Distributions of vascular plants in the Czech Republic. Part 4

Rozšíření cévnatých rostlin v České republice. Část 4

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This the fourth part of the series on the distributions of vascular plants in the Czech Republic includes grid maps of 84 taxa of the genera *Aldrovanda*, *Alisma*, *Asclepias*, *Azolla*, *Blechnum*, *Botrychium*, *Butomus*, *Carex*, *Centaurea*, *Drosera*, *Dysphania*, *Hypochaeris*, *Illecebrum*, *Luronium*, *Ophioglossum*, *Persicaria*, *Pilularia*, *Rubrivena*, *Sagittaria*, *Salvinia*, *Scirpoides*, *Sideritis*, *Streptopus*, *Teesdalia* and *Thesium*. These maps were produced by taxonomic experts based on herbarium specimens, literature and field records. Of the native taxa studied, 40 are on the national Red List. Among them, *Carex pseudobrizoides*, *Hypochaeris glabra* and *Illecebrum verticillatum* are rare species of mainly sandy habitats, which are all now restricted to a few or several sites and are therefore classified as critically threatened. Endangered aquatics and wetland plants are represented by *Alisma gramineum*, *Salvinia natans*, three *Drosera* species, *Luronium natans* and *Pilularia globulifera*, of which the latter two are species with sub-Atlantic distributions, reaching in this country their south-eastern and eastern distribution limits, respectively. All eight species of the genus *Thesium* and most species of *Botrychium* are endangered, either because they are rare or they are now considerably less common than they were, or combination of both. Two of the species mapped in this paper are now extirpated from this country. *Botrychium simplex* was last recorded more than 120 years ago, whereas the spontaneous occurrences of *Aldrovanda vesiculosa* vanished after 1952. However, the latter species has recently been deliberately planted in the wild for conservation purposes. The taxonomically extremely difficult *Centaurea* sect. *Jacea*, whose taxonomy and evolution is complicated by polyploidization and frequent hybridization, includes many taxa whose distributions were unclear until recently. Maps

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of *Centaurea* species and subspecies based on revised herbarium specimens are given, supplemented with the occurrence of their hybrids in grid cells where the parental species have not been documented. Alien species are mainly species originally introduced into Europe as ornamental and/or medicinal plants, such as *Azolla filiculoides*, *Carex muskingumensis*, *Rubrivena polystachya*, *Sagittaria latifolia*, three species of *Dysphania* and two of *Persicaria*. Another one, *Asclepias syriaca*, has become locally abundant and invasive. Other aliens were introduced unintentionally, such as *Dysphania melanocarpa* and *D. pumilio* with wool from Australia or *Persicaria pensylvanica* with soybeans from North America. Spatial distributions and temporal dynamics of individual taxa 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 the distribution, habitats, taxonomy and biology of the taxa.

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

Introduction

The first three years of this project on the mapping of the distributions of plants in the Czech Republic resulted in the establishment of a team of taxonomic experts and regional contributors of floristic records, a modern plant record database Pladias and the first sets of maps. So far, grid based distribution maps have been produced for 267 vascular plants, based on critically evaluated and sorted records (Kaplan et al. 2015, 2016a, b). The ultimate aim, which was initiated within the PLADIAS project (www.pladias.org), was to produce a series of publications that would form the basis for a complete atlas of the distribution of vascular plants in the Czech Republic.

From September 2016 to February 2017 the Pladias database was increased by about 77,000 new records. Of these more than 42,000 records resulted from the critical examination of herbarium specimens by taxonomic experts. Maps for a further 84 taxa were finished at the beginning of February 2017 and these are published in this paper.

Current revisions of central-European plant diversity have resulted in several new findings both among native and alien species. *Spergularia kurkae*, a previously little known and considered to be a primary hybrid, is resolved as a stabilized allopolyploid species (Kúr et al. 2016). Large-scale flow cytometric screening of the highly polyploid and taxonomically intriguing *Symphytum tuberosum* complex revealed two dominant cytotypes classified as subspecies (Kobrlová et al. 2016). A new species, *Festuca tomanii*, was described from relict base-rich sand dunes in the northern Upper Rhine river basin and middle Main river basin in Germany and in the western Labe river basin in the Czech Republic (Korneck & Gregor 2015). Five *Rubus* species were recorded as new for the Czech Republic (Velebil et al. 2016). An inventory of Czech garden flora was carried out because ornamental plants constitute an important source of alien, and potentially even invasive species (Pergl et al. 2016). Several alien plant taxa have recently been discovered in the Czech Republic (Hadinec & Lustyk 2016, Kocián et al. 2016), for which distribution maps of the introduced *Centaurea* species and *Persicaria capitata* are provided in this paper, as well as of aliens belonging to seven other genera. Among them, *Asclepias syriaca*, *Azolla filiculoides*, *Carex muskingumensis*, *Rubrivena polystachya*, *Sagittaria latifolia*, three species of *Dysphania* and two of *Persicaria* were originally introduced into Europe as ornamental and/or medicinal plants. Of these, *Asclepias syriaca*

has become locally abundant and invasive. Other species were introduced unintentionally, such as *Dysphania melanocarpa* and *D. pumilio* with wool from Australia or *Persicaria pensylvanica* with soybeans from North America. Among the native plants, those that are endangered are particularly represented. Altogether, distribution maps are provided for 40 red-listed taxa (Grulich 2012). Two species, namely *Aldrovanda vesiculosa* and *Botrychium simplex*, are now extirpated from this country, although the former has recently been deliberately planted in the wild for conservation purposes.

Materials and methods

Taxonomic scope

The following groups of vascular plants are mapped: native taxa, naturalized aliens, most casuals and certain hybrids. Distribution maps are produced for species and subspecies, and 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 maps that resulted from recent revisions are printed preferentially.

Data sources

All relevant floristic data sources are used. Major national herbaria and some local and foreign collections, incl. B, BRA, BRNL, BRNM, BRNU, CB, CBFS, CESK, CHEB, CHOM, FMM, GM, HOMP, HR, JE, KHMS, LIM, LIT, MJ, MMI, MP, MZ, NJM, OH, OL, OLM, OMJ, OP, OSM, OVMB, PL, PR, PRA, PRC, ROZ, SAV, SOB, SOKO, SUM, VM, VYM, WRSL, WU and ZMT (acronyms follow Thiers 2017), were consulted as the main source of taxonomically revised records. Most records for maps of common and easy-to-identify taxa came from the recently developed Pladias database (hosted at the Institute of Botany, Průhonice), 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), the Database of Forest Typology of the Forest Management Institute of the Czech Republic (DLT) and the Floristic Database of the South Bohemian Branch of the Czech Botanical Society (JCP CBS). Unpublished field records previously entered into the Pladias database by the authors of maps or regional contributors were also considered.

Mapping procedure

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 borders of this country. Individual records and the whole distribution of each taxon are checked and evaluated by the author of a particular map in a web-based mapping interface of the Pladias database. Maps of taxonomically critical groups 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 1–91. 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 by field botanists, regional collaborators 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 the distribution maps.

Final maps and comments

The treatment of each taxon consists of a grid distribution map and accompanying text; authors of the maps are indicated in the figure captions, who also had a major role in preparing the first drafts of the respective texts. Maps are displayed using a spherical Mercator projection (EPSG:3857) in which meridians and parallels are shown perpendicularly, and the mapping CEBA grids are thus nicely displayed. The background relief was derived from 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 records of plant distributions: (i) recent versus old records, (ii) native occurrences versus introductions, or (iii) 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 particular grid cell are shown in Table 1. Symbols specific to individual maps are explained in their captions. To save space, rare taxa of the genera *Centaurea*, *Dysphania* and *Persicaria* with distinct distributions are shown in maps in groups of 2 or 3, with symbols and annotations of individual taxa on the maps distinguished using different colours. Distributions of several *Centaurea* species are supplemented with the occurrence of their hybrids in grid cells where the parental species has not been documented. 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 symbols used in the distribution maps to indicate the different attributes of occurrence in particular grid cells.

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 a record(s) that is uncertain regarding identification and/or locality

Distribution maps and comments

Aldrovanda vesiculosa (Fig. 1)

In the past *A. vesiculosa* occurred in Europe from southern France through central and southern Europe eastwards to European Russia, in the north reaching Poland, the Baltic countries and Lake Ladoga in the adjacent part of Russia. Further eastwards it had a highly fragmented range, being recorded in Kazakhstan, Uzbekistan, eastern India, north-eastern China, on the Korean Peninsula and in Japan. It also occurred in tropical and sub-tropical Africa, in East Timor and in coastal areas of Australia (Meusel et al. 1965, Cross 2012). Nowadays *A. vesiculosa* is a globally endangered species, which has declined over the last century to only about 50 recently confirmed extant populations, as it is extirpated from most of the countries where it was previously recorded (Cross 2012). Its past occurrence in the Czech Republic is documented by a single undated (but apparently from the 19th century) herbarium specimen from the vicinity of the town of Těšín on the Czech-Polish border. In addition, *A. vesiculosa* was observed in 1952 in a small population in a ditch connecting ponds formed by land subsidence after underground coal mining close to the village of Louky. Both sites are situated not far from former occurrences in Polish Silesia. Since 1995 *A. vesiculosa* has been deliberately introduced for conservation purposes into shallow sheltered coves or pools in reed stands in fishponds and in abandoned sand pits in the surroundings of the towns of Doksy and Česká Lípa in northern Bohemia, in the Třeboňská pánev basin in southern Bohemia and near the city of Ostrava in Silesia (Adamec 1995, 2005, Adamec & Lev 1999).

Alisma gramineum (Fig. 2)

Alisma gramineum occurs in temperate zones in Eurasia and North America, and also in northern Africa. In Europe it is found mainly in central and eastern parts except the Alps

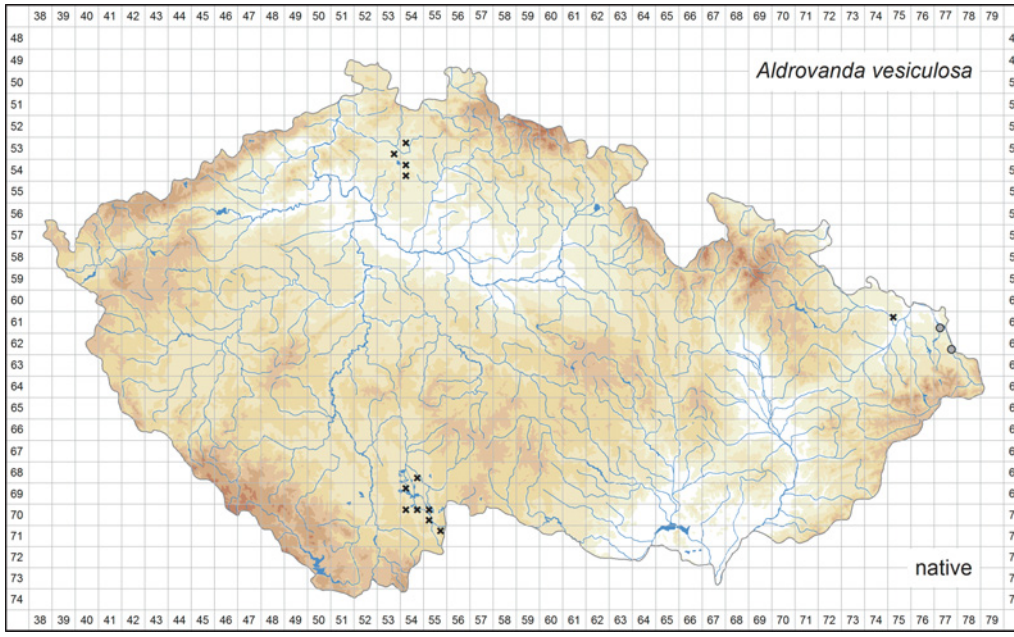

Fig. 1. – Distribution of *Aldrovanda vesiculosa* in the Czech Republic: ● pre 2000 records only (2 quadrants), × deliberate introductions only (12 quadrants). Prepared by Zdeněk Kaplan.

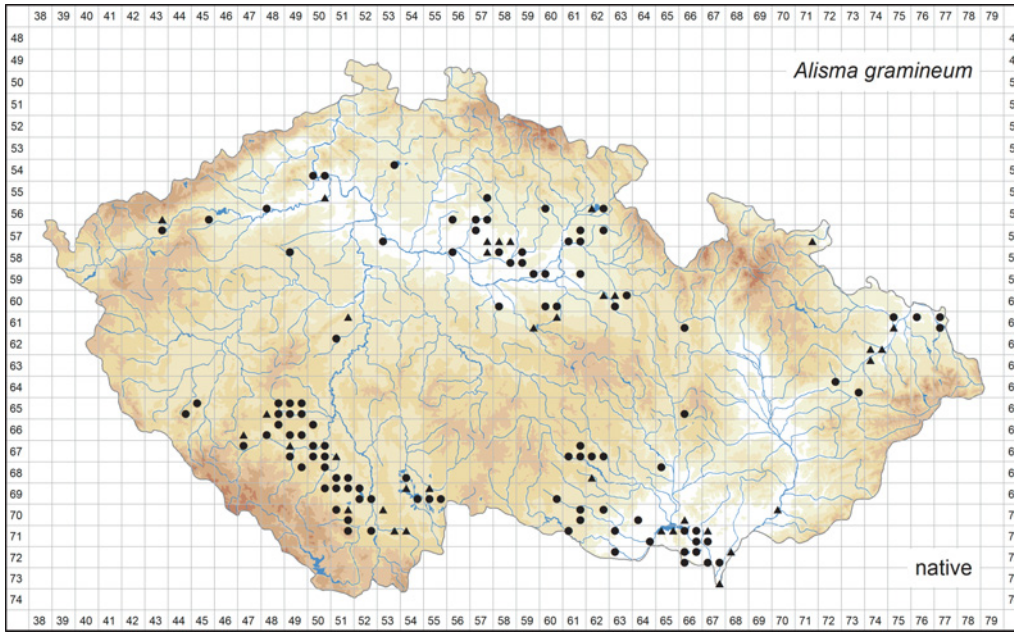

Fig. 2. – Distribution of *Alisma gramineum* in the Czech Republic: ● occurrence documented by herbarium specimens (102 quadrants), ▲ occurrence based on other records (35 quadrants). Prepared by Zdenka Hroudová.

and Carpathians, westwards reaching central and southern France, eastwards Ukraine and the north-western part of European Russia; further to the east there are only isolated localities in western and central Siberia, Anatolia and the Caucasus Mts (Meusel et al. 1965, Hultén & Fries 1986). In the Czech Republic *A. gramineum* inhabits mainly littorals of shallow standing water, most frequently fishponds. It is well adapted to an aquatic environment and even submerged plants can produce seed, but a temporary decrease in water level enhances flowering and fruiting. Long-time survival under unfavourable conditions (drying or deep-flooded habitats) is facilitated by dormant seed; consequently, *A. gramineum* can re-appear after several years of absence at a site. Within this country, it is mainly found in the middle and eastern parts of the Labe river basin in eastern Bohemia and in fishpond basins in south-western and southern Bohemia, except for the nutrient-poorer Třeboňská pánev basin, where this species has spread only in recent decades, apparently due to eutrophication and liming of fishponds and transfer of the diaspores by fish farming equipment. Less frequently it is recorded in southern Moravia, occurring mainly in the lowlands along the Dyje and Morava rivers, and in the Odra river basin in north-eastern Moravia. Elsewhere at low altitudes it is rare, while being absent from highlands and mountains. Nevertheless, *A. gramineum* is a scarce species and is therefore classified as endangered (Grulich 2012).

Alisma lanceolatum (Fig. 3)

Alisma lanceolatum occurs in Europe except for most of Scandinavia and the northern part of European Russia. Outside Europe it occurs along the Mediterranean coast of Africa and in western Asia eastwards approximately to Kazakhstan (Hultén & Fries 1986). It has been introduced into the western USA (Haynes & Hellquist 2000). In the Czech Republic it grows on river banks, in oxbows, pools, wet depressions in arable fields and along railways, fishponds and wet ditches. It is mainly found in river floodplains in warm areas, particularly in the Labe river basin in central and eastern Bohemia and on the floodplains of the Dyje and Morava rivers in southern and central Moravia. The occurrence in other areas is also largely along river courses.

Alisma plantago-aquatica (Fig. 4)

Alisma plantago-aquatica is native to Eurasia. It is distributed almost throughout Europe except in coastal regions and the extreme north, extending eastwards approximately between 40°N and 60°N through Siberia as far as the Russian Far East. It also occurs in south-western Asia, in northernmost Africa and in the mountains of tropical Africa (Björkquist 1967, Hultén & Fries 1986). It has been introduced into Alaska (Haynes & Hellquist 2000). *Alisma plantago-aquatica* has a wide ecological amplitude and occurs in a range of wetland and aquatic habitats, particularly those with organic sediments and fluctuating water levels, such as fishponds, banks of rivers and streams, pools in river floodplains, temporarily flooded depressions in arable fields, wet ditches along roads or railways, abandoned sand pits and brick-clay pits. In contrast to other species of *Alisma*, *A. plantago-aquatica* is also able to colonize some forest wetlands, such as drainage ditches and channels, wet forest tracks and wetlands surrounding springs. In the Czech Republic it is rather common almost throughout the country, locally occurring even in the mountains and ascending its altitudinal maximum at about 1000 m in the Šumava Mts and

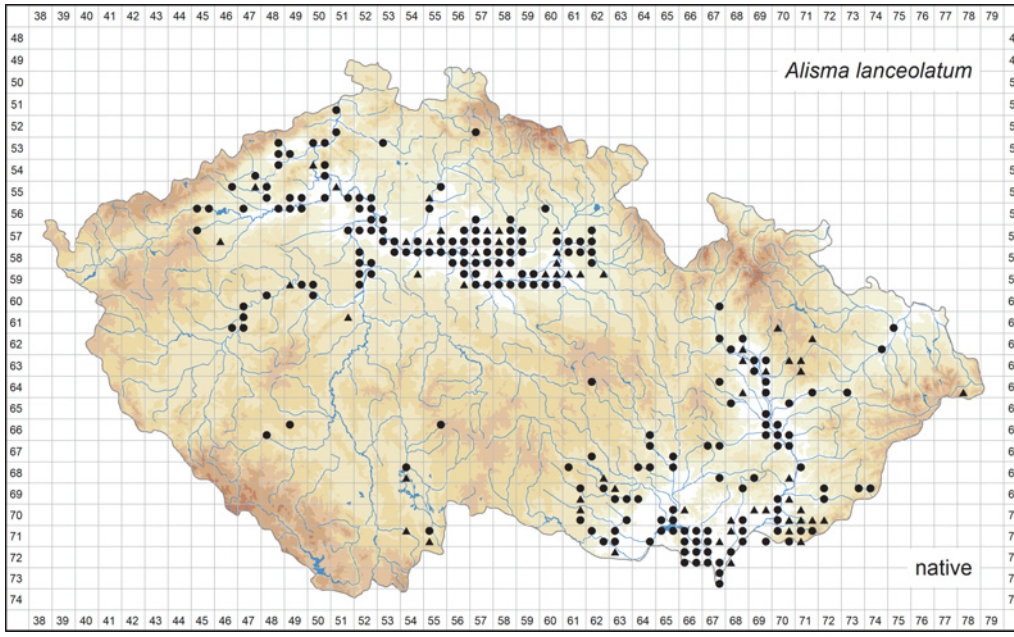

Fig. 3. – Distribution of *Alisma lanceolatum* in the Czech Republic: ● occurrence documented by herbarium specimens (200 quadrants), ▲ occurrence based on other records (59 quadrants). Prepared by Zdenka Hroudová.

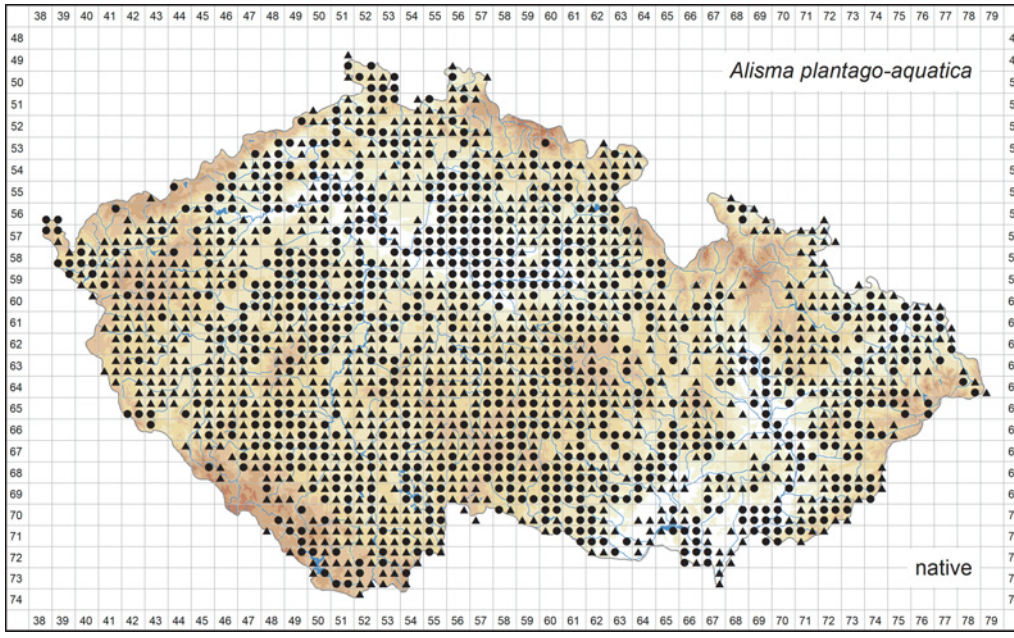

Fig. 4. – Distribution of *Alisma plantago-aquatica* in the Czech Republic: ● occurrence documented by herbarium specimens (772 quadrants), ▲ occurrence based on other records (1056 quadrants). Prepared by Zdenka Hroudová.

at about 900 m in the Krušné hory Mts. It is most frequent in areas with acidic bedrock, such as fishpond landscapes in south-western and southern Bohemia and the Českomoravská vrchovina highlands. In contrast, it is less frequent in areas with mineral-rich substrates, such as north-western Bohemia and southern Moravia, where it is confined to habitats along rivers and streams saturated by water from the watercourse.

Asclepias syriaca (Fig. 5)

Asclepias syriaca is native to the north-eastern, north central and south-eastern USA and adjacent areas in Canada (Hartzler & Buhler 2000). It has been introduced to cultivation in Europe and later recorded as escaped or intentionally planted in the countryside in most countries in central Europe, as well as in Sweden, France, Italy, Bulgaria, Lithuania, Moldova and Ukraine. Currently, it has also been found in Japan (Teeling 2010). *Asclepias syriaca* is found in various habitats, including arable land, pastures, roadsides, railways, ditches, abandoned fields and vineyards, shores of artificial lakes, river banks and disturbed sites in human settlements. It grows on dry, loamy to stony soils (Láníková 2009). It has been introduced into the Czech Republic as an ornamental and medicinal plant; as a nectariferous plant it used to be planted also by beekeepers. The first report of its cultivation dates back to 1785 (the garden of the Lány chateau; Haenke 1786), and it was first recorded in the wild in the broad vicinity of the town of Krnov in Silesia (Koschatzky 1821). Currently, it occurs scattered in the lowlands of north-western, central and eastern Bohemia and there are isolated records for southern Bohemia. In Moravia it grows mainly in its southern and central part, where it is locally abundant and invasive. In the Czech Republic *A. syriaca* is rare at high altitudes, where it is mainly found in remnants of cultivation; its altitudinal maximum is 880 m in the village of Prášily in the Šumava Mts. It is classified as an invasive neophyte (Pyšek et al. 2012).

Azolla filiculoides (Fig. 6)

Azolla is a taxonomically difficult genus. The number of species recognized varies among different authors, and different characters are used for their delimitation. Evrard & Van Hove (2004) abandoned previous concepts as inconvenient and recognized only two species native to the New World, both also introduced into Europe. While *A. cristata* (syn. *A. caroliniana* auct.) is documented in Europe only from the Netherlands, *A. filiculoides* is recorded in several countries, particularly in western and central Europe. The only species of this genus proven to occur in the field in the Czech Republic is *A. filiculoides* (Danihelka et al. 2012). Its native distribution spans from the western and southern USA in the north to Chile and Argentina in the south (Evrard & Van Hove 2004), but currently it is cosmopolitan, as it has been introduced into Europe, Asia, Africa and Australia (Hill 2014). *Azolla filiculoides* was introduced into Europe in the 1870s–1880s (Rasbach et al. 1976) and since then it has been recorded in the British Isles, the Netherlands, Belgium, Germany, France and Portugal (Evrard & Van Hove 2004), and also in other more northern, eastern and southern countries, including Norway and Sweden in the north, Lithuania, Ukraine and European Russia in the east and Spain, Italy, Greece and Bulgaria in the south (Christenhusz & Raab-Straube 2013, Hill 2014). In the Czech Republic it is seldom grown in aquaria and apparently sometimes deliberately planted in fishponds, pools, ditches and canals, mostly in or near villages or towns. It was first recorded in the field in

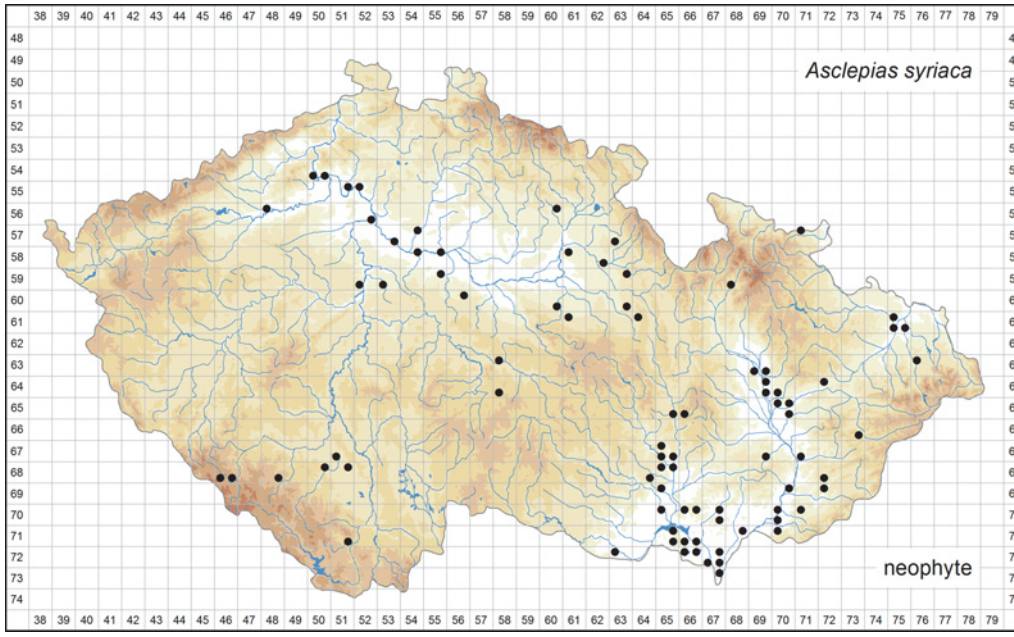

Fig. 5. – Distribution of *Asclepias syriaca* in the Czech Republic (83 occupied quadrants). Prepared by Jitka Štěpánková.

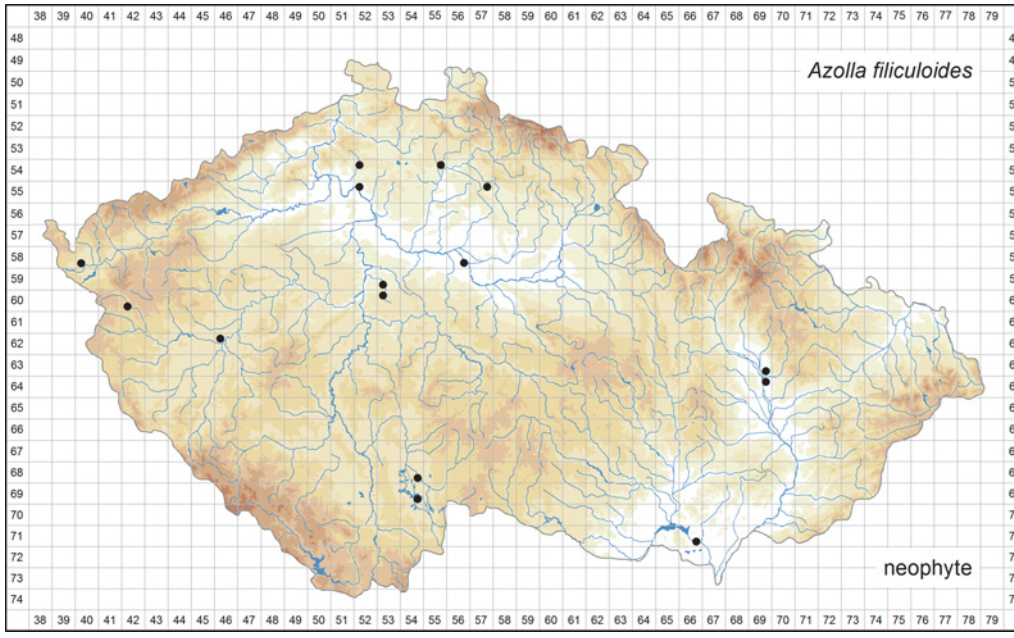

Fig. 6. – Distribution of *Azolla filiculoides* in the Czech Republic (15 occupied quadrants). Prepared by Zdeněk Kaplan & Libor Ekrt.

1895 and since then it has been found at about 17 sites mainly in Bohemia. At some of them *A. filiculoides* persisted for up to two decades and is therefore classified as a naturalized neophyte (Pyšek et al. 2012). At most of its sites it grows rapidly and produces dense mats, by which it outcompetes the native submerged vegetation.

Blechnum spicant (Fig. 7)

Blechnum spicant has a disjunct Atlantic and sub-Atlantic distribution. It occurs in western and central Europe, towards the east reaching the mountains on the Balkan Peninsula, Anatolia, the Caucasus and northern Iran. It also occurs in Iceland, Macaronesia, northernmost mountainous parts of Africa, central China, Japan and westernmost North America (Hultén & Fries 1986). In the Czech Republic *B. spicant* is mainly found in spruce forests, occasionally also alder carrs, pine and beech forests, *Pinus mugo* scrub or gorges in sandstone areas. It is most frequent in siliceous mountain ranges along this country's border and scattered in highlands such as the Slavkovský les hills, the Brdy Mts, the Českomoravská vrchovina highlands and the Žďárské vrchy, Oderské vrchy and Hostýnské vrchy hills. It only locally occurs in humid areas at middle altitudes and is rare in lowlands, where its occurrence is only temporary. It is classified as of lower risk – near threatened (Grulich 2012).

Botrychium lunaria (Fig. 8)

Botrychium lunaria complex is a taxonomically difficult group with numerous cryptic lineages (Stensvold 2008, Dauphin et al. 2014) of which only the diploid *B. lunaria* (var. *lunaria*) occurs in the Czech Republic. It has a circumboreal-temperate distribution. It is widespread in Europe except its southernmost regions, scattered in northernmost Africa, in the boreal and temperate parts of Asia; it occurs also in Canada, the northern USA, Greenland, Patagonia, New Zealand, Tasmania and south-eastern Australia (Hultén & Fries 1986, Stensvold 2008). In the Czech Republic it grows both on calcareous and siliceous soils in moderately dry grasslands, pastures, heathlands and on rocky ledges. It is distributed throughout this country from the lowlands to the mountains, where it is more frequent. In contrast, it is markedly less frequent in dry areas in north-western, central and eastern Bohemia. In Moravia it is rare or absent from the floodplains of lowland rivers and the adjacent warm hills. Particularly in the past *B. lunaria* may have been more widespread. It has disappeared from many sites, particularly in the lowlands and at middle altitudes, as a result of the abandonment of pastures, nutrient enrichment and subsequent spread of competitively strong species and succession of tree and scrub vegetation. Because this species is inconspicuous, it is easily overlooked. Consequently, the majority of the gaps in the map probably indicate under-recording in the past rather than true absences. It is classified as endangered (Grulich 2012).

Botrychium matricariifolium (Fig. 9)

Botrychium matricariifolium is a tetraploid species with a limited sub-Atlantic distribution in Europe and North America. It is the only member of the *B. matricariifolium* complex in Europe, whose diploid parents are North American *B. pallidum* and a still unresolved taxon (Williams et al. 2016). It is widespread in central Europe and southern Scandinavia,

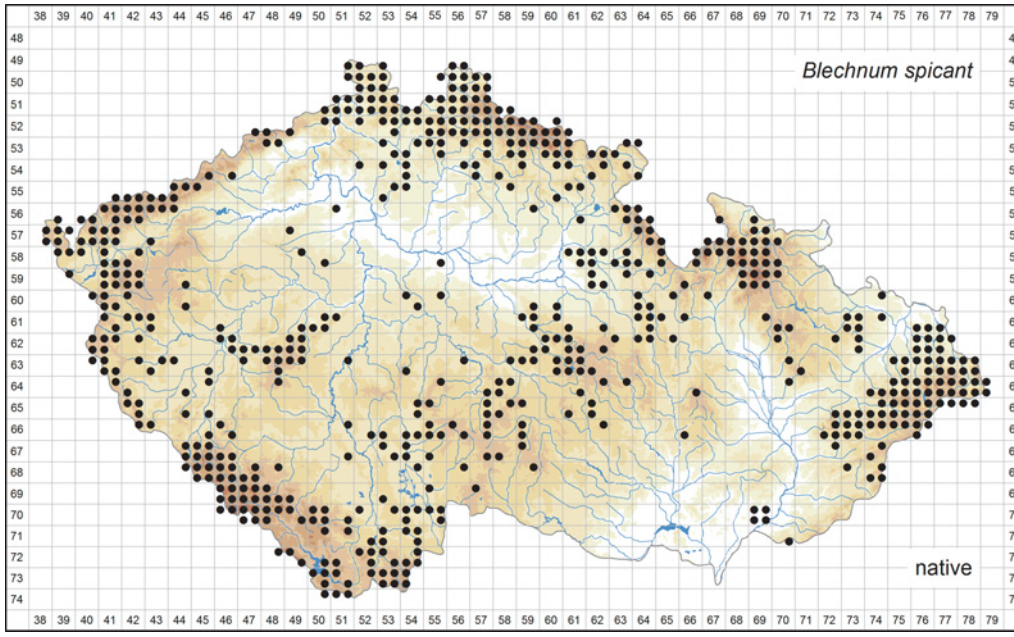

Fig. 7. – Distribution of *Blechnum spicant* in the Czech Republic (614 occupied quadrants). Prepared by Libor Ekrt.

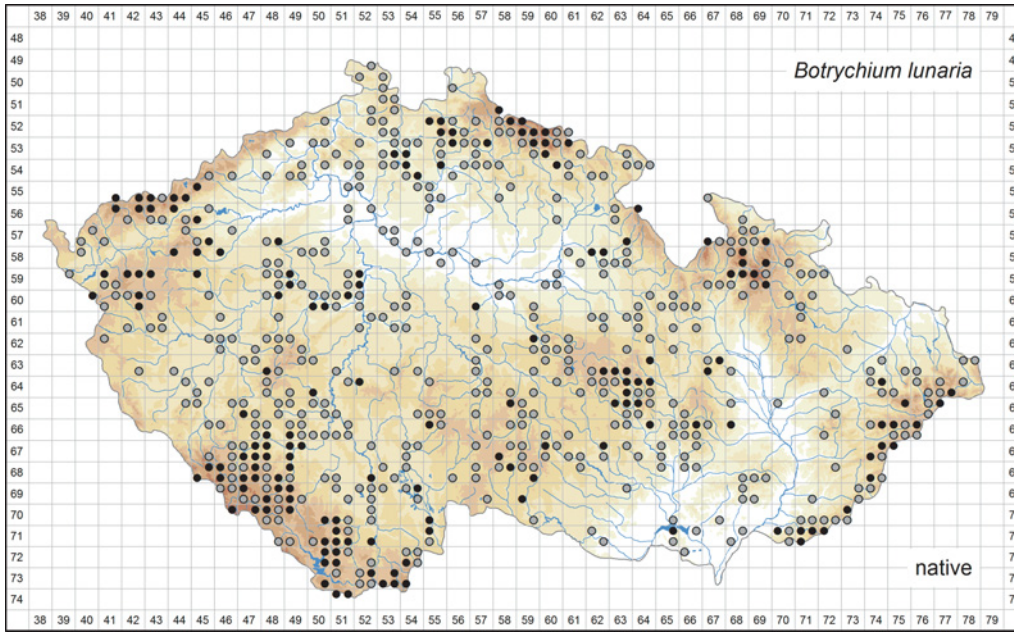

Fig. 8. – Distribution of *Botrychium lunaria* in the Czech Republic: ● at least one record in 2000–2016 (167 quadrants), ◍ pre 2000 records only (454 quadrants). Prepared by Libor Ekrt.

eastwards reaching European Russia, while it is rare in the north of the British Isles, Corsica, Croatia and Montenegro. In North America it occurs in the north-eastern USA and adjacent south-eastern Canada, and as scattered extending westwards to central California (Hultén & Fries 1986, Stešević & Berg 2015). *Botrychium matricariifolium* inhabits nutrient-poor short grasslands, forest and road edges, and occasionally also ravine forest or *Fraxinus excelsior* stands. It mainly occurs in the mountains and highlands in Bohemia, particularly in the Šumava Mts and adjacent foothills. It also occurs in Silesia, particularly in the Jeseníky Mts, and in western and north-western Moravia. The knowledge of the recent distribution of *B. matricariifolium* has greatly improved over the last two decades. In the last revision published 40 years ago (Kubát 1977), only 13 localities were known in the 1960s and 1970s. Since 2000, it has been recorded in 57 quadrants. Despite the large number of recent records, it remains a rare species, as it probably always was. The recent records are usually only for small populations or single plants. In general, *B. matricariifolium* has disappeared from the majority of its sites at low altitudes and many sites in highlands and mountains, probably due to the abandonment of pastures, nutrient enrichment, atmospheric deposition and tree and scrub succession. It is classified as critically threatened (Grulich 2012).

Botrychium multifidum (Fig. 10)

Botrychium multifidum is a diploid species, which occurs particularly in central and northern Europe, eastwards reaching central Siberia, and with isolated occurrences in the eastern Himalayas, Japan, the northern USA and adjacent Canada (Hultén & Fries 1986). In the Czech Republic *B. multifidum* formerly inhabited mainly nutrient-poor short grasslands, pastures, heathlands and forest edges, but recently only roadsides and disturbed places in forests used for temporary storage of logs. *Botrychium multifidum* was recorded in Bohemia mainly in the mountain ranges along the country's border (except in the north-west) and also in highlands, such as the Brdy Mts and the Českomoravská vrchovina highlands. It was scattered in the highlands in northern Moravia and adjacent Silesia, as well as in the Carpathians. It is almost absent from the lowlands. Around 2000 it was considered as having disappeared from this country but in 2002 it was rediscovered in the Šumava Mts, where probably the most abundant recent population in central Europe is located (Půbal & Procházka 2002), with more than 2000 individuals in 2006 (D. Půbal, pers. comm.). Currently *B. multifidum* is known from several sites in the Šumava Mts and the Jeseníky Mts and one site in the Krkonoše Mts. It probably disappeared from abandoned pastures and grasslands because of the lack of disturbation and their subsequent eutrophication and succession to woodland. Because of its rarity it is classified as critically threatened (Grulich 2012).

Botrychium simplex (Fig. 11)

Botrychium simplex is a diploid species with a disjunct distribution. It is found in central Europe and southern Scandinavia, eastwards reaching European Russia. It has isolated occurrences in southern Greenland, Iceland, the Pyrenees, northern Italy, Corsica, Slovenia, Japan, in the eastern and western USA and southwestern Canada (Hultén & Fries 1986). Recently it was also discovered in the Indian part of the Himalayas (Kholia 2012). In central Europe *B. simplex* is now very rare. It is a very inconspicuous fern

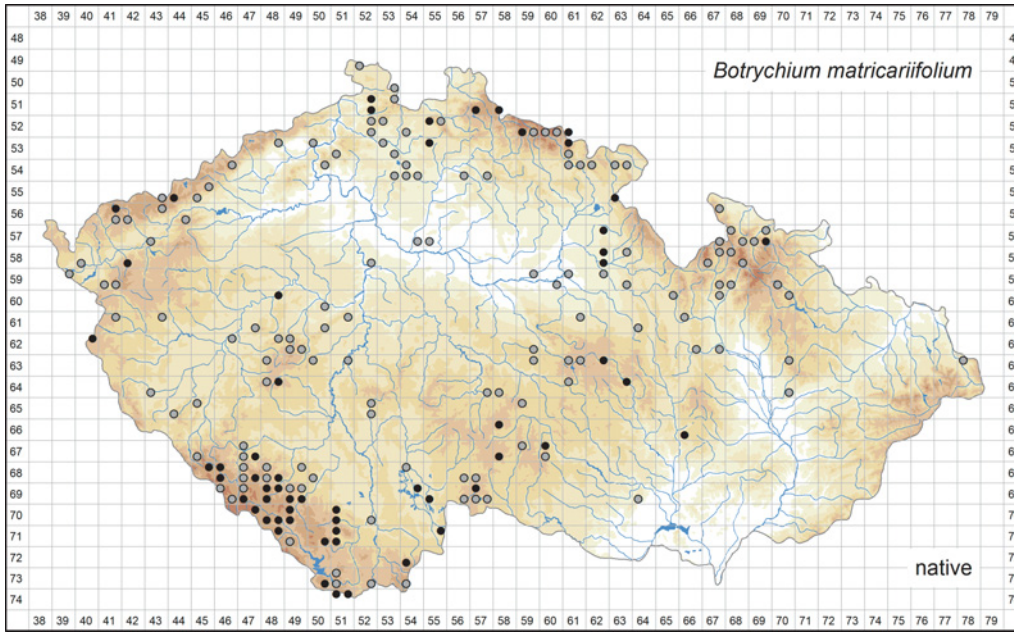

Fig. 9. – Distribution of *Botrychium matricariifolium* in the Czech Republic: ● at least one record in 2000–2016 (57 quadrants), ◍ pre 2000 records only (132 quadrants). Prepared by Libor Ekrt.

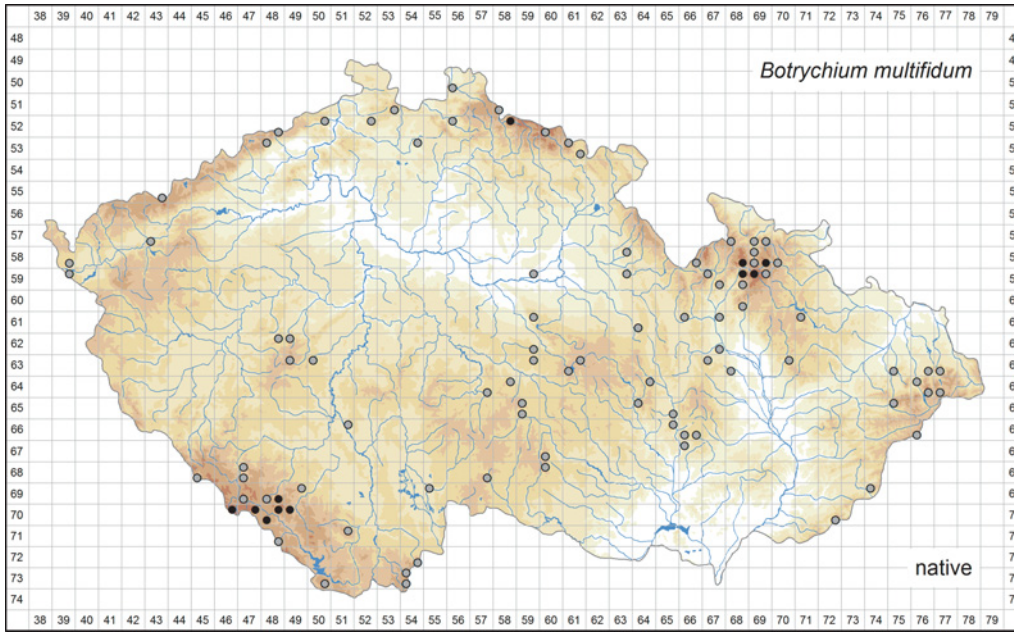

Fig. 10. – Distribution of *Botrychium multifidum* in the Czech Republic: ● at least one record in 2000–2016 (11 quadrants), ◍ pre 2000 records only (86 quadrants). Prepared by Libor Ekrt.

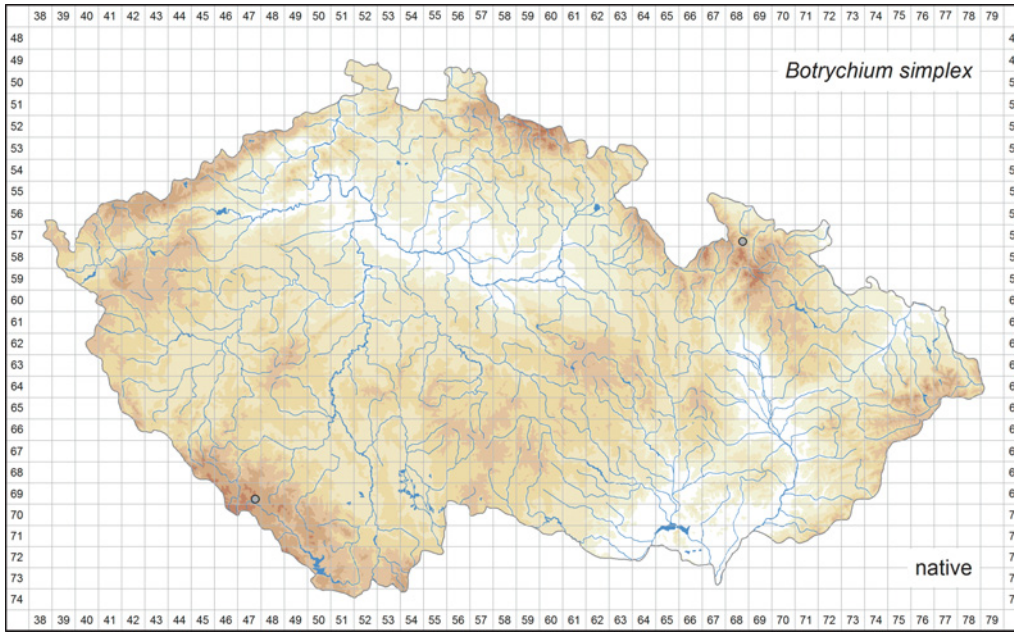

Fig. 11. – Distribution of *Botrychium simplex* in the Czech Republic: ● pre 2000 records only (2 quadrants). Prepared by Libor Ekrt.

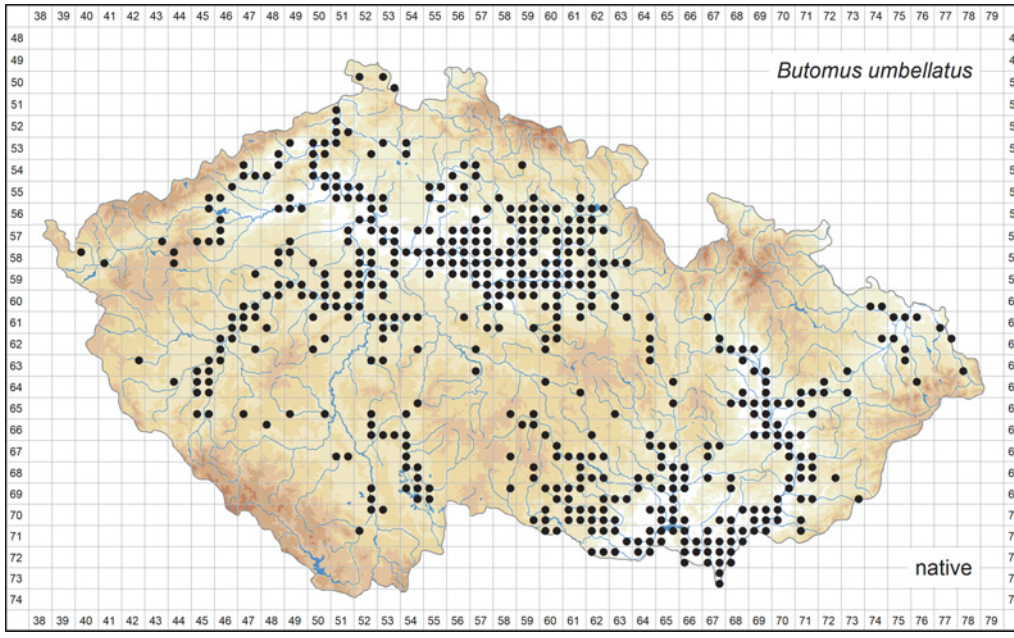

Fig. 12. – Distribution of *Butomus umbellatus* in the Czech Republic (506 occupied quadrants). Prepared by Zdenka Hroudová.

whose sporophytes can remain dormant for one or more years without producing leaves. As a short-lived (a few years only) low growing plant and a weak competitor *B. simplex* is dependent on an open vegetation (Bennert et al. 2014). In the Czech Republic, as well as in all isolated occurrences around the Alps, *B. simplex* is considered as a glacial relict (Bennert et al. 2014). It was recorded only twice in the 19th century: on the edge of a peat bog near the village of Borová Lada in the Šumava Mts in 1895 and in a mountain meadow near the village of Dolní Lipová in the Jeseníky Mts in 1857. As it has not been seen for more than 120 years, *B. simplex* is classified as extinct (Grulich 2012).

Butomus umbellatus (Fig. 12)

Butomus umbellatus is a Eurasian species with more or less continuous occurrence from western Europe to central Siberia between 40°N and 60°N; it is absent from Scotland and northern Scandinavia and sparse on the Iberian Peninsula and in the Mediterranean area. There are geographically isolated patches in south-western and central Asia, Pakistan, eastern Siberia and the Russian Far East. It has been introduced into North America (Meusel et al. 1965, Hultén & Fries 1986). In the Czech Republic *B. umbellatus* occurs in various types of standing and slowly flowing water. It prefers shallow water on eutrophic and mineral-rich substrates, and its growth is supported by temporary drying of the bottom. In small rivers and streams it produces submerged forms with ribbon-like leaves. As a thermophilous species it is mainly found at low altitudes and in warm areas. It is most frequent on floodplains of large rivers and their tributaries, particularly in the Labe river basin in Bohemia and along the lower Morava and Dyje rivers in southern Moravia. It is also common along the Ohře and Berounka rivers and the upper course of the Morava river. Elsewhere it is scattered or rare from lowlands to the supracolline vegetation belt. There are two cytotypes of *B. umbellatus*, diploids and triploids. Diploids occur particularly in the Třeboňská pánev basin in southern Bohemia and in north-eastern Moravia, inhabit mainly fishponds and can reproduce by seed. Triploids prevail in river floodplains, are self-incompatible and only rarely produce seed; thus they spread along rivers predominantly vegetatively by rhizome fragments or bulbils (Krahulcová & Jarolímová 1993). *Butomus umbellatus* has declined slightly due to the destruction of suitable habitats and changes in fishpond management and is therefore classified as of lower risk – near threatened (Grulich 2012).

Carex bohemica (Fig. 13)

Carex bohemica has a large Eurasian distribution, which extends from western Europe to Japan. It is continuously distributed mainly in central Europe and in some parts of western and eastern Europe, but occurs scattered in other parts of its distribution (Meusel et al. 1965, Hultén & Fries 1986). In the Czech Republic *C. bohemica* is typical of the exposed bottoms of fishponds and other water reservoirs, rarely growing also on exposed banks of watercourses. Although it is a perennial species, it usually behaves as an annual or a short-lived perennial, often with a very short life cycle. It quickly germinates after the water level subsides and tolerates temporary flooding. It is found on sandy or loamy, acidic, calcium-poor soils. It suffers from competition by tall-growing herbaceous plants. Its diaspores tolerate long flooding and can survive for decades in the soil seed bank (Poschlod 1996). They are easily spread by water and waterfowl. In the Czech Republic

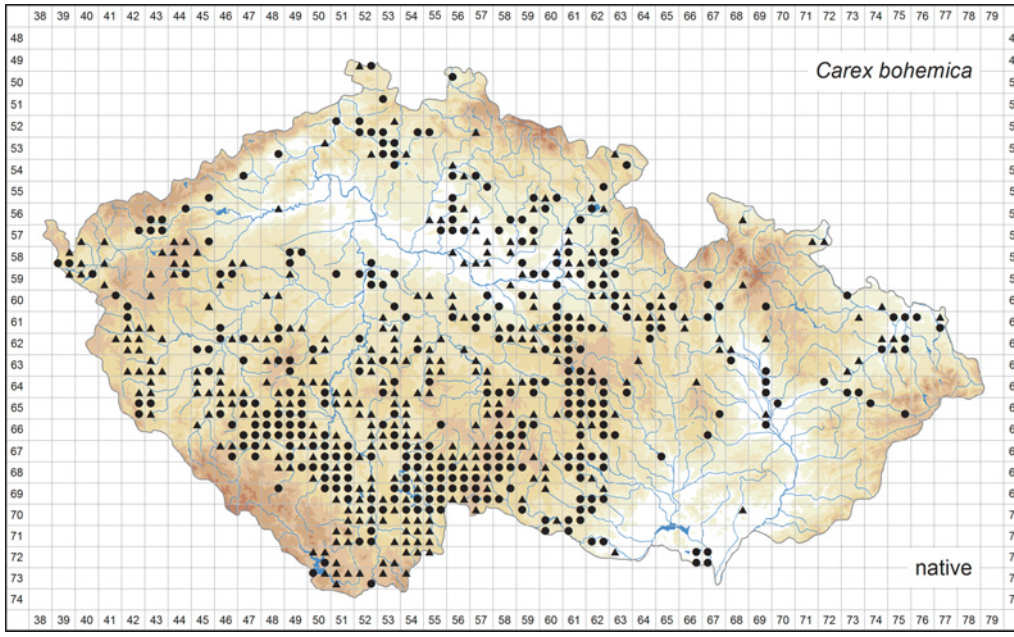

Fig. 13. – Distribution of *Carex bohemica* in the Czech Republic: ● occurrence documented by herbarium specimens (325 quadrants), ▲ occurrence based on other records (317 quadrants). Prepared by Vít Grulich & Radomír Řepka.

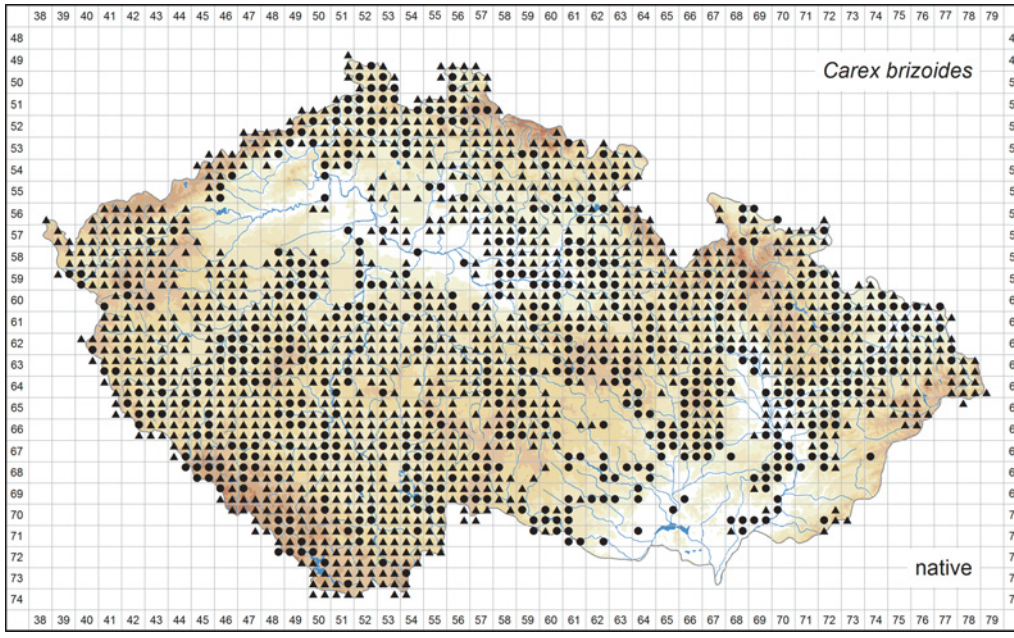

Fig. 14. – Distribution of *Carex brizoides* in the Czech Republic: ● occurrence documented by herbarium specimens (517 quadrants), ▲ occurrence based on other records (1279 quadrants). Prepared by Vít Grulich & Radomír Řepka.

C. bohemica occurs almost throughout the country, but with very different frequencies. Most of its localities are situated in areas with numerous fishponds, such as basins of south-western and southern Bohemia, the Českomoravská vrchovina highlands and the Jihlavské vrchy and Žďárské vrchy hills. It is very rare in warm and dry parts of this country, including north-western Bohemia and southern Moravia, and is also rare in Silesia and almost absent from the Carpathians. Only exceptionally does it occur above 700 m, reaching its altitudinal maximum at 770 m in the Novohradské hory Mts. It is classified as of lower risk – near threatened (Grulich 2012).

Carex brizoides (Fig. 14)

Carex brizoides is a European species occurring mainly in the temperate parts of Europe, southwards reaching as far as northern Italy and the Balkan Peninsula, and eastwards the Volga river (Meusel et al. 1965, Egorova 1999). In the Czech Republic *C. brizoides* often grows in alluvial forests, wet pine forests and acidophilous oak forests, at high altitudes sometimes even in wet to mesophilous meadows. It prefers humid to wet habitats and tolerates a high groundwater level, but at high altitudes it usually grows in mesic conditions. It prefers gley or semi-gley soils rather poor in nutrients. It can be dominant in meadows and some types of forests. Due to high biomass production it is a strong competitor, being locally expansive in unmown grasslands. It produces a high amount of biomass, which makes it a strong competitor. *Carex brizoides* is widely distributed in the Czech Republic, but its frequency varies throughout the country. It is mainly found in moderately warm areas. In the mountains it is distributed only locally, in the Šumava Mts reaching its altitudinal maximum at 1220 m. It is rather rare in the warm parts of this country, being absent from the driest areas in central and northern Bohemia and southern Moravia. It occurs relatively rarely in the Moravian part of the Českomoravská vrchovina highlands, in some parts of north-eastern Bohemia and in the Carpathians. It is sometimes difficult to distinguish *C. brizoides* from *C. curvata* (especially plants with immature perigynia), therefore undocumented records from the areas where both species co-occur (mainly in northern and central Bohemia, and eastern Moravia) may be erroneous.

Carex canescens (Fig. 15)

Carex canescens is a widespread cosmopolitan species. It occurs almost continuously throughout the temperate zone in Europe and northern Asia, from Ireland in the west to Kamchatka, Korea and Japan in the east. However, it is rare in or absent from south-western Europe, the Mediterranean area, Pannonian Basin and Balkan Peninsula. Isolated distribution areas are known from Asian mountains, from Turkey in the west to the Himalayas in the east. In North America, it occurs on the northern part of the continent. In the southern hemisphere it is found in the mountains of New Guinea, in south-eastern Australia and Tasmania, as well as in southern South America (Meusel et al. 1965, Moore & Chater 1971, Hultén & Fries 1986). *Carex canescens* is a calcifuge species, in the Czech Republic preferring transitional mires, bogs and acidic moss-rich fens. It also rarely grows in alder carrs and waterlogged spruce forests. The soils where it grows are usually poor in nutrients and constantly wet, heavy or organic and acidic. It is abundant especially in areas with cold and humid climates, but scarce elsewhere. It is particularly common in the uplands and mountains along the country's border, occurring at altitudes of

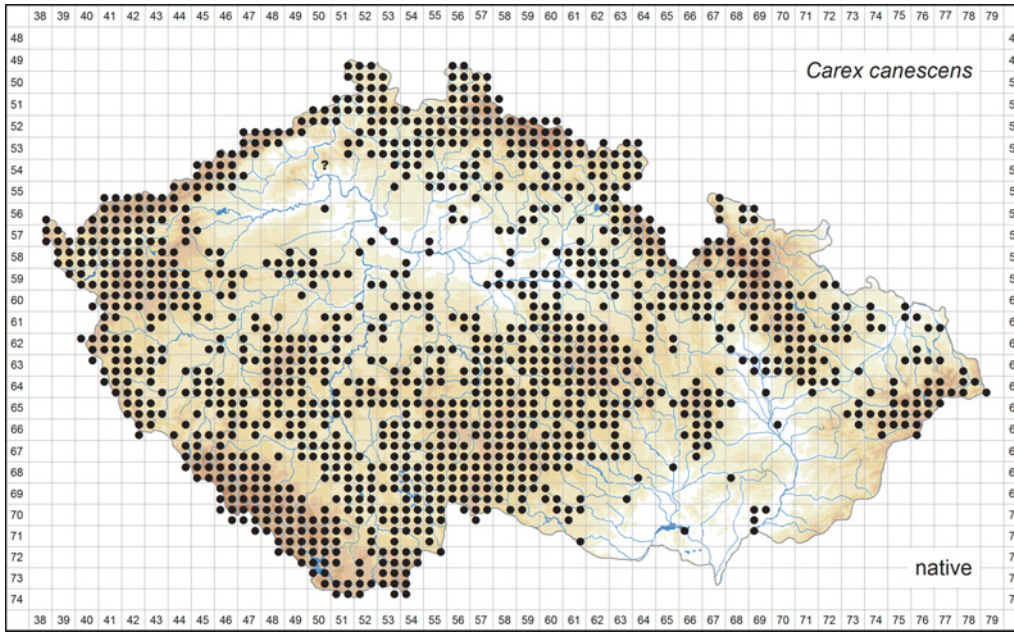

Fig. 15. – Distribution of *Carex canescens* in the Czech Republic (1286 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

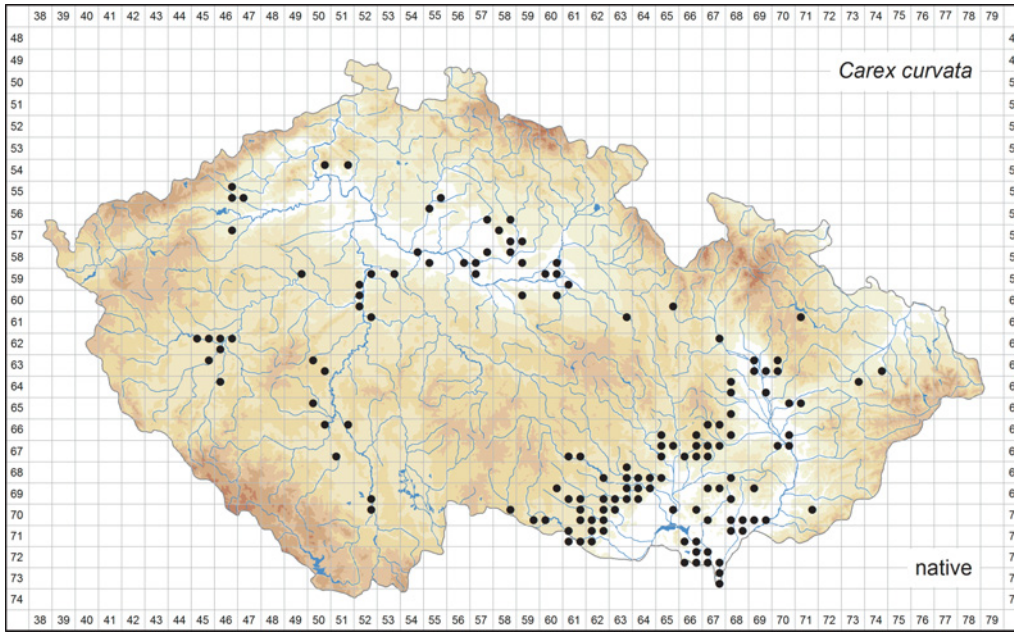

Fig. 16. – Distribution of *Carex curvata* in the Czech Republic (141 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

about 1400 m in the Krkonoše Mts. It is absent from warm and dry areas in central and northern Bohemia and southern Moravia, as well as from most of the Carpathian part of Moravia.

Carex curvata (Fig. 16)

Carex curvata is a poorly known species described from northern Bohemia (Knaf 1847), occurring mainly in Germany, Austria, the Czech Republic, Poland, Slovakia and Hungary. Remote occurrences are known from Belgium, Ukraine and Romania (Koopman 2011). In the Czech Republic *C. curvata* grows in open-canopy oak and oak-hornbeam forests and at the fringes of forests, less frequently in meadows. It prefers rather dry or intermittently wet, permeable soils, rather well supplied with mineral nutrients. *Carex curvata* is scattered to rare, occurring in areas with warm and moderately warm climates. In Bohemia it is found around the town of Chomutov (locus classicus), in the vicinity of the cities and towns of Plzeň, Příbram, České Budějovice and Prague, becoming more frequent in central and eastern Bohemia. In Moravia it is most frequent on the edge of the Bohemian Massif between the towns of Znojmo and Vyškov, and in sandy areas near the towns of Valtice and Hodonín, towards the northeast reaching central Moravia north of the city of Olomouc. For other areas in Bohemia and Moravia there are only isolated records. Most localities are situated at altitudes below 450 m; its altitudinal maximum of 650 m is reached at Mt Sedlo near the town of Úštěk in northern Bohemia. It is classified as vulnerable (Grulich 2012). In the field it is often overlooked or confused with the similar *C. brizoides* because it often remains sterile. The map is based solely on revised herbarium specimens.

Carex echinata (Fig. 17)

The large bipolar distribution of *C. echinata* includes a large part of Europe, northern Africa, western Asia, the eastern part of North America, and the mountains of Australia and New Zealand. This species is common in the temperate and boreal zones in Europe and in the Mediterranean area confined to high mountain ranges. A few isolated sites are known in the mountains of Turkey, the Caucasus, Transcaucasia and the Middle East (Meusel et al. 1965, Hultén & Fries 1986). In the Czech Republic *C. echinata* grows most frequently in acidic moss-rich fens and transitional mires, less often in wet meadows, rarely also in forest habitats with an open canopy, mainly alder carrs and waterlogged spruce forests. It prefers acidic, oligotrophic or mesotrophic soils, as well as gley and organic soils with an acidic soil reaction. *Carex echinata* occurs mostly in the uplands and mountains. It is rare in or locally absent from the lowlands with moderately warm and warm climates, especially in central and northern Bohemia and southern Moravia, while being rather rare in the Carpathian part of Moravia. Its absence coincides with the occurrence of basic bedrock and heavy soils. In the mountains it occurs up to the subalpine belt, reaching its altitudinal maximum at 1400 m in the Krkonoše Mts.

Carex elongata (Fig. 18)

Carex elongata is a species distributed in Europe and western Asia, being most frequent in central Europe. Westwards it reaches France and Ireland and southwards central Italy,

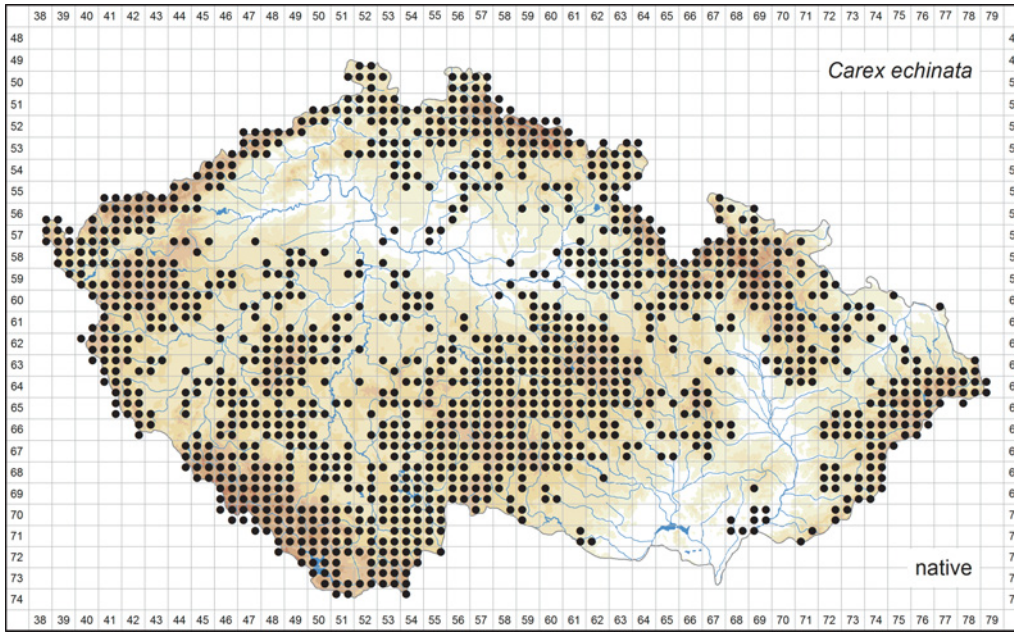

Fig. 17. – Distribution of *Carex echinata* in the Czech Republic (1261 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

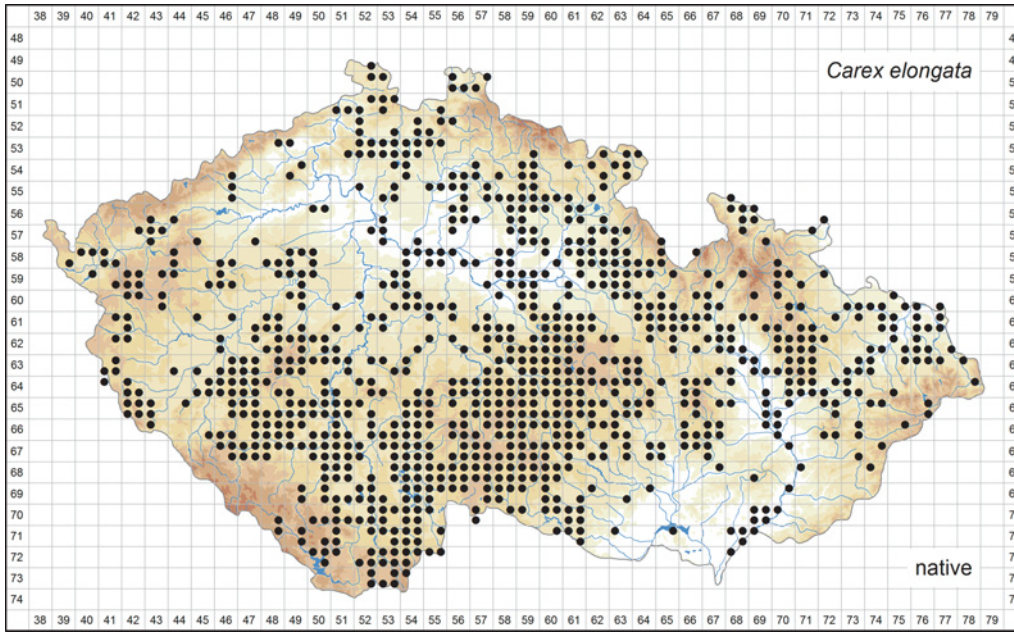

Fig. 18. – Distribution of *Carex elongata* in the Czech Republic (949 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

being known also from Serbia and Romania; however, it does not occur in most of the Mediterranean area. In Scandinavia isolated occurrences are known in northern Norway and central Finland. It is rare in eastern Europe and Siberia, eastwards it reaches as far as the Yenisei river basin. It is also found in the Caucasus and Transcaucasia (Meusel et al. 1965, Egorova 1999). In the Czech Republic *C. elongata* most frequently grows in alder carrs and narrow strips of floodplain forests along streams, on the banks of water reservoirs, in the edges of tall-sedge beds and in fen meadows. Sometimes it is found at waterlogged sites at the basis of tree trunks or around stumps. The soils are gley or organic, moderately rich in nutrients, humid to wet, often with a permanently high ground water level, very often developed above gravel or sand. Within this country *C. elongata* is distributed rather unevenly. It is particularly frequent in the Šumava foothills, fishpond basins in southern Bohemia, in the Českomoravská vrchovina highlands and Nízký Jeseník hills and the eastern part of the Labe river basin. In contrast, it is almost absent from the deforested dry and warm parts of the country, particularly northern, north-western, central and western Bohemia, and southern and central Moravia. It is scattered elsewhere but generally rare in the Carpathians. This species is found from the lowlands to the uplands, becoming rarer in the mountains. It reaches its altitudinal maximum at 840 m in the Javorníky Mts.

Carex leporina (Fig. 19)

Carex leporina is distributed mainly in Europe and western Asia. It is common throughout most of Europe, westwards reaching as far as Portugal and Ireland, and northwards to the Arctic Circle, while being very rare in the Mediterranean area. Isolated occurrences are recorded for Morocco and Algeria in north-western Africa. In northern Asia it reaches the Ob river basin in the east with isolated localities further east as far as Lake Baikal. It also occurs in the Middle East and the Caucasus. It has been introduced into North America (Meusel et al. 1965, Hultén & Fries 1986). In the Czech Republic *C. leporina* grows in various types of forest and non-forest habitats, including rather dry to wet meadows (including fen meadows) and pastures, open-canopy deciduous and coniferous forests and clearings. It is also found in places subject to trampling, especially along forest tracks. It tolerates thick layers of litter in spruce plantations. The soils are acidic, poor to moderately rich in nutrients. *Carex leporina* is frequent at middle and high altitudes. In contrast, it is scarce to rare in the warmest parts of central and northern Bohemia and southern Moravia, being confined to large patches of forest. Further, it is almost absent from areas with basic soils. Though occurring as high as the subalpine belt, it occurs less frequently above 1000 m a.s.l., reaching an altitudinal maximum in the Krkonoše Mts at about 1400 m. Although usually easy to identify, young plants are sometimes identified as *C. spicata* or *C. brizoides* and vice versa.

Carex muskingumensis (Fig. 20)

Carex muskingumensis is native to North America, where it is distributed in the eastern half from the Canadian province of Ontario in the north to Arkansas in the south. It grows there in floodplain habitats at altitudes below 400 m (Mastrogiuseppe et al. 2002). In Europe it is sometimes cultivated as an ornamental. In the Czech Republic it was first collected in the city of Brno in the late 1940s (Grüll 1952). It had probably escaped from

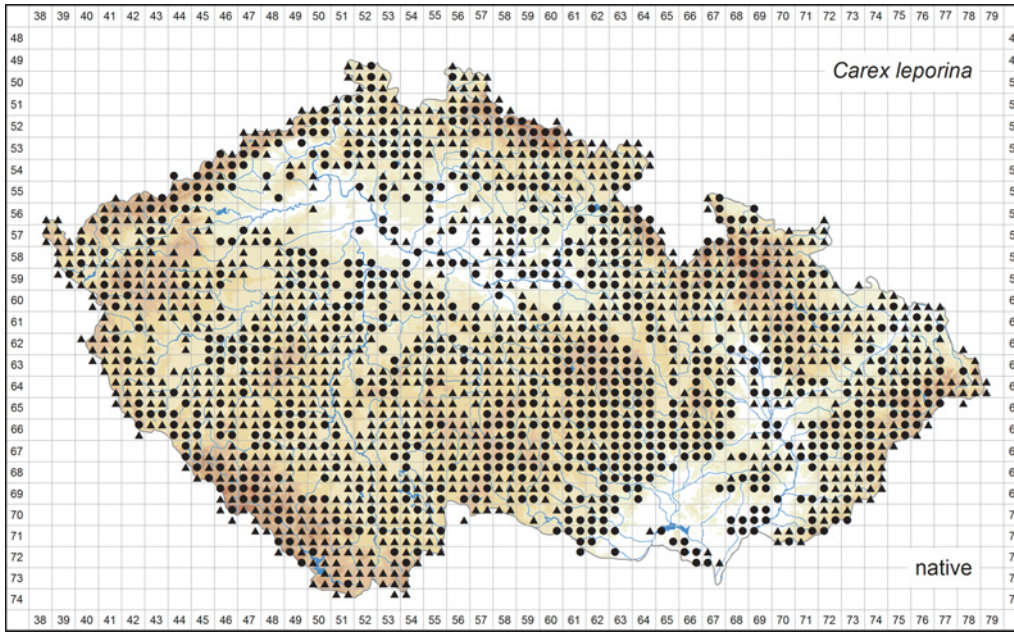

Fig. 19. – Distribution of *Carex leporina* in the Czech Republic: ● occurrence documented by herbarium specimens (762 quadrants), ▲ occurrence based on other records (1136 quadrants). Prepared by Vít Grulich & Radomír Řepka.

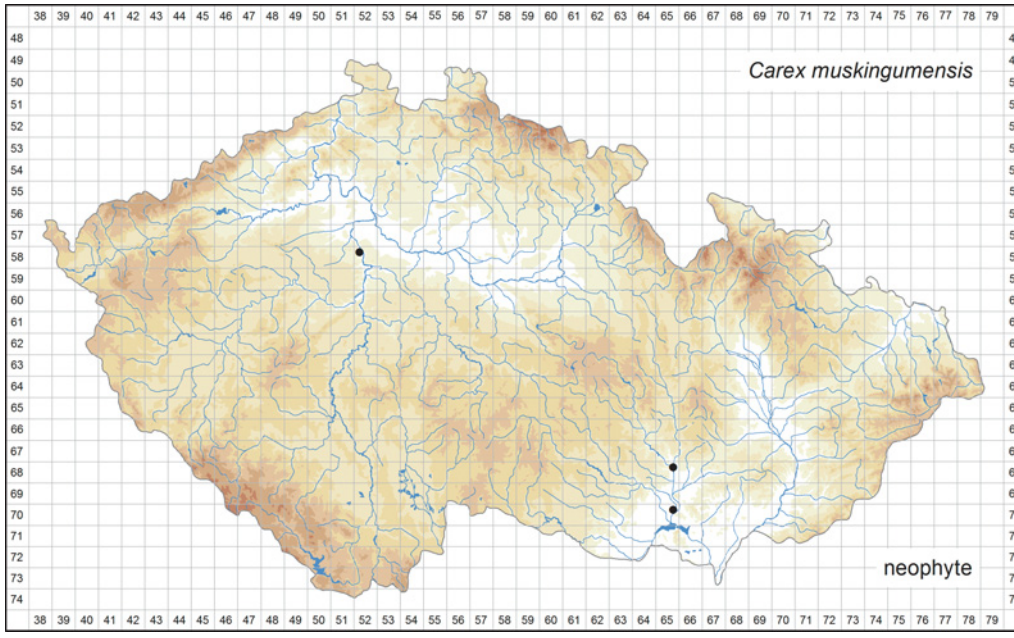

Fig. 20. – Distribution of *Carex muskingumensis* in the Czech Republic (3 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

plantings at the local fairgrounds and remained there for more than 15 years. Recently, it was found at another site in southern Moravia, growing at the edge of a floodplain forest, and in Bohemia on the embankment of the Vltava river north of Prague. Both records probably represent garden escapes. *Carex muskingumensis* is classified as a casual neophyte (Pyšek et al. 2012).

Carex otrubae (Fig. 21)

Carex otrubae is a member of *C.* sect. *Vulpinae*, which in the Czech Republic includes also *C. vulpina*. It is a Eurasian species distributed in western, central and southern Europe, and in Scandinavia extending as far as central Norway. It also occurs in northern Africa, the Canary Islands, the Caucasus, western and central Asia, eastwards extending as far as the western Himalayas and north-western China (Egorova 1999, Koopman 2011). In the Czech Republic *C. otrubae* grows in meadows, at margins of reed beds and on banks of water reservoirs not shaded by trees. It prefers heavy and clayey, usually intermittently wet soils, often on Mesozoic or Tertiary sediments. Unlike *C. vulpina* it is usually absent from sites affected by regular flooding. It is occasionally found in semi-ruderal habitats, e.g. fallow land, ditches, edges of arable fields and meadows, along paths, in forest clearings and at places used for temporary storage of logs and building materials. It occurs in warm to moderately warm parts of this country, including lowlands in northern, central and eastern Bohemia, and southern, central and eastern Moravia, reaching its altitudinal maximum in the Bílé Karpaty Mts at about 700 m. The scattered occurrences elsewhere are either linked to exceptional edaphic conditions (e.g. the Soos National Nature Reserve near the town of Cheb in western Bohemia), or they may be due to introduction (e.g., vicinity of the town of Třeboň in southern Bohemia). It is classified as of lower risk – near threatened (Grulich 2012). *Carex otrubae* is confused not only with *C. vulpina*, but also with *C. spicata* and *C. otomana*. For this reason, only records based on revised herbarium specimens are included in the map.

Carex praecox (Fig. 22)

The Eurasian distribution of *C. praecox* spans from south-western Europe in the west to the Russian Far East and Korea in the east, including northern Turkey, Kazakhstan and north-western China (Meusel et al. 1965, Egorova 1999, Koopman 2011). In the Czech Republic *C. praecox* grows mainly in various types of dry, partly anthropogenic grasslands on floodplains of lowland rivers and in periodically flooded meadows. It is rarely found also at the edges of forests and in open-canopy thermophilous oak forests. In addition, it tends to colonize secondary habitats along roads and railways. It prefers dry, but also periodically flooded, permeable, mostly non-calcareous, but often mineral-rich soils. *Carex praecox* occurs mainly in warm areas with a subcontinental type of climate. Its distribution in this country consists of two separate patches: in Bohemia it grows in warm lowlands in its northern half; in Moravia it is continuously distributed in its southern and central parts. At high altitudes and in colder areas only isolated occurrences are recorded. In southern Bohemia *C. praecox* is mostly introduced since it is found only in secondary habitats, such as road verges and railway stations, and often only temporarily, but it may be native in the valley of the Vltava river. It reaches its altitudinal maximum at about 800 m on Mt Milešovka in the České Středohoří Mts.

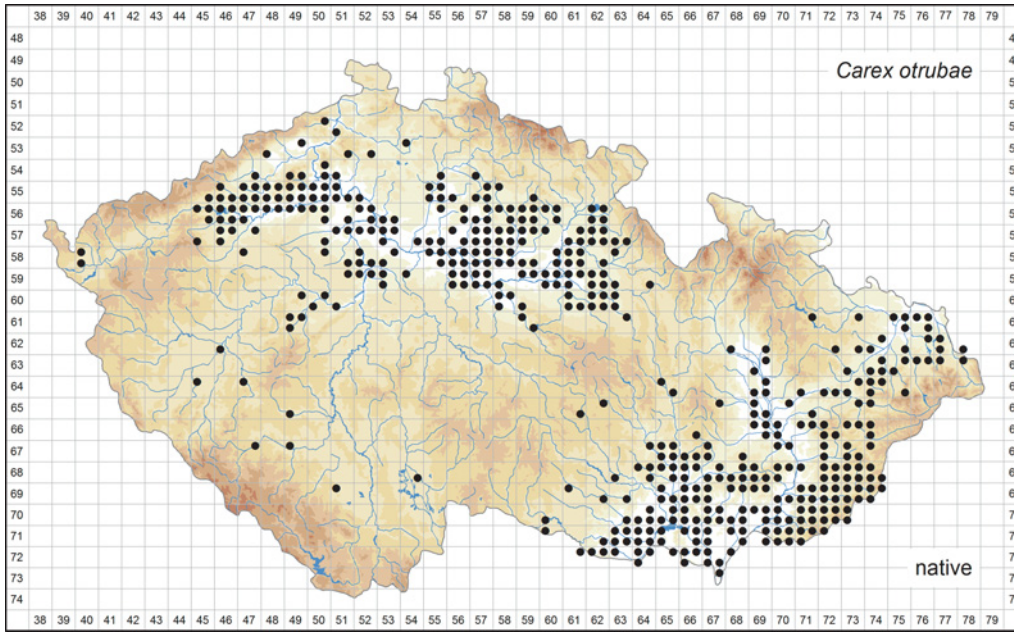

Fig. 21. – Distribution of *Carex otrubae* in the Czech Republic (462 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

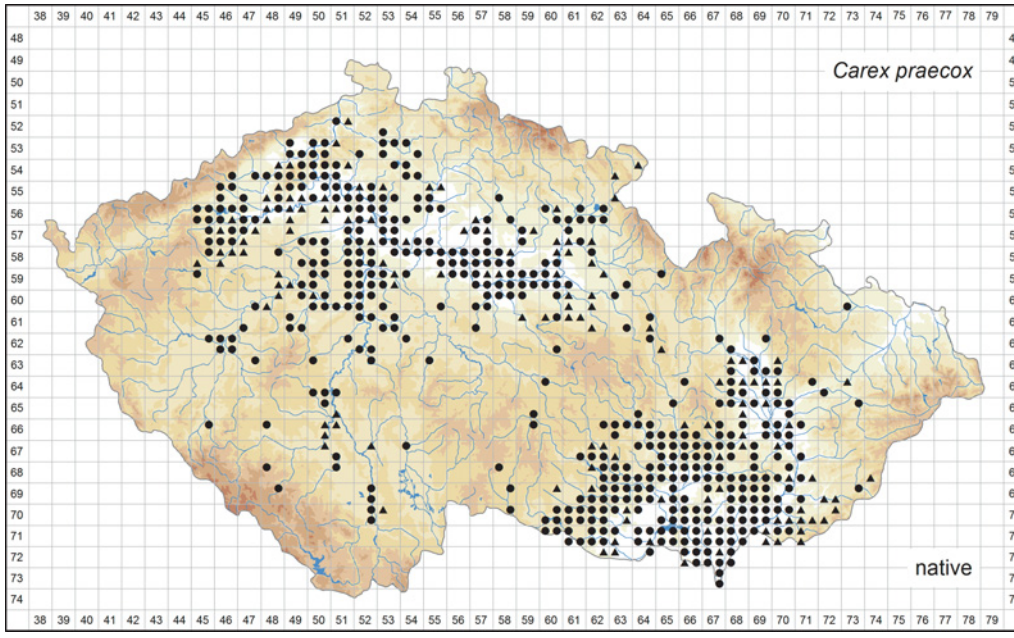

Fig. 22. – Distribution of *Carex praecox* in the Czech Republic: ● occurrence documented by herbarium specimens (446 quadrants), ▲ occurrence based on other records (137 quadrants). Prepared by Vít Grulich & Radomír Řepka.

Carex pseudobrizoides (Fig. 23)

Carex pseudobrizoides is a species with a small distribution ranging from central Spain through France, Belgium, the Netherlands and Germany to southwestern Poland and the Czech Republic, with the easternmost localities in Lithuania and the Kaliningrad Oblast of Russia. The localities in the Czech Republic are situated at the south-eastern limit of its distribution. It grows there at the fringes of dry pine and mixed open-canopy forests, grasslands and tall mesic scrub, mainly on mineral-poor, dry, permeable sandy soils. It is extremely rare in this country and was neglected for a long time. It was first discovered near the city of Pardubice in eastern Bohemia in the 1970s. Later it was found in the vicinity of the town of Rumburk in northern Bohemia, not far from its localities in Saxony. This species occurs at altitudes of 225 to 410 m. An additional herbarium specimen from the vicinity of the town of Týnec nad Sázavou in central Bohemia was recently found, dated 1887; however, this collection is mixed, containing *C. leporina* and *C. pseudobrizoides*, and the latter may have originated from a different site. *Carex pseudobrizoides* is classified as critically threatened due to its rarity (Grulich 2012).

Carex remota (Fig. 24)

Carex remota occurs in Europe and western Asia with isolated occurrences in northern Africa. It is common all over Europe, being rare only in the Mediterranean area, the Crimea and Scandinavia. Towards the east it reaches Anatolia, Syria and the Caucasus, extending as far as northern Iran and southern Turkmenistan (Meusel et al. 1965, Hultén 1986, Egorova 1999). In the Czech Republic *C. remota* most frequently occurs in floodplain forests along lowland rivers and alluvial ash-alder forests, often in forest springs and on humid forest tracks, rarely also in moist herb-rich beech forests. It prefers soils rich or moderately rich in mineral nutrients. *Carex remota* is distributed all over this country, only rare in dry and deforested areas, where it occurs only in floodplain forests, and in areas with very acidic soils poor in nutrients, e.g. western Bohemia. It is found from the lowlands to the mountains, reaching its altitudinal maximum on Mt Králický Sněžník at 1280 m.

Carex vulpina (Fig. 25)

Carex vulpina is the other European member of the *C.* sect. *Vulpinae*. It grows in most of Europe but is absent from Portugal, Ireland, Iceland and most of the Mediterranean area. Northernmost localities are situated in the southern part of Scandinavia and northern part of Russia. Towards the east it occurs in the Caucasus, in the southern parts of Siberia as far as Lake Baikal, in Central Asia and north-western China (Egorova 1999, Koopman 2011). In the Czech Republic *C. vulpina* grows in wet, often regularly flooded meadows, in tall-sedge beds, on banks of ponds and pools, usually in open places with a high groundwater level and neutral or slightly acidic soils. At high altitudes, however, it is found along small streams in floodplain and alder forests. It is distributed throughout this country, with most records concentrated in warm and moderately warm areas. It is particularly common in the floodplains of large lowland rivers, such as the Labe, Dyje and Morava rivers. It is scattered in the Českomoravská vrchovina, Drahanská vrchovina and

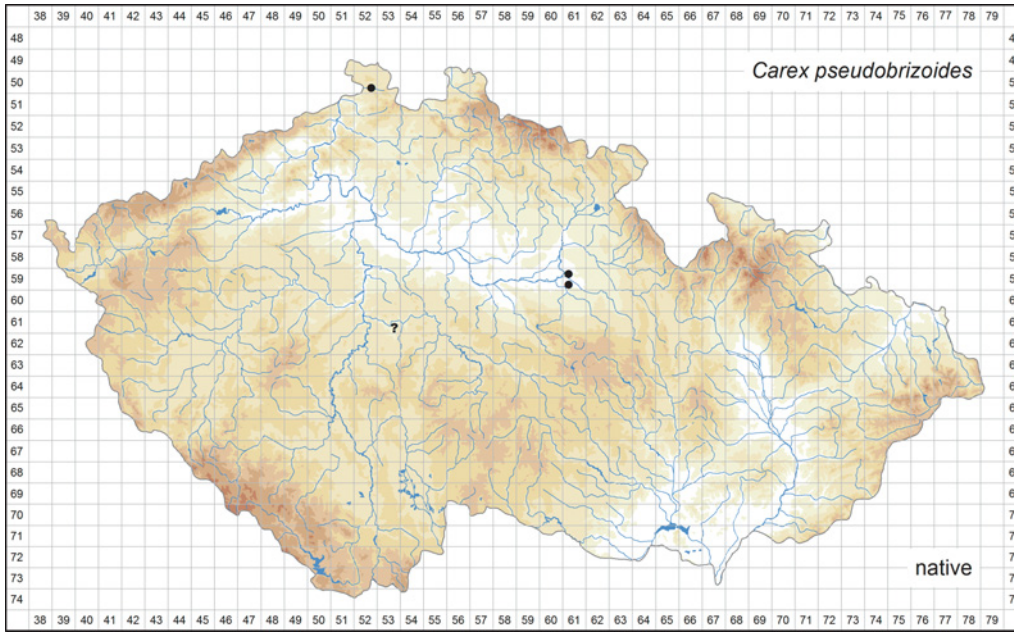

Fig. 23. – Distribution of *Carex pseudobrizoides* in the Czech Republic (3 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

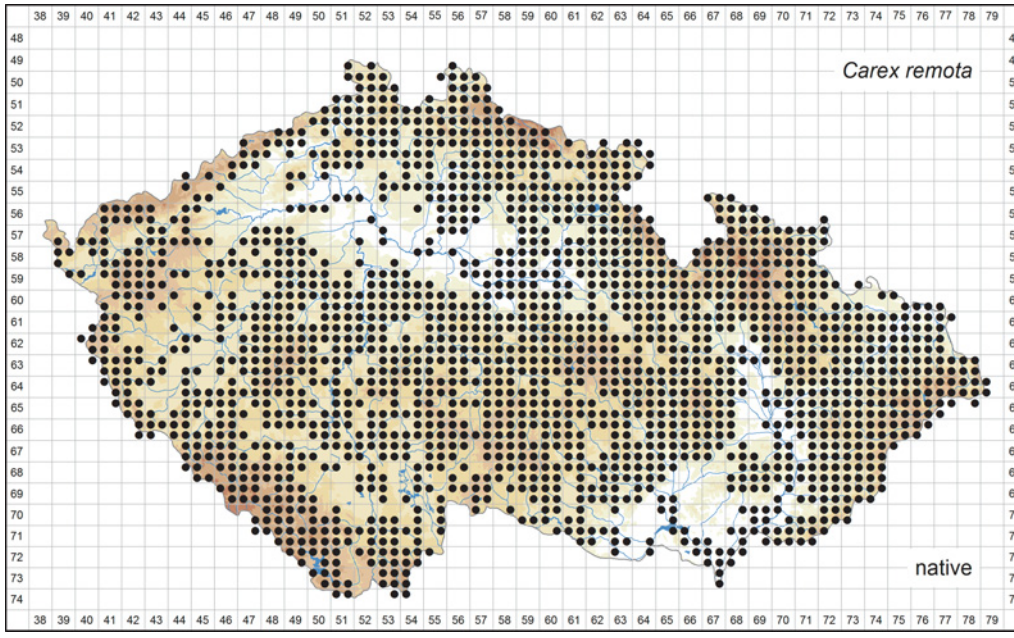

Fig. 24. – Distribution of *Carex remota* in the Czech Republic (1816 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

Nízký Jeseník hills, and in the Carpathian part of Moravia east of the Morava river. In contrast, it is absent from or very rare in the mountain ranges along the country's border; if present there, then it is very rare and confined to their lower parts. *Carex vulpina* can be confused with the similar species *C. otrubae*. These sedges were not distinguished until the mid-1960s (Holub 1964) and are still sometimes misidentified. Thus, in the areas where both species co-occur (mainly in northern, central and eastern Bohemia, and eastern Moravia), undocumented records of either species may be erroneous.

Centaurea jacea agg.
Centaurea jacea (Fig. 26), *C. jacea* subsp. *angustifolia* (Fig. 27), *C. jacea* subsp. *jacea* (Fig. 28), *C. oxylepis* (Fig. 29), *C. weldeniana* (Fig. 30) and *C.* ×*fleischeri*

The *C. jacea* group includes about 10 taxa, which occur mainly in southern Europe (Dostál 1976). In the taxonomic concept adopted here they are treated as separate species, although they are sometimes reduced to subspecies of the broadly defined *C. jacea* (e.g. Greuter 2006). The taxonomy of this complex in southern and eastern Europe remains unresolved. Most of the taxa have relatively small and non-overlapping distributions, except for *C. jacea* (Meusel & Jäger 1992). In the Czech Republic two native and one introduced species are known.

Centaurea jacea occurs throughout continental Europe from northern Spain and Italy to Scandinavia, eastwards it reaches as far as the east of European Russia but there is no native occurrence in Asia (Meusel & Jäger 1992); however, the eastern and south-eastern limits of its distribution are uncertain. This species has been introduced into the British Isles and North and South America, Greenland and temperate Asia (the Altai Mts and Japan). It grows mainly in various types of mesophilous or moderately dry and moderately wet meadows, forest fringes and clearings, road verges and lawns in towns. In the Czech Republic *C. jacea* is widespread except at altitudes above ca 1000 m and in most of northern Moravia and Silesia where morphologically pure populations of *C. jacea* are very rare as they are soon affected by hybridization with *C. erdneri*, *C. oxylepis* and *C. erdneri* × *C. oxylepis*. Consequently, most of the records of *C. jacea* there are either recent introductions or extremes of variation of hybrid swarms, which could not be distinguished based on the available specimens.

Two subspecies are recognized within *C. jacea* in central Europe: *C. jacea* subsp. *jacea* occurs throughout the range of this species whereas *C. jacea* subsp. *angustifolia* is confined to central and southern Europe (Meusel & Jäger 1992). In the Czech Republic the former is widespread both in warm and rather cold areas whereas the latter occurs mainly in warm parts of this country in southern Moravia and in north-western and central Bohemia. In the areas of co-occurrence and at the limits of distribution of the subsp. *angustifolia* towards colder areas, populations intermediate between the two subspecies can be found. Moreover, due to enormous phenotypic plasticity only undamaged plants from typical habitats can be determined to the subspecies level, while plants from shady, extremely dry or humid places and specimens re-grown after some damage (e.g. due to mowing of a meadow) can often be determined only to the species level. For these reasons and taking into consideration the generally high level of misidentifications in *Centaurea*, only revised herbarium specimens or our own field data are included in the distribution maps of the subspecies, which are thus inevitably incomplete. The species' distribution map (Fig. 26) includes also intermediate populations and plants indeterminable to the

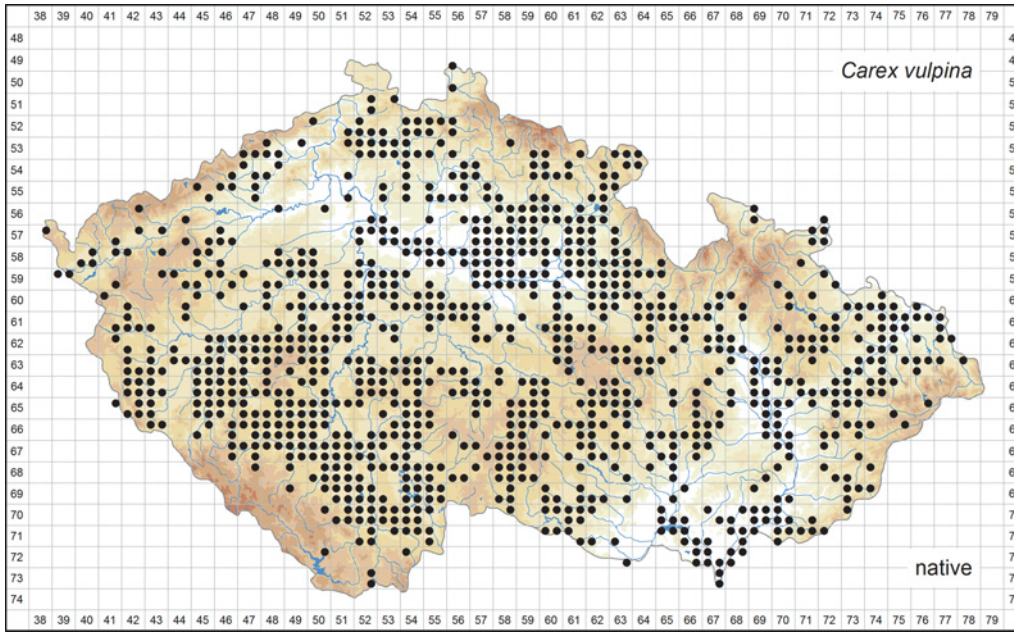

Fig. 25. – Distribution of *Carex vulpina* in the Czech Republic (1011 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

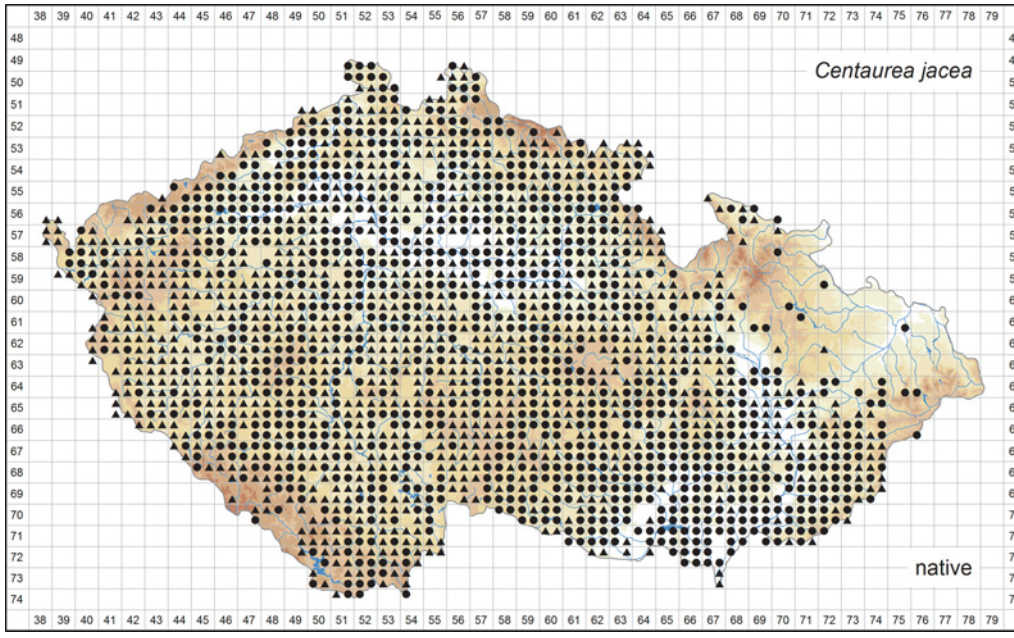

Fig. 26. – Distribution of *Centaurea jacea* in the Czech Republic: ● occurrence documented by herbarium specimens (1034 quadrants), ▲ occurrence based on other records (962 quadrants). Prepared by Petr Koutecký.

subspecies level. The literature and database records that conform to this species' ecological demands are also included.

Centaurea jacea forms hybrids with all the other taxa of *C.* sect. *Jacea* present in the Czech Republic (all *Centaurea* species included in this article). Rarely does it hybridize with other less related *Centaurea* species, e.g. *C. stoebe*. *Centaurea jacea* (both subspecies) is tetraploid; diploid counts from other parts of Europe probably refer to other taxa (Koutecký 2012). Since the difference in the ploidy levels is the main breeding barrier in *Centaurea* (Koutecký et al. 2011), only hybrids with other tetraploids (*C. erdneri*, *C. nigra* agg., *C. nigrescens*, *C. oxylepis* and *C. transalpina*) are frequent and may form extensive hybrid swarms while hybrids with diploids occur rarely in mixed populations. The hybrids are commented on under the respective second parental taxa.

Centaurea weldeniana is a diploid member of the *C. jacea* agg., which has a small distribution along the north-eastern coast of the Adriatic Sea extending from eastern Italy to northern Greece (Meusel & Jäger 1992). It has been only rarely introduced into central Europe: in Austria a single naturalized population is known (Koutecký 2012) and in the Czech Republic it was only recently recognized. A single herbarium gathering collected in 1946 from the Český kras area in central Bohemia exists and this species should be classified as a casual neophyte.

Centaurea oxylepis has a small distribution in central Europe, which includes the Czech Republic, southern Poland, western and southern Slovakia and northernmost Hungary (Meusel & Jäger 1992, Koutecký 2007). It is morphologically intermediate between *C. jacea* and *C. phrygia* agg. but owing to its similarity with *C. jacea* in vegetative and seed characters, frequent hybridization, and a long-standing taxonomic tradition, it is assigned to the *C. jacea* agg. for practical reasons. It occurs mainly in mesophilous or moderately dry meadows, forest fringes and clearings and road verges. In the Czech Republic it is frequent in eastern Bohemia, Silesia, north-western and central Moravia and in the northern part of the Bílé Karpaty Mts. Scattered occurrence is recorded in the eastern half of the Českomoravská vrchovina highlands, parts of central and southern Bohemia (there often on limestone) and northern and north-western Bohemia; isolated localities might be recent introductions. In north-eastern Moravia and Silesia, there are mainly hybrids with *C. erdneri* (see below). This species is classified as of lower risk – near threatened (Grulich 2012).

Centaurea oxylepis is tetraploid (Koutecký 2007) and forms hybrids with other tetraploid taxa of *C.* sect. *Jacea*. The hybrid with *C. jacea* (*C.* ×*fleischeri*) is present at most *C. oxylepis* localities; in old literature, it was often erroneously named *C. subjacea* (Koutecký 2009). The hybrid is fertile and forms large hybrid swarms. In northern Bohemia and some parts of Moravia south-west of the main *C. oxylepis* distribution, *C.* ×*fleischeri* populations prevail over pure *C. oxylepis* populations or only hybrids occur there; these areas can be considered as a zone of introgression towards *C. jacea*. Hence, occurrence of *C.* ×*fleischeri* in those quadrants, where pure *C. oxylepis* is not documented, is included in the map of the latter; all records of the hybrid are based solely on revised herbarium specimens or our own field records. Similarly, in most of northern Moravia and Silesia, hybrids *C. erdneri* × *C. oxylepis* are most frequent (see below under *C. phrygia* agg.) and typical populations of *C. oxylepis* are very rare there and confined mainly to low altitudes along the Czech-Polish border and in the area between the Nízký Jeseník hills and Moravskoslezské Beskydy Mts. Some records of *C. oxylepis* might also be extremes of

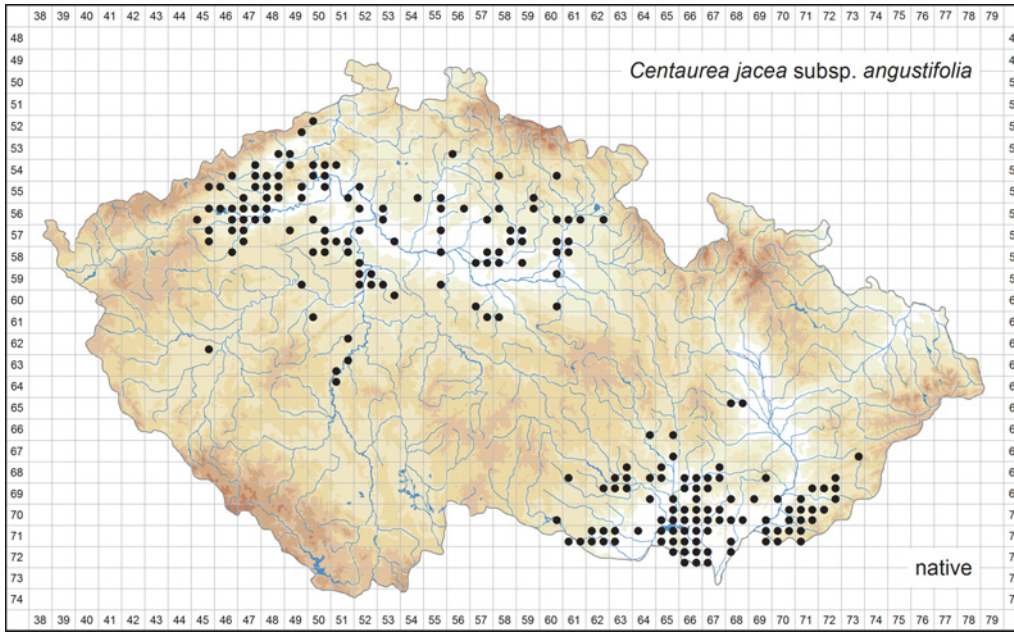

Fig. 27. – Distribution of *Centaurea jacea* subsp. *angustifolia* in the Czech Republic (203 occupied quadrants). Prepared by Petr Koutecký.

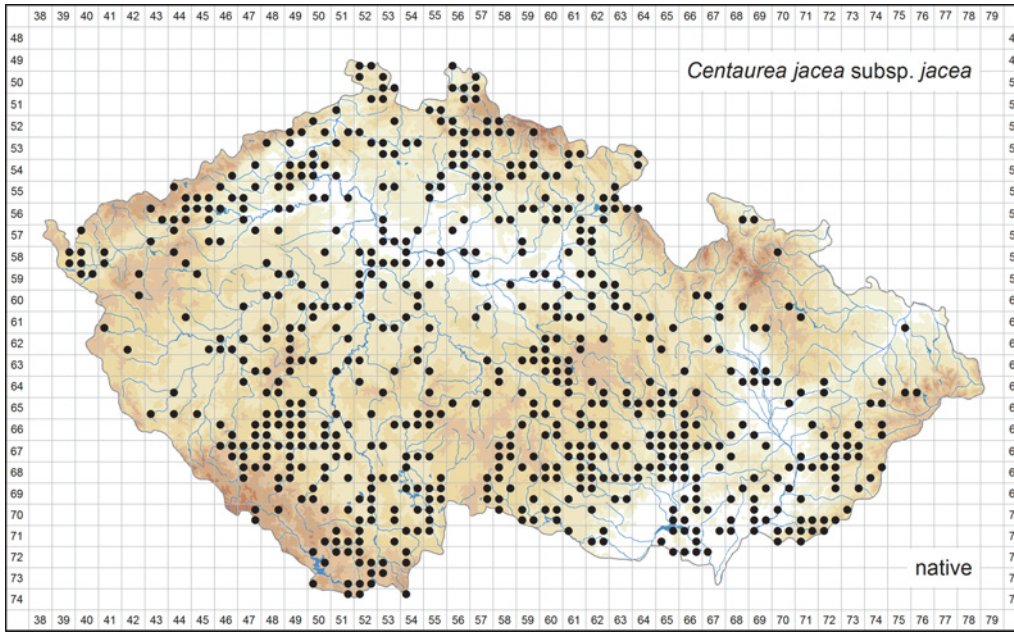

Fig. 28. – Distribution of *Centaurea jacea* subsp. *jacea* in the Czech Republic (646 occupied quadrants). Prepared by Petr Koutecký.

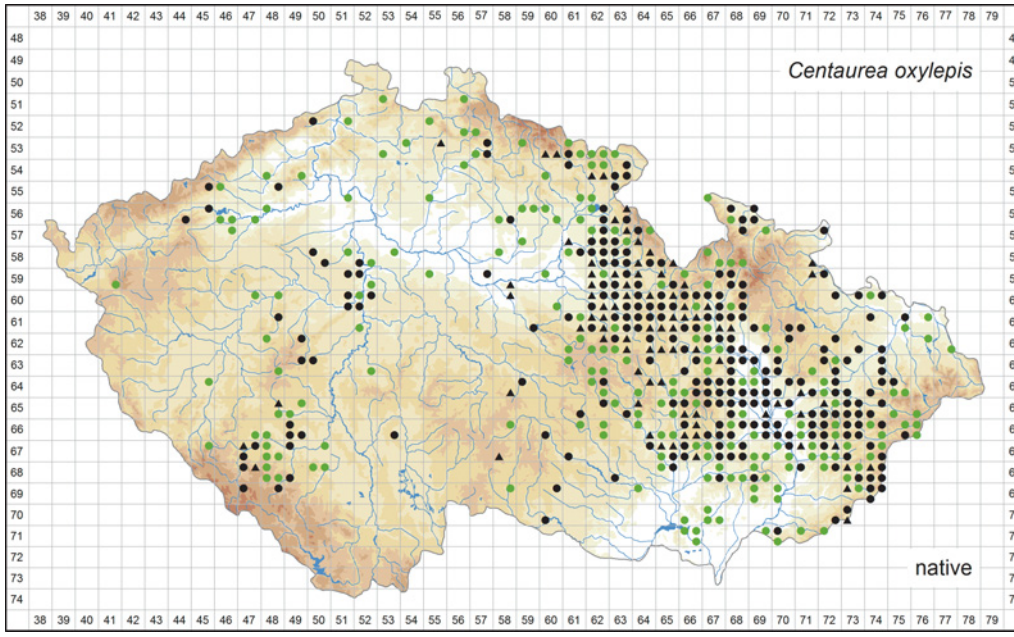

Fig. 29. – Distribution of *Centaurea oxylepis* in the Czech Republic: ● occurrence documented by herbarium specimens (246 quadrants), ▲ occurrence based on other records (82 quadrants), ● only the hybrid with *C. jacea* (*C.* ×*fleischeri*) documented (201 quadrants). Prepared by Petr Koutecký.

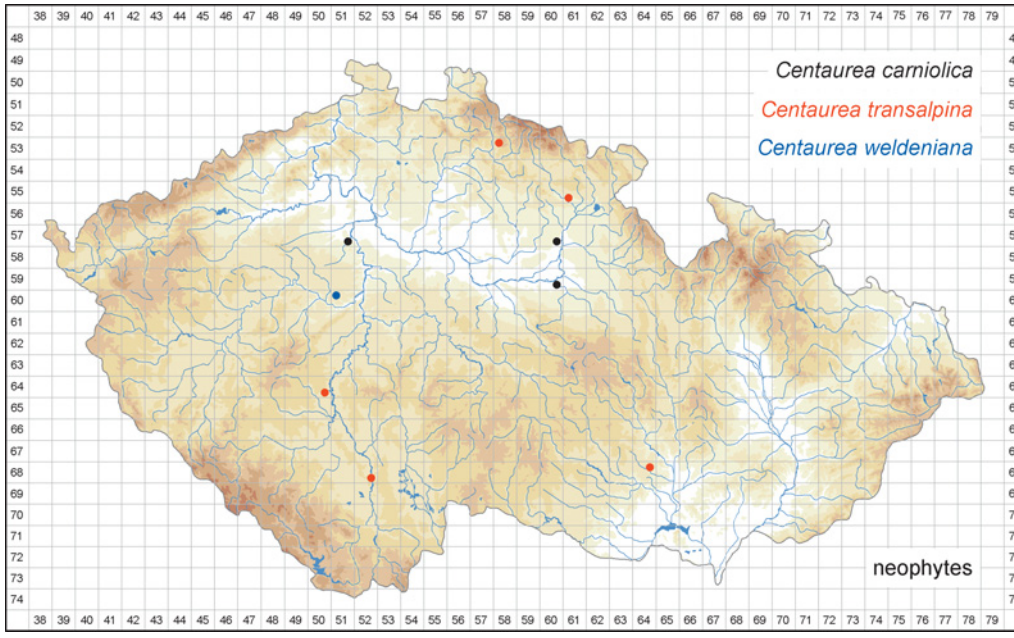

Fig. 30. – Distribution of *Centaurea carniolica* (3 occupied quadrants), *C. transalpina* (5 occupied quadrants) and *C. weldeniana* (1 occupied quadrant) in the Czech Republic. Prepared by Petr Koutecký.

variation of the hybrid. Finally, in central Moravia in the surroundings of the towns of Prostějov and Kroměříž, atypical *C. oxylepis* populations seemingly transitional to *C. nigrescens* (neophyte in the Czech Republic) occur; status of these plants is not clear and they need further study. The hybrid *C. nigrescens* × *C. oxylepis* (*C.* ×*javorkae*) is, however, documented in several mixed populations of both species.

Centaurea nigra agg. (Fig. 31)

Of the 10 taxa that are recognized within the *C. nigra* group only two, *C. nigra* and *C. nemoralis*, are distributed throughout western and central Europe while the others are confined to the Iberian Peninsula and southern France and one unclear taxon is described from Bosnia and Herzegovina (Dostál 1976, Meusel & Jäger 1992). The distribution of the two widespread species is similar: they are native from northern Spain to the British Isles and southern Scandinavia, towards the east reaching Italy, Switzerland and south-western Germany; the localities in northern and eastern Germany are considered to be secondary. Morphological separation of *C. nigra* and *C. nemoralis* is not particularly clear (the latter is often classified as a subspecies of the former). In central Europe, populations morphologically corresponding to both taxa can be found but some populations have various combinations of their characters and cannot be identified unambiguously. A similar situation is also sometimes reported from western Europe where the distributions of both species largely overlap (e.g. Marsden-Jones & Turrill 1954, Meusel & Jäger 1992: 299). Moreover, hybridization with *C. jacea* increases the variation in *C. nigra* agg. populations. The entire *C. nigra* agg. requires taxonomic revision. For these reasons, only a map of *C. nigra* agg. was prepared, in which the individual taxa are not distinguished; it is based only on revised herbarium specimens. Most finds in the Czech Republic are along railways and road verges; several occurrences in chateau parks are also documented, probably due to accidental introduction with grass seed from western Europe. Occasionally it is found in semi-natural vegetation such as mesophilous meadows. This species is most frequent in northern and north-western Bohemia, which is in accordance with the expected direction of introduction, and it is classified as a naturalized neophyte (Pyšek et al. 2012).

The hybrids *C. jacea* × *C. nigra* agg. (*C.* ×*gerstlaueri*) are found in many populations of the *C. nigra* agg. At some localities only hybrids were documented. Hybrids between the tetraploid *C. nigra* agg. and *C. jacea* are fertile and may occur and persist independently of their parents (Marsden-Jones & Turrill 1954). Records of this hybrid are included in the map of *C. nigra* agg. in quadrants where pure *C. nigra* agg. has not been documented; all records are based solely on revised herbarium specimens.

Centaurea nigrescens agg.
Centaurea carniolica (Fig. 30), *C. nigrescens* (Fig. 32), *C. transalpina* (Fig. 30), *C.* ×*extranea* and *C.* ×*javorkae*

This group includes about seven taxa that are regarded as species or subspecies of the broadly circumscribed *C. nigrescens*, which occurs mainly in the southern Alps, Italy and on the Balkan Peninsula (Dostál 1976, Meusel & Jäger 1992). *Centaurea nigrescens* s. l. occurs also in Romania but most of the records from there (as mapped e.g. by Meusel & Jäger 1992) are probably based on misidentified polymorphic hybrids *C. phrygia* agg. ×

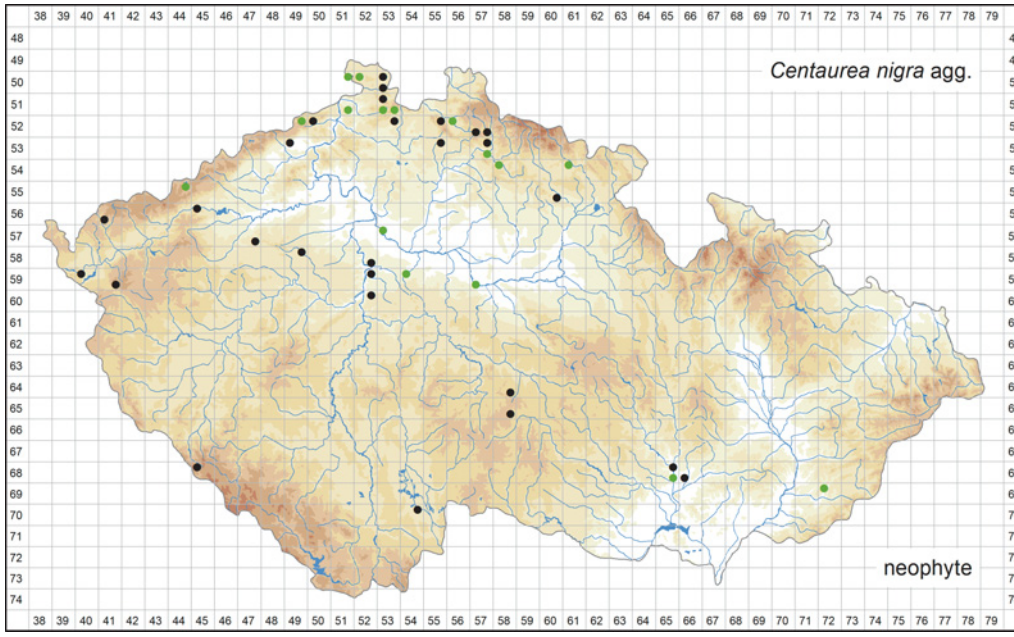

Fig. 31. – Distribution of *Centaurea nigra* agg. in the Czech Republic: ● (27 occupied quadrants), ● only the hybrid with *C. jacea* (*C.* ×*gerstlaueri*) documented (16 quadrants). Prepared by Petr Koutecký.

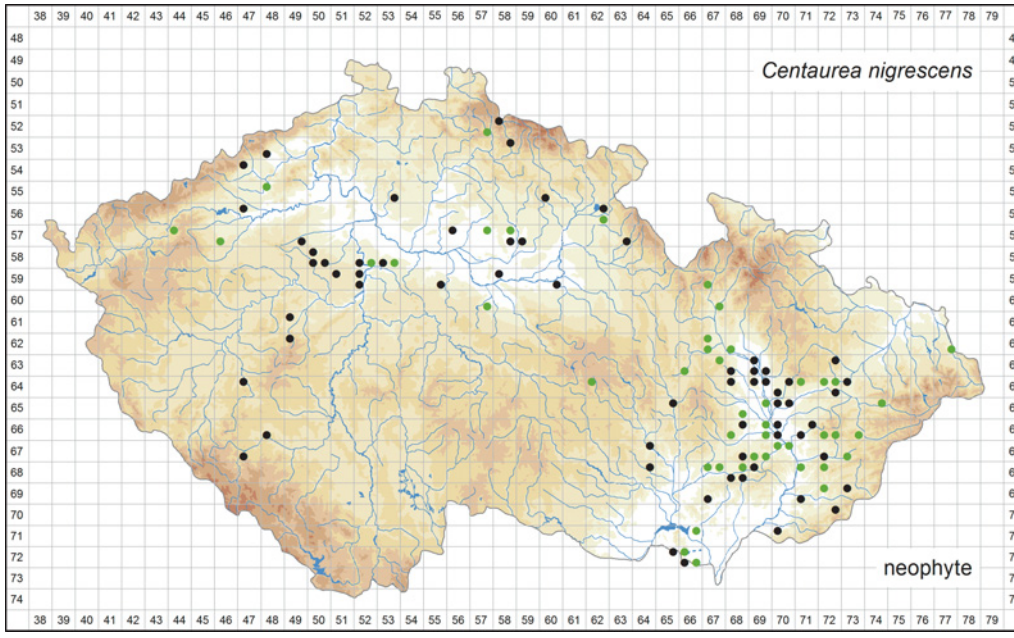

Fig. 32. – Distribution of *Centaurea nigrescens* in the Czech Republic: ● (63 occupied quadrants), ● only the hybrid with *C. jacea* (*C.* ×*extranea*) and/or *C. oxylepis* (*C.* ×*javorkae*) documented (45 quadrants). Prepared by Petr Koutecký.

C. jacea agg., which might resemble *C. nigrescens*. The whole group requires a thorough taxonomic revision. Three taxa reach central Europe: they are native to Austria and perhaps Hungary and are classified as casual neophytes in more northern countries, including the Czech Republic (Pyšek et al. 2012).

Centaurea carniolica is a diploid member of this group. It has a small distribution in Slovenia, eastern Italy, south-eastern Austria and south-western Hungary. As a casual neophyte it is known from the Czech Republic and Germany. In the Czech Republic it is only known from three early herbarium specimens collected between 1820s and 1914; however, new introductions are likely.

Centaurea nigrescens s. str. is native in the eastern outskirts of the Alps, on the Balkan Peninsula and perhaps in Romania; it has been introduced into the Czech Republic, Slovakia and Germany. In the Czech Republic it was recorded already in the 19th century. Most of the finds were reported from southern and central Moravia, which corresponds well with the expected direction of introduction. However, it also occurs scattered in Bohemia. Most of the records come from warm and moderately warm parts of the country, mainly from road verges or sites along railways but sometimes this species can also be found in various types of mesophilous meadows in contact with human settlements or traffic infrastructure. The distribution map is based solely on revised herbarium specimens.

Centaurea nigrescens is tetraploid and hybridizes with other tetraploid *Centaurea* taxa. Hybrids with *C. jacea* (*C.* ×*extranea*) are regularly found in *C. nigrescens* populations. At many localities only *C.* ×*extranea* is documented; these records are also included in the map of *C. nigrescens*. The hybrid is fertile and can occur independently of one or both parents. The hybrid *C.* ×*javorkae* (*C. nigrescens* × *C. oxylepis*; see also the comment under second parent) is also recorded and even a triple hybrid *C. jacea* × *C. nigrescens* × *C. oxylepis* is known from the Czech Republic.

Centaurea transalpina is native to mesophilous meadows and pastures in southern parts of the Alps from France to Austria; as a casual neophyte it is known from the Czech Republic, Germany and Poland. In the Czech Republic five localities are documented by herbarium vouchers, originating from the beginning of the 20th century to the very recent. Hybrids with *C. jacea* were found north of the city of České Budějovice in southern Bohemia; both species are tetraploid and their hybridization may be expected in any *C. transalpina* population.

Centaurea phrygia agg.
Centaurea erdneri (Fig. 33), *C. phrygia* (Fig. 34), *C. pseudophrygia* (Fig. 35), *C. stenolepis* (Fig. 36), *C. erdneri* × *C. oxylepis* (Fig. 37), *C. pseudophrygia* × *C. stenolepis* (Fig. 38), *C.* ×*melanocalathia* and *C. erdneri* × *C. jacea* × *C. oxylepis*

Centaurea phrygia agg. includes about 10 central- and eastern-European taxa and about three taxa native to the Caucasus Mts (Dostál 1976, Meusel & Jäger 1992); they are often treated as subspecies of *C. phrygia* in the broad sense but are considered as species in the concept adopted here. Most of the European taxa have medium to small distributions in the Carpathians and south-eastern Europe while only three are more widespread. However, the group outside central Europe requires a taxonomic revision. In the Czech Republic four species are currently recognized. Moreover, extensive hybrid zones may

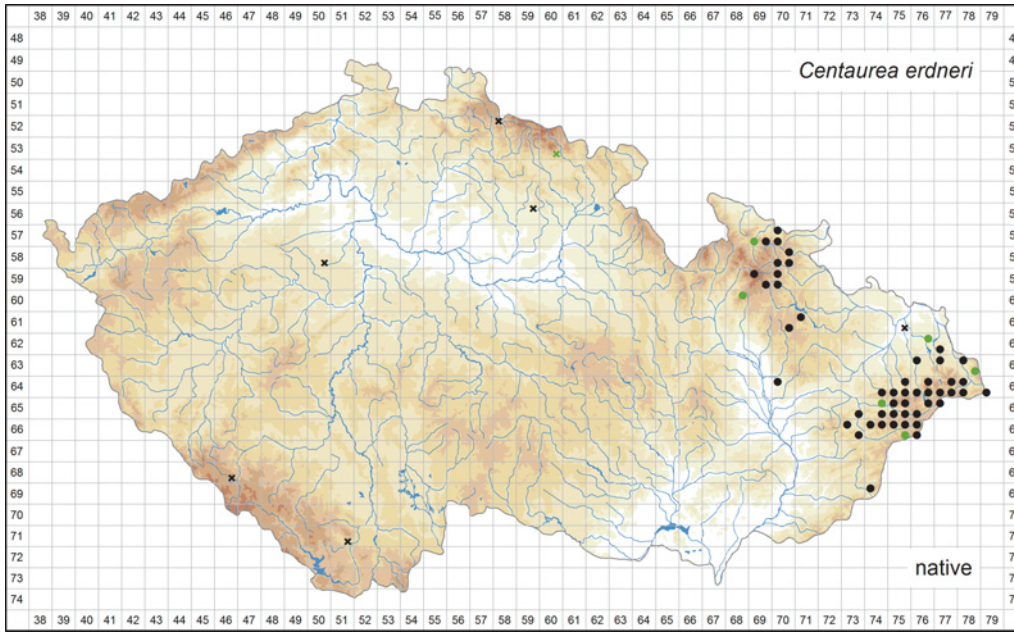

Fig. 33. – Distribution of *Centaurea erdneri* in the Czech Republic: ● native (48 quadrants), × alien (6 quadrants), ● / × only the hybrid with *C. jacea* (*C.* ×*melanocalathia*) documented, native (6 quadrants) or alien (1 quadrant). Prepared by Petr Koutecký.

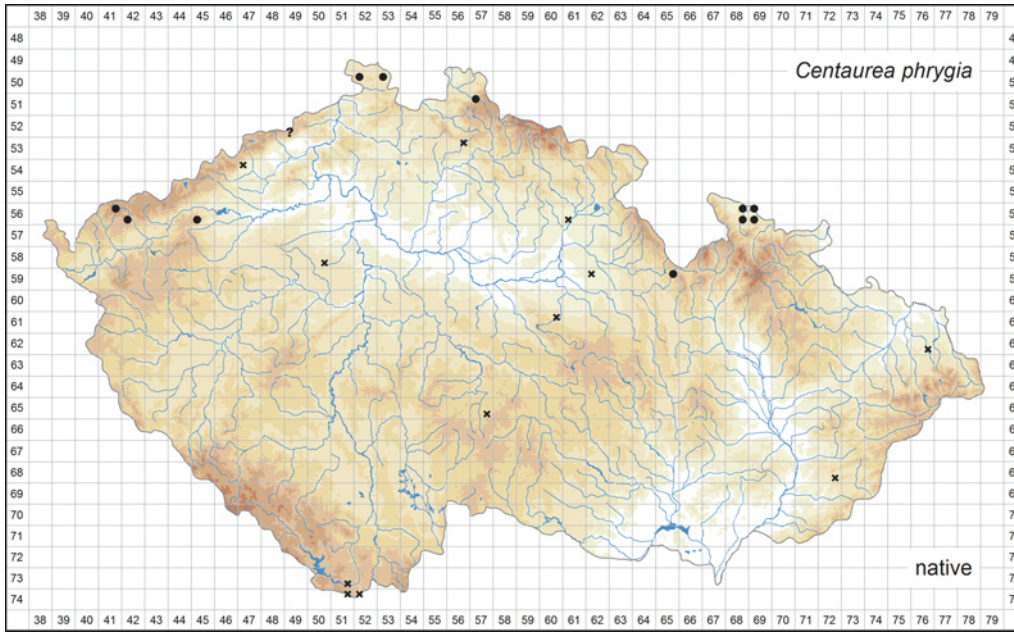

Fig. 34. – Distribution of *Centaurea phrygia* in the Czech Republic: ● native (11 quadrants), × alien (12 quadrants). Prepared by Petr Koutecký.

occur where the species' ranges come into contact and all populations are more or less affected by hybridization; introgression of certain taxa may be detectable also far outside these zones. In the Czech Republic two large hybrid zones (of two different hybrids) are present and these are mapped separately (Figs 37 and 38).

Centaurea erdneri has been recently recognized as a widespread species of mesophilous submontane and montane meadows in the Western Carpathians (Koutecký et al. 2012); it occurs also in Romania, especially in the Apuşeni Mts (Koutecký, unpublished). It is the only tetraploid central-European taxon in this group. In the Czech Republic it is frequent in the Moravskoslezské Beskydy Mts, Javorníky Mts (both being parts of the Western Carpathians) and Hrubý Jeseník Mts. It rarely also occurs in some of the adjacent lower mountains, such as the Hostýnské vrchy hills and Nízký Jeseník hills. Individual records come from low altitudes in northern Moravia; however, these might also be extremes of variation of the hybrid *C. erdneri* × *C. oxylepis*, which is widespread there, or might originate from recent introductions. All occurrences in other parts of this country are undoubtedly introductions; some are in ruderal stands (road verges, railways) while others are in semi-natural vegetation such as meadows, as is occasionally the case also for other species of *Centaurea*. Due to its limited distribution in the Czech Republic it is classified as vulnerable (Grulich 2012). Since this species was only recognized recently, the map is based solely on revised herbarium specimens and our own field records.

Hybrids with the tetraploid *C. jacea* (*C.* ×*melanocalathia*) are occasionally found in populations of *C. erdneri* but are rather rare due to the different ecological demands of the parental species (*C. jacea* being rare in montane areas). The hybrid is fertile and can occur independently of one or both parents; it is included in the map of *C. erdneri* in quadrants where pure *C. erdneri* has not been documented. In the whole of northern Moravia, easternmost Bohemia and the Žďárské vrchy hills there is a hybrid zone where populations of *C. erdneri* × *C. oxylepis* are most frequent and pure populations of parental taxa are rare or absent. Individual specimens of this hybrid are sometimes found also in otherwise more or less typical populations of *C. oxylepis* in central Moravia and eastern and northern Bohemia. Occurrences of the hybrid in central and western Bohemia are due to introductions. This hybrid is tetraploid and fully fertile and can occasionally cross with *C. jacea* forming a triple hybrid, which is also fertile and may occur in the absence of the parental species. The map is solely based on revised herbarium specimens and our own field records; the occurrence of the triple hybrid is included in quadrants where *C. erdneri* × *C. oxylepis* is not documented.

Centaurea phrygia s. str. is a continental species that occurs mainly in flat or slightly hilly landscapes from European Russia (a few localities also eastwards of the Ural Mts in Asia) and southern Scandinavia to Poland, with the south-western limit of its distribution situated in easternmost Germany and along the Czech-German and Czech-Polish borders (Meusel & Jäger 1992). This species is not present in most of the Western Carpathians except for a few occurrences in continental intra-montane basins in Slovakia, but is rather widespread in the Eastern Carpathians from Slovakia to Romania, where it reaches the southern limits of its distribution (Koutecký et al. 2012). It grows mainly in mesophilous meadows and forest fringes and rarely also in road verges, lawns in towns and similar habitats. In the Czech Republic it is probably native at only a few sites along the northern border. The status of localities in the Krušné hory Mts and one locality in the Doupovské

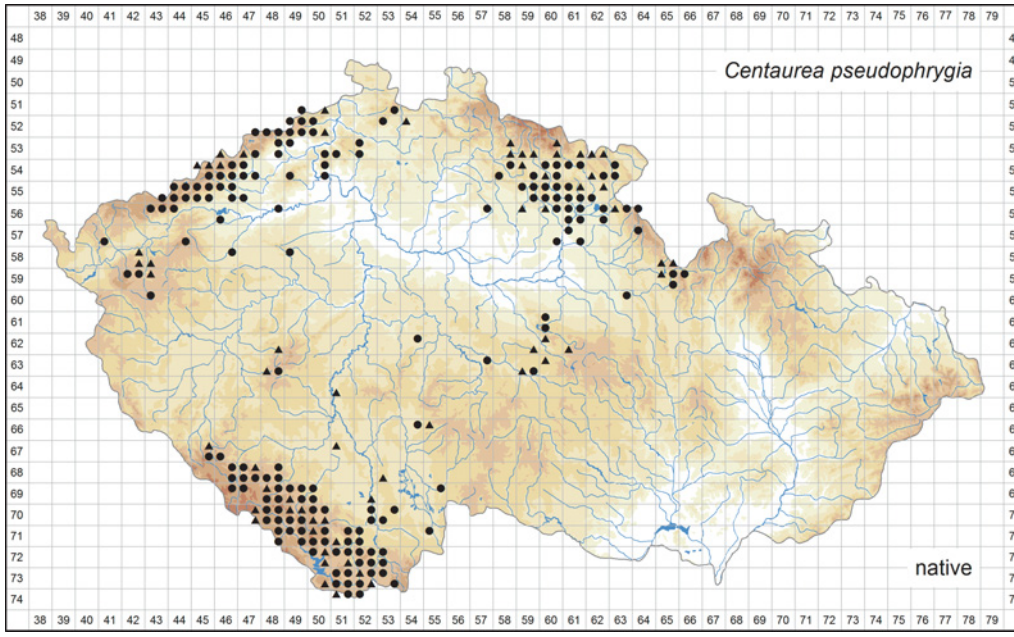

Fig. 35. – Distribution of *Centaurea pseudophrygia* in the Czech Republic: ● occurrence documented by herbarium specimens (167 quadrants), ▲ occurrence based on other records (63 quadrants). Prepared by Petr Koutecký.

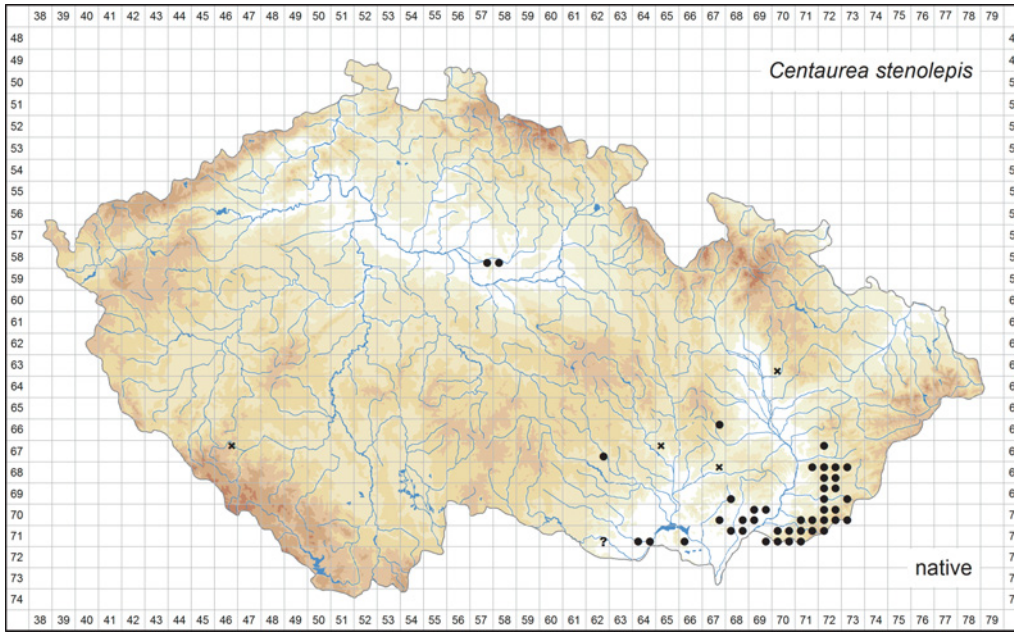

Fig. 36. – Distribution of *Centaurea stenolepis* in the Czech Republic: ● native (42 quadrants), × alien (4 quadrants). Prepared by Petr Koutecký.

hory Mts is uncertain as they are rather isolated and there are no records of this species on the German side of the mountains. However, this species occurs there in semi-natural vegetation and its native status cannot be excluded. All other occurrences are most probably due to introductions. Because of their rarity, the native populations of *C. phrygia* are classified as endangered (Grulich 2012). Since this species is not correctly recognized in the Czech botanical literature and has often been misidentified, the map is based solely on revised herbarium specimens. *Centaurea phrygia* is diploid and crosses, therefore, only rarely with the widespread tetraploid *C. jacea*. No other hybrids are known in the Czech Republic.

Centaurea pseudophrygia occurs mainly in the Alps, extending northwards on the Bohemian Massif and Germany to Denmark and southern Norway and in the south-east it reaches the northern part of the Dinarids (Meusel & Jäger 1992). This species is often reported from the Carpathians but all records are either erroneous (confusion with *C. erdneri*; Koutecký et al. 2012) or require taxonomic revision and probably belong to other taxa (in Romania; Koutecký, unpublished). This species is also mapped as occurring in eastern Ukraine and the south of European Russia (Meusel & Jäger 1992); however, the habitat affinity of these populations differs from that of the central-European populations and minor differences in morphology are also reported (e.g. Dostál 1976), which indicates that they are probably a different taxon. *Centaurea pseudophrygia* is a species of submontane to montane areas and moderately wet or mesophilous meadows, pastures, forest fringes and road verges. In the Czech Republic it mainly occurs in three rather separate areas: the Šumava Mts and their foothills; the Slavkovský les hills and the Krušné hory Mts and their foothills; foothills of the Krkonoše Mts and in the Orlické hory Mts and their foothills. This species occurs scattered in the northern part of the České středohoří Mts and the neighbouring Lužické hory Mts, in the Železné hory Mts and the Brdy Mts (in the latter only in the past but probably native). Along rivers, especially the Labe and Vltava rivers, it occurs at low altitudes. There are several isolated localities between these main distributions; some of them are most probably native while some may be due to introductions but it is often not possible to assess their status. This species is classified as of lower risk – near threatened (Grulich 2012). The map is based on revised herbarium specimens, our own field records and a limited number of literature and database records that conform to this species' ecological demands and are for areas neighbouring on those documented in herbaria. As a diploid, *C. pseudophrygia* crosses only rarely with the widespread tetraploid *C. jacea* (Koutecký et al. 2011). A hybrid zone with diploid *C. stenolepis* exists in the contact areas between both species (see below).

Centaurea stenolepis is a thermophilous member of the *C. phrygia* group. It is widespread on the Balkan Peninsula. It extends northwards to low altitudes in the Carpathians and along margins of the Pannonian basin in Austria, the Czech Republic, Slovakia, Ukraine and Romania; rarely does it reach Italy and southern Germany (Meusel & Jäger 1992) and scattered localities are known east and north of the Carpathians in Moldova and Ukraine. In the Czech Republic this species is frequent in semi-dry meadows in the Bílé Karpaty Mts and scattered in the neighbouring Zlínské vrchy hills; an isolated and possible native locality in the Drahanská vrchovina hills is probably also for this type of vegetation. The other native occurrences in southern Moravia and central Bohemia are in thermophilous oak forests (canopy gaps, margins, abandoned roads). At some localities this species is undoubtedly introduced: western Bohemia, northern Moravia, but also at

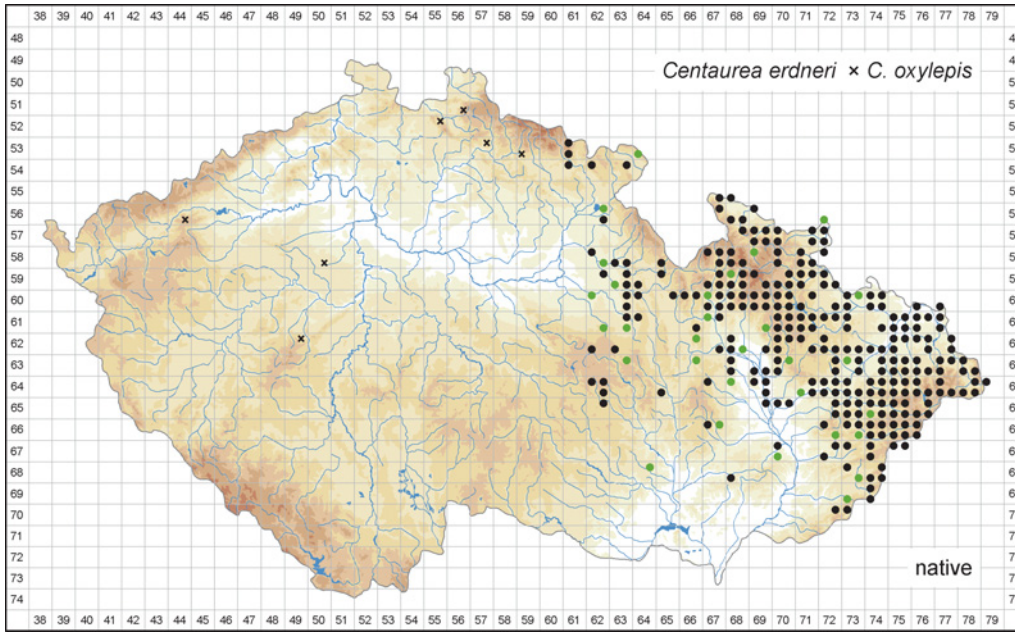

Fig. 37. – Distribution of *Centaurea erdneri* × *C. oxylepis* in the Czech Republic: ● native (256 quadrants), × alien (7 quadrants), ● only the triple hybrid *C. erdneri* × *C. jacea* × *C. oxylepis* documented (30 quadrants). Prepared by Petr Koutecký.

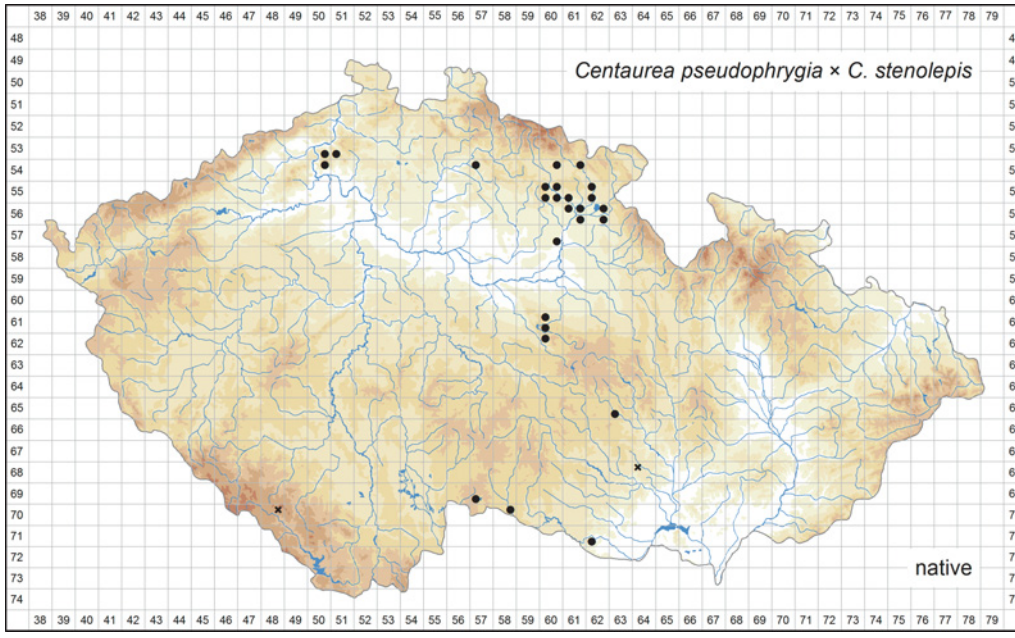

Fig. 38. – Distribution of *Centaurea pseudophrygia* × *C. stenolepis* in the Czech Republic: ● native (26 quadrants), × alien (2 quadrants). Prepared by Petr Koutecký.

some places in southern Moravia (the records from road verges). This species is classified as endangered (Grulich 2012). The map is based on revised herbarium specimens, our own field records and a limited number of literature and database records that conform to this species' ecological demands and come from areas adjacent to those documented in herbaria. *Centaurea stenolepis* is diploid and therefore its hybrids with the widespread tetraploid *C. jacea* are very rare.

A hybrid zone exists where the distributions of *C. pseudophrygia* and *C. stenolepis* come into contact and where all the populations are morphologically intermediate (Koutecký 2007); a similar situation is known also from Austria and western Hungary along the border between the Alps and the Pannonian basin. Both parental species are diploid (Koutecký 2007), and the hybrid is therefore fertile and may occur independently of its parental species. The hybrid is known in eastern Bohemia (foothills of the Krkonoše Mts and the Orlické hory Mts and in the Železné hory hills), eastern and southern margin of the Českomoravská vrchovina highlands and in the České středohoří Mts in north-western Bohemia. In the last area or in its close surroundings *C. stenolepis* has never been recorded. However, the hybrid plants occur in "relict" semi-dry meadows that are similar to the vegetation in the Bílé Karpaty Mts, where *C. stenolepis* is common. The hybrid population in the České středohoří Mts thus might be a remnant of a former population of *C. stenolepis* that has been eroded by hybridization with *C. pseudophrygia* occurring in the surroundings. This hybrid is documented for one ruderal site each in southern Bohemia and southern Moravia, where it was most probably introduced. The map is based solely on revised herbarium specimens.

Drosera anglica (Fig. 39)

Drosera anglica is an amphidiploid species that originated in North America from the hybrid *D. linearis* × *D. rotundifolia* (Wood 1955), in which *D. rotundifolia* is the maternal parent (Rivadavia et al. 2003). Currently *D. anglica* is a circumpolar species, which in addition to Canada and the northern USA occurs also in the northern half of Europe and the Alps, in western and central Siberia, the Russian Far East and northern Japan (Meusel et al. 1965, Hultén & Fries 1986). In the Czech Republic *D. anglica* occurs in permanently wet to waterlogged and occasionally disturbed microhabitats in acidic to neutral peat bogs and mires, particularly on a wet bare peat substrate at the edges of bog pools or small springs. It occurred mainly in the Třeboňská pánev basin and the adjacent edge of the Českomoravská vrchovina highlands, where it was found mainly in transitional mires often located at the edges of fishponds. However, most of its populations have vanished and recent occurrences are confirmed for only four sites. *Drosera anglica* is also found in several ombrotrophic peat bogs in the south-western Krušné hory Mts and the central Šumava Mts. A few isolated sites once existed in other Bohemian mountains and one in a fen in the middle Labe river basin. Because of its rarity and population decline it is classified as critically threatened (Grulich 2012). It has been intentionally introduced into about three new sites during the past decades.

Drosera intermedia (Fig. 40)

Drosera intermedia is found mainly in western and central Europe, northwards extending to southern Scandinavia, eastwards to the north-western part of European Russia,

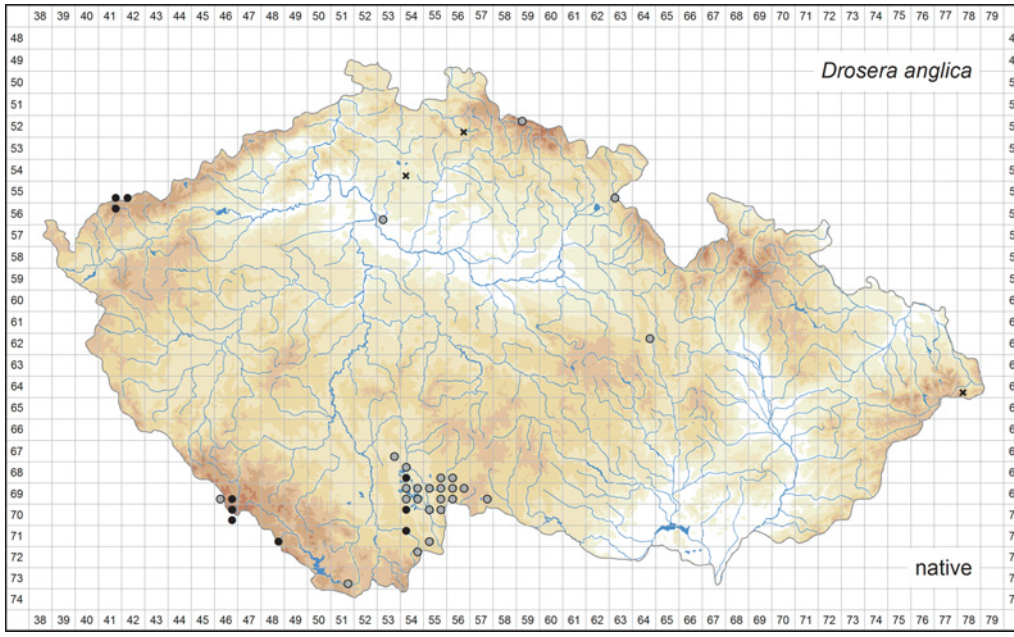

Fig. 39. – Distribution of *Drosera anglica* in the Czech Republic: ● at least one record in 2000–2016 (10 quadrants), ● pre 2000 records only (25 quadrants), × deliberate introductions only (3 quadrants). Prepared by Zdeněk Kaplan.

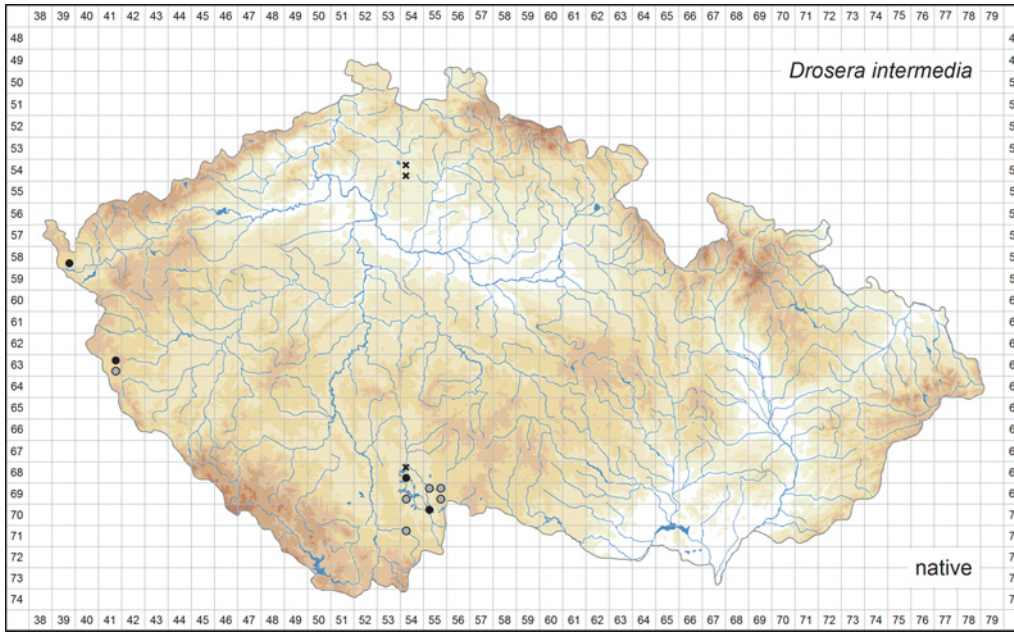

Fig. 40. – Distribution of *Drosera intermedia* in the Czech Republic: ● at least one record in 2000–2016 (4 quadrants), ● pre 2000 records only (6 quadrants), × deliberate introductions only (3 quadrants). Prepared by Zdeněk Kaplan.

Ukraine and the Southern Carpathians, and southwards to the northern parts of the Iberian Peninsula and northern Italy. It also occurs in the Caucasus Mts, eastern North America, Cuba and northern South America (Hultén & Fries 1986). In the Czech Republic *D. intermedia* grows on wet *Sphagnum* hummocks, in intermittently flooded bog hollows and on wet bare peat in mires and bogs. It was recorded at about 10 spontaneous sites in the Třeboňská pánev basin in southern Bohemia but only two of them may be extant. It has also been found at three sites in the Český les Mts and one site near the town of Františkovy Lázně in westernmost Bohemia. *Drosera intermedia* is classified as critically threatened (Grulich 2012). Recently, it has been intentionally introduced at two sites in the surroundings of the town of Doksy in northern Bohemia and one in the Třeboňská pánev basin.

Drosera rotundifolia (Fig. 41)

Drosera rotundifolia is a circumpolar species, widespread in Europe except in its driest Mediterranean parts, extending eastwards through Siberia to north-eastern China, the Russian Far East and Japan. It also occurs in northern and eastern North America (Hultén & Fries 1986). In the Czech Republic *D. rotundifolia* grows in ombrotrophic peat bogs, mires, wet meadows and mountain springs, usually on acidic, oligotrophic to dystrophic substrates, where it is mostly found on wet *Sphagnum* hummocks, less frequently in dystrophic bog hollows. It sometimes also colonizes wet sands, particularly in flooded sand pits. In Bohemia it was distributed mainly in the mountain ranges along the country's borders and also in highlands such as those of the Brdy Mts and the Českomoravská vrchovina highlands. At low altitudes it is found mainly in areas with scattered peatlands such as in the surroundings of the towns of Doksy and Česká Lípa in northern Bohemia and in the Třeboňská pánev basin in southern Bohemia. In the eastern part of this country it occurs mainly in the mountains in northern and eastern Moravia. In the lowlands it has always been rare, confined to local suitable habitats, and nearly absent from the warm and dry areas with mineral-rich soils in north-western Bohemia and southern Moravia and from the middle Labe river basin. Nowadays, *D. rotundifolia* is still present and locally even quite frequent in the Bohemian mountains. However, it has largely vanished from the foothills and lowlands where its habitats have been drained and converted into arable land or abandoned and overgrown by more competitive species. It is therefore classified as vulnerable (Grulich 2012).

Drosera ×*obovata* (Fig. 42)

Drosera ×*obovata* is a sterile triploid hybrid often found in Eurasia and North America at sites where its parental species *D. anglica* and *D. rotundifolia* co-occur. In the Czech Republic *D.* ×*obovata* nearly coincides with the distribution of the rarer parent, *D. anglica*. At its sites it often shares microhabitats with *D. anglica*. The hybrid was recorded mainly in the Třeboňská pánev basin, at several peat bogs in the south-western Krušné hory Mts and in the central Šumava Mts, at a single locality in both the Krkonoše Mts and Orlické hory Mts, and two close by sites at the south-western edge of the Českomoravská vrchovina highlands.

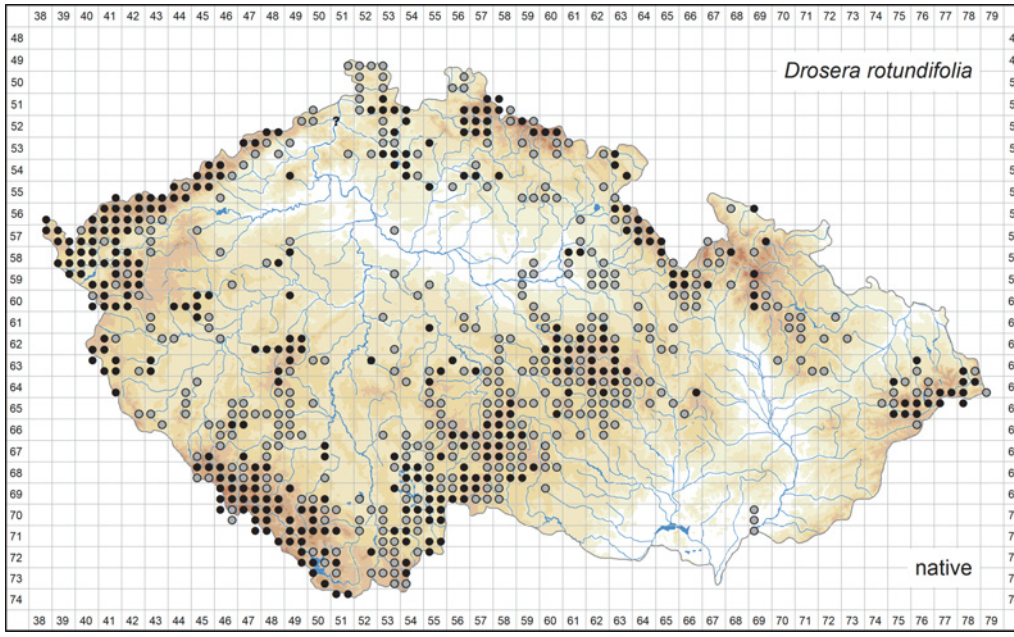

Fig. 41. – Distribution of *Drosera rotundifolia* in the Czech Republic: ● at least one record in 2000–2016 (317 quadrants), ◍ pre 2000 records only (354 quadrants). Prepared by Zdeněk Kaplan.

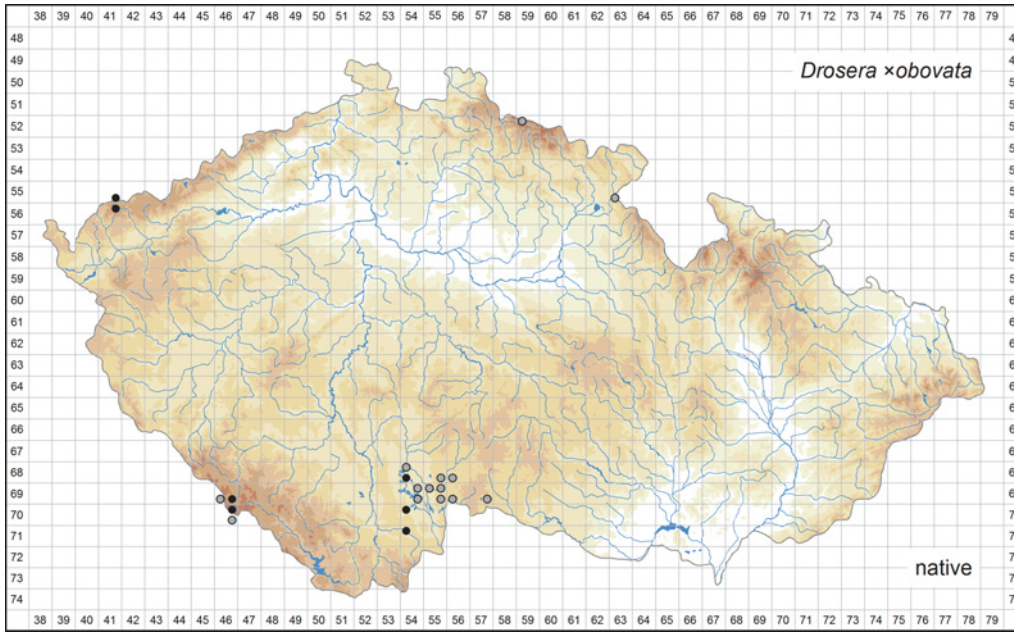

Fig. 42. – Distribution of *Drosera ×obovata* in the Czech Republic: ● at least one record in 2000–2016 (7 quadrants), ◍ pre 2000 records only (14 quadrants). Prepared by Zdeněk Kaplan.

Dysphania ambrosioides (Fig. 43)

Dysphania ambrosioides is native to subtropical and tropical America from the southern USA through Mexico and Central America to South America (Clemants & Mosyakin 2003). It has been intentionally introduced throughout tropical and warm-temperate regions of the world as a culinary and aromatic herb, tea, food commodity, source of essential oils and a medicinal plant, and also accidentally spread as a seed contaminant. It has escaped from cultivation and currently can be found widely naturalized in the northern USA, the West Indies, Europe, southern and south-eastern Asia, southern half of Africa, eastern Australia and the Pacific Islands, being considered invasive in a wide range of environments (Rojas-Sandoval & Acevedo-Rodríguez 2016). In Europe it has been recorded from most European countries, particularly in the western, central and southern parts (Akeroyd 1993, Uotila 2011, DAISIE 2017). In the Czech Republic *D. ambrosioides* used to be grown in the past as a medicinal plant and in botanical gardens, and occasionally escaped. A few occurrences in the vicinity of transit sheds and in railway stations may have resulted from accidental introductions as a contaminant of agricultural commodities. *Dysphania ambrosioides* is classified as a casual neophyte (Pyšek et al. 2012). Only the spontaneous occurrences are shown in the map.

Dysphania botrys (Fig. 44)

Dysphania botrys is native to the Mediterranean part of Europe and to south-western Asia, eastwards extending to north-western India and through Central Asia to north-western China and south-western Mongolia (Uotila 2013). It has been introduced into and became naturalized in most of central Europe, the northern coast of Africa, southern Africa, southern Siberia and North America (Jalas & Suominen 1980, Uotila 2011, 2013). In the Czech Republic *D. botrys* used to be grown as a medicinal plant in the past and many of the early records relate to garden escapes. However, it has also been dispersed unintentionally and colonized rubble sites, heaps of soil, railway stations and other disturbed habitats in settlements. Furthermore, it has been found in abandoned quarries and sand-pits, open dry grasslands and on edges of tracks and fields, mainly on sandy or gravel substrates. Due to mining and the use of these substrates (mainly sand) at construction sites, *D. botrys* seeds may be spread over large distances. Particularly in industrial areas it also occurs on spoil and slag heaps, in ore yards and sludge beds. *Dysphania botrys* is a thermophilous species, occurring mainly in warm lowlands. It is most frequent in southern Moravia, being locally naturalized. It has also occurred at numerous sites in large cities such as Prague, Brno and Ostrava. In other parts of this country it is rare and occurs mainly as a casual. Particularly in Bohemia it has declined during the last five decades due to a decrease in the availability of suitable habitats. At the country level it is classified as a naturalized archaeophyte (Pyšek et al. 2012).

Dysphania melanocarpa (Fig. 45)

Dysphania melanocarpa is native to Australia where it is widespread south of 20°S (Shepherd & Wilson 2008). In Europe it has been recorded only in the Czech Republic. A single plant was found introduced with wool waste at an abandoned limestone quarry at Raspenava in northern Bohemia by V. Jehlík and J. Stuchlý in 1959, and identified by P. Aellen. *Dysphania melanocarpa* is classified as a casual neophyte (Pyšek et al. 2012).

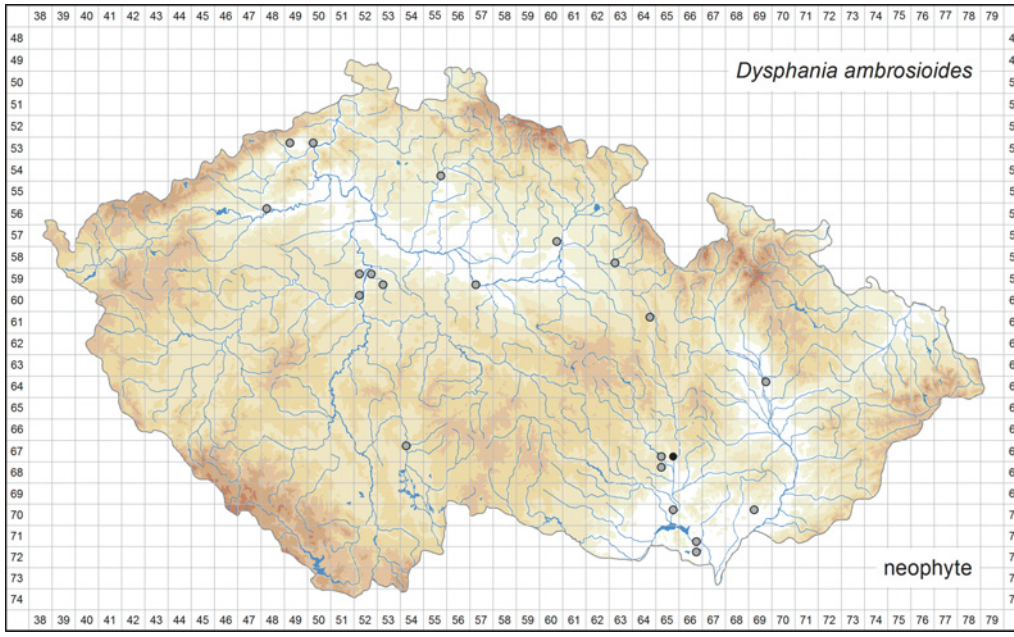

Fig. 43. – Distribution of *Dysphania ambrosioides* in the Czech Republic: ● at least one record in 2000–2016 (1 quadrant), ● pre 2000 records only (20 quadrants). Prepared by Zdeněk Kaplan, Pavel Dřevojan & Kateřina Šumberová.

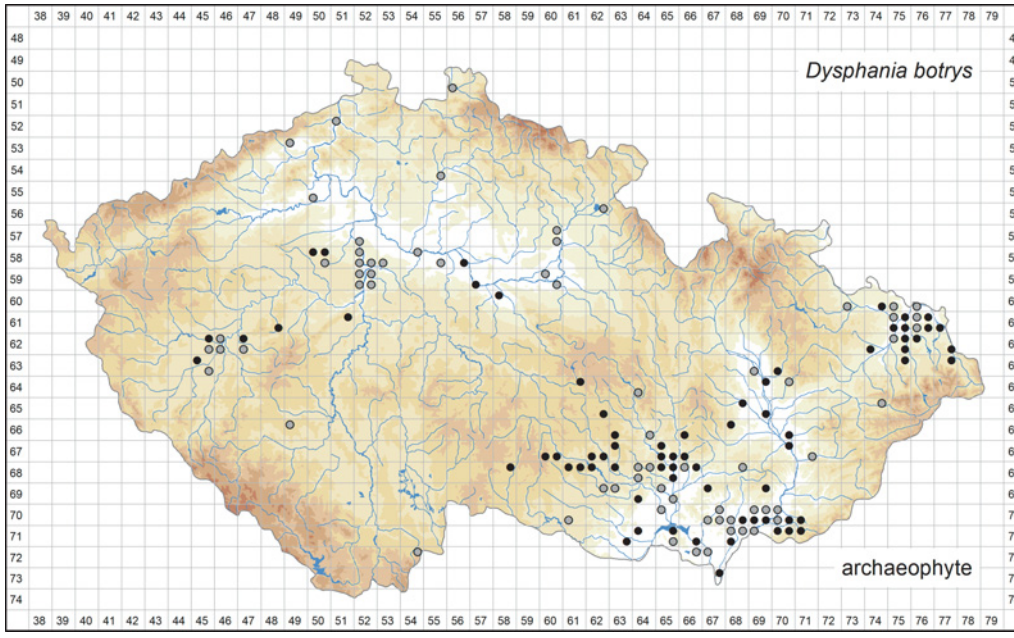

Fig. 44. – Distribution of *Dysphania botrys* in the Czech Republic: ● at least one record in 2000–2016 (70 quadrants), ● pre 2000 records only (67 quadrants). Prepared by Zdeněk Kaplan, Pavel Dřevojan & Kateřina Šumberová.

Dysphania pumilio (Fig. 45)

Dysphania pumilio is native to southern Australia (Shepherd & Wilson 2008). It has been introduced with wool mainly in western and central Europe (Uotila 2011, DAISIE 2017), Iran (Rahiminejad et al. 2004), the western and eastern USA (Clemants & Mosyakin 2003) and possibly also elsewhere but the identity of plants is uncertain. In the Czech Republic *D. pumilio* was first recorded in the village of Nosislav in southern Moravia in 1890 (Schierl 1896, as *Chenopodium carinatum*). Soon after it was also collected downstream on the banks of the Svratka river, indicating that it may had been dispersed by water (the ability of fruits with a perigone to float for more than 10 hours is recorded by Lhotská & Hejný 1979). The original source of this dispersal may have been one of the woollen mills upstream (possibly in the vicinity of the city of Brno, where *D. pumilio* was first collected in 1898), where Australian wool was processed and cleaned. *Dysphania pumilio* spread or escaped from local woollen mills and colonized several dozens of villages and towns and their surroundings in southern Moravia, particularly in the lowland basins of the Svratka and Dyje rivers. This species has occurred on river banks, edges of tracks, in railway stations, disturbed grasslands and trampled places, particularly on sandy soils. The first record of *D. pumilio* in Bohemia dates back to 1912 when it was discovered in Prague. Elsewhere it is rare, mostly confined to open ruderal habitats in cities and railway stations. Since the last reviews of its distribution in this country (Hejný & Schwarzová 1978, Jehlík 1998) it has been introduced into Silesia and new sites mainly in southern and eastern Bohemia. At many of the sites it occurred only as a casual and particularly in the countryside it vanished from some of its former habitats. In contrast, it is naturalized in large cities such as Prague and Brno, where it is locally frequent in the joints between paving stones in pavements, mainly at the bases of walls, and along the edges of paved streets and squares in the centres of these cities. Further spread may be expected, particularly in urban areas, as this species is dispersed by vehicles (von der Lippe & Kowarik 2007) and its establishment may be enhanced by extraordinary hot summers. At the country level, *D. pumilio* is classified as a naturalized neophyte (Pyšek et al. 2012).

Dysphania schraderiana (Fig. 46)

Dysphania schraderiana is native to eastern Africa and the Arabian Peninsula; it was earlier grown in botanic gardens and recorded as escaped and locally even naturalized in most of central and eastern Europe; it has also been found as introduced into Pakistan and the Russian Far East (Jalas & Suominen 1980, Uotila 2011, 2013, DAISIE 2017). In the Czech Republic *D. schraderiana* used to be grown in the past, mainly in the eastern part of this country, as a medicinal plant in gardens and rarely also in fields, and occasionally escaped as a casual or survived a few seasons in the field as a weed when the crops were changed. As a consequence of its lower frequency in past cultivation and its high demands in terms of temperature it has been recorded from a substantially smaller number of localities than the ecologically similar *D. botrys* (Schwarzová 1996). It is classified as a casual neophyte (Pyšek et al. 2012). Only the spontaneous occurrences are shown in the map, mostly documented by herbarium specimens.

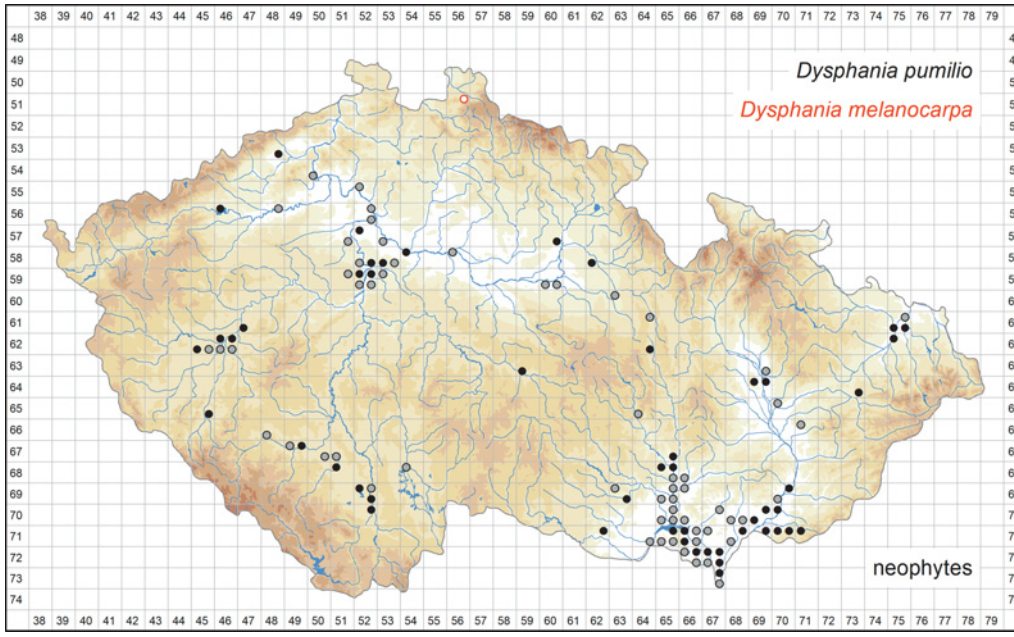

Fig. 45. – Distribution of *Dysphania melanocarpa* (○ pre 2000 records only: 1 quadrant) and *D. pumilio* (● at least one record in 2000–2016: 50 quadrants, ● pre 2000 records only: 58 quadrants) in the Czech Republic. Prepared by Zdeněk Kaplan, Pavel Dřevojan & Kateřina Šumberová.

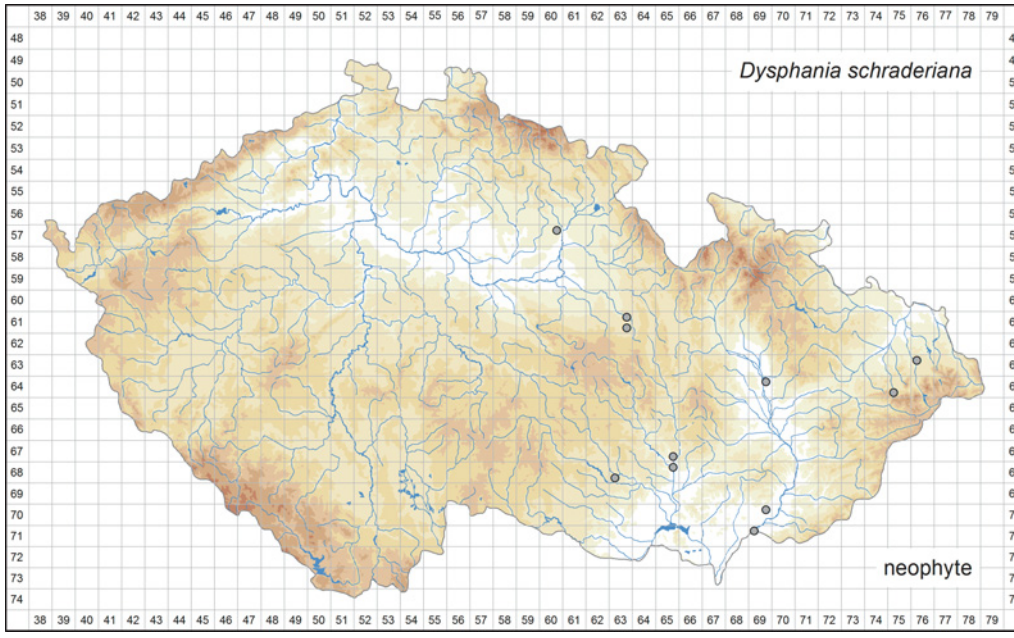

Fig. 46. – Distribution of *Dysphania schraderiana* in the Czech Republic: ● pre 2000 records only (11 quadrants). Prepared by Zdeněk Kaplan, Pavel Dřevojan & Kateřina Šumberová.

Hypochaeris glabra (Fig. 47)

Hypochaeris glabra is native to temperate Europe and northern Africa. During the last centuries, it has been introduced into many other parts of the world and is now a widespread alien in North America, southern Africa, Australia and New Zealand (Hultén & Fries 1986). In Europe it occurs from the western part of the Iberian Peninsula northwards across France, southern parts of Great Britain and the Netherlands to southern Scandinavia. In eastern Europe it becomes scattered, reaching across Belarus and Ukraine as far as western European Russia and south-western parts of Asia Minor. Southwards its distribution extends to northern Africa (Meusel & Jäger 1992, Greuter 2006). In the Czech Republic it was found in sandy grasslands, open-canopy pine forests and their clearings, as a weed on sandy arable land, on the shores of water bodies in sand pits and other water reservoirs, on railway embankments, road verges, playgrounds and disturbed lawns in villages, usually on sandy soils. Most of the localities of *H. glabra* were situated in the lowlands, mainly in the Labe river basin, central Moravia and Silesia, but some records exist also from high altitudes up to 690 m. As a consequence of the overall eutrophication and changes associated with agricultural intensification, the number of records has decreased considerably since 1960. Since 2000 it has been recorded only at 5 sites in 4 quadrants in southern Bohemia and one of these populations may have vanished in the meantime, hence *H. glabra* currently may occur only in 3 quadrants. This species is therefore classified as critically threatened (Grulich 2012). Because *H. radicata* is frequently confused with *H. glabra*, the distribution map of the latter is based solely on revised herbarium specimens.

Hypochaeris maculata (Fig. 48)

Hypochaeris maculata is a temperate Eurasian species distributed mainly in central and eastern Europe and Asia. In Europe it is continuously distributed from south-eastern France northwards across Germany to southern Scandinavia and the Baltic countries, towards the east to Belarus and Ukraine and through northern Italy to the Balkan Peninsula, reaching its southern limit at approximately 40°N. In western Europe its distribution is markedly disjunct, reaching 5°W in Great Britain. In Asia its range continues across western Siberia as far as the Altai Mts (Wells 1976). In the Czech Republic it grows both in pastures and meadows, less frequently in open-canopy forests, their margins and clearings. It occurs on mesic, often intermittently wet soils, moderately acidic to alkaline, often developed on limestone or other calcareous sediments (Wells 1976). In the Czech Republic it is found mainly in undulating landscapes at middle altitudes. It occurs in southern and eastern Moravia, especially on calcium-rich flysch sediments in the Western Carpathians; there are also many records from the Nízký Jeseník hills. In Bohemia it is mainly found in deforested areas in southern and north-western Bohemia. This species' altitudinal minimum is recorded in the Dyje river floodplain at about 170 m and its maximum in the Krušné hory Mts at about 1000 m. It is classified as vulnerable (Grulich 2012).

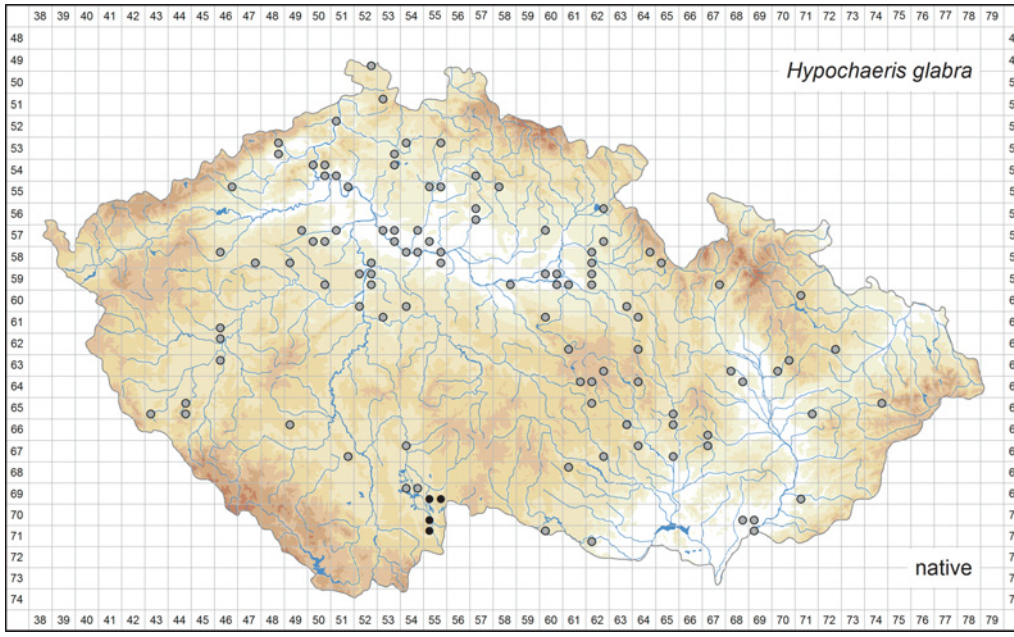

Fig. 47. – Distribution of *Hypochaeris glabra* in the Czech Republic: ● at least one record in 2000–2016 (4 quadrants), ● pre 2000 records only (104 quadrants). Prepared by Jitka Štěpánková.

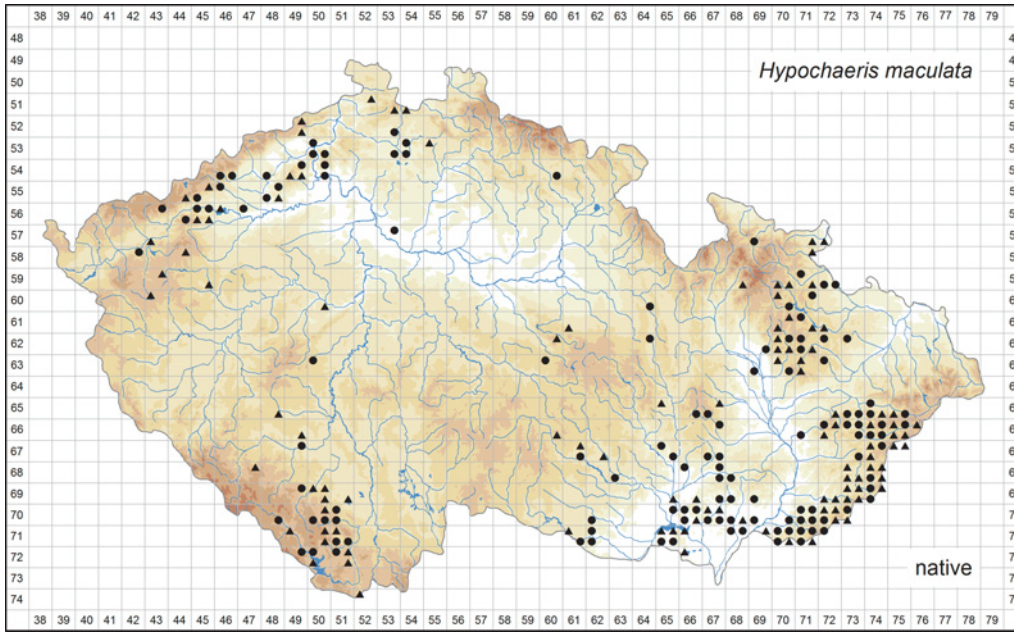

Fig. 48. – Distribution of *Hypochaeris maculata* in the Czech Republic: ● occurrence documented by herbarium specimens (122 quadrants), ▲ occurrence based on other records (107 quadrants). Prepared by Jitka Štěpánková.

Hypochaeris radicata (Fig. 49)

Hypochaeris radicata is a species both of man-made and natural habitats and currently is distributed across most of the world. Based on molecular data, it originated in Morocco and during the Quaternary period it spread into the Mediterranean area (Ortiz et al. 2008). Its further spread to other parts of Europe, Asia and Africa was associated with human activities; more recently it has been introduced also into the Americas. In Europe it is widespread in most areas, towards the north reaching 62°N at coastal sites in Norway, and towards the south extending as far as 30°N in north-western Africa (Turkington & Aarssen 1983, Meusel & Jäger 1992). It grows predominately in semi-natural grasslands that are frequently mown or heavily grazed, and in forest clearings, especially those on sandy soil, along forest paths, on road verges and railway embankments, on sandy shores of water reservoirs, and in various man-made habitats in settlements. It prefers moderately alkaline to acidic, semi-dry, usually well-drained soils (Turkington & Aarssen 1983). It is common throughout the Czech Republic from the lowlands to submontane areas. At these altitudes most of the gaps in the distribution map are due to under-recording, but some of the gaps in rather warm and dry lowlands with prevailing arable land may represent true absences. In the mountains *H. radicata* is generally rare, being found mostly at disturbed sites. This species reaches its altitudinal maximum in the Krkonoše Mts at 1400–1420 m.

Hypochaeris uniflora (Fig. 50)

Hypochaeris uniflora has a small distribution as it is confined to high mountains in Europe. It occurs in the Alps and Carpathians, with an outpost in the Sudetes Mts (Meusel & Jäger 1992). *Hypochaeris uniflora* grows in natural species-rich grasslands and on the edges of cliffs above the timberline, less often in mountain meadows at deforested sites close to the tree line. It occurs in a variety of soil conditions, ranging from acidic and moist to alkaline, well drained soils on limestone. In the Czech Republic it is scattered in the Krkonoše, Králický Sněžník and Hrubý Jeseník Mts, reaching there the limit of its northern distribution. Most populations occur in the subalpine, rarely in the montane belt, reaching their altitudinal minimum at about 800 m. This species is classified as vulnerable because of its restricted distribution (Grulich 2012).

Illecebrum verticillatum (Fig. 51)

Illecebrum verticillatum is mainly a European species with a sub-Atlantic distribution. It has a more or less continuous distribution from the western part of the Iberian Peninsula through France, the Benelux countries to northern Germany, the Czech Republic and western and southern Poland. There are isolated occurrences mainly in surrounding areas, particularly in other parts of central Europe and in Great Britain and Denmark. More remote outposts are scattered in the Mediterranean area including the north-western coast of Africa, in the Azores and the Canary Islands (Meusel et al. 1965, Jalas & Suominen 1983, Hultén & Fries 1986). *Illecebrum verticillatum* is a competitively weak annual species, growing on sandy or peaty, nutrient-poor, wet or intermittently wet substrates with an acidic soil reaction, such as exposed edges of fishponds, ditches, sand pits, peat mining areas, low-intensity managed arable fields, exposed river beds and oxbows.

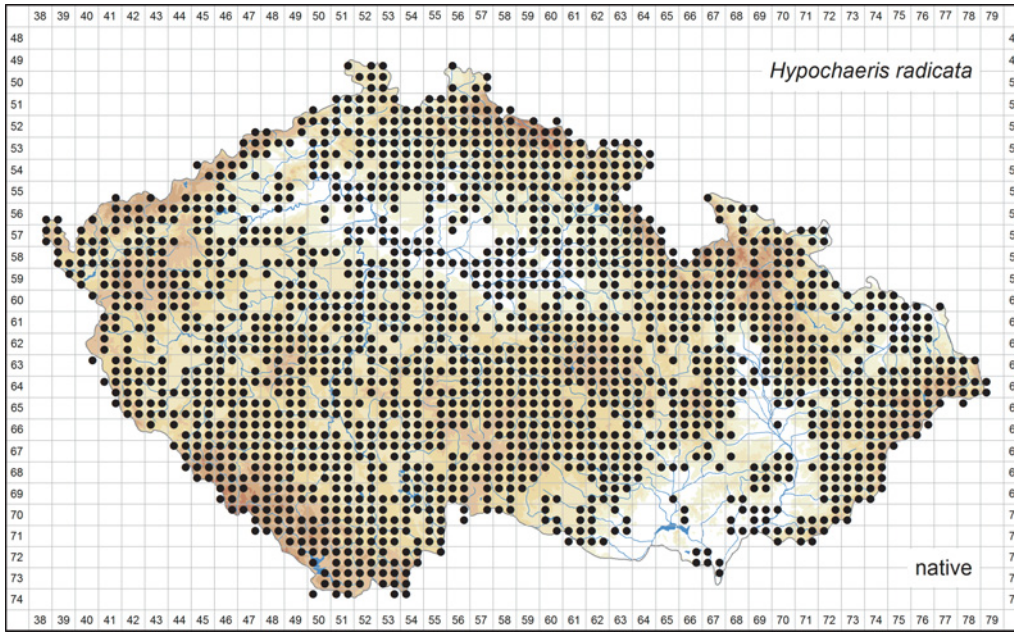

Fig. 49. – Distribution of *Hypochaeris radicata* in the Czech Republic (1819 occupied quadrants). Prepared by Jitka Štěpánková.

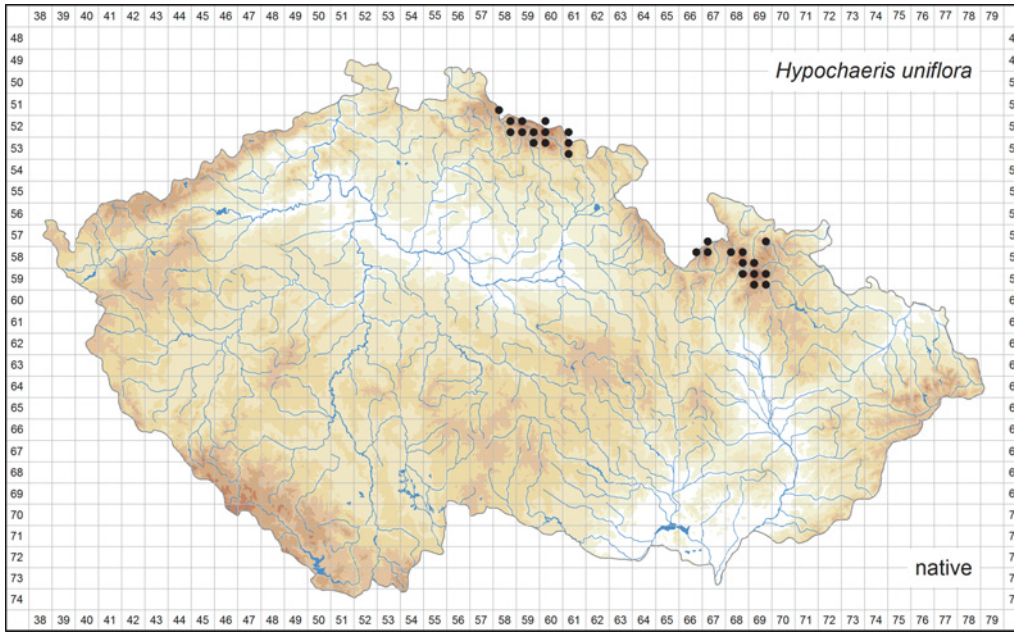

Fig. 50. – Distribution of *Hypochaeris uniflora* in the Czech Republic (26 occupied quadrants). Prepared by Jitka Štěpánková.

In the Czech Republic it is almost confined to the Třeboňská pánev basin and the adjacent edge of the Českomoravská vrchovina highlands in southern Bohemia. Several isolated localities were in the past recorded elsewhere in Bohemia and Silesia, most of which vanished more than a century ago. *Illecebrum verticillatum* declined markedly during the second half of the 20th century due to changes in fishpond management (particularly restriction on regular summer drainage, intensification of fertilization, liming and combined fish and duck farming), abandonment of low-intensity arable fields, overall eutrophication and fast succession by more competitive species. Of the more than 100 spontaneous localities recorded in southern Bohemia in the past, only about five are confirmed as extant and this species is therefore classified as critically threatened (Grulich 2012). Rescue cultivations were recently attempted by sowing seed of this species at about 11 abandoned sand pits in the Třeboňská pánev basin (Kučerová et al. 2016). In contrast to the considerable decline in southern Bohemia, *I. verticillatum* has recently been discovered as naturalized in six forest nurseries in the sandy basin of the Orlice river in eastern Bohemia. Since 1966 the sandy soils in these nurseries have been improved with peat mined near Soběslav in the Třeboňská pánev basin, with which *I. verticillatum* was unintentionally introduced into eastern Bohemia and flourishes there due to a combination of suitable physical and chemical soil properties, regular watering and disturbance (Doležal 2016).

Luronium natans (Fig. 52)

Luronium natans is endemic to western Europe and the north-western part of central Europe. Its range extends from northern Spain, France and the British Isles northwards to southern Norway and southern Sweden and eastwards to north-western Poland and north-western Czech Republic (Cook 1983, Lansdown 2011). In the Czech Republic *L. natans* occurs as a sub-Atlantic geoelement (Kaplan 2012), reaching the south-eastern limit of its distribution in Bohemia. It grows in slightly acidic, mesotrophic to oligotrophic, clear, cold standing water. It was first recorded in 1938 near the town of Stráž nad Nežárkou in southern Bohemia. Later it was recorded in 1958–1960 near the village of Černousy in northern Bohemia and then considered extirpated for almost four decades until it was discovered in 1999 at two close by sites in forests near the Czech-German border in northern Bohemia: in a pond near the village of Maxičky and in a pool near the village of Dolní Žleb. Being confined to two spontaneous populations, *L. natans* is classified as critically threatened (Grulich 2012). In 2004–2007 it was introduced from rescue cultivations into pools at four abandoned sand pits in the Třeboňská pánev basin in southern Bohemia (Kučerová et al. 2016).

Ophioglossum vulgatum (Fig. 53)

Ophioglossum vulgatum has a highly disjunct distribution. It is widespread in Europe except northern Scandinavia and the eastern and southernmost parts of Europe, where it is rare or scattered. It also occurs in Iceland, Macaronesia, northern and western Africa, Anatolia, the eastern Himalayas, central and western Siberia, Japan, Kamchatka, the eastern USA and sporadically in the western USA (Hultén & Fries 1986). It occurs in intermittently wet meadows and disturbed short grasslands and pastures, and it is also found in floodplain oak-ash forests and young stands of *Fraxinus excelsior* and *Alnus glutinosa* (Muller 2000). *Ophioglossum vulgatum* is distributed throughout this country from the

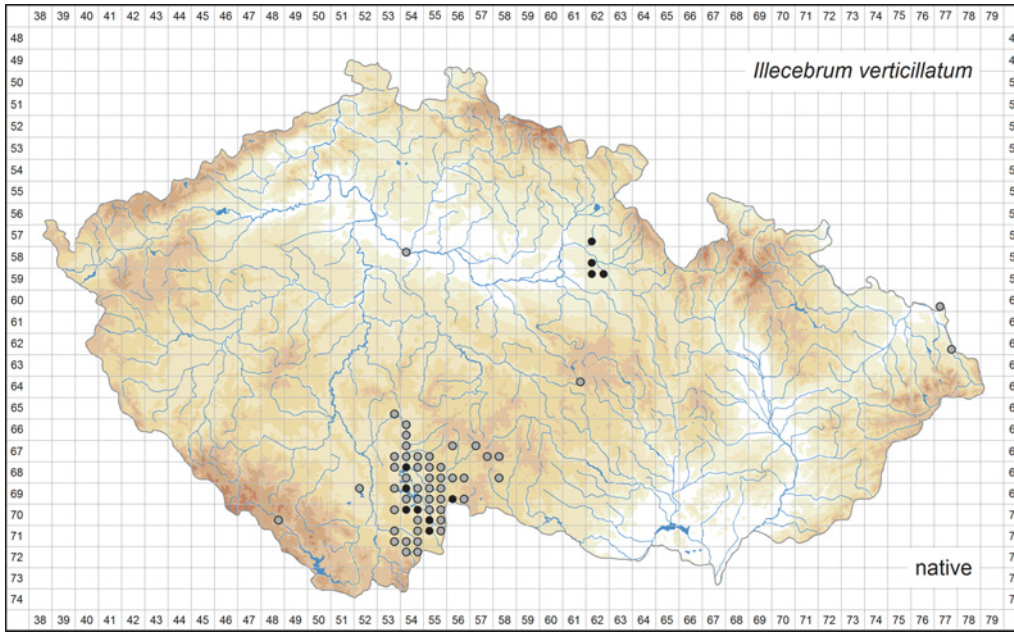

Fig. 51. – Distribution of *Illecebrum verticillatum* in the Czech Republic: ● at least one record in 2000–2016 (11 quadrants), ● pre 2000 records only (50 quadrants). Prepared by Zdeněk Kaplan.

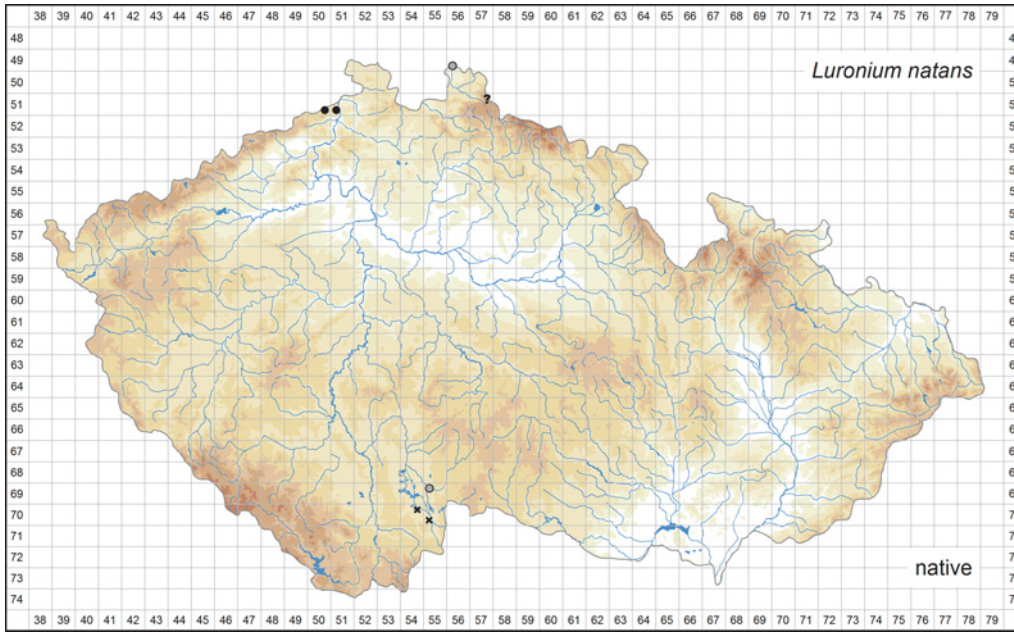

Fig. 52. – Distribution of *Luronium natans* in the Czech Republic: ● at least one record in 2000–2016 (2 quadrants), ● pre 2000 records only (2 quadrants), × deliberate introductions only (2 quadrants). Prepared by Zdeněk Kaplan.

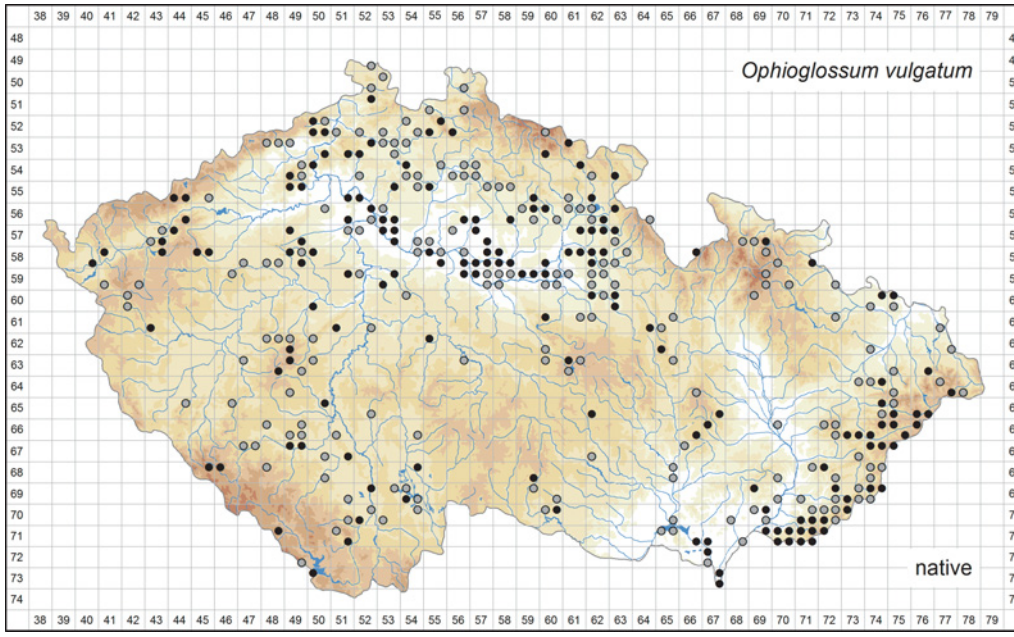

Fig. 53. – Distribution of *Ophioglossum vulgatum* in the Czech Republic: ● at least one record in 2000–2016 (165 quadrants), ● pre 2000 records only (191 quadrants). Prepared by Libor Ekrt.

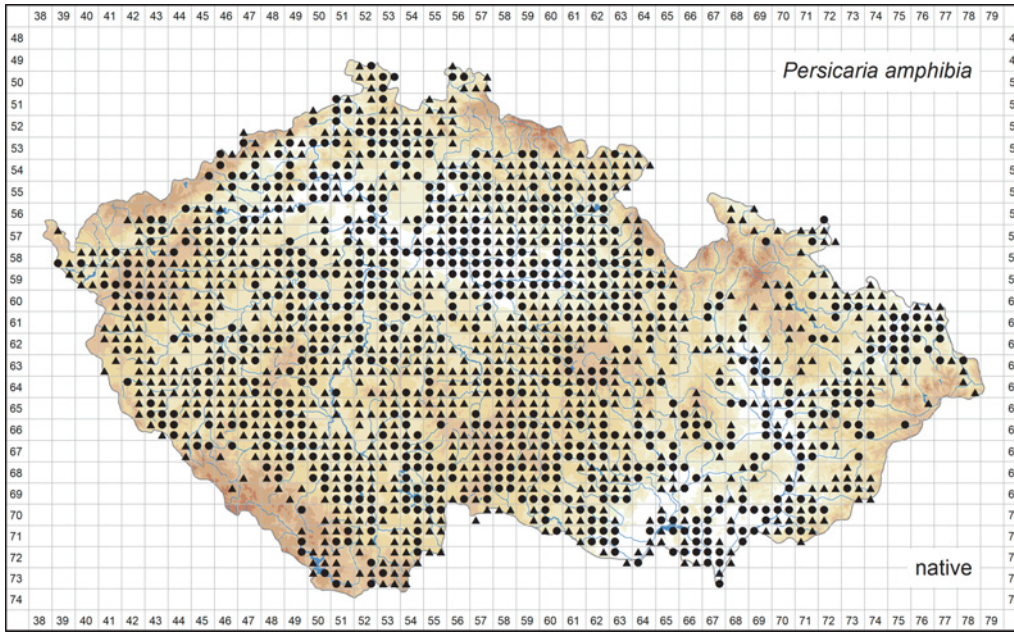

Fig. 54. – Distribution of *Persicaria amphibia* in the Czech Republic: ● occurrence documented by herbarium specimens (690 quadrants), ▲ occurrence based on other records (959 quadrants). Prepared by Jan Prančl, Jiří Danihelka & Kateřina Šumberová.

lowlands to high altitudes, being most frequent in the northern half of Bohemia and in the Carpathians along the border with Slovakia. Elsewhere it is scarce except in the central part of western Bohemia, the Českomoravská vrchovina highlands and northern Moravia, where it is absent or very rare. It has disappeared from numerous sites as a result of changes in land-use during the past century. It is therefore classified as endangered (Grulich 2012).

Persicaria amphibia (Fig. 54)

Persicaria amphibia is a circumpolar species widespread in the temperate zones of Eurasia and North America, with outposts in northern Africa and western Asia. In Europe it is absent only from northernmost Scandinavia and some parts of the Mediterranean area (Meusel et al. 1965, Hultén & Fries 1986). It has become naturalized in Mexico, South America and southern Africa (Partridge 2001, Hinds & Freeman 2005). *Persicaria amphibia* is a species that is well adapted to fluctuations in water level and occurs in two growth-forms: the aquatic growth-form is found in standing and slowly flowing water such as fishponds and other reservoirs, oxbows, alluvial pools and ditches; the terrestrial growth-form, which often remains sterile and is thus neglected by botanists, is found mainly in humid places on the shores of water reservoirs, in alluvial meadows, on fallow land, along roads and paths, in ruderal grasslands in settlements and other ruderal sites. In root crop fields this species may become a noxious weed. It prefers open sites with soils rich in nutrients. *Persicaria amphibia* is widespread throughout this country from the lowlands up to about 600 m a.s.l., becoming rather rare at high altitudes. It reaches its altitudinal maximum at about 850 m in the Šumava Mts. The gaps in the lowlands may be due to a lack of records rather than due to species' absence, while at middle altitudes a combination of both.

Persicaria capitata (Fig. 55)

Persicaria capitata is native to western China, Bhutan, northern India and Nepal (Hinds & Freeman 2005). It is planted as a garden groundcover in many parts of the world, including Europe, where it has been cultivated since the 1870s. Since then, it has escaped from cultivation and has become naturalized in many countries of the world with subtropical and temperate oceanic or temperate warm climates. In Europe it has become naturalized, for instance, in the British Isles, Belgium and Portugal (Doležal & Uher 2016, DAISIE 2017), and records of escaped plants exist for other countries. It was introduced into the Czech market about 20 years ago (Doležal & Uher 2016). In its native range *P. capitata* is a perennial herbaceous plant with a lignified stem base. However, this species does not survive central-European winters, and therefore it is grown as an annual. In the Czech Republic it was first found escaped from cultivation in 2014 near the town of Lednice in southern Moravia, and another three finds followed in 2015. This species should be classified as a casual neophyte.

Persicaria hydropiper (Fig. 56)

Persicaria hydropiper has a wide distribution encompassing the temperate zone in Eurasia, some parts of south-western Asia and much of the subtropical and tropical

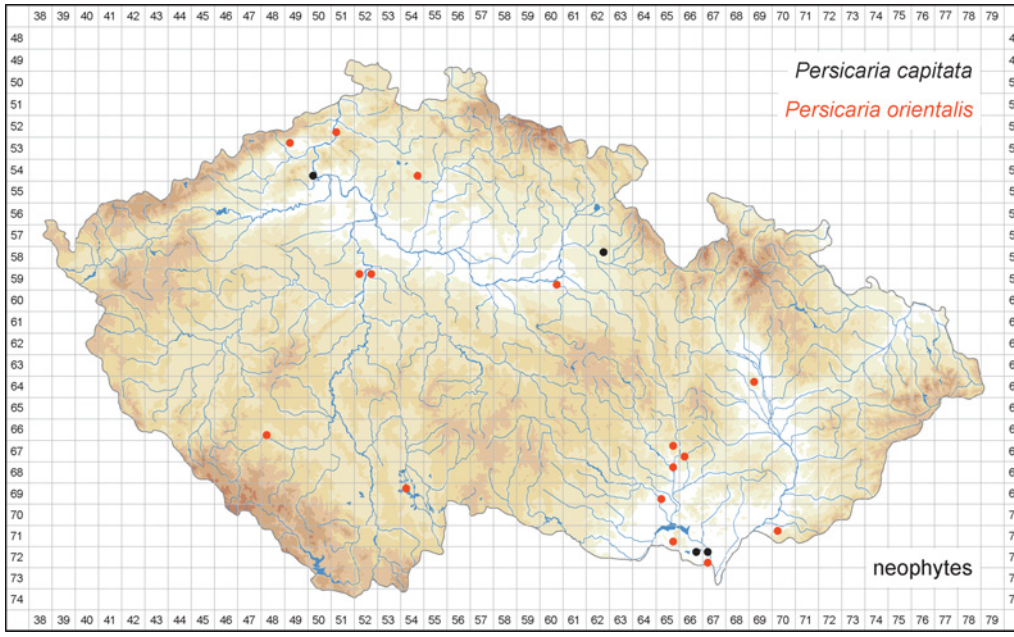

Fig. 55. – Distribution of *Persicaria capitata* (4 occupied quadrants) and *P. orientalis* (16 occupied quadrants) in the Czech Republic. Prepared by Jiří Danihelka & Kateřina Šumberová.

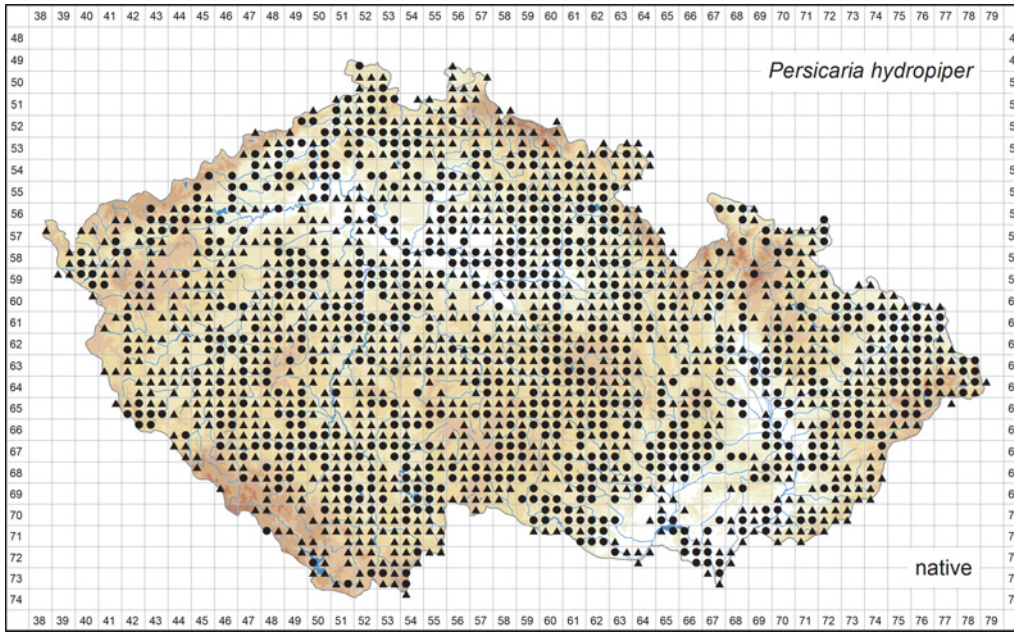

Fig. 56. – Distribution of *Persicaria hydropiper* in the Czech Republic: ● occurrence documented by herbarium specimens (755 quadrants), ▲ occurrence based on other records (1066 quadrants). Prepared by Jiří Danihelka & Kateřina Šumberová.

south-eastern Asia including the islands. In Europe it is absent only from northernmost Scandinavia and some parts of the Mediterranean area. It has become naturalized in North America and Australia (Meusel et al. 1965, Hultén & Fries 1986, Li et al. 2003, Hinds & Freeman 2005). In the Czech Republic *P. hydropiper* is found in various types of humid and moist habitats, including banks of water courses, shores of water reservoirs, ditches, drying out puddles in forest tracks and paths, margins of wet arable fields, waste ground, ruderal places in and around settlements, and other sites subject to disturbances by streams, water level fluctuations or management. It prefers mineral, well oxygenated soils and those with admixed undecomposed organic detritus, rich to moderately rich in nutrients, permanently or intermittently wet, while avoiding deep sapropelic mud typical of the exposed bottoms of fishponds. It occurs in from open to shaded sites and only in dry areas is it confined to the latter. Adult plants are well adapted to temporary flooding and in clear shallow water they are even able to grow submerged throughout the growing season. This species is widespread and common all over this country up to altitudes of about 800 m and the gaps in the map in the lowlands are a result of under-recording rather than true absences. It becomes progressively rarer with increase in altitude but was found accidentally introduced even at about 1310 m on Mt Poledník in the Šumava Mts and at about 1300 m around the Ovčárna chalet in the Hrubý Jeseník Mts.

Persicaria lapathifolia (Fig. 57)

Persicaria lapathifolia in its broad circumscription is an almost cosmopolitan species absent only from South America. It is found in the whole of Europe apart from its northernmost parts (Meusel et al. 1965, Hultén & Fries 1986). In the Czech Republic *P. lapathifolia* grows on exposed bottoms of water reservoirs and on their shores, on banks of slowly flowing watercourses, in ditches, along roads, on waste ground, in arable fields, sometimes as a noxious weed, and in disturbed places in ruderal grasslands. The species prefers wet to shallow flooded fine-grained sediments with a medium high content of organic matter, usually rich in nutrients, however, it is able to grow on a broad range of other substrata, including sand, gravel, and even stones and artificial substrates with a thin layer of fine mud and pronounced fluctuations in moisture. It is confined to open habitats. *Persicaria lapathifolia* includes four subspecies in central Europe (Wißkirchen 1995, 2011), of which three occur in the Czech Republic (Danihelka et al. 2012). Unfortunately, the previous identifications of the subspecies in herbaria have proven to be unreliable, particularly those of *P. l.* subsp. *pallida*. The main reasons are the descriptions in earlier floras (e.g. Dostál 1989), where the tomentose indument of the leaf blade was considered diagnostic (but see Wißkirchen 1995), and a literal interpretation of the epithet in the name *P. tomentosa*, which was accepted by Chrtek (1990) for the same taxon. There were also numerous identification mistakes concerning *P. l.* subsp. *brittingeri*. For these reasons, the distribution maps of these less common subspecies are based only on revised herbarium specimens. The revised specimens of the common *P. l.* subsp. *lapathifolia* were not recorded because of their high number in most of the collections studied; consequently, a separate distribution map for this subspecies was not prepared. The plants morphologically intermediate between *P. l.* subsp. *lapathifolia* and *P. l.* subsp. *pallida*, which are sometimes recognized as *P. l.* subsp. *mesomorpha* (e.g. Chrtek 1990), were identified only to species level. The overall species' distribution map summarizes

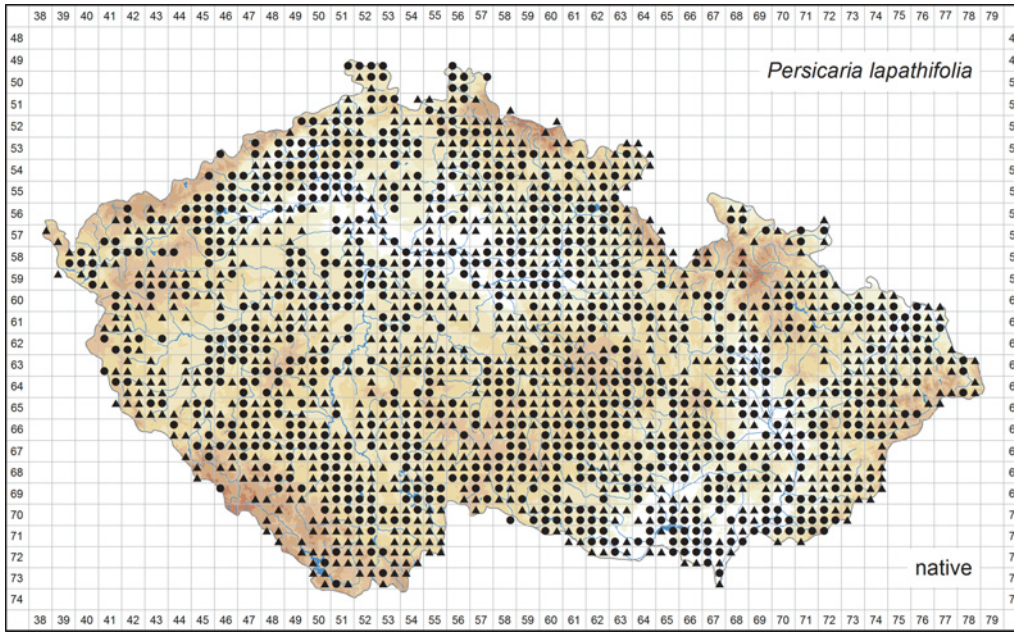

Fig. 57. – Distribution of *Persicaria lapathifolia* in the Czech Republic: ● occurrence documented by herbarium specimens (811 quadrants), ▲ occurrence based on other records (984 quadrants). Prepared by Jiří Danihelka & Kateřina Šumberová.

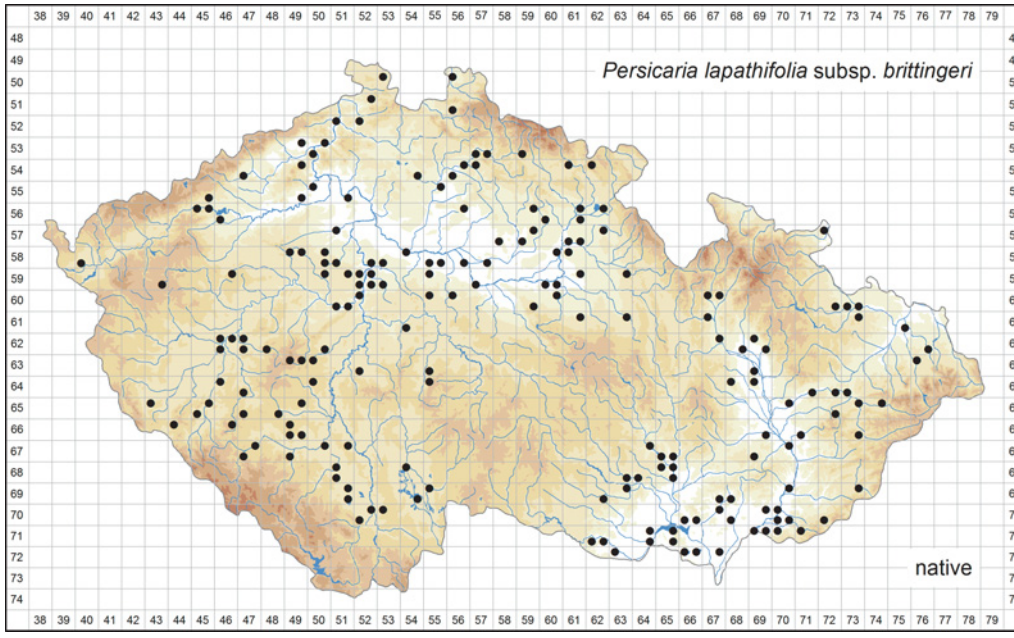

Fig. 58. – Distribution of *Persicaria lapathifolia* subsp. *brittingeri* in the Czech Republic (190 occupied quadrants). Prepared by Jiří Danihelka & Kateřina Šumberová.

all available herbarium, literature and field records of this species including all three subspecies. Some of the field records may be erroneous, based mainly on misidentifications of *P. maculosa*, but such misidentifications are not frequent enough to influence the species distribution pattern as shown in the map.

Persicaria lapathifolia subsp. *brittingeri* (Fig. 58)

Persicaria lapathifolia subsp. *brittingeri* occurs in central, western and south-eastern Europe (Wißkirchen 1991, Ekman et al. 2000). In the Czech Republic it is found mainly on exposed deposits in river beds, sometimes also in ruderal habitats, abandoned sand pits, stone quarries and on exposed bottoms of fishponds and other water reservoirs. It grows on sandy or gravelly substrates, often rich in nutrients. This subspecies occurs scattered from the lowlands up to altitudes of about 500 m, being more frequent only in fishpond landscapes and along large rivers. It reaches its altitudinal maximum at about 590 m near the town of Sušice and the village of Myslív in south-western Bohemia. This subspecies is likely to be more widespread than indicated by the map as only records supported by herbarium specimens were included in the map.

Persicaria lapathifolia subsp. *pallida* (Fig. 59)

Persicaria lapathifolia subsp. *pallida* occurs mainly in Europe and the temperate zone of Asia and it has been introduced into North America (Wißkirchen 1991, Ekman et al. 2000). It is the subspecies typical of arable land, sometimes a noxious weed of root crops, but it is frequently found also on waste ground and in other ruderal habitats, less so along streams and on the exposed bottoms of water reservoirs. It occurs from the lowlands to altitudes of about 700 m, its altitudinal maximum is about 920 m and reached near the town of Kaplice in southern Bohemia. This subspecies is definitely under-recorded and much more frequent than indicated in the map as only herbarium specimens were included.

Persicaria maculosa (Fig. 60)

Persicaria maculosa is distributed in most of Europe including the Mediterranean area, northern Africa, the Caucasus, western and Central Asia. It has become naturalized in North America, Greenland and New Zealand (Hultén & Fries 1986, Hinds & Freeman 2005). In the Czech Republic *P. maculosa* occurs on arable land, mainly as a weed in potato fields, in ditches and disturbed places along roads, in railway stations, on waste ground and in other ruderal habitats, sometimes also on quickly drying sites on exposed bottoms of water reservoirs, e.g. on sandy accumulations. Its occurrence there is usually temporary, associated with seed dispersal from the surroundings or, as in fishponds, with cereals used as feed for fish and ducks. It is thus ecologically separated from *P. lapathifolia* whose seed is able to survive in submerged sediments and which forms large stands on exposed bottoms. It is found mainly in open places. The soils are usually humid and rich in nutrients but this species is rather tolerant of large fluctuation in moisture including dry periods. *Persicaria maculosa* is a widespread species found from the lowlands up to the mountains; in the Krkonoše and Hrubý Jeseník Mts it was accidentally introduced at altitudes over 1300 m. At low altitudes this species occurs with different frequencies, locally being scarce or even rare, such as in southernmost Moravia. Misidentifications in herbaria are frequent:

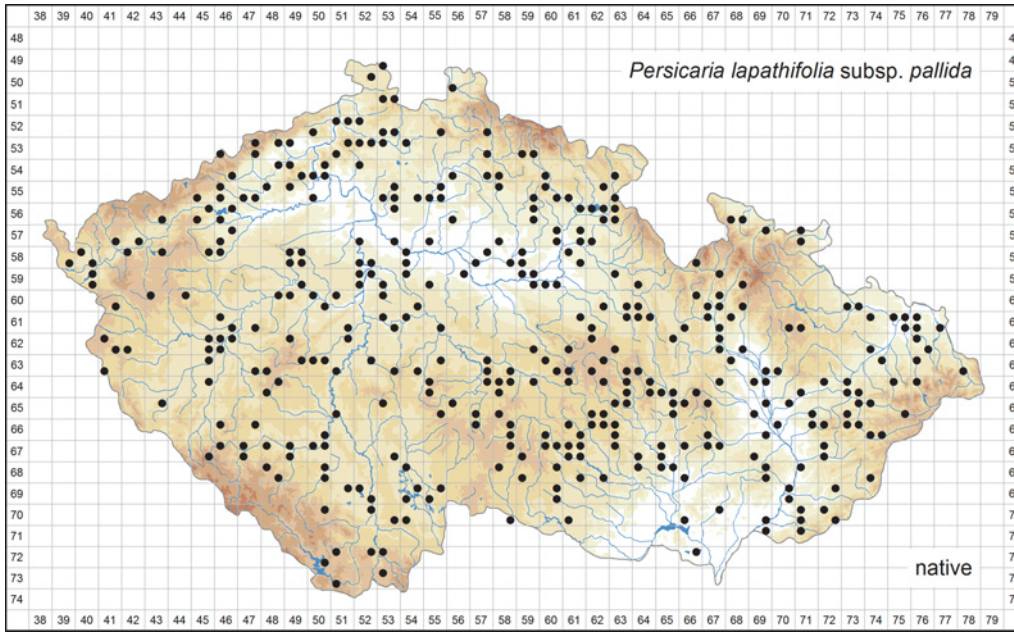

Fig. 59. – Distribution of *Persicaria lapathifolia* subsp. *pallida* in the Czech Republic (386 occupied quadrants). Prepared by Jiří Danihelka & Kateřina Šumberová.

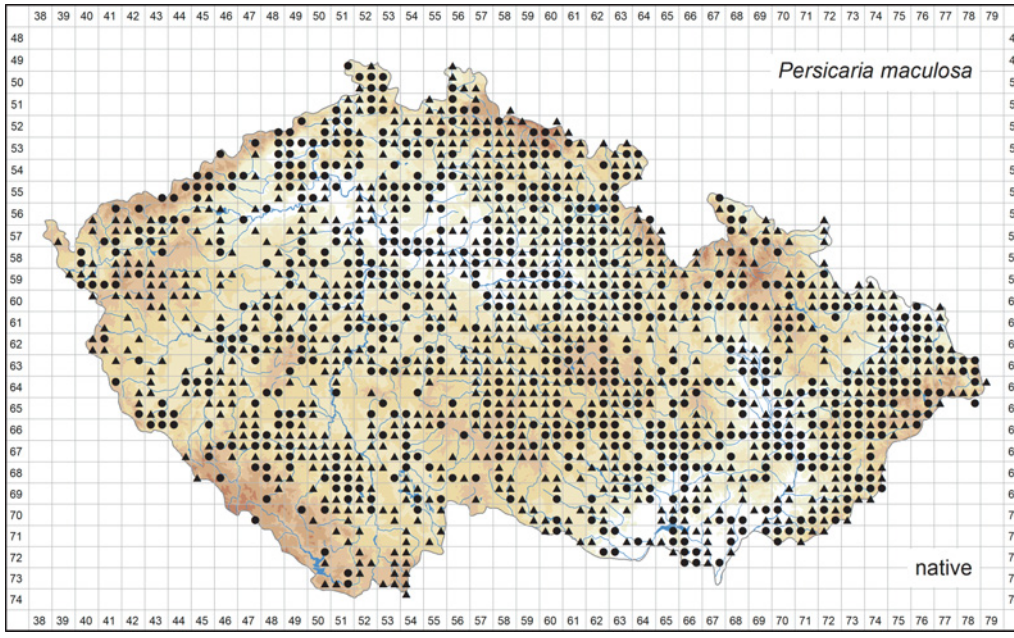

Fig. 60. – Distribution of *Persicaria maculosa* in the Czech Republic: ● occurrence documented by herbarium specimens (679 quadrants), ▲ occurrence based on other records (848 quadrants). Prepared by Jiří Danihelka & Kateřina Šumberová.

about 15% of the revised herbarium specimens were originally misidentified as *P. lapathifolia*, while about 8% of the 475 *P. lapathifolia* specimens in the herbarium BRNU were originally identified as *P. maculosa*. Therefore, a considerable part of the records not supported by herbarium specimens may be erroneous.

Persicaria minor (Fig. 61)

Persicaria minor has a wide distribution centred in the temperate zone in Eurasia, in the east reaching as far as eastern Siberia; it occurs also in south-eastern Asia. In Europe it is absent from the northernmost parts and also from some parts of the Mediterranean area. It has become naturalized in western North America and some other parts of the world (Hultén & Fries 1986, Hinds & Freeman 2005, Kantachot et al. 2010). In the Czech Republic *P. minor* occurs in the margins of fishponds, less frequently on their exposed bottoms, in drained fish storage ponds, puddles on forest tracks and paths, in roadside ditches, disturbed places in wet meadows, tall sedge stands and reed beds and in ruderal places in settlements. It is found both in open and shaded places, usually on humid, slightly acidic to neutral soils, moderately rich to rich in nutrients. *Persicaria minor* is a widespread species found from the lowlands up to the mountains, but with different frequencies, locally being scarce or even rare, such as in western Bohemia, central Bohemia north-west of Prague and south-western Moravia, generally in deforested areas. However, some of these gaps may be a result of a lack of records rather than true absences. This species is most frequent from the lowlands to altitudes of about 600 m, reaching its altitudinal maximum at about 980 m on Mt Černá hora in the Krkonoše Mts. Misidentifications in herbaria are moderately frequent: only about 40 specimens originally identified as *P. minor* turned out to be *P. mitis*, whereas about 900 specimens were identified correctly. The records not supported by herbarium specimens may therefore be considered to be reasonably reliable.

Persicaria mitis (Fig. 62)

Persicaria mitis is a European species occurring from the Pyrenees in the west as far as the Don river in the east; it is absent from Scandinavia and some parts of the Mediterranean area (Jalas & Suominen 1979). In the Czech Republic *P. mitis* grows on forest tracks and in their ditches, in disturbed and wet places in deciduous forests, in margins of fishponds and other reservoirs, along irrigation and drainage channels, sometimes also as a weed on arable land and in ruderal places. It is rather a thermophilous species occurring on wet to moist, nutrient rich, mainly basic soils and able to grow also on shallowly flooded sites. It is frequent in shaded places but may also occur in habitats exposed to full sun. This species is common in southern, central and eastern Moravia. It is also quite common in eastern Bohemia as well as along the Labe river in northern and central Bohemia. In contrast, it is very rare in western and southern Bohemia, and some of the populations found there may represent recent introductions. *Persicaria mitis* occurs from the lowlands up to altitudes of about 500 m, reaching its altitudinal maximum at about 600 m near the town of Valašské Meziříčí in eastern Moravia. Unfortunately, the identification keys until recently used the width of the leaf blade to separate *P. mitis* and *P. minor* (e.g. Chrtek 1990). As a result, about 130 herbarium specimens of *P. minor* seen by us were originally identified as *P. mitis*, as were a further 80 specimens of *P. hydropiper*.

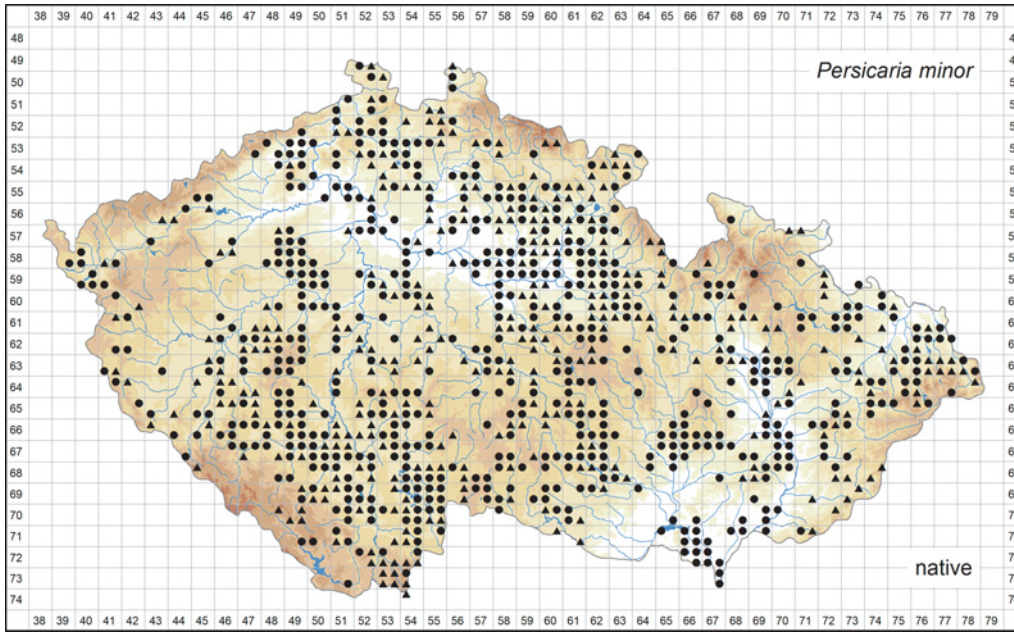

Fig. 61. – Distribution of *Persicaria minor* in the Czech Republic: ● occurrence documented by herbarium specimens (575 quadrants), ▲ occurrence based on other records (337 quadrants). Prepared by Jiří Danihelka & Kateřina Šumberová.

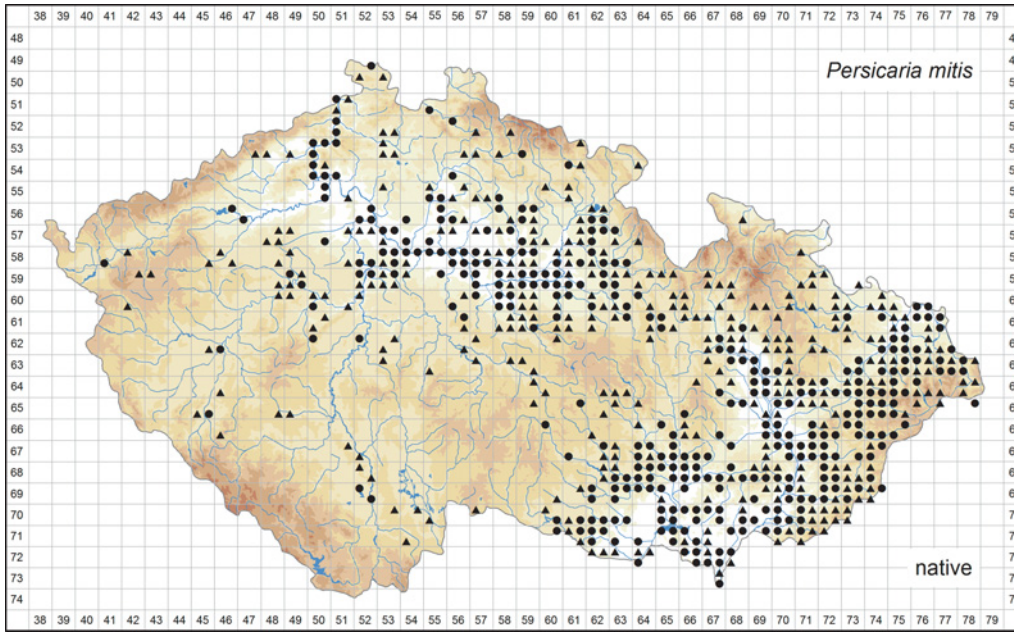

Fig. 62. – Distribution of *Persicaria mitis* in the Czech Republic: ● occurrence documented by herbarium specimens (340 quadrants), ▲ occurrence based on other records (340 quadrants). Prepared by Jiří Danihelka & Kateřina Šumberová.

Considering that we have seen only about 700 specimens of *P. mitis*, these numbers are rather large. The undocumented records of *P. mitis* may thus be strongly contaminated with misidentifications. For this reason, many isolated records of *P. mitis* not supported by herbarium specimens were discarded or tagged as dubious.

Persicaria orientalis (Fig. 55)

Persicaria orientalis is native to India and a more or less established alien in many countries in southern Asia and other parts of the world, mainly with tropical, subtropical and warm temperate climates (Li et al. 2003). This species is sometimes cultivated as a garden ornamental because of its large leaves and purple flowers. It is found as a garden escape in numerous European countries (Jalas & Suominen 1979) but it is considered established only in a few countries in the western Mediterranean area (DAISIE 2017). *Persicaria orientalis* has been cultivated in the Czech Republic probably since the early 19th century. The first record of escaped plants in the surrounding of the town of Teplice in northern Bohemia dates back to 1860. Altogether, almost 20 records exist for this country, mainly from waste ground, compost heaps and other ruderal places in and around human settlements. This species is classified as a casual neophyte (Pyšek et al. 2012).

Persicaria pensylvanica (Fig. 63)

Persicaria pensylvanica is native to North America where it occurs in most of the USA including Alaska and the eastern provinces of Canada (Hinds & Freeman 2005). This species was first recorded in Europe in 1947 and since then it has been found in more than 10 countries. It has become naturalized at least locally, for instance, in Portugal, Germany and Italy (Kubát & Jehlík 2003, Verloove & Alves 2016, DAISIE 2017). In the Czech Republic it was first collected in 1968 in northern Bohemia, namely in the town of Děčín and in the city of Ústí nad Labem, having been introduced via the ports on the Labe river, railway yards and a railway siding of a factory processing soybeans imported from North America. In the same year *P. pensylvanica* was found also at a railway station in the town of Kolín in central Bohemia and around a nearby factory processing the same commodity, and in the following years also around agricultural farms where soybean wastes were fed to livestock. The finds of single plants or small stands here and there continued until the late 1980s. In 2001 two or three populations of *P. pensylvanica* were found growing on railway embankments and on the bank of the Labe river near the town of Litoměřice (Kubát & Jehlík 2003). Based on these records and recent finds on exposed gravel deposits in the bed of the Labe river near the town of Děčín, this species seems to be locally naturalized in that area. So far, it is classified as a casual neophyte by Pyšek et al. (2012).

Pilularia globulifera (Fig. 64)

Pilularia globulifera is an amphibious fern endemic to Europe. It has a sub-Atlantic distribution, as it occurs mainly in the British Isles and in a wide belt from southern Scandinavia to central and western France, with rare occurrences extending into central Europe, Portugal and Italy (Hultén & Fries 1986). The Czech Republic is situated on the eastern limit of this species' distribution, where it usually forms poor and short-lasting populations that are sensitive to freezing during winter. It inhabits edges of shallow oligotrophic

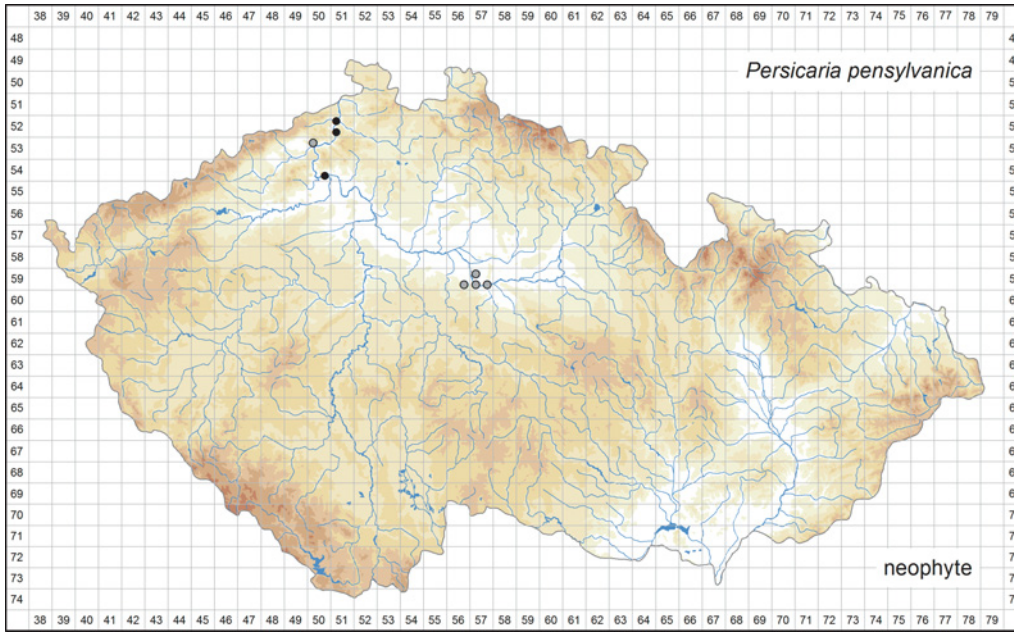

Fig. 63. – Distribution of *Persicaria pensylvanica* in the Czech Republic: ● at least one record in 2000–2016 (3 quadrants), ◍ pre 2000 records only (5 quadrants). Prepared by Jiří Danihelka & Kateřina Šumberová.

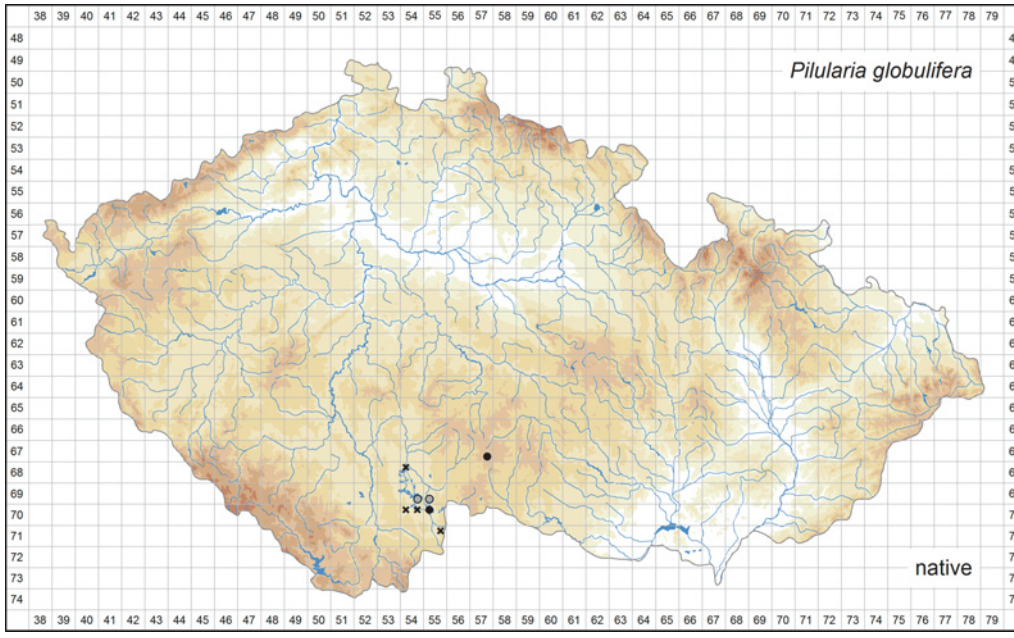

Fig. 64. – Distribution of *Pilularia globulifera* in the Czech Republic: ● at least one record in 2000–2016 (2 quadrants), ◍ pre 2000 records only (2 quadrants), × deliberate introductions only (4 quadrants). Prepared by Libor Ekrt.

to mesotrophic fishponds and water reservoirs with periodically fluctuating water levels. It prefers moist muddy and sandy substrates with an admixture of peat. In the summer its stands may be damaged by drought or by surge (Šumberová 2011). In the Czech Republic *P. globulifera* was discovered in the 1930s in three fishponds in the Třeboňská pánev basin in southern Bohemia (Ambrož 1933, Hrobař 1934), where it soon disappeared. During the last decade, two new sites of spontaneous origin were found in southern Bohemia (Ekrtová et al. 2008, Hesoun et al. 2016). All these occurrences are documented by herbarium specimens and the plants have developed sporocarps. Because *P. globulifera* was considered extirpated in the past and now it is classified as critically threatened (Grulich 2012), it was introduced into seven shallow sand-pits in the Třeboňská pánev basin and the populations there have been monitored ever since (Kučerová et al. 2016).

Rubrivena polystachya (Fig. 65)

The native distribution of *R. polystachya* is centred in the Himalayas, extending to eastern Afghanistan in the west and to northern Thailand in the southeast (Li et al. 2003, Kantachot et al. 2010). Being an ornamental and grown for its general habit and leaves, this species is sometimes cultivated in Europe and North America (Hinds & Freeman 2005), mainly in areas with rather humid climates, and repeatedly has escaped from cultivation. In Europe records of escaped and to a large extent also of established plants exist for 15 countries in northern, western and central Europe (Jalas & Suominen 1979, DAISIE 2017). In some countries, such as Switzerland, *R. polystachya* is considered invasive (Buholzer et al. 2014). In the Czech Republic this species is sometimes cultivated in chateau parks and gardens. The plants do not form ripe achenes, probably because they flower late, and they propagate only vegetatively by means of fragments of their rhizomes. The earliest record of escaped plants in the Šumava Mts dates back to 1967 (Král 1969). Since then, plants have escaped from cultivation or stands have persisted for decades in abandoned gardens at more than three dozen sites throughout this country, but most of the records come from middle altitudes in areas with humid climates. *Rubrivena polystachya* usually forms large stands in unmown places along streams, in road ditches and similar ruderal habitats. Based on its ongoing spread, this species is classified as a naturalized neophyte (Pyšek et al. 2012).

Sagittaria latifolia (Fig. 66)

Sagittaria latifolia is native to North and South America, where it is distributed from south-eastern Canada through eastern and south-eastern parts of the USA (isolated occurrence in California), Mexico and Guatemala to the northern part of South America (Haynes & Hellquist 2000). It has been introduced into Europe as an ornamental plant suitable for cultivation in garden pools. It has spread to natural habitats in France, Germany, the Netherlands, Denmark, Austria (Casper & Krausch 1980) and in some other countries. In the Czech Republic it was first recorded escaped in 1945 (Sutorý 2006) and the number of localities has markedly increased since then. *Sagittaria latifolia* occurs in shallow, standing or slowly flowing water, such as small ponds, river oxbows and quiet backwaters with slowly flowing water. Some occurrences are results of intentional planting, while others may be escapes from village ponds or garden pools. Because only dioecious plants of *S. latifolia* are found in the Czech Republic, and no mixed population

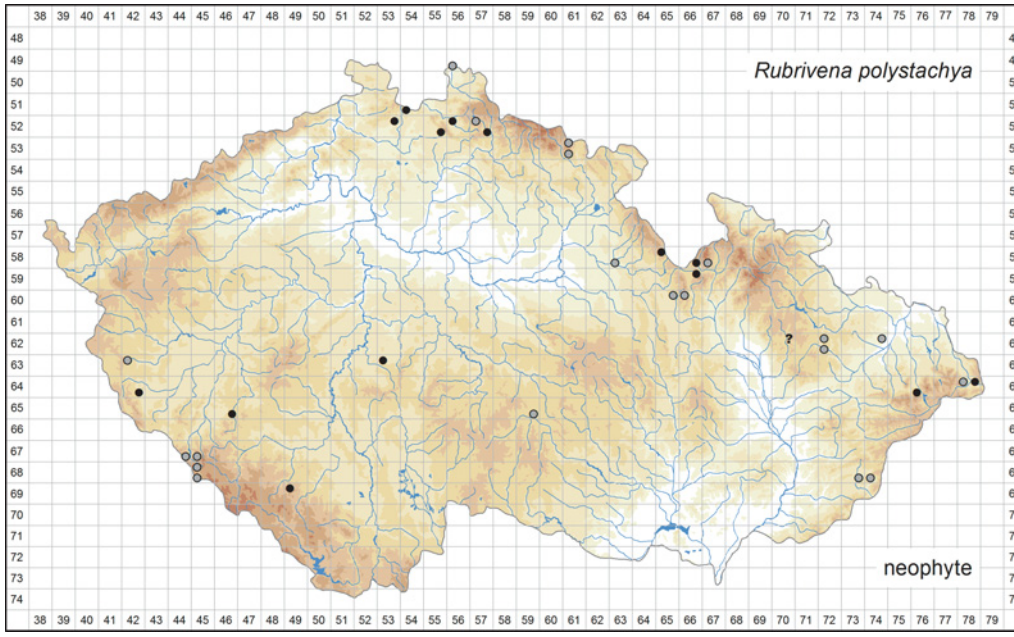

Fig. 65. – Distribution of *Rubrivena polystachya* in the Czech Republic: ● at least one record in 2000–2016 (14 quadrants), ◍ pre 2000 records only (20 quadrants). Prepared by Jiří Danihelka & Kateřina Šumberová.

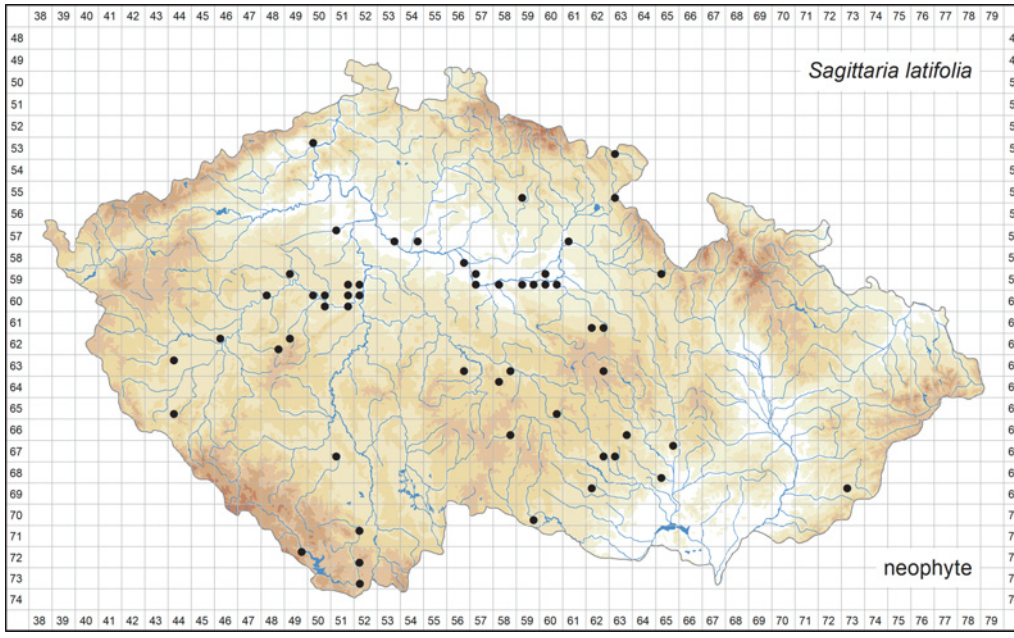

Fig. 66. – Distribution of *Sagittaria latifolia* in the Czech Republic (54 occupied quadrants). Prepared by Zdenka Hroudová.

with both male and female plants have occurred, this species can spread here only vegetatively. On river banks it may spread downstream by underground tubers washed out during floods. This is the case of the localities along the Labe river in eastern Bohemia and along the Berounka river in western and central Bohemia.

Sagittaria sagittifolia (Fig. 67)

Sagittaria sagittifolia occurs in almost the whole of Europe except for the Iberian Peninsula, the Mediterranean coast and northern Scandinavia; eastwards it reaches the European part of Russia and south-western Siberia, isolated patches are found throughout the temperate zone in Asia eastwards as far as the Kamchatka Peninsula (Hultén & Fries 1986). In the Czech Republic *S. sagittifolia* occurs in habitats with standing or slowly flowing shallow water, often with a fluctuating water level, such as fishponds, pools and oxbows in river floodplains and in quiet backwaters. In small rivers and streams it produces submerged forms with ribbon-like leaves. It prefers muddy sediments with a high content of organic matter and an acid to neutral soil reaction, and survives also in eutrophic habitats (Hroudová et al. 1988). *Sagittaria sagittifolia* is mainly found along rivers and in fishpond landscapes from lowlands to the submontane vegetation belt. It is most frequent in fishpond basins in south-western and southern Bohemia, in middle and eastern parts of the Labe river basin and in north-eastern Moravia. In contrast, it avoids standing waters on alkaline substrates, particularly when a mineral-rich habitat is combined with warm climate, such as in lowlands of southern Moravia, where *S. sagittifolia* is confined to rivers and nearby habitats saturated with river water.

Salvinia natans (Fig. 68)

Salvinia natans occurs in the temperate zone of Eurasia. In Europe it is mainly found in its central part, westwards reaching western France (naturalized in north-western Spain), northwards to northern Poland and northern Lithuania (as a casual alien also in southern Sweden), eastwards to the southern part of the Ural Mts and southwards to central Italy and northern Greece (Jalas & Suominen 1972). Further eastwards it extends through south-western Asia, Central Asia, northern India and southern China as far as Japan; it is also found in Algeria and Tunisia in northernmost Africa (Meusel et al. 1965). In the Czech Republic *S. natans* is native to Silesia, being found in the Odra river basin and around the city of Ostrava. Currently it occurs there mainly in fishponds, rarely also in wetland pools and in water bodies created by land subsidence after mining. Elsewhere it is very rare, being recorded at three sites in eastern and southern Bohemia and one site in southern Moravia as introduced by waterfowl or, more likely, intentionally planted by aquarists. It became temporarily naturalized in the Lodrant fishpond in eastern Bohemia, being observed there for about five decades before it disappeared. At the three other sites it apparently occurred for only one season and did not survive the winter. *Salvinia natans* has almost disappeared from alluvial pools due to their terrestrialization after river canalization and declined in fishponds due to changes in fishpond management and eutrophication. It is classified as critically threatened (Grulich 2012).

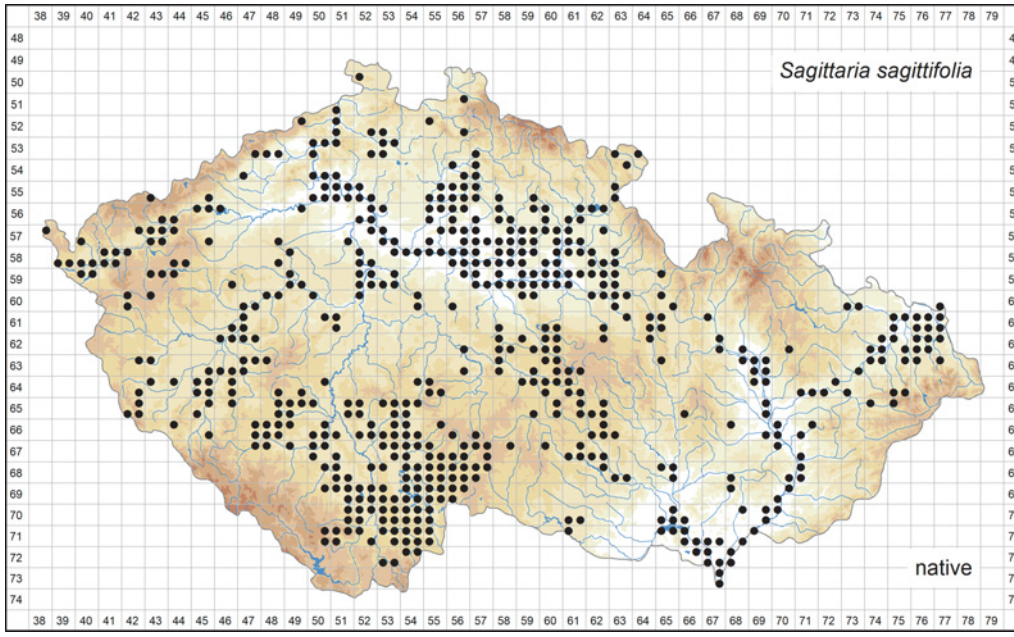

Fig. 67. – Distribution of *Sagittaria sagittifolia* in the Czech Republic (570 occupied quadrants). Prepared by Zdenka Hroudová.

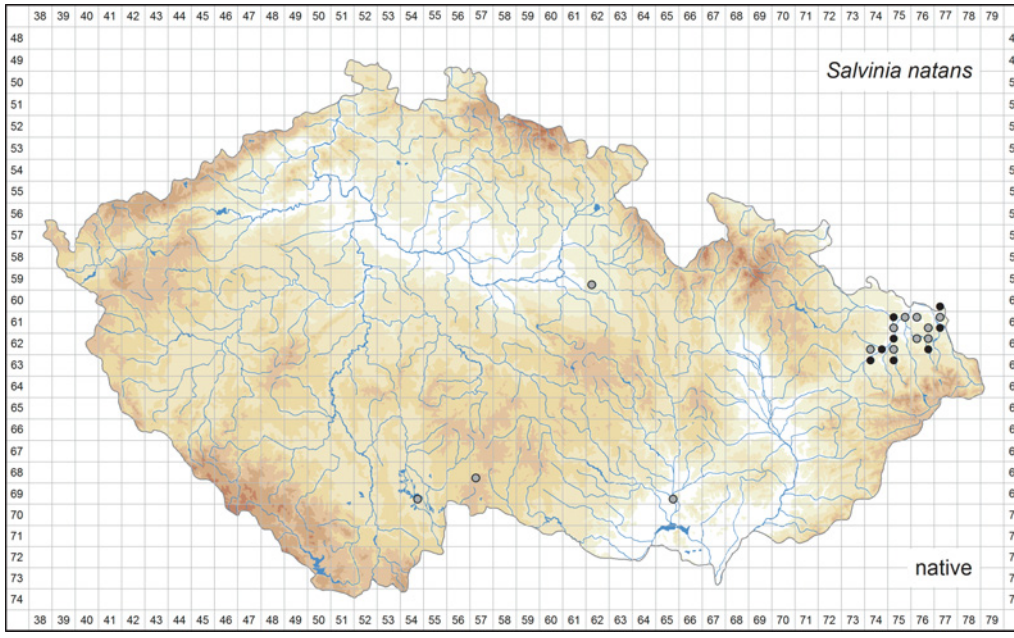

Fig. 68. – Distribution of *Salvinia natans* in the Czech Republic: ● at least one record in 2000–2016 (8 quadrants), ● pre 2000 records only and/or extirpated occurrences (13 quadrants). Prepared by Zdeněk Kaplan & Libor Ekrt.

Scirpoides holoschoenus (Fig. 69)

Scirpoides holoschoenus has a wide distribution including the Atlantic, central and southern Europe, northern Africa, the Caucasus Mts, westernmost Siberia, western Asia and parts of Central Asia (Schultze-Motel 1980, Jiménez-Mejías & Luceño 2011). It has also been introduced into the eastern USA (USDA, NRCS 2017). In the Czech Republic *S. holoschoenus* is found mainly in fen meadows and in open vegetation in sandy places that are sometimes wet in spring but dry out in summer. Although its distribution is associated with lowland rivers, individual sites are on terraces or sand dunes above the zone inundated by ordinary floods. This species mainly occurs along the middle Labe river in central Bohemia and along the lower stretches of the Dyje and Morava rivers in southern Moravia. All native occurrences are situated in the lowlands at altitudes between 150–220 m. Elsewhere it has been recorded at only four sites in western, northern and southern Bohemia, in each case introduced as a casual, mostly along railways. As a mycorrhizal plant (Kovács & Szigetvári 2002), *S. holoschoenus* suffers mainly from eutrophication, but some populations may have disappeared due to conversion of fens to arable land and abandonment followed by succession. It has strongly declined in the Czech Republic and recent records exist for about 9% of previously recorded sites. It is therefore classified as endangered (Grulich 2012).

Sideritis montana (Fig. 70)

Sideritis montana is distributed in southern and southern-central Europe, the Caucasus Mts, south-western and Central Asia (Heywood 1972). In Europe it has been introduced into other countries north of its main distribution, including the British Isles, Germany, Belgium, Finland, Estonia and Lithuania, mainly as a casual alien (Anonymus 2017, DAISIE 2017). It has been also introduced into North America (USDA, NRCS 2017). Three subspecies are recognized: the type subspecies, which is also found in the Czech Republic, is distributed almost throughout this species' range, while the other two subspecies are restricted to the Iberian and Balkan Peninsulas, respectively (Heywood 1972). In the Czech Republic *S. montana* occurs in two groups of habitats. Most of the populations in southern Moravia south-west to south-east of Brno, which are situated at the northern border of the overall species' distribution and which are considered native, occur in somewhat disturbed dry grasslands, in fallows and in margins of vineyards and arable fields. They are found mainly on alkaline or neutral soils developed over loess, limestone or Tertiary sediments rich in mineral nutrients at altitudes up to 350–400 m. Introduced plants recorded elsewhere in the country occur in various types of habitats, such as railway stations, tracks and embankments, fields with forage crops, ore yards, river ports and embankments, waste disposal places and market places in towns. These populations usually disappear after a short time. Based on the variety of sites in which the introduced plants are found, it is likely the seed was introduced mainly as a contaminant of crop seed or agricultural commodities, and also with iron ore from Ukraine. The populations of *S. montana* in natural habitats are classified as critically threatened because they have declined greatly in abundance (Grulich 2012).

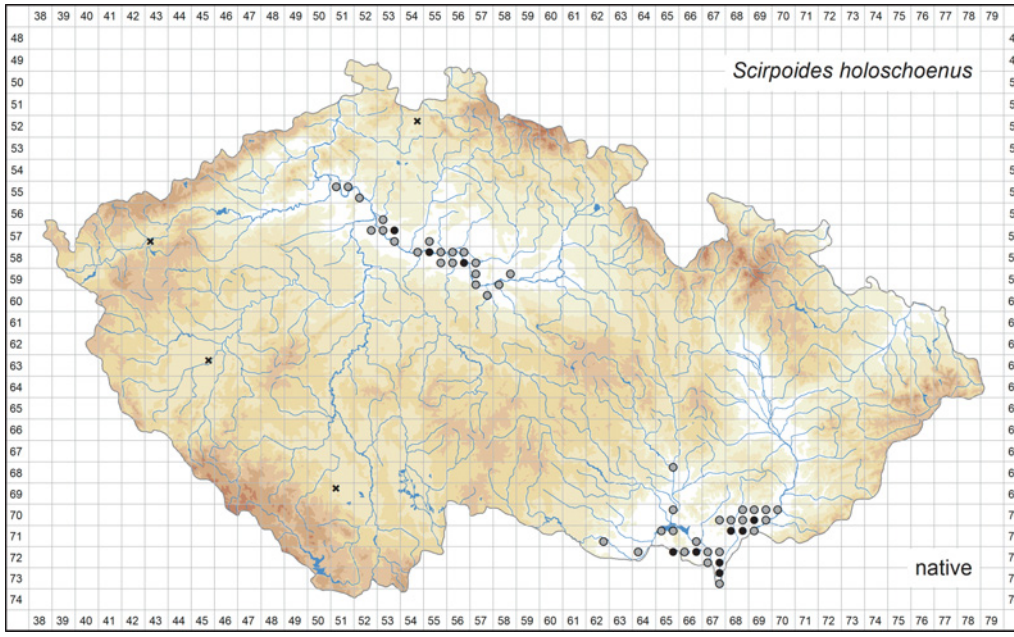

Fig. 69. – Distribution of *Scirpoides holoschoenus* in the Czech Republic: ● at least one record in 2000–2016 (10 quadrants), ● pre 2000 records only (41 quadrants), × alien only (4 quadrants). Prepared by Zdeněk Kaplan & Jiří Danihelka.

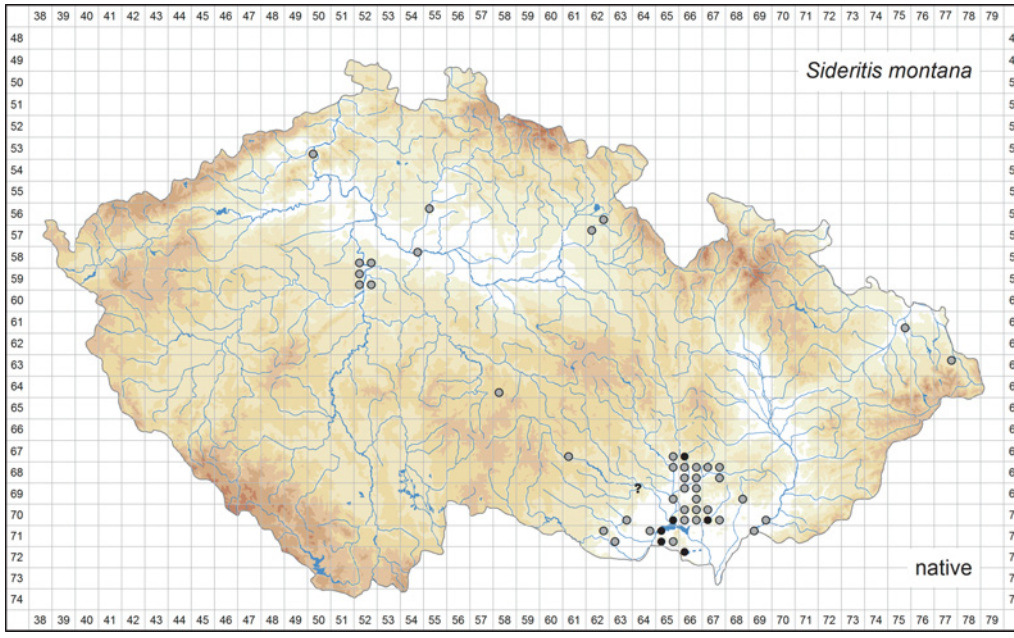

Fig. 70. – Distribution of *Sideritis montana* in the Czech Republic: ● at least one record in 2000–2016 (6 quadrants), ● pre 2000 records only (41 quadrants). Prepared by Jiří Danihelka & Zdeněk Kaplan.

Streptopus amplexifolius (Fig. 71)

Streptopus amplexifolius is widely distributed across most of temperate North America, being scattered through Europe and eastern Asia. In Europe it is confined to montane areas from northern Spain and south-eastern France northwards to Poland, eastwards to Ukraine; southwards its range reaches southern Italy and the north of the Balkan Peninsula. In eastern Asia it occurs on the Kamchatka Peninsula, Sakhalin, the Kuril Islands, Japan and the Korean Peninsula (Meusel et al. 1965). It most often occurs on banks of shaded streams and within moist thickets in shady mountain forests and in scrub in glacial cirques, where it ascends to 1400 m a.s.l. When it rarely occurs at low altitudes, it is usually in deep valleys in sandstone landscapes with cool topoclimates where it reaches its altitudinal minimum at 150 m on the Kamenice river near the village of Hřensko in northern Bohemia. It grows on acidic, moist, nutrient-poor to moderately rich soils. In the Czech Republic *S. amplexifolius* occurs mainly in the Sudetes Mts, the Šumava Mts, the Moravskoslezské Beskydy Mts and the Žďárské vrchy hills, with scattered records in adjacent areas at mid-altitudes. Because of its decline this species is classified as endangered (Grulich 2012).

Teesdalia nudicaulis (Fig. 72)

Teesdalia nudicaulis is distributed in Europe from the British Isles and Portugal in the west through France, the Benelux countries, Germany and Denmark to southern Norway and southern Sweden in the north and to eastern Poland and western Belarus in the east (Meusel et al. 1965, Hultén & Fries 1986, Jalas et al. 1996). As a sub-Atlantic geoelement it reaches the south-eastern limit of its continuous distribution in central Europe, including the Czech Republic (Kaplan 2012), with scarce isolated occurrences further to the south and east, such as in Lithuania, Ukraine, western Slovakia, eastern Serbia and north-western Italy. In the Czech Republic *T. nudicaulis* grows in disturbed, acidic, nutrient-poor, open sandy habitats such as sand dunes, abandoned sand pits, edges of sandy tracks and pine forests, formerly also at edges of sandy arable fields and fallows. Within this country it is almost confined to Bohemia, where it grows mainly in sandstone areas in northern Bohemia and on sand along lowland rivers, particularly in the Labe river basin and in the Třeboňská pánev basin. Locally it also occurs in western, south-western and south-eastern Bohemia. In Moravia it was recorded at only two sites during the first quarter of the 20th century. It no longer occurs at the majority of these sites due to eutrophication followed by succession, changes in landscape management, direct habitat destruction and afforestation. It is therefore classified as endangered (Grulich 2012).

Thesium alpinum (Fig. 73)

Thesium alpinum has a rather fragmented distribution extending from the Iberian Peninsula in the west over central and eastern Europe eastwards as far as western Russia and the Caucasus Mts. The northern limit to its distribution is in southern Sweden and the southern limit in northern Greece and north-eastern Anatolia (Hendrych 1966b, Hultén & Fries 1986). *Thesium alpinum* occurs in sunny and rather dry habitats such as low-growing grasslands, pastures, rocky and grassy slopes, rarely also in open forests. It grows on various types of soils, usually over acidic crystalline rocks, erlan, limestone and serpentinite.

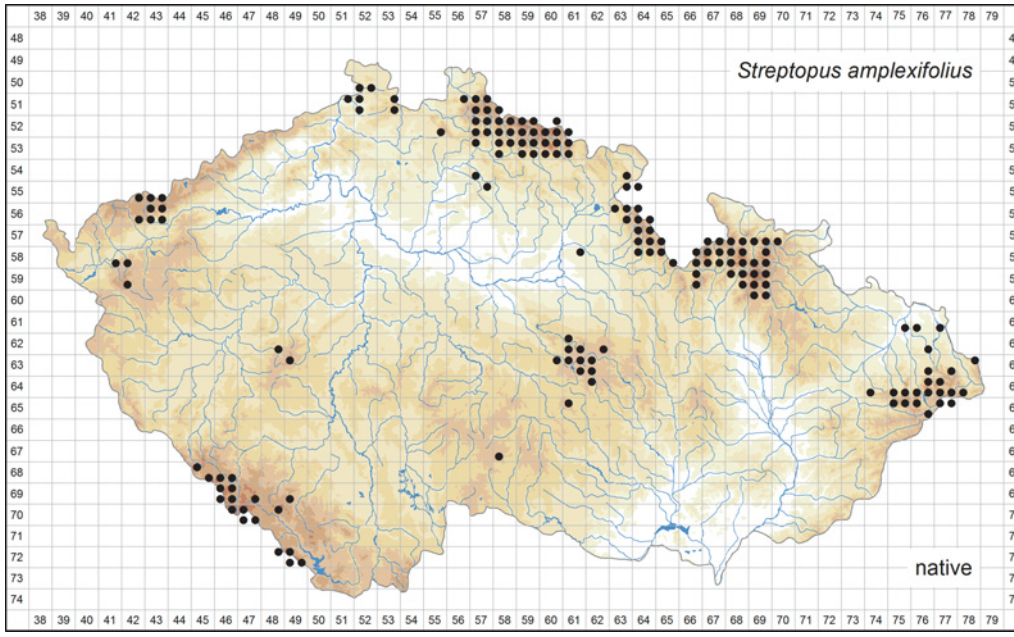

Fig. 71. – Distribution of *Streptopus amplexifolius* in the Czech Republic (164 occupied quadrants). Prepared by Jitka Štěpánková.

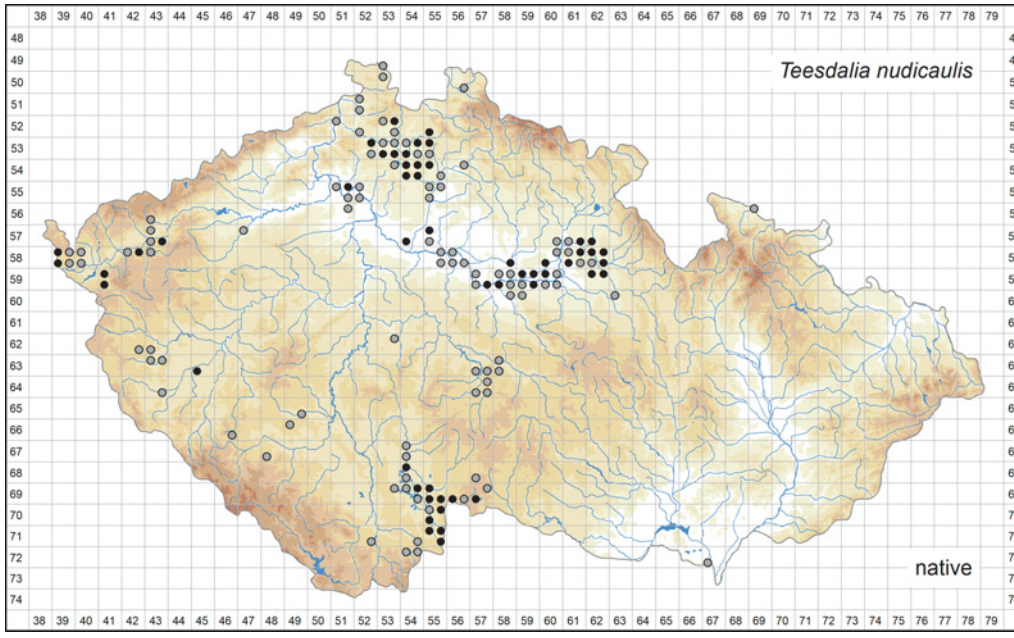

Fig. 72. – Distribution of *Teesdalia nudicaulis* in the Czech Republic: ● at least one record in 2000–2016 (52 quadrants), ● pre 2000 records only (93 quadrants). Prepared by Zdeněk Kaplan.

Like all members of this genus, *Th. alpinum* is a perennial hemiparasitic plant. In the Czech Republic *Th. alpinum* occurs scattered in the mountains and at middle altitudes, while it is very rare in the warm lowlands. It is found mainly in western, northern and central Bohemia, rarely also in southern and eastern Bohemia. In Moravia it is almost confined to the Hrubý Jeseník and Králický Sněžník Mts. An isolated site is in relic vegetation on serpentine at an altitude of 300–350 m in the Jihlava river valley in south-western Moravia. It is classified as vulnerable (Grulich 2012).

Thesium bavarum (Fig. 74)

Thesium bavarum is found mainly in central Europe and on the Balkan Peninsula, reaching westwards to south-western France, northwards to central Germany, eastwards to Romania and southwards to Greece. An isolated occurrence exists in Anatolia (Hendrych 1969). In the Czech Republic it mostly grows in dry or mesic scrub and forest edges, less often in dry grasslands and open forests. It is found in hilly areas south-west and north-west of Prague, in the České středohoří Mts, in the Krušné hory foothills and in the Doupovské hory Mts in Bohemia, and on Šobes hill near the town of Znojmo in south-western Moravia following a rare occurrence in north-eastern Austria. Together with a few former occurrences in the German state of Saxony, the populations in Bohemia represent isolated outposts at the north-eastern limits of this species' distribution. It is classified as endangered because of its rarity (Grulich 2012).

Thesium dollineri (Fig. 75)

Thesium dollineri is endemic to the Pannonian basin and the adjacent part of south-eastern Europe as it occurs in the Czech Republic, Austria, Slovakia, Hungary, Serbia, Romania, Bulgaria, Moldova and Ukraine (Hendrych 1972). Two subspecies are recognized: the widespread type subspecies and subsp. *moesiacum*, which occurs in the eastern part of the species' distribution (Romo et al. 2004). *Thesium dollineri* is a thermophilous species of open and sunny habitats. It is found in dry grasslands, edges of sandy or loamy paths, fallows and sand quarries. In the Czech Republic *Th. dollineri* is distributed in southern and central Moravia in the planar and colline vegetation belts, with an altitudinal maximum at about 400 m. The single record from 1955 from central Bohemia is doubtful though it is documented by a herbarium specimen. This species, currently found at about 40 sites, has been recorded at almost 100 localities; the decline observed since the 1950s may have been caused by changes in land-use, particularly the abandonment of pastures and the large-scale conversion of grasslands into arable land. It is classified as critically threatened (Grulich 2012), though this seems to be somewhat exaggerated.

Thesium ebracteatum (Fig. 76)

Thesium ebracteatum occurs in central and eastern Europe, westwards reaching northern Germany, northwards the southern and eastern coasts of the Baltic Sea, southwards Transylvania in Romania and eastwards the Ural Mts in Russia (Hultén & Fries 1986). In central Europe this species has a limited distribution and is distinguished as a Sarmatian geoelement (Kaplan 2012). It is found in calcareous fens and intermittently wet meadows, outside the Czech Republic also in thermophilous grasslands on acidic sandy soils,

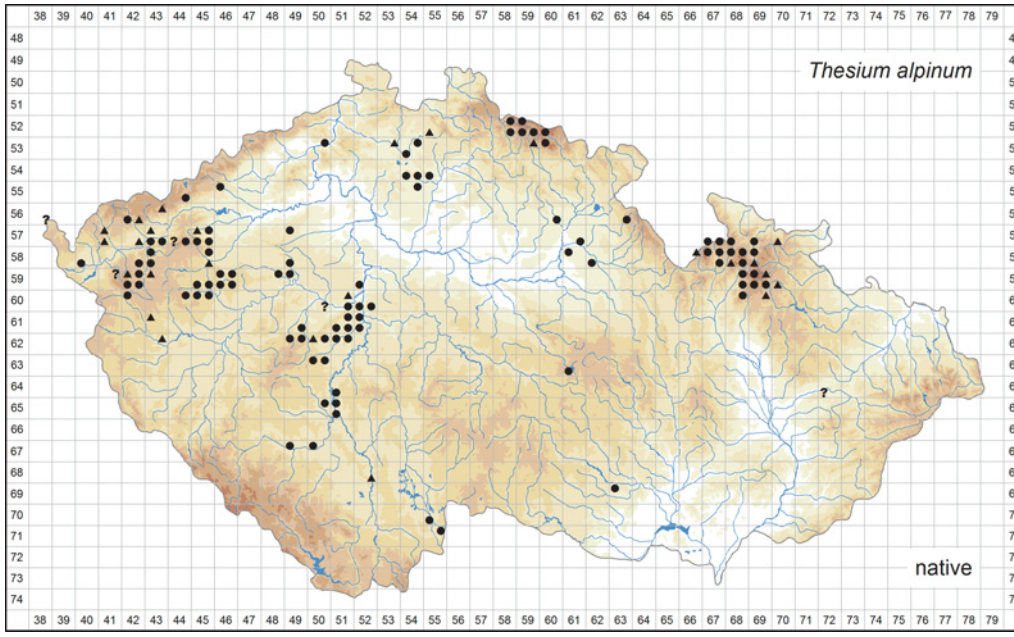

Fig. 73. – Distribution of *Thesium alpinum* in the Czech Republic: ● occurrence documented by herbarium specimens (94 quadrants), ▲ occurrence based on other records (25 quadrants). Prepared by Václav Dvořák & Martin Dančák.

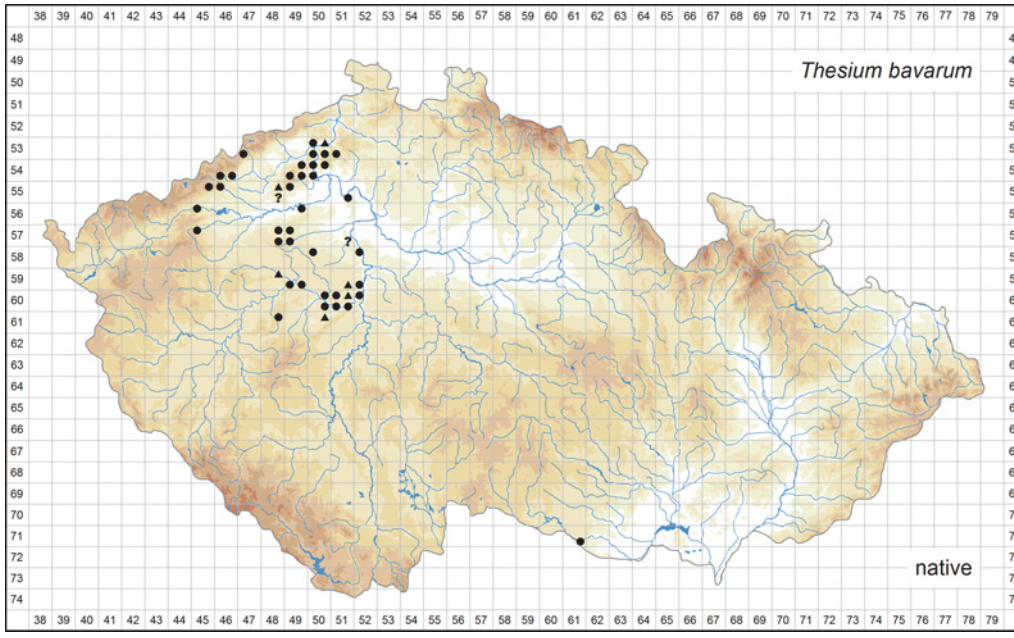

Fig. 74. – Distribution of *Thesium bavarum* in the Czech Republic: ● occurrence documented by herbarium specimens (37 quadrants), ▲ occurrence based on other records (6 quadrants). Prepared by Václav Dvořák & Martin Dančák.

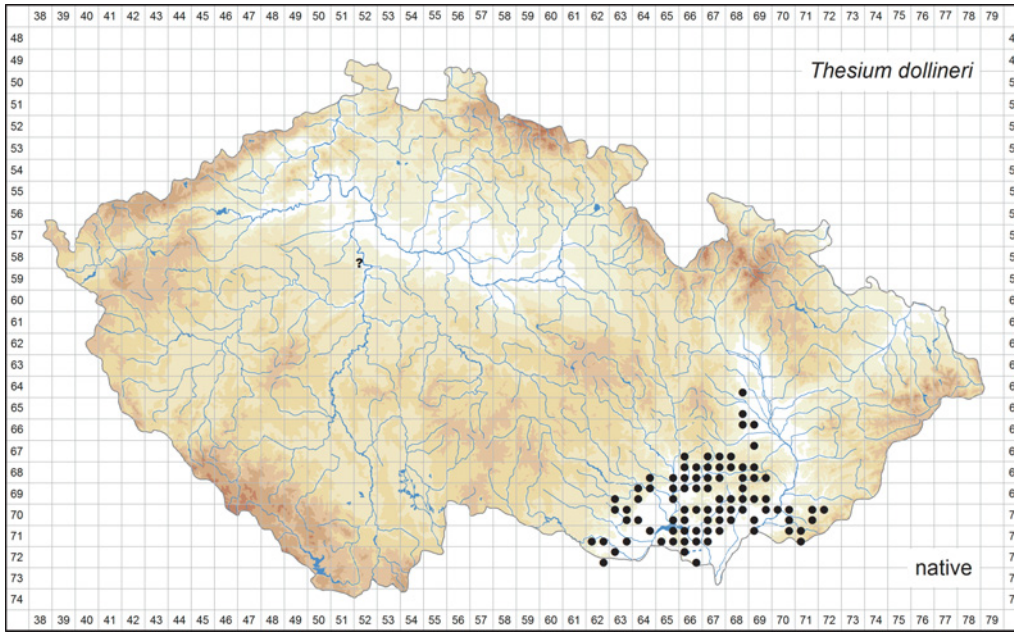

Fig. 75. – Distribution of *Thesium dollineri* in the Czech Republic (85 occupied quadrants). Prepared by Václav Dvořák & Martin Dančák.

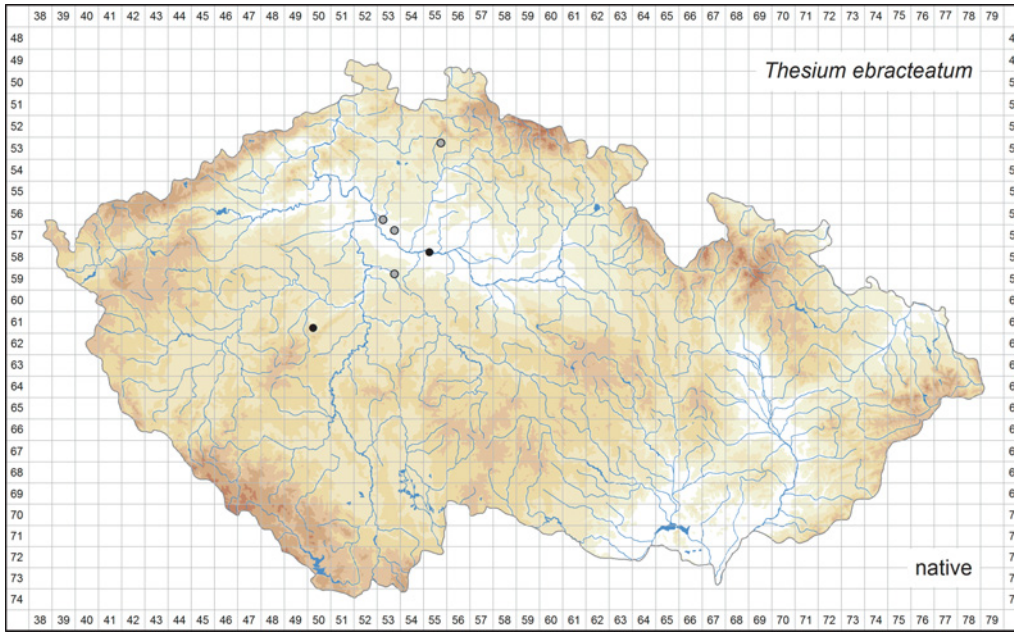

Fig. 76. – Distribution of *Thesium ebracteatum* in the Czech Republic: ● at least one record in 2000–2016 (2 quadrants), ◍ pre 2000 records only (4 quadrants). Prepared by Václav Dvořák & Martin Dančák.

acidic heathlands (Oberdorfer 2001) and in open thermophilous oak forests, often along roads (Dostálek et al. 2014). In the Czech Republic it is very rare, confined mostly to the Labe river basin, where at present it grows at a single locality near the village of Velenka. Another population was only recently discovered near the village of Běštín in the Brdy Mts (Prach & Zajíčková 2009). In the past *Th. ebracteatum* was known also from the surroundings of the town of Český Dub in northern Bohemia and the surroundings of the villages of Mělnická Vrutice, Běchovice and Dřísy in central Bohemia. Literature records for other sites were probably based on misidentifications. This species is decreasing throughout its distribution, and in Denmark and Slovakia it is already extinct (Heide-Jørgensen 2014, Eliáš et al. 2015). Its decline is caused probably by direct habitat destruction, drainage and changes in landscape management. It is therefore classified as critically threatened (Grulich 2012).

Thesium linophyllon (Fig. 77)

Thesium linophyllon is almost a central European species, which is absent from the Atlantic regions of Europe (Hendrych 1969). Its continuous distribution extends from central France in the west to Ukraine in the east, reaching north-eastern Germany and northern Poland in the north and southern Italy in the south (Meusel et al. 1965). In the Czech Republic *Th. linophyllon* grows in dry to moderately dry grasslands, on grassy and rocky slopes, in orchards, edges of shrubland or in open broad-leaved forests. It prefers nutrient-poor soils, basic to moderately acid (Těšitel et al. 2015). It occurs from low to middle altitudes, reaching its altitudinal maximum at 750 m in the Doupovské hory Mts. It is scattered in north-western and central Bohemia and scattered to rare in eastern Bohemia. In the eastern part of this 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. The isolated occurrence near the villages of Úvalno and Dívčí Hrad in Silesia has not been confirmed in the past decades. Though the most frequent species of this genus in the Czech Republic, it may have slightly declined because of eutrophication and abandonment of former pastures and other grasslands, both enhancing succession by scrub vegetation. It is therefore classified as vulnerable (Grulich 2012).

Thesium pyrenaicum (Fig. 78)

Thesium pyrenaicum is a European species. Its continuous distribution extends from the northern part of the Iberian Peninsula in the west to the Julian Alps in the east, northwards reaching the Harz Mts in Germany and south-western and western Bohemia in the Czech Republic (Meusel et al. 1965). Isolated occurrences are recorded in central Italy, in the Velebit Mts in Croatia, in the western Sudetes Mts in Poland and in the Moravian and Slovak Carpathians and their foothills. This species is classified as extinct in Poland and Slovakia (Kaźmierczakowa et al. 2014, Eliáš et al. 2015). Two subspecies are recognized: in the Czech Republic only the type subspecies occurs, while the plants from the Eastern Alps are assigned to subsp. *grandiflorum* (Jalas & Suominen 1976). *Thesium pyrenaicum* grows in both dry and moist grasslands, pastures, grassy slopes, heathlands and in drier parts of fen grasslands. It prefers acidic soils but also rarely grows on limestone. In the Czech Republic it occurs scattered at middle altitudes and in mountains of south-western

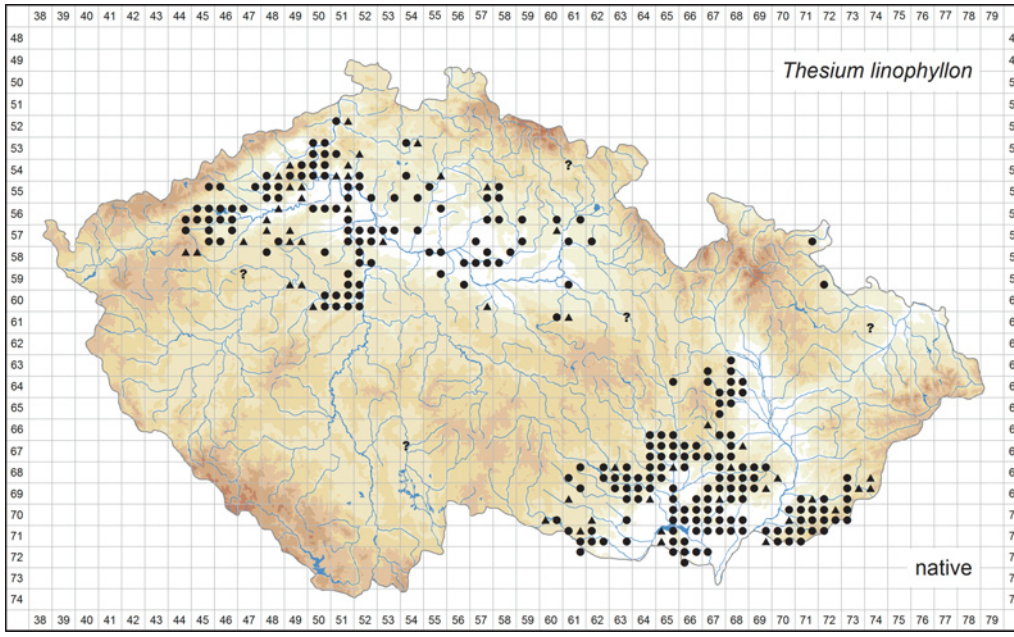

Fig. 77. – Distribution of *Thesium linophyllon* in the Czech Republic: ● occurrence documented by herbarium specimens (232 quadrants), ▲ occurrence based on other records (52 quadrants). Prepared by Václav Dvořák & Martin Dančák.

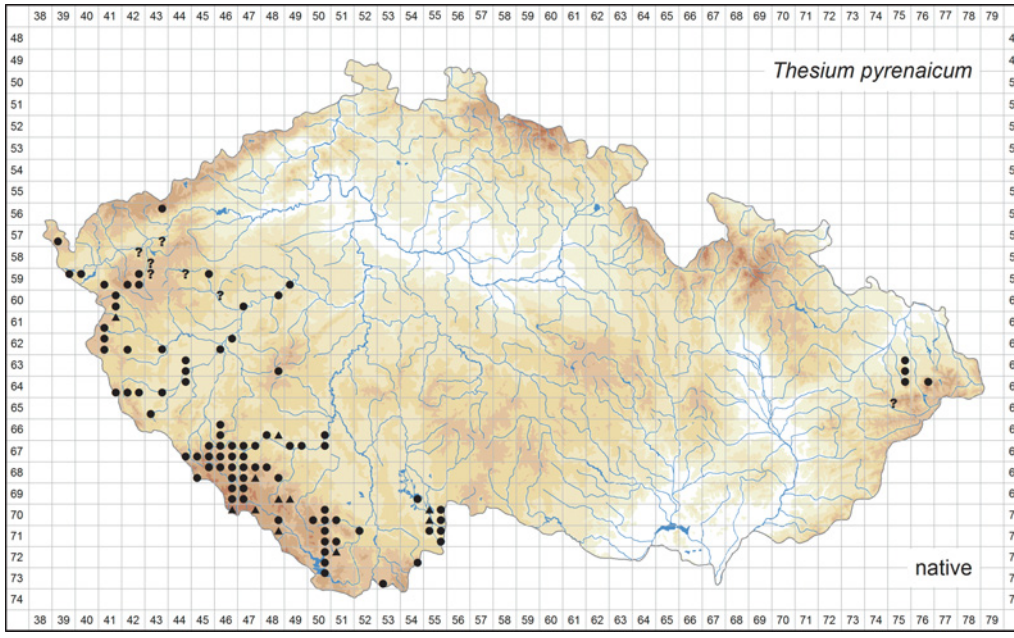

Fig. 78. – Distribution of *Thesium pyrenaicum* in the Czech Republic: ● occurrence documented by herbarium specimens (86 quadrants), ▲ occurrence based on other records (11 quadrants). Prepared by Václav Dvořák & Martin Dančák.

and western Bohemia, particularly in the Šumava Mts and their foothills, with an altitudinal maximum at about 1200 m. In the past it occurred also in the Moravskoslezské Beskydy Mts and their foothills, with the last record from the surroundings of the village of Malenovice dating back to the early 1990s (Dvořák & Dančák 2013). It is classified as endangered (Grulich 2012).

Thesium ramosum (Fig. 79)

Thesium ramosum has one of the widest distributions within the genus. This species is native to Eurasia, ranging from central Europe eastwards to central Asia (Hendrych 1968). In Europe it is distributed mainly in the Pannonian Basin and steppes north of the Black Sea. Recently, it was reported also in Lithuania, Belarus and Poland, where it has probably been introduced and is now spreading along railways (Kalinowski 2014). In Asia it occurs in Anatolia, the Caucasus Mts, northern Iran, western Turkmenistan, Kazakhstan and south-western Siberia, and further eastwards as far as the northern part of the Xinjiang province in China (Hendrych 1968, Fet & Atamuradov 1994). It has been introduced into North America (Alberta, Montana and North Dakota; Mincemoyer 2013, Brouillet et al. 2016). *Thesium ramosum* is a light-demanding species of sandy, calcareous dry soils. It is found in dry grasslands, fallows, railway embankments, edges of sandy paths and in the past also as a weed in crop fields. In the Czech Republic it is a native of warm areas in southern Moravia, where it is most frequent in its southernmost part. It has been introduced along railways to central Moravia and Bohemia. All records from other areas are erroneous and refer to other species. *Thesium ramosum* is classified as critically threatened (Grulich 2012). Because of frequent misidentifications, the distribution map is based mainly on revised herbarium specimens and our own field records, supplemented by a few selected records from the literature.

Thesium rostratum (Fig. 80)

Thesium rostratum has a rather small distribution mainly in the southern part of central Europe. Its western distributional limit runs through Switzerland and Germany, the northern one through the Czech Republic, the eastern one through Austria and Slovenia, and in the south it reaches north-eastern Italy. The very isolated occurrence in southern Croatia (Hendrych 1966a) is questionable and despite that this species is not considered doubtful in the Flora of Croatia Database (Nikolić 2016), it is not mentioned in the Red Data Book of Croatia (Nikolić & Topić 2005). Typical habitats of *T. rostratum* are calcareous fens and openings in oak forests; in the Alps it occurs also in calcareous pinewoods. In the Czech Republic it has always been extremely rare and it has been recorded only from four sites in Bohemia. Two of them, in the surroundings of the town of Kutná Hora and at the village of Skryje near the town of Rakovník, are documented each by a single herbarium specimen collected in the 19th century. At the other two, near the village of Bílichov in central Bohemia and on Zlín hill at the village of Dolní Lukavice near the city of Plzeň, *T. rostratum* has been repeatedly recorded. Of these, only the population near Bílichov still survives and thus this species is classified as critically threatened (Grulich 2012).

See www.preslia.cz for Electronic Appendices 1–91

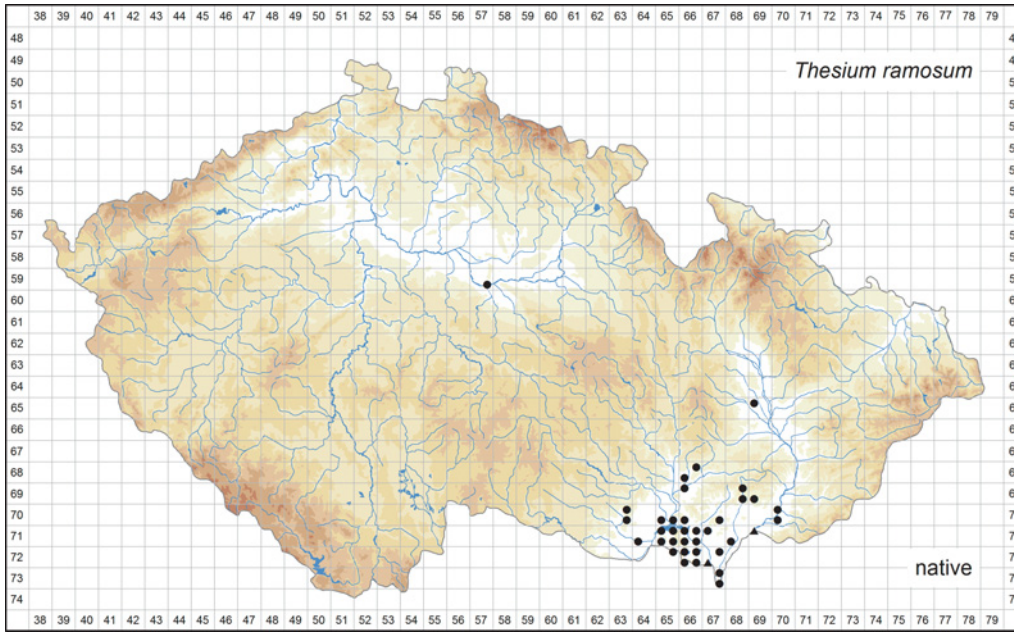

Fig. 79. – Distribution of *Thesium ramosum* in the Czech Republic: ● occurrence documented by herbarium specimens (35 quadrants), ▲ occurrence based on other records (2 quadrants). Prepared by Václav Dvořák & Martin Dančák.

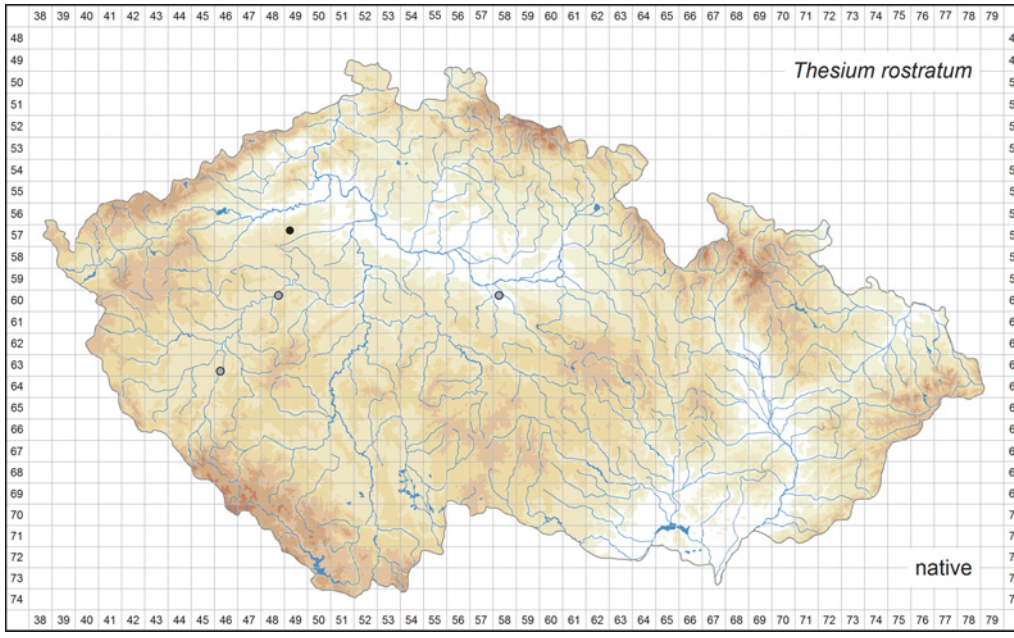

Fig. 80. – Distribution of *Thesium rostratum* in the Czech Republic: ● at least one record in 2000–2016 (1 quadrant), ● pre 2000 records only (3 quadrants). Prepared by Václav Dvořák & Martin Dančák.

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Souhrn

Čtvrtá část ze série prací věnovaných rozšíření cévnatých rostlin v České republice obsahuje síťové mapy a komentáře k 84 taxonům rodů *Aldrovanda*, *Alisma*, *Asclepias*, *Azolla*, *Blechnum*, *Botrychium*, *Butomus*, *Carex*, *Centaurea*, *Drosera*, *Dysphania*, *Hypochaeris*, *Illecebrum*, *Luronium*, *Ophioglossum*, *Persicaria*, *Pilularia*, *Rubrivena*, *Sagittaria*, *Salvinia*, *Scirpoides*, *Sideritis*, *Streptopus*, *Teesdalia* a *Thesium*. Základem jsou údaje získané excerpcí herbářů a literatury, terénní zápisy a nálezy dostupné v databázích, které prověřili taxonomičtí experti. Mezi mapovanými rostlinami je 40 taxonů červeného seznamu, a to různé míry ohrožení. Mezi mapovanými rostlinami lze rozlišit několik výrazných ekologických nebo taxonomických skupin. K druhům vázaným na váté písky nebo nejčastěji rostoucím na písčitých stanovištích patří *Carex pseudobrizoides*, *Hypochaeris glabra* a *Illecebrum verticillatum*. Všechny jsou dnes velmi vzácné, jejich výskyt byl v posledních letech potvrzen jen na malém počtu míst, a jsou proto zařazeny mezi kriticky ohrožené taxony. Vzácné a ohrožené vodní a mokřadní rostliny jsou zastoupeny druhy *Alisma gramineum*, *Salvinia natans*, *Drosera anglica*, *D. intermedia*, *D. rotundifolia*, *Luronium natans* a *Pilularia globulifera*. Dva posledně jmenované jsou druhy se subatlantským rozšířením, které se u nás nacházejí na jihovýchodní nebo východní hranici celkového areálu. Rovněž všechny druhy rodu *Thesium* a většina druhů rodu *Botrychium* patří mezi ohrožené vzhledem ke své vzácnosti, výraznému ústupu nebo kombinaci obojího. Dva druhy, vzácné ostatně i v minulosti, jsou u nás považovány za vyhynulé: *Botrychium simplex* bylo naposledy pozorováno před více než 120 lety, zatímco poslední spontánní výskyt *Aldrovanda vesiculosa* byl zaznamenán v roce 1952. Posledně jmenovaný druh, ohrožený dokonce globálně, však byl na několika místech před časem záměrně vysazen ve snaze najít stanoviště vhodná pro jeho dlouhodobé přežití. Rozšíření chrp ze skupiny *Centaurea* sect. *Jacea*, jejíž taxonomické zhodnocení komplikují polyploidizace a hybridizace, bylo donedávna nedokonale známé. Článek přináší mapy jednotlivých druhů, přičemž v několika případech je jejich rozšíření doplněno o informaci o výskytu jejich kříženců v těch polích, odkud výskyt rodičovských druhů zatím nebyl spolehlivě doložen. Dále byly zpracovány mapy několika nepůvodních druhů, zejména rostlin původně zavlečených do Evropy k okrasným nebo lékařským účelům. Sem patří *Asclepias syriaca*, *Azolla filiculoides*, *Carex muskingumensis*, *Rubrivena polystachya*, *Sagittaria latifolia*, tři druhy rodu *Dysphania* a dva druhy rodu *Persicaria*. Jiné cizokrajné druhy byly neúmyslně zavlečeny s dováženými zemědělskými surovinami: například *Dysphania melanocarpa* a *D. pumilio* s vlnou z Austrálie nebo *Persicaria pensylvanica* se sójou ze Severní Ameriky. 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.

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