Distributions of vascular plants in the Czech Republic. Part 9

Rozšíření cévnatých rostlin v České republice. Část 9

Zdeněk Kaplan[1,2], Jiří Danihelka[1,3], Libor Ekrt[4], Milan Štech[4], Radomír Řepka[5], Jindřich Chrtek Jr.[1,2], Vít Grulich[3], Olga Rotreklová[3], Pavel Dřevojan[3], Kateřina Šumberová[1] & Jan Wild[1]

[1]*Czech Academy of Sciences, Institute of Botany, Zámek 1, CZ-252 43 Průhonice, Czech Republic, e-mail: kaplan@ibot.cas.cz, chrtek@ibot.cas.cz, katerina.sumberova@ibot.cas.cz, wild@ibot.cas.cz;* [2]*Department of Botany, Faculty of Science, Charles University, Benátská 2, CZ-128 01 Prague, Czech Republic;* [3]*Department of Botany and Zoology, Masaryk University, Faculty of Science, Kotlářská 2, CZ-611 37 Brno, Czech Republic, e-mail: danihel@sci.muni.cz, grulich@sci.muni.cz, orotrekl@sci.muni.cz, pavel.drevojan @seznam.cz;* [4]*Department of Botany, Faculty of Science, University of South Bohemia, Branišovská 1760, CZ-370 05 České Budějovice, Czech Republic, e-mail: libor.ekrt @gmail.com, stech@prf.jcu.cz;* [5]*Department of Forest Botany, Dendrology and Geobiocenology, Faculty of Forestry and Wood Technology, Mendel University, Zemědělská 3, CZ-613 00 Brno, Czech Republic, e-mail: repka@mendelu.cz*

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The ninth part of the series on the distributions of vascular plants in the Czech Republic includes grid maps of 83 taxa in the genera *Aphanes*, *Buglossoides*, *Calamagrostis*, *Carex*, *Cerastium*, *Chenopodium*, *Corynephorus*, *Crypsis*, *Dorycnium*, *Equisetum*, *Marrubium*, *Montia*, *Oxalis*, *Pilosella*, *Pteris* and *Spergula*. These maps were produced by taxonomic experts based on examined herbarium specimens, literature and field records. The plants studied cover various taxonomic and ecological groups. Habitat specialists are represented by *Calamagrostis pseudophragmites*, which is confined to river banks and gravel bars, *Calamagrostis stricta*, a species of fens and wet meadows, and the obligate halophyte *Crypsis aculeata*. Almost half the studied species are on the national Red List. Two of the subspecies of *Spergula arvensis*, namely subsp. *linicola* and subsp. *maxima*, have been extirpated from this country. *Cerastium subtetrandrum*, which was discovered on verges of motorways and main roads in Bohemia, is reported here as a new alien species in the Czech Republic. Three other mapped taxa have only recently been discovered in this country. *Calamagrostis rivalis* had been considered an endemic species of Saxony in Germany until it was discovered in Bohemia. The previously neglected *Carex depressa* subsp. *transsilvanica* was found at a few sites in eastern Moravia. A single plant of *Pteris cretica* was discovered in an inner wall of a castle well in central Moravia. 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.

Keywords: alien species, central Europe, chorology, Czech Republic, distribution atlas, distribution patterns, endangered species, endemic, flora, grid maps, herbaria, phytogeography, plant record, vascular plants

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Introduction

Mapping of plant distributions of vascular plants in the Czech Republic was initiated within the PLADIAS project funded by the Czech Science Foundation in 2014–2018. A new central Pladias database has been established and a web-based mapping interface developed (Wild et al. 2019). Based on examined herbarium specimens as well as literature and field records that were transferred to the database and critically evaluated and sorted by a team of taxonomic experts, grid-based distribution maps of 674 vascular plants were produced and published during the project (Kaplan et al. 2015, 2016a, b, 2017a, b, 2018a, b). Since the completion of this project, the database continues to be maintained by the Institute of Botany of the Czech Academy of Sciences in Průhonice and supplemented with new records. New maps are finalized and published once a year, with the latest instalment containing maps of 104 taxa (Kaplan et al. 2019b).

Revisions of national and central-European plant diversity continue as well. A new edition of the field guide "Key to the Flora of the Czech Republic" was published last year (Kaplan et al. 2019a). Several taxonomically complicated groups were revised, and new species (Trávníček et al. 2018, Király et al. 2019, Kirschner et al. 2019, Lepší et al. 2019) and hybrids (Hodková & Mandák 2018, Prančl et al. 2018, Popelka et al. 2019) were discovered. Additional plant taxa were recorded for the first time in this country, comprising previously unrecognized native ones (Roleček et al. 2018, Velebil 2018) as well as introduced aliens (Danihelka 2019a, Lustyk & Doležal 2019).

Maps for a further 83 taxa were finished by the end of April 2020 and are included in this paper. The taxa studied cover various taxonomic and ecological groups of plants. Habitat specialists are represented by *Calamagrostis pseudophragmites*, which is confined to river banks and gravel bars, *Calamagrostis stricta*, a species of fens and wet meadows, and the obligate halophyte *Crypsis aculeata*. An additional 37 species are on the national Red List (Grulich 2012), including the critically threatened species *Aphanes australis*, *Carex vaginata*, *Crypsis alopecuroides*, *Marrubium vulgare*, *Montia arvensis*, *Pilosella blyttiana* and *Spergula pentandra*. All of these now occur at single sites or a few sites only. Two of the subspecies of *Spegula arvensis*, namely subsp. *linicola* and subsp. *maxima*, have been extirpated from this country. In contrast, frequent and widespread species include e.g. *Calamagrostis arundinacea*, *C. epigejos*, *Carex sylvatica*, *Chenopodium polyspermum*, *Equisetum arvense*, *Oxalis acetosella* and *Pilosella officinarum*.

Four of the mapped taxa have only recently been discovered in the Czech Republic. *Calamagrostis rivalis* had been considered an endemic species of Saxony in Germany until it was discovered in Bohemia (Štech 2019). The previously neglected *Carex depressa* subsp. *transsilvanica* was found at a few sites in eastern Moravia (Řepka & Fajmon 2016). The secondary occurrence of the alien *Cerastium subtetrandrum* was identified on verges of motorways and main roads in Bohemia (this paper). A single plant of *Pteris cretica* was discovered in an inner wall of a castle well in central Moravia (Novák 2018), probably resulting from an escape from cultivation via spores.

Additional alien species studied for this paper include e.g. *Buglossoides arvensis*, *Chenopodium bonus-henricus*, *Ch. capitatum* and *Ch. foliosum*. Some of the neophytes have been detected at a single site or a few sites only (*Buglossoides incrassata* subsp. *incrassata*, *Oxalis debilis* and *Pteris multifida*), while others have become widespread and naturalized (*Oxalis stricta*) or have recently become invasive (*Oxalis corniculata* and

O. dillenii). In contrast, some of the previously archaeophytes that had been rather common locally have experienced considerable declines and are rare now (e.g. *Marrubium peregrinum*).

Several studied groups are taxonomically difficult, with their numerous literature and database records unreliable. Consequently, the distributions of the constituent species are insufficiently known. Maps of some or all species of *Aphanes*, *Buglossoides*, *Chenopodium*, *Dorycnium*, *Equisetum*, *Montia*, *Pilosella* and *Spergula* are therefore based solely or mainly on herbarium specimens examined by experts. The resulting maps fill knowledge gaps, clarify distributions and frequencies of the taxa within these complexes or point out to the need for further research.

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 Kaplan et al. (2019a), with differences indicated where necessary. For taxa not included in that source, 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. BRNL, BRNM, BRNU, CB, CBFS, CESK, CHEB, CHOM, FMM, GM, HOMP, HR, KHMS, LIM, LIT, MJ, MMI, MP, MZ, NJM, OL, OLM, OMJ, OMP, OP, OSM, OVMB, PL, PR, PRA, PRC, ROZ, SOB, SOKO, SUM, VM, VYM and ZMT (acronyms follow Thiers 2020), were consulted as the main sources of taxonomically examined records. Most records for maps of common and easy-to-identify taxa came from the Pladias database (Wild et al. 2019), which has integrated data from five large national databases, several regional projects and unpublished field records from the maps' authors and regional contributors.

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 1–83. 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 *Calamagrostis*, *Carex*, *Cerastium*, *Oxalis*, *Pilosella*, *Pteris* and *Spergula* 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

Aphanes arvensis (Fig. 1)

Aphanes arvensis is widespread in western, central and southern Europe, northwards reaching Denmark, southern Sweden and the Baltic countries; it also occurs in Crimea, Transcaucasia and the eastern Mediterranean area (Fröhner 1995, Kurtto et al. 2007). It prefers areas with oceanic climates but penetrates further east than *A. australis*. *Aphanes arvensis* has been widely introduced, for instance, into North and South America, the Azores, Ethiopia, Australia and New Zealand (Hultén & Fries 1986). In the Czech Republic it usually grows on siliceous or, less frequently, calcareous, sandy, loamy and sandy-loamy soils that are usually slightly acidic to neutral. The species occurs mainly as a weed on arable land, especially in fields of cereal, stubble or forage crops such as *Medicago sativa* and *Trifolium pratense*, in fallows and other man-made habitats, and rarely also in natural sandy habitats and sandy brook deposits. *Aphanes arvensis* is scattered over most of this country, occurring mainly at middle elevations and reaching its elevational maximum in the Krušné hory Mts at about 920 m. It is absent from or rare in southern and central Moravia. It has declined due to intensive agriculture and is now classified as vulnerable (Grulich 2012).

Aphanes australis (Fig. 2)

Aphanes australis is a European sub-Atlantic species distributed mainly in western Europe, extending northwards to the British Isles, the Jutland Peninsula and southern Sweden, eastwards to Poland and Romania, and southwards to the Iberian, Italian and Balkan Peninsulas. As an established alien it is present at least in North America (Kurtto et al. 2007). In the Czech Republic *A. australis* grows in open habitats with sparse vegetation such as sandy fields, fallows, edges of pine forests and sandy grasslands on sandy, usually acidic soils, and avoids areas with calcareous substrates. In this country it has always been a rare species, previously collected at about three dozen localities in various parts of Bohemia and one site in eastern Moravia. Now it survives at only a few localities in the Třeboňská pánev basin in southern Bohemia. *Aphanes australis* is an oligotrophic

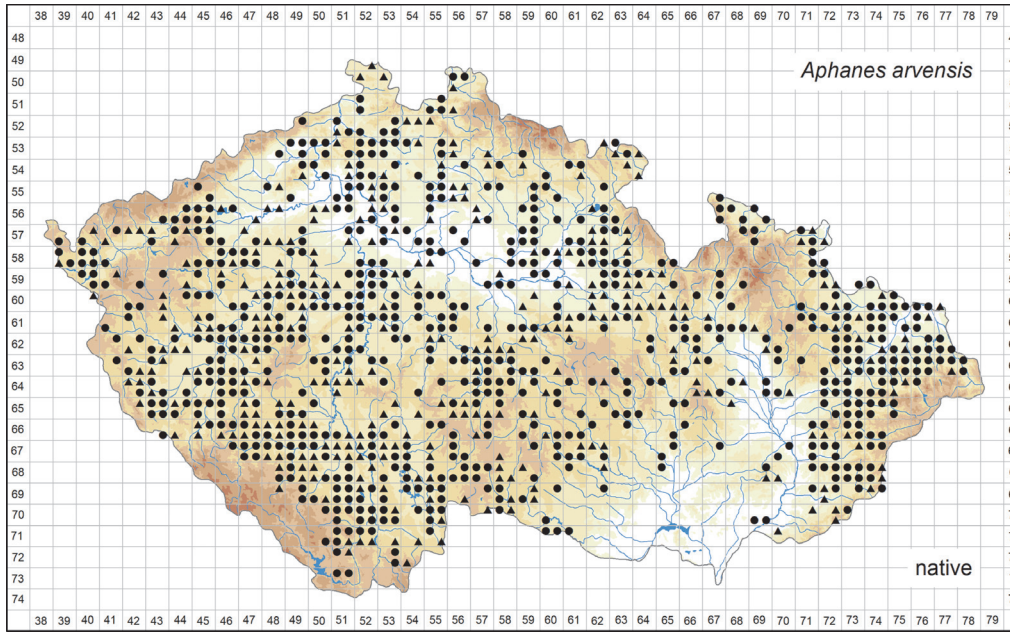

Fig. 1. – Distribution of *Aphanes arvensis* in the Czech Republic: ● occurrence documented by herbarium specimens (671 quadrants), ▲ occurrence based on other records (325 quadrants). Prepared by Pavel Dřevojan.

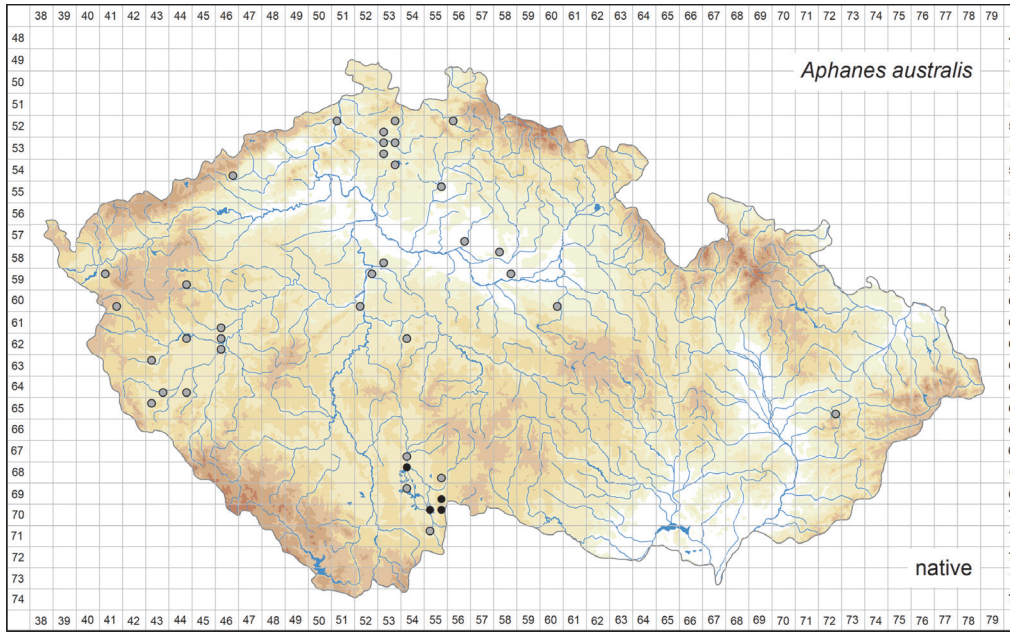

Fig. 2. – Distribution of *Aphanes australis* in the Czech Republic: ● at least one record in 2000–2020 (4 quadrants), ● pre 2000 records only (34 quadrants). Prepared by Pavel Dřevojan.

species that is endangered by the overall eutrophication of the landscape. Therefore, it is classified as critically threatened (Grulich 2012). This inconspicuous species was previously confused with *A. arvensis* and overlooked. The distribution map is based only on examined herbarium specimens. In many cases, plants of both species were mixed in one herbarium gathering.

Buglossoides arvensis agg. (Fig. 3)

Buglossoides arvensis agg. is a taxonomically difficult group originally distributed mainly in the Mediterranean area. Although this group is currently stated to comprise six species (Valdés 2011, Cecchi et al. 2014), its taxonomy is still under dispute and requires further study. In central Europe two similar widespread taxa have been recognized, namely *B. arvensis* and *B. incrassata* subsp. *splitgerberi* (Clermont et al. 2003), until recently not distinguished and both subsumed under *B. arvensis*. Their morphological differences are subtle and include mainly the shape and venation of cotyledons and the shape of pedicels and receptacle in fruit. Consequently, for herbarium specimens without cotyledons and ripe fruits, distinction cannot be made between the two taxa. This map summarizes all records of the group in this country, including herbarium specimens not identifiable to the species level and undocumented field records (mainly under the names *Lithospermum arvense* and *B. arvensis*). The third taxon, the morphologically distinct *B. incrassata* subsp. *incrassata*, has been known only from one site, as a recent introduction.

Buglossoides arvensis (Fig. 4)

Buglossoides arvensis is distributed in the Mediterranean area, in the temperate zone in Europe and western Siberia, and in western and central Asia. However, at least in the northern part of its European range this species has to be considered an archaeophyte. The occurrences in eastern Asia, North America, Australia and New Zealand are secondary (Meusel et al. 1978, Hultén & Fries 1986). Here the species is accepted as circumscribed by Clermont et al. (2003) and Cecchi et al. (2014). In addition, plants with blue corollas and, at the same time, with erect stems, thin pedicels and symmetric receptacles, repeatedly collected in 1876–1890 near the village of Přívory in central Bohemia (originally identified as *Lithospermum arvense* var. *coeruleum*) are also included here. In the Czech Republic *B. arvensis* occurs as a weed in arable fields, less frequently in disturbed patches of dry grasslands, on railways and in other ruderal habitats. The soils are usually fresh, slightly acidic to slightly basic and moderately rich in nutrients. *Buglossoides arvensis* is widespread in this country, definitely much more frequent than indicated on the map based on examined specimens only. However, it is probably rare in areas with acidic soils poor in nutrients and small proportions of arable land. *Buglossoides arvensis* is found from the lowlands up to elevations of about 600 m, reaching its elevational maximum at 630 m near the village of Rovečné in western Moravia. It is considered a naturalized archaeophyte (Pyšek et al. 2012).

Buglossoides incrassata subsp. *incrassata* (Fig. 4)

Based on current knowledge, *B. incrassata* subsp. *incrassata* is a circum-Mediterranean taxon, found in Europe only in the southern part of its Mediterranean area (Hultén & Fries

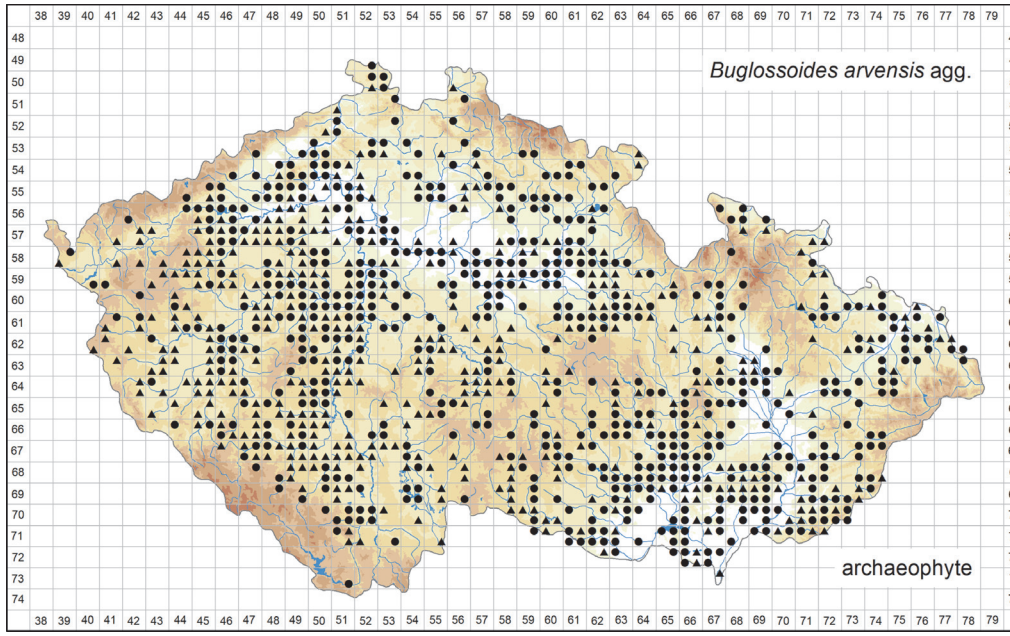

Fig. 3. – Distribution of *Buglossoides arvensis* agg. in the Czech Republic: ● occurrence documented by herbarium specimens (595 quadrants), ▲ occurrence based on other records (414 quadrants). Prepared by Jiří Danihelka & Petra Štěpánková.

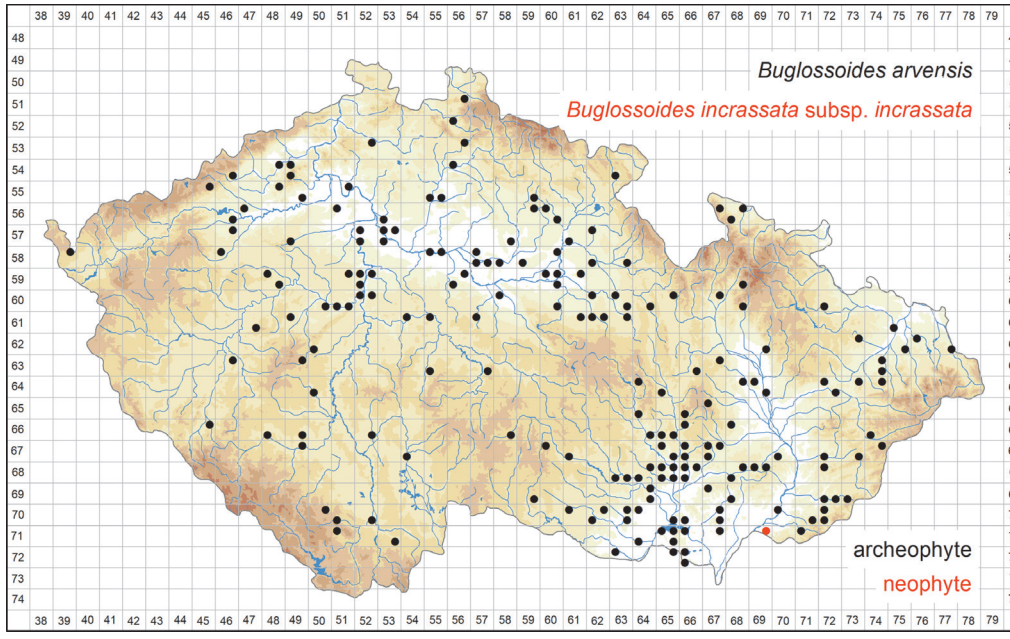

Fig. 4. – Distribution of *Buglossoides arvensis* (193 occupied quadrants) and *B. incrassata* subsp. *incrassata* (1 occupied quadrant) in the Czech Republic. Prepared by Jiří Danihelka & Petra Štěpánková.

1986, Valdés 2011). In its native range it occurs in dry grasslands, pastures and rocky places at middle elevations, usually on sandy or calcareous soils. This subspecies was first found in the Czech Republic in 2005 near the railway station in the town of Strážnice in south-eastern Moravia, and this small population still exists, as documented by a specimen collected in 2017. It occurs there together with *B. incrassata* subsp. *splitgerberi*. It is considered a casual neophyte (Pyšek et al. 2012).

Buglossoides incrassata subsp. *splitgerberi* (Fig. 5)

Buglossoides incrassata subsp. *splitgerberi* probably occurs in most of the Mediterranean area and in central and eastern Europe (Valdés 2011, as *B. arvensis* subsp. *sibthorpiana*). However, this map is not precise because this taxon had been confused with *B. arvensis* (s. str.) until recently. Based on the examined specimens, *B. i.* subsp. *splitgerberi* is present also in Austria, Poland and Ukraine. In the Czech Republic *B. incrassata* subsp. *splitgerberi* occurs mainly in somewhat disturbed dry grasslands, rather dry ruderal habitats, on road verges, along railways tracks and less frequently than *B. arvensis* also as a weed on arable land. The soils are usually fresh but drying out during the growing season, slightly acidic to slightly basic and moderately rich in nutrients. This subspecies is widespread in this country, in general somewhat more frequent than *B. arvensis*. It occurs from the lowlands up to elevations of about 600 m, reaching its elevational maximum of 780 m on Vacovický vrch hill near the village of Čkyně in southern Bohemia. The gaps on the map are to a large extent due to under-recording, as this taxon has been recognized only recently, and the map had to be based only on examined herbarium specimens. *Buglossoides incrassata* subsp. *splitgerberi* is considered a naturalized archaeophyte (Pyšek et al. 2012), but it may also be native to the warm, dry areas in central Bohemia and southern Moravia.

Buglossoides purpurocaerulea (Fig. 6)

Buglossoides purpurocaerulea is a predominantly European species. It is distributed from the Pyrenees in the west, and as far as the western coast of the Black Sea, southwestern Ukraine, Crimea and the southern part of European Russia in the east, while towards the south it reaches Sardinia, Sicily and Peloponnese, and northward it extends to central France and central Germany, and disjunctly also southern England. In Asia it is found only in Transcaucasia and Anatolia (Meusel et al. 1978). In the Czech Republic *B. purpurocaerulea* occurs mainly in thermophilous oak forests and their fringes, rather dry oak-hornbeam forests and tall mesic and xeric scrub. The soils are usually fresh but drying out later in the growing season, rich in calcium and poor to moderately rich in other nutrients. *Buglossoides purpurocaerulea* has a discontinuous distribution in this country, restricted to areas with warm climates. It is found in hilly landscapes of northern and central Bohemia, and central, southern and south-eastern Moravia, with a handful of outposts elsewhere. It is also rarely cultivated ornamentally in gardens and parks but only very few records exist. This species is assessed as of lower risk – near threatened (Grulich 2012), probably due to its limited distribution.

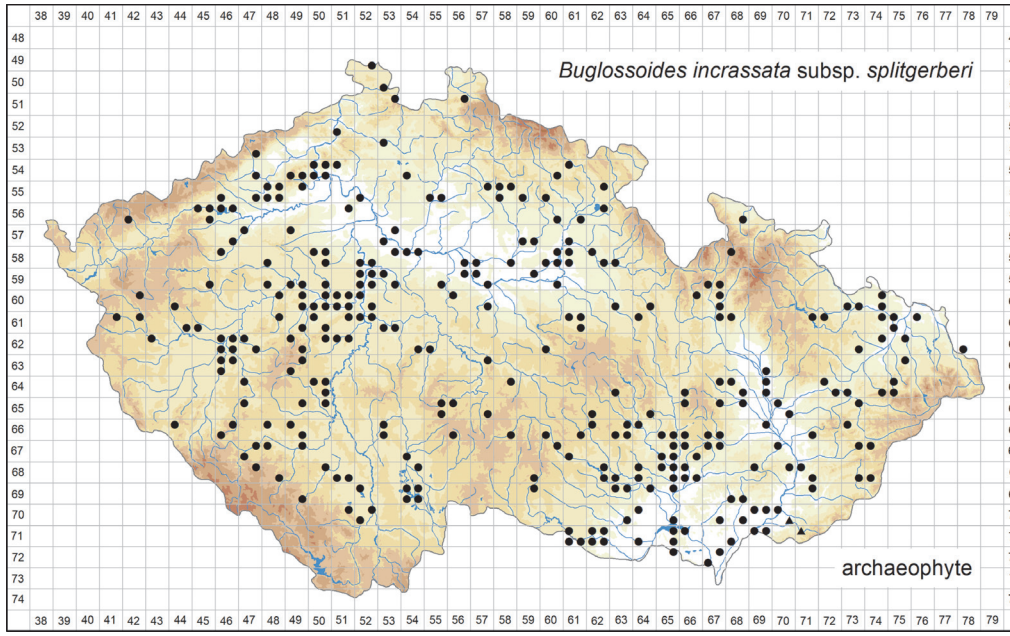

Fig. 5. – Distribution of *Buglossoides incrassata* subsp. *splitgerberi* in the Czech Republic: ● occurrence documented by herbarium specimens (313 quadrants), ▲ occurrence based on other records (2 quadrants). Prepared by Jiří Danihelka & Petra Štěpánková.

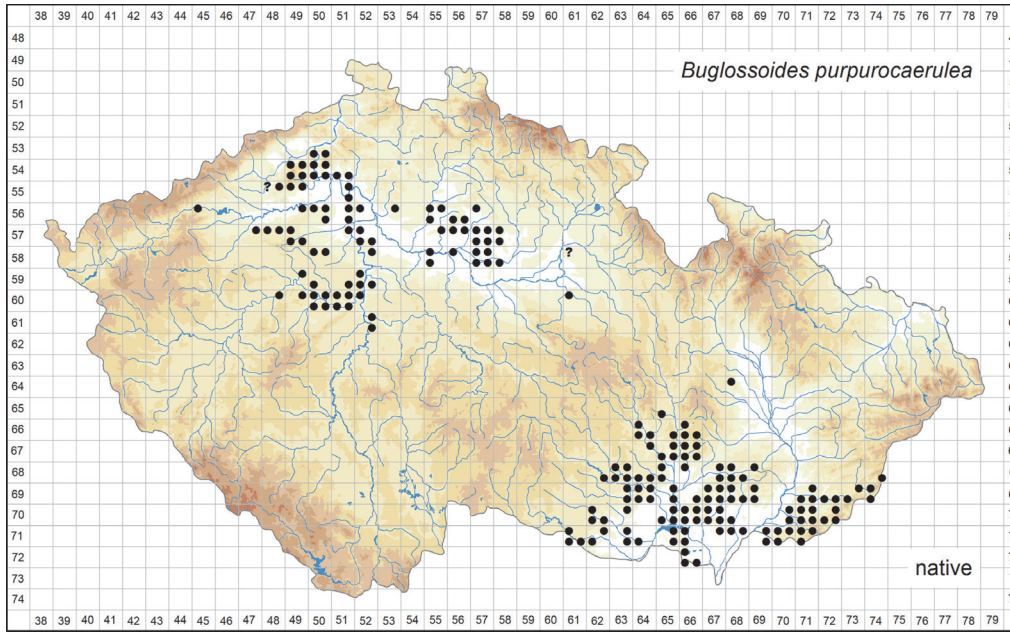

Fig. 6. – Distribution of *Buglossoides purpurocaerulea* in the Czech Republic (194 occupied quadrants). Prepared by Jiří Danihelka.

Calamagrostis arundinacea (Fig. 7)

Calamagrostis arundinacea is a Euro-Siberian species, being widespread in the temperate zone in Europe and western Asia, extending from northern Spain to western Siberia (Hultén & Fries 1986). The eastern limit of this species' distribution is unclear due to confusion with the similar *C. brachytricha*, which is sometimes considered to be conspecific with *C. arundinacea* (Lu & Phillips 2006b). In the Czech Republic *C. arundinacea* grows in various types of rather open forests, in forest cleanings, fringes, scrub and on cliffs, and at high elevations also in subalpine grasslands. It prefers moderately humid soils that are moderately supplied with nutrients. *Calamagrostis arundinacea* is a species common throughout this country, especially in the areas with rugged relief. It is less frequent in flat and wetland areas and probably missing from small areas in dry lowlands without suitable habitats. At the sites where they co-occur, *C. arundinacea* frequently forms a hybrid with *C. epigejos* (= *C.* ×*acutiflora*), which resembles *C. varia* and is often confused with this species.

Calamagrostis canescens (Fig. 8)

Calamagrostis canescens is predominantly a European tetraploid species distributed from the north-eastern Iberian Peninsula and the British Isles in the west to western Siberia in the east. In the western part of its range, the species is widespread from northern Scandinavia and the Kola Peninsula in the north to Italy, Slovenia, Hungary, Romania and Bulgaria in the south; isolated occurrences are known from Turkey and the Caucasus Mts (Hultén & Fries 1986, Conert 1998a). In the Czech Republic *C. canescens* indicates wet, poorly aerated soils and usually moderately nutrient-rich sites. It grows in various wetland types, including fishpond shores, reed beds, marsh vegetation of tall sedges, wet meadows, ditches and alder and willow carrs. It is often expansive in abandoned meadows. *Calamagrostis canescens* occurs mainly in wetland and fishpond basins and wet hilly landscapes and highlands. It is common in the fishpond landscapes in northern, southern and eastern Bohemia and throughout the Českomoravská vrchovina highlands including the Jihlavské vrchy, Žďárské vrchy and Železné hory hills. It is also frequent in the Brdy, Český les, Slavkovský les, Drahanská vrchovina, Nízký Jeseník and Oderské vrchy hills. Elsewhere it is scattered in suitable habitats. It also occurs in the warm lowlands but is absent from very dry areas. It usually avoids elevations above 850 m a. s. l. *Calamagrostis canescens* is frequently confused with the similar *C. villosa*, and some literature records, especially those from high elevations, may be erroneous.

Calamagrostis epigejos (Fig. 9)

Calamagrostis epigejos has a large, continuous distribution in Eurasia, from the boreal to the meridional zone. It occurs from north-eastern Spain, the British Isles and Scandinavia throughout almost the whole of Europe, central Asia, southern Siberia, eastern Asia eastwards to the Russian Far East, eastern China and Japan. Its occurrence is more or less scattered in some parts of central and eastern Asia (Hultén & Fries 1986, Rebele & Lehmann 2001). Outside central Europe, several taxa of unclear taxonomic value have been distinguished at the subspecific or even specific ranks (Tzvelev 1976, Conert 1998a, Rebele & Lehmann 2001, Lu & Phillips 2006a). Secondary occurrences are known from

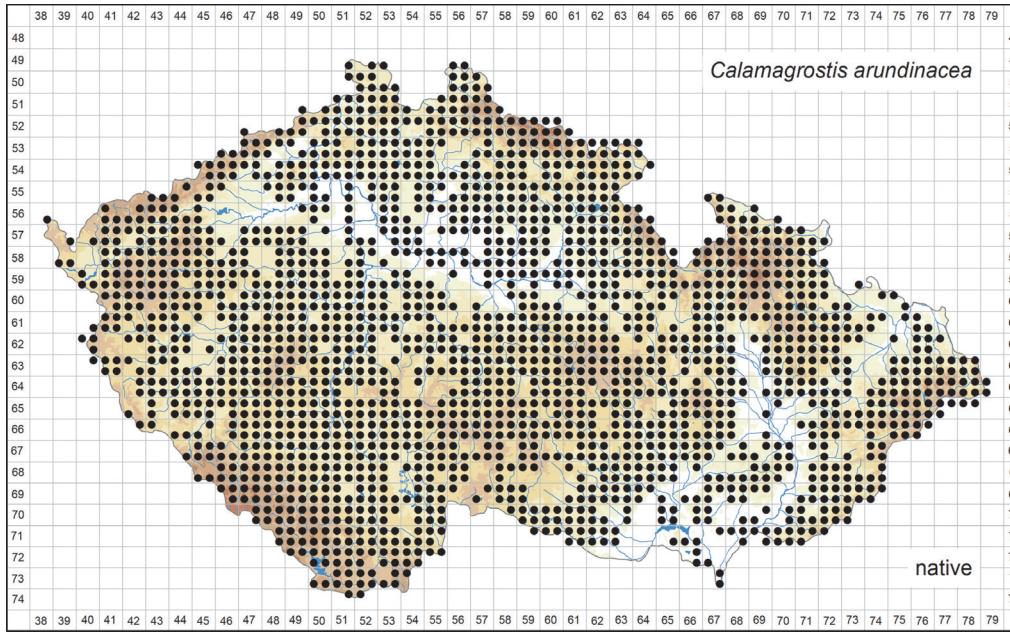

Fig. 7. – Distribution of *Calamagrostis arundinacea* in the Czech Republic (1922 occupied quadrants). Prepared by Milan Štech.

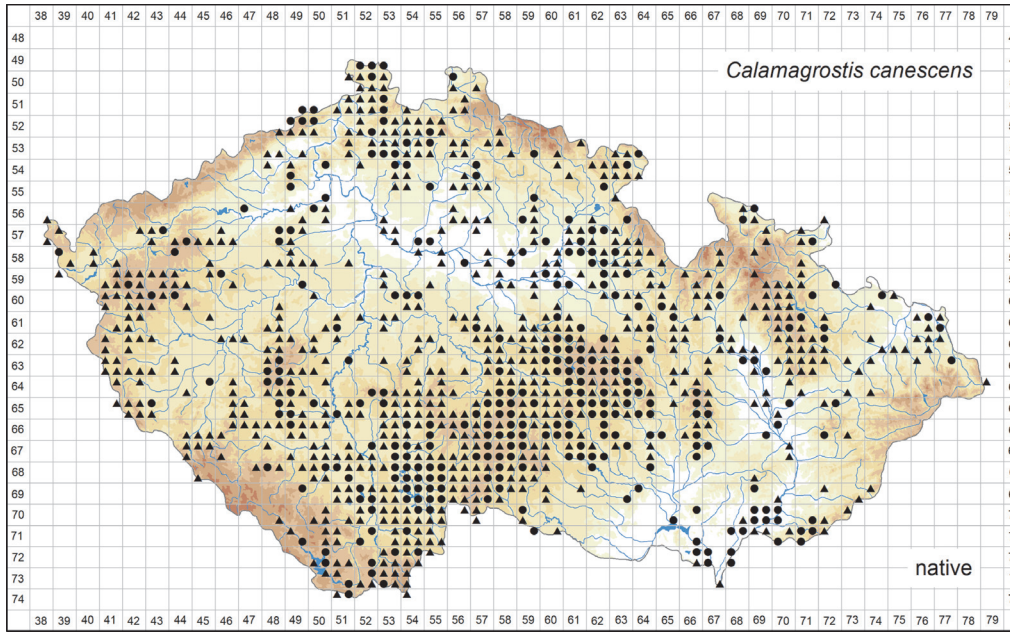

Fig. 8. – Distribution of *Calamagrostis canescens* in the Czech Republic: ● occurrence documented by herbarium specimens (303 quadrants), ▲ occurrence based on other records (675 quadrants). Prepared by Milan Štech.

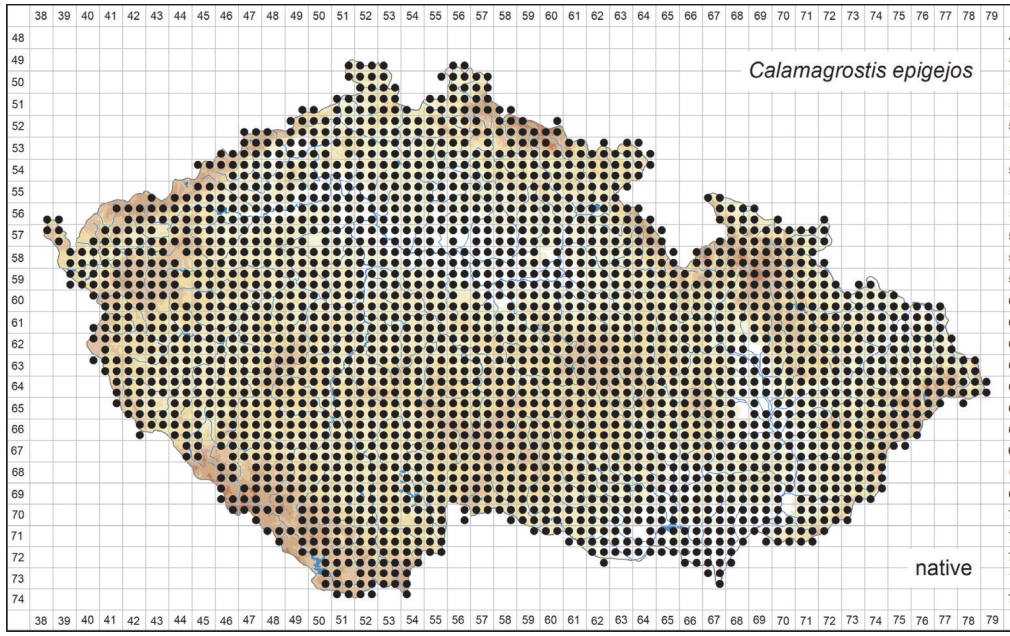

Fig. 9. – Distribution of *Calamagrostis epigejos* in the Czech Republic (2390 occupied quadrants). Prepared by Milan Štech.

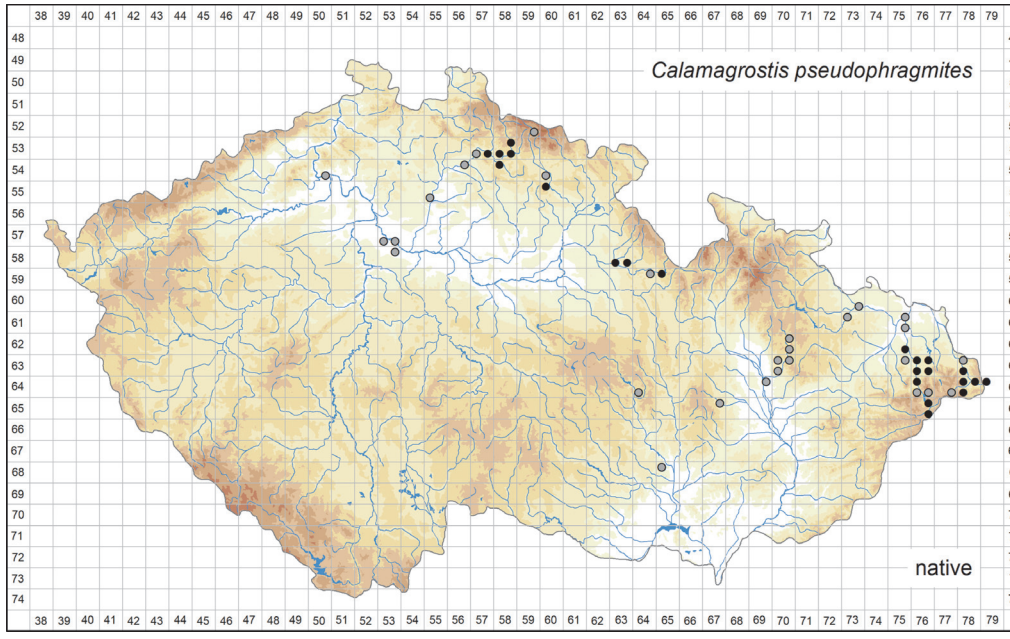

Fig. 10. – Distribution of *Calamagrostis pseudophragmites* in the Czech Republic: ● at least one record in 2000–2020 (22 quadrants), ● pre 2000 records only (28 quadrants). Prepared by Milan Štech.

North America (Marr et al. 2007), northern New Zealand and Tasmania (Rebele & Lehmann 2001). This species also occurs in eastern and South Africa, where it is represented by subsp. *capensis* (Tzvelev 1976). In the Czech Republic only subsp. *epigejos* occurs. It is abundant in forest clearings, forest fringes and openings, scrub, on roadsides, in various types of grasslands from floodplain meadows to steppes, at sandy sites and on wastelands. Its ecological range is very wide, and it grows in dry sites as well as in wetlands. The soils are stony, sandy, clayey or organic, showing wide ranges of pH and nutrient amounts (Rebele & Lehmann 2001). *Calamagrostis epigejos* is a very strong competitor that has expanded due to changes in land use, particularly abandonment of mowing and grazing. It is widespread and very frequent almost throughout this country. Only at the highest elevations it is rare and usually restricted to man-made habitats, particularly along roads. From the three main cytotypes (tetraploid, hexaploid and octoploid), only tetraploids (2n=28) have been reported for the Czech Republic so far. *Calamagrostis epigejos* readily hybridizes with *C. arundinacea*, which is also tetraploid. At sites where both species co-occur, their hybrid, *C.* ×*acutiflora*, is frequent.

Calamagrostis pseudophragmites (Fig. 10)

Calamagrostis pseudophragmites is a Eurasian montane species. As a habitat specialist occurring on river banks and gravel deposits, it is scattered from the Alps, the Carpathians and the mountains of the Balkan Peninsula eastwards to the mountains of central and eastern Asia (Conert 1998a). While several subspecies are distinguished in Asia, only the type subspecies is known in central Europe (Tzvelev 1976). Several isolated (some now vanished) occurrences in highlands and mountain foothills from the Netherlands to eastern Siberia (Conert 1998a) suggest a much more widespread distribution during the late Pleistocene and the early Holocene as well as long-distance dispersal along rivers. In the Czech Republic *C. pseudophragmites* grows mostly on gravel bars of submontane fast-flowing rivers, but occurs also on loamy river banks. It is most frequent on rivers in the foothills of the Slezské and Moravskoslezské Beskydy Mts (Ostravice, Morávka, Lomná and Olše rivers) in Silesia and adjacent parts of Moravia. The occurrences on the Moravice and Bystřice rivers in the foothills of the Nízký Jeseník hills have not been confirmed recently. Rare occurrences in central Moravia disappeared long ago. In Bohemia *C. pseudophragmites* still occurs on the Divoká Orlice, Labe and Jizera rivers in the foothills of the Krkonoše and Orlické hory Mts, although it has vanished from the lowlands. The main causes of this species' retreat in the Czech Republic are channelization of rivers and especially building of dams. Therefore, the species is classified as critically threatened (Grulich 2012).

Calamagrostis purpurea (Fig. 11)

Calamagrostis purpurea belongs to the taxonomically intricate *C. canadensis* agg. or the *C. purpurea–langsdorfii–canadensis* complex, with a circumpolar distribution (Tateoka 1974, Hultén & Fries 1986). This complex includes several taxa but their taxonomic treatments differ among authors (e.g., Tzvelev 1976, Hultén & Fries 1986). The taxonomic difficulties are caused by considerable phenotypic plasticity, presence of several ploidy levels, presumed facultative apomixis and possible hybridization in some parts of the range (Nygren 1962, Mitchell 1968, Tateoka 1974, Tzvelev 1976). European plants

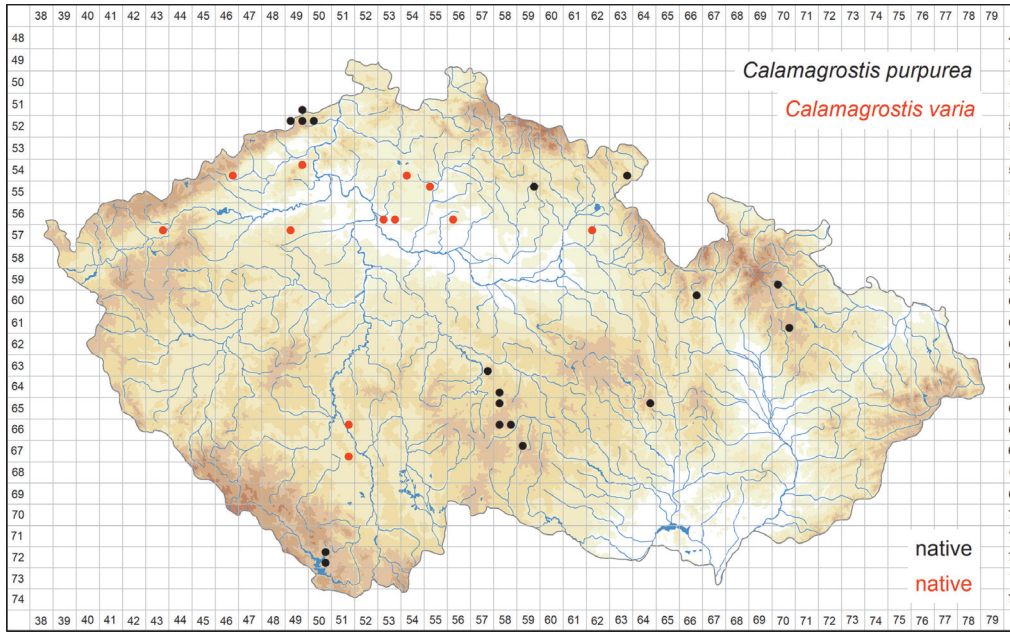

Fig. 11. – Distribution of *Calamagrostis purpurea* (18 occupied quadrants) and *C. varia* (12 occupied quadrants) in the Czech Republic. Prepared by Milan Štech.

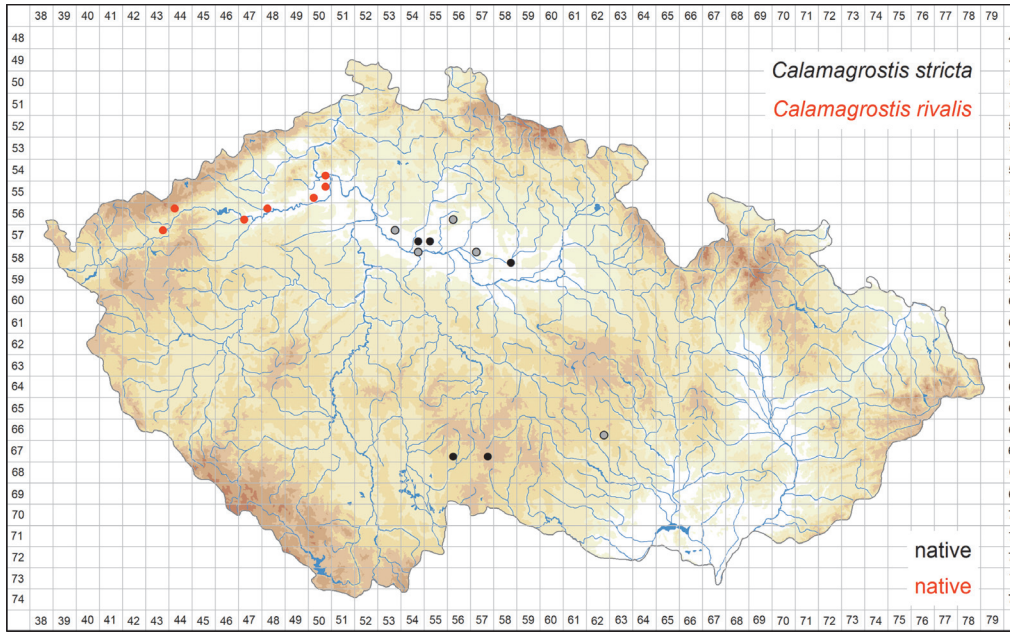

Fig. 12. – Distribution of *Calamagrostis rivalis* (7 occupied quadrants) and *C. stricta* (● at least one record in 2000–2020: 5 quadrants, ◍ pre 2000 records only: 5 quadrants) in the Czech Republic. Prepared by Milan Štech.

have traditionally been treated as *C. phragmitoides* and often considered to be a product of past hybridization between *C. canescens* and Asian plants of the *C. canadensis* complex (Scholz 1971, Tzvelev 1976, Conert 1998a). A taxonomic lumping of the European and the Asian plants of *C. purpurea* is preferred here, due to still insufficiently explored morphological and cytological variation in Asia, which seems to include also variation of European plants (V. Schaabová et al. unpubl.). *Calamagrostis purpurea* is closely related to, and possibly conspecific with, *C. canadensis*, which is widespread mainly throughout the boreal and temperate zones in North America (Marr et al. 2007). In its broad circumscription, *C. purpurea* is widespread in boreal and temperate zones in Eurasia from Scandinavia to the Russian Far East. This species is rare in central Europe, distributed mainly in highland areas from the Massif Central in France in the west through the Mittelgebirge ranges in Germany to the Českomoravská vrchovina highlands in the Czech Republic in the east (Scholz 1971). It is very rare in the Alps, the Carpathians and their foothills (Štech et al. 2020). In the Czech Republic, octoploids and rare dodecaploids were detected (V. Schaabová et al. unpubl.). *Calamagrostis purpurea* grows along streams, in wet meadows, on the shores of fishponds, in bog edges, forest springs and openings. It prefers wet, poorly aerated soils and usually moderately nutrient-rich sites. It may behave expansively in degraded and abandoned meadows. *Calamagrostis purpurea* was not discovered in the Czech Republic until 1974 (Smejkal 1976). However, the species is currently known from more than 20 sites across this country at the elevations between 400 and 750 m. Most of them are situated in the Českomoravská vrchovina highlands and at the north-eastern edge of the Krušné hory Mts. Other occurrences are known from the south-eastern part of the Šumava Mts, eastern Bohemia and northern Moravia. Additional populations may be found in the future, especially in the highlands. Now it is classified as endangered due to its rarity (Grulich 2012).

Calamagrostis rivalis (Fig. 12)

Until recently, *Calamagrostis rivalis* was considered an endemic species of the catchment area of the Mulde river in the federal states of Saxony and Saxony-Anhalt in Germany (Conert 1998a, Schiebold et al. 2008). It is thought to be a hybridogenous hexaploid species with mostly apomictic reproduction (Heine 1972). Based on morphology, the ploidy level and molecular markers, the plants occurring along the Ohře river in north-western Bohemia that were previously assigned to *C. pseudophragmites* (Kubát et al. 1981) have recently been identified as *C. rivalis* (Štech 2019, J. Piherová et al. unpubl.). In the Czech Republic *C. rivalis* grows on lower parts of river banks. Several localities are currently known along the Ohře river between the city of Karlovy Vary and its confluence with the Labe river. Although finds of other populations along the Ohře river are likely, the species deserves to be included in the next edition of the Red List as critically threatened because of its rarity and subendemic status.

Calamagrostis stricta (Fig. 12)

Calamagrostis stricta is a circumpolar species with a rather discontinuous distribution in the arctic, boreal and temperate zones in the Northern Hemisphere (Hultén & Fries 1986). While suitable habitats are frequent in the north, they are rare in the south, very scattered and vanishing over time. Only *C. stricta* subsp. *stricta* occurs in Europe, and its southern

limit runs from the British Isles through France, Switzerland, Germany, the Czech Republic, Hungary and Romania to the Caucasus Mts. In the Czech Republic this species occurs in fens and wet meadows on slightly acidic to slightly basic soils. In this country *C. stricta* occurs mainly in the middle Labe river basin in central Bohemia. However, most populations have vanished due to succession, habitat degradation or destruction. Three populations have been discovered in the Českomoravská vrchovina highlands over the past three decades. Nevertheless, this species still has to be classified as critically threatened (Grulich 2012).

Calamagrostis varia (Fig. 11)

Calamagrostis varia is endemic to central Europe and adjacent areas. It mainly occurs in limestone parts of the Alps, Western Carpathians, Apennines and Dinarids. Relict locations are scattered northwards to the Harz Mts, and an isolated outpost exists on the Swedish island of Gotland (Conert 1998a). Recently it has also been found on the Estonian island of Saaremaa (Lindell 2006). All these occurrences belong to subsp. *varia*, while subsp. *corsica* is reported from Corsica (Conert 1998a). The populations of *C. varia* in the Czech Republic are considered as relict and are located in fens, open-canopy pine forests and on calcareous cliffs where the species survived since the early Holocene. Occurrences of *C. varia* usually indicate calcium-rich substrates. Its present distribution in this country comprises scattered sites in the northern half of Bohemia. Two isolated occurrences in southern Bohemia in the 1920s are represented by herbarium specimens. Additionally, specimens from several other Bohemian localities that do not now host this species are of plants insufficiently developed to distinguish *C. varia* from the very similar hybrid between *C. arundinacea* and *C. epigejos*. Because *C. varia* is rare in this country, some populations have been extirpated and habitats of other have degraded, this species is classified as critically threatened (Grulich 2012).

Calamagrostis villosa (Fig. 13)

Calamagrostis villosa is an endemic species of the mountains of central and south-eastern Europe. Its distribution is restricted to the Bohemian Massif, the Alps, the Carpathians, the south-eastern Dinarids and the mountains in Bulgaria (Conert 1998a). In the Czech Republic *C. villosa* grows in various types of mountain forests, forest clearings, mountain and alpine grasslands. It is a very strong competitor, expanding in deforested sites (Pyšek 1993). It prefers damp, nutrient-poor or moderately nutrient-rich sites, generally with acidic soils. *Calamagrostis villosa* is widespread in the mountain ranges along the country's border except for south-eastern Moravia. It is also common in the Slavkovský les, Brdy, Jihlavské vrchy, Žďárské vrchy, Nízký Jeseník and Oderské vrchy hills, the Hrubý Jeseník Mts and in the highest parts of the Železné hory hills and Českomoravská vrchovina and Drahanská vrchovina highlands. Its abundance decreases towards low elevations, except for rather humid and oligotrophic areas such as the Třeboňská pánev basin, the sandstone pseudokarst in northern Bohemia and the south-eastern vicinity of the city of Hradec Králové, where *C. villosa* is rather common. It is rare in or absent from warm and dry areas. Some isolated populations may have been unintentionally introduced with the planting stock of forest trees.

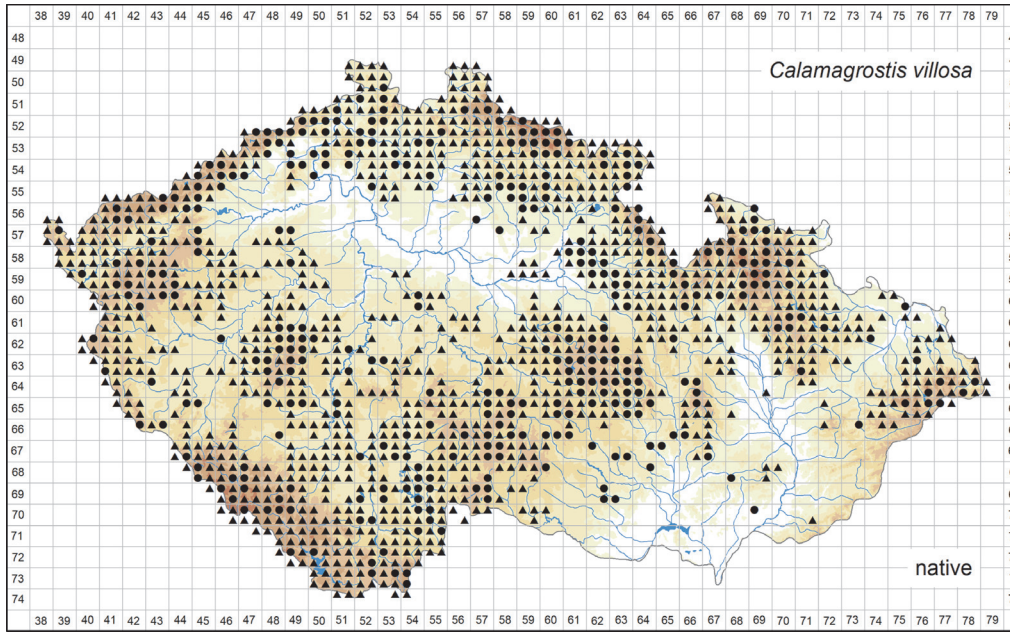

Fig. 13. – Distribution of *Calamagrostis villosa* in the Czech Republic: ● occurrence documented by herbarium specimens (349 quadrants), ▲ occurrence based on other records (1047 quadrants). Prepared by Milan Štech.

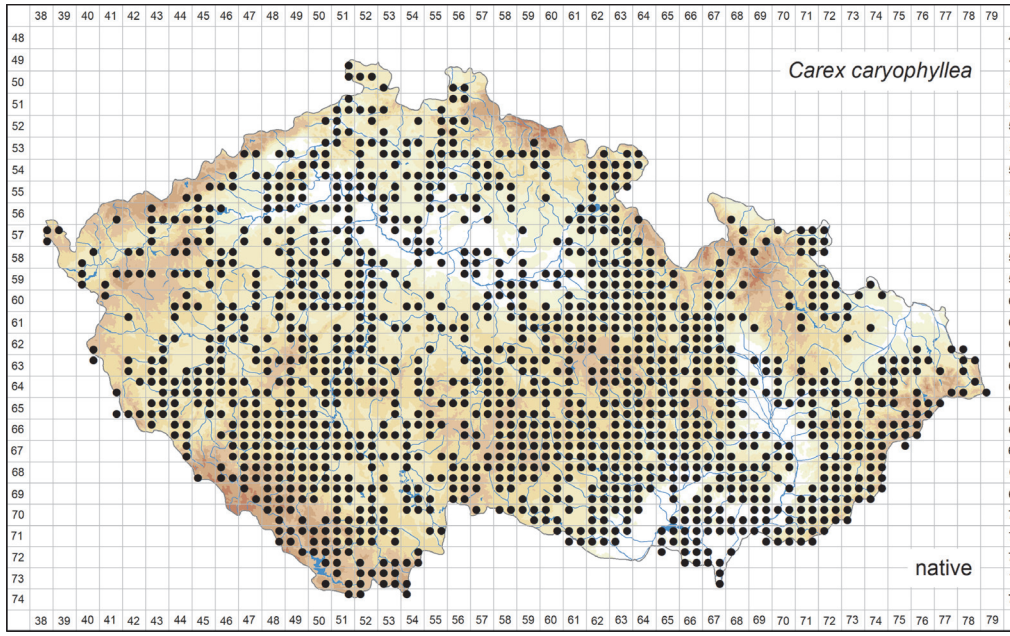

Fig. 14. – Distribution of *Carex caryophyllea* in the Czech Republic (1382 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

Carex caryophyllea (Fig. 14)

Carex caryophyllea is a Eurasian species with a more or less continuous distribution from northern Spain to the Altai Mts, Kazakhstan and Kyrgyzstan and separate occurrences in the Caucasus Mts and Anatolia; it is rare in or missing from most of the Mediterranean area (Meusel et al. 1965, Hultén & Fries 1986, Egorova 1999). It has been introduced to North America (Standley 2002). It occupies various types of mesophilous and semi-dry meadows, pastures and heathlands, rarely also semi-shady mesophilous or semi-thermophilous oak or hornbeam-oak forests, where it often remains sterile. It grows on various types of bedrock (but usually prefers slightly acidic ones in warm areas), generally on rather shallow sandy or loamy soils at places with reduced herb cover. *Carex caryophyllea* flowers very early (often during April), and the small sterile plants are obscured by other species later. In the Czech Republic it is rather common and is continuously distributed from the dry, warm lowlands up to the lower mountains, reaching its elevational maximum at 1110 m in the Šumava Mts. Its more or less discontinuous distribution in some parts of the country (e.g. western Bohemia, some parts of the Česko-moravská vrchovina highlands and northern Moravia), as shown in the map, may reflect a lack of records rather than true absences. On the other hand, the absences shown in the area around the town of Žatec, in the eastern part of the Labe river basin, near the town of Znojmo, in the central part of Moravia, in the Odra river basin as well as in the mountains reflect the actual situation.

Carex depressa subsp. *transsilvanica* (Fig. 15)

Carex depressa has a discontinuous distribution in southern, central, and south-eastern Europe and western Asia. Egorova (1999) distinguished three subspecies within *C. depressa*. The type subspecies occurs only in the Iberian Peninsula; subsp. *basillaris* grows in northern Africa and in south-western Europe, extending from northern Spain through southern France, Corsica and Sardinia to Italy; and subsp. *transsilvanica* has the largest distribution area of the three. *Carex depressa* subsp. *transsilvanica* grows mainly in the Carpathians and the Balkan Peninsula (Montenegro, Serbia, Bulgaria, north-western part of Turkey), with further occurrences scattered towards the north-west including northern Italy, south-eastern Austria, northern Hungary and the Czech Republic. It is also found in Poland, Lithuania and Crimea. Outside Europe, it occurs in the Caucasus Mts, Transcaucasia and north-western Iran. In the Czech Republic *C. depressa* subsp. *transsilvanica* prefers short-growing meadows and pastures on slopes, usually adjacent to deciduous forests and shrub stands. It is found in sunny or partially shaded places on flysh, with rather acidic soils that dry out in summer. It suffers from competition from tall broad-leaved herbs (Řepka & Fajmon 2016) and therefore prefers habitats disturbed by grazing. In the Czech Republic it only occurs in eastern Moravia. It this country *C. depressa* was first discovered in 2014 near the town of Luhačovice, and two populations were later found near the town of Vsetín. They are situated at the elevations of 330–525 m. The species is classified as critically threatened due to its rarity (Grulich 2017).

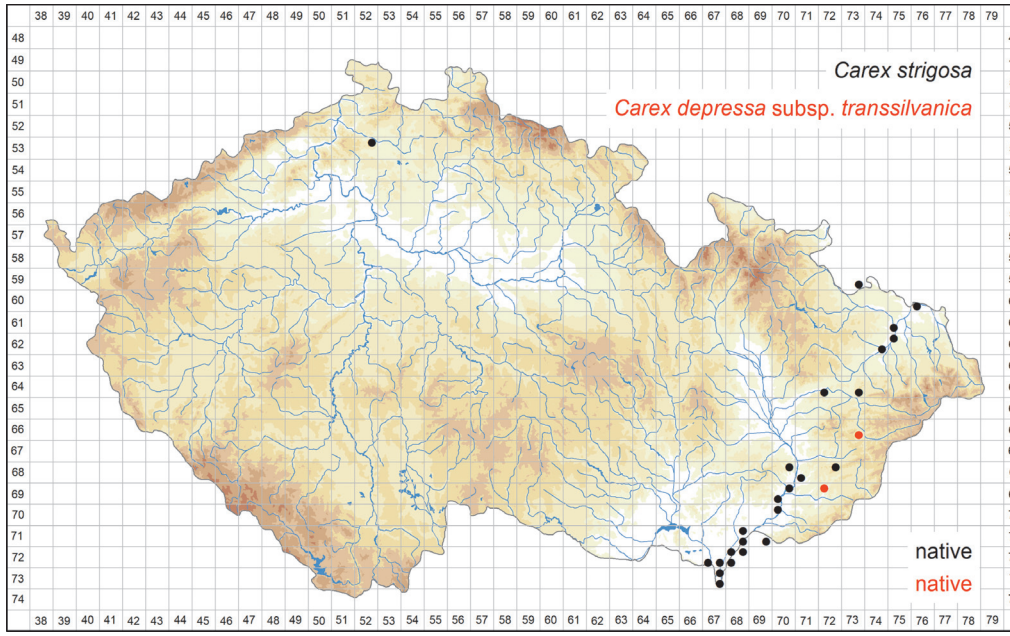

Fig. 15. – Distribution of *Carex depressa* subsp. *transsilvanica* (2 occupied quadrants) and *C. strigosa* (24 occupied quadrants) in the Czech Republic. Prepared by Vít Grulich & Radomír Řepka.

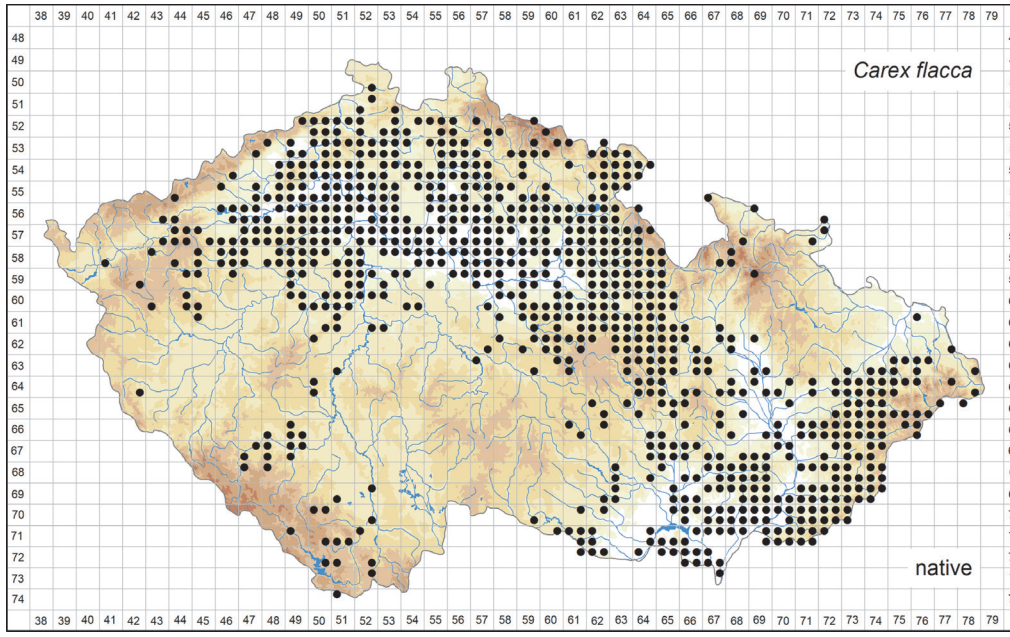

Fig. 16. – Distribution of *Carex flacca* in the Czech Republic (854 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

Carex flacca (Fig. 16)

Carex flacca is a European species growing from Portugal in the west to the central part of European Russia in the east, northwards reaching central Norway and Iceland. The southern limit of its distribution is not clear since most of the records from the Mediterranean area, northern Africa, Turkey, Syria and Iran may refer to the closely related *C. cuspidata*. It has been introduced to North America (Egorova 1999). *Carex flacca* occurs on clay soils and it is a good ecological indicator of basic, usually calcareous bedrock, such as marlstone, calcareous sandstone and limestone. It grows usually in semi-dry thermophilous grasslands and intermittently or continuously wet fen meadows, rarely in light deciduous or pine forests, where it can remain sterile. In the Czech Republic *C. flacca* grows mainly in areas with rather warm climates. Its abundant occurrence in northern and north-eastern Bohemia and eastern Moravia may be explained by the species' affinity for calcareous substrates. In other areas, especially at rather high elevations and in areas with predominantly acidic, crystalline rocks (e.g. in western and southern Bohemia, the Českomoravská vrchovina highlands, central and northern Moravia) it is rather rare, usually confined to spot occurrences of calcareous bedrock. It reaches its elevational maximum at about 1500 m in the Krkonoše Mts. Some of the undocumented records may be erroneous, based on misidentified specimens of *C. panicea*.

Carex michelii (Fig. 17)

The range of *Carex michelii* is situated mainly in central and south-eastern Europe, extending from Bulgaria and central Italy northwards to Austria, Bavaria (only one site), the Czech Republic and southern Poland. From the southern part of European Russia, its distribution extends to the Caucasus Mts, Transcaucasia and north-western Anatolia (Egorova 1999). In the Czech Republic *C. michelii* occurs mainly in open-canopy thermophilous oak and oak-hornbeam forests and their fringes, usually on basic, rarely also on acidic bedrock or sand. It is also found in broad-leaved dry grasslands, predominantly on basic, heavy soils. In the Czech Republic there are two isolated groups of localities. The larger group of sites has been documented from southern and central Moravia, with the northernmost occurrences in the vicinity of the town of Litovel, eastwards reaching western and central part of the Bílé Karpaty Mts. The smaller group of sites is situated in the warmest parts of central and northern Bohemia, where *C. michelii* reaches its north-western distribution limit. There it occurs mainly in the Český kras karst area and České středohoří Mts, but some specimens were collected in the central part of the Labe river basin and between the towns of Mladá Boleslav and Chlumec nad Cidlinou. Quite isolated occurrences have been documented from marble bedrock in southern Bohemia in the foothills of the Blanský les Mts near the town of Český Krumlov and in south-western Bohemia on Minovka hill near the town of Sušice.

Carex panicea (Fig. 18)

Carex panicea occurs almost all over Europe from northern Spain in the west as far as the Ural Mts in the east, northwards reaching the Arctic Circle in Finland, while the southern limit of the distribution area runs through central Italy and northern Greece; it is known from the Faroe Islands and Iceland. Its Asian distribution ranges from the Caucasus Mts,

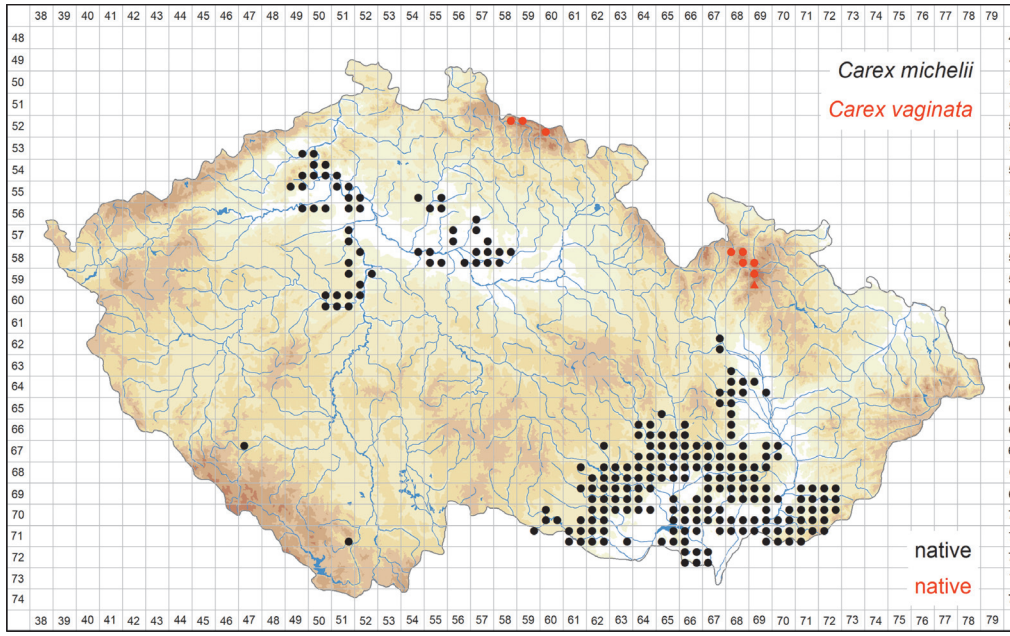

Fig. 17. – Distribution of *Carex michelii* (240 occupied quadrants) and *C. vaginata* (● occurrence documented by herbarium specimens: 8 quadrants, ▲ occurrence based on other records: 1 quadrant) in the Czech Republic. Prepared by Vít Grulich & Radomír Řepka.

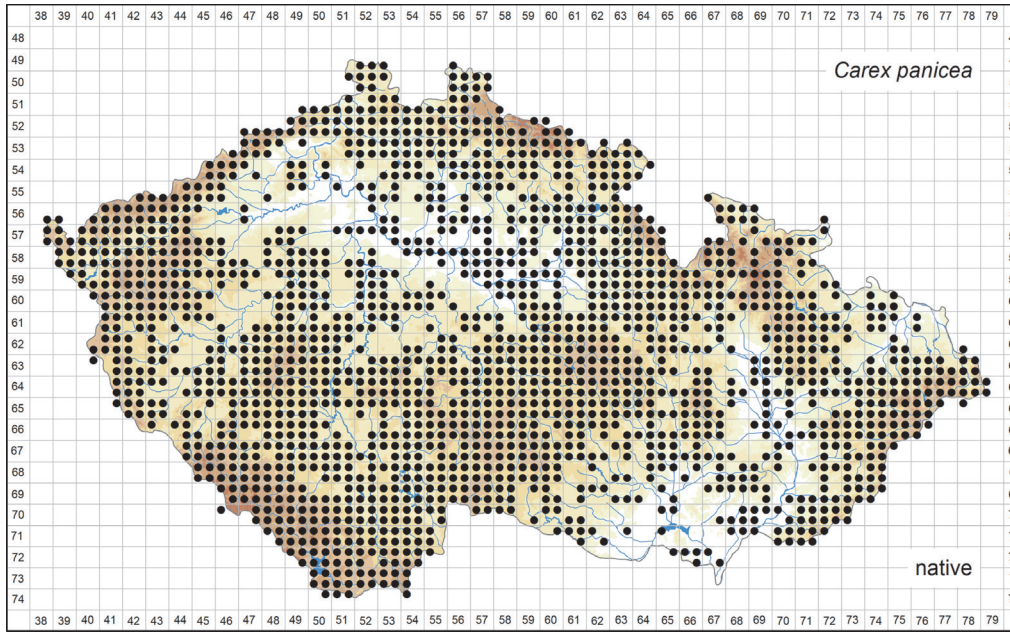

Fig. 18. – Distribution of *Carex panicea* in the Czech Republic (1770 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

Anatolia, Iraq and Iran in Central Asia to Lake Baikal and the upper part of the Lena River Basin. It also occurs in Greenland and northern Africa and as an introduced species also in New Zealand and the continental part of North America. *Carex panicea* grows in peat meadows, less frequently in other types of wet meadows, rarely in tall sedge stands, open-canopy alder and other damp deciduous forests. It occurs on various geological substrates, both acidic and basic, mostly rich in mineral nutrients, in places that are usually sunny. *Carex panicea* is widespread in the Czech Republic but is absent from or rare in the warmest, driest parts of this country. This rarity may have natural causes or may have been caused by the destruction of suitable habitats in recent times. It is found from the lowlands up to the lower mountains, reaching its elevational maximum at 1150 m in the Šumava Mts.

Carex pilosa (Fig. 19)

Carex pilosa is a European species distributed westwards to central France, northwards to Latvia and the environs of Saint Petersburg in Russia, eastwards to the Ural Mts and southwards to the Central Apennine Mts and Bulgaria. The range of the similar and closely related *C. campylorhina* is confined to eastern Asia (Meusel et al. 1965, Egorova 1999). In the Czech Republic *C. pilosa* prefers humid and shady oak-hornbeam and beech forests, usually on humid loamy soils rich in mineral nutrients. Most localities of *C. pilosa* in this country are in Moravia, especially in its south-western, central and eastern parts, where it is locally common. It is much less frequent in eastern Bohemia, with scattered occurrences westwards to the surroundings of the town of Mladá Boleslav in central Bohemia. Only isolated records exist from the Českomoravská vrchovina highlands, the Sázava and Kocába river valleys and from southern and western Bohemia. Some of these occurrences may be secondary due to introductions with young trees from forest nurseries. *Carex pilosa* was also recorded near the city of Karlovy Vary in western Bohemia (Vojta 2003); this occurrence may be related to the populations in the adjacent parts of Germany but it may also be secondary. The species reaches its elevational maximum at 970 m in the Bílé Karpaty Mts.

Carex strigosa (Fig. 15)

Carex strigosa is a European sub-oceanic species with its eastern distributional limit in the Republic of Moldova, the Caucasus Mts and northern Iran. In Europe it reaches Ireland in the north and central Italy in the south (Egorova 1999). It prefers wet deciduous forests, especially in the floodplains of larger rivers. In the Czech Republic *C. strigosa* is rare species, growing on wet to damp, nutrient-rich, loamy to clayey soils with a neutral reaction, usually in semi-shaded to shaded places, mainly in alder and floodplain forests. It was found in the Ranšpurk nature reserve south of the town of Břeclav in 1967; before then it was only known from one locality in Bohemia near the town of Česká Lípa, where it is now considered extinct. In Moravia, several tens to a hundred populations have been found to this day. This species is almost continuously distributed in the Morava floodplain between the town of Napajedla in eastern Moravia downstream to its confluence with the Dyje river. It also rarely occurs in the floodplains of the Bečva and Odra rivers in north-eastern Moravia and in the hills of the Carpathian part of Moravia. The species' occurrence in northern Moravia is related to its distribution in southern Poland.

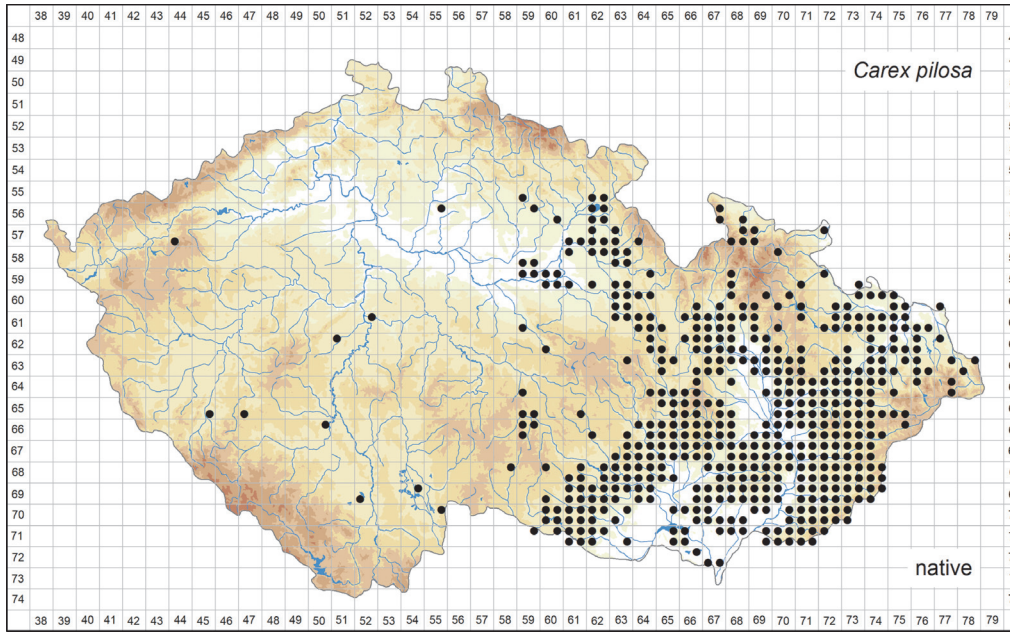

Fig. 19. – Distribution of *Carex pilosa* in the Czech Republic (509 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

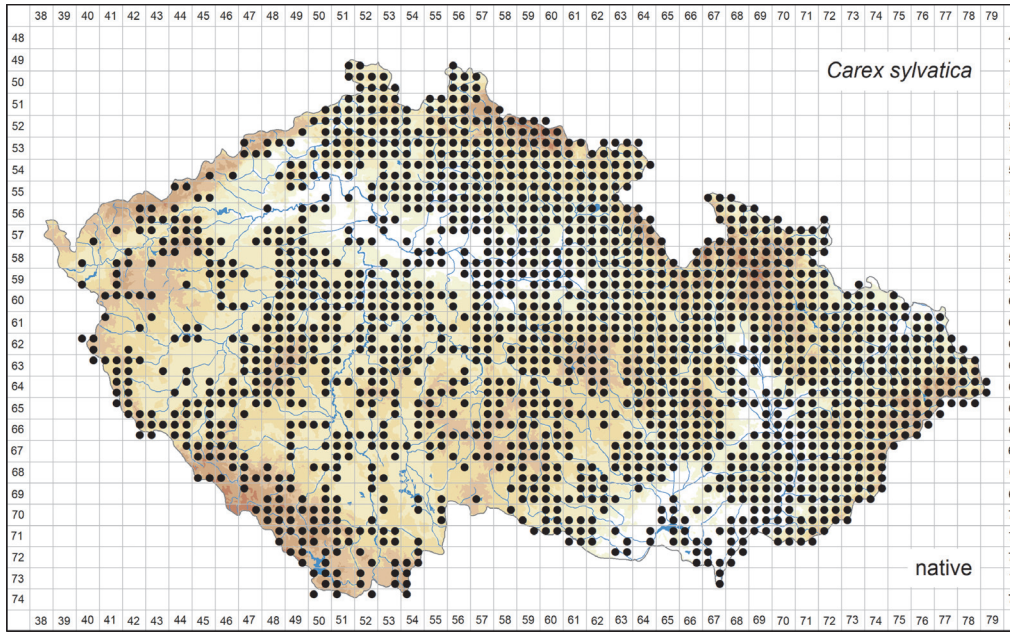

Fig. 20. – Distribution of *Carex sylvatica* in the Czech Republic (1710 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

The species' elevational range in this country is 150–300 m. It is classified as endangered due to its rarity (Grulich 2012).

Carex sylvatica (Fig. 20)

The distribution of *Carex sylvatica* includes most of Europe, but the species is rare in the Mediterranean area. To the east it reaches Anatolia, Syria, Lebanon, and extends as far as northern Iran and western Siberia (Meusel et al. 1965, Hultén & Fries 1986, Egorova 1999). In the Czech Republic *C. sylvatica* occurs in floodplain forests along lowland rivers, in alluvial ash-alder forests, forest springs, humid herb-rich beech forests and on verges of forest roads and paths, preferring shaded places and soils rich in mineral nutrients. *Carex sylvatica* is one of the most common forest sedges in the Czech Republic, distributed all over the country. It is particularly common in eastern Bohemia and central, northern and eastern Moravia; in contrast, it is rare in dry and deforested areas, e.g. in northern and central Bohemia and south-western Moravia, as well as in areas with acidic, often sandy soils poor in nutrients, e.g. in western Bohemia and the basins in southern Bohemia. It reaches its elevational maximum at 1170 m in the Šumava Mts.

Carex umbrosa (Fig. 21)

Carex umbrosa is a European species distributed from northern Spain in the west to the central part of European Russia in the east, reaching northern Germany, Poland and the Baltic countries in the north and central Italy and the Balkan Peninsula in the south. Populations from the south-eastern part of its range are separated as subsp. *huetiana*, which is known also from the Caucasus Mts, Transcaucasia and Anatolia (Meusel et al. 1965). In Siberia it is replaced by the related *C. sabynensis*, while the identity of similar plants from the Far East (referred to as *C. umbrosa* subsp. *pseudosabynensis*) is not clear (Egorova 1999). In the Czech Republic *C. umbrosa* is known from various types of wet meadows and pastures on mineral-rich substrates or mineral-rich fens and also from open-canopy forest communities, e.g. some types of oak-hornbeam forests, alder carrs or ash-alder alluvial forests as well as stands of early successional woody species, e.g., birches. It prefers rather heavy, often intermittently wet soils (especially of pseudogley type) with acidic to neutral reaction, both in sunny and semi-shady sites. In the Czech Republic *C. umbrosa* has been recorded as locally common in some moderately warm areas, especially in the foothills of the Brdy and Šumava Mts in central and south-western Bohemia. Another group of populations is known from western Bohemia in the vicinity of the towns Mariánské Lázně and Karlovy Vary. There are scattered records from moderately warm parts of northern and eastern Bohemia, the Českomoravská vrchovina highlands and elsewhere. *Carex umbrosa* is very rare in the lowlands of southern Moravia, with only a single record near the town of Hodonín, while it is completely absent from the Carpathians. It reaches its elevational maximum at 1170 m in the Šumava Mts.

Carex vaginata (Fig. 17)

Carex vaginata is a circumpolar species found in the boreal and arctic zones. It occurs in eastern Europe and northern Asia in a wide strip extending through Siberia to the Far East; it is also reported to occur in northern China and northern Japan. In Europe it is

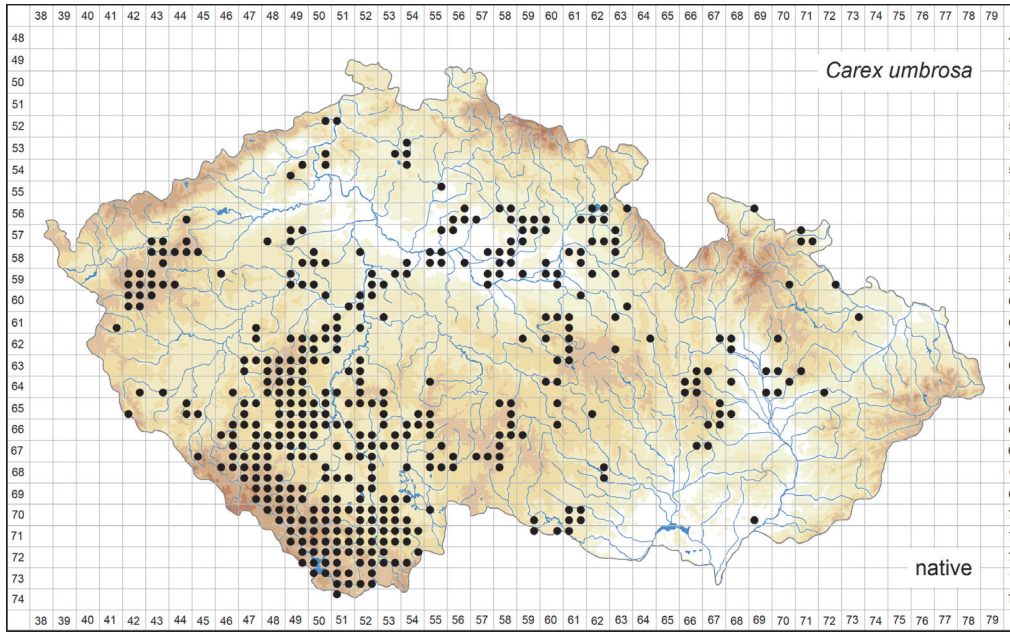

Fig. 21. – Distribution of *Carex umbrosa* in the Czech Republic (421 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

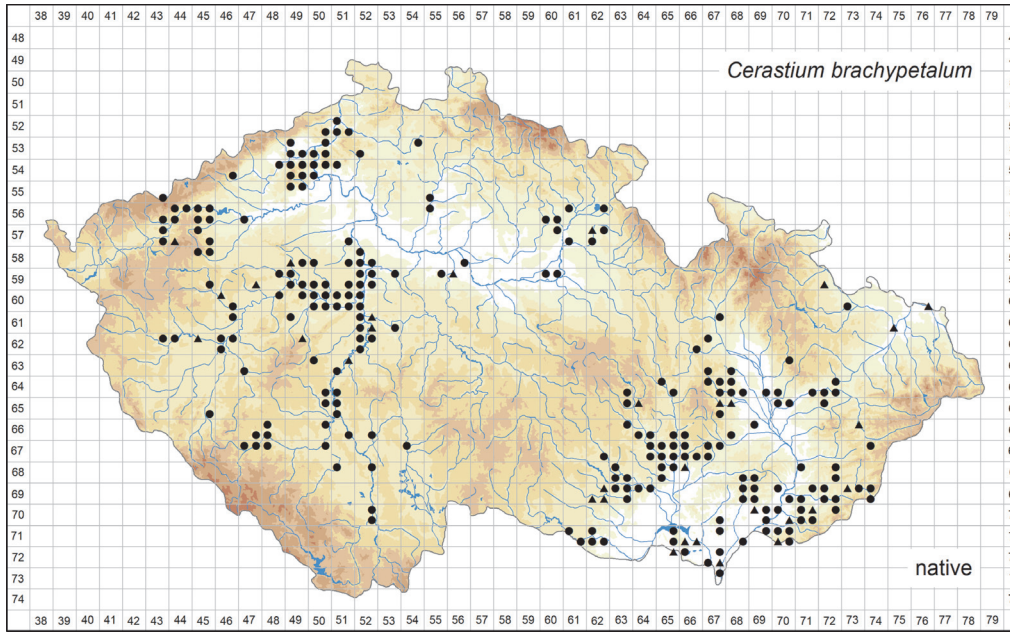

Fig. 22. – Distribution of *Cerastium brachypetalum* in the Czech Republic: ● occurrence documented by herbarium specimens (227 quadrants), ▲ occurrence based on other records (31 quadrants). Prepared by Jiří Danihelka.

found mainly in its northern part including Iceland, the northern part of Great Britain, Scandinavia, northern Russia and the Baltic countries, and reliable records exist from the lowlands of northern Germany and Poland. It also occurs in the subalpine zone of the Europe's highest mountains, including the Pyrenees, the Masiff Central in France, the Alps, Harz Mts, Sudetes Mts, and Western and Eastern Carpathians. There is an isolated area of occurrence in the Caucasus Mts. In North America it grows from Alaska in the west to Greenland in the east, southwards reaching the Great Lakes region (Meusel et al. 1965, Hultén & Fries 1986, Egorova 1999). Its habitats in the Czech Republic are subalpine grasslands above the timber-line as well as edges of subalpine springs. It grows at sunny places on wet non-calcareous soils with slightly to moderately acidic reaction. In this country *C. vaginata* is very rare and is confined to the Krkonoše and Hrubý Jeseník Mts, occurring there only at a limited number of sites, mostly in small populations in the subalpine belt at elevations 1150–1400 m. It is considered as critically threatened due to its rarity (Grulich 2012).

Cerastium brachypetalum (Fig. 22)

Cerastium brachypetalum is a mainly European species distributed from Portugal in the west to the Wisła river, the Southern Carpathians and the western coast of the Black Sea in the east, while in the south it occupies most of the Mediterranean area. Towards the north it reaches southern England and the southern coast of Scandinavia and Crimea (Jalas & Suominen 1983). This species is also found in the Caucasus Mts, Anatolia, the adjacent parts of western Asia and north-western Africa (Marhold 2011). It has been introduced into North America and is now rather widespread all over the eastern part of the USA (Morton 2005). *Cerastium brachypetalum* is subdivided into eight subspecies (Jalas et al. 1993), of which only the widespread subsp. *brachypetalum* (subsp. *tauricum* is taxonomically identical) occurs in the Czech Republic. The records from North America also refer to the type subspecies (Morton 2005). The rather widespread subsp. *tenoreanum*, another of the eight subspecies, is accepted here as a species of its own due to morphological differences and different chromosome number. In the southern part of the Balkan Peninsula subsp. *brachypetalum* is replaced by subsp. *roeseri*, while the other four subspecies are local endemics, some of them of doubtful taxonomic status (Jalas et al. 1993). *Cerastium brachypetalum* subsp. *brachypetalum* includes plants with two types of indumentum: individuals with both glandular and non-glandular hairs (traditionally referred to as subsp. *tauricum*, but with their indumentum corresponding to the type of the name *C. brachypetalum*) are more widespread, while those with only non-glandular hairs (sometimes named var. *eglandulosum*) are found mainly in rather warm and dry areas of the Czech Republic. However, both morphotypes sometimes co-occur, and this character is of minor taxonomic importance. In this country *C. brachypetalum* occurs on grassy slopes with rock outcrops, other types of dry grasslands, along fringes and in openings of thermophilous oak forests, in dry meadows, on railway embankments, road verges and, particularly recently, also at railway stations. The soils are usually dry, slightly acidic to slightly basic and poor in nutrients. This species has a discontinuous distribution in the Czech Republic, confined mainly to hilly areas and slopes of narrow river valleys with warm to moderately warm climates. Elsewhere, only single records of secondary occurrences exist. Most of the occurrences are at elevations below 500 m, and the

species reaches its elevational maximum at 615 m near the village of Valeč in western Bohemia. However, there is a record of introduced plants in the Krušné hory Mts at about 1000 m a.s.l. Particularly during the last two decades, this species has been found at new sites, usually at railway stations, on railway embankments, along roads and in disturbed dry meadows, with further finds likely. This trend corresponds to the situation in Germany and Austria (Meierott 2008). *Cerastium brachypetalum* is considered as vulnerable in the Czech Republic (Grulich 2012), probably due to its limited distribution, but no decline has been observed, and the species is spreading in secondary habitats.

Cerastium glomeratum (Fig. 23)

Cerastium glomeratum is native probably only to the temperate zone in Eurasia; however, it has been introduced into many other parts of the world with oceanic or moderately continental and rather warm climates, and now this species is almost cosmopolitan (Hultén & Fries 1986). In Europe it occurs in its western and central parts as well as the Balkan Peninsula, and reaches northward as far as southern Scandinavia (Jalas & Suominen 1983). In the Czech Republic *C. glomeratum* grows in a wide range of disturbed, mainly secondary habitats, including margins of walking paths, road verges, disturbed places in forests used for the temporary storage of logs, railway stations and ruderal lawns in settlements and parks, and less frequently in disturbed places in mesophilous and dry meadows. It is also found as a weed on arable land, mainly in row crops, and it is particularly common in nurseries, from where it is spread to gardens, flower beds and graveyards. The soils are usually moderately humid (at least in the spring), slightly acidic and well supplied with nutrients. *Cerastium glomeratum* is widespread all over this country from the lowlands up to 800 m a.s.l. It is particularly common at low and middle elevations in southern and eastern Bohemia and eastern Moravia and Silesia, mostly in areas with rather humid, warm to moderately warm climates. In contrast, it has only scattered occurrence in the warm and rather dry lowlands and in less populated areas with a small share of arable land. The occurrences in the country's highest mountains, with an elevational maximum at 1490 m on Mt Praděd in the Hrubý Jeseník Mts, are usually concentrated around mountain hotels and chalets, and therefore clearly secondary and probably also temporary. *Cerastium glomeratum* may have recently become more frequent than in the past, profiting from frequent grass cutting in the settlements and also dry summers, both of which create gaps in streetside and park lawns. At railway stations and in settlements its occurrence may also be supported by the use of herbicides, which affects mainly perennial and biennial species. Many gaps on the map likely indicate a lack of records rather than true absences, as the species has a short growing season, and its habitats are not particularly attractive to botanists.

Cerastium subtetrandrum (Fig. 24)

Cerastium subtetrandrum is a poorly known annual species, in the past usually merged with *C. pumilum*. However, it is most similar to the much more widespread *C. glutinosum*, and both species are octoploid, in contrast to the dodecaploid *C. pumilum*. Its morphological characters are discussed in detail by Karlsson (in Jonsell et al. 2001). It occurs on the coast of southern Scandinavia, the islands of Öland and Gotland in the Baltic sea, possibly also in Poland along the Baltic coast and further in inland saline habitats of southern

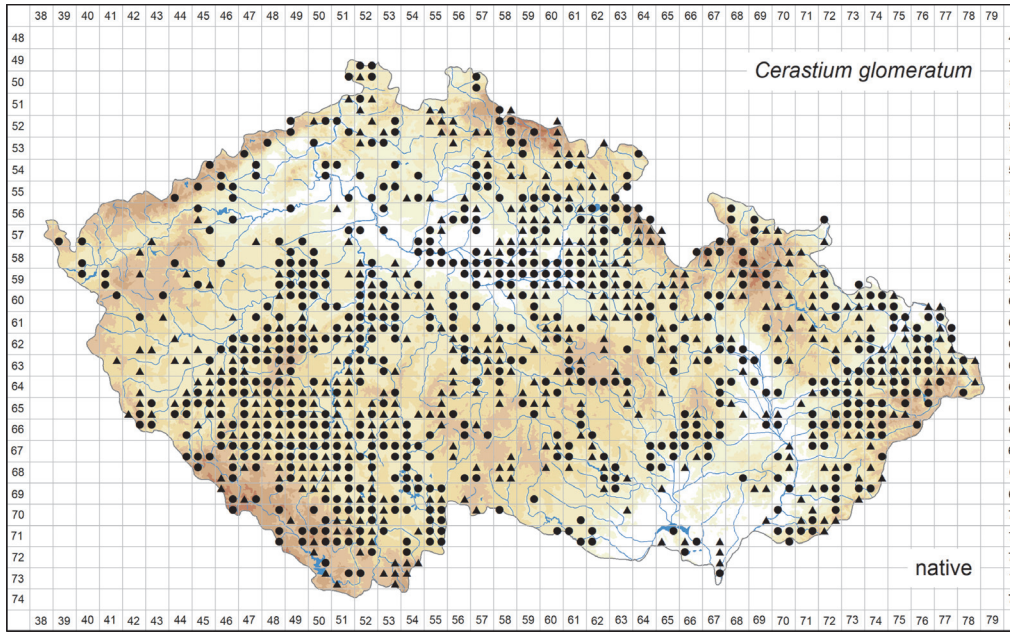

Fig. 23. – Distribution of *Cerastium glomeratum* in the Czech Republic: ● occurrence documented by herbarium specimens (608 quadrants), ▲ occurrence based on other records (464 quadrants). Prepared by Jiří Danihelka.

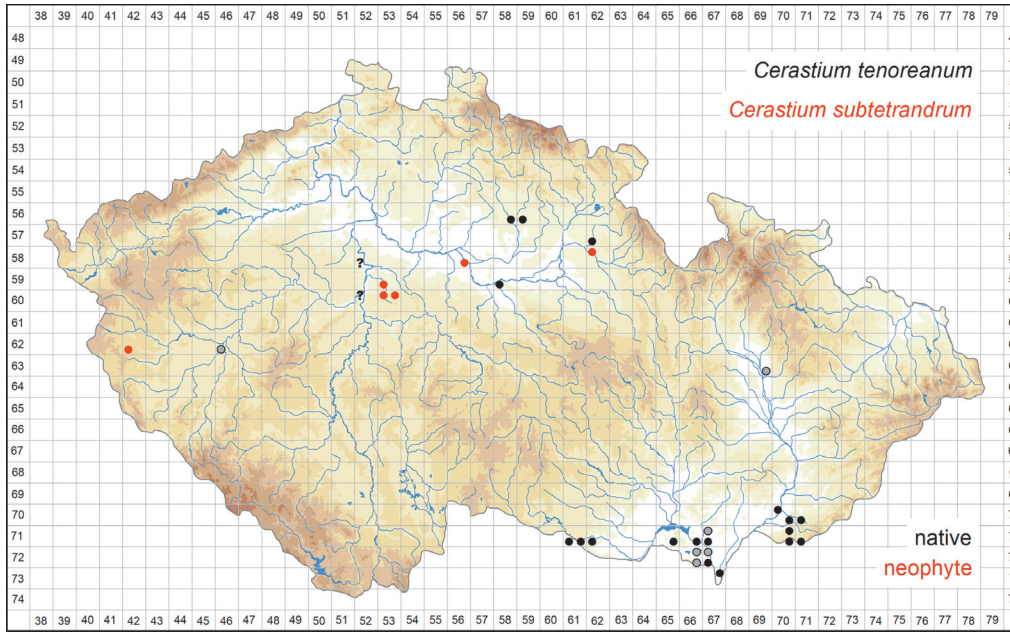

Fig. 24. – Distribution of *Cerastium subtetrandrum* (6 occupied quadrants) and *C. tenoreanum* (● at least one record in 2000–2020: 18 quadrants, ◍ pre 2000 records only: 6 quadrants) in the Czech Republic. Prepared by Jiří Danihelka, Michal Ducháček & Zdeněk Kaplan (*C. s.*) and by Jiří Danihelka (*C. t.*).

Slovakia, eastern Austria, western Hungary and north-western Serbia (Jonsell et al. 2001, Niketić et al. 2009, Letz & Dřevojan 2018). Recently, it was discovered in the federal state of Upper Austria, occurring there at numerous sites along main roads in settlements (Kleesadl 2017) and at a few sites in Germany (Schanz et al. 2019), where the species was first recorded already in 1992 but misidentified as *C. siculum*. In Scandinavia and Denmark *C. subtetrandrum* grows in seashore meadows and less frequently in ruderal habitats. In the Pannonian Basin it occurs in saline meadows, usually in disturbed patches, and in semiruderal grasslands that replaced destroyed saline meadows. The secondary occurrences are confined to road verges of road sections treated with de-icing salt. In the Czech Republic *C. subtetrandrum* was first recorded in 2017 on motorway D5 near the village of Mlýnec in western Bohemia. It occurred there on a road verge together with *C. glutinosum*, and in the vicinity other species spreading along motorways in the Czech Republic were recorded, including *Cochlearia danica*, *Dittrichia graveolens*, *Hordeum jubatum*, *Plantago coronopus* and *Senecio inaequidens*. In spring 2020 a targeted search yielded a series of records in the environs of Prague, near the town of Poděbrady in central Bohemia and near the town of Týniště nad Orlicí in eastern Bohemia. The habitats were verges of motorways and main roads with accumulations of de-icing salt. Further records of this casual neophyte are likely, and it has to be looked for elsewhere in this country.

Cerastium tenoreanum (Fig. 24)

Cerastium tenoreanum occurs in the southern part of central Europe, Italy and the Balkan Peninsula, towards the north reaching the south-eastern Czech Republic, southern Slovakia and Romania (Jalas & Suominen 1983). It has been recently found as introduced in Bavaria (Meierott 2008). In the Czech Republic *C. tenoreanum* grows in various types of dry grasslands (including seasonally dry meadows) and ruderal habitats at railway stations. The soils are dry to moderately humid, often permeable, slightly acidic to basic and usually rather poor in nutrients. This species has a very limited distribution in the Czech Republic. It was first found in the late 1950s in the floodplain of the Dyje river and adjacent landscapes in southernmost Moravia (Smejkal 1990), which remained its known range of occurrence for decades. However, since the early 2000s, *C. tenoreanum* has been found in the Bílé Karpaty Mts, Pavlovské vrchy hills and most recently also along the valley of the Dyje river west and south-west of the town of Znojmo, as well as at four sites in eastern and eastern central Bohemia. Some of the populations recently discovered in Bohemia are large, and the species may be considered there to be locally established. This is particularly true of the occurrence in the village of Záboří nad Labem, which was documented by a herbarium specimen (but not recognized as *C. tenoreanum*) as early as 1982. Earlier herbarium records of introduced plants of this species exist from the environs of the cities of Plzeň and Olomouc, and probably also from Prague, the latter dating back to the 19th century. It is classified as critically threatened due to its rarity and assumed decline (Grulich 2012), but based on numerous new finds and its spread, this classification may be reconsidered in the future.

Chenopodium bonus-henricus (Fig. 25)

This ruderal perennial herb occurs in Europe and has been introduced into North America (Meusel et al. 1965, Hultén & Fries 1986). However, its native European distribution remains unclear, as the species has been cultivated for centuries as a medicinal plant and a leaf vegetable. Nowadays its distribution extends from the British Isles, France and northern Spain in the west to Bulgaria, Romania and the southern and central parts of European Russia in the east, southern Scandinavia in the north and southern Italy and southern Greece in the south (Jalas & Suominen 1980). In the easternmost parts of its range it is very rare. In the British Isles, Scandinavia and, according to some authors, also other parts of western Europe and in central Europe, it likely is an introduced species (Meusel et al. 1965, Jalas & Suominen 1980, Brenan & Akeroyd 1993). In the Czech Republic it is classified as a naturalized archaeophyte (Pyšek et al. 2012). *Chenopodium bonus-henricus* is a typical representative of "village flora" (Aellen 1979), i.e., species growing at sites with high amounts of nitrogen and regular disturbance, and indicating even former presence of human settlements such as villages and chalets. It mainly grows in ruderalized grasslands, disturbed road verges, around farmhouses, manure heaps, village squares, rubble, poultry yards and pastures, sometimes also in unmown but disturbed grasslands along railway tracks and on river banks and fishpond shores. In the Czech Republic this species occurs mainly in hilly landscapes and the mountains, reaching its elevational maximum at 1400 m in the Krkonoše Mts. It is rather rare in the warm lowlands in some parts of north-western, central and eastern Bohemia, and central and southern Moravia; the gaps elsewhere on the map are likely due to under-recording rather than true absences. Due to land-use changes, particularly village modernization, it has somewhat declined in the past decades (Dostálek et al. 1990); however, it is still sufficiently frequent, particularly in the parts of this country that still practice traditional village management such as in southern Bohemia and the Českomoravská vrchovina highlands. Therefore, this species is classified as of lower risk – near threatened (Grulich 2012).

Chenopodium capitatum (Fig. 26)

Chenopodium capitatum is an annual herb of unclear origin. Most authors either consider this species as native to North America (Jalas & Suominen 1980, Hultén & Fries 1986, Clemants & Mosyakin 2003, Pyšek et al. 2012) or they do not provide any information on the species' native distribution (Aellen 1979, Brenan & Akeroyd 1993). Two varieties with distinct morphology, ecology and distribution are recognized: var. *capitatum*, characterized by a fleshy perianth covering ripe achenes, and var. *parvicapitatum* (recently sometimes treated as separate species *Ch. overi*). Clemants & Mosyakin (2003) consider both varieties to be native to North America, with the type variety growing from the lowlands to the subalpine level over a broad range of semi-natural and man-made habitats and occurring almost throughout the whole distribution of the species. The latter variety occurs only in high-mountain forests, meadows and riparian habitats in the south-western USA (Clemants & Mosyakin 2003). Only the type variety has been documented in Eurasia; however, its distribution there is imperfectly known as it is considered to be non-native, originating from cultivation and occasionally escaping to ruderal habitats, where its populations establish only for a short time (Jalas & Suominen 1980, Brenan &

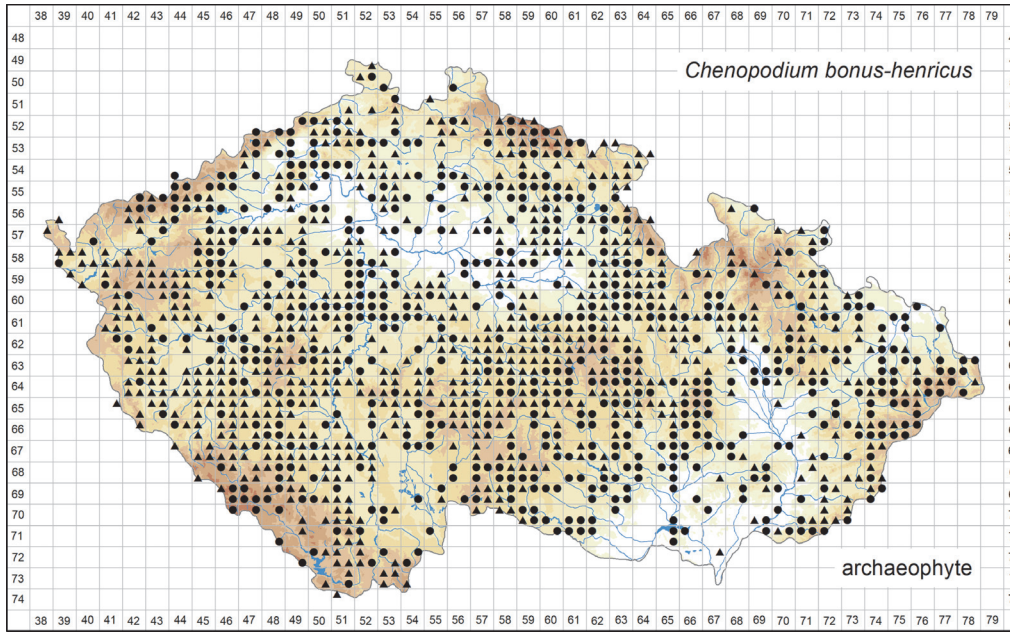

Fig. 25. – Distribution of *Chenopodium bonus-henricus* in the Czech Republic: ● occurrence documented by herbarium specimens (590 quadrants), ▲ occurrence based on other records (731 quadrants). Prepared by Kateřina Šumberová & Pavel Dřevojan.

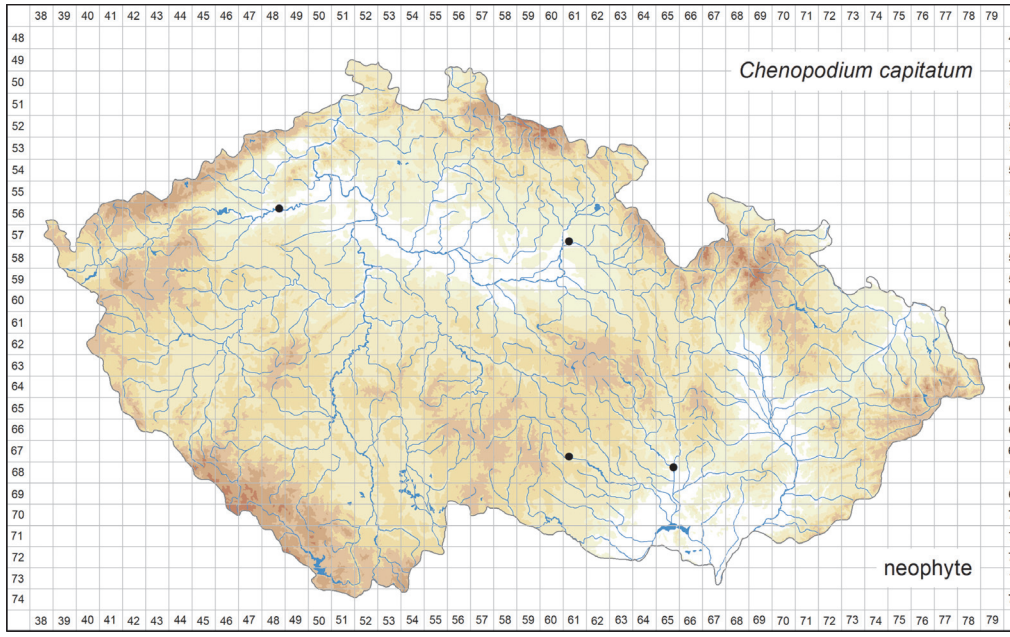

Fig. 26. – Distribution of *Chenopodium capitatum* in the Czech Republic (4 occupied quadrants). Prepared by Kateřina Šumberová & Pavel Dřevojan.

Akeroyd 1993). Moreover, it may be confused with the more frequent *Ch. foliosum*. In the Czech Republic *Ch. capitatum* was cultivated in the 19th and early 20th centuries in botanical gardens, and also in villages as a leaf vegetable and an ornamental plant (Dostálek et al. 1990). In this period also the majority of herbarium specimens that are preserved in Czech herbaria were collected. Therefore, we included in the map only the records documented by herbarium specimens with labels explicitly referring to escaped plants; the localities identified only by a settlement name and undocumented records were not considered due, respectively, to missing information on the escape and the possible misidentification of *Ch. foliosum*. Although the first reported escape from cultivation dates back to 1809 (Pyšek et al. 2012), we had to push back this date to 1910 due to the strict criteria described above. Reliable information on the escape of *Ch. capitatum* in this country is very rare and so is the information on the habitats colonized by this species. The species has been found in forest clearings, dumps and settlements, in ruderal vegetation probably adjacent to the gardens with source populations. Altogether, four sites have been mapped as the escapes: in the town of Louny in north-western Bohemia, in the city of Hradec Králové in eastern Bohemia, near the town of Třebíč in south-western Moravia and in the city of Brno in southern Moravia. The latest occurrence dates back to 1966, and to our knowledge, nowadays no occurrence outside cultivation exists in this country. Still, *Ch. capitatum* is classified as a casual neophyte because its seeds are available in specialized shops, and the species may escape from cultivation (Pyšek et al. 2012).

Chenopodium ficifolium (Fig. 27)

Chenopodium ficifolium is a species of the *Ch. album* agg., which, unlike the majority of the species in this complex, is rather easily recognizable by its characteristic morphology and ecology. It is a wetland annual nitrophilous plant that requires rather high temperatures, which is reflected in its distribution. In Europe it extends from southern Scandinavia in the north to the Mediterranean area (particularly its northern parts) in the south, and from the British Isles in the west to the southern and central parts of European Russia in the east (Aellen 1979, Jalas & Suominen 1980). In northern Europe it is usually considered as non-native and casual (Jalas & Suominen 1980, Brenan & Akeroyd 1993). It was in the past classified as introduced also in the Czech Republic (Pyšek et al. 2002) and some other parts of temperate Europe (Aellen 1979), but recently it has been listed as native (Pyšek et al. 2012). According to Aellen (1979), this species' native distribution extends eastwards to western and central Asia and southern Siberia. It has also been introduced into North America. Besides the type subspecies, subsp. *blomianum* has been described, with assumed native distribution in southern and south-eastern Asia and along with occurrence as an introduced species in Florida (Aellen 1979, Mosyakin 2016). *Chenopodium ficifolium* colonizes sites with open mineral soil or organic substrates that are wet at the time of seed germination. Habitats characteristic of this species are subjected to intensive disturbance by temporary flooding or by ploughing and are very rich in nutrients, particularly nitrogen and phosphorus, and in basic ions. The species usually occurs on exposed bottoms of fishponds and fish storage ponds, as well as river banks, alluvial deposits, exposed margins of oxbows and alluvial pools, wet arable fields, ditches, around manure heaps and farmhouses, wet waste places and building grounds. The ecology of *Ch. ficifolium* is thus rather similar to that of *Ch. glaucum*, and so is its

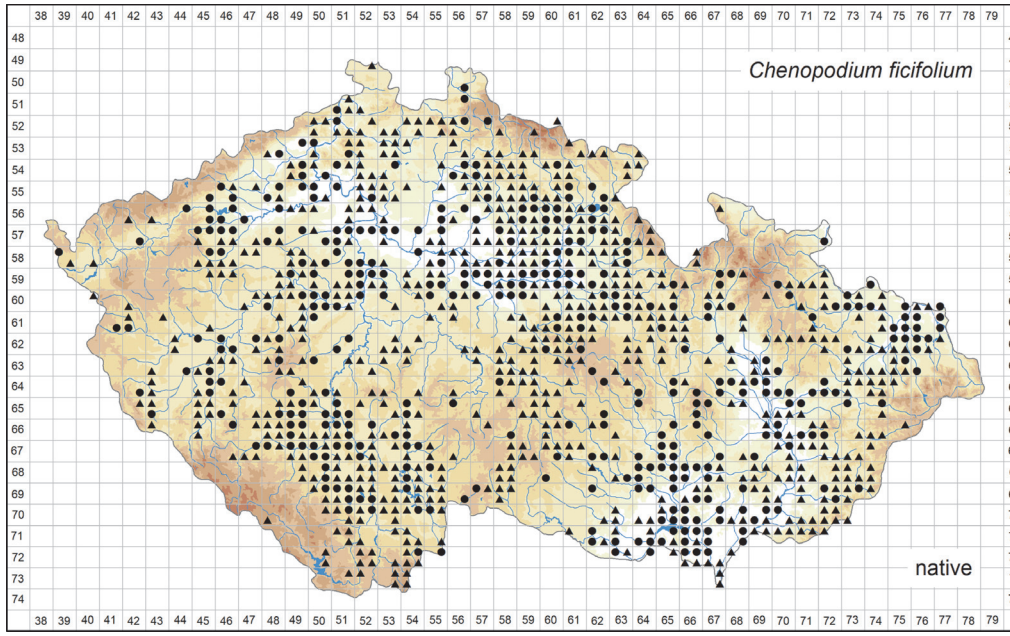

Fig. 27. – Distribution of *Chenopodium ficifolium* in the Czech Republic: ● occurrence documented by herbarium specimens (380 quadrants), ▲ occurrence based on other records (676 quadrants). Prepared by Kateřina Šumberová & Pavel Dřevojan.

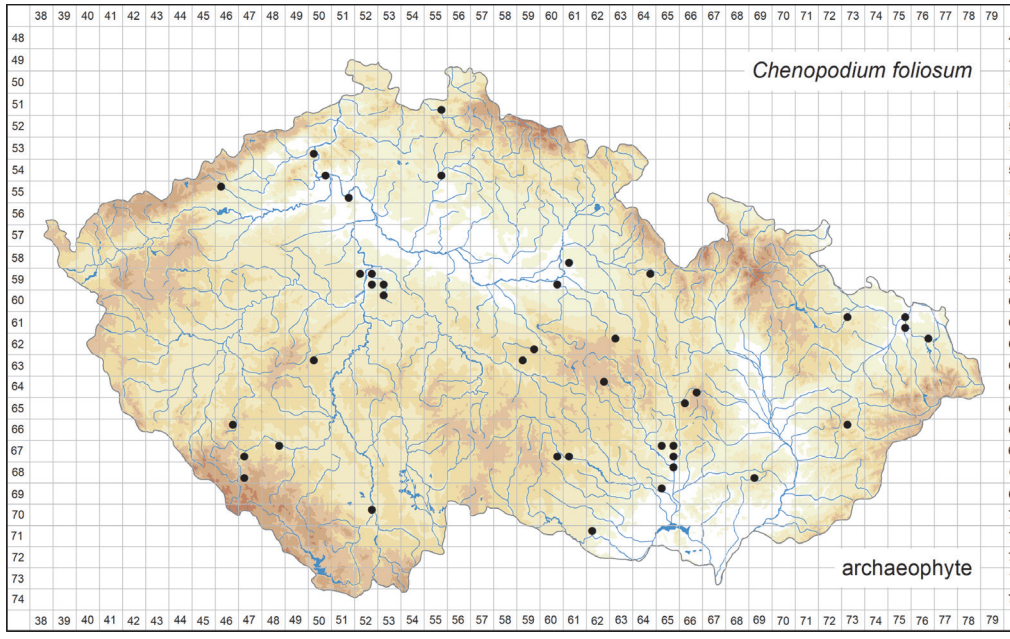

Fig. 28. – Distribution of *Chenopodium foliosum* in the Czech Republic (40 occupied quadrants). Prepared by Kateřina Šumberová & Pavel Dřevojan.

distribution in the Czech Republic (see Kaplan et al. 2018b). *Chenopodium ficifolium* is common in the areas with numerous fishponds and in large river floodplains in southern, north-western, central and eastern Bohemia, in the Dyje and Morava river floodplains in southern and central Moravia, and the Odra river floodplain in north-eastern Moravia. In the Carpathians, where there is a lack of water bodies, this species usually occurs in temporary wetlands within pastures or arable fields. The low numbers of records in some areas, such as large parts of western Bohemia, is likely due to under-recording; however, in the mountains, large forest patches and areas without suitable wet sites, the gaps on the map may reflect real absence of *Ch. ficifolium*.

Chenopodium foliosum (Fig. 28)

This *Chenopodium* species is also an annual with a human-influenced distribution because of its traditional cultivation as a leaf vegetable and for edible fleshy inflorescences at seed maturity. Although it is reported as a species of Eurasian origin, in Europe it may be considered as native only to the Alps and the mountains in the Iberian Peninsula and the Balkan Peninsula (Jalas & Suominen 1980, Hultén & Fries 1986, Brenan & Akeroyd 1993). Mereďa et al. (2016) classify as indigenous also the occurrences in the Veľká Fatra Mts in Slovakia; these are thought to be relict occurrences at the northern limit of the species' distribution. Elsewhere in Europe this species is considered as introduced, i.e., in the lowlands of central and western Europe, Scandinavia, central and southern Russia; the same applies to north-western Africa. It is probable that the populations in large parts of Asia are native (Zhu et al. 2003). There the distribution extends from Anatolia and the Caucasus Mts to the mountain ranges of central Asia, Nepal, southern China, Mongolia and south-western and southern Siberia (Hultén & Fries 1986, Press et al. 2000). *Chenopodium foliosum* has also been introduced into North America (Hultén & Fries 1986, Clemants & Mosyakin 2003) and according to Aellen (1979) also into South Africa. Several closely related taxa of unclear taxonomic status, usually treated within the *Ch. foliosum* agg., occur in central Asia and China (Zhu et al. 2003). The published distribution map of the overall species' distribution encompasses all the taxa within the complex along with the similar *Ch. excussum*, which grows in Spain and northern Africa (see Hultén & Fries 1986). In the Czech Republic *Ch. foliosum* is classified as a casual neophyte (Pyšek et al. 2012), as its populations are mainly remnants of former cultivation, which, unlike *Ch. capitatum*, often survive for decades. The earliest herbarium specimen of *Ch. foliosum* collected in this country, with clear identification of its escape on a rubble heap, dates back to 1847. Since then this species has been documented at several dozen sites across the country, mainly in various ruderal habitats in settlements, such as rubble heaps, dumping grounds, soil heaps, areas around gardens, along pavements and around buildings. Rather rarely it also occurs in open landscapes, e.g. along dirt roads among fields. Its occurrences are concentrated in the lowlands and hilly areas. There are a relatively high number of records, for instance, from the cities Prague and Brno.

Chenopodium hybridum (Fig. 29)

Chenopodium hybridum is an annual, rather thermophilous ruderal herb. It is distributed throughout the temperate zone in Eurasia, in Europe reaching the southern Mediterranean area (southern Spain and Sicily) in the south and southern Scandinavia in the north.

In Asia its distribution extends somewhat to the south, where it reaches the subtropical climate zone in north-eastern India and south-western China (Hultén & Fries 1986, Zhu et al. 2003). Further eastwards its distribution extends up to the Korean Peninsula and Japan (Zhu et al. 2003). In North America the type subspecies is replaced by *Ch. hybridum* subsp. *gigantospermum* (Meusel et al. 1965, Hultén & Fries 1986), recently treated as a separate species (Aellen 1979, Clemants & Mosyakin 2003, Zhu et al. 2003, Fuentes-Bazan et al. 2012). However, the taxonomy of *Ch. hybridum* agg. and the distributions of its constituents have not yet been sufficiently clarified. Similarly as in other *Chenopodium* species, opinions about the native range of *Ch. hybridum* differ among the authors. For instance, the occurrences in the British Isles and Scandinavia or its parts (Aellen 1979, Jalas & Suominen 1980, Hultén & Fries 1986), Japan (Meusel et al. 1965) and North America (Clemants & Mosyakin 2003) are believed to represent introductions. In the Czech Republic *Ch. hybridum* was formerly classified as an archaeophyte (Dostálek et al. 1990); however, already as of Pyšek et al. (2002) it was excluded from the list of alien species. Dostálek et al. (1990) drew attention to *Ch. gigantospermum* (= *Ch. hybridum* subsp. *gigantospermum*), which could have been introduced as a casual into this country. Indeed, in the herbarium PRA we found herbarium specimens from the town of Beroun and nearby village of Tobolka in central Bohemia, both collected at sites with cotton waste from a spinning factory, that had been identified by P. Aellen as "probably *Ch. gigantospermum*". However, the amount and quality of the specimens did not allow for reliable identification. *Chenopodium hybridum* grows in a broad range of dry to moist, disturbed habitats such as rubble, waste grounds, construction sites, soil heaps, farmhouses surroundings, manure heaps, shores of fishponds, river banks, arable fields, vineyards, railway stations and embankments, road verges, disturbed grasslands, forest margins and clearings, and various ruderal habitats within cities, towns and villages. It is common in the lowlands and warm hilly areas with mineral-rich substrates across this country, particularly in north-western, central and eastern Bohemia, and southern and central Moravia. The number of records has recently increased in some parts of southern Bohemia. The species is scattered elsewhere and missing from high elevations of most of the mountain ranges. An exception is the Krkonoše Mts, where this species as introduced reaches its elevational maxima at 1100–1285 m.

Chenopodium polyspermum (Fig. 30)

Chenopodium polyspermum is an annual moisture-demanding ruderal herb originating from Eurasia and introduced into North America, Ethiopia, South Africa and the Philippines (Meusel et al. 1965, Aellen 1979, Hultén & Fries 1986). The Eurasian range of this species now includes most of Europe except its northernmost parts, Anatolia, the Caucasus Mts and south-western Siberia, as well as an outpost in eastern Siberia. However, in large parts of the British Isles, the Mediterranean area, the steppe zones in Ukraine, European Russia and Asia this species is scattered to rare. Due to intensive spread by humans since the Early Neolithic (Pokorná et al. 2018), the status of this species in some parts of its Eurasian distribution remains unclear. While Meusel et al. (1965) consider *Ch. polyspermum* as a neophyte in Scotland, Ireland and eastern Siberia, and Jalas & Suominen (1980) give non-native status to some of the occurrences in central Scandinavia, Aellen (1979), Hultén & Fries (1986) and Brenan & Akeroyd (1993) do not provide any details

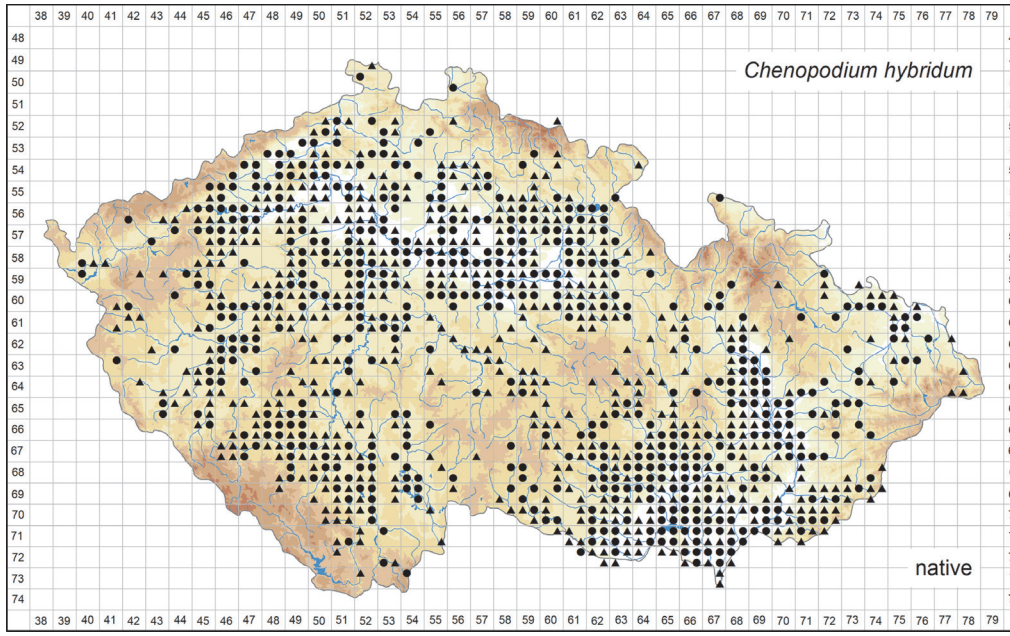

Fig. 29. – Distribution of *Chenopodium hybridum* in the Czech Republic: ● occurrence documented by herbarium specimens (519 quadrants), ▲ occurrence based on other records (549 quadrants). Prepared by Kateřina Šumberová & Pavel Dřevojan.

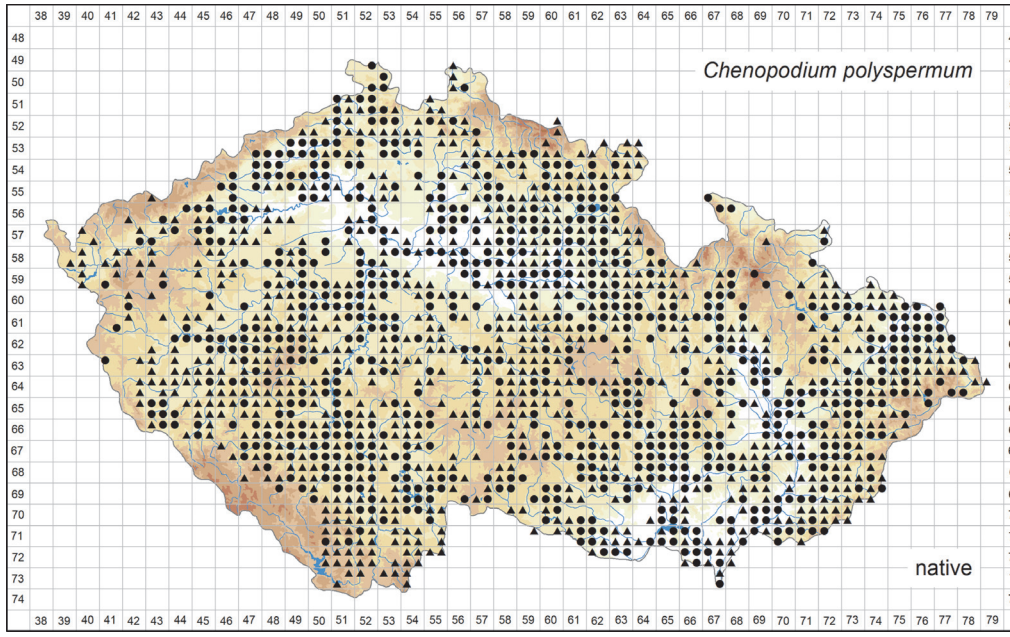

Fig. 30. – Distribution of *Chenopodium polyspermum* in the Czech Republic: ● occurrence documented by herbarium specimens (735 quadrants), ▲ occurrence based on other records (778 quadrants). Prepared by Kateřina Šumberová & Pavel Dřevojan.

on the species' status within Eurasia. In the Czech Republic *Ch. polyspermum* has been considered as an archaeophyte (Dostálek 1990, Pyšek et al. 2002) but it has been reclassified recently as a native species due to the lack of evidence for an alien origin (Pyšek et al. 2012). The species colonizes a broad range of habitats and substrates that are temporarily flooded or water-saturated including such sites as wet arable fields (particularly root-crop cultures), ditches, wet field and forest tracks, road verges, river banks, alluvial deposits, construction sites, wet pastures, exposed bottoms of fishponds and fish storage ponds, mining ponds, waste grounds and rubble heaps. In the Czech Republic this species occurs throughout the country from the lowlands up to the mountains, with the elevational maxima at 1080 m in the Krušné hory Mts and at 1030–1285 m in the Krkonoše Mts. The gaps on the map are likely mainly due to under-recording, but in the dry and warm lowlands and in wooded mountain areas they may indicate true absences.

Corynephorus canescens (Fig. 31)

Corynephorus canescens is a sub-Atlantic species occurring mainly in western Europe. Its almost continuous distribution includes Portugal, north-western Spain, north-western and central France, south-easternmost England, the Benelux countries, northern Germany, Denmark, southernmost Sweden, Poland, Lithuania, Belarus and northern Ukraine. Elsewhere it is very scattered, reaching north-western Africa, northern Italy, Austria, Hungary, Romania and the western part of European Russia (Conert 1998b). Secondary occurrences are reported from North America (Thieretf 2007) and New Zealand (Edgar et al. 1991). In the Czech Republic *C. canescens* grows in various sandy grasslands, fringes and clearings of oak and pine forests and on rock outcrops. This rather weak competitor prefers dry, acidic and nutrient-poor sites with scarce vegetation cover (Rychnovská-Soudková 1961). It mainly occurs in sandy and sandstone areas in north-western, central and eastern Bohemia and southern Moravia. It is rare in western Bohemia, in the Třeboňská pánev basin in southern Bohemia and in Silesia. There is also a group of occurrences on granite and granodiorite outcrops in the middle Vltava river valley. Due to its scarcity and ongoing degradation of its habitats it is classified as of lower risk – near threatened (Grulich 2012).

Crypsis aculeata (Fig. 32)

Crypsis aculeata is distributed mainly in the submeridional and meridional zones in Europe, western, central and eastern Asia, and northern Africa, and also in some parts of the temperate zone with continental climates. Its distribution is strongly fragmented, confined to the saline habitats of the sea-coasts and inland salt marshes. In central Europe its northern distributional limit runs through the south-eastern Czech Republic and southern Slovakia. It has been introduced into South Africa (Conert 1998c), whereas this species' records from North America (mainly California; cf. Conert 1998c) actually refer to *C. vaginiflora*, native to Egypt and south-western Asia (Hammel & Reeder 2003). *Crypsis aculeata* is an obligate halophyte occurring in periodically flooded places that dry out during the season. In the Czech Republic the species' most frequent habitats were temporary pools on pastures and arable land, shores and exposed bottoms of lakes and fishponds with saline water, and margins of saline reed beds. Soils are usually heavy, less frequently sandy, slightly acidic to basic, usually rich in mineral nutrients and nitrogen,

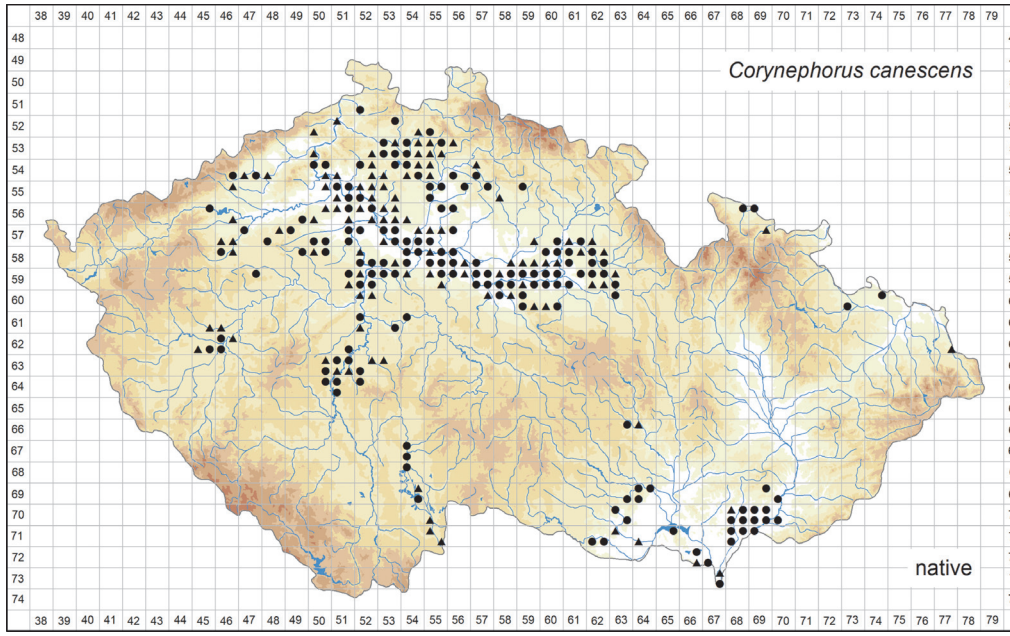

Fig. 31. – Distribution of *Corynephorus canescens* in the Czech Republic: ● occurrence documented by herbarium specimens (157 quadrants), ▲ occurrence based on other records (107 quadrants). Prepared by Milan Štech.

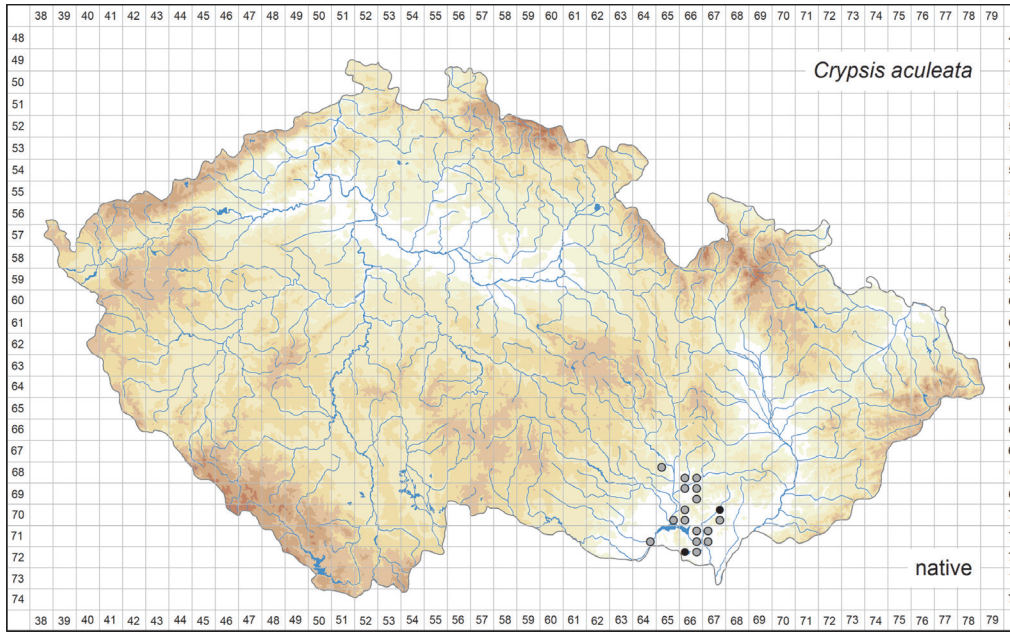

Fig. 32. – Distribution of *Crypsis aculeata* in the Czech Republic: ● at least one record in 2000–2020 (2 quadrants), ● pre 2000 records only (16 quadrants). Prepared by Jiří Danihelka & Zdeněk Kaplan.

and in summer always rich in soluble sulphates and chlorides (Šumberová 2007). In this country *C. aculeata* occurred only in southern Moravia south and south-east of the city of Brno, together with a dozen other obligate halophytes. However, most populations were destroyed by drainage and subsequent desalinization, which started already in the 19th century. This development accelerated after World War II, and as of the late 1980s only two populations survived (Grulich 1987). Nowadays a small population, re-established by the transfer of seeds from a nearby site and dependent on conservation management, exists in the Slanisko u Nesytu National Nature Reserve near the village of Sedlec. In 2008 the species was also recorded in another of its former sites near the village of Terezín in the Hodonín district after a shallow pool was dug there. The 19th-century record from the outskirts of the city of Brno may refer to introduced plants. *Crypsis aculeata* is classified as critically threatened due to its decline (Grulich 2012).

Crypsis alopecuroides (Fig. 33)

Crypsis alopecuroides is distributed mainly in the submeridional and meridional zones in Europe, western and central Asia, western Siberia and northern Africa and also in some parts of the temperate zone with continental climates. In central Europe its northern distributional limit runs through the south-eastern Czech Republic and southern Slovakia. There are some records also from Germany but they most likely refer to introduced plants. This species has been introduced into and become naturalized in the western USA (Conert 1998c, Hammel & Reeder 2003). In the Czech Republic *C. alopecuroides* occurred on the banks of rivers, in ditches, wet depressions on arable land, in meadows and pastures, as well as on periodically exposed bottoms and margins of fishponds and other water reservoirs. The soils were slightly acidic to slightly basic, usually rich in nutrients, sometimes with a rather high content of soluble sulphates and chlorides, wet in spring but becoming dry during the summer. In this country *C. alopecuroides* once had stable populations in southern Moravia south and south-east of the city of Brno, mainly in the Dyje river floodplain and adjacent landscapes. However, these occurrences vanished during the 1970s, probably due to regulation of the river. It also occurred at a handful of places along the lower Morava river in south-eastern Moravia. In addition, there are several records from Bohemia, all documenting temporary occurrences, the latest in a fishpond on the outskirts of the town of Strakonice in south-western Bohemia in 1990 and 1991 (Žíla & Chán 1994). These isolated occurrences may be explained by accidental introductions with young fish or fish feed (imported grains), or by dispersal by waterfowl. For some time this species was classified as missing, but in 2005 several abundant populations were found along the margins and on the exposed bottom of the Vranov water reservoir on the Dyje river west of the town of Znojmo in south-western Moravia (Bravencová et al. 2007). The species' presence at several sites in the reservoir has repeatedly been confirmed since then, and the populations seem to be stable. Still, *C. alopecuroides* is classified as critically threatened due to its decline (Grulich 2012).

Crypsis schoenoides (Fig. 34)

Crypsis schoenoides is distributed mainly in the submeridional and meridional zones, less frequently in some parts of the temperate zone with continental climates (usually south of 50°N) in Europe, western and central Asia, Siberia and northern Africa, and also

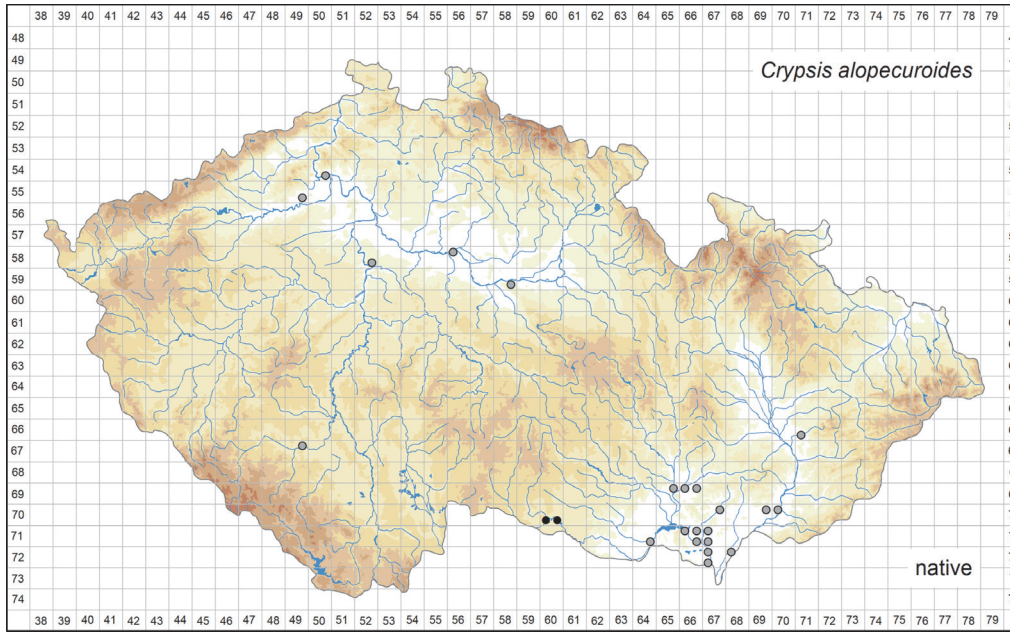

Fig. 33. – Distribution of *Crypsis alopecuroides* in the Czech Republic: ● at least one record in 2000–2020 (2 quadrants), ● pre 2000 records only (22 quadrants). Prepared by Jiří Danihelka & Zdeněk Kaplan.

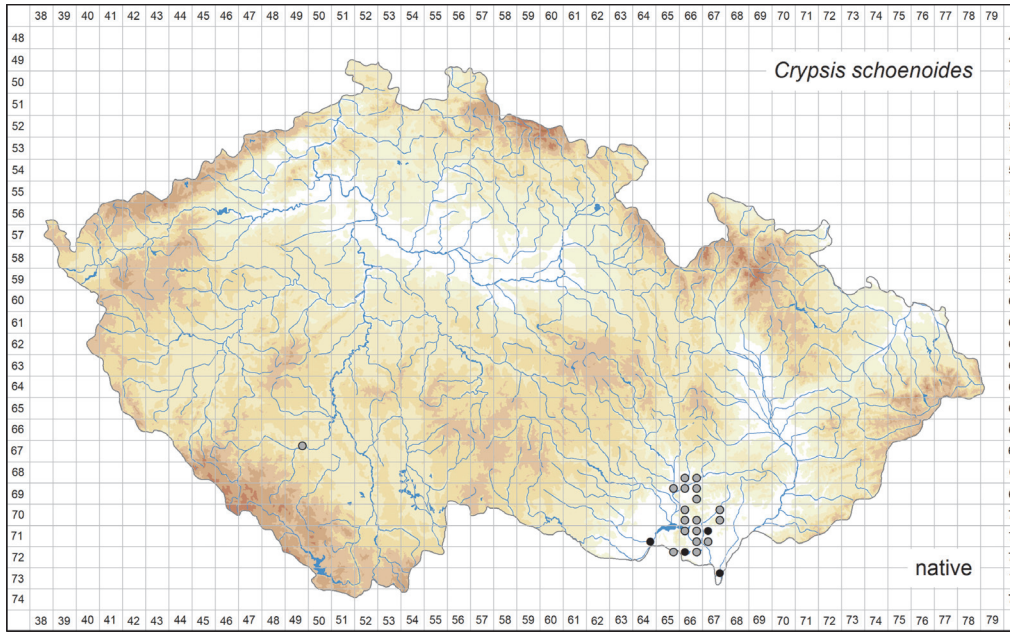

Fig. 34. – Distribution of *Crypsis schoenoides* in the Czech Republic: ● at least one record in 2000–2020 (4 quadrants), ● pre 2000 records only (18 quadrants). Prepared by Jiří Danihelka & Zdeněk Kaplan.

occurs in subtropical Africa and Madagascar. In central Europe its northern distributional limit runs through south-eastern Austria, the south-eastern Czech Republic and southern Slovakia. Further northwards there are a few records of introduced plants, for instance in Germany. This species has been introduced into the south-western USA, where it has become naturalized (Conert 1998c, Hammel & Reeder 2003), and south-western Australia (Simon 2005). In the Czech Republic *C. schoenoides* occurs on regularly exposed bottoms and shores of fishponds and river oxbows, and in temporary pools in saline meadows, pastures and even on arable land. The soils are heavy, wet in spring but drying out in summer, usually rich in nutrients including nitrogen and phosphorus and with a rather high content of soluble sulphates and chlorides. However, this species' affinity for saline habitats is somewhat weaker than that of *C. aculeata* (Šumberová 2007). In the Czech Republic *C. schoenoides* occurred only in southern Moravia south-west to south-east of the city of Brno. Most of the populations vanished due to the destruction of their habitats, usually caused by drainage followed by desalinization, which started already in the mid-19th century. Since 2000 this species has been observed only in saline habitats near the villages of Rakvice and Novosedly, in saline meadows on the western shores of the Nesyt fishpond near the village of Sedlec and periodically on its exposed bottom, and on gravel bars in an oxbow of the Dyje river south of the town of Lanžhot. In 1990 and 1991 *C. schoenoides* was collected (together with *C. alopecuroides*) on the exposed bottom of a fishpond on the outskirts of the town of Strakonice in south-western Bohemia (Žíla & Chán 1994). This isolated occurrence may be explained by accidental introduction with young fish or fish feed (imported grains) or by dispersal by waterfowl. *Crypsis schoenoides* is classified as critically threatened due to its decline (Grulich 2012).

Dorycnium pentaphyllum agg. (Figs 35–37)

The *Dorycnium pentaphyllum* complex includes six species distributed mainly in the Mediterranean area and extends northwards to central Europe (Meusel et al. 1965, Slavík 1995b), sometimes accepted only at the subspecies level. Two species are represented in the Czech Republic, *D. germanicum* and *D. herbaceum* (Slavík 1995a, b). Besides the typical plants discussed below, transient forms of probable hybrid origin also occur in the areas of the co-occurrence of these species (Gams 1924, Slavík 1995a, b). However, there has been no published experimental or molecular study testing the hybridization. Gams (1924) reported these intermediate forms from eastern Austria and adjacent parts of Italy and Slovenia. In the Czech Republic they are more similar to *D. herbaceum* in general appearance, but the indumentum of the calyx and leaflets combines characteristics of both species. These forms mostly co-occur with *D. herbaceum*, less frequently with both putative parents. However, there are also a few populations without typical plants of either of these species. These transient forms seem to have the ability to spread to secondary habitats, as is the case with *D. herbaceum*. They have been documented at 66 sites so far in the Czech Republic, mainly in hilly landscapes of southern Moravia (Fig. 37), where both putative parental species occur. Only the records supported by herbarium specimens have been included in this map.

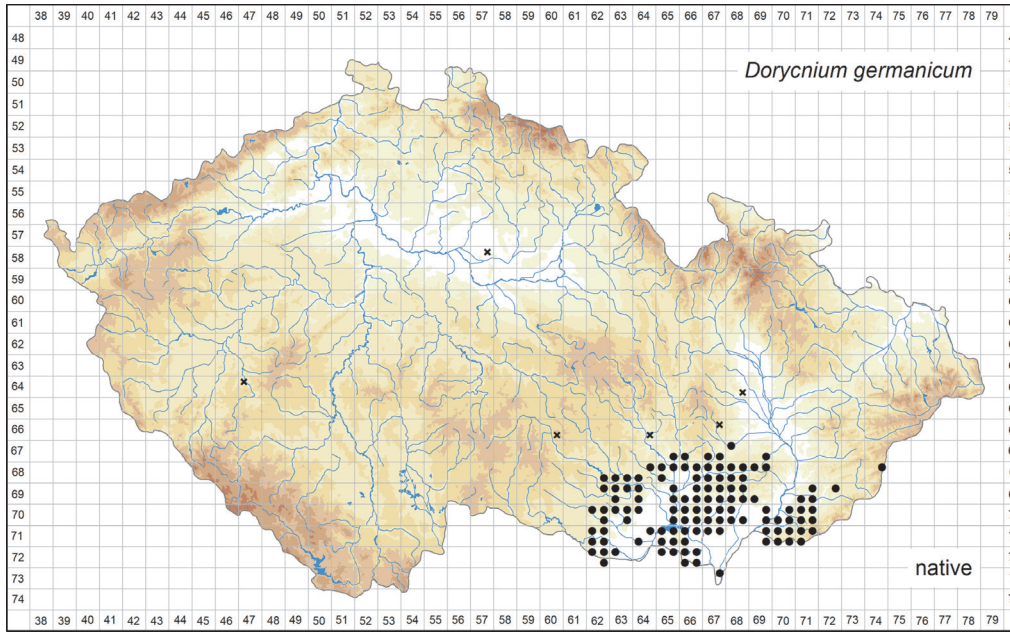

Fig. 35. – Distribution of *Dorycnium germanicum* in the Czech Republic: ● native (116 quadrants), × alien (6 quadrants). Prepared by Radomír Řepka.

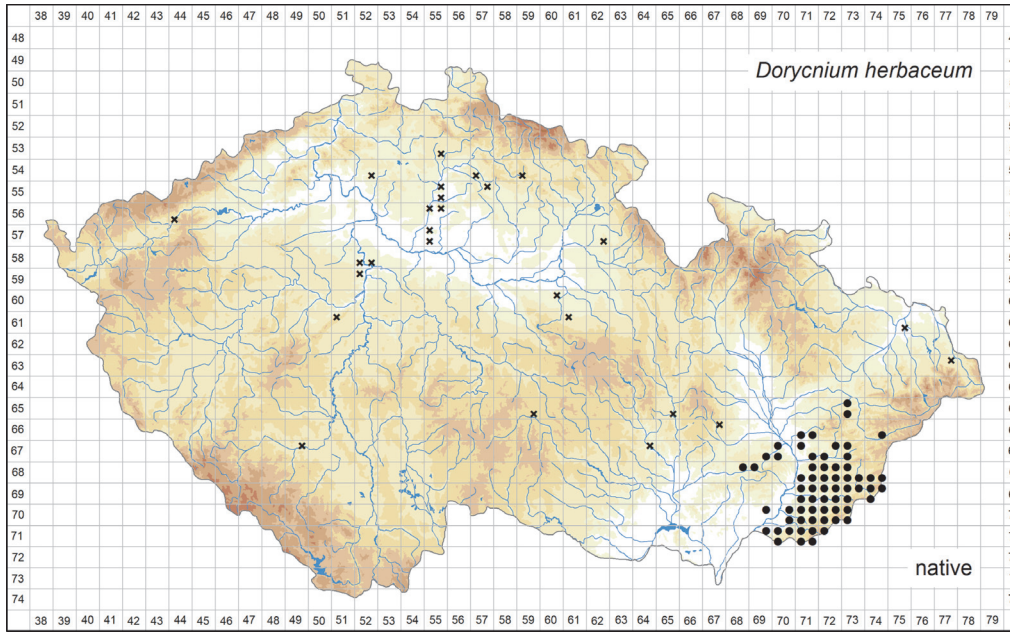

Fig. 36. – Distribution of *Dorycnium herbaceum* in the Czech Republic: ● native (116 quadrants), × alien (26 quadrants). Prepared by Radomír Řepka.

Dorycnium germanicum (Fig. 35)

A continuous distribution of *D. germanicum* is situated in the Balkan Peninsula, where its southern boundary reaches northern Greece. Isolated occurrences are found in Switzerland, southern Germany, Austria, the Czech Republic, Slovakia, south-eastern Poland, Hungary and south-western Romania (Meusel et al. 1965, Slavík 1995a). The Czech Republic is situated at the northern limit of the species' range. In this country *D. germanicum* grows mainly in areas with hard, base-rich (limestone or serpentine) bedrock, but also with granitoids rich in mineral nutrients. It is often found in open sunny habitats on stony, permeable, mostly shallow soils. However, sometimes it is found also on deep heavy soils developed on calcareous tertiary sediments. It mainly grows in dry and semi-dry grasslands, and rarely in open forests. It shows a stronger affinity for dry habitats than *D. herbaceum*. It is native to the warm parts of southern Moravia, with the northernmost occurrences situated on outcrops of calcareous bedrock around the towns of Vyškov, Kroměříž and Vizovice. Records from other parts of this country are rare; these records are either erroneous (confusion with *D. herbaceum*) or represent secondary occurrences. Slavík (1995a) noted that the distribution of *D. germanicum* is quite stable and the narrow ecological niche of this species limits it in secondary spread, in contrast to the related *D. herbaceum*. *Dorycnium germanicum* still grows at about 200 sites, but many populations have been destroyed by former landscaping for vineyards. The present populations are threatened by abandonment of low-intensity disturbances, eutrophication and consequent shading by tall herbs, grasses or shrubs, as well as invasion by *Robinia pseudoacacia*. It is classified as vulnerable (Grulich 2012). The map is based mainly on examined herbarium specimens.

Dorycnium herbaceum (Fig. 36)

Dorycnium herbaceum is distributed mainly in southern Europe from south-eastern France in the west through Italy, the western part of the Balkan Peninsula and Romania to Trans-Carpathian Ukraine, Crimea, northern Anatolia, the Caucasus Mts and Transcaucasia (Meusel et al. 1965). The northern limit of its native distribution runs through Austria, the Czech Republic, Slovakia and western Ukraine. The occurrences in Germany and Poland are secondary (Slavík 1995b). In the Czech Republic *D. herbaceum* grows mainly in semi-dry grasslands, pastures and forest fringes, on deep loamy soils on calcareous sediments. It tolerates higher competition by other herbs and tends to spread to secondary habitats more than *D. germanicum* (Slavík 1995a). The occurrences in south-eastern Moravia are considered as native, with most localities concentrated in the Bílé Karpaty Mts and the adjacent hilly areas. The occurrences in other parts of Moravia and in various parts of Bohemia are considered as secondary. It is classified as vulnerable (Grulich 2012). The map is based solely on examined herbarium specimens.

Equisetum arvense (Fig. 38)

Equisetum arvense is the most widely distributed horsetail of the Northern Hemisphere. It occurs from southernmost Europe, northern Anatolia, northern Iran, the north-western Himalaya, central China, Japan and the southern USA (with several outposts in Mexico) northwards to the northernmost Arctic regions; isolated outposts in the Southern

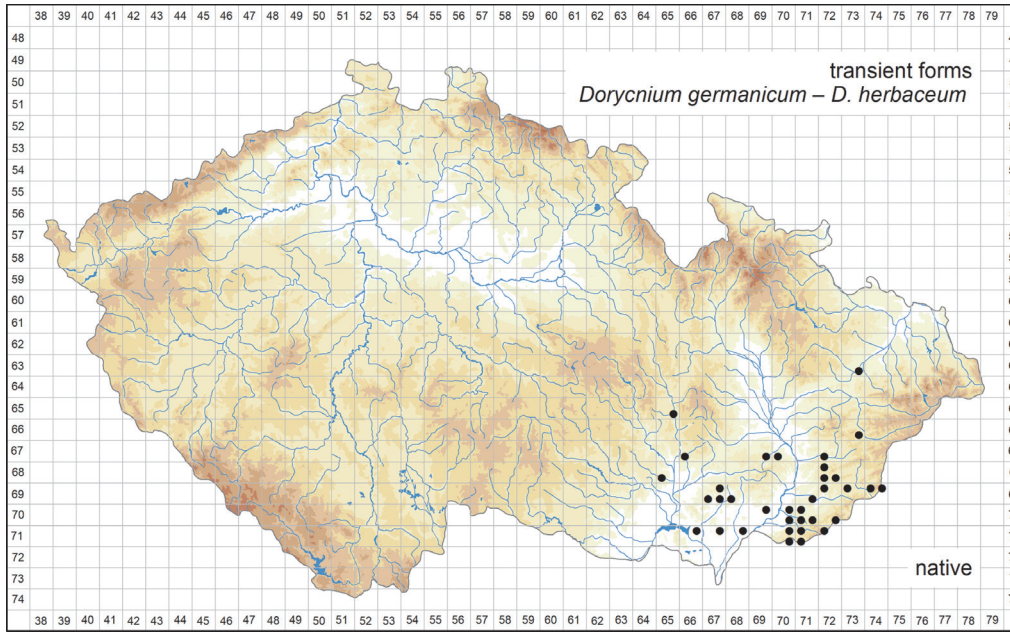

Fig. 37. – Distribution of transient forms *Dorycnium germanicum – D. herbaceum* in the Czech Republic (35 occupied quadrants). Prepared by Radomír Řepka.

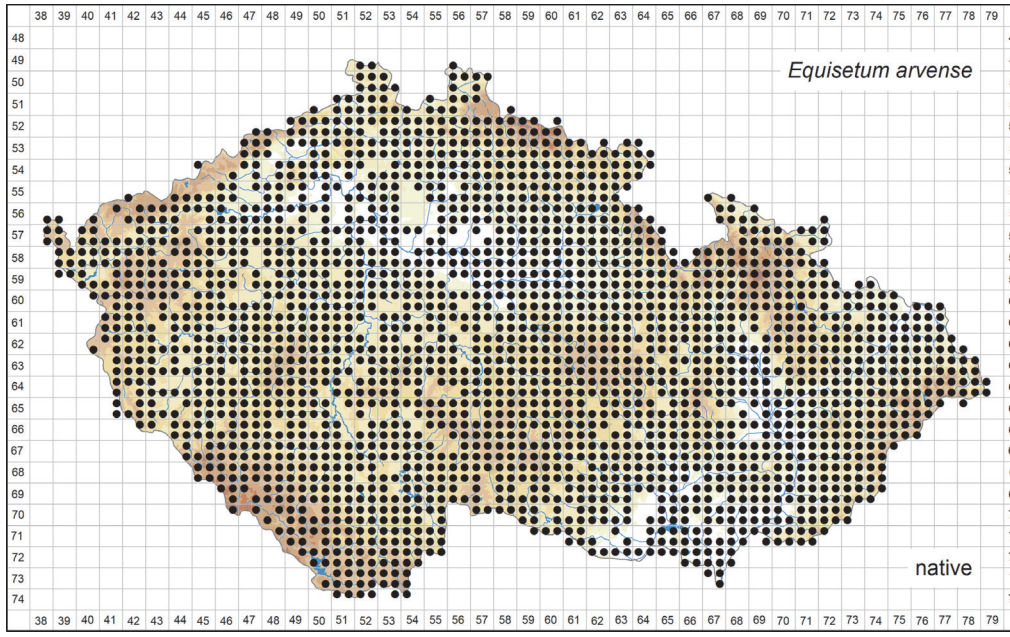

Fig. 38. – Distribution of *Equisetum arvense* in the Czech Republic (2189 occupied quadrants). Prepared by Libor Ekrt.

Hemisphere, e.g. in Australia and New Zealand, are probably of secondary origin (Hultén & Fries 1986). In the Czech Republic *E. arvense* is common in various types of ruderal habitats such as road verges and railway embankments, river banks, arable fields and various types of meadows and forests. It prefers rather deep humid soils that are acidic to moderately basic. *Equisetum arvense* is the most widespread species of *Equisetum* in this country, occurring from the lowlands up to the mountains. Still, it is rare or scattered in the high mountains, reaching its elevational maxima at about 1400–1420 in the Krkonoše Mts and Hrubý Jeseník Mts. The gaps on the map are most likely due to a lack of records rather than true absences.

Equisetum fluviatile (Fig. 39)

Equisetum fluviatile has a wide circumboreal distribution in the Northern Hemisphere from Europe (except its southernmost parts) eastwards to the Russian Far East and Japan; it also occurs in Canada and the north-eastern USA (Hultén & Fries 1986). In the Czech Republic *E. fluviatile* is most frequent in shallow edges of fishponds and other still waters, often as a dominant of initial communities of reed beds (Holub 1972). It also grows along old terrestrialized river beds, in alder carrs, peat bogs, fens, wetlands with sedge stands and in springs. It is a light-demanding species with a preference for waterlogged to shallowly flooded acidic substrates poor in nutrients. *Equisetum fluviatile* is widespread in this country at middle and high elevations and rare in or absent from dry areas, especially the lowlands. Outside the lowlands, the gaps on the map may be due to under-recording rather than true absences. It reaches its elevational maximum at 1420 m near the Čertova louka meadow in the Krkonoše Mts and at 1400 m in the glacial cirque of Velká kotlina in the Hrubý Jeseník Mts.

Equisetum hyemale (Fig. 40)

Equisetum hyemale occurs in Europe (except its southernmost parts) including Iceland, and in the Caucasus Mts, and from there extends eastwards to central Siberia, the north-western Himalayas, the Russian Far East and Japan. It is also found in North America from southern Canada southwards to Mexico and Guatemala (Hultén & Fries 1986). In the Czech Republic *E. hyemale* mainly inhabits banks of rivers and streams, and alluvial, alder, beech, spruce and oak-hornbeam forests in deep river valleys. The soils are sandy, clayey or gravelly, moist to moderately humid, neutral to basic, mesotrophic to eutrophic (Holub 1972). It is scattered to rare in southern, central and eastern Bohemia, southern and eastern Moravia and rare in northern Bohemia and western and eastern Silesia. This species has vanished from the majority of its sites due to eutrophication of river banks and construction of water reservoirs, e.g. in the Vltava and Otava river valleys. It is therefore classified as endangered (Grulich 2012).

Equisetum palustre (Fig. 41)

Equisetum palustre is a circumboreal species widely distributed in the Northern Hemisphere from Europe, northern Anatolia and the Caucasus Mts eastwards to central and northern Siberia, the Russian Far East and Japan, with outposts in the Himalayas, south-eastern China and the Korean Peninsula. In North America it is distributed in its north-western

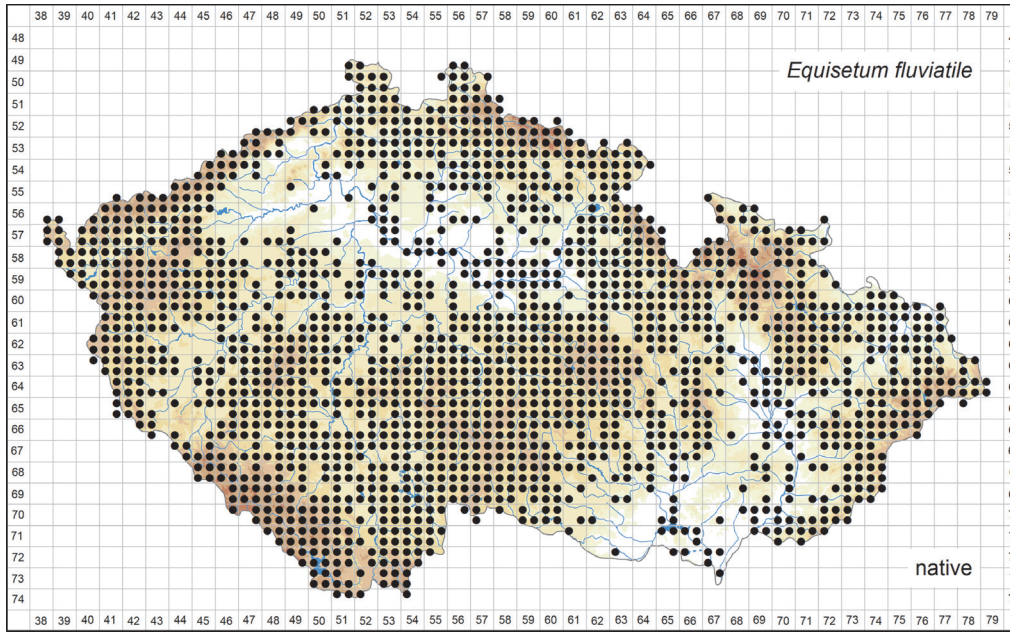

Fig. 39. – Distribution of *Equisetum fluviatile* in the Czech Republic (1751 occupied quadrants). Prepared by Libor Ekrt.

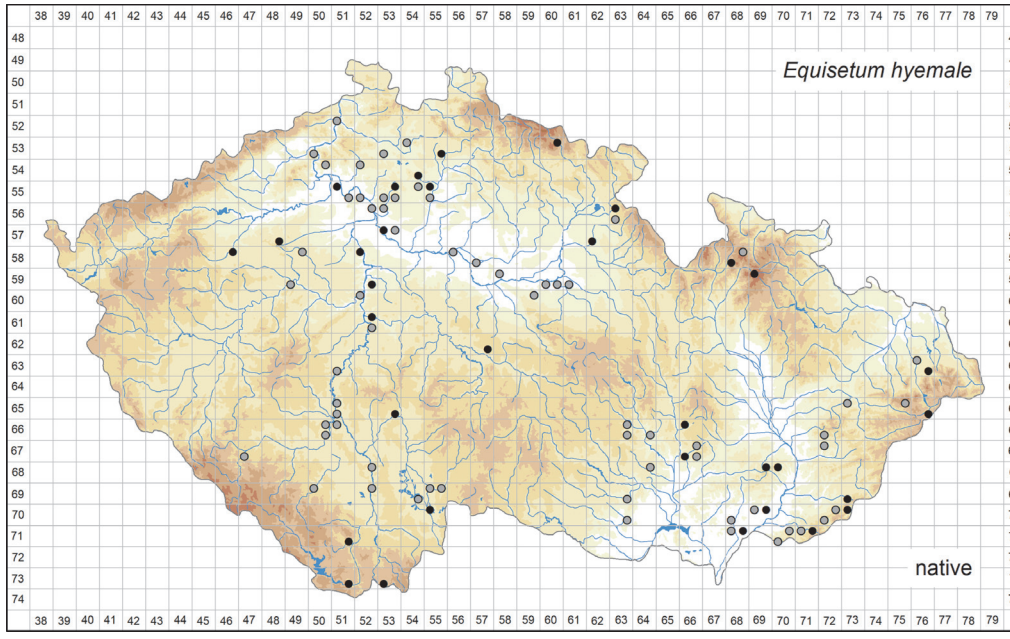

Fig. 40. – Distribution of *Equisetum hyemale* in the Czech Republic: ● at least one record in 2000–2020 (33 quadrants), ● pre 2000 records only (62 quadrants). Prepared by Libor Ekrt.

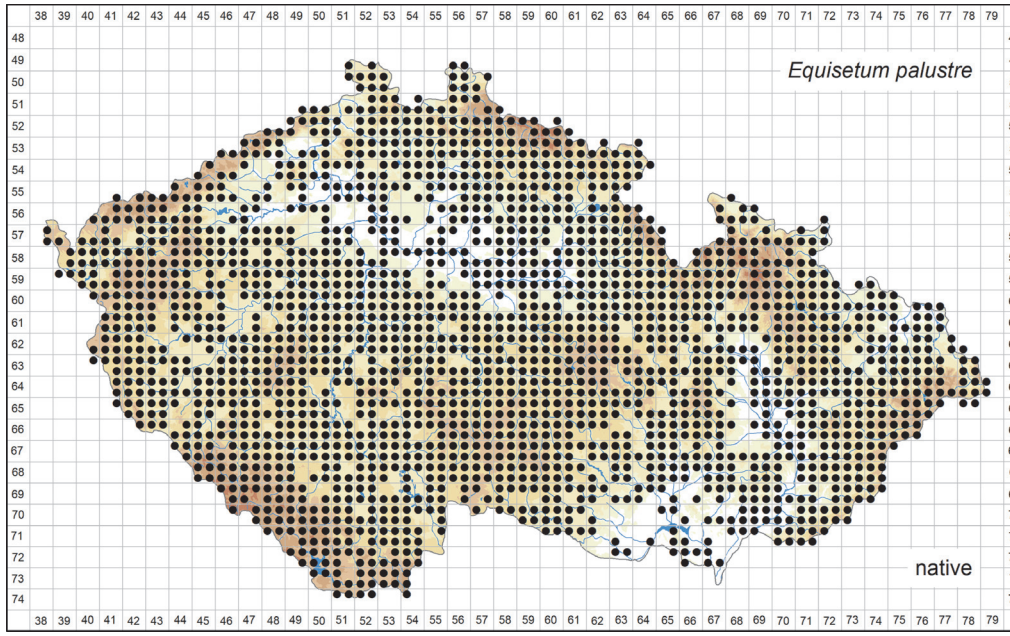

Fig. 41. – Distribution of *Equisetum palustre* in the Czech Republic (2028 occupied quadrants). Prepared by Libor Ekrt.

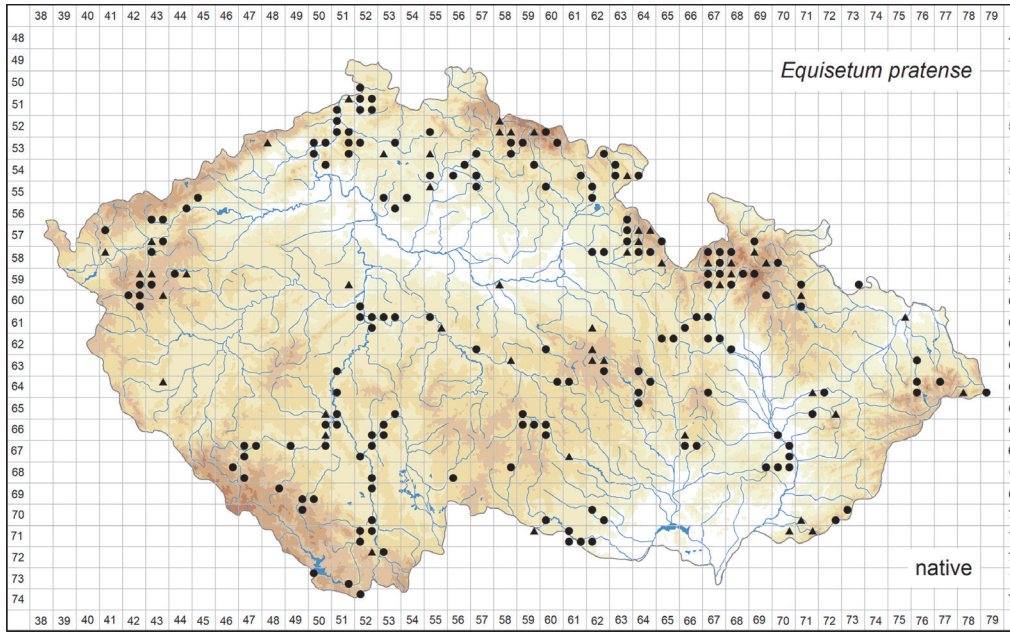

Fig. 42. – Distribution of *Equisetum pratense* in the Czech Republic: ● occurrence documented by herbarium specimens (166 quadrants), ▲ occurrence based on other records (50 quadrants). Prepared by Libor Ekrt.

and north-eastern parts (Hultén & Fries 1986). In the Czech Republic *E. palustre* occurs in wet meadows, peat bogs, fens, fishpond banks, alder forests and secondary habitats such as moist places along roads, railway embankments and arable fields. The soils are moist to humid, usually poor in nutrients. In the past it was believed that *E. palustre* is frequent only at rather low elevations, only rarely reaching higher elevations up to 900 m (Holub 1972). However, intensive recording during the past decades and herbarium studies revealed that *E. palustre* is rather widespread throughout this country. It is fairly common at middle and high elevations, ascending to about 1200 m, with its absolute maximum at about 1400–1440 m in the Velká kotlina glacial cirque in the Hrubý Jeseník Mts. It is rare in or absent from those dry lowlands of north-western and central Bohemia and central and southern Moravia where arable land prevails and acidic soils are absent. The gaps on the map at middle elevations are most likely due to a lack of records rather than true absences.

Equisetum pratense (Fig. 42)

Equisetum pratense is a circumboreal species distributed in the Northern Hemisphere. It occurs in northern, central and eastern Europe with several outposts in the mountains of south-eastern Europe, Crimea as well as the Caucasus Mts. Eastwards it extends through central Siberia to the Russian Far East and Japan; it is also found in the northern USA and north-western and north-eastern Canada (Hultén & Fries 1986). In the Czech Republic *E. pratense* grows in alluvial, alder, beech and oak-hornbeam forests usually directly adjacent to rivers and large streams. The soils are rich to moderately rich in nutrients, permanently moist to humid, usually poor in calcium. *Equisetum pratense* is scattered throughout this country, particularly at middle elevations, sporadically up to about 800 m, reaching its elevational maximum at about 1100 m near the village of Vidly in the Hrubý Jeseník Mts. However, it is rare in or absent from the central Bohemian and central and southern Moravian lowlands, reaching its elevational minima at 150 m near the Laber river near the town of Ústí nad Labem in northern Bohemia and at 190 m near the Morava river near the town of Kroměříž in eastern Moravia. *Equisetum pratense* is often neglected or confused with *E. arvense* and *E. sylvaticum*, which renders the undocumented records less reliable. Due to frequent misidentifications, the distribution map is based primarily on examined herbarium specimens and field records by experienced botanists. Because this species is often neglected and its sites are not always easy accessible, it may be locally more common than indicated by the map. The species is threatened particularly by overall eutrophication of the landscape, river regulation and construction of water reservoirs. It is therefore classified as vulnerable (Grulich 2012).

Equisetum ramosissimum (Fig. 43)

Equisetum ramosissimum has a wide (sub)continental range. It occurs in the southern half of Europe, Macaronesia, northern Africa, Anatolia and eastwards in a wide belt through southern Siberia and the Himalayas to the Russian Far East, south-eastern China, Japan and Taiwan; isolated occurrences are in the southern part of the Arabian Peninsula, southernmost Africa and Madagascar (Meusel et al. 1965). It has been introduced into the south-eastern USA (Hauke 1993). In the Czech Republic *E. ramosissimum* is found in oligotrophic habitats with sandy and gravely substrates, including pine forests, gravel

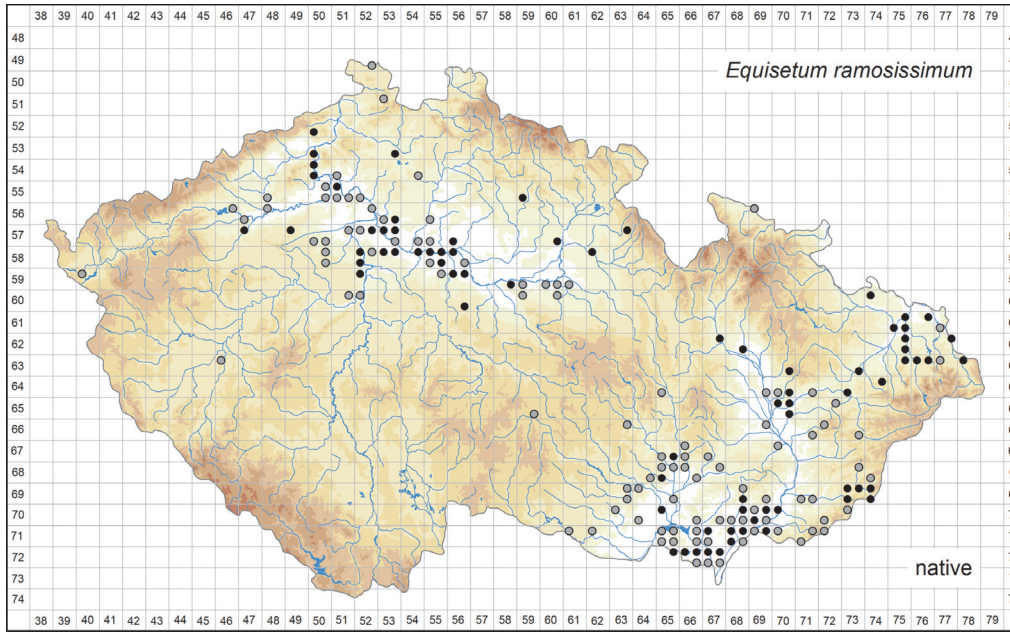

Fig. 43. – Distribution of *Equisetum ramosissimum* in the Czech Republic: ● at least one record in 2000–2020 (76 quadrants), ● pre 2000 records only (102 quadrants). Prepared by Libor Ekrt.

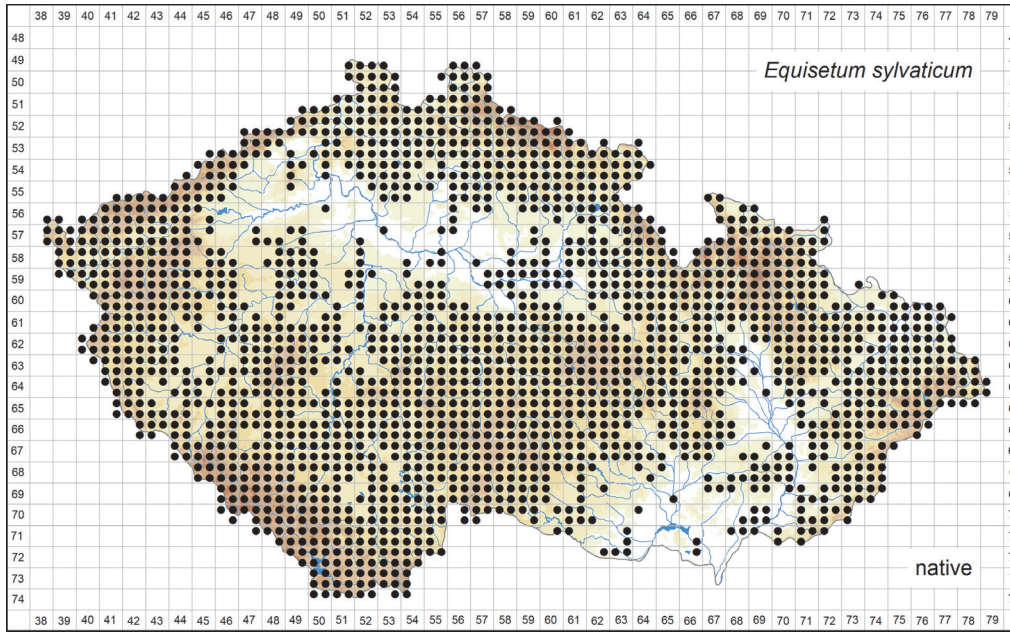

Fig. 44. – Distribution of *Equisetum sylvaticum* in the Czech Republic (1906 occupied quadrants). Prepared by Libor Ekrt.

bars in riverbeds and very often also in secondary habitats such as margins of arable fields, road verges, railway embankments and ruderal sites in towns and mining areas. It is a weak competitor, requiring mechanical disturbance. *Equisetum ramosissimum* is scattered over warm and moderately warm parts of north-western, central and eastern Bohemia, and central, southern and south-western Moravia and Silesia. A few secondary occurrences exist elsewhere. This species usually reaches elevations up to 350–400 m, having its elevational maximum at about 600 m in the village of Horní Němčí in the Bílé Karpaty Mts in south-eastern Moravia. It is threatened by the overall eutrophication of the landscape and successional changes of its habitats, and many populations have vanished. It is therefore classified as endangered (Grulich 2012).

Equisetum sylvaticum (Fig. 44)

Equisetum sylvaticum has a wide circumboreal distribution in the Northern Hemisphere. It is widespread in Europe except for its southern and south-western parts, where it is present locally only in the mountains (incl. Crete and Cyprus). Its continuous range extends eastwards through central Siberia to the Russian Far East; it is also found in Canada, the northern and north-eastern parts of the USA and southern Greenland (Hultén & Fries 1986). In the Czech Republic *E. sylvaticum* occurs in spruce and alder forests, moist places and springs in beech and fir forests, and in peat bogs. At rather high elevations it also inhabits various secondary habitats such as road embankments, moist fields and edges of meadows. The soils are usually acidic and moist. It is widespread in this country at middle and rather high elevations while it is rare in or absent from the dry, warm lowlands. Apart from the lowlands, the gaps on the map may be due to under-recording rather than true absences. This species reaches its elevational maxima at 1360 m near the town of Pec pod Sněžkou in the Krkonoše Mts and at 1350 m in the glacial cirque of Velká kotlina in the Hrubý Jeseník Mts, and its elevational minimum at about 150 m at sites with topoclimatic inversion in the Labe river valley near the town of Děčín in northern Bohemia.

Equisetum telmateia (Fig. 45)

Equisetum telmateia s. str. occurs mainly in western, central and southern Europe and northern Africa, in the north it reaches Scotland, the Baltic countries and southernmost Sweden, and also has a widely patchy distribution in Macaronesia, along the northern coast of the Black Sea, in Anatolia, the Caucasus Mts and northern Iran. In the western and central parts of North America *E. telmateia* var. *braunii* is recognized (Hultén & Fries 1986, Hauke 1993). In the Czech Republic *E. telmateia* usually grows in large, tall stands and shows a relatively narrow ecological amplitude, inhabiting specific types of habitats. It occurs in springs, swamps, fens, disturbed slopes above streams and rivers, on edges of small water pools, and in alluvial forests and alder carrs. Secondary occurrences have been recorded in moist pastures, along roads and on railway embankments. This species prefers marlstone, limestone, tuff, calcareous clay or sandy-loam substrates prone to landslides. The soils are moist, usually moderately rich to rich in calcium and other nutrients, with flowing, well-oxygenated groundwater; therefore, *E. telmateia* occurs frequently in calcareous springs (Holub 1972). It is distributed locally at middle elevations and in the foothills of mountains up to about 800 m. It is common in the Carpathian flysch belt in eastern and north-eastern Moravia and eastern Silesia and rare

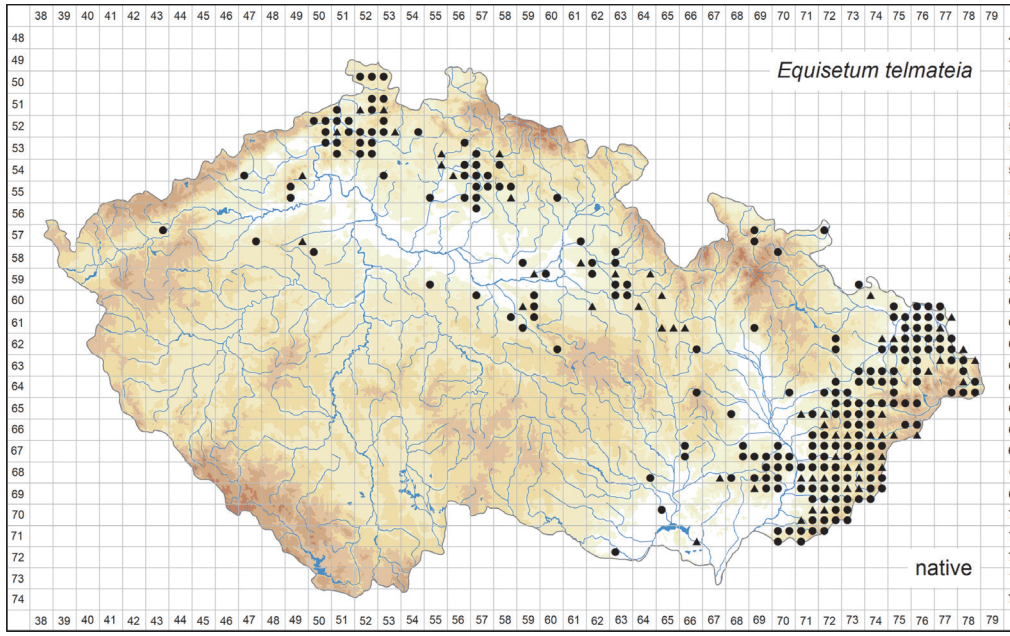

Fig. 45. – Distribution of *Equisetum telmateia* in the Czech Republic: ● occurrence documented by herbarium specimens (215 quadrants), ▲ occurrence based on other records (60 quadrants). Prepared by Libor Ekrt.

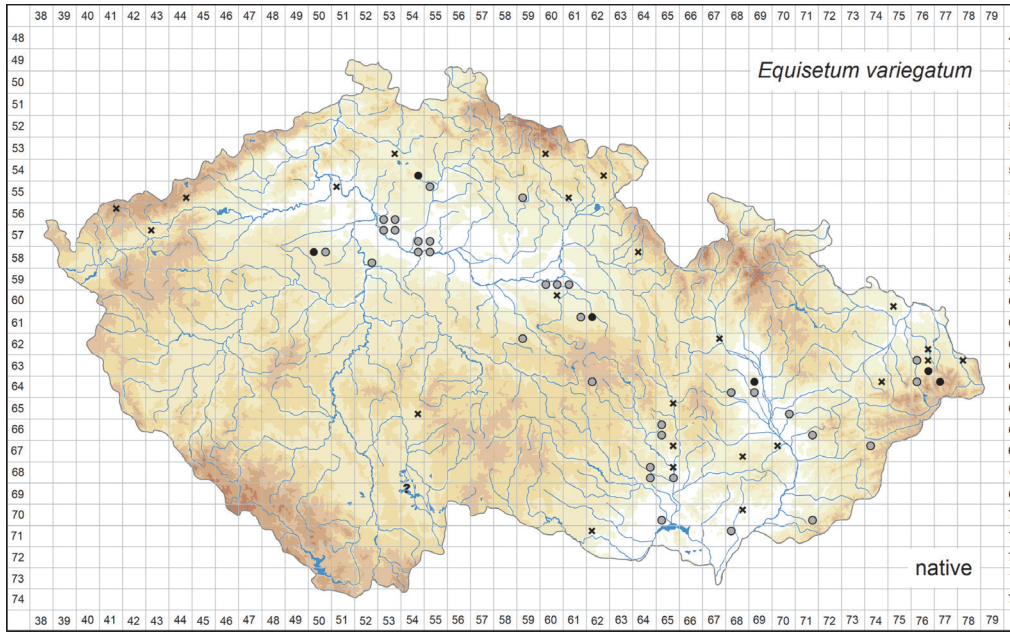

Fig. 46. – Distribution of *Equisetum variegatum* in the Czech Republic: ● occurrence in natural habitats in 2000–2020 (6 quadrants), ◍ occurrence in natural habitats only before 2000 (33 quadrants), × occurrence in secondary habitats (24 quadrants). Prepared by Libor Ekrt.

to scattered in southern and central Moravia and northern Silesia. In Bohemia *E. telmateia* is scattered in its northern and eastern parts, rare in its central part and absent from its southern half. It reaches its elevational minima at 130 m near the Laber river in the town of Děčín in northern Bohemia and at 160 m near the Dyje river in the town of Lednice in southern Moravia. This species is threatened by direct destruction of its habitats by drainage and recently also by general eutrophication and succession. It is classified as of lower risk – near threatened (Grulich 2012).

Equisetum variegatum (Fig. 46)

Equisetum variegatum has a wide range in the northern half of the Northern Hemisphere. It occurs in Europe except for its southern and eastern parts, being more frequent in the mountains, including the Pyrenees, Alps, Carpathians, Caucasus and Ural Mts, and in northern Europe (Ireland, Scotland, Scandinavia), while it is scattered elsewhere. In the north it occurs in Iceland, Svalbard, and eastwards through Arctic northern Russia, Siberia and northern Mongolia as far as the Russian Far East and Japan. It is also known from Canada, the north-eastern, central and north-western USA and Greenland (Hultén & Fries 1986). In the Czech Republic *E. variegatum* usually inhabits calcareous fens, springs, meadows, moist sandy habitats and gravel bars in riverbeds. It is a weak competitor requiring habitat disturbances. The soils it grows on are moist to moderately humid and basic to neutral (Holub 1972). Secondary occurrences are found at the bottoms of limestone and kaolin quarries and other mining sites. *Equisetum variegatum* is native to warm areas in central and eastern Bohemia, Silesia, and southern and central Moravia and usually reaches elevations of up to 400 m, with its elevational maximum at 690 m in the village of Rokytno in the Žďárské vrchy hills. However, natural occurrences have been predominantly extirpated, and the majority of current occurrences are in secondary habitats. These are found also in other parts of this country, e.g. in north-western, northern and southern Bohemia, south-western and south-eastern Moravia and Silesia. The secondary occurrences reach their elevational maximum at a former tin mining site at 920 m near the village of Rolava in the Krušné hory Mts. *Equisetum variegatum* is threatened by direct destruction of its habitats due to drainage and succession triggered by overall eutrophication or the absence of appropriate management. It is classified as endangered (Grulich 2012).

Marrubium peregrinum (Fig. 47)

Marrubium peregrinum is native to south-eastern Europe and adjacent warm parts of central Europe, with its range extending northwards and westwards to the south-eastern Czech Republic, eastwards to the northern coast of the Black Sea and southwards to southern Greece. Rare occurrences in other parts of central Europe are due to temporary introductions (Meusel et al. 1978). In the Czech Republic *M. peregrinum* is considered to be a naturalized archaeophyte (Pyšek et al. 2012). It grows in ruderalized dry grasslands, along roads and tracks, in village squares, rubble, at the bases of walls and in other ruderal places in villages, including roofs of small underground wine cellars. The soils are usually dry and developed on loess or hard base-rich bedrock types, but also on anthropogenic substrates. *Marrubium peregrinum* used to be widespread in the warm, dry areas in southern Moravia northwards to the city of Brno. However, it has declined considerably

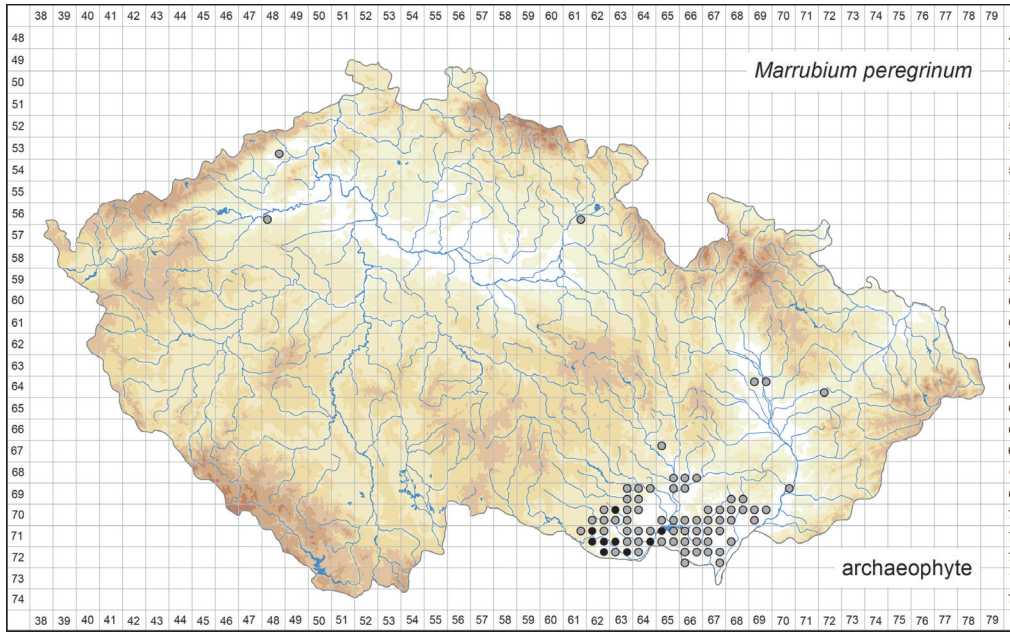

Fig. 47. – Distribution of *Marrubium peregrinum* in the Czech Republic: ● at least one record in 2000–2020 (9 quadrants), ● pre 2000 records only and/or extirpated occurrences (67 quadrants). Prepared by Zdeněk Kaplan.

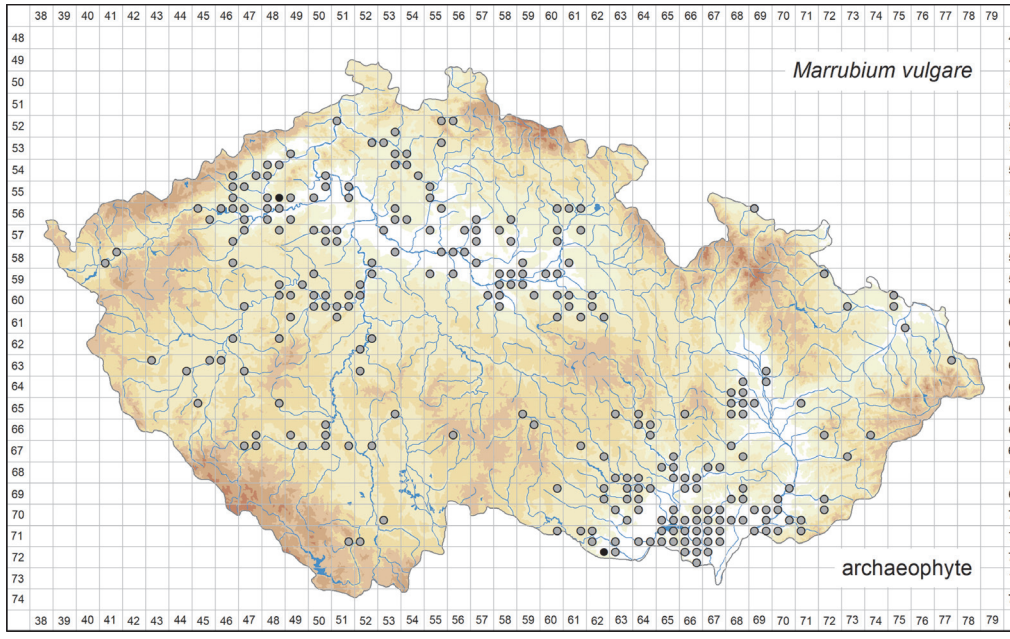

Fig. 48. – Distribution of *Marrubium vulgare* in the Czech Republic: ● at least one record in 2000–2020 (2 quadrants), ● pre 2000 records only and/or extirpated occurrences (255 quadrants). Prepared by Zdeněk Kaplan.

due to land-use changes, particularly modernization of villages, absence of regular low-intensity disturbances and eutrophication of the landscape followed by succession of stronger competitors. It is therefore classified as critically threatened (Grulich 2012). The rare occurrences in the northern half of Bohemia and central Moravia were casual introductions in the late 19th and early 20th centuries.

Marrubium vulgare (Fig. 48)

Marrubium vulgare is probably native to the Mediterranean area and south-western Asia. However, it used to be grown as a medicinal herb and has become naturalized in many parts of the world including Europe northwards to the British Isles and southern Scandinavia, central Asia, Japan, North and South America, southern Africa, Australia and New Zealand (Meusel et al. 1978, Hultén & Fries 1986). Currently it is invasive in Australia, New Zealand and some Pacific islands (Popay 2013, IPIF 2020). In the Czech Republic *M. vulgare* is classified as a casual archaeophyte (Pyšek et al. 2012). It occurs in various ruderal habitats in villages such as disturbed sites in village squares, along roads, garden fences and walls, at rubble sites and on waste ground, and seldom in the countryside on rocky slopes and along trails. It prefers permeable, basic, calcareous soils that are rich in nutrients. The great majority of the sites of *M. vulgare* were in the lowlands and adjacent warm hilly landscapes in north-western Bohemia, the Labe river basin, the Český kras karst area and southern Moravia, with less frequent occurrence in south-western and southern Bohemia and central Moravia, while elsewhere it was rare. Many of the occurrences, particularly in Bohemia, probably represent escapes from local gardens. As *M. vulgare* has become less popular in gardens during the second half of the 20th century and the amount of suitable habitats has decreased, this species has also markedly declined in the village flora. It has only been recorded at three sites recently: a small population is established on Raná hill near the town of Louny in northern Bohemia, a single plant was found in the village of Nedabyle in southern Bohemia in 2016, and a small declining population in an abandoned poultry yard was observed in the village of Dyjákovičky in southern Moravia in 2019. This species is therefore classified as critically threatened (Grulich 2012).

Montia arvensis (Fig. 49)

Montia arvensis is distributed mainly in central Europe, extending northwards to the British Isles and southern Sweden, westwards to France and Spain, eastwards to the eastern coast of the Black Sea, and in the south it reaches the African continent in Morocco (Meusel et al. 1965, Jalas & Suominen 1980, Hultén & Fries 1986); it probably also occurs in western North America, Chile, Uruguay, south-eastern Australia and New Zealand (Moore 1963). In the Czech Republic *M. arvensis* grows on disturbed sites with sparse vegetation mainly on sandy to loamy-sandy soils that are wet in spring but dry out in summer. These include damp arable fields and fallows and periodically exposed shores of fishponds, but temporary occurrences have also been recorded at damp sandy and clayey places on construction sites and on loosened soil around street trees. *Montia arvensis* was recorded at about 30 sites in the fishpond basins in southern Bohemia, and six isolated occurrences were discovered in northern, central and eastern Bohemia in the 19th and the first half the 20th centuries. This species has declined considerably since

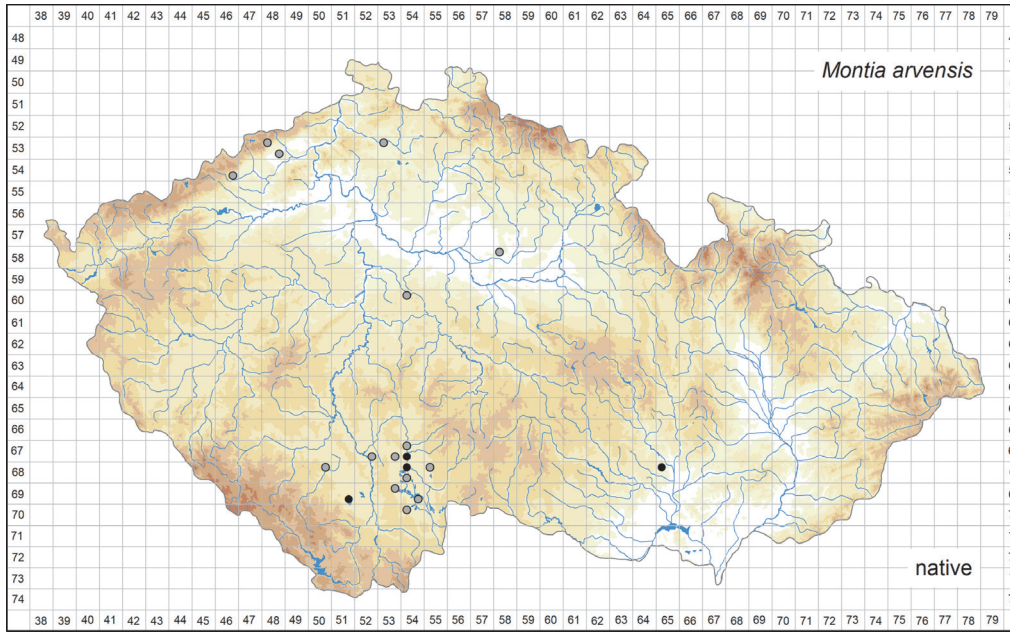

Fig. 49. – Distribution of *Montia arvensis* in the Czech Republic: ● at least one record in 2000–2020 (4 quadrants), ● pre 2000 records only (15 quadrants). Prepared by Zdeněk Kaplan.

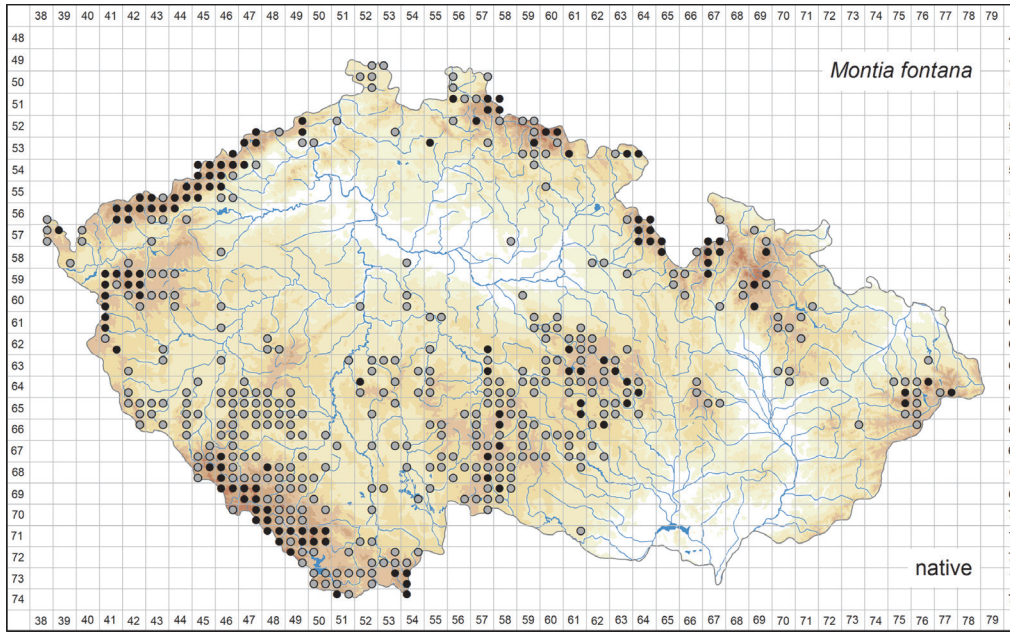

Fig. 50. – Distribution of *Montia fontana* in the Czech Republic: ● at least one record in 2000–2020 (131 quadrants), ● pre 2000 records only (348 quadrants). Prepared by Zdeněk Kaplan.

World War II due to intensification of agriculture, eutrophication and drainage, so that it has been considered extinct in this country until recently (Skalický & Sutorý 1990, Lepší 2009, Grulich 2012). However, *M. arvensis* has been rediscovered at one of its former sites, namely the littoral zone of the Dehtář fishpond at the village of Dehtáře, and three temporary occurrences have been detected around the town of Veselí nad Lužnicí, where this species colonized wet bare ground of construction sites, all located in southern Bohemia. Additionally, it has recently been found as introduced with soil from a tree nursery into the city of Brno. A single extant population is known at present and the species is therefore classified as critically threatened (Grulich 2017).

Montia fontana (Figs 50–52)

Montia fontana is a polymorphic species. Walters (1953) divided it into four subspecies based mainly on fruit characteristics. Of these, subsp. *chondrosperma* is here treated as *M. arvensis*, based on more pronounced morphological and ecological differentiation, following the recent literature (e.g. Nilsson 2001, Buttler & Hand 2008, Danihelka et al. 2012, Raab-Straube 2018, Kaplan 2019). The remaining three subspecies are included here in *M. fontana*, which is distributed mainly in the western half of Europe, in northernmost (Morocco) and eastern Africa, the Caucasus Mts, the Russian Far East, Japan, western, northern and eastern North America, Greenland, South America, New Guinea, southern Australia and New Zealand (Meusel et al. 1965, Jage 1979, Hultén & Fries 1986). The differentiation of this species outside Europe is little understood. In Europe subsp. *fontana* is most frequent in Iceland, the northern British Isles and Scandinavia including Finland, scattered in central Europe and rare southwards, extending to the mountains in the Iberian and Apennine Peninsulas; subsp. *amporitana* is distributed mainly in the British Isles, southernmost Scandinavia and central Europe, being less frequent to rare in France, the Alps and southern Europe (Jage 1979, Jalas & Suominen 1980). Intermediate forms have been recorded in the areas of the distributional overlap of these subspecies in the British Isles and central Europe, and these were distinguished as subsp. *variabilis* (Walters 1953, Jage 1979, Jalas & Suominen 1980). Reduced pollen fertility and reduced seed set were recorded in this taxon (Jage 1979), which resulted in its recognition as hybrid subsp. *fontana* × subsp. *amporitana* (Fischer et al. 2005) and classification as nothosubsp. *variabilis* (Danihelka et al. 2012, Kaplan 2019). The recent field observations and examination of the herbarium material from the Czech Republic revealed that while subsp. *fontana* is usually rather easily recognizable and is geographically restricted in this country, the other two taxa, subsp. *amporitana* and (notho)subsp. *variabilis*, are connected by a continuous spectrum of intermediates (sometimes certain variation can be observed even within a population or even within a single plant) and are both more widespread but exhibit almost identical distribution in the Czech Republic. To identify whether this variation pattern indicates a lack of differentiation or a result of a long-lasting hybridization process requires further study. In any case, the separation of these two forms within the Czech material is only arbitrary, and subsp. *amporitana* and subsp. *variabilis* are therefore considered as a single taxon here.

In the Czech Republic the subspecies of *M. fontana* exhibit similar ecology: they grow in permanently wet places, often by slowly running cold and clear water on sandy, clayey or peaty substrates with acidic to neutral reaction and low calcium content, mainly in

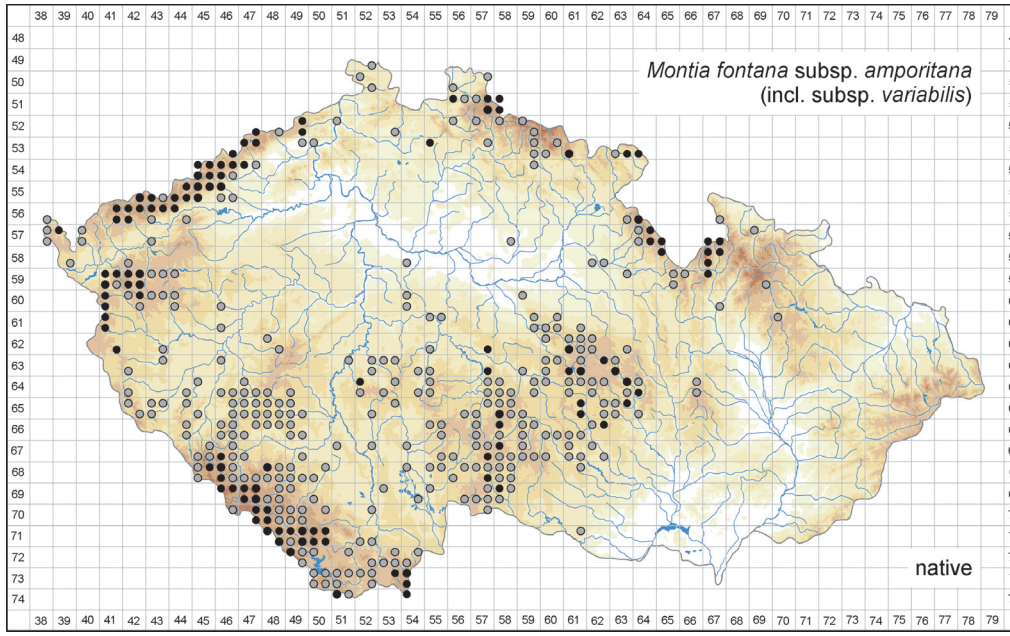

Fig. 51. – Distribution of *Montia fontana* subsp. *amporitana* (incl. subsp. *variabilis*) in the Czech Republic: ● at least one record in 2000–2020 (116 quadrants), ● pre 2000 records only (300 quadrants). Prepared by Zdeněk Kaplan.

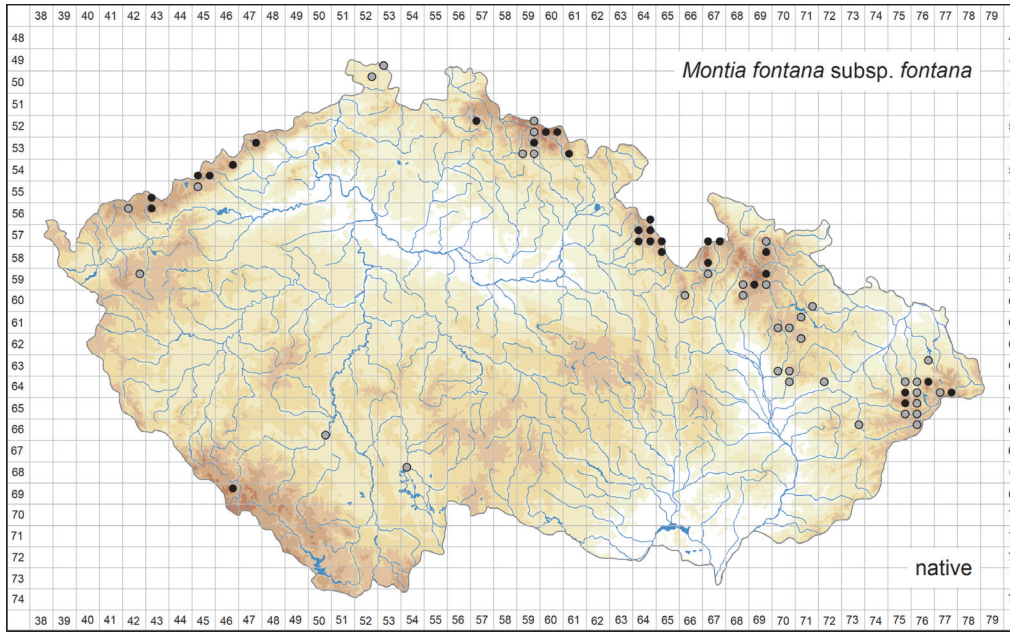

Fig. 52. – Distribution of *Montia fontana* subsp. *fontana* in the Czech Republic: ● at least one record in 2000–2020 (29 quadrants), ● pre 2000 records only (36 quadrants). Prepared by Zdeněk Kaplan.

springs and their outflows, small streams and their banks, and irrigation ditches. *Montia fontana* subsp. *fontana* occurs mainly in the mountains along the northern country's borders, particularly in the Krušné hory Mts, Jizerské hory Mts, Krkonoše Mts, Orlické hory Mts, Králický Sněžník Mts, Hrubý Jeseník Mts, Nízký Jeseník hills and Moravskoslezské Beskydy Mts. A few isolated sites were detected in western and southern Bohemia (Fig. 52). *Montia fontana* subsp. *amporitana* (incl. *M. f.* subsp. *variabilis*) is more widespread, being found in the mountains along the country's border in Bohemia and their foothills as well as in the Českomoravská vrchovina highlands and locally also at middle elevations in western and southern Bohemia, while in Moravia it has only been documented at a few sites in its northern half (Fig. 51). The *Montia* habitats are threatened by drainage, eutrophication, abandonment of meadows with springs and other changes in land use, and many populations have vanished. Consequently, *M. f.* subsp. *fontana* is classified as critically threatened and *M. f.* subsp. *amporitana* as endangered (Grulich 2012).

Due to the unstable species concept in the past and unreliable data from the literature, the maps of the subspecies (Figs 51–52) are based mainly on examined herbarium specimens with ripe fruits and the present author's field records, and are thus locally incomplete. The map of the entire species (Fig. 50) is based on all the herbarium records, including the specimens without ripe fruits that could not be assigned to subspecies, and all available literature and database records.

Oxalis acetosella (Fig. 53)

Oxalis acetosella is native to the boreal and temperate zones in Eurasia, in the south reaching as far as the Himalayas, in the east as far as the Kamchatka Peninsula, Sakhalin, Japan and China. It also occurs in the Caucasus Mts and northern Anatolia. In Europe this species is absent from the southern part of the Iberian Peninsula, most of Italy, the southern part of the Balkan Peninsula and most of the Mediterranean islands (Meusel et al. 1978). In the Czech Republic *O. acetosella* is found mainly in various types of forests, both coniferous (including Norway spruce plantations) and deciduous, subalpine tall-forb and tall-grass vegetation, subalpine scrub communities and forest clearings. The soils are usually fresh to well-moistened, acidic to moderately acidic, rich in humus and moderately rich to rich in nutrients. *Oxalis acetosella* is widespread in the Czech Republic and particularly common at middle elevations and in the mountains. In contrast, it is absent from or rare in the largely deforested warm and dry lowlands of north-western, central and eastern Bohemia, and central and particularly southern Moravia.

Oxalis corniculata (Fig. 54)

Oxalis corniculata is probably native to Mexico, the West Indies, Central and South America (Nesom 2009, 2016) or to south-eastern Asia (Groom et al. 2019), but many earlier authors (e.g. Hultén & Fries 1986) considered it as native to the Old World including the Mediterranean area. Nowadays it has an almost cosmopolitan range including most of the USA (apart from Alaska) and the southern part of Canada, most of Europe, large parts of Asia (mainly India, China and Japan), sub-Saharan Africa, New Zealand and Australia. In Europe it is found in the whole Mediterranean area and in western and central Europe, towards the north reaching southern England and southern Scandinavia (Meusel

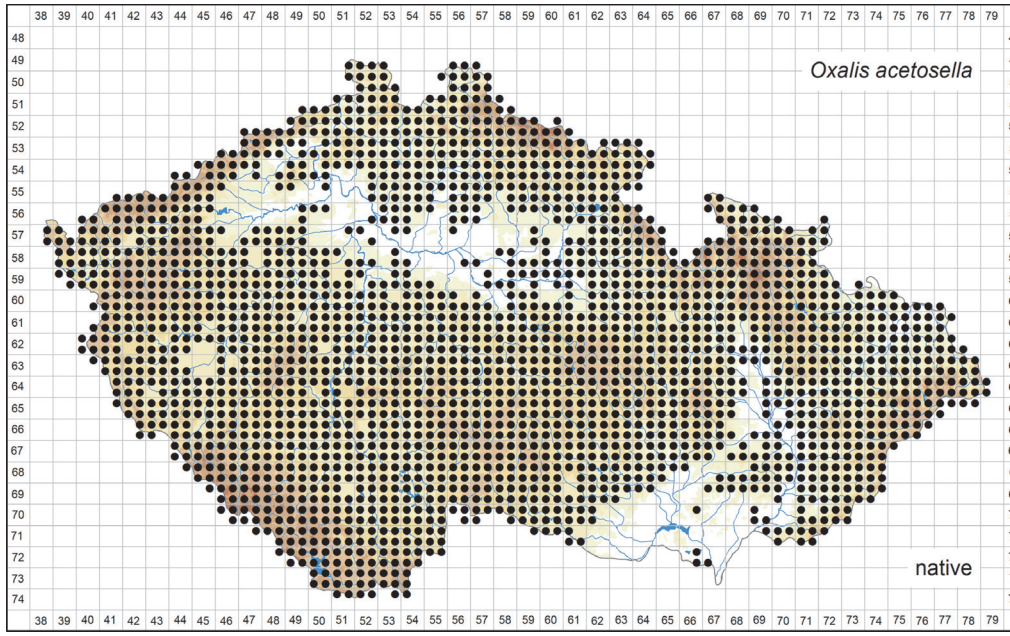

Fig. 53. – Distribution of *Oxalis acetosella* in the Czech Republic (2179 occupied quadrants). Prepared by Jiří Danihelka.

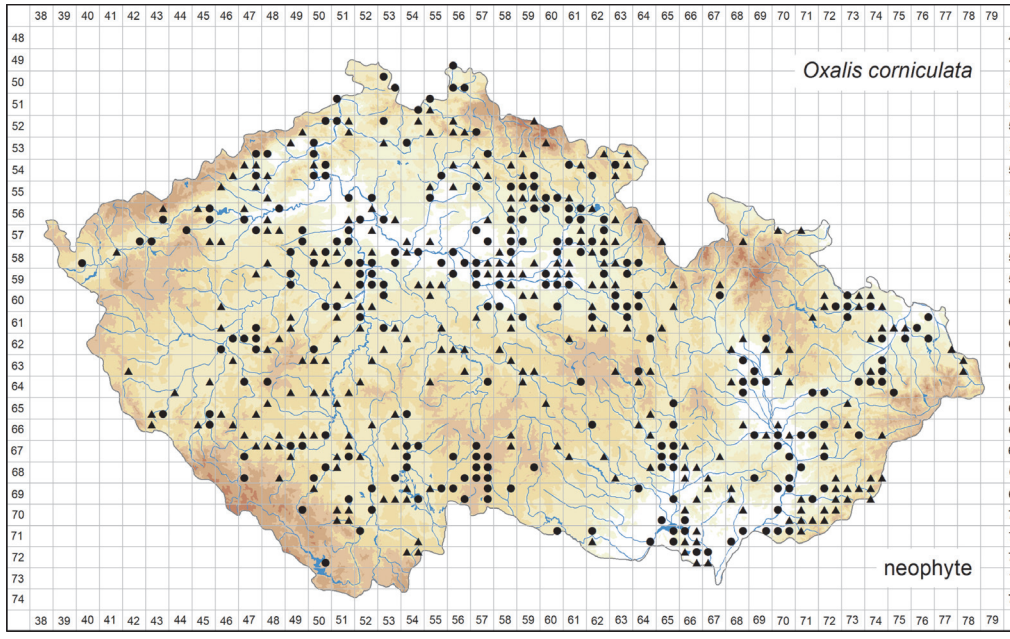

Fig. 54. – Distribution of *Oxalis corniculata* in the Czech Republic: ● occurrence documented by herbarium specimens (244 quadrants), ▲ occurrence based on other records (272 quadrants). Prepared by Jan Dohnal & Jiří Danihelka.

et al. 1978, Hultén & Fries 1986). The taxonomy of *O. corniculata* is still controversial, and small plants with thin, creeping stems, usually also with purple leaves, are sometimes separated as *O. repens* (e.g. Holub 1997). In the Czech Republic such purple-leaved plants (referred to as f. *purpurea*) strongly prevail, while those corresponding to the type variety (widespread in the Mediterranean area) are scarce. Additionally, plants of intermediate appearance are sometimes encountered. This may be explained by the reproduction mode: outcrossing is combined here with pseudogamous apomixis if the flower is pollinated by pollen from the same individual (Nesom 2009), which makes possible, at least in the short term, the co-occurrence of both morphotypes. Here, both distinct morphotypes together with some intermediates are mapped together as *O. corniculata*. In the Czech Republic *O. corniculata* occurs mainly in settlements as a weed in flower beds and gardens, trampled places, pavement joints, along walls and in their crevices, and at other disturbed secondary habitats. It is a noxious weed in greenhouses (records not considered in the map) and nurseries, sometimes even indoors as a hitchhiker in flower pots. Therefore, it is particularly common in graveyards, spread there with planting stock of ornamental species. The purple-leaved plants are sometimes cultivated ornamentally, and therefore intentionally transferred to new sites. The soils are dry to fresh, moderately acidic to moderately basic, moderately rich to rich in nutrients. In the Czech Republic it was first collected in the city of Karlovy Vary as early as 1850. Now it is widespread all over the country, particularly in the lowlands and at middle elevations, but the occurrences are generally confined to settlements. *Oxalis corniculata* is probably more widespread than indicated on the map as its habitats are only occasionally surveyed. It is considered as an invasive neophyte (Pyšek et al. 2012).

Oxalis debilis (Fig. 55)

Oxalis debilis is native to South America south of the Equator. It was sometimes cultivated ornamentally and has been introduced into Central America, Mexico, the eastern and south-western USA, Macaronesia, western Europe and the western Mediterranean area, Greece (including some of its islands), south-eastern Asia, Pacific Islands and Australia (Jehlík 1995, Nesom 2016, Henning & Raab-Straube 2016). In the western Mediterranean area this species is found mainly at disturbed sites such as cultivated ground, in gardens and on road verges. In the Czech Republic *O. debilis* used to be rarely cultivated as an indoor ornamental pot plant and was locally spread as a weed in greenhouses already by the 1960s. From there it was accidentally introduced with planting stock into a field near the village of Lnáře in southern Bohemia (Machovec 1967). The second time this species was observed outdoors consisted of a temporary escape in 1978 and 1979 in one of Prague's graveyards (Holub & Holubičková 1980), also as a result of introduction with plants from greenhouse cultivation. All other records reported by Jehlík (1995) are from greenhouses and are not mapped here. The species is considered as a casual neophyte (Pyšek et al. 2012), and its establishment is rather unlikely due to the country's cold climate. The similar, related *O. latifolia* has never been recorded outdoors in this country (Jehlík 1995).

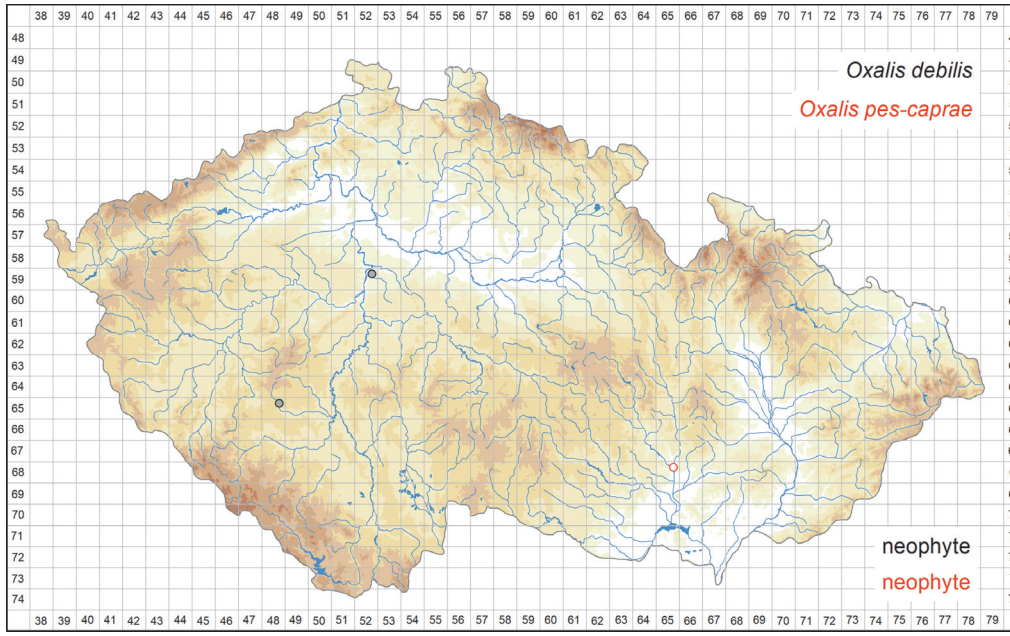

Fig. 55. – Distribution of *Oxalis debilis* (◍ pre 2000 records only: 2 quadrants) and *O. pes-caprae* (◍ pre 2000 records only: 1 quadrant) in the Czech Republic. Prepared by Jiří Danihelka.

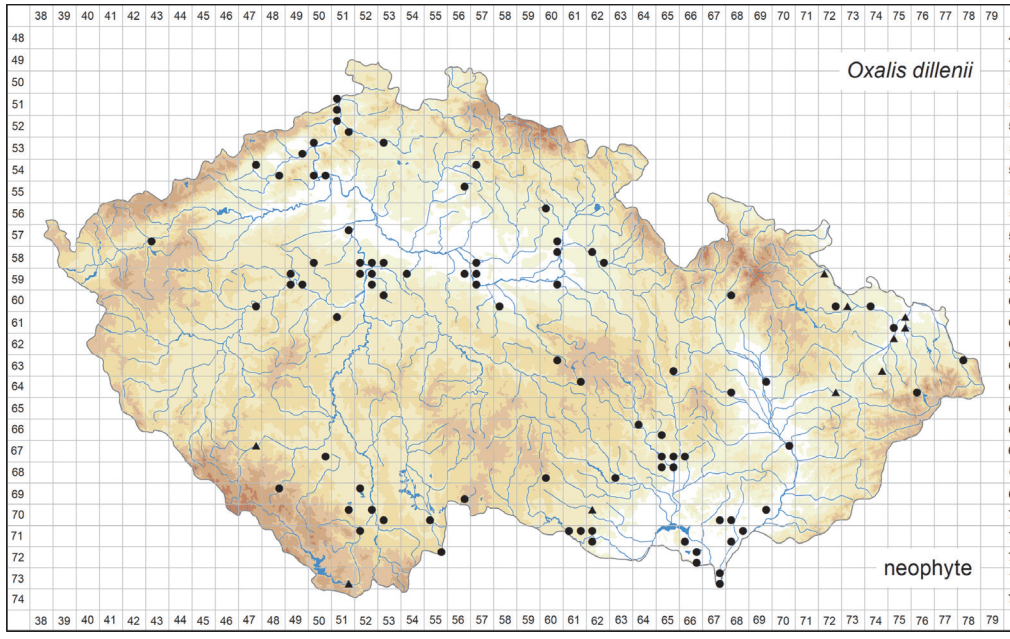

Fig. 56. – Distribution of *Oxalis dillenii* (● occurrence documented by herbarium specimens: 85 quadrants, ▲ occurrence based on other records: 10 quadrants). Prepared by Jan Dohnal & Jiří Danihelka.

Oxalis dillenii (Fig. 56)

Oxalis dillenii is native to North America, including most of the USA and southern provinces of Canada. It has been introduced into and became naturalized in Bermuda and Europe (Nesom 2009, 2016). No worldwide distribution map for this species is available. In Europe *O. dillenii* was recorded in most of its countries apart from most of European Russia and large parts of Scandinavia (Henning & Raab-Straube 2016); however, some of the country records may be based on misidentified plants of *O. corniculata* or records under *O. stricta* misinterpreted to belong to this species. In the Czech Republic *O. dillenii* occurs mainly on disturbed ground, including city lawns and other ruderal grasslands, flower beds, graveyards, field margins, and recently also on exposed gravel deposits in river beds (of the Elbe) and at railway stations. The soils are usually fresh but may dry out during the season, rich in nutrients and slightly acidic to slightly basic. *Oxalis dillenii* is nowadays scattered all over the country, established mainly in and around cities, but also locally elsewhere with warm climates, particularly in areas with sandy soils, such as in the surroundings of the towns of Znojmo and Břeclav in southern Moravia. This species was first recognized for this country's flora by Smejkal (1965), based on a specimen collected in 1963 near the village of Lednice in southern Moravia; however, a revision of all available herbarium specimens revealed several earlier gatherings, among them a herbarium specimen collected in the old university botanical garden in the village of Smíchov near Prague as early as 1876. *Oxalis dillenii* is considered as an invasive neophyte (Pyšek et al. 2012) because of its recent rapid spread. Due to nomenclatural confusion (cf. Holub 1997) and frequent misidentifications, the map is based on examined herbarium specimens and recent field records by botanists familiar with this species.

Oxalis pes-caprae (Fig. 55)

Oxalis pes-caprae, native to the Cape Region of South Africa, has been introduced into many parts of the World with Mediterranean or subtropical climates, including Arizona and California in the USA, South America, the whole Mediterranean area in Europe, northern Africa and western Asia, Iran, the Indian subcontinent, China and Australia (Nesom 2016, Henning & Raab-Straube 2016, Weber 2017). It is now considered invasive in many parts of its secondary range (Weber 2017). In the Mediterranean area *O. pes-caprae* is found at disturbed sites, including disturbed grasslands, cultivated grounds of various kind, coastal dunes, tree plantations around settlements, pasture woods and hedgerows. In the Czech Republic this species was found only once, from 1958 to 1961 in Brno as a weed in strawberry beds fertilized with waste from wool sorting and cleaning (Dvořák & Kühn 1966). It is considered a casual neophyte (Pyšek et al. 2012), and its naturalization in this country is unlikely due to winter frosts.

Oxalis stricta (Fig. 57)

Oxalis stricta is native to North America, probably to the eastern USA, and introduced elsewhere on that continent. It has also been introduced into and become naturalized in Europe, the temperate parts of eastern Asia (Japan and China), locally also in Africa, New Zealand and Australia (Hultén & Fries 1986, Nesom 2009). In Europe it is rather widespread apart from the north-east and some parts of the Mediterranean area (Henning

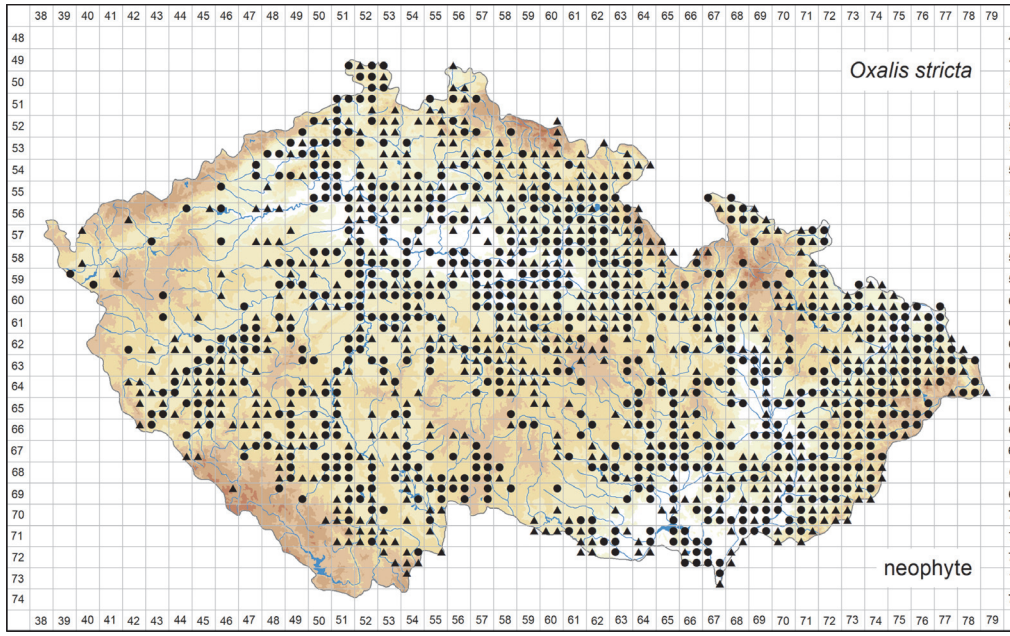

Fig. 57. – Distribution of *Oxalis stricta* in the Czech Republic: ● occurrence documented by herbarium specimens (688 quadrants), ▲ occurrence based on other records (600 quadrants). Prepared by Jan Dohnal & Jiří Danihelka.

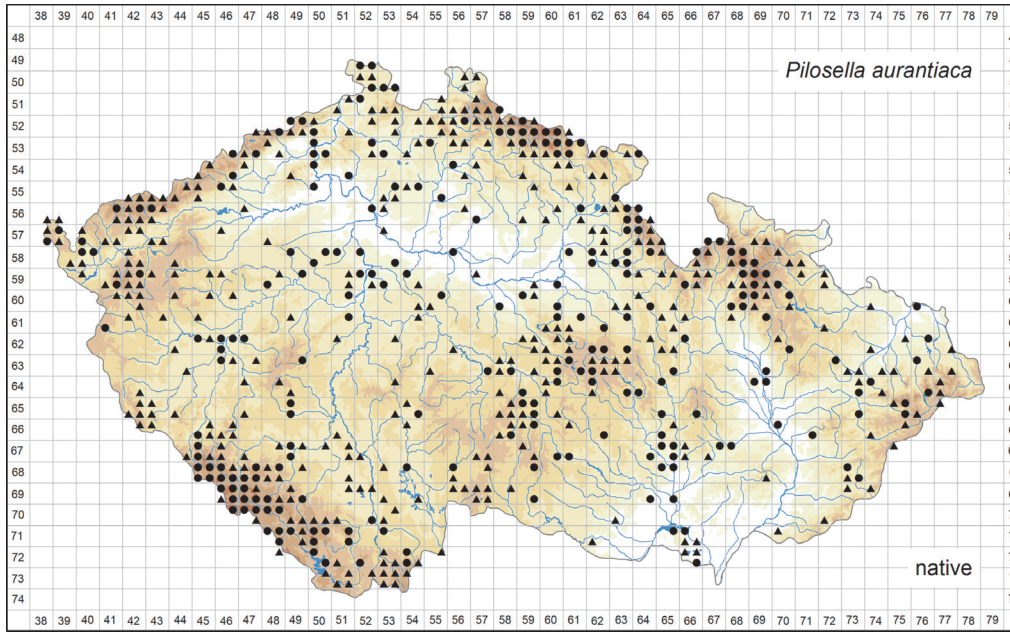

Fig. 58. – Distribution of *Pilosella aurantiaca* in the Czech Republic: ● occurrence documented by herbarium specimens (236 quadrants), ▲ occurrence based on other records (365 quadrants). Prepared by Jindřich Chrtek Jr. & Olga Rotreklová.

& Raab-Straube 2016). In the Czech Republic *O. stricta* occurs most frequently as a weed on arable land (mainly in root crops) and in gardens, in margins of deciduous forests, in tall mesic scrub, poplar plantations and rather humid ruderal habitats. The soils are usually fresh, slightly acidic to slightly basic and mostly rich in nutrients. The earliest record of *O. stricta* on the territory of the Czech Republic dates back to the early 19th century (Pohl 1814) and already at that time the species was considered rather widespread. Nowadays it is widespread all over this country and almost continuously distributed from the lowlands up to elevations about 700 m, reaching its elevational maxima at 855 m near the village of Staré Srní in the Šumava Mts and at about 800 m on Mt Velká Čantoryja in the Slezské Beskydy Mts. The gaps on the map reflect the lack of records, particularly in western Bohemia, as well as real absences at middle elevations in areas with a low share of arable land and soils poor in nutrients. *Oxalis stricta* is considered as a naturalized neophyte (Pyšek et al. 2012).

Pilosella aurantiaca (Fig. 58)

Pilosella aurantiaca is native to the European mountains from the Massif Central in the west through the Alps, Sudetes and Carpathians to the Dinaric mountains in Bosnia and Herzegovina, and northwards to southern Scandinavia, Finland and a few outposts in north-western Russia. It has been widely cultivated as an ornamental and has become naturalized in many European countries westwards to Iceland, the British Isles and the Pyrenees, northwards to northern Scandinavia and eastwards to eastern Ukraine and the western part of European Russia; the southern limit of the range runs through northern Italy, North Macedonia and Bulgaria. It has also been introduced into and has become naturalized in western Siberia, the Russian Far East, Japan, North America, Australia, Tasmania, New Zealand and the Falkland Islands (Hultén & Fries 1986, Meusel & Jäger 1992, USDA, NRCS 2020). In the Czech Republic *P. aurantiaca* occurs in meadows, grassy slopes, pastures, disturbed grasslands in settlements and along roads and paths. It usually grows on moderately humid, non-calcareous, acidic to neutral soils, which are poor to moderately rich in nutrients. In this country *P. aurantiaca* is most likely native to the Šumava Mts, Krkonoše Mts, Mt Králický Sněžník, the Hrubý Jeseník Mts and probably also to the Beskydy Mts; it reaches its elevational maximum at about 1400 m in the Krkonoše Mts. It is often cultivated as an ornamental, especially in the mountains that were inhabited primarily by the German-speaking population, and escaped plants are recorded nearly elsewhere in these mountains, less often at middle elevations, rarely also in the lowlands and dry, warm hilly areas throughout this country. However, it is hardly possible to delimit its native distribution with certainty, and the native and secondary occurrences are thus not distinguished on the map. In the Czech Republic native populations are classified as vulnerable (Grulich 2012).

Pilosella blyttiana (Fig. 59)

Pilosella blyttiana is a species morphologically occupying a position between *P. aurantiaca* and *P. lactucella*. It is distributed in the Alps, Sudetes, Carpathians and in northern Europe from Scandinavia eastwards to north-western Russia; it has also been reported from Bosnia and Herzegovina (Chrtek 2004). In the Czech Republic it occurs in wet meadows and road verges, on humid to wet, acidic to slightly acidic soils, which are

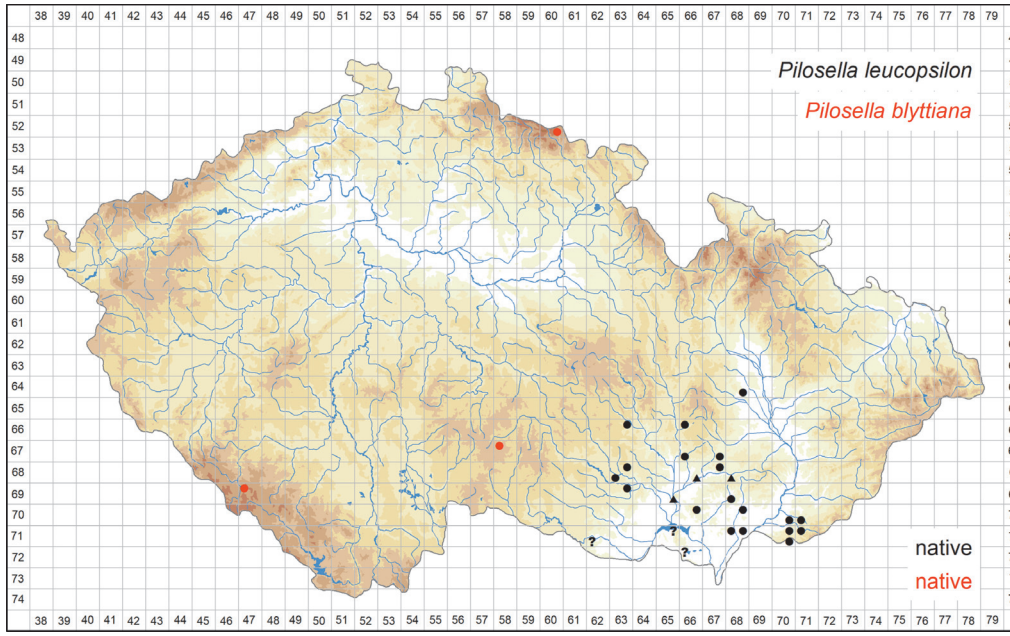

Fig. 59. – Distribution of *Pilosella blyttiana* (3 occupied quadrants) and *P. leucopsilon* (● occurrence documented by herbarium specimens: 19 occupied quadrants, ▲ occurrence based on other records: 3 quadrants) in the Czech Republic. Prepared by Jindřich Chrtek Jr. & Olga Rotreklová.

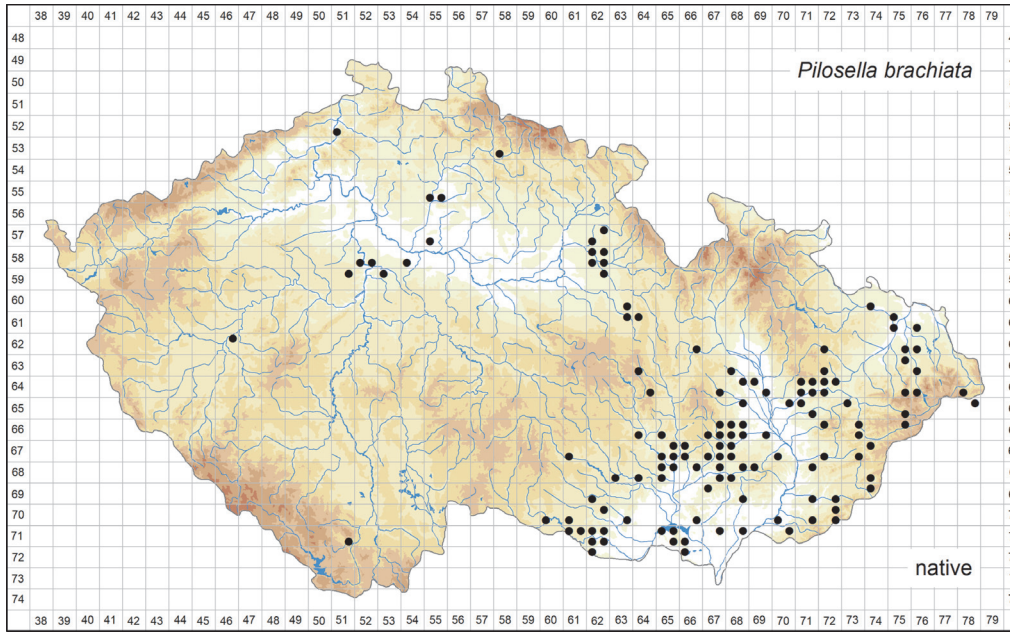

Fig. 60. – Distribution of *Pilosella brachiata* in the Czech Republic (129 occupied quadrants). Prepared by Olga Rotreklová & Jindřich Chrtek Jr.

rather poor in nutrients. *Pilosella blyttiana* is confined to a few meadows around the settlements of Pomezní Boudy and Malá Úpa in the easternmost part of the Krkonoše Mts in north-eastern Bohemia and to two localities in the Šumava Mts and Jihlavské vrchy hills. Plants from the Krkonoše Mts are stabilized apomicts independent from the parental species (*P. aurantiaca* and *P. lactucella*; Krahulcová et al. 2001), whereas plants from the two latter localities might be primary hybrids between *P. aurantiaca* (escaped from cultivation) and *P. lactucella*, morphologically identical with plants from the Krkonoše Mts. In this country *P. blyttiana* is classified as critically threatened due to its rarity (Grulich 2012).

Pilosella brachiata (Fig. 60)

Pilosella brachiata is a species morphologically occupying a position between *P. officinarum* and *P. bauhini*/*P. piloselloides*, being more closely related and thus more similar to the former. It is distributed throughout central, southern and south-eastern Europe, extending westwards to eastern France, northwards to Poland and the Baltic countries, eastwards to the central part of European Russia, Crimea and Bulgaria, and southwards to Italy, Croatia and Albania; it is also known from Anatolia, the Caucasus Mts and Transcaucasia (Chrtek 2004). It has been introduced into North America (USDA, NRCS 2020). In the Czech Republic *P. brachiata* occurs in open habitats such as dry and semi-dry disturbed grasslands, grassy or stony slopes and road verges and ruderal and semi-ruderal grasslands in settlements. It usually grows on shallow to deep, slightly acidic to basic, dry to moderately humid soils that are poor to moderately rich in nutrients. *Pilosella brachiata* is found from the lowlands to middle elevations, being scattered to locally common in Moravia and rare to locally scattered in Bohemia. However, some gaps on the map in warm hilly areas in Bohemia likely reflect lack of records rather than real absences. In Moravia *P. brachiata* is also found at rather high elevations, reaching its elevational maximum at about 750 m in the Beskydy Mts. *Pilosella brachiata* is more frequent than the other hybridogenous species of the same parental combination, *P. leptophyton* (see below). This is probably caused by the prevailing mode of reproduction in the parental taxa, i.e., apomixis in *P. bauhini*/*P. piloselloides* and sexuality in *P. officinarum*, as hybridogenous species morphologically closer to the sexually reproducing parents are as a rule more frequent in the field. *Pilosella brachiata* occurs mostly together with at least one of the parental taxa and displays large variation in the breeding systems (sexual, apomictic and sterile plants were found in this country, sometimes even within a single hybrid swarm; Krahulcová et al. 2009, Rosenbaumová & Krahulec 2015). Because of frequent misidentifications, the map is based mainly on examined herbarium specimens, which have been supplemented with selected literature records by botanists familiar with this species.

Pilosella glomerata (Fig. 61)

Pilosella glomerata is regarded as a fixed hybridogenous species between *P. caespitosa* and *P. cymosa*, combining morphological characters of both. It is distributed in central, northern and eastern Europe, extending westwards to the Rhine valley in western Germany and north-eastern Switzerland, southwards to Austria, Slovakia and Romania (it is also reported from North Macedonia), and northwards to central Scandinavia, Finland

and European Russia (north to 55°N); the exact distribution in Asia is unclear, with the eastern limit likely running along the Yenisei river in eastern Siberia. It has been introduced into North America (Wilson et al. 2006). In the Czech Republic *P. glomerata* occurs in open habitats such as meadows, grassy slopes, pastures, disturbed places along roads and paths and railway stations. It usually grows on moderately humid to dry, slightly acidic to slightly basic soils that are usually moderately rich in nutrients. *Pilosella glomerata* is scattered in the montane belt of the Šumava Mts and high Sudetes (the Krkonoše Mts, Hrubý Jeseník Mts and Mt Králický Sněžník) and in southern Bohemia, and is rare in or nearly absent from the Carpathian mountains in eastern Moravia. It is also rare in or nearly absent from warm lowlands and warm and dry hilly areas. Many of the records in the literature might be erroneous and based especially on misidentification of *P. caespitosa* or *P. cymosa*. The map is therefore based on examined herbarium specimens and field records from botanists familiar with these species. *Pilosella glomerata* is classified as of lower risk – near threatened in this country (Grulich 2012).

Pilosella leptophyton (Fig. 62)

Pilosella leptophyton is a species morphologically occupying a position between *P. officinarum* and *P. bauhini*, being more closely related and thus more similar to the latter. It is distributed throughout central, southern and south-eastern Europe, extending westwards to the Rhine valley in western Germany, northwards to central Germany, eastwards to the Dniester river basin in Ukraine and to Anatolia, and southwards to Italy, Croatia and Bulgaria (Chrtek 2004). In the Czech Republic *P. leptophyton* occurs in open habitats such as dry and semi-dry disturbed grasslands, grassy and stony slopes, railway stations, road verges and ruderal and semi-ruderal grasslands in settlements, less often in thermophilous oak forests. It usually grows on shallow, slightly acidic to basic, dry to moderately humid soils that are poor to moderately rich in nutrients. *Pilosella leptophyton* is mainly found in warm and moderately warm hilly landscapes in north-western, central and eastern Bohemia, and central, southern and eastern Moravia. In Moravia it also tends to spread into higher elevations, reaching its elevational maximum at about 700 m in the Hostýnské vrchy Mts. The gaps on the map in warm and dry areas might be partly due to under-recording rather than true absences. *Pilosella leptophyton* is less frequent than *P. brachiata*, a hybridogenous taxon originating from the same combination of parental species (see above). It occurs mostly together with at least one of the parental species and displays both sexual and apomictic mating systems. Misidentifications in herbaria are frequent and the map is thus based on examined herbarium specimens only. In the Czech flora *P. leptophyton* is considered as of lower risk – near threatened (Grulich 2012).

Pilosella leucopsilon (Fig. 59)

Pilosella leucopsilon is distributed in southern, central and south-eastern Europe, in Anatolia, the Caucasus Mts and north-western Iran. Its western distributional limit runs through Bavaria and Italy, in the north its range reaches central Moravia, Slovakia and Crimea (Bräutigam & Knapp 1976). In the Czech Republic it occurs in short, often slightly but regularly disturbed grasslands, less often in thermophilous oak forests and open-canopy pine forests. Soils are dry to moderately or intermittently humid, slightly

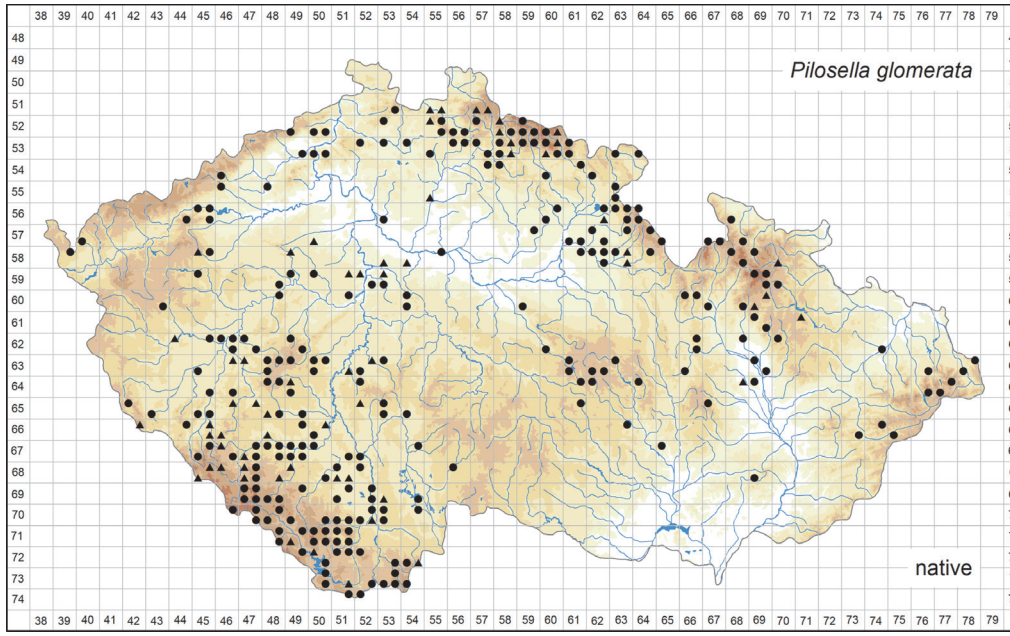

Fig. 61. – Distribution of *Pilosella glomerata* in the Czech Republic: ● occurrence documented by herbarium specimens (249 occupied quadrants), ▲ occurrence based on other records (62 quadrants). Prepared by Jindřich Chrtek Jr. & Olga Rotreklová.

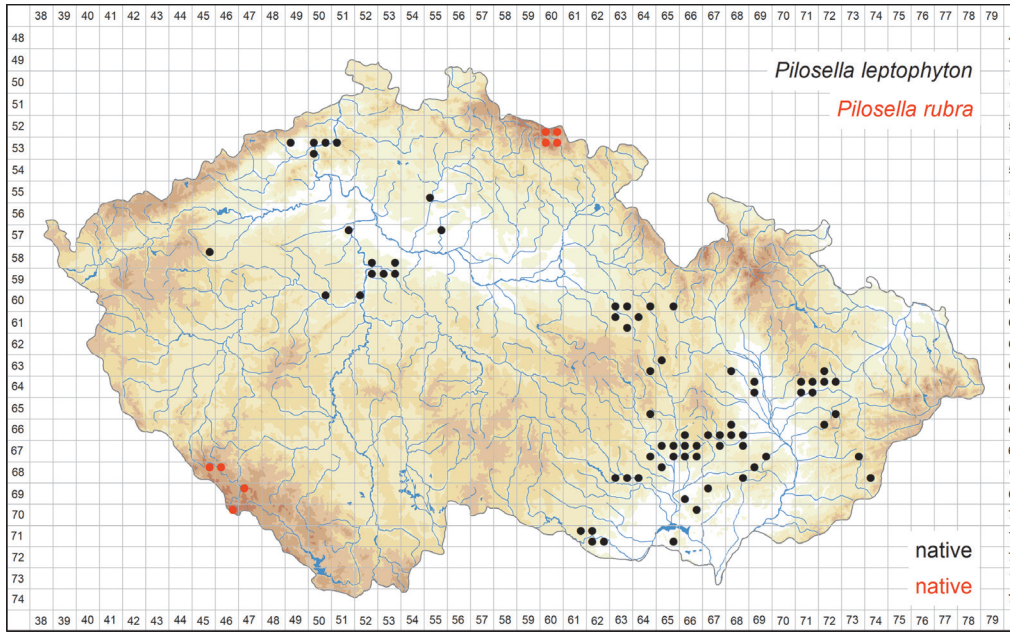

Fig. 62. – Distribution of *Pilosella leptophyton* (71 occupied quadrants) and *P. rubra* (8 occupied quadrants) in the Czech Republic. Prepared by Olga Rotreklová & Jindřich Chrtek Jr. (*P. l.*) and Jindřich Chrtek Jr. & Olga Rotreklová (*P. r.*).

acidic to basic, poor to moderately rich in nutrients. In this country *P. leucopsilon* is confined to southern, south-eastern and central Moravia. Several localities are concentrated in the south-western part of the Bílé Karpaty Mts and in the Dúbrava forest near the town of Hodonín. Occurrences outside this area are very rare. Several localities are situated in the deforested parts of the warm and dry hilly area between the cities of Brno and Olomouc and the town of Hodonín, a few outposts are known in the foothills of the Českomoravská vrchovina highlands west of Brno and in the karst area of Moravský kras north of Brno. The literature record from the vicinity of the town of Znojmo that is not documented by a herbarium specimen may refer to *P. officinarum*. There are also two specimens allegedly collected in the Pavlovské vrchy hills and near the village of Sedlec in southernmost Moravia. These specimens might have resulted from labelling mistakes, because such occurrences in these well-explored areas were neither reported nor documented by earlier herbarium specimens. On the other hand, both sites correspond well with the ecological requirements of the species and are situated inside of its geographical range at the northern margin of the Pannonian Basin. *Pilosella leucopsilon* is frequently confused with *P. officinarum*, which renders the undocumented records rather unreliable. It is classified as endangered in this country (Grulich 2012).

Pilosella officinarum (Fig. 63)

The range of *Pilosella officinarum* extends from the British Isles and the northern part of the Iberian Peninsula in the west across almost the whole of Europe (except the Arctic parts, Sardinia, Sicilia and the southern part of the Balkan Peninsula) eastwards to Anatolia, the Caucasus Mts and western Siberia. It has been introduced into North America, Patagonia and New Zealand (Hultén & Fries 1986, Meusel & Jäger 1992, USDA, NRCS 2020). In the Czech Republic *P. officinarum* grows in various dry grasslands, stony slopes, heathlands, rocky outcrops and open-canopy thermophilous oak and pine forests. Due to its low competitive ability, it tends to establish itself at open, sparsely vegetated sites. It prefers dry, permeable, acidic to slightly basic, non-calcareous and nutrient-poor soils. *Pilosella officinarum* is frequent throughout this country from lowlands to the montane belt, it has also been introduced into the subalpine belt, reaching its elevational maximum at about 1410 m in the Krkonoše Mts. Most of the gaps on the map are likely due to under-recording rather than true absences.

Pilosella onegensis (Fig. 64)

Pilosella onegensis occurs in eastern-central and eastern Europe, westwards extending to central Poland, the Czech Republic and Austria, southwards to Croatia, mountains of northern Greece and Bulgaria, northwards to southern Scandinavia (isolated occurrences up to the Polar Circle), southern Finland and north-western Russia; eastwards it extends to eastern Siberia and central Asia, with isolated occurrences known from Anatolia (Chrtek 2004). In the Czech Republic it is found in both mountain and lowland (often floodplain) meadows and in thermophilous oak forests. It usually grows on moderately humid or intermittently wet, acidic to slightly basic soils that are poor to moderately rich in nutrients. The distribution of *P. onegensis* in this country is still imperfectly known, partly due to under-recording and also to frequent misidentifications with *P. caespitosa* and *P. glomerata*. It is scattered in mountain meadows in the Hrubý Jeseník Mts and rare

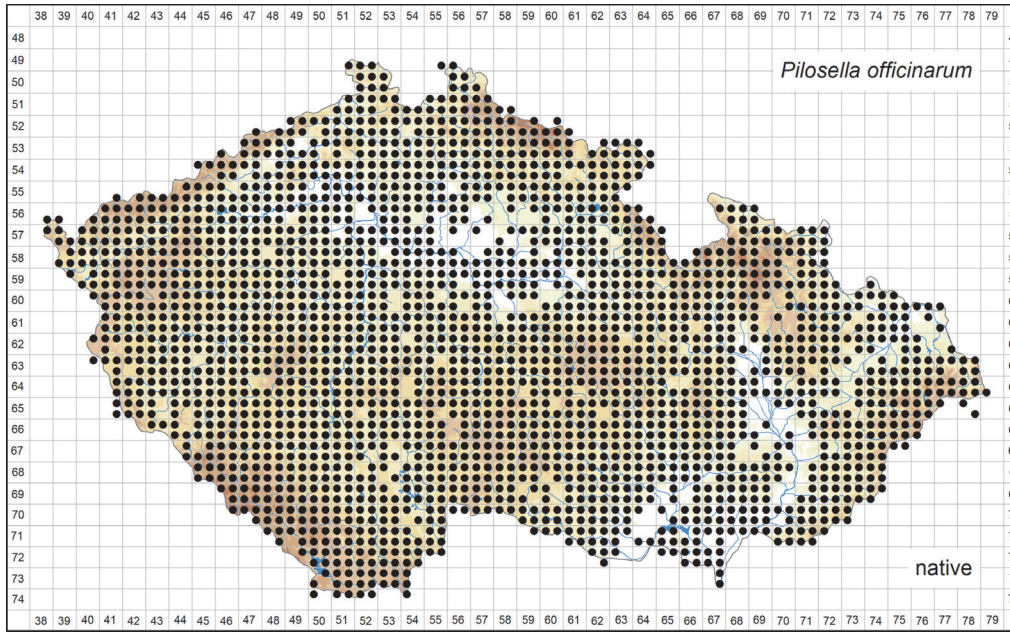

Fig. 63. – Distribution of *Pilosella officinarum* in the Czech Republic (2211 occupied quadrants). Prepared by Jindřich Chrtek Jr. & Olga Rotreklová.

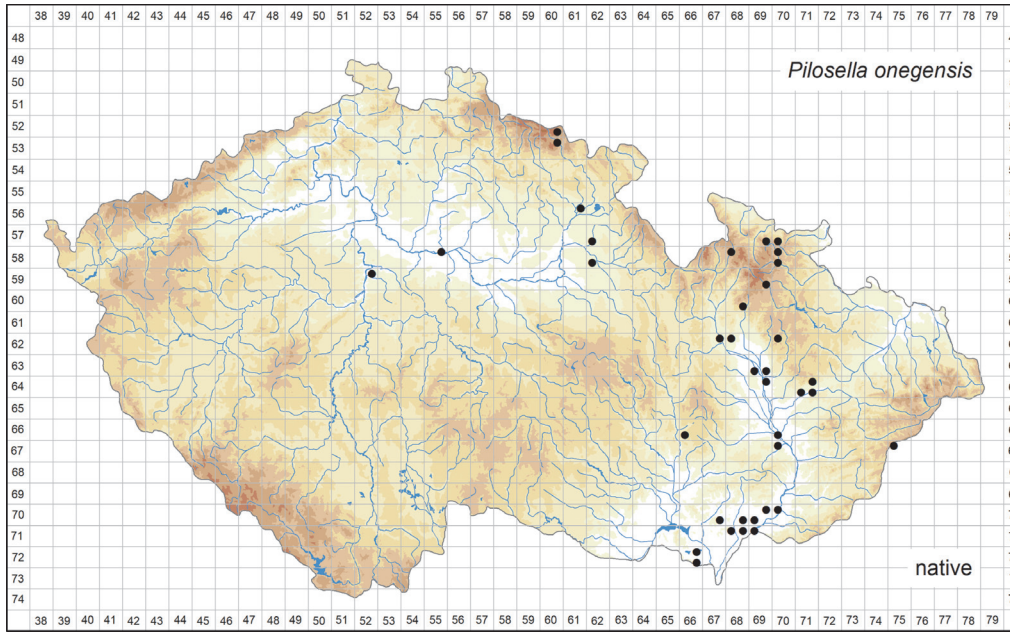

Fig. 64. – Distribution of *Pilosella onegensis* in the Czech Republic (37 occupied quadrants). Prepared by Olga Rotreklová & Jindřich Chrtek Jr.

in the Krkonoše Mts and Beskydy Mts. In the past it was collected at numerous sites in the Morava river basin between the towns of Mohelnice and Hodonín and in the Bečva river basin near the town of Lipník nad Bečvou; nowadays it still occurs in the Dúbrava forest near the town of Hodonín. It was also collected at three sites in eastern Bohemia, two sites in central Bohemia, near the town of Jedovnice north of the city of Brno and near the towns of Čejč, Valtice and Lednice in southern Moravia. The map is based on examined herbarium specimens supplemented with selected literature records by a few botanists familiar with the species. *Pilosella onegensis* may be more frequent than displayed in the map, especially in the Moravian Carpathians. This species is classified in this country as endangered due to its rarity (Grulich 2012).

Pilosella rubra (Fig. 62)

Pilosella rubra is a species morphologically occupying a position between *P. aurantiaca* and *P. officinarum*, being more closely related and thus more similar to the former. It is known from a few sites in the Alps, Germany, the Šumava Mts, the Krkonoše Mts and from the vicinity of the town of Braşov in Southern Carpathians (Chrtek 2004). In the Czech Republic *P. rubra* grows in mountain meadows, on moderately humid, acidic to slightly acidic soils that are poor to moderately rich in nutrients. Plants of *P. rubra* are either stabilized hybridogenous apomicts with a low level of residual sexuality or recent hybrids with a much lower degree of apomixis and higher degree of residual sexuality (Krahulcová et al. 2004, Krahulec et al. 2008). The first holds for plants from the Krkonoše Mts; their recent occurrences are scattered in meadows around the settlement of Pomezní Boudy, whereas in the past *P. rubra* was also recorded from the vicinity of the town of Pec pod Sněžkou and from one site at the Polish side of these mountains. Primary hybrids of the same parentage and morphologically identical with hybridogenous apomicts were discovered in the Šumava Mts in south-western Bohemia (Krahulec et al. 2008). *Pilosella rubra* in the Krkonoše Mts partly disappears during the course of succession following abandonment, as it requires grazing or other minor disturbances. It is classified as critically threatened due to its rarity (Grulich 2012).

Pilosella stoloniflora (Fig. 65)

Pilosella stoloniflora is a species morphologically occupying a position between *P. aurantiaca* and *P. officinarum*, being more closely related and thus more similar to the latter. It has a widely patchy distribution in European mountains reaching from the Alps in the west through the Šumava Mts, the Krkonoše Mts, the Carpathians and their foothills as far as Bosnia and Herzegovina; isolated occurrences are also in Germany, the Netherlands, Sweden and North America (Chrtek 2004). In the Czech Republic *P. stoloniflora* occurs in meadows, disturbed grasslands and along roads and paths. It is usually found growing on moderately humid, acidic to neutral non-calcareous soils that are poor or less often moderately rich in nutrients. Its distribution in this country is limited to the easternmost part of the Krkonoše Mts, the Šumava Mts between the towns of Železná Ruda and Hartmanice and a few localities elsewhere. Plants of *P. stoloniflora* from the Krkonoše Mts and Šumava Mts, differ from each other in their evolutionary histories, which is reflected in their ploidy levels. In both areas, there are recent hybrid, not stabilized types. In the Šumava Mts *P. stoloniflora* is a primary sexual hybrid between the two

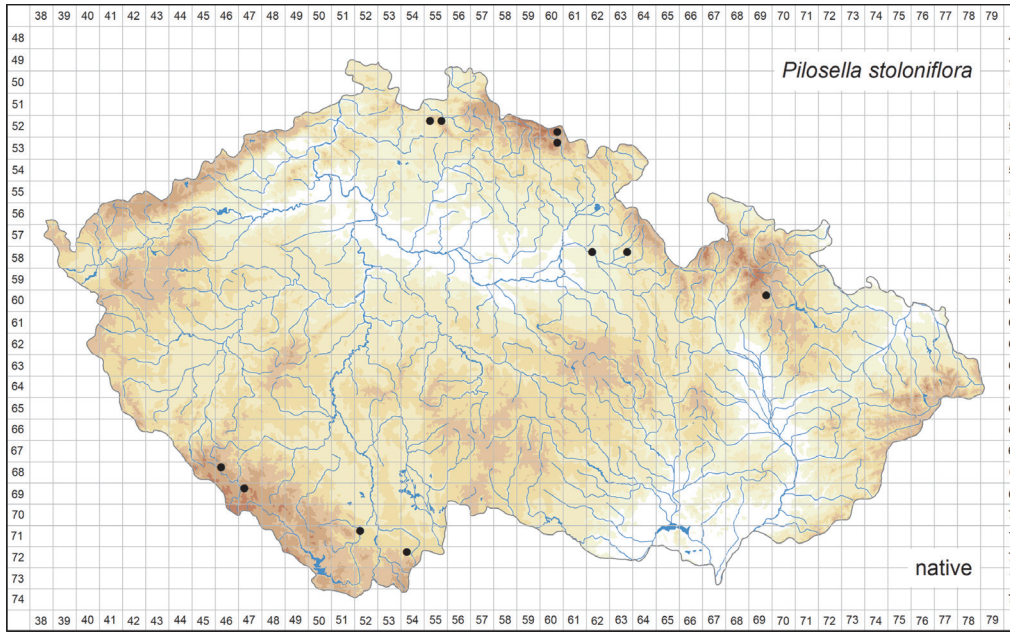

Fig. 65. – Distribution of *Pilosella stoloniflora* in the Czech Republic (11 occupied quadrants). Prepared by Jindřich Chrtek Jr. & Olga Rotreklová.

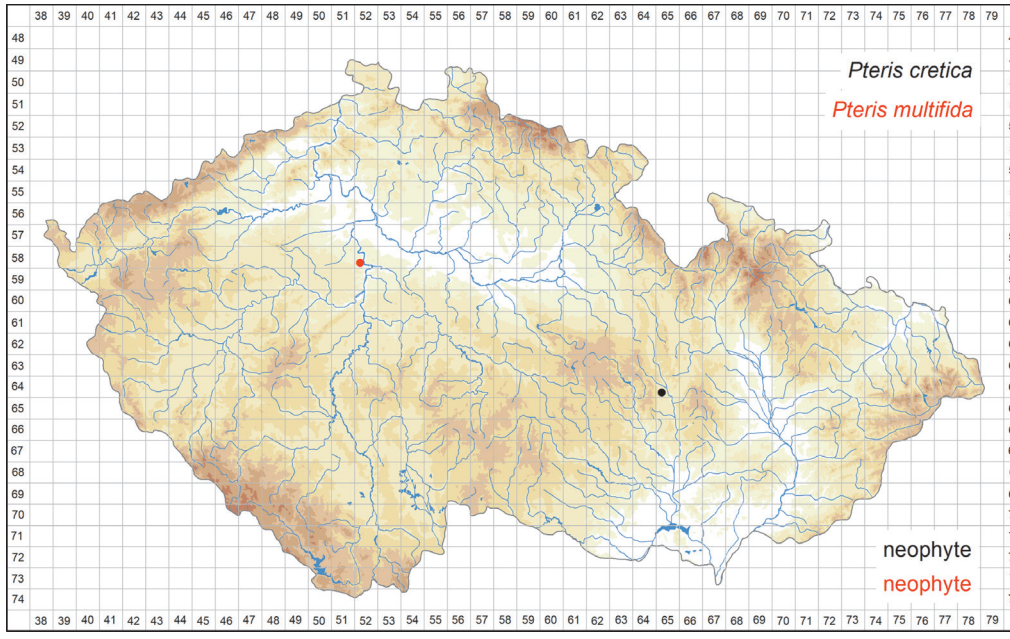

Fig. 66. – Distribution of *Pteris cretica* in the Czech Republic (1 occupied quadrant) and *P. multifida* in the Czech Republic (1 occupied quadrant). Prepared by Libor Ekrt.

tetraploid parents, *P. aurantiaca* (apomictic) and *P. officinarum* (sexual). In contrast, in the Krkonoše Mts the apomictic pentaploid *P. stoloniflora* is a product of a cross between hybridogenous *P. rubra* and *P. officinarum*, while the origin of apomictic hexaploids from this mountain is unclear (Krahulec et al. 2008). *Pilosella stoloniflora* disappears in the course of succession following abandonment (it requires grazing or other minor disturbance) and mulching of meadows and is therefore classified as endangered (Grulich 2012).

Pteris cretica (Fig. 66)

Pteris cretica belongs to a taxonomically difficult polyploid complex comprising diploid, triploid and tetraploid cytotypes with apomictic reproduction (Walker 1962, Saggoo & Kaur 2017). This species is sub-cosmopolitan and widely distributed in tropical and warm temperate regions almost throughout the world. Because it is commonly cultivated and appears to escape easily, its native range is difficult to identify. In Europe *P. cretica* is scattered in the (sub-)Mediterranean area reaching the northern limit of its distribution in north-eastern Spain, southern France, northern Italy, southernmost Switzerland and Greece (Dostál 1984). It is probably native only to the (sub-)Mediterranean area, while other occurrences may be plants escaped from cultivation (Bignall 1980, Keil et al. 2009). In the Czech Republic a single plant of *P. cretica* var. *albolineata* was discovered recently in an inner wall of the castle well in Letovice in central Moravia at a depth of about 3 m (Novák 2018). This plant apparently represents an escape, via spores, from cultivation. The stable moist microclimate inside the well enabled this shade-tolerant fern to survive. This new alien species of the Czech Republic should be considered as a casual neophyte.

Pteris multifida (Fig. 66)

Pteris multifida is a tetraploid ornamental fern with mixed (sexual and apomictic) mating strategies (Kawakami et al. 1995, Murakami et al. 1997). It is native to China and Japan. However, it is cultivated and sometimes escapes in other humid and warm parts of the world, e.g. Macaronesia and southern parts of North America (Jones 1955, Dostál 1984, Valentine & Moore 1993). In the Czech Republic it was recorded temporarily in 1998 in a moist and shaded part of a house wall in the city district of Dejvice in Prague (Ekrt 2011). The plants were destroyed during renovation work the year after their discovery. This occurrence represents an escape from cultivation enabled by light, wind-borne spores, followed by short-term survival in the man-made habitat. *Pteris multifida* is classified as a casual neophyte (Pyšek et al. 2012).

Spergula arvensis (Figs 67–70)

Spergula arvensis is an almost cosmopolitan species, being most frequent in Europe and eastern North America, while in the tropics it is confined to high elevations (Hultén & Fries 1986). It is probably native to southern parts of Europe and adjacent south-western Asia (Uotila 2001), whereas it has been introduced into North America and other parts of the world (Hartman & Rabeler 2005). In Europe it is distributed almost throughout the continent but it is rare in or absent from dry areas of the Mediterranean and the south-eastern parts as well as boreal north-eastern Europe (Jalas & Suominen 1983). Four taxa

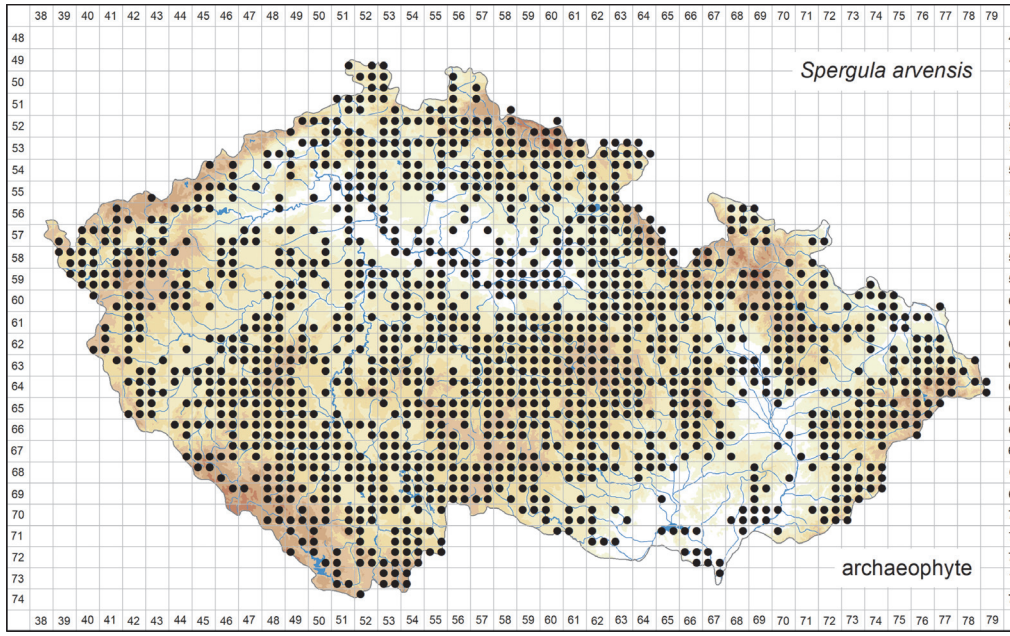

Fig. 67. – Distribution of *Spergula arvensis* in the Czech Republic (1447 occupied quadrants). Prepared by Zdeněk Kaplan.

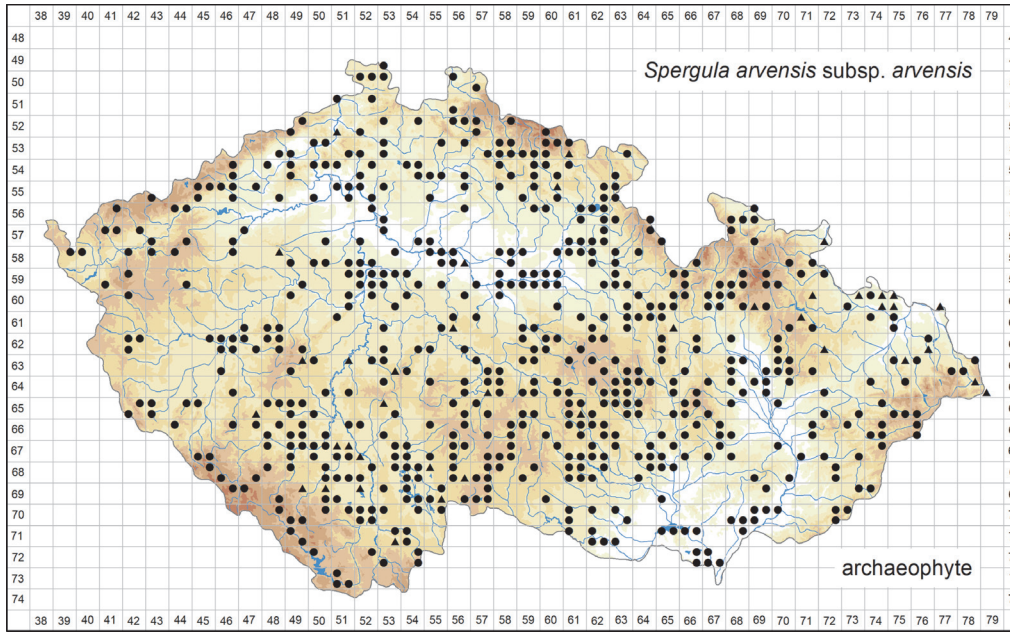

Fig. 68. – Distribution of *Spergula arvensis* subsp. *arvensis* in the Czech Republic: ● occurrence documented by herbarium specimens (600 quadrants), ▲ occurrence based on other records (39 quadrants). Prepared by Zdeněk Kaplan.

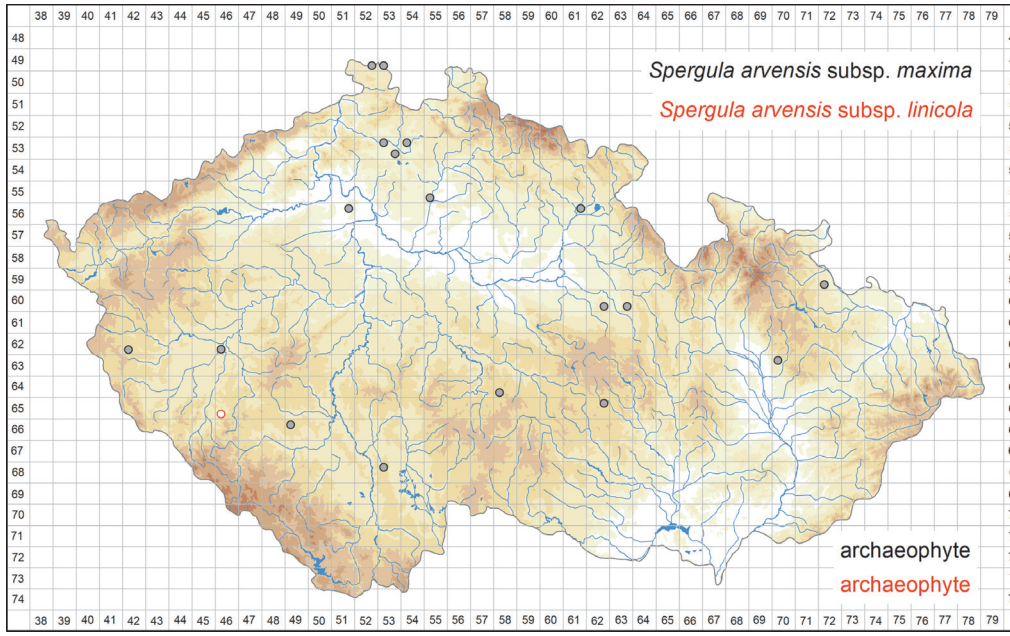

Fig. 69. – Distribution of *Spergula arvensis* subsp. *linicola* (◍ pre 2000 records only: 1 quadrant) and *S. a.* subsp. *maxima* (◍ pre 2000 records only: 18 quadrants) in the Czech Republic. Prepared by Zdeněk Kaplan.

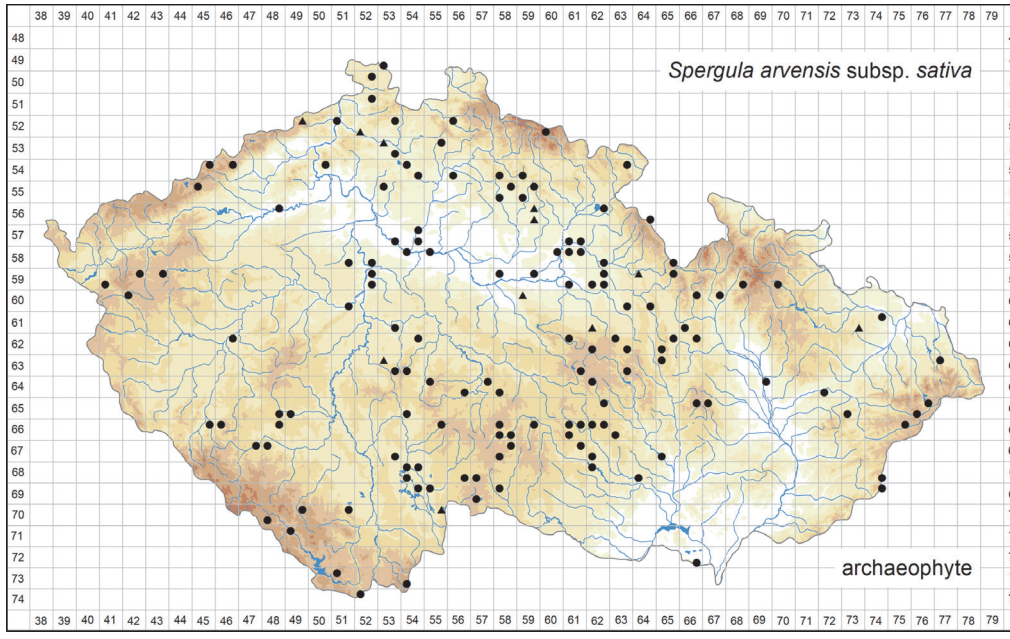

Fig. 70. – Distribution of *Spergula arvensis* subsp. *sativa* in the Czech Republic: ● occurrence documented by herbarium specimens (139 quadrants), ▲ occurrence based on other records (11 quadrants). Prepared by Zdeněk Kaplan.

are sometimes distinguished, mostly at the subspecies level, based on seed size and the absence or presence of papillae on the seed-coat: subsp. *arvensis*, subsp. *linicola*, subsp. *maxima* and subsp. *sativa* (Uotila 2001, Jäger & Werner 2002, Buttler & Hand 2008, Danihelka et al. 2012, Danihelka 2019b). Although they probably do not deserve this rank and may be better recognized as varieties, the established classification is followed here. In Europe subsp. *arvensis* is more frequent in its southern and eastern parts and subsp. *sativa* more common in the north (New 1961, Uotila 2001). The distributions of the two taxa that have evolved as adaptations to growing in flax fields, subsp. *linicola* and subsp. *maxima*, follow the distribution of flax cultivation (Uotila 2001).

In the Czech Republic *S. arvensis* subsp. *arvensis* grows mainly in arable fields and fallows, less frequently along roads, on soil heaps, at rubble sites, railway stations, in sand pits, at edges of pine forests and on exposed fishpond littorals. The soils are mostly acid, often nutrient-poor, sandy to loamy. This is the most frequent subspecies of *S. arvensis* in this country. It is widespread, mainly at middle elevations, but rare in or absent from the areas with mineral-rich soils in north-western Bohemia and southern Moravia (Fig. 68). *Spergula arvensis* subsp. *sativa* used to be grown for forage on arable fields in the past and now occurs in similar habitats as subsp. *arvensis*, but is markedly less frequent, with the majority of records situated in eastern Bohemia and the Česko-moravská vrchovina highlands (Fig. 70). The other two subspecies occurred as weeds in flax fields, and they were probably also occasionally cultivated in the past. *Spergula arvensis* subsp. *maxima* was recorded at about 18 sites outside cultivation (Fig. 69), with the last observation in 1952, while *S. a.* subsp. *linicola* was documented only once outside cultivation, namely at the village of Otín in south-western Bohemia in 1882 (Fig. 69). *Spergula arvensis* subsp. *arvensis* and subsp. *sativa* are classified as naturalized archaeophytes, while subsp. *linicola* and subsp. *maxima* as casual archaeophytes (Pyšek et al. 2012) and nationally extinct (Grulich 2012). The maps of subsp. *arvensis* and subsp. *sativa* are based on examined herbarium specimens and selected field and literature records by reliable botanists, the maps of subsp. *linicola* and subsp. *maxima* include only spontaneous occurrences documented by examined herbarium specimens. The records used for the maps of subspecies, the records from specimens without seeds that could not be identified to subspecies, and all available literature and database records were summarized to produce a map for the entire species (Fig. 67).

Spergula morisonii (Fig. 71)

Spergula morisonii is native to Europe, where it occurs from the Iberian Peninsula in the west through France, the Benelux countries and central Europe eastwards to Belarus and central Ukraine, northwards reaching central Sweden and southern Finland. It also occurs in Algeria in northern Africa (Jalas & Suominen 1983, Hultén & Fries 1986) and has been introduced into the eastern coast of the USA (Hartman & Rabeler 2005). In the Czech Republic *S. morisonii* grows in open vegetation in disturbed sandy habitats such as sand dunes, sand pits, edges of sandy tracks and open pine forests; the sand in such habitats is acidic, free of calcium carbonate, nutrient-poor and has very low humus content. This species also occurs on thin soil on barren rock outcrops. It is mainly distributed in the northern half of Bohemia, particularly on sandy terraces of the Labe and Orlice rivers and in sandstone areas in northern Bohemia. Isolated areas of occurrence are on sand in the

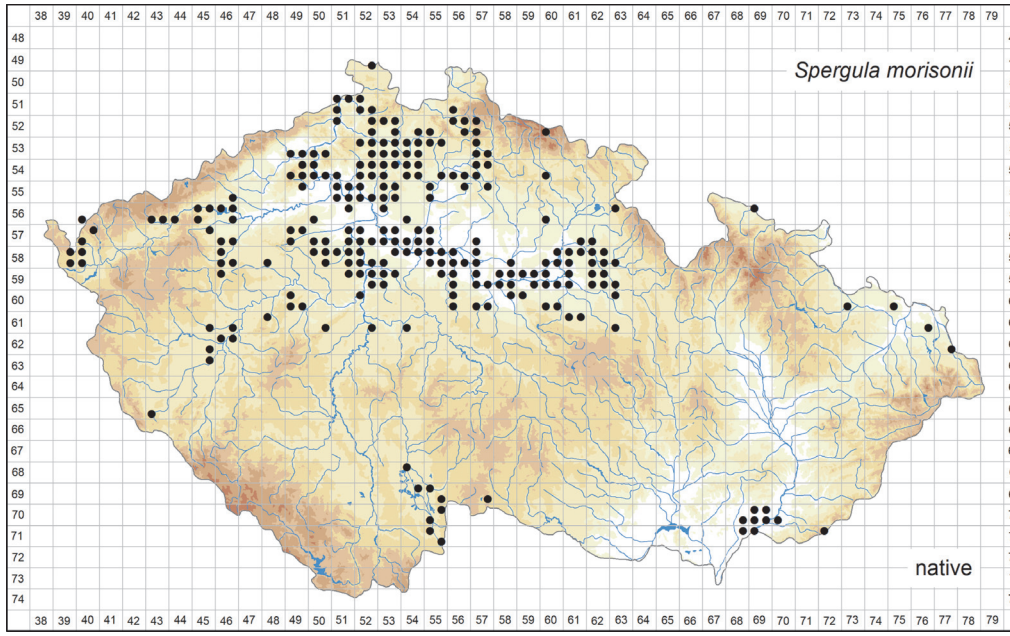

Fig. 71. – Distribution of *Spergula morisonii* in the Czech Republic (250 occupied quadrants). Prepared by Zdeněk Kaplan.

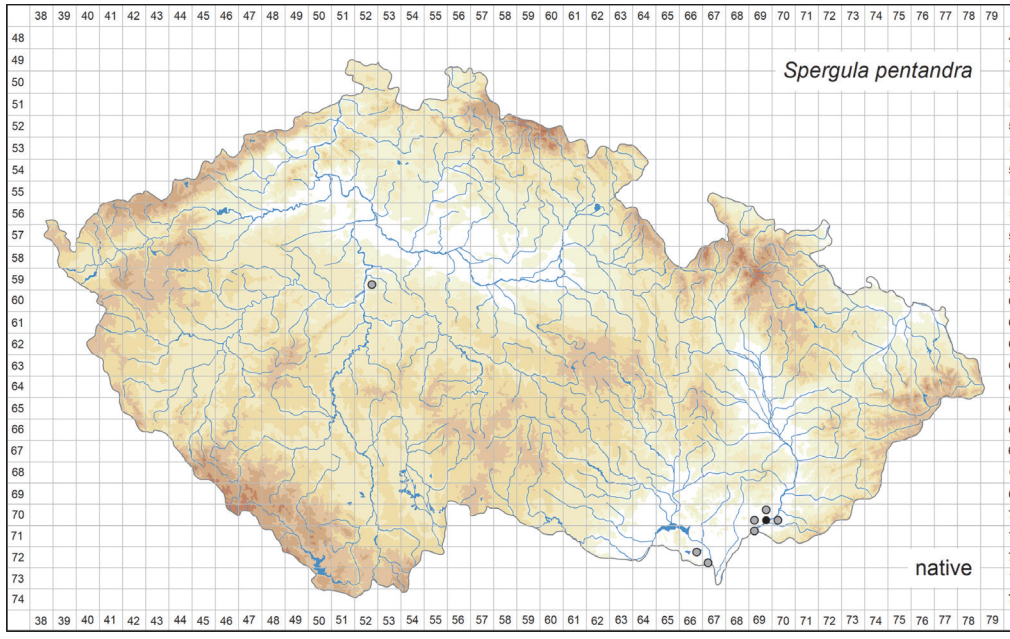

Fig. 72. – Distribution of *Spergula pentandra* in the Czech Republic: ● at least one record in 2000–2020 (1 quadrant), ● pre 2000 records only (7 quadrants). Prepared by Zdeněk Kaplan.

Třeboňská pánev basin in southern Bohemia (where it was first recorded in 1984) and between the towns of Hodonín and Moravský Písek in the Morava river basin in southern Moravia. Elsewhere it is rare and only casual. *Spergula morisonii* is classified as of lower risk – near threatened (Grulich 2012).

Spergula pentandra (Fig. 72)

Spergula pentandra is distributed mainly in south-western Europe, scattered in central Europe eastwards to Poland and Hungary, and rare in southern Europe eastwards to the Balkan Peninsula; it also occurs in Anatolia, the Canary Islands and northernmost Africa (Jalas & Suominen 1983, Marhold 2011). It has been introduced into the eastern USA and Australia (Hartman & Rabeler 2005). In the Czech Republic *S. pentandra* grows on open acidic nutrient-poor sands with very low humus content in sandy areas along the lower stretches of the Dyje and Morava rivers in southernmost Moravia. It has been recorded from sand dunes in a treeless fire-prevention strip along the railway between the towns of Hodonín and Veselí nad Moravou, but now it occurs there only in the section near the town of Bzenec. In the past it was also recorded at two sites near the town of Břeclav. A single occurrence from Bohemia is documented by a herbarium specimen from a ravine at Modřany, which is now a suburb of Prague. It is classified as critically threatened (Grulich 2012).

See www.preslia.cz for Electronic Appendices 1–83

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Souhrn

Devátá část ze série prací věnovaných rozšíření cévnatých rostlin v České republice obsahuje síťové mapy a komentáře k 83 taxonům rodů *Aphanes*, *Buglossoides*, *Calamagrostis*, *Carex*, *Cerastium*, *Chenopodium*, *Corynephorus*, *Crypsis*, *Dorycnium*, *Equisetum*, *Marrubium*, *Montia*, *Oxalis*, *Pilosella*, *Pteris* a *Spergula*. Základem jsou údaje získané excerpcí herbářů a literatury, terénní zápisy a databázové údaje, které prověřili taxonomičtí experti. Studované rostliny pokrývají široké spektrum taxonomických a ekologických skupin. Vzácné druhy specializované na úzké spektrum stanovišť zastupuje *Calamagrostis pseudophragmites*, vázaná na štěrkovité náplavy a břehy řek, *Calamagrostis stricta*, druh slatinných luk a přechodových rašelinišť, jakož i obligátní halofyt *Crypsis aculeata*. I mnohé další mapované druhy patří mezi ohrožené rostliny. Dva z poddruhů *Spegula arvensis*, konkrétně subsp. *linicola* and subsp. *maxima*, patří mezi rostliny u nás vyhynulé. Druh *Cerastium subtetrandrum*, nalezený v roce 2017 na dálnici D5 u vsi Mlýnec v západních Čechách a následně na dalších místech ve středních a východních Čechách, je zde uveden jako nově zaznamenaný nepůvodní druh pro Českou republiku. Vymapovány jsou i další tři druhy, které u nás byly zjištěny teprve nedávno: *Calamagrostis rivalis* byla donedávna považována za endemit Saska, roste však na Ohři v západních Čechách. Jako původní, ale přehlížený taxon byla na několika lokalitách na východní Moravě rozpoznána také *Carex depressa* subsp. *transsilvanica*. Naopak *Pteris cretica* je u nás nepůvodní; jediná rostlina byla nalezena ve studni zámku v Letovicích na střední Moravě, kam se patrně dostala přenosem spor z kultury. Celkový obraz rozšíření zpracovávaných taxonů v ČR poskytují mapy; konkrétní floristické údaje zachycující frekvenci výskytu v různých oblastech a v různých obdobích, a dokumentující ústup nebo naopak šíření některých druhů, jsou uložené v databázi Pladias a dostupné v elektronických přílohách. Každou mapu doprovází 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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