries 1986). It has become naturalized in most of North America, where it is considered an invasive and noxious weed; it has also been introduced to southern Africa (Scribailo & Alix 2014, Weyl & Coetzee 2014). In the Czech Republic *M. spicatum* shows a broad ecological amplitude, inhabiting various types of standing and running waters, such as rivers and bigger streams, fishponds, reservoirs, sand-pits, drainage channels, alluvial and artificial pools. It grows in mesotrophic to strongly eutrophic water and prefers habitats in early succession stages or with regular disturbance. It is distributed almost throughout the country, from lowlands to middle elevations and only rarely exceeds the altitude of 600 m. It is most frequent along the middle and lower courses of large rivers and in flat fishpond-rich basins, where it is one of the most common aquatic plants. Under optimal conditions it is able to form large dense stands and become a noxious weed in farm fishponds. In contrast, it is rare in or locally missing from the driest lowlands with a lack of suitable habitats.

Myriophyllum verticillatum (Fig. 63)

Myriophyllum verticillatum is a circumpolar species, growing mainly in temperate regions of Europe, Asia and North America. The continuous distribution range extends from the British Islands and France to central Asia. Further eastwards the species becomes scattered, reaching Japan, the Russian Far East and China. In North America it is scattered throughout the temperate and boreal zones and also occurs in north-western Africa (Meusel et al. 1978, Hultén & Fries 1986, Scribailo & Alix 2014). In Europe it is widespread in its Atlantic, central and eastern parts but is rare in the Mediterranean area and in the coldest regions. *Myriophyllum verticillatum* grows in mesotrophic to naturally eutrophic, transparent, standing or very slowly running waters. It occurs in habitats in an advanced stage of terrestrialization with a thick layer of organic mud on the bottom, and frequently forms terrestrial stands on the deep muddy substrates. In the Czech Republic it grows most often in alluvial pools, oxbow lakes, lightly managed fishponds and channels. It is a scattered species, with most records from basins of large rivers (especially in the Labe river basin and in southern Moravia) and in wet and relatively warm regions in

northern Bohemia (broader vicinity of Česká Lípa and Jičín towns), but rare elsewhere. It is largely a lowland species, only rarely exceeding the altitude of 450 m. *Myriophyllum verticillatum* is endangered by eutrophication, habitat destruction, river regulations and intensive fish farming. It has markedly declined during the last decades and is currently absent from Czech Silesia. Therefore it is classified as vulnerable (Grulich 2012). Because of frequent confusion of *M. spicatum* and *M. verticillatum*, the distribution map of the latter was based solely on revised herbarium specimens.

Notholaena marantae (Fig. 64)

Notholaena marantae has a highly fragmented distribution range. It is most frequent in the Mediterranean area, Macaronesia, the southern part of the Arabian Peninsula, Ethiopia and around the Himalayas (Pichi Sermoli 1979). It reaches the northernmost limit of its distribution in the Czech Republic (Kaplan 2012). Only two recent localities and one uncertain are known in the Czech Republic. *Notholaena marantae* was discovered in 1858 by C. Römer on the serpentines near the town of Mohelno in southern Moravia (Juratzka 1858). The population comprises of nearly 2000 clumps, growing on dry and sunny serpentine rocks and in rocky steppe with southern to south-eastern aspect at altitudes 270–370 m (Ekrt 2015). The second population was discovered about 10 years ago in the karst area of Český kras near the village of Hlásná Třebaň in central Bohemia. This site hosts several clumps growing on ultrabasic picrite rocks (Šprynar 2004). In the past another locality of *N. marantae* was reported to exist in the serpentines at the Spálený mlýn mill in the valley of the Nedvědička stream near the village of Pernštejn in western Moravia (Formánek 1884). However, this record is uncertain, because the occurrence was not confirmed there later and no herbarium voucher has been found. *Notholaena marantae* is classified as critically threatened because of its rarity (Grulich 2012).

Nymphoides peltata (Fig. 65)

Nymphoides peltata is native to Europe and northern Asia. In Europe it reaches the British Isles, southern Scandinavia and the Baltic countries in the north and the Iberian Peninsula, Italy and Greece in the south. In Asia it extends through its temperate zone eastwards to China, the Russian Far East and Japan (Meusel et al. 1978, Hultén & Fries 1986). It has become naturalized in North America (Stuckey 1974) and has been introduced to Australia (Randall 2007) and New Zealand (Howell & Sawyer 2006). In the Czech Republic *N. peltata* grows in fishponds, slow-moving rivers and adjacent oxbow lakes. It occurs in 50–150 cm deep water, but tolerates drops of the water table down to the bottom and even requires such drops for seed germination. It grows in water bodies with a mineral bottom, therefore it is common in early succession stages but it declines with accumulation of organic sediments (Šumberová 2011a). *Nymphoides peltata* was most frequent in fishpond landscapes of south-western and southern Bohemia. It occurred very locally also in central Bohemia and in south-western, central and north-eastern Moravia, and only rarely elsewhere. It has declined during the 20th century due to terrestrialization of alluvial pools and changes in fishpond management, particularly in its intensification and elimination of regular summer drainage. As a decorative plant, *N. peltata* has become available in garden stores and plant nurseries since the 1990s. It is being occasionally cultivated in garden pools and sometimes intentionally planted for

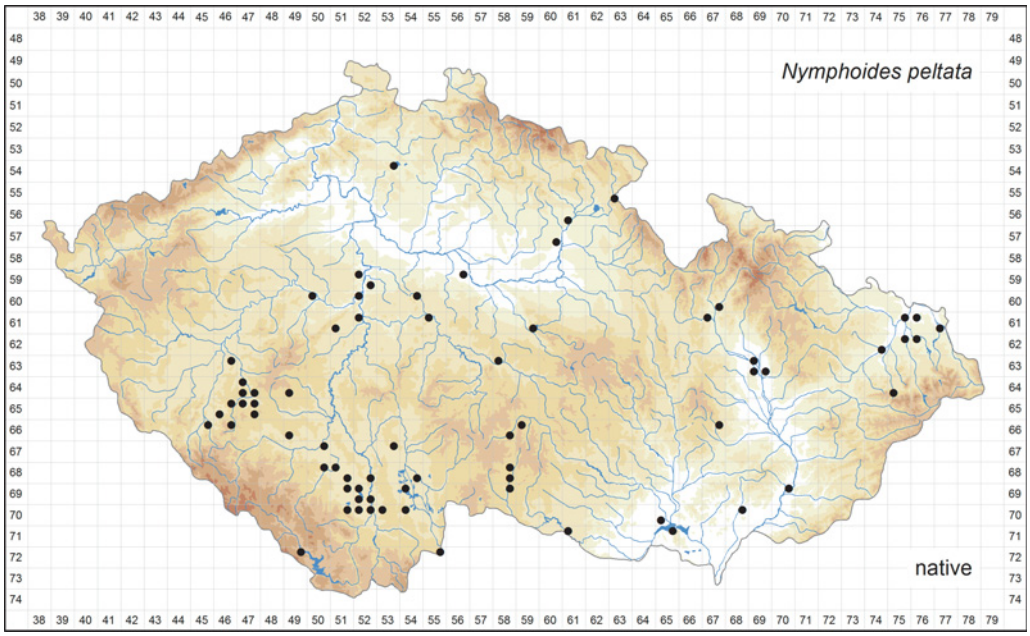


Fig. 65. – Distribution of *Nymphoides peltata* in the Czech Republic (70 occupied quadrants). Prepared by Zdeněk Kaplan.

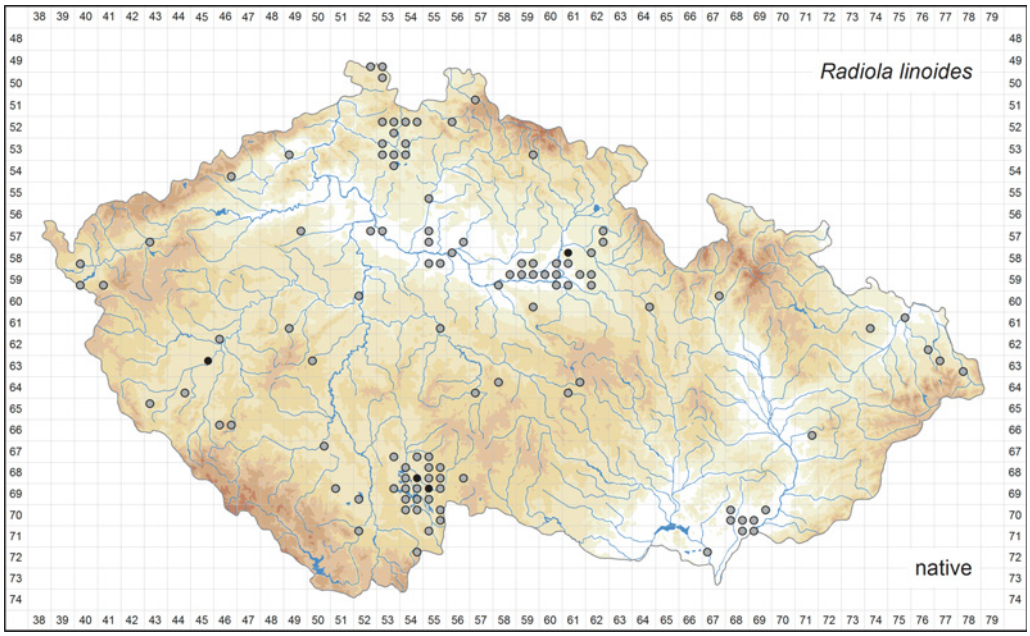


Fig. 66. – Distribution of *Radiola linoides* in the Czech Republic: ● at least one record in 2000–2016 (4 quadrants), ● pre 2000 records only (108 quadrants). Prepared by Jan Prančl.

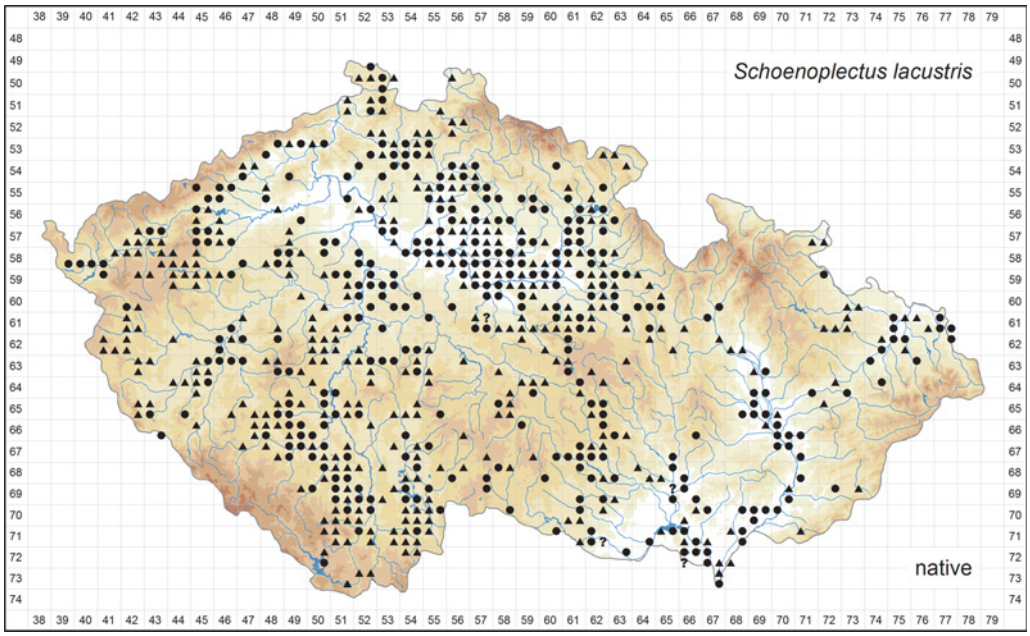


Fig. 67. – Distribution of *Schoenoplectus lacustris* in the Czech Republic: ● occurrence documented by herbarium specimens (325 quadrants), ▲ occurrence based on other records (353 quadrants). Prepared by Petr Filippov & Jiří Danihelka.

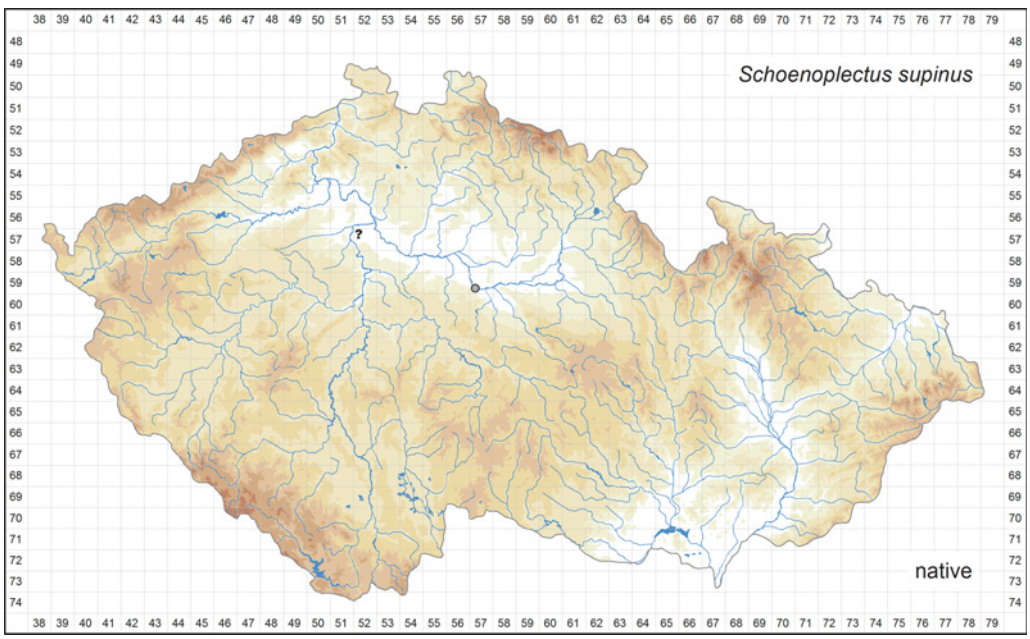


Fig. 68. – Distribution of *Schoenoplectus supinus* in the Czech Republic (1 occupied quadrant). Prepared by Petr Filippov & Jiří Danihelka.

ornamental purposes in fishponds and flooded abandoned quarries. These plants are of unknown, but probably distant origin and may cause genetic erosion of native populations. In many of the recently emerged localities populations of spontaneous origin cannot be distinguished from those deliberately established by planting. However, the fact that most of the new localities appeared in areas where the species was previously unknown indicates that the latter is more likely. The native populations are apparently rarer and more endangered than the number of currently known sites may indicate. The species is classified as critically threatened (Grulich 2012).

Radiola linoides (Fig. 66)

Radiola linoides is mainly a European species with a sub-Atlantic distribution. It is relatively widespread (at least historically) in western Europe, occurring from Shetland and southern Sweden to Spain, Italy and Crete. Eastwards it becomes more scattered, reaching western Russia and north-western Anatolia (Meusel et al. 1978, Hultén & Fries 1986, von Lampe 1996). Outside Europe it is reported from Lebanon, Macaronesia, northern Africa and as very rare from tropical Africa. Is has been also introduced to north-eastern part of the USA (Meusel et al. 1978, Hultén & Fries 1986). The species is a competitively weak wetland annual, growing mainly on sandy, nutrient-poor substrates with acidic soil reaction (Popiela 1998), rarely also on peat soils. It inhabits exposed pond bottoms, abandoned sand-pits, lightly managed arable fields (often stubble fields), disturbed sites in pastures, ditches, the edges of sandy tracks and other damp places with sparse vegetation cover. In the Czech Republic *R. linoides* used to grow mainly in flat areas with frequent open sandy habitats, such as the Třeboňská pánev basin in southern Bohemia, the broader vicinity of the town of Česká Lípa in northern Bohemia, the Labe river basin in eastern Bohemia and the surroundings of the town of Hodonín in southern Moravia, being rare elsewhere. *Radiola linoides* declined markedly after World War II. At present, it is extinct in Moravia and has been confirmed only at four sites in Bohemia since 2000. However, the species can be easily overlooked due to its diminutive habit and late phenology. Several populations in sand-pits in the Třeboňská pánev basin are not native, as they originated from recent rescue cultivations (A. Kučerová, in litt.; not included in the map). The species has totally vanished from fishponds and fields for the same reasons as did the ecologically and phenologically similar *Centunculus minimus* (Šumberová 2013c, and see above under that species). *Radiola linoides* is currently close to its extirpation from the Czech Republic and it is therefore classified as critically threatened (Grulich 2012).

Schoenoplectus lacustris (Fig. 67)

Schoenoplectus lacustris is found in most of European countries, northern Africa, the Caucasus Mts, Anatolia and southern Siberia (Hultén & Fries 1986, Jiménez-Mejías & Luceño 2011) but the eastern European and north Asian populations are sometimes treated as a separate subspecies or even species, *S. hypoliti* (Timohina 1990). In North America it is replaced by its sibling species *S. heterochaetus* (Smith 2002). In the Czech Republic *S. lacustris* occurs mainly in littoral zones of fishponds, sand pits, oxbow lakes and beds of lowland rivers, usually in mesotrophic to slightly eutrophic habitats. It is able to form submerged stands with ribbon-leaved forms, especially in rivers, and readily

colonizes recently disturbed or newly created water reservoirs (Šumberová 2011b). The species occurs scattered all over the country, being locally common in river basins, floodplains of lowland rivers and areas with many fishponds such as the Třeboňská pánev and Budějovická pánev basins. It is rare in dry parts of the country without large water bodies, such as north-west of Prague or south-west and north of Brno, and absent from the mountains. *Schoenoplectus lacustris* must have spread considerably with the establishment of fishponds during the Middle Ages. However, it has been declining for decades due to changes in fishpond management and eutrophication, and even longer due to river canalization and drainage. Being still quite common at some parts of the country, it is classified only as near threatened (Grulich 2012).

Schoenoplectus supinus (Fig. 68)

Schoenoplectus supinus is a cosmopolitan species found in most parts of the World apart from Antarctica and North America. The type subspecies occurs in northern Africa, south-western and central Asia and Europe (Liang et al. 2010), being absent from its northern and eastern part. The Czech Republic is situated at the northern limits of species' distribution range. *Schoenoplectus supinus* is generally rare and declining in central Europe (e.g. Fischer 2008), and only two records exists from the Czech Republic, both from central Bohemia. The species was discovered as new for the Bohemian flora in July 1881 in sandy wet places along a road north of the town of Kolín; this occurrence is documented by numerous herbarium specimens collected in 1881–1885. In contrast, we consider the other record, published under *Isolepis supina* (J. Rozum in Rohlena 1926), from the vicinity of the village of Úžice west of the town of Kralupy nad Vltavou somewhat doubtful. One would take it for granted that a herbarium specimen had been collected but we failed to locate it despite the targeted search both at PRC and PR. The habitat of the population found in 1881 was described in herbarium labels as the shores of a shallow pool or wet sandy places, whereas Rohlena (1926) referred to a destroyed saline meadow. These one or two temporary occurrences may be explained by long distance seed dispersal by waterfowl. Not seen for almost a century, the species is now considered extinct (Grulich 2012).

Schoenoplectus tabernaemontani (Fig. 69)

If *Schoenoplectus tabernaemontani* and *S. validus*, reported to occur in the Far East, North America and elsewhere, are considered conspecific (e.g. Smith 2002), the resulting variable taxon has an almost cosmopolitan distribution range (Meusel et al. 1965, Hultén & Fries 1986). It is found in most European countries, in western and northern Europe showing a clear affinity to sea shores. In the Czech Republic *S. tabernaemontani* grows in ditches, wet depressions in arable fields, pools in abandoned quarries, pits after open cast coal mining, remnants of salt marshes and littorals of fishponds, formerly also in the surroundings of mineral springs and around brackish lakes. Sometimes it forms large stands, sometimes only small colonies are found (Sádlo 2011). Its distribution in the Czech Republic is discontinuous, restricted mainly to the areas with substrates rich in nutrients and warm climate. It is found in north-western, central and eastern Bohemia, mainly in the basins of the Ohře and Labe rivers. Particularly remarkable is the population around mineral springs in the Soos National Nature Reserve near the town of Františkovy Lázně in western Bohemia. In the eastern parts of the country, it is scattered over central and southern Moravia,

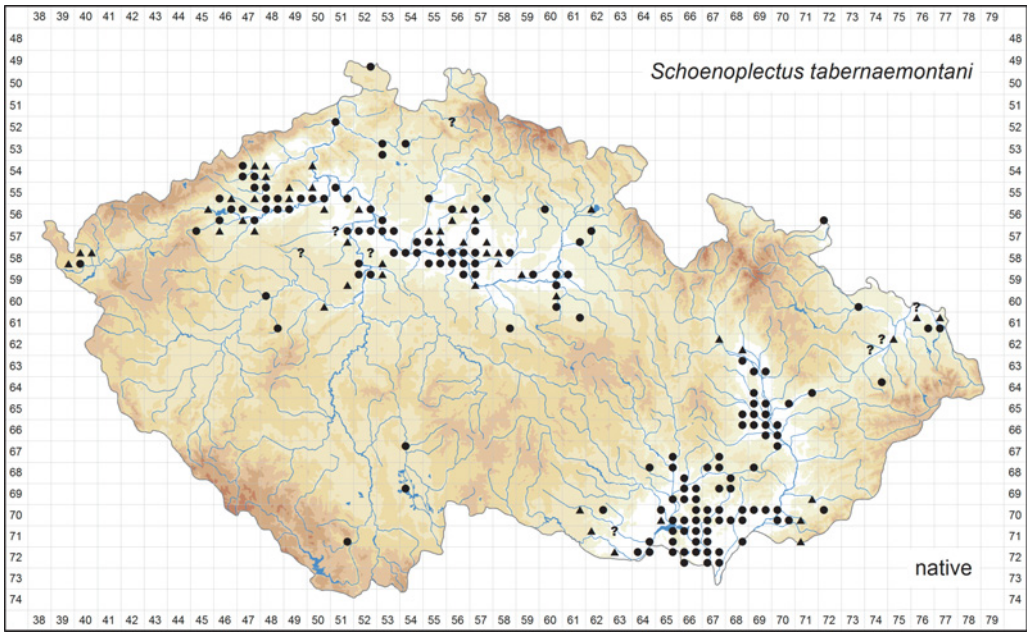


Fig. 69. – Distribution of *Schoenoplectus tabernaemontani* in the Czech Republic: ● occurrence documented by herbarium specimens (151 quadrants), ▲ occurrence based on other records (50 quadrants). Prepared by Petr Filippov & Jiří Danihelka.

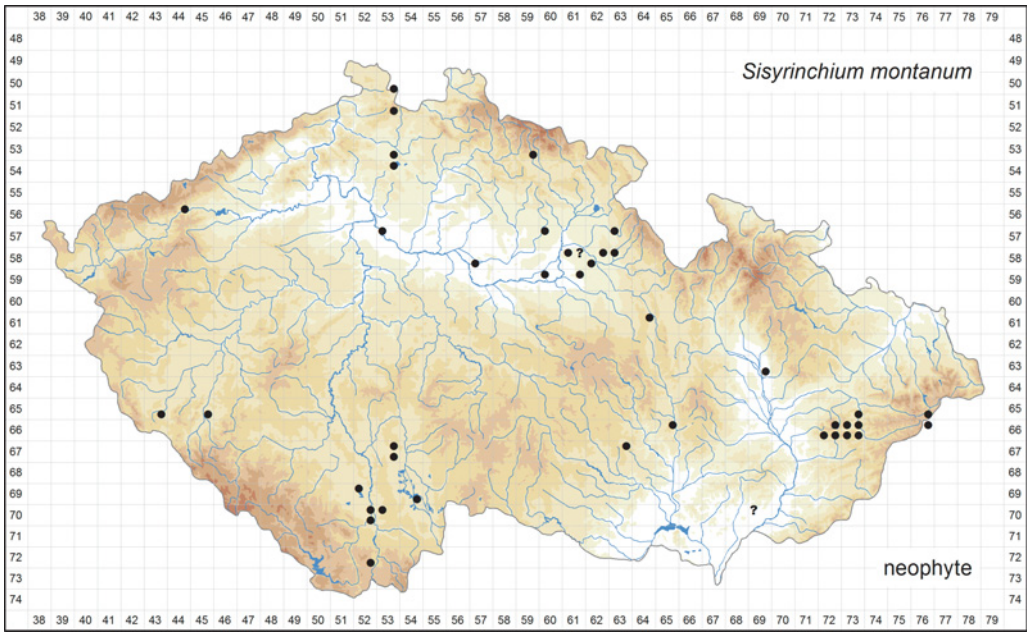


Fig. 70. – Distribution of *Sisyrinchium montanum* in the Czech Republic (40 occupied quadrants). Prepared by Jindřich Chrtek Jr.

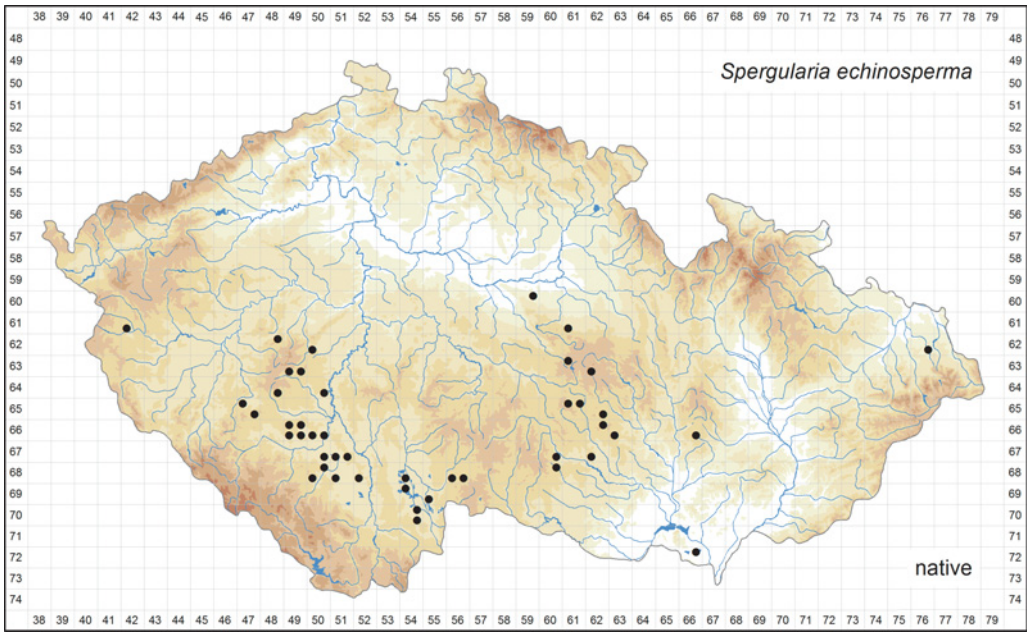


Fig. 71. – Distribution of *Spergularia echinosperma* in the Czech Republic (44 occupied quadrants). Prepared by Pavel Kúr.

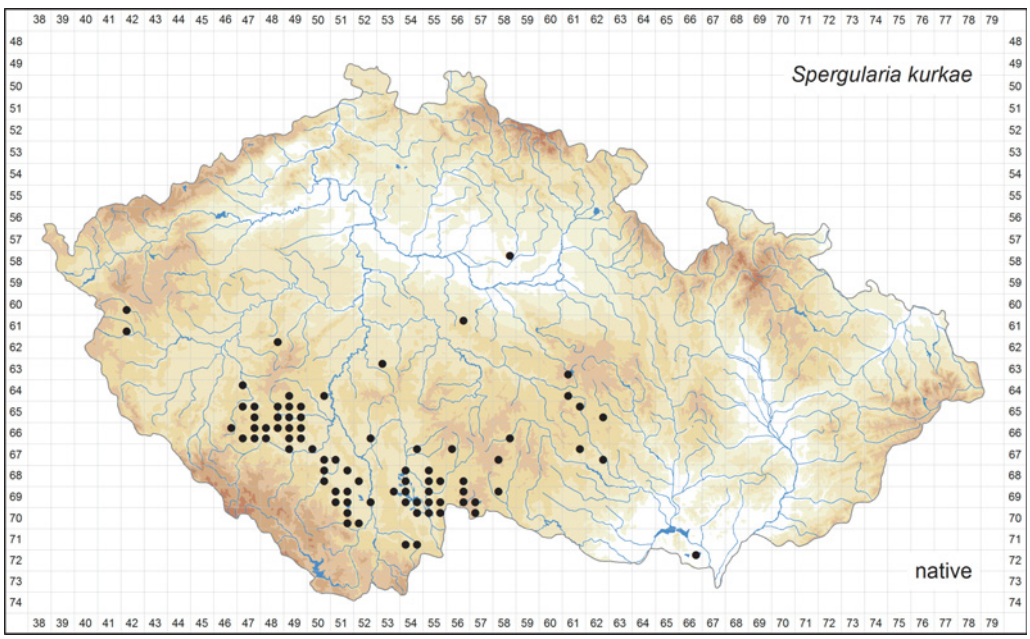


Fig. 72. – Distribution of *Spergularia kurkae* in the Czech Republic (80 occupied quadrants). Prepared by Pavel Kúr.

being more common in the areas where halophilous vegetation once used to be present. It was collected also elsewhere throughout the country, usually in secondary habitats, probably due to long-distance dispersal by waterfowl. Despite its colonization ability, it has generally declined and is therefore considered endangered (Grulich 2012).

Sisyrinchium montanum (Fig. 70)

Sisyrinchium montanum is native to North America but has been introduced to and locally naturalized in Europe (Hultén 1958). Grown as a garden ornamental, it used to escape to wet disturbed grassy places, wet depressions, ditches and waysides. In the Czech Republic it was first reported as escaped in the village of Boršov nad Vltavou near the city of České Budějovice in southern Bohemia in 1853. Since then, it rather occasionally escaped elsewhere. However, many occurrences were short-term as plants suffer from competition by grass species. It has become widely naturalized only in the Hostýnské vrchy Mts (first collected there at the beginning of the 20th century, scattered till now) in eastern Moravia. Less frequently it escaped as a casual in the surroundings of the city of Hradec Králové in eastern Bohemia (for the first time at the beginning of the 20th century, nowadays very rare) and in the vicinity of České Budějovice and the town of Veselí nad Lužnicí in southern Bohemia (nowadays very rare). It occurs from the planar to montane vegetation belts, with altitudinal maximum at 870 m.

Spergularia echinosperma (Fig. 71)

Spergularia echinosperma is a central-European endemic (Friedrich 1979, Dvořák 1990). A recent critical revision of herbarium collections (Kúr et al., in prep.) has confirmed its presence in the Czech Republic, Germany, Austria and Slovakia only. It is confined to vegetation of annual wetland herbs on periodically exposed bottoms of freshwater reservoirs. The primary habitat of *S. echinosperma* includes alluvial pools and sandy banks of rivers; the species, however, most frequently occurs in secondary habitats, mainly exposed bottoms of fishponds (Friedrich 1979, Dvořák 1990). In the Czech Republic *S. echinosperma* is most frequent in areas with many fishponds, i.e. southern, south-western and eastern Bohemia. The species prefers pond bottoms with lower trophic levels and a sandy substrate, which may be covered with a thin layer of mineral mud (Kúr et al., in prep.). It is currently threatened by the intensification of fishpond management and is classified as endangered (Grulich 2012). *Spergularia echinosperma* has unresolved taxonomy, and it probably comprises two intraspecific taxa. A taxonomic study of this species, employing molecular markers (Kúr et al. 2014), is currently in progress (Kúr et al., in prep.). Because of frequent misidentifications, the distribution map was based solely on revised herbarium specimens and our own field records.

Spergularia kurkae (Fig. 72)

Spergularia kurkae is a newly recognized species, which was described by Dvořák (1989) as a hybrid between *S. echinosperma* and *S. rubra* but has not been listed in any flora or checklist except for the Flora of the Czech Republic (Dvořák 1990) since then. Recent studies have proved that *S. kurkae*, although truly being of hybrid origin, is a stabilized, morphologically and ecologically well-separated species (Kúr et al. 2012, Kúr et

al., in prep.). The species occurs mainly in central Europe (Czech Republic, Germany and Austria), although outposts in Switzerland and France possibly exist (the taxonomic identity of these plants needs to be further investigated; Kúr et al., in prep.). It is confined to vegetation of annual wetland herbs on periodically exposed bottoms of freshwater reservoirs. The typical habitats of the species are alluvial pools, river banks, and, above all, fishponds and fish storage ponds. In the Czech Republic *S. kurkae* is most frequent in areas with many fishponds, i.e. southern, south-western and eastern Bohemia. The species has a wider ecological niche than *S. echinosperma* and can very rarely and for a short time survive outside pond bottoms (e.g. in pond sediment deposits). Its current threat level is unknown; herbarium records show that it is approximately twice as common as *S. echinosperma*. Because of frequent misidentifications, the distribution map was based solely on revised herbarium specimens and our own field records.

Spergularia marina (Fig. 73)

Spergularia marina is a nearly cosmopolitan halophilous species occurring in coastal and inland salt marshes of Europe, Asia, northern and southern Africa, North and South America, Australia and New Zealand (Hultén & Fries 1986, Meusel & Jäger 1992, Monnier & Ratter 1993, Hartman & Rabeler 2005, Adams et al. 2008). It is not clear in which parts of its distribution range the species is indigenous and where it has been introduced. In the Czech Republic *S. marina* used to grow relatively frequently in natural saline habitats in north-western Bohemia and southern Moravia. An isolated occurrence was around mineral springs in the Soos National Nature Reserve in western Bohemia. Since World War II the species has declined considerably as a result of habitat destruction and changes in landscape management. Today it survives at a few localities only (two sites in north-western Bohemia and about ten sites in southern Moravia). However, the species has been recently found to be rapidly spreading along roads that are treated by de-icing salts during the winter. In Austria and Germany the spread of *S. marina* on road verges has been known since the 1970s (Friedrich 1979, Hohla & Melzer 2003, Hetzel 2006). In the Czech Republic the species occurs most frequently along motorways, especially in colder areas where the application of de-icing salts is more intense, and is rare in warm and dry areas. There is also a noticeable decreasing gradient in the species' abundance from the west of the country to the east. The indigenous populations are currently classified as critically threatened (Grulich 2012). Because of frequent misidentifications, the distribution map was based solely on revised herbarium specimens and our own field records.

Spergularia media (Fig. 74)

Spergularia media is an obligate halophyte native to coastal and inland salt marshes of Eurasia and North Africa. It has been introduced to North and South America, Australia, New Zealand and southern Africa (Hultén & Fries 1986, Meusel & Jäger 1992, Monnier & Ratter 1993, Hartman & Rabeler 2005, Adams et al. 2008). In the Czech Republic *S. media* used to grow naturally in saline habitats in north-western Bohemia (three localities only) and southern Moravia (a few dozens of localities). It was also introduced to the ore yard of the ironworks in Polanka nad Odrou, north-eastern Moravia, in the 1960s (Kilián & Krkavec 1962; misidentified as *S. salina*). Since World War II the species has declined dramatically as a result of habitat destruction and changes in landscape management.

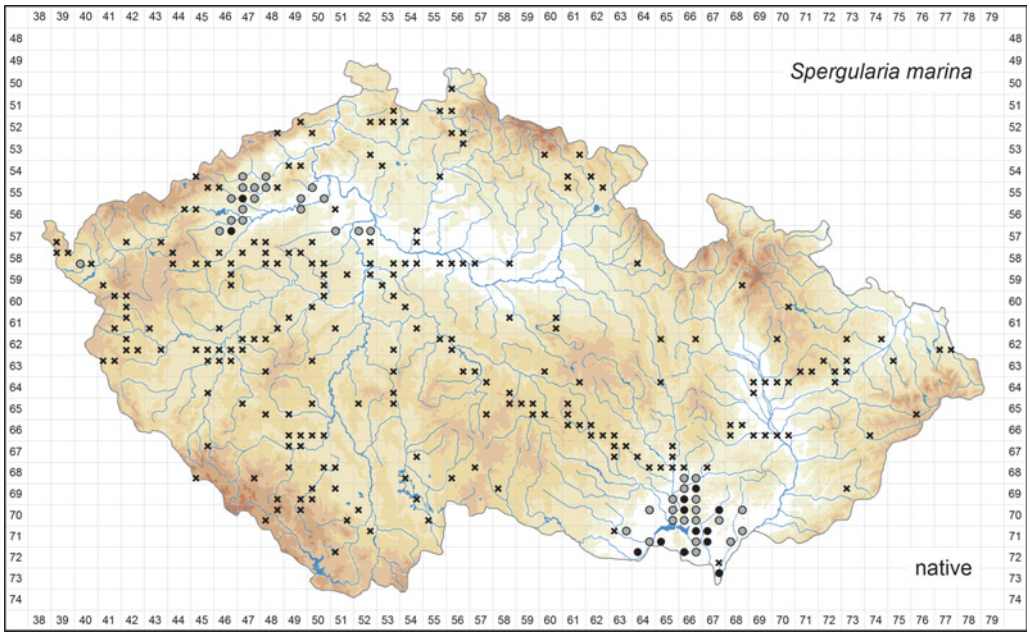


Fig. 73. – Distribution of *Spergularia marina* in the Czech Republic: ● native, at least one record in 2000–2016 (13 quadrants), ◍ native, pre 2000 records only (38 quadrants), × alien (224 quadrants). Prepared by Michal Ducháček & Pavel Kúr.

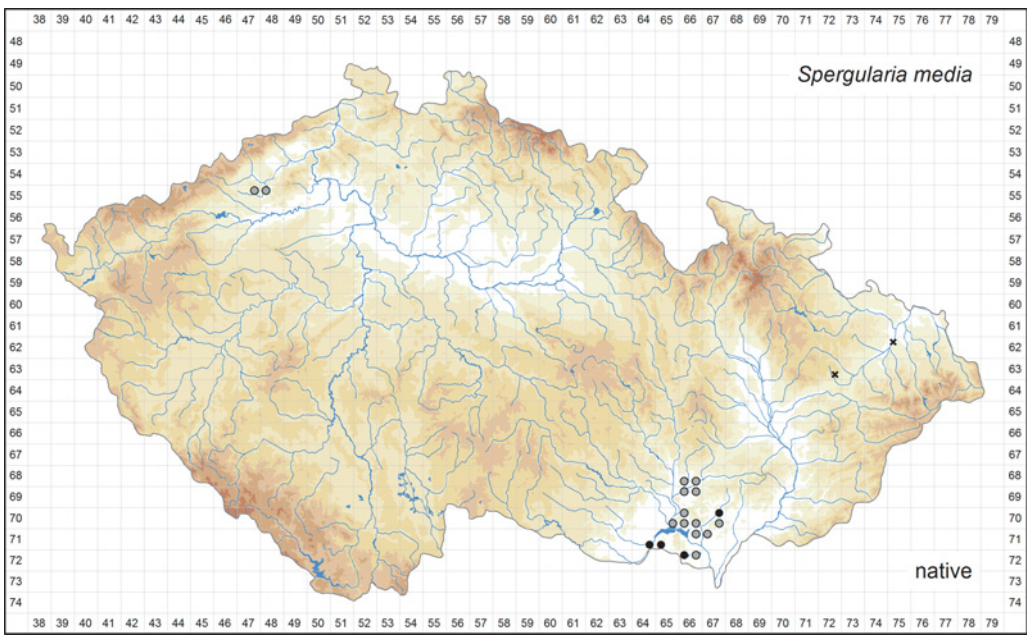


Fig. 74. – Distribution of *Spergularia media* in the Czech Republic: ● native, at least one record in 2000–2016 (4 quadrants), ◍ native, pre 2000 records only (14 quadrants), × alien (2 quadrants). Prepared by Michal Ducháček & Pavel Kúr.

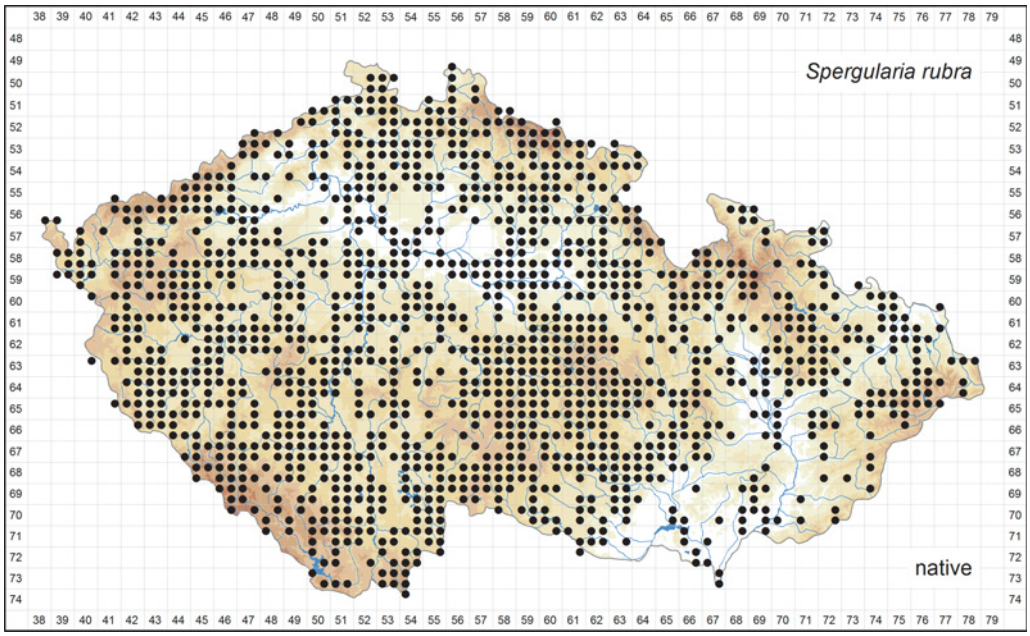


Fig. 75. – Distribution of *Spergularia rubra* in the Czech Republic (1395 occupied quadrants). Prepared by Pavel Kúr & Michal Ducháček.

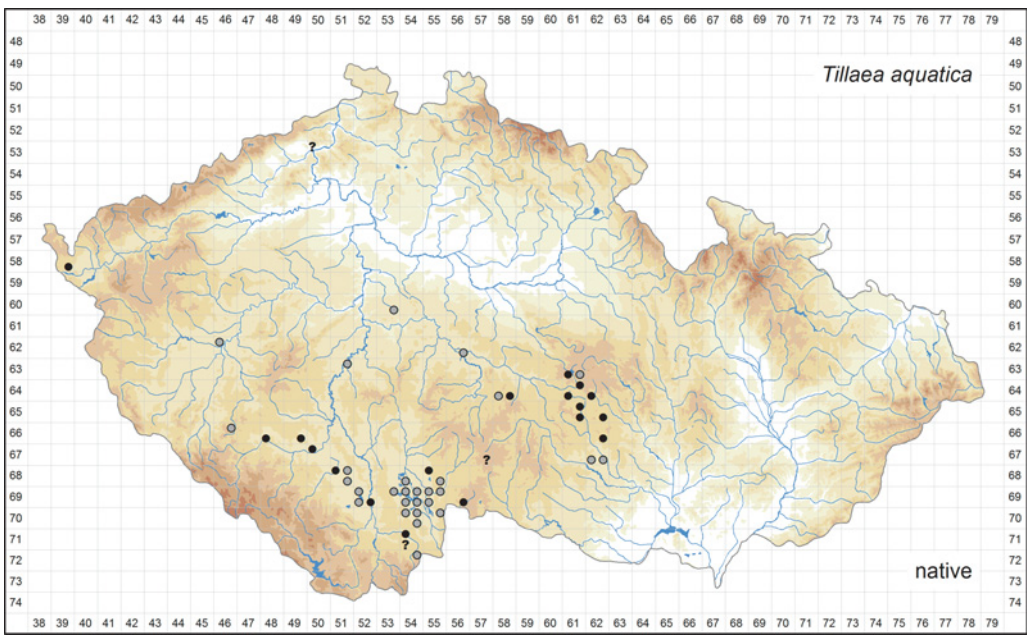


Fig. 76. – Distribution of *Tillaea aquatica* in the Czech Republic: ● at least one record in 2000–2016 (18 quadrants), ◍ pre 2000 records only (28 quadrants). Prepared by Kateřina Šumberová, Jan Prančl & Michal Ducháček.

Today it survives at four localities in southern Moravia only. *Spergularia media* has also been recently found at three sites on motorway verges (motorways D1 in north-eastern Moravia and D2 in southern Moravia). The species has been known from this type of habitat from Austria too (Hohla & Melzer 2003, Adler et al. 2008, Fischer et al. 2008), but its establishment and spread along road verges is slow as it is adapted to less disturbed habitats (Scott & Davison 1982). The species is currently classified as critically threatened (Grulich 2012). Because of frequent misidentifications, the distribution map was based solely on revised herbarium specimens and our own field records.

Spergularia rubra (Fig. 75)

Spergularia rubra is a cosmopolitan species native to Eurasia and introduced to North and South America, southern Africa, Australia and New Zealand (Hultén & Fries 1986, Monnier & Ratter 1993, Hartman & Rabeler 2005, Adams et al. 2008). Its assumed primary habitats are river banks and alluvial pools, but it has successfully spread to various types of secondary habitats. It prefers disturbed sandy sites, like footpaths, field margins or road verges, avoiding calcareous soils (Friedrich 1979, Hartman & Rabeler 2005). In the Czech Republic *S. rubra* is widespread throughout the country. Most of the gaps in the distribution map are due to under-recording but some may be true absences caused by the lack of suitable habitats or the dominance of base-rich and heavy soils.

Tillaea aquatica (Fig. 76)

Tillaea aquatica has a sub-oceanic circumpolar distribution. In Europe its localities are concentrated to Scandinavia with northernmost occurrences along the Arctic Circle, south- and eastwards it is scattered throughout western and central Europe and European Russia (Hultén & Fries 1986); in some parts of its range the species has vanished during the last decades (Šumberová et al. 2012a). Outside Europe, the species occurs in North America and eastern Asia (Hultén & Fries 1986). The species' distribution pattern shows its preference for acidic, non-calcareous substrates and a relatively cold and moist climate. *Tillaea aquatica* is a low-growing, competitively weak wetland annual. It is a typical component of the vegetation of temporarily exposed pond bottoms, growing on sandy or loamy littorals and bottoms of fishponds, fish storage ponds, water reservoirs and rarely also in river beds. The development of the plants is slow and therefore *T. aquatica* does not produce its first ripe seeds until some four months after the spring germination (Šumberová et al. 2012a). Its localities in the Czech Republic are at the southern limit of the species' distribution range. It has been recorded at several dozens of localities, particularly in fishpond landscapes of southern Bohemia and in the Českomoravská vrchovina highlands. Isolated records are known also from western and central Bohemia. Since the 1960s *Tillaea aquatica* vanished from majority of its former sites (Grulich 1985, Šumberová et al. 2012a). The restriction of the length of summer drainage and the long intervals between them, not enabling reproduction of the species in most of the fishponds, had probably the major impact. High amounts of fertilisers and lime applied in fishponds supported tall-growing species, which outcompeted *T. aquatica*. Recently, the species has been found in fishponds used for low-intensity fish farming and in fish storage ponds with long summer drainage and vegetation grazed by sheep or eliminated by glyphosate herbicides, i.e. the management selectively favouring *T. aquatica* (Šumberová et al.

2012a). Although about 20 populations have been recorded during the last two decades, only some of them have a chance of a long-time survival. Consequently, *Tillaea aquatica* is classified as critically threatened (Grulich 2012). Because of rather frequent misidentifications, including even specimens of *Callitriche* and *Elatine*, the map is based mainly on revised herbarium specimens, supplemented by our own finds and reliable literature records. Several populations in abandoned sand pits around the town of Třeboň in southern Bohemia have originated from rescue cultivations (A. Kučerová, in litt.) and they were not included into the map.

Veratrum album subsp. *album* (Fig. 77)

Veratrum album subsp. *album* is distributed in European mountains and on adjacent foothills from the Iberian Peninsula through the Alps and Carpathians to the central part of the Balkan Peninsula, northwards reaching southern Bohemia in the Czech Republic, north-eastern Austria and south-eastern Poland. In the Czech Republic, it is confined to the Novohradské hory Mts, southern part of the Šumava Mts and their foothills in southernmost Bohemia. It is a good example of biogeographical links between the Eastern Alps and the mountain ranges forming the southern border of Bohemia (Kaplan 2012). *Veratrum album* subsp. *album* occurs in hygrophilous forests, springs, fen meadows and pastures at altitudes about 530–1300 m. Its populations are stable and not threatened, individual plants can even survive in a vegetative state in spruce plantations. Because of its rarity, it is classified as endangered (Grulich 2012).

Veratrum album subsp. *lobelianum* (Fig. 78)

Veratrum album subsp. *lobelianum* is distributed in south-western, central and eastern Europe, reaching central France in the west, Poland and the coast of the Arctic Ocean in the north, central Italy and northern Greece in the south and the Ural Mts in the east. Outside Europe the range continues eastwards through Siberia as far as the Russian Far East and Japan, and southwards to the Tian Shan Mts, China and Mongolia (Meusel et al. 1965). In the Czech Republic *V. album* subsp. *lobelianum* occurs in subalpine grasslands and shrub communities, tall fern stands, springs, wet meadows and pastures, and deciduous and spruce forests. It is scattered to locally common over mountains in northern and north-eastern Bohemia, Silesia, and northern and north-eastern Moravia. Most populations are found in the subalpine and montane belts, with an altitudinal maximum at 1535 m. In northern and north-eastern Bohemia, it has locally spread into lower altitudes, especially in the understory of forests along rivers (mainly the Jizera river), reaching elevations of ca 330 m. In contrast, in eastern Bohemia, Moravia and Silesia it reaches areas more distant from mountain ridges, and lower elevations, the latter especially in the Morava river basin (near the town of Litovel, ca 230 m a.s.l.) and close to Czech-Polish border (near the town of Vidnava, ca 240 m). *Veratrum album* subsp. *lobelianum* is classified as lower risk – near threatened (Grulich 2012).

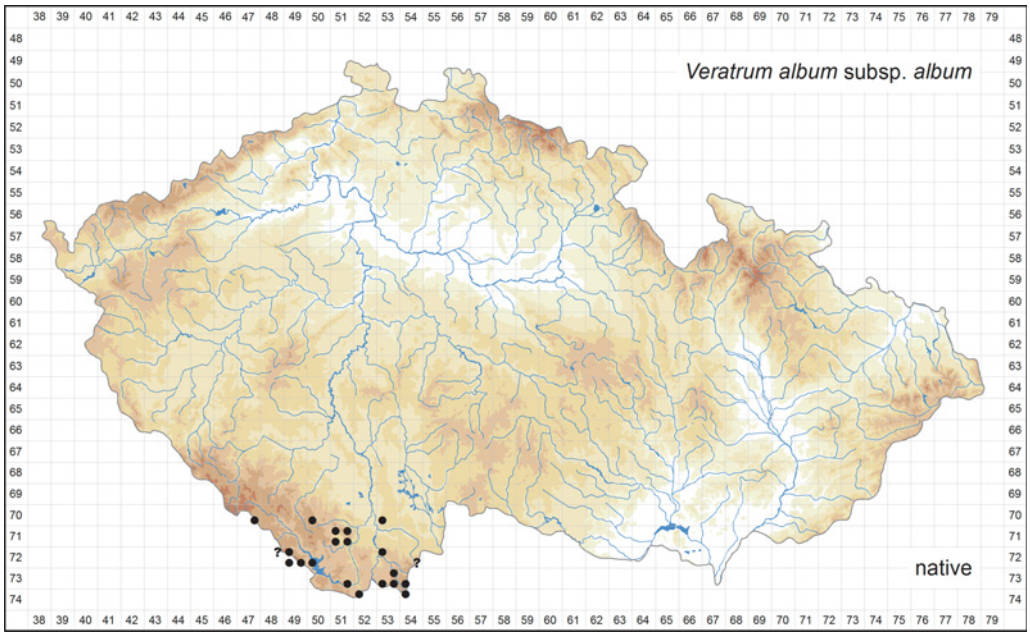


Fig. 77. – Distribution of *Veratrum album* subsp. *album* in the Czech Republic (19 occupied quadrants). Prepared by Jindřich Chrtek Jr.

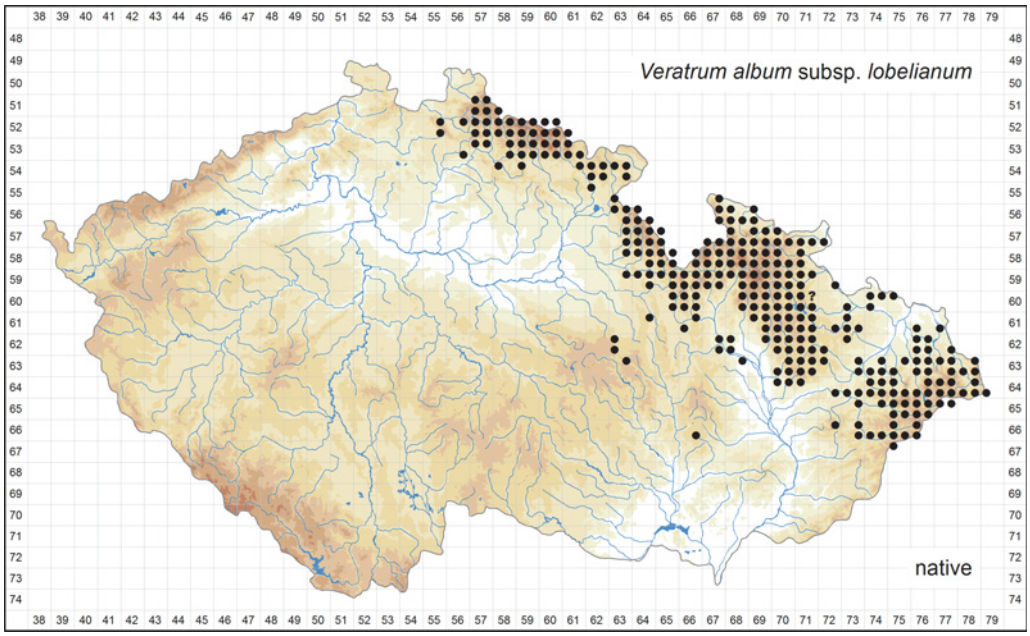


Fig. 78. – Distribution of *Veratrum album* subsp. *lobelianum* in the Czech Republic (288 occupied quadrants). Prepared by Jindřich Chrtek Jr.

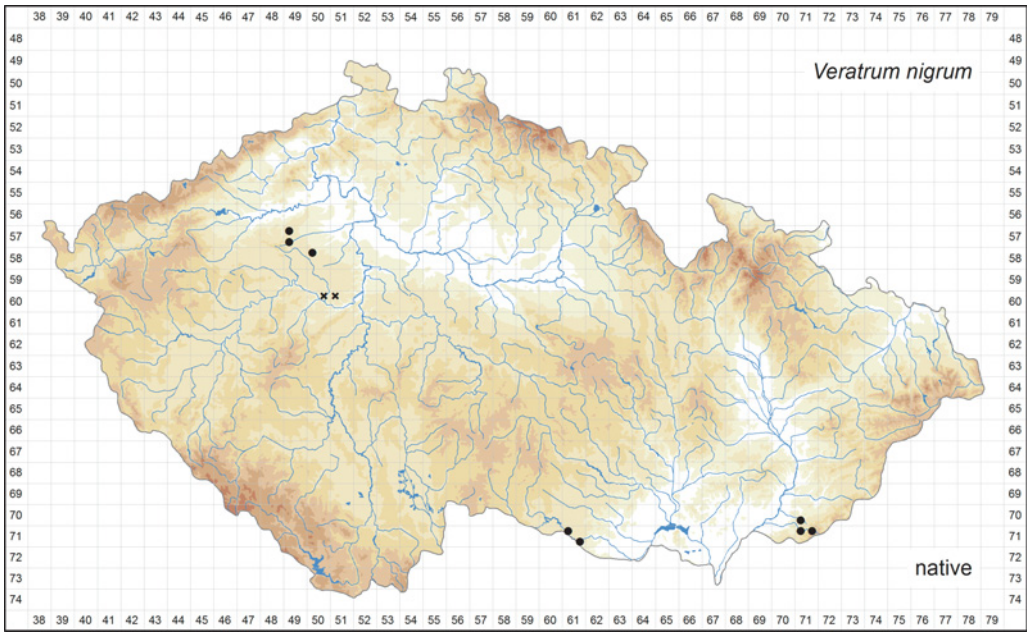


Fig. 79. – Distribution of *Veratrum nigrum* in the Czech Republic: ● native (8 quadrants), × alien (2 quadrants). Prepared by Jindřich Chrtek Jr.

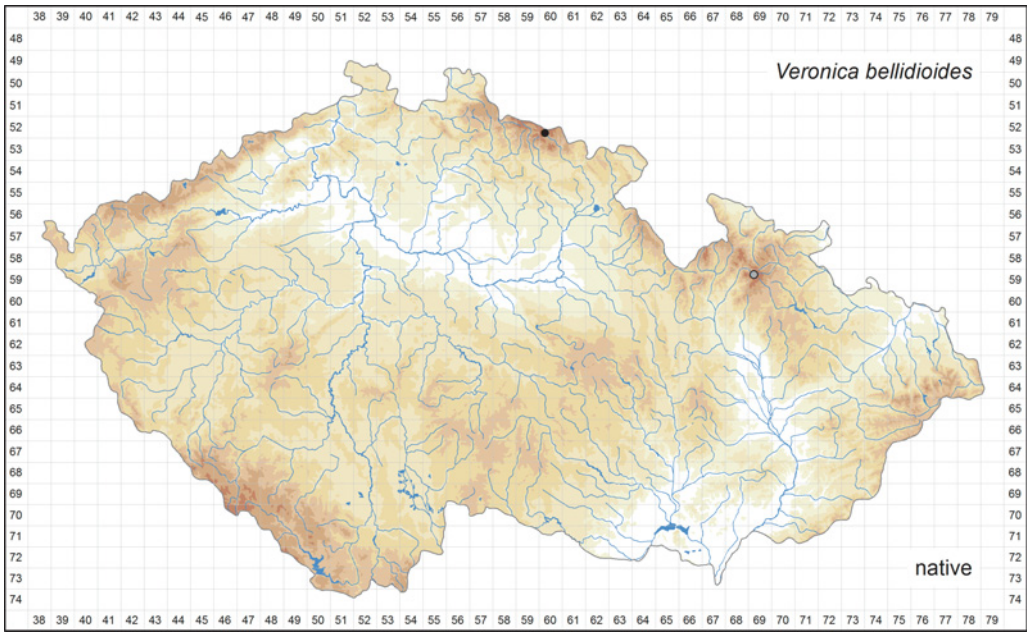


Fig. 80. – Distribution of *Veronica bellidioides* in the Czech Republic: ● at least one record in 2000–2016 (1 quadrant), ◍ pre 2000 records only (1 quadrant). Prepared by Jiří Danihelka.

Veratrum nigrum (Fig. 79)

Veratrum nigrum is a Eurasian species with disjunct European range reaching southern France in the west, Austria, the Czech Republic and southern Poland in the north, central Italy and northern Greece in the south and the Volga river in the east (Niklfeld 1971). The more or less continuous Asian part of the range includes Kazakhstan, southern Siberia (zone of hemiboreal forests), the Amur river basin, Mongolia and China (Nosova 1965). In central Europe it is considered to be a relict from earlier periods of the Holocene (Hájková et al. 2011, Roleček et al. 2015). In the Czech Republic it is found in open-canopy forests, clearings, semi-dry and mesophilous meadows at altitudes about 190–510 m. Its disjunct range in the country is split into three small parts; the first one is located in forests west of the village of Bílichov and near the town of Kladno in central Bohemia, the second one in the narrow valley of the Dyje river along the border between Moravia and Austria west of the town of Znojmo, and the third one in the vicinity of the town of Velká nad Veličkou in the south-western part of the Bílé Karpaty Mts. It was deliberately planted and still survives at Velká hora hill near Beroun in central Bohemia. *Veratrum nigrum* has not declined and does not seem endangered; closing of forest canopy affects flowering and the plants then survive as basal rosettes. Still, due to its rarity it is classified as critically threatened (Grulich 2012).

Veronica bellidioides (Fig. 80)

Veronica bellidioides is distributed in the high mountains of Europe, including the Pyrenees, Alps, Sudetes in the Czech Republic, Eastern Carpathians and the mountain systems of the Balkan Peninsula (Küpfer 1974). The localities in the Krkonoše Mts and the Hrubý Jeseník Mts are situated at the northern edge of the species' distribution range. In the Krkonoše Mts the species was discovered on the summit of Mt Sněžka as early as 1786 by Th. Haenke and repeatedly collected for herbaria, including two exsiccate collections, since then. It grows in species-poor alpine grasslands dominated by *Juncus trifidus*, *Festuca supina* and *Avenella flexuosa*. In 2001–2004, 150–200 plants were counted, growing in four patches (Chrtek et al. 2007). The other population existed in the Velká kotlina glacier cirque in the Hrubý Jeseník Mts. The plants were discovered in 1838 by J. Spatzier and once again collected by the same author 10 years later; the last observation may be that by F. Kolenati from summer 1859 (Kolenati 1860). Heinrich Grabowski (Grabowski 1843), who saw the plants there in summer 1839, reported *V. bellidioides* growing "among *Plantago montana*". It may be therefore assumed that the plants grew there on a rocky slope in a species-rich alpine grassland together with *Helianthemum grandiflorum*, *Poa alpina*, *Plantago atrata* subsp. *sudetica* and *Thymus pulcherrimus* (Bureš 2013). The species is now classified as critically endangered (Grulich 2012).

Veronica filiformis (Fig. 81)

Veronica filiformis is native to the Caucasus Mts and north-eastern Anatolia. It was first found in continental Europe in 1893 near Marseille in France as "plants being packed around the roots of vine shoots imported from Georgia" and since then repeatedly introduced for ornamental purposes because of its small but showy flowers. First records of escaped plants in western and central Europe date back to the period 1901–1930. Nowadays

it is fully naturalized in north-western, northern and central Europe, all areas with Atlantic and Subatlantic climates (Scalone & Albach 2012). It is now naturalized also in the east and west of North America (USDA, NRCS 2016) and New Zealand (Webb et al. 1988). In the Czech Republic the cultivation of *V. filiformis* in plant nurseries has been documented from 1930 onwards; the first escaped plants were recorded in the Lednice chateau park in southern Moravia as early as in 1938 (still present there) as well as in Prague and in the town of Smiřice in eastern Bohemia in 1941 (Jehlík 1998). In its secondary distribution area in Europe, *V. filiformis* is a strictly clonal plant, propagating only vegetatively because of strong self-incompatibility, which is combined with the presence of a limited number of clones. In already colonized sites it spreads by intense growth and rooting from almost all nodes of its creeping stems. If the stem is cut by a mowing machine or torn to pieces by raking, each of fragments produces adventitious roots from all its nodes within three days under standard conditions (Scalone & Albach 2012). These propagules are transported with garden waste or in streams and easily colonize new sites. It is also spread by deliberate planting. In the Czech Republic *V. filiformis* usually occurs in lawns and frequently mown meadows in settlements, gardens, chateau parks, around weekend houses and in alluvial meadows. It prefers humid soils rich in humus and nutrients. The current distribution of *V. filiformis* in the Czech Republic reflects its affinity to the Atlantic climate. It occurs mainly at middle elevations, less frequently in the mountains and lowlands. Its presence in warm and dry parts of the country is limited to floodplain meadows and sites with suitable mesoclimate. *Veronica filiformis* is currently classified as a naturalized neophyte (Pyšek et al. 2012b).

Veronica montana (Fig. 82)

Veronica montana is distributed mainly in the British Isles, western and central Europe, and the Carpathians, with some outposts in southern Scandinavia, the Iberian Peninsula, north Africa, the Apennine and the Balkan Peninsula, where it usually occurs in the mountains. The eastern distribution limit runs through the Baltic countries, Belorussia and Ukraine. Its general distribution is very similar to that of *Fagus sylvatica* (Meusel et al. 1978). In the Czech Republic it occurs usually in beech and beech-fir forests, alder and common ash floodplain forests, forest springs and in shady places on streamsides; rarely it is also found in hardwood floodplain forests. It requires humid to moist, neutral to slightly acidic loamy soils, usually developed over acidic to slightly alkaline bedrock. In Bohemia *V. montana* is distributed mainly in the mountain ranges along the country's border and also in highlands such as the Brdy hills and the Českomoravská vrchovina highlands. It is almost continuously distributed in northern Moravia and adjacent Silesia, as well as in the Carpathians. The occurrence in the floodplain forests of southernmost Moravia south of the town of Břeclav may be explained by propagule transport from the Carpathians during major floods. The species is found at altitudes from 151 m at the confluence of the Morava and Dyje rivers up to 1290 m in the Hrubý Jeseník Mts. The distribution map clearly demonstrates the species' affinity to areas with humid and moderately warm to cold climate, which is correlated with middle and high elevations. *Veronica montana* is easily identified; still, some of literature records may be wrong, based on misidentifications of vegetative shoots of *V. chamaedrys* and *Galeobdolon* sp. The species is classified as lower risk – near threatened (Grulich 2012).

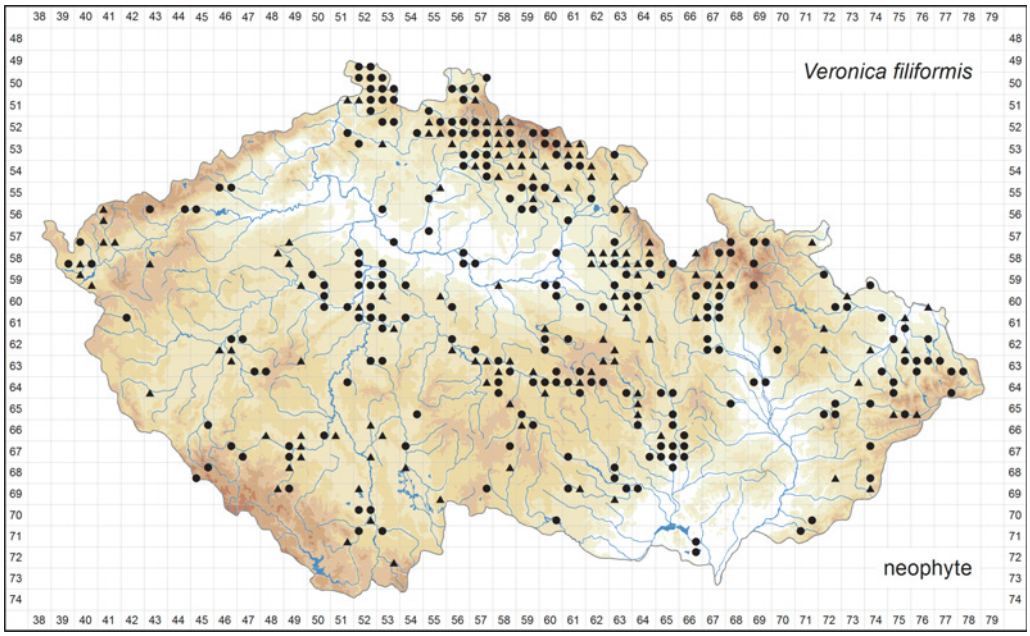


Fig. 81. – Distribution of *Veronica filiformis* in the Czech Republic: ● occurrence documented by herbarium specimens (227 quadrants), ▲ occurrence based on other records (132 quadrants). Prepared by Jiří Danihelka.

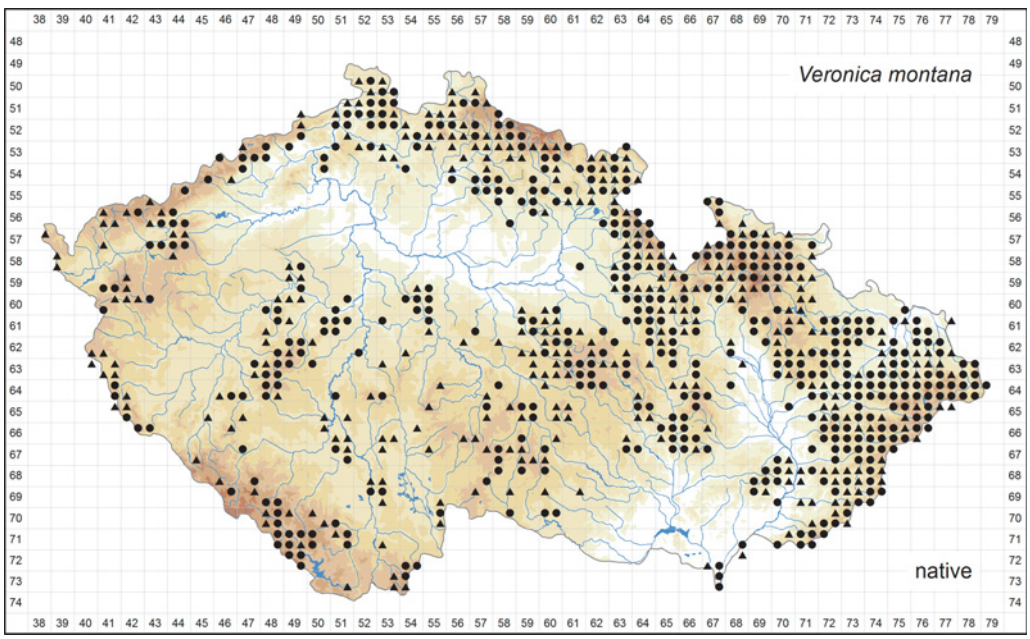


Fig. 82. – Distribution of *Veronica montana* in the Czech Republic: ● occurrence documented by herbarium specimens (448 quadrants), ▲ occurrence based on other records (334 quadrants). Prepared by Jiří Danihelka.

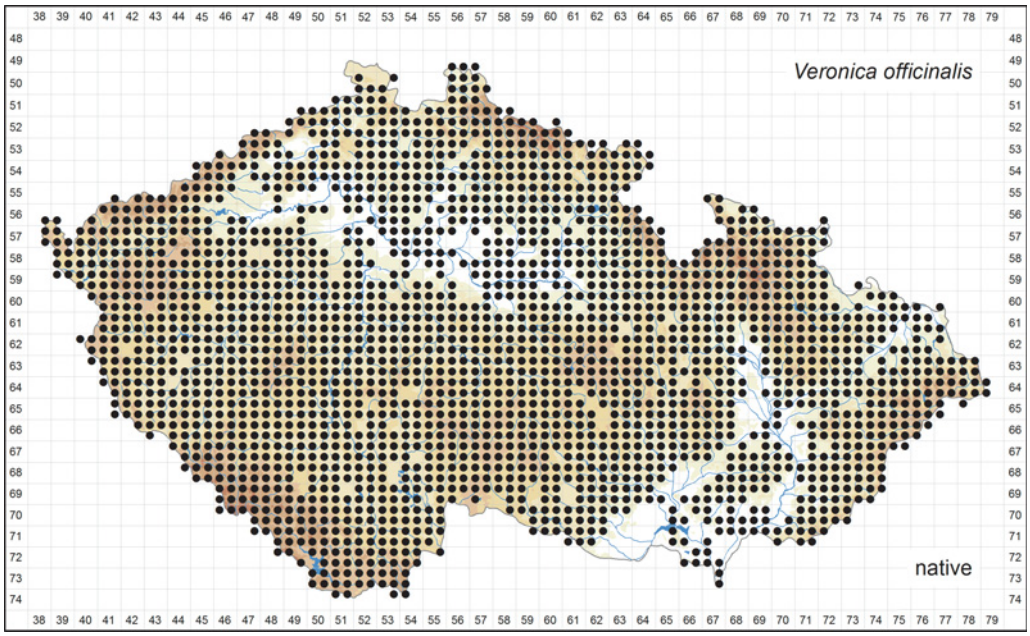


Fig. 83. – Distribution of *Veronica officinalis* in the Czech Republic (2180 occupied quadrants). Prepared by Jiří Danihelka.

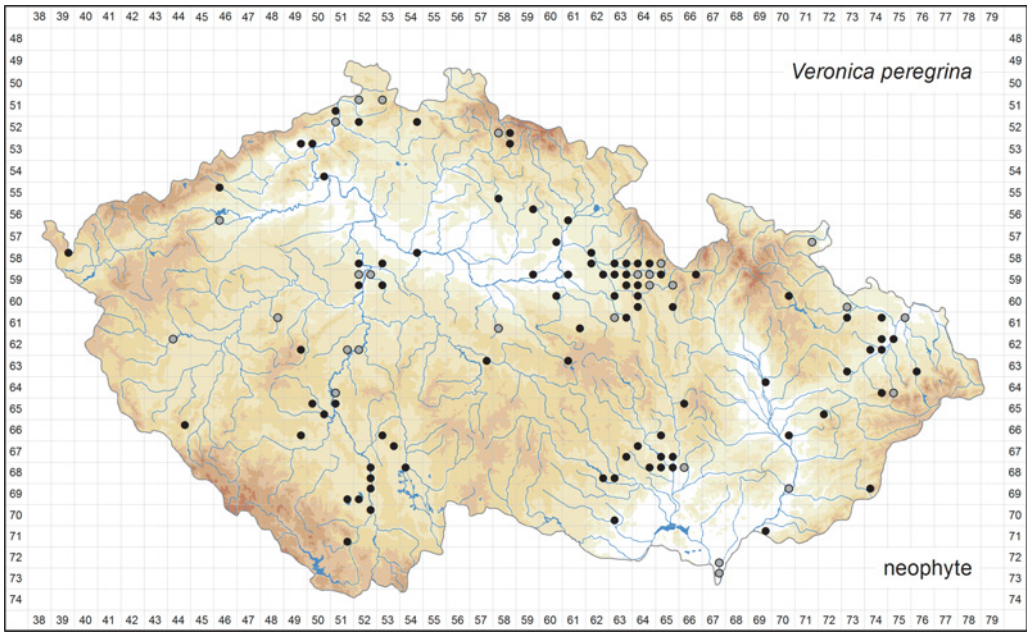


Fig. 84. – Distribution of *Veronica peregrina* in the Czech Republic: ● at least one record in 2000–2016 (86 quadrants), ● pre 2000 records only (27 quadrants). Prepared by Jiří Danihelka.

Veronica officinalis (Fig. 83)

Veronica officinalis is a European species with an outpost in the Caucasus Mts, missing only from the northernmost part of the European continent and southern parts of the Mediterranean area (Meusel et al. 1978). It has become naturalized in North America (USDA, NRCS 2016). The species varies in growth habit, indumentum and flower colour but this variation is of little taxonomic value, considerable part of it being attributable to habitat modifications. In the Czech Republic *V. officinalis* grows in broad-leaved and coniferous forests with open canopies, forest clearings, along forest roads and paths, in acidophilous dry grasslands, heathlands, dry and mountain meadows, usually on acidic soils poor in nutrients and developed above siliceous bedrock. If it occurs above carbonate-rich bedrock, then the soil is deep and decalcified in the upper horizons. *Veronica officinalis* is widespread in the Czech Republic, missing only from areas with prevailing arable land, over carbonate-rich bedrock and with very nutrient-rich and wet soils. It occurs from the lowlands up to 1450 m a.s.l. in the Krkonoše Mts.

Veronica peregrina (Fig. 84)

Veronica peregrina is a species native to the mountains of Central and South America (Fischer 2008), in the 17th century introduced to Europe. Nowadays it is naturalized in most countries of western and central Europe (Meusel et al. 1978), and in China, Japan, Korea and Mongolia (Hong & Fischer 1998). The earliest records from central Europe date back to the 19th century, with the very first one in Alsace, France, from 1825. The year of the first record in Bohemia is uncertain. This species was already recorded as occurring in Prague by Schmidt (1789); however, no herbarium specimen is available for this record. Reliable records were published by Čelakovský (1871) and the earliest discovered herbarium specimen was collected in 1882 in the old botanical garden in Prague. Both glabrous and glandular plants have been collected in the Czech Republic, the latter, usually referred to as *V. p.* subsp. *xalapensis*, being far less frequent. The main source of *V. peregrina* in the Czech Republic are plant nurseries and garden centres where it occurs as a weed in irrigated cultivation beds. From there it is transported with plants to private and public gardens, city and chateau parks, cemeteries and flowerbeds in settlements. It occurs also as weed in humid waste places, ruderal vegetation and in field margins. In the 1970s it was for the first time collected on the shores of the Slapy water reservoir, which is the habitat type known from other countries. Since then, the number of records from the shores of water reservoirs, banks of rivers and exposed fishpond bottoms has been steadily growing, and the species became a locally permanent part of their flora. The map suggests that there are some local plant nurseries acting as source of propagules, such as in easternmost Bohemia, but the pattern may be also strongly influenced by varied recording efforts.

Veronica pumila (Fig. 85)

Veronica pumila is very closely related to *V. alpina*, and by some authors it is even not recognized at any rank as a separate taxon (Albach et al. 2006; but see Elven 2016). *Veronica alpina* s. l. has a large disjunct distribution range including Iceland, northern Scandinavia, northern European Russia, high mountain ranges of central and southern Europe, mountains of southern Siberia, as well as Labrador and Greenland in North

America (Meusel et al. 1978, Albach et al. 2006, Elven 2016). Based on morphological characters, the central European populations are assigned to *V. pumila* (syn. *V. alpina* subp. *pumila*), described from the Western Alps in northern Italy. In the Czech Republic *V. pumila* with certainty occurred in the Krkonoše Mts near the Luční bouda chalet, as documented by herbarium specimens from the 19th century, probably in subalpine grasslands dominated by *Nardus stricta*. The latest specimen seen was collected by J. v. Sterneck in 1901; he noted on the label that the population, consisting of about 40 plants, is protected from "aliens" by the chalet owner. Only 19th century literature records exist from Mt Sněžka, where another small population may have existed. Not seen for more than a century, the species is now classified as extinct (Grulich 2012), but a small population still survives on the Polish side of the mountains above Mały Staw Lake.

Veronica scutellata (Fig. 86)

Veronica scutellata is a circumboreal species distributed in Europe, western and central Siberia, and western and eastern North America. In southern Europe its distribution is restricted to more humid areas, usually at higher altitudes (Meusel et al. 1978). In the Czech Republic it is usually found in fishpond littorals, on shores of sand pits, in marsh vegetation dominated by tall sedges, fen meadows, along ditches and in reed stands, quite often in somewhat disturbed places. It is a heliophilous species of permanently wet or inundated soils with high groundwater level, usually moderately rich in nutrients and slightly acidic. *Veronica scutellata* is widespread in the Czech Republic, being particularly common at middle altitudes, mainly in fishpond landscapes and other areas harbouring wetland vegetation. In contrast, it is absent from dry and warm areas, such as northwest and east of Prague, or from large parts of central and southern Moravia, where it is more or less confined to river floodplains. It is found at elevations from 151 m up to 950 m in the Šumava Mts but it was recorded as introduced at 1100 m or even higher in the Krkonoše Mts. Having somewhat declined mainly because of drainage, it is currently ranked as lower risk – near threatened (Grulich 2012).

Veronica serpyllifolia (Fig. 87)

Veronica serpyllifolia is an almost cosmopolitan species, native to Eurasia, northern Africa, North and South America. It has become naturalized in South Africa, New Zealand and Australia. It has usually been divided in two subspecies, with the type subspecies originally restricted to Eurasia and *V. s.* subsp. *humifusa*, an arctic-montane subspecies, which is a circumpolar plant with a discontinuous distribution range (Meusel et al. 1978, Hultén & Fries 1986). *Veronica serpyllifolia* is widespread all over Europe, being absent only from some parts of the Mediterranean area. In the Czech Republic only the type subspecies is present. *Veronica serpyllifolia* occurs mainly in mesophilous and floodplain meadows, pastures, along paths, in trampled lawns, gardens and backyards in settlements, on fallow land and in forests with open canopy. It requires humid soils, well supplied with nutrients including nitrogen, usually not above carbonate rock. In sufficiently humid areas it is found in sunny places, whereas in rather dry and warm areas it is confined to semi-shaded habitats. Its altitudinal range spans from 151 m to 1603 m at the summit of Mt Sněžka. In the Czech Republic it is a widespread species with an almost continuous distribution in middle and high altitudes, where the gaps indicate under-recording rather

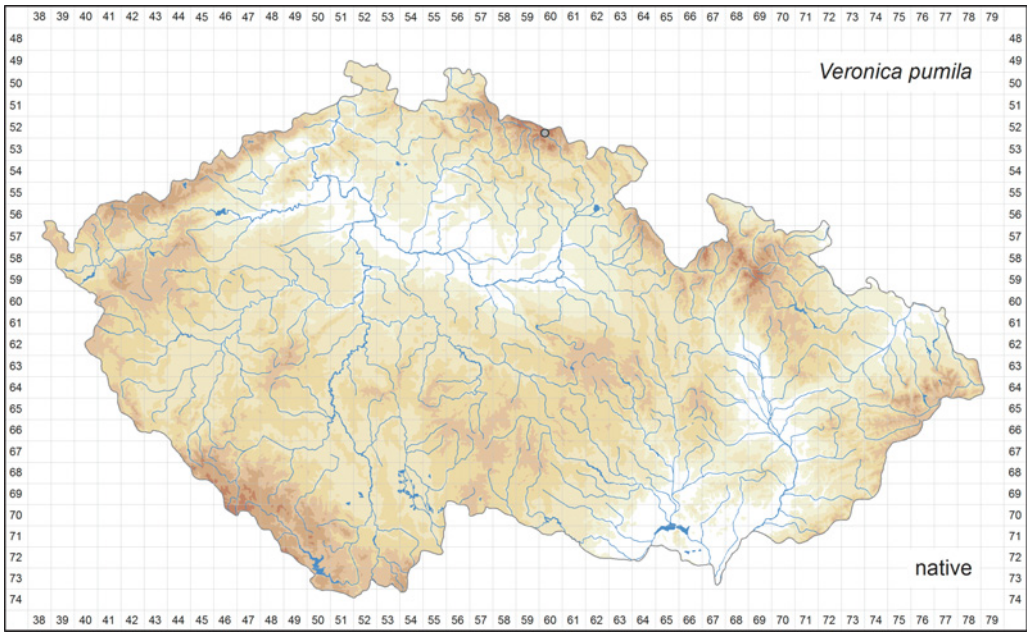


Fig. 85. – Distribution of *Veronica pumila* in the Czech Republic (1 occupied quadrant). Prepared by Jiří Danihelka.

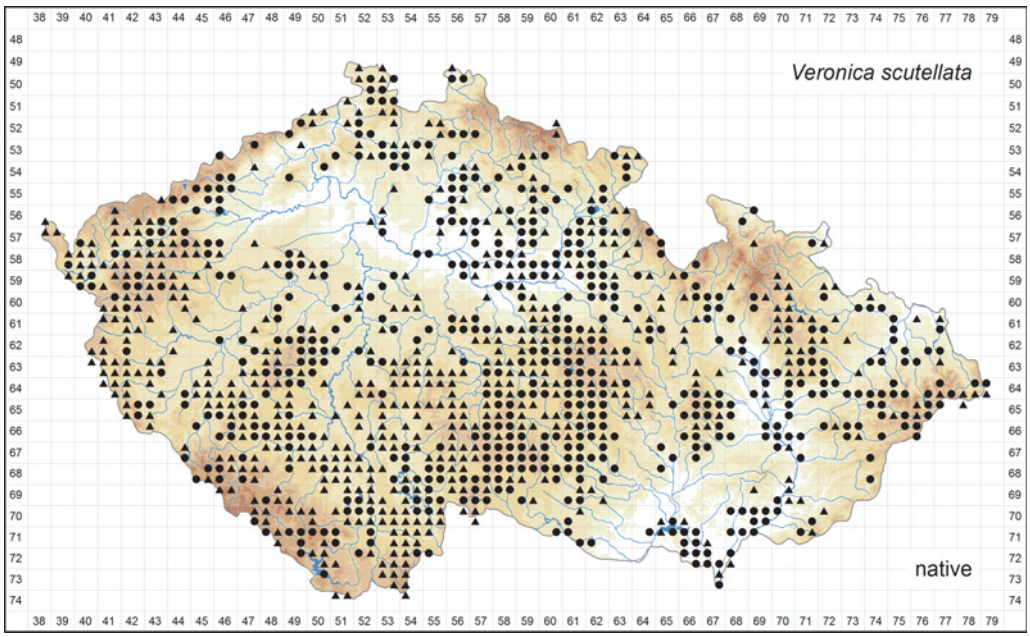


Fig. 86. – Distribution of *Veronica scutellata* in the Czech Republic: ● occurrence documented by herbarium specimens (551 quadrants), ▲ occurrence based on other records (553 quadrants). Prepared by Jiří Danihelka.

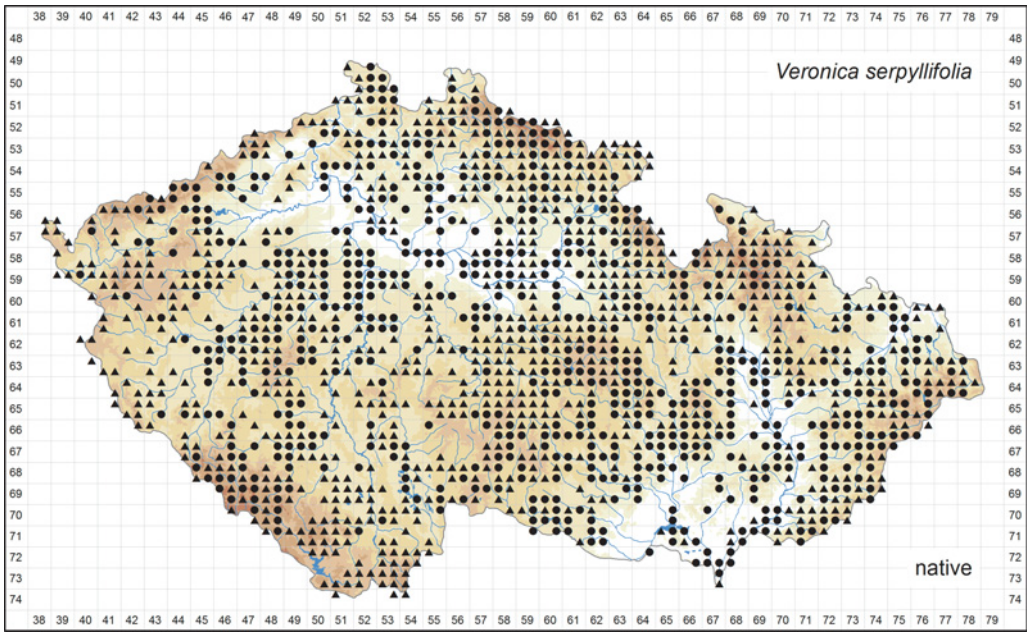


Fig. 87. – Distribution of *Veronica serpyllifolia* in the Czech Republic: ● occurrence documented by herbarium specimens (692 quadrants), ▲ occurrence based on other records (810 quadrants). Prepared by Jiří Danihelka & Michal Ducháček.

than true absences. In contrast, the gaps in warm and dry areas with prevailing arable land in central and north-western Bohemia, and in central and southern Moravia, may be to a large extent true absences.

See www.preslia.cz for Electronic Appendices 1–87

Acknowledgements

Producing distribution maps would not be possible without the effort of innumerable field botanists who often devoted a lot of their time, and frequently also much of their lives, to collecting plant distribution records and plant specimens for herbaria. We are grateful to all who made this study possible and helped us in any way. Curators of the herbaria visited allowed us to study their specimens and collect records. Administrators of the integrated databases, particularly Jan Štěpánek, Milan Chytrý, Dana Michalcová and Karel Chobot as representatives of the major ones, agreed to share plant distribution records. Pavel Dřevojan, Petr Filippov and Zdenka Hroudová contributed with records to produce maps. The South-Bohemian branch of the Czech Botanical Society kindly provided data from the regional floristic database of Václav Chán. Regional collaborators, particularly Jan Doležal, Radek Štencl, Leo Bureš, Pavel Dřevojan, Lenka Pivoňková, Daniel Koutecký, David Hlisnikovský, Radim Paulič, Rudolf Hlaváček, Luděk Čech, Zuzana Mruzíková, Jiří Brabec, Věra Hromádková, Milan Štech, Jan Blahovec, Jan Košnar, Romana Prausová, Tomáš Svačina, Hana Galušková, Petr Koutecký, Tomáš Tichý, Karel Fajmon, Josef Komárek, Vladimír Melichar, Věra Samková, Ester Ekrtová, Petr Lepší, Petr Petřík, Martin Lepší, Pavel Lustyk, Jiří Kocián, Sylvie Pecháčková, Čestmír Ondráček, David Půbal, Hana Houzarová, Petra Juřáková, Milan Kotilínek, Martin Dančák, Michal Juříček, Dagmar Zábranská, Jana Janáková, Josef Albrecht, Milan Marek and Jaroslav Zámečník commented on early versions of maps

and/or provided additional records from their areas. Jörg Böckelmann, Kateřina Bubíková, Josef Harčarik, Soňa Píšová and Karin Tremetsberger helped with fieldwork. Anna Daňková, Petr Filippov, Hana Galušková, Klára Kabátová, Anna KladivováVěra Matějovičová, Ludmila Mikovcová, Helena Prokešová, Lucie Rejchrtová, Petra Štěpánková, Václav Šulc, Kristýna Vazačová and Jan Wild georeferenced distribution records, computerized data, helped with the preparation of maps or provided other technical assistance. Programmers Petr Novotný and Martin Rohn produced the Pladias database and an internet-accessible mapping interface. Milan Štech and Christopher D. Preston carefully read the manuscript and suggested numerous valuable improvements. The research was supported by the Centre of Excellence PLADIAS, project no. 14-36079G from the Czech Science Foundation. ZK, JD, JŠ, JC, JZ, JP, KŠ and JB were also supported by the long-term research development project no. RVO 67985939 from the Academy of Sciences of the Czech Republic, JP partly by the project Kontakt II, no. LH12099 from Ministry of Education, Youth and Sports of the Czech Republic, and partly by the institutional resources of Ministry of Education, Youth and Sports of the Czech Republic for the support of science and research, MD by project no. 00023272 (National Museum, DKRVO 2015/10 and 2015/11) from the Ministry of Culture of the Czech Republic, and KŠ partly by the project FISHPOND2014, no. LD14045 from Ministry of Education, Youth and Sports of the Czech Republic, and partly by the project P 24558-B16 from Austrian Science Fund (FWF).

Souhrn

Druhá část ze série publikací věnovaných rozšíření cévnatých rostlin v České republice obsahuje síťové mapy a doprovodné komentáře k 87 taxonům z rodů *Antennaria*, *Aposeris*, *Astragalus*, *Avenula*, *Bidens*, *Carex*, *Cenchrus*, *Centunculus*, *Convallaria*, *Crocus*, *Cryptogramma*, *Cyperus*, *Dryopteris*, *Gladiolus*, *Gratiola*, *Helictochloa*, *Hierochloë*, *Lindernia*, *Maianthemum*, *Myriophyllum*, *Notholaena*, *Nymphoides*, *Radiola*, *Schoenoplectus*, *Sisyrinchium*, *Spergularia*, *Tillaea*, *Veratrum* a *Veronica*. Základem jsou údaje získané excerpcí herbářů a literatury, terénní zápisy a nálezy dostupné v databázích, které prověřili taxonomičtí experti. Mnohé taxony patří mezi vzácné nebo ohrožené rostliny a jsou proto zařazeny na Červeném seznamu. Mezi skupiny rostlin zvláště zasažené změnami nebo úplným zničením biotopů patří psamofyty. *Astragalus arenarius*, *Hierochloë odorata* a *H. repens* jsou kriticky ohrožené druhy, které ustoupily zejména v důsledku převodu písčin na ornou půdu, těžbě písku, zalesňování, změnám v obhospodařování krajiny a eutrofizace prostředí následovanou sukcesí. Všechny tři jmenované druhy se dnes vyskytují na malém počtu lokalit a jejich populace jsou většinou velmi chudé. Další skupinou ohroženou kvůli vazbě na specifická stanoviště jsou konkurenčně slabé mokřadní jednoletky, jako jsou *Centunculus minimus*, *Cyperus flavescens*, *C. michelianus*, *Lindernia procumbens*, *Radiola linoides* a *Tillaea aquatica*. Ty se nejčastěji vyskytují na obnažených dnech rybníků nebo řečišť toků, v opuštěných pískovnách a na extenzivně obhospodařovaných vlhkých písčitých polích. Ačkoliv některé byly v minulosti i hojnější, všechny výrazně ustoupily v důsledku intenzifikace hospodaření na rybnících, zejména následkem přihnojování a omezení pravidelného letnění rybníků, a dále v důsledku rozsáhlých změn ve využívání krajiny. Dnes se tyto druhy vyskytují jen na malém počtu posledních lokalit, mnohdy nepravidelně, s delšími periodami absence, a jsou proto řazeny mezi kriticky ohrožené taxony. Článek přináší i první mapu rozšíření středoevropského endemita *Spergularia kurkae*, který byl jako samostatný druh rozlišen teprve nedávno. Dříve vzácné druhy *Astragalus asper*, *Schoenoplectus supinus* a *Veronica pumila* dnes patří mezi taxony na území ČR vyhynulé. Naproti tomu dříve vzácný druh *Spergularia marina*, která se vyskytoval jen na několika přirozených slaniskách, se v důsledku zimního solení silnic rozšířil po většině území ČR. Revize herbářového dokladu ke starému literárnímu údaji o výskytu zavlečeného druhu *Astragalus alopecuroides* ukázala, že se ve skutečnosti jedná o druh, jehož správné jméno je *A. alopecurus*. Mezi další přechodně zavlečené nebo jen lokálně zdomácnělé druhy, jejichž rozšíření je podrobně zpracováno v tomto článku, patří *Bidens pilosus*, *Cenchrus echinatus*, *Gratiola neglecta* a *Lindernia dubia*, které jsou dokumentovány jen z malého počtu lokalit. *Bidens connatus* byl donedávna velmi vzácný, ale v poslední době se začal šířit na nově uvolněná stanoviště po extrémní povodni v roce 2002. Typickým případem zdomácnělých neofytů jsou *Veronica filiformis* a *V. peregrina*, které se již vyskytují na několika až mnoha stovkách lokalit v různých částech ČR. Invazní druhy zastupuje *Bidens frondosus*, který se začal intenzivněji šířit ve 30. letech 20. století a dnes je široce rozšířený a běžný. Celkový obraz rozšíření jednotlivých zpracovávaných taxonů poskytují mapy, konkrétní floristické údaje odrážející odlišné trendy v různých oblastech a v různých obdobích jsou uloženy v databázi Pladias a dostupné v elektronických přílohách. Každou mapu doprovází textový komentář, který obsahuje nástin celkového rozšíření, výčet nejčastějších stanovišť a stručnou charakteristiku rozšíření v České republice, případně i doplňující informace k taxonomii, biologii, změnám v rozšíření a míře ohrožení.

References

Adams L. G., West J. G. & Cowley K. J. (2008): Revision of *Spergularia* (*Caryophyllaceae*) in Australia. – Aust. Syst. Bot. 21: 251–270.

Adler W., Mrkvicka A. Ch. & Fischer M. A. (2008): Nachträge zur „Flora Wiens“ (III). – Neilreichia 5: 173–180.

Albach D. C., Schönswetter P. & Tribsch A. (2006): Comparative phylogeography of the *Veronica alpina* complex in Europe and North America. – Mol. Ecol. 15: 3269–3286.

Bayer R. J. (2000): Observations on the morphology and geographic range of *Antennaria dioica* (L.) Gaertn. (*Asteraceae*: *Gnaphalieae*). – Madroño 46: 205–207.

Bílý F. (1931): Druhý příspěvek ku poznání kapradin Moravského krasu [The second contribution to the knowledge of ferns of the Moravian Karst]. – Sborn. Klubu Přírod. Brno 14: 65–77.

Bílý F. (1937): Třetí příspěvek ku poznání kapradin Moravského krasu [The third contribution to the knowledge of ferns of the Moravian Karst]. – Sborn. Klubu Přírod. Brno 19: 22–32.

Bureš L. (2013): Chráněné a ohrožené rostliny chráněné krajinné oblasti Jeseníky [Protected and endangered plants of the Protected Landscape Area Jeseníky]. – Agentura Rubico, Olomouc-Slavonín.

Burkart M. (2001): River corridor plants (Stromtalpflanzen) in Central European lowland: a review of a poorly understood plant distribution pattern. – Global Ecol. Biogeogr. 10: 449–468.

Chater A. O. (1980): *Carex*. – In: Tutin T. G., Heywood V. H., Burges N. A., Moore D. M., Valentine D. H. Walters S. M. & Webb D. A. (eds), Flora Europaea 5: 290–323, Cambridge University Press, Cambridge.

Chen Y.-S. & Hind D. J. N. (2011): Tribe *Heliantheae*. – In: Wu Z. Y., Raven P. H. & Hong D. Y. (eds.), Flora of China 20–21: 852–878, Science Press, Beijing & Missouri Botanical Garden Press, St. Louis.

Chrtek J. & Jirásek V. (1964): Beitrag zur Kenntnis der Veränderlichkeit von *Hierochloë* (L.) Pal.-Beauv. in der Tschechoslowakei. – Preslia 36: 245–250.

Chrtek J., Plačková I., Zahradníková J., Kirschner J., Kirschnerová L., Štěpánek J., Krahulcová A., Krahulec F. & Harčarik J. (2007): Genetická variabilita vybraných horských druhů cévnatých rostlin v Krkonoších [Genetic variation in selected mountain species of vascular plants in the Giant Mountains]. – In: Štursa J. & Knapik R. (eds), Geoekologické problémy Krkonoš, Sborn. Mezin. Věd. Konf., říjen 2006, Svoboda nad Úpou, Opera Corcont. 44: 251–264.

Chytrý M. (2007a): *Euphorbio cyparissiae-Callunetum vulgaris* Schubert 1960. Suchá vřesoviště nížin a pahorkatin [*Euphorbio cyparissiae-Callunetum vulgaris* Schubert 1960. Dry heathlands in lowland and colline landscapes]. – In: Chytrý M. (ed.), Vegetace České republiky 1. Travinná a keříčková vegetace [Vegetation of the Czech Republic 1. Grassland and Heathland Vegetation], p. 308–310, Academia, Praha.

Chytrý M. (2007b): *Festucion valesiacae* Klika 1931. Úzkolisté suché trávníky [*Festucion valesiacae* Klika 1931. Narrow-leaved dry grasslands]. – In: Chytrý M. (ed.), Vegetace České republiky 1. Travinná a keříčková vegetace [Vegetation of the Czech Republic 1. Grassland and Heathland Vegetation], p. 409–425, Academia, Praha.

Chytrý M. & Sádlo J. (2007): *Corynephorion canescentis* Klika 1931. Otevřené trávníky vátých písků s paličkovcem šedavým [*Corynephorion canescentis* Klika 1931. Open vegetation of inland sand dunes dominated by *Corynephorus canescens*]. – In: Chytrý M. (ed.), Vegetace České republiky 1. Travinná a keříčková vegetace. [Vegetation of the Czech Republic. Vol. 1. Grassland and heathland vegetation], p. 323–330, Academia, Praha.

Conert H. J. (ed.) (1998): Gustav Hegi, Illustrierte Flora von Mitteleuropa. Ed. 3. Vol. 1/3. *Spermatophyta*: *Angiospermae*: *Monocotyledones* 1/2. *Poaceae* (Echte Gräser oder Süßgräser). – Parey Buchverlag, Berlin.

Čelakovský L. (1871): Prodromus der Flora von Böhmen. Vol. 2. – Prag.

Čelakovský L. (1875): Prodromus der Flora von Böhmen. Vol. 3. – Prag.

Čížek K. & Král M. (2009): Park v areálu nemocnice v Klatovech [The park of the Klatovy hospital]. – Calluna 14: 7–8.

Danihelka J., Chrtek J. jun. & Kaplan Z. (2012): Checklist of vascular plants of the Czech Republic. – Preslia 84: 647–811.

DeLisle D. G. (1963): Taxonomy and distribution of the genus *Cenchrus*. – Iowa State Coll. J. Sci. 37: 259–351.

Dřevojan P. (2012): Kozinec bezlodyžný (*Astragalus exscapus*) – dosud součástí flóry Znojemska [*Astragalus exscapus* – still a flora element of the Znojmo region, SE Czech Republic]. – Zpr. Čes. Bot. Společ. 47: 291–296.

Dvořák F. (1989): Chromosome counts and chromosome morphology of some selected species. – Scr. Fac. Sci. Natur. Univ. Purkyn. Brun., Biol., 19: 301–322.

Dvořák F. (1990): *Spergularia* (Pers.) J. et C. Presl – kuřinka. – In: Hejný S., Slavík B., Hrouda L. & Skalický V. (eds), Květena České republiky [Flora of the Czech Republic] 2: 81–86, Academia, Praha.

Egorova T. V. (1999): The sedges (*Carex* L.) of Russia and adjacent states (within the limits of the former USSR). – St.-Peterburg State Chemical Pharmaceutical Academy & Missouri Botanical Garden Press, St.-Peterburg & St. Louis.

Ekrt L. (2015): Revize populace podmrvky hadcové (*Notholaena marantae*) na Mohelenské hadcové stepi: rozšíření, početnost, stanovištní preference [Revision of *Notholaena marantae* population on serpentine steppe near Mohelno: distribution, abundance, habitat preferences]. – Acta Rer. Natur. 18: 1–8.

Ekrt L., Lepší M., Boublík K. & Lepší P. (2007): *Dryopteris remota* rediscovered for the flora of the Czech Republic. – Preslia 79: 69–82.

Ekrt L., Linhartová R. & Štech M. (2013): Rozlišování a revize rozšíření kapradě podobné (*Dryopteris expansa*) a jejího křížence *D.* ×*ambroseae* v České republice [Determination and revision of distribution of *Dryopteris expansa* and its hybrid *D.* ×*ambroseae* in the Czech Republic]. – Zpr. Čes. Bot. Společ. 48: 263–291.

Ekrt L., Štech M., Lepší M. & Boublík K. (2010): Rozšíření a taxonomická problematika skupiny *Dryopteris affinis* v České republice [Distribution and taxonomy of the *Dryopteris affinis* group in the Czech Republic]. – Zpr. Čes. Bot. Společ. 45: 25–52.

Ekrt L., Trávníček P., Jarolímová V., Vít P. & Urfus T. (2009): Genome size and morphology of the *Dryopteris affinis* group in Central Europe. – Preslia 81: 261–280.

Elven R. (ed.) (2016): Annotated Checklist of the Panarctic Flora (PAF). Vascular plants. – Natural History Museum, University of Oslo, URL: http://nhm2.uio.no/paf/ (accessed February 2016).

Fischer M. A. (ed.) (2008): Exkursionsflora für Österreich, Liechtenstein und Südtirol. Ed. 3. – OÖ Landesmuseen, Linz.

Formánek E. (1884): Correspondenz. – Oesterr. Bot. Z. 34: 448.

Fraser-Jenkins C. R. (1976): *Dryopteris caucasica* and the cytology of its hybrids. – Fern Gaz. 11: 263–267.

Fraser-Jenkins C. R. (2007): The species and subspecies in the *Dryopteris affinis* group. – Fern Gaz. 18: 1–26.

Friedrich H. C. (1979): Familie *Caryophyllaceae*. – In: Reichinger K. H. (ed.), Gustav Hegi, Illustrierte Flora von Mitteleuropa, ed. 2, vol. 3/2. *Angiospermae*, *Dicotyledones* 1. *Phytolaccaceae*, *Amaranthaceae*, *Chenopodiaceae*, *Illecebraceae*, *Caryophyllaceae*, *Portulacaceae*, p. 763–1182, Verlag Paul Parey, Berlin & Hamburg.

Gibby M. & Walker S. (1977): Further cytogenetic studies and a reappraisal of the diploid ancestry in the *Dryopteris carthusiana* complex. – Brit. Fern Gaz. 11: 313–324.

Grabowski H. (1843): Flora von Ober-Schlesien und dem Gesenke. – Breslau.

Gregor T. (2009): The distribution of *Galeopsis ladanum* in Germany based on an analysis of herbarium material is smaller than that indicated in plant atlases. – Preslia 81: 377–386.

Greuter W. (2006): *Compositae* (pro parte majore). – In: Euro+Med Plantbase – the information resource for Euro-Mediterranean plant diversity. URL: http://ww2.bgbm.org/EuroPlusMed (accessed February 2016).

Grulich V. (1985). Masnice vodní (*Tillaea aquatica* L.) v Československu [*Tillaea aquatica* in Czechoslovakia]. – Sborn. Jihočes. Muz. České Budějovice, Přír. Vědy, 25: 53–56.

Grulich V. (2012): Red List of vascular plants of the Czech Republic: 3rd edition. – Preslia 84: 631–645.

Hadač E. & Hadačová V. (1969): Notes on the ecology and distribution of *Bidens pilosa* L. in Cuba. – Folia Geobot. Phytotax. 4: 165–173.

Hadinec J. & Lustyk P. (eds) (2015): Additamenta ad floram Reipublicae Bohemicae. XIII [Additions to the flora of the Czech Republic. XIII]. – Zpr. Čes. Bot. Společ. 50: 23–129.

Hájková P., Roleček J., Hájek M., Horsák M., Fajmon K., Polák M. & Jamrichová E. (2011): Prehistoric origin of the extremely species-rich semi-dry grasslands in the Bílé Karpaty Mts (Czech Republic and Slovakia). – Preslia 83: 185–204.

Han Y., Cho Y., Kim Y., Lim H., Kwon O. & Nam S-H. (2009): Insect herbivores associated with the introduced weed *Bidens frondosa* L. (*Asteraceae*) in Korea, and their potential role as augmentative biological control agents. – Entomological Research 39: 394–400.

Harpke D., Carta A., Tomović G., Ranđelović V., Ranđelović N., Blattner F. R. & Peruzzi L. (2015): Phylogeny, karyotype evolution and taxonomy of *Crocus* series *Verni* (*Iridaceae*). – Pl. Syst. Evol. 301: 309–325.

Hartl D. (1975): Familie *Scrophulariaceae*. – In: Hartl D. & Wagenitz G. (eds), Gustav Hegi, Illustrierte Flora von Mitteleuropa, ed. 2, vol. 6/1, *Angiospermae*, *Dicotyledones* 4. *Scrophulariaceae*, *Orobanchaceae*, *Lentibulariaceae*, *Globulariaceae*, *Plantaginaceae*, p. 1–469, Verlag Paul Parey, Berlin & Hamburg.

Hartman R. L. & Rabeler K. R. (2005): *Spergularia*. – In: Flora of North America Editorial Committee (eds), Flora of North America North of Mexico 5/2: 16–23, Oxford University Press, New York & Oxford.

Hartvig P. (1987): Chromosome numbers in Nordic populations of the *Carex muricata* group (*Cyperaceae*). – Symb. Bot. Upsal. 27: 127–138.

Hegi G. (1925): Illustrierte Flora von Mittel-Europa. Vol. 6/1. – München.

Hejný S. (1948): Zdomácnění dvouzubce listnatého (*Bidens frondosus* L.) v ČSR [Naturalization of *Bidens frondosus* L. in the Czechoslovak Republic]. – Čs. Bot. Listy 1: 56–63.
Hejný S. (1960): Ökologische Charakteristik der Wasser- und Sumpfpflanzen in den slowakischen Tiefebenen (Donau- und Theissgebiet). – Vydavateľstvo SAV, Bratislava.
Hejný S. (1999): Trojřadka Micheliova (*Dichostylis micheliana*), puštička rozprostřená (*Lindernia procumbens*), šmel okoličnatý (*Butomus umbellatus*) a rybniční soustava Podkrčí u Protivína [*Dichostylis micheliana*, *Lindernia procumbens*, *Butomus umbellatus* and the fishpond system of Podkrčí near Protivín]. – Sborn. Jihočes. Muz. České Budějovice, Přír. Vědy, 39: 47–52.
Hetzel G. (2006): Die Neophyten Oberfrankens. Floristik, Standortcharakteristik, Vergesellschaftung, Verbreitung, Dynamik. – PhD thesis, Universität Würzburg, Fakultät für Biologie, Würzburg.
Hohla M. & Melzer H. (2003): Floristisches von den Autobahnen der Bundesländer Salzburg, Oberösterreich, Niederösterreich und Burgenland. – Linzer Biol. Beitr. 35: 1307–1326.
Holm L. G., Pancho J. V., Herberger J. P. & Plucknett D. L. (1991): A geographic atlas of World weeds. – Krieger Publishing Company, Malabar.
Holub J. (1958): Bemerkungen zur Taxonomie der Gattung *Helictotrichon* Bess. – In: Klášterský I. et al. (eds), Philipp Maxmilian Opiz und seine Bedeutung für die Pflanzentaxonomie, p. 101–133, Praha.
Holub J. (1962): *Helictotrichon desertorum* (Less.) Nevskij – ein bedeutsames Relikt der tschechoslowakischen Flora. – Acta Univ. Carol. – Biol. 2 (1962): 153–188.
Holub J. (1972): A note on the infraspecific classification of *Helictotrichon desertorum* (Less.) Nevskij. – Folia Geobot. Phytotax. 7: 419–421.
Hong D.-Y. & Fischer M. A. (1998): *Veronica*. – In: Wu Z.-Y. & Raven P. H. (eds), Flora of China 18: 65–80, Science Press, Beijing & Missouri Botanical Garden Press, St. Louis.
Howell C. J. & Sawyer J. W. (2006): New Zealand naturalised vascular plant checklist. – New Zealand Plant Conservation Network, Wellington.
Hrivnák R., Kochjarová J., Šumberová K. & Schmotzer A. (2016): *Lindernia dubia* (*Scrophulariaceae*): a new alien species to the Slovak flora. – Biológia, 71: 281–286.
Hsu T.-C., Lin J.-J. & Chung S. W. (2009): Two newly discovered plants in Taiwan. – Taiwania 54: 403–407.
Hultén E. (1958): The amphi-atlantic plants and their phytogeographical connections. – Stockholm.
Hultén E. & Fries M. (1986): Atlas of North European vascular plants north of the Tropic of Cancer. Vols 1–3. – Koeltz Scientific Books, Königstein.
Hylander N. (1966): Nordisk Kärlväxtflora [Scandinavian Flora]. Vol. 2. – Almquist & Wiksell, Stockholm.
Jehlík V. (ed.) (1998): Cizí expanzivní plevele České republiky a Slovenské republiky [Alien expansive weeds of the Czech Republic and Slovak Republic]. – Academia, Praha.
Jessen S., Bujnoch W., Zenner G. & Stark C. (2011): *Dryopteris lacunosa* – eine neue Art des *Dryopteris-affinis*-Aggregats (*Dryopteridaceae*, *Pteridophyta*). – Kochia 5: 9–31.
Jiménez-Mejías P. & Luceño M. (2011): *Cyperaceae*. – In: Euro+Med Plantbase – the information resource for Euro-Mediterranean plant diversity. URL: http://ww2.bgbm.org/EuroPlusMed/ (accessed 11 February 2016).
Juratzka J. (1858): Ueber die Entdeckung von *Notochlaena marantae* R. Br. in Mähren. – Verh. Zool.-Bot. Ges., S.-B., 8: 92.
Juslén A., Väre H. & Wikström N. (2011): Relationships and evolutionary origins of polyploid *Dryopteris* (*Dryopteridaceae*) from Europe inferred using nuclear *pgi*C and plastid *trn*L-F sequence data. – Taxon 60: 1284–1294.
Kaplan Z. (2012): Flora and phytogeography of the Czech Republic. – Preslia 84: 505–573.
Kaplan Z., Danihelka J., Štěpánková J., Bureš P., Zázvorka J., Hroudová Z., Ducháček M., Grulich V., Řepka R., Dančák M., Prančl J., Šumberová K., Wild J. & Trávníček B. (2015): Distributions of vascular plants in the Czech Republic. Part 1. – Preslia 87: 417–500.
Kilián Z. & Krkavec F. (1962): Několik dalších rostlin z rudišť na Ostravsku [Several other plant species from the ore yards in the Ostrava region]. – Zpr. Slezs. Úst. ČSAV Opava, ser. B, 126: 7–10.
Kocián P. (2014): *Linaria pelisseriana* (L.) Mill. – a new alien species in the Czech Republic. – Acta Mus. Siles., Sci. Natur., 63: 283–288.
Kolář F., Kaplan Z., Suda J. & Štech M. (2015): Populations of *Knautia* in ecologically distinct refugia of the Hercynian massif belong to two endemic species. – Preslia 87: 363–386.
Kolbek J. & Boublík K. (2007): Rostlinná společenstva s *Helictotrichon desertorum* v České republice [Plant communities with *Helictotrichon desertorum* in the Czech Republic]. – Severočes. Přír. 38 (2006): 1–10.
Kolenati F. A. (1860): Höhenflora des Altvaters. – Brünn.
Korniak T. (1987): *Carex stenophylla* Wahlenberg – nowy gatunek turzycy dla flory polskiej i inne interesujące rośliny kserotermiczne koło Dąbrowy Białostockiej [*Carex stenophylla* Wahlenberg – a new species of

sedge in the Polish flora and other interesting xerothermic plants near Dąbrowa Białostocka (north-western Poland)] – Fragm. Flor. Geobot. 31–32: 55–63.

Kupriyanova L. A. (1986): Nekotorye voprosy sistematiki i palinomorfologii vidov roda *Convallaria* (*Asparagaceae*) [Some topics of systematics and palynology of *Convallaria* species (*Asparagaceae*)]. – Bot. Zhurn. 71: 185–194.

Küpfer Ph. (1974): Recherches sur les liens de parenté entre la flore orophile des Alpes et celle des Pyrénées. – Boissiera 23: 1–322.

Kurka R. (1990): *Lindernia dubia* – nový zavlečený druh v Československu [*Lindernia dubia* – a new alien species to the flora of the Czech Republic]. – Zpr. Čes. Bot. Společ. 25: 47–48.

Kúr P., Košnar J. & Štech M. (2014): Characterization and cross-species amplification of 16 microsatellite loci in *Spergularia echinosperma* (*Caryophyllales*: *Caryophyllaceae*). – Conserv. Genet. Res. 6: 571–573.

Kúr P., Štech M., Koutecký P. & Trávníček P. (2012): Morphological and cytological variation in *Spergularia echinosperma* and *S. rubra*, and notes on potential hybridization of these two species. – Preslia 84: 905–924.

Lampe M. von (1996): Wuchsform, Wuchsrhythmus und Verbreitung der Arten der Zwergbinsengesellschaften. – Diss. Bot. 266: 1–353.

Lepší M. & Douda J. (2005): *Lindernia dubia* (L.) Pennel – puštička pochybná. – In: Chán V., Lepší M. & Lepší P. (eds), Nálezy zajímavých a nových druhů v květeně jižní části Čech XI [Records of interesting and new plants in the South Bohemian flora XI], Sborn. Jihočes. Muz. České Budějovice, Přír. Vědy, 45: 170–171.

Lepší M., Lepší P., Koutecký P., Bílá J. & Vít P. (2015): Taxonomic revision of *Sorbus* subgenus *Aria* occurring in the Czech Republic. – Preslia 87: 109–162.

Lhotská M. (1966): Der älteste Fund der *Bidens frondosa* L. in Europa. – Folia Geobot. Phytotax. 1: 186–189.

Lhotská M. (1968): Die Gattung *Bidens* L. in der Tschechoslowakei. – Folia Geobot. Phytotax. 3: 65–98.

Liang S.-Y., Tucker G. C. & Koyama T. (2010): *Schoenoplectus*. – In: Wu Z. Y., Raven P. H. & Hong D. Y. (eds), Flora of China 23. *Acoraceae* through *Cyperaceae*, p. 181–188, Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Loos G. H. (1996): Zur Identität von *Carex leersiana* Rauschert, *C. chabertii* F. W. Schultz, *C. polyphylla* Kar. et Kir. und *C. guestphalica* (Boenn. ex Rchb.) Boenn. ex O. F. Lang. – Feddes Repert. 107: 61–74.

Lustyk P. (2015): *Gratiola neglecta* Torr. – In: Hadinec J. & Lustyk P. (eds), Additamenta ad floram Reipublicae Bohemicae. XIII [Additions to the flora of the Czech Republic. XIII], Zpr. Čes. Bot. Společ. 50: 66–67.

Meusel H. & Jäger E. J. (eds) (1992): Vergleichende Chorologie der zentraleuropäischen Flora. Vol. 3. – Gustav Fischer, Jena, Stuttgart & New York.

Meusel H., Jäger E., Rauschert S. & Weinert E. (1978): Vergleichende Chorologie der zentraleuropäischen Flora. Vol. 2. – Gustav Fischer, Jena.

Meusel H., Jäger E. & Weinert E. (1965): Vergleichende Chorologie der zentraleuropäischen Flora. Vol. 1. – Gustav Fischer, Jena.

Molina A., Acedo C. & Llamas F. (2008a): Taxonomy and new taxa of the *Carex divulsa* aggregate in Eurasia (section *Phaestoglochin*, *Cyperaceae*). – Bot. J. Linn. Soc. 156: 385–409.

Molina A., Acedo C. & Llamas F. (2008b): Taxonomy and new taxa in Eurasian *Carex* (section *Phaestoglochin*, *Cyperaceae*). – Syst. Botany 33: 237–250.

Monnier P. & Ratter J. A. (1993): *Spergularia* (Pers.) J. & C. Presl. – In: Tutin T. G., Burges N. A., Chater A. O., Edmondson J. R., Heywood V. H., Moore D. M., Valentine D. H., Walters S. M. & Webb D. A. (eds), Flora Europaea, ed. 2, 1: 186–188, Cambridge University Press, Cambridge.

Mouterde P. (1986): Nouvelle flore du Liban et de la Syrie. Vol. 3. Texte. – Librairie orientale, Beyrouth & Secrétariat Optima, Berlin.

Niklfeld H. (1971): Bericht über die Kartierung der Flora Mitteleuropas. – Taxon 20: 545–574.

Niklfeld H. (1999): Mapping the flora of Austria and the Eastern Alps. – Rev. Valdôtaine Hist. Nat. 51, suppl. 51: 53–62.

Nobis M. & Nowak A. (2011): New data on the vascular flora of the central Pamir Alai Mountains (Tajikistan, Central Asia). – Pol. Bot. J. 56: 195–201.

Nobis A., Nobis M., Piotrowicz K., Kącki Z. & Dajdok Z. (2010): *Lindernia procumbens* in Poland: the relationships between weather conditions and the occurrence of the species. – Biodiv. Res. Conserv. 17: 39–46.

Nosova L. M. (1965): Nekotorye vidy s dizjunktivnymi arealami vo flore severnoj (lugovoi) stepi evropejskoi chasti SSSR [Some new species with disjunctive ranges in the flora of northern steppe in the European part of USSR]. – Bjull. Moskov. Obshch. Isp. Prir., sect. biol., 70/6: 116–130.

Novák J. & Chytrý M. (2007): *Cirsio-Brachypodion pinnati* Hadač et Klika ex Klika 1951. Subkontinentální širokolisté suché trávníky [*Cirsio-Brachypodion pinnati* Hadač et Klika ex Klika 1951. Subcontinental

semi-dry broad-leaved grasslands]. – In: Chytrý M. (ed.), Vegetace České republiky 1. Travinná a keříčková vegetace [Vegetation of the Czech Republic 1. Grassland and Heathland Vegetation], p. 425–449, Academia, Praha.

Ohwi J. (1965): Flora of Japan. – Smithsonian Institution, Washington.

Page S. E. & Rieley J. O. (1985): Ecology and distribution of *Carex chordorrhiza* L. fil. – Watsonia 15: 253–259.

Pennell F. W. (1935): The *Scrophulariaceae* of eastern temperate North America. – Acad. Natur. Sci. Phil. Monogr. 1: 1–650.

Peruzzi L., Carta A. & Garbari F. (2013): Lectotypification of the name *Crocus sativus* var. *vernus* L. (*Iridaceae*) and its consequences within *Crocus* ser. *Verni*. – Taxon 65: 1037–1040.

Pichi Sermoli R. E. (1979): A survey of the pteridological flora of the Mediterranean region. – Webbia 34: 175–242.

Plocek A. (1986): Květena Jizerských hor. 4. *Balsaminaceae* až *Cyperaceae* [Flora of the Jizerské hory Mts. 4. *Balsaminaceae* to *Cyperaceae*]. – Sborn. Severočes. Muz. – Přír. Vědy 15: 5–52.

Podlech D. & Zarre Sh. (2013): A taxonomic revision of the genus *Astragalus* L. (*Leguminosae*) in the Old World. Vol. 1–3. – Naturhistorisches Museum Wien, Wien.

Podpěra J. (1930): Květena Moravy ve vztazích systematických a geobotanických. Fasc. 6/3 [Flora of Moravia in taxonomic and geobotanical context]. – Pr. Morav. Přírod. Společ. 5 (1928)/5: 57–415.

Popiela A. (1998): The distribution of character species of the *Isoëto-Nanojuncetea*-class in Poland. Part I. *Centunculus minimus*, *Radiola linoides* and *Illecebrum verticillatum*. – Fragm. Florist. Geobot. 43: 223–230.

Procházka F. (1977). Současné změny východočeské flóry a poznámky k rozšíření chráněných druhů rostlin [Recent changes in the flora of eastern Bohemia and notes on the distribution of protected species]. – Hradec Králové.

Pyke S. B., Michaud H., Ferrer, P., Argagnon O., Virevaire, M. & Montserrat J. M. (2008): Notes on vascular plants in Morocco. – Lagascalia 28: 473–480.

Pyšek P., Chytrý M., Pergl J., Sádlo J. & Wild J. (2012a): Plant invasions in the Czech Republic: current state, introduction dynamics, invasive species and invaded habitats. – Preslia 84: 575–629.

Pyšek P., Danihelka J., Sádlo J., Chrtek J. Jr., Chytrý M., Jarošík V., Kaplan Z., Krahulec F., Moravcová L., Pergl J., Štajerová K. & Tichý L. (2012b): Catalogue of alien plants of the Czech Republic (2nd edition): checklist update, taxonomic diversity and invasion patterns. – Preslia 84: 155–255.

Raabe U. (2007): Ein Vorkommen des Übersehenen Gnadenkrautes (*Gratiola neglecta* Torr.) in Brandenburg. – Flor. Runbr. 40: 111–112.

Randall R. P. (2007): The introduced flora of Australia and its weed status. – CRC for Australian Weed Management, Adelaide.

Rohlena J. (1926): Příspěvky k floristickému výzkumu Čech. VI. [Contributions to the research into the flora of Bohemia]. – Čas. Nár. Mus., sect. sci. natur., 100: 139–158.

Roleček J., Hájek M., Karlík P. & Novák J. (2015): Reliktní vegetace na mezických stanovištích [Relict vegetation on mesic sites]. – Zpr. Čes. Bot. Společ. 50: 201–245.

Romero-Zarco C. (2011): *Helictochloa* Romero Zarco (*Poaceae*), a new genus of oat grass. – Candollea 66: 87–103.

Röser M. (1996): Ecogeography of the grass genus *Helictotrichon* (*Poaceae*: *Aveneae*) in the Mediterranean and adjacent regions. – Plant Syst. Evol. 203: 181–281.

Rünk K., Zobel M. & Zobel K. (2012): Biological flora of the British Isles: *Dryopteris carthusiana*, *D. dilatata* and *D. expansa*. – J. Ecol. 100: 1039–1063.

Řepka R. (1983): Poznámky k výskytu *Carex stenophylla* Wahlenb. na Moravě [Notes on the occurrence of *Carex stenophylla* in Moravia]. – Zpr. Čs. Bot. Společ. 18: 123–128.

Řepka R. (1988): Předběžné sdělení o výskytu *Carex chabertii* F. W. Schultz v Československu [A preliminary report on the occurence of *Carex chabertii* in Czechoslovakia]. – Zpr. Čs. Bot. Společ. 23: 81–90.

Řepka R. (2003): *Carex muricata* aggregate in the Czech Republic: multivariate analysis of quantitative morphological characters. – Preslia 75: 233–248.

Sádlo J. (2011): *Schoenoplectetum tabernaemontani* De Soó 1947. Brakické rákosiny se skřípincem Tabaernemontanovým [*Schoenoplectetum tabernaemontani* De Soó 1947. Brackish marshes dominated by *Schoenoplectus tabernaemontani*]. – In: Chytrý M. (ed.), Vegetace České republiky 3. Vodní a mokřadní vegetace [Vegetation of the Czech Republic 3. Aquatic and wetland vegetation], p. 437–440, Academia, Praha.

Sarika-Hatzinikolaou M., Koupli-Sovantzi L. & Yannitsaros A. (1994): *Myriophyllum alterniflorum* DC. (*Haloragaceae*), a new record for the Greek flora. – Phyton (Horn) 34: 243–246.

Scalone R. & Albach D. (2012): Degradation of sexual reproduction in *Veronica filiformis* after introduction to Europe. – BMC Evolutionary Biology 12: 233.

Schmidt F. W. (1793): Flora Boëmica inchoata, exhibens plantarum regni Boëmiae indigenarum species. Cent. 1. – Pragae.

Schultze-Motel W. (1980): *Cyperus* L. – In: Conert H. J., Hamann U., Schultze-Motel W. & Wagenitz G. (eds), Gustav Hegi, Illustrierte Flora von Mitteleuropa, ed. 3, vol. 2/1. *Angiospermae*. *Monocotyledones* 2. *Cyperaceae*, *Typhaceae*, incl. *Sparganiaceae*, *Araceae*, *Lemnaceae*, *Juncaceae*, p. 80–92, Verlag Paul Parey, Berlin & Hamburg.

Scribailo R. W. & Alix M. S. (2014): *Haloragaceae*. – In: Flora of North America Editorial Committee (eds), Flora of North America, Provisional Publication (May 28, 2014), p. 1–23, Flora of North America Association. URL: http://floranorthamerica.org/files/Haloragaceae.provisional.Gal_.pdf (accessed 10 February 2016).

Scott N. E. & Davison A. W. (1982): De-icing salt and the invasion of road verges by maritime plants. – Watsonia 14: 41–52.

Sessa E. B., Zimmer E. A. & Givnish T. J. (2012): Unraveling reticulate evolution in North American *Dryopteris* (*Dryopteridaceae*). – BMC Evol. Biol. 12: 104.

Simon C. (1960): *Gratiola neglecta* Torr. im Oberelsaß. – Bauhinia 1: 184–188.

Skokan J. (1928): Konitrud lékařský (*Gratiola officinalis* L.). – Věda Přír. 9: 131–144, 212–216, 247–251.

Smith S. G. (2002): *Schoenoplectus*. – In: Flora of North America Editorial Committee (eds), Flora of North America north of Mexico 23: 44–60, Oxford University Press, New York & Oxford.

Soriano I. & Romero T. (2008): Sobre el género *Gratiola* L. (*Scrophulariaceae*) en el norte de Marruecos y Andalucía. – Lagascalia 28: 443–450.

Soukup M., Štech M., Paulič R. & Chán V. (2010): Rozšíření ovsíře lučního *Avenula pratensis* (L.) Dumort. v jižní části Čech [Distribution of *Avenula pratensis* (L.) Dumort. in southern Bohemia]. – Sborn. Jihočes. Muz. České Budějovice, sci. natur., 50: 105–114.

Stace C. (2010): Flora of the British Isles. Ed. 3. – Cambridge University Press, Cambridge.

Stein D. B., Hutton C., Conant D. S., Haufler C. H. & Werth C. R. (2010): Reconstructing *Dryopteris* "*semicristata*" (*Dryopteridaceae*): Molecular profiles of tetraploids verify their undiscovered diploid ancestor. – Am. J. Bot. 97: 998–1004.

Stuckey R. L. (1974): The introduction and distribution of *Nymphoides peltatum* (*Menyanthaceae*) in North America. - Bartonia 42: 14–23.

Suominen J. (1984): *Gratiola neglecta* (*Scrophulariaceae*), Mantsalanjoen rantakasvi [*Gratiola neglecta*, a North American wetland plant naturalized in Finland]. – Memor. Soc. Fauna Fl. Fenn. 60: 5–9.

Šprynar P. (2004): Poznámky k překvapivému výskytu podmrvky jižní (*Notholaena marantae*) a sleziníku hadcového (*Asplenium cuneifolium*) na ultrabazickém pikritu v Českém krasu [Notes on the surprising occurrence of *Notholaena marantae* and *Asplenium cuneifolium* on the ultrabasic picrite in the Bohemian Karst (central Bohemia)]. – Zpr. Čes. Bot. Společ. 30: 321–338.

Šumberová K. (2003): Veränderungen in der Teichwirtschaft und ihr Einfluß auf die Vegetation in der Tschechischen Republik. Mit Beispielen von *Isoëto-Nanojuncetea*-, *Isoëto-Littorelletea*- und *Bidentetea*-Arten im Becken von Třeboň (Wittingauer Becken). – Mitt. Bad. Landesver. Naturkunde u. Naturschutz, N. F., 18: 7–24.

Šumberová K. (2011a): *Nymphoidetum peltatae* Bellot 1951. Vegetace mělkých stojatých vod teplých oblastí s plavínem štítnatým [*Nymphoidetum peltatae* Bellot 1951. Vegetation of shallow water bodies in warm areas dominated by *Nymphoides peltata*]. – In: Chytrý M. (ed.), Vegetace České republiky 3. Vodní a mokřadní vegetace [Vegetation of the Czech Republic 3. Aquatic and wetland vegetation], p. 124–127, Academia, Praha.

Šumberová K. (2011b): *Schoenoplectetum lacustris* Chouard 1924. Rákosiny se skřípincem jezerním [*Schoenoplectetum lacustris* Chouard 1924. Marshes dominated by *Schoenoplectus lacustris*]. – In: Chytrý M. (ed.), Vegetace České republiky 3. Vodní a mokřadní vegetace [Vegetation of the Czech Republic 3. Aquatic and wetland vegetation], p. 394–397, Academia, Praha.

Šumberová K. (2013a): *Cyperus fuscus* L. – šáchor hnědý, š. tmavý. – In: Lepší P., Lepší M., Boublík K., Štech M. & Hans V. (eds), Červená kniha květeny jižní části Čech [Red Data Book of the flora of southern part of Bohemia], p. 151–152, Jihočeské muzeum v Českých Budějovicích, České Budějovice.

Šumberová K. (2013b): *Gratiola neglecta* Torr. – In: Hadinec J. & Lustyk P. (eds), Additamenta ad floram Reipublicae Bohemicae. XI. [Additions to the flora of the Czech Republic. XI], Zpr. Čes. Bot. Společ. 48: 92–90.

Šumberová K. (2013c): *Radiola linoides* Roth – stozrník lnovitý. – In: Lepší P., Lepší M., Boublík K., Štech M. & Hans V. (eds), Červená kniha květeny jižní části Čech [Red Data Book of the flora of southern part of Bohemia], p. 341, Jihočeské muzeum v Českých Budějovicích, České Budějovice.

Šumberová K. & Ducháček M. (2009): *Gratiola neglecta* – nový zavlečený druh pro květenu České republiky [*Gratiola neglecta* – a new alien species to the flora of the Czech Republic]. – Zpr. Čes. Bot. Společ. 44: 151–175.

Šumberová K., Ducháček M. & Lososová Z. (2012a): Life-history traits controlling the survival of *Tillaea aquatica*: a threatened wetland species in intensively managed fishpond landscapes of the Czech Republic. – Hydrobiologia 689: 91–110.

Šumberová K., Lososová Z., Ducháček M., Horáková V. & Fabšičová M. (2012b): Distribution, habitat ecology, soil seed bank and seed dispersal of threatened *Lindernia procumbens* and alien *Lindernia dubia* (*Antirrhinaceae*) in the Czech Republic. – Phyton (Horn) 52: 39–72.

Šumberová K., Štech M. & Rektoris L. (2013): *Lindernia procumbens* (Krock.) Borbás – puštička pouzdernatá, p. rozprostřená. – In: Lepší P., Lepší M., Boublík K., Štech M. & Hans V. (eds), Červená kniha květeny jižní části Čech [Red Data Book of the flora of southern part of Bohemia], p. 248–249, Jihočeské muzeum v Českých Budějovicích, České Budějovice.

Thiers B. (2016): Index Herbariorum: a global directory of public herbaria and associated staff. – New York Botanical Garden's Virtual Herbarium. URL: http://sciweb.nybg.org/science2/IndexHerbariorum.asp (accessed February 2016)

Timohina S. A. (1990): *Scirpus* L. – Kamyš. – In: Peshkova G. A. & Malyshev L. I. (eds), Flora Sibiri [Flora of Siberia] 3: 20–74, Nauka, Novosibirsk.

Toman M. (1973): Rozšíření některých stepních druhů v Čechách [Distribution of some steppe species in Bohemia]. – Sborn. Pedagog. Fak. Ústí nad Labem, ser. sci. natur., 2: 21–102.

Tsvelev N. N. (1980): Nizmyanka *Centunculus* (*Primulaceae*): novyi rod flory Dal'nego Vostoka [*Centunculus* (*Primulaceae*): a new genus of the flora of the Far East]. – Bot. Zhurn. 65: 587–588.

Turland N. J. & Jarvis C. E. (1997): Typification of Linnaean specific and varietal names in the *Leguminosae* (*Fabaceae*). – Taxon 46: 457–485.

USDA, NRCS (2016): The Plants Database. – United States Department of Agriculture. URL: http://plants.usda.gov (accessed 9 February 2016).

Valdés B., Scholz H., Raab-Straube E. von & Parolly G. (2009): *Poaceae* (pro parte majore). – In: Euro+Med Plantbase – the information resource for Euro-Mediterranean plant diversity. URL: http://ww2.bgbm.org/EuroPlusMed (accessed February 2016).

van den Berg L. J. L., Dorland E., Vergeer P., Hart M. A. C., Bobbink R. & Roelefs J. G. M. (2005): Decline of acid sensitive plant species in heathland can be attributed to ammonium toxicity in combination with low pH. – New Phytol. 166: 551–564.

von Lampe M. (1996): Wuchsform, Wuchsrhythmus und Verbreitung der Arten der Zwergbinsengesellschaften. – Diss. Bot. 226: 1–353.

Vydrina S. N. (1994): *Astragalus* L. – Astragal. – In: Polozhiy A. V. & Malyshev L. I. (eds), Flora Sibiri [Flora of Siberia] 9: 20–74, Nauka, Novosibirsk.

Walsh N. G. (2003): *Primulaceae*. – In: Walsh N. G. &. Entwisle T. J. (eds), Flora of Victoria 3: 517–522, Inkata Press, Melbourne.

Webb C. J., Sykes W. R. & Garnock-Jones P. J. (1988): Flora of New Zealand. Vol. 4. Naturalised pteridophytes, gymnosperm and dicotyledons. – Christchurch, New Zealand.

Weimarck G. (1971): Variation and taxonomy of *Hierochloë* (*Gramineae*) in the Northern Hemisphere. – Bot. Not. 124: 129–175.

Weyl P. S. R. & Coetzee J. A. (2014): The invasion status of *Myriophyllum spicatum* L. in southern Africa. – Manag. Biol. Invas. 5: 31–37.

Widén C.-J., Fraser-Jenkins C. R., Reichstein T., Gibby M. & Sarvela J. (1996): Phloroglucinol derivatives in *Dryopteris* sect. *Fibrillosae* and related taxa (*Pteridophyta*, *Dryopteridaceae*). – Ann. Bot. Fenn. 33: 69–100.

Yu D., Wang D., Li Z.-Y. & Funston A. M. (2002): The taxonomic revision of the genus *Myriophyllum* (*Haloragaceae*) in China. – Rhodora 104: 396–421.

Zuloaga F. O. & Morrone O. (1999): Catálogo de las plantas vasculares de la República Argentina [Catalogue of vascular plants of Argentina]. Vol. 2. – Missouri Botanical Garden, St. Louis.

Received 27 February 2016
Revision received 15 May 2016
Accepted 16 May 2016