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SYSTEMATICS OF EURASIAN AND NORTH AFRICAN *DORONICUM* (ASTERACEAE: SENECIONEAE)[1]

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ABSTRACT

The genus *Doronicum* (Asteraceae: Senecioneae) comprises perennial herbs distributed in Europe, North Africa, and Asia. A worldwide revision of the genus recognizing 26 species and 4 subspecies is presented. In the present taxonomic treatment no infrageneric groups are recognized. Seven names are newly lectotypified herein: *Arnica doronicum* Jacq., *Doronicum caucasicum* M. Bieb., *Doronicum portae* Chabert, *Doronicum scorpioides* Lam., *Doronicum souliei* Cavill., *Doronicum thibetanum* Cavill., and *Doronicum turkestanicum* Cavill. A new chromosome count is provided for *D. carpetanum* subsp. *diazii*.

Key words: Asia, Asteraceae, *Doronicum*, Europe, North Africa, Senecioneae.

The genus *Doronicum* L. (Asteraceae: Senecioneae) includes rhizomatous herbs with yellow or green-tinted radiate capitula. All phyllaries are similar, generally herbaceous and arranged in two or three rows. Cypselae are cylindric to obovate-cylindric with 10 longitudinal ribs and bear a pappus of white-tinted minutely scabrous capillary bristles. The pappus can be absent in ray flowers of some heterocarpic species.

This genus belongs in the Senecioneae, one of the largest and most complex tribes in the Asteraceae with 123 genera and around 3200 species (Cassini, 1819; Bentham & Hooker, 1873b; Hoffmann, 1892; Nordenstam, 1977; Bremer, 1994). Its 26 species constitute a presumably natural group (Bremer, 1994; involucre without shorter supplementary bracts, phyllaries herbaceous arranged in two or three rows, and cypselae cylindric to ob-

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ovate-cylindric with 10 longitudinal ribs). Its geographical area extends from Europe and North Africa to Asia, growing in mesic woods and open rocky places with moist soil, and near watercourses, from sea level to 5000 m of elevation.

Although there are several regional studies of the genus (Turkey, Edmondson, 1973, 1975, 1978; Armenia, Avetisyan, 1980; Iberian peninsula, Chacón, 1987; Belgium, Duvigneaud, 1992), there is only one previous worldwide revision of *Doronicum* (Cavillier, 1907, 1911). Fifteen new species (Diels, 1922; Widder, 1925; Sergievskaja, 1949; Widder & Rechinger, 1950; Edmondson, 1973, 1978; Chacón, 1987; Pérez & Penas, 1990; Pérez et al., 1994; Chen, 1998) and six hybrids (Bornmüller & Koch, 1930; Widder, 1934, 1948; Stace, 1991) were subsequently described. Two species included in Cavillier's monograph have since been transferred to other genera (i.e., *D. hookeri* C. B. Clarke ex Hook. to *Nannoglottis* (Kitamura, 1980), and *D. thibetanum* Cavill. to *Aster* (Álvarez Fernández & Nieto Feliner, 2000)). Cavillier (1907, 1911) studied the morphology of the genus in great detail, especially the indumentum, but his proposed infrageneric classification is of rather limited value since these groups are obscurely defined based mainly on nonexclusive characters. As a result, classifying newly described taxa in any infrageneric framework is problematic.

The need to evaluate the newly described species and to assess the infrageneric taxonomy provides justification for this work. The objectives were to study as many morphological characters (qualitative and quantitative) as possible so that (1) only entities that could be consistently diagnosed were recognized in the taxonomic treatment, and (2) species were classified as groups on the basis of shared synapomorphies (secondary homologies, De Pinna, 1991).

Material and Methods

More than 50 qualitative and quantitative morphological characters were studied in ca. 4300 dried specimens from the following herbaria: B, BC, BCF, BM, BR, BRNM, COI-WILLK, E, FI, G, GAZI, GH, GZU, HVR, IRAN, JACA, JE, K, LAU, LE, LINN, LY, MA, MACB, MAF, MO, NY, RO, S, SANT, UPS, W, WU, ZA, and the Sánchez-Pedraja personal herbarium. From other institutions, only photographs and photocopies of specimens, or additional information, were available: AV, B-W, BOLO, BP, C, CL, G-BOIS, G-DC, GE, GRM, LD, NAP, P-HA, P-LA, LEB, PAL, and SZB. A list of species and subspecies and an index to exsiccatae are presented in Appendices 1 and 2, respectively.

Observations were made directly or with the aid of binocular lenses. Microcharacters of indumentum and cypselae were studied by SEM. Quantitative characters were recorded using a Brown & Shape Plus digital caliper (model 599-571-3). Measurements were made on herbarium specimens, after flattening and drying.

Distribution maps for each taxon are based on the specimens studied. Note that geographical areas and countries follow Hollis and Brummitt (1992), and major political divisions for countries were included when that information was available.

Taxonomic History

The name *Doronicum* is apparently derived from the Arabic word "darawnay," used for at least two different plants (Dozy, 1877). The pre-Linnaean botanists (Dioscorides, 1554, 1557; Dodoens, 1574) and other Greek authors referred to species of *Doronicum* as *Aconitum pardalianches,* and the plant was probably introduced in Western culture by Avicenna (Dodoens, 1574; Dalenchamps, 1587).

The genus *Doronicum* was described by Linnaeus (1753) to include four species, only two of which are currently accepted in the genus: *D. pardalianches* and *D. plantagineum.* The remaining species correspond to *Senecio* and *Aster,* respectively. Further, one species of *Arnica* described by Linnaeus (1753), *A. scorpioides* L., also belongs in *Doronicum* as recognized by Lamarck (1786). Several pre-Linnaean authors also confused species of *Senecio, Aster,* and *Arnica* with *Doronicum* (Dalenchamps, 1587; Clusius, 1601; Bauhin, 1623; Tournefort, 1700). In particular, the overall morphological similarity between *Arnica* and *Doronicum* suggested their close affiliation until the 1970s. However, Nordenstam's (1977) micromorphological study of style, anthers, and pollen definitively has excluded *Arnica* from the Senecioneae.

The cypsela dimorphism that occurs in some species has been a relevant feature in the taxonomic history of the genus. Lamarck (1786) referred to the heterocarpic and homocarpic species as "arniques" and "doronics," respectively. Necker (1790) even proposed the different genus *Aronicum* for the homocarpic species, and his classification had wide acceptance in the 19th century (de Candolle, 1838; Koch, 1843; Hausmann, 1851; Reichenbach, 1854; Schur, 1866; Ardoino, 1867; Simonkai, 1886), although some authors only recognized *Aronicum* as a section of *Doronicum*

(Ambrosi, 1854; Willkomm & Lange, 1870; Nyman, 1879; Hoffmann, 1892; Beck, 1893). This classification persisted until Bentham and Hooker (1873a) placed *Aronicum* as a synonym of *Doronicum*. Tausch (1828) also recognized these two groups but referred the heterocarpic species to *Pardalianches*, not *Aronicum*.

Cassini (1817) established the genus *Grammarthron* with two species, *G. biligulatum* and *G. scorpioides*, now subsumed within *Doronicum* (Jacquin, 1773; Lamarck, 1786); de Candolle (1836) described the monotypic genus *Fullartonia* (*F. kamaonensis*), now *D. kamaonense* (DC.) Álv. Fern. (Álvarez Fernández, 2001). In 1838, de Candolle proposed two sections within *Doronicum*: section *Eudoronicum*, including some species of *Senecio*, and the monotypic section *Chromochaeta*, with *Doronicum linifolium* (Wall.) DC., now also in *Senecio* (Maguire, 1943).

Webb in Webb and Berthelot (1846) treated the genus *Pericallis* D. Don (in Sweet, 1833–1835: tab. 228) including five species as a section of *Doronicum* (*D. cruentum*, *D. echinatum*, *D. papyraceum*, *D. tussilaginis*, and *D. webbii*), but it is now treated at its original rank (Nordenstam, 1978).

Cavillier (1907, 1911) divided his study of the genus *Doronicum*, the first devoted to the study of the homocarpic species (1907), and the second to the heterocarpic ones (1911). However, he later concluded (1911) that this character was not useful to delimit natural groups. Cavillier proposed a new classification (1911) that included 3 sections, 7 subsections, and 34 species within *Doronicum*: section *Doronicastrum* (subsect. *Corsica*, subsect. *Austriaca*, subsect. *Cardiophylla*, subsect. *Macrophylla*, subsect. *Pardalianchia*, subsect. *Plantaginea*, and subsect. *Grandiflora*), section *Soulieastrum* (*D. stenoglossum* Maxim.), and section *Hookerastrum* (*D. hookeri* C. B. Clarke ex Hook.). However, this sectional treatment is not satisfactory, since section *Hookerastrum* was described on the basis of a species from another tribe (*Nannoglottis hookeri*, Astereae) and the phylogenetic position (Álvarez Fernández et al., 2001) of section *Soulieastrum*'s only taxon precludes recognition at the sectional level without artificially splitting the bulk of the genus. The subsections in *Doronicum* were defined (Cavillier, 1911) mainly from the shape of basal leaves, the size of leaves, and the presence of cypselae dimorphism. Phylogenetic study of the genus (Álvarez Fernández et al., 2001) concluded that these are not synapomorphic characters, and therefore Cavillier's classification does not recognize natural groups.

Even after Cavillier's work the relevance of heterocarpy was claimed again (Gorschkova, 1961). In the *Flora of the U.S.S.R.*, the classification proposed by Willkomm and Lange (1870) was merged with that of Cavillier (1911) to distinguish two sections in *Doronicum* (Gorschkova, 1961): section *Aronicum* (ser. *Altaica*, ser. *Carpatica*), and section *Pardalianches* (ser. *Austriaca*, ser. *Cardiophylla*, ser. *Macrophylla*, ser. *Pardalianches*, and ser. *Plantaginea*). More recently, Edmondson (1978) followed Cavillier's classification (1911) instead of Gorschkova's (1961), but described the monotypic subsection *Isaurica* (*D. cacaliifolium* Boiss. & Heldr.) within section *Doronicum*, which corresponded to Cavillier's section *Doronicastrum* (1911).

The phylogenetic analysis herein confirms what a preliminary morphological study suggested: the morphological characters used are too labile to provide a sound classification at the infrageneric level (Álvarez Fernández et al., 2001). The molecular data from nuclear ribosomal and chloroplast DNA suggest some groups but without enough support to recommend formal taxonomic groupings. One exception is a Mediterranean group of species (*D. plantagineum* group), which receives good support from both molecular and morphological data. To avoid adding to the already complex taxonomic history of the genus, a formal infrageneric treatment is not proposed here, but is deferred against new evidence.

As already mentioned in the introduction, after Cavillier's revision and until the present work, a large number of taxonomic actions were taken within *Doronicum*. These include the description of new species (Sergievskaja, 1949; Edmondson, 1973, 1978; Chen, 1998, among others) and one subsection (Edmondson, 1978), and a few lectotypifications (Chacón, 1987; Pérez et al., 1997; Jarvis & Turland, 1998). Despite all of these actions the genus was still lacking nomenclatural stability. Thus, during this study and immediately preceding this work, several nomenclatural and taxonomic clarifications were done (Álvarez Fernández & Nieto Feliner, 1997, 1999, 2000; Álvarez Fernández, 2001). The lectotypification of 16 names of *Doronicum* in current use (Álvarez Fernández & Nieto Feliner, 1999) gave the genus nomenclatural stability leading up to this revision. In this work, additional lectotypification of seven names belonging in *Doronicum*, although not in current use, is also presented to consolidate and clarify as far as possible the nomenclature of the genus. Despite the efforts made to locate type material for all the names in current use, 4 out of 30 names (i.e., *D. carpaticum*, *D. clusii*, *D. corsicum*, and *D. orientale*)

still required further investigations for lectotype designation. Because at present these names clearly represent different recognized taxonomic entities, they are cited herein as names in current use, although their formal identity is not conclusive until lectotypes are designated.

Geographical Distribution

Half of the 26 recognized species of *Doronicum* are distributed in Europe and North Africa. Seven of the remainder are from southwestern Asia (Iran, Iraq, Caucasus, and Turkey), and 6 species are distributed in central Asia (Turkistan, Altay, Tibet, Yunnan, and the Himalayas).

With the exception of *Doronicum orientale,* each species is restricted to one of the three well-delimited areas: Europe, southwestern Asia, central Asia. *Doronicum orientale* is distributed in Europe and southwestern Asia, abundantly in the eastern Mediterranean (Greece, western Turkey, southern Italy, and Lebanon–Syria), and scattered in central Europe, where its proximity to inhabited places suggests possibly having escaped from gardens. Delimiting the natural areas of distribution is also difficult in the case of two other European species: *D. plantagineum* and *D. pardalianches.* Both were used as ornamental plants in previous centuries (Pena, 1571; Miller, 1787) and now are considered alien plants in the United Kingdom (Harron, 1986; Clement & Foster, 1994).

The species discussed above (*D. orientale, D. plantagineum,* and *D. pardalianches*) occur in similar mesic habitats from sea level up to subalpine regions, but not in high mountain habitats (the upper tree-line). *Doronicum hungaricum,* occupying similar habitats in Eastern Europe, can be considered vicariant with *D. plantagineum* in this region. *Doronicum austriacum* is widely distributed in Europe, most abundantly in the Austrian Alps, Macedonia, and Ukraine, always in subalpine regions, and in the Iberian peninsula it occurs only in a few localities in the eastern Pyrenees.

The strictly alpine species of the genus in Europe are represented by *Doronicum grandiflorum, D. clusii,* and *D. glaciale.* The first of these species is the most widely distributed of them. It is abundant in the Alps, the Pyrenees, and in the Cantabrian range (northern Spain). In addition, there are two specimens from Corsica dated 1878 and 1917, suggesting its extinction on this Mediterranean island, which has well known floristic affinities with the Alps (Briquet, 1901). *Doronicum clusii* is present in the Alps and Carpathians, while *D. glaciale* is restricted to the Alps (mainly the Austrian Alps), where it can coexist with *D. clusii.* The alpine and subalpine habitats of the central and northern half of the Iberian peninsula (except the Pyrenees) are occupied by *D. carpetanum,* under which four subspecies are recognized.

Other alpine to subalpine species in central and eastern Europe are *Doronicum columnae* and *D. carpaticum.* The first is widely distributed from Italy to Romania, and *D. carpaticum* is restricted to the Carpathians.

The remaining two European species are endemics, *D. cataractarum* in the Austrian Alps and *D. corsicum* in Corsica, and both occur in subalpine habitats.

The genus *Doronicum* in southwestern Asia is represented by seven species. Only one, *D. oblongifolium* (from the Caucasus), is morphologically quite different from the others. Three of them are widely distributed: *D. macrophyllum* (Caucasus and northern Turkey), *D. dolichotrichum* (Caucasus and south of the Caspian Sea), and *D. maximum* (eastern Turkey, and south of the Caspian Sea). Of the three remaining species a limited number of specimens are known, and this results in a scattered distribution.

All of the central Asian species (*D. altaicum, D. briquetii, D. falconeri, D. gansuense, D. kamaonense, D. stenoglossum*) overlap at least in one point of their distributions.

Morphology

rhizomes

All representatives of *Doronicum* are perennial rhizomatous herbs. The shape and structure of the rhizome are constant within each species, but are not exclusive to any one. These characters are useful, sometimes indispensable, to discriminate between species. There are fleshy or woody (or somewhat woody) rhizomes in *Doronicum.* This character was described by Cavillier (1911: 199), who provided histological diagrams, as "tubéreux" and "non tubéreux," respectively. To distinguish between these, observations on fresh material are required, although when pressed, fleshy rhizomes flatten easily while the woody ones retain their original more or less terete shape. When fresh, fleshy rhizomes are succulent and brittle, while woody ones are fibrous and tough. Fleshy rhizomes are easily recognized in some European species (e.g., *D. plantagineum, D. pardalianches, D. hungaricum*), while woody rhizomes are well represented in Asian species (e.g., *D. macrophyllum, D. maximum, D. stenoglossum*). In a few cases, rhizomes are fleshy to somewhat woody and cannot be as-

signed to either type (e.g., *D. grandiflorum*, *D. cataractarum*).

Within a species, rhizome internodes may have roughly constant length and width (e.g., *D. altaicum*, Fig. 1G), or may vary in length and width, resulting in stolon-like structures. Most species have the former condition, and only *D. orientale* (Fig. 1A), *D. plantagineum*, *D. pardalianches*, and sometimes *D. hungaricum* have clearly irregular internodes.

Sometimes rhizome nodes have brown-tinted scales remaining from the sheath of basal leaves from previous years (e.g., *D. carpetanum*, Fig. 1F).

The persistent remains of basal fibers from old petioles occur, for example, in *Doronicum oblongifolium*, but they are frequently absent (e.g., *D. austriacum*, Fig. 1C).

Hyaline, shiny, and smooth trichomes are sometimes present on the younger nodes of rhizomes and also in the axils of basal leaves. Sometimes these trichomes are long, abundant, entangled, and white to yellow, and they can cover a large part of the rhizome (e.g., *D. orientale*). Such rhizomes were referred to as "ériopode" by Cavillier (1911: 199) in contrast to "gymnopode" rhizomes, which lack this indumentum (e.g., *D. columnae*). In many cases it is difficult to see trichomes on rhizomes, because they are short and scarce and can be covered with leaf remains (e.g., *D. carpetanum*, *D. clusii*, *D. glaciale*, and *D. grandiflorum*).

Buds are evident on some fleshy rhizomes (e.g., *D. hungaricum*, Fig. 1B). These stem buds can be seen in plants two years or older, but these must be collected carefully. Sometimes the scales that cover young buds can also be observed.

Two species each have unique rhizomes. *Doronicum cacaliifolium* has moniliform rhizomes with uniform, spherical, swollen internodes, alternating with nodal constrictions, sometimes covered by a fibrous net. In the second type, seen in most *D. stenoglossum*, the main stem is inserted on a convex swollen woody surface. Sometimes, pieces of a woody organ perpendicular to the stem were also collected. Although the whole structure has not been seen, it is presumed to be a kind of distinct woody rhizome, but further study of the subterranean organ is needed.

Adventitious roots are present in *Doronicum stenoglossum* and sometimes in *D. kamaonense* a few centimeters above the subterranean woody organ, suggesting that the lowest vertical part of the stem was buried.

STEMS

The stems in *Doronicum* are always erect, fistulose, cylindric, and slightly ribbed, green when fresh, and pale yellow to brown when dry. Generally stems are straight, but zigzag stems occur in some species (e.g., *D. austriacum*). The stems are often simple and end in a single capitulum. When bearing several capitula, the stem is branched only in the upper part. Exceptions are seen in *D. stenoglossum* and *D. kamaonense*, which sometimes have branches on the lower part of the stem.

The main stem terminates in a capitulum, which matures first. Further capitula, if any, are on terminal lateral branches, which for the most part overtop the main head. Each species generally has a characteristic number of capitula, e.g., one in *D. falconeri*, up to 5 in *D. pardalianches*, and more than 5 (up to 20) in *D. corsicum*.

LEAVES

Leaves are simple and alternate. Leaf characters have been traditionally used in the taxonomy of the genus (Cavillier, 1911), but their usefulness is limited to the specific level. The shape and size of leaves are variable even within a single specimen for some species. For this reason, basal leaves (those inserted on the rhizome nodes) and cauline leaves are necessary for descriptive purposes. Similarly, cauline leaves are distinguished by position as lower, middle, and upper, i.e., inserted in the basal, middle, and upper third of the stem, respectively. In some species, basal and lower cauline leaves are usually absent at flowering time.

Basal leaves are petiolate, the petiole being short and wide (e.g., *D. briquetii*), or much longer than the leaf blade (e.g., *D. columnae*). In species with large basal leaves, sheaths are conspicuous (e.g., *D. macrophyllum*, *D. maximum*, and *D. dolichotrichum*). Acropetally, along the stem, the petiole gradually shortens, often leading to fiddle-shaped leaves. The upper cauline leaves are reduced, sessile, and ovate to bract-like. This leaf transition is marked in *D. austriacum*, *D. carpetanum*, *D. macrophyllum*, and *D. pardalianches*.

Leaves may be orbicular, ovate, elliptic, and obovate, as well as fiddle-shaped or bract-like. The base of leaves can be cordate (Fig. 2A), subcordate, truncate, or attenuate (Fig. 3A, C, F, I). Leaf margins are generally entire to subentire, sometimes markedly dentate (e.g., *D. cacaliifolium*, *D. columnae*, *D. corsicum*, and *D. grandiflorum*).

Number and arrangement of cauline leaves determine to a large extent the architecture of the plant. In some species the number of cauline leaves is low (2 to 4, e.g., *D. orientale*) and they are confined to the basal third of the stem. In other leafy species (*D. austriacum*, *D. corsicum*, or *D. altai-*

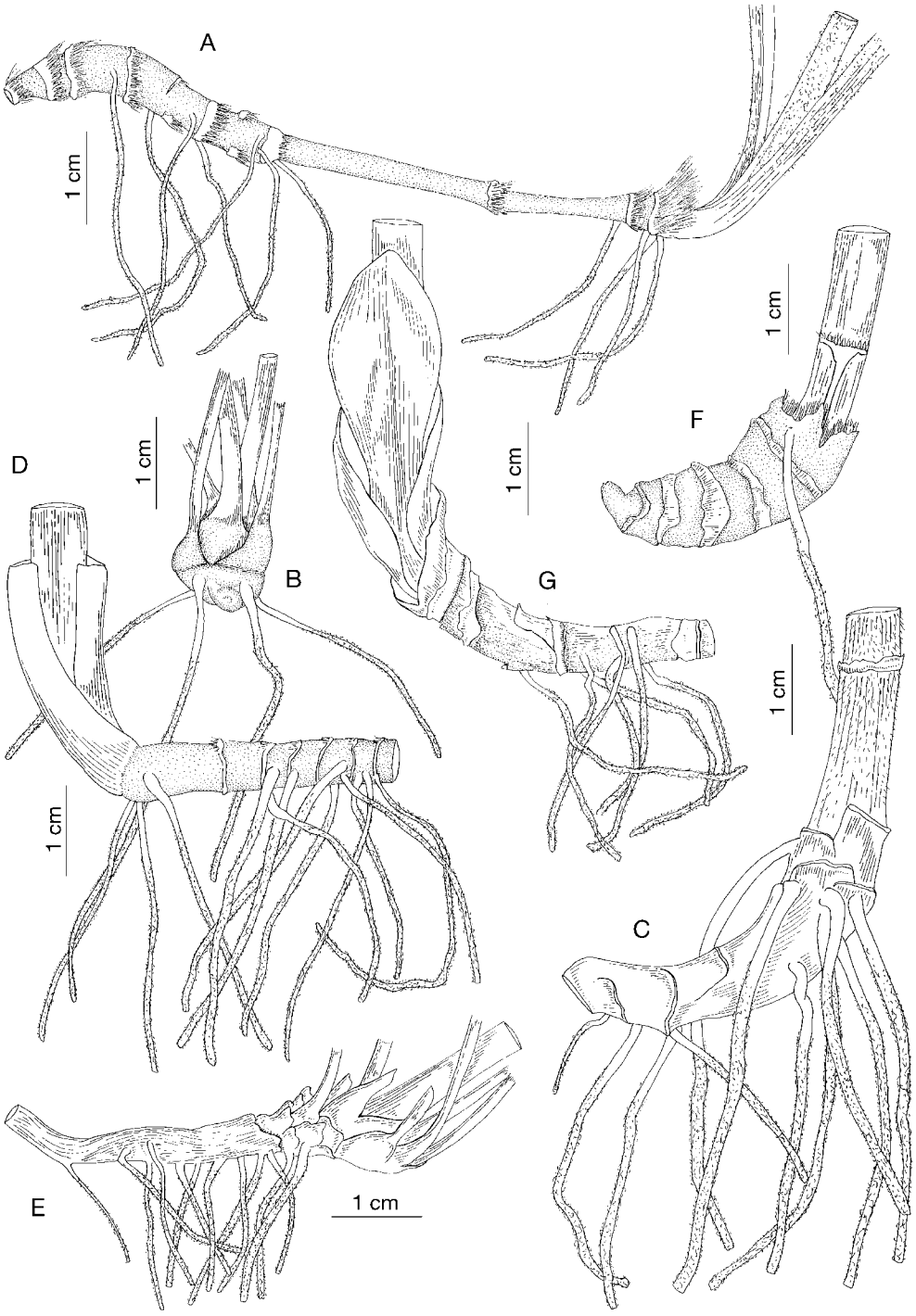

Figure 1. Rhizomes in *Doronicum*. —A. *Doronicum orientale* (drawn from *Willing 3515*, B). —B. *Doronicum hungaricum* (drawn from *Grundl s.n.*, G, as *D. longifolium*). —C. *Doronicum austriacum* (drawn from *Strid et al. 18585*, B). —D. *Doronicum cataractarum* (drawn from *Höpflinger s.n.*, BM). —E. *Doronicum columnae* (drawn from *Sladen 9/4/452*, BM). —F. *Doronicum carpetanum* subsp. *carpetanum* (drawn from *Luceño & Vargas 208*, MA). —G. *Doronicum altaicum* (drawn from *Krasnoborov et al. 959*, K).

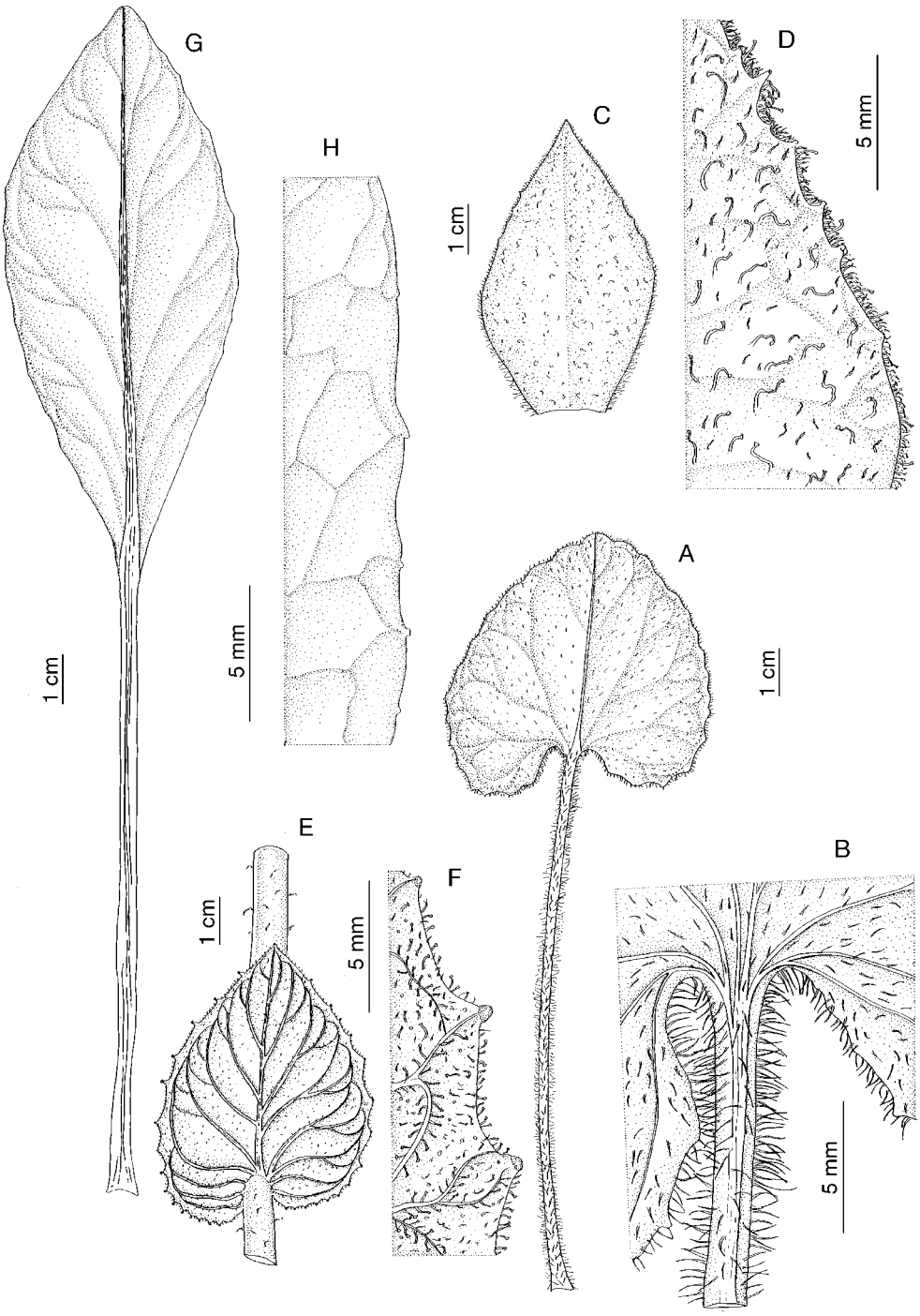

Figure 2. A, B. *Doronicum pardalianches* (drawn from *Rivas-Goday s.n.*, MA). —A. Basal leaf. —B. Indumentum of basal leaf. C, D. *Doronicum dolichotrichum* (drawn from *Davis & Hedge 29493,* K). —C. Upper cauline leaf. —D. Indumentum of upper cauline leaf. E, F. *Doronicum briquetii* (drawn from *Rock 22380,* E). —E. Upper cauline leaf. —F. Indumentum of upper cauline leaf. G, H. *Doronicum altaicum* (drawn from *Krasnoborov et al. 959,* K). —G. Basal leaf. —H. Margin of basal leaf.

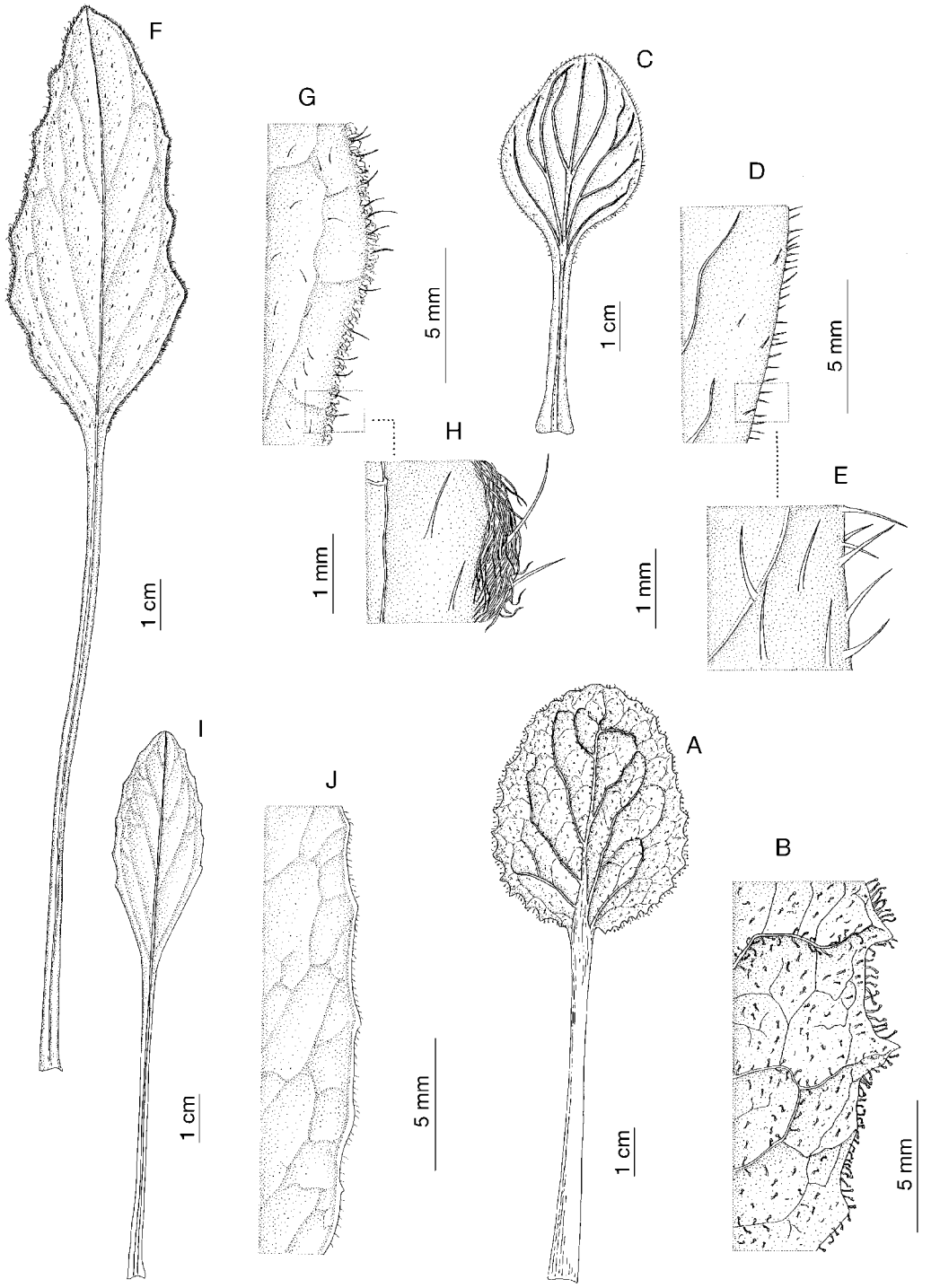

Figure 3. A, B. *Doronicum grandiflorum* (drawn from *Maquet 83/56*, MA). —A. Basal leaf. —B. Indumentum of basal leaf. C–E. *Doronicum glaciale* (drawn from *Steininger s.n.*, B). —C. Basal leaf. —D, E. Indumentum of basal leaf. F–H. *Doronicum clusii* (drawn from *Castroviejo et al. 11615*, MA). —F. Basal leaf. —G, H. Indumentum of basal leaf. I, J. *Doronicum oblongifolium* (drawn from *Albury et al. 3176*, K). —I. Basal leaf. —J. Margin of basal leaf.

cum) leaves are arranged along the stem. The largest leaves are usually seen at the middle or basal parts of stems.

Leaf venation is a good taxonomic character, easily observed in dry specimens and preferably from basal leaves. For its description and categorization the terms proposed by the Leaf Architecture Working Group (1999) are used. Most species have an actinodromous venation for first vein category (e.g., *D. grandiflorum*, *D. carpetanum*, *D. reticulatum*) in which all secondary and tertiary veins are more or less equally evident. Pinnate venation for the first vein category occurs in central Asian species. In this type, the tertiary veins are not well marked, and both the secondary veins and the main vein are equally prominent and thick (e.g., *D. altaicum*, *D. gansuense*, *D. kamaonense*, *D. stenoglossum*). The acrodromous type of venation for the first vein category is restricted to a European group of species (*D. hungaricum*, *D. orientale*, *D. plantagineum*, and *D. columnae*). Intermediate cases between the latter and the actinodromous type occur in *D. columnae*, *D. carpaticum*, and *D. pardalianches*, and between pinnate and actinodromous venation in *D. clusii* and *D. glaciale*.

HABIT

Four main habit classes can be distinguished:
(1) An "*orientale*" type: solitary capitulum with a scapose stem, sometimes bearing bract-like leaves; a few cauline leaves (2 to 4) inserted in the basal third of the stem. It is displayed by some European species (e.g., *D. orientale*, *D. columnae*, *D. plantagineum*).
(2) An "*altaicum*" type: generally a single capitulum; a mostly leafy stem and a variable number of uniform leaves (4+) along the stem length, or at least in its lower half. This is present in some central Asian as well as European species (e.g., *D. altaicum*, *D. falconeri*, *D. grandiflorum*).
(3) A "*macrophyllum*" type: several capitula; stem branched in the upper third; large cauline leaves (3 to 5) mainly in the lower half of the stem, and bract-like leaves on the upper stem. This is restricted to the southwestern Asian species.
(4) A "*corsicum*" type: several capitula; a variable number of ± uniform leaves (5+) ± evenly inserted along the stem. This is characteristic of *D. corsicum* and *D. austriacum*.

In some species the habit does not correspond to these patterns (e.g., *D. kamaonense* and *D. stenoglossum*, which are sometimes branched from the base), and sometimes intermediate patterns occur (e.g., *D. pardalianches*, *D. cacaliifolium*).

CAPITULA

All *Doronicum* species have radiate, hemispheric to widely campanulate, homochromous capitula (Fig. 5A, E) with yellow or green-yellow corollas. Capitulum diameter ranges from 8 to 15 mm (e.g., *D. cacaliifolium* and *D. kamaonense*) and 7 to 8 cm (e.g., *D. falconeri* and *D. cataractarum*). The receptacle is convex to hemispheric, glabrous or pubescent. In fruit, the base of the capitulum is sometimes widely turbinate.

Ray flowers are female with strap-like or narrowly elliptic to slightly obovate rays, generally ending in three or two teeth, sometimes entire (e.g., *D. altaicum*). Disk flowers are hermaphrodite, actinomorphic, and narrowly funnel-shaped.

Phyllaries are herbaceous to slightly papery at the base in some species (e.g., *D. austriacum*) and arranged in 2 or 3 rows, the outer being wider than the inner. In most species the phyllaries are clearly shorter than the ray flowers, but they can be almost equal or even longer than them (e.g., *D. stenoglossum*, *D. pardalianches*). Phyllaries are ovate-triangular, ovate-elliptic, or ovate-lanceolate to linear. The phyllary apex is usually acute, except in *D. gansuense* where it bears a sessile gland (Fig. 4A–C). Phyllary margins are entire, except in *D. haussknechtii* where they are slightly fimbriate. A group of species (*D. orientale*, *D. plantagineum*, *D. hungaricum*, *D. carpaticum*, and *D. columnae*) have phyllaries with ciliate margins, bearing thin, stiff, acute, and equidistant trichomes (0.2–1.5 mm) (Fig. 5E–G).

FRUITS

Some species of the genus have dimorphic cypselae (heterocarpy), evident primarily by the absence of a pappus in ray flowers. Cypselae without pappuses are also generally larger than those with a pappus in the same specimen (Fig. 6A, B). Heterocarpy occurs in other genera of Asteraceae such as *Senecio*, *Crepis*, *Erigeron*, *Leontodon*, and *Heterotheca*, as well as in other families, Caryophyllaceae, Apiaceae, Poaceae (Zohary, 1950). These morphologic differences serve different functions. In *Heterotheca latifolia*, in which the type of dimorphism is similar to *Doronicum*, Venable and Levin (1985) suggested that the pappose cypselae are dispersed away by wind, while epappose cypselae fall near the mother plant. This double dispersal strategy implies the potential to colonize different habitats (Venable & Levin, 1985; Tanowitz et al., 1987; Imbert et al., 1996). Although plants with incompletely developed pappuses on ray florets are found in some species (e.g., *D. carpaticum*,

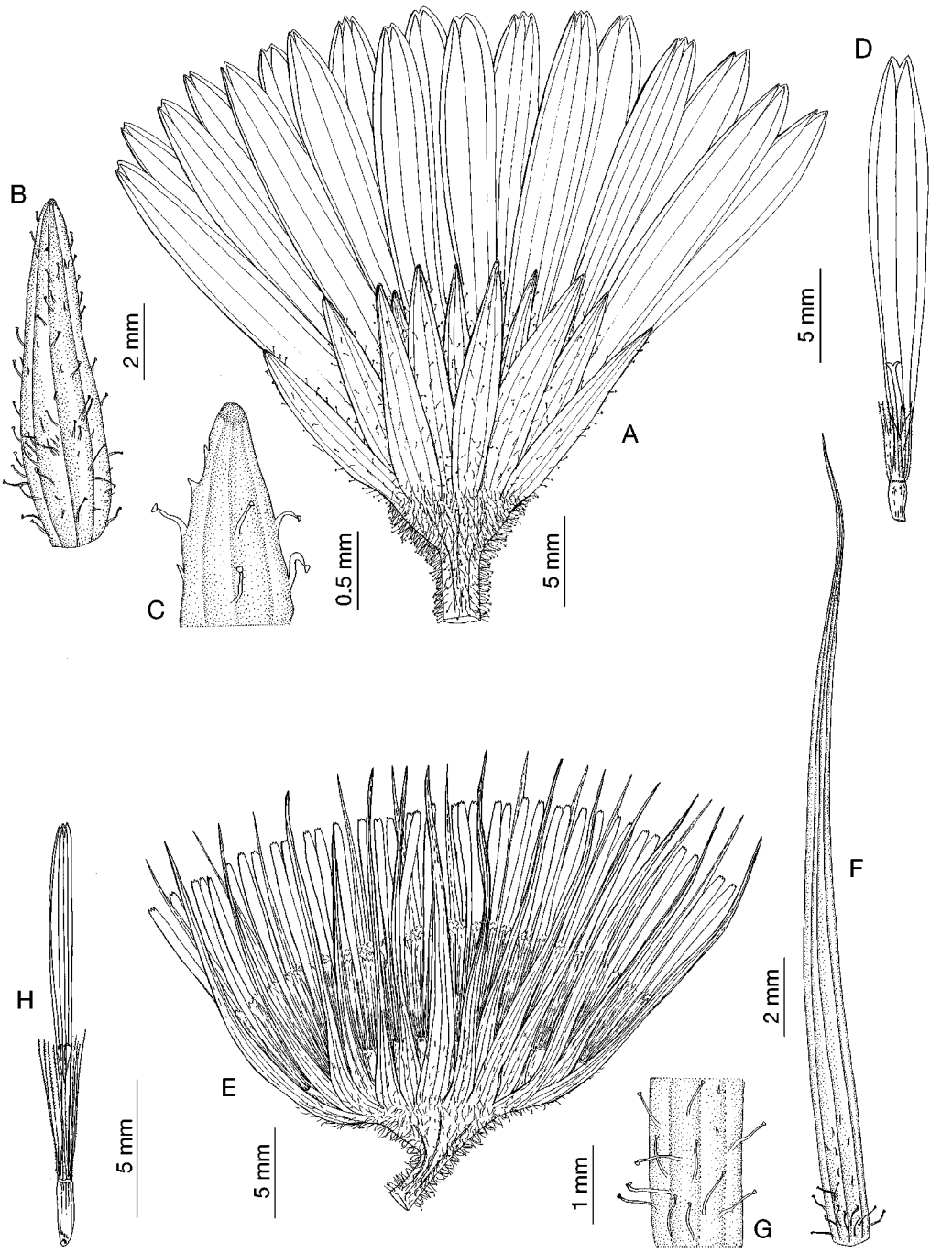

Figure 4. A–D. *Doronicum gansuense* (drawn from *Rock 12192*, E, as *D. thibetanum*). —A. Capitulum. —B. Phyllary. —C. Apex of phyllary. —D. Ray flower. E–H. *Doronicum stenoglossum* (drawn from *Rock 12941*, GH). —E. Capitulum. —F. Phyllary. —G. Indumentum of the base of phyllary. —H. Ray flower.

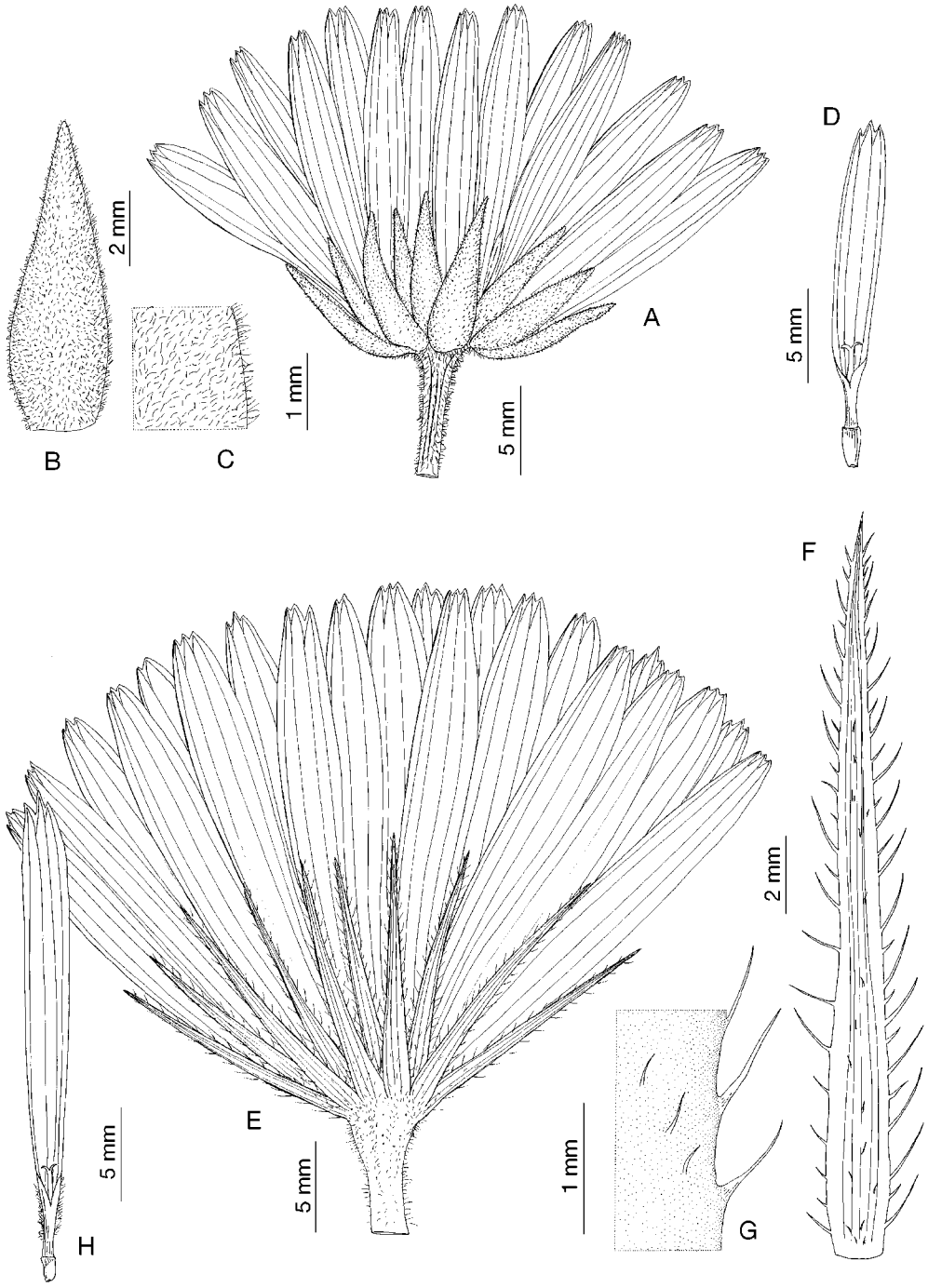

Figure 5. A–D. *Doronicum cacaliifolium* (drawn from *Davis 14381*, K). —A. Capitulum. —B. Phyllary. —C. Indumentum of phyllary. —D. Ray flower. E–H. *Doronicum orientale* (drawn from *Willing 14441*, B). —E. Capitulum. —F. Phyllary. —G. Indumentum of phyllary. —H. Ray flower.

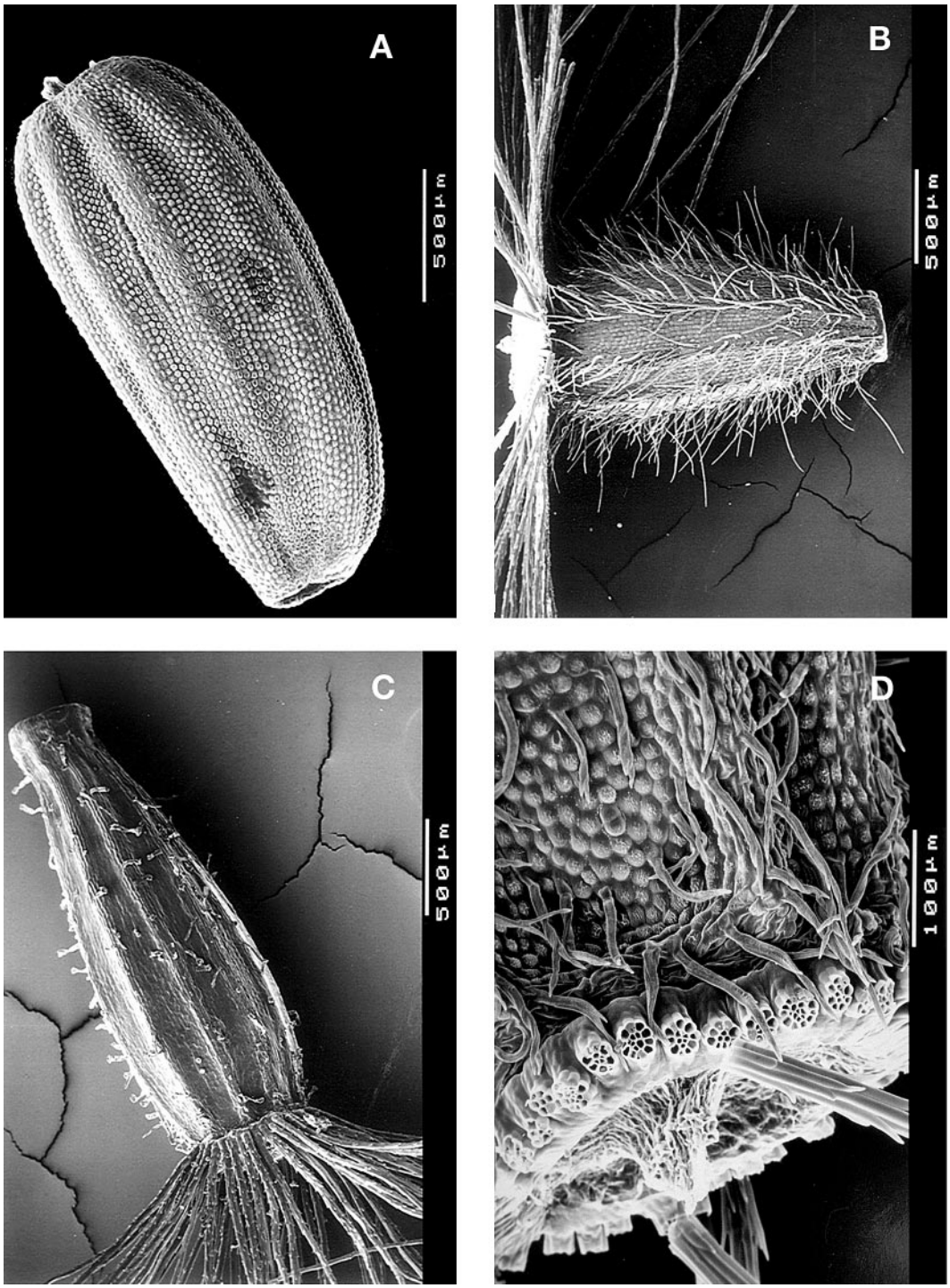

Figure 6. A, B. *Doronicum plantagineum* (from *Álvarez et al. 954,* MA). —A. Cypsela from a ray flower. —B. Cypsela from a disk flower. —C. Cypsela of *Doronicum carpetanum* subsp. *diazii* (from *Álvarez et al. 924,* MA). —D. Base of caducous pappus in *Doronicum stenoglossum* (from *Bartholomew & Gilbert 1205,* E).

D. carpetanum), dimorphism is generally either present or not in *Doronicum*. Such intermediate situations were considered hybrids by Cavillier (1911). In the present taxonomic treatment, since hybrids were not confirmed, intermediates are included with the closest species.

Cypselae are cylindric to obovate, have 10 longitudinal ribs, and are black, brown, brown-red, or olive-green. When an indumentum is present, this occurs mainly on the ribs, except for *D. stenoglossum*, where trichomes are spread across the cypsela surface. In most species, the pappus consists of 2 or 3 rows of minutely scabrous, white or yellow-tinged capillary bristles. A single row of bristles is present in some southwestern Asian species (e.g., *D. macrophyllum, D. maximum*) as well as in *D. stenoglossum*. This latter species is functionally heterocarpic since the pappus in ray flowers is caducous. A thick base, or "crown," remains when the pappus falls (Fig. 6D).

Surfaces of cypselae are warty to slightly warty (Fig. 7A), reticulate-grooved (Fig. 7B), grooved to slightly grooved (Fig. 7C), or smooth (Fig. 7D).

INDUMENTUM

This was the most relevant taxonomic character for Cavillier (1907, 1911) at the specific level. Other authors also considered the type and arrangement of indumentum very important (Pérez et al., 1994). While the indumentum pattern identifies certain species (e.g., *D. clusii, D. glaciale, D. haussknechtii, D. hungaricum, D. dolichotrichum*), any quantitative variation within the same indumentum type is not useful in distinguishing species. The latter quantitative criterion led to the erroneous characterization of the species *D. austriacum* (Pérez et al., 1997). When indumentum is scarce, it may be most dense on the upper third of the stem, on veins, margins and abaxial surfaces of leaves, as well as in the basal part of outer phyllaries (abaxial surfaces). In *Doronicum*, the adaxial surfaces of the phyllaries are always glabrous. The following types of trichomes have been recognized in *Doronicum*:

Eglandular trichomes

(1) Multiseriate trichomes with blunt apices that are formed at least by two rows of rectangular cells, these trichomes are usually 0.3–0.5 mm long, but sometimes up to 1.5 mm (in *D. plantagineum*) or even up to 4.5 mm (in *D. hungaricum*). They occur on stems, leaves, and phyllaries, more frequently in European species but are almost absent in central Asian species.

(2) Uniseriate trichomes with blunt apices that are formed by a single row of rectangular or square cells, these trichomes are 0.1–0.4 mm long. This is the most common pubescence, occurring on stems, leaves, and phyllaries in almost all species. In *D. cacaliifolium* (Fig. 5A–C) they cover the abaxial phyllary surface and differ from others by their enlarged basal part and curved apex (Fig. 8B). This type of trichome also occurs in *D. clusii,* in which the cells are clearly rectangular, but the trichome length is up to 5 mm, and they may form an entangled covering on the leaf margins.

(3) Multiseriate trichomes with acute apices. These consist of at least two rows of fusiform cells ending in one or two cells with an acute apex. Four subtypes occur:

(3a) Stiff trichomes (0.5–2.5 mm long), consisting generally of more than two rows of cells, characteristic of leaves and phyllaries in *D. glaciale* and *D. clusii* (Fig. 3C–H).

(3b) Somewhat stiff trichomes (0.2–1.5 mm long), sometimes crooked (cilia). They are only present on the margins of phyllaries of *D. orientale* (Fig. 5E–G), *D. plantagineum, D. hungaricum, D. carpaticum,* and *D. columnae.*

(3c) Trichomes (ca. 0.3 mm long), formed by two or three cells. They occur on the cypselae of almost all *Doronicum* species (Fig. 8A).

(3d) Trichomes (0.5–5 mm long) that end in two acute cells, and are present only on leaves and petioles of *D. pardalianches.*

Glandular trichomes

The following types of glandular trichomes are recognized in this work:

(1) Short-stalked glandular trichomes. These consist of 4 to 8 cells, 0.05–0.3 mm long, and are present on the stems, leaves, phyllaries, cypselae, and flowers of all the species. Two subtypes are distinguished:

(1a) Trichomes with apices (of 2 cells) of the same diameter as the cells of the trichome stalk (Fig. 8C).

(1b) Trichomes with capitate apices (of 3 or 4 cells) and wider than the stalk.

(2) Long-stalked glandular trichomes. These consist of more than 6 cells, 0.3–5 mm long, and are present on the stems, leaves, and phyllaries in many *Doronicum* species. Two subtypes are distinguished:

(2a) Trichomes with apices of 3 or 4 cells of the same diameter as stalk cells.

(2b) Trichomes with apices (of more than 4 cells) exceeding stalk cells (Fig. 8D). This latter type is present in a few species (*D. macrophyllum, D. hun-*

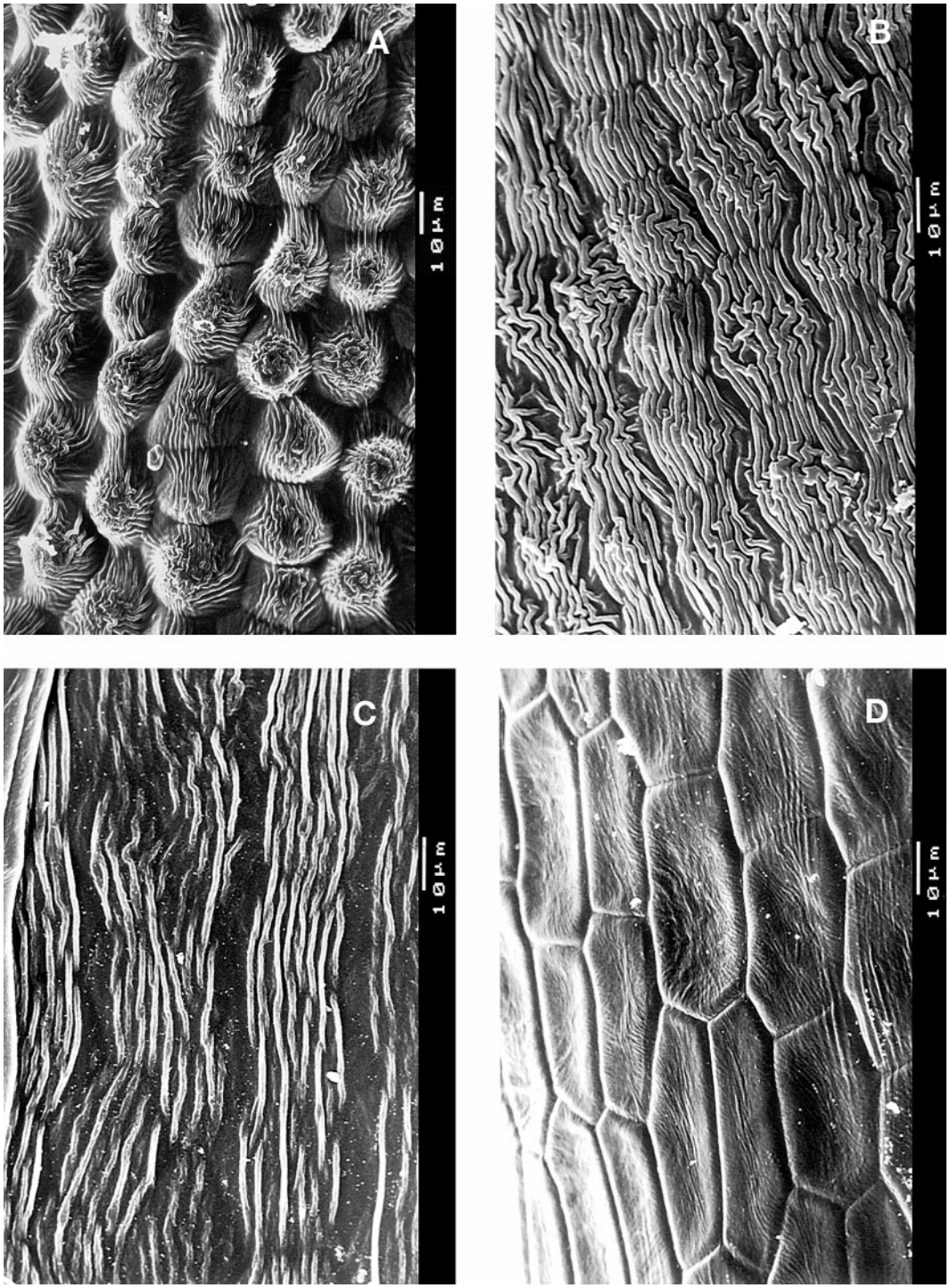

Figure 7. Cypselae surfaces in *Doronicum*. —A. *Doronicum pardalianches* (from *Almaraz et al. 1015*, MA). —B. *Doronicum reticulatum* (from *Baytop & Baytop 20972*, E, as *D. bithynicum*). —C. *Doronicum cacaliifolium* (from *Davis 14551*, K). —D. *Doronicum dolichotrichum* (from *Davis & Polunin 24383*, E).

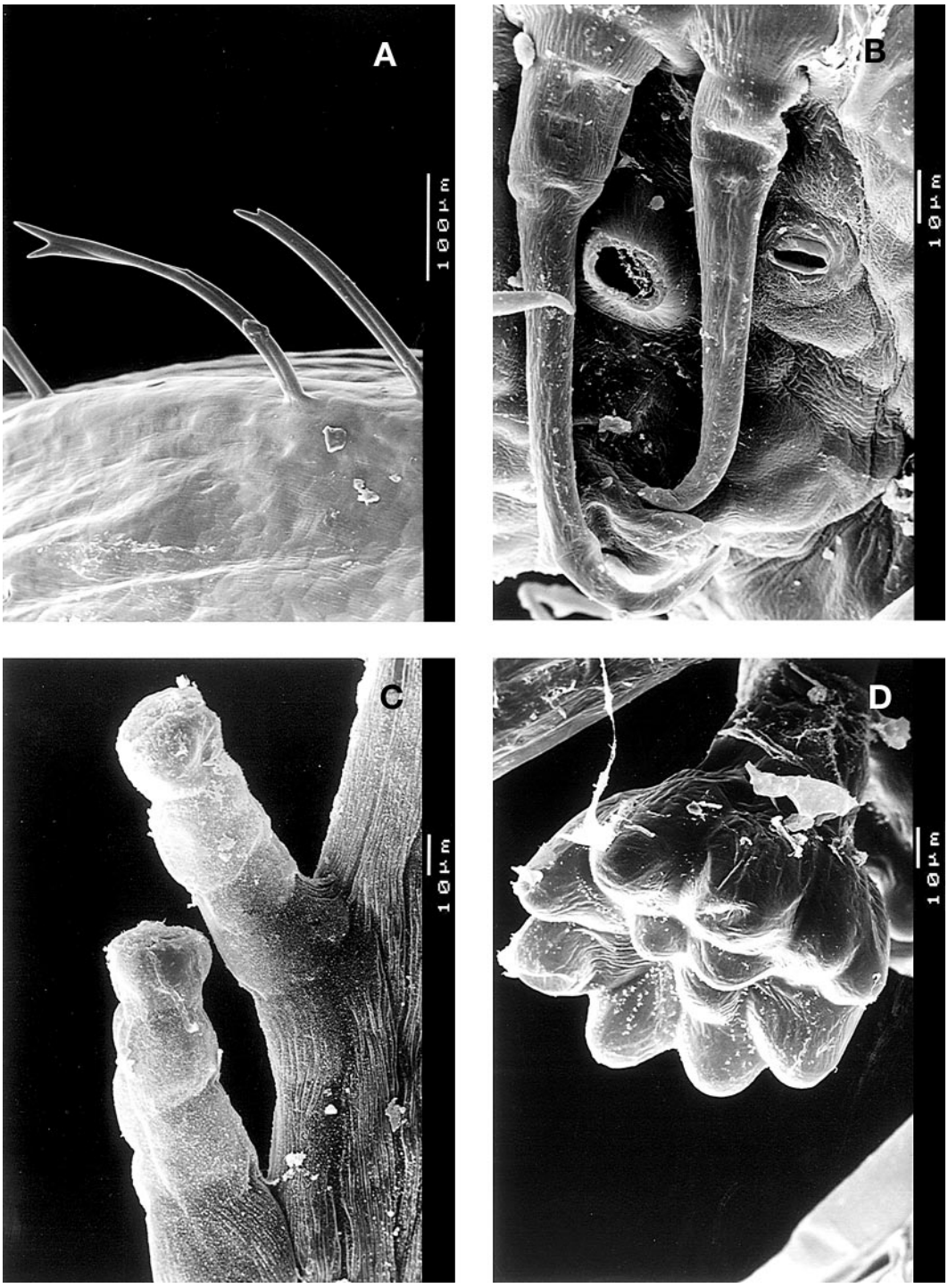

Figure 8. —A. Uniseriate eglandular trichomes with acute apices on a cypsela of *Doronicum maximum* (from *Davis & Polunin 24113,* E). —B. Uniseriate eglandular trichomes with blunt apices on a phyllary of *Doronicum cacaliifolium* (from *Davis 14551,* K). —C. Uniseriate glandular trichomes on the margins of a phyllary of *Doronicum cataractarum* (from *Fest 571,* B). —D. Apex of a multiseriate glandular trichome from the base of the capitulum in *Doronicum kamaonense* (from *Polunin et al. 401,* G, as *D. roylei*).

garicum, and *D. kamaonense*). Only in this last species is the apex markedly obconical and can be observed near the capitula without a magnifying glass.

Chemistry

Several chemical analyses on *Doronicum macrophyllum* (Bohlmann & Grenz, 1979), *D. pardalianches* (Bohlmann & Abraham, 1979), *D. hungaricum* (Bohlmann et al., 1980), and *D. grandiflorum* (Reynaud & Raynaud, 1984, 1986; Reynaud et al., 1985) have resulted in the isolation of 52 different compounds. Two of them are pyrrolizidine alkaloids, a few are aromatic compounds: 10 benzofurane-derivatives, 4 phenols, and 2 flavonoids. Twenty-one monoterpenes, mainly thymol-derivatives, were also isolated. The remaining compounds are 5 diterpenes with kaurane structure, 2 triterpenes (one of them a lupane-derivative and other oleanane-derivative), and 6 sesquiterpenes, most of these germacradiene-derivative.

Since only four species were analyzed, the taxonomic usefulness of these chemical characters at the specific level cannot be assessed. However, the presence of alkaloids of the pyrrolizidine group (Bohlmann & Grenz, 1979) is consistent with the inclusion of the genus within the tribe Senecioneae, which is characterized by these alkaloids (Robins, 1977).

Chromosome Numbers

Chromosome numbers in *Doronicum* are rather constant. Most reports included herein were obtained from the literature (Lindqvist, 1950; Skalinska, 1950; Baksay, 1956; Contandriopoulos, 1957; Favarger & Huynh, 1964; Polatschek, 1966; Favarger & Küpfer, 1968; Lovka et al., 1972; Kuzmanov & Ancev, 1973; Löve & Kjellqvist, 1974; Garbari et al., 1980; Van Loon, 1980; Belaeva & Siplivinsky, 1981; Van Loon & Oudemans, 1982; Kuzmanov & Georgieva, 1983; Strid & Franzén, 1983; Davlianidze, 1985; Strid & Anderson, 1985; Chacón, 1987; Lippert & Heubl, 1988; Tasenkevitch et al., 1989; Vir Jee & Kachroo, 1989; Baltisberger, 1991; Ruiz de Clavijo, 1993). Only when no original sources were available (i.e., *D. cataractarum*, *D. macrophyllum*, among other counts), data from indexes of plant chromosome numbers (Fedorov, 1969; Moore, 1982; Goldblatt, 1985, 1988; Goldblatt & Johnson, 1994, 1996, 1998) were cited, and they are indicated by an asterisk after the number. However, chromosome counts were made here for *D. carpetanum* subsp. *diazii* ($2n = 60$) and *D. carpetanum* subsp. *kuepferi* ($2n = 60$). Material was cultivated from fresh rhizomes or seeds. Apices of secondary roots as well as immature disk flowers were used for counting. Both were fixed in 3:1 ethanol: acetic acid for 48 hours and then kept in 70% ethanol at −20°C. Chromosomes were stained with acetic orcein.

The basic chromosome number $x = 30$, characteristic of the "cacalioid" group in Senecioneae, is also considered to be the basic number in *Doronicum* (Bremer, 1994), although previous authors suggested $x = 10$ (Fernandes & Queirós, 1971; Májovský & Murín, 1987). Chromosome numbers, known for 19 taxa, are consistent with both hypotheses, although the fact that most of them are multiples of 30 ($2n = 60$) may support the basic number $x = 30$. Only *D. carpetanum* subsp. *carpetanum*, *D. carpetanum* subsp. *pubescens*, *D. plantagineum*, and several populations of *D. clusii* and *D. pardalianches* had higher counts, at $2n = 120$. Other species show both ploidy levels (e.g., *D. altaicum* $2n = 30^*, 60$; *D. macrophyllum*, $n = 30^*, 60$; and *D. oblongifolium*, $2n = 60, 40$), suggesting that polyploidy is common in the genus. *Doronicum oblongifolium* ($2n = 40$) is the only count that is inconsistent with $x = 30$, and it should be recounted.

Phylogeny

The first phylogenetic hypothesis for *Doronicum* sect. *Doronicastrum* (i.e., *D. altaicum*, *D. austriacum*, *D. balansae*, *D. briquetii*, *D. cacaliifolium*, *D. carpaticum*, *D. carpetanum*, *D. clusii*, *D. cordatum*, *D. corsicum*, *D. dolichotrichum*, *D. falconeri*, *D. glaciale*, *D. grandiflorum*, *D. haussknechtii*, *D. longifolium*, *D. macrolepis*, *D. macrophyllum*, *D. maximum*, *D. oblongifolium*, *D. orientale*, *D. pardalianches*, *D. plantagineum*, *D. portae*, *D. reticulatum*, *D. thibetanum*, *D. thirkei*, *D. turkestanicum*, and *D. viscosum*) was presented by Cavillier (1911).

Cavillier (1911) mentioned that his three sections (sect. *Doronicastrum*, sect. *Soulieastrum*, and sect. *Hookerastrum*) were not closely related, and thus the genus so circumscribed is polyphyletic.

Cavillier considered the *Doronicum* subsections included in section *Doronicastrum* to be natural groups, and his classification was developed accordingly. He thought that subsection *Plantaginea* (*D. plantagineum*, *D. longifolium* (= *D. hungaricum* herein), *D. oblongifolium*, and *D. falconeri*) was monophyletic and the most ancient group in the genus. *Doronicum* subsect. *Pardalianchia* (*D. pardalianches*, *D. roylei* (= *D. kamaonense* herein), *D. reticulatum*, and *D. atlanticum* (= *D. plantagineum* herein)) was a grouping derived from subsec-

tion *Plantaginea*. *Doronicum* subsects. *Cardiophylla* (*D. carpetanum*, *D. orientale*, *D. carpaticum*, and *D. cordatum* (= *D. columnae* herein)) and *Macrophylla* (*D. macrophyllum*, *D. dolichotrichum*, *D. haussknechtii*, *D. maximum*, and *D. cacaliifolium*) were derived from subsection *Pardalianchia*, and were also natural groups. In contrast, Cavillier placed the probable origin of subsection *Grandiflora* (*D. altaicum*, *D. briquetii*, *D. grandiflorum*, *D. glaciale*, and *D. clusii*) among several members of subsection *Plantaginea*. The monotypic subsections *Corsica* and *Austriaca* would be derived from different members of subsection *Pardalianchia*. Morphologically, Cavillier (1911) noted a trend from ancient plants bearing one capitulum and basal leaves with a truncate or attenuate base to evolved plants with several capitula and basal leaves with cordate bases. Biogeographically this is not easy to reconcile since these groups include members from different continents.

The phylogenetic analysis of Álvarez Fernández et al. (2001) was based on morphological evidence as well as molecular data (nuclear ribosomal ITS and chloroplast *trn*L-F sequences).

When morphological characters were mapped onto the most parsimonious topologies, only three were free from homoplasy (scapiform habit, acrodromous basal leaf venation, and ciliate involucral bracts). All of these characters are synapomorphic for the *D. plantagineum* clade, and the strict consensus can be seen in Figure 9.

There are only two clades with bootstrap support above 90%, both basal. The *Doronicum* clade had 100% bootstrap support in all analyses, using *Ligularia* and *Tussilago* as outgroups. Although the use of only two outgroups does not provide stringent conditions for testing the monophyly of the ingroup, other evidence also indicates the monophyly of *Doronicum*. In particular, sequences aligned well within *Doronicum* but were difficult to align with any other genera suggesting that *Doronicum*, as circumscribed in this work, is monophyletic. The other clade with strong bootstrap support (97%) includes all the species of *Doronicum* except *D. corsicum*, which is sister to it (Fig. 9). This noteworthy result has strong biogeographic implications. The next taxon that is a derivative of this Corsican endemic is *D. pardalianches*, followed by the *D. plantagineum* group, which has 85% of bootstrap support. All these species are European, mostly Mediterranean, suggesting that early diversification took place on the European continent, specifically within the Mediterranean Basin.

Taxonomy

Doronicum L., Sp. Pl. 885. 1753. *Pardalianches* Tausch, Flora 11: 182. 1828. *Doronicum* sect. *Doronicastrum* Cavill., Annuaire Conserv. Jard. Bot. Genève 13–14: 337. 1911. *Doronicum* subsect. *Pardalianches* [*Pardalianchia*] Cavill., Annuaire Conserv. Jard. Bot. Genève 13–14: 338. 1911. *Doronicum* sect. *Pardalianches* (Tausch) Gorschk., in Schischk. & Bobrov, Fl. URSS 26: 773. 1961. *Doronicum* ser. *Pardalianches* (Tausch) Gorschk., in Schischk. & Bobrov, Fl. URSS 26: 778. 1961. TYPE: Herb. Clifford, 411.1 [sine collector] (lectotype, designated by Llamas et al. in Jarvis & Turland (1998: 360), BM!).

Aronicum Neck., Elem. Bot. 1: 27. 1790, nom. inval. (ICBN, App. V, Greuter et al., 2000).

Grammarthron Cass., Bull. Soc. Philom. Paris: 32. 1817. TYPE: "Doronicum radice scorpii brachiata," Herb. Burser X: 16 [sine collector] (lectotype, designated by Álvarez in Jarvis & Turland (1998: 353), UPS!, photograph). [= *Doronicum pardalianches* L.]

Fullartonia DC., Prodr. 5: 281. 1836. TYPE: "Comp. angl. des Indes 1830" [sine collector], ex herb. de Candolle (lectotype, designated by Álvarez Fernández (2001: 294), G-DC!, photograph). [≡ *Doronicum kamaonense* (DC.) Álv. Fern.]

Doronicum subsect. *Corsica* Cavill., Annuaire Conserv. Jard. Bot. Genève 13–14: 337. 1911. TYPE: not located; protologue citation: "in Corsica, ad rupes aquis fluentibus irriguas (D. Richard. Herb.)."

Doronicum subsect. *Austriaca* Cavill., Annuaire Conserv. Jard. Bot. Genève 13–14: 338. 1911. *Doronicum* ser. *Austriaca* (Cavill.) Gorschk., in Schischk. & Bobrov, Fl. URSS 26: 774. 1961. TYPE: [sine collector] ex herb. Linnaeus (LINN n.° 1002.4!) (lectotype, designated by Pérez et al. (1997: 3)).

Doronicum subsect. *Cardiophylla* Cavill., Annuaire Conserv. Jard. Bot. Genève 13–14: 338. 1911. *Doronicum* ser. *Cardiophylla* (Cavill.) Gorschk., in Schischk. & Bobrov, Fl. URSS 26: 775. 1961. TYPE: not designated; although this subsection was originally published without a type species, its name is valid (ICBN, Art. 37.1, Greuter et al., 2000).

Doronicum subsect. *Macrophylla* Cavill., Annuaire Conserv. Jard. Bot. Genève 13–14: 338. 1911. *Doronicum* ser. *Macrophylla* (Cavill.) Gorschk., in Schischk. & Bobrov, Fl. URSS 26: 776. 1961. TYPE: North Caucasus. Beschtau, [*F. A. F. Marschall von Bieberstein s.n.*], ex herb. Marschall von Bieberstein (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 804), LE!).

Doronicum subsect. *Plantaginea* Cavill., Annuaire Conserv. Jard. Bot. Genève 13–14: 338. 1911. *Doronicum* ser. *Plantaginea* (Cavill.) Gorschk., in Schischk. & Bobrov, Fl. URSS 26: 779. 1961. TYPE: Herb. Clifford, 411.2 [sine collector] (lectotype, designated by Llamas et al., in Jarvis & Turland (1998: 360), BM!).

Doronicum subsect. *Grandiflora* Cavill., Annuaire Conserv. Jard. Bot. Genève 13–14: 338. 1911. TYPE: "Arnica altaic. pall., tige simple unifl. haute de 4 ou

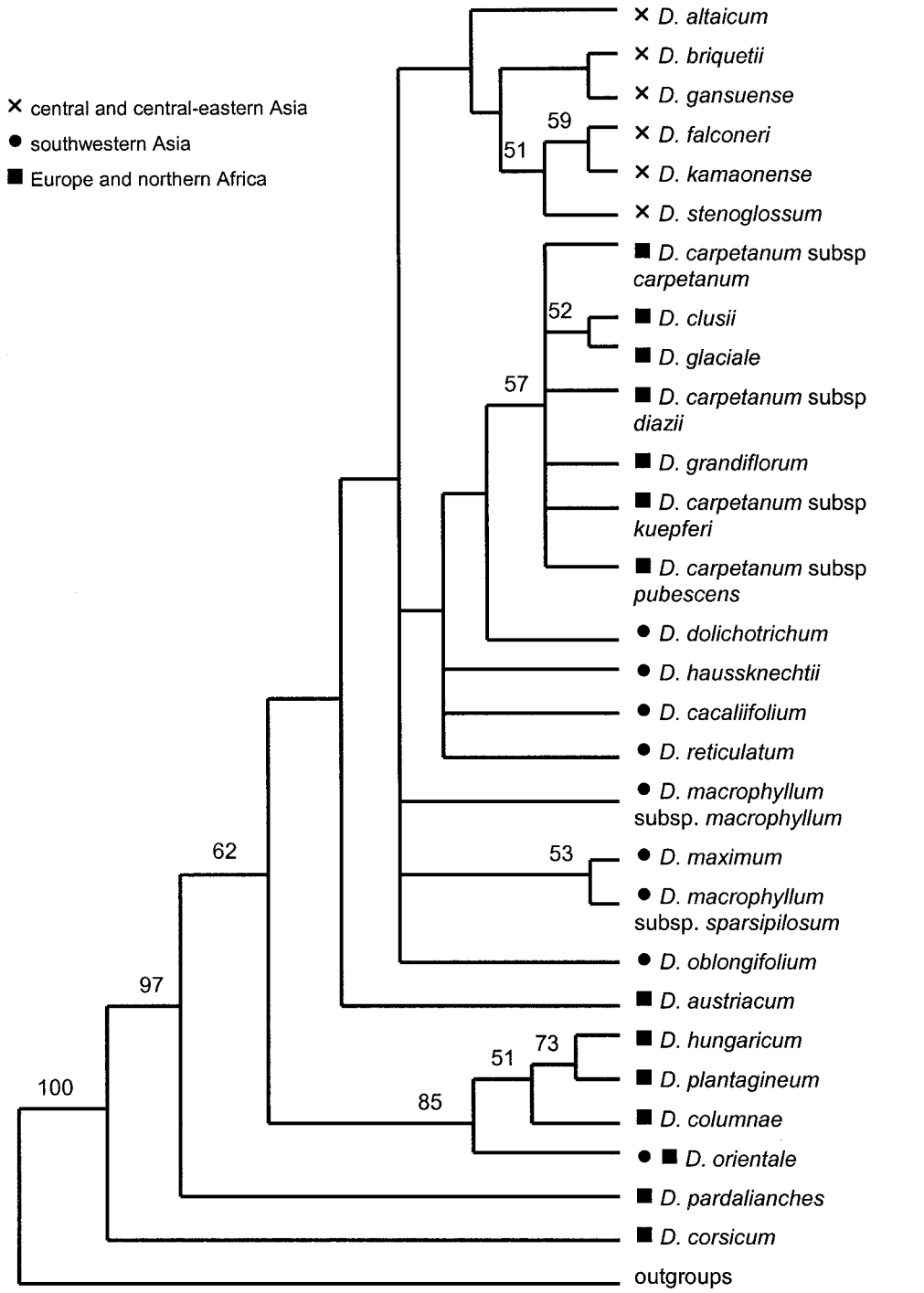

Figure 9. Strict consensus from 228 most parsimonious trees resulting from the combined analysis of three data sets in *Doronicum* (morphology, nrITS, cpDNA *trn*L-F sequence data, see Álvarez Fernández et al., 2001). Bootstrap values above 50% are shown above the branches. Outgroups: *Tussilago farfara* L. and *Ligularia sibirica* (L.) Cass. Geographical distribution of taxa: central and central-eastern Asia (crosses), southwestern Asia (circles), and Europe and northern Africa (squares).

7 pouces, fl. tres grande, fleurit au com. + de mai" [sine collector], ex herb. Lamarck (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 803), P-LA!, photograph).

Doronicum sect. *Soulieastrum* Cavill., Annuaire Conserv. Jard. Bot. Genève 13–14: 338. 1911. TYPE: China. Tibet: Kiala, Tongolo, *J. A. Soulié 335* (lectotype, designated here, G!; isotype, K!), [= *Doronicum stenoglossum* Maxim.]

Doronicum ser. *Altaica* Gorschk., in Schischk. & Bobrov, Fl. URSS 26: 768. 1961. TYPE: [Asia] "E Sumis montium altaicorum" [sine collector], ex herb. Pallas (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 801), BM!).

Doronicum ser. *Carpatica* Gorschk., in Schischk. & Bobrov, Fl. URSS 26: 771. 1961. TYPE: not located; protologue citation: "Siebenbürgen: in der alpinen Region der südlichen Karpaten, z. B. am Szurul (Fuss), nach Schur bis 7000' austeigend."

Doronicum subsect. *Isaurica* J. R. Edm., Notes Roy. Bot. Gard. Edinburgh 37(1): 72. 1978. TYPE: Turkey. Taurus, Mt. Gheï-Dagh, [*T. Heldreich*] *1043* (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 802), G-BOIS!; isotype, BM!).

Perennial herbs, 10–150(+) cm tall. *Rhizomes* fleshy or woody, glabrous to pubescent, sometimes with buds. *Stems* terete, fistulous, slightly ribbed, erect, branched or not, scape-like to leafy, sometimes with persistent leaf remains forming dark scales or fibers at the base, yellow to brown-tinged when dry. Indumentum variable, eglandular or glandular, abundant near the capitulum to very scarce at the base of the plant, sometimes absent. *Leaves* alternate, simple, entire to dentate, pubescent or glabrous, with actinodromous or pinnate-actinodromous venation, sometimes somewhat acrodromous. Basal leaves sometimes reduced to cataphylls or absent at flowering time, petiolate, with orbicular, ovate, elliptic or obovate blades, generally with a blunt apex; base of blade truncate, attenuate or cordate; petiole generally as long as the blade or longer, sometimes shorter. Lower cauline leaves similar to basal leaves, sometimes sessile. Middle cauline leaves sessile, ovate, elliptic, obovate, or fiddle-shaped, semi-amplexicaul, with blunt or acute apex. Upper cauline leaves similar, sometimes bract-like. *Capitula* 1 to 20(+), heterogamous, arranged in cymose synflorescences, terminal when solitary, radiate, 0.8–8 cm diam. including rays. Involucre much shorter than rays or rarely exceeding them. *Phyllaries* arranged in 2 to 3 rows, similar, herbaceous to somewhat papery at base and margins, ovate-elliptic to obovate-elliptic, or linear, generally with acute to tapering apex; margins entire, sometimes ciliate or minutely fimbriate; pubescent on the abaxial surface, rarely glabrous, indumentum absent on the adaxial surface. *Receptacles* convex, glabrous to pubescent. *Flowers* with yellow or green-yellow shaded corollas, uniform in color. Style branches short and blunt, adaxial papillate. Anthers without appendages. Ray flowers female, arranged in 1 row. Rays oblong-elliptic to linear; apex with 2 or 3 teeth or acute; sometimes pubescent at the base. Disk flowers, tubular, bisexual. *Cypselae* homomorphic (all cypselae with pappus) or dimorphic (ray flower cypselae without pappus), cylindrical, elliptic-obovate, with 10 ribs, light brown to brown, brown-red, olive green, or black. Surface smooth, grooved or warty, glabrous, or pubescent. Pappus arranged in 1 to 3 rows, with minutely scabrous capillary bristles, white to yellow tints. Base chromosome number $x = 30$.

Distribution. *Doronicum* is found mostly between 25º and 55° longitude in Asia, Europe, and North Africa (Morocco and northeastern Algeria), growing in forests, open rocky places with moist soil, meadows, and near watercourses, from sea level up to 5000 m in elevation.

KEY TO SPECIES OF *DORONICUM*

1.	Ray flowers without pappus (heterocarpic plant)	2
1′.	Ray flowers with pappus, although sometimes poorly developed (homocarpic plant)	20
2(1).	Base of blade of basal leaves truncate or attenuate; plants usually bearing a single capitulum	3
2′.	Base of blade of basal leaves cordate or subcordate; plants bearing one to several capitula	6
3(2).	Basal leaves with acrodromous venation	4
3′.	Basal leaves with pinnate-actinodromous, or actinodromous venation	5
4(3).	Basal leaves oblong-elliptic; indumentum of the adaxial surface of basal leaves generally consisting of eglandular trichomes (2–5 mm long), sometimes sparse	17. *D. hungaricum*
4′.	Basal leaves ovate to ovate-elliptic; indumentum of the adaxial surface of basal leaves mainly glandular, sometimes with eglandular trichomes (up to 2 mm)	24. *D. plantagineum*
5(3).	Outer phyllaries 2.5–5 mm wide; petiole of basal leaves with well-marked veins, and sometimes persisting fibers at the base of the stem; margins of leaf blades slightly swollen, sometimes with white-tinted eglandular trichomes (up to 1 mm)	21. *D. oblongifolium*
5′.	Outer phyllaries 1–3.5 mm wide; petiole of basal leaves without well-marked veins; margins of leaf blades flat, glabrous, glabrate or glandular	12. *D. falconeri*
6(2).	At least ray cypselae black, with warty surface; plant branched in the upper part, usually with more than 2 capitula; basal leaves eglandular pubescent, with base of blade clearly cordate and margins entire to subentire	23. *D. pardalianches*

6′. All cypselae brown, red-brown, or olive-green; plants branched or not; basal leaves eglandular or glandular pubescent or glabrous, with base of blade cordate, subcordate, or truncate and margins entire or dentate 7

7(6). Outer phyllaries ciliate (cilia not glandular) 8

7′. Outer phyllaries not ciliate 10

8(7). Rhizome woody to somewhat woody, glabrous ..... 9. *D. columnae*

8′. Rhizome fleshy, with pubescent nodes 9

9(8). Basal leaves with ovate blades, subcordate to truncate at base ..... 24. *D. plantagineum*

9′. Basal leaves with reniform to widely ovate blades, cordate to subcordate at base ..... 22. *D. orientale*

10(7). Rhizome fleshy with short trichomes on nodes, sometimes scarce and absent on the oldest nodes 11

10′. Rhizome woody to somewhat woody, glabrous 12

11(10). Upper part of stem and phyllaries glabrous or with short-stalked glandular trichomes (up to 0.3 mm), sometimes also with scattered eglandular trichomes (up to 0.4 mm); plants bearing more than 2 capitula; receptacle glabrous ..... 7. *D. cataractarum*

11′. Upper part of stem with long-stalked glandular trichomes (up to 5 mm), sometimes also with eglandular trichomes and short-stalked glandular trichomes; plants bearing 1 to 6 capitula; receptacle glabrous or pubescent ..... 6. *D. carpetanum*

12(10). Leaves with pinnate-actinodromous venation; upper part of stem and base of phyllaries generally with long-stalked glandular trichomes, the gland markedly obconical; sometimes with adventitious roots and sometimes branched near the base ..... 18. *D. kamaonense*

12′. Leaves with actinodromous venation; upper part of stem and phyllaries glabrous, with eglandular or glandular trichomes, but if glandular, the gland not obconical; plants without adventitious roots and branched in the upper part of stem 13

13(12). Stem leafy (more than 6 cauline leaves); middle and upper cauline leaves generally longer than the adjacent internodes; basal leaves and lower cauline leaves generally absent at flowering time; receptacle generally pubescent ..... 2. *D. austriacum*

13′. Stem not leafy (less than 6 cauline leaves); middle and upper cauline leaves generally shorter than the adjacent internodes; basal leaves and lower cauline leaves sometimes present at flowering time; receptacle glabrous to glabrate 14

14(13). Plants with a single capitulum (exceptionally 2 to 3); basal leaves dentate; petiole of basal leaves 0.5–2 mm wide ..... 9. *D. columnae*

14′. Plants with two to several capitula; basal leaves dentate to entire; petiole of basal leaves more than 2 mm wide, sometimes with a sheath more than 3 cm long 15

15(14). Basal leaves with a reniform blade and dentate margins; phyllaries covered with sericeous uniseriate eglandular trichomes (0.2–0.4 mm); rhizome moniliform, covered with scarious remains or fibers ..... 4. *D. cacaliifolium*

15′. Basal leaves ovate to widely ovate with cordate to subcordate base or reniform, margins dentate to entire; phyllaries glabrous, pubescent (eglandular or glandular), but not sericeous; rhizome not moniliform 16

16(15). Upper part of stem with long-stalked glandular trichomes or pubescent 17

16′. Upper part of stem glabrous to glabrate or with very short white eglandular trichomes restricted to the base of capitula 19

17(16). Phyllaries with subulate apex and dark-colored longitudinal veins ..... 25. *D. reticulatum*

17′. Phyllaries with acute but not subulate apex, veins not dark-colored 18

18(17). Upper part of stem and upper cauline leaves with white multiseriate glandular and/or eglandular trichomes (0.5–3 mm), sometimes scattered, sometimes also glandular ..... 11. *D. dolichotrichum*

18′. Upper part of stem generally glandular and without white multiseriate eglandular trichomes ..... 19. *D. macrophyllum*

19(16). Base of capitula with short white eglandular trichomes (ca. 0.2 mm); margins of phyllaries sometimes slightly fimbriate or glandular ..... 16. *D. haussknechtii*

19′. Base of capitula glabrous; margins of phyllaries entire ..... 20. *D. maximum*

20(1). Corollas with pale yellow to green tints; rays linear (0.5–1.8 mm wide); phyllaries erect, triangular-subulate, generally longer than rays; pappus consisting of one row of thin capillary bristles, caducous (at least in ray flowers); lower stems sometimes with adventitious roots ..... 26. *D. stenoglossum*

20′. Corollas yellow; rays elliptic to obovate-elliptic (1.2–4.5 mm wide); phyllaries erect to patent or patent, generally shorter than rays; pappus with more than one row of trichomes, not caducous (sometimes poorly developed in ray flowers); lower stems without adventitious roots 21

21(20). All cauline leaves sessile; plants bearing several capitula ..... 10. *D. corsicum*

21′. At least lower cauline leaves petiolate; plants bearing one to several capitula 22

22(21). Rhizomes with very short trichomes on nodes, generally covered by scarious remains of basal leaves, these sometimes scarce 23

22′. Rhizomes glabrous 27

23(22). Stems generally more than 50 cm; basal leaves with cordate to subcordate base; plants bearing several capitula; base of capitula glabrous or with short-stalked glands, generally scattered ..... 7. *D. cataractarum*

23′. Stems generally less than 50 cm; basal leaves with subcordate, truncate or attenuate base; plants bearing one to several capitula; base of capitula with eglandular or long-stalked glandular trichomes 24

24(23). Leaf margins mainly glandular, sometimes also with scattered eglandular trichomes 25

24′. Leaf margins with eglandular trichomes, these sometimes scarce 26
25(24). Pappus of ray flowers well developed, similar to pappus of disk flowers; cypselae of disk flowers pubescent, sometimes with glands ..... 15. *D. grandiflorum*
25′. Pappus of ray flowers poorly developed; cypselae of disk flowers mainly glandular ..... 6. *D. carpetanum*
26(24). Leaf margins scarcely hirsute (acute, stiff, multiseriate eglandular trichomes 0.5–2.5 mm), sometimes also with short-stalked glands, scattered (Fig. 3C–E) ... 14. *D. glaciale*
26′. Leaf margins pubescent (tangled, hyaline, uniseriate eglandular trichomes longer than 1 mm), sometimes also with hirsute scattered eglandular trichomes and short-stalked glands (Fig. 3F–H) ..... 8. *D. clusii*
27(22). Basal leaves with cordate base ..... 5. *D. carpaticum*
27′. Basal leaves with truncate, attenuate, or subcordate base 28
28(27). Phyllaries with blunt apex that bears a sessile gland ..... 13. *D. gansuense*
28′. Phyllaries with acute apex, without a sessile gland 29
29(28). Base of capitula with long-stalked glandular trichomes (1–5 mm); plants bearing one capitulum ..... 3. *D. briquetii*
29′. Base of capitula glabrous or with short-stalked glandular trichomes (up to 1.5 mm), scattered; plants bearing 1 to 4 capitula ..... 1. *D. altaicum*

1. Doronicum altaicum Pall., Acta Acad. Sci. Imp. Petrop. 2: 271, tab. 16. 1779. *Aronicum altaicum* (Pall.) DC., Prodr. 6: 320. 1838. *Arnica altaica* (Pall.) Turcz., Bull. Soc. Imp. Naturalistes Moscou 1: 95. 1838. TYPE: [Asia] "E Sumis montium altaicorum" [sine collector], ex herb. Pallas (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 801), BM!).

Plant up to 80 cm tall. *Rhizomes* somewhat woody, glabrous, generally with scaly leaf remains. *Stems* simple, sometimes branched at the upper part, leafy, with leaves all along the stem, internodes generally shorter than adjacent leaves. Indumentum of short-stalked glandular trichomes and eglandular trichomes (up to 1 mm), more abundant near the capitula, sometimes glabrate to glabrous. *Leaves* entire to slightly dentate. Basal leaves generally absent at flowering time; blade 5–8(10) × 2.5–3 cm, ovate, elliptic or obovate, with attenuate base, and blunt or subacute apex, with actinodromous to pinnate-actinodromous venation; petiole (2)7–10(27) cm long, 3–4(7) mm wide. Lower and middle cauline leaves (2.5)3–8(11.2) × (1)3–5(6) cm, similar to basal leaves or sessile, elliptic to obovate, sometimes widely ovate to suborbiculate, semi-amplexicaul, with blunt apex. Upper cauline leaves 2.5–7(8.5) × (0.5)0.2–4(5.5) cm, similar to middle cauline leaves or ovate-lanceolate and with subacute apex. Indumentum similar to the adjacent part of stem, sometimes glabrous. *Capitula* 1 to 4; (2.5)4–5 cm diam. including rays; involucre shorter than rays, (3)3.5–4.5 cm diam. *Phyllaries* herbaceous, (0.7)1–1.2(1.7) cm long, 1.2–2 mm wide, ovate-lanceolate to subulate. Indumentum similar to the upper part of stem, sometimes glabrate. *Receptacles* glabrous. *Flowers* with yellow corollas. Ray flower corollas 1.2–2.1 cm long, (1.5)2–3.5 mm wide, obovate-elliptic, apex with 2 or 3 teeth, sometimes toothless, acute or blunt. Disk flower corollas 4–5.5 × 2–2.5 mm. *Cypselae* dark brown, with smooth or slightly grooved surface, homomorphic, ca. 2.8 × 1 mm, generally glabrous, sometimes with scattered eglandular trichomes or glands. Pappus up to 5 mm, white to brown yellow-tinted. Chromosome number, $2n = 30$*, 60 (Belaeva & Splivinsky, 1981, as *D. bargusiense* Serg.; *Goldblatt & Johnson, 1998, see comments below).

Illustrations. Pallas (1779: tab. 16); Figures 1G, 2G, H, 10A, B.

Distribution. Central Asia (Turkistan and Altai region to lake Baikal). Woods, meadows, and near watercourses, altitude 1300–3400 m (Fig. 11).

In central Asia there are some species morphologically similar to *Doronicum altaicum* (i.e., *D. briquetii, D. falconeri,* and *D. gansuense*). All of them have the same habit (solitary capitulum and mostly leafy stems with uniform leaves), but only one of these, *D. falconeri,* overlaps its area of distribution with *D. altaicum.* The character used to distinguish between these two species is the presence of a pappus in the ray flowers of *D. altaicum* versus its absence in *D. falconeri.* The remaining similar species are differentiated based on the indumentum (long trichomes on the base of capitulum in *D. briquetii* vs. short trichomes in *D. altaicum* (Fig. 10)), and on the apex shape of phyllaries, which is blunt (due to a sessile gland) in *D. gansuense* (Fig. 4B, C) and acute (lacking the sessile gland) in *D. altaicum.*

The citation of the chromosome number $2n = 30$ for *Doronicum altaicum* was found in Goldblatt and Johnson's (1998) index, but the original source for this data was not seen.

Selected specimens examined. KAZAKHSTAN. Lepsoi i Tentekom, 11 Sep. 1931, *Enden s.n.* (LE); Belogore, Tukschinskoe, 15 Aug. 1949, *Fedorov et al. s.n.* (LE); Alatau, *Richter 2772* (GH). RUSSIA. **Altay:** montes del Altai, Ayu-Kel, río Baijs, *Castroviejo & Valdés Bermejo 14032* (MA); Tigeretzkyi, 31 July 1891, *Krylov s.n.* (S); Tomskaya,

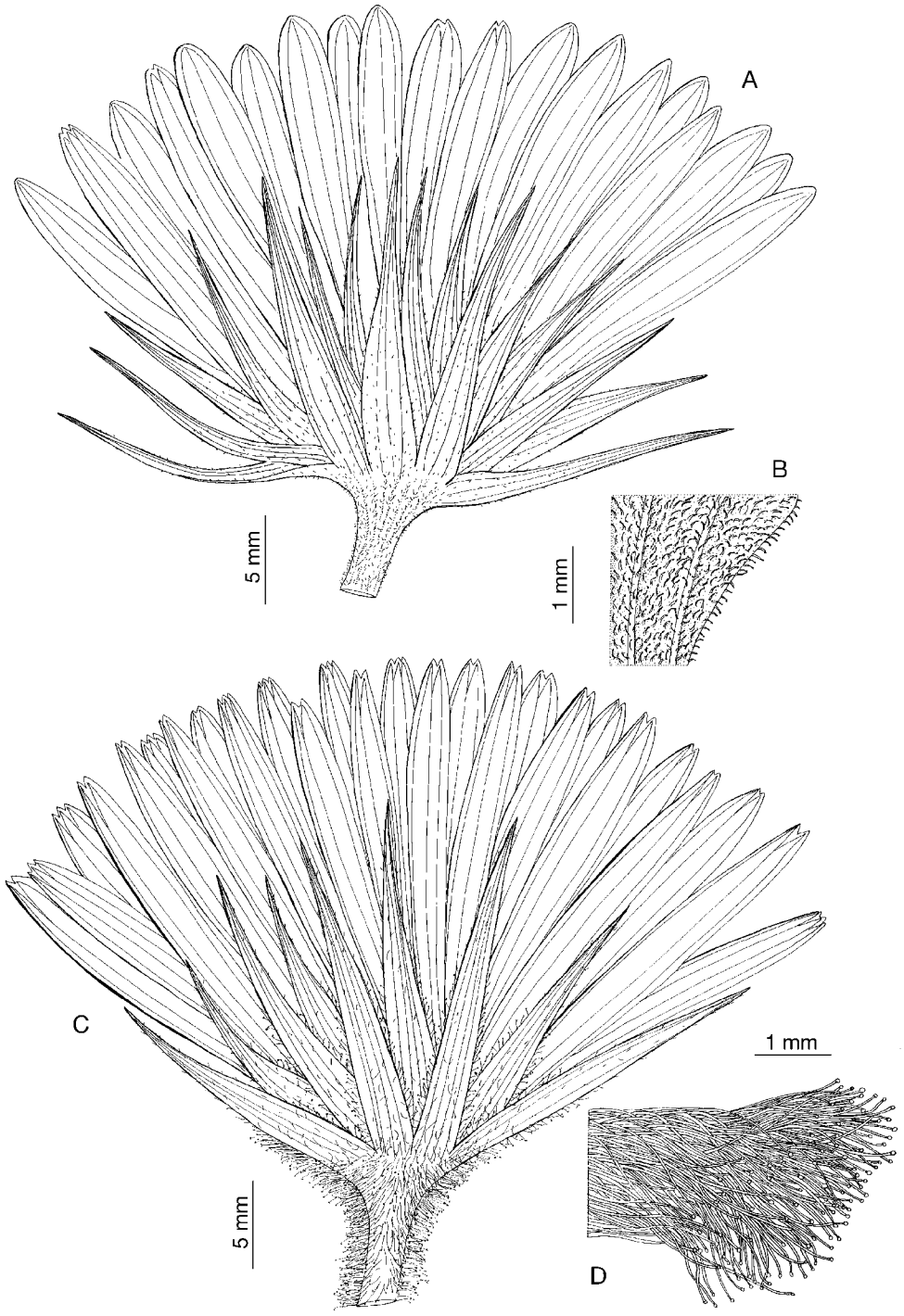

Figure 10. A, B. *Doronicum altaicum* (drawn from *Krasnoborov et al. 959*, K). —A. Capitulum. —B. Indumentum of the base of capitulum. C, D. *Doronicum briquetii* (drawn from *Rock 22380*, E). —C. Capitulum. —D. Indumentum of the base of capitulum.

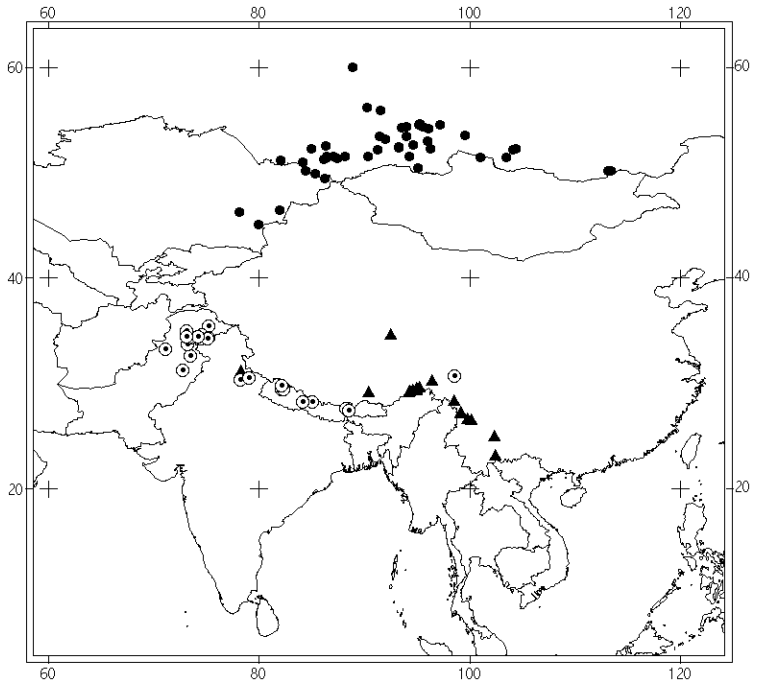

Figure 11. Distribution map for: *Doronicum altaicum* (●); *Doronicum briquetii* (▲); *Doronicum kamaonense* (⊙).

Bijskij, Inskoj, 16 July 1913, *Kuznetsov s.n.* (LE); Elekmonarskij, Chemal, Katuni, 12 July 1947, *Matveeva & Tkatchenko s.n.* (LE); Sumultinskije, 14 Aug. 1923, *Saposhnikov s.n.* (W); Gorno-Altaiskaya, Mt. Eshumo, lake Teletskoye, *Turesson 848* (UPS). **Buryatiya:** Sibiria, gubernium Ircutense, montes Sajan ad decursum superiorem fluviorum Ircut et Oka, 30 July 1902, *Komarov s.n.* (K, LE). **Chita:** Zabajkalskaya, Akshinskij, *Smirnov 314* (LE). **Irkutsk:** Verkhove, Belki, Agulskie, 7 Aug. 1949, *Fedorov et al. s.n.* (LE); Inzhneud, *Golovnin 158* (LE); Baikal, Kultuk Khamar-Dazang, *Poplavskaja, Tzinzerling & Sukačev 2069* (LE); Enisejskaya, Kanskij, Dor Gutara, 14 June 1912, *Troickij s.n.* (LE). **Krasnoyarsk:** Shushenskij, Stanitsya Olenya, 12 July 1963, *Cherepnin & Laletina s.n.* (LE); Yangi, Belogore, Tukshinskoe, *Fedorov et al. 219* (LE); Sayan, Aradanki, 20 July 1967, *Gudoshnikov & Dirin s.n.* (LE); Kuraginskij, Mt. Moskva, 22 Aug. 1962, *Krasnoborov & Ershova s.n.* (LE); Sayan, Alan, Taskalik, Dzhoya i Klaya, *Krasnoborov 8179* (LE); Severnaya, Aradanskago, 8 June 1892, *Krylov s.n.* (LE); Enisejskaya gub., Kanskij, *Kuznetsov 927* (LE); Sidi, Sisima i Mani, Eniseya, *Volkov 185* (LE). **Tuva:** Sayan, Sayanskij, Aldi-Ishkina, *Krasnoborov 8172* (LE); Baj-Tajhinskij, Sajan, Kara-Chol', Jerjitajha, *Krasnoborov, Hrubov & Jakovleva 959* (K); Pij-Khemskij, Sayan, Uyukskij Azyut, Chakpak, *Lomonosova & Shaulo 732* (LE); Todzhinskij, Ak-Attig-Khol, Ulug-Taiga, 3 July 1971, *Vidrina s.n.* (LE). **West Siberia:** Tomskaya, Zmeinogorsk, 15 June 1909, *Iljin s.n.* (LE).

2. Doronicum austriacum Jacq., Fl. Austriac. 2: 18, tab. 130. 1774. *Arnica austriaca* (Jacq.) Hoppe, in Sturm, Deutschl. Fl. 10: 16. 1814. TYPE: [sine collector] ex herb. Linnaeus (LINN n.º 1002.4!) (lectotype, designated by Pérez et al. (1997: 3)).

Plant up to 150(+) cm tall. *Rhizomes* woody to somewhat woody, glabrous, and generally without scaly or fibrous leaf remains. *Stems* generally branched in the upper part, leafy, internodes generally shorter than the adjacent leaves. Indumentum of glandular trichomes, uniseriate and multiseriate eglandular trichomes (up to 2 mm), sometimes only eglandular trichomes, sometimes glabrate, more abundant near the capitula. *Leaves* entire to slightly dentate. Basal leaves absent at flowering time, petiolate, ovate to orbicular, with cordate to subcordate base and blunt apex, with actinodromous venation. Lower and middle cauline leaves 6.5–19 × 4.5–12.5 cm, similar to basal leaves or sessile, fiddle-shaped, semi-amplexicaul. Upper cauline leaves 2.5–13 × 0.7–5 cm, ovate-lanceolate, generally with acute apex. Indumentum similar to the adjacent part of the stem. *Capitula* (1)2 to 16; 3–7 cm diam. including rays; involucre generally shorter than rays, 1.5–3.5 cm diam.; peduncles 1.5–16 cm long, 0.5–2 mm diam. *Phyllaries* herbaceous, sometimes slightly papery at the base or at the margins, ovate-subulate, generally with acute apex; the outer 0.5–1.8 cm long, 1.2–4 mm wide; the inner 0.6–1.4 cm long, 0.7–3 mm wide. Indumentum of glandular and eglandular trichomes, sometimes glabrous. *Receptacles* pubescent, rarely glabrate. *Flowers* with yellow corollas. Ray flower corollas (1.2)1.5–3.5 cm long, (1)2–4

mm wide, oblong-elliptic to obovate-elliptic; apex generally with 3 teeth. Disk flower corollas 4.5–5.5 × 1–1.5 mm. *Cypselae* brown-tinted to olive-green, with grooved-reticulate surface, dimorphic. Cypselae of ray flowers 2–3.5 × 0.7–1.3 mm, glabrous or glabrate, without pappus. Cypselae of disk flowers 1.5–3 × 0.7–1 mm, pubescent, with white pappus 3–6 mm. Chromosome number $2n = 60$ (Skalinska, 1950; Baksay, 1956; Kuzmanov & Ancev, 1973; Strid & Franzén, 1983).

Illustrations. Jacquin (1774: tab. 130); Hegi (1928: 713, fig. 421); Săvulescu (1964: pl. 189, fig. 2); Bolòs & Vigo (1995: 839); Figures 1C, 12A–D.

Distribution. Europe (Carpathians, Balkans, Alps, Apennines, and eastern Pyrenees). Cultivated and naturalized at least in Great Britain. Growing in forest, meadows, near watercourses, and in moist rocky places, altitude 300–2200 m (Fig. 13).

Doronicum austriacum is a variable species with regard to phyllary shape, number of capitula and, in particular, type and abundance of indumentum. Based on the protologue, where there is no mention of the presence of glandular trichomes, Pérez et al. (1997) characterized it as a non-glandulose species, and accordingly, they chose a lectotype with no glandular trichomes. Although their lectotypification is technically correct, the distinguishing characters given for this species are erroneous since many populations from Greece are glandular. According to Pérez et al. (1997), these glandular populations might be included in *Doronicum carpetanum,* a different species as recognized here. Although both *D. austriacum* and *D. carpetanum* are similar, they basically differ in type of rhizome (fleshy and scarcely pubescent in *D. carpetanum* vs. woody to somewhat woody and glabrous in *D. austriacum*), but not in type of indumentum, which can be glandular in both species. These two species do not overlap their areas of distribution.

In addition, there are two other species morphologically similar to *Doronicum austriacum* (i.e., *D. cataractarum* and *D. pardalianches*) that may overlap their distributions with *D. austriacum.* The characters to distinguish between those species and *D. austriacum* are the type of rhizome (fleshy rhizomes in *D. pardalianches* vs. woody to somewhat woody in *D. austriacum*), the fruit color at maturity (black cypselae in *D. pardalianches* vs. brown-tinted to olive-green in *D. austriacum*), the indumentum on the base of capitulum (scarce and short (up to 0.4 mm long) to glabrate in *D. cataractarum* vs. pubescent (glandular or not) in *D. austriacum* (Fig. 12A, E, F)), and the heterocarpy in *D. austriacum* versus homocarpy (sometimes pappus poorly developed) in *D. cataractarum.*

Selected specimens examined. ALBANIA. **Korçë:** Ostrovicë, Moskopolë, *Alston & Sandwith 2119* (BM, K). ANDORRA. Pla de Sorteny, 7 Aug. 1948, *Losa & Montserrat s.n.* (BCF). AUSTRIA. **Kärnten:** Plöcken pass, 4 Aug. 1972, *Lousley s.n.* (BM). **Niederösterreich:** Lackenhof, 19 July 1933, *Cufodontis s.n.* (W). **Oberösterreich:** Oberar Gosausee, Vachsteingebiet, *Baschant H531* (B). **Salzburg:** Boden der Alpen Lofers, *Spitzel 972* (B, NY). **Steiermark:** valle Schaftal prope urbem Graz, July 1907, *Fritsch s.n.* (BM, E). **Tirol:** Zillertaler Alps, Gerlostal-Zillertal, *Kramer 1366* (NY). BULGARIA. **Blagoevgrad:** Mt. Pirin, lago Okomo, 27 July 1993, *Carrasco, Burgaz & Martín-Blanco s.n.* (MACB). **Kyustendil:** Rila planina, in valle Bistritza, *Schneider & Bergmann 881* (B, BM, K, MO). **Smolyan:** Pamprovo, Smolyan, *Jury & Thornton-Wood 9876* (BM). **Veliko Tŭrnovo:** Béla Cherkva, July 1909, *Střibrný s.n.* (K). CZECHOSLOVAKIA. Tatra Magna, Velká Studená, 14 July 1925, *Suza s.n.* (K, MO). FRANCE. **Cantal:** L'Ombrière, commune de Raulhac, *Puyfol 4925* (BM, NY). **Loire:** Pilat, route de Pélussin au Crêt de l'Oeillon, *Barbezat 1834* (K). **Pyrénées-Orientales:** Cerdagne, massif du Carlite à Matanègre, *Sennen 3968* (BC, MA). GERMANY. **Oschatz:** Hirschkamm, Gusenke, Wermsdorf, 12 Aug. 1878, *Oborny s.n.* (K). GREECE. **Makedhonía:** Pisoderion, *Alston & Sandwith 441* (BM, K); Kastoria, *Polunin 8268* (E); Kozani, Mt. Pieria, supra Kataphygion, *Rechinger 17881* (B, G, K, W). HUNGARY. Szepes, Zips, Hohern-Tatra, Kleineskohlbachtal, 28 Aug. 1911, *Nyárády s.n.* (MA). ITALY. **Toscana:** Etruria, Firenze, Boscolungo, 25 Aug. 1917, *Fiori s.n.* (B, BM, K). POLAND. **Olkusz:** Klucze, Biala, 31 May 1971, *Frey & Sztyler s.n.* (LE, NY). ROMANIA. **Gorj:** Oltenia, valle Gilort, Rînca, 28 June 1972, *D. & M. Cîrtu s.n.* (B, BM, MA, NY). UKRAINE. **Ivano-Frankovskaja:** Verkhovinskij, Chernij Cheremosh, Popadinets, *Geltman et al. 1650* (LE). **Zakarpatskaja:** Veritskij, 19 June 1950, *Igoshina s.n.* (LE). YUGOSLAVIA. **Crna Gora:** between Ramna and Banasnica, *Edmonson 328* (BM, E). **Hrvatska:** Gerovo, *M. F. & S. G. Gardner 2586* (BM); Žumberačka gora circa Sošice, 17 May 1874, *Vukotinović s.n.* (ZA). **Makedonija:** Gebiet der Mala Rupa, *Biesalski 469* (B); Golešnica-planina, Begova, *Bornmüller 4269* (B). **Slovenija:** Pekel-Schluchbi Ohonica südlich Borovnica, südwestlich von Lubljana, 28 May 1966, *Lippert s.n.* (LE).

3. Doronicum briquetii Cavill., Annuaire Conserv. Jard. Bot. Genève 10: 197. 1907. TYPE: India. Kumaun, near the Kalam glacier, *J. F. Duthie 3066* (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 802), G!).

Plant up to 80 cm tall. *Rhizomes* somewhat woody, glabrous, generally with scaly leaf remains. *Stems* not branched, leafy completely up entire stem, internodes generally shorter than adjacent leaves. Indumentum of short- and long-stalked glandular trichomes (1–5 mm), more abundant near the capitula, rarely only eglandular trichomes. *Leaves* entire to slightly dentate. Basal leaves generally absent at flowering time; blade (1.2)2–4 × (0.9)1–2(3) cm wide, ovate, elliptic or obovate, with

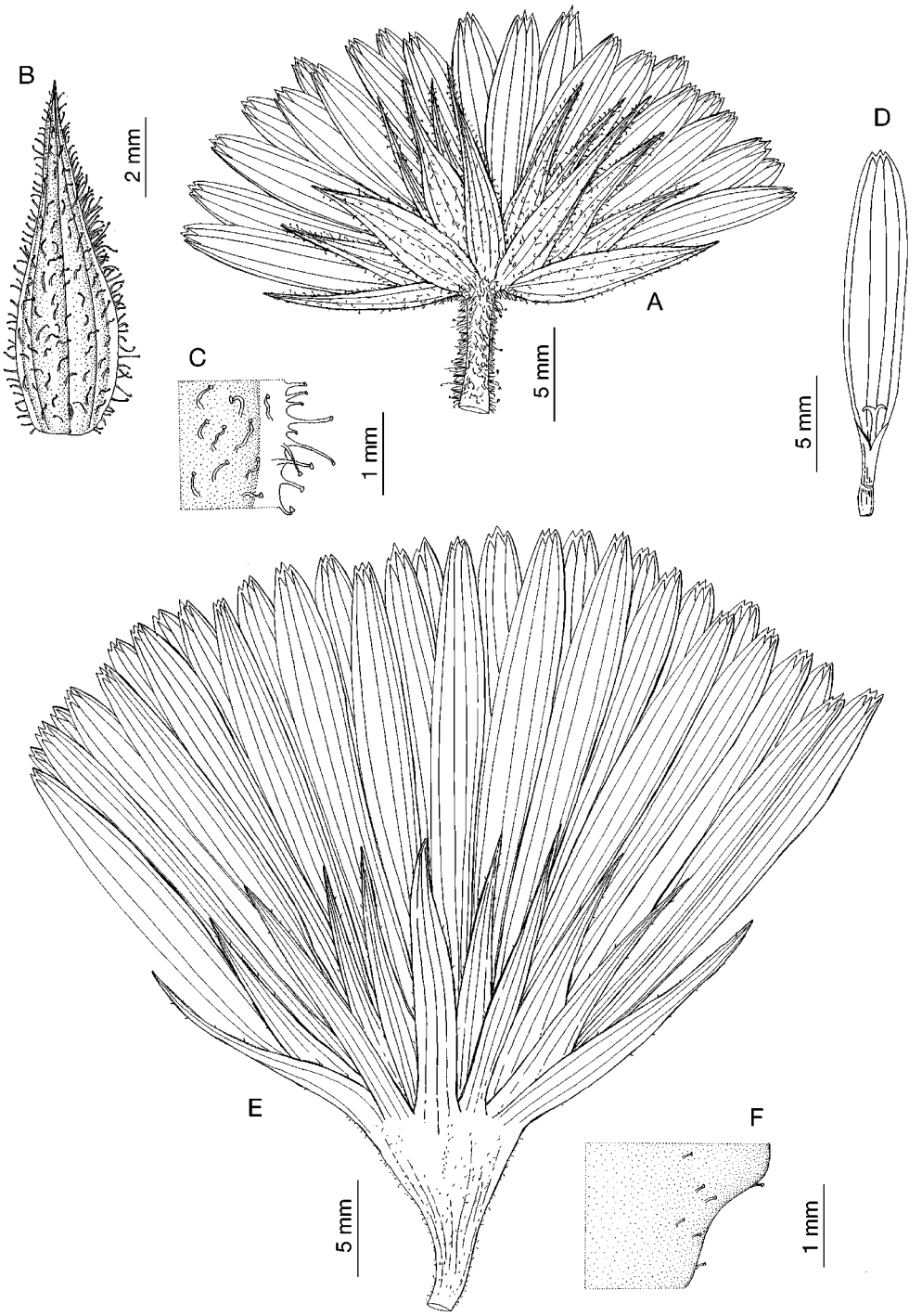

Figure 12. A–D. *Doronicum austriacum* (drawn from *Strid et al. 18585,* B). —A. Capitulum. —B. Phyllary. —C. Indumentum of a phyllary. —D. Ray flower. E, F. *Doronicum cataractarum* (drawn from *Höpflinger s.n.*, BM). —E. Capitulum. —F. Base of the capitulum.

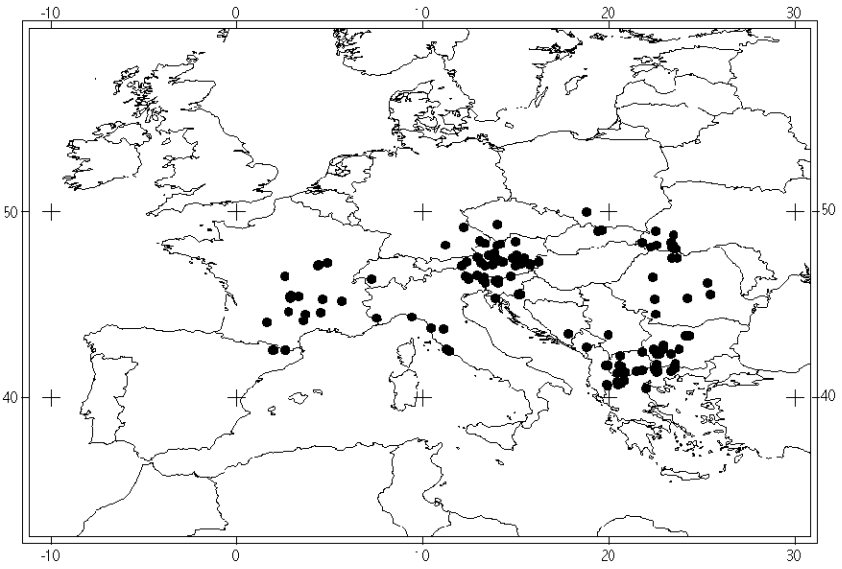

Figure 13. Distribution map for *Doronicum austriacum*.

attenuate base, and blunt or subacute apex, with actinodromous to pinnate-actinodromous venation; petiole (0.9)1.5–3(5) cm long, (1)2–3(5) mm wide. Lower and middle cauline leaves (3)4–9(12.3) × (0.5)1.5–3.5(6.2) cm, sessile, ovate-elliptic to obovate-elliptic, semi-amplexicaul. Upper cauline leaves 2–4(5.5) × (0.3)1–2(3) cm, similar to middle cauline leaves or ovate. Indumentum similar to the adjacent part of stem, sometimes with glandular margins. *Capitula* solitary, (4)5–7(8) cm diam. including rays; involucre shorter than rays, rarely equaling them, (3)3.5–4.5(5) cm diam. *Phyllaries* herbaceous; the outer (1)1.5–2(2.5) cm long, 1.5–2.5(3) mm wide; the inner 1–2 cm long, 1–2(3.5) mm wide, ovate-lanceolate to subulate. Indumentum similar to the upper part of stem, more abundant at the base. *Receptacles* glabrous, rarely with scattered short-stalked glandular trichomes. *Flowers* with yellow corollas. Ray flower corollas (1.8)2–3 cm long, 2–3(3.5) mm wide, obovate-elliptic, apex generally with 2 or 3 teeth. Disk flower corollas 3.5–5 × 1.5–2 mm. *Cypselae* dark brown, homomorphic, 1.5–3 × 1 mm, glabrous, sometimes with scattered eglandular trichomes or glands. Pappus up to 6 mm, white to yellow-tinted. Chromosome number unknown.

Illustrations. Figures 2E, F, 10C, D.

Distribution. Central and southern China (provinces of Sichuan, Tibet-Qinghai, and Yunnan), and the Himalayas. Open moist rocky places and woods, altitude 3000–5000 m (Fig. 11).

As already discussed (see comments for *D. altaicum*), there is a group of central Asian species morphologically very similar to each other. *Doronicum briquetii* is included in this group, but its distribution may only overlap that of *D. falconeri*. The character used to distinguish between them is the heterocarpy in *D. falconeri* versus the homocarpy in *D. briquetii*. There are other species outside this morphological group, *D. kamaonense* and *D. stenoglossum*, that also overlap part of their area of distribution with *D. briquetii*. But *D. stenoglossum* is quite different from *D. briquetii* in noticeable characters (i.e., numer of capitula, color, shape and size of ray flowers, and shape and size of phyllaries) as well as *D. kamaonense* (i.e., number and size of capitula and type of indumentum). (See also comments under *D. gansuense*.)

Selected specimens examined. CHINA. **Sichuan:** Mt. Konka, Risonquemba, Konkaling, *Rock 16834* (E, K, GH, MO, NY, W); Dongrergo, *Smith 3270* (S, UPS); Sikang, Kangting, Tachienlu, Tapaoshan, *Smith 11473* (S, UPS). **Tibet-Qinghai:** Mekong–Salween divide behind Tzekon, *Forrest 666* (E); Bei-lua Shan, Mekong–Yangtze divide, *Forrest 13164* (E); Oika-gur-pu, Mekong–Salween divide, Sarong, *Forrest 14526* (BM, E, K, W); Dü Chu valley, Pashö, Kham, *Hanbury-Tracy 22* (BM); Doshong La, *Kingdon Ward 5866* (E); Sobbé La, *Kingdon Ward 12125* (BM); Tha Chu valley, *Kingdon Ward 19592* (BM, E, UPS); Kongbo, Tsangpo valley, Lusha Chu, *Ludlow et al. 4752* (BM, E, UPS); Kongbo, Tsangpo valley, Pero La, *Ludlow et al. 5205* (BM, E, UPS); Kongbo, Tsangpo valley, Doshong La, *Ludlow et al. 5258* (BM, E, UPS); Tsanang La, near Paka, *Ludlow et al. 5870* (BM, E, UPS); above Showa Dzong, Pome, *Ludlow et al. 13148* (BM, E, UPS); Ba La, Pasum Chu, Kongbo, *Ludlow et al. 13955* (BM, E, G, UPS); Budi Tsepo La, Kongbo, *Ludlow et al. 15261* (BM, E, UPS); Kongbo, Nyoto Sama, *Ludlow et al. 15604* (BM,

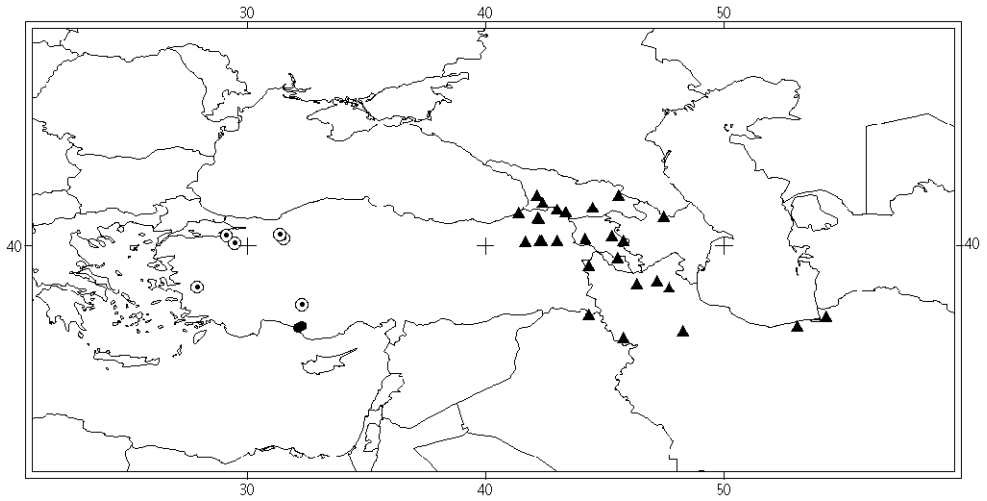

Figure 14. Distribution map for: *Doronicum cacaliifolium* (●); *Doronicum dolichotrichum* (▲); *Doronicum reticulatum* (⊙).

E); Tsarung, Wuli-la, *Rock 22380* (GH, NY); Bálti, Thále La to Bagmaharál, *Schlagintweit 5962* (GH). **Yunnan:** Chien Chuan & Hsi valleys, *Forrest 7662* (E); Chungtian plateau mountains, *Forrest 13009* (E); Mekong–Salween divide, *Forrest 14413* (E, K); Mekong–Yangtze divide, A-wa, *Forrest 25695* (E, G, K); Wei-Hsi area, *Forrest 30434* (BM, E); inter fluvios Lu-djiang Salween et Djiou-djiang, in jugi Tschiangschel, *Handel-Mazzetti 1765* (W); A-tun-tse, 3660 m, *Kingdon Ward* (E); Lichiang, *McLaren 167D* (BM); Mt. Habashan, Ndaku, Likiang range, Yangtze drainage basin, *Rock 9681* (E, GH, K); mountains of Hung-po, Tung-chu-ling, *Rock 22891* (BM, E, GH, K, MO, NY); Dokerla, A-tun-tze, *Wang 64905* (GH); Mekong–Salween divide, Sila, *Yü 22268* (E, GH). INDIA. **Uttar Pradesh:** Tilvie-Garheval, Chimpul opposite Bandarpunch, *Duthie 849* (G, K).

4. Doronicum cacaliifolium Boiss. & Heldr., Diagn. Pl. Orient. ser. 1, 11: 31. 1849. TYPE: Turkey. Taurus, Mt. Gheï-Dagh, [*T. Heldreich*] *1043* (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 802), G-BOIS!; isotype, BM!).

Plant up to 50(+) cm tall. *Rhizomes* woody to somewhat woody, glabrous, moniliform, sometimes with fibrous leaf remains. *Stems* branched in the upper part, leaves mainly distributed in the lower middle, upper internodes generally longer than the adjacent leaves. Indumentum of uniseriate eglandular trichomes (0.2–0.4 mm), sometimes with short-stalked glandular trichomes and a few multiseriate eglandular trichomes, more abundant near the capitula and sometimes glabrous at the base. *Leaves* dentate. Basal leaves generally present at flowering time; blade 5.5–8 × 5–9 cm, orbicular to suborbicular, with cordate base and blunt apex, with actinodromous venation; petiole 8–19.5 cm long, 2–2.3 mm wide. Lower cauline leaves with blade ca. 6 × 8 cm; petiole ca. 6.5 cm long, 1.5 mm wide, similar to basal leaves. Middle and upper cauline leaves 3–4 × 1.2–5.5 cm, sessile, fiddle-shaped, semi-amplexicaul, the upper leaves ovate to bract-like. Indumentum similar to the adjacent part of the stem or glabrate. *Capitula* 2 to 13; ca. 3.5 cm diam. including rays; involucre shorter than rays, 1–2 cm diam. *Phyllaries* herbaceous, 6–7 × 2.5 mm, ovate-elliptic to ovate-subulate, generally with acute apex. Indumentum of uniseriate eglandular trichomes (0.2–0.4 mm), sericeous, abundant. *Receptacles* glabrous or glabrate. *Flowers* with yellow corollas. Ray flower corollas ca. 1.7 cm long, 2 mm wide, oblong-elliptic, apex generally with 3 teeth. Disk flower corollas ca. 5 mm long. *Cypselae* brown-tinted, with slightly reticulate surface, dimorphic. Cypselae from ray flowers 2–3 × 0.9–1.2 mm, glabrous or glabrate, without pappus. Cypselae from disk flowers 2–2.7 × 0.9–1 mm, pubescent (eglandular trichomes), with pappus white-tinted, 3–4 mm. Chromosome number unknown.

Illustrations. Figures 5A–D, 7C, 8B.

Distribution. Southern Turkey (Antalya and Konya provinces). Growing in shady rocky places, elevation 1800–2300 m (Fig. 14).

Most of the *Doronicum* species from Turkey are similar morphologically (rhizomes woody to somewhat woody and glabrous, several heterocarpic capitula, and a few but very large leaves). These species have a few diagnostic characters; sometimes only one of these is consistent, making species

identification difficult. *Doronicum cacaliifolium* is one of the best delimited species within this morphological group, and is also the one that has the most restricted area of distribution. The distinctive characters are its exclusive type of rhizome (moniliform) and the shape, size, and type of indumentum of phyllaries (Figs. 5A–C, 8B). Geographically, the closest species within its morphological group is *D. reticulatum* from western Turkey (Figs. 14, 26), but this one has different shape, size, type of indumentum, and color of phyllaries (Fig. 26E–G). Outside this morphological group, only *D. orientale* may overlap its area of distribution with *D. cacaliifolium* (Figs. 14, 27), but there are noticeable characters to distinguish between them. In addition to the difference in their phyllary characters (Fig. 5A–C, E–G), rhizomes from both species are quite different (fleshy and pubescent in *D. orientale* vs. woody to somewhat woody, glabrous, and moniliform in *D. cacaliifolium*).

Selected specimens examined. TURKEY. **Antalya:** Ak dag, *Davis 14381* (E, G, K, MO, W); Ak dag, *Davis 14551* (K). **Konya:** Hadim-Alanya, *Duman 5581* (GAZI).

5. Doronicum carpaticum (Griseb. & A. Schenk) Nyman, Syll. Fl. Eur. Suppl.: 1. 1865. *Aronicum scorpioides* var. *carpaticum* Griseb. & A. Schenk, Arch. Naturgesch. 18: 342. 1852. *Aronicum carpaticum* (Griseb. & A. Schenk) Schur, Verh. Mitth. Siebenbürg. Vereins Naturwiss. Hermannstadt 10: 137. 1859, as "*carpathicum.*" *Doronicum grandiflorum* subsp. *carpaticum* (Griseb. & A. Schenk) Rouy, Rev. Bot. Syst. Géogr. Bot. 1: 53. 1903. TYPE: not located; protologue citation: "Siebenbürgen: in der alpinen Region der südlichen Karpaten, z. B. am Szurul (Fuss), nach Schur bis 7000′ austeigend."

Plant up to 50 cm tall. *Rhizomes* woody to somewhat woody, glabrous, sometimes with leaf remains forming dark scales on nodes. *Stems* not branched, generally scape-like. Indumentum of uniseriate, multiseriate, and glandular trichomes, scattered, glabrous in the lower part. *Leaves* dentate to slightly dentate. Basal leaves generally present at flowering time; blade 2–4 × 2–4 cm, orbicular to broadly ovate with cordate base and with blunt or subacute apex, with an actinodromous venation that sometimes tends to be acrodromous; petiole 4–11 cm long, 0.5–1 mm wide. Lower and middle cauline leaves 3–6 × 1.4–3 mm, similar to basal leaves or sessile, fiddle-shaped, semi-amplexicaul. Upper cauline leaves 1.5–3 × 0.9–2.5 cm, ovate-elliptic to ovate-lanceolate, sometimes bract-like. Indumentum of white-tinted scattered multiseriate eglandular trichomes (up to 1.5 mm), uniseriate eglandular trichomes mainly on the edge of the blade, and scarce short-stalked glandular trichomes. *Capitula* solitary, 3.5–5 cm diam. including rays; involucre shorter than rays, 2.5–3 cm diam. *Phyllaries* herbaceous, 0.9–1.2 cm long, 1.5–4 mm wide, ovate-subulate; margins sometimes ciliate, with acute, stiff and equidistant multiseriate eglandular trichomes (up to 0.6 mm long). Indumentum mainly glandular, and sometimes with uniseriate eglandular trichomes. *Receptacles* glabrous or almost glabrous. *Flowers* with yellow corollas. Ray flower corollas 1.4–2.2 cm long, 2–2.8 mm wide, oblong-elliptic, apex generally with 3 teeth. Disk flower corollas up to 4 mm long. *Cypselae* (not seen at maturity), brown-tinted, homomorphic, 1.5 × 0.8 mm, scarcely pubescent (eglandular trichomes) to glabrate. Cypselae from ray flowers sometimes with a poorly developed pappus. Pappus up to 3.5 mm, white-tinted. Chromosome number $2n = 60$ (Tasenkevitch et al., 1989).

Illustrations. Săvulescu (1964: pl. 98, fig. 3).

Distribution. Europe (Carpathians). Meadows, shady rocky places, and near watercourses, altitude 1200–2200 m (Fig. 15).

The type material of *Aronicum scorpioides* DC. var. *carpaticum* Griseb. & A. Schenk could not be found, and although the protologue matches the diagnostic features of this taxa, its identity here is tentative and the formal synonymy needs to wait until clarification.

Doronicum carpaticum and *D. columnae* are closely related species, which differ only by their heteromorphic versus homomorphic fruits, respectively. Simonkai (1886) described a new species, including specimens without well-developed pappus: *Aronicum barcense.* Later, this name was considered by Cavillier (1911) to be a hybrid species (*D. carpaticum* × *D. columnae*). I cannot confirm the hybrid origin for this taxon and therefore include it as a synonym of *D. carpaticum* due to the presence of pappus, although poorly developed.

Selected specimens examined. BULGARIA. **Plovdiv:** Kalofer, *Wagner 77* (G). HUNGARY. **Beszteroze–Naszód:** monte Clisia ad Rodnam, 25 Aug. 1902, *Degen s.n.* (LE). ROMANIA. **Maramureş:** montis Hagy Pietrosz, 5 July 1907, *Filarszky & Jávorka s.n.* (LE). **Neamţ:** Mt. Ceahlau, 1900 m, 11 July 1922, *Grintescu s.n.* (BM, G, K, MO, S). **Fogaras:** Bîlea Cascada, 17 Aug. 1960, *Liebenow s.n.* (B); Transsilvaniae alpes Arpasenses, Vurtop, 9 Aug. 1883, *Simkovics s.n.* (B); Vertop et Vertopul, *Simonkai 1816* (B, BM, G, K, S); circa lacum Bîlea, supra pag. Arpás, 23 July 1914, *Tuzson s.n.* (B). UKRAINE. **Ivano–Frankovskaja:** Verkhovinskij r-n, r. Chernij Cheremosh,

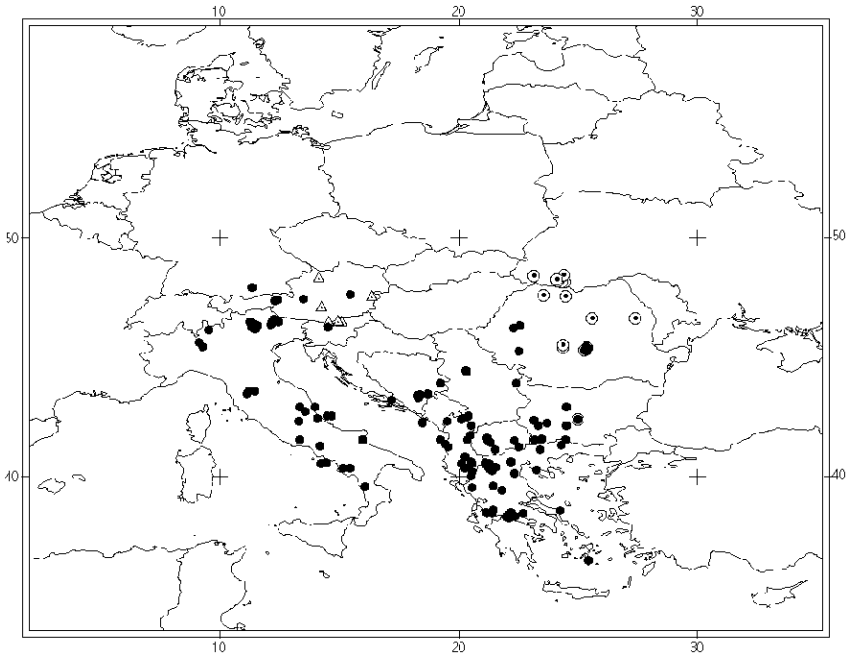

Figure 15. Distribution map for: *Doronicum carpaticum* (⊙); *Doronicum cataractarum* (△); *Doronicum columnae* (●).

ur. Popadinets, *Geltman et al. 1636* (LE); Verkhovinskij r-n, 30–33 km k Yuyuz ot Verkhovini g. Chivchin, *Geltman et al. 1880* (LE); Karpati khr. Chernogora, 7 July 1964, *Ivanina s.n.* (LE). **Stanislavskaja:** Mt. Goberla, Rakhovskij r-n, 13 July 1958, *Fodor s.n.* (LE). **Zakarpatskaja:** Rakhovskij r-n, 27 July 1976, *Borodina et al. s.n.* (LE). YUGOSLAVIA. **Srbija:** Mt. Gnila greda supra vallem Dobrido dispersum, prope Trebinje, Aug. 1891, *Vandas s.n.* (K).

6. Doronicum carpetanum Boiss. & Reut. ex Willk. & Lange, Prodr. Fl. Hispan. 2: 108. 1870. *Doronicum plantagineum* subsp. *carpetanum* (Boiss. & Reut. ex Willk.) Rouy, Rev. Bot. Syst. Géogr. Bot. 1: 34. 1903. TYPE: Spain. Madrid, sierra de Guadarrama, Peña Lara, July 1858 [*P. E. Boissier s.n.*] (lectotype, designated by Chacón (1987: 267), COI-WILLK!).

Plant up to 120 cm tall. *Rhizomes* fleshy, with shining white-tinted short trichomes on nodes, sometimes with buds, and generally with leaf remains. *Stems* branched in the upper part or simple. Indumentum of multiseriate eglandular trichomes (up to 1.5 mm) and short-stalked glandular trichomes at the middle part of stem, and also long-stalked glandular trichomes (up to 5 mm) at the upper part of the stem, sometimes glabrous at the base, sometimes mainly glandular, more abundant near the capitula. *Leaves* entire to slightly dentate. Basal leaves generally absent at flowering time; blade 2.5–9 × 2–7 cm, ovate to orbicular, with subcordate to truncate base and blunt or subacute apex, with actinodromous venation; petiole (1.5)3.5–13.5 cm long, (0.5)1–3 mm wide. Lower and middle cauline leaves 3–11(15) × 1.5–7.5(10) cm, similar to basal leaves or sessile, fiddle-shaped, sometimes ovate, semi-amplexicaul. Upper cauline leaves 1–7.5(9) × 0.2–4 cm, ovate-lanceolate, sometimes bract-like. Indumentum similar to the adjacent part of the stem. *Capitula* 1 to 6, 2.5–6(7) cm diam. including rays; involucre shorter than rays, 1.5–4 cm diam.; peduncles (0.7)1–16(21) cm long, 0.5–2.5 mm wide. *Phyllaries* herbaceous, ovate-subulate to narrowly elliptic; the outer 0.8–2.2 cm long, 1–3(3.5) mm wide; the inner 0.7–2.1 cm long, 0.5–2.5 mm wide. Indumentum of long-stalked glandular trichomes and sometimes also with eglandular trichomes. *Receptacles* pubescent or glabrous. *Flowers* with yellow corollas. Ray flower corollas (1.2)1.5–3 cm long, 1.7–5 mm wide, obovate-elliptic, apex generally with 3 teeth. Disk flower corollas 4–7(8) × 1–2.5 mm. *Cypselae* brown-tinted to olive-green, with grooved-reticulate to somewhat warty surface, dimorphic or homomorphic. Cypselae from ray flowers (1.5)3–4.3 × 0.7–1.5 mm, glabrous or glabrate, with or without pappus. Cypselae from disk flowers (1.5)2–4 × 0.2–

1.3 mm, with eglandular or glandular trichomes, with pappus. Pappus (2.5)4–5.5 mm, white. Chromosome number $2n = 60, 120$ (Fernandes & Queirós, 1971, as *D. pardalianches*).

Illustrations. Figures 1F, 6C, 16.

Distribution. North of the Iberian peninsula and mountains in central Spain and eastern Portugal. Open moist rocky places, cliffs, screes, woods, and near watercourses, from sea level to 2500 m elevation (Figs. 17, 18).

This taxon can be confused with *Doronicum austriacum* due to their similarities (e.g., habit, leaves, capitula, habitat; see comments under this species), but the presence of this latter species in the Iberian peninsula is only based on a few gatherings more than 50 years old from Andorra and Cerdagne in the Pyrenees. This species must be searched for in these areas in the Pyrenees.

Doronicum carpetanum is variable with regard to quantity of indumentum, size, ploidy level, and presence of pappus in the ray flowers. Variation in these characters follows geographical patterns, and in most cases these populations can be distinguished morphologically. Hybridization events both contemporary and in the origin of one of the subspecies here recognized (subsp. *diazii*) cannot be discarded in this group. However, further investigation is needed, and at present, taxonomic recognition at the subspecific level is preferred to handle the intraspecific variability (see also comments for *D. grandiflorum*). In the present taxonomic treatment the following subspecies are recognized:

Key to Subspecies of *Doronicum carpetanum*

1. Receptacle glabrous or glabrate; plants generally bearing one capitulum 2
1′. Receptacle pubescent; plants bearing one to several capitula 3
2(1). Cypselae of disk flowers with mostly glandular trichomes ..... 6b. *D. carpetanum* subsp. *diazii*
2′. Cypselae of disk flowers with mostly eglandular trichomes ..... 6c. *D. carpetanum* subsp. *kuepferi*
3(1). Lower and middle cauline leaves with eglandular trichomes, sometimes also with glandular trichomes ..... 6d. *D. carpetanum* subsp. *pubescens*
3′. Lower and middle cauline leaves glabrous or with mainly glandular trichomes ..... 6a. *D. carpetanum* subsp. *carpetanum*

6a. **Doronicum carpetanum** subsp. **carpetanum**

Plants glabrous or glabrate, generally glandular in the upper part, sometimes also with scattered eglandular trichomes. *Receptacle* pubescent. *Cypselae* dimorphic, the inner with eglandular trichomes. Chromosome number $2n = 120$ (Chacón, 1987).

Illustrations. Figures 1F, 16A–D.

Distribution. Massifs in the center of the Iberian peninsula in Spain, plus some scattered populations in the north. Open moist rocky places and near watercourses, altitude 900–2300 m (Fig. 17).

Selected specimens examined. SPAIN. **Castilla–La Mancha:** Guadalajara, Cantalojas, Tejera Negra, 20 June 1985, *Burgos & Cardiel, s.n.* (MACB). **Castilla y León:** Ávila, Solana de Ávila, laguna del Duque, arroyo Malillo, *Álvarez & Yagüe 931* (MA); Salamanca, Candelario, sierra de Béjar, 28 June 1979, *Amich et al. s.n.* (MA); Burgos, Pineda de la Sierra, pico Mancillas, 14 July 1984, *Benedí et al. s.n.* (MA, MAF); Ávila, sierra de Majarreina au dessus de Tornavacas près Plasencia, *Bourgeau 2508* (COI-WILLK, K, MA, NY); Ávila, El Calvitero, 16 July 1979, *Carrasco et al. s.n.* (MACB); Zamora, Puebla de Sanabria, sierra Calva de Porto, 19 July 1973, *Casaseca s.n.* (MA); Burgos, pico Trigaza, *Castroviejo & Fernández Quirós 5868* (MA); Ávila, El Barco de Ávila, sierra del Barco, *Castroviejo et al. 7133* (MA); Segovia, Cerezo de Arriba, pico del Lobo, *Castroviejo et al. 10709* (MA); Burgos, valle de Valdelaguna, sierra de Neila, Mt. Haedillo, *Gil Zúñiga & Alejandre 225–88* (MA); Ávila, Hoyos del Espino, Las Chorreras, *Luceño & Vargas 208* (MA); Soria, sierra Cebollera, rio Racioncillo, 5 July 1979, *Mendiola s.n.* (MACB); Soria, sierra Carbonera, 6 July 1979, *Mendiola s.n.* (MACB); Soria, El Bercolar, sierra Cebollera, 17 July 1980, *Mendiola s.n.* (MACB); Soria, Laguna Negra de Urbión, 15 July 1985, *Navarro s.n.* (MAF); Ávila, Cepeda de la Mora, La Serrota, El Nevero, 5 July 1982, *Rivas Martínez et al. s.n.* (MAF); Zamora, San Martín de Castañeda, El Cabezo, 22 June 1987, *Roa s.n.* (MA); Ávila, sierra de Gredos oriental, puerto de Mijares, July 1984, *Sánchez-Mata s.n.* (MAF); Ávila, Navalguijo, garganta de los Caballeros, 3 June 1990, *Sardinero s.n.* (MAF); Soria, Santa Inés, Majadarrubia, *Segura Zubizarreta 12525* (MA); Ávila, San Martín del Pimpollar, *Segura Zubizarreta 22654* (MA). **Comunidad de Madrid:** Sierra de Guadarrama, laguna de Peñalara, *Almaraz et al. 802* (MA). **La Rioja:** Ezcaray, cerro de San Lorenzo, *Almaraz et al. 805* (MA); puerto de Piqueras, *Sandwith 5684* (K); Zaldierna, sierra de la Demanda, pico Torocuervo, 14 July 1992, *Urrutia s.n.* (MA). **País Vasco:** Álava, La Leze, sierra de Alzarria, 1 July 1985, *Uribe-Echebarría s.n.* (MA). **Principado de Asturias:** lagos de Saliencia, *Luceño & Vargas 2569′* (MA).

6b. **Doronicum carpetanum** subsp. **diazii**

(Pérez Morales & Penas) Álv. Fern., Novon 11: 294. 2001. *Doronicum diazii* Pérez Morales & Penas, Lagascalia 15: 155, fig. 2. 1990. TYPE: Spain. León, Abelgas, Puerto Bermejo, July 1974, *C. Romero s.n.* (holotype, LEB 4290 not seen).

Plant up to 70 cm tall, glabrous or glabrate in the lower part, glandular at the middle and upper part, sometimes also with scarce eglandular trichomes. *Stems* generally simple. Basal leaves

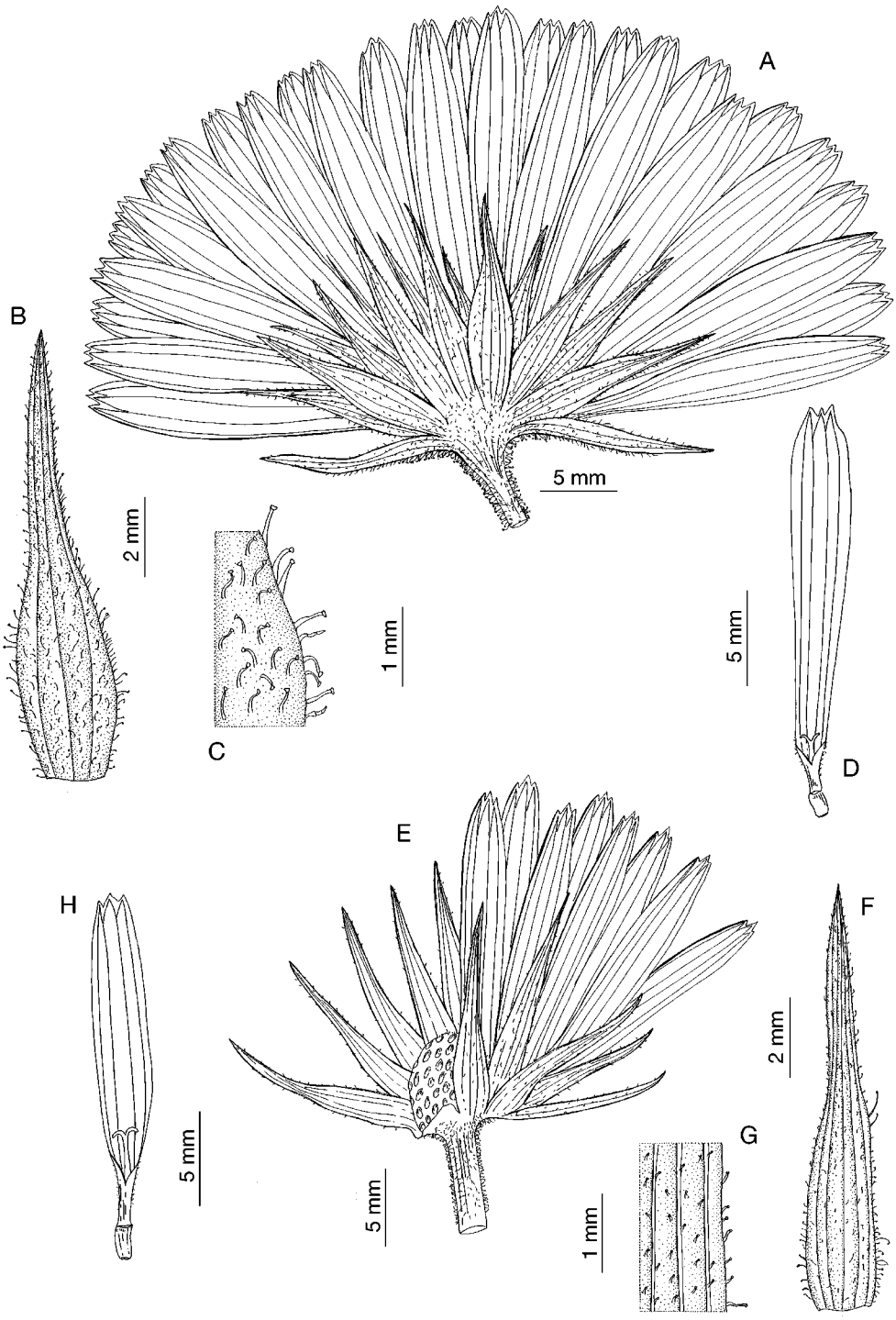

Figure 16. A–D. *Doronicum carpetanum* subsp. *carpetanum* (drawn from *Luceño & Vargas 208*, MA). —A. Capitulum. —B. Phyllary. —C. Indumentum of a phyllary. —D. Ray flower. E–H. *Doronicum carpetanum* subsp. *kuepferi* (drawn from *Navarro & Valle s.n.*, MA). —E. Capitulum. —F. Phyllary. —G. Indumentum of a phyllary. —H. Ray flower.

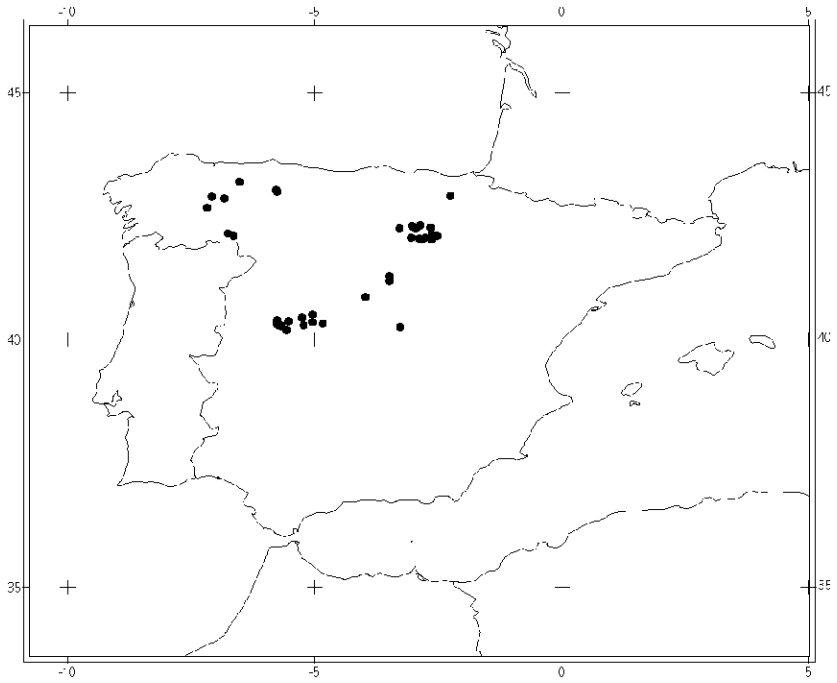

Figure 17. Distribution map for *Doronicum carpetanum* subsp. *carpetanum*.

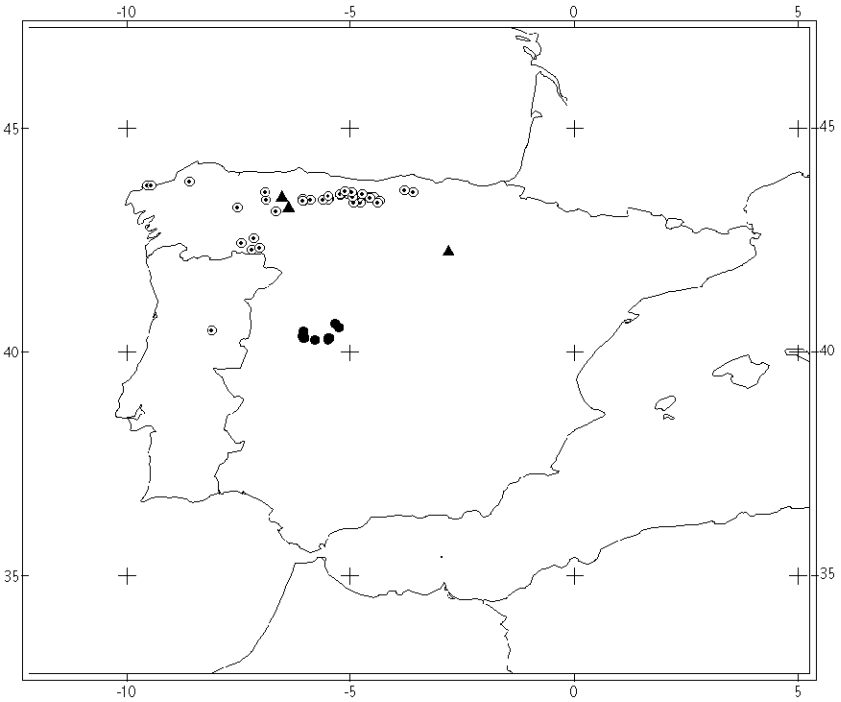

Figure 18. Distribution map for: *Doronicum carpetanum* subsp. *diazii* (▲); *Doronicum carpetanum* subsp. *kuepferi* (●); *Doronicum carpetanum* subsp. *pubescens* (⊙).

sometimes present at flowering time; blade 4–6 × 3–4 cm; petiole 6.5–10 cm long, 1–2 mm wide. Lower and middle cauline leaves 3.5–8.5 × 2–6 cm. Upper cauline leaves 1.2–5.5 × 0.5–2 cm. *Capitula* 1 to 2(4), 3–4 cm diam. including rays; involucre 2–2.5 cm diam. *Phyllaries* 0.9–1.4 cm long, 1.5–3 mm wide. *Receptacles* glabrous to glabrate. Ray flower corollas 1.3–1.9 cm long, 3–3.5 mm wide. *Cypselae* generally dimorphic, ray flowers sometimes with pappus poorly developed. The inner cypselae mainly glandular. Chromosome number $2n = 60$ (new count reported here: Spain. León, Riolago, *Álvarez et al. 924* (MA 611192)).

Illustrations. Pérez & Penas (1990: 156, fig. 2); Figure 6C.

Distribution. Northern Iberian peninsula (Cantabrian range) and central-eastern ranges (Picos de Urbión) in Spain. Open moist rocky places and screes, altitude 1700–2100 m (Fig. 18).

Although type material was not available, plants collected at the type locality and also several specimens identified by Pérez (one of the authors) as *Doronicum diazii* were studied.

Selected specimens examined. SPAIN. **Castilla y León:** León, San Emiliano, Riolago, pico Penouta, *Álvarez et al. 924* (MA); Soria, Sierra de Urbión, *Ceballos & Vicioso 1136* (MA); Soria, Covaleda, macizo de Urbión, laguna Larga, *Gil Zúñiga & Alejandre 320/93* (MA); Soria, sierra de Urbión, Laguna Negra, *Harrold & McBeath 240* (E); Soria, del pico de Urbión al pico Tres Cruces, 26 July 1982, *Navarro s.n.* (MAF); León, peña Penouta, Abelgas, 27 July 1988, *Puente & Pérez Morales s.n.* (MA, MAF); Soria, sierra de Urbión, *Sandwith 5340* (K). **Principado de Asturias:** Somiedo, braña de Murias Longas, 25 Aug. 1985, *Aedo s.n.* (MA).

6c. Doronicum carpetanum subsp. **kuepferi** (R. Chacón) Álv. Fern., Novon 11: 294. 2001. *Doronicum kuepferi* R. Chacón, Anales Jard. Bot. Madrid 43: 269. 1987. TYPE: Spain. Cáceres, sierra de Majarreina, cerca del pico del Telégrafo, 7 Aug. 1946, *S. Rivas Goday s.n.* (holotype, MA 155587!; isotypes, MA 348763!, MAF 11944!).

Plants up to 70 cm tall, glabrous or glabrate in the lower part, glandular at the middle and upper part, sometimes also with scarce eglandular trichomes. *Stems* generally simple. Blade of basal leaves 2.5–5 × 2–6 cm; petiole 4.5–14 cm long, 1–2 mm wide. Lower and middle cauline leaves 3–6 × 1.5–4 cm. Upper cauline leaves 1–3 × 0.2–1.5 cm. *Capitula* 1 to 2(4), 2.5–5.5 cm diam. including rays; involucre 2–3.5 cm diam. Phyllaries 0.9–1.7 cm long, 0.5–2.5 mm wide. *Receptacles* glabrous to glabrate. Ray flower corollas 1.4–1.7 cm long, 1.7–4 mm wide. *Cypselae* dimorphic, ray flowers sometimes with pappus poorly developed. The inner cypselae mainly with eglandular trichomes. Chromosome number $2n = 60$ (Chacón, 1987; recounted and confirmed here: Spain. Ávila, Portilla de Talamanca, *Álvarez & Yagüe 933* (MA 611198)).

Illustrations. Figure 16E–H.

Distribution. Central-western of the Iberian peninsula (Sierra de Gredos). Open moist rocky places, screes, and near watercourses, altitude 1800–2500 m (Fig. 18).

Selected specimens examined. SPAIN. **Castilla y León:** Ávila, Solana de Ávila, Portilla de Talamanca, *Álvarez & Yagüe 933* (MA); Ávila, El Calvitero, 16 July 1979, *Carrasco et al. s.n.* (MA); Salamanca, sierra de Béjar, El Trampal, 4 Aug. 1977, *Casaseca et al. s.n.* (MA); Ávila, laguna de Gredos, sierra de Gredos, *Dresser 846* (E); Salamanca, sierra de Béjar, El Trampal, *Nieto Feliner et al. 2736* (MA); Ávila, Villatoro, La Serrota, 5 July 1997, *Palacio et al. s.n.* (MA); Salamanca, Trampal, 27 July 1900, *Pau s.n.* (LY); Salamanca, sierra de Béjar, Hoyamoro, 22 Aug. 1983, *Rico s.n.* (MACB); Ávila, Sierra de Gredos, El Morezón, 26 July 1958, *Rivas Goday s.n.* (MAF); Ávila, sierra de Béjar, La Ceja, 26 July 1989, *Rivas Martínez et al. s.n.* (MAF); Ávila, puerto de Villatoro-Villanueva del Campillo, 20 May 1982, *Sánchez-Mata et al. s.n.* (MAF); Salamanca, sierra de Béjar, La Hoya, circo de la Peña Negra, 14 July 1990, *Sardinero s.n.* (MAF); Ávila, sierra de Tormantos, Puerto Castilla, circo de El Barco, 23 Aug. 1990, *Sardinero s.n.* (MAF); Salamanca, Candelario, Calvitero, *Valdés Bermejo et al. 5812* (MA). **Extremadura:** Cáceres, sierra Majarreina, cerca del Pico del Telégrafo, 7 Aug. 1946, *Rivas Goday s.n.* (MA, MAF).

6d. Doronicum carpetanum subsp. **pubescens** (C. Pérez Morales, A. Penas, F. Llamas & C. Acedo) Aizpuru, in Aizpuru et al., Munibe 50: 11. 1998. *Doronicum pubescens* C. Pérez Morales, A. Penas, F. Llamas & C. Acedo, Lazaroa 14: 7. 1994. TYPE: Spain. León: puerto del Pontón, 12 June 1992, *A. Penas & M. E. García s.n.* (holotype, LEB 47120 not seen).

Plants mainly with eglandular trichomes at least in the middle part, also glandular in the upper part. Blade of basal leaves 4–6.5 × 3.5–5.5 cm; petiole 7–9 cm long. *Capitula* 4.5–5(7) cm diam. including rays. *Receptacles* pubescent. *Cypselae* dimorphic, the inner with eglandular trichomes. Chromosome number $2n = 120$ (Chacón, 1987, as *D. carpetanum*).

Distribution. Northern Iberian peninsula in Spain and central Portugal (Serra da Estrela). Open moist rocky places, cliffs, woods, and near watercourses, altitude 50–2200 m (Fig. 18).

Although type material of *Doronicum pubescens*

was not seen, plants collected at the type locality as well as several specimens identified by Pérez (one of the original authors) as *Doronicum pubescens,* were studied.

Selected specimens examined. PORTUGAL. **Beira Alta:** Manteigas, Serra da Estrela, Mondeguinho, *Álvarez et al. 1296* (MA). SPAIN. **Cantabria:** pico Tresmares, 25 July 1982, *Aedo s.n.* (MA); Mt. Gulatrapa, Mazandrero, 2 July 1983, *Aedo s.n.* (MA); puerto de Piedrasluengas, *Álvarez 923* (MA); Vega de Liébana, Ledantes, puertos de Pineda, *Álvarez & Yagüe 941* (MA); Fuente Dé, *Harrold & McBeath 158* (E); Vega de Pas, puerto de Estacas de Trueba, *Pardo de Santayana & Morales 1690* (MA); Soba, puerto de La Sía, 27 May 1990, *Patino et al. s.n.* (MA); El Henar, 13 July 1977, *Rivas Martínez et al. s.n.* (MAF); Curavacas, *Valdés Bermejo et al. 4233* (MA). **Castilla y León:** Palencia, Cardaño de Arriba, *Aedo et al. 3631b* (MA); León, Encinedo, laguna de La Baña, *Álvarez 927* (MA); León, Oseja de Sajambre, puerto del Pontón, *Álvarez & Yagüe 936* (MA); León, Boca de Huérgano, Coriscao, arroyo Luriana, *Álvarez & Yagüe 937* (MA); León, Puebla de Lillo, 18 July 1974, *Andrés s.n.* (MAF); León, Nocedo, Cueto Ancino, 18 July 1951, *Borja s.n.* (MAF); León, circo Cebollero, puerto de San Isidro, 16 July 1974, *Casaseca & Fernández Díaz s.n.* (MA); León, puerto de las Señales, 27 July 1979, *Casaseca et al. s.n.* (MA); León, entre le col de Panderruedas et Posada de Valdeón, *Charpin 15017* (B); León, Palacios del Sil, pico Catoute, 15 Aug. 1997, *Martín Blanco s.n.* (MACB); León, puerto de Pandetrave, 16 June 1981, *Rivas Martínez et al. s.n.* (MAF); Zamora, Portilla del Padornelo, 24 July 1972, *Valdés Bermejo s.n.* (MA). **Galicia:** Lugo, Cervantes, monte Camporredondo, Degrada, pico Tres Obispos, *Álvarez et al. 926* (MA); La Coruña, Caaveiro, 25 Apr. 1981, *Amich et al. s.n.* (MA); La Coruña, Puente Carreira, 29 May 1953, *Bellot s.n.* (MA, MACB, MAF); Orense, sierra do Invernadeiro, Cabeza de Val do Cabreiro, 10 July 1973, *Castroviejo s.n.* (MA); Orense, Viana del Bollo, montaña de Ramilo, *Merino 18* (MA); La Coruña, Malpica, As Portelas, 19 June 1994, *Soñora s.n.* (SANT). **Principado de Asturias:** supra Pajares, 14 July 1892, *Lomax s.n.* (MA); Cangas de Narcea, vega de Renfos, Muniellos, *Silva Pando et al. 1394* (MA, MACB, MAF).

7. Doronicum cataractarum Widder, Feddes Repert. 22: 115, Taf. 25–27. 1925. TYPE: Kärnten, Koralpe, Im obersten Weiβwassergraben, nahe der Waldgrenze bei etwa 1630 m, zwischen den Felsblöcken des Baches, 20 Aug. 1923, *F. J. Widder s.n.* (holotype, GZU!; isotypes, GZU!).

Plant up to 100(+) cm tall. *Rhizomes* woody to somewhat woody, scarcely pubescent to pubescent, and generally with leaf remains forming dark scales on nodes. *Stem* branched in the upper part, leafy, internodes generally shorter than the adjacent leaves. Indumentum of uniseriate eglandular trichomes (up to 0.4 mm), also with short-stalked or subsessile glandular trichomes near the capitula, sometimes glabrate. *Leaves* slightly dentate to dentate. Basal leaves sometimes present at flowering; blade 8–20 × 8.5–19.5 cm, ovate to orbicular, with cordate to subcordate base and generally blunt apex, with actinodromous venation; petiole 21–26 cm long, 2.5–4.5 mm wide. Lower and middle cauline leaves 7–19 × 6–15 cm, similar to basal leaves or sessile, fiddle-shaped, semi-amplexicaul. Upper cauline leaves 2.5–4.5 × 0.8–2 cm, ovate to ovate-lanceolate, sometimes bract-like. Indumentum similar to the adjacent part of the stem, sometimes with uniseriate and multiseriate eglandular trichomes (up to 2 mm). *Capitula* 2 to 14, 4–8 cm diam. including rays; involucre shorter than rays, 2.5–5 mm diam.; peduncles 3–16 cm long, 0.7–1.5 mm wide, sometimes with turbinate base during fruit (up to 12 mm width). *Phyllaries* herbaceous, 1.2–1.8 cm long, 1.5–3.5 mm wide, ovate-lanceolate to elliptic, generally with acute apex. Indumentum of short-stalked glandular trichomes and uniseriate eglandular trichomes, sometimes glabrate. *Receptacles* glabrous. *Flowers* with yellow corollas. Ray flower corollas 2.5–3.5 cm long, 1.7–3 mm wide, oblong-elliptic to obovate-elliptic, apex generally with 3 teeth. Disk flower corollas 4–5 × 2–3 mm. *Cypselae* brown-tinted, with grooved-reticulate surface, dimorphic. Cypselae from ray flowers ca. 3.5 × 1 mm, glabrous or glabrate, without pappus or sometimes with a poorly developed pappus. Cypselae from disk flowers 2.5–3 × 0.6–0.8 mm; pappus 4–5.5 mm, white. Chromosome number $2n = 60$ (data obtained from several indexes of plant chromosome numbers: Fedorov, 1969; Goldblatt, 1985; Goldblatt & Johnson, 1994, 1996; original sources not seen).

Illustrations. Widder (1925: Taf. 25–27); Hegi (1928: 716, fig. 424); Figures 1D, 8C, 12E, 12F.

Distribution. Europe (Austrian Alps). In gullies and rocky places near watercourses, altitude 1600–1900 m (Fig. 15).

Morphologically, the closest species to *Doronicum cataractarum* is *D. austriacum* (see comments above), and there are only slight and few differences between them. *Doronicum cataractarum* is an endemic from the Austrian Alps, which is included within the area of distribution of *D. austriacum.* The characters used to distinguish them are the scarcely pubescent to pubescent rhizomes of *D. cataractarum* versus glabrous rhizomes of *D. austriacum*; base of capitula glabrous to glabrate with short-stalked or subsessile gladular trichomes in *D. cataractarum* versus base of capitula glabrate to pubescent or with long-stalked glandular trichomes in *D. austriacum.* In addition, although these two species have dimorphic cypselae (ray flowers without pappus and disk flowers with pappus), this is not a very

stable character in *D. cataractarum* and sometimes the ray flowers in this species have a poorly developed pappus, which is never present in *D. austriacum*.

Selected specimens examined. AUSTRIA. **Kärnten:** Koralpe, am Bache im Himmelreich, 22 Aug. 1934, *Drobny s.n.* (B); Koralpe bei Deutschlandberg, *Fest 571* (B); Koralpe, Bachufer unterhalb der Grillitschhütte, 30 July 1950, *Höpflinger s.n.* (BM, G); Koralpe, Grosses Kaar, Sep. 1953, *Patzak s.n.* (K); Weißwassergraben, Waldgrenze, 20 Aug. 1923, *Widder s.n.* (GZU); Weißwassergraben, Grillitschhütte, Sturzbach, 19 Aug. 1928, *Widder s.n.* (MAF). **Steiermark:** Ronde des Seebaches, Seekar der Koralpe, 24 Aug. 1936, *Widder s.n.* (G); Seebach der Koralpe, Seekar, 28 Aug. 1939, *Widder s.n.* (B).

8. Doronicum clusii (All.) Tausch, Flora 11: 178. 1828. *Arnica clusii* All., Auct. Syn. Stirp. Taurin.: [18]. 1773. *Aronicum clusii* (All.) W. D. J. Koch, Syn. Fl. Germ. Helv.: 382. 1837. TYPE: not located; protologue citation: "in Albula Rhaetica & aliis Rhaetorum alpibus."

Plant up to 40 cm tall. *Rhizomes* fleshy to somewhat woody, with shining white-tinted short trichomes on nodes, generally with leaf remains. *Stems* generally not branched, with leaves mainly at the base or in the middle basal part of stem. Indumentum of eglandular and glandular trichomes, more abundant near the capitula. *Leaves* entire to dentate. Basal leaves generally present at flowering time; blade 7(8.5)–(1.5)2 × 1–2.5(3.5) cm, elliptic to ovate-elliptic, truncate or attenuate base, blunt to acute apex, with actinodromous to pinnate-actinodromous venation; petiole (0.8)2–10 cm long, 1–3(4) mm wide. Lower and middle cauline leaves 2.5–10 × 0.7–2.5(3.5) cm, similar to basal leaves or sessile, ovate-elliptic to narrowly elliptic, semi-amplexicaul. Upper cauline leaves 1.5–5.5 × 0.5–3 cm, similar to middle cauline leaves, or ovate-lanceolate. Indumentum of stiff, acute, and shiny multiseriate eglandular trichomes (up to 2.5 mm), and thin, tangled uniseriate eglandular trichomes (up to 2 mm), mainly on leaf margins, also short-stalked glandular trichomes on leaf blade. *Capitula* 1(to 4), 4–7.5 cm diam. including rays; involucre shorter than rays, 2.5–5 cm diam. *Phyllaries* herbaceous; the outer 1.2–2 cm long, 1.5–3.3 mm wide; the inner 1–2 cm long, 1–2.3 mm wide, ovate-lanceolate to widely subulate. Indumentum similar to the upper part of stem. *Receptacles* glabrous. *Flowers* with yellow corollas. Ray flower corollas 1.8–2.5 cm long, 2.5–4.5 mm wide, obovate-elliptic, apex generally with 3 teeth. Disk flower corollas 4–5 × 1.5–2 mm long. *Cypselae* brown, with grooved-reticulate surface, homomorphic, 1.5–2.5 × 0.7–1 mm, with eglandular trichomes or glabrate. Pappus up to 5.5 mm, white. Chromosome number $2n = 60$*, 120 (Skalinska, 1950, as *Aronicum clusii*; Tasenkevitch et al., 1989; *Goldblatt & Johnson, 1996, see comments below).

Illustrations. Reichenbach (1854: tab. 63, fig. 2); Hegi (1928: fig. 432); Săvulescu (1964: pl. 99, fig. 1), Resmeriţă & Moravetz (1956: fig. 1); Figure 3F–H.

Distribution. Europe (Alps and Carpathians). Open moist rocky places and screes, altitude 1500–3000 m (Fig. 19).

The type material of *Arnica clusii* could not be found, and although the protologue matches the diagnostic features of this taxon, its identity here is tentative and the formal synonymies need to wait until clarification.

There are three European species, *Doronicum clusii*, *D. glaciale*, and *D. grandiflorum*, that are morphologically similar, and whose areas of distribution overlap in some places in the Alps occupying the same habitats. All of them have homomorphic fruits (all cypselae with pappus), ovate to elliptic basal leaves with truncate or attenuate bases, and rhizomes fleshy to somewhat woody with short trichomes on nodes, generally with a single capitulum or sometimes a few (2 to 4). All of them grow in open moist rocky places in the mountains, preferably the upper tree line to 3000 m in elevation. Although they only differ in the type of indumentum, it is a very constant character (more noticeable on the leaf margins). In *D. clusii* and *D. glaciale*, stalked glandular trichomes are absent or scarce, while they are common in *D. grandiflorum* (Fig. 3B). In contrast, long (up to 2.5 mm) nonglandular trichomes are present in both *D. clusii* and *D. glaciale* (Fig. 3E, H). Differences between *D. clusii* and *D. glaciale* are slight, and it is difficult to delimit them. Typical individuals from *D. clusii* and from *D. glaciale* present the indumentum as it is represented (Fig. 3H and E, respectively), but some individuals have a very few scattered thin and tangled uniseriate trichomes, which are abundant in typical *D. clusii* and absent in typical *D. glaciale*. Because of this, the present taxonomic treatment includes those exceptional individuals within *D. clusii*, although the existence of hybrids between these two species is not rejected.

The citation of the chromosome number $2n = 60$ for *D. clusii* was found in Goldblatt and Johnson's (1996) index, but the original source for this data was not seen.

Selected specimens examined. AUSTRIA. **Steiermark:** Grafenalpe, Krakaudorf, July 1902, *Fest s.n.* (B); Rottenmanner Tauern, Haute Styrie, 21 July 1868, *Ober-*

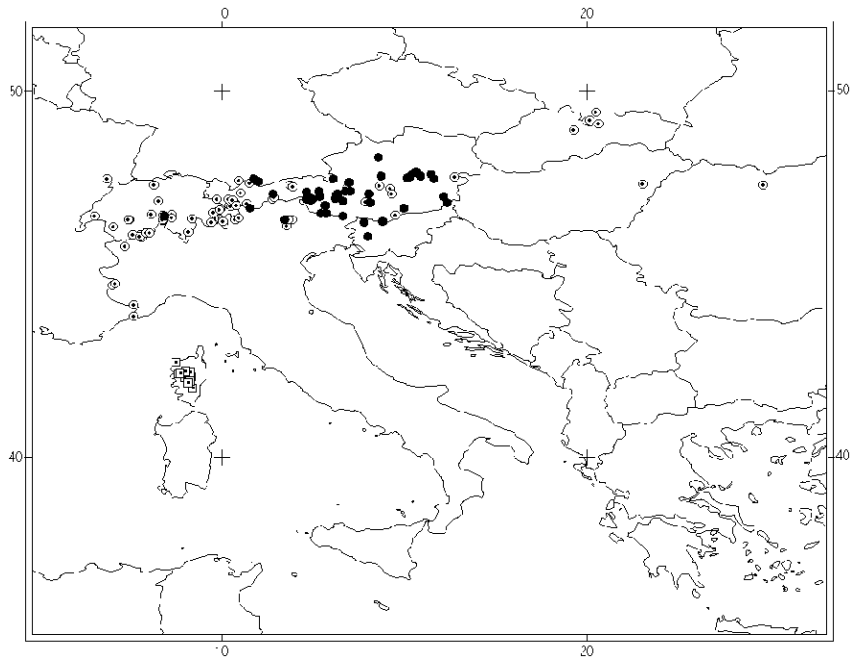

Figure 19. Distribution map for: *Doronicum clusii* (⊙); *Doronicum corsicum* (⊡); *Doronicum glaciale* (●).

leitner s.n. (B, LE). **Tirol:** Paznaun, Fladner Massio, 2 Aug. 1932, *Bornmüller s.n.* (B); Ferwallgruppe, Fasultal, 2 Aug. 1942, *Freiberg s.n.* (MA); Ötzthaler Alpen, Oberimtal, Glocktürmgebrit Felsblock in der Radurschelalm, 25 Aug. 1939, *Günther s.n.* (B); Alpbach bei Brixlegg am Galtenberg, Schiefer, 10 Aug. 1933, *Reiter s.n.* (B); Gsehnitz, Mt. Muttenjoch, 16 Aug. 1890, *Schafferer s.n.* (B). **Vorarlberg:** Schruns, Sulzfluh, 27 July 1895, *Bornmüller s.n.* (B). CZECHOSLOVAKIA. Vysoké Tatry in valle montana Mlynica, 6 Aug. 1933, *Dostál s.n.* (BM, MA, NY); Felka pod Gerlachovský Štít, July 1895, *Fitko s.n.* (B); Magas Tátra, lacum Késmárki Zöld-tó, *Kümmerle & Timkó 790* (B, E, MO); Brezno, Mt. Dumbier, 3 Aug. 1898, *Kupčok s.n.* (E). FRANCE. **Alpes-Maritimes:** Mt. Bissa, col de Tende, *Bourgeau 139* (COI-WILLK, G, K). ITALY. **Lombardia:** Bormio, passo dello Stelvio, *Álvarez et al. 1355* (MA); Sondrio, Bormio, Mt. Leverone, 31 July 1911, *Longa s.n.* (BM). **Piemonte:** passo del Domignone, Alpes Bergamasques, 31 July 1910, *Chenevard s.n.* (G). **Trentino-Alto Adige:** Trento, Canazei, col del Cuc, *Álvarez et al. 1353* (MA). **Valle d'Aosta:** Aufstieg zum Colle Pinter, am Bergbach, in Felsen, 1982, *Royl & Schiers s.n.* (B). POLAND. Zakopane, Beskid, o-alpin, Karpaten, *Hempel 2786* (B); Rysy, lacum Czarny Staw, Tatry Wysokie, Tatri Alti, 3 Sep. 1938, *Madalski s.n.* (B). SWITZERLAND. **Graubünden:** Alp d'Ischolàs, Engadine, *Binz 405* (MO); Pontresina, Morteratsch, paso del Bernina, Lejner, *Castroviejo et al. 11615* (MA). **Tessin:** San Bernardino, 28 July 1920, *Valentine s.n.* (NY). **Valais:** près Zermatt, 14 Aug. 1888, *Bernouilli s.n.* (MA); Ferpècle-Barcolla, *Bonnier 163* (MO); Weismieshütte, Quellflur, *Damboldt 679/70* (B); Saas-Tal, Grashang bei Spielbodenalm, Saas-Fee, *Damboldt 714/70* (B); près des alpes de Taesch, 5 June 1908, *Palibin s.n.* (LE). YUGOSLAVIA. Visoki Verch, Liptau, July 1894, *Ullepitsch s.n.* (B).

9. Doronicum columnae Ten., Fl. Napol.1, Prodr.: 49. 1811. TYPE: Italy. "Majella" [*M. Tenore s.n.*] (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 802), NAP!).

Plant up to 70 cm tall. *Rhizomes* woody to somewhat woody, glabrous, generally with leaf remains forming dark fibers or scales on nodes. *Stems* not branched, generally scape-like. Indumentum of uniseriate, multiseriate eglandular trichomes, short-stalked and long-stalked glandular trichomes, scarce at the base, more abundant near the capitula. *Leaves* dentate to slightly dentate. Basal leaves generally present at flowering time; blade 1.5–7 × 2–6.5 cm, orbicular to broadly ovate with cordate to subcordate base, with blunt or subacute apex, with actinodromous venation that sometimes tends to be acrodromous; petiole thin and stiff, 4–15(24) cm long, 0.5(–2) mm wide. Lower and middle cauline leaves 1.9–8(10.4) × 1.2–6(7) cm, similar to basal leaves or sessile, fiddle-shaped, semi-amplexicaul. Upper cauline leaves 1.5–4.5(7.1) × 0.8–3 cm, ovate-elliptic to ovate-lanceolate, sometimes bract-like. Indumentum of uniseriate eglandular trichomes (up to 0.5 mm), conspicuously on the blade edge. *Capitula* 1(2 to 3), 2.8–7 cm diam. including rays; involucre shorter than rays, rarely equaling them, 1.8–4 cm diam. *Phyllaries* herba-

ceous, ovate-subulate, generally with acute apex; the outer 0.7–1.8 cm long, 0.7–2.8 mm wide, the inner 0.7–1.6 cm long, 0.5–1.8 mm wide; margins sometimes ciliate, with acute, stiff and equidistant multiseriate eglandular trichomes (up to 0.6 mm). Indumentum mainly glandular, but also with uniseriate eglandular trichomes. *Receptacles* glabrous or pubescent. *Flowers* with yellow corollas. Ray flower corollas 1–3 cm long, 1.5–3.8 mm wide, oblong-elliptic, apex generally with 3 teeth. Disk flower corollas 3.5–4.5 × 1.8–2 mm. *Cypselae* brown, with grooved-reticulate surface, dimorphic. Cypselae from ray flowers 2–2.5 × 0.7–1 mm, glabrous to glabrate, without pappus. Cypselae from disk flowers 1–2.3 × 0.4–0.8 mm, with eglandular trichomes; pappus 3–4 mm, white. Chromosome number $2n = 60$ (Garbari et al., 1980; Van Loon, 1980; Strid & Franzén, 1983; Lippert & Heubl, 1988; Baltisberger, 1991).

Illustrations. Reichenbach (1854: tab. 64, fig. 1); Hegi (1928: 715, fig. 423); Săvulescu (1964: pl. 98, fig. 2); Figure 1E.

Distribution. Europe (Balkans extending to central Greece, Carpathians, Alps, and Appenines). Meadows, shady rocky places and gullies, from sea level up to 2700 m in elevation (Fig. 15).

Doronicum columnae is a polymorphic species morphologically similar to *D. carpaticum* and *D. orientale*. These species share the habit (scape-like stem with a few caulinar leaves bearing a single capitulum), the shape of basal leaves (orbicular to ovate with cordate to subcordate base), and the ciliate margins of phyllaries (Fig. 5E, F), although this latter character is not constant in *D. columnae* and *D. carpaticum*. The most distinctive character between *D. orientale* and both *D. columnae* and *D. carpaticum* is the type of rhizome, which is fleshy with pubescent nodes in *D. orientale* versus woody to somewhat woody and glabrous in *D. columnae* and *D. carpaticum*. There is only one character to distinguish *D. columnae* and *D. carpaticum*: the dimorphic cypselae (ray flowers without pappus) in *D. columnae* versus the homomorphic cypselae (all flowers with pappus) in *D. carpaticum*. Some specimens that have poorly developed pappus in the ray flowers are included in *D. carpaticum*, although the hybrid nature of them is not rejected. In addition, there are some exceptional specimens of *D. columnae* that have a few capitula instead of a single one and that can be confused with another sympatric species, *D. pardalianches*. It is easy to distinguish between them by comparing their rhizomes, which are woody and glabrous in *D. columnae* while fleshy with pubescent nodes in *D. pardalianches*. Besides, cypselae in *D. pardalianches* turn black at maturity, which is a unique character in the genus.

The type designation for *Doronicum columnae* was difficult (Álvarez Fernández & Nieto Feliner, 1999). Since there is no collection date, doubt remains concerning this issue. Based on historical records, Tenore visited the type locality himself describing several new species in his *Prodromus* in 1811. Taking into account this fact, and without other suitable type material, this was the best choice as lectotype.

Selected specimens examined. ALBANIA. **Gjirokastër:** Mali Gjer, *Alston & Sandwith 1528* (BM, K). **Korçë:** Ostrovicë, Moskopolë, Korcë, *Alston & Sandwith 2065* (BM, K). **Shkodër:** Nikči, Klementi, *Baldacci 457* (BM). **Tiranë:** Dajti, *Pennington 41* (K). AUSTRIA. **Tirol:** Schlern, auf Felsgeroll in der Klamm, 14 July 1903, *Behrendsen s.n.* (G). BULGARIA. **Grad Sofiya:** Vitoša, ref. Salzica, 16 June 1974, *Markova, Cerneva & Gerginov s.n.* (BM, E, G, MA). **Plovdiv:** Kalofer, *Wagner 77* (BM). **Sofiya:** Borovez, Musala, 11 Aug. 1976, *Beck s.n.* (B). GERMANY. **Bayern:** Hocheis-spitz-Gruppe, Hirschbichl Bind-Alm Mittereis-Alm Hocheis-Alm Hintereis, *Lippert & Podlech 25818* (NY). GREECE. **Ípiros:** Mt. Smolika, *Atchley 945* (K); Papignon, Mt. Gamila, *Lancaster 120* (BM). **Makedhonía:** Chaliki, Mt. Peristeri, *Sintenis 733* (B, E, G, K). **Nísoi Ayaíou:** Mt. Korax Aetoliae adjectae, 23 July 1879, *Heldreich s.n.* (K, LE). **Stereá Ellás–Evvoia:** Trapeza, Katafigon, Oeta, *Balls & Gourlay B3231* (BM, E, K). **Thessalía:** Mt. Olympus, *Archibald 326* (E). HUNGARY. **Nógrad:** Orsova, in valle Kazár, *Schneider 11* (B, BM, K, MO). **Veszprém:** Bihania, in valle Izvor, Remecse, 22 May 1906, *Gulyás s.n.* (G). ITALY. **Abruzzi:** La Majella, *Bornmüller 127* (B). **Campània:** Montevergine, Avellino, 10 May 1913, *Pellanda s.n.* (G). **Emilia-Romagna:** Corniolo, Forli, Foresta di Campigna, *Chiapella & Poldini 8743* (G, MA, MAF). **Lombardia:** Como, Mt. Barbisino, Val Massino, 17 July 1850, *Daenen s.n.* (LE). **Puglia:** Gargano, Mt. S. Angelo, 29 May 1895, *Porta & Rigo s.n.* (LE). **Toscana:** Mt. Senario prope Florentiam, 20 Apr. 1856, *Caruel s.n.* (LE). **Trentino-Alto Adige:** Trento, passo Gardena, Sella Gruppe, *Álvarez et al. 1354* (MA). ROMANIA. **Alba:** Piatra Strutu prope pag. Avram Iancu, 24 May 1973, *Gergely & Toader s.n.* (B, BM, G, K, MA). **Braşov:** Mt. Bucegi, m. Predeal, S of Braşov, Ploiesti, *Sidebotham 15* (BM). **Hunedoara:** Mt. Retezat, lacum Zanoaga, 9 Aug. 1933, *Borza & Nyárády s.n.* (BM, G, K, MO). **Prahova:** Mt. Baiului, Muntele Cumpatu, 17 June 1983, *Zamfir s.n.* (B). YUGOSLAVIA. **Bosna i Hercegovina:** Mt. Frebovic, Sarajevo, *Beck & Fiala 232* (G, K, LE). **Crna Gora:** Mt. Durmitor, *Leaver 174* (BM). **Makedonija:** Usküb, ad fluvium Treska, *Bornmüller 4263* (NY). **Srbija:** Belgrad, Ripanj, 8 May 1887, *Bornmüller s.n.* (B).

10. Doronicum corsicum (Loisel.) Poir., in Lam., Encycl. Suppl. 2: 517. 1811. *Arnica corsica* Loisel., Fl. Gall. 2: 576, tab. 20. 1807. *Aronicum corsicum* (Loisel.) DC., Prodr. 6: 319. 1838. TYPE: not located; protologue citation: "in Corsica, ad rupes aquis fluentibus irriguas (D. Richard. Herb.)."

Plant up to 100(+) cm tall. *Rhizomes* woody to somewhat woody, glabrous. *Stems* branched in the upper part, leafy, internodes generally shorter than the adjacent leaves. Indumentum glandular and also with uniseriate and multiseriate eglandular trichomes, abundant near the capitulum, sometimes glabrous in the lower part. *Leaves* dentate to slightly dentate. Basal leaves absent at flowering time, similar to cauline leaves. Cauline leaves oblong-elliptic, sessile, slightly auriculate, semi-amplexicaul, acute apex, pinnate-actinodromous venation. Middle cauline leaves 7–16 × 2–5.5 cm. Upper cauline leaves 3.5–10 × 1–2.5 cm. Indumentum scarce, with uniseriate and multiseriate eglandular trichomes, and short-stalked glands. *Capitula* several, 5(+), ca. 5 cm diam. including rays; involucre much shorter than rays, 2–2.5 cm diam.; peduncles 3.5–7 cm long, 1 mm wide. *Phyllaries* herbaceous, ovate to ovate-lanceolate, generally with acute apex, sometimes slightly papery at the base or at the margins; the outer 0.6–0.8 cm long, 1.7–2.5 mm wide; the inner 0.7–1 cm long, 0.7–1.6 mm wide. Indumentum mainly of uniseriate eglandular trichomes, sometimes also with multiseriate eglandular trichomes and glandular trichomes. *Receptacles* glabrous or pubescent. *Flowers* with yellow corollas. Ray flower corollas ca. 2.5 × 0.4 cm, oblong-elliptic to obovate-elliptic, apex generally with 3 teeth. Disk flower corollas up to 0.7 cm long. *Cypselae* brown and with a smooth to grooved surface, homomorphic, ca. 3 × 1 mm, glabrous or glabrate; pappus ca. 5.5 mm, white. Chromosome number $2n = 60$ (Contandriopoulos, 1957).

Illustrations. Loiseleur-Deslongchamps (1807: tab. 20).

Distribution. Corsica. In forests and gullies and on rocky slopes that are sometimes inundated, altitude 700–1750 m (Fig. 19).

The type material cited in the protologue of *Arnica corsica* refers to one sheet from the D. Richard herbarium. This collection should be in P, but no material was found there. Unfortunately, the protologue includes only a crude and incomplete illustration that is not appropriate as a lectotype. Although the protologue and the illustration included both match the diagnostic features of this taxon, its formal identity needs further investigation in the search of an appropriate lectotype or a neotype.

Currently, this is the only species of *Doronicum* growing in Corsica (see comments under *D. grandiflorum*). Although *D. corsicum* is morphologically similar to *D. austriacum*, they differ basically in the homomorphic cypselae in *D. corsicum* versus dimorphic in *D. austriacum*. In addition, *D. corsicum* has uniform, elliptic, sessile caulinar leaves with dentate margins, while *D. austriacum* presents different types of caulinar leaves in the same specimen (acropetally, petiolate to fiddle-shaped and ovate), with entire to slightly dentate margins.

Selected specimens examined. FRANCE. **Corse:** forêt d'Aïtone bei Evisa, 20 July 1932, *Aellen s.n.* (MA); Calacuccia, Golo, Sidossi, July 1912, *Cousturier s.n.* (NY); Mt. d'Oro, 12 July 1916, *Forsyth-Major s.n.* (K); valleé de Mangamullo, près Vriario, 18 July 1906, *Gysperger s.n.* (B); Calvi, Mt. Sollier, 1822, *Jacquemont s.n.* (NY); Tavignano, Corte, *Kralik 538* (E, K); Fiumorbo, Pazzi du Mt. Renoso, *Kralik 638a* (E, K); l'Incudine, *Lambinon 86/Co/264* (MA); Lit de la Restonica, près de Corte, *Mabille 142* (BM, K); Mt. Niolo, *Requien 250* (BM, K); Bastelica, 18 July 1878, *Reverchon s.n.* (COI-WILLK, E, K, NY); forêt d'Aïtone, 1885, *Reverchon s.n.* (B, E, NY).

11. Doronicum dolichotrichum Cavill., Annuaire Conserv. Jard. Bot. Genève 13–14: 252. 1911. TYPE: Transcaucasus. Gourie, descente du mont Khino au défilé Goghieti, 18 July 1893, *N. M. Alboff s.n.* (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 802), G!).

Doronicum hyrcanum Widder & Rech. f., Oesterr. Bot. Z. 97: 235. 1950. Syn. nov. TYPE: Transcaucasus. Azerbaidjan, Sari Chaman, *Mirdamadi K2381* (holotype, W!).

Doronicum hakkiaricum J. R. Edm., Notes Roy. Bot. Gard. Edinburgh 32(2): 255. 1973. Syn. nov. TYPE: Turkey. Hakkâri, Kara Da, *P. H. Davis & O. Polunin D24383* (holotype, E!; isotypes, BM!, K!).

Doronicum bracteatum J. R. Edm., Notes Roy. Bot. Gard. Edinburgh 32(2): 257. 1973. Syn. nov. TYPE: Iraq. Arl Gird Dagh, near Rust, *E. R. Guest & E. R. Ludlow-Hewitt 2928* (holotype, K!).

Plant up to 100(+?) cm tall. *Rhizomes* woody, glabrous, generally without leaf remains. *Stems* branched in the upper part, leaves distributed along the stem, upper internodes generally longer than the adjacent leaves. Indumentum of triangular, white-tinted, multiseriate eglandular trichomes (1–3 mm), sometimes scattered, long-stalked glandular trichomes (0.5–3 mm), sometimes abundant near the capitula, and occasionally uniseriate eglandular trichomes and short-stalked glandular trichomes, sometimes glabrous at the base. *Leaves* entire to dentate. Basal leaves sometimes present at flowering time; blade 6–15 × 8.5–18.5 cm, orbicular or ovate, with cordate base and blunt or acute apex, with actinodromous venation; petiole 4.7–23 cm long, 3–3.5(6) mm wide, with sheathing base, sheath ca. 5 cm long. Lower and middle cauline leaves with blade 10–26 × 5–21.5 cm, similar to basal leaves or sessile, fiddle-shaped, semi-amplexicaul; petiole 12–20 cm long, 3.5–5.5 mm

wide. Upper cauline leaves 4–9 × 1.6–7.5 cm, sessile, ovate to obovate, or bract-like. Indumentum similar to the adjacent part of the stem, sometimes also with uniseriate eglandular trichomes on margins and on veins in the abaxial surface of leaves. *Capitula* 2 to 8, 4–5.5 cm diam. including rays; involucre shorter than rays, 2.5–3.5 cm diam.; peduncles 2–9 cm long, 1.5–2.3 mm wide, sometimes turbinate at the base of capitula (4–7 mm wide) in fruit. *Phyllaries* herbaceous, ovate-lanceolate to obovate-lanceolate with acute apex; the outer 1.1–1.7 cm long, 2–5.5 mm wide; the inner 1.2–1.5 cm long, 1.5–2.3 mm wide. Indumentum similar to the upper part of stem. *Receptacles* glabrous. *Flowers* with yellow corollas. Ray flower corollas 1.5–2.5 cm long, 2–3.8 mm wide, obovate-elliptic to oblong-elliptic, apex generally with 3 teeth. Disk flower corollas 4–5 mm long. *Cypselae* brown, with smooth or slightly reticulate surface, dimorphic. Cypselae from ray flowers 2.8–4.3 × 1–1.5 mm, glabrous or glabrate, without pappus. Cypselae from disk flowers 2–2.5 × 1–1.5 mm, sometimes with eglandular trichomes; pappus ca. 4.5 mm, white. (Only immature cypselae seen.) Chromosome number unknown.

Illustrations. Figures 2C, D, 7D, 20A–D.

Distribution. Northeastern Turkey, Caucasus, and south of the Caspian Sea. Growing in woods, open moist rocky places, meadows, gullies, and near watercourses, altitude 800–3300 m (Fig. 14).

The type of indumentum is critical for distinguishing among species of *Doronicum* in southwestern Asia. The variability of this character both in type and abundance in *D. dolichotrichum* (Fig. 2C, D) sometimes makes it difficult to identify material conclusively. Plants with intermediate characters between *D. maximum* (Fig. 23B, C) and *D. macrophyllum* (Fig. 26B, C) have been found.

The diagnostic characters used to separate *Doronicum bracteatum* (Edmondson, 1973), *D. hakkiaricum* (Edmondson, 1973), and *D. hyrcanum* (Widder & Rechinger, 1950) overlap substantially with those of *D. dolichotrichum.* The patterns of indumentum variability also match those of *D. dolichotrichum.* Accordingly, these names are considered synonyms.

Selected specimens examined. CAUCASUS. **North Caucasus:** Daghistan, Schalbur dagh, *Backir 183* (LE). **Transcaucasus:** Carthalinia, Tabiszchuri, *A. H. & V. F. Brotherus 500b* (BM, G); Kachetia, Mt. Choczal-dagh, 12 July 1898, *Fomin s.n.* (LE); Armenia, Migri Gjunej, inter m. Gjeljedzhik et m. Ketshmas, 20 Aug. 1932, *Karjagin & Grossheim s.n.* (K); Tiflisskaja, Gorijskij, Gora Tschra-Tscharò, 7 July 1916, *Krylov & Schteinberg s.n.* (LE); Batumskaja, Artvinskij, Arsiyanskij, 16 June 1910, *Nesterov s.n.* (LE); Nachitschevan, Mt. Ketshal-dagh, 4 Aug. 1934, *Prilipko & Isaev s.n.* (K); Nor-Bajazet, Gri-zör, 16 Aug. 1928, *Schelkovnikov & Kara-Murza s.n.* (LE); Mt. Alagëz, Kaznafar, 31 July 1931, *Tamemshian & Maleer s.n.* (E); Chokhatauri, Bakhmaro, Meskhetski, Mt. Grdzeli-vake, 22 July 1979, *Vašák & Esvandzhia s.n.* (G, W). IRAN. Azerbaidjan, Maku to Khoy, Kelisakandi, *Assadi & Mozaffarian 30306* (E); Zanjan, Vansar mountains, 20 June 1983, *Moussavi et al. s.n.* (IRAN); Ostan 2, Dimelo, *Schmid 5989* (G, W); Gorgan, Ketul, *Sharif 224* (W); Azerbaidjan, Ahar, Hassano, 8 Aug. 1968, *Termeh s.n.* (IRAN); Azerbaidjan, Kalibar, Nabidjan, Kouhha-ye Doghroun, 26 June 1978, *Termeh et al. s.n.* (IRAN). IRAQ. Helgord range, *Rawi & Serhang 24553* (K); Qandil mountain, Qala Diza, *Thesiger 1154* (BM). TURKEY. **Artvin:** Yalniczam Silsilesi, Savsat, *Albury et al. 3159* (K); Ardanuç, Kordevan dag, Yalnizcam Daglari, at Kütül yayla, *Davis & Hedge 30342* (BM, E, K, W); Yalnizcam-Gebirge bei Karaköy, Savsat, *Raus 4864* (B). **Erzurum:** Bingöze Köyü yaylas, Yildiz Dagi, *Tatli 5171* (E). **Hakkari:** Kara dag, *Davis & Polunin 24383* (BM, E, K). **Kars:** Yagmurlu dag between Sarikamis and Karuargan, *Davis & Hedge 30819* (E, K); Arpogay, Kaya Diplei, *Ocakverdi 2340* (GAZI).

12. Doronicum falconeri C. B. Clarke, Fl. Brit. Ind. 3: 333. 1881. TYPE: Karakorum, *C. B. Clarke 30258 A* (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 803), K!).

Doronicum turkestanicum Cavill., Annuaire Conserv. Jard. Bot. Genève 13–14: 301. 1911. Syn. nov. TYPE: Russia. Siberia: "Mont. sent. milit.," *M. J. Chaffanjon 385* (lectotype, designated here, G!).

Plant up to 90 cm tall. *Rhizomes* woody to somewhat woody, glabrous, generally with leaf remains forming dark scales. *Stems* not branched, leaves generally arranged all along the stem, internodes generally shorter than adjacent leaves. Indumentum of glandular trichomes (up to 2 mm), more abundant near the capitula, sometimes only very scarce eglandular trichomes or glabrate. *Leaves* entire. Basal leaves sometimes absent at flowering time; blade 2–7(9) × (0.2)1–2.5(3.2) cm, elliptic to obovate, with attenuate base and generally blunt apex, with actinodromous to pinnate-actinodromous venation; petiole 1–4.5 cm long, 2–5 mm wide. Lower and middle cauline leaves (3)5–12.5 × (0.3)1.5–4(5.5) cm, similar to basal leaves or sessile, obovate, ovate, elliptic, or almost fiddle-shaped, semi-amplexicaul, with blunt apex. Upper cauline leaves 2.5–6(7.5) × (0.4)0.5–1.5(3.6) cm, similar to middle cauline leaves or ovate-lanceolate. Indumentum similar to the adjacent part of stem, sometimes also with uniseriate eglandular trichomes and glands on margins. *Capitula* solitary, (4)5–7.5 cm diam. including rays; involucre shorter than rays, rarely equaling them, 3–5 cm diam. *Phyllaries* herbaceous, ovate-lanceolate to subulate; the outer 1.2–2(3) cm long, (1)1.5–2.5(3.5) mm

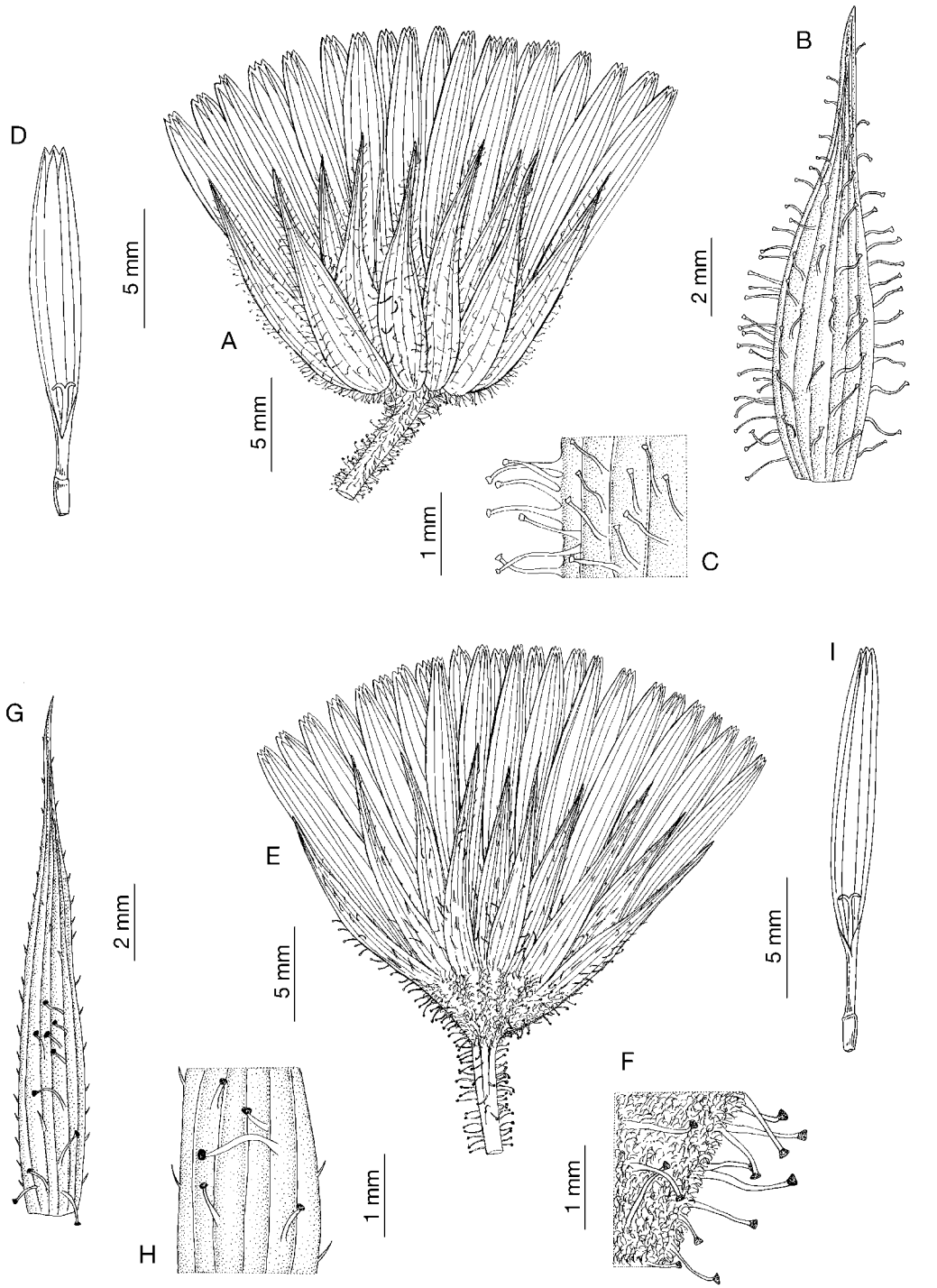

Figure 20. A–D. *Doronicum dolichotrichum* (drawn from *Davis & Hedge 29493*, K). —A. Capitulum. —B. Phyllary. —C. Indumentum of a phyllary. —D. Ray flower. E–I. *Doronicum kamaonense* (drawn from *Polunin 56/170* E, as *D. roylei*). —E. Capitulum. —F. Indumentum of the base of capitulum. —G. Phyllary. —H. Indumentum of a phyllary. —I. Ray flower.

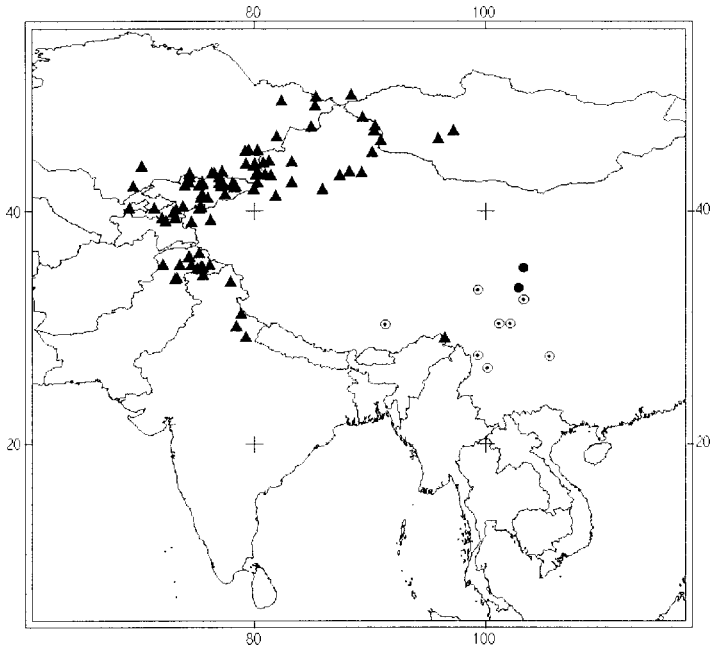

Figure 21. Distribution map for: *Doronicum gansuense* (●); *Doronicum falconeri* (▲); *Doronicum stenoglossum* (⊙).

wide; the inner 1–2 cm long, 0.7–2 mm wide. Indumentum similar to the upper part of stem, very scarce at the apex. *Receptacles* glabrous. *Flowers* with yellow corollas. Ray flower corollas 2–3 cm long, 1–2.5(3) mm wide, obovate-elliptic, apex with 2 or 3 teeth, sometimes without teeth, acute. Disk flower corollas 4.3–5.3 × 1.3 mm. *Cypselae* brown, with smooth surface, dimorphic, generally glabrous, sometimes with scattered eglandular or glandular trichomes. Cypselae from ray flowers without pappus. Pappus up to 5 mm, white. (Mature cypselae not seen.) Chromosome number unknown.

Distribution. Central-western China (provinces of Tibet-Qinghai and Xinjiang), Mongolia, Turkistan, Pamir, and Himalayas. Woods, open rocky places, gullies, and near watercourses, altitude 1800–5000 m (Fig. 21).

Cavillier (1911) recognized two sympatric species, *Doronicum falconeri* and *D. turkestanicum*. The character claimed to distinguish them (shape of leaves) is vague and quite polymorphic, and based on it the differentiation into two groups of species is not easy to make. Some specimens determined by Cavillier as *D. falconeri* and *D. turkestanicum* were included in a multivariate morphometric study (Álvarez Fernández & Nieto Feliner, 2001) resulting in no discrimination at all. Because of the lack of consistency in the delimitation between these two species, *D. turkestanicum*, which was described later, is here treated as synonym of *D. falconeri*.

Despite the recognition of Cavillier's species *Doronicum turkestanicum* in a local floristic study (Gorschkova, 1961), this name was still lacking a type designation. Thus, in this work the best preserved specimen chosen among Cavillier's citations as *D. turkestanicum* is designated as its lectotype (see synonym above).

The morphological similarities of *Doronicum falconeri* with other central Asian species is discussed above (see comments for *D. altaicum* and *D. briquetii*).

Selected specimens examined. CHINA. **Tibet-Qinghai:** Ata Kang La, Nagong, *Kingdon Ward 10876* (BM, E). **Xinjiang:** Thianschan, Rigil-tasch, l'Ak-son, *Brocherel 39* (G); Sairam, 18 July 1878, *Fetissow s.n.* (LE, S); Tien Shan, Urumqi river, *Liston 818-1* (MO); Mts. Bogdo-ola et Urumtschi, *Merzbacher 1275* (LE, W); Pamir, Kashgar, Bostan Terek, 5 Aug. 1934, *Persson s.n.* (S); Tian-Shan, Karagajte, Sari-dzhasa, 30 June 1902, *Saposhnikov s.n.* (LE). INDIA. **Uttar Pradesh:** Bhowáni, *Duthie 4127* (LE). **Punjab:** Rotang, Kulu Lahaul, *Drummond 22598* (K); Rupin pass, Dhaola Dhar, Simla Hill, *Sherriff 7405* (BM, E). JAMMU-KASHMIR. Kagan valley between Balakot and Babusar pass, *Abel 94* (BM); Astor, Alampi Lá, *Duthie 12164* (BM, E, K); Burzil, *Koelz 9429* (GH, NY); Srinagar, Vishensar, *Lancaster 160* (BM); Haramukh, *Ludlow & Sherriff 7850* (BM, E, UPS); Karakoram, Gharesa glacier, Nagar, *Polunin 6238* (B, BM, E); Karakoram, Hispar glacier, Turmun-Makerum, *Russell 1235* (BM); Nafran, Lidder, *Stewart 12638* (NY). KAZAKHSTAN. Talgarskoe,

14 June 1909, *Bogolubow s.n.* (LE); Alma-Atinskij, Alma-Atinskoe, 16 July 1927, *Dubiansky & Basilevskaja s.n.* (LE); Sarkana, Basken-Sarkan, 25 Aug. 1930, *Matveeva s.n.* (LE); Ketmen pass, 19 June 1878, *Regel s.n.* (LE); Narymense, Katon-Karagaj, 10 Aug. 1930, *Smirnow s.n.* (E, W). KIRGIZISTAN. Fergana, Ak-basoga, 31 June 1901, *Alexcenko s.n.* (LE); Sir-Darinsk, Tian-shan, Alamed, 6 July 1910, *Golbek s.n.* (LE); Boamskoe, Issik-Kulskaya, Terskej-Alatau, Turgen-Aksu, Kujliu, Inilchek, 23 July 1965, *Grudzinskaja s.n.* (LE); Zailyijskij Alatau, Semirechenskaya, Vernenskij, *Lipsky 1179* (LE); Terskej Alatau, Tekes, 26 May 1950, *Medvedeva et al. s.n.* (LE); Semirechenskaja, Pishpekskij, Aleksandrovskago, Ala-archi, *Sovetkina 428* (LE). MONGOLIA. Changai, *Kondratieva 68* (LE); Khara-Chzarga, Khairkhan-Duru, *Pobedimova 339* (LE); Mt. Alaschan, *Przevalski 101* (LE); Kobdosekij, Bulugun, *Yunatov 13101* (LE). RUSSIA. **Altay:** Ojrotiya, Koshagachskij, Chujskij, Chegan-uzuna, 17 Aug. 1937, *Shatakelberg & Knorring s.n.* (LE). TADZHIKISTAN. Zaalajskij, Gordaba, 2 July 1901, *O. A. & B. A. Fedchenko s.n.* (LE). UZBEKISTAN. Fergana, Osch., in Frag. Schart jugi Alaici, 12 July 1900, *Tranzschel s.n.* (LE).

13. Doronicum gansuense Y. L. Chen, Acta Phytotax. Sin. 36: 73. 1998. TYPE: China. Gansu: Tebbu Yian, *J. F. Rock 12102* (holotype, PE not seen).

Doronicum cavillieri Álv. Fern. & Nieto Fel., Ann. Bot. Fenn. 37: 250. 2000. Syn. nov. TYPE: China. Gansu: T'ao river basin, Minshan range, Kuang ke, *J. F. Rock 12389* (holotype, NY!; isotypes, BM!, GH!, LE!).

Plant up to 30 cm tall. *Rhizomes* somewhat woody, glabrous, generally with leaf remains. *Stems* not branched, with leaves all along the stem, internodes generally shorter than adjacent leaves. Indumentum of glandular trichomes (up to 2 mm), more abundant near the capitula, sometimes glabrous at the base. *Leaves* entire. Basal leaves sometimes absent at flowering time; blade 1.4–3.5 × 1.5–3 cm, orbicular, suborbicular, or elliptic, with truncate or attenuate base and blunt apex, with actinodromous to pinnate-actinodromous venation; petiole 3–8.5 cm long, 0.8–1.5 mm wide. Lower and middle cauline leaves 3–5 × 1–3 cm, sessile, ovate-elliptic to widely elliptic, semi-amplexicaul. Upper cauline leaves 1.5–4 × 0.7–2 cm, similar to middle cauline leaves. Indumentum of uniseriate eglandular trichomes (up to 0.5 mm), short-stalked glandular trichomes, and sometimes also long-stalked glandular trichomes, mainly on leaf margins, scarce, sometimes glabrous. *Capitula* solitary, 3–5.5 cm diam. including rays; involucre shorter than rays, 2–3 cm diam. *Phyllaries* herbaceous, 1.2–1.4 cm long, 1.5–2.5 mm wide, ovate-lanceolate to widely subulate, with blunt apex (bearing a sessile gland). Indumentum similar to the upper part of stem, more abundant at the base. *Receptacles* glabrous. *Flowers* with yellow corollas. Ray flower corollas 2–2.5 cm long, 2–3 mm wide, obovate-elliptic, apex generally with 2 or 3 teeth. Disk flower corollas ca. 5 × 2 mm. *Cypselae* brown, homomorphic, ca. 3 × 1 mm, with eglandular trichomes or glabrate, sometimes glandular. Pappus up to 4 mm, white. (Mature cypselae not seen.) Chromosome number unknown.

Illustrations. Chen (1998: 36, fig. 1); Álvarez Fernández & Nieto Feliner (2000: 251, fig. 1); Figure 4A–D.

Distribution. Central China (provinces of Gansu and Sichuan). Woods, rocky places, and grassy slopes, altitude 3000–3700 m (Fig. 21).

After the name *Doronicum cavillieri* (Álvarez Fernández & Nieto Feliner, 2000) was published, the authors realized that a previously published name of which they were not aware corresponded to the same species. Although the type material of *Doronicum gansuense* was not available for the present study, plants from the type locality, as well as from other localities cited in protologue were examined. Morphological relationships of *D. gansuense* with other central Asian species is discussed above (see comments for *D. altaicum* and *D. briquetii*).

Selected specimens examined. CHINA. **Gansu:** T'ao river, Merku valley, *Rock 12192* (E, K, NY, S, W); T'ao river, Minshan range, Mt. Kuang ke, *Rock 12389* (BM, GH, LE, NY); Tebbu, Shimen, *Rock 13020* (E, GH, K, LE, NY, S, W); Lianhuashan, Kangle Xian, *Wang 91161* (MO). **Sichuan:** Hongyuan plain, road to Songpan, 1989, *Chamberlain et al. s.n.* (E).

14. Doronicum glaciale (Wulfen) Nyman, Syll. Fl. Eur.: 1. 1855. *Arnica glacialis* Wulfen, in Jacq., Collectanea 1: 230. 1786. *Aronicum glaciale* (Wulfen) Rchb., Fl. Germ. Excurs. 1: 234. 1831–1832. *Doronicum hirsutum* subsp. *glaciale* (Wulfen) Rouy, Rev. Bot. Syst. Géogr. Bot. 1: 55. 1903. TYPE: Austria. Malnizer Tauern [sine collector], ex herb. Wulfen (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 803), W!).

Arnica doronicum Jacq., Fl. Austriac. 1: 57, tab. 92. 1773. *Grammarthron biligulatum* Cass., in Cuvier, Dict. Sci. Nat. 19: 295. 1821. *Aronicum doronicum* (Jacq.) Rchb., Fl. Germ. Excurs. 1: 233. 1831–1832. TYPE: "Arnica doronicum" [sine collector], ex herb. Linnaeus (lectotype, designated here, LINN nº 1001.4!).

Plant up to 30 cm tall. *Rhizomes* fleshy to somewhat woody, with shining white-tinted short trichomes on nodes, generally with leaf remains. *Stems* not branched, with leaves mainly at the base

or on the middle lower part of stem. Indumentum of short-stalked glandular trichomes, also with eglandular trichomes more abundant near the capitula. *Leaves* entire to slightly dentate. Basal leaves generally present at flowering time; blade 1.5–4.5 × 1–2 cm, elliptic to ovate-elliptic, with truncate or attenuate base, blunt to subacute apex, with actinodromous to pinnate-actinodromous venation; petiole 2–6 cm long, 1–2.5 mm wide. Lower and middle cauline leaves 3–7.5 × 1–4 cm, similar to basal leaves or sessile, ovate-elliptic to narrowly elliptic, semi-amplexicaul. Upper cauline leaves 1.5–3.5 × 0.3–2 cm, similar to middle cauline leaves, or ovate-lanceolate. Indumentum of stiff, acute, and shiny eglandular trichomes (up to 2.5 mm), mainly on leaf margins, and also short-stalked glandular trichomes. *Capitula* solitary, 4–5.5 cm diam. including rays; involucre shorter than rays, 1.5–3.5 cm diam. *Phyllaries* herbaceous, ovate-lanceolate to widely subulate; the outer 1.2–1.5 cm long, 1.5–3.3 mm wide; the inner 1–1.4 cm long, 1–1.3 mm wide. Indumentum similar to the upper part of stem. *Receptacles* glabrous to glabrate. *Flowers* with yellow corollas. Ray flower corollas 2–2.2 cm long, 2.5–3 mm wide, obovate-elliptic, apex generally with 3 teeth. Disk flower corollas up to 4 mm long. *Cypselae* brown, with grooved-reticulate surface, homomorphic, up to 2 mm long, with eglandular trichomes or glabrate. Pappus up to 4 mm, white. Chromosome number $2n = 60$ (Polatschek, 1966, as *D. calcareum*; Lovka et al., 1972).

Illustrations. Jacquin (1773: tab. 92, 1789: tab. 586); Sturm (1814: tab 19.2); Reichenbach (1854: tab. 62, tab. 63 figs. 1, 3); Hegi (1928: fig. 431); Figure 3C–E.

Distribution. Europe (central-eastern Alps). Open moist rocky places and screes, altitude 1000–2800 m (Fig. 19).

In 1773 Jacquin described *Arnica doronicum*. This species corresponds to *Doronicum* and although Jacquin named it first, the ICBN (Greuter et al., 2000) does not allow the use of the same epithet for both genus and species; thus the correct epithet is "*glaciale*" given by Wulfen in Jacquin (1786). Part of Jacquin's collection is kept at LINN. When this herbarium was studied, one sheet of Jacquin's material labeled as "*Arnica doronicum*" was found. To clarify as far as possible the identity of Jacquin's name, its lectotype is designated here (see *D. glaciale* synonyms).

Doronicum glaciale is a species very similar to *D. clusii* and to a lesser extent to *D. grandiflorum*. Similarities and differences among these species are discussed above (see comments for *D. clusii*).

Selected specimens examined. AUSTRIA. **Kärnten:** Gartnerkofel zur Kühnveger Alp., 15 July 1928, *Bothe s.n.* (B); Wolayer-Alpe, Bierbaum, Lesachthal, 25 July 1907, *Engelhardt s.n.* (B); Stonhütte, Bärental, Karawanken, *Hodgkin 168* (K); Wolayer See, Qailtal, *Hodgkin 220* (K); Gloknerhauses am Steige zur Pasterze, 27 July 1899, *Schulz s.n.* (B). **Salzburg:** Radstädter Tauern, Plu Menspitze, *Jacquemoud 3888* (G); Auf den Thanern bei Wildbad Sastein, July 1892, *Pichler s.n.* (G); Pinzgau, *Sauter 971* (B, K); Gamskaar Kogel, *Wyatt 28* (K); Sulzkar, Ennothaler Alps, *Wyatt 89* (K). **Steiermark:** Grafenalpe prope Krakaudorf, July 1902, *Fest s.n.* (K); Mt. Hochschwab, Aug. 1887, *Steininger s.n.* (G, LY). **Tirol:** Virgen in valle Isolae, 10 Aug. 1873, *Ausserdorfer s.n.* (E, K); Kleiner Ispeltal, Johannishütte, July 1929, *Beger s.n.* (B); Gröden, Dolomiten, Hochjoch, Geislen gruppe, 27 July 1907, *Bornmüller s.n.* (B); montem Weisspitz pr. Herzing, Aug. 1888, *Huter s.n.* (K); Pfumpenseetauern, Bavaria, 25 July 1955, *Launert s.n.* (BM); Lienz, auf der Zoche, Herschbaummer Alpe, 31 July 1899, *Schulz s.n.* (B); Steinhaus, June 1878, *Treffer s.n.* (B); Tristen in Weissenbach, 24 July 1890, *Treffer s.n.* (G); Bendelstein, Wippthal, *Wyatt 56* (K). GERMANY. **Bayern:** Steinige zehatteze Triften in Hasenthal Prettan, Aug. 1882, *Treffer s.n.* (B). ITALY. **Trentino-Alto Adige:** Trento, Campitello di Fassa, col Rodella, *Álvarez et al. 1350* (MA). SWITZERLAND. Furka pass, Rhônegletscher, 24 July 1886, *Bornmüller s.n.* (B).

15. Doronicum grandiflorum Lam., Encycl. 2: 313. 1786. TYPE: "Arnica altaic. pall., tige simple unifl. haute de 4 ou 7 pouces, fl. tres grande, fleurit au com. + de mai" [sine collector], ex herb. Lamarck (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 803), P-LA!, photograph).

Doronicum scorpioides Lam., Encycl. 2: 313. 1786. TYPE: "A Arnica scorpioides L." [sine collector], ex herb. Lamarck (lectotype, designated here, P-LA!, photograph).

Doronicum portae Chabert, Bull. Soc. Bot. France 53: 547. 1906. Syn. nov. TYPE: Austria. Valbona, Aug. 1893, *P. Porta s.n.* (lectotype, designated here, FI!).

Plant up to ca. 70 cm tall. *Rhizomes* fleshy to somewhat woody, with shining white-tinted short trichomes on nodes, generally with leaf remains. *Stems* generally simple. Indumentum of short- and long-stalked glandular trichomes, also with multiseriate eglandular trichomes more abundant near the capitula. *Leaves* slightly dentate to dentate. Basal leaves sometimes present at flowering time; blade 3–6(7) × (1)2–5 cm, ovate-elliptic, ovate or suborbicular, with subcordate, truncate or attenuate base, blunt apex, actinodromous venation; petiole 10(20)–(1.5)4 cm long, 1–4(6) mm wide. Lower and middle cauline leaves (1)4–9(13.2) × (1)1.5–6(7) cm, similar to basal leaves or sessile, ovate-elliptic, sometimes almost fiddle-shaped, semi-amplexicaul. Upper cauline leaves 1.2–5.5 × 0.5–2 cm, similar to middle cauline leaves, ovate to ovate-lanceolate.

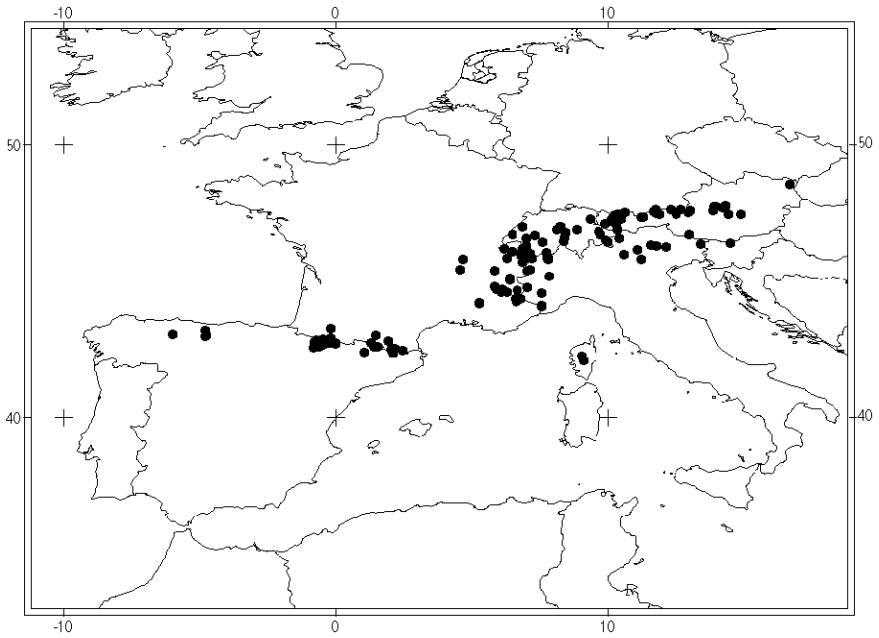

Figure 22. Distribution map for *Doronicum grandiflorum*.

Indumentum mainly of glandular trichomes, sometimes also with eglandular trichomes. *Capitula* 1(to 4), 3.5–5.5 cm diam. including rays; involucre shorter than rays, 2–4 cm diam. *Phyllaries* herbaceous, ovate-lanceolate to widely subulate; the outer 1–2(2.5) cm long, 1.5–4 mm wide; the inner 1–2 cm long, 1–2.8 mm wide. Indumentum of glandular trichomes, sometimes also with eglandular trichomes. *Receptacles* glabrous to glabrate. *Flowers* with yellow corollas. Ray flower corollas 1.3–2.6 cm long, 2–4.5 mm wide, obovate-elliptic, apex generally with 3 teeth. Disk flower corollas 3.5–5 × 1–2.5 mm. *Cypselae* brown, with grooved-reticulate surface, homomorphic, 2.5–4.5 × 0.5–1.5 mm, with eglandular trichomes or glabrate, sometimes with glandular trichomes. Pappus up to 5.5 mm, white. Chromosome number $2n = 60$ (Favarger & Huynh, 1964; Favarger & Küpfer, 1968).

Illustrations. Jacquin (1776: tab. 349); Sturm (1814: tab 19.2); Reichenbach (1854: tab. 62); Săvulescu (1964: pl. 188 fig. 1); Bolòs & Vigo (1995: 837); Figure 3A, B.

Distribution. Central-western Europe. Open moist rocky places, screes, and near watercourses, altitude 900–3000 m (Fig. 22).

Variable in size and shape of basal leaves and type of indumentum. Based on the latter, two species were recognized in the previous revision of the genus (Cavillier, 1907), *Doronicum viscosum* and *D. portae*, which are separated virtually solely by glandular versus mainly eglandular indumentum, respectively. Although type material of *D. viscosum* was not seen, several populations from the type locality were studied. The type material of *D. portae* was found at FI, and its lectotype is designated above. Abundant intermediates preclude recognition of these two species, which are here placed as synonyms of *D. grandiflorum*.

To clarify as far as possible the confusion around the epithet "*scorpioides*" the lectotype for *Doronicum scorpioides* is designated above. In the protologue, Lamarck mentioned "A *Arnica scorpioides* L.," refering to Jacquin's plate *Arnica scorpioides* L. (Jacquin, 1776: tab. 349). Although the type of Linnaeus's name corresponds to *D. pardalianches* L., Jacquin's plate represents a specimen of *D. grandiflorum*, as well as the only sheet kept at P-LA with the handwritten "A *Arnica scorpioides* L." (see comments below about *D. pardalianches*).

Although similar in their morphology, the differences in the type of indumentum among *Doronicum grandiflorum*, *D. clusii*, and *D. glaciale* are quite clear. In *D. grandiflorum* the trichomes are never entangled and always have a blunt apex (generally ending in two cells), and the stalked glands are similar to these trichomes (Fig. 3B) but with a glandular apex (generally two or more cells containing a brown substance). In *D. glaciale* the trichomes are stiff with an acute apex, and in *D. clusii*, which

also has this latter type of indumentum, trichomes are very thin, long, and entangled (see comments under *D. clusii*).

Some populations of *Doronicum grandiflorum* from the Cantabrian range in northern Spain have broadly ovate to suborbicular, scarcely dentate to subentire basal leaves, and are difficult to distinguish from *D. carpetanum* subsp. *diazii*. These two taxa are similar but the nature of their relationship is not clear. A likely hypothesis, which should be investigated, is that *D. carpetanum* subsp. *diazii* is of hybrid origin, its putative progenitors being *D. grandiflorum* and *D. carpetanum* subsp. *carpetanum*.

Although widely distributed in the European mountains, the most recent collection of *Doronicum grandiflorum* from Corsica was in 1917, suggesting that it is now extinct there.

Selected specimens examined. ANDORRA. Mt. Canillo, 27 June 1847, *Bourgeau s.n.* (G, LY). AUSTRIA. **Kärnten:** Dobratsch, 20 July 1928, *Widder s.n.* (MAF). **Oberösterreich:** Windischgarsten, *Oberleitner 73* (B). **Steiermark:** Totes Gebirge, Feuertal, *Rechinger 2377* (BM, E, K). **Tirol:** Paznauntal, Ischgl, *Townsend 93/574* (K). **Vorarlberg:** Schruns, 27 July 1895, *Bornmüller s.n.* (B). FRANCE. **Alpes-Maritimes:** col de Tende, *Bourgeau 140* (COI-WILLK). **Ariège:** Artigues, étang du Laurenti, *Charpin & Dittrich 17387* (G). **Basses-Alpes:** Le Lautaret Dauphiny, July 1906, *Brown s.n.* (E). **Corse:** Mt. Rotondo, *Forsyth-Major 292–23* (K). **Isère:** Mt. Obiou, 7 Aug. 1864, *Borel s.n.* (K). **Haute-Savoie:** Mt. Vergy, *Timothée 4264* (BR). **Hautes-Alpes:** Vars, Saint-André d'Embrun, *Sieber 85* (G, K). **Hautes-Pyrénées:** Vignemale, 24 July 1850, *Hennecart s.n.* (NY). **Loire:** Pilatus, 10 Sep. 1884, *Hamilton s.n.* (E). GERMANY. **Bayern:** Bavaria, Mts. Krotten-kopf, 15 July 1894, *Bornmüller s.n.* (B). ITALY. **Friuli-Venezia Giulia:** Mts. Baldi, 8 July 1870, *Rigo s.n.* (E). **Liguria:** Carro, lago della Seala, 3 Aug. 1912, *Beger s.n.* (B). **Lombardia:** Sondrio, Bormio, Valpisello, Aug. 1920, *Longa s.n.* (BM). **Piemonte:** Cúneo, Colla dell Pizzo, Alpes d'Ormea, *Charpin & Salaman 17480* (G). **Trentino-Alto Adige:** Avisio, inter Peniam et jugum Fedaja, 18 July 1906, *Handel-Mazzetti s.n.* (G). **Valle d'Aosta:** Grand St. Bernard pass, *Brummitt 5494a* (K). **Veneto:** Belluno, Forcella Beccher, 11 July 1970, *Dusa & Mortin s.n.* (MA). SPAIN. **Aragón:** Huesca, San Juan de Plan, Posets, *Almaraz & Cano 288* (MA); Huesca, Jaca, Canfranc, ibón de Ip, *Vogt 3960* (B). **Cantabria:** Vega de Liébana, laguna de Peña Prieta, *Álvarez et al. 943* (MA); Picos de Europa, inter lacus Los Pozos et La Canalona, *Rechinger 1701* (W). **Castilla y León:** León, San Emiliano, Peña Ubiña, 8 July 1990, *Aedo s.n.* (MA). **Cataluña:** Lérida, val de Arán, torrent de Barrongueta, *Vogt & Prem 7327* (B). SWITZERLAND. **Graubünden:** Piz Padella, *Lorenz 27532* (B). **Valais:** val d'Entremont, Bec Rond, 4 Aug. 1927, *Cuatrecasas s.n.* (MAF). **Vaud:** Ormond-Dessous, pic Chaussy, col des Mosses, *Kramer 8672* (MA). YUGOSLAVIA. **Slovenija:** Julijske Alpe, Vrh Krnic, lacum Bohinjsko, *Wraber 9748/4* (B, BM).

16. Doronicum haussknechtii Cavill., Annuaire Conserv. Jard. Bot. Genève 13–14: 255. 1911. TYPE: Turkey. Beryt dagh, *H. K. Haussknecht 1029* (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 804)).

Doronicum tobeyi J. R. Edm., Notes Roy. Bot. Gard. Edinburgh 32(2): 256. 1973. Syn. nov. TYPE: Turkey. Giresun, Karagöl, *C. Tobey 1484* (holotype, E!).

Plant up to 100(+) cm tall. *Rhizomes* woody, glabrous, with or without leaf remains. *Stems* branched in the upper part, leaves distributed along the stem, upper internodes generally longer than the adjacent leaves. Indumentum of multiseriate and uniseriate white eglandular trichomes (ca. 0.2 mm), abundant near the capitula, sometimes glabrate. *Leaves* entire to dentate. Basal leaves sometimes present at flowering time; blade ca. 11 × 12–12.5 cm, orbicular or ovate, with cordate base and generally blunt apex, with actinodromous venation; petiole 12–20 cm long, with sheathing base, sheath ca. 6–8 cm long. Lower cauline leaves with blade ca. 23 × 18 cm; petiole (0.7–)37.5 cm long, similar to basal leaves. Middle cauline leaves ca. 16 × 9 cm, sessile, fiddle-shaped, semi-amplexicaul. Upper cauline leaves ca. 5 × 2.5 cm, similar to middle cauline leaves or ovate to obovate, sometimes bract-like. Indumentum similar to the adjacent part of the stem and with short-stalked glandular trichomes, generally scarce, more abundant on margins of leaves. *Capitula* up to 17(+), ca. 4 cm diam. including rays; involucre shorter than rays, ca. 2 cm diam.; sometimes turbinate at the base of capitula in fruit. *Phyllaries* herbaceous, ca. 1.3 cm long, 2 mm wide, ovate-lanceolate to obovate-lanceolate and acute. Margins scarcely and slightly fimbriate. Indumentum similar to the upper part of stem, sometimes with scarce multiseriate eglandular trichomes. *Receptacles* glabrous or glabrate. *Flowers* with yellow corollas. Ray flower corollas 1.3–1.6 cm long, 2–4 mm wide, obovate-elliptic to oblong-elliptic, apex generally with 3 teeth. Disk flower corollas 4–4.5 × 1.5 mm. *Cypselae* brown, with smooth to slightly grooved surface, dimorphic. Cypselae from ray flowers 4–6 × 1.5–2 mm, glabrous or glabrate, without pappus. Cypselae from disk flowers 3.5–4 × 1.2–1.7 mm, sometimes with eglandular trichomes; pappus 3.5–4.5 mm, white. Chromosome number unknown.

Illustrations. Figure 23F–J.

Distribution. Northern and central Turkey (provinces of Giresun, Kayseri, and Maraş). Meadows and near watercourses, altitude 2100–2600 m (Fig. 24).

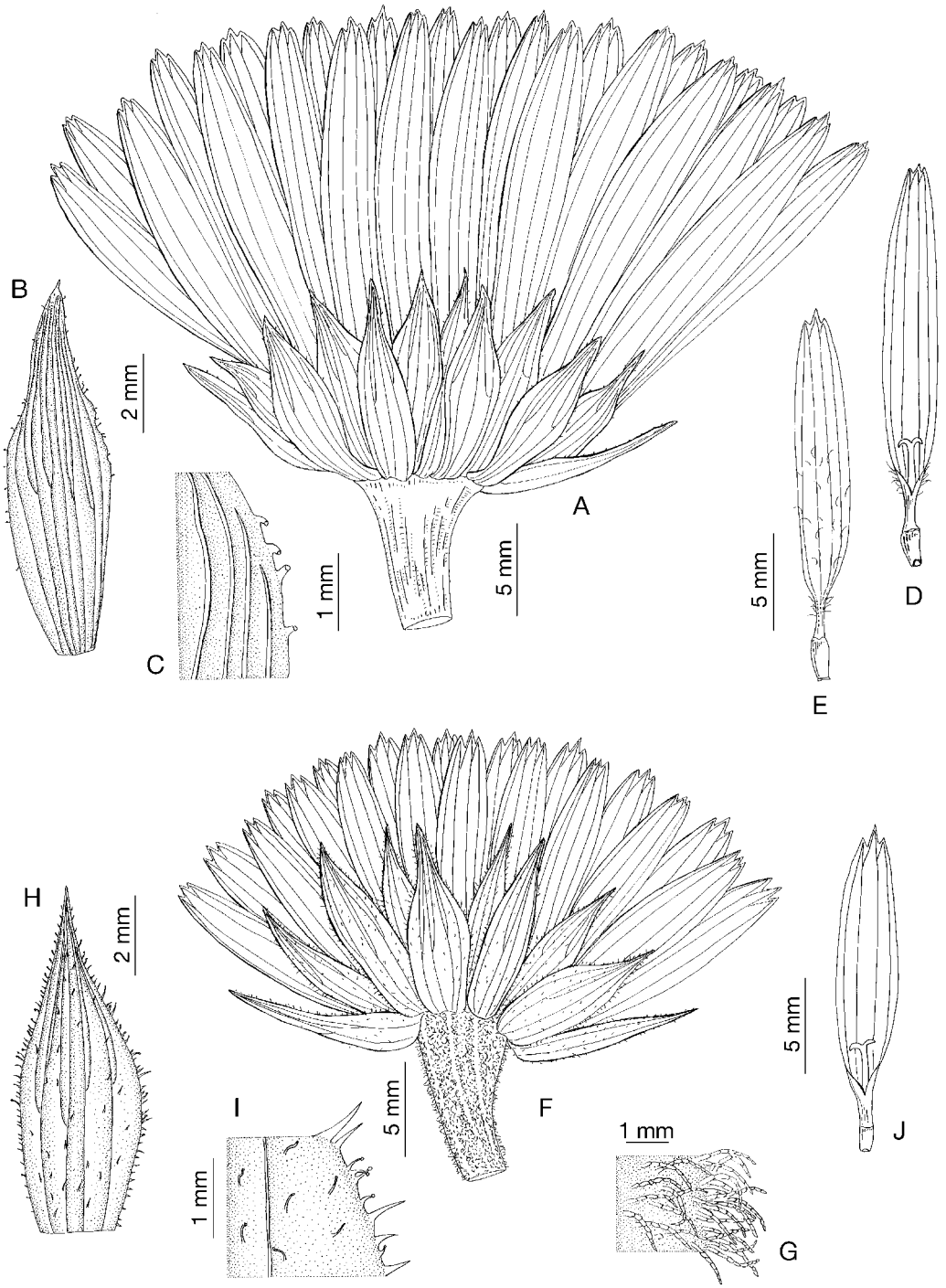

Figure 23. A–E. *Doronicum maximum* (drawn from *Davis et al. 20588,* E). —A. Capitulum. —B. Phyllary. —C. Indumentum of a phyllary. —D–E. Ray flower. F–J. *Doronicum haussknechtii* (drawn from *Davis et al. 20010,* E). —F. Capitulum. —G. Indumentum of the base of the capitulum. —H. Phyllary. —I. Indumentum of a phyllary. —J. Ray flower.

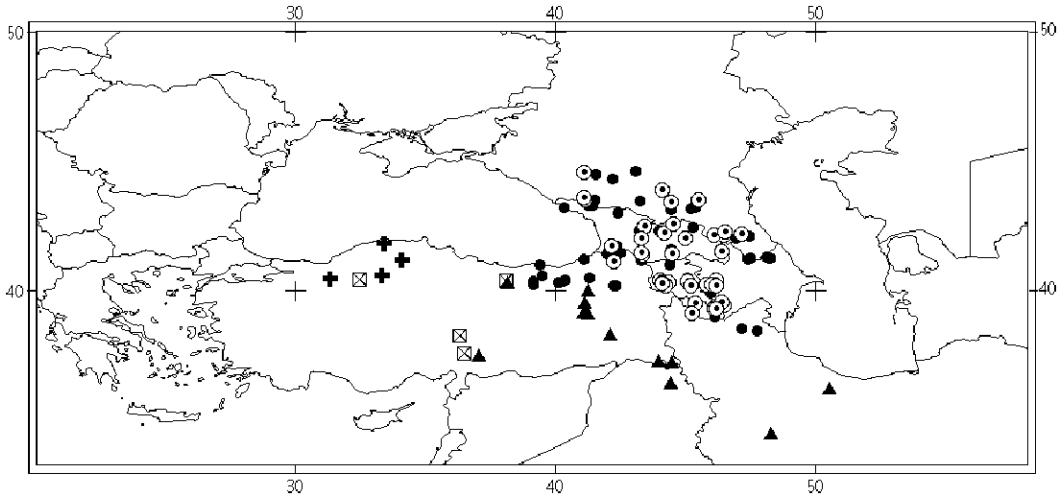

Figure 24. Distribution map for: *Doronicum haussknechtii* (⊠); *Doronicum macrophyllum* subsp. *macrophyllum* (●); *Doronicum macrophyllum* subsp. *sparsipilosum* (+); *Doronicum maximum* (▲); *Doronicum oblongifolium* (⊙).

There are several Turkish species included in the same morphological group (see comments for *D. cacaliifolium* and *D. dolichotrichum* above) that are distinguished from each other only based on the type of indumentum. *Doronicum haussknechtii* is included in this group, and morphologically the most similar species is *D. maximum*, which also overlaps part of its area of distribution with *D. haussknechtii* (Fig. 24). In both *D. haussknechtii* and *D. maximum*, the indumentum on the phyllaries is very scarce or even absent (Fig. 23B, C, H, I), while the rest of the Turkish species have pubescent or glandular phyllaries. The characters to distinguish between these two species are the white pubescence at the top of the peduncle (base of the capitulum) in *D. haussknechtii* (Fig. 23F, G), which is glabrous in *D. maximum* (Fig. 23A), and the scarcely fimbriate margins of phyllaries in *D. haussknechtii* (Fig. 23H, I), which are entire, sometimes with glands in *D. maximum* (Fig. 23B, C).

The diagnostic characters used to separate *Doronicum tobeyi* (Edmondson, 1973) overlap substantially with those of *D. haussknechtii*, and its patterns of indumentum match those of *D. haussknechtii*. Accordingly, this name is considered a synonym.

Selected specimens examined. TURKEY. **Kayseri:** Isikdagi, Karlidere, *Duman. & Aytaç 5413* (GAZI). **Maraş:** Goksun, Binboga dag, Isik dag, *Davis et al. 20010* (BM, E, K).

17. Doronicum hungaricum Rchb. fil., Icon. Fl. Germ. Helv. 16: 34, tab. 65, fig. 1. 1854. TYPE: icon in Reichenbach (1854: tab. 65, fig. 966 I 1–8) (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 804)).

Plant up to 80 cm tall. *Rhizomes* fleshy, glabrate to scarcely pubescent, with inconspicuous shining white-tinted trichomes on nodes, thick and short, sometimes stoloniform, with buds. *Stems* generally unbranched, scape-like. Indumentum mainly glandular, with short-stalked and long-stalked glandular trichomes, sometimes also uniseriate and multiseriate eglandular trichomes, more abundant near the capitula. *Leaves* entire, rarely subdentate. Basal leaves generally present at flowering time; blade 4–9 × 1–3 cm, oblong-elliptic with truncate or attenuate base, blunt apex, with acrodromous venation; petiole 4–8 cm long, 1–2 mm wide. Lower cauline leaves 3–11 × (0.5)1–2.6 cm, similar to basal leaves or sessile, elliptic to fiddle-shaped, sometimes semi-amplexicaul. Upper cauline leaves 2–5 × 0.4–1.3 cm, ovate-lanceolate, sometimes bract-like. Indumentum with uniseriate eglandular trichomes and short-stalked glands, scarce. Generally also with long multiseriate eglandular trichomes (up to 5 mm), mainly on the adaxial surface of middle vein. *Capitula* 1(2 to 3), 3–6 mm diam. including rays; involucre a little shorter than rays or equaling them, 2.5–4.5 cm diam. *Phyllaries* herbaceous, ovate-subulate, generally with acute apex; the outer 1–1.5 cm long, 1–1.5 mm wide; the inner 1.1–1.8 cm long, 0.7–1 mm wide. Margins sometimes ciliate, with acute, stiff and equidistant multiseriate eglandular trichomes (up to 1 mm). Indumentum mainly glandular. *Receptacles* glabrous or scarcely pubescent. *Flowers* with yellow corollas. Ray flower corollas 1.4–2.5 cm long, 1–2(3) mm wide, oblong-elliptic, apex generally with 3 teeth. Disk flower corollas up to 4 mm long. *Cypselae* brown, with

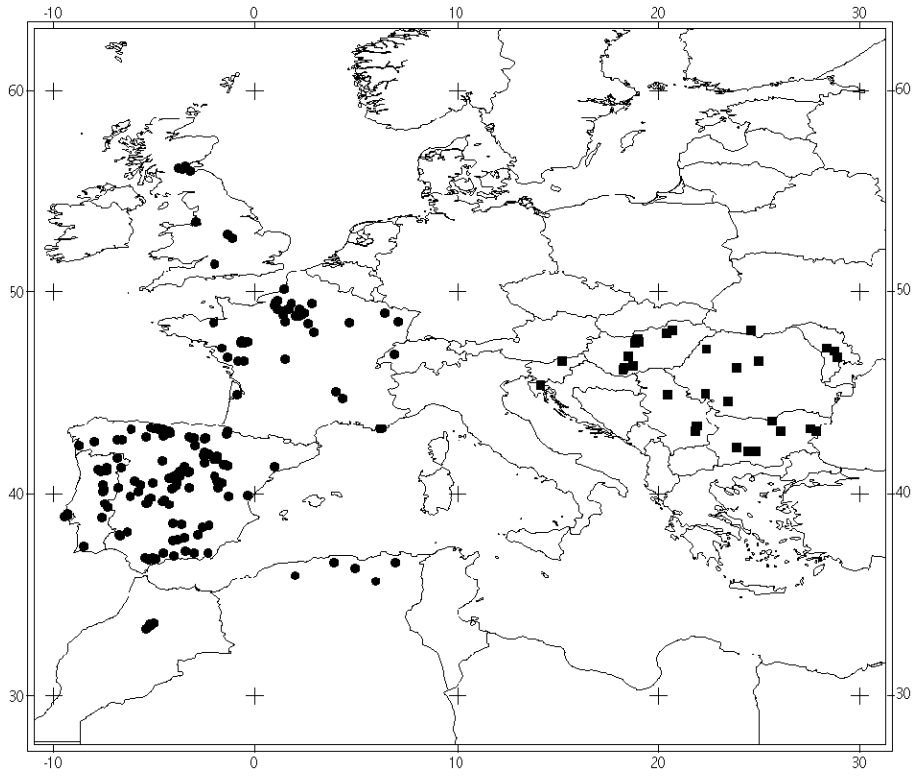

Figure 25. Distribution map for: *Doronicum hungaricum* (■); *Doronicum plantagineum* (●).

rugose-reticulate surface, dimorphic. Cypselae from ray flowers 2–2.3 × 0.6–1 mm, generally glabrous, without pappus. Cypselae from disk flowers 1.7–2 × 0.7–1 mm, with eglandular trichomes; pappus up to 3.5 mm, white. Chromosome number $2n$ = 60 (Baksay, 1956).

Illustrations. Reichenbach (1854: tab. 65, fig. 966 I 1–8); Săvulescu (1964: pl. 98, fig. 1); Figure 1B.

Distribution. Eastern Europe (Balkans, Carpathians, and Ukraine). Forests and meadows, altitude 160–1900 m. Cultivated and sometimes naturalized (Fig. 25).

The name *Doronicum plantagineum* var. *hungaricum* Sadler (1840) was published before the accepted name for this species, *Doronicum hungaricum* Rchb. fil. (1854). Plants collected by Sadler are included in the protologue of Reichenbach's specific name. However, in the protologue Reichenbach did not mention the earlier name, and so his name is not based on Sadler's.

The name *Doronicum longifolium* Rchb. (1831–1832) is clearly a synonym of *Doronicum clusii* (All.) Tausch. However, when Grisebach (1846) combined it as *Doronicum plantagineum* var. *longifolium* (Rchb.) Griseb., his description and geographical distribution were those of *D. hungaricum*, not *D. clusii*. Later, the same author (Grisebach & Schenk, 1852) explicitly treated Reichenbach's name as a synonym of *D. plantagineum* var. *hungaricum* Sadler. Thus, the names *D. longifolium* auct., non Rchb., and *D. plantagineum* var. *longifolium* (Rchb.) sensu Griseb. are synonyms of *D. hungaricum* Rchb. fil.

Doronicum hungaricum could be confused with *D. clusii*, *D. glaciale*, and the Caucasian *D. oblongifolium* because of the elliptic entire basal leaves and similar habit in some specimens of those species, but in the case of *D. hungaricum* the rhizome is fleshy with pubescent nodes, the basal leaf venation has an acrodromous pattern, and the phyllary margins are ciliate to somewhat ciliate. All these characters together lead to the inclusion of this species in the morphologic and phylogenetic "*plantagineum*" group (see Phylogeny above and Fig. 9). Within this group the most closely related species is *D. plantagineum*, which differs mostly in the shape of basal leaves (ovate in *D. plantagineum* vs. elliptic in *D. hungaricum*) and in the type of

indumentum. *Doronicum hungaricum* is considered the vicariant species of *D. plantagineum* in eastern Europe, although it has a more restricted area than *D. plantagineum* has in western Europe and northern Africa (Fig. 25).

Selected specimens examined. BULGARIA. **Pazardzhik:** Belovo, May 1894, *Střibrný s.n.* (E, K); Sestrimo, May 1907, *Střibrný s.n.* (E). **Plovdiv:** Krichim, May 1901, *Střibrný s.n.* (E). **Ruse:** Mt. Rhodope ad Čaušovo, 26 May 1900, *Střibrný s.n.* (W); Rhodope ad Stanimaka, May 1900, *Střibrný s.n.* (G). **Varna:** Varna, *Gilliat-Smith 554* (K); Kamcyr, *Schneider 300* (B, BM, MO). HUNGARY. **Baranya:** Mecsek prope Pécs, 25 May 1922, *Boros s.n.* (BM). **Heves:** Agria, Mt. Mészhegy, 10 May 1870, *Vrabélyi s.n.* (B). **Pest:** Kamaerdo, 18 May 1885, *Degen s.n.* (W); Mt. Hárshegy prope Budapest, May 1886, *Degen s.n.* (B); Mt. Kamen prope Pomáz, 16 May 1904, *Degen s.n.* (LE); vallis Farkasvölgy prope Budam, *Filarszky & Schilberszky s.n.* (B, BM, E, G, K, MO, NY); Leopoldifeld bei Ofen, 1873, *Freyn s.n.* (W); Budapest, Crilleberc bei Budakeszi, 24 May 1933, *Korb s.n.* (W); Mt. Kopaszhegy, Nagykovácsi supra Budapest, 28 Apr. 1912, *Kümmerle Szurák & Timkó s.n.* (B, BM, E, G, K, MO, NY, W); Kammerwald, prope Budam, *Richter 520* (B, BM, G, W). **Tolna:** Mt. Csòkás, Simontornya, 27 May 1875, *Tauscher s.n.* (G, LE). ROMANIA. **Alba:** Blaj, Apr. 1923, *Pop s.n.* (E, G, K, MO, W). UKRAINE. Strashenskij, 28 May 1955, *Ananiva s.n.* (LE); Chernaya, 22 Apr. 1961, *Fodor s.n.* (LE); Zlotij, Bendery, 23 Apr. 1909, *Paczoski s.n.* (LE); Stramenskogo, 6 May 1948, *Shirokova s.n.* (LE). YUGOSLAVIA. **Srbija:** Belgrad, Tapeider, 1888, *Bornmüller s.n.* (B); Gabrovac prope Nisch, *Petrovič 2200* (BM, G, K, W).

18. Doronicum kamaonense (DC.) Álv. Fern., Novon 11: 294. 2001. *Fullartonia kamaonensis* DC., Prod. 5: 281. 1836. TYPE: "Comp. angl. des Indes 1830" [sine collector], ex herb. de Candolle (lectotype, designated by Álvarez Fernández (2001: 294), G-DC!, photograph).

Doronicum roylei DC., Prodr. 6: 321. 1838. TYPE: Cachemire, *J. F. Royle 232* (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 805), G-DC!, photograph).

Plant up to 130 cm tall. *Rhizomes* woody to somewhat woody, glabrous. *Stems* branched in the upper part or sometimes from the base, internodes generally longer than the adjacent leaves. Indumentum in the lower part of stem made up of multiseriate, retrorse and white-tinted eglandular trichomes (up to 4 mm), sometimes absent, upper part of stem generally glandular, with long-stalked glandular trichomes (up to 4 mm), sometimes also with uniseriate or multiseriate eglandular trichomes, rarely without glands; apex of glandular trichomes capitate, with more than 6 cells, peduncle capillary. *Leaves* entire to slightly dentate. Basal leaves generally absent at flowering time; blade 3.5–6.5 × 3.5–7 cm, ovate to ovate-elliptic, with attenuate, truncate, or subcordate base and generally blunt apex, with pinnate-actinodromous venation; petiole 5–16 cm long, 1.5–2 mm wide. Lower cauline leaves 3–11 × (0.8)2.5–9 cm; petiole 3–13 cm long, 1.5–4 mm wide, similar to basal leaves. Middle cauline leaves 7–15.5 × 3–10 cm, sessile, fiddle-shaped, semi-amplexicaul. Upper cauline leaves (0.8)1.5–7.5(11.6) × (0.1)0.8–4.5(6.2) cm, ovate-lanceolate, sometimes bract-like. Indumentum similar to the adjacent part of the stem. *Capitula* 2 to 18, 1.5–4 cm diam. including rays; involucre shorter than rays, 0.8–3 cm diam.; peduncles 1–10(18.5) cm long, 0.5–1.5(2) mm wide. *Phyllaries* herbaceous, ovate-subulate, generally with acute apex; the outer 0.6–1.2 cm long, 1–3 mm wide; the inner 0.6–1.2 cm long, 0.5–1.5 mm wide. Indumentum similar to the upper part of stem. *Receptacles* glabrous. *Flowers* with yellow corollas. Ray flower corollas 0.8–1.5 cm long, 1.2–2 mm wide, oblong-elliptic, apex generally with 3 teeth. Disk flower corollas 2.5–4 × 1–2.5 mm. *Cypselae* brown to brown-red with grooved-reticulate surface, dimorphic. Cypselae from ray flowers 2–3.6 × 1–1.5 mm, glabrous or glabrate, without pappus. Cypselae from disk flowers 2–3 × 1–1.5 mm, with eglandular trichomes; pappus (1.7)2–4 mm, white to yellow. Chromosome number $2n = 60$ (Vir Jee & Kachroo, 1989, as *D. roylei*).

Illustrations. Figures 8D, 20E–I.

Distribution. Central-southern Asia (Jammu-Kashmir to Nepal, Bhutan, and Tibet). Forests and meadows, elevation 1900–5000 m (Fig. 11).

There is only one species in central-southern Asia, *Doronicum stenoglossum,* which could become confused with *D. kamaonense* because of their similarities in habit. The differences between them are remarkable, since both have unique characters within the genus. *Doronicum stenoglossum* has corollas pale yellow to green shaded, linear ray flower corollas, and linear phyllaries (Fig. 4E, F). In *D. kamaonense* the type of indumentum at the base of the capitulum (glandular trichomes with a capillar peduncle and capitate apex bearing 6 or more cells; Figs. 8D, 20E, F) is a character to distinguish it from other species. Although the area of distribution of *D. kamaonense* overlaps in part with *D. briquetii* and *D. falconeri* (see comments for these species and Figs. 11, 21), there are no noticeable morphological similarities between those and *D. kamaonense.*

The name *Doronicum roylei* DC. was in use until the recent realization that the name *Fullartonia ka-*

maonensis DC. represents the same species and that it has priority (Álvarez Fernández, 2001).

Selected specimens examined. BHUTAN-SIKKIM. Sikkim, Gharu napo, *Cooper 867* (E). CHINA. **Sichuan:** Shingbe, Me La, *Ludlow et al. 20406* (E). **Tibet-Qinghai:** Chumbi, *Cooper 230* (E). INDIA. **Uttar Pradesh:** Chitona, Tehri, *Koelz 22052* (NY); Garhvál, Gaurikúnd via Tríjugi Naráin and Máser Tal to Bílung, 1855, *Schlagintweit s.n.* (GH). JAMMU-KASHMIR. Grorai, *Clarke 29287D* (BM, LE); Sonamurg, *Clarke 30842* (BM, K); Liddar Valley, *Drummond 14024* (E, K); Satrundi, Chamba, 13 Aug. 1897, *Lace s.n.* (E); Srinagar, Gulmarg, Khillanmarg plateau, *Lancaster 206* (BM); Sinthan pass, *Ludlow & Sherriff 9292* (BM, E); Karauli forest, near Rampur, Jhelun valley, *Ludlow & Sherriff 7719* (BM); Kishenganga valley, *Osmaston 28* (K); Khelanmarg, *Polunin 56/170* (B, BM, E); Sind valley, *Stainton 7894* (E); Shanda-Kel, Kishenganga valley, road to Nanga Parbat, *R. R. & I. D. Stewart 17786* (NY); Harwart, *Timins 174* (BM, E); Hazara, Mokspuri, Murree hills, *Webster & Sack 5715* (G, GH, K, S, W). NEPAL. Lamrak, *Dhwoj 196* (BM); Ghurchi Lagua, *Polunin et al. 4364* (BM, E, G, UPS); Barbaria Lekh, *Polunin et al. 89* (E, UPS); Balangra pass, *Polunin et al. 2622* (BM, E, UPS); Ratamata, Chakure Lekh, *Polunin et al. 401* (BM, E, G, UPS); Mailung Khola, *Stainton 7400* (BM); Chalike Pahar, *Stainton et al. 3145* (BM, E, UPS); Rambrong, Lamjung Himal, *Stainton et al. 6051* (E, UPS); Kapthad, Doti, *Tabata et al. 1072* (GH); Rara, Mugu, *Tabata et al. 12900* (BM, GH); Kali Lagna, Jumla, *Tabata et al. 19355* (GH); between Chautra and Maure lekh, Jumla district, *Tabata et al. 3309* (GH); Merghang, *Wigram 45* (E, K).

19. Doronicum macrophyllum Fisch., Cat. Jard. Gorenki ed. 2: 40. 1812. TYPE: North Caucasus. Beschtau [*F. A. F. Marschall von Bieberstein s.n.*], ex herb. Marschall von Bieberstein (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 804), LE!).

Plant up to 120(+) cm tall. *Rhizomes* woody to somewhat fleshy, glabrous, with or without leaf remains. *Stems* branched in the upper part, leaves distributed along the stem or mainly on the basal part of stem, upper internodes generally longer than the adjacent leaves. Indumentum of uniseriate (ca. 0.2 mm), multiseriate (up to 1 mm) eglandular trichomes, and glandular trichomes (0.5–2 mm) generally abundant near the capitula, sometimes glabrate at the base. *Leaves* entire to dentate. Basal leaves sometimes present at flowering time; blade (8)19–26(30) × (7)17–23 cm, orbicular or ovate, with cordate base and blunt or acute apex, with actinodromous venation; petiole 7–18 cm long, with sheathing base, sheath 3–8(10.7) cm long. Lower cauline leaves with blade 6–24 × 5–19.5 cm; petiole 9–33 cm long, 1–5 mm wide, similar to basal leaves. Middle cauline leaves 5–21.5 × 2–16.5 cm, sessile, fiddle-shaped, semi-amplexicaul. Upper cauline leaves 3–17 × 0.9–14(15) cm, similar to middle cauline leaves or ovate to obovate, sometimes bract-like. Indumentum similar to the adjacent part of the stem, more abundant on margins and on veins on the abaxial surface of leaves. *Capitula* 2 to 13, 3–5.5(7) cm diam. including rays; involucre shorter than rays, 1.5–3.5(4.5) cm diam.; peduncles (1.5)3–10.5(16) cm long, 1–1.6 mm wide, sometimes turbinate at the base of capitula (1.3 cm wide) in fruit. *Phyllaries* herbaceous or sometimes slightly papery at the base or at the margins, 0.6–1.5(2) cm long, 0.8–3(4) mm wide, ovate-lanceolate to obovate-lanceolate or subulate. Indumentum similar to the upper part of stem. *Receptacles* glabrous or glabrate. *Flowers* yellow. Ray flower corollas 1.5(1.9)–3(3.5) cm long, (1.7)2.3–3.3(5) mm wide, obovate-elliptic to oblong-elliptic, apex generally with 3 teeth. Disk flower corollas (3.5)4–6 × 1.5–2.5 mm. *Cypselae* brown, with smooth to grooved surface, dimorphic. Cypselae from ray flowers 3–4.5 × 1–1.3 mm, glabrous or glabrate, without pappus. Cypselae from disk flowers (2)2.3–4.5 × 0.5–1(1.5) mm, sometimes with eglandular trichomes; pappus (1.5)3–5 mm, white. Chromosome number $2n = 30, 60$ (data obtained from two indexes of plant chromosome numbers: Fedorov, 1969; Goldblatt, 1988; original sources not seen).

Illustrations. Figures 24, 26A–D.

Distribution. Northern Turkey and Caucasus. Growing in woods, open moist rocky places, meadows, and near watercourses, altitude 1500–3700 m.

The characters distinguishing this species from others in southwestern Asia are mainly based on the type of indumentum (see comments on *D. dolichotrichum*). *Doronicum macrophyllum* is a polymorphic species, and within it, two subspecies can be distinguished:

KEY TO THE SUBSPECIES OF *DORONICUM MACROPHYLLUM*

1. Plants generally with more than 3 capitula and more than 3 cauline leaves (including bract-like leaves) ---------- 19a. *D. macrophyllum* subsp. *macrophyllum*
1′. Plants bearing 1 to 3 capitula and 2 or 3 cauline leaves (including bract-like leaves) ---------- 19b. *D. macrophyllum* subsp. *sparsipilosum*

19a. Doronicum macrophyllum subsp. **macrophyllum**

Doronicum macrolepis Freyn & Sint., in Freyn, Bull. Herb. Boissier 3: 351. 1895. Syn. nov. TYPE: Turkey. Gümüschkane, in valle Böjükdere tractu Karagölldagh supra Artabir, *P. Sintenis 7173* (lectotype, designated by Edmondson (1975: 142), G!; isotypes, B!, BM!,

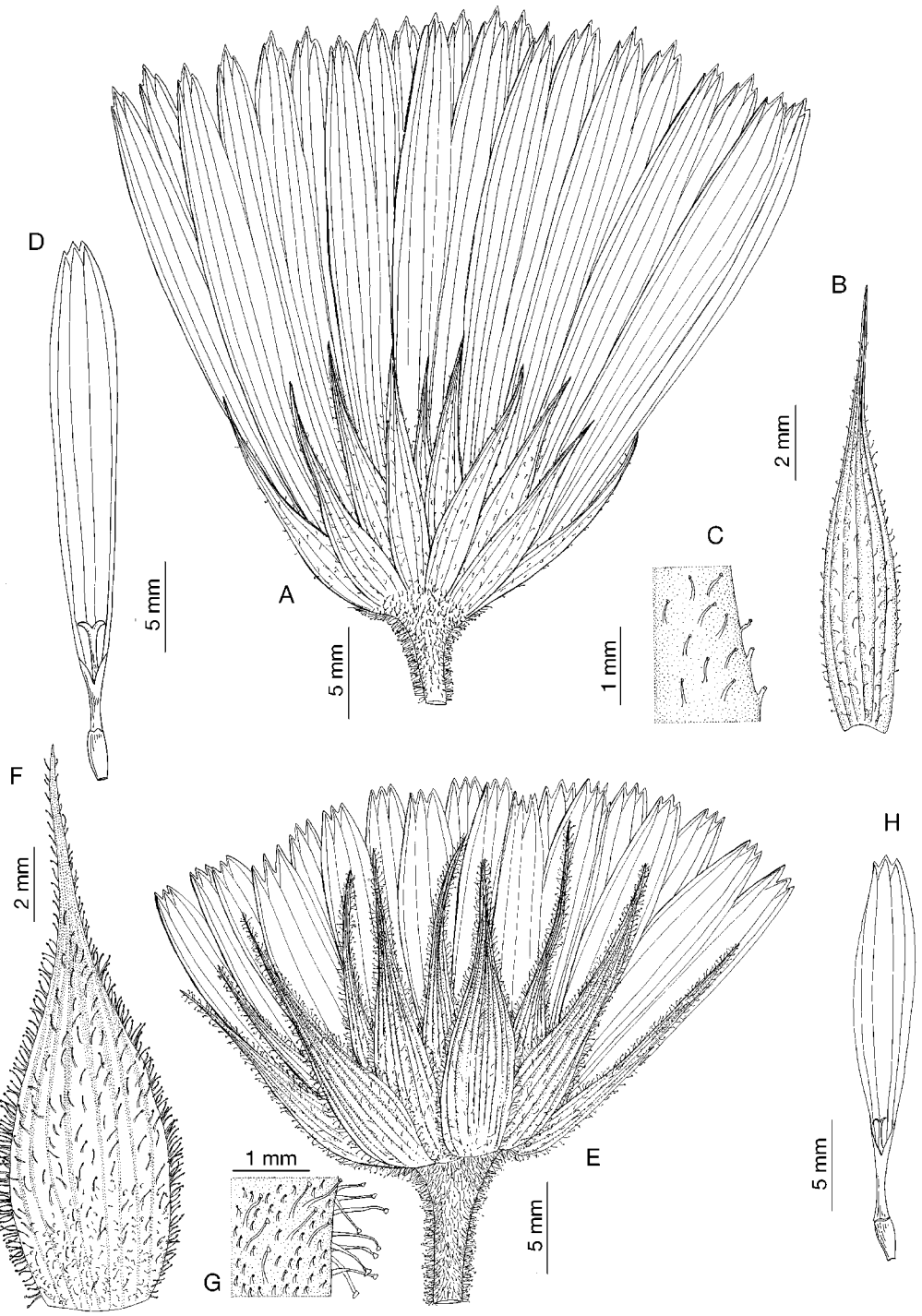

Figure 26. A–D. *Doronicum macrophyllum* subsp. *macrophyllum* (drawn from *Hohenacker s.n.*, K). —A. Capitulum. —B. Phyllary. —C. Indumentum of a phyllary. —D. Ray flower. E–H. *Doronicum reticulatum* (drawn from *Bornmüller 9620*, B). —E. Capitulum. —F. Phyllary. —G. Indumentum of a phyllary. —H. Ray flower.

BRNM!, E not seen, K!, LD! photograph, P not seen, S!, W!).

Doronicum balansae Cavill., Annuaire Conserv. Jard. Bot. Genève 14: 260. 1911. Syn. nov. TYPE: Turkey. Lazistan, près de Djimil, 1866, *B. Balansa s.n.* (lectotype, designated by Edmondson (1975: 140), G!; isotype, W!).

Rhizome woody. Stem with more than 3 cauline leaves. Plants generally bearing more than 3 capitula, which are sometimes turbinate at the base (1.3 cm wide) in fruit. Chromosome number unknown.

Illustrations. Avetisyan & Oganesyan (1995: tab. 174); Figure 26A–D.

Distribution. Northern Turkey and Caucasus. Growing in woods, open moist rocky places, meadows, and near watercourses, altitude 1500–3700 m (Fig. 24).

All the specimens from the only collection of *Doronicum macrolepis* differ from *D. macrophyllum* subsp. *macrophyllum* in size of capitula. Although the population is somewhat anomalous, the name is treated as a synonym of *D. macrophyllum* subsp. *macrophyllum.* The diagnostic characters used to separate *D. balansae* (Cavillier, 1911) overlap substantially with those of *D. macrophyllum* subsp. *macrophyllum.* Besides, the patterns of indumentum variability match those of *D. macrophyllum* subsp. *macrophyllum.* Accordingly, this name is considered a synonym.

Selected specimens examined. CAUCASUS. **North Caucasus:** Dagestan, Dargi, Maara, Akuscha, *Alexcenko 12861* (LE); Sharoj, Sharoargun, Serchikhi, *Averianov et al. 2837* (LE); Schelbur dagh, Daghestania, *Becker 132* (LE); Digoriya, Tators, Digor-Tors, 12 Aug. 1927, *E. & N. Busch s.n.* (LE); Stavropolskij, Karachaevo-Cherkesskaya, Pastvishnogo, *Geltman et al. 1179* (LE); Checheno-Ingushskaya, Argun, Itum-kale, *Geltman et al. 2358* (LE); Beschtau, June 1842, *Hohenacker s.n.* (G, GH, K, W); Kuba, Kardtokiurt, 5 July 1890, *Lipsky s.n.* (LE); Kavardino-Balkariya, Baksanskij, Bilim, Aktoprak, 18 July 1990, *Menitskij et al. s.n.* (LE); Dagestan, Lakskij, 9 Sep. 1927, *Poretsky & Schultz s.n.* (LE). **Transcaucasus:** Ossetia, Brutsabseli, Didi Liachva, *A. H. & V. F. Brotherus 500 a* (S); Tersk, Adai-su, *E. & N. Busch 47* (S); Teberda, 18 June 1968, *Ehwald & Wendt s.n.* (B); Cartalinia, Mts. Tzkura-Tzkharo, 9 July 1923, *Juzepczuk s.n.* (LE); Azerbajdzhan, Kuba, Leze, Schach-dagh, 8 July 1935, *Karjagin s.n.* (NY); Azerbayan, Baku, Gandzha, Rashnar-dagh, 30 June 1929, *Kasumova s.n.* (LE); Azerbayan, Karabach, Lyzagorsk, 30 June 1929, *Kolakovsky s.n.* (LE); Armenia, Daratschitschach, *Radle 400* (LE); Tiflis, Mt. Saghuramo, 6 July 1919, *Schischkin s.n.* (BM); Svanetia, Latpari inter flumina Hippum et Ingur, *Sommier & Levier 709* (G); Gruzniskaya, Bogdanovskij, Bogdanovka, *Tsvelev & Cherepanov 1032* (LE); Goris, Mts. Karabakhskoie, Brun, 27 July 1975, *Vašák s.n.* (B); Tiflis, *Wittmann 294* (LE). IRAN. Azerbaijan, Qareh Dagh, Aliabad, *Lamond & Termeh 4876* (E, G, IRAN, K, W). TURKEY. **Artvin:** Yusufeli, Altiparmak, Kaçkar Daglari, *Aytaç 2933* (GAZI). **Kars:** Ardahan, *Sorger & Buchner 82-94-38* (W). **Rize:** Ikizdere, Balliköy, Anzer, Çevresi, Sulak, *Güner & Vural 5974* (GAZI); Çamlihemsin, Yukari Amlakit, Çayirlik, Çokyillik, *Güner & Vural 6115* (GAZI); Ikizdere, Gölyayla-Cihantepe, *Güner & Vural 6643* (GAZI). **Trabzon:** Soganli Daglari, Bayburt, *Edmondson 851* (E); Zigana Passhöhe, *Sorger & Buchner 82-89-3* (W).

19b. Doronicum macrophyllum subsp. **sparsipilosum** (J. R. Edm.) Álv. Fern., Novon 11: 295. 2001. *Doronicum bithynicum* subsp. *sparsipilosum* J. R. Edm., Notes Roy. Bot. Gard. Edinburgh 32: 258. 1973. TYPE: Turkey. "Ilgaz Daglari, 35 km S of Kastamonu, roadside on N side of pass top," 27 July 1971, *J. R. Edmondson 463* (holotype, E!; isotypes, G!, ISTF not seen, K!, W!).

Plant up to 90 cm tall. *Rhizomes* woody to somewhat fleshy. *Stems* with 2 or 3 cauline leaves. Blade of basal leaves 6.5–13.5 × 7–11 cm. Blade of lower cauline leaves 7.5–9.6 × 9.3–12 cm. Middle and upper cauline leaves 4.5–11 × 3–6 cm. *Capitula* 2 or 3, ca. 6.5 cm diam. including rays; involucre ca. 3.5 cm diam.; peduncles up to 16 cm long. *Receptacles* glabrous. Ray flower corollas 1.9–3.5 cm long, 1.7–4 mm wide. Disk flower corollas 3.5–4.5 mm long. Pappus 1.5–3.5 mm (on immature ovaries). Chromosome number unknown.

Distribution. Northern Turkey (provinces of Bolu and Kastamonu). Growing in woods and open moist rocky places, altitude 1700–2200 m (Fig. 24).

Selected specimens examined. TURKEY. **Bolu:** Ala dag, Kartal Kaya, *Davis & Coode 37370* (E, K). **Kastamonu:** Ilgaz Dag, *Davis et al. 38312* (E, K); Ilgaz, Karakol, Çankiri, *Nydegger 19037* (G).

This subspecies combines characters from two species of *Doronicum.* Rhizome, phyllary shape, and indumentum are similar to *D. macrophyllum* subsp. *macrophyllum,* while size and leaf arrangement are similar to *D. orientale.* It was described as a subspecies of *D. bithynicum* J. R. Edm., which is considered a synonym of *D. reticulatum* Boiss., but the diagnostic character for this species (ovate phyllaries with a dark-colored major venation and a long tapered-acute apex) does not occur in subspecies *sparsipilosum.* The subspecies has the phyllary type and other characters of *D. macrophyllum* subsp. *macrophyllum,* from which it differs mainly in having fewer capitula and in leaf arrangement, and there are intermediate specimens.

20. Doronicum maximum Boiss. & A. Huet, in Boiss., Diagn. Pl. Orient. ser. 2, 3: 31. 1856. TYPE: Turkey. Tech-Dagh, *A. Huet du Pavillon s.n.* (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 805), G-BOIS!, photograph; isotypes, BM!, G!, K!).

Plant up to 100(+) cm tall. *Rhizomes* woody, glabrous, with or without leaf remains. *Stems* branched in the upper part, leaves distributed along the stem, upper internodes generally longer than the adjacent leaves. Indumentum of multiseriate and uniseriate eglandular trichomes (ca. 0.2 mm) and glandular trichomes (up to 1.7 mm), scattered, sometimes glabrous. *Leaves* entire to dentate. Basal leaves sometimes present at flowering time; blade 11–20 × 10–21.5 cm, orbicular or ovate, with cordate base and generally blunt apex, with actinodromous venation; petiole 8–36 cm long, with sheathing base, sheath ca. 3 cm long. Lower cauline leaves with blade 4.5–17 × 5.5–24 cm; petiole 6.5–40 cm long, 2–3.5 mm wide, similar to basal leaves. Middle cauline leaves 3–13 × 2–14 cm, sessile, fiddle-shaped, semi-amplexicaul. Upper cauline leaves 1.2–5.5 × 1–3.5 cm, similar to middle cauline leaves or ovate to obovate, sometimes bract-like. Indumentum similar to the adjacent part of the stem, generally scarce, more abundant on margins of leaves. *Capitula* 3 to 18(+), 2–4 cm diam. including rays; involucre shorter than rays, 1.5–2 cm diam., sometimes turbinate at the base of capitula (ca. 5 mm wide) in fruit. *Phyllaries* herbaceous, ovate-lanceolate to obovate-lanceolate and acute, glabrous or glabrate; the outer 0.7–1.2 cm long, 2–2.3 mm wide; the inner 0.9–1.2 cm long, 1.5–2.3 mm wide. *Receptacles* glabrous. *Flowers* with yellow corollas. Ray flower corollas 1.2–2 cm long, 1.5–3 mm wide, obovate-elliptic to oblong-elliptic, apex generally with 3 teeth. Disk flower corollas 4–5 × 1.5 mm. *Cypselae* brown, with smooth to slightly grooved surface, dimorphic. Cypselae from ray flowers 2.2–3.3 × 1–1.3 mm, glabrous or glabrate, without pappus. Cypselae from disk flowers 1.5–2.3 × 0.5–1 mm, sometimes with eglandular trichomes; pappus 3–5 mm, white. Chromosome number unknown.

Illustrations. Figures 8A, 23A–E.

Distribution. Eastern Turkey, south of Caucasus and south of the Caspian Sea. Moist rocky places and near watercourses, altitude 1700–3300 m (Fig. 24).

Doronicum maximum is morphologically close to those southwestern Asian species with a "*macrophyllum*" type of habit, and the type of indumentum is the only character to distinguish among them. Within this "*macrophyllum*" group it is more similar to *D. haussknechtii* than to any other (see comments on *D. haussknechtii*), but the almost absolute absence of indumentum at the base of the capitula in *D. maximum* makes it different (Fig. 23A–F).

Selected specimens examined. IRAN. Mt. Elvend, *Pabot 1717* (G); Azerbaijan, Chalil Kuh, Selvana, *Renz 48989* (E, G, W); Kurdistania, Mt. Takht-i-Soleiman, June 1898, *Strauss s.n.* (B); Azerbaidjan, Rezaich, Silvaneh, 24 June 1970, *Termeh s.n.* (W). IRAQ. Arl Gird Dagh, Algurd Dagh, Rawandiz, *Guest & Ludlow-Hewitt 2928* (K). TURKEY. **Bitlis:** Tatvan, *Sorger 84-41-5* (W). **Erzurum:** Mt. Tech-Dagh, July 1853, *Huet du Pavillon s.n.* (BM, G, K); Bachrunse, Karliova-Çat, Karliova, *Nydegger 17340* (G). **Giresun:** Balabandaglari, Kilinc Tepe, Tamdere, *Davis et al. 20588* (BM, E, K). **Hakkari:** Cilo Tepe, Cilo yayla, *Davis & Polunin 24113* (BM, E). **Maraş:** Çaglayancerit, Engizek Dagi, *Duman 4068* (GAZI). **Muş:** vallis Merga Sauk, Bimgoell, Gumgum, Warto, *Kotschy 363* (B, G, K, S, UPS, W).

21. Doronicum oblongifolium DC., Prodr. 6: 321. 1838. TYPE: "Doronicum plantagineum, En. pl. cauc. nº 674," 1832, *C. A. Meyer* (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 805), G-DC!, photograph).

Plant up to 50 cm tall. *Rhizomes* woody to somewhat woody, glabrous, generally with leaf remains forming fibers or dark scales. *Stems* not branched, leaves mainly in the lower middle of the stem. Indumentum of white eglandular trichomes (up to 2.5 mm), more abundant near the capitula, also with scarce glandular trichomes, sometimes glabrous at the base. *Leaves* entire to slightly dentate. Basal leaves generally present at flowering time; blade (1.8)2–6 × (0.9)1.5–3 cm, elliptic, with attenuate base, and generally blunt apex, with actinodromous to pinnate-actinodromous venation; petiole 3–10 cm long, 1–3 mm wide. Lower and middle cauline leaves 3.5–8(9.5) × 1.4–2.5 cm, similar to basal leaves or sessile, elliptic to ovate-elliptic, sometimes widely ovate to suborbiculate, semi-amplexicaul, with blunt apex. Upper cauline leaves (1.6)3–6 × (0.2)1–2 cm, similar to middle cauline leaves or ovate-lanceolate, sometimes bract-like. Indumentum similar to the adjacent part of stem, sometimes with white, tangled, uniseriate eglandular trichomes (up to 1 mm), more abundant on leaf margins. *Capitula* solitary, 4.5–7.5 cm diam. including rays; involucre shorter than rays, 2–5 cm diam. *Phyllaries* herbaceous, 1–1.5(2) cm long, 2.5–5 mm wide, ovate-lanceolate to elliptic. Indumentum similar to the upper part of stem, sometimes abundant. *Receptacles* glabrous. *Flowers* with yellow corollas. Ray flower corollas 2–3.5 cm long,

2.5–5.5 mm wide, obovate-elliptic, apex with 2 or 3 teeth. Disk flower corollas 4–5 mm long. *Cypselae* brown, with striate-reticulate to warty surface, dimorphic, ca. 4 × 1 mm, generally glabrous, sometimes with eglandular trichomes or glabrate. Cypselae from ray flowers without pappus. Pappus up to 4.5 mm, white. Chromosome number $2n = 40$, 60* (Davlianidze, 1985; *Fedorov, 1969).

Illustrations. Avetisyan & Oganesyan (1995: tab. 175); Figure 3I, J.

Distribution. Caucasus. Open moist rocky places, and along watercourses, altitude 1400–3900 m (Fig. 24).

Doronicum oblongifolium is distinctive among the species from Caucasus. While the rest of the species in this area (except *D. orientale*) have the "*macrophyllum*" type of habit, *D. oblongifolium* bears only one capitulum and has elliptic basal leaves making it similar in habit to other European or central Asian species (e.g., *D. clusii, D. hungaricum, D. falconeri,* among others). Besides, the type of rhizome (woody, glabrous, and with fibrous leaf remains) is quite different from that of *D. orientale* (fleshy and with pubescent nodes). In addition, *D. oblongifolium* has a special type of indumentum on margins of basal leaves (Fig. 3I, J).

The citation of the chromosome number $2n = 60$ for *Doronicum oblongifolium* was found in Fedorov's index (1969), but the original source for this data was not seen.

Selected specimens examined. CAUCASUS. **North Caucasus:** Dagestan, Kaitag, Tabassaran, Urgah, Dshufu dag, *Alexcenko & Woronow 13586* (LE); Checheno-Ingushskaya, Argun, Itum-kale, *Averianov et al. 2421* (LE); Balkariya, Sukan, 1 July 1927, *E. A. & N. A. Busch s.n.* (LE); Kaepes-Dagh, Karabach, June 1844, *Kolenati s.n.* (LE); Digoria, Ossetia, Alagir, *Ruprecht 156* (LE); Tindal, Mts. Bogos, Aatschabala, 10 June 1861, *Ruprecht s.n.* (LE). **Transcaucasus:** Azerbajdzhan, Mt. Mechtukjan, 15 Aug. 1929, *Achverdov & Doluchanow s.n.* (LE); Carthalinia, Zhra Zhraras, *A. H. & V. F. Brotherus 501* (BM, G, S); Armenia, Alägez, 20 July 1932, *E. & N. Busch s.n.* (LE); Azerbajdzhan, Gandzha, Koshkar-dagh, 22 July 1928, *Doluchanow s.n.* (LE); Aragac, lacum Kari, *Gabrielian 12787* (E, G); Azerbayan, Nachitshevan, Zangezur, inter Dashurry-Dagh et Kjavin-Kaja, 1 July 1928, *Gavrilov s.n.* (LE); Mt. Sarial, May 1838, *Hohenacker s.n.* (B, E, G, K, W); Armenia, Daralogez, Alogez, 25 July 1931, *Karjagin & Saflev s.n.* (LE, S); Azerbayan, Nagornogo Karabacha, Gadrutskij, Znarat, 27 May 1948, *Kirpichnikov s.n.* (LE); Azerbajdzhan, Karabach, inter Lysagorse et Mt. Kyus, 17 June 1929, *Kolakovsky s.n.* (LE); Tiflis, Bokhriani, Mt. Sanislo, 7 Aug. 1928, *Kozlovsky s.n.* (LE); Georgia, Borzhom, Bakuriani, 24 May 1936, *Kozlovsky s.n.* (LE); Gruzinkaya, Chevsuretiya, Tsuvrovani, Choki, 6 Aug. 1982, *Menitskij s.n.* (LE); Azerbayan, Nachitschevan, Mt. Agdaban, 17 July 1934, *Prilipko & Isaev s.n.* (LE); Armenia, Mt. Alajos, *Radle 142* (LE); Murov-dag, Giamish, Elisabetholsk, 15 July 1909, *Schelkovnikov s.n.* (LE); Mts. Areguni, ad lacum Sevan, Krasnoselsk, Shorsha, 8 Oct. 1974, *Vašák s.n.* (B, G); Ashtarak, Mt. Aragac, 13 July 1975, *Vašák s.n.* (G, W); Armenia, Razdan, Mt. Alibeg, Cakhkdzor, 4 July 1982, *Vašák s.n.* (W). TURKEY. **Artvin:** Yalnizçam Silsilesi, Savsat, *Albury et al. 3176* (K); Çoruh, Ardanuç, Kordevan dag, Yalnizcam Daglari, *Davis & Hedge 30365* (E, K, W). **Erzurum:** Dumluda, *Sorger & Buchner 82-123-9* (W).

22. Doronicum orientale Hoffm., Com. Soc. Phys. Med. Moscou 1: 8. 1808. TYPE: not located; protologue citation: "Habitat passim circa Zehet in Iberia."

Doronicum caucasicum M. Bieb., Fl. Taur.-Caucas. 2: 321. 1808. TYPE: "ex Caucaso iberico. Adam. 1805" [*Adam.? s.n.*], ex herb. Marschall von Bieberstein (lectotype, designated here, LE!).

Plant up to 140 cm tall. *Rhizomes* fleshy, pubescent to very pubescent, with shining white-tinted trichomes on nodes, stoloniform, sometimes with buds. *Stems* unbranched, scape-like. Indumentum of uniseriate and multiseriate eglandular trichomes and short-stalked glandular trichomes. *Leaves* entire to slightly dentate. Basal leaves sometimes present at flowering time; blade (2)4–7(8.5) × 2(3)–6(7.5) cm, reniform to widely ovate with cordate base and generally blunt apex, with acrodromous venation; petiole (1.8)4–10(20) cm long, (0.5)1–2(3.5) mm wide. Lower cauline leaves (3.2)5–7.5(9) × (1.8)3–5(7.7) cm, similar to basal leaves or sessile, fiddle-shaped, semi-amplexicaul. Upper cauline leaves (1.5)4–7(10.5) × (0.4)3–6(7.6) cm, ovate-elliptic to ovate-lanceolate, sometimes bract-like. Indumentum mainly of short-stalked glandular trichomes, also with uniseriate and multiseriate eglandular trichomes. *Capitula* 1(2 or 3), 3(4)–(6)7 cm diam. including rays; involucre shorter than rays or equaling them, (2.3)3–5(5.5) mm diam. *Phyllaries* herbaceous, ovate-subulate, generally with acute apex; the outer (1)1.5–2(2.5) cm long, (1)1.5–2 (3) mm wide; the inner 1–1.5(2) cm long, 0.5–1.5(2) mm wide. Margins ciliate, with acute, stiff and equidistant multiseriate eglandular trichomes (up to 1.5 mm). Indumentum mainly glandular, but also with eglandular trichomes. *Receptacles* generally pubescent, sometimes glabrous. *Flowers* with yellow corollas. Ray flower corollas (1.4)2–2.5(3) cm long, 2–2.5(3.8) mm wide, oblong-elliptic, apex generally with 3 teeth. Disk flower corollas 3.5–4(5) × 1.2–1.5 mm. *Cypselae* olive-green or brown, with warty or rugose-reticulate surface, dimorphic. Cypselae from ray flowers (1)1.5–2(2.3) × (0.2)0.5–0.8(1.7) mm, glabrous, without pappus. Cypselae from disk flowers (1)1.3–1.5(1.8) × 0.5–0.7(1) mm, with eglandular trichomes; pap-

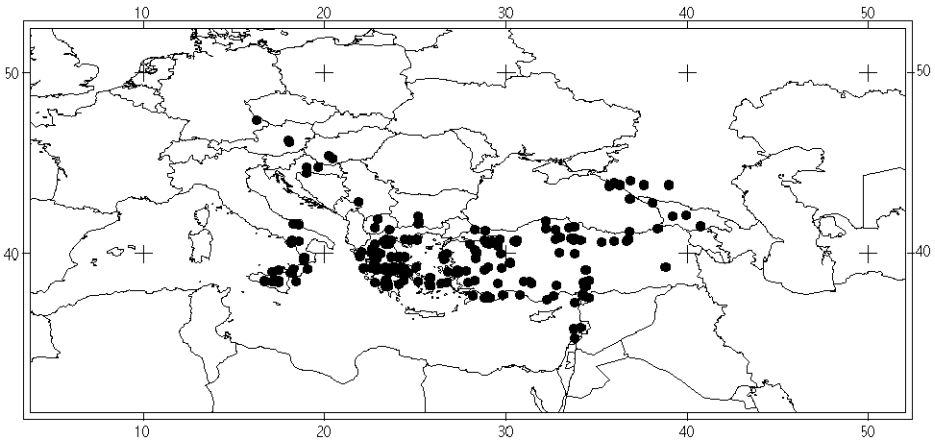

Figure 27. Distribution map for *Doronicum orientale*.

pus (2.5)3–5 mm, white. Chromosome number 2*n* = 60 (Lindqvist, 1950, as *D. cordatum*; Baksay, 1956; Strid & Anderson, 1985).

Illustrations. Sadler in Nendtvich (1836: tab. 2): Săvulescu (1964: pl. 99, fig. 2); Figures 1A, 5E–H.

Distribution. Eastern Mediterranean region, from Syria to Sicily, and Caucasus (absent in northern Africa?). Cultivated and naturalized in central Europe. Forests, meadows, rocky places, and shady gullies, from sea level up to 2000 m in elevation (Fig. 27).

Both *Doronicum orientale* Hoffm. and *D. caucasicum* M. Bieb. were described in 1808 with the month of publication unknown. One year later the former name was choosen by Willdenow (1809) as the valid name, and, hence, it is the correct name (ICBN, Art. 11.5, Greuter et al., 2000). The type material of *D. orientale* has so far not been located, and although its description in the protologue matches the taxonomic identity recognized as *D. orientale* by Willdenow (1809), its formal identity needs to wait until a lectotype is designated. Since both names were alternately used by different authors in floristic studies, the lectotype for *D. caucasicum* M. Bieb. is designated above. The only sheet found in Marschall von Bieberstein's herbarium that matches the protologue was selected as the lectotype.

The possible occurrence of *Doronicum orientale* in North Africa requires further work (see comments for *D. pardalianches* and *D. plantagineum*).

Selected specimens examined. LEBANON–SYRIA. Beikos agri Byzantini, *J. & F. Bornmüller 11965* (B); Faraya, *Polunin 5332* (B, E, K). CAUCASUS. **Northcaucasus:** Kuban, *Busch & Klopotov 668* (LE, NY); Krasnodarskii, Gelendzhikskii, Pschadi, Pschala, *Dolmatova et al. 2360* (LE). **Transcaucasus:** Tiflis, ad rivulum Kura, 22 Mar. 1861, *Ruprecht s.n.* (LE). TURKEY. **Adana:** Bahçe, Dildil dag, Haruniye, *Davis & Polunin 26107 D* (BM, E, K). **Afyon:** Darkiri, Hisaralan, *Aytaç 1167* (GAZI). **Amasya:** Direkli, Üçoluk, *Peker 1178* (GAZI). **Antalya:** Termessos, *C. & M. North 42* (E). **Aydin:** Karacasu, Baba Dag, Seki, *Davis 41627* (E, K). **Balikesir:** Kaz Dag, Sarakoy, *Dudley 34813* (E, K, MO). **Bolu:** Abant, *Prieè 492* (K). **Bursa:** Ulu Dag, *Wilde 4026* (E). **Çorum:** Iskilip, Kebabdere, Karmis, *Coode & Jones 1754* (E, GH). **Hatay:** Belen, Amanus, Karlik, Soguk Oluk, *Davis & Hedge 27089* (BM, E, K). **Izmir:** Kusadasi, *Kayacik & Yaltirik 3368* (E). **Kastamonu:** Paphlagonia, Tossia, Bepik-Ilkazdagh, *Sintenis 3995* (B, BM, BRNM, K). **Kütahya:** Simav, Kiçir to Akdag, *Coode & Jones 2733* (E, K). **Muğla:** Inçealiler, *H. & E. Walter 342* (B). **Trabzon:** Trabzon, *Stainton 8113* (E, K). **Yozgat:** Akdagmadeni, Aktas, *Curtis 144* (E). AUSTRIA. **Niederösterreich:** Theresienthal bei Gratzen, 19 May 1899, *Jahn s.n.* (B, S). BULGARIA. **Plovdiv:** Stanimaka, 10 June 1889, *Stříbrný s.n.* (G). GREECE. **Ípiros:** Arta, Skoulikaria, *Willing 33327* (B). **Makedhonía:** Naussa, Mt. Vermion, *K. H. & F. Rechinger 8758* (BM). **Nísoi Aiyaíou:** Samos, Mt. Kerkis, Agia, *Davis 1654 K* (E, K); Nenedes, insula Samos, *K. H. & F. Rechinger 3794* (BM, K, G). **Pelopónnisos:** Lirkio, Kefalovrison, *García 953* (MA). **Stereá Ellás-Évvoia:** Katafigon, Oeta, *Balls & Gourlay B3264* (BM, E, K); Mt. Hymetti, *Orphanides 196* (COI-WILLK, E). **Thessalía:** Pelion, Kissos, *Beauverd 272* (G). HUNGARY. **Baranya:** Pécs, Mecsek, 25 Apr. 1946, *Papp s.n.* (S). **Tolna:** silva Gurovica prope Szekszárd, 13 May 1914, *Hollós s.n.* (S). ITALY. **Basilicata:** Potenza, in silva Pallareta, 20 Apr. 1924, *Gavioli s.n.* (MA). **Calabria:** Pizzo, 20 Apr. 1938, *Lenander s.n.* (S). **Sicilia:** Parco delle Madonie, Piano Sempria, *Nieto 3888* (MA). YUGOSLAVIA. **Makedonija:** Doiran, Marianska planina, Hudowa, *Bornmüller 4265* (B, NY). **Srbija:** Rakovika, prope Belgradum, *Petrovič 2340* (G, K, MA).

23. Doronicum pardalianches L., Sp. Pl.: 885. 1753. TYPE: Herb. Clifford, 411.1 [sine collector] (lectotype, designated by Llamas et al. in Jarvis & Turland (1998: 360), BM!).

Arnica scorpioides L., Sp. Pl.: 884. 1753. *Aster scorpioides* (L.) Scop., Fl. Carniol. ed. 2, 2: 169. 1771. *Grammarthron scorpioides* (L.) Cass., in Cuvier, Dict. Sci. Nat. 19: 294. 1821. *Aronicum scorpioides* (L.) Rchb., Fl. Germ. Excurs. 1: 233. 1831–1832. TYPE: "Doronicum radice scorpii brachiata," Herb. Burser X: 16 [sine collector] (lectotype, designated by Álvarez in Jarvis & Turland (1998: 353), UPS!, photograph).

Plant up to 150(+) cm tall. *Rhizomes* fleshy, pubescent to scarcely pubescent or glabrate with shining white-tinted trichomes on nodes, stoloniform, sometimes with buds. *Stems* scarcely branched in the upper part, with few leaves mainly distributed along the basal ⅔ of the stem, internodes generally longer than the adjacent leaves. Indumentum of thin and acute multiseriate eglandular trichomes (up to 5 mm) in the lower part, uniseriate eglandular trichomes and glandular trichomes in the middle and upper part, abundant near the capitula. *Leaves* entire to slightly dentate. Basal leaves sometimes present at flowering time; blade 3.6–16.5 × 3.3–14 cm, ovate with cordate base and blunt apex, with acrodromous to actinodromous venation; petiole 4.5–27 cm long, 1–4.5 mm wide. Lower cauline leaves 3.3–22 × 2.3–11 cm; petiole (3.4)6–10(27) cm long, 1–1.5 mm wide, similar to basal leaves. Middle cauline leaves (2.7)5–9(15.3) × (1.6)3–6(10) cm, sessile, fiddle-shaped, semi-amplexicaul. Upper cauline leaves (1)2–6(10) × (0.2)1–2(5.5) cm, ovate-elliptic to ovate-lanceolate, sometimes bract-like. Indumentum similar to the adjacent part of the stem. *Capitula* (1)2–7, 2–5.1 cm diam. including rays; involucre almost equaling rays, sometimes exceeding them, 1–3.3 cm diam.; peduncles (0.5)5–7(20) cm long, (0.5)0.8–1(2) mm wide. *Phyllaries* herbaceous, (1)1.2–1.4(1.7) cm long, (0.7)1–1.5(2.7) mm wide, ovate-subulate, generally with acute apex. Margins sometimes ciliate, with acute, stiff and equidistant multiseriate eglandular trichomes. Indumentum of glandular and eglandular trichomes. *Receptacles* pubescent or glabrate. *Flowers* with yellow corollas. Ray flower corollas 1.1–2.5 cm long, 2–3.5 mm wide, oblong-elliptic, apex generally with 3 teeth. Disk flower corollas 4–6 × 1–2.5 mm. *Cypselae* black and with warty surface in maturity, dimorphic. Cypselae from ray flowers 1.7–3.5 × 0.7–1.3 mm, glabrous, without pappus. Cypselae from disk flowers 1.2–1.8 × 0.7–1 mm, with eglandular trichomes; pappus (2.5)3–4 mm, white. Chromosome number $2n$ = 60, 120* (Lindqvist, 1950; *Moore, 1982, see comments below).

Illustrations. Jacquin (1776: t. 350); Reichenbach (1854: t. 64, fig. 2); Săvulescu (1964: pl. 97, fig. 2; pl. 189, fig. 1); Bolòs & Vigo (1995: 839); Figures 2A, B, 7A.

Distribution. Northeastern Iberian peninsula and central Europe. Cultivated and naturalized at least in Great Britain and Northern Europe, so that the limits of the natural distribution are uncertain. Forests, meadows, hedges, and near watercourses, from sea level up to 1800 m in elevation (Fig. 28).

As indicated above, in the protologue of *Arnica scorpioides* L., several pre-Linnaean synonyms are included. This name has been treated as a synonym of *Doronicum grandiflorum* Lam. by all the authors that combined it, probably because Jacquin (1776: 26, t. 349) illustrated it with a plant of *D. grandiflorum* Lam. However, the lectotype designated by Álvarez in Jarvis and Turland (1998) represents *Doronicum pardalianches* L., since all of the original elements of *A. scorpioides* belong to *D. pardalianches* L. Formally, all the combinations based on *Arnica scorpioides* L. are homotypic synonyms of *Arnica scorpioides* L. and thus synonyms of *D. pardalianches* L., even though the descriptions and references in protologues correspond mainly to *Doronicum grandiflorum* Lam. (see also comments above on *D. scorpioides* Lam. under *D. grandiflorum* Lam.).

Desfontaines (1798) cited *Doronicum pardalianches* in North Africa: "in cacumis Atlantis prope Belide," but all the specimens from North Africa represent *D. plantagineum.* A few populations have broadly ovate basal leaves with subcordate bases that are similar to *D. orientale*, so their identity is uncertain. *Doronicum pardalianches* has similar basal leaves, but is quite different from both *D. orientale* and *D. plantagineum* in habit, number of capitula, number of cauline leaves, and color of cypselae. Although no sheet from Desfontaines's locality was seen, the presence of *D. pardalianches* in North Africa is unlikely. Desfontaines's description matches *D. plantagineum*, or even *D. orientale* (whose presence in North Africa is questionable). Hybridization between *D. plantagineum* and *D. orientale* in this area is a possibility. (See comments for *D. orientale* and *D. plantagineum.*)

Determining the native distribution of *Doronicum pardalianches* is difficult. Records are scattered in central Europe, but absent in the Iberian peninsula, except for northeastern Spain, where it is notably abundant, exactly in the gap presented by *D. plantagineum* (Figs. 25, 28). This suggests these species do not overlap in their presumably natural areas of distribution, and that the native area of *D. pardalianches* reaches southwestern Europe in northeastern Spain.

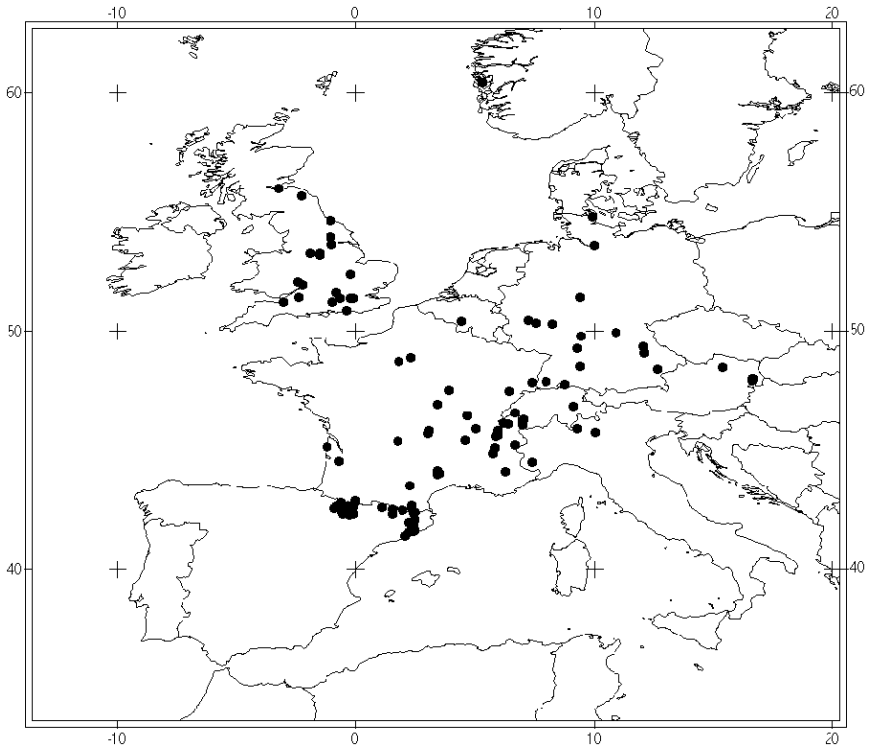

Figure 28. Distribution map for *Doronicum pardalianches.*

The citation of the chromosome number $2n = 120$ for *Doronicum pardalianches* was found in Moore's (1982) index, but the original source for this data was not seen.

Selected specimens examined. ANDORRA. Sant Miquel d'Engolasters, Les Escaldes, *Almaraz et al. 1015* (MA). AUSTRIA. **Niederösterreich:** Sachsen, Schlopberg Hartenstein, May 1904, *Lehmann s.n.* (B). BELGIUM. **Hainaut:** Marchienne-au-Pont, *Duvigneaud 76 B 325* (MA). FRANCE. **Basses-Alpes:** Mt. des Dourbes, près de Digne, 2 June 1868, *Borel s.n.* (K). **Cote d'Or:** bois de Saulon, 19 June 1873, *Bonnet s.n.* (K). **Doubs:** bois de Châtay à Uzelle, *Paillot 2279'* (B, G, NY). **Haute-Savoie:** St. Pierre-de-Rumilly à St. Laurent, *Jacquemoud 3459* (G). **Hautes-Alpes:** Séuse, 23 July 1885, *Girod s.n.* (G). **Hautes-Pyrénées:** bois de Sia près Luz, July 1872, *Borderè s.n.* (K). **Iserè:** Grenoble, 2 June 1850, *Chabert s.n.* (G). **Loire:** Mt. Pilat, *Mutel 120* (MA). **Pyrénées-Orientales:** Vernet, Aug. 1843, *Handris s.n.* (G). **Saône-et-Loire:** Cluny, 31 May 1892, *Grandmaison s.n.* (G). **Seine-et-Oise:** Paris, *Duby 263* (MA). GERMANY. **Bayern:** Steiniger Wald, Baumberg, 20 June 1908, *Harz s.n.* (NY, W). **Berlin:** prope Berolinum, Borussia, 10 July 1887, *Scheppig s.n.* (G). **Halle:** Winningen, 1 June 1857, *Wirtgen s.n.* (B, G). **Hessen:** Taunus, *Andres 695* (B). **Rheinland-Pfalz:** Binningen, Birtgen, *Lechler 48* (B, E). GREAT BRITAIN. **England:** Ledbury, *Bickham 876* (K); Woodchester Park, West Gloucester, *Lousley 954* (K); Bucks, between Marlow and Medneuham, *Sandwith 3737'* (K). **Scotland:** Inverness, Edinburgh, *Syme 653* (K). ITALY. **Lombardia:** Mt. Bronzone sur Tavernola, 16 May 1910, *Wilczek s.n.* (G). **Piemonte:** Turin, Val Salice, 5 May 1870, *Joad s.n.* (E). NORWAY. Bergen, *Fredholm 1189* (NY). SPAIN. **Aragón:** Huesca, sierra de Guara, Nocito, barranco Fuente Espátula, *Álvarez et al. 801* (MA); Huesca, Las Paúles, 2 Aug. 1988, *Aseginolaza & Gómez s.n.* (JACA). **Cataluña:** Lérida, Cava, sierra del Cadí, arroyo de la Vena, collado de Basses, *Almaraz et al. 1008* (MA); Lérida, Alta Ribagorza, bosque de Besiberri, 10 Aug. 1987, *Arán & Tohá s.n.* (MA); Barcelona, Olzinelles, *Fernández Casas 605* (MA); Gerona, San Feliu de Pallarols à la Salut, 9 June 1927, *Gonzalo s.n.* (G, MA). SWEDEN. Insula Haito prope Carlskra Majest, June 1880, *Lübeck s.n.* (G). SWITZERLAND. **Valais:** pres Allesse, 1869, *Thomas s.n.* (K). **Vaud:** Graugette prope Pandex, 28 May 1870, *Faurat s.n.* (BM).

24. Doronicum plantagineum L., Sp. Pl.: 885. 1753. TYPE: Herb. Clifford, 411.2 [sine collector] (lectotype, designated by Llamas et al. in Jarvis & Turland (1998: 360), BM!).

Plant up to 150 cm tall. *Rhizomes* fleshy, pubescent to very pubescent, with shining white-tinted trichomes on nodes, stoloniform, sometimes with buds. *Stems* generally unbranched, scape-like. Indumentum mainly glandular, with short-stalked and long-stalked glandular trichomes (up to 0.7 mm), sometimes also uniseriate and multiseriate eglandular trichomes, more abundant near the capitula. *Leaves* entire to slightly dentate. Basal leaves some-

times present at flowering time; blade (2.5)4–8(12) × (1.5)2.5–6(9.5) cm, ovate with truncate, attenuate or subcordate base, blunt or somewhat acute apex, with acrodromous venation; petiole (2)4–8(19) cm long, (0.5)1.5–3(7) mm wide. Lower cauline leaves (1.5)3–7(19) × (1)2–5(8.5) cm, similar to basal leaves or sessile, fiddle-shaped to ovate-elliptic, semi-amplexicaul. Upper cauline leaves (1)2–4(9.5) × (0.1)0.7–2(5.5) cm, ovate-elliptic to ovate-lanceolate, sometimes bract-like. Indumentum mainly glandular, with short-stalked and long-stalked glandular trichomes, also with uniseriate (0.2 mm), and multiseriate (up to 2 mm) eglandular trichomes. *Capitula* 1(2 or 3), 3–4(6.5) cm diam. including rays; involucre almost equaling rays, sometimes exceeding them, 3–4(5.5) cm diam. *Phyllaries* herbaceous, ovate-subulate, generally with acute apex; the outer (1)1.5–2.5(3) cm long, (1)1.3–2(3) mm wide; the inner (1)1.5–2(2.5) cm long, 0.5–0.7(2) mm wide. Margins ciliate, with acute, stiff and equidistant multiseriate eglandular trichomes (up to 1.5 mm). Indumentum mainly glandular. *Receptacles* glabrous or scarcely pubescent. *Flowers* with yellow corollas. Ray flower corollas (1.1)1.5–2.5(3) cm long, (1.5)–2(3) mm wide, oblong-elliptic, apex generally with 3 teeth. Disk flower corollas 4(4.3)–4.5(5.5) × (1)1.3–1.5(2) mm. *Cypselae* olive-green or brown, with warty surface, dimorphic. Cypselae from ray flowers 2–2.8(4) × (0.7)1–1.3 mm, generally glabrous, without pappus. Cypselae from disk flowers (1.5)2–2.7(3) × (0.7)1–1.3 mm, with eglandular trichomes; pappus (3)3.5–4.5(5) mm, white. Chromosome number $2n = 120$ (Lindqvist, 1950; Fernandes & Queirós, 1971; Löve & Kjellqvist, 1974; Ruiz de Clavijo, 1993).

Illustrations. Reichenbach (1854: tab. 65, fig. 2); Hegi (1928: 711, fig. 420); Valdés et al. (1987: 77); Bolòs & Vigo (1995: 838); Figure 6A, B.

Distribution. Southwestern Europe (Portugal and Spain) and northern Africa (Morocco and Algeria). Cultivated and naturalized in Great Britain and central Europe. Limits of its native range uncertain. Forests, meadows, hedges, and on shady moist rocky places, altitude 400–2200 m (Fig. 25).

Doronicum plantagineum is variable for some characters (e.g., size and robustness of the plants, size and shape of basal leaves, number of leaves and capitula, type and abundance of indumentum). Cultivated, naturalized plants, and a few natural populations tend to have basal leaves broadly ovate-elliptic to elliptic, with slightly dentate margins, attenuate bases and somewhat acute apices. Some authors (Rouy, 1893, 1903a, 1903b; Legrand, 1894; Coutinho, 1939; Fournier, 1939) have given taxonomic recognition to these trends.

The North African populations are the most distinctive, generally being more robust and pubescent than the European, and having broadly ovate basal leaves with subcordate bases. The shape of the basal leaves in these plants does not allow a clear distinction between *Doronicum plantagineum* and *D. orientale*. These North African populations have been treated as subspecies or varieties of *D. pardalianches* or *D. plantagineum* (Chabert, 1892; Barratte, 1893), or as a separate species, *D. atlanticum* (Chabert, 1891; Rouy, 1893), as in Cavillier's monograph (1907, 1911). A multivariate morphometric analysis (PCA and DA) of *Doronicum* (Álvarez Fernández & Nieto Feliner, 2001) reveals no morphometric support for the segregation of these populations as a species from the European populations of *D. plantagineum*. On the other hand, a phylogenetic analysis based on morphological, nuclear ribosomal (ITS), and chloroplast (*trn*L-F) data (Álvarez Fernández et al., 2001) showed differences in ITS sequences between these populations that somewhat support separate species status despite the poor morphological differentiation. Introgression from *D. orientale* into populations of *D. plantagineum* is not ruled out as the cause of sequence differences. Until further work is done, these populations are provisionally included in *D. plantagineum*.

The bulk of the records of *Doronicum plantagineum* are from the Iberian peninsula; a gap occurs in northeastern Spain and southern France, and most of the French records are from near Paris. This is the only representative of the genus in North Africa (northern Algeria and Atlas) and thus seems to be native to the Iberian peninsula and North Africa, its current area of distribution being expanded by human action.

Selected specimens examined. ALGERIA. Teniet el Had, pic des Cêdres, *Alston & Simpson 37736* (BM); Djurdjura, Tala Guilef, Boghni, *Davis 59243* (BM, E); Kabylie, Mt. Magris, *Reverchon 391* (BM, G). MOROCCO. **Meknès:** Ifrane, Azrou, *Bocquet 10476* (BM); Aïn Leuh, *Jahandiez 386* (B, MA). FRANCE. **Haute-Marne:** Louze, Brienne-le Château, *Retz 89985* (G, MA, MACB, MAF). **Seine-et-Marne:** Fontainebleau, *Feuilleaubois 2872* (BR, MA). **Seine-et-Oise:** Port-Villez, 11 May 1873, *Delacour s.n.* (K); forêt de Bondy, Paris, 15 May 1846, *Kralik s.n.* (K); Yvelines, Véthenil, bois du Coudray, *Lawalrée 15798* (BR); Verrières-le-Buisson, Essone, forêt de Verrières, *Retz 67398* (BR, G, MA, MAF). **Somme:** bois de Lize près Ault, May 1862, *Brutelette s.n.* (G). **Var:** bois del Mauret, 28 May 1884, *Leresche s.n.* (B). GREAT BRITAIN. **England:** Great Saling, Essex, *Fox 780* (B, W); Belton, Grantham, 14 June 1887, *Woodward s.n.* (K). **Scotland:** Blair, Culross, 18 Apr. 1872, *Drummond s.n.* (K); Amiston

Wood, Edinburgh, *Syme 654* (G). PORTUGAL. **Algarve:** entre Monchique e Alferce, *Malato-Beliz et al. 3120* (MA). **Alto Alentejo:** Castelo de Vide, Amieira, *Malato-Beliz 196* (MA). **Beira Alta:** serra da Estrela inter Caldas de Manteigas et Poço do Inferno, *Lawrence et al. 4844* (MA). **Beira Baixa:** Fundao, 25 Mar. 1926, *Carrisso & Mendoça s.n.* (BR). **Estremadura:** Malveira, Mt. Leite, *Rainha 1047* (G, MA). **Tras-os-Montes:** Tabuaço, foz do Távora, *G. B., F. G. & J. Vasconcellos 7877* (HVR). SPAIN. **Andalucía:** Jaén, sierra Morena, Despeñaperros, collado de los Jardines, *Cuatrecasas 3526* (MAF); Cádiz, Grazalema, sierra del Pinar, *López & Morales 3008 GF* (MA). **Aragón:** Zaragoza, entre Cosuenda et Tobed, sierra de Algairén, *Gómez et al. 63591* (G, MAF). **Cantabria:** Vega de Liébana, entre Dobres y Bárago, *Álvarez et al. 966* (MA). **Castilla-La Mancha:** Guadalajara, Retiendas, hoz del río Jarama, *Álvarez et al. 954* (MA). **Castilla y León:** Burgos, Frías, entre Tobera y Valderrama, *Almaraz & Álvarez 977* (MA). **Comunidad de Madrid:** Lozoya, puerto de Navafría, *Susanna 776* (MA, MO, NY); **Comunidad foral de Navarra:** Foz de Arbayún, 11 May 1971, *Villar s.n.* (JACA). **Extremadura:** Cáceres, Guadalupe, 18 May 1991, *Rubio s.n.* (MAF). **Galicia:** Orense, Cobas, *García Martínez et al.* (MA); **Principado de Asturias:** Ponga, Beleño, 10 Apr. 1998, *Medina s.n.* (MA). **Región de Murcia:** Moratalla, sierra de La Muela, *Álvarez et al. 1103* (MA).

25. Doronicum reticulatum Boiss., Diagn. Pl. Orient. ser. 1, 4: 12. 1844. TYPE: Turkey. Tmolus Bogdagh, Lydia, [*P. E. Boissier*] *3969* (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 805), G-BOIS!).

Doronicum bithynicum J. R. Edm., Notes Roy. Bot. Gard. Edinburgh 32(2): 257. 1973. Syn. nov. TYPE: Turkey. Bursa, Olympi Bithyni, *P. M. R. Aucher-Eloy 3269* (holotype, G!; isotypes, BM!, E!, K!).

Plant up to 80(+) cm tall. *Rhizomes* woody to somewhat woody, glabrous, sometimes with leaf remains forming scales on nodes. *Stems* branched in the upper part, leaves mainly distributed in the lower middle portion, upper internodes generally longer than the adjacent leaves. Indumentum of uniseriate eglandular trichomes, rarely with a few multiseriate eglandular trichomes, sometimes with glandular trichomes, more abundant near the capitula and sometimes glabrous at the base. *Leaves* entire or subentire. Basal leaves sometimes present at flowering time; blade 7.5–16.5 × 7–15 cm, orbicular or ovate, with cordate base and blunt apex, with actinodromous venation; petiole 10–17.5 cm long, with sheathing base, sheath (1)3–5 cm long. Lower cauline leaves with blade 8–9.5 × 7–8 cm; petiole 10–13 cm long, 1.5–2.5 mm wide, similar to basal leaves. Middle cauline leaves 6.3–10 × 2.6–7 cm, sessile, fiddle-shaped to obovate, semiamplexicaul. Upper cauline leaves 2.8–4.5 × 1–1.6 cm, sessile, ovate to obovate, or bract-like. Indumentum similar to the adjacent part of the stem, sometimes abundant on veins on the abaxial surface of leaves. *Capitula* 3 to 5, 4–6.5 cm diam. including rays; involucre shorter than rays or equaling them, 3.5–4 cm diam.; peduncles up to 11 cm. *Phyllaries* herbaceous, sometimes slightly papery, ovate-lanceolate with very tapering acute apex, generally with 8 to 12 longitudinal veins dark-colored; the outer 1.5–2 cm long, 2.2–5.5 mm wide; the inner 1.4–1.6 cm long, 1.2–3 mm wide. Indumentum of glandular trichomes. *Receptacles* glabrous. *Flowers* with yellow corollas. Ray flower corollas 1.7–3 cm long, 4–6 mm wide, obovate-elliptic to oblong-elliptic, apex generally with 3 teeth. Disk flower corollas 5–6 × 1–3 mm. *Cypselae* brown, with slightly grooved-reticulate surface, dimorphic. Cypselae from ray flowers 3.5 × 0.8 mm, glabrous or glabrate, without pappus. Cypselae from disk flowers 3 × 1 mm, sometimes with eglandular trichomes; pappus ca. 4 mm, white. (Completely mature cypselae not seen.) Chromosome number unknown.

Illustrations. Figures 7B, 26E–H.

Distribution. Western Turkey (Bolu, Bursa, and Konya provinces). Growing in woods and open moist rocky places, altitude 1800–2200 m (Fig. 14).

Doronicum reticulatum is morphologically similar to those species with a "*macrophyllum*" habit in southwestern Asia, but it is quite distinctive because of its unique type of phyllaries (Fig. 26E, F), which are ovate-lanceolate ending in a long tapering apex, and with 8 to 12 longitudinal veins dark-colored. *Doronicum reticulatum* grows only in western Turkey where there is no overlap with any other species of the "*macrophyllum*" group, although it is geographically close to *D. cacaliifolium*. The only species that overlaps its area is *D. orientale*, which is morphologically quite different (i.e., habit, type of phyllaries, type of rhizome; Figs. 5E, F, 26E, F). See also comments on *D. cacaliifolium* and *D. macrophyllum* subsp. *sparsipilosum*.

The name *Doronicum bithynicum* J. R. Edm. was given by Edmondson (1973) for a *pro parte* of the illegitimate name *D. thirkei* Schultz Bip. ex Boiss. (Boissier, 1875: 379). Boissier's name includes his *D. reticulatum* Boiss. (1844), which was collected in Tmolus Bogdagh, and also plants from Mt. Olympus in Bithynia. Edmondson (1973) considered these to be two different species, and he gave the name *D. bithynicum* for those plants from Mt. Olympus, reserving the name *D. reticulatum* for those from Tmolus Bogdagh. In this study, however, no diagnostic characters to separate *D. bithynicum* (Edmondson, 1973) and *D. reticulatum* were found.

Accordingly, these names are here considered synonyms.

Selected specimens examined. TURKEY. **Bolu:** Ala dag Kartalkoy, *Alpay 2642* (E); Köroglu, *Buchner 83-70-13* (W); Ala dag, Kartal Kaya, *Davis & Coode 37372* (E, K). **Bursa:** Uludag, *Aytaç & Ekici 6229* (GAZI); Uludag, *A. & T. Baytop 20972* (E); Uludag, Bithyniae, *Bernardi 18013* (G); Mt. Olymp., July 1873, *Pichler s.n.* (K); Belvedere above Bursa, *Polunin 15054* (E); Uludag, 1968, *Sorger 68-53a-6* (W); Uludag bei Bursa, *H. & E. Walter 641* (B). **Konya:** Phrygia, Akscheher, Mt. Sultandagh, *Bornmüller 9620* (B).

26. Doronicum stenoglossum Maxim., Bull. Acad. Imp. Sci. Saint-Petersbourg 27: 483. 1881. TYPE: "China occidentalis, Regio Tangut (prov. Kansu)," 1880, *N. M. Przevalski s.n.* (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999: 805), K!).

Doronicum souliei Cavill., Annuaire Conserv. Jard. Bot. Genève 10: 235. 1907. Syn. nov. TYPE: China. Tibet, Kiala, Tongolo, *J. A. Soulié 335* (lectotype, designated here, G!; isotype, K!).

Plant up to 120 cm tall. *Rhizomes* woody, glabrous, without leaf remains, sometimes with adventitious roots at the base of stem. *Stems* simple or branched, sometimes branched from the base, with leaves all along the stem. Indumentum of long-stalked glandular trichomes (0.5–1 mm), and sometimes also eglandular blunt trichomes (ca. 1 mm), more abundant near the capitula, sometimes glabrous to glabrate at the base. *Leaves* entire to very slightly dentate. Basal leaves absent at flowering time; blade ca. 6 × 3 cm, oblong elliptic, with attenuate base and blunt to subacute apex, with actinodromous to pinnate-actinodromous venation; petiole ca. 13 cm long, 2 mm wide. Lower and middle cauline leaves 3.5–15 × 1.1–6 cm, similar to basal leaves or sessile, almost fiddle-shaped to ovate-elliptic, semi-amplexicaul. Upper cauline leaves 2–6 × 0.5–2.5 cm, similar to middle cauline leaves, or ovate-lanceolate, sometimes bract-like. Indumentum scarce, mainly glandular, sometimes also eglandular blunt trichomes, more abundant on margins of upper leaves. *Capitula* 2 to 11, 1.5–3 cm diam. including rays and phyllaries; involucre longer than rays or equaling them. *Phyllaries* herbaceous, very narrowly triangular-subulate, almost linear, erect, acute; the outer 1.3–2.1 cm long, 1–2 mm wide; the inner 1.3–1.8 cm long, 0.7–1.5 mm wide. Indumentum only present in the lower half, similar to the upper part of stem, absolutely glabrous in the upper half. *Receptacles* glabrous. *Flowers* with pale yellow to green corollas. Ray flower corollas 1–1.3 cm long, 0.5–1.8 mm wide, linear, apex generally with 3 teeth. Disk flower corollas 3.5–4.3 × 0.5–0.8 mm, narrowly obconical. *Cypselae* brown to brown-red, with warty surface, homomorphic, 2–3 × 0.7–1.8 mm, glabrous to glabrate, with scattered short eglandular trichomes (ca. 0.1 mm). Pappus 4–6 mm, consisting of one row of white to white-yellow capillary bristles; pappus from ray flowers caducous as a whole crown. Chromosome number unknown.

Illustrations. Figures 4E–H, 6D.

Distribution. South-central China (provinces of Gansu, Sichuan, Tibet-Qinghai, and Yunnan). Open moist rocky places, woods, meadows, and near watercourses, altitude 3000–5000 m (Fig. 21).

Doronicum stenoglossum is the most distinctive species within the genus. In fact, historically it was treated as a different section (*Soulieastrum*), under *D. souliei* Cavill. by Cavillier (1911). Together, the large amount of autapomorphies makes its appearance quite different, specially regarding the capitula. The shape, size, and color of flowers and shape and size of phyllaries are unique within the genus (Fig. 4E, F). In a phylogenetic analysis based on molecular data (Álvarez Fernández et al., 2001) it is deeply nested within a group of central Asian species that share no morphological synapomorphies at all, indicating that its distinctive characters are autapomorphies and that the subgeneric treatment in this case is not appropriate. (See also comments under *D. briquetii* and *D. kamaonense*.)

Cavillier (1911: 360) included *Doronicum stenoglossum* in his section *Soulieastrum*, but because he could not see the type material, he concluded that the treatment was tentative. He mentioned that based on its protologue, the most similar species is *D. souliei* Cavill. When type material of both names was studied, the same identity was determined in both cases. Thus, the name *D. souliei* is treated as a synonym of *D. stenoglossum*, which has priority. To clarify the identity of *D. souliei*, a lectotype was designated above based on Cavillier's citation in the protologue. Two sheets that match his citation were found at G and K, respectively, and the one best preserved was selected as lectotype.

Selected specimens examined. CHINA. **Gansu:** Hai Tchoang ze, *Licent 4730* (BM, K); T'ao river, Merku valley, *Rock 12941* (GH); Tebbu, Drakana, Wapaku, *Rock 14599* (E, K, NY). **Sichuan:** Sungpan-hsien, *Fang 4129* (E, K, NY); Mts. Hu-li, *Forrest 16825* (E, K); Mt. Kungala, 25 July 1885, *Potanin s.n.* (LE); Guma-Kika, 6 Aug. 1885, *Potanin s.n.* (LE); Mt. Mitzuga, Muli Gomba, *Rock 16566* (E); Sikang, Kangting, Tachienlu, Chungo Valley, Hsintientzü, *Smith 11378* (BM, GH, MO, UPS, W); Dongrergo, *Smith 3587* (E, UPS); Hsioeh-shan, 19 July 1922, *Smith 3880* (UPS); Tachienlu, Hadjaha, *Stevens 392* (W); Sung-

pan, 1914, *Weigold s.n.* (W). **Tibet-Qinghai:** Dari Darlag Xian, Sainaniuda, Jimai Güymai Xiang, Huang He, *Bartholomew & Gilbert 1205* (E, MO); Reting, *Ludlow & Sherriff 8931* (BM, E). **Yunnan:** Lai-cha-tse-ka, Hsia-Chungtien, *Feng 1893* (GH); Lichiang, *Forrest 2663* (BM, E); Chungtien plateau, *Forrest 10586* (BM, E, K, W); Muli, Dschungdien, Tschako, *Handel-Mazzetti 1343* (W); between Likiang, Tungshan, Tuinaoko and Tsilikiang, *Rock 9747* (E, GH, NY); Muli, Wachin, Jin-chang, *Yü 14593* (BM, E, GH).

Taxa Excluded from *Doronicum*

Doronicum thibetanum Cavill., Annuaire Conserv. Jard. Bot. Genève 10: 225. 1907. TYPE: "Thibet" 1882, *J. Murr s.n.* (lectotype, designated here, G-BOIS!).

This taxon belongs in the genus *Aster* sect. *Alpigeni* subsect. *Homochaeta* (cf. Álvarez Fernández & Nieto Feliner, 2000). To clarify the identity of this name that was in current use until a recent study (Álvarez Fernández & Nieto Feliner, 2000), its lectotype was designated above.

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Appendix 1

List of species and subspecies

1. *Doronicum altaicum* Pall. [LT (lectotype) by Álvarez Fernández & Nieto Feliner, 1999]
2. *Doronicum austriacum* Jacq. [LT by Pérez, Llamas, Acedo & Penas, 1997]
3. *Doronicum briquetii* Cavill. [LT by Álvarez Fernández & Nieto Feliner, 1999]
4. *Doronicum cacaliifolium* Boiss. & Heldr. [LT by Álvarez Fernández & Nieto Feliner, 1999]
5. *Doronicum carpaticum* (Griseb. & A. Schenk) Nyman
6. *Doronicum carpetanum* Boiss. & Reut. ex Willk. [LT by Chacón, 1987]
6a. *Doronicum carpetanum* Boiss. & Reut. ex Willk. subsp. *carpetanum*
6b. *Doronicum carpetanum* Boiss. & Reut. ex Willk. subsp. *diazii* (C. Pérez Morales & A. Penas) Álv. Fern.
6c. *Doronicum carpetanum* Boiss. & Reut. ex Willk. subsp. *kuepferi* (R. Chacón) Álv. Fern.
6d. *Doronicum carpetanum* Boiss. & Reut. ex Willk.

subsp. *pubescens* (C. Pérez Morales, A. Penas, F. Llamas & C. Acedo) Aizpuru

7. *Doronicum cataractarum* Widder

8. *Doronicum clusii* (All.) Tausch

9. *Doronicum columnae* Ten. [LT by Álvarez Fernández & Nieto Feliner, 1999]

10. *Doronicum corsicum* (Loisel.) Poir.

11. *Doronicum dolichotrichum* Cavill. [LT by Álvarez Fernández & Nieto Feliner, 1999]

12. *Doronicum falconeri* C. B. Clarke [LT by Álvarez Fernández & Nieto Feliner, 1999] = *Doronicum turkestanicum* Cavill. [LT here]

13. *Doronicum gansuense* Y. L. Chen

14. *Doronicum glaciale* (Wulfen) Nyman [LT by Álvarez Fernández & Nieto Feliner, 1999]
= *Arnica doronicum* Jacq. [LT here]

15. *Doronicum grandiflorum* Lam. [LT by Álvarez Fernández & Nieto Feliner, 1999]
= *Doronicum portae* Chabert [LT here]
= *Doronicum scorpioides* Lam. [LT here]

16. *Doronicum haussknechtii* Cavill. [LT by Álvarez Fernández & Nieto Feliner, 1999]

17. *Doronicum hungaricum* Rchb. fil. [LT by Álvarez Fernández & Nieto Feliner, 1999]

18. *Doronicum kamaonense* (DC.) Álv. Fern. [LT by Álvarez Fernández, 2001]

19. *Doronicum macrophyllum* Fisch. [LT by Álvarez Fernández & Nieto Feliner, 1999]

19a. *Doronicum macrophyllum* Fisch. subsp. *macrophyllum*

19b. *Doronicum macrophyllum* Fisch. subsp. *sparsipilosum* (J. R. Edm.) Álv. Fern.

20. *Doronicum maximum* Boiss. & A. Huet [LT by Álvarez Fernández & Nieto Feliner, 1999]

21. *Doronicum oblongifolium* DC. [LT by Álvarez Fernández & Nieto Feliner, 1999]

22. *Doronicum orientale* Hoffm.
= *Doronicum caucasicum* M. Bieb. [LT here]

23. *Doronicum pardalianches* L. [LT by Llamas, Pérez, Acedo & Penas in Jarvis & Turland, 1998]

24. *Doronicum plantagineum* L. [LT by Llamas, Pérez, Acedo & Penas in Jarvis & Turland, 1998]

25. *Doronicum reticulatum* Boiss. [LT by Álvarez Fernández & Nieto Feliner, 1999]

26. *Doronicum stenoglossum* Maxim. [LT by Álvarez Fernández & Nieto Feliner, 1999]
= *Doronicum souliei* Cavill. [LT here]

Appendix 2

index to exsiccatae

Specimens are listed alphabetically by collector, followed by collection number or date, only when collector number is unavailable. The number in parentheses corresponds to the number in the List of Species and Subspecies above.

J. Abel, 94 (12); A. Achverdov & A. Doluchanow, 15 Aug. 1929 (21), 17 Aug. 1929 (21); Adamovic, May 1896 (17), June 190? (22), July 1900 (9), July 1905 (9), July 1917 (5); C. Aedo, 25 July 1982 (6d), 2 July 1983 (6d), 25 Aug. 1985 (6b), 16 May 1987 (24), 2 Aug. 1987 (15), 8 July 1990 (15); C. Aedo et al., 2888 (23), 3631b (6d); P. Aellen, 20 July 1932 (10); R. Ajdarova, 21 May 1983 (12); J. R. Akeroyd, 53 (9); I. Akinfiew, 29 July 1893 (21); Al. Buia, 2 May 1963 (17); Albury, Cheese & Watson, 705 (22), 1751 (22), 3159 (11), 3176 (21); J. A. Alejandre, 333-86 (24); J. A. Alejandre et al., 1460 (6d); R. C. Alexander, 1842 (2) (14); Alexcenko, 12861 (19a), 8 July 1897 (19a), 31 June 1901 (12); Alexcenko & Woronow, 13586 (21); Ch. S. Ali & Metz, 157 (12); T. Almaraz, 26 July 1997 (15); T. Almaraz & I. Álvarez, 977 (24), 979 (24); T. Almaraz, I. Álvarez, & M. A. García, 1008 (23), 1009 (23), 1015 (23); T. Almaraz, I. Álvarez, M. A. García & R. Duno, 984 (24); T. Almaraz, I. Álvarez, M. A. García & L. Medina, 802 (6a); T. Almaraz, I. Álvarez, M. A. García & E. Monasterio-Huelín, 804 (6a), 805 (6a); T. Almaraz & A. Cano, 275 (15), 288 (15); Alpay, 2641 (22), 2642 (25); A. H. G. Alston & N. Y. Sandwith, 45 (9), 441 (2), 691 (9), 2119 (2), 2065 (9), 1528 (9); A. H. G. Alston & N. D. Simpson, 37736 (24); I. Álvarez, 923 (6d), 927 (6d); I. Álvarez, M. A. García, Jansen, L. Medina & M. Sequeira, 1296 (6d); I. Álvarez, M. A. García & E. Monasterio-Huelín, 924 (6b), 926 (6d); I. Álvarez & N. Yagüe, 929 (6a), 931 (6a), 932 (6a), 933 (6c), 935 (6c), 936 (6d), 937 (6d), 941 (6d), 942 (6d), 944 (15); I. Álvarez et al., 800 (23), 801 (23), 943 (15), 954 (24), 966 (24), 1038 (6c); I. Álvarez, A. Herrero & N. Yagüe, 1350 (14), 1353 (8), 1354 (9), 1355 (8); F. Amich, 22 Apr. 1978 (24), 12 May 1978 (24); F. Amich. & F. Herrero, 17 May 1983 (24); F. Amich, E. Rico & J. Sánchez, 26 July 1977 (15), 28 June 1979 (6a); F. Amich, E. Rico, J. Sánchez & X. Giráldez, 25 Apr. 1981 (6d); Ananiva, 28 May 1955 (17); H. Andres, 695 (23); R. M. Andrés, 18 July 1974 (6d); R. Ansin, 392 (22); A. Aparicio, P. Murillo & S. Silvestre, 28 June 1984 (24); J. M. Aparicio & P. M. Uribe-Echevarría, 27 July 1993 (15); H. Appleton, 749 (12), 902 (12); V. J. Arán & M. J. Tohá, 10 Aug. 1987 (23), 13 May 1995 (24); M. Arbella, 16 June 1981 (15); J. C. Archibald, 326 (9), 585 (2); Ar-Leybuev, 532 (9); E. Armstrong, 19 May 1949 (23); A. Arvat, 7 May 1934 (17); Arvet-Touvet, Chaboisseau & Fauré, 1687 (8); C. Aseginolaza & D. Gómez, 21 July 1988 (23), 2 Aug. 1988 (23); Assadi & Mozaffarian, 30306 (11); S. C. Atchley, 945 (9), 2250 (9); L. Ateride, Aug. 1918 (15); Aucher-Eloy, 3268 (22), 3269 (25), 3848 (22), 4751 (22), 2 Apr. 1865 (22); Audibert, 1828 (24); Ausserdorfer, July 1863–65 (9), 6 July 1865 (9), 13 July 1865 (9), 10 Aug. 1873 (14); Averianov et al., 2421 (21), 2461 (21), 2837 (19a), 3200 (19a); Z. Aytaç, 1167 (22), 2933 (19a); Z. Aytaç & M. Ekici, 6229 (25); G. V. Aznavour, 27 Mar. 1892 (22), 10 May 1896 (22), 7 Apr. 1889 (22), 12 Apr. 1904 (22).

M. Bäbler & I. Quasdorf, 625 (9), 758 (9), 965 (9); Backir, 183 (11), 220 (19a); C. Baenitz, 7 Aug. 1895 (2); Balansa, 728 (25), 1866 (19a); A. Baldacci, 14 (9), 258 (9), 371 (9), 457 (9); J. Ball, Sep. 1842 (15), July 1844 (2), 6 Aug. 1858 (2), 25 Aug. 1860 (9), 14 Aug. 1861 (15), 18 June 1862 (23), 3 July 1862 (15), 15 Aug. 1866 (15), 29 Aug. 1869 (9), 3 Aug. 1875 (9), July 1877 (9), Sep. 1883 (15), 24 Aug. 1884 (15), Aug. 1887 (15), Sep. 1887 (2); P. W. Ball, 28 May 1958 (23); E. K. Balls, 298 (22), 1049 (22); E. K. Balls & W. B. Gourlay, 3231B (9), 3264B (22); L. Baniova & L. Kuprienova, 14 June 1960 (2); V. Barabas, 18 July 1973 (2); W. Barbey, 919 (22), 23 Apr. 1873 (22); R. Barbezat, 1834 (2); T. H. Barbour, Aug. 1922 (18); C. Barclay, 1521 (22); I. Barrera, 29 June 1982 (24); J. Barth, 20 May 1873 (17), 17 June 1885 (2), 15 June 1887 (2), 15 Aug. 1888 (9); B. Bartholomew & M. Gilbert, 1205 (26); E. Baschant, Aug. 1922 (2), June 1925 (23), 14 May 1934 (23), July 1935 (8), 24 June 1937 (2), 1 July 1937 (8), 1943 (2), 1 July 1947 (2), Aug. 1948 (15), Aug. 1950 (15); Bayern, 1860 (19a); A. Baytop, 4108 (22); A. & T. Baytop, 20972 (25); T. Baytop, 11296 (22); G. Beauverd, 272 (22); C. Beck, 6 Aug. 1968 (8), 13 Aug. 1968 (2), 6 July 1974 (19a), 11 Aug. 1976 (9); G. Beck

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F. Oberleitner, 73 (15), 8 July 1864 (2), 30 July 1865 (14), 19 July 1867 (8), 21 July 1868 (8), 30 June 1869 (2), 2 Aug. 1872 (8), 28 July 1874 (14); L. Oberneder, 5817 (15), 5935 (2); R. & L. Oberneder, 6497 (8); A. Oborny, 12 Aug. 1878 (2); H. Ocakverdi, 2340 (11); V.

M. & B. M. Ogievskie, 25 June 1913 (1); T. G. Orphanides, 196 (22), 340 (9), July 1854 (9), July 1854 (9), 5 May 1857 (22); B. B. Osmaston, 28 (18); B. Ovchinnikov & M. Usov, 301 (12); Owerin, 26 June 1861 (19a); Ch. Ozanon, 3 Aug. 1858 (15).

H. Pabot, 1717 (20); J. Paczoski, 6 May 1901 (17), 23 Apr. 1909 (17); J. Paillot, 2279′, 24 May 1859 (23); Pajarón, 683 (24); Palacio, Carrillo & Ferrero, 5 July 1997 (6c); P. Palézieux, 1 Aug. 1898 (9); I. V. Palibin, 5 June 1908 (8), 7 Aug. 1908 (15); A. Pallarés, 15 Apr. 1990 (24), July 1994 (15), May 1996 (24); W. Panknin, 24 May 1936 (23); J. Pantocsek, May 1868 (17), 8 Apr. 1906 (17); J. Papp, 25 Apr. 1946 (22); D. Parascan, 7 June 1960 (5); D. Parascan, E. Lungescu & D. Radu, 30 June 1960 (9); M. Pardo de Santayana & R. Morales, 1690 (6d); Parlatore, 18 Apr. 1856 (9), 1863 (22), 1866 (2); Parseval-Grandmaison, 31 May 1872 (23); N. L. Pastushov, 20 Apr. 1925 (22); S. Patino, Uribe-Echevarría & Valencia, 27 May 1990 (6d); Patrin, 1780 (1); Patzak, Sep. 1953 (2) (7); C. Pau, 2386 (24), 27 July 1900 (6c); A. Pávai, 1875 (17), 187? (9); N. V. Pavlov, 601 (12); V. Payot, 1855 (15); S. Peker, 1178 (22); G. Pellanda, 10 May 1913 (9); A. Penas & M. E. García, 31 Mar. 1983 (24); A. Penas, M. E. García & L. Herrero, 3 May 1987 (24); E. Penkovskaya & I. Krasnoborov, 1 July 1964 (1); R. V. Pennington, 22 (9), 25 (9), 30 (9), 41 (9); J. L. Pérez Chiscano, 1 June 1974 (24); Tx. Pérez, A. Salazar & P. Urrutia, 20 July 1991 (6a); C. Pérez Morales, 27 July 1988 (6b); Pérez Morales et al., 11 July 1992 (6d); E. Perrier, 1849 (23); C. Persson, 5 Aug. 1934 (12); H. Pesmen, 727 (22); H. Pesmen & A. Güner, 2213 (22); S. Petrovič, 2200 (17), 2340 (22), Apr. 1882 (22), Apr. 1885 (17), Apr. 1887 (22), June 1887 (2); F. Petzi, 193 (2); V. V. Peznichenko, 108 (12); T. Pichler, 81 (22), 21 Aug. 1864 (15), Aug. 1864 (9), June 1872 (9), July 1873 (25), June 1874 (22), July 1874 (25), Apr. 1876 (22), 1878 (14), May 1890 (9), July 1892 (14); C. Pinard, 1843 (22); Pirker, Royl & Fleischer, 315 (2); C. J. Pitard, July 1906 (15); E. Pobedimova, 45 (12), 339 (12); D. Podlech, 37607 (9); Poisson, May 1879 (24); A. Polatschek, July 1969 (2), 9 May 1981 (23); A. V. Polo hij, 18 July 1947 (1); O. Polunin, 56/170 (18), 5332 (22), 6238 (12), 8268 (2), 14033 (22), 15054 (25), 15940 (22), 18 Apr. 1956 (22); O. Polunin, W. R. Sykes & L. Williams, 89 (18), 401 (18), 2622 (18), 4364 (18); E. Pop, Apr. 1923 (17); Poplavskaja, Tzinzerling & Sukačev, 2069 (1); M. G. Popov, 311 (12); T. Popova et al., 325 (11); Popovic, 8 July 1954 (8); A. Poretsky, 23 July 1928 (19a); A. Poretsky & G. Schultz, 9 Sep. 1927 (19a); P. Porta, July 1911 (15), Aug. 1858 (15), 27 June 1867 (15), July 1889 (9), Aug. 1893 (15); P. Porta & G. Rigo, 160 (24), 257 (24), 319 (9), 29 May 1895 (9); Post, 12 Aug. 1893 (22); G. N. Potanin, 1884–85 (3), 25 July 1885 (26), 6 Aug. 1885 (26), 24 June 1893 (3); Pojarkova, Rozhetits & Shishkin, 21 July 1940 (2); A. E. Pratt, 570 (26); Preissmann, 31 May 1886 (2); C. Prem & R. Vogt 5026 (2); F. Prenn, 13 Aug. 1945 (15); Prescott, 1830 (1) (22); Prescott-Decie, 1915 (18); M. P. Price, 1910 (1); W. R. Prieè, 492 (22); L. Prilipko, 19 June 1932 (21); L. Prilipko & J. Isaev, 17 July 1934 (21), 4 Aug. 1934 (11); E. Pritzel, July 1927 (8); N. M. Przevalski, 101 (12), 333 (26), 7 July 1877 (12); M. I. Ptaschizky, 16 July 1908 (12); E. Puente & C. Pérez Morales, 27 July 1988 (6b); J. Puyfol, 4925 (2).

H. Raap, 25 May 1895 (9); E. I. Rachkovskaja & V. I. Grubov, 4 Sep. 1949 (2); G. Radle, 40 (19a), 142 (21), 149 (21), 400 (19a); B. Rainha, 1047 (24); J. Ramsbottom, 1918 (22); V. Rastetter, 16 May 1993 (23); Raus, 4864 (11); Raus & Royl, 5057a (9); A. Rawi & I. Serhang, 24553 (11); K. H. Rechinger, 1701 (15), 3224 (15), 17881 (2), 20984 (9), 22674 (22), 23159 (22), 38768 (9), 54337 (22); K. H. & F. Rechinger, 851 (22), 661 (22), 3128 (2), 3794 (22), 3927 (22), 8758 (22), 10735 (2), 25 July 1928 (8); K. H. Rechinger & Scheffer, 711 (9), 1367 (9); L. Rechinger, 2377 (15); A. Regel, 686 (12), 19 July 1877 (12), 26 Aug. 1877 (12), 11 Sep. 1877 (12), 19 June 1878 (12), 20 June 1878 (12), 22 June 1878 (12), 24 July 1878 (12), 4 June 1879 (12), 14 June 1879 (12), 15 June 1879 (12), 16 June 1879 (12); C. Regel, 1 June 1964 (22), 10 June 1964 (22); J. R. Reid, 9 Sep. 1885 (18); Reiter, 10 Aug. 1933 (8); J. Renz, 48989 (20); Renz et al., 11 July 1974 (11); Requien, 250 (10); F. Ressman, 1878 (14); B. Retz, 46062 (24), 67398 (24), 89985 (24), 17 July 1856 (12); E. Reverchon, 16 Aug. 1872 (15), 18 July 1878 (10), 25 July 1878 (15), 28 Aug. 1878 (10), 21 July 1885 (10), 22 June 1886 (23), June 1898 (24); V. V. Reverdatto, 26 July 1942 (1); M. Reymond, 27 July 1931 (12); H. H. Rich, 1165 (18); A. Richter, 520 (17), 2772 (1), May 1872 (17), 13 May 1900 (17), 25 June 1900 (2), 12 May 1902 (9), 15 May 1907 (17), 31 July 1908 (9), 11 July 1909 (9); K. Richter, 17 July 1887 (2); E. Rico, 27 May 1983 (6a), 22 Aug. 1983 (6c); E. Rico, X. Giráldez & T. Romero, 17 July 1985 (6a); G. Rigo, 24 (22), 70 (9), 430 (9), 8 July 1870 (15), May 1873 (17), 12 July 1886 (9); S. Rivas Goday, 15 May 1924 (24), 18 May 1941 (24), 30 Apr. 1944 (23), 22 Apr. 1945 (24), 7 Aug. 1946 (6c), 18 Apr. 1957 (24), 26 July 1958 (6c), 20 May 1959 (24), 1 June 1966 (24); S. Rivas Goday & F. Bellot, 30 Mar. 1940 (24); S. Rivas Goday & M. Ladero, 3 Apr. 1969 (24); S. Rivas Goday, M. Ladero & Valdés, 12 July 1974 (6a); S. Rivas Goday & Monasterio, 10 Aug. 1947 (6a); S. Rivas Goday, S. Rivas Martínez & M. Ladero, 28 June 1970 (6a), 30 June 1973 (6a); S. Rivas Goday & E. Valdés Bermejo, 11 July 1974 (6d); S. Rivas Martínez, 25 Aug. 1957 (6a), 25 July 1958 (6c), 13 July 1965 (15), 1 June 1975 (24), 24 Aug. 1978 (6a); Rivas Martínez, M. Costa & J. Izco, 11 July 1973 (6a); S. Rivas Martínez & J. Izco, 25 Aug. 1967 (6c); S. Rivas Martínez, M. Ladero & M. Mayor, 1 June 1966 (24); S. Rivas Martínez & E. Valdés Bermejo, 7312 (6d); S. Rivas Martínez et al., 13 July 1965 (15), 13 July 1977 (6d), 16 June 1981 (6d), 5 July 1982 (6a) (24), 26 July 1989 (6c); J. Rivera, 25 Apr. 1978 (24); A. Roa, 22 June 1987 (6a); V. I. Roborowski, 205 (12); J. F. Rock, 9681 (3), 9747 (26), 9989 (3), 12192 (13), 12389 (13), 12941 (26), 13020 (13), 14599 (26), 16566 (26), 16834 (3), 22380 (3), 22891 (3), 23067 (1); L. Rodin, 1231 (12); J. Rodríguez-Oubiña & I. Cruces, 20 June 1997 (6d); Rogers, 234 (23), 717 (22); J. Rohlena, Aug. 1912 (9), June 1922 (9), July 1933 (9); I. Roldugin, 4871 (12); Römer, 30 May 1886 (9), June 1892 (9); C. Romero, July 1976 (15); K. Ronniger, 29 July 1883 (2), 29 July 1892 (2), 8 July 1918 (8), 20 May 1924 (9), 21 July 1930 (2), 24 July 1930 (2); R. J. Roshevitz, 11 June 1908 (12), 27 June 1908 (12), 7 July 1908 (12), 9 July 1908 (12), 1 Aug. 1908 (12), 3 July 1909 (12); H. Ross, July 1888 (22), May 1901 (22), June 1901 (22); S. Rossi & A. Malladra, Aug. 1890 (8) (15); W. Rössler, 8 (2); E. Rostan, 1850 (8), July 1860 (15); J. Röthlisberger, 29 July 1978 (9), 17 Apr. 1979 (22); W. Rothmaler, 8 Aug. 1933 (6d); W. Rothmaler & A. P. Silva, 15813 (24); Rotky, July 1885 (15); Rottenbach, 23 May 1894 (23); N. Roux & Blanc, 28 July 1899 (15); G. Rouy, 24 July 1874 (2), 14 May 1876 (24), 7 May 1879 (24); C. Royer, July 1874 (2); Royl & Hempel, 22 Sep. 1986 (8); Royl, Hempel & Richter, 19 Sep. 1986 (8); Royl & Ketelhut, 4 Sep. 1987 (15); Royl & Schiers, 1982

(8); A. Rozeira, 19 May 1946 (24); A. Rubio, 18 May 1991 (24); N. I. Rudstov, 13 July 1934 (12); Ruprecht, 154 (21), 156 (21), 1354 (19a), 22 Mar. 1861 (22), 10 June 1861 (21), 5 July 1861 (21), 8 July 1861 (21), 15 July 1861 (21), 26 July 1861 (21), 9 Aug. 1861 (19a), 7 Sep. 1861 (19a); Russell, 1235 (12), 1291 (12), 1424 (12).

J. Šafer, 15 June 1895 (2); Saint-Lager, 3 July 1896 (22), 7 June 1919 (23); G. Samuelsson, 21 May 1933 (22), 26 Apr. 1933 (22); G. Samuelsson & A. Zander, 22 Apr. 1931 (22); D. Sánchez-Mata, 9 June 1984 (24), July 1984 (6a), 9 July 1986 (6a); D. Sánchez-Mata, S. Laorge & D. Belmonte, 20 May 1982 (6c); Sánchez Pedraja, 21 Apr. 1992 (24); Sánchez Pedraja & Tapia Bon, 226/96 (24), 598b/96 (6d); N. Y. Sandwith, 3737B (23), 5340 (6b), 5684 (6a), 18 May 1935 (24), 30 June 1935 (23); V. Saposhnikov, 16 June 1902 (12), 30 June 1902 (12), 6 July 1912 (12), 22 June 1913 (12), 13 July 1913 (12), 14 Aug. 1923 (1); V. Saposhnikov & Shishkin, 15 July 1912 (12); V. Saposhnikov & T. Tripolitova, 7 July 1915 (12); F. Sappa & E. F. Galiano, 9 Aug. 1952 (15); S. Sardinero, 3 June 1990 (6a), 12 July 1990 (6a), 14 July 1990 (6c), 3 Aug. 1990 (6c), 23 Aug. 1990 (6c), 21 June 1991 (6a), 12 July 1991 (6c), 19 July 1991 (6a), 25 July 1990 (6c), 29 July 1991 (6a); E. M. Saunders, June 1915 (18); D. Sauter, 971 (14); D. Sauter & A. Traunsteiner, May 1836 (14); Schafferer, 16 Aug. 1890 (8); K. Scheer, 5 May 1918 (22); A. B. Schelkovnikov, 29 June 1909 (21), 15 July 1909 (21), 2 July 1911 (19a); A. B. Schelkovnikov & E. Kara-Murza, 13 July 1927 (19a), 9 Aug. 1928 (21), 16 Aug. 1928 (11) (19a); C. Scheppig, 30 June 1885 (23), 10 July 1887 (23); A. Scherfel, July 1880 (8), 28 July 1893 (8); N. Schestunov, 1137 (22); B. Schischkin, 26 May 1912 (12), 7 June 1912 (12), 2 Apr. 1917 (22), 6 July 1919 (19a), 4 July 1920 (11); B. Shishkin & G. Sumnevicz, 24 June 1931 (1); Schlagintweit, 5962 (3), 1855 (18); F. Schmid, 438 (12), 5989 (11); C. K. Schneider, 11 (9), 300 (17); C. K. Schneider, & Bergmann, 881 (2); J. Schneider, 22 May 1929 (17); Schneller, 23 June 1859 (17); H. Scholz & P. Hiepko, 988 (24); M. Schreiber, 10 Aug. 1911 (8); H. Schrenk, 8 Aug. 1925 (15); F. Schuhwerk, 85/32 (23); O. & R. Schulz, 20 July 1894 (2), 21 July 1894 (2); R. Schulz, 6 May 1894 (23), 19 July 1894 (2), 27 July 1899 (14), 31 July 1899 (14), 1 Aug. 1899 (9), 6 July 1902 (23); R. & O. Schulz, 18 May 1895 (9), 7 July 1896 (9); A. Schumacher, 1 June 1933 (23), 4 June 1968 (23); Schur, July 1839 (2), 27 July 1850 (5); O. Schwarz, 642 (22); Schwarzer, 28 Apr. 1848 (9); Schwerdtfeger, 17789 (6a); A. Segura Zubizarreta, 12525 (6a), 12526 (6a), 12527 (6a), 22654 (6a), 16 May 1970 (24), 10 June 1960 (24), 10 Apr. 1961 (24), 8 June 1967 (24), 23 Apr. 1970 (24); Seidl, 90 (21); Seidlitz, 33 (19a); R. Seligman, 53 (9), 103 (9); Sendtner, 301 (9), 302 (2); F. Sennen, 1973 (15), 3968 (2), 4433 (15), 3 Aug. 191? (15), May 1910 (23), 4 Aug. 1916 (15), 10 Aug. 1916 (15), 27 July 1931 (15); F. Sennen & Elías, 1906 (24); M. Serim, 17 S (22); J. A. Sesé, 7 July 1992 (23); J. A. Sesé et al., 18 July 1987 (15); Sharif, 224 (11); B. A. Shatakelberg & I. G. Knorring, 17 Aug. 1937 (12); G. Sherriff, 7405 (12); Shirokova, 6 May 1948 (17); H. Sholz, 19 May 1974 (23); T. B. Shrestha, 5165 (18), 5180 (18); Siami, 3809 (11); Sidebotham, 15 (9); F. G. Sieber, 85 (15); W. Siehe, 118 (22), 1895 (22); F. J. Silva Pando et al., 1394 (6d); L. Simkovics, 20 Apr. 1873 (22), 9 Aug. 1883 (5); Simonkai, 1816 (5); P. Sintenis, 80 (22), 196 (22), 244 (22), 414 (2), 731 (2), 733 (9), 882 (22), 3844 (22), 3902 (22), 3995 (22), 5529 (22), 7173 (19a); P. Sintenis & J. Bornmüller, 17 May 1891 (22); W. Sladen, 9/4/451 (2), 9/4/452 (9); J. Šmarda, Aug. 1934 (8); P. Smirnov, 10 Aug. 1930 (1); V. I. Smirnow, 314 (1), 2968 (1), 17 June 1910 (1), 4 Aug. 1936 (1); A. M. Smith, 17 July 1872 (9); H. Smith, 3270 (3), 3477 (3), 3587 (26), 3880 (26), 11378 (26), 11473 (3); Soc. Rochelaise, 1881 (24); N. D. Socalsky, 76, (12), 141 (12); Soleirol, 2303 (10); Sommier & Levier, 709 (19a); F. X. Soñora, 19 June 1994 (6d); F. Sorger, 84-41-5 (20), 68-53a-6 (25), May 1960 (22), July 1960 (9); F. Sorger & Buchner, 82-89-3 (19a), 82-94-38 (19a), 82-119-16 (19a), 82-123-9 (21); J. A. Soulié, 335 (26); M. Sovetkina, 187 (12), 319 (12), 428 (12); M. Sovetkina & S. Chausova, 1963 (12); V. Spitzel, 1150 (15), 972 (2), May 1836 (2); Sredinski, 1873 (19a); J. D. A. Stainton, 8113 (22), 7381 (9), 7400 (18), 7894 (18), 7961 (9), 8011 (2); J. D. A. Stainton & Henderson, 6197 (19a); J. D. A. Stainton, Sykes & Williams, 3145 (18), 6051 (18); Steane, 62 (18); H. Steininger, July 1881 (2), July 1883 (2), 5 Aug. 1887 (14), 6 Aug. 1887 (2); W. Steinitz, 24 May 1879 (17), 10 May 1881 (17), 20 Apr. 1882 (17), 10 May 1889 (17); W. Steiniz & J. Briquet, 2 May 1880 (17); H. Sterking et al., 28 Apr. 1885 (9); Sterneck, July 1904 (15), July 1908 (9); C. Steurer, 17 Aug. 1886 (15); H. Stevens, 392 (26); J. L. Stewart, 1733 (18); R. R. Stewart, 350a (18), 5367 (18), 6854 (18), 10370 (18), 12638 (12), 20301 (12), 20755 (12), 21539a (18), 21839 (12), 23132 (18); R. R. & I. D. Stewart, 17786 (18); Stewart, 627/K (18); A. Stork, 7025–6 (22), 17 May 1987 (22); I. F. Stranskij, 25 July 1911 (2); T. Strauss, June 1898 (20); V. Střibrný, 10 June 1889 (22), 17 Apr. 1893 (9), 13 May 1893 (9), May 1894 (17), 19 May 1895 (22), 9 May 1896 (17), Aug. 1896 (2), 11 May 1898 (22), 14 May 1899 (22), 5 Aug. 1899 (2), 10 Aug. 1899 (2), 12 Aug. 1899 (2), 26 May 1900 (17), May 1901 (17), Aug. 1903 (2), July 1909 (2), May 1910 (17) (22); Strid, Christiansen & Laulund, 26639 (22); Strid, Christiansen, Moller, 26147 (22); Strid & Papanicolau, 16449 (2); Strid et al., 18182 (9), 18205 (9), 18862 (2), 19540 (2); I. Strupinsij, 25 June 1913 (1); Stubbendorf, 1848 (1); E. Stuckenberg, 29 June 1912 (19a); Stud. biol. Rheno-Trai., 327 (15), 68–1979 (2); Sukačev, Rassadina & Brizshev, 1606 (1); V. S. Summerhayes, 2035 (23), 3548 (2); V. S. Summerhayes & P. F. Hunt, 3767 (23); A. Susanna, 776 (24); J. Suza, 14 July 1925 (2); J. T. Syme, 653 (23), 654 (24); Szépligeti, 6 May 1885 (17), 1890 (17); A. Sztehlo, Aug. 1876 (2).

H. Tabata, Rajbhandari & Tsuchiya, 1072 (18), 3309 (18); H. Tabata et al., 12900 (18), 19355 (18); K. Tamanjan, 4 June 1988 (21); J. Tamemshian & W. Maleer, 31 July 1931 (12); Targioni, 12 July 1857 (2); A. Tatli, 5171 (11); Tausch, Apr. 1865 (17); J. A. Tauscher, 27 May 1875 (17); C. F. Tebbutt, 15 May 1957 (23); H. G. Tedd, 1648 (22); N. I. Temnoev, 123 (1); T. A. Tengwall, 278 (22); Termeh, 8 Aug. 1968 (11), 24 June 1970 (20), 20 July 1971 (19a); Termeh, Moussavi & Habibi, 26 June 1978 (11); Terracciano, July 1871 (9); C. G. H. Thedenius, Aug. 1903 (23); W. Thesiger, 1154 (11); Thomas, 1869 (23); H. P. & H. P. Thompson, 199 (9); Rev. & H. P. Thompson, 77 (9), 123 (9), 176 (9), 523 (9); Thompson, July 1922 (23); Thuillier, 1812 (24); M. K. Timins, 174 (18); Timothée, 4264 (15); V. S. Titov, 15 June 1910 (1), 22 June 1910 (1), 1 July 1914 (12); V. I. Tkatchenko, 182 (12); C. Tobey, 1 (22), 570 (22), 570A (22), 1484 (16), 2563–3 (22); Todaro, 537 (22); A. I. Tolmačev, 10 July 1964 (2); M. Toma, 7 June 1967 (17); E. Topa, 3482b (9); S. Topali, 23 Aug. 1937 (9), 8 July 1938 (9); A. Topitz, 8 July 1885 (2), 20 June 1887 (22); A. Topitz & Jahn, 20 June 1887 (22), July 1889 (22); Torges, 21 May 1894 (23); Touton, July 1887 (15), 6 Aug. 1887 (15), 20 Apr. 1902 (23), 1

June 1902 (23), 21 July 1902 (9), 30 July 1902 (15), 22 July 1903 (15), 13 Aug. 1905 (15), 30 July 1907 (15), 15 July 1912 (15); C. C. Townsend, 84/55 (15), 90/247 (2), 93/574 (15), 94/32 (2), 4 June 1952 (23), 25 May 1953 (23), 18 June 1957 (23); W. Tranzschel, 12 July 1900 (12); G. Treffer, June 1878 (14), 13 July 1878 (8), Aug. 1882 (14), 3 July 1888 (14), 24 July 1890 (14), 13 July 1896 (14), 30 June 1900 (14); A. W. Trethewy, May 1932 (23), May 1937 (23); W. C. Trevelyan, 4 May 1846 (24); L. C. Treviranus, 1825 (14); W. P. Troickij, 14 June 1912 (1), 23 June 1912 (1); N. Tsvelev & S. Cherepanov, 1032 (19a); A. I. Tugarinov, 17 June 1912 (1); Tuhrman, 46 (1); Turczaninov, 1828 (1), 1836 (1); G. Turesson, 848U (1); Turland, 314 (22); J. Tuzson, 23 July 1914 (5); Y. Tzinzerling, 2015 (1).

J. Ullepitsch, 88 (8), July 1894 (8); P. M. Uribe-Echebarría, 228 (24), 1 July 1985 (6a), 30 June 1987 (23); P. Urrutia, 14 July 1992 (6a).

Valdés, Demetrio & Pavón, 14 May 1969 (24); E. Valdés Bermejo et al., 4233 (6d); E. Valdés Bermejo et al., 5812 (6c); V. Valdés Bermejo, 24 July 1972 (6d); O. Valentine, 28 July 1920 (8); Vallin, 20 May 1911 (23); E. Valon, 3 (15); K. Vandas, Aug. 1891 (5), Sep. 1891 (15); C. Vanden Berghen, 18 Aug. 1975 (15); P. Vargas, 2151 (24); V. Vašák, 26 May 1973 (22), 8 Oct. 1974 (21), 9 Oct. 1974 (21), 13 July 1975 (21), 27 July 1975 (19a), 4 July 1982 (21); V. Vašák & G. Esvandzhia, 22 July 1979 (11), 24 July 1979 (11); V. Vašák & A. Zlatník, 28 May 1974 (12); G. B., F. G. & J. Vasconcellos, 7877 (24); Y. Y. Vasiliev, 15 May 1930 (22); S. Vautier, 23 May 1954 (23); Veitch, July 1912 (14); A. Velasco, 6 Apr. 1977 (24), May 1980 (24); M. Velayos et al., 7574 (6d); B. Verlot, 27 Aug. 1879 (15); Veselský, 1862 (17); J. Vetter, 30 June 1916 (2), 11 June 1931 (2), 9 June 1932 (2); E. Vetterhall, 18 June 1898 (9); C. Vicioso, 22 Apr. 1908 (24), May 1912 (24), Aug. 1912 (6a), June 1916 (24), 5 May 1918 (24), 18 June 1918 (24), 5 June 1934 (24); C. Vicioso & F. Beltrán, Aug. 1912 (6a); S. N. Vidrina, 3 July 1971 (1); J. Vigo & L. Villar, 5 Aug. 1974 (2); L. Villar, 11 May 1971 (24), 23 July 1975 (15), 6 June 1986 (23); L. Villar & D. Gómez, 17 Aug. 1984 (15); E. Violleau, 23 Apr. 1897 (24); J. Vivant, 14 May 1970 (24); R. Vogt, 3299 (24), 3321 (24), 3502 (6c), 3960 (15); R. Vogt & C. Oberprieler, 13937 (22), 13942 (22), 14039 (9); R. Vogt & C. Prem, 7069 (15), 7315 (15), 7327 (15); Volkov, 185 (1); E. V. Volkova & L. I. Ivanina, 5 July 1964 (2), 10 July 1964 (2); E. V. Volkova, Ivanina, Egorova & Matsenko, 7 July 1964 (5); E. A. Volkova et al., 7279 (12); V. J. Vorobiev & B. N. Klopotov, 1906 (21); Vrabélyi, 11 May 1867 (17), 10 May 1870 (17); Vukotinović, 17 May 1874 (2), 20 May 1880 (2), 29 May 1880 (2), 23 June 1880 (2), June 1897 (2); Vulpius, 26 July 1849 (8).

G. Wagenitz, 730 (15); J. Wagner, 76 (2), 77 (9), 24 June 1897 (1); Walger, 29 May 1941 (22); E. Wall, 25/433 (22), 24/535 (22); Wallace, 1918 (22); H. & E. Walter, 342 (22), 641 (25), 27 July 1967 (2), 28 July 1967 (2); H. Walter, E. Walter & C. Bilger, 4561 (22), 4693 (22); Walz, 25 June 1900 (9), 30 June 1900 (5); C. W. Wang, 64905 (3); G. H. Wang, 91161 (13); W. Wangerin, 15776 (15); G. L. Webster & J. Sack, 5715 (18); W. Weck, 22 Aug. 1891 (15); Weddell, July 1840 (23); H. Weigold, 1914 (26); Weiler, 4 Aug. 1956 (12); Welwitsch, Apr. 1840 (24); E. Werdermann & D. Meyer, 29 (8), 133 (9), 181 (14); Whittall, Aug. 1893 (22); F. J. Widder, 20 Aug. 1923 (7), 9 Sep. 1925 (7), 1 Aug. 1926 (7), 20 July 1928 (15), 19 Aug. 1928 (7), 24 Aug. 1936 (7), 28 Aug. 1939 (7), 16 July 1947 (15); Wierzbicki, 1652 (9), 2155 (2), 12 May 1843 (9); J. Wiesbauer, 28 July 1864 (14); C. Wigram, 45 (18); Wilander, July 1871 (23); E. Wilczek, 15 May 1910 (23), 16 May 1910 (23), 27 July 1911 (9), 31 July 1911 (15), 22 July 1928 (15); J. J. F. E. Wilde, 4026 (22); Willing, 2896 (22), 3281 (22), 3515 (22), 3820 (22), 4832 (9), 6884 (2), 7054 (2), 7071 (2), 8305 (22), 8376 (22), 9102 (22), 9126 (9), 9217 (22), 9566 (9), 9614 (9), 9885 (9), 10881 (2), 11102 (9), 11305 (2), 11343 (9), 11772 (22), 11848 (22), 12092 (22), 12147 (22), 12782 (22), 13577 (9), 13873 (22), 14109 (22), 14150 (22), 14319 (22), 14441 (22), 14695 (9), 14712 (22), 14898 (22), 15139 (22), 15152 (9), 15649 (22), 17141 (9), 17596 (9), 22806 (22), 23151 (22), 26433 (22), 26604 (22), 29069 (22), 29732 (22), 30047 (22), 33124 (22), 33327 (22), 34599 (22); Willkomm, 1146 (24); E. H. Wilson, 3870 (26); Wimmer, 1857 (2); Winter, 107/3276 (8), 10 Aug. 1892 (9); Wirtgen, 1 June 1857 (23), 31 May 1895 (23); T. Wiśniewski, 392 (21); Witte, July 1918 (15); E. Witting, 30/7-883 (14); Wittmann, 294 (19a); J. Wolff, May 1886 (17); W. Wollny, 26 July 1902 (2); J. J. Wood, 188 (22); Woodward, 14 June 1887 (24), 28 July 1905 (8); Y. Woronow, 18 June 1903 (1); I. Worovin, 739 (1); W. C. Worsdell, June 1895 (23), June 1904 (23); J. Woynar, 66 (15), July 1875 (15), July 1882 (15), July 1885 (15), Aug. 1885 (8), July 1887 (14) (15), Aug. 1887 (8); T. Wraber, 9748/4 (15), 13 July 1959 (15), 22 Aug. 1959 (2); Wright, 25 July 1898 (15); W. Wróblówna et al., 6 July 1952 (8); J. W. Wyatt, 28 (14), 45 (2), 56 (14), 59 (15), 66 (2), 69 (2), 89 (14), 114 (15), 124 (15), 291 (2).

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N. I. Yakubova & B. Y. Rudenskaya, 21 Aug. 1942 (1); A. & S. Yaylasi, 643 (22); M. Young, 71/H (22); Ysern, July 1855 (6a), 25 July 1858 (6a); T. T. Yü, 7615 (26), 12137 (3), 12732 (26), 12871 (26), 14593 (26), 19356 (3), 22268 (3); A. A. Yunatov, 10071 (12), 13101 (12).

T. I. Zaikonnikova, 18 July 1974 (19a), 12 Aug. 1977 (2); M. Zamfir, 17 June 1983 (9); O. Zedelmejer, 10 May 1925 (22); O. Zedelmejer et al., 9 Aug. 1928 (19a); Zehzad, 1305 (11); Zeller, 15 May 1904 (23); H. Zerny, 19 June 1919 (2), 21 July 1930 (2); W. Zovits, 1829 (21), 7 May 1830 (22).