Distributions of vascular plants in the Czech Republic. Part 5

Rozšíření cévnatých rostlin v České republice. Část 5

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The fifth part of the series on the distributions of vascular plants in the Czech Republic includes grid maps of 106 taxa of the genera *Arnica*, *Carduus*, *Cicuta*, *Coleanthus*, *Comarum*, *Dactylorhiza*, *Digitaria*, *Gagea*, *Gypsophila*, *Hieracium*, *Hydrocotyle*, *Leersia*, *Myosurus*, *Oenanthe*, *Oreopteris*, *Paris*, *Phalaris*, *Phegopteris*, *Pilosella*, *Polystichum*, *Portulaca*, *Pulicaria*, *Salicornia*, *Saxifraga*, *Suaeda*, *Thalictrum*, *Thelypteris*, *Tripolium*, *Utricularia*, *Veronica* and *Xeranthemum*. These maps were produced by taxonomic experts based on herbarium specimens, literature and field records. Almost two-thirds of the mapped taxa are on the national Red List. These include endangered plants of rather dry habitats such as *Gypsophila paniculata*, *Thalictrum foetidum*, *Veronica austriaca* and *Xeranthemum annuum* as well as species of various sorts of wetlands such as *Cicuta virosa* and species of the genera *Dactylorhiza* and *Utricularia*, or fens and intermittently wet meadows including *Oenanthe fistulosa*, *Thalictrum flavum* and *Th. simplex* subsp. *galioides*. Particularly endangered are ecological specialists; for example, many species of saline habitats such as *Salicornia perennans* and *Suaeda prostrata*, both confined to saline habitats, are now extirpated from this country. In contrast, *Saxifraga tridactylites*, previously a rare species found mainly on base-rich rock outcrops, has become more abundant by spreading along railways during the last two decades. Maps based solely or mainly on herbarium records revised by experts are provided for taxonomically critical groups, particularly those of the genus *Pilosella*. Alien species mapped in this paper include both archaeophytes and neophytes, with various modes of introduction. For example, *Carduus tenuiflorus* has been introduced with wool, *Digitaria ciliaris* with cotton, *Gypsophila perfoliata* with iron ore from Ukraine, while the ornamentals *G. elegans* and *G. scorzonerifolia* escaped from cultivation. The halophytic *Suaeda salsa* is recorded as a new alien species for this country's flora; it has recently colonized motorway verges of which the

doi: 10.23855/preslia.2017.333

salinity of the soil was increased by the application of de-icing salts. Two archaeophyte species, *Digitaria ischaemum* and *Portulaca oleracea*, are now classified as invasive. Spatial distributions and often also 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, endemic, flora, grid maps, herbaria, introduction, phytogeography, plant record, vascular plants

Introduction

The mapping of the distributions of plants in the Czech Republic has successfully entered its fourth year. So far, the team of taxonomic experts has produced grid-based distribution maps of 352 vascular plants, based on critically evaluated and sorted records, which are published in four papers (Kaplan et al. 2015, 2016a, b, 2017). The ultimate aim of this effort, which was initiated within the PLADIAS project (www.pladias.org), is to produce a series of publications that will form the basis of a complete atlas of the distribution of vascular plants in the Czech Republic.

From March to August 2017 the Pladias database was increased by almost 56,000 new records. Of these more than 39,000 resulted from the critical examination of herbarium specimens by taxonomic experts. Maps for a further 106 taxa were finished by the beginning of August 2017 and are included in this paper. These maps include both native and alien species, rare species confined to small geographic areas as well as widespread species, and endangered as well as common species.

Almost two-thirds of the mapped taxa are on the national Red List (Grulich 2012). They include species of various ecological requirements, including plants of rather dry habitats such as *Gypsophila paniculata*, *Thalictrum foetidum*, *Veronica austriaca* and *Xeranthemum annuum*, as well as endangered forest species such as *Polystichum braunii* and *P. aculeatum*. However, most of the included species are plants of various sorts of wetlands such as *Cicuta virosa*, *Comarum palustre*, *Dactylorhiza* species, *Hydrocotyle vulgaris*, *Thelypteris palustris* and *Utricularia* species, and plants of fens and intermittently wet meadows including *Oenanthe fistulosa*, *Thalictrum flavum* and *Th. simplex* subsp. *galioides*. Certain endangered species are remarkable ecological specialists: *Gagea bohemica* grows mainly on outcrops of acid rocks, *Coleanthus subtilis* is mostly found in fishponds with regular but short-term summer drainage, and *Pulicaria dysenterica*, *Salicornia perennans*, *Suaeda prostrata* and *Tripolium pannonicum* are confined to saline habitats. There has been an extraordinary change in the distribution and abundance of *Saxifraga tridactylites*. Originally it used to be a rare species found mainly on base-rich rock outcrops, but it has spread during the last two decades and now is widespread as it occupied ecologically similar habitats along railways. Six of the species mapped in this paper, namely *Dactylorhiza curvifolia*, *Oenanthe fistulosa*, *Oenanthe silaifolia*, *Polystichum setiferum*, *Salicornia perennans* and *Suaeda prostrata*, are now extirpated from this country.

In contrast, the Czech flora is being enriched by introduced plants. The exact mode of introduction of many species is unknown. However, a few neophytes were detected soon

after their arrival and their sources were identified: *Carduus tenuiflorus* has been introduced with wool, *Digitaria ciliaris* with cotton and *Gypsophila perfoliata* with iron ore from Ukraine. Others were first introduced intentionally into gardens as ornamentals and later escaped, examples being *Gypsophila elegans* and *G. scorzonerifolia*. A new alien species for this country's flora, *Suaeda salsa*, has recently colonized motorway verges where the salinity of the soil had been increased due to the application of de-icing salts. Many archaeophytes have become naturalized; those of the genus *Veronica* are now mainly found as weeds in fields and gardens. Two archaeophyte species, *Digitaria ischaemum* and *Portulaca oleracea*, are now classified as invasive.

Although the flora of the Czech Republic is not particularly rich in endemics (Kaplan 2012), three *Dactylorhiza* taxa mapped in this paper, namely *D. bohemica*, *D. carpatica* and *D. majalis* subsp. *turfosa*, are considered endemic to this country. Being confined to a single or only a few sites each, they all belong among critically threatened taxa, as well as some other *Dactylorhiza* taxa. Maps based solely or mainly on herbarium records revised by experts are provided also for selected species of the taxonomically critical genus *Pilosella*, which is well known for its complicated evolutionary history and complex breeding systems.

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 mainly the maps that resulted from recent revisions are printed.

Data sources

All relevant floristic data sources are used. Major national herbaria and some local and foreign collections, incl. BRNL, BRNM, BRNU, CB, CBFS, CELM, CESK, CHEB, CHOM, FMM, GM, HOMP, HR, KHMS, KMKV, LIM, LIT, MJ, MMI, MP, MZ, NJM, OH, OL, OLM, OMJ, OMP, OP, OSM, OVMB, PL, PR, PRA, PRC, ROZ, SOB, SOKO, SUM, VM, VYM, W, 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 the 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 1–106. 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 appear as straight lines, and the fields of the mapping grid are thus displayed as squares. 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 on the maps in order to distinguish one of the following attributes: (1) recent versus old records, (2) native occurrences versus introductions, or (3) records based on revised herbarium specimens versus all other records. These classifications of records are used only for those taxa where such distinction provides important information and, in addition, the amount and quality of records are sufficient. The mapping symbols used to indicate the different attributes of the records in particular grid cells are shown in Table 1. Symbols specific to individual maps are explained in their captions. To save space, rare taxa of the genera *Carduus*, *Dactylorhiza*, *Gagea*, *Gypsophila* and *Oenanthe* with distinct distributions are

shown in maps in groups of 2, with symbols and annotations of individual taxa on the maps distinguished using different colours. 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 of 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

Arnica montana (Fig. 1)

Arnica montana is most frequent in the mountains of central Europe, reaching France and the Pyrenees in the west, southern Scandinavia in the north, the Baltic countries, the adjacent part of Russia and the Eastern Carpathians in the east, and northern Italy and Croatia in the south (Hultén & Fries 1986, Meusel et al. 1992). In the Czech Republic *A. montana* occurs in short grasslands, heathlands, montane pastures, wet meadows, openings in coniferous forests and their fringes, along forest roads and in subalpine grasslands and dwarf-shrub vegetation. It grows mainly on humid, acidic and shallow soils, which are rich in humus but poor in nutrients and have developed on siliceous bedrock. In Bohemia *A. montana* is distributed mainly in the mountain ranges along the country's border and their foothills, and also in highlands such as the Slavkovský les hills, the Brdy hills and the south-western part of the Českomoravská vrchovina highlands. At lower elevations it is rare, being somewhat more frequent only in the Třeboňská pánev basin in southern Bohemia. It is absent from most of Moravia, having several localities only in the Eastern Sudetes, Moravskoslezské Beskydy and Javorníky Mts. It is still scattered to locally frequent in the mountains but declined at lower elevations during the second half of the 20th century due to abandonment of low-intensity grazing, intensification of agriculture and overall eutrophication followed by succession to tall-herb or woodland communities.

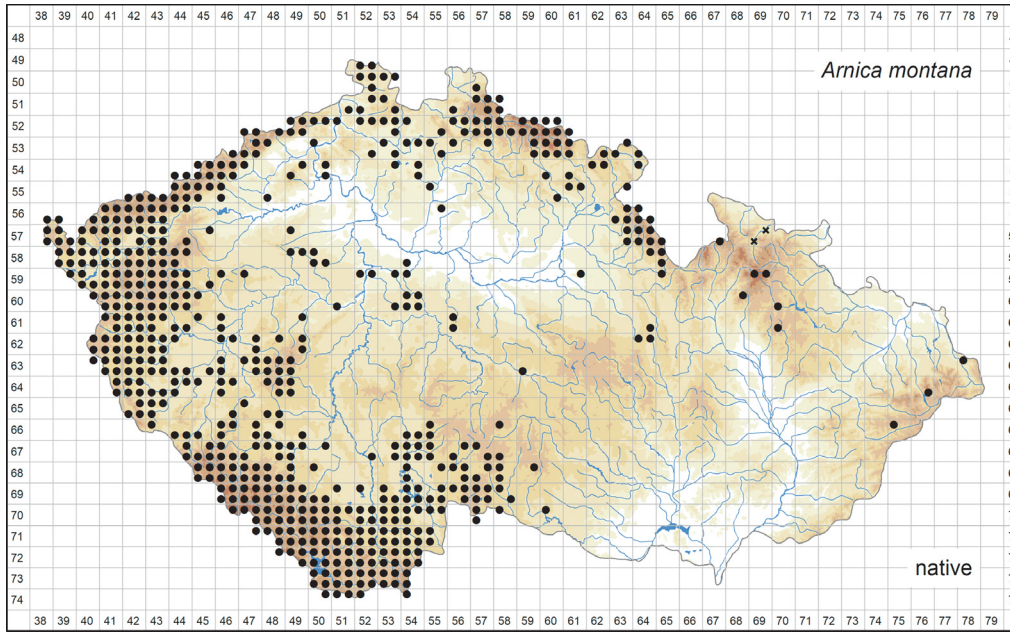

Fig. 1. – Distribution of *Arnica montana* in the Czech Republic: ● native (601 quadrants), × deliberate introductions only (2 quadrants). Prepared by Zdeněk Kaplan.

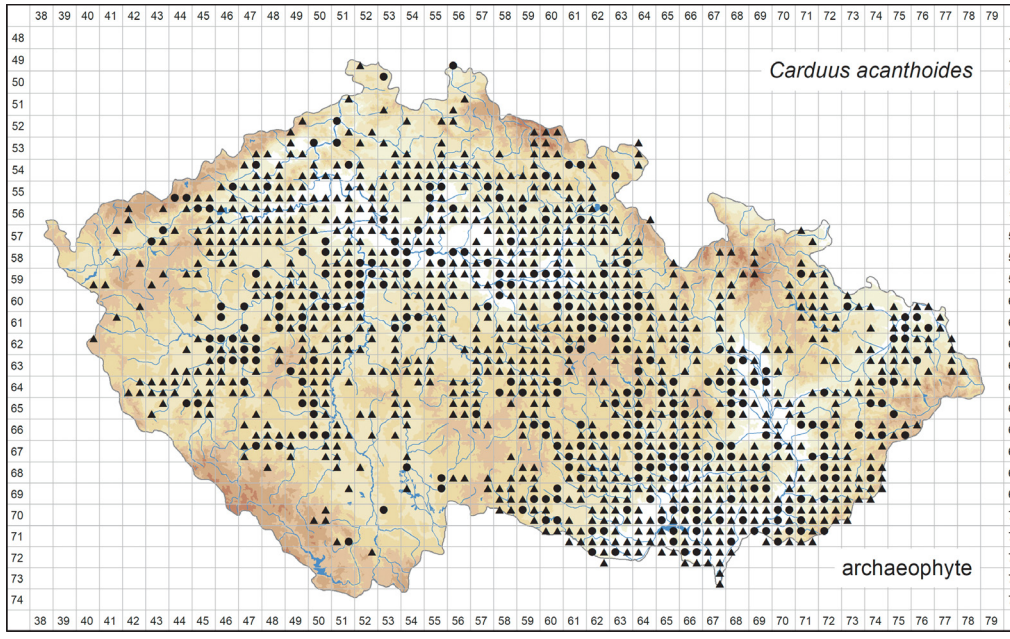

Fig. 2. – Distribution of *Carduus acanthoides* in the Czech Republic: ● occurrence documented by herbarium specimens (273 quadrants), ▲ occurrence based on other records (973 quadrants). Prepared by Jitka Štěpánková.

Carduus acanthoides (Fig. 2)

Carduus acanthoides is native to Europe and naturalized in China, North America and New Zealand. In Europe it occurs from eastern France in the west as far as the Southern Ural Mts in the east and from southern Scandinavia and the Baltic countries southwards to northern Italy, the central Balkan Peninsula, the Black Sea coast and the northern foothills of the Caucasus Mts (Kazmi 1964, Hultén & Fries 1986, Meusel & Jäger 1992, Greuter 2006). *Carduus acanthoides* grows in a wide range of habitats, most frequently in rather dry, well-drained sites. It is found in dry meadows, pastures, and other types of grasslands, on scree slopes, in clearings, disturbed areas along roads and railways, field edges, on disturbed river banks and gravelly or sandy alluvial deposits and in various ruderal sites in settlements. In the Czech Republic it is frequent in the lowlands and at middle elevations throughout the country except southern and south-western Bohemia, where it is relatively rare. It has been rarely introduced to the mountains, reaching its elevational maximum in the Hrubý Jeseník Mts at 1170 m.

Carduus crispus (Fig. 3)

Carduus crispus is native to Eurasia and naturalized in North America. In Europe two subspecies are distinguished: subsp. *crispus* and subsp. *multiflorus*. While the latter is found only in a narrow zone extending from the Netherlands in the north to eastern-central France in the south, *C. c.* subsp. *crispus* is continuously distributed from eastern France through the temperate zone of Eurasia as far as Lake Baikal in the east. In eastern Asia the related *C. dahuricus*, sometimes treated as *C. crispus* subsp. *dahuricus*, is widely distributed (Kazmi 1964, Hultén & Fries 1986, Meusel & Jäger 1992, Greuter 2006). This species grows on nutrient-rich, well water-supplied soils on the banks of rivers, streams and ditches, usually in tall-forb vegetation, scrub fringes and edges of forests. It is also found along forest roads, in clearings, on humid waste ground, in road ditches, in edges of wet arable fields and in humid ruderal sites in human settlements. In the Czech Republic it is frequent in the lowlands and at middle elevations throughout the country, except western and southern Bohemia, where it is less frequent. In other parts of this country gaps in the lowlands are due to under-recording rather than true absences. It has been less frequently introduced into the mountains, reaching its elevational maximum at 1200–1300 m.

Carduus nutans (Fig. 4)

Carduus nutans s. l. is native to Eurasia and has become an invasive species in various parts of the world, being considered as a noxious weed in North America, South America, South Africa, New Zealand and Australia (CABI 2017). The *C. nutans* complex is very variable and it is treated either as one species with several subspecies or as a group of geographically vicariant sibling species. Populations found in the Czech Republic belong to *C. nutans* subsp. *nutans*, whose distribution is confined to Europe. It occurs from the Pyrenees in the west as far as western European Russia in the east and from the southern part of the British Isles and middle Scandinavia in the north as far as southern Italy, the northern Balkan Peninsula and the western Black Sea coast in the south (Kazmi 1964, Meusel & Jäger 1992). *Carduus nutans* grows in a wide range of habitats, most frequently

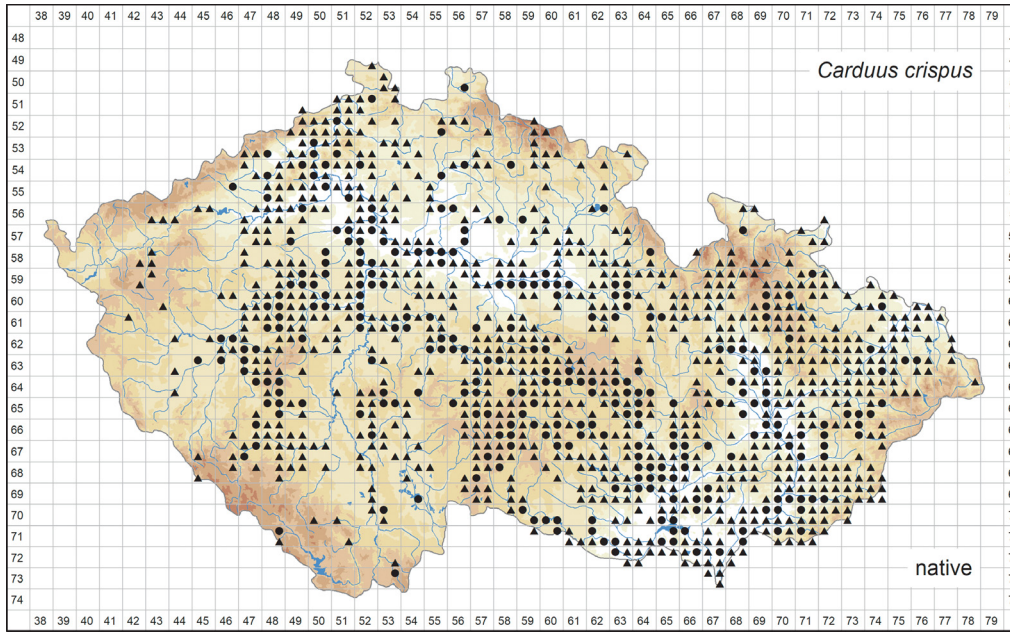

Fig. 3. – Distribution of *Carduus crispus* in the Czech Republic: ● occurrence documented by herbarium specimens (277 quadrants), ▲ occurrence based on other records (846 quadrants). Prepared by Jitka Štěpánková.

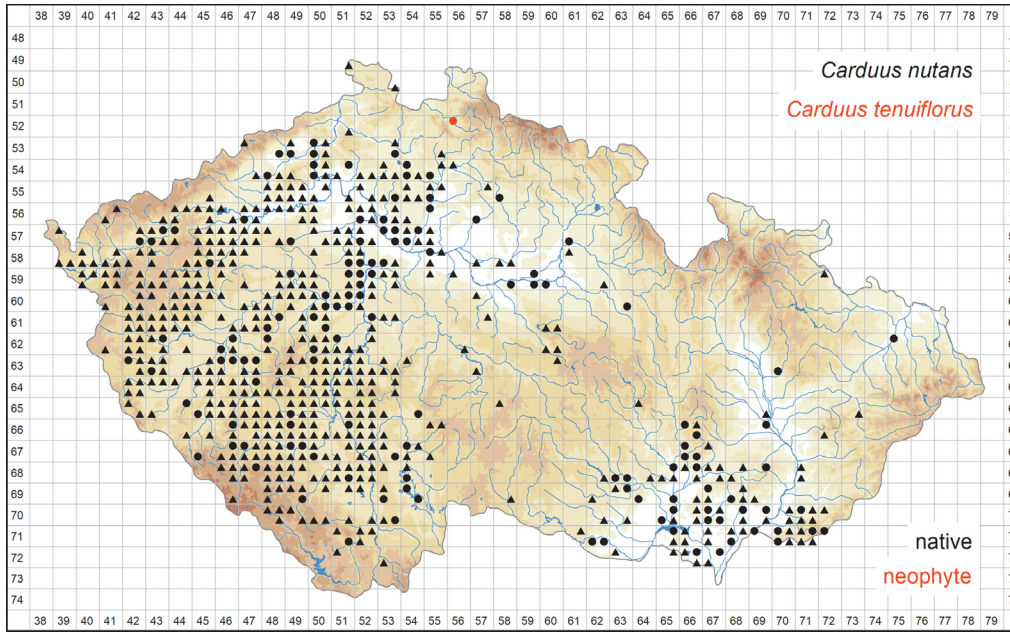

Fig. 4. – Distribution of *Carduus nutans* in the Czech Republic: ● occurrence documented by herbarium specimens (134 quadrants), ▲ occurrence based on other records (501 quadrants) and *C. tenuiflorus* (1 occupied quadrant) in the Czech Republic. Prepared by Jitka Štěpánková.

on rather dry, well-drained sites often over limestone or other calcium rich substrates. It is found in dry grasslands, often with low-intensity grazing, in abandoned fields, deforested rocky slopes, clearings, on disturbed ground along roads and railways, around castle ruins and in various ruderal sites in settlements. This species is frequent in the western half of Bohemia and in southern Moravia. It occurs in the lowlands and at middle elevations. In the mountains it is generally rare, being found mostly at disturbed sites; it reaches its elevational maximum in the Šumava Mts at about 1100 m. Being still quite frequent in some parts of the country, it is classified only as near threatened (Grulich 2012).

Carduus personata (Fig. 5)

Carduus personata has a small distribution confined to the montane areas of Europe. It is distributed in the Massif Central, Vosges, Alps, Sudetes, Carpathians, Apennines and mountains of the Balkan Peninsula. Two subspecies are recognized within this species: subsp. *personata*, found in central Europe and southwards extending to central Italy, and subsp. *albidus*, found in eastern and south-eastern Europe (Kazmi 1964, Meusel & Jäger 1992). In the Czech Republic only *C. p.* subsp. *personata* is present. It occurs on nutrient rich, moist soils, usually containing sand or gravel. It grows on the banks of rivers, streams and alluvial gravel sediments in submontane and montane areas. Above the timberline it occurs in wet places around springs and along small streams, most often in the lower parts of glacial cirques. It also inhabits wet places around mountain huts and abandoned stables, at lower elevations it can be found in road ditches. In the Czech Republic it is common in the Krkonoše Mts, Orlické hory Mts, Králický Sněžník Mts, Hrubý Jeseník Mts and in the south-eastern part of the Šumava Mts. In contrast, it is scattered to rare in the south-western part of the Krušné hory Mts and in the mountains of eastern Moravia, including the Javorníky Mts, Beskydy Mts and Bílé Karpaty Mts. Its occurrences in the Sudetes Mts are at the species' absolute northern distribution limit. It has also spread along rivers, namely the Labe, Jizera, Otava, Vltava and Morava rivers, reaching areas more distant from mountain ridges and an elevational minima of 200–300 m. At low elevations it frequently hybridizes with other species of the genus, particularly with *C. crispus*, which causes identification difficulties. Therefore, records from low elevations not documented by herbarium specimens remain uncertain. Unfortunately, there are few herbarium specimens of thistles and a map based only on revised herbarium specimens would be far from reality.

Carduus tenuiflorus (Fig. 4)

Carduus tenuiflorus is native to western Europe and North Africa, being introduced over most other continents. In Europe its primary range includes the Iberian Peninsula, islands in the western Mediterranean area, Italy, Great Britain, Ireland, the Netherlands, Belgium and western France (Greuter 2006). As a casual alien it has been recorded from the Czech Republic, Poland and Scandinavia. In the Czech Republic *C. tenuiflorus* was found in 1967 in the city of Liberec on wool waste deposits in a textile factory. It is classified as a casual neophyte (Pyšek et al. 2002).

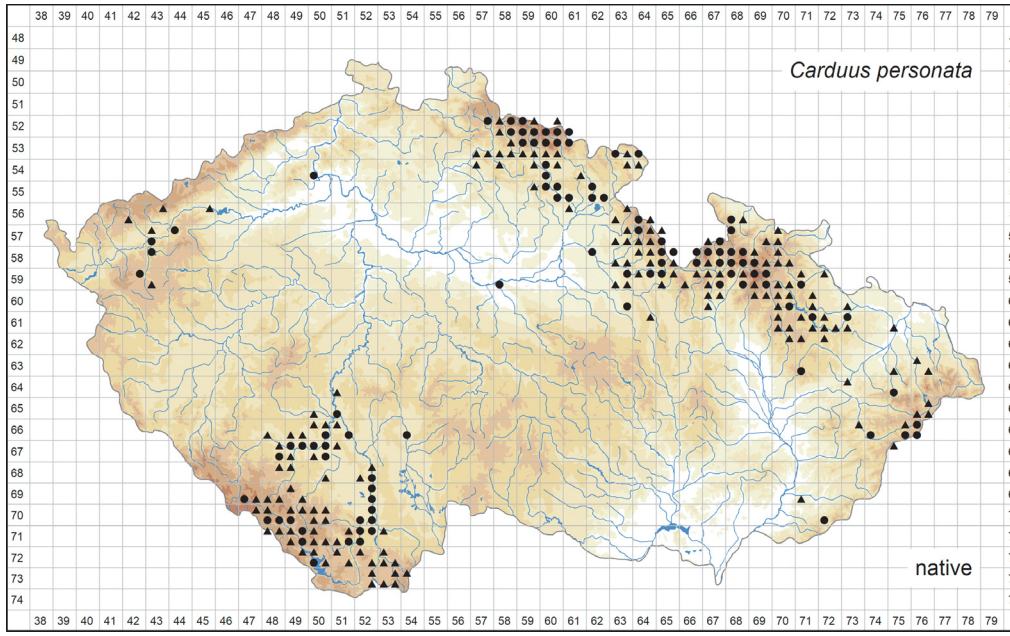

Fig. 5. – Distribution of *Carduus personata* (● occurrence documented by herbarium specimens: 99 quadrants, ▲ occurrence based on other records: 163 quadrants). Prepared by Jitka Štěpánková.

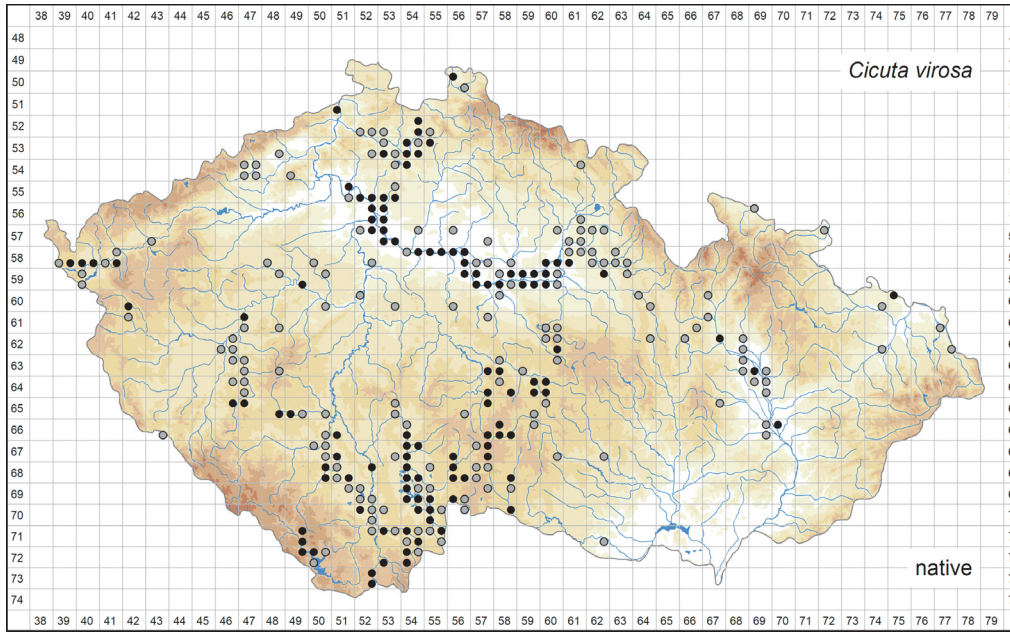

Fig. 6. – Distribution of *Cicuta virosa* in the Czech Republic: ● at least one record in 2000–2016 (117 quadrants), ● pre 2000 records only (157 quadrants). Prepared by Jan Prančl.

Cicuta virosa (Fig. 6)

Cicuta virosa is a circumpolar species occurring in temperate to boreal zones in Eurasia and North America. In Europe it is distributed northwards to Scotland and the Arctic Circle in Scandinavia and southwards to southern France, northern Italy, north of the Balkan Peninsula and the northern coast of the Black Sea (Meusel et al. 1965, Mulligan 1980, Hultén & Fries 1986, Lee & Downie 2006). In the Czech Republic *C. virosa* is mainly found in littoral zones of fishponds, in oxbows and alluvial pools, alder carrs and on the muddy banks of slowly running rivers and streams. This species is characteristic of wetland habitats in an advanced stage of terrestrialization with an accumulation of organic sediment, most often formed by a thick layer of thin, unconsolidated mud. It can occur in shallow, mesotrophic to eutrophic water, sometimes also on slightly dystrophic peaty substrates. Although it occurs mainly on shallowly flooded substrates, it is only to a certain extent adapted to fluctuations in water level. It may even grow completely emerged during summer, but requires at least permanently wet substrates (Šumberová 2011). The distribution of *C. virosa* in the Czech Republic follows the large river floodplains. It also occurs more frequently in some wetland-rich areas, such as in the fishpond basins in southern Bohemia, western parts of the Českomoravská vrchovina highlands or surroundings of the town of Česká Lípa in northern Bohemia, while being rare elsewhere. In the eastern part of this country this species was always rare, being almost completely absent from southern Moravia. It has been recorded from the lowlands up to 730 m a.s.l. in the Šumava Mts. This species is threatened mainly by strong eutrophication, habitat destruction, river regulation and drying out of wetlands as a result of climate change. It has markedly declined in abundance during the last decades and is currently classified as endangered (Grulich 2012). The decline is most striking in Moravia and Silesia, where this species has been recorded at only four sites since 2000.

Coleanthus subtilis (Fig. 7)

Coleanthus subtilis is a wetland annual species with a disjunct distribution in boreal and temperate zones in Eurasia and North America. One of the important distribution centres is situated in central Europe (Germany, Poland, Czech Republic, Austria, in the past also Slovakia) with outposts in western France, Norway, northern Italy and north-western Russia. Further occurrences are known from western Siberia, the Russian Far East and north-eastern China where this species is rather widespread. Several sites are also known from the western USA and Canada (Lampe 1996, Richert et al. 2016). This species prefers a slightly Atlantic to continental climate. Specific climate requirements and avoidance of calcareous bedrock are reflected in the patterns of its distribution throughout its whole range (Lampe 1996). *Coleanthus subtilis* grows on shores of lakes, rivers, ponds and water reservoirs, in the Czech Republic mainly in fishponds with regular but short-term summer drainage. This management ensures emergence of waterlogged substrate suitable for *C. subtilis* development, which takes 5–8 weeks (Lampe 1996) and consecutively, after the water level rises, it restricts the succession of perennial vegetation. *Coleanthus subtilis* grows on slightly acidic to neutral substrates, preferring sapropelic mud but in high moisture conditions it may also grow on sand. It survives temporarily unsuitable conditions (flooding, drought) as seeds, which form a persistent soil seed bank and are easily dispersed by water, waterfowl and on fish-farming equipment (Richert et

al. 2016). This strategy ensures long-term survival at sites as well as colonization of new or temporarily lost sites (e.g. after the removal of mud from fishponds). This species is well adapted even to recent, relatively intensive fish farming and has not declined significantly. An exception is the fishponds with combined fish and duck farming, i.e. management that results in big changes in substrate chemistry. Some old and isolated records in areas with suboptimal conditions (e.g. in the Moravskoslezské Beskydy Mts in north-eastern Moravia) may represent only temporary occurrences. For a long time, *C. subtilis* was only known from the fishpond landscapes in southern Bohemia and the Českomoravská vrchovina highlands. In the last two decades this species started to be recorded more frequently, partly due to a targeted search, partly due to summer droughts and high autumn temperatures contributing to a more frequent occurrence of suitable habitats and earlier production of seeds by late autumn-germinated plants that survived the winter. New sites were recently found in other areas, including eastern Bohemia, the Krušné hory Mts in north-western Bohemia (with species' elevational maximum at about 800 m) and south-western Moravia. Scattered occurrences are also documented in western and central Bohemia. The species is classified as vulnerable (Grulich 2012).

Comarum palustre (Fig. 8)

Comarum palustre has a large circumboreal distribution including temperate to Arctic regions of Eurasia, North America and the southern parts of Greenland. In Europe it reaches Iceland and the Scandinavian coast of the Arctic Ocean northwards, whereas it is rare in or absent from western France, the Mediterranean area and the most continental south-eastern regions (Meusel et al. 1965, Hultén & Fries 1986). In the Czech Republic *C. palustre* occurs in permanently waterlogged, sometimes also flooded habitats, most often on peaty substrates, such as fens, transitional mires, wet moss-rich meadows, tall sedge stands, margins of fishponds, willow scrub and alder carrs, less often also in bog hollows. Although it grows most abundantly on acidic soils, it can occur also in calcium-rich fens. It is most abundant at middle and high elevations in wetland-rich areas such as the northernmost, eastern and southern Bohemia as well as in the Českomoravská vrchovina highlands, with elevational maximum at 1280 m in the Krkonoše Mts. In contrast, it is rare in the lowlands and in the eastern part of this country, being almost absent from most of Moravia. This species can survive for quite a long time in degraded habitats, however, it does not tolerate strong eutrophication and changes in water regime; it is also endangered by habitat destruction and gradual climate change towards more frequent dry summers. Whereas it is still relatively common in the Bohemian highlands, it has strongly declined at low elevations and vanished completely from southern Moravia. It still survives at the last five sites in northern Moravia and Silesia, while being probably only deliberately introduced at the easternmost of them. Therefore, it is currently classified as of lower risk – near threatened (Grulich 2012).

Dactylorhiza bohemica (Fig. 9)

Dactylorhiza bohemica is considered endemic to the Czech Republic (Businský 1989, Eccarius 2016). It is an allopolyploid species of uncertain origin, probably derived from *D. traunsteineri*, and sometimes classified as *D. traunsteineri* subsp. *bohemica* (Eccarius 2016). It was described and is still known solely from the Jestřebské slatiny fens near

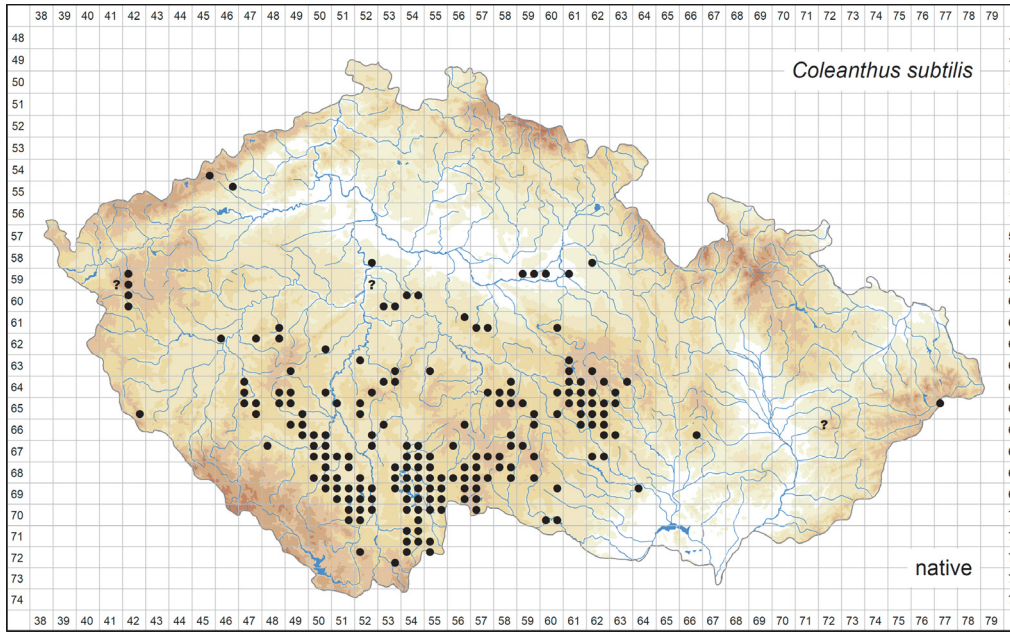

Fig. 7. – Distribution of *Coleanthus subtilis* in the Czech Republic (186 occupied quadrants). Prepared by Kateřina Šumberová & Michal Ducháček.

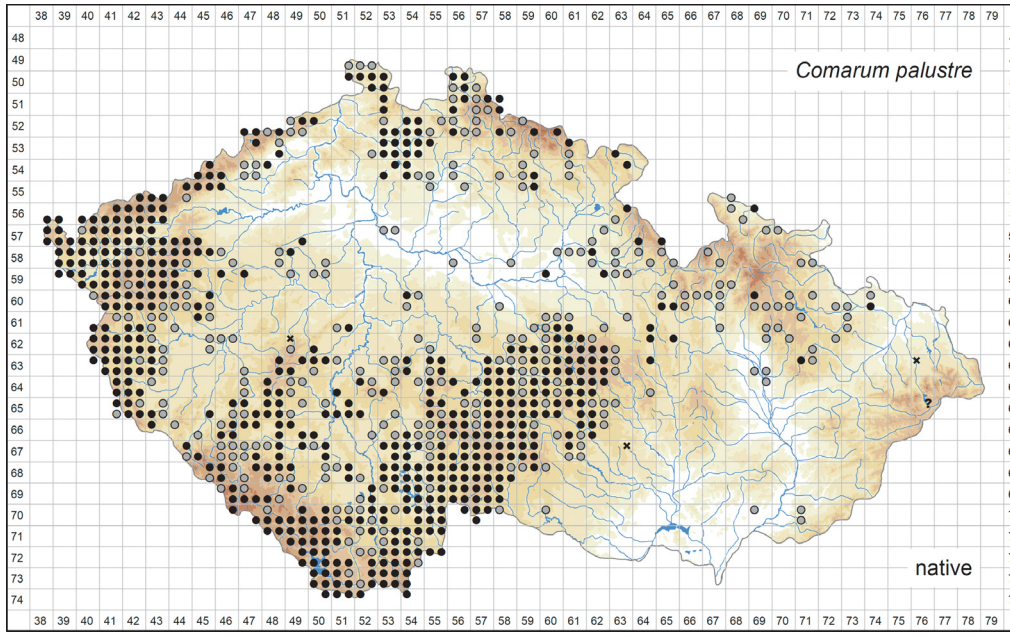

Fig. 8. – Distribution of *Comarum palustre* in the Czech Republic: ● at least one record in 2000–2016 (526 quadrants), ● pre 2000 records only (284 quadrants), × deliberate introductions only (3 quadrants). Prepared by Jan Prančl.

Jestřebí in northern Bohemia (Businský 1989), where two small populations can be currently found, in total accounting for tens or hundreds of individuals. Its populations are restricted to the most intact parts of the fens and transitional mires harbouring several relic species (e.g. *Ligularia sibirica*). The two recently known populations are found within a protected area and seem not to be currently threatened. Yet, this species is classified as critically threatened because of its small range (Grulich 2012).

Dactylorhiza carpatica (Fig. 9)

Dactylorhiza carpatica is endemic to the Czech Republic (Delforge 2006); it is probably of hybrid origin. It was originally described as *D. traunsteineri* subsp. *carpatica* (Batoušek & Kreutz 1999), but it probably originates from an interspecific hybridization of unknown parental taxa and should thus be considered a separate species. It is known from a single locality near the village of Březová in the Bílé Karpaty Mts, where it grows in a meadow spring with tufa formation. Currently, this population accounts for several tens of individuals and the locality is under legal protection. Although *D. carpatica* is not included on the Czech Red List (Grulich 2012), it deserves to be classified as critically threatened because of its rarity.

Dactylorhiza curvifolia (Fig. 10)

Dactylorhiza curvifolia is an allopolyploid taxon of the *D. traunsteineri* group, which is often considered conspecific with *D. russowii* (Delforge 2006, Kubát 2010); this concept is also followed here. In this wider circumscription, it is recognized from the Scandinavian Peninsula, the Baltic countries, Belarus and Russia eastwards as far as central Siberia, with isolated occurrences in north-eastern Germany and western Bohemia (Procházka & Velísek 1983, Delforge 2006, Eccarius 2016). It grows in fens and transitional mires with slightly acidic to slightly alkaline substrates. In the Czech Republic it only occurred at the Soos National Nature Reserve in westernmost Bohemia. Previously, the population was assigned to *D. traunsteineri* (Domin 1925) and it was re-classified as *D. russowii* based on herbarium specimens after the population had become extinct (Procházka 1979). Moreover, *D. curvifolia*, *D. russowii* and *D. traunsteineri* are very closely related and should not be separated according to recent molecular studies (Nordström & Hedrén 2009). Nevertheless, *D. curvifolia* (incl. *D. russowii*) is still recognized at the species level in the Czech Republic (Kubát 2010, Danihelka et al. 2012) and is classified as extinct (Grulich 2012).

Dactylorhiza incarnata (Fig. 11)

Dactylorhiza incarnata is widely distributed in Europe (although it is rare in the south) and Siberia eastwards as far as Lake Baikal. It is also recorded in Anatolia, the Caucasus Mts and northern Africa (Delforge 2006, Eccarius 2016). Two subspecies are recognized in the Czech Republic (Kubát 2010, Danihelka et al. 2012): the early flowering *D. incarnata* subsp. *incarnata* and the late flowering subsp. *serotina*. *Dactylorhiza incarnata* subsp. *incarnata* occurs throughout this species range. In the Czech Republic it mainly occurs in open habitats with damp to wet, alkaline to neutral, nutrient and base-rich, often calcareous soils. It usually inhabits calcareous fens and wet meadows, but it

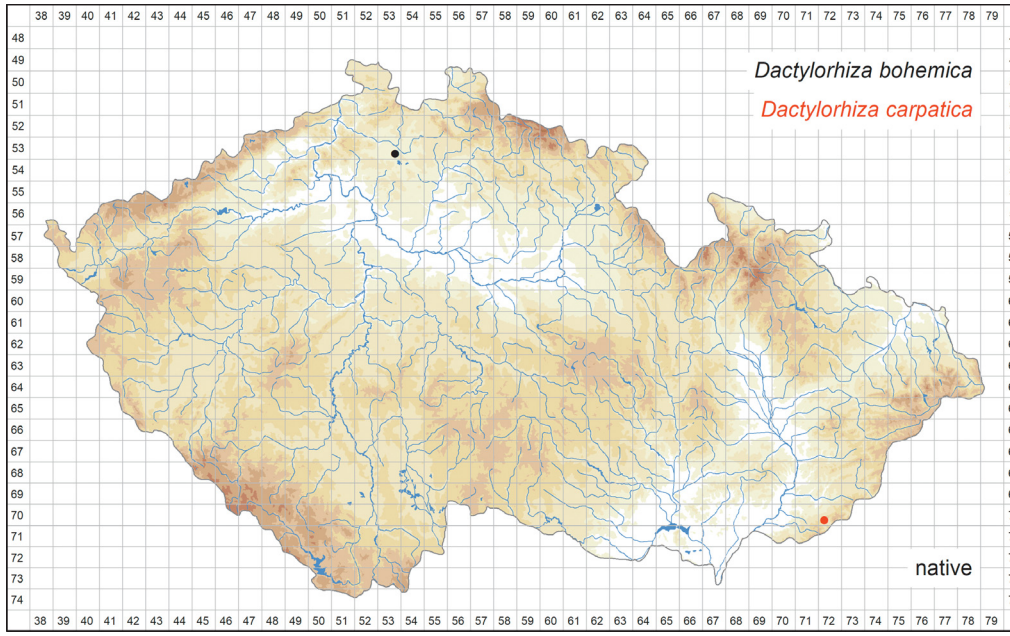

Fig. 9. – Distribution of *Dactylorhiza bohemica* (● at least one record in 2000–2016: 1 quadrant) and *D. carpatica* (● at least one record in 2000–2016: 1 quadrant) in the Czech Republic. Prepared by Bohumil Trávníček & Vojtěch Taraška.

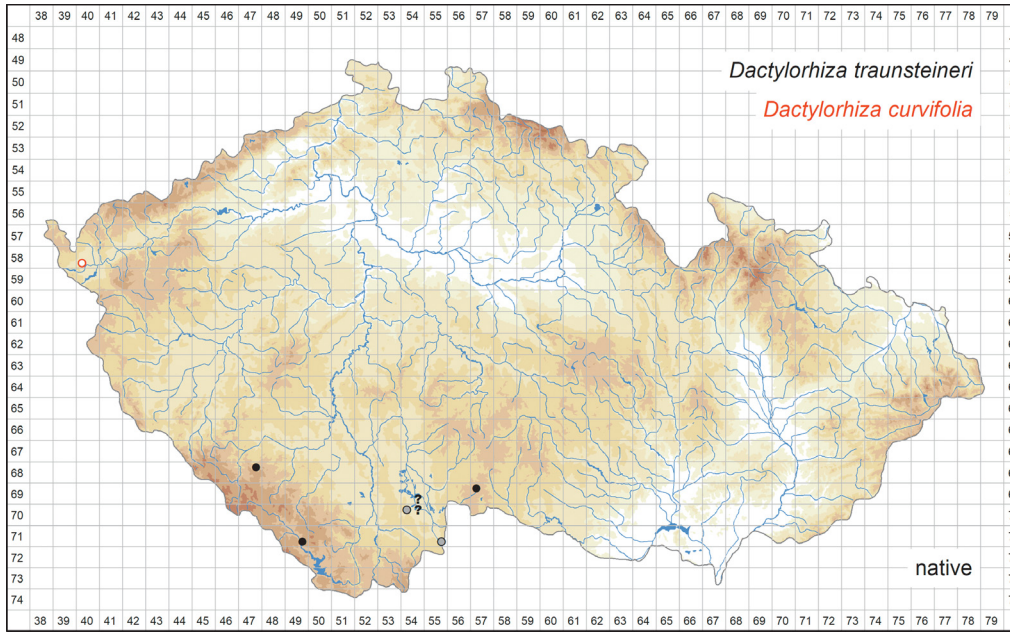

Fig. 10. – Distribution of *Dactylorhiza curvifolia* (○ pre 2000 records only: 1 quadrant) and *D. traunsteineri* (● at least one record in 2000–2016: 3 quadrants, ◍ pre 2000 records only: 2 quadrants) in the Czech Republic. Prepared by Bohumil Trávníček & Vojtěch Taraška.

can be found in secondary habitats as well. It occurs mainly in warm lowlands in both Bohemia and Moravia, where suitable habitats used to be quite common in the past. Several localities were scattered in the adjacent hilly areas, particularly in the Bílé Karpaty Mts, Českomoravská vrchovina highlands, northern Bohemia and Budějovická pánev basin. Elsewhere it is rare or absent. *Dactylorhiza incarnata* subsp. *incarnata* markedly declined in the second half of the 20th century mainly due to habitat loss. This subspecies is thus classified as critically threatened (Grulich 2012). The late flowering populations of *D. incarnata* are recorded in the British Isles, Scandinavia and central Europe under various epithets (*serotina*, *pulchella*, *coccinea*, *lobelii*); however, the taxonomic status of *D. i.* subsp. *serotina* is still uncertain and there is no comprehensive study that clarifies evolutionary relationships of various *D. incarnata* taxa. In central Europe the late flowering populations are usually called *D. incarnata* subsp. *serotina* (Procházka & Velísek 1983, Kubát 2010, Danihelka et al. 2012). This subspecies is known from several localities in northern Bohemia, mainly in the surroundings of the towns of Doksy and Česká Lípa. It is classified as critically threatened (Grulich 2012). Although the two subspecies are distinguishable by several morphological characters, in addition to flowering time, determination of herbarium specimens is precarious. Therefore, only a map for the species is presented here.

Dactylorhiza maculata agg. (Fig. 12)
Dactylorhiza fuchsii subsp. *fuchsii* var. *fuchsii* (Fig. 13), *D. fuchsii* subsp. *fuchsii var. psychrophila* (Fig. 14), *D. fuchsii* subsp. *sooana* (Fig. 15), *D. maculata* subsp. *maculata* (Fig. 16) and *D. maculata* subsp. *transsilvanica* (Fig. 17)

Dactylorhiza maculata agg. is a taxonomically critical complex of diploid and polyploid taxa. It is widely distributed from the Atlantic regions in Europe to Central Asia and from the northern coasts of Africa to northernmost Scandinavia and the Kola Peninsula (Delforge 2006, Eccarius 2016). Two species are usually recognized in the Czech Republic: *D. fuchsii* and *D. maculata* s. str. They were suggested to differ in their morphology, as well as ploidy level, since the former was considered to be diploid while the latter tetraploid. However, a number of studies indicate that the morphology is not always associated with the ploidy level, as the plants morphologically corresponding to *D. fuchsii* are often tetraploid, especially in central Europe (Jagiełło & Lankosz-Mróz 1988, Ståhlberg & Hedrén 2010). The same ploidy level very probably allows gene-flow between the two taxa. As a result, many tetraploid populations are probably of more complex origin and vary morphologically between *D. fuchsii* and *D. maculata* s. str. Moreover, a large number of taxa have been described within the *D. maculata* agg., of which some cannot be clearly assigned either to *D. maculata* s. str. or *D. fuchsii*. Because of these taxonomic ambiguities and until a comprehensive taxonomic revision is done, we maintain the concept of the two species traditionally used in Czech literature (Kubát 2010, Danihelka et al. 2012), although the whole complex may be better treated as a single species with several infraspecific taxa. Because of frequent misidentifications, all maps of both species and their infraspecific taxa are based solely on revised herbarium specimens. An additional map of *D. maculata* agg. was prepared based on both herbarium and non-herbarium records. Herbarium specimens that could not be reliably classified to subspecies or variety level were also included in this map. Nevertheless, most of these records probably

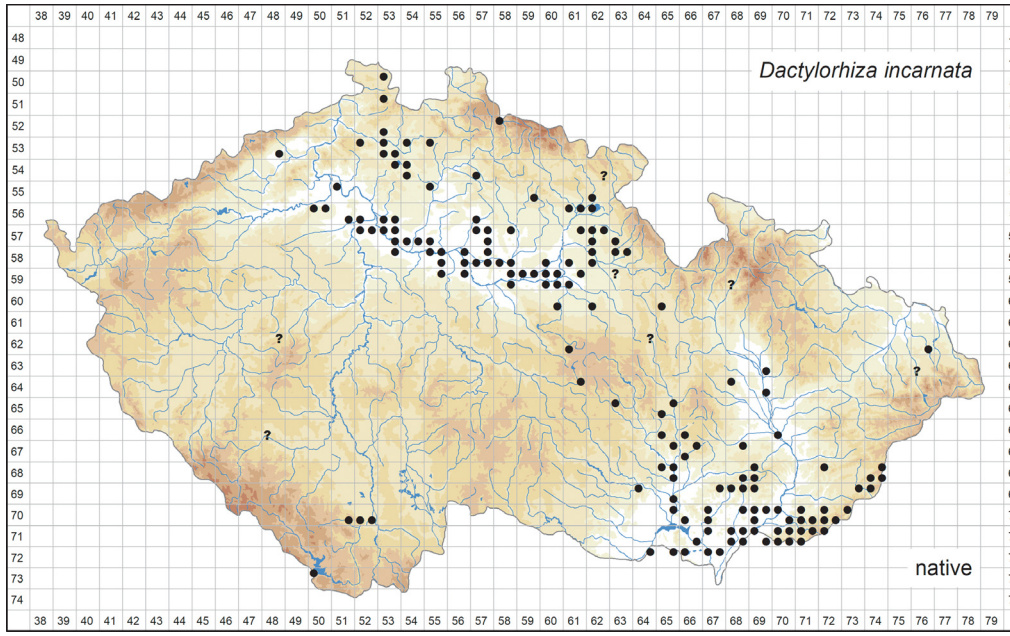

Fig. 11. – Distribution of *Dactylorhiza incarnata* in the Czech Republic (154 occupied quadrants). Prepared by Adam Kantor, Bohumil Trávníček & Vojtěch Taraška.

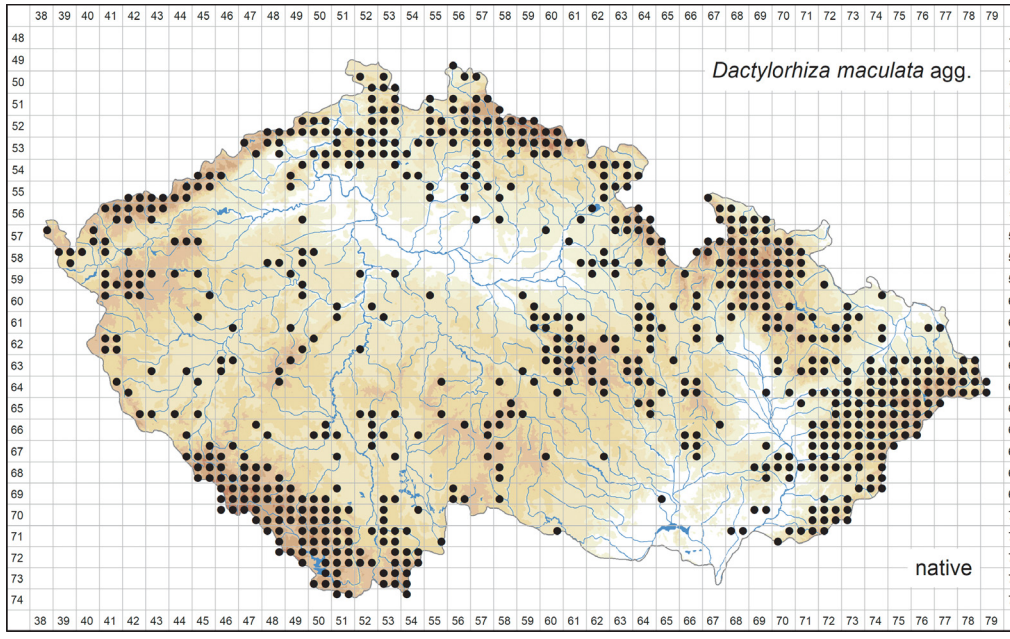

Fig. 12. – Distribution of *Dactylorhiza maculata* agg. in the Czech Republic (705 occupied quadrants). Prepared by Vojtěch Taraška & Bohumil Trávníček.

belong to *D. fuchsii* var. *fuchsii*, which is by far more widespread in the Czech Republic than the other taxa in this complex. The entire complex occurs from the lowlands to the subalpine vegetation belt, but mainly in the mountains.

Dactylorhiza fuchsii var. *fuchsii* is widely distributed across temperate and boreal zones in Europe and Asia. It occurs in most of Europe, being absent from northern Scandinavia and the warm southern parts of Europe, only reaching the northern part of the Iberian Peninsula. The southern border of its range in the Balkan Peninsula is not clear because of the confusion with *D. saccifera*. In Asia it occurs in the Caucasus Mts, Central Asia and southern Siberia eastwards as far as Lake Baikal (Delforge 2006, Eccarius 2016). Overall, its distribution is poorly known because of confusions with other taxa of the *D. maculata* agg. It inhabits a wide range of natural and semi-natural habitats, preferably on wet soils. It grows in forests, forest edges, fringes of mountain brooks, both forest and non-forest springs, marshes, peat bogs, moss-rich fens, wet to mesophilous meadows and pastures, road ditches etc. It grows mainly on alkaline to slightly acidic soils. In the Czech Republic it occurs from the colline to supramontane belt, more frequently in the mountains up to 1250 m a.s.l. Since the map of *D. fuchsii* var. *fuchsii* is based solely on revised herbarium specimens, the taxon is probably more widespread than indicated by the map. A lot of the specimens revised as *D. maculata* agg. are likely to be just atypical individuals of *D. fuchsii* var. *fuchsii*; these records are not included in the map for this variety. Also, most of the earlier non-herbarium records of "*D. maculata*" probably refer to *D. fuchsii* (var. *fuchsii*), because the two species were not distinguished until the second half of the 20th century. Although *D. fuchsii* var. *fuchsii* is still the second most common *Dactylorhiza* (after *D. majalis* subsp. *majalis*) in the Czech Republic, the number of its localities has recently declined (Jatiová & Šmiták 1996) and this variety is thus classified as of lower risk – near threatened (Grulich 2012).

The total distribution of *D. fuchsii* var. *psychrophila* is impossible to asses because of its taxonomic ambiguity. In the Czech Republic this name is traditionally used for populations known from the subalpine vegetation belt in the Krkonoše Mts and one locality in the Hrubý Jeseník Mts. In addition, this variety was reported to occur in the Krušné hory and Orlické hory Mts and Mt Králický Sněžník. However, our field experience indicates that the populations in the Krušné hory and Orlické hory Mts are not the same as those in the Krkonoše and Hrubý Jeseník Mts. We have not seen any herbarium specimens resembling *D. fuchsii* var. *psychrophila* from Mt Králický Sněžník. The type of *D. psychrophila* is from northern Finland (Vermeulen 1947) and represents a taxon that is widely distributed in northern Scandinavia. However, the Czech populations probably differ in their morphology, as well as ploidy level: *D. psychrophila* is reported to be diploid and closely related to *D. fuchsii* var. *fuchsii* (Averyanov 1982, Eccarius 2016), while the Czech plants are tetraploid (Krahulcová 2003, Taraška, Batoušek & Trávníček unpubl.) and their taxonomic position is uncertain, as they are often assigned to *D. maculata* s. str. (e.g. Eccarius 2016, Jagiełło 1988). According to Devillers & Devillers-Terschuren (2000), the populations in the Sudetes Mts might be an independent, local evolutionary unit. In this case their correct name should be based on the basionym *Orchis maculata* var. *sudetica* Rchb. f., described from the Krkonoše Mts. According to some authors, these populations should be considered to be only an ecomorphosis of *D. fuchsii* var. *fuchsii*, adapted to the extreme environmental conditions in the subalpine belt (Potůček 1969). Since this taxonomic riddle remains unresolved, here we consider these populations to be

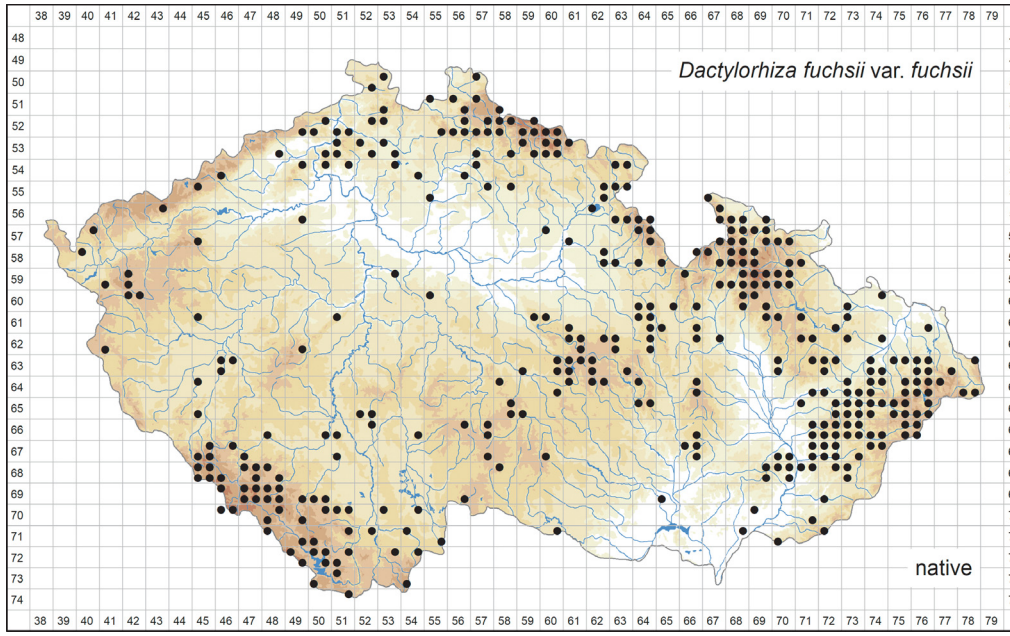

Fig. 13. – Distribution of *Dactylorhiza fuchsii* (subsp. *fuchsii*) var. *fuchsii* in the Czech Republic (374 occupied quadrants). Prepared by Vojtěch Taraška & Bohumil Trávníček.

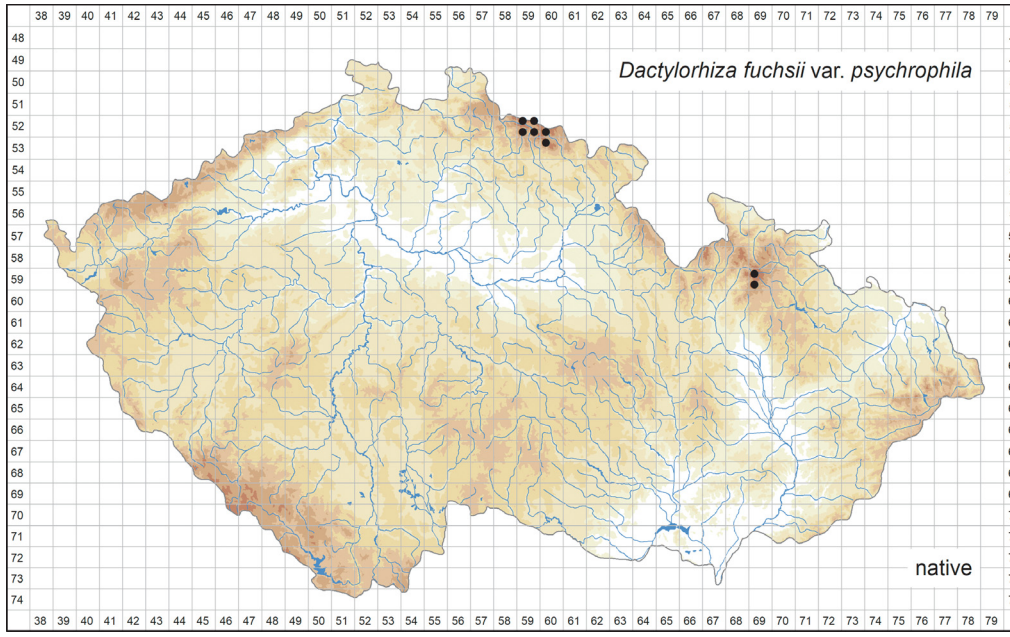

Fig. 14. – Distribution of *Dactylorhiza fuchsii* (subsp. *fuchsii*) var. *psychrophila* in the Czech Republic (8 occupied quadrants). Prepared by Vojtěch Taraška & Bohumil Trávníček.

a unique evolutionary lineage, for which we provisionally use the name *D. fuchsii* var. *psychrophila*, following the current Czech plant checklist (Danihelka et al. 2012). In the Krkonoše Mts this variety is abundant in subalpine springs, marshes and cirque vegetation, where it reaches an elevation of 1350 m. However, it also occurs in wet meadows at lower elevations, particularly close to mountain huts. In the Hrubý Jeseník Mts it was recently confirmed only in cliff vegetation in the Velká kotlina cirque but in the past it also occurred in the Malá kotlina cirque. Although its populations are abundant and not directly threatened, it is classified as endangered because of its overall rarity (Grulich 2012).

Dactylorhiza fuchsii subsp. *sooana* occurs in Hungary, Slovakia and the Czech Republic (Batoušek 1995), where it was recently recorded at several localities in the Bílé Karpaty Mts. In addition, there is an old herbarium specimen from the eastern part of Litenčické vrchy hills, which might also belong to this taxon. This subspecies grows in wet and mesophilous meadows, spring fens and edges of forests in the supracolline belt, usually on fresh, slightly acidic to slightly alkaline soils. This subspecies is classified as critically threatened (Grulich 2012).

The total distribution of *D. maculata* subsp. *maculata* is difficult to estimate because of confusion with *D. fuchsii* var. *fuchsii*, which was not reliably distinguished until recently and has never been accepted as a separate species by many authors (e.g. Buttler 2000, Ståhlberg & Hedrén 2010). *Dactylorhiza maculata* subsp. *maculata* is considered to occur in temperate and boreal zones in Eurasia. It is widespread in Atlantic and northern Europe, including Scandinavia and the Baltic countries. In central and eastern Europe it is rather scattered. Its range extends as far as central Siberia (Delforge 2006, Eccarius 2016). It occurs mainly in fens and mires, peat bogs and wet meadows, mainly on acidic to neutral soils with a permanent water supply. In the Czech Republic this subspecies is known from the Jestřebské slatiny fens near the town of Doksy and from the Krušné hory Mts in northern Bohemia. It is classified as critically threatened (Grulich 2012).

Dactylorhiza maculata subsp. *transsilvanica* is recorded mainly in the mountains in central and south-eastern Europe: the Carpathians and adjacent areas (Czech Republic, Slovakia, north-eastern Hungary, Romania), north of the Balkan Peninsula (Bosnia and Herzegovina, Bulgaria) and the Eastern Alps (Slovenia) (Eccarius 2016). Nevertheless, its taxonomy has not yet been resolved and the name may be used for various evolutionary lineages in different countries. *Dactylorhiza maculata* subsp. *transsilvanica* grows in spring fens, wet to mesophilous meadows, mountain meadows and pastures. In the Czech Republic it has been recorded in the Bílé Karpaty Mts, Hostýnské vrchy hills, Javorníky Mts and the Moravskoslezské Beskydy Mts. In addition, there is a single collection from the Dúbrava forest near the town of Bzenec, which probably belongs to this subspecies. In the Moravskoslezské Beskydy Mts it was believed to form mixed populations with *D. fuchsii* var. *fuchsii* and their hybrids, with the main discriminating traits being the colour of their flowers and the occurrence of the spots on the leaves (Batoušek 2010, Vlačiha 2013). However, our research indicates that these populations do not comprise two distinct species (all plants are uniform in terms of quantitative traits and ploidy level) and they should be considered to be two forms of a single taxon. Thus, *D. maculata* subsp. *transsilvanica* in our concept includes both of these colour forms, as well as transitional individuals. Populations in the Bílé Karpaty Mts are rather uniform in terms of flower and leaf pigmentation. The occurrence of this subspecies in the Javorníky Mts has not been

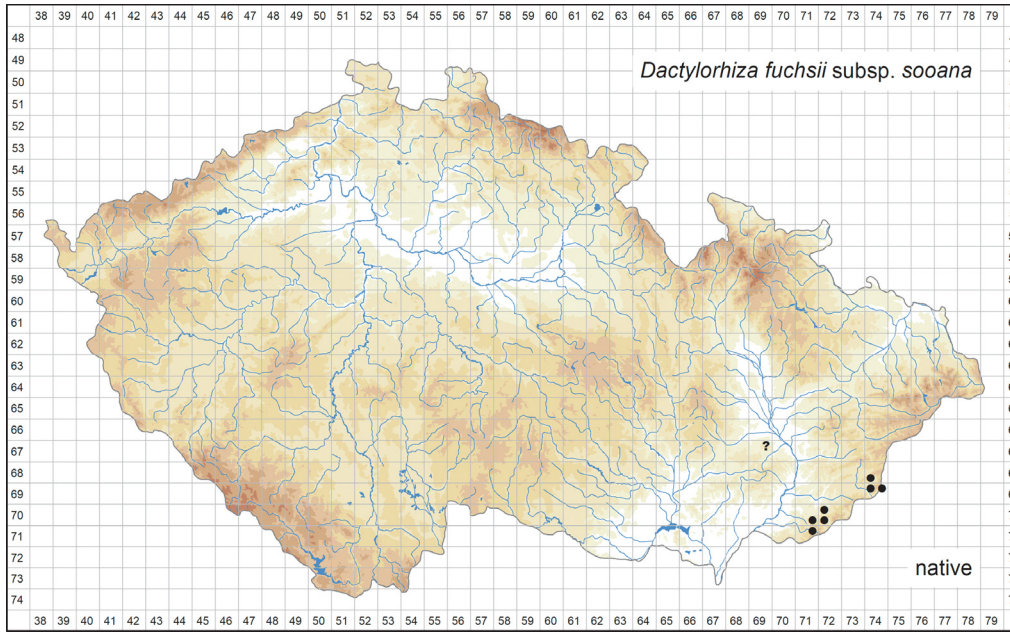

Fig. 15. – Distribution of *Dactylorhiza fuchsii* subsp. *sooana* in the Czech Republic (7 occupied quadrants). Prepared by Vojtěch Taraška & Bohumil Trávníček.

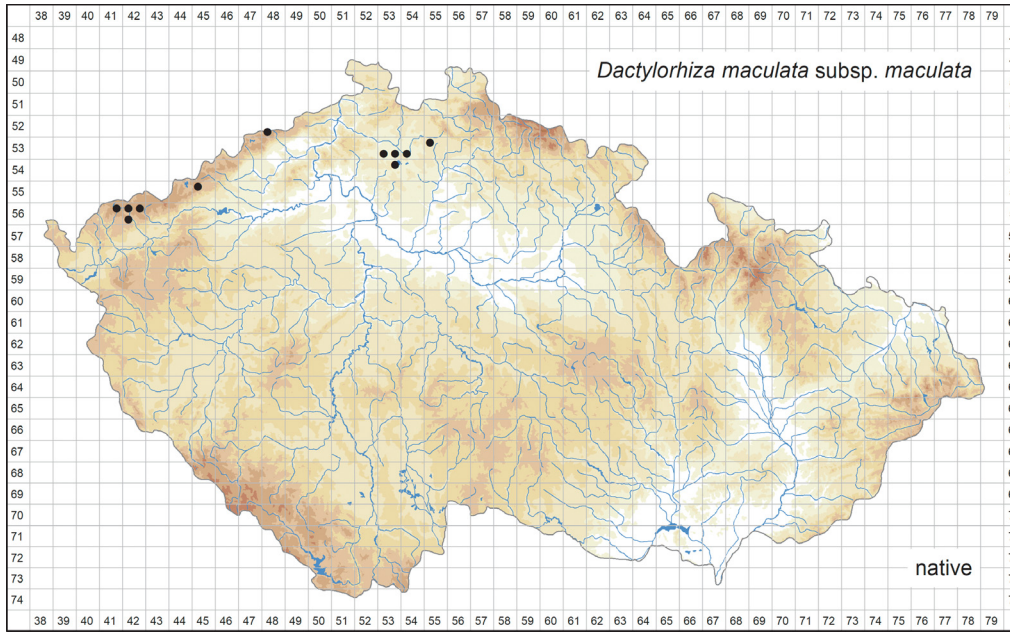

Fig. 16. – Distribution of *Dactylorhiza maculata* subsp. *maculata* in the Czech Republic (11 occupied quadrants). Prepared by Vojtěch Taraška & Bohumil Trávníček.

recently confirmed. The relationships between populations from various parts of this subspecies' range and their relationships to the type population from Transylvania need further investigation. In the Czech Republic this subspecies is classified as critically threatened (Grulich 2012).

Dactylorhiza majalis subsp. *majalis* (Fig. 18)

Dactylorhiza majalis subsp. *majalis* is a taxon of an allopolyploid origin, widely distributed in western and central Europe, reaching southern Scandinavia in the north, France in the west, the Pyrenees and Alps in the south and Ukraine and the European part of Russia in the east, but the eastern border of its range is poorly known because of confusion with related taxa (Delforge 2006, Eccarius 2016). *Dactylorhiza majalis* subsp. *majalis* grows in various types of wetlands such as springs, fens, mires, margins of peat bogs, reed and sedge beds, wet meadows and pastures, but also in man-made habitats, mainly wet road ditches. It usually occurs in open vegetation with slightly acidic to alkaline substrates. In the Czech Republic it occurs from the lowlands to the subalpine belt, up to a maximum of 1380 m a.s.l. In the past this subspecies was fairly common in most of this country; it was absent only from the driest areas in southern Moravia and north-western Bohemia, where it lacked suitable habitats. On the other hand, it was frequent in the mountains as well as in fishpond basins. In the second half of the 20th century its populations decreased due to habitat degradation or destruction, usually caused by draining. Currently, this subspecies is abundant only in the mountains and rather rare at middle and low elevations, which were more affected by landscape changes. Although it remains the most frequent *Dactylorhiza* in the Czech Republic, it is classified as vulnerable (Grulich 2012).

Dactylorhiza majalis subsp. *turfosa* (Fig. 19)

Dactylorhiza majalis subsp. *turfosa* is usually considered a Bohemian endemic (Delforge 2006, Eccarius 2016). It very probably originated from hybridization between *D. majalis* subsp. *majalis* and *D. traunsteineri* (Kubát 2010). For this reason, it is sometimes classified as *D. traunsteineri* subsp. *turfosa*. It is morphologically and phenologically transitional between its putative parents, while being ecologically close to *D. traunsteineri*. However, populations are morphologically variable, forming a continuous transition towards both of its parents. Its taxonomic status is thus questionable and it might be perhaps better regarded as an interspecific hybrid, *D.* ×*dufftiana*, or as a less stabilized local hybridogenous species, analogous to the endemic species *D. bohemica* and *D. carpatica*. *Dactylorhiza majalis* subsp. *turfosa* was described from the Šumava Mts (Procházka 1982), where it occurs at several localities in the vicinity of the villages of Horská Kvilda and Filipova Huť. It is confined to acidic substrates; it grows in transitional mires and oligotrophic, moss-rich peat bogs in the supramontane belt at an elevations of around 1000 m. A small population morphologically corresponding to *D. majalis* subsp. *turfosa* occurs also in the Krušné hory Mts. However, its relations to the populations in the Šumava Mts are unresolved and thus it cannot be reliably included into the same taxon. Further investigation is needed to assess the relationship between the populations from these two areas, as well as from areas outside the Czech Republic (e.g. Bavarian Alps). Because of its rarity, *D. majalis* subsp. *turfosa* is classified as critically threatened (Grulich 2012).

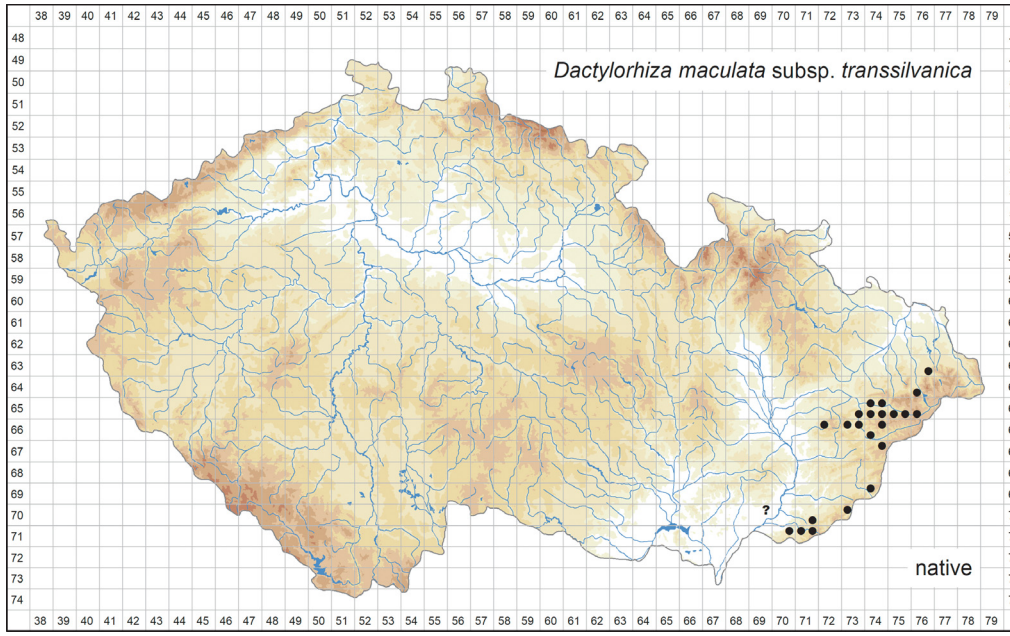

Fig. 17. – Distribution of *Dactylorhiza maculata* subsp. *transsilvanica* in the Czech Republic (22 occupied quadrants). Prepared by Vojtěch Taraška & Bohumil Trávníček.

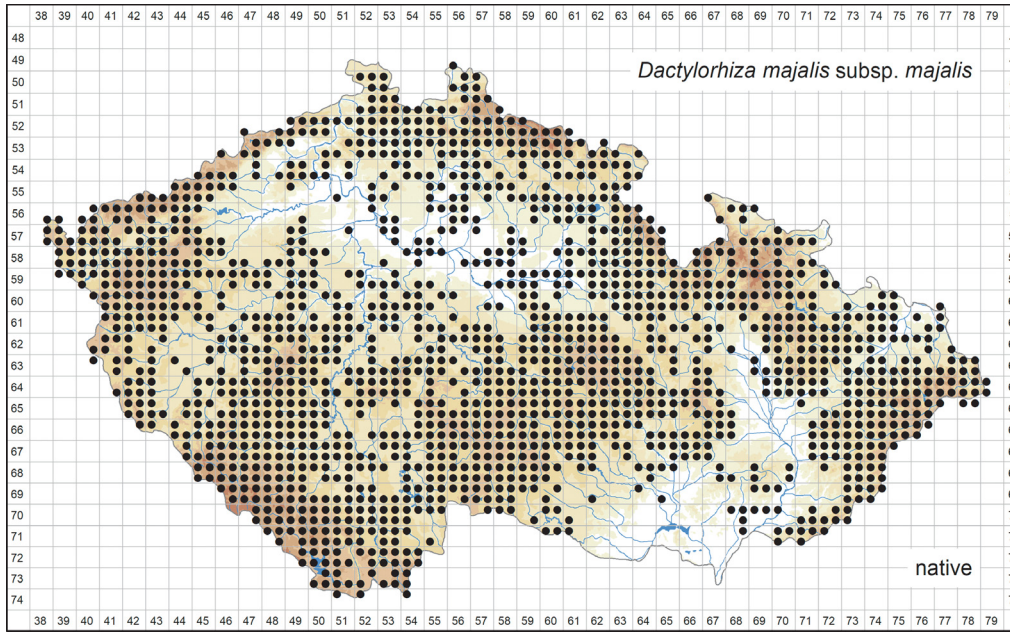

Fig. 18. – Distribution of *Dactylorhiza majalis* subsp. *majalis* in the Czech Republic (1594 occupied quadrants). Prepared by Vojtěch Taraška & Bohumil Trávníček.

Dactylorhiza sambucina (Fig. 20)

Dactylorhiza sambucina is continuously distributed from the Mediterranean area to the temperate zone in Europe. It occurs from Sicily in the south to central Germany and Poland in the north and from the Iberian Peninsula in the west to Ukraine in the east. There are isolated areas of occurrence in southern Scandinavia, the Baltic countries, Belarus, Crimea, northern Anatolia and the Caucasus Mts. It is absent from Atlantic parts of Europe (Meusel et al. 1965, Delforge 2006, Eccarius 2016). It grows in open-canopy forests, dry to mesophilous meadows, some other types of grasslands and mountain pastures, mainly on calcareous substrates but also on slightly acidic soils. In the Czech Republic it occurs from middle elevations to the mountains, with a maximum at about 1000 m a.s.l. In Bohemia it used to be more frequent mainly in the karst area of Český kras and the České středohoří Mts. In Moravia it used to be widespread in the Carpathian mountain ranges, where it is still locally scattered. Elsewhere it was rare across this country at middle and high elevations. The abundance of *D. sambucina* decreased rapidly in the second half of the 20th century as a result of changes in land use and consequent habitat loss. It is thus classified as endangered (Grulich 2012).

Dactylorhiza traunsteineri (Fig. 10)

Dactylorhiza traunsteineri is an allopolyploid species, perhaps of multiple origins, which makes its taxonomy very difficult. In a narrow species concept, three similar allotetraploid taxa are recognized, namely *D. traunsteineri*, *D. lapponica* and *D. russowii*. Molecular data (Pillon et al. 2007) indicate that these three taxa originate from the same parental combination and a merger of them has been suggested (*D. traunsteineri* s. l.). Since the genomic origin of this taxon is similar to that of *D. majalis*, some authors even consider this group as a subspecies of the latter (Nordström & Hedrén 2008, 2009); if so, the name *D. majalis* subsp. *lapponica* should be used. However, besides morphology, *D. majalis* and *D. traunsteineri* s. l. also differ in their flowering time, which is later in *D. traunsteineri*, and we thus consider them separate species. In this sense, *D. traunsteineri* s. l. is a boreal-alpine taxon distributed in the mountains of western and central Europe, in Scandinavia, the Baltic countries and northern Russia. Since the taxonomy of this group requires further study, we follow here the narrow species concept used in the recent checklist of Czech plants (Danihelka et al. 2012) and consider *D. traunsteineri* a species that occurs only in the Alps and adjacent areas, including southern Bohemia (see also Delforge 2006). It grows in moss-rich peat bogs, fens and transitional mires, mainly those with slightly alkaline to acidic soils. It has been recorded at only five localities in the Czech Republic, all of them in southern Bohemia. This species has vanished from both earlier localities in the Třeboňská pánev basin (Svět fishpond and surroundings of the village of Nová Ves nad Lužnicí), while it still occurs in the foothills of the Šumava Mts (Na Volešku Nature Reserve and near the village of Želnava) and in the Jihlavské vrchy Mts (Kaproun Nature Reserve). *Dactylorhiza traunsteineri* is classified as critically threatened (Grulich 2012). *Dactylorhiza lapponica* and *D. curvifolia*, which also belong to this group, have also been recorded in the Czech Republic. All records of the former probably refer to misidentified slender specimens of *D. majalis* subsp. *majalis*, typical plants of which always co-occur at their sites and do not differ in their phenology (in contrast to the

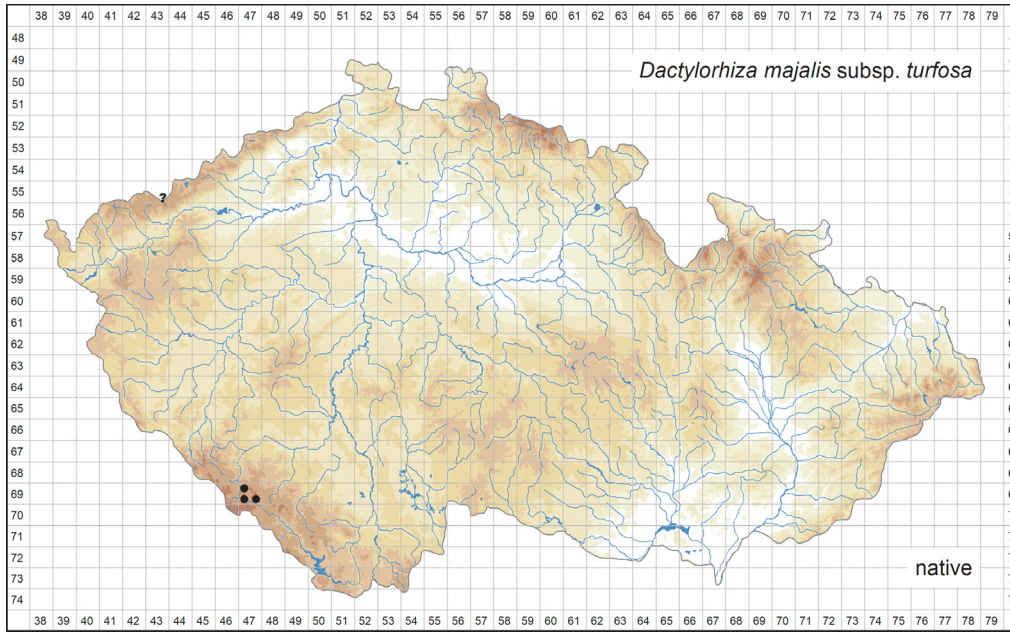

Fig. 19. – Distribution of *Dactylorhiza majalis* subsp. *turfosa* in the Czech Republic (3 occupied quadrants). Prepared by Bohumil Trávníček & Vojtěch Taraška.

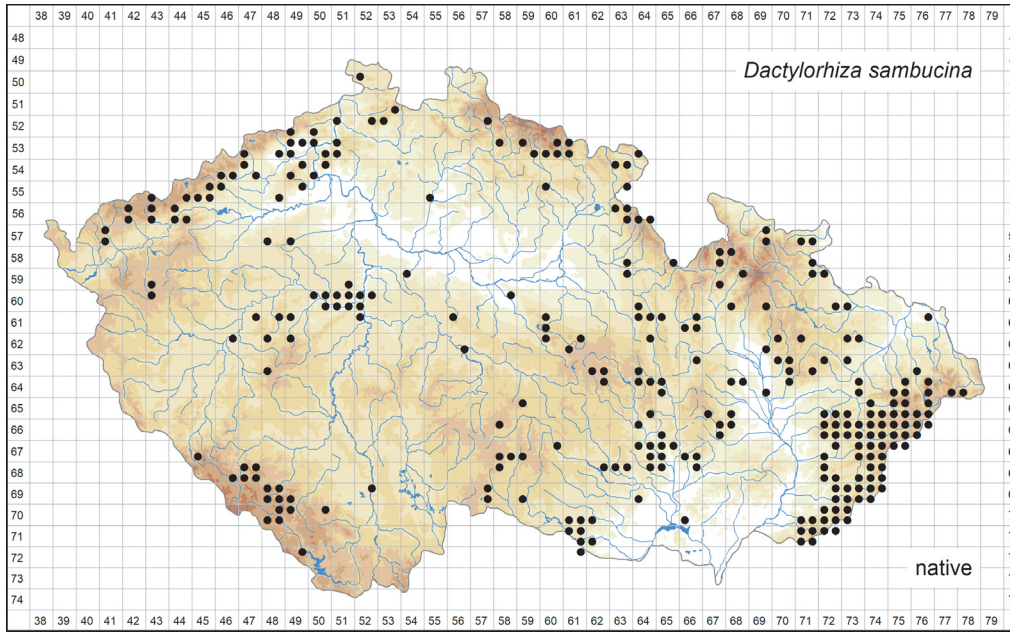

Fig. 20. – Distribution of *Dactylorhiza sambucina* in the Czech Republic (288 occupied quadrants). Prepared by Vojtěch Taraška & Bohumil Trávníček.

true *D. lapponica*, which flowers much later, similarly to the taxa in the *D. maculata* agg.). For *D. curvifolia* see above.

Digitaria ciliaris (Fig. 21)

Digitaria ciliaris is common throughout the tropics and subtropics. Nowadays it is probably naturalized in many places on the European Mediterranean coast, while non-persistent introductions are recorded in several countries in central and northern Europe (Wilhalm 2009). There are two records of this species in the Czech Republic: it was collected in 1908 on cotton waste in a spinning factory in the village of Podhůří (now part of Vrchlabí) in north-eastern Bohemia and in 1926 on waste ground in the quarter Holešovice in Prague. All other records under the name *D. ciliaris* for this country actually refer to *D. sanguinalis* var. *pectiniformis*. This species is classified as a casual neophyte in this country's flora (Pyšek et al. 2012) and the central-European climate seems to be too harsh for this species to become established.

Digitaria ischaemum (Fig. 22)

Digitaria ischaemum is native to Eurasia. It is now distributed throughout the temperate zone of Europe from western France in the west to the Ural Mts in the east, being absent only from northern Scandinavia and the Balkan Peninsula. It occurs also in large parts of temperate and subtropical Asia, and has been introduced into North America and New Zealand (Hultén & Fries 1986). In the Czech Republic *D. ischaemum* is found mainly as a weed in root crop fields, gardens, disturbed grasslands, on road verges, in fissures in pavements, ruderal places in settlements, railway stations, along railway tracks and around sand pits, where the soils are permeable, usually sandy and poor to moderately rich in nutrients, mostly non-calcareous. *Digitaria ischaemum* is common to scattered at low and middle elevations, being rare in or absent from areas with heavy soils and without arable fields or large settlements. Most of the records are from elevations below 500 m but there are a few records for road verges at elevations of 800–870 m. Profiting from the growing volume of traffic and probably also from the very warm summers during the last decades, this species seems to have recently colonized new sites; it is therefore classified as an invasive archaeophyte in the Czech flora (Pyšek et al. 2012). Some of the records on the map that are not supported by herbarium specimens may be erroneous as this species is frequently confused with *D. sanguinalis*.

Digitaria sanguinalis (Figs 23, 24 and 25)

Digitaria sanguinalis is reported to be native to India but is now distributed throughout most of the warm-temperate and subtropical regions of the world (Hultén & Fries 1986). In the Czech Republic it used to be sometimes cultivated as a cereal crop on sandy soils from the Middle Ages (then referred to as "Bohemian rice") until the early 19th century (Berchtold & Opiz 1836) or even later. Nowadays it is a weedy species confined to secondary habitats such as fields of root crops and less frequently of cereals, gardens, rather dry ruderal and disturbed sites, roadsides, fissures in pavements, most frequently in settlements and their surroundings; it is also abundant in railway stations and among railway tracks, around sand pits, ruderalized margins of fishponds and on river deposits. It profits

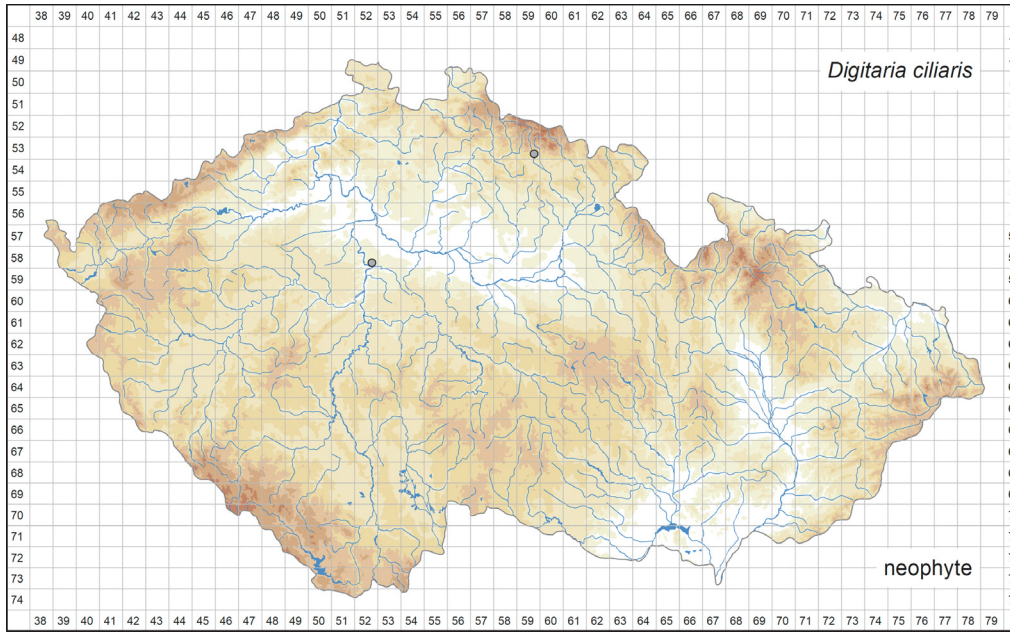

Fig. 21. – Distribution of *Digitaria ciliaris* in the Czech Republic: ● pre 2000 records only (2 quadrants). Prepared by Jiří Danihelka & Michal Ducháček.

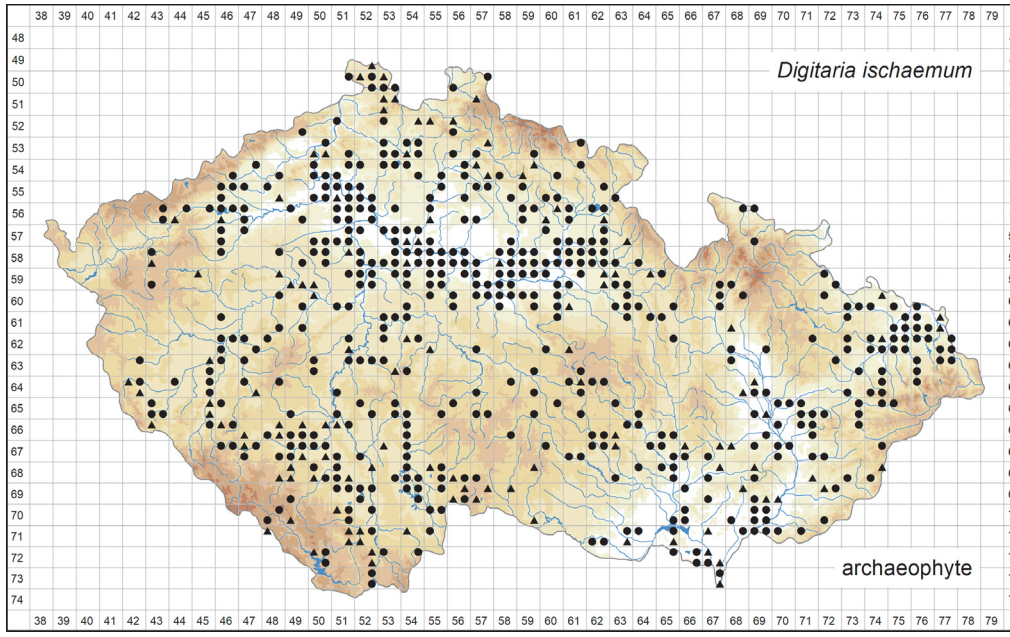

Fig. 22. – Distribution of *Digitaria ischaemum* in the Czech Republic: ● occurrence documented by herbarium specimens (480 quadrants), ▲ occurrence based on other records (121 quadrants). Prepared by Jiří Danihelka & Michal Ducháček.

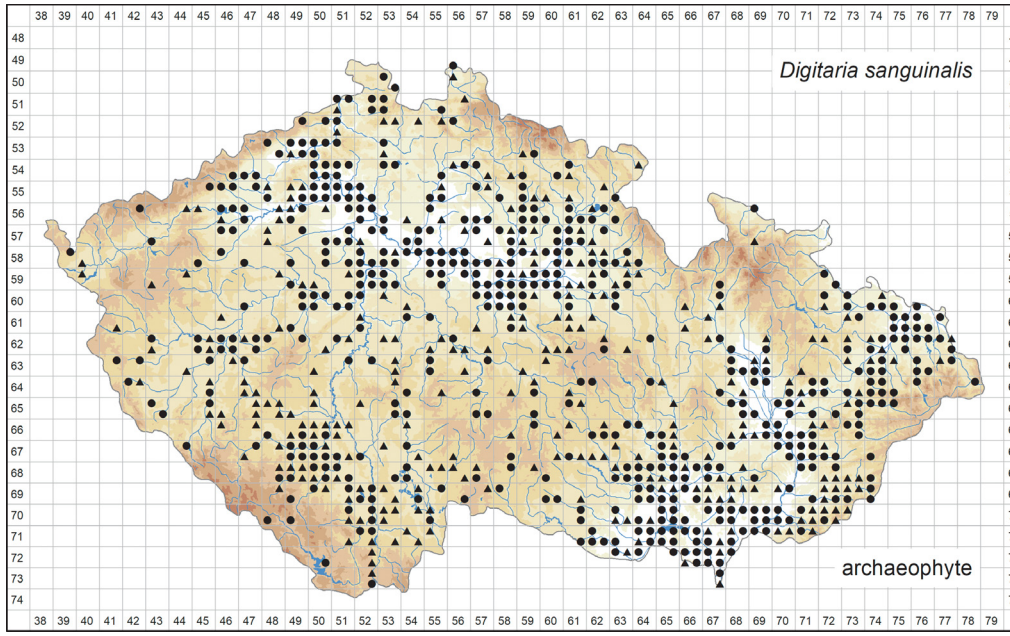

Fig. 23. – Distribution of *Digitaria sanguinalis* in the Czech Republic: ● occurrence documented by herbarium specimens (506 quadrants), ▲ occurrence based on other records (295 quadrants). Prepared by Jiří Danihelka & Michal Ducháček.

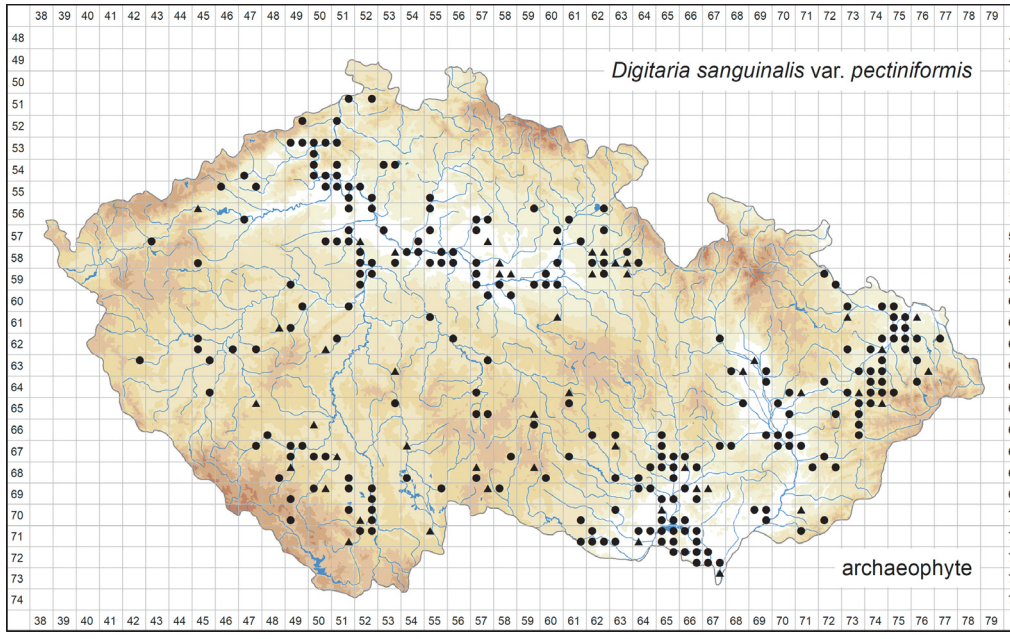

Fig. 24. – Distribution of *Digitaria sanguinalis* var. *pectiniformis* in the Czech Republic: ● occurrence documented by herbarium specimens (233 quadrants), ▲ occurrence based on other records (49 quadrants). Prepared by Jiří Danihelka & Michal Ducháček.

from the use of herbicides, as it germinates late and so avoids damage. It grows on soils that are sandy or loamy, permeable, moderately supplied with nutrients and acidic to neutral. *Digitaria sanguinalis* is common to scattered at low and middle elevations in areas with warm and moderately warm climates. Most of the records are from elevations below 500 m but along roads it occurs as high as at 825 m a.s.l. Two varieties are easily distinguished, *D. sanguinalis* var. *sanguinalis* and *D. s.* var. *pectiniformis*, which were mapped separately. The type variety seems to be more widespread, while the records of *D. s.* var. *pectiniformis* are mainly from roads, railways and arable land. Though there are a few records of the latter from the early 19th century, it has become more widespread only recently. Because of numerous misidentifications, both maps are based mainly on herbarium specimens, while the species' map includes some undocumented field records. Still, *D. sanguinalis* seems to be strongly under-recorded as many occurrences in villages and railway stations remain unnoticed. It is considered a naturalized archaeophyte in the Czech Republic (Pyšek et al. 2012).

Gagea bohemica subsp. *bohemica* (Fig. 26)

Gagea bohemica is a morphologically and cytologically variable species distributed mainly in the Mediterranean area from Portugal to Israel, northwards reaching Germany and the Czech Republic (Richardson 1980, Peterson et al. 2010). It was described by F. W. Schmidt from rocks above the Vltava river in Prague (Kirschner et al. 2007). Plants from central Europe with obovate tepals, glabrous or sparsely hairy stems and a pentaploid chromosome number (2n = 60) are traditionally treated as the type subspecies (Richardson 1980, Hrouda 2011, Danihelka et al. 2012). However, there is also an alternative approach treating *G. bohemica* in a wide sense as one polymorphic species without subspecies (Peterson et al. 2010). *Gagea bohemica* subsp. *bohemica* certainly occurs in Bohemia and the north-western part of the Pannonian Basin in Moravia, Austria, Slovakia and north-western Hungary (Hrouda 2011, Košťál et al. 2013). In the Czech Republic it grows mainly on outcrops of acid rocks (e.g. quarcite and schist) or at similar sites where there is little competition from other plants, such as sand dunes (Černý et al. 2011), but currently also in *Robinia pseudoacacia* plantations and at the fringes of oak forests, in the past rarely also in field margins. It is found mainly in central Bohemia and south-western Moravia, with several isolated populations in the České středohoří Mts in northern Bohemia, near the town of Hodonín in southern Moravia and near the village of Luleč in central Moravia. This subspecies is classified as endangered, mainly due to eutrophication enhancing succession and because of direct habitat destruction (Grulich 2012).

Gagea bohemica subsp. *saxatilis* (Fig. 26)

Gagea bohemica subsp. *saxatilis* is considered to be a western-European taxon of the *G. bohemica* complex, originally described from Germany. Generally, it is characterized by smaller flowers with oblong to oblanceolate tepals and the densely hairy stem (Richardson 1980, John et al. 2004). Due to taxonomic difficulties, it is not recognized by many authors and therefore its exact distribution is not well known. It is reported from Germany, France, Switzerland, Czech Republic and Slovakia (Richardson 1980, Hrouda 2011, Košťál et al. 2013). In the Czech Republic it was identified based on earlier collections from the Hluboký žleb valley (now the Terezské údolí valley) near the town of Náměšť na

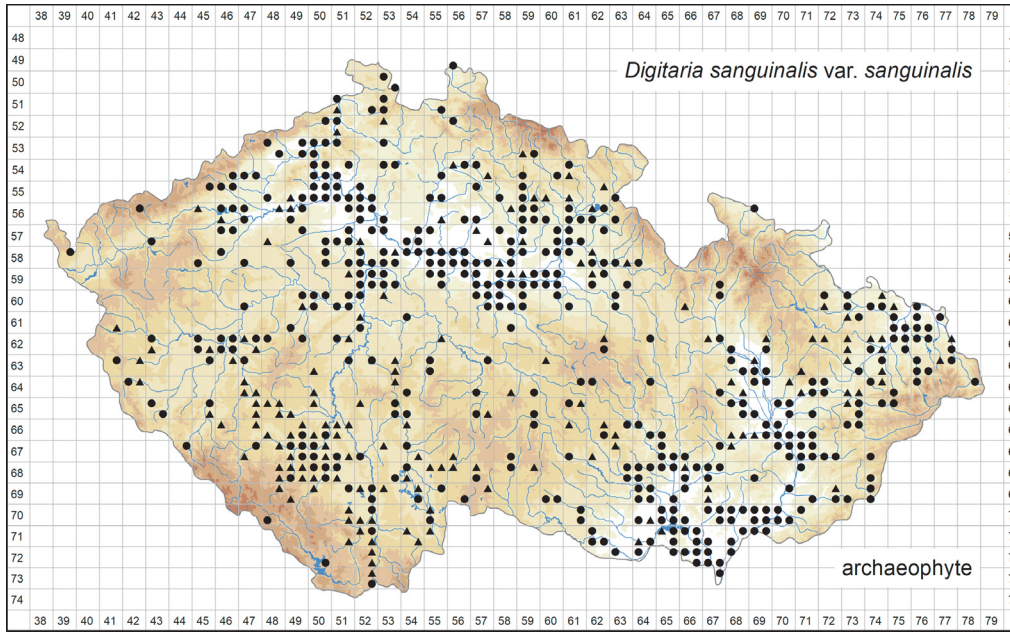

Fig. 25. – Distribution of *Digitaria sanguinalis* var. *sanguinalis* in the Czech Republic: ● occurrence documented by herbarium specimens (434 quadrants), ▲ occurrence based on other records (166 quadrants). Prepared by Jiří Danihelka & Michal Ducháček.

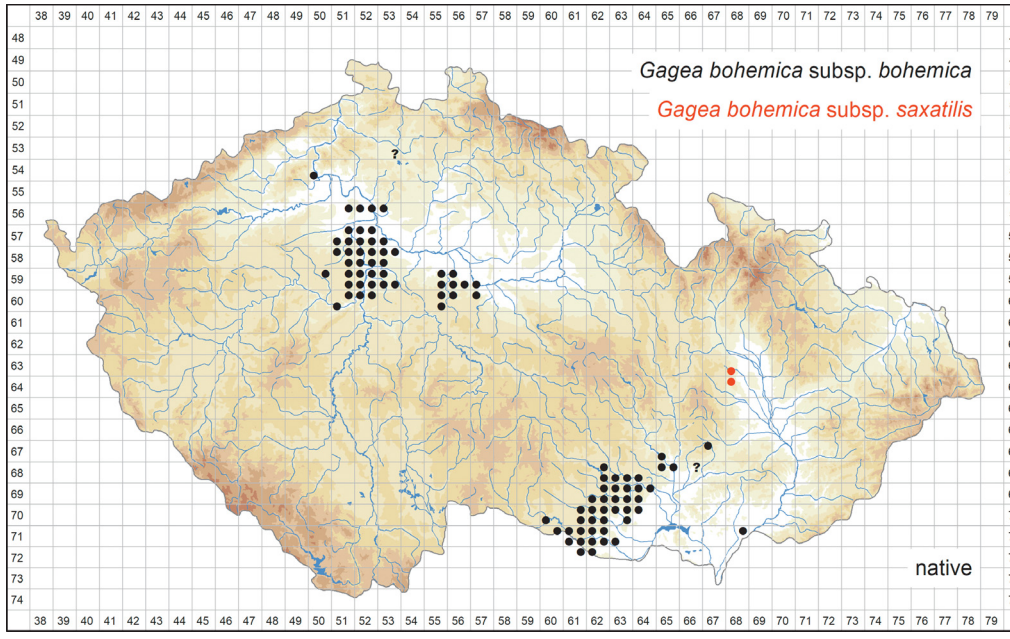

Fig. 26. – Distribution of *Gagea bohemica* subsp. *bohemica* (90 occupied quadrants) and *G. b.* subsp. *saxatilis* (2 occupied quadrants) in the Czech Republic. Prepared by David Horák, Michal Hroneš & Lucie Kobrlová.

Hané and later recorded also near the village of Senička, both in central Moravia (Hrouda 1989, Dančák 2004). Both localities were probably used as pastures in the past but nowadays are covered by oak and *Robinia pseudoacacia* forests, respectively. *Gagea bohemica* subsp. *saxatilis* is still present at both sites but the populations are very small and threatened by succession. It is therefore classified as critically threatened because of its rarity (Grulich 2012).

Gagea lutea (Fig. 27)

The distribution of *Gagea lutea* includes temperate areas in Europe and eastern Asia, with several relic populations scattered in-between. In Europe it is distributed across most of the continent, but appears to be rare in the Mediterranean area and the northernmost parts of the continent (Meusel et al. 1965, Hultén & Fries 1986). It grows in wet deciduous forests (i.e. floodplain, ravine and oak-hornbeam forests) and scrubs, and also in lawns and parks. It is the most widespread and abundant species of *Gagea* in the Czech flora, only being rare (or under-recorded) in south-eastern Bohemia. Most of the other gaps on the map are due to under-recording rather than true absences of this species. It occurs from the lowlands up to 1340 m a.s.l. in the Velká and Malá kotlina glacial cirques in the Hrubý Jeseník Mts.

Gagea minima (Fig. 28)

Gagea minima is distributed mainly in central and eastern Europe, and absent from western, northernmost and southern parts of the continent. Some isolated populations occur in western and central Asia (Meusel et al. 1965, Hultén & Fries 1986). It grows mainly in open-canopy deciduous forests, scrubs and forest fringes. In the Czech Republic *G. minima* is frequent in warm and moderately warm lowlands, mostly along large rivers, i.e. in north-western, central and eastern Bohemia and in south-western, southern and central Moravia. This species rarely ascends up to the mountains, reaching its elevational maxima at about 1000 and 1200 m in the Krkonoše and Hrubý Jeseník Mts, respectively. The occurences at middle and high elevations are mostly associated with base-rich substrates. *Gagea minima* is classified as vulnerable due to its limited distribution (Grulich 2012). Its populations may consist of only sterile individuals and it often grows together with *G. lutea*. Therefore, it may be easily overlooked and its actual distribution may be somewhat wider than shown on the map.

Gagea pratensis (Fig. 29)

Gagea pratensis is a pentaploid species (2n = 60) of the taxonomically complicated *G. pratensis* group. The total distribution of this species is uncertain due to the taxonomic confusion with other species. Pentaploid plants consistent with *G. pratensis* s. str. are reported from western, southern and central Europe (e.g. Měsíček & Hrouda 1974, Peruzzi & Aquaro 2005, Zonneveld et al. 2015). In the Czech Republic *G. pratensis* inhabits mostly mesic grasslands, *Robinia pseudoacacia* plantations, mesic scrubs, ruderal places, field margins and in the past also arable fields. It is scattered throughout this country, mostly at low elevations, but is generally very rare at elevations above 500 m. *Gagea pratensis* has slightly declined in abundance due to changes in land-use.

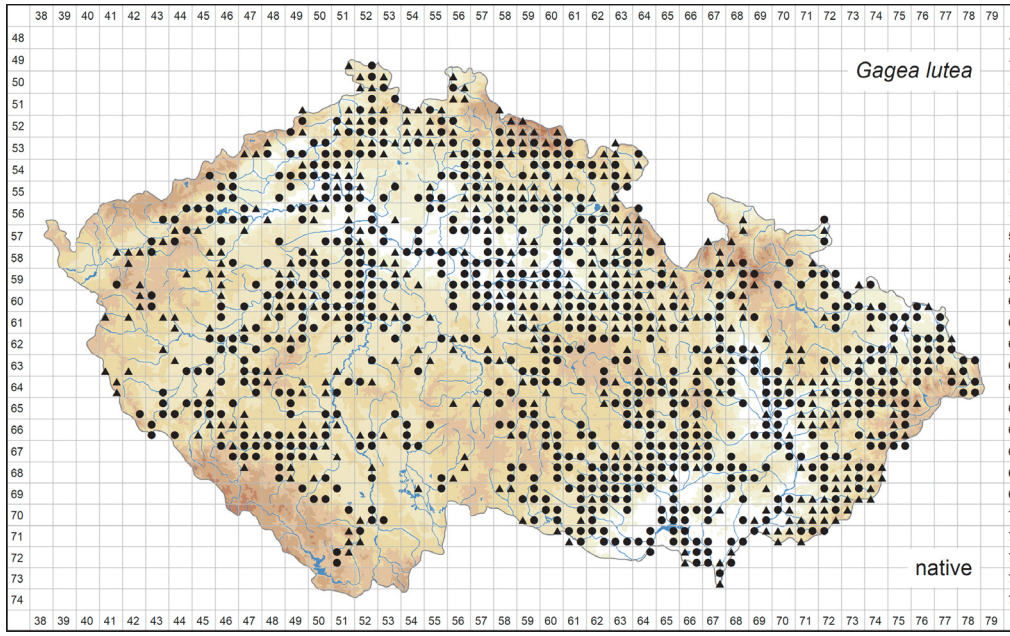

Fig. 27. – Distribution of *Gagea lutea* in the Czech Republic: ● occurrence documented by herbarium specimens (759 quadrants), ▲ occurrence based on other records (408 quadrants). Prepared by Lucie Kobrlová, Michal Hroneš & David Horák.

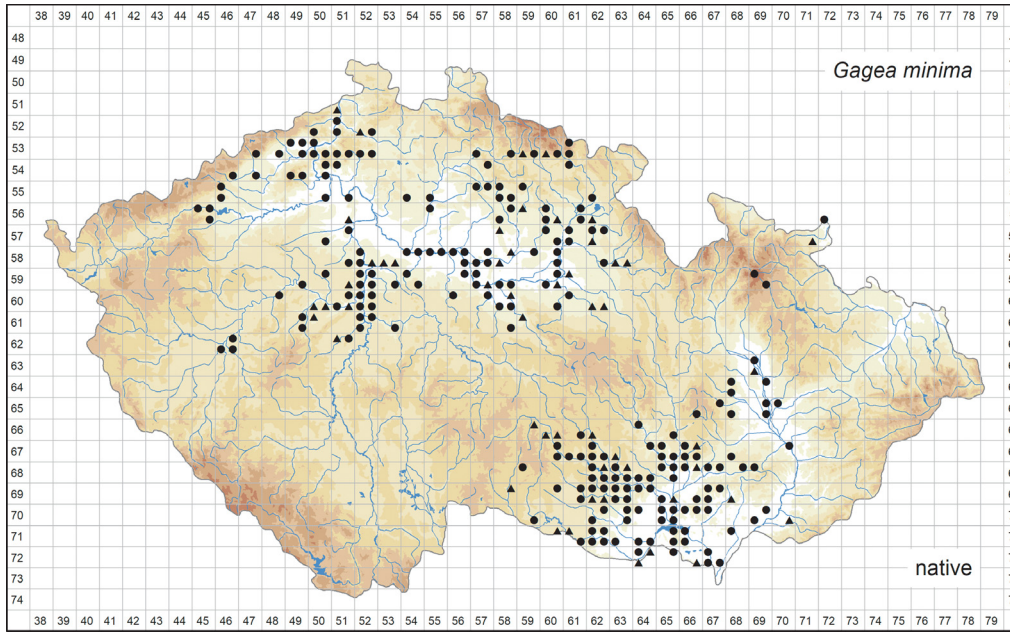

Fig. 28. – Distribution of *Gagea minima* in the Czech Republic: ● occurrence documented by herbarium specimens (217 quadrants), ▲ occurrence based on other records (52 quadrants). Prepared by Lucie Kobrlová, Michal Hroneš & David Horák.

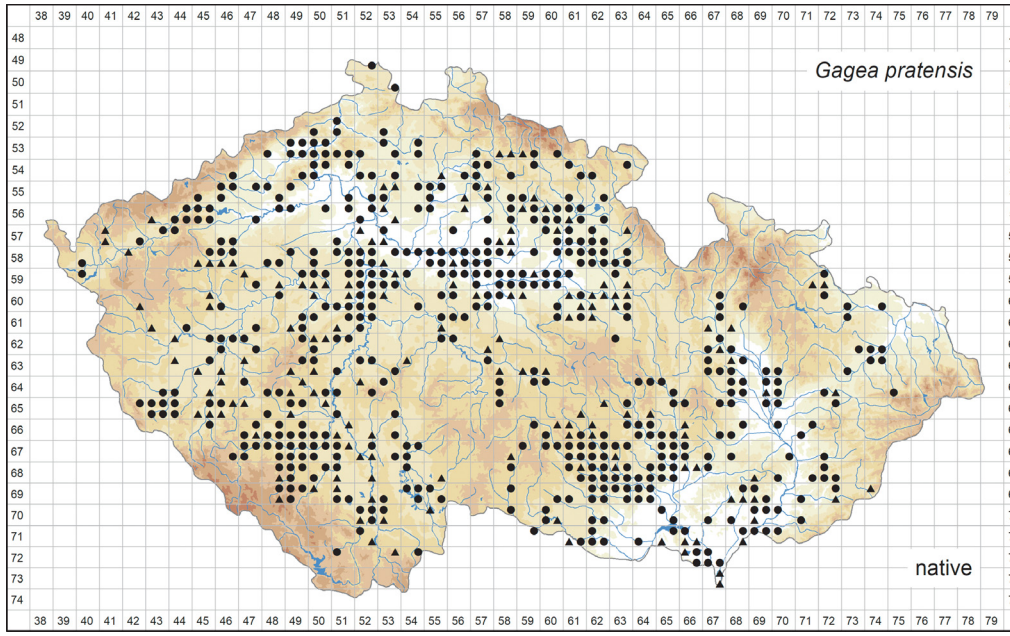

Fig. 29. – Distribution of *Gagea pratensis* in the Czech Republic: ● occurrence documented by herbarium specimens (488 quadrants), ▲ occurrence based on other records (157 quadrants). Prepared by Michal Hroneš, Lucie Kobrlová & David Horák.

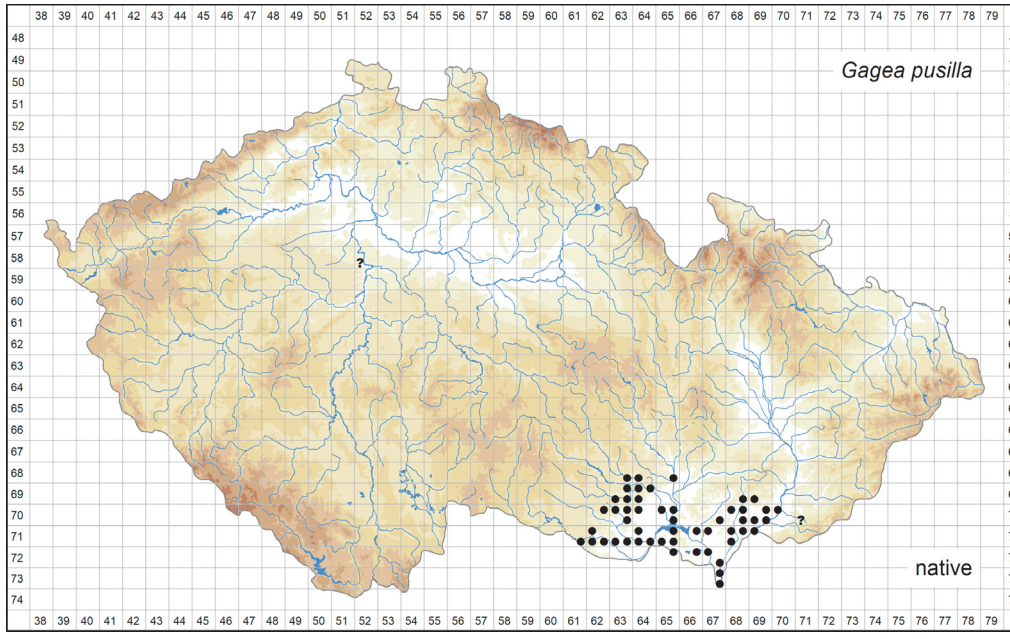

Fig. 30. – Distribution of *Gagea pusilla* in the Czech Republic (51 occupied quadrants). Prepared by Michal Hroneš, Lucie Kobrlová & David Horák.

Gagea pusilla (Fig. 30)

Gagea pusilla is a diploid species (2n = 24) distributed mostly in the Pannonian Basin and adjacent areas and in northern parts of the Balkan Peninsula (Tison & Perret 2004). Its north-western distribution limit runs through southern Moravia. In the Czech Republic *G. pusilla* grows mainly in dry grasslands, rock outcrops and inland sand dunes. It is also found in *Robinia pseudoacacia* plantations established on former pastures and in sandy places along roads. It occurs only in warm parts in southern Moravia, where it reaches the eastern edge of the Bohemian massif and the area between the towns of Kyjov and Hodonín. Although this species was described by F. W. Schmidt from Prague, the original material is lost and no reliable records exist for Bohemia. The specimens allegedly collected near Prague and distributed by I. F. Tausch under the name *G. pusilla* may have actually originated from southern Moravia (Kirschner et al. 2007). This species is classified as vulnerable mostly due to its limited distribution (Grulich 2012). The distribution map is based only on revised herbarium specimens.

Gagea transversalis (Fig. 31)

Gagea transversalis is a tetraploid (2n = 48) member of the *G. pratensis* group. It is generally not included in most recent floras and, therefore, its total distribution is not well known. Tetraploid plants of the *G. pratensis* group are reported from the Czech Republic, Germany, Netherlands, Poland, Slovakia and Ukraine and are probably present also in Austria, Hungary and Romania (Měsíček & Hrouda 1974, Pogan et al. 1980, Zonneveld et al. 2015). In the Czech Republic *G. transversalis* inhabits mainly dry grasslands and rock outcrops, rarely also oak and oak-hornbeam forests and *Robinia pseudoacacia* plantations on basic substrates. It is confined to the warmest areas in southern Moravia and central and north-western Bohemia. Reliable records and herbarium specimens are scarce and this species may be more frequent within these areas than displayed on the map. *Gagea transversalis* is classified as of lower risk – near threatened (Grulich 2012), however, given its restricted distribution and the low number of extant populations, it should be treated as vulnerable. The distribution map is based only on revised herbarium specimens and our own records confirmed using flow cytometry.

Gagea villosa (Fig. 32)

Gagea villosa is distributed from the northern parts of Mediterranean area northwards to southernmost Scandinavia and eastwards to the surroundings of the Black Sea (Hultén & Fries 1986). It is reported to be diploid (2n = 24) and tetraploid (2n = 48; Měsíček & Hrouda 1974, Peruzzi & Aquaro 2005, Zonneveld et al. 2015). In the Czech Republic *G. villosa* is considered to be an archaeophyte (Pyšek et al. 2012) and as such it grows mostly in man-made habitats such as *Robinia pseudoacacia* plantations, semi-ruderal places, lawns, parks, vineyards and field margins, and in the past it occurred also in arable fields. It is distributed mainly in the warmest parts of this country, i.e. lowlands of central, eastern and north-western Bohemia and central and southern Moravia. At higher elevations it is confined to limestone or loess, being found e.g. around the town of Strakonice in southern Bohemia and in the Bílé Karpaty Mts in south-eastern Moravia. Its popula-

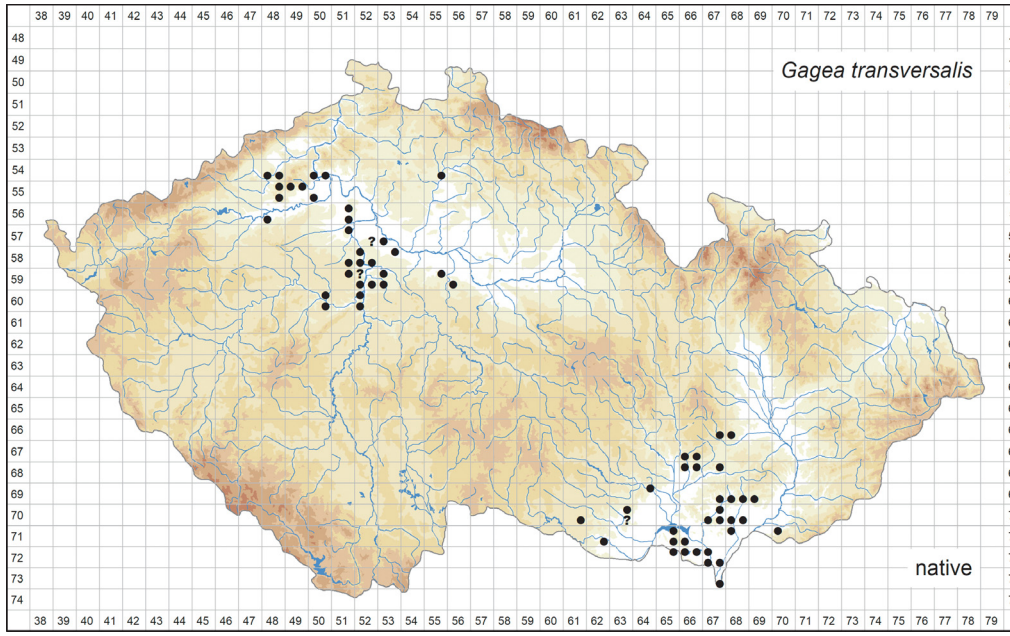

Fig. 31. – Distribution of *Gagea transversalis* in the Czech Republic (63 occupied quadrants). Prepared by Michal Hroneš, Lucie Kobrlová & David Horák.

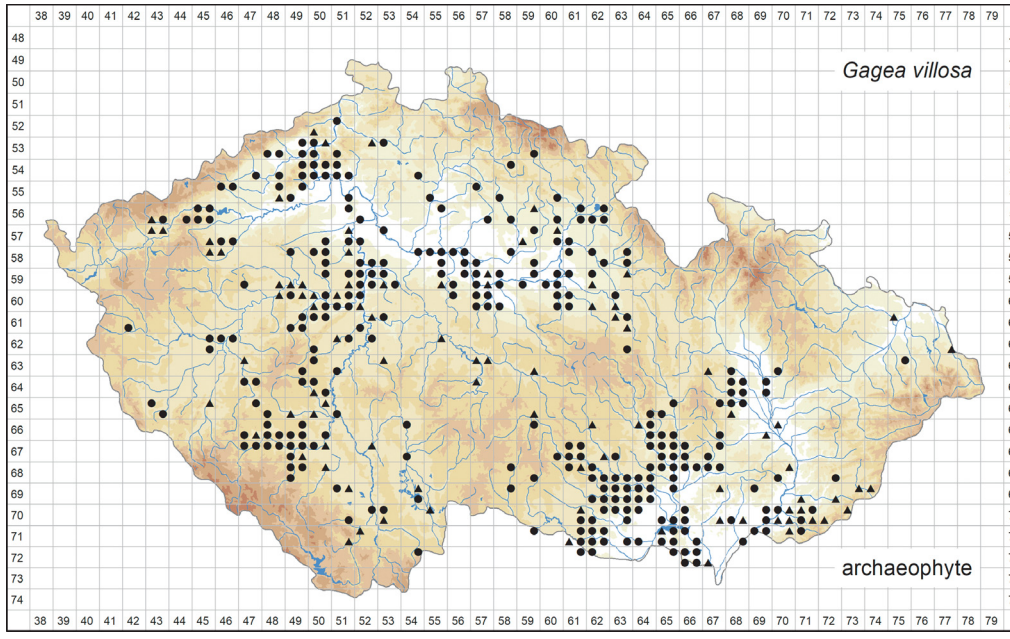

Fig. 32. – Distribution of *Gagea villosa* in the Czech Republic: ● occurrence documented by herbarium specimens (291 quadrants), ▲ occurrence based on other records (91 quadrants). Prepared by Michal Hroneš, Lucie Kobrlová & David Horák.

tions have declined considerably during the past 50 years mainly due to changes in land-use. It is therefore classified as endangered (Grulich 2012).

Gypsophila elegans (Fig. 33)

Gypsophila elegans is native to eastern Anatolia, the Caucaus Mts and northern Iran as well as to the area along the northern Black Sea coast in Ukraine. It occurs there on stony slopes, waterside pebbles and as a weed on arable land (Šiškin 1936, Jalas & Suominen 1986, Šourková 1990). It is cultivated as an ornamental in gardens, sometimes in variants with supernumerary petals, in many countries of the world, including the Czech Republic. Escaped plants are recorded in several European countries (Jalas & Suominen 1986), North America, Central America and the West Indies (Pringle 2005). In the Czech Republic *G. elegans* is recorded as escaped from cultivation on garden waste, in abandoned fields and in street lawns in settlements. All these occurrences are short-lived. About 10 records of escaped plants exist for this country, the earliest one from 1911, the latest from 2015. This species is classified as a casual neophyte (Pyšek et al. 2012).

Gypsophila fastigiata (Fig. 34)

Gypsophila fastigiata is native to central-eastern Europe, including the Baltic countries, Poland, eastern Germany, the Czech Republic, Slovakia, western Ukraine, eastern Austria, Hungary and possibly also northern Croatia, with a few outposts in Scandinavia (Hultén & Fries 1986, Jalas & Suominen 1986). Based on the sculpturing of the testa, two poorly differentiated taxa are distinguished, usually with the rank of subspecies (e.g. Šourková 1990; see also Holub et al. 1971). The populations in Bohemia are assigned to the type subspecies, while those in Moravia to *G. fastigiata* subsp. *arenaria*, which is considered endemic to the Pannonian part of Europe (Hultén & Fries 1986). In the Czech Republic *G. fastigiata* is found mainly in open sandy habitats, open-canopy pine forests and their fringes and also in dry grasslands usually over sand or sandstone, often calcareous, less frequently also over loess or marl. The type subspecies occurs scattered over northern and central Bohemia, while *G. f.* subsp. *arenaria* is confined to southern Moravia. The latter subspecies was also accidentally introduced into the town of Jihlava in western Moravia, probably with sand from south-eastern Moravia, and also the town of Třinec in Silesia, probably with iron ore from Ukraine. These secondary occurrences turned out to be temporary. Both subspecies are classified as endangered because they are declining in abundance and are rare (Grulich 2012).

Gypsophila muralis (Fig. 35)

Gypsophila muralis is native to Europe, being absent only from most of Scandinavia, the British Isles, the Iberian Peninsula and some parts of the Mediterranean area. It occurs also in the Caucasus Mts, western Siberia, north-eastern China and the adjacent part of the Russian Far East (Hultén & Fries 1986, Meusel et al. 1965). It has become naturalized in the north-eastern USA (Pringle 2005). In the Czech Republic *G. muralis* occurs on the shores of water reservoirs and their exposed bottoms, on banks of watercourses, wet arable land, particularly in stubble fields, in pastures, along roads and paths and in other disturbed places. It grows mainly on sandy soils, sometimes rich in nutrients and usually

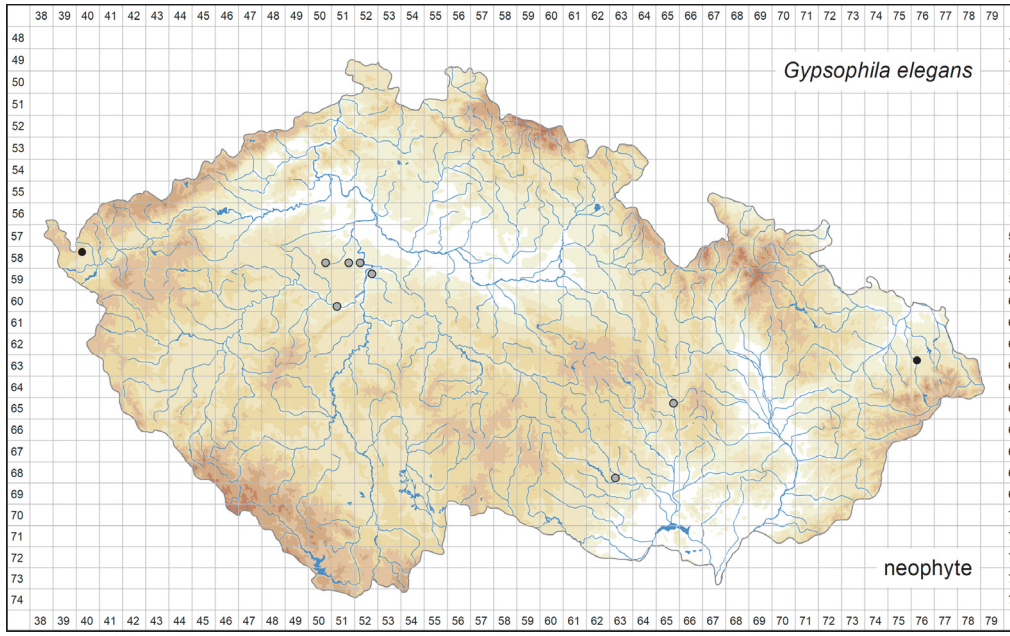

Fig. 33. – Distribution of *Gypsophila elegans* in the Czech Republic: ● at least one record in 2000–2016 (2 quadrants), ● pre 2000 records only (7 quadrants). Prepared by Jiří Danihelka & Kateřina Šumberová.

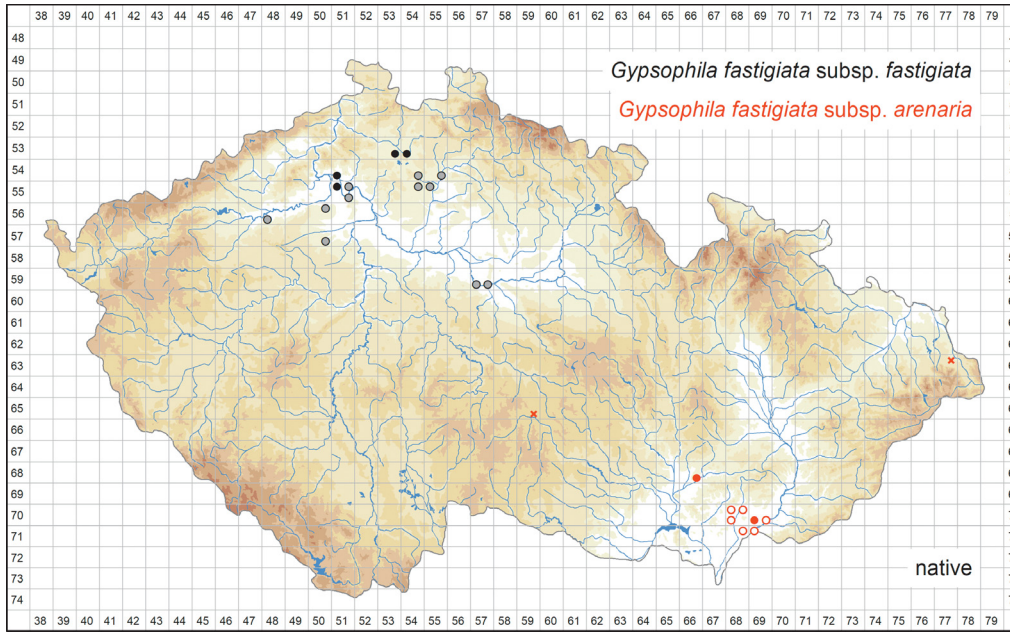

Fig. 34. – Distribution of *Gypsophila fastigiata* subsp. *arenaria* (● native, at least one record in 2000–2016: 2 quadrants, ○ native, pre 2000 records only: 6 quadrants, × alien: 2 quadrants) and *G. f.* subsp. *fastigiata* (● at least one record in 2000–2016: 4 quadrants, ● pre 2000 records only: 11 quadrants) in the Czech Republic. Prepared by Jiří Danihelka & Kateřina Šumberová.

non-calcareous. Its frequency and range of habitats fluctuates depending on rain fall: in dry years it is found mainly around water bodies while in years with wet springs and summers it is found more frequently and even in rather dry habitats (e.g. pastures on slopes). *Gypsophila muralis* occurs with different frequencies at low and middle elevations all over this country, reaching its elevational maximum of about 720 m in the Doupovské hory Mts in north-western Bohemia and in the Žďárské vrchy hills in western Moravia. However, it was found even at 810 m a.s.l. near the village of Hliniště in the Šumava Mts, probably introduced by traffic. This species is particularly common in the fishpond landscapes in southern Bohemia and south-western and north-eastern Moravia. In contrast, it seems to be very rare in or even locally absent from the area north-west of Prague, large parts of the Bohemian-Moravian Highlands and of central and southern Moravia.

Gypsophila paniculata (Fig. 36)

Gypsophila paniculata is native to southern-central and south-eastern Europe, reaching the south-eastern Czech Republic and eastern Austria in the west, eastern Poland in the north and Bulgaria in the south. In Asia it occurs in Siberia, Kazakhstan, north-western China and Mongolia (Jalas & Suominen 1986, Hultén & Fries 1986). This species is frequently cultivated as an ornamental and for florists, sometimes in double- or pink-flowered variants. It has escaped from cultivation and become locally established in several European countries, mainly north of its native range (Jalas & Suominen 1986), and also in North America (Pringle 2005). In the Czech Republic *G. paniculata* grows in species-rich sandy grasslands and open dry grasslands over Tertiary deposits rich in sand. Its natural occurrences in the Czech Republic are confined to southern Moravia; these populations are situated at the absolute north-western limit of this species's range. However, it repeatedly escapes from cultivation, being found in waste places or dry grasslands and open pine forests on sandy soils. Some of these secondary occurrences persist for a long time. The occurrences in secondary habitats (mainly along railways) within the species' native distribution range in southern Moravia are accepted as natural. *Gypsophila paniculata* is classified as critically threatened because it has dramatically declined in abundance (Grulich 2012).

Gypsophila perfoliata (Fig. 37)

Gypsophila perfoliata is native to south-eastern Europe, mainly the coast of the Black Sea in Bulgaria, Romania and Ukraine, and south-eastern European Russia, western and central Siberia and Central Asia (Jalas & Suominen 1986, Šiškin 1936). It has been accidentally introduced into several European countries including, e.g., the Baltic countries, Poland, Slovakia and Hungary (Jalas & Suominen 1986, Eliáš & Dítě 2012, Bartoszek & Stachurska-Swakoń 2016, DAISIE 2017). In its natural range it is found mainly in saline meadows and open sandy habitats. In the Czech Republic it was collected in iron ore storage yards in two parts of the city of Ostrava, namely Ostrava-Vítkovice and Polanka nad Odrou, in October 1965 by Zdeněk Kilián; this species was probably introduced to these sites with iron ore from Ukraine. The herbarium specimens deposited in the herbaria OSM and MP were correctly identified a year later, but the finds remained unpublished.

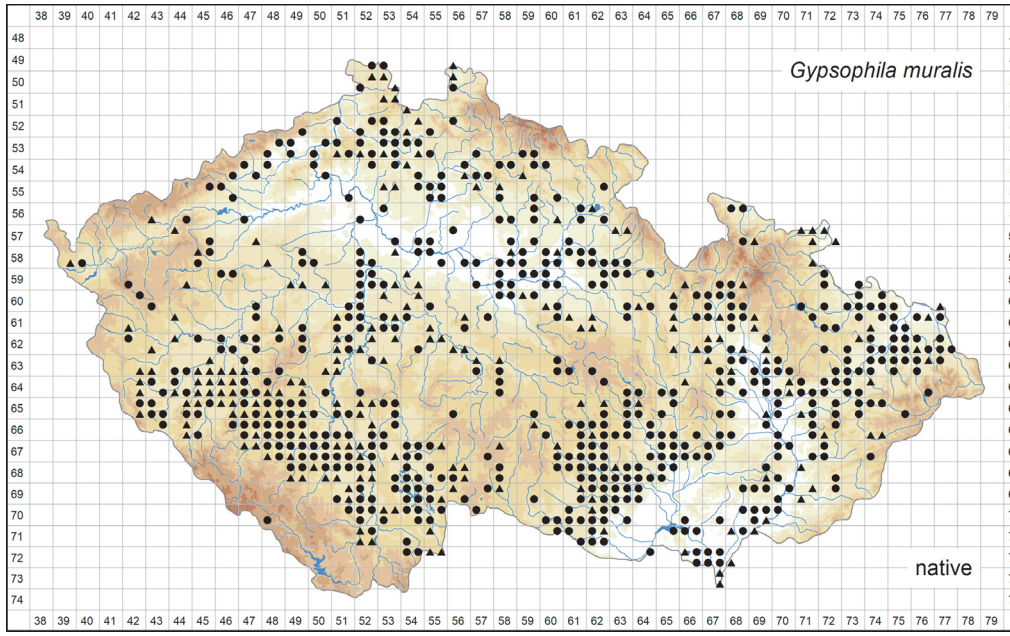

Fig. 35. – Distribution of *Gypsophila muralis* in the Czech Republic: ● occurrence documented by herbarium specimens (544 quadrants), ▲ occurrence based on other records (216 quadrants). Prepared by Jiří Danihelka & Kateřina Šumberová.

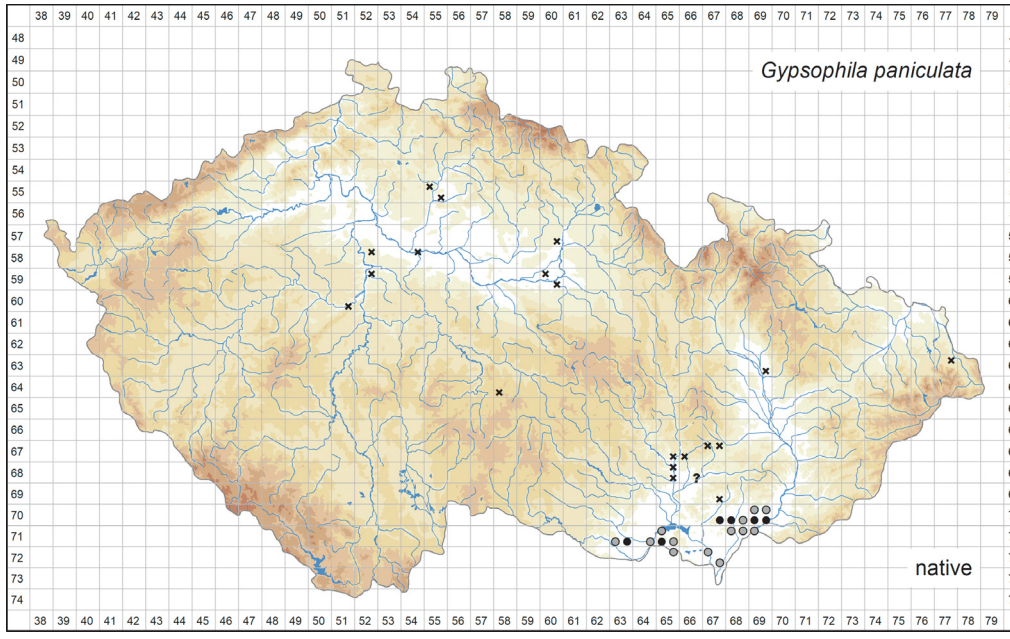

Fig. 36. – Distribution of *Gypsophila paniculata* in the Czech Republic: ● native, at least one record in 2000–2016 (6 quadrants), ◍ native, pre 2000 records only (13 quadrants), × alien (19 quadrants). Prepared by Jiří Danihelka & Kateřina Šumberová.

Gypsophila scorzonerifolia (Fig. 37)

Gypsophila scorzonerifolia has a small distribution north-east of the Caspian Sea (Šiškin 1936, Jalas & Suominen 1986), where it occurs in humid sandy habitats. It has been introduced into a few European countries, including Belgium, Belarus and Hungary; it has become established in Germany and also in North America (Jalas & Suominen 1986, Pringle 2005, DAISIE 2017). In this country this species was first cultivated in botanical gardens, usually under the name *G. acutifolia*. The earliest records of escaped or accidentally introduced plants date back to the 1940s and 1950s. They were found in waste places, ruderal grasslands in settlements and along roads. A small population that was discovered in Brno in 1958 persisted for at least 15 years. Currently there is only one established population, which is found on an ash and slag heap in the town of Oslavany in south-western Moravia, where it was first recorded in 1994. This species is classified as a casual neophyte (Pyšek et al. 2012).

Hieracium racemosum (Fig. 38)

Hieracium racemosum is distributed throughout southern Europe from the eastern Pyrenees in the west to Bulgaria in the east; isolated outposts occur in Greece from which it extends to Turkey. Its northern distributional limit runs through central France, Switzerland, Austria, the Czech Republic, southern Poland and Romania; it has been introduced into Germany (Meusel & Jäger 1992). In the Czech Republic *H. racemosum* occurs in deciduous and mixed, less often coniferous forests, forest fringes and scrub. It is usually found on permeable loam, acidic to neutral, less often alkaline, moderately humid soils, which are poor to moderately rich in nutrients. In contrast to the morphologically similar *H. sabaudum*, *H. racemosum* does not occur at ruderal sites. *Hieracium racemosum* is scattered to locally common in hilly landscapes in central and eastern Moravia, becoming less frequent or absent towards the Moravian lowlands and high mountains, and towards the western part of the Czech Republic. In Bohemia it occurs disjunctly in its eastern and north-eastern parts, with outposts in northern, central and western parts, often on calcareous bedrock (marl and fine calcareous sandstone) and on solitary volcanic hills. It is absent from southern and westernmost Bohemia. It is found mostly at middle elevations, reaching its elevational maximum at 820–880 m in the Beskydy Mts in eastern Moravia (Moltašová et al. 2014). *Hieracium racemosum* is classified as of lower risk – near threatened in this country (Grulich 2012). The quality of identification of herbarium specimens is generally poor, numerous herbarium specimens (especially from Bohemia) originally identified as *H. racemosum* are actually *H. sabaudum*. The map is thus based almost solely on revised herbarium specimens.

Hieracium sabaudum (Fig. 39)

Hieracium sabaudum is predominantly a European species distributed from the British Isles and the northern and central parts of the Iberian Peninsula in the west to the central part of European Russia, eastern Ukraine and the eastern Black Sea coast in the east. Northwards it reaches Denmark and the Baltic countries, and has been introduced into Norway and Sweden; in the south its continuous range reaches central Italy, Albania, northern Greece and the southern Black Sea coast with some outposts in Sardinia,

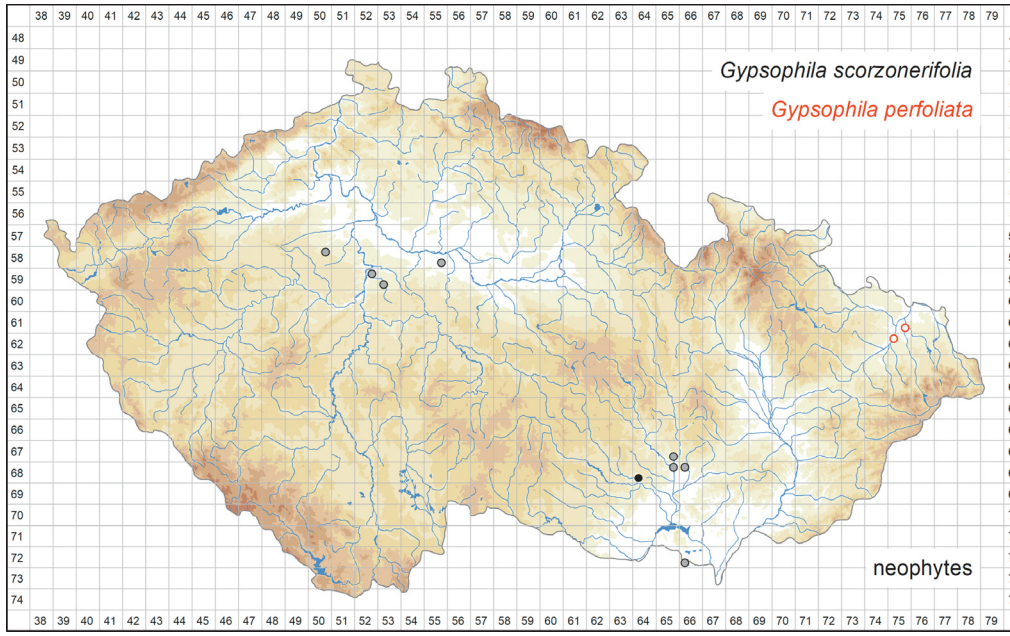

Fig. 37. – Distribution of *Gypsophila perfoliata* (○ pre 2000 records only: 2 quadrants) and *G. scorzonerifolia* (● at least one record in 2000–2016: 1 quadrant, ● pre 2000 records only: 8 quadrants) in the Czech Republic. Prepared by Jiří Danihelka & Kateřina Šumberová.

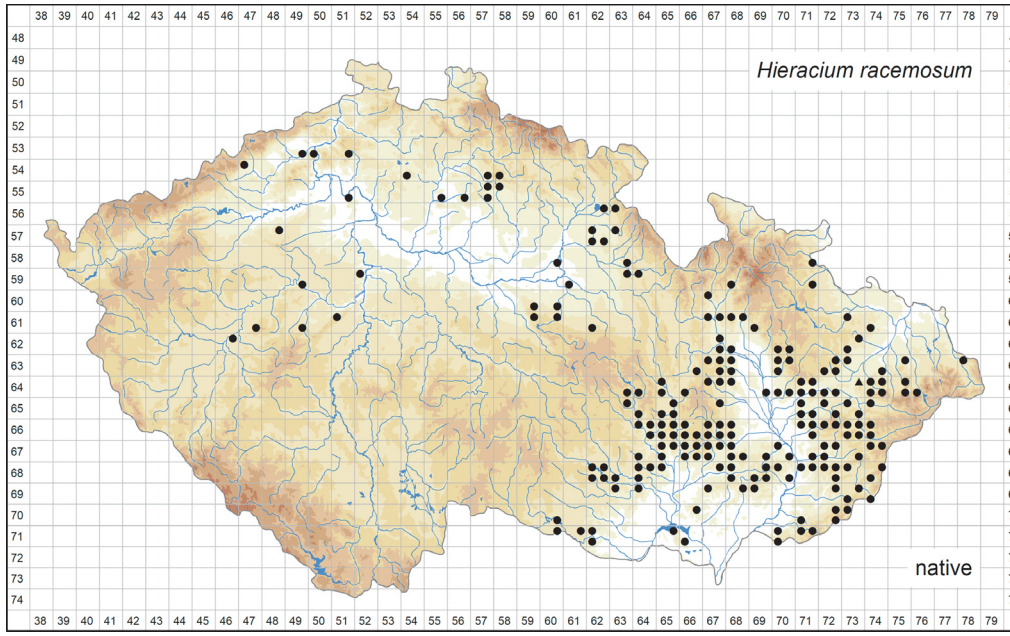

Fig. 38. – Distribution of *Hieracium racemosum* in the Czech Republic: ● occurrence documented by herbarium specimens (209 quadrants), ▲ occurrence based on other records (1 quadrant). Prepared by Jiří Danihelka, Olga Rotreklová & Jindřich Chrtek jun.

southern Italy, the Peloponnese Peninsula, southern Turkey and the Caucasus Mts (Meusel & Jäger 1992). It has been introduced into North America and New Zealand (USDA, NRCS 2017). In the Czech Republic it occurs in oak-hornbeam and oak forests, less often in open habitats, such as dry grasslands, heathlands, disused stone quarries, road verges and ruderal and semi-ruderal patches in settlements. It is usually found on rather shallow and permeable loam, siliceous, highly to moderately acidic, rarely neutral, dry to moderately humid soils, which are poor to moderately rich in nutrients. *Hieracium sabaudum* is distributed almost over the entire country except in the highest parts of mountainous areas (Bidmanová et al. 2016). The gaps in western, south-eastern Bohemia, central and south-western Moravia and elsewhere are likely to reflect real absences or scarcity, partly caused by a lack of suitable habitats.

Hieracium umbellatum (Fig. 40)

Hieracium umbellatum has a wide distribution encompassing the temperate zones of Eurasia and North America. In Europe it is absent only from its northernmost part, the Mediterranean Basin, central part of the Iberian Peninsula and Greek mountains (Meusel & Jäger 1992). In the Czech Republic it occurs in dry grasslands, intermittently wet to wet meadows, pastures, lowland and middle-elevation heathlands, thermophilous scrub, rock crevices, disused stone quarries, waste ground, road verges, open-canopy acidophilous oak and birch forests and their fringes and on fishpond dams. It usually grows on rather shallow and permeable, loam or sandy, rarely clay, siliceous, acidic to neutral, less often alkaline, dry to moderately humid soils, which are poor to moderately rich in nutrients. *Hieracium umbellatum* occurs with different frequencies from the lowlands to the uplands in most parts of this country. It is rare or absent from the mountains and some parts of western, north-eastern and south-eastern Bohemia and northern, southwestern and eastern Moravia (Novotná et al. 2014). However, some of the gaps on the map at low elevations can be a result of under-recording rather than true absences. It becomes rarer towards high elevations but was found accidentally introduced even at about 1250 m a.s.l. in the Hrubý Jeseník Mts and at about 1000 m a.s.l. at several sites in the Šumava Mts. Misidentifications in herbaria are only moderately frequent and the records not supported by herbarium specimens may therefore be considered reasonably reliable.

Hydrocotyle vulgaris (Fig. 41)

Hydrocotyle vulgaris is mainly a European species with a distinctly sub-Atlantic distribution. It is most common in western Europe, reaching the Baltic countries, Belarus, western Ukraine, Hungary, Croatia, Italy and Malta eastwards, with rare outposts on the Balkan Peninsula. Northwards it occurs in southern Scandinavia, Shetland and in Iceland, where it grows exclusively around hot springs. Outside Europe it is rare in the Azores, northern Africa, Israel, Syria, Transcaucasia, southern Azerbaijan and northern Iran (Hultén & Fries 1986, Hand 2011). It was introduced into China in the 1990s and is now considered as potentially invasive there (Liu et al. 2014). In the Czech Republic *H. vulgaris* occurs in permanently waterlogged, sometimes also shallowly flooded habitats, such as in fens, fen meadows, peaty margins of fishponds, meadow ditches, sometimes also in alder carrs and wet sandy habitats. It grows mainly on acidic, nutrient-poor soils. The distribution of *H. vulgaris* is restricted to a few flat climatically suitable wetland-rich

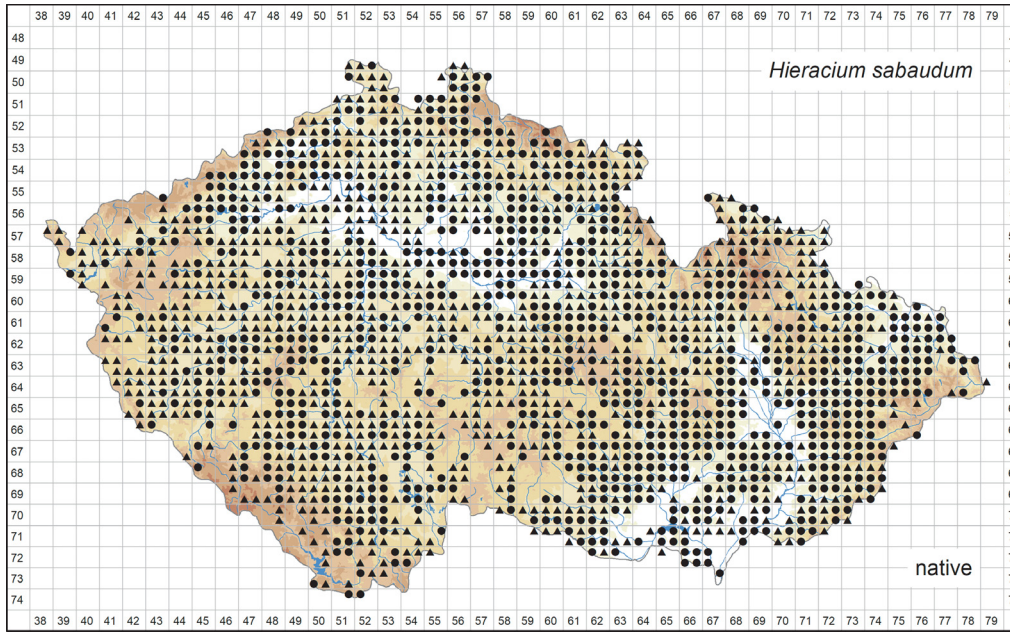

Fig. 39. – Distribution of *Hieracium sabaudum* in the Czech Republic: ● occurrence documented by herbarium specimens (957 quadrants), ▲ occurrence based on other records (940 quadrants). Prepared by Jiří Danihelka, Olga Rotreklová & Jindřich Chrtek jun.

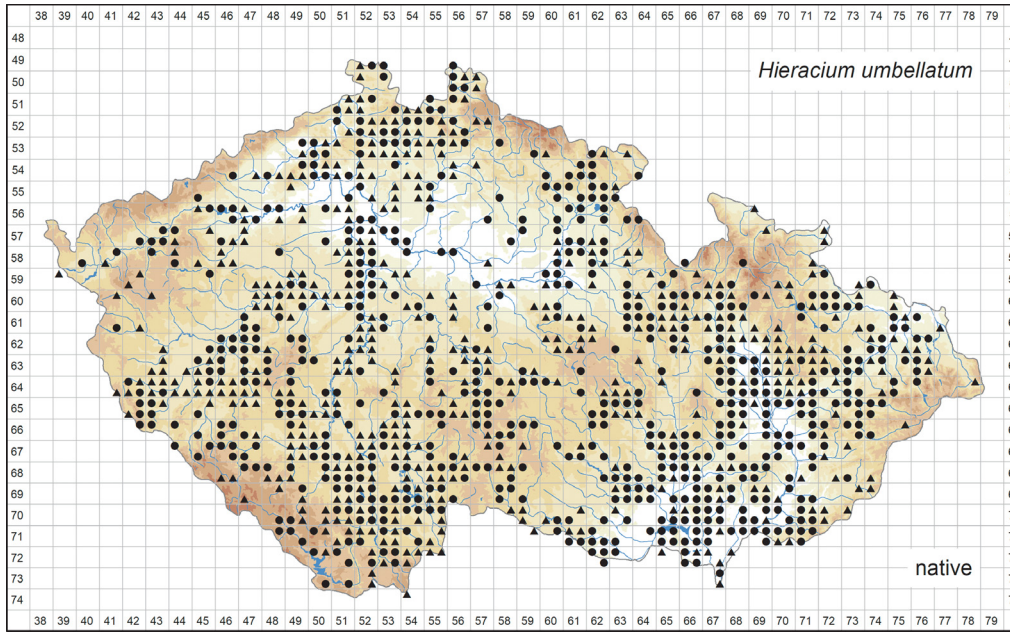

Fig. 40. – Distribution of *Hieracium umbellatum* in the Czech Republic: ● occurrence documented by herbarium specimens (612 quadrants), ▲ occurrence based on other records (464 quadrants). Prepared by Jiří Danihelka, Olga Rotreklová & Jindřich Chrtek jun.

areas, namely the Třeboňská pánev basin in southern Bohemia, the Labe and Orlice river basins in eastern Bohemia, surroundings of the towns of Česká Lípa in northern Bohemia and of Aš in westernmost Bohemia. It is very rare and mostly extinct elsewhere. In Silesia this species was rare around the town of Osoblaha (now vanished) and recently was found at two sites in the foothills of the Moravskoslezské Beskydy Mts, where it has been probably intentionally introduced. *Hydrocotyle vulgaris* has declined due to eutrophication, drainage and habitat destruction and it is currently classified as vulnerable (Grulich 2012). In the future, there is also a threat of further decline as a result of the desiccation of wetlands associated with climate change.

Leersia oryzoides (Fig. 42)

Leersia oryzoides is a perennial wetland grass distributed in temperate and boreal zones in Europe and North America, with scattered occurrences in the Azores, Caucasus Mts, central Asia, western Siberia, the Russian Far East, eastern China, Korea, Japan and Mexico. It has been introduced into Cuba, Australia and New Zealand (Hultén & Fries 1986, eMonocot 2017). In Europe this species extends northwards to southern Scandinavia and southwards to northern parts of the Mediterranean area. It is highly moisture demanding, which is reflected in its absence in southern parts of the Mediterranean area and other dry regions. *Leersia oryzoides* grows on the shores of ponds (in the Czech Republic particularly fishponds and fish storage ponds), artificial water reservoirs, rivers, brooks, channels, ditches and other wet habitats with fluctuating water levels and/or regular mechanical disturbances by fast flowing water or management. It grows mainly on nutrient rich, waterlogged or shallow flooded sapropelic or clayey muddy substrates, but in high moisture conditions it is able to grow also on sand or gravel. At undisturbed sites *L. oryzoides* is often quickly outcompeted by taller grasses such as *Phalaris arundinacea*. It is capable of surviving unsuitable conditions such as competition or a high water level in the form of rhizomes and seeds in the soil propagule bank. The seeds are highly resistant to mechanical and chemical damage, and easily dispersed by water and animals. Thanks to this strategy this species survives well even in present-day wetlands, despite strong changes in their use and management. However, depending on site conditions, the occurrence may fluctuate, which, together with frequent cleistogamy, results in under-recording. In the Czech Republic *L. oryzoides* occurs mainly in the lowlands and moderately warm uplands, with an elevational maximum in the upper Vltava river basin in the Šumava Mts at 725 m. The species is most frequent in the fishpond landscapes in southern Bohemia, the Českomoravská vrchovina highlands and northern Moravia, and in the basins of large rivers. There are large areas without any records, which, however, may be due to under-recording rather than the actual absence of this species. *Leersia oryzoides* is classified as vulnerable (Grulich 2012).

Myosurus minimus (Fig. 43)

Myosurus minimus is an annual herbaceous plant with an extensive distribution including large parts of the temperate and boreal zones in Europe, western Asia and North America. Scattered occurrence is also recorded in the Mediterranean areas in Europe, Africa and Mexico, and as an introduced species it is reported in Australia (Hultén & Fries 1986, Lampe 1996). Records from other areas are doubtful and may relate to different taxa (see

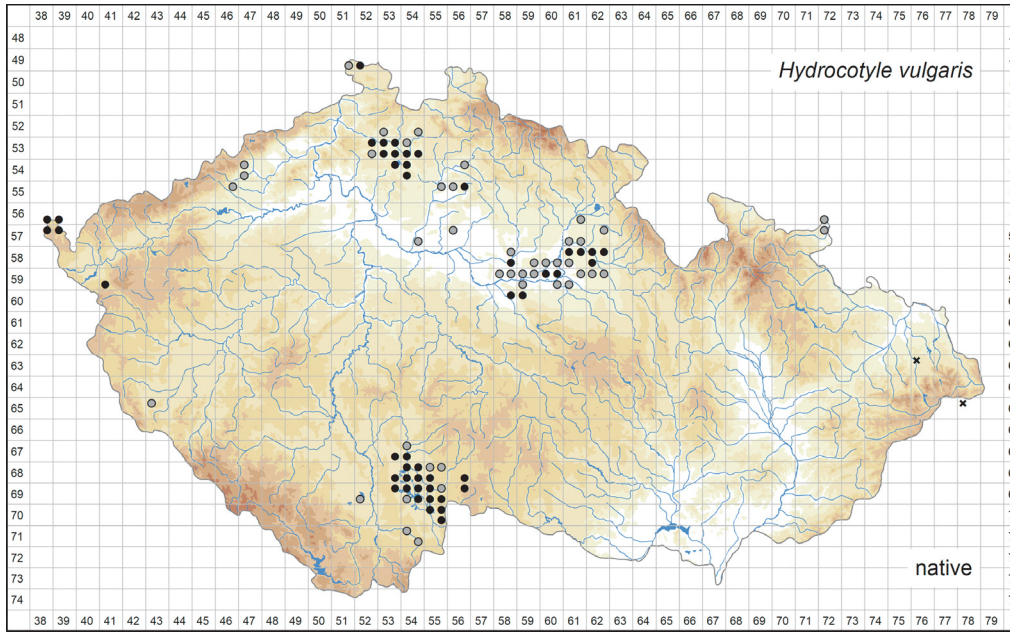

Fig. 41. – Distribution of *Hydrocotyle vulgaris* in the Czech Republic: ● at least one record in 2000–2016 (47 quadrants), ◍ pre 2000 records only (43 quadrants), × deliberate introductions only (2 quadrants). Prepared by Jan Prančl.

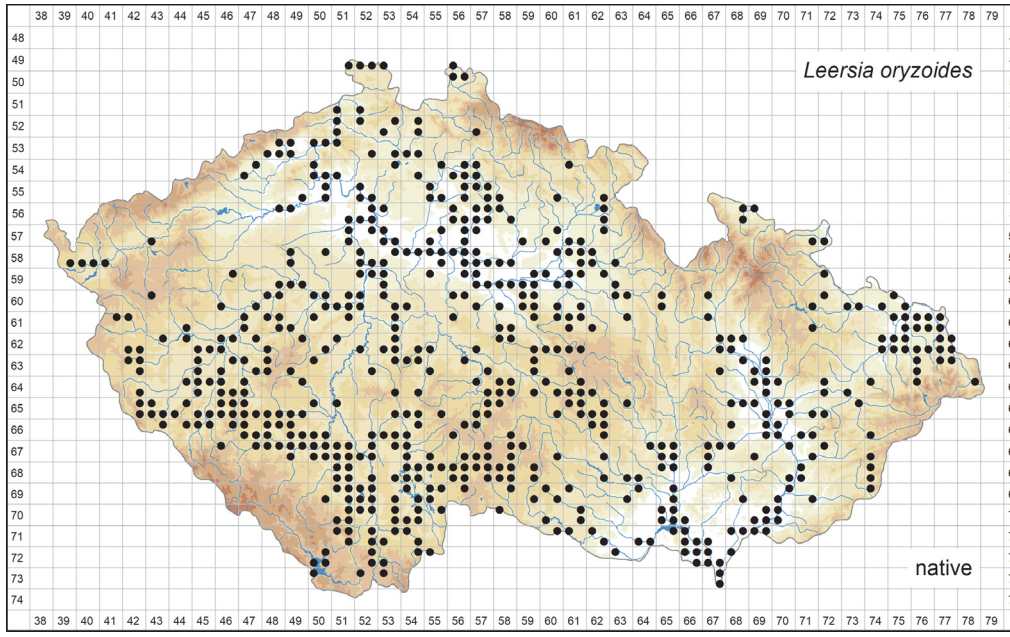

Fig. 42. – Distribution of *Leersia oryzoides* in the Czech Republic (610 occupied quadrants). Prepared by Kateřina Šumberová & Michal Ducháček.

e.g. Garnock-Jones 1986). This species does not occur in tropical and subtropical zones and is rather rare in regions without frosty winters. In central Europe it usually behaves as a winter annual, i.e. germinates in autumn, survives the winter in a vegetative stage and finishes its development by flowering and fruiting in spring of the following year (Lampe 1996). This strategy enables the plants to avoid dry and warm summers. However, it probably restricts the occurrence of this species to the lowlands and uplands, as the autumn temperatures in the mountains are too low at the time this species normally germinates. *Myosurus minimus* grows in wet or waterlogged habitats with a low vegetation cover such as wet depressions in arable fields and meadows, field and forest tracks, banks and bottoms of fishponds and fish storage ponds, ditches and sand pits. Although it is usually reported growing on sandy soils, it is able to grow on a variety of substrates, including clayey or loamy mud, gravel and even organic material such as dead wood or bases of tall sedge tussocks. *Myosurus minimus* is not recorded growing on calcareous soils (Lampe 1996), but it is able to grow on wet saline soils (Vicherek 1968). In the Czech Republic it occurs in the lowlands and uplands throughout this country, being most frequent in the fishpond landscapes in southern and eastern Bohemia and along the floodplains of large rivers. It is rare at high elevations, reaching its elevational maxima at about 550–600 m. Due to its small size, ephemeral occurrence and strong inter-annual fluctuations in population size, depending on the amount of rainfall, it may be easily overlooked. Therefore, it is likely that many occurrences remain unnoticed. Although this species was thought to be declining, mild winters during the last two decades may have supported its more frequent occurrence. *Myosurus minimus* is classified as vulnerable (Grulich 2012).

Oenanthe aquatica (Fig. 44)

The distribution of *Oenanthe aquatica* spans from Ireland and Spain in the west to the Altai Mts in the east, mostly occurring in zones with temperate and sub-Mediterranean climates, with outposts in Turkey and northern Iran. In Europe this species is widespread, being absent from subarctic and arctic regions and rare in the Mediterranean area (Hultén & Fries 1986, Hand 2011). It has been introduced into the north-eastern part of the USA (USDA, NRCS 2017) and New Zealand (Johnson & Brooke 1989). *Oenanthe aquatica* grows mainly in still water bodies such as fishponds, oxbows, alluvial pools and wet depressions in meadows, also on exposed fishpond bottoms, less often in ditches and canals with slowly running water. It occurs mostly in open, nutrient-rich habitats with a thick layer of organic mud, but it can also inhabit less nutrient-rich waters and sandy substrates or saline soils. It occurs mainly in periodically flooded habitats, as during flooding it is able to develop and thrive as a submerged growth form in deep water (Hroudová et al. 1992, Šumberová & Hroudová 2011). In the Czech Republic it is mainly found in fishpond-rich areas and large river floodplains from the lowlands to middle elevations. It seems to be rare in or locally absent from mountainous areas, such as in northern and eastern Moravia, or from the driest lowlands without suitable habitats. However, some of the gaps on the map may have resulted from under-recording rather than true absences, because at many of its sites this species occurs only periodically. *Oenanthe aquatica* is one of the few aquatic plants that have not declined due to eutrophication and intensification of fish farming. Currently, it is common in fishpond-rich areas and also

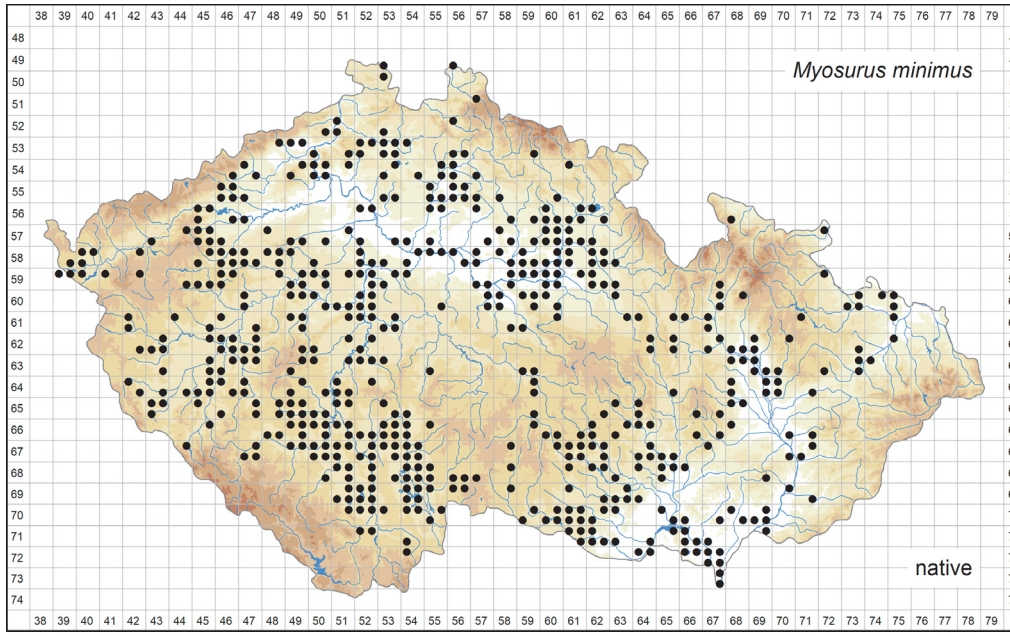

Fig. 43. – Distribution of *Myosurus minimus* in the Czech Republic (555 occupied quadrants). Prepared by Kateřina Šumberová.

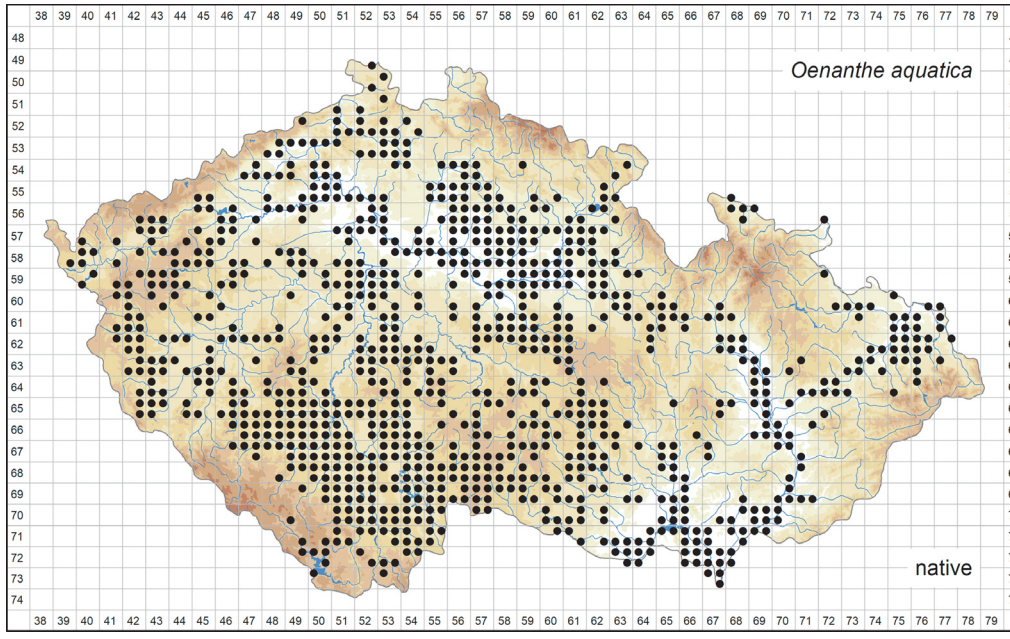

Fig. 44. – Distribution of *Oenanthe aquatica* in the Czech Republic (960 occupied quadrants). Prepared by Jan Prančl.

spreads to higher elevations, reaching its current elevational maximum at about 810 m in the Slavkovský les Mts.

Oenanthe fistulosa (Fig. 45)

Oenanthe fistulosa is mainly a European Atlantic-Mediterranean species distributed particularly in western and southern Europe. Eastwards it reaches Poland, Belarus, Slovakia, Romania, Bulgaria and Greece, towards the north extending as far as the British Isles, Denmark and southernmost Scandinavia. Outside Europe it is known from northern Africa, Anatolia, Israel, Syria and north-western Iran (Hultén & Fries 1986, Hand 2011). It grows in permanently waterlogged or shallowly flooded habitats on heavy clayey soils, such as in periodically flooded depressions in fen meadows, margins of oxbows, alluvial pools and ditches (Bertová 1973). In the Czech Republic *O. fistulosa* has occurred very rarely in Moravia in the floodplain of the Morava river. Three of these localities were situated north-west of the city of Olomouc (last record in 1942), an additional 6–7 localities were known in southern Moravia (last observation in 1970). In Bohemia it was collected only once in 1934 in the vicinity of the city of Hradec Králové. As it has not been seen for more than 45 years, *O. fistulosa* is classified as extinct (Grulich 2012).

Oenanthe silaifolia (Fig. 45)

Oenanthe silaifolia is distributed mainly in southern Europe. Northwards it extends as far as Great Britain and Belgium, very rarely reaching central Europe; eastwards it extends to Ukraine and the western coast of the Black Sea. Outside Europe it occurs in northern Africa, the Middle East, the Caucasus Mts and Transcaucasia (Hand 2011). Four subspecies are recognized (although not widely accepted), of which only subsp. *silaifolia* was recorded in the Czech Republic. It occured on wet, neutral to base-rich heavy gley soils, in habitats such as wet meadows, margins of oxbows, alluvial pools and shallow marshes (Bertová 1973). In the Czech Republic *O. silaifolia* reached the northern limit of its overall distribution. It was recorded at 2–3 sites near the village of Radějov in the Bílé Karpaty Mts in southern Moravia. The first of them, situated in the valley of the Mandát brook, was discovered in 1925 and the plants were last seen there in 1981. This species was further collected in 1932 and 1934 in the vicinity of the nearby village of Malá Vrbka. There is also a single record dated 1978 from the forest of Království near the city of Olomouc in central Moravia; however, it is not clear, if it was a native occurrence. *Oenanthe silaifolia* is currently extinct in the Czech Republic (Grulich 2012).

Oreopteris limbosperma (Fig. 46)

This species was until recently often treated as *Thelypteris limbosperma* or *Lastrea limbosperma* but recent phylogenetic studies (He & Zhang 2012, Almeida et al. 2016) indicate an isolated and monophyletic position of a small north-temperate genus *Oreopteris* within *Thelypteridaceae* and that this species should, therefore, be classified as *O. limbosperma* (Holub 1969, PPG I 2016). It has a disjunct distribution mainly in regions with oceanic and sub-oceanic climates. It is widely distributed in western Europe and north-western Scandinavia, reaching central and eastern Europe, where it usually occurs at high elevations. It occurs also in the Caucasus Mts, rarely in central Siberia, the

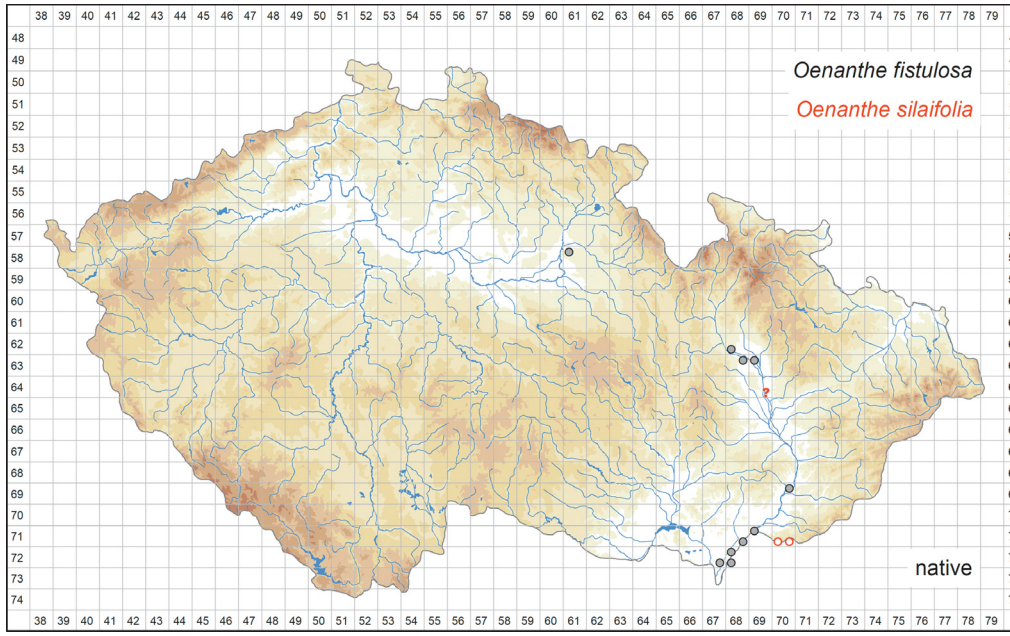

Fig. 45. – Distribution of *Oenanthe fistulosa* (◍ pre 2000 records only: 10 quadrants) and *Oe. silaifolia* (○ pre 2000 records only: 2 quadrants) in the Czech Republic. Prepared by Jan Prančl.

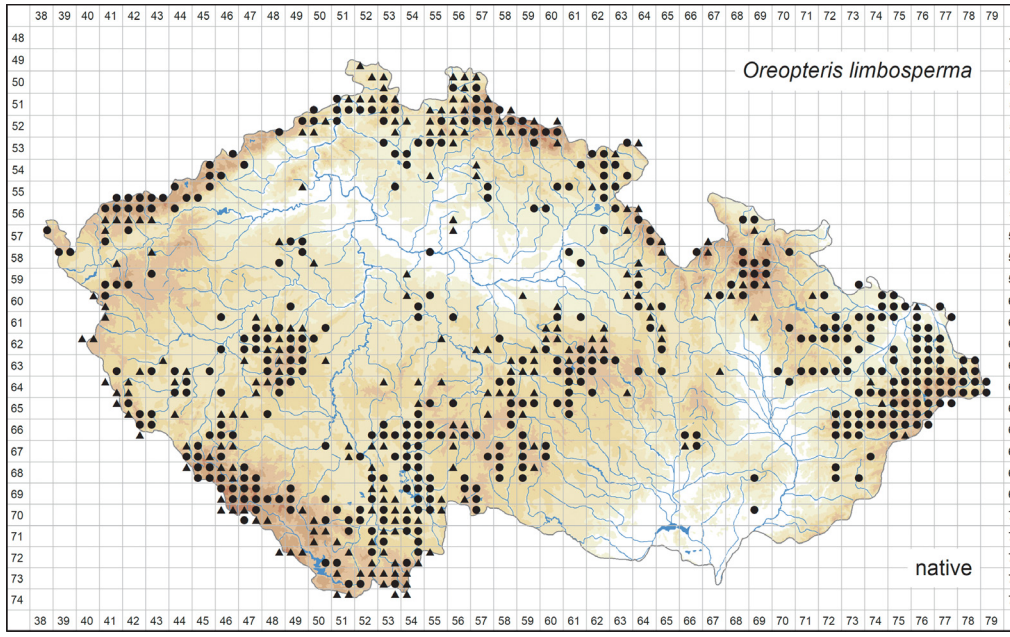

Fig. 46. – Distribution of *Oreopteris limbosperma* in the Czech Republic: ● occurrence documented by herbarium specimens (415 quadrants), ▲ occurrence based on other records (226 quadrants). Prepared by Libor Ekrt.

southern Kamchatka Peninsula, Japan, and in North America from westernmost Canada to the Aleutian Islands (Hultén & Fries 1986). In the Czech Republic *O. limbosperma* is mainly found in spruce forests in the mountains, in tall-forb subalpine vegetation and *Pinus mugo* scrub. At middle elevations it is mainly found in humid and rather cold valleys where it inhabits moist places along forest roads, banks of forest streams and alder carrs. It occurs also in deep gorges in sandstone areas. *Oreopteris limbosperma* is most frequent in the mountain ranges along this country's border, and scattered in highlands such as the Slavkovský les hills, Brdy Mts, some parts of southern Bohemia, the Českomoravská vrchovina highlands, the Oderské vrchy hills and Hostýnské vrchy hills. At lower elevations it occurs only locally and probably temporarily in humid areas.

Paris quadrifolia (Fig. 47)

Paris quadrifolia occurs in boreal and temperate zones in Eurasia. In Europe it is fairly widespread over the whole of the continent, being absent only from its northernmost and north-eastern parts; in the Mediterranean area it is confined to the mountains. In Asia it reaches south-eastern Siberia, northern Mongolia and northern China (Hultén & Fries 1986, Meusel & Jäger 1992). In the Czech Republic it occurs usually in broad-leaved forests with dense canopies on moderately wet soils that are rich in nutrients. Above the timberline it grows in glacial cirques and in shrub communities along small streams. In the Czech Republic it occurs throughout the country with different frequencies. It is frequent in forested areas from the lowlands to the mountains and rare in or absent from the warm, largely deforested lowlands with prevailing arable land in western, central and eastern Bohemia and southern Moravia.

Phalaris arundinacea (Fig. 48)

Phalaris arundinacea is a circumpolar species. It is generally considered to be native to temperate parts of Europe, Asia and North America. It has been introduced into New Zealand, Australia, South America and Africa (Baldini 1995, Lansdown 2014). In Europe it is widespread over the whole continent. *Phalaris arundinacea* can be found in most wetland habitats, often behaving as an aggressive colonist of disturbed, nutrient-rich wetlands (Lansdown 2014). Its spread in some habitats is enhanced by abandonment of traditional management, particularly the mowing of wet meadows. It is also one of the most common species colonizing the bottoms of abandoned fishponds (i.e. drained for more than one year). It grows on the banks of rivers, canals and streams, on the shores of fishponds and oxbows, in wet meadows, wet sites in forests, fringes of floodplain forests, road ditches, wet depressions in arable fields, on wet waste ground and at wet ruderal sites in human settlements. It is common throughout the Czech Republic from the lowlands up to the mountains. Most of the gaps on the map are due to under-recording. It reaches its elevational maxima at 1300–1350 m in the Šumava Mts, Krkonoše Mts and Hrubý Jeseník Mts.

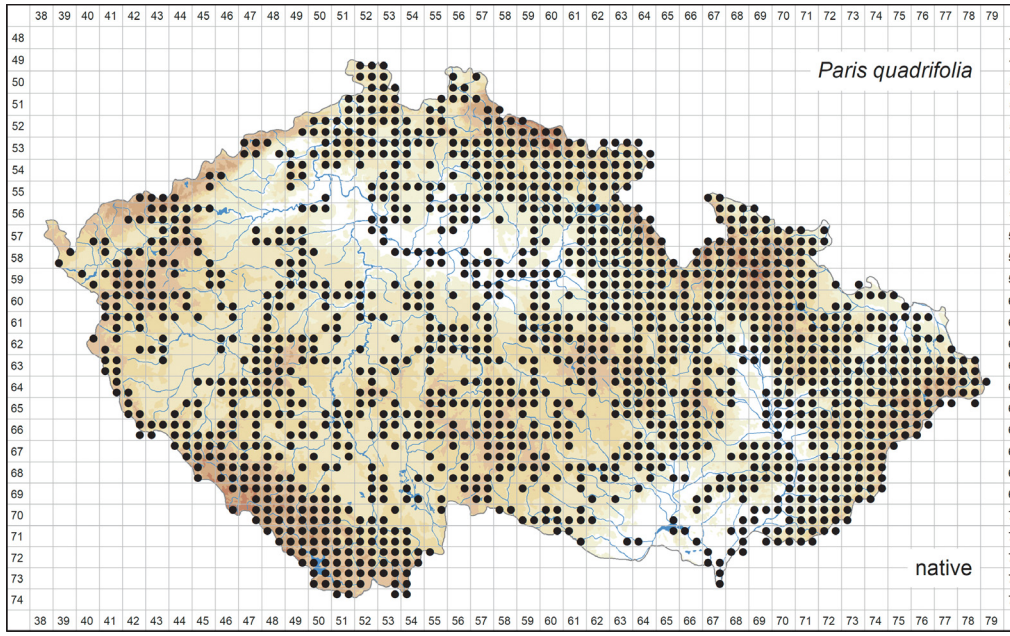

Fig. 47. – Distribution of *Paris quadrifolia* in the Czech Republic (1512 occupied quadrants). Prepared by Jitka Štěpánková.

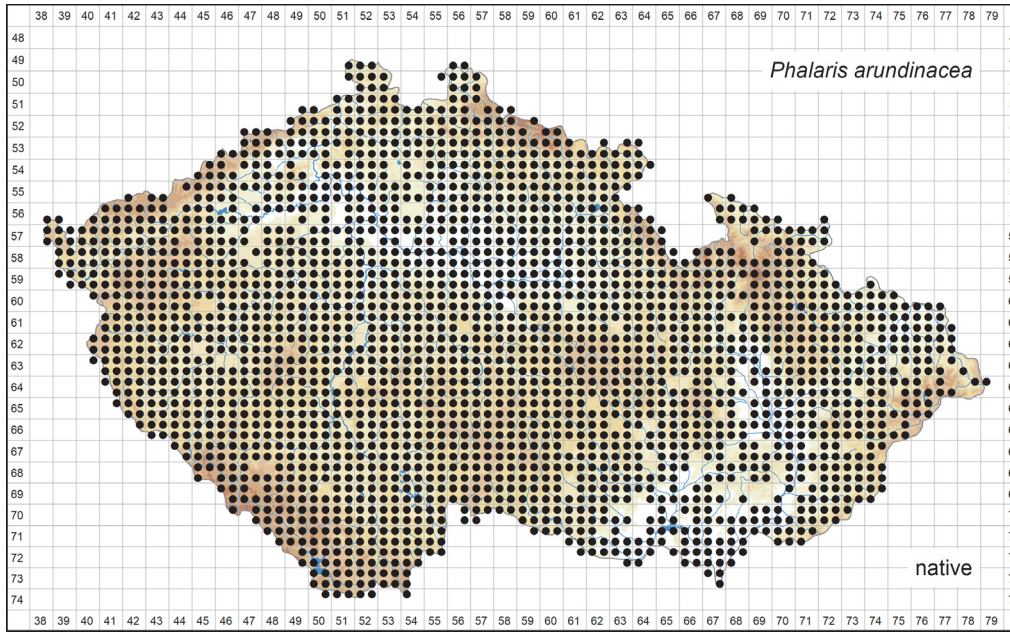

Fig. 48. – Distribution of *Phalaris arundinacea* in the Czech Republic (2289 occupied quadrants). Prepared by Jitka Štěpánková.

Phegopteris connectilis (Fig. 49)

Phegopteris connectilis is a triploid apomictic species with a wide but disjunct distribution in temperate areas in the Northern Hemisphere (Manton 1950), including Europe, western and central Siberia, the Russian Far East, easternmost China, Korea, Japan, North America and Greenland. It is widely distributed in Europe, where it is common except in its southernmost parts (Hultén & Fries 1986). It inhabits moist and shady places in spruce, beech and ravine forests and *Pinus mugo* scrub, growing terrestrially, on old decayed trunks of trees or in crevices in moss covered rocks. In the Czech Republic *Ph. connectilis* occurs most frequently in the mountains along the country's border and in the Českomoravská vrchovina highlands, being scattered also in other highlands across the country. Many gaps on the map in these areas are probably due to under-recording rather than indicating true absences. At lower elevations the species is rare, being confined to humid habitats such as deep and narrow valleys and sandstone areas. There are also a few records from rather dry lowland areas.

Pilosella bauhini (Fig. 50)

Pilosella bauhini is distributed throughout central, south-eastern and eastern Europe and also in Anatolia, the Middle East, the Caucasus Mts, Transcaucasia and northern Iran. Isolated outposts are recorded in Belgium, the Netherlands, eastern France, Gotland and Italy. It has been introduced into the British Isles, parts of Belgium, the Netherlands, France and North America (Meusel & Jäger 1992, USDA, NRCS 2017). This species is very variable in the indumentum of the inflorescence and stem, and two subspecies were recently recognized in the Czech Republic, namely *P. b.* subsp. *bauhini* and *P. b.* subsp. *magyarica* (Danihelka et al. 2012). Nevertheless, there are many plants with an unclear assignment and the subspecies are thus not recognized here. In the Czech Republic *P. bauhini* occurs in open habitats such as semi-dry disturbed grasslands, thermophilous scrub, grassy or stony slopes, disused stone quarries, railway stations, road verges and ruderal and semi-ruderal patches in settlements, less often in thermophilous oak forests. It usually grows on shallow to deep, slightly acidic to alkaline, dry to moderately humid soils, which are poor to moderately rich in nutrients. *Pilosella bauhini* is found from the lowlands to middle elevations almost over the entire country, becoming less frequent or absent in the Českomoravská vrchovina highlands and towards southern and western Bohemia. In the Carpathians it occurs at higher elevations reaching its elevational maximum in the Beskydy Mts at about 900–1000 m. The gaps on the map in western and southern Bohemia are likely to reflect a lack of records as well as real absences or scarcity, partly caused by a lack of suitable habitats (in the Slavkovský les Mts, Šumava Mts and Třeboňská pánev basin). Misidentifications in herbaria are only moderately frequent, except for the many herbarium specimens from southern and south-eastern Moravia originally identified as *P. bauhini* that were actually *P. densiflora.* In the area of the co-occurrence of both species the map is therefore based on revised herbarium specimens and field records of a few botanists familiar with these species.

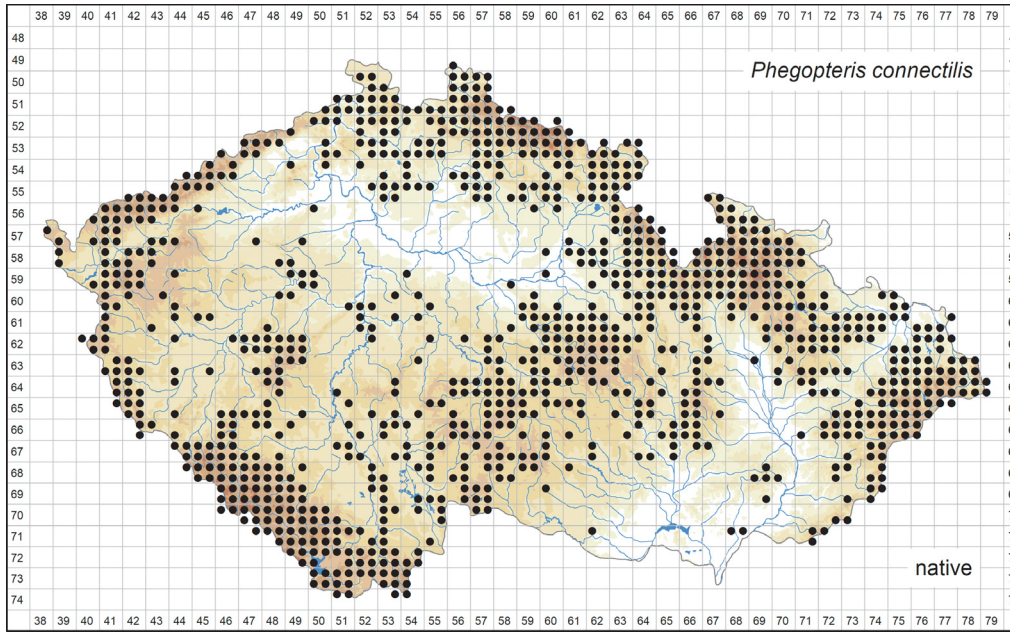

Fig. 49. – Distribution of *Phegopteris connectilis* in the Czech Republic (1012 occupied quadrants). Prepared by Libor Ekrt.

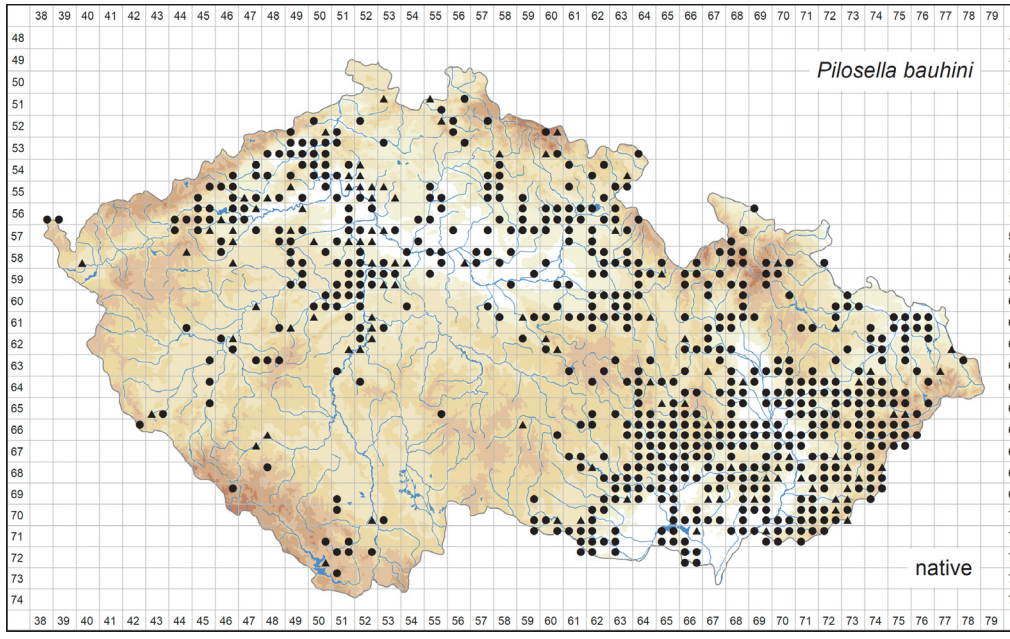

Fig. 50. – Distribution of *Pilosella bauhini* in the Czech Republic: ● occurrence documented by herbarium specimens (593 quadrants), ▲ occurrence based on other records (102 quadrants). Prepared by Olga Rotreklová & Jindřich Chrtek jun.

Pilosella bifurca (Fig. 51)

Pilosella bifurca is a species morphologically occupying a position between *P. echioides* and *P. officinarum*, being more closely related to and thus more similar to the latter. It is partly a stabilized hybridogeneous species and partly primary hybrids between *P. officinarum* and *P. echioides* or *P. rothiana*. *Pilosella bifurca* has a strongly disjunct distribution reaching from the Rhine valley in Germany in the west as far as the Dnieper river basin, the Caucasus Mts and Transcaucasia in the east, from north-eastern Germany, central Poland, Baltic countries and north-western Russia in the north, and Croatia and Romania in the south. In the Czech Republic it occurs in crevices in mostly siliceous and volcanic rocks, on stony slopes and in heathlands and dry to semi-dry grasslands. It mainly grows in shallow, permeable, dry acidic to neutral soils poor to moderately rich in nutrients. *Pilosella bifurca* is a rare species, found in the České středohoří Mts in northern Bohemia, in the Vltava river valley in the city of Prague, at a handful of sites in central Bohemia and in south-western and southern Moravia. It achieves its elevational maximum of 510 m on Mt Kalich in the České středohoří Mts. This species declined due to general eutrophication of the landscape and expansion of tall clonal grasses into heathland vegetation. It is considered as endangered because it is generally rare and declining in abundance (Grulich 2012).

Pilosella caespitosa (Fig. 52)

Pilosella caespitosa is distributed throughout Europe from central France in the west to the Caucasus Mts and western and central Siberia in the east. Its northern distributional limit runs through southern Scandinavia, southern Finland and north-western Russia; in the south its continuous range reaches northern Italy, Bulgaria, Ukraine and the central part of European Russia. It has been introduced into the British Isles, North America and New Zealand (Meusel & Jäger 1992, USDA, NRCS 2017). In the Czech Republic *P. caespitosa* occurs in open habitats such as meadows, grassy slopes, pastures and roadsides. It usually grows on moderately humid, acidic to neutral soils, which are usually poor to moderately rich in nutrients. *Pilosella caespitosa* is found from the lowlands to high elevations almost over the entire country, becoming more frequent in areas with a humid climate and reaching its elevational maximum at 1491 m in the Hrubý Jeseník Mts. It is less frequent in or absent from warm and dry areas. Many of the records in the literature might be erroneous and based especially on a misidentification of *P. glomerata* (a species occupying an intermediate position between *P. caespitosa* and *P. cymosa*). The map is therefore based on revised herbarium specimens and field records of botanists familiar with these species.

Pilosella cymosa (Fig. 53)

Pilosella cymosa occurs mainly in central, northern, south-eastern and eastern Europe. It also occurs in Anatolia and western Siberia (Meusel & Jäger 1992). This species is very variable in terms of its indumentum, and three subspecies were recently recognized in Europe (Bräutigam & Greuter 2007). The plants found in the Czech Republic correspond to either the type subspecies or to *P. c*. subsp. *vaillantii*. Nevertheless, there are some plants with an unclear assignment and especially the subsp. *vaillantii* is rather variable

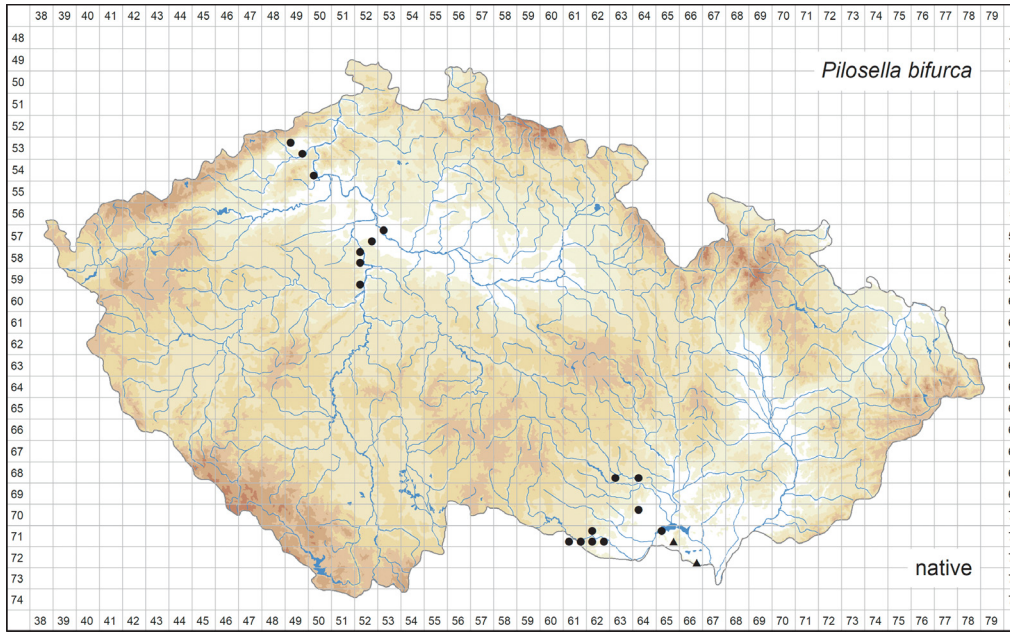

Fig. 51. – Distribution of *Pilosella bifurca* in the Czech Republic: ● occurrence documented by herbarium specimens (17 quadrants), ▲ occurrence based on other records (2 quadrants). Prepared by Jindřich Chrtek jun. & Olga Rotreklová.

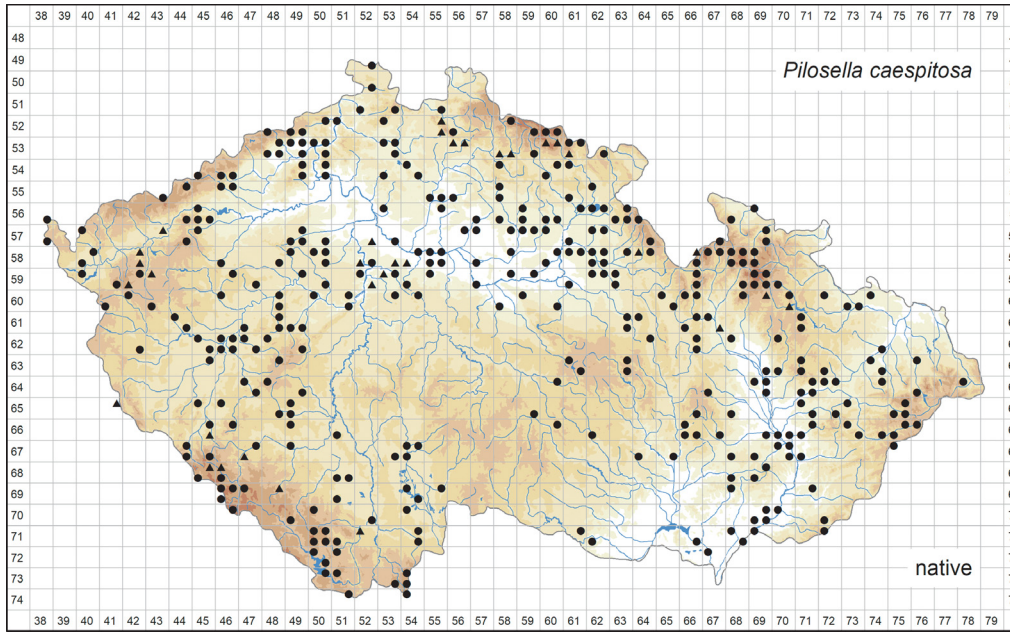

Fig. 52. – Distribution of *Pilosella caespitosa* in the Czech Republic: ● occurrence documented by herbarium specimens (350 quadrants), ▲ occurrence based on other records (32 quadrants). Prepared by Olga Rotreklová & Jindřich Chrtek jun.

and the subspecies are thus not recognized here. In the Czech Republic *P. cymosa* occurs in rock crevices, dry grasslands, thermophilous scrub, fringes of thermophilous forests and open-canopy oak and pine forests. It usually grows on rather shallow and permeable, slightly acidic to basic, dry to moderately humid soils, which are poor to moderately rich in nutrients. *Pilosella cymosa* is found in hilly areas, often with deep river valleys, up to about 550 m a.s.l., and was accidentally introduced up to 1020 m a.s.l. It is scattered in the Doupovské hory Mts and České střehohoří Mts in north-western Bohemia, in the valleys of the Vltava, Berounka and Lužnice rivers in central and southern Bohemia, in south-western Moravia, north of the city of Brno and in the Pavlovské vrchy hills in southernmost Moravia. Isolated occurrences exist in western and north-eastern Bohemia and northern, central and south-eastern Moravia. *Pilosella cymosa* subsp. *cymosa* is classified as of lower risk – near threatened, and *P. c.* subsp. *vaillantii* as vulnerable (Grulich 2012).

Pilosella densiflora (Fig. 54)

Pilosella densiflora is a stabilized hybridogeneous species morphologically occupying an intermediate position between *P. bauhini* and *P. cymosa*. It occurs throughout central, south-eastern and eastern Europe from eastern France in the west to the eastern part of European Russia in the east and from central Germany, Poland and Lithuania in the north to central Italy, Croatia and Greece in the south. In the Czech Republic *P. densiflora* occurs in open habitats such as dry to semi-dry disturbed grasslands, stony slopes and thermophilous scrub. In contrast to *P. bauhini*, *P. densiflora* occurs very rarely at ruderal sites. It usually grows on shallow to deep, slightly acidic to alkaline soils, which are usually rich in nutrients. *Pilosella densiflora* occurs in warm and dry areas in the Czech Republic mostly at elevations 200–400 m, reaching its elevational maximum at 500 m in the Hostýnské vrchy hills in eastern Moravia and at 560 m near the town of Polička in eastern Bohemia. It is common in southern and south-eastern Moravia reaching the karst area of Moravský kras and in the vicinity of the town of Olomouc in the north and the Bílé Karpaty Mts in the east. In Bohemia it is quite common in the hilly area along the Ohře river in the vicinity of the town of Kadaň and in the České středohoří Mts and rare in southern Bohemia on limestone rocks in the vicinity of the town of Český Krumlov and the village of Rabí. It is classified as of lower risk – near threatened (Grulich 2012).

Pilosella echioides (Fig. 55)

Pilosella echioides occurs in central and eastern Europe, westwards it extends up to central Germany, northwards to northern Poland and Baltic countries, southwards it reaches Macedonia and Bulgaria. In Asia it occurs in Anatolia, the Caucasus Mts, Iran, central Asia, south-western Siberia, Mongolia and China (Meusel & Jäger 1992). In the Czech Republic *P. echioides* is found at sunny and dry sites over hard siliceous and volcanic rocks, in heathlands and dry grasslands and in open-canopy pine forests over sand. It usually grows on shallow, dry, acidic to neutral non-calcareous soils, poor or moderately rich in nutrients. It occurs in the České středohoří Mts in northern Bohemia, on rocks in the Vltava river valley and in sandy habitats in central Bohemia, in south-western Moravia (most frequently between the town of Znojmo and the Czech-Austrian border) and occasionally also in southern and south-eastern Moravia at elevations of about 180–350 m

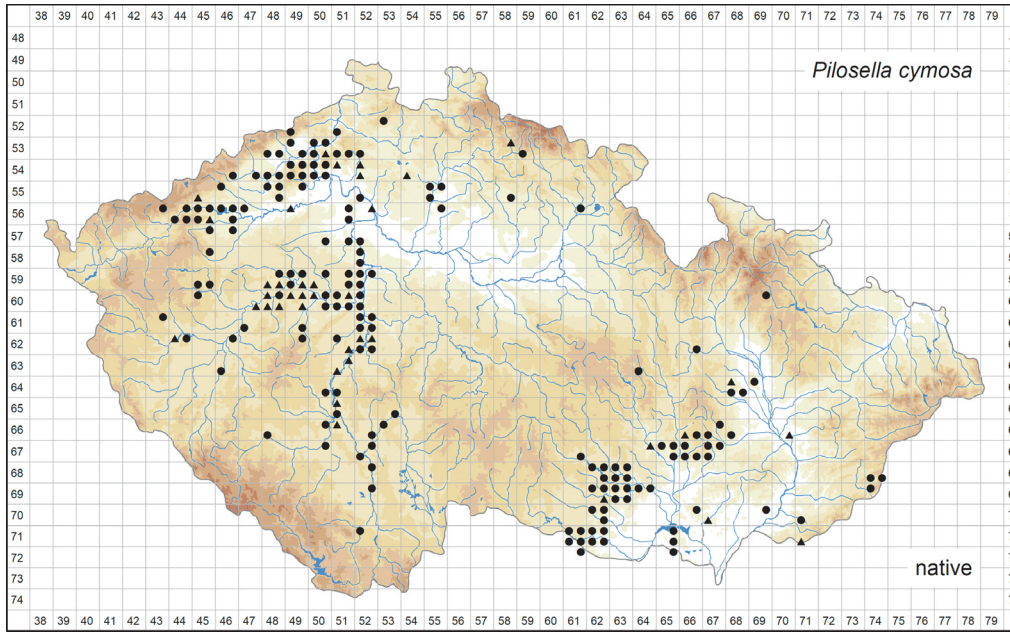

Fig. 53. – Distribution of *Pilosella cymosa* in the Czech Republic: ● occurrence documented by herbarium specimens (164 quadrants), ▲ occurrence based on other records (38 quadrants). Prepared by Jindřich Chrtek jun. & Olga Rotreklová.

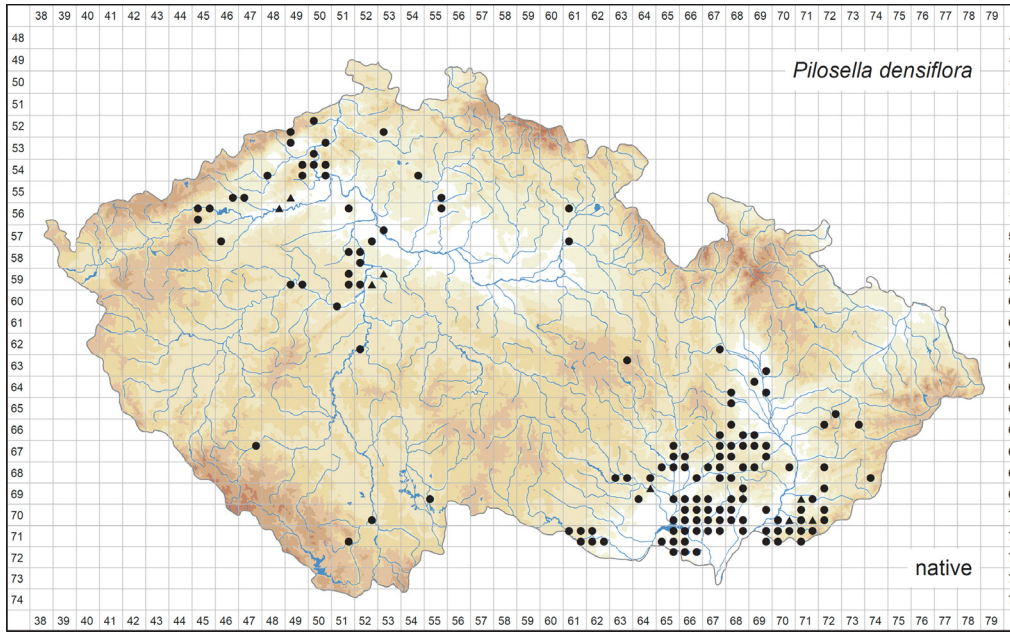

Fig. 54. – Distribution of *Pilosella densiflora* in the Czech Republic: ● occurrence documented by herbarium specimens (135 quadrants), ▲ occurrence based on other records (8 quadrants). Prepared by Olga Rotreklová & Jindřich Chrtek jun.

(Peckert 2002). *Pilosella echioides* has declined in sandy habitats due to changes in land-use and habitat loss and partly also in heathlands due to their colonization by the competitively strong grasses *Arrhenatherum elatius* and *Calamagrostis epigejos*; populations on rocks seem to be stable and not threatened. Therefore, it is classified as vulnerable (Grulich 2012).

Pilosella flagellaris (Fig. 56)

Pilosella flagellaris is a stabilized hybridogeneous species morphologically intermediate between *P. caespitosa* and *P. officinarum*. It is native to north-eastern and central Europe, reaching the western part of Germany (with an outpost in Shetland) in the west, and the Alps, Bosnia and Herzegovina and Romania in the south, and it is also native to the Caucasus Mts; it has been introduced into western Europe and North America. In the Czech Republic *P. flagellaris* occurs in meadows, pastures, forest margins, on grassy roadsides and along paths. It is usually found on moderately humid, acidic to neutral non-calcareous soils, poor or moderately rich in nutrients. *Pilosella flagellaris* is scattered in north-eastern and eastern Bohemia, in the vicinity of the city of Brno and in northern and north-eastern Moravia, and rare in other parts of Moravia. It shows an affinity for areas with a humid and moderately warm to cold climate, which is correlated with its occurrence at middle and high elevations, up to 1400 m a.s.l. *Pilosella flagellaris* has declined considerably and disappeared from large areas, especially in Bohemia, as a result of changes in land-use, most often abandonment of meadows. This species is listed as vulnerable in this country (Grulich 2012).

Pilosella floribunda (Fig. 57)

Pilosella floribunda is a stabilized hybridogeneous species morphologically intermediate between *P. caespitosa* and *P. lactucella*. It has a disjunct distribution ranging from eastern France and north-western Germany in the west as far as the central part of European Russia in the east, and from Norway, Finland and north-western Russia in the north as far as the Alps, southern Carpathians and Ukraine in the south; it has been introduced into the British Isles and North America (Meusel & Jäger 1992, USDA, NRCS 2017). In the Czech Republic *P. floribunda* occurs in meadows, pastures, disturbed grasslands in settlements and along roads and paths. It is usually found growing on moderately humid, acidic to neutral non-calcareous soils, poor or moderately rich in nutrients. It is scattered in the Šumava Mts in south-western Bohemia, Krušné hory Mts in north-western Bohemia and in the Sudetes mountains along the Czech-Polish border (reaching its elevational maximum in the Krkonoše Mts at about 1200 m) and rather rare in adjacent hilly areas with a cold or moderately warm climate. It is nearly absent from warm and dry regions, large parts of western and southern Bohemia, the Českomoravská vrchovina highlands and Carpathian mountains in eastern Moravia. Although *P. floribunda* partly disappears during the course of succession following abandonment (it requires grazing and minor disturbance), it is not immediately threatened. In the Czech flora it is classified as of lower risk – near threatened (Grulich 2012).

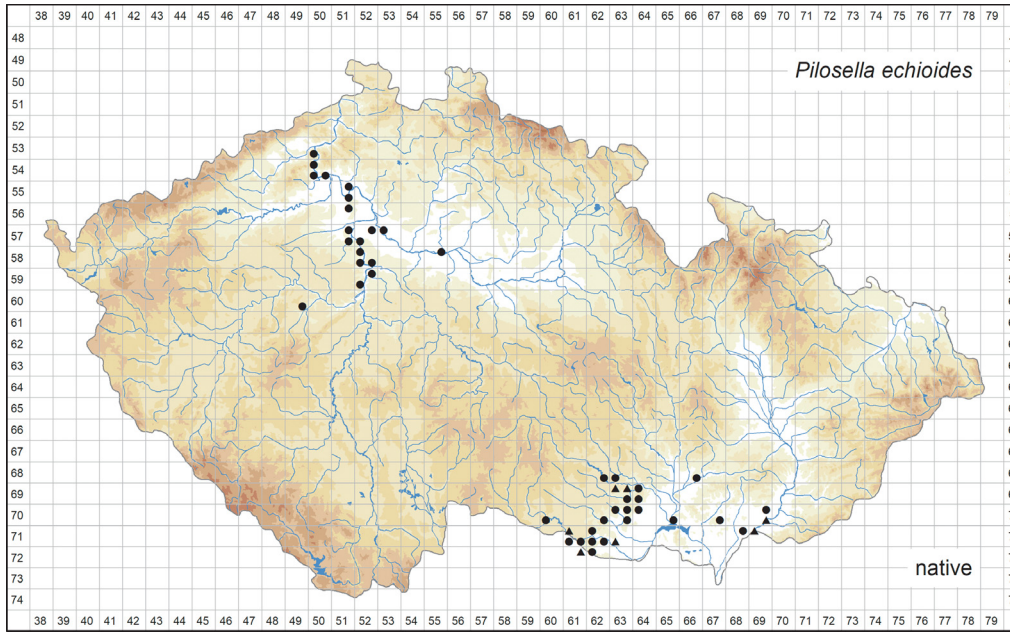

Fig. 55. – Distribution of *Pilosella echioides* in the Czech Republic: ● occurrence documented by herbarium specimens (41 quadrants), ▲ occurrence based on other records (7 quadrants). Prepared by Jindřich Chrtek jun. & Olga Rotreklová.

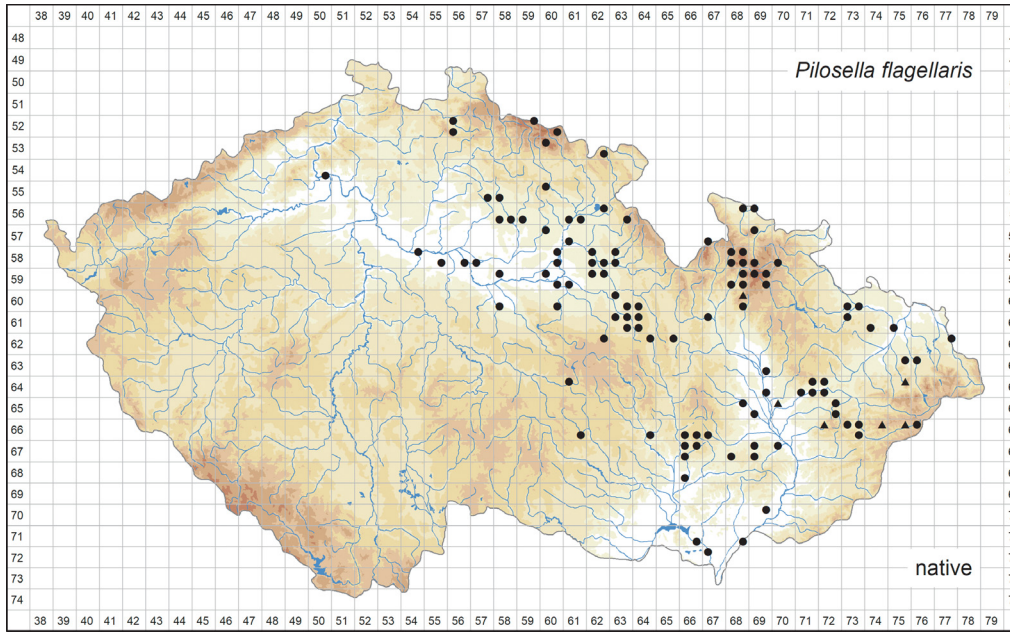

Fig. 56. – Distribution of *Pilosella flagellaris* in the Czech Republic: ● occurrence documented by herbarium specimens (108 quadrants), ▲ occurrence based on other records (6 quadrants). Prepared by Jindřich Chrtek jun. & Olga Rotreklová.

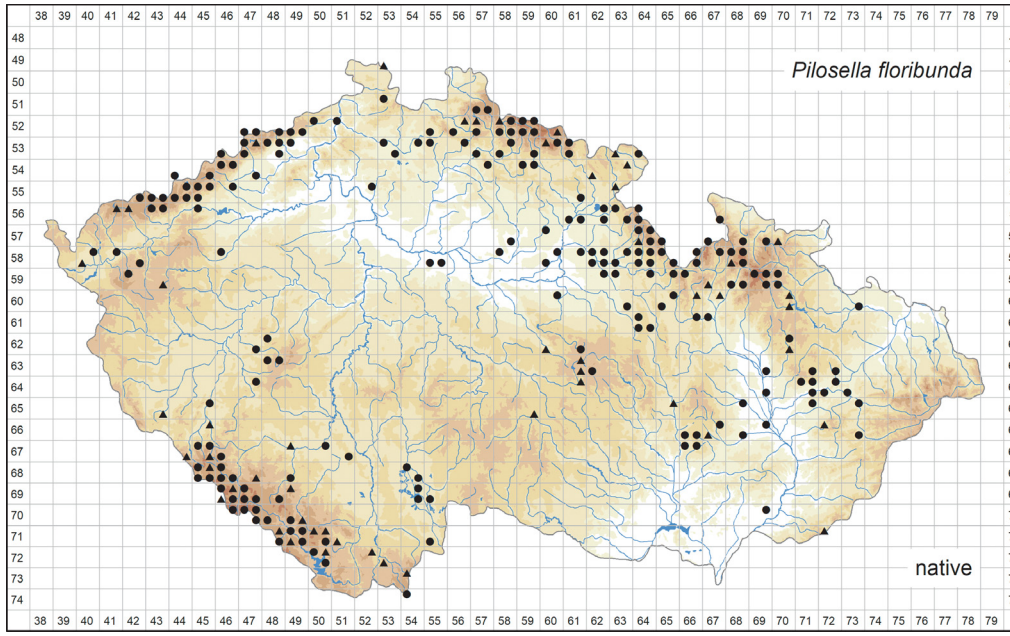

Fig. 57. – Distribution of *Pilosella floribunda* in the Czech Republic: ● occurrence documented by herbarium specimens (201 quadrants), ▲ occurrence based on other records (53 quadrants). Prepared by Jindřich Chrtek jun. & Olga Rotreklová.

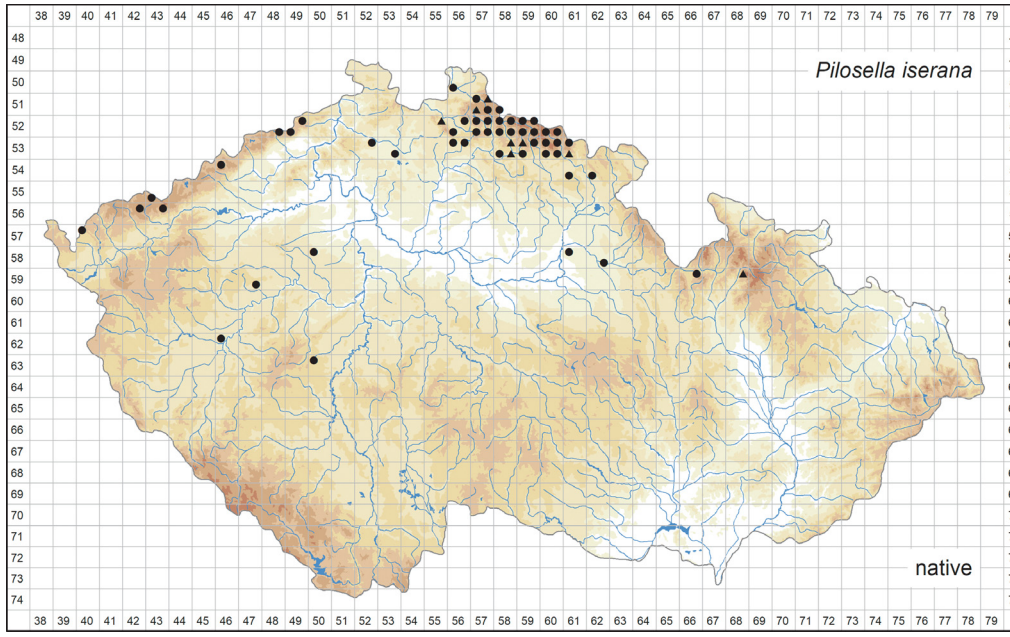

Fig. 58. – Distribution of *Pilosella iserana* in the Czech Republic: ● occurrence documented by herbarium specimens (49 quadrants), ▲ occurrence based on other records (8 quadrants). Prepared by Jindřich Chrtek jun. & Olga Rotreklová.

Pilosella iserana (Fig. 58)

Pilosella iserana is a species morphologically occupying a position between *P. floribunda* and *P. officinarum*, being more closely related to and thus more resembling the former. It has a disjunct distribution ranging from western Germany in the west as far as the Volga river basin in European Russia in the east, and from Poland, the Baltic countries and north-western Russia in the north as far as the Czech Republic, Slovakia and Ukraine in the south. In the Czech Republic *P. iserana* occurs in meadows, disturbed grasslands in settlements and along roads and paths. It is usually found growing on moderately humid, acidic to neutral non-calcareous soils, poor or moderately rich in nutrients. *Pilosella iserana* is scattered in the Jizerské hory Mts and Krkonoše Mts in northern and north-eastern Bohemia and rare in the Krušné hory Mts in north-western Bohemia, at middle elevations in western, central, northern and eastern Bohemia and at high elevations in the Hrubý Jeseník Mts in northern Moravia. Most populations occur in the montane belt; this species has been introduced into the subalpine belt reaching its elevational maximum at 1410 m near the Luční bouda chalet in the Krkonoše Mts. *Pilosella iserana* partly disappears in the course of succession following abandonment (it requires grazing and minor disturbance) and is therefore classified as vulnerable (Grulich 2012).

Pilosella lactucella (Fig. 59)

Pilosella lactucella is distributed throughout Europe from France in the west to the Volga river basin in European Russia in the east. Its northern distributional limit runs through central Norway, Sweden and Finland, in the south its continuous range reaches Corsica, central Italy, Croatia, Bosnia and Herzegovina, Serbia and Romania. Isolated outposts occur in western and north-western parts of the Iberian Peninsula, Norway and in the northern part of European Russia (Meusel & Jäger 1992). In the Czech Republic *P. lactucella* occurs in open habitats such as wet and moderately wet meadows (including peat meadows), pastures and grassy roadsides. It usually grows on acidic, oligotrophic, non-calcareous soils. *Pilosella lactucella* was once widespread from the lowlands to the mountains almost over the entire country becoming more frequent in areas with a humid and moderately cold to cold climate. Most localities were situated at elevations of 700 to 900 m a.s.l., with an elevational maximum at 1424 m on Mt Králický Sněžník. It is absent or nearly absent from warm and dry areas, especially in southern Moravia and central Bohemia. *Pilosella lactucella* has markedly declined since World War II, particularly due to drainage, abandonment of traditional land-use and overall eutrophication. Nowadays it is rare to scattered even in the areas where it formerly frequently occurred. It is considered as endangered in this country (Grulich 2012).

Pilosella piloselloides (Fig. 60)

Pilosella piloselloides is distributed throughout central, south-eastern and eastern Europe from the south-eastern part of the Netherlands and central France in the west to the central part of European Russia in the east, and from northern Germany and southern Finland in the north to Corsica, Italy and the Balkan Peninsula (except southern Greece) in the south. Isolated outposts occur in Anatolia and the Caucasus Mts. It has been introduced into North America and New Zealand (Meusel & Jäger 1992, USDA, NRCS 2017). Two

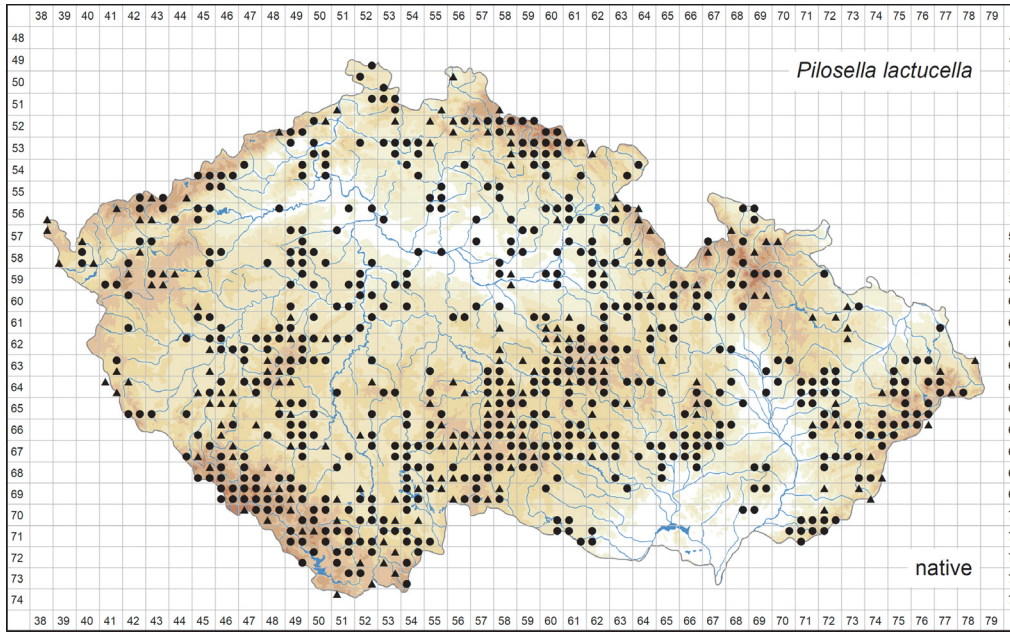

Fig. 59. – Distribution of *Pilosella lactucella* in the Czech Republic: ● occurrence documented by herbarium specimens (563 quadrants), ▲ occurrence based on other records (188 quadrants). Prepared by Olga Rotreklová & Jindřich Chrtek jun.

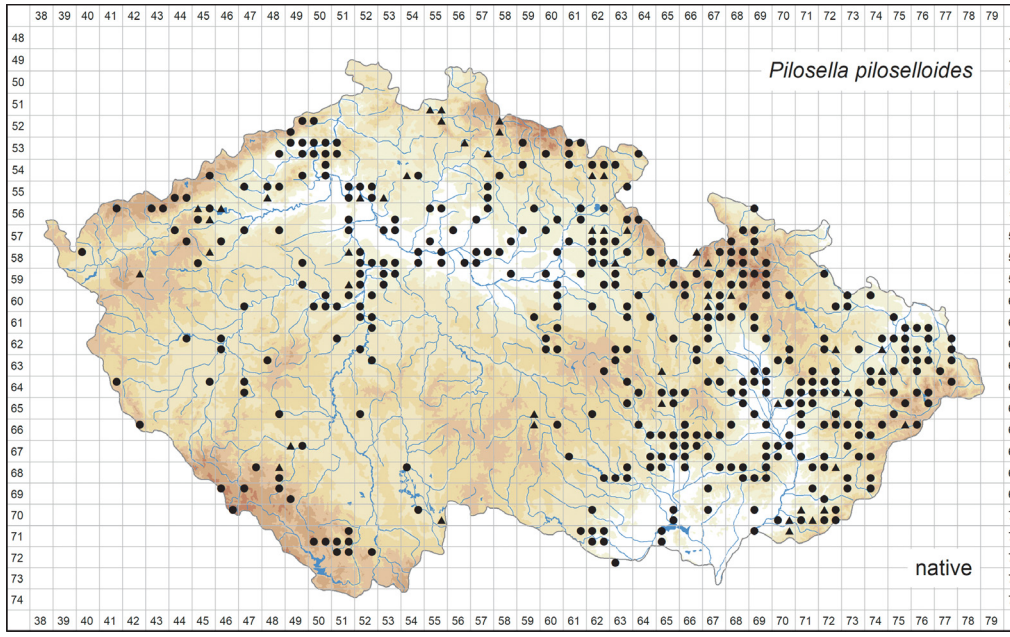

Fig. 60. – Distribution of *Pilosella piloselloides* in the Czech Republic: ● occurrence documented by herbarium specimens (375 quadrants), ▲ occurrence based on other records (46 quadrants). Prepared by Olga Rotreklová & Jindřich Chrtek jun.

subspecies were recently recognized in the Czech Republic, namely *P. p*. subsp. *piloselloides* and *P. p*. subsp. *praealta* (Danihelka et al. 2012), which differ in indumentum and leaf shape. Nevertheless, there are many plants with unclear assignment and these subspecies are thus not recognized here. In the Czech Republic *P. piloselloides* occurs in open habitats such as semi-dry disturbed grasslands, grassy slopes, thermophilous scrub, disused stone quarries, road verges, railway stations and ruderal and semi-ruderal patches in settlements. It usually grows on shallow to deep, slightly acidic to alkaline, dry to moderately humid soils that are poor to moderately rich in nutrients. *Pilosella piloselloides* is found from the lowlands to high elevations almost over the entire country, becoming less frequent or absent in the Českomoravská vrchovina highlands and towards southern and western Bohemia, reaching its elevational maximum in the Hrubý Jeseník Mts at 1350 m. The gaps on the map in western and southern Bohemia are likely to reflect a lack of records as well as real absences or scarcity, partly caused by a lack of suitable habitats (e.g. in the Slavkovský les Mts and much of the Českomoravská vrchovina highlands).

Pilosella rothiana (Fig. 61)

Pilosella rothiana is a stabilized hybridogeneous species morphologically intermediate between *P. echioides* and *P. officinarum*. It is found in central and eastern Europe westwards to the Rhine valley, northwards to northern Germany, Poland, Lithuania and northwestern Russia and southwards to Bulgaria; it also occurs in the Caucasus Mts. In the Czech Republic *P. rothiana* grows in semi-dry grasslands, heathlands, crevices in siliceous and volcanic, less often also limestone rocks, on stony slopes, roadsides, in open-canopy pine forests and lawns in settlements. It is usually found growing on dry to moderately humid, acidic to neutral soils, poor or moderately rich in nutrients. *Pilosella rothiana* occurs in this country's warmest and driest parts, as a rule up to about 400 m (however, it has been accidentally introduced up to 1013 m a.s.l. in the Krkonoše Mts); it is quite common in the hilly area along the Ohře river near the towns of Kadaň and Žatec in north-western Bohemia, scattered in the České středohoří Mts in northern Bohemia and in central Bohemia, locally common in south-western Moravia, especially in the vicinity of the town of Znojmo and scattered in southern and south-eastern Moravia with an outpost near the town of Olomouc (Peckert 2002). Recently it has been spread by traffic, especially in central Bohemia and in the city of Brno; it has also been accidentally introduced into south-western, northern and eastern Bohemia. *Pilosella rothiana* is not immediately endangered and it is therefore classified only as vulnerable (Grulich 2012).

Polystichum aculeatum (Fig. 62)

Polystichum aculeatum is an allotetraploid species whose diploid parents are *P. lonchitis* and *P. setiferum* (Manton 1950). The continuous range of *P. aculeatum* s. str. includes western, central and southern Europe, towards the east reaching only some mountain ranges on the Balkan Peninsula and in Anatolia, the Caucasus Mts and northern Iran. It is also found in northern Africa (Dostál & Reichstein 1984). The plants mapped as *P. aculeatum* s. l. in other countries in Africa, North and South America, Asia and Australia (e.g. Hultén & Fries 1986) belong probably to other species (Dostál & Reichstein 1984). *Polystichum aculeatum* usually grows on neutral to basic soils rich in humus and nutrients in ravine and beech forests, rarely also on old walls. In the Czech Republic

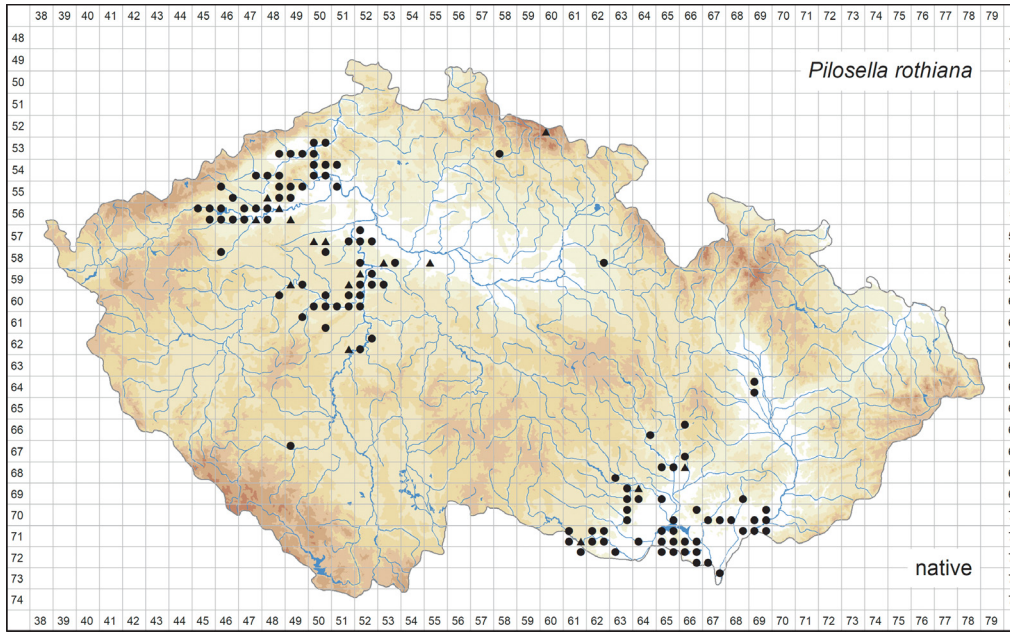

Fig. 61. – Distribution of *Pilosella rothiana* in the Czech Republic: ● occurrence documented by herbarium specimens (108 quadrants), ▲ occurrence based on other records (16 quadrants). Prepared by Jindřich Chrtek jun. & Olga Rotreklová.

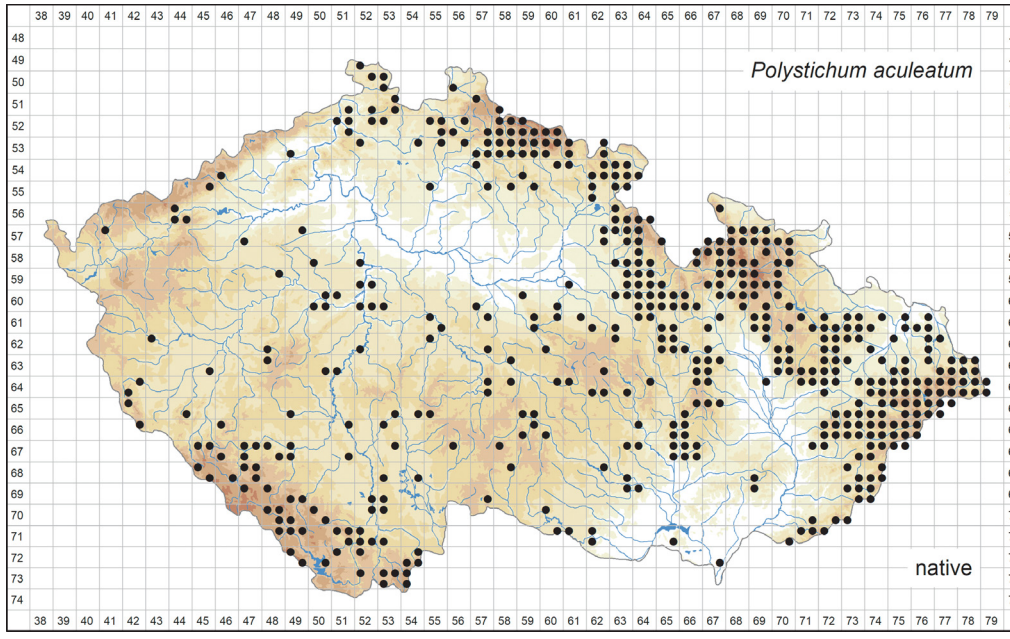

Fig. 62. – Distribution of *Polystichum aculeatum* in the Czech Republic (487 occupied quadrants). Prepared by Libor Ekrt.

P. aculeatum occurs mainly in the Sudetes Mts and the Carpathians in the north and north-east of this country, as well as in the Šumava Mts and their foothills and in the Novohradské hory Mts in southern Bohemia. At middle elevations it is scattered to rare and mainly grows on walls. It is classified as of lower risk – near threatened (Grulich 2012).

Polystichum braunii (Fig. 63)

Polystichum braunii is an allotetraploid species with unknown, most likely extinct ancestral taxa (Jorgensen & Barrington 2017). It has a strongly disjunct circumboreal distribution in the Northern Hemisphere, including European mountain ranges (the Pyrenees, Alps, Carpathians and the Scandes in western Norway), the Caucasus Mts, mountains in central Siberia, in the Far East and in the eastern and western parts of North America (Hultén & Fries 1986). This species is remarkably genetically uniform, most likely because it is capable of selfing, and likely to have expanded its range in the recent past (Jorgensen & Barrington 2017). In the Czech Republic *P. braunii* grows most often in the understory of humid beech, spruce and ravine forests at rather high elevations and in the mountains. It occurs mainly in the Carpathians, particularly in the Moravskoslezské Beskydy Mts, and in the Jeseníky Mts. Westwards it is very rare, being found mainly in western Moravia and northern and eastern Bohemia. It is classified as endangered (Grulich 2012).

Polystichum lonchitis (Fig. 64)

Polystichum lonchitis is a diploid species with a disjunct distribution mainly in temperate zones in the Northern Hemisphere, being found in the majority of mountain ranges in Europe, in Anatolia, the Caucasus Mts, Siberia, the Kamchatka Peninsula, Japan, the western and eastern parts of North America and Greenland (Hultén & Fries 1986). In the Czech Republic it occurs mainly above the timberline in the mountains where it occurs predominantly on calcareous rocks and rocky screes and in *Pinus mugo* scrub. It rarely grows also in montane beech and spruce forests. At lower elevations it is scattered in secondary habitats such as limestone quarries, old walls and road verges; it rarely occurs also in primary habitats in areas with limestone or serpentine rocks. *Polystichum lonchitis* is distributed mainly at high elevations in the Sudetes Mts. It rarely occurs also in northwestern Bohemia, the karst area of Český kras, the Českomoravská vrchovina highlands, southern Bohemia and western Moravia. Records from forests at low elevations are usually doubtful and most likely based on misidentifications of juvenile specimens of *P. aculeatum*. This species is classified as endangered (Grulich 2012).

Polystichum setiferum (Fig. 65)

Polystichum setiferum is a diploid species with an Atlantic and sub-Mediterranean distribution, including Macaronesia, northern Africa and western and southern Europe; it is also found in the mountains in central and eastern Europe and in the Caucasus Mts (Rauschert in Dostál & Reichstein 1984). The Czech Republic is situated at the northern limit of this species' distribution. Based on a detailed revision of herbarium specimens, *P. setiferum* was recorded from the Moravskoslezské Beskydy Mts (Mt Kněhyně and Mt Smrk), the karst area of Moravský kras and the Jeseníky Mts (Ekrt 2016). This species

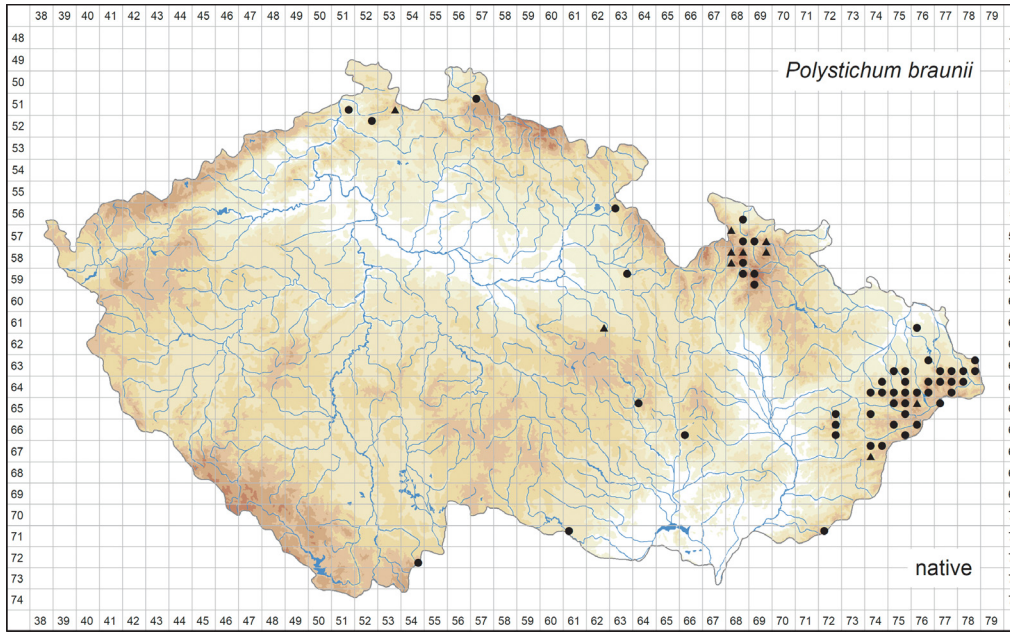

Fig. 63. – Distribution of *Polystichum braunii* in the Czech Republic: ● occurrence documented by herbarium specimens (52 quadrants), ▲ occurrence based on other records (10 quadrants). Prepared by Libor Ekrt.

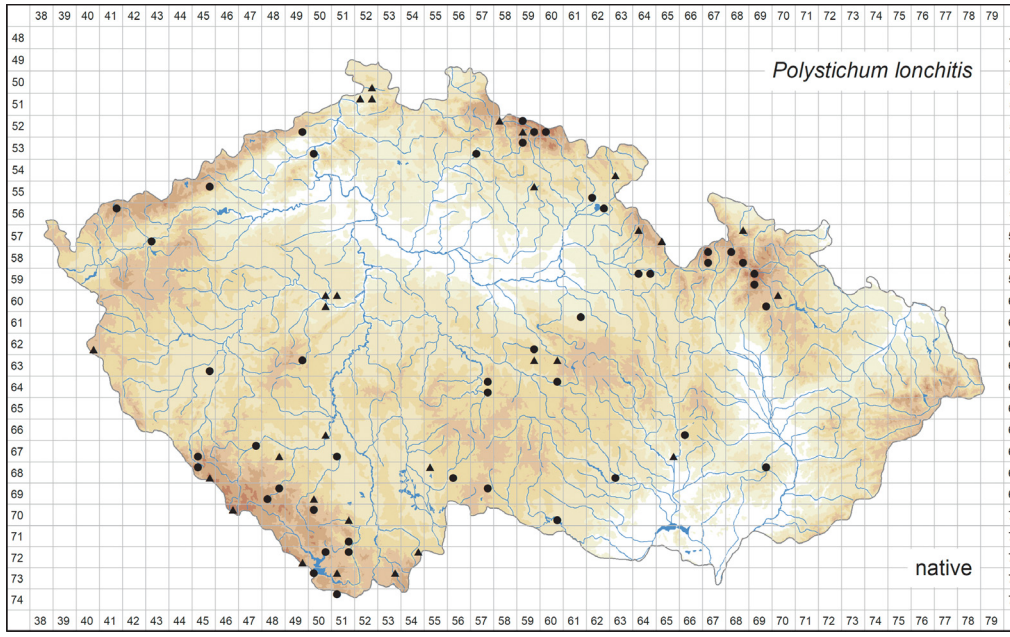

Fig. 64. – Distribution of *Polystichum lonchitis* in the Czech Republic: ● occurrence documented by herbarium specimens (46 quadrants), ▲ occurrence based on other records (29 quadrants). Prepared by Libor Ekrt.

grew in the understory of beech and ravine forests and in other humid forest habitats. The herbarium specimens were collected in 1881–1926, and a search for extant populations in the field proved unsuccessful. *Polystichum setiferum* is therefore considered as extirpated in this country.

Portulaca oleracea (Fig. 66)

Portulaca oleracea is a cosmopolitan species (Danin et al. 1978, Hultén & Fries 1986), ranked as the fourth most widely distributed naturalized plant in the world (Pyšek et al. 2017). The region of origin is uncertain, possibly in arid areas such as northern Africa (Chapman et al. 1974); however, the archaeological evidence shows that *P. oleracea* occurred both in Europe and in the New World already in pre-Columbian times (Byrne & McAndrews 1975). It is a thermophilous plant, in the Czech Republic growing in dry and sunny man-made habitats such as gardens, vineyards, roadsides, railway stations, pavement crevices and other disturbed places, occasionally also in gravel deposits of rivers. It is most abundant in the warm parts of north-western, central and eastern Bohemia and of southern Moravia. In the last two decades, this species has been rapidly spreading, which is probably related to the high frequency of extraordinary warm summers during this period. All records on the map are considered to be *P. oleracea* subsp. *oleracea*. The once rarely cultivated *P. o.* subsp. *sativa* was recorded only as a sporadical garden escape. However, it was not possible to identify all the herbarium specimens unequivocally. In the Czech flora *P. oleracea* subsp. *oleracea* is considered to be an invasive archaeophyte (Pyšek et al. 2012).

Pulicaria dysenterica (Fig. 67)

Pulicaria dysenterica is a perennial herbaceous plant with its main distribution in temperate and Mediterranean zones in Europe, northern Africa and western Asia, and several outposts in the Caucasus Mts, India and Nepal. In Europe it mainly occurs in the west, reaching the limits of its northern distribution in Denmark and southern Scotland. It has been introduced into Norway, the eastern coast of North America and China (Meusel & Jäger 1992, Greuter 2006, Chen & Anderberg 2011). It is confined to wet disturbed grasslands in mineral-rich, usually sub-saline habitats such as coastal and inland salt marshes, pastures, ditches and wetlands on arable land. In the Czech Republic it colonizes also road verges and railway embankments, where it thrives thanks to occasional mowing and along roads also due to winter salting. In contrast, it disappeared from native habitats in some of the inland salt marshes, as these were destroyed during the 20th century by drainage, conversion to arable land and abandonment of grazing (similar to *P. vulgaris*, *P. dysenterica* also profits from grazing since its content of essential oils makes it unpalatable for animals). However, if there is sufficient moisture and competition from other plants is reduced by disturbance, populations of *P. dysenterica* are rather stable even in ruderal habitats. Its native range in the Czech Republic includes the lowlands in southern Moravia, particularly the sub-saline habitats along the floodplains of the Dyje and Svratka rivers, and the southern, steppe part of the Bílé Karpaty Mts. All the occurrences in Bohemia and probably also in central and northern Moravia are secondary, as they are all in man-made habitats (e.g. road verges, ditches along roads, banks of fishponds). Due to the threat to its native habitats it is classified as critically threatened (Grulich 2012).

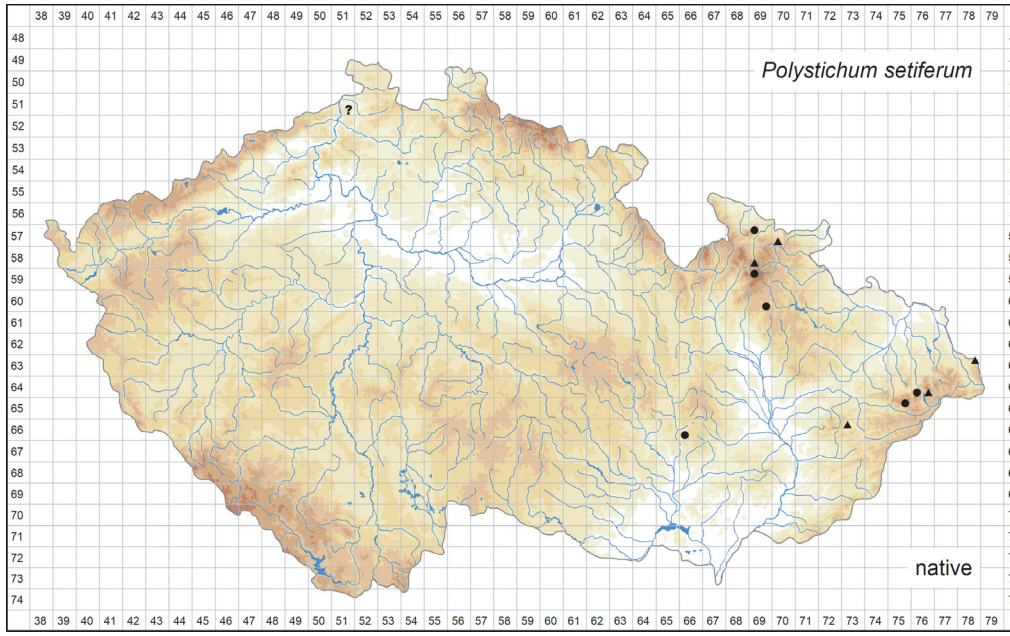

Fig. 65. – Distribution of *Polystichum setiferum* in the Czech Republic: ● occurrence documented by herbarium specimens (6 quadrants), ▲ occurrence based on other records (5 quadrants). Prepared by Libor Ekrt.

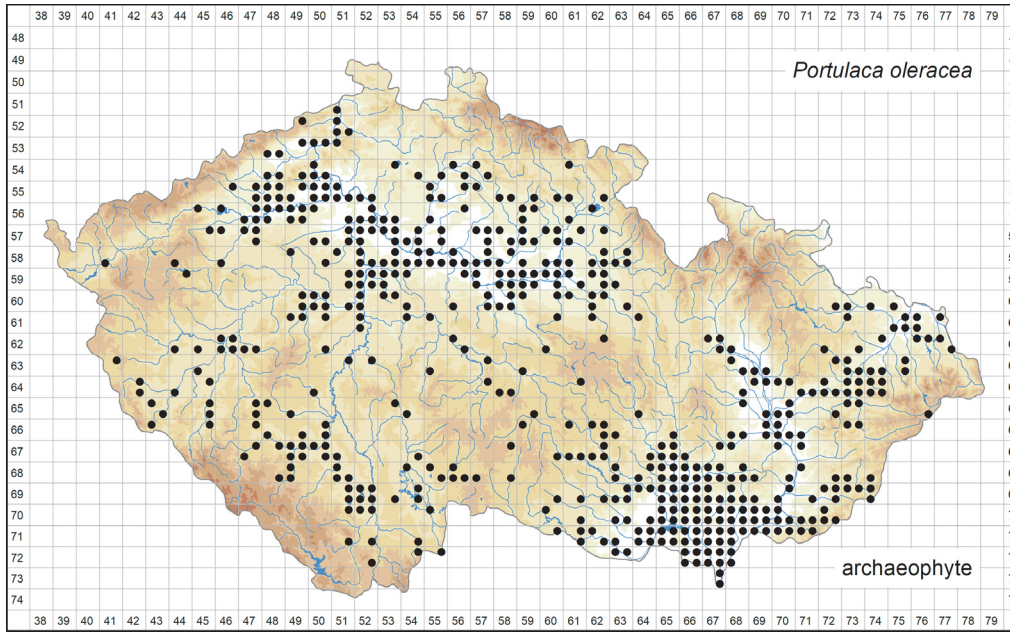

Fig. 66. – Distribution of *Portulaca oleracea* in the Czech Republic (540 occupied quadrants). Prepared by Michal Ducháček.

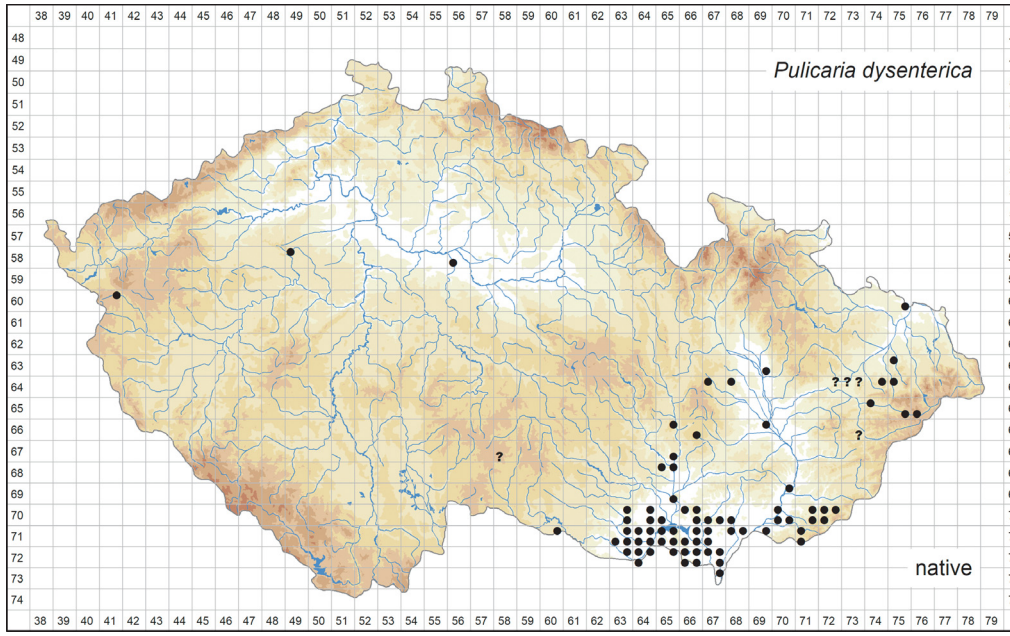

Fig. 67. – Distribution of *Pulicaria dysenterica* in the Czech Republic (75 occupied quadrants). Prepared by Kateřina Šumberová.

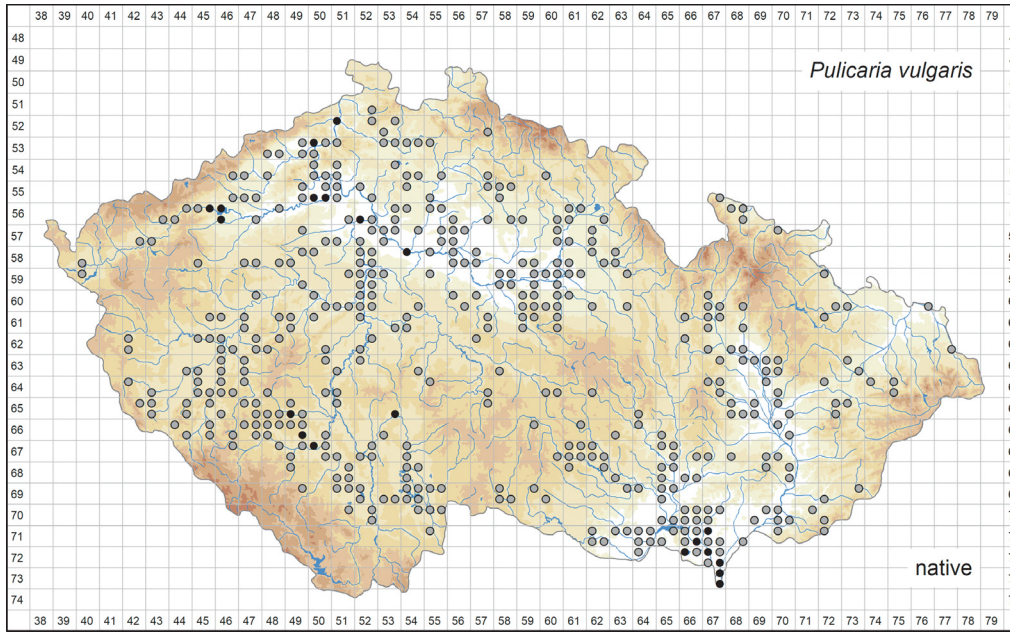

Fig. 68. – Distribution of *Pulicaria vulgaris* in the Czech Republic: ● at least one record in 2000–2016 (20 quadrants), ● pre 2000 records only (430 quadrants). Prepared by Kateřina Šumberová.

Pulicaria vulgaris (Fig. 68)

Pulicaria vulgaris is a thermophilous wetland annual herbaceous plant with its main distribution in temperate zones in Europe and south-western and central Asia, reaching the limit in its eastern distribution in south-western Siberia and north-western Mongolia. Several outposts are known in northern Africa and north-western India, and a non-native occurrence is reported in the Russian Far East. In Europe this species reaches its western limits in northern Spain and eastern Great Britain and northern limit in southern Scandinavia; it is very rare in the southernmost parts of Europe (Hultén & Fries 1986, von Lampe 1996). *Pulicaria vulgaris* occupies sandy, muddy or gravelly, usually nutrient-rich, temporarily flooded substrates on the banks and shores of lakes, ponds, sand and gravel pits, and rivers, in wet ditches, depressions in wet meadows and pastures (including sub-saline ones) and similar habitats with a regular but low-intensity disturbance. During germination, which in central Europe starts at the end of May or in early June, the species requires wet places without competition from other herbs (von Lampe 1996). Once established, the plants are able to survive even deep desiccation of the substrate. Due to its content of aromatic compounds it is unpalatable for most animals and thus protected against damage by grazing. In the Czech Republic *P. vulgaris* has been reported from the lowlands and warm uplands in the whole country. It is likely that the number of localities is underestimated, as this species used to be very frequent and considered not worth recording. It was a typical plant of wet ground in villages (e.g. in the surroundings of village ponds with poultry breeding) and grazed landscapes. As this land-use started to be abandoned during the 20th century, particularly after World War II, *P. vulgaris* strongly declined during the last decades, being maintained at a limited number of sites in north-western, central and southern Bohemia and southern Moravia. These are mainly disturbed river banks, traditionally managed fish storage ponds, sand pits and floodplain meadows grazed by game. In contrast, this species completely disappeared from villages. It is therefore classified as critically threatened (Grulich 2012).

Salicornia perennans (Fig. 69)

Salicornia perennans is a member of a taxonomically difficult group of diploid glassworts distributed from the western Adriatic coast of Italy in the west to the shores of the Aral Sea in the east (Kadereit et al. 2007). In the circumscription accepted here this species includes only inland populations, which until recently were known under the name *S. prostrata* (see Freitag 2011). In the south-eastern Czech Republic this species reaches the north-western limit of its distribution. *Salicornia perennans* is an obligate halophyte occurring in saline habitats mainly around lakes and fishponds or in depressions without natural drainage; the sites are flooded in spring but dry out during summer. The occurrence of stands of *Salicornia* is restricted to places with the strongest concentration of chlorides and sulphates; in Moravia such sites are mineral springs or Tertiary deposits. The concentration of sulphates and chlorides in the upper soil layers is facilitated by a continental climate in which summer temperatures are high and annual precipitation less than 550 mm. The soils, approaching solonchaks in their properties, are heavy, clay or loamy, moderately rich in nutrients, neutral to slightly alkaline (Šumberová 2007). In the Czech Republic *S. perennans* occurred only in the lowlands in southern Moravia south-west to south-east of Brno. However, the fishponds and lakes with saline

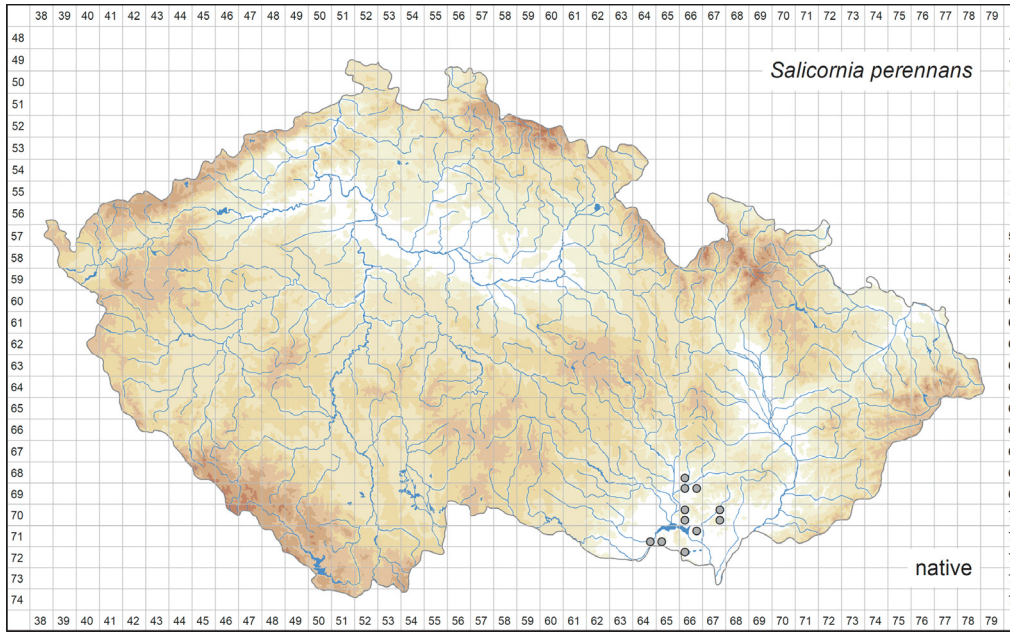

Fig. 69. – Distribution of *Salicornia perennans* in the Czech Republic: ● pre 2000 records only (11 quadrants). Prepared by Jiří Danihelka.

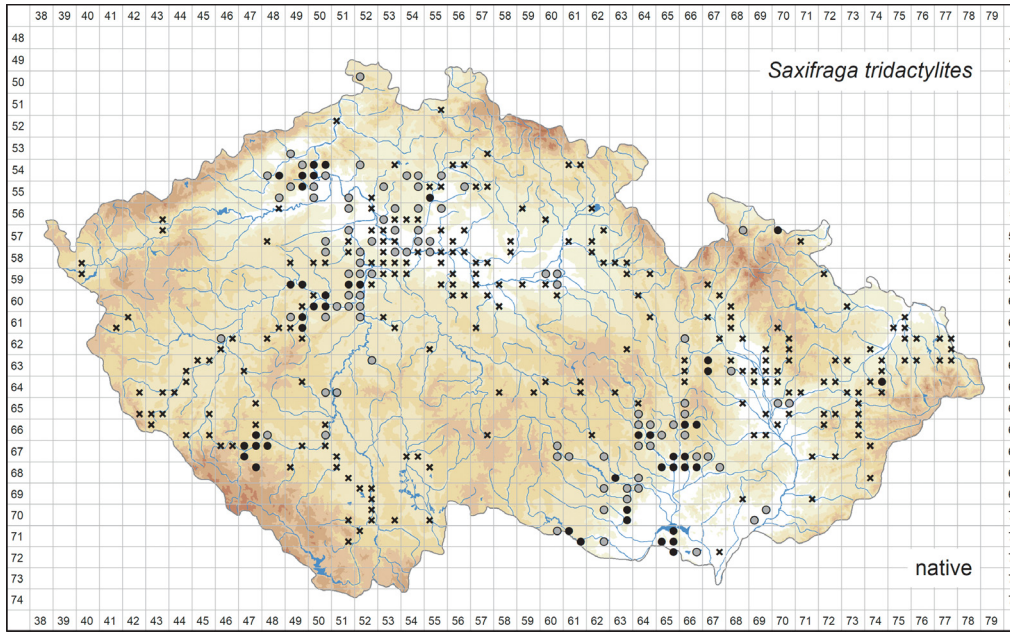

Fig. 70. – Distribution of *Saxifraga tridactylites* in the Czech Republic: ● native, at least one record in 2000–2016 (45 quadrants), ● native, pre 2000 records only (88 quadrants), × alien only (217 quadrants). Prepared by Michal Ducháček & Petr Kocián.

water were drained already in the first half of the 19th century and used to grow sugar beet. The destruction of saline habitats has continued since then, further accelerating in the 1950s because of large-scale drainage and changes in agriculture, as grazing became a rare agricultural practice in this area. Water regime of still preserved remnants of saline habitats was markedly changed, followed by desalinisation. Under such conditions this species suffered from rapid succession of common glycophytic plants. The last population of *S. perennans* in this country, found in a nature reserve on the western shores of the Nesyt fishpond (south-east of the town of Mikulov), vanished in the 1970s (the last specimens were collected in 1976). *Salicornia perennans* is therefore classified as nationally extinct (Grulich 2012).

Saxifraga tridactylites (Fig. 70)

Saxifraga tridactylites occurs in most of Europe, being absent from its northernmost and eastern parts; it also occurs at isolated localities in western Asia and northern Africa (Meusel et al. 1965). Native occurrences in the Czech Republic are mainly in vegetation consisting of vernal therophytes growing on shallow soils on rock outcrops and in gaps in dry grasslands, mostly on limestone or other base-rich soils, and occasionally also in sandy habitats. This species grows mainly in the warmest parts in central and north-western Bohemia and south-western Moravia, but sometimes also on limestone in colder areas. It is a weakly competitive annual species, which is dependent on disturbance. Since 1950 it has disappeared from more than half of its original localities. In contrast, during the last two decades it has rapidly spread along railway tracks, being most frequent in the fine gravel between the tracks in railway stations together with some other vernal therophytes (Ducháček 2009); these secondary occurrences are located also in areas with colder climates.

Suaeda prostrata (Fig. 71)

There are four species of the taxonomically difficult *Suaeda maritima* agg. in Europe (Uotila 2011). Of these, *S. prostrata* is distributed from the Pannonian Basin in the west through Ukraine and southern European Russia to north-western Kazakhstan and south-western Siberia in the east (Freitag et al. 1996, Freitag & Lomonosova 2006). In the Czech Republic this species reaches the north-western limit of its distribution. This obligate halophyte occurs around lakes and fishponds with saline water and in depressions flooded in spring but drying out in summer, always in places with the highest concentration of chlorides and sulphates, originating from mineral springs or Tertiary deposits. The other necessary condition is a continental climate with an annual precipitation of less than 550 mm. The soils are heavy, clay or loamy, very rich in nutrients, mainly nitrogen, and alkaline (Šumberová 2007). Succession is blocked by salinity combined with grazing by domestic animals including waterfowl. In the Czech Republic *S. prostrata* occurred only in the lowlands in southern Moravia south-west to south-east of Brno, usually together with *Salicornia perennans*, and both species were affected by changes in land use almost in the same way. The last population in this country, once found on the western shores of the Nesyt fishpond (south-east of the town of Mikulov), disappeared in the 1980s: the last specimens were seen there in 1987, and *S. prostrata* is now classified as nationally extinct (Grulich 2012).

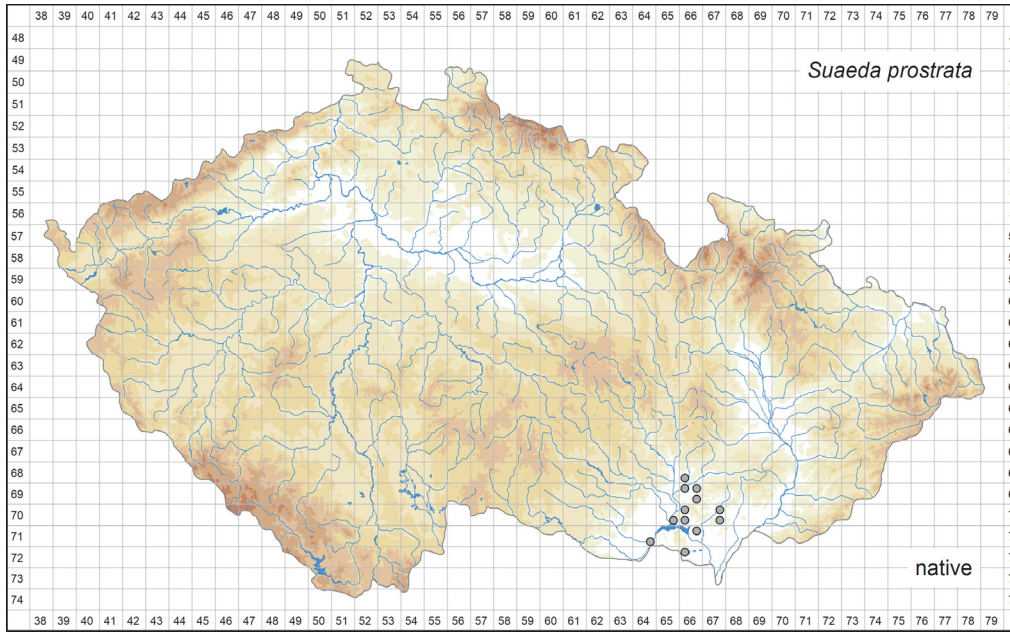

Fig. 71. – Distribution of *Suaeda prostrata* in the Czech Republic: ● pre 2000 records only (12 quadrants). Prepared by Jiří Danihelka & Zdeněk Kaplan.

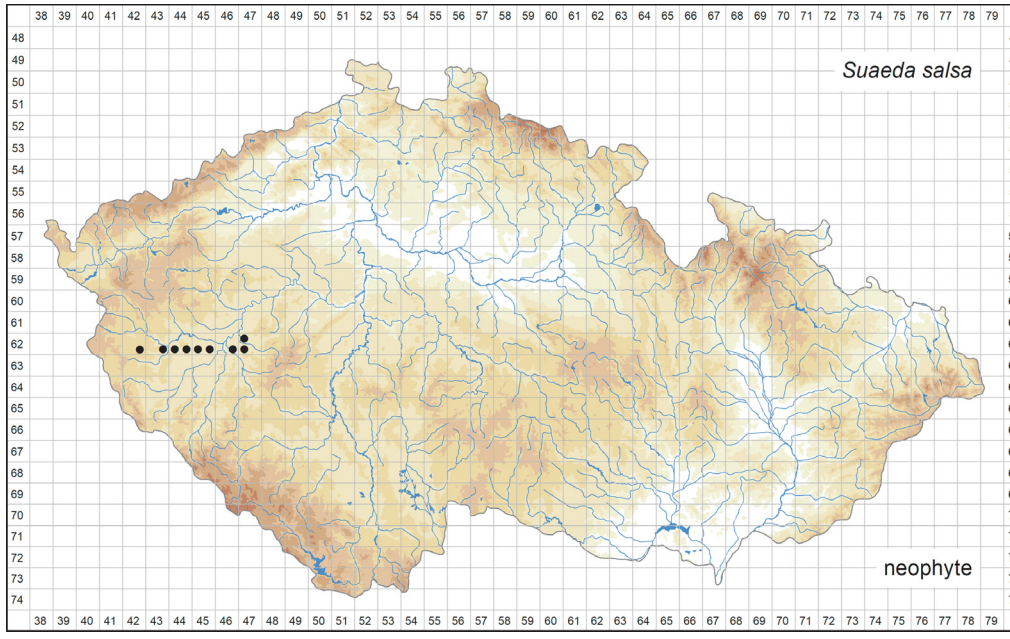

Fig. 72. – Distribution of *Suaeda salsa* in the Czech Republic (9 occupied quadrants). Prepared by Michal Ducháček, Pavel Kúr & Zdeněk Kaplan.

Suaeda salsa (Fig. 72)

Suaeda salsa is another species of the *S. maritima* agg. It is native to the forest steppe and northern steppe zones between the Pannonian Basin in the west and south-western Siberia in the east (Freitag & Lomonosova 2006). In the Czech Republic it was first found as introduced on the motorway D5 in 2014. The targeted field survey in 2015–2016 revealed 9 sites with *S. salsa* along a 66 km stretch of this motorway, between the towns of Tachov and Rokycany in western Bohemia. This species occurs on motorway verges where soil salinity is increased by the application of de-icing salts; at one site it has colonized saline bare ground under a motorway bridge. Rich herbarium collections from some of these sites were examined and identified as *S. salsa* by H. Freitag. This species should be currently classified as a casual neophyte in the Czech Republic, with a potential to become naturalized and spread further. However, the targeted surveys in 2015–2017 indicate that *S. salsa* has not yet spread to other Czech motorways.

Thalictrum aquilegiifolium (Fig. 73)

Thalictrum aquilegiifolium mainly occurs in the mountains in central and southern Europe, extending westwards to the Pyrenees, northwards to southern Scandinavia and eastwards to the central part of European Russia (Meusel et al. 1965, Hultén & Fries 1986). In the Czech Republic it grows along forest streams and springs, in beech, ravine and floodplain forests and alder carrs, along wet forest tracks, in willow scrub and wet meadows along streams and rivers, and in subalpine tall-forb vegetation. The soils are humid and rich in humus. *Thalictrum aquilegiifolium* is most frequent in the mountain ranges along this country's border, in the Českomoravská vrchovina highlands and in Eastern Sudetes Mts, and scattered in some other highlands including the Slavkovský les hills and the Drahanská vrchovina highlands. In contrast, it is rare at low elevations, being confined there to humid and rather cold mesoclimates such as in deep valleys of watercourses, large floodplain forests and gorges in sandstone landscapes, where it reaches its elevational minimum at about 150 m along the Kamenice river near the village of Hřensko in northern Bohemia. It is absent or nearly absent from the deforested dry and warm parts of this country, particularly in western, northern and central Bohemia, and southern and central Moravia.

Thalictrum flavum (Fig. 74)

Thalictrum flavum is widespread in Europe except its southernmost parts and Iceland, while the records from Asia are doubtful and most likely erroneous (Hand 2001). In the Czech Republic it is almost confined to alluvial and fen meadows in lowland floodplains of large rivers, namely the Morava and Dyje in southern Moravia, and the middle Labe river basin in central Bohemia. It has only rarely been introduced elsewhere in this country. *Thalictrum flavum* has vanished from many of its former sites due to conversion of fens to arable land and abandonment of meadows followed by succession. Many sites in southern Moravia were lost after the construction of the Nové Mlýny reservoirs on the Dyje river. This species is therefore classified as endangered (Grulich 2012). *Thalictrum flavum* and *Th. lucidum* were not distinguished as separate species in the past and are still sometimes confused. The revision of herbarium collections showed that 41% of specimens originally

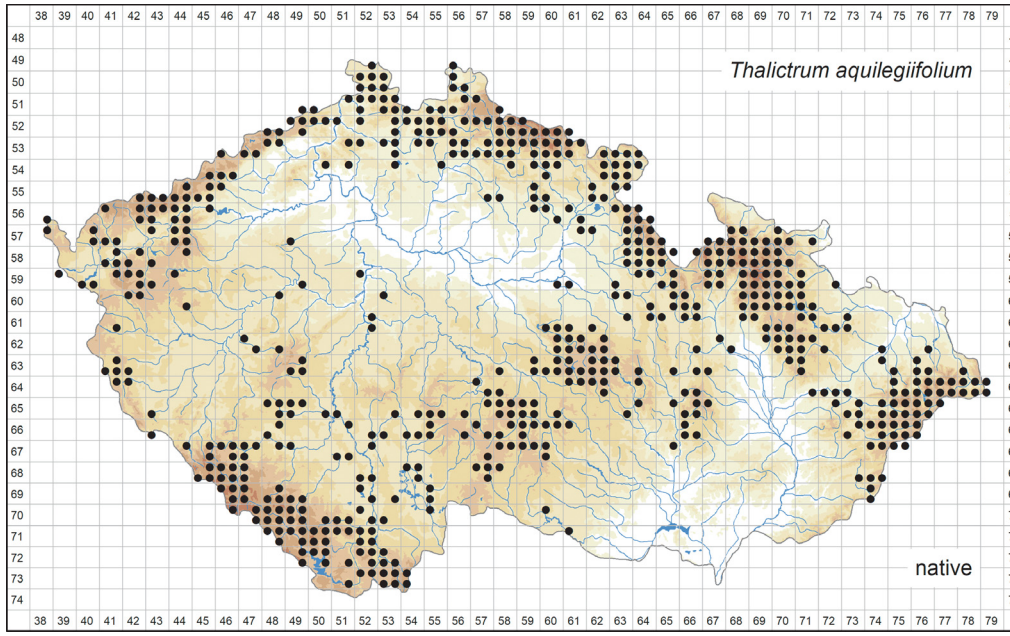

Fig. 73. – Distribution of *Thalictrum aquilegiifolium* in the Czech Republic (604 occupied quadrants). Prepared by Zdeněk Kaplan.

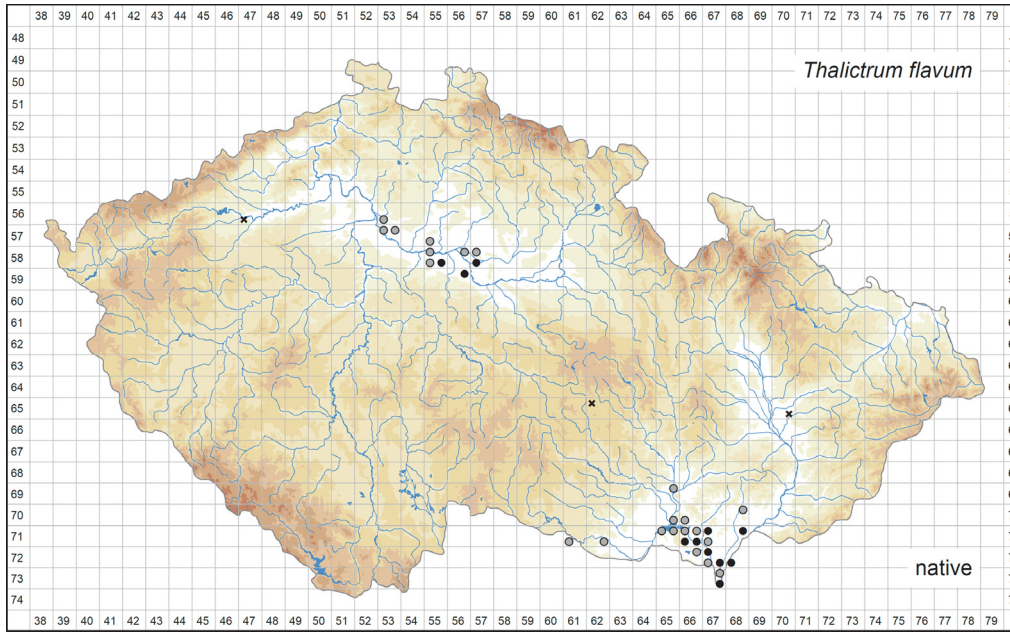

Fig. 74. – Distribution of *Thalictrum flavum* in the Czech Republic: ● native, at least one record in 2000–2016 (11 quadrants), ◍ native, pre 2000 records only (22 quadrants), × alien (3 quadrants). Prepared by Zdeněk Kaplan.

identified as *Th. flavum* were actually the more widespread *Th. lucidum* and that all reports of the former from many areas of this country are erroneous. The distribution map was therefore based solely on the revised herbarium specimens and our own field records.

Thalictrum foetidum (Fig. 75)

Thalictrum foetidum has a highly disjunct Eurasian range. In Europe it occurs in the eastern Pyrenees, the Alps, and in central and southern Europe from the Czech Republic (the northern distribution limit runs through northern Bohemia), Slovakia and Ukraine southwards to central Italy and the Balkan Peninsula. It also occurs in the Caucasus and the Southern Ural Mts. In Asia it is widespread in southern and eastern Siberia, southwards reaching northern Turkey, northern Iran, the Himalayas, northern Mongolia and northern China, and eastwards extending to Japan (Meusel et al. 1965, Hand 2001). Most of the range is occupied by *Th. foetidum* subsp. *foetidum* while the populations in Japan and the southern Kuril Islands are classified as *Th. foetidum* subsp. *glabrescens* (Hand 2001). In the Czech Republic *Th. foetidum* subsp. *foetidum* grows at rather dry sites with shallow soils on rocks and rocky slopes on limestone and basalt outcrops. It mainly occurs in the karst areas of Český kras; elsewhere in Bohemia it was recorded at five sites in the České středohoří Mts and their foothills in north-western Bohemia and at four sites in the deep valley of the lower stretches of the Vltava river around Prague in central Bohemia. In Moravia it is confined to its southernmost part, where it occurs on five hills in the Pavlovské vrchy hills. *Thalictrum foetidum* has vanished from all sites around Prague and from most of the hills in the České středohoří Mts, probably due to succession, and is rare elsewhere. It is therefore classified as endangered (Grulich 2012). Because of occasional confusion with slender forms of *Th. minus*, the distribution map was based solely on the revised herbarium specimens.

Thalictrum lucidum (Fig. 76)

Thalictrum lucidum is distributed in central, southern and eastern Europe and in western Turkey. It extends northwards to the Baltic countries and the area around Lake Onega, eastwards to the southern parts of European Russia and southwards to the north-eastern Iberian Peninsula, central Italy and reaches Turkey across the Balkan Peninsula (Hand 2001). In the Czech Republic *Th. lucidum* grows mainly in wet meadows in floodplains or at edges of fishponds, on banks of oxbow lakes, alluvial pools and drainage ditches and in fens, less frequently it occurs in floodplain forests and scrub, alder carrs, around forest springs, in willow scrub along rivers, in wet openings in deciduous forests and in open reed stands. It is rather frequent in the Labe river basin and adjacent parts of northern, central and eastern Bohemia eastwards as far as the foothills of the Orlické hory Mts, and in the fishpond basins in southern Bohemia. Elsewhere it is scattered around the towns of Doksy and Česká Lípa in northern Bohemia, around the city of Plzeň in south-western Bohemia, and in the foothills of the north-eastern Krušné hory Mts in north-western Bohemia and in the Brdy Mts in central Bohemia. In Moravia it is most frequent in the Bílé Karpaty Mts and scattered along the middle and lower stretches of the Morava, Dyje and Odra rivers. Elsewhere in this country it is rare at middle elevations and generally absent from the mountains. *Thalictrum lucidum* is one of the species that survives for a relatively long time after the abandonment and drainage of wet meadows. Although

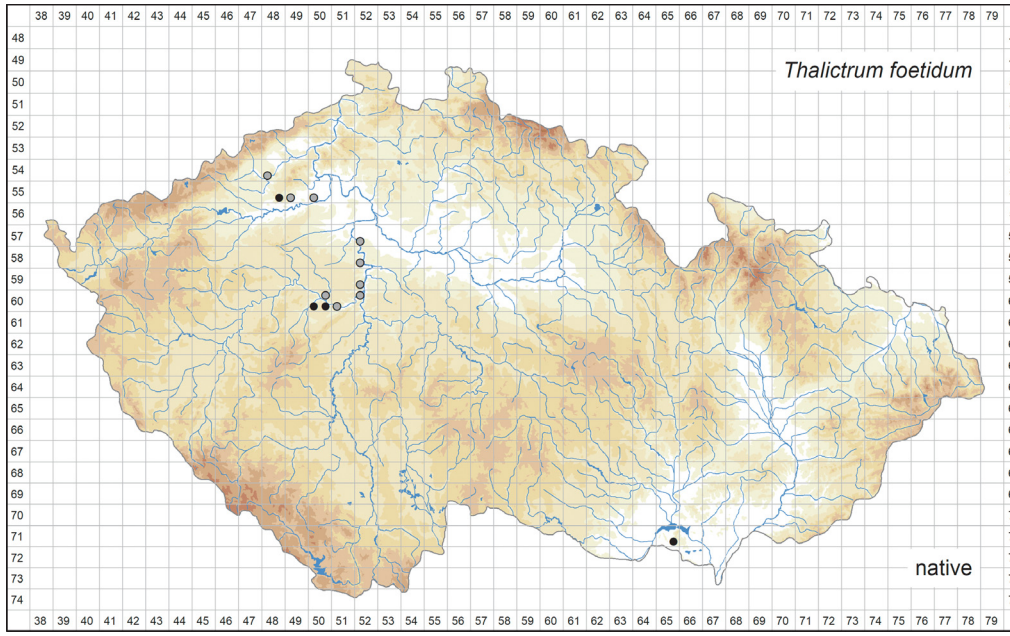

Fig. 75. – Distribution of *Thalictrum foetidum* in the Czech Republic: ● at least one record in 2000–2016 (4 quadrants), ● pre 2000 records only (9 quadrants). Prepared by Zdeněk Kaplan.

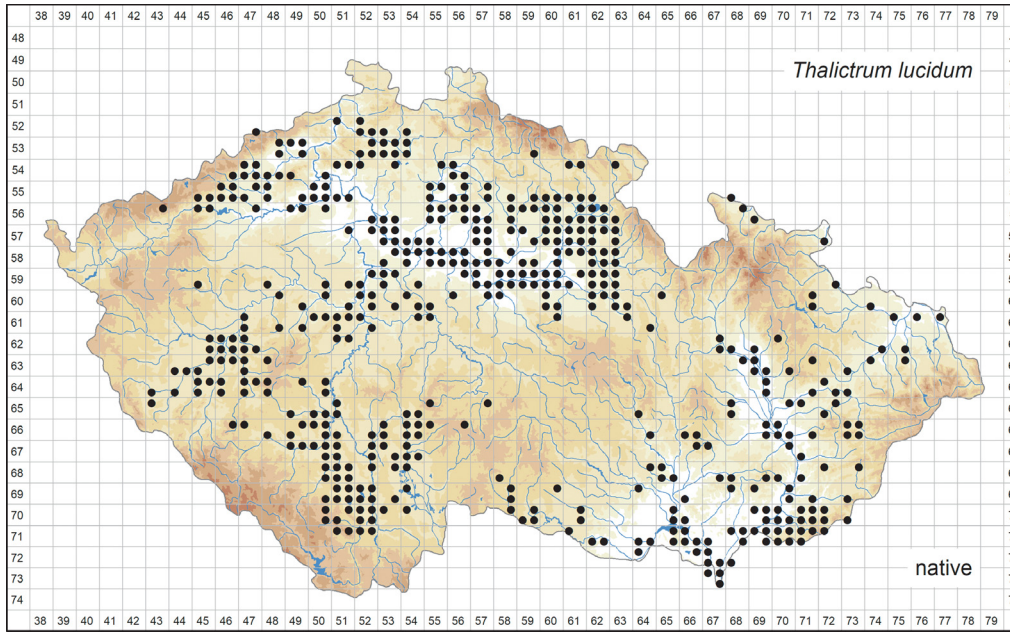

Fig. 76. – Distribution of *Thalictrum lucidum* in the Czech Republic (490 occupied quadrants). Prepared by Zdeněk Kaplan.

many of its former sites were lost, this species is not immediately endangered and is therefore classified only as vulnerable (Grulich 2012).

Thalictrum minus (Fig. 77)

Thalictrum minus has a large Eurasian distribution, which extends from western Europe as far as the Russian Far East and Japan. In Europe this species reaches southern Scandinavia and the northern part of European Russia in the north and the Iberian, Apennine and Balkan Peninsulas in the south. It also occurs in northern, eastern and southern Africa (Meusel et al. 1965, Hultén & Fries 1986, Hand 2001). It is taxonomically complex and the last revision distinguishes as many as eight subspecies (Hand 2001). Of the European subspecies, only *Th. minus* subsp. *minus* occurs in its typical form in the Czech Republic. This subspecies is found in Europe from Denmark and Gotland in the north to northern Italy and the central Balkan Peninsula in the south, extending eastwards to southern Siberia and northern Mongolia. Some Czech populations show characters transitional to *Th. m.* subsp. *saxatile*, a subspecies mainly distributed in the western half of Europe and in the Mediterranean area (Hand 2001). These transitional forms can be formally recognized as *Th. m.* nothosubsp. *flexuosum*. Because of taxonomic difficulties and the occurrence of intermediate forms of unclear identity, only the map of the species is presented here. *Thalictrum minus* is most often found in dry grasslands, rocky slopes, thermophilous scrub and fringes of thermophilous forests, less frequently in open thermophilous oak and pine forests, at the edges of vineyards, in abandoned limestone quarries, on railway embankments and in the past sometimes even as a weed in cereal crops. This species is widely distributed in the lowlands and in the rather warm and dry colline areas on limestone or basalt bedrocks such as the karst areas of Český kras in central Bohemia, the České středohoří Mts and their foothills in north-western Bohemia, and in the Bílé Karpaty Mts and the hilly areas south-west, south and south-east of the city of Brno in southern Moravia. Isolated occurrences are locally scattered at middle elevations, often only as temporary introductions. There are two ecologically remarkable populations of *Th. minus* on rock outcrops in the subalpine vegetation belt in the Velká kotlina and Malá kotlina glacial cirques in the Hrubý Jeseník Mts at about 1320 m a.s.l. This species is classified as vulnerable (Grulich 2012).

Thalictrum simplex (Fig. 78)

Thalictrum simplex has a Eurasian distribution, ranging from the Iberian Peninsula, the Pyrenees and eastern France in the west to eastern Siberia and Japan in the east. In Europe it extends northwards to northern Scandinavia and southwards to Italy and the central Balkan Peninsula (Hultén & Fries 1986, Hand 2001). Six subspecies are recognized, of which only *Th. simplex* subsp. *galioides* occurs in the Czech Republic. This subspecies is endemic to southern parts of central Europe, reaching central Germany and the Czech Republic in the north, eastern France in the west, northern Italy in the south and Slovakia and Hungary in the east (Hand 2001). In the Czech Republic it occurs in calcareous fens, intermittently wet meadows, openings in thermophilous oak forests, fringes of thermophilous forests and scrub and in forest tufa springs. It grows mainly on heavy, calcium-rich, intermittently wet soils. In Bohemia *Th. simplex* subsp. *galioides* was recorded at six sites in the middle Labe river basin and at one site near the village of Bílichov in central

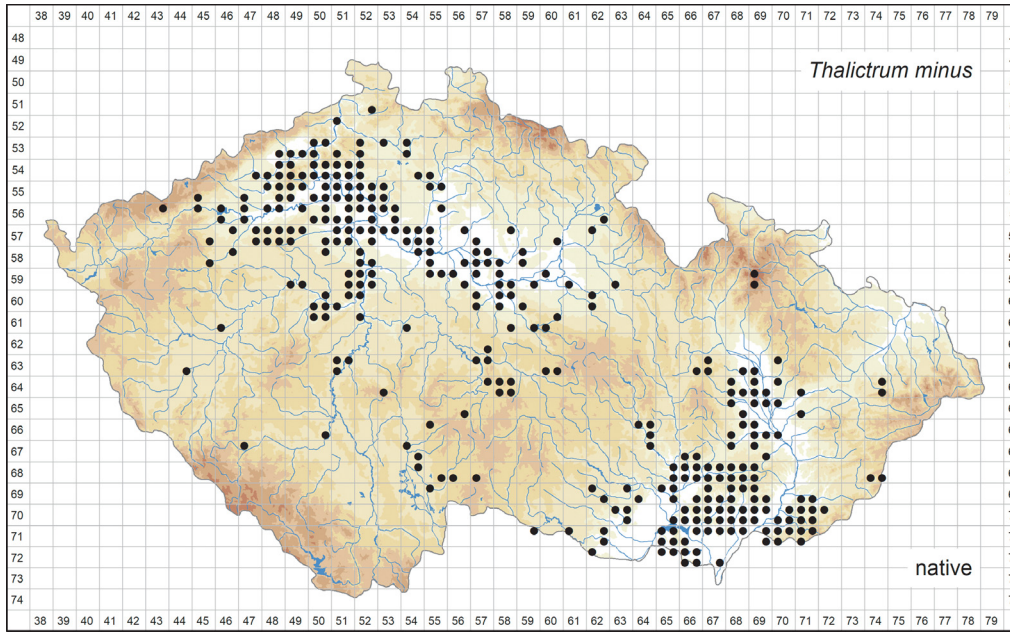

Fig. 77. – Distribution of *Thalictrum minus* in the Czech Republic (330 occupied quadrants). Prepared by Zdeněk Kaplan.

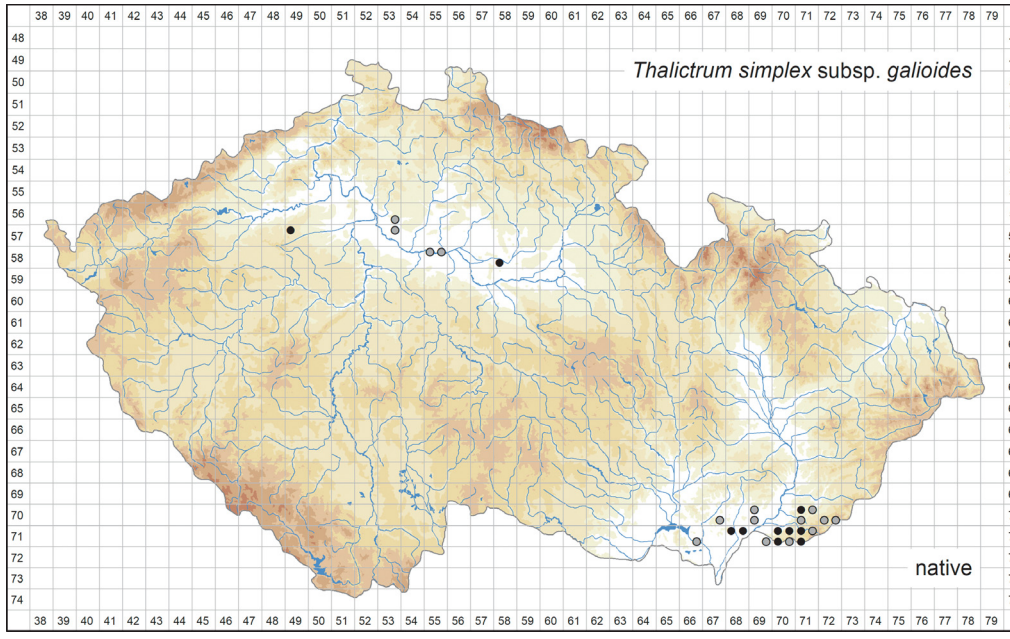

Fig. 78. – Distribution of *Thalictrum simplex* subsp. *galioides* in the Czech Republic: ● at least one record in 2000–2016 (10 quadrants), ● pre 2000 records only (15 quadrants). Prepared by Zdeněk Kaplan.

Bohemia. In Moravia it is confined to its southern parts. Most localities were situated in the Bílé Karpaty Mts, particularly in their south-western part, where the species was recorded at about 20 sites and is still present at more than a half of them. Several nearby populations survive also in the Dúbrava forest near the town of Hodonín. Another handful of populations existed in adjacent areas in the past but these mostly vanished long ago. *Thalictrum simplex* has disappeared from about two thirds of its former sites in this country, mainly because of the abandonment of meadows, drainage and conversion of fens to arable land. In Bohemia, only three small populations survive and all are threatened by drying out and encroachment of their habitats (Hadinec & Kaplan 2009). *Thalictrum simplex* is therefore classified as critically threatened nationally (Grulich 2012). Because of frequent misidentifications of the slender forms of *Th. lucidum* as *Th. simplex*, the distribution map of the latter was based almost solely on herbarium specimens.

Thelypteris palustris (Fig. 79)

Thelypteris palustris has a wide range in the temperate zones in the Northern Hemisphere reaching from western Europe and northern Africa to central Asia. It occurs also in northern India, eastern Asia including Japan, New Zealand and the eastern part of North America, being often recognized there as distinct varieties (Hultén & Fries 1986). In the Czech Republic it mainly grows in fens and mires, peaty margins of fishponds, tall-sedge beds or reed beds and various tree and scrub wetland vegetation such as alder carrs, birch mire forests and willow scrub. In water bodies that are not disturbed it forms, together with some other wetland species, floating islands. Most of its localities are situated around the towns of Doksy and Česká Lípa in northern Bohemia, around the cities of Pardubice and Hradec Králové in eastern Bohemia, in the Třeboňská pánev basin in southern Bohemia and in south-eastern Moravia. Individual records exist from other parts of this country; some of these sites were discovered only recently. However, many populations of *Th. palustris* vanished because of drainage of wetlands and other changes in land-use. This species is classified as vulnerable (Grulich 2012).

Tripolium pannonicum (Fig. 80)

Tripolium pannonicum is a Eurasian species discontinuously distributed from the British Isles in the west through the temperate zones in eastern Europe and Central Asia as far as eastern China and Japan. This species is very variable, and its coastal populations, distributed along most of the European sea coasts, are sometimes treated as a separate subspecies, *T. p.* subsp. *tripolium*, which is followed here. In Europe continental populations occur mainly in north-eastern Spain, central Germany, the Pannonian Basin and south-eastern Europe (Meusel & Jäger 1992). In the Czech Republic *T. pannonicum* occurs in saline grasslands, brackish marshes dominated by *Bolboschoneus maritimus* and in saline ruderal habitats in settlements that are flooded or wet in winter and spring but dry out during summer (Šumberová et al. 2007). *Tripolium pannonicum* subp. *pannonicum* is an obligate halophyte growing on heavy clay or loamy soils that are neutral to alkaline and well supplied with nutrients. It is a weak competitor, profiting from disturbance by grazing cattle and domestic waterfowl. In the Czech Republic this species once occurred at about 40 sites in the lowlands in southern Moravia south-west, south and south-east of Brno, being slightly more widespread than the sometimes co-occurring *Salicornia perennans* and

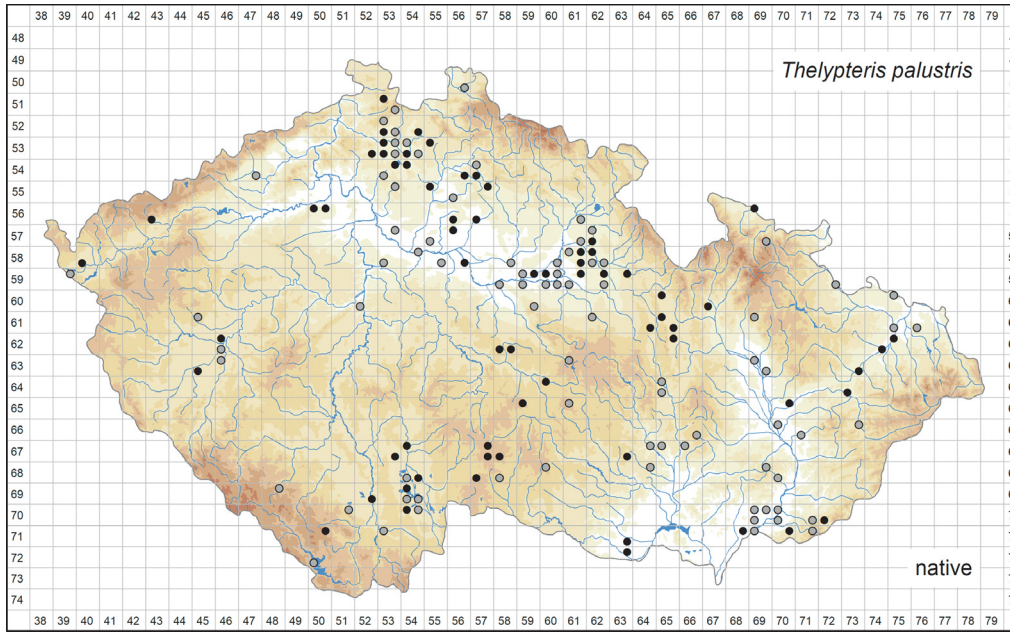

Fig. 79. – Distribution of *Thelypteris palustris* in the Czech Republic: ● at least one record in 2000–2016 (66 quadrants), ● pre 2000 records only (81 quadrants). Prepared by Libor Ekrt.

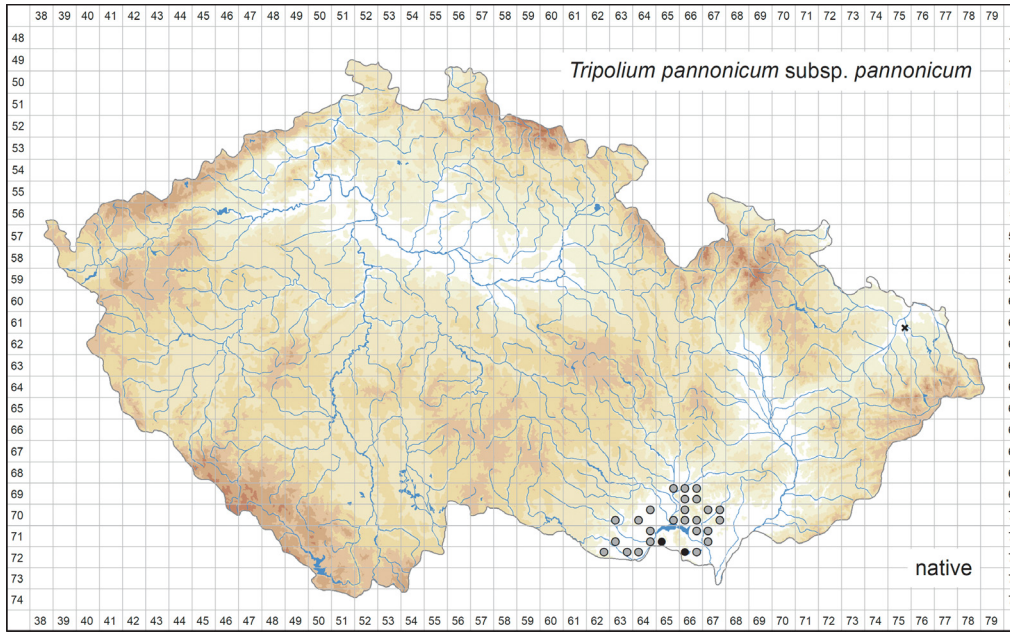

Fig. 80. – Distribution of *Tripolium pannonicum* subsp. *pannonicum* in the Czech Republic: ● native, at least one record in 2000–2016 (2 quadrants), ● native, pre 2000 records only (25 quadrants), × alien (1 quadrant). Prepared by Jiří Danihelka.

Suaeda prostrata. In 1959 *T. pannonicum* was collected in an iron ore yard in the city of Ostrava; it was introduced there probably with iron ore from Ukraine. The destruction of this species' natural habitats started already in the first half of the 19th century and accelerated after World War II with the profound changes in agriculture practices and land-use, of which drainage and elimination of grazing were most harmful. Since 2000 *T. pannonicum* has been recorded only at two sites, of which only the population on the western shores of the Nesyt fishpond is abundant enough and responding well to grazing and other management measures introduced by nature conservation authorities. This species is therefore classified as critically threatened because of its strong decline (Grulich 2012).

Utricularia australis (Fig. 81)

Utricularia australis is a species of hybrid origin, derived from crossing *U. tenuicaulis* and *U. macrorhiza* (Kameyama et al. 2005). Although it is sterile, due to its vegetative propagation and easy dispersal by waterfowl it is an effective colonist of new sites. Currently, *U. australis* is widespread, distributed throughout Europe except in the extreme north, in temperate Asia eastwards to China and Japan, in tropical and southern Africa, tropical Asia, Australia and New Zealand (Taylor 1989). In the Czech Republic *U. australis* occurs in a rather wide range of aquatic habitats; consequently, it is the most widespread and frequent species in this genus in this country. It occurs in fishponds, alluvial pools, oxbow lakes, drainage ditches and shallow lakes in abandoned quarries and sand pits, with mesotrophic to eutrophic, slightly acidic to neutral water on various types of mineral and organic substrates. It is most frequent at middle elevations, particularly in fishpond landscapes in southern and south-western Bohemia, in the Českomoravská vrchovina highlands, in the foothills of the mountains in western, northern and north-eastern Bohemia, and in Silesia. In the lowlands it is often restricted to river floodplains. It rarely occurs also in mountains, reaching its elevational maximum in the Šumava Mts at 848 m. This is the only *Utricularia* species in this country that is not particularly endangered. Still, it is classified as of lower risk – near threatened (Grulich 2012).

Utricularia bremii (Fig. 82)

Utricularia bremii is a rare species distributed in central and western Europe, extending westwards to France, northwards to Denmark and Poland, southwards to northern Italy and eastwards to Ukraine and Romania (Taylor 1989, Krajewski & Płachno 2015). In the Czech Republic *U. bremii* occurs in shallow pools and hollows in peat bogs and mires, around calcareous springs, in forest pools formed by land subsidence after underground clay mining and in shallow pools in abandoned clay pits. It grows in oligotrophic to mesotrophic or dystrophic, slightly acidic to slightly basic waters on peat or clayey substrates. *Utricularia bremii* was always rare in this country. For a long time this species was known from only two sites and in the 1980s–1990s it was even considered to be extirpated. However, several sites have been discovered during the past two decades. Altogether, *U. bremii* was documented from nine sites in northern, western and southern Bohemia. Of these, at least three populations have vanished due to eutrophication followed by succession and due to changes in water regime. Consequently, this species is classified as critically threatened (Grulich 2012). In 2004–2009 it was introduced from rescue cultivations into pools at four abandoned sand pits in the Třeboňská pánev basin in

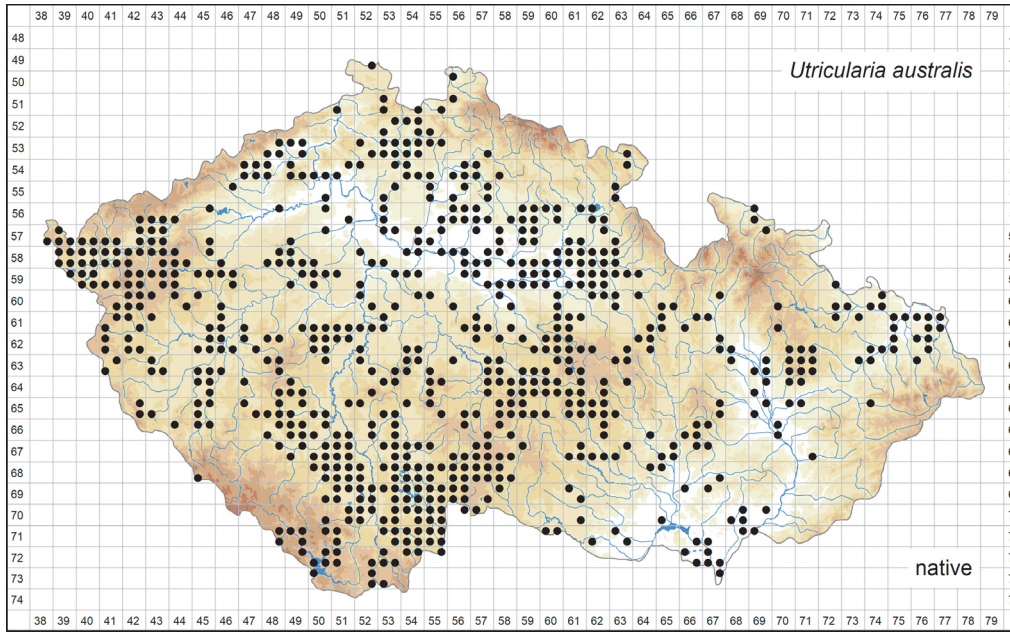

Fig. 81. – Distribution of *Utricularia australis* in the Czech Republic (722 occupied quadrants). Prepared by Zdeněk Kaplan.

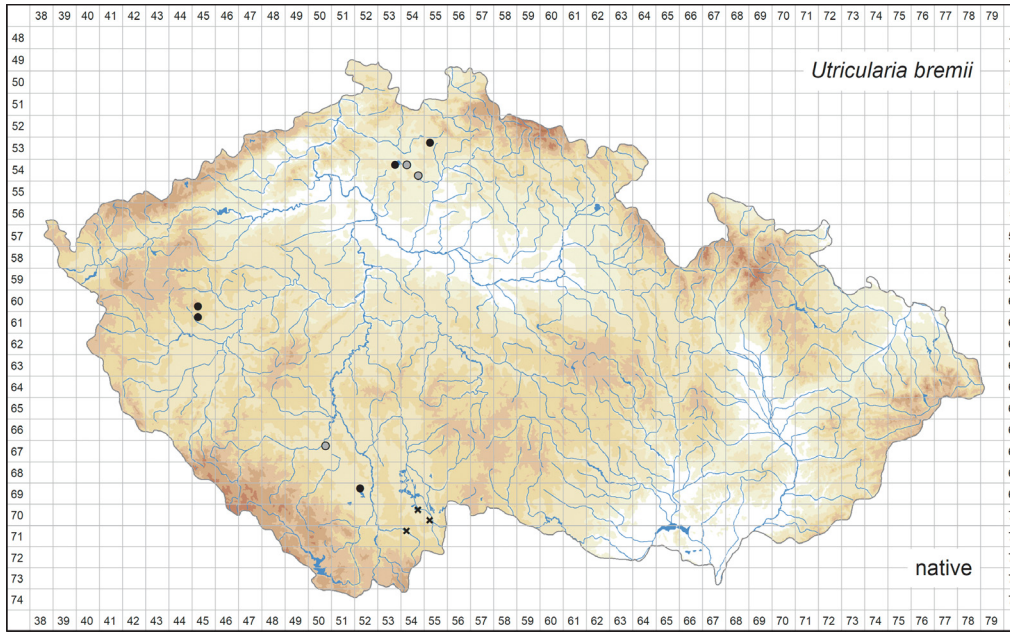

Fig. 82. – Distribution of *Utricularia bremii* in the Czech Republic: ● at least one record in 2000–2016 (5 quadrants), ◍ pre 2000 records only (3 quadrants), × deliberate introductions only (3 quadrants). Prepared by Zdeněk Kaplan.

southern Bohemia (Adamec & Kučerová 2013). Because of occasional confusion with *U. minor*, the distribution map of *U. bremii* was based solely on revised herbarium specimens and records from a few botanists familiar with this species.

Utricularia intermedia (Fig. 83)

Utricularia intermedia is a circumboreal species. In Europe it mainly occurs in its northern and central parts, southwards to France, northern Italy and the central Balkan Peninsula. In Asia it extends from the Ural Mts through Siberia to the Russian Far East and Japan, and to northern China, and in North America it is distributed throughout Canada and in the north-western and north-eastern USA (Hultén & Fries 1986, Taylor 1989). In the Czech Republic it occurs in shallow bog pools and bog hollows with oligotrophic to mesotrophic or dystrophic, slightly acidic to neutral, non-calcareous water on peaty or sandy substrates, most frequently located at the edges of forest fishponds. It was recorded at about 17 sites in the Třeboňská pánev basin in southern Bohemia but only six of them may be extant. In the 19th century it was also found at two sites near the towns of Františkovy Lázně and Cheb in westernmost Bohemia. *Utricularia intermedia* has vanished from the majority of its sites due to succession triggered by eutrophication and changes in water regime, mainly as a result of extremely hot summers during the past decades, and partly also due to direct habitat destruction. This species is therefore classified as critically threatened (Grulich 2012). It was intentionally introduced into the vicinity of the town of Doksy in northern Bohemia in the 1990s and survived there for at least 10 years. Because of frequent confusions with the similar *U. ochroleuca*, the distribution map is based solely on revised herbarium specimens.

Utricularia minor (Fig. 84)

Utricularia minor is a circumboreal species. It is distributed throughout Europe but is rare in the Mediterranean area. In Asia it is most frequent in Siberia, from which it extends southwards to Afghanistan, the Himalayas and Burma and eastwards to the Russian Far East and Japan; a few isolated occurrences are recorded from Papua New Guinea. In North America it is distributed throughout Canada and in the western and northern USA (Hultén & Fries 1986, Taylor 1989). In the Czech Republic *U. minor* occurs in shallow pools and hollows in peat bogs and mires, with oligotrophic to mesotrophic or dystrophic, slightly acidic to neutral water on a peat or sandy substrate, often located at edges of fishponds. It is found mainly in fishpond and peatland landscapes such as in the Třeboňská pánev basin in southern Bohemia, in the Českomoravská vrchovina highlands and in the surroundings of the towns of Česká Lípa, Doksy and Mimoň in northern Bohemia. Rarely does it also occur elsewhere in Bohemia, and is absent from dry areas with mineral-rich soils, agricultural landscapes and high mountains. However, in the Šumava Mts it ascends up to an elevation of about 900 m. Because of the general lack of suitable habitats, *U. minor* is almost absent from Moravia. It has vanished from more than half of its earlier sites due to drainage, eutrophication and succession and is therefore classified as endangered (Grulich 2012). It is sometimes confused with other *Utricularia* species, mainly with slender phenotypes of *U. australis*. For this reason, the distribution map of *U. minor* is based mainly on revised herbarium specimens, supplemented by a few selected records from the literature.

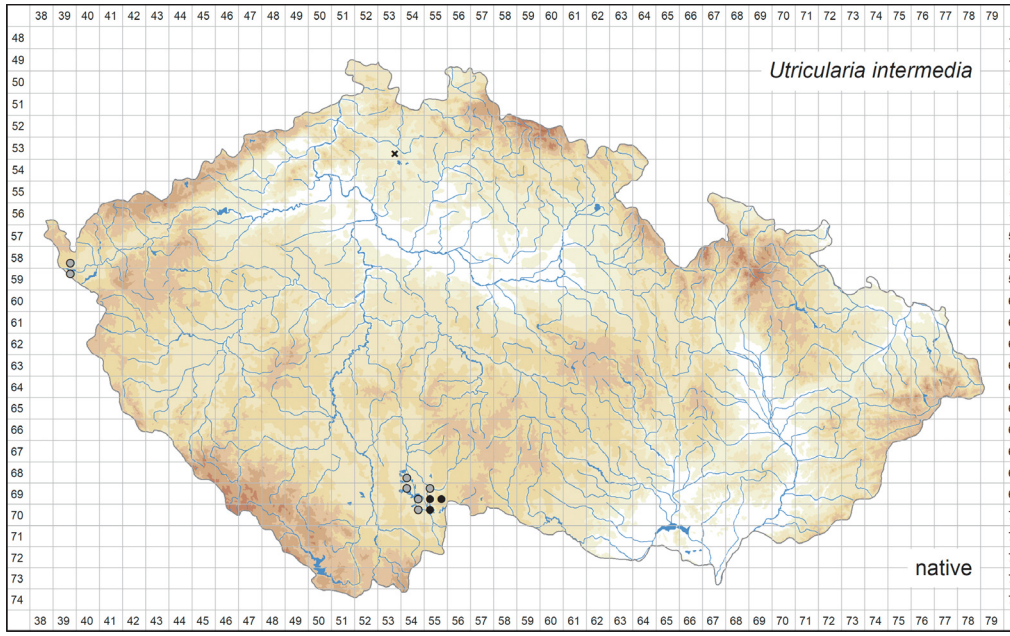

Fig. 83. – Distribution of *Utricularia intermedia* in the Czech Republic: ● at least one record in 2000–2016 (3 quadrants), ● pre 2000 records only (7 quadrants), × deliberate introductions only (1 quadrant). Prepared by Zdeněk Kaplan.

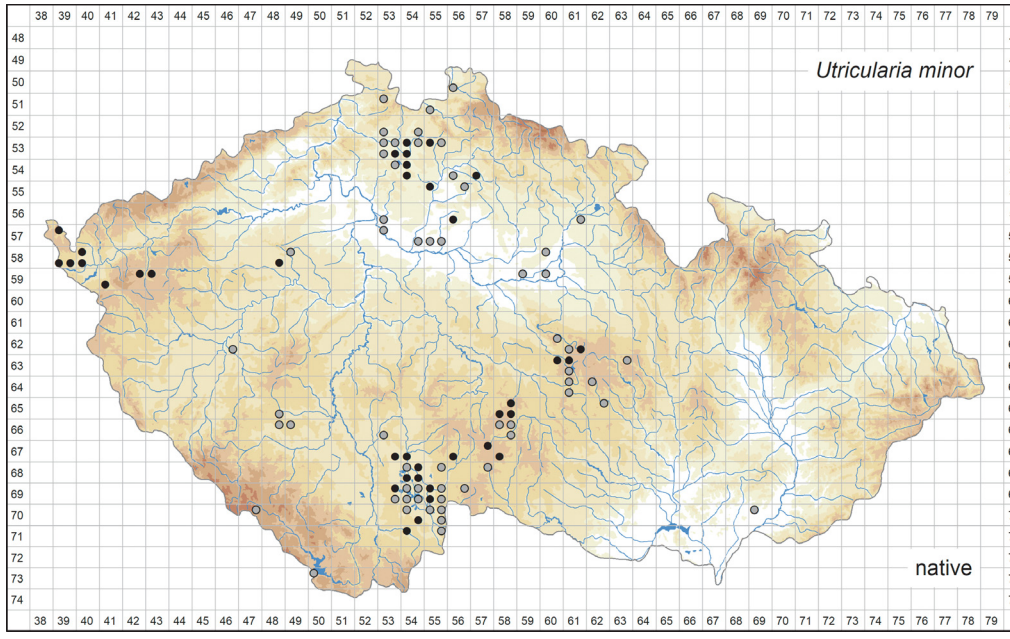

Fig. 84. – Distribution of *Utricularia minor* in the Czech Republic: ● at least one record in 2000–2016 (37 quadrants), ● pre 2000 records only (58 quadrants). Prepared by Zdeněk Kaplan.

Utricularia ochroleuca (Fig. 85)

The circumscription of *Utricularia ochroleuca* adopted here includes *U. stygia*, which was separated from the former by minor morphological differences (Thor 1988). Both taxa are sterile and apparently of hybrid origin (Thor 1988, Płachno & Adamec 2007). Morphological characters show some overlap and seem to be regionally correlated (Płachno & Adamec 2007). These two forms may be different clones of a recurrently produced hybrid taxon rather than two distinct stabilized species. Taxonomically, they are therefore best treated under a single binomial, *U. ochroleuca*. It has a circumboreal distribution, being found in northern, central and western Europe, reliably documented from Afghanistan and Japan, but very probably occurring also elsewhere in the temperate and arctic regions in Asia, and in North America being distributed in most of Canada and in the western and northern USA (Taylor 1989). The populations in the Czech Republic are situated at the south-eastern limit of the distribution of *U. ochroleuca* in Europe. This species occurs in shallow bog pools and bog hollows with oligotrophic to mesotrophic or dystrophic, slightly acidic to neutral, non-calcareous water on a peat or sandy substrate, most frequently located at the edges of forest fishponds. It was recorded at about 29 sites in the Třeboňská pánev basin in southern Bohemia but only nine of them may be extant. Elsewhere in southern Bohemia it was found at five sites in the Šumava Mts and at one in the Budějovická pánev basin. The last area in this country with the occurrence of *U. ochroleuca* is westernmost Bohemia, where this species was recorded at four sites. *Utricularia ochroleuca* has vanished from the majority of its sites due to succession triggered by eutrophication and changes in water regime, mainly as a result of the extremely hot summers during the past decades, and partly also due to direct habitat destruction. This species is therefore classified as critically threatened (Grulich 2012). Because of frequent confusions with the similar *U. intermedia*, the distribution map is based solely on revised herbarium specimens.

Utricularia vulgaris (Fig. 86)

Utricularia vulgaris is distributed throughout Europe, being absent only from its northernmost parts and rare in the south. It also occurs in northern Africa and temperate Asia northwards to western Siberia and southwards to Turkey, Syria, the Caucasus Mts, Afghanistan, Pakistan and Tibet (Taylor 1989). The eastern limits of distribution in Asia are imperfectly known because of confusions with the similar *U. macrorhiza*. In the Czech Republic *U. vulgaris* occurs in alluvial pools, oxbow lakes, pools in fens, drainage and irrigation channels and ditches and shallow edges of fishponds, mainly on mesotrophic to slightly eutrophic water on mineral-rich substrates, often with a deep layer of organic silt on the bottom. It is mainly found in floodplains of large rivers in warm lowlands, such as in the middle Labe river basin in central and eastern Bohemia and along the lower stretches of the Morava and Dyje rivers in southern Moravia. Isolated occurrences were rarely recorded in southern Bohemia and south-western, southern and central Moravia. *Utricularia vulgaris* is endangered by habitat destruction, river regulation, disruption of regular flood dynamics, silting of alluvial pools, eutrophication and intensive fish farming. It has been reliably documented at about 40 sites in the Czech Republic, but there are currently only five confirmed extant populations, of which only two appear to be stable in a long-term perspective. It is therefore classified as critically

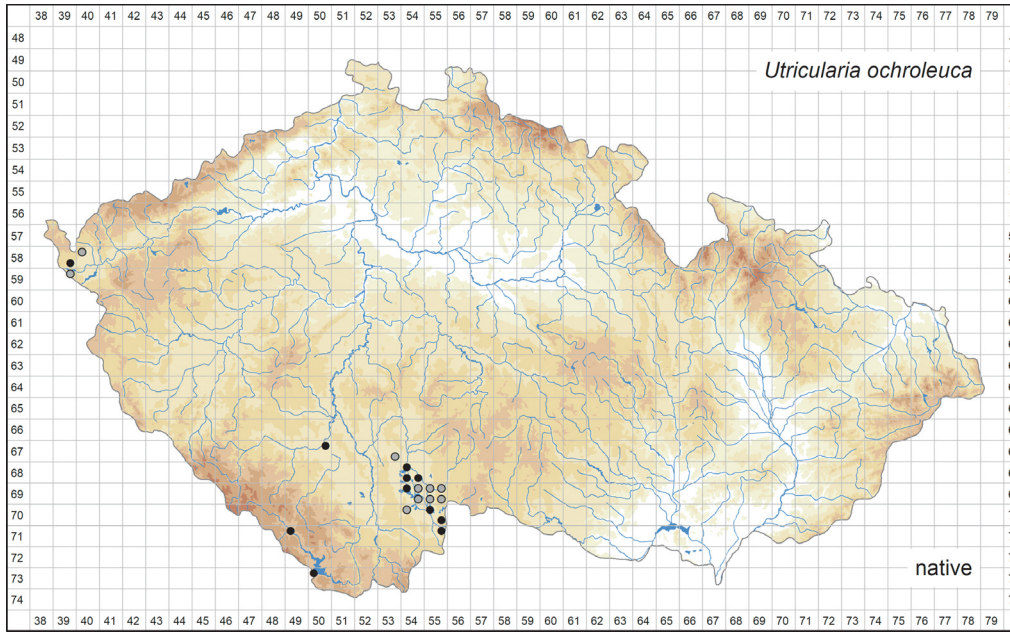

Fig. 85. – Distribution of *Utricularia ochroleuca* in the Czech Republic: ● at least one record in 2000–2016 (11 quadrants), ● pre 2000 records only (10 quadrants). Prepared by Zdeněk Kaplan.

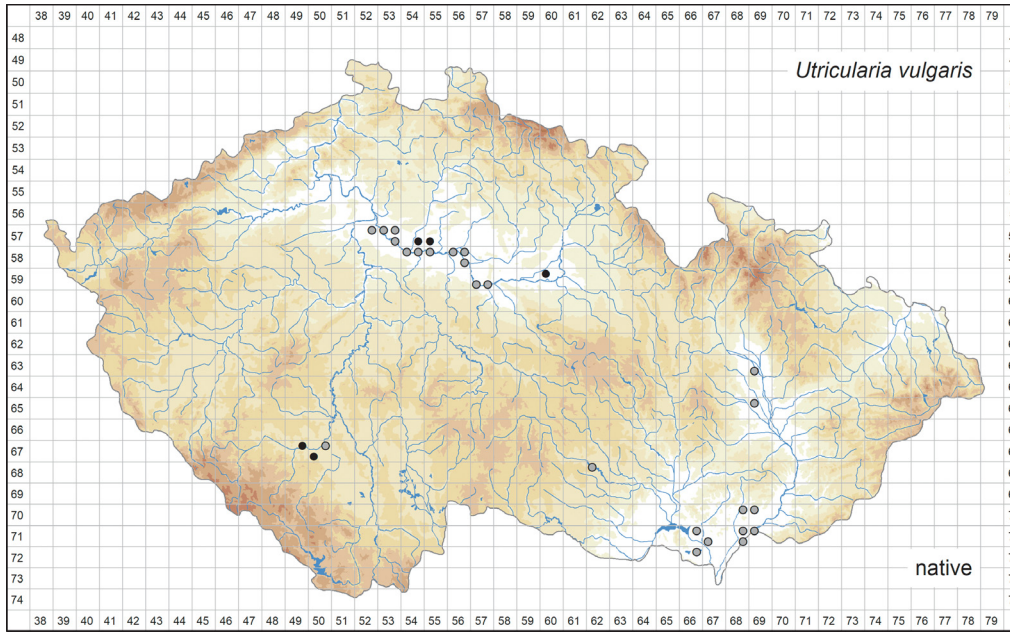

Fig. 86. – Distribution of *Utricularia vulgaris* in the Czech Republic: ● at least one record in 2000–2016 (5 quadrants), ● pre 2000 records only and/or extirpated occurrences (24 quadrants). Prepared by Zdeněk Kaplan.

threatened (Grulich 2012). *Utricularia vulgaris* is frequently confused with the similar *U. australis*: only 29% of the 339 examined herbarium specimens originally identified as *U. vulgaris* actually belong to this species, while 70% are *U. australis*. Comparison of identifications and origins of records in databases against the revised distribution showed that more than 79% of the records of *U. vulgaris* stored in databases are likely to be erroneous. The distribution map of this species is therefore based solely on revised herbarium specimens.

Veronica agrestis (Fig. 87)

Veronica agrestis is a European species found mainly in western, central and eastern Europe, the British Isles, the southern half of Scandinavia, Corsica and Sardinia. It is also reported to occur in Portugal, Madeira, the Canary Islands, Sicily, Crete, in the north of the Balkan Peninsula and in northern Africa. It has been introduced into North America, New Zealand and probably also some parts of temperate Asia (Meusel et al. 1978, Hultén & Fries 1986, USDA, NRCS 2017). In the Czech Republic *V. agrestis* occurs mainly as a weed in gardens and root crops, less frequently also in cereals and only rarely in ruderal habitats. It grows mainly on rather light and humid soils, rich in humus and well-supplied with nutrients, usually slightly acidic and non-calcareous. This species occurs scattered over most of this country, but seems to be almost absent from some parts of western Bohemia and southern and north-eastern Moravia. Most records are from middle and low elevations, but this species occurs at localities as high as about 750 m in the Krušné hory Mts and over 800 m around the town of Horní Planá in the Šumava Mts. *Veronica agrestis* is considered to be a naturalized archaeophyte in the Czech Republic (Pyšek et al. 2012) and in the same time endangered because of its assumed considerable decline (Grulich 2012). Recently the number of records somewhat increased, which may be an effect of better knowledge and more focused recording, possibly combined with the recovery of some populations. The quality of identification of herbarium specimens is generally low: we have seen about 450 herbarium specimens of *V. agrestis*, of which about 250 were identified correctly, whereas more than 300 other herbarium specimens (we did not keep records of all misidentifications) originally identified as *V. agrestis* were actually *V. polita* (most frequently), *V. persica*, *V. opaca* or even *V. arvensis*. The map is therefore based on revised herbarium specimens and field records by botanists with a good knowledge of these species. This species also seems (at least locally) to be under-recorded.

Veronica arvensis (Fig. 88)

Veronica arvensis is native probably to the Caucasus Mts, northern Anatolia and Central Asia. It is now widely distributed throughout Europe except in its northernmost part, in the east reaching as far as the Volga river, and in northernmost Africa, in both areas being most likely an archeophyte. It was later introduced into several parts of the world with temperate and subtropical climates, where it has become naturalized (Meusel et al. 1978, USDA, NRCS 2017). In the Czech Republic *V. arvensis* occurs in many types of open vegetation, usually in disturbed patches, including dry and mesophilous meadows, dry pastures and other dry grasslands, subruderal lawns in settlements, road verges, margins of paths, various types of sandy habitats, rock outcrops and railway embankments and stations. It also occurs in dry disturbed margins of rivers and fishponds and as a weed in

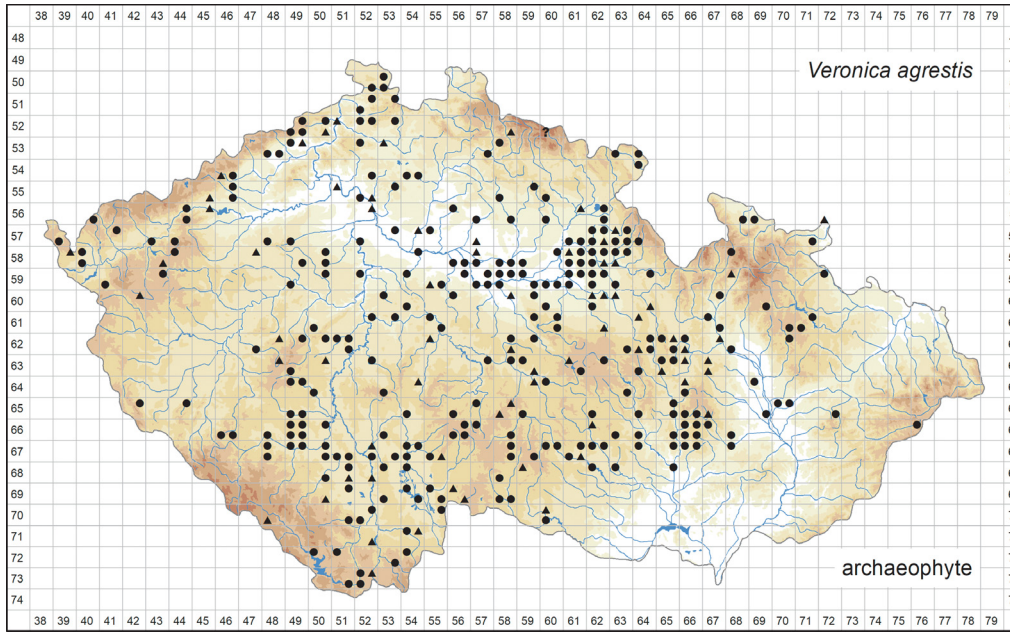

Fig. 87. – Distribution of *Veronica agrestis* in the Czech Republic: ● occurrence documented by herbarium specimens (267 quadrants), ▲ occurrence based on other records (70 quadrants). Prepared by Pavel Dřevojan & Jiří Danihelka.

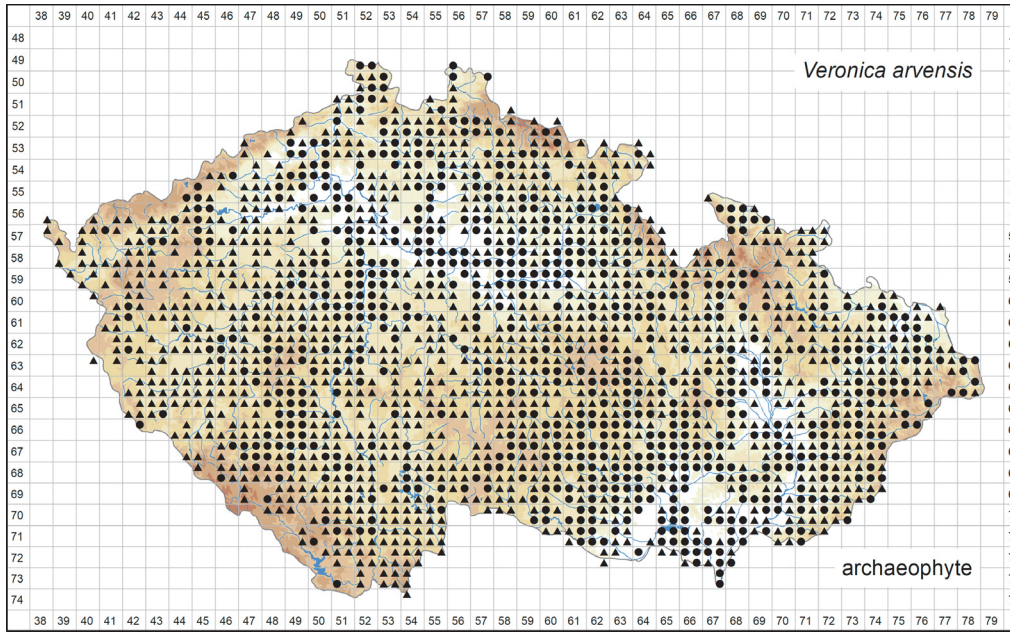

Fig. 88. – Distribution of *Veronica arvensis* in the Czech Republic: ● occurrence documented by herbarium specimens (697 quadrants), ▲ occurrence based on other records (1198 quadrants). Prepared by Jiří Danihelka.

gardens and arable land. It grows mainly on dry to moderately humid but well drained soils, usually well supplied with nutrients and not too acidic. This species is classified as a naturalized archaeophyte (Pyšek et al. 2012) and is now widespread in this country from the lowlands up to the lower mountains. In the Krkonoše Mts and Hrubý Jeseník Mts it was repeatedly recorded as introduced even at elevations of 1300–1360 m. The gaps on the map at low and middle elevations are certainly due to under-recording.

Veronica austriaca (Fig. 89)

Veronica austriaca has a rather small distribution including south-western France, southern Germany, the Czech Republic, southern Slovakia, Hungary, Romania, southern Ukraine and probably also Poland and Croatia (Rojas-Andrés & Martínez-Ortega 2016 as *V. a.* subsp. *austriaca* and *V. a.* subsp. *dentata*). Towards the south and south-east it is replaced by the closely related *V. jacquiniana*. In the Czech Republic *V. austriaca* grows in various types of dry grasslands ranging from rocky steppes to grasslands on moderately deep soils, and also in open places in thermophilous forests and their fringes. It grows mainly on basic to neutral loamy soils developed over base-rich rocks, usually moderately supplied with nutrients. *Veronica austriaca* is a rare species, found mainly in north-western Bohemia, the Český kras karst area in central Bohemia and in central and southern Moravia. Isolated occurrences are known near the town of Bělá pod Bezdězem in northern Bohemia, from the Dyje river valley west of the town of Znojmo in south-western Moravia (both based on a single record) and from Kotouč hill near the town of Štramberk in north-eastern Moravia. Many undocumented records are erroneous due to misidentifications of *V. prostrata* and *V. teucrium*; records not supported by a herbarium specimen were thus accepted only from sites from which this species' presence is documented in herbaria. *Veronica austriaca* is considered as endangered because of its general rarity and because it is declining in abundance (Grulich 2012).

Veronica dillenii (Fig. 90)

Veronica dillenii, a member of the *V. verna* agg., is discontinuously distributed mainly in the temperate zone in Europe from southern France in the west to south-eastern European Russia in the east, just reaching the Baltic Sea coast in the north and the Aegean Sea coast in the south. It is also found in the Caucasus Mts and central Asia (Meusel et al. 1978). It was recorded as introduced into the western USA (USDA, NRCS 2017). In the Czech Republic *V. dillenii* occurs in places with low vegetation cover, most frequently in dry grasslands, including rocky steppes, rock outcrops, dry pastures, sandy habitats and margins of pine forests and paths, less frequently in field margins and on fallow land. It grows mainly on shallow, permeable, usually acidic soils poor in nutrients. However, in humid areas it is believed to be somewhat more tolerant of base-rich substrates than *V. verna*. *Veronica dillenii* is found at low and middle elevations up to about 600 m in areas with warm to moderately warm climates, reaching its elevational maximum of 750 m near the village of Úhošťany in north-western Bohemia. It is locally common along deep river valleys with rock outcrops, such as the Vltava river valley in southern Bohemia and Jihlava river valley in western Moravia. In contrast, it is absent from eastern Moravia and Silesia except for a single locality at an abandoned railway station in the town of Nový Jičín, where it is a recent introduction. Though rather easy-to-identify, this species is frequently

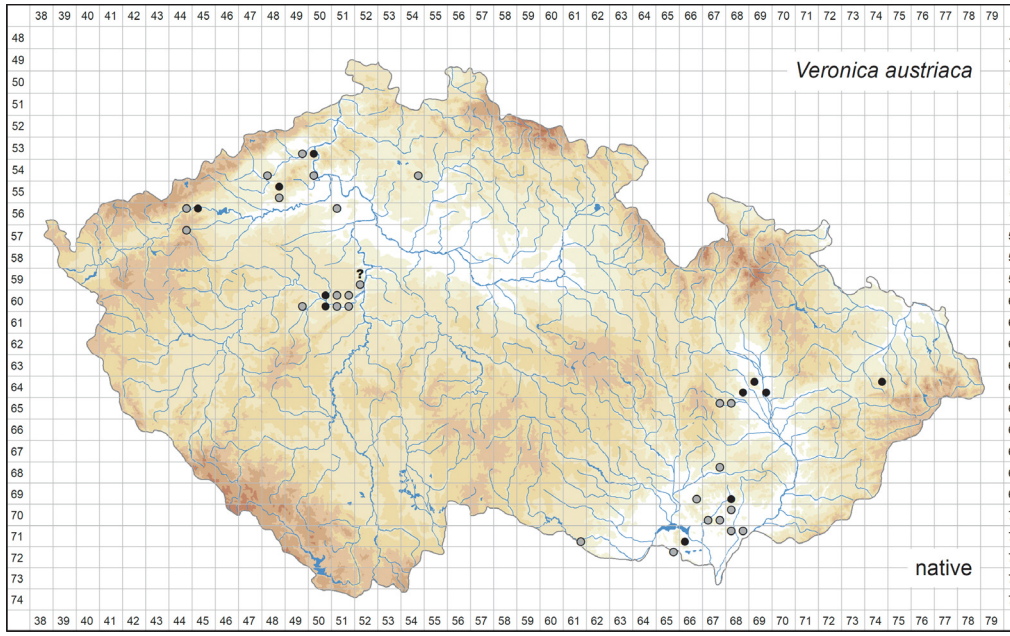

Fig. 89. – Distribution of *Veronica austriaca* in the Czech Republic: ● at least one record in 2000–2016 (11 quadrants), ● pre 2000 records only (25 quadrants). Prepared by Jiří Danihelka.

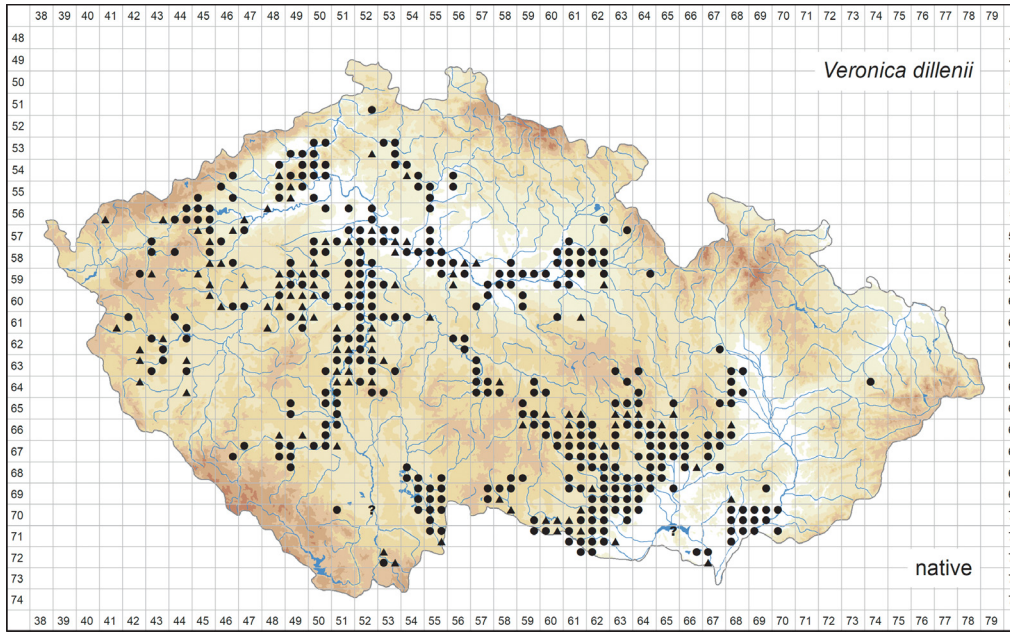

Fig. 90. – Distribution of *Veronica dillenii* in the Czech Republic: ● occurrence documented by herbarium specimens (350 quadrants), ▲ occurrence based on other records (102 quadrants). Prepared by Jiří Danihelka.

confused with *V. verna*, with which it frequently co-occurs, and records not documented by herbarium specimens may, therefore, be erroneous. *Veronica dillenii* is classified as of lower risk – near threatened in this country (Grulich 2012).

Veronica opaca (Fig. 91)

Veronica opaca is distributed mainly in the northern and north-eastern parts of central Europe, in the southern part of Scandinavia and in north-eastern Europe (Meusel et al. 1978, Hultén & Fries 1986, Hügin & Hügin 1994). It is also recorded in north-western Anatolia and the Caucasus Mts (Fischer 1994). In the Czech Republic *V. opaca* occurs mainly as a weed in gardens and root crops, less frequently also in cereals, while only a handful of records exist from ruderal habitats. It grows on rather light and sufficiently humid soils, usually rich in nutrients, slightly acidic or neutral, well supplied with calcium. This species occurs scattered at middle and less frequently low elevations in the northern half of Bohemia and in central and south-eastern Moravia. It rarely occurs also in southern Bohemia. In contrast, it is almost absent from the Českomoravská vrchovina highlands and the lowlands in north-eastern and southern Moravia. *Veronica opaca* is believed to be a naturalized archaeophyte in the Czech Republic (Pyšek et al. 2012) and is classified as critically threatened because of its assumed considerable decline in abundance (Grulich 2012). This species was always rather rare and also under-recorded; it was even considered extinct in the 1990s (Hrouda 2000). However, numerous records have been reported during the past two decades, and the classification as critically threatened seems to be somewhat exaggerated. The proportion of misidentified herbarium specimens was lower than for *V. agrestis*, but misidentifications were also frequent, including specimens of *V. polita* and less frequently also *V. agrestis* and *V. persica*. The map is based on revised herbarium specimens and field records of a few botanists familiar with these species.

Veronica persica (Fig. 92)

Veronica persica is considered to be an allotetraploid derivate from the hybridization of the diploid species *V. ceratocarpa* and *V. polita*, which probably originated in the Caucasus Mts and northern Iran (Fischer 1987). It is now distributed over most of Europe, some parts of Central Asia, Japan, North America, South America, southern Australia and New Zealand (Meusel et al. 1978, Hultén & Fries 1986, USDA, NRCS 2017). In the Czech Republic *V. persica* occurs as a weed in root and cereal crops, gardens and vineyards. It often grows on dry sand and gravel at the margins of fishponds and fish storage ponds and in near-natural habitats in river floodplains (e.g. river deposits). It is particularly frequent in ruderal habitats, including waste places, disturbed ruderal grasslands in settlements, along roads and paths and in disturbed places in meadows. This species has no special ecological requirements but does not occur in wet or very dry habitats and sandy soils very poor in nutrients. It is distributed all over the country at low and middle elevations, being absent only from the mountains and areas without settlements and arable land. However, it was repeatedly recorded in the Krkonoše Mts and the Hrubý Jeseník Mts at elevations up to 1350 m a.s.l. Most of the gaps on the map at low elevations may be due to under-recording rather than true absences. In central Europe *V. persica* is considered a neophyte, which was first recorded near Karlsruhe in Germany in 1805 (Meusel et al.

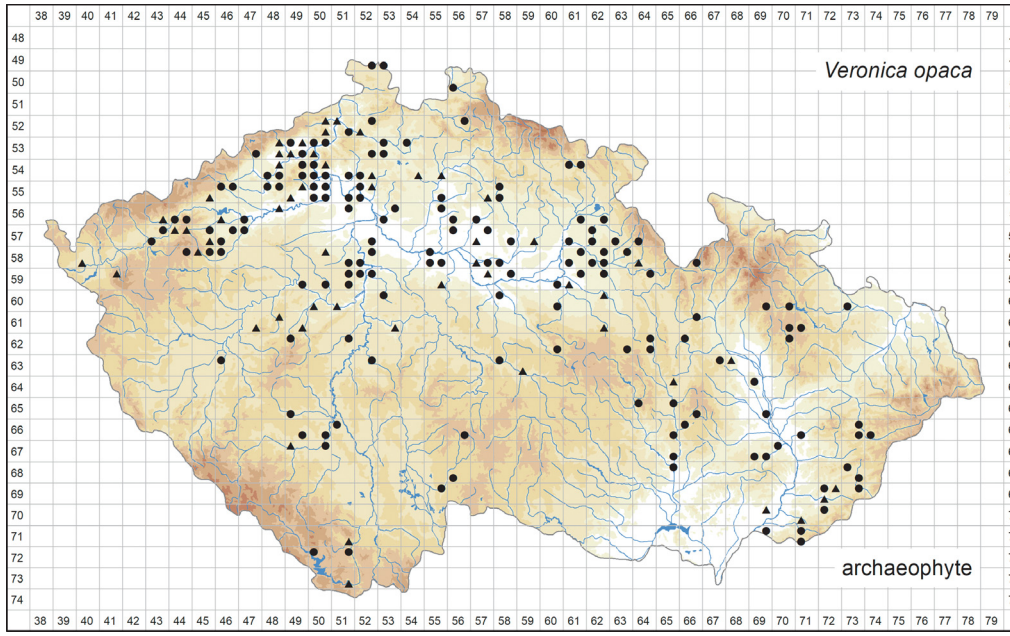

Fig. 91. – Distribution of *Veronica opaca* in the Czech Republic: ● occurrence documented by herbarium specimens (150 quadrants), ▲ occurrence based on other records (54 quadrants). Prepared by Pavel Dřevojan & Jiří Danihelka.

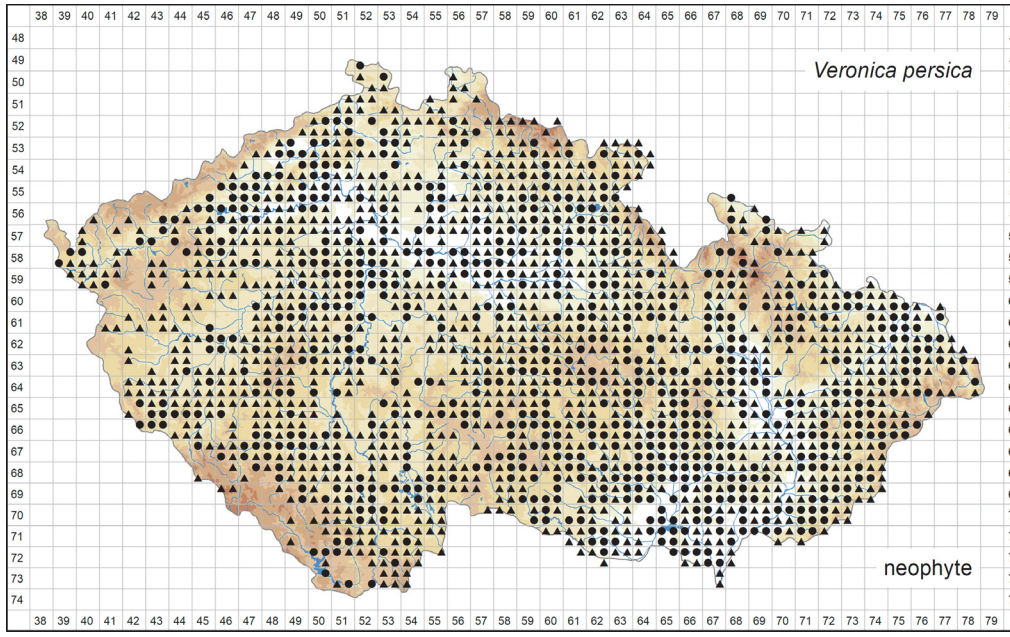

Fig. 92. – Distribution of *Veronica persica* in the Czech Republic: ● occurrence documented by herbarium specimens (689 quadrants), ▲ occurrence based on other records (1150 quadrants). Prepared by Pavel Dřevojan & Jiří Danihelka.

1978, Fischer 1987). The earliest records in this country date back to the early 19th century: in Bohemia it was first collected in 1810 in Prague and in Moravia 10 years later in the vicinity of Olomouc. In the Czech Republic this species is classified as a naturalized neophyte (Pyšek et al. 2012).

Veronica polita (Fig. 93)

Veronica polita occurs in western, central and south-eastern Europe, the British Isles and the southern part of Scandinavia. It also occurs in the Caucasus Mts, some parts of south-western and Central Asia and in northern Africa. In Japan it is replaced by the closely related *V. caninotesticulata*. *Veronica polita* has become naturalized in the eastern part of North America, New Zealand (Hultén & Fries 1986, USDA, NRCS 2017) and probably also in other parts of the world. In the Czech Republic this species occurs as a weed on arable land, in forage and root crops, vineyards and in recently abandoned fields, as well as in various ruderal habitats including disturbed places in settlements, along roads and paths, and in waste places. It grows mainly on heavy soils rich in nutrients and well supplied with calcium, usually dry to moderately humid. *Veronica polita* occurs frequently in warm and moderately warm parts of this country, particularly in the northern half of Bohemia and central and southern Moravia. It is also scattered to locally frequent in south-western and southern Bohemia and north-eastern Moravia, while being rare elsewhere. Most of the records are from the lowlands, but particularly in southern Bohemia this species is recorded also at elevations between 650 and 685 m. In the Czech Republic this species is considered to be a naturalized archaeophyte (Pyšek et al. 2012).

Veronica praecox (Fig. 94)

Veronica praecox has a strongly disjunct distribution reaching from the Iberian Peninsula in the west as far as the western shores of the Caspian Sea in the east and from southernmost Scandinavia in the north as far as southern Italy and the eastern part of the Balkan Peninsula in the south. It is also found in the mountains of north-western Africa (Meusel et al. 1978). In the Czech Republic *V. praecox* occurs in dry grasslands with a low cover of the herb layer, on rock outcrops, in field margins, vineyards and at least formerly also on railway embankments. It grows mainly on permeable soils, which dry out in summer, basic to neutral, well supplied with nutrients and rich in bases. This species is found in the warmest and driest parts of this country, i.e. in the lowlands and hilly areas (up to 550 m a.s.l.) of central and north-western Bohemia and in southern Moravia, towards the north reaching up to the city of Brno. There are remote occurrences in areas with limestone outcrops in southern Bohemia, with the earliest record only dating back to the 1940s. A few records exist also from other parts of this country, which are most likely temporary introductions. The map is based mainly on revised herbarium specimens since misidentifications are frequent, involving mainly specimens of *V. arvensis*, *V. triphyllos* and *V. dillenii*. This species has declined slightly in abundance and is therefore classified as vulnerable (Grulich 2012).

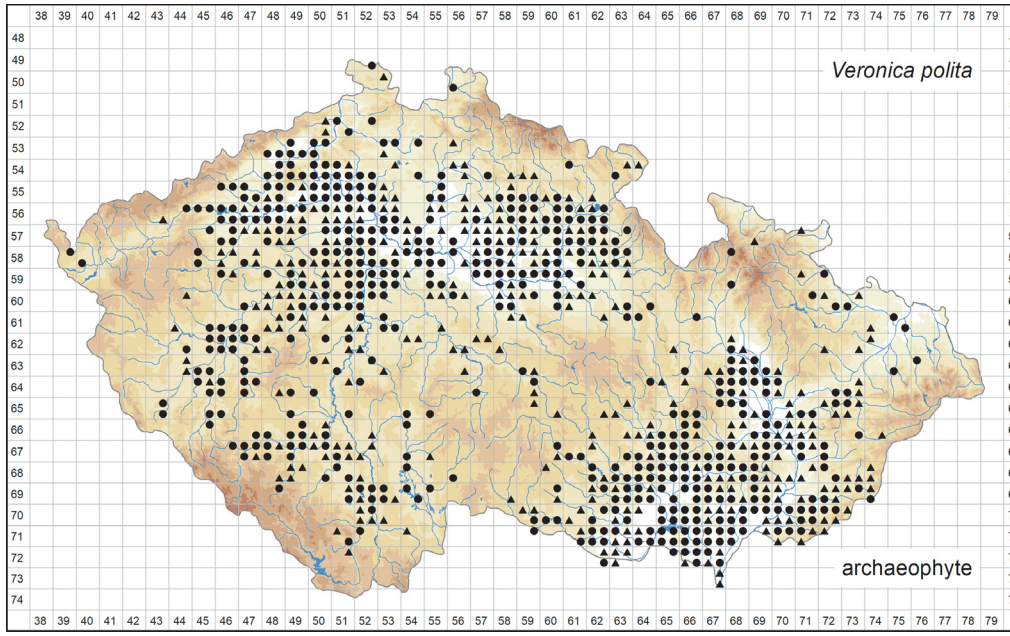

Fig. 93. – Distribution of *Veronica polita* in the Czech Republic: ● occurrence documented by herbarium specimens (508 quadrants), ▲ occurrence based on other records (326 quadrants). Prepared by Pavel Dřevojan & Jiří Danihelka.

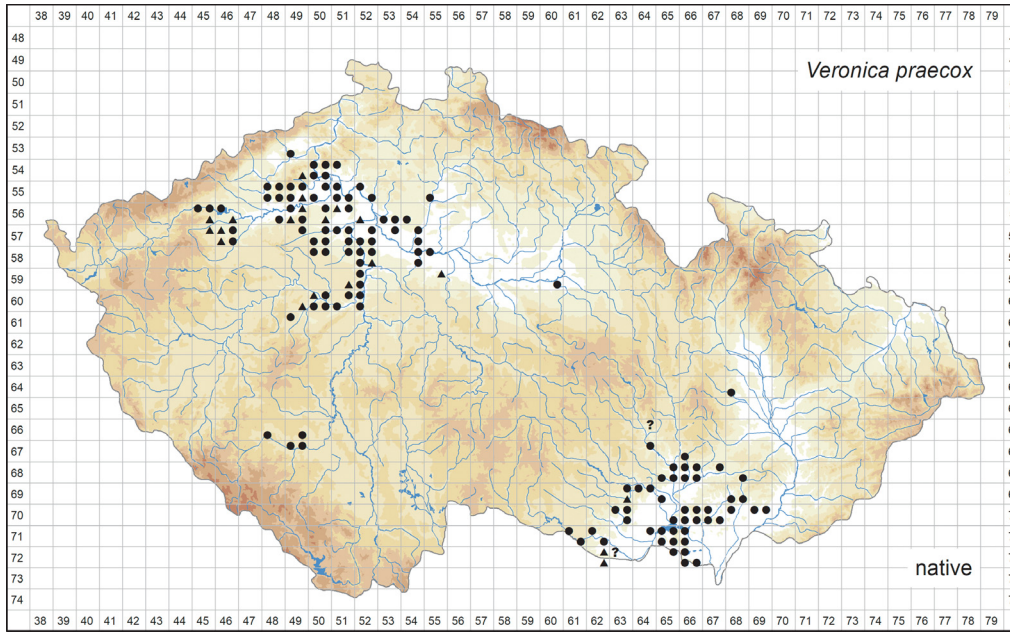

Fig. 94. – Distribution of *Veronica praecox* in the Czech Republic: ● occurrence documented by herbarium specimens (118 quadrants), ▲ occurrence based on other records (20 quadrants). Prepared by Jiří Danihelka.

Veronica prostrata (Fig. 95)

Veronica prostrata, the second member of the *V. austriaca* agg. in the Czech flora, occurs in the temperate zone in Europe and western Siberia from central Germany in the west as far as the Ob' river in the east, towards the north reaching northern Germany and in the south with isolated occurrences in Sicily and the Rhodope Mts in Bulgaria. The localities in Bohemia are situated close to the absolute western limit of this species' distribution (Meusel et al. 1978). It is reported as introduced into Minnesota in the USA (USDA, NRCS 2017). In the Czech Republic *V. prostrata* grows in various types of dry grasslands, dry meadows and pastures. It usually grows in moderately basic to moderately acidic, often shallow, permeable soils that dry out later in the season, which develop over various types of rocks including sand and are poor to moderately rich in nutrients. This species is also rarely cultivated as an ornamental but some of the plants found under this name in the market may be other species or hybrids, among them the western-European *V. satureiifolia*. *Veronica prostrata* is more or less continuously distributed and locally common in the lowlands and at middle elevations in northern, north-western, central and south-western Bohemia and central, south-western, southern and south-eastern Moravia. There are several isolated occurrences throughout the country, of which some may be escapes from cultivation or accidental introductions. The species reaches its elevational maximum at 700 m on Mt Hradišťany near the village of Třebívlice in north-western Bohemia, but most of the localities are situated below 550 m a.s.l. *Veronica prostrata* is frequently collected and based on more than 2000 revised specimens the map may be considered fairly representative. This species may have declined slightly in abundance due to abandonment of pastures and general eutrophication of the landscape, and is classified as of lower risk – near threatened in this country (Grulich 2012).

Veronica teucrium (Fig. 96)

Veronica teucrium, the third member of the *V. austriaca* agg. in the Czech flora, is native to the temperate zone in Europe and westernmost Asia, in the north reaching as far as the Baltic states and in the south the Mediterranean coast of France, northern Italy and southern Bulgaria. It occurs also in the Caucasus Mts (Meusel et al. 1978). However, many records from south-western Europe and the Apennine Peninsula probably refer to the closely related *V. orsiniana*, while those from Kazakhstan may actually refer to another sibling species, *V. krylovii*. Secondary occurrences are known from northern Europe, and this species is also reported as introduced into eastern North America (USDA, NRCS 2017). In the Czech Republic *V. teucrium* grows in openings and in the fringes of broad-leaved, rather dry, particularly thermophilous oak forests, in thermophilous scrub and dry grasslands and in open places around castle ruins. It usually grows in rather deep soils that dry out in summer, neutral to slightly basic and well supplied with nutrients, often developed over calcium- and base-rich rocks. This species is widely distributed in the lowlands and at middle elevations up to about 600 m in areas with warm or moderately warm climates. The occurrences at middle elevations are usually confined to sites over base-rich or calcareous rocks and to castle hills. Some of the isolated records may represent garden escapes as this species is sometimes cultivated as an ornamental, but if there is no evidence for that they are accepted here as native. This species achieves its elevational maximum of 780 m a.s.l. near the village of Bražec in western Bohemia. The

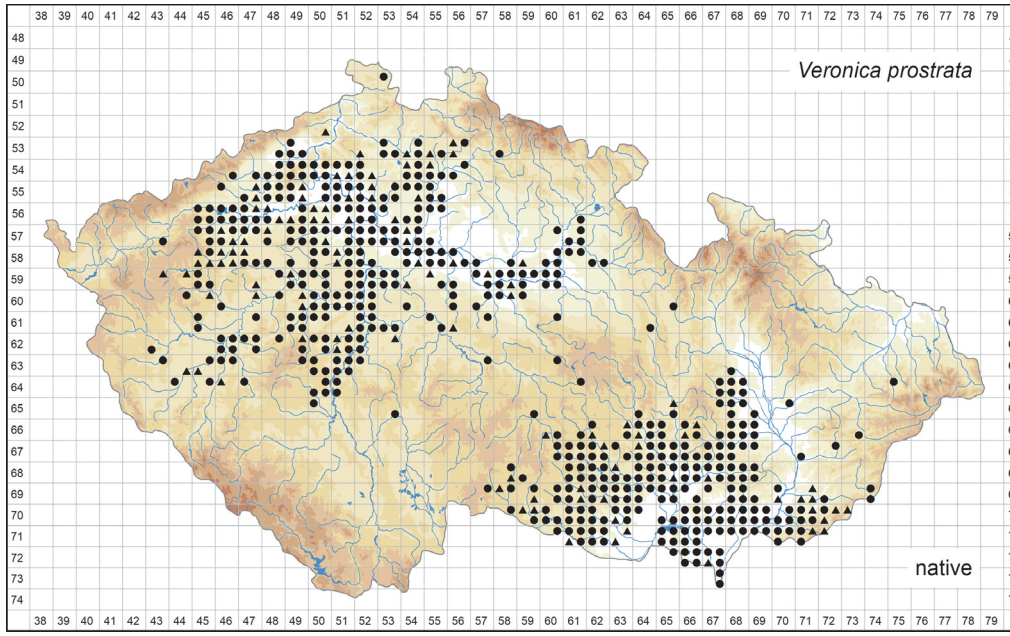

Fig. 95. – Distribution of *Veronica prostrata* in the Czech Republic: ● occurrence documented by herbarium specimens (483 quadrants), ▲ occurrence based on other records (106 quadrants). Prepared by Jiří Danihelka.

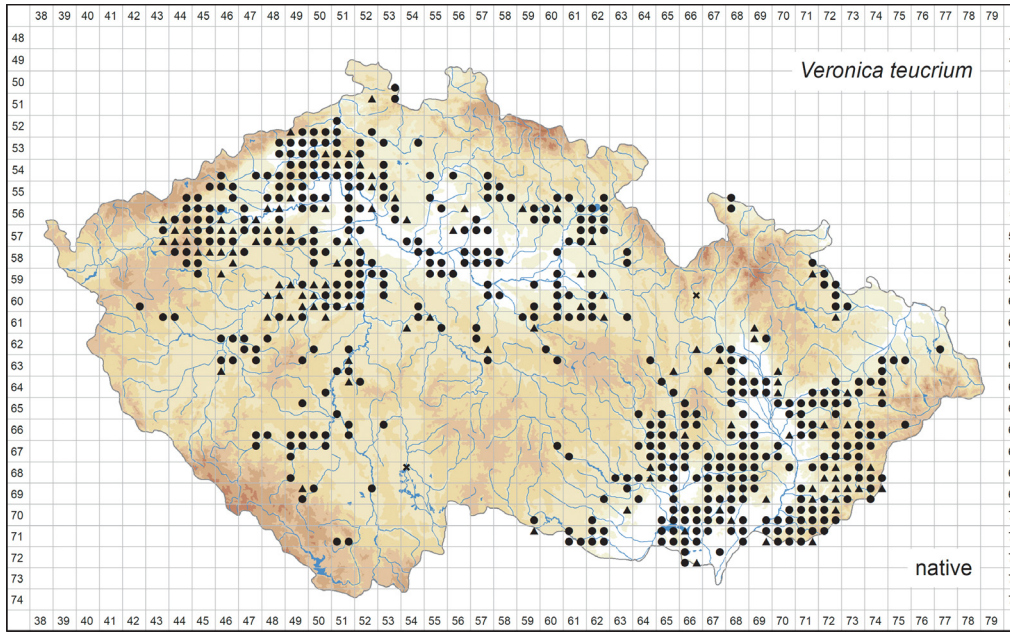

Fig. 96. – Distribution of *Veronica teucrium* in the Czech Republic: ● occurrence documented by herbarium specimens (460 quadrants), ▲ occurrence based on other records (108 quadrants). Prepared by Jiří Danihelka.

map is based on more than 1900 revised specimens and may be considered fairly complete. In the Czech flora *V. teucrium* is classified as of lower risk – near threatened (Grulich 2012).

Veronica triphyllos (Fig. 97)

Veronica triphyllos, native probably to Anatolia and to the steppe areas north of the Black Sea, is now continuously distributed in western and central Europe and north of the Balkan Peninsula, reaching as far as south-eastern England, southernmost Scandinavia and the Baltic countries, while being almost absent from the Mediterranean area. Isolated occurrences are known from the area north of the Caspian Sea and north-western Africa (Meusel et al. 1978). It has been introduced into North America (USDA, NRCS 2017). In the Czech Republic *V. triphyllos* occurs in places with low vegetation cover, most frequently as a weed in margins of fields with cereals, in gardens, vineyards, dry grasslands, also in disturbed places along roads, paths and on fallow land. It grows mainly in permeable sandy soils moderately supplied with nutrients. *Veronica triphyllos* is found at low and middle elevations up to about 600 m in areas with warm to moderately warm climates, reaching its elevational maxima in isolated occurrences at about 850 m in the Růžový důl valley in the Krkonoše Mts and at about 800 m near the town of Vimperk in southern Bohemia. It is locally absent from western Bohemia and eastern Moravia, in the latter area probably due to prevalence of heavy soils. Some of the isolated records, including those in the mountains, may represent temporary introductions. In the Czech flora this species is considered to be a naturalized archaeophyte (Pyšek et al. 2012).

Veronica verna (Fig. 98)

Veronica verna has an almost continuous distribution extending from western France in the west as far as the Ural Mts in the east, in the north reaching southern Scandinavia and in the south northern Italy, southern Hungary and the northern coast of the Black Sea. Isolated and scattered occurrences are known from the Iberian Peninsula, Corsica, Sardinia and the Apennine and Balkan peninsulas. It is also found in the Caucasus Mts and central Asia (Meusel et al. 1978). It is reported as introduced into North America (USDA, NRCS 2017). In the Czech Republic *V. verna* occurs in habitats with low vegetation cover, mainly in dry grasslands, on rock outcrops and in sandy places, less frequently in dry pastures, margins of pine forests, along paths, in field margins and on fallow land. It grows usually on shallow and permeable sandy acidic soils, which are rather poor in nutrients. Being found from the lowlands to middle elevations up to about 650 m, it is slightly more widespread than the similar *V. dillenii*. It reaches its elevational maximum at 840 m on Podhorní vrch hill near the town of Mariánské Lázně in western Bohemia. This species is rare in or absent from areas with heavy soils such as in eastern Moravia or from lowland areas with mainly arable land and soils rich in nutrients. *Veronica verna* is frequently confused with other species in this genus, most frequently *V. dillenii*, *V. arvensis* and *V. triphyllos*; consequently, some of the records not supported by a herbarium specimen may be erroneous. This species is classified as of lower risk – near threatened in this country (Grulich 2012).

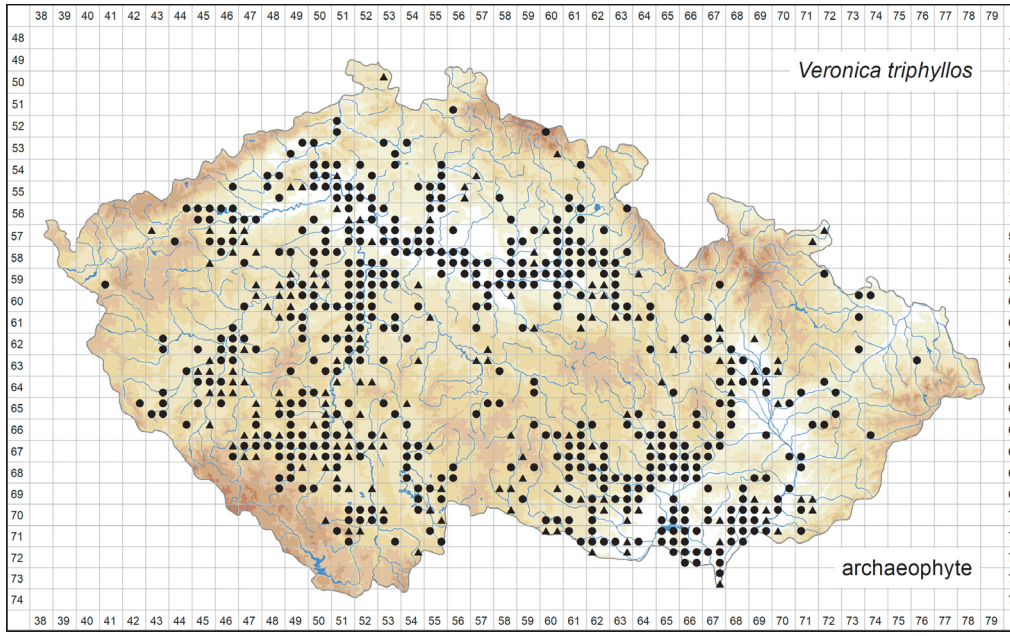

Fig. 97. – Distribution of *Veronica triphyllos* in the Czech Republic: ● occurrence documented by herbarium specimens (487 quadrants), ▲ occurrence based on other records (155 quadrants). Prepared by Jiří Danihelka.

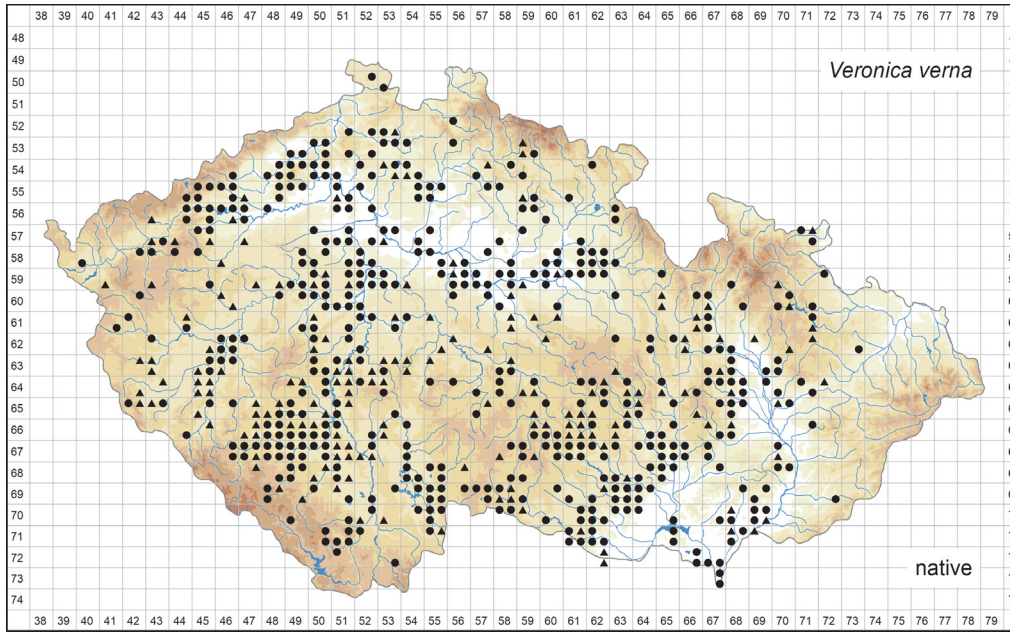

Fig. 98. – Distribution of *Veronica verna* in the Czech Republic: ● occurrence documented by herbarium specimens (450 quadrants), ▲ occurrence based on other records (178 quadrants). Prepared by Jiří Danihelka.

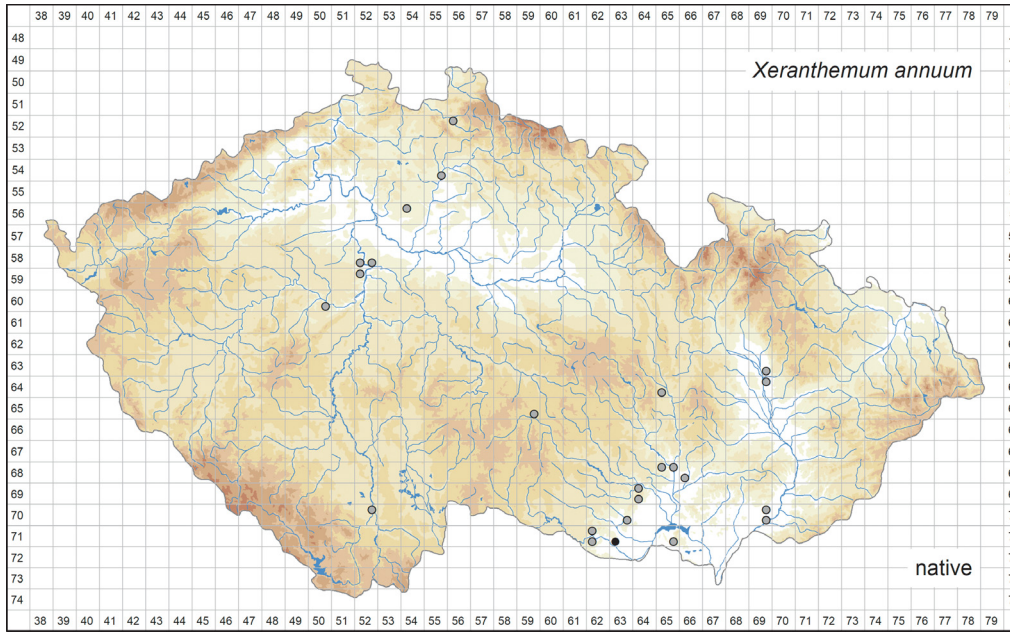

Fig. 99. – Distribution of *Xeranthemum annuum* in the Czech Republic: ● at least one record in 2000–2016 (1 quadrant), ● pre 2000 records only and/or extirpated occurrences (23 quadrants). Prepared by Zdeněk Kaplan.

Xeranthemum annuum (Fig. 99)

Xeranthemum annuum is probably native to south-eastern Europe and southern parts of eastern Europe, extending westwards to the Balkan Peninsula and northwards to southernmost Slovakia, Ukraine and southern part of European Russia, and in south-western Asia throughout Anatolia eastwards to the Caucasus and western Iran. It has been introduced, mostly as a casual, into several countries in western and central Europe, including Portugal, Spain, France, Switzerland, Italy, Germany and southern Poland, and is also recorded in Norway (Meusel et al. 1992, Greuter 2006). The native status of *X. annuum* in the Czech Republic is uncertain. Most of the occurrences in this country were in southern Moravia northwards up to the city of Brno, which is the north-westernmost projection of the Pannonian Basin. Some of these populations may have been native and indicated the northern border of the primary range of this species. They occurred in disturbed dry grasslands, on rocky slopes, railway embankments, fallow land, in edges of vineyards and on rubble. Introduced or escaped plants are recorded elsewhere in this country but these plants mostly disappear after a short time. An exception is the occurrence on rocky slopes near Prague in central Bohemia, where *X. annuum* was recorded already in the 18th century and occurred there up to the 1890s. At present, only two extant populations are known in this country, both located at the edges of the village of Hodonice in southern Moravia. Consequently, *X. annuum* is classified as critically threatened (Grulich 2012).

See www.preslia.cz for Electronic Appendices 1–106

Acknowledgements

We are grateful to all who made this study possible and helped us in any way. Field botanists collected distribution records and plant specimens for herbaria, which served as a basis for the distribution maps. Curators of the herbaria visited allowed us to study their specimens and collect records. Administrators of the integrated databases, particularly Jan Štěpánek, Milan Chytrý, Dana Michalcová and Karel Chobot as representatives of the major ones, agreed to share plant distribution records. Pavel Dřevojan, Petr Kocián, Adam Kantor and Pavel Kúr helped with the preparation of certain maps. The South-Bohemian branch of the Czech Botanical Society kindly provided records from the regional floristic database of Václav Chán. Regional collaborators, particularly Radim Paulič, Pavel Dřevojan, Jan Doležal, Petr Koutecký, Luděk Čech, Petr Kocián, Milan Kotilínek, David Hlisnikovský, Petr Lepší, Tomáš Svačina, Zdenka Hroudová, Karel Fajmon, Zuzana Mruzíková, Rudolf Hlaváček, Jaroslav Rydlo, Jana Janáková, Jan Košnar, Karel Boublík, David Půbal, Vít Grulich, Martin Dančák, Pavel Lustyk, Pavel Zdvořák, Pavel Kúr, Josef Komárek, Leo Bureš, Jiří Brabec, Hana Galušková, Petr Petřík, Václav Dvořák, Lenka Pivoňková, Jan Blahovec, Jiří Juřička, Jaroslav Zámečník, Radomír Němec and Zdenka Rozbrojová commented on early versions of maps and/or provided additional records for their areas. Petra Bidmanová (née Strnadová), Josef Brůna, Petr Filippov, Hana Galušková, Ondřej Hornych, Klára Kabátová, Anna Kladivová, Adam Knotek, Markéta Kollárovičová, Kristýna Marvanová, Ludmila Mikovcová, Helena Moltašová, Soňa Novotná (née Dvořáková), Helena Prokešová, Lucie Rejchrtová, Ludmila Roithová, Jan Rys, Nina Slováková, Petra Šilarová, Lucie Šmejdová, Petra Štěpánková, Václav Šulc and Kristýna Vazačová georeferenced distribution records, computerized data, helped with the preparation of maps or provided other technical assistance. Helmut Freitag kindly examined and identified the first specimens of *Suaeda salsa*. Lukáš Číhal, Jiří Hadinec, Hana Houzarová, Jana Jelínková, Milan Marek, Lenka Šafářová and Otakar Šída helped with the deciphering of old herbarium labels or identification of localities. Programmers Petr Novotný and Martin Rohn produced the Pladias database and an internet-accessible mapping interface. An anonymous reviewer carefully read the manuscript and suggested numerous valuable improvements. Tony Dixon proofread the English text. The research was supported by the Centre of Excellence PLADIAS, project no. 14-36079G from the Czech Science Foundation. ZK, JD, KŠ, JCh, JŠ, JP and JW were also supported by the long-term research development project no. RVO 67985939 from the Czech Academy of Sciences, MH, LK, VT and DH by the project no. IGA_PrF_2017_001 from the Internal Grant Agency of the Palacký University, and MD by the project no. 00023272 (National Museum, DKRVO 2017/11) from the Ministry of Culture of the Czech Republic.

Souhrn

Pátá část ze série prací věnovaných rozšíření cévnatých rostlin v České republice obsahuje síťové mapy a komentáře k 106 taxonům rodů *Arnica*, *Carduus*, *Cicuta*, *Coleanthus*, *Comarum*, *Dactylorhiza*, *Digitaria*, *Gagea*, *Gypsophila*, *Hieracium*, *Hydrocotyle*, *Leersia*, *Myosurus*, *Oenanthe*, *Oreopteris*, *Paris*, *Phalaris*, *Phegopteris*, *Pilosella*, *Polystichum*, *Portulaca*, *Pulicaria*, *Salicornia*, *Saxifraga*, *Suaeda*, *Thalictrum*, *Thelypteris*, *Tripolium*, *Utricularia*, *Veronica* a *Xeranthemum*. Základem jsou údaje získané excerpcí herbářů a literatury, terénní zápisy a nálezy dostupné v databázích, které prověřili taxonomičtí experti. Téměř dvě třetiny mapovaných druhů jsou s různou mírou ohrožení zařazeny do červeného seznamu. Tyto rostliny se vyznačují různými ekologickými nároky. Rostliny spíše sušších stanovišť jsou zastoupeny druhy *Gypsophila paniculata*, *Thalictrum foetidum*, *Veronica austriaca* a *Xeranthemum annuum*, zatímco příkladem ohrožených lesních druhů jsou kapradiny *Polystichum braunii* a *P. aculeatum*. Ještě více ohrožených druhů je však mezi rostlinami různých typů mokřadů, kam patří např. *Cicuta virosa*, *Comarum palustre*, *Hydrocotyle vulgaris*, *Thelypteris palustris* a druhy rodů *Dactylorhiza* a *Utricularia*. Podobně jsou výrazně ohroženy rostliny slatin a střídavě mokrých luk, např. *Oenanthe fistulosa*, *Thalictrum flavum* a *Th. simplex* subsp. *galioides*. Některé mapované ohrožené druhy jsou výrazně ekologicky specializované: *Gagea bohemica* roste hlavně na skalních výchozech, *Coleanthus subtilis* na pravidelně obnažovaných dnech rybníků a *Pulicaria dysenterica*, *Salicornia perennans*, *Suaeda prostrata* a *Tripolium pannonicum* na zasolených stanovištích. K mimořádné změně v rozšíření a četnosti výskytu došlo u druhu *Saxifraga tridactylites*, který původně rostl především na skalních výchozech, ale během posledních dvou desetiletí se rozšířil na ekologicky podobných stanovištích podél železnic. Rozšíření druhů taxonomicky obtížného rodu *Pilosella* bylo donedávna nedokonale známé; vybrané druhy chlupáčků byly proto mapovány na základě herbářových sběrů revidovaných specialisty. Šest druhů zahrnutých do tohoto příspěvku patří mezi rostliny v České republice vyhynulé: je to *Dactylorhiza curvifolia*, *Oenanthe fistulosa*, *Oenanthe silaifolia*, *Polystichum setiferum*, *Salicornia perennans* a *Suaeda prostrata*. Zatímco je česká flóra ochuzována o druhy původní, nové druhy jsou k nám postupně zavlékány. Přesný způsob zavlečení mnoha

cizích rostlin většinou zůstane neznámý, ale u několika neofytů zjištěných brzy po zavlečení se podaří zdroj a mechanismus zavlečení identifikovat. *Carduus tenuiflorus* k nám byl zavlečen s vlnou ze Středozemí, *Digitaria ciliaris* s bavlnou a *Gypsophila perfoliata* s železnou rudou z Ukrajiny. Jiné rostliny byly nejdříve záměrně dovezeny a pěstovány pro okrasu a teprve později zplaněly ze zahrad; je to např. *Gypsophila elegans* a *G. scorzonerifolia*. Jako nový druh pro českou květenu byl nedávno v západních Čechách zjištěn halofyt *Suaeda salsa*, který byl zavlečen na zasolené okraje dálnic. Mnohé archeofyty z rodu *Veronica* u nás zdomácněly a rozšířily se nejčastěji jako plevele polí a zahrad. Dva archeofyty, *Digitaria ischaemum* a *Portulaca oleracea*, dnes dokonce patří mezi invazní druhy. Celkový obraz rozšíření zpracovávaných taxonů poskytují mapy; konkrétní floristické údaje zachycující frekvenci výskytu v různých oblastech a v různých obdobích a dokumentující tak ústup nebo naopak šíření některých druhů 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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Received 21 August 2017
Revision received 19 October 2017
Accepted 23 October 2017