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Species of *Cotoneaster (Rosaceae, Maloideae)* indigenous to, naturalising or commonly cultivated in Central Europe

Abstract

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Several alien species of the Eurasian genus *Cotoneaster* are naturalising in Central Europe, apparently increasingly so, and some on a massive scale. They presumably originate from large-scale cultivation for ground cover, hedges or as ornamental shrubs. The present paper keys and synopses the *Cotoneaster* species indigenous to, naturalising or commonly cultivated in Central Europe, on the basis of, relatively limited, both living (wild, adventive and cultivated) and herbarium material. An attempt is made to understand the nature of variation from the genus' centre of diversification, the mountains of China and the Himalayas, which are likewise the origin of most cultivated and naturalising *Cotoneaster* species. Taxonomic and nomenclatural problems, putatively relating to the presence of apomixis and hybridization in the genus, are discussed. Many of the more than 500 published binomials, including a substantial proportion of those based on cultivated material, seem to be poorly defined, both morphologically and chorologically. Of an estimated total of only 50–70 *Cotoneaster* species worldwide, about 20, mainly Chinese species have been found escaping from cultivation in Central Europe. Presently, about ten species must be considered fully naturalised and, locally at least, invasive.

Additional key words: taxonomy, ornamental shrubs, alien plants, adventives, neophytes, China

Introduction

The genus *Cotoneaster (Rosaceae, Maloideae)* occurs in large parts of mainly continental temperate Eurasia (and including northwestern Africa, southern India and Taiwan, excluding Japan). Its distribution is often scattered and mainly concentrated in the mountains of the meridional and nemoral zones, while having a clear centre of diversity in China and the Himalayas. A probably increasing number of Asiatic *Cotoneaster* species is found alien, escaping from cultivation or naturalising in Central Europe.

While *Cotoneaster* is unequivocal in its generic circumscription, many species, whether in their native ranges, alien or cultivated, cannot readily be identified. The genus is taxonomically difficult, mainly because it comprises nearly 500 published binomials (IPNI 2009). Extensive species inventories were given by Flinck & Hylmö (1966) and Klotz (1982). However, these are neither consistent, nor are the vast majority of species names accepted or even recognised in regional Floras of Eurasia. A recent monograph by Fryer & Hylmö (2009) has added another c. 70 'new species'. Floras relating to Central Europe (e.g., Jäger & Werner 2005; Fischer & al. 2008; Kutzelnigg 1994) and larger-scale compilations (Sennikov 2009), as well as garden handbooks and guides to trees and shrubs (Schneider 1906; Krüssmann 1976; Bärtels 2001; Roloff & Bärtels 2006; Meyer & al. 2006; Hrevcova 1999; Jerzak 2007) diverge widely as to nomenclature, circumscription and status of the included species.

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The present paper aims at a taxonomic review and synopsis of the *Cotoneaster* species indigenous to, commonly cultivated or naturalising in Central Europe. Taxonomic problems in the genus, apparently, relate to several specifics or syndromes, which need to be addressed in some detail: (a) *Cotoneaster* is poor in clear-cut morphological characters; (b) it is of great horticultural interest and many species were described on the basis of cultivated strains, often with unknown or corrupt provenances; (c) native distribution and variation of many taxa are poorly known; and (d) indiscriminate numbers of species have been described in assuming apomixis and hybridisation, but probably often on an insufficient factual basis.

Material and methods

The present study is based on a relatively limited material from five domains.

(1) Native and alien *Cotoneaster* species of Central Europe were studied in the field, mainly in, but not limited to, the surroundings of Göttingen, southern Lower Saxony, and Munich, southern Bavaria, Germany. (2) Herbarium material was revised in the herbaria (abbreviations according to Thiers 2009) B, HAL, HBG, JE, M, MSB, WU and the private herbarium of P. Pilsl (Salzburg). Images of mainly type specimens were consulted on the respective platforms of some major herbaria including A, GH, K and PE. Additional images were obtained from specimens deposited at A, DD, GH and LZ. (3) Living accessions were studied in the botanical gardens of Berlin, Göttingen, Halle and Munich, and in the private garden of G. Klotz, Jena. (4) We have collected and examined several species in the field during expeditions in China and the Himalayas. (5) The literature and online resources were scanned for diagnostic characters, distribution, other biological features and reports of alien occurrences.

Given the huge number of described species and apparent taxonomic ambiguities in *Cotoneaster,* the present study must remain provisional. The whole genus needs a major taxonomic revision including type studies, which could only to a minor extent be accomplished within the present framework. Furthermore, naturalisations of various species seem an ongoing, probably also recently accelerating process.

Morphology

The genus *Cotoneaster* consists entirely of unarmed shrubs. As an almost exclusive character, the leaves are always entire, while otherwise the range of variation resembles that of related genera *(Crataegus, Pyracantha, Sorbus)*. Morphological characters used to distinguish *Cotoneaster* species are mostly difficult to classify, i.e., often variable within wide ranges but between few discrete states. They include growth form, leaf size, form, texture and indumentum, inflorescence size (number of flowers), petal form and colour, fruit size, form, colour, indumentum and number of nutlets included.

Growth forms encompass a wide range of differently sized and formed shrubs, ranging from low carpets or creepers to almost treelike types. However, constructive features are difficult to describe and also highly variable with age and ecology.

Leaf duration is an important character, while apparently in some species ecologically controlled. Sometimes deciduous and evergreen types are morphologically almost indistinguishable.

Indumentum of leaves is often distinctive, while the upper (adaxial) surface often soon becomes glabrous and the lower (abaxial) surface commonly remains strigose or tomentose.

Flower morphology discriminates, possibly not quite consistently so, between the two subgenera: *Cotoneaster* subg. *Cotoneaster* has small pink red-tinged or red, cup- or bowl-shaped flowers, with petals erect or incurved, cuneate at base and often erose-dentate along the margin; the flowers of *C.* subg. *Chaenopetalum* (Koehne) G. Klotz (in Wiss. Z. Friedrich-Schiller-Univ. Jena, Math.-Naturwiss. Reihe 10: 77. 1982) are mostly white (sometimes pink), fully opening stellate, with petals patent, often distinctly stalked and mostly entire. Probably all species of *Cotoneaster* flower for only a very short period of time, in spring or early summer, while ripe fruit is present in autumn only, with characters mainly discriminating between red or black-coloured, in form, pubescence and by number of nutlets included.

Taxonomic constraints

Acknowledging that it is virtually impossible to have flowers and fruit on the same *Cotoneaster* specimen, while all traditional dichotomous keys require both for identification, some general taxonomic dogmas need to be scrutinised. It is obvious that the same constraint must apply for the bulk of type specimens and original descriptions in the genus. Theoretically, some related caveats can be overcome by repeated visits to a living individual, through cultivation or by considering secondary sources.

In fact, much of the taxonomic information about *Cotoneaster* is based on either incomplete herbarium specimens or on cultivated material. However, the extensive horticultural career of the genus seems to have created a suite of new problems. An immense pool of cultivated selections, forms, strains, mutations or hybrids, often with unknown or corrupt provenances and histories, has emerged in the gardens. In turn, this same stock has served, deliberately, by chance or by necessity, to amend descriptions and to describe scores of ‘new species’. It, thus, seems amazing that, again, the same stock of probably billions of (in Europe) cultivated Chinese *Cotoneaster* plants gave rise to naturalisations of only a handful of

fairly well-marked species, which mostly are unequivocal among different botanists and sources.

While we have to offer little more than some lucky field experience, home and abroad including the native ranges of some Chinese and Himalayan *Cotoneaster* species, here it also needs to return to some more general taxonomic issues. Unfortunately, the great works of the *Cotoneaster* monographers, Klotz (1957, 1963a–b, 1966a–b, 1968, 1972a–b, 1978, 1982, 1996a–b, 2008), Flinck & Hylmö (1966) and Hylmö & Fryer (1999) lack reproducibility and general acceptance, while other classifications of the genus are inconsistent as well (Pojarkova 1939, 1955; Yü 1954; Yü & Kuan 1963; Hurusawa & al. 1967; Hurusawa 1973). Flinck & Hylmö (1966) have placed much weight on cultivated strains and artificial or marginal populations, which probably do not have much relevance to variation in the wild and on the population level. The monographic work of Klotz, summarised in a first part of a synopsis (Klotz 1982), likewise proposes narrow species concepts. Through careful observation and cultivation, Klotz often arrives at reasonable taxonomic entities, while admitting that many 'microspecies' were linking up with increasing material and knowledge. However, it still seems that 'biological species' should largely be defined on basis of his 'series'. Klotz's often corroborated statement, that '*Cotoneaster* species in their native ranges often grade freely one into another' (Kutzelnigg 1994; John & Frank 2008) must be rejected. As a matter of fact, and although still incompletely understood, there is a limited number of species with discrete morphologies and distributions in the genus' centre of diversity, the mountains of central and western China and the eastern Himalayas. The same seems to hold true for Middle Asia, while probably at a lower diversity level but with more geographic fragmentation. Herbarium specimens are indeed often very misleading and rarely showing the huge range of vegetative variation in most species, induced by, e.g., moisture, soil, shading or browsing. While taxonomy of *Cotoneaster* was, from the beginning, often based on cultivated plants and vegetatively propagated clones, specific names should only be given to taxa that form discrete, recognisable entities in the wild (Long 1991, on *Rhododendron*). Most of those published by Fryer & Hylmö (2009) and many others obviously do not fulfil this criterion.

Some even more sensitive general points need to be addressed. Sax (1954) investigated polyploidy and apomixis in *Cotoneaster*. Subsequently, most species were found to be either diploid ($2n = 34$) or tetraploid ($2n = 68$) (Zeilinga 1964; Kroon 1975; Krügel 1992). While the diploids were considered reproducing sexually, tetraploids were, apparently, generally 'declared' apomicts. Experimental proof for the latter or, rather, for extensive speciation on higher ploidy levels, seems weak. While Fryer & Hylmö (2009) put it 'apomictic, true from seed', apomixis seems to be just inferred from apparent uniformity of normal seed progeny. A 'new species syndrome' (Fraser-Jenkins 1997), as also evident in *Cotoneaster,* is then obviously justified by claiming both the 'commonplace' arguments for putative geneses of 'cryptic' species, i.e., apomixis (Hjelmquist 1962) and hybridisation (Klotz 1970). While both mechanisms could well exist here, their universal distribution and relevance in the genus seem far from proven. Considering the low overall morphological variation within the genus it may, furthermore, be asked how this might go together on a taxonomic level? Bartish & al. (2001) seem to have failed to prove apomixis by RAPD analysis in the genus. They rather circle around their own 'specimen-level' species concepts, with most of the 'species' apparently comprising selective individuals and cultivated strains, often either unknown from the wild or not having natural distribution ranges. In consequence, Nybom & Bartish (2007) revealed multiclonal and poorly defined taxa in *Cotoneaster*. While these studies might lead in the right direction, their relevance to a sort of predictive quality of taxonomy still remains in question.

Diversity and distribution

In Europe, *Cotoneaster* comprises about seven native species (three of subgenus *Chaenopetalum* and four of subgenus *Cotoneaster;* Browicz 1968). Substantially higher species numbers resulted from recognition or segregation of critical and intermediate taxa (e.g., Flinck & al. 1998). The most recent treatment of *Cotoneaster* by Sennikov (2009) accepts as many as 22 species indigenous to Europe. The specific recognition of some additional segregates of *C.* subg. *Chaenopetalum* from the Mediterranean and the Asiatic borders might be justified. However, 'splitting' concepts in *C.* subg. *Cotoneaster* from Central Europe and especially the Baltic region seem highly problematic (see under *C. integerrimus*). We regard three species only, of *C.* subg. *Cotoneaster,* as indigenous to Central Europe: *C. integerrimus* Medik. (Kutzelnigg 1994; Sennikov 2009 as *C. pyrenaicus*), *C. laxiflorus* Lindl. (Kutzelnigg 1994 as *C. melanocarpus*) and *C. tomentosus* Lindl. (Kutzelnigg 1994).

The centre of diversity in the genus, both in terms of species number and overall morphological variation (both subgenera, subgenus *Cotoneaster* dominating) is situated in the mountains of central and southwest China, mainly comprising the provinces of Gansu, Hubei, Shaanxi, Sichuan, Yunnan and (the southern and eastern parts of) Tibet (Xizang A. R.), and in the adjacent eastern Himalayas. The same area is also home to most of the species cultivated and adventive in Europe. Lu & Brach (2003) accepted a total of only 58 *Cotoneaster* species for China including Taiwan. Even though they obviously used wide species concepts, this number may still be disputable. About one-third of all accepted species in the Flora of China is, apparently, known only from few collections or morphologically poorly defined. On the other

hand, relegation of some taxa to the synonymy may have been unjustified.

The Himalayas or the countries adjacent (south-)west to China contribute some but probably not too many additional species. The published inventories for Bhutan (Grierson 1987), Nepal (Ohashi 1979; Press & al. 2000), and India (Kumar & Panigrahi 1995) are largely repetitive or partly incongruent. For Nepal, 14 species are recognised in the latest treatment (Brach, in prep.). At the species level, there seems still relatively little overlap between the *Cotoneaster* floras of China and the Himalayas. Both subgenera are represented in the (far) western Himalayas (northern Pakistan, Kashmir, northwestern India), which links the West and East Asian floras. Marwat (2004), in a thesis on the genus for Pakistan accepted 63 species of *Cotoneaster* including '44 new' to the area. However, this is a gross overestimate, based on many redundant taxa and inclusion of several, rather unlikely, species 'to be expected'. Minus extensive synonymies, there are probably no more than ten species present in this region; Parker (1924) accepted eight species. None of the western Himalayan species, except possibly *C. roseus*, *C. affinis* and the 'European' *C. integerrimus,* is of horticultural or adventive significance in Europe.

NW Africa, SW and Middle Asia, i.e., the vast area extending approximately from Turkey, Arabia and the Caucasus to Afghanistan, Pamir-Alai, Tien Shan, the Altai mountains and southern Siberia, do not seem to be particularly rich in *Cotoneaster* species. The Flora of Turkey (Browicz 1972) treats a mere seven species. However, numerous species have been published from the Middle East, Russia and the former Soviet Central Asian republics. While many have been accepted in some major Floras (Pojarkova 1939, 1955; Riedl 1966) this does also relate to general 'splitting' taxonomic concepts employed in these. The distribution of *Cotoneaster* in much of the steppe and desert area of Middle Asia is confined to higher elevations, while the possible effect of habitat fragmentation on speciation seems to be rather exaggerated. Much of the reported variation seems to refer to a few highly plastic species, mainly of *C.* subg. *Chaenopetalum*. Except for *C. multiflorus* (and possibly related taxa), Middle Asia is unimportant as a source of cultivated or alien species in Central Europe. Contrary to common and often fuzzy geographical assumptions, the genus *Cotoneaster* is almost absent in the vast arid and high mountain areas of Central Asia (sensu Grubov 1963) including much of northwestern China, Mongolia (four species according to Grubov 1982) and most of the Tibetan Plateau excluding the far south and east.

Alien *Cotoneaster* species are commonly cultivated and naturalising in temperate and subtropical regions almost worldwide. While also attracting attention as sometimes notorious invasives, however, methodical and systematic consistency of the adventive record seems often deficient. There is an excellent record for adventive *Cotoneaster* species of the British Isles (Palmer 1988; Stace 1997), while still probably including some problematic identifications. The European compilation of Sennikov (2009) recognizes 21 adventive species.

Key to *Cotoneaster* species indigenous to, adventive or commonly cultivated in Central Europe

The following dichotomous key (for the advantages of multi-access interactive keys see Brach & Song 2005, with specific reference to the genus *Cotoneaster*) has been designed with the intention of allowing identification of fruiting and, hopefully, vegetative plants. It does, therefore, not necessarily follow the primary systematic subdivision into subgenera *Cotoneaster* and *Chaenopetalum,* based on flower characters. In consequence, many character alternatives are not exclusive. Sections and other lower infrageneric categories in the genus are here considered as largely obsolete. Leaf measurements are given for short shoots; form and size can differ considerably on long shoots. While long-shoot leaves are often larger, more acute and less hairy, quite the opposite seems to hold true for regrowth after cutting or browsing in some species.

1. *Leaves* evergreen, coriaceous, ± plane but with margin often narrowly revolute, usually distinctly discolorous, adaxially mostly glabrescent, dark green and shiny, abaxially often pale bluish green, ± densely whitish or sometimes yellowish villous, tomentose, or pubescent to glabrescent, narrowly oblong-lanceolate to (ob-)ovate in outline, margin ± evenly rounded, apex usually shortly acuminate or apiculate, sometimes retuse; *shrub* dwarf or small, prostrate, carpet-forming, trailing, arching or erect, or shrub large, erect and almost treelike; *branching* ± divaricate or irregular (branches sometimes flexuous-contorted), terminal branches not distinctly distichously arranged; *flowers* conspicuous, 6–12 mm diam., petals white, patent; ripe *fruit* red or orange, ± globose or pyriform 2

– *Leaves* usually deciduous (if, rarely, semi-evergreen, then not coriaceous), membranaceous, papery or cartilaginous (if cartilaginous, then often ± carinate or margin laterally contorted), margin not revolute, concolorous or ± discolorous, adaxially thinly pilose, arachnoid-tomentose or glabrescent, abaxially ± densely whitish, greyish or yellowish tomentose, pubescent or glabrescent, oblong-lanceolate, ovate or rhombic in outline, margin often ± unevenly rounded, often more abruptly contracted toward a short or longer petiole, or into ± long-exserted apex; *shrub* dwarf to large, divaricate, arching or erect, usually many-stemmed, usually not carpet-forming (if so, then branches rather rigid and at least partly ascending, erect or squarrose-contorted); *branching* divaricate, the terminal branches often regularly distichously arranged (herring-bone pattern);

flowers inconspicuous, 3–6 mm diam., petals erect or incurved, pink or red, or flowers conspicuous, 6–12 mm diam., petals white, patent; *fruit* orange, red, purple or black, cylindric, obovoid (pyriform) or ± globose 5

2. *Shrub* large, treelike, to 8 m high; *leaves* large, 4–9 × 1–3 cm, lanceolate to ovate-lanceolate, ± long-acuminate, lateral veins c. 4–8, adaxially conspicuous, ± impressed; *inflorescence* 8–50-flowered . . . . . ***C. salicifolius***

– *Shrub* small or dwarf, 0.05–1 m high, carpet-forming, prostrate-trailing, squarrose or ascending-arching; *leaves* small or medium sized, 0.5–3.5(–4) × 0.2–2 cm, lanceolate, ovate or obovate, acute or ± blunt and minutely pointed or retuse at apex, lateral veins 2–5, adaxially inconspicuous or not impressed; *inflorescence* 1–5-flowered 3

3. *Leaves* medium-sized, 1.5–3.5(–4) × 0.6–2 cm, ovate, adaxial surface minutely rugose by impressed veinlets, abaxially glabrescent or glabrous; *shrub* dwarf, creeping, prostrate or trailing, sometimes ascending-arching, usually with a substantial creeping main trunk; branches thin, flexuous; *inflorescence* 2–5-flowered . . . . . ***C. dammeri***

– *Leaves* small, 0.5–2 × 0.2–1.5 cm, lanceolate, ovate or obovate, adaxial surface smooth, abaxially villous, pubescent or glabrous; *shrub* small or dwarf, creeping, trailing or squarrose-erect; branches ± rigid; *inflorescence* 1–3-flowered 4

4. *Leaves* lanceolate to ovate, obtuse, acute or minutely pointed, margin ± revolute, abaxially tomentose, pubescent or sometimes glabrescent; *shrub* small or dwarf, divaricate or squarrose; *branching* regular, branches rigid, ± erect or laterally trailing . . . . . ***C. integrifolius***

– *Leaves* lanceolate to ± obovate or obcordate, obtuse or commonly ± retuse, rarely acute, margin plane, abaxially glabrous or glabrescent; *shrub* dwarf, prostrate, rarely somewhat arching; *branching* irregular contorted and horizontally compressed, terminal branches thin, ± appressed to the ground . . . . . ***C. microphyllus***

5. *Flowers* 6–12 mm diam., petals patent, white or rarely sometimes pink; *leaves* membranaceous or papery, often ± glabrescent at least adaxially, often somewhat pruinose, (ob)ovate or orbicular, ± regularly rounded in outline, obtuse or shortly acuminate, usually with a distinct petiole > 1 cm long; *shrub* medium-sized or large; *branching* ± regular, broomlike or divaricate, not distichous 6

– *Flowers* 3–6 mm diam., petals incurved or erect, pink or red; leaves papery or cartilaginous, ± glabrescent or often at least abaxially persistently villous, tomentose, pilose or strigose, usually not pruinose, ovate-lanceolate, rhombic, (ob)ovate or ± orbicular, ± regularly rounded or somewhat angled, apex often ± exserted, acute or acuminate, petiole short; *shrub* small, medium-sized or large; *branching* ± regularly divaricate, irregularly contorted or distinctly distichous 10

6. *Leaves* large, to 12 × 4.5 cm, oblong, green, abaxially ± strigose; *inflorescence* 20–100-flowered; *anthers* red; *hypanthium and sepals* tomentose; *fruit* globose, 4–8 mm diam., red . . . . . ***C. frigidus***

– *Leaves* small to medium-sized, 3–5 cm long, broadly ovate or obovate, ± glaucous, glabrescent or abaxially villous; *inflorescence* 5–50-flowered; anthers white or pink; *hypanthium and sepals* tomentose, strigose or glabrescent; *fruit* globose or pyriform, 8–14 mm, red or ± black 7

7. *Flowers* pink; *inflorescence* 5–15-flowered; *leaves* abaxially ± glabrescent; *hypanthium and sepals* subglabrous; *fruit* 8–10 mm, red . . . . . ***C. roseus***

– *Flowers* white; *inflorescence* 5–50(–100)-flowered; *leaves* abaxially villous, pilose or ± glabrescent; *hypanthium and sepals* tomentose, villous-strigose or subglabrous; *fruit* 8–14 mm, red or ± black 8

8. *Fruit* 8–14 mm, black or dark bluish violet, often pruinose; *hypanthium and sepals* villous-strigose; *inflorescence* densely congested; *leaves* obovate or elliptic . . . . . ***C. affinis***

– *Fruit* 8–12 mm, crimson or carmine red, sometimes darkening on drying; *hypanthium and sepals* tomentose or subglabrous; *inflorescence* dense or ± lax; *leaves* ovate, lanceolate-ovate or ± rhombic elliptic 9

9. *Hypanthium and sepals* subglabrous; *fruit* globose, 9–12 mm, crimson or bright red, globose; *inflorescence* ± dense, 10–50(–100)-flowered; *leaves* ovate-elliptic, margin ± evenly rounded, glabrescent . . . . . ***C. multiflorus***

– *Hypanthium and sepals* tomentose; *fruit* globose or pyriform, 8–10 mm, carmine red, darkening on drying; *inflorescence* lax, 5–20-flowered; *leaves* lanceolate-ovate or ± rhombic-elliptic, margin ± expanded near middle, abaxially ± villous . . . . . ***C. racemiflorus***

10. *Leaves* medium-sized or large, 5–12(–15) × 3–7 cm, ± ovate, acute or acuminate, surface often ± wrinkled, rugose or bullate (adaxially appearing blistered between sunken main veins and anastomoses), abaxially ± densely yellowish tomentose-strigose, or glabrescent; *inflorescence* c. (1–)3–50-flowered . . 11

– *Leaves* small or medium-sized, 0.5–5(–7) × 0.3–4(–5) cm, lanceolate, rhombic or ovate, obtuse, acute or acuminate, surface not bullate, almost plane or only primary lateral veins slightly impressed, abaxially ± strigose, or with short crisp hairs especially along veins or ± glabrescent; *inflorescence* 1–5(–10)-flowered 13

11. *Leaves* ± plane or slightly wrinkled, not bullate, main lateral veins not or slightly impressed; *inflorescence* 1–5(–7)-flowered; *fruit* cylindric to pyriform, black, often tomentose, nutlets 2 or 3 . . . . . ***C. ambiguus***

– *Leaves* ± wrinkled or bullate, lateral veins and anastomoses ± impressed; *inflorescence* (3–)5–50-flowered; *fruit* ± globose, red or black, often glabrous, nutlets 3–5 12

12. *Fruit* bright red (rarely ultimately turning dark violet or almost black on drying), nutlets (4 or) 5; *inflorescence* (1–)5–50-flowered; *leaves* bullate, lateral veins and anastomoses ± strongly impressed, abaxially ± densely yellowish tomentose, rarely glabrescent . . . . . ***C. bullatus***

– *Fruit* dark violet or black, nutlets 3–4(–5); *inflorescence* (1–)2–15-flowered; *leaves* ± wrinkled, main lateral veins ± impressed, abaxially thinly to moderately densely pilose or tomentose or ± glabrescent except on veins . . . . . ***C. moupinensis***

13. *Leaves* usually cartilaginous, small, 1–3 × 0.5–2.5 cm, often somewhat carinate or contorted at margin, adaxially thinly strigose, mostly soon glabrescent, ± shiny, abaxially strigose or glabrescent, lateral veins inconspicuous; *inflorescence* 1–6-flowered; *branching* divaricate, ± markedly distichous or irregularly contorted 14

– *Leaves* papery, small to medium-sized, 1.5–5(–7) × 1–4(–5) cm, ± plane, adaxially strigose or glabrescent, ± dull or sometimes shiny, abaxially ± densely strigose or tomentose, lateral veins ± conspicuous; *inflorescence* 2–15(–25)-flowered; *branching* ± divaricate 19

14. *Fruit* dark violet or black, cylindric or pyriform; *shrub* small to medium-sized, divaricate-arching; *branching* partly irregularly contorted, but with the terminal branches ± markedly distichously arranged . . . . . ***C. nitens***

– *Fruit* red, cylindric, pyriform or globose; *shrub* small to large; *branching* either ± entirely contorted or ± regularly divaricate, ± arching and with the terminal branches either divaricate or distichously arranged 15

15. *Shrub* dwarf or small, to 1.5 m, arching or sometimes mat-forming; *branching* squarrose-contorted; *leaf margin* ± distinctly contorted; *petals* ± erect, deep red; *fruit* cylindric-oblong . . . . . ***C. adpressus***

– Shrub dwarf, small or large, branching ± straight, divaricate or distinctly distichous; *leaf margin* flat or slightly contorted; *petals* ± incurved, whitish, pink or rose-coloured, sometimes reddish tinged; *fruit* cylindric-oblong or ± globose 16

16. *Leaves* ovate or orbicular-ovate to almost circular, acuminate or distinctly apiculate; *shrub* dwarf or small, to 1 m (rarely 3 m); *main branches* oblique-ascending to arching, terminal branches distinctly distichous ('herring-bone' pattern); *inflorescence* 1–3-flowered, ± sessile; *fruit* ± globose 17

– *Leaves* lanceolate, oblong-ovate or ovate-rhombic, acute; *shrub* medium-sized to large, 1–4 m; *main branches* divaricate, erect or arching, terminal branches not or less distinctly distichous; *inflorescence* 1–6-flowered, shortly pedunculate; *fruit* cylindric to pyriform 18

17. *Leaves* cartilaginous, ± persisting until early winter, usually < 1 cm, ovate or orbicular-ovate, acuminate, abaxially thinly strigose with short hairs; *terminal branching* densely and rigidly distichous; *inflorescence* 1–3-flowered; *fruit* globose or pyriform . . . . . ***C. horizontalis***

– *Leaves* ± papery or only slightly cartilaginous, deciduous in autumn, usually 1–1.5 cm, broadly ovate to almost circular, distinctly apiculate or sometimes retuse, abaxially ± densely strigose with long hairs; *terminal branching* distichous but branches less densely set and ± flexuous; *inflorescence* usually 1-flowered; *fruit* ± depressed globose . . . . . ***C. apiculatus***

18. *Shrub* effuse, obliquely ascending or arching, to 3 m, branching divaricate or often somewhat distichous; *leaves* small, 1–2.5 cm long, ± lanceolate-ovate to ovate-rhombic, acute, abaxially thinly villous or strigose to glabrescent; *inflorescence* 1–4-flowered; *sepals* acute; *fruit* cylindric; nutlets 2 or 3 . . . . ***C. divaricatus***

– *Shrub* erect, to 4 m, branching divaricate, not distichous; *leaves* small to medium-sized, 1.5–3.5 cm long, ovate to oblong, acute to acuminate, abaxially remaining moderately densely strigose; *inflorescence* 3–6-flowered; *sepals* acuminate; *fruit* pyriform; nutlets 3 or 4 . . . . . ***C. symondsii***

19. *Leaves* medium-sized, ± lanceolate to lanceolate-ovate or rhombic, acute or ± long-acuminate, adaxially thinly strigose and soon glabrescent, ± shiny, abaxially thinly pilose with ± erect-ascending, straight or little contorted hairs or ± glabrescent; *fruit* cylindric, pyriform or ± globose 20

– *Leaves* small to medium-sized, ± elliptic, rhombic, ovate or orbicular, ± rounded in outline, blunt, shortly apiculate or sometimes acute or acuminate, adaxially persistently strigose or thinly villous or glabrescent, ± matt, abaxially ± densely and persistently whitish, greyish or yellowish appressed-tomentose with ± strongly contorted and interwoven hairs; *fruit* pyriform or ± globose 21

20. Ripe *fruit* dark violet or black, pyriform or globose; *leaves* ± ovate or rhombic, acute or shortly acuminate, dark green, abaxially ± pale, ± pilose . . . . . ***C. acutifolius***

– Ripe *fruit* red, ultimately sometimes turning blackish, cylindric or pyriform; *leaves* ± lanceolate or narrowly rhombic, ± long-acuminate, bright green, ± concolorous, abaxially ± glabrescent . . . . . ***C. acuminatus***

21. *Leaves* adaxially ± persistently strigose or tomentose, ± rhombic or ovate-elliptic in outline, often acute or acuminate, lateral veins often somewhat impressed; *fruit* orange or red 22

– *Leaves* adaxially often glabrescent, lanceolate-ovate, elliptic or orbicular in outline, ± blunt or shortly apiculate, lateral veins not impressed or ± inconspicuous; *fruit* red, purple or black 24

22. *Leaves* ± ovate, blunt and shortly apiculate, lateral veins not impressed; *inflorescence* 3–10-flowered; *peduncles* long, pendent; *fruit* pyriform to subglobose, large, 7–8 mm long, nutlets 2 (or 3) . . . . . ***C. zabelii***
– *Leaves* ± rhombic to ovate-elliptic, ± acute or acuminate, lateral veins ± impressed; *inflorescence* 2–8-flowered; *peduncles* short, ± erect or divaricate; *fruit* ± globose, small, 5–7 mm diam., nutlets (2–) 3–4 23
23. *Leaves* deciduous, small, 1–2 cm long, ± ovate, acute; *inflorescence* 2–5-flowered; *fruit* usually deep red . . . . . ***C. dielsianus***
– *Leaves* semi-evergreen, often larger, 1.5–3 cm long, ovate or ovate-lanceolate, acute or ± acuminate; *inflorescence* 4–8-flowered; *fruit* orange or brick-red . . . . . ***C. franchetii***
24. *Fruit* black, glabrous, nutlets mostly 2 (or 3); *inflorescence* (1–)3–15(–25)-flowered . . . . . ***C. laxiflorus***
– *Fruit* red, glabrous or tomentose, nutlets (2–)3–5; *inflorescence* 1–12-flowered 25
25. *Fruit and sepals* glabrous or sepals pubescent at margin only, nutlets 2–4; *inflorescence* 1–4-flowered, peduncles thinly tomentose or subglabrous; *leaves* ± lanceolate-ovate, 1–5 × 0.5–3 cm, abaxially yellowish or greenish tomentose, sometimes ± glabrescent . . . . . ***C. integerrimus***
– *Fruit and sepals* ± densely tomentose, nutlets 3–5; *inflorescence* 2–12-flowered; *leaves* ovate or broadly ovate, 2–7 cm long, abaxially persistently white or greyish tomentose . . . . . ***C. tomentosus***

Synopsis of *Cotoneaster* in Central Europe

Listed are accepted *Cotoneaster* species names with full reference to publication, synonyms (with year of publication), general distribution, examples of adventive occurrence in Central Europe and beyond, and additional notes. Proposed synonymies are inferred from occasional types seen, but often only from secondary sources including published, miscellaneous specimens and other likely evidence. Synonymies are neither comprehensive nor often proven or confirmed, provided here as a rough circumscription of proposed taxonomic content. We propose taxonomic 'lumping' with the intention of tracking down reasonable entities, while acknowledging that defined horticultural strains, hybrids and other taxa could well exist. On a given methodically weak and often ambiguous factual basis, it is, furthermore, understood that some names, assignations or identities might, incidentally, prove incorrect or oversimplified with further research. We explicitly admit that the bibliographical record is incomplete and that identities or taxonomic interpretations could often not be verified.

Species names in English (C. = Cotoneaster) and German (Z. = Zwergmispel) are given, selected or coined where absent or ambiguous. Chinese provincial distributions are taken from Lu & Brach (2003), with occasional doubts indicated in square brackets. Published adventive records are listed according to the proposed synonymy, while doubts and possible misidentifications are also indicated. Additional records from the Global Biodiversity Information Facility (GBIF 2009) were extracted on a more casual basis, while some of these were inconclusive on account of controversial taxonomies and floristic status not being indicated.

Symbols and abbreviations
● : Native distribution
△ : Secondary range record in Central Europe
□ : Secondary range in other areas (examples)

Abbreviations of federal states follow Fischer & al. (2008) for Austria and Jäger & Werner (2005) for Germany:

Austria (Österreich): **B** = Burgenland, **K** = Carinthia (Kärnten), **N** = Lower Austria (Niederösterreich), **O** = Upper Austria (Oberösterreich), **S** = Salzburg, **St** = Styria (Steiermark), **T** = Tyrol (Tirol), **V** = Vorarlberg, **W** = Vienna (Wien).

Germany (Deutschland): **An** = Saxony-Anhalt (Sachsen-Anhalt), **Ba** = Bavaria (Bayern), **Br** = Brandenburg with Berlin, **Bw** = Baden-Wuerttemberg, **He** = Hesse (Hessen), **Me** = Mecklenburg-West Pomerania (Mecklenburg-Vorpommern), **Ns** = Lower Saxony (Niedersachsen) with Bremen, **Rh** = Rhineland-Palatinate (Rheinland-Pfalz) with Saarland, **Sa** = Saxony (Sachsen), **Sh** = Schleswig-Holstein with Hamburg, **Th** = Thuringia (Thüringen), **We** = North Rhine-Westphalia (Nordrhein-Westfalen).

For additional national territories Iso-Code names (ISO 3166-1) are followed (International Organisation for Standardisation 1997).

(1) *Cotoneaster acuminatus* Lindl. in Trans. Linn. Soc. London 13(1): 101. 1821.

Mespilus acuminata (Lindl.) Lodd. 1824, *C. mucronatus* Franch. 1889, *C. nepalensis* André 1875, *C. wallichianus* G. Klotz 1966, ?*C.* ×*parkeri* G. Klotz 1966, ?*C. stracheyi* G. Klotz 1966, *C. bakeri* G. Klotz 1972, ?*C. kongboensis* G. Klotz 1972

Acuminate-leaved C., Zugespitzte Z.

● Himalayas: NW India (Himachal Pradesh) to N Myanmar, SW China (SE Tibet, NW Yunnan, [?]Sichuan)
△ [?]Germany: **An** Halle/Saale (Schaberg & Weinert 1972). – [?]Switzerland: Basel (Brodtbeck & al. 1997)
□ [?]Great Britain (Stace 1997)

Cotoneaster acuminatus is a characteristic element of humid mountain and treeline forest on the southern slopes of the Himalayas, at elevations between c. 2500

and 4200 m, occurring from northwestern India to southeastern Tibet, Myanmar and northwestern Yunnan. Synonyms of *C. acuminatus* as cited above largely pertain to names given to populations from different sections of its 2000 km long but often only c. 20 km wide distribution. Still, morphological and ecological variation in *C. acuminatus* seem relatively restricted and continuous, probably unbroken geographically and reproductively.

Its morphologic and taxonomic delimitation toward various edges and possibly further distribution remains problematic. *Cotoneaster acuminatus* seems to be lacking from Kashmir and the far western Himalayas. *C. kaganensis* G. Klotz 1966, described from northern Pakistan (Hazara), does not seem to belong here (as a potentially 'diminutive form'), but probably rather relates to *C. integerrimus*. Photographs seen are not conclusive, but a separate taxon endemic in this area seems unlikely.

From the inner eastern Himalayas through the southeastern part of the Tibetan Plateau east- and northward, *Cotoneaster acuminatus* seems largely substituted by black-fruited but otherwise very similar species related to *C. acutifolius* (adjacent to eastern Tibet probably, mostly, *C. ambiguus*). A further distribution of *C. acuminatus* into Sichuan as given by Lu & Brach (2003) might need confirmation (*C. obscurus*?). The leaves of *C. acuminatus* are often somewhat narrower, long-acuminate and of a brighter green as compared to *C. acutifolius*. Without ripe fruit, both species are difficult to differentiate, but red versus black fruit in the former does also not seem an unequivocal character.

Cotoneaster acuminatus is rarely cultivated in Central Europe (Jena private garden of G. Klotz!, Berlin BG!, Munich BG?, apparently not growing well and fruit ultimately turning black). The adventive record is very doubtful. There is no voucher for the apparently only German record from Halle/Saale (Schaberg & Weinert 1972), which also could not be confirmed by John & Frank (2008). A single record from Great Britain was subsequently found to have black fruit and referred to *C. acutifolius* (Palmer 1985a). However, *C. acuminatus* might generally be expected to do better in humid climates.

Selected specimens seen. — China: Tibet/Xizang: Gyamda Chu, NE tributary, Pasum Tso S shore (above Camp 17), 30°00'N, 93°56'E, 3650 m, mont. mixed forest *(Betula, Acer, Picea, Larix),* scrub, on steep slope, siliceous rocks and boulders, 30.8.1994, *B. Dickoré 11857* (MSB). — Yunnan: Prope urbem Lidjiang ("Likiang"), imprimis in monte Yülung-schan, 1914, *H. Handel-Mazzetti 3959* (WU).
India: Sikkim: Temp., 9000–10000 ft., *J. D. Hooker* (M). Nepal: 1821, *N. Wallich 664a* (M).

Cotoneaster obscurus Rehder & E. H. Wilson in Sargent, Pl. Wilson. 1(2): 161. 1912, was described from western Sichuan and reported as occurring in Guizhou, Hubei, Sichuan, Xizang and Yunnan by Lu & Brach (2003). It differs from *C. acuminatus* by inflorescences 3–7-flowered, fruit ovoid and the leaves having adaxially impressed veins, being adaxially appressed pubescent and abaxially yellowish grey-tomentose. In Central Europe, it is rarely cultivated (Göttingen BG!, Halle BG!). A doubtfully 'subspontaneous' plant of *C. obscurus* was reported from Halle (John & Frank 2008), but the accompanying photograph rather suggests *C. acutifolius,* probably with fruit not fully ripe.

Selected specimens seen. — Cultivated: Halle/Saale, Botanischer Garten, Neuwerkhang, 22.9.2009, *B. Dickoré 39480* (M); Göttingen, Alter Botanischer Garten, 18.8.2009, *B. Dickoré 39369* (M).

(2) *Cotoneaster acutifolius* Turcz. in Bull. Soc. Imp. Naturalistes Moscou 5: 190. 1832.

Cotoneaster lucidus Schltdl. 1856, *C. acutifolius* f. *pekinensis* Koehne 1893, *C. pekinensis* (Koehne) Zabel 1898, *C. hurusawaianus* G. Klotz 1972

Beijing C., Peking-Z.

● N and E Asia: Russia (approximately from Lake Baikal eastward), Mongolia, N, C and E China, Korea.
△ Austria: **N** Wiener Wald, Mitterberg, *F. Tod 94096*. **T** Innsbruck (Polatschek 2000: *'C. lucidus'*); **W** Wien (Forstner & Hübl 1971: *'C. lucidus'*). — Germany: **An** Calbe/Saale (Klotz 1982: *'C. lucidus'*), Halle/Saale (John & Frank 2008 *'C. lucidus'*). **Ba** Ries (*R. Fischer*!); München-Neuaubing, Lochhausen (*Dickoré*!). **Br** Berlin (Prasse & al. 2001: *'C. lucidus'*). **Me** Usedom (Henker & Kiesewetter 2006). **Sa** Leipzig (Gutte 2006: *'C. lucidus'*). **Th** Gera (Fleischer 1986); Altenburg (Strumpf 1992: *'C. lucidus'*). **We** Ruhrgebiet (Keil & Loos 2005: *'C. lucidus'*). — Poland: Wielkopolski National Park (Mirek & al. 2002); Bialowieza Forest (Luczay & Adamowski 1991: *'C. lucidus'*).
□ Great Britain (Stace 1997); Sweden (Flinck & Hylmö 1958; Hylmö 1993: *'C. lucidus'*); European Russia (Moscow area, *Skvortsov*!). NW USA (GBIF 2009).

The correct volume number for Turczaninow's protologue is 5 (1832), not 4 as often cited. *Cotoneaster acutifolius* is widely distributed in eastern Asia and apparently quite variable. Leaf characters including size, form, shiny or matt adaxial surface and indumentum seem to vary also with season. Fruit could turn black only in late autumn and vary in form from pyriform to (ob-)ovoid or almost globose. While the inclusion of *C. lucidus* seems straightforward, the species concept of *C. acutifolius* used by Lu & Brach (2002) might have been a bit too wide and probably has included discordant elements *(C. ambiguus),* thus possibly obscuring provincial Chinese distributions of either species. The cultivated and adventive record (mostly as *C. lucidus*) would also need confirmation, due to potential confusion with *C. acuminatus,*

C. ambiguus, C. moupinensis and *C. laxiflorus*. The last, probably only distantly related species seems to overlap geographically with *C. acutifolius* through much of eastern Asia (from southern Siberia through northern Mongolia and northern China). *C. acutifolius* can be distinguished from *C. laxiflorus* by the relatively small, acute and abaxially glabrescent leaves. *C. acutifolius* was apparently frequently planted (recently perhaps less so) as a hedge along roadsides, in parking lot and other borders of 'public space'. It is not particularly 'pretty' and its deciduous foliage and vigorous growth do not seem to have made it particularly attractive to private gardeners. However, its somewhat 'somber' appearance seems to have rather given it a place in graveyards. Some of the reported adventive occurrences might rather comprise relicts from former cultivation.

Selected specimens seen. — Austria: **N** Wiener Wald, Mitterberg ober der Ruine Rauhenstein (c. 2–3 km NW Baden) , 400 m, 5.9.1993, *F. Tod 94096* (WU).
China: [?]Nei Mongol: 1831, *Turczaninow* (JE, photo, type of *C. acutifolius*).
Germany: **Ba** Ries, an der Straße Schmähingen–Hohenaltheim, 1980, *R. Fischer* (M); München-Neuaubing, Gleislager, 530 m, 48°08'N, 11°24'E, MTB 7834/411, 9.8.2009, *B. Dickoré & K. Lewejohann 39352* (M). **Br** Berlin-Schmöckwitz, Kiefernforst östlich von Schmöckwitz nahe Schwarze Berge, 16.6.1972, *C. Beck s.n.* (B); Brandenburg, Oberhavel, Teufelsbruchwiesen, *Royl 6320* (B).
Russian Federation: Provincia Mosqua, districtus Zvenigorod, prope Zvenigorod, "advena", 14.6.1981, *A. K. Skvortsov* (M); ad Baicalem, 1833, *Turczaninow* (M) *"C. lucidus"* det. B. Hylmö 1964.

Cotoneaster tenuipes Rehder & E. H. Wilson in Sargent, Pl. Wilson. 1(2): 171. 1912, in the absence of flowers originally referred to [*C.* subg.] *Chaenopetalum,* was described from western Sichuan and reported as occurring in Gansu, Qinghai, Shaanxi, Sichuan, Xizang and Yunnan by Lu & Brach (2003). *C. tenuipes* is a small slender shrub, which differs from the probably related *C. acutifolius* by cylindric, pubescent fruit and narrow, abaxially grey, appressed, tomentose leaves. In Central Europe it is rarely cultivated (Göttingen BG!).

Selected specimens seen. — Cultivated: Göttingen, Alter Botanischer Garten, 18.8.2009, *B. Dickoré 39372* (M).

(3) *Cotoneaster adpressus* Bois in Vilmorin & Bois, Frutic. Vilm.: 116. 1904.

Cotoneaster horizontalis var. *adpressus* (Bois) C. K. Schneid. 1906, *C. distichus* var. *duthieanus* C. K. Schneid. 1906, *C. adpressus* var. *praecox* Bois & Berthault 1918, *C. praecox* (Bois & Berthault) Vilmorin ex Bois & Berthault 1918, *C. nanshan* Mottet 1925, *C. duthieanus* (C. K. Schneid.) G. Klotz 1963, *C. garhwalensis* G. Klotz 1966, *C. taoensis* G. Klotz 1972, *C. kerstanii* G. Klotz 1972

Squarrose C., Sparrige Z.

● C and E Himalayas (NW India: Himachal Pradesh to Myanmar), S and E Tibet, SW and C China (Gansu, Guizhou, Hubei, Qinghai, Shaanxi, Sichuan, Xizang, Yunnan).
△ Germany: **Ba** Erlangen (Asmus 1981: *'C. praecox'*); München (*Dickoré*!). **We**: Königswinter (Lohmeyer 1981: *'C. praecox'*). — Switzerland: Basel (Brodtbeck & al. 1997).
□ Great Britain (Palmer 1985b); Stace 1997); Norway (GBIF 2009). SW Canada and NW USA (New York; GBIF 2009).

Cotoneaster adpressus occupies a wide and largely contiguous native range in the subalpine and alpine belts of the Inner Himalayas, the southern and eastern parts of the Tibetan Plateau (where at elevations of up to 4500 m being the commonest or exclusive species of the genus) and the mountains of southwestern China. The species is relatively characteristic with its low-growing, irregular and much contorted-squarrose branching habit, small, deciduous, often strongly contorted leaves and red flowers.

Nonetheless, *Cotoneaster adpressus* seems to be among the most misunderstood of all *Cotoneaster* species. On the one hand, it was often mingled or confused, especially with *C. horizontalis, C. apiculatus, C. nitidus (C. distichus)* and *C. divaricatus,* but also with the widely different *C. rotundifolius*. On the other hand, relatively minor variations, mainly of size, have led to the description of numerous very similar 'microspecies'. Together with the few synonyms given above, probably many more names should be relegated to the synonymy of *C. adpressus,* in particular all species of *C.* sect. *Adpressi* (Hurus.) Hurus. 1973 sensu Fryer & Hylmö (2009), as well as further names placed in other sections. Interesting is *C. kerstanii,* based on a cultivated plant allegedly raised from seed collected by Kerstan on the Afghanistan-Pakistan border, which is still extant in Halle BG(!). The herbarium collection of G. Kerstan in HAL contains several *Cotoneaster* specimens, but none of this relationship. While the identity of *C. kerstanii* and *C. adpressus* is unequivocal, this species (or affinity) is unknown from Kashmir westward and was apparently never found in this region, which is relatively well-known from historical collections. Disjunctions of this type are, likewise, unknown from other taxa. The provenance of *C. kerstanii* is thus very likely corrupt, possibly due to mix-up or contamination of seed. *C. adpressus* is frequently grown in 'alpine' gardens and in graveyards as a small, dense shrub, which can also form, usually not closely appressed, carpets. While it could become quite vigorous, difficult to eradicate and also freely seeding in gardens, *C. adpressus* is an uncommon adventive species

and some of the reported occurrences might be relicts of former cultivation. A single but apparently very old shrub of *C. adpressus* was found in Munich on an abandoned gravel dam constructed for the 'Reichsautobahn' in the 1930s, along with numerous shrubs of *C. divaricatus* and *C. dielsianus*. While not likely planted, seedlings of *C. adpressus* were not found in the neighbourhood. Other occurrences were observed in abandoned gardens. The species might be easily overlooked or find its way further into near-natural habitats from garden rubbish deposits.

Selected specimens seen. — China: Gansu: Lower Tebbu County, exposed banks of Ngongo, 8500–9000 ft., 10.9.1926, *J. F. Rock 14972* (DD, photo). — Xizang/Tibet: E Lhasa, above Ganden Gompa (Dhagze), 29°45'N, 91°28'E, 4520 m, 5.8.1989, *B. Dickoré 3693* (MSB).
Germany: **Ba** München-Allach, alte Autobahntrasse, 48°11'N, 11°26'E, MTB 7834/212, 510 m, 7.6.2009, *B. Dickoré & F. Winter 39107* (M).
India: Uttarakhand: Gărhvál, Badrinath, 10000–10600 ft., 31.–1.8.1855, *Schlagintweit 10004* (HBG); Badrinath, N Garhwal, 10000–12000 ft., 26.10.1919, *A. E. Osmaston 1155* (DD, photo). — Sikkim: Temp., 9000–10000 ft., *J. D. Hooker* (M).
Nepal: Gossainthan, *N. Wallich 663* (M).

(4) *Cotoneaster affinis* Wall. ex Lindl. in Trans. Linn. Soc. London 13(1): 101. 1821.

Cotoneaster obtusus Wall. ex Lindl. 1830 ["1829"], *C. bacillaris* Lindl. 1830 ["1829"], *C. lindleyi* Steud. 1840, *C. insignis* Pojark. 1939, ?*C. ovatus* Pojark. 1954, ?*C. transiens* [*"transens"*] G. Klotz 1968, *C. confusus* G. Klotz 1970, *C. royleanus* (Dippel) J. Fryer & B. Hylmö 2009

Purpleberry C., Stumpfblättrige Z.

● SW and Middle Asia, W Himalaya: ?N Iran, Uzbekistan, Tajikistan, N and E Afghanistan, N Pakistan, NW India (Kashmir to Uttarakhand), ?W Nepal.
△ [?]Germany: **We** Leverkusen (Kutzelnigg 1994: Adolphi in litt. *'C. insignis'*).
□ Great Britain (Stace 1997); Hungary (Udvardy 1999 *'C. insignis'*).

The above proposed synonymy of *Cotoneaster affinis* is largely tentative, while the whole relationship seems very imperfectly understood (see under *C. multiflorus*). Likely including *C. insignis* as a synonym, *C. affinis* occurs on the borders of the Irano-Turanian (winter-rain) and the western Himalayan region with moderate monsoon (summer-rain) influence. *C. affinis* is a large, usually vigorously growing and copiously flowering shrub, with broadly ovate, often somewhat cartilaginous, glabrescent leaves and dark violet to black, often distinctly pruinose fruit. In Central Europe it is, except in botanical gardens, rarely cultivated and the adventive record seems presently unconfirmed. There is a wide range of possible confusion or unresolved relationships with *C. roseus, C. racemiflorus, C. multiflorus* and *C. nummularius*. Because browsed or cut *C. frigidus* commonly develops relatively small-leaved branches, there is also a potential confusion between these partly sympatric species.

Selected specimens seen. — India: Jammu & Kashmir: Kashmir, Tangmarg, 6000 ft., 17.8.1956, banks of cultivation, fruit reddish brown, plant 6–8 ft., *O. Polunin 56/408* (B); 1831, *N. Wallich 660* (B, isotype of *C. bacillaris*). – Uttarakhand: Kumaon, Milam Bugyals, 4000–5000 m [?elevation inaccurate, Milam is situated at 3420 m], "a medium sized shrub with white flowers", 17.6.1958, *T. A. Rao 6975* (B, M).
Nepal: 1830, *N. Wallich* (B, isotype of *C. obtusus*); Káli Valley near Káwa, 10000–11000 ft., 28.7.1886, *J. F. Duthie 5528* (WU).
Pakistan: North-West Frontier Province, Swat Division, Kalam, 2350 m, enges Tälchen am Südwestrande des Ortes, Laubwaldfragment auf steilem, nordexponierten Hang, 21.9.1983, *H. Ern 7647* (B); Northern Areas, Nanga Parbat, Astor, Mushkin forest, 35°49'N, 74°43'E, 2580 m, 5.9.1995, *B. Dickoré 12711* (MSB).

(5) *Cotoneaster ambiguus* Rehder & E. H. Wilson in Sargent, Pl. Wilson. 1(2): 159. 1912.

Cotoneaster acutifolius var. *villosulus* Rehder & E. H. Wilson 1912, *C. acutifolius* var. *ambiguus* (Rehder & E. H. Wilson) Hurus. 1943, *C. villosulus* (Rehder & E. H. Wilson) Flinck & B. Hylmö 1962, *C. laetevirens* (Rehder & E. H. Wilson) G. Klotz 1972, *C. pseudoambiguus* J. Fryer & B. Hylmö 1997, ?*C. hsingshangensis* J. Fryer & B. Hylmö 1997

Dubious C., Zweifelhafte Z.

● SW and C China ([?]Anhui, Gansu, Guizhou, [?]Hebei, Hubei, Ningxia, Shaanxi, Sichuan, [?]Taiwan, [?]Xizang, Yunnan).
△ Germany: **An** Halle/Saale (John & Frank 2008 *'C. villosulus'*). **Ns** Göttinger Wald (*D. Klärner*, *K. Lewejohann, Dickoré*!); Nieste (*Dickoré*!, probably planted). **We**: Iserlohn (GBIF 2009 *'C. villosulus'*).
□ Great Britain (England, Stace 1997, *'C. villosulus'*); Norway; Sweden (GBIF 2009 *'C. villosulus'*). NW USA (GBIF 2009).

As already discussed by Rehder & Wilson (1912), *Cotoneaster ambiguus* links the morphological extremes of *C. moupinensis* and *C. acutifolius* without too obvious or sharp boundaries in-between. While claiming that 'the living plants look quite different' they hoped that cultivation would resolve this relationship. However, neither describing and upgrading of many 'new species' around, nor formal treatments (Lu & Brach 2003) seem to have brought much light to our understanding of the group. The accepted name and proposed synonymy for the

Rehder & Wilson varieties seem straightforward on account of type specimen photographs seen. However, close similarities or relationships with both the above species obviously exist and some of the respective isotypes or syntypes might be mixed up with *C. moupinensis (C. foveolatus)*.

Cotoneaster ambiguus is a large shrub, which can be distinguished by its relatively large leaves, usually with a long-exserted tip, veins not or only slightly impressed and adaxially with a persistent, ± patent or thinly villous indumentum, few-flowered inflorescences and ± black, ± strigose, cylindric fruit containing 2 or 3 nutlets. While, as yet, only occasionally being reported adventive in Central Europe (as *C. villosulus*), *C. ambiguus* is probably easily overlooked, especially so as obviously being able to persist and propagate in relatively dense forest. Spontaneous and obviously self-sustained mass occurrence, of estimatedly more than 20 000 individuals, was reported from Halle/Saale (John & Frank 2008: 'invasive'). A population in Göttingen consists of more than 50 shrubs, adult and many juveniles, in shaded *Fagus sylvatica* forest.

Selected specimens seen. — China: Sichuan: Pan-lan-shan, west of Kuan Hsien, bush 6 ft., fl. pinkish, 7000–9000 ft., 6.1908, *E. H. Wilson 2179* (A, photo, holotype of *C. ambiguus*); northern Qionglai Shan, Barkam, 31°57'N, 102°39'E, 3350–3700 m, 4.10.1994, *U. Wündisch 94-489-1* (MSB).
Germany: **An** Dölauer Heide, Schn. 19/20, Stelle 200 × 200 m, 27.5.1969, *Schaberg* s.n. (HAL). **Ns** Göttinger Wald, Hainberg S Herberhäuser Stieg, 51°32'N, 9°58'E, MTB 4425/4-04, 300 m, c. 50 Pfl. in *Fagus sylvatica*-Wald, 31.8.2009, *K. Lewejohann 39417* (M).

(6) *Cotoneaster apiculatus* Rehder & E. H. Wilson in Sargent, Pl. Wilson. 1(2): 156. 1912.

?*Cotoneaster distichus* var. *tongolensis* C. K. Schneid. 1906, *C. kansuensis* G. Klotz 1972, *C. hjelmqvistii* Flinck & B. Hylmö 1991

Apiculate C., Bespitzte Z.

● SW and C China (Gansu, Hubei, Shaanxi, Sichuan, Yunnan).
△ Germany: **Sh** Helgoland (*Adolphi,* obs.). **He** Zierenberg (*Dickoré*!). **Ba** Oberstdorf (*Dörr*!); Mittenwald (*Dickoré*!). — Switzerland: Basel (Brodtbeck & al. 1997).
□ Great Britain (Stace 1997); Scotland (GBIF 2009); Italy: Friuli (*Jäger*!). NE USA (Pennsylvania; GBIF 2009).

Cotoneaster apiculatus is similar to *C. horizontalis,* but differs by often larger leaves, which are almost circular in outline, often distinctly apiculate and ± papery (discoloring bright red and deciduous by about early to mid October), and by its depressed ovoid fruit. While potentially (in cultivation) forming relatively large shrubs to 2.5 m, the branching, originally described as "ramis robustis divaricatis" might show a quite regular distichous herring-bone pattern as in *C. horizontalis,* but with the branches more flexuous and less densely set. *C. apiculatus* seems also related to *C. nitidus* and *C. verruculosus* or might be confused with *C. adpressus,* and there remain some ambiguities regarding description and distribution. *C. apiculatus* seems to ascend to relatively higher elevations, both in its native range and adventive, as compared to *C. horizontalis,* up to 1200 m in the Bavarian Alps. While probably easily overlooked or confused, the adventive record of *C. apiculatus* in Central Europe is scattered.

Selected specimens seen. — China: Sichuan: Pan-lan-shan, west of Kuan Hsien, upland thickets, 9000–10000 ft., 10.1910, *E. H. Wilson 4311* (A, photo, holotype of *C. apiculatus*).
Germany: **He** E Zierenberg, W Wichtelkirche, 380 m, 51°21'N, 9°20'E, 9.9.2009, *B. Dickoré 39456* (M). **Ba** Palmenberg bei Oberstdorf, MTB 8428/3, 1200 m, 14.10.1996, *E. Dörr* (M); E Mittenwald, E Karwendelbahn-Talstation, oberhalb der B2, 47°26'N, 11°16'E, 980 m, 3.10.2009, *B. Dickoré 39498* (M).
Italy: Provinz Friuli, Carnia, östlich von Tolmezzo, Schotterkegel, 5.8.1996, *E. Jäger* (HAL).

(7) *Cotoneaster bullatus* Bois in Vilmorin & Bois, Frutic. Vilm.: 119, f. 2. 1904.

Cotoneaster bullatus var. *macrophyllus* Rehder & E. H. Wilson 1912, *C. reticulatus* Rehder & E. H. Wilson 1912, ?*C. glomerulatus* W. W. Sm. 1917, *C. rehderi* Pojark. 1955, *C. boisianus* G. Klotz 1972

Bullate C., Runzelblatt-Z.

● SW China (Hubei, Guizhou, Sichuan, [SE] Xizang, Yunnan).
△ Austria: **N** Deutsch-Wagram (*Bartha*!, Melzer & Bartha 2003). **O** Braunau am Inn (Hohla 2006). **S** Glasenbach (Schröck & al. 2004). **W** Wien (Schinninger & Rozánek 2008). — Belgium (Verloove 2002). —Czech Republic: Praha (Pysek & al. 2002). — Germany: **An** Halle/Saale (John & Frank 2008). **Ba** Erlangen (Asmus 1981); München-Feldmoching (*Dickoré*!); Mittenwald (*Dickoré*!). **Br** Berlin (Asmus 1990). **Me** Rügen (Adolphi 2006); Usedom (Henker & Kiesewetter 2006 '*C. rehderi*', det. G. Klotz). **Ns** Delmenhorst, *T. Tataru* (M!); Braunschweig (Brandes 2003). **Rh** Ludwigshafen (Mazomeit 2005). **Sa** Leipzig, Markkleeberg (*Gutte*!). **Sh** Hamburg (Ringenberg 1994). **We** Königswinter (Lohmeyer 1981); Ruhrgebiet (Keil & Loos 2004). — Switzerland: Winterthur (Schaeppi 1987); Zürich (Landolt 1993).
□ Great Britain, Ireland (Palmer 1986; Stace 1997).

While *Cotoneaster bullatus* seems relatively rare in its native range, the species is well-known in cultivation. However, as a relatively large decorative shrub it seems to have come somewhat out of fashion in Central European gardens, possibly in favour of the evergreen *C. salicifolius*.

Vegetative specimens could be confused with *Cotoneaster ambiguus,* which lacks the characteristic impressed leaf-veins and the usually dense yellowish tomentose indumentum of the abaxial leaf surface and young shoots, and especially with *C. moupinensis*. This species differs by often less conspicuously rugose-bullate leaves, abaxially glabrescent, often fewer-flowered inflorescences and black fruit with mostly 3 or 4 nutlets (usually 5 in *C. bullatus*). Some of these characters, however, do not seem quite consistently informative and might lead to ambiguities regarding the identification of native, cultivated or adventive specimens and also be responsible for some additional, unresolved putative synonyms.

The few synonyms of *Cotoneaster bullatus* annotated above largely describe leaf and inflorescence size variation, which seem very plastic according to habitat conditions and development. *C. bullatus* var. *macrophyllus* and *C. rehderi* do not seem to be taxonomically informative other than that *C. bullatus* is the species having the potentially largest leaves in the genus. Much the same seems to hold true for relatively smaller leaved forms and fewer flowered inflorescences *(C. boisianus)*.

The Central European adventive record is conclusive as for occasional, scattered or locally regular occurrence of self-sown shrubs, especially on open ground, in disturbed or initial scrub and forest, while it might also encompass relicts from former cultivation. *Cotoneaster bullatus* seems to have become a widespread weed in forests of southern Bavaria and ascends to at least 950 m in the Alps.

Selected specimens seen. — Austria: **N** Marchfeld, c. 2.15 km NE der Kirche von Deutsch-Wagram, c. 1.15 km WSW der Eisenbahn-Haltestelle Helmahof, Wegrand im Schwarzföhrenwald, 160–165 m, 2002, *T. Bartha 2002-107* (WU).
China: Guizhou: Jiangkou Xian, vicinity of Jinding along the crest of Fanjing Shan, 2200 m, *B. Bartholomew & al. (Sino-Amer. Guizhou Bot. Exp.) 425* (M).
Germany: **Ba** München-Feldmoching, Fasanerie N Rangierbahnhof, 48°11'N, 11°30'E, MTB 7835/111, 500 m, *Betula pendula*-Wald, "c. 500 Pfl.", 11.10.2009, *B. Dickoré 39528* (M); München-Neuaubing, Gleislager, 48°08'N, 11°24'E, MTB 7834/413, 530 m, 2.7.2009, *B. Dickoré & Flora-München 39207* (M); Germering, Waldschläge und Forststraßen südwestl. der Autobahn München–Lindau, 29.9.2006, *W. Lippert 29169* (M); E Mittenwald, E Karwendelbahn-Talstation, oberhalb der B2, 47°26'N, 11°16'E, 950 m, 3.10.2009, *B. Dickoré 39503* (M). **Ns** Fl. Brem., Delmenhorst, Deichhorst, 29.5.1980, *T. Tataru* (M). **Rh** Wied-Tal WNW Roßbach, Gehölzsaum bei Einmündung Brochenbach, "1 Ex. sehr wahrsch. spontan", MTB 5410/123, 23.10.1999, *G. Kasperek & K. Adolphi 99-122* (herb. Kasperek). **Sa** Leipzig, Markkleeberg, in der Neuen Hardt, 4740/13, Gebüschrand, 9.9.2009, *P. Gutte 187/09* (LZ, photocopy). **Sh** Hamburg-Ohlsdorf, Friedhof, "rote Fr., 5 Steine, rosa Blüten", 23.10.1952, *Anonymus* (HBG); Ohlsdorfer Friedhof, Strauchrabatte bei der Seemannskapelle, "fruchtend, Blüten rosa", 30.9. 1995, *H. Kuschel 9563* (HBG); Hamburg 52, Reichskanzlerstraße 8, "Sämling, spontan", 21.6.1989, *J. Ringenberg 90-22* (HBG); Hamburg 52, Reichskanzlerstraße 9a, "Sämling, spontan", 28.6.1989, *J. Ringenberg 90-21* (HBG). **We** Bergisches Land, Waldbröl, Eichbornweg, Parzelle der ev. Kirchengemeinde, 5.10.1970, *A. Schumacher 14387* (HBG).

(8) *Cotoneaster dammeri* C. K. Schneid., Ill. Handb. Laubholzk. 1(5): 761, f. 429h–k. 1906.

Cotoneaster radicans C. K. Schneid. 1906, *C. humifusus* J. H. Veitch 1906

Bearberry C., Kriech-Z.

● SW China (Gansu, Guizhou, Hubei, Sichuan, [?]Xizang, Yunnan).
△ Austria: **N** (Melzer & Bartha 2003). **O** Wels (Hohla & al. 1998). **S** Flachgau (Schröck & al. 2004). **St** Graz (Essl & Rabitsch 2002). **T** (Fischer & al. 2008). — Germany: **Ba** Erlangen (Asmus 1981); München (*Dickoré*!). **Br** Berlin (Kowarik 1992). **Bw** Bischoffingen (*Kasperek*!). **He** Frankfurt (Ottich 2007). **Ns** Göttingen (*Kasperek, Dickoré*!). **Rh** Rossbach/Wied (Adolphi 1995); Bernkastel-Wittlich (*R. Hand & P. Jaskowski*!). **Sh** Helgoland (*Kasperek & Adolphi*!). **We** Aachen (Schmitz 1991). — Switzerland: Winterthur (Schaeppi 1987); Zürich (Landolt 1993); Basel (Brodtbeck & al. 1997).
□ Great Britain (Stace 1997); Norway; Sweden (GBIF 2009). SW Canada, NW USA (GBIF 2009). New Zealand (North Island; GBIF 2009).

Cotoneaster dammeri is commonly planted as a ground cover and frequently occurs as an adventive from garden rubbish or a relict from former cultivation, occasionally spontaneous from seed. The plants are competitive and persistent in a variety of open or semi-shaded habitats, such as disturbed urban sites and among gravel and rocks, in grassland, in forest clearings and borders. Individuals forming impressive 'carpet trees' of more than 10 m in diameter and with arm-thick woody trunks radiating on the ground were found in Munich. The respective habitats, a derelict railway area and an abandoned dam of the 'Reichsautobahn' were between 40 and 70 years old. In another abandoned railway area in Munich and in several other places, *C. dammeri* was found as a

regular, but rather inconspicuous undergrowth in initial *Betula pendula* forest, as small, apparently isolated, vegetative shoots. However, it formed dense and copiously fruiting mats at clearings and on open banks nearby.

Leaf form and size of *Cotoneaster dammeri* is very variable, apparently rather during development and also depending on light and moisture available than due to taxonomic or clonal properties. Hybrids are reportedly formed with *C. integrifolius* (*C.* ×*suecicus*) and *C. salicifolius* (*C.* ×'Hybridus Pendulus'). However, these need review and might only partly comply with occasionally occurring arching-ascending habit.

Selected specimens seen. — China: Hubei: Western Hupeh, 11.1907, *E. H. Wilson 481* (HBG); 7.1900, *E. H. Wilson 1966* (HBG, isotype of *C. dammeri*). — Sichuan: [Mupin, 2000–2600 m, uplands], 10.6.1908, *E. H. Wilson 1071* (HBG); Tatsienlu (Ost-Tibet), karstige Hänge am Wege nach Sheto, 2600 m, 19.9.1914, *Limpricht 1631* (WU); chiefly near Tachienlu, 9000–13500 ft., *A. E. Pratt 2* (B, type of *C. radicans*).
Germany: **Ba** München-Feldmoching, Fasanerie N Rangierbahnhof, 500 m, 48°11'N, 11°30'E, MTB 7835/111, *Betula pendula*-Wald, ">1000 Pfl.", 11.10. 2009, *B. Dickoré 39529* (M). **Bw** NE Bischoffingen, NNW-Hang der Mondhalde, c. 300 m N Maiengrundhütte, Böschung zwischen Wald und Weinberg, MTB 7811/4, "dichter Bestand mind. 30 qm, siedlungsfern", 26.3.2006, *G. Kasperek 06-001* (herb. Kasperek). **Rh** Brauneberg, Landkreis Bernkastel-Wittlich, Mauer des Friedhofs, MTB 6007/4, 7.9.1997, *R. Hand & P. Jaskowski 1669* (B). **Sh** Helgoland, Hänge des Mittellands SE der Paracelsus-Nordseeklinik, MTB 1813, "sehr zahlreich", 4.9.2003, *G. Kasperek & K. Adolphi 03-090* (herb. *Kasperek*).

Cotoneaster dammeri* × *integrifolius [*Cotoneaster* ×*suecicus* G. Klotz in Wiss. Beitr. Friedrich-Schiller Univ. Jena, Beitr. Phytotax. 10: 47. 1982 (as *C. conspicuus* × *dammeri*)]. This hybrid is probably common in cultivation and, apparently, intermediate between the rather dissimilar though variable putative parents. It combines the widely trailing, rooting habit of *C. dammeri* with a somewhat more erect to arching growth. While the plant can be commercially propagated by cuttings, it seems to escape only occasionally (e.g., Schröck & al. 2004), predominantly by shoot-fragments from garden rubbish deposits. The plants seem often sterile, while occasional seedlings were reported to split to parental characters (Keil & Loos 2004). Spontaneous hybridisation could also occur (see under *C. integrifolius*).

Selected specimens seen. — Germany: **Ba** München-Neuaubing, Gleislager, 48°08'N, 11°24'E, MTB 7834/413, 530 m, "einzeln, Teppichstrauch c. 2,5 m im Durchmesser", 6.9.2009, *B. Dickoré 39427* (M).

***Cotoneaster dammeri* × *salicifolius*.** Putative hybrids (and graftings?) of these, very dissimilar, parents are sometimes cultivated. An adventive record seems uncertain or lacking possibly due to reduced fertility.

(9) *Cotoneaster dielsianus* E. Pritz. ex Diels in Bot. Jahrb. Syst. 29: 385. 1900.

Cotoneaster elegans (Rehder & E. H. Wilson) Flinck & B. Hylmö 1962, *C. fangianus* T. T. Yü 1963, *C. splendens* Flinck & B. Hylmö 1964

Diels' C., Diels Z.

● SW China (Gansu, Guizhou, Hubei, Sichuan, [?E] Xizang, Yunnan).
△ Austria: **K** Drau-Tal (Essl 2008a). **N** Strasshof an der Nordbahn (Essl & Stöhr 2006). **O** Franking (Hohla 2006). **S** Flachgau (Schröck & al. 2004). **V** Bregenz (Stöhr & al. 2009). — Germany: **An** Halle/Saale (John & Frank 2008). **Ba** Erlangen (Asmus 1981); Sulzbach am Inn (Hohla & al. 2002); Mittenwald (*Dickoré*!). **Br** Berlin (Kowarik 1992; Prasse & al. 2001 *'C. elegans'*). **Bw** Kirchheim unter Teck (Böhling 2008). **He** Taunus (Uebeler & al. 2008). **Me** Rostock (*Duty*!); Rügen (Adolphi 2006); Usedom (Henker & Kiesewetter 2006). **Ns** Göttingen (*Dickoré*!). **We** Ruhrgebiet (Keil & Loos 2004). Waldbröl (*A. Schumacher*!); Köln (*Kasperek*!). **Rh** Waldbreitbach (Adolphi 1995). **Sh** Hamburg (Ringenberg 1994); Helgoland (Adolphi 2008). — Poland: Poznan (Czekalski & Wyrzykiewicz-Raszewska 1992). — Switzerland: Basel (Brodtbeck & al. 1997).
□ Great Britain; Ireland (Stace 1997); Sweden (Hylmö 1993); Norway (GBIF 2009). SW Canada; NW USA. New Zealand (South Island; GBIF 2009).

Cotoneaster dielsianus is commonly planted and occasionally found as a relict from former cultivation or definitely spontaneous, often as single shrubs, but sometimes in larger populations. It is definitely naturalised in Austria and Germany, occurs widely scattered and locally common, especially in the warmer and drier regions, but also ascends to at least 980 m in the Bavarian Alps (western foot of the Karwendel massif, several hundred shrubs with numerous *C. divaricatus* and *C. horizontalis,* and few individuals of *C. bullatus* and *C. tomentosus*).

Well grown shrubs of *Cotoneaster dielsianus* seem quite distinctive on account of their elegant, arching and often markedly distichous branching and deciduous, small, abaxially densely tomentose foliage. However, the species seems ecologically and morphologically plastic and an additional synonymy is probably inherent. On superficial inspection, it might even be confused with the European indigenous *C. tomentosus*. An unusual form of *C. dielsianus,* possibly a mutation, with thin, relatively narrow, adaxially glabrous leaves is cultivated in Munich BG. The inclusion of *C. splendens* and other taxa in *C. dielsianus* is difficult to verify without authentic and ample, additional material from China. It seems though

reasonable on account of probable morphological and geographical continuity. For possible confusion with the semi-evergreen *C. franchetii,* see there.

Selected specimens seen. — Austria: **N** Großer Geyergraben SW von Steinhof (SW von Berndorf), Quadrant 8062/3, 380 m, Rand des Schwarzföhrenwaldes, 19.10.1997, *W. Till* (WU).
Belgium: Queue-du-Bois, prov. de Liège, 23.5.1993, *J. Beaujean 95/5* (B).
China: Hubei: W. Hupeh, 6.1900, *E. H. Wilson 1127* (HBG). — Sichuan: Nan ch'uan, 1891, *v. Rosthorn 492* (B, holotype of *C. dielsianus);* W Chengdu, Yingjing–Hanyuan pass top, 29°40'N, 102°37'E, 2360 m, 21.6.1994, *B. Dickoré 8047* (MSB).
Germany: **Ba** Niederbayern, Landkreis Kelheim, Fränkischer Jura, am Brand (Gronsdorfer Hänge, Gemarkung Kelheim/Ihrlerstein), 48°55'N, 11°41'E, MTB 7037/31, 420 m, Halbtrockenrasen, "2 Büsche entfernt", 22.5.2006, *F. Schuhwerk 06/89* (M); München-Feldmoching, Fasanerie E, W Lasallestr., 48°11'N, 11°31'E, MTB 7835/112, 500 m, 10.10.2009, *B. Dickoré 39511* (M); E Mittenwald, E Karwendelbahn-Talstation, oberhalb der B2, 47°26'N, 11°16'E, 960 m, 3.10.2009, *B. Dickoré 39501* (M). **He** Limburger Becken, Runkel-Steeden, Herrenwiesen an der Lahn, aufgeschüttetes Bodenmaterial, 5.6.2003, *H. Kahlheber 03-1184.2* (M). **Me** Bornstorfer Tannen (Rostock), a. Teichrand, 5.1975, *J. Duty* (JE). **Ns** Göttinger Wald, Hainberg S Herberhäuser Stieg, 51°32'N, 9°58'E, MTB 4425/4-04, 300 m, 31.8.2009, *K. Lewejohann 39418* (M). **Sh** Hamburg 53, Randowstraße, "Sämling, spontan", 21.5.1990, *J. Ringenberg 90-5* (HBG); Hamburg 70, Schatzmeisterstraße, Sämling, spontan, 6.7.1989, *J. Ringenberg 90-41* (HBG). **We** Waldbröl, "im Garten aus eingeschlepptem Samen spontan entstanden", 25.9.1964, *A. Schumacher* (HBG); Köln-Müngersdorf, Bahndamm, nördliche Böschung zum Girlitzweg hin, MTB 5007/321, 5.10.2001, *G. Kasperek 01-136,* 1.6.2002, *G. Kasparek 02-074* (herb. Kasperek).
Cultivated: Sweden: At Bjuv, raised from the holotype collection of *C. splendens*, *H. Smith 12925*, Sikang, Tachienlu, 2900 m, 7.7.1980, *B. Hylmö 9414* (JE).

(10) *Cotoneaster divaricatus* Rehder & E. H. Wilson in Sargent, Pl. Wilson. 1(2): 157. 1912.

Divaricate C., Spreizende Z.

● C and SW China (Anhui, Gansu, Guizhou, Hubei, Hunan, Jiangxi, Shaanxi, Sichuan, Xinjiang, [?]Xizang, Yunnan, Zhejiang).
△ Austria: **B** Bernstein (Essl & Stöhr 2006). **K** (Fischer & al. 2008). **N** Piestingtal (Melzer & Bartha 2003); Krems (Essl 2008b). Gainfarn (*Till*!). **O** Trauntal (Strauch 1992). **S** Salzburg (Schröck & al. 2004); Hallein (Stöhr & al. 2004). **St** Eibiswald (Essl 2008b). **T** (Fischer & al. 2008). **V** Bregenz (Stöhr & al. 2009). **W** Wien (Essl & Stöhr 2006). — Germany: **An** Halle/Saale (John & Frank 2008). **Ba** Erlangen (Asmus 1981); Kehlheim (*Schuhwerk*!); Königssee (*Adolphi*!). **Br** Berlin (Asmus 1990). **Bw** Erkenbrechtshausen (*Dunkel*!). **He** Fuldaer Senke (Gregor 1997); Limburg (*Kahlheber*!); Frankfurt (Ottich 2007). **Me** Usedom (Henker & Kiesewetter 2006). **Ns** Braunschweig (Brandes 2003). **Rh** Waldbreitbach (Adolphi 1995); Ludwigshafen (Mazomeit 1997); *Dunkel*!). **Sa** Leipzig (Gutte 2006). **Sh** Hamburg (Ringenberg 1994); Helgoland (Adolphi 2008). **We** Königswinter (Lohmeyer 1981); Ruhrgebiet (Keil & Loos 2004). — Poland: Near Kórnik Arboretum (Dolatowski 1992). — Switzerland: Winterthur (Schaeppi 1987); Basel (Brodtbeck & al. 1997).
□ Denmark (GBIF 2009); Great Britain (Stace 1997); Hungary (Udvardy 1999); Norway (GBIF 2009); Sweden (Hylmö 1993). SW Canada and NW USA (GBIF 2009), NE USA (Zika 2002). New Zealand (South Island, GBIF 2009).

Cotoneaster divaricatus is commonly planted and probably throughout Central Europe the commonest adventive and naturalising species of the genus, occurring widely scattered and locally in large, probably bird-sown and obviously self-sustained colonies, 'invasive' (John & Frank 2008). An almost impenetrable mass population of *C. divaricatus* occurs on abandoned railway area in Munich-Feldmoching, estimatedly comprising some 50 000 plants (with lesser quantities of *C. horizontalis, C. dielsianus, C. dammeri* and *C. bullatus*), forming sort of a '*Cotoneaster* forest' (Hetzel 2006) under fully grown *Betula pendula*.

Until recently, *Cotoneaster divaricatus* was apparently often overlooked or misidentified as *C. horizontalis*. Young and disturbed plants are sometimes difficult to distinguish from *C. horizontalis* and could also, especially in dry habitats, imitate the characteristic herring-bone branching of that species. The generally more erect habit, somewhat larger, often more oblong leaves and cylindric fruit could serve to distinguish it from that species; for delimitation against *C. symondsii,* see there. *C. divaricatus* occurs in a variety of habitats, such as urban disturbed ground (often with *C. horizontalis*), in dry grassland and scrub (often with *C. dielsianus*) and on forest margins, clearings or within forest; it has also been observed in riverine and montane forest, often far from habitation, ascending in the Bavarian Alps to at least 1000 m.

Selected specimens seen. — Austria: **N** NW Gainfarn, Qu. 8063/1, 300–320 m, 15.10.1994, Waldrand, *W. Till* (WU).
China: Hubei: Western Hupeh [S of Wushan, 1650–2000 m], 9.7.1907, *E. H. Wilson 153Q* (HBG, paratype of *C. divaricatus*).
Germany: **An** Dölauer Heide, Wald b. Nietlebener Str., 4.6.1966, *Schaberg s.n.* (HAL). **Ba** Oberfranken,

Landkreis Forchheim, Fränkischer Jura, Felskopf an der Südostseite des Rodenstein auf der Ehrenbürg nördlich Schlaifhausen, 49°42'N, 11°10'E, MTB 6232/44, "*C. horizontalis;* die Art beginnt sich an naturnahen Wuchsorten wie diesem zunehmend einzubürgern und teilweise *Cotoneaster integerrimus* zu verdrängen"; 500 m, 21.6.1992, *F. Schuhwerk (92/143)*, *S. Bräutigam & N. Meyer, Cormoph. Exsicc. 97* (B); München-Feldmoching, Fasanerie N Rangierbahnhof, 48°11'N, 11°30'E, MTB 7835/111, 500 m, *Betula pendula*-Wald, "c. 20 000 Pfl.", 11.10.2009, *B. Dickoré 39526* (M); München-Pasing, N Paosostr., 48°08'N, 11°26'E, MTB 7834/412, 530 m, Bahndamm, 6.9.2009, *B. Dickoré 39420* (M); Grünwald, rechtes Isar-Ufer knapp unterhalb der Isarbücke, MTB 7935/31, "2 junge Sträucher am Fuß des buchenbestandenen Steilhangs im Bereich der Hochwasserlinie, sicher wildwachsend", MTB 7935/31, 26.6.2009, *B. Dickoré & G. Kasperek 09-016* (herb. Kasperek); E Mittenwald, E Karwendelbahn-Talstation, oberhalb der B2, 47°26'N, 11°16'E, 960 m, offener Bergwald, "zahlreich", 3.10.2009, *B. Dickoré 39499* (M); "Marzoller Au" N Weißbach, im Auwald nahe des Uferpfades (c. 400–800 m unterhalb Einmündung Mühlengraben), "zerstreut 6 Ex. gesehen", MTB 8243/14, 26.6.2009, *B. Dickoré & G. Kasperek 09-017* (herb. Kasperek); Ort Königssee, am Weg vom Hotel Bergheimat zum See an einer Felswand, MTB 8443/2, "diese Aufsammlung Basis für die Angabe von *Cotoneaster simonsii* bei Wisskirchen & Haeupler!", 26.8.1996, *K. Adolphi* (M). **Bw** Erkenbrechtshausen, Steinbruch nördlich E., offene Pionierrasen, MTB 6826/11, 4.7.1998, *F. G. Dunkel Du-774-1* (M). **He** E Zierenberg, Dörnberg W-Seite, Alpenpfad, 51°21'N, 9°19'E, 400 m, 9.9.2009, *B. Dickoré 39457* (M); Gießen, Rodthohl, gegenüber Zentrum für Innere Medizin (Haus Nr. 57) am Fuß einer alten, 2–3 m hohen Stützmauer, mehrere Ex., einige blühend, MTB 5418/113, 23.5.2003, *G. Kasperek 03-025* (herb. Kasperek). **Rh** Ludwigshafen, an der Bahnlinie zwischen dem Paketpostamt und der Teufelsbrücke, "z.T. verwildert", MTB 6516/23, 20.6.1998, *F. G. Dunkel Du-778-3* (M); Ahrtal unterhalb Altenahr, Böschung an der Uferstraße unter den Eisenbahnbrücken, MTB 5407, 18.5.2003, *G. Kasperek, I. Ottich & K. Adolphi 03-019* (herb. Kasperek). **Sh** Helgoland, Hänge des Mittellands SE der Paracelsus-Nordseeklinik, K, MTB 1813, "zusammen mit *C. horizontalis* und *C. dammeri,* häufig mit Jungwuchs", 4.9.2003, *G. Kasperek & K. Adolphi 03-091, 03-092* (herb. Kasperek); Helgoland, 19.9.2009, *K. Adolphi, K. & H. Kuhbier 39490* (M); Hamburg, Bezirk Mitte, U-Bahnhof Legienstrasse zwischen den Gleisen in Richtung Abstellbahnhof, 35728r 59355h, Anflugwald mit lichteren Stellen, "spontan", *Poppendieck, Samu & v. Prondzinski* (HBG). **We** Köln-Müngersdorf, Bahndamm, nördliche Böschung zum Girlitzweg hin, MTB 5007/321, 5.10.2001, *G. Kasperek 01-135* (herb. Kasperek).

(11) ***Cotoneaster franchetii*** Bois. in Rev. Hort. 74: 379. 1902.

Cotoneaster mairei H. Lév. 1915, *C. wardii* W. W. Sm. 1917, ?*C. sternianus* (Turrill) Boom 1957, *C. cinerascens* (Rehder) Flinck & B. Hylmo 1962, *C. vilmorinianus* G. Klotz 1972, *C. tengyuehensis* J. Fryer & B. Hylmö 1997

Franchet's C., Franchets Z.

● SW China (Guizhou, Sichuan, [?SE] Xizang, Yunnan), N Thailand.
△ Austria: **N** Marchfeld, Strasshof (*Stöhr*!). [?]**W** Wien (Forstner & Hübl 1971). — [?] Germany: **Ba** Erlangen (Asmus 1981). **We** Ruhrgebiet (Keil & Loos 2005). — [?] Switzerland: Basel (Brodtbeck & al. 1997).
□ France (GBIF 2009); Great Britain; Ireland (Kelly 1988; Stace 1997, apparently mostly in the S and W); Spain (GBIF 2009). South Africa (Plants of Southern Africa 2009). USA: California (Calflora 2009: 'invasive'; many records from W USA). SW Australia and New Zealand (North and South Islands; GBIF 2009).

Cotoneaster franchetii is only occasionally cultivated in Central Europe. It differs by semi-evergreen, somewhat larger and more elongate leaves and brick-red fruit from the otherwise very similar and variable *C. dielsianus*. However, while *C. franchetii* does not shed its leaves in autumn, these are often killed during severe winters. Furthermore, the leaves do not substantially differ in texture or structure from the deciduous ones of *C. dielsianus,* which renders this character almost useless for herbarium material. The adventive record of *C. franchetii* for Austria (Marchfeld, *Stöhr*!), of a specimen with leaves and fruit collected in early spring, is unequivocal. Possible spontaneous occurrence was also observed in Munich BG (where also cultivated), while other Central European records might turn out to belong to *C. dielsianus*.

Selected specimens seen. — Austria: N Marchfeld, Straßhof an der Nordbahn, verwildert in einem Schwarzföhrenforst nahe Bartoschviertel, MTB 7665/4, 160 m, 1.4.2004, *O. Stöhr 4139* (herb. *Pilsl*).
China: Yunnan: 20 km N Lijiang, reiche *Quercus-Rhododendron* Wälder, Wiesen, 2900–3100 m, 31.7.1996, *D. Podlech 54436* (MSB).
Cultivated: Halle/Saale, Botanischer Garten, Neuwerkhang, 22.9.2009, *B. Dickoré 39469* (M).

Cotoneaster insculptus Diels in Notes Roy. Bot. Gard. Edinburgh 5: 273. 1912, described from northwestern Yunnan, was included as a synonym under *C. franchetii* by Lu & Brach (2003). While still possibly contiguous to this species, it looks distinctive by its small, somewhat coriaceous, adaxially glabrescent leaves with deeply impressed veins. In Central Europe, *C. insculptus* is apparently rarely cultivated (Berlin BG!) and unknown oth-

erwise. It is reported as naturalised from Great Britain (Wales, Stace 1997).

Cotoneaster pannosus Franch., Pl. Delavay.: 223. 1890 (*C. amoenus* E. H. Wilson 1912, ?*C. lidjiangensis* G. Klotz 1963), from southwestern China (Sichuan, Yunnan), seems to come vegetatively close to *C. franchetii* but has spreading white petals. While thus belonging to *C.* subg. *Chaenopetalum,* herbarium specimens from the native range of both species are apparently difficult to distinguish. The abaxial leaf surface seems to be more thickly white-tomentose (pannose) in this species, with the overlapping indumentum giving a characteristic white margin to the leaf seen from above. *C. pannosus* is reported as adventive in southern England (Palmer 1992; Stace 1997) and from other, warmer parts of the world: USA: California (Bossard & al. 2000; Calflora 2009: 'invasive'); South Africa (Plants of Southern Africa 2009), etc. (Fryer & Hylmö 2009).

Selected specimens seen. — China: Yunnan: Bei Kuming, Kalkfelsen über Kloster, 19.6.1965, *H. Meusel* (HAL, paratype of *C. lidjiangensis*). — United States of America: California, abundantly naturalised, Stinson Beach, Marin County, 4.11.1959, *J. T. Howell 35109* (B).

Cotoneaster coriaceus Franchet, Pl. Delavay.: 222. 1890 (*C. lacteus* W. W. Sm. 1917, *C. oligocarpus* C. K. Schneid. 1917, *C. smithii* G. Klotz 1996), from southwestern China (Guizhou, Sichuan, Xizang, Yunnan), is another evergreen species of *C.* subg. *Chaenopetalum* that is not hardy in Central Europe. It is widely cultivated and naturalised in warmer regions, such as the British Isles and many subtropical regions of the world. *C. coriaceus* is an invasive weed, e.g., in California and southwestern Australia.

Selected specimens seen. — China: Yunnan: Chuxiong Xian, in the vicinity of Longtang, near km marker 159 W of Kumming on the Burma Rd., roadside and badly disturbed shrubby slopes, shrub c. 3 m tall, flowers white, anthers red, leaves white beneath, 25°04'N, 101°47'E, 1820 m, 25.7.1984, *Sino-Amer. Bot. Exp. 1249* (B).

(12) ***Cotoneaster frigidus*** Wall. ex Lindl. in Edwards's Bot. Reg. 15: t. 1229. 1829.

Cotoneaster gamblei G. Klotz 1966

Frigid C., Kälte-Z.

● C Himalayas: NW India (Himachal Pradesh) to Bhutan.
△ [?]Austria: **O** Obernberg am Inn (Hohla 2006 *'Cotoneaster ×watereri'*). **S** Salzburg (Pilsl & al. 2008 *'C. ×watereri'*). — [?] Belgium: (Verloove 2001 *'C. ×watereri'*). — [?] Switzerland (Brodtbeck & al. 1997 '*C. ×watereri'*).
□ Great Britain; Ireland (Stace 1997, frequent).

Cotoneaster frigidus was already published in 1829, in one of the first fascicles of volume 15 of the magazine Edwards's Botanical Register, unlike the protologue of *C. laxiflorus,* which appeared in the last fascicle of volume 15, in 1830. *C. frigidus* is a large, sometimes almost treelike shrub, apparently confined to the central Himalayas. The provenance of exsiccata claiming southern Indian origin (Tamil Nadu: Nilgiri Hills, *Hohenacker, Pl. Ind. Or. 1575 'C. affinis'*) is likely corrupt or refers to a cultivated plant (*C. buxifolius* is the only native species of *Cotoneaster* known from this far disjunctive area).

Cotoneaster frigidus is commonly considered less hardy in Central Europe, but seems to do quite well where it is rarely cultivated (Berlin BG!, former forest garden Hann. Münden!). The putative hybrid *C. ×watereri* Exell *(C. frigidus × salicifolius)* is allegedly hardier and more commonly cultivated in Central Europe and was repeatedly reported adventive. However, the identity of plants cultivated under this name and its adventive presence in Central Europe need further investigation. Most cultivated specimens seen by us so far, seemed to belong to the one or the other species, with no obvious need to consider hybrid origin. Furthermore, hybrid progeny would likely split to parental characters. With especially *C. salicifolius* being an extremely variable species (or considered to comprise several morphologically different 'microspecies'), the adventive record for *C. ×watereri* could well include misidentifications of *C. salicifolius,* young shoots of which often have relatively short and abaxially glabrescent leaves.

Selected specimens seen. — India: Sikkim: 8000 ft., *J. D. Hooker* (M); Singalila Ridge, Darjeeling, 2000 m, common, flowers white, 12.5.1981, *Ganesh Rai 291* (B). Nepal: Gossain Than, *N. Wallich Cat. No. 675* (M).

(13) ***Cotoneaster horizontalis*** Decne. in Fl. Serres Jard. Eur. 22: 168. 1879.

Cotoneaster horizontalis var. *perpusillus* C. K. Schneid. 1906, *C. perpusillus* (C. K. Schneid.) Flinck & B. Hylmö 1966, *C. ascendens* Flinck & B. Hylmö 1966, *C. atropurpureus* Flinck & B. Hylmö 1991, *C. atrovirens* J. Fryer & B. Hylmö 2009

Wall C., Fächer-Z.

● C and SW China (Gansu, Guizhou, Hubei, Hunan, Jiangsu, Shaanxi, Sichuan, [?]Taiwan, [?]Xizang, Yunnan, Zhejiang), [?]Nepal.
△ Austria: **B** Güssing (Traxler 1985). **N** Semmering (Melzer 1986). **O** Linz (Hohla & al. 1998). **S** Salzburg (Wittmann & Pilsl 1997; Pilsl & al. 2002). **St** Graz (Melzer 1976). **T** Innsbruck (Polatschek 2000). **V** Bregenz (Stöhr & al. 2009). **W** Wien (Forstner & Hübl 1971). — Belgium (Verloove 2002; Piqueray & al. 2008). — Czech Republic: Praha (Pysek & al. 2002). — Ger-

many: **An** Halle/Saale (John & Frank 2008). **Ba** Allgäu (Dörr 1970); Erlangen (Asmus 1981). **Br** Berlin (Kowarik 1992). **Bw** Stuttgart, etc. (Kreh 1951; Seybold 1992). **He** Frankfurt (Ottich 2007). **Me** Rügen (*Endtmann*!); Usedom (Henker & Kiesewetter 2006). **Ns** Braunschweig (Brandes 1978, 1987). **Rh** Ludwigshafen (Mazomeit 1997); Kasbach (Adolphi 1995). **Sa** Leipzig (Gutte 2006). **Sh** Helgoland (Adolphi 2008). **Th** Arenshausen (Zündorf & al. 2006). **We** Leverkusen (Adolphi 1977). Ruhrgebiet (Keil & Loos 2005); Biggetal, Heggen (*Schumacher*!). — Luxembourg (Kariger 1992). — Netherlands (Denters 2006). — Poland: Poznan (Czekalski & Wyrzykiewicz-Raszewska 1992). — Switzerland: Winterthur (Schaeppi 1987); Locarno (Gianoni & al. 1988); Zürich (Landolt 1993). Basel (Brodtbeck & al. 1997: *'C. horizontalis'* and *'C. ascendens'*); Wallis (*Angerer*!).

□ Great Britain and Ireland (Stace 1997, almost throughout); Hungary (Udvardy 1999). SW Canada; NW and NE USA (Washington). Japan; Taiwan. SE Australia and New Zealand (North and South Islands; GBIF 2009).

The date of Decaisne's protologue usually given as 1877 has to be corrected because it was not published until 1879 (cf. p. 173).

Cotoneaster horizontalis is commonly planted, adventive and locally naturalised in Central Europe. It seems to favour rocky situations and many urban occurrences are in clefts of stone walls, along road borders, house walls or on railway and industrial sites. Larger spontaneous and self-sustaining populations are occasionally found in natural rocky areas (Helgoland, Middle Rhine area, etc.). *C. horizontalis* is also often found in dry calcareous grassland with rocky outcrops, such as in northern Hesse and in the Jura of Baden-Württemberg and Bavaria, and ascends to at least 1000 m in the Alps.

Despite its usually characteristic habit, *Cotoneaster horizontalis* has often been confused or intermingled, especially with *C. adpressus* and *C. divaricatus* (see under these species). The native range of *C. horizontalis* does not seem to be well-known and some records, e.g., from Tibet, Taiwan and Nepal might either belong to different species or be adventive. While *C. horizontalis* itself is certainly variable, its taxonomic circumscription seems poorly understood and also blurred by numerous, probably minor variants described for species and partly assigned to different sections or series. The few synonyms cited above (and probably several more) seem to describe mostly cultivated strains or selections, characterised by largely quantitative characters of growth form and leaf size. However, while presently being difficult to qualify, some of this variation might also turn up in adventive plants. Many adventive specimens from dry, exposed habitats seem to come close to *C.* (*horizontalis* var.) *perpusillus*. Related species might include *C. apiculatus* (see there), and the following.

Selected specimens seen. — Austria: **N** Mödlinger Klause, westlich der Johannesruhe, Schwarzföhrenwald über Dolomit, 30.4.1994, *G. M. Schneeweiß* (WU). **S** Tennengau, Salzachtal zwischen Elsbethen und Puch bei Hallein, Stauraum des Kraftwerkes Urstein, Auwaldfragmente SW vom Schloss Urstein, 440 m, MTB 8244/4, 14.5.2001, *H. Wittmann s.n.* (M).

China: Hubei: S. Hupeh [Chang-yang, 1500 m], 5.1900, *E. H. Wilson 564* (HBG, syntype of *C. horizontalis* var. *perpusillus*). — Sichuan: Nan ch'uan, 1891, *v. Rosthorn 1808* (B).

Germany: **Ba** Felsen am Zwieselberg bei Roßhaupten, 6.8.1970, *E. Dörr* (M); Allgäu, Zipfelschrofen, 1000 m, 29.7.1991, *E. Dörr* (M); Landkreis Ostallgäu, Füssen, beim Parkplatz Hohenschwangau, MTB 8430/1, 800 m, 16.10.2000, *N. Mathes 2/2000* (M). **Bw** NSG "Pferdstrieb" S Sandhausen, in lichtem Kiefernbestand auf Dünenkante im südlichen Teilgebiet, Einzelex. bildet ein kniehohes Gebüsch von 4 m Durchmesser, MTB 6617, 25.6.2001, *G. Kasperek & Florist.-Soziol. Arbeitsgem. 01-075* (herb. Kasperek). **Me** Feuersteinfelder von Neu-Mukran auf Rügen, 22.11.1959, *Endtmann* (JE). **Sh** Helgoland, Hänge des Mittellands SE und NE der Paracelsus-Nordseeklinik auf flachgründigen, schwach entwickelten Böden, sehr zahlreich, ältere und jüngere Exemplare über große Flächen verteilt, MTB 1813, 1.9.2002 und 4.9.2003, *G. Kasperek & K. Adolphi 02-151, 03-089* (herb. Kasperek). **Th** NW Treffurt, Adolfsburg, Trockengebüsche am unteren Südhang, c. 150 m vom Ortsrand, MTB 4827/3, "mehrere gut entwickelte Sträucher", 25.5.2002, *G. Kasperek & Florist.-Soziol. Arbeitsgem. 02-066* (herb. Kasperek). **We** Sauerland, Biggetal, Heggen, Hohe Ley, auf Geröll an der hohen Steilwand, "vielleicht durch Vögel verschleppt", 16.8.1968, *A. Schumacher 1438d* (HBG); Kasbach, an der Bahnlinie nach Kalenborn, hohe Stützmauer im Geländeeinschnitt ESE Kirche/Friedhof, MTB 5409/213, "sehr individuenreicher wildwachsender Bestand flächenhaft in der gesamten Stützmauer", MTB 5409/213, 22.8.2002, *G. Kasperek, E. Foerster & K. Adolphi 02-138* (herb. Kasperek).

Switzerland: Wallis, Rhonetal zw. Ollon und Aigle, c. 400 m westlich Ollon gegen Vehiez, im feuergeschädigten Föhrenwald auf stark erodiertem sowie exponierten Gipssteilhang, 550 m, 12.6.1986, *O. Angerer s.n.* (M).

Cotoneaster nitidus Jacques in J. Soc. Imp. Centr. Hort. 5: 516. 1859 (?*C. distichus* Lange 1882, *C. cordifolius* G. Klotz 1964, *C. forrestii* G. Klotz 1964, *C. salwinensis* G. Klotz 1972) is a distinct species, apparently confined to a rather small area on the borders of the eastern Himalayas (northeastern India, Arunachal Pradesh), northern Myanmar and southwestern China (westernmost Yunnan). It is rarely cultivated (private garden of *G. Klotz*, Jena!). *C. nitidus* resembles *C. horizontalis* and *C. apiculatus* in its regular distichous branching, but the leaves are ± ad-

axially strigose, somewhat pale-pruinose, inflorescences 2–6-flowered, peduncles reflexed and fruit scarlet. Much confusion has apparently arisen about the identity of *C. distichus,* which also seems to have caused considerable problems as to the identities and provenances in several other species, described from cultivated specimens with basically unknown origins *(C. adpressus, C. symondsii).*

Selected specimens seen. — India: Meghalaya: Assam, Khasi Hills, Laitlyngkon, 6500 ft., 25.9.1913, *Upendranath Kanjital 2650* (DD, photo).
Cultivated: Sweden: Bjuv, from *G. Forrest 30397,* 4.11.1980, *B. Hylmö* (JE). Germany: Jena, Dornblumthweg, Garten G. Klotz, 24.9.2009, *B. Dickoré 39489* (M).

Cotoneaster verruculosus Diels in Notes Roy. Bot. Gard. Edinburgh 5: 272. 1912 (*C. improvisus* G. Klotz 1972) is similar to *C. horizontalis,* but differs in its reduced indumentum, with bases of hairs giving a characteristic prickly appearance to the shoots. The relevance of this character and distributional features (or, of a whole series around this taxon, *C.* ser. *Verruculosi* G. Klotz 1972, Fryer & Hylmö 2009) seem to be largely unknown. *C. verruculosus* probably originates from SW China (Sichuan, [?]Xizang, Yunnan), while an additional distribution in the Himalayas (Bhutan, N India, Myanmar, Nepal), as given by Lu & Brach (2003), might need confirmation. Cultivated plants hanging from walls of Salzburg (*Pilsl*!, *Adolphi, Dickoré, Kasperek & Nowack*!) seem to refer to here.

Selected specimens seen. — Austria: **S** Stadt-Salzburg, Nonntal/Mönchsberg, Erhardsgäßchen, Oberkante einer Mauer, 8244/1, 425 m, 13.9.2002, *P. Pilsl, C. Schröck & O. Stöhr 11955* (herb. Pilsl).

(14) ***Cotoneaster integerrimus*** Medik., Gesch. Bot.: 85. 1793.

Mespilus cotoneaster L. 1753, *Cotoneaster vulgaris* Lindl. 1821, *C. juranus* Gand. 1875, *C. pyrenaicus* Gand. 1875, *C. suboblongus* Gand. 1875, *C. humilis* Dunn 1924, *C. gilgitensis* G. Klotz 1966, ?*C. kaganensis* G. Klotz 1966, *C. integerrimus* subsp. *masclansii* J. M. Monts. & Romo 1983, *C. canescens* Vestergren ex B. Hylmö 1993, *C. kullensis* B. Hylmö 1993, *C. scandinavicus* B. Hylmö 1993, *C. cambricus* J. Fryer & B. Hylmö 1994

Common C., Gewöhnliche Z.

● N, W, C and S Europe, SW Asia (disjunct). — Austria: **B**, **K**, **N**, **O**, **S**, **St**, **T**, **V**, **W** (Fischer & al. 2008). — Belgium. Czech Republic. Germany: **An**, **Ba**, **Bw**, **He**, **Ns**, **Rh**, **Sa**, **Th**, **We**. Luxembourg. Poland. Switzerland.
△ Germany: [?]**Br** (Kowarik 1992; Prasse & al. 2001).

While the total, large though often disjunctive, European-W Asiatic distribution of *Cotoneaster integerrimus* seems well depicted by the map of Jäger in Kutzelnigg (1994), there remains considerable controversy about the taxonomic circumscription of the species. Isolated European populations, e.g., in the Baltic region and on the British Isles have been accommodated by several specific epithets. Actually, the British Isles' population *(C. cambricus)* comprises very few plants on limestone of Great Orme's Head (northwest Wales), "known since 1783; the six plants remaining in 1983 have since increased by reintroduction of native material" (Fryer & Hylmö 1994). Most recently, Sennikov (2009) has segregated the Central and southern European (including British) populations under the name *C. pyrenaicus* from *C. integerrimus* (s.str.) for an exclusively Baltic and Scandinavian taxon. His treatment does not give morphological or molecular backgrounds. Although Hylmö (1993) had made some similar statements on Scandinavian *Cotoneaster* taxa, this splitting approach seems problematic. *C. integerrimus* is lacking from northern Germany, Denmark and northern Poland, but the geographical distance between the Central European and Baltic/Scandinavian populations does not seem to be substantially larger than between other disjunctive occurrences of this species. The problem could, furthermore, relate to possible intermediates or hybrids of *C. integerrimus* and *C. laxiflorus* (in the Baltic region) or *C. tomentosus* (in the Alps) and its discrimination against other northeastern European and northern Asiatic taxa (*C. cinnabarinus* Juz. 1950, *C. uniflorus* Bunge 1830). However, conclusive investigations, covering large enough an area and sample size, are apparently absent. For now, while acknowledging reproductive isolation and possible phytochemical distinctiveness for disjunctive or marginal populations, *C. integerrimus* (s.l.) seems still best treated as one contiguous species.

In southern Asia, *Cotoneaster integerrimus* also occurs in a relatively large, while likewise probably isolated area on the borders of the inner northwestern Himalaya, northeastern Hindukush, southwestern Karakorum and Kashmir (eastern Afghanistan, northern Pakistan, northwestern India: as *C. humilis, C. gilgitensis* and *C. uniflorus* auct., respectively; see also Parker 1924). While *C. integerrimus* could well extend into adjacent western China (Xinjiang), an additional record of the species for large parts of northern China (Hebei, Heilongjiang, Nei Mongol, Qinghai, Xinjiang) and Korea by Lu & Brach (2003) seems to require verification. Ambiguities might relate to odd historical records under this well-known European species name or occasional, incorrect synonymies, such as for *C. zabelii* (GBIF 2009).

In its native Central European part of range, *Cotoneaster integerrimus* occurs discontinuously, being largely confined to areas with larger rock outcrops. Natural habitats are often under threats from development and probably generally diminishing. Apart from its long-known sites, with few additions recently added and some treated in phytocoenological detail (e.g., Oberdorfer 1927; Gerlach 1967; Moor 1979), the species does not seem to have much potential for colonising new or dis-

turbed habitats (such as quarries or gravel pits?). Records of *C. integerrimus* as spontaneous, non-native shrub for Berlin and Brandenburg (Kowarik 1992; Prasse & al. 2001) need confirmation. We have not seen evidence of new colonisations but miscellaneous herbarium material suggests that especially *C. divaricatus* and *C. dielsianus* were sometimes confused with *C. integerrimus*.

Selected specimens seen. — Afghanistan: Badakhshan, Wakhan, Tal westlich des Darya-e Uch Jelga am Kol-e Chaqmaqtin, 37°10'N, 74°08'E, 4150–4350 m, 15.7.1971, *O. Anders 7456* (MSB).
Germany: **He** E Zierenberg, Wichtelkirche, 390 m, 51°21'N, 9°20'E, 9.9.2009, *B. Dickoré 39455* (M). **Rh** Burg Are bei Altenahr, zahlreich auf Mauerkronen der Burgruine, MTB 5407/44, 18.5.2003, *G. Kasperek & K. Adolphi 03-021* (herb. Kasperek).
Italy: Region Aosta, Valle di Cogne, E Lillaz, linker Talhang des Vallone di Urtier, Waldsaum am Abstieg vom Lago di Loie, 1700 m, 23.7.2003, *G. Kasperek & U. Sittig 03-065* (herb. Kasperek).
Pakistan: [Northern Areas, Nanga Parbat] Tibet, Hasóra, Tap to Maséno glacier (Lolio Dúru) and Achursbótt (Diámer glacier group), 17.–19.9.1856, *Schlagintweit* (M).
Finland: Varsinas-Suomi, Nummi-Peninsula, Vivola village, 60°22'N, 24°01'E, 70 m, 4.6.2000, *J. Nurmi 2000-8, Soc. Èch. Pl. Vasc. Eur. Bass. Médit. 19059* (M).

(15) ***Cotoneaster integrifolius*** (Roxb.) G. Klotz in Wiss. Z. Martin-Luther-Univ. Halle-Wittenberg, Math.-Naturwiss. Reihe 12(10): 779. 1963.

Crataegus integrifolia Roxb. 1832, *Cotoneaster buxifolius* var. *marginatus* Lindl. ex Loudon 1842, *C. marginatus* (Loudon) Schltdl. 1856, *C. lanatus* Jacques 1859, *C. congestus* Baker 1869, *C. prostratus* Baker 1869, *C. thymifolius* Baker 1869, *C. brevirameus* Rehder & E. H. Wilson 1912, *C. conspicuus* Marq. 1937, *C. meuselii* G. Klotz 1963, *C. nanus* (G. Klotz) G. Klotz 1963, *C. permutatus* G. Klotz 1963, *C. pluriflorus* G. Klotz 1963, *C. brandisii* G. Klotz 1966, *C. insolitus* G. Klotz 1966

Entire-leaved C., Ganzrandige Z.

● Himalaya (Kashmir to Myanmar), S Tibet, SW China (Guizhou, Sichuan, [S and SE] Xizang, Yunnan).
△ Austria: **S** Salzburg (*Pilsl*!). — Germany: **Ba** München-Neuaubing (*Dickoré*!). **Sh** Hamburg (*Kasperek*!). **We** Ruhrgebiet (Keil & Loos 2005).
□ Great Britain (Stace 1997).

Taxonomy and nomenclature of *Cotoneaster integrifolius* seem extremely complicated for several reasons. The main source of confusion about *C. integrifolius* comprises its delimitation against *C. microphyllus*. Numerous published species' epithets and infraspecific taxa seem to circle around this problem. Trying to sort this out, it appears that the broad-ranged *C. integrifolius* is a diploid species ($2n = 34$, Zhou & Wu 1999, as *C. conspicuus*), while *C. microphyllus* is tetraploid ($2n = 68$, Zhou & Wu 2001). Both species seem to segregate elevationally almost throughout the Himalayas and along the eastern rim of the Tibetan Plateau. *C. integrifolius* is a montane to subalpine species at elevations of c. 2300–3900 m and spatially extending more into the forelands and the dry inner valleys of southern Tibet. *C. microphyllus,* in contrast, is an alpine species, with an almost linear distribution along the Himalayan main range and the highest massifs of the Hengduan Shan in southwestern China, mostly at elevations between 3500 and 4500 m. Many, but not all records from lower elevations apparently comprise misidentifications of the former. However, the chromosomal segregation does not seem to be quite perfect and triploid plants have also been reported. There remain considerable ambiguities as to the delimitations of either species and to the identities of many published names.

Cotoneaster integrifolius in our circumscription is intended to include *C. conspicuus*, under which name is usually understood the common garden plant originating from southeastern Tibet. Both taxa seem to be perfectly contiguous, morphologically and geographically, from the lower elevations of the outer western and central Himalayas through the dry valleys of the inner eastern Himalayas, adjacent southeastern Tibet and southwestern China.

Cultivated possibly even more common than *Cotoneaster integrifolius* is the artificial hybrid *C.* ×*suecicus* G. Klotz (*C. dammeri* × *C. integrifolius* [see there]), originally as *C. conspicuus* × *C. dammeri*. This hybrid is reported to seed freely, while seedlings split to parental characters (Keil & Loos 2004, G. Klotz, pers. comm.). Principally, a single cultivated hybrid plant could thus give rise to at least three 'morpho-taxa', which would resemble either parent or were intermediate, respectively, let alone back-crossings. Single, but probably very old and long established individuals of *C. dammeri, C. integrifolius* and the putative hybrid were found in an abandoned railway area in Munich-Neulangwied. Especially in graveyards, these rather different species are commonly grown together, often along with the putative hybrid and *C. microphyllus*. Adventive occurrences of *C. integrifolius* are probably still uncommon, while it might have been overlooked or misidentified for *C. microphyllus*. We have repeatedly observed seedlings in pavement-fissures, which apparently originated from nearby planted *C. integrifolius* (or *C.* ×*suecicus*?), but these have always been cleaned shortly after. Several similar occurrences of young and vegetative plants are documented in the collections of P. Pilsl from Salzburg (as *C.* ×*suecicus*). Part of the adventive record of *C. integrifolius* might actually belong to *C. microphyllus*. Especially on the British Isles, *C. integrifolius* seems to have predominantly been understood as a segregate or synonym of *C. microphyllus*.

Selected specimens seen. — Austria: **Sa** Tennengau, Taugltal SE von Vigaun, bewachsene Schotterterasse der Taugl N der 220 KV-Leitung, 8344/2, 47°39'35"N, 13°08'30"E, 470 m, 27.8.2008, *P. Pilsl* (herb. Pilsl). China: Sichuan: In montium Daliang-schan (territorii Lolo) ad orientem urbis Ningyüen regione calide temperata, prope vicum Lemoka, in lapidosis, substr. calcareo, 1730–2270 m, 23.4.1914, *H. Handel-Mazzetti 1563* (WU). — Tibet/Xizang: Gyala Peri N, Bong Chu, E of Dongjuk (Camp 15), 30°00'N, 94°54"E, 2730 m, subtrop.-coll. *Pinus armandi*-mixed deciduous forest and scrub, 17.8.1994, *B. Dickoré 11175* (MSB). — Yunnan: Xiangyun Xian, in the vicinity of Tianshengtang, near km marker 270 W of Kunming on the Burma Rd., badly eroded and denuded shale slopes, shrub, 25°21'N, 100°52'E, 2300 m, 24.7.1984, *Sino-Amer. Bot. Exp. 1249* (B); Umgebung von Kunming […], 2000 m, 30.5. 1980, *H. Hertel 23279* (M).
Germany: **Ba** München-Neuaubing, Gleislager, 48° 08'N, 11°24'E, MTB 7834/413, 530 m, eine Pfl., Teppichstrauch 1,20 m im Durchmesser, 2.7.2009, *B. Dickoré & Flora München 39205* (M). **Sh** Hamburg, Herrengraben, Terrasse am Herrengrabenfleet-Ufer neben Haus Nr. 30, MTB 2425/42, "eine Jungpflanze in Pflasterritze (in c. 1 m Entfernung von kultiviertem Exemplar)", 26.8.2009, *G. Kasperek 09-063* (herb. Kasperek).
India: Himachal Pradesh: Simla, 20.5.1954, *Ram Singh 12708* (M); Nainital, *Cupressus*-Wald, 5.12.1962, *H. Meusel s.n.* (HAL). — Uttarakhand: Garhwal, trockener Eichenwald (*Q. incana* mit Zedern) bei Mussoori, nördl. Dehra Dun, 13.10.1962, *H. Meusel & R. Schubert s.n.* (HAL, holotype of *C. meuselii*); Kumaon, Gori valley, Rargari–Bogdiyar, 30°11'N, 80°13'E, 2300 m, 29.9.2004, *B. Dickoré 19137* (MSB).

Cotoneaster buxifolius Wall. ex Lindl. in Edwards's Bot. Reg. 15: sub t. 1229. 1829, described from the Nilgiri Hills, Tamil Nadu, southern India, was taken as the accepted species name for the *C. integrifolius* complex by Lu & Brach (2003). While there are strong genetic links between the far disjunct floras of Nilgiri Hills and the Himalayas, most of these are no longer considered as conspecific, and *C. buxifolius* likely comprises a disjunctive endemic of southern India. Morphologically, *C. buxifolius* differs from *C. integrifolius* by its many-flowered inflorescences, rather long-acuminate leaves and a very dense tomentum of the whole plant. However, similar densely tomentose and, possibly, other aberrant plants (*C. hodjingensis* G. Klotz 1963?) seem to occur also in southwestern China, Yunnan, which in their relationships seem largely unresolved.

Selected specimens seen. — India: Tamil Nadu: Nilgiris, Ooty, 7000 ft., 6.1886, *J. S. Gamble 17447* (HBG); Kodanad, Nilgiri, "berries small red; etiam 154 Ooty", 6000 ft., 7.1882, *D. Brandis* (HBG).

Cotoneaster rotundifolius Wall. ex Lindl. in Edwards's Bot. Reg. 15: t. 1229. 1829 (*C. microphyllus* var. *uva-ursi* Lindl. 1827, *C. uva-ursi* (Lindl.) G. Don 1830). This evergreen small, divaricate shrub from the central Himalayas (Bhutan, N India: Sikkim, Nepal) is probably related to *C. integrifolius* and *C. microphyllus*. *C. rotundifolius* was often combined or mixed up with *C. adpressus, C. nitidus (distichus)* or *C. horizontalis*. This is probably due to the illustration in Saunders (1869: t. 54), which did not show the typical flower of *C.* subg. *Chaenopetalum* with patent, white petals, but either a flower in bud or of a representative of *C.* subg. *Cotoneaster*. Fitch's illustration (Hemsley 1905: t. 8010) depicts patent rose-coloured petals and, probably unusual, oblong-pyriform fruits. While trying to resolve some of this confusion, Fryer & Hylmö (2009) did not arrive at the correct conclusion. They illustrated *C. rotundifolius* (t. 95) but their typification is incorrect and the description apparently contains mainly elements of *C. adpressus* and/or *C. nitidus*. *C. rotundifolius* is rarely cultivated in botanical gardens (Göttingen BG!).

Selected specimens seen. — Cultivated: Göttingen, Alter Botanischer Garten, 16.8.2009, *B. Dickoré 39360* (M).

(16) ***Cotoneaster laxiflorus*** J. Jacq. ex Lindl. in Edwards's Bot. Reg. 15: t. 1305. 1830 ["1829"].

Mespilus cotoneaster var. *nigra* Wahlb. 1820 (non *Mespilus nigra* Willd. 1809), *Cotoneaster melanocarpus* Lodd. & al. 1830 (nom. nud.), *C. niger* (Wahlb.) Fr. 1845, *C. orientalis* A. Kern. 1869, *C. matrensis* Domokos 1941, *C. alaunicus* Golitsin 1964, ?*C. antoninae* Juz. 1950

Black C., Schwarzfrüchtige Z.

● E Europe through Russia (Siberia) to Mongolia and N China, [?]Japan (map: Jäger in Kutzelnigg 1994). Native on the eastern edges of Central Europe (S Sweden, Denmark [Bornholm], Poland, Czech Republic and Slovakia). △ [?]Austria: **N** (Fischer & al. 2008: *'C. melanocarpus'*). **S** Salzburg (Pilsl & al. 2008: *'C. melanocarpus'*; *Schröck!*?). **W** 'verwildert in Wien' (Janchen 1977: *'C. niger'*). — [?] Germany: **Ba** Erlangen (Asmus 1981: *'C. niger'*).

We consider *Cotoneaster melanocarpus* Lodd. & al., Bot. Cab. 16(4): t. 1531. 1830, a nomen nudum. The respective plate lacks an analysis; accordingly, it does not meet the requirements of Art. 44.1 (ICBN 2006). Properties described in the accompanying written statement do not meet the requirements of Art. 32.2 (ICBN 2006). Nomenclatural instability and unavailability of a 'descriptive' name for the common black-fruited *Cotoneaster* may be regretted. The many-flowered inflorescence depicted with the original description of *C. laxiflorus* does not seem to be quite 'normal', but appears to comply with a relative wide range of variation of this character in the species. The situation might, however, be further complicated by alleged hybridisation between *C. laxiflorus* and *C. integerrimus*. However, treatment of most of the above synonyms and probably several more as independent species by Fryer & Hylmö (2009) or as

infraspecific taxa by Hrabetová-Uhrová (1962), does not seem appropriate. Likewise, a '*C. melanocarpus* aggr.' including *C. melanocarpus* and *C. niger* (Sennikov 2009) seems largely an artefact and, as to its geographical representation, apparently includes some discordant elements as well. The adventive record of *C. laxiflorus* for Central Europe (as enumerated above) seems doubtful. We have not seen conclusive specimens, while confusion might have occurred with *C. acutifolius*. A vegetative specimen relating to the record for Salzburg (Pilsl & al. 2008) might belong to *C. laxiflorus* but is uncertain on account of its relatively narrow, abaxially thinly tomentose leaves. However, since the native range of *C. laxiflorus* skirts Central Europe along its eastern border, adventive occurrence also cannot be ruled out. The species is only rarely cultivated (in botanical gardens: Göttingen BG!, Halle BG!).

Selected specimens seen. — Austria: **S** Salzburg-Stadt, Kendlersiedlung, Grabenstraße, Schotterstreifen am Straßenrand, 8244/1, 430 m, 10.8.2002, *C. Schröck 12608* (herb. Pilsl) [?identification uncertain, vegetative specimen].
Czech Republic: Moravia australis, Moravský Krumlov, 300 m, 26.6.1988, *F. Černoch 47779, Soc. Èch. Pl. Vasc. Eur. Bass. Médit. 14119* (M).
Kazakhstan: Jugum Transiliense (Zailijski), 1800 m, 15.5.1965, *A. K. Skvortsov* (M).
Russian Federation: Ostpreussen, Dallwitz bei Lyck, 15.6.1910, *H. Gross 5483* (B); Karelia ladogensis, Pitkäranta District, Impilahti, Mäkisalo, Hill Pekanmäki, 20 m, 27.6.1997, *P. Uotila, Soc. Èch. Pl. Vasc. Eur. Bass. Médit. 42254* (M); Krasnojarskkij kraj, Minussinsk, Felshang direkt oberhalb der Minussinska-Mündung am NW-Rand der Stadt, 53°43'N, 91°39'E, 270 m, 9.7.1997, *R. Hand 1363* (B); Jakutia, Olekminskiy rayon, s. Kalandarashvili, 2.9.1979, *I. A. Ivanov, Herb. Vavilov Inst. 881* (M).
Sweden: Halland, Gottskär, in rupibus, 6.8.1929, *G. Samuelsson & A. Zander* (B).

(17) *Cotoneaster microphyllus* Wall. ex Lindl. in Bot. Reg. 13: t. 1114. 1828.

Cotoneaster microphyllus f. *glacialis* Wenzig 1874, ?*C. buxifolius* f. *cochleatus* Franch. 1890, ?*C. cochleatus* (Franch.) G. Klotz 1957, *C. procumbens* G. Klotz 1957, *C. cashmirensis* G. Klotz 1963, *C. elatus* G. Klotz 1963, *C. glacialis* (Wenzig) Panigrahi & Arv. Kumar 1988, *C. nivalis* (G. Klotz) Panigrahi & Arv. Kumar 1988, *C. astrophorus* J. Fryer & E. C. Nelson 1995

Small-leaved C., Kleinblättrige Z.

● Himalayas (Kashmir to Myanmar) and SW China: Hengduan Shan (Sichuan, Yunnan).
△ Germany: **Ba** Nürnberg (Gatterer & al. 2003); Oberpfalz, Bahnhof Parsberg (*Schuhwerk*!). [?]**Br** Berlin (Kowarik 1992). [?]**He** Frankfurt (Ottich 2007). **We** Aachen (Schmitz 1991).
□ Great Britain; Ireland (Stace 1997, frequent). USA: California (Calflora 2009).

While *Cotoneaster microphyllus* is long-established in near-natural habitats in the British Isles (limestone-grassland, cliffs, etc.), its adventive presence in Central Europe seems somewhat ambiguous. *C. microphyllus* is commonly planted as a low carpet groundcover, usually strictly appressed to the ground, especially in 'alpine' gardens and in graveyards. While occasionally found escaping, 'creeping away' (or through fragmented branches?), the only specimen seen of *C. microphyllus* established in rocks is from Bavaria, Parsberg. However, initial planting also cannot be ruled out here. Obviously planted was a dense carpet of this species (with *C. dammeri*) near the railway (S) station Fröttmaning, Munich. Records of '*C. integrifolius*' (Haeupler & al. 2003), might in part belong here (for problems regarding the delimitations of both species, see there).

Selected specimens seen. — China: Tibet/Xizang: Mt Everest E, Kangchung Glacier tongue landslide, 27°59'N, 87°08'E, 4430 m, 12.10.1989, *B. Dickoré 6283* (MSB); Tsangpo tributary, Nangxian–Mainling, Lilung Chu Eastern branch (Camp 14–High Camp), 29°02'N, 93°56'E, 3880 m, upper mont. moist meadow, *Salix* and *Juniperus* scrub, 14.8.1994, *B. Dickoré 11016* (MSB).
Germany: **Ba** Oberpfalz, Landkreis Neumarkt, Fränkischer Jura, Bahnhof Parsberg, 520 m, 49°09'N, 11°43'E, MTB 6836/14, als Spalierstrauch an Felsen, basaler Stamm c. 2 cm dick, 3.5.2007, *F. Schuhwerk 07/86* (M).
India: Jammu & Kashmir: Kashmir, Gund–Sind Valley, 6000 ft., growing appressed to rocks on river bank, 26.7.1891, *G. A. Gammie s.n.* (DD, photo) *"C. cashmirensis"* det. G. Klotz, 28.1.1964; Kashmir, Lidderwat, 11000 ft., growing over rocks & ledges, fruit carmine, quite prostrate, 25.8.1965, *O. Polunin 56/493* (B). — Sikkim: temp. et alp., 9000–14000 ft., *J. D. Hooker* (M) *"C. microphyllus* f. *thymifolius"* det. G. Klotz 18.6.1958.
Ireland: Co. Kerry, Killarney Dt., Ufergebüsch am Looscaunagh Lough an der Straße Killarney–Kenmare, 10.8.1964, *Doppelbaur* (M).
Nepal: Khumbu, felsige Hänge östlich Khumzung gegen das Tutkositал, 3800 m, 19.9.1962, *J. Poelt* (M).

(18) *Cotoneaster moupinensis* Franch. in Nouv. Arch. Mus. Hist. Nat., ser. 2, 8: 224. 1885.

Cotoneaster foveolatus Rehder & E. H. Wilson 1912, *C. obscurus* var. *cornifolius* Rehder & E. H. Wilson 1912, *C. cornifolius* (Rehder & E. H. Wilson) Flinck & B. Hylmö 1962, *C. hummelii* J. Fryer & B. Hylmö 1997

Moupin C., Mupin-Z.

● C and SW China (Gansu, Guizhou, Hubei, Ningxia, Shaanxi, Sichuan, [?SE] Xizang, Yunnan).
△ Germany: **An** Halle/Saale (John & Frank 2008 *'C. cornifolius'*). **Ba** München-Pasing *(Dickoré)*. **Me** Use-

dom (Henker & Kiesewetter 2006 [det. G. Klotz]). — Poland: Poznan (Czekalski & Wyrzykiewicz-Raszewska 1992: *'C. foveolatus'*).
□ Great Britain (Stace 1997).

While the natural distribution in southwestern and central China seems wider than that of the related red-fruited *Cotoneaster bullatus, C. moupinensis* is relatively rare in cultivation, probably due to its relatively less attractive black fruit. Apparently spontaneous shrubs are occasionally seen, such as on railway bank in Munich (with many *C. divaricatus* and single *Corylus colurna,* likewise probably self-sown). The inflorescence of *C. moupinensis* is often fewer-flowered as compared to *C. bullatus,* but this and leaf characters seem quite plastic. While the original description states 5 nutlets, 3 or 4 nutlets per fruit seem to be more common in cultivated and adventive plants. Much the same variation in the number of nutlets seems to occur in *C. foveolatus* and *C. cornifolius,* which are reasonably included in the synonymy of *C. moupinensis,* possibly along with several other names published from this affinity. *C. ambiguus* (see there) differs by the non-rugose leaves and fruit with 2 or 3 nutlets.

Selected specimens seen. — China: Yunnan: Trans vicum Ganhaidse ad urbem Lidjiang ("Likiang"), in regionis temperatae silva opima supra vic. Akalü, 3000 m, 19.6.1915, *H. Handel-Mazzetti 6827* (WU).
Germany: **Ba** München-Pasing, E Gleisdreieck Neuaubing, N Paosostr., 48°08'N, 11°26'E, MTB 7834/412, 530 m, 9.8.2009, *B. Dickoré & K. Lewejohann 39338* (M); München, Nymphenburger Park NW, nahe Mauer Höhe Pagodenburgstr./An der Schlossmauer, 48°09'N, 11°29'E, MTB 7834/412, 520 m, 4 Pfl., 25.7.2009, *B. Dickoré 39237* (M).

(19) *Cotoneaster multiflorus* Bunge in Ledebour, Fl. Altaica 2: 220. 1830.

Many-flowered C., Vielblütige Z.

● ?SW and Middle Asia: ?Turkey to Russia, N Mongolia, N China.
△ Austria: **W** Wien (Forstner & Hübl 1971). — Germany: **Ba** Nürnberg (Gatterer & al. 2003); Passau (*Dunkel*!). **Br** Berlin (Asmus 1990). [?]**Sa** Leipzig (Sattler 2001). **Sh** Hamburg (Ringenberg 1994).
□ Great Britain (Stace 1997, England); Hungary (Udvardy 1999).

Cotoneaster multiflorus, described from Kazakhstan, belongs to a species complex of mostly large shrubs, occurring from northwestern Africa, the Mediterranean and southern Europe through Arabia, southwestern and comprising Middle Asia to Siberia, Mongolia and China. This group, comprising the deciduous species of *C.* subg. *Chaenopetalum,* is obviously poorly understood across the entire area and no consistent review is available. Species delimitations, number of taxa accepted and assignation to various taxonomic subgroups differ widely between different floras and do not seem settled, even for the probably few European indigenous representatives. A thorough review of the group across Eurasia is needed to ascertain exact identities of *C. multiflorus* and related species.

Cotoneaster multiflorus is probably the only more commonly planted and occasionally escaping species of the complex in Central Europe. It is one of the earliest and most copiously flowering of *Cotoneaster* species and the flowers emit an unpleasant smell. *C. multiflorus* is commonly planted in 'public greenery', occasionally seen as a relict from cultivation in abandoned hedgerows or gardens, and rarely probably self-sown. Several additional taxa are reported as adventive from the British Isles (Stace 1997) or, while also being occasionally cultivated in Central European gardens, might also be expected adventive here. *C. racemiflorus* is probably closely related and some of the adventive records listed above might actually belong there. *C. affinis* and *C. roseus* seem also to belong to this affinity. Besides these species (see there), the four taxa listed subsequently are occasionally cultivated or might be otherwise of note.

Selected specimens seen. — China: Xinjiang: Songarei, *Schrenk* (M).
Germany: **Ba** Niederbayern, Passau, befestigte Uferböschung des Inns, rechtsseitig, c. 100 m vor der letzten Staustufe, MTB 7446/23, 29.7.1998, *F. G. Dunkel Du-691-2* (M); München-Aubing N, Langwieder Bach, 48°10'N, 11°24'E, MTB 7834/231, 520 m, "Kulturrelikt?, evtl. gepflanzt", 12.5.2009, *B. Dickoré 39007* (M).
Russian Federation: Fl. Orient. Altaica [small label illegible], 1839, *A. Bunge* (B, type of *C. multiflorus?*).
Uzbekistan: Tashkentskaya oblast', Bostanlykskiy rayon, Kan-say, 12.8.1976, *O. N. Korovina & N. M. Chernomorskaya, Herb. Vavilov Inst.* (M).
Cultivated: Liège, Parc d'Avroy, 4.8.1991, *J. Lambinon 91/8/361* (M); German, Berlin [Arboretum] Späth, Baumschulenweg, 30.5.1900 (fl.), 1.9.1900 (fr.), *E. Koehne, Herb. dendrol. 385* (M).

Cotoneaster granatensis Boiss., Elench. Pl. Nov.: 41. 1838, is an endemic of southern Spain (Sierra Nevada), rarely cultivated in botanical gardens. It should, however, be reconsidered in the context with *C. nummularius* s.l. and a number of other highly disjunctive representatives of *C.* subg. *Chaenopetalum* from northwestern Africa, the southwestern Alps and the eastern Mediterranean eastward through southwestern and Middle Asia.

Selected specimens seen. — Spain: Prov. Granada gorge of Gallego, 1650–1700 m, banks and sides of gorge, 16.6.1988, *B. Valdés & al. 488/88* (B).

Cotoneaster hebephyllus Diels in Notes Roy. Bot. Gard. Edinburgh 5: 273. 1912 (*C. multiflorus* var. *calo-*

carpus Rehder & E. H. Wilson 1912, *C. hebephyllus* var. *monopyrenus* W. W. Sm. 1917, *C. monopyrenus* (W. W. Sm.) Flinck & B. Hylmö 1966, *C. tibeticus* G. Klotz 1968), seems to be one of the probably few species of the group occurring in southwestern China and southeastern Tibet. It is rarely cultivated (Halle BG!). A probably somewhat greater number of related species occurs from northern Central Asia to northern and central China. Names possibly pertaining to these seem to be largely unresolved by Lu & Brach (2003).

Selected specimens seen. — China: Xizang/Tibet: Namchabarwa/Tsangpo gorge, above village "Pei No. 4" [Kyikar], 29°35'N, 94°55'E, 3230 m, 23.9.1989, *B. Dickoré 5692* (MSB).

Cotoneaster nummularius Fisch. & C. A. Mey., Index Seminum [St. Petersburg] 2: 34. 1835 (*C. oliganthus* Pojark. 1938, ?*C. nummularioides* Pojark. 1954, ?*C. subuniflorus* (Kitamura) G. Klotz 1963, *C. pruinosus* G. Klotz 1966, *C. afghanicus* G. Klotz 1966, *C. falconeri* G. Klotz 1966, ?*C. hissaricus* Pojark. 1954, *C. discolour* Pojark. 1954, *C. minutus* G. Klotz 1963, ?*C. obovatus* Dunn 1921, ?*C. delphinensis* Chatenier 1923, ?*C. parnassicus* Boiss. & Heldr. 1856, ?*C. creticus* J. Fryer & B. Hylmö 2009). If considering a likely wide variation, also including red and black-fruiting types, *C. nummularius* (s.l.) might include numerous synonyms or minor segregates. It is a characteristic steppe shrub extending geographically at least from mainland Greece and Crete, through Lebanon, Syria, Turkey, the Caucasus, Iran, Afghanistan, Tajikistan and Uzbekistan to northern Pakistan and northwestern India (Kashmir, Himachal Pradesh).

Selected specimens seen. — India: Kashmir, Pir Panjal range, 10000–11000 ft., 21.5.1892, J. *F. Duthie 11154* (WU). — Pakistan: Chitral, Jambatai, 5.5.1895, *S. A. Harriss (Chitral Relief Expedition) 16109* (WU) "C. cf. falconeri", det. H. Riedl 1968; Gilgit, Kar Gah, Dormushk–Jut, 35°55'N, 74°10'E, 2250 m, 25.9.1995, *B. Dickoré 13711* (MSB). — Tajikistan: Gorno-Badakhshan, Pyandzh Valley, Chorog–Rushan, 37°48'N, 71°35'E, 2110 m, 24.9.2002, *B. Dickoré 18500* (MSB).

Cotoneaster orbicularis Schltdl. in Linnaea 27: 544. 1854 (nom. subnud.?), from Egypt (Sinai) and Arabia is also close to *C. nummularius,* but a probably distinct, low-growing desert shrub.

(20) ***Cotoneaster nitens*** Rehder & E. H. Wilson in Sargent, Pl. Wilson. 1(2): 156. 1912.

Cotoneaster harrysmithii Flinck & B. Hylmö 1962

Shiny C., Glänzende Z.

● SW China: W Sichuan, [?E] Xizang.
△ Austria: **N** Wiener Neustadt (*T. Barta*!). — Germany: **An** Bitterfeld (John & Frank 2008). **Sa** Leipzig – Knaufkleeberg (*Liers*!).
□ Great Britain: SW and S England (Stace 1997); Hungary (Udvardy 1999).

Cotoneaster nitens, originating from an apparently small area in western Sichuan, is rarely cultivated (Halle BG!, Munich BG!, as *C. harrysmithii*). *C. nitens* is similar in habit to *C. horizontalis* and *C. divaricatus,* but differs in its black cylindrical fruit and rather irregular contorted branching. Insofar as limited material seen permits, *C. harrysmithii,* described from the same area, does not seem to differ substantially from *C. nitens*.

Selected specimens seen. — Austria: N Steinfeld, SW von Wiener Neustadt, verwildert neben dem Bahnsteig am Rand des Schwarzföhrenwaldes beim Bahnhof St. Egyden, 330 m, 1.11.2003, *T. Barta 2003-59* (B).
China: Sichuan: Wenchuan Hsien, häufig an den Berghängen bei Leong ho kou im Tale von Tsao po, 1600 m, "blt. hellrot", 7.5.1914, *Limpricht 1391* (WU).
Germany: **Sa** Leipzig–Knaufkleeberg, zw. Ilsterstausee und Kn., 4739/2.4, Ruderalstelle, 13.5.2006, *E. Liers* (LZ, photocopy).
Cultivated: Sweden, at Bjuv, raised from the holotype collection of *C. harrysmithii*, *H. Smith 12647*, 18.9.1980, *B. Hylmö 9772* (JE).

(21) ***Cotoneaster racemiflorus*** (Desf.) K. Koch, Dendrologie 1: 170. 1869

?*Cotoneaster atlanticus* G. Klotz 1963, ?*C. tauricus* Pojark. 1938*,* ?*C. suavis* Pojark. 1954, ?*C. luristanicus* G. Klotz 1967

Racemose C., Rispige Z.

● ?NW Africa, Cyprus, SW Asia (Caucasia, N Iran), ?Middle Asia.
△ Germany: **An** Dölau (*Schaberg*!); Halle (John & Frank 2008: '*C.* aff. *multiflorus*). [?]**Me** Usedom (Henker & Kiesewetter 2006: '*C. multiflorus* Hort. non Bunge in Ledebour', det. G. Klotz). **Sa** Bienitz (*Duty*!); Leipzig (*Gutte*!).

This imperfectly understood and commonly confused taxon is similar to *Cotoneaster multiflorus* and *C. nummularius*. It differs from the former by fewer-flowered inflorescence, tomentose hypanthium and sepals, and rather lanceolate-ovate or somewhat rhombic leaves. *C. racemiflorus* is also very similar to *C. nummularius*, but probably more restricted and disjunctive in its distribution. *C. racemiflorus* is rarely cultivated in botanical gardens (Göttingen BG!, Halle BG!), while potential adventive occurrences might be spurious or, partly, filed under *C. multiflorus*.

Selected specimens seen. — Germany: **An** Halle-Dölau, O.-Kaining-Str., 24.5.1972, *Schaberg* (HAL). **Sa** Bienitz, verwildert, 1.8.1958, *J. Duty* (JE).
Cultivated: Göttingen, Alter Botanischer Garten, 18.8. 2009, *B. Dickoré 39370* (M).

(22) *Cotoneaster roseus* Edgew. in Trans. Linn. Soc. London 20: 46. 1846.

Cotoneaster osmastonii G. Klotz 1966, ?*C. lacei* Klotz 1966

Pink C., Rosablühende Z.

● W Himalayas: E Afghanistan (Kurram, Nuristan), N Pakistan (Swat, Hazara), NW India (Kashmir to Uttarakhand), ?W Nepal.

Cotoneaster roseus is only rarely cultivated (Göttingen New BG!). A single adventive occurrence was reported from Saxony-Anhalt, Halle/Saale (Schaberg & Weinert 1972). However, the fruiting specimen preserved at HAL(!) has a relatively dense tomentum on the abaxial leaf surface and thus more likely represents *C. racemiflorus*. Herbarium specimens of *C. roseus* are often difficult to distinguish from species of the *C. multiflorus* group (see there). Relatively glabrous or soon glabrescent leaves and spreading pink petals are characteristic but occur also in other related species. *C. roseus* is a relatively narrow-ranged endemic of the far western (Kashmir) and western Himalayas. Despite detailed investigations around this species (Klotz 1966), its exact delimitation, distribution and relationships (with *C. affinis*?) need critical review. Putative hybridisation with *C. acuminatus* or presumed origin of a group of 'microspecies' around *C. roseus* from crossings between species of *C.* subg. *Chaenopetalum* and subg. *Cotoneaster* (Klotz 1966) seem rather speculative.

Selected specimens seen. — India: Jammu & Kashmir: Kashmir, Gulmarg, 8000–9000 ft., 16.6.1892, *J. F. Duthie 11427* (WU). — Uttarakhand: Tihri-Garhwál, Deota, 8000–9000 ft., 13.5.1898, *J. F. Duthie 21041* (WU).
Pakistan: Rawalpindi Dt., Murree Hills, Ghoragali Forest Rest House, 10.5.1971, *S. M. A. Kazmi 3183* (M).
Cultivated: Göttingen, Neuer Botanischer Garten, 25.10. 2009, *B. Dickoré 39538* (M).

(23) *Cotoneaster salicifolius* Franch. in Nouv. Arch. Mus. Hist. Nat., sér. 2, 8: 225. 1885.

Cotoneaster rugosus E. Pritz. 1900, *C. rugosus* var. *henryanus* C. K. Schneid. 1906, *C. henryanus* (C. K. Schneid.) Rehder & E. H. Wilson 1912, *C. hylmoei* Flinck & J. Fryer 1993, *C. sargentii* G. Klotz 1996

Willow-leaved C., Weidenblättrige Z.

● SW China: (Guizhou, Hubei, Hunan, Sichuan, Yunnan).
△ Austria: **S** Salzburg (Pilsl & al. 2008). — Germany: **Ba** Erlangen (Asmus 1981); München (*Pilsl*!). **Bw** (Buttler 2004: *'C. rugosus'*). **He** Seeheim (Hillesheim-Kimmel 1995); Frankfurt (Ottich 2007: '*C. salicifolius* agg.'). **Ns** Braunschweig (Brandes 1987). **Rh** Ludwigshafen (Mazomeit 1997: '*C. salicifolius* agg.'). **Sh** Hamburg (Ringenberg 1994. **We** Königswinter (Lohmeyer 1981); Bonn (Adolphi 1995); Köln-Zollstock (*Kasperek*!); Ruhrgebiet (Keil & Loos 2005). — Netherlands (Denters 2006). — Switzerland: Winterthur (Schaeppi 1987); Zürich (Landolt 1993); Basel (Brodtbeck & al. 1997).
□ Great Britain (Stace 1997, common).

Cotoneaster salicifolius forms few-stemmed, almost tree-like large shrubs of up to c. 8 m, highly recommended in horticulture. It could be due to both relatively high nursery cost to produce well-grown plants and the need for space that *C. salicifolius* is often seen planted in gardens but usually only as single individuals and rarely in 'public greenery'. In its native range, the species seems to be a characteristic component of mixed deciduous-evergreen or laurophyllous forest. In Central Europe, *C. salicifolius* individuals, obviously bird-distributed, are occasionally seen, apparently more regularly so in the warmer regions and situations, such as railway areas in the Rhineland, where *C. salicifolius* seems to have become naturalised. A spontaneous population of at least 20, up to 4 m high shrubs was observed on the edges of abandoned railway tracks in Cologne-Zollstock in 2001 (*Kasperek*!, now destroyed).

A probably more extensive synonymy than given above seems to cover mostly variation of the abaxial leaf surface indumentum, which actually ranges from densely villous-tomentose or floccose to almost glabrescent. Nevertheless, problems remain with low-growing, arching specimens with relatively shorter and subglabrous leaves. These might comprise the occasionally cultivated (and escaping?), hybrid *Cotoneaster dammeri* × *salicifolius*. While adventive specimens, insofar as seen, often had leaves abaxially nearly glabrous with lateral veins relatively little impressed, they still seemed to fall into the range of variation of *C. salicifolius*. Possible hybrids or even a potential for confusion with young plants of, the otherwise very different, *C. dammeri,* need further attention.

Selected specimens seen. — China: Hubei: Western Hupeh [north and south of Ichang, "thickets, bush 1–3 m tall, flowers white, fruit coral-red", 1600–2000 m], 10.6.1907, *E. H. Wilson 335* (HBG).
Germany: **Ba** München, Gelände des Hauptbahnhofs, Spalten in den Begrenzungsmauern der Bahnsteige, 530 m, 30.4.2005, *P. Pilsl 14572* (herb. Pilsl). **Sh** Hamburg 60, Leinpfad, Sämling, spontan, 7.7.1989, *J. Ringenberg 90-28* (HBG); Hamburg 90, Alter Postweg, Sämling, spontanes Vorkommen, 28.9.1989, *J. Ringenberg 90-57* (HBG).
Cultivated: Bei Dachau, 27.6.1951, *G. Besel* (M).

(24) *Cotoneaster symondsii* T. Moore in Proc. Roy. Hort. Soc. London 1: 298. 1861

Cotoneaster simonsii Baker 1869, ?*C. khasiensis* G. Klotz 1963, *C. assamensis* G. Klotz 1972

Himalayan C., Himalaya-Z.

● C and E Himalayas, Khasia mountains: Bhutan, northern India (Uttarakhand, Sikkim, Arunachal Pradesh), Myanmar, Nepal.
□ Great Britain; Ireland (Stace 1997, rather common throughout); Scandinavia (Flinck & Hylmö 1958: *'C. simonsii'*). USA: California (Calflora 2009).

As Kumar & Panigrahi (1992) have pointed out, on the basis of priority, *Cotoneaster symondsii* T. Moore replaces the later synonym *C. simonsii* Baker. Moore's name was effectively published in a journal and accompanied by a description. It does not matter that, contrary to Baker's protologue of *C. simonsii,* his description is not in Latin and is lacking an illustration. Orthography cannot be corrected, since there is no unequivocal indication as to whom Moore intended to commemorate (possibly, *P. L. Simmonds*, or, as for Baker's name, *C. J. Simons*; Kumar & Panigrahi 1992).

Cotoneaster symondsii is obviously closely related to *C. divaricatus*, but is a taller erect shrub with non-distichous branching; leaves somewhat larger and more hairy, sepals acuminate and fruit usually with 3 or 4 nutlets (2 or 3 in *C. divaricatus*). The geographical divergence between both species seems to approximately follow the Mekong-Salween divide, which probably is an important phytogeographical border between the floras of China and the Himalayas (Ward 1921).

While *Cotoneaster symondsii* is reportedly more commonly naturalised in the British Isles than *C. divaricatus,* probably all records from Germany refer to the latter species. Specimens related to an unpublished record from Königssee (*K. Adolphi*), on which the inclusion of *C. symondsii* in the 'Illustrated Atlas of the German Flora' (Haeupler & Muer 2007) was based, were *C. divaricatus* (M!). A specimen referring to potential occurrence in Helgoland (Adolphi 2008), kindly provided by K. Adolphi, also proved to be *C. divaricatus*. While this common adventive is not otherwise mentioned there, a record of *C. symondsii* from Braunschweig (Brandes & Schlender 1999) could very likely prove to be *C. divaricatus* as well.

Selected specimens seen. — Cultivated: Nürnberg, cult., 6.1904, *C. Schreyer* (M).

(25) *Cotoneaster tomentosus* Lindl. in Trans. Linn. Soc. London 13(1): 101. 1821.

Tomentose C., Filzige Z.

● SC and S Europe (map: Jäger in Kutzelnigg 1994). — Austria: **B**, **K**, **N**, **O**, **S**, **St**, **T**, **V**, **W**. — Czech Republic. Germany: **Ba**, **Bw**. — Poland (south). — Switzerland.

Following Browicz (1968) the species was sometimes wrongly filed under *Cotoneaster nebrodensis* (Guss.) K. Koch. *C. tomentosus* is native in large parts of the European alpine system including some of the forelands. Marginal populations are probably generally endangered or decreasing. *C. tomentosus* was also observed in open disturbed mountain forest, heavily invaded by adventive *Cotoneaster* species (*C. horizontalis, C. divaricatus, C. dielsianus, C. bullatus;* Bavaria near Mittenwald, *Dickoré*). There seems a potential of confusion especially with *C. dielsianus,* which differs in the smaller and more acute leaves, usually with conspicuously impressed veins. An outlying record of *C. tomentosus* from Hesse, Darmstadt (Marquardt 1971) could not be substantiated, it might have been *C. dielsianus*. *C. tomentosus* is rarely cultivated except in botanical gardens.

Selected specimens seen. — Germany: **Ba** E Mittenwald, E Karwendelbahn-Talstation, oberhalb der B2, 47°26'N, 11°16'E, 950 m, 3.10.2009, *B. Dickoré 39501* (M); Langleger SW Lenggries, linkes Isarufer, 47°36'N, 11°33'E, 730 m, 14.6.2009, *B. Dickoré 39153* (M).
Greece: Macedonia, prov. Dhrama, in latere boreali verticis orientalis montium Meniki (Boz dag Serron), 41°12'N, 23°45'E, 1850 m, 20.7.1978, *W. Greuter 16181* (B).
Switzerland: Wallis, Derborence, 4.8.1968, *T. Eckardt 1037* (B).

Cotoneaster nebrodensis (Guss.) K. Koch, Hort. Dendrol.: 179. 1853 (*Pyrus nebrodensis* Guss. 1827), is a species or segregate of *C.* subg. *Chaenopetalum* of southern Italy and Sicily (Sennikov 2009). It should be re-examined in conjunction with the *C. multiflorus* group, e.g., *C. granatensis*.

Selected specimens seen. — Italy: Calabria, Prov. Cosenza, Monte Pollino, N of Morano Calabra, just SE of Rifugio, at boundary of limestone grassland and wooded area, 39°44'N, 19°09'E, 1740 m, 25.7.1983, Akeroyd & al. 3982 (B).

(26) *Cotoneaster zabelii* C. K. Schneid., Ill. Handb. Laubholzk. 1(5): 749. 1906.

Cotoneaster giraldii Flinck & B. Hylmö ex G. Klotz 1972

Zabel's C., Zabels Z.

● C China (Gansu, Hebei, Henan, Hubei, Hunan, Jiangxi, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shandong, Shanxi).
△ Germany: **An** Halle/Saale (John & Frank 2008).
□ Great Britain, England (Stace 1997).

Cotoneaster zabelii is rarely cultivated in Central Europe (Halle BG!, where it apparently seeds freely). Two adventive plants were observed by John & Frank (2008) in

the Dölauer Heide near Halle, approximately 4 km distant from the botanical garden. *C. zabelii* might have a potential to naturalise in the drier and warmer parts of Central Europe. While leaf characters seem highly variable during development, young or vegetative specimens can easily be overlooked or confused with *C. dielsianus*.

Selected specimens seen. — China: Shaanxi: Kan-y-san SO von Huokiazaer, 12.6.1897, *G. Girardi 5005* (B) det. C. K. Schneider.
Cultivated: Halle/Saale, Botanischer Garten, Neuwerkhang, 22.9.2009, *B. Dickoré 39479* (M).

Discussion

Biological invasions are an important issue worldwide (Kowarik 2003), whether with regard to, sometimes dubious, measures against invasive species (Udvardy 1998; Bossard & al. 2000) or as potential climate indicators. For the adventive *Cotoneaster* species in Central Europe, inventories (Kunick 1985) or prognoses being made (Sukopp & Wurzel 2000; Adolphi 2002) seem still hampered by insufficient taxonomic and chorological knowledge. Table 1 assesses the present status for Central European countries.

Climatic properties in the secondary areas of naturalisation of *Cotoneaster* species are likely concordant with those of the native ranges. Recently increasing naturalisations of Chinese *Cotoneaster* species in Central Europe might well reflect climatic trends, specifically warming. However, it must also be taken into consideration that southwestern China is a traditional source of numerous hardy garden plants, which are literally considered to have survived the ice ages there, while the Central European flora is assumed to have simultaneously been significantly impoverished (Schroeder 1998). Furthermore, the tectonically active geography of, especially southwestern, China provides an enormous habitat diversity, while its unique continuity from tropical to boreal forest vegetation is another important reason for high species richness (Axelrod & al. 1996).

In consequence, several additional factors could play important roles in the increase of alien *Cotoneaster* species in Central Europe. First is the provision of ample diaspore supply. In general, private gardens and all sorts of 'public' or 'industrial green' and, in particular, graveyards seem important sources for diaspore supply. Up to ten species of *Cotoneaster* have been found cultivated even on small graveyards. Several species or hybrids seem to propagate largely vegetatively while being able to develop persistent clones, e.g., from garden rubbish. Given the relative length of generations in woody plants, a considerable time of response and population-building would be needed. However, one of the probably most important factors responsible for *Cotoneaster* naturalisations comprises the increasing urbanisation and large-scale creation of 'new' habitats or niches, especially anthropogenic and disturbed, and apparently prone to colonisation by neophytes (recently introduced plants). While concrete observations are scattered and not unequivocal, all three factors – climate, population dynamics and disturbance – seem to play different roles in various species and subareas of secondary distributions. The secondary ranges of alien *Cotoneaster* in Central Europe are probably still unsaturated while certain chorological and ecological trends seem to emerge.

Cotoneaster horizontalis was among the earliest species to be considered naturalised in Austria (Forstner & Hübl 1971) and Germany (Adolphi 1977). Seybold (1992), for Baden-Wuerttemberg, mentioned it as the only adventive species and as not being established. This situation seems to have much changed. Garve (2007), for Lower Saxony, recognised two additional adventive species, *C. bullatus* and *C. divaricatus;* but, on account of few and diffuse records, did not find them worthy to map. Local Floras are only beginning to depict obviously increasing numbers and densities of alien *Cotoneaster* species (e.g., Brodtbeck & al. 1997; Meierott 2008). *C. horizontalis* is relatively easily identified, but with the caveat that, subsequently, other species might have been overlooked or, especially young plants of *C. divaricatus,* been mistaken for that species. The naturalisation of *C. horizontalis* started from obviously bird-distributed diaspores colonising stone walls and borders, where also readily fruiting, but mostly staying close to cultivated gardens. Its present distribution in Central Europe seems to be wide, though scattered and still showing preference to the same types of rocky habitat. Meanwhile, *C. horizontalis* also forms locally large, obviously independent populations, also in more natural dry, open, rocky areas, such as on Helgoland (Adolphi 2008), in the Middle Rhine area (Kutzelnigg 1994, Adolphi pers. comm.), Bavaria and elsewhere.

Seedlings and adult plants of *Cotoneaster divaricatus* are often found in relatively remote forest clearings, woodland borders, along forest roads or in open scrub, and this species seems meanwhile to be the most universally distributed and common in many regions of Central Europe. As probably similar for *C. dielsianus,* the increase of *C. divaricatus* seems to be related to massive plantings along roadsides and as hedges. *C. divaricatus* can form large and independently propagating spontaneous populations, consisting of hundreds to tens of thousand shrubs (Halle/Saale, John & Frank 2008; Munich), in dry open grassland, open or disturbed forests and along forest borders. *C. dielsianus* seems to naturalise in similar habitats. It occurs widely scattered, probably mostly as a few individuals or in smaller populations, and apparently preferring the warmer and drier regions of Germany and Austria.

Ecological preferences and potential reproduction modes are difficult to circumscribe for other, apparently less commonly occurring or less obviously naturalised species. *Cotoneaster ambiguus* was found naturalised in forests, near Halle/Saale (in large quantity, "invasive",

John & Frank 2008) and Göttingen. Elsewhere it is, as yet, possibly overlooked. Similarly, *C. bullatus* and the apparently somewhat rarer *C. moupinensis* seem to increasingly establish themselves in forest margins or clearings and disturbed sites; mostly probably bird-sown from planted or already established sources. The creeper *C. dammeri* is of interest for being often found as vegetatively propagating clones. These seem to often stem from former cultivation or garden rubbish deposits. However, e.g., on the rock island of Helgoland, but also in urban habitats (Göttingen), *C. dammeri* also propagates by seeds. Locally, extensive mats of this species are well established (Munich) and obviously propagate further, both vegetatively and by seeding. Vegetative propagation may also occur in other species. In *C. horizontalis* we have occasionally observed over-arching branches, which rooted on ground contact. While *C. integrifolius* is planted as a ground cover on a very large scale, seedlings or shoot fragments escaping are, as yet, only rarely found. In contrast to its long known establishment in the British Isles, *C. microphyllus* seems to rarely escape in Central Europe.

To some degree, lesser or only smaller-scale cultivation of *Cotoneaster* species seems to also comply with absent or rare evidence for naturalisation. Despite birds being the most obvious vectors of diaspores, the distance or speed by which most *Cotoneaster* species radiate seems relatively low, while germination rates can also be

Table 1. Summary report of *Cotoneaster* species indigenous to, escaping and naturalised in Central Europe
AT: Austria, BE: Belgium, CH: Switzerland, CZ: Czech Republic, GE: Germany, PO: Poland. Indig. distr.: indigenous distribution (main range), CHI = China, EUR = Europe, HIM = Himalayas, NAS = Northern Asia, WAS = Western Asia. N = Native; Escaping / naturalized: * = occasionally escaping, ** = regularly escaping or locally naturalised, *** = commonly escaping and/or fully naturalised, ? = adventive record doubtful, – erroneous record.

	AT	BE	CH	CZ	GE	PO	Indig. distr.
Cotoneaster subg. ***Cotoneaster***							
C. acuminatus Lindl.			?		–		HIM
C. acutifolius Turcz.	*				*	**	CHI + NAS
C. adpressus Bois			*		*		CHI + HIM
C. ambiguus Rehder & E. H. Wilson					*		CHI
C. apiculatus Rehder & E. H. Wilson			*		*		CHI
C. bullatus Bois	**		**	*	**		CHI
C. dielsianus E. Pritz.	**	*	**		***	*	CHI
C. divaricatus Rehder & E. H. Wilson	***		***		***	**	CHI
C. franchetii Bois	*		?		?		CHI
C. horizontalis Decne.	***	***	***	**	***	**	CHI
C. integerrimus Medik.	N	N	N	N	N	N	EUR + WAS
C. laxiflorus Lindl.	?			N		N	EUR + NAS
C. moupinensis Franch.					*	*	CHI
C. nitens Rehder & E. H. Wilson	*				*		CHI
C. symondsii T. Moore					–		HIM
C. tomentosus Lindl.	N		N		N		EUR
C. zabelii C. K. Schneid.					*		CHI
Cotoneaster subg. ***Chaenopetalum*** (Koehne) G. Klotz							
C. affinis Lindl.						?	HIM + WAS
C. dammeri C. K. Schneid.	**		**		**		CHI
C. frigidus Lindl.	?	?	?				HIM
C. integrifolius (Roxb.) G. Klotz	*				*		CHI + HIM
C. microphyllus Lindl.					*		CHI + HIM
C. multiflorus Bunge					*		NAS + WAS
C. racemiflorus (Desf.) K. Koch					*		WAS
C. roseus Edgew.					–		HIM
C. salicifolius Franch.	*	*			**		CHI

low or lag (Fryer & Hylmö 2009). On the other hand, it seems that *Cotoneaster* individuals can reach considerable age. Once established in open ground, they might thus survive shading by short-lived pioneer trees.

Concerning conservation, several alien *Cotoneaster* species are increasingly becoming 'normal' constituents of the scrub and forest vegetation in Central Europe, probably similar to *Juglans regia*. Potential outbreeding or, at least for undisturbed habitats, ecological competition with native *Cotoneaster* species (Schönfelder & Bresinsky 1990) seems rather unlikely. Possible misidentifications, e.g., in the course of habitat management programs, could well cause problems. As yet, encroachment of various alien *Cotoneaster* on species-rich dry grasslands and thermophilous scrub seems to be a local problem. Nonetheless, *C. dammeri, C. divaricatus, C. dielsianus, C. horizontalis* and possibly others, certainly belong to a suite of shrubs and trees that tend to overgrow conservation-relevant habitats and are also highly resistant to cutting or grazing. As probably for almost all adventive and invasive species, complete eradication of alien *Cotoneaster* species, other than on a very expensive, local and temporary scale, would simply be impossible. Rather, the still common practice of large-scale planting of mass-produced non-native species in the open landscape should be considered a dangerous potential pool of new plant invaders and a deliberate threat to the native flora.

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References

Adolphi K. 1977: Über das Vorkommen von *Cotoneaster horizontalis* Decaisne an Mauern. – Göttinger Florist. Rundbr. **11:** 100–101.

Adolphi K. 1995: Neophytische Kultur- und Anbaupflanzen als Kulturflüchtlinge des Rheinlandes. – Nardus **2.**

Adolphi K. 2002 ["2001"]: In jüngster Zeit entdeckte Neophyten und Überlegungen über ihre mögliche Einbürgerung. – Braunschweig. Geobotan. Arbeiten **8:** 15–25.

Adolphi K. 2006: Neophyten in Binz auf Rügen, eine kommentierte Artenliste mit Anmerkungen aus überregionaler Sicht. – Bot. Rundbr. Mecklenburg-Vorpommern **41:** 113–124.

Adolphi K. 2008: Neues zur Flora von Helgoland. – Braunschweig. Geobotan. Arbeiten **9:** 9–19.

Asmus U. 1981: Der Einfluß von Nutzungsänderung und Ziergärten auf die Florenzusammensetzung stadtnaher Forste in Erlangen. – Ber. Bayer. Bot. Ges. **52:** 117–121.

Asmus U. 1990: Floristische und vegetationskundliche Untersuchung in der Gropiusstadt (Berlin). – Verh. Berliner Bot. Vereins **8:** 97–139.

Axelrod D. I., Al-Shehbaz I. & Raven P. H. 1996: History of the modern flora of China. – Pp. 43–55 in: Zhang Aolou & Wu Sugong (ed.), Proceedings of the First International Symposium on Floristic Characteristics and Diversity of East Asian Plants. – Beijing.

Bärtels A. 2001: Enzyklopädie der Gartengehölze: Bäume und Sträucher für mitteleuropäische und mediterrane Gärten, ed. 4. – Stuttgart.

Bartish I. V., Hylmö B. & Nybom H. 2001: RAPD analysis of interspecific relationships in presumably apomictic *Cotoneaster* species. – Euphytica **120:** 273–280. [CrossRef]

Böhling N. 2008: Neue Fundorte, Bestätigungen, Verluste, Nr. 541–551. – Ber. Bot. Arbeitsgem. Südwestdeutschl. **5:** 133–134.

Bossard C. C., Randall J. M., Hoshovsky M. C. (ed.) 2000: Invasive plants of California's wildlands. – Berkeley.

Brach A. R. & Song, H. 2005: ActKey: a Web-based interactive identification key program. – Taxon **54:** 1041–1046. [CrossRef]

Brandes D. 1978: Zur Verbreitung von Ruderalpflanzen im östlichen Niedersachsen. (Beiträge zur Flora der Stadt Braunschweig, VI.). – Göttinger Florist. Rundbr. **12:** 106–112.

Brandes D. 1987: Zur Kenntnis der spontanen Gehölzflora norddeutscher Städte. – Florist. Rundbr. **21:** 33–38.

Brandes D. 2003: Die aktuelle Situation der Neophyten in Braunschweig. – Braunschweig. Naturk. Schriften **6:** 705–760.

Brandes D. & Schlender H. 1999: Zum Einfluß der Gartenkultur auf die Flora der Waldränder. – Braunschweig. Naturk. Schriften **5:** 769–779.

Brodtbeck T., Zemp M., Frei M., Kienzle U. & Knecht D. 1997: Flora von Basel und Umgebung 1980–1996. Teil 1. – Mitt. Naturf. Ges. Basel **2.**

Browicz K. 1968: *Cotoneaster*. – Pp. 72–73 in: Tutin T. G., Heywood V. H., Burges N. A., Moore D. M., Valentine D. H., Walters S. M. & Webb D. A. (ed.), Flora europaea **2.** – Cambridge, etc.

Browicz K. 1972: *Cotoneaster*. – Pp. 129–132 in: Davis P. H. (ed.), Flora of Turkey and the East Aegean Islands **4.** – Edinburgh.

Buttler K. P. 2004: Namensverzeichnis zur Flora (Florenliste) der Farn- und Samenpflanzen von Hessen und Baden-Württemberg. – Published at http://www.bvnh.de/bnh/download/Liste/Hessenliste_2.exe

Calflora 2009: Information on wild California plants for conservation, education, and appreciation. – Published at http://www.calflora.org/ [accessed on 28.8.2009]

Czekalski M. & Wyrzykiewicz-Raszewska M. 1992: Naturalne obsiewanie sie drzew i krzewow na terenie Poznania. – Rocz. Dendrol. **40:** 75–84.

Denters T. 2006: Bijzondere plantenvondsten in de regio Amsterdam 2005. – Floron Nieuwsbrief nr. **37**, maart 2006 – Groot-Amsterdam, District 14. – Published at http://www.frontlinie.nl/floron/floronNIEUWS2006.pdf

Dörr E. 1970: Ergebnisse der Allgäuer Floristik für das Jahr 1970. – Mitt. Naturwiss. Arbeitskreises Kempten/Allgäu **14(2):** 23–38.

Dolatowski J. 1992: Samosiewy introdukowanych gatunków drzew i krzewów w Arboretum Kórnickim w latach 1983–1990. – Rocz. Dendrol. **40:** 69–73.

Essl F. 2008a: Beitrag zur Floristik von Kärnten, Nord- und Osttirol (Österreich). – Linzer Biol. Beitr. **40:** 329–339.

Essl F. 2008b: Bemerkenswerte floristische Funde aus Wien, Niederösterreich, dem Burgenland und der Steiermark, Teil V. – Linzer Biol. Beitr. **40:** 341–369.

Essl F. & Rabitsch W. 2002: Neobiota in Österreich. Mit Beiträgen von O. Breuss, E. Christian, E. Eder, H. Englisch, M. A. Fischer, S. Gaviria, F. Grims, J. Gruber, D. Hohenwallner. – Wien.

Essl F. & Stöhr O. 2006: Bemerkenswerte floristische Funde aus Wien, Niederösterreich, dem Burgenland und der Steiermark, Teil III. – Linzer Biol. Beitr. **38:** 121–163.

Fischer M. A., Oswald K. & Adler W. 2008: Exkursionsflora für Österreich, Liechtenstein und Südtirol, ed. **3.** – Linz.

Fleischer M. 1986: Gehölze in Gera. – Veröff. Mus. Stadt Gera, Naturwiss. Reihe **12:** 6–104.

Flinck K. E. & Hylmö B. 1958: *Cotoneaster* som trädgardsrymling [*Cotoneaster* escaped from gardens]. – Bot. Not. **111:** 650–652.

Flinck K. E. & Hylmö B. 1962: *Cotoneaster sikangensis*, a new species from western China. – Bot. Not. **115:** 376.

Flinck K. E. & Hylmö B. 1966: A list of series and species in the genus *Cotoneaster*. – Bot. Not. **119:** 445–463.

Flinck K. E., Fryer J., Garraud L., Hylmö B. & Zeller J. 1998: *Cotoneaster raboutensis*, espèce nouvelle de l'ouest des Alpes, et révision du genre *Cotoneaster* dans les Alpes francaises. – Bull. Mens. Soc. Linn. Soc. Bot. Lyon **67(10):** 272–282.

Forstner W. & Hübl E. 1971: Ruderal-, Segetal- und Adventivflora von Wien. – Wien.

Fraser-Jenkins C. R. 1997: New species syndrome in Indian pteridology and the ferns of Nepal. – Dehra Dun.

Fryer J. & Hylmö B. 1994: The native British *Cotoneaster,* great orme berry, renamed. – Watsonia **20:** 61–71.

Fryer J. & Hylmö B. 1997: Five new species of *Cotoneaster* Medik. *(Rosaceae)* naturalised in Britain. – Watsonia **21:** 335–349.

Fryer J. & Hylmö B. 2009: Cotoneasters. A comprehensive guide to shrubs for flowers, fruit, and foliage. – Portland.

Garve E. 2007: Verbreitungsatlas der Farn- und Blütenpflanzen in Niedersachsen und Bremen. – Naturschutz Landschaftspfl. Niedersachsen **43.**

Gatterer K., Nezadal W., Fürnrohr F., Wagenknecht J. & Welss W. (ed.) 2003: Flora des Regnitzgebietes. Die Farn- und Blütenpflanzen im zentralen Nordbayern **1–2.** – Eching.

GBIF 2009: *Cotoneaster.* – In: Global Biodiversity Information Facility. – Published at http://data.gbif.org/species/13178819 [accessed on 15.10.2009].

Gerlach A. 1967: Ein Fundort von *Cotoneaster integerrimus* Med. im Westharz. – Göttinger Florist. Rundbr. **1:** 10.

Gianoni G., Carraro G. & Klötzli F. 1988: Thermophile, an laurophyllen Pflanzenarten reiche Waldgesellschaften im hyperinsubrischen Seenbereich des Tessins. – Ber. Geobot. Inst. E. T. H. Stiftung Rübel **54:** 164–180.

Gregor T. 1997: Floristische Meldungen. Neufunde, Bestätigungen, Verluste. – Bot. Naturschutz Hessen **9:** 166–170.

Grierson A. J. C. 1987: *Cotoneaster*. – Pp. 588–591 in: Grierson A. J. C. & Long D. G., Flora of Bhutan **1(3).** – Edinburgh.

Grubov V. I. 1963: Rasteniya Zentral'noy Azii [Plantae Asiae centralis] **1.** – Moskva & Leningrad.

Grubov V. I. 1982: Opredelitel' Sosudistykh Rasteniy Mongolii [Key to the vascular plants of Mongolia]. – Leningrad.

Gutte P. 2006: Flora der Stadt Leipzig einschließlich Markkleeberg. – Jena.

Haeupler H., Jagel A. & Schumacher W. 2003: Verbreitungsatlas der Farn- und Blütenpflanzen in Nordrhein-Westfalen. – Recklinghausen.

Haeupler H. & Muer T. 2007: Bildatlas der Farn- und Blütenpflanzen Deutschlands, ed. 2. – Stuttgart.

Hemsley, W. B. 1905: *Cotoneaster rotundifolia*. – Curtis's Bot. Mag. **131:** t. 8010.

Henker H. & Kiesewetter H. 2006: Erstnachweise kritischer Pflanzensippen für Mecklenburg-Vorpommern (Blütenpflanzen). *Cotoneaster* Medik., Zwergmispel. – Bot. Rundbr. Mecklenburg-Vorpommern **41:** 11–20.

Hetzel G. 2006: Die Neophyten Oberfrankens. Floristik, Standortcharakteristik, Vergesellschaftung, Verbreitung, Dynamik. – Diss. Univ. Würzburg; published at urn:nbn:de:bvb:20-opus-18288

Hillesheim-Kimmel U. 1995: Pflanzenfunde in der Umgebung von Seeheim (Südhessen) III. – Hess. Florist. Briefe **44:** 57–61.

Hjelmqvist H. 1962: The embryo sac development of some *Cotoneaster* species. – Bot. Not. **115:** 208–236.

Hohla M. 2006: *Panicum riparium* (*Poaceae*), neu für Österreich, und weitere Beiträge zur Kenntnis der Adventivflora Oberösterreich. – Neilreichia **4:** 9–44.

Hohla M., Kleesadl G. & Melzer H. 1998: Floristisches von den Bahnanlagen Oberösterreichs. – Beitr. Naturk. Oberösterreichs **6:** 139–301.

Hohla M., Kleesadl G. & Melzer H. 2002: Neues zur Flora der oberösterreichischen Bahnanlagen, mit Einbeziehung einiger grenznaher Bahnhöfe Bayerns, Fortsetzung. – Beitr. Naturk. Oberösterreichs **11:** 507–578.

Hrabetová-Uhrová A. 1962: Beitrag zur Taxonomie und Verbreitung der Gattung *Cotoneaster* in der Tschechoslowakei. – Acta Acad. Sci. Cechoslov. Basis Brun. **34:** 197–246 .

Hrevcova H. T. 1999: Atlas kizil'niki. *Cotoneaster* (Medic.) Bauhin [In Ukrainian, English and Russian]. – Kiev.

Hurusawa I. 1943: *Cotoneaster* Asiae Orient. – Acta Phytotax. Geobot. **13:** 225–237.

Hurusawa I. 1973: Taxonomische Untersuchungen der Gattung *Cotoneaster (Rosaceae)* auf karpologischer Grundlage. – J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. **11:** 195–242.

Hurusawa I., Kawakami S. & Ito Y. 1967: Revisio generis *Cotoneaster* quoad species in horto botanico Roishikawaensi cultas (1). – Inform. Annuales Hort. Bot. Fac. Sci. Univ. Tokyo **1967:** 1–19.

Hylmö B. 1993: Oxbär, *Cotoneaster*, i Sverige. – Svensk Bot. Tidskr. **87:** 305–330.

Hylmö B. & Fryer J. 1999: Cotoneasters in Europe. – Acta Bot. Fenn. **162:** 179–184.

International Organisation for Standardisation 1997: Codes for the representation of names of countries and their subdivisions. 1. Country codes, ed. 5 (International Standard ISO 3166-1). – Genève.

IPNI 2009: The International Plant Names Index. – Published at http://www.ipni.org

Jäger E. J. & Werner K. (ed.) 2005: Rothmaler. Exkursionsflora von Deutschland 4. Gefäßpflanzen: Kritischer Band. – München.

Janchen E. 1977: Flora von Wien, Niederösterreich und Nordburgenland, ed. 2. – Wien.

Jerzak E. 2007: Irgi uprawiane w Polsce [Cotoneasters cultivated in Poland]. – Kraków.

John H. & Frank D. 2008: Verwilderte *Cotoneaster*-Arten in Halle (Saale) und Umgebung. – Mitt. Florist. Kart. Sachsen-Anhalt **13:** 3–28.

Kariger J. J. 1992: Auf der Suche nach Seltenheiten und Verschwundenem 1990 und 1991. Mit Rückblick und Bezugnahme auf die Zeit seit 1945. – Bull. Soc. Naturalistes Luxemb. **93:** 113–137.

Keil P. & Loos G. H. 2004: Ergasiophygophyten auf Industriebrachen des Ruhrgebietes. – Florist. Rundbr. **38(1/2):** 101–112.

Keil P. & Loos G. H. 2005: Non-established adventive plants in the western and central Ruhrgebiet (North-rhine-Westphalia, Germany), a preliminary overview. – Electr. Publ. Biol. Stat. Western Ruhrgebiet **5:** 1–16.

Kelly D. L. 1988: Killarney, Co. Kerry, 26th–27th July. (Reports of field meetings, 1986.) – BSBI News **49:** 36–37.

Klotz G. 1957: Übersicht über die in Kultur befindlichen *Cotoneaster*-Arten und -formen. – Wiss. Z. Martin-Luther-Univ. Halle-Wittenberg, Math.-Naturwiss. Reihe **6:** 945–982.

Klotz G. 1963a: Neue oder kritische *Cotoneaster*-Arten. – Wiss. Z. Martin-Luther-Univ. Halle-Wittenberg, Math.-Naturwiss. Reihe **12:** 753–768.

Klotz G. 1963b: Neue oder kritische *Cotoneaster*-Arten. 2. – Wiss. Z. Martin-Luther-Univ. Halle-Wittenberg, Math.-Naturwiss. Reihe **12:** 769–786.

Klotz G. 1966a: Neue oder kritische *Cotoneaster*-Arten. 3. – Wiss. Z. Martin-Luther-Univ. Halle-Wittenberg, Math.-Naturwiss. Reihe **15:** 529–544.

Klotz G. 1966b: Neue oder kritische *Cotoneaster*-Arten. 4. – Wiss. Z. Martin-Luther-Univ. Halle-Wittenberg, Math.-Naturwiss. Reihe **15:** 847–855.

Klotz G. 1967: Zwei neue *Cotoneaster*-Arten aus dem Bereich der Flora Iranica. – Feddes. Repert. **76:** 201–203.

Klotz G. 1968: Neue oder kritische *Cotoneaster*-Arten. 5. – Wiss. Z. Friedrich-Schiller-Univ. Jena, Math.-Naturwiss. Reihe **17:** 333–339.

Klotz G. 1970: Die Hybridisation, ein wichtiger Evolutionsfaktor der Gattung *Cotoneaster* Medicus. – Wiss. Z. Friedrich-Schiller-Univ. Jena, Math.-Naturwiss. Reihe **19:** 329–344.

Klotz G. 1972a: Neue oder kritische *Cotoneaster*-Arten. 6. – Wiss. Z. Friedrich-Schiller-Univ. Jena, Math.-Naturwiss. Reihe **21:** 969–977.

Klotz G. 1972b: Neue oder kritische *Cotoneaster*-Arten. 7. – Wiss. Z. Friedrich-Schiller-Univ. Jena, Math.-Naturwiss. Reihe **21:** 979–1021.

Klotz G. 1978: Neue oder kritische *Cotoneaster*-Arten. 8. – Wiss. Z. Friedrich-Schiller-Univ. Jena, Math.-Naturwiss. Reihe **27:** 19–26, t. 1–4.

Klotz G. 1982: Synopsis der Gattung *Cotoneaster* Medikus I. – Beitr. Phytotax. **10:** 7–81. Jena.

Klotz G. 1996a: *Cotoneaster melanotrichus* (Franch.) Klotz eine bisher verkannte *Cotoneaster*-Sippe aus Yunnan. – Mitt. Deutsch. Dendrol. Ges. **82:** 63–66.

Klotz G. 1996b: Neue oder kritische *Cotoneaster*-Arten. 9. Die Weidenblättrigen Felsmispeln (*Cotoneaster* sect. *Densiflos* Yü, ser. *Salicifolii* Yü) in der Natur und Kultur. – Mitt. Deutsch. Dendrol. Ges. **82:** 67–85.

Klotz G. 2008: Neue oder kritische *Cotoneaster*-Arten 10 *(Rosaceae)*. – Feddes Repert. **119:** 272–280. [CrossRef]

Kowarik I. 1992: Einführung und Ausbreitung nichteinheimischer Gehölzarten in Berlin und Brandenburg und ihre Folgen für Flora und Vegetation. Ein Modell für die Freisetzung gentechnisch veränderter Organismen. – Verh. Bot. Vereins Berlin Brandenburg, Beiheft **3.**

Kowarik I. 2003: Biologische Invasionen, Neophyten und Neozoen in Mitteleuropa. – Stuttgart.

Kreh W. 1951: Verlust und Gewinn der Stuttgarter Flora im letzten Jahrhundert. – Jahresh. Vereins Vaterl. Naturk. Württemberg **106:** 69-124.

Kroon G. H. 1975: Polyploidy in *Cotoneaster* II. – Acta Bot. Neerl. **24:** 417–420.

Krügel T. 1992: Zur zytologischen Struktur der Gattung *Cotoneaster (Rosaceae, Maloideae)* III. – Beitr. Phytotax. **15:** 69–86.

Krüssmann G. 1976: Handbuch der Laubgehölze, ed. 2, **1.** – Berlin.

Kumar A. & Panigrahi G. 1992 [“1989”]: Nomenclatural notes on *Cotoneaster symondsii* Th. Moore (*Rosaceae*). – Bull. Bot. Surv. India **31:** 168–170.

Kumar A. & Panigrahi G. 1995: Revisionary studies on *Cotoneaster* Medik. (The family *Rosaceae* in India **3**). – Dehra Dun.

Kunick W. 1985: Gehölzvegetation im Siedlungsbereich. – Landschaft & Stadt **17:** 120–133.

Kutzelnigg H. 1994: *Cotoneaster*. – Pp. 405–420 in: Scholz H. (vol. ed.), Gustav Hegi, Illustrierte Flora von Mitteleuropa, ed. 2, **4(2B)**, Lieferung 4–6. – Berlin, etc.

Landolt E. 1993: Über Pflanzenarten, die sich in den letzten 150 Jahren in der Stadt Zürich stark ausgebreitet haben. – Phytocoenologia **23:** 651–663.

Lohmeyer W. 1981: Über die Flora und Vegetation der dem Uferschutz dienenden Bruchsteinmauern, -pflaster und -schüttungen am nördlichen Mittelrhein. – Natur & Landschaft **56:** 253–260.

Long D. G. 1991: *Rhododendron* L. – Pp. 358–387 in: Grierson A. J. C. & Long D. G.: Flora of Bhutan **2(1).** – Edinburgh.

Lu Lingdi & Brach A. R. 2003: *Cotoneaster.* – Pp. 85–107 in: Wu Z. Y., Raven P. H. & Hong D. Y. (ed.), Flora of China **9.** – Beijing & St. Louis. – Also published at http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=108169, http://flora.huh.harvard.edu/china/PDF/PDF09/Cotoneaster.PDF

Luczay L. & Adamowski W. 1991: Dziczenie irgi lsniacej (*Cotoneaster lucidus* Schlecht.) w Puszczy Bialowieskiej [*Cotoneaster lucidus* Schlecht. turning wild in the Bialowieza Forest]. – Phytocoenosis, ser. 3, Seminarium Geobot. **1:** 269–274.

Marquardt F. 1971: Neuere floristische Beobachtungen aus Südhessen, insbesondere an der nördlichen Bergstraße. – Hess. Florist. Briefe **20:** 21–24.

Marwat Q. 2004: Taxonomic studies of the genus *Cotoneaster* Ruppert ex Medikus of Pakistan and Azad Kashmir. – PhD thesis, Dept. of Biological Sciences, Quaid-i-Azam University, Islamabad.

Mazomeit J. 1997 [“1995”]: Zur Adventivflora (seit 1850) von Ludwigshafen am Rhein – mit besonderer Berücksichtigung der Einbürgerungsgeschichte der Neophyten. – Mitt. Pollichia Pfälz. Vereins Naturk. **82:** 157–246.

Mazomeit J. 2005: Erste Nachträge zur “Adventivflora von Ludwigshafen am Rhein”. – Mitt. Pollichia Pfälz. Vereins Naturk. **91:** 111–120.

Meierott L. 2008: *Cotoneaster*. – Pp. 515–519 in: Flora der Haßberge und des Grabfelds, Neue Flora von Schweinfurt **1.** – Eching.

Melzer H. 1976: Neues zur Flora von Steiermark, XVIII. – Mitt. Naturwiss. Vereines Steiermark **106**: 147–159.

Melzer H. 1986: Notizen zur Flora des Burgenlandes, von Nieder- und Oberösterreich. – Verh. Zool.-Bot. Ges. Österreich **124:** 81–92.

Melzer H. & Barta T. 2003: Neue Daten zur Flora von Wien, Niederösterreich und dem Burgenland. – Linzer Biol. Beitr. **35:** 1159–1193.

Meyer F. H., Hecker U., Höster H. R. & Schroeder F.-G. (ed.) 2006 [“2007”]: Jost Fitschen, Gehölzflora, ed. 12. – Wiebelsheim.

Mirek Z., Piekos-Mirkowa H., Zajac A. & Zajac M. 2002: Flowering plants and pteridophytes of Poland, a checklist. – Biodiversity of Poland **1.** – Krakow.

Moor M. 1979: Das Felsenbirnen-Gebüsch (*Cotoneastro*-Amelanchieretum), eine natürliche Mantelgesellschaft im Jura. – Phytocoenologia **6:** 388–402.

Nybom H. & Bartish I. V. 2007: DNA markers and morphometry reveal multiclonal and poorly defined taxa in an apomictic *Cotoneaster* species complex. – Taxon **56:** 119–128. [CrossRef]

Oberdorfer E. 1927: *Cotoneaster integerrima* Med. am Feldberg im Schwarzwald. – Mitt. Bad. Landesvereins Naturk. Naturschutz Freiburg **2:** 125–126.

Ohashi H. 1979: *Cotoneaster*. – Pp. 134–136 in: Hara H. & Williams H. J., An enumeration of the flowering plants of Nepal **2.** – London.

Ottich I. 2007: Archäophyten und Neophyten im Stadtgebiet von Frankfurt am Main und ihre Auswirkungen auf die Biodiversität. – Diss. Fachber. Biowissensch. Univ. Frankfurt.

Palmer J. R. 1985a: Naturalised *Cotoneasters* [“Con[sic!] toneasters”]. – BSBI News **39:** 20.

Palmer J. R. 1985b: *Cotoneaster adpressus* Bois. – BSBI News **39:** 20–21.

Palmer J. R. 1986: *Cotoneaster bullatus* Bois. – BSBI News **44:** 18–19.

Palmer J. R. 1988: A check-list for Cotoneasters naturalised in the British Isles. – BSBI News **50:** 32–33.

Palmer J. R. 1992: *Cotoneaster pannosus* illustrated. – BSBI News **62:** 43–44.

Parker R. N. 1924: A forest flora for the Punjab with Hazara and Delhi. – Lahore.

Pilsl P., Wittmann H. & Nowotny G. 2002: Beiträge zur Flora des Bundeslandes Salzburg III. – Linzer Biol. Beitr. **34:** 5–165.

Pilsl P., Schröck C., Kaiser R. Gewolf S., Nowotny G. & Stöhr O. 2008: Neophytenflora der Stadt Salzburg (Österreich). – Sauteria **17.**

Piqueray J., Mahy G. & Vanderhoeven S. 2008: Naturalisation and impact of a horticultural species, *Cotoneaster horizontalis (Rosaceae)* in biodiversity hotspots in Belgium. – Belg. J. Bot. **141:** 113–124.

Plants of Southern Africa 2009: an online checklist. – Published at http://posa.sanbi.org/searchspp.php [accessed on 28.8.2009]

Pojarkova A. I. 1939: *Cotoneaster*. – Pp. 319–333 in: Komarov V. L. (ed.), Flora SSSR **9.** – Leningrad.

Pojarkova A. I. 1955: Addenda secunda ad elaborationem generis *Cotoneaster* Med. in "Flora URSS". – Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. **17:** 179–212.

Polatschek A. 2000: Flora von Nordtirol, Osttirol und Vorarlberg **3.** – Innsbruck.

Prasse R., Ristow M., Klemm G., Machatzi B., Raus T., Scholz H., Stohr G., Sukopp H. & Zimmermann F. 2001: Liste der wildwachsenden Gefäßpflanzen des Landes Berlin mit Roter Liste. – Published at http://www.stadtentwicklung.berlin.de/umwelt/naturschutz/downloads/artenschutz/rotelisten/gefaesspflanzen.pdf

Press J. R., Shrestha K. K. & Sutton D. A. 2000: Annotated checklist of the flowering plants of Nepal. – London.

Pysek P., Sádlo J. & Mandák B. 2002: Catalogue of alien plants of the Czech Republic. – Preslia **74:** 97–186.

Rehder A. & Wilson E. H. 1912: *Cotoneaster*. – Pp. 154–177 in: Sargent C. S. (ed.), Plantae wilsonianae. An enumeration of the woody plants collected in western China for the Arnold arboretum of Harvard university during the years 1907, 1908 and 1910. Part 2. – Publ. Arnold Arb. **4.**

Riedl H. 1966: *Cotoneaster*. – Pp. 13–26 in: Rechinger K. H., Flora iranica **66.** – Graz.

Ringenberg J. 1994: Analyse urbaner Gehölzbestände am Beispiel der Hamburger Wohnbebauung. – Hamburg.

Roloff A. & Bärtels A. 2006: Flora der Gehölze, ed. 2. – Stuttgart.

Sattler D. 2001: Analyse der gepflanzten und spontanen Gehölzvegetation der Städte Halle (Saale) und Leipzig. – UFZ-Ber. **13/2001.**

Saunders W. W. (ed.) 1869: Refugium botanicum, or, figures and descriptions from living specimens of little known or new plants of botanical interest **1.** – London.

Sax H. J. 1954: Polyploidy and apomixis in *Cotoneaster*. – J. Arnold Arbor. **35:** 334–365.

Schaberg F. & Weinert E. 1972: Veränderungen in der Flora der Dölauer Heide bei Halle (Saale). – Hercynia, ser. 2., **9:** 409–422.

Schaeppi H. 1987: Über die Florenverfälschung im Lindbergwald. – Mitt. Naturwiss. Ges. Winterthur **38:** 17–28.

Schinninger I. & Rozánek R. 2008: Bemerkenswerte Gefäßpflanzenfunde auf brachliegendem Eisenbahngelände in Wien. – Neilreichia **5:** 203–210.

Schmitz J. 1991: Vorkommen und Soziologie neophytischer Sträucher im Raum Aachen. – Decheniana **144:** 22–38.

Schneider C. K. 1906: *Cotoneaster* Med. – Pp. 744–761 in: Schneider C. K. 1904–06: Illustriertes Handbuch der Laubholzkunde. Charakteristik der in Mitteleuropa heimischen und im Freien angepflanzten angiospermen Gehölzarten und Formen mit Ausschluss der Bambuseen und Kakteen **1.** – Jena.

Schönfelder P. & Bresinsky A. (ed.) 1990: Verbreitungsatlas der Farn- und Blütenpflanzen Bayerns. – Stuttgart.

Schröck C., Stöhr O., Gewolf S., Eichberger C., Nowotny G. & Pilsl P. 2004: Beiträge zur Adventivflora von Salzburg I. – Sauteria **13:** 221–338.

Schroeder F.-G. 1998: Lehrbuch der Pflanzengeographie. – Wiesbaden.

Sennikov A. 2009: *Cotoneaster*. – In: Kurtto A. (ed.), *Rosaceae*. Euro+Med Plantbase, the information resource for Euro-Mediterranean plant diversity. – Published at http://ww2.bgbm.org/EuroPlusMed/results.asp [accessed on 6.11.2009].

Seybold S. 1992: *Rosaceae,* mit Beiträgen von O. Sebald, G. Timmermann und H. E. Weber. – Pp. 27–226 in: Sebald O., Seybold S. & Philippi G. (ed.), Die Farn- und Blütenpflanzen Baden-Württembergs **3.** – Stuttgart.

Stace C. 1997: New Flora of the British Isles, ed. 2. – Cambridge.

Stöhr O., Pilsl P., Schröck C., Nowotny G. & Kaiser R. 2004: Neue Gefäßpflanzenkunde aus Salzburg. – Mitt. Haus Natur Salzburg **16:** 46–64.

Stöhr O., Pilsl P., Essl F., Wittmann H. & Hohla M. 2009: Beiträge zur Flora von Österreich III. – Linzer Biol. Beitr. **41:** 1677–1755.

Strauch M. 1992: Die Flora im Unteren Trauntal (Oberösterreich). – Kat. Oberösterr. Landesmus. N.F. **54:** 277–330.

Strumpf K. 1992: Flora von Altenburg. – Mauritiana **13:** 339–523.

Sukopp H. & Wurzel A. 2000: Changing climate and the effects on vegetation in Central European cities. – Arboric. J. **24:** 257–281.

Thiers B. 2009 [continuously updated]: Index Herbariorum: A global directory of public herbaria and associated staff. – Published at http://sweetgum.nybg.org/ih/

Traxler G. 1985: Floristische Neuigkeiten aus dem Burgenland (XIX). – Burgenl. Heimatbl. **47(1):** 20–31.

Udvardy L. 1998: Classification of adventives dangerous to the Hungarian natural flora. – Acta Bot. Hung. **41:** 315–331.

Udvardy L. 1999: Exotic shrubs and trees inclining to escape in an arboretum under strong urban effect in Budapest. – Kert. Elelmisz. Egyet. Közl. **59:** 171–174.

Uebeler M., Ehmke W., Nawrath S., König A. & Wittig R. 2008: Ergebnisse der Floristischen Kartierung im Hohen Taunus. – Pp. 23–42 in: Wittig R., Uebeler M. & Ehmke W. (ed.), Die Flora des Hohen Taunus Geobot. Kolloq. **21.**

Verloove F. 2001: *Conyza bilbaoana* J. Rémy, *Cotoneaster* ×*watereri* Exell en *Erigeron karvinskianus* DC., nieuw voor de Belgische flora in Kortrijk. – Dumortiera **78:** 24–27.

Verloove F. 2002: Ingeburgerde plantensoorten in Vlaanderen. – Meded. Inst. Natuurbehoud **20.** – Brussel.

Ward F. K. 1921: The Mekong-Salween divide as a geographical barrier. – Geogr. J. (London) **58:** 49–56.

Wittmann H. & Pilsl P. 1997: Beiträge zur Flora des Bundeslandes Salzburg II. – Linzer Biol. Beitr. **29:** 385–506.

Yü T. T. 1954: Cotoneasters from the eastern Himalaya. – Bull. Brit. Mus. (Nat. Hist.), Bot. **1(5):** 125–141.

Yü T. T. & Kuan K. C. 1963: Taxa nova Rosacearum sinicarum (I). – Acta Phytotax. Sin. **8:** 202–234.

Zeilinga A. E. 1964: Polyploidy in *Cotoneaster*. – Bot. Not. **117:** 262–278.

Zhou L.-H. & Wu Z.-Y. 1999: Taxonomic revision on *Cotoneaster conspicuus (Rosaceae)*. [In Chinese with English abstract.] – Acta Bot. Yunnan. **21:** 160–166.

Zika P. F. 2002: *Cotoneaster divaricatus (Rosaceae)* naturalized in Massachusetts. – Rhodora **104:** 302–303.

Zündorf H.-J., Günther K.-F., Korsch H. & Westhus W. 2006: Flora von Thüringen. – Jena.