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Distributions of vascular plants in the Czech Republic. Part 12

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Abstract: The twelfth part of the series on the distributions of vascular plants in the Czech Republic includes grid maps of 105 taxa in the genera *Androsace*, *Anthemis*, *Aristolochia*, *Berteroa*, *Celtis*, *Cnidium*, *Cynodon*, *Descurainia*, *Echium*, *Erechtites*, *Euphorbia*, *Homogyne*, *Laserpitium*, *Linaria*, *Pinus*, *Rosa*, *Sesleria*, *Spiraea* and *Verbena*. These maps were produced by taxonomic experts based on examined herbarium specimens, literature and field records. Both native and alien species are represented. In addition to widespread plants such as *Berteroa incana*, *Descurainia sophia*, *Echium vulgare*, *Euphorbia cyparissias*, *Linaria vulgaris* and *Pinus sylvestris*, plants that are rare or have more localized distributions were also studied, with 39 of them being on the national Red List. The highest rates of decline, smallest population sizes and the highest degree of population fragmentation are found in critically threatened species, represented by *Androsace septentrionalis*, *Echium maculatum*, *Euphorbia salicifolia*, *Laserpitium archangelica* and *Sesleria uliginosa*. Two species, *Androsace maxima* and *Linaria arvensis*, have been extirpated from this country; however, the former survives in a university botanical garden where it has become naturalized. With 13 archaeophytes and 41 neophytes among the mapped taxa, over a half of them are alien to the Czech Republic. Two of the alien species have become invasive. *Pinus strobus* has considerable physical impact on ecosystems particularly in sandstone landscapes, while *Erechtites hieraciifolius* started to be common mainly in forest clearings, with this spread being facilitated by the increasing extent of this habitat in the landscape due to the recent bark beetle outbreak. Another species that regionally started to spread intensively during recent decades is *Cynodon dactylon*. Five species were identified as new neophytes for the Czech Republic. Of these, *Aristolochia macrophylla* and *Pinus contorta* escaped from cultivation, *Euphorbia nutans* and *Verbena incompta* were unintentionally imported with various commodities, whereas *Linaria dalmatica* was introduced through the combination of intentional sowing and spontaneous escape from cultivation. Important revisions and adjustments are provided for taxonomically difficult and species-rich genera such as *Euphorbia*, *Pinus*, *Rosa*, *Spiraea* and *Verbena*. 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 the Supplementary materials. The maps are accompanied by

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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 records, vascular plants

Introduction

The mapping of the distributions of plants in the Czech Republic was initiated within the PLADIAS project in 2014. To date, 11 papers have been published (Kaplan et al. 2015, 2016a, b, 2017a, b, 2018a, b, 2019b, 2020, 2021, 2022), altogether containing 992 grid-based distribution maps of vascular plants and accompanying commentaries. The records were assembled, critically evaluated and sorted by a team of taxonomic experts and are used not only for producing the maps but also for follow-up studies such as analyses of the main geographic patterns in selected plant characteristics (Chytrý et al. 2021). New taxonomic assessment of herbarium specimens (e.g. Danihelka 2019, Danihelka & Hlisnikovský 2021a, b, Kaplan 2014a, b, 2020, Kaplan et al. 2021, Prančl 2015, this study), identification of escaped or introduced plants discovered during fieldwork (e.g. Danihelka & Sedláček 2017, Danihelka et al. 2017, 2020, Dřevojan & Letz 2016, Kaplan 2021, Kaplan et al. 2020, Řepka et al. 2021) and other data accumulated within the revision of the taxonomic diversity and mapping plant distributions in this country were also used in the recently published third edition of the Catalogue of alien plants of the Czech Republic (Pyšek et al. 2022). Going forward, this synthesis will be the main reference source for classification of alien plants.

While the eleventh instalment of this mapping series was being prepared for publication, maps for a further 105 taxa were finished and these are included in this paper. The total number of mapped taxa in this project has thus surpassed one thousand, accounting for about 30% of the flora of the Czech Republic, which comprises 3,713 species and subspecies (Kaplan et al. 2019a).

Over a third of the taxa mapped in this paper are on the national Red List (Grulich 2012), including the critically threatened species *Androsace maxima*, *A. septentrionalis*, *Echium maculatum*, *Euphorbia salicifolia*, *Laserpitium archangelica* and *Sesleria uliginosa*. However, since the publication of this last inventory, the only extant population of *Androsace maxima* has vanished, and this species has been extirpated from this country. *Linaria arvensis* has not been observed for more than two decades, and this archaeophyte is therefore classified as missing, probably also being extirpated. In contrast to the earlier opinions, *Rosa arvensis* is considered alien to this country here, and therefore its inclusion on the national Red List is not supported. An additional 10 taxa are endangered, namely *Anthemis cotula*, *Cnidium dubium*, *Euphorbia angulata*, *E. falcata*, *E. lucida*, *E. seguieriana*, *Laserpitium prutenicum*, *Pinus uncinata*, *Rosa majalis* and *R. spinosissima*. The remaining 22 species are classified in other categories, with lower rates of decline and rarity.

Over half the mapped taxa are alien to the Czech Republic. They include 13 archaeophytes and 41 neophytes. While most of them are casuals that have been detected at a single

site or only a few sites, others have become widespread and naturalized. Two species of North American origin have even become invasive. *Pinus strobus* has been commonly cultivated in this country since the late 18th century and became invasive in the late 20th century, particularly in sandstone landscapes, with considerable physical impact on ecosystems (Hadincová et al. 1997, 2007, Pyšek et al. 2012). For more than a century after its first discovery in this country, *Erechtites hieraciifolius* remained rare. However, it started to spread rapidly in the early 2000s and is now frequent mainly in forest clearings. Consequently, it has recently been reclassified from naturalized to invasive (Kaplan 2019a, Pyšek et al. 2022). Another alien species, *Cynodon dactylon*, has regionally started to spread intensively in southern Moravia during recent decades.

During the revisions of the diversity of the target genera for this paper, five species were identified as new neophytes for this country. *Aristolochia macrophylla* and *Pinus contorta* escaped from cultivation. *Euphorbia nutans* was unintentionally introduced, once with imported soya beans, the second time with bauxite. *Verbena incompta* was accidentally introduced with sheep wool from South America. The recorded occurrences of *Linaria dalmatica* are due partly to intentional sowing of seeds of this ornamental plant, and partly to spontaneous escapes from cultivation.

Valuable revisions are provided for taxonomically difficult groups, for which reliable data on distributions have not been available, and for which the literature and database records have been contaminated with numerous misidentifications. These include the *Pinus mugo* complex, which contains ecologically highly specialized taxa often with restricted distributions, sometimes prone to hybridization in contact zones. The taxonomy of the alien *Spiraea* is difficult due to the occurrence of garden cultivars and spontaneous hybridization in secondary areas. *Rosa* is taxonomically complex due to its complicated evolutionary history, which involves hybridization and polyploidy, and millennia of its use in horticulture having given rise to numerous cultivars often of unknown origin, sometimes introgressing with the wild species. This has resulted in high polymorphism and obscures species delimitation. Critical examination of herbarium specimens was important also in the species-rich genus *Euphorbia*. Many of the species of these genera were mapped based solely on examined herbarium specimens and our own field records in order to provide a reliable picture of their distributions.

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. BRA, BRNL, BRNM, BRNU, CB, CBFS, CESK, CHEB, CHOM, DR, FMM, GM, GOET, HOMP, HR, JE, KHMS, L, LIM, LIT, MJ, MMI, MP, MSTR, MZ, NJM, OL, OLM, OMJ, OMP, OP, OSM, OVMB, PL, PR, PRA, PRC, ROK, ROZ, SAV, SOB, SOKO, SUM, VM, VYM, W, WU and ZMT (acronyms follow NYBG 2022), 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, Chytrý et al. 2021), 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, Schönfelder 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 Supplementary materials S1–S85. 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. 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

Androsace elongata (Fig. 1)

Androsace elongata occurs mainly in the Pontic-Pannonian area in central and south-eastern Europe; with isolated occurrences it extends westwards to the Pyrenees, southwards to Sicily and the Balkan Peninsula, and also occurs in the Caucasus Mts (Meusel et al. 1978). It has been introduced to Sweden and Finland (Marhold 2011c). In the Czech Republic *A. elongata* grows mainly in various types of disturbed open habitats such as bare places in dry grasslands, rocky slopes, road margins, railway stations and embankments, stony fallow land, vineyards, abandoned quarries and sand pits; in the past it also grew on margins of arable fields. It is mostly found on shallow, permeable, often rocky or sandy, nutrient-poor soils and on man-made gravel deposits. *Androsace elongata* is a competitively weak annual plant that is found in places in early stages of succession and in disturbed sites, but vanishes soon with succession of stronger competitors. In this country it is mainly found in dry, warm lowlands and hilly areas in north-western and central Bohemia, and south-western and southern Moravia, extending from there northwards to the western environs of the city of Olomouc. Isolated occurrences, mostly only temporary introductions, have been documented elsewhere at middle elevations in this country. Many populations, particularly in central Bohemia, have vanished due to land-use

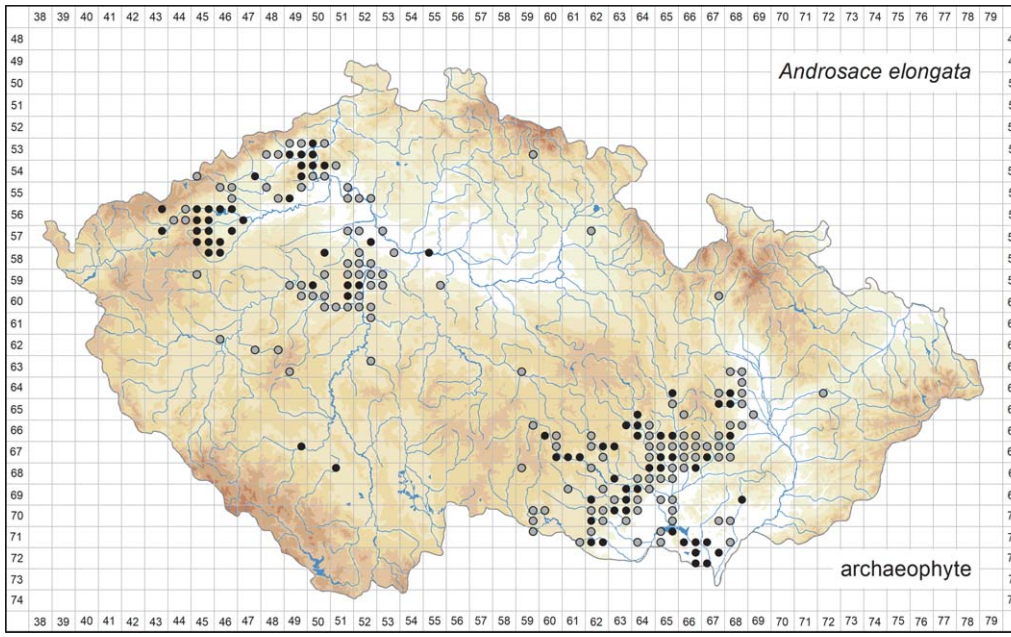

Fig. 1. Distribution of *Androsace elongata* in the Czech Republic: ● at least one record in 2000–2022 (78 quadrants), ● pre-2000 records only (130 quadrants). Prepared by Zdeněk Kaplan.

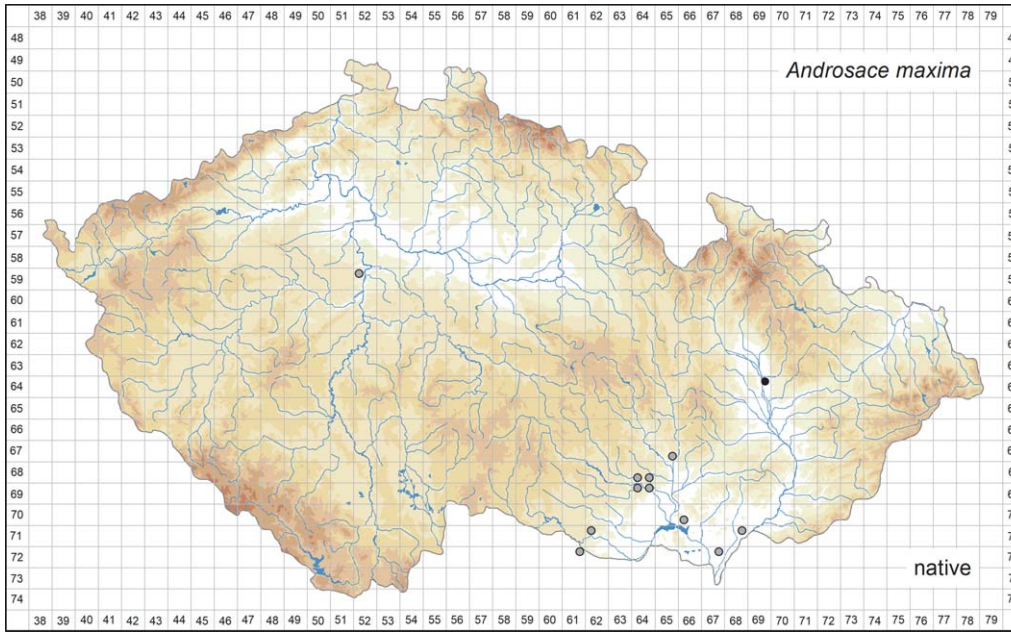

Fig. 2. Distribution of *Androsace maxima* in the Czech Republic: ● at least one record in 2000–2022 (1 quadrant), ● pre-2000 records only and/or extirpated occurrences (11 quadrants). Prepared by Zdeněk Kaplan.

changes and eutrophication. The status of *A. elongata* in the Czech Republic is difficult to assess, at the moment this species is classified as a naturalized archaeophyte (Pyšek et al. 2022) and as vulnerable (Grulich 2012).

Androsace maxima (Fig. 2)

Androsace maxima is distributed mainly in the Mediterranean area, south-eastern Europe, south-western and central Asia and southern Siberia as far as Lake Baikal. In Europe it has a disjunct distribution, extending northwards to north-eastern France, the Czech Republic, northern Ukraine and the middle Volga river basin in Russia, with sporadic secondary occurrences in more northern areas (Meusel et al. 1978). In the Czech Republic *A. maxima* was recorded in pioneer communities on trampled road margins, in disturbed grasslands along roads and among arable fields, and on railway embankments. It used to grow mainly on heavy, rather dry soils rich in calcium and other nutrients. This species was recorded from about 13 sites in southern Moravia northwards to the city of Brno. The single record from Prague, from the mid-19th century, apparently represented an escape within a botanical garden. This species has become naturalized also in the university botanical garden in the city of Olomouc in central Moravia where it was grown in the first half of the 20th century (Bábková Hrochová et al. 2020). *Androsace maxima* has declined since the 1950s with land-use changes and intensification of agriculture. The last documented find in a rural landscape is dated to 1968 and comes from the vicinity of the town of Ivančice in south-western Moravia. Consequently, *A. maxima* was considered extirpated from the Czech Republic (e.g. Holub et al. 1979, Kovanda 1992, Holub & Procházka 2000). In 2001 a small population was found on a railway embankment in the Hrušky railway station in southern Moravia, which was disturbed during construction work on the railway (Šumberová 2004). Consequently, this species was reclassified as critically threatened (Grulich 2012). However, this small population vanished by 2008 due to encroachment by scrub and no extant occurrence in the wild is known in this country (Kaplan 2019b). The only occurrence that still exists is in the Olomouc botanical garden.

Androsace septentrionalis (Fig. 3)

Androsace septentrionalis is a circumpolar species occurring in temperate to arctic zones in Eurasia and North America. In Europe it is distributed mainly in its northern and eastern parts, extending with isolated occurrences to central Europe, the Alps, the Carpathians and Sicily, it is also found in the Caucasus Mts (Meusel et al. 1978, Hultén & Fries 1986). In the Czech Republic *A. septentrionalis* mostly grows in open sandy habitats with low vegetation cover such as sand dunes, edges of sandy fields and roads, fallows, open-canopy pine forests and abandoned sand pits, but it has also been recorded on stony slopes and rock outcrops, as well as on railway embankments. It is mostly found on permeable, basic to neutral, sandy or gravelly substrates with moderate humus content but free of calcium carbonate. In this country it is almost entirely restricted to warm north-western to central Bohemia, where it has been recorded mainly on sands in the Labe river basin, and in adjacent hilly landscapes and deep river valleys with exposed rock surfaces, mainly in the České středohoří Mts and along the lower stretches of the Vltava river. In Moravia it has been found at only two sites in its southern part. *Androsace septentrionalis* no longer occurs at the majority of these sites due to eutrophication followed by succession, changes

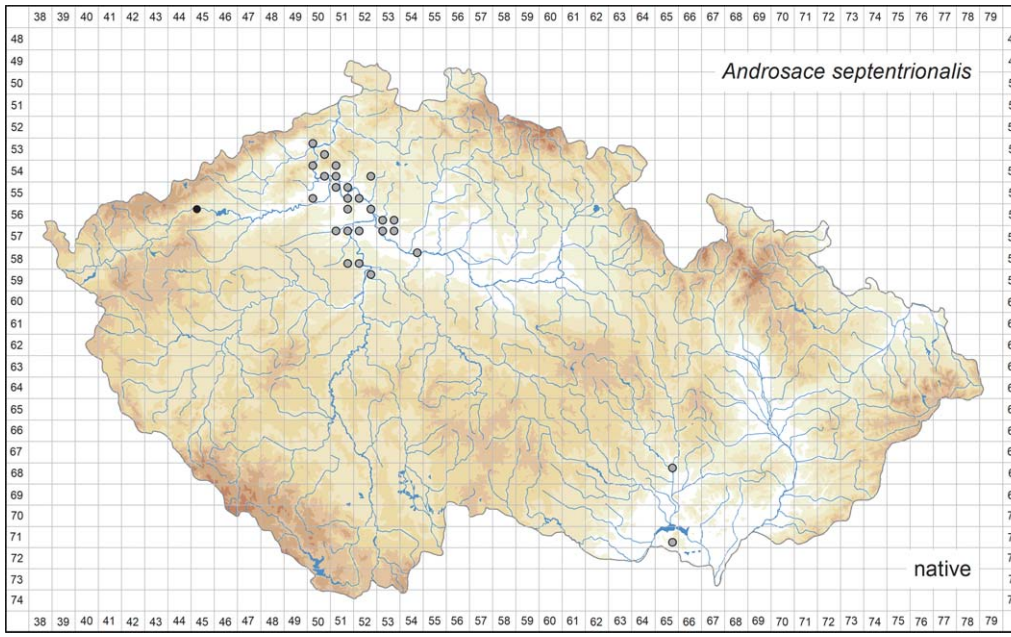

Fig. 3. Distribution of *Androsace septentrionalis* in the Czech Republic: ● at least one record in 2000–2022 (1 quadrant), ● pre-2000 records only (27 quadrants). Prepared by Zdeněk Kaplan.

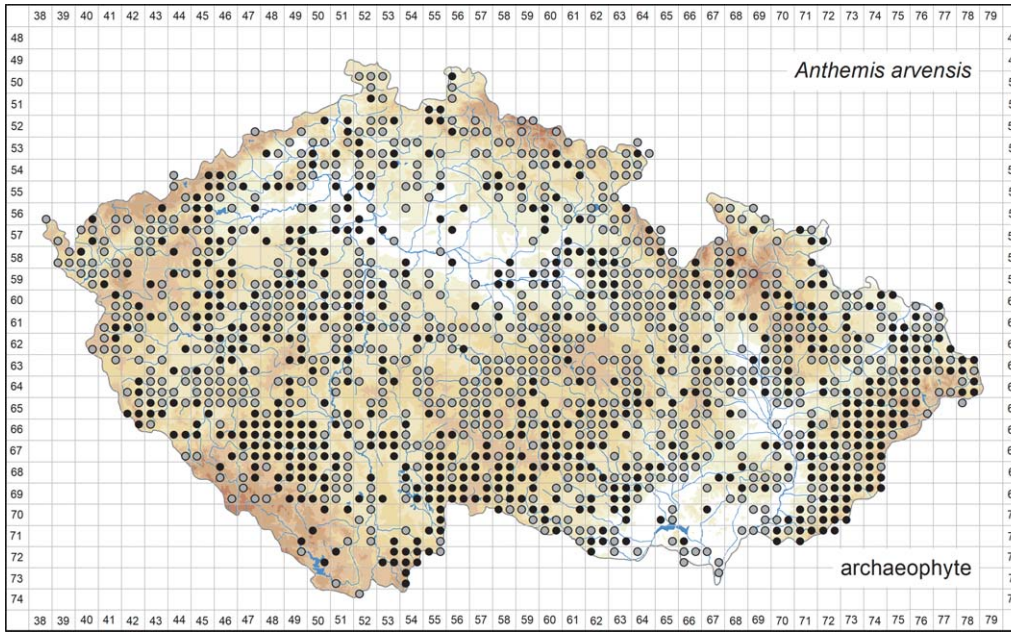

Fig. 4. Distribution of *Anthemis arvensis* in the Czech Republic: ● at least one record in 2000–2022 (603 quadrants), ● pre-2000 records only (764 quadrants). Prepared by Jan Prančl.

in landscape management, afforestation, sand mining and other forms of direct habitat destruction. It has vanished from all its sandy sites in the lowlands and a vast majority of its rocky sites. Since 2000 its presence has been confirmed at only one site: Rašovické skály Nature Monument in the Doupovské hory Mts. This species is therefore classified as critically threatened (Grulich 2012).

Anthemis arvensis (Fig. 4)

Anthemis arvensis is probably native to southern Europe. Nowadays, it grows in most of Europe except the northernmost and easternmost parts, and in northern Africa and the Middle East as far as Saudi Arabia and Iran, where it is considered an archaeophyte. Elsewhere it is considered a neophyte, including Ireland, Iceland, the Canary Islands and Azores, vast areas of North America, southern Africa, Pakistan, Japan, Kamchatka, Australia, New Zealand, Chile and Uruguay, the Juan Fernández Islands and Falkland Islands (Hultén & Fries 1986, Meusel & Jäger 1992, Greuter 2006–2022, GBIF 2022). Six subspecies are currently recognized, of which only subsp. *arvensis* occurs in central Europe (Greuter 2006–2022). In the Czech Republic *A. arvensis* grows mainly as a weed in arable fields, gardens and fallow land, on waste ground, road verges, railway stations and embankments, occasionally also in disturbed dry grasslands. It prefers acidic to neutral, sandy to loamy soils; although it tolerates regular fertilization well, it occurs mainly on naturally nutrient-poor soils and avoids hypertrophic habitats. In this country the species is almost continuously distributed at low and middle elevations: some gaps on the map in these areas are most likely due to the lack of records rather than true absences. It is locally rare in flat lowlands on basic substrates and is only occasionally introduced into the mountains, reaching its elevational maximum at 1,490 m in the Hrubý Jeseník Mts. *Anthemis arvensis*, although still being relatively common in some regions, suffered a significant decline during recent decades due to intensification of agriculture. It is considered a naturalized archaeophyte (Pyšek et al. 2022).

Anthemis austriaca (Fig. 5)

Anthemis austriaca occurs mainly in south-eastern Europe and Anatolia. Its northern distribution limit extends from southern Germany, the Czech Republic, Slovakia and southern Ukraine through the Caucasus to Iran; westwards it reaches Austria and Italy. It is not entirely clear where the species is native, and it is considered an archaeophyte at least in the peripheral parts of its continuous range. Additionally, it has been reported as a neophyte from Portugal, the British Isles, Belgium, Switzerland, northern parts of Germany, Poland, Norway, Tunisia and the USA (Meusel & Jäger 1992, Oberprieler 1998, Greuter 2006–2022). In the Czech Republic *A. austriaca* grows mainly as a weed on arable land (mainly in the margins of cereal fields), fallow land, along dirt roads among fields, on road verges, at railway stations and embankments, vineyards, waste places, often also in disturbed dry grasslands. It prefers neutral to basic, sandy-loamy to loamy soils, being particularly frequent on chernozems and brown soils developed on loess but also occurring on rendzina soils (Lososová 2009). In this country *A. austriaca* is unevenly distributed, being most frequent in the lowlands and warm hilly areas adjacent to these lowlands, particularly in north-western Bohemia, the Labe river basin, the vicinity of Prague and the town of Kladno in central Bohemia, in southern and central Moravia. Outside of

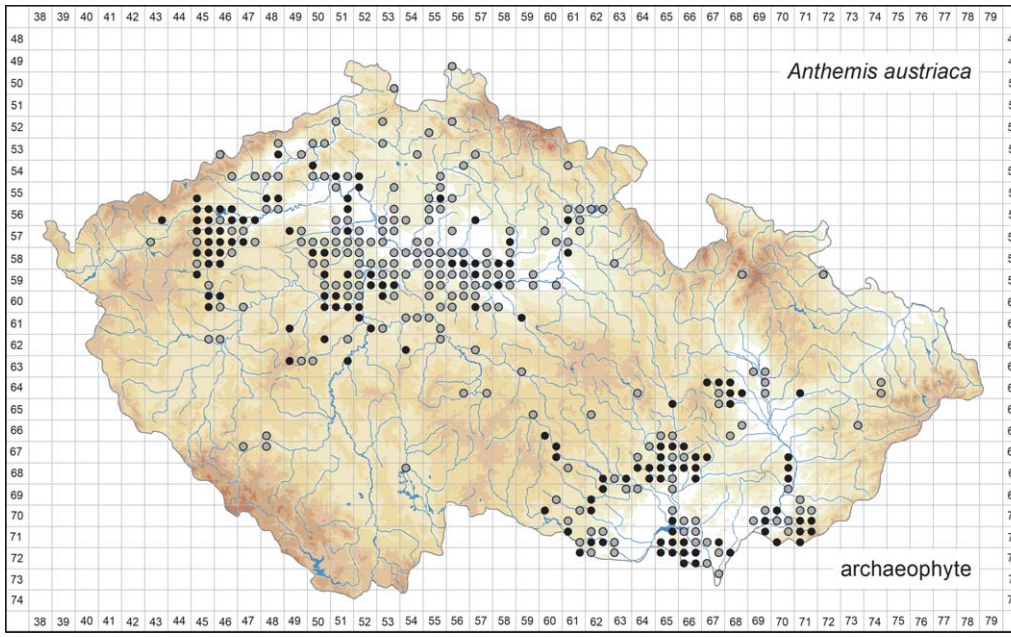

Fig. 5. Distribution of *Anthemis austriaca* in the Czech Republic: ● at least one record in 2000–2022 (135 quadrants), ● pre-2000 records only (210 quadrants). Prepared by Jan Prančl.

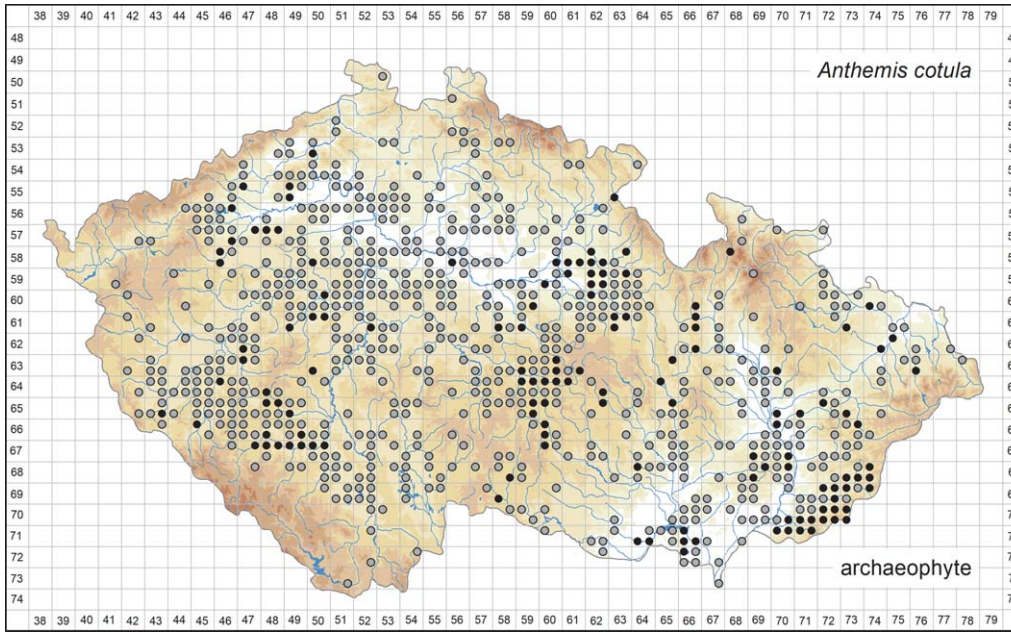

Fig. 6. Distribution of *Anthemis cotula* in the Czech Republic: ● at least one record in 2000–2022 (132 quadrants), ● pre-2000 records only (635 quadrants). Prepared by Jan Prančl.

the areas with warm climates it is rare and such records usually represent casual introductions; the elevational maximum was recorded at about 1,300 m in the Hrubý Jeseník Mts. *Anthemis austriaca* has significantly declined after World War II due to the intensification of agriculture and abandonment of grazing in dry grasslands. It is considered a naturalized archaeophyte (Pyšek et al. 2022) and classified as vulnerable (Grulich 2012).

Anthemis cotula (Fig. 6)

Anthemis cotula is probably native to southern Europe. Elsewhere it grows as an archaeophyte in almost all but the northernmost and easternmost parts of Europe, in northern Africa, the Caucasus Mts and the Middle East as far as Saudi Arabia and Iran. In many other parts of the world it is considered a neophyte, e.g. in large parts of the Americas, Macaronesia, southern Africa, central and eastern Asia, Australia, New Zealand, the Juan Fernández Islands and Tristan da Cunha (Hultén & Fries 1986, Meusel & Jäger 1992, Greuter 2006–2022, GBIF 2022). In the Czech Republic *A. cotula* is characteristic of disturbed places under traditional management, such as poultry yards, trampled places and ruderal sites around compost and manure heaps; less often it occurs in the margins of arable fields, on the edges of dirt roads, ruderalized banks of water bodies, road verges, railway stations and embankments. It grows on nutrient-rich, compacted soils that are often wet and enriched with dung water. In this country *A. cotula* occurs at low and middle elevations, where it was probably almost continuously distributed in the past; most of the gaps on the map in these areas are likely due to the lack of records rather than true absences. It is rare and usually temporarily occurring in highlands, reaching its elevational maximum at about 800 m in the Hrubý Jeseník Mts. Since the 1950s, and particularly after 1990, *A. cotula* has declined strongly due to urbanization and changes in land management in villages, including abandonment of poultry farming, removal of small waste places, paving and intensification of agriculture. It is considered a naturalized archaeophyte (Pyšek et al. 2022) and classified as endangered (Grulich 2012).

Anthemis cretica (Fig. 7)

Anthemis cretica represents an extremely polymorphic species complex including up to 30 taxa classified at the level of subspecies or microspecies, with the centre of diversity in the mountains of Anatolia and south-eastern Europe. However, a comprehensive taxonomic treatment of this group is still needed and a number of the currently recognized infraspecific taxa may turn out to be only local variants of low taxonomic value (Franzén 1986, Greuter 2006–2022, Selvi 2009). The distribution of this species in its broadest circumscription encompasses the mountains of southern Europe from Portugal to Greece and Bulgaria, Austrian Central Alps, the Eastern Carpathians, Algeria, the Caucasus Mts and the Middle East to Iran (Meusel & Jäger 1992, Greuter 2006–2022). In the Czech Republic *A. cretica* was found at two sites in central Bohemia during the second half of the 19th century. It was recorded between 1865–1906 on the rocky slate slopes near the town of Dobříš at elevation of about 370 m, and between 1875–1908 in open-canopy sandy pine forests near the village of Zlosyň at elevation of about 200 m. At both sites the species was abundant but later vanished, probably due to successional changes. These populations, sometimes considered indigenous, were recently assigned to subsp. *columnae* (Dvořáková 2004). However, their characters do not fully correspond to any of

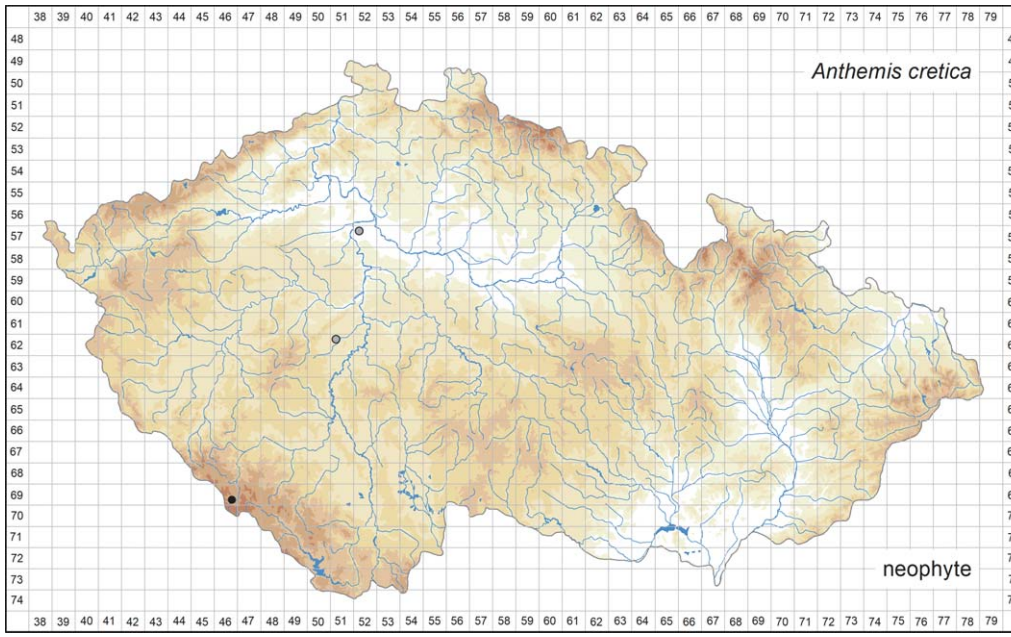

Fig. 7. Distribution of *Anthemis cretica* in the Czech Republic: ● at least one record in 2000–2022 (1 quadrant), ● pre-2000 records only (2 quadrants). Prepared by Jan Prančl.

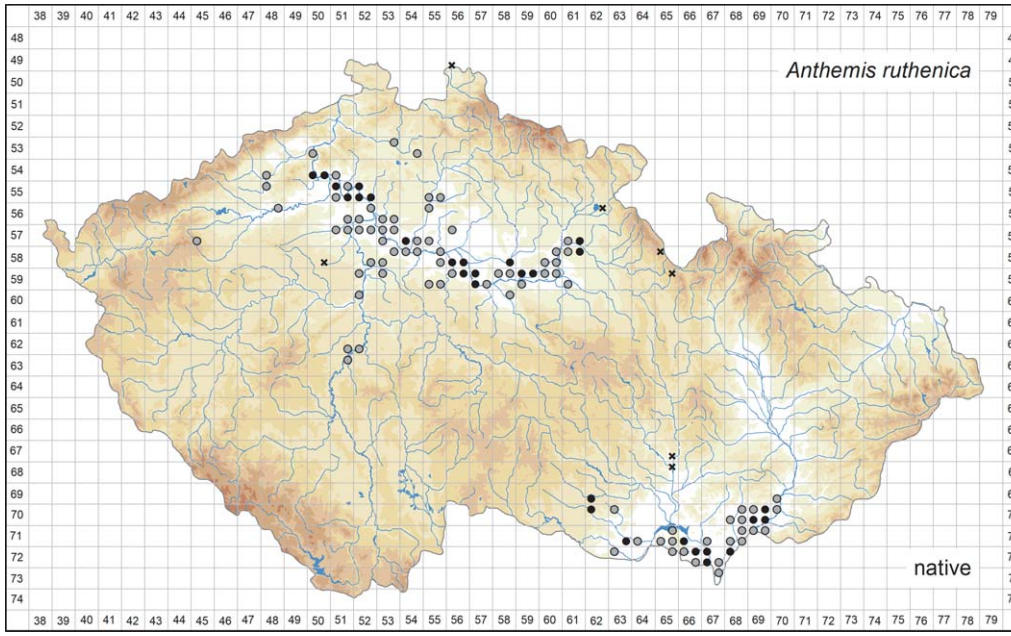

Fig. 8. Distribution of *Anthemis ruthenica* in the Czech Republic: ● native, at least one record in 2000–2022 (29 quadrants), ● native, pre-2000 records only (80, quadrants), × alien only (7 quadrants). Prepared by Jan Prančl.

the recognized subspecies, hence we assign them only to the species. The indigenous status of these populations in this country is also highly unlikely; they were probably introduced, e.g. with seeds or cones of *Pinus nigra*. The only recent introduction of the species was recorded in 2019 near the village of Modrava in the Šumava Mts at the elevation of 1,060 m (Štech et al. 2021). *Anthemis cretica* is considered a casual neophyte (Pyšek et al. 2022).

Anthemis ruthenica (Fig. 8)

Anthemis ruthenica is mainly a European species, distributed in areas with continental climates. Its continuous distribution includes the Pannonian basin, Outer Subcarpathia, Ukraine and the foothills of the Caucasus Mts, with outposts in easternmost Germany, Bohemia and mountains of the Balkan Peninsula, southwards extending to Greece and the European part of Turkey. It has been introduced elsewhere, including the British Isles, France, Belgium, Italy, most of Germany, Poland, the Baltic countries, Norway, the central part of European Russia and central Asia (Meusel & Jäger 1992, Lazkov & Sennikov 2014, Greuter 2006–2022). In the Czech Republic it grows in dry open places such as sandy dunes, open-canopy pine forests and grasslands on sandy substrates, sandy arable fields, and also in sand pits, waste places, at railway stations and along road verges. The species is an indicator of sandy habitats, only exceptionally it may also occur on shallow skeletal soils. It occurs on neutral to mineral-rich, usually nutrient-poor sandy soils but tolerates non-intensive fertilization well. In this country the distribution of *A. ruthenica* is almost exclusively restricted to dry habitats along lowland floodplains, such as old river terraces, and sand hummocks directly in the floodplains. It occurs mainly in the Labe river basin and the adjacent part of the Vltava river valley in Bohemia, and in the basins of the rivers of Morava and Dyje in southern Moravia. Elsewhere it is rare, and at least some of these occurrences, if not all, represent recent introductions. *Anthemis ruthenica* has declined considerably during recent decades due to changes in land use, including succession and afforestation of open sandy areas, retreat of open-canopy forests and intensification of agriculture. It is classified as vulnerable (Grulich 2012).

Anthemis tinctoria (Fig. 9)

Anthemis tinctoria is a highly polymorphic species, containing a number of intraspecific taxa (sometimes even classified at the species level); in Europe, eight subspecies are currently recognized (Greuter 2006–2022). However, a comprehensive intraspecific taxonomic treatment is still missing. The species' range includes the temperate and Mediterranean areas of Europe and the Middle East along with the temperate zone in Siberia, extending from France in the west to Lake Baikal in the east. It is not native to western or northern Europe, being reported as an alien from the British Isles, Iceland, most of Scandinavia and the northern parts of Russia. It has also been introduced to Gran Canaria Island and the temperate regions of North America, the Russian Far East and Australia (Hultén & Fries 1986, Greuter 2006–2022, GBIF 2022). In the Czech Republic two subspecies have been reported to occur, namely subsp. *tinctoria* and subsp. *subtinctoria* (Dvořáková 2004). However, plants morphologically corresponding to one or the other subspecies are very probably only ecotypes or extreme manifestations of variation of a single taxon, and most populations show a combination of characters of both subspecies.

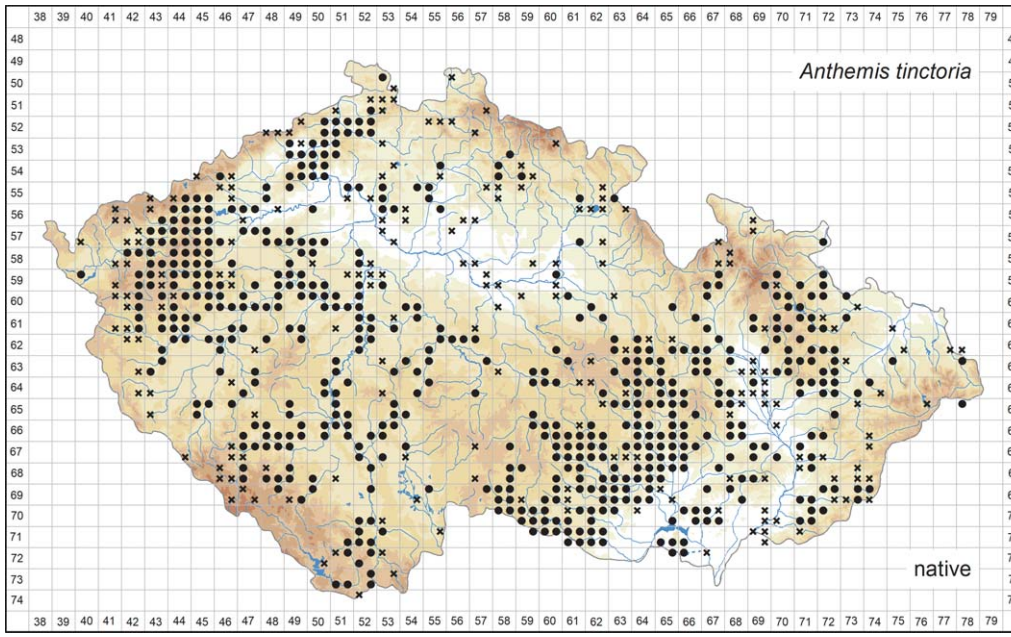

Fig. 9. Distribution of *Anthemis tinctoria* in the Czech Republic: ● native (552 quadrants), × alien (211 quadrants). Prepared by Jan Prančl.

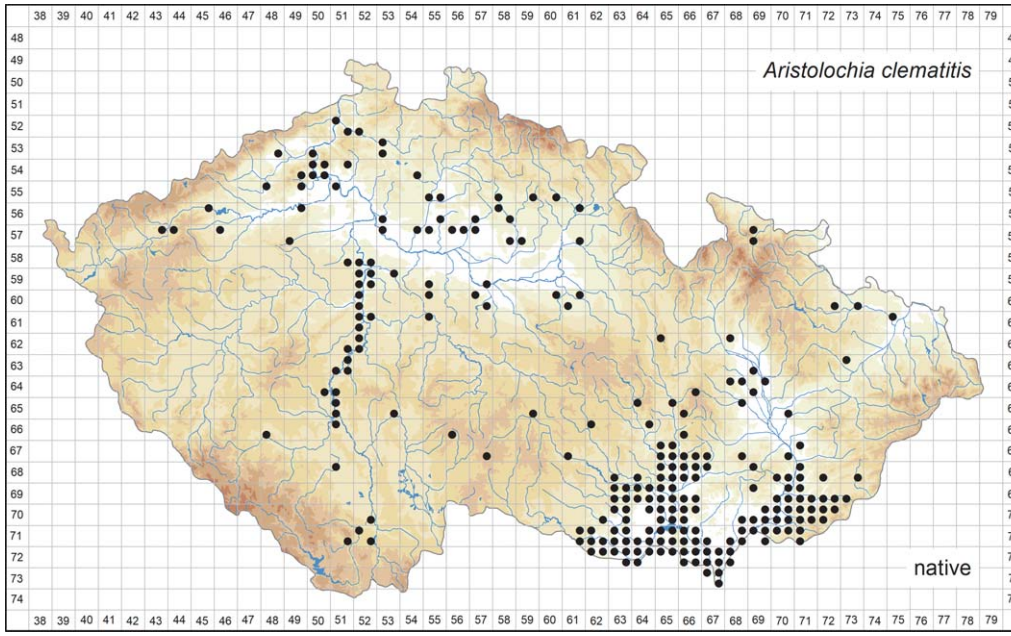

Fig. 10. Distribution of *Aristolochia clematitis* in the Czech Republic (242 occupied quadrants). Prepared by Kateřina Šumberová.

Therefore, we prefer to classify all Czech populations as the typical subspecies. In this country *A. tinctoria* occurs in sunny dry grasslands and pastures, stony slopes, rock outcrops, open steppe vegetation, castle ruins, quarries and sand pits, stony margins of fields and fallow land, road verges, railway stations and embankments. It grows on slightly acidic to basic, shallow to deep soils, often on disturbed and slightly ruderalized habitats. In the Czech Republic the native distribution of *A. tinctoria* is mainly concentrated along deep river valleys and in hilly landscapes rich in steppe vegetation. It is most frequent at middle elevations, with the occurrences in flat lowlands and mountains only secondary. It is also less frequent in the areas with a predominance of hard, acidic substrates. The elevational maxima of the species have been recorded at 780 m for native populations in the Doupovské hory Mts and 1,110 m for secondary occurrences in the Šumava Mts. *Anthemis tinctoria* has somewhat declined due to abandonment of grazing, succession of grasslands and stony slopes to shrub communities and intensification of land use; it is classified as of lower risk – near threatened (Grulich 2012). Recently, this ornamental plant has become a common constituent of commercially sold "wildflower meadow" seed mixtures that are intentionally sown in various places in the landscape. It is therefore probable that the number of secondary occurrences will increase.

Aristolochia clematitis (Fig. 10)

Aristolochia clematitis is mainly a European species, extending eastwards to the Baltic countries, Poland, Ukraine, the Caucasus Mts and Anatolia. According to Holubová & Slavíková (1964) and Skalická (1997), in Europe it is native only to the Mediterranean area and adjacent parts, extending northwards to the eastern parts of Austria and the Czech Republic, Slovakia, Hungary, Romania and Ukraine. However, Jalas & Suominen (1976) and Nardi (2009) consider as alien only the occurrences in the British Isles, Scandinavia and the Baltic countries. The species is also known as sometimes escaping from cultivation in eastern Canada and the north-eastern USA; however, these occurrences are probably only temporary (Barringer 1997). The status of *A. clematitis* is difficult to assess in some areas due to its frequent former cultivation as a medicinal and probably also ornamental herb (Holubová & Slavíková 1964). The species grows in a broad range of habitats with very variable moisture and light conditions. From alluvial forests and shrublands, which are considered native habitats of *A. clematitis* (Holubová & Slavíková 1964), it spreads to river, road and railway embankments, unmown edges of grasslands, road verges and vineyards. In Bohemia it is also known from rocky slopes around castles and old monasteries. In the Czech Republic the species is considered as native only to southern and south-eastern Moravia where it exhibits stable occurrence at many sites. Populations elsewhere are probably related to former cultivation. However, as the boundary between the native and non-native distribution is unclear in the south-eastern part of this country, the potentially alien populations are not distinguished on the map. Although *A. clematitis* is able to colonize man-made habitats, its distribution in the Czech Republic is rather restricted. Therefore, it is classified as of lower risk – near threatened (Grulich 2012).

Aristolochia macrophylla (Fig. 11)

Aristolochia macrophylla is a liana native to the eastern parts of Canada and USA (Barringer 1997), where it grows in forests and rocky slopes. In 1783 it was introduced to Europe for ornamental purposes and since then it has been cultivated in chateau and city parks and large gardens (Skalická 1997). *Aristolochia macrophylla* has the status of a naturalized species in Germany; however, relevant information is probably lacking from the other countries, as shown by an incomplete map of its cultivations in Europe (Nardi 2009). Among several dozen herbarium specimens of *A. macrophylla* preserved in the Czech herbaria, the vast majority of the records were either clearly related to cultivation or cultivation was highly probable (e.g. old records with the settlement name but no further details). These records were not included in the distribution map. Only two escaped populations have been documented in the Czech Republic so far. The earliest record, dated to 1994, is related to the stand spreading from an ornamental garden into an adjacent railway embankment in Prague; this occurrence vanished after construction work on the railway. The second escaped population was discovered in 2005 in a small patch of woody and shrubby vegetation at the Koudelovský potok brook near the village of Chotusice in central Bohemia. The source of this population remains unclear. The species is classified as a casual neophyte (Pyšek et al. 2022).

Berteroa incana (Figs 12–14)

Berteroa incana is now widespread in most of Europe, with the exception of its westernmost and south-western parts. It extends south- and eastwards to northern Turkey, the Caucasus Mts, central Asia, northern China and Lake Baikal (Meusel et al. 1965, Hultén & Fries 1986, Jalas et al. 1996, Cheo et al. 2001, Marhold 2011a). Due to its long period of spread by humans, its native range is not sufficiently known. Most probably it is native to the eastern Mediterranean area, the region with the highest taxonomic diversity of the *Berteroa* genus (Meusel et al. 1965, Marhold 2011a, Özbek et al. 2015, Yüzbaşioğlu et al. 2017), as well as the adjacent areas of Asia and eastern Europe. It is reported as introduced in northern, western and south-western Europe (Marhold 2011a). The status of central-European populations is questionable, as they are assessed as native by some authors (Marhold 2011a) and alien by others (Pyšek et al. 2022). *Berteroa incana* has been recently introduced to North America, now spreading as an invasive weed in pastures in large parts of the continent (Warwick & Francis 2006, Al-Shehbaz 2010). Two subspecies of *B. incana* are sometimes distinguished, subsp. *incana* and subsp. *stricta* (e.g. Danihelka et al. 2012, Štěpánek 2019), but some authors treat them as separate species (Meusel et al. 1965, Smejkal 1992, 1994), and others (e.g. Ball 1993a), in contrast, not distinguishing them at all. The taxonomic value of *B. incana* subsp. *stricta*, said to be native to the central Balkan Peninsula, has not been sufficiently clarified. It needs further study also in relation to other *Berteroa* species, particularly *B. obliqua*. Although currently there is a tendency not to distinguish *B. incana* subsp. *stricta* as a separate taxon at all, we follow the concept maintained in the recent Czech literature (Štěpánek 2019). We do so, because in addition to its morphological differences, *B. incana* subsp. *stricta* occurs only in ruderal vegetation at railway stations, as shown during the examination of hundreds of herbarium specimens of *B. incana*. In contrast, the ecological range of *B. incana* subsp. *incana* is much broader and besides being found in ruderal habitats such as railway stations

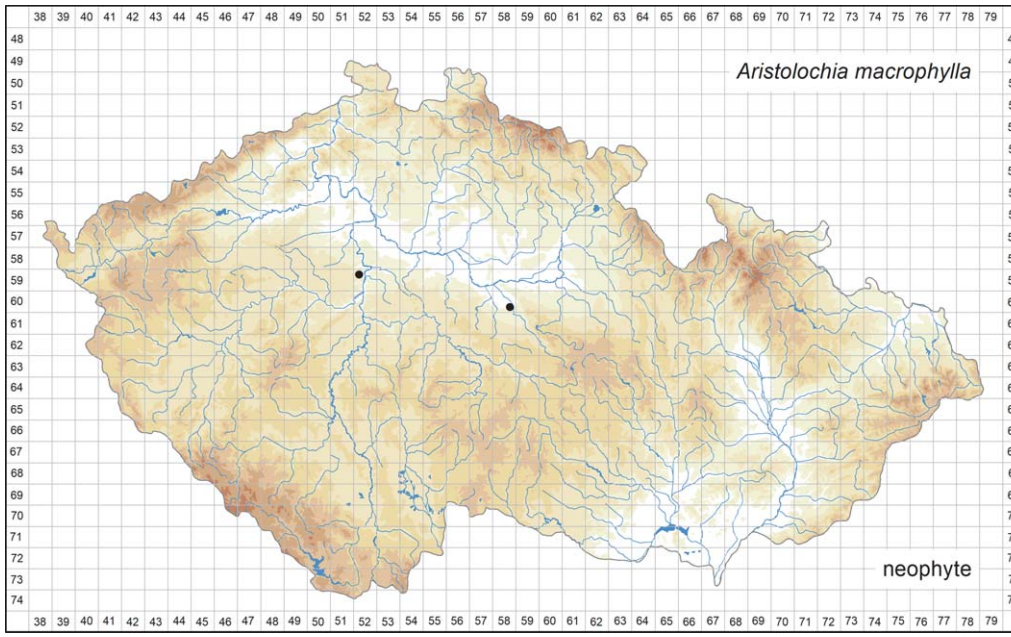

Fig. 11. Distribution of *Aristolochia macrophylla* in the Czech Republic (2 occupied quadrants). Prepared by Kateřina Šumberová.

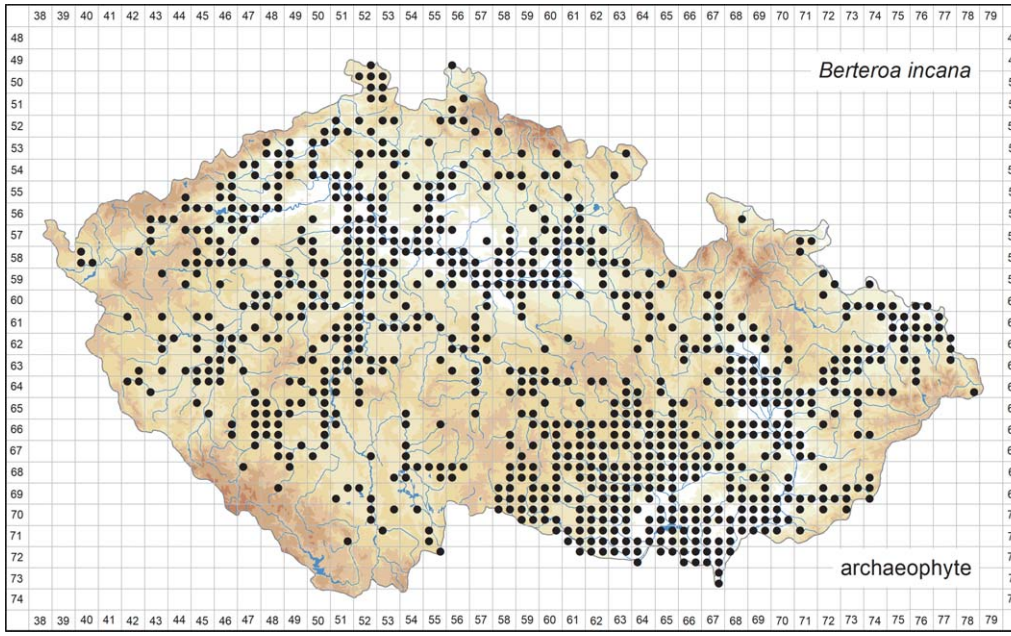

Fig. 12. Distribution of *Berteroa incana* in the Czech Republic (901 occupied quadrants). Prepared by Kateřina Šumberová.

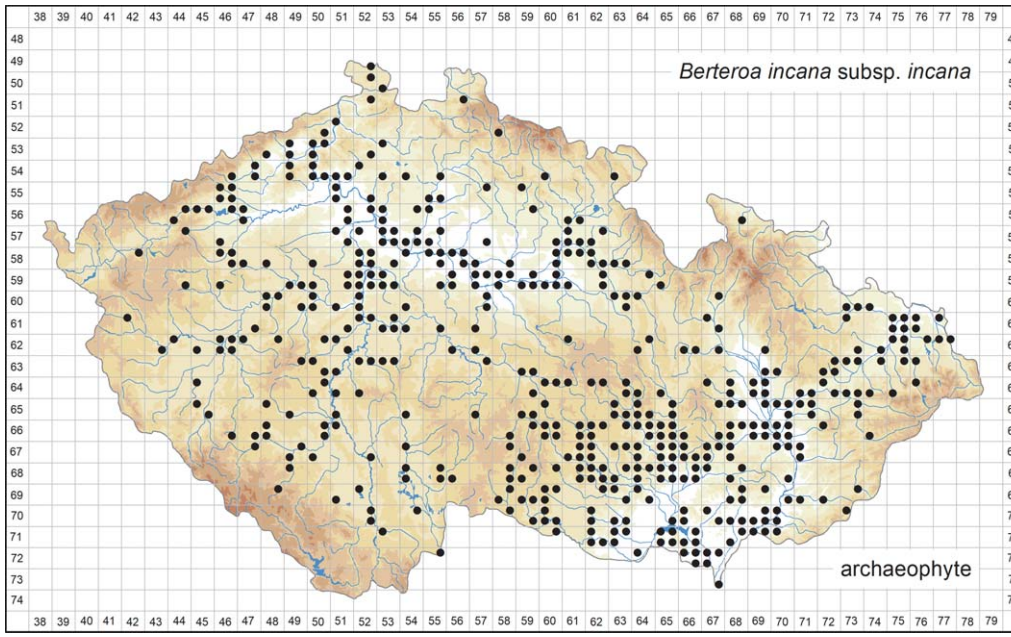

Fig. 13. Distribution of *Berteroa incana* subsp. *incana* in the Czech Republic (482 occupied quadrants). Prepared by Kateřina Šumberová.

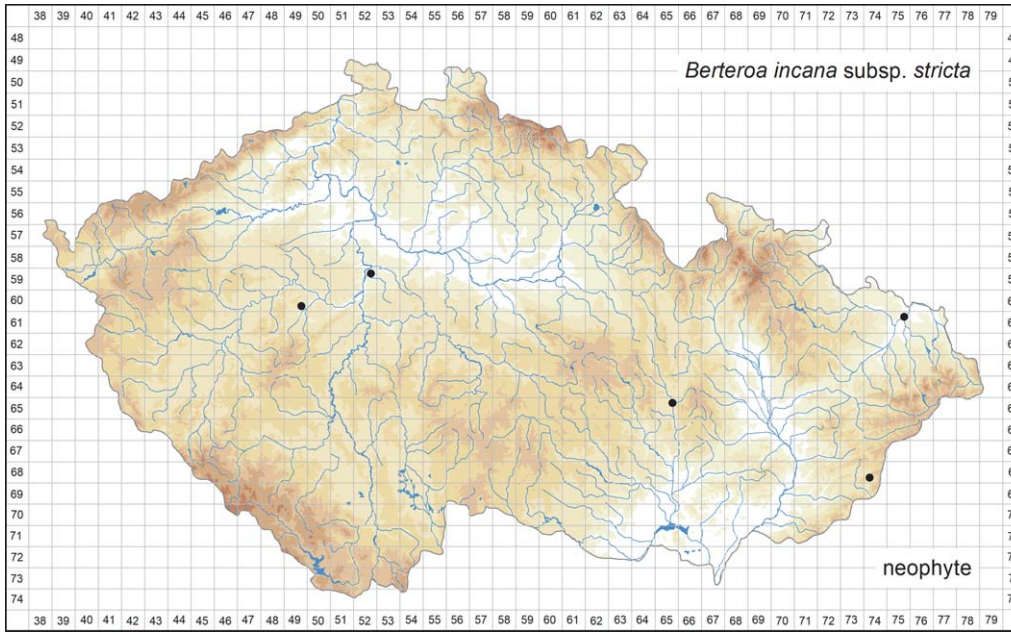

Fig. 14. Distribution of *Berteroa incana* subsp. *stricta* in the Czech Republic (5 occupied quadrants). Prepared by Kateřina Šumberová.

and embankments, edges of arable fields, road verges, dry dump areas, quarries, sand and gravel pits, it also occurs in semi-natural dry grasslands, particularly in open vegetation on sandy soils. *Berteroa incana* subsp. *stricta* is considered a casual neophyte in the Czech Republic (Pyšek et al. 2022), having only five, probably temporary occurrences in this country (Fig. 14). It has been collected at railway stations in Prague and in the town of Zdice in central Bohemia, in the village of Lhota Rapotina in central Moravia, in the city of Ostrava in northern Moravia and in the town of Valašské Klobouky in eastern Moravia. *Berteroa incana* subsp. *incana* is classified as a naturalized archaeophyte (Pyšek et al. 2022) and it is widespread in the lowlands and warm hilly areas across this country, particularly in north-western, central and eastern Bohemia, and southern, central and north-eastern Moravia (Fig. 13). Plants transitional between subsp. *stricta* and subsp. *incana* have been found, e.g. at the railway stations in the village of Černousy in northern Bohemia and in the town of Bohumín in northern Moravia. These occurrences have been included in the map of *B. incana*. Because the subspecies are usually not distinguished in the field by most botanists, their maps are based solely on examined herbarium specimens. The map of *B. incana* (Fig. 12) also includes all reliable records from the literature and databases as well as herbarium specimens without fruits required for identification of the subspecies. Besides the areas indicated on the map of subsp. *incana*, the map of the entire species shows its frequent occurrence also in western and south-western Bohemia and low parts of the Českomoravská vrchovina highlands. In some areas, e. g. in the basins of south-western and southern Bohemia, it has started to spread rather recently. However, it is still likely that most of these occurrences belong to *B. incana* subsp. *incana*.

Celtis occidentalis (Fig. 15)

Celtis occidentalis is native to North America from Wyoming and Colorado in the west to Maine, New Hampshire, and Massachusetts in the east, and from northern Mississippi, northern Alabama and northern Georgia in the south as far as Manitoba, Ontario and Quebec in the north. In its primary range it grows on nutrient-rich, damp soils along streams, in floodplains, on rocks and in various types of woodlands, occurring from coastal areas up to elevations of about 1,800 m (Barker 1997). In Europe *C. occidentalis* has been cultivated since 1636, and in the Czech Republic since 1794, when it was planted in the Nové Dvory manor garden near the city of Kutná Hora in central Bohemia (Pejchal et al. 2021). Although the first report of this species having escaped in this country has been stated to be from 2001 in Prague (Pyšek et al. 2002), Danihelka & Šumberová (2004) reported records of escaped plants from southern Moravia already in the 1990s, with the earliest record from the vicinity of the town of Valtice from 1994. This species is used in landscape design, chiefly valued as a street tree because of its tolerance to drought. In towns, it spontaneously spreads in the surroundings of cultivated trees, especially in pavement joints and various kinds of scrub and at ruderal sites. Most of the recent records are from cities and towns, including Prague, Mladá Boleslav, Hradec Králové, Olomouc and Přerov. In addition, there are several records from the landscape around the towns of Lednice and Valtice in southernmost Moravia, where *C. occidentalis* has been cultivated for a long time. The species is classified as a casual neophyte (Pyšek et al. 2022). Only records explicitly referring to escaped plants were included in the map.

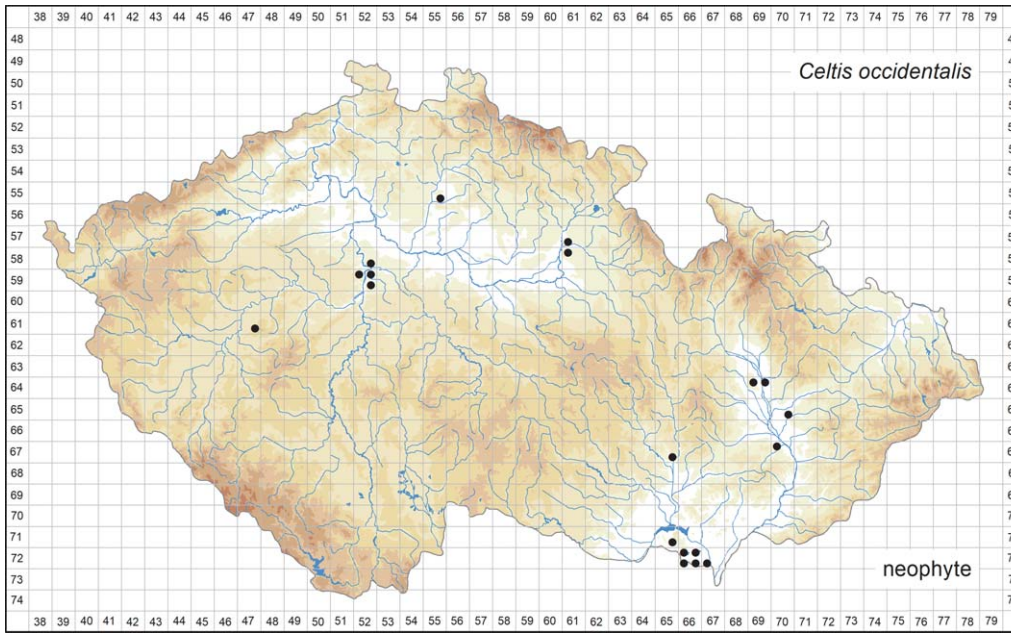

Fig. 15. Distribution of *Celtis occidentalis* in the Czech Republic (19 occupied quadrants). Prepared by Jiří Velebil.

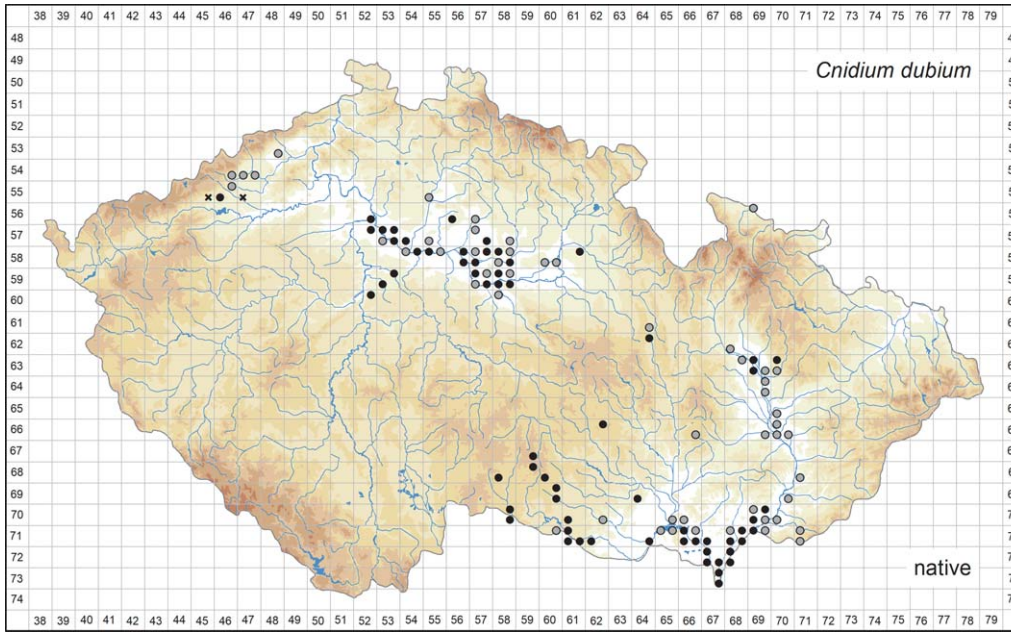

Fig. 16. Distribution of *Cnidium dubium* in the Czech Republic: ● at least one record in 2000–2022 (63 quadrants), ● pre-2000 records only (52 quadrants), × deliberate introductions only (2 quadrants). Prepared by Jan Prančl.

Cnidium dubium (Fig. 16)

Cnidium dubium is a Eurasian species characteristic of areas with a temperate continental climate, being continuously distributed in eastern Europe and Siberia. The overall range of this species extends from eastern France in the west to central Siberia in the east; further east it is replaced by a similar species, *C. salinum*. It is absent from western Europe, the Mediterranean area and most of Scandinavia except southern Sweden (Meusel et al. 1978, Hand 2011). In the Czech Republic *C. dubium* occurs mainly in alluvial meadows, especially those that flood in spring and dry up in summer. Less often it grows on wet meadows in spring areas, in wet open-canopy oak forests and alder carrs and along wet ditches at sites of former alluvial meadows. Most occurrences are on heavy clayey soils, but the species tolerates a relatively wide range of substrates and pH and is capable of growing, e.g. on sandy, slightly peaty or slightly salty soils. In this country the vast majority of its sites are located in lowland floodplains, especially in the basins of the rivers of Labe in Bohemia, and of Morava and Dyje in Moravia. Formerly, it also occurred in the Mostecká pánev basin in north-western Bohemia, from which it has vanished due to strip mining of coal (last recorded in 2004), but individuals from the last remnant population were transferred to new sites in that area (Ondráček 2019). Outside the floodplains, the species occurs only sporadically. Several sites are located in the Českomoravská vrchovina highlands, where it reaches its elevational maximum at 655 m near the village of Opatov. *Cnidium dubium* is a rare species that has declined further during recent decades due to habitat destruction, drainage, reclamation and management changes of alluvial meadows. It is classified as endangered (Grulich 2012). It is an inconspicuous, late-flowering species, often present as a small number of individuals and remaining sterile; it is also frequently confused with other species of the *Apiaceae* family. Many occurrences have only recently been discovered, and its actual distribution may be somewhat wider than shown on the map.

Cnidium silaifolium (Fig. 17)

The native distribution of *Cnidium silaifolium* includes southern and south-eastern Europe, Anatolia, Syria and Lebanon. Its distribution reaches south-eastern France in the west; towards the north it extends into the Alps, Dinarides and the mountain ranges on the Balkan Peninsula, with an outpost in Romanian Transylvania. It has been introduced into Germany, Austria, Czech Republic, Denmark and Sweden (Leute 1970, Hand 2011, Barta 2020). In its native range, the species grows in thermophilous shrub communities, forest fringes and open-canopy forests on calcareous stony soils, most often in the mountains. In the Czech Republic *C. silaifolium* was for the first time found escaped in 1868 on Petřín hill in Prague, where it became locally abundant and persisted until 1943. In 1916 it was also recorded on the nearby Letná hill. The last record in this country dates back to 1956, when it was collected on a temporarily abandoned construction site of the D1 motorway near the village of Průhonice close to the south-eastern edge of Prague. *Cnidium silaifolium* is classified as a casual neophyte (Pyšek et al. 2022).

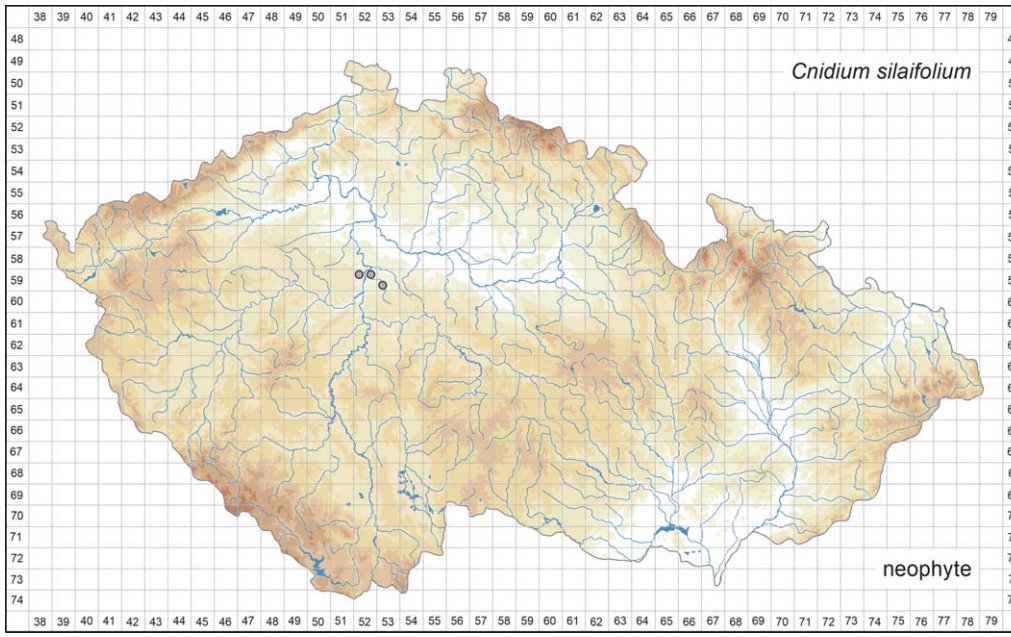

Fig. 17. Distribution of *Cnidium silaifolium* in the Czech Republic: ◍ pre-2000 records only (3 quadrants). Prepared by Jan Prančl.

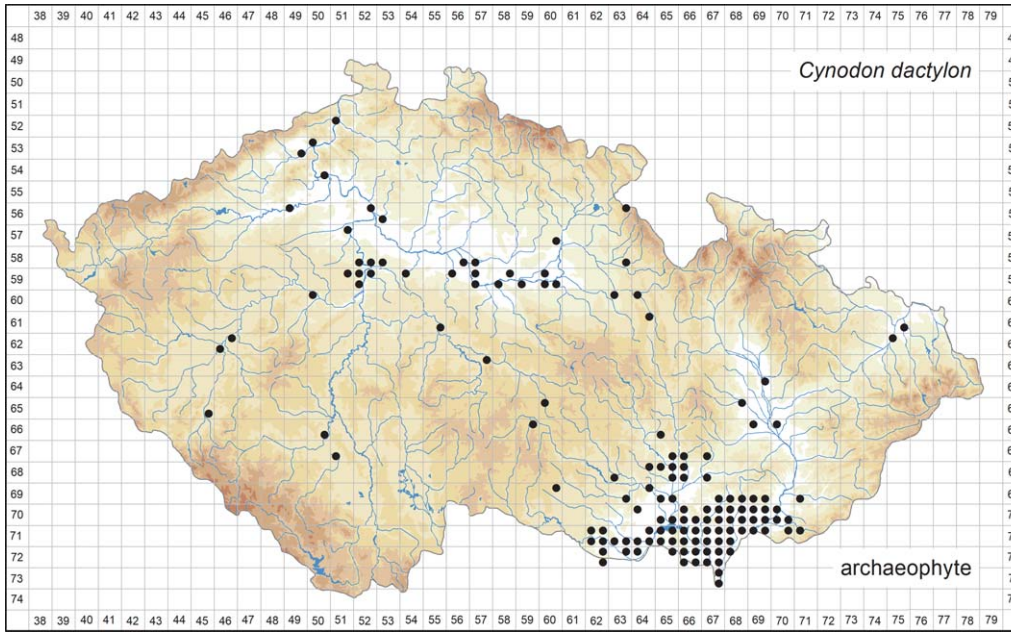

Fig. 18. Distribution of *Cynodon dactylon* in the Czech Republic (137 occupied quadrants). Prepared by Kateřina Šumberová.

Cynodon dactylon (Fig. 18)

Cynodon dactylon is a perennial thermophilous grass, which is widely distributed throughout warm temperate and tropical zones of the world (Barkworth 2003, Sun & Phillips 2006). However, its precise geographic distribution and status in many countries are not well known because of its cultivation, particularly as forage crop, along with its high level of variation (several varieties are distinguished and their possibly higher taxonomic rank is discussed by some authors, e.g. Barkworth 2003) and possibility of misidentification with other *Cynodon* species and their hybrids (Barkworth 2003, Sun & Phillips 2006). In Europe *C. dactylon* occurs in its western, southern, south-eastern and eastern parts, northwards extending to southern England, the Netherlands, Czech Republic, Slovakia, northern Ukraine and European Russia (Tutin 1980, Valdés et al. 2009). According to Valdés et al. (2009) it is considered as introduced in Germany and Denmark and casual in Norway; however, some authors consider it as native only to the Mediterranean area, Africa or Asia (e.g. Langdon 1955, Pyšek et al. 2022). Natural habitats of this species probably comprise open vegetation on sand dunes. In warm, dry areas, e.g. in the Balkan Peninsula, *C. dactylon* even colonizes temporary wetlands, e.g. gravel bars and sandy deposits in rivers and margins of lakes with fluctuating water levels. Similar habitats are saline pastures; such occurrences were documented in the Czech Republic as well. However, recently *C. dactylon* has become much more common on habitats highly affected by humans, such as road verges, railway embankments, vineyards and dirt roads, ruderal grasslands in villages and towns and village sport grounds. Frequent mowing, trampling and grazing support spread of this creeping grass at the expense of tall grasses and herbs. Unlike most other lawn grasses, *C. dactylon* thrives in hot and dry climates. In the Czech Republic its occurrence is restricted to the warm lowlands of southern Moravia and central, north-western and eastern Bohemia. New records, e.g. from northern and central Moravia, are most probably related to recent introductions. Once established on new sites, its populations may survive there for decades in suboptimal conditions. Such stable populations without further propagation are known, e.g. from southern Bohemia. On the other hand, in southern Moravia the species has spread intensively in the landscape for about the past 20–25 years, possibly as a consequence of changing management (i.e. very frequent mowing of some habitats) along with frequent severe droughts and extraordinarily high summer temperatures. It has started to dominate ruderal grasslands at many sites, where it has replaced mesophilous grasses such as *Lolium perenne* and *Poa pratensis*. *Cynodon dactylon* is classified as a naturalized archaeophyte in this country (Pyšek et al. 2022) and as of lower risk – near threatened (Grulich 2012). Considering the recent fast spread of the species, we suggest its deletion from the Red Data List.

Descurainia sophia (Fig. 19)

Descurainia sophia is a ruderal annual herb, which is nowadays almost cosmopolitan: its general distribution includes Europe, large parts of temperate Asia (with numerous outposts in the tropical zone and some records in the boreal zone), northern and southern Africa, the Americas, Australia and New Zealand (Meusel et al. 1965, Hultén & Fries 1986, Ball 1993b, Jalas & Suominen 1994, Cheo et al. 2001, Al-Shehbaz 2010). According to Hultén & Fries (1986), only south-eastern Europe and south-western Asia fall into the native range of *D. sophia*. Similarly, Meusel et al. (1965) accept only the easternmost

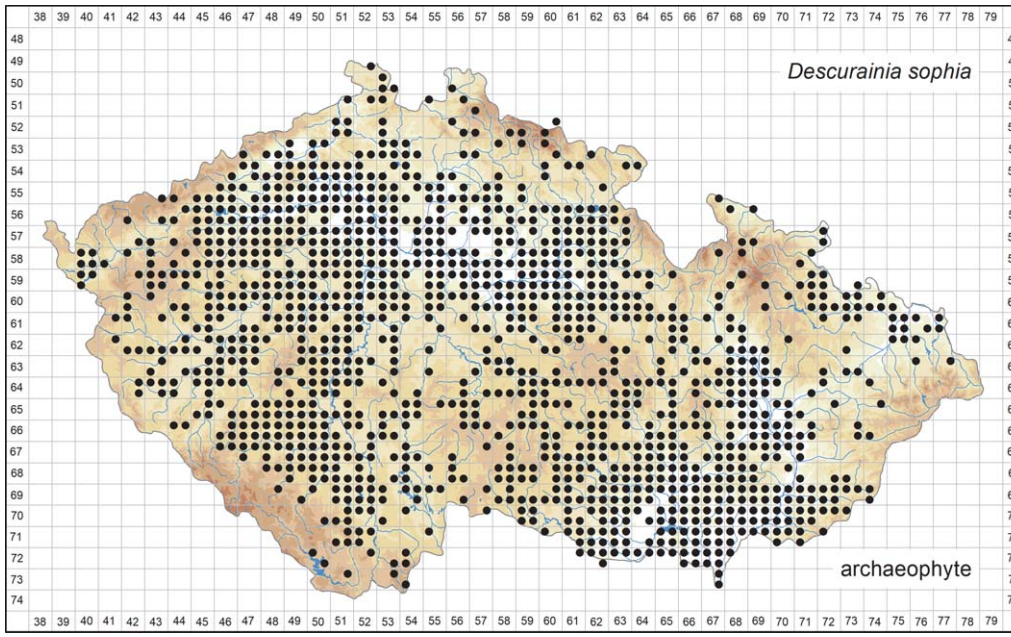

Fig. 19. Distribution of *Descurainia sophia* in the Czech Republic (1272 occupied quadrants). Prepared by Kateřina Šumberová.

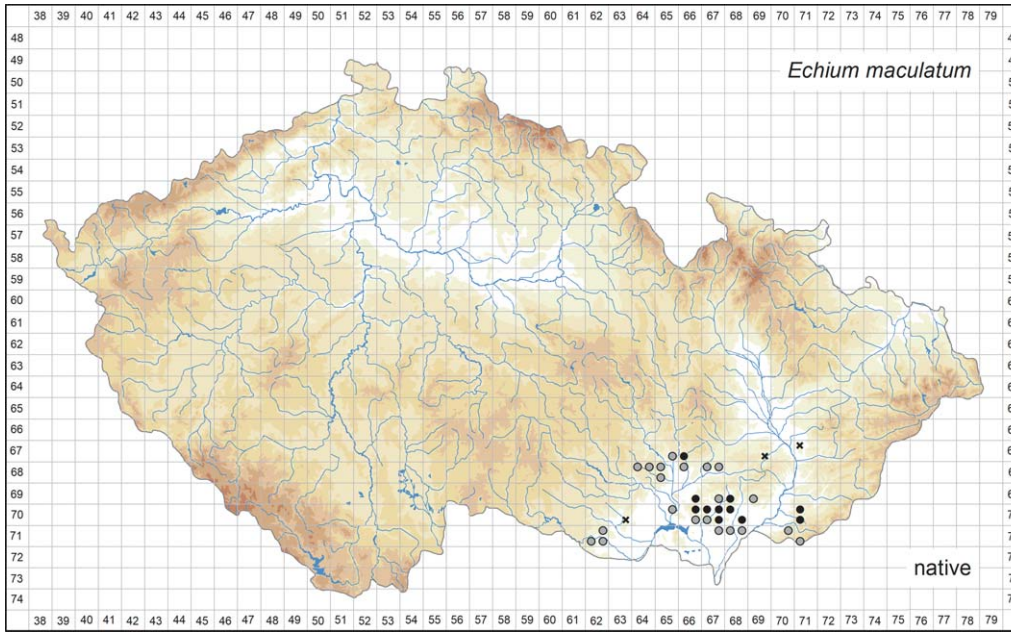

Fig. 20. Distribution of *Echium maculatum* in the Czech Republic: ● at least one record in 2000–2022 (11 quadrants), ● pre-2000 records only (21 quadrants), × alien (3 quadrants). Prepared by Zdeněk Kaplan.

Europe as a region of the species' origin. In contrast, Ball (1993b) and Jalas & Suominen (1994) consider most of Europe, with the exception of high mountain ranges and north-western and northern parts of this continent, as regions where the species is native. It is probably impossible to determine the precise boundary between the primary and secondary ranges as the species has accompanied humans and their activities in the landscape for centuries. As an annual, *D. sophia* requires open habitats, usually damp to dry and rich in nutrients. It grows on margins of arable fields and vineyards, on soil heaps after excavation work, waste grounds, along railways and road verges and in disturbed ruderal grasslands in cities and villages. It is occasionally found also on sandy margins of fishponds where it is introduced with cereals used as fish food. In the Czech Republic *D. sophia* occurs mainly in the lowlands and warm hilly areas such as in north-western, central, south-western and eastern Bohemia and southern and central Moravia, with scattered occurrence or absence at higher elevations with colder climates. It is classified as a naturalized archaeophyte (Pyšek et al. 2022).

Echium maculatum (Fig. 20)

Echium maculatum is distributed mainly in the Pontic region in south-eastern Europe, extending southwards to Romania and the Caucasus Mts (Meusel et al. 1978). It reaches the western limit of its overall range in the Czech Republic and eastern Austria (Kaplan 2017), while the northernmost European occurrences are situated around Moscow in Russia. Isolated outposts are found southwards as far as North Macedonia, Bulgaria, Turkey and northern Iran, and eastwards in the middle Ural river basin in Russia, Turkmenistan and Uzbekistan (Meusel et al. 1978, Ovchinnikova et al. 2021). In the Czech Republic *E. maculatum* grows in dry grasslands and fringes of thermophilous oak forests, mostly on slopes or tops of hills. It prefers loamy, skeletal, neutral to slightly basic, mineral-rich soils developed over loess, limestone or Tertiary calcareous sediments. In this country its distribution is restricted to the warm, dry areas of southern Moravia. Most of the previously recorded populations have vanished due to conversion of its sites to vineyards and arable land, and abandonment and succession toward shrub communities and *Robinia pseudoacacia* groves. *Echium maculatum* has recently been found at three new sites. In each of these cases only a single plant was observed. These occurrences have almost certainly resulted from intentional introductions. The species is classified as critically threatened (Grulich 2012).

Echium plantagineum (Fig. 21)

Echium plantagineum originates from the western Mediterranean area, but the expansion of areas of human settlement has led to its broadly circum-Mediterranean distribution. As an ornamental plant it has been deliberately introduced into all continents (except Antarctica) and has escaped from gardens particularly in regions with a Mediterranean type of climate. There, it has spread along roadsides, in pastures and on waste ground. It has become naturalized or invasive mainly in eastern and southern Africa, Australia, New Zealand, the western USA and South America. In Europe it has been introduced into most countries, including those in its northern part such as Sweden and Norway (Holm et al. 1979, CABI 2022). In the Czech Republic *E. plantagineum* was collected in 1940 between the villages of Černošice and Dolní Mokropsy (now in the town of Černošice)

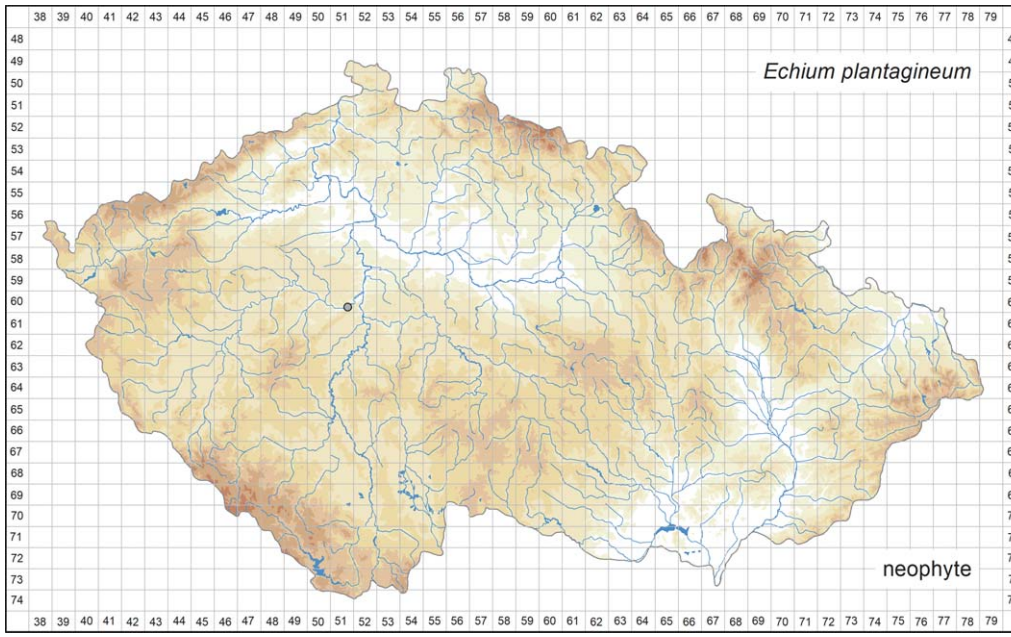

Fig. 21. Distribution of *Echium plantagineum* in the Czech Republic: ● pre-2000 records only (1 quadrant). Prepared by Zdeněk Kaplan.

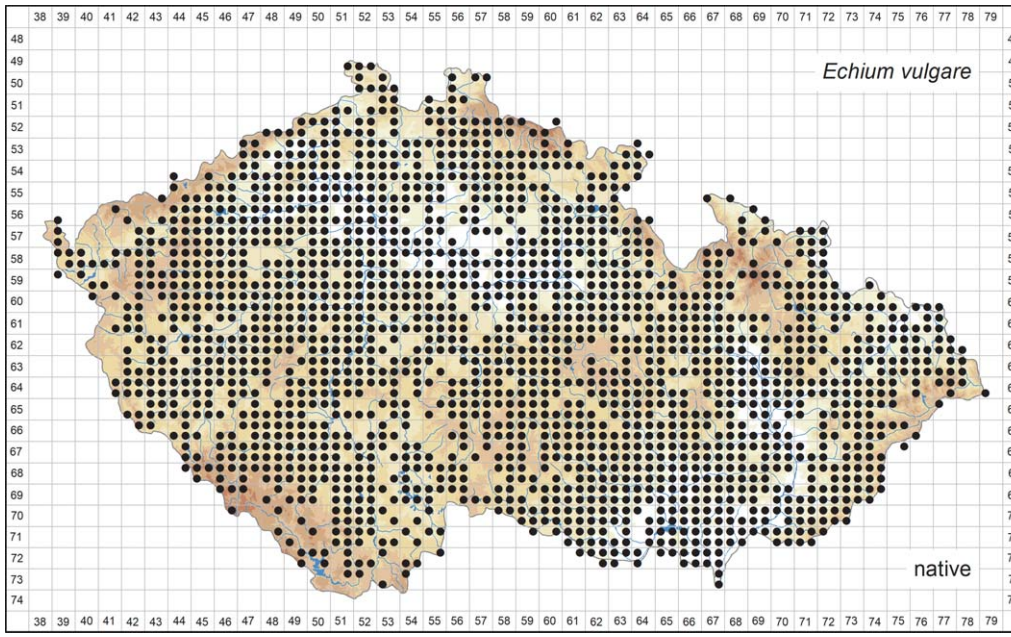

Fig. 22. Distribution of *Echium vulgare* in the Czech Republic (1868 occupied quadrants). Prepared by Zdeněk Kaplan.

not far from Prague in central Bohemia (Klotz 1963, as *E. lycopsis*). Consequently, this species is classified as a casual neophyte (Chrtek 2019, Pyšek et al. 2022). With the increasing popularity of annual flower mixtures during the past two decades, this species has been observed to occur in flower strips along pavements and roads in towns, as well as along paths outside built-up areas. These intentional introductions are not included in the map. However, they may serve as a source of diaspores for future escapes into the landscape.

Echium vulgare (Fig. 22)

Echium vulgare is considered as having originated in the European Mediterranean area and the Pontic region of south-eastern Europe (Hultén & Fries 1986), but it is now widespread across most of Europe (being rare in its northern and eastern parts), with isolated occurrences extending to the Caucasus Mts, central Asia and southern Siberia as far as Lake Baikal; it has also been introduced to northernmost and southern Africa, the Russian Far East, North America and New Zealand (Meusel et al. 1978, Hultén & Fries 1986). In the Czech Republic *E. vulgare* grows in a wide range of habitats, both natural and seminatural, such as rocky slopes, rock outcrops and disturbed dry grasslands, as well as man-made ones including road verges, field edges, fallows, railway stations and embankments, soil and spoil heaps, pastures, abandoned quarries and sand pits, forest clearings, vineyards, waste ground and other ruderal places. It is mostly found on permeable substrates. *Echium vulgare* is distributed across this country from the lowlands up to the low mountains, but occasionally it is introduced even to the high mountains, reaching its elevational maximum at about 1,390 m in the Krkonoše Mts. In contrast, it is rare in or absent from large forest patches and the highest parts of the mountains, where suitable habitats are absent. Many gaps on the map, particularly at low and middle elevations, are likely due to a lack of records rather than true absences, as the ruderal habitats of this species are not particularly attractive to botanists.

Erechtites hieraciifolius (Fig. 23)

Erechtites hieraciifolius is native to the Americas from south-eastern Canada to northern Argentina and Uruguay, where it grows in coniferous, deciduous and mixed forests, particularly in places receiving direct sunlight such as openings, forest edges and along trails (Belcher 1956, Darbyshire et al. 2012). It became a common weed in eastern North America after the great forests were cleared in the early 19th century (Darbyshire et al. 2012). It has been widely introduced into central and south-eastern Europe, China, the Korean Peninsula, Japan, Taiwan, Indonesia, Singapore, Hawaii, Cuba, the Galapagos Islands, New Zealand and a number of islands in Oceania, becoming invasive in some of these places (Darbyshire et al. 2012, Rojas-Sandoval 2017). The earliest record of escaped plants in Europe dates back to 1876 when *E. hieraciifolius* was found in a clearing next to a vineyard near Zagreb in Croatia (Kornhuber & Heimerl 1885). Soon after, in 1895, this species was recorded also in the Czech Republic, namely in the village of Bludov in northern Moravia (Panek 1895). However, *E. hieraciifolius* was previously grown in some central-European botanical gardens, for example in Prague already in the first half of the 19th century (Hadinec 2011), and it cannot be excluded that many of the occurrences in the landscape originated as escapes from such sites due to efficient long-

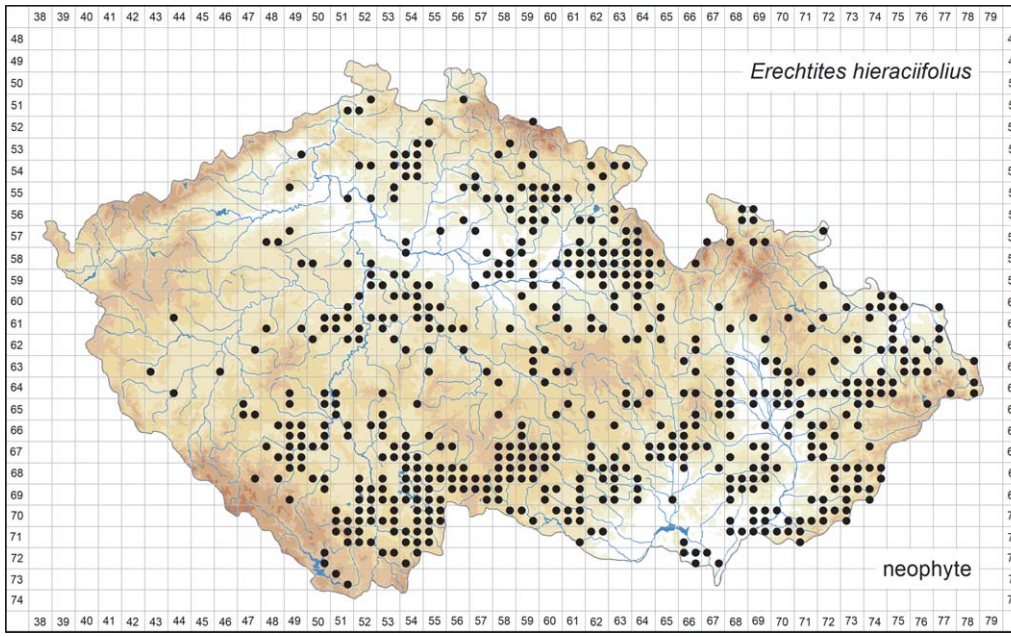

Fig. 23. Distribution of *Erechtites hieraciifolius* in the Czech Republic (576 occupied quadrants). Prepared by Zdeněk Kaplan.

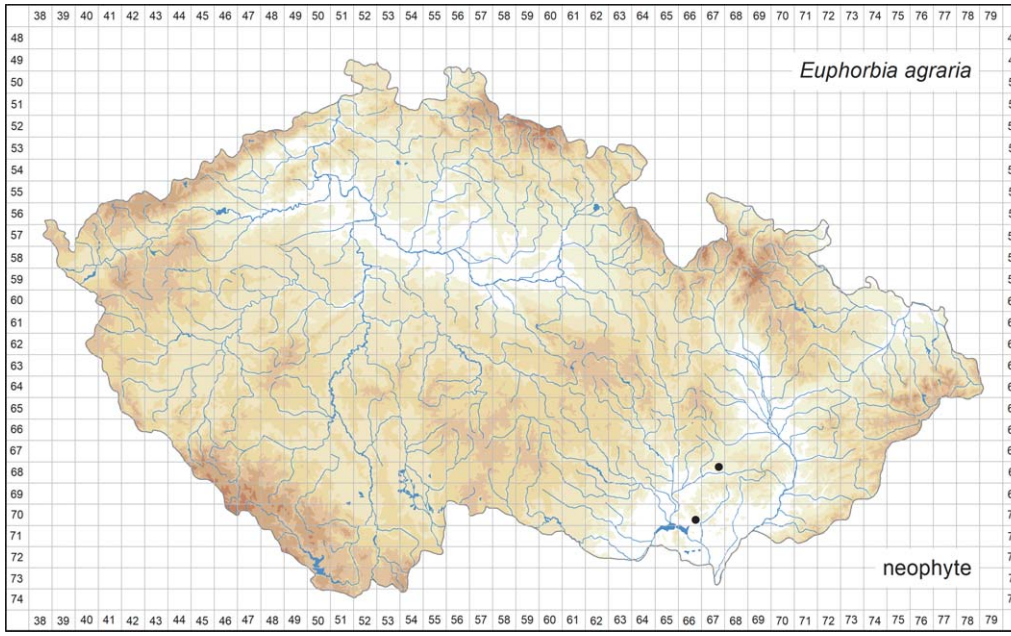

Fig. 24. Distribution of *Euphorbia agraria* in the Czech Republic: ● records since 2000 only (2 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

distance dispersal by wind. For more than a century this species remained rare, but at the beginning of the 21st century the number of records in central Europe rapidly increased (Klotz & Schuhwerk 2009, Hadinec 2011, Krahulec & Hadinec 2011, Celka et al. 2017, Zaniewski et al. 2020), with the spread predominantly in the western direction. *Erechtites hieraciifolius* is now widespread in most of this country, being absent only from most of western Bohemia and locally also elsewhere, particularly in high mountains and deforested agricultural landscapes. Consequently, this neophyte has recently been reclassified from naturalized (Pyšek et al. 2012) to invasive (Kaplan 2019a, Pyšek et al. 2022). The highest concentration of populations is in eastern and southern Bohemia and central and north-eastern Moravia. However, this pattern may be affected by varied recording efforts. The spread of this species is much faster than the recording of new sites by field botanists, thus the distribution map is inevitably incomplete. The vast majority of the occurrences are in forest clearings, where *E. hieraciifolius* often forms abundant populations. However, it has also been recorded in open-canopy forests and in various types of man-made habitats in early successional stages or with regular disturbance such as verges of forest roads, places used for temporary storage of timber, waste grounds, exposed bottoms of drained fishponds as well as flower beds in settlements, where it occurs as a weed. The spread of this species in forest clearings has been facilitated by the increasing extent of this habitat in the landscape due to the recent bark beetle outbreak.

Euphorbia agraria (Fig. 24)

Euphorbia agraria is a perennial species native to the southern and eastern parts of the Balkan Peninsula, Romania, and southern Ukraine including Crimea (Smith & Tutin 1968). There are records of introduced plants from southern Sweden (GBIF 2022) and the Czech Republic. In its native range *E. agraria* occurs in dry grasslands, as a weed on arable land and in vineyards, along roads and on fallow land. There have been two documented records of this species in the Czech Republic, both from southern Moravia: in 2005 it was collected near the village of Komořany (Čáp 2008) and in 2018 near the town of Velké Pavlovice. The plants occurred on fallow land and in scrub along a dirt road. The mode of introduction is unknown. *Euphorbia agraria* is classified as a casual neophyte (Pyšek et al. 2022).

Euphorbia amygdaloides (Fig. 25)

Euphorbia amygdaloides is a mainly European species distributed from the Iberian Peninsula in the west as far as the western coast of the Black Sea in the east, towards the north extending to southern England and slightly beyond 50°N in the continent. It is also found in southern Crimea, the western Caucasus Mts and Transcaucasia, in the mountains flanking the southern coast of the Caspian Sea as well as in the Atlas Mts in Algeria (Meusel et al. 1978). In the Czech Republic *E. amygdaloides* occurs mainly in beech and oak-hornbeam forests, less frequently in Norway spruce plantations that replaced deciduous forests, in forest fringes and scrub. It is sometimes also cultivated for ornament in shady places and around country houses. Soils are usually deep, loamy to clayey, acidic to slightly basic and well supplied with water. *Euphorbia amygdaloides* occurs mainly in the eastern, Carpathian part of the country, in the Moravský kras karst area north of the city of Brno and in the eastern part of the Českomoravská vrchovina highlands. Similar to

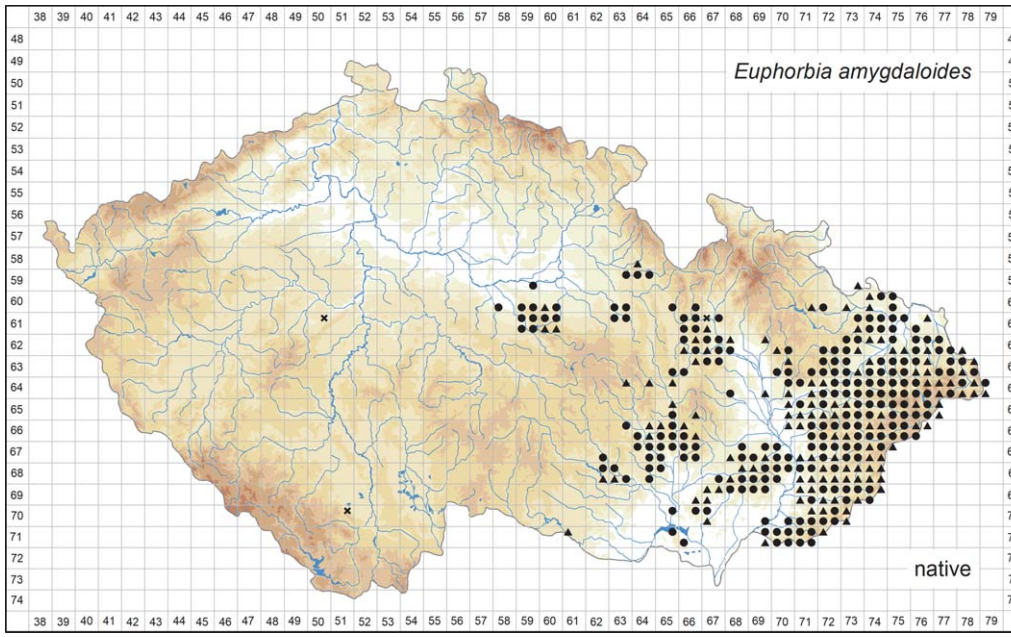

Fig. 25. Distribution of *Euphorbia amygdaloides* in the Czech Republic: ● occurrence documented by herbarium specimens (221 quadrants), ▲ occurrence based on other records (124 quadrants), × alien (3 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

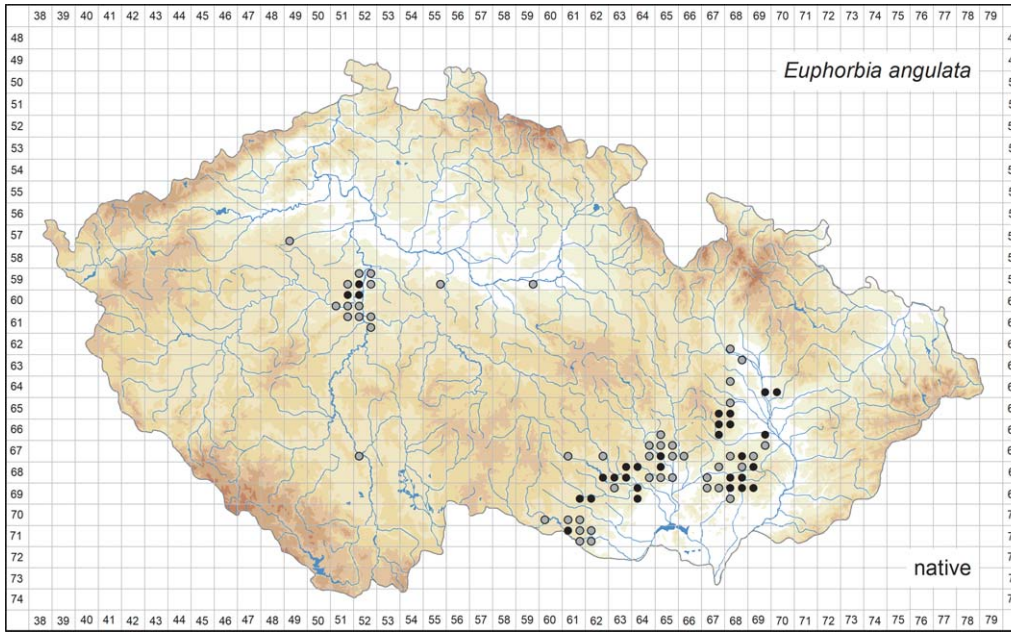

Fig. 26. Distribution of *Euphorbia angulata* in the Czech Republic: ● at least one record in 2000–2022 (29 quadrants), ● pre-2000 records only (50 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

some other plants with regional affinity to the Carpathians, it is also found in eastern Bohemia and the adjacent part of central Moravia; the westernmost indigenous occurrences are in the Železné hory hills. Other records from Bohemia, all situated west of 15°30'E, refer to introduced or escaped plants. *Euphorbia amygdaloides* occurs from the lowlands up to the mountains, reaching its elevational maxima at about 1,050 m in the Moravskoslezské Beskydy Mts on Mt Lysá hora and Mt Velký Polom. It is classified as of lower risk – near threatened (Grulich 2012), probably due to its rarity in the western part of the country.

Euphorbia angulata (Fig. 26)

Euphorbia angulata has a disjunct range extending from the north-western coast of the Iberian Peninsula to the east as far as western Ukraine. The western part of the distribution includes mainly the Cantabrian Mts, western Pyrenees and parts of western France. The eastern part of the range includes the northern part of the Dinarids, easternmost part of the Eastern Alps, the Carpathians and the adjacent parts of western Ukraine. There are isolated occurrences in southern France, central Bohemia and north-eastern Hungary (Meusel et al. 1978). In the Czech Republic *E. angulata* occurs mainly in open-canopy thermophilous oak forests, oak-hornbeam forests, and their fringes, rarely also in scrub communities, usually on slopes. Soils are usually shallow, stony, loamy or loamy sandy, basic to slightly acidic, moderately supplied with water but often drying out later in the season. *Euphorbia angulata* is found mainly in central and south-western Moravia and in the Ždánický les hills and Chřiby hills, as well as in the Brněnská vrchovina highlands and Českomoravská vrchovina highlands in a broad zone between the city of Olomouc and the town of Znojmo. In Bohemia, most of the occurrences are found in the Český kras karst area and along the Vltava river valley south-west and south of Prague. There are also records from five other sites in various parts of Bohemia, some of them rather uncertain and none of them extant. *Euphorbia angulata* occurs from the lowlands up to the middle elevations, reaching its elevational maximum of about 480 m in the Moravanské lúky Nature Reserve in the Chřiby hills in south-eastern Moravia. It is classified as endangered due to its rarity (Grulich 2012).

Euphorbia cyparissias (Fig. 27)

Euphorbia cyparissias is a European species distributed in a broad belt extending eastwards from the western Pyrenees to approximately the 35th meridian in Ukraine, towards the south to southern Italy and southern Bulgaria, towards the north southern England, northern France, southern Sweden, the Baltic Sea coast and Lithuania. The occurrences in the northern part of this range are secondary, and there are records of introduced specimens further towards the north-east and east of the described area (Meusel et al. 1978). It has been introduced into North America, where it has become widely naturalized (Berry et al. 2016), as well as to the Russian Far East, Japan and New Zealand (GBIF 2022). Three cytotypes (diploid, tetraploid and hexaploid) are known within this species, but only tetraploid plants have been found in the Czech Republic (Chrtek & Křísa 1992b, Šmarda et al. 2019). In this country *E. cyparissias* occurs in various types of mesophilous to xerophilous grasslands including dry meadows and pastures, fallow land, semiruderal to ruderal grasslands in settlements, road verges, open-canopy

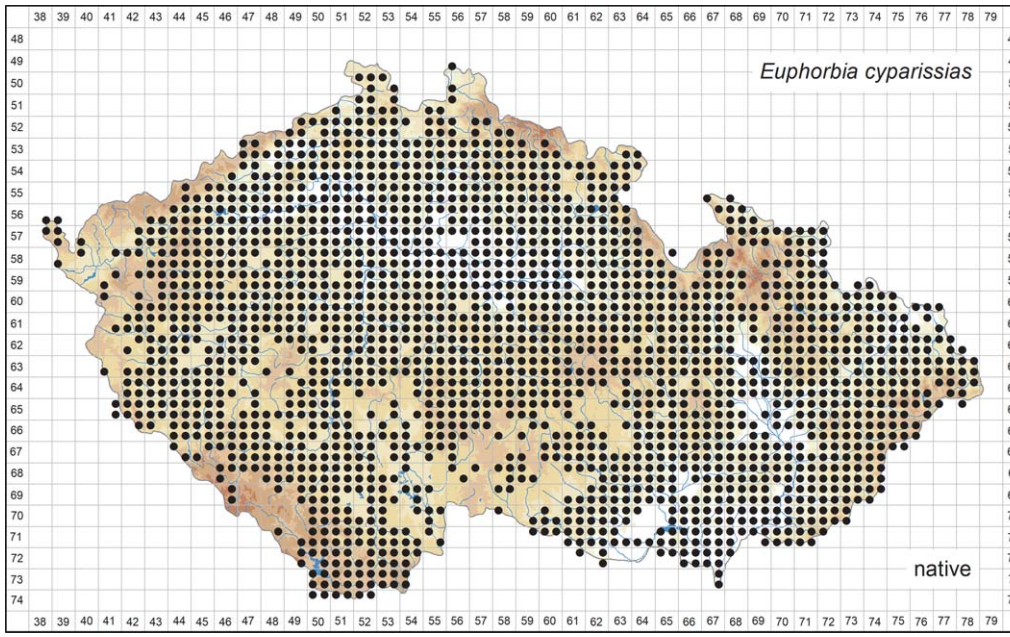

Fig. 27. Distribution of *Euphorbia cyparissias* in the Czech Republic (1973 occupied quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

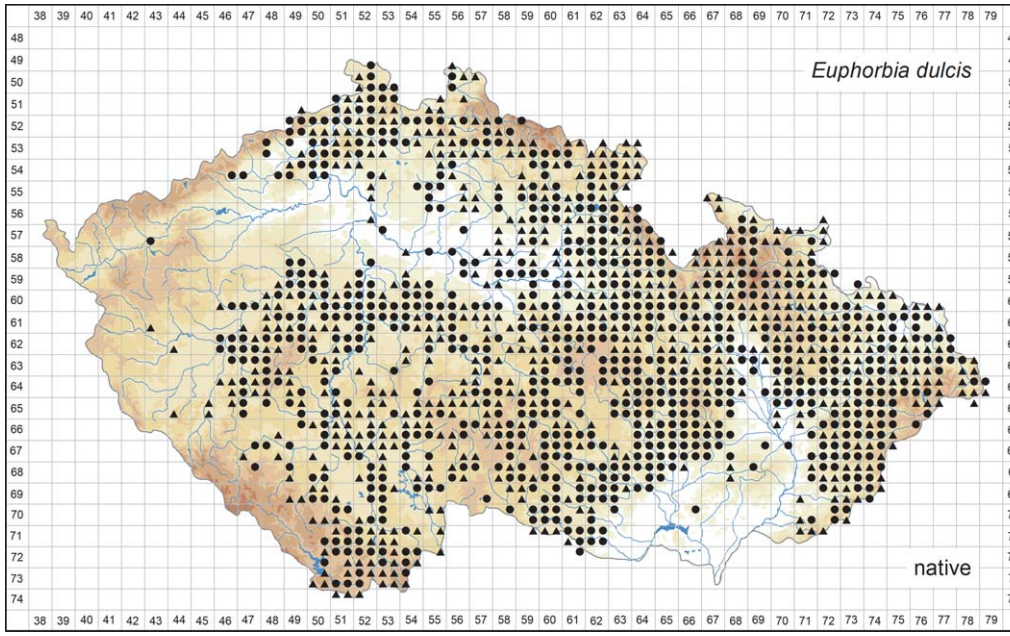

Fig. 28. Distribution of *Euphorbia dulcis* in the Czech Republic: ● occurrence documented by herbarium specimens (750 quadrants), ▲ occurrence based on other records (588 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

deciduous forests and their fringes, pine forests and scrub communities. Soils are usually loamy to sandy, sometimes stony, basic to acidic, moderately supplied with or poor in nutrients and dry to moderately supplied with water. *Euphorbia cyparissias* is widespread in the Czech Republic. It is absent only from high elevations in the mountains along the country's border and probably also from large parts of the Českomoravská vrchovina highlands and some parts of southern and south-western Bohemia, as well as locally from areas in the lowlands lacking suitable habitats. It occurs from the lowlands to the low mountains up to elevations of ~800 m, reaching its elevational maxima at ~1,150 m on Mt Smrčina in the Šumava Mts and at ~1,250 m on Mt Černá hora in the Krkonoše Mts. However, some of the occurrences at rather high elevations may be temporary introductions.

Euphorbia dulcis (Fig. 28)

Euphorbia dulcis is a European species occurring from the north-western part of the Iberian Peninsula in the west as far as western Ukraine in the east, towards the south extending to central Italy and Bosnia and Herzegovina, towards the north Brittany and Normandy in France, central Germany and southern Poland. The occurrences in the British Isles are secondary (Meusel et al. 1978). In the Czech Republic *E. dulcis* occurs in deciduous forests, mainly in hornbeam and beech, less frequently in floodplain and ravine forests, rarely also in coniferous plantations and scrub communities. Soils are usually well supplied with nutrients, rich in humus, slightly basic to slightly acidic. *Euphorbia dulcis* is widespread in the Czech Republic. However, it is absent from the deforested and dry areas in central and north-western Bohemia, and central and southern Moravia due to lack of suitable habitats. It is also almost absent from large parts of western, south-western and southern central Bohemia as well as from the central part of the Českomoravská vrchovina highlands, probably due to the prevalence of acidic rocks and soils poor in nutrients. *Euphorbia dulcis* occurs from the lowlands up to elevations of ~900 m, reaching its elevational maximum at ~1,020 m on Mt Šerlich in the Orlické hory Mts.

Euphorbia epithymoides (Fig. 29)

Euphorbia epithymoides has a rather small native distribution in the south-eastern part of central Europe from Slovenia, eastern Austria, the Czech Republic and southern Slovakia in the north-west to northern Greece, south-western Bulgaria and eastern Serbia in the south-east, with some outposts towards the east, mainly in Transylvania and Moldova (Meusel et al. 1978). This species is quite frequently cultivated for ornament and temporarily escaping, e.g. in the Benelux countries and southern Scandinavia (GBIF 2022) as well as in the USA (Berry et al. 2016). In the Czech Republic *E. epithymoides* occurs in thermophilous oak forests, their fringes and openings, and in dry grasslands on slopes around rock outcrops. It is also rather frequently cultivated for ornament in rock gardens. Its indigenous occurrences in the Czech Republic are restricted to the hilly areas in southern Moravia in the Moravský kras karst area along with the south-eastern margin of the Českomoravská vrchovina highlands, where this species occurs mainly on slopes of river valleys, as well as south-west, south and south-east of the city of Brno. All the remaining occurrences in this country are either garden escapes or specimens planted in the wild largely deliberately, but possibly also introduced with saplings of forest trees. *Euphorbia*

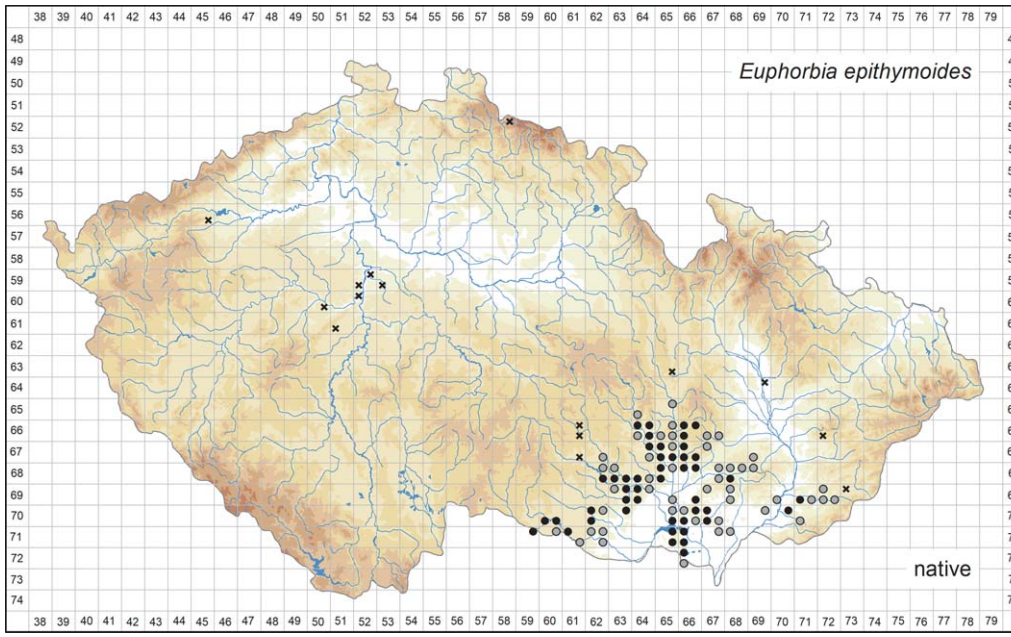

Fig. 29. Distribution of *Euphorbia epithymoides* in the Czech Republic: ● at least one record in 2000–2022 (46 quadrants), ◍ pre-2000 records only (48 quadrants), × alien (15 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

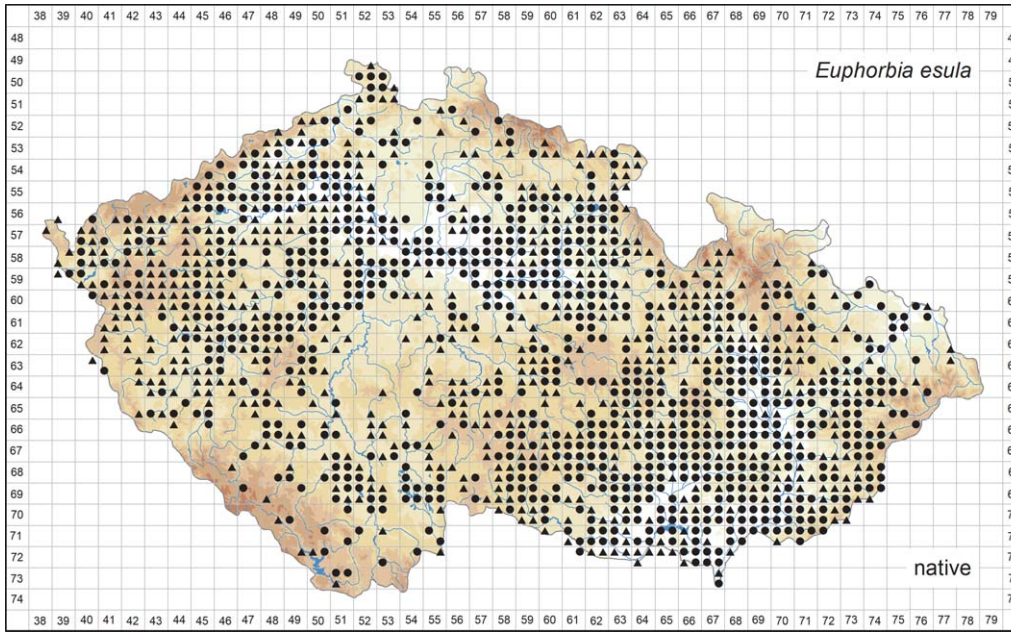

Fig. 30. Distribution of *Euphorbia esula* in the Czech Republic: ● occurrence documented by herbarium specimens (829 quadrants), ▲ occurrence based on other records (594 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

epithymoides reaches its elevational maximum on Děvín hill in the Pavlovské vrchy hills at ~500 m. This species considerably declined mainly due to changes in the management of forests and it is classified as vulnerable (Grulich 2012).

Euphorbia esula (Fig. 30)

Euphorbia esula is a member of a taxonomically difficult polyploid complex with a reticulate relationship consisting of ~10 taxa distributed in the temperate zone in Eurasia from the Pyrenees in the west to the Russian Far East and eastern China in the east (Geltman 1996). The hexaploid *E. esula* is a highly polymorphic and phenotypically plastic species continuously distributed from the Pyrenees in the west to the Volga river in southern European Russia in the east. In the north it occurs in the British Isles (mainly in England), southern Sweden and southern Finland, while the north-eastern limit of its range remains unclear. In southern Europe, there are some occurrences of *E. esula* in the Iberian Peninsula, while it is absent from central and southern Italy and most of the Balkan Peninsula (Meusel et al. 1978). Most of the records from North America probably refer to other taxa, mainly *E. virgata* (Berry et al. 2016) and *E. saratoi*. Chrtek & Křísa (1992b) recognized two subspecies in the Czech flora, i.e. subsp. *esula* and subsp. *riparia*. However, we were not able to recognize the latter subspecies in either herbaria or the field. The records of subsp. *riparia* probably combine tall specimens of *E. esula* and, in small part, plants we reidentified as *E. saratoi*. In the Czech Republic *E. esula* occurs in meadows, pastures, ruderal grasslands and at other ruderal sites in settlements, in road ditches, on roadsides, along railways and dirt roads, and in margins of arable fields. Soils are loamy to sandy, well to moderately supplied with water and nutrients, slightly basic to moderately acidic. *Euphorbia esula* is widespread in the Czech Republic but it is absent from or rare in northernmost central Bohemia, a large part of southern central and southern Bohemia, the Žďárské vrchy hills, as well as northern and north-eastern Moravia and Silesia. These absences probably have various causes, including acidic soils poor in nutrients and a cold climate. Most of the occurrences of *E. esula* are from the lowlands up to elevations of ~700 m. There are several records from elevations of 800–900 m in various parts of this country, but they may at least in part represent temporary occurrences of introduced plants, which is also the case with the record at ~1,300 m from Mt Černá hora in the Krkonoše Mts.

Euphorbia exigua (Fig. 31)

Euphorbia exigua occurs in the western and central parts of Europe, Macaronesia, northernmost Africa and in the Mediterranean parts of western Asia. The eastern limit of its range runs through Latvia, Belorussia, westernmost Ukraine, eastern Romania and Bulgaria (Meusel et al. 1978). It is probably native to the Mediterranean area, while being an archaeophyte or neophyte in central and northern Europe. It has been introduced into North America, where it has become locally naturalized in some coastal provinces and states of Canada and the USA (Berry et al. 2016). Some records exist also from southernmost Australia and New Zealand (GBIF 2022). In the Czech Republic *E. exigua* grows as a weed on arable land, mainly in cereal fields, and in adjacent disturbed grasslands, on fallow land, in waste places, along dirt roads and on other kinds of disturbed ground. Soils are usually loamy, well supplied with nutrients and neutral to basic. *Euphorbia*

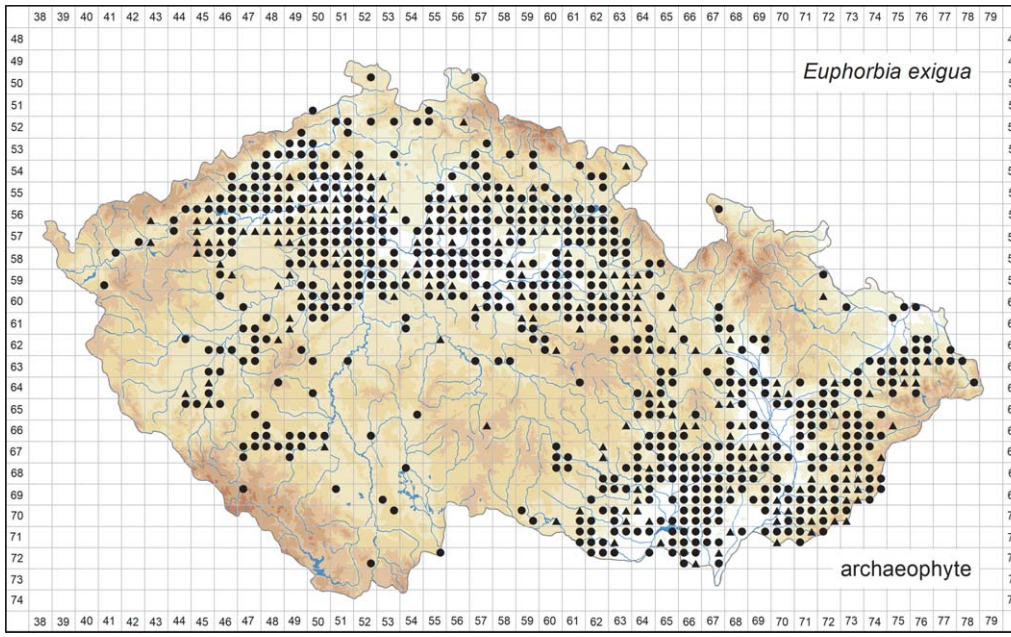

Fig. 31. Distribution of *Euphorbia exigua* in the Czech Republic: ● occurrence documented by herbarium specimens (628 quadrants), ▲ occurrence based on other records (184 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

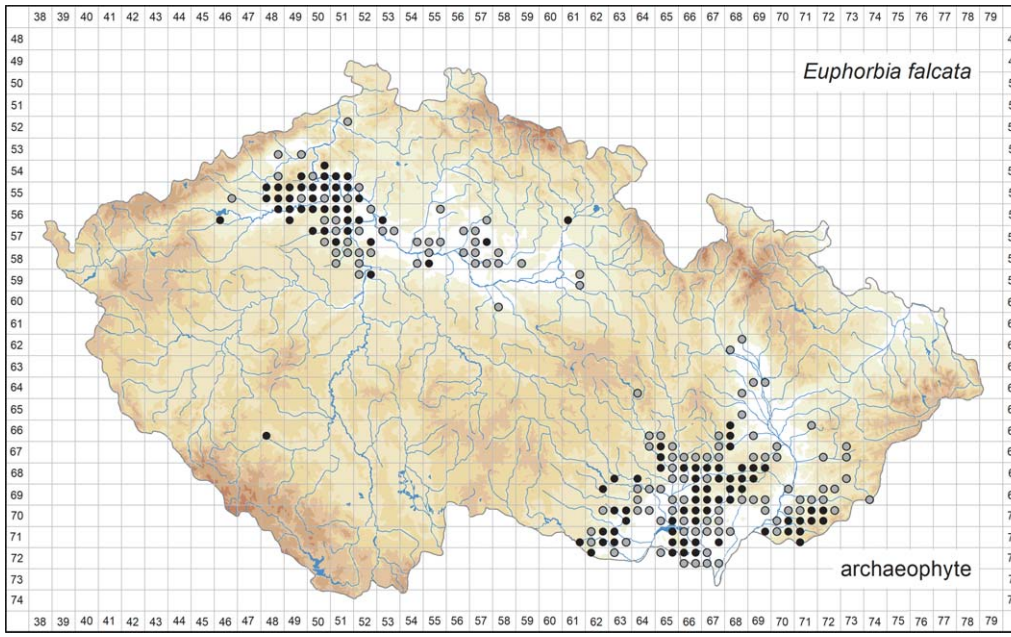

Fig. 32. Distribution of *Euphorbia falcata* in the Czech Republic: ● at least one record in 2000–2022 (102 quadrants), ● pre-2000 records only (124 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

exigua occurs in the lowlands and hilly areas with rather warm, dry climates, while it is absent from or rare elsewhere. The vast majority of records are from elevations below 600 m, with elevational maxima at 650 m on Čepičná hill near the town of Sušice in south-western Bohemia and at 660 m near the village of Lopeník in the Bílé Karpaty Mts. In southern Bohemia in the Šumava Mts near the village of Srní, introduced plants were recorded at an elevation of 930 m but this and similar occurrences are usually temporary. *Euphorbia exigua* is considered a naturalized archaeophyte (Pyšek et al. 2022) and also as of lower risk – near threatened (Grulich 2012), probably due to its occurrence on arable land used for intensive farming.

Euphorbia falcata (Fig. 32)

Euphorbia falcata is distributed in the whole Mediterranean area, western and central Europe, and towards the east through southern Ukraine and southern European Russia as far as south-western and central Asia (Berry et al. 2016, GBIF 2022, POWO 2022). In Europe the occurrences in the Mediterranean area are native, whereas this species is an archaeophyte or neophyte in central and northern Europe. It has been introduced into and has become naturalized in the western USA (Berry et al. 2016). In the Czech Republic *E. falcata* occurs as a weed in the margins of arable fields, on fallow land, along dirt roads and at disturbed semiruderal sites. Soils are loamy or loamy clayey, basic and rich in nutrients. It is particularly typical of weed communities developing later in the season in stubble fields. In the Czech Republic *E. falcata* occurs in the lowlands and hilly areas mainly in north-western, central and eastern Bohemia, and in central and southern Moravia. There are a few records from other parts of this country, but most of these occurrences turned out to be temporary. All records of this species from northern Moravia and Silesia (cf. Cimalová 2006) are erroneous and refer to *E. taurinensis*. *Euphorbia falcata* is considered a naturalized archaeophyte (Pyšek et al. 2022) in this country's flora. It has declined considerably, mainly due to intensification in farming; especially in Bohemia, this species is nowadays rare. Therefore, it is also categorized as endangered (Grulich 2012).

Euphorbia helioscopia (Fig. 33)

Euphorbia helioscopia is probably native to the Mediterranean area and central Europe (Meusel et al. 1978). Nowadays it is an almost cosmopolitan weedy species distributed in areas with temperate climates (Meusel et al. 1978, Berry et al. 2016, GBIF 2022). In the Czech Republic this species occurs as a weed on arable land, particularly in root crops, and at ruderal sites, mainly waste places, on other kinds of disturbed ground, and frequently also as a weed in private gardens and flower beds in public spaces. Soils are usually loamy, moderately acidic to moderately basic, well supplied with nutrients and moderately humid to dry. *Euphorbia helioscopia* is widespread in the Czech Republic, in general associated with arable land. It is absent only from the areas without arable fields, i.e. from the mountains and areas with soils very poor in nutrients. It occurs from the lowlands up to elevations of ~800 m. There are numerous records from higher elevations, with the elevational maximum at ~1,300 m near the Labská bouda mountain chalet in the Krkonoše Mts; however, all such occurrences are temporary introductions, usually with

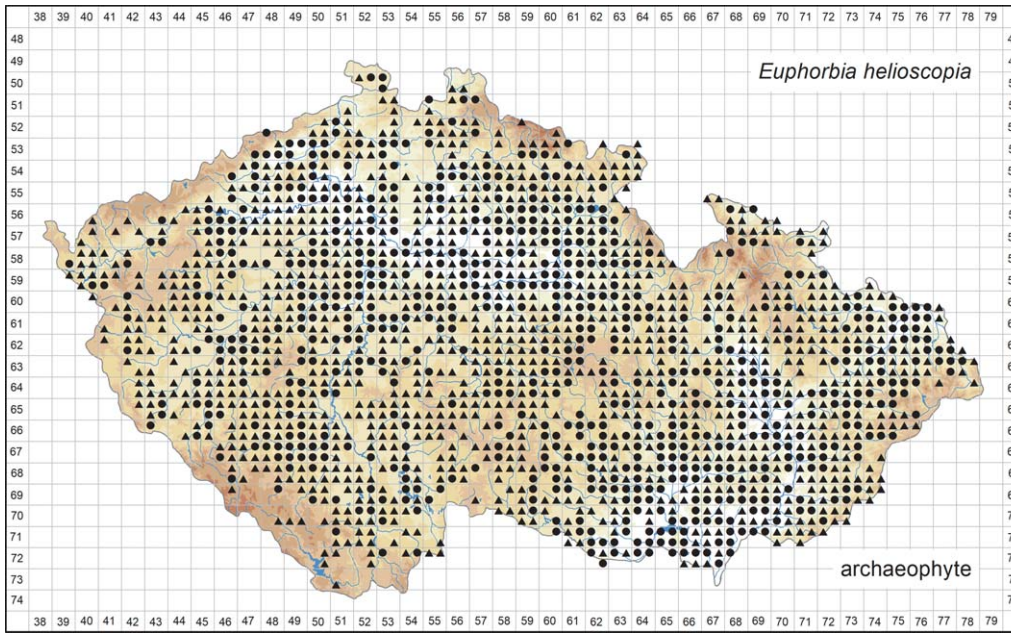

Fig. 33. Distribution of *Euphorbia helioscopia* in the Czech Republic: ● occurrence documented by herbarium specimens (673 quadrants), ▲ occurrence based on other records (1101 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

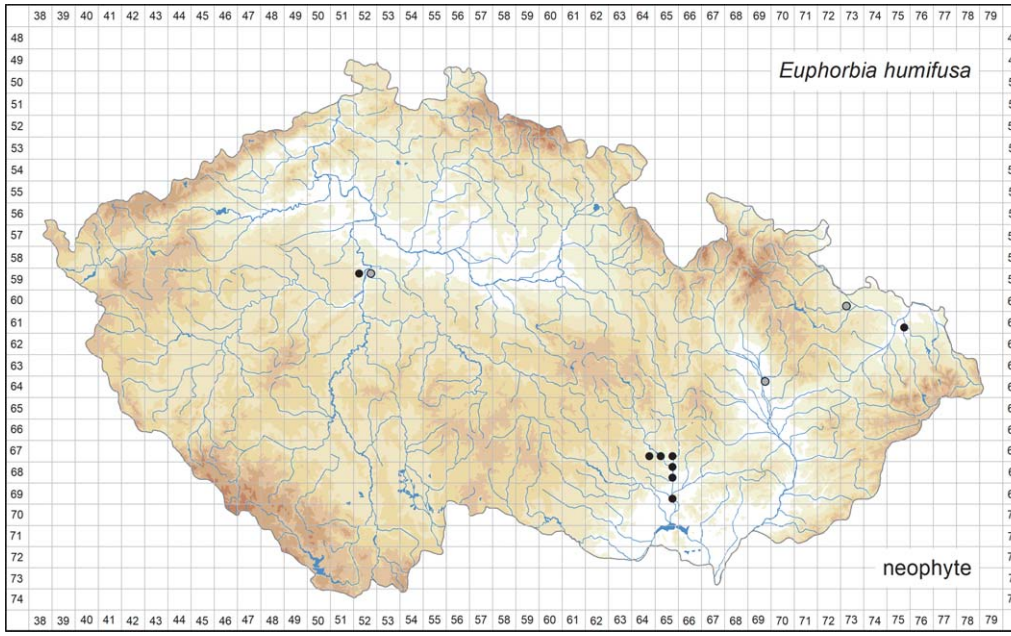

Fig. 34. Distribution of *Euphorbia humifusa* in the Czech Republic: ● at least one record in 2000–2022 (8 quadrants), ◍ pre-2000 records only (3 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

earth or ornamental plants. *Euphorbia helioscopia* is considered a naturalized archaeophyte (Pyšek et al. 2022).

Euphorbia humifusa (Fig. 34)

Euphorbia humifusa is native most likely to south-eastern and central Asia, Siberia and probably also to Transcaucasia, the Caucasus Mts, south-western European Russia and south-eastern Ukraine (Meusel et al. 1978, Hügin 1998). Its secondary range includes most of central Europe, France, Italy and some countries of south-eastern Europe (Hügin 1999, GBIF 2022). In the Czech Republic *E. humifusa* was first collected by K. Domin as a weed in the botanical garden of Charles University in Prague in 1903 (along with *E. maculata*) and identified as *E. chamaesyce* var. *canescens*. Records of weedy plants from the botanical gardens in the cities of Olomouc and Brno followed in 1904 and 1926, respectively; in Brno this species was abundant enough to be collected for an exsiccate series. *Euphorbia humifusa* has been repeatedly collected in this botanical garden since then, co-occurring there with *E. maculata*, but now in rather small numbers. The earliest record from a site outside a botanical garden dates back to 1953, when *E. humifusa* was found in a park near the city centre of Brno. Since the early 2000s the number of records has grown, and now this species has been established at least in Brno. It occurs in pavement joints and cemeteries, probably being spread with ornamental plants. *Euphorbia humifusa* is considered a casual neophyte (Pyšek et al. 2022). In contrast to the information in the latest literature (e.g. Chrtek & Křísa 1992a, Hrouda 2019), we could not confirm the presence of *E. chamaesyce* in the Czech Republic; the records cited therein probably refer partly to this species and partly to *E. maculata*.

Euphorbia illirica (Fig. 35)

Euphorbia illirica is a member of a taxonomically difficult group with a disjunct distribution extending from the Iberian Peninsula in the west as far as the northern foothills of the Altai Mts in the east. In Europe the most widespread taxon is *E. illirica*, with a disjunct range in the Cantabrian Mts in northern Spain, western France, the southern Alps and the western part of the Pannonian lowland, and numerous point occurrences mainly in Romania and the northern part of the Balkan Peninsula (Meusel et al. 1978). *Euphorbia austriaca*, considered as endemic to the Western Alps, and *E. carpatica* and *E. sojakii*, both with small ranges in the eastern Carpathians, probably do not merit specific status (Frajman et al. 2016). In the Czech Republic *E. illirica* grows mainly in fen and other humid meadows, including those drying out later in the season, as well as in open-canopy oak forests and their openings. Soils are humid at least in the spring, usually rich in nutrients, including calcium, and humus. In this country *E. illirica* occurs from the lowlands up elevations of ~450 m, with the elevational maxima at 465 m in the Moravanské lúky Nature Reserve in the Chřiby hills and 520 m near the village of Březová in the Bílé Karpaty Mts. The occurrences of *E. illirica* in this country are restricted to three separate areas. The populations once found in fen meadows near the town of Všetaty in central Bohemia were destroyed with the drainage of the area a long time ago. The occurrences in humid oak forests in eastern-central and eastern Bohemia still exist, but the number of populations was strongly reduced by drainage and inappropriate forestry practices. The third local range is situated in central, southern and south-eastern Moravia. While the

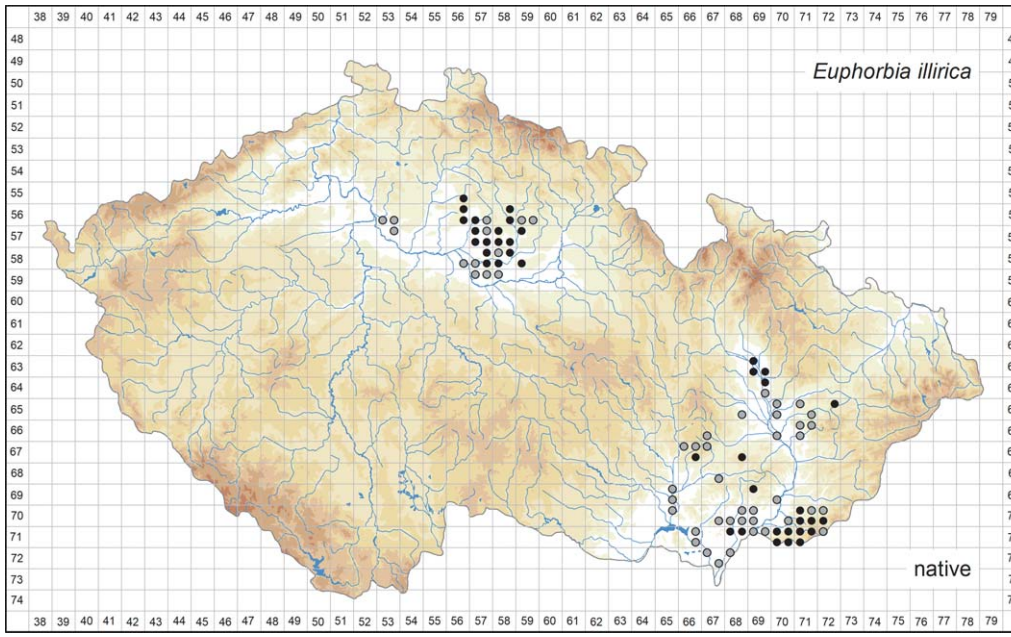

Fig. 35. Distribution of *Euphorbia illirica* in the Czech Republic: ● at least one record in 2000–2022 (39 quadrants), ● pre-2000 records only (49 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

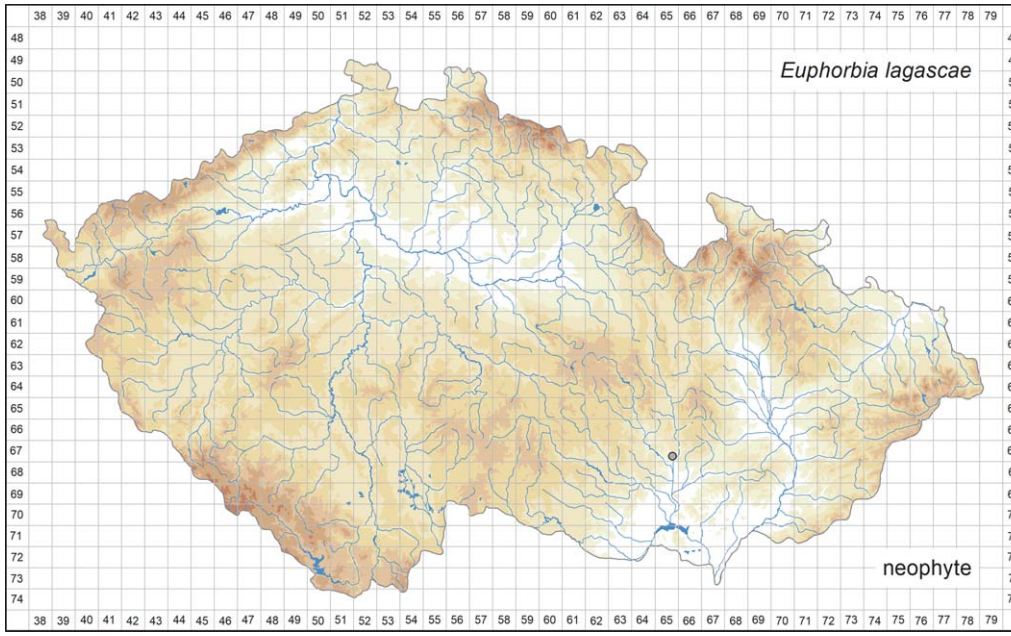

Fig. 36. Distribution of *Euphorbia lagascae* in the Czech Republic: ● pre-2000 records only (1 quadrant). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

occurrences in the floodplains of the Dyje river were destroyed a long time ago, *E. illirica* still survives in several areas, with the largest populations in the open-canopy oak forests north of the town of Hodonín and particularly in the meadows in the Bílé Karpaty Mts. In Moravia, the number of populations and their sizes have been substantially reduced, the causes being the same those described as above. Therefore, *E. illirica* is classified as vulnerable (Grulich 2012).

Euphorbia lagascae (Fig. 36)

Euphorbia lagascae is an annual species native to south-eastern Spain and Sardinia. In its native range this species occurs on disturbed bare ground, in ruderal grasslands and in some other ruderal habitats (Benedí et al. 1997, Pignatti 2017). In 1974 *E. lagascae* was found in the botanical garden of Masaryk University in Brno as a weed in the flower bed with *Caryophyllaceae* species, most likely accidentally introduced. In 1976 all plants were removed, and a year later only a few rather small specimens were observed at the site (Unar 1978). *Euphorbia lagascae* is considered a casual neophyte (Pyšek et al. 2022).

Euphorbia lathyris (Fig. 37)

Euphorbia lathyris is a biennial species frequently cultivated for ornament due to its unusual appearance, escaping and widely naturalized in areas with temperate climates all over the world. Its origin is uncertain: some authors (e.g. Berry et al. 2016) considered it native to the Mediterranean area, or to its eastern and central part (Smith & Tutin 1968), while other authors (e.g. Benedí et al. 1997) place its native range in central Asia and China. In the territory of today's Czech Republic this species has been cultivated for a long time for ornament, and also due to the popular belief that it repels rodents. The earliest dated records of escaped plants are from the 1870s (Čelakovský 1872), but there are some earlier undated specimens of uncertain status. *Euphorbia lathyris* escapes temporarily in gardens, cemeteries, waste places and other kinds of disturbed ground. The records of escaped plants are scattered mainly in the lowlands and at middle elevations all over the country without any geographic pattern. *Euphorbia lathyris* is considered a casual neophyte (Pyšek et al. 2022).

Euphorbia lucida (Fig. 38)

Euphorbia lucida is native to the Pannonian lowland and the Pontic area. North of this area, it occurs in the floodplains of the Odra, Wisła, Bug and Dnipro rivers, including some of their tributaries. Isolated occurrences exist or existed in southern Germany and Bohemia (Slavík 1973). In the Czech Republic *E. lucida* grows mainly in alluvial and other wet meadows, along drainage ditches, in fringes of alluvial forests and rarely also in their openings. Soils are sandy loamy or loamy, wet in the spring but often dry later in the season, neutral to basic, rich in nutrients. *Euphorbia lucida* occurs in the basin of the Labe river in central and eastern Bohemia, and in the floodplains of the Svratka river, lower Dyje river and lower Morava river in southern Moravia. The rather remote occurrences near the town of Mladá Boleslav and east of the city of Pardubice in Bohemia do not exist any longer. The same accounts also for some former occurrences in the river

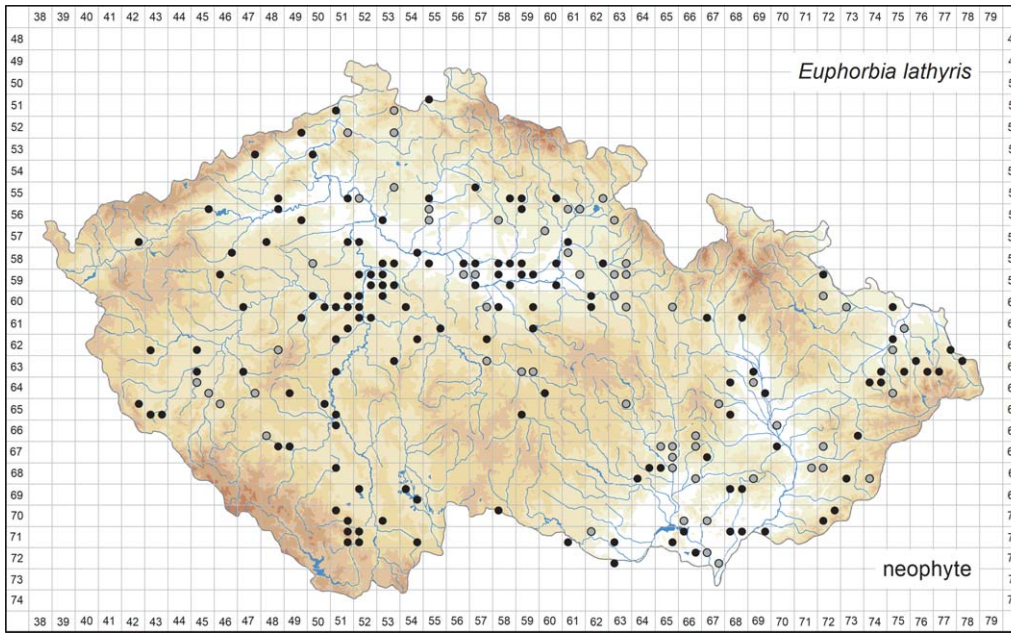

Fig. 37. Distribution of *Euphorbia lathyris* in the Czech Republic: ● at least one record in 2000–2022 (138 quadrants), ◍ pre-2000 records only (60 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

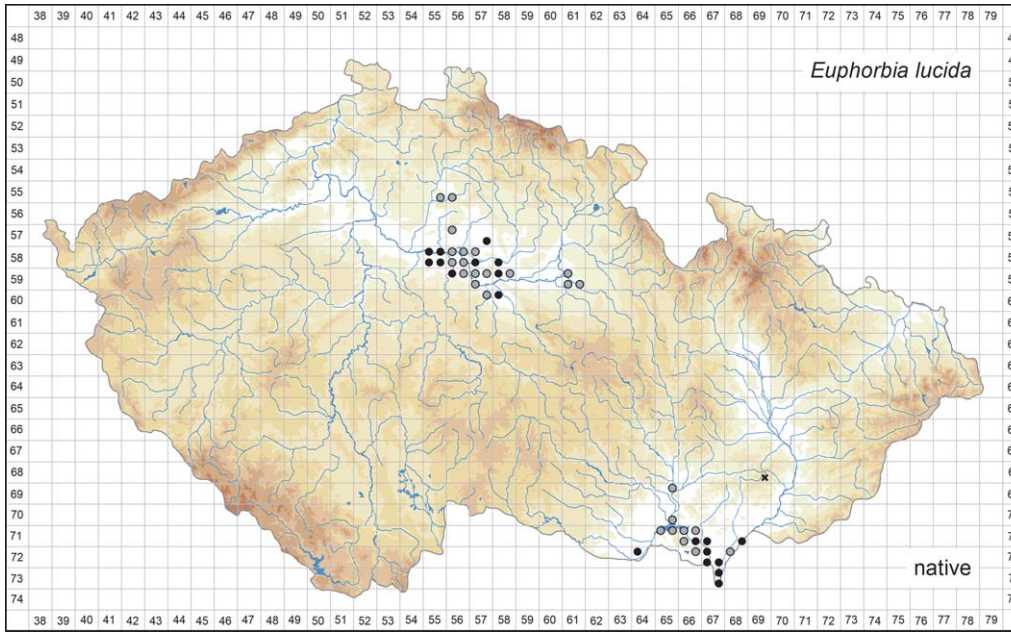

Fig. 38. Distribution of *Euphorbia lucida* in the Czech Republic: ● at least one record in 2000–2022 (19 quadrants), ◍ pre-2000 records only (26 quadrants), × alien (1 quadrant). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

floodplains in southern Moravia, particularly those in meadows nowadays flooded by the Nové Mlýny water reservoirs. Most of the indigenous occurrences are from the lowlands at elevations up to 200 m, with the elevational maximum at 230 m near the village of Dománovice in central Bohemia. The only secondary occurrence known to us, namely from a roadside near the town of Buchlovice in the Chřiby hills, is from the elevation of 380 m. The map is based mainly on herbarium specimens due to numerous misidentifications of *E. illirica* and *E. virgata* as *E. lucida* seen in the herbaria. *Euphorbia lucida* is classified as endangered because of its rarity and recent decline (Grulich 2012).

Euphorbia maculata (Fig. 39)

Euphorbia maculata is native probably to eastern and central North America, but this is uncertain because of its weedy behaviour (Berry et al. 2016). Nowadays it is a cosmopolitan weed widespread in areas with warm temperate climates, and also at high elevations in the tropics (Berry et al. 2016, GBIF 2022). It has been introduced into and has become naturalized in most European countries (Hügin 1999, GBIF 2022). In the Czech Republic *E. maculata* was first collected by K. Domin as a weed in the botanical garden of Charles University in Prague in 1903 (along with *E. humifusa*) and identified as *E. chamaesyce* var. *canescens*. It was collected repeatedly there until 1950. In 1941 it was found in the town of Přerov in central Moravia and in 1950 in the town of Lednice in southern Moravia. Since the early 2000s the number of records has been rapidly growing, first in cities and more recently also in towns and villages. *Euphorbia maculata* is locally naturalized in this country, with a tendency towards invasive behaviour. It is spread from plant nurseries via gardening and flower shops to cemeteries, flower beds in public spaces and private gardens, and from there it colonizes adjacent areas in settlements. The most typical habitats are pavement joints, parts of flower beds and gardens covered by pebbles, trampled bare ground and also railway tracks. *Euphorbia maculata* is considered a naturalized neophyte (Pyšek et al. 2022).

Euphorbia marginata (Fig. 40)

Euphorbia marginata is native to the central USA as far south as Arizona, New Mexico and Texas, and as far east as southern Minnesota, western Iowa and Missouri, elsewhere being naturalized (Berry et al. 2016). It is widely cultivated for ornament, at least temporarily escaping in various parts of the world with temperate climates, including in Europe, eastern Asia, southern America and Australia (GBIF 2022). In the Czech Republic it is cultivated rather frequently and is temporarily escaping, mainly at ruderal sites in settlements, waste places, on fallow land and other disturbed ground. The earliest documented record in this country dates back to 1967, when *E. marginata* was collected in the city of Pardubice in eastern Bohemia. The records of escaped plants are concentrated in areas with rather warm climates, with several records elsewhere. There seems to have been no change in the number of records through time. *Euphorbia marginata* is considered a casual neophyte (Pyšek et al. 2022).

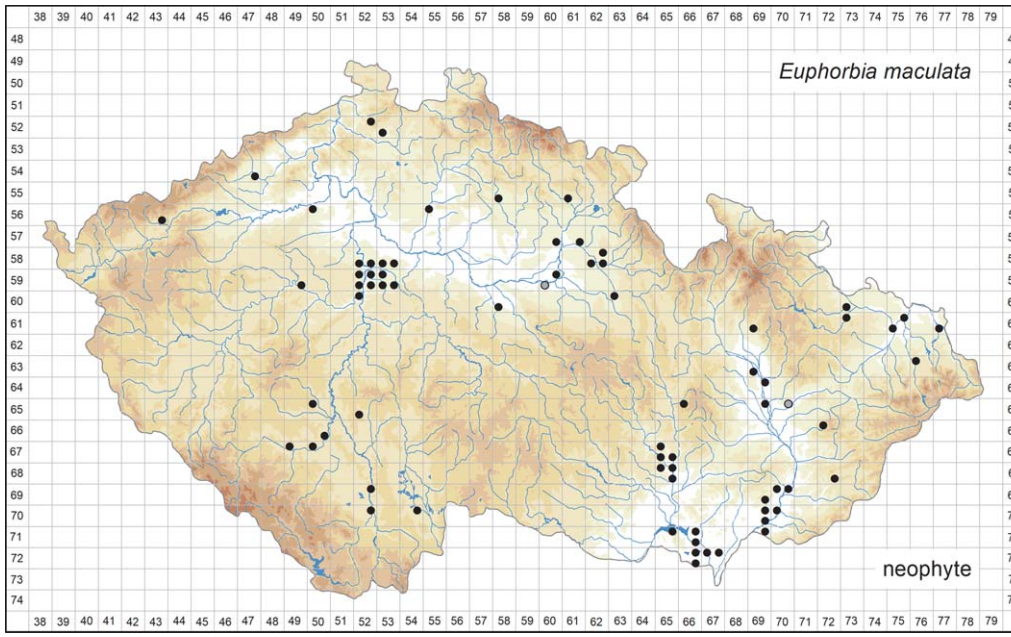

Fig. 39. Distribution of *Euphorbia maculata* in the Czech Republic: ● at least one record in 2000–2022 (70 quadrants), ● pre-2000 records only (2 quadrants). Prepared by Jiří Danihelka, Jan Doležal, Pavel Dřevojan & Michal Ducháček.

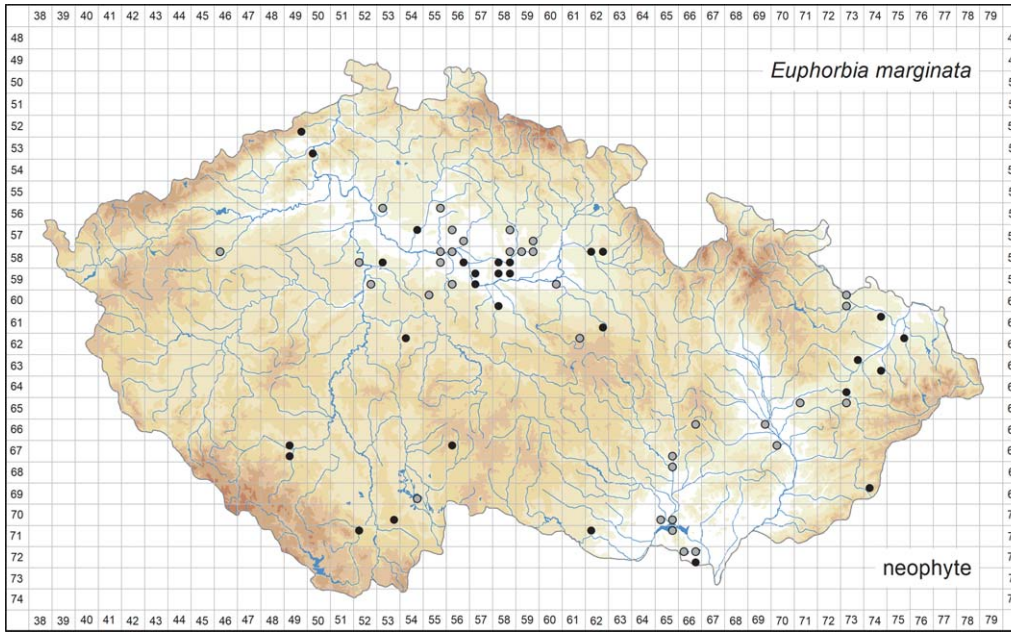

Fig. 40. Distribution of *Euphorbia marginata* in the Czech Republic: ● at least one record in 2000–2022 (29 quadrants), ● pre-2000 records only (34 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

Euphorbia myrsinites (Fig. 41)

Euphorbia myrsinites is native to the Balearic Islands, Italy, the eastern Mediterranean area, the western coast of the Black Sea, Crimea, Transcaucasia and Anatolia (Smith & Tutin 1968, World Checklist of Selected Plant Families 2010). It is widely cultivated for ornament, and escapes from cultivation have been reported from several countries in Europe (e.g. Belgium, Austria and Germany; Peregrym 2020) and North America (Berry et al. 2016). In the Czech Republic *E. myrsinites* has been cultivated for ornament rather frequently, mainly in rock gardens. The earliest find of *E. myrsinites* outside gardens dates back to 1925 when it was collected on limestone rocks near the town of Karlštejn in the Český kras karst area; however, the herbarium label states that the plants were planted at the site. This occurrence does not exist any longer. In 1979–1982 escaped plants were observed on fallow land in the city of Olomouc, probably with no immediate connection to cultivated specimens. Other records of *E. myrsinites* are from abandoned stone quarries and a railway station. *Euphorbia myrsinites* is considered a casual neophyte (Pyšek et al. 2022).

Euphorbia nutans (Fig. 42)

Euphorbia nutans is probably native to central and eastern North America but its indigenous range may be smaller given its aggressive weedy behaviour. It was introduced to the Old World and South America (Berry et al. 2016). There are records of introduced plants in Europe, e.g. from Germany, France, Switzerland, Italy and Austria (Hügin 1999). In its primary area, *E. nutans* occurs on stream banks, at pond edges, disturbed places in prairies, along railways and on roadsides (Berry et al. 2016). In central Europe its usual habitat is gravelly and sandy sites at railway stations (Hügin 1999). In the Czech Republic a single plant was collected in the town of Kolín in a factory processing imported soya beans in 1981 by V. Jehlík and colleagues. The plant was identified correctly as *Chamaesyce nutans*, but the record remained unpublished. The second record is from 2022, when a single plant was found at the Borohrádek railway station in eastern Bohemia, probably introduced with bauxite from Montenegro or Bosnia and Herzegovina. *Euphorbia nutans* is classified as a casual neophyte (Pyšek et al. 2022).

Euphorbia palustris (Fig. 43)

Euphorbia palustris is a European species with a strongly disjunct range extending from the northern Iberian Peninsula in the west as far as the Volga and Ural rivers in the east. Towards the north it reaches southernmost Scandinavia, towards the south, northern Italy and the northern part of the Balkan Peninsula, while there are some outposts situated more southwardly (Meusel et al. 1978). In the Czech Republic *E. palustris* grows in wet, usually alluvial meadows, around temporary alluvial pools, in alluvial shrub communities and in openings and fringes of alluvial forests. Soils are wet at least in the spring, neutral to basic, rich in nutrients and sometimes in humus. In this country *E. palustris* occurs only in the lowlands in the floodplains of the Labe river in central Bohemia and of the Svratka, Dyje and Morava rivers in southern Moravia, reaching its elevational maximum at ~225 m near the village of Velké Kolodějе in eastern Bohemia and at ~195 m near the town of Chropyně in central Moravia. The occurrences in Bohemia were found along the

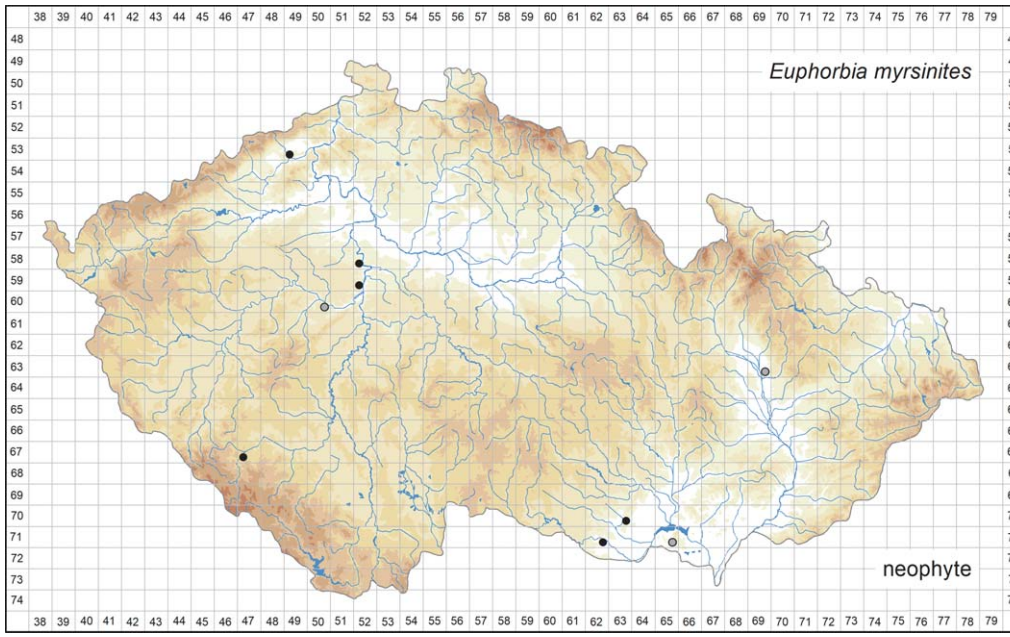

Fig. 41. Distribution of *Euphorbia myrsinites* in the Czech Republic: ● at least one record in 2000–2022 (6 quadrants), ◍ pre-2000 records only (3 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

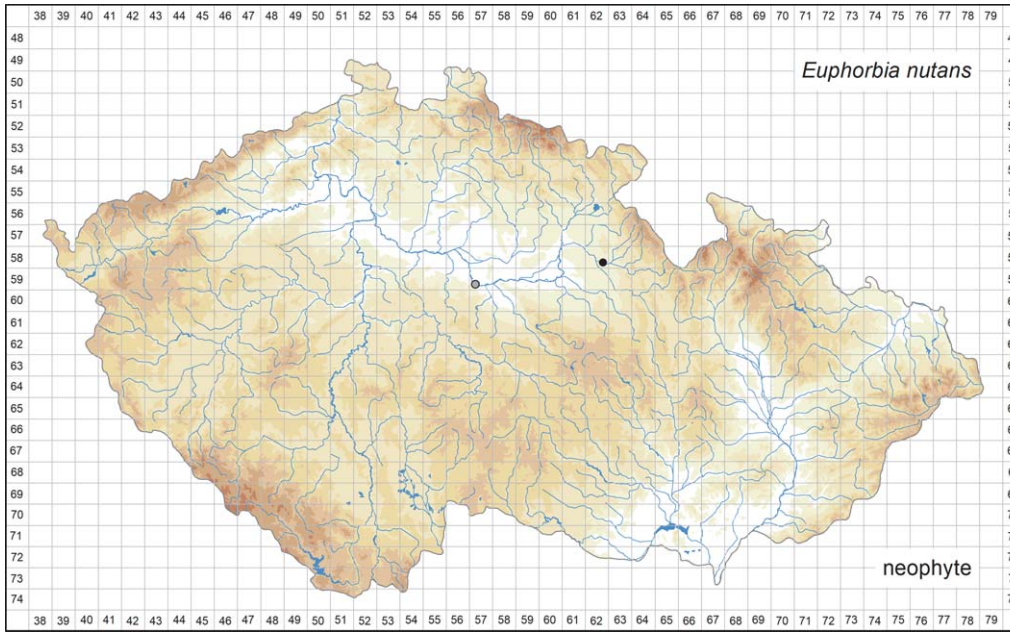

Fig. 42. Distribution of *Euphorbia nutans* in the Czech Republic: ● at least one record in 2000–2022 (1 quadrant), ◍ pre-2000 records only (1 quadrant). Prepared by Jiří Danihelka, Jan Doležal, Pavel Dřevojan & Michal Ducháček.

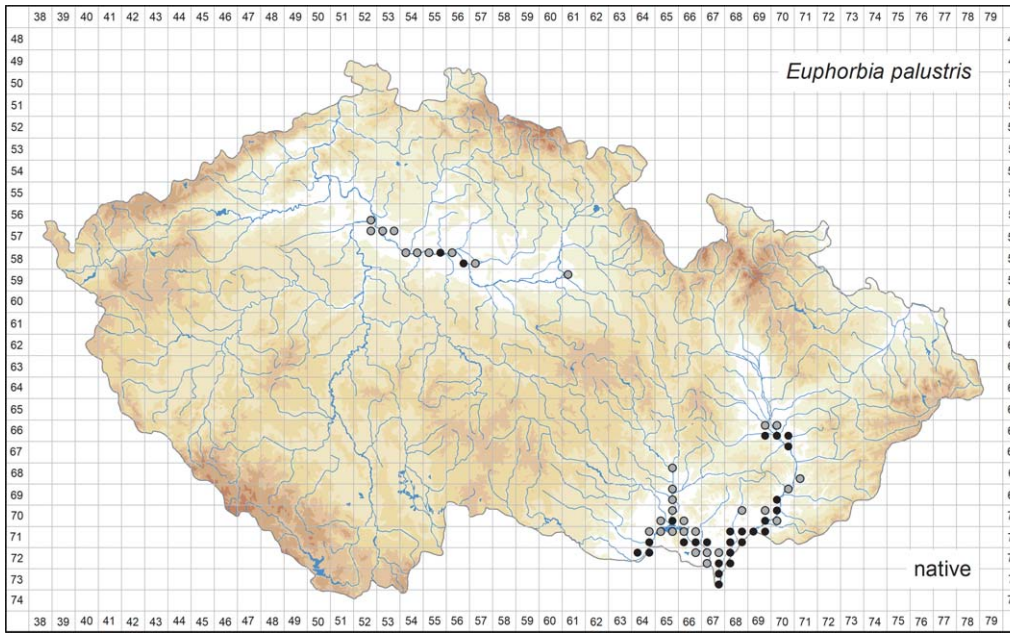

Fig. 43. Distribution of *Euphorbia palustris* in the Czech Republic: ● at least one record in 2000–2022 (27 quadrants), ● pre-2000 records only (32 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

Labe river between the towns of Nymburk and Mělník, with one outpost on the Loučná river east of the city of Pardubice, where *E. palustris* co-occurred with *E. lucida*. Most occurrences of this species in Bohemia disappeared, mainly due to river channelization, and probably only four populations have been preserved until recently. In Moravia the occurrences along the Svratka river were reduced to a single population and there was a strong decline also in the populations along the Dyje and Morava river, mainly due to drainage and river channelization. Still, *E. palustris* is locally common in the floodplains south of the towns of Břeclav and Lanžhot. It is classified as vulnerable (Grulich 2012) but may deserve reclassification as endangered due to its decline.

Euphorbia peplus (Fig. 44)

Euphorbia peplus is an annual species probably native to the Mediterranean and sub-Mediterranean area. Nowadays it is a weed naturalized in areas with temperate and oceanic climates all over the world (Meusel et al. 1978, Berry et al. 2016, GBIF 2022). In the Czech Republic *E. peplus* occurs mainly as a weed in vegetable and flower beds in settlements, in ruderal habitats and other kinds of disturbed ground, less frequently also as a weed on arable land. Soils are sandy to loamy, slightly basic to moderately acidic, well supplied with nutrients and water. *Euphorbia peplus* is widespread in the Czech Republic, occurring from the lowlands up to elevations of about 700 m. It is generally absent from or rare in the mountains and areas with soils poor in nutrients, such as large parts of the Českomoravská vrchovina highlands, and its occurrences in such areas are restricted

to gardens and public spaces in settlements and are only temporary. *Euphorbia peplus* is considered a naturalized archaeophyte (Pyšek et al. 2022).

Euphorbia platyphyllos (Fig. 45)

Euphorbia platyphyllos is native to western, southern and central Europe, towards the north extending to northern Germany and central Poland, and towards the east as far as western Ukraine and Crimea. The occurrences in the British Isles, Netherlands and Denmark are secondary (Smith & Tutin 1968, GBIF 2022). It has been introduced into and has become naturalized in the areas of temperate climates in the Americas, southern Australia and New Zealand (Berry et al. 2016, Benedí et al. 1997, GBIF 2022). Rather small, densely hairy plants (mainly on the lower side of the leaves) are traditionally separated as subsp. *literata* (e.g. Chrtek & Křísa 1992b, World Checklist of Selected Plant Families 2010) but their taxonomic value seems to be rather low. They are reported to occur commonly in the Mediterranean area (GBIF 2022) and to lesser degree in central Europe, including the Czech Republic (Chrtek & Křísa 1992b). This record in this country is based on a single specimen collected near the town of Nové Město nad Metují in north-eastern Bohemia, now probably lost. Here we do not accept subsp. *literata* as a separate taxon. In the Czech Republic *E. platyphyllos* grows on stream and river banks, along dirt roads, as a weed on arable land, on fallow land, waste places and other kinds of disturbed ground. Soils are usually loamy, rich in nutrients, sometimes even saline, neutral to basic, and are generally wet in the spring. In this country *E. platyphyllos* occurs in Bohemia in its lowlands and adjacent north-western, central and eastern parts, as well as in the lowlands and hilly areas of Moravia and Silesia. In this area it is scattered to locally common. In addition, there are a few records of temporary introduced plants from other parts of the country. While this species reaches its elevational maximum at ~600 m above the village of Bílá in the Moravskoslezské Beskydy Mts, most of its occurrences are situated at elevations below ~450 m.

Euphorbia prostrata (Fig. 46)

Euphorbia prostrata is native to the tropical Americas and probably also the southernmost USA. Nowadays it is a cosmopolitan species naturalized over most of the tropics (Berry et al. 2016). It also occurs over most of the European Mediterranean area, where it has been naturalized as well, and western and central Europe, where some of the occurrences in areas with rather cold climates are probably temporary (Hügin 1999, GBIF 2022). In the Czech Republic *E. prostrata* was first found in 2013 in a parking lot of a shopping centre at the outskirts in the city of Olomouc and in the marshalling yard of Mariánské Hory in the city of Ostrava (Hlisnikovský 2014). Since then *E. prostrata* has been recorded at ~17 sites all over the country, and it has become the second most widespread *Euphorbia* of the section *Anisophyllum* after *E. maculata*. *Euphorbia prostrata* grows mainly in pavement joints in settlements, in cemeteries, as a weed in flower beds and flower-pots in towns, and in plant nurseries. This species seems to be locally naturalized in Prague and probably also elsewhere, mainly in plant nurseries, from where it is spread with plants. It has been considered a casual neophyte (Pyšek et al. 2022).

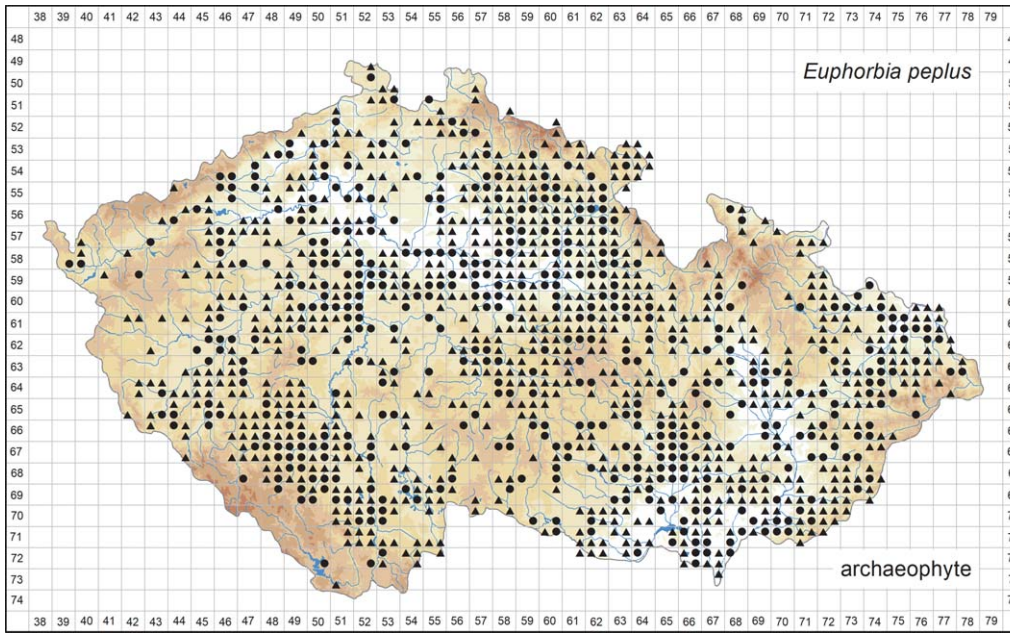

Fig. 44. Distribution of *Euphorbia peplus* in the Czech Republic: ● occurrence documented by herbarium specimens (455 quadrants), ▲ occurrence based on other records (802 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

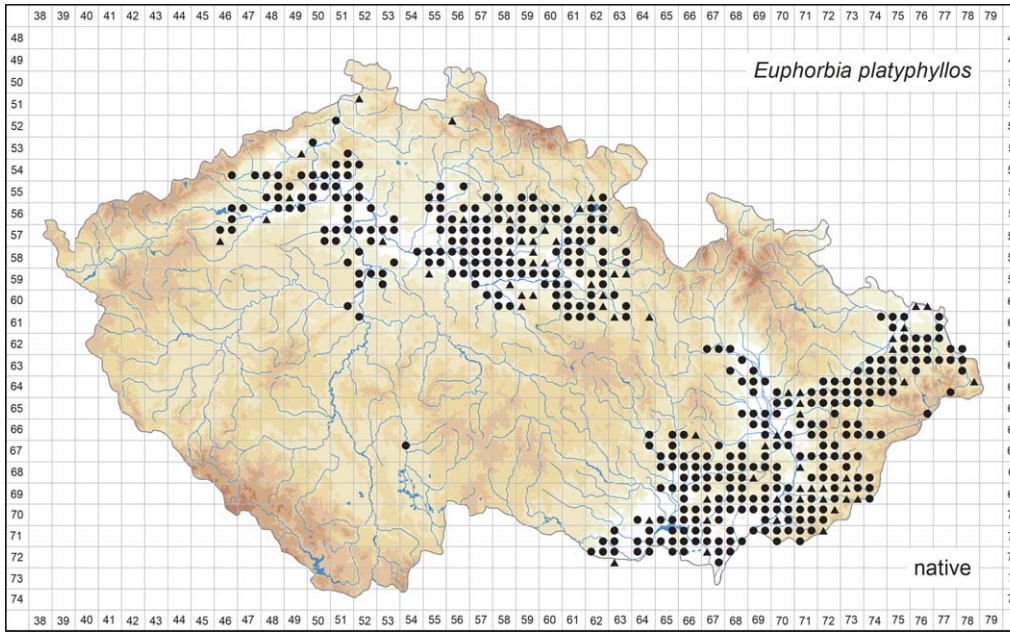

Fig. 45. Distribution of *Euphorbia platyphyllos* in the Czech Republic: ● occurrence documented by herbarium specimens (395 quadrants), ▲ occurrence based on other records (65 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

Euphorbia salicifolia (Fig. 47)

Euphorbia salicifolia is native to central Europe, the Balkan Peninsula, Romania and western Ukraine, reaching its north-western distribution limit in eastern Austria, southern Moravia and southern Slovakia (Smith & Tutin 1968). As a neophyte, it has been recorded, for instance, in Bavaria and southern Sweden (GBIF 2022). In the Czech Republic *E. salicifolia* grows in dry grasslands and open scrub and adjacent fringes. Soils are loamy, basic and rather dry. This species occurs only in southern Moravia where it is known from three sites. One, in the Moravský kras karst area north-east of the city of Brno, was discovered in 1977 and comprises two distinct stands about 300 m from each other. Another site is on slopes above the town of Újezd u Brna and was discovered in the 1850s, whereas the third, near the village of Kožušice in southern Moravia, was first discovered in 1956 and independently rediscovered in 2020. These localities are situated at the north-western edge of this species' range. In addition to these natural occurrences of the species, it has also been found along the railway near the village of Počeplice in northern Bohemia in 1993, presumably resulting from accidental introduction. The purported record of *E. salicifolia* from iron ore yards in the town of Třinec in Silesia is erroneous as it is based on misidentified specimens of *E. seguieriana* (Danihelka & Hlisnikovský 2021b). *Euphorbia salicifolia* is classified as critically threatened because of its rarity (Grulich 2012).

Euphorbia saratoi (Fig. 48)

Euphorbia saratoi is an insufficiently known hexaploid species, closely related and similar to the hexaploid *E. esula* and the diploid *E. virgata*. Morphologically it resembles the latter more than the former, and some poorly collected specimens are difficult to distinguish from *E. virgata*. The main character is, apart from the different ploidy, the leaf shape and its general habit as at most sites *E. saratoi* is usually taller than *E. virgata* (Reichert et al. 2018). In the past, specimens of *E. saratoi* were sometimes identified as hybrids of *E. esula* and *E. virgata*; indeed, the type of the name *E.* ×*intercedens* (Podpěra 1922) corresponds to *E. saratoi*. In the Key to the flora of the Czech Republic (Hrouda 2019) this taxon is included under the name *E.* ×*pseudovirgata*. In our opinion, *E. saratoi* is probably native to eastern Ukraine, central and southern European Russia, north-western Kazakhstan and western Siberia, where it is mostly identified as *E. virgata*. It has been introduced into and has become naturalized in most countries of central and western Europe, southern Scandinavia, parts of Asia with temperate climates and North America (Reichert et al. 2018). In the territory of today's Czech Republic *E. saratoi* was first collected in the mid-19th century near the town of Náměšť nad Oslavou (Reichert et al. 2018), whereas the first dated specimen was collected in 1902 or 1903 at the railway station Martinice v Krkonoších or near the town of Jilemnice in north-eastern Bohemia. It occurs at various kinds of man-made and disturbed sites, mainly in and around railway stations, on railway embankments, roadsides, in road ditches, on waste places, in abandoned stone quarries, rarely also in open scrub and abandoned pastures. The species is widespread in the Czech Republic, but the records show no clear pattern apart from being associated with railways, roads and industrial areas with high proportions of disturbed habitats. At some sites the occurrences of *E. saratoi* lasted for several decades: near the railway station in the town of Protivín in southern Bohemia it was repeatedly collected in

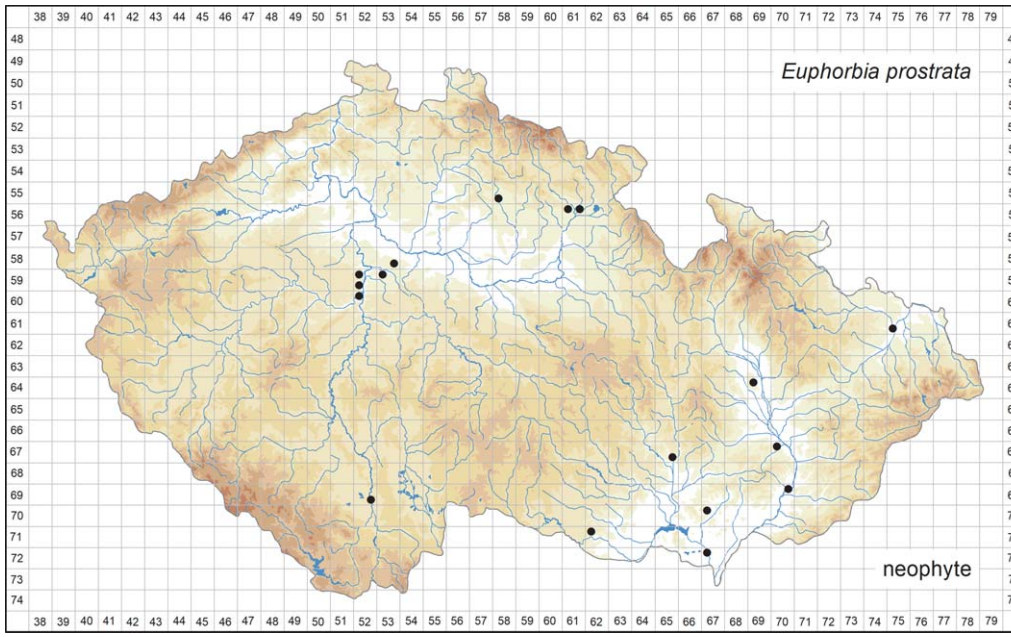

Fig. 46. Distribution of *Euphorbia prostrata* in the Czech Republic: ● records since 2000 only (17 quadrants). Prepared by Jiří Danihelka, Jan Doležal, Pavel Dřevojan & Michal Ducháček.

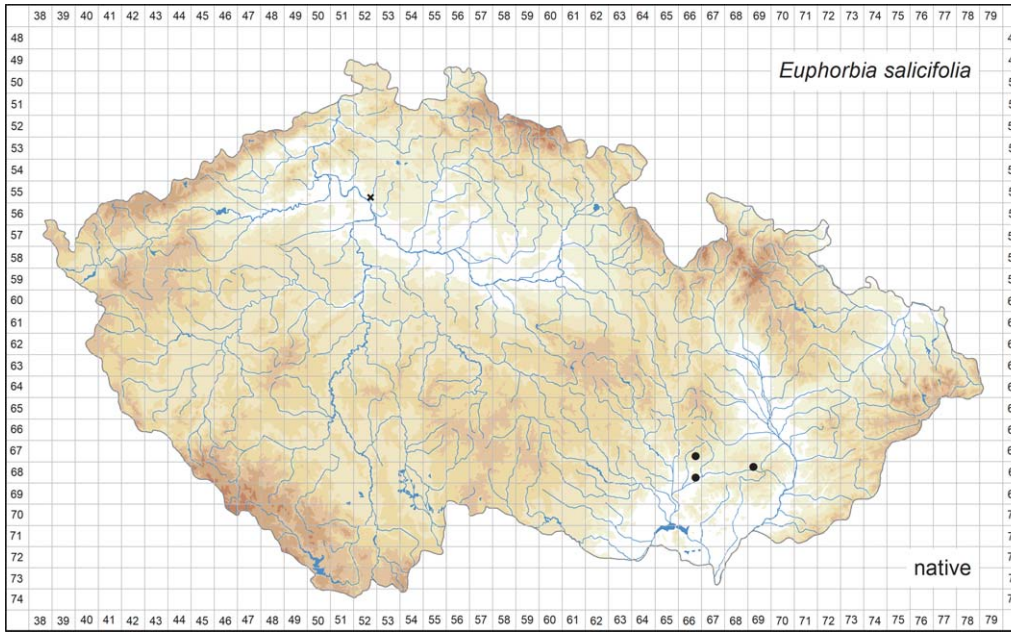

Fig. 47. Distribution of *Euphorbia salicifolia* in the Czech Republic: ● native, at least one record in 2000–2022 (3 quadrants), × alien (1 quadrant). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

1966–2022 and in the limestone quarries near the village of Grygov in central Moravia in 1921–1964. The map is based on studied herbarium specimens and also on plants with ploidy levels estimated by flow cytometry. *Euphorbia saratoi* is classified as a naturalized neophyte (Pyšek et al. 2022).

Euphorbia seguieriana (Fig. 49)

Euphorbia seguieriana is a Eurasian species occurring from eastern Spain to the Altai Mts. Whereas its distribution in the steppe zone in eastern Europe and western Siberia is rather continuous, the range in central and western Europe is disjunct, consisting of three separate areas mainly in France, the Pannonian lowland and adjacent areas, and the Balkan Peninsula. It occurs also in westernmost and eastern Anatolia, the Caucasus Mts and Transcaucasia, northern Iran and Afghanistan (Meusel et al. 1978). Its populations from the Balkan Peninsula and western Asia are usually separated as subsp. *niciciana* (Smith & Tutin 1968), which was recently confirmed by Frajman et al. (2019), who even suggested distinguishing them at the species level; in addition, they described a new subspecies, subsp. *armeniaca*, to accommodate the populations from the western part of the Asian species' range. The populations in central Europe, though morphologically rather varied, pertain to subsp. *seguieriana*. *Euphorbia seguieriana* subsp. *minor*, recognized, for instance, by Chrtek & Křísa (1992b), probably does not merit taxonomic recognition. These rather dwarf plants from rocky habitats on serpentinite near the town of Mohelno in south-western Moravia and from dolomitic limestone in the Pavlovské vrchy hills in southern Moravia represent most likely habitat-related modifications, while the taxonomic identity of tall plants with inflorescences consisting of numerous rays introduced to Silesia and north-eastern Moravia with iron ore, reportedly from the environs of the city of Kryvyi Rih in southern Ukraine, remains uncertain although they allegedly originated from the range of subsp. *seguieriana* (Frajman et al. 2019). The same accounts for plants recently cultivated for ornament in private gardens and in public spaces. In the Czech Republic *E. seguieriana* grows mainly in dry grasslands, usually on rocky slopes, former sand dunes and other sandy substrates, in open-canopy pine forests, their fringes, openings and clearings, and less frequently on road verges. Soils are stony or sandy, slightly acidic to basic, invariably permeable and dry. The native occurrences of *E. seguieriana* in the Czech Republic are restricted to two areas, one each in Bohemia and Moravia. In Bohemia its occurrences are found along the Vltava and Labe rivers from Prague in the south as far as the town of Děčín in the north, with some outposts at sandy sites towards the west and east. Most of these occurrences vanished a long time ago. In Moravia this species occurs in dry grasslands and in open-canopy pine forests near Mohelno in south-western Moravia, on Šibeniční vrch hill south of the town of Mikulov and on steppe slopes on loess and on eolic sand deposits between the towns of Klobouky u Brna and Bzenec, both in southern Moravia. Czech occurrences are situated at the northern limit of this species' range. There are also records of introduced plants from the iron ore yards and railways near the city of Olomouc and in the industrial area in north-eastern Moravia and Silesia; in the town of Třinec, where *E. seguieriana* was first recorded in 1959, a vital population still exists. *Euphorbia seguieriana* is classified as endangered because of its rarity and decline, while subsp. *minor*, not recognized here, is considered even as critically threatened due to its rarity (Grulich 2012).

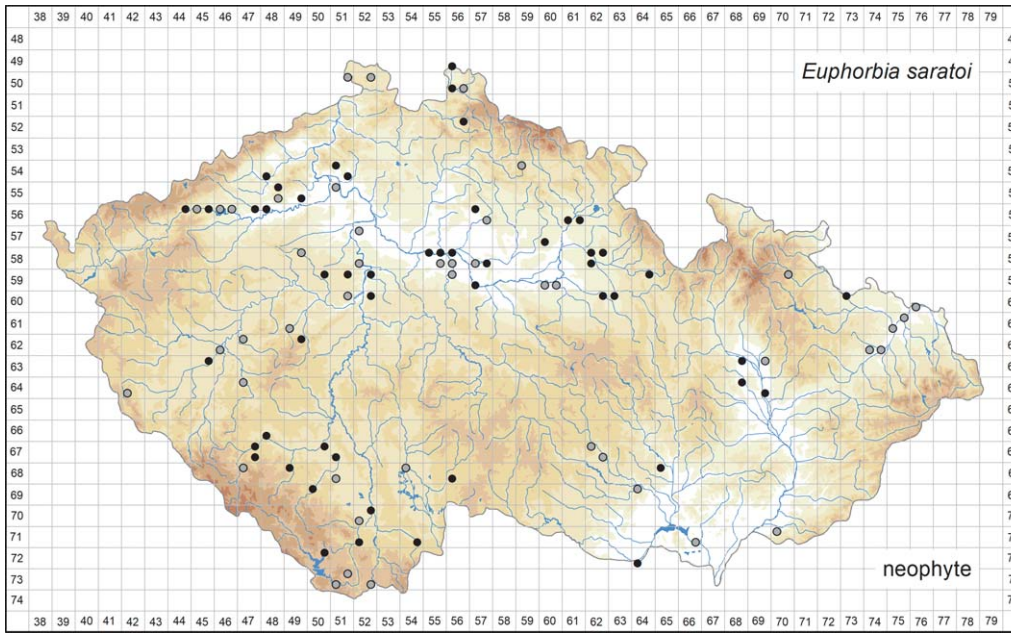

Fig. 48. Distribution of *Euphorbia saratoi* in the Czech Republic: ● at least one record in 2000–2022 (51 quadrants), ◍ pre-2000 records only (44 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

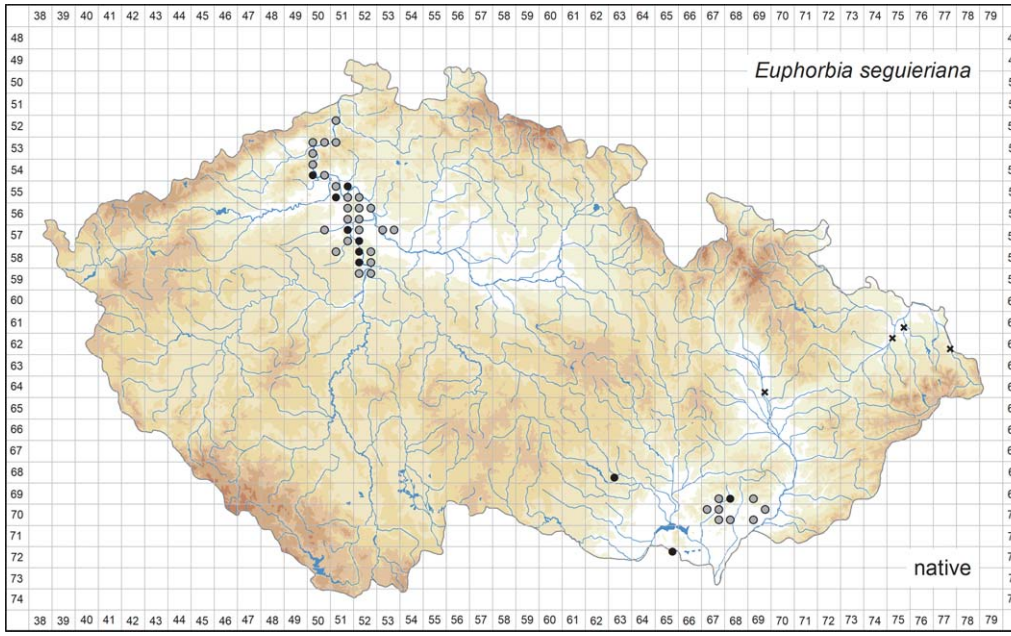

Fig. 49. Distribution of *Euphorbia seguieriana* in the Czech Republic: ● at least one record in 2000–2022 (10 quadrants), ◍ pre-2000 records only (33 quadrants), × alien (4 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

Euphorbia serpens (Fig. 50)

Euphorbia serpens is native to the New World, where it is one of the most widespread species of the genus. It may be indigenous to the southern USA, but it is almost certainly alien in Canada and the eastern USA. It has been introduced into the Old World, where it has become established in the Mediterranean area and some countries in western and central Europe (Hügin 1999, Berry et al. 2016). *Euphorbia serpens* was first collected in the Czech Republic in Prague in 2017 (Sádlo 2018). Until recently, there have been altogether 11 records, most of them from plant nurseries and gardening shops, as well as from the streets of Prague. This species was probably introduced into this country with plants imported from the Mediterranean area and became a weed in plant nurseries, from which it is spread with ornamental plants. It is classified as a casual neophyte (Pyšek et al. 2022).

Euphorbia stricta (Fig. 51)

Euphorbia stricta is native to southern, central and western Europe, occurring from the Pyrenees in the west as far southern piedmonts of the Caucasus Mts in the east, towards the north extending to England, the North Sea coast, central Germany, southern Poland, Romania, central Ukraine and Crimea. It is also present in Anatolia and Transcaucasia, but absent from all islands in the Mediterranean Sea (Smith & Tutin 1968, GBIF 2022, Seregin 2022). In the Czech Republic the typical habitats of *E. stricta* are verges of dirt roads in forests, riparian sediment (primarily gravel) deposits, road ditches, other kinds of disturbed ground, rarely also waste places and fallow land. The soils are loamy or loamy sandy, usually neutral to basic, rich in nutrients and humid. In this country *E. stricta* occurs in north-eastern Moravia and eastern Silesia from the Slezské Beskydy Mts in the north as far as the northern part of the Bílé Karpaty Mts in the south, also in the Chřiby hills and Ždánický les hills, as well as along the Morava and Bečva rivers in central Moravia. The isolated records elsewhere, particularly in south-western Bohemia, may refer to accidentally introduced plants. This species occurs in hilly areas and low mountains up to the elevations ~600 m, reaching its elevational maximum in the Slezské Beskydy Mts west of the town of Jablunkov at 820 m, while the occurrences in the lowlands are due to downstream seed dispersal from higher elevations. Misidentifications were rather common in herbaria; therefore, some of the undocumented records may actually refer to *E. platyphyllos*. *Euphorbia stricta* is classified as vulnerable (Grulich 2012).

Euphorbia taurinensis (Fig. 52)

Euphorbia taurinensis is an annual species native to southern Europe, distributed from the Iberian Peninsula in the west as far as Crimea and southernmost European Russia in the east (Smith & Tutin 1968, Seregin 2022), and also in Anatolia (GBIF 2022). There are numerous records of introduced plants from more northern parts of Europe, including the Netherlands, Germany, the Czech Republic, Slovakia, Austria and Hungary, in the north being a casual alien, while it is locally established in the south (Smith & Tutin 1968, GBIF 2022). In the Czech Republic *E. taurinensis* was first recorded in southern Moravia in the early 1920s: in 1922 it was found in the outskirts of the city of Brno and in 1923 near the village of Čejč. In Bohemia this species was first collected near the village of

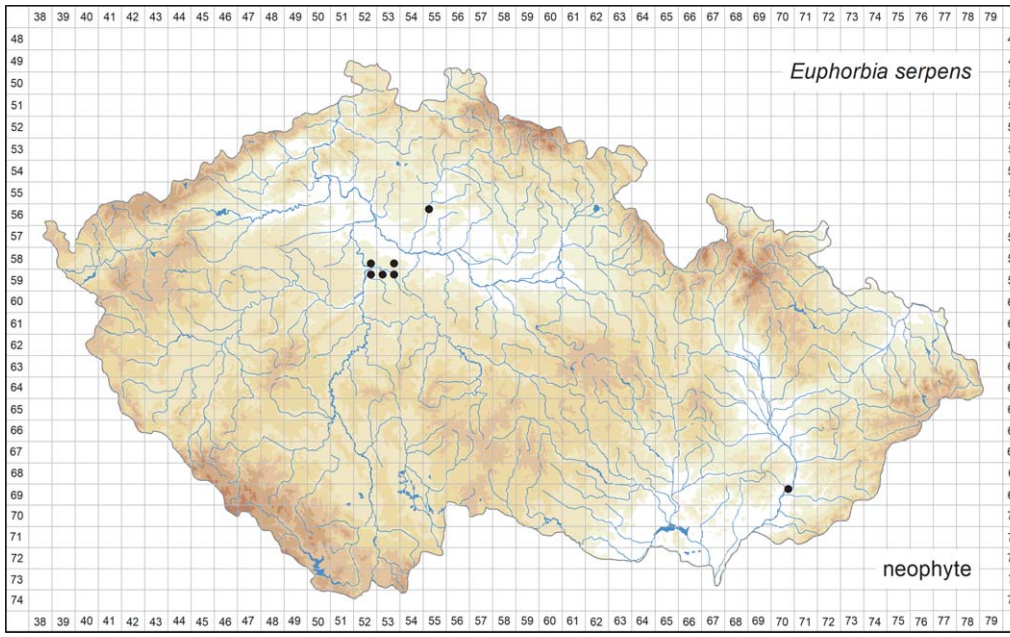

Fig. 50. Distribution of *Euphorbia serpens* in the Czech Republic: ● records since 2000 only (7 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

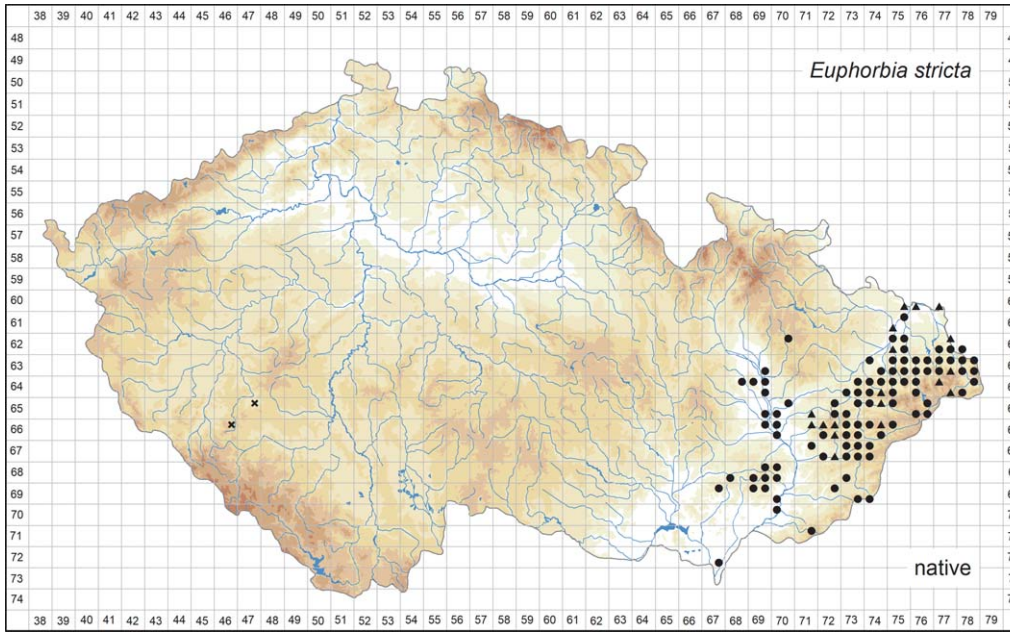

Fig. 51. Distribution of *Euphorbia stricta* in the Czech Republic: ● native, occurrence documented by herbarium specimens (91 quadrants), ▲ native, occurrence based on other records (18 quadrants), × alien only (2 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

Pačejov north of the town of Horažďovice in 1959. All these plants were misidentified as *E. falcata*, some collected later also as *E. exigua* and *E. segetalis* (e.g. Kühn 1967). The correct identity of these specimens was established only by Chrtek & Křísa (1970) and Smejkal & Dvořáková (1975). Until recently, there have been up to 60 records of *E. taurinensis* in the Czech Republic, mainly in Moravia and Silesia, where its records are concentrated in the industrial area in the north-east, in the city of Brno and in south-eastern Moravia. Most of these finds are from railway stations and embankments; however, this species was also repeatedly collected as a weed on arable land, mainly in Brno and near the village of Čejč, where it occurred (as locally established?) for decades. *Euphorbia taurinensis* is considered a casual neophyte (Pyšek et al. 2022).

Euphorbia virgata (Fig. 53)

Euphorbia virgata is a diploid species closely related to *E. esula*, sometimes even considered a subspecies of it (e.g. Smith & Tutin 1968). However, this is incorrect due to the differences in ploidy, morphology, ecology and distribution. *Euphorbia virgata* occurs in southern, eastern and eastern central Europe, western Siberia and northern Kazakhstan (Smith & Tutin 1968), but its distribution is insufficiently known because of the varied concepts of this taxon, along with nomenclatural confusion and identification mistakes. Therefore, many records from northern Europe may actually refer to *E. saratoi*. It has been introduced into and has become naturalized in North America (Berry et al. 2016), but also some of these records may be based on misidentifications of *E. saratoi*. In the Czech Republic *E. virgata* grows mainly in dry grasslands, sometimes ruderalized, forest fringes, scrub communities, on road verges and along railways and dirt roads, rarely in margins of arable fields. Soils are loamy to sandy, sometimes shallow and stony, neutral to basic, usually dry later in the season. In this country *E. virgata* occurs mainly in the lowlands and hilly areas with rather warm climates, including north-western, central and eastern Bohemia, as well as south-western, southern, south-eastern and central Moravia. Particularly in southern Moravia its distribution is continuous, and the species is locally common. In addition, there are remote occurrences in north-eastern and southern Bohemia, around the town of Polička in eastern Bohemia, in Silesia and northern Moravia; at least some of these occurrences may be native. In contrast, single records scattered elsewhere are probably due to introductions with seed, grain and other commodities; some of these have existed for decades. While most of the occurrences of *E. virgata* are at elevations below 550 m, it reaches its elevational maxima at ~620 m on Štranchýř hill near the village of Podmokly in south-western Bohemia and at ~640 m east of the village of Nedašov in the Bílé Karpaty Mts. A few records from even higher elevations are undocumented or otherwise uncertain and, in addition, may refer to temporarily introduced plants. Whereas in southern Moravia no clear trend in its abundance has been observed, it has become rather rare in central Bohemia.

Homogyne alpina (Fig. 54)

Homogyne alpina is distributed mainly in the high mountain ranges of central Europe and in parts of southern Europe, namely in the Cantabrian Mts, Pyrenees, Jura, Schwarzwald, Alps, Šumava, Krušné hory, Sudetes, Carpathians and mountains of the Balkan Peninsula. The Czech Republic is situated at the northern limit of the species' range (Meusel et

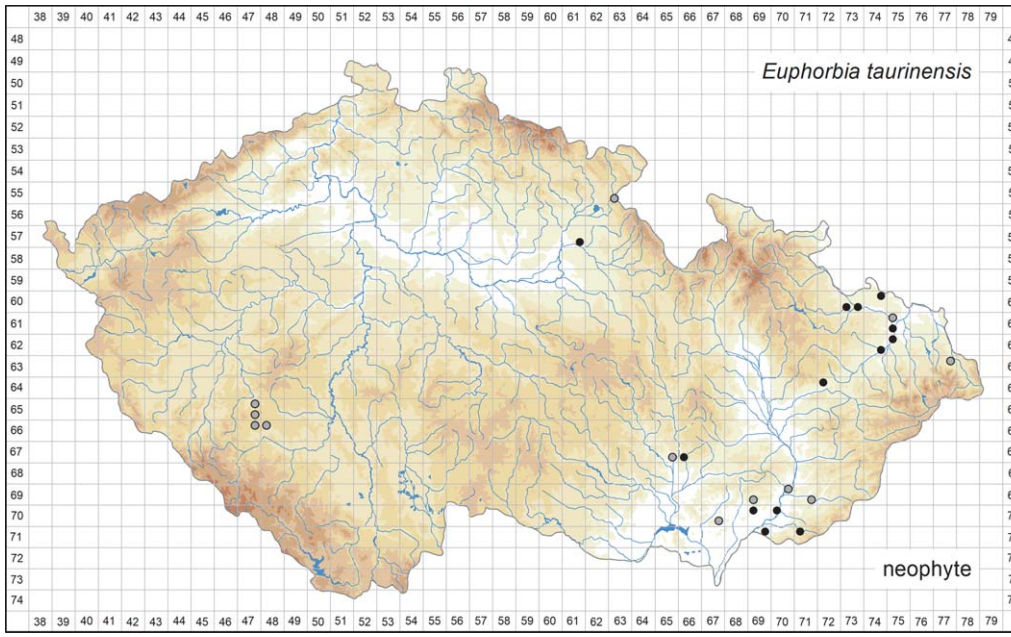

Fig. 52. Distribution of *Euphorbia taurinensis* in the Czech Republic: ● at least one record in 2000–2022 (13 quadrants), ◍ pre-2000 records only (12 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

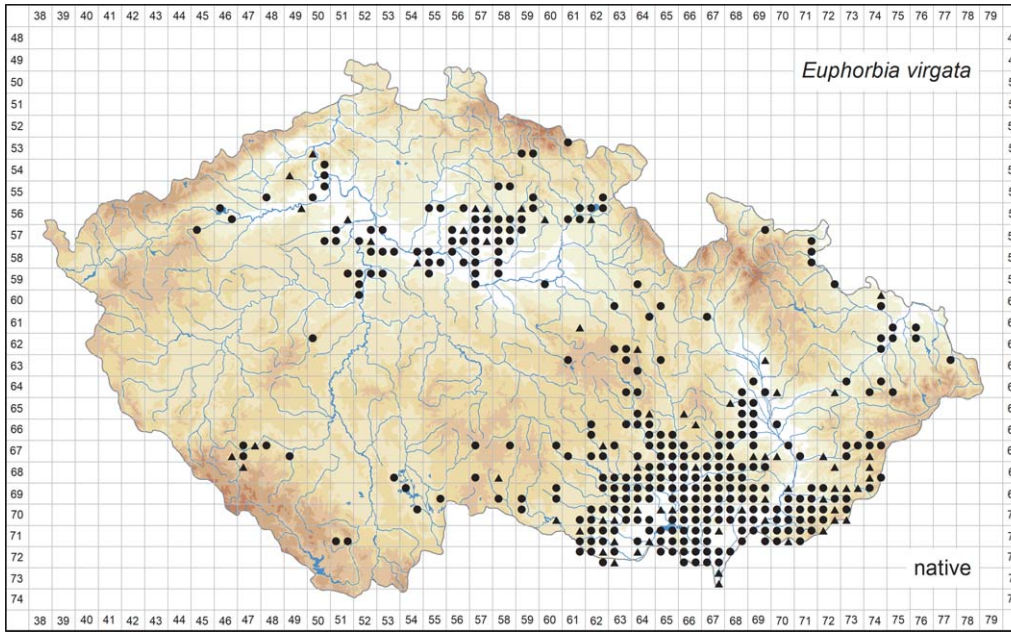

Fig. 53. Distribution of *Euphorbia virgata* in the Czech Republic: ● occurrence documented by herbarium specimens (306 quadrants), ▲ occurrence based on other records (68 quadrants). Prepared by Jiří Danihelka, Pavel Dřevojan & Michal Ducháček.

al. 1992). In this country *H. alpina* grows mainly in montane acidophilous spruce and beech forests, subalpine grasslands (mostly dominated by *Calamagrostis villosa* or *Nardus stricta*), subalpine dwarf-shrub vegetation, dwarf mountain pine scrub and in edges of peat bogs, where it occupies semi-shaded to open sites. The soils are skeletal to loamy, nutrient-poor and acidic, often humid and with a thick layer of poorly decomposed litter, developed over siliceous bedrock. The distribution of *H. alpina* in the Czech Republic largely overlaps with the cold mountain areas with floristic composition and vegetation types corresponding to those of forests in the boreal zone, and indicates the natural distribution of montane acidophilous spruce forests and mixed forests with high abundances of conifers (Kaplan 2004, 2017). It is mainly distributed in the high mountain ranges along this country's border, namely in the south-western part of the Krušné hory Mts in north-western Bohemia, in the Sudetes mountains along the Czech-Polish border, in the Šumava and Novohradské hory Mts in southern Bohemia and in the Moravskoslezské Beskydy in eastern Moravia. Elsewhere it is rare, being found mainly on mountains, in deep river valleys or on isolated high hills.

Laserpitium archangelica (Fig. 55)

Laserpitium archangelica is a rare European montane species. Its distribution includes the Carpathians from the Czech Republic to Romania, the Dinaric Alps in Slovenia, Croatia and Bosnia and Herzegovina, the mountains in North Macedonia and Bulgaria, and very rare occurrences are found in the Salzkammergut Mts in Austria (Hand 2011, Kästner et al. 2016). It is a submontane to subalpine species, growing in tall-forb subalpine vegetation, along mountain streams and in forest fringes on base-rich substrates, most often on limestone. In the Czech Republic native populations are found only in the Hrubý Jeseník Mts in northern Moravia and adjacent Silesia. In the past the species occurred at several localities in these areas; some of the occurrences were only secondary and short-term, such as those near the village of Klepáčov at an elevation of ~700–750 m. Currently, it persists only in the Velká kotlina and Malá kotlina glacial cirques, at the elevation range ~1,120–1,340 m. It grows there mainly in species-rich tall-forb vegetation on avalanche tracks and sites with pronounced snow accumulation on the low parts of the cirques, on soils well supplied with water and nutrients, and is a part of the endemic association *Laserpitio archangelicae-Dactylidetum glomeratae* (Kočí 2007). In both cirques the abundance of the species has fluctuated in recent decades, but it does not appear to be under immediate threat at present (Bureš 2013). Nevertheless, it is classified as critically threatened due to its rarity (Grulich 2012). Outside the Hrubý Jeseník Mts, the species has been introduced to two additional sites. One was on Ožiňák hill near the village of Rajnochovice in the Hostýnské vrchy Mts in eastern Moravia, where it was observed between 1943–1957. The other, situated in the forest fringe near the village of Ostrý Kámen in eastern Bohemia at an elevation of 490 m, was first observed in 1965 and has persisted to the present day.

Laserpitium latifolium (Fig. 56)

Laserpitium latifolium is a European species, mainly distributed in central Europe and the mountains of southern Europe. Its range extends from Galicia in the west to central parts of European Russia in the east; northwards it extends to southern Scandinavia. It is absent

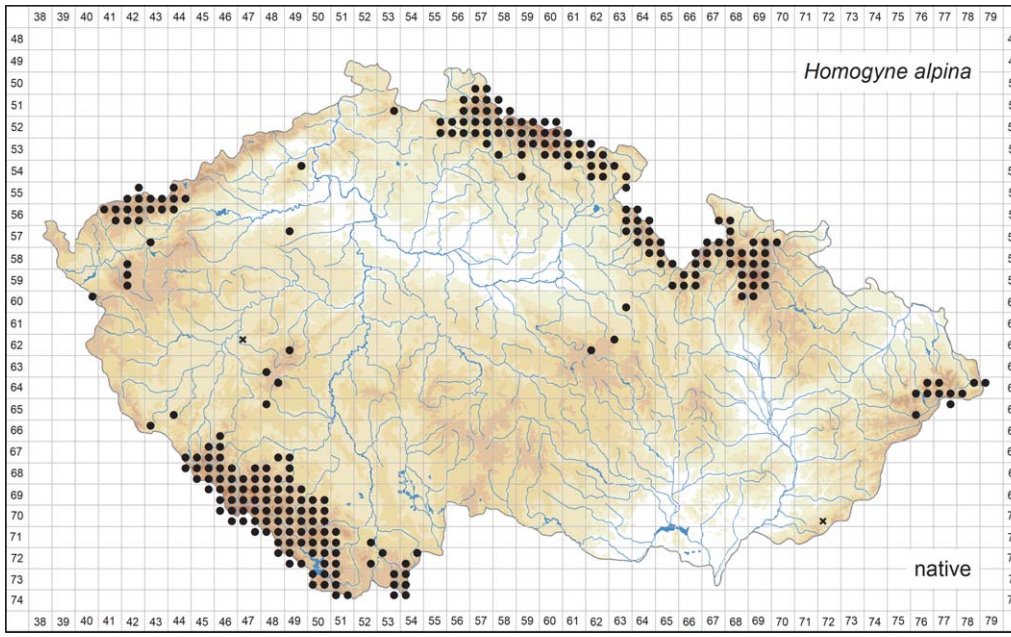

Fig. 54. Distribution of *Homogyne alpina* in the Czech Republic: ● native (261 quadrants), × deliberate introductions only (2 quadrants). Prepared by Zdeněk Kaplan.

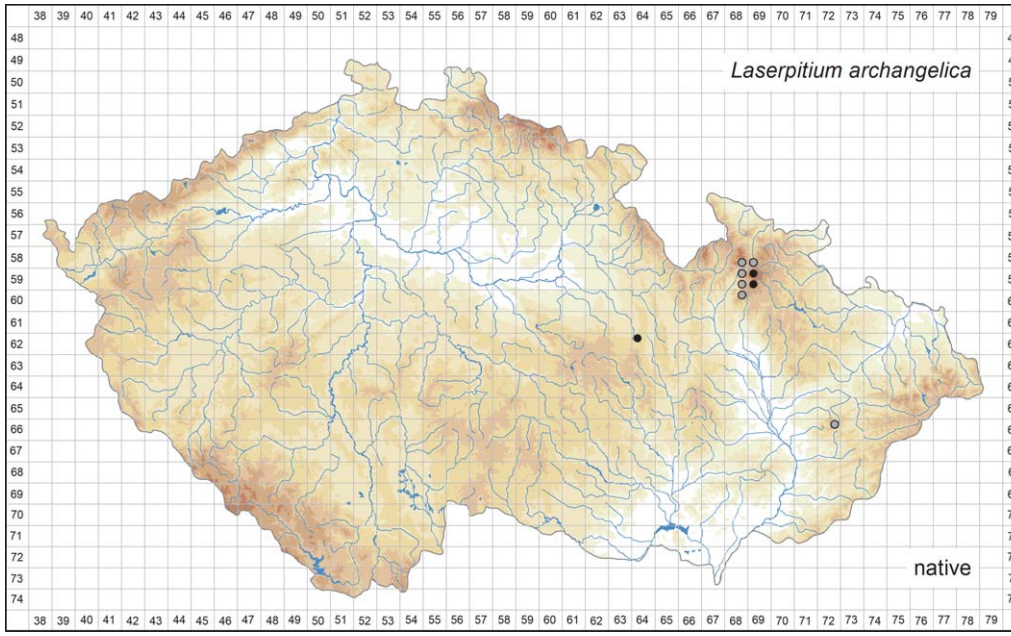

Fig. 55. Distribution of *Laserpitium archangelica* in the Czech Republic: ● at least one record in 2000–2022 (3 quadrants), ◍ pre-2000 records only (6 quadrants). Prepared by Jan Prančl.

from the British Isles and only rarely occurs in southernmost Europe and in lowland areas with an oceanic climate (Meusel et al. 1978, Hultén & Fries 1986, Hand 2011). Three subspecies are distinguished, of which the typical subspecies is widespread and the remaining two are restricted to Spain (Montserrat 2003). *Laserpitium latifolium* is a good indicator of basic substrates, such as limestone, basalt, siltstone, marlstone and calcareous flysch. In the Czech Republic it grows in meadows and their shrubby edges, forest fringes and open-canopy deciduous forests. It usually grows on nutrient-rich, deep, often heavy and intermittently wet soils, but can also occur on rather shallow semi-arid substrates on rock outcrops. In this country it occurs in thermophilous and mesophilous vegetation at elevations of 200–800 m; in contrast to other areas in Europe, it does not grow here at higher elevations due to the lack of suitable base-rich habitats. In Bohemia it has the largest number of occurrences in the České středohoří Mts; it also occurs more frequently in the Džbán hills, the Český kras karst area and the marlstone area near the town of Luže in eastern Bohemia. In Moravia, it is most frequent in the Bílé Karpaty Mts; in the past it was also locally more common in the vicinity of the city of Brno. Outside these areas it is rare, and many isolated occurrences have already disappeared. *Laserpitium latifolium* has markedly declined during the last decades, being mostly threatened by abandonment or intensive use of meadows and pastures, as well as by the succession of open-canopy forests to dense stands or their replacement with plantations of introduced trees. Many recent populations consist of only small numbers of individuals. Therefore, it is classified as vulnerable (Grulich 2012).

Laserpitium prutenicum (Fig. 57)

Two allopatric subspecies are recognized within *L. prutenicum*. The typical subspecies is distributed in the temperate regions of Europe from south-eastern France to the Ural Mts; to the north it reaches northern Germany, northern Poland and Estonia, to the south it extends to northern Italy and the Balkan countries including Croatia, Bosnia and Herzegovina, Serbia and Bulgaria. In Finland it is classified as a casual alien. The second intraspecific taxon, subsp. *dufourianum*, occurs in northern Spain, northern Portugal and south-western France (Meusel et al. 1978, Hultén & Fries 1986, Montserrat 2003, Hand 2011). In the Czech Republic *L. prutenicum* grows mainly in two types of habitats, including (i) wet mesic or fen meadows, especially those dominated by *Molinia* species (alliance *Molinion caeruleae*), and (ii) open-canopy, often sub-xerophilous oak and oak-hornbeam forests, rarely also pine woods. It also occurs in the sparse shrub communities adjacent to the edges of both mentioned habitats. It most frequently grows on intermittently wet soils that dry out during summer, preferring nutrient-poor, slightly acidic to basic substrates. In this country this species is unevenly distributed with most localities situated in flat to hilly landscapes at middle and low elevations but is rare in or absent from the areas with a predominance of hard acidic substrates, such as western Bohemia and most of the Českomoravská vrchovina highlands. It reaches its elevational maximum of ~840 m in the Boletice military training area in southern Bohemia. In the whole western part of central Europe, *L. prutenicum* strongly declined after World War II due to changes in land use, including abandonment, drainage, fertilization and reclamation of wet meadows, as well as forestry practices leading to the retreat of open-canopy forests and competition of undergrowth forest species profiting from increased nutrient availability

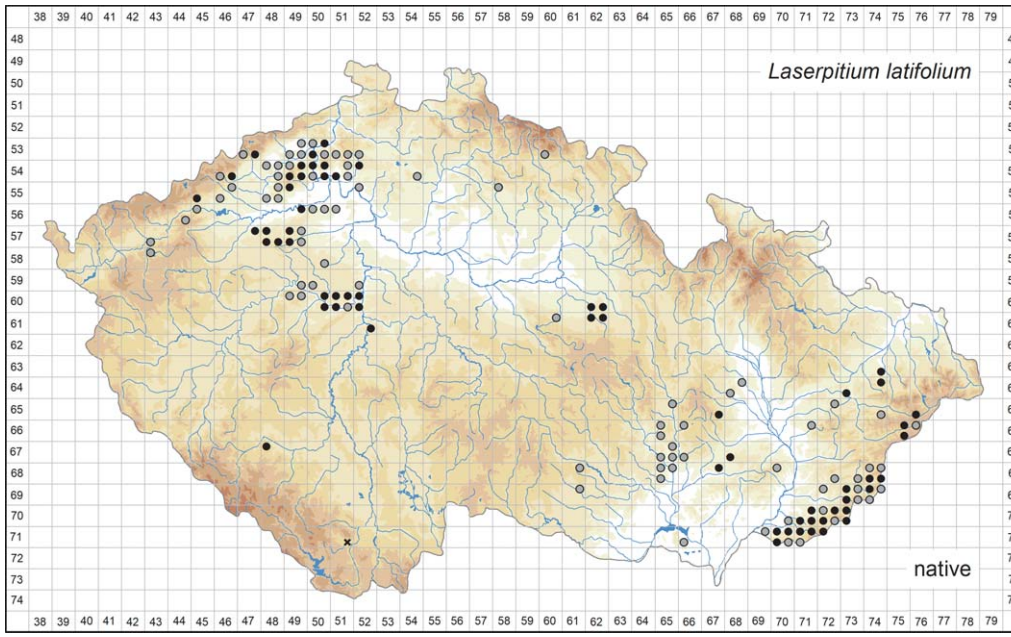

Fig. 56. Distribution of *Laserpitium latifolium* in the Czech Republic: ● at least one record in 2000–2022 (61 quadrants), ● pre-2000 records only (79 quadrants), × alien (1 quadrant). Prepared by Jan Prančl.

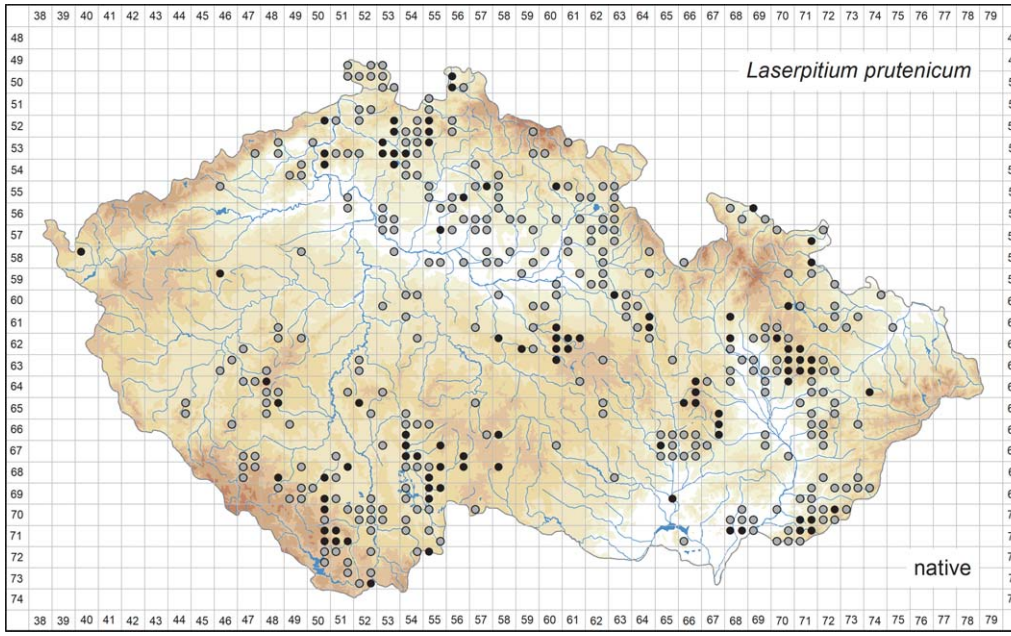

Fig. 57. Distribution of *Laserpitium prutenicum* in the Czech Republic: ● at least one record in 2000–2022 (95 quadrants), ● pre-2000 records only (296 quadrants). Prepared by Jan Prančl.

(Reichel 2013). In the Czech Republic it is classified as endangered (Grulich 2012), as it still rarely occurs in wet meadows but has almost disappeared from forest habitats.

Linaria arvensis (Fig. 58)

Linaria arvensis occurs in southern, western and central Europe, north-western Africa and south-western Asia; however, its distribution is not precisely known due to frequent confusion with *L. micrantha* and *L. simplex* (Sutton 1988). In the more northern and subcontinental parts of this range, e.g. in Germany, Czech Republic and Poland, this species is considered an archaeophyte. It has been introduced into and has become naturalized in Australia and New Zealand. In the Czech Republic *L. arvensis* once occurred as a weed on arable fields, fallow land, in sand pits and stone quarries, along dirt roads and in short grasslands with patches of bare ground, usually on sandy or stony, permeable acidic soils poor in nutrients. *Linaria arvensis* was widespread in the lowlands and hilly parts of Bohemia and western half of Moravia, with only several occurrences elsewhere, in the same time being absent from the Českomoravská vrchovina highlands. While most of the occurrences are at elevations below 500 m, it reaches its elevational maximum at ~750 m near the former village of Telcov (Töltsch) in the Doupovské vrchy hills in north-western Bohemia. Based on the information from herbarium labels and local floras, *L. arvensis* used to be common only very locally, and already in the 19th century botanists tended to list individual records. It started declining already before World War II, and there have been 16 unique records of the species since 1950. The last record dates back to 1998, when *L. arvensis* was observed near the village of Chanovice in south-western Bohemia (Suda 1999, 2001). The causes for this decline are not exactly known but they may include eutrophication due to the use of fertilizers and deep tillage. *Linaria arvensis* is considered a casual archaeophyte (Pyšek et al. 2022) and at the same time a missing species (Grulich 2012).

Linaria dalmatica (Fig. 59)

Linaria dalmatica, a member of the sect. *Speciosae*, is native to the Balkan Peninsula, Romania, Anatolia, Iraq and Iran; in the Asian part of its range it co-occurs with the similar and closely related *L. grandiflora*, which occurs also in the Caucasus Mts (Sutton 1988). In herbaria, some specimens are difficult to distinguish from large-flowered individuals of *L. genistifolia*. *Linaria dalmatica* is sometimes cultivated for ornament due to its large, showy flowers. It has been introduced into and has become naturalized in the British Isles (mainly in southern England), North America and possibly also in south-eastern Australia and New Zealand (Sutton 1988, GBIF 2022). In its native range it occurs in dry grasslands, usually pastures, and at semiruderal sites. In the Czech Republic *L. dalmatica* was first recorded in north-western Bohemia below a castle ruin north of the village of Perštejn in the Krušné hory Mts in 1907 by G. Merker, who collected the plant at the same site four years later. He misidentified the specimen as *L. genistifolia*, and this record remained unpublished. In 1976 sterile plants closely resembling *L. dalmatica* in terms of its foliage were collected at another site next to Perštejn, but their identification is somehow uncertain. In 1917–1947 *L. dalmatica* occurred south of the village of Brnky north of Prague. Based on the information on a herbarium label, this species was sown there in the 1910s by M. Fulín, a famous horticulturist, and survived at the site for at least

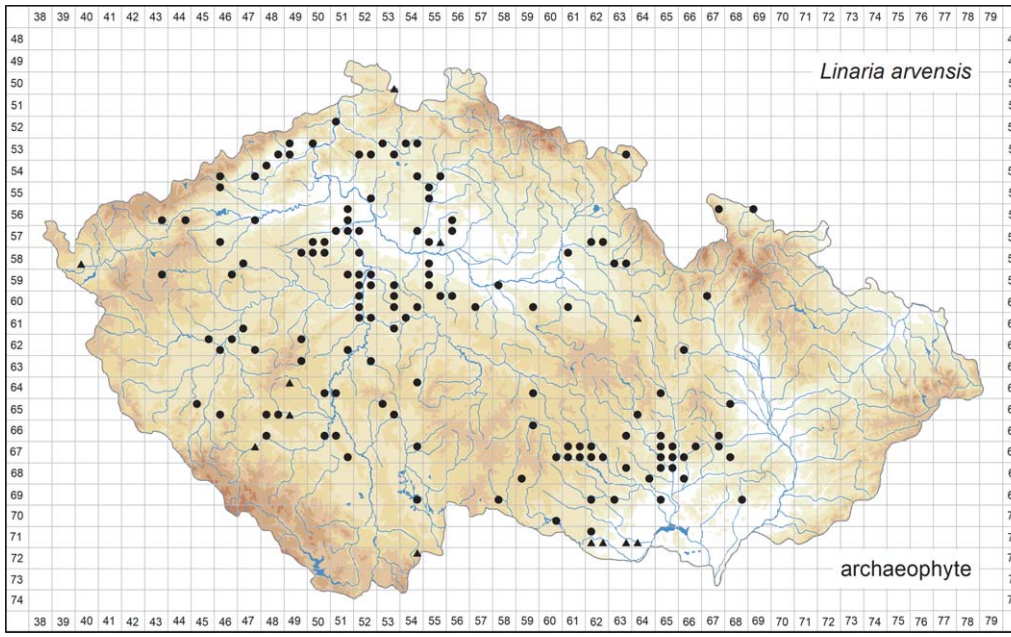

Fig. 58. Distribution of *Linaria arvensis* in the Czech Republic: ● occurrence documented by herbarium specimens (137 quadrants), ▲ occurrence based on other records (12 quadrants). Prepared by Jiří Danihelka & Hana Galušková.

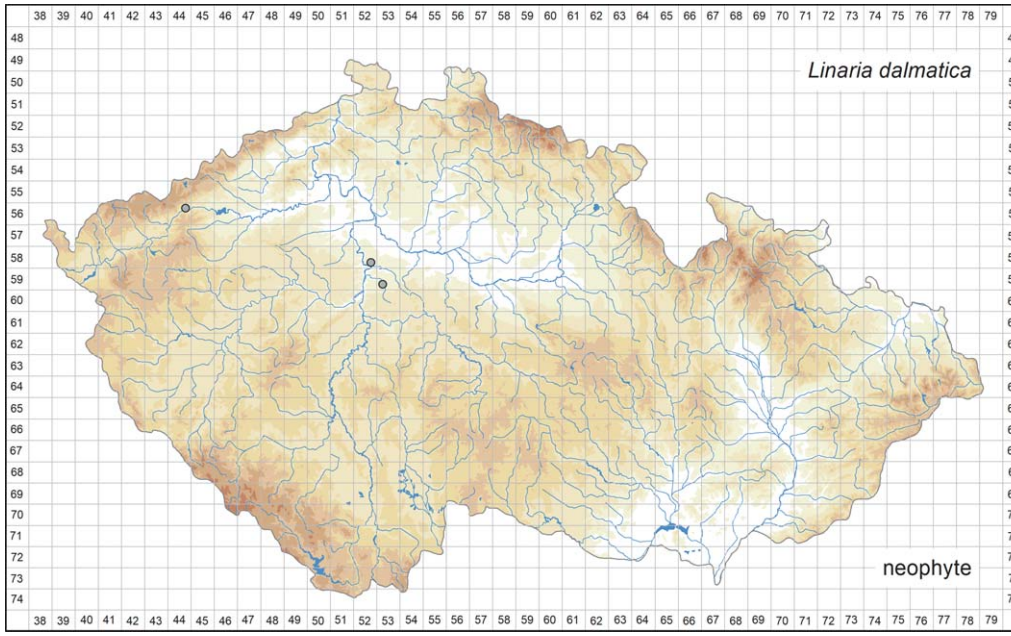

Fig. 59. Distribution of *Linaria dalmatica* in the Czech Republic: ● pre-2000 records only (3 quadrants). Prepared by Jiří Danihelka & Hana Galušková.

three decades. The record from the village of Hostivař south-east of Prague may also be explained by intentional introduction (Rohlena 1928). However, there are also two records of escaped plants from ruderal places in Prague in 1952 and 1960. In contrast, the record from the village of Průhonice (Domin 1943) is erroneous, as the corresponding herbarium specimen, originally identified as *L. dalmatica* var. *macedonica*, was revised as *L. repens*. We suggest classifying *L. dalmatica* in this country's flora as a casual neophyte.

Linaria genistifolia (Fig. 60)

Linaria genistifolia, a very variable species and another member of the sect. *Speciosae*, is native to central, south-eastern and eastern Europe, as well as western Asia and Siberia, with isolated occurrences extending as far as the piedmonts of the Altai Mts. Secondary occurrences have been known from several countries of northern, central and western Europe, the British Isles, North America and probably also South Africa (Sutton 1988, GBIF 2022), but some of the records may actually refer to *L. dalmatica*. Six subspecies are recognized, of which only subsp. *genistifolia* and subsp. *euxina* occur in Europe, the latter being restricted to the areas around the Black Sea (Sutton 1988). However, even the subsp. *genistifolia* is very variable at least in leaf shape and corolla size, but the recognition of subsp. *angustata* (e.g. Marhold 2011b) is not taxonomically justified. In the Czech Republic *L. genistifolia* grows in dry grasslands, often on rock outcrops or on sand, in openings of thermophilous oak forests, less frequently on fallow land, in vineyards, along roads and railways. Soils are usually shallow, stony or sandy, acidic to basic, rich to poor in nutrients and usually dry. The native occurrences of *L. genistifolia* in this country are more or less restricted to southern Moravia; it is locally common in south-western Moravia. It occurs from the lowlands up to elevations of ~450 m, reaching its elevational maximum at ~550 m on Děvín hill in the Pavlovské vrchy hills in southern Moravia. The Moravian occurrences are situated at the northern limit of this species' range. All other occurrences in this country, particularly in Bohemia and northern Moravia, are secondary. Some of the occurrences, e.g. two populations on volcanic hills near the town of Jičín in north-eastern Bohemia, discovered in 2007, may have arisen from artificial introductions. However, there have also been accidental introductions, mainly with various commodities, e.g. with iron ore from southern Ukraine to the industrial areas in northern Moravia and Silesia: *L. genistifolia* still occurs in the town of Třinec in Silesia, where the earliest record dates back to 1960. This species is also able to spread along railway and roads. Among the occurrences considered as secondary, those on the western slopes of the Železné hory hills in former vineyards and dry grasslands east of the town of Kutná Hora in central Bohemia are particularly old, dating back possibly to the middle ages (Grulich 2000). They are listed in the earliest flora of Bohemia (Presl & Presl 1819); based on the information from herbarium labels, they were discovered as early as 1810 by Ph. M. Opiz. Further records at secondary sites are likely to follow, as *L. genistifolia* is nowadays planted for ornament in public spaces. Its native occurrences are classified as vulnerable (Grulich 2012).

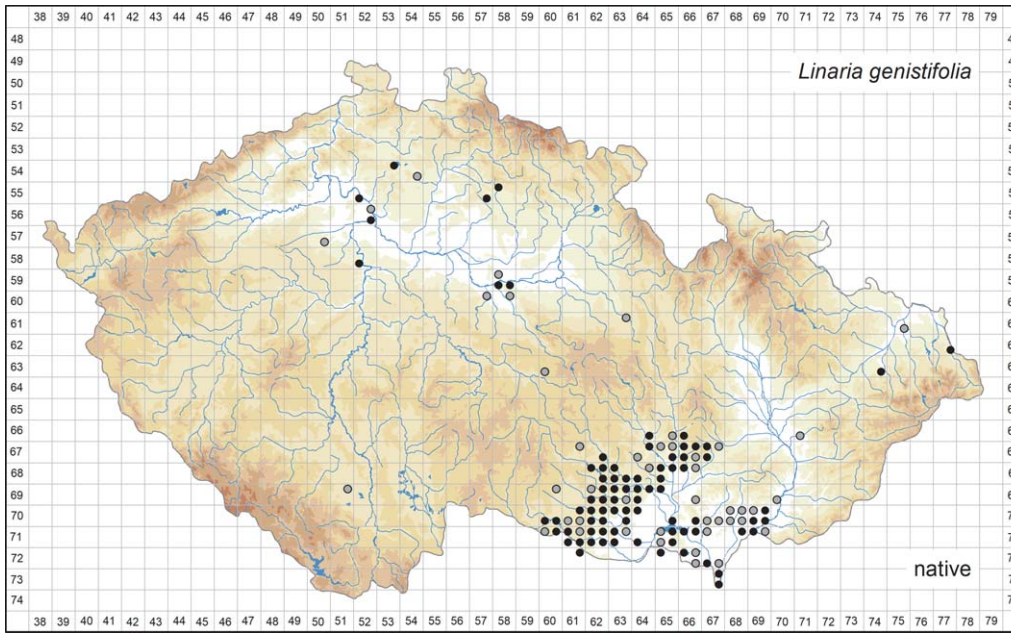

Fig. 60. Distribution of *Linaria genistifolia* in the Czech Republic: ● at least one record in 2000–2022 (80 quadrants), ● pre-2000 records only (44 quadrants). Prepared by Jiří Danihelka & Hana Galušková.

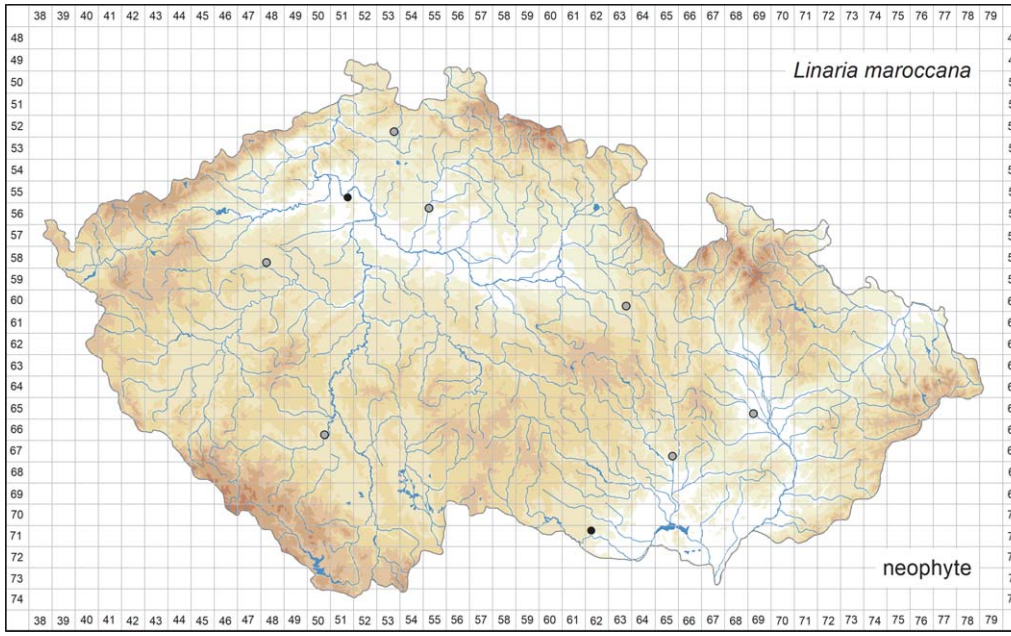

Fig. 61. Distribution of *Linaria maroccana* in the Czech Republic: ● at least one record in 2000–2022 (2 quadrants), ● pre-2000 records only (7 quadrants). Prepared by Jiří Danihelka & Hana Galušková.

Linaria maroccana (Fig. 61)

The species of *Linaria* sect. *Versicolores* are distributed mainly in north-western Africa and the Iberian Peninsula (Sutton 1988). This section includes annual plants cultivated for ornament in European gardens, in central Europe probably since the early 19th century. They were referred to as *L. bifida* in earlier literature (e.g. Čelakovský 1872) and as *L. maroccana* recently (e.g. Grulich 2000, Danihelka 2019). There are several cultivars in the market, the most popular probably being 'Fairy Bouquet', with a wide range of flower colours. As suggested by Sutton (1988), these plants are probably derived from the hybridization of *L. gharbensis* and *L. versicolor*, and the subsequent crosses probably also involved the true *L. maroccana*, all three native to Morocco. Here we accept the widely used name *L. maroccana* for practical reasons. Escaped plants have been recorded in numerous countries of Europe, in North America and possibly also in Australia and New Zealand (GBIF 2022). In this country the earliest record of escaped plants of *L. maroccana* is from the town of Sloup v Čechách in northern Bohemia and dates back to 1852 (Čelakovský 1872). Since then there have been eight records of escaped plants, mainly from gardens and roadsides. *Linaria maroccana* is classified as a casual neophyte (Pyšek et al. 2022).

Linaria odora (Fig. 62)

Linaria odora, a member of the *L. vulgaris* group (Chater et al. 1972), is native to southern Ukraine and the south-eastern part of European Russia, and possibly also to westernmost Siberia and the European part of Turkey. It occurs on coastal dunes of the Black and Caspian Seas and on sandy river banks of their tributaries, mainly of the Volga river (Meusel et al. 1978, Ivanina 1981, Sutton 1988). In the Czech Republic *L. odora* was collected in 1963 and 1964 from iron ore heaps near the town of Polanka nad Odrou in Silesia; it was most likely accidentally introduced with iron ore from southern Ukraine. These finds remained neglected because the plants were misidentified as *L. angustissima*. Their taxonomic identity was recognized only recently (Danihelka & Hlisnikovský 2021a). *Linaria odora* is classified as a casual neophyte (Pyšek et al. 2022).

Linaria pelisseriana (Fig. 63)

Linaria pelisseriana is native to the central and eastern Mediterranean area and western Europe (Sutton 1988). It has been introduced, for instance, into Great Britain and Denmark as well as to Australia and New Zealand (GBIF 2022). In its native range it grows at sandy and rocky sites, and often as a weed on arable and fallow land (Sutton 1988). Only a single record exists from the Czech Republic, in which four flowering individuals of *L. pelisseriana* were found at the railway freight station in the town of Kopřivnice in 2014 (Kocián 2014). This species is classified as a casual neophyte (Pyšek et al. 2022).

Linaria purpurea (Fig. 64)

Linaria purpurea is native to southern Italy and Sicily (Sutton 1988). This species is rather frequently cultivated for ornament, and there are several cultivars with variously coloured corollas. It has been introduced into and become naturalized in the British Isles, western, central and northern Europe, as well as in North America, southern Australia and New Zealand (Sutton 1988, GBIF 2022). In its native range it occurs in pioneer vegetation at

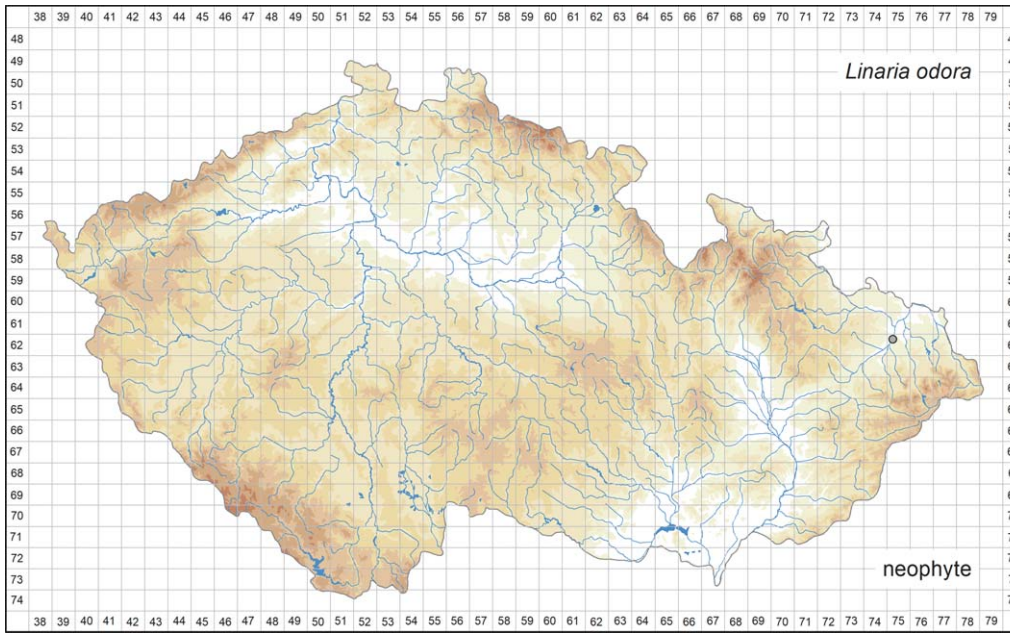

Fig. 62. Distribution of *Linaria odora* in the Czech Republic: ◍ pre-2000 records only (1 quadrant). Prepared by Jiří Danihelka & Hana Galušková.

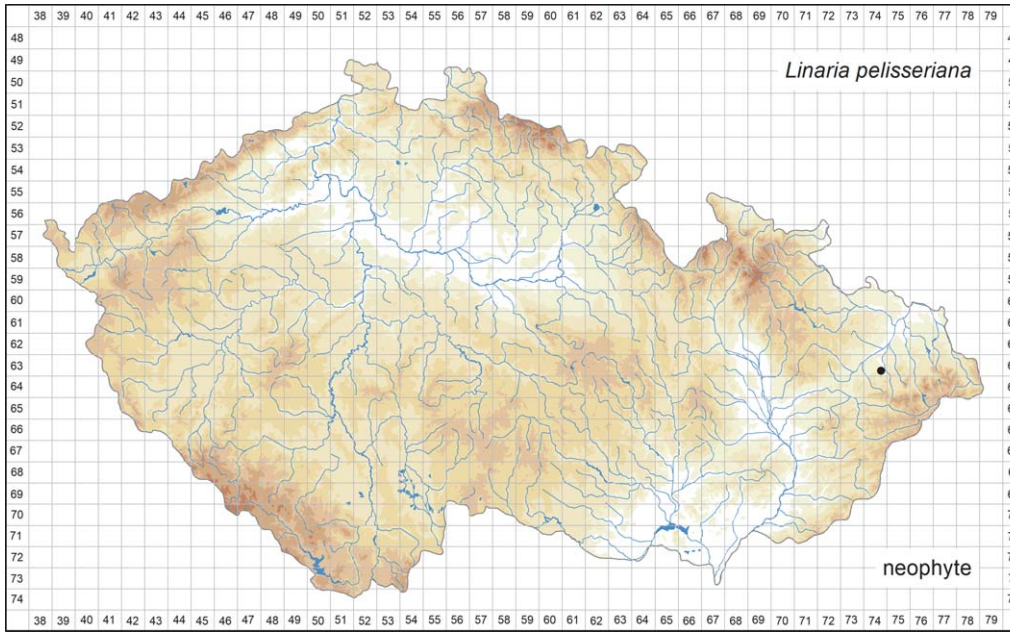

Fig. 63. Distribution of *Linaria pelisseriana* in the Czech Republic: ● records since 2000 only (1 quadrant). Prepared by Jiří Danihelka & Hana Galušková.

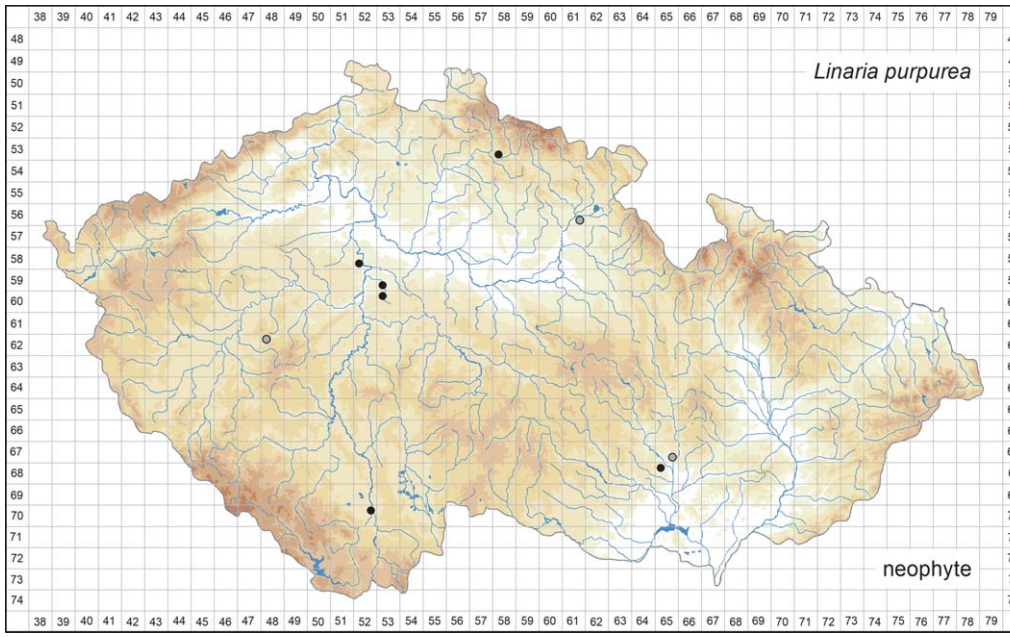

Fig. 64. Distribution of *Linaria purpurea* in the Czech Republic: ● at least one record in 2000–2022 (6 quadrants), ● pre-2000 records only (3 quadrants). Prepared by Jiří Danihelka & Hana Galušková.

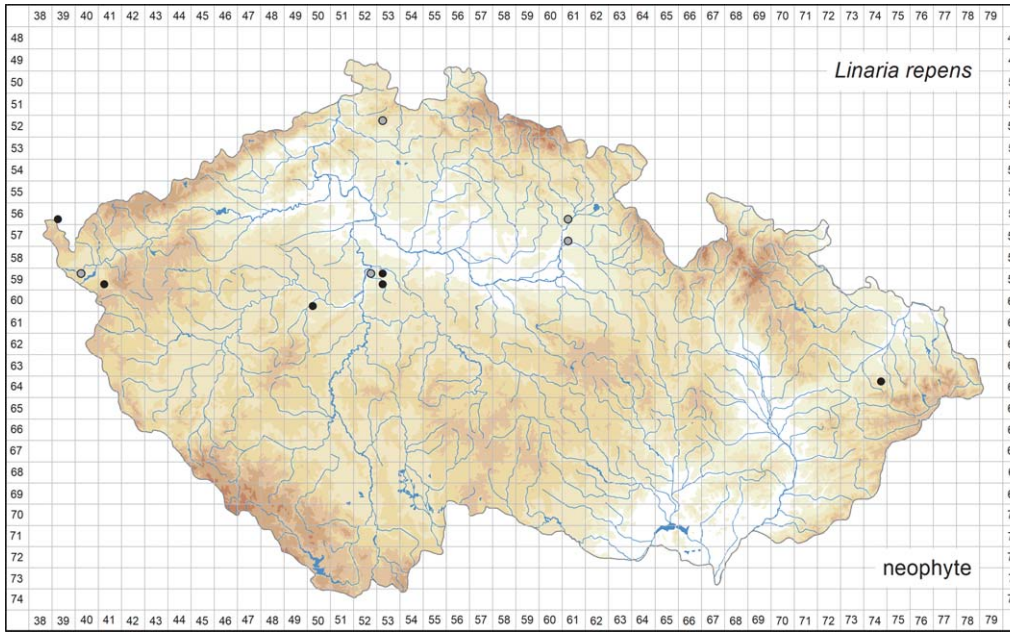

Fig. 65. Distribution of *Linaria repens* in the Czech Republic: ● at least one record in 2000–2022 (6 quadrants), ● pre-2000 records only (5 quadrants). Prepared by Jiří Danihelka & Hana Galušková.

stony or gravelly sites, including gravelly deposits in river and stream beds. In this country escaped plants of *L. purpurea* were first collected near the town of Jaroměř in eastern Bohemia in 1878 (Čelakovský 1883). Until recently, there have been ~10 records from various parts of this country, some of them recent. Our observations indicate that *L. purpurea* may escape from cultivation and become locally established at least for several years, but it is probably prone to frost damage during hard winters in areas with rather continental climates. It is classified as a casual neophyte (Pyšek et al. 2022).

Linaria repens (Fig. 65)

Linaria repens is native to western Europe and the western Mediterranean area. It has been introduced to and become naturalized in many countries of Europe including the British Isles and southern Scandinavia and eastern North America (Meusel et al. 1978, Sutton 1988, GBIF 2022). In its native range it occurs in various types of grasslands, usually disturbed, at rocky sites, on fallow land and in margins of arable fields. In this country the first observation of *L. repens* outside cultivation dates back to 1912 when it was collected in the town of Jaroměř and the city of Hradec Králové, both in eastern Bohemia. In Jaroměř the plants were collected again in 1920. This species is locally naturalized at a few sites: for instance, in Průhonice the earliest record dates to 1943, the latest is from 2020. Most records are from man-made habitats, such as railway and motorway embankments, gravelly places in settlements and abandoned stone quarries. While occurrences along railways may represent accidental introductions, those in abandoned stone quarries may have arisen via intentional sowing. Altogether, *L. repens* was recorded in 11 quadrants of the mapping grid. It is locally established only in the western part of the country, which may indicate that it requires rather oceanic climates. It is classified as a naturalized neophyte (Pyšek et al. 2022).

Linaria ×*sepium* (Fig. 66)

Linaria ×*sepium* (*L. repens* × *L. vulgaris*) is the most widespread hybrid within the genus in Europe (Chater et al. 1972). It occurs in western Europe, the British Isles and southern Scandinavia and also in Newfoundland in North America (Chater et al. 1972, Sutton 1988, GBIF 2022). Hybridization in *Linaria* is facilitated by self-incompatibility (Sutton 1988). *Linaria* ×*sepium* was recorded at two sites in central Bohemia. In 1948–1953 it was collected at sandy places in a margin of a pine forest north of the town of Loučeň in central Bohemia (*L. repens* was probably not present at the site any longer). In 2007 it was found on the railway embankment in Prague's city district of Malešice, co-occurring there with *L. repens*.

Linaria vulgaris (Fig. 67)

Linaria vulgaris has a large distribution from the Pyrenees in the west as far as Lake Baikal in the east, in the European part of its range extending northwards to northern Scandinavia and southwards to Sardinia, central Italy, northern Greece and southern Bulgaria (Meusel et al. 1978). In the northernmost part of this range it is probably an archaeophyte or even a neophyte. Nowadays, *L. vulgaris* has become naturalized or even invasive in other parts of the world with temperate climates, including North America,

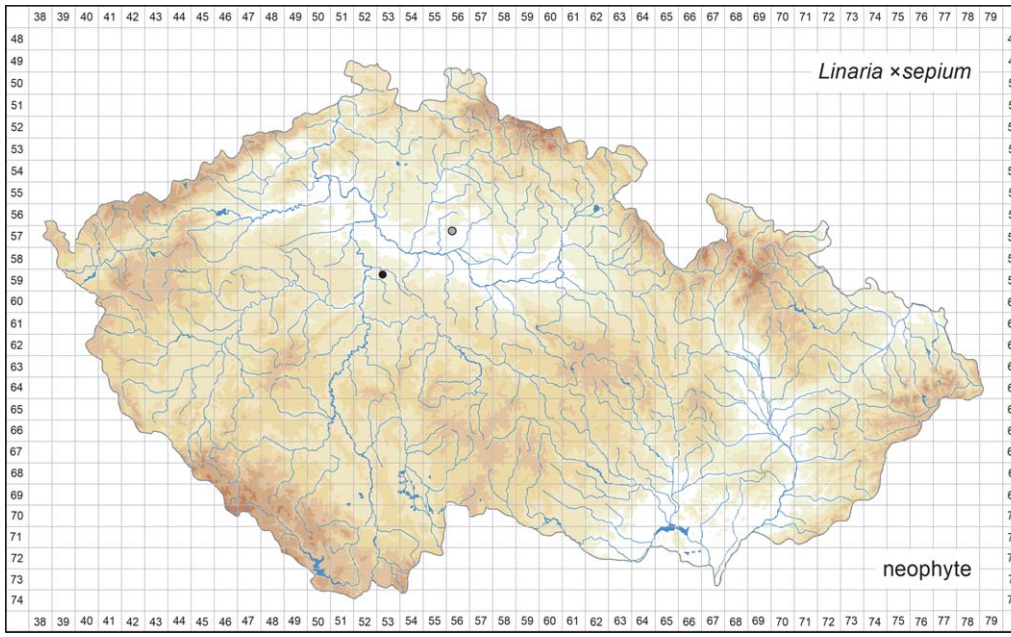

Fig. 66. Distribution of *Linaria* ×*sepium* in the Czech Republic: ● at least one record in 2000–2022 (1 quadrant), ● pre-2000 records only (1 quadrant). Prepared by Jiří Danihelka & Hana Galušková.

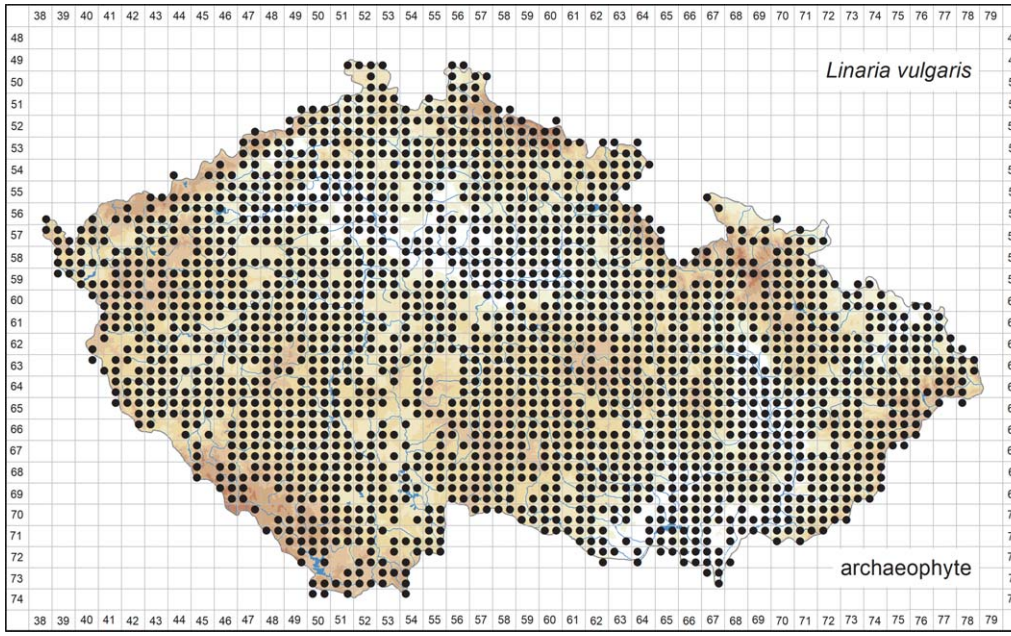

Fig. 67. Distribution of *Linaria vulgaris* in the Czech Republic (2073 occupied quadrants). Prepared by Jiří Danihelka & Hana Galušková.

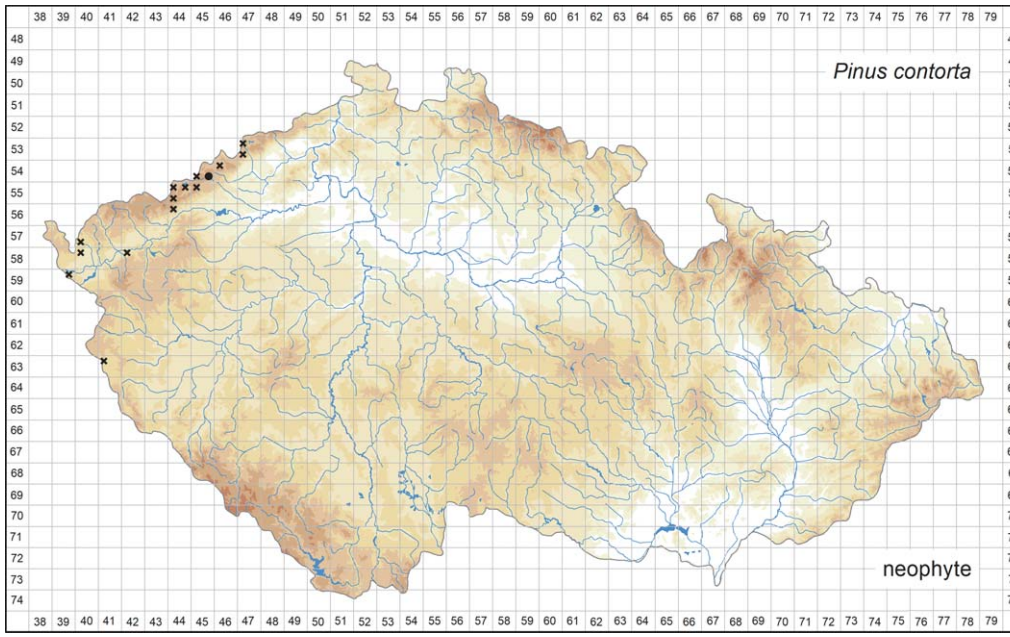

Fig. 68. Distribution of *Pinus contorta* in the Czech Republic: ● spontaneous escape from cultivation (1 quadrant), × deliberate introductions in the countryside (14 quadrants). Prepared by Jiří Velebil.

South Africa, south-eastern Australia and New Zealand (Meusel et al. 1978, GBIF 2022). In the Czech Republic *L. vulgaris* grows in ruderal grasslands, along roads, railways, at disturbed sites in settlements, in abandoned stone quarries and similar habitats. Soils are usually loamy sandy or sandy, sometimes stony or gravelly, usually slightly acidic to basic, moderately rich in nutrients. *Linaria vulgaris* is widespread in the Czech Republic and common in most of its territory, occurring from the lowlands up to elevations of ~700 m. There are several records from the Krkonoše Mts and Hrubý Jeseník Mts of introduced plants from elevations above 1,300 m, with the elevational maximum reached at the summit of Mt Praděd at 1480 m. *Linaria vulgaris* is considered a naturalized archaeophyte (Pyšek et al. 2022).

Pinus contorta (Fig. 68)

Pinus contorta includes four (Critchfield 1957) or three (Businský 2008) rather geographically defined subspecies or varieties (Kral 1993, Farjon 2001), in cultivation difficult to distinguish without knowledge of their provenance. Therefore, *P. contorta* is mapped here at the species level. The native distribution of the species includes western Canada and the western USA, with an extension to north-western Mexico. It occurs from middle Yukon in the north to Baja California Norte in the south and from the Pacific coast in the west to the North Dakota and central Colorado in the east (Critchfield & Little 1966). *Pinus contorta* has a wide ecological amplitude with distinct pioneer abilities and is also fire successional. Depending on provenance, in its primary range it grows in maritime fog

forests, bogs, low to high montane forests, from the coastline up to timberline at elevations of about 3,500 m (Kral 1993). In Europe it has been cultivated since 1831, and in the Czech Republic since 1852, when it was planted in the Sychrov manor garden in northern Bohemia (Pejchal et al. 2021). *Pinus contorta* is used in landscape design and forestry, chiefly valued for planting in unfavourable soil conditions. During the second half of the 20th century it was used as an alternative woody plant in forestry in the areas affected by air pollution, especially in the Krušné hory Mts, where the main distribution in this country is situated. Additional, scarce occurrences were reported from the Český les hills, Slavkovský les hills and the environs of the town of Cheb in western Bohemia. It is occasionally confused with indigenous *P. uncinata* subsp. *uliginosa*, which is similar at first sight. In this country *P. contorta* was for the first time observed as escaped in 2022, when three saplings 0.5–1.5 m tall were found at a plantation of adult trees near the village of Hora Svatého Šebestiána in the Krušné hory Mts.

Pinus mugo (Fig. 69)

Pinus mugo s. str. is a member of the *P. mugo* complex, which has been classified in various ways. Some authors have circumscribed *P. mugo* in a broad sense, i.e. including *P. uncinata* subsp. *uliginosa* but without *P. uncinata* s. str. (Farjon 2010) or including all taxa of the *P. mugo* complex (Christensen 1987, Farjon 2001). *Pinus mugo* s. str. is a European species native mainly to central and south-eastern Europe. It is confined to the higher mountain ranges, with a fairly continuous distribution in the Alps (except their south-western part) and disjunct distribution across the Carpathians and Dinarids to the mountains of the northern Balkan Peninsula, reaching its south-eastern limit in the western Rhodope Mts. Isolated occurrences are in the border mountains of Bohemia in the Czech Republic and in the Abruzzi Mts in the central Apennines (Jalas & Suominen 1973). Although in the Alps, Carpathians and Dinarids this species grows on various types of rocks, often in limestones, all areas of its distribution north of the Alp including in the Czech Republic are only on siliceous bedrock. In the Czech Republic *P. mugo* forms large indigenous populations in the subalpine zone above the spruce timberline in the Krkonoše Mts, in the forest zone on open peatbogs in the Krušné hory Mts and Šumava Mts (in the latter also on rocks and boulder slopes), and in flat stream basins in the Jizerské hory Mts; one relict stand on a peatbog occurs in the Novohradské hory Mts. However, Slavík (1990) did not consider the occurrences in the Krušné hory Mts and Novohradské hory Mts as native. The subalpine stands are situated at elevations of 1,200–1,560 m (Šourek 1969, Skalická & Skalický 1988), the lowest indigenous occurrences at 770 m in the Jizerské hory Mts. This species is valued in forestry and landscape design. It has been planted in other high mountains, mainly in the Orlické hory Mts, Králický Sněžník Mts, Hrubý Jeseník Mts and Moravskoslezské Beskydy Mts. *Pinus mugo* commonly hybridizes with *P. uncinata* subsp. *uliginosa* in the Czech Republic and adjacent parts of Poland, Germany and Austria (see under *P.* ×*ascendens* nothosubsp. *skalickyi*).

Pinus nigra (Fig. 70)

The native distribution of *Pinus nigra* includes southern and middle parts of Europe, Anatolia, the Crimean Peninsula, coastal foothill of the western Caucasus Mts, Cyprus, and northern Morocco and northern Algeria in Africa (Critchfield & Little 1966, Jalas &

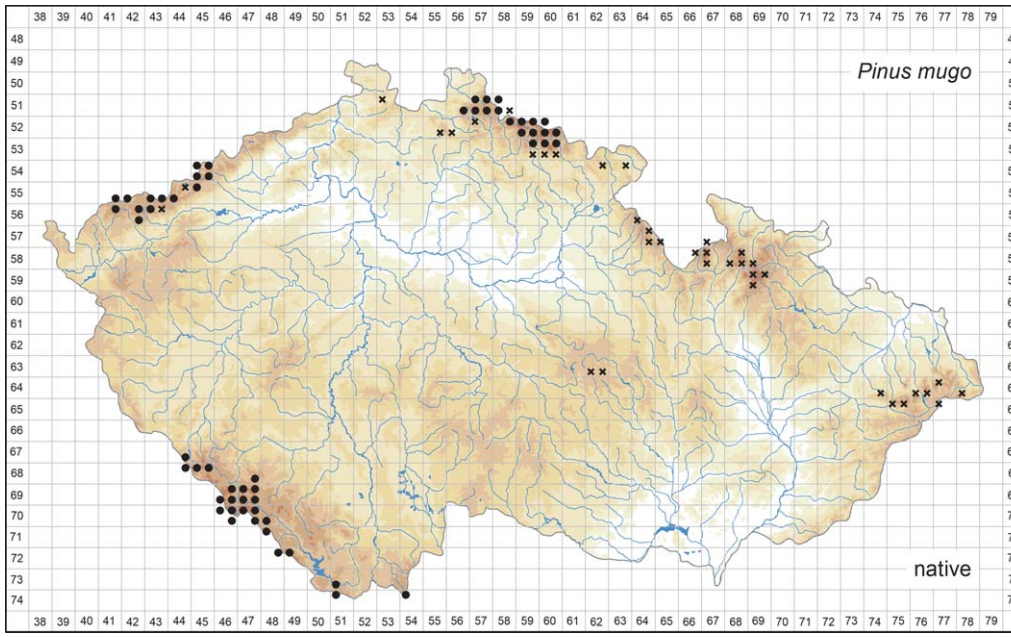

Fig. 69. Distribution of *Pinus mugo* in the Czech Republic: ● native (57 quadrants), × alien (37 quadrants). Prepared by Roman Businský & Jiří Velebil.

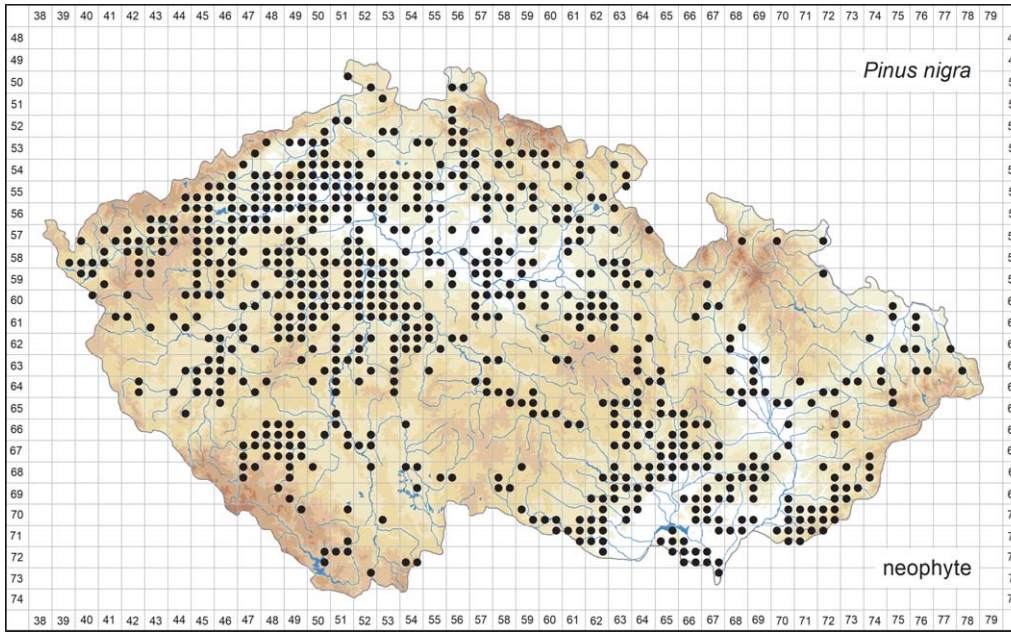

Fig. 70. Distribution of *Pinus nigra* in the Czech Republic (744 occupied quadrants). Prepared by Jiří Velebil.

Suominen 1973). In central Europe the northernmost indigenous occurrences are found south-west of Vienna in Lower Austria. The species splits into five rather geographically defined subspecies (Businský 2008), which in cultivation are very difficult to distinguish without knowledge of the geographic origin of the plants. Therefore, *P. nigra* is mapped here at the species level. In the Czech Republic *P. nigra* occurs scattered almost throughout the country in forest plantations, along motorways and on reclaimed spoil heaps; it is also frequently cultivated for ornament in gardens and parks. It is most frequently planted in the northern half of Bohemia and southern Moravia, especially at low and middle elevations, but it is also found elsewhere except at high elevations and in deforested areas in the lowlands. It grows well in karst areas with soils rich in calcium, but it tolerates acidic soils as well. Plants used in forestry apparently belong mostly to the typical subspecies, whereas other subspecies are cultivated rarely in parks and arboreta. On rocks, scree slopes, sands and at other sunny sites without strong competition from other plants, it spontaneously regenerates from seed and occasionally hybridizes with the indigenous *P. sylvestris.* The earliest record of cultivated plants in the Czech Republic dates back to 1804 when *P. nigra* was planted in the surroundings of the towns of Lednice and Valtice in southern Moravia (Pejchal & Krejčiřík 2010). It is classified as a naturalized neophyte (Pyšek et al. 2012).

Pinus strobus (Fig. 71)

Pinus strobus is native to the north-eastern USA and south-eastern Canada. It occurs from northern Georgia in the south to Newfoundland in the north, while the westernmost localities are in Manitoba and Minnesota (Critchfield & Little 1966). In the Czech Republic this species occurs almost throughout the country, especially at middle elevations, being most frequent in northern and western Bohemia. It is locally abundant also in the foothills of the Šumava Mts in Bohemia and in the Ostravská pánev basin in northern Moravia and Silesia. It is the most commonly cultivated alien pine in this country, used in forestry and landscape architecture. The earliest record of cultivated trees dates back to 1785 when *P. strobus* was planted in the Lány manor garden in central Bohemia (Stumph 1790). Already by the end of the 18th century this fast-growing species was cultivated for its softwood timber (Skalická & Skalický 1988) either in monocultures or in mixed plantations. *Pinus strobus* grows well both on humid soils and on sandstone rocks; the soils are usually acidic and poorly or moderately supplied with nutrients. The middle-aged and mature trees are sometimes infected with *Cronartium ribicola*, a two-host rust fungus, causing the white pine blister rust disease. *Pinus strobus* can easily regenerate from seed spontaneously and colonize suitable habitats without competitive vegetation, mainly at sunny or semi-shaded sites. Fast spread has been observed in areas with sand and coal mining. This species is classified as an invasive neophyte (Pyšek et al. 2022).

Pinus sylvestris (Fig. 72)

The range of *Pinus sylvestris* spans Eurasia, from western Spain and Scotland in the west to the Russian Far East (ca 142°E) and from southern Spain and central Turkey in the south to northern Norway (rarely exceeding 70°N) in the north. In Europe it is almost evenly distributed, but is less frequent in the southern and western parts of its range. In Asia it is continuously distributed across middle and southern Siberia, marginally in Kazakhstan, Mongolia, north-eastern China and in an isolated area around the Black Sea

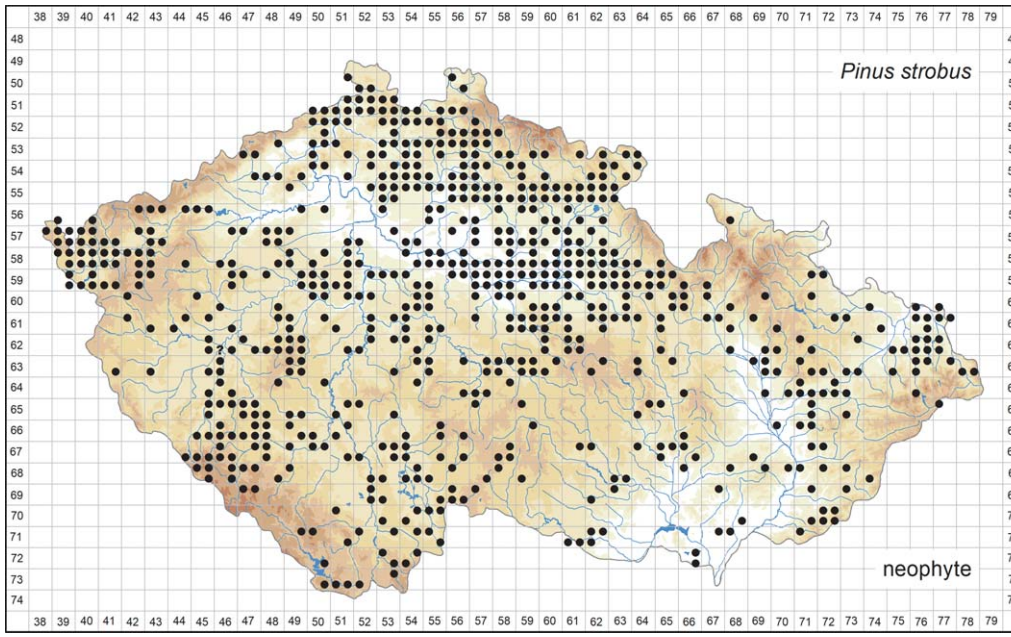

Fig. 71. Distribution of *Pinus strobus* in the Czech Republic (706 occupied quadrants). Prepared by Jiří Velebil.

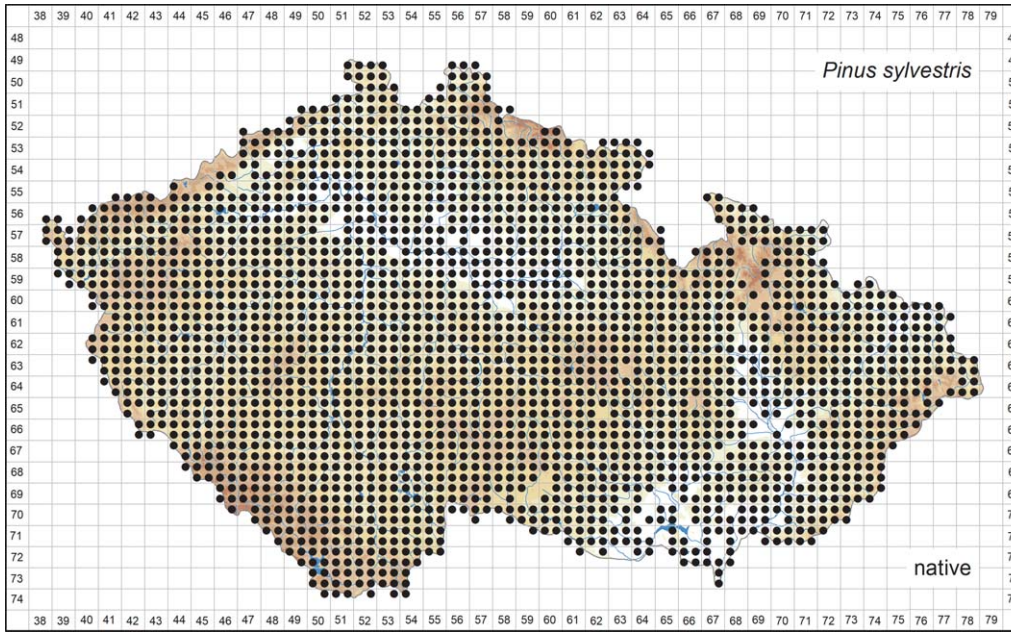

Fig. 72. Distribution of *Pinus sylvestris* in the Czech Republic (2354 occupied quadrants). Prepared by Jiří Velebil.

(Critchfield & Little 1966, Jalas & Suominen 1973). In the Czech Republic *P. sylvestris* is scattered to common almost throughout this country, especially at middle elevations. Only in the deforested lowlands and in the mountains (up to 1,100 m) is it relatively rare or locally absent. *Pinus sylvestris* has a wide ecological amplitude with distinct pioneer abilities, growing in various types of forest habitats from the lowlands up to the mountains in open-canopy forests, on rocks, scree slopes, sands and in peat bogs on various types of soils. It is often planted for timber. Its native distribution has been strongly modified by such plantations, and it is usually not possible to identify the indigenous stands. *Pinus sylvestris* has the most extensive overall range of all the pines, and it is inconsistently classified by various authors as comprising several infraspecific taxa at the rank of subspecies or varieties. In the Czech Republic only var. *sylvestris* is present (Businský 2008).

Pinus uncinata subsp. *uliginosa* (Fig. 73)

Pinus uncinata subsp. *uliginosa* is a central-European vicariant subspecies divided by the upper Danube basin from the more widely distributed west- to central-European subsp. *uncinata*, towards the east extending to the northern Alps in Bavaria. The distribution of subsp. *uliginosa* is restricted to the Czech Republic and adjacent parts of south-western Poland, Germany (Saxony and Bavaria) and Upper Austria, in all cases up to the distance of ~30 km from the border of Bohemia (Businský 2009, Businský & Kirschner 2010). Thus, it can be regarded as a subendemic taxon of the Czech flora. *Pinus uncinata* subsp. *uliginosa* is an ecologically highly specialized taxon occurring only on relict peat bogs, in which it forms a specific type of bog pine growth. Rather abundant populations are found in the Třeboňská pánev basin and at low elevations in the Šumava Mts in southern and south-western Bohemia. Further populations are scattered in western Bohemia, namely in the Český les and Slavkovský les hills, near the town of Cheb, and in the western and central parts of the Krušné hory Mts. Isolated populations are found on the boundary of Bohemia and Moravia near the Velké Dářko fishpond in the Žďárské vrchy hills and in Silesia near the Rejvíz hamlet in the Hrubý Jeseník Mts. Most of the occurrences outside Bohemia are represented only by scattered old trees or rather small, isolated populations, in some cases only by their remnants. The elevation range for populations of this taxon in the Czech Republic is between 420 and 780 m, with the upper limit of scattered trees is 940 m in the northern Šumava Mts; the lowest elevation occurrence outside the Czech Republic is at 195 m in Lower Silesia, Poland. Rarely it happens that unrecognized plants of *P. uncinata* subsp. *uliginosa* are used in forestry and planted to the landscape. This taxon has been for a long time referred to as *P. rotundata* (Skalická & Skalický 1988), but this name was later identified as a synonym of *P. uncinata* subsp. *uncinata* (Businský & Kirschner 2010). Chiefly at middle elevations *P. uncinata* subsp. *uliginosa* commonly hybridizes with *P. sylvestris*, and such populations are often genetically eroded by this hybridization. This taxon also hybridizes with *P. mugo* in the Krušné hory Mts, Slavkovský les hills and the Šumava Mts. At some sites only introgressive populations (*P.* ×*ascendens* nothosubsp. *skalickyi*) have been preserved, for instance, locally in the Krušné hory and Šumava Mts., in the Lysiny peat bog in the Slavkovský les hills and near the village of Pohoří na Šumavě in the Novohradské hory Mts. Because of the general decline of peat bog habitats in the Czech Republic, degeneration of old stands and hybridization, *P. uncinata* subsp. *uliginosa* is classified as endangered (Grulich 2012).

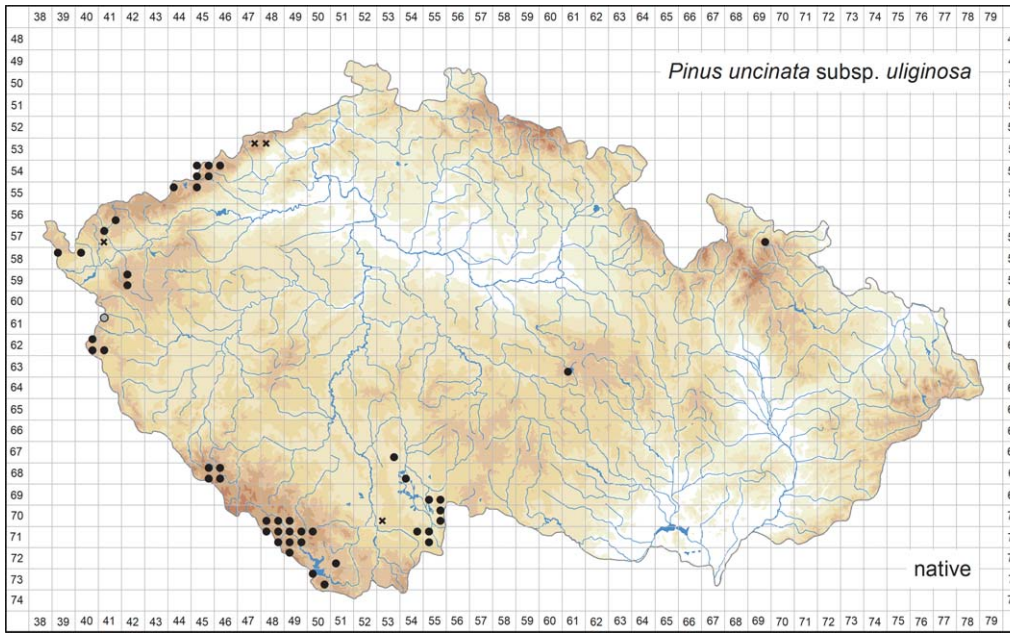

Fig. 73. Distribution of *Pinus uncinata* subsp. *uliginosa* in the Czech Republic: ● at least one record in 2000–2022 (46 quadrants), ◍ pre-2000 records only (1 quadrant), × alien (4 quadrants). Prepared by Roman Businský & Jiří Velebil.

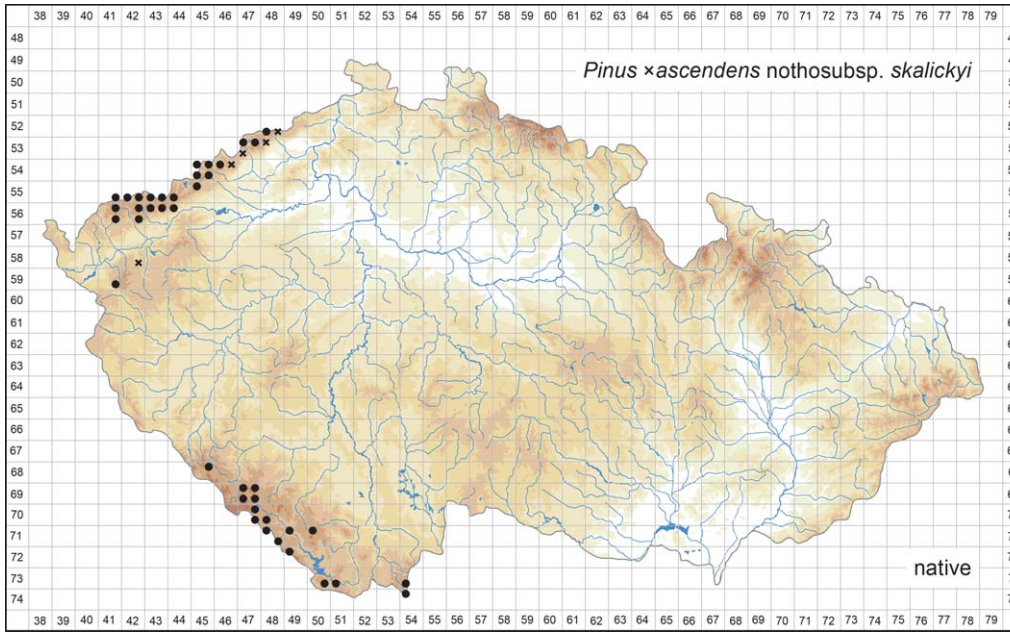

Fig. 74. Distribution of *Pinus ×ascendens* nothosubsp. *skalickyi* in the Czech Republic: ● native (40 quadrants), × alien (5 quadrants). Prepared by Roman Businský & Jiří Velebil.

Pinus ×*ascendens* nothosubsp. *skalickyi* (Fig. 74)

Pinus ×*ascendens* nothosubsp. *skalickyi* is a hybrid of *P. mugo* and *P. uncinata* subsp. *uliginosa*. Most populations of this hybrid display introgressive morphological characters and they co-occur with morphologically typical individuals of *P. mugo* or, in some places, both parents are missing. The least frequent case represents populations of *P. uncinata* accompanied by hybrid individuals. The most abundant populations of this hybrids in the Czech Republic, usually accompanied by *P. mugo*, are found in the Krušné hory Mts and on peat bogs at elevations of 800–1,000 m in the Šumava Mts. Further hybrid populations with advanced stages of introgression are found in the Lysiny peat bog in the Slavkovský les hills and near the village of Pohoří na Šumavě in the Novohradské hory Mts. Large populations of this form also exist on the Austrian side of the Novohradské hory Mts and in the Góry Bystrzyckie Mts in south-western Poland. Sometimes it is unintentionally used in forestry for planting, often in unfavourable soil conditions. As in the case of *P.* ×*celakovskiorum*, cultivated plants of *P.* ×*ascendens* come from unknown sources, and their use in the landscape should be avoided because of the potential threat of genetic erosion of native populations. This hybrid was previously referred to as *P.* ×*pseudopumilio* (Skalická & Skalický 1988, Businský 1998, 2002), but this name was reinterpreted as a synonym of the name *P. mugo* (Businský & Kirschner 2006). *Pinus* ×*ascendens* nothosubsp. *skalickyi* is categorized as lower risk – near threatened (Grulich 2012).

Pinus ×*celakovskiorum* (Fig. 75)

Pinus ×*celakovskiorum*, a hybrid of *P. mugo* and *P. sylvestris*, is the rarest interspecific hybrid of the genus *Pinus* in the Czech Republic. It was described based on one tree growing close to the latter parent on a boulder moraine near Plešné Jezero lake in the Šumava Mts in 1892. It was rediscovered a hundred years later in the same place in the form of two shrubby individuals (Businský & Kirschner 2010). Other occurrences of single individuals or very small groups of this hybrid were found in the 1990s in the Stráženská slatina peat bog near the village of Strážný and in the Chalupská slať peat bog near the village of Borová Lada in the Šumava Mts, and at the south-eastern foot of Mt Macecha in the central Krušné hory Mts. Another site of this hybrid was discovered in 2019 in the vicinity of the village of Modrava in the Šumava Mts. All known occurrences are at elevations of 800–1,100 m. This hybrid has probably been overlooked and can be found in both mountain ranges, most often on margins of peat bogs and on screes inhabited by *P. mugo*, not necessarily in contact with *P. sylvestris* (due to long-distance pollination by wind). Unrecognized plants of this hybrid are on rare occasions used in forestry and planted in the landscape. Such undesirable introduction into the Rolavská vrchoviště National Nature Reserve in the Krušné hory Mts has been recorded recently.

Pinus ×*rhaetica* nothosubsp. *digenea* (Fig. 76)

Pinus ×*rhaetica* nothosubsp. *digenea* is a hybrid of *P. uncinata* subsp. *uliginosa* and *P. sylvestris* and occurs with various frequencies at all middle elevation sites and individually also in some mountain populations of the former parent. It is most frequent within the populations of *P. uncinata* in the Třeboňská pánev basin in southern Bohemia, where

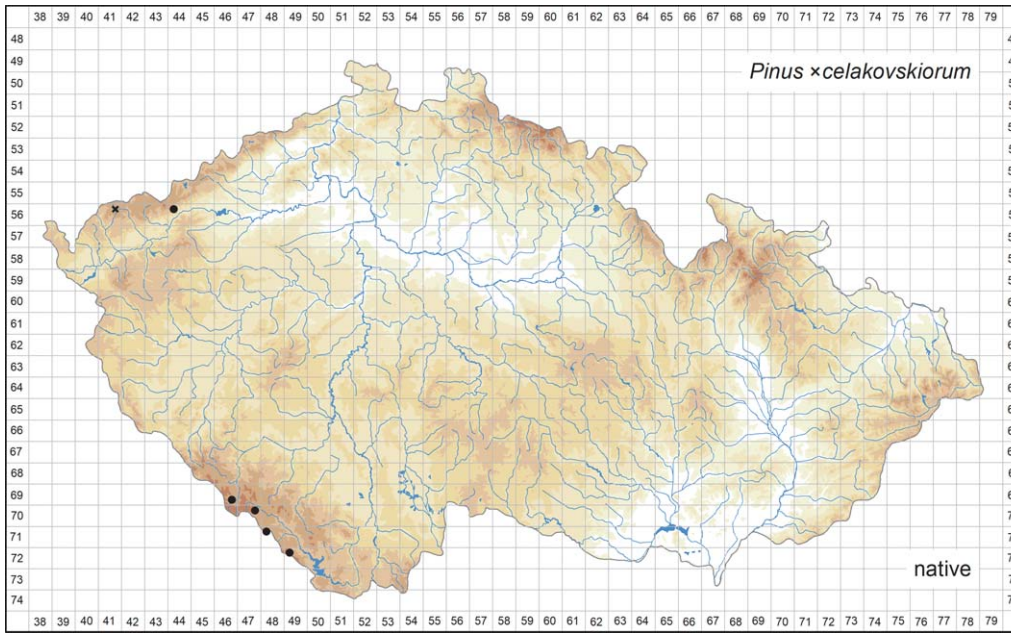

Fig. 75. Distribution of *Pinus* ×*celakovskiorum* in the Czech Republic: ● native (5 quadrants), × alien (1 quadrant). Prepared by Roman Businský & Jiří Velebil.

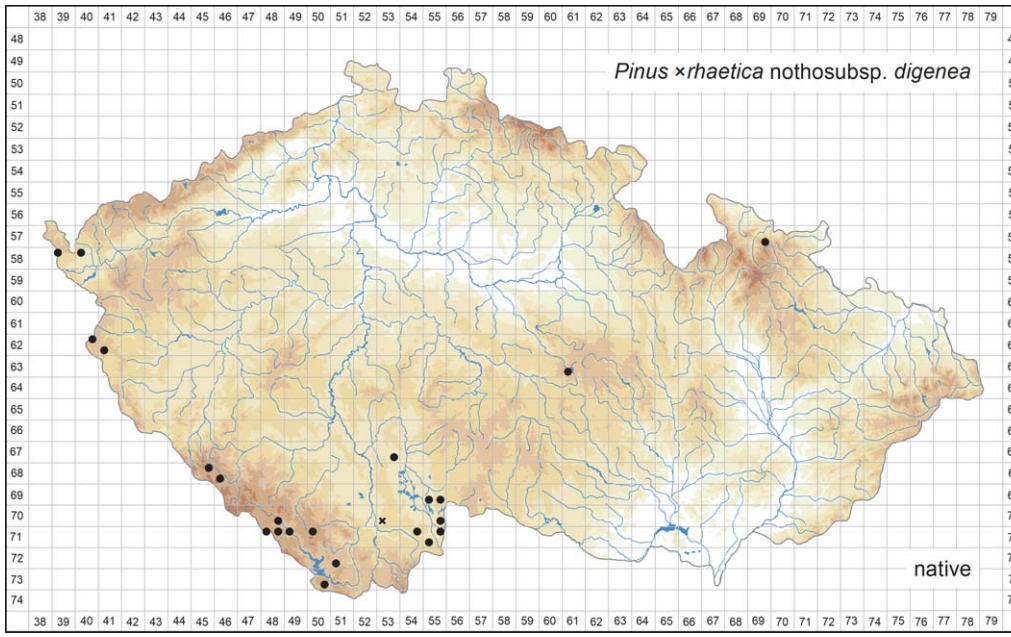

Fig. 76. Distribution of *Pinus* ×*rhaetica* nothosubsp. *digenea* in the Czech Republic: ● native (22 quadrants), × alien (1 quadrant). Prepared by Roman Businský & Jiří Velebil.

its stands are usually in contact with native or planted stands of *P. sylvestris*. At such sites, the core of the *P. uncinata* population in the most waterlogged centre of the peat bog is surrounded by hybrids in the drier periphery of the bog, and these stands are transitioning in pure growth of *P. sylvestris* outside the peat bog bed. There are several sites in which this hybrid forms introgressive populations, with *P. uncinata* no longer present as phenotypically pure individuals. In the mountain populations of *P. uncinata*, this hybrid is only scattered to rare (for instance, in the upper Vltava river valley in the Šumava Mts and near the Rejvíz hamlet in the Hrubý Jeseník Mts). This hybrid was formerly reported under the name *P.* ×*digenea* in the Czech botanical literature (Skalická & Skalický 1988, Businský 1998, 2002).

Rosa agrestis (Fig. 77)

Rosa agrestis is a variable species that includes several forms previously described as *R. albiflora*, *R. gizellae* and *R. schulzei*, and now either considered as intraspecific taxa (Větvička & Kirschner 2019) or not recognized at all (Větvička 1995). It occurs in western, central and southern Europe, from Ireland to eastern Romania and Bulgaria, Crimea, southwards to the Mediterranean area and northwards to Denmark. It is also distributed in north-western Africa, the Caucasus Mts and rarely in Anatolia (Kurtto et al. 2004). In the Czech Republic *R. agrestis* occurs predominantly in tall mesic and xeric scrub, in pastures, along dirt roads, on rock outcrops, in dry grasslands, and open oak and pine forests and their fringes (Lustyk & Vahalík 2021), usually on calcareous soils. Most of the localities of *R. agrestis* are found in central and south-western Bohemia and in a strip between the town of Znojmo and the city of Olomouc in southern and central Moravia. Elsewhere it is rare. It occurs mainly in hilly areas and reaches elevations of up to 850 m. Over the past 30 years *R. agrestis* has strongly declined, and at many sites it has been displaced by the expansive *R. canina* agg. This was probably caused by eutrophication of the landscape, abandonment of traditional management practices and the direct destruction of habitats. This species is classified as of lower risk – data deficient (Grulich 2012). Due to frequent misidentifications, the map is based solely on examined herbarium specimens.

Rosa arvensis (Fig. 78)

Rosa arvensis is a European species with a continuous distribution in the Atlantic, sub-Atlantic and sub-Mediterranean parts of the continent. It occurs from Ireland in the northwest through France, northern Italy (absent from the Alps), the southern part of central Europe and central Romania to the Balkan Peninsula, where it extends to western Bulgaria and northern Greece. It also occurs in northern Spain and rarely in the mountains of the Mediterranean area. In addition, there are secondary occurrences in northern Germany, southern Poland and Trans-Carpathian Ukraine (Meusel et al. 1965, Klášterský 1968, Kurtto et al. 2004). It grows in thermophilous forests and scrub, at the edges of oak and hornbeam forests, on rocky slopes, especially in hilly areas, both on basic and acidic substrates. In the Czech Republic the occurrence of *R. arvensis* outside cultivation has been documented in the Březina chateau park in western Bohemia in 1898 and in the city of Brno and the Pavlovské vrchy hills in southern Moravia, in 2015 and 1912, respectively. Although Meusel et al. (1965), Klášterský (1968) and Větvička (1995) considered *R. arvensis* to be native to the Czech Republic, occurring there at the northern boundary

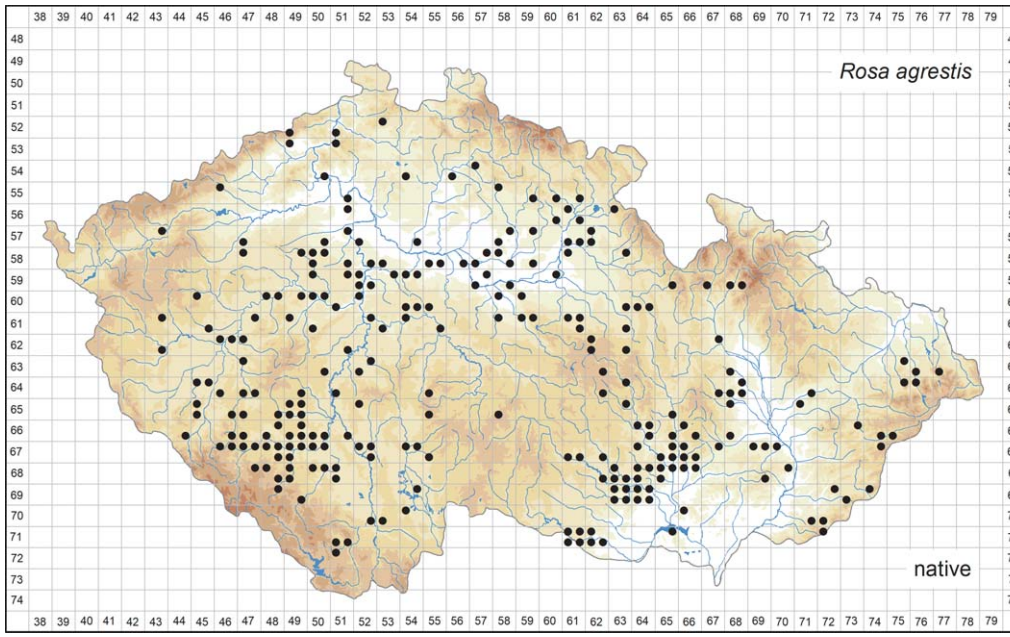

Fig. 77. Distribution of *Rosa agrestis* in the Czech Republic (259 occupied quadrants). Prepared by Radomír Řepka & Petr Maděra.

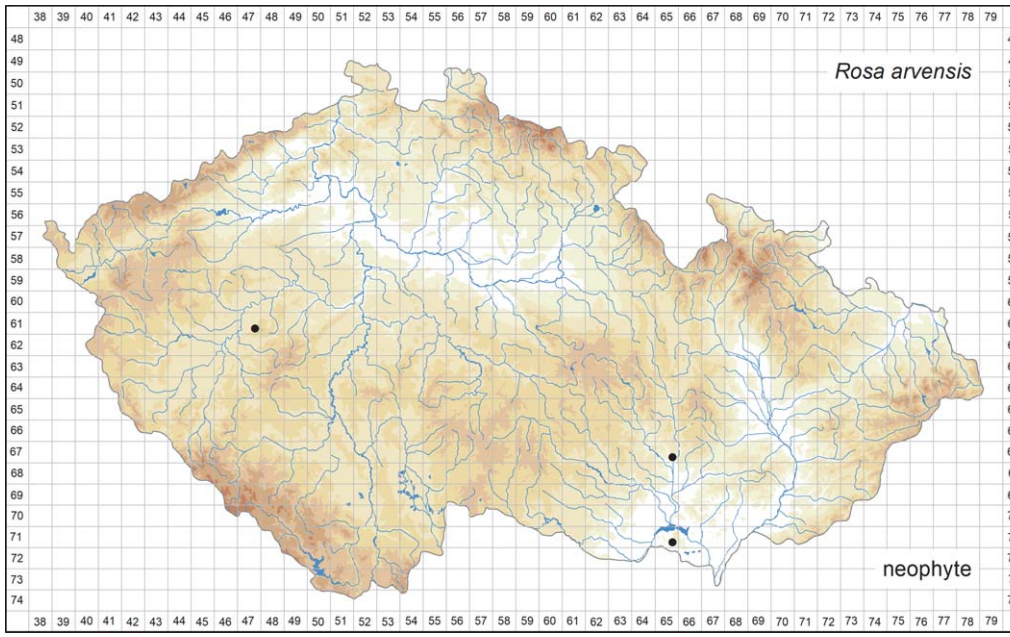

Fig. 78. Distribution of *Rosa arvensis* in the Czech Republic (3 occupied quadrants). Prepared by Radomír Řepka & Petr Maděra.

of its range, its past distribution there shows isolated localities suggesting only temporary occurrences resulting from escapes from cultivation. We therefore assume that *R. arvensis* is alien to this country. Previously, when the species was considered native, it was classified as nationally extinct (Grulich 2012), but due to its alien status, the designation is no longer appropriate.

Rosa elliptica (Fig. 79)

The continuous distribution of *Rosa elliptica* extends from the Pyrenees in the south-west to Denmark and southern Scandinavia in the north, Hungary in the east and northern Italy in the south; outposts are in Corsica and central Italy and eastwards as far as Romania and western Ukraine (Meusel et al. 1965, Kurtto et al. 2004). In the Czech Republic *R. elliptica* grows in shrub communities, dry grasslands and margins of mesophilous and thermophilous forests, mostly atop nutrient-rich substrates, less frequently atop crystalline bedrock. The species mainly occupies warm south- and south-west-facing slopes. It occurs mainly in warm hilly areas in south-western, central and northern Bohemia, in south-western Moravia and in the Hostýnské vrchy Mts. Elsewhere in the hilly areas it is scattered to rare, and largely absent from the peripheral mountain ranges, the Českomoravská vrchovina highlands and most of the Carpathians. It is mostly found at elevations up to 500 m, reaching its elevational maximum at 700 m in the Krušné hory Mts. *Rosa elliptica* has become a rare species in recent decades. A number of its populations have been destroyed, and the expansive *R. canina* agg. displaces this species in the succession of scrubby habitats. This species is classified as of lower risk – data deficient (Grulich 2012). The map is based solely on examined herbarium specimens.

Rosa gallica (Fig. 80)

Rosa gallica is distributed in central and southern Europe including the Mediterranean islands but is absent from the Alps. The northern boundary runs through the southern half of Germany and Poland, in the west it extends to eastern France and in the east to the western coast of the Black Sea, with an isolated occurrence in Crimea. Marginal populations in central Ukraine that originated from hybridization of *R. canina* agg. and *R. gallica* are now recognized as the separate species *R. pygmaea* (Kurtto et al. 2004). In the Czech Republic *R. gallica* grows in sunny and dry places such as dry grasslands, shrub communities, open-canopy forests and their fringes, mostly on south-facing slopes, on rather heavy and deep, loamy or clayey, calcareous soils. It is mainly distributed in warm, hilly areas of northern, central and eastern Bohemia, with isolated patches in southern and western Bohemia. In Moravia it is most frequent in the warmest hilly areas of its southern and central parts and in the south-western Carpathians Mts (Klášterský & Browicz 1964). Elsewhere it is rare. It reaches its elevational maximum of 600 m near the town of Vsetín in eastern Moravia. *Rosa gallica* has declined due to intensification of agriculture, direct destruction of its habitats and overall eutrophication followed by succession of stronger competitors. Therefore, it has been classified as vulnerable (Grulich 2012).

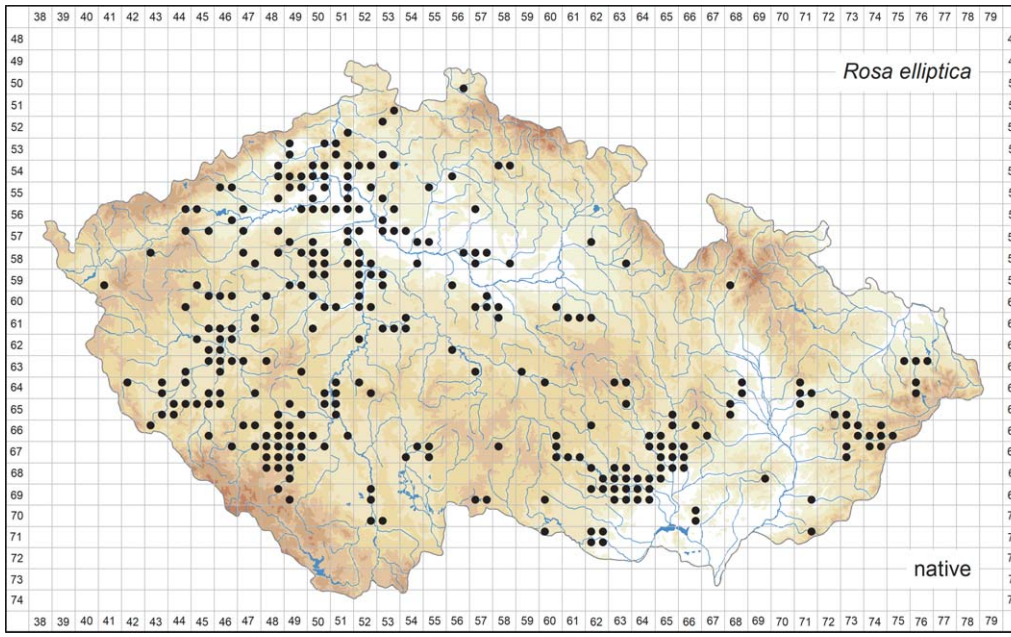

Fig. 79. Distribution of *Rosa elliptica* in the Czech Republic (293 occupied quadrants). Prepared by Radomír Řepka & Petr Maděra.

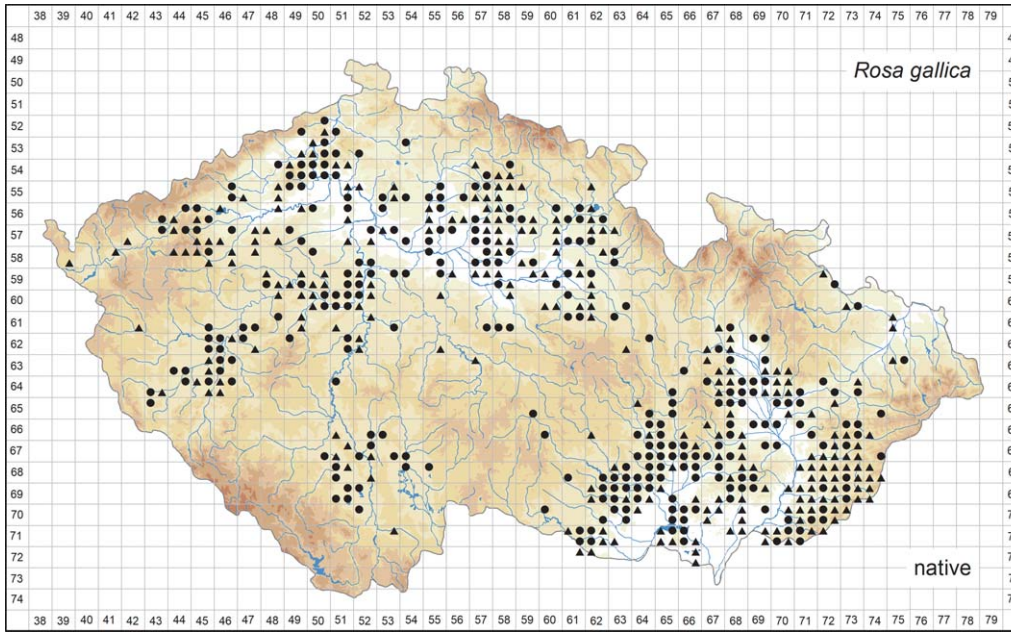

Fig. 80. Distribution of *Rosa gallica* in the Czech Republic: ● occurrence documented by herbarium specimens (276 quadrants), ▲ occurrence based on other records (259 quadrants). Prepared by Radomír Řepka & Petr Maděra.

Rosa glauca (Fig. 81)

Rosa glauca is native to the large mountain ranges of western, southern and central Europe, namely the Pyrenees, Alps, Apennines, Carpathians and Dinaric Mts; it is frequently cultivated, and secondary occurrences are found elsewhere in Europe, particularly in the British Isles, southern Scandinavia and the Baltic countries (Kurtto et al. 2004, Khapugin et al. 2021). In the Czech Republic it has been used in horticulture as a rootstock and ornamental shrub, serving as the source of occasional escapes in the vicinity of human settlements and parks (Větvička 1995). It has been mainly found around cities and large towns in central and western Bohemia and in central Moravia. Individual sites were further documented from northern and eastern Bohemia and southern Moravia. *Rosa glauca* is classified as a casual neophyte (Pyšek et al. 2012). The map is based on examined herbarium specimens.

Rosa majalis (Fig. 82)

Rosa majalis is most frequent in Scandinavia, Finland, adjacent parts of European Russia, the Baltic countries and Belarus, from which it extends with scattered populations southwards to the Alps, southern Poland and southern Ukraine and eastwards to western Siberia (Kurtto et al. 2004, Khapugin et al. 2021). In the Czech Republic *R. majalis* grows in shrub communities on scree slopes, banks of water bodies and in willow thickets. It is apparently native to the České středohoří Mts in northern Bohemia and the Třeboňská pánev basin in southern Bohemia. The scattered occurrences in other parts of Bohemia as well as in central and northern Moravia are secondary, i.e. escapes from cultivation. The species is classified as endangered due to its rarity (Grulich 2012). The map is based on examined herbarium specimens and selected literature and database records.

Rosa marginata (Fig. 83)

Rosa marginata is regarded as a morphologically variable, stabilized hybridogenous species originated from crossing between the members of *R. canina* agg. and *R. gallica* (Větvička 1995). It has a sub-Mediterranean range extending from central France to eastern Ukraine, with the northern limit in southern Germany and southern Poland; isolated occurrences are found in Romania, Moldova and Transcaucasia. It avoids the Alps and the warm Mediterranean area (Meusel et al. 1965, Kurtto et al. 2004). In the Czech Republic *R. marginata* grows on sunny slopes, strips of uncultivated land along dirt roads, abandoned fields and vineyards and forest edges. It prefers south-facing slopes. It is most widespread in northern, central and southern Bohemia, and around the city of Brno and the town of Znojmo in southern Moravia. Elsewhere it is scattered to rare. It occurs from the lowlands up to elevations of about 400 m, with the elevational maxima at 530–580 m at several localities in southern and western Bohemia. *Rosa marginata* is endangered due to intensification of agriculture, eutrophication and abandonment of pastures and grasslands followed by succession and is therefore classified as vulnerable (Grulich 2012). The map is based on examined herbarium specimens.

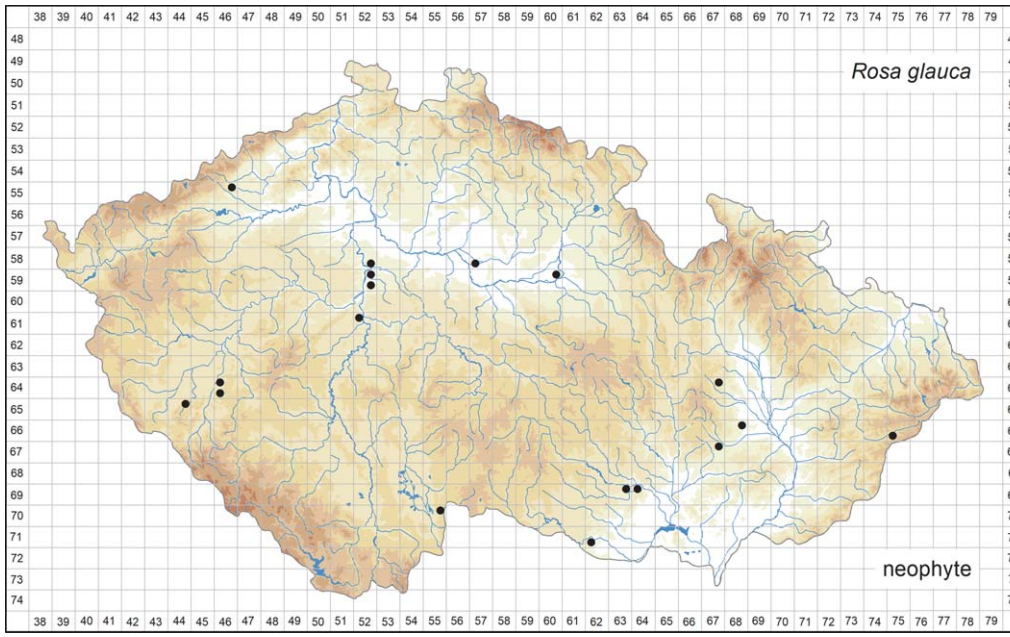

Fig. 81. Distribution of *Rosa glauca* in the Czech Republic (18 occupied quadrants). Prepared by Radomír Řepka & Petr Maděra.

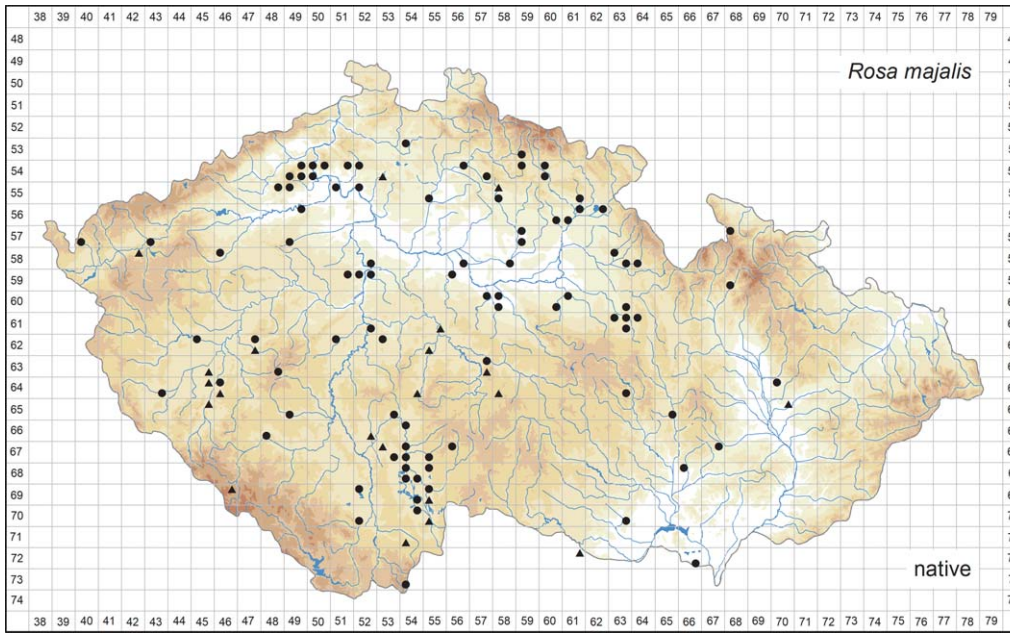

Fig. 82. Distribution of *Rosa majalis* in the Czech Republic: ● occurrence documented by herbarium specimens (90 quadrants), ▲ occurrence based on other records (21 quadrants). Prepared by Radomír Řepka & Petr Maděra.

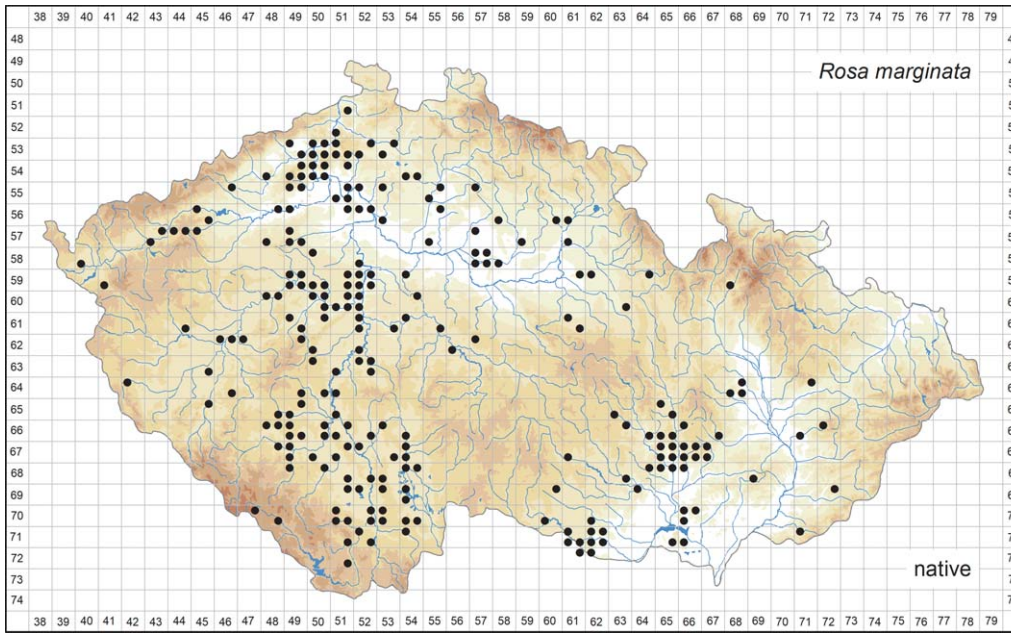

Fig. 83. Distribution of *Rosa marginata* in the Czech Republic (237 occupied quadrants). Prepared by Radomír Řepka & Petr Maděra.

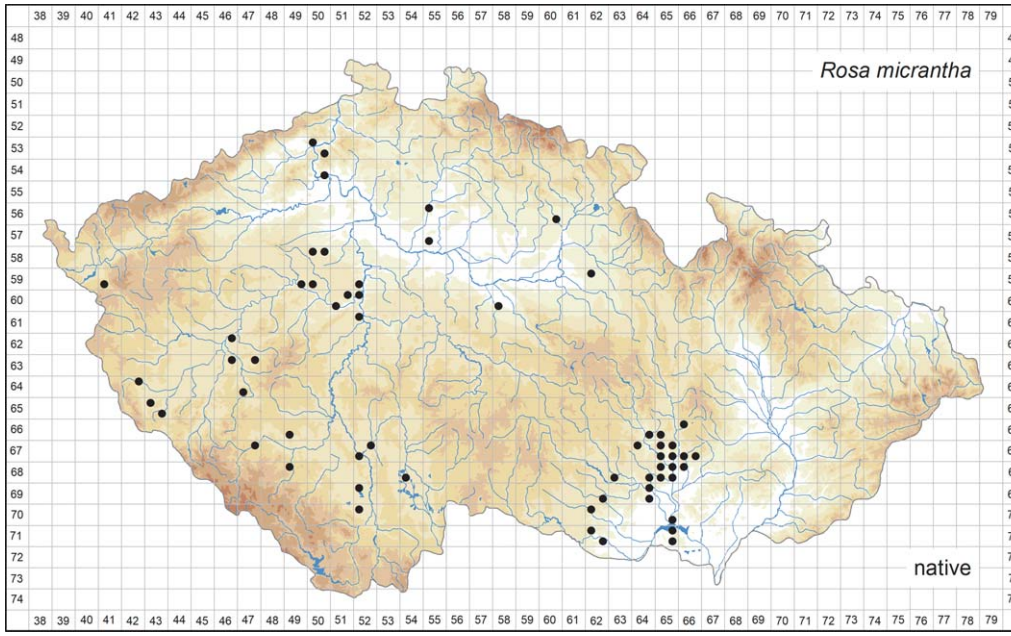

Fig. 84. Distribution of *Rosa micrantha* in the Czech Republic (59 occupied quadrants). Prepared by Radomír Řepka & Petr Maděra.

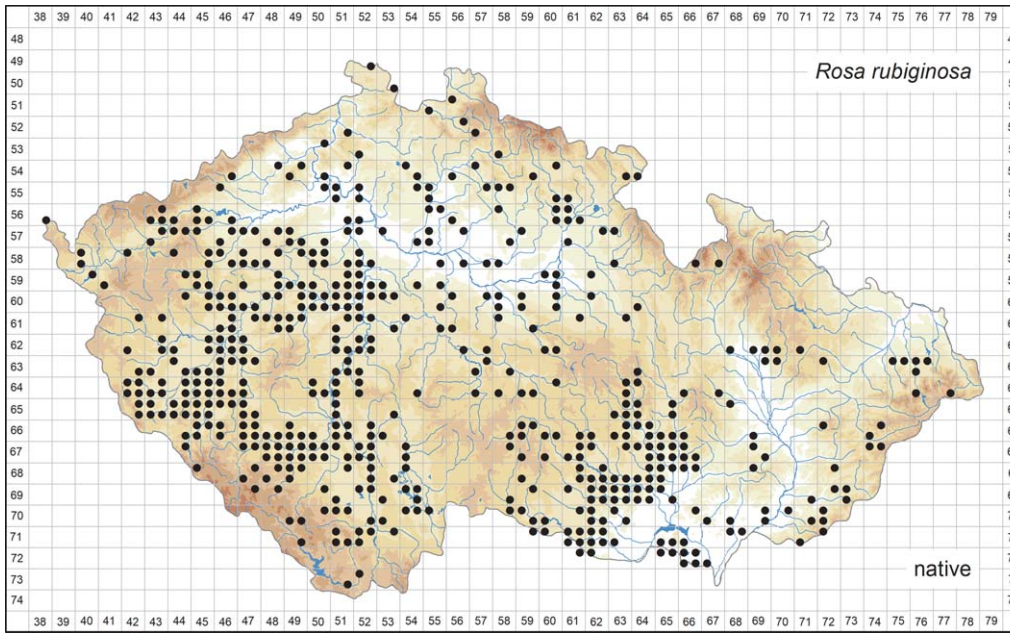

Fig. 85. Distribution of *Rosa rubiginosa* in the Czech Republic (539 occupied quadrants). Prepared by Radomír Řepka & Petr Maděra.

Rosa micrantha (Fig. 84)

Rosa micrantha is distributed from the Iberian Peninsula and the British Isles through central and southern Europe to central Romania, with an isolated occurrence in Crimea (Kurtto et al. 2004). Outside Europe it grows in north-western Africa and northern Anatolia (Zieliński 1985, Hultén & Fries 1986). In the Czech Republic it grows in shrub communities and dry grasslands, pastures, abandoned vineyards and fringes of oak forests over basic substrates such as limestone and loess (Lustyk & Vahalík 2021), often together with the similar *R. rubiginosa*. *Rosa micrantha* is rare in this country, with the majority of populations restricted to southern Moravia, where it grows in the broad vicinity of the city of Brno and in a strip between Brno and the town of Znojmo. In Bohemia it has only isolated occurrences mainly in its central, south-western, southern and eastern parts. Some of them may be secondary. It grows in hilly areas and reaches its elevational maximum of about 550 m at the village of Salajna in western Bohemia. Due to its rarity it is classified as vulnerable (Grulich 2012). The map is based on examined herbarium specimens.

Rosa rubiginosa (Fig. 85)

Rosa rubiginosa is widespread in Europe, especially in its western and central parts. It occurs from Ireland to the Volga river basin in southern European Russia, in the north extending to 60°N in southern Scandinavia and in the south to northern Spain and central Italy, with scattered occurrences in the Mediterranean area (Kurtto et al. 2004). It has been recorded from Argentina, where it is regarded as an invasive species (Hirsch et al.

2011). In the Czech Republic *R. rubiginosa* grows mainly in shrub communities on sunny, south-facing slopes, as well as along roads, in vineyards and open-canopy thermophilous forests and their fringes, mainly over basic substrates. It occurs predominantly in the western half of Bohemia and between the towns of Znojmo and Vyškov in south-western Moravia. Elsewhere it is scattered to rare. It grows from the lowlands to middle elevations, mostly up to 500 m, with the elevational maximum at about 800 m in the Krušné hory and Šumava Mts.

Rosa sherardii (Fig. 86)

Rosa sherardii occurs mainly in north-western and central Europe (Kurtto et al. 2004). It is common in the British Isles and southern Scandinavia, where it occurs up to 65°N, as well as in northern and central Germany, the Baltic countries, Belarus, scattered in western Ukraine and rarely in western European Russia. The Czech Republic is situated at the southern boundary of its continuous distribution. Isolated occurrences are in the French and Swiss Alps. In the Czech Republic *R. sherardii* is found at forest edges and on sunny, stony and rocky slopes, along roads and in shrub communities established after pasture abandonment. It prefers rather dry, slightly acidic to neutral soils. It is scattered to rare throughout the country, with the majority of sites in hilly areas, particularly in northern Bohemia, central and northern Moravia as well as in the foothills of the Moravskoslezské Beskydy Mts and Javorníky Mts in eastern Moravia. It reaches its elevational maximum of 850 m in the Krušné hory Mts. It is classified as vulnerable (Grulich 2012). *Rosa sherardii* is often confused with the morphologically similar *R. tomentosa*. Therefore, the map is based only on examined herbarium specimens.

Rosa spinosissima (Fig. 87)

Rosa spinosissima has a Euro-Siberian distribution, being most frequent in the Atlantic and Mediterranean parts of Europe. It occurs from the British Isles through most of western and central Europe to the Balkan Peninsula and Romania, southwards extending to the coast of the Mediterranean Sea. It also occurs in Crimea, the Caucasus Mts and rarely in southern European Russia and western Siberia. It is also found in Denmark and Iceland. Secondary occurrences are found in southern Scandinavia, the Baltic countries and adjacent parts of eastern Europe (Khapugin et al. 2021). In the Czech Republic *R. spinosissima* grows in low shrub communities on warm and sunny, south-facing slopes, along dirt roads, in rock crevices, dry grasslands and dry herbaceous fringes of oak forests (Lustyk & Vahalík 2021). It mostly grows on dry and shallow soils over limestone, conglomerate, marl and loess. It is native to two areas in the warmest parts of this country. The major one is located in hilly areas of southern and central Moravia, where it is most frequent between the towns of Znojmo and Vyškov, in the Pavlovské vrchy hills, in the environs of the town of Hustopeče and in the warm, south-western foothills of the Bílé Karpaty Mts; isolated occurrences are near the town of Prostějov in central Moravia. The second is in northern Bohemia, where this species is restricted to several sites in the central part of the České středohoří Mts; other occurrences in Bohemia are probably secondary. *Rosa spinosissima* reaches its elevational maximum at 520 m near the town of Litoměřice in northern Bohemia. It is classified as endangered (Grulich 2012) due to abandonment of traditional management practices as well as habitat degradation and destruction.

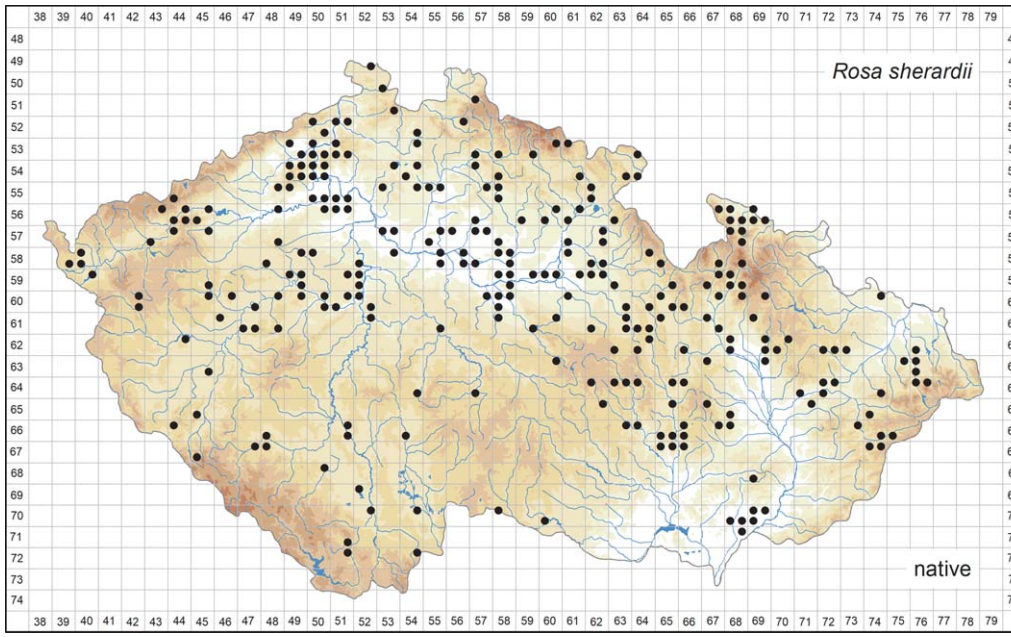

Fig. 86. Distribution of *Rosa sherardii* in the Czech Republic (275 occupied quadrants). Prepared by Radomír Řepka & Petr Maděra.

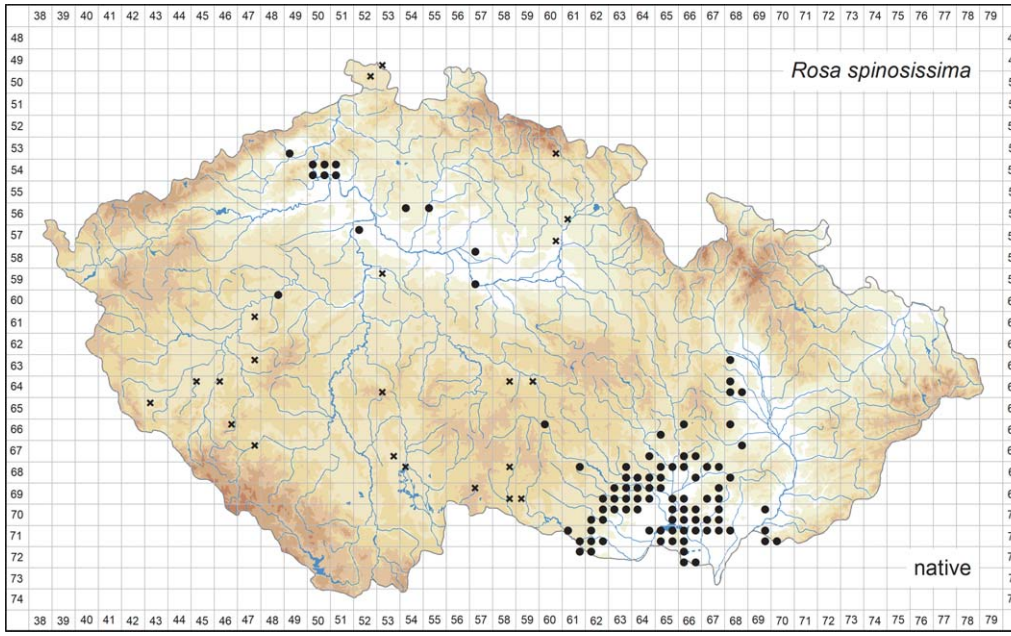

Fig. 87. Distribution of *Rosa spinosissima* in the Czech Republic: ● native (93 quadrants), × alien (22 quadrants). Prepared by Radomír Řepka & Petr Maděra.

Rosa tomentosa (Fig. 88)

Rosa tomentosa occurs in almost all of Europe with the exception of Scandinavia; it is distributed from Ireland in the west to the Don basin in south-western European Russia in the east, northwards to Denmark and southwards to the mountains of the Mediterranean area (Kurtto et al. 2004). In the Czech Republic *R. tomentosa* grows in pastures, forests margins and along dirt roads, without a preference for specific soils and bedrock, tolerating both full sunlight and partial shade. It is found scattered across most of this country, being locally more frequent in northern, central, eastern and south-western Bohemia and northern and central Moravia. It is less common in warm landscapes, growing mainly in the hilly areas and reaching its elevational maximum at about 800 m at the village of Závišín in western Bohemia. *Rosa tomentosa* has declined due to habitat destruction and eutrophication followed by succession. Therefore, it is classified as vulnerable (Grulich 2012). In herbaria confusion with *R. sherardii*, *R. villosa*, *R. dumalis* and some forms of *R. marginata* is frequent. The map is therefore based only on examined herbarium specimens.

Rosa villosa (Fig. 89)

Rosa villosa is distributed mainly in north-western, western and central Europe. It also grows in the Pyrenees Mts and the mountains of the Mediterranean area, and eastwards it extends to the Don river basin in southern European Russia. It is most frequent in Norway, the British Isles, the Baltic countries, Poland and the Alps; elsewhere in its range it is scattered. *Rosa villosa* has been in cultivation for a long time, and native occurrences sometimes cannot be reliably distinguished from secondary ones (Klášterský 1968, Větvička 1995, Kurtto et al. 2004). In the Czech Republic *R. villosa* grows mainly along roads and forest margins, on slopes, around settlements and on fishpond dams, without a preference for specific soils or light conditions. Several sites are documented from south-western, southern and eastern Bohemia, whereas only a few records exist from southern and south-eastern Moravia. In the Czech Republic *R. villosa* is classified as a naturalized alien, in the broad classification considered an archaeophyte (Pyšek et al. 2022). This assessment is supported by the local distribution pattern: the occurrences are isolated, without any geographic relationship and often near sites of former cultivation.

Sesleria caerulea (Fig. 90)

Sesleria caerulea is distributed in western and central Europe, being most frequent in the Alps, extending westwards to the Pyrenees, northwards to the British Isles, Germany and the Czech Republic, and eastwards to eastern Slovakia; isolated outposts are found in Iceland, southern Spain, Poland, Romania and Croatia (Deyl 1946, Meusel et al. 1965, Dixon 1982). The records from Albania were recently identified as erroneous, referring to *S. skipetarum* (Barina et al. 2018). In the Czech Republic *S. caerulea* grows in grasslands and open-canopy pine, lime, beech and oak forests, most frequently on north-facing cliffs and rocky slopes. The soils are mostly shallow, skeletal, permeable, usually neutral to basic, often affected by erosion, developed mostly over limestone, but also over marlstone, marl, calcareous sandstone, basalt, phonolite, serpentinite, diabase, spilite and conglomerates. Although this species often grows on exposed rocky habitats, it is sensitive to drought and its tussocks often perish during extremely dry summers (Chytrý

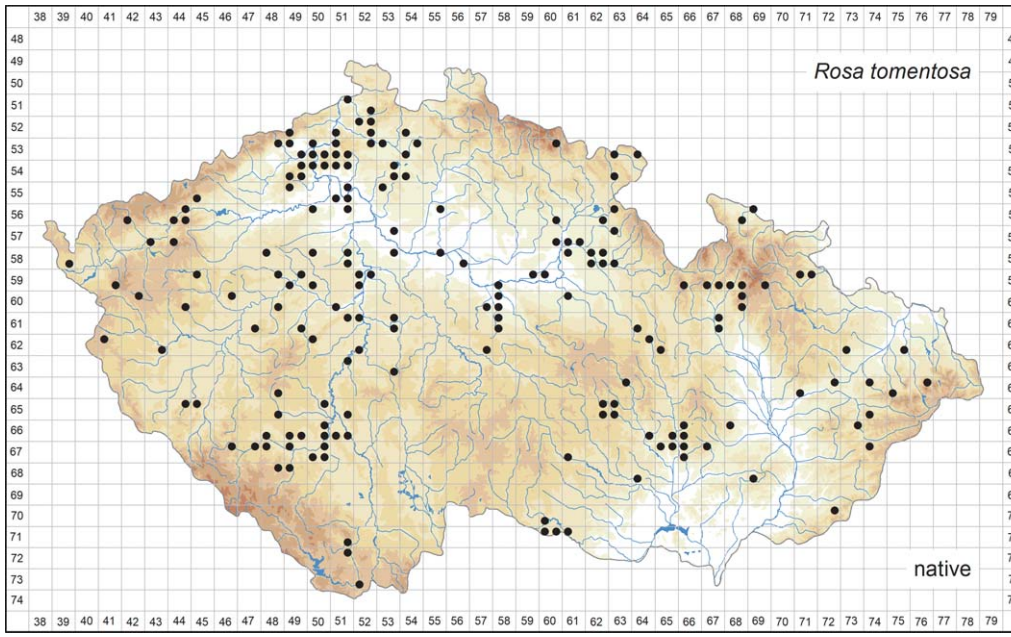

Fig. 88. Distribution of *Rosa tomentosa* in the Czech Republic (183 occupied quadrants). Prepared by Radomír Řepka & Petr Maděra.

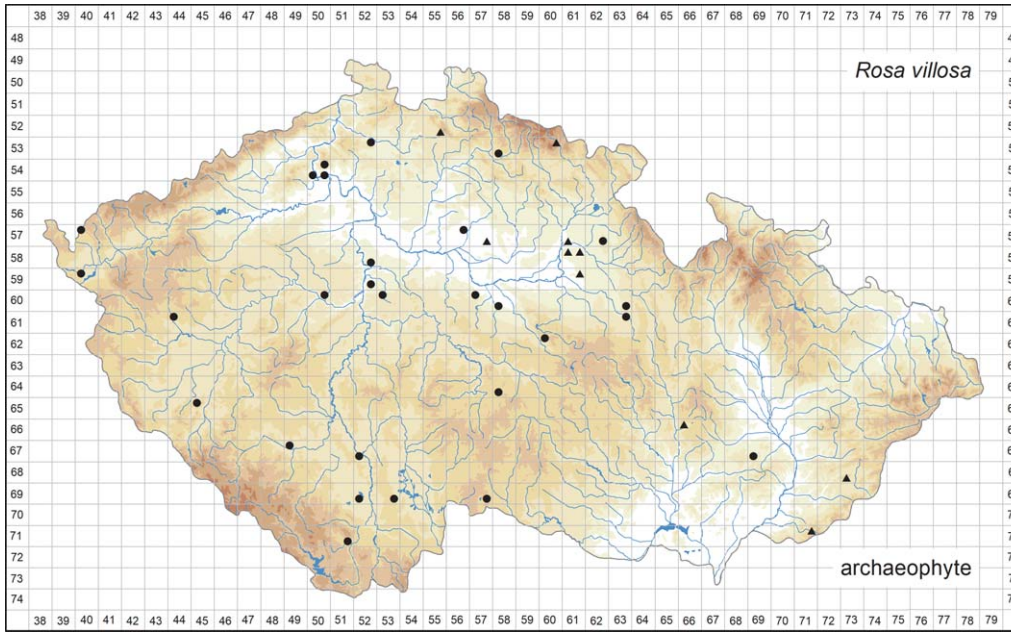

Fig. 89. Distribution of *Rosa villosa* in the Czech Republic: ● occurrence documented by herbarium specimens (28 quadrants), ▲ occurrence based on other records (10 quadrants). Prepared by Radomír Řepka & Petr Maděra.

2007). In the Czech Republic *S. caerulea* is considered a relict dealpine species (Skalický 1990). During the Holocene it largely retreated from lowlands to higher elevations in the Alps and Carpathians but also persisted in suitable refugia in deep, rocky river valleys and in hilly landscapes with abundant exposed rock surfaces and erosion-prone marl slopes. Most of the occurrences in this country are in northern and central Bohemia, mainly in the České středohoří Mts, the Džbán hills, along the lower stretches of the Labe river and in the valleys of the Berounka and Vltava rivers. Another area of occurrence is situated in southern Moravia, where is it most frequent in the Moravský kras karst area, in the Pavlovské vrchy hills and in the valleys of the Svratka, Oslava, Jihlava and Rokytná rivers. Elsewhere it is rare.

Sesleria uliginosa (Fig. 91)

Sesleria uliginosa is endemic to eastern-central and northern Europe, distributed mainly on the coasts of the Baltic sea in southern Sweden, south-western Finland and Estonia, with isolated occurrences extending southwards through Latvia, Lithuania and Poland to the Czech Republic; outposts are found even further in south in Slovakia, Austria, Hungary, Slovenia, Bosnia and Herzegovina, Montenegro, Romania and western Bulgaria (Deyl 1946, Meusel et al. 1965). In the Czech Republic *S. uliginosa* grows in calcareous fens and open dry grasslands on marl slopes, rarely also in wet meadows, ditches and grasslands along roads, and open thermophilous oak forests. It prefers heavy, clayey, calcium-rich neutral to basic soils that are wet in spring but dry out in summer. In this country it is almost restricted to the Labe and Orlice river basins in central and eastern Bohemia and the adjacent hilly areas on marl bedrock. An isolated population is situated near the town of Kynšperk nad Ohří in western Bohemia. It has strongly declined due to drainage, conversion of fens to arable land, cessation of mowing followed by succession and eutrophication, and is therefore classified as critically threatened (Grulich 2012).

Spiraea alba (Fig. 92)

Spiraea alba is native to North America from Alberta to Quebec in the north as far as Missouri to Georgia in the south. It was introduced into Europe probably in 1759 (Rehder 1940). It is very similar to *S. salicifolia*, therefore it was usually considered to be a variety of it in the 19th century, sometimes under the name *S. salicifolia* var. *paniculata*. In its native range *S. alba* occurs at damp to very wet sites and forms thickets spreading by root suckers. It is a parent of two interspecific hybrids, of which *S.* ×*billardii* has been commonly planted and occasionally escapes in the Czech Republic. The horticultural importance and use of *S. alba* are limited. However, it was planted for land improvement at waterlogged and riparian sites. Based on herbarium specimens, *S. alba* has been cultivated in this country since the 1840s and it was first recorded as escaped in the Březina manor garden in western Bohemia in 1898 (Businský & Businská 2002). Records of escaped plants are scattered across the Czech Republic at middle elevations, mainly in areas with humid climates. Large naturalized stands outside cultivation were found recently, for instance, near the village of Rozvadov in the Český les hills and south of the town of Hlinsko in the Žďárské vrchy hills. *Spiraea alba* is classified as a naturalized neophyte (Pyšek et al. 2022).

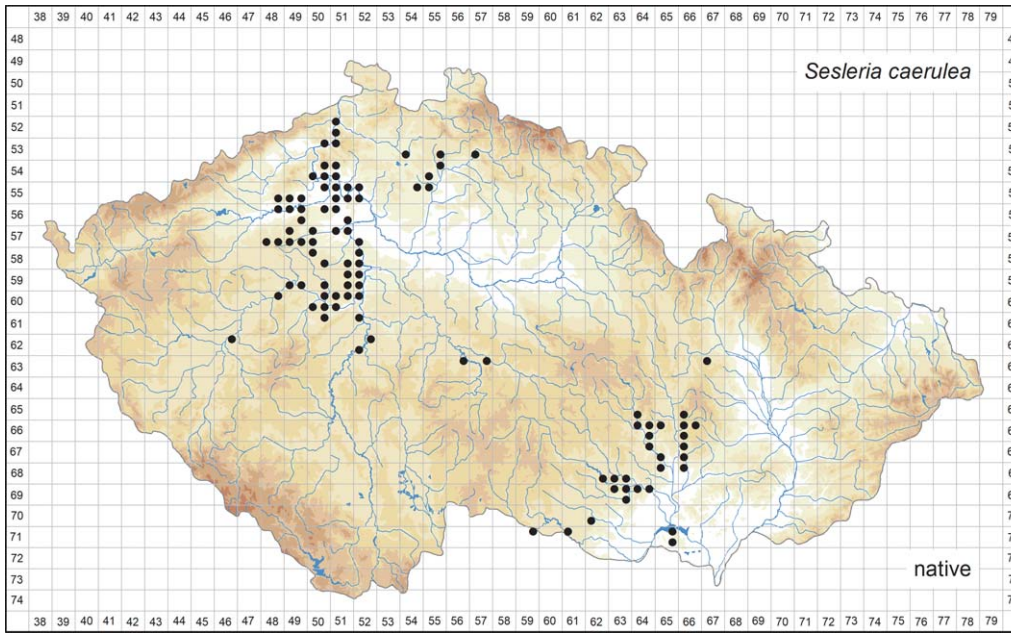

Fig. 90. Distribution of *Sesleria caerulea* in the Czech Republic (99 occupied quadrants). Prepared by Zdeněk Kaplan.

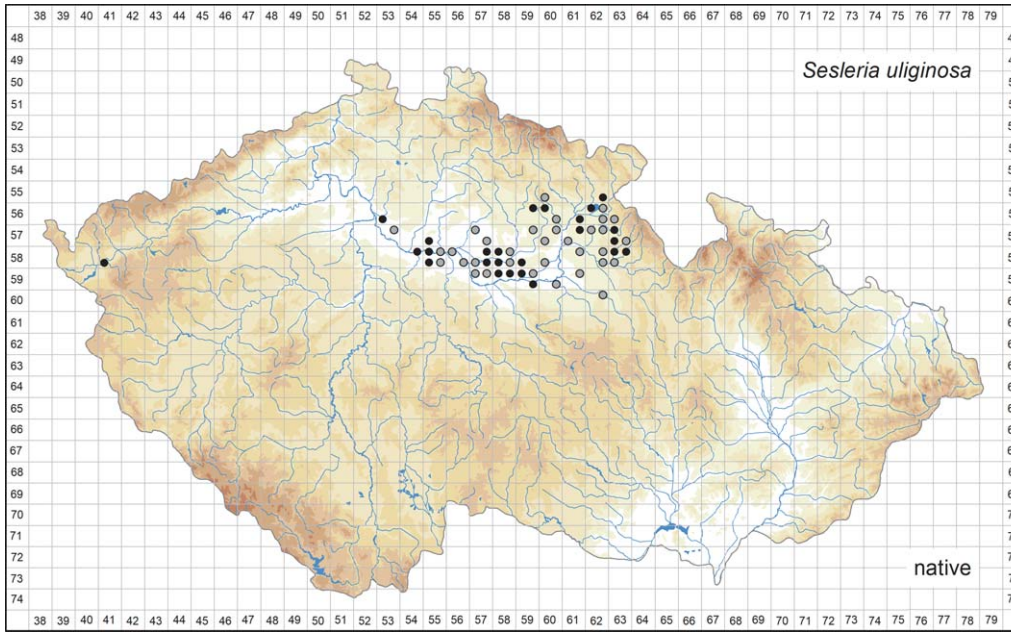

Fig. 91. Distribution of *Sesleria uliginosa* in the Czech Republic: ● at least one record in 2000–2022 (25 quadrants), ● pre-2000 records only (33 quadrants). Prepared by Zdeněk Kaplan.

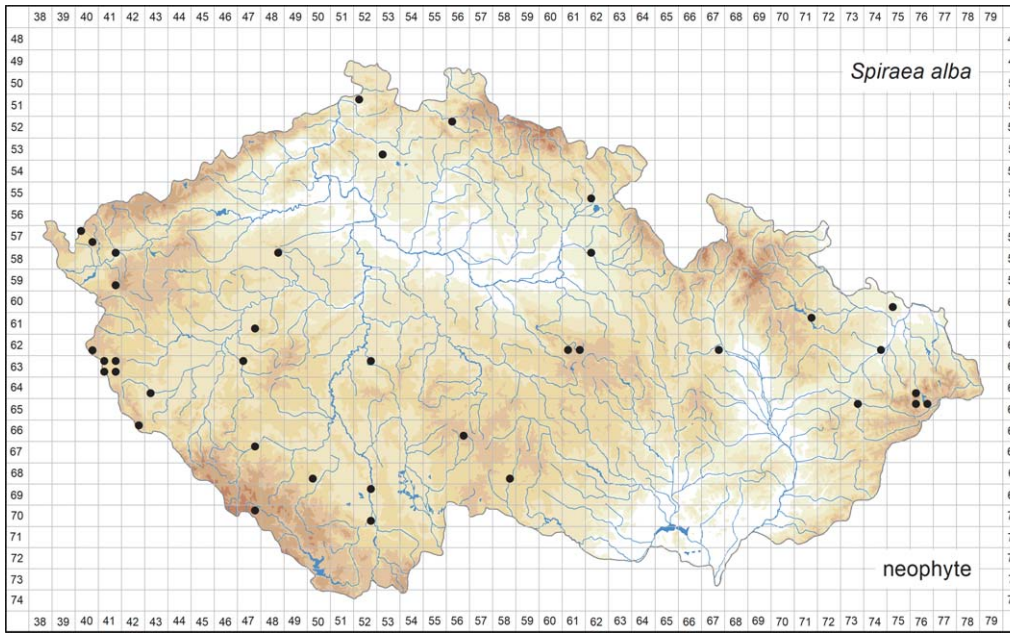

Fig. 92. Distribution of *Spiraea alba* in the Czech Republic (37 occupied quadrants). Prepared by Roman Businský & Jiří Velebil.

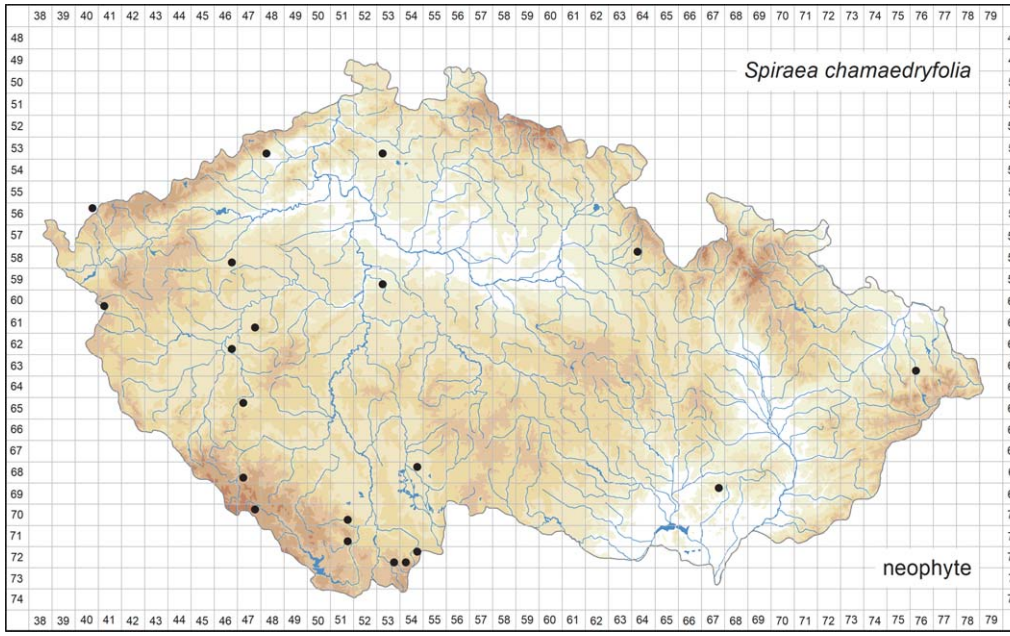

Fig. 93. Distribution of *Spiraea chamaedryfolia* in the Czech Republic (20 occupied quadrants). Prepared by Roman Businský & Jiří Velebil.

Spiraea chamaedryfolia (Fig. 93)

Spiraea chamaedryfolia is a species with a large range divided into two areas separated by a gap of about 4000 km. The large eastern part of its range is situated in central Siberia, where it is found in the Altai Mts and north-eastwards from there as far as 115°E, with the northern limit beyond 60°N (Svyazeva 1980), and southwards extending to north-western China (northern Xinjiang) and northern Mongolia. The western area occupies south-eastern Europe, from the south-eastern Alps across the Dinaric Mts to the Balkan Peninsula and the Southern and Eastern Carpathians, with the northern limit in south-western Ukraine near 48°N (Kurtto et al. 2004). Plants from the European part of the range were classified by some authors (Rehder 1940, Krüssmann 1978, Cullen et al. 1995, Businský & Businská 2002) as a separate variety or subspecies based on the name *S. ulmifolia*. Because of two ploidies known in *S. chamaedryfolia* (2n = 2x, 4x) found in cultivated plants, there was an opinion that the European plants are tetraploid whereas the Asian ones are diploid (Adolphi 1995). One of the most cultivated European morphotypes (probably corresponding to the tetraploid cytotype) is characterized by vigorous erect growth, raceme-like elongating inflorescence and rounded base of leaves. However, the variation of plants observed, e.g. in the Carpathians, embraces a wide range of morphotypes of which some are similar to the mentioned cultivated form, and some are not distinguishable morphologically from the Asian plants. For this reason, in accordance with Kurtto et al. (2004), we prefer not to accept any infraspecific taxon for the European plants of *S. chamaedryfolia*. In the Czech Republic this species is rather rare outside cultivation. The escaped plants usually grow as a result of former plantings at sites of abandoned villages, in open-canopy woods, in riparian stands, around castle ruins and in waste places. Rarely, this species can spontaneously grow from seeds. It is distributed mainly in the western part of Bohemia. Elsewhere it is scarce. The earliest herbarium voucher of escaped plants came from the Březina manor garden in western Bohemia in 1896. *Spiraea chamaedryfolia* is classified as a naturalized neophyte (Pyšek et al. 2022).

Spiraea douglasii (Fig. 94)

Spiraea douglasii is native to western North America from Alaska to California. A recent treatment (Lis 2014) divided it into three varieties, the typical one with leaves grey lanate to tomentose beneath, and two varieties with leaves glabrous to pubescent beneath. Of them only var. *douglasii* and var. *menziesii* were introduced outside their native ranges. The latter was recognized as a separate species, *Spiraea menziesii*, in the earlier literature (Rehder 1940), originally described parallelly to *S. douglasii*. The range of both varieties considerably overlaps: while the typical variety is distributed from British Columbia southwards, var. *menziesii* occurs northwards of north Oregon and Idaho and extends further to the inland. Var. *douglasii* was introduced from British Columbia into the British Isles around 1827 (Rehder 1940, Bean 1981); var. *menziesii* was introduced into Europe in 1838 (Rehder 1940). In cultivation *S. douglasii* var. *douglasii* commonly hybridizes with related species (*S. salicifolia* s. str., *S. alba*, *S. latifolia*) and has given rise to many hybrid forms. Both varieties are very valuable as ornamental shrubs suitable for damp to very wet sites, where they are able to form thickets spreading by root suckers. In the Czech Republic *S. douglasii* has been fairly frequently cultivated for a long time (Polívka et al. 1928). The earliest herbarium specimen of a cultivated individual was collected in

Prague in the 1840s (Businský & Businská 2002). Around the turn of the 20th century *S. douglasii* var. *douglasii* was not rare in town parks and private gardens but it has not been planted much recently. The earliest herbarium voucher of escaped plants came from the vicinity of the village of Prádlo in south-western Bohemia from 1939. In contrast, var. *menziesii* was often confused with various hybrids of the section *Spiraea*, and there is no herbarium voucher or any other reliable record of it outside of arboreta. Currently we have confirmed occurrences of *S. douglasii* var. *douglasii* in 17 quadrants in western to southern and east-central Bohemia and at one site south of the town Nové Město na Moravě in the eastern part of the Českomoravská vrchovina highlands. *Spiraea douglasii* is classified as a naturalized neophyte (Pyšek et al. 2022).

Spiraea japonica (Fig. 95)

Spiraea japonica is a species with considerable variation and a large native range in south-eastern Asia. Its typical variety occurs in the main islands of Japan except Hokkaido, in south-eastern and south-central China, northernmost Vietnam and northern Myanmar (Businský 2020). Altogether seven varieties are now recognized (Businský 2020). *Spiraea japonica* has an unreplaceable ornamental value among spireas in cultivation. The largest number of cultivars and cultural hybrids was bred and has been cultivated from this species. Only three varieties were involved in origin of the many cultural forms and cultivars, var. *japonica*, and two varieties that are widely distributed in China, var. *acuminata* and var. *fortunei*. The first plants of *S. japonica* that were sent from China to Europe in 1849 or 1850 belonged to the tall var. *fortunei*, while the Japanese plants (i.e. var. *japonica*) were imported for the first time before 1864 in the low, white-flowered cultivar 'Albiflora', at that time recognized as *S. albiflora* (Bean 1981), and var. *acuminata* was introduced into Europe in 1908 (Rehder 1940). The name *S. bumalda* has been commonly used in the horticultural literature since 1893 for a cultural form of *S. japonica*, which was considered to be an interspecific hybrid between *S. albiflora* and *S. japonica*. As *S. albiflora* is now recognized as a cultivar of *S. japonica*, *S. bumalda* was relegated to its synonymy (Businský 2020). *Spiraea japonica* in its natural forms has been cultivated sporadically in the Czech Republic since the end of the 19th century, recently rather rarely in arboreta or botanical gardens (Businský & Businská 2002). However, many old cultivars of *S. japonica* are often cultivated in various plantings, including strips along roads and motorways. Also, some modern, usually low cultivars with aberrantly coloured leaves have been planted in parks and private gardens during last decades. Most cultivars are not fertile, but they can persist for a long time in abandoned plantings. In the Czech Republic the species was observed escaped only at six sites in western, central and southern Bohemia, the earliest record being from 1995. However, at only one site, in the Průhonice manor garden, did the plants seem to have originated from seeds (Pyšek et al. 2012). *Spiraea japonica* is classified as a casual neophyte (Pyšek et al. 2022).

Spiraea latifolia (Fig. 96)

Spiraea latifolia is a North American species very similar to *S. alba*, in which it is usually included by American authors (e.g. Lis 2014) as *S. alba* var. *latifolia*. But the recent molecular analyses (Záveská Drábková et al. 2017) justified its separate species status. Based on recent measurements, it is both pentaploid and hexaploid, while the other natural

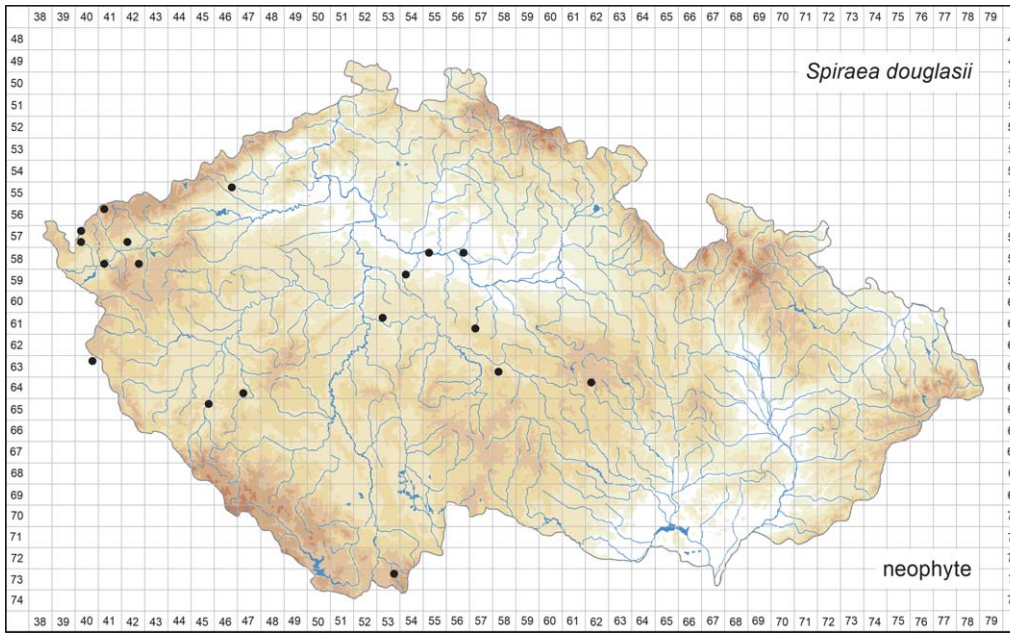

Fig. 94. Distribution of *Spiraea douglasii* in the Czech Republic (18 occupied quadrants). Prepared by Roman Businský & Jiří Velebil.

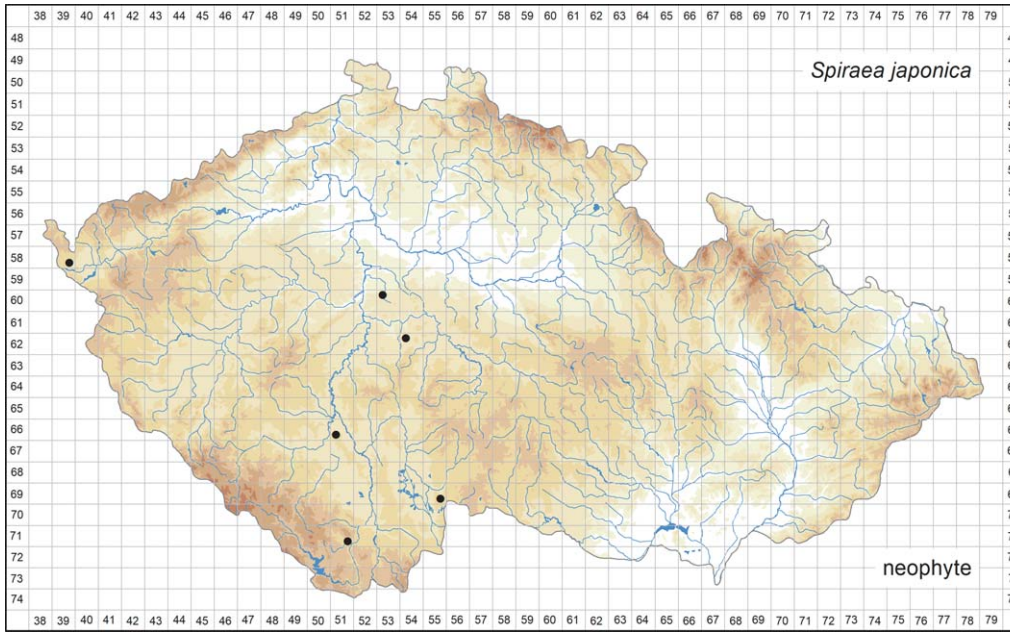

Fig. 95. Distribution of *Spiraea japonica* in the Czech Republic (6 occupied quadrants). Prepared by Roman Businský & Jiří Velebil.

taxa of the section *Spiraea* are diploid, tetraploid or octoploid (Velebil, in prep.). The native distributions of both taxa overlap in a large area of the north-eastern USA and southern provinces of Canada, but the range of *S. latifolia* is shifted towards the north-east up to Ungava Bay in northern Quebec (Scoggan 1978). The time of its supposed introduction into Europe coincides with the year of its first scientific description, 1789 (Rehder 1940). The ecological requirements, horticultural importance and uses of both taxa are very similar. The cultivation of *S. latifolia* in Bohemia is documented by herbarium specimens collected in Prague before 1850 (Businský & Businská 2002), but the plants were misidentified either as *S. salicifolia* or *S. alba*. Escaped plants have been recorded in the Czech Republic at four sites. Herbarium specimens document the occurrences near the town of Nová Cerekev in Českomoravská vrchovina highlands in 1967 and near the village of Bystřička in eastern Moravia in 1946. Two recent records, namely in the periphery of the village of Tisá in northern Bohemia and near the village Šejby in the Novohradské hory Mts, refer to stands established from abandoned plantings. The species is classified as a casual neophyte (Pyšek et al. 2022).

Spiraea salicifolia (Fig. 97)

Spiraea salicifolia is a Eurasian species widespread across Siberia and the Russian Far East from ca 70°E in the west to the Kamchatka Peninsula and Bering Sea in the east, with scattered occurrences northwards up to or slightly beyond 70°N (Svyazeva 1980). Towards the south it extends to Mongolia, north-eastern China and northern Japan. The species has a disjunct range in central Europe, extending from southern Bohemia, Carinthia and Slovenia in the west to eastern Romania and north-western Ukraine in the east, while other occurrences in Europe including Germany are secondary or of uncertain status (Kurtto et al. 2004). In the Czech Republic *S. salicifolia* is indigenous in southern Bohemia, mainly in the Třeboňská pánev basin and in the upper Vltava river basin in the Šumava Mts. Earlier herbarium specimens from the middle Vltava valley are due to dispersal by water from abundant populations located upstream. An isolated population exists in the Dúbrava forest north of the town of Hodonín in southern Moravia. We treat this occurrence tentatively as indigenous because there are mid-19th century records of *S. salicifolia* from the adjacent Záhorská nížina lowland in Slovakia (Zahradníková 1992). However, some authors (e.g. Slavík 1998, Kurtto et al. 2004) consider these occurrences secondary. In the Czech Republic *S. salicifolia* occurs mainly at edges of peat bogs and on stream banks, preferring open sites where it forms dense growths slowly expanding by root offsets. It is classified as vulnerable (Grulich 2012). *Spiraea salicifolia* commonly hybridizes with *S. alba*, *S. douglasii* and *S. latifolia*, all native to North America and introduced to Europe about two centuries ago (Rehder 1940). Hybrid plants have been emerging but have long gone unnoticed in European gardens, parks and nurseries, and they have been planted, sometimes together with mother taxa, for ornament in and around settlements and even in the landscape. As long-living shrubs, they often persist at sites after they were abandoned and occasionally spread by root suckers. Consequently, there are many literature records (e.g. Úradníček et al. 2017) and herbarium specimens of alleged occurrences of *S. salicifolia* in the Czech Republic and in the neighbouring countries that, however, pertain to various similar hybrid taxa. The distribution map was therefore based solely on the revised herbarium specimens and our own field records. Actual *S. salicifolia* is not

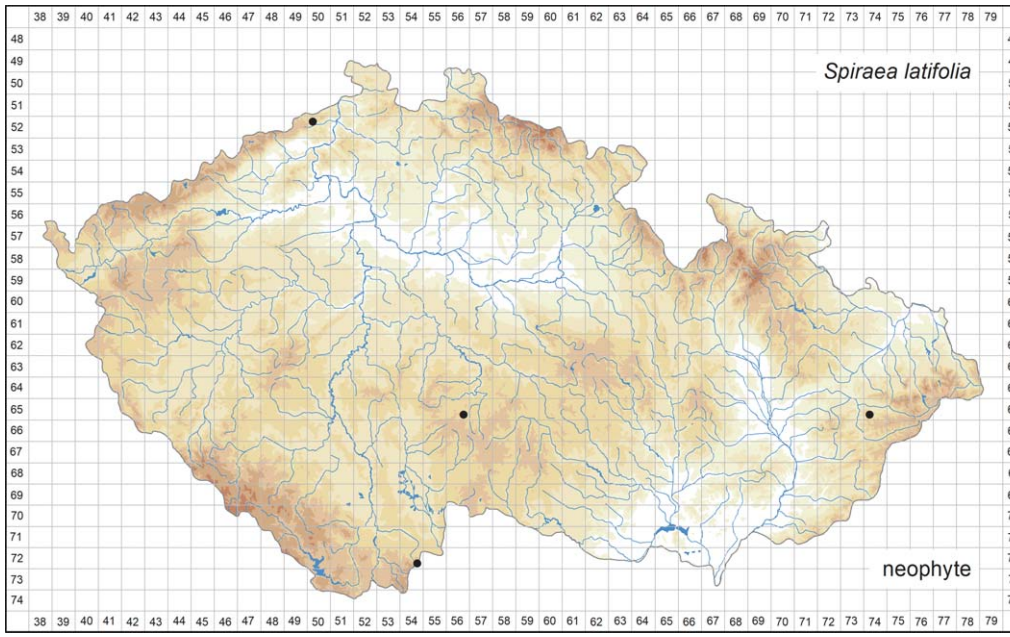

Fig. 96. Distribution of *Spiraea latifolia* in the Czech Republic (4 occupied quadrants). Prepared by Roman Businský & Jiří Velebil.

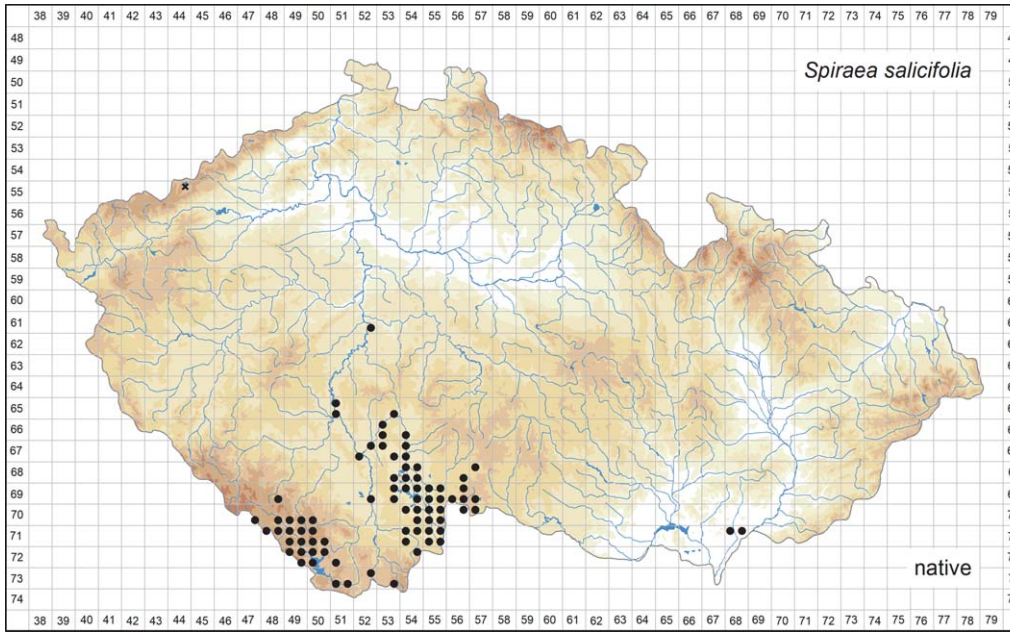

Fig. 97. Distribution of *Spiraea salicifolia* in the Czech Republic: ● native (79 quadrants), × alien (1 quadrant). Prepared by Roman Businský & Jiří Velebil.

horticulturally valuable, because it does not blossom profusely and often suffers from aphids; therefore, it was usually not planted intentionally for ornament.

Spiraea ×*billardii* (Fig. 98)

The name *Spiraea* ×*billardii* had been for a long time used for hybrids with the assumed parentage *S. douglasii* × *S. salicifolia* s. l., arisen spontaneously in gardens at various places in Europe (Zabel 1893, Krüssmann 1978). Such plants were found for the first time around 1850 (Rehder 1940, Bean 1981). Already in the 19th century, several clones were described and propagated, later considered as cultivars. The hybrids of *S. douglasii* × *S. salicifolia* s. l. were also considered to be conspecific with the American taxon *S. menziesii* (Zabel 1893), currently recognized as *S. douglasii* var. *menziesii*. However, the protologue of *S.* ×*billardii* was shown to correspond to the parental combination *S. alba* × *S. douglasii*, while plants derived from the parental combination *S. douglasii* × *S. salicifolia* s. str. were described as *S.* ×*pseudosalicifolia* (Silverside 1990). The clones and cultivars of *S.* ×*billardii* (s. l., i.e. incl. *S.* ×*pseudosalicifolia* and *S.* ×*macrothyrsa*) are much more frequently planted than non-hybrid individuals. Similar to its parental species, *S.* ×*billardii* prefers damp to waterlogged sites at middle elevations. The herbarium materials are scarce, and their identification is sometimes difficult, but they document the cultivation of *S.* ×*billardii* in the Bohemian lands since the 1870s. The earliest record of an escaped plant is from the village of Hřibiny in north-eastern Bohemia in 1932. Since then, escaped plants have been recorded in 21 quadrants of the mapping grid, mainly in Bohemia. *Spiraea* ×*billardii* is classified as a naturalized neophyte (Pyšek et al. 2022).

Spiraea ×*macrothyrsa* (Fig. 99)

Under the name *Spiraea* ×*macrothyrsa*, we classify a group of cultural hybrid morphotypes with supposed parents *S. douglasii* and *S. latifolia*. As *S. latifolia* s. str. was included in *S. salicifolia* s. l. in the past, or in *S. alba* more recently, both *S.* ×*macrothyrsa* and *S.* ×*billardii* were united under the latter name (Krüssmann 1978, Silverside 1990). We treat this hybrid at the rank of nothospecies because of the separate status of *S. latifolia* justified by recent molecular analyses (Záveská Drábková et al. 2017). This cultural hybrid has been allegedly cultivated since 1870 (Rehder 1940). Now the hybrid is represented in the Czech Republic by several morphotypes or clones of spontaneous origin. Also, several ploidy levels in this hybrid were revealed, which corresponds with two levels found in the parent *S. latifolia* (Velebil, in prep.). Glabrescent morphotypes of this hybrid were confused with *S.* ×*rubella* (Koblížek 1992), the hybrid between *S. salicifolia* and *S. latifolia*, which has not been detected in the Czech Republic according to latest knowledge. Recently we have distinguished 31 quadrants of the mapping grid in this country, mainly in its western and southern parts, with occurrences of *S.* ×*macrothyrsa* outside town parks and private gardens, either in abandoned plantings or as escaped plants, mostly at damp to waterlogged sites at middle elevations. The earliest herbarium evidence comes from 1946 when this hybrid was recorded as escaped at the top of Mt Bobek in the Beskydy Mts. *Spiraea* ×*macrothyrsa* is classified as a naturalized neophyte (Pyšek et al. 2022).

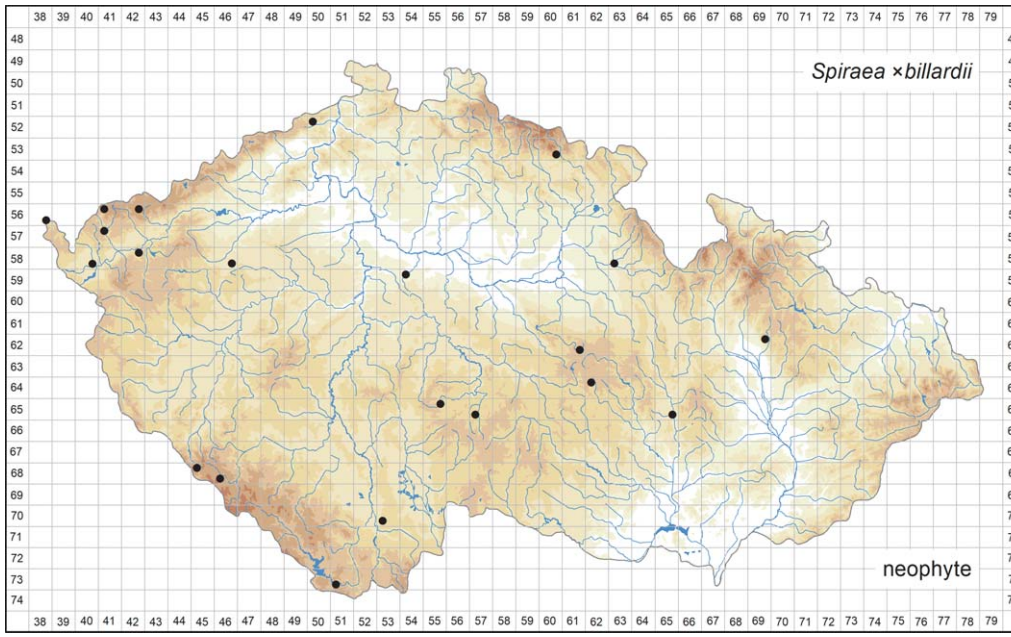

Fig. 98. Distribution of *Spiraea ×billardii* in the Czech Republic (21 occupied quadrants). Prepared by Roman Businský & Jiří Velebil.

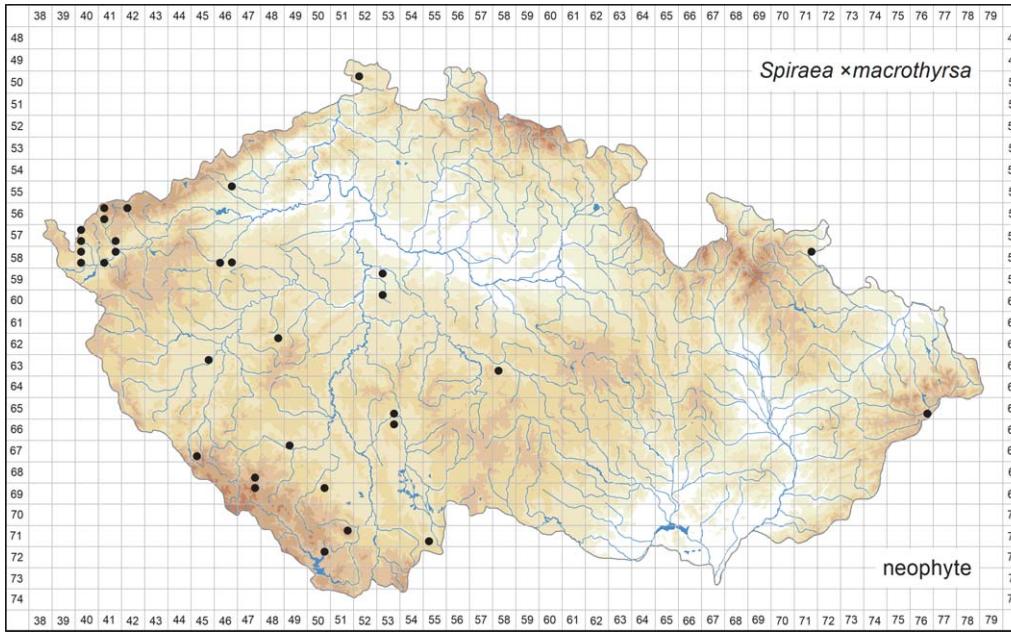

Fig. 99. Distribution of *Spiraea ×macrothyrsa* in the Czech Republic (31 occupied quadrants). Prepared by Roman Businský & Jiří Velebil.

Spiraea ×pseudosalicifolia (Fig. 100)

Spiraea ×pseudosalicifolia is a hybrid between *S. douglasii* and *S. salicifolia* (s. str.), distinguished only about 30 years ago in the British Isles in naturalized populations of three similar hybrid combinations (Silverside 1990). Subsequently, Adolphi (1995) considered *S. ×pseudosalicifolia* widely naturalized also in some parts of central Europe, where it spreads as a residue of old plantings at rather damp sites. More recently it was established that the cultivar known as *S. ×billardii* 'Triumphans', which arose in Europe at the end of the 19th century (Krüssmann 1978) and cultivated for a long time in the Czech Republic, belongs to *S. ×pseudosalicifolia* (Businský & Businská 2002). *Spiraea ×pseudosalicifolia* prefers damp to waterlogged sites at middle elevations. The oldest herbarium evidence of escaped plants come from the environs of the village of Malá Morávka in the Jeseníky Mts from 1946. Since then, there have been records of escaped plants or abandoned plantings outside of parks and gardens from 16 quadrants of the mapping grid in Bohemia and six in Moravia and Silesia. *Spiraea ×pseudosalicifolia* is classified as a naturalized neophyte (Pyšek et al. 2022).

Verbena bonariensis (Fig. 101)

Verbena bonariensis is native to southern Brazil, Paraguay, Uruguay and northern Argentina, but as an ornamental plant it has been introduced into other parts of the world, including North America, Europe, Africa, Taiwan, Mauritius, Australia and New Zealand (do Amaral Franco 1972, Slavík 2000, Nesom 2010a). In Europe it has been grown since 1774, and thus most of its secondary occurrences are probably escapes from cultivation. Nowadays, the species is reported as casual or introduced with unknown status of naturalization in Finland, the British Isles, Belgium, Portugal, France, Germany and as naturalized in the Netherlands and Italy (Raab-Straube 2022). In the Czech Republic the earliest records originally identified as *V. bonariensis* are from the city of Brno in the 1960s for plants imported with sheep wool from South America (Dvořák & Kühn 1966, Dvořák et al. 1983); these records were incorporated into the review on alien plants by Pyšek et al. (2012). However, recent examination of herbarium specimens of *Verbena* in BRNU has shown that these records are actually related to *V. incompta*, a species closely related to and only in 1995 separated from *V. bonariensis* (Nesom 2010a, Verloove 2011). Therefore, the date of the earliest record of *V. bonariensis* outside of cultivation must be corrected to 2002, when the species was recorded in the vicinity of the town of Hořice in eastern Bohemia. The plant grew there in a ditch along a busy road, near a small area of private gardens. For a long time, there were no additional records of escaped plants. The species started to be intentionally cultivated in this country probably rather late, as the herbarium specimens documenting cultivation are not from earlier than the late 20th century (earlier records of cultivated plants were revised as *V. rigida*). The boom in popularity of this species in this country started probably after 2000 and in recent years it has been one of the most frequent ornamental plants in city flower beds and flowerpots, sometimes being grown also in village gardens. As a consequence, escapes of *V. bonariensis* from cultivations started to be more common since 2015, particularly in southern Bohemia and northern Moravia. Occasionally it was also recorded elsewhere, and further records can be expected. The species was usually collected on road verges near flower beds with *V. bonariensis* cultivations. However, there are also records from

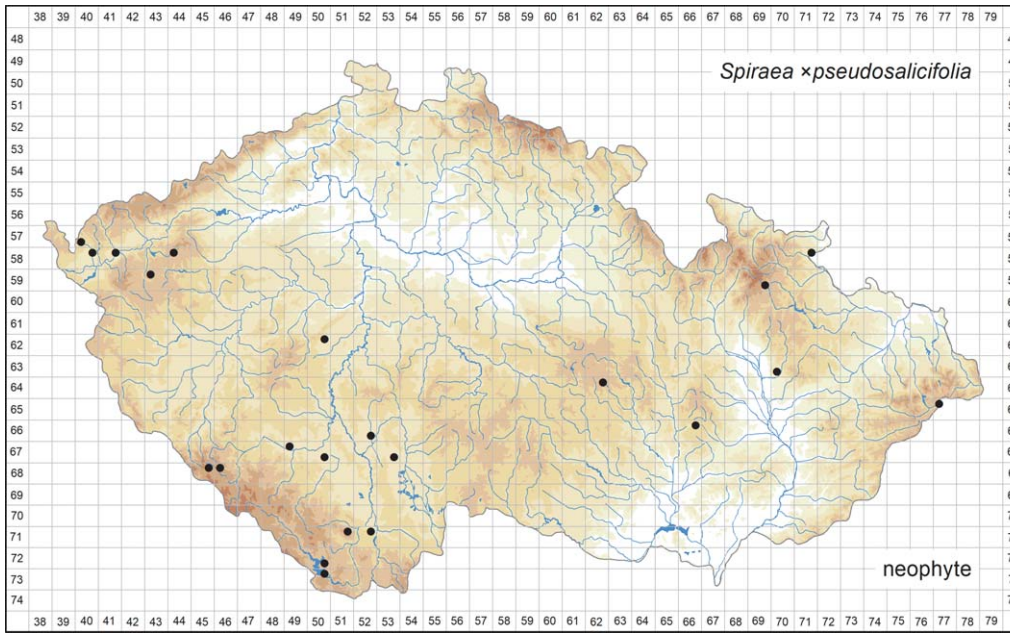

Fig. 100. Distribution of *Spiraea ×pseudosalicifolia* in the Czech Republic (22 occupied quadrants). Prepared by Roman Businský & Jiří Velebil.

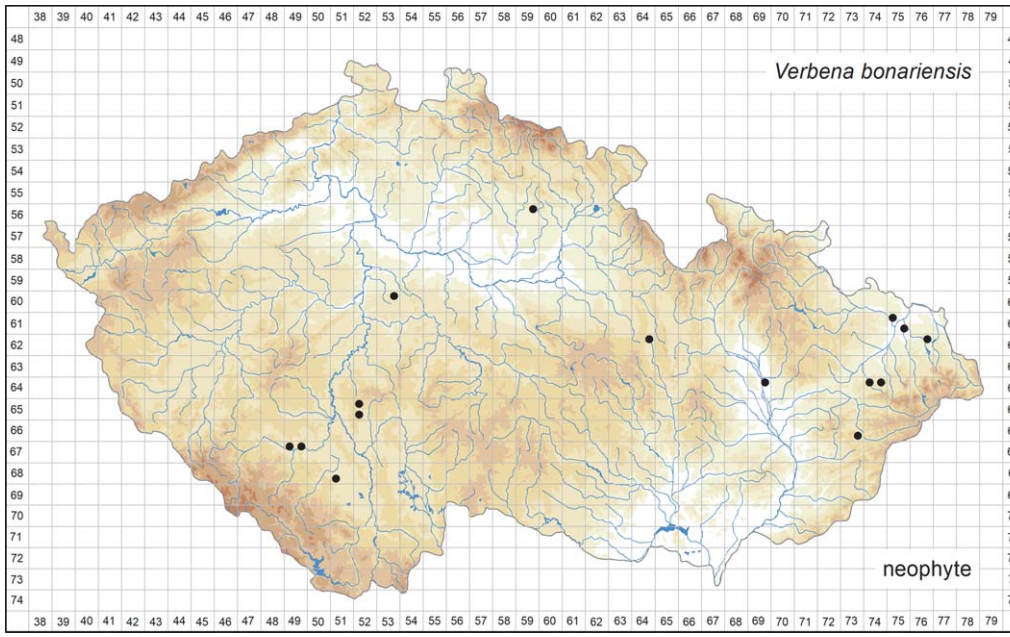

Fig. 101. Distribution of *Verbena bonariensis* in the Czech Republic (15 occupied quadrants). Prepared by Kateřina Šumberová.

gravel bars in rivers. The species is classified as a casual neophyte (Pyšek et al. 2022) despite the increasing number of records, because the populations of this species are still very small and temporary.

Verbena ×*hybrida* (Fig. 102)

Verbena ×*hybrida* is a hybrid derived from crosses between several South American *Verbena* species, most probably *V. peruviana*, *V. phlogiflora* and *V. platensis*, which were recently included into the separate genus *Glandularia* (e.g. O'Leary & Thode 2016). *Verbena* ×*hybrida* has been widely cultivated for ornamental purposes already since the 19th century, being common in private gardens, particularly in villages, but also in flower beds and flower-pots in cities. It occasionally escapes from cultivation into man-made habitats such as rubble sites, abandoned gardens, places with garden waste and soil heaps after excavation work. These occurrences are usually temporary and, therefore, this taxon is classified as a casual neophyte (Pyšek et al. 2022). *Verbena* ×*hybrida* is known in a broad range of cultivars with different flower colours and sometimes also leaf shapes, making it difficult to distinguish from some other cultivated *Verbena* species. Therefore, only the records that were documented by herbarium specimens were considered for the mapping purposes and then only the records that were clearly related to escaped plants are displayed on the map. As a result, the map is only tentative because escaped garden plants, particularly of hybrid origin, are only scarcely collected for herbaria.

One of the putative parental species of *V.* ×*hybrida*, *V. peruviana* (syn. *V. chamaedryfolia*) has also occasionally been cultivated as an ornamental plant since 1827 (Slavík 2000). It is listed as a casual neophyte for the Czech Republic by Pyšek et al. (2022) based on the published record by Sekera (1854), who reported this species from the compost heaps at the town of Mnichovo Hradiště in central Bohemia. Because of the absence of a herbarium specimen and possible misidentification with *V.* ×*hybrida* or other relative *Verbena* species, we did not prepare a map for *V. peruviana*.

Verbena incompta (Fig. 103)

Verbena incompta is, similarly to *V. bonariensis*, native to South America; however, it has been introduced to many other parts of the world, including large parts of North America, Central America, Europe, central, eastern and southern parts of Africa, Indonesia, the Malay Peninsula, Australia, New Zealand and Pacific Islands (Nesom 2010a, Verloove 2011). In Europe the species has been reported as casual from the British Isles and as naturalized from France, Italy and Spain (Verloove 2011, Raab-Straube 2022). The origins of this species in most countries are unknown, but Verloove (2011) suggests these occurrences are due to unintentional introductions with foreign goods rather than cultivation for ornamental purposes, as the flower corollas of *V. incompta* are small and inconspicuous. This inference is in accordance with the way of introduction into the Czech Republic, where records of this species were formerly reported under the name *V. bonariensis* and identified only recently during revisions of herbarium specimens. Its occurrences in this country were related to the import of sheep wool of South American origin for processing in the city of Brno (Dvořák & Kühn 1966). Wool waste, i.e. soil particles containing also plant seeds, was used by employees of this factory for fertilization of their gardens in several parts of the city of Brno; the species was documented there

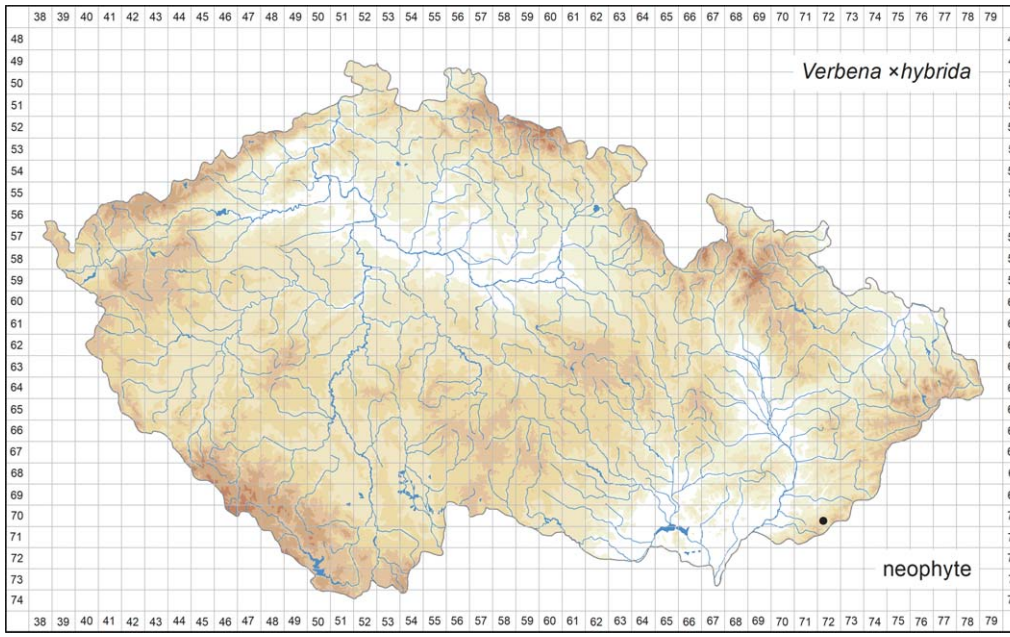

Fig. 102. Distribution of *Verbena ×hybrida* in the Czech Republic (1 occupied quadrant). Prepared by Kateřina Šumberová.

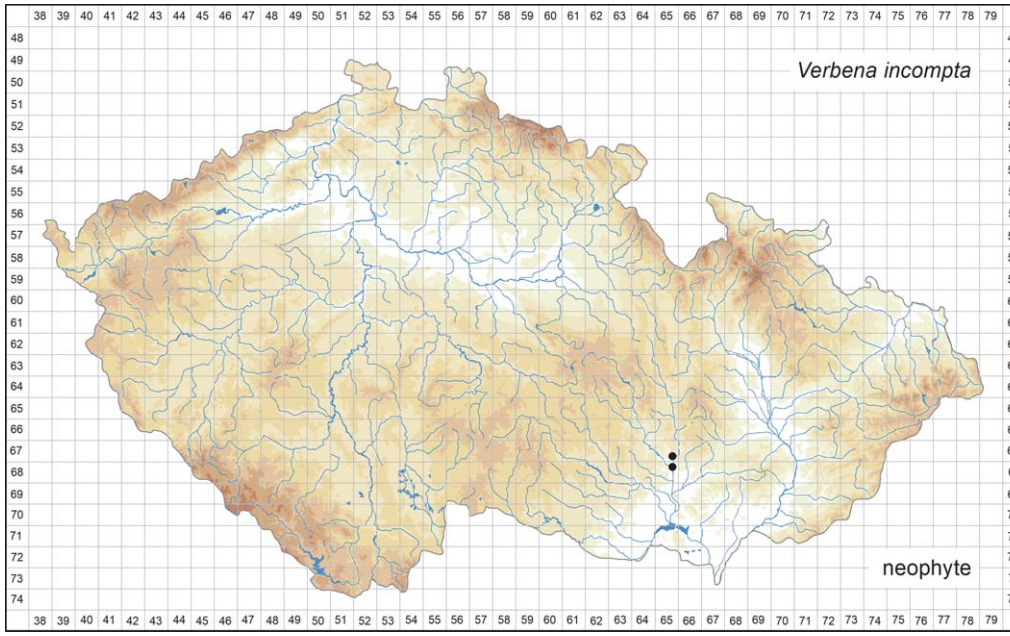

Fig. 103. Distribution of *Verbena incompta* in the Czech Republic (2 occupied quadrants). Prepared by Kateřina Šumberová.

several times in the 1960s (Dvořák & Kühn 1966, Dvořák et al. 1983). Precisely dated herbarium specimens stored in BRNU are from 1968, but the first records published by Dvořák & Kühn (1966) are obviously somewhat earlier. Localities of *V. incompta* in Brno were only ephemeral and nowadays no occurrence of this species outside cultivations is known. However, despite its low ornamental value, the species has recently been found as cultivated in the park in the town of Strakonice in south-western Bohemia; further cultivations and possible escapes should be expected elsewhere. The species should be included in the list of aliens of the Czech Republic as a casual neophyte.

Another species, closely related to *V. incompta* and *V. bonariensis*, namely *V. brasiliensis*, is reported as introduced and already naturalized in some of the western and southern European countries (Nesom 2010a, Verloove 2011, Raab-Straube 2022). The possibility of its occurrence elsewhere in Europe, including the Czech Republic, is not excluded.

Verbena officinalis (Fig. 104)

Verbena officinalis nowadays has a nearly cosmopolitan range comprising a major part of Europe (with the exception of northernmost regions), large parts of Asia, Africa and North America, and scattered occurrences in South America, southern Australia, New Zealand and a number of islands in the Indian and Pacific Oceans (do Amaral Franco 1972, Meusel et al. 1978, Hultén & Fries 1986). The native range of this species includes the Mediterranean area and probably also western Asia and northern half of Africa (do Amaral Franco 1972, Hultén & Fries 1986). Whereas the extant occurrences in northern Europe are reported as recent introductions (do Amaral Franco 1972, Meusel et al. 1978, Raab-Straube 2022), it is unclear if the occurrences in western and central Europe should be considered a part of the native distribution (e.g. do Amaral Franco 1972, Raab-Straube 2022) or they are most likely old introductions (Hultén & Fries 1986). In the Czech Republic the species is classified as a naturalized archaeophyte (Pyšek et al. 2022). *Verbena officinalis* colonizes man-made habitats such as margins of roads, frequently mown, often ruderalized and disturbed grasslands in settlements, rubble heaps, waste grounds, grazed places and yards. It usually forms only small, scattered stands. Similarly as other species of village flora, *V. officinalis* started to decline probably after World War II due to land-use changes, particularly those affecting the village structure. Still, in our data the most important decline is indicated between the 1970s and the 1980s. Recently this species seems to again be somewhat increasing, probably as a consequence of frequent grassland mowing in the settlements combined with summer droughts, which reduce the cover of competitive grasses and support some species requiring open vegetation. *Verbena officinalis* is now scattered in the lowlands and warm hilly areas throughout the Czech Republic, with the greatest amounts of records in southern, central and eastern Bohemia and southern, south-eastern and northern Moravia. The species is rare and probably only temporary at middle and high elevations including the mountain ranges along the country's border and the Českomoravská vrchovina highlands. Due to its sensitivity to land-use change, *V. officinalis* is classified as vulnerable (Grulich 2012).

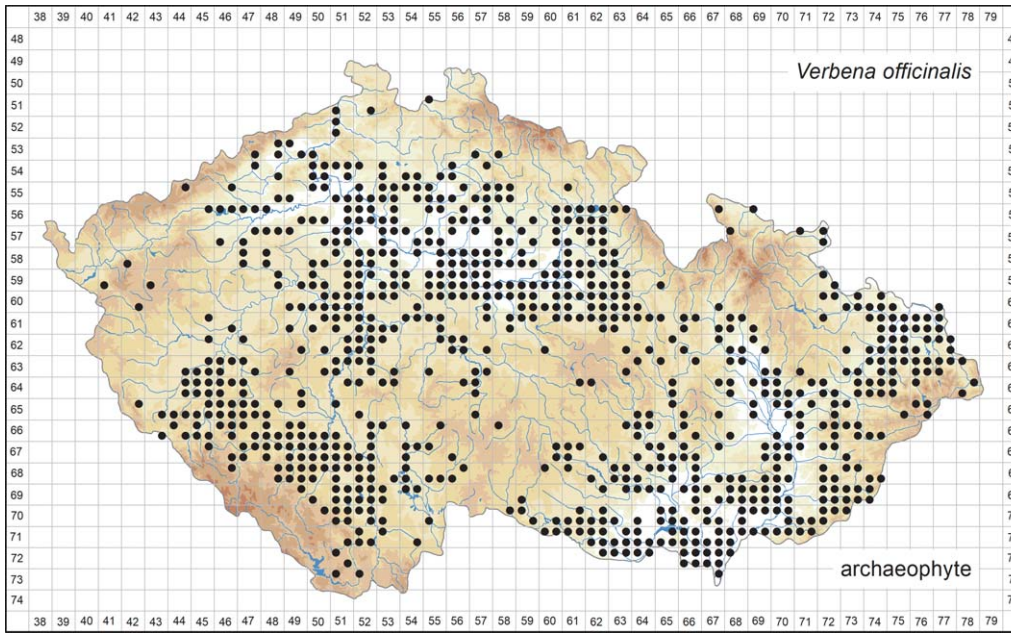

Fig. 104. Distribution of *Verbena officinalis* in the Czech Republic (822 occupied quadrants). Prepared by Kateřina Šumberová.

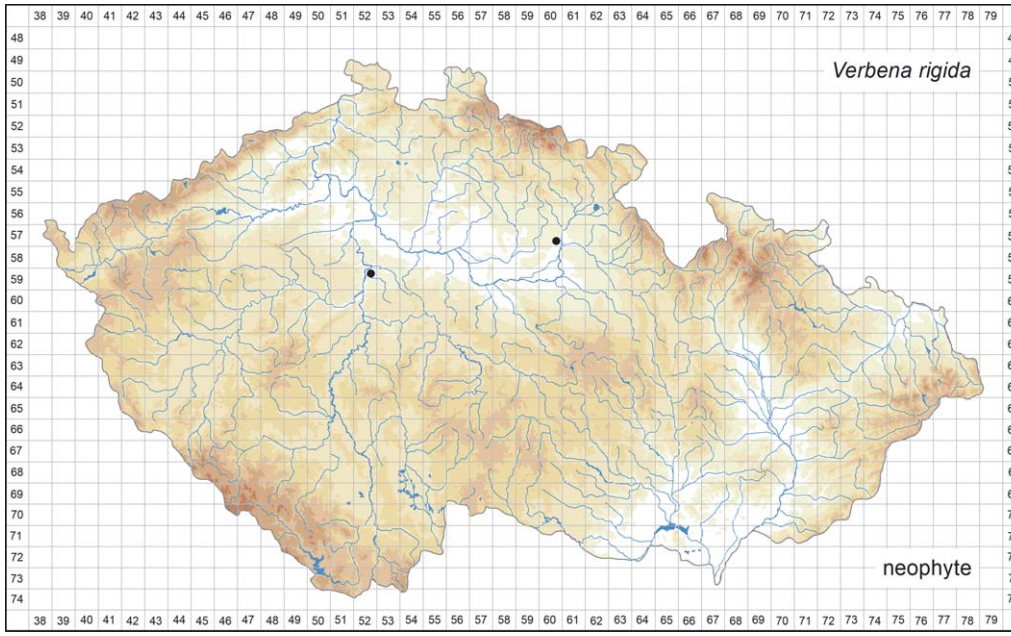

Fig. 105. Distribution of *Verbena rigida* in the Czech Republic (2 occupied quadrants). Prepared by Kateřina Šumberová.

Verbena rigida (Fig. 105)

This perennial *Verbena* species is native to Argentina and Brazil but it is cultivated for ornament also in other continents (do Amaral Franco 1972, Slavík 2000). In Europe it started to be grown in 1830 (Slavík 2000). Since then, *V. rigida* has occasionally escaped from cultivation in several countries, and thus it has the status of a casual neophyte in Germany, the British Isles, Belgium, Italy and France, whereas in Croatia and the Azores it is considered as naturalized (do Amaral Franco 1972, Raab-Straube 2022). The earliest herbarium specimen from cultivation in the Czech territory was collected in 1902 in the city of Brno in southern Moravia, followed by records from other large cities (e.g. Olomouc in central Moravia, Plzeň in western Bohemia, Hradec Králové in eastern Bohemia) since the 1910s. However, only two records documenting escapes from cultivation are available. The first one, dated to 1935, originates from Hradec Králové and no details on the habitat type are available. The second occurrence, dated to 1967, was documented in Prague, where *V. rigida* was found on a rubble site originating from excavation work. In that period, the species was frequently cultivated at many sites in the city of Prague (Slavík 2000). Recently, the species seems to be cultivated rather rarely, compared to, e.g. *V. bonariensis*, and its escapes are therefore less probable. It is classified as a casual neophyte in this country (Pyšek et al. 2022). The map is based solely on the records excluding cultivated plants. Several other *Verbena* species, e.g. *Verbena hastata*, *V. urticifolia* and *V. stricta*, originating in the USA (Nesom 2010b), are sometimes grown in ornamental gardens or flower beds. Two former species have already been documented as escaped from cultivations in some parts of Europe, e.g. in Belgium and Germany (Verloove 2006, Raab-Straube 2022), and their temporary escapes in the Czech Republic are possible.

Supplementary materials

Data S1–S105. – Records used for producing maps.

Supplementary materials are available at www.preslia.cz

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Rozšíření cévnatých rostlin v České republice. Část 12

Dvanáctá část ze série prací o rozšíření cévnatých rostlin v České republice obsahuje síťové mapy a komentáře ke 105 taxonům rodů *Androsace*, *Anthemis*, *Aristolochia*, *Berteroa*, *Celtis*, *Cnidium*, *Cynodon*, *Descurainia*, *Echium*, *Erechtites*, *Euphorbia*, *Homogyne*, *Laserpitium*, *Linaria*, *Pinus*, *Rosa*, *Sesleria*, *Spiraea* a *Verbena*. Základem jsou údaje získané excerpcí herbářů a literatury, terénní zápisy a databázové údaje, které prověřili taxonomičtí experti. Mezi studovanými rostlinami jsou jak naše původní druhy, tak druhy nepůvodní. Kromě běžných a široce rozšířených druhů, jako je *Berteroa incana*, *Descurainia sophia*, *Echium vulgare*, *Euphorbia cyparissias*, *Linaria vulgaris* a *Pinus sylvestris*, byly studovány i rostliny roztroušené a vzácné, přičemž 39 mapovaných druhů je s různou mírou ohrožení zařazeno do červeného seznamu. Zvláštní pozornost byla věnována kriticky ohroženým rostlinám, které se vyznačují výrazným ústupem, chudými populacemi a celkovou fragmentací areálu. V tomto příspěvku jsou zastoupeny druhy *Androsace septentrionalis*, *Echium maculatum*, *Euphorbia salicifolia*, *Laserpitium archangelica* a *Sesleria uliginosa*. Další druh donedávna řazený mezi kriticky ohrožené, *Androsace maxima*, mezitím na jediné známé lokalitě v přírodě vyhynul; nyní již existuje jen jedna spontánně se udržující populace v univerzitní botanické zahradě v Olomouci. Mezi nezvěstné a v ČR patrně již vyhynulé se řadí také *Linaria arvensis*. Více než polovina zpracovávaných druhů patří mezi rostliny v ČR nepůvodní, z nichž 13 je hodnoceno jako archeofyty a 41 jako neofyty. Dva druhy se u nás staly invazními v uplynulých desetiletích: *Pinus strobus* se šíří zvláště v pískovcových skalních městech, zatímco *Erechtites hieraciifolius* je nejhojnější na lesních pasekách, kde jeho šíření usnadnily kůrovcové kalamity. Nápadný nárůst počtu populací lze v poslední době pozorovat také u druhu *Cynodon dactylon* na jižní Moravě. Během revize herbářů a terénního výzkumu pro tuto studii jsme zjistili pět nových neofytů pro květenu ČR: *Aristolochia macrophylla* a *Pinus contorta* jsou druhy uniklé z kultury, *Euphorbia nutans* a *Verbena incompta* k nám byly neúmyslně zavlečeny s různým komoditami ze zahraničí, zatímco v případě druhu *Linaria dalmatica* se na obohacení naší flóry podílely jak úniky ze zahrad, tak záměrné výsevy semen do přírody. Významné jsou také revize taxonomicky kritických a druhově bohatých rodů, jako je *Euphorbia*, *Pinus*, *Rosa*, *Spiraea* a *Verbena*, pro jejichž druhy mnohdy doposud nebylo známé přesné rozšíření pro determinační obtíže a z nich plynoucí velký podíl chybných údajů v literatuře a databázích. Celkový obraz rozšíření zpracovávaných taxonů v ČR poskytují mapy; konkrétní floristické údaje, které zachycují frekvenci výskytu v různých oblastech a v různých obdobích, případně dokumentují ústup, nebo naopak šíření některých druhů, jsou uloženy v databázi Pladias a dostupné v 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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