Distributions of vascular plants in the Czech Republic. Part 8

Rozšíření cévnatých rostlin v České republice. Část 8

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The eighth part of the series on the distributions of vascular plants in the Czech Republic includes grid maps of 106 taxa in the genera *Abutilon*, *Achillea*, *Arctium*, *Arenaria*, *Arnoseris*, *Carex*, *Chamaecytisus*, *Cornus*, *Diphasiastrum*, *Echinops*, *Galeopsis*, *Galium*, *Huperzia*, *Isoëtes*, *Lycopodiella*, *Lycopodium*, *Moehringia*, *Orobanche*, *Phelipanche*, *Prunus*, *Ranunculus*, *Selaginella*, *Stachys*, *Telekia*, *Typha* and *Zannichellia*. These maps were produced by taxonomic experts based on examined herbarium specimens, literature and field records. Many of the studied native species are on the national Red List. They are represented by plants that are rare in the Czech Republic, in extreme cases confined to single sites (*Arenaria grandiflora*, *Galium austriacum*, *Isoëtes echinospora*, *I. lacustris* and *Orobanche teucrii*), or that have experienced a considerable decline (e.g. *Arnoseris minima*, *Carex hordeistichos*, *C. secalina*, *Diphasiastrum tristachyum* and *Lycopodiella inundata*), or a combination of both (e.g. *Orobanche artemisiae-campestris*, *O. coerulescens*, *Phelipanche arenaria*, *Ph. caesia* and *Stachys germanica*). Three species (*Moehringia muscosa*, *Selaginella helvetica* and *Typha minima*) have been extirpated from this country. Alien species are represented by both archaeophytes (e.g. *Arctium lappa*, *A. tomentosum*, *Orobanche minor*, *Stachys annua* and *S. arvensis*) and neophytes (e.g. *Abutilon theophrasti* and *Typha laxmannii*). Two species have become invasive: *Echinops sphaerocephalus* spreads mainly in dry and disturbed habitats along roads and railways in warm lowlands, whereas *Telekia speciosa* is now locally frequent in various habitats mainly at middle and high elevations. *Echinops bannaticus* is reported here as a new alien species in the Czech Republic that occasionally escapes from cultivation. Spatial distributions and often also temporal dynamics of individual taxa are shown in maps and documented by records included in the Pladias database and available in electronic appendices. The maps are accompanied by comments that include additional information on the distribution, habitats, taxonomy and biology of the taxa.

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

Introduction

Integration of all available records on the distribution of vascular plants in the Czech Republic into a single central database and initiation of mapping their distributions were two of the aims of the PLADIAS project funded by the Czech Science Foundation in 2014–2018. The plant occurrence module within a new Pladias database (www.pladias.cz) was launched in 2014 and now contains more than 13 million records of almost 5 thousand taxa of various ranks (Wild et al. 2019). This database and an associated web-based mapping interface serve as a basic platform for mapping plant distributions within this country. Based on examined herbarium specimens as well as literature and field records, which were transferred to the database and critically evaluated and sorted by a team of taxonomic experts, grid-based distribution maps of 674 vascular plants were produced and published during the project (Kaplan et al. 2015, 2016a, b, 2017a, b, 2018a, b). Although the PLADIAS project has ended, the database continues to be maintained by the Institute of Botany of the Czech Academy of Sciences in Průhonice. Taxonomic experts collect new records and proceed in evaluating database data with the ultimate aim of producing an atlas of the distribution of vascular plants in the Czech Republic.

Since producing the maps for the seventh part of the series on plant distributions in the Czech Republic in August 2018, the Pladias database has increased by nearly 111,000 new records. Of these, over 41,000 resulted from critical examination of herbarium specimens by taxonomic experts. Maps for a further 106 taxa were finished by the end of July 2019 and are included in this paper.

A second, updated and thoroughly revised edition of the field guide "Key to the Flora of the Czech Republic", another result of the PLADIAS project, was published recently (Kaplan et al. 2019). This new inventory of Czech plant diversity is a result of the cooperation of 51 botanists, many of whose are also involved in this mapping. The Key reflects the considerable progress in plant taxonomy and floristics made since the publication of the first edition (Kubát et al. 2002) and the checklist of vascular plants of the Czech Republic (Danihelka et al. 2012). Many changes in plant systematics resulting from new phylogenetic studies and taxonomic monographs and revisions were adopted, and the novelties in the Czech flora included. This book is therefore used here as a new standard regarding taxonomic delimitations and nomenclature.

Recent taxonomic revisions of taxonomically critical groups have resulted in refining species boundaries and consequently better understanding species distributions. Maps resulting from studies on *Ranunculus* sect. *Batrachium* (Prančl et al. 2018), *Diphasiastrum* (Hanušová et al. 2014) and *Orobanche* (Zázvorka 2010) are included in this paper. Another genus with species difficult to identify is *Carex*, which is represented here by ten species.

Over two-thirds of the studied native species are on the national Red List (Grulich 2012). They represent plants that are rare in the Czech Republic, in extreme cases confined to single sites (*Arenaria grandiflora*, *Galium austriacum*, *Isoëtes echinospora*, *I. lacustris* and *Orobanche teucrii*), or that have experienced considerable declines

(e.g. *Arnoseris minima*, *Carex hordeistichos*, *C. secalina*, *Diphasiastrum tristachyum* and *Lycopodiella inundata*) or a combination of both (e.g. *Orobanche artemisiae-campestris*, *O. coerulescens*, *Phelipanche arenaria*, *Ph. caesia* and *Stachys germanica*). Three species (*Moehringia muscosa*, *Selaginella helvetica* and *Typha minima*) have been extirpated from this country.

Alien species comprise both archaeophytes and neophytes. Naturalized archeophytes that are now widespread include *Arctium lappa* and *A. tomentosum*, while *Orobanche minor*, *Stachys annua* and *S. arvensis* are scattered to rare at present, and *Phelipanche ramosa* has vanished. Neophytes that have become naturalized and spread include *Abutilon theophrasti* and *Typha laxmannii*, and two species have even become invasive: *Echinops sphaerocephalus* spreads mainly in dry and disturbed habitats along roads and railways in warm lowlands, whereas *Telekia speciosa* is now locally frequent in various habitats at mainly middle and high elevations. Examination of herbarium specimens of *Echinops* led to the discovery of *E. bannaticus* as a new alien species for this country.

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. (2019), with differences indicated where necessary. For taxa not included in that source, a taxonomic reference is given. Publication of maps does not follow any alphabetical or systematic order, but mainly the maps resulting from recent revisions are included.

Data sources

All relevant floristic data sources are used. Major national herbaria and some local and foreign collections, incl. BRNL, BRNM, BRNU, CB, CBFS, CESK, CHEB, CHOM, FMM, GLM, GM, HOMP, HR, KHMS, LIM, LIT, MJ, MMI, MP, MZ, NJM, OH, OL, OLM, OMJ, OMP, OP, OSM, OVMB, PL, PR, PRA, PRC, ROZ, SOB, SOKO, SUM, VM, VYM, W and ZMT (acronyms follow Thiers 2019), were consulted as the main sources of taxonomically examined records. Most records for maps of common and easy-to-identify taxa came from the Pladias database (Wild et al. 2019), which has integrated data from five large national databases, several regional projects and unpublished field records from the maps' authors and regional contributors.

Mapping procedure

All records used for mapping are entered into the Pladias database and geographically sorted according to the traditionally used CEBA (Central European Basic Area) grid template (Niklfeld 1999) divided into quadrants of 5 × 3 arc minutes (corresponding to

approximately 5.5 × 5.9 km). The territory of the Czech Republic is covered by 2551 quadrants, of which 2181 are completely within the borders of this country. Individual records and the whole distribution of each taxon are checked and evaluated by the author of a particular map in a web-based mapping interface of the Pladias database. Maps of taxonomically critical groups are based solely or mainly on herbarium specimens examined by taxonomic experts; these cases are indicated in the text accompanying the particular map. Maps of all other taxa are based on records from databases, literature and herbaria, which were scrutinized by the authors of the respective maps. Records used for producing maps are listed in Electronic Appendices 1–106. In selected maps, native versus introduced occurrences are distinguished, and corresponding records in the database classified accordingly. Draft distribution maps and the background records are released in a web-based review process for scrutiny by field botanists, regional collaborators and members of the Czech Botanical Society. Their comments and additional records are collected in the database and returned to the responsible specialists for consideration before producing the distribution maps.

Final maps and comments

The treatment of each taxon consists of a grid distribution map and accompanying text; the maps' authors, indicated in the figure captions, also had major roles in writing the first drafts of the texts for the subject taxa. Maps are displayed using a spherical Mercator projection (EPSG:3857) in which meridians and parallels appear as straight lines, and the fields of the mapping grid are thus displayed as squares. The background relief was derived from SRTM data (http://www2.jpl.nasa.gov/srtm/, the version provided by http://srtm.csi.cgiar.org) and the river network was adapted from data provided by CENIA (www.cenia.cz). When appropriate, different symbols are used on the maps to distinguish between the following alternative attribute states: (1) recent versus old records; (2) native occurrences versus introductions; and (3) records based on examined herbarium specimens versus all other records. These classifications of records are used only for those taxa where such distinction provides important information and the amount and quality of records are sufficient. The mapping symbols used to indicate the different attributes of the records in particular grid cells are shown in Table 1. Symbols specific to individual maps are explained in their captions. To save space, rare taxa of the genera *Echinops*, *Galium*, *Isoëtes*, *Orobanche*, *Phelipanche* and *Typha* with distinct distributions are shown in maps in groups of two, with symbols and annotations of individual taxa on the maps distinguished using different colours. In the caption for each map, the counts of occupied quadrants are indicated according to the symbols used in the map; uncertain occurrences are not included in the counts. The accompanying text includes the accepted scientific name, a brief outline of the total distribution, information on habitats occupied by the species and a description of its distribution in the Czech Republic. Where appropriate, comments on taxonomy, biology and details of the spatial and temporal dynamics of the distribution are given.

Table 1. – The symbols used in the distribution maps to indicate the different attributes of occurrence in particular grid cells.

Attribute distinguished	Symbol	Attribute state
None	●	All records
Time	●	Recent occurrence (at least one record since 2000)
	◍	Old occurrence (all records before 2000, or demonstrably extirpated from all localities after 2000, or all records undated)
Origin	●	Native (at least one record)
	×	Alien
Source of data	●	Examined herbarium specimen (at least one record)
	▲	All other
All	?	Only record(s) uncertain regarding identification and/or locality

Distribution maps and comments

Abutilon theophrasti (Fig. 1)

Abutilon theophrasti is an annual thermophilous herb probably native to southern China, although some authors place its origin more westwards in India or Central Asia (Spencer 1984, Jehlík 1998). In Asia this species has been cultivated for centuries, particularly as a medicinal and fibre crop; for these purposes and also as an ornamental plant it has been intentionally introduced to other parts of the world. Escapes from cultivation were one way this species spread; another, probably more important one, was unintentional introductions with industrial crops, seed corn or soybeans. The secondary range of *A. theophrasti* includes Europe except for its northern parts, Africa, North and Central America, Australia and New Zealand (Jehlík 1998). In Europe this species occurs mainly in regions with warm temperate or sub-Mediterranean climates, and is absent or scarce and temporary in regions where summers are too cold or remain dry too long (Jehlík 1998). Its habitat preferences are strongly correlated with climate: whereas in the southern part of its European range this species has always colonized particularly arable fields with maize and sunflower and other wide-row crops, in central and western Europe, including the Czech Republic, it used to be confined to ruderal habitats in settlements, such as railway stations, harbours, waste dumps, dunghills, and surroundings of farms and factories processing oil and fibre crops. Occasionally it also occurred on exposed river deposits and fishpond bottoms (Jehlík 1998). The first escapes of *A. theophrastii* in the Czech Republic were recorded in the cities of Brno and Prague and dated to 1894 and 1903, respectively (Jehlík 1998). During the 20th century, the species was rather rarely found in warm regions, especially in eastern and central Bohemia and central Moravia. However, since 2000 the number of occurrences of *A. theophrasti*, particularly in arable fields, has strongly increased in the whole of central Europe, and the spectrum of crops invaded expanded (Follak et al. 2014). In the Czech Republic this species now usually occurs in sugar beet, maize and sunflower fields, but it has also been recorded among cereals, potatoes and other vegetables (Mikulka & Štrobach 2017). Moreover, regular, repeated occurrence on sites across growing seasons started to be common, and population sizes of

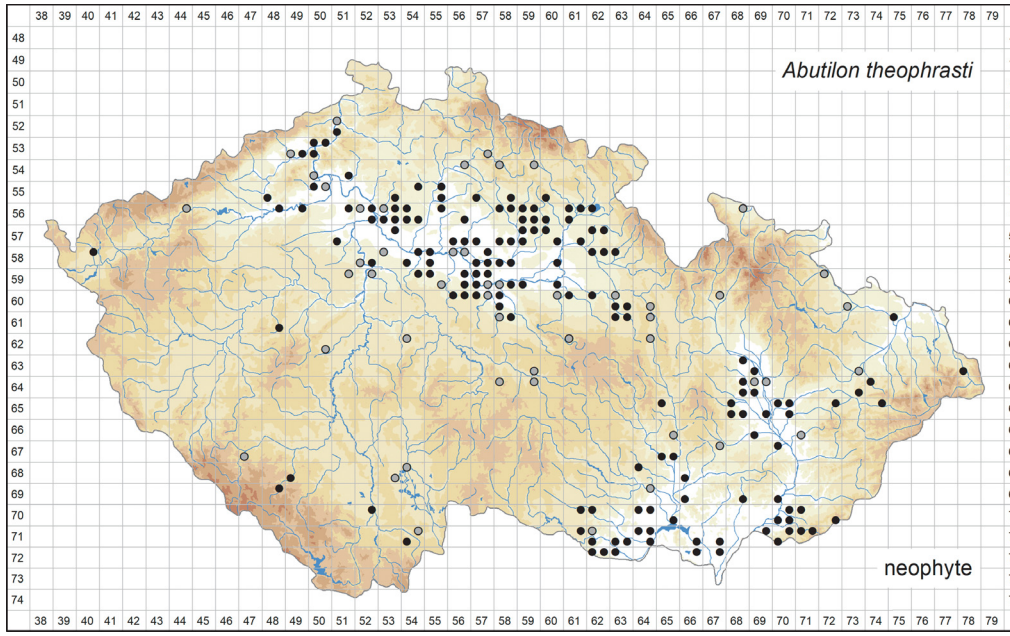


Fig. 1. – Distribution of *Abutilon theophrasti* in the Czech Republic: ● at least one record in 2000–2019 (146 quadrants), ● pre 2000 records only (50 quadrants). Prepared by Kateřina Šumberová, Michal Ducháček, Jan Štrobach & Jan Mikulka.

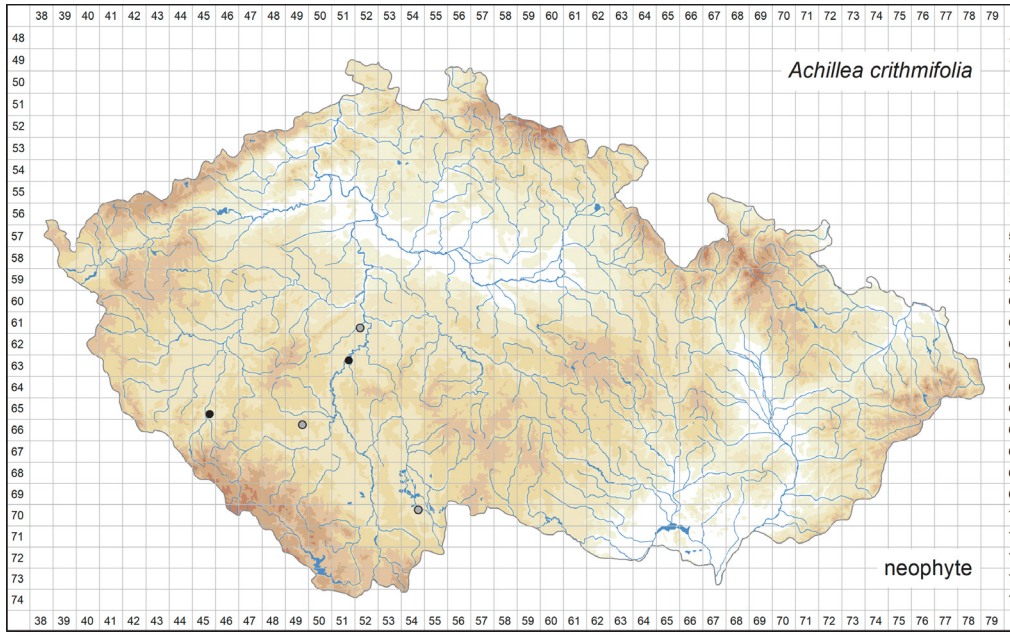


Fig. 2. – Distribution of *Achillea crithmifolia* in the Czech Republic: ● at least one record in 2000–2019 (2 quadrants), ● pre 2000 records only (3 quadrants). Prepared by Jiří Danihelka.

this species have increased, rendering it a locally important competitor of cultivated crops (Šumberová unpubl.). These changes may be attributed to the high frequency of extraordinarily hot summers during the last two decades, because heat supports this species' seeds germination, further development and seed productivity (Mikulka & Štrobach 2017). In the Czech Republic this species currently forms stable populations with high potential for further spread in the lowlands of eastern, central and north-western Bohemia and central and southern Moravia. Most of the occurrences scattered elsewhere are related to small and temporary populations, but this situation may change due to climate warming. The distribution and frequency of *A. theophrasti* in this country have dramatically increased during the last decade, and it is turning into an aggressive weed. It is therefore classified as a naturalized neophyte (Pyšek et al. 2012).

Achillea crithmifolia (Fig. 2)

Achillea crithmifolia occurs in the Balkan Peninsula, towards the north reaching Croatia, Hungary, southern Slovakia and Romania. As an introduced species it has been recorded in north-eastern Italy, Austria, the Czech Republic, Germany, Poland and Sweden, and at least in Germany and Poland it is locally established (Dąbrowska 1982, Greuter 2006). The species is considerably variable throughout its range, and numerous constituent taxa (mainly at the variety and species levels) have been described. However, a modern taxonomic study covering the species' entire range is lacking. Diploid and tetraploid populations exist within this species, but the relationship between the ploidy level and morphology remains unclear. In the Czech Republic *A. crithmifolia* has been recorded in dry meadows and ruderal sites, with the first report dating to 1886 in the courtyard of a mill in the town of Třeboň in southern Bohemia. No direct information on the mode of introduction is available, but based on the circumstances, the most likely pathways were accidental introductions with grain from south-eastern Europe. However, the occurrence in the town of Klatovy in south-western Bohemia observed in 1960–2006 (and probably still extant) may have originated as escapes from plantings around the district hospital. Of the altogether five populations recorded in the Czech Republic, at least the one found near the village of Hřiměždice in central Bohemia is extant and abundant (Hadinec 2013). In the Czech Republic *A. crithmifolia* is classified as a casual neophyte (Pyšek et al. 2012).

Achillea nobilis (Fig. 3)

Achillea nobilis has a large Eurasian range spanning the temperate zone from south-western France in the west as far as western Siberia in the east. It is also present in Anatolia, the Caucasus Mts, northern Iraq and north-western Iran. Its distribution in central Europe is discontinuous, confined to areas with rather dry and warm climates. Adventive occurrences, usually casual, have been recorded in north-western, northern and north-eastern Europe from the British Isles in the west as far as northern European Russia in the east (Meusel & Jäger 1992). Five subspecies are usually recognized (e.g. Greuter 2006), of which the type subspecies and *A. nobilis* subsp. *neilreichii* are reported to occur in central Europe, but this classification is not applicable to the populations found in the Czech Republic and the map is produced only at the species level. In this country *A. nobilis* grows mainly in open thermophilous oak forests, both basiphilous and acidophilous, thermophilous forest fringes and narrow-leaved subcontinental steppes. Secondary

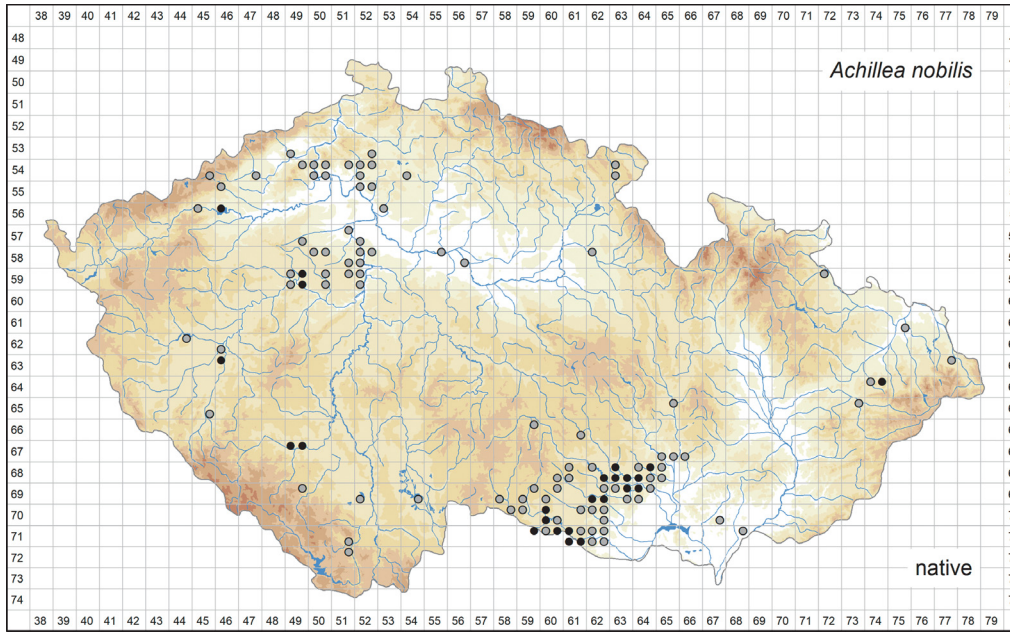


Fig. 3. – Distribution of *Achillea nobilis* in the Czech Republic: ● at least one record in 2000–2019 (24 quadrants), ● pre 2000 records only (92 quadrants). Prepared by Jiří Danihelka.

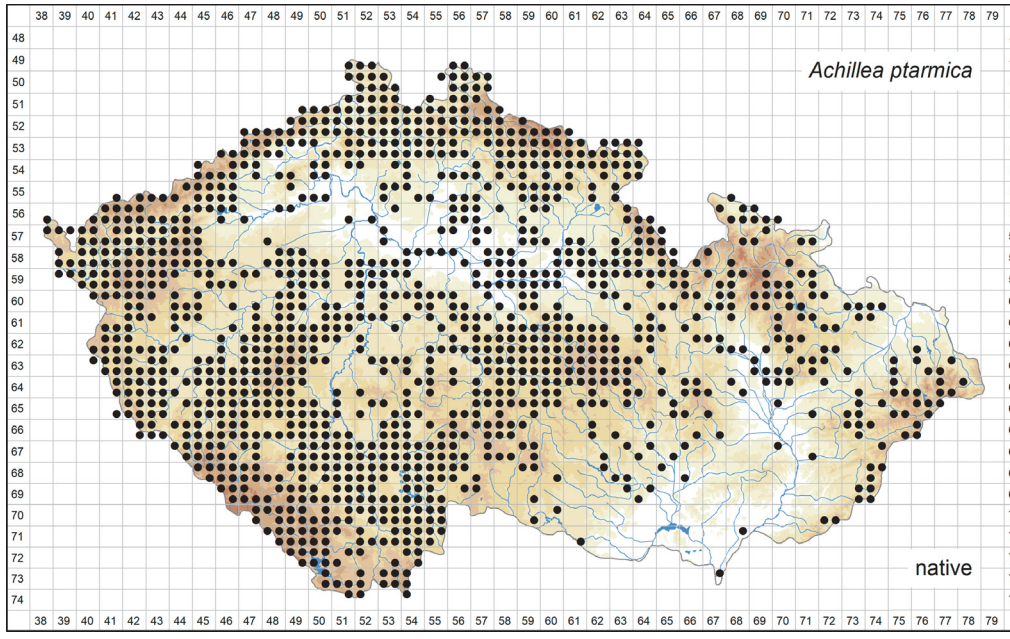


Fig. 4. – Distribution of *Achillea ptarmica* in the Czech Republic (1283 occupied quadrants). Prepared by Jiří Danihelka.

occurrences have been recorded in subruderal and ruderal grasslands. Soils are usually dry and rich in calcium but poor in other nutrients. In the Czech Republic *A. nobilis* occurs mainly at rather low and middle elevations in hilly areas in north-western and central Bohemia and south-western Moravia. These occurrences are considered native, which is also the case with the occurrence on limestone hills around the town of Štramberk in northern Moravia, while most other occurrences scattered across the country have been largely secondary and usually (but not always) temporary. However, the status of some populations is uncertain, and no attempt at such categorization is made in the map. The seeds of *A. nobilis* were usually introduced with grain and other commodities, while the occurrences once recorded in the city of Ostrava and the town of Třinec may be explained by seed introductions with iron ore from southern Ukraine. Since the 1950s, many populations in seminatural grasslands have vanished due to succession after low-productive pastures were abandoned. *Achillea nobilis* is therefore classified as vulnerable (Grulich 2012).

Achillea ptarmica (Fig. 4)

Achillea ptarmica is a European species distributed in the boreal and hemiboreal zones of the continent as well as in the temperate zone in western and central Europe from western France in the west as far as the Eastern Carpathians in Romania in the east. In eastern Europe it is replaced by the related and fairly similar *A. cartilaginea* (Meusel & Jäger 1992). Numerous secondary occurrences have been recorded elsewhere in Europe and as this species has been cultivated as a traditional medicinal plant and for ornament, the status of many other populations is uncertain. In the Czech Republic *A. ptarmica* most frequently occurs in wet and intermittently wet meadows, less frequently in other types of meadows, various types of wetland and riverine herbaceous vegetation, around springs and mires and on stream and river banks. It is a light-demanding species growing on moist, often poorly aerated soils that are acidic to moderately acidic, and poor to moderately rich in nutrients. *Achillea ptarmica* is widespread in areas with moderately warm to cold and usually humid climates mainly at middle elevations, becoming progressively less common towards the east. It is generally rare in or almost absent from the dry, warm lowlands and hilly areas in central and north-western Bohemia, and south-western, southern, south-eastern and central Moravia. However, there may have existed some occurrences on wet meadows and along rivers even in these areas, but if so they were destroyed by drainage. Some of the populations now considered native may have been established by plants escaped from cultivation; however, such a determination is not clear-cut in most cases. In general, if plants with filled capitula ("flore pleno") are present in a population, it is more likely that its status is secondary, which would account for the populations in dry lowlands and around human settlements in the mountains. In the Czech Republic *A. ptarmica* reaches its elevational maximum at about 900 m but there are numerous records from the Krkonoše and Šumava Mts from higher elevations, all probably representing cultivation relicts or plants escaped from cultivation. Though many populations in the lowlands may have been destroyed by drainage or conversion of meadows to arable land, the species is still locally common in some areas, and therefore it is not classified as vulnerable yet.

Arctium lappa (Fig. 5)

The distribution of *Arctium lappa* spans Europe except for its northern parts (rarely exceeding 60°N), the northern part of the British Isles and most of the Iberian Peninsula; in the Mediterranean area it is rather rare. In Asia it extends to the Caucasus, Iran and central Asia (Kazakhstan, Pakistan); the eastern limit of its native distribution is not clear (Meusel & Jäger 1992, Duistermmat 1996). Plants from Transcaucasia are sometimes classified as *A. lappa* subsp. *platylepis* (Greuter 2006). Since *A. lappa* is associated with human-influenced habitats, its indigenous status is uncertain in some parts of its range; in the Czech Republic it is classified as a naturalized archaeophyte (Pyšek et al. 2012). This species has also been introduced into eastern Asia (incl. Japan), the Americas, Australia and New Zealand (Meusel & Jäger 1992, GCW 2019). In the Czech Republic this species mainly occurs in various types of perennial nitrophilous ruderal vegetation in towns and villages (along walls, ruins, abandoned construction sites), along roads, in field margins, and at dump sites and fallows. Sometimes it also enters strongly human-influenced types of semi-natural vegetation, such as abandoned meadows and pastures, nitrophilous shrub communities and ruderalized forest fringes; it is rare in forested areas, being confined to clearings and verges of forest roads. *Arctium lappa* is common throughout this country at elevations below ca 800 m, but it is occasionally introduced to higher elevations. Most of the gaps on the map except for the mountains along this country's border are due to under-recording.

Arctium minus (Fig. 6)

Arctium minus occurs in most of Europe except for the northern part of the British Isles, northern Scandinavia, the northern and south-eastern parts of European Russia and the southern part of the Balkan Peninsula. It is also reported from Madeira, northern Africa and south-western Asia (Duistermmat 1996), but these records need verification due to possible confusion with similar species. It has been introduced into the Americas, Australia, Tasmania and New Zealand (Duistermmat 1996, GCW 2019). In the Czech Republic it was previously considered as a naturalized archaeophyte (Pyšek et al. 2002) but later was re-classified as a native species (Pyšek et al. 2012). In this country it occurs in perennial nitrophilous ruderal vegetation along roads, in towns and villages (along walls, ruins, abandoned construction sites), at field margins and dump sites, sometimes also in forest fringes and clearings and along forest roads. It is less frequent in this country than the other two ruderal congeners, *A. lappa* and *A. tomentosum*, being scattered in the lowlands and at middle elevations below ca 750 m. The distribution map is obviously incomplete and some gaps are due to under-recording.

Arctium nemorosum (Fig. 7)

Arctium nemorosum is distributed mainly in central Europe. Towards the west it extends to northern France and the British Isles, to the south to south-eastern France, Italy and Sicily (mainly in mountains) and the northern part of the Balkan Peninsula, to the east to the Ural Mts and to the north to southern Scandinavia. Isolated occurrences are in the Pyrenees, the mountains of Crimea and the Caucasus (Hultén & Fries 1986, Meusel & Jäger 1992, Duistermmat 1996). It has been introduced into Canada (GCW 2019). In the

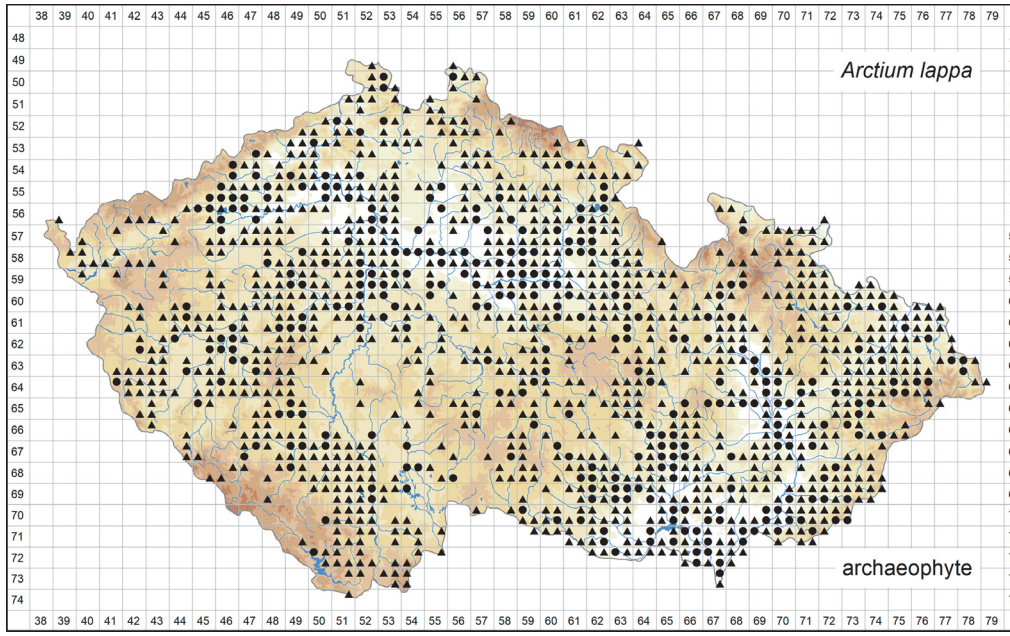


Fig. 5. – Distribution of *Arctium lappa* in the Czech Republic: ● occurrence documented by herbarium specimens (306 quadrants), ▲ occurrence based on other records (1045 quadrants). Prepared by Petr Koutecký.

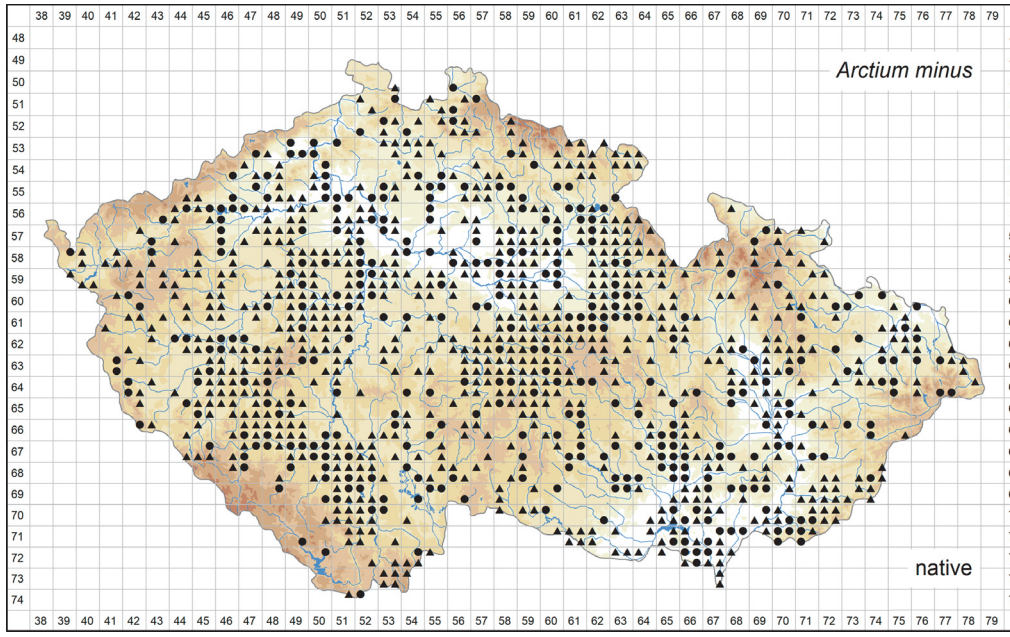


Fig. 6. – Distribution of *Arctium minus* in the Czech Republic: ● occurrence documented by herbarium specimens (342 quadrants), ▲ occurrence based on other records (747 quadrants). Prepared by Petr Koutecký.

Czech Republic this species occurs mainly in forest clearings and fringes, and along forest roads, usually in rather large deciduous forests on nutrient-rich and moderately wet soils, most often in beech, ravine and floodplain forests. Most of its localities are concentrated in eastern Moravia, the south-eastern margin of the Českomoravská vrchovina highlands, eastern, central and northern Bohemia and a few areas in southern Bohemia, while it is absent from or very rare in large parts of western and southern Bohemia and western and northern Moravia. This species is classified as of lower risk – near threatened (Grulich 2012). Due to frequent misidentifications, the distribution map is based mainly on examined herbarium specimens supplemented with some reliable literature and database records.

Arctium tomentosum (Fig. 8)

Arctium tomentosum occurs from Belgium, the Netherlands and eastern France in the west as far as the surroundings of Lake Baikal in the east; northwards it extends to Scandinavia (mainly its southern part but isolated sites are present in the north) and southwards to northern Italy, the northern Balkan Peninsula and the Caucasus Mts. It has been introduced into the British Isles, Spain and Norway (Meusel & Jäger 1992, Duistermmat 1996, Greuter 2006). However, due to its association with human-influenced habitats, its native status is questionable in central- and north-European countries; in the Czech Republic it is classified as a naturalized archaeophyte (Pyšek et al. 2012). It has also been introduced into North America (Hultén & Fries 1986, GCW 2019). In the Czech Republic this species occurs in various types of perennial nitrophilous ruderal communities, mainly in roadsides, field margins and fallows, dump sites and in towns and villages. It is also found in forest fringes, along streams, in nitrophilous scrub and in abandoned meadows and pastures; occasionally it is found also along forest roads and in clearings. *Arctium tomentosum* is the most frequent species of this genus in this country. It is common at elevations below ca 800 m; its rare occurrences at higher elevations are mainly due to recent and only temporary introductions. Most of the gaps on the map except for the mountains along this country's border are due to under-recording.

Arenaria grandiflora (Fig. 9)

Arenaria grandiflora is an orophyte of the western-Mediterranean area, found mainly in the mountains of the Iberian Peninsula, the Apennines and the mountains of northern Africa. It reaches central Europe in the Eastern Alps in Austria and in the Pavlovské vrchy hills in southern Moravia (south-eastern Czech Republic), with these hills representing an isolated outpost towards the north-east. Three subspecies are recognized, of which only *A. grandiflora* subsp. *grandiflora* is present in central Europe (Küpfer 1974, Jalas & Suominen 1983). In the Czech Republic *A. grandiflora* occurs only in fissures of limestone rocks on Děvín hill in the northern part of the Pavlovské vrchy hills, usually in *Sesleria caerulea*-dominated dry grasslands. There are also reliable records from the rocks of Růžový vrch hill above the village of Klentnice (Fröhlich & Leitl 1968) but this occurrence, probably no longer extant, may have been a relict of a small botanical garden established there in the 1920s. There exists also a specimen allegedly collected by F. S. Pluskal on Květnice hill near the town of Tišnov north-west of the city of Brno in 1846. However, this herbarium voucher probably resulted from a later labelling mistake,

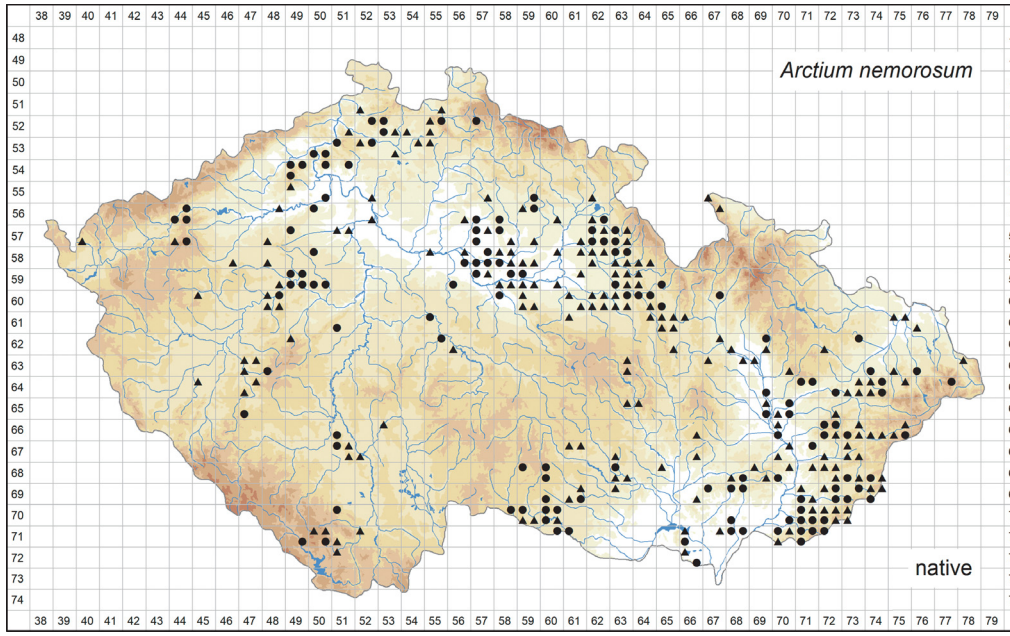


Fig. 7. – Distribution of *Arctium nemorosum* in the Czech Republic: ● occurrence documented by herbarium specimens (133 quadrants), ▲ occurrence based on other records (189 quadrants). Prepared by Petr Koutecký.

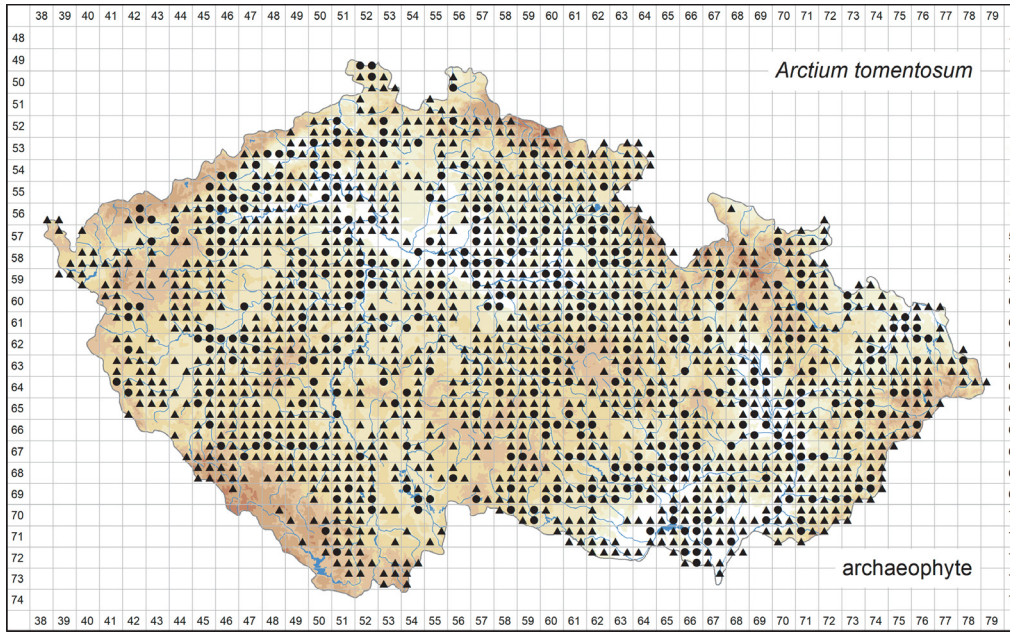


Fig. 8. – Distribution of *Arctium tomentosum* in the Czech Republic: ● occurrence documented by herbarium specimens (359 quadrants), ▲ occurrence based on other records (1376 quadrants). Prepared by Petr Koutecký.

because such an occurrence is reported neither in the local flora of that area (Pluskal 1854) nor in the flora of the Brno county published a decade later (Makowsky 1863). *Arenaria grandiflora* is classified as critically threatened due to its rarity (Grulich 2012), but its populations are rather stable.

Arenaria serpyllifolia (Fig. 10)

The *Arenaria serpyllifolia* agg. includes diploid and tetraploid populations originally distributed in the temperate zone in Europe, western and some parts of central Asia, and northern Africa. It has been introduced into North America, eastern Asia, Australia and New Zealand (Hultén & Fries 1986, Hartman et al. 2005). The morphological differences between populations from different parts of the aggregate's native range are rather minor and probably also obscured by the remarkable species' plasticity. Consequently, the taxonomy of the *A. serpyllifolia* agg. is still under dispute and the numbers of recognized taxa differ in various sources. Here, we follow the treatment by Chater & Halliday (1993), but accept their five subspecies at the species level. For this country, mainly the tetraploid *A. serpyllifolia* has been recorded as a widespread and locally common species, but there are also numerous reports on past scattered occurrences of *A. leptoclados* in rather warm areas (e.g. Dostál 1958). However, Dvořák (1990) introduced the recent concept of *A. leptoclados* as a diploid species distributed mainly in the Mediterranean area and rather warm parts of Atlantic Europe. At the same time, he treated slender (tetraploid) specimens of this group, which until then had been referred to as *A. leptoclados* in the Czech botanical literature, as *A. patula*. However, these records are here included in *A. serpyllifolia*, tentatively treated as *A. serpyllifolia* var. *patula* by Danihelka (2019). According to Dvořák (1958), there are four herbarium specimens of *A. leptoclados* that were collected between 1880 and 1943 in different parts of this country, usually in ruderal habitats and without any geographic pattern. They were assigned to the diploid taxon based on the size of pollen grains, but their condition does not allow for certain identification. The occurrence of *A. leptoclados* in the Czech Republic (no map provided) still remains somewhat uncertain, and the species may rather be considered a casual neophyte unless there are recent records supported by chromosome counts or flow cytometry.

The range of *A. serpyllifolia* includes the whole of Europe except its northernmost parts (Jalas & Suominen 1983) and, according to various sources, also some parts of northern Africa and probably also some parts of western and central Asia. However, records from Asia and Africa may actually refer to other taxa of the aggregate due to taxonomic uncertainties. In the Czech Republic *A. serpyllifolia* occurs mainly in dry grasslands (frequently in disturbed patches), sand grasslands and rock outcrops, and in various types of ruderal and segetal vegetation, quite often at railway stations and in pavement joints in settlements. The soils are usually dry to moderately humid, moderately acidic to slightly basic, poor to moderately rich in nutrients. The species is widespread in this country, being most frequent at low and middle elevations. However, in the Krkonoše and Hrubý Jeseník Mts there are some records from elevations over 1000 m, with the elevational maximum at 1357 m near the Pomezní boudy chalets in the Krkonoše Mts; these occurrences are clearly casual recent introductions. While the gaps at lower elevations, particularly in north-western and central Bohemia and central and southern Moravia most likely represent under-recording, those at middle elevations and particularly in the mountains at least partly reflect true absences.

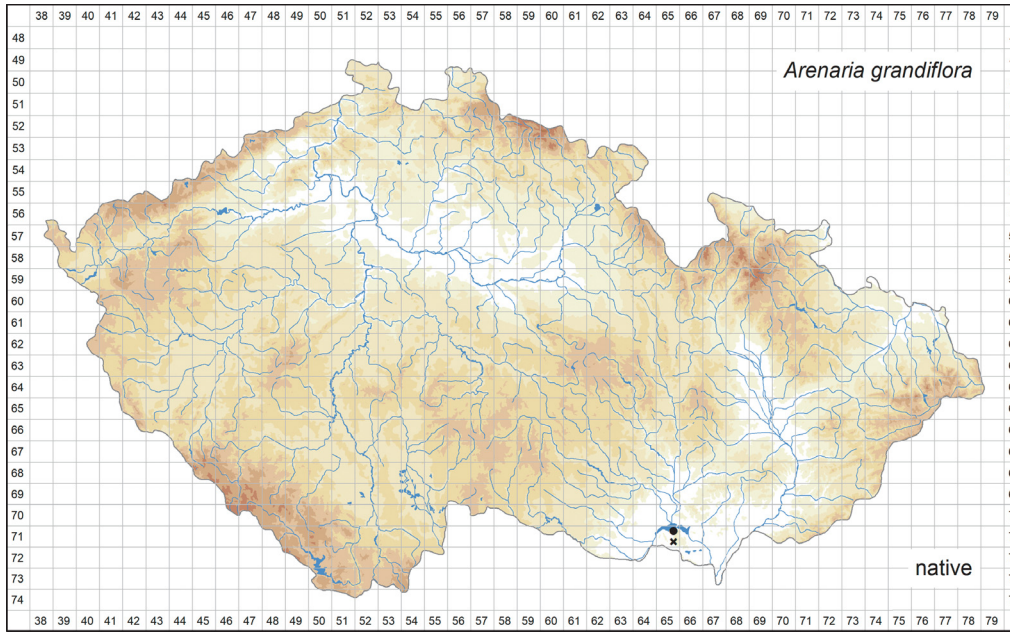


Fig. 9. – Distribution of *Arenaria grandiflora* in the Czech Republic: ● native (1 quadrant), × alien (1 quadrant). Prepared by Jiří Danihelka.

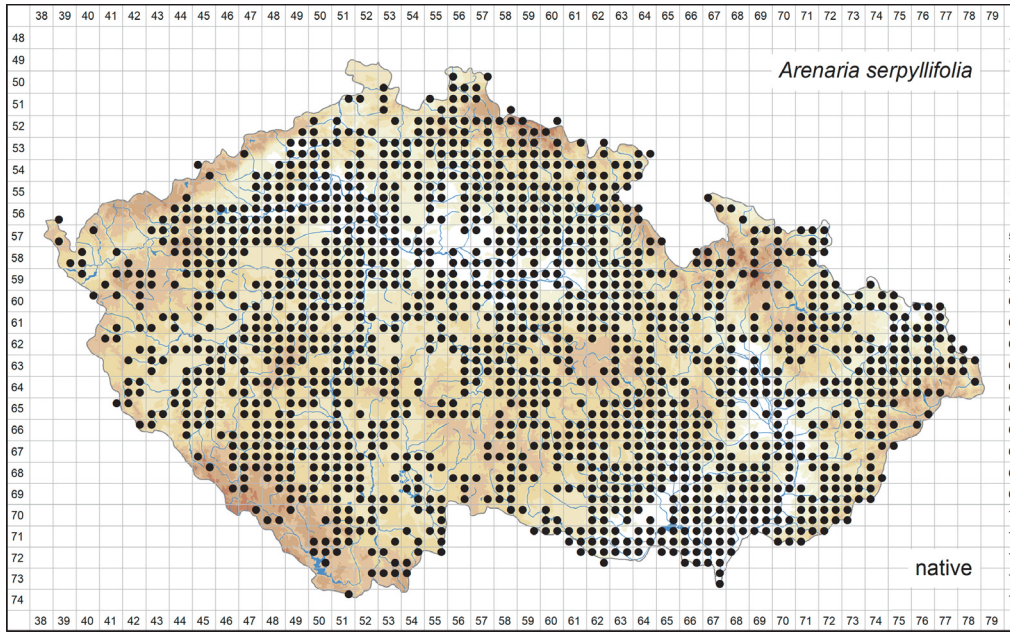


Fig. 10. – Distribution of *Arenaria serpyllifolia* in the Czech Republic (1585 occupied quadrants). Prepared by Jiří Danihelka.

Arnoseris minima (Fig. 11)

Arnoseris minima is almost exclusively a European species with a sub-Atlantic distribution. It is native to western and central Europe, from the northern Iberian Peninsula through France northwards to south-eastern England, Denmark and southern Sweden, and eastwards to Lithuania, Belarus and western Ukraine (Hultén & Fries 1986, Meusel & Jäger 1992). Like many other sub-Atlantic geoelements, *A. minima* reaches the south-eastern limit of its continuous distribution in central Europe, including the Czech Republic (Kaplan 2012, 2017), with scarce isolated occurrences further to the south and east, such as in Corsica, Sardinia, central Italy and Croatia. Secondary occurrences are recorded from Scotland, central Sweden and western and southern Finland. Outside Europe it is native only to northern Morocco. It has been introduced also to the north-eastern USA, south-eastern Canada, Australia and New Zealand (Hultén & Fries 1986, Meusel & Jäger 1992). In the Czech Republic *A. minima* has been recorded as a weed in edges of cereal fields and in fallows, and less frequently in fringes of pine forests, along sandy tracks, in open dry grasslands and on sand dunes. It grows mainly on acidic, nutrient-poor, sandy soils that are sometimes wet in spring but dry out in summer. Within the Czech Republic it is distributed mainly in the lowlands and at middle elevations in Bohemia, particularly in the areas with rather frequent occurrence of sandy habitats. In Moravia and Silesia it was recorded only at about a dozen sites. Most of the occurrences in the past were on arable land, and *A. minima* has almost completely vanished from these habitats due to the use of fertilizers and herbicides. It has also considerably declined from the other habitats, mainly due to general eutrophication of the landscape followed by succession. Since 2000 it has been recorded at slightly more than a dozen sites, most hosting only a small population or even a single plant each, and is therefore classified as critically threatened (Grulich 2012).

Carex acutiformis (Fig. 12)

This species occurs almost continuously from western Europe to the Ob river basin in western Siberia, towards the north reaching as far as the central part of Scandinavia and the central Ural Mts, towards the south extending to the Mediterranean area, northern Africa, Turkey, the Caucasus Mts, Iran and the Himalayas in central Asia; isolated occurrences are found around Lake Baikal, and it probably occurs even in northern China. It is an alien species along the eastern sea coast of North America (Egorova 1999). The most common habitats are wet meadows and fen meadows, meadow wetlands, pond shores, alder carrs and alluvial forests. It grows in sunny or semi-shady places, permanently waterlogged or flooded habitats on deeper, loamy or clay soils (semi-gley or gley), well-supplied with nutrients. *Carex acutiformis* is scattered to abundant in the warm and moderately warm areas of the Czech Republic, being most frequent from the lowlands up to 500 m a.s.l. In contrast, it is largely absent from the peripheral mountain ranges, reaching its elevational maximum in the Šumava Mts at ca 800 m. In Bohemia it is particularly common in its northern part, and is scattered in the South Bohemian fishpond basins and at several places in the Českomoravská vrchovina highlands. However, it is missing from some parts of western and southern Bohemia, large parts of the Českomoravská vrchovina highlands and the Středočeská pahorkatina uplands. It is rather widespread in southern and central Moravia apart from river floodplain. In herbaria there has been frequent confusion with the similar but not closely related species *C. acuta*, *C. buekii*, *C. vesicaria* and especially *C. riparia*.

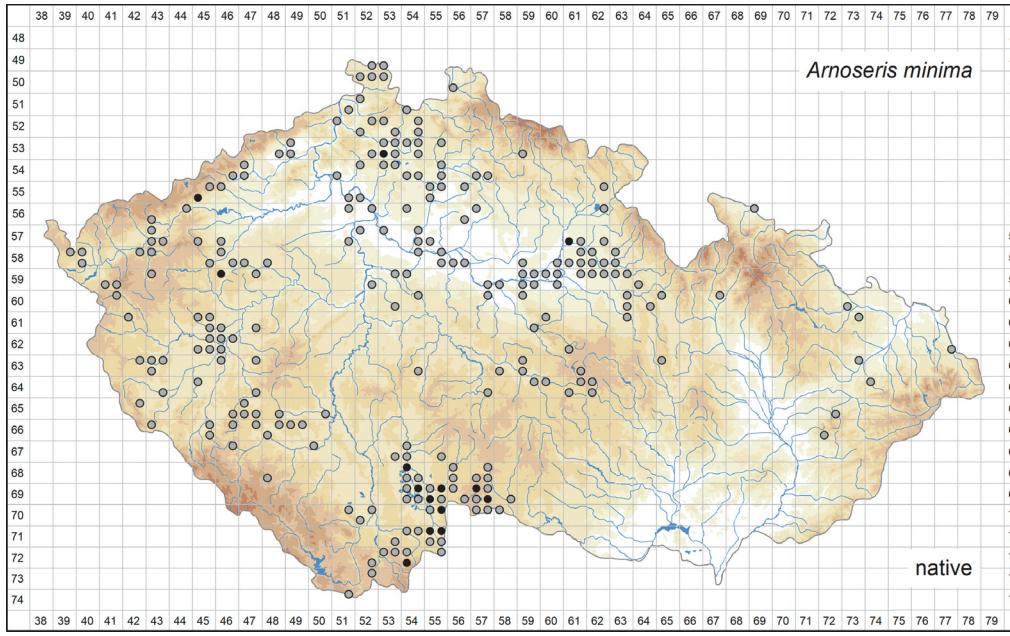


Fig. 11. – Distribution of *Arnoseris minima* in the Czech Republic: ● at least one record in 2000–2019 (14 quadrants), ● pre 2000 records only and/or extirpated occurrences (233 quadrants). Prepared by Zdeněk Kaplan.

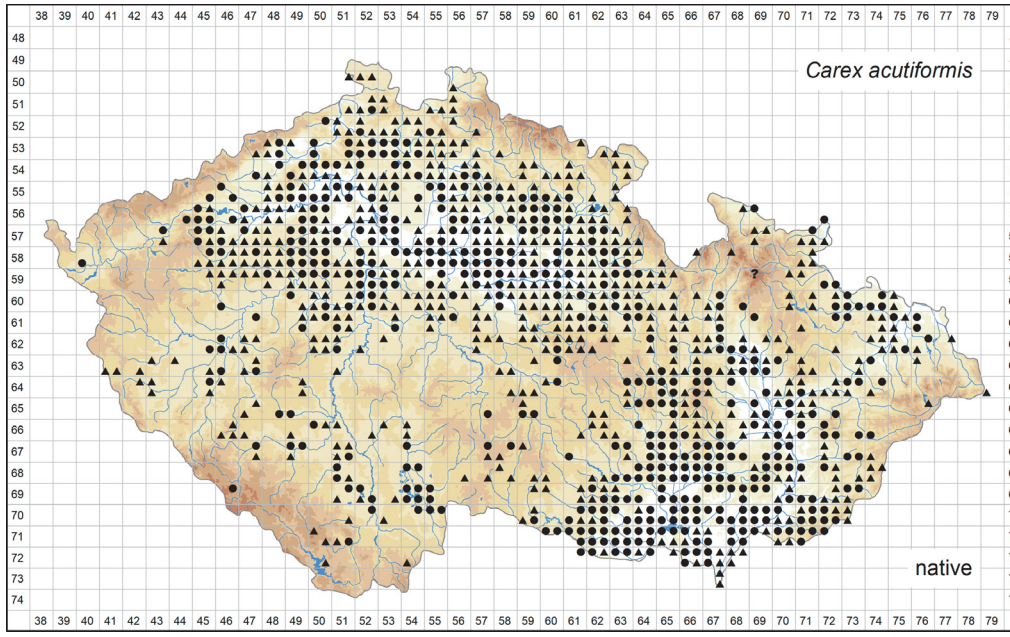


Fig. 12. – Distribution of *Carex acutiformis* in the Czech Republic: ● occurrence documented by herbarium specimens (488 quadrants), ▲ occurrence based on other records (573 quadrants). Prepared by Vít Grulich & Radomír Řepka.

Carex hirta (Fig. 13)

Carex hirta occurs almost all over Europe, extending eastwards to the Ural Mts. It is rare only in the Mediterranean area, where it is missing from most of the islands, and in northernmost Scandinavia. Outside Europe it is distributed in north-western Africa (Morocco and Algeria) and in Asia. Secondary occurrences are reported from the eastern part of North America and from New Zealand (Hultén & Fries 1986, Reznicek & Catling 2002a). This species inhabits meadows, road margins, railway embankments, clearings and places with ruderal vegetation, rarely also light forests, on acidic to basic soils. *Carex hirta* is widespread and common throughout the Czech Republic from the lowlands up to the mountains, reaching its elevational maximum at 1250 m in the Krkonoše Mts.

Carex hordeistichos (Fig. 14)

The main part of the range of *C. hordeistichos* extends through southern and central Europe from Spain in the west to southern European Russia in the east, towards the north reaching central Germany, the Czech Republic and Slovakia; however, it is only very rare in many parts of its range. It is also known from northern Africa (Morocco, Algeria and Tunisia), Anatolia, Transcaucasia, northern Iraq and northern Iran (Meusel et al. 1965, Schultze-Motel 1980, Dítě et al. 2012). *Carex hordeistichos* is a facultative halophyte found in salt marshes and pastures, but it is also found along rural and forest roads, in disturbed places used for the temporary storage of timber and disturbed margins of alkaline fens or dry grasslands. It prefers heavy, intermittently wet alkaline soils on tertiary or quaternary sediments, usually in sunny places. In the Czech Republic *C. hordeistichos* is known only from southern and south-eastern Moravia, mainly from the triangle between the city of Brno and the towns of Znojmo and Uherské Hradiště, and from the Bílé Karpaty Mts. It was also once recorded near the city of Olomouc. All records from Bohemia are based on misidentified specimens of *C. secalina* (cf. Čelakovský 1871) or on cultivated plants; the recently published occurrence in southern Bohemia (Albrechtová et al. 2018) is based on a specimen that most likely has a mistaken herbarium label. *Carex hordeistichos* reaches its elevational maximum at 650 m on Mt Lesná near the village of Horní Němčí in the Bílé Karpaty Mts. Most of this species' populations recorded in the past in south-western and southern Moravia have vanished, and it now only occurs scattered in south-eastern Moravia. It is therefore classified as endangered (Grulich 2012).

Carex lasiocarpa (Fig. 15)

Carex lasiocarpa is a boreal circumpolar species widespread throughout northern Europe and Asia. In central and southern parts of Europe it is scattered, reaching southwards France, northern Italy, Hungary, Bosnia and Herzegovina, Serbia and Bulgaria. Isolated populations exist in the Caucasus Mts, Georgia and central Kazakhstan. In North America it occurs from Alaska in the west to Newfoundland in the east, southwards reaching as far as California and Virginia (Hultén 1968, Hultén & Fries 1986, Reznicek & Catling 2002b). *Carex lasiocarpa* occurs mainly in transitional mires, margins of reed and tall sedge beds, rarely in alder carrs and pine or birch bog forests. It prefers organic or gley, slightly acidic to slightly basic soil, usually on sunny, seldom in semi-shady places. It is rare to scattered throughout almost the entire Czech Republic, being locally more

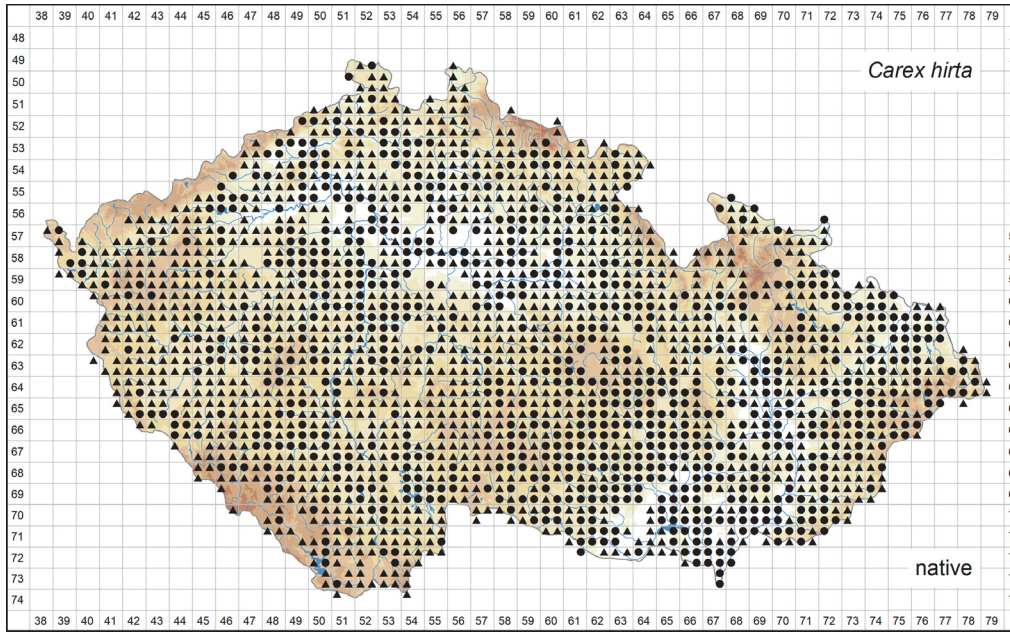


Fig. 13. – Distribution of *Carex hirta* in the Czech Republic: ● occurrence documented by herbarium specimens (821 quadrants), ▲ occurrence based on other records (1301 quadrants). Prepared by Vít Grulich & Radomír Řepka.

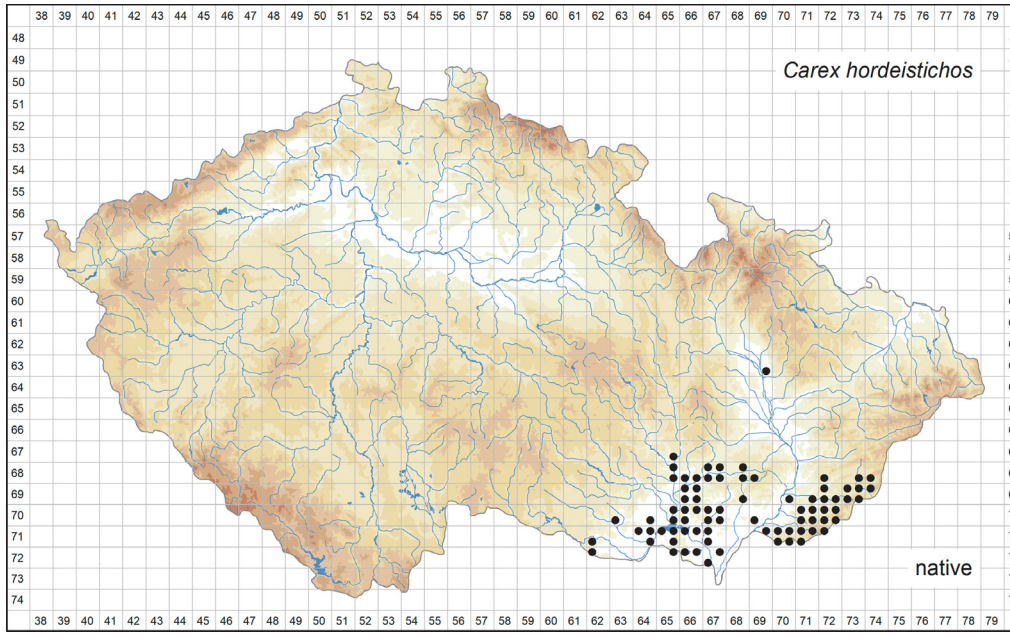


Fig. 14. – Distribution of *Carex hordeistichos* in the Czech Republic (77 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

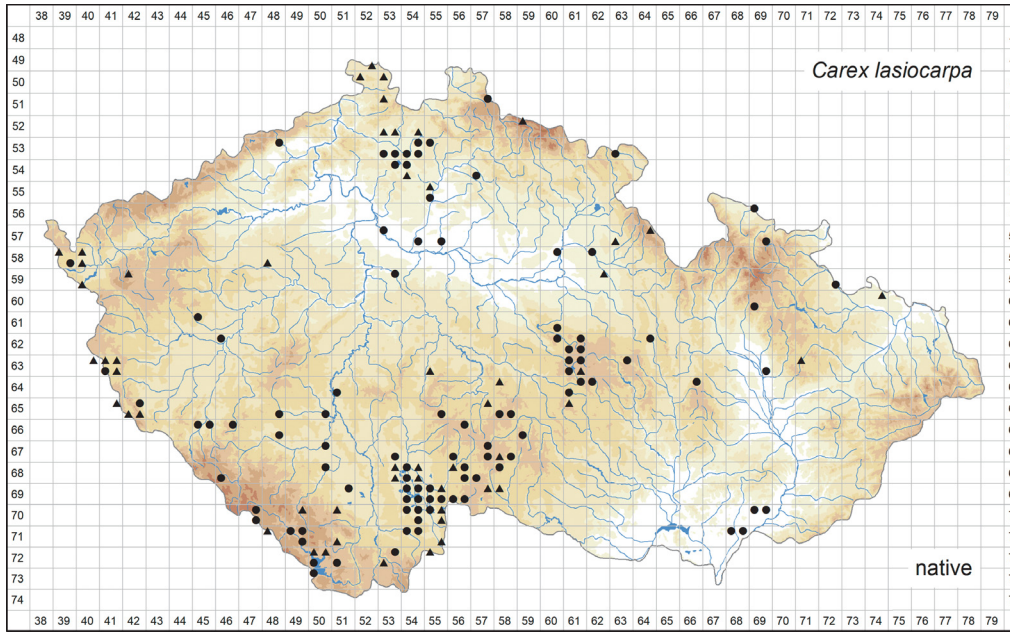


Fig. 15. – Distribution of *Carex lasiocarpa* in the Czech Republic: ● occurrence documented by herbarium specimens (98 quadrants), ▲ occurrence based on other records (53 quadrants). Prepared by Vít Grulich & Radomír Řepka.

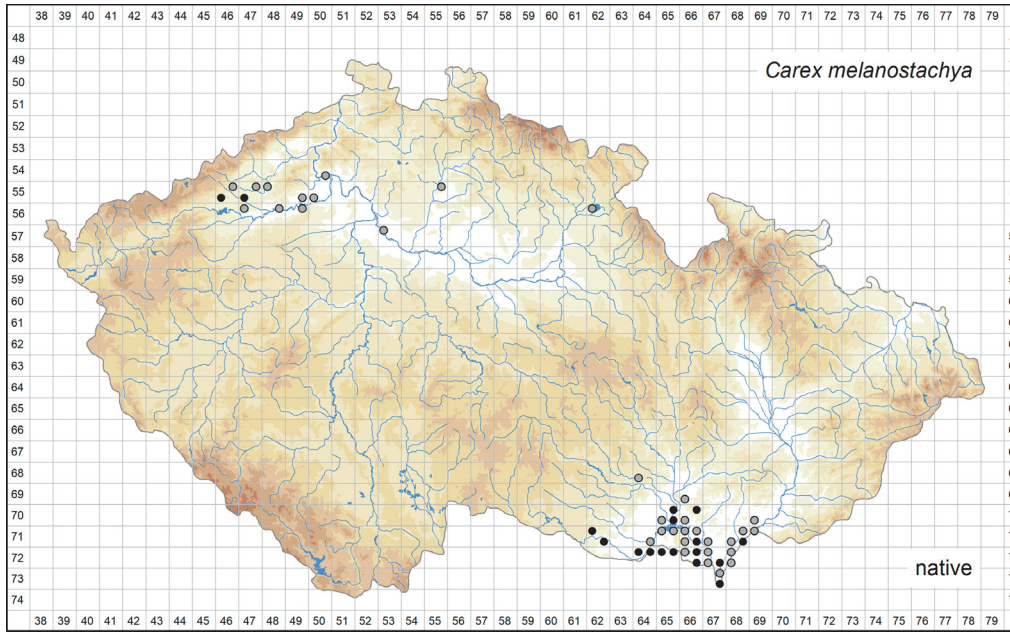


Fig. 16. – Distribution of *Carex melanostachya* in the Czech Republic: ● at least one record in 2000–2019 (17 quadrants), ● pre 2000 records only (33 quadrants). Prepared by Vít Grulich & Radomír Řepka.

frequent in northern Bohemia around the towns of Česká Lípa and Doksy, in the Českomoravská vrchovina highlands and in southern Bohemia, mainly in fishpond basins. It is very rare in Moravia, occurring there near the town of Hodonín, in the Drahanská vrchovina highlands and Oderské vrchy hills, as well as at two sites in Silesia adjacent to the Polish border. It reaches its elevational maximum in the Krkonoše Mts at 1300 m. Some populations, especially in suboptimal habitats or partially drained or shaded places, often remain sterile for long periods. *Carex lasiocarpa* is classified as vulnerable because of its decline (Grulich 2012).

Carex melanostachya (Fig. 16)

Carex melanostachya is a Eurasian species occurring from central France in the west through Europe to the Balkan Peninsula, Ukraine and southern Russia to the Caucasus Mts, and further east through southern Siberia as far as the Yenisei river basin in the east. The Asian part of its range includes also north-eastern Anatolia, Transcaucasia and central Asia, extending as far as Afghanistan and Pakistan (Meusel et al. 1965). It has been introduced into North America in Kansas, Nebraska and Oklahoma (Reznicek & Catling 2002b). In the Czech Republic *C. melanostachya* is found mainly in lowland floodplain meadows that become dry in summer, less frequently growing in tall sedge communities and in the fringes of lowland floodplain forests, occasionally even in secondary habitats, such as road ditches, flood dams, slopes of railway embankments and shores of ponds. It grows in sunny or semi-shady places flooded in spring but becoming rather dry during summer, usually on clay to sandy-loamy soils that are rich in nutrients and/or slightly saline (Řepka & Grulich 2014). It survives elimination of flooding by river regulation and also tolerates regular mowing. In the Czech Republic *C. melanostachya* is found only in the warm lowlands. It is rare in Bohemia, now occurring only in the Podkrušnohorská pánev basin, with isolated populations near the towns of Roudnice nad Labem, Mladá Boleslav and Česká Skalice extirpated. In southern Moravia *C. melanostachya* is moderately abundant in the lower Dyje river floodplain (although many populations were flooded when the Nové Mlýny water reservoirs were created) and scattered in the lower Morava river floodplain, while occurrences in the adjacent hilly areas may be considered as secondary. It is classified as endangered because of its decline (Grulich 2012).

Carex pseudocyperus (Fig. 17)

Carex pseudocyperus is a boreal to circumpolar species. The Eurasian part of its distribution reaches from western Europe to the basin of the Lena river in central Siberia. Its southernmost occurrences are in Sicily, Anatolia and northern Iran, and isolated populations are known from Algeria, Tunisia, Kazakhstan, Uzbekistan, central China and Hokkaido island in Japan. It also occurs in eastern North America from Nova Scotia to Manitoba, southwards reaching Indiana and Minnesota (Hultén & Fries 1986, Reznicek & Ford 2002). While in Eurasia it has no closely related species, there is some confusion with the similar American sedges *C. comosa* and *C. hystericina*, which both produce sterile hybrids with *C. pseudocyperus* (Reznicek & Ford 2002). In the Czech Republic *C. pseudocyperus* occurs in the margins of fishponds and pools, and in alder carrs, usually in shallow water, preferring moderate nutrient content. *Carex pseudocyperus* occurs as scattered in this country, mainly in the lowlands and at middle elevations. It is relatively

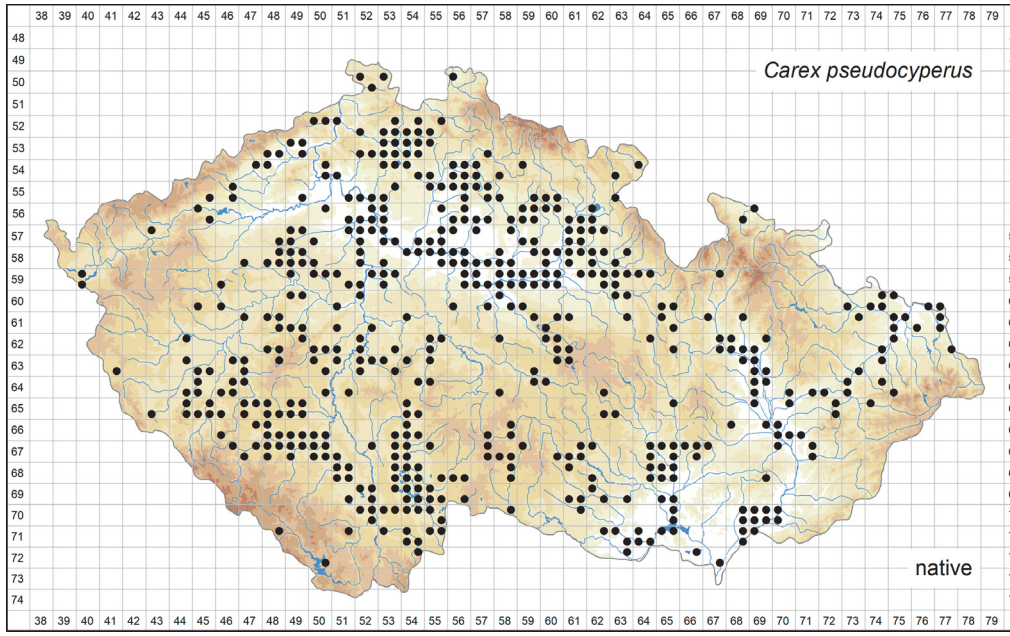


Fig. 17. – Distribution of *Carex pseudocyperus* in the Czech Republic (519 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

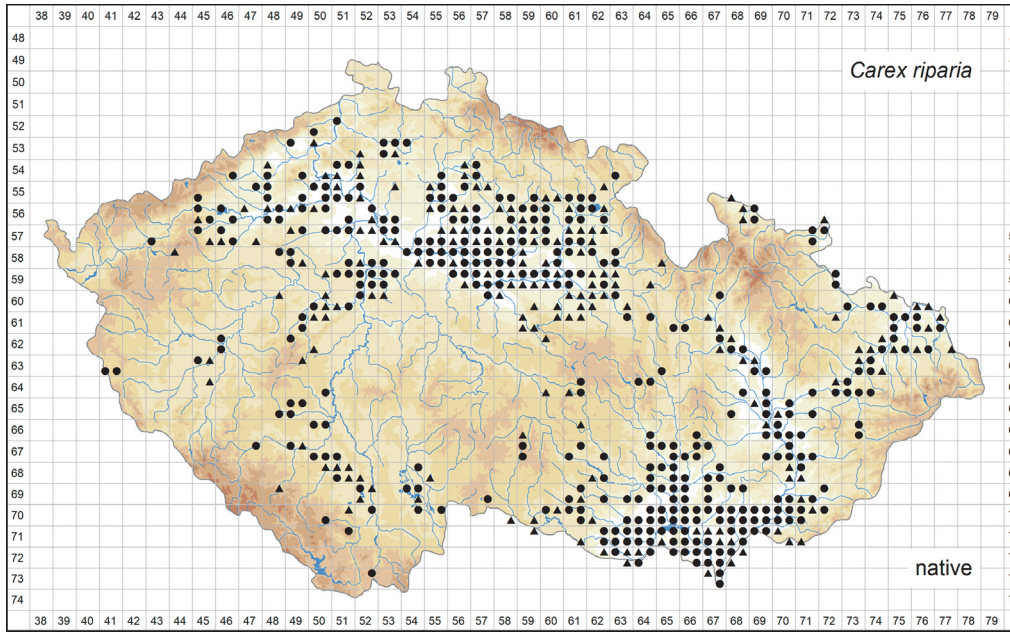


Fig. 18. – Distribution of *Carex riparia* in the Czech Republic: ● occurrence documented by herbarium specimens (362 quadrants), ▲ occurrence based on other records (184 quadrants). Prepared by Vít Grulich & Radomír Řepka.

common in the Labe river basin, northern and eastern Bohemia, and in fishpond basins in southern Bohemia. In Moravia it is found mainly in the surroundings of the city of Brno and the town of Hodonín, in the middle part of the Morava river basin and in the Odra river basin. It is scarce in western Bohemia, the Českomoravská vrchovina highlands, northern Moravia and the Carpathians. Its elevational maximum is reached at 870 m near the village of České Žleby in the Šumava Mts. *Carex pseudocyperus* is classified as of lower risk – near threatened (Grulich 2012).

Carex riparia (Fig. 18)

Carex riparia is a Eurasian species. Its main Eurasian range stretches from Ireland and Portugal in the west as far as the Yenisei river basin in the east, in the north reaching Scotland and southern Scandinavia. It also occurs in northern Africa (Morocco and Algeria), Anatolia, the Caucasus Mts, Iran and parts of central Asia (Meusel et al. 1965). In the Czech Republic *C. riparia* grows on the shores of fishponds and oxbows, in meadow wetlands, lowland floodplain forests and alder carrs. These sites are waterlogged, usually semi-shady or fully open, with loamy to clay soils that are moderately rich to rich in nutrients. This species often forms monodominant stands but sometimes grows in reed stands. *Carex riparia* occurs mainly in warm and moderately warm parts of this country. It is rather common in the lowlands in southern and central Moravia (forming abundant populations in floodplain forests) and in the Labe and Ohře river basins in Bohemia. It is locally common also in some other parts of this country, usually in river basins or in areas rich in fishponds. There are scattered occurrences elsewhere but at least some of them may be recognized as secondary. *Carex riparia* is absent from high elevations: it reaches its local elevational maximum in the Doupovské hory Mts at 733 m. It is classified as of lower risk – near threatened (Grulich 2012).

Carex rostrata (Fig. 19)

Carex rostrata is a circumboreal to circumpolar species, widespread in Eurasia and North America, in Europe extending southwards to the mountains in the Mediterranean area. In Asia it is widespread in Siberia and the Far East, occurring also in Anatolia, the Caucasus Mts, the mountains of central Asia and the Western Himalayas. In North America it reaches southwards to Wisconsin and Michigan; it is also found in south-eastern Greenland (Hultén 1964, Egorova 1999). This species occurs in a wide range of habitats including spring fens and fen meadows in rather warm areas, as well as transitional mires, raised bogs, spring sites, depressions in wet meadows, pond shores, willow scrub, alder carrs and bog spruce forests at rather high elevations. Substrates are usually moderately rich or poor in nutrients. In the Czech Republic *C. rostrata* is widespread in areas with cold sub-Atlantic climates, mainly in the mountain ranges in the west of this country and also in a broad strip of highlands from southern Bohemia to northern Moravia. Its occurrences are found at elevations of 500–1200 m, with a local elevational maximum at 1450 m in the Krkonoše Mts. This species is missing from or rare in the warm lowlands and hilly areas in Bohemia, southern Moravia and the southern half of the Carpathians.

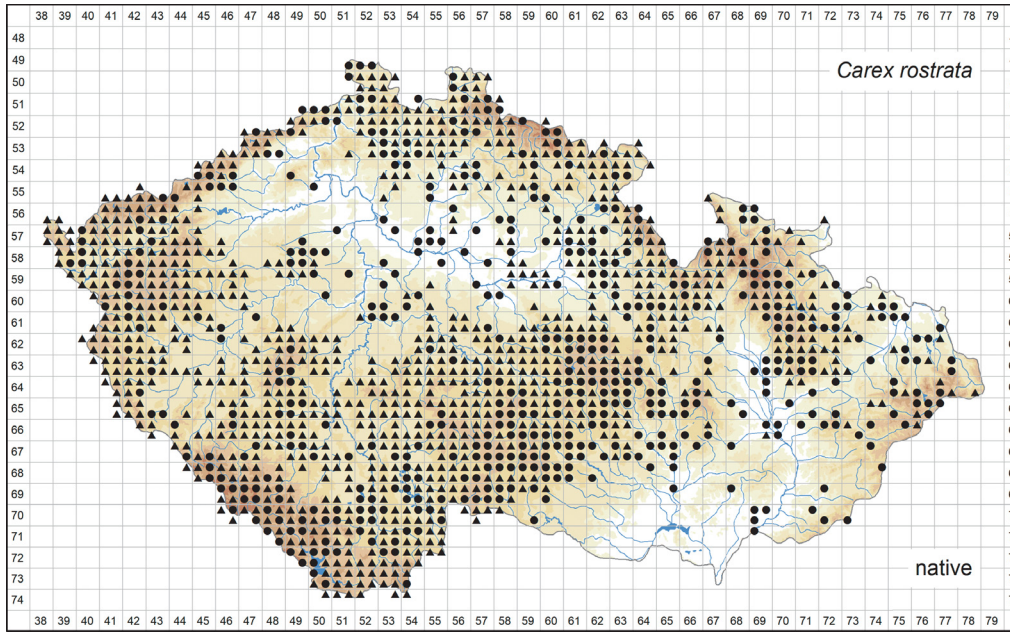


Fig. 19. – Distribution of *Carex rostrata* in the Czech Republic: ● occurrence documented by herbarium specimens (499 quadrants), ▲ occurrence based on other records (899 quadrants). Prepared by Vít Grulich & Radomír Řepka.

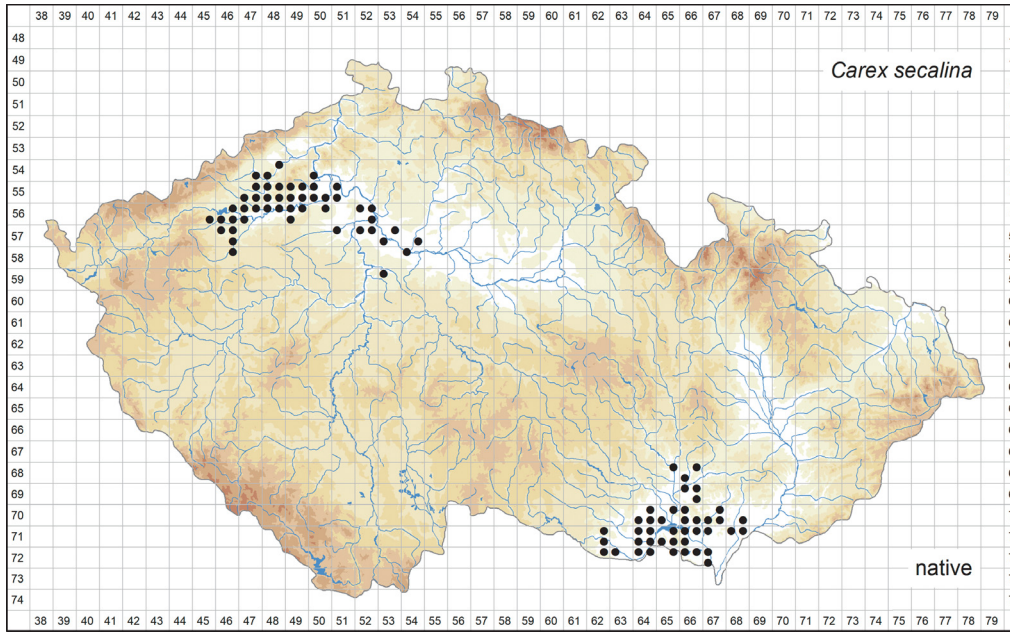


Fig. 20. – Distribution of *Carex secalina* in the Czech Republic (90 occupied quadrants). Prepared by Vít Grulich & Radomír Řepka.

Carex secalina (Fig. 20)

Carex secalina is a continental Eurasian species. It has a strongly disjunct range reaching from central Germany in the west to Lake Baikal in the east; it is also found in Georgia, Iran and Kazakhstan (Meusel et al. 1965, Eliáš et al. 2012). In the Czech Republic *C. secalina* occurs in intermittently wet habitats such as inland salt marshes, meadows and pastures on heavy soils with higher concentrations of sodium or magnesium minerals, most frequently on Tertiary or Quaternary sediments at sites not affected by regular inundations; it is also found in wet depressions in fields or in stands of perennial forage crops such as alfalfa. This species prefers disturbed places with low cover of perennial competitive species. It is biennial or a short-lived perennial, usually monocarpic. In the Czech Republic *C. secalina* is found in the warmest and driest lowlands of Bohemia and Moravia in areas where summer droughts increase soil salinity due to strong evaporation. In Bohemia most of the occurrences are concentrated to the Ohře river basin between the towns of Kadaň and Podbořany in the west and Lovosice and Libochovice in the east; additional occurrences are situated near the town of Velvary and in the Labe river basin between the towns of Mělník, Kralupy nad Vltavou and Neratovice (Sládek 1996). There are also records from sand pits near the town of Lysá nad Labem and meadows in the periphery of Prague; these occurrences were only temporary. In southern Moravia this species is found in a triangle between the city of Brno and the towns of Znojmo and Hodonín. *Carex secalina* has shown declines due to both the intensification of agriculture and abandonment; therefore it is classified as endangered (Grulich 2012).

Carex vesicaria (Fig. 21)

Carex vesicaria is widespread throughout Eurasia. It is common in northern Europe, and progressively rarer towards the Mediterranean area. It also occurs in Anatolia, the Caucasus Mts, and Iran. In North America it is found in the southern part of Canada, and in the USA from Maine in the east to California in the west, being more widespread in the east (Reznicek & Ford 2002). In Siberia it is partly replaced by the related and similar *C. vesicata* (Egorova 1999). In the Czech Republic *C. vesicaria* occurs in eutrophic wetlands, on the shores of fishponds and lowland oxbows and in the wettest parts of moist meadows; it also appears on the margins of peat bogs and fens. Together with *C. acuta* it indicates eutrophication of oligotrophic and mesotrophic habitats. *Carex vesicaria* is widespread in this country. It is particularly common in the lowlands and at middle elevations. With a few exceptions, it does not occur at the highest elevations of the mountain ranges along the country's border nor in the warm and dry areas with prevailing arable land. Some of the gaps on the map (e.g. in the surroundings of the city of Plzeň, the area north-west of Prague and the Drahanská vrchovina highlands) may reflect a lack of records rather than actual absences. Most sites are found below 600 m a.s.l., while the elevational maximum was recorded at about 1100 m in the Šumava Mts. In the Czech Republic confusion with other species (mainly *C. rostrata*) is likely only at an early phenological stage. Hybrids with *C. rostrata* are relatively rare despite the frequent co-occurrence of these species.

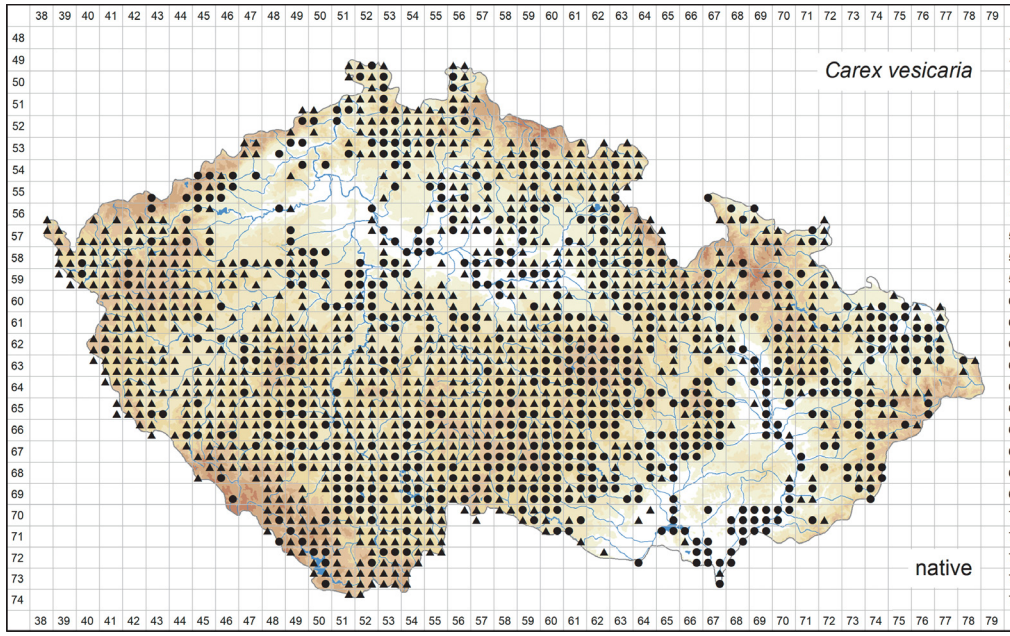


Fig. 21. – Distribution of *Carex vesicaria* in the Czech Republic: ● occurrence documented by herbarium specimens (634 quadrants), ▲ occurrence based on other records (1029 quadrants). Prepared by Vít Grulich & Radomír Řepka.

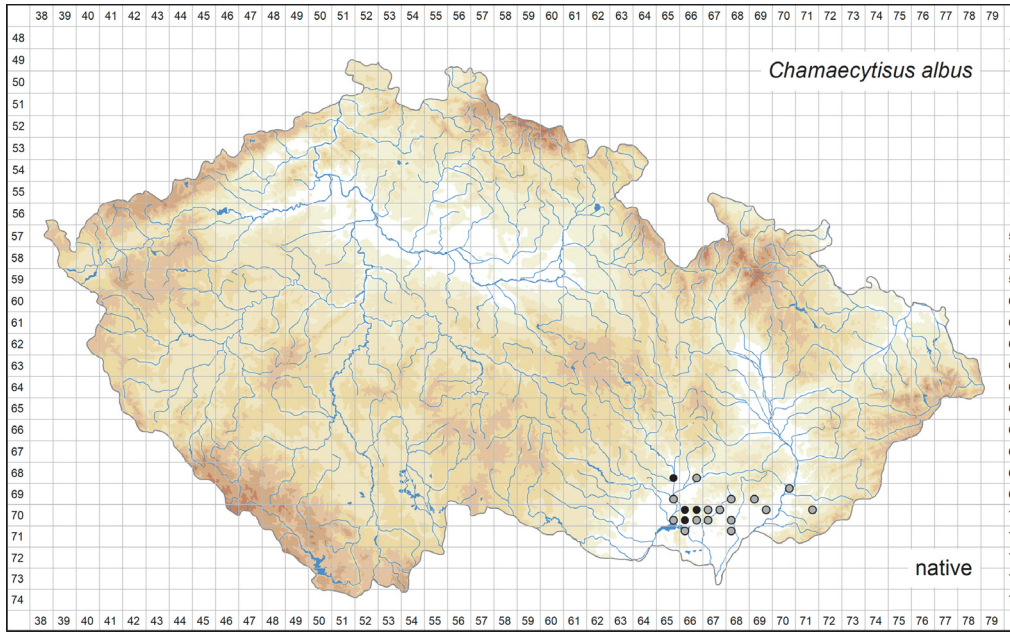


Fig. 22. – Distribution of *Chamaecytisus albus* in the Czech Republic: ● at least one record in 2000–2019 (4 quadrants), ● pre 2000 records only (15 quadrants). Prepared by Radomír Řepka.

Chamaecytisus albus (Fig. 22)

Chamaecytisus albus occurs in the Pannonian Basin and south-eastern Europe, particularly in the Balkan Peninsula. The northern distribution limit reaches the south-eastern Czech Republic, Slovakia and northern Hungary. Isolated occurrences are found in southern and eastern Poland. The eastern limit of its range is at the eastern edge of the Romanian Carpathians and in western Ukraine (Heywood & Frodin 1968, Przemyski & Piwowarski 2009). In the Czech Republic *Ch. albus* grows on slopes with dry grasslands among low shrubs, at fringes of thermophilous oak forests and less frequently on fallows. It prefers deep, clayey-loamy soils on calcareous substrates, most frequently on loess, limestone and Tertiary calcareous sediments (Skalická 1995). In this country it is confined to warm hilly landscapes in southern Moravia, where it has been recorded at about twenty sites. Recently its occurrence has been confirmed at ten sites in loess hills in the vicinity of the town of Hustopeče and at two sites south and south-east of the city of Brno. Its populations outside protected areas face destruction due to intensification of the management in vineyards and orchards, abandonment of pastures and grasslands, and competition from tall grasses such as *Calamagrostis epigejos*. *Chamaecytisus albus* partly tolerates occasional mowing because it regenerates relatively well. It is classified as endangered (Grulich 2012).

Chamaecytisus austriacus (Fig. 23)

Chamaecytisus austriacus occurs mainly in the Balkan Peninsula, where it reaches its southern distribution limit in northern Greece. It extends northwards to Austria, the Czech Republic and Slovakia, and eastwards to Romania, Moldova, Ukraine and the lower and middle Volga river basin in Russia (Skalická 1995, Pifkó & Barina 2017). In the Czech Republic it mainly grows in tall dry grasslands, edges of shrubs, fringes of thermophilous oak forests, abandoned vineyards and orchards (Skalická 1995, Chytrý 2007). It prefers sites without frequent disturbances on deep loamy-clayey soil on calcareous substrates, most often loess, marl, Tertiary limestone and calcareous sand and gravel. The native occurrences of *Ch. austriacus* in this country are confined to hilly landscapes in southern Moravia, northwards to the city of Brno. Several occurrences, mainly in the middle Labe river basin in Bohemia, recorded in the 19th and early 20th centuries were apparently casual introductions. The respective habitats differed from those occupied by *Ch. austriacus* in southern Moravia, some of them being secondary and strongly affected by human activities. In addition, plants collected in Bohemia differ slightly morphologically from those occurring in southern Moravia. Although Skalická (1995) considered *Ch. austriacus* as native to Bohemia, these occurrences were rather escapes from its cultivations as an ornamental, medicinal or honeybee plant. Many populations of this species were destroyed mainly due to terracing of slopes for vineyards and habitat eutrophication. It is therefore classified as vulnerable (Grulich 2012). However, the lack of management does not threaten *Ch. austriacus* considerably, because it thrives well on dry fallows in abandoned orchards and vineyards.

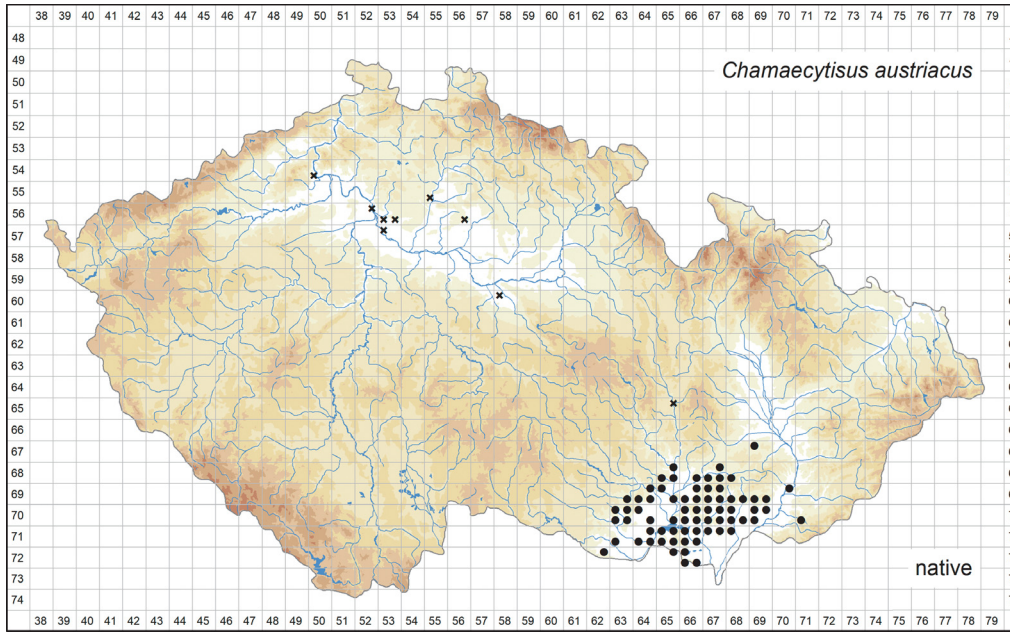


Fig. 23. – Distribution of *Chamaecytisus austriacus* in the Czech Republic: ● native (69 quadrants), × alien (9 quadrants). Prepared by Radomír Řepka.

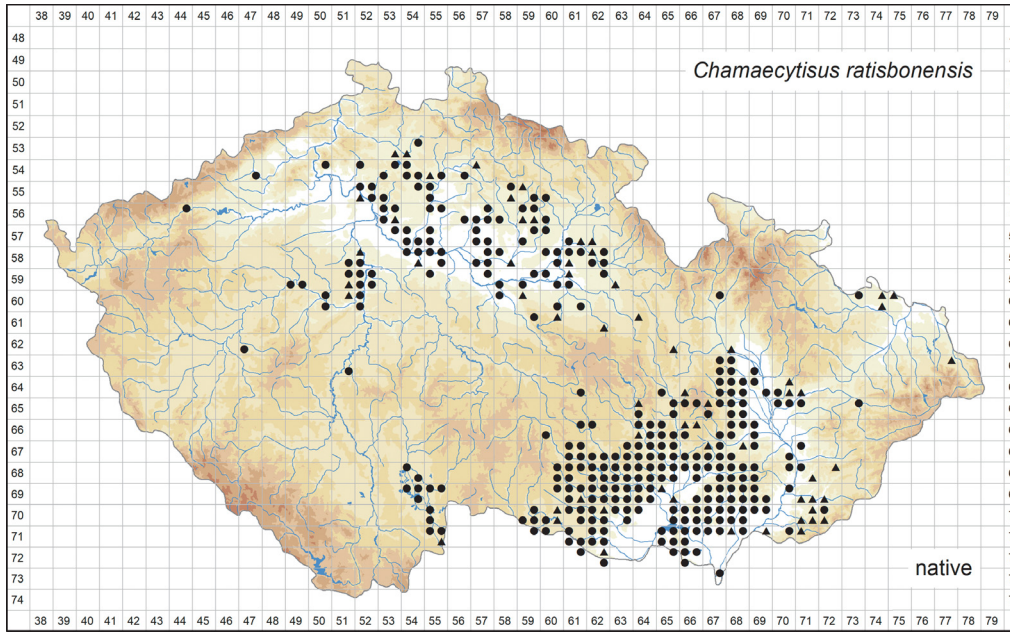


Fig. 24. – Distribution of *Chamaecytisus ratisbonensis* in the Czech Republic: ● occurrence documented by herbarium specimens (300 quadrants), ▲ occurrence based on other records (63 quadrants). Prepared by Radomír Řepka.

Chamaecytisus ratisbonensis (Fig. 24)

The distribution of *Ch. ratisbonensis* extends from Germany to forest steppes of eastern Europe and further eastwards to western Siberia (Meusel et al. 1965). Its distribution forms a strip with the northern limits in Poland and the southern limits passing through Hungary and Romania. However, the precise distribution is unclear in the eastern areas where related species occur (Cristolofini 1991, Skalická 1995, Pifkó & Barina 2017). The north-western limit runs through the Czech Republic (Skalická 1995). In this country *Ch. ratisbonensis* grows mainly in non-forest habitats such as shrubby and steppe hillsides, dry grasslands and low xeric scrub (Chytrý 2007) on permeable, acidic and basic, mostly shallow, stony and sandy soils. It is also found in edges of thermophilous oak and oak-hornbeam forests, less frequently in the understory of open pine and oak forests. It mainly occurs in warm hilly landscapes in southern half of Moravia, less frequently in northern and eastern Bohemia, in the vicinity of Prague and in the Třeboňská pánev basin in southern Bohemia. Elsewhere it is rare. *Chamaecytisus ratisbonensis* is classified as of lower risk – near threatened in this country (Grulich 2012).

Chamaecytisus supinus (Fig. 25)

Chamaecytisus supinus occurs in the Sub-Mediterranean area and in central Europe, extending from Spain in the west to the Balkan Peninsula and Anatolia in the east, with an isolated occurrence in Armenia. Its precise distribution is uncertain in the areas of co-occurrence with the similar *Ch. triflorus* s. l. (Skalická 1986, Holub & Bertová 1988). In the Czech Republic *Ch. supinus* mainly grows in herbaceous fringes of deciduous and mixed forests and in their clearings on both acidic and basic soils. It is most frequent in hilly landscapes and foothills in Moravia and eastern Bohemia, and from there it extends westwards to the eastern vicinity of Prague. Individual isolated sites in northern and north-western Bohemia can be considered secondary due to introductions. The occurrences in southern Bohemia and in south-western Moravia are projections of the species' distribution in the Danube river basin in Bavaria and Upper and Lower Austria. The northern distribution limit of *Ch. supinus* runs through Bohemia (Skalická 1995). In central and south-eastern Moravia, where *Ch. supinus* co-occurs with *Ch. virescens*, only the records supported by herbarium specimens were included in the map. *Chamaecytisus supinus* is classified as of lower risk – near threatened (Grulich 2012).

Chamaecytisus virescens (Fig. 26)

The overall distribution of *Chamaecytisus virescens* is imperfectly known due to taxonomic difficulties and uncertain delimitation from related taxa (Skalická 1995). *Chamaecytisus virescens* is probably a Sub-Mediterranean hybridogenous species distributed within the ranges of its assumed parental species *Ch. austriacus* and *Ch. supinus* (Holub & Bertová 1988, Skalická 1995). It occurs from eastern Austria and the south-eastern Czech Republic in the west through southern Slovakia and along the Carpathian arch to western Romania in the south-east. In the Czech Republic *Ch. virescens* grows in broad-leaved dry grasslands, fringes of thermophilous and mesophilous deciduous forests and low xeric scrub, in forest clearings, meadows, pastures and old fruit orchards. It is mostly found on calcareous soils, but it also occurs on decalcified and partly acidic

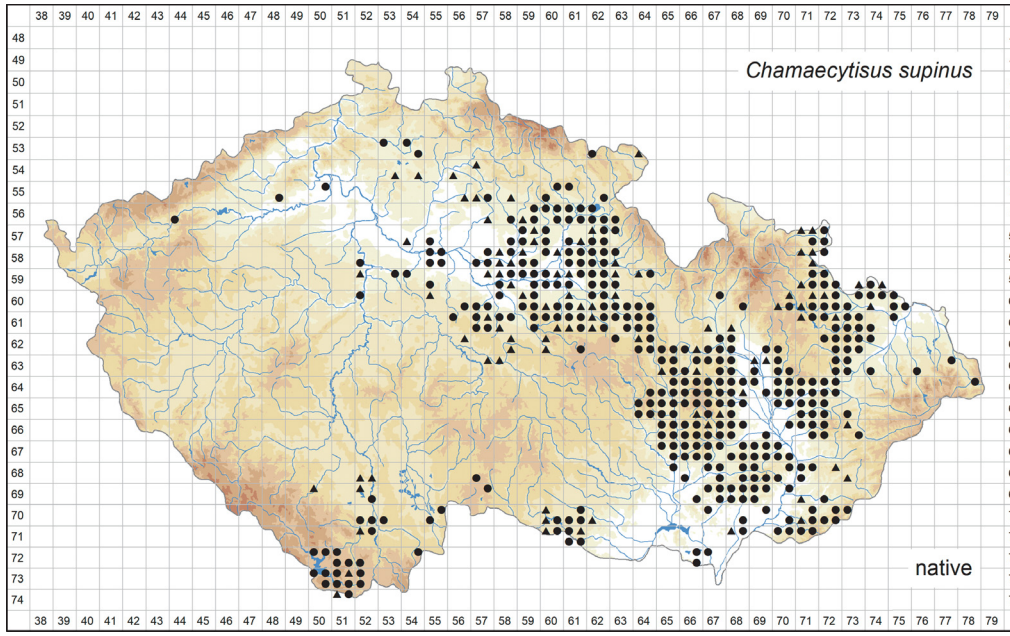


Fig. 25. – Distribution of *Chamaecytisus supinus* in the Czech Republic: ● occurrence documented by herbarium specimens (369 quadrants), ▲ occurrence based on other records (95 quadrants). Prepared by Radomír Řepka.

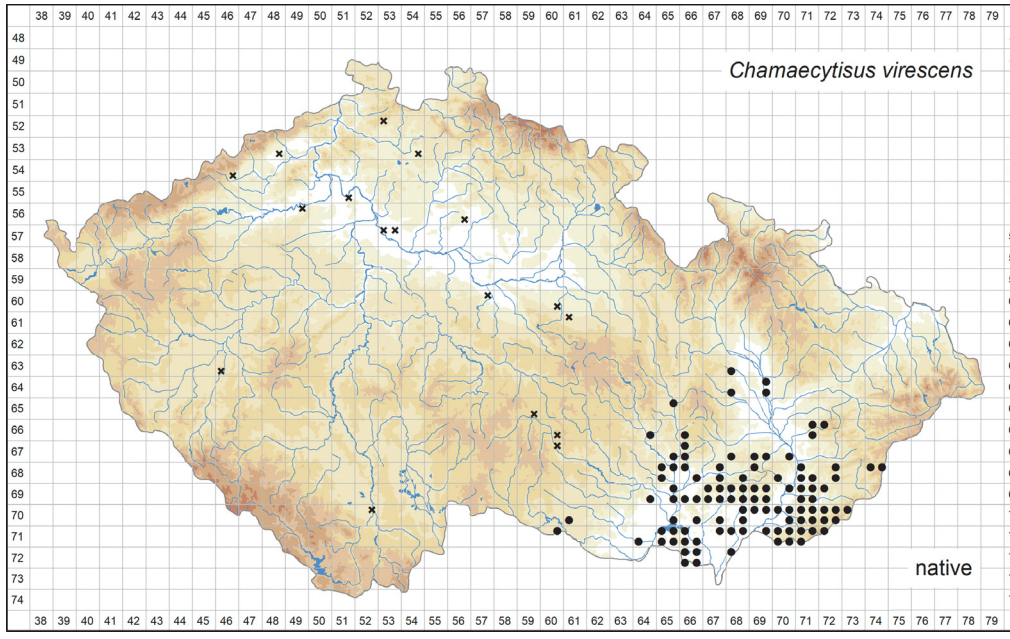


Fig. 26. – Distribution of *Chamaecytisus virescens* in the Czech Republic: ● native (103 quadrants), × alien (17 quadrants). Prepared by Radomír Řepka.

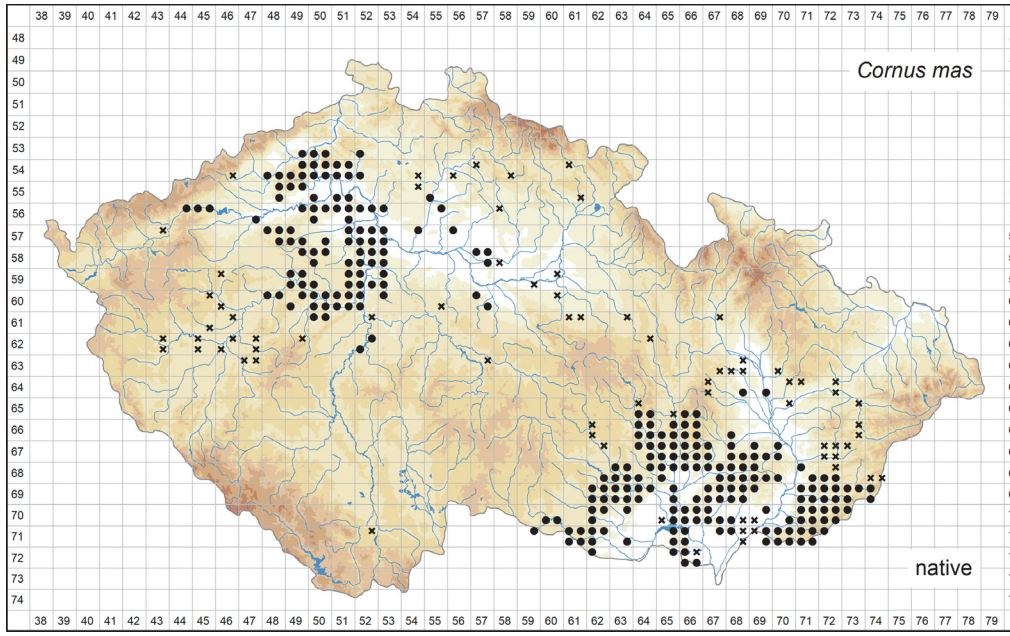


Fig. 27. – Distribution of *Cornus mas* in the Czech Republic: ● native (265 quadrants), × alien (74 quadrants). Prepared by Boleslav Jelínek.

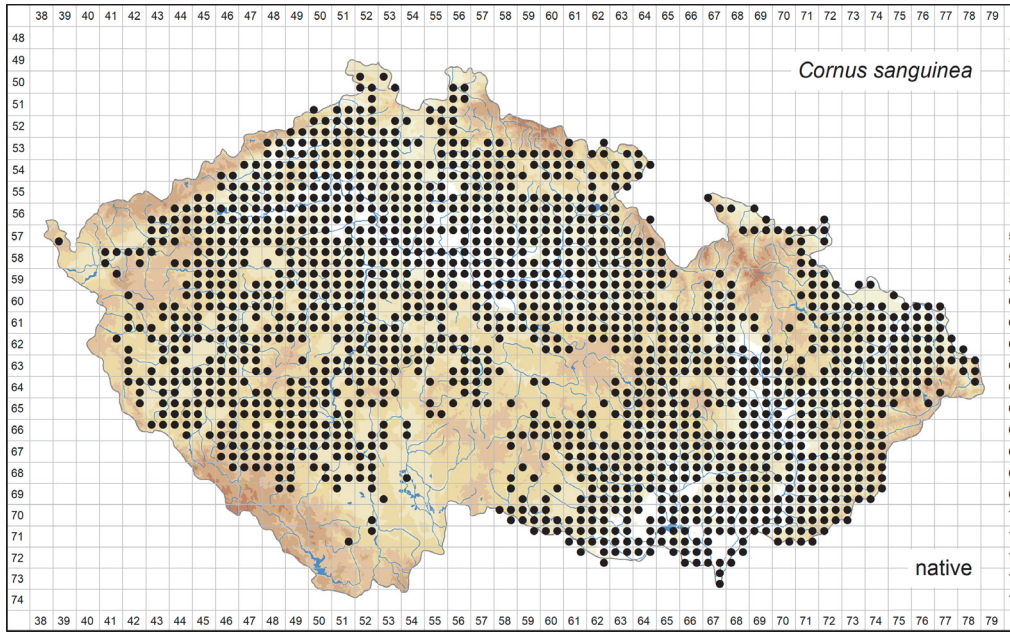


Fig. 28. – Distribution of *Cornus sanguinea* in the Czech Republic (1614 occupied quadrants). Prepared by Boleslav Jelínek.

soils. In this country it is native to warm hilly landscapes in southern and central Moravia, northwards extending to the city of Olomouc. It is rare in the lowlands. The isolated occurrences in Bohemia and western Moravia are secondary, some of them being cultivated plants near castles, gamekeepers' lodges and mills, while others represent possibly escaped or accidentally introduced plants. The independent rise of *Ch. virescens* in situ in Bohemia via hybridization is unlikely, due to the absence of native populations of *Ch. austriacus*. It is classified as endangered in this country (Grulich 2012).

Cornus mas (Fig. 27)

Cornus mas is a Eurasian species occurring from the Pyrenees in the west through southern Europe to south-western Asia, in the east reaching as far as Anatolia and Transcaucasia; however, it is absent from the Mediterranean islands. In Europe the northern boundary of its native range passes through northern France, Belgium, Germany, the Czech Republic, Slovakia, southernmost Ukraine and south-western European Russia (Poyarkova 1951, Meusel et al. 1978, Holub 1997). In the Czech Republic *C. mas* is found mainly in peri-Alpidic basiphilous thermophilous oak forests, sub-continental thermophilous oak forests, Pannonian oak-hornbeam forests and thermophilous associations of ravine forests, as well as in tall mesic and xeric scrub, less frequently also in dry grasslands. It prefers warm and rocky slopes with shallow and rather dry soils on alkaline rocks. In the Czech Republic this species occurs in the areas with rather warm and dry climates in central and north-western Bohemia and south-western, southern and south-eastern Moravia. The occurrences of *C. mas* in Moravia are a projection of its native range in Slovakia and eastern Austria. This species is found in hilly landscapes south-west and south of Brno, in the Bílé Karpaty Mts and in the Moravský kras karst area north of Brno. The northernmost isolated occurrences that are considered as native are situated in the vicinity of the city of Olomouc. *Cornus mas* is particularly abundant on the slopes of river valleys in south-western Moravia. This species' occurrences in central and north-western Bohemia form an outpost: it is particularly abundant in the Český kras karst area, along the lower Vltava river north of Prague and in the České středohoří Mts. There are also some other occurrences in western and eastern-central Bohemia and on the slopes along the middle Vltava river south of Prague that may be considered native. *Cornus mas* has been planted as a fruit and ornamental tree for centuries and therefore spread to areas outside its native range. Consequently, the status of many populations, mainly of peripheral ones, will always remain uncertain. *Cornus mas* is classified as of lower risk – near threatened (Grulich 2012).

Cornus sanguinea (Figs 28–31)

Cornus sanguinea is distributed over most of Europe, from northern Portugal and the Pyrenees in the west as far the western part of European Russia in the east. In the south it is absent only from the southern part of the Iberian Peninsula, southern Greece and Crete. In the north the boundary of its native range passes through the northern portion of the British Isles, southern Scandinavia and the upper part of the Volga river basin. It occurs also along the northern coast of Anatolia, in the Caucasus Mts and Transcaucasia (Poyarkova 1951, Meusel et al. 1978, Holub 1981). *Cornus sanguinea* has a broad ecological amplitude. In the Czech Republic it occurs in open vegetation and forests, most

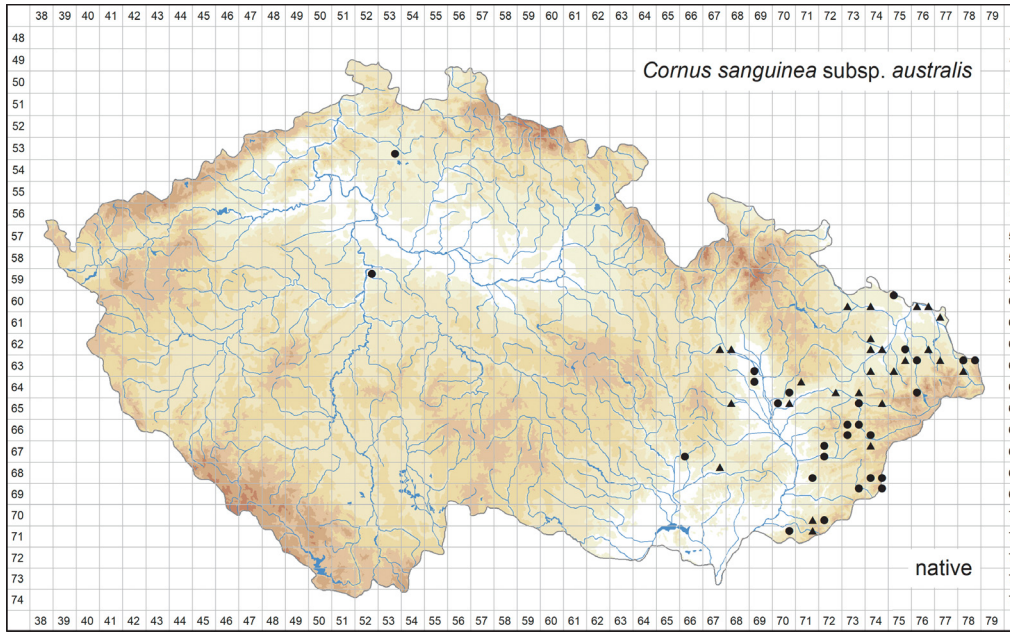


Fig. 29. – Distribution of *Cornus sanguinea* subsp. *australis* in the Czech Republic: ● occurrence documented by herbarium specimens (27 quadrants), ▲ occurrence based on other records (25 quadrants). Prepared by Boleslav Jelínek.

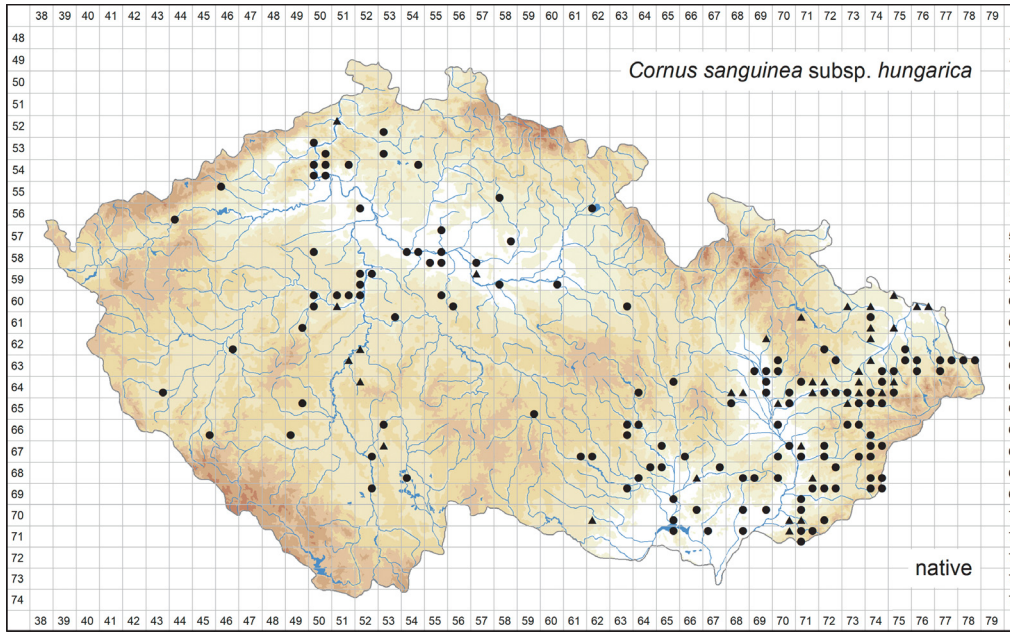


Fig. 30. – Distribution of *Cornus sanguinea* subsp. *hungarica* in the Czech Republic: ● occurrence documented by herbarium specimens (134 quadrants), ▲ occurrence based on other records (37 quadrants). Prepared by Boleslav Jelínek.

frequently in forest fringes, in tall mesic and xeric scrub, low xeric scrub and various types of forests, such as alluvial, oak-hornbeam, ravine and thermophilous oak forests. It prefers mineral-rich soils but grows on both acidic and alkaline soils. It is widespread in the lowlands and at middle elevations almost throughout this country, but is locally rare in to absent from parts of western and southern Bohemia (Fig. 28).

Based on the indumentum of the lower leaf side, three entities are recognized within *C. sanguinea* in the Czech Republic, often classified at subspecies or even species level. Plants mainly with simple patent and more-or-less curled hairs are assigned to *C. s*. subsp. *sanguinea*, while plants with almost exclusively appressed symmetric compass hairs are classified as *C. s.* subsp. *australis*; plants with mainly compass hairs, usually asymmetric and at least partly patent, are assigned to *C. s.* subsp. *hungarica*, a taxon of assumed hybridogenous origin (Holub 1997). This concept is also adopted here. However, a recent study of native and introduced populations in northern Bavaria (Riebl et al. 2017) has shown that only two entities may be recognized: the native type subspecies and the most-likely-introduced *C. s.* subsp. *australis*, the former with indumentum composed of simple and compass hairs, the latter with various types of compass hairs only. Therefore, infraspecific classification of *C. sanguinea* and the origin of assumed hybridogenous populations require further study. *Cornus sanguinea* subsp. *sanguinea* is found over most of the species' European range. *Cornus sanguinea* subsp. *australis* occurs in south-eastern Europe, including the southern part of European Russia, southern Ukraine and northern Balkan Peninsula, from that area reaching Hungary, Slovakia, the eastern part of the Czech Republic and southern Poland; isolated occurrences are reported in Germany (Netzwerk Phytodiversität Deutschland & Bundesamt für Naturschutz 2013, Jäger 2017). This subspecies completely replaces the type subspecies in the Asian part of the species' range (Poyarkova 1951, Hrynkiewicz-Sudnik 1967). *Cornus sanguinea* subsp. *hungarica* is distributed in central Europe, the north of the Balkan Peninsula, eastern Europe and Anatolia (Ludwig & Lenski 1971). Distributions of the latter two subspecies are poorly known, mainly due to taxonomic difficulties. Another source of difficulties is the use of *C. sanguinea* in ornamental plantations and artificially established hedgerows in the landscape, sometimes using seed and plants imported from other (sometimes rather distant) parts of the species' range. Therefore, the status of isolated populations is uncertain, and many of them may have been established by introduction.

In the Czech Republic *C. sanguinea* subsp. *sanguinea* is widespread (Fig. 31). It occurs at low and middle elevations in areas with warm and moderately warm climates; it is absent from the mountains along this country's borders, the central part of the Českomoravská vrchovina highlands, Novohradské hory Mts and Třeboňská pánev basin. The distribution of the other subspecies is poorly known due to lack of herbarium specimens in general and uncertain morphological delimitation of *C. sanguinea* subsp. *hungarica* in particular. *Cornus sanguinea* subsp. *australis* occurs in eastern Moravia and adjacent Silesia in the Podbeskydská pahorkatina hills, Hostýnské vrchy hills and Bílé Karpaty Mts, as well as in the hilly landscapes west of the city of Olomouc and east of the city of Brno (Fig. 29). These populations spatially connect local ranges of this subspecies in south-western and western Slovakia (Holub 1981, 1984) and southern Poland (Hrynkiewicz-Sudnik 1967). The distribution of *C. sanguinea* subsp. *hungarica* is somewhat similar to that of the type subspecies, but it is less widespread and much less frequent than the former (Fig. 30). It is most abundant in eastern Moravia, where its local

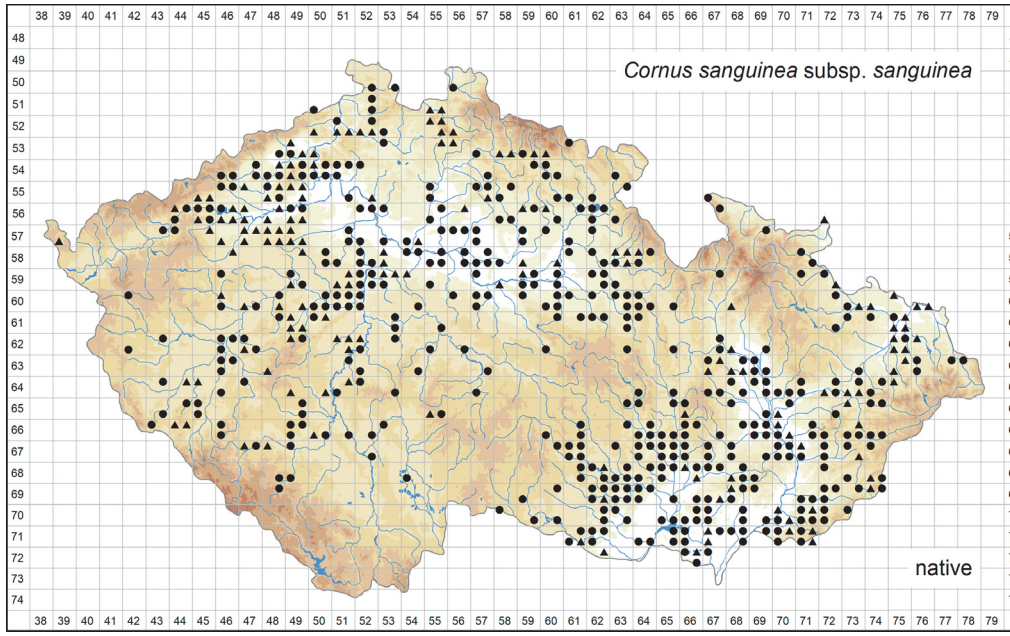


Fig. 31. – Distribution of *Cornus sanguinea* subsp. *sanguinea* in the Czech Republic: ● occurrence documented by herbarium specimens (432 quadrants), ▲ occurrence based on other records (161 quadrants). Prepared by Boleslav Jelínek.

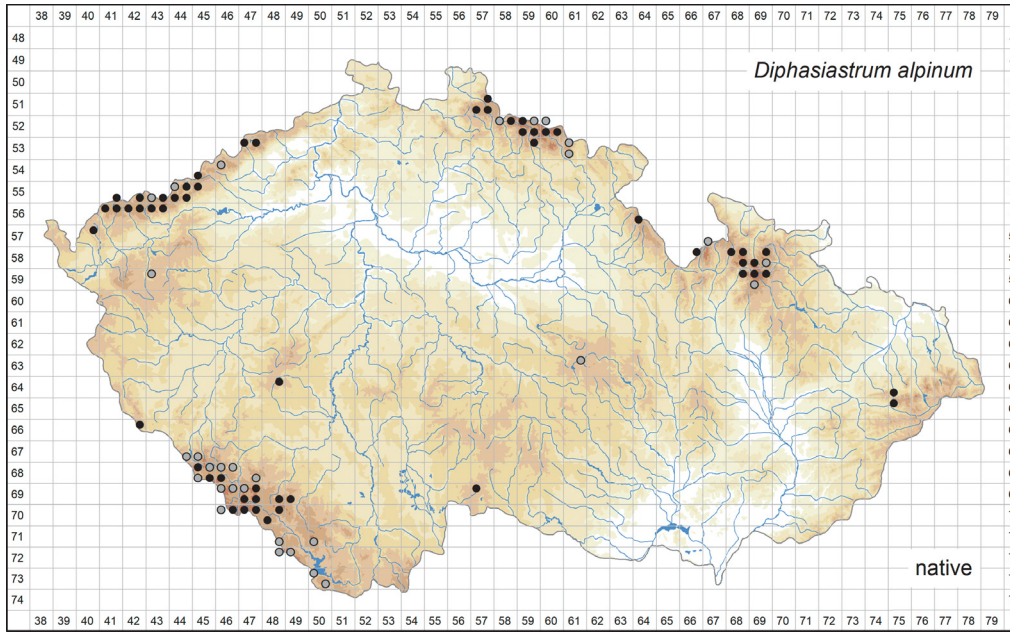


Fig. 32. – Distribution of *Diphasiastrum alpinum* in the Czech Republic: ● at least one record in 2000–2019 (55 quadrants), ● pre 2000 records only (30 quadrants). Prepared by Libor Ekrt.

range coincides with that of *C. sanguinea* subsp. *australis*. In Bohemia it is locally common only in the České středohoří Mts and in the Český kras karst area. *Cornus sanguinea* subsp. *australis* and *C. s.* subsp. *hungarica* are classified as of lower risk – data deficient (Grulich 2012), but they do not seem to be endangered at all.

Four maps were prepared for *Cornus sanguinea*. The maps of each subspecies are based on examined herbarium specimens, the present authors' own field records and selected reliable literature and database records and thus are inevitably incomplete. The map of the entire species derives from all the available literature and database records as well as all data accepted for the subspecies.

Diphasiastrum alpinum (Fig. 32)

Diphasiastrum alpinum is an arctic-alpine circumpolar lycopod of the Northern Hemisphere. It occurs in the (sub)arctic regions of northern Europe, Iceland, in the mountains of central and south-eastern Europe, the Caucasus Mts, western and central Siberia, the Russian Far East, Japan, the northern parts of North America and Greenland (Hultén & Fries 1986). In the Czech Republic *D. alpinum* prefers acidic soils poor in nutrients. It occurs in alpine meadows, rocky slopes and screes, *Nardus* grasslands, heathlands, mountain pastures, disturbed sites along forest roads, ski slopes, and glades and margins of spruce forests. In this country, *D. alpinum* is distributed mainly in the Šumava Mts, Krušné hory Mts, Krkonoše Mts and Hrubý Jeseník Mts. Rarely and probably temporarily it occurs also at middle elevations in the Orlické hory Mts, Mt Králický Sněžník, the Moravskoslezské Beskydy Mts, Českomoravská vrchovina highlands, Brdy hills, Slavkovský les hills and Český les hills. Populations found on the mountains above timberline are stable and not threatened. In contrast, it is under threat of strong competitors (grasses and trees) at sites below timberline, due to the absence of periodic disturbance. It is classified as endangered in this country (Grulich 2012).

Diphasiastrum complanatum agg. (Fig. 33)

The taxonomically critical *Diphasiastrum complanatum* agg. includes all central-European *Diphasiastrum* taxa except the morphologically distinct *D. alpinum* (Danihelka et al. 2012). In general, the central-European genus *Diphasiastrum* comprises three diploid species, namely *D. alpinum*, *D. complanatum* and *D. tristachyum*, and their diploid hybrids *D.* ×*issleri*, *D.* ×*oellgaardii*, *D.* ×*zeilleri*, previously considered as separate species. The hybrids are capable of at least partial spontaneous reproduction, may occur independently of the parental species (Bennert 1999) and are even able to form triploid hybrids with them (Bennert et al. 2011). The previously supposed introgressive hybridization within the species and hybrids (Aagaard et al. 2009, Hanušová et al. 2014) was not confirmed recently (Schnittler et al. 2019). Because *D. complanatum*, *D. tristachyum* and the three hybrids with their involvement are morphologically not sharply separated, their identification is often difficult (Hanušová et al. 2014). Despite the fact that all these taxa are homoploid, the genome size can be used for identification (Bennert et al. 2011); however, there are also overlaps in this character (Hanušová et al. 2014). In the Czech Republic members of the *D. complanatum* agg. usually grow on acidic soils poor in nutrients in open-canopy coniferous forests, alpine meadows, stony screes, *Nardus* grasslands, ski slopes and margins of forest roads. The co-occurrence of all (or at least the majority) of

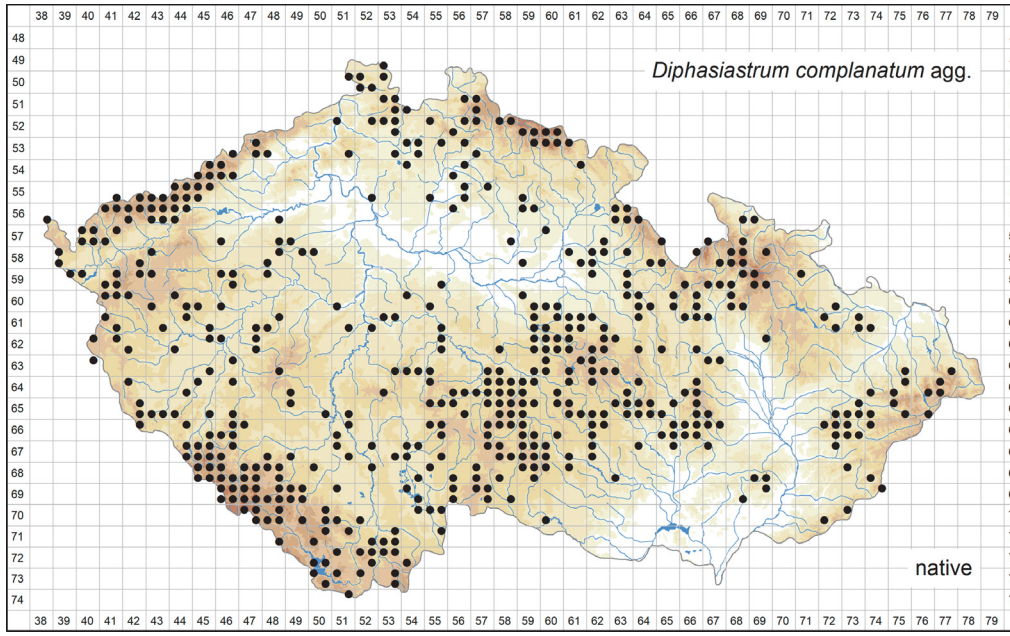


Fig. 33. – Distribution of *Diphasiastrum complanatum* agg. in the Czech Republic (523 occupied quadrants). Prepared by Libor Ekrt.

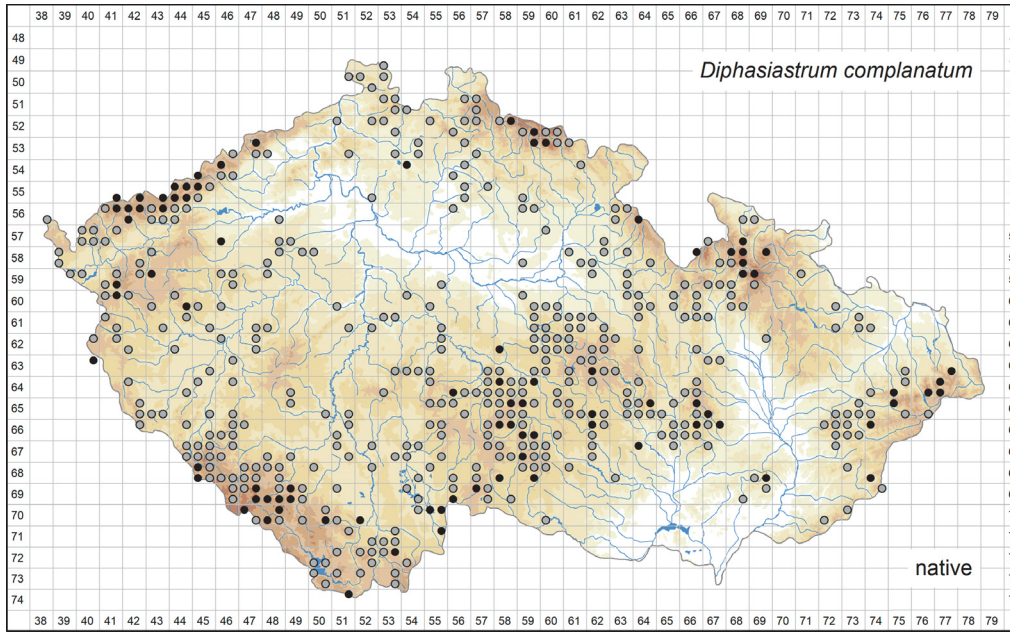


Fig. 34. – Distribution of *Diphasiastrum complanatum* in the Czech Republic: ● at least one record in 2000–2019 (87 quadrants), ◍ pre 2000 records only (406 quadrants). Prepared by Libor Ekrt.

Diphasiastrum species may be most frequently observed in regularly disturbed sites, e.g. on ski slopes and similar places (Hanušová et al. 2014). At those sites, a high proportion of hybrids is usually encountered. The members of the *D. complanatum* agg. occur scattered in the mountains and rarely at middle elevations throughout this country. They are missing from or very rare in the lowlands. The map of the *D. complanatum* agg. includes records of *D. complanatum*, *D. tristachyum*, as well as all hybrids and records of plants that could not be assigned to a particular taxon. *Diphasiastrum complanatum* is classified as endangered, and *D. tristachyum*, *D.* ×*issleri*, *D.* ×*oellgaardii* and *D.* ×*zeilleri* as critically threatened in this country (Grulich 2012).

Diphasiastrum complanatum (Fig. 34)

Diphasiastrum complanatum has a circumboreal distribution in the Northern Hemisphere. It occurs in central and northern Europe; eastwards it extends in a wide belt to central Siberia, and it is also distributed in eastern Asia, Japan, Canada, the northern USA and southern Greenland (Dostál 1984). The plants mapped as *D. complanatum* (sensu lato) in the Southern Hemisphere (Meusel et al. 1965, Hultén & Fries 1986) probably belong to a similar species (Dostál 1984). In the Czech Republic *D. complanatum* usually grows on acidic soils poor in nutrients in open-canopy coniferous forests, rarely in alpine meadows, on screes, in *Nardus* grasslands, on ski slopes and in margins of forest roads. It used to be scattered in the mountains and rare at middle elevations throughout this country. Nowadays it is still extant in the Šumava Mts, Krušné hory Mts, Krkonoše Mts, Hrubý Jeseník Mts and Moravskoslezské Beskydy Mts but it has disappeared from the majority of its former sites at middle elevations except for the foothills of the Šumava Mts, Třeboňská pánev basin, Českomoravská vrchovina highlands and Drahanská vrchovina highlands. This species is extremely rare in or absent from the lowlands. Its decline is probably caused by recent forestry practices (such as drainage and intensive management) and landscape eutrophication. The species is classified as endangered (Grulich 2012).

Diphasiastrum tristachyum (Fig. 35)

Diphasiastrum tristachyum is a member of the *D. complanatum* agg. It exhibits a widely patchy distribution across an area extending from northern Italy and central France to southern Scandinavia, Finland and Baltic states in the north, while also being found in the Eastern and Southern Carpathians in Romania as well as in the Caucasus Mts. The other major part of its geographical range includes eastern and north-eastern North America (Hultén & Fries 1986). In the Czech Republic *D. tristachyum* inhabits open-canopy pine and spruce forest, forest margins, alpine meadows, heathlands, *Nardus* grasslands, forest road margins and ski slopes. It prefers disturbed sites on acidic soils poor in nutrients. It occurs rarely in the Šumava Mts, Český les hills, Krkonoše Mts, Orlické hory Mts, Králický Sněžník Mts and the Hrubý Jeseníky Mts, and very rarely and temporarily in the Krušné hory Mts, foothills of the Šumava Mts, Českomoravská vrchovina highlands and Brdy hills. *Diphasiastrum tristachyum* has disappeared from many sites due to landscape eutrophication and subsequent successional changes. It is therefore classified as critically threatened in this country (Grulich 2012).

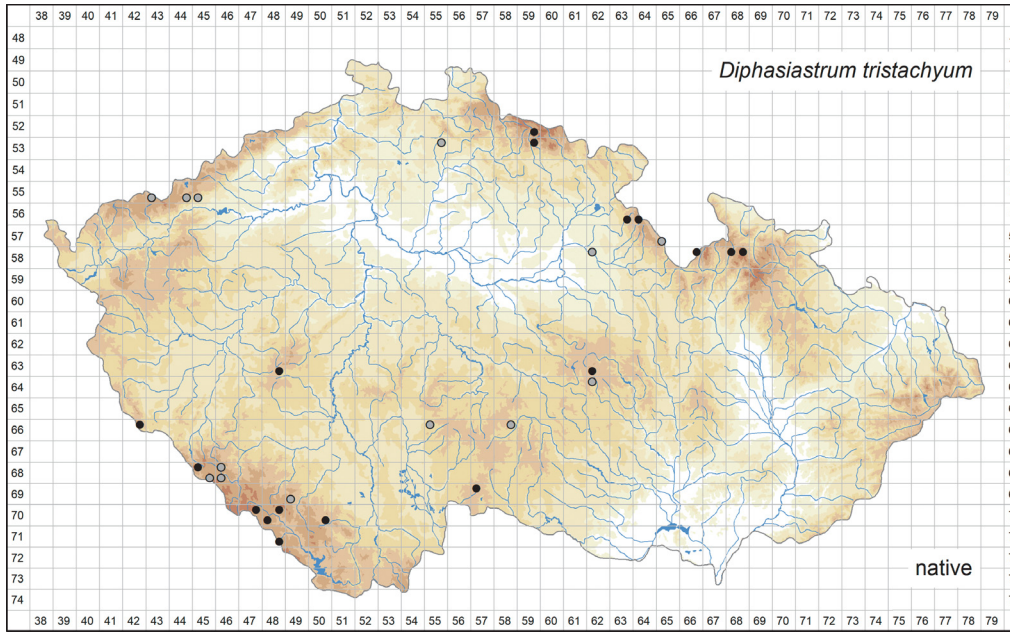


Fig. 35. – Distribution of *Diphasiastrum tristachyum* in the Czech Republic: ● at least one record in 2000–2019 (17 quadrants), ● pre 2000 records only and/or extirpated occurrences (13 quadrants). Prepared by Libor Ekrt.

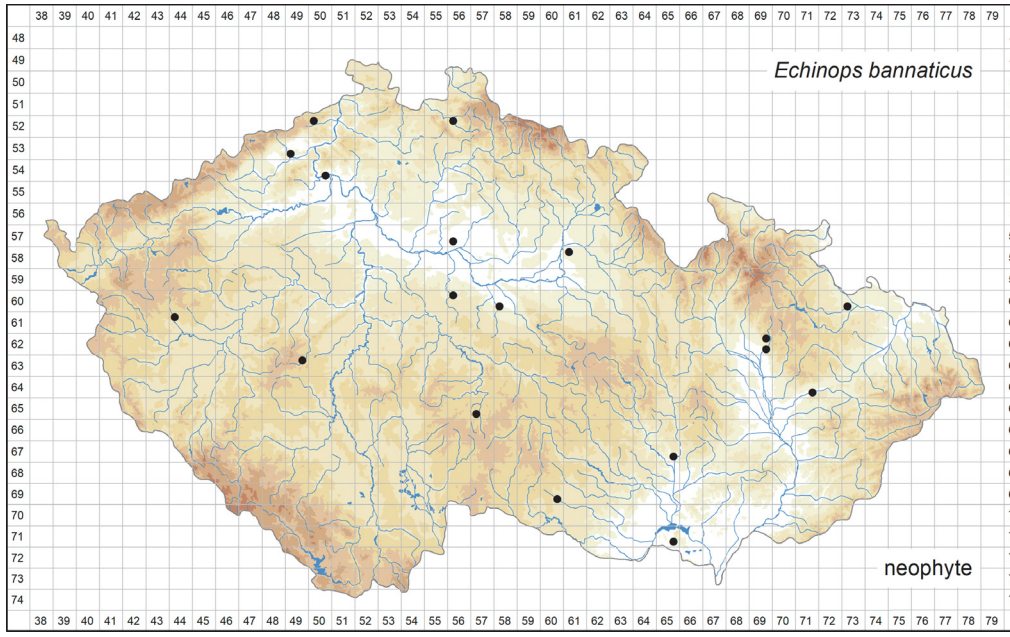


Fig. 36. – Distribution of *Echinops bannaticus* in the Czech Republic (18 occupied quadrants). Prepared by Petr Koutecký.

Echinops bannaticus (Fig. 36)

Echinops bannaticus is native to the Balkan Peninsula (Kožuharov 1976, Greuter 2006); records from Crimea (e.g. Kožuharov 1976) seem to belong to another species, *E. armatus* (e.g. Cherneva 1994). In Europe *E. bannaticus* is cultivated as an ornamental plant (sometimes under the name *E. ritro*; Jäger et al. 2007) and escapes from cultivation. It is recognized as an alien species in several European countries (GCW 2019); in some of them it is classified as naturalized, e.g. in Germany (FloraWeb 2019) or Great Britain, where it is the most frequent species of the genus (Stace 2010). The species has never been reported from the Czech Republic except for cultivation. However, the current revision of the herbarium material revealed that it is occasionally escaping, similarly as in neighbouring Germany (Jäger et al. 2011, FloraWeb 2019) and Austria (Fischer et al. 2008), and has been overlooked and mistaken for other *Echinops* species (the earliest specimens in the Czech Republic having been collected already in late 19th century). In this country *E. bannaticus* is a neophyte that has been found mainly along roads and at dry, sunny, semi-natural sites (e.g. grassy slopes and forest fringes) close to human settlements. The map is based solely on examined herbarium specimens.

Echinops exaltatus (Fig. 37)

Echinops exaltatus is native to western Ukraine, Moldova, Romania and the northern and central parts of the Balkan Peninsula, westwards reaching easternmost Italy (Kožuharov 1976, Meusel & Jäger 1992). As an alien species it occurs in many other European countries and rarely also in North America (USDA, NRCS 2019); however, the exact distribution is poorly known due to numerous misidentifications. In the Czech Republic it is classified as a naturalized neophyte (Pyšek et al. 2012). It has been recorded at about 20–30 sites scattered all over the country, sometimes next to places of its cultivation (used as an ornamental plant and nectar source for honeybees). It is usually found in forest fringes, scrub, disturbed grassy slopes, and along garden fences and walls. The map is based on examined herbarium specimens and a few reliable literature records.

Echinops ritro subsp. *ruthenicus* (Fig. 37)

The distribution of *Echinops ritro* extends from eastern Spain through the Mediterranean parts of France and Italy, the Balkan Peninsula, Hungary, Romania, southern Ukraine and southern Russia to Kazakhstan and northernmost China; in the south it reaches Turkey and Armenia. In central Europe isolated northernmost occurrences are in Austria, Slovakia and possibly also the Czech Republic (Meusel & Jäger 1992, Greuter 2006). This species is also reported as introduced into several European countries and the USA (USDA, NRCS 2019). However, the records of introduced plants need revision due to a high number of misidentifications; notably *E. bannaticus* is sometimes cultivated under the name *E. ritro* (Jäger et al. 2007). *Echinops ritro* is taxonomically heterogenous, comprising several subspecies whose validity needs re-evaluation. The central-European plants are traditionally classified as *E. ritro* subsp. *ruthenicus*, which occupies the eastern part of the species' distribution eastwards from Italy (Kožuharov 1976). In the Czech Republic this species was allegedly collected by Johann Hruby as early as 1922 in the Pavlovské vrchy hills in southernmost Moravia, and the specimens are now stored in two

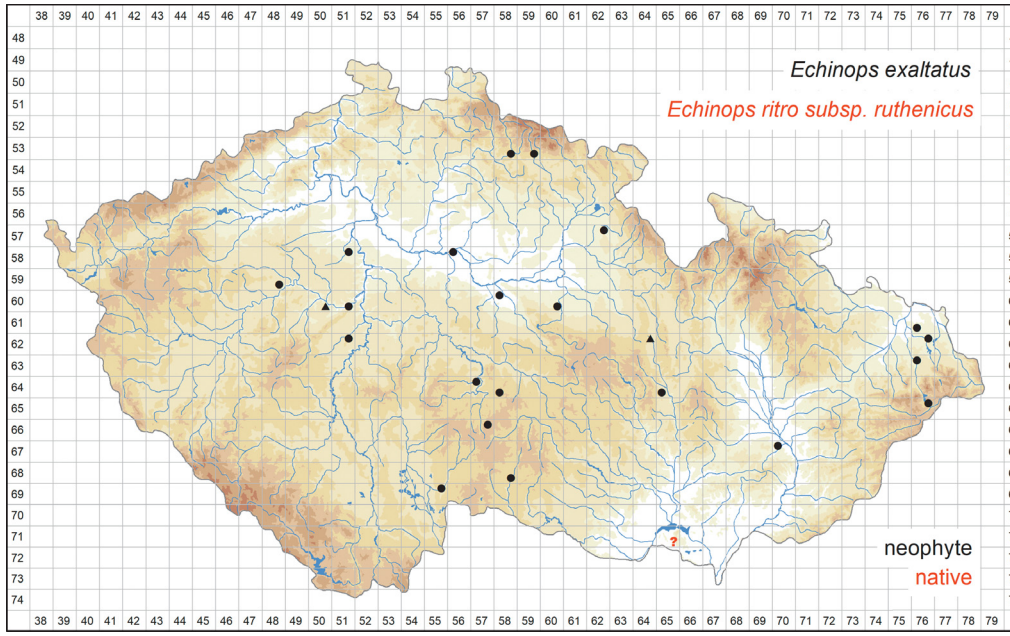


Fig. 37. – Distribution of *Echinops exaltatus* (● occurrence documented by herbarium specimens: 21 quadrants, ▲ occurrence based on other records: 2 quadrants) and *E. ritro* subsp. *ruthenicus* (1 doubtful record only) in the Czech Republic. Prepared by Petr Koutecký.

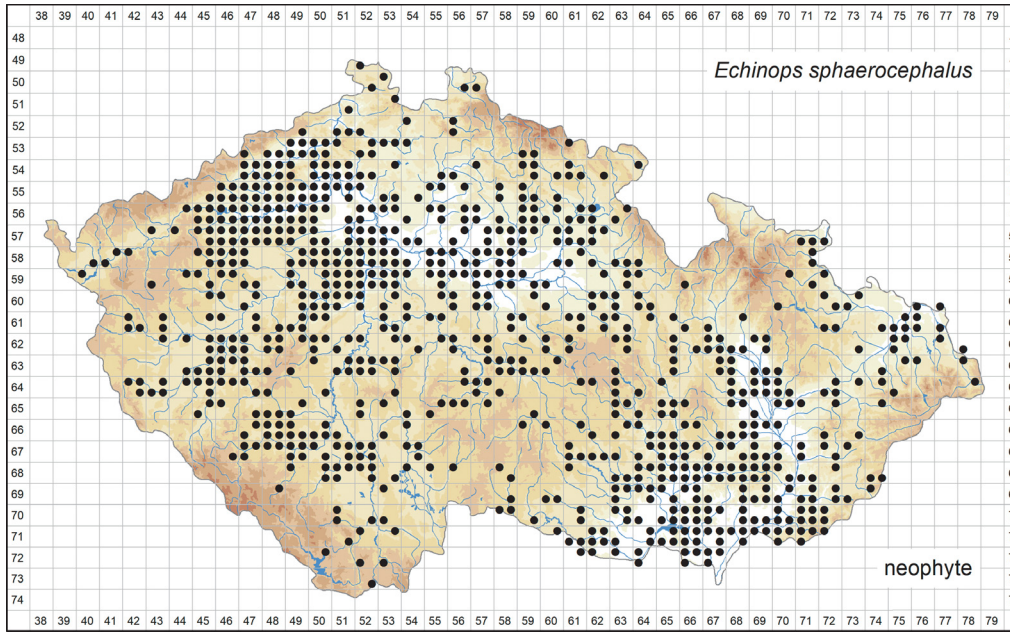


Fig. 38. – Distribution of *Echinops sphaerocephalus* in the Czech Republic (842 occupied quadrants). Prepared by Petr Koutecký.

different herbaria (BRNM, PRC). However, the locality information is rather general ("Pollauer Berge"), and the find was first reported decades later by Hendrych (1987a). This occurrence is considered native in the recent Czech botanical literature. An occurrence of this species on the limestone outcrops of the Pavlovské vrchy hills is possible, as there are suitable habitats, the site is not far (ca 80 km) from the nearest localities in Slovakia and Austria, and many other species of sub-Mediterranean distribution occur there. On the other hand, J. Hruby was an experienced botanist, so it seems improbable that he would have not ever reported this find. In the Pladias database there is no other collecting by Hruby reported from 1922 from this area, although it hosts a lot of attractive and frequently collected species. In addition, this area is quite small and has been well-explored since the beginning of botanical research, so overlooking this species by all other collectors is rather unlikely. Therefore, we consider this solitary record from this country and consequently this species' native status doubtful.

Echinops sphaerocephalus (Fig. 38)

Echinops sphaerocephalus is native to southern Europe except most of the Iberian Peninsula, reaching northern Anatolia, the Caucasus, Kazakhstan and southern Siberia, and occurring as far east as the foothills of the Dzungarian Alatau and Altai Mts (Meusel & Jäger 1992). It has been introduced into many countries of central and eastern Europe (the northern limit of the native distribution being not clear), southern Scandinavia, and also North America and Australia (GCW 2019). Two endemic subspecies are recognized in the Mediterranean area, while in the most of the species' distribution including its introduced range only the type subspecies is present. In the Czech Republic *E. sphaerocephalus* has been cultivated as an ornamental plant and source of nectar for honeybees; it has spread since the beginning of the 19th century and is classified as an invasive neophyte (Pyšek et al. 2012). In this country it occurs along roads, railways, walls and fences, and in various disturbed sunny, dry to moderately wet places such as grassy slopes, abandoned meadows and fields, quarries and forest fringes. It is frequent in the warm lowlands and scattered at middle elevations in this country, only rarely exceeding 600 m a.s.l.

Galeopsis angustifolia (Fig. 39)

Galeopsis angustifolia is one of two members of the *G. ladanum* agg. in the flora of the Czech Republic. The two species may be distinguished rather easily, but in poorly collected specimens the calyx indumentum has to be examined (Gregor 2009). *Galeopsis angustifolia* is a European species occurring from the mountains of the Iberian Peninsula in the west as far as the Pannonian basin in the east and from Great Britain in the north as far as southern Italy and the north of the Balkan Peninsula in the south, with some outposts in the Eastern Carpathians. There are records of introduced plants from several countries of northern Europe (Meusel et al. 1978, Hultén & Fries 1986). In the Czech Republic the native habitat of *G. angustifolia* is mainly calcareous screes. Rather frequently it is found also in quarries, on railway embankments and at railway stations, as well as in various types of dry grasslands, xeric scrub communities, thermophilous oak forests and as a weed in arable fields. The soils are usually dry, base- or calcium-rich but poor in nutrients. *Galeopsis angustifolia* occurs in warm and moderately warm areas from the lowlands to middle elevations, most frequently in hilly areas. It is widespread

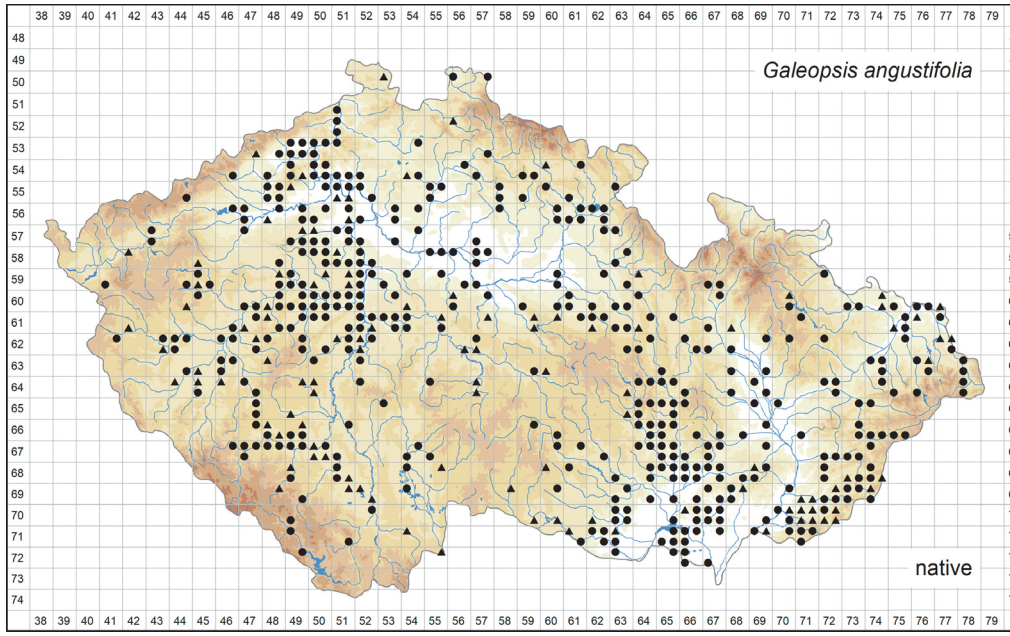


Fig. 39. – Distribution of *Galeopsis angustifolia* in the Czech Republic: ● occurrence documented by herbarium specimens (419 quadrants), ▲ occurrence based on other records (108 quadrants). Prepared by Jiří Danihelka & Petra Štěpánková.

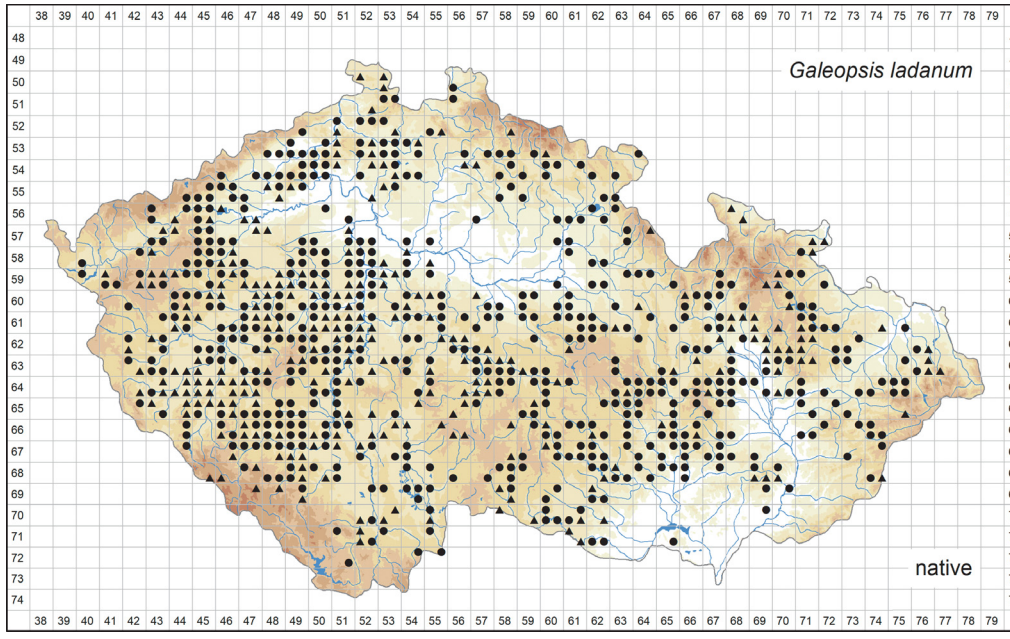


Fig. 40. – Distribution of *Galeopsis ladanum* in the Czech Republic: ● occurrence documented by herbarium specimens (551 quadrants), ▲ occurrence based on other records (271 quadrants). Prepared by Jiří Danihelka & Petra Štěpánková.

but generally scattered in this country, being locally common only in the areas with outcrops of calcareous bedrocks, including limestone, argillite and loess. However, it is completely absent from the mountains and areas formed by acidic bedrocks apart from (temporal) occurrences in secondary habitats. Most of the records are from elevations below 600 m but there are records of casual introductions from elevations over 700 m, both from the railways in the Šumava Mts. While the species is still spreading along the railways and while the populations on screes of base-rich rocks and in other seminatural habitats are more or less stable, there has been some decline on arable land. *Galeopsis angustifolia* is classified as vulnerable (Grulich 2012). As the species is frequently confused with *G. ladanum*, some of the undocumented records, mainly those from man-made habitats, may be erroneous.

Galeopsis ladanum (Fig. 40)

In the Czech flora, *Galeopsis ladanum* is the only member of the *G. ladanum* agg. other than *G. angustifolia*. It is a Eurasian species distributed in the temperate zone from the Pyrenees in the west as far Lake Baikal in the east; discontinuously it occurs in Great Britain, northern Europe and the Caucasus Mts. It has been introduced into North America (Hultén & Fries 1986). In the Czech Republic *G. ladanum* occurs on siliceous rock cliffs and block fields, at middle elevations also on limestone cliffs, in dry grasslands on rock outcrops, as a weed on arable fields with potatoes or cereals, and less frequently on heathlands, and in scrub communities and various types of oak forests. Soils are moderately supplied with water, neither wet nor too dry, moderately acidic and moderately rich in nutrients. *Galeopsis ladanum* is widespread from the lowlands to middle elevations, occurring with varying frequency. It is rare in or almost absent from large lowland parts of central and eastern Bohemia and central and southern Moravia, as well as from large parts of the Krušné hory Mts, Šumava Mts, Českomoravská vrchovina highlands, Krkonoše Mts, Hrubý Jeseník Mts and Moravskoslezské Beskydy Mts, generally from areas with acidic bedrocks or with a small proportion of arable land. However, even in these areas *G. ladanum* is sometimes found as accidentally introduced on arable land. Most of the records are from elevations below 600 m but in southern Bohemia this species was recorded at elevations 800–845 m. This species declined mainly on arable land due to intensive farming, but also with other occurrences vanishing due to the abandonment of low-productivity arable land. It is nowadays classified as of lower risk – near threatened (Grulich 2012). Some of the undocumented records incorporated into the map may actually refer to *G. angustifolia* due to frequent confusion (cf. Gregor 2009).

Galeopsis segetum (Fig. 41)

Galeopsis segetum is a western European species distributed from the northern Pyrenees in the west as far as northern Germany in the north-east, with isolated occurrences in England and Denmark. Introduced plants have been recorded, for instance, in the Czech Republic, Slovakia and probably also in Hungary (Meusel et al. 1978). In its native range this calcifuge species occurs mainly on gravel bars and low-intensity managed arable land on sandy or stony soils. *Galeopsis segetum* has been used in folk medicine for centuries, nowadays also in formal medical practice, and occasionally cultivated. In the Czech Republic this species has been recorded several times outside cultivation, for the first

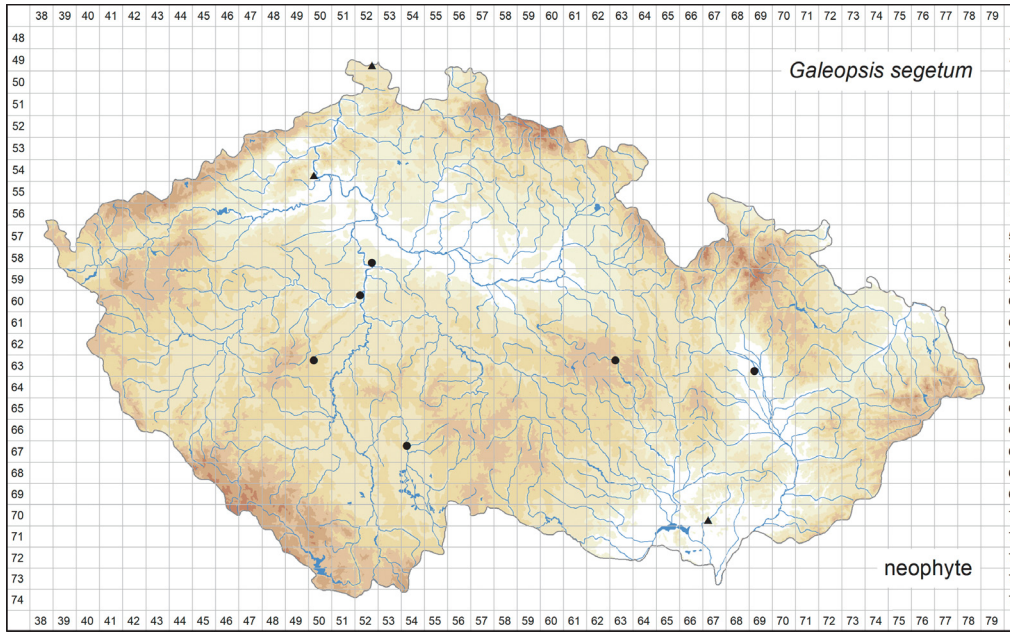


Fig. 41. – Distribution of *Galeopsis segetum* in the Czech Republic: ● occurrence documented by herbarium specimens (6 quadrants), ▲ occurrence based on other records (3 quadrants). Prepared by Jiří Danihelka & Petra Štěpánková.

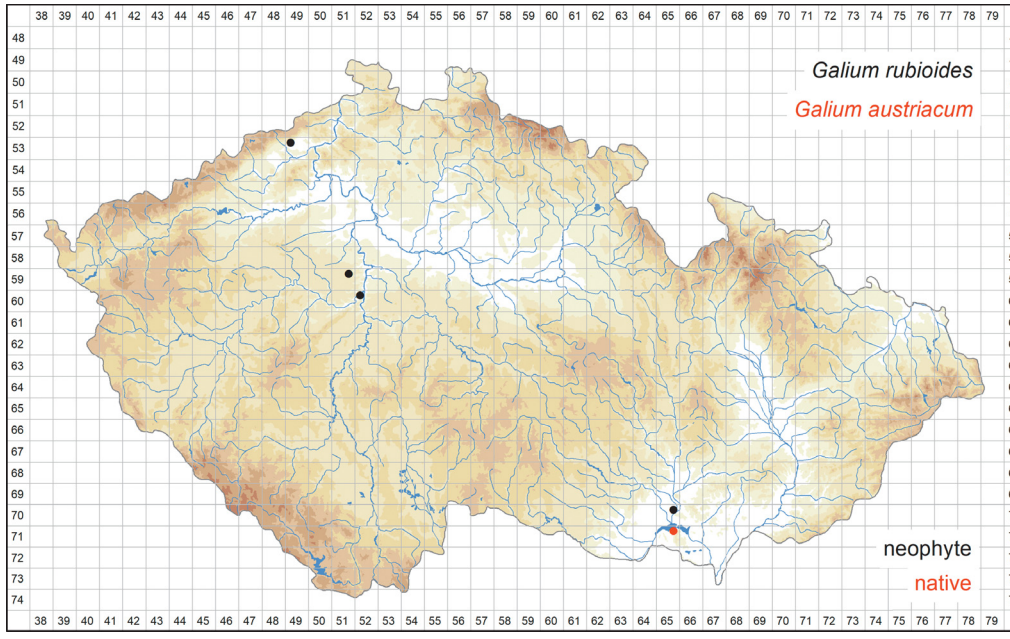


Fig. 42. – Distribution of *Galium austriacum* (1 occupied quadrant) and *G. rubioides* (4 occupied quadrants) in the Czech Republic. Prepared by Jitka Štěpánková.

time in Prague's periphery in 1835, while the latest record dates to 1995. About half the records refer to accidentally introduced plants, while the other half regard plants that escaped from cultivation. To our knowledge, there is no extant population in this country, and *G. segetum* is therefore classified as a casual neophyte (Pyšek et al. 2012).

Galium austriacum (Fig. 42)

Galium austriacum is a member of the highly polymorphic polyploid complex of *G. pumilum* agg. *Galium austriacum* encompasses two cytotypes, a diploid and a tetraploid, confined to a small area in central Europe. It occurs in Austria, the Czech Republic, Slovakia, Hungary and northern Slovenia (Ehrendorfer 1949, Šípošová 1987, Krendl 1993, Krahulcová & Štěpánková 1998). It grows on dry, well-drained sites, often over limestone or other calcium-rich bedrock and on serpentine outcrops. While diploids are known to grow only on non-serpentine sites, tetraploids occur both on non-serpentine and serpentine sites. On serpentine they prefer soil with a higher content of calcium, tolerating surprisingly high concentrations of nickel (Krahulcová & Štěpánková 1998). In the Czech Republic the occurrence of *G. austriacum* was published for the first time in 1998 (Krahulcová & Štěpánková 1998), and only the tetraploid cytotype has been found. It grows in a small area in the Pavlovské vrchy hills in southern Moravia, on calcareous rocks of Děvín hill. This locality is at the north-western limit of the species' distribution. *Galium austriacum* is classified as critically threatened (Grulich 2012).

Galium glaucum (Fig. 43)

Galium glaucum is a temperate European species, mainly distributed in central and south-eastern Europe. It is scattered from south-eastern France, Germany and the Czech Republic northwards to southern Poland, southwards to northern Italy and Bulgaria, eastwards through Slovakia and Hungary to Romania and Moldova. Remote occurrences have been reported from Portugal, Spain and Crimea (Meusel & Jäger 1992, Marhold 2011). It grows on dry soils poor to moderately rich in nutrients developed on base-rich bedrock (limestone, basalt and serpentine outcrops or loess), less often on acidic bedrock. In the Czech Republic *G. glaucum* is found in relatively warm and dry parts of northern and central Bohemia and central and southern Moravia, namely on volcanic hills, along deep river valleys with rock outcrops and steep, south-facing slopes. There are many remote occurrences in hilly areas, for example on calcareous cliffs in eastern Bohemia and in areas with limestone and serpentine outcrops in southern Bohemia, where it reaches its elevational maximum at about 600 m. *Galium glaucum* is classified as of lower risk – near threatened in this country (Grulich 2012).

Galium odoratum (Fig. 44)

Galium odoratum is mainly distributed in the temperate zone in Europe, extending eastwards through Anatolia to the Caucasus Mts. Two small outposts are found in southern Siberia and eastern Asia. It has also been introduced into North America (USDA, NRCS 2019). In Europe it extends from Ireland northwards to southern Scandinavia, southwards to the Pyrenees, southern France, Italy and the northern part of the Balkan Peninsula, eastwards to the central part of European Russia (Hultén & Fries 1986, Meusel

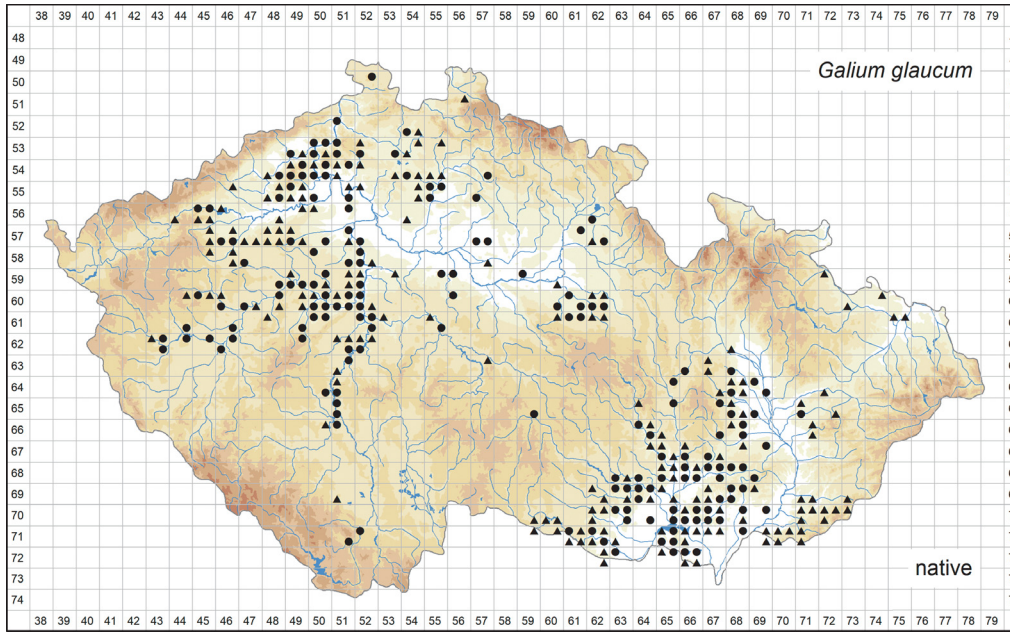


Fig. 43. – Distribution of *Galium glaucum* in the Czech Republic: ● occurrence documented by herbarium specimens (170 quadrants), ▲ occurrence based on other records (178 quadrants). Prepared by Jitka Štěpánková.

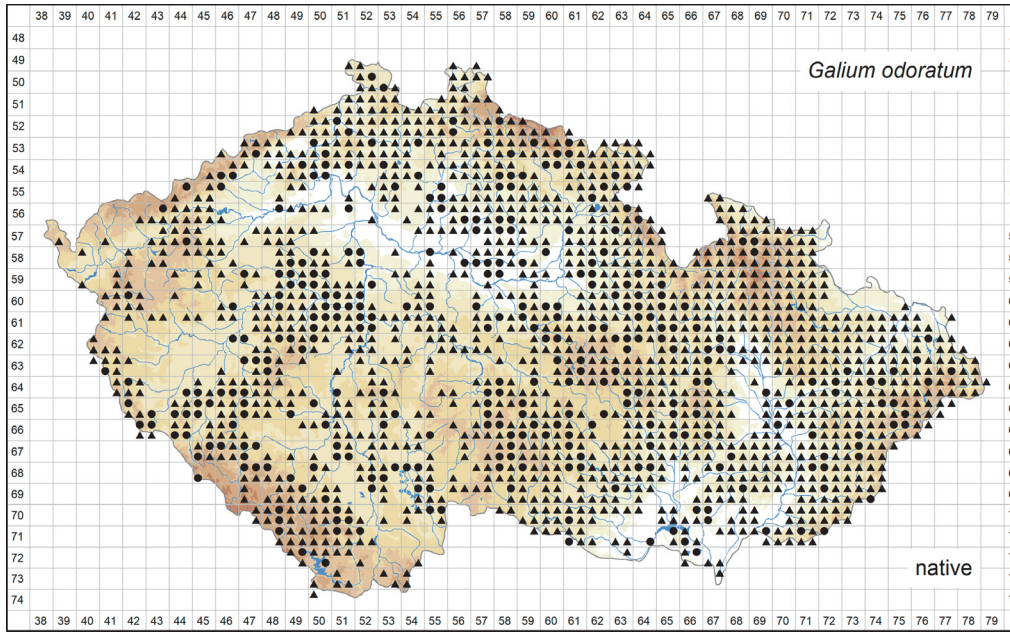


Fig. 44. – Distribution of *Galium odoratum* in the Czech Republic: ● occurrence documented by herbarium specimens (323 quadrants), ▲ occurrence based on other records (1353 quadrants). Prepared by Jitka Štěpánková.

& Jäger 1992). The European populations are tetraploid, while diploids are recorded from eastern Asia (Ehrendorfer & Schönbeck-Temesy 2005). In the Czech Republic *G. odoratum* occurs across a broad range of soil conditions from moderately acidic to calcareous and from moderately dry to humid, preferring soils rich in nutrients. It grows in various types of broad-leaved deciduous forests, less often in moderately wet coniferous forests and subalpine tall-forb vegetation. It also inhabits secondary habitats such as forest clearings or nitrophilous edge of forests. In the Czech Republic it is widespread but with varying frequencies. It is frequent in forested areas from the lowlands to the mountains, whereas it is rare in or absent from the warm, largely deforested lowlands with prevailing arable lands of western, central and eastern Bohemia, and central and southern Moravia. Above the timberline in the Krkonoše and Hrubý Jeseník Mts it is found in glacial cirques, where it reaches its elevational maxima at 1350–1450 m.

Galium rivale (Fig. 45)

Galium rivale s. str. belongs to the polymorphic and still poorly understood polyploid complex of *G. rivale* agg. In former treatments (e.g. Ehrendorfer & Krendl 1976, Ehrendorfer & Schönbeck-Temesy 1982) *G. rivale* was circumscribed in a broad sense. We follow the concept of a narrow species as used by Ehrendorfer & Schönbeck-Temesy (2005) and Pobedimova (1958). The distribution of *Galium rivale* extends from Austria and the Czech Republic northwards to Estonia, eastwards through European Russia as far as the Tobol river basin in western Siberia, southwards to the Balkan Peninsula and Anatolia. The closely related *G. pseudorivale* occurs in south-eastern and eastern Europe, Anatolia, Transcaucasia and central Asia (Pobedimova 1958, Ehrendorfer & Schönbeck-Temesy 2005). *Galium rivale* grows on nutrient-rich soils on the banks of rivers, in fringes of floodplain forests and scrub, and on the shores of fishponds, oxbows and wet depressions in floodplain meadows. It is found also in secondary habitats such as wet waste places, abandoned wet meadows, forest clearings in river floodplains, road ditches and other ruderal wet sites in human settlements. In the Czech Republic it occurs from the lowlands to the mountains in the eastern part of the country (Moravia and Silesia), particularly in the floodplains of the Morava and Dyje rivers, as well as along small rivers at rather high elevations in Silesia and eastern Moravia, reaching its elevational maximum at 1100 m in the Hrubý Jeseník Mts. There are also records in old literature of occurrences from Prague, undoubtedly referring to introduced plants. Localities of *G. rivale* in the western half of Moravia are situated at the western limit of the species' distribution. It is classified as of lower risk – near threatened (Grulich 2012).

Galium rotundifolium (Fig. 46)

Galium rotundifolium is widely distributed in forested areas of central, eastern and south-eastern Europe. In south-western Asia there are remote occurrences in the mountains along the southern and south-eastern coast of the Black Sea. In Europe this species extends from France and Germany northwards to southern Sweden, southwards to Italy and the northern Balkan Peninsula. Isolated localities are reported from southern France, the Iberian Peninsula, Morocco and Algeria (Meusel & Jäger 1992, Marhold 2011). In the Czech Republic *G. rotundifolium* grows in various types of broad-leaved deciduous forests, namely in oak-hornbeam forests, beech forests, acidophilous oak forests and

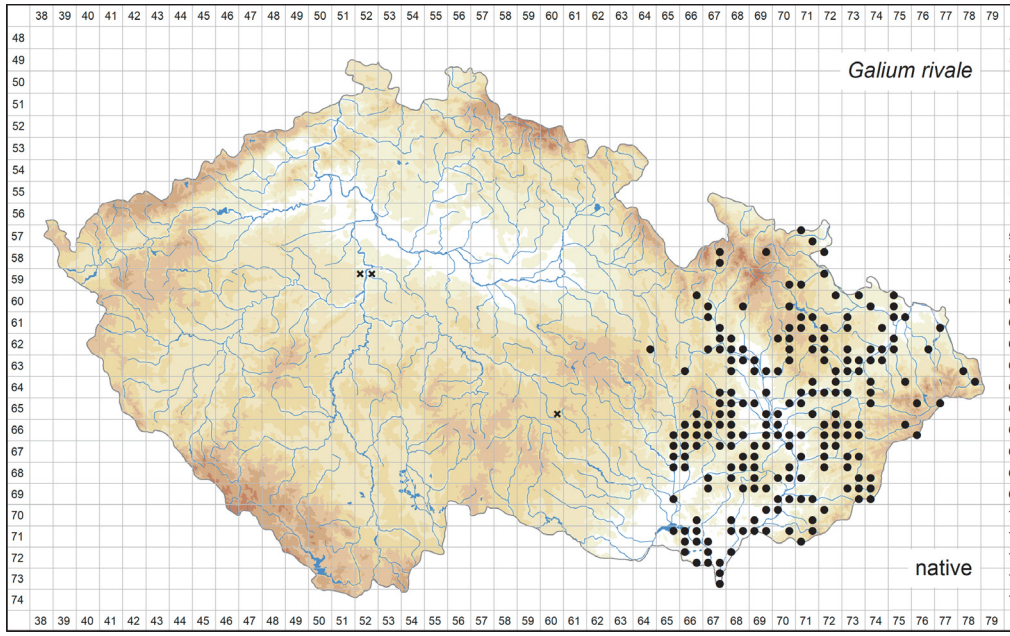


Fig. 45. – Distribution of *Galium rivale* in the Czech Republic: ● native (202 quadrants), × alien (3 quadrants). Prepared by Jitka Štěpánková.

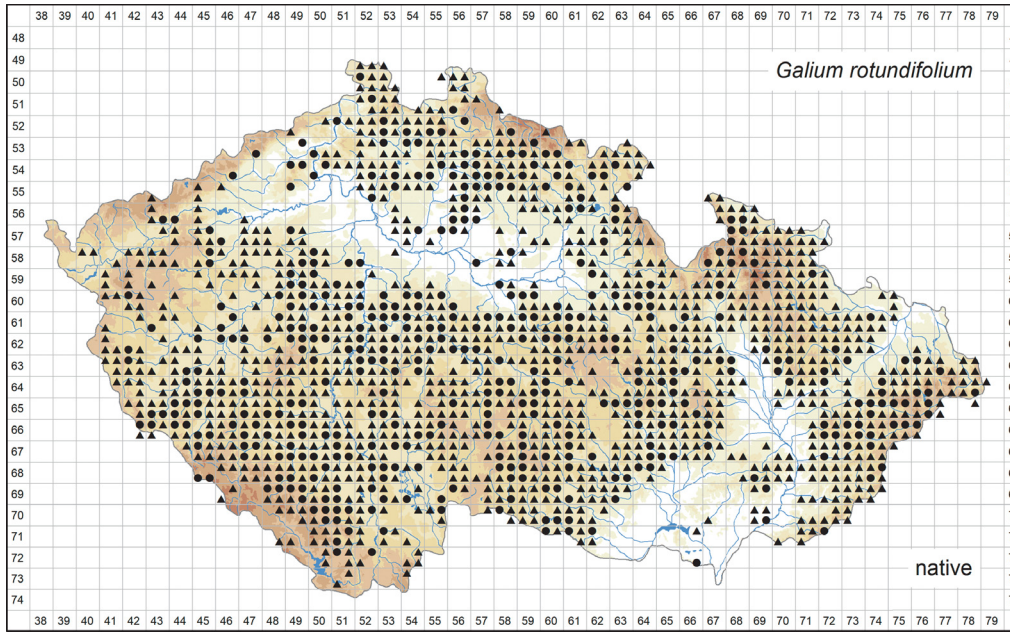


Fig. 46. – Distribution of *Galium rotundifolium* in the Czech Republic: ● occurrence documented by herbarium specimens (432 quadrants), ▲ occurrence based on other records (1085 quadrants). Prepared by Jitka Štěpánková.

coniferous forests; less often it inhabits forest clearings. It prefers fresh, moderately humid, moderately acidic to neutral soils, usually moderately supplied with nutrients. In the Czech Republic *G. rotundifolium* is distributed throughout the country but with varying frequency. It is frequent in forested areas at low and middle elevations, whereas it is rare in or absent from high mountains in Bohemia and also from warm, largely deforested lowlands, such as the basin of the Ohře river, central and eastern parts of the Labe river basin, and central and southern Moravia.

Galium rubioides (Fig. 42)

Galium rubioides is a hexaploid member of the highly polymorphic polyploid *G. boreale* complex. It is native to central, eastern and south-eastern Europe, while secondary occurrences are found in Germany and the Baltic countries (Marhold 2011); it is also reported from China (Chen & Ehrendorfer 2011). However, its exact distribution is still unknown due to the lack of a comprehensive revision of this complex and ambiguities in species treatment in regional floras. In its native range it grows on wet or intermittently wet to mesic meadows in large river basins, in open broad-leaved deciduous forests and herbaceous forest fringes. It is usually found on rather deep soils, often over base-rich substrates. In the Czech Republic *G. rubioides* was first mentioned in 1809 (Pohl 1809). The oldest herbarium specimens were collected by I. F. Tausch before 1838 (they are not dated but cited by Berchtold & Opiz 1838). This species has been afterward collected in the Hvězda arboretum in Prague, near the town of Teplice in northern Bohemia (1885) and between the towns of Židlochovice and Hustopeče in southern Moravia (1927). In the Czech flora *G. rubioides* is classified as a casual neophyte (Pyšek et al. 2012).

Galium saxatile (Fig. 47)

Galium saxatile is widespread to scattered in the Atlantic and sub-Atlantic parts of Europe, and rare in or absent from continental south-eastern and eastern regions of Europe. It has been introduced into Québec and California in North America (Hultén & Fries 1986, USDA, NRCS 2019). In Europe its continuous range reaches the southern Scandinavian coast and southern Finland in the north, northern Spain, Portugal and Italy in the south, Ireland in the west and the Czech Republic and Austria in the east. Further eastwards it occurs only sporadically in southern Poland, Lithuania and in the Karelian Isthmus (north-western Russia), and south-eastwards in Romania and Ukraine (Pobedimova 1958, Meusel & Jäger 1992, Marhold 2011). It grows in alpine and subalpine acidophilous grasslands dominated by *Nardus stricta*, and in basiphilous grasslands occurring on steep rocky slopes of glacial cirques, furthermore in subalpine heathlands, *Pinus mugo* scrubs and in natural montane spruce forests. It is also found in montane secondary grasslands or wet pastures, in secondary coniferous forests or spruce-fir-beech forests at middle elevations. It additionally inhabits forest clearings, namely deforested spruce plantation sites and disturbed places along forest roads or drainage ditches. Soil is usually wet to mesic and poor in nutrients. Nowadays in the Czech Republic *G. saxatile* occurs most frequently in all the mountain ranges along the country's border, from which it spreads far into the foothills. However, at the end of the 19th century the species was only reported from the Sudetes mountains in Bohemia (Čelakovský 1873). The earliest record of *G. saxatile* from Moravia dates back to 1944 (Otruba 1945). Since the second

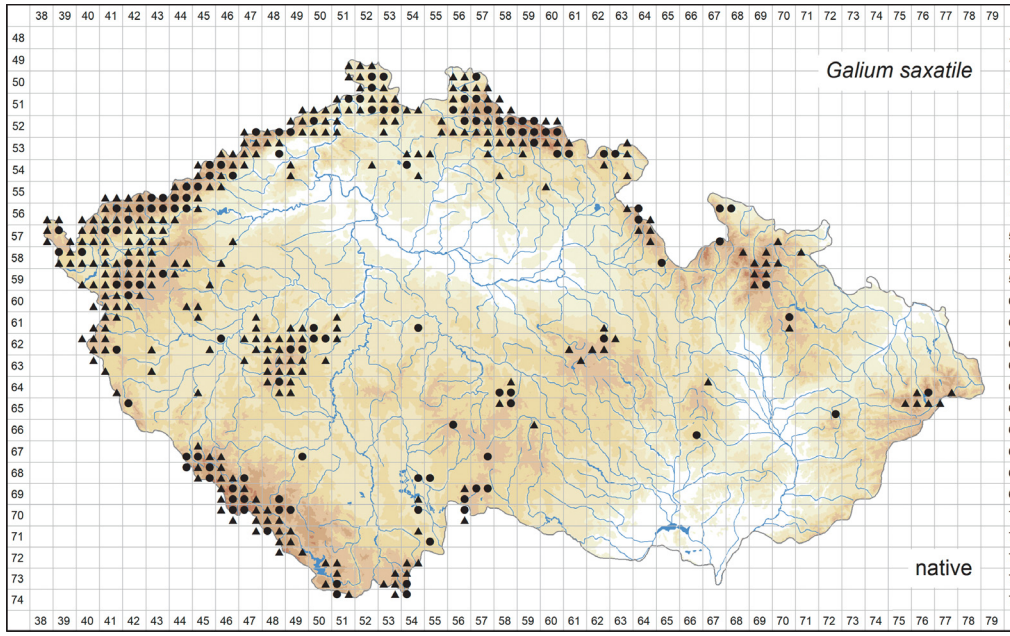


Fig. 47. – Distribution of *Galium saxatile* in the Czech Republic: ● occurrence documented by herbarium specimens (118 quadrants), ▲ occurrence based on other records (285 quadrants). Prepared by Jitka Štěpánková.

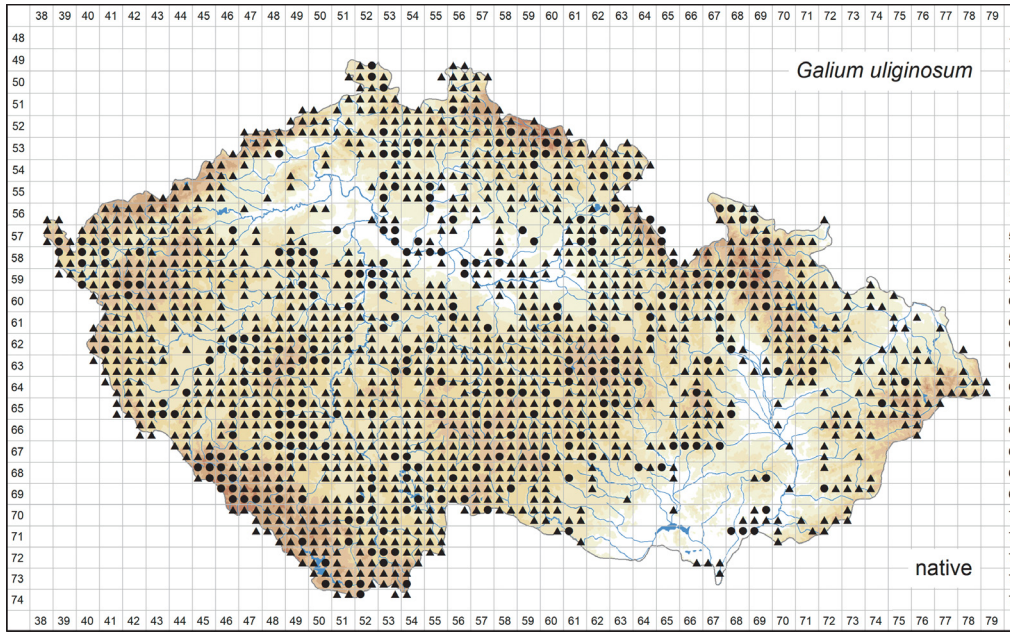


Fig. 48. – Distribution of *Galium uliginosum* in the Czech Republic: ● occurrence documented by herbarium specimens (271 quadrants), ▲ occurrence based on other records (1370 quadrants). Prepared by Jitka Štěpánková.

half of the 20th century the species has spread to other parts of this country, and nowadays it invades forested habitats even in the lowlands, reaching its elevational minimum at about 300 m. It is still rare in Moravia and Silesia, but its frequency of occurrence is also increasing.

Galium uliginosum (Fig. 48)

Galium uliginosum is widespread in temperate and boreal zones in Europe and adjacent parts of western Asia (Meusel & Jäger 1992); it is reported also from Greenland (USDA, NRCS 2019) and China (Chen & Ehrendorfer 2011). Secondary occurrences are known from New Zealand (Howell & Sawyer 2006). In Europe it reaches the Arctic Circle in Scandinavia and Finland in the north, and the Pyrenees, northern Italy and the Balkan Peninsula in the south. Eastwards it extends through the European Russia to western Siberia (Meusel & Jäger 1992). In the Czech Republic *G. uliginosum* is found in various types of wet meadows on moderately acidic to basic soils with a high ground-water level, and usually moderately rich in nutrients. It occurs in fen meadows, fens and bogs, in meadow springs and ditches, around wet depressions, on the shores of fishponds and often on wet pastures. *Galium uliginosum* is widespread in the Czech Republic, being common from the lowlands to the mountains, reaching its elevational maximum at about 1400 m. However, it is scarce or rare in the lowlands with warm and dry climates and with prevalently arable land, i.e. in north-western and central Bohemia and central and southern Moravia.

Huperzia selago (Fig. 49)

Huperzia selago belongs to the taxonomically critical and still not satisfactorily resolved *Huperzia* sect. *Huperzia* (Zhang & Kung 1998, Shalimov et al. 2017). The former distribution maps of *H. selago* (e.g. Meusel et al. 1965, Hultén & Fries 1986) obviously include also records of similar taxa within *H. selago* s. l. *Huperzia selago* s. str. is a polyploid, morphologically polymorphic taxon widely distributed in the Northern Hemisphere. It occurs in Europe except its southernmost and south-eastern parts, being more frequent in northern latitudes and in the mountains (Jalas & Suominen 1972). In Asia it has a disjunct distribution in arctic and boreal western and eastern Siberia, the Caucasus Mts, Central Asia, the Russian Far East (Tzvelev & Czerepanov 1999), southern Himalayas (Shalimov et al. 2017) and north-eastern China (Zhang & Iwatsuki 2013); it also occurs in the north-eastern USA and eastern and central Canada (Wagner & Beitel 1993). It inhabits acidophilous spruce and beech forests, subalpine and alpine meadows, moist rocks, stony screes and *Pinus mugo* scrubs. *Huperzia selago* is most frequent in the mountains and their foothills along this country's border, and scattered in the highlands such as the Slavkovský les hills, Brdy hills and Českomoravská vrchovina highlands. It is scattered also in areas with cold mesoclimates, such as deep and shady gorges in the sandstone areas in north-eastern Bohemia. Elsewhere it is absent or very rare. It is threatened by inappropriate forestry practices, including drainage of moist and bog forests. *Huperzia selago* is classified as vulnerable in this country (Grulich 2012).

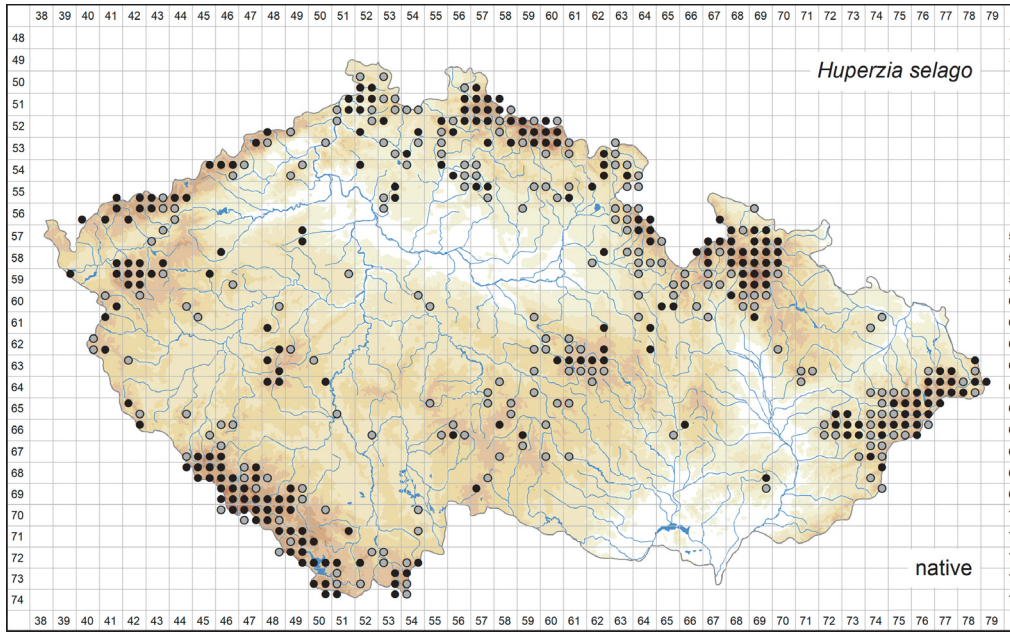


Fig. 49. – Distribution of *Huperzia selago* in the Czech Republic: ● at least one record in 2000–2019 (237 quadrants), ● pre 2000 records only (209 quadrants). Prepared by Libor Ekrt.

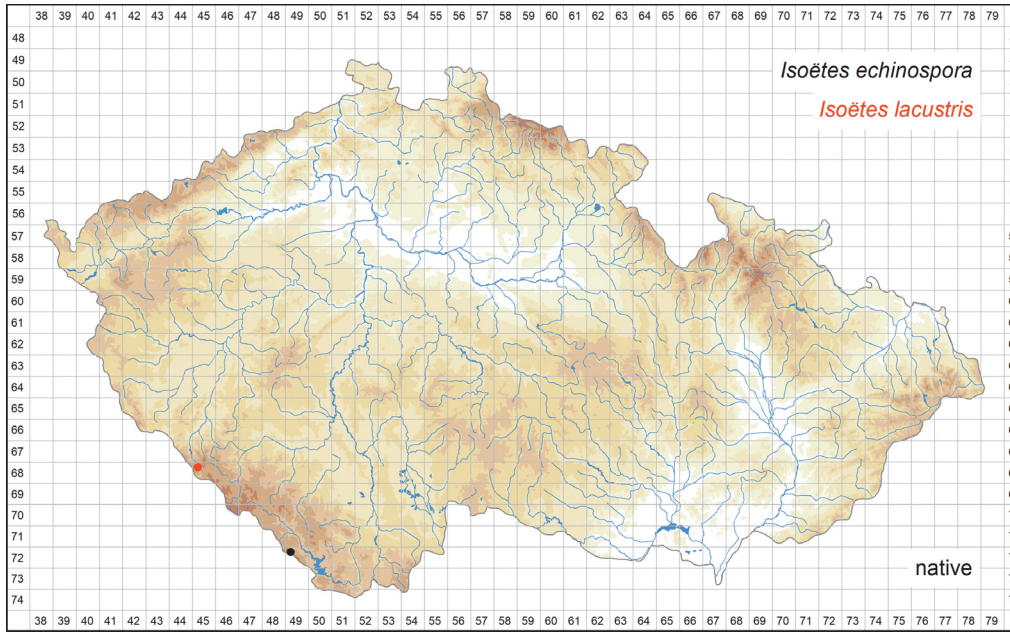


Fig. 50. – Distribution of *Isoëtes echinospora* (1 occupied quadrant) and *I. lacustris* (1 occupied quadrant) in the Czech Republic. Prepared by Martina Čtvrtlíková & Libor Ekrt.

Isoëtes echinospora (Fig. 50)

Isoëtes echinospora is a diploid submerged aquatic specialist of oligotrophic conditions in softwater lakes (Smolders et al. 2002, Bolin et al. 2017). It is widely but disjunctly distributed in regions with oceanic and sub-oceanic climates; it is also found rarely in areas with continental mountainous climates in northern and western Europe and the western part of central Europe, with a few outposts in Iceland and Bulgaria. It occurs also in Canada, the north-eastern and north-western parts of the USA and in Greenland. Several outposts exist in the Ural Mts, central Siberia, easternmost Asia and Japan (Hultén & Fries 1986). In the Czech Republic *I. echinospora* obviously represents a glacial relict (Procházka 2000). The sole population of *I. echinospora* has inhabited the glacial lake of Plešné jezero in the Šumava Mts (1087 m a.s.l.) since the end of the last Glacial period (~10 kyr BP; Jankovská 2006). It was first discovered by J. Pfund in 1842 but misidentified as *I. lacustris*. In 1892, L. Čelakovský jun. redetermined it as *I. echinospora* (Procházka 2000). The population was seriously threatened by the strong acidification of Plešné jezero during the 1960s–2000s, when it failed to reproduce due to all-year-long extreme acidity and high concentrations of toxic ionic aluminium in the lake water (Majer et al. 2003, Kopáček et al. 2009), both exceeding the thresholds for growth of shallow sporeling roots at the sediment surface (Čtvrtlíková et al. 2009, 2012). Nonetheless, 1000–5000 deep-rooted, long-living adult plants were resistant to these toxicants and enabled a long-term population persistence (Husák et al. 2000) and recovery due to spore production that gave rise to sporelings (Čtvrtlíková et al. 2016) after recent improvement in water quality (Kopáček et al. 2017, Oulehle et al. 2018). As a result, the population counts increased to 28.000 individuals in 2012, including about 20% of juveniles that have appeared during the last two decades (Čtvrtlíková et al. 2016). Currently, dense stands of this quillwort in the shallow (0.3–0.75 m depth) inshore area (about 0.03 ha) have been reduced again to only several thousand individuals by grazing mallards and competitive growth of *Carex rostrata*. However, the population is partially restored by juveniles every year (Čtvrtlíková et al. 2016). *Isoëtes echinospora* is classified as critically endangered due to its rarity and serious environmental threats (Grulich 2012).

Isoëtes lacustris (Fig. 50)

Isoëtes lacustris is a decaploid submerged aquatic specialist of oligotrophic conditions of softwater lakes (Hanson & Leitch 2002, Smolders et al. 2002). It inhabits the deepest littoral zone of thousands of lakes in Ireland, Scotland and Scandinavia. It also occurs in several mountain lakes of central Europe as a glacial relict (Břízová 2011). Outposts exist also in southern Greenland, Iceland, the Balkan Peninsula, Central Ural Mts and Japan (Hultén & Fries 1986). *Isoëtes macrospora* from north-eastern North America is most likely conspecific (Taylor et al. 1993). In the Czech Republic the only population of *I. lacustris* is found in the glacial lake of Černé jezero in the Šumava Mts, where it was discovered by I. F. Tausch in 1816 (Tausch 1819, Procházka 2000). The population has failed to reproduce under severe acidification of Černé jezero since the 1960s and has not yet started to recover in spite of recent seasonal improvements in water quality. Although adult plants of *I. lacustris* population persist in the lake for several decades (Husák et al. 2000), their reproduction is hampered by low pH and high values of toxic aluminium in lake water detrimental to the fine absorptive organs of sporelings developing at the sedi-

ment surface (Čtvrtlíková et al. unpubl.). The recruitment success of *I. lacustris* is particularly hindered by its very slow germination, which results in a longer exposure to toxic conditions (Čtvrtlíková et al. unpubl.) than is the case for *I. echinospora* (Čtvrtlíková et al. 2014). In 2004–2018, the monospecific plant stands of *I. lacustris* in Černé jezero, found at the depths of 1–4 m, contained 4000 adult plants and covered an area of 640 m^2 in total (Čtvrtlíková et al. 2014, Čtvrtlíková et al. unpubl.). Its occurrence in the Krkonoše Mts is confined to the Wielki Staw glacial lake on the Polish side of the mountains. *Isoëtes lacustris* is classified as critically endangered due to its rarity and serious environmental threats (Grulich 2012).

Lycopodiella inundata (Fig. 51)

Lycopodiella inundata is distributed disjunctly throughout the Northern Hemisphere with a preference for rather oceanic climates. It occurs in Europe except for its southern, easternmost and northernmost parts. Outside Europe it occurs in the western Caucasus Mts, southern Siberia, Japan, and North America (Hultén & Fries 1986). In the Czech Republic it is mainly found in periodically flooded sandy and peaty sites in margins of shallow peat bogs and fishponds, and also occurs in disturbed secondary sites on margins of sandy roads and in moist parts of sand pits. It prefers moist acidic to neutral soils that are poor in nutrients. In the majority of sites it occurs only temporarily (usually within ten years) before it is gradually suppressed by stronger competitors if no disturbance occurs. However, it is capable of colonizing new suitable sites nearby or also at longer distances. Nowadays, all extant populations of *L. inundata* in this country are found at secondary sites. In some large and periodically disturbed sites *L. inundata* is capable of surviving for many decades, e.g. at the Kamenný rybník fishpond near the city of Plzeň (for about 50 years) and the Rožmberk fishpond near the town of Třeboň (for about 85 years). This species is distributed from the lowlands to mountains, reaching its elevational maxima at about 1200 m in the Krkonoše Mts and the Hrubý Jeseník Mts. *Lypocopodiella inundata* is most common in the Šumava Mts and the Třeboňská pánev basin in southern Bohemia, and rare in western, northern and eastern Bohemia, the Žďárské vrchy hills, Hrubý Jeseník Mts, the Silesian Lowland and the Slezské Beskydy Mts. The species disappeared from many of its former sites because of drainage, absence of regular disturbances, and eutrophication followed by succession of stronger competitors. Therefore, it is classified as critically threatened (Grulich 2012).

Lycopodium annotinum (Fig. 52)

Lycopodium annotinum has a wide circumboreal distribution in the Northern Hemisphere. It occurs in Europe except for its westernmost, southernmost and south-eastern parts, with outposts in Iceland and the Caucasus Mts, eastwards reaching central Siberia, the Russian Far East, north-eastern China, and Japan. It is also found in Canada, the northern and north-eastern USA and Greenland (Hultén & Fries 1986). Two subspecies are recognized, of which only *L. annotinum* subsp. *annotinum* is present in the Czech Republic. It prefers spruce forests at high elevations, bog birch, pine and spruce forests and mountain beech forests. It is scattered to common in all the mountain areas except the Krušné hory Mts, where it is scattered to rare. At middle elevations *L. annotinum* is less frequent, being locally common only in the Českomoravská vrchovina highlands and

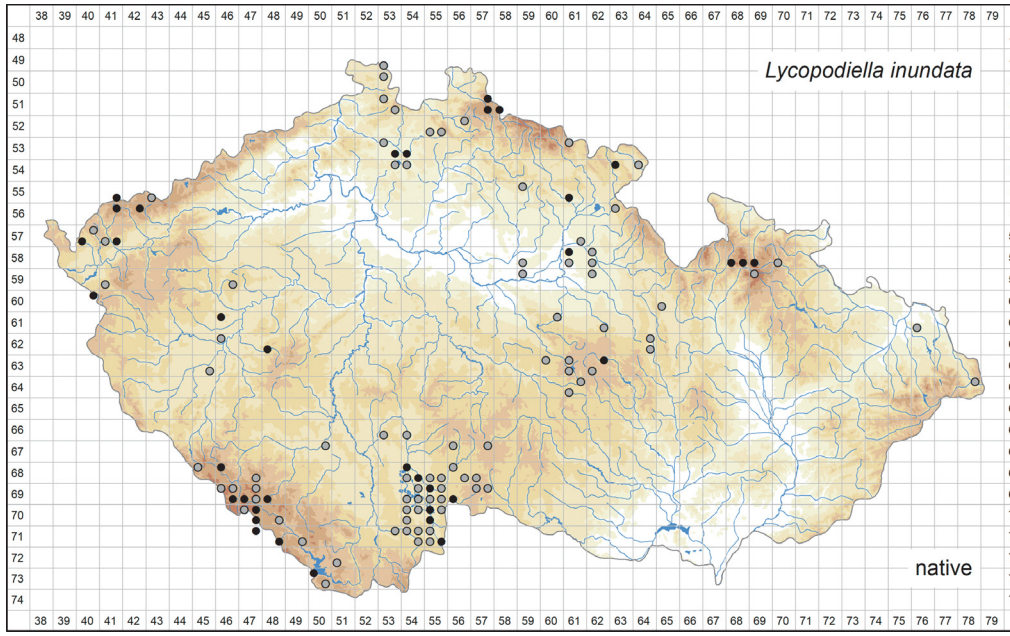


Fig. 51. – Distribution of *Lycopodiella inundata* in the Czech Republic: ● at least one record in 2000–2019 (36 quadrants), ● pre 2000 records only and/or extirpated occurrences (82 quadrants). Prepared by Libor Ekrt.

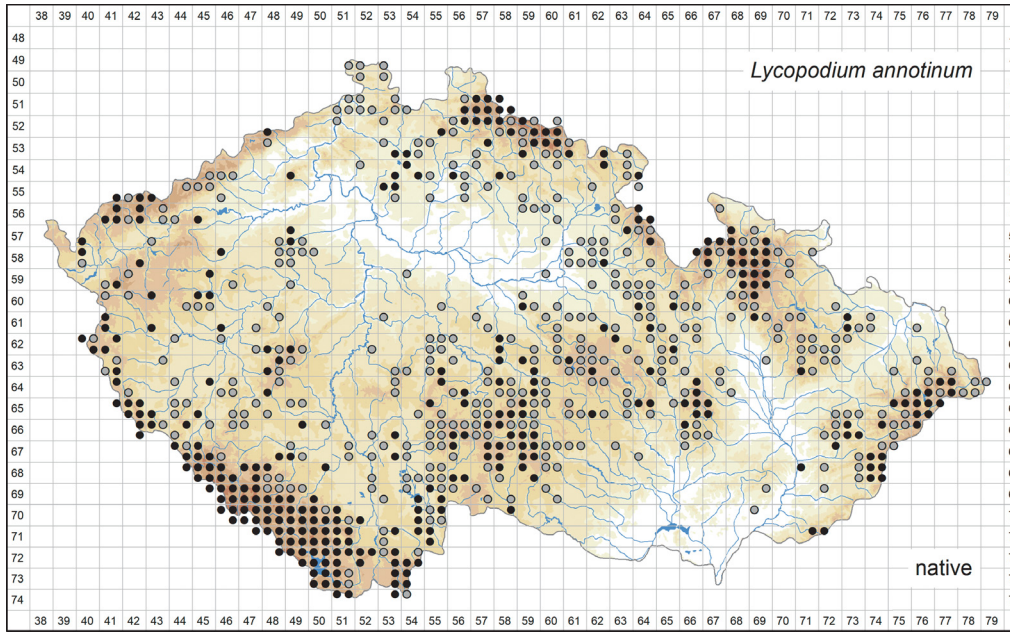


Fig. 52. – Distribution of *Lycopodium annotinum* in the Czech Republic: ● at least one record in 2000–2019 (319 quadrants), ● pre 2000 records only (395 quadrants). Prepared by Libor Ekrt.

their surroundings. It is very rare in or absent from the lowlands. While still being rather common in the mountains, it has vanished from many sites at middle and low elevations due to inappropriate forestry practices, including drainage of moist and bog forests. It is therefore classified as vulnerable in this country (Grulich 2012).

Lycopodium clavatum (Fig. 53)

Lycopodium clavatum is a circumboreal species distributed continuously in the Northern Hemisphere from Europe (except its southern parts) eastwards to central and northern Siberia, the Russian Far East and Japan, with outposts in Iceland, the Caucasus Mts, Himalayas and south-eastern China. In North America it is distributed in the north-west and north-east, while several outposts exist in southern Greenland. In the Southern Hemisphere *L. clavatum* is distributed very disjunctly in South America, the Falkland Islands, eastern and southern Africa, the Kerguelen Islands, Philippines, Sunda Islands and New Guinea (Hultén & Fries 1986). Of the two subspecies usually recognized, only *L. clavatum* subsp. *clavatum* occurs in the Czech Republic. It is a species of sunny and semi-shaded sites with acidic soils that are poor in nutrients. It occurs in *Nardus* grasslands, heathlands, open-canopy spruce and pine forests, disturbed sandy and peaty sites such as margins of forest roads and bottoms of old quarries. It used to be common at high elevations, scattered at middle elevations and rare in or absent from the lowlands, especially in central and southern Moravia. Nowadays *L. clavatum* is common in the mountains and rare at middle elevations, while it has almost disappeared from the lowlands, mainly due to land-use changes, intensive forestry and agriculture practices, and eutrophication of the landscape followed by the spread of woody species. It is classified as vulnerable in this country (Grulich 2012).

Moehringia muscosa (Fig. 54)

Moehringia muscosa occurs mainly in the mountains of southern and central Europe, including the Pyrenees, Massif Central, Alps (locally including their foothills), Apennines, Carpathians and the mountains of the north-western Balkan Peninsula (Jalas & Suominen 1983). In the Czech Republic it was recorded at only 2–3 sites in the Křivoklátsko area in central Bohemia: on rocks near the village of Křivoklát in 1827 and 1884, and on damp rocks along a stream in a forest valley near the village of Zbečno in 1905. Other records are either from cultivation or highly doubtful. *Moehringia muscosa* has not been observed for more than a century and is therefore classified as nationally extinct (Grulich 2012).

Moehringia trinervia (Fig. 55)

Moehringia trinervia is distributed throughout Europe except for its northernmost parts, being rare in eastern Europe and the driest parts of the Mediterranean area; several isolated occurrences are in western Siberia (Meusel et al. 1965, Jalas & Suominen 1983). In the Czech Republic it mainly grows in both coniferous and deciduous forests, in forest clearings and openings, shrub communities, along forest tracks and springs, in parks, and sometimes also in ruderal habitats. It is mostly found at shaded or semi-shaded sites, rarely even unshaded places, preferring acidic to neutral, moist, nutrient-rich soils. *Moehringia trinervia* is frequent throughout this country, being only locally rare in or absent from agricultural deforested landscapes in the dry lowlands.

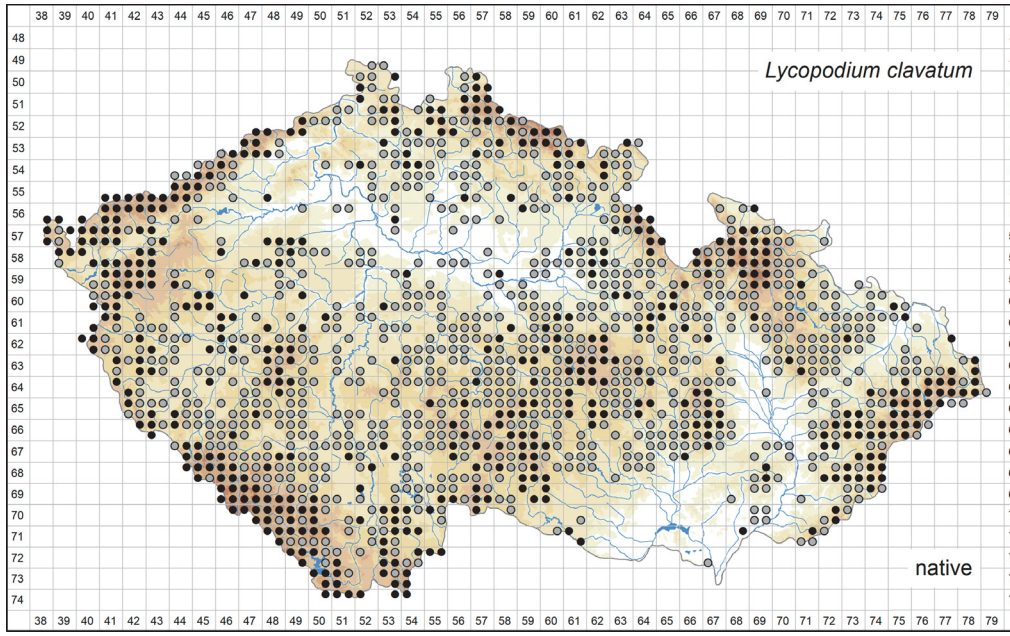


Fig. 53. – Distribution of *Lycopodium clavatum* in the Czech Republic: ● at least one record in 2000–2019 (500 quadrants), ● pre 2000 records only (814 quadrants). Prepared by Libor Ekrt.

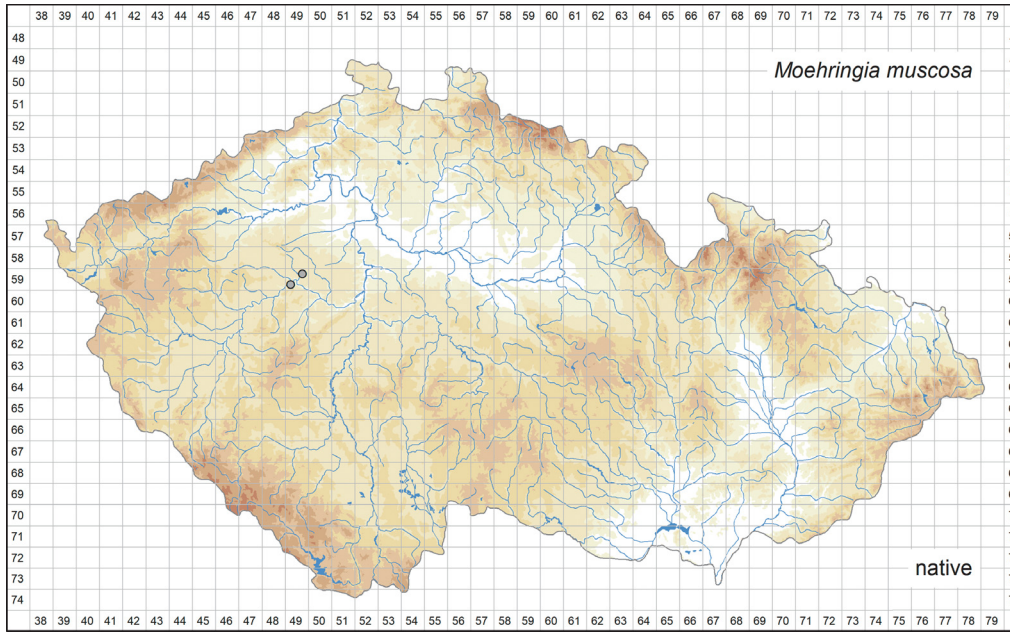


Fig. 54. – Distribution of *Moehringia muscosa* in the Czech Republic: ● pre 2000 records only (2 quadrants). Prepared by Zdeněk Kaplan.

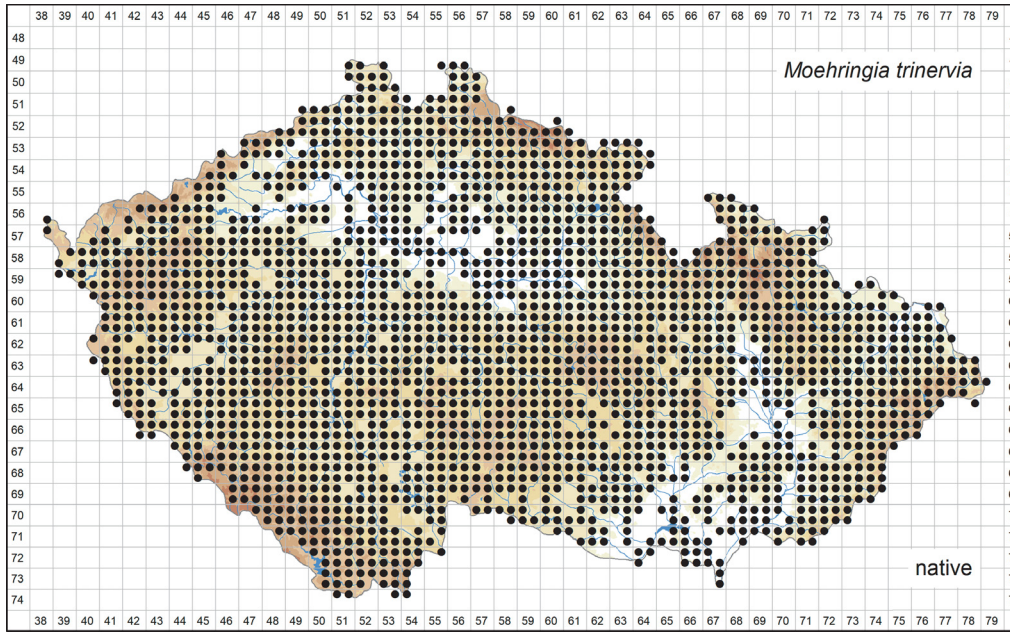


Fig. 55. – Distribution of *Moehringia trinervia* in the Czech Republic (2133 occupied quadrants). Prepared by Zdeněk Kaplan.

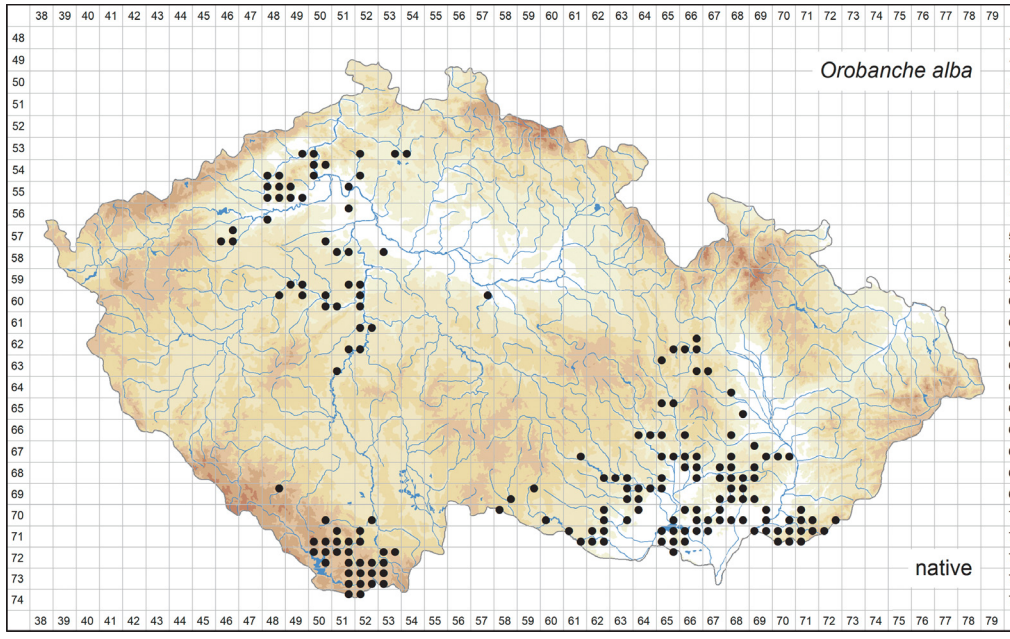


Fig. 56. – Distribution of *Orobanche alba* in the Czech Republic (177 occupied quadrants). Prepared by Jiří Zázvorka.

Orobanche alba (Fig. 56)

The distribution of *Orobanche alba* extends from the British Isles and Spain throughout central and southern Europe, Ukraine, the European part of Russia, Turkey, Iran, Transcaucasia, south-western Siberia, Afghanistan, Pakistan and Nepal to China (Hultén & Fries 1986, Kreutz 1995, Uhlich et al. 1995, Zhang & Tzvelev 1998, Domina & Raab-Straube 2010, Sánchez Pedraja et al. 2019). In the Czech Republic, Slovakia and south-eastern Poland *O. alba* reaches its northern range limit. In the Czech Republic most of its localities are situated in central and north-western Bohemia, in southern Bohemia in the broader vicinity of the towns of Český Krumlov and Kaplice (often associated with limestone and serpentine outcrops), and in warm southern and central parts of Moravia. It grows in open sunny habitats such as thermophilous grasslands, rocky slopes, abandoned quarries, steppe meadows and fallows predominantly in territories with base-rich soils on limestone, basalt, marlstone, serpentine, loess and flysch sediments. *Orobanche alba* prefers warm, low and middle elevations at 170–600 m, reaching its elevational maxima at 700–985 m at several sites near the town of Horní Planá in southern Bohemia. Regarding their host specificity, the populations of *O. alba* can be divided into two groups. The species has predominantly been found parasitizing various species of *Thymus*, and rarely also *Clinopodium vulgare* if it co-occurs with *Thymus*. *Thymus* is the most frequent host in southern Bohemia, partly in central and northern Bohemia as well as in Moravia except for the Bílé Karpaty Mts. *Orobanche alba* parasitic on *Salvia nemorosa*, *S. pratensis* or *S. verticillata* is commonly encountered in the České středohoří Mts in north-western Bohemia and in the Bílé Karpaty Mts in south-eastern Moravia, where suitable *Thymus* plants are also widespread. These host variants are geographically vicariant and morphologically differentiated in the Czech Republic (Zázvorka 2000, 2003). *Orobanche alba* is classified as vulnerable (Grulich 2012).

Orobanche alsatica (Fig. 57)

Orobanche alsatica is predominantly a European species distributed from France and northern Italy through all central European countries to the Baltic countries and to the vicinity of Saint Petersburg in the north. The eastern limit of its distribution runs through Belarus, Ukraine, the European part of Russia and the northern part of the Balkan Peninsula. It is almost absent from the Mediterranean area and the British Isles. Outside Europe it has been reported mainly from the Caucasus Mts, south-western Siberia, Central Asia and China (Meusel et al. 1978, Hultén & Fries 1986, Kreutz 1995, Uhlich et al. 1995, Zhang & Tzvelev 1998, Pusch 2009, Domina & Raab-Straube 2010, Sánchez Pedraja et al. 2019). The distribution of *O. alsatica* in Asia has not been established precisely due to diverse approaches to its classification. The species (s. l.) has usually been divided into *O. alsatica*, which is parasitic on *Peucedanum cervaria*, and *O. bartlingii*, which is parasitic on *Libanotis pyrenaica* (Nieschalk & Nieschalk 1968, 1974, Piwowarczyk 2012a, Sánchez Pedraja et al. 2019). In the Czech Republic it parasitizes at least six species of the family *Apiaceae*, most frequently *Libanotis pyrenaica*, *Peucedanum cervaria* and *P. alsaticum*; rarely it is parasitic on *Seseli osseum* and *S. pallasii*, and, exceptionally, on *Pimpinella major*. *Orobanche alsatica* is mapped here as a species complex, incl. *O. bartlingii*. In the Czech Republic it is scattered in warm and dry hilly areas of southern Moravia where it is native. In Bohemia it is much rarer and occurs only locally without any clear phytogeographical pattern; the occurrences on castle hills (Kunětická hora hill

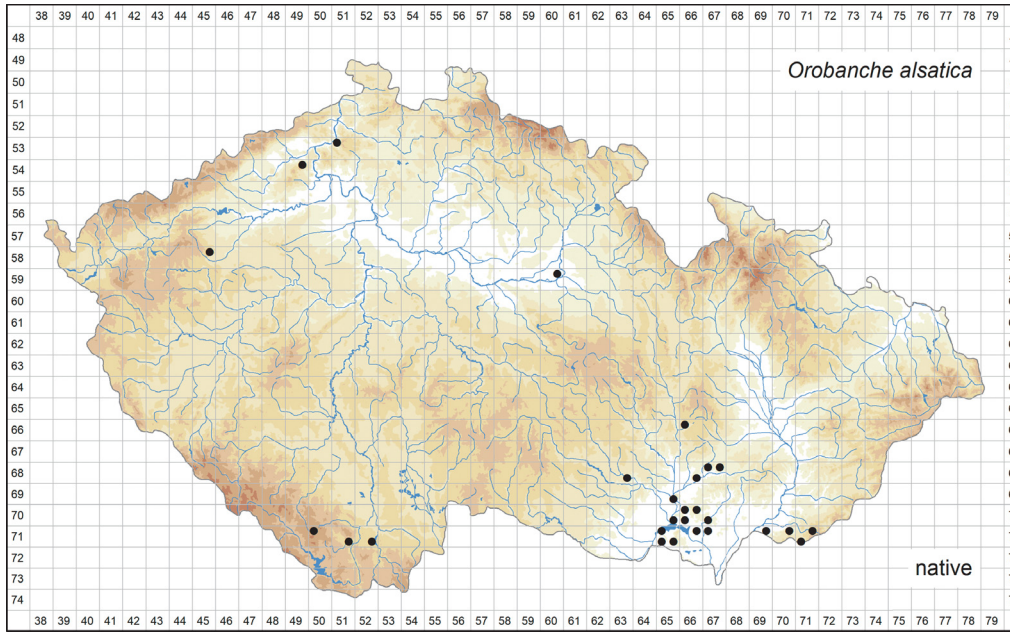


Fig. 57. – Distribution of *Orobanche alsatica* in the Czech Republic (27 occupied quadrants). Prepared by Jiří Zázvorka.

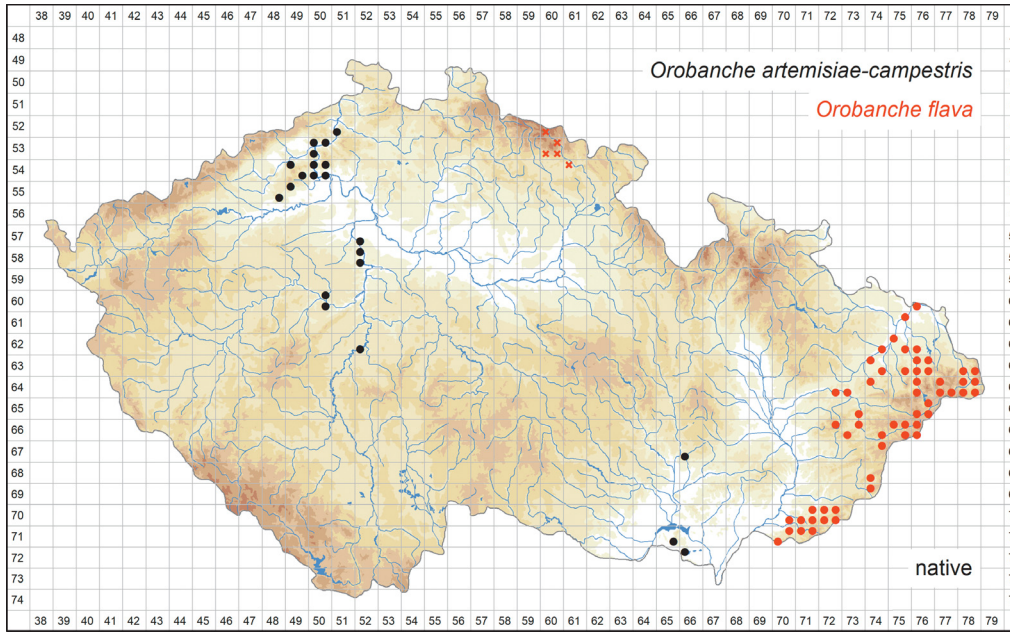


Fig. 58. – Distribution of *Orobanche artemisiae-campestris* (21 occupied quadrants) and *O. flava* (● native: 55 quadrants, × alien: 5 quadrants) in the Czech Republic. Prepared by Jiří Zázvorka.

near the city of Pardubice and ruins of the Velešín castle) and at least partly in the town of Český Krumlov are likely non-native. *Orobanche alsatica* grows in open, sunny slopes on deep base-rich soils predominantly on loess. It is mainly found in thermophilous grasslands, abandoned vineyards, orchards and fields, in dry semiruderal grasslands and in fallows (Zázvorka 2000, 2003). *Orobanche alsatica* prefers warm, low and middle elevations at 160–600 m. Parasitizing *Pimpinella major*, *O. alsatica* reaches its exceptional elevational maximum at 1005 m in the Boletice military training area in southern Bohemia. *Orobanche alsatica* is classified as endangered (Grulich 2012).

Orobanche artemisiae-campestris (Fig. 58)

Orobanche artemisiae-campestris occurs in central Europe, namely in Switzerland, Thuringia in central Germany, Czech Republic, south-western Slovakia, Lower Austria and Hungary, extending westwards as far as north-eastern Spain, France and northern Italy; the western and eastern limits of its range are poorly known because of confusion with related taxa, mainly *O. picridis*. The records from Slovenia, Croatia, Serbia, North Macedonia, Romania, Bulgaria, Greece and Crimea are either erroneous (based on confusion with *O. picridis* or *O. minor*) or uncertain (Meusel et al. 1978 as *O. loricata*, Hultén & Fries 1986, Kreutz 1995, Uhlich et al. 1995, Pusch 2009). In the Czech Republic it is a rare thermophilous species occurring in warm parts of the České středohoří Mts in north-western Bohemia, in the Vltava river valley and the karstic area of Český kras in central Bohemia, and at three sites in southern Moravia. It prefers undeveloped, shallow, slightly acidic to slightly basic soils on basalts, schist and limestone at elevations of 220–520 m. It is confined to sunny, rocky habitats with sparse vegetation; all populations are very small (Zázvorka 2000, 2003). *Orobanche artemisiae-campestris* exclusively parasitizes *Artemisia campestris* in its whole range. It is classified as critically threatened because of its rarity and decline (Grulich 2012).

Orobanche caryophyllacea (Fig. 59)

Orobanche caryophyllacea is distributed in the temperate zone from the British Isles and the Iberian Peninsula eastwards to the Caucasus Mts, western and central Asia and China. It occurs in southern Finland and in most of European Russia in the north, being rare in or absent from the Mediterranean area (Meusel et al. 1978, Kreutz 1995, Uhlich et al. 1995, Zhang & Tzvelev 1998, Domina & Raab-Straube 2010, Sánchez Pedraja et al. 2019). In the Czech Republic it occurs mainly in the České středohoří Mts in north-western Bohemia and in the Džbán hills and the karstic area of Český kras in central Bohemia. In Moravia it is rare, being somewhat more frequent only in the karstic area of Moravský kras. It avoids or only rarely occurs in warm and dry parts of this country, particularly in southern Moravia, being absent from large areas, namely the southern half of Bohemia and central and northern Moravia. The species occurs in various habitats according to ecological demands of the hosts, including mesophilous to moderately dry grasslands, shrublands, forest clearings, karstic rocks and in open broad-leaved forests on basalt, limestone and other basic bedrocks at elevations of 180–660 m (Zázvorka 2000, 2003). *Orobanche caryophyllacea* parasitizes various species of *Rubiaceae*, in the Czech Republic mainly *Galium album*, *G. verum*, *G. mollugo*, *G. sylvaticum*, less frequently *G. glaucum*, *G. intermedium* and *G. odoratum*. *Orobanche caryophyllacea* is currently classified as vulnerable (Grulich 2012).

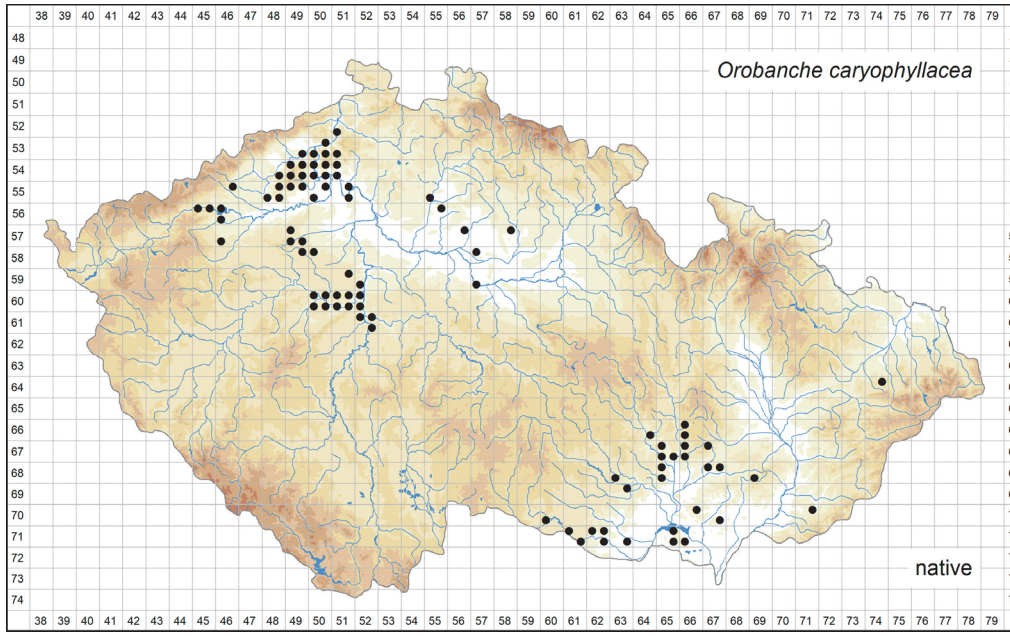


Fig. 59. – Distribution of *Orobanche caryophyllacea* in the Czech Republic (88 occupied quadrants). Prepared by Jiří Zázvorka.

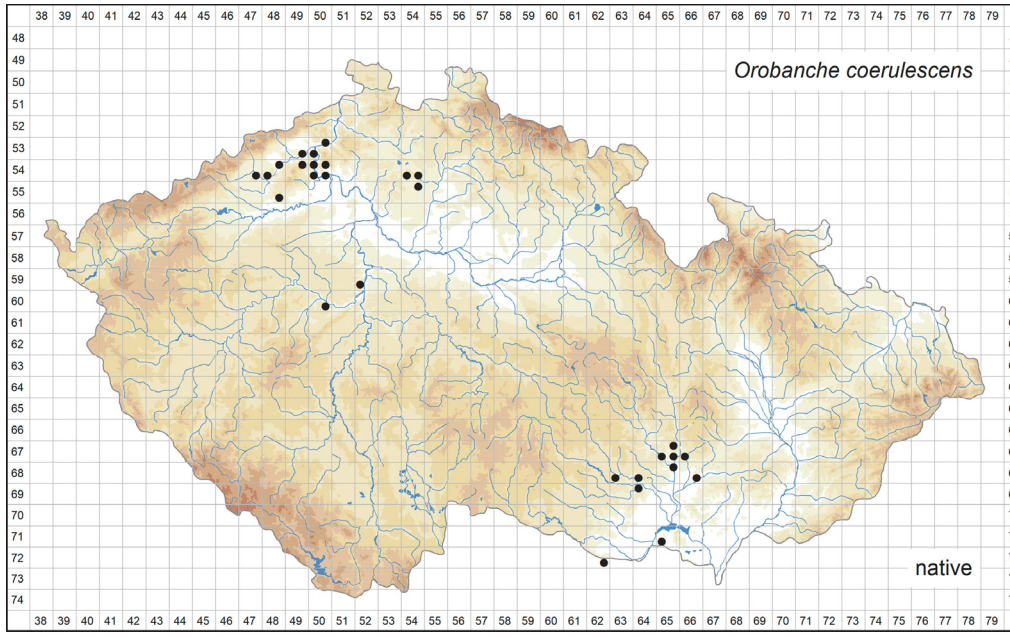


Fig. 60. – Distribution of *Orobanche coerulescens* in the Czech Republic (28 occupied quadrants). Prepared by Jiří Zázvorka.

Orobanche coerulescens (Fig. 60)

Orobanche coerulescens is a Eurasian continental steppe plant distributed from central Europe as far as Yakutia, Sakhalin, the Korean Peninsula, Japan, China and Nepal. The western limit of this species' distribution runs through Latvia, Poland, Germany and Austria (Meusel et al. 1978, Kreutz 1995, Uhlich et al. 1995, Zhang & Tzvelev 1998, Pusch 2009, Domina & Raab-Straube 2010, Piwowarczyk 2012b, Sánchez Pedraja et al. 2019). In the westernmost part of its range it is considered a relict of the early Holocene periglacial steppes. In the Czech Republic *Orobanche coerulescens* is a rare thermophilous species occurring in the warmest and driest parts of north-western Bohemia and southern Moravia. It is confined to south- and west-facing open rocky slopes on shallow and skeletal soils usually developed over basic substrates, such as basalt, rarely limestone and calcareous sandstone. The populations consist of a few individuals, and the plants may not appear each year. Altogether, it has been recorded there at about 30 sites, but at half of them it is now considered vanished. Most of the localities are located in the České středohoří Mts in north-western Bohemia. In Moravia this species has vanished from several sites in the city of Brno and its surroundings, and currently, it is known only from 2–3 localities in southern Moravia. Most of this species' sites can be considered naturally treeless, and the species does not colonize new sites (Zázvorka 2000, 2003). It occurs at elevations from 240 m (Ječmeniště Nature Monument near the village of Dyjákovičky) to 400 m (Raná hill near the town of Louny). In the Czech Republic, as well as in the whole western part of its distribution area, *O. coerulescens* exclusively parasitizes *Artemisia campestris*. It is classified as critically threatened due to its rarity and decline (Grulich 2012).

Orobanche elatior (Fig. 61)

The name *Orobanche elatior* has been commonly used for over 100 years for a non-homogeneous taxon of a Eurasian distribution extending from England in the west to China in the east (e.g. Pusch 2009). The range of *O. elatior* s. str. (excluding *O. kochii*) is restricted to western and central Europe. It is distributed in England, the Netherlands, southernmost Norway and Sweden, Denmark, Switzerland, Spain, France, Italy, Germany, eastwards it reaches the Baltic countries (Lithuania, Estonia), Poland and the Czech Republic, Slovakia, Austria and Slovenia. Its eastern range limit is insufficiently known, but its occurrence has not been confirmed in Hungary, Belorussia, Ukraine or Russia (Domina & Raab-Straube 2010, Zázvorka 2010, Piwowarczyk & Krajewski 2015, Sánchez Pedraja et al. 2019). In the Czech Republic it is a rare species, which probably applies also to its whole range, while *O. kochii* is much more frequent. In the Czech Republic *O. elatior* is confined to grassy, sunny slopes, usually meadows on deep slope loams overlaying marlite (fine calcareous sandstone or sandy marl), basalt, less frequently limestone and other base-rich bedrocks. *Orobanche elatior* cannot be considered a thermophilous species: it prefers moderately warm, dry or slightly humid habitats at elevations of 200–670 m. It avoids steppe grasslands and other sites occupied by xerophilous vegetation in the warmest parts of southern Moravia and north-western Bohemia. *Orobanche elatior* parasitizes *Centaurea scabiosa*, exceptionally also *C. jacea*. It is classified as critically threatened because of its decline (Grulich 2012).

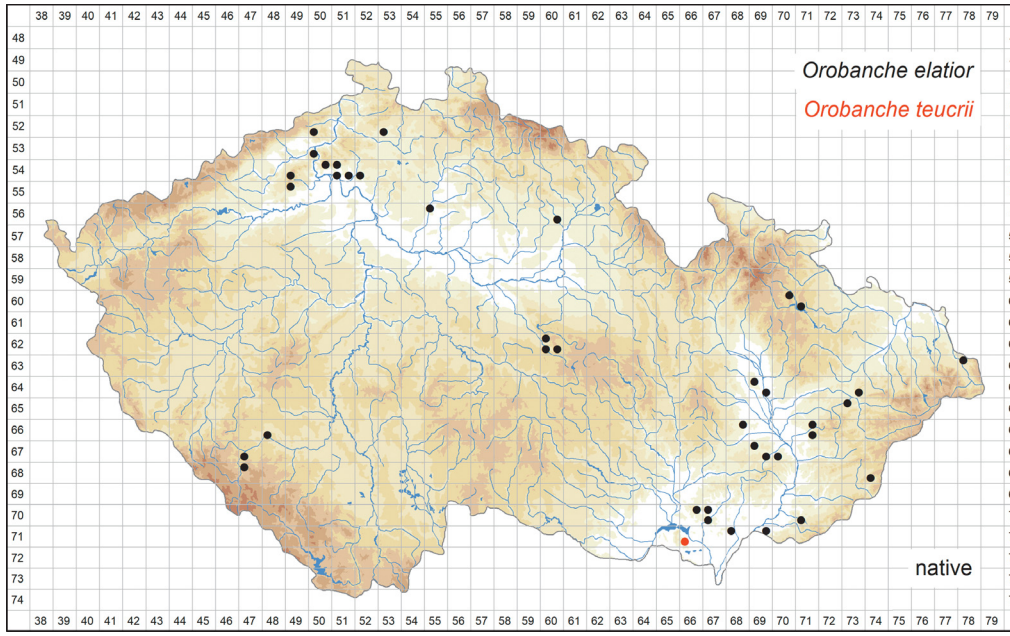


Fig. 61. – Distribution of *Orobanche elatior* (38 occupied quadrants) and *O. teucrii* (1 occupied quadrant) in the Czech Republic. Prepared by Jiří Zázvorka.

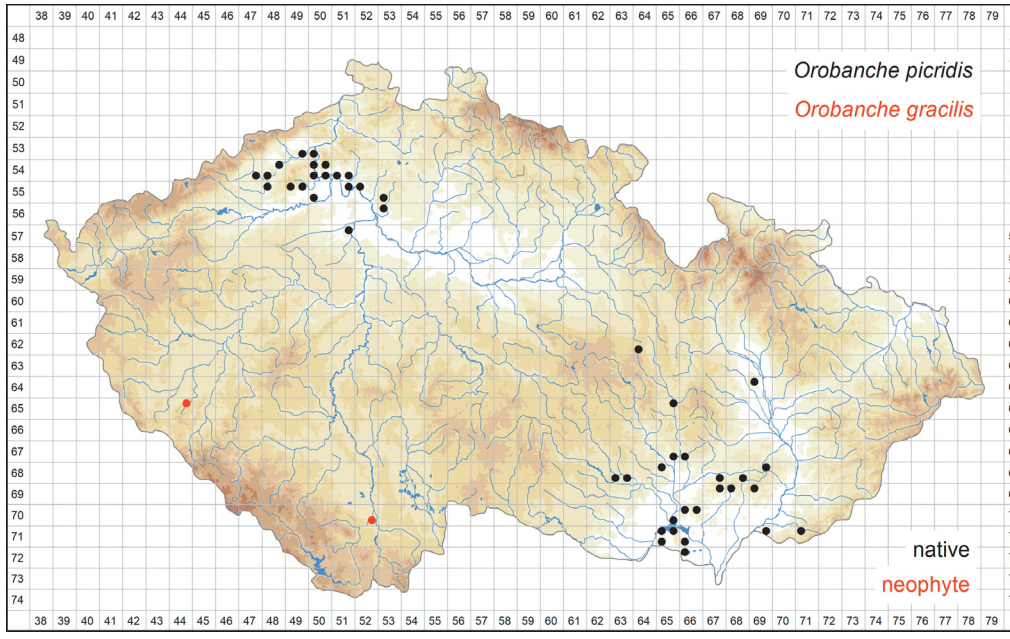


Fig. 62. – Distribution of *Orobanche gracilis* (2 occupied quadrants) and *O. picridis* (44 occupied quadrants) in the Czech Republic. Prepared by Jiří Zázvorka.

Orobanche flava (Fig. 58)

Orobanche flava is confined to limestone, dolomitic and flysch outcrops of the Alps and Carpathians; it has also been reported from the Caucasus Mts (Beck 1930, Meusel et al. 1978, Kreutz 1995, Pusch 2009, Piwowarczyk 2014). In the Czech Republic it is parasitic on *Petasites albus* and *P. kablikianus*, less frequently on *P. hybridus*. Its native distribution is limited to the Carpathians in eastern Moravia, including the Beskydy Mts, Hostýnské vrchy hills, Javorníky Mts and Bílé Karpaty Mts (Hendrych 1987b, Zázvorka 2000). In 1945–1950, *O. flava* was accidentally introduced with plants of *Petasites albus* from the Slovak Carpathians to a garden in the village of Pec pod Sněžkou in the Krkonoše Mts; it still occurs on the bank of the Úpa river close to this site. In 1990–1997 it was observed on the river banks in the village of Maršov and the town of Trutnov more than 15 km downstream (Zázvorka 1999). In the Carpathians it grows in tall-herb communities along small rivers and streams on deep and fertile soils. It is occasionally found also in edges and clearings of wet forests and in semiruderal habitats, e.g. along walking paths, on road verges and embankments. The elevational maximum of native occurrences in Moravia is at about 700 m in the Beskydy Mts, and its elevational minimum is at about 200 m in the Moravská brána and Ostravská pánev basins. In the Krkonoše Mts it grows at elevations of 400–910 m. *Orobanche flava* is currently classified as vulnerable (Grulich 2012).

Orobanche gracilis (Fig. 62)

The range of *Orobanche gracilis* extends almost continuously throughout the Mediterranean area in southern Europe from the Iberian Peninsula in the west to the Black Sea coast in the east, including Anatolia and the Caucasus Mts. In south-western Africa it occurs in northern Morocco, Algeria and Tunisia. In the north it reaches France, Switzerland, Germany and Austria where it is confined to limestone, dolomitic and flysch outcrops of the Alps at high elevations. North of the Alps it occurs sporadically in Bavaria and in Thuringia in Germany, in Lower Austria and Burgenland in Austria as well as in adjacent south-western Slovakia (Kreutz 1995, Zázvorka 1997, Pusch et al. 2001, Domina & Raab-Straube 2010, Sánchez Pedraja et al. 2019). In the Czech Republic *O. gracilis* is known from two sites in south-western Bohemia. In 1878 it was found only temporarily introduced near the village of Chudenice near Klatovy. The occurrences near the village of Včelná may be due to earlier introductions from the Alps. The species was first recorded there in 1908 and the population still exists. It has been repeatedly recorded there from about three sites along railways on railway embankments, road verges and in adjacent dry meadows. It is found here at an elevation of about 440 m. At the localities in Bohemia *O. gracilis* it is parasitic on *Lotus corniculatus*. Literature records for other sites both in Bohemia (e.g. Praha-Zbraslav and Praha-Hlubočepy) and Moravia (repeatedly from several places in various sources) were probably based on misidentifications (Beck 1930, Kučera 1968, Zázvorka 2000). In the Czech Republic *O. gracilis* is classified as a casual neophyte (Pyšek et al. 2012).

Orobanche kochii (Fig. 63)

Orobanche kochii was incorrectly included in *O. elatior* for over 100 years. The preferred host for both species is *Centaurea scabiosa*, but their distribution patterns are different as the ranges of the "western" *O. elatior* and the "eastern" *O. kochii* overlap only in central Europe. *Orobanche kochii* is a Eurasian species occurring in warm subcontinental climates from south-western Europe to India, central Asia and central China. The distribution in Europe reaches from France and Italy through central-European countries to Ukraine and European Russia in the east and to Greece in the south-east. The distribution in Asia is still incompletely known. Reliable literature records (under the names *O. elatior* or *O. major*) indicate its occurrence from the Caucasus Mts across the southern part of western Siberia to central Asia and the Himalayas and, in the south, from Anatolia across Iran to India and central China (Beck 1930, Tzvelev 1981, Zhang & Tzvelev 1998, Pusch 2009, Zázvorka 2010). In the Czech Republic *O. kochii* grows in natural and seminatural habitats in warm hilly areas at elevations of 200–600 m. It is scattered in southern, south-eastern and central Moravia and central and northern Bohemia; isolated occurrences in southern Bohemia are associated with limestone outcrops. As a thermophilous species, *O. kochii* prefers grassy, shrubby and rocky south-west facing slopes, including open dry habitats occupied by steppe vegetation. It grows on both deep soils and rocks or sands, usually on basalt, limestone, loess and other base-rich outcrops. In the Czech Republic it is native, being parasitic mainly on *Centaurea scabiosa*, rarely on *C. jacea* and *C. triumfetti*. In the neighbouring countries it parasitizes several other species of *Centaurea*. *Orobanche kochii* is classified as vulnerable (Grulich 2012).

Orobanche lutea (Fig. 64)

Orobanche lutea is a Eurasian species distributed in the temperate zone between Spain and France in the west and western and central Asia in the east; in Europe it extends northwards to the Netherlands, Belgium, Germany and Poland (Kreutz 1995, Uhlich et al. 1995, Pusch 2009, Domina & Raab-Straube 2010, Sánchez Pedraja et al. 2019). In the Czech Republic *O. lutea* is scattered in northern to central and eastern Bohemia, being found more frequently in the České středohoří Mts and between the towns of Chrudim and Litomyšl. In Moravia it is quite common only in the Bílé Karpaty Mts, elsewhere being rare to scattered. *Orobanche lutea* prefers warm, low and middle elevations at 200–400 m, reaching its elevational maxima at 600 m at several sites in the Bílé Karpaty Mts. It parasitizes *Medicago falcata*, *M. sativa* and *M.* ×*varia*. It grows in dry grasslands, dry to mesic meadows and open shrub communities always on deep loamy soils or loess overlaying basalt, marlite, flysch, less frequently limestone and other base-rich bedrocks. *Orobanche lutea* has been recorded as a noxious weed in alfalfa (*Medicago sativa*) fields parasitizing, it in the areas where the fields are in contact with abundant native populations of the parasite. It has thus been frequently recorded on such fields, for instance, in the České středohoří Mts near the town of Litoměřice and in the Bílé Karpaty Mts in south-eastern Moravia (Zázvorka 2000, 2003). *Orobanche lutea* is classified as vulnerable (Grulich 2012).

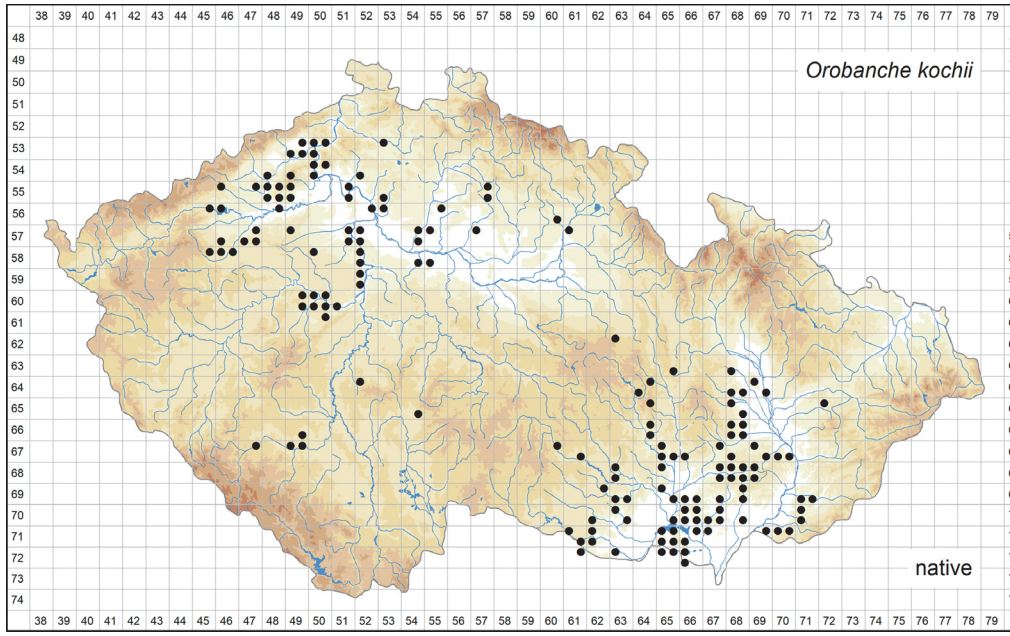


Fig. 63. – Distribution of *Orobanche kochii* in the Czech Republic (159 occupied quadrants). Prepared by Jiří Zázvorka.

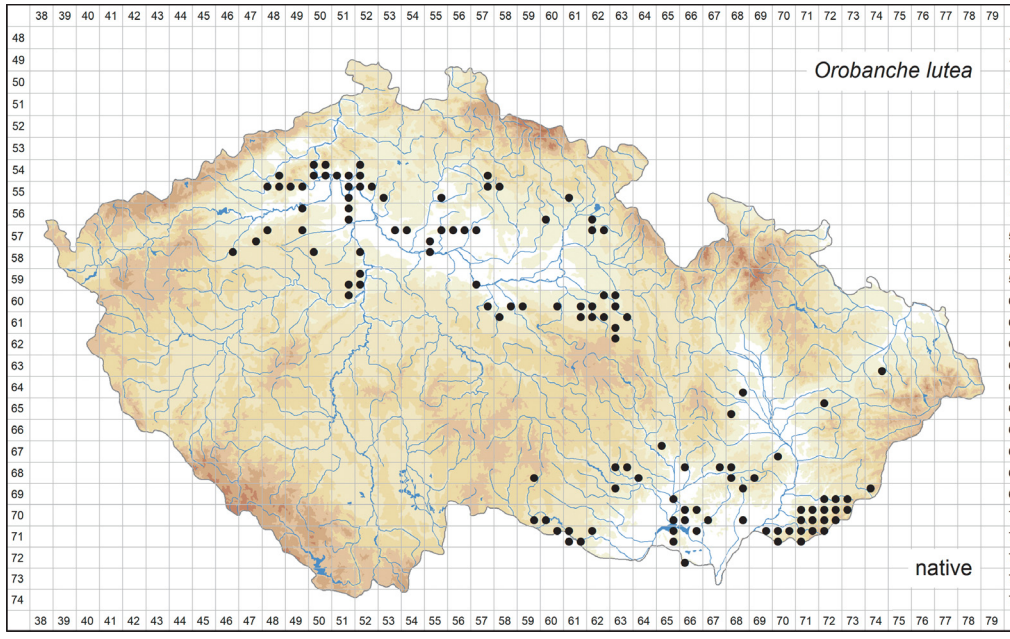


Fig. 64. – Distribution of *Orobanche lutea* in the Czech Republic (121 occupied quadrants). Prepared by Jiří Zázvorka.

Orobanche minor (Fig. 65)

Orobanche minor is probably native only to western and south-western Europe, the Mediterranean area, north-western Africa, the Caucasus Mts and south-western Asia. It has been introduced with contaminated crop seed to most of the countries of Europe including Switzerland, Germany, the Czech Republic, western Slovakia, Austria, Hungary, southern Ukraine and Moldova, as well as southern Scandinavia. It has been introduced into and has become locally naturalized in northern and central Africa, North America (Atlantic and Pacific coasts of the USA), Australia and New Zealand (Meusel et al. 1978, Musselman 1980, Hultén & Fries 1986, Kreutz 1995, Uhlich et al. 1995, Domina & Raab-Straube 2010, Sánchez Pedraja et al. 2019). In Europe *Orobanche minor* prefers regions with oceanic and sub-oceanic climates. The taxonomy of *O. minor* is quite intricate, as the species is highly polymorphic and may consist of several regional, poorly understood taxa. Regarding the hosts, hundreds of species in several families have been infested, but with clear preference for *Fabaceae* and *Asteraceae* (Beck 1930, Rumsey & Jury 1991, Hipkin 1992). *Orobanche minor* has efficient seed dispersal with fodder crops; in many countries it is regarded as a noxious weed, as heavy infestations can even cause crop failure. Despite effective control and protection measures, *O. minor* is still a serious problem on clover fields in many parts of the world. In the Czech Republic this species is considered a naturalized archaeophyte (Pyšek et al. 2012), nowadays occurring only in clover fields and mesic meadows. The species has spread at elevations between 190 and 420 m, reaching its elevational maximum at 650 m near the village of Kořenov in northern Bohemia. The earliest record of *O. minor* in the Czech Republic, dating to 1876, originates from that site. A massive spread of *O. minor* into the fields with red clover started after World War II, particularly in 1950–1970. The species colonized many sites from the Labe and Sázava river basins in central Bohemia eastwards as far as eastern Bohemia and northern Moravia. Outside this area the records have been rather scarce. Since 1980 *O. minor* has disappeared from most of the localities as a result of quarantine control. Recently the number of records strongly declined as a result of the reduction of clover cultivation after 1990, and nowadays the species is rare. In the Czech Republic it usually parasitizes *Trifolium pratense*, and occasionally *T. repens* and *T. hybridum* (Kropáč 1973, 1997, Zázvorka 2000).

Orobanche picridis (Fig. 62)

Orobanche picridis is a predominantly European species distributed from the Atlantic coast in the west to south-western Asia in the east. Its range includes almost all countries of Europe, reaching its northern limit in England, southern Sweden, south-eastern Poland, south-western Ukraine, Moldova and the southern parts of European Russia. In the south it reaches Portugal, Spain, central Italy, the Balkan Peninsula, Transcaucasia and western Anatolia. However, the distribution of *O. picridis* is imperfectly known because it has sometimes been considered as conspecific with *O. artemisiae-campestris* or classified as a subspecies of it (Rumsey & Jury 1991, Uhlich et al. 1995, Pusch 2009, Piwowarczyk 2012c, Sánchez Pedraja et al. 2019). In the Czech Republic *O. picridis* is rare: in Bohemia it is restricted to the warm part of the České středohoří Mts, eastwards reaching the towns of Štětí and Mělník; in Moravia it is rare in its central and southern parts, being somewhat more frequent in the Dunajovické kopce hills and the northern

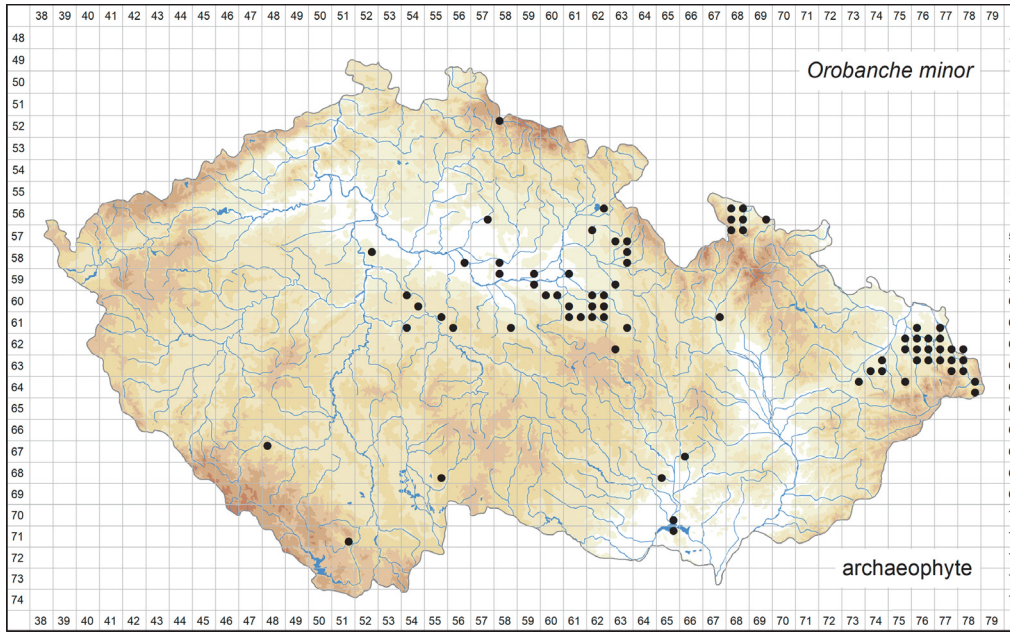


Fig. 65. – Distribution of *Orobanche minor* in the Czech Republic (76 occupied quadrants). Prepared by Jiří Zázvorka.

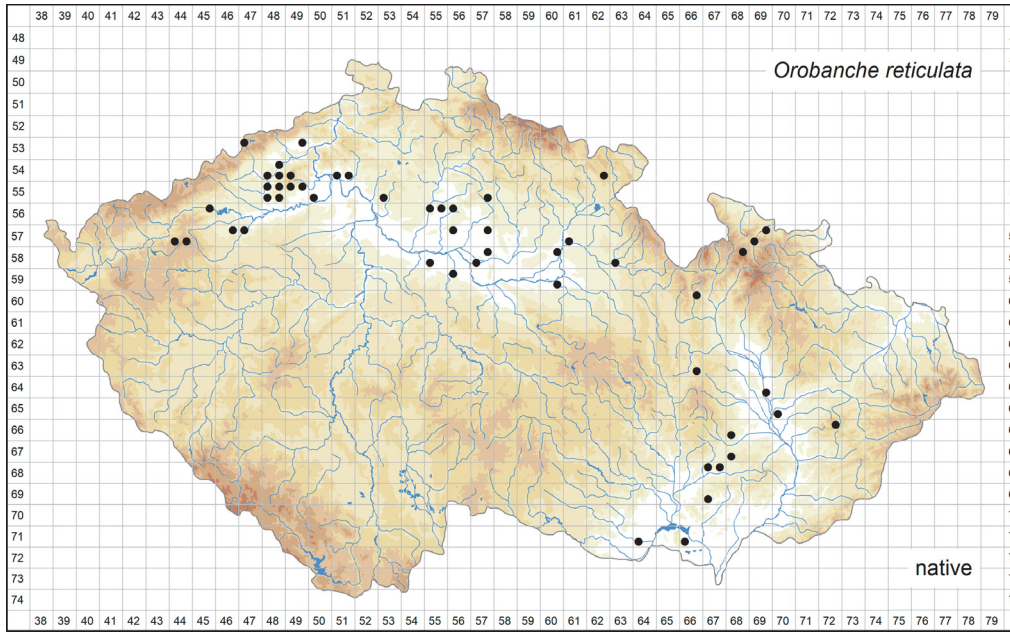


Fig. 66. – Distribution of *Orobanche reticulata* in the Czech Republic (51 occupied quadrants). Prepared by Jiří Zázvorka.

foothills of the Pavlovské vrchy hills in southernmost Moravia. It prefers low and middle elevations of 190–480 m, reaching its elevational maximum at 560 m near the village of Vendolí in central Moravia. *Orobanche picridis* prefers open sunny sites in fallow land, disturbed places with sparse vegetation in initial stages of succession, unstable steep slopes and margins of vineyards. It disappears when the sites are overgrown by tall vegetation of more competitive species. It grows on deep loamy soils overlaying basalt, marlite, limestone and other base-rich bedrocks. The usual host of *O. picridis* is *Picris hieracioides*, but the co-occurring *Daucus carota* is also parasitized (Zázvorka 2000, 2003). *Orobanche picridis* is classified as endangered because of its rarity and decline (Grulich 2012).

Orobanche reticulata (Fig. 66)

Orobanche reticulata (incl. *O. pallidiflora*) has a Eurasian distribution extending from Spain and England in the west to western Asia in the east (Meusel et al. 1978, Hultén & Fries 1986, Foley 1993, Kreutz 1995, Uhlich et al. 1995). Its range includes most European countries. It has also been reported from northern Africa and the Himalayas, but the species' entire range is still insufficiently known. *Orobanche pallidiflora* is usually understood as a lowland to submontane plant, in contrast to *O. reticulata*, which occupies montane and alpine belts of the mountains in Europe. All plants in the Czech Republic formally belong to *O. pallidiflora*, but a clear delimitation into two (sub)species is impossible in the mountains of Slovakia (Zázvorka 1997, 2000, Piwowarczyk et al. 2010) and probably also elsewhere. In the Czech Republic *O. reticulata* is generally rare, but during the last decades it has been recorded in areas from which it had not previously been known. Consequently, it is the only *Orobanche* species in this country's flora for which the number of localities has somewhat increased. Recently the species has spread from the lowlands to higher elevations, reaching its elevational maximum at 870 m in the Krušné hory Mts. It occurs in the northern half of Bohemia without any clear phytogeographical pattern, which is also the case in Moravia. In the Czech Republic the usual hosts are species of the genera *Cirsium* and *Carduus*, but other thistles, such as *Carlina*, may also be parasitized. The habitats of *O. reticulata* are very varied: it occurs in various types of meadows (both dry and wet), parasitizing *Cirsium oleraceum*, *C. palustre*, *C. canum*, *C. heterophyllum* and *C. acaulon*; in old abandoned orchards, many of them grazed, on *Cirsium eriophorum*; and in various types of ruderal vegetation on *Cirsium arvense*, *C. vulgare* and *Carduus acanthoides*. It also inhabits forest tracks, clearings, disturbed places along forest roads, ditches, fallows and similar sites. Despite the fact that the majority of habitats are secondary, seminatural or ruderal, *O. reticulata* is considered native to the Czech Republic. It is classified as critically threatened (Grulich 2012).

Orobanche teucrii (Fig. 61)

Orobanche teucrii is a European species distributed mainly in the Pyrenees in Spain and France, and the Alps and adjacent mountain areas in France, Italy, Switzerland, southern Belgium, Germany and Austria; it is rarely found at low elevations north of the Danube in southern Moravia, south-western Slovakia and Hungary. It has also been recorded from Romania, Bulgaria, Slovenia, Croatia, Bosnia-Herzegovina, Serbia, Albania and Corsica (Meusel et al. 1978, Kreutz 1995, Uhlich et al. 1995, Domina & Raab-Straube 2010,

Sánchez Pedraja et al. 2019). Outside this range there are undocumented and probably erroneous reports from Bohemia, Slovakia, Poland and the Ukrainian Carpathians; they may be based on misidentified plants of the closely related and widespread *O. caryophyllacea* or *O. alba*, probably due to host misidentification. In the Czech Republic *O. teucrii* grows in south-west facing slopes on soils developed over calcareous sandstone, flysch sediments and loess. This species was discovered as new for this country's flora on steppe slopes south-west of the village of Milovice in southern Moravia as late as in 1997. However, the first specimens of *O. teucrii* were collected there about two decades earlier but remained unrecognized. At the site, it parasitizes *Teucrium chamaedrys* and occurs scattered at elevations of 200–240 m (Zázvorka 2000). *Orobanche teucrii* is classified as critically threatened due to its rarity (Grulich 2012).

Phelipanche arenaria (Fig. 67)

Phelipanche arenaria is distributed mainly in central and sub-Mediterranean Europe extending to south-western Asia. In Europe it occurs from Portugal and France in the west to southern parts of European Russia and the Caucasus Mts in the east. It has also been reported from northern Africa (Morocco, Algeria, Tunisia), but it is absent from the majority of the Balkan Peninsula and the Mediterranean islands (Meusel et al. 1978, Kreutz 1995, Uhlich et al. 1995, Pusch 2009, Domina & Raab-Straube 2010, Sánchez Pedraja et al. 2019). *Phelipanche arenaria* is a rare thermophilous species that in the Czech Republic occurs in the warmest, driest areas of central and north-western Bohemia, as well as southern Moravia. It is confined to south- and west-facing rocky slopes on shallow and skeletal soils usually developed over basic bedrocks, such as basalt and limestone; in Moravia it also grows on loess, loam and sand. *Phelipanche arenaria* occurs in open vegetation in natural habitats that may be considered relict and naturally tree-less. The species mainly grows at low and middle elevations between 190 and 500 m, reaching its elevational minimum at 155 m near the town of Lanžhot in southernmost Moravia (Zázvorka 2000, 2003). In the Czech Republic and in central Europe as a whole it parasitizes *Artemisia campestris* exclusively. *Phelipanche arenaria* is classified as endangered due to its rarity and decline (Grulich 2012).

Phelipanche caesia (Fig. 68)

Phelipanche caesia is a species of Eurasian continental steppes distributed from the western shore of Lake Baikal to central Europe. It occurs throughout the southern Siberian steppe zone, in north-western Mongolia, north-western China, Kyrgyzstan, Kazakhstan, Uzbekistan, Georgia, Armenia, Azerbaijan, Iran, Afghanistan, steppes north of the Black Sea, in the southern part of European Russia northwards to the upper Volga and Don river basins, southern Ukraine and Moldova. *Phelipanche caesia* extends into central Europe along the margins of the Pannonian basin between the Alps and Carpathians in Romania (Transylvania), Hungary (Budapest), Austria (only Lower Austria and Burgenland) and southern Moravia, where it reaches its westernmost distribution limit (Beck 1930, Kreutz 1995, Uhlich et al. 1995, Domina & Raab-Straube 2010, Sánchez Pedraja et al. 2019). In southern Moravia *Phelipanche caesia* was first distinguished from other blue-flowered broomrapes in 1980. It occurs there in old fallows in dry sunny sites on deep, neutral to slightly basic soils developed over loess. It has been known only from six localities in

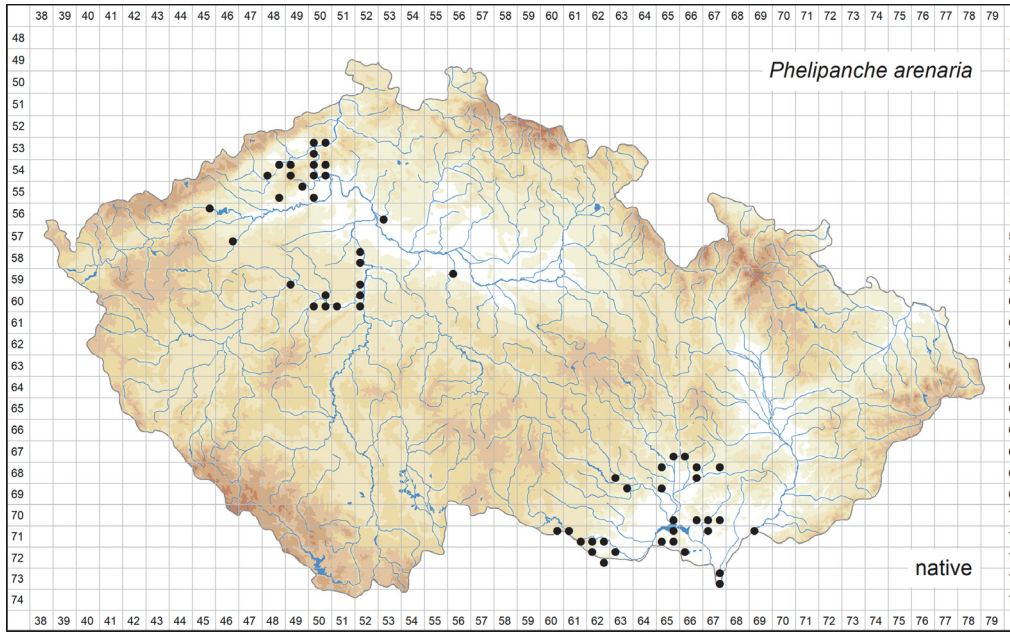


Fig. 67. – Distribution of *Phelipanche arenaria* in the Czech Republic (57 occupied quadrants). Prepared by Jiří Zázvorka.

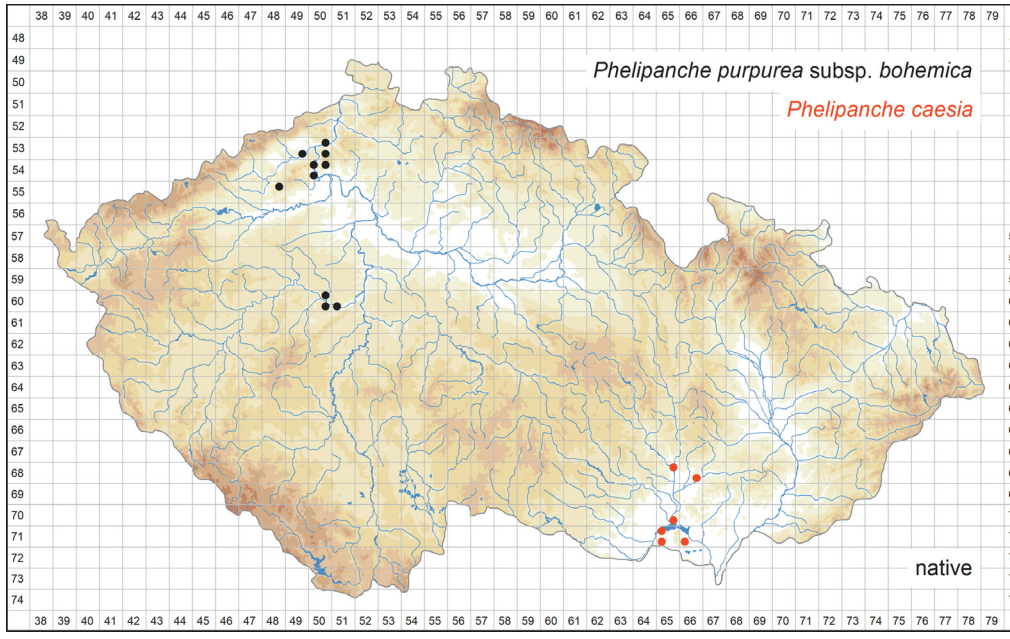


Fig. 68. – Distribution of *Phelipanche caesia* (6 occupied quadrants) and *Ph. purpurea* subsp. *bohemica* (10 occupied quadrants) in the Czech Republic. Prepared by Jiří Zázvorka.

southern Moravia: Újezd u Brna, Špice hill; Pouzdřany, Pouzdřanská step; between Pouzdřany and Popice; Dunajovické kopce hills; Brno, Petrov hill; and Bulhary, Milovický les forest. However, it has vanished from the latter two sites (Zázvorka 2000). The plants of *Ph. caesia* are often hidden in dense stands of *Artemisia pontica*, which is its usual host, but *A. absinthium* is occasionally parasitized, too. The occurrences in this country are situated at elevations of 200–300 m. *Phelipanche caesia* is classified as critically threatened due to its rarity (Grulich 2012).

Phelipanche purpurea subsp. *bohemica* (Fig. 68)

This taxon is currently classified as either a subspecies, as accepted here, or at the species level as *Phelipanche bohemica*. It has a rather small distribution, including central Europe (Switzerland, Germany, Poland, Czech Republic, Danube river basin in Lower Austria), and extends to northern Italy, southern and south-eastern France; it has also been reported from north-eastern Spain. This subspecies is rare across its whole range, and no more than 50 localities have been recorded. The majority of sites are concentrated in north-eastern Germany (federal states of Mecklenburg-Vorpommern, Brandenburg, Sachsen-Anhalt, Sachsen and Thüringen). In the Czech Republic it occurs at 12 localities in Bohemia, and in northern Italy at about 10–12 localities. Recently it was found at two sites in north-western and southern Poland, the latter being the easternmost in this subspecies' range (Uhlich et al. 1995, Pusch 2006, 2009, Carlón et al. 2008, Piwowarczyk 2012d, Rätzel 2012, Sánchez Pedraja et al. 2019). In the Czech Republic *Ph. purpurea* subsp. *bohemica* occurs in warm, dry areas of northern and central Bohemia, in the České středohoří Mts (8 sites) and in the Český kras karstic area (4 sites). It is confined to south- and west-facing rocky slopes on shallow and skeletal soils developed over basic bedrock, namely basalt and limestone. Most of this subspecies' sites can be considered naturally treeless and relict. It grows at low and middle elevations between 220 and 550 m. It was described in 1874 by L. J. Čelakovský from Velká hora hill near the village of KarlŠtějn in the Český kras karstic area, where it is still present (Zázvorka 2000, 2003). It parasitizes *Artemisia campestris* exclusively over its entire range. *Phelipanche purpurea* subsp. *bohemica* is classified as critically threatened due to its rarity and decline (Grulich 2012).

Phelipanche purpurea subsp. *purpurea* (Fig. 69)

Phelipanche purpurea subsp. *purpurea* is a widely distributed Eurasian taxon extending from the Atlantic coast of Europe in the west to central Asia in the east. Its distribution includes the Canary Islands, Portugal and Spain, France, southern parts of Great Britain, southern Denmark, Skåne and Öland in southernmost Sweden, all central-European countries, the Baltic countries, the central part of European Russia, Ukraine, southwards reaching Italy, Albania, Bulgaria, Greece and many islands in the Mediterranean Sea. In Asia it is known from Turkey, Iran, Transcaucasia and Afghanistan (Hultén & Fries 1986, Kreutz 1995, Uhlich et al. 1995, Sánchez Pedraja et al. 2019). Populations from Morocco were recently described as *Ph. p.* subsp. *ballii* (Carlón et al. 2008). Despite its large geographical range, *Ph. p.* subsp. *purpurea* is rare in most parts of Europe. In Bohemia it occurs in its western and north-western parts in the Doupovské hory Mts and České středohoří Mts. Isolated occurrences have been recorded on rocks in the valleys of the Berounka and Vltava rivers. In Moravia it is scattered through warm and dry hills in its

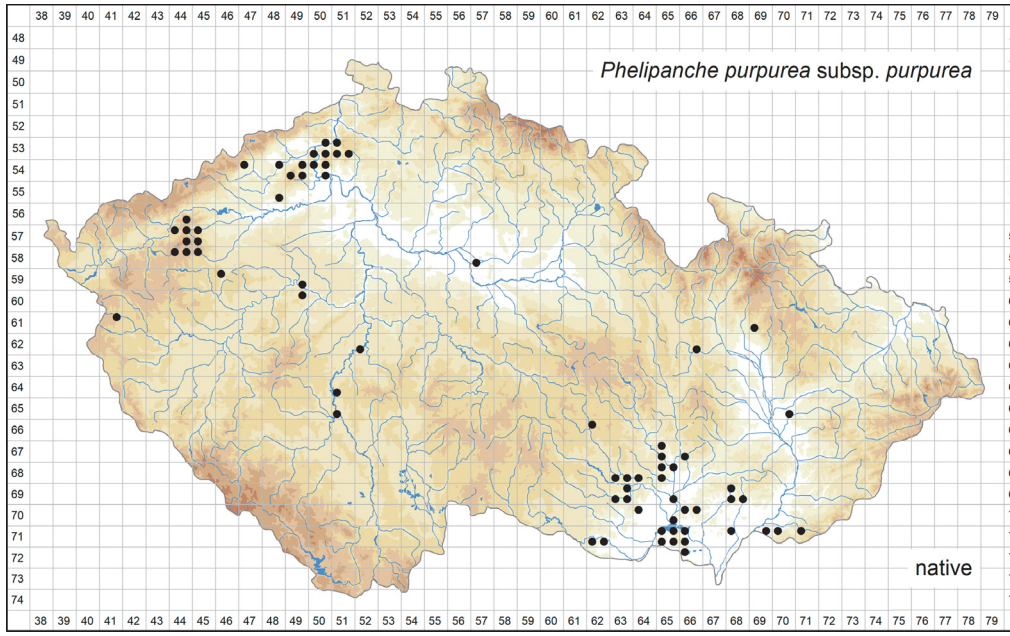


Fig. 69. – Distribution of *Phelipanche purpurea* subsp. *purpurea* in the Czech Republic (69 occupied quadrants). Prepared by Jiří Zázvorka.

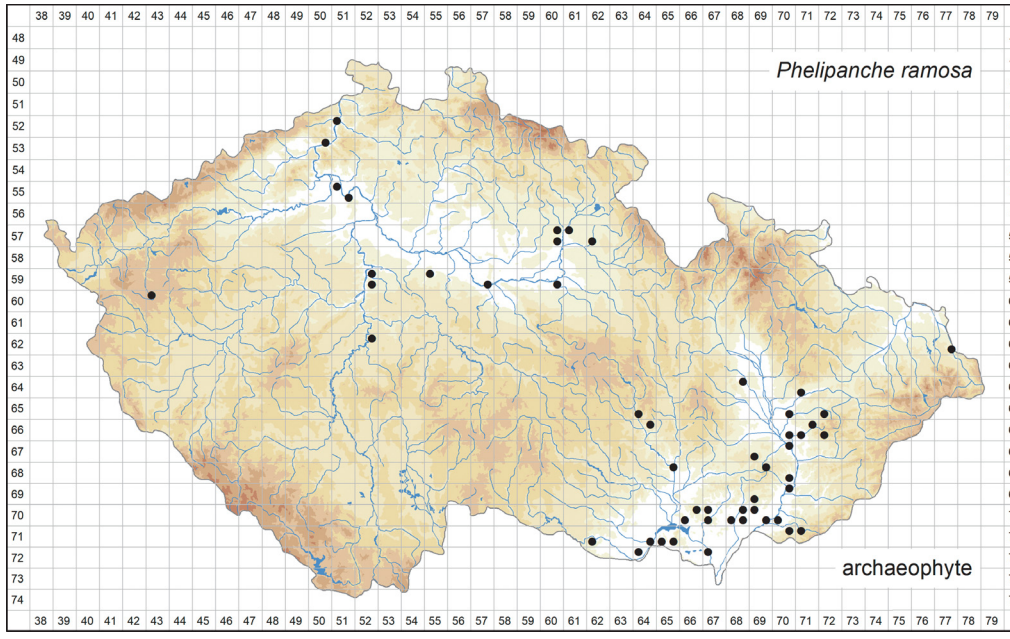


Fig. 70. – Distribution of *Phelipanche ramosa* in the Czech Republic (51 occupied quadrants). Prepared by Jiří Zázvorka.

southern parts, extending northwards to the city of Brno, and isolated occurrences are found in central Moravia. In the Czech Republic it grows in sunny grassy and rocky slopes, dry meadows, fallows, abandoned vineyards, old orchards, pastures, and in dry semiruderal grasslands mainly in areas with base-rich soils over basalt, limestone, calcareous sandstone, loess and flysch sediments. *Phelipanche purpurea* subsp. *purpurea* is found at low and middle elevations at 180–700 m, reaching its elevational maxima in the Doupovské hory Mts in western Bohemia. It has predominantly been found parasitizing various species of the *Achillea millefolium* agg. but in southern Moravia it was rarely found also parasitizing *Artemisia vulgaris*. *Phelipanche purpurea* subsp. *purpurea* is classified as critically threatened due to its rarity and decline (Grulich 2012).

Phelipanche ramosa (Fig. 70)

Phelipanche ramosa is probably native to the eastern Mediterranean area, north-eastern Africa and central Asia. It has been introduced into the temperate zone of Europe, and also to Africa, the USA and Cuba, and in some areas it is categorized as a noxious weed. In some rather warm parts of Europe, such as southern Slovakia and Hungary, it became locally established (Kreutz 1995, Uhlich et al. 1995, Zázvorka 1997, Piwowarczyk 2012e, Sánchez Pedraja et al. 2019). *Phelipanche ramosa* has accompanied hemp (*Cannabis sativa*) probably since the beginning of its cultivation in the Iron Age (Fuchs-Eckert 1987, Demuth 1992). However, its presence in the territory of the Czech Republic has been reliably documented only from the early 19th century, always from arable land. Due to the decline in hemp cultivation after 1950, it has vanished from a majority of its former sites. However, it survived locally in south-eastern Moravia on other hosts, mainly *Solanum lycopersicum*, *Capsicum annuum*, *Zea mays* and *Nicotiana tabacum*. Its latest record in the surroundings of the villages of Kozojídky and Žeraviny in south-eastern Moravia dates to 1990 (Kropáč 1973, Zázvorka 2000). Its historical distribution in the northern half of Bohemia, central and southern Moravia indicates its preference for warm climates. *Phelipanche ramosa* was under quarantine regulations for control of noxious weeds in 1964–1996 and is classified as a casual archaeophyte in this country's flora (Pyšek et al. 2012).

Prunus mahaleb (Figs 71–73)

Prunus mahaleb occurs in the southern half of Europe from Spain and Portugal in the west through southern central Europe, Romania and Moldova as far as to south-western Ukraine. It also occurs in mountains of south-western and central Asia (Poyarkova 1941, Kurtto et al. 2013) and in north-western Africa (Terpó 1968, Maire 1980). Within this species, four subspecies are sometimes distinguished: subsp. *mahaleb*, subsp. *baldaccii*, subsp. *cupaniana* and subsp. *simonkaii* (Terpó 1968). Of these subspecies only subsp. *mahaleb* and subsp. *simonkaii* are reported to occur in the Czech Republic (Chrtek 1992a). It is assumed that all native populations in Bohemia correspond to the type subspecies, while those in Moravia belong to *P. m.* subsp. *simonkaii*. However, *P. mahaleb* is grown ornamentally and occasionally used as a rootstock for stone fruit (Chrtek 1992a, Hanelt 1997, Jäger 2017). This is connected with the import of seed and transport of plants from different parts of the species' range, which may have obscured the original biogeographic pattern. In the Czech Republic *P. mahaleb* is found in xeric scrub and

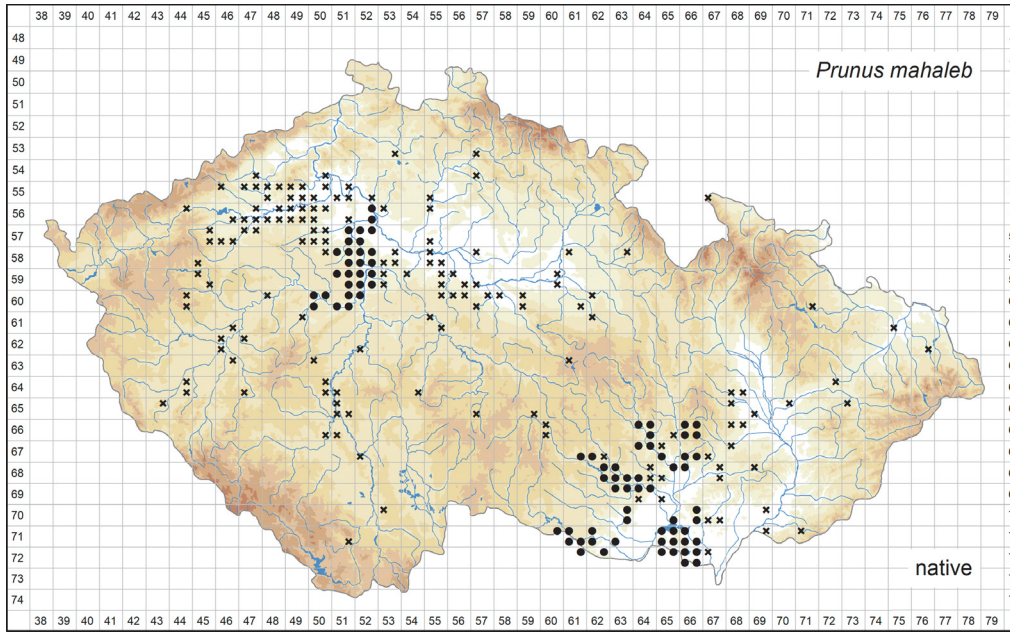


Fig. 71. – Distribution of *Prunus mahaleb* in the Czech Republic: ● native (80 quadrants), × alien (153 quadrants). Prepared by Boleslav Jelínek.

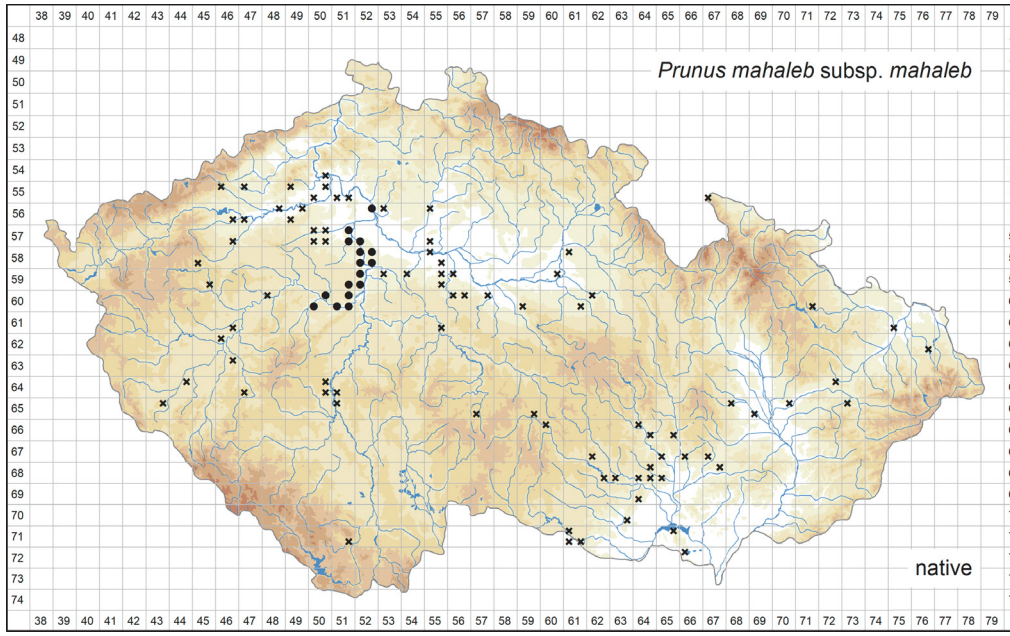


Fig. 72. – Distribution of *Prunus mahaleb* subsp. *mahaleb* in the Czech Republic: ● native (17 quadrants), × alien (83 quadrants). Prepared by Boleslav Jelínek.

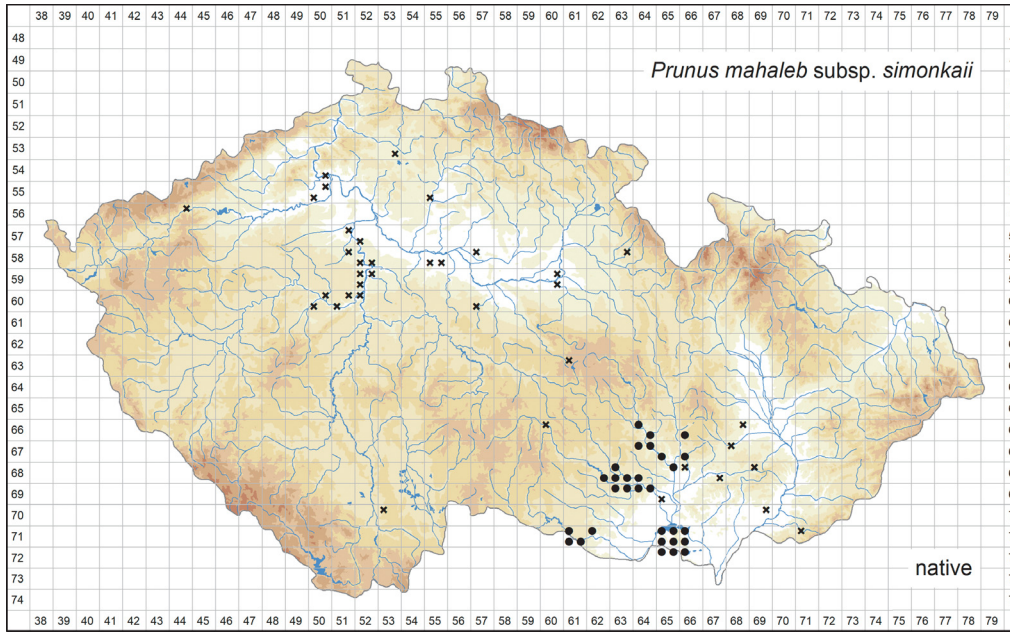


Fig. 73. – Distribution of *Prunus mahaleb* subsp. *simonkaii* in the Czech Republic: ● native (30 quadrants), × alien (37 quadrants). Prepared by Boleslav Jelínek.

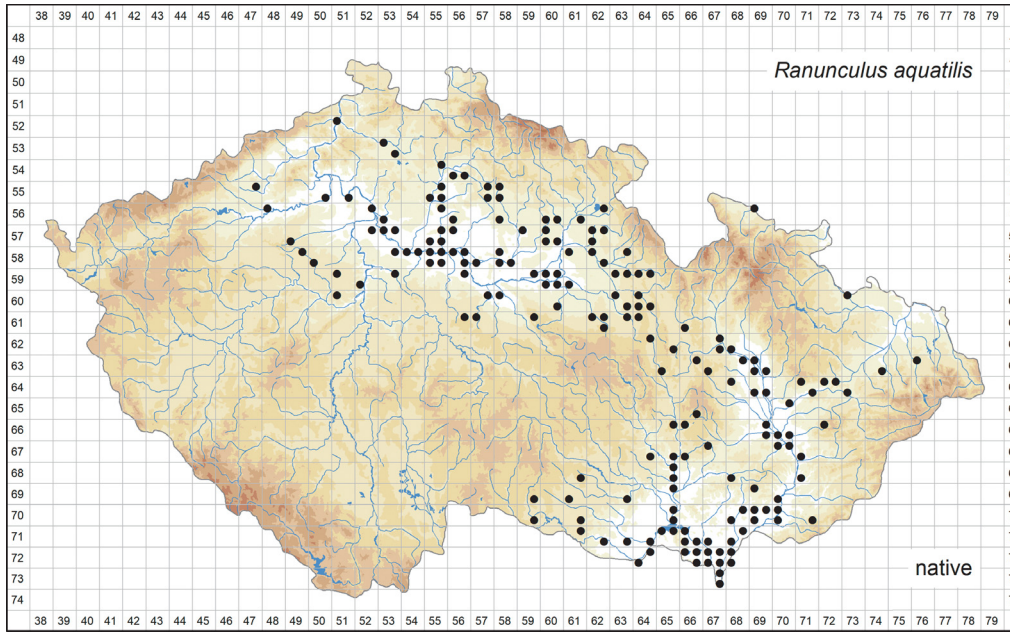


Fig. 74. – Distribution of *Ranunculus aquatilis* in the Czech Republic (181 occupied quadrants). Prepared by Jan Prančl, Petr Koutecký & Zdeněk Kaplan.

thermophilous oak forests on warm rocky and stony slopes, and on shallow and dry soils mainly above alkaline bedrock, with native populations being found mainly on rocky slopes in river valleys. Fossil records indicate the occurrence of *P. mahaleb* in Prague in the Early Middle Ages (Čulíková 1998). The native occurrence of *P. m.* subsp. *mahaleb* in this country is probably confined to the Berounka and Vltava river valleys from the town of Beroun downstream to the vicinity of the town of Kralupy nad Vltavou in central Bohemia (Fig. 72) with those of *P. m.* subsp. *simonkai* located in the Dyje, Jihlava and Rokytná river valleys, the vicinity of the city of Brno and the Pavlovské vrchy hills in south-western and southern Moravia (Fig. 73). In the Czech Republic *P. m.* subsp. *simonkai* is classified as vulnerable and *P. m.* subsp. *mahaleb* as lower risk – data deficient (Grulich 2012).

Ranunculus aquatilis (Fig. 74)

Ranunculus aquatilis occurs in most of Europe. It is distributed from southern Scandinavia in the north to the Mediterranean area in the south, extending eastwards to western regions of European Russia. Outside Europe it has been recorded in northern Africa and in the western countries of the Middle East, but the exact eastern boundary is unclear (Cook 1966, Wiegleb et al. 2017). It is also reported to have been introduced into Chile (Lumbreras et al. 2014), but the identity of these plants should be examined. In the Czech Republic *R. aquatilis* grows in still, clear, mesotrophic to naturally eutrophic, mineral-rich aquatic habitats, often with significant fluctuations in water levels during the growing season. It most frequently occurs in pools, oxbows and fishponds in early successional stages or in sites affected by frequent disturbance. In this country it has been only rarely recorded in rivers and streams. It can also grow in periodically dry aquatic habitats, where it produces specific terrestrial forms on exposed bottoms. The species occurs mainly in the lowlands on the base-rich substrates, such as in the Labe river basin, marlstone areas of eastern Bohemia and large river floodplains in southern and central Moravia. It is absent from western and southern Bohemia and appears to have vanished from north-western Bohemia, northern Moravia and Silesia. *Ranunculus aquatilis* was classified as of lower risk – data deficient in the last Red List (Grulich 2012). This species has declined during the last decades due to eutrophication, intensive fishpond management, habitat destruction and draining. We therefore suggest its classification as vulnerable. Until recently, *R. aquatilis* has been considered the most abundant water-crowfoot species in this country; however, most of the earlier records belong to *R. peltatus*, which has not been distinguished in former floras (e.g. Husák et al. 1988). Because of frequent misidentifications, the distribution map of this species is based solely on examined herbarium specimens and on plants examined using flow cytometry (Prančl et al. 2018).

Ranunculus baudotii (Fig. 75)

Ranunculus baudotii occurs in most of Europe south of 65°N and in northern Africa. It is characteristic of brackish waters in coastal areas across Europe but rarely grows also in inland aquatic habitats. The eastern limit of the species' range is poorly known; it is known from as far east as along the Gulf of Finland, inland areas of Slovakia and Hungary and coastal areas of Slovenia, Croatia and Greece (Cook 1966, Wiegleb et al. 2017, Prančl et al. unpubl.). In the Czech Republic *R. baudotii* grows in eutrophic, mineral-rich,

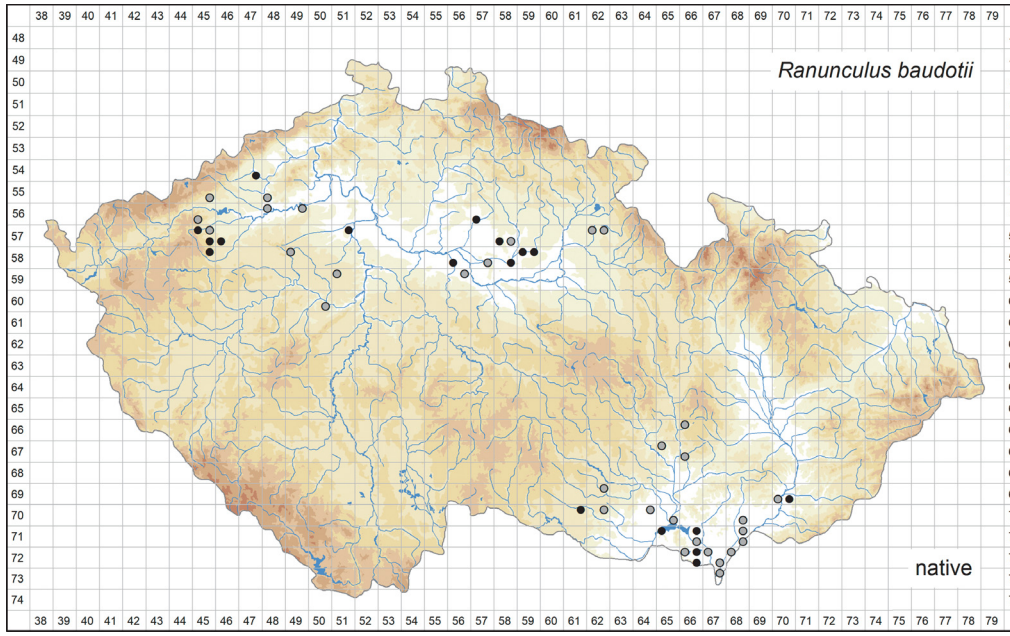


Fig. 75. – Distribution of *Ranunculus baudotii* in the Czech Republic: ● at least one record in 2000–2019 (18 quadrants), ● pre 2000 records only (31 quadrants). Prepared by Jan Prančl, Petr Koutecký & Zdeněk Kaplan.

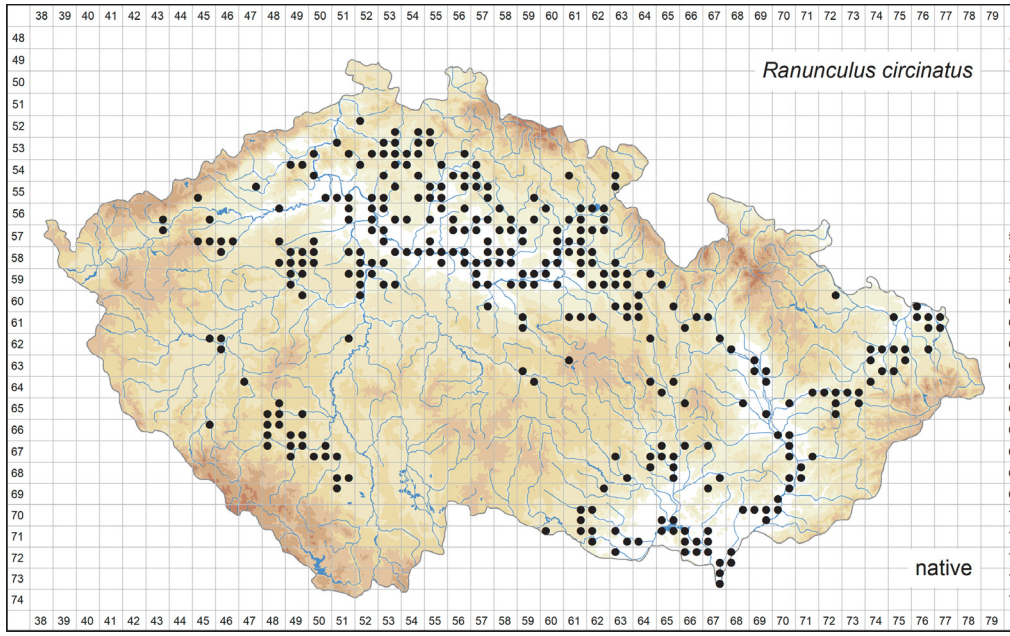


Fig. 76. – Distribution of *Ranunculus circinatus* in the Czech Republic (314 occupied quadrants). Prepared by Jan Prančl, Petr Koutecký & Zdeněk Kaplan.

sunny waters, often with high concentrations of chlorides (Šumberová 2011b). It occurs mainly in man-made habitats, such as flooded abandoned quarries or sand and gravel pits on basic substrates (especially kaolinite and calcareous sandstones and sands) and fishponds with naturally eutrophic water. It prefers early successional stages when enough nutrients are available but the water is not yet turbid or affected by massive algal development. It rarely occurs in streams. In this country *R. baudotii* is almost exclusively a lowland species, having most of its sites in southern Moravia, the Labe river basin and the kaolin mining area in the vicinity of the town of Podbořany. The species is threatened by its overall rarity, strong eutrophication and succession in flooded quarries. It is classified as critically endangered (Grulich 2012). The map is based solely on examined herbarium specimens and on fresh plants examined by flow cytometry (Prančl et al. 2018).

Ranunculus circinatus (Fig. 76)

Ranunculus circinatus is a Eurasian species. In Europe it is restricted mainly to its temperate zone. The species' distribution reaches from Ireland, Scotland and southern Scandinavia in the north to central France, northern Italy and Slovenia southwards. The south-eastern limit of the European distribution is poorly known. In Asia the species has been reported from large areas of the temperate and boreal zones as far as easternmost Siberia (Cook 1966). It is also reported from northern Africa and south-western Asia (Wiegleb et al. 2017) but these occurrences require revision considering the absence of this species in the Mediterranean part of Europe. It occurs in mesotrophic to naturally eutrophic, base-rich sunny waters; it is also capable of growing in brackish habitats. It prefers permanent water bodies that do not dry out, and it often persists only vegetatively in deep water. In the Czech Republic *R. circinatus* occurs mainly in fishponds, alluvial pools and oxbows, abandoned flooded quarries, and sand and gravel pits in early stages of terrestrialization. It avoids organic-rich substrates such as sapropelic mud (Šumberová 2011b). Unlike elsewhere in Europe, it is only rarely found in running water. *Ranunculus circinatus* is distributed in rather warm areas in the northern half of Bohemia, with an outpost in the fishpond-rich areas of south-western Bohemia (but it is absent from the Třeboňská pánev basin), and in large river floodplains in Moravia and Silesia, being rare elsewhere. It is classified as vulnerable (Grulich 2012). The map is based on examined herbarium specimens, flow cytometric data (Prančl et al. 2018) and selected literature and database records.

Ranunculus fluitans (Fig. 77)

Ranunculus fluitans is a European species with a sub-Atlantic distribution, being most common in north-western Europe. In the west it extends to Northern Ireland, France and northernmost Spain, in the east it occurs as far as in Lithuania, Poland, Slovakia and Hungary, northwards it reaches Denmark and southernmost Sweden, southwards it is distributed as far as southern France, Switzerland, Austria and possibly also northernmost Italy (Cook 1966, Englmaier 2016, Wiegleb et al. 2017). *Ranunculus fluitans* is an obligatory running-water species characteristic of fast-running rivers and streams with a stony, gravelly or sandy bottom. In the Czech Republic it most often grows in middle reaches of rivers with cool, clear, nutrient-poor water (Šumberová 2011a), occasionally also in artificial channels and millraces. In large regulated rivers with turbid water it occurs predominantly in rapidly flowing sections below weirs. The distribution of *R. fluitans* is restricted to

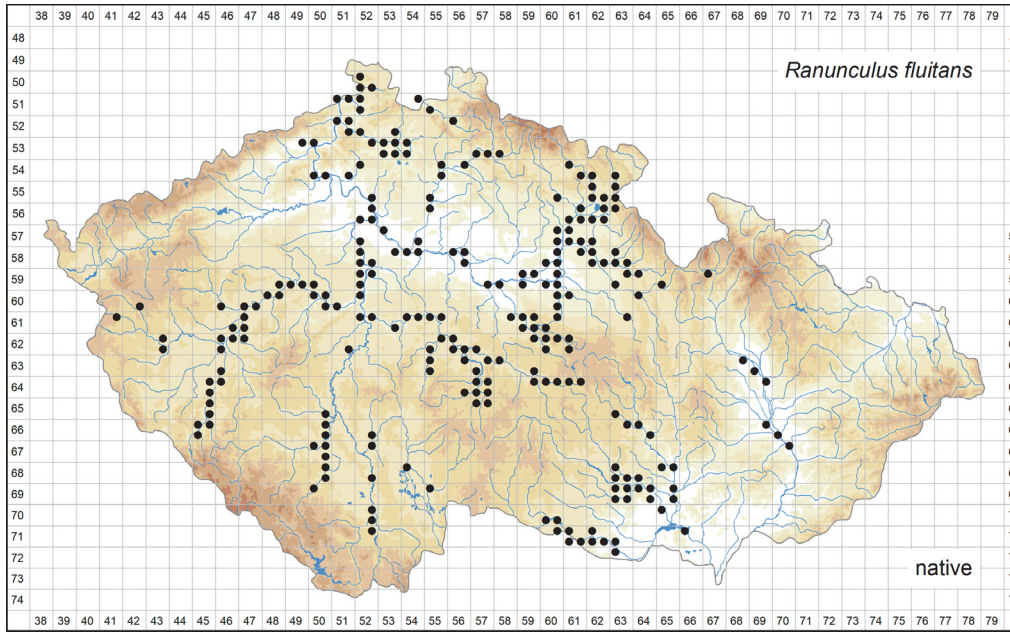


Fig. 77. – Distribution of *Ranunculus fluitans* in the Czech Republic (241 occupied quadrants). Prepared by Jan Prančl, Petr Koutecký & Zdeněk Kaplan.

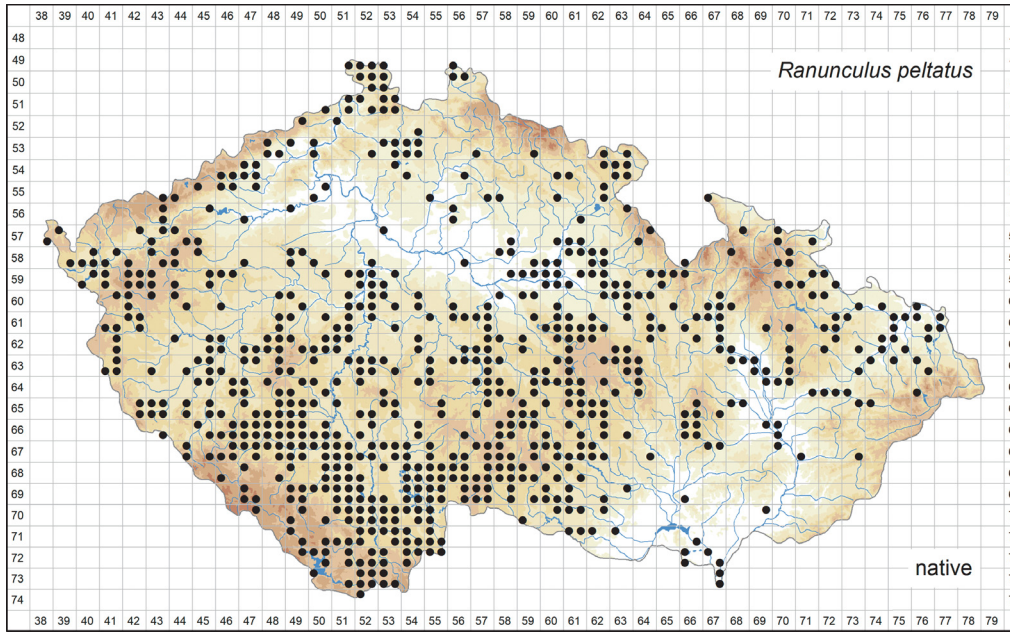


Fig. 78. – Distribution of *Ranunculus peltatus* in the Czech Republic (739 occupied quadrants). Prepared by Jan Prančl, Petr Koutecký & Zdeněk Kaplan.

several dozen streams at middle and low elevations in Bohemia and south-western Moravia. Formerly this species occurred also in the Morava river in central Moravia, from which it has vanished. *Ranunculus fluitans* has somewhat declined due to river regulation, pollution and construction of water reservoirs. It is therefore classified as vulnerable (Grulich 2012). The map is based on examined herbarium specimens, flow cytometric data (Prančl et al. 2018), and selected literature and database records, mainly from those rivers where this species is also documented in herbaria. However, we rejected many non-herbarium records as the name *Batrachium fluitans* has often been erroneously used for any *Ranunculus* sect. *Batrachium* species growing in running waters.

Ranunculus peltatus (Fig. 78)

Ranunculus peltatus is mainly a European species that includes several infraspecific taxa and different ploidy levels (Cook 1966). It is reported from the whole of the continent except the northernmost parts and also occurs in northern Africa and south-western Asia. However, the exact distribution limits in the middle and eastern Mediterranean area are unknown due to the confusion with similar taxa (e.g. *R. saniculifolius* and *R. sphaerospermus*). Also, the northern distribution limits in Scandinavia and Russia are poorly known due to the confusion with *R. schmalhausenii*. In the east, the confirmed species' distribution reaches the Baltic countries, Belorussia and Ukraine (Wiegleb et al. 2017). In the Czech Republic only tetraploid plants occur (Prančl et al. 2018). This species grows in fishponds as well as on their exposed bottoms, in various other types of pools, in rivers and brooks, often at sites with significant fluctuations in water level during the growing season. It has a relatively wide ecological amplitude and occurs in oligotrophic to eutrophic (but not highly turbid) water with sandy or organic substrate, but mostly in areas on acidic bedrock. *Ranunculus peltatus* grows throughout this country but it is rare in the lowlands. This is probably caused by the fact that the warm lowlands in the Czech Republic are composed mainly of mineral-rich sediments. *Ranunculus peltatus* is the most common water-crowfoot species in this country; however, it has somewhat declined as a result of intensive fish farming, eutrophication, river regulation and pollution. The map is based on examined herbarium specimens, flow cytometric data (Prančl et al. 2018), and selected literature and database records.

Ranunculus penicillatus agg. (Fig. 79)

The *Ranunculus penicillatus* agg. consists of various allopolyploids arising from hybridization of *R. fluitans* with several other species (*R. peltatus*, *R. aquatilis*, *R. trichophyllus* and perhaps also *R. circinatus* and *R. baudotii*; e.g. Cook 1966, Zalewska-Gałosz et al. 2014). Some phenotypes are recognized at the species or subspecies level (*R. penicillatus* s. str., *R. pseudofluitans*, *R. vertumnus*; Wiegleb et al. 2017), but the current taxonomic concept does not correspond with the actual diversity, which remains largely unrecognized (Prančl et al. 2018). The taxa of the *R. penicillatus* agg. are obligatory running-water plants growing in rivers and streams with gravelly, sandy and muddy bottoms, both on alkaline and acidic bedrock. They are reported across Europe, with the highest concentration of localities in the western part of the continent. Northwards they reach Ireland, England, Denmark and the Baltic countries, southwards they are distributed in the western half of the Mediterranean area. The eastern limit of distribution is poorly known;

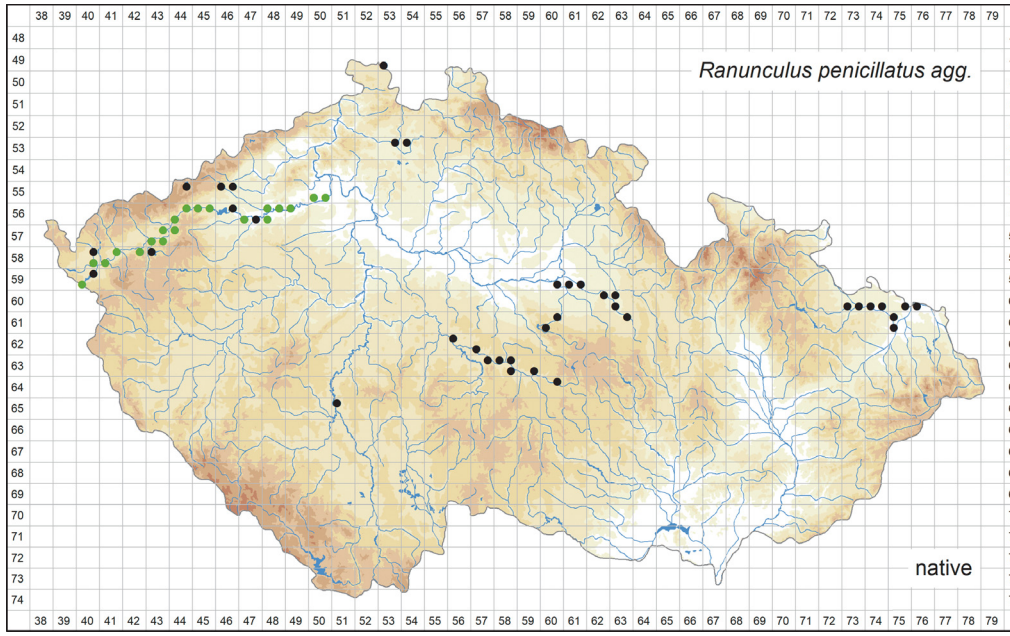


Fig. 79. – Distribution of *Ranunculus penicillatus* agg. (●, 37 occupied quadrants) and the hybrid swarm of *R. peltatus* × *R. penicillatus* agg. (●, 20 occupied quadrants) in the Czech Republic. Prepared by Jan Prančl, Petr Koutecký & Zdeněk Kaplan.

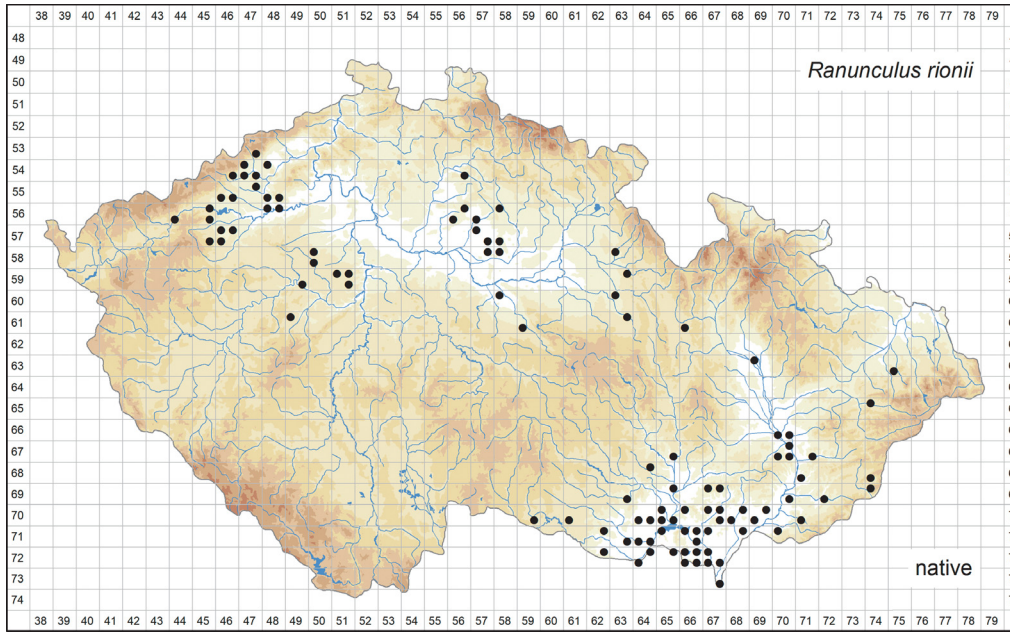


Fig. 80. – Distribution of *Ranunculus rionii* in the Czech Republic (103 occupied quadrants). Prepared by Jan Prančl, Petr Koutecký & Zdeněk Kaplan.

however, the individual taxa have been reported from Belorussia, Ukraine and the Black Sea area (Wiegleb et al. 2017). In the Czech Republic *R. penicillatus* agg. is rare. Two tetraploid cytotypes, apparently of different origin, are reported from this country (cytotypes A and B sensu Prančl et al. 2018). Cytotype A was recorded in the Opava and Odra rivers in Silesia and in a few rivers in Bohemia, namely Sázava and Chrudimka in the Českomoravská vrchovina highlands, and Ploučnice and Spréva (Spree) in northern Bohemia, and formerly also in the Vltava river. Cytotype B has been revealed in the base-rich course of the Loučná river in eastern Bohemia. *Ranunculus penicillatus* is classified as endangered (Grulich 2012). It is threatened by river regulation, pollution and eutrophication. The map is based on examined herbarium specimens, flow cytometric data (Prančl et al. 2018), and selected literature and database records.

In the Ohře river and its tributaries in north-western Bohemia, a large hybrid swarm between *R. penicillatus* agg. (cytotype A) and *R. peltatus* occurs. Some plants are morphologically intermediate while others resemble the parental species, although genome size data suggest that all analysed populations (irrespective of their morphology) are intermediate (Prančl et al. 2018). The distribution in the Ohře river basin was therefore mapped including intermediate plants of putative hybrid origin. In most of the mapping grid quadrants, the intermediates (morphology and genome size) are present. In a few quadrants, only herbarium specimens of morphology more or less typical of *R. penicillatus* agg. were available; these quadrants are mapped accordingly as pure *R. penicillatus* agg. although the specimens may represent extremes of morphological variation of the hybrid, whose occurrence in that section of the river is highly probable anyway.

Ranunculus rionii (Fig. 80)

Ranunculus rionii is distributed in Europe, western and central Asia eastwards to China. In Europe it is distributed mainly in the south-eastern part of the continent, reaching easternmost France in the west and central Germany, the Czech Republic, Slovakia and Ukraine in the north (Cook 1966, Wolff 1989, Wiegleb et al. 2017). In the Czech Republic *R. rionii* grows in still, eutrophic, mineral-rich sunny aquatic habitats, often with elevated salt concentration, mostly in the lowlands. It is characteristic of habitats in early successional stages, but also tolerates polluted and turbid waters. It mainly occurs in shallow, warm fishpond margins and on exposed bottoms of fishponds, in flooded abandoned quarries and sand and gravel pits on base-rich substrates and occasionally also in alluvial pools. It appears to be an annual species, disappearing during summer. In deep water it often flowers and set fruits completely submerged. In this country *R. rionii* is most frequent in southern Moravia, while in central and northern Moravia it is rare. In Bohemia, the species occurs in four main areas, including the warmest parts of north-western Bohemia, the area west and south-west of Prague, the mildly undulating landscape between the towns of Turnov and Golčův Jeníkov and in marlstone areas of eastern Bohemia. *Ranunculus rionii* is classified as endangered (Grulich 2012). It is locally threatened by intensive fish farming. However, it is also under-recorded due to its inconspicuous appearance and confusion with *R. trichophyllus*. The species was collected for the first time in 1900 in southern Moravia, and the earliest find in Bohemia was not until 1956. In addition, most of the occurrences in this country have been recorded since the 1990s, which indicates that this species has been spreading during the past decades, probably

due to the continuing eutrophication, fertilizing and liming of fishponds and perhaps also climatic change. Currently it is probably the most common species of *Ranunculus* sect. *Batrachium* in southern Moravia. The map is based on examined herbarium specimens, flow cytometric data (Prančl et al. 2018), and the limited number of literature and database records.

Ranunculus trichophyllus s. l. (Fig. 81)

Ranunculus trichophyllus s. l. has a sub-cosmopolitan distribution, being reported from Eurasia except for Japan, North and South America, Greenland, northern and southern Africa, Australia, Tasmania and New Zealand (Wiegleb et al. 2017). The group includes several cryptic taxa with unresolved taxonomy. In the Czech Republic two tetraploid cytotypes of somewhat different genome size were revealed (cytotypes A and B sensu Prančl et al. 2018). Based on flow cytometric data, the cytotypes significantly differ in their distributions and ecological preferences. Cytotype A occurs in mesotrophic to eutrophic water, usually on acidic substrates. It mainly grows in fishponds, water reservoirs and their exposed bottoms, occasionally also in adjacent pools. It appears to be usually annual. Most localities are situated in the fishpond basins in southern Bohemia. Cytotype B grows mostly in naturally eutrophic, base-rich water, such as in fishponds and alluvial wetlands; formerly it was also frequent in pools in lowland calcareous fens. It is mainly distributed in the lowlands, including the Labe river basin, warm areas of southern Moravia and the Morava river floodplain in central Moravia. In areas with basic bedrock it occurs also at middle elevations, such as in the vicinity of the town of Strakonice in southern Bohemia and in the marlstone areas of eastern Bohemia. Both cytotypes have been rarely found in streams. When growing in deep water, they often flower and set fruits completely submerged. Despite considerable differences, it is not always possible to assign herbarium specimens to a particular cytotype with certainty, and the map is thus prepared only for the collective species. *Ranunculus trichophyllus* is classified as of lower risk – near threatened (Grulich 2012). It has declined as a result of strong eutrophication, intensive fish farming and habitat destruction. It is also frequently overlooked due to its inconspicuous appearance and lack of prominent diagnostic characters; cytotype B may sometimes be confused with *R. aquatilis*.

Ranunculus peltatus × *R. trichophyllus* s. l. (Fig. 82)

This hybrid is known from Great Britain, Germany, Austria and the Czech Republic (Wiegleb et al. 2017, Prančl et al. 2018). It is reported also from the Aegean Islands (Dahlgren 1991), but this record requires revision. Of at least six hybrid combinations of water-crowfoots recorded in the Czech Republic (Prančl et al. 2018), this is the only hybrid that is relatively common. It occurs at sites where parental species co-occur, such as fishponds and streams, but can also persist at localities from which one or both parental species have vanished. It grows mainly in mesotrophic clear waters on sandy or organic substrates, preferring soft waters on acidic bedrock. In the Czech Republic this hybrid has an uneven frequency, with most of its localities situated in the southern Bohemian fishpond basins and in the Českomoravská vrchovina highlands (having the most plentiful localities in the upper course of Svratka river). This hybrid most often represents the F1 generation of a cross between *R. peltatus* and *R. trichophyllus* cytotype A (sensu

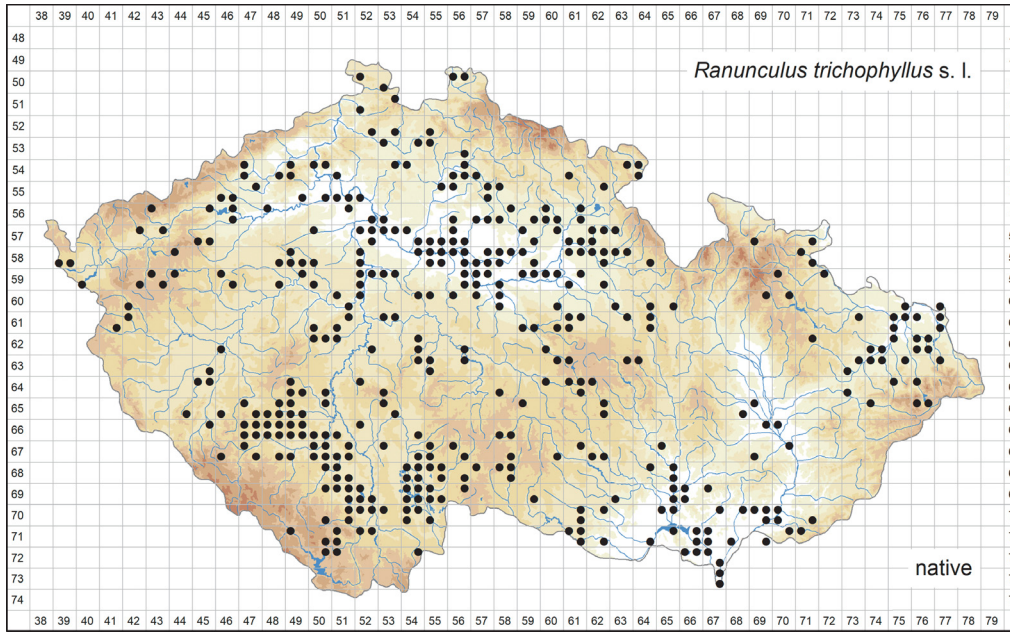


Fig. 81. – Distribution of *Ranunculus trichophyllus* s. l. in the Czech Republic (410 occupied quadrants). Prepared by Jan Prančl, Petr Koutecký & Zdeněk Kaplan.

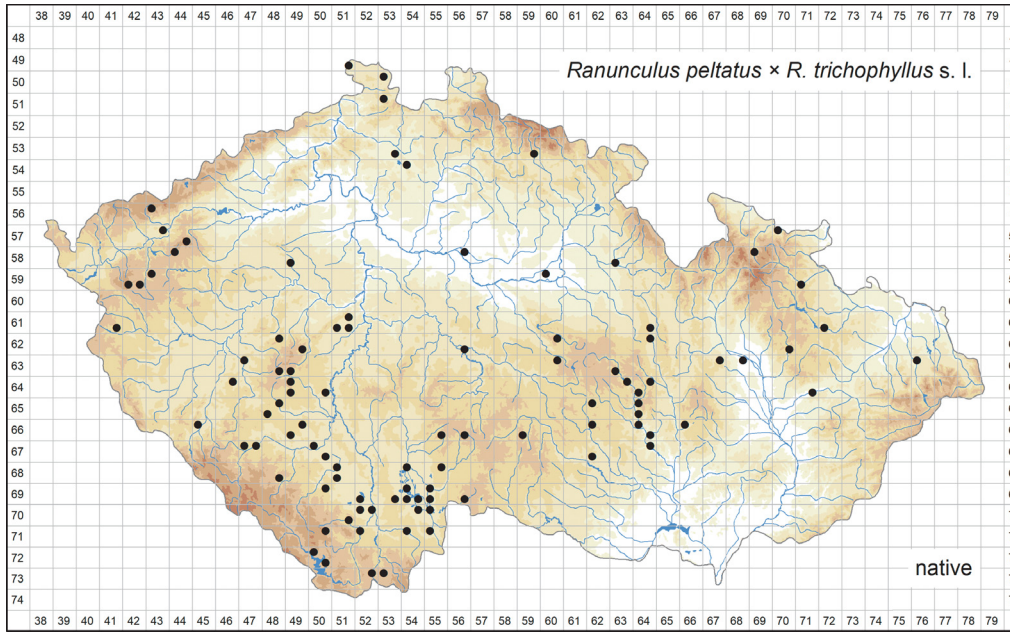


Fig. 82. – Distribution of *Ranunculus peltatus* × *R. trichophyllus* s. l. in the Czech Republic (96 occupied quadrants). Prepared by Jan Prančl, Petr Koutecký & Zdeněk Kaplan.

Prančl et al. 2018; see comment on *R. trichophyllus*) but is also capable of backcrossing with both parental species. The backcrosses, which occur primarily towards *R. peltatus* and rarely towards *R. trichophyllus*, were revealed by flow cytometry (Prančl et al. 2018) and are often difficult to be recognized by morphology; remarkably, backcrossed plants are frequent in several rivers, such as Lužnice, Stropnice and Malše in southern Bohemia and Moravice in northern Moravia (Prančl et al. 2018). This hybrid is often misidentified as the morphologically similar but unrelated *R. aquatilis*. The map is based solely on examined herbarium specimens and flow cytometric data (Prančl et al. 2018).

Selaginella helvetica (Fig. 83)

Selaginella helvetica occurs disjunctly in mountains of central and south-eastern Europe, in northern Anatolia, the Caucasus Mts, north-eastern China, North Korea and the Russian Far East (Meusel et al. 1965). It is a species of moist mossy rocks, moist screes and also of moist alluvial meadows. In this country there are only three reliable records of this rare lycopod. Old occurrences documented by herbarium specimens came from the Labské pískovce sandstone area in northern Bohemia (Köck 1983) and from the Krkonoše Mts (Chrtek 1981). Records of *S. helvetica* in old botanical literature from sites next to the border of the Czech Republic actually refer to sites in Polish territory (e.g. villages of Branice and Bliszczyce east of the town of Krnov in Silesia; Podpěra 1926). Some old records are clearly erroneous, based on misidentified herbarium specimens of cultivated species from the tropics, or remain doubtful. With the latest record dating to 1929, *S. helvetica* is considered extirpated from the Czech Republic (Grulich 2012).

Selaginella selaginoides (Fig. 84)

Selaginella selaginoides is a small terrestrial lycopod with a circumboreal distribution in arctic and subalpine areas of the Northern Hemisphere. It occurs in northern Europe, Iceland, Greenland and in the mountains throughout Europe, including the Pyrenees, Alps, Carpathians and the mountains of the Balkan Peninsula; it is also found in the higher parts of the Caucasus Mts. Its range extends eastwards to northern Russia, central Siberia, easternmost Russia, Japan and northern parts of North America (Hultén & Fries 1986). In the Czech Republic *S. selaginoides* inhabits subalpine meadows and moist rocky slopes of the highest parts (usually at elevations 1100–1400 m) of the Krkonoše Mts and Hrubý Jeseník Mts and formerly Mt Králický Sněžník. Because of its limited distribution it is considered endangered in this country (Grulich 2012).

Stachys alpina (Fig. 85)

Stachys alpina is distributed in the mountains of central, southern and south-eastern Europe from northern and central Spain (it has been introduced to Great Britain) in the west to the Eastern Carpathians in the east. Its northern distributional limit runs through the Ardennes, central Germany, the Sudetes mountains and the Carpathians, with several outposts in the vicinity of the city of Lublin in south-eastern Poland; southwards it reaches southern Italy and central Greece from which it extends to northern Anatolia, the Caucasus Mts and northern Iran. In the Czech Republic *S. alpina* occurs in deciduous and mixed forests, forest fringes and clearings, subalpine tall-forb and tall-grass vegetation,

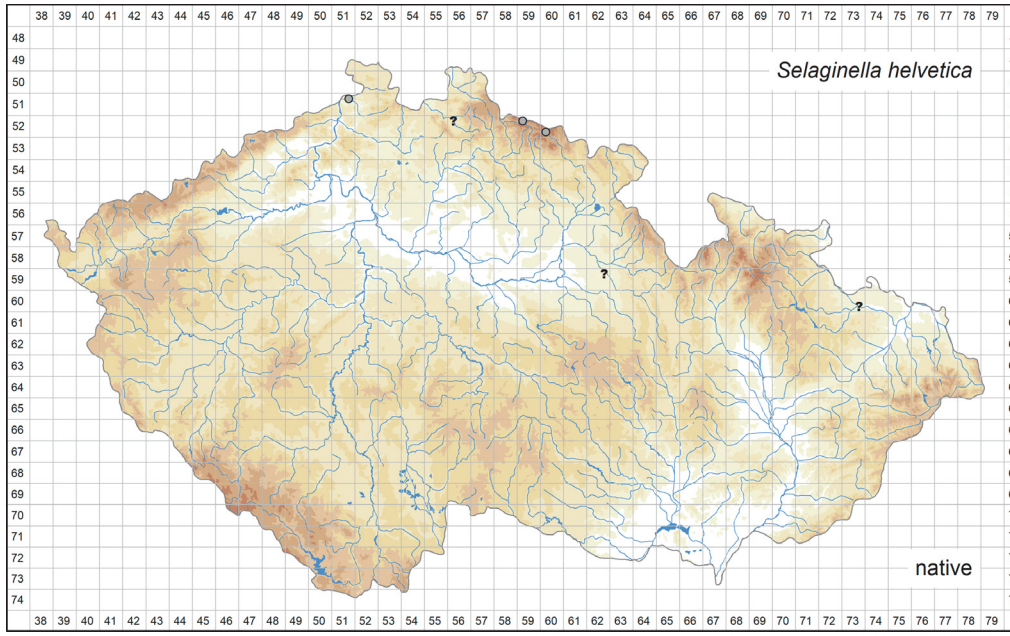


Fig. 83. – Distribution of *Selaginella helvetica* in the Czech Republic: ● pre 2000 records only (3 quadrants). Prepared by Libor Ekrt.

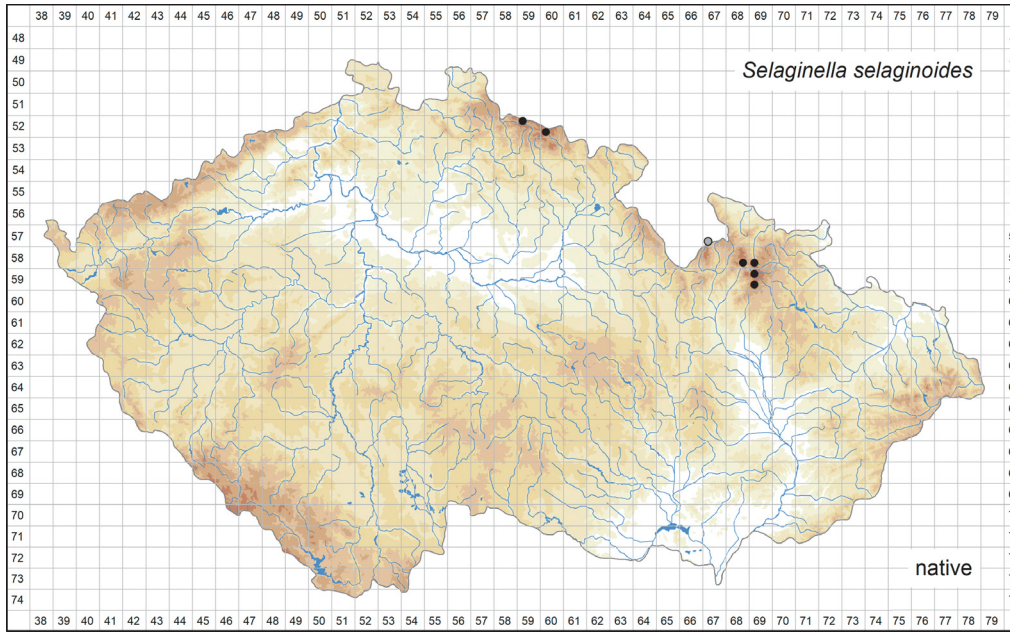


Fig. 84. – Distribution of *Selaginella selaginoides* in the Czech Republic: ● at least one record in 2000–2019 (6 quadrants), ● pre 2000 records only (1 quadrant). Prepared by Libor Ekrt.

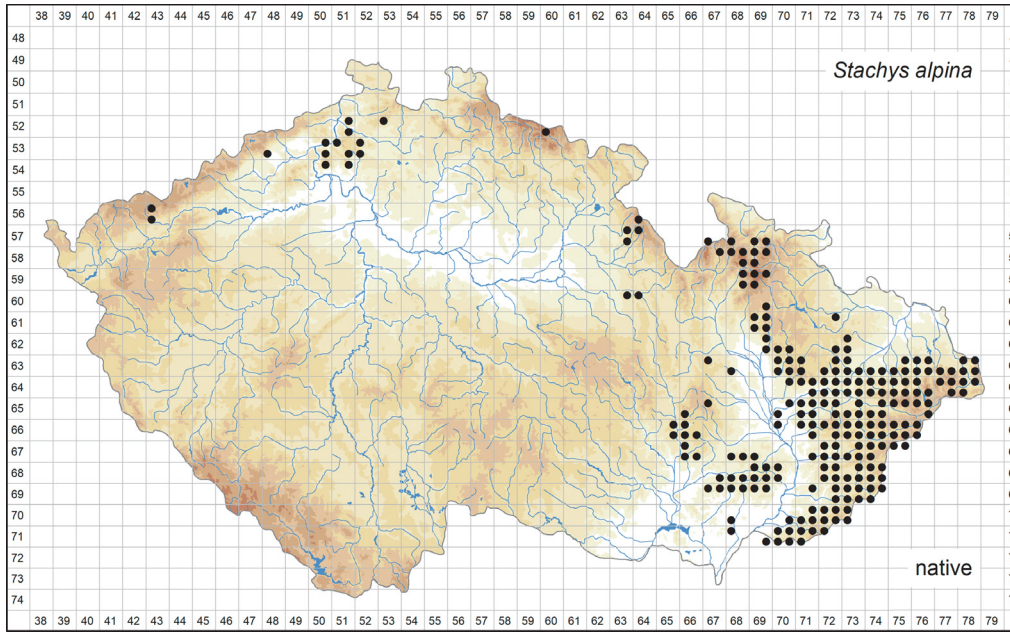


Fig. 85. – Distribution of *Stachys alpina* in the Czech Republic (227 occupied quadrants). Prepared by Jindřich Chrtek Jr.

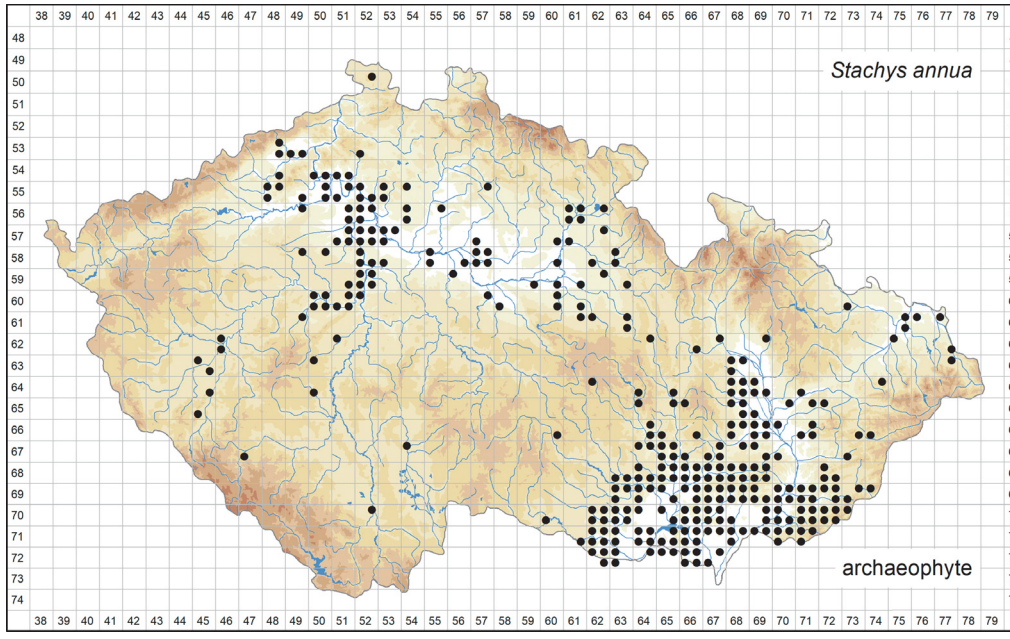


Fig. 86. – Distribution of *Stachys annua* in the Czech Republic (316 occupied quadrants). Prepared by Jindřich Chrtek Jr.

and on the fringes of montane brooks. It is usually found on moderately humid to humid, slightly acidic to basic soils rich in nutrients and humus. *Stachys alpina* is scattered to locally common in the mountains and hilly landscapes of the Carpathians in north-eastern and eastern Moravia, becoming less frequent in adjacent hilly landscapes and reaching lowlands in forests around the towns of Přerov, Kroměříž and Hodonín. Westwards it is scattered in the Oderské vrchy hills, Nízký Jeseník hills, Hrubý Jeseník Mts and on Mt Králický Sněžník in northern Moravia and Silesia. In Bohemia it occurs disjunctly in the Orlické hory Mts and their foothills, also the Krkonoše Mts and Lužické hory Mts as well as in the northern and north-eastern parts of the České středohoří Mts and in the Krušné hory Mts (Němečková 1973). In the Carpathians *Stachys alpina* has declined slightly in its abundance but does not seem to be immediately threatened. In contrast, it has vanished from many sites in north-western and northern Moravia and in Bohemia, in the latter being very rare. *Stachys alpina* is classified as vulnerable in this country (Grulich 2012).

Stachys annua (Fig. 86)

Stachys annua is continuously distributed from Spain in the west to western Siberia, the Caspian Sea and Iran in the east; northwards it reaches northern Germany, northern Poland, the Baltic countries and north-western Russia; the southern distributional limit runs through southern continental Italy (it is absent from Sicily, as well as from most of the Mediterranean islands), southern Greece and Syria. It has been introduced into North America (Meusel et al. 1978, USDA, NRCS 2019). In the Czech Republic *S. annua* occurs as a weed in arable land, especially in stubble fields, in road verges, vineyards, ruderal habitats, less often in open disturbed grasslands. It prefers moderately dry to dry, neutral to basic soils, moderately nutrient-rich and calcium-rich. *Stachys annua* is found at low and middle elevations in areas with warm to moderately warm climates, reaching its elevational maxima in isolated occurrences at about 670 m in the Bílé Karpaty Mts in eastern Moravia and in the town of Nové Město na Moravě in western Moravia. In Bohemia it is scattered to rare in its north-western, central and eastern parts and very rare or absent elsewhere. It is still scattered to locally common in southern and central Moravia, northwards reaching the towns of Litovel and Lipník nad Bečvou, and rare (and exclusively in ruderal habitats) in northern Moravia and Silesia. *Stachys annua* declined markedly due to stubble tillage, which was widely introduced in this country in the 1950s. In the Czech flora this species is considered to be a naturalized archaeophyte (Pyšek et al. 2012) and classified as endangered (Grulich 2012).

Stachys arvensis (Fig. 87)

In Europe *Stachys arvensis* has an Atlantic-Mediterranean distribution; northwards it reaches the British Isles, southern Scandinavia, and isolated outposts exist in north-western Russia; the eastern distributional limit runs through the Baltic countries, western Poland, Serbia and Greece. Outside Europe it occurs in Anatolia, Israel, Afghanistan, Macaronesia and north-western Africa. It has been introduced into various locations globally, including the Americas and southern Africa (Meusel et al. 1978, Hultén & Fries 1986). *Stachys arvensis* occurs in arable fields, on waste ground, in road verges and gardens, usually on moderately humid, acidic to neutral, non-calcareous soils, moderately supplied with nutrients. In the Czech Republic it has always been extremely rare. In

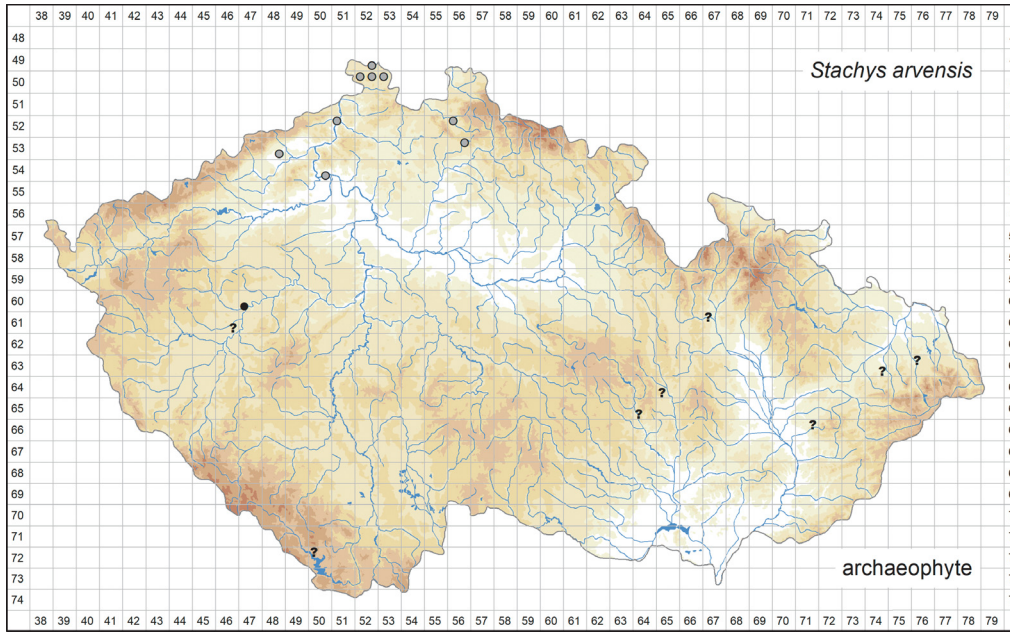


Fig. 87. – Distribution of *Stachys arvensis* in the Czech Republic: ● at least one record in 2000–2019 (1 quadrant), ◍ pre 2000 records only (8 quadrants). Prepared by Jindřich Chrtek Jr.

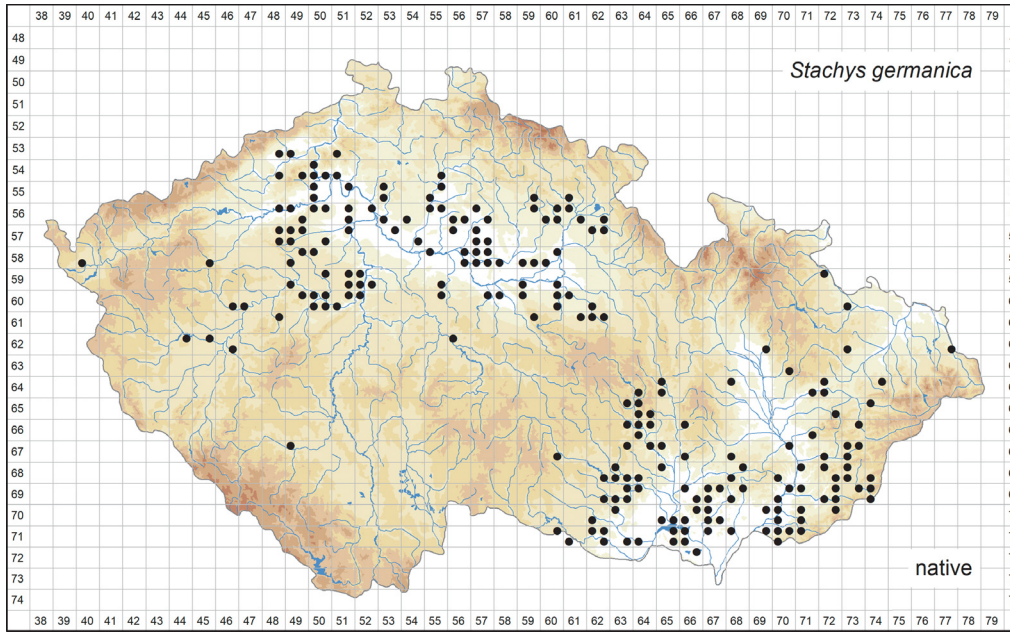


Fig. 88. – Distribution of *Stachys germanica* in the Czech Republic (219 occupied quadrants). Prepared by Jindřich Chrtek Jr.

Bohemia it was repeatedly collected in the 1830s and 1840s from flax fields in the vicinity of the towns of Šluknov and Mikulášovice and the village of Jiříkov in northernmost Bohemia, close to the Czech-Saxonian border; old herbarium specimens come also from the vicinity of the towns of Litoměřice and Děčín and literature records from the vicinity of the town of Liberec (second half of the 19th century). For a substantial period afterwards, the species either vanished or was overlooked in Bohemia. However, during World War II (in 1941) it was collected near the town of Hodkovice nad Mohelkou in northern Bohemia and later (in 1953) it was also reported to occur near the village of Chrást in western Bohemia (Hadač et al. 1968). Recently (2005) *S. arvensis* was found near the village of Robčice (not far from the preceding locality); the population is still (2019) extant. Literature records from northern and central Moravia (Borač near Tišnov, Kunštát, Zábřeh, Rusava, Příbor, Místek, Těšín) are not documented by herbarium specimens and are somewhat doubtful. In the Czech flora this species is considered to be a casual archaeophyte (Pyšek et al. 2012) and classified as critically threatened (Grulich 2012).

Stachys germanica (Fig. 88)

Stachys germanica is native to the temperate zone in Europe and westernmost Asia from the Iberian Peninsula in the west to the Dniepr river basin, Crimea, the Caucasus Mts and northern Iran in the east. Its northern distributional limit runs through the British Isles, north-eastern Germany, northern Poland and Belarus; in the south it reaches the Mediterranean basin in Europe and Morocco; it also occurs in the Canary Islands (Dunn 1997). Secondary occurrences are known from the eastern part of North America (USDA, NRCS 2019). In the Czech Republic *S. germanica* occurs in thermophilous dry grasslands and scrub, in the fringes of thermophilous forests, along roads, in stone quarries and various semi-ruderal sites and fallow land. It usually grows on dry, slightly acidic to basic soils, moderately supplied with nutrients, developed particularly over limestone, marlstone and flysh. The species is rare to locally scattered in hilly landscapes with warm or moderately warm climates in north-western, central and eastern Bohemia and central and southern Moravia, while it is absent or very rare elsewhere. *Stachys germanica* occurs at low and middle elevations, reaching its elevational maximum of 650 m near the village of Jasenná in eastern Moravia. It has declined in abundance, mostly due to lack of disturbance, and is currently classified as endangered (Grulich 2012).

Stachys palustris (Fig. 89)

Stachys palustris is common in the temperate and boreal zones in Eurasia and North America. In extends throughout much of Europe, except for the most of the Iberian Peninsula, the Mediterranean islands and the northernmost part north of the Polar Circle; eastwards it reaches central Asia (Meusel et al. 1978, Hultén & Fries 1986, Taylor & Rowland 2011, USDA, NRCS 2019). In the Czech Republic it occurs in reed and sedge beds, marshy places, damp pastures and fields, wet meadows, alder carrs, fringes of floodplain forests, drainage and irrigation channels, and at various wet ruderal places. It prefers well-moistened but usually not wet, slightly acidic to slightly basic soils, moderately rich to rich in nutrients. The plants are adapted to temporary flooding as well as to temporarily dry soils. *Stachys palustris* is distributed throughout this country, except for the highest mountains, reaching its elevational maximum at 820 m in the Beskydy Mts in

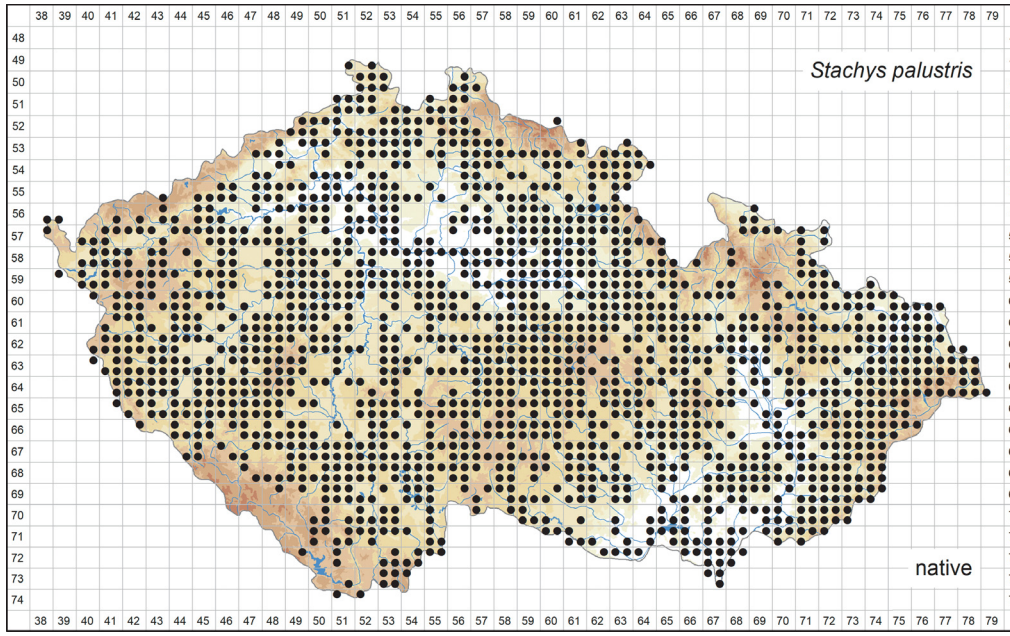


Fig. 89. – Distribution of *Stachys palustris* in the Czech Republic (1606 occupied quadrants). Prepared by Jindřich Chrtek Jr.

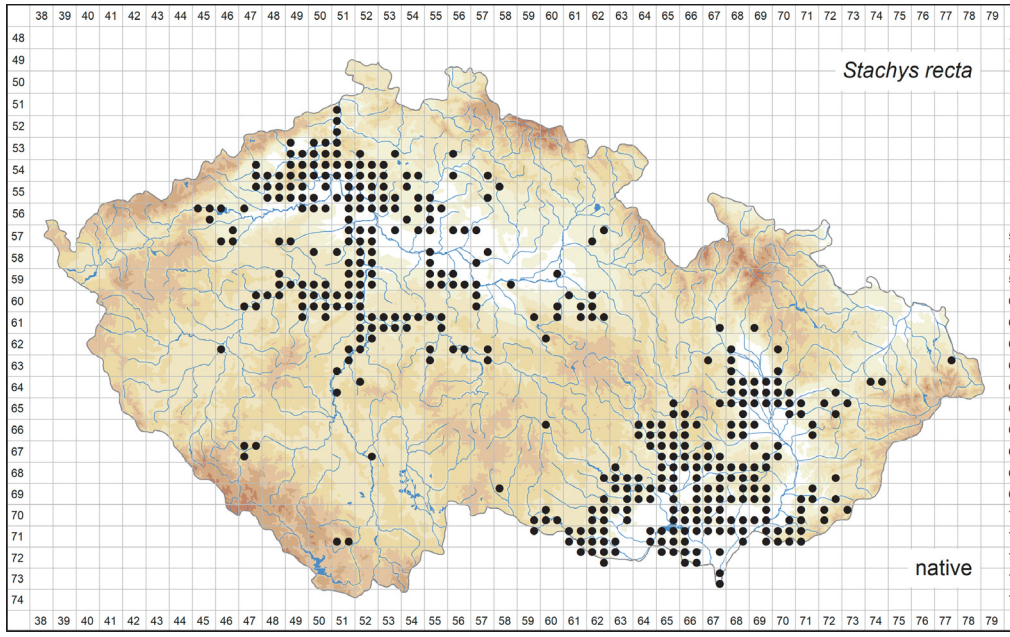


Fig. 90. – Distribution of *Stachys recta* in the Czech Republic (392 occupied quadrants). Prepared by Jindřich Chrtek Jr.

eastern Moravia. It is rather rare in the warmest, driest parts of this country. Most of the gaps on the map are due to under-recording rather than true absences.

Stachys recta (Fig. 90)

Stachys recta is almost exclusively a European species, being distributed from the northern part of the Iberian Peninsula in the west as far as the Volga river basin and the Caucasus Mts in the east, extending northwards to north-eastern Germany, northern Poland, Lithuania and the central part of European Russia (north to 55°N), and southwards to southern Italy and Greece; it is absent from most of the Mediterranean islands. Outside Europe it is known from north-western Anatolia and northern Iran (Meusel et al. 1978). *Stachys recta* is a variable species, with the highest morphological diversity in the Balkan Peninsula, and 7–8 subspecies currently recognized. Of these subspecies, only the type subspecies is found in the northern parts of this species' range, including the Czech Republic. *Stachys recta* subsp. *labiosa* occurs in the southern Alps and has also been reported from the Apennines and the Dinarids, while the remaining subspecies are mostly confined to the Balkan Peninsula (Chrtek 1992b). In the Czech Republic it occurs in dry and semi-dry grasslands, rocks and rocky slopes, fringes of oak and oak-hornbeam forests, forest-steppes, locally also in open-canopy oak and pine forests. It prefers moderately dry, neutral to basic, less often slightly acidic soils, poor to moderately supplied with nutrients; especially at rather high elevations it strongly prefers calcium-rich substrates. *Stachys recta* is scattered to locally common in warm and moderately warm hilly landscapes and deep river valleys of north-western, northern and central Bohemia and southern and central Moravia, northwards to the vicinity of the town of Litovel, while being rare and often confined to calcareous substrates elsewhere. It is distributed at low and middle elevations, reaching its elevational maximum of about 720 m at Mt Milešovka in the České středohoří Mts. The species is not immediately threatened. Locally, it suffers from succession after the abandonment of pastures.

Stachys sylvatica (Fig. 91)

Stachys sylvatica is widely distributed in Europe, but is absent from its northernmost part and rare in the Mediterranean area. Outside Europe it is disjunctly distributed in south-western and central Asia, western Siberia and Macaronesia; it has been introduced into the eastern part of North America (Meusel et al. 1978, Hultén & Fries 1986, Taylor & Rowland 2010, USDA, NRCS 2019). In the Czech Republic it occurs in beech, ravine, and oak-hornbeam forests, alder carrs, on the banks of rivers and streams, rarely also in subalpine tall-forb vegetation. It prefers moist or damp but not wet, slightly acidic to slightly basic soils, well-supplied with nutrients. It is widely distributed throughout this country, being less frequent in the warm, largely deforested lowlands and hilly landscapes with prevailing arable land in north-western Bohemia and southern Moravia. Most of the gaps on the map are due to under-recording rather than true absences.

Telekia speciosa (Fig. 92)

Telekia speciosa is native to the Carpathians, the Bükk Mts in Hungary, the mountains of the Balkan Peninsula and northern Anatolia, and the Caucasus. Since the 19th century it

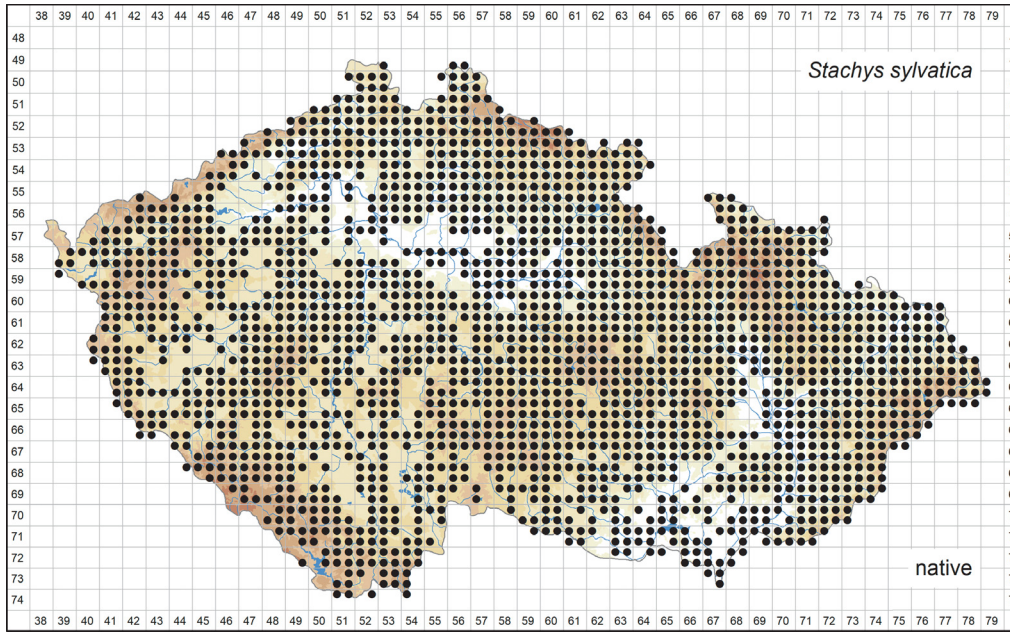


Fig. 91. – Distribution of *Stachys sylvatica* in the Czech Republic (2016 occupied quadrants). Prepared by Jindřich Chrtek Jr.

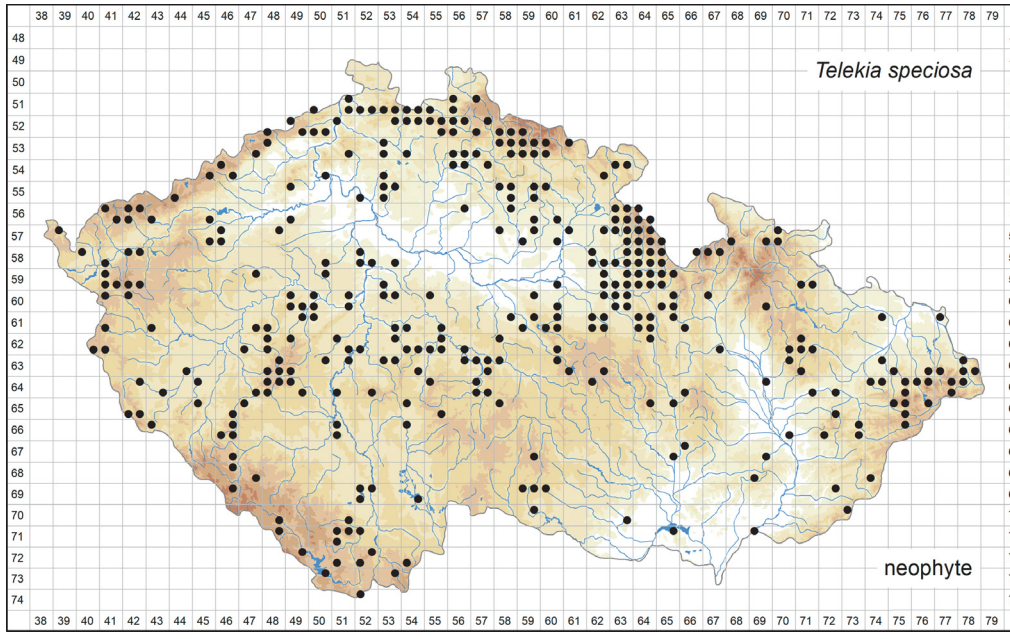


Fig. 92. – Distribution of *Telekia speciosa* in the Czech Republic (360 occupied quadrants). Prepared by Zdeněk Kaplan.

has been cultivated as an ornamental and has become naturalized in many European countries ranging from the British Isles and France to the north-western part of European Russia, being most frequent in central Europe (Meusel et al. 1992, Greuter 2006). In its native range *T. speciosa* grows in beech forests, alder carrs and open shrub communities along streams (Dobolyi 1983). In the Czech Republic it has been cultivated since the 19th century in chateau parks and botanical gardens, later also around mountain chalets, gamekeeper's lodges, in village gardens, town parks and cemeteries. It escaped at many sites almost throughout this country, mainly at middle and high elevations, became naturalized and in many cases spread along streams and rivers, forest tracks and to forest clearings and abandoned montane meadows. It prefers sunny or semi-shaded sites on slightly acidic to slightly basic, nutrient-rich moist soils. Currently it is most frequent in the Orlické hory Mts in eastern Bohemia, where it is locally dominant in suitable habitats and threatens the natural vegetation. It is classified as an invasive neophyte (Pyšek et al. 2012).

Typha angustifolia (Fig. 93)

Typha angustifolia is native to Europe northwards to southern Scotland, southern Sweden, southern Finland and the north-western part of European Russia, while in the south it is absent from the southern part of the Balkan Peninsula; in Asia it is distributed from northern Anatolia and the Caucasus through central Asia, Siberia and northern China to Japan; it also occurs in northern Africa (Hultén & Fries 1986, Murphy 2007). It has been introduced into the USA and southern Canada (Smith 2000, Ciotir et al. 2013). Records from southern and south-eastern Asia, most of Africa, Central and South America and Australia are apparently due to confusion with *T. domingensis* (Murphy 2007). In the Czech Republic *T. angustifolia* grows mainly in littoral zones of fishponds, less frequently in edges of lakes in abandoned sand pits and stone quarries, oxbow lakes, irrigation channels and along banks of slowly flowing rivers. It prefers mesotrophic to naturally eutrophic, 20–60 cm deep water on acidic to slightly basic, often nutrient-rich, loamy to clayey substrates, sometimes with an admixture of sand and covered with a thin layer of organic silt (Šumberová 2011c). It colonizes the habitats in early successional stages and declines with siltation. *Typha angustifolia* is distributed in the lowlands and at middle elevations in most of this country. It is most frequent in fishpond landscapes in south-western, southern and eastern Bohemia and in the Českomoravská vrchovina highlands. In Moravia it is less frequent, being found mainly in the areas with numerous wetlands such as the lowland floodplains of the Morava, Dyje and Odra rivers. It is rare in or locally absent from agricultural landscapes in the dry lowlands in north-western Bohemia and central Moravia, as well as from the mountains. Although in the 19th century and the first half of the 20th century *T. angustifolia* was reported to be more frequent than *T. latifolia* in this country, at present the opposite is the case (Štechová & Kubát 2011). This may be due to better adaptation of *T. latifolia* to silting and eutrophication, which have occurred in Czech fishponds since the 1950s. However, *T. angustifolia* is still quite frequent in some parts of this country and is not threatened.

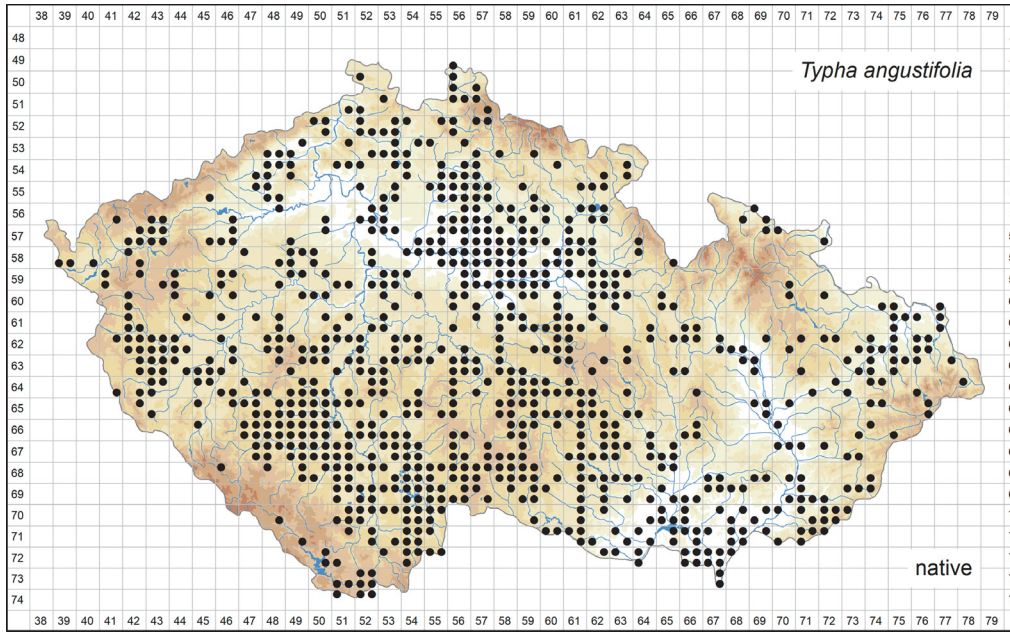


Fig. 93. – Distribution of *Typha angustifolia* in the Czech Republic (872 occupied quadrants). Prepared by Zdeněk Kaplan.

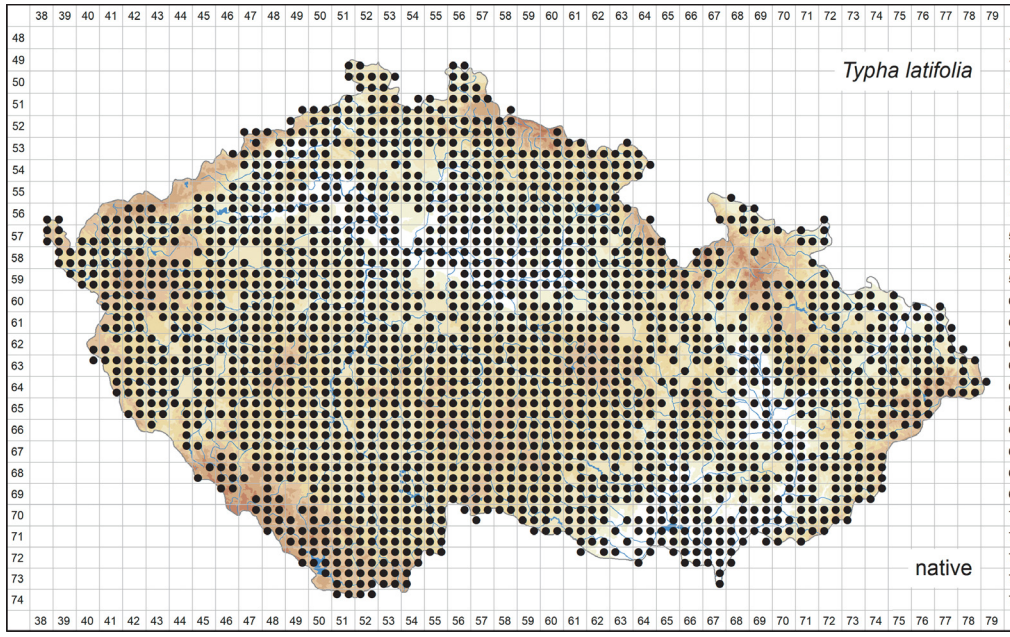


Fig. 94. – Distribution of *Typha latifolia* in the Czech Republic (2091 occupied quadrants). Prepared by Zdeněk Kaplan.

Typha latifolia (Fig. 94)

Typha latifolia is a cosmopolitan species distributed through most of the temperate zone in Eurasia and North America, and also occurring in mainly subtropical areas in Africa, south-eastern Asia, Australia and South America (Hultén & Fries 1986, Clements 2010). In the Czech Republic it occupies a wide range of wetland habitats, often in advanced stages of terrestrialization with an accumulation of organic sediment. It is mainly found in littoral zones of fishponds and water reservoirs, oxbow lakes, alluvial pools, lakes in abandoned sand pits and stone quarries, irrigation channels, along banks of slowly flowing rivers, in ditches along roads or railways, wet depressions in arable fields, abandoned wet meadows, wetlands surrounding springs, edges of peat bogs and various wet waste places in settlements. It prefers mesotrophic to strongly eutrophic, 10–60 cm deep water on acidic to slightly basic, loamy to clayey substrates covered with a thick layer of organic silt (Šumberová 2011d). The habitats of *T. latifolia* are usually submerged or wet in winter and spring but occasionally may dry out in summer. When co-occurring with *T. angustifolia*, it usually grows in shallower water. Due to its wide ecological amplitude and seeds adapted to dispersal by wind, *T. latifolia* can easily colonize new wet sites. It is distributed throughout this country, being rare in or absent from the high mountains. Some of the gaps on the map are certainly due to a lack of records rather than true absences.

Typha laxmannii (Fig. 95)

At present *Typha laxmannii* is distributed mainly in the temperate zone in Eurasia from France in the west as far as Primorsky Krai in the Russian Far East. However, the western part of its current range is of secondary origin. In Europe this species is native apparently only to Bulgaria, Romania, Ukraine and the southern part of European Russia, while as introduced and/or escaped from cultivation it is recorded from many countries including the United Kingdom, France, Belgium, Germany, Czech Republic, Poland, Slovakia, Italy and Slovenia (Fiala & Jankovská 1968, Cook 1980, Baryła et al. 2004, Verloove 2010). In the Czech Republic *T. laxmannii* was first recorded in 1968 in a moist brick-clay pit in the village of Vážany (now a suburb of the town of Kroměříž) in central Moravia. Since then it has been found at about 50 sites mainly in floodplains of the Morava, Odra, Svratka and Dyje rivers in Moravia, and in north-western Bohemia. *Typha laxmannii* most frequently colonizes wet shores of lakes in sand pits, clay pits and abandoned stone quarries, flooded depressions on restored spoil tips and pits after open-cast coal mining, pools formed by land subsidence after underground coal mining, wet waste places in settlements, roadside ditches, village ponds, alluvial pools, wet depressions in meadows and banks of water reservoirs and channels. It mostly grows in mesotrophic, up to 20 cm deep water that often dries out in summer, on shallow, acidic to basic, loamy to clayey substrates. Like other ornamental aquatics, e.g. *Nymphoides peltata* (Kaplan et al. 2016a), *Stratiotes aloides* (Kaplan et al. 2018a), *Trapa natans* and *Hippuris vulgaris* (Kaplan et al. 2016b), *T. laxmannii* has become popular in garden pools and park ponds during the past three decades. Consequently, some of the recent occurrences in the countryside (mainly in sand pits) may have resulted from intentional planting, while some others may represent spontaneous escapes from cultivation due to seed dispersal by wind. This species is classified as a naturalized neophyte (Pyšek et al. 2012).

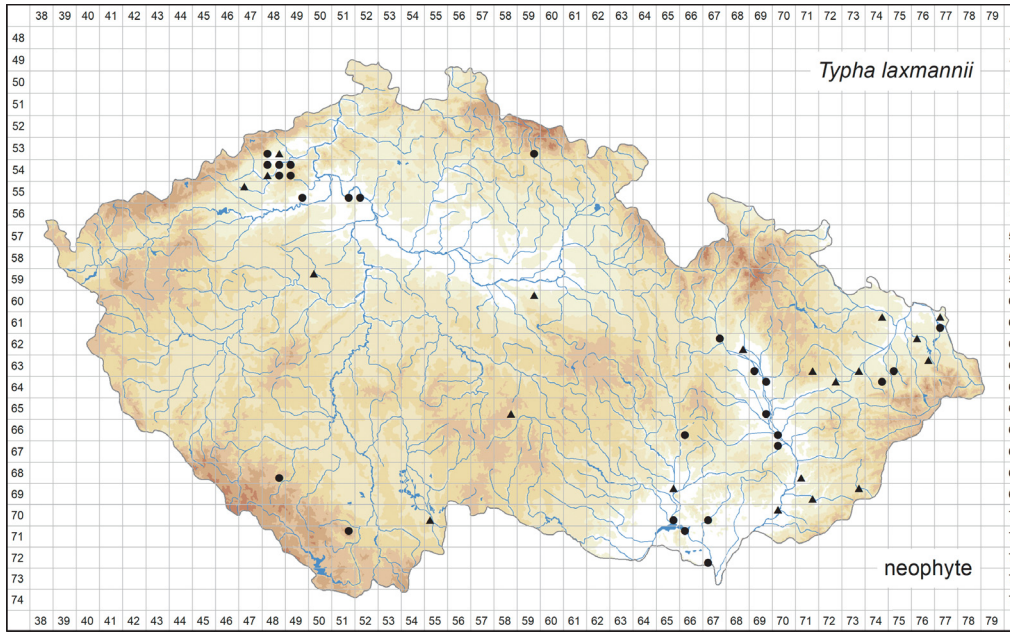


Fig. 95. – Distribution of *Typha laxmannii* in the Czech Republic: ● occurrence documented by herbarium specimens (25 quadrants), ▲ occurrence based on other records (21 quadrants). Prepared by Zdeněk Kaplan.

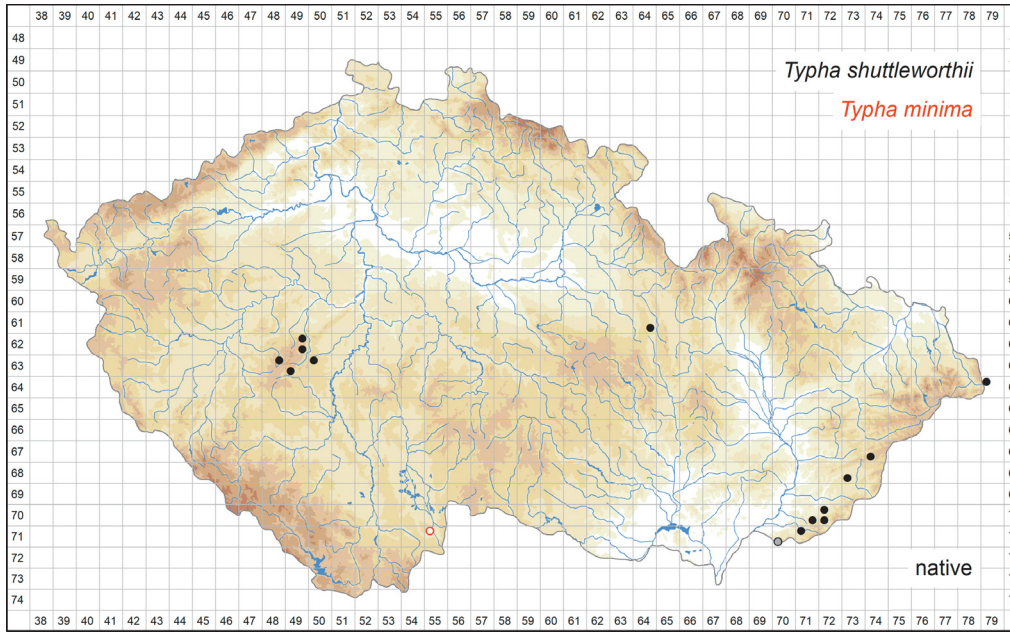


Fig. 96. – Distribution of *Typha minima* (○ pre 2000 records only: 1 quadrant) and *T. shuttleworthii* (● at least one record in 2000–2019: 13 quadrants, ● pre 2000 records only: 1 quadrant) in the Czech Republic. Prepared by Zdeněk Kaplan.

Typha minima (Fig. 96)

Typha minima has a disjunct distribution in Eurasia, including the foothills of the Alps, the Apennine Peninsula, the Southern Carpathians in Romania, eastern Anatolia, the Caucasus, Iran and the foothills of the mountains in central Asia (Müller 1991). In the Czech Republic it was observed only in 1913–1914 at a bank of a fishpond near the village of Hrdlořezy in southern Bohemia (Houfek 1957). This occurrence probably represented a temporary spontaneous colonization from sites along the Donau river in Austria (see Müller 1991), which are only about 80 km away. *Typha minima* is currently classified as extinct in the Czech Republic (Grulich 2012).

Typha shuttleworthii (Fig. 96)

Typha shuttleworthii is distributed in Europe between eastern France in the west and western Russia, Ukraine, Romania and Bulgaria in the east; in Asia it was recorded from Turkey and Iran (Cook 1980, Hamdi et al. 2009, Kozłowska et al. 2011). In the Czech Republic it grows in wetlands in meadows, littoral zones of fishponds and water reservoirs, damp ditches along roads or railways and on exposed river beds. The substrates are mesotrophic to naturally eutrophic, clayey to loamy or loamy-sandy substrates that are inundated by shallow water or exposed throughout the year (Šumberová 2011e). The occurrence of *T. shuttleworthii* in this country has been documented at 15 sites so far, of which 13 have been discovered since 2000. Most of them are in the Carpathians in south-eastern and eastern Moravia, another group of localities is in the Brdy hills in central Bohemia, and an isolated occurrence was recorded near the village of Třebovice in eastern Bohemia. Due to the low number of populations it is classified as critically threatened (Grulich 2012).

Zannichellia palustris (Fig. 97)

Zannichellia palustris has a cosmopolitan distribution, being absent only from arctic regions, high mountains, tropical forests and extremely dry areas without water bodies (Hultén & Fries 1986). It is a variable species, which is sometimes subdivided into various numbers of varieties, subspecies or even narrow species (e.g. van Vierssen 1982, Uotila et al. 1983, Talavera et al. 1986). Within the Czech Republic the morphological variation appears to be continuous and does not allow any clear separation of the traditionally recognized subspecies *palustris* and *pedicellata* (Kaplan 2010). Consequently, only a map for the entire species is presented here. In this country *Z. palustris* occurs mainly in fishponds, less frequently in brooks, drainage channels, rivers, lakes in abandoned sand pits and clay pits, fish storage ponds and pools in wetlands. It grows mainly in mesotrophic to strongly eutrophic, 5–100 cm deep water on clayey, loamy or sandy substrates, and tolerates increased salinity and turbidity. It is most frequent in the fishpond basins of south-western and southern Bohemia, in the Labe river basin and the adjacent parts of north-western, central and eastern Bohemia. In Moravia it is less frequent, being found mainly in the areas with numerous wetlands such as the lowland floodplains of the Dyje, Morava and Odra rivers. It is absent from the mountains, reaching its elevational maximum at about 820 m near the village of Polná na Šumavě in southern Bohemia.

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

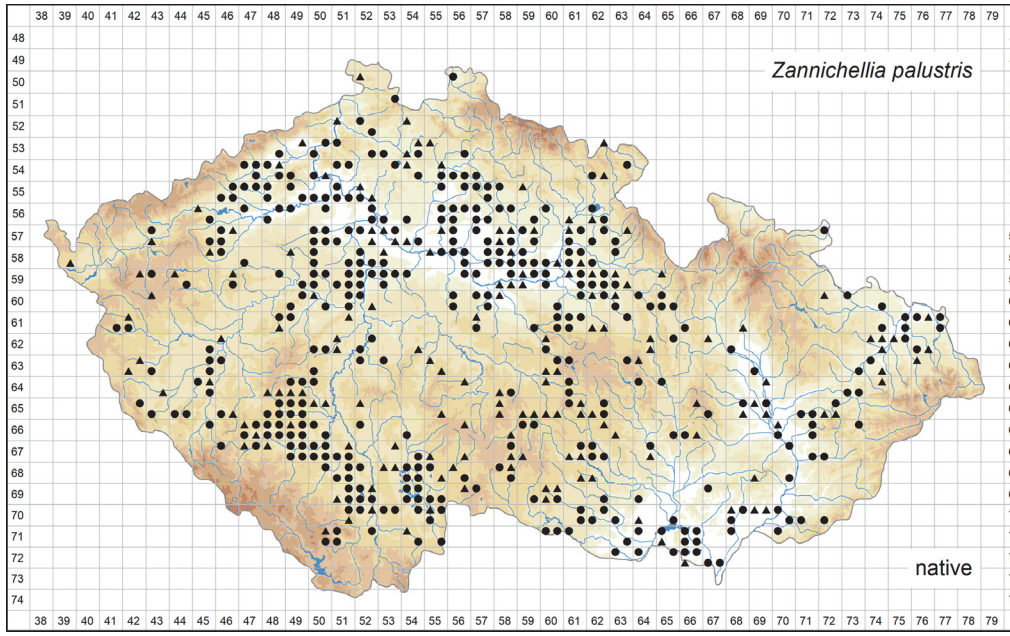


Fig. 97. – Distribution of *Zannichellia palustris* in the Czech Republic: ● occurrence documented by herbarium specimens (373 quadrants), ▲ occurrence based on other records (166 quadrants). Prepared by Zdeněk Kaplan.

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Souhrn

Osmá část ze série prací věnovaných rozšíření cévnatých rostlin v České republice obsahuje síťové mapy a komentáře k 106 taxonům rodů *Abutilon*, *Achillea*, *Arctium*, *Arenaria*, *Arnoseris*, *Carex*, *Chamaecytisus*, *Cornus*, *Diphasiastrum*, *Echinops*, *Galeopsis*, *Galium*, *Huperzia*, *Isoëtes*, *Lycopodiella*, *Lycopodium*, *Moehringia*, *Orobanche*, *Phelipanche*, *Prunus*, *Ranunculus*, *Selaginella*, *Stachys*, *Telekia*, *Typha* a *Zannichellia*. Základem jsou údaje získané excerpcí herbářů a literatury, terénní zápisy a databázové nálezy, které prověřili taxonomičtí experti. Mnohé ze studovaných původních druhů patří mezi ohrožené rostliny. Jejich ohrožení vyplývá buď z jejich vzácnosti, přičemž v krajních případech jde o rostliny, které se v ČR vyskytují na jediné lokalitě (*Arenaria grandiflora*, *Galium austriacum*, *Isoëtes echinospora*, *I. lacustris*, *Orobanche teucrii*), nebo se jedná o rostliny, které byly v minulosti hojnější, ale zaznamenaly prudký úbytek lokalit (např. *Arnoseris minima*, *Carex hordeistichos*, *C. secalina*, *Diphasiastrum tristachyum* a *Lycopodiella inundata*), případně jsou ohroženy kombinací vzácnosti a ústupu (např. *Orobanche artemisiae-campestris*, *O. coerulescens*, *Phelipanche arenaria*, *Ph. caesia* a *Stachys germanica*). Tři druhy (*Moehringia muscosa*, *Selaginella helvetica* a *Typha minima*) patří mezi rostliny u nás vyhynulé. Nepůvodní druhy jsou zastoupeny archeofyty (např. *Arctium lappa*, *A. tomentosum*, *Orobanche minor*, *Stachys annua* a *S. arvensis*) i neofyty (např. *Abutilon theophrasti* a *Typha laxmannii*). Dva druhy se projevují jako invazní: *Echinops sphaerocephalus* se šíří zejména na suchých a narušovaných stanovištích podél cest a železnic v teplejších územích, zatímco *Telekia speciosa* se šíří na mnoha místech ve středních a vyšších polohách, a zejména v Orlických horách je již hojná. *Echinops bannaticus* je zde uveden jako nově zjištěný nepůvodní druh, který občas zplaňuje z kultury. Celkový obraz rozšíření zpracovávaných taxonů v ČR poskytují mapy; konkrétní floristické údaje zachycující frekvenci výskytu v různých oblastech a v různých obdobích, a dokumentující ústup nebo naopak šíření některých druhů, jsou uložené v databázi Pladias a dostupné v elektronických přílohách. Každou mapu doprovází komentář, který obsahuje nástin celkového areálu, výčet nejčastějších stanovišť a stručnou charakteristiku rozšíření v České republice, případně i doplňující informace k taxonomii, biologii, změnám v rozšíření a míře ohrožení.

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