Distributions of vascular plants in the Czech Republic. Part 6

Rozšíření cévnatých rostlin v České republice. Část 6

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The sixth part of the series on the distributions of vascular plants in the Czech Republic includes grid maps of 112 taxa in the genera *Athyrium*, *Carex*, *Centaurea*, *Chenopodium*, *Corispermum*, *Corrigiola*, *Crepis*, *Cystopteris*, *Glaucium*, *Hackelia*, *Hammarbya*, *Hippocrepis*, *Lappula*, *Lepidium*, *Liparis*, *Loranthus*, *Lycopus*, *Lythrum*, *Matteuccia*, *Osmunda*, *Plantago*, *Psephellus*, *Pteridium*, *Salvia*, *Scirpus* and *Viola*. These maps were produced by taxonomic experts based on examined herbarium specimens, literature and field records. The native species include common and widespread plants such as *Athyrium filix-femina*, *Carex acuta*, *Crepis biennis*, *Lycopus europaeus*, *Lythrum salicaria* and *Plantago lanceolata*, as well as rare species such as *Carex buxbaumii*, *Osmunda regalis* and *Viola alba*. Almost 42% of the mapped taxa are on the national Red List. Among the mapped taxa there are rare mountain species (e.g. *Carex aterrima*, *C. atrata*, *Centaurea mollis*, *C. montana*, *Crepis mollis* subsp. *mollis*, *C. sibirica* and the endemic *Plantago atrata* subsp. *sudetica*), wetland orchids (*Hammarbya paludosa*, *Liparis loeselii*) and plants of dry grasslands (e.g. *Crepis pannonica*, *Hippocrepis comosa*, *Lappula semicincta* and *Salvia aethiopis*). Rare ecological specialists include *Corrigiola litoralis* from seasonally exposed sand and gravel bars in rivers, *Plantago arenaria* confined to dry open sandy habitats, and *Chenopodium chenopodioides* and *Plantago maritima* subsp. *ciliata* from saline habitats. Alien species mapped in this paper include both archaeophytes and neophytes, most of them from the genera *Centaurea*, *Crepis* and *Lepidium*. *Salvia hispanica* is recorded as a new alien species for this country's flora; its spontaneous occurrence was first detected in 2013, and since then this species has been found at about a dozen sites. *Plantago coronopus* has recently spread along the

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roads treated with de-icing salt. A number of species are at the limits of their distributions in the Czech Republic. The distribution maps of three interspecific hybrids are also included. 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 that 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, phytogeography, plant record, vascular plants

Introduction

The mapping of the distributions of plants in the Czech Republic has reached its fifth and final year supported by the PLADIAS project (www.pladias.org). One of the aims of this project 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. So far, the team of taxonomic experts has produced grid-based distribution maps of 458 vascular plants, which have been published in five papers (Kaplan et al. 2015, 2016a, b, 2017a, b).

From August 2017 to February 2018 the Pladias database increased by about 167,000 new records. Of these more than 32,000 resulted from the critical examination of herbarium specimens by taxonomic experts. Maps for a further 112 taxa were finished by the beginning of February 2018 and are included in this paper.

The most species-rich genera for which maps are given below are *Carex*, *Centaurea* and *Crepis*. The latter two include high proportions of introduced species. The genera represented in this country only by alien species are *Corispermum*, *Glaucium*, *Lepidium*, *Matteuccia* and *Psephellus*. Taxonomic identities of some of these have been elucidated only recently, and their precise distributions in the Czech Republic are shown here for the first time. Some neophytes have found a suitable niche in this country and started to spread recently. An example is *Plantago coronopus*, which has spread rapidly during the past five years along the roads treated by de-icing salt. *Salvia hispanica* is a new alien species for this country's flora. It was recorded in 2013 for the first time, and since then it has been found at about a dozen sites.

The native species include common and widespread plants, such as *Athyrium filix-femina*, *Carex acuta*, *Crepis biennis*, *Lycopus europaeus*, *Lythrum salicaria* and *Plantago lanceolata*, which are recorded for the great majority of grid cells, as well as rare species, such as *Carex buxbaumii*, *Lappula semicincta*, *Osmunda regalis*, *Salvia aethiopis* and *Viola alba*, which are confined to a small number of sites. The rare species are often also endangered. Almost 42% of the mapped taxa are on the national Red List (Grulich 2012). Among them, the group of mountain species confined to small areas is the most highly represented, for example by *Carex aterrima*, *C. atrata*, *C. bigelowii*, *Centaurea mollis*, *C. montana*, *Crepis conyzifolia*, *C. mollis* subsp. *mollis*, *C. sibirica*, *Cystopteris sudetica* and the endemic *Plantago atrata* subsp. *sudetica*. Two rare wetland orchids, *Hammarbya paludosa* and *Liparis loeselii*, survive at no more than three and eight sites, respectively. Plants of dry grasslands are represented by *Crepis pannonica*, *Hippocrepis comosa*, *Lappula semicincta*, *Salvia aethiopis* and *Viola ambigua*. Rare ecological specialists include *Corrigiola litoralis*, a species of seasonally exposed sand and

gravel bars in river beds, *Plantago arenaria*, confined to dry open sandy habitats, and plants such as *Chenopodium chenopodioides* and *Plantago maritima* subsp. *ciliata*, which are restricted to saline habitats.

A number of widespread species are at the limits of their distributions in the Czech Republic (Kaplan 2012, 2017). In this paper, the distribution maps are provided for *Crepis pannonica* and *C. sibirica*, which both have extensive disjunct ranges, reaching their western limits in this country as isolated relict occurrences. Other mapped species are distributed mainly in southern or south-eastern Europe, sometimes extending eastwards to Asia, and their occurrences in the Czech Republic are situated at the northern (*Crepis conyzifolia*, *Salvia aethiopis*) or north-western (*Loranthus europaeus*, *Lycopus exaltatus*, *Lythrum virgatum*, *Salvia austriaca*) limits of their ranges. Some of the mountain species, such as *Centaurea mollis*, *Crepis mollis* subsp. *mollis* and *Salvia glutinosa*, occur mainly in the Alps, Carpathians and Dinarids, and these have the most north-western occurrences in the Czech mountains.

Besides the "pure" species, some interspecific hybrids also can be quite frequent in the field and deserve to be recorded. However, most of them are difficult to identify, and they are neglected, with reliable records only coming from a few experts. The distribution maps of two *Carex* hybrids and one *Centaurea* hybrid are included in this paper.

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 resulting from recent revisions are included.

Data sources

All relevant floristic data sources are used. Major national herbaria and some local and foreign collections, incl. BRA, BRNL, BRNM, BRNU, CB, CBFS, CESK, CHEB, CHOM, DR, FMM, GM, GZU, HOMP, HR, KHMS, LIM, LIT, MJ, MMI, MP, MZ, NJM, OH, OL, OLM, OMJ, OMP, OP, OSM, OVMB, PL, PR, PRA, PRC, ROZ, SAV, SOB, SOKO, SUM, VM, VYM, WA, WRSL and ZMT (acronyms follow Thiers 2017), were consulted as the main sources of taxonomically examined 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 maps' authors 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 specimens examined 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 1–112. 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; the maps' authors, indicated in the figure captions, also had major roles in writing the first drafts of the texts for the subject taxa. 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 to distinguish between the following alternative attribute states: (1) recent versus old records; (2) native occurrences versus introductions; and (3) records based on examined herbarium specimens versus all other records. These classifications of records are used only for those taxa where such distinction provides important information and 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 *Centaurea*, *Crepis*, *Cystoperis*, *Lappula*, *Lepidium*, *Plantago* and *Salvia* with distinct distributions are shown in maps in groups of two, with symbols and annotations of individual taxa on the maps distinguished using different colours. In the caption for each map, the 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 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 extirpated from all localities after 2000, or all records undated)
Origin	●	Native (at least one record)
	×	Alien
Source of data	●	Examined herbarium specimen (at least one record)
	▲	All other
All	?	Only record(s) uncertain regarding identification and/or locality

Distribution maps and comments

Athyrium distentifolium (Fig. 1)

Athyrium distentifolium has a disjunct circumpolar arctic-montane distribution in the Northern Hemisphere. In Europe it is found in the majority of the mountain ranges from the Pyrenees in the west to the Carpathians in the east, and also in Scotland, on the Faroe Islands, in Iceland, and in the Ural Mts and the Kola Peninsula in Russia. Outside Europe it occurs in northern Anatolia, the Caucasus Mts, Siberia, the Kamchatka Peninsula, Japan and Greenland (Meusel et al. 1965). Its populations in the western and north-eastern parts of North America are recognized as *A. distentifolium* var. *americanum* (Kato 1993). *Athyrium distentifolium* occurs at high elevations and in areas with long periods of snow cover in winters, usually at higher latitudes. Deep snow provides insulation from severe frosts and prevents early growth in a mild spring (McHaffie 2005). In the Czech Republic *A. distentifolium* mainly occurs in the mountains, where it grows in montane sycamore-beech and spruce forests, *Pinus mugo* scrub, subalpine tall-fern vegetation, on rocky slopes and open screes at elevations 900–1400 m. It is most frequent in the mountain ranges along this country's border and in the Hrubý Jeseník Mts. At lower elevations it is rare, being confined to areas with cold mesoclimates such as deep and shady gorges in the sandstone areas in north-eastern Bohemia, where it reaches its elevational minimum at about 520 m near the town of Adršpach.

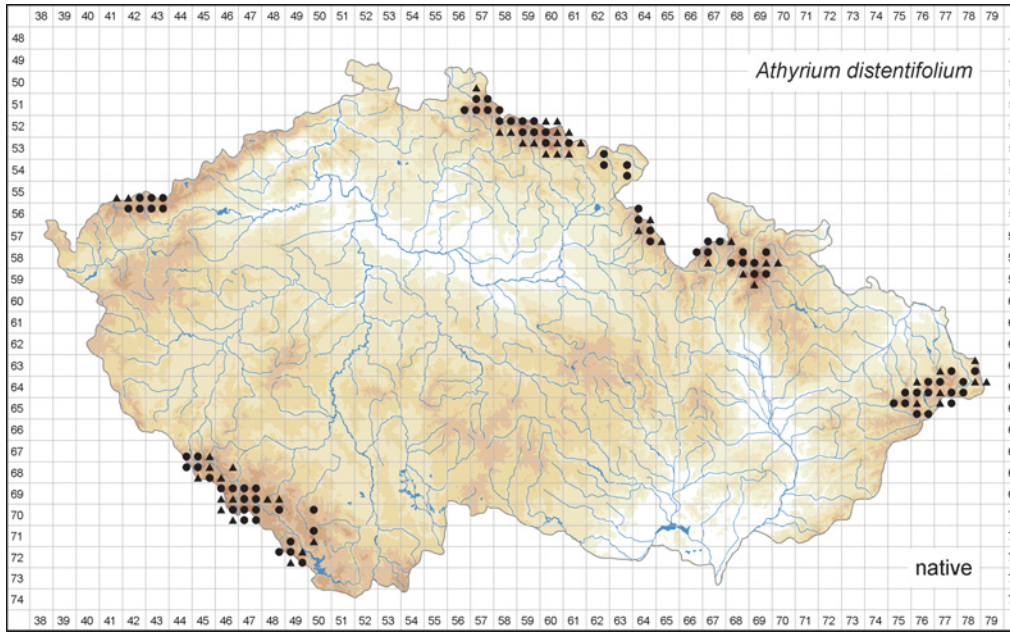

Fig. 1. – Distribution of *Athyrium distentifolium* in the Czech Republic: ● occurrence documented by herbarium specimens (79 quadrants), ▲ occurrence based on other records (47 quadrants). Prepared by Libor Ekrt.

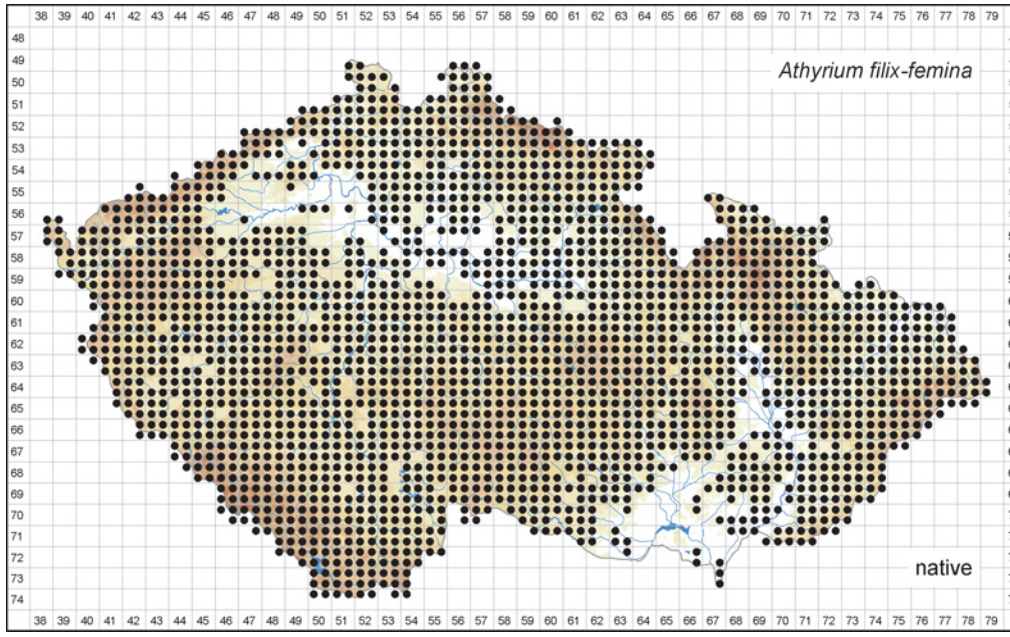

Fig. 2. – Distribution of *Athyrium filix-femina* in the Czech Republic (2211 occupied quadrants). Prepared by Libor Ekrt.

Athyrium filix-femina (Fig. 2)

Athyrium filix-femina is widespread in the Northern Hemisphere. It occurs throughout Europe including Iceland, in Macaronesia, northernmost Africa, and eastwards through southern Siberia as far as Japan and the Kamchatka Peninsula, with isolated occurrences in more southern parts of Asia including southern India and Java (Hultén & Fries 1986). It is also widespread in North America (except the northernmost parts), having diversified there into several reproductively isolated taxa (Kato 1993, Kelloff et al. 2002). Outposts of this species in the Southern Hemisphere exist in the Andes in Peru and Argentina, in Haiti and southern Africa (Hultén & Fries 1986). In the Czech Republic *A. filix-femina* is the most frequent fern growing in the understory of moist and humus-rich deciduous and coniferous forests, alder carrs, willow scrub and *Pinus mugo* scrub. It prefers moist soils along streams, springs, surroundings of ponds and peat bogs and subalpine tall-forb communities. It also occurs in wet screes, on rocky slopes and ledges and disturbed places along forest roads. *Athyrium filix-femina* is widespread in this country from the middle elevations to the mountains, and the gaps on the map in these areas are certainly due to under-recording. However, in the lowlands it is rare or absent because of the lack of suitable humid forest habitats.

Carex acuta (Fig. 3)

Carex acuta grows in almost all of Europe, but it is rare in the Mediterranean area and absent from most of the Mediterranean islands. In northern Europe it extends to Scandinavia but is absent from Iceland. In northern Asia *C. acuta* occurs throughout Siberia eastwards as far as to the Lena River. It also occurs in Turkey, Syria, Lebanon and the Transcaucasia and in northern Africa including Morocco, Algeria and Tunisia (Hultén & Fries 1986, Egorova 1999). This species is very variable, with two subspecies usually recognized in central Europe, subsp. *acuta* and subsp. *intermedia*. Their taxonomy is, however, unclear, and only a map for the species is presented here. In the Czech Republic *C. acuta* is abundant especially in basins with eutrophic fishponds, where it finds optimal conditions in their littoral zones. It easily tolerates fluctuations of the groundwater level, including flooding. Long-term observations indicate that *C. acuta* has spread over the past 30 years due to eutrophication. In the Czech Republic *C. acuta* is widespread from the lowlands up to 800 m a.s.l., although most of its localities are situated at low and middle elevations. The empty patches on the map, such as in the southern part of the Českomoravská vrchovina highlands, western Bohemia and northern Moravia, represent under-recording rather than true absences. However, the species is rare in the mountains and in lowland areas where arable land prevails and suitable wetlands are scarce. *Carex acuta* frequently hybridizes with each of *C. buekii*, *C. elata* and *C. nigra*, and the hybrids are difficult to distinguish in the field and, even more so, in the herbarium. It is frequently confused with the three species listed above and also with *C. acutiformis*; some of the records not supported by herbarium specimens may therefore be erroneous.

Carex aterrima (Fig. 4)

Carex aterrima grows mainly in the mountains of central and southern Europe; it is also known from the Ural Mts, Siberia and mountains of central Asia (Egorova 1999). The

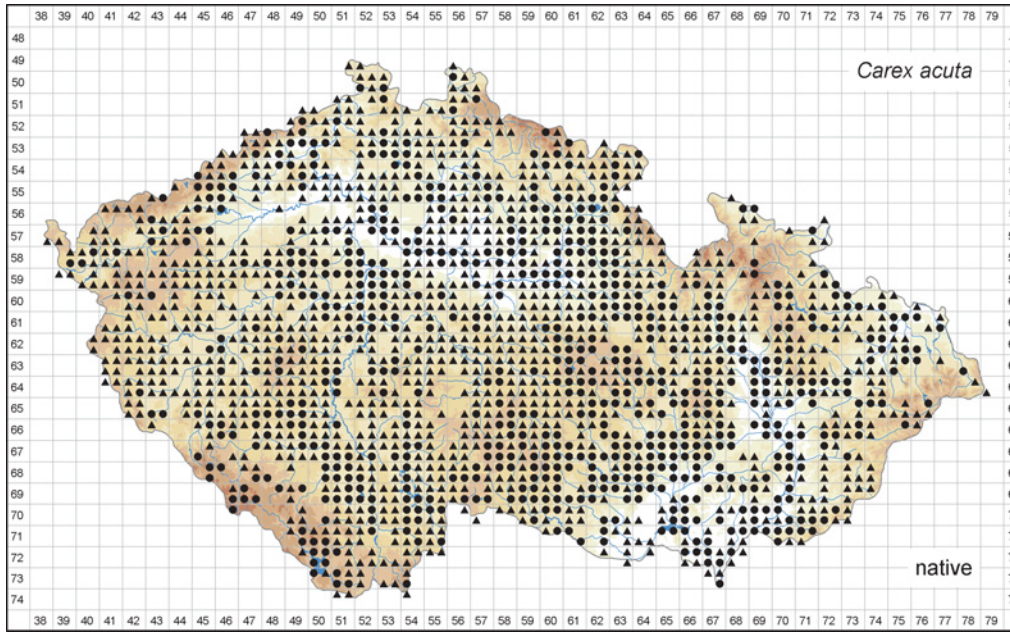

Fig. 3. – Distribution of *Carex acuta* in the Czech Republic: ● occurrence documented by herbarium specimens (681 quadrants), ▲ occurrence based on other records (1133 quadrants). Prepared by Vít Grulich & Radomír Řepka.

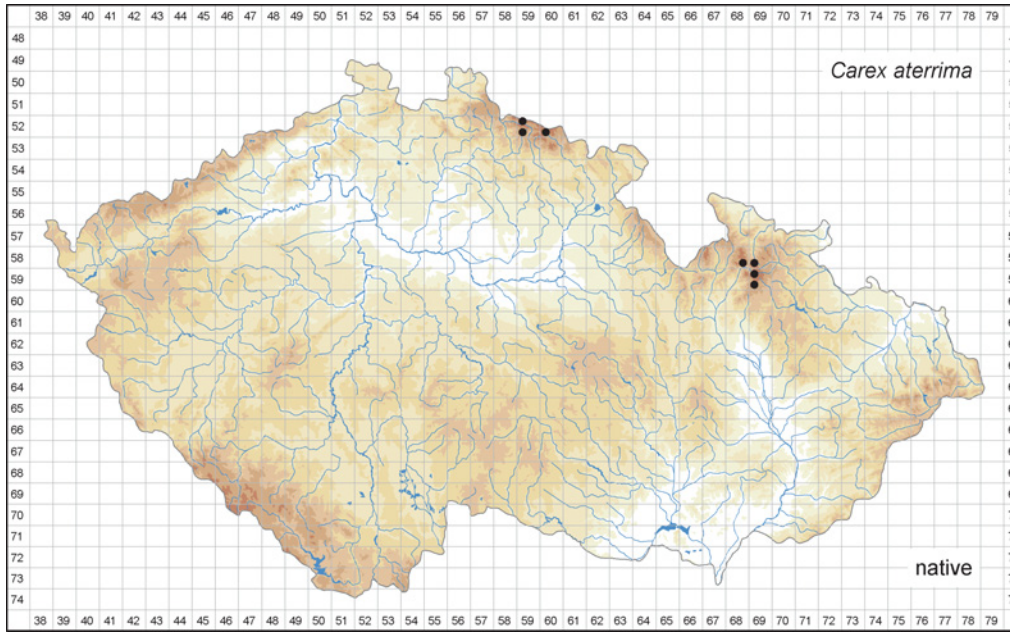

Fig. 4. – Distribution of *Carex aterrima* in the Czech Republic (7 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

records of *C. aterrima* in North America refer to some other species of sect. *Atratae* (Murray 2002). Unlike the similar *C. atrata*, *C. aterrima* prefers wet, grassy places in the subalpine belt, but it also descends to glacial cirques, where it reaches its elevational minimum. It usually grows on rather deep soils of acidic to neutral pH, in places with long-lasting snow cover, and most often around springs or along small streams. Thanks to its robust growth, it tolerates the competition of broad-leaved plants. In the Czech Republic it is a rare species confined to the highest elevations of the Krkonoše and Hrubý Jeseník Mts, at about 1100–1450 m (Řepka & Grulich 2014). Besides typical ones, morphologically transient forms towards *C. atrata* are also known in the Czech Republic (see below). *Carex aterrima* is classified as endangered due to its rarity (Grulich 2012).

Carex atrata (Fig. 5)

This predominantly arcto-alpine European species occurs in the Pyrenees, Alps, Carpathians, Sudetes and Dinaric Mts. It is also found in Scotland, the Faroe Islands, Scandinavia and the Kola Peninsula in Russia, as well as in Iceland and Greenland (Hultén & Fries 1986). In the Czech Republic it grows in grassy and rocky habitats of the subalpine belt, where it prefers shallow, dry to moist, stony soils with an acidic to neutral pH, in places with thin snow cover, often exposed to winds. It is a rare species in this country, limited to the subalpine belt of the Krkonoše and Hrubý Jeseník Mts, but it also descends to glacial cirques. It is found at elevations 950–1550 m. The species is morphologically variable, and confusion with *C. aterrima* is very frequent in herbaria. Moreover, in the Krkonoše and Hrubý Jeseník Mts, morphologically transient types with characters of both species are known (see also Egorova 1999: 397); these specimens were not included in the maps. Rarely occurring sterile plants are probably hybrids of these two species. Due to its rarity, *C. atrata* is classified as a critically endangered species (Grulich 2012).

Carex bigelowii subsp. *dacica* (Fig. 6)

The more-or-less continuous distribution of *C. bigelowii* s. l. is situated in the subarctic and arctic zones in the Northern Hemisphere; it also occurs in the mountain ranges of central Europe, and central and eastern Asia and North America (Hultén & Fries 1986, Egorova 1999). In the Czech Republic only *C. bigelowii* subsp. *dacica* occurs, which is confined to northern Europe and the mountains of central Europe (Koopman 2011). In the Czech Republic *C. bigelowii* subsp. *dacica* grows in subalpine grasslands, usually at sites affected by strong winds and with thin snow cover, on shallow, acidic, stony soils. It is also found in *Nardus stricta* grasslands and in rather dry parts of peat bogs. It is an arcto-alpine element, and in central Europe is considered a glacial relict well indicating the natural timberline in the Sudetes Mts, i.e. the Krkonoše, Králický Sněžník and Hrubý Jeseník Mts (Řepka & Grulich 2014). The record from Mt Velký Špičák at 920 m a.s.l. in the Krušné hory Mts (Křísa 1988) is remarkable as there is no subalpine belt in these mountains. Because of its rarity in the Czech Republic, *C. bigelowii* subsp. *dacica* is classified as endangered (Grulich 2012). In central Europe this taxon is morphologically distinct, but some plants resembling *C. nigra*, which are probably of hybrid origin, occur.

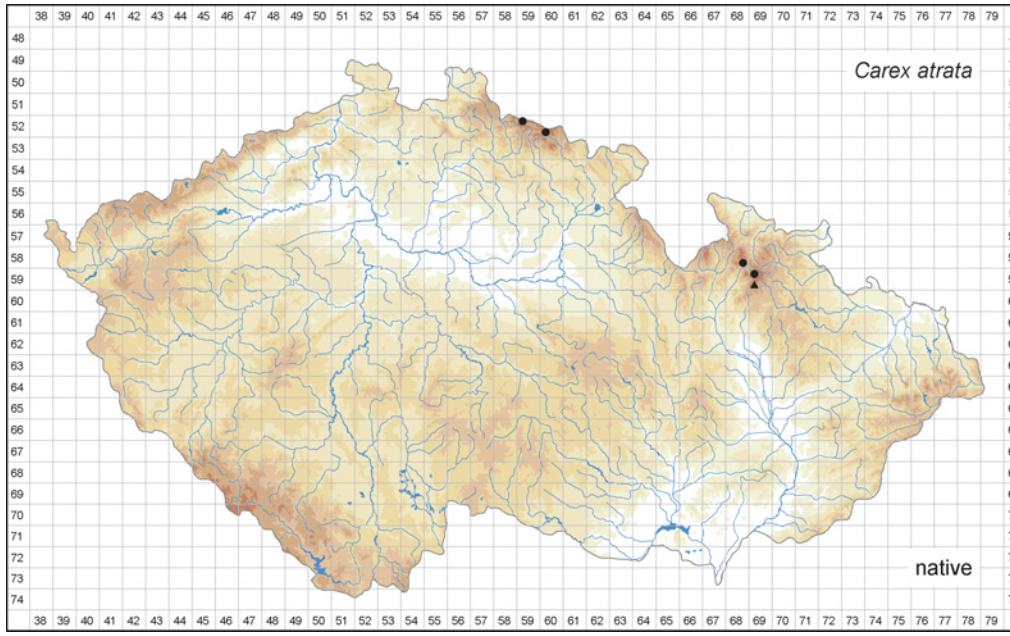

Fig. 5. – Distribution of *Carex atrata* in the Czech Republic: ● occurrence documented by herbarium specimens (4 quadrants), ▲ occurrence based on other records (1 quadrant). Prepared by Vít Grulich & Radomír Řepka.

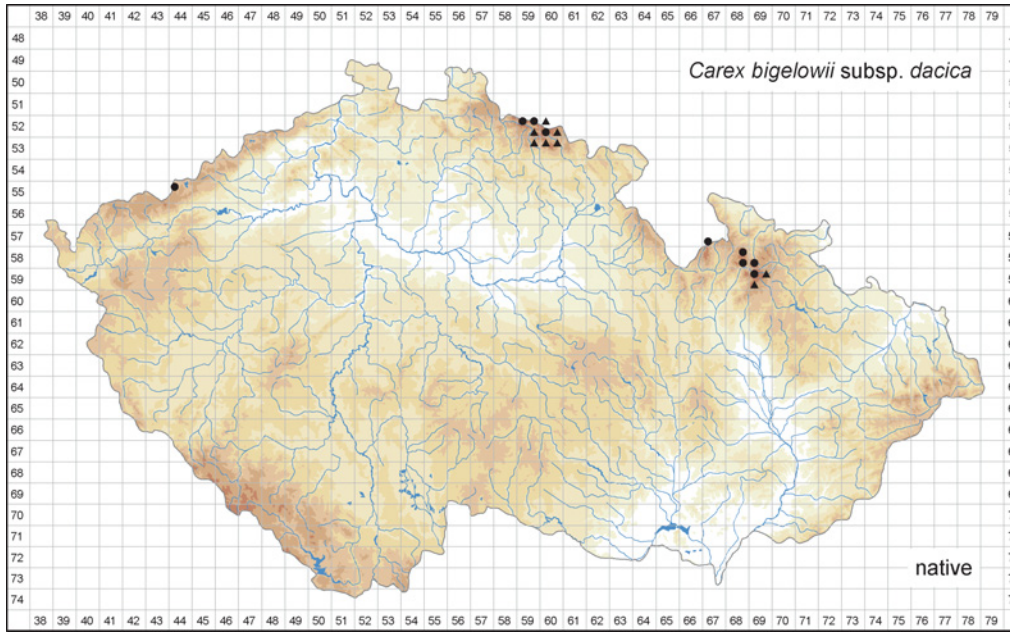

Fig. 6. – Distribution of *Carex bigelowii* subsp. *dacica* in the Czech Republic: ● occurrence documented by herbarium specimens (9 quadrants), ▲ occurrence based on other records (8 quadrants). Prepared by Vít Grulich & Radomír Řepka.

Carex buekii (Fig. 7)

Carex buekii is a Euro-Siberian species, distributed in central, south-eastern and eastern Europe, westwards reaching Germany (and possibly also Belgium) and southwards extending to Bulgaria. The eastern boundary of its distribution runs through northern Kazakhstan and southern Siberia (Meusel et al. 1965, Koopman et al. 2018). *Carex buekii* is typical of riverine reed vegetation; less frequently it also occurs in tall-sedge communities, usually in floodplains, and in ash-alder alluvial forests. It prefers fluvisoils on sandy or gravelly substrates that are rich in nutrients, often at margins of water bodies. It is a competitively strong species, which usually forms species-poor monodominant stands. Some populations of *C. buekii* produce only very small amounts of seeds and spread mainly vegetatively. Most localities in the Czech Republic are concentrated in warm and moderately warm areas along major rivers. Some stands were destroyed by construction of water reservoirs, e.g. in the Vltava river valley, while elsewhere the species colonized abandoned alluvial meadows. *Carex buekii* occurs from the lowlands up to 775 m a.s.l. in the Šumava Mts. The species was formerly considered rare (Grulich 2012); Podpěra (1930), for instance, knew of only about 10 localities in Moravia. However, it was both overlooked and misidentified, mainly as *C. acuta*.

Carex buxbaumii (Fig. 8)

Carex buxbaumii is a boreal circumpolar species that is widespread throughout northern Europe and Asia as far as the Lena river basin in eastern Siberia. Its distribution in the central and southern parts of both continents is very scattered. In Europe *C. buxbaumii* reaches southwards to France, central Italy and Bulgaria, and outside Europe to the Caucasus Mts and mountains in central Asia; it probably also occurs in northern Algeria. In North America it occurs from Alaska in the west to Greenland in the east, southwards reaching as far as California and Arizona (Hultén & Fries 1986, Murray 2002). In the Czech Republic *C. buxbaumii* occurs mainly in calcareous fens, but it is known also from alder carrs and wet slopes in the subalpine belt; all populations have a distinctly relict character. It prefers gley or organic, slightly acidic to slightly basic soils. *Carex buxbaumii* is very rare in the Czech Republic. Its localities are concentrated in four areas. About 10 sites have been known in the Labe river basin in the warm part of central Bohemia, and another group of lowland sites in the forested area north of the town of Hodonín in southern Moravia. An isolated occurrence (now vanished) was known from the vicinity of the town of Vimperk in south-western Bohemia at 550 m a.s.l. The other known locality is situated in the Velká Kotlina glacial cirque in the Hrubý Jeseník Mts at about 1300 m a.s.l. Due to its rarity and decline this species is classified as critically endangered (Grulich 2012).

Carex cespitosa (Fig. 9)

Carex cespitosa is a Euro-Siberian species. In Europe it occurs from north-eastern Spain, southern England and Scandinavia in the west as far as Bulgaria in the south-east. It is also found in Georgia, Armenia and northern Iran, and is widespread in northern Asia as far as northern China, Korea and Japan (Hultén & Fries 1986, Jiménez-Mejías et al. 2014). In the Czech Republic it is most frequent in wet meadows, sometimes forming

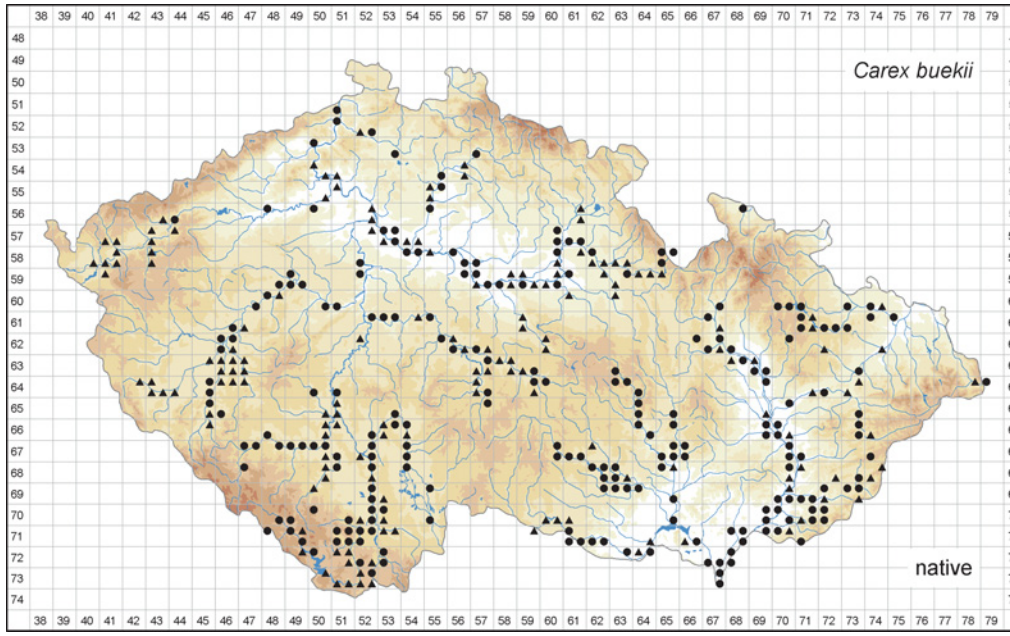

Fig. 7. – Distribution of *Carex buekii* in the Czech Republic: ● occurrence documented by herbarium specimens (224 quadrants), ▲ occurrence based on other records (158 quadrants). Prepared by Vít Grulich & Radomír Řepka.

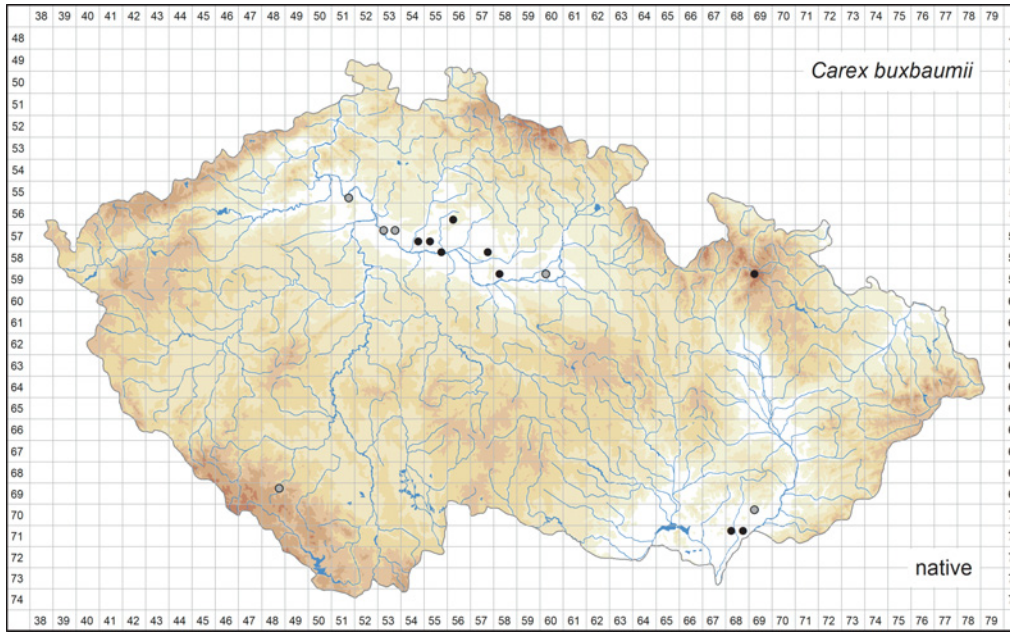

Fig. 8. – Distribution of *Carex buxbaumii* in the Czech Republic: ● at least one record in 2000–2018 (9 quadrants), ◍ pre-2000 records only (6 quadrants). Prepared by Vít Grulich & Radomír Řepka.

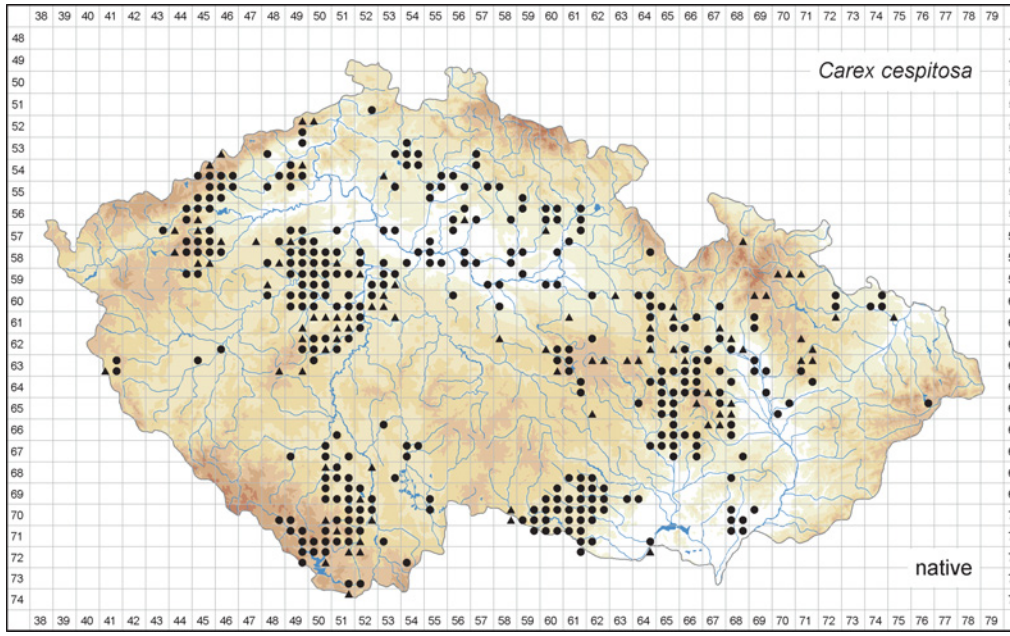

Fig. 9. – Distribution of *Carex cespitosa* in the Czech Republic: ● occurrence documented by herbarium specimens (317 quadrants), ▲ occurrence based on other records (91 quadrants). Prepared by Vít Grulich & Radomír Řepka.

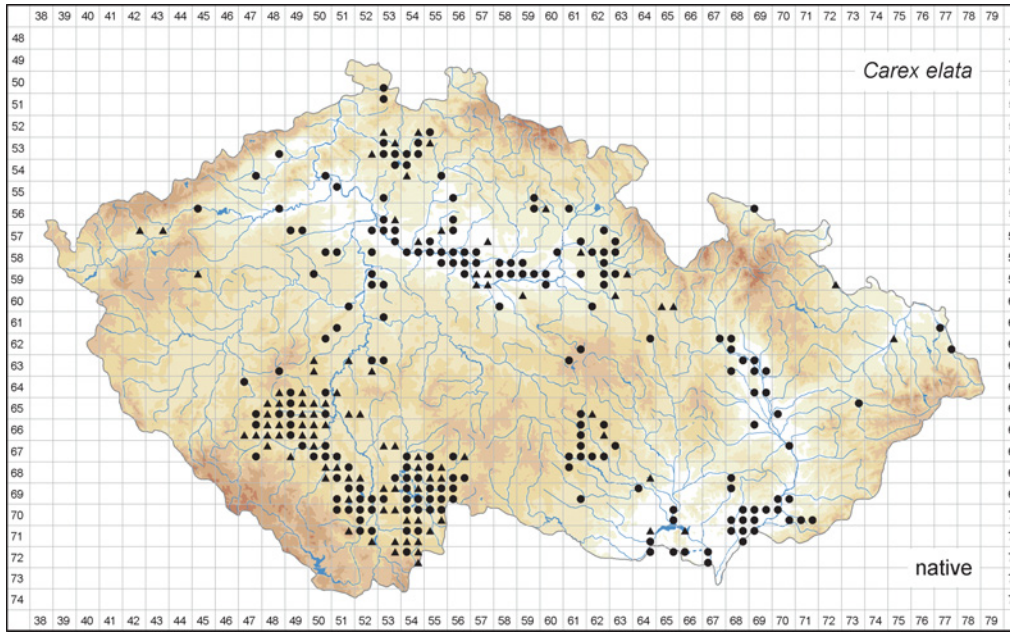

Fig. 10. – Distribution of *Carex elata* in the Czech Republic: ● occurrence documented by herbarium specimens (199 quadrants), ▲ occurrence based on other records (93 quadrants). Prepared by Vít Grulich & Radomír Řepka.

even monodominant stands there; less frequently it occurs in rich fens or ash-alder alluvial forests. It prefers base-rich, rarely organic, slightly acidic to slightly basic gley soils with rather higher groundwater levels. *Carex cespitosa* is scattered in the warm and moderately warm parts of this country. It is rather common in areas with slightly continental climate, such as some parts of southern Bohemia and south-western Moravia. In contrast, it is rather rare in the mountains and almost absent from western Bohemia and the Carpathians. Its elevational range is 160–1000 m. Literature records may be contaminated with misidentifications of the tussock forms of *C. nigra*. Although some populations were destroyed or vanished due to the overall eutrophication of the landscape, tussocks of *C. cespitosa* are very tolerant to drops in groundwater level and persist for a long time in damaged habitats.

Carex elata (Fig. 10)

Carex elata is distributed across Europe with the exception of its northern and southernmost parts; it also occurs in the Caucasus Mts, south-western Asia, southern Siberia, central Asia and northern Africa (Hultén & Fries 1986). It is divided into four subspecies, whose distributions overlap (Koopman 2011). *Carex elata* subsp. *elata* occurs in Europe with the exception of northern Scandinavia and most of the Mediterranean area, and eastwards it extends to Anatolia, Georgia, Armenia, Iraq and Iran (Meusel et al. 1965, Hultén & Fries 1986, Egorova 1999). The plants from Finland, eastern Europe, Siberia and central Asia are usually treated as *C. elata* subsp. *omskiana*. Two subspecies are recognized in the Iberian Peninsula: subsp. *reuteriana* and subsp. *tartessiana* (Luceño et al. 2008), to which plants from northern Africa (Algeria and Tunisia) may belong. In the Czech Republic only *C. elata* subsp. *elata* occurs, growing in tall sedge communities, especially on shores of fishponds, and rarely in wet meadows, alder carrs and fens. It prefers gley soils, which are nutrient-poor and acidic, but always with high groundwater levels. Sometimes it forms monodominant stands. It is scattered over warm and moderately warm regions of this country. Most localities are situated in Bohemia, particularly in the Labe river basin and the fishpond landscapes of southern Bohemia. In Moravia this species is rare, but is locally common only in the vicinity of the town of Hodonín. *Carex elata* reaches its elevational maximum at 630 m in the Českomoravská vrchovina highlands. Because many populations have vanished, it is classified as vulnerable (Grulich 2012).

Carex hartmanii (Fig. 11)

Carex hartmanii was not separated from *C. buxbaumii* until the 1930s (Cajander 1935). It is distributed mainly in central and eastern Europe, northwards reaching as far as central Sweden and southern Finland, westwards to central France and southwards to northern Italy and Bulgaria. Easternmost localities are known in the Ob' river basin and the Altai Mts, and isolated occurrences are known from the Caucasus Mts and northern Anatolia (Hultén & Fries 1986). In the Czech Republic *C. hartmanii* is found in wet meadows, base-rich fens, rarely in alder carrs, most often over base-rich substrates on soils with neutral or slightly acidic pH and higher groundwater levels. It seems that *C. hartmanii* recently expanded in abandoned meadows. In the Czech Republic it prefers moderately warm middle elevations, while being rather rare both in the lowlands and mountains. It is

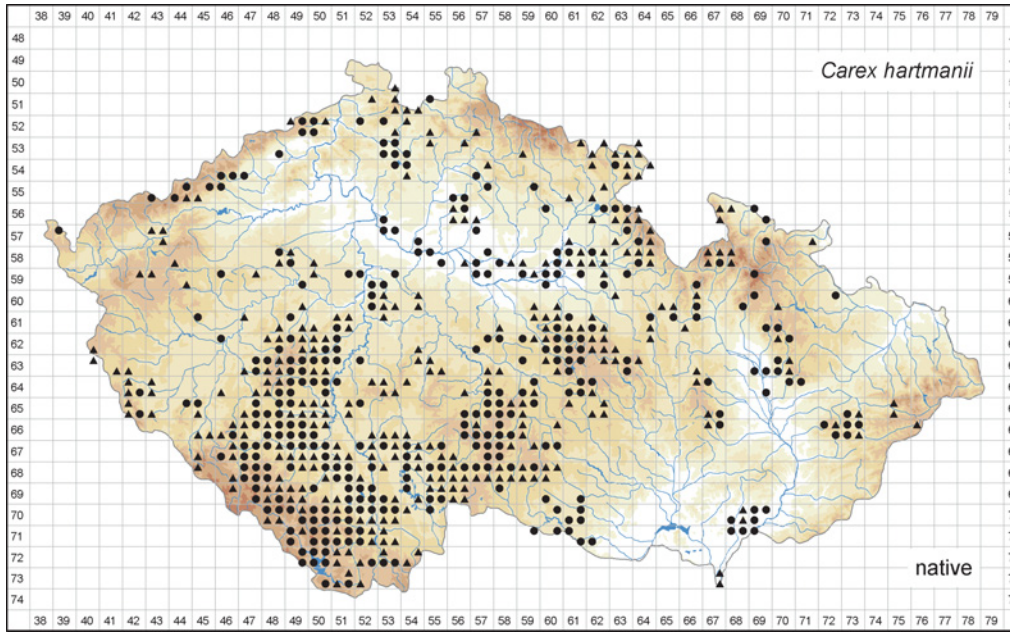

Fig. 11. – Distribution of *Carex hartmanii* in the Czech Republic: ● occurrence documented by herbarium specimens (314 quadrants), ▲ occurrence based on other records (317 quadrants). Prepared by Vít Grulich & Radomír Řepka.

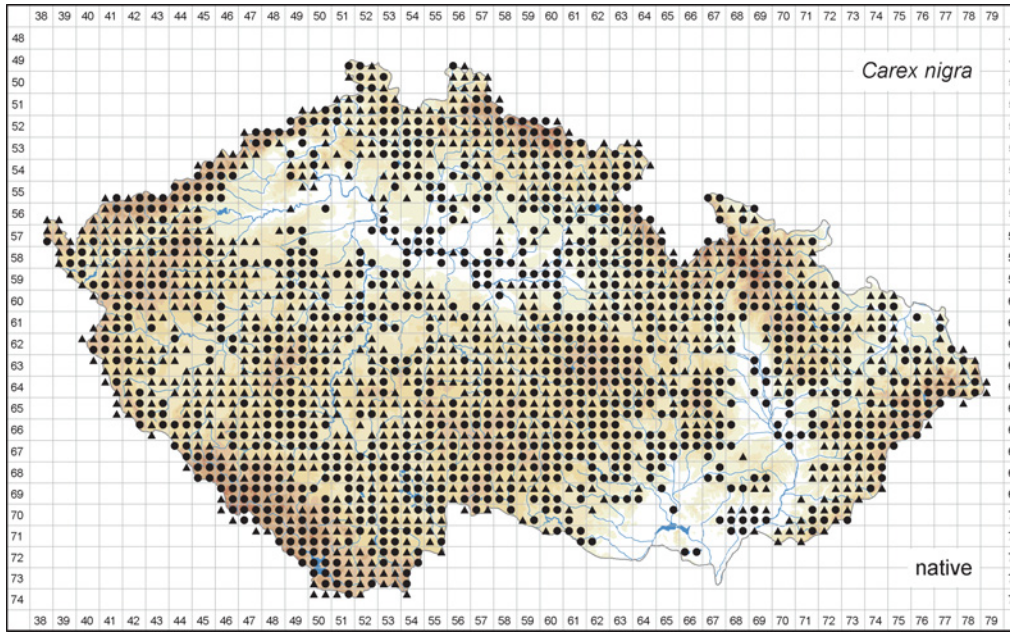

Fig. 12. – Distribution of *Carex nigra* in the Czech Republic: ● occurrence documented by herbarium specimens (972 quadrants), ▲ occurrence based on other records (923 quadrants). Prepared by Vít Grulich & Radomír Řepka.

almost continuously distributed in south-western and southern Bohemia and throughout the Českomoravská vrchovina highlands; many populations are also known from the surroundings of the towns of Doksy and Česká Lípa in northern Bohemia. *Carex hartmanii* is scattered elsewhere in Bohemia and Moravia, while it is rare and very local in the Carpathians. It reaches its maximum elevation at 1000 m in the Krušné hory Mts.

Carex nigra (Fig. 12)

Carex nigra grows almost all over Europe and is rare only in the Mediterranean area, where it is found mostly in the mountains. It extends northwards to Iceland. Outside Europe it was recorded in the mountains of Morocco, Turkey and Iran, and is distributed continuously from eastern Europe to the Yenisei river basin in western Siberia. It also grows in the eastern part of North America and in southern Greenland (Hultén & Fries 1986). Its ecological range is very wide and in the Czech Republic this species inhabits moist to wet meadows, fens, mires, bogs, littoral vegetation of water reservoirs, springs, bog and waterlogged spruce and pine forests and alder carrs. It grows most often in low-growing vegetation in sunny places where the ground water level reaches close to the soil surface, on soils with acidic or neutral pH, and rarely occurs in calcareous fens. *Carex nigra* is found throughout almost all of the Czech Republic but is rare in dry areas with predominantly basic substrates. In this country it is abundant almost everywhere at middle and high elevations, in the mountains usually ascending to the highest summits, and reaching its elevational maximum at 1500 m in the Krkonoše Mts. It is absent from the dry and warm lowlands of southern Moravia, and from the central part of northern Bohemia, while other gaps on the map are more likely due to a lack of records. *Carex nigra*, however, is absent from landscapes strongly modified by coal mining or intensive agriculture. In central Europe, *C. nigra* exhibits a high morphological variation, which may have been caused by recurrent hybridization with other species of *C.* sect. *Acutae* and enormous phenotypic plasticity (Košnar et al. 2012).

Carex ×*elytroides* (Fig. 13)

Carex ×*elytroides*, a hybrid between *C. acuta* and *C. nigra*, is reported from western and northern Europe, and in central Europe it is known from the Czech Republic and Austria (Koopman 2011). It is also reported from Russia (Papchenkov 2006). Its distribution in the Czech Republic nearly coincides with the areas where its parent species most frequently co-occur. It is scattered in southern Bohemia and the Českomoravská vrchovina highlands, and there are numerous records also from the eastern part of the Labe river basin and from the surroundings of the cities of Brno and Olomouc. Both sterile and fertile plants that combine characters of both parent species have been included in the map. Because the plants are difficult to identify, only records supported by herbarium specimens were accepted.

Carex ×*vratislaviensis* (Fig. 14)

This hybrid between *C. acuta* × *C. buekii* is reported to occur in Poland, Germany, the Czech Republic, Slovakia, Austria, Hungary and Italy (Koopman 2011). The distribution of *C.* ×*vratislaviensis* in the Czech Republic mainly coincides with that of *C. buekii*, i.e. it

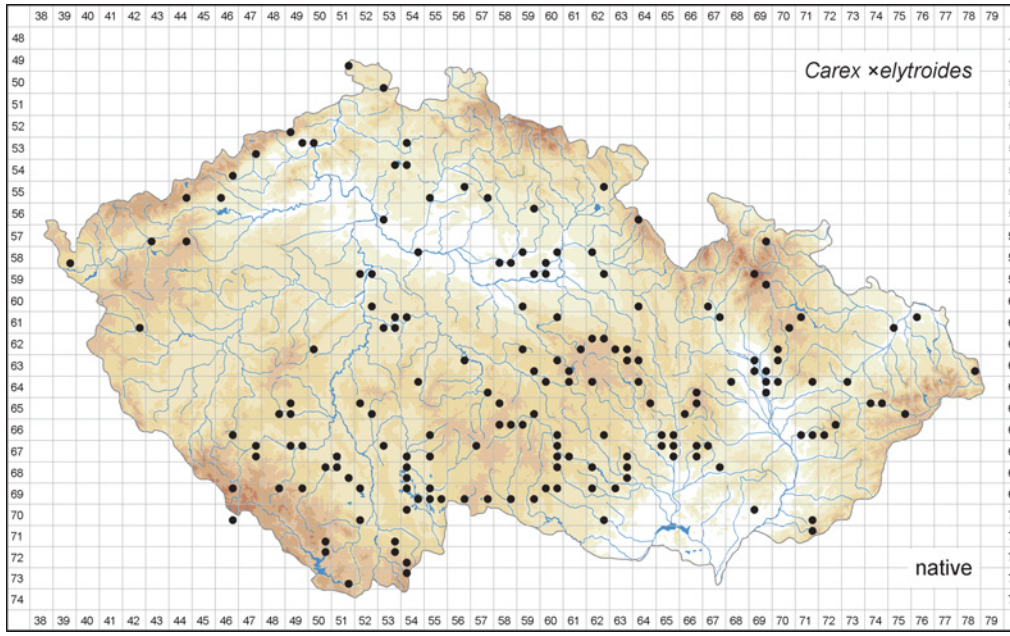

Fig. 13. – Distribution of *Carex* ×*elytroides* in the Czech Republic (170 occupied quadrants). Prepared by Radomír Řepka & Vít Grulich.

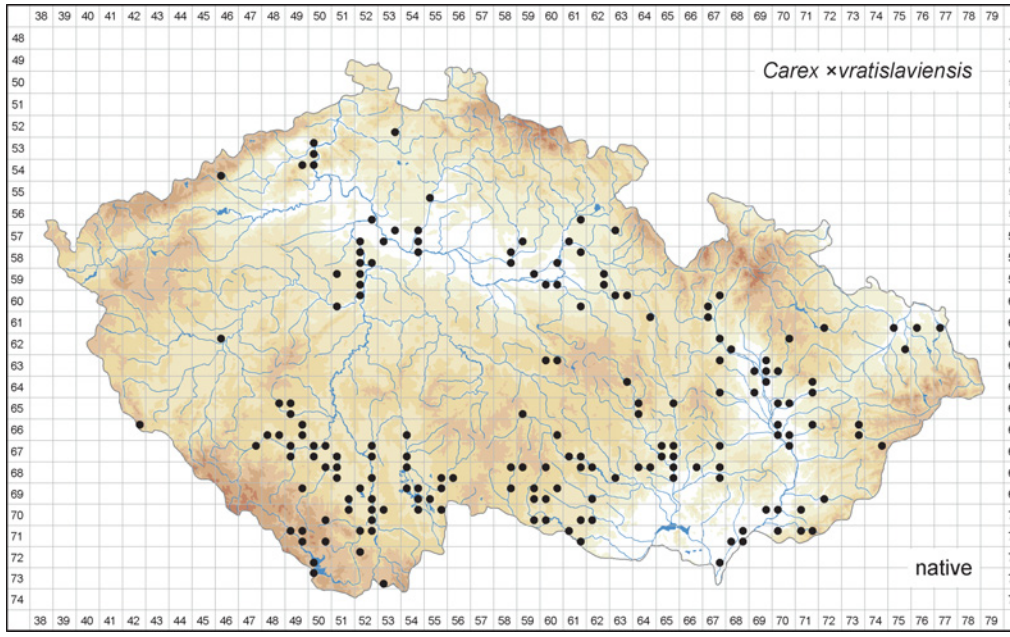

Fig. 14. – Distribution of *Carex* ×*vratislaviensis* in the Czech Republic (174 occupied quadrants). Prepared by Radomír Řepka & Vít Grulich.

grows on river banks and in floodplains. However, in southern Bohemia and south-western Moravia this hybrid is found also outside floodplains, occurring on the shores of fishponds and in adjacent marshes. These localities are situated at distances of 3–10(–19) km from rivers. These plants, which are fully fertile, are very probably introgressants of *C. acuta*, reproducing generatively (Koopman et al. 2018). In contrast, we have found many populations of apparently pure *C. buekii* in the Czech Republic that bear mostly empty utricles, with fertile ones found only at the base of the lower female spike. Besides their partial sterility these plants do not exhibit any characters of *C. acuta* nor do they resemble the intermediate morphotype of *C.* ×*vratislaviensis*. The examined specimens of this hybrid as circumscribed here include approx. 35% of intermediate plants, 5–10% of plants closer to *C. buekii* and approx. 55% of plants closer to *C. acuta*. Because of the identification difficulties, only data from examined herbarium specimens have been included in the map.

Centaurea benedicta (Fig. 15)

The native distribution of *Centaurea benedicta* extends from the Mediterranean area across Anatolia and Iran eastwards to Pakistan and Kazakhstan (Meusel & Jäger 1992). Secondary occurrences are known from most European countries except in northern Europe (Greuter 2006), and from North and South America and Japan (Keil & Ochsmann 2006, GCW 2017). In the Czech Republic *C. benedicta* used to be cultivated as a medicinal plant in gardens or as a field crop, which sometimes escaped to roadsides and similar habitats neighbouring fields or persisted at sites a few years after cultivation. Nowadays it is only very rarely cultivated in gardens but might be found introduced along railways (two of three records over the last 50 years). *Centaurea benedicta* is classified as a casual archaeophyte (Pyšek et al. 2012).

Centaurea bruguiereana subsp. *belangeriana* (Fig. 15)

Centaurea bruguiereana is a Central Asian species occurring from eastern Turkey to Pakistan, southwards to Saudi Arabia and northwards to northern Turkmenistan and southern Uzbekistan (Czerepanov 1963, Wagenitz 1975, Mandeville 1990). In its native range it occurs in open vegetation in both natural (semi-deserts, stony or loess slopes and sandy places) and man-made habitats (e.g. roadsides). Two subspecies are recognized: subsp. *bruguiereana* occurring in the western part and subsp. *belangeriana* occurring in the eastern part of this species range. The border of the subspecies' distributions runs through Armenia and Iran. In 1974, eight individuals of *C. bruguiereana* subsp. *belangeriana* were found in the port on the Labe river in the town of Lovosice in northern Bohemia. They occurred there near a warehouse where oil-plant seed was stored, suggesting that they were probably introduced with flax seed from Afghanistan (Jehlík 2013). It is the only record of this taxon in central Europe. The only other European record comes from Cardiff in Wales (Clement & Foster 1994). In the Czech Republic this taxon is classified as a casual neophyte but is absent from the current species lists (Danihelka et al. 2012, Pyšek et al. 2012) because the record remained unpublished and the two herbarium sheets (despite being correctly identified) have been unavailable among unsorted materials of the collector until recently.

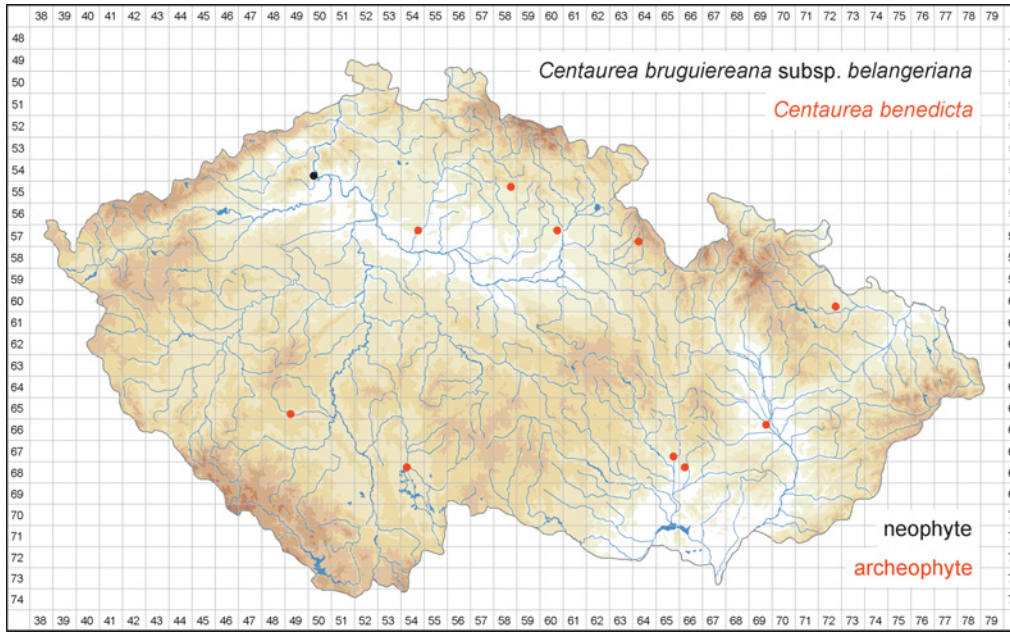

Fig. 15. – Distribution of *Centaurea benedicta* (10 occupied quadrants) and *C. bruguiereana* subsp. *belangeriana* (1 occupied quadrant) in the Czech Republic. Prepared by Petr Koutecký.

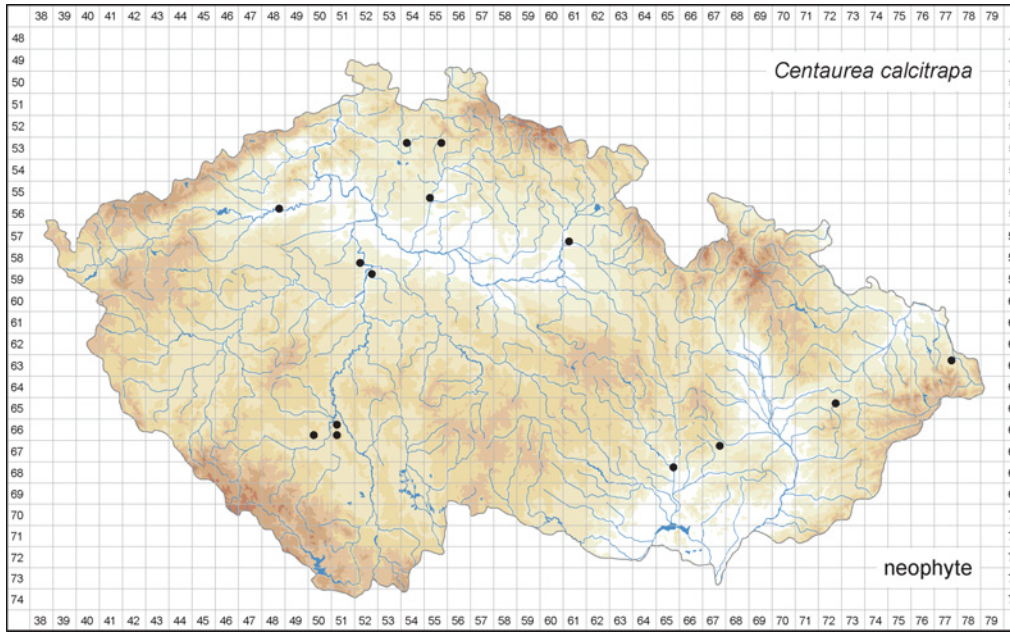

Fig. 16. – Distribution of *Centaurea calcitrapa* in the Czech Republic (14 occupied quadrants). Prepared by Petr Koutecký.

Centaurea calcitrapa (Fig. 16)

Centaurea calcitrapa is native to the Mediterranean area (but there are doubts about its indigenous status in its easternmost part) and perhaps also Macaronesia. It has been introduced to western and central Europe (northernmost records in the British Isles and southern Scandinavia), and to North and South America, eastern Asia, Australia and New Zealand (Meusel & Jäger 1992, Greuter et al. 2006, DAISIE 2017, GCW 2017). In the Czech Republic it has been recorded since the second half of the 19th century in ruderal habitats or as a weed, often in alfalfa fields. The occurrences in crop fields ceased in the first half of the 20th century, probably due to changes in agricultural practices and sources of alfalfa seed. Records since the 1950s come from railway stations, iron-ore storage yards near the town of Třinec in Silesia, and fields and gardens fertilized by waste from imported sheep wool. This species is classified as a casual neophyte (Pyšek et al. 2012).

Centaurea cyanus (Fig. 17)

This is one of the iconic weeds of central-European cereal fields. *Centaurea cyanus* is probably native to the Mediterranean area but at present it is impossible to delimit its native distribution with certainty. It started to spread already with early agriculture, at least in southern Europe and south-western Asia. However, in central and western Europe, its history is surprisingly recent. Pollen grains of *Centaurea cyanus*-type (which might, however, belong to other related species) are known from steppic vegetation in the late Pleistocene or early Holocene but then there is a long phase of absence or extreme rarity of this species, followed by massive spread as late as in the Early Middle Ages; a similar pattern is shown by macrofossils (Bakels 2012, Pokorná et al. 2018). Nowadays, *C. cyanus* occurs across Europe including Scandinavia, and in the temperate part of western and central Siberia. As an adventive it has been recorded also from eastern Asia, North and South America, southern Africa, Australia and New Zealand (Meusel & Jäger 1992). In the Czech Republic it is classified as an archaeophyte (Pyšek et al. 2012). Most often it occurs as a weed of cereals, less often also of other crops, such as oilseed rape. It can appear on fallows from the soil seed bank formed in previous years when cereals were planted at a site. It also sometimes occurs in ruderal vegetation such as roadsides, railways or waste places in villages, and on exposed sandy bottoms of fishponds where it is introduced with grain used for fish feeding. Its cultivars with large sterile florets are rarely cultivated as ornamentals and may escape from cultivation. *Centaurea cyanus* occurs across the Czech Republic except for the mountains along the country's border. It usually occurs at elevations below 650 m a.s.l., but rarely may be found even above 800 m a.s.l. This species was very common until the 1950s, then it declined due to improved methods of seed cleaning and use of herbicides and fertilizers, but its populations have restored in the last three decades. Now it is therefore not classified as threatened (Grulich 2012). Most of the gaps on the map are due to under-recording. However, the scarcity of data for warm areas in the northern half of Bohemia and southern Moravia may reflect this species' actual state there, which is probably caused partly by climatic and soil conditions and partly by slower recovery of the populations due to intensive agriculture and growing of crops not suitable for this species.

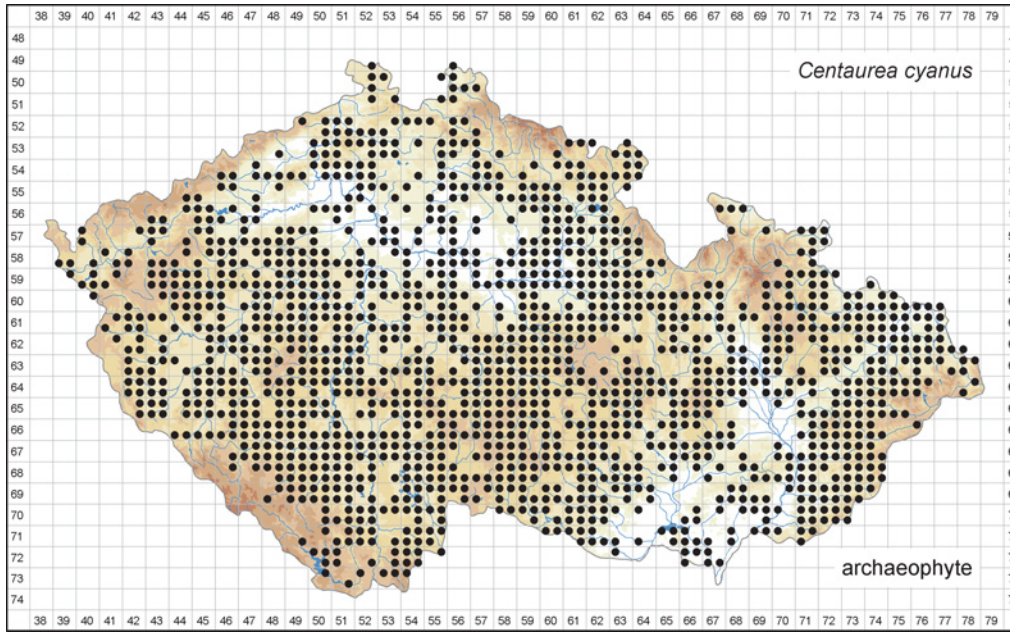

Fig. 17. – Distribution of *Centaurea cyanus* in the Czech Republic (1500 occupied quadrants). Prepared by Petr Koutecký.

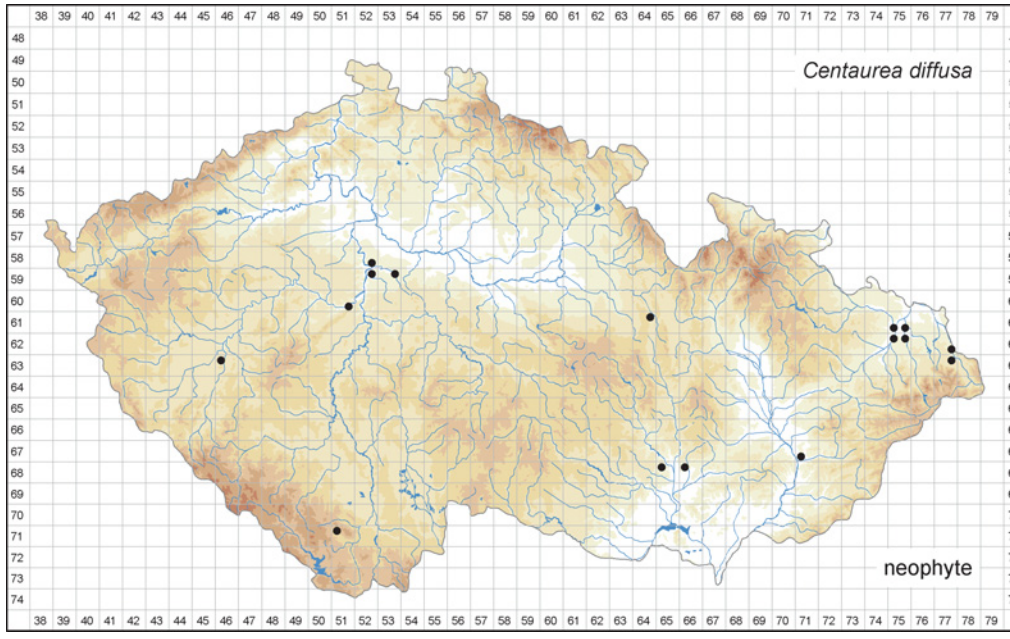

Fig. 18. – Distribution of *Centaurea diffusa* in the Czech Republic (16 occupied quadrants). Prepared by Petr Koutecký & Patrik Mráz.

Centaurea diffusa (Fig. 18)

Centaurea diffusa is native to the south-eastern Europe and south-western Asia. Its range extends from Greece along the northern coast of the Black Sea eastwards to the Volgograd area and the western coast of the Caspian Sea, with a few localities in Anatolia and Transcaucasia (Meusel & Jäger 1992). Secondary occurrences are reported from most of the other European countries (e.g. Greuter 2006), Asia (Kazakhstan, southern Siberia, China; Zhirova 1997, Shi & Martins 2011), and also North America, where it is highly invasive (e.g. Sheley et al. 1998, LeJeune & Seastedt 2000). In its native range *C. diffusa* is confined to open vegetation on dry and disturbed habitats (steppes, dry pastures, sands, roadsides, railways). In the Czech Republic about 25 localities of *C. diffusa* have been documented so far. The first finds date back to the mid-1940s. About half of the records, both the earliest and the recent ones, are from railways and main roads. At least five different sites were documented in the 1950s–1970s from iron-ore storage yards in the city of Ostrava in northern Moravia and in the town of Třinec in Silesia, where iron ore from Ukraine was processed at the time. The remaining localities include various ruderal sites. For some of them there is no obvious mode of introduction. Interestingly, this is also true for one of the earliest (1947) records from the Czech Republic, where this species was found in a crop field near the village of Chvalšiny in southern Bohemia, which is quite remote from big towns and main transportation routes. Most populations are ephemeral but at two sites this species has been recorded repeatedly over 15 years (not considering the localities in iron-ore storage yards where multiple introductions are likely). Therefore, *C. diffusa* has been classified as a naturalized neophyte (Pyšek et al. 2012).

Two ploidy levels, diploid (2n = 18 and aneuploids 2n = 16) and tetraploid (2n = 36), have been reported for this species (e.g. Ochsmann 2000, Bancheva & Greilhuber 2006). However, the vast majority of the counts are diploid. The only two tetraploid and two aneuploid counts might be counting or identification mistakes and need confirmation. At sites where the diploid cytotypes of *C. diffusa* and *C. stoebe* co-occur, they frequently form a hybrid *C.* ×*varnensis* (see below), which has been the case in the Czech Republic.

Centaurea macrocephala (Fig. 19)

Centaurea macrocephala is native to the southern and eastern Caucasus Mts and to the Lesser Caucasus Mts in easternmost Turkey, Georgia, Armenia and Azerbaijan where it grows in tall-herb communities in the upper montane and subalpine belts (Sosnovskii 1963, Wagenitz 1975). It is sometimes cultivated as an ornamental. In Europe it is rarely recorded as escaping from cultivation (UK, Finland, Denmark; Stace 2010, GCW 2017). It has been introduced to North America (Keil & Ochsmann 2006). In the Czech Republic this species is rarely planted, and most of the available records relate to cultivated individuals or plants that obviously persisted in abandoned gardens (as a stout, long-lived perennial it may survive for many years); these records are not mapped. However, there are at least three records of occurrences of *C. macrocephala* outside of gardens: an abandoned field close to the town of Třebíč (1954), a ruderalized forest fringe near the village of Henčov near the city of Jihlava (1958) and restored meadows in Podyjí National Park, where it was probably introduced with meadow plant seed (2007). This species is classified as a casual neophyte (Pyšek et al. 2012).

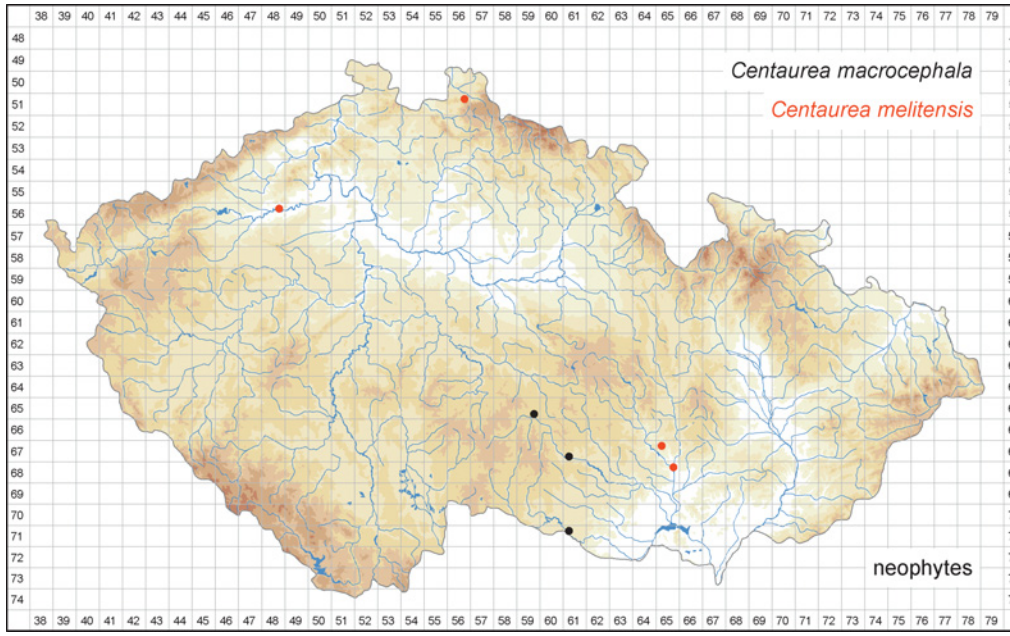

Fig. 19. – Distribution of *Centaurea macrocephala* (3 occupied quadrants) and *C. melitensis* (4 occupied quadrants) in the Czech Republic. Prepared by Petr Koutecký.

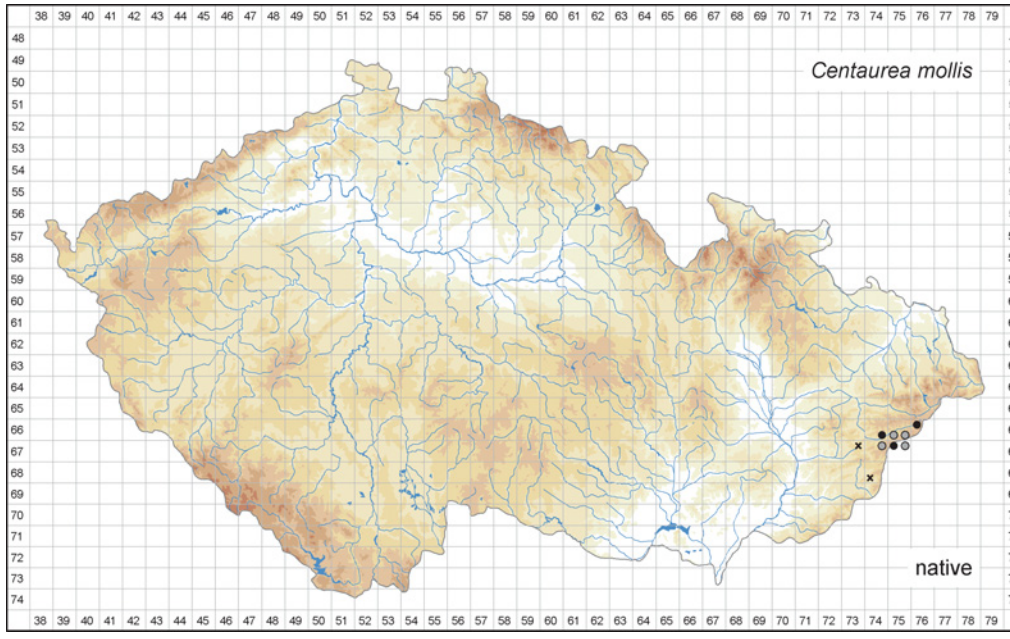

Fig. 20. – Distribution of *Centaurea mollis* in the Czech Republic: ● at least one record in 2000–2018 (3 quadrants), ◍ pre-2000 records only (4 quadrants), × alien (2 quadrants). Prepared by Petr Koutecký.

Centaurea melitensis (Fig. 19)

Centaurea melitensis is native to the most of the Mediterranean area, but no further east than Greece and Egypt (Dostál 1976, Greuter 2006). It occurs as an introduced species in all areas of the Mediterranean-type climate in North and South America, southern Africa, Australia and New Zealand, and rarely is it found elsewhere in the world (GCW 2017). In North and South America it is highly invasive (e.g. Moroney & Rundel 2013). In Europe it has been introduced to most of the western- and central-European countries, Scandinavia, the Azores and the Canary Islands (Greuter 2006). There are only four records from the Czech Republic. In contrast with other spiny Mediterranean *Centaurea* species (*C. calcitrapa*, *C. solstitialis*), it was found only once as a weed in a crop field. All other occurrences were at places where waste from cleaning of foreign sheep wool was deposited or that were fertilized with such material. This species is classified as a casual neophyte (Pyšek et al. 2012).

Centaurea montana agg.
Centaurea mollis (Fig. 20) and *C. montana* s. str. (Fig. 21)

The *Centaurea montana* group includes two or three taxa, which are often treated as subspecies of the broadly defined *C. montana*. However, using crossing experiments, Olšavská & Löser (2013) have demonstrated that *C. montana* s. str. (= *C. montana* subsp. *montana*) and *C. mollis* (= *C. montana* subsp. *mollis*) are reproductively well isolated. These two taxa also differ by ca. 11% in genome size (Olšavská et al. 2013). Together with their allopatric distributions and subtle but constant morphological differences, these facts provide a firm basis for recognizing them as distinct species. For the third taxon of the group, *C. maramarosiensis* from the Eastern Carpathians (Ukraine, Romania), detailed information is missing and the level of its distinctiveness from *C. mollis* is not clear.

Centaurea montana s. str. occurs mainly in the Alps. It is native also to the Pyrenees and adjacent mountains of north-eastern Spain, several mountain areas north of the Alps from the Massif Central in France to the Harz Mts in Germany, the southernmost part of the Šumava / Böhmerwald Mts and their foothills in Austria and the Czech Republic, and also the Apennines and mountains of the northern part of the Balkan Peninsula, occurring rarely in both these areas (Dostál 1976, Meusel & Jäger 1992). It is often cultivated as an ornamental and sometimes escapes from cultivation. Secondary occurrences are known from most European countries, including Iceland, as well as from North America, Australia and New Zealand (Keil & Ochsmann 2006, GCW 2017). In its native range it occurs in various types of mountain forests, *Pinus mugo* scrub, tall-forb communities and mountain meadows, often but not exclusively on calcareous bedrock. In the Czech Republic it is native only to the southern part. In the south-eastern part of the Šumava Mts and their foothills it occurs on banks of watercourses, in ravine forests and forest fringes as well as at similar sites in secondary forests (e.g. pine plantations and hazel scrub). Outside the Šumava Mts it occurs as a native downstream on banks of the Vltava and Malše rivers, reaching northwards as far as the city of České Budějovice. Additionally, a former site about 50 km more to the north of this city, on the bank of the Vltava river opposite the village and castle of Orlík nad Vltavou, which is now flooded by a river dam, might also have represented a native occurrence. All other occurrences in the Czech Republic are

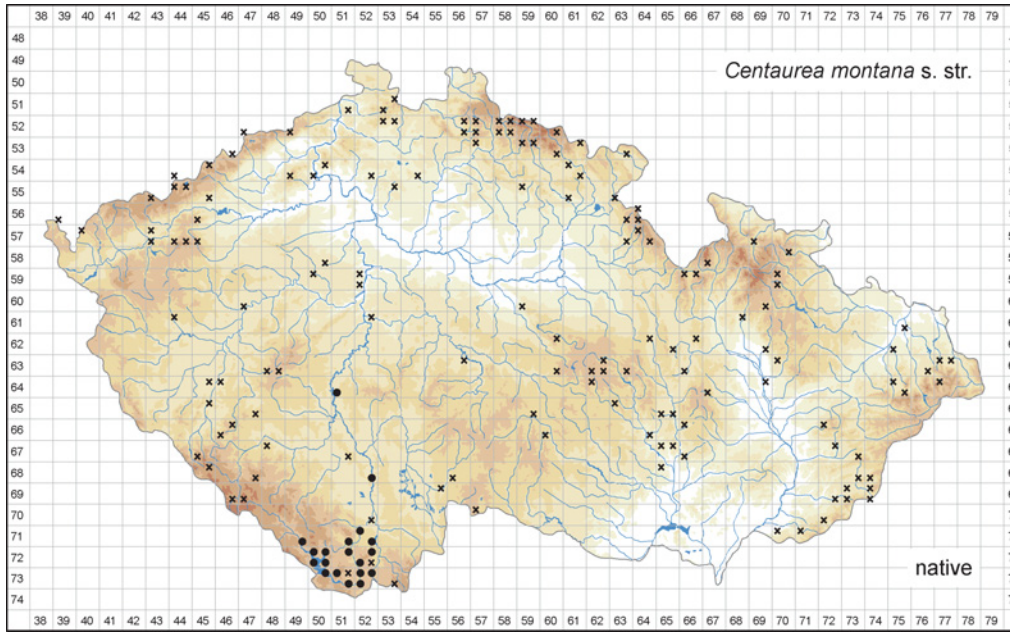

Fig. 21. – Distribution of *Centaurea montana* s. str. in the Czech Republic: ● native (19 quadrants), × alien (143 quadrants). Prepared by Petr Koutecký.

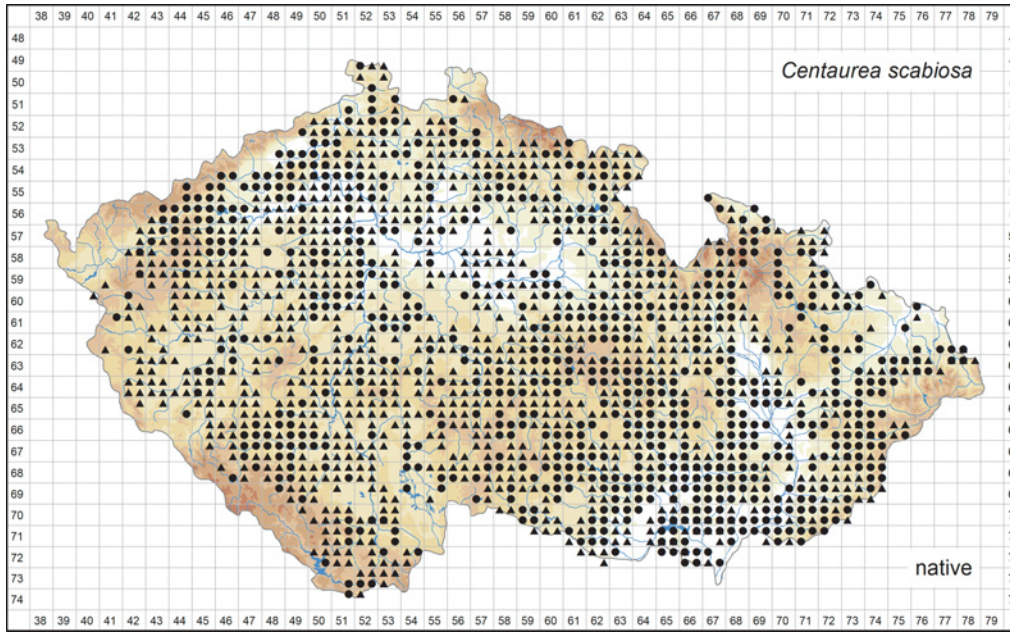

Fig. 22. – Distribution of *Centaurea scabiosa* in the Czech Republic: ● occurrence documented by herbarium specimens (708 quadrants), ▲ occurrence based on other records (913 quadrants). Prepared by Petr Koutecký.

certainly secondary; these include various habitats (waste places, road ditches) in villages and towns as well as (semi-)natural habitats such as wet meadows, forest fringes and banks of watercourses. This species spreads with garden waste easily and may also survive in abandoned gardens for many years. Because of their rarity, the native populations of *C. montana* are classified as endangered (Grulich 2012). The map is based on herbarium specimens, the literature and data from databases. Non-herbarium records of *C. montana* s. l. (not specifying "s. str." or the subsp. *montana*) were mostly interpreted as *C. montana* s. str., since the other taxon of the group (*C. mollis*) is only exceptionally planted and because it is a very rare plant, it would be properly designated by most authors.

Centaurea mollis occurs throughout the Carpathians (but rarely in the Southern Carpathians) and in the northern Dinarids, where it grows in similar vegetation types as *C. montana* s. str. in the Alps. It prefers calcareous bedrock (Dostál 1976, Meusel & Jäger 1992). In the Czech Republic it occurs only in the Javorníky Mts on the Czech-Slovak border where it reaches its north-western distribution limit. There it grows in mountain meadows, pastures and forest fringes on mountain ridges. Most of its populations are now extinct due to abandonment of meadows or their conversion to spruce plantations. Only one larger and one very small meadow populations remain on the Czech side of the mountains. Additionally, the largest population in the area known since the 19th century is still extant; however, its site, despite often being referred to in the literature and on herbarium labels as near the village of Velké Karlovice in the Czech Republic, is in fact in Slovakia, across the border from this Czech village. A few small colonies of *C. mollis* (each might be a single clone spread due to vegetative growth of creeping rhizomes) have recently been found in the valleys along small brooks; they might represent natural occurrences or might be remnants of former cultivation. Although this species is only exceptionally cultivated (unlike the related *C. montana* s. str.), there are at least two cases of escapes from cultivation documented by herbarium specimens; both come from an area neighbouring the species' native distribution. *Centaurea mollis* is classified as critically threatened because of its rarity and decline (Grulich 2012).

Centaurea scabiosa (Fig. 22)

The *Centaurea scabiosa* group is a complex of more than ten taxa whose exact distribution as well as morphological delimitation, chromosome numbers, genetic variation and phylogenetic relationships are poorly known. Most of the taxa occur in southern Europe. Among them, only *C. scabiosa* s. str. (= *C. scabiosa* subsp. *scabiosa*) occurs in the Czech Republic. It is widespread throughout Europe except for its Mediterranean part and the extreme north. Eastwards it reaches Lake Baikal in eastern Siberia (Meusel & Jäger 1992). It has been introduced to eastern Asia, North America, Australia and New Zealand (Hultén & Fries 1986, Keil & Ochsmann 2006, GCW 2017). In the Czech Republic it grows in various types of dry to mesophilous grasslands and pastures, forest fringes, scrub, and in open oak or pine forests on steep rocky slopes or serpentines. In the past, it has also occurred as a weed in crop fields. It is also found along roads and railways and on waste ground. *Centaurea scabiosa* is scattered to common in the Czech Republic at low and middle elevations up to ca. 800 m; exceptionally it was found as an introduced population near a mountain chalet on Mt Králický Sněžník at 1380 m a.s.l.

Centaurea solstitialis (Fig. 23)

Centaurea solstitialis is native to most of the European Mediterranean area (except for most of Spain), the Pannonian Basin (northwards to Hungary), south-western Ukraine, Crimea, Transcaucasia, Anatolia and Iran, and it rarely occurs also in northern Africa and central Asia (Meusel & Jäger 1992). Three endemic subspecies are recognized, one in northern Africa, Sicily and Sardinia, and two in Anatolia. The subsp. *solstitialis* occurs throughout the range of this species. Other taxa often recognized in older literature, such as the subsp. *adamii*, probably do not merit recognition at a level higher than variety within the type subspecies (Wagenitz 1975). *Centaurea solstitialis* subsp. *solstitialis* has been introduced to most European countries, in the north reaching southern Scandinavia (Dostál 1976, Meusel & Jäger 1992, Greuter 2006), and to North America, South America, southern Africa, Australia and New Zealand (GCW 2017). In western North America it is recognized as one of the most noxious plant invaders (DiTomaso 2000). In the Czech Republic the distribution and dynamics of *C. solstitialis* is similar to another spiny *Centaurea* species of Mediterranean origin, *C. calcitrapa*, but *C. solstitialis* is by far more frequent. This species has been recorded since the first half of 19th century. It used to occur as a weed of alfalfa and clover fields, less often also in various ruderal habitats such as roadsides, waste places and railway embankments. Most of these finds were in the lowlands of southern Moravia and central and north-western Bohemia with some individual records from higher elevations but none from the mountains. After World War II, the number of records strongly declined and this species has not been found as a weed anymore, probably due to changes in agricultural practices and seed sources. *Centaurea solstitialis* has since the mid-20th century been recorded along railways, on deposits of waste from imported sheep wool cleaning and in places fertilized with such material, rarely also in other ruderal habitats and in storage yards for ironworks in the city of Ostrava in north-eastern Moravia, where iron ore from Ukraine was processed. Over the last 40 years, this species has been found only at a single locality (observed 2013–2016 there). *Centaurea solstitialis* is classified as a casual neophyte (Pyšek et al. 2012).

Centaurea stoebe (Figs 24–26)

The native range of *Centaurea stoebe* extends throughout most of temperate Europe: from France in the west to Russia in the east (reaching westernmost Siberia) and from Poland and the Baltic countries in the north to northern Italy and Greece in the south (Meusel & Jäger 1992, Ochsmann 2000). Adventive occurrences are known from the United Kingdom and Scandinavia (Greuter 2006, Tyler 1999). This species has also been introduced to North America, the Russian Far East and Australia (e.g. Mráz et al. 2011).

There are two cytotypes of *C. stoebe*, a diploid and a tetraploid one, which are reproductively isolated and differ in their life forms, several morphological traits, distributions and habitat preferences (Mráz et al. 2012b). These between-cytotype differences have likely been driven by hybrid origin of the tetraploid cytotype, which originated from crosses between the diploid cytotype of *C. stoebe* and an as-yet unknown taxon (Mráz et al. 2012a). These combined lines of evidence strongly support distinct taxonomic status for both cytotypes. Although in such a situation specific rank would be more appropriate (Mráz et al. 2011), in this study we have adopted the subspecies concept mostly for practical reasons. These include: (i) the overlapping pattern of morphological variation preventing

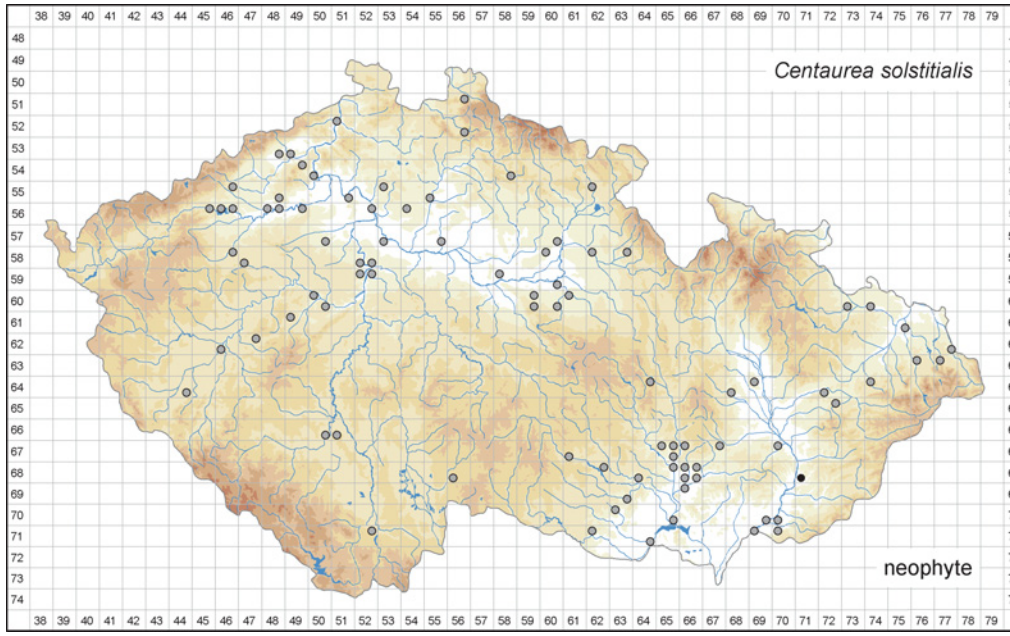

Fig. 23. – Distribution of *Centaurea solstitalis* in the Czech Republic: ● at least one record in 2000–2018 (1 quadrant), ◍ pre-2000 records only (87 quadrants). Prepared by Petr Koutecký.

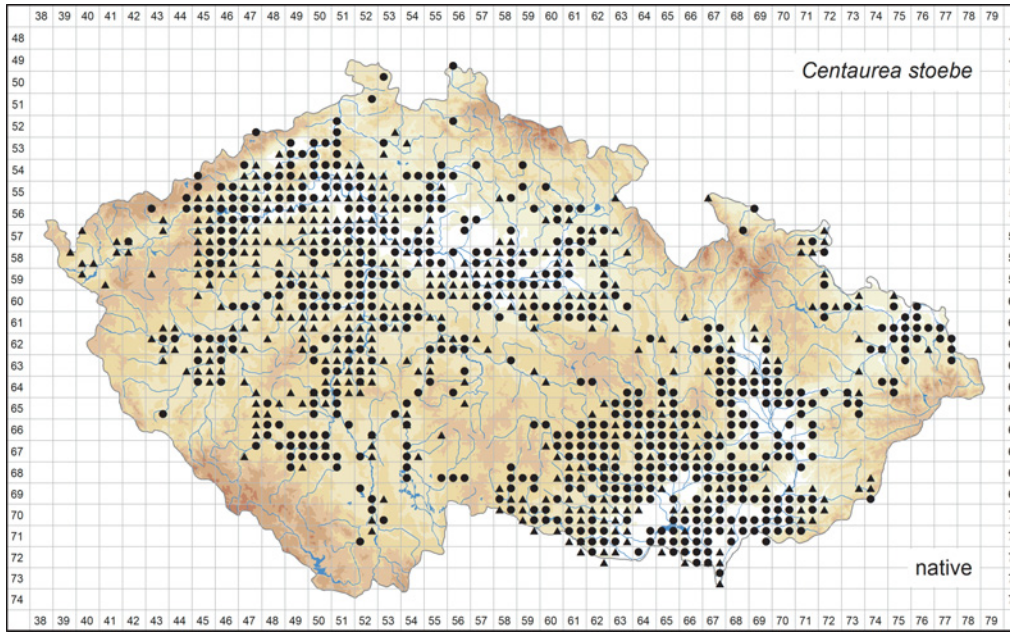

Fig. 24. – Distribution of *Centaurea stoebe* in the Czech Republic: ● occurrence documented by herbarium specimens (384 quadrants), ▲ occurrence based on other records (569 quadrants). Prepared by Petr Koutecký & Patrik Mráz.

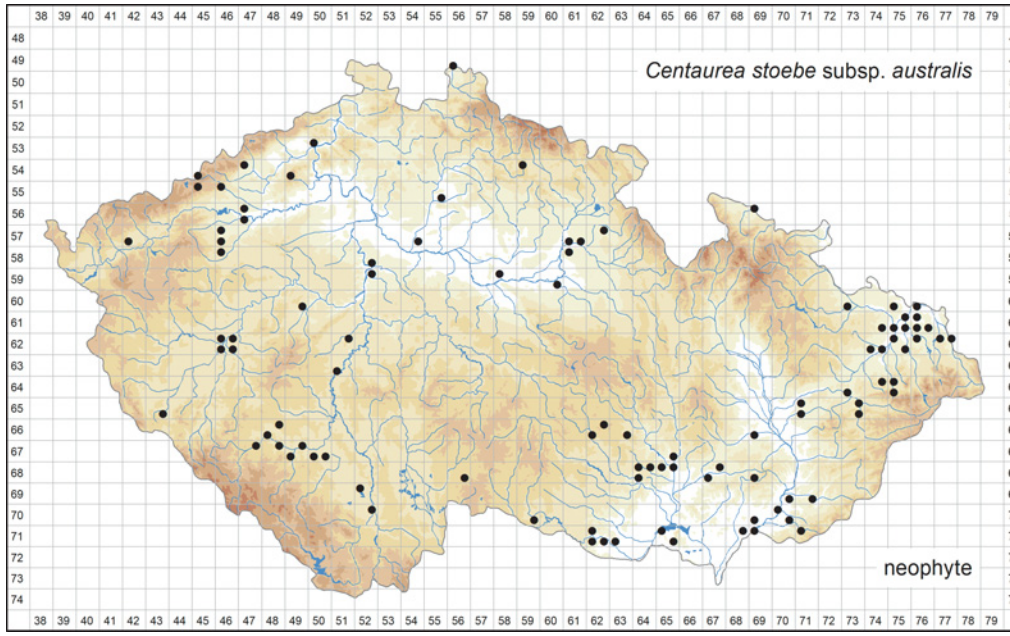

Fig. 25. – Distribution of *Centaurea stoebe* subsp. *australis* in the Czech Republic (97 occupied quadrants). Prepared by Petr Koutecký & Patrik Mráz.

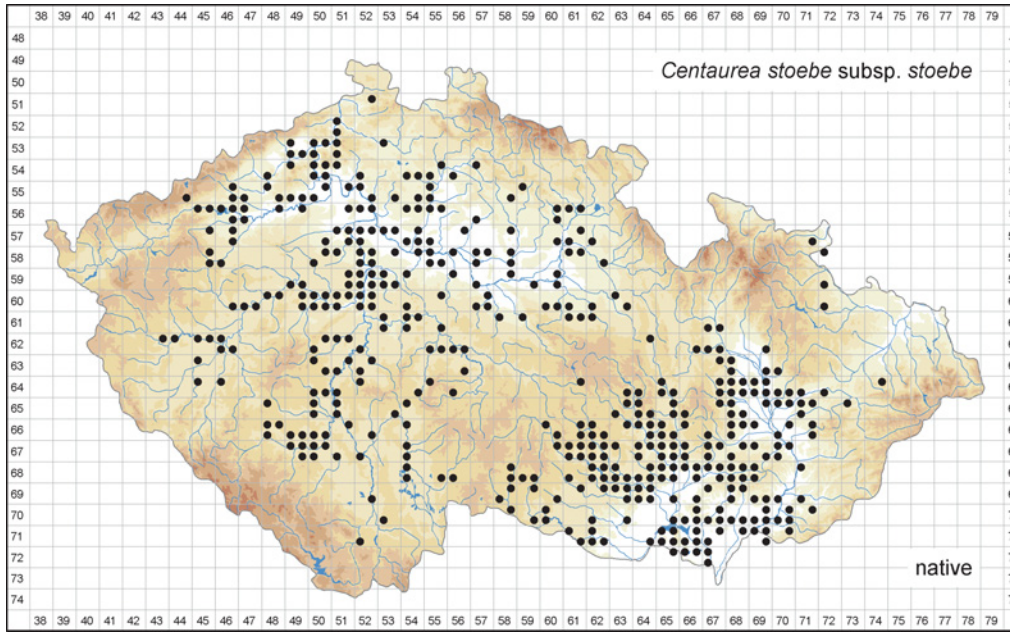

Fig. 26. – Distribution of *Centaurea stoebe* subsp. *stoebe* in the Czech Republic (448 occupied quadrants). Prepared by Petr Koutecký & Patrik Mráz.

reliable discrimination between the cytotypes in all situations; (ii) nomenclatural issues outlined by Mráz et al. (2011); and (iii) the frequent use of subspecies treatment in current taxonomic literature (e.g. Fischer et al. 2008, Jäger 2011).

Diploid *C. stoebe* subsp. *stoebe* (2n = 18) occurs throughout the native range of this species, being only rarely introduced elsewhere (Kazakhstan, eastern Siberia and the Russian Far East, all as *C. pseudomaculosa*; Probatova et al. 2013). Though the diploid cytotype has been reported from North America (Treier et al. 2009), these records are with high probability erroneous (confusion with *C.* ×*varnensis* or *C. diffusa*, see Mráz et al. 2011). In the Czech Republic this subspecies is scattered to common in the lowlands and at middle elevations up to about 600 m a.s.l. It grows in various types of natural and seminatural habitats, such as dry grasslands, forest fringes, old fallows, rocky ledges and open vegetation on sand. However, especially in areas of frequent occurrence, it may also colonize man-made habitats, such as roadsides, railways or stone quarries (Otisková et al. 2014).

The native occurrence of the tetraploid (2n = 36) *C. stoebe* subsp. *australis* is probably confined to the southern half of the species' European distribution (Ochsmann 2000). As an adventive taxon, this subspecies occurs throughout Europe and is invasive in North America (Mráz et al. 2011, Broennimann et al. 2014), where it ranks among the most noxious invasive plants (e.g. Sheley et al. 1998, DiTomaso 2000; from the introduced range it is often reported as *C. stoebe* subsp. *micranthos* or incorrectly as *C. maculosa*). It is scattered in the Czech Republic, being found mainly in man-made habitats, especially along railways, less frequently also on roadsides (highways including) and in stone quarries (Otisková et al. 2014). The tetraploid subspecies has rarely been reported from seminatural vegetation such as dry grasslands and sandy areas in southernmost Moravia. This taxon has been spreading as a neophyte in the Czech Republic. Although most of the records come from the last ~50 years, the spread started earlier as the first herbarium specimens date back to second half of the 19th century.

Three maps were prepared for *Centaurea stoebe*. The maps of the subspecies are based only on examined herbarium specimens, our own field records and ploidy level records based on flow cytometry (Otisková et al. 2014 and our own unpublished measurements). These maps are inevitably incomplete. The map of this species comprises all data accepted for the subspecies, herbarium specimens indeterminable to the subspecies level and selected literature and database records that conform to this species' ecological demands and distribution.

Centaurea stoebe hybridizes with several *Centaurea* taxa. With its closest relative in the Czech flora, *C. diffusa*, it forms a fertile hybrid *C.* ×*varnensis* (see below). Hybrids with C. *jacea* (*C.* ×*beckiana*) and *C. oxylepis* (*C.* ×*kupcsokiana*) are found in mixed populations of the parental species but are very rare and sterile. The other reported hybrid combinations, such as *C. scabiosa* × *C. stoebe* (*C.* ×*grabowskiana*) were not confirmed in the studied material; all herbarium specimens determined as such by their collectors turned out to be atypical individuals of *C. stoebe*.

Centaurea triumfetti agg. (Fig. 27)

The taxonomically critical *C. triumfetti* group comprises about 15 taxa recognized at the species and/or subspecies levels. However, due to morphological, ecological (Olšavská et al. 2011) and genome size differences (Olšavská et al. 2013) as well as breeding barriers

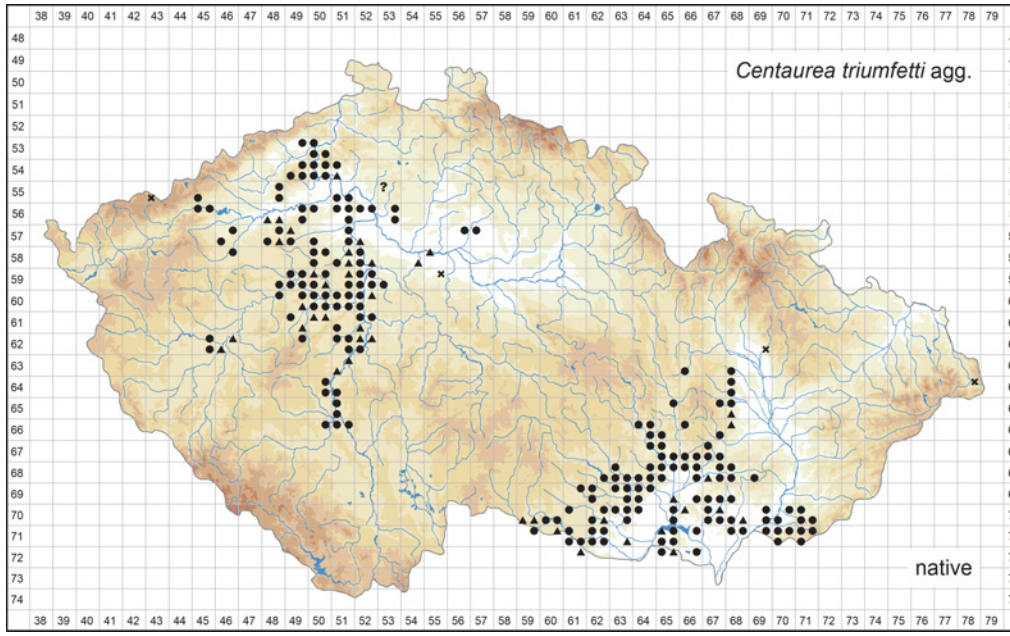

Fig. 27. – Distribution of *Centaurea triumfetti* agg. in the Czech Republic: ● occurrence documented by herbarium specimens (188 quadrants), ▲ occurrence based on other records (41 quadrants), × alien (4 quadrants). Prepared by Petr Koutecký.

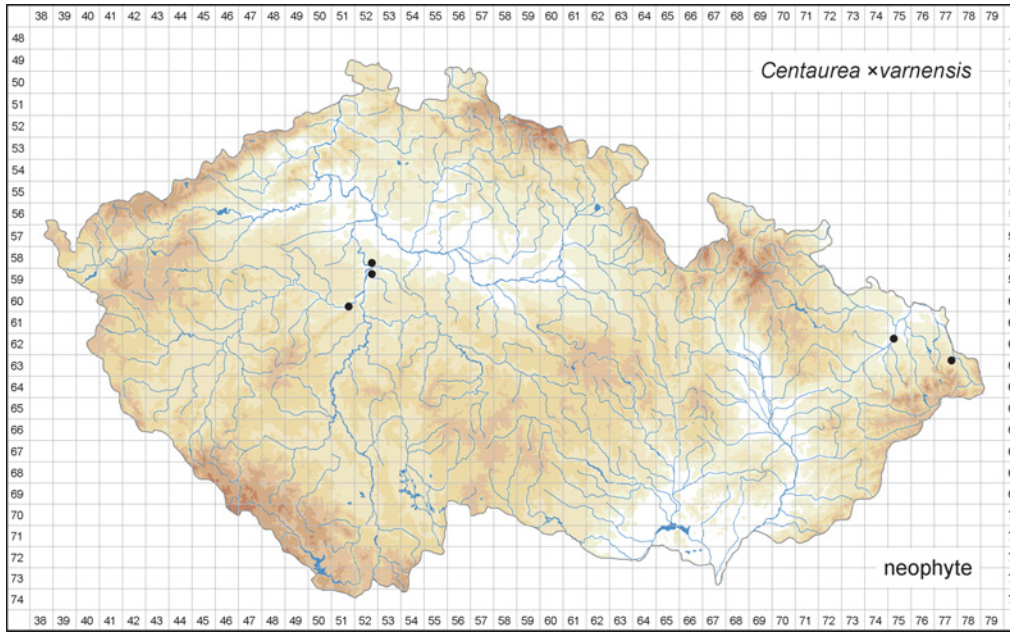

Fig. 28. – Distribution of *Centaurea* ×*varnensis* in the Czech Republic (5 occupied quadrants). Prepared by Petr Koutecký & Patrik Mráz.

between some of the taxa (Olšavská & Löser 2013), species status is appropriate for most of them. As a whole, the group is native throughout the southern half of Europe from Spain to southern Ukraine, to the north reaching southern Germany, the Czech Republic and the Slovak-Polish border, and also to the south-western Asia (Transcaucasia, Turkey, Iran, Iraq and Syria). It also occurs in Morocco, although it is not certain that it is native there (Meusel & Jäger 1992, Greuter 2006). Most of the taxa grow in sunny habitats (steppes, rocks, open forests) from the lowlands to the subalpine belt. Some taxa of *C. triumfetti* group were introduced to other European countries (Belgium, Great Britain, Norway) and to North America (Greuter 2006, DAISIE 2017, GCW 2017, USDA, NRCS 2017). The exact distribution of the individual taxa of the *C. triumfetti* group is imperfectly known. However, based on a recent taxonomic revision, only one polymorphic species is present in the Czech Republic (Olšavská et al. 2011). It is most often referred as *C. axillaris*, *C. triumfetti* subsp. *axillaris*, or *C. triumfetti* subsp. *aligera*, but as shown by Olšavská et al. (2011), no legitimate name at the species level is available for this taxon at the moment. To distinguish this taxon from the group as a whole, we henceforth refer it as *C.* '*axillaris*'.

Centaurea '*axillaris*' is apparently the most widespread taxon of the *C. triumfetti* group occurring throughout most of the group's range (Dostál 1976, Greuter 2006, Olšavská et al. 2011). However, even within the part of its range comprising central Europe, two main genetic groups can be distinguished within this species that are not consistent with the morphological variation. Whether this pattern results from a complex biogeographic history (several lineages originating from separate Pleistocene refugia) or hybridization with other taxa, and whether it has any taxonomic value require further study on a broader geographic scale. The current taxonomic classification as a single taxon is thus provisional. Nevertheless, all populations from the Czech Republic belong to the same genetic group (Olšavská et al. 2011).

Centaurea '*axillaris*' is a thermophilous species that grows on rocks, dry grassy slopes and margins and openings of thermophilous scrub and forests (particularly oak and pine forests). It is confined to hilly landscapes and deep river valleys while it is nearly absent from flat, although warm areas. In the Czech Republic it has two separate areas of occurrence. In Bohemia it occurs in volcanic areas of the České středohoří Mts and the eastern margin of the Doupovské hory Mts, in undulating landscape between these and the city of Prague, in the karst area of Český kras, and in the valleys of the Berounka, Vltava and lower Otava rivers and their tributaries. This species is very rare in the lowlands in central and eastern Bohemia east of Prague, where it is confined to a few isolated hills. In Moravia *C.* '*axillaris*' occurs along the eastern margin of the Bohemian Massif, northwards to the vicinity of the city of Olomouc, in the river valleys incised in the eastern part of the Českomoravská vrchovina highlands, in the hilly landscape south and south-east of the city of Brno, on the limestone outcrops of the Pavlovské vrchy hills and in the lower parts of the Bílé Karpaty Mts. *Centaurea* '*axillaris*' is declining due to eutrophication and abandonment of grazing and mowing followed by the spread of woody species and nitrophilous herbs and also due to conversion of some localities to tree plantations (particularly of *Robinia pseudoacacia*) or arable land. It is therefore classified as vulnerable (Grulich 2012).

Centaurea ×*varnensis* (Fig. 28)

Centaurea ×*varnensis* (more often referred to as *C.* ×*psammogena*) is a fertile hybrid between *C. diffusa* and *C. stoebe*. Both parental species are phylogenetically very close. Individual hybrid populations may involve plants of several filial generations and backcrosses with the parental taxa, similarly to many other *Centaurea* hybrids (e.g. Štěpánek & Koutecký 2004, Kaplan et al. 2017a). It is likely that the majority or all of *C.* ×*varnensis* populations are diploid (i.e., *C. diffusa* × *C. stoebe* subsp. *stoebe*), because: (i) all counts and ploidy level estimates available for this hybrid so far are diploid (Ochsmann 1999, Mráz et al. 2011, P. Mráz unpubl.); (ii) *C. diffusa* is mostly, if not exclusively, diploid (see above); and (iii) there is a strong inter-ploidy breeding barrier in *Centaurea* (Koutecký et al. 2011, Mráz et al. 2012b) making hybridization with the tetraploid cytotype of *C. stoebe* impossible. In the Czech Republic *C.* ×*varnensis* has been found at five sites. At all of them it co-occurred with *C. diffusa*. However, *C. stoebe* subsp. *stoebe* is absent from at least two localities in the north-east of the Czech Republic (iron-ore storage yards in Ostrava and Třinec). It is thus clear that the hybrid did not emerge in situ and was introduced, most probably together with *C. diffusa*, from source populations that already contained hybrids. Indeed, the same pattern has been documented from North America using genetic data (Blair & Hufbauer 2010). Future introductions of *C.* ×*varnensis* in the absence of one or both parental taxa are thus likely and formation of new hybrid swarms at the sites of parents' co-occurrence is also possible.

Chenopodium chenopodioides (Fig. 29)

Chenopodium chenopodioides is a wetland annual nitrophilous herb with an extensive distribution that involves Europe, Anatolia, the Caucasus, central Asia, western and southern Siberia as far as Lake Baikal and Transbaikalia, North America and tropical and southern Africa (Aelen 1979, Hultén & Fries 1986). As this distribution involves a broad range of environments, several similar taxa might actually be mapped as a single species, and the taxonomy of *Ch. chenopodioides* needs further study. Populations in North America are sometimes reported as introduced (Hultén & Fries 1986). In Europe this species grows along the Atlantic coast from the Iberian Peninsula northwards to Denmark and further to the Baltic coast of southern Scandinavia, and along the Mediterranean and Black Sea coasts from the Iberian Peninsula to the Balkan Peninsula and Ukraine. Outside the coastal areas it is rare, confined to inland saline habitats in Germany, the Czech Republic, Austria, Slovakia, Hungary, Serbia, Romania and central and southern Russia (Slavnić 1972, Aelen 1979, Jalas & Suominen 1980). In the Czech Republic *Ch. chenopodioides* inhabited littorals of saline lakes in the past, and after their drainage and conversion to arable land it has been preserved in small, temporarily flooded pools within salt marshes and some fishponds constructed over sediments with high salt content. It requires a wet sandy or muddy nitrogen- and mineral-rich substrate with low competition from other plants. It has been documented only from southernmost Moravia. Due to its strict habitat specialisation, overall rarity and misidentifications with common *Ch. rubrum*, with which it may co-occur, it was not recorded in 1971–1997 and consequently considered extirpated from the Czech Republic. However, since 1997 *Ch. chenopodioides* has been regularly recorded at some of its former sites, and even new localities have been found. Now, it is better known than in the past and is therefore usually correctly

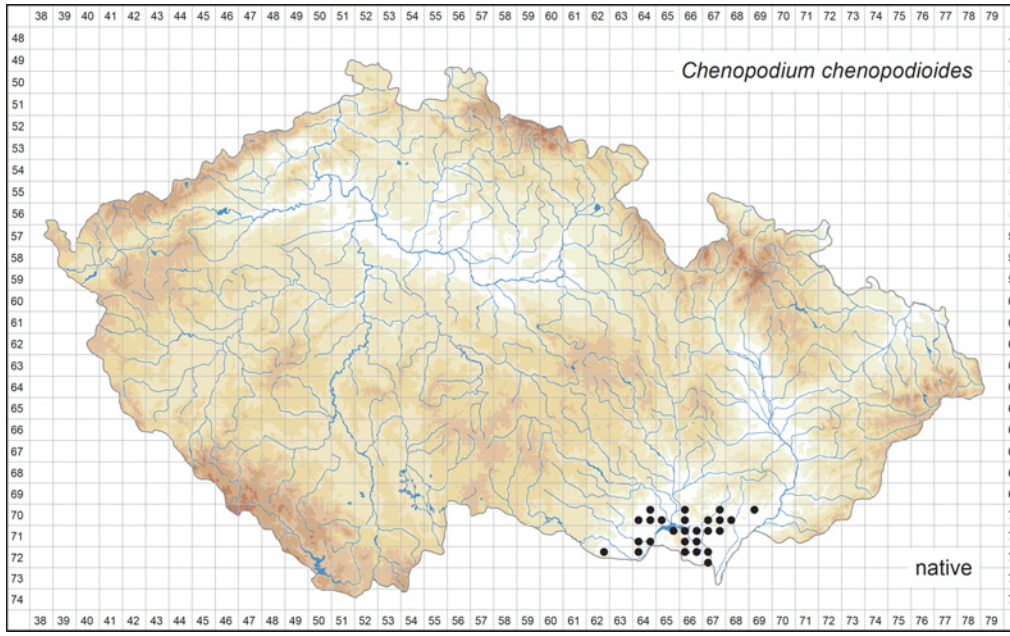

Fig. 29. – Distribution of *Chenopodium chenopodioides* in the Czech Republic (26 occupied quadrants). Prepared by Pavel Dřevojan & Kateřina Šumberová.

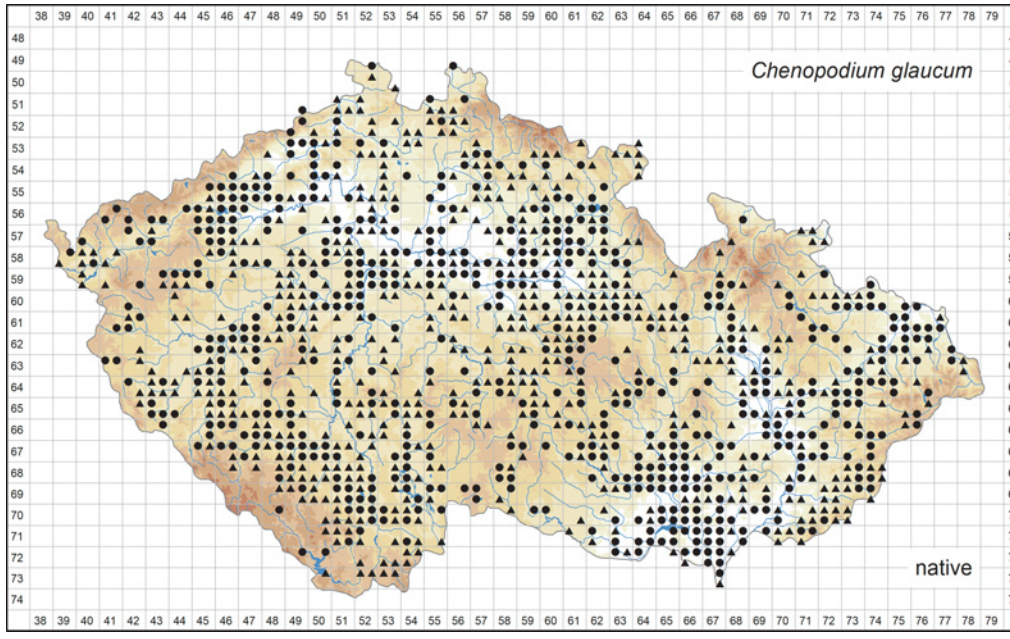

Fig. 30. – Distribution of *Chenopodium glaucum* in the Czech Republic: ● occurrence documented by herbarium specimens (582 quadrants), ▲ occurrence based on other records (545 quadrants). Prepared by Kateřina Šumberová & Pavel Dřevojan.

distinguished from the morphologically and ecologically similar *Ch. rubrum*. It seems that its frequency has somewhat increased recently, probably due to hot and dry summers in the last two decades supporting development of suitable habitats. However, due to its rarity and the general threat to wetland habitats in agricultural landscapes, it is classified as critically endangered (Grulich 2012).

Chenopodium glaucum (Fig. 30)

Chenopodium glaucum is a wetland annual nitrophilous herb with an extensive distribution. It is widespread in the temperate zone and scattered in boreal, Mediterranean and subtropical zones in Eurasia and North America. Additional populations are known from South Africa, Mexico, South America, Australia, New Zealand and Pacific Islands (Meusel et al. 1965, Hultén & Fries 1986). Although most of the extra-Eurasian populations have been treated as separate subspecies or even species (Hultén & Fries 1986, Mosyakin 2013), their taxonomic value is often considered doubtful (Mereďa 2016), and their native status in some countries also needs verification. In Europe *Ch. glaucum* occurs throughout most of its temperate zone, reaching central Scandinavia in the north, while being rare in most of the Mediterranean area and the steppe zone north of the Black and Caspian Sea (Jalas & Suominen 1980). *Chenopodium glaucum* occupies open, nitrogen, phosphorus and mineral-rich habitats exposed to full sun, with low cover of perennial vegetation. It needs wet and warm environments during germination, being tolerant to substrate desiccation and lower temperatures at flowering and fruiting times. Primary habitats of this species were probably exposed sandy and muddy margins of lakes, river beds and pools in river alluvia and small-scale disturbed patches in reed and sedge beds and salt marshes. Its occurrence has been enhanced by waterfowl that consume potentially competing plants. Nowadays, *Ch. glaucum* also occupies a broad range of man-made habitats such as artificial ponds (particularly fishponds with duck or geese farming), wetlands on arable land, road verges treated by de-icing salt, wet road ditches and sites with organic manure, compost, sewage and waste from sugar factories. Its seeds are easily dispersed along with the substrate adhering to agricultural machinery (Šumberová & Ducháček 2017). *Chenopodium glaucum* is common in lowlands and at warm middle elevations throughout the Czech Republic. In contrast, it is rare in or absent from high elevations, where its occurrences are all attributable to occasional introductions, reaching its elevational maximum of 1230 m above the town of Jánské Lázně in the Krkonoše Mts.

Chenopodium rubrum (Fig. 31)

Chenopodium rubrum is a wetland annual nitrophilous herb. Its main distribution is in temperate zones in Europe, western Asia (particularly south-western Siberia) and western North America. It is scattered to rare in boreal and Mediterranean Europe, northern Africa and northern and eastern Asia. The populations in eastern North America, Mexico, South America and southern Africa are reported as introduced (Jalas & Suominen 1980, Hultén & Fries 1986). Intraspecific taxa (subspecies or varieties) are sometimes distinguished within its native range (Aelen 1979, Mosyakin 2013), however, their taxonomic value is unclear or even doubtful (Mereďa 2016). *Chenopodium rubrum* frequently co-occurs with the ecologically similar *Ch. glaucum*. However, *Ch. rubrum* is less tolerant to substrate desiccation and high concentrations of salts and is much more

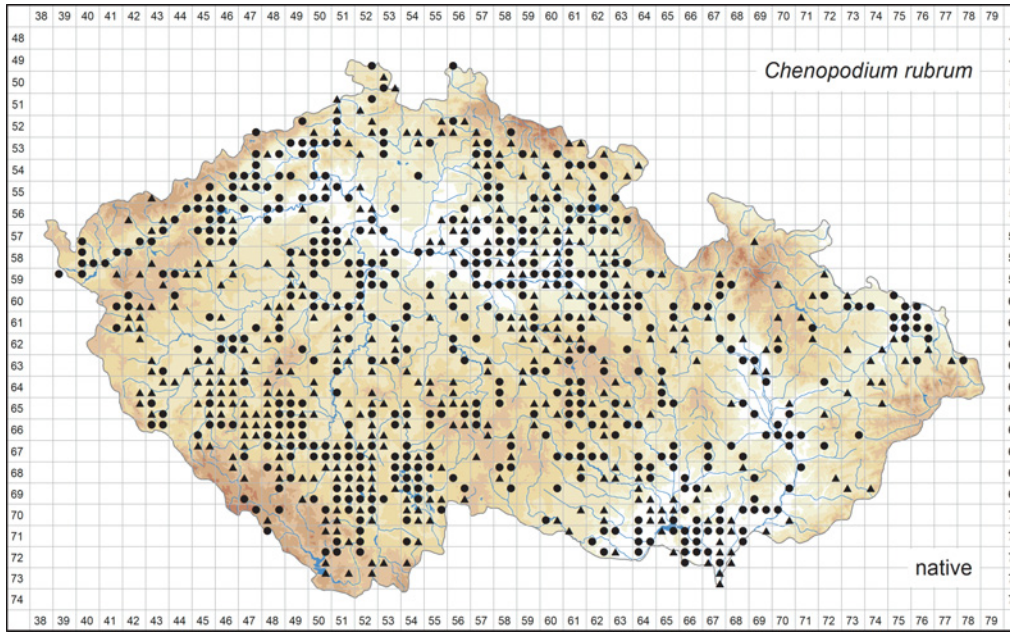

Fig. 31. – Distribution of *Chenopodium rubrum* in the Czech Republic: ● occurrence documented by herbarium specimens (473 quadrants), ▲ occurrence based on other records (397 quadrants). Prepared by Kateřina Šumberová & Pavel Dřevojan.

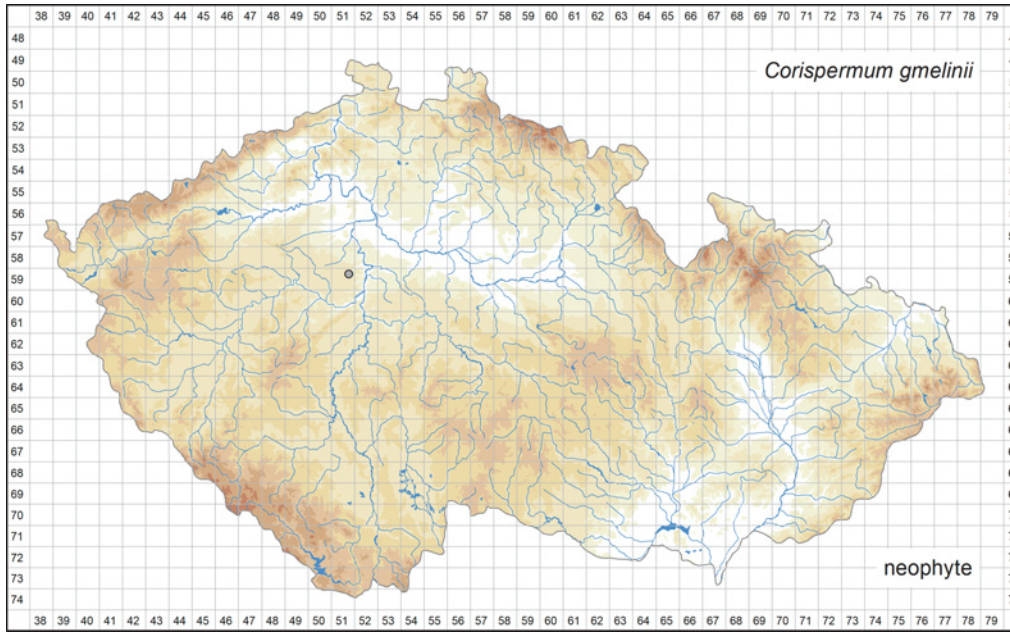

Fig. 32. – Distribution of *Corispermum gmelinii* in the Czech Republic: ◍ pre-2000 records only (1 quadrant). Prepared by Jiří Danihelka.

frequent than *Ch. glaucum* in natural and semi-natural habitats such as exposed margins and bottoms of lakes, fishponds and other artificial water bodies, river arms, and sandy and muddy river deposits. In contrast, *Ch. rubrum* is less frequent than *Ch. glaucum* in man-made habitats such as road verges and wet road ditches under the influence of de-icing salts, surroundings of manure heaps, compost, sewage ditches and waste from sugar factories. As a result, *Ch. rubrum* is less common than *Ch. glaucum*, which is obvious on both local and global scales. In the Czech Republic it is mainly found in the lowlands and middle elevations. It is scattered in montane areas, with elevational maxima of 1060 m in the village of Kvilda in the Šumava Mts and 1080 m at the town of Boží Dar in the Krušné hory Mts. At high elevations it is usually found at man-made sites. Unlike *Ch. glaucum*, *Ch. rubrum* seems to be rather rare in the driest parts of this country such as northern and north-western Bohemia and south-western and central Moravia, where it is confined to river floodplains. It is also very rare in the Carpathians, probably due to a lack of suitable habitats.

Corispermum gmelinii (Fig. 32)

Corispermum gmelinii is a member of *C.* sect. *Declinata*, which is a poorly known group comprising two or three species native to central Asia, Mongolia, China and southern Siberia (Zhu et al. 2003, Sukhorukov 2007). *Corispermum gmelinii*, sometimes included in *C. tylocarpum* (Zhu et al. 2003), is native to Mongolia and to the Chinese province of Inner Mongolia (Suchorukow 2007). In its native range *C. gmelinii* occurs on sandy places including wasteland, riversides, field margins and roadsides. This species was collected as introduced on waste ground in Prague as early as 1960; the mode of introduction is unknown. The gathering was identified half a century later as *C. declinatum* (J. Danihelka in Pyšek et al. 2012), but this identification was soon corrected to *C. gmelinii*, based on hairy fruits (Danihelka 2013). This record is one of the three known from Europe and is the earliest one. The other two records are from France (1994; Suchorukow 2007) and Belgium (2009; Verloove 2018). All three introductions were accidental and turned out to be casual (i.e., to not persist). In the Czech flora *C. gmelinii* species is classified as a casual neophyte (Pyšek et al. 2012).

Corispermum pallasii (Fig. 33)

Corispermum pallasii (incl. *C. leptopterum*) is native to south-eastern Siberia and probably also to North America (Mosyakin 2003). It has been naturalized in many European countries (Mosyakin 2006), for instance in central Europe, it has this status in Germany, the Czech Republic and Slovakia. It was introduced to Germany from Siberia through Russian botanical gardens during the first half of the 19th century (Mosyakin 2003). It was cultivated in many botanical gardens and purposefully sown in sandy places near the city of Darmstadt, where it almost immediately became established (Schnittspahn 1851). However, there also may have been garden escapes and direct introductions from the native range or elsewhere. In its native range it occurs in open sandy habitats with low vegetation cover, most frequently on mobile sand dunes, sandy and gravelly shores and in sandy ruderal habitats (Mosyakin 2003). In the Czech Republic *C. pallasii* was first collected in Brno (1933) and then in Prague (1960), in both cases on waste ground, and probably also in Pardubice (1960; identification uncertain) on the railway. These

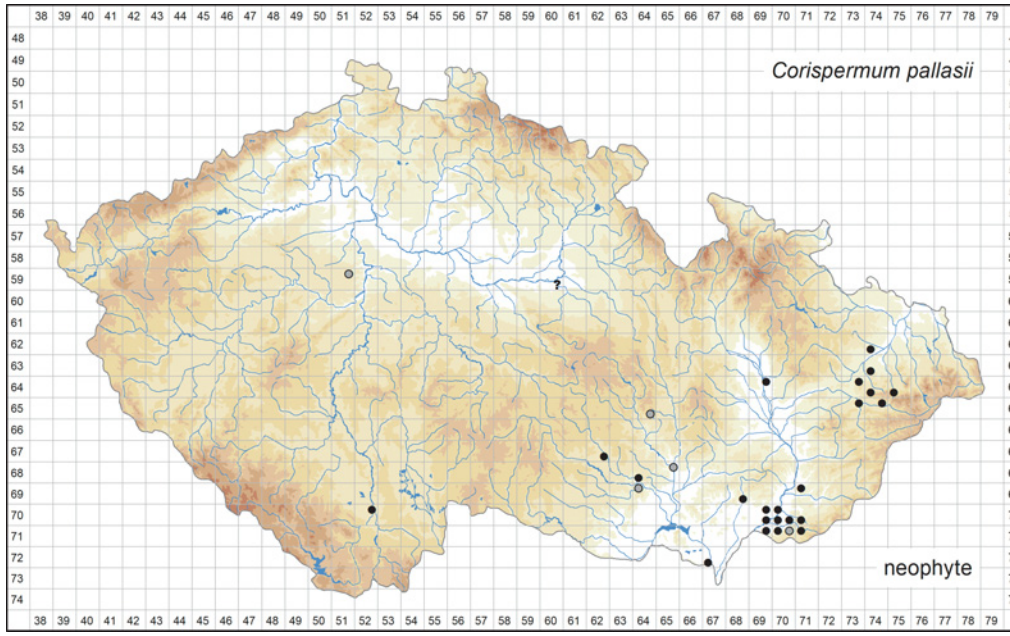

Fig. 33. – Distribution of *Corispermum pallasii* in the Czech Republic: ● at least one record in 2000–2018 (23 quadrants), ● pre-2000 records only (5 quadrants). Prepared by Jiří Danihelka.

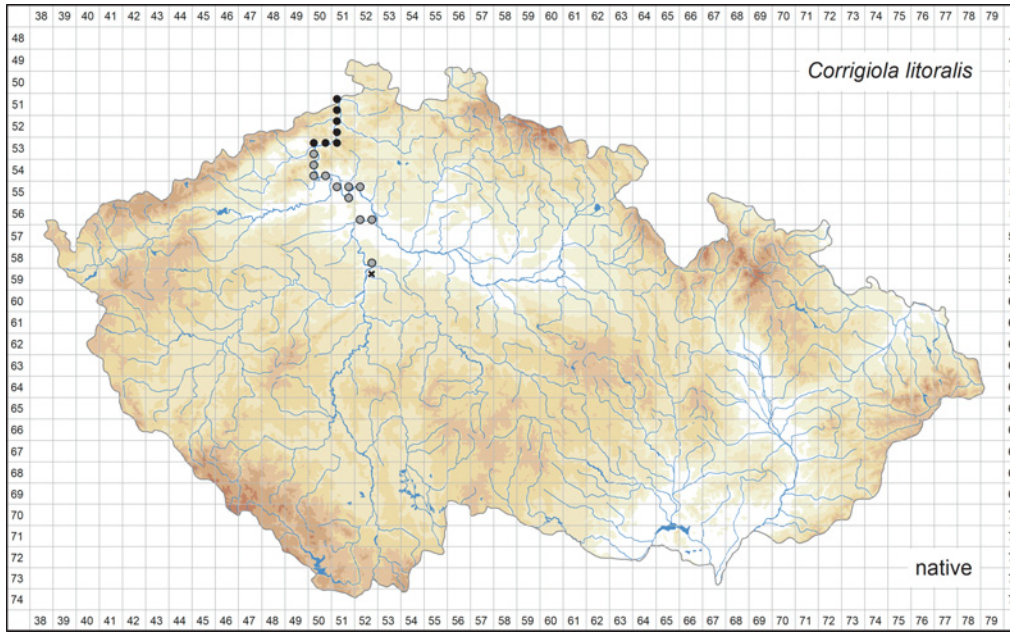

Fig. 34. – Distribution of *Corrigiola litoralis* in the Czech Republic: ● occurrence in natural habitats in 2000–2018 (7 quadrants), ● occurrence in natural habitats only before 2000 (11 quadrants), × occurrence in secondary habitats (1 quadrant). Prepared by Karel Kubát.

occurrences were causal, most probably derived from diaspores introduced from abroad. Since the late 1980s and early 1990s, two stable populations have been known in the south-east of the country: one on an ash and slag heap near a former power plant in the town of Oslavany west of the city of Brno and another in sand pits and adjacent sandy habitats near the town of Bzenec south-east of Brno. However, a record from roadsides north-west of Brno dating back to 1969 suggests that the former population may have existed already in the 1960s. All other recent records refer to plants originating from the two stable populations and found growing on sand transported to various places as construction material or on ash and slag mixture used for the treatment of roads in winter and temporarily deposited on roadsides. *Corispermum pallasii* is classified as a naturalized neophyte in this country (Pyšek et al. 2012).

Corrigiola litoralis (Fig. 34)

Corrigiola litoralis occurs mainly in western Europe, northwards extending to southern England and Denmark, and along the coasts of the Mediterranean Sea eastwards as far as Greece, western Turkey and Lebanon; it is also found in northern Africa from Morocco to Tunisia. It has been introduced into Sweden, southern and central Africa and North and Central America (Meusel et al. 1965, Hultén & Fries 1986, Jalas & Suominen 1983). As is the case for several other Atlantic-Sub-Mediterranean species, *C. litoralis* reaches the eastern limit of its continuous central-European distribution in the Czech Republic (Kaplan 2012, 2017). *Corrigiola litoralis* is a competitively weak annual plant. In this country it grows at sunny sites that are moist but that become dessicated during summer and located on seasonally exposed sand and gravel bars of the lower stretches of the Vltava and Labe rivers downstream of Prague. The existence of its populations is dependent on regular water level fluctuations. The construction of the system of dams on the rivers between the cities of Prague and Ústí nad Labem in 1907–1936 and regulation of the water flow resulted in stabilization of the water level. As a consequence, habitats of *C. litoralis* have been destroyed, and the species has disappeared from most of its sites, at present surviving only below the lowest dam on the Labe river in Ústí nad Labem (Kubát 1999b). An unusual occurrence of *C. litoralis* was recorded in the railway yard of the railway station of Praha-Žižkov, where it still occurs 50 years after its discovery. Although *C. litoralis* requires terrestrial conditions during most of its life cycle, in extremely dry summers it dies back before its reproduction phase. The species is classified as critically endangered because of its population decline (Grulich 2012).

Crepis biennis (Fig. 35)

Crepis biennis is almost exclusively a European species, being distributed from the British Isles and western France in the west as far as central European Russia in the east, extending southwards to north-eastern Spain, northern Italy and the Balkan Peninsula. Secondary occurrences are in southern Scandinavia (Babcock 1947, Hultén & Fries 1986, Meusel & Jäger 1992). It has also been introduced into eastern North America (Bogler 2006). In the Czech Republic *C. biennis* is most frequent in meadows and other grasslands, road verges, ruderal and semi-ruderal sites in settlements, edges of arable fields, scrub fringes, abandoned quarries, fallow land and at railway stations. It prefers acidic to slightly basic, moderately dry to moderately humid soils that are moderately

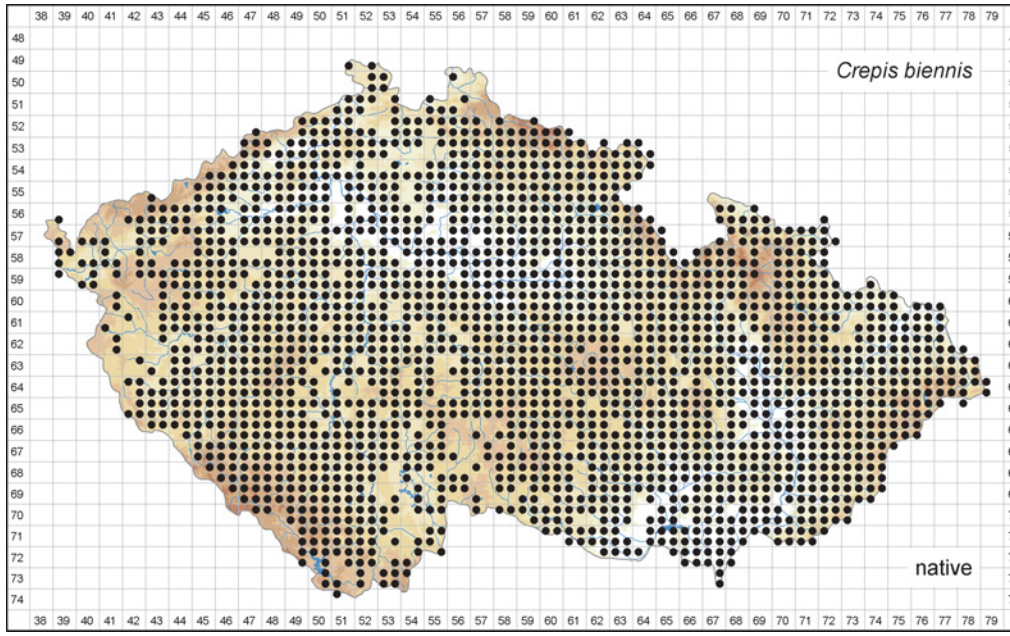

Fig. 35. – Distribution of *Crepis biennis* in the Czech Republic (2063 occupied quadrants). Prepared by Zdeněk Kaplan.

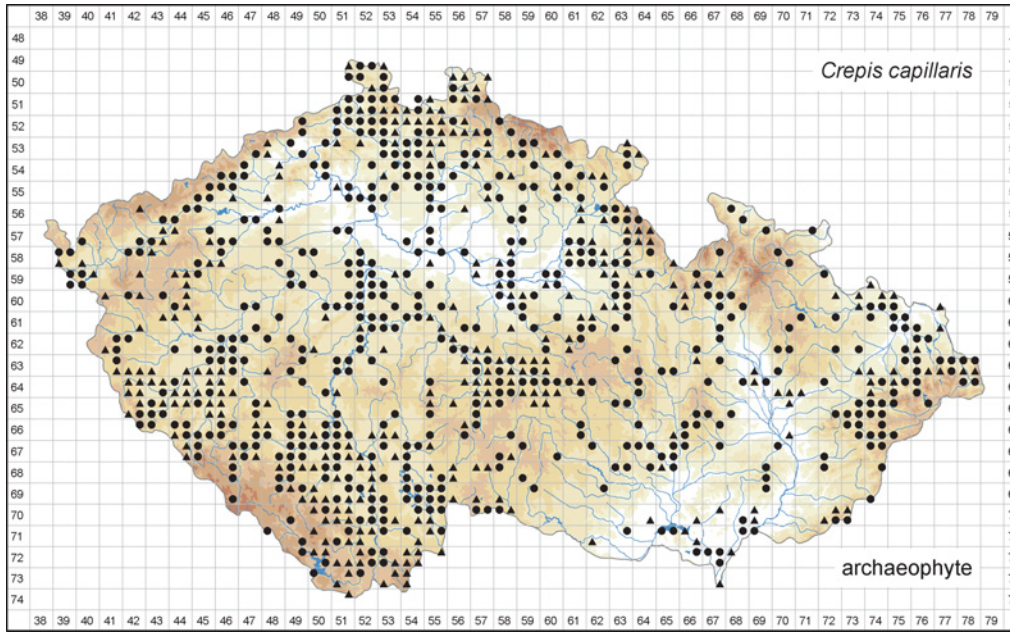

Fig. 36. – Distribution of *Crepis capillaris* in the Czech Republic: ● occurrence documented by herbarium specimens (543 quadrants), ▲ occurrence based on other records (317 quadrants). Prepared by Zdeněk Kaplan.

rich to rich in nutrients. It is frequent throughout this country from the lowlands up to mountains. The gaps on the map may all be due to under-recording rather than true absences.

Crepis capillaris (Fig. 36)

Crepis capillaris mainly occurs in western and central Europe, extending southwards to Spain, central Italy and the northern part of the Balkan Peninsula, and eastwards to western Ukraine and Romania (Hultén & Fries 1986, Meusel & Jäger 1992). Secondary occurrences have been recorded in Iceland, southern Scandinavia, westernmost Russia, Belarus and the Azores (Greuter 2006). It has also been introduced into North America (Bogler 2006), South America (Hultén & Fries 1986), southern Africa (Kilian et al. 2009), southern Australia (Walsh 1999) and New Zealand (Howell & Sawyer 2006). In the Czech Republic *C. capillaris* grows mainly in short disturbed grasslands, road verges, pavement crevices, semi-ruderal sites in settlements, at bases of walls, at railway stations, on fallow land and in abandoned quarries. It prefers acidic to slightly basic, moderately dry to moderately humid soils that are poor or moderately rich in nutrients. It occurs mainly at middle elevations in precipitation-rich areas, particularly in the foothills of the mountains along the country's borders in Bohemia and in eastern Silesia and eastern Moravia. It is also found in northern Bohemia, in and around the cities of Plzeň and Prague, in the flat basins of southern Bohemia and in the drainage basin of the Sázava river in the Českomoravská vrchovina highlands. Elsewhere it is only locally scattered or rare, mainly in the warm and dry lowlands, which is most apparent in agricultural landscapes in southern Moravia. Some of the gaps on the map, particularly those in western and southern Bohemia, are due to under-recording rather than true absences. *Crepis capillaris* is classified as a naturalized archaeophyte (Pyšek et al. 2012).

Crepis conyzifolia (Fig. 37)

Crepis conyzifolia has a disjunct range in the European mountains from the Pyrenees in the west through the Alps to the Carpathians in the east, and in the Sudetes in the north and the mountains of the Balkan Peninsula in the south (Meusel & Jäger 1992). In the Czech Republic it occurs in montane meadows and species-rich subalpine grasslands, open patches in *Pinus mugo* scrub and in glacial cirques. It usually grows on moderately humid, skeletal, nutrient-poor soils over acidic bedrock. *Crepis conyzifolia* is confined to high elevations of the Sudetes Mts, reaching there the northern limits of its total range. It is most widespread in the Krkonoše Mts, less common in the Hrubý Jeseník Mts, and found in only a few sites in the Králický Sněžník Mts. A single site in the Jizerské hory Mts is of secondary origin. Many of its occurrences have been at deforested sites below the timberline. These grasslands used to be grazed or mown in the past but most of them have been abandoned since the 1950s. Due to nutrient enrichment and subsequent spread of more competitive species, *C. conyzifolia* has declined or vanished from some of its former sites. It is therefore classified as endangered in this country (Grulich 2012).

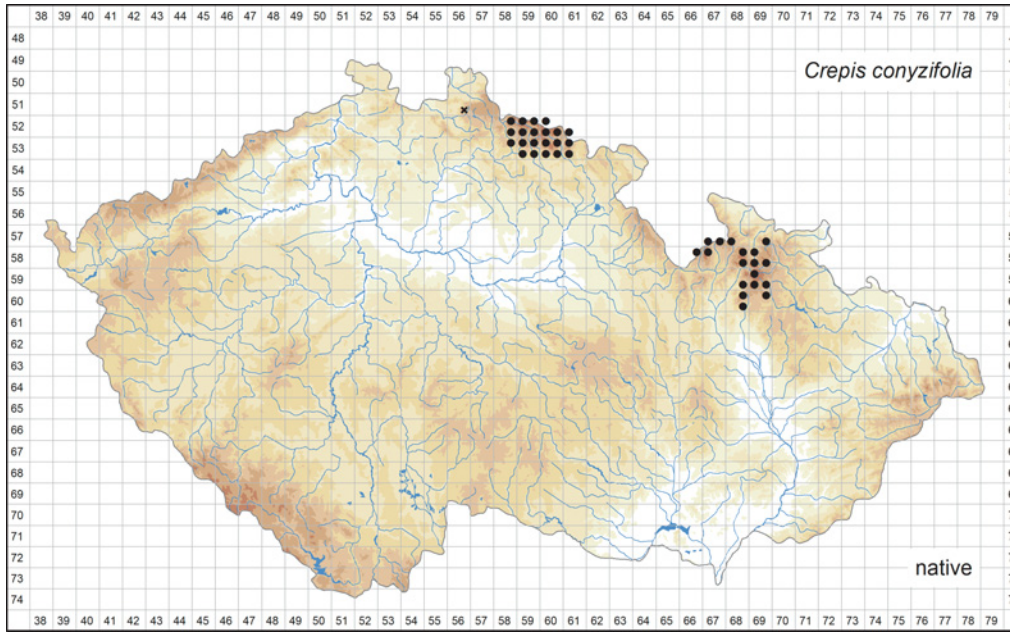

Fig. 37. – Distribution of *Crepis conyzifolia* in the Czech Republic: ● native (39 quadrants), × alien (1 quadrant). Prepared by Zdeněk Kaplan.

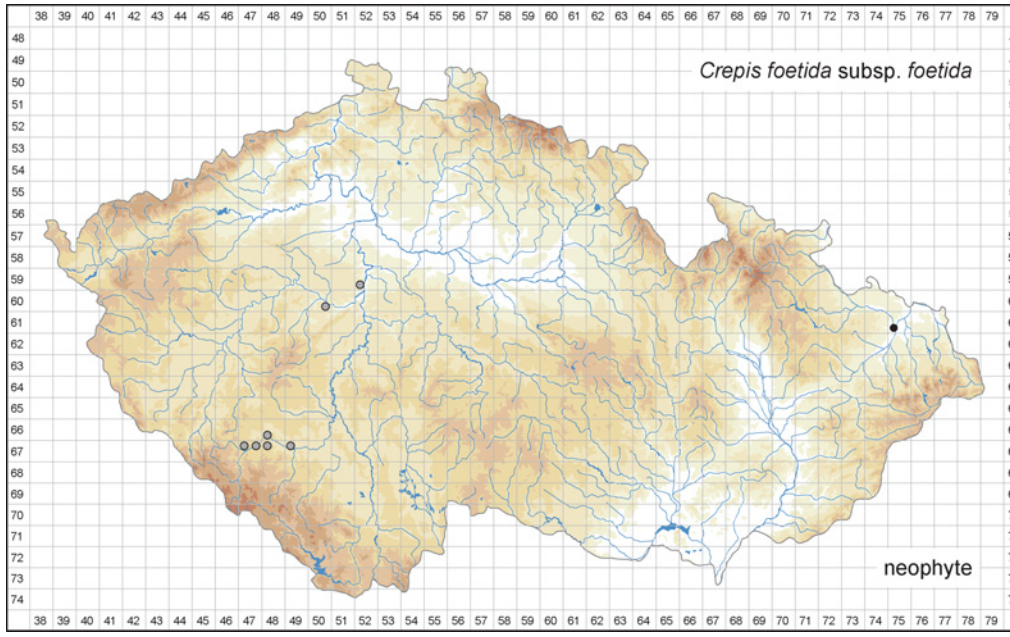

Fig. 38. – Distribution of *Crepis foetida* subsp. *foetida* in the Czech Republic: ● at least one record in 2000–2018 (1 quadrant), ● pre-2000 records only (7 quadrants). Prepared by Zdeněk Kaplan.

Crepis foetida (Figs 38–39)

Crepis foetida is mainly distributed in the Mediterranean part of Europe, extending northwards to England, northern Germany, Poland, Belarus and an adjacent part of European Russia (the occurrences along the northern edge of this range are secondary), eastward extending along the coasts of the Black Sea as far as the Caspian Sea and Iran. Isolated occurrences are in Morocco and Algeria in northern Africa (Meusel & Jäger 1992, Greuter 2006). It has been introduced into eastern Africa (Kilian et al. 2009), eastern North America (Bogler 2006), Argentina (Kilian et al. 2009), Australia (Walsh 1999) and New Zealand (Howell & Sawyer 2006). It is a polymorphic species with two to five subspecies, but only two of them are widespread and generally accepted. *Crepis foetida* subsp. *foetida* occurs mainly in western and southern Europe, but through the warmest parts of the Mediterranean area it extends eastward as far as Iran. The more widespread subsp. *rhoeadifolia* occupies the eastern part of the species range, locally co-occuring with the type subspecies in the Balkan Peninsula and south-western Asia but replacing it east of central Europe. It has also been introduced to western Europe. These two subspecies occur also in the Czech Republic, growing in similar habitats such as railway stations, roadsides, ruderal sites in settlements, pavement crevices, edges of tracks and fields, vineyards, fallow land, abandoned limestone, marlstone and basalt quarries, sand pits, disturbed patches in dry grasslands and rocky slopes. They prefer shallow, permeable, stony, gravelly or sandy substrates that are poor to moderately rich in nutrients.

Much more widespread in the Czech Republic is *C. f.* subsp. *rhoeadifolia*, which is frequent at ruderal sites in warm areas in central Bohemia, mainly in Prague and in the karst area of Český kras, and in southern Moravia northwards to the city of Brno. It is also locally distributed in north-western Bohemia, mainly along the railways. Elsewhere it is rare, often being confined to isolated sites at low and middle elevations, and these occurrences are mostly temporary. It is classified as a naturalized archaeophyte (Pyšek et al. 2012) and lower risk – near threatened (Grulich 2012), but locally it has abundant populations that do not show any decline.

In contrast, *C. f.* subsp. *foetida* has a very limited distribution in the Czech Republic. It was introduced into Prague and recorded there on limestone rocks in 1846–1849. A single record from the karst area of Český kras dates back to 1903. A notable occurrence was recorded between the 1870s and 1950s in south-western Bohemia, where *C. f.* subsp. *foetida* occurred at a minimum of nine sites in the area between the towns of Sušice in the west and Strakonice in the east. It used to even be locally abundant there on pastures and disturbed short grasslands on limestone hills and in limestone quarries. After several decades of absence in this country *C. f.* subsp. *foetida* was found in 2014 at the railway station of Ostrava-Mariánské Hory in north-eastern Moravia. The small population size indicated that it was a recent introduction. It is classified as a casual neophyte (Pyšek et al. 2012).

Crepis mollis (Figs 40–41)

Crepis mollis is most frequent in central Europe between central and southern Germany in the west and the Western Carpathians in the east. Isolated occurrences extend to the Pyrenees in the south-west, to northern Italy and the Balkan Peninsula in the south, to central Ukraine in the east and to Poland and the Baltic countries in the north-east.

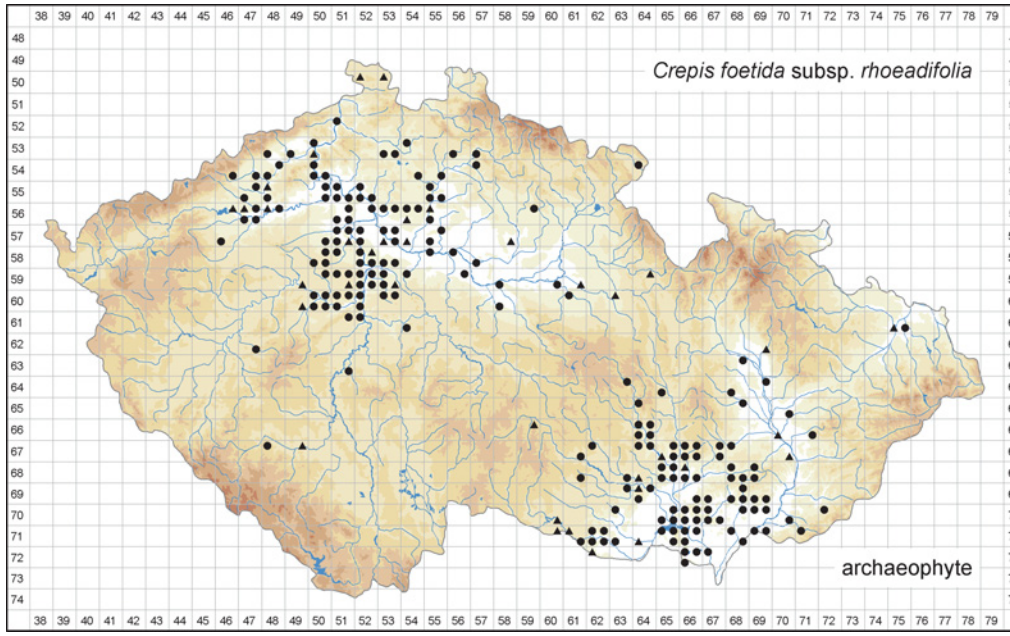

Fig. 39. – Distribution of *Crepis foetida* subsp. *rhoeadifolia* in the Czech Republic: ● occurrence documented by herbarium specimens (191 quadrants), ▲ occurrence based on other records (36 quadrants). Prepared by Zdeněk Kaplan.

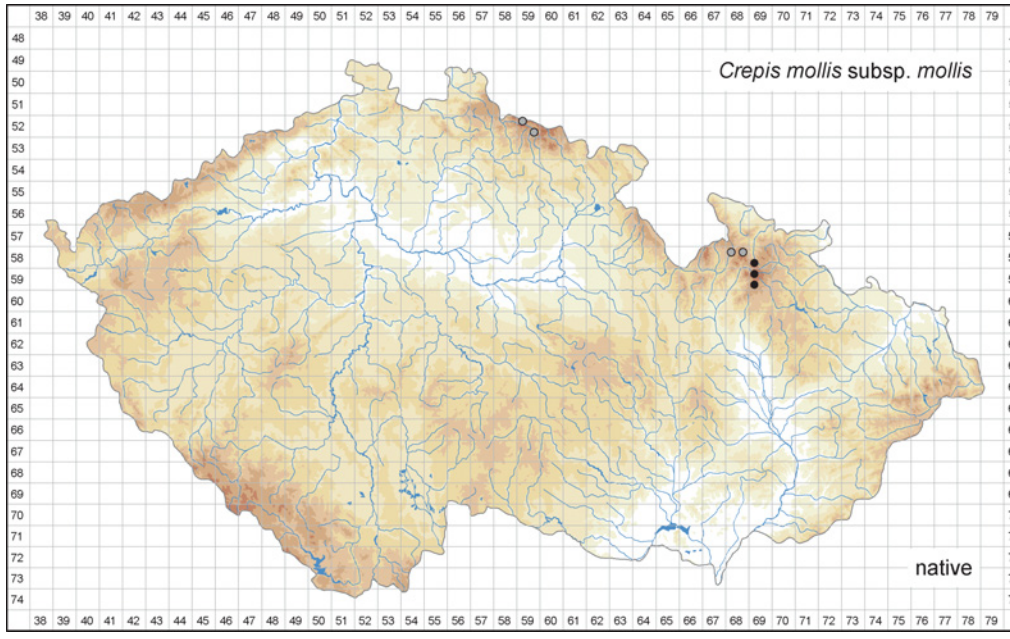

Fig. 40. – Distribution of *Crepis mollis* subsp. *mollis* in the Czech Republic: ● at least one record in 2000–2018 (3 quadrants), ◍ pre-2000 records only (4 quadrants). Prepared by Zdeněk Kaplan.

Remote outposts are also in the British Isles (Meusel & Jäger 1992). Three subspecies are sometimes recognized (Dostál 1989, Greuter 2006, Kilian et al. 2009): subsp. *mollis*, subsp. *succisifolia* and subsp. *velenovskyi*. *Crepis mollis* subsp. *velenovskyi* was described from the Czech Republic based on a single aberrant specimen, and a recent revision included it in *C. m.* subsp. *succisifolia* (Kaplan & Kirschner 2004, Kaplan 2012, 2017). In contrast, the other two subspecies, although not recognized in the monograph of the genus (Babcock 1947), exhibit a combination of morphological, ecological and geographical differentiation in the Czech Republic and the adjacent areas and thus deserve to be recognized.

Crepis mollis subsp. *mollis* occurs in the south-western, southern and eastern parts of this species' range, being reliably recorded for the Jura Mts, the Alps, the Bohemian Massif, the Western Carpathians and the Dinarids (Kaplan & Kirschner 2004). In the Czech Republic *C. m.* subsp. *mollis* is rare, growing in wet to moderately wet subalpine grasslands and tall-forb subalpine vegetation mainly in glacial cirques, and less frequently in summit areas and montane valleys. It is confined to the highest Sudetes, reaching there its north-western distribution limit. In the Krkonoše Mts it has been collected at two sites in the past but not reliably recorded during the past decades. In the Hrubý Jeseník Mts it has been found at 8–11 sites at elevations about 1000–1450 m. Most of the populations outside the glacial cirques are small and only temporary. Some may have vanished due to eutrophication and abandonment of low-intensity grazing followed by succession. Due to its rarity and population decline *C. m.* subsp. *mollis* is classified as critically threatened (Grulich 2012). Because the subspecies of *C. mollis* are not always correctly distinguished, the distribution map is based solely on examined herbarium specimens.

Crepis mollis subsp. *succisifolia* appears to replace the type subspecies in the north-western part of this species' range. In central Europe it has been reliably recorded from Germany, the Czech Republic, Austria, Slovakia, Poland and Estonia (Kaplan & Kirschner 2004). In the Czech Republic it is more widespread than the type subspecies. It mainly occurs in montane and submontane species-rich meadows and peat meadows, at lower elevations also in fens and at seepage sites in grasslands on marl slopes and in open deciduous forests. It prefers intermittently wet to waterlogged nutrient-rich soils, sometimes growing also on peaty and fen soils. *Crepis mollis* subsp. *succisifolia* mainly occurs in the mountain ranges along the country's border except for eastern and south-eastern Moravia, and is scattered also in the Slavkovský les, Brdy, Žďárské vrchy, Nízký Jeseník and Oderské vrchy hills, the Hrubý Jeseník Mts and the Českomoravská vrchovina and Drahanská vrchovina highlands. Most of its sites are at elevations 300–1100 m. At middle and low elevations it is rare or absent, particularly in warm and dry areas in central Bohemia and southern Moravia. Many of its former occurrences have vanished due to overall eutrophication followed by succession, and to changes in land use, particularly intensification of agriculture, drainage and abandonment of pastures and meadows. It is therefore classified as vulnerable (Grulich 2012).

Crepis nicaeensis (Fig. 42)

Crepis nicaeensis is native to the approximate area ranging from the eastern Pyrenees in the west through the south-western foothills of the Alps to the western Balkan Peninsula in the east. Secondary occurrences, often being only temporary, are found in several

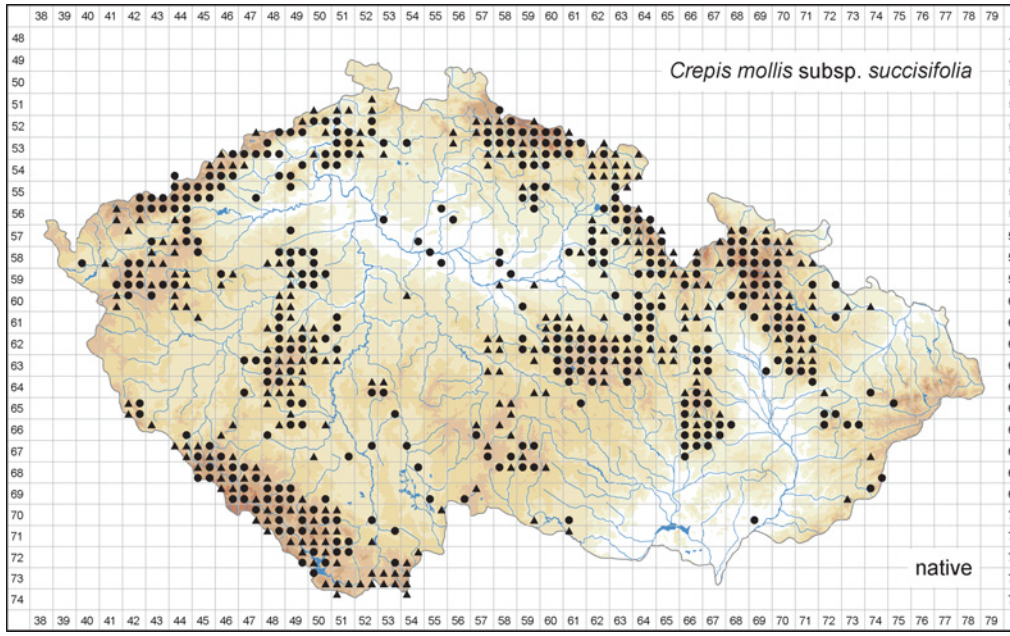

Fig. 41. – Distribution of *Crepis mollis* subsp. *succisifolia* in the Czech Republic: ● occurrence documented by herbarium specimens (352 quadrants), ▲ occurrence based on other records (282 quadrants). Prepared by Zdeněk Kaplan.

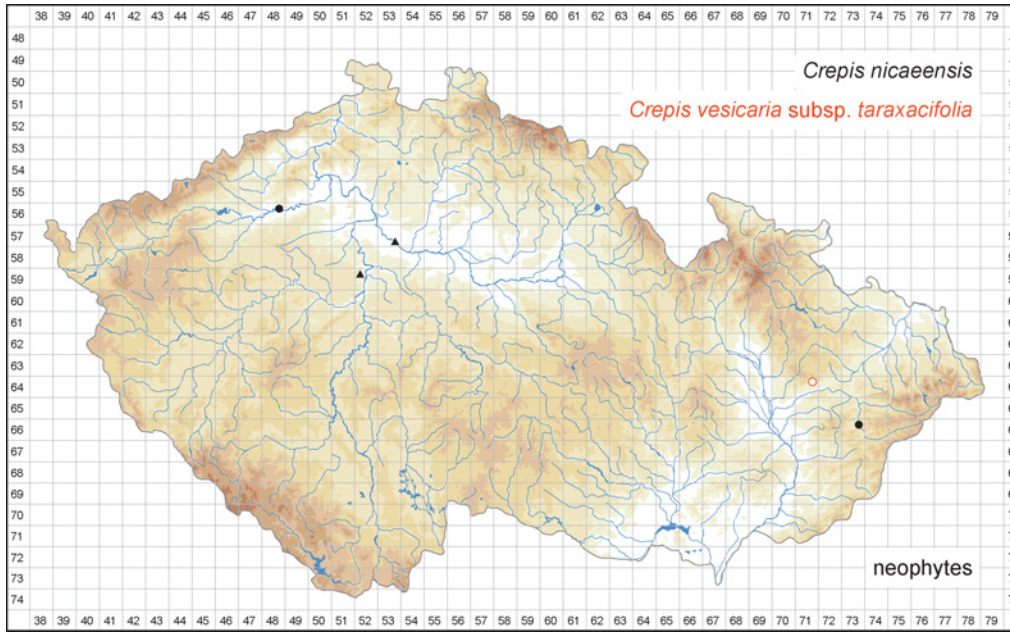

Fig. 42. – Distribution of *Crepis nicaeensis* (● occurrence documented by herbarium specimens: 2 quadrants, ▲ occurrence based on other records: 2 quadrants) and *C. vesicaria* subsp. *taraxacifolia* (○ pre-2000 records only: 1 quadrant) in the Czech Republic. Prepared by Zdeněk Kaplan.

European countries northwards to the British Isles, southern Norway, central Sweden and southern Finland (Hultén & Fries 1986, Meusel & Jäger 1992, Kilian et al. 2009). It has also been introduced into western and eastern North America (Bogler 2006). In the Czech Republic *C. nicaeensis* was recorded in the 1880s in meadows, urban grasslands and on fallow land at four sites, probably having been introduced with grass seed from western Europe. It is classified as a casual neophyte (Pyšek et al. 2012). It may have been overlooked due to its similarity with *C. biennis*. However, most of the herbarium specimens identified as *C. nicaeensis* are actually *C. biennis* or *Picris hieracioides*.

Crepis paludosa (Fig. 43)

Crepis paludosa is a European species distributed mainly in the boreal and temperate zones, extending southwards to the Pyrenees, central Italy and the Balkan Peninsula; it is absent from most of France, most of the Pannonian Basin, from large dry areas in south-eastern Europe east of the Carpathians, and from the northernmost European Russia (Meusel & Jäger 1992). In the Czech Republic *C. paludosa* grows mainly around springs, in wet meadows (including peat meadows), alder carrs, willow scrub, wet spruce forests, on banks of streams and forest ponds, along wet forest tracks, and in ditches and tall-forb subalpine vegetation. It prefers acidic to neutral, wet to waterlogged, organic, nutrient-rich, deep soils. This species is widespread in the mountains and humid highlands throughout this country. In contrast, it is rare in or absent from the warm and dry lowlands in north-western and central Bohemia and southern Moravia, and scarce in flat basins in western and southern Bohemia lacking suitable habitats.

Crepis pannonica (Fig. 44)

Crepis pannonica is mainly distributed in the steppes and forest-steppes in southern European Russia and the adjacent parts of eastern Ukraine, north-western Kazakhstan and Siberia. It also occurs in the Caucasus Mts and Crimea. Further west it extends through isolated occurrences in the Ukrainian and Romanian lowlands as far as the Pannonian Basin and the northern part of the Balkan Peninsula (Meusel & Jäger 1992). It has been introduced into Connecticut in North America (Bogler 2006). In the Czech Republic *C. pannonica* reaches the western limit of its total geographic range as well as the northern limit of its distribution in central Europe, being there a relict of the continental steppe from the Late Glacial (Kaplan 2012, 2017). It mainly grows in sunny dry grasslands on deep, neutral to slightly basic, mineral-rich soils developed over loess. It is confined to southern Moravia, where it has been recorded at about eight sites south, south-east and east of the city of Brno. However, most of these occurrences vanished by the 1950s, and currently this species survives in a small population at a single site close to the village of Komořany near the town of Vyškov. It is classified as critically threatened (Grulich 2012).

Crepis praemorsa (Fig. 45)

Crepis praemorsa occurs in the temperate zone in Eurasia from the eastern France in the west as far as Lake Baikal in the east. In Europe it extends northwards to southern Scandinavia and southwards to the foothills of the Alps and the northern part of the Balkan

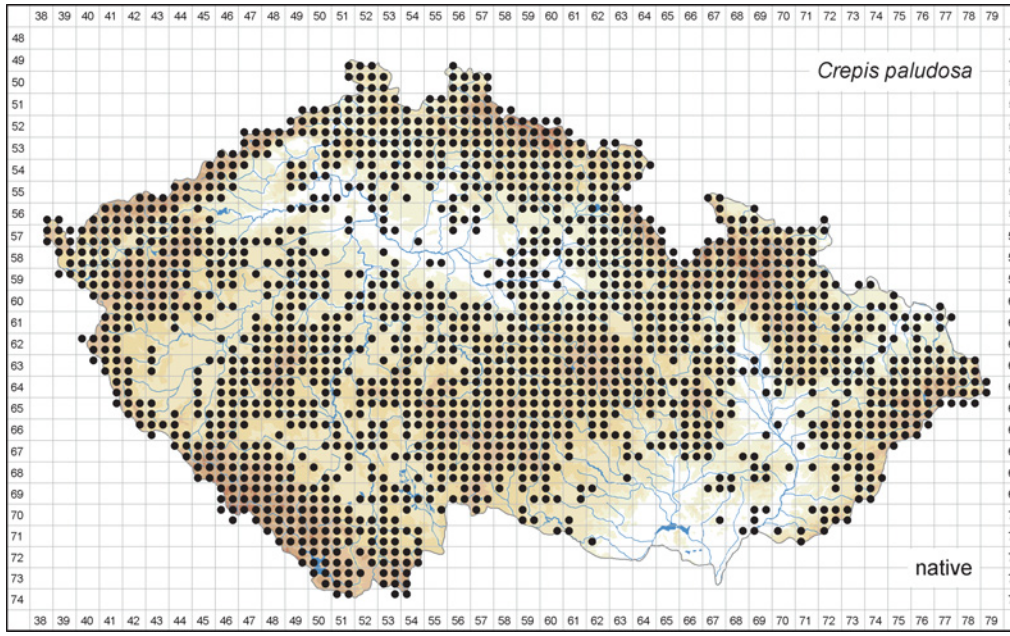

Fig. 43. – Distribution of *Crepis paludosa* in the Czech Republic (1694 occupied quadrants). Prepared by Zdeněk Kaplan.

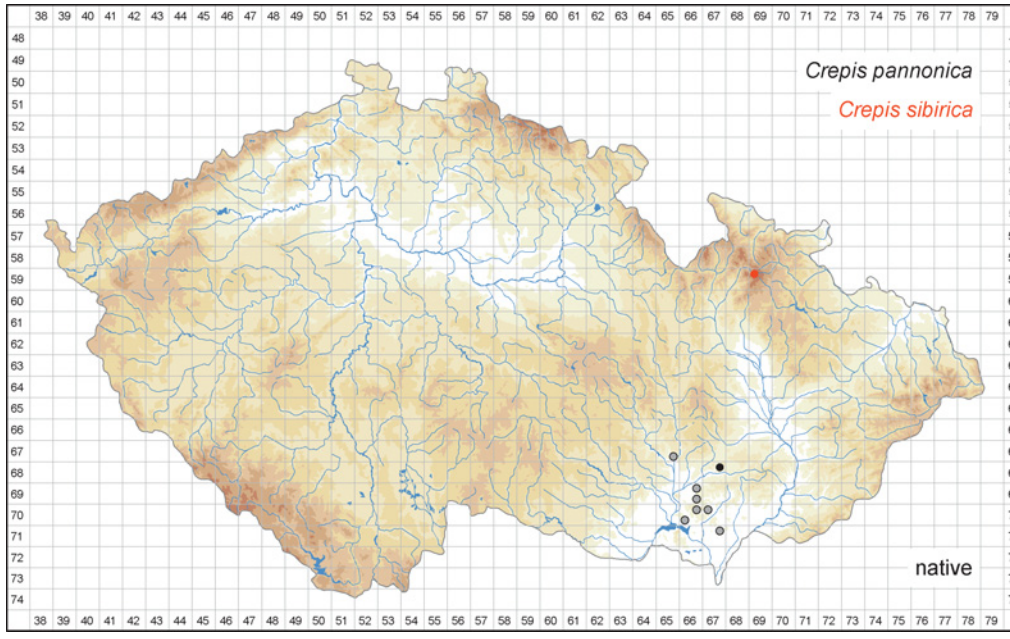

Fig. 44. – Distribution of *Crepis pannonica* (● at least one record in 2000–2018: 1 quadrant, ● pre-2000 records only: 7 quadrants) and *C. sibirica* (1 occupied quadrant) in the Czech Republic. Prepared by Zdeněk Kaplan.

Peninsula (Hultén & Fries 1986, Meusel & Jäger 1992). In the Czech Republic it grows in open deciduous forests (particularly thermophilous oak forests and oak-hornbeam forests) and their fringes, in forest-steppes, species-rich semi-dry grasslands and fens. It prefers intermittently wet, deep, mineral-rich soils, which are usually developed over base-rich bedrock, particularly flysch, marlstone, limestone and basalt. *Crepis praemorsa* occurs mainly in hilly landscapes in southern and south-eastern Moravia, being rare in central Moravia and in Silesia. In Bohemia it has only isolated occurrences, which are mostly associated with calcareous bedrock, the largest of them being in the karst area of Český kras and in the České středohoří Mts. Additional outposts are dispersed over eastern Bohemia, and several sites have also been recorded in south-western and southern Bohemia. *Crepis praemorsa* vanished from many of its sites mainly due to abandonment of pastures and meadows followed by succession. Particularly in Bohemia it has strongly declined and recent records exist for less than 10% of previously recorded sites. It is therefore classified as endangered (Grulich 2012).

Crepis setosa (Fig. 46)

Crepis setosa is native mainly to the European Mediterranean area, extending eastwards to Anatolia, the surroundings of the Black Sea and the Caucasus Mts; secondary occurrences are found in Europe northwards to Ireland, southern Norway, Sweden and Poland (Babcock 1947, Kilian et al. 2009). It has been also introduced into western and eastern North America (Bogler 2006), southern South America (Kilian et al. 2009), Australia (Walsh 1999) and New Zealand (Howell & Sawyer 2006). In the Czech Republic *C. setosa* grows mainly in semi-ruderal lawns in settlements, road verges, disturbed dry grasslands, edges of clover and alfalfa fields, in vineyards, on dry fallow land, in pavement crevices and abandoned sand pits. It prefers shallow, permeable, loamy or clayey soils rich in nutrients. It is found mainly in the warmest areas of southernmost Moravia, locally forming abundant populations, and isolated occurrences are scattered northwards to the city of Brno. Elsewhere in this country it has been rarely introduced to semi-ruderal and dry sites mostly in warm areas, but these occurrences often consist of single plants and are only temporary. *Crepis setosa* is classified as a naturalized archaeophyte (Pyšek et al. 2012) and as critically threatened (Grulich 2012) but the latter classification is worthy of reconsideration.

Crepis sibirica (Fig. 44)

Crepis sibirica is mainly distributed in eastern and north-eastern Europe and western and central Siberia. Isolated occurrences are in the Carpathians, the Caucasus and the mountain ranges in central Asia, Mongolia and north-eastern China (Hultén & Fries 1986, Meusel & Jäger 1992). The westernmost outpost of its distribution is in the Hrubý Jeseník Mts in the Czech Republic (Kaplan 2012, 2017). *Crepis sibirica* occurs there in subalpine species-rich tall-forb communities and subalpine vegetation dominated by open deciduous scrub and low birch trees at the end of the avalanche track in the Velká kotlina glacial cirque, at elevations of about 1150–1270 m. It grows there on rather deep, moist, nutrient-rich soils. Because in this country *C. sibirica* is confined to this single population, it is classified as critically threatened (Grulich 2012).

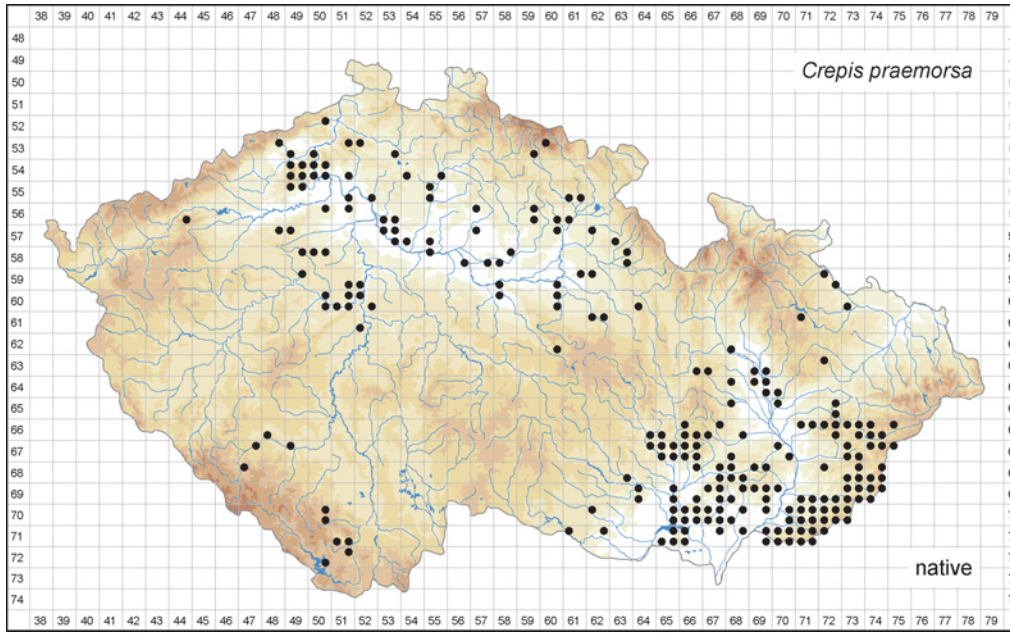

Fig. 45. – Distribution of *Crepis praemorsa* in the Czech Republic (235 occupied quadrants). Prepared by Zdeněk Kaplan.

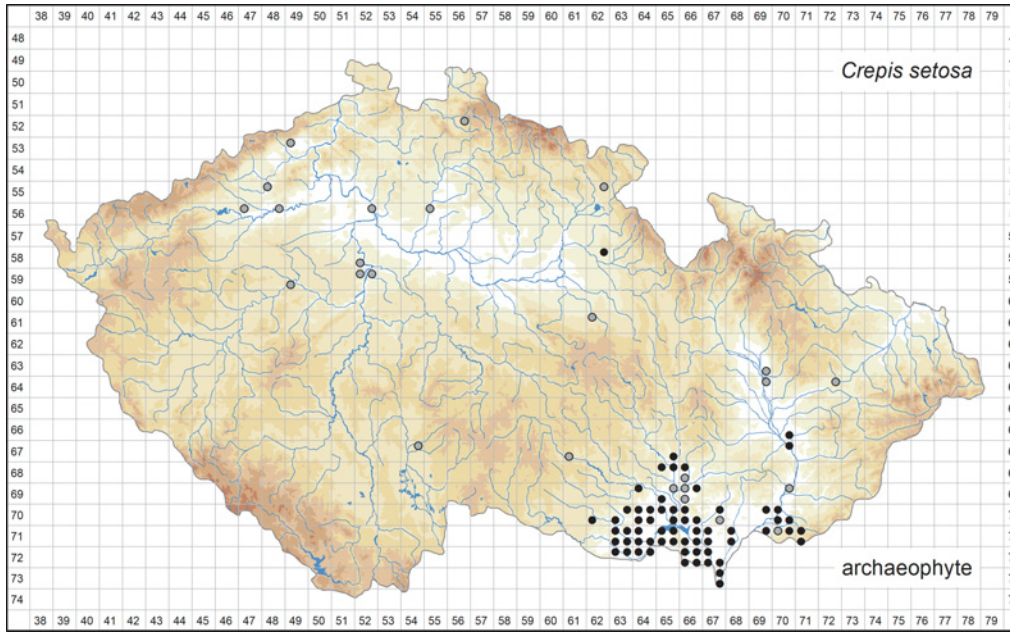

Fig. 46. – Distribution of *Crepis setosa* in the Czech Republic: ● at least one record in 2000–2018 (63 quadrants), ● pre-2000 records only (25 quadrants). Prepared by Zdeněk Kaplan & Pavel Dřevojan.

Crepis tectorum (Fig. 47)

Crepis tectorum is widespread in the temperate areas in Eurasia. In Europe it occurs mainly in the central, northern and eastern parts but is rare south and west of the Alps. Eastwards it occurs in southern Siberia, Kazakhstan, with isolated (often secondary) occurrences extending through Mongolia and north-eastern China as far as the Russian Far East (Hultén & Fries 1986, Meusel & Jäger 1992). It has been introduced into eastern North America, where it is now widespread from Alaska to the eastern coast (Bogler 2006). In the Czech Republic it occurs mainly at railway stations, on old walls and in pavement crevices, less frequently at edges of sandy tracks, abandoned sand pits and other open sandy habitats, and occasionally also in vineyards, dry fallow land, abandoned quarries, dry pastures and disturbed grasslands; in the past it also occurred as a weed in fields. It prefers shallow, permeable, stony, gravelly or sandy substrates that are poor in nutrients. *Crepis tectorum* has been most frequently recorded in southern Moravia, particularly in the sandy area between the towns of Hodonín and Veselí nad Moravou, and in and around the city of Brno. Elsewhere it has been recorded in the lowlands and at middle elevations almost throughout this country, particularly in central and eastern Bohemia and in central Moravia. However, in most quadrants it has been recorded only at single sites, and these occurrences were only temporary and consisted of small populations or individual plants. A majority of these occurrences disappeared long ago. *Crepis tectorum* is currently a rare species: since 2000 it has been observed in only 9% of all the quadrants from which it has ever been reported. In this country it is classified as a naturalized archaeophyte (Pyšek et al. 2012) and as vulnerable (Grulich 2012). Because of frequent confusion with *C. capillaris* and slender phenotypes of *C. biennis*, the distribution map of *C. tectorum* is based almost solely on examined herbarium specimens.

Crepis vesicaria subsp. *taraxacifolia* (Fig. 42)

Crepis vesicaria is a polymorphic species native to the Mediterranean area. Nine subspecies are recognized, the majority of which are local endemics (Babcock 1947, Greuter 2006, Kilian et al. 2009). *Crepis vesicaria* subsp. *taraxacifolia* is the most widespread subspecies, being distributed in the western Mediterranean area, mainly in the Iberian Peninsula, France, northern Italy, and eastwards to Greece, with secondary occurrences northwards as far as the British Isles and Poland; it also occurs in northern Morocco and Algeria (Meusel & Jäger 1992, Kilian et al. 2009). It has been introduced into western and eastern North America (Bogler 2006), southern South America (Kilian et al. 2009), Australia (Walsh 1999) and New Zealand (Howell & Sawyer 2006). In the Czech Republic it was found only as temporarily introduced at a single site, in the village of Podhoří near the town of Lipník nad Bečvou in central Moravia, where it was collected in 1899 and 1900. It is classified as a casual neophyte (Pyšek et al. 2012).

Cystopteris bulbifera (Fig. 48)

Cystopteris bulbifera is a diploid species native to the eastern part of the USA with outposts in New Mexico and Utah (Haufler et al. 1993). In the Czech Republic it occurs at a single site on humid limestone rocks at the waterfalls of Bubovické vodopády in the karst area of Český kras near the town of Beroun in central Bohemia (Marek et al. 2002).

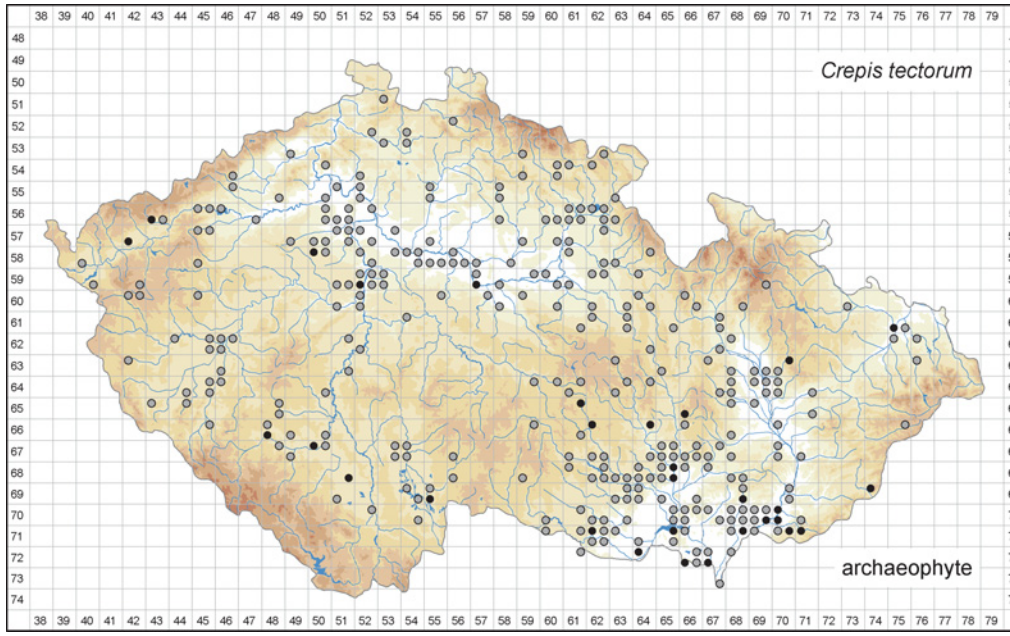

Fig. 47. – Distribution of *Crepis tectorum* in the Czech Republic: ● at least one record in 2000–2018 (30 quadrants), ◍ pre-2000 records only (291 quadrants). Prepared by Zdeněk Kaplan.

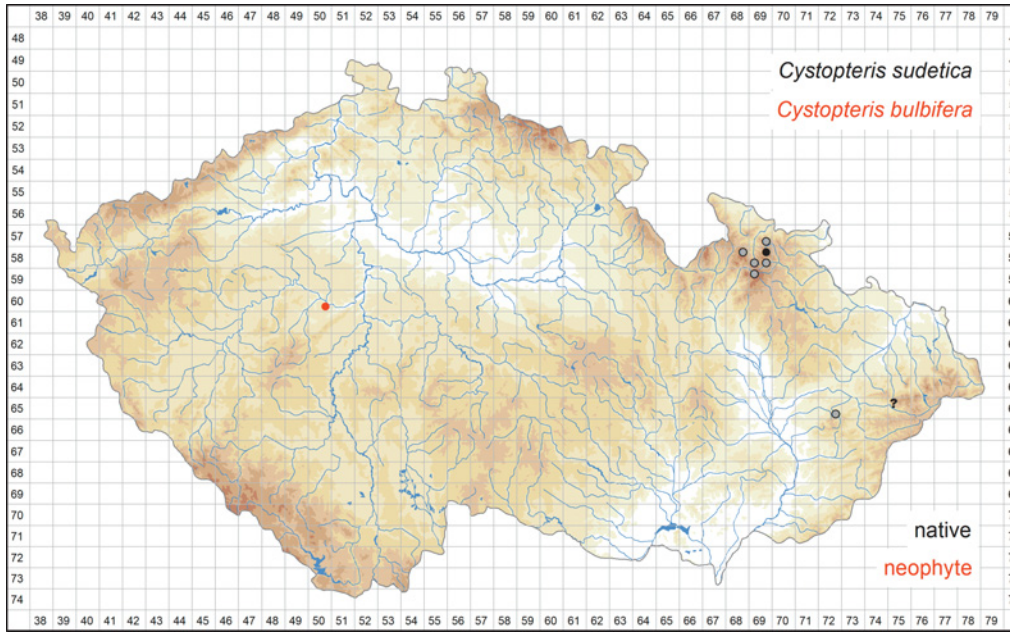

Fig. 48. – Distribution of *Cystopteris bulbifera* (1 occupied quadrant) and *C. sudetica* (● at least one record in 2000–2018: 1 quadrant, ◍ pre-2000 records only: 6 quadrants) in the Czech Republic. Prepared by Libor Ekrt.

The origin of this population is uncertain but it was most likely deliberately planted. *Cystopteris bulbifera* is also documented from cultivation in botanical gardens in Prague during the 19th and the first half of the 20th centuries. In the Czech flora it is considered as a casual neophyte (Pyšek et al. 2012).

Cystopteris fragilis (Fig. 49)

Cystopteris fragilis s. l. is one of the most widespread ferns in the world, distributed almost throughout the Northern Hemisphere. In the Southern Hemisphere it has a disjunct range in southern to southernmost South America, in eastern and southern Africa, south-eastern Australia, New Zealand and on many isolated islands (Hultén & Fries 1986). Unlikely any other fern, it has colonized cold areas and extends as far as 83°N in Greenland and 55°S in South America (Tryon 1986). *Cystopteris fragilis* s. l. represents a very polymorphic complex. Numerous ploidy levels (4x, 5x, 6x, 8x, 10x) are known and several species are recognized (Rothfels et al. 2013, 2014, Kawakami et al. 2016). In the Czech Republic, only *C. fragilis* s. str. occurs. The records of another species, *C. dickieana*, in the Czech Republic (Kubát 2002, Grulich 2012) are erroneous. These two taxa differ only in the type of perisporium (spiny vs. rugose, respectively), and the reported occurrence of *C. dickieana* from the foothills of the Krkonoše Mts is based on plants of *C. fragilis* s. str. with undeveloped perisporium. Moreover, the taxonomic value of this character is uncertain, and these forms are often considered conspecific (Haufler & Windham 1991, Parks et al. 2000). In the Czech Republic *C. fragilis* occurs in shady humid sites, such as crevices of predominantly calcareous but also siliceous and serpentine rocks, screes, ravine forests and old walls. It is frequent at middle elevations throughout this country, while it is scattered to rare in the mountains and absent from or rare in the lowlands due to the lack of suitable humid habitats.

Cystopteris sudetica (Fig. 48)

Cystopteris sudetica has a disjunct distribution in Eurasia. It is rare in the Bavarian Alps, Eastern Sudetes and Carpathians, in Norway, the northern part of European Russia, the Caucasus, Siberia, eastern Asia and Japan (Dostál 1984). In the Czech Republic it grows in mountain sycamore-beech forests, where it is found in shaded, moist and nutrient-rich places on stony, rocky and mossy slopes, around forest springs and occasionally also at the moss-covered bases of tree trunks. In the past, *C. sudetica* was recorded at several sites in the Hrubý Jeseník Mts (from where it was first described) and in the northern part of the Hostýnské vrchy Mts. It was also reported in the literature to occur on Mt Radhošť in the Moravskoslezské Beskydy Mts but this record is uncertain. Recently it is only known from the slopes of Mt Malé Bradlo in the Hrubý Jeseník Mts. The decline of this species was probably caused by inappropriate forest management that involved large-scale clearing and conversion of deciduous forests to uniform spruce plantations. For about 70 years it was considered extirpated from this country until its rediscovery in 2010 (Kočí 2012). Now it is classified as critically threatened (Grulich 2012).

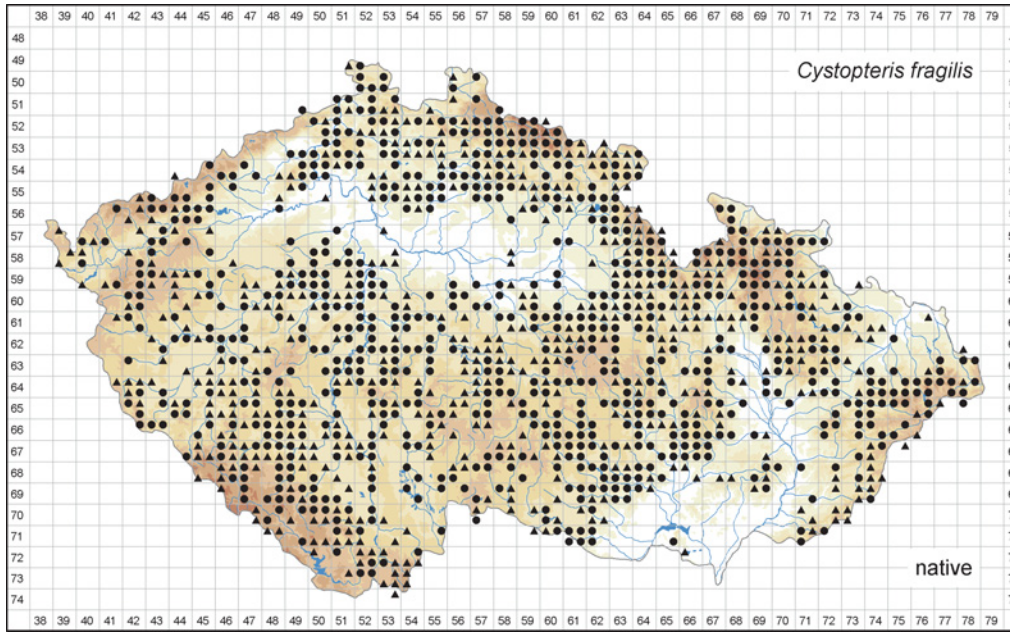

Fig. 49. – Distribution of *Cystopteris fragilis* in the Czech Republic: ● occurrence documented by herbarium specimens (729 quadrants), ▲ occurrence based on other records (493 quadrants). Prepared by Libor Ekrt.

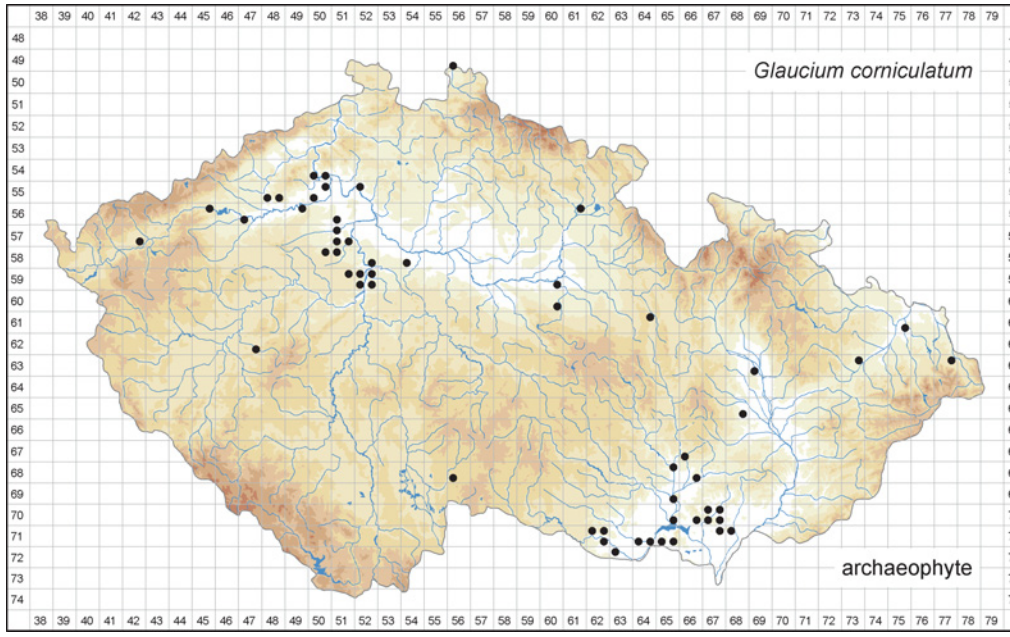

Fig. 50. – Distribution of *Glaucium corniculatum* in the Czech Republic (56 occupied quadrants). Prepared by Karel Kubát.

Glaucium corniculatum (Fig. 50)

The exact limits of the original range of *G. corniculatum* are uncertain but it is probably native to the Mediterranean area northwards to southern France, central Italy and the south of the Balkan Peninsula, southwards to north-western Africa and eastwards to Anatolia, extending as far as the southern part of European Russia. In more northern areas, including Switzerland, Austria, Germany, the Czech Republic, Poland and Hungary, it was probably introduced only as an archaeophyte (Mowat 1964, Woch et al. 2008). The species is also naturalized in New Zealand (Garnock-Jones 1979) and North America (Kiger 1997). In the Czech Republic *G. corniculatum* occurs at railway stations, river ports, along tracks, in vineyards and dry disturbed grasslands (Kubát 1979). It is mainly distributed in warm areas in central and north-western Bohemia, particularly in the surroundings of Prague and in the lower stretches of the Ohře river, and in southern Moravia. Rarely, the species has been introduced elsewhere but these occurrences were only temporary and vanished long ago. Particularly in the 1960s–1980s it used to be introduced occasionally with materials from Ukraine (Jehlík & Hejný 1974). *Glaucium corniculatum* is classified as a casual archaeophyte (Pyšek et al. 2012) and as critically endangered because of its population decline (Grulich 2012).

Hackelia deflexa (Fig. 51)

Hackelia deflexa has a disjunct distribution in Eurasia. In Europe it mainly grows in Scandinavia, extending eastwards to Karelia. It also occurs in central Europe, particularly in the Alps and the Carpathians but isolated occurrences are dispersed elsewhere. Eastwards it is scattered across eastern Europe to the Ural Mts and in Asia it occurs in southern Siberia, mountains of central Asia and the Russian Far East (Meusel et al. 1978, Hultén & Fries 1986). It has been introduced into North America (Rolfsmeier 2012). In the Czech Republic *H. deflexa* grows on shaded edges of screes, at bases of rock cliffs and on wall ruins, mainly of medieval castles. It occurs on slightly acidic to basic substrates with low vegetation cover. In this country it is a rare species, recorded mainly in the Moravian part of the Českomoravská vrchovina highlands between the towns of Znojmo and Moravská Třebová, in the adjacent karst area of Moravský kras and in the Hrubý Jeseník Mts. In Bohemia it is found in the České středohoří Mts, and isolated occurrences are at middle elevations in northern, western and south-western Bohemia. Many records of *H. deflexa* date to the end of the 19th century and have not been confirmed since then. This species is therefore classified as endangered (Grulich 2012).

Hammarbya paludosa (Fig. 52)

Hammarbya paludosa has a wide but disjunct distribution in the temperate zone in the Northern Hemisphere. In Europe it occurs from the British Isles and France in the west to central European Russia in the east, extending northwards to northern Scandinavia and southwards to northernmost Italy. Elsewhere it is very rare, with isolated occurrences in western and southern Siberia, Sakhalin Island, Japan and in North America between Alaska in the west and Ontario in the east (Meusel et al. 1965, Hultén & Fries 1986). In the Czech Republic *H. paludosa* occurs in waterlogged parts of transitional mires, often located at edges of fishponds or along streams on peaty mud. *Hammarbya paludosa*

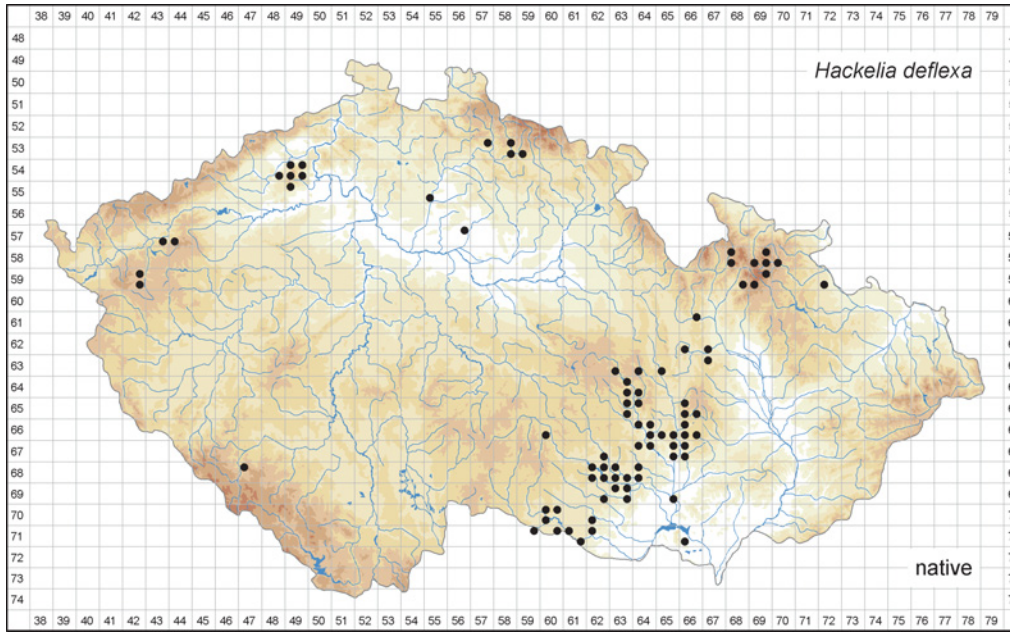

Fig. 51. – Distribution of *Hackelia deflexa* in the Czech Republic (83 occupied quadrants). Prepared by Karel Kubát.

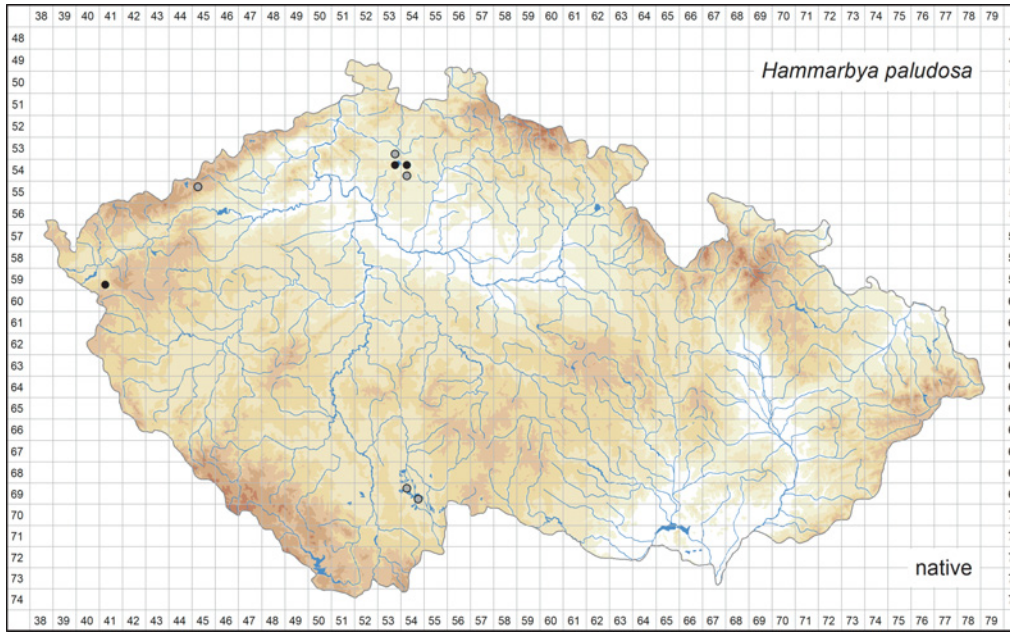

Fig. 52. – Distribution of *Hammarbya paludosa* in the Czech Republic: ● at least one record in 2000–2018 (3 quadrants), ◍ pre-2000 records only (5 quadrants). Prepared by Zdeněk Kaplan.

usually grows there on wet *Sphagnum* hummocks or on bases of sedge tussocks. It has been recorded at eight sites in Bohemia, of which only three are extant: two near the town of Doksy in northern Bohemia and one at the village of Dolní Žandov near the town of Cheb in western Bohemia. The other occurrences vanished apparently due to eutrophication followed by succession. Consequently, this species is classified as critically threatened (Grulich 2012).

Hippocrepis comosa (Fig. 53)

Hippocrepis comosa is a European species, which is most frequent in the Alps and their foothills, and extends westwards to France and the Pyrenees, northwards to England and Germany, eastwards to the Western, Eastern and Southern Carpathians and southwards to Sardinia, Sicily and the Peloponnese Peninsula (Meusel et al. 1965). In the USA, it has been introduced into Pennsylvania (USDA, NRCS 2017). In the Czech Republic *H. comosa* occurs in open dry grasslands mostly on flysh or marl slopes. It is mainly distributed in the Bílé Karpaty Mts in south-eastern Moravia, which is the south-westernmost projection of the Western Carpathians, at elevations about 200–720 m. It used to be locally frequent there, but vanished from most of its sites during the second half of the 20th century due to eutrophication followed by succession and abandonment of low-intensity grazing and mowing. *Hippocrepis comosa* is therefore classified as critically threatened (Grulich 2012). It has also been recorded at five sites in north-western and eastern Bohemia, where its native status is uncertain. However, some of these occurrences, particularly those in north-western Bohemia, are in well-preserved species-rich dry grasslands, where *H. comosa* is accompanied by a number of rare thermophilous species with similar distribution patterns, and may therefore represent relict isolated outposts at the northern limits of this species' distribution. Alternatively, these occurrences may have resulted from accidental introductions with hay, grass seed or sheep.

Lappula patula (Fig. 54)

Lappula patula is native to south-eastern Europe, the southern part of European Russia, south-western Asia, southern Siberia and western China; isolated occurrences are in southern Spain, Sicily and north-western Africa (Holub 1974, Jäger et al. 1985). It has been introduced into France, Italy, the Czech Republic and Hungary. *Lappula patula* or closely related species are reported as introduced also in southern Africa (Holub 1974). In its native range it is found mainly at dry and stony sites in steppes or semi-deserts. In the Czech Republic it has been found at two sites, probably introduced from the former USSR. First, it was collected in 1960 in an iron-ore yard in the city of Ostrava in north-eastern Moravia, and in 1973 at the railway station in the town of Česká Třebová in eastern Bohemia. It is classified as a casual neophyte (Pyšek et al. 2012).

Lappula semicincta (Fig. 54)

The total distribution of *L. semicincta* is unclear due to uncertain delimitation from related taxa. It has been recorded from the Czech Republic, Slovakia and Ukraine (Chater 1972, Valdés 2011), and perhaps also occurs in France (Hlavaček 1958); however, sometimes this species is considered conspecific with *L. heteracantha*, which occurs also in

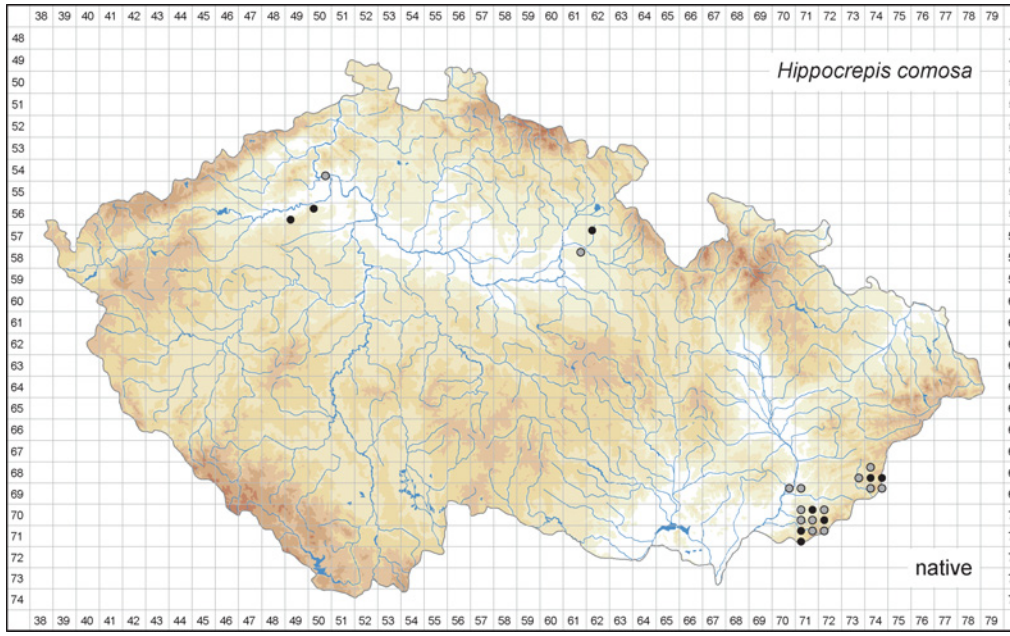

Fig. 53. – Distribution of *Hippocrepis comosa* in the Czech Republic: ● at least one record in 2000–2018 (9 quadrants), ● pre-2000 records only (14 quadrants). Prepared by Zdeněk Kaplan.

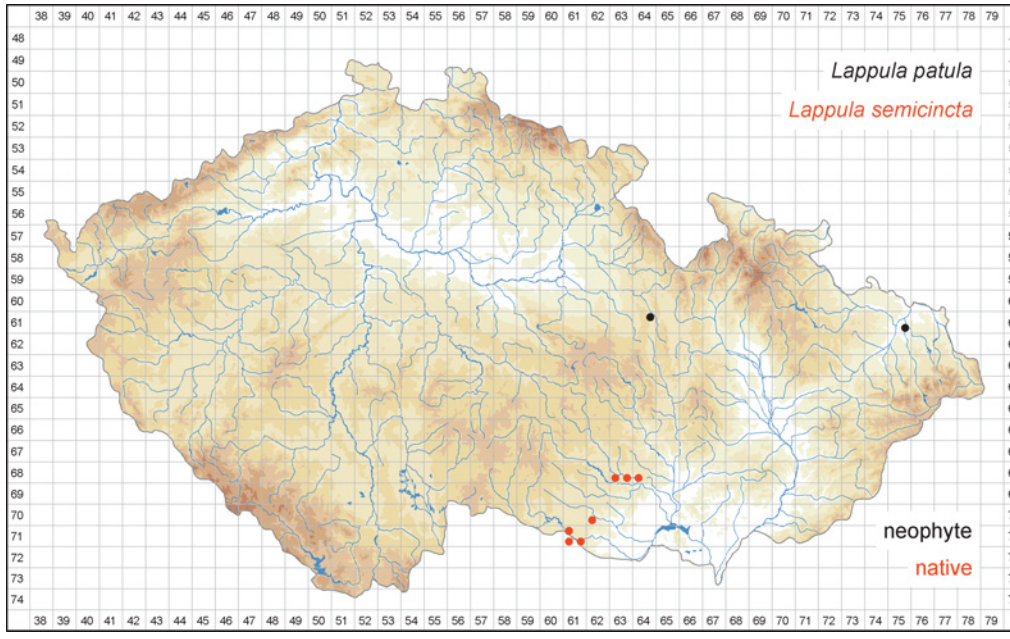

Fig. 54. – Distribution of *Lappula patula* (2 occupied quadrants) and *L. semicincta* (7 occupied quadrants) in the Czech Republic. Prepared by Karel Kubát.

Hungary, Romania, southern European Russia and the Caucasus (Roleček et al. 2012). In the Czech Republic *L. semicincta* mainly grows in disturbed dry grasslands, on rocky slopes, at edges of limestone quarries and on the top of ruined walls of medieval castles. It is mostly found in sunny places on dry, neutral to basic, stony substrates. It has been recorded from about 14 sites in south-western Moravia only, where it occurred in the valleys of the Oslava, Chvojnice and Dyje rivers, and on the ruins of the Lapikus castle near the village of Plaveč. Recently, its occurrence has been confirmed for only about five sites in the valley of the Oslava river near the village of Ketkovice and on Lapikus (Roleček et al. 2012). The species is classified as critically endangered because of its rarity (Grulich 2012).

Lappula squarrosa (Fig. 55)

The large distribution range of *L. squarrosa* extends from Spain in the west across Europe and Siberia between 50°N and 60°N as far as the Russian Far East, with isolated occurrences in the mountains of central Asia (Meusel et al. 1978, Hultén & Fries 1986). It has been occasionally introduced into the British Isles (Stace 2010) and Iceland (Meusel et al. 1978). It is naturalized in large areas in North America, sometimes being a noxious weed (Rousseau 1968, Frick 1984). It has also been introduced into southern Africa, Australia and Japan (Holm et al. 1979). In the Czech Republic *L. squarrosa* grows on sunny and rocky slopes, in sand pits, stone quarries, road verges, on ruined walls, in fields, at railway stations and river ports. It is found mostly on neutral to basic, dry, often calcareous soils. In Bohemia it is most frequent in warm and dry areas in its central and northwestern parts, particularly along the middle stretches of the Ohře river, in the České středohoří Mts, in the surroundings of Prague and in the karst area of Český kras. Isolated occurrences are found also in northern, eastern and southern Bohemia. In Moravia it is most frequent in its southern parts, extending northwards to the surroundings of the city of Olomouc; isolated occurrences are scattered elsewhere except for the mountains (Kubát 1999a). *Lappula squarrosa* is considered as a naturalized archaeophyte (Pyšek et al. 2012). Because it has vanished from most of its former sites, it is classified as vulnerable (Grulich 2012).

Lepidium africanum (Fig. 56)

Lepidium africanum is native to Africa, where it has a disjunct distribution. It occurs in southern and eastern tropical and subtropical Africa in open dry grasslands, arable fields and roadsides (Jonsell 1975). It has been introduced to Australia, where it became naturalized (Hewson 1982), and with cotton to South Carolina in the USA (Al-Shehbaz 1986). There have also been sporadic introductions of this species to some parts of Europe, e.g. the British Isles (Ryves 1977). In the Czech Republic it was recorded at three localities (in the towns of Liberec in northern Bohemia and Kuřim in southern Moravia, and in the village of Lesík near Nejdek in western Bohemia) between the years 1964–1990, probably having been introduced with wool or cotton. Recurrent introductions are unlikely due to the collapsing textile industry. *Lepidium africanum* is classified as a casual neophyte (Pyšek et al. 2012).

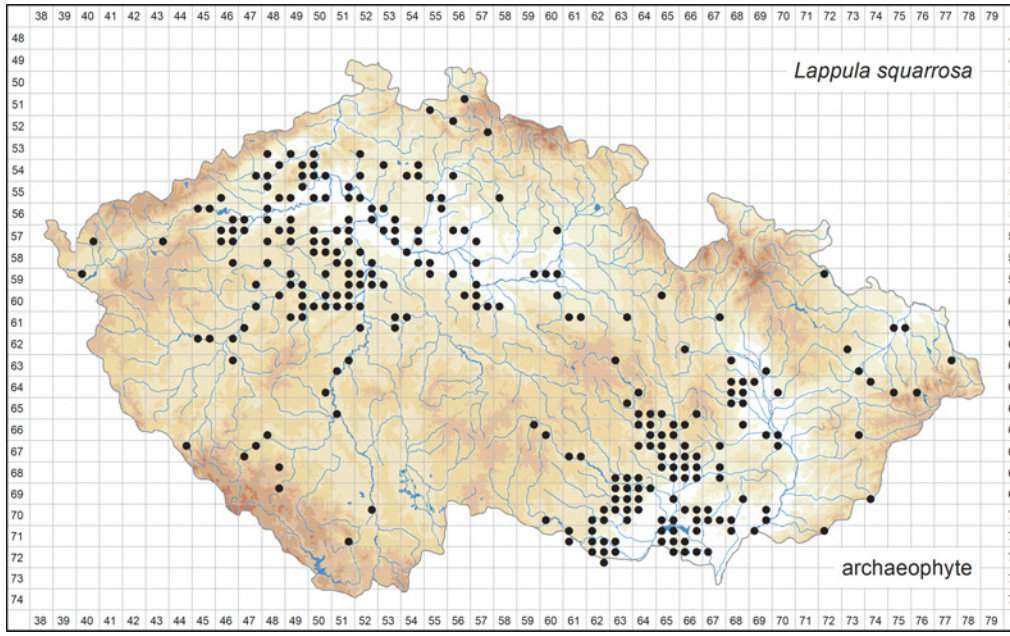

Fig. 55. – Distribution of *Lappula squarrosa* in the Czech Republic (268 occupied quadrants). Prepared by Karel Kubát.

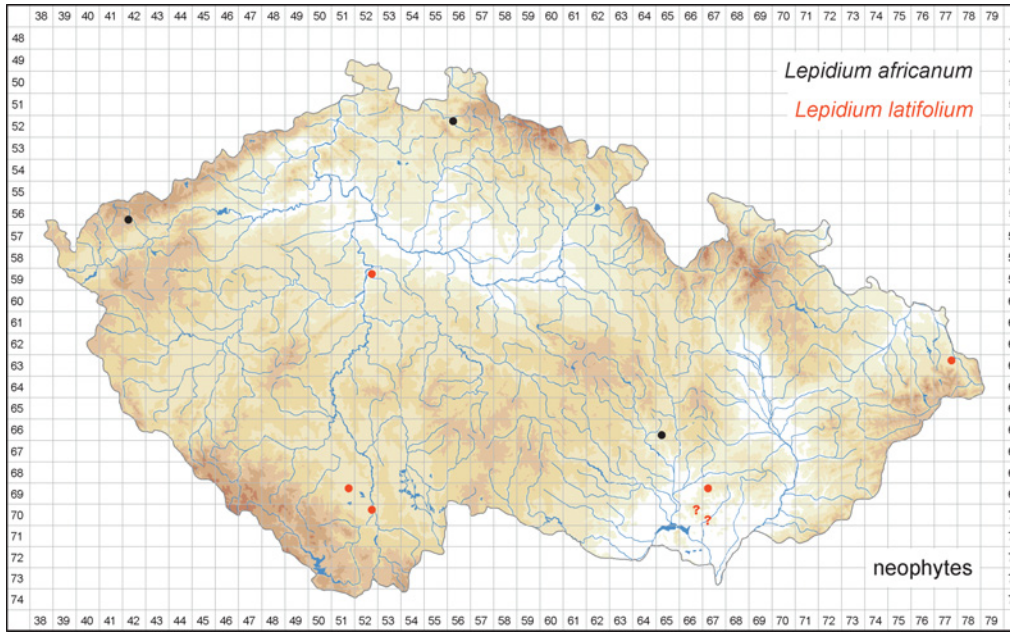

Fig. 56. – Distribution of *Lepidium africanum* (3 occupied quadrants) and *L. latifolium* (5 occupied quadrants) in the Czech Republic. Prepared by Michal Ducháček.

Lepidium campestre (Fig. 57)

Lepidium campestre is widespread throughout Europe except the arctic north, and also occurs in Turkey, Armenia and the Caucasus (Thellung 1906). Introductions are reported from North America and Australia (Hewson 1982, Al-Shehbaz 1986). It is usually a biennial. It grows in disturbed vegetation on sunny slopes and screes but also in man-made habitats such as road verges, embankments, railway stations, abandoned quarries, field margins and other ruderal sites. It prefers calcareous soils, often over limestone and marlstone. *Lepidium campestre* is most abundant in the warm lowlands, and its abundance decreases towards higher elevations. It is classified as a naturalized archaeophyte (Pyšek et al. 2002).

Lepidium coronopus (Fig. 58)

Lepidium coronopus is widespread throughout Europe except the arctic north and in northern Africa (Meusel et al. 1965). It has been introduced to North and South America (Chile), South Africa and Australia (Al-Shehbaz 2010). It is an annual or biennial growing in man-made disturbed habitats such as field tracks, wetlands in arable fields and wet disturbed places in pastures and villages. It prefers heavy, base-rich or even saline soils. In the Czech Republic this species occurs mainly in the warm lowland areas, being markedly rarer in Moravia than in Bohemia. At middle elevations it is rare, recorded mainly in the surroundings of the city of Plzeň and in the Doupovská pahorkatina highlands in western Bohemia. It is almost absent from northern Moravia, where it occurred only as temporarily introduced on deposits of iron ore. *Lepidium coronopus* has vanished from many of its former sites due to succession, changes in agricultural techniques (particularly decline of grazing) and structural changes in villages (e.g. paving and sealing). It is classified as a naturalized archaeophyte (Pyšek et al. 2012) and also as endangered (Grulich 2012).

Lepidium densiflorum (Fig. 59)

Lepidium densiflorum is native to the USA and some adjacent areas of Canada and Mexico (Thellung 1906). It has been introduced to Europe, Asia and Argentina (Al-Shehbaz 2010). It has started to spread in Europe after 1870 and now is found in most areas except for the arctic region (Meusel et al. 1965). The earliest documented record in the Czech Republic is from the vicinity of the city of Ústí nad Labem and dates back to 1904. Typical sites are railway stations and their surroundings, railway tracks, embankments, transit sheds and river ports. Its occurrence is apparently mostly random, sometimes temporary, but at many places this species has been documented for many years, particularly in industrial areas. *Lepidium densiflorum* sometimes spreads to sandy habitats including sand pits. For example, it has been repeatedly collected from the sandy habitats between the towns of Bzenec and Hodonín in southern Moravia. It is classified as a naturalized neophyte (Pyšek et al. 2012). Since *L. densiflorum* is often confused with both the rare *L. virginicum* and the much more common *L. ruderale*, the map of *L. densiflorum* is based solely on examined herbarium specimens.

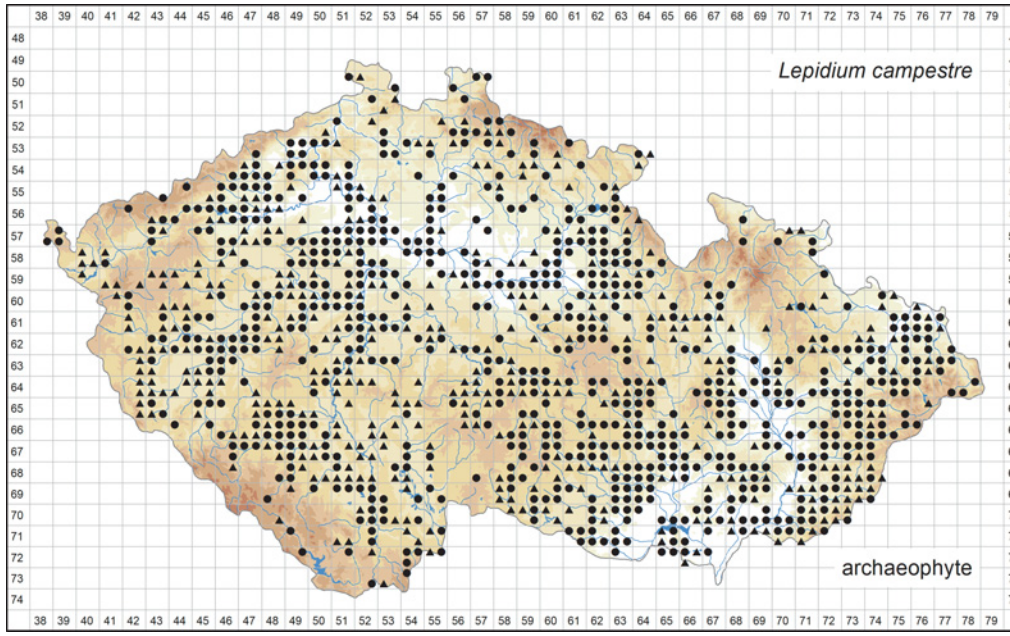

Fig. 57. – Distribution of *Lepidium campestre* in the Czech Republic: ● occurrence documented by herbarium specimens (705 quadrants), ▲ occurrence based on other records (397 quadrants). Prepared by Michal Ducháček.

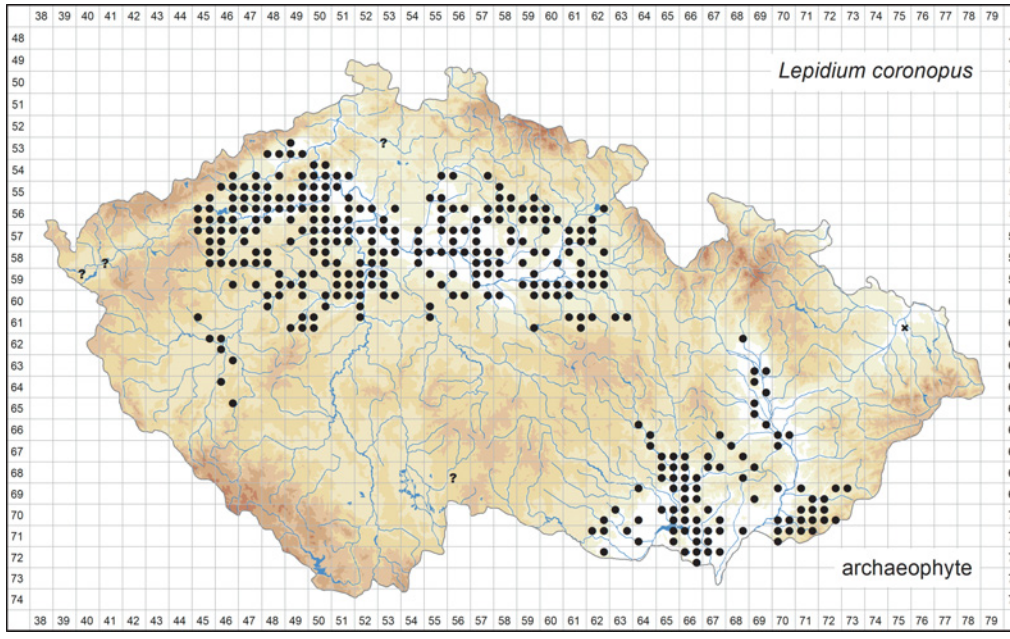

Fig. 58. – Distribution of *Lepidium coronopus* in the Czech Republic (341 occupied quadrants). Prepared by Michal Ducháček.

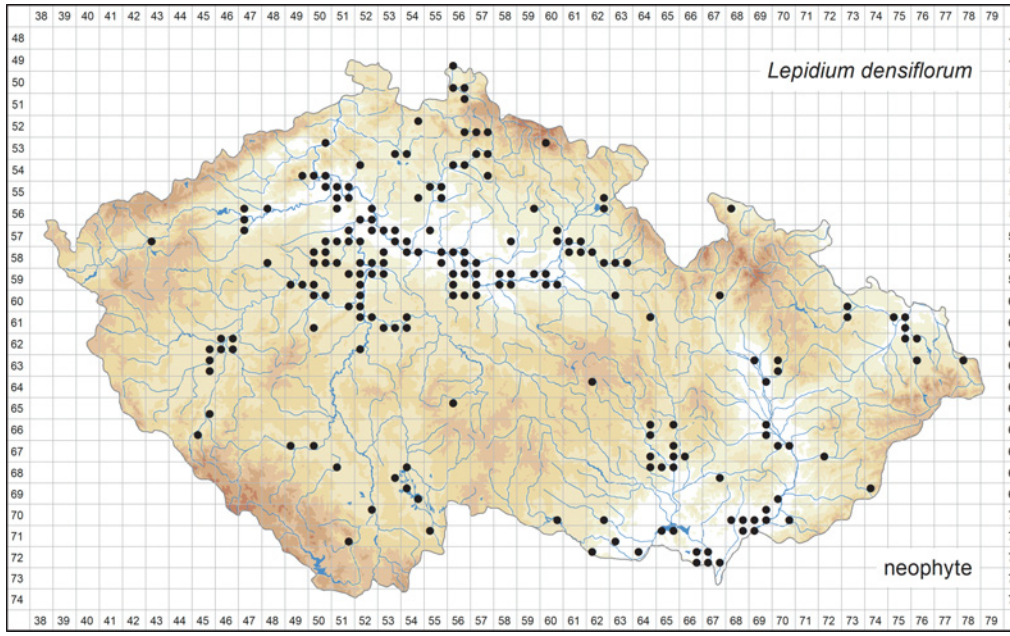

Fig. 59. – Distribution of *Lepidium densiflorum* in the Czech Republic (195 occupied quadrants). Prepared by Michal Ducháček.

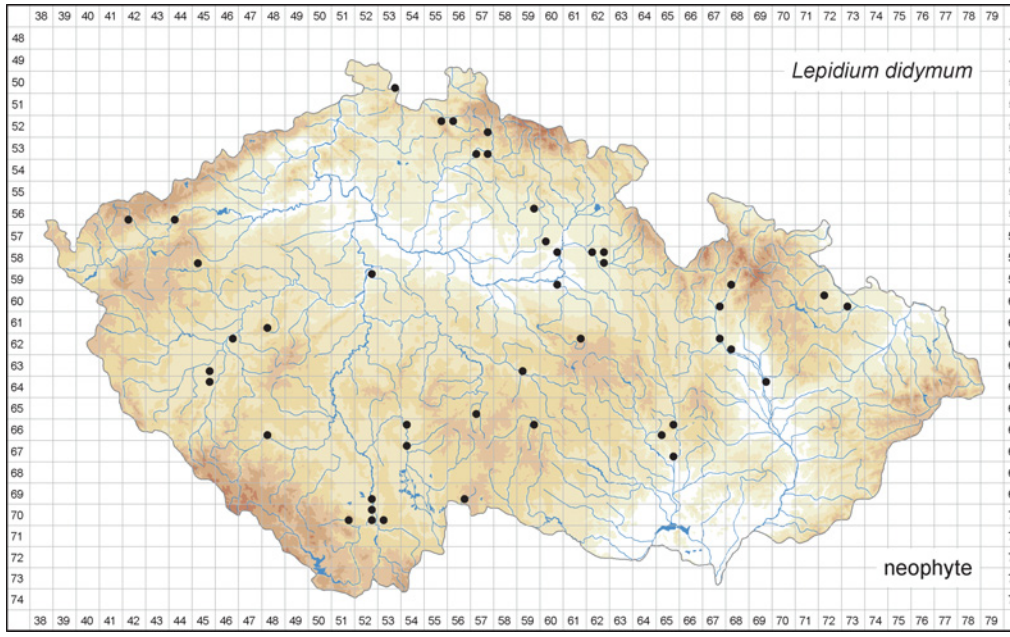

Fig. 60. – Distribution of *Lepidium didymum* in the Czech Republic (44 occupied quadrants). Prepared by Michal Ducháček.

Lepidium didymum (Fig. 60)

Lepidium didymum is native to southern South America and naturalized in Central and North America, Europe, Asia, Africa and Australia (Al-Shehbaz 2010). In the Czech Republic it was first found in the village of Sobotín in northern Moravia in 1903, but most of the localities were recorded after 1960. This species is still very rare. Its occurrences are often only temporary, though it has been repeatedly recorded from several places. It grows in man-made habitats such as dump sites, old building rubble, railway stations and surroundings of spinning factories. It has also been recorded as a weed in gardens and cemeteries, occasionally also at the edges of city pavements. It is classified as a casual neophyte (Pyšek et al. 2002).

Lepidium draba (Fig. 61)

Lepidium draba is probably native to south-eastern Europe, the Mediterranean area including northern Africa and to central Asia, but today it is widespread throughout Europe with the exception of northern Scandinavia (Meusel et al. 1965). It has also become naturalized in South Africa, Australia, North America and South America (Al-Shehbaz 2010). In the Czech Republic this perennial grows most frequently in man-disturbed habitats, where it spreads through sprouting and adventitious buds of the extensive root system. It grows in habitats such as rubble sites, soil deposits, disturbed slopes, field edges, ditches, road verges, railway tracks and railway stations and median strips of motorways. In the Czech Republic it is abundant to scattered in most of the warm areas and less frequent to rare at middle elevations, locally being absent or only sporadically and temporarily introduced to ruderal habitats. It is classified as a naturalized archaeophyte (Pyšek et al. 2012).

Lepidium heterophyllum (Fig. 62)

Lepidium heterophyllum is probably native to south-western Europe (Portugal, Spain, France) and the British Isles. Elsewhere in Europe it has been introduced rarely to Germany, Belgium, Switzerland and Scandinavia (Thellung 1909, De Carvalho e Vasconcellos et al. 1993). It has also become naturalized in North America and Chile (Al-Shehbaz 2010). The natural habitats are sunny slopes, pastures and stony places in rather high elevations over siliceous bedrock (Hernández-Bermejo & Clemente 1993). In the Czech Republic this perennial is very rare, occurring at railway stations and in their vicinities (in rubble sites, soil deposits, rocks) and rarely along rivers. It grows in rather cold areas, with the majority of sites concentrated in western and southern Bohemia. The first record dates back to 1905 when it was discovered near the town of Třemošná near the city of Plzeň. Most of the occurrences were recorded during the second half of the 20th century. In some places (such as the Strunkovice nad Volyňkou railway station in southern Bohemia and the Domina railway station in northern Bohemia) this species has continued to persist for a long time. Because of the frequent confusion with *L. campestre*, the map is based solely on examined herbarium specimens. *Lepidium heterophyllum* is classified as a casual neophyte (Pyšek et al. 2012).

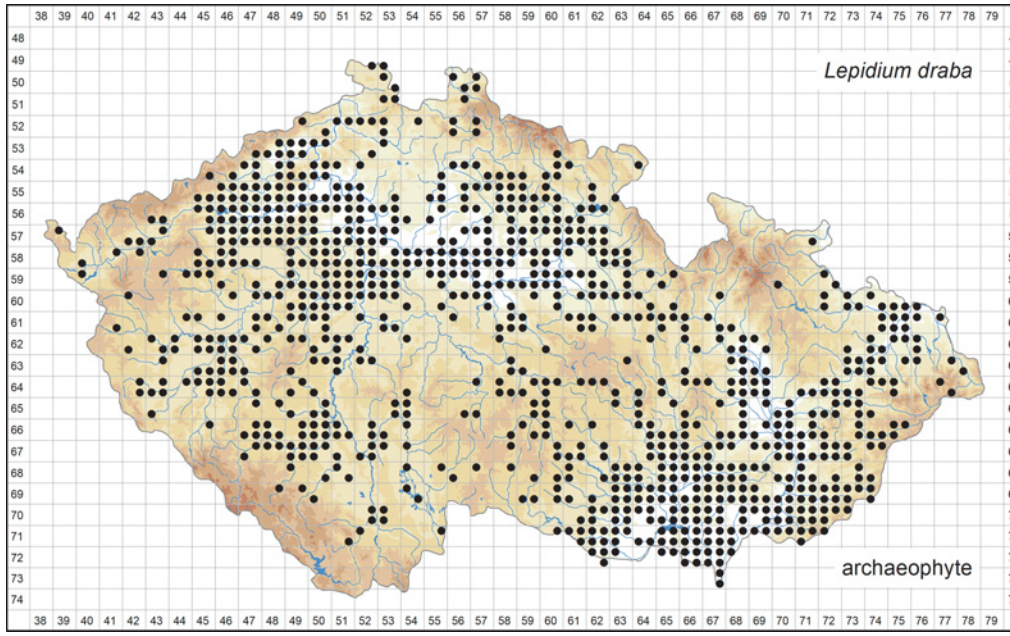

Fig. 61. – Distribution of *Lepidium draba* in the Czech Republic (930 occupied quadrants). Prepared by Michal Ducháček.

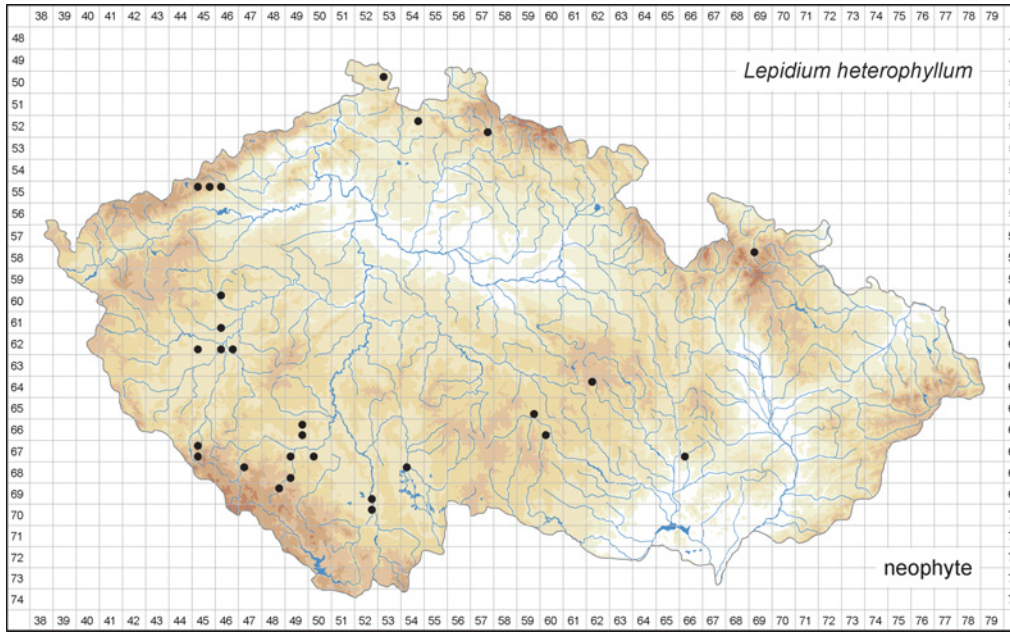

Fig. 62. – Distribution of *Lepidium heterophyllum* in the Czech Republic (28 occupied quadrants). Prepared by Michal Ducháček.

Lepidium latifolium (Fig. 56)

Lepidium latifolium is native to the Mediterranean area, seaside regions of western, central and northern Europe, Anatolia and Iran, extending eastwards to central Asia, China, Mongolia and Siberia (Thellung 1909, Jalas et al. 1996). It has been introduced to North America, South America (Argentina) and Australia (Al-Shehbaz 2010). In its native range it grows on slopes and river banks (Hernández-Bermejo & Clemente 1993). There are only a few records from the Czech Republic, with the earliest documented one from the village of Bošovice in southern Moravia (in 1878–1947), where it was cultivated for a long time as a vegetable and apparently escaped several times. This species was also recorded in the town of Třinec on deposits of iron ore imported from Ukraine (Kryvyj Rih) in 1960–1997. Recently, *L. latifolium* was also found near the freight station in the city of České Budějovice and on the railway line near the village of Zbudov in southern Bohemia. It is classified as a casual neophyte (Pyšek et al. 2012).

Lepidium perfoliatum (Fig. 63)

Lepidium perfoliatum is native to south-eastern Europe and Asia from its south-western parts as far as the Himalayas and Altai Mts (Thellung 1906). Elsewhere in Europe, as well as in North and South America and Australia it has been introduced (Al-Shehbaz 2010). It grows in saline habitats and sandy places but also in railway embankments, railway stations, iron deposits and dump sites. In the Czech Republic *L. perfoliatum* is alien; the nearest native occurrences are in the salt marshes in southern Slovakia (Kmeťová 2002). This species has been rarely and mostly temporarily introduced to various locations, most frequently the cities of Prague, Brno, Olomouc and Ostrava. Recently, *L. perfoliatum* has been found only at several sites. It is classified as a casual neophyte (Pyšek et al. 2012).

Lepidium ruderale (Fig. 64)

Lepidium ruderale is found throughout almost all of Europe with the exception of the arctic region, and also occurs in large parts of temperate and subtropical Asia (Thellung 1906, Meusel et al. 1965). It is likely to have been introduced into many places in the world, but due to confusion with similar species, its distribution cannot be outlined with certainty (Jonsell 1975, Hewson 1982, Al-Shehbaz 2010). It is reliably recorded as introduced into North America (Al-Shehbaz & Gaskin 2010). In the Czech Republic it grows almost exclusively in man-made habitats, particularly in villages and towns. Typical habitats are rubble sites, crevices in street pavement, railway stations and landfills. This species also grows on salted road verges, where it has been spreading intensively to rather high elevations in recent decades. *Lepidium ruderale* grows abundantly throughout the Czech Republic, but is rare in mountains. Many of the gaps on the map are most likely due to under-recording rather than true absences. This species is classified as a naturalized archaeophyte (Pyšek et al. 2012).

Lepidium sativum (Fig. 65)

Lepidium sativum is native to north-eastern Africa and south-eastern Asia (Thellung 1906). It is cultivated and has become naturalized in Europe, Asia, North America, South America (Argentina) and Australia (Cheo et al. 2001, Al-Shehbaz 2010). In the Czech

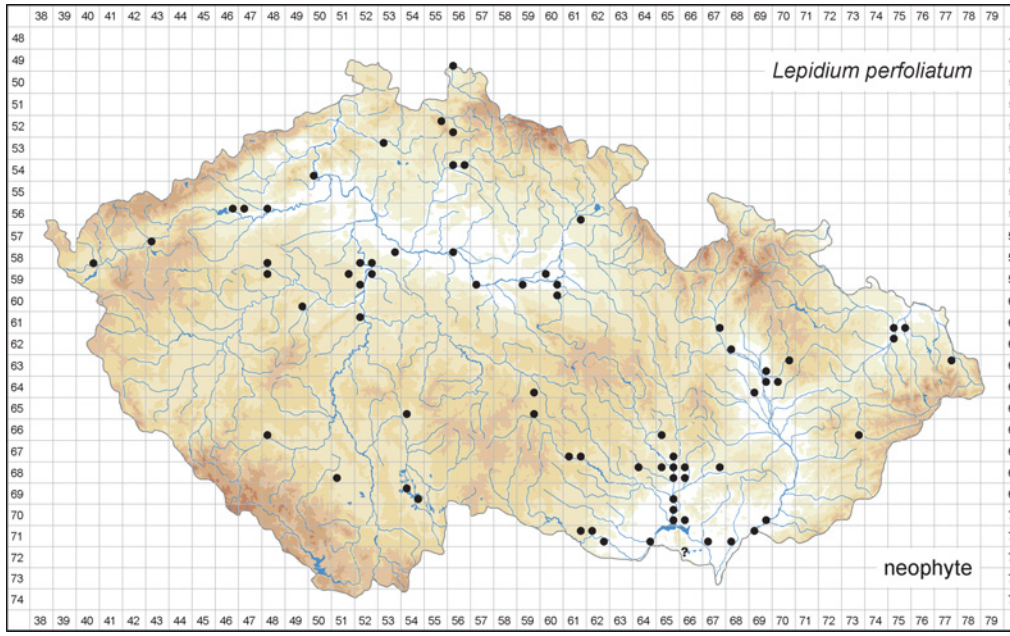

Fig. 63. – Distribution of *Lepidium perfoliatum* in the Czech Republic (71 occupied quadrants). Prepared by Michal Ducháček.

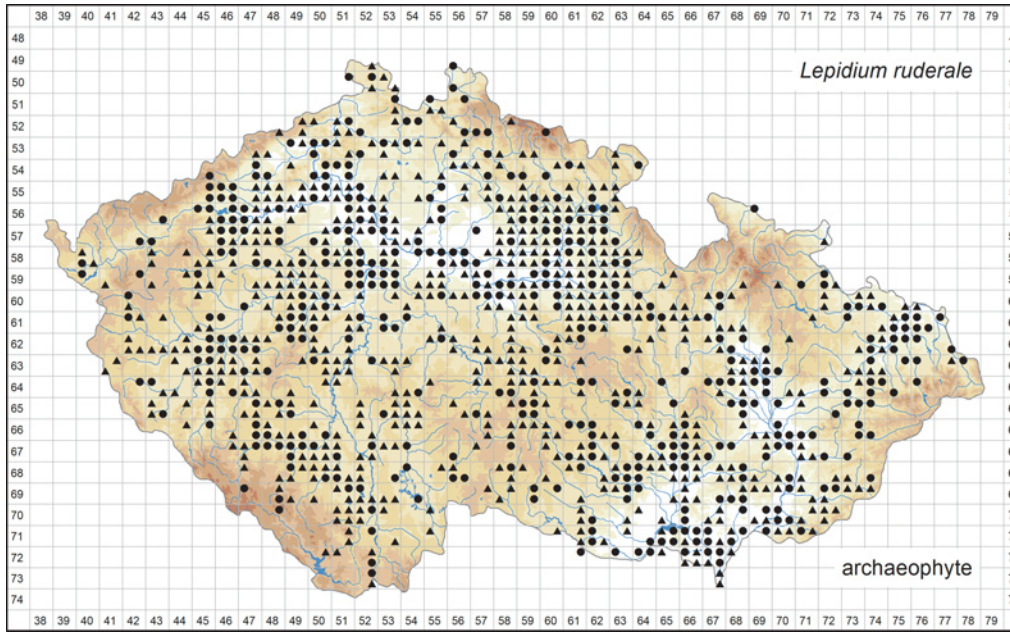

Fig. 64. – Distribution of *Lepidium ruderale* in the Czech Republic: ● occurrence documented by herbarium specimens (426 quadrants), ▲ occurrence based on other records (600 quadrants). Prepared by Michal Ducháček.

Republic it is often cultivated but usually only as a vegetable in pots, with seedlings or young plants harvested. It temporarily escapes from cultivation in the vicinity of villages and towns, mainly in dump sites, and occasionally it is also found at railway stations and in the past was encountered as a weed in flax fields. Herbarium specimens documenting spontaneously propagating plants in gardens where this species has been cultivated are frequent, but these records are not included in the map. *Lepidium sativum* is classified as a casual neophyte (Pyšek et al. 2012).

Lepidium virginicum (Fig. 66)

Lepidium virginicum is native to North America, where it occurs in almost the entire USA and in some adjacent parts of Canada, extending southwards to Mexico (Thellung 1906). It has been introduced into South America, Europe, Asia and Australia (Al-Shehbaz 2010). In Europe it was first recorded in the second half of the 19th century. The earliest record from the Czech Republic dates back to 1920 when it was found in the surroundings of the town of Roudnice nad Labem in northern Bohemia. Typical habitats of *L. virginicum* are railway stations and railway lines, river ports, transit sheds, industrial areas and their surroundings. It is considerably rarer than the related *L. densiflorum*, being more frequent only in northern Moravia and southern Bohemia. Because it is often confused with *L. densiflorum*, the map is based solely on examined herbarium specimens. *Lepidium virginicum* is classified as a naturalized neophyte (Pyšek et al. 2012).

Liparis loeselii (Fig. 67)

Liparis loeselii is a temperate species, distributed in Europe mainly in its central part, extending westwards to the British Isles and France, northwards to southern Norway and Sweden, eastwards to the central part of European Russia and southwards to northern Italy and Bulgaria. It also occurs in western Siberia and in mainly eastern, but also rarely western North America (Meusel et al. 1965, Hultén & Fries 1986). In the Czech Republic *L. loeselii* occurs in fens, transitional mires and around calcareous springs. It mostly grows on mineral-rich, neutral to alkaline soils with high groundwater levels, often in places in the initial succession stage or in disturbed patches with low herb layer cover or only a moss layer. It has been recorded at about 22 sites in the lowlands and at middle elevations, most of which are in northern and eastern Bohemia, while isolated sites have been recorded in southern Bohemia and in southern, central and north-eastern Moravia. The majority of these populations disappeared in the late 19th century or during the first half of the 20th century due to direct habitat destruction, including drainage and conversion to arable land, and as a result of mowing abandonment and eutrophication followed by succession. Since 2000 *L. loeselii* has been observed at only eight sites in this country. This species is therefore classified as critically threatened (Grulich 2012).

Loranthus europaeus (Fig. 68)

Loranthus europaeus occurs mainly in south-eastern Europe, extending westwards to central and southern Italy and northwards to the Czech Republic (with one extant site in Germany close to the Czech border) and Slovakia, and eastwards to Ukraine, Romania and Bulgaria; isolated sites are in Crimea and southern Turkey (Meusel et al. 1965).

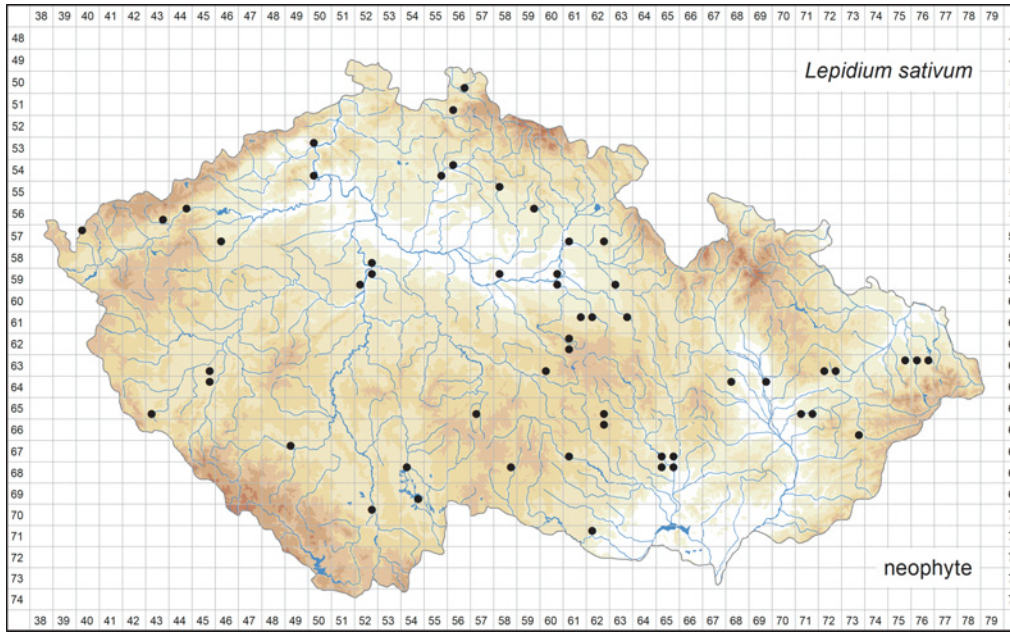

Fig. 65. – Distribution of *Lepidium sativum* in the Czech Republic (54 occupied quadrants). Prepared by Michal Ducháček.

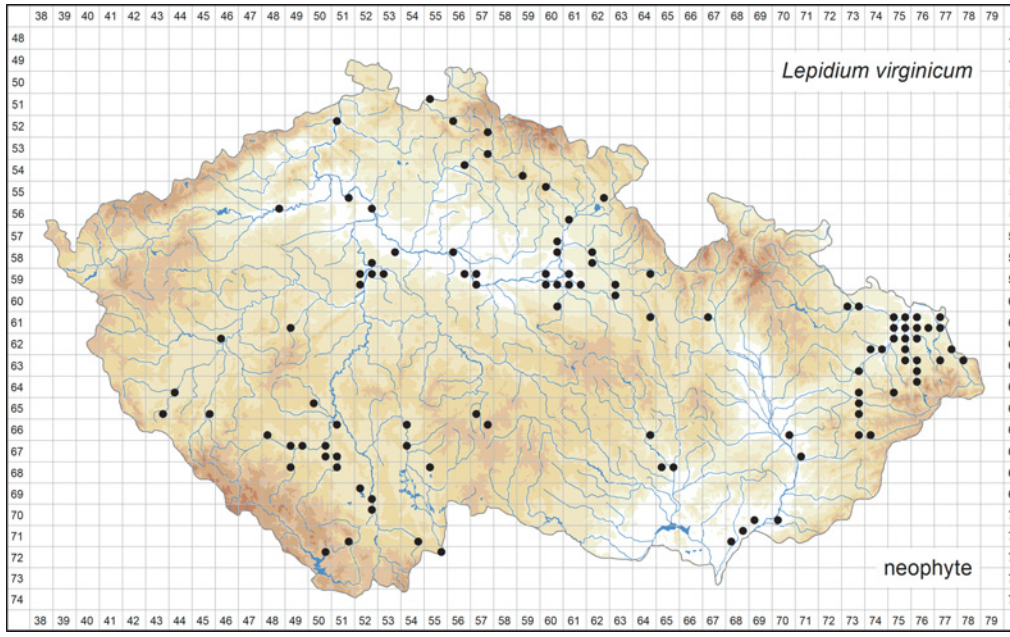

Fig. 66. – Distribution of *Lepidium virginicum* in the Czech Republic (106 occupied quadrants). Prepared by Michal Ducháček.

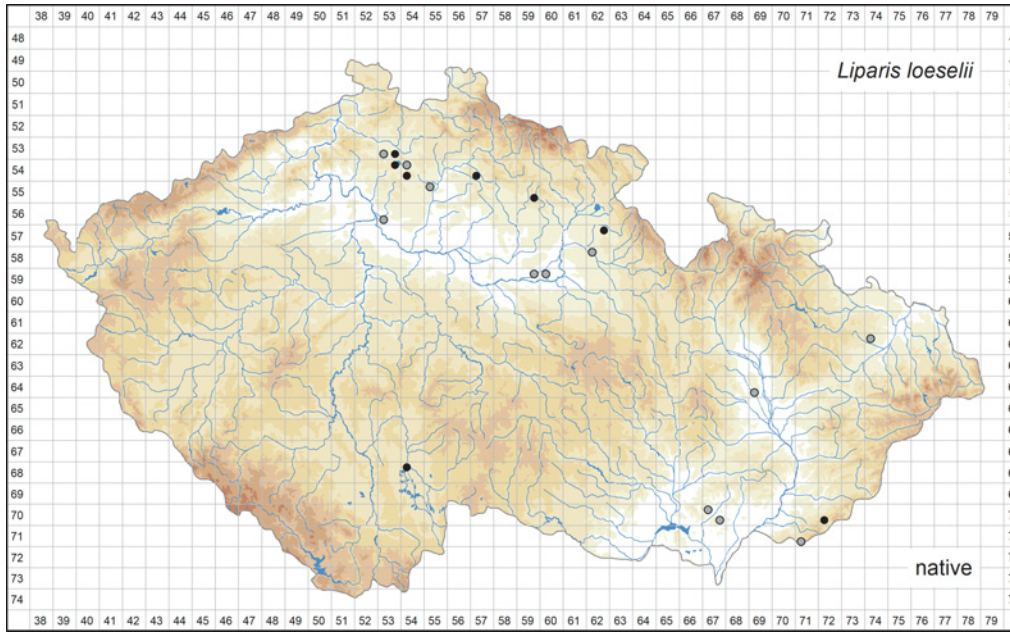

Fig. 67. – Distribution of *Liparis loeselii* in the Czech Republic: ● at least one record in 2000–2018 (8 quadrants), ◍ pre-2000 records only (12 quadrants). Prepared by Zdeněk Kaplan.

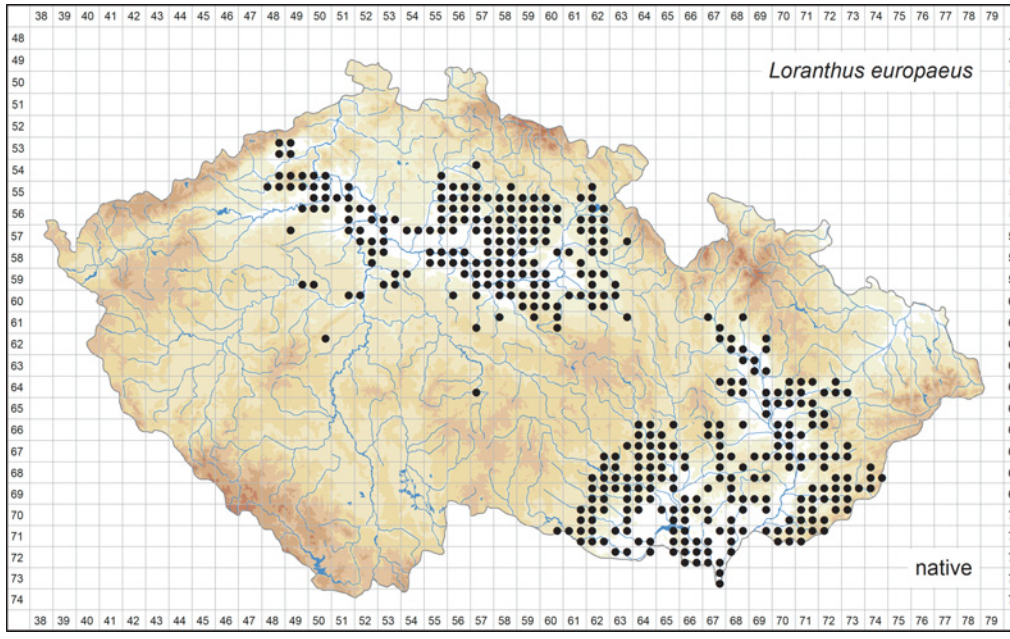

Fig. 68. – Distribution of *Loranthus europaeus* in the Czech Republic (399 occupied quadrants). Prepared by Karel Kubát.

Loranthus europaeus is a stem hemiparasite. The host trees in the Czech Republic are mostly *Quercus robur* and *Qu. petraea*, scarcely also other oak species (*Qu. pubescens*, *Qu. cerris* and *Qu. rubra*). It has rarely been collected on *Prunus spinosa*, *Carpinus betulus* and *Acer campestre*. In this country *L. europaeus* occurs mainly in the warm areas in central and southern Moravia, north-western and eastern Bohemia and an adjacent part of central Bohemia. Isolated occurrences in other areas have mostly not been confirmed for more than a century (Kubát 1994). It appears that at least in north-western Bohemia, close to the north-western limit of its range, *L. europaeus* is found mostly on isolated trees, particularly in parks, along the roads, in edges of forests or along broad forest roads, and is more scarce inside the forests. Abundant populations are mainly found on oak trees in floodplain forests and in alluvia of large rivers, such as Labe, Ohře, Dyje and Morava, and in southern Moravia in open thermophilous oak forests. *Loranthus europaeus* is classified as being at lower risk – near threatened (Grulich 2012).

Lycopus europaeus (Fig. 69)

Lycopus europaeus is a perennial wetland forb native to temperate and Mediterranean zones in Europe, western parts of Asia and northern Africa and introduced to North America, Australia and New Zealand. In addition to subsp. *europaeus*, in southern Europe subsp. *menthifolius* also occurs. The latter has also been recorded as introduced at a single site in the Czech Republic (Meusel et al. 1978, Hultén & Fries 1986, Chrtek jun. 2000). However, due to the rarity and unclear taxonomic value of subsp. *menthifolius*, we do not distinguish between these two subspecies in the map. *Lycopus europaeus* is one of the most common components of various types of marshland vegetation, particularly of reed and tall sedge beds, occurring in a broad range of habitats such as littoral zones of various artificial water bodies (in the Czech Republic particularly fishponds), mires, banks of rivers, brooks and canals, river arms, mining pits, springs, wet forest tracks and clearings. It grows on various substrates including loam, clay, gravel or sand, often with a layer of undecomposed organic detritus, only avoiding deep sapropelic mud. Its sticky fruits exhibit long buoyancy and are easily attached to objects such as stony fishpond dams or pieces of dead wood, enabling establishment of young plants even in these extreme conditions. *Lycopus europaeus* is rather tolerant to fluctuations in water level, surviving deep submersion of its stems and leaves (in clear water or during cold periods of the year for several weeks to several months) as well as substrate desiccation. In the Czech Republic it occurs from the lowlands to the mountains, reaching its elevational maximum of about 980–990 m at the villages of Kvilda and Nová Pec in the Šumava Mts. It is rare in or missing from the high mountains and landscapes with prevailing arable land and a lack of suitable habitats. However, some of the gaps on the map, e.g. in western Bohemia and central Moravia, are likely due to under-recording rather than true absences.

Lycopus exaltatus (Fig. 70)

Lycopus exaltatus is a perennial wetland forb with its main distribution in continental parts of Eurasia, in central Europe being considered as Pontic-Pannonian species accompanying large river floodplains. Its native range extends from the Altai, Himalaya and Ural Mts westwards through the lowlands around the Caspian Sea and Black Sea, the

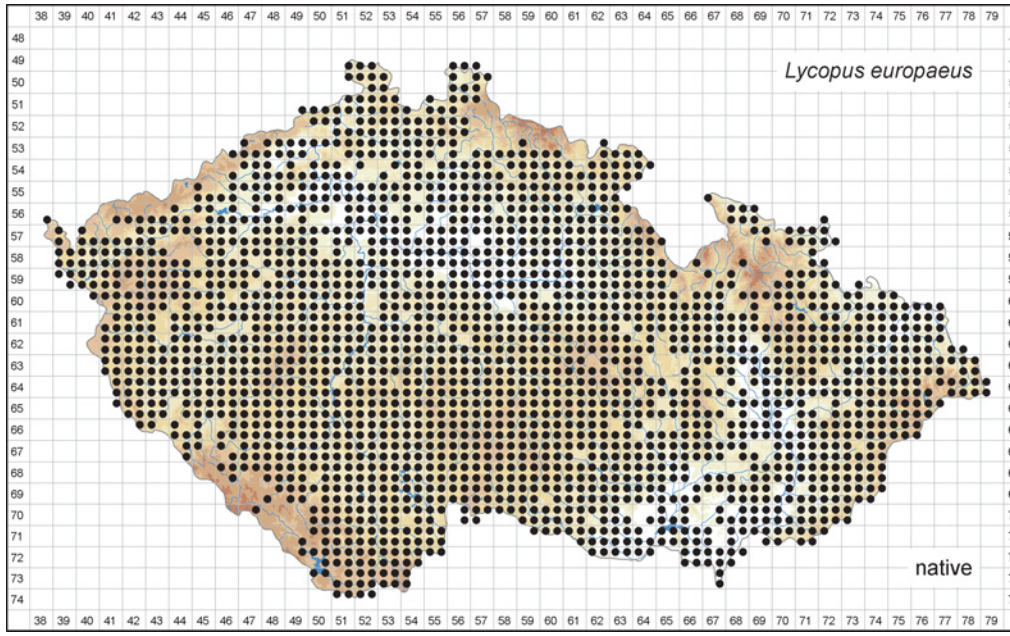

Fig. 69. – Distribution of *Lycopus europaeus* in the Czech Republic (2078 occupied quadrants). Prepared by Kateřina Šumberová.

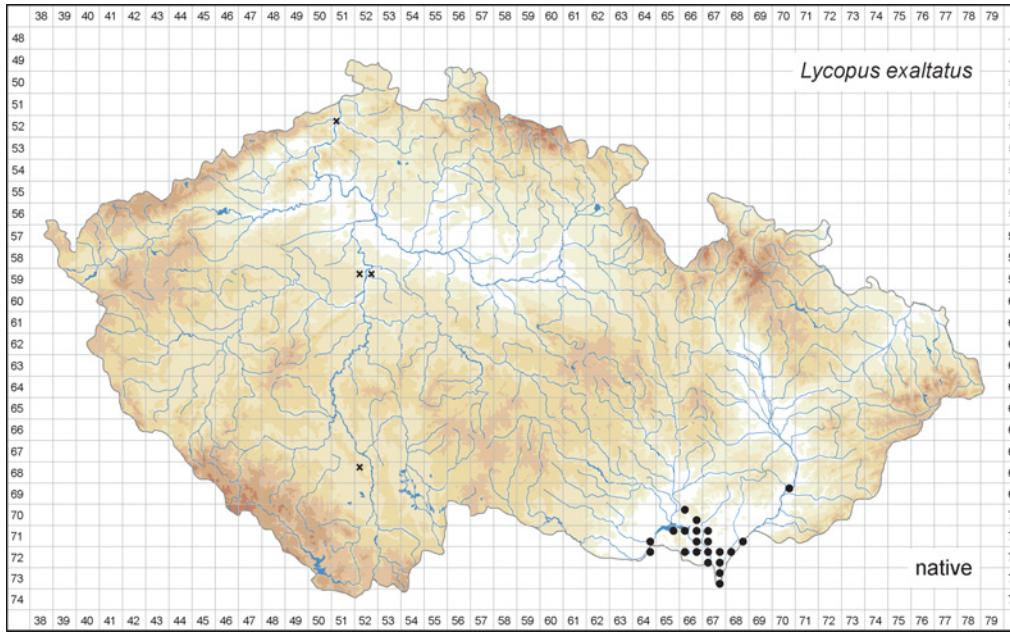

Fig. 70. – Distribution of *Lycopus exaltatus* in the Czech Republic: ● native (21 quadrants), × alien (4 quadrants). Prepared by Kateřina Šumberová.

upper Volga valley in Russia, southern Belarus and southern Poland as far as the Pannonian Basin in Hungary, eastern Austria, southern Slovakia and southern Moravia in the Czech Republic. Southwards this species reaches the Caucasus, Anatolia, northern Greece and northern Italy (Hegi 1964, Chrtek jun. 2000). The occurrences in southern Moravia are situated at the north-western limit of the species' native distribution. Earlier occurrences situated further north- and westwards in Bohemia, Germany, Belgium and France are considered as introductions (Hegi 1964, Verloove 2006). *Lycopus exaltatus* grows in unmown or occasionally mown tall-forb vegetation at the fringes of floodplain forests and meadows, in floodplain forest clearings, verges of rarely used roads, on river banks, at margins of reed beds and salt marshes, in wetlands on arable land and similar habitats with regular disturbances by floods and/or management. It is capable of surviving even in stands with high proportions of competitive invasive species such as *Symphyotrichum novi-belgii* agg. *Lycopus exaltatus* grows on heavy, often saline, neutral to slightly basic, nutrient- and mineral-rich soils, which are usually very wet but which get deeply desiccated in summer. In the Czech Republic *L. exaltatus* grows only in floodplains of the lower stretches of the Dyje and Morava rivers in southernmost Moravia and in adjacent lowlands, with a northernmost outpost at the town of Uherské Hradiště. In the past this species was certainly more frequent, because large areas of potentially suitable habitats were converted to arable land or destroyed during river regulations in the 1970s and 1980s. Past occurrences in the town of Děčín in northern Bohemia, near the town of Týn nad Vltavou in southern Bohemia and in Prague are considered to have been temporary introductions. Due to its overall rarity and the endangerment of native tall-forb vegetation in the lowland floodplains *L. exaltatus* is classified as endangered (Grulich 2012).

Lythrum hyssopifolia (Fig. 71)

Lythrum hyssopifolia is a wetland annual with an extensive but disjunct distribution range. It is native to Europe, southwards extending to the Azores, Canary Islands and the northern half of Africa, and eastwards to south-western Asia, Transcaucasia and south-western Siberia. The occurrences in North and South America, southern Africa, southern Australia and New Zealand are considered as secondary. In Europe this species occurs in the Mediterranean and warm temperate zones, reaching northern distribution limits in southern England, northern Germany and northern Poland and north-eastern distribution limits in the middle Dnepr and Volga river basins; records from Denmark, northern England and Scotland refer to introductions (Meusel et al. 1978, von Lampe 1996). In the Czech Republic *Lythrum hyssopifolia* colonizes various types of wet habitats with weak competition from perennial vegetation; these include such sites as exposed margins and bottoms of fishponds, fish storage ponds, sand pits, river arms and active river beds, wet pastures, salt marshes, field and meadow tracks and wetlands on arable land. It is most common in warm, moderately humid areas, where it grows on mineral-rich, often slightly saline substrates. *Lythrum hyssopifolia* exhibits a very broad ecological range in the relation to substrate texture and moisture, growing on sands, gravels, loams and clays and surviving under shallow flooding as well as on deeply dried soils (von Lampe 1996). However, as a thermophilous, late germinating species it suffers from the reduction in length of summer drainage of fishponds and the absence of low-intensity disturbances in

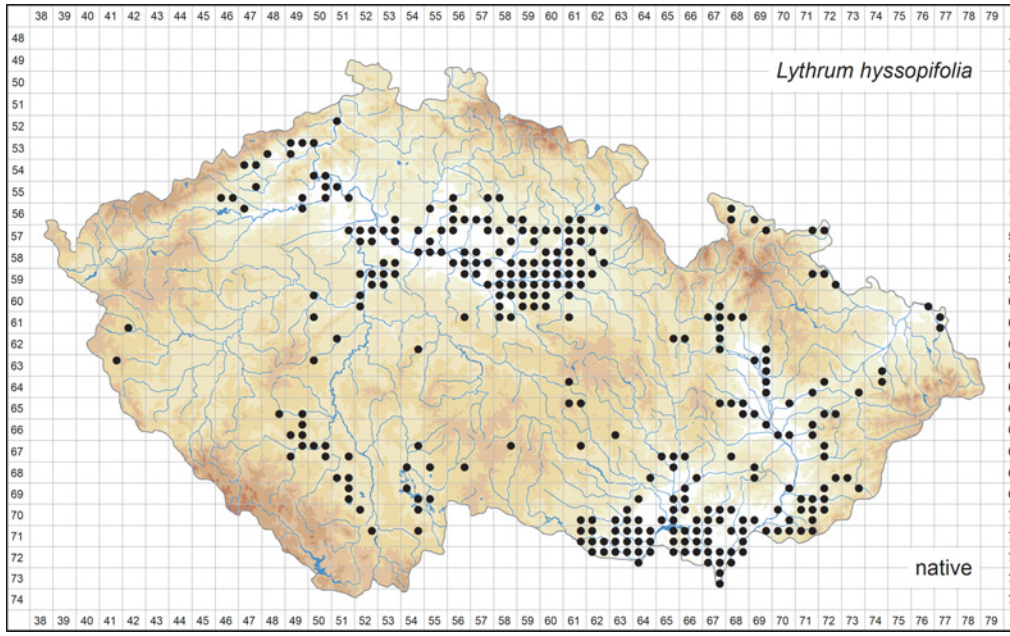

Fig. 71. – Distribution of *Lythrum hyssopifolia* in the Czech Republic (306 occupied quadrants). Prepared by Kateřina Šumberová.

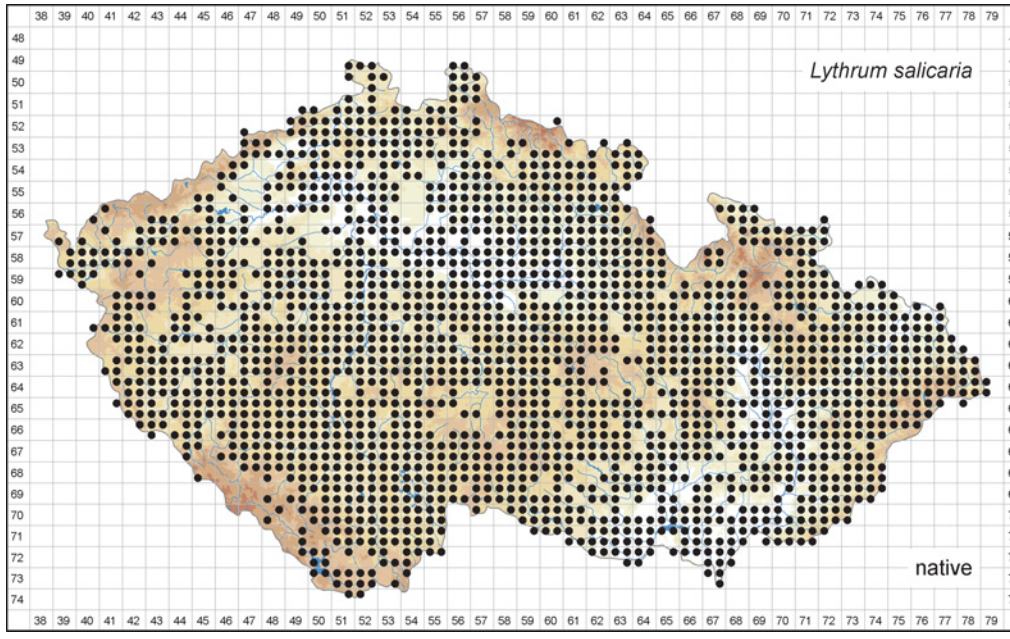

Fig. 72. – Distribution of *Lythrum salicaria* in the Czech Republic (1935 occupied quadrants). Prepared by Kateřina Šumberová.

most of the habitats. In the Czech Republic *L. hyssopifolia* occurs mainly in the lowlands and adjacent hilly areas (up to about 300 m a.s.l.) in north-western, central and eastern Bohemia and southern, south-eastern and central Moravia. The largest, stable populations of this species are known from wetlands on arable land in southern Moravia and the Bílé Karpaty Mts. Many fishpond populations formerly frequent in warm areas (e.g. eastern Bohemia) have disappeared, but since the 1930s this species has spread at middle elevations (usually of about 400–500 m a.s.l., with a maximum at 580 m a.s.l.) in fishpond landscapes in southern Bohemia and later also in western Bohemia and the Česko-moravská vrchovina highlands, being introduced with cereals for feeding carp and ducks. In some of these fishponds, mainly those with a shortage of water in dry years, *L. hyssopifolia* has survived for decades. Because of its strong overall decline, this species is classified as endangered (Grulich 2012).

Lythrum salicaria (Fig. 72)

Lythrum salicaria is a perennial wetland forb native to Europe, north-western Africa, Anatolia, the Caucasus Mts and Transcaucasia, western Siberia, Russian Far East, Korea, Japan and eastern and south-eastern China; it is very rare in or missing from large parts of Asia with very warm, dry or cold climate. It has been introduced to the USA, Canada, Peru, Ethiopia and Australia (Meusel et al. 1978, Hultén & Fries 1986), being an invasive weed particularly in North America (Blossey et al. 2001). Its European distribution range involves nearly the whole continent except for its northernmost parts and very dry areas in the surroundings of the Caspian Sea. *Lythrum salicaria* is a species occurring across a broad range of wetland habitats such as littoral zones of ponds (in the Czech Republic particularly fishponds), banks of rivers, river arms, channels and alluvial pools, various types of wet meadows and floodplain forests, wet ditches, wet dump areas and wetlands on arable land. Along with wetland annual herbs it is one of the most common colonizers of exposed muddy substrates, where its seedlings may appear in large numbers due to its high seed production. In the Czech Republic *L. salicaria* is widespread throughout the country from the lowlands to the mountains, but it is absent from the high mountains. In warm and dry areas such as north-western Bohemia and southern Moravia it mainly occurs in river floodplains, being rare in landscapes with prevailing arable land and a lack of suitable wet habitats. However, some of the gaps, e.g. in western Bohemia, are likely due to under-recording rather than representing true absences.

Lythrum virgatum (Fig. 73)

Lythrum virgatum is a perennial wetland forb with Eurasian distribution, occurring mainly in the regions with a continental climate. In Europe it is most frequent in its south-eastern part, extending as far as north-western Italy, northern Austria, the Czech Republic, north-eastern Poland, Lithuania and the central part of European Russia. In Asia it extends to Anatolia, the Caucasus, central Asia and southern Siberia as far as Lake Baikal. The localities in the Czech Republic are situated at the north-western limit of the species' native distribution. Further to the north-west this species was recorded in the past as introduced in Belgium (Hegi 1965, Dvořáková 1997, Verloove 2006). *Lythrum virgatum* is a species typical of wet meadows in lowland floodplains of large rivers, where it usually occurs approximately in the middle of the moisture gradient. It may also

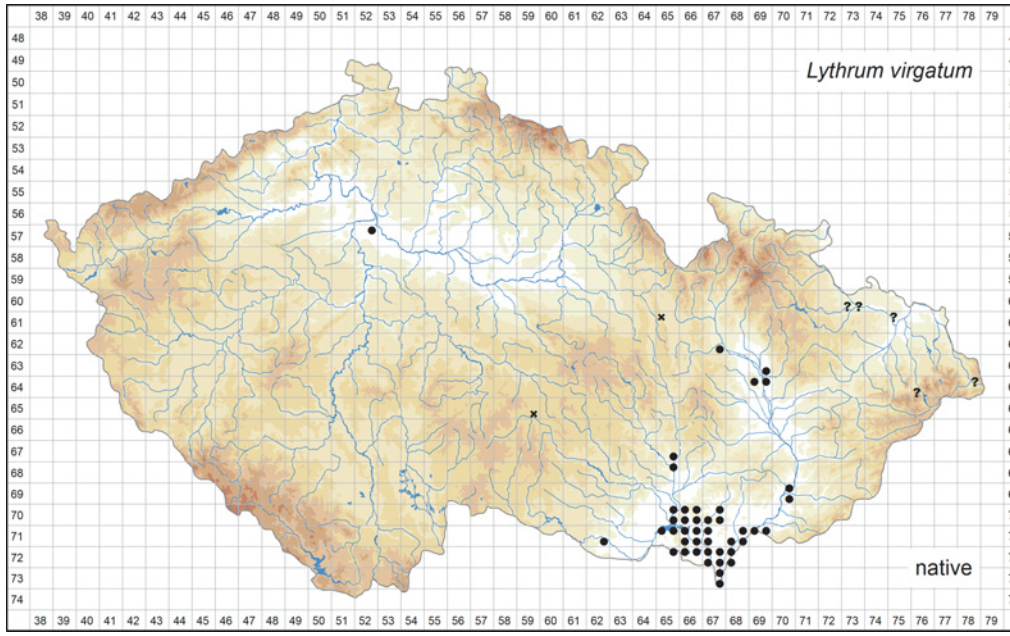

Fig. 73. – Distribution of *Lythrum virgatum* in the Czech Republic: ● native (43 quadrants), × alien (2 quadrants). Prepared by Kateřina Šumberová.

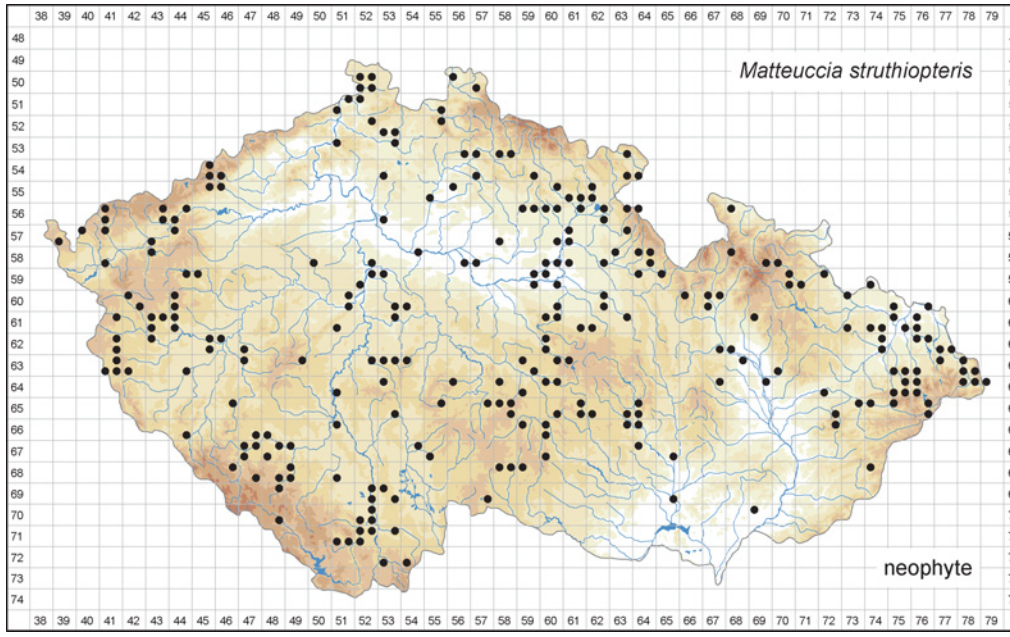

Fig. 74. – Distribution of *Matteuccia struthiopteris* in the Czech Republic (268 occupied quadrants). Prepared by Libor Ekrt.

grow in intermittently wet fen meadows, sub-saline wet grasslands, at the margins of reed and tall sedge beds and exceptionally also in semi-ruderal vegetation on railway embankments or in disturbed patches around mining areas. The soils are usually heavy, loamy or clayey, mineral and nutrient-rich, slightly acidic to slightly basic. Although this species prefers regularly mown meadows, in vegetation without very strong competitors it is able to persist for a couple of years even without suitable management. Most of the records of *L. virgatum* in the Czech Republic come from the floodplains of the Morava and Dyje rivers and the adjacent plain to hilly landscapes in southern Moravia. In the past its distribution extended northwards as far as the city of Brno and the town of Mohelnice, and isolated occurrences were reported from northern Moravia and Silesia around the towns of Opava, Ostravice and Jablunkov. This species was also collected in the Labe river floodplain near the town of Mělník in central Bohemia. The latter occurrence is considered to be doubtful in the Flora of the Czech Republic (Dvořáková 1997), and similarly the records undocumented by specimens from northern Moravia and Silesia seem to be either misidentifications with *L. salicaria* or temporary introductions. However, there are specimens of other species with similar ecology from these areas, e.g. *Gratiola officinalis* (see Kaplan et al. 2016b) and thus, a native past occurrence of *L. virgatum* cannot be excluded. Although this species is able to establish outside of its native range, as shown by its secondary occurrences in the surroundings of Jihlava in the Českomoravská vrchovina highlands and near the town of Lanškroun in eastern Bohemia, it vanished from many of its former sites already during the 19th century. The loss of its populations accelerated in the 1970s and 1980s, affecting even sites in the floodplains of southern Moravia. Many of the populations were lost due to river regulation, conversion of wet meadows to arable land and recently also their long-term abandonment or afforestation. This species is further threatened by land-use changes and is therefore classified as endangered (Grulich 2012).

Matteuccia struthiopteris (Fig. 74)

Matteuccia struthiopteris has a circumpolar distribution in temperate areas in the Northern Hemisphere. In Europe it is most frequent in Scandinavia, the northern part of European Russia and in the Alps. The occurrences in western Europe, and possibly also those in the Czech Republic, are secondary. In Asia *M. struthiopteris* occurs in the area between the Black and Caspian Seas, in south-western Siberia, China, the Russian Far East and Japan. In North America it is found in temperate areas of the USA and Canada and also in Alaska (Hultén & Fries 1986). In the Czech Republic it grows on moist, nutrient-rich soils with sand and gravel components, usually on banks and in alder carrs in alluvia of small rivers and streams. It is an ornamental species, which is planted in gardens, parks, cemeteries, at chapels, mills and along roads. Because of the capability to spread fast by stolons and possibly also by spores, *M. struthiopteris* colonized numerous locations spontaneously. It is scattered at middle elevations throughout this country, being almost absent from the lowlands, from the mountains at elevations above 700 m and from south-eastern and south-western Moravia. In the recent past, *M. struthiopteris* was considered as native and threatened (Holub & Procházka 2000) but recently it was reassessed as a naturalized neophyte (Pyšek et al. 2012).

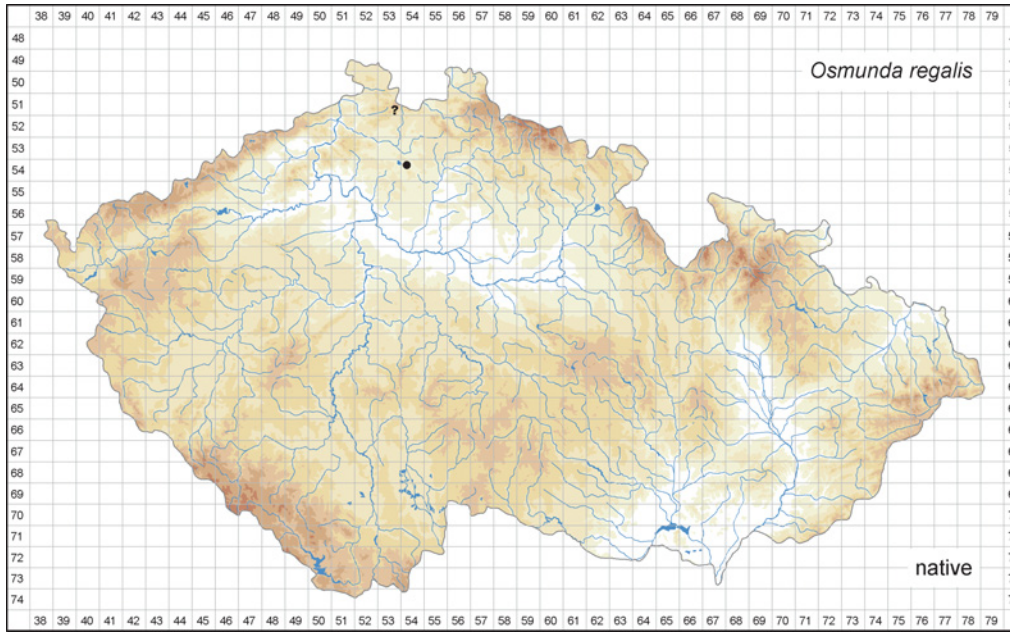

Fig. 75. – Distribution of *Osmunda regalis* in the Czech Republic (1 occupied quadrant). Prepared by Libor Ekrt.

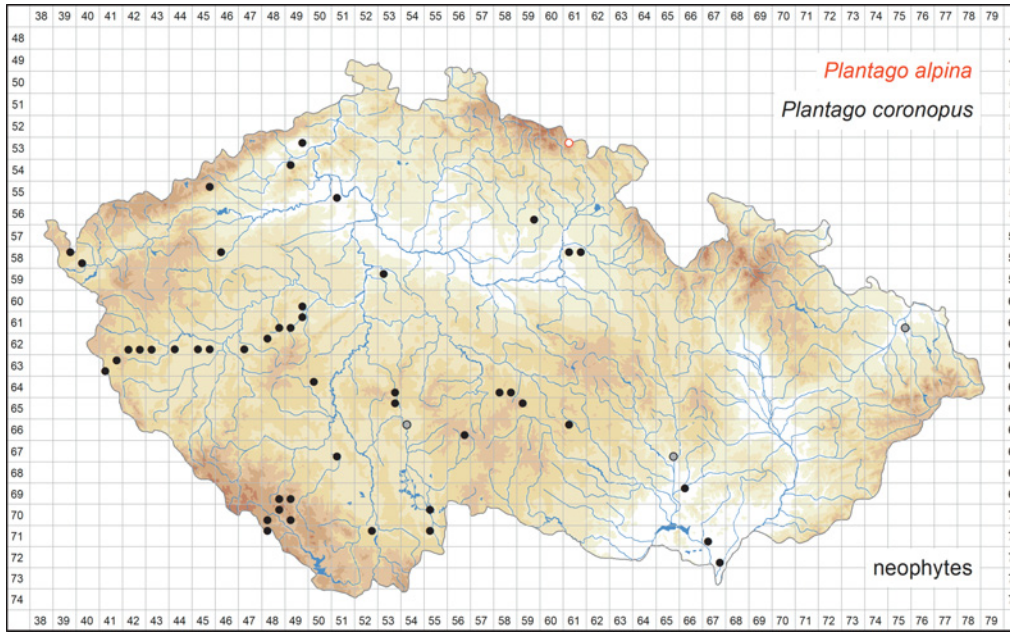

Fig. 76. – Distribution of *Plantago alpina* (○ pre-2000 records only: 1 quadrant) and *P. coronopus* (● at least one record in 2000–2018: 46 quadrants, ● pre-2000 records only: 3 quadrants) in the Czech Republic. Prepared by Jiří Danihelka & Zdeněk Kaplan (*P. a.*) and by Jiří Danihelka, Michal Ducháček, Pavel Kúr & Zdeněk Kaplan (*P. c.*).

Osmunda regalis (Fig. 75)

Osmunda regalis has a disjunct world-wide distribution mainly in regions with oceanic and sub-oceanic climates. It is widespread in western and south-western Europe, extending eastwards to Italy, northwards to southern Scandinavia and southwards to northernmost Africa. Isolated occurrences are in the Balkan Peninsula, Crete, Anatolia and closely adjacent areas. Outposts of this species' range are also in southern Africa, Madagascar, India, south-eastern Asia, Japan, the eastern USA, Central America and eastern South America (Meusel et al. 1965). The occurrence of *O. regalis* in the Czech Republic is situated at the local south-eastern limit of its distribution in central Europe, where this species forms only small and short-lasting populations. There is a report in the literature of it occurring at Pěnkavčí vrch hill in the Lužické hory Mts in the 19th century (Hendrych 2001), but this is now considered doubtful. However, in 2014 *O. regalis* was discovered at the Břehyňský rybník fishpond near town of Doksy in northern Bohemia (Ekrt & Leugnerová 2016). Only a single sterile plant was found there, growing in a peaty patch in a reed stand in mires at the edge of the pond. The occurrence of *O. regalis* in the Czech flora was considered until recently as uncertain (Holub & Procházka 2000, Grulich 2012); however, now it deserves to be classified as critically threatened because of its rarity.

Plantago alpina (Fig. 76)

Plantago alpina is native to the mountains of central Spain, to the Pyrenees, the Massif Central, the Jura and the Alps (Meusel et al. 1978). In the Czech Republic it was recorded in 1934 and 1948 on montane grassland in the Rýchory ridge in the Krkonoše Mts, at an elevation of about 990 m (Chrtek & Skočdopolová 1995). In 1948 it was represented by only a single clump. This occurrence was apparently a temporary remnant of earlier introduction. *Plantago alpina* is classified as a casual neophyte (Pyšek et al. 2012).

Plantago altisima (Fig. 77)

Plantago altissima is native to the Pannonian Basin, the Balkan Peninsula and Romania, in the north-west reaching as far as southern Slovakia, the south-eastern Czech Republic and eastern Austria (Chater & Cartier 1976, Shipunov 2000). It was once recorded as alien in the upper Volga Basin in Russia (Shipunov 2000). Records from western Europe and central Europe north and west of Moravia are most likely erroneous, based on luxuriant specimens of *P. lanceolata* from wet and nutrient-rich habitats. In spite of several records in the literature, the occurrence of *P. altissima* in the Czech Republic is documented by only a single instance of collecting it from alluvial meadows near the confluence of the Morava and Dyje rivers in southernmost Moravia, dated June 1912 and issued by F. Petrak in his Flora Bohemiae et Moraviae exsiccata. This species' occurrence has never been confirmed since then. Consequently, *P. altissima* has been classified as vanished (Grulich 2012). Two other records accepted by Chrtek sen. (2000; Blatec near Olomouc and Brno) are based on misidentified stout specimens of *P. lanceolata*, traditionally referred to as *P. l.* var. *sylvatica.*

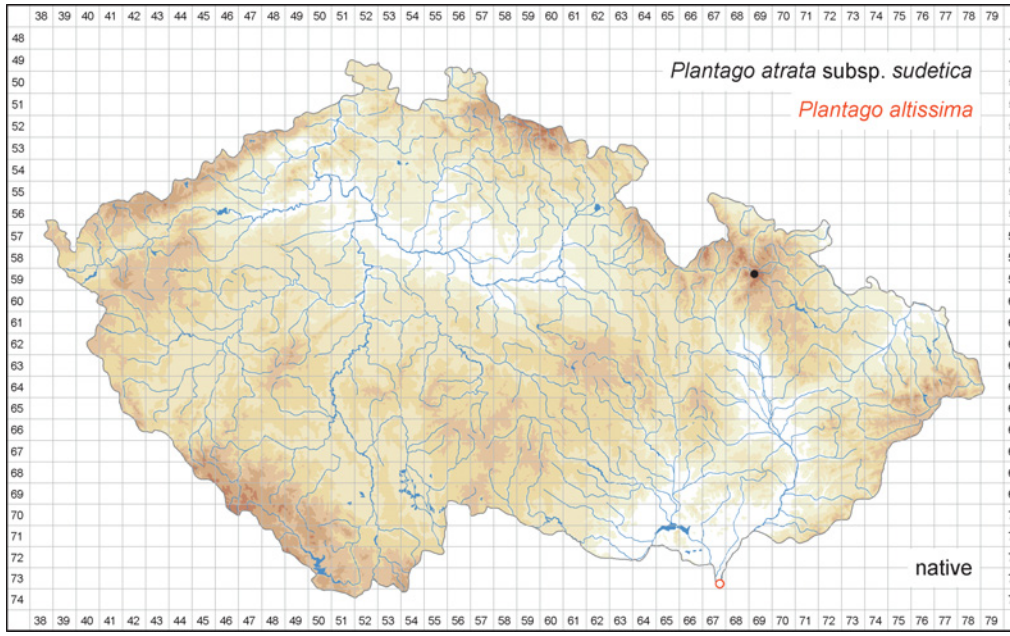

Fig. 77. – Distribution of *Plantago altissima* (○ pre-2000 records only: 1 quadrant) and *P. atrata* subsp. *sudetica* (● at least one record in 2000–2018: 1 quadrant) in the Czech Republic. Prepared by Jiří Danihelka & Zdeněk Kaplan.

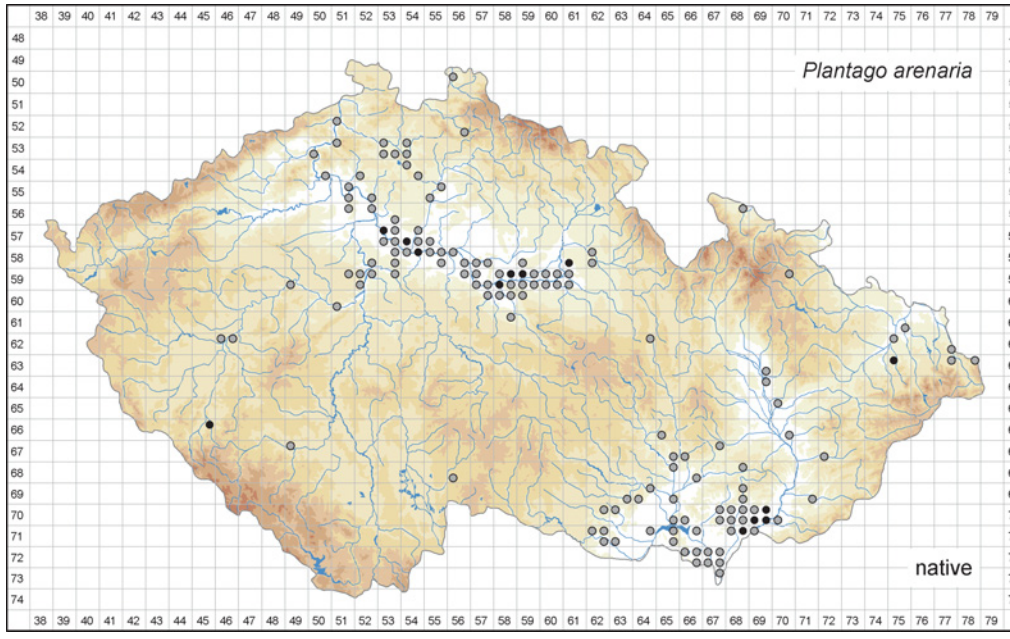

Fig. 78. – Distribution of *Plantago arenaria* in the Czech Republic: ● at least one record in 2000–2018 (13 quadrants), ● pre-2000 records only (130 quadrants). Prepared by Jiří Danihelka & Zdeněk Kaplan.

Plantago arenaria (Fig. 78)

Plantago arenaria is distributed in western, central and south-eastern Europe; it is also present in northern Anatolia, the Caucasus Mts, south-western Siberia, Kazakhstan and Egypt. In Europe it has a rather continuous range mainly in the forest-steppe zone, while being scattered to rare in the west and the Mediterranean area. The species' native range is difficult to identify, but the occurrences in Scandinavia, the British Isles and some of those in western and western-central Europe are certainly due to introductions (Meusel et al. 1978). It is also known as an introduced species in eastern and western North America (USDA, NRCS 2017). In the Czech Republic *P. arenaria* is found in semi-natural open sandy habitats with low vegetation cover, in sand pits, margins of sandy fields, on fallow land, in disturbed places on roadsides and along railways. It occurs mainly in the lowlands of northern Bohemia (mainly in the surroundings of the town of Česká Lípa), along the Labe river in central and eastern Bohemia and in southern Moravia south-west to south-east of the city of Brno; at least some of these occurrences used to be more or less stable. There are also numerous records from other parts of this country referring to introduced plants, most frequently emerging from seeds brought with sand to construction sites, rarely also with iron ore imported from Ukraine. In the Czech flora *P. arenaria* is classified as endangered due to its scarcity and decline (Grulich 2012), caused mainly by afforestation and succession in abandoned grasslands.

Plantago atrata subsp. *sudetica* (Fig. 77)

Plantago atrata has a disjunct distribution in the mountains of central and southern Europe, including the Alps, Massif Central (Cevennes), Apennines, Carpathians and the mountains of the Balkan Peninsula. This complex is rich in taxa, with closely related species occurring in the mountains of the Iberian Peninsula, the Caucasus Mts and some other mountain ranges in western Asia (Chater & Cartier 1976, Meusel et al. 1978). Based on the species' variation and two different ploidy levels, 5–8 poorly delimited subspecies of *P. atrata* are recognized by some authors (Meusel et al. 1978, Marhold 2011). The small population confined to the Velká kotlina glacial cirque in the Hrubý Jeseník Mts in northern Moravia is classified as the narrow endemic *P. a.* subsp. *sudetica*. The geographically closest populations in the Western Tatra Mts are assigned to a different subspecies, *P. a.* subsp. *carpatica*. The population in the Velká kotlina glacial cirque, discovered in 1834, is confined to a small patch (about 40 m^2) of subalpine grassland and consists of 150–200 specimens. It suffers from grazing by introduced chamois (Bureš 2013). *Plantago atrata* subsp. *sudetica* is classified as critically threatened due to its rarity (Grulich 2012).

Plantago coronopus (Fig. 76)

Plantago coronopus is native to the Mediterranean area, western Europe (including the British Isles), the shores of the North Sea and the westernmost shores of the Baltic Sea. It is also found in the warm temperate and subtropical parts of western Asia. Secondary occurrences have been recorded, for instance, in the Baltic countries and in central Europe (Meusel et al. 1978). It has also been introduced to the Americas, Australia and New Zealand (Meusel et al. 1978, USDA, NRCS 2017). *Plantago coronopus* is a very

variable species, with at least four subspecies recognized: the type subspecies is distributed through the entire species' range, *P. c.* subsp. *commutata* (sometimes separated as *P. weldenii*) is found mainly in the central and western part of the Mediterranean area, and the two remaining subspecies are confined to the Balearic Islands and Sicily (Chater & Cartier 1976). The populations introduced to Bavaria (Gerstberger 2001) and Hungary (Schmidt et al. 2016), which spread along roads and motorways, were assigned to *P. c.* subsp. *commutata* by the authors of the cited reports. However, the characters of the plants collected in the Czech Republic correspond fairly well to the type subspecies as described by Chater & Cartier (1976) because they have rather long, lax and thin spikes. This identification is also supported by comparisons with specimens of *P. coronopus* collected from various parts of the species' range. The earliest introductions to this country were recorded on wasteland in the city of Brno in 1933 and in iron-ore yards in the city of Ostrava in 1960; both occurrences turned out to be casual. However, in 2009 *P. coronopus* was collected on a motorway verge near the village of Ladná in southern Moravia, and more than 60 new records from roadsides along roads and motorways throughout this country followed in 2015–2017, partly due to targeted field surveys. These occurrences seem to be associated with road sections intensively treated with de-icing salt in winter, which explains the presence of *P. coronopus* even at elevations of 800–1000 m in the Šumava Mts. This species, until recently classified as casual neophyte (Pyšek et al. 2012), seems to now be locally established.

Plantago lanceolata (Fig. 79)

Plantago lanceolata is continuously distributed throughout Europe apart from its northernmost part, in northern Africa and the temperate zone in western Asia. It has been introduced to and become naturalized in many places in other continents, being particularly widespread in North America (Meusel et al. 1978, Pyšek et al. 2017, USDA, NRCS 2017). In the Czech Republic it is found in meadows, pastures, ruderal grasslands in settlements, on road verges, along paths, in field margins, on fallow land, in gardens and on wasteland. It is common all over the country from the lowlands up to the mountains. In the Krkonoše Mts and Hrubý Jeseník Mts it has been recorded even above 1400 m a.s.l.; however, these occurrences at high elevations probably represent recent and only temporary introductions. The map is based mainly on records from various databases, and the few gaps on the map are most likely due to a lack of records rather than true absences.

Plantago major (Fig. 80)

Plantago major is probably native to the temperate zone in Europe and western Asia. However, nowadays, it is almost a cosmopolitan species, particularly widespread in eastern Asia, North America and southern Africa (Meusel et al. 1978, USDA, NRCS 2017), being ranked as the 15th most widely distributed naturalized plant in the world (Pyšek et al. 2017). It is a very variable species even after separating populations classified as *P. m.* subsp. *intermedia* (e.g. Chater & Cartier 1976; for characters see Pěnková 1986) or even considering subsp. *intermedia* as species of its own (*P. uliginosa*), as preferred here. In contrast, we refrained from distinguishing *P. m.* subsp. *winteri*, reported from saline habitats in northern Bohemia and southern Moravia; this issue requires further taxonomic study. In the Czech Republic *P. major* occurs mainly along paths and in other trampled

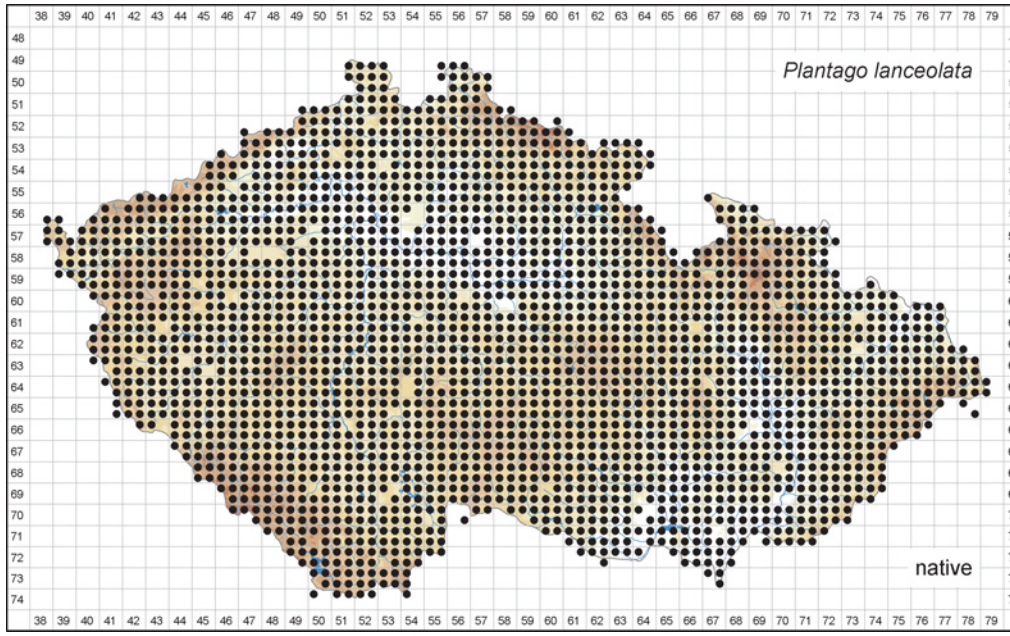

Fig. 79. – Distribution of *Plantago lanceolata* in the Czech Republic (2393 occupied quadrants). Prepared by Jiří Danihelka & Zdeněk Kaplan.

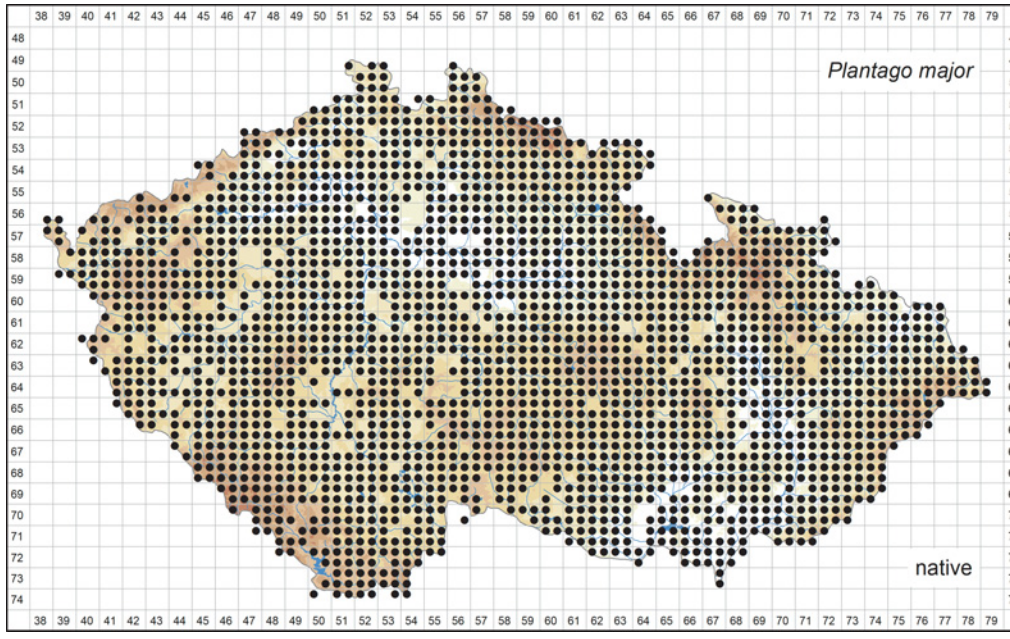

Fig. 80. – Distribution of *Plantago major* in the Czech Republic (2213 occupied quadrants). Prepared by Jiří Danihelka & Zdeněk Kaplan.

places, ruderal grasslands in settlements, field margins, pastures, gardens and on wasteland. It is widespread and common throughout the country from lowlands up to the mountains, with a casual occurrence recorded even at the top of Mt Sněžka at 1603 m a.s.l. in the Krkonoše Mts. As in *P. lanceolata*, the map is based mainly on records from various databases, and the gaps on the map are most likely due to a lack of records rather than true absences.

Plantago maritima subsp. *ciliata* (Fig. 81)

Plantago maritima has an almost cosmopolitan but largely fragmented distribution. It occurs along the coasts of western and northern Europe including Iceland, eastern and western North America and southernmost South America. It is also distributed in the interior of the Eurasian continent from the Iberian Peninsula in the west as far as Mongolia and the adjacent Chinese province of Inner Mongolia in the east. While the westernmost part of this mainland range is strongly fragmented, the distribution in the steppe zone in eastern Europe and southern Siberia is rather continuous (Meusel et al. 1978). The taxonomy of this very variable species is still in dispute, and three (Chater & Cartier 1976), four (Meusel et al. 1978, Chrtek sen. 2000) or even six (Marhold 2011) subspecies are recognized in Europe, although they are difficult to define morphologically. The populations from inland saline habitats in Eurasia are traditionally separated as *P. m.* subsp. *ciliata*, which is followed here. In the Czech Republic *P. maritima* occurs in saline pastures and other types of saline grasslands, usually on alkaline to neutral heavy soils, which are wet or even flooded in spring but dry out in summer. There is also one old record from wasteland, and since 2015 a handful of new occurrences have been found on road verges. Spread of this halophyte along roads, made possible by the massive use of de-icing salt, was observed, for instance, in Germany (Friese 2011), and further records are likely to follow. In the Czech Republic the original occurrence of *P. maritima* was confined to the warm and dry lowlands in north-western and central Bohemia and southern Moravia; this corresponds well with the area where halophilous vegetation once occurred. The isolated occurrence in the Bílé Karpaty Mts (still extant) is associated with heavy, mineral-rich soils developed above clay layers. Many of the former sites of *P. maritima* were destroyed, mainly by drainage and conversion to arable land. Although it is one of the halophilous species that can survive for long even in degraded saline habitats, it was extirpated in most of its former sites, with the decline being stronger in southern Moravia than in north-western Bohemia. *Plantago maritima* subsp. *ciliata* is now classified as critically threatened (Grulich 2012).

Plantago media (Fig. 82)

Plantago media is a Eurasian species continuously distributed in the temperate zone between the Iberian Peninsula in the west and Transbaikalia in eastern Siberia in the east. It has been introduced to various parts of the world, and nowadays it is widely naturalized in the north-eastern USA and eastern and western Canada (Meusel et al. 1978). The taxonomy of this very variable species is still unresolved. Populations from the steppe zone of Eurasia, based on their morphology and ploidy level, are often separated as *P. media* subsp. *stepposa* (Shipunov 2000). In contrast, Chater & Cartier (1976) do not recognize any infraspecific taxa and believe that numerous morphological variants are best recognized

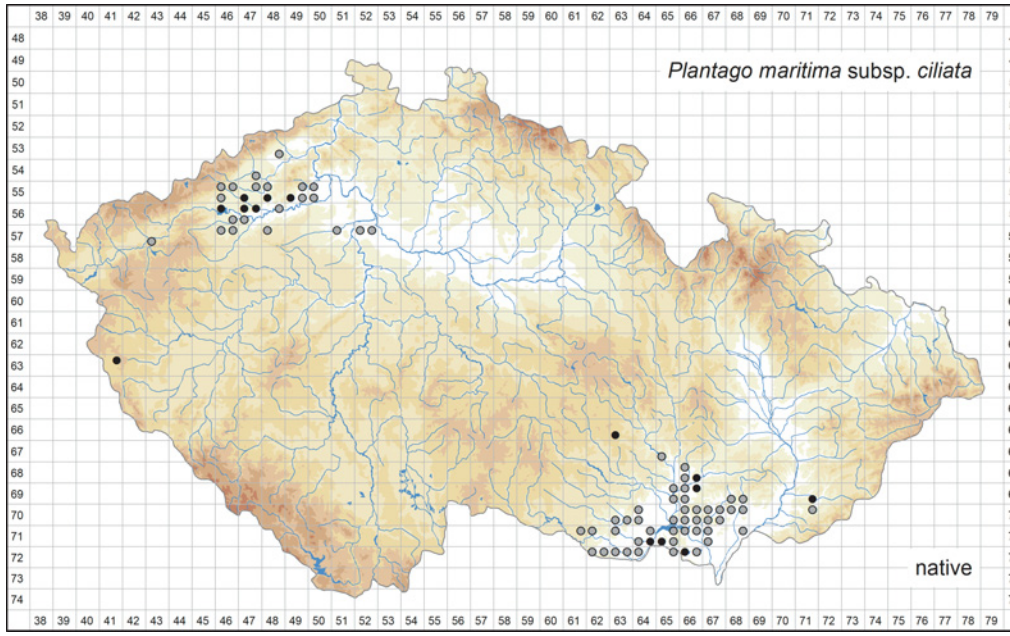

Fig. 81. – Distribution of *Plantago maritima* subsp. *ciliata* in the Czech Republic: ● at least one record in 2000–2018 (14 quadrants), ◍ pre-2000 records only (65 quadrants). Prepared by Jiří Danihelka & Zdeněk Kaplan.

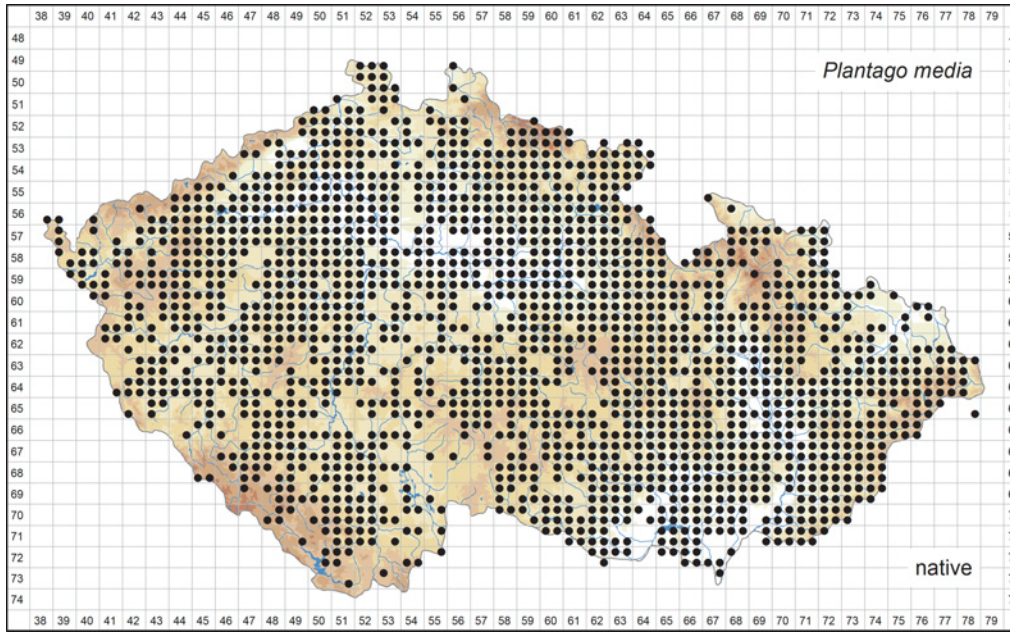

Fig. 82. – Distribution of *Plantago media* in the Czech Republic (1784 occupied quadrants). Prepared by Jiří Danihelka & Zdeněk Kaplan.

as ecotypes. Chrtek sen. (2000) separates the populations with ascending to erect long leaves, occurring mainly in the warm and dry parts of the Czech Republic, as *P. m.* subsp. *longifolia*, being in his opinion taxonomically different from *P. m.* subsp. *stepposa*. Mapping this species' distribution, we refrained from distinguishing these too poorly delimited taxa. In the Czech Republic *P. media* occurs in dry meadows, pastures and other types of dry grasslands, in semiruderal grasslands in settlements, and less frequently on roadsides and along railways. It is tolerant to trampling and frequent mowing. In the Czech Republic it occurs throughout the country at lower and middle elevations, less frequently also in the mountains. As introduced populations, it is also found in the subalpine belt in the Krkonoše and Hrubý Jeseník Mts, where it was repeatedly recorded at elevations 1300–1400 m. The species is probably rare in or even absent from forested areas. The map is based mainly on records from databases.

Plantago uliginosa (Fig. 83)

Plantago uliginosa is probably distributed in most of Eurasia and as an introduced species also in North America and elsewhere in the world (Chater & Cartier 1976, Chrtek sen. 2000, Shipunov 2000). However, its distribution is insufficiently known as it is often not distinguished from *P. major* (s. str.). Though its morphological characters were described in detail, for instance, by Pěnková (1986), identification of some immature specimens remains uncertain because convergent habitat-related phenotypes occur in both species. In the Czech Republic *P. uliginosa* is found in wet places on arable land, in exposed shores and bottoms of fishponds, fish storage ponds, and on river banks, in disturbed places in wet meadows and pastures, in abandoned sand pits and wet ruderal habitats. It occurs mainly in the lowlands and at middle elevations, becoming rarer with the growing elevation. There are several records from elevations above 700 m, and introduced plants were observed in the Krkonoše Mts even at about 1200 m a.s.l. As there was only a limited number *P. uliginosa* specimens in the studied herbaria, the distribution map is based on a combination of these and records undocumented by specimens. However, some of the field records may be wrong, based on misidentified specimens of *P. major*, whereas at least some gaps on the map may be due to a lack of records rather than true absences.

Psephellus dealbatus (Fig. 84)

Psephellus dealbatus is native to the Caucasus and the mountains of Transcaucasia, easternmost Turkey and northern Iran, where it occurs in subalpine meadows (Czerepanov 1963, Wagenitz 1975). It is widely cultivated as an ornamental and sometimes escapes from cultivation. Adventive occurrences have been reported from several European countries and North America (Greuter 2006, GCW 2017). In the Czech Republic it is sometimes found on garden waste and in various slightly disturbed ruderal communities close to sites where this species is cultivated. As a perennial species, it may survive for many seasons. However, it does not spread to the countryside. It is classified as a naturalized neophyte (Pyšek et al. 2012).

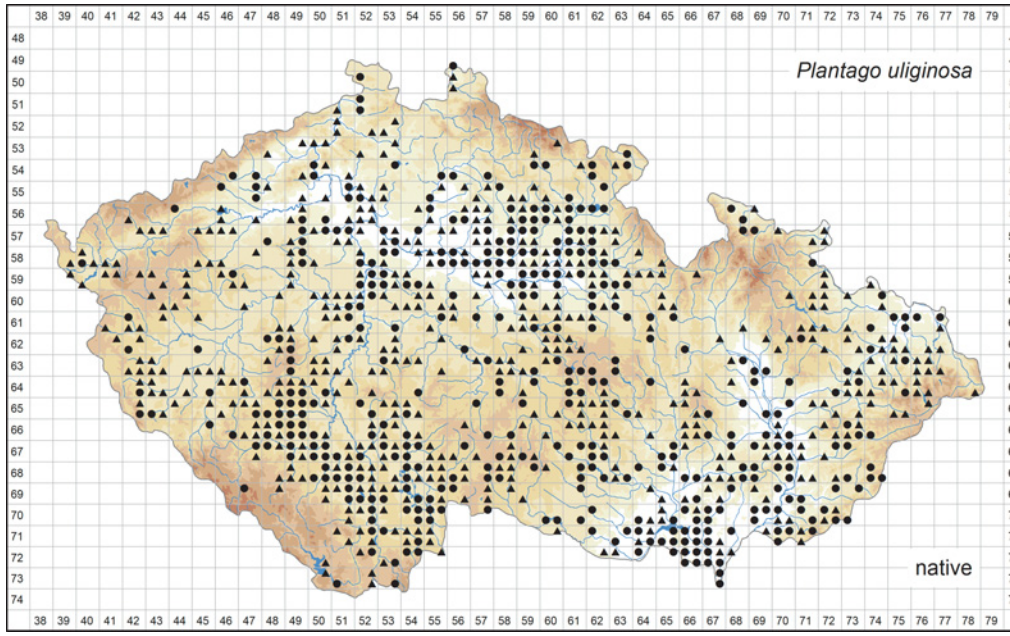

Fig. 83. – Distribution of *Plantago uliginosa* in the Czech Republic: ● occurrence documented by herbarium specimens (396 quadrants), ▲ occurrence based on other records (513 quadrants). Prepared by Jiří Danihelka & Zdeněk Kaplan.

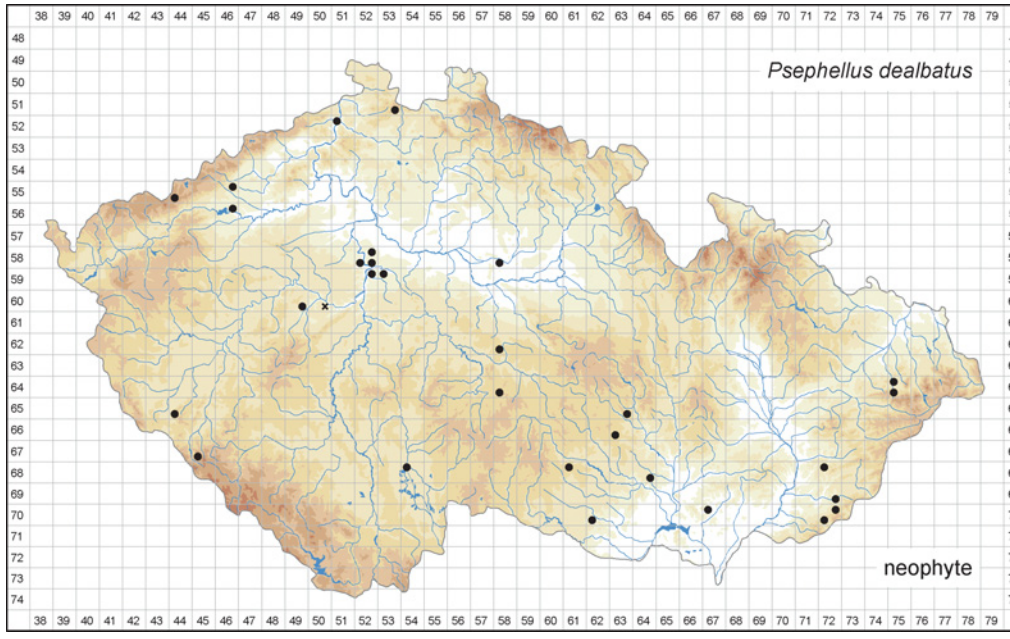

Fig. 84. – Distribution of *Psephellus dealbatus* in the Czech Republic: ● alien (29 quadrants), × deliberate introductions in the countryside (1 quadrant). Prepared by Petr Koutecký.

Pteridium aquilinum (Fig. 85)

Pteridium aquilinum s. l. has a cosmopolitan distribution, being most frequent in tropical, temperate and sub-boreal regions and absent mainly from dry regions (Meusel et al. 1965). The species includes several genetic lineages, which are treated as subspecies. The European clade corresponds to *P. a.* subsp. *aquilinum* (Der et al. 2009). In the Czech Republic *P. aquilinum* occurs mainly on siliceous and nutrient-poor soils usually in the understory of pine, spruce, oak and beech forests. It is also frequent in moderately humid sites along forest and shrub margins, in forest clearings, abandoned meadows and pastures, subalpine tall-fern vegetation above the timberline and at various disturbed sites, where it expands as an aggressive weed. *Pteridium aquilinum* is most abundant at middle and high elevations throughout almost the entire country, with elevational maxima at about 1350 m in the Krkonoše Mts and on Mt Králický Sněžník. However, it is only scattered or rare in parts of central and western Bohemia and western and central Moravia, and almost absent from southern Moravia.

Salvia aethiopis (Fig. 86)

Salvia aethiopis occurs in southern, central and south-eastern Europe and south-western and central Asia. It has been introduced into Australia (Conn 1992) and recorded as a noxious weed in warmer western parts of the USA (USDA, NRCS 2017). In Europe it is distributed throughout the Mediterranean area extending northwards to France, Austria, the Czech Republic, Slovakia and Ukraine (WCSP 2017). Secondary occurrences have been recorded in Belgium and Germany (DAISIE 2017). In Asia this species occurs in Turkey, the Caucasus, Iraq, Iran, Turkmenistan and Uzbekistan, and as an introduced species in Kazakhstan and Kyrgyzstan (Hedge 1982a, b, Lazkov et al. 2014). In the Czech Republic *S. aethiopis* grows on dry soils on calcareous bedrock. It inhabits dry grasslands, grassy south-facing slopes, and secondarily road verges and railway embankments. It occurs in the Pavlovské kopce hills in southern Moravia. Isolated occurrences of secondary origin, which most likely represent garden escapes, have been found in the town of Mělník in central Bohemia and in the city of Brno in Moravia. In the Czech Republic this species reaches the northern limit of its distribution. It is classified as critically threatened (Grulich 2012).

Salvia austriaca (Fig. 87)

Salvia austriaca is confined to central, eastern and south-eastern Europe. It is distributed from Austria and the Czech Republic eastwards through Slovakia, Belarus and Ukraine to south-eastern Russia and southwards it extends to Bulgaria and Macedonia (Pobedimova 1978, Markova 1989, Kmeťová 1993, Fischer et al. 2008, WCSP 2017). This species grows in various types of mesophilous or moderately dry meadows, open scrub communities, pastures, on road verges and railway embankments, and on lawns in settlements. It prefers moderately dry soils on calcareous bedrock. In the past, most of its occurrences were found in southern and south-eastern Moravia. Additional isolated occurrences of secondary origin were recorded in the cities of Prague in central Bohemia and Olomouc in central Moravia. At present, the only extant locality of *S. austriaca* in this country is found near the town of Znojmo in southern Moravia. The localities in the

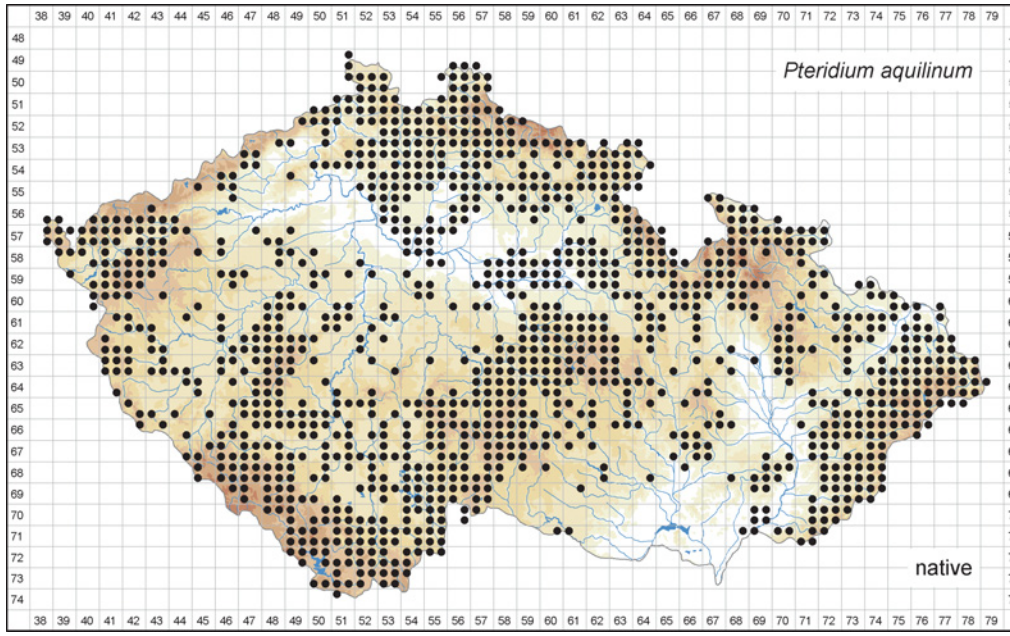

Fig. 85. – Distribution of *Pteridium aquilinum* in the Czech Republic (1234 occupied quadrants). Prepared by Libor Ekrt & Jan Podroužek.

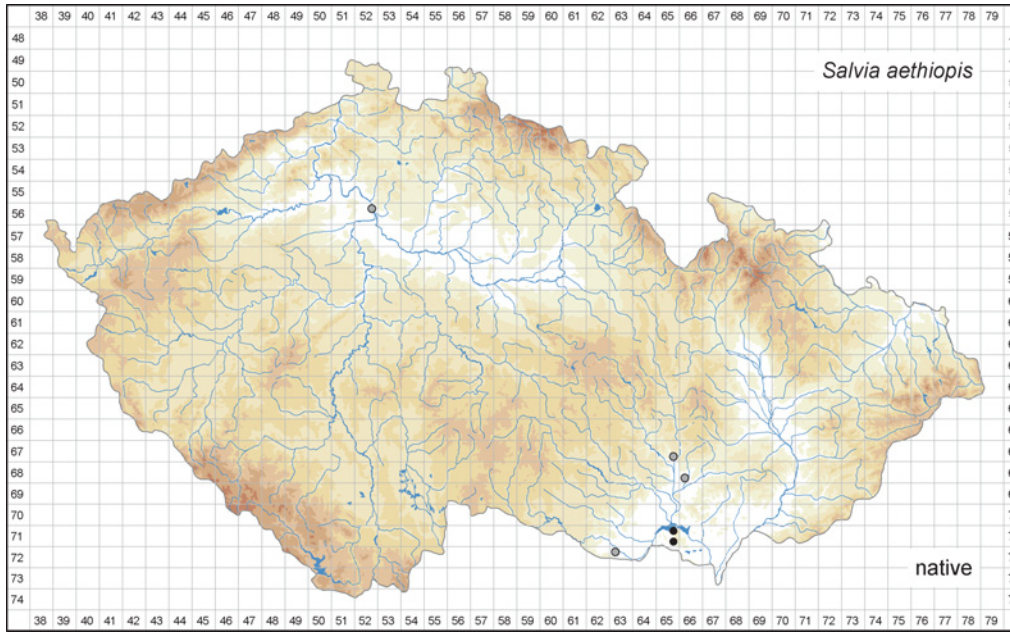

Fig. 86. – Distribution of *Salvia aethiopis* in the Czech Republic: ● at least one record in 2000–2018 (2 quadrants), ◍ pre-2000 records only (4 quadrants). Prepared by Jitka Štěpánková.

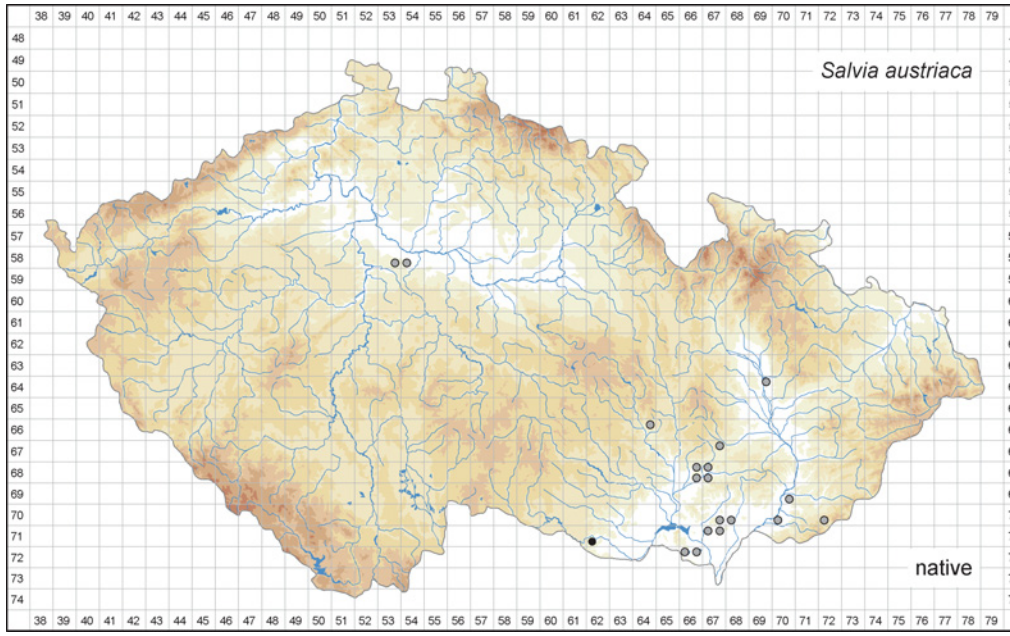

Fig. 87. – Distribution of *Salvia austriaca* in the Czech Republic: ● at least one record in 2000–2018 (1 quadrant), ● pre-2000 records only (18 quadrants). Prepared by Jitka Štěpánková.

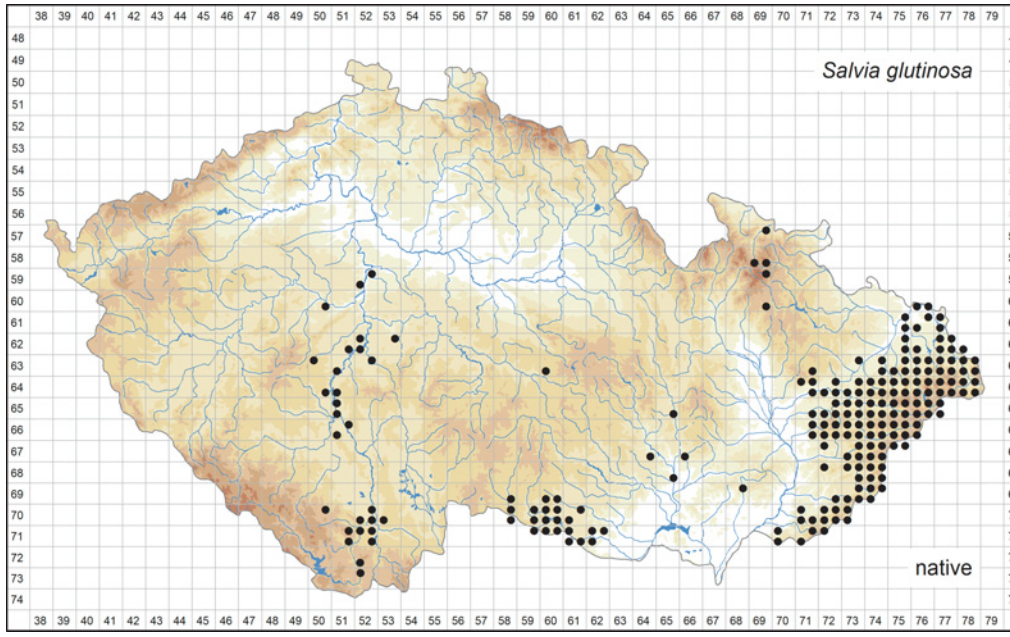

Fig. 88. – Distribution of *Salvia glutinosa* in the Czech Republic (206 occupied quadrants). Prepared by Jitka Štěpánková.

Czech Republic are situated at the north-western limit of its distribution. This species is classified as critically threatened (Grulich 2012).

Salvia glutinosa (Fig. 88)

In Europe *Salvia glutinosa* mainly occurs in the Alps with an outpost in the Bohemian Massif, in the Carpathians and Dinarids, in the west reaching the Massif Central and northern Spain, in the south the Apennines and the mountains of the Balkan Peninsula, and remote occurrences are found in European Russia. In Asia it extends across northern Turkey and the Caucasus as far as Iran (Meusel et al. 1978, Hedge 1982a). It has been introduced into the USA (USDA, NRCS 2017). In the Czech Republic *S. glutinosa* prefers wet, nutrient-rich soils on flysch or calcareous bedrock. It grows in various types of mesic, often ravine forests in the lower part of steep slopes, in wet coniferous forests, along streams at the bottom of narrow valleys with mesoclimates influenced by temperature inversion. It also inhabits secondary habitats such as forest road ditches or wet clearings. Most of its occurrences are in the Moravian Carpathians, along the valleys of the Dyje river and its tributaries in south-western Moravia and in the deep valleys of the Malše and Vltava rivers in southern Bohemia. It has occasionally drifted along the Vltava river down to Prague. The localities in the Czech Republic are situated at the northern limit of this species' distribution. Sometimes it escapes from cultivation, being found in wet meadows of chateau gardens or city parks. Some of these secondary occurrences persist for a long time.

Salvia hispanica (Fig. 89)

Salvia hispanica is a species originating from the mountains of Mexico and Guatemala (Cahill 2004). It was traditionally one of the basic elements in the diet of Central American civilizations in the pre-Columbian epoch, and is currently cultivated in Bolivia, Colombia, Guatemala, Mexico, Peru, Argentina and Australia. At present its seeds are exported to Japan, the USA and Europe (Baginski et al. 2016). In Europe secondary occurrences of *S. hispanica* have been reported from Belgium, Germany, Austria, Sweden (Sauberer & Till 2015, Verloove 2015, Hohla 2016, Shah & Coulson 2018) and the Czech Republic (Tkáčiková 2017). In the Czech Republic this species was repeatedly collected on the banks of the Vltava river in the city of Prague in 2013 and again in 2015. It has also been recorded at the railway station of the town of Kladno on waste ground accompanying soil that originated from the Prague site (2016), on the banks of the Klabava river in the town of Rokycany in western Bohemia (2016), on the banks of the Labe river near the town of Děčín in north-western Bohemia (2015, 2017), at the railway station of the town of Jeseník in Silesia (2015) and on the banks of the Bečva river near the town of Valašské Meziříčí in eastern Moravia (2017). *Salvia hispanica* is an annual, short-day plant, with a 12-hour photoperiod threshold for flower induction. It has been suggested that seed production is restricted to the zones between 22°55'N and 25°05'S (Jamboonsri et al. 2012). In the Northern Hemisphere its flowering period begins in October and then the plants usually die due to frosts. In the Czech Republic *S. hispanica* is a casual neophyte.

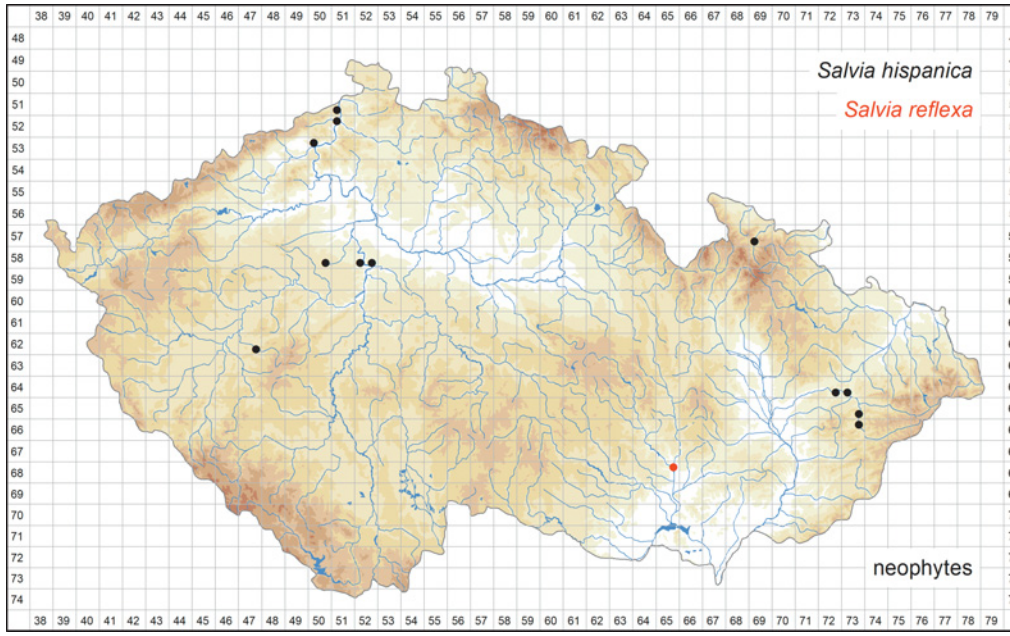

Fig. 89. – Distribution of *Salvia hispanica* (12 occupied quadrants) and *S. reflexa* (1 occupied quadrant) in the Czech Republic. Prepared by Jitka Štěpánková.

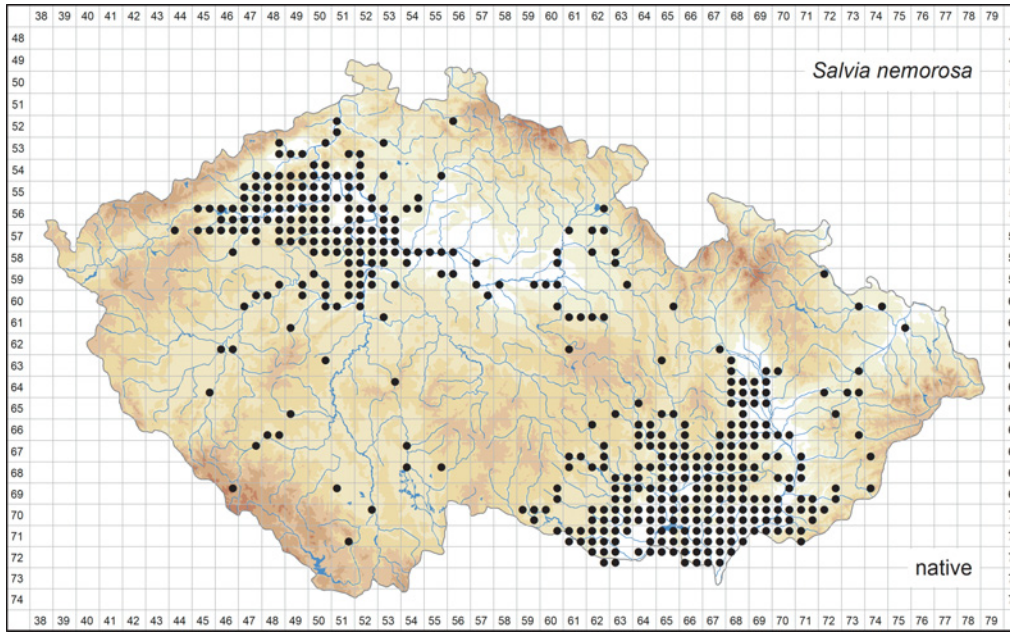

Fig. 90. – Distribution of *Salvia nemorosa* in the Czech Republic (432 occupied quadrants). Prepared by Jitka Štěpánková.

Salvia nemorosa (Fig. 90)

Salvia nemorosa is native to central and eastern Europe and central Asia. In Europe it is distributed from Germany, the Czech Republic and Poland eastwards across Belarus and Ukraine to Russia, and southwards to the Balkan Peninsula. In western and south-western Europe *S. nemorosa* is introduced, being rare or scattered. In Asia its distribution reaches from Turkey and Iran to the north-east across western Russia as far as central Asia (Meusel et al. 1978, Hedge 1982a, b). Secondary occurrences have also been recorded in North America and New Zealand (Webb et al. 1988, USDA, NRCS 2017, Brouillet et al. 2017). In the Czech Republic it grows on dry soils on calcareous bedrock. It is often found in continental and subcontinental disturbed semi-dry grasslands, grassy south-facing slopes, and less frequently in open scrub communities, on road verges and railway embankments. This species occurs mainly in the warm areas of north-western and central Bohemia and in southern and central Moravia while it is rare and only introduced in southern and eastern Bohemia and in Silesia. In the Czech Republic most of the localities are situated below 450 m a.s.l. An isolated, undoubtedly secondary occurrence has been recorded in the Šumava Mts, at an elevation of about 850 m.

Salvia pratensis (Fig. 91)

Salvia pratensis is a temperate European species, which is continuously distributed from northern Spain in the west as far as the Volga river in the east, extending northwards to the Netherlands, Germany and Poland, and southwards to the Apennine Peninsula and the Balkan Peninsula. Isolated occurrences are also found in the British Isles and central Spain. The localities in southern Scandinavia and the Baltic countries are considered to be of secondary origin (Meusel et al. 1978). It has been introduced into North America (USDA, NRCS 2017, Brouillet et al. 2017). In the Czech Republic it grows mainly in various types of moderately dry meadows, pastures, rocky and grassy slopes, scrub, forest edges, lawns in settlements, on road verges and railway embankments. It prefers moderately alkaline to acidic, moderately dry, usually well-drained soils. *Salvia pratensis* is more or less continuously distributed in the lowlands and at middle elevations of the northern half of Bohemia and central and southern parts of Moravia. In contrast, it is relatively rare in southern Bohemia and Silesia. It is scarce in the mountains, where it reaches its elevational maximum at 750–800 m in the Krkonoše Mts, Žďárské vrchy hills and Hrubý Jeseník Mts.

Salvia reflexa (Fig. 89)

Salvia reflexa is native to the USA and has been introduced into southern parts of Canada (USDA, NRCS 2017, Brouillet et al. 2017). This species has also been occasionally introduced into other parts of the world, and has been recorded in South America, southern Africa and New Zealand (Webb et al. 1988, WCSP 2017). In Europe secondary occurrences have been recorded in the British Isles, Belgium, the Czech Republic, Latvia, Lithuania, Belarus, Romania and Ukraine (DAISIE 2017). In the Czech Republic *S. reflexa* was collected from a waste dump in the city of Brno in 1934 and 1972. It is classified as a casual neophyte (Pyšek et al. 2012).

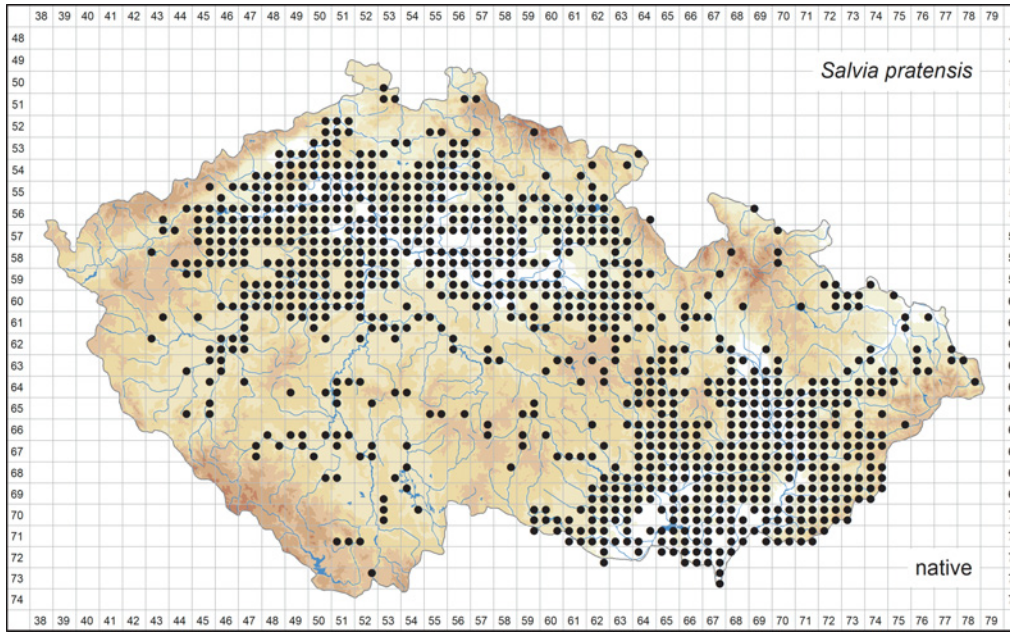

Fig. 91. – Distribution of *Salvia pratensis* in the Czech Republic (972 occupied quadrants). Prepared by Jitka Štěpánková.

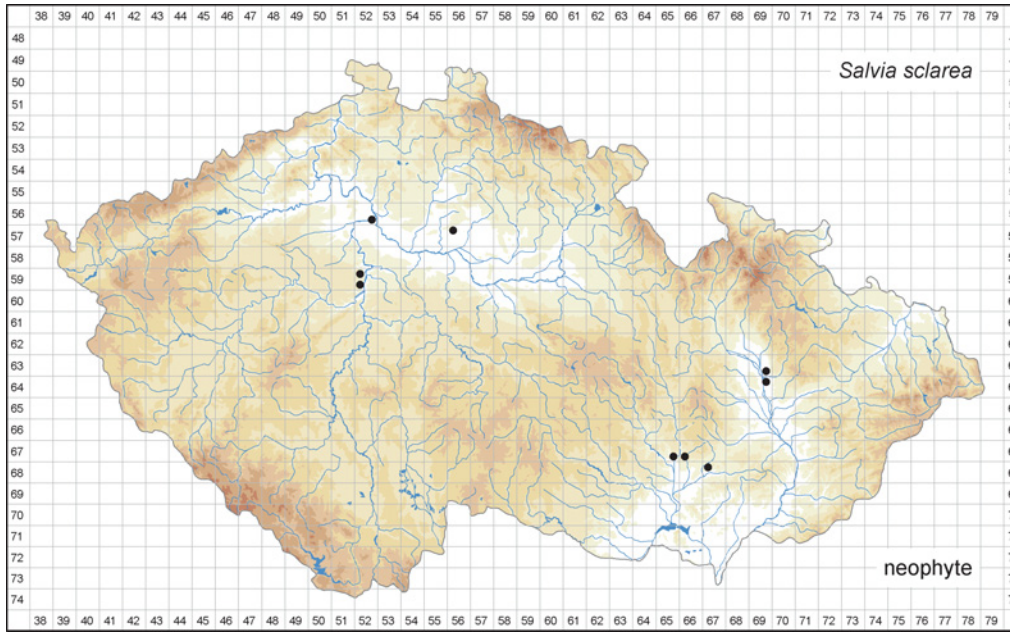

Fig. 92. – Distribution of *Salvia sclarea* in the Czech Republic (9 occupied quadrants). Prepared by Jitka Štěpánková.

Salvia sclarea (Fig. 92)

The native range of *S. sclarea* is confined to the Mediterranean area including small parts of northern Africa, eastward extending throughout Ukraine, the Caucasus and Turkey to Afghanistan (Pobedimova 1978, Hedge 1982a, b, WCSP 2017). This species has been also introduced into cultivation in other parts of Europe and later recorded as escaped or intentionally planted in the countryside. Secondary occurrences have been found in the British Isles, Belgium, Lithuania, the Czech Republic, Austria, Hungary and Romania (DAISIE 2017). It has also been introduced into North America (USDA, NRCS 2017, Brouillet et al. 2017) and Australia (Conn 1992). In the Czech Republic *S. sclarea* has been recorded along roads, river banks and waste disposal places or as escaped from cultivation in settlements. This species has been found in Prague and the towns of Mělník and Loučeň in central Bohemia and in the cities of Brno and Olomouc and the town of Slavkov in Moravia. It is classified as a casual neophyte (Pyšek et al. 2012).

Salvia spinosa (Fig. 93)

Salvia spinosa is native to the Mediterranean parts of northern Africa (Morocco, Libya, Egypt) and south-western Asia from Turkey and the Arabian Peninsula eastwards as far as Afghanistan (Täckholm 1974, Hedge 1982a, b, WCSP 2017). A secondary occurrence is known from the Czech Republic (Štěpánková 1999), where this species was collected from the post-mining dumps in Vítkovice in the city of Ostrava in northern Moravia in 1966. It is classified as a casual neophyte (Pyšek et al. 2012).

Salvia verbenaca (Fig. 93)

The native range of *S. verbenaca* is confined to western, southern and south-eastern Europe, extending eastwards to south-western Asia and southwards to the Mediterranean part of northern Africa (WCSP 2017). In Europe secondary occurrences have been recorded in Belgium, Switzerland, the Czech Republic, Hungary, Romania and Ukraine (Pobedimova 1978, DAISIE 2017). It has also been introduced into the Americas, southern Africa, Australia, New Zealand and China (Webb et al. 1988, Conn 1992, USDA, NRCS 2017, WCSP 2017). In the Czech Republic this species was first collected in the city of Brno in 1965. The last record from the same locality dates back to 1976. These plants may have escaped from local gardens and persisted there for more than 10 years. *Salvia verbenaca* is classified as a casual neophyte (Pyšek et al. 2012).

Salvia verticillata (Fig. 94)

Salvia verticillata is native to central, eastern and southern Europe as well as south-western Asia. It has been introduced into north-western Europe, north-eastern North America and New Zealand (Hultén & Fries 1986, Heenan et al. 2004). In Europe its continuous distribution extends from France in the west as far as the Southern Ural Mts in the east, northwards to Germany and Poland, and southwards to the southern Apennine Peninsula and the Balkan Peninsula. It has been introduced into the British Isles, Scandinavia, Finland and the Baltic countries (DAISIE 2017). In Asia this species is found in Turkey, the Caucasus, Iraq and Iran (Hedge 1982a, b). In the Czech Republic it grows in semi-dry grasslands, open scrub communities, orchards, on road verges and railway embankments,

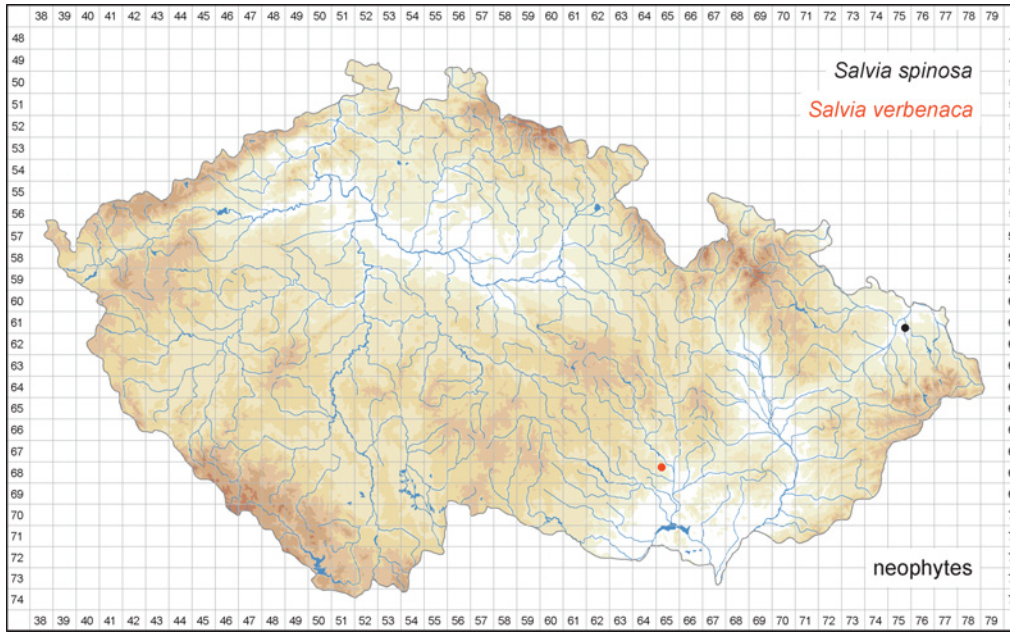

Fig. 93. – Distribution of *Salvia spinosa* (1 occupied quadrant) and *S. verbenaca* (1 occupied quadrant) in the Czech Republic. Prepared by Jitka Štěpánková.

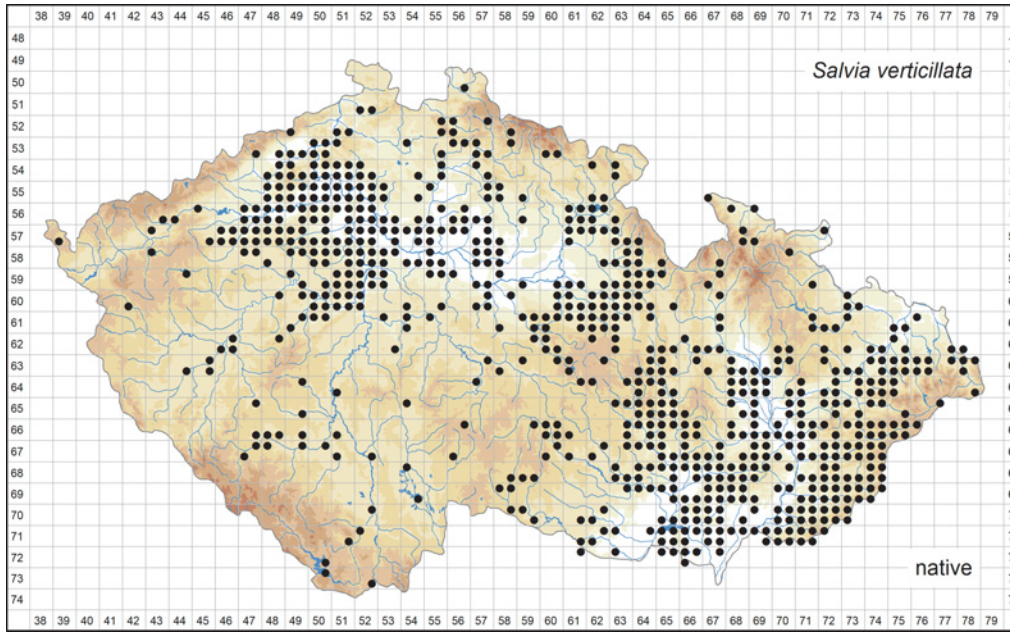

Fig. 94. – Distribution of *Salvia verticillata* in the Czech Republic (733 occupied quadrants). Prepared by Jitka Štěpánková.

and in various man-made habitats in settlements. It prefers moderately alkaline to moderately acidic, moderately dry, often deep, heavy, nutrient-rich soils. In the Czech Republic *S. verticillata* is frequent in the lowlands and hilly areas in central, north-western and north-eastern Bohemia, and in Moravia and Silesia. In contrast, it is relatively rare in western and southern Bohemia. It has been rarely introduced to the mountains, reaching its elevational maximum at about 800 m.

Scirpus radicans (Fig. 95)

Scirpus radicans is distributed in the temperate zone in Eurasia. In Europe it mainly occurs in its central and eastern parts, extending westwards to eastern France, northwards to southern Scandinavia and the Baltic countries, and southwards to northern Italy and Serbia. In Asia it is scattered from the Ural Mts eastwards as far as the Russian Far East, Japan and north-eastern China (Hultén & Fries 1986). In the Czech Republic *S. radicans* occurs in disturbed wet habitats with periodically fluctuating water levels such as exposed bottoms, littorals and banks of fishponds and water reservoirs, pools and oxbow lakes in river floodplains, and less frequently in ditches, fish storage ponds, banks of rivers and shores of lakes in abandoned sand pits. It prefers acidic, sapropelic or peaty substrates. Large populations of *S. radicans* can emerge quickly from the soil seed bank on exposed fishpond bottoms, and the individual ramets spread further by means of runners. However, these colonies disappear rapidly after the water level rises (Hroudová et al. 2011). *Scirpus radicans* is scattered to locally frequent in fishpond landscapes of southern Bohemia and the Českomoravská vrchovina highlands. Elsewhere in this country it is rare, being found mainly along rivers, such as the Vltava, Berounka, Labe, Orlice and Morava, or as isolated occurrences at fishponds. It is absent from the warm and dry areas with mineral-rich soils in north-western and north-eastern Bohemia and from most of southern Moravia, and only rarely occurs in the mountains with suitable habitats, such as the lowest parts of the Šumava Mts and the Brdy and Žďárské vrchy hills. While it is still quite common in southern Bohemia, elsewhere it has vanished from many of its sites or its occurrences are only temporary. It is endangered by fish-farming intensification, particularly restriction of regular summer fishpond drainage and destruction of littorals during desilting. Some occurrences on rivers disappeared due to eutrophication, habitat destruction, river regulation and drainage. It is therefore classified as vulnerable (Grulich 2012).

Scirpus sylvaticus (Fig. 96)

Scirpus sylvaticus occurs throughout almost the entirety of Europe, with the exception of its extreme north, warmest and driest Mediterranean areas, southern Ukraine and southern European Russia. Isolated occurrences are found in the Caucasus Mts and in the mountains of central Asia and southern Siberia; the eastern limit of distribution is imperfectly known because of confusion with *S. orientalis* (Hultén & Fries 1986). In the Czech Republic *S. sylvaticus* is most frequent in wet meadows and around springs, and it also occurs in ditches, on banks of rivers and streams, at fishponds, in alder carrs and forest wetlands, mostly on wet, nutrient-rich and slightly acidic soils. *Scirpus sylvaticus* is widespread throughout almost the whole country, and is most frequent at precipitation-rich middle and high elevations. It has locally expanded due to overall eutrophication and

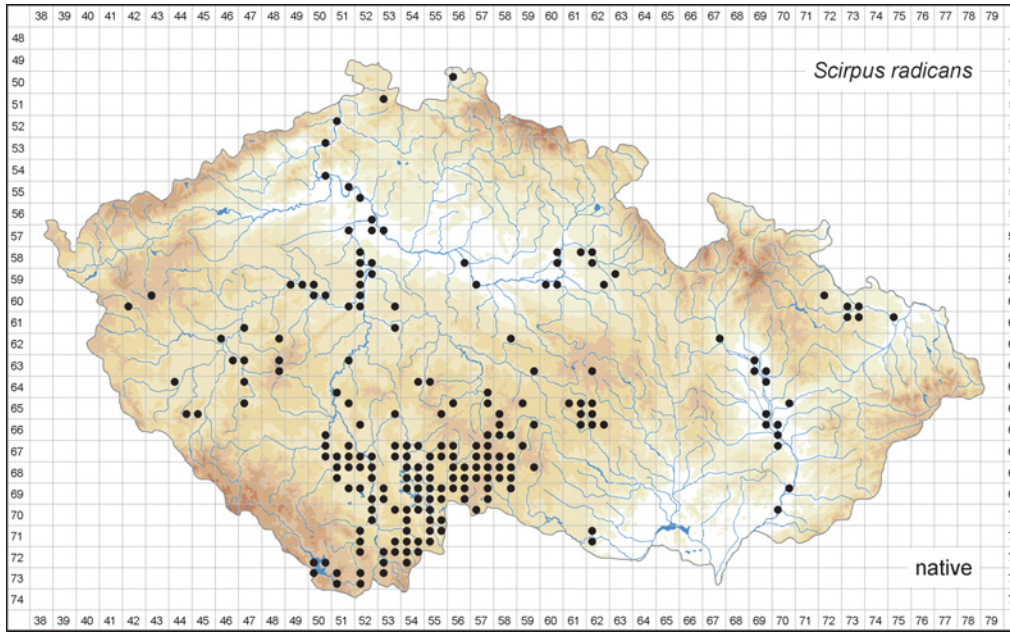

Fig. 95. – Distribution of *Scirpus radicans* in the Czech Republic (204 occupied quadrants). Prepared by Zdeněk Kaplan.

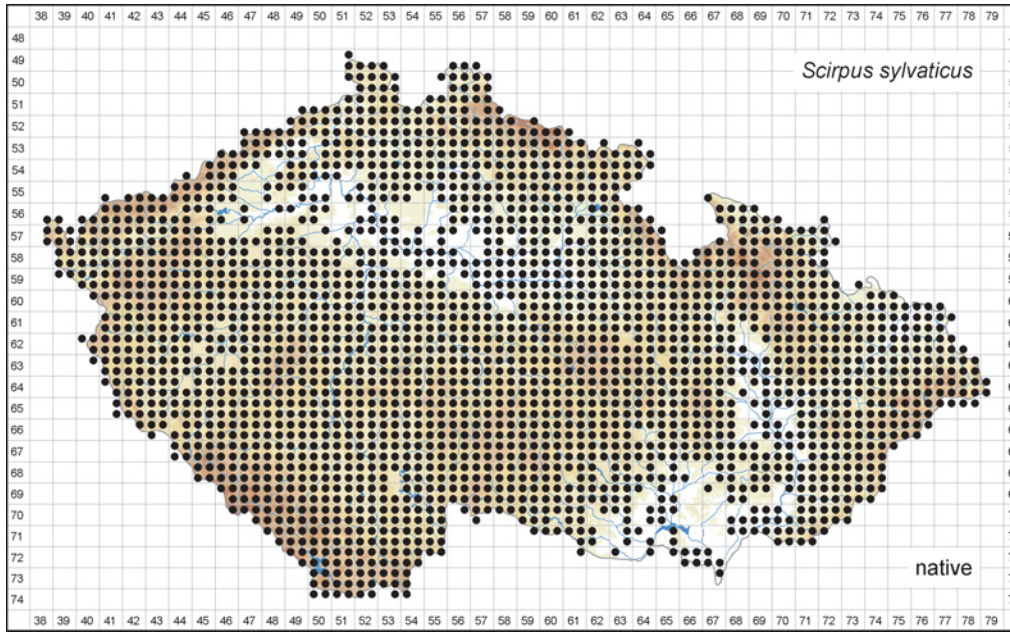

Fig. 96. – Distribution of *Scirpus sylvaticus* in the Czech Republic (2274 occupied quadrants). Prepared by Zdeněk Kaplan.

changes in land use, particularly abandonment of mowing. At lower elevations it is found locally only at water-logged sites and is rare in or absent from the dry and warm lowlands with agricultural landscapes.

Viola alba (Fig. 97)

Viola alba is distributed mainly in the European Mediterranean area, including most of the large islands, in northern and south-eastern Anatolia, the Caucasus Mts, and north-western Africa (Atlas Mts), with some outposts in adjacent areas. In Europe the species extends northwards as far as central France, southern Germany, the south-eastern Czech Republic and the Western Carpathians (Marcussen 2003). Of the three subspecies currently recognized, only the type subspecies is found in the northern parts of this species' range (including the Czech Republic), while *V. a.* subsp. *denhardtii* is confined more or less to the Mediterranean area and *V. a.* subsp. *cretica* is endemic to Crete. In the Czech Republic *V. alba* occurs mainly in oak-hornbeam, oak and beech forests, their fringes and adjacent shrub communities, and less frequently in meadows and low-intensity orchards. Its occurrence in this country is restricted to the Carpathians, namely to the western part of the Bílé Karpaty Mts, the eastern part of the Chřiby hills and two sites in the hilly landscape south-east of the city of Brno. An exception is the late-19th-century record from the Boří les forest west of the town of Břeclav, which is a lowland area with pine forests on sandy soils (see also Oborny 1886). *Viola alba* is classified as critically threatened because of its rarity (Grulich 2012), but the actual degree of endangerment seems to be lower than previously assumed. Apart from two isolated sites, no decline has been observed. The occurrences in the Chřiby hills were discovered only recently, and further records in that area are likely to follow. In particular, the populations consisting of blue-flowering specimens, known from the Bílé Karpaty Mts, may be easily overlooked. The map is based entirely on examined herbarium specimens, as confusions with white-flowering plants of *V. odorata* and *V. suavis* are frequent.

Viola ambigua (Fig. 98)

Viola ambigua is distributed mainly in the continental part of the temperate zone in Europe, in the north-west reaching as far as the Czech Republic, eastern Austria and southern Slovakia, in the south as far as Bulgaria and in the east as far as the Southern Ural Mts. It is also found in the very south-west of western Siberia and the Caucasus Mts (Nikitin 1996). In the Czech Republic it occurs in dry grasslands, most frequently on south-facing slopes over basic substrates, including loess, limestone, basalt and similar rocks. The soils are dry, often stony and shallow. Most of the sites known in this country are found in the hilly areas of southern Moravia southwest, south and east of the city of Brno. They represent a projection of a more or less continuous distribution in the hilly areas at the fringes of the Pannonian Basin. The four sites on isolated volcanic hills of the České středohoří Mts, of which three are extant, are the north-westernmost outposts of this species' range. These occurrences may be considered relict, as these hills are also outposts of several species of generally continental distributions (see e.g. Kaplan et al. 2016b). *Viola ambigua* is classified as vulnerable (Grulich 2012), because of its relative rarity and moderate decline due to both succession in abandoned grasslands and stone

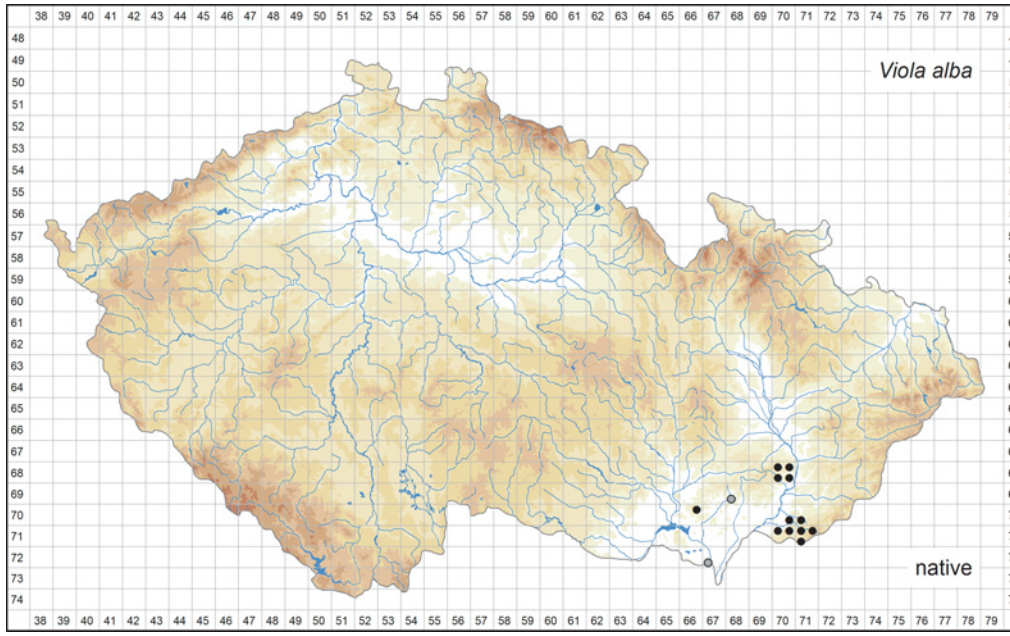

Fig. 97. – Distribution of *Viola alba* in the Czech Republic: ● at least one record in 2000–2018 (12 quadrants), ◍ pre-2000 records only (2 quadrants). Prepared by Jiří Danihelka, Jan Kirschner & Karel Fajmon.

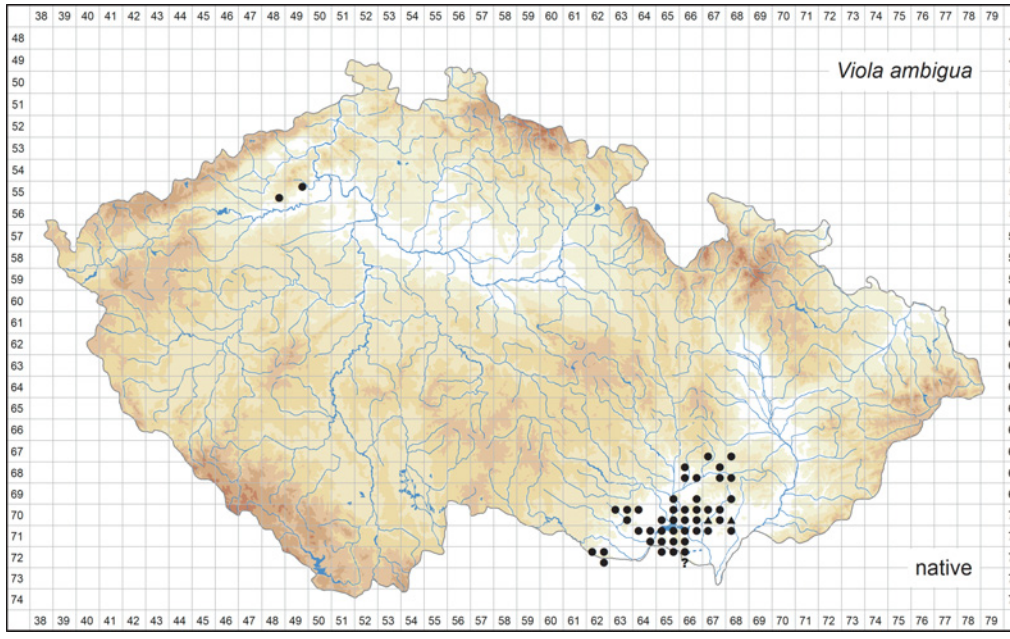

Fig. 98. – Distribution of *Viola ambigua* in the Czech Republic: ● occurrence documented by herbarium specimens (45 quadrants), ▲ occurrence based on other records (2 quadrants). Prepared by Jiří Danihelka & Jan Kirschner.

quarrying. The map is based in large part on examined herbarium specimens, because confusion with *V. hirta* is particularly common.

Viola biflora (Fig. 99)

Viola biflora has a large continuous distribution in the arctic and boreal zones in Eurasia and in Alaska in North America. It also occurs in the mountains of southern and central Europe, the Caucasus Mts, mountain ranges of southern Siberia, the Pamir Mts, Himalayas, and in the northern part of Japan (Meusel et al. 1978). In the Czech Republic *V. biflora* is found mainly in the mountains around springs, in tall-forb vegetation along streams and in crevices of moist rocks. It also occurs at middle and rather low elevations along streams and rivers, and in places with topoclimatic inversion, such as narrow and deep river valleys and sandstone pseudokarst areas. In the Czech Republic *V. biflora* has been recorded in the Sudetes Mts (apart from the Nízký Jeseník Mts) and in the Moravskoslezské Beskydy and Javorníky Mts in eastern Moravia, as well in the sandstone pseudokarst in northern and north-eastern Bohemia. There is a remarkable elevational contrast between the species' localities: whereas in the mountains *V. biflora* ascends up to 1450 m a.s.l. on the slopes of Mt Sněžka in the Krkonoše Mts, the isolated occurrences associated with topoclimatic inversion near the village of Hřensko in northern Bohemia are at about 140 m a.s.l. The status of the rather unexpected recent record from the Moravský kras karst area north of the city Brno, which has been botanically well explored, is somewhat doubtful: the plants may have been deliberately planted there, but no direct evidence exists. In the Czech flora it is classified as being at lower risk – near threatened (Grulich 2012).

Viola mirabilis (Fig. 100)

Viola mirabilis is distributed in western, central and eastern Europe, in Scandinavia reaching almost up to the Polar Circle, in the west as far as central France and in the east to the Ural Mts, while being absent from the Mediterranean area; an outpost is found in the Pyrenees. In Asia it occurs in the Caucasus Mts, western and eastern part of southern Siberia, mountains of central Asia and in eastern China, the north of the Korean Peninsula and southern Japan (Meusel et al. 1978). In the Czech Republic *V. mirabilis* grows in broad-leaved forests, mainly oak-hornbeam, oak and ravine forests, less frequently also in lowland alluvial forests. It requires deep soils that are rather humid in spring and rich in humus and nutrients, with slightly acidic to basic pH. It occurs in the warm and moderately warm hilly landscapes and lowlands of northern, central and eastern Bohemia and central and southern Moravia. Isolated occurrences have been recorded in western and southern Bohemia; here and elsewhere at middle elevations these scattered occurrences are often associated with limestone outcrops. The species reaches its elevational maximum in this country at 1100 m in the Obří důl valley in the Krkonoše Mts, at a site with limestone rock and a fragment of beach woodland, later destroyed by fire. It is classified as being at lower risk – near threatened (Grulich 2012). Although *V. mirabilis* is easy to identify, misidentifications in herbaria are not rare, and some of the records undocumented by specimens accepted in the map may therefore actually refer to other violets, most frequently to *V. rivinana*.

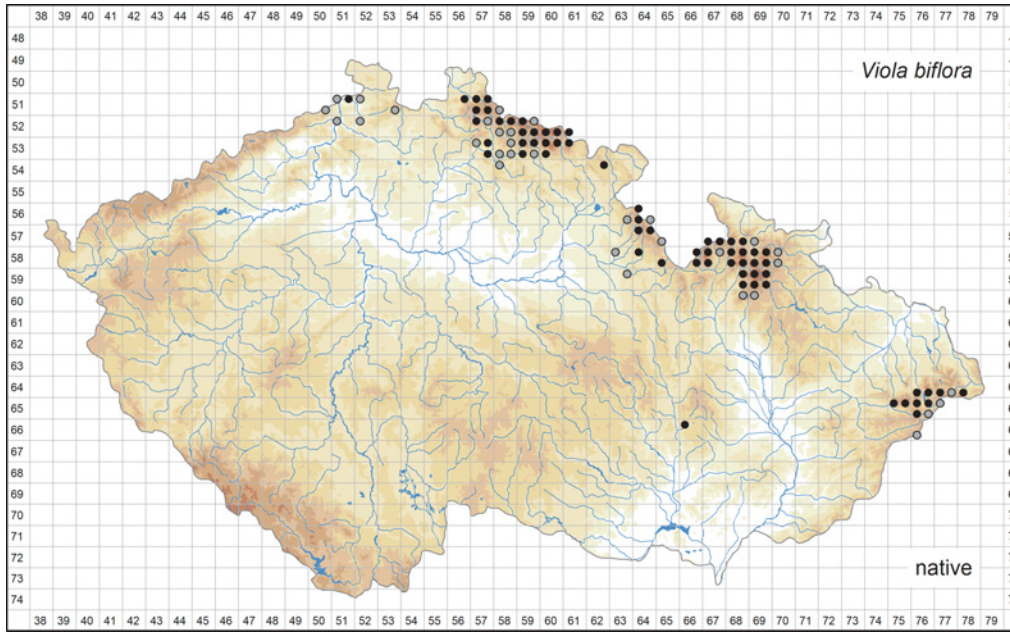

Fig. 99. – Distribution of *Viola biflora* in the Czech Republic: ● at least one record in 2000–2018 (63 quadrants), ◍ pre-2000 records only (32 quadrants). Prepared by Jiří Danihelka, Zdeněk Kaplan & Jan Kirschner.

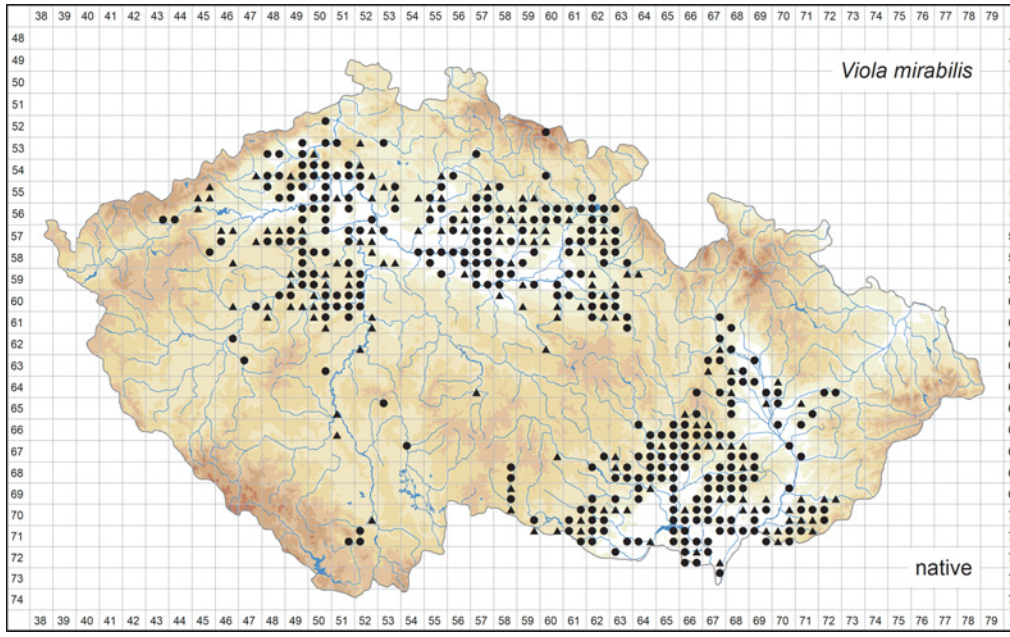

Fig. 100. – Distribution of *Viola mirabilis* in the Czech Republic: ● occurrence documented by herbarium specimens (305 quadrants), ▲ occurrence based on other records (143 quadrants). Prepared by Jiří Danihelka & Jan Kirschner.

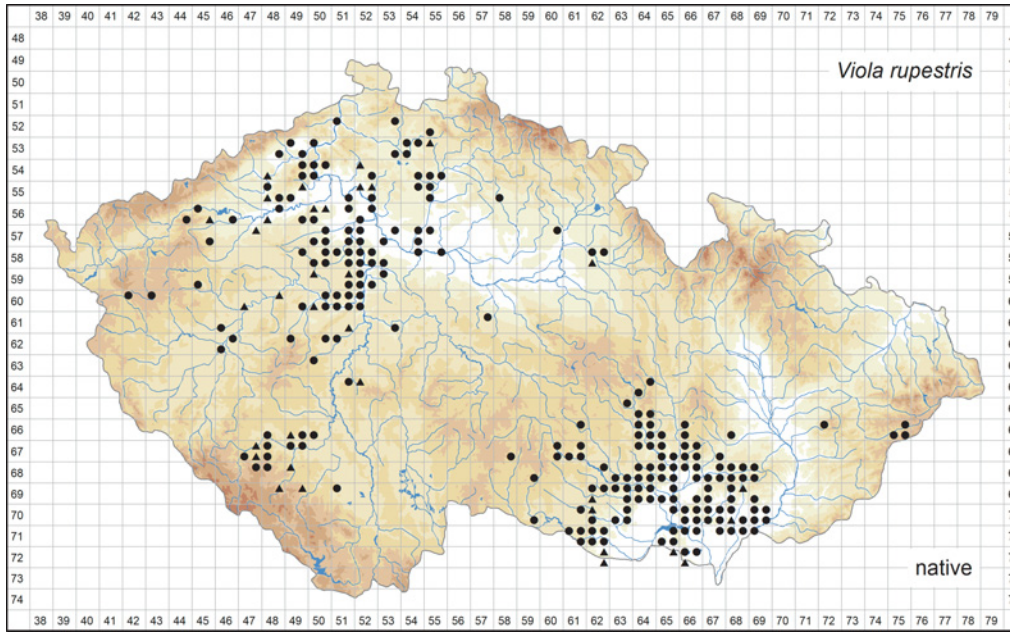

Fig. 101. – Distribution of *Viola rupestris* in the Czech Republic: ● occurrence documented by herbarium specimens (221 quadrants), ▲ occurrence based on other records (34 quadrants). Prepared by Jiří Danihelka & Jan Kirschner.

Viola rupestris (Fig. 101)

Viola rupestris is distributed in the temperate zone in Eurasia, mainly in its parts with a continental climate. In southern Europe it occurs only in mountains. It is also found in the Caucasus Mts and the mountains of central Asia (Meusel et al. 1978, Nordal et al. 2005). The plants occurring along the western and north-western coast of Scandinavia are separated as *V. r.* subsp. *relicta* (Nordal et al. 2005). Within the type subspecies, there are two main forms that differ in their indumentum, densely pubescent versus almost glabrous (reportedly more frequent in the north), and occasional intermediates, sometimes recognized at the subspecies (e.g. Nikitin 1996) or even species level (Tzvelev 1980). In the Czech Republic hairy plants strongly prevail, but we do not recognize these forms taxonomically. *Viola rupestris* occurs in dry grasslands, on rocks and in open-canopy pine forests, usually on permeable mineral soils, which are basic to slightly acidic. It is found in northern and central Bohemia, and in south-western and southern Moravia. There is also a striking concentration of records from limestone outcrops in broader surroundings of the town of Strakonice in southern Bohemia. Rather isolated occurrences are found elsewhere; they also tend to coincide with the occurrence of base-rich rocks. Most of the occurrences are at middle or lower elevations, with an elevational maximum at 930 m in the Javorníky Mts in eastern Moravia. *Viola rupestris* is classified as vulnerable (Grulich 2012) due to its relative rarity and moderate decline, most frequently caused by succession in abandoned grasslands. The species is sometimes confused with *V. canina* and *V. riviniana*, and some of the records undocumented by specimens may therefore be erroneous.

See www.preslia.cz for Electronic Appendices 1–112

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Souhrn

Šestá část ze série prací věnovaných rozšíření cévnatých rostlin v České republice obsahuje síťové mapy a komentáře k 112 taxonům rodů *Athyrium*, *Carex*, *Centaurea*, *Chenopodium*, *Corispermum*, *Corrigiola*, *Crepis*, *Cystopteris*, *Glaucium*, *Hackelia*, *Hammarbya*, *Hippocrepis*, *Lappula*, *Lepidium*, *Liparis*, *Loranthus*, *Lycopus*, *Lythrum*, *Matteuccia*, *Osmunda*, *Plantago*, *Psephellus*, *Pteridium*, *Salvia*, *Scirpus* a *Viola*. Základem jsou údaje získané excerpcí herbářů a literatury, terénní zápisy a nálezy dostupné v databázích, které prověřili taxonomičtí experti. Původní druhy jsou zastoupeny jak těmi hojnými, jako je *Athyrium filix-femina*, *Carex acuta*, *Crepis biennis*, *Lycopus europaeus*, *Lythrum salicaria* a *Plantago lanceolata*, tak vzácnými, ke kterým patří *Carex buxbaumii*, *Lappula semicincta*, *Osmunda regalis*, *Salvia aethiopis* a *Viola alba*. Bezmála 42 % mapovaných druhů je s různou mírou ohrožení zařazeno do červeného seznamu. Mezi ně patří zejména vzácné horské rostliny (např. *Carex aterrima*, *C. atrata*, *C. bigelowii*, *Centaurea mollis*, *C. montana*, *Crepis conyzifolia*, *C. mollis* subsp. *mollis*, *C. sibirica*, *Cystopteris sudetica* a endemická *Plantago atrata* subsp. *sudetica*), mokřadní orchideje (*Hammarbya paludosa* a *Liparis loeselii*) a rostliny zachovalých sušších trávníků (např. *Crepis pannonica*, *Hippocrepis comosa*, *Lappula semicincta* a *Salvia aethiopis*). Mezi ohroženými rostlinami jsou i druhy výrazně ekologicky specializované: *Corrigiola litoralis* se vyskytuje výhradně na periodicky obnažovaných písčitých nebo štěrkových lavicích na dolních tocích řek, *Plantago arenaria* vyžaduje otevřené suché písčiny, zatímco slanomilné *Chenopodium chenopodioides* a *Plantago maritima* subsp. *ciliata* rostly zejména v minulosti na slaniskách. Mezi nepůvodními druhy zavlečenými na naše území jsou jak archeofyty, tak neofyty. Největší zastoupení mají v rodech *Centaurea*, *Crepis* a *Lepidium*. K rostlinám, které rychle obsazují volnou niku na zasolených krajnicích silnic a dálnic, patří *Plantago coronopus*; nálezy tohoto druhu pocházejí z posledních pěti let. Mnohé z mapovaných druhů se u nás nacházející na hranici svého rozšíření, nejčastěji ve směru na západ, severozápad nebo sever. V některých rodech jsou dosti častí mezidruhoví kříženci. Jsou však často obtížně rozpoznatelní a přehlížení, a spolehlivé údaje pocházejí pouze od velmi omezeného počtu expertů. Dva kříženci ostřic a jeden kříženec chrp proto byli zahrnuti do toho příspěvku. 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 areálu, 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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