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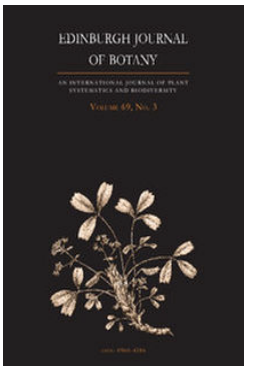

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A REVISION OF *BERBERIS S.S.* (BERBERIDACEAE) IN NEPAL

B. ADHIKARI[1], C. A. PENDRY[1], R. T. PENNINGTON[1] & R. I. MILNE[1,2]

The genus *Berberis* (Berberidaceae) in Nepal is revised and 21 species are recognised. Two species, *Berberis pendryi* Bh.Adhikari and *Berberis karnaliensis* Bh.Adhikari, are newly described and 11 taxa are lectotypified. A key to species is provided and all species are fully described and illustrated, and their distributions within Nepal mapped. An IUCN conservation assessment is given for each species.

Keywords. Berberis, Nepal, new species, revision.

INTRODUCTION

The family Berberidaceae consists of the large woody genus *Berberis* L. and a few much smaller herbaceous genera. Members of the Berberidaceae are morphologically diverse, which has led some authors to split it into small families. For example, Hutchinson (1959), Airy Shaw (1965) and Takhtajan (1969) recognised Nandinaceae (*Nandina*), Podophyllaceae (*Podophyllum*) and Berberidaceae (*Berberis*, *Mahonia*, *Epimedium*). APG II (2003) and APG III (2009) placed all these small families into the Berberidaceae. The family as currently accepted (Mabberley, 2008) includes 14 genera and about 715 species. In Nepal, the Berberidaceae is represented by *Berberis* (including *Mahonia*) and *Podophyllum*.

The name *Berberis* derives from '*Berberys*', the Arabic name for the fruit (Quattrocchi, 1947). *Berberis* is the largest genus in the Berberidaceae and the most recent monograph of the whole genus was by Ahrendt (1961), who included 496 species with a further 110 in *Mahonia* (Ahrendt listed the species in his monograph from 1 to 497, but omitted number 365, so the total number of species is 496). There are conflicting views on generic delimitation in *Berberis* and *Mahonia*. Ahrendt (1961) postulated that the simple-leaved *Berberis* are derived from the compound-leaved *Mahonia* and maintained *Mahonia* as a distinct genus. Studies of chromosome numbers (Derman, 1931), floral anatomy (Terabayashi, 1978) and seedling morphology (Terabayashi, 1987) found no significant differences between *Berberis* and *Mahonia*. Kim & Jansen (1994) reported that *Berberis* and *Mahonia* share a 11.5 kb expansion of

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the inverted repeat (IR) region of the chloroplast genome, which suggests a close phylogenetic relationship. Marroquin & Laferriere (1997) and Laferriere (1997) transferred all the species of *Mahonia* to *Berberis*. *Mahonia* is not included in this revision and the term *Berberis sensu stricto* (*s.s.*) is used to refer to simple-leaved *Berberis*.

Berberis s.s. has two important centres of diversity: Eurasia with c.300 species mainly in the Himalayas and in China, and South America with c.200 (Ahrendt, 1961). It is, however, very likely that the true number of species in *Berberis* is significantly lower, as Ahrendt (1961) used very narrow species definitions and many of the species which he recognised have been reduced to synonymy by later authors. For example, Landrum (1999) recognised only 20 out of the 60 species reported by Ahrendt (1961) from Chile. Similarly, in this study only 21 species are accepted in Nepal (including two novelties), compared with Ahrendt (1961) who reported 27 species and 16 varieties in Nepal in his worldwide monograph, Tebbs (1979) who listed 30 species and 12 varieties, Bista *et al.* (2001) who reported 36 species and 20 varieties, and Press *et al.* (2000) who recorded 30 species and 13 varieties.

Taxonomic History of Nepalese *Berberis s.s.*

The genus *Berberis* was first described by Linnaeus (1753). Later, de Candolle (1821) published a global treatment of *Berberis* and included 29 species. Amongst them was *Berberis aristata*, the first species of *Berberis* collected from Nepal in 1802 by the country's earliest plant collector Francis Buchanan (later Hamilton), and another Himalayan species, *B. asiatica* Roxb. ex DC. De Candolle (1824) listed 32 species of *Berberis* which included the addition of another Nepalese species, *B. wallichiana* DC., based on Nathaniel Wallich's specimens.

Using the Buchanan and Wallich specimens, David Don (1825) produced the first account of the plants of Nepal, *Prodromus Florae Nepalensis*, in which he mentioned only the three species of *Berberis* which had already been published by de Candolle in 1824. George Don (1831) listed 43 species of *Berberis* from throughout the world, including seven species from Nepal. Hooker & Thomson (1855) enumerated 11 species of *Berberis* from the Himalayan region including six species from Nepal, of which two were newly described (*Berberis angulosa* and *B. insignis*). This list was the same in their later work, Hooker & Thomson (1872).

A monograph of the genus was published by Schneider (1904, 1905) in which he recognised 156 species. The number of species of *Berberis* increased significantly in the 1940s when Ahrendt (1941, 1942, 1944a, 1945a) described new species of *Berberis* from Bhutan, Assam, southern Tibet, Upper Burma and NW Yunnan. He went on to publish his worldwide monograph of 496 species of *Berberis* in 1961, with 27 species from Nepal.

Chatterjee (1953) published a revision of the genus from India in which he included 68 species, while Rao *et al.* (1998a, 1998b) recognised only 55 species of *Berberis* in their revision of the Indian species. Grierson (1984) recorded 14 species of *Berberis* in the Flora of Bhutan, of which nine species are also found in Nepal.

Chamberlain & Hu (1985) provided a synopsis of *Berberis* sect. *Wallichianae* and recognised 75 species with two new taxa. Most of the species in this section were from China, with four species reported from Nepal.

The most recent account of *Berberis* is in the Flora of China (Junsheng, 2011) with 215 species. However, a more thorough revision of Chinese *Berberis* is currently being prepared by Julian Harber with the recognition of about 200 species (J. Harber, pers. comm.).

Infrageneric Classification of *Berberis s.s.*

The first major infrageneric classification of *Berberis s.s.* was by C. K. Schneider (1904, 1905), who classified 156 species into 21 sections and 32 subsections. Schneider (1908) updated his monograph and also divided the genus into two subgeneric groups, the Eurasian *Septentrionales* and the South American *Australes*. Later Schneider (1942) revised *Berberis* sect. *Wallichianae* and recognised 71 species.

The most recent monograph by Ahrendt (1961) classified the genus into 33 sections and 50 subsections and listed 496 species (including species of apparently hybrid origin), which included 114 species newly described by him.

The validity of Ahrendt's (1961) infrageneric classification has been called into doubt by Landrum's (1999) revision of *Berberis* from continental Chile, the Juan Fernandez Islands and adjacent southern Argentina in which he synonymised three species from three of Ahrendt's sections into a single species. In addition Landrum recognised only 20 out of the 60 species reported by Ahrendt (1961). We agree that Ahrendt's species concept is unrealistically narrow, especially because delimitation of his species was based on dubious characters such as the colour of stems and margin of leaves. The true number of *Berberis* species worldwide is therefore likely to be significantly lower than the 496 he reported.

Ahrendt's infrageneric classification is rejected, but a new classification will require a revision of the entire genus on the basis of both morphological and molecular data. We do not follow any infrageneric classification in this account for Nepal and taxa are grouped according to their overall morphological similarity.

Materials and Methods

This revision is based on a study of over 700 herbarium specimens and on field observations of wild populations of *Berberis* in Nepal. It is not possible to get a true picture of the morphological variation in *Berberis* from a limited number of herbarium specimens, so every attempt was made to observe variation within wild populations in addition to examining all available herbarium specimens. All but two of the 21 species recognised in this study were collected and studied in the wild. Specimens of all collections made during the field visits are deposited in the herbaria of the Royal Botanic Garden Edinburgh (E) and the National Herbarium in Kathmandu (KATH), Nepal.

Specimens were studied from the herbaria with major holdings of Himalayan material (BM, E, K, KATH, TUCH), including material gifted to E from Tokyo University (TI). Images of specimens were consulted from BR, CGE, G, OXF, W and WU, particularly for type specimens, but most of the important collections from Himalayan regions were found to be deposited in BM, E and K.

Data from herbarium labels of all *Berberis* specimens and associated information were entered into the PADME database developed at the Royal Botanic Garden Edinburgh (RBGE). Conservation assessments for all species were made using the criteria provided by IUCN (2001).

The genus *Berberis* is commonly thought to hybridise both in cultivation and in the wild, potentially causing problems for species level identifications. During this study a few individuals were observed in the field which appeared to be of hybrid origin and these are referred to under their putative parent species.

In this revision *Berberis* species are delimited by combinations of morphological characters. To determine the diagnostic characters of a particular species, the morphology of all herbarium specimens was studied along with field observations of wild populations of *Berberis* species.

Morphology

Habit

All Nepalese species of *Berberis* are woody and they range from small shrubs to large tree-like shrubs up to 6 m tall. On the basis of height, Nepalese *Berberis* can be divided into three categories:

1 Small shrubs rarely exceeding 1 m tall: *Berberis everestiana* var. *ventosa*, *B. kumaonensis*, *B. mucrifolia*, *B. pendryi* and *B. tsarica*.
2 Shrubs usually more than 1 m and up to 2 m tall: *Berberis angulosa*, *B. concinna* (*B. concinna* var. *concinna* is sometimes less than 1 m), *B. hookeri*, *B. jaeschkeana* var. *usteriana*, *B. karnaliensis* and *B. wallichiana*.
3 Large shrubs or small tree-like shrubs usually more than 2 m and up to 6 m tall: *Berberis aristata*, *B. asiatica*, *B. glaucocarpa*, *B. hamiltoniana*, *B. insignis*, *B. koehneana*, *B. orthobotrys* var. *rubicunda*, *B. petiolaris*, *B. thomsoniana* and *B. virescens*.

Most of the species are erect and branch profusely from the base. *Berberis kumaonensis* is the only exception and is a semi-erect or prostrate shrub.

Stem

Stems are terete, angled or sulcate. They can be divided into two categories: primary stem (long shoots) and short axillary stems (short shoots). Short shoots are distinct and elongated in some species like *Berberis petiolaris* and *B. thomsoniana*, while very short or indistinct in other Nepalese species. Mature long shoots are usually reddish

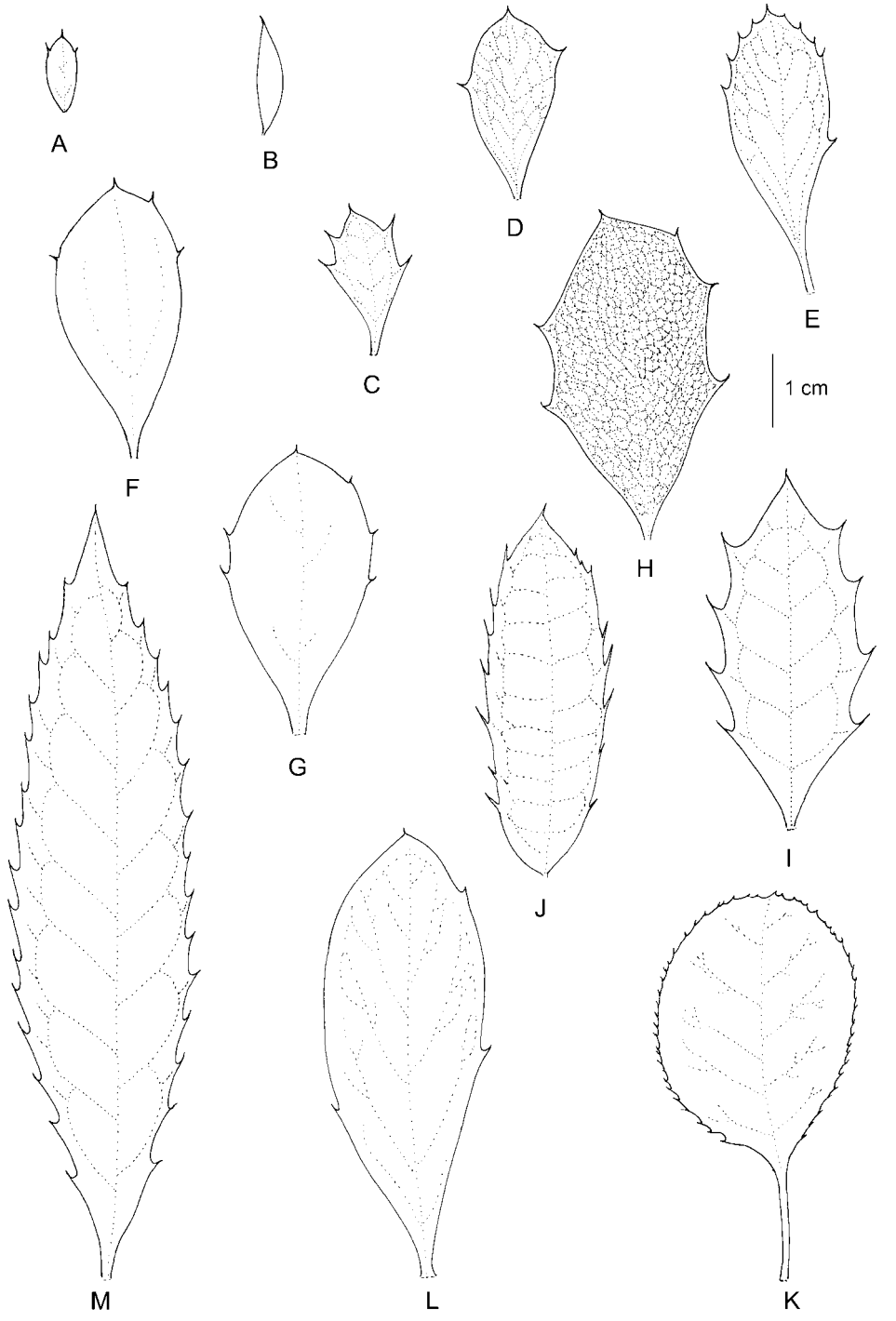
brown, ash grey or sometimes yellowish grey, while young twigs are usually green. Twigs which receive more exposure to sun turn reddish brown. Twig colour is therefore variable on a single plant and cannot be taken as a diagnostic character for species delimitation. Young twigs are puberulous in some species, but they are soon glabrescent.

Leaves and spines

Spines have sometimes been interpreted as the reduced leaves of long shoots, and normal leaves as the leaves of short shoots (Landrum, 1999). Spines are usually present in all Nepalese species, and in all cases they are distinct and strong, and not foliaceous. The least spiny individuals, with solitary spines or even spineless stems, are found in *Berberis insignis* and *B. petiolaris*. Spines are 3- or rarely 5-fid (*Berberis tsarica*) or solitary towards the apex of the twigs. They are usually terete, angled or slightly sulcate below. Leaves are borne only on short shoots, and are simple and pinnate-veined in all species of *Berberis s.s.* They are arranged in whorls or in fascicles. Petioles are usually very small or indistinct in the Nepalese taxa except in *Berberis petiolaris* (Fig. 1K), which has petioles up to 3.5 cm long. Leaves are obovate, elliptic, lanceolate, obovate to elliptic or obovate to oblanceolate in shape and their lengths range from 0.5 cm in *Berberis tsarica* to 17 cm in *B. insignis* (Fig. 1). The apices of the leaves are obtuse to acute and mucronate, and the bases are cuneate or attenuate to the small petiole. The margins are entire or spinose-spinulose toothed and variable within the species. Four types of venation can be recognised in Nepalese taxa: few veins which are slightly prominent below and less distinct above (*Berberis angulosa*, *B. hamiltoniana*, *B. jaeschkeana* var. *usteriana*, *B. karnaliensis*, *B. orthobotrys* var. *rubicunda*, *B. pendryi*, *B. tsarica* and *B. virescens*); venation prominent on both sides with distinct primary and few secondary veins (*Berberis aristata*, *B. concinna*, *B. koehneana*, *B. kumaonensis*, *B. petiolaris* and *B. thomsoniana*); venation prominent on both sides with reticulate veins (*Berberis asiatica* and *B. glaucocarpa*) and venation prominent on both sides with distinctly looping closed primary veins (*Berberis hookeri*, *B. insignis* and *B. wallichiana*). The veins are not visible in *Berberis mucrifolia*. Leaf texture varies from papery in *Berberis petiolaris* to leathery coriaceous in *B. asiatica.* Leaves are usually glabrous above and papillose below. Leaves of some species are distinctly glaucous on their lower surfaces (*Berberis asiatica* and *B. concinna*).

Inflorescences

The most frequent types of inflorescence are racemes, which are either pedunculate (*Berberis aristata*, *B. petiolaris* and *B. thomsoniana*) or shortly pedunculate or epedunculate (*B. asiatica*), and fascicles (*Berberis hookeri*, *B. insignis* and *B. wallichiana*). Some intermediate types such as sub-umbellate inflorescences are also present in some taxa. Some species (*Berberis kumaonensis*, *B. pendryi* and *B. tsarica*) have solitary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flowers. Bracts are visible and distinct in racemes and panicles but not in fasciculate inflorescences or with solitary flowers. Bracteoles are rarely present.

Flowers

Flowers are 0.8–2.5 cm in diameter, bright yellow or sometimes greenish yellow in some species (*Berberis hookeri* and *B. wallichiana*). The flowers have 2–4 whorls of sepals with three sepals in each whorl. The sepals of the outermost whorl are small and have been called prophylls in many publications (Ahrendt, 1961; Rao *et al.*, 1998a, 1998b). As there is no clear distinction between the sepals and the prophylls in all the Nepalese species of *Berberis*, the term 'outermost sepal' is used throughout the descriptions where four whorls of sepals are present. The shapes of the outer sepals and inner sepals are usually ovate and obovate, respectively. The petals are in two whorls of three petals each and are usually obovate. They are usually smaller than the inner sepals and are distinguished from them by the presence of two nectariferous glands on the base of the inner surface (Fig. 2). The apices of the petals range from entire or emarginate to distinctly notched. Petals have a central vein and 1–3 pairs of lateral veins, though this is not always constant within species. Stamens are attached at the base of each petal. The connective of the stamens is sometimes distinctly produced beyond the anther locules and is an important character in distinguishing several species. The apices of connectives are apiculate, bifurcate, retuse or conical in shape (Fig. 3). The pistil is simple and the ovary contains 1–13 ovules. The stigma is sessile or sub-sessile and the style is usually indistinct at the time of flowering.

Fruits

The fruits are berries and are globose, ellipsoid, ovoid or obovoid in shape. As the fruits develop, the style becomes more distinct in some species. The colour of the berries ranges from bright red to dark purplish black. Some of the species (*Berberis asiatica* and *B. glaucocarpa*) have glaucous berries. The seeds are usually ellipsoid in shape and range from 3 to 7 mm long.

Ecology and Distribution

The Nepalese species of *Berberis* usually grow in somewhat disturbed habitats such as forest margins, open pastures at higher altitudes, semi-desert vegetation, and the

FIG. 1. Leaves of various species of *Berberis*. A. *B. tsarica* (*DNEP3* BY132). B. *B. mucrifolia* (*SSW* 8111). C. *B. kumaonensis* (*JRS* B163). D. *B. concinna* var. *extensiflora* (*Manaslu 08* 20812277). E. *B. thomsoniana* (*LKSR* B181). F. *B. angulosa* var. *angulosa* (*Adhikari* BL2 38). G. *B. koehneana* (*Adhikari, B.* BL2 51). H. *B. asiatica* (*Adhikari, B.* B105). I. *B. hookeri* (*Proud, D.* 1). J. *B. wallichiana* (*Adhikari* BL 123). K. *B. petiolaris* var. *petiolaris* (*JRS* A122). L. *B. glaucocarpa* (*JRS* A134). M. *B. insignis* (*EMAK* 875). All leaves are drawn at the same scale.

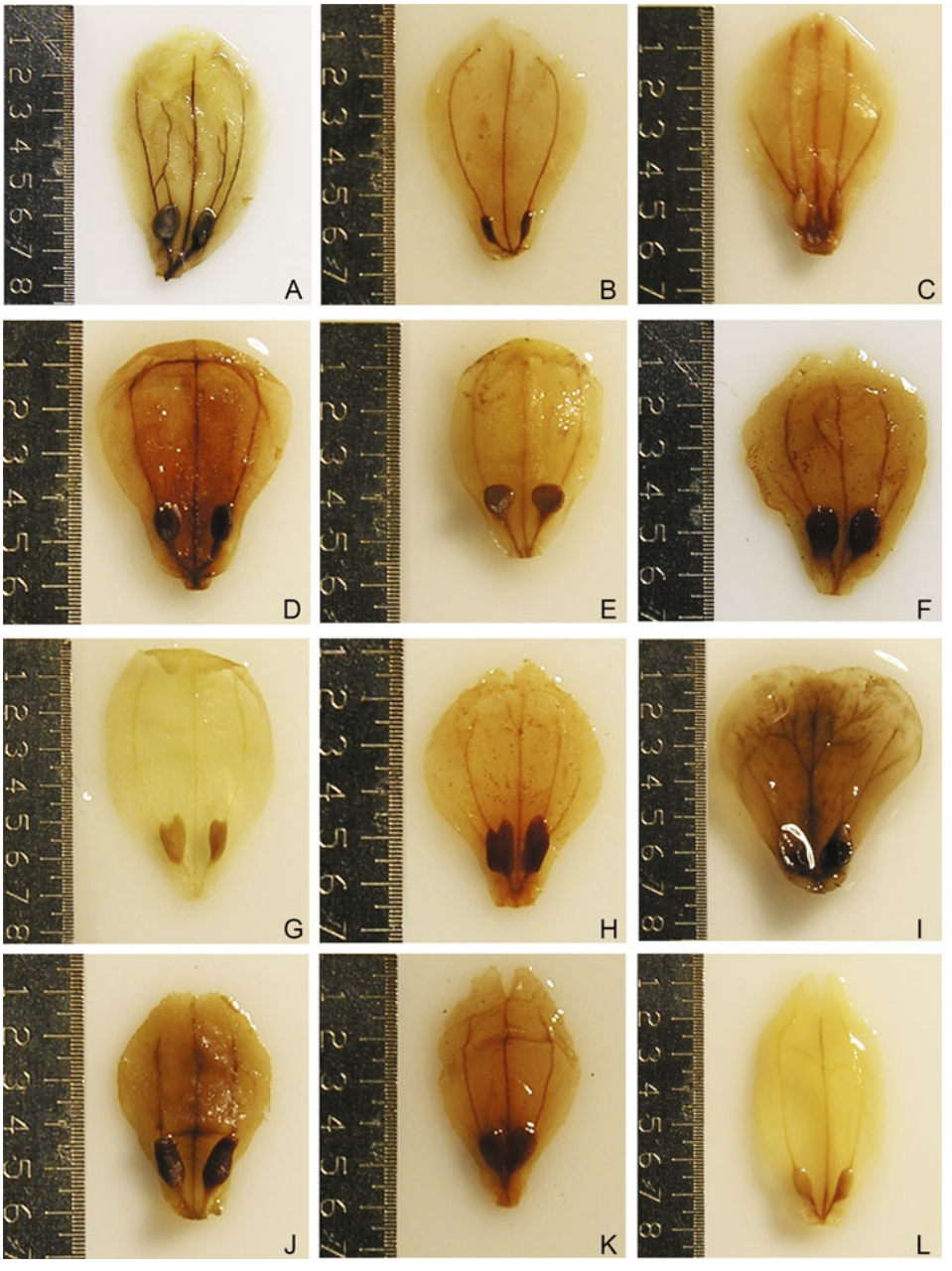

FIG. 2. Petals of various species of *Berberis*. A. *B. angulosa* var. *angulosa* (*LKSR* B71). B. *B. aristata* (*Proud, D.* 5). C. *B. asiatica* (*Adhikari, B.* 101). D. *B. concinna* var. *concinna* (*SSW* 5595). E. *B. concinna* var. *extensiflora* (*Manaslu 08* 20812277). F. *B. everestiana* var. *ventosa* (*Stainton* 4289). G. *B. glaucocarpa* (*JRS* A80). H. *B. hamiltoniana* (*PSW* 4579). I. *B. hookeri* (*LKSR* B22). J. *B. insignis* (*Suzuki et al.* 9263024). K. *B. jaeschkeana* var. *usteriana* (*SSW* 1225). L. *B. karnaliensis* (*JRS* A59). Scale in millimetres.

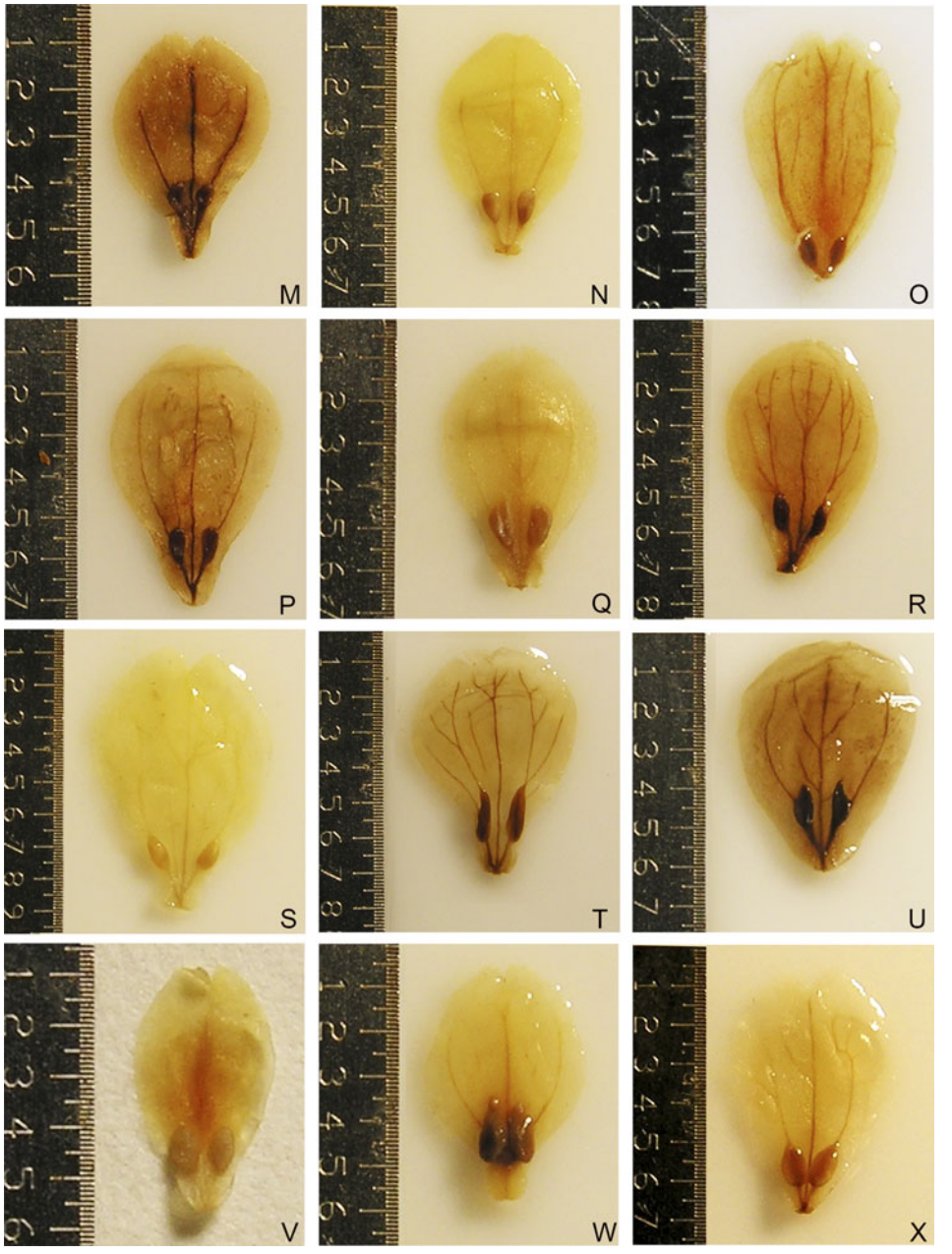

FIG. 2. (*Cont'd*) Petals of various species of *Berberis*. M. *B. koehneana* (*Polunin* 506). N. *B. kumaonensis* (*JRS* B163). O. *B. mucrifolia* (*Stainton* 4847). P. *B. orthobotrys* var. *rubicunda* (*Polunin* 514). Q. *B. pendryi* (*Pendry, Milne & Adhikari* EA 34). R. *B. petiolaris* var. *petiolaris* (*JRS* B39). S. *B. petiolaris* var. *petiolaris* (*PSW* 2066). T. *B. petiolaris* var. *garhwalana* (*Dobremez* 1967). U. *B. thomsoniana* (*LKSR* B15). V. *B. tsarica* (*DNEP1* 153). W. *B. virescens* (*DNEP1* 238). X. *B. wallichiana* (*Adhikari* G18). Scale in millimetres.

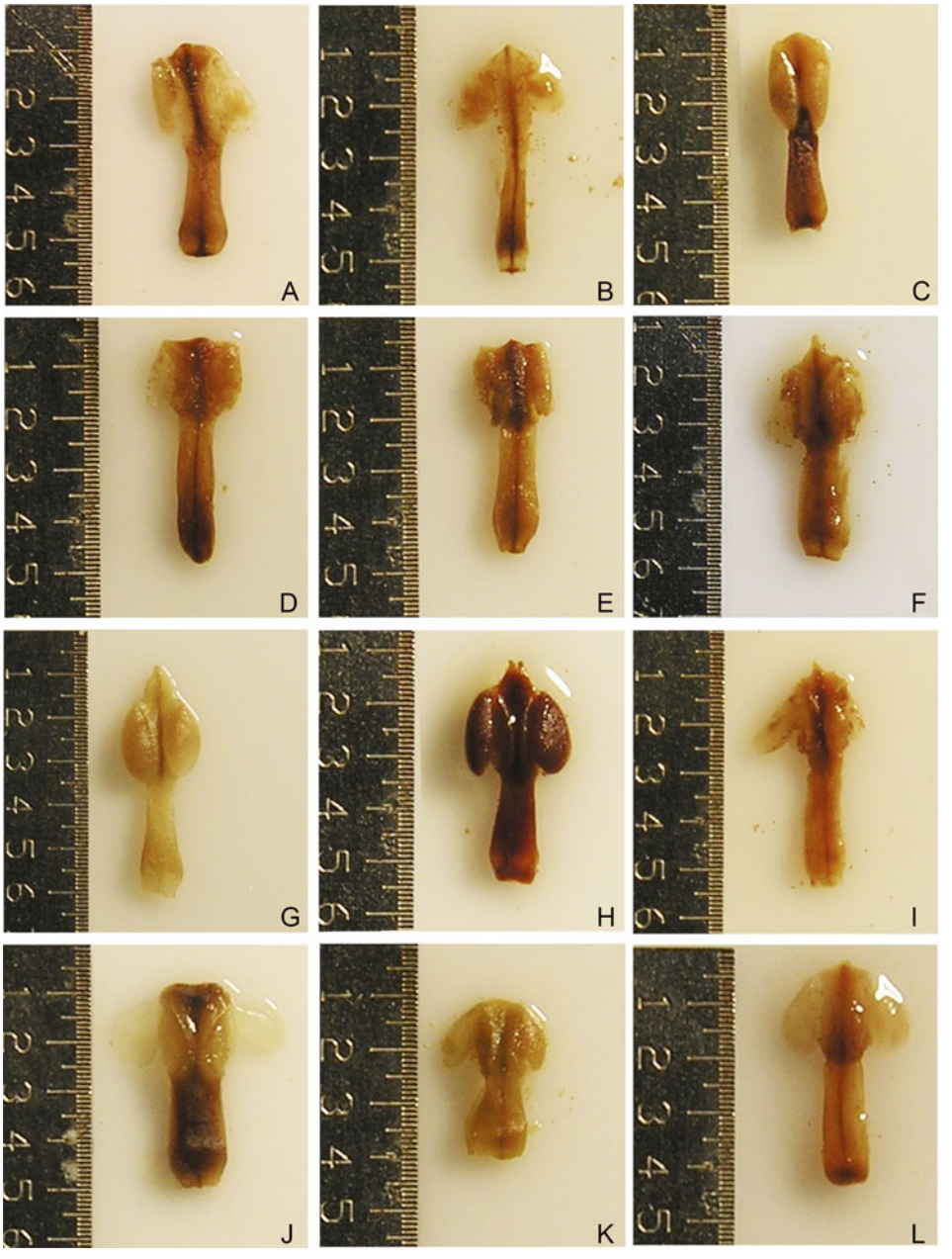

FIG. 3. Stamens of various species of *Berberis*. A. *B. angulosa* var. *angulosa* (*LKSR* B71). B. *B. aristata* (*Proud, D.* 5). C. *B. asiatica* (*Adhikari, B.* 101). D. *B. concinna* var. *concinna* (*SSW* 5595). E. *B. concinna* var. *extensiflora* (*Manaslu 08* 20812277). F. *B. everestiana* var. *ventosa* (*Stainton* 4289). G. *B. glaucocarpa* (*JRS* A80). H. *B. hamiltoniana* (*PSW* 4579). I. *B. hamiltoniana* (*Lowndes* 941). J. *B. hookeri* (*LKSR* B22). K. *B. insignis* (*Suzuki et al.* 9263024). L. *B. jaeschkeana* var. *usteriana* (*SSW* 1225). Scale in millimetres.

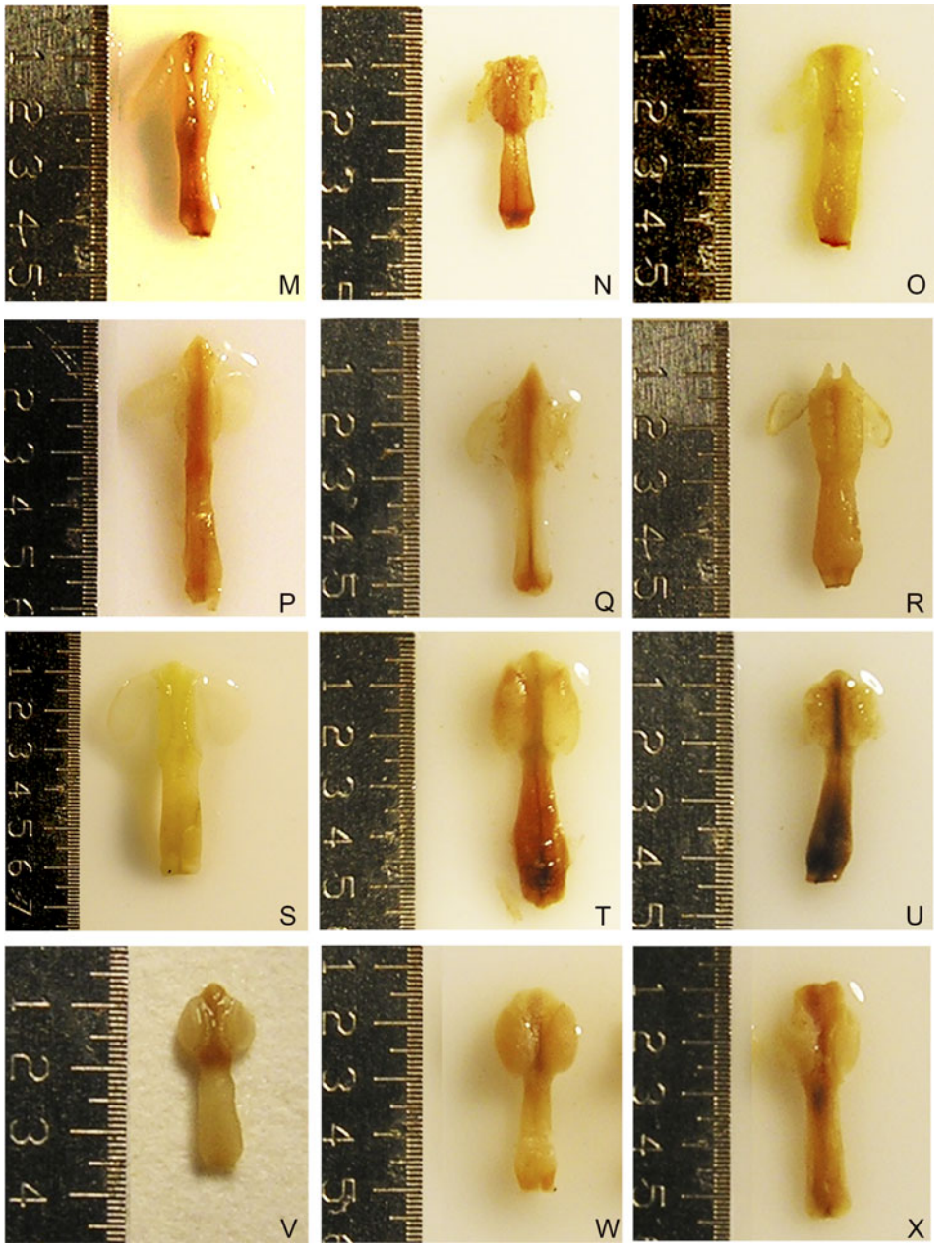

FIG. 3. (*Cont'd*) Stamens of various species of *Berberis*. M. *B. karnaliensis* (*JRS* A59). N. *B. koehneana* (*Polunin* 506). O. *B. kumaonensis* (*JRS* B163). P. *B. mucrifolia* (*Stainton* 4847). Q. *B. orthobotrys* var. *rubicunda* (*Polunin* 514). R. *B. pendryi* (*Pendry, Milne* & *Adhikari* EA 34). S. *B. petiolaris* var. *petiolaris* (*JRS* B39). T. *B. petiolaris* var. *garhwalana* (*Dobremez* 1967). U. *B. thomsoniana* (*LKSR* B15). V. *B. tsarica* (*DNEP1* 153). W. *B. virescens* (*DNEP1* 238). X. *B. wallichiana* (*Adhikari* G18). Scale in millimetres.

margins of cultivated land. A few exceptions include *Berberis insignis* and *B. wallichiana* which usually grow on the forest floor of oak–laurel forest in eastern Nepal. Similarly, *Berberis petiolaris* is a component of temperate moist *Abies–Betula–Acer* forest in western Nepal. Nepalese *Berberis* species grow in a wide range of rainfall regimes from wet forests in eastern Nepal to the very much drier trans-Himalayan regions of western Nepal. They grow from as low as 1000 m altitude (*Berberis asiatica*) up to 4700 m (*B. tsarica*). The distribution of *Berberis* collections in Nepal is shown in Fig. 4.

Uses

Most of the Nepalese species of *Berberis* have medicinal uses due to the presence of the alkaloid berberine. Extracts from the stem and root of *Berberis* are used in ophthalmic medicine, and to treat jaundice, malarial fever, diarrhoea and peptic ulcers (Manandhar, 2002). Fruits are eaten fresh and are sometimes used locally for making alcoholic drinks. In Nepali, all the species are commonly known as 'chutro'.

Taxonomic Treatment

Berberis L., Sp. Pl. 330 (1753). – Type species: *Berberis vulgaris* L., designated by Britton & Brown (1913).

Shrubs or small tree-like shrubs, evergreen or deciduous, usually with yellow wood. *Stems* and branches terete, sulcate or angled, reddish brown or yellowish brown becoming ash grey when older. *Spines* 3–5-fid, terete, sulcate or angled, strong or weak. *Leaves* simple, petiolate or sessile, in fascicles or in whorls, margin entire or

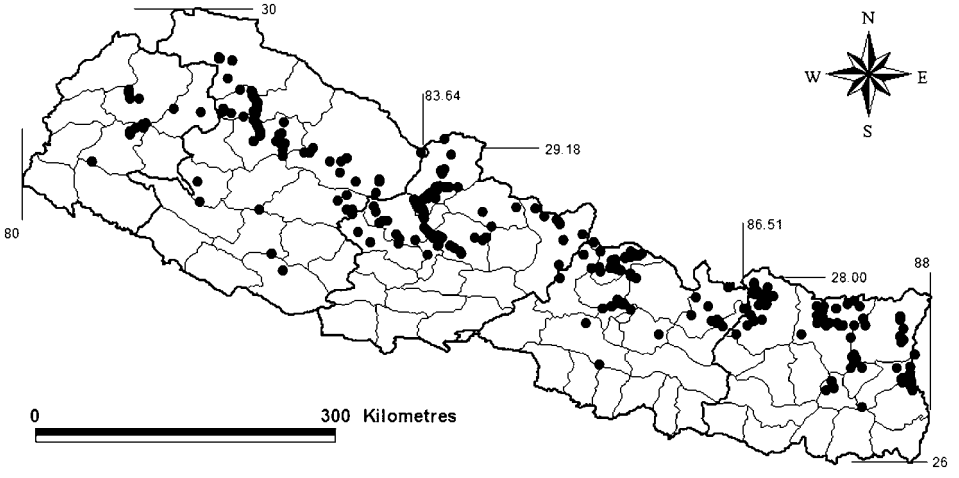

Fig. 4. Distribution of *Berberis* collections in Nepal.

spinose-spinulose toothed, venation pinnate, prominent or obscure. *Flowers* solitary, fascicled, or in pedunculate or epedunculate racemes, umbels or in panicles. *Bracts* often present, bracteoles rarely present. *Perianth* greenish yellow to yellow (in Nepal), 3-merous. *Perianth segments* in 4–6 whorls, outer 2–4 whorls of sepals, inner 2 whorls of petals. Outermost sepals small, bract-like, median sepals usually smaller than the inner sepals, innermost sepals usually larger than the petals. *Petals* with nectariferous glands at the base; venation usually distinct, with 1 central vein and 1–3 pairs of lateral veins. *Stamens* 6; filament thick, sometimes with connective produced beyond the apex of anther-locules; anther-locules opening by valves. *Pistil* usually barrel-shaped. *Ovary* 1-locular, ovules 1–13, stigma peltate. *Berries* ellipsoid, sub-globose, ovoid, ovoid to oblong, obovoid to oblong, usually red or purplish black, with or without style, sometimes covered with white or bluish white bloom (glaucous).

Distribution. About 500 species reported but it is very likely that the true number of species is significantly lower. Widespread in the northern hemisphere (especially in Himalayas and E Asia) and extending into Africa (three species), and C and S America (secondary centre of diversity); 21 species in Nepal.

Key to the species

1a. Flowers solitary or in fascicles (sometimes in a 2–3-flowered umbel in *B. concinna* var. *extensiflora*) ____ 2
1b. Flowers in racemes, panicles or in umbels (with more than 4 flowers) ____ 11

2a. Evergreen shrubs. Berries black ____ 3
2b. Deciduous shrubs. Berries red ____ 5

3a. Spines usually absent. Leaves large, up to 17 cm long. Anther connectives slightly produced or not ____ **21. B. insignis**
3b. Spines present. Leaves small, up to 8 cm long (rarely up to 11 cm in *B. wallichiana*). Anther connectives distinctly produced ____ 4

4a. Berries with a distinct style. Inflorescence a fascicle of 10–25(–30) flowers. Ovule solitary ____ **19. B. wallichiana**
4b. Berries without a style. Inflorescence a fascicle of 3–8(–11) flowers. Ovules 3–6 ____ **20. B. hookeri**

5a. Semi-prostrate shrubs up to 20 cm tall ____ **3. B. kumaonensis**
5b. Erect shrubs (*B. mucrifolia* rarely semi-prostrate) more than 20 cm tall ____ 6

6a. Stem spines mostly 5-fid ____ **6. B. tsarica**
6b. Stem spines mostly 3-fid ____ 7

7a. Flowers large, 1.5–2.5 cm in diameter. Berries without a style ____ 8
7b. Flowers small, up to 1 cm in diameter. Berries with a distinct style ____ 9

8a. Leaves glaucous below, venation prominent both sides. Nectariferous glands cup-shaped ____ **4. B. concinna**
8b. Leaves not glaucous, venation sub-conspicuous above, slightly prominent below. Nectariferous glands obovoid ____ **1. B. angulosa**

9a. Leaves rigidly coriaceous. Anther connectives slightly produced ____ ____ **5. B. mucrifolia**
9b. Leaves thin or slightly coriaceous. Anther connectives distinctly produced __ 10

10a. Sepals in 4 whorls. Anther connectives apiculate ____ ____ **2. B. everestiana** var. **ventosa**
10b. Sepals in 3 whorls. Anther connectives produced into 2 or 3 tooth-like appendages ____ **7. B. pendryi**

11a. Secondary and tertiary leaf venation usually reticulate. Berries very glaucous ____ 12
11b. Secondary leaf venation with closed or open loops, tertiary venation obscure. Berries slightly glaucous or not glaucous ____ 13

12a. Flowers in flexible epedunculate racemes or in fascicles ____ **17. B. asiatica**
12b. Flowers in stiff pedunculate racemes ____ **18. B. glaucocarpa**

13a. Leaves with a distinct petiole up to 3.5 cm long. Lamina broadly obovate or broadly elliptic to rounded ____ **13. B. petiolaris**
13b. Leaves without a distinct petiole. Lamina obovate or narrowly obovate to narrowly elliptic ____ 14

14a. Inflorescence (3–)8–16 cm long, a panicle with 15–70 flowers ____ ____ **10. B. koehneana**
14b. Inflorescence 1–6 cm long, a simple raceme, or umbellate, sub-umbellate or sub-paniculate raceme with 2–15 flowers (up to 20 in *B. aristata*) ____ 15

15a. Berries dark purple or black, slightly glaucous ____ **8. B. aristata**
15b. Berries red, non-glaucous ____ 16

16a. Sepals in 4 whorls ____ **9. B. thomsoniana**
16b. Sepals in 3 whorls ____ 17

17a. Shrubs usually less than 2 m tall. Berries with a distinct style ____ 18
17b. Shrubs usually more than 2 m tall. Berries without a style (sometimes very short, $\leq$ 0.5 mm in *B. virescens*) ____ 19

18a. Young branches glabrous. Peduncle usually less than 1 cm long ____ ____ **14. B. jaeschkeana** var. **usteriana**
18b. Young branches densely puberulous. Peduncle usually more than 1 cm long ____ **15. B. karnaliensis**

19a. Outer sepals up to 3.5 mm long. Apex of connectives obtuse or retuse ____ **16. B. virescens**

19b. Outer sepals 3.5 mm or more long. Apex of connectives pointed or bifurcate _____ 20

20a. Berries ovate-ellipsoid. Petals notched _____ **12. B. hamiltoniana**
20b. Berries ellipsoid to oblong-obovoid. Petals obtuse, rarely emarginate or crenate _____ **11. B. orthobotrys** var. **rubicunda**

1. Berberis angulosa Wall. ex Hook.f. & Thomson, Fl. Ind. 1: 227 (1855); Hooker & Thomson in Hooker, Fl. Brit. India 1(1): 111 (1872); Hooker, Bot. Mag. 115: t. 7071 (1889); Schneider, Bull. Herb. Boissier 2.5: 398 (1905); Chatterjee, Rec. Bot. Surv. India 16(2): 24 (1953); Ahrendt, J. Linn. Soc. Bot. 57: 113 (1961); Tebbs in Hara & Williams, Enum. Fl. Pl. Nepal 2: 29 (1979); Grierson in Grierson & Long, Fl. Bhutan 1(2): 323 (1984); Rao *et al.*, Rheedea 8(2): 110 (1998); Press *et al.*, Annot. Checkl. Fl. Pl. Nepal 25 (2000). – Type: Nepal, Gosaithan, *Wallich* 1475.1 (lecto K-W!, designated here by Harber; isolecto K! [barcode K000077366], labelled as 'a'). **Figs 5, 6.**

Berberis parisepala Ahrendt, Gard. Chron. 109(3): 100 (1941). – Type: Cultivated from *K.W.* 8350 (holo BM!).

Shrub to 2 m. *Stems* and branches terete to sulcate, glabrous, reddish brown when young becoming greyish and verruculose when older. *Internodes* 1–2.5 cm. *Spines* 3(–5)-fid, strong, usually terete, central spine 1–3 cm, lateral spines 0.5–1.5 cm. *Leaves* deciduous, slightly coriaceous. *Petiole* indistinct or short, 2–5 mm. *Lamina* obovate to oblanceolate, 1.5–4.5 × 0.5–1.5 cm, base cuneate to shortly attenuate, apex obtuse, mucronate, margin usually entire, sometimes with 1–3 spinulose teeth on each side, dark green above, paler beneath, venation sub-conspicuous above, slightly prominent below. *Flowers* solitary or in fascicles of 2–6 flowers. *Bracts* indistinct. *Perianth* yellow, 1.5–2 cm in diameter. *Pedicel* 0.5–2 cm, glabrous to puberulous. *Sepals* in 2 whorls, outer sepals ovate or spathulate, 6–10 × 3.5–4.5 mm; inner sepals obovate, 7–10 × 5–7 mm. *Petals* obovate, 5.5–8.5 × 3.5–5.5 mm, base cuneate, apex undulate or rounded, margin entire, venation distinct with 2–3 pairs of lateral veins; glands obovoid, c.1 mm long. *Stamens* 4–5 mm long, connectives slightly produced, tip conical. *Pistil* 3–4 mm long; ovules 4–6. *Berries* bright red, sub-globose, 8–10 mm long; style absent.

Distinguishing features. *Berberis angulosa* is distinguished by its low stature of less than 2 m and its bright red, estylose and usually solitary fruits.

Key to the varieties of Berberis angulosa

1a. Flowers solitary _____ **1a.** var. **angulosa**
1b. Flowers in fascicles of 2–6 flowers _____ **1b.** var. **fasciculata**

1a. Berberis angulosa var. **angulosa**

Flowers always solitary. Pedicels glabrous to puberulous.

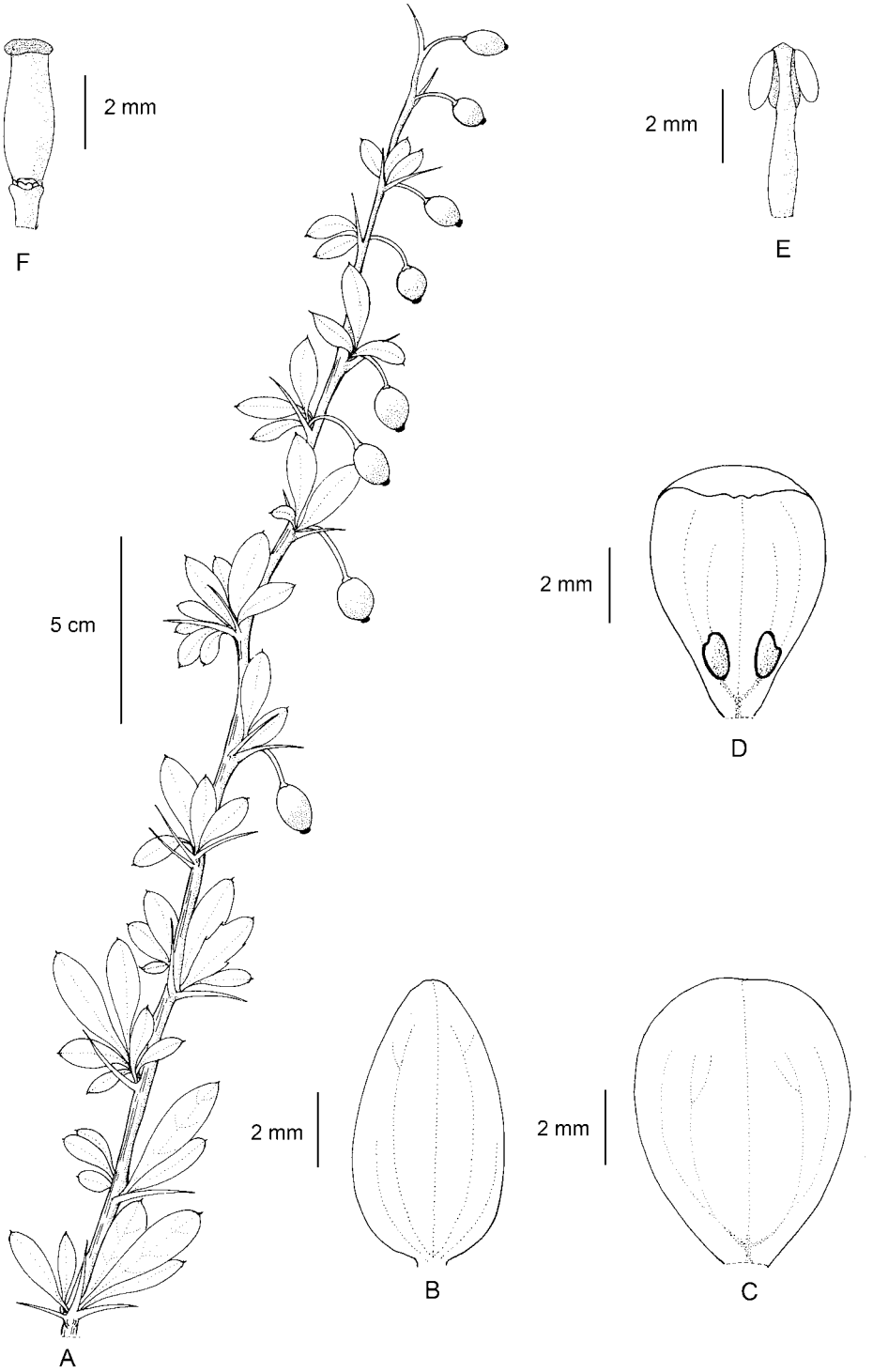

FIG. 5. *Berberis angulosa* var. *angulosa*. A, fruiting branch; B, outer sepal; C, inner sepal; D, petal; E, stamen; F, pistil (A from *EMAK* 585; B–F from *LKSR* B45).

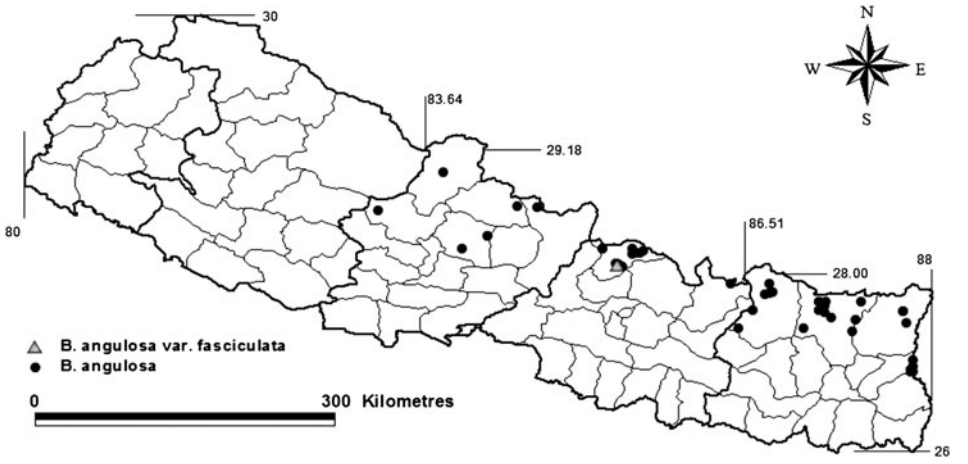

FIG. 6. Distribution of *Berberis angulosa*.

Phenology. May–Jul (fl.); Jun–Oct (fr.).

Habitat and ecology. In dry open rocky places at 3000–4500 m altitude.

Distribution. Nepal (Central, Eastern), E Himalaya, Tibetan Plateau.

Proposed IUCN conservation status. Least Concern (LC). The extent of occurrence of this taxon is more than 20,000 km^2 in Nepal and it is also widespread in Bhutan and Sikkim.

Selected specimens. CENTRAL. Baglung, east of Dhorpatan, 11,500 ft, 21 x 1954, *Stainton, Sykes & Williams* 9109 (BM); Kaski, Annapurna Himal, Setikhola, 12,500 ft, 3 viii 1954, *Stainton, Sykes & Williams* 6656 (BM); Lamjung, Rambrong, Lamjung Himal, 12,000 ft, 29 vi 1954, *Stainton, Sykes & Williams* 6047 (BM); Manang, Bimatang, 3730 m, 13 viii 2008, *Manaslu 08* 20815195 (E); Myagdi, south of Gurjakhani, 12,500 ft, 8 vi 1954, *Stainton, Sykes & Williams* 3062 (BM, E); Rasuwa, Gosaikund-Cholangpati, 4030 m, 9 x 2001, *ENEP* 280 (E); Rasuwa, Langtang khola, 11,100 ft, 24 v 1962, *Bowes-Lyon* 147 (BM, E). EASTERN. Panchthar, Prangbung 6, Pasi Bhanjyang, 3236 m, 11 vi 2007, *LKSR* 45 (E, TUCH); Sankhuwasabha, N bank of Barun Khola below Repu Kharka, 3560 m, 8 x 1991, *EMAK* 585 (E); Sankhuwasabha, Numbuk-Yangri Kharka, 3470 m, 18 vii 1988, *Suzuki et al.* 8840287 (E); Taplejung, Topkegola, 12,000 ft, 19 x 1971, *Beer, Lancaster & Morris* 88 (BM).

Julian Harber has designated *Wallich* 1475.1 at K-W! as lectotype for *Berberis angulosa* but this work is as yet unpublished. By agreement we publish and credit him here for this lectotypification.

1b. Berberis angulosa var. **fasciculata** Ahrendt, J. Bot. 79 (Suppl.): 42 (1941); Ahrendt, J. Linn. Soc. Bot. 57: 114 (1961). – Type: India, Sikkim, 10,700 ft, *Hooker & Thomson* s.n. (lecto K!, designated by Ahrendt (1961: 114)).

Flowers in fascicles of 2–6 flowers. Pedicels usually puberulous.

Phenology. May–Jul (fl.); Jun–Oct (fr.).

Habitat and ecology. In dry open rocky places around 3000 m altitude.

Distribution. Nepal (Central).

Proposed IUCN conservation status. Data Deficient (DD). In Nepal this taxon is currently confirmed only from a single location in central Nepal.

New record for the Flora of Nepal.

Specimen examined. CENTRAL. Rasuwa, Cholangpati, 3623 m, 20 x 2006, *Adhikari* EL 127 (E).

Hooker & Thomson (1855) mentioned within their description of *Berberis angulosa* a variety β with fasciculate pedicels. This was later formally described by Ahrendt (1941) as *Berberis angulosa* var. *fasciculata* but without the citation of specimens. Later Ahrendt (1961) cited the type as 'Sikkim: 10,700 ft, Hooker and Thomson (Type K)' which is an effective lectotypification.

Rao *et al.* (1998b) did not recognise *Berberis angulosa* var. *fasciculata*, noting that a putative isotype of *Berberis angulosa* from BM (*Wallich* 1475) has fasciculate to sub-umbellate inflorescences. *Wallich* 1475 actually comprises two gatherings: 1475.1 which is *Berberis angulosa* var. *angulosa* from Nepal and 1475.2 which is *B. umbellata* from Kumaon. *Wallich* 1475 in BM is more likely to be 1475.2 or from different gatherings. The flowers of *Wallich* 1475.1 in K-W are all solitary. Both varieties were observed in the field and are considered in this paper to be distinct varieties. However, the type specimen of *Berberis angulosa* var. *fasciculata* contains only fruits and fragments of leaves, and is similar to *B. lasioclema* and *B. cooperi* from Sikkim and Bhutan (J. Harber, pers. comm.). More detailed study of material from the Sikkim and Bhutan regions is necessary to further clarify the status of *Berberis angulosa* var. *fasciculata*.

2. Berberis everestiana Ahrendt var. **ventosa** Ahrendt, J. Linn. Soc. Bot. 57: 117 (1961); Tebbs in Hara & Williams, Enum. Fl. Pl. Nepal 2: 30 (1979); Rao *et al.*, Rheedea 8(2): 116 (1998); Press *et al.*, Annot. Checkl. Fl. Pl. Nepal 26 (2000). – Type: Nepal, Dolpa, between Pudamigaon and Ringmigaon, *Polunin, Sykes & Williams* 3554 (holo BM!). **Figs 7, 8.**

Shrub to 1 m. *Stems* and branches terete to slightly sulcate, glabrous, yellowish brown when young becoming greyish and verruculose when older. *Internodes* 0.5–2 cm. *Spines* 3(–5)-fid, strong, usually terete, central spine 1–1.5 cm, lateral spines 0.5–1.2 cm. *Leaves* deciduous, thin or slightly coriaceous. *Petiole* absent. *Lamina* usually obovate, 0.5–2.5 × 0.5–1 cm, base cuneate, apex obtuse, mucronate, margin entire or sometimes with 1–3 spinulose teeth on each side, dark green above, paler beneath, venation prominent below. *Flowers* solitary, rarely 2, yellow, c.1 cm in

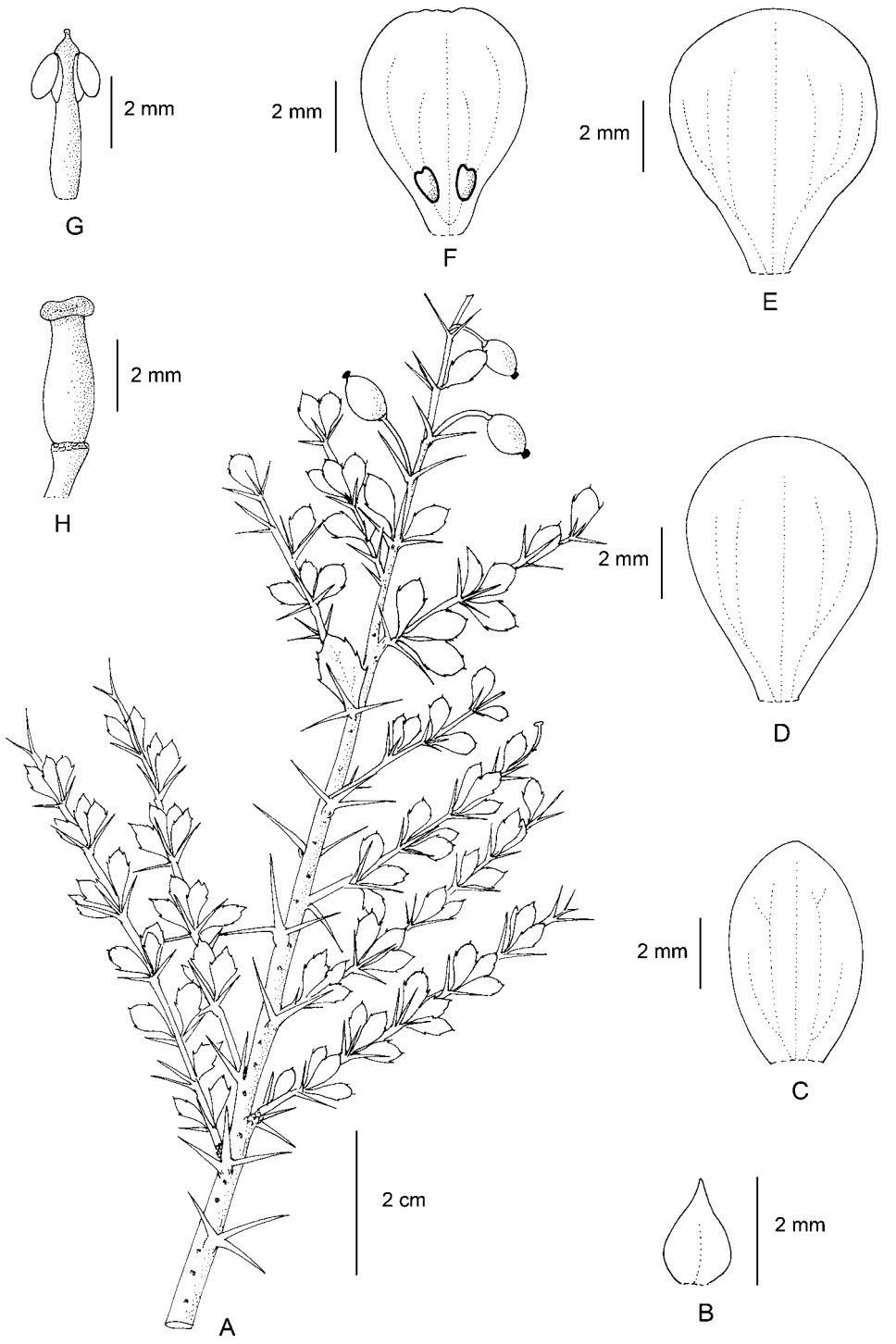

FIG. 7. *Berberis everestiana* var. *ventosa*. A, fruiting branch; B, outermost sepal; C, outer sepal; D, median sepal; E, inner sepal; F, petal; G, stamen; H, pistil (A from *Polunin, Sykes* & *Williams* 3554; B–H from *Stainton* 4289).

diameter. *Bracts* indistinct. *Pedicel* 0.3–1 cm. *Sepals* in 4 whorls, outermost sepals ovate with acute apex, 2 × 1.5 mm; outer sepals ovate or elliptic-ovate, 6–7 × 3–4 mm; median sepals ovate-elliptic, 7–7.5 × 5–5.5 mm; inner sepals broadly obovate, 6.5–7.5 × 5–6 mm. *Petals* obovate, 5–6.5 × 3.5–4.5 mm, base cuneate, apex obtuse, undulate or slightly notched, margin entire, venation distinct with 1 or 2 pairs of lateral veins; glands obovoid, 1–1.5 mm long. *Stamens* 3.5–5 mm long, connectives distinctly produced, tip apiculate. *Pistil* 3–4 mm long; ovules 5–7. *Berries* red, sub-globose or oblong-ovoid, c.1 cm long; style small, c.1 mm long.

Phenology. Jun–Sep (fl.); Aug–Oct (fr.).

Habitat and ecology. Usually grows on exposed dry slopes at 2700–4550 m altitude.

Distribution. Nepal (Western, Central, Eastern), E Himalaya (Sikkim).

Proposed IUCN conservation status. Least Concern (LC).

Distinguishing features. Small shrub less than 1.5 m; flowers usually solitary; connective distinctly produced; berries red with a short style. *Berberis everestiana* var. *ventosa* is most likely to be confused with *B. angulosa* but is easily distinguished by its smaller flowers and leaves, and distinctly produced anther connective.

Selected specimens. WESTERN. Dolpa, Barbung Khola, Pemrigaon, 15,000 ft, 9 vi 1952, *Polunin, Sykes* & *Williams* 1104 (E); Dolpa, Phoksundo Tal, 12,500 ft, 11 x 1952, *Polunin, Sykes* & *Williams* 2202 (BM, E). CENTRAL. Mustang, Kaligandaki Valley, 27 ix 2006, *Pendry, Milne* & *Adhikari* EA 46 (E). EASTERN. Solukhumbu, Bhotekoshi Valley, 3917 m, 23 ix 2005, *DNEP3* BY156 (E).

Berberis everestiana var. *ventosa* differs from *B. everestiana* var. *everestiana* by its distinctly produced anther connective. The only specimen of the typical variety cited

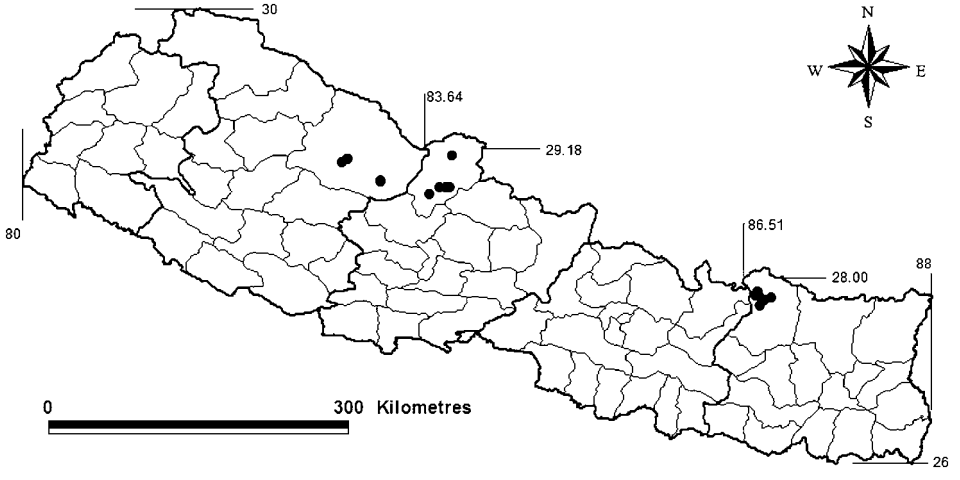

FIG. 8. Distribution of *Berberis everestiana* var. *ventosa.*

by Ahrendt (1961) from Nepal is *Bailey* 46 from Cholong Pati. *Bailey* 46 has been identified as *Berberis angulosa* in this study and no specimens of *B. everestiana* var. *everestiana* have been recorded from Nepal. However, *Berberis everestiana* var. *everestiana* has been reported from Tibet close to the Nepal border and we consider it likely that it also grows in Nepal.

3. **Berberis kumaonensis** C.K.Schneid., Bull. Herb. Boissier 2.5: 397 (1905); Chatterjee, Rec. Bot. Surv. India 16(2): 25 (1953); Ahrendt, J. Linn. Soc. Bot. 57: 120 (1961); Tebbs in Hara & Williams, Enum. Fl. Pl. Nepal 2: 30 (1979); Rao *et al.*, Rheedea 8(2): 112 (1998); Press *et al.*, Annot. Checkl. Fl. Pl. Nepal 26 (2000). – Type: India, Kumaon, rocks near Garbyang, Kalivalley, 13,000 ft, *Duthie* 2697 (holo G!; iso K!). **Figs 9, 10.**

Semi-prostrate shrub to 20 cm. *Stems* and branches sulcate, glabrous, brownish-grey. *Internodes* 0.5–2 cm. *Spines* usually 3-fid, sulcate, central spine 1–3 cm, the lateral spines equal or slightly shorter than the central. *Leaves* deciduous, slightly coriaceous. *Petiole* absent. *Lamina* obovate, 1–2 × 0.3–1 cm, base cuneate, apex acute or obtuse, tapering to a spine-like mucro, margin with 1–2(–3) spinose teeth on each side, green above, papillose and slightly glaucous beneath, venation prominent on both sides. *Flowers* solitary, yellow, 1.5–2 cm in diameter. *Pedicel* 0.5–1.2 cm, reddish yellow. *Sepals* in 3(–4) whorls, outermost sepals linear or oblong-ovate, 4–6 × 1–2 mm (if present); outer sepals ovate-elliptic, 4–6 × 2–4 mm; median sepals broadly obovate to elliptic, 6–8 × 3.5–5 mm; inner sepals broadly obovate to elliptic, 5.5–8.5 × 3.5–5 mm. *Petals* obovate, 4.5–6 × 3–4 mm, base cuneate, apex obtuse or slightly notched to 0.2–0.4 mm, margin entire, venation distinct with 1 pair of lateral veins; glands ellipsoid, 0.5–1 mm long. *Stamens* 3.5–4 mm long, connective scarcely produced or not. *Pistil* 3–3.5 mm long; ovules 7–12. *Berries* not seen.

Phenology. May–Jul (fl.); Jun–Sep (fr.).

Habitat and ecology. In dry, rocky, open and exposed areas at 3000–4000 m altitude.

Distribution. Nepal (Western), W Himalaya (Kumaon).

Proposed IUCN conservation status. Least Concern (LC). In Nepal, this species is recorded only from far western Nepal but it is common in the Kumaon and Garhwal regions of India.

Distinguishing features. Small spiny semi-prostrate shrub; flowers large, up to 2 cm in diameter, ovules 7–12.

Selected specimens. WESTERN. Doti, Khaptad National Park, 2967 m, 2 vii 2009, *Bajhang 09* 20915029 (E); Humla, Norkeni, above Simikot, 3650 m, 21 vi 2008, *JRS* B163 (E); Mugu, Ghurchi lekh, between Lumsa and Murma, 3330 m, 11 viii 1952, *Polunin, Sykes* & *Williams* 5124 (BM).

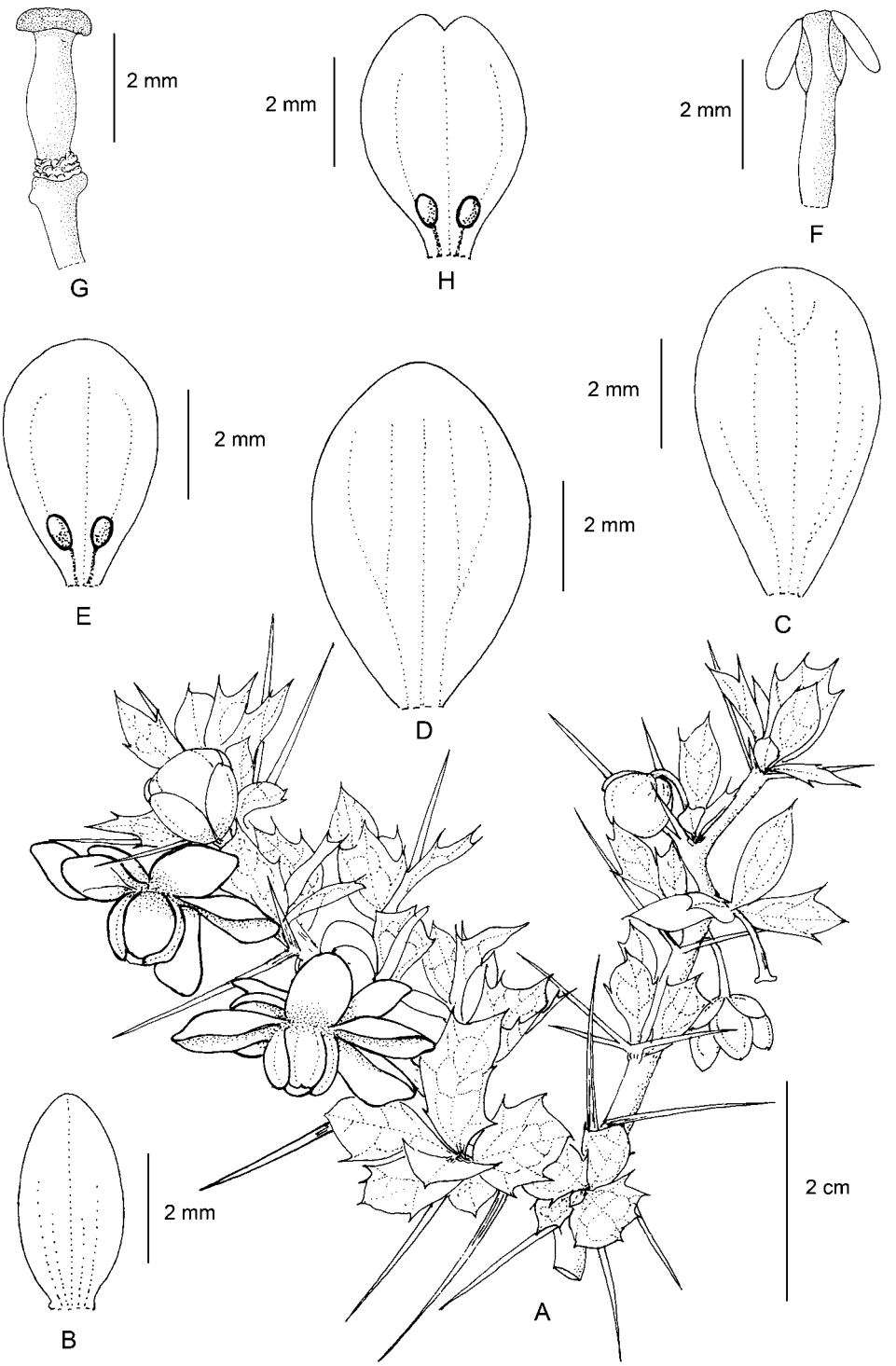

FIG. 9. *Berberis kumaonensis*. A, flowering branch; B, outer sepal; C, median sepal; D, inner sepal; E & H, petal; F, stamen; G, pistil (A–G from *JRS* B163; H from *JRS* B172).

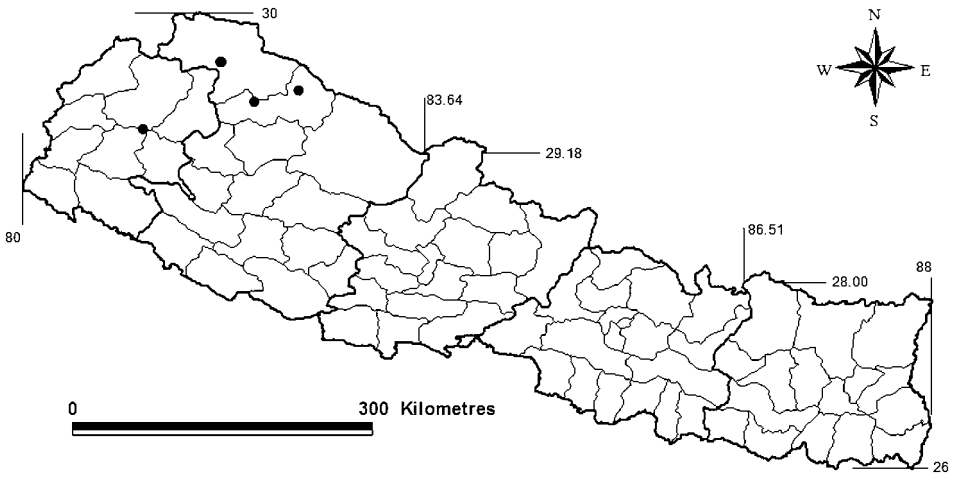

FIG. 10. Distribution of *Berberis kumaonensis*.

4. Berberis concinna Hook.f., Bot. Mag. 79: t. 4744 (1853); Hooker & Thomson, Fl. Ind. 1: 228 (1855); Hooker & Thomson in Hooker, Fl. Brit. India 1(1): 111 (1872); Schneider, Bull. Herb. Boissier 2.5: 397 (1905); Chatterjee, Rec. Bot. Surv. India 16(2): 26 (1953); Ahrendt, J. Linn. Soc. Bot. 57: 118 (1961); Tebbs in Hara & Williams, Enum. Fl. Pl. Nepal 2: 30 (1979); Grierson in Grierson & Long, Fl. Bhutan 1(2): 324 (1984); Rao *et al.*, Rheedea 8(2): 111 (1998); Press *et al.*, Annot. Checkl. Fl. Pl. Nepal 25 (2000). – Type: India, Sikkim, Lachen Valley, 12,000–13,000 ft, *Hooker* s.n. (lecto K! [barcode K000077361], designated by Ahrendt (1961: 119)). **Figs 11, 12.**

Berberis concinna var. *brevior* Ahrendt, J. Asiat. Soc. Bengal (Sci.) 11: 3 (1945). – Type: Nepal, Namlang, *Sharma* E269 (holo BM!; iso E!).

Shrub to 2 m. *Stems* and branches usually sulcate, glabrous, yellowish grey, sparsely verruculose. *Internodes* 1–2.5 cm. *Spines* usually 3-fid, terete, angled or slightly sulcate below, strong, central spine 0.8–1.5 cm, lateral spines 0.5–1.2 cm. *Leaves* deciduous, slightly coriaceous. *Petiole* absent. *Lamina* obovate, 1–3 × 0.5–1.5 cm, base cuneate, apex obtuse, sometimes acute, usually mucronate, margin with 1–3 spinose teeth on each side, dark green above, glaucous and papillose beneath, venation reticulate, prominent both sides. *Inflorescence* 1–5 cm long, flowers solitary or an umbel of 2 or 3 flowers. *Bracts* ovate-triangular, 1.5–3 × 1–1.5 mm, bracteole ovate, 1–3 × 0.8–1.5 mm (if present). *Flowers* yellow, 1.5–2.5 cm in diameter. *Peduncle* 1.5–3 cm in umbellate flowers. *Pedicel* 0.5–2 cm, glabrous, red, slightly swollen at the base of fruit. *Sepals* in 4 whorls, outermost sepals ovate, 2–4 × 1.5–2.5 mm; outer sepals ovate, elliptic, obovate or narrowly obovate, 5–8.5 × 2.5–4 mm; median sepals elliptic, ovate, broadly obovate-elliptic, 5–8.5 × 3–5.5 mm; inner sepals broadly ovate to obovate-elliptic, 5.5–9 × (2.5–)4–6 mm. *Petals* obovate, 4.5–6.5 × 2.5–4.5 mm, base

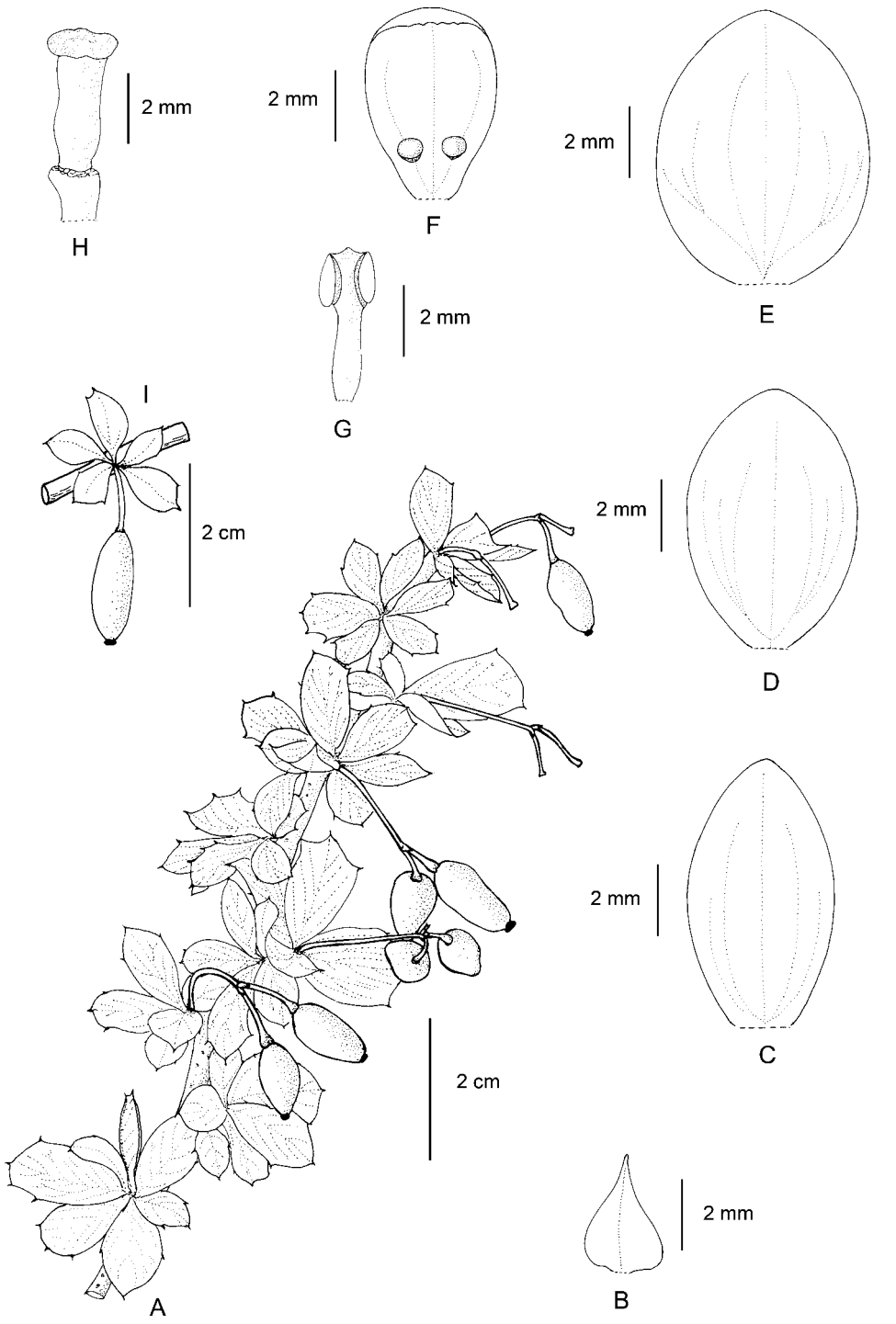

FIG. 11. A–H. *Berberis concinna* var. *extensiflora.* A, fruiting branch; B, outermost sepal; C, outer sepal; D, median sepal; E, inner sepal; F, petal; G, stamen; H, pistil (A from *Pendry, Milne* & *Adhikari* EA 105; B–H from *Manaslu 08* 20812277). I. *Berberis concinna* var. *concinna*. Fruiting branch (from *Adhikari, B.* EL 125).

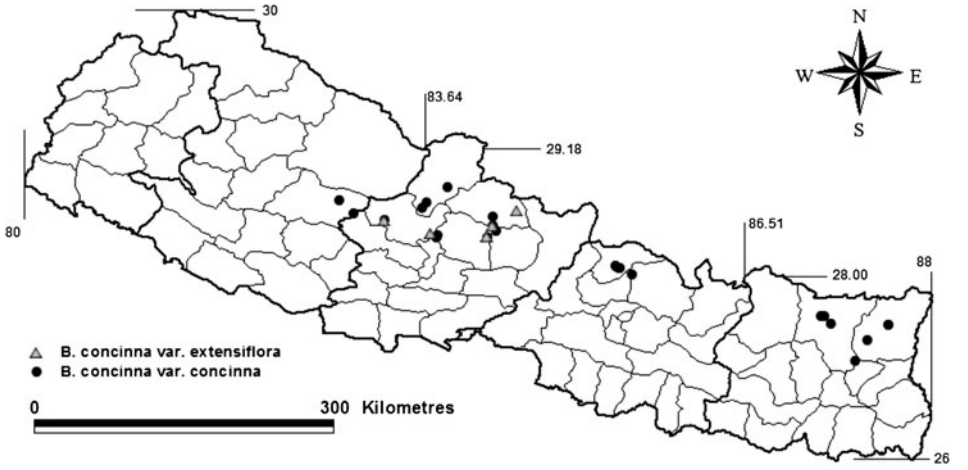

FIG. 12. Distribution of *Berberis concinna*.

cuneate, apex obtuse, slightly emarginate or crenate, margin entire, venation distinct with 1 pair of lateral veins; glands cup-shaped, 0.3–0.5 mm in diameter. *Stamens* 3.5–4.5 mm long, connective scarcely produced. *Pistil* 3–4 mm long; ovules 7–13. *Berries* red, oblong-ovoid, 1–1.5 cm long; style absent.

Distinguishing features. *Berberis concinna* is usually identified by its glaucous leaves with reticulate venation, flowers solitary or 2–3 in umbels and large, estylose berries up to 1.5 cm long.

Key to the varieties of Berberis concinna

1a. Flowers solitary without bracts on the middle of pedicel. Inflorescence 0.8–1.5 cm long _____ **4a.** var. **concinna**
1b. Flowers 2–3, usually in umbels, if solitary subtended by bracteoles on the middle of pedicel. Inflorescence 2–5 cm long _____ **4b.** var. **extensiflora**

4a. Berberis concinna var. **concinna**

Shrub up to 1 m. Flowers solitary. Ovules usually 7–10.

Phenology. Jun–Aug (fl.); Aug–Oct (fr.).

Habitat and ecology. Open areas on sunny dry slopes at 2600–4600 m altitude.

Distribution. Nepal (Western, Central, Eastern), E Himalaya.

Proposed IUCN conservation status. Least Concern (LC).

Selected specimens. WESTERN. Rukum, above Ranmagaon, 12,000 ft, 2 vii 1954, *Stainton, Sykes* & *Williams* 3352 (E). CENTRAL. Mustang, Kaligandaki, Lete, 11,500 ft, 4 vi 1954, *Stainton, Sykes* & *Williams* 5595 (BM, E). EASTERN. Sankhuwasabha, Milkedada, 3480 m, 1971, *Beer, Lancaster* & *Morris* 41 (BM); Sankhuwasabha, Ridge near Kauma, S of Shipton La, 3530 m, 26 ix 1991, *EMAK* 315 (E).

Ahrendt (1945b) separated *Berberis concinna* var. *brevior* from *B. concinna* var. *concinna* on the basis of length of the pedicels and size of the fruits, but these characters are not consistent within these two varieties, so *B. concinna* var. *brevior* is considered to be a synonym of *B. concinna* var. *concinna*.

4b. Berberis concinna var. **extensiflora** Ahrendt, J. Linn. Soc. Bot. 57: 119 (1961). – Type: Nepal, Larjung, Kaligandaki Valley, *Stainton, Sykes* & *Williams* 8175 (holo BM!; iso E!). **Fig. 11A–H.**

Shrub up to 2 m. Flowers usually 2–3 in umbels. Ovules usually 10–13.

Phenology. Jun–Aug (fl.); Aug–Oct (fr.).

Habitat and ecology. Open areas in sunny dry slopes at 3000–3400 m altitude.

Distribution. Nepal (Central).

Proposed IUCN conservation status. Vulnerable (VU B1ab(iii)). This taxon is currently known only from central Nepal and has not been reported from Tibet, India or Bhutan. It might qualify for Endangered (EN) status but considering the low collection density over much of Nepal, we prefer to consider this taxon Vulnerable.

Selected specimens. CENTRAL. Lamjung, Rambrong, Lamjung Himal, 11,000 ft, 27 x 1954, *Stainton, Sykes* & *Williams* 9352 (BM, E); Manang, Bimtang-Gho, 3280 m, 14 viii 2008, *Manaslu 08* 20812277 (E); Myagdi, Ghorepani, Poon hill, 3120 m, 4 x 2006, *Pendry*, *Milne* & *Adhikari* EA 105 (E).

5. Berberis mucrifolia Ahrendt, J. Roy. Hort. Soc. 81: 135 (1956); Ahrendt, J. Linn. Soc. Bot. 57: 135 (1961); Tebbs in Hara & Williams, Enum. Fl. Pl. Nepal 2: 31 (1979); Press *et al.*, Annot. Checkl. Fl. Pl. Nepal 26 (2000). – Type: Nepal, Tegar, N of Mustang, *Stainton, Sykes* & *Williams* 8111 (holo BM!; iso E!). **Figs 13, 14.**

Dwarf shrub, rarely semi-prostrate, up to 1 m. *Stems* and branches terete, puberulous to glabrous, dark grey to greyish yellow, verruculose, young shoots reddish green. *Internodes* 0.3–1.2 cm. *Spines* 3-fid, strong, terete or slightly angular, central spine 1–2 cm, lateral spines 0.5–1.5 cm. *Leaves* deciduous, coriaceous. *Petiole* absent. *Lamina* narrowly elliptic to narrowly obovate, 0.8–2.5 × 0.2–0.5 cm, base cuneate, apex acute to acuminate, tapering to a spine-like mucro of 0.5–1.5 mm, margin usually entire, rarely one spine-like tooth on either side, lustrous green above, paler whitish green beneath, venation indistinct. *Flowers* solitary or in fascicles of

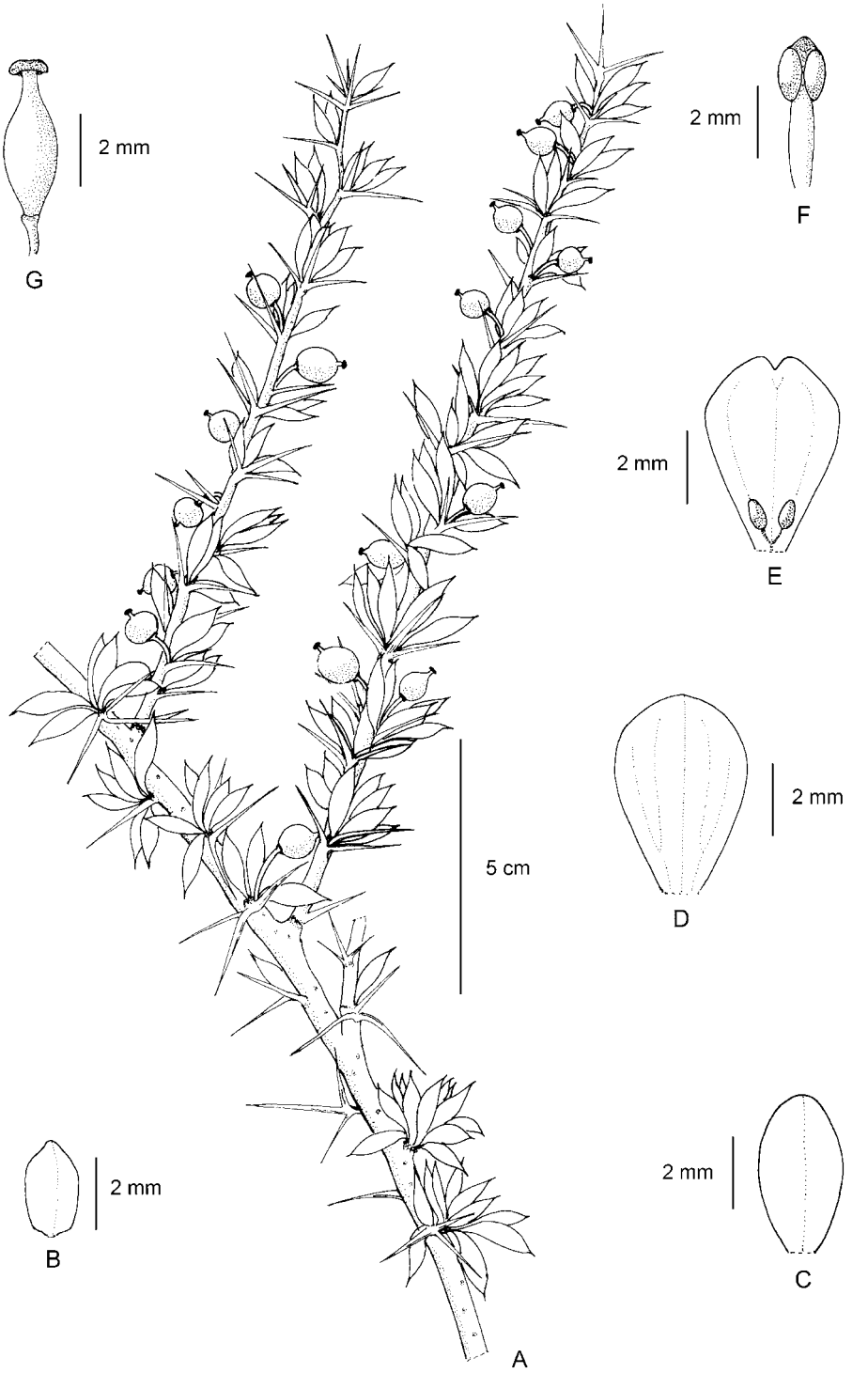

FIG. 13. *Berberis mucrifolia*. A, fruiting branch; B, outer sepal; C, median sepal; D, inner sepal; E, petal; F, stamen; G, pistil (A from *JRS* A1; B–G from *Stainton* 4847).

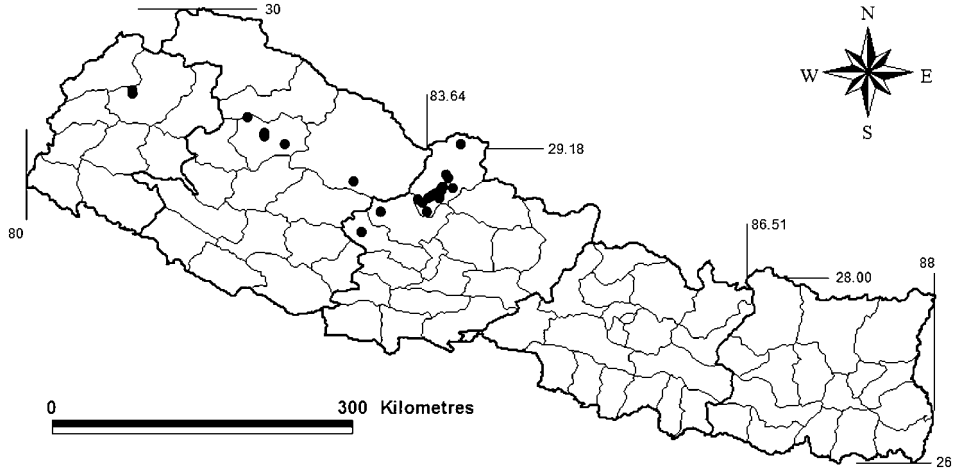

FIG. 14. Distribution of *Berberis mucrifolia*.

2–3 flowers. *Bracts* ovate-triangular, 0.5–1 mm. *Perianth* yellow, c.0.8 cm in diameter. *Pedicel* 0.5–1 mm. *Sepals* in 3 whorls, outer sepals oblong-ovate, 2.5–3 × 1.5–2 mm; median sepals ovate-elliptic, 4–4.5 × 1.5–2.8 mm; inner sepals broadly obovate, 5.5–7 × 3.5–4.5 mm. *Petals* broadly obovate, 5–6 × 3–5 mm, base cuneate, apex slightly notched, 0.2–0.5 mm deep, margin entire, venation distinct with 1 pair of lateral veins; glands oblong or oblong-ovate, 0.8–1.3 mm long. *Stamens* 3.5–5 mm long, connective slightly produced, tip conical. *Pistil* 4–5 mm long; ovules 3–6(–9). *Berries* red, globose or obovoid-globose, 5–7 mm long; style 1–1.5 mm long.

Phenology. Apr–Jun (fl.); Jun–Oct (fr.).

Habitat and ecology. In dry, rocky and open areas at 2000–4400 m altitude.

Distribution. Nepal (Western, Central). Endemic to Nepal.

Proposed IUCN conservation status. Vulnerable (VU B1ab(iii)). This species is endemic to Nepal and grows only in calcareous soils in dry, trans-Himalayan regions of western Nepal.

Distinguishing features. *Berberis mucrifolia* is easily distinguished by its low stature, coriaceous leaves and red, stylose berries.

Selected specimens. WESTERN. Jumla, Munigaon, 9500 ft, 28 ix 1952, *Polunin, Sykes* & *Williams* 5444 (BM). CENTRAL. Baglung, Okhaldhungagaon, south of Dhorpatan, 11,000 ft, 1 v 1954, *Stainton*, *Sykes* & *Williams* 367 (BM, E); Mustang, Tetang, 3600 m, 18 v 1974, *Dobremez* & *Manandhar* 3029 (74-658) (E); Mustang, Kaligandaki, 500 m north of Jomsom, 2750 m, 26 ix 2006, *Pendry*, *Milne* & *Adhikari* EA 1 (E); Mustang, south of Eklobhatti, 28 ix 2006, *Pendry*, *Milne* & *Adhikari* EA 40 (E); Myagdi, above Gurjakhani, 9500 ft, 21 vii 1954, *Stainton, Sykes* & *Williams* 3567 (BM, E).

One individual from Jumla, *JRSA* 12, is considered to be a potential hybrid of *Berberis mucrifolia* and *B. jaeschkeana* var. *usteriana*. It resembles *Berberis mucrifolia* in its coriaceous leaves but differs by its 2–4-flowered racemes.

6. Berberis tsarica Ahrendt, J. Bot. 79 (Suppl.): 48 (1941); Ahrendt, J. Linn. Soc. Bot. 57: 133 (1961); Tebbs in Hara & Williams, Enum. Fl. Pl. Nepal 2: 31 (1979); Grierson in Grierson & Long, Fl. Bhutan 1(2): 324 (1984); Press *et al.*, Annot. Checkl. Fl. Pl. Nepal 26 (2000). – Type: SE Tibet, Tsari district, near Langong, Chianang, *Ludlow, Sherriff & Taylor* 3961 (lecto BM! sheet 1 [barcode 00055959], designated here; isolecto BM! sheet 2 [barcode 000559592]). **Figs 15, 16.**

Shrub to 50 cm, sometimes with arching branches. *Stems* and branches terete to sulcate, glabrous, dark grey to black, young shoots purplish brown, slightly sulcate or angular, puberulous. *Internodes* 0.2–1 cm. *Spines* usually 5-fid, rarely 3-fid, sulcate, central spine 0.7–1.5 cm, the lateral spines equal or slightly shorter than the central. *Leaves* deciduous, thin or slightly coriaceous. *Petiole* absent. *Lamina* obovate-elliptic, 0.5–1.5 × 0.2–0.5 cm, base cuneate, apex acute, rarely obtuse, margin usually entire, sometimes with 1–3 spinose teeth on each side, mucronate, green above, slightly glaucous beneath, venation slightly prominent below. *Flowers* solitary, yellow with red tips, c.1 cm in diameter. *Pedicel* 2–8 mm. *Sepals* in 2 whorls, outer sepals ovate-elliptic, 4–5.5 × 2–2.5 mm; inner sepals broadly obovate, 4.5–6.5 × 3–4.5 mm. *Petals* obovate, 4–6 × 2–3 mm, base cuneate, apex notched, 0.3–0.6 mm deep, rarely obtuse, margin entire, venation obscure or with the central vein and 1 pair of lateral veins evident; glands elliptic, 0.8–1 mm long. *Stamens* 2.5–3.5 mm long, connective slightly produced, tip conical. *Pistil* 3–4 mm long; ovules 2–5. *Berries* red, oblong-obovoid, 0.8–1 cm long; style very short or absent.

Phenology. May–Jul (fl.); Jun–Oct (fr.).

Habitat and ecology. Dry rocky slopes, open dry *Rhododendron* and *Juniper* shrubland at 4000–4700 m altitude.

Distribution. Nepal (Central, Eastern), E Himalaya, Tibetan Plateau.

Proposed IUCN conservation status. Least Concern (LC). *Berberis tsarica* is recorded from only a few localities of the Sagarmatha region of Nepal but has been widely recorded in SE Xizang.

Distinguishing features. *Berberis tsarica* is easily identified by its 5-fid spines and distinctly notched petals.

Selected specimens. CENTRAL. Dolkha, Rolwaling, 15,000 ft, 30 vi 1964, *Stainton* 4718 (BM). EASTERN. Solukhumbu, Bhote Koshi, 4700 m, 21 ix 2005, *DNEP3* BY134 (E); Solukhumbu, Dole-Luza, 4300 m, 15 v 2004, *DNEP1* 153 (E); Solukhumbu, Khumbu, Tsolu Khola, 4550 m, 25 vi 1964, *Bowes-Lyon* 2103 (BM); Solukhumbu, Langmuche Valley, 4400 m, 24 ix 2005, *DNEP3* BY188 (E).

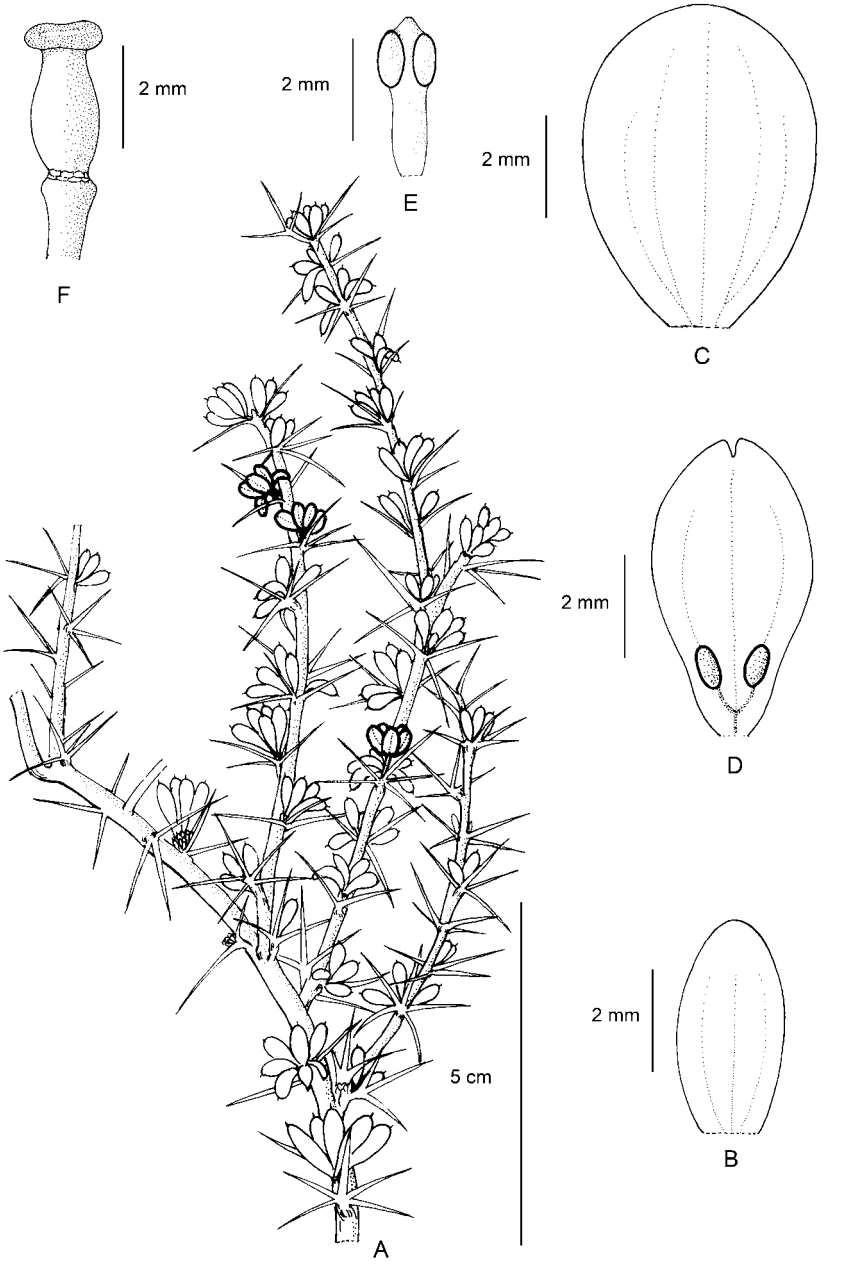

FIG. 15. *Berberis tsarica*. A, flowering branch; B, outer sepal; C, inner sepal; D, petal; E, stamen; F, pistil (from *DNEP1* 153).

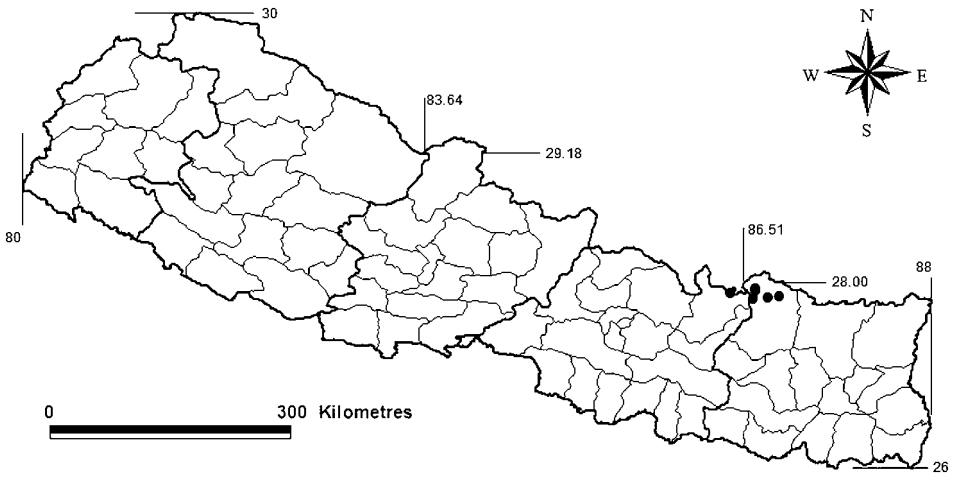

FIG. 16. Distribution of *Berberis tsarica*.

7. Berberis pendryi Bh.Adhikari, **sp. nov.**

Species *Berberis tsarica* Ahrendt affinis; spinae 3-fidae, flores solitarii, petala apice incisura, stamina apice producta bicornis, ovulis 2–3. – Type: Nepal, Mustang, below Muktinath, *Pendry*, *Milne* & *Adhikari* EA 34 (holo E!; iso KATH!). **Figs 17, 18.**

Low-growing shrub to 70 cm. *Stems* and branches terete, young shoots slightly sulcate, reddish brown, puberulous, becoming greyish and sparsely verruculose when older. *Internodes* 0.2–1 cm. *Spines* usually 3-fid, rarely 5-fid in smallest outermost pair, strong, terete or angular, central spine 0.5–1.2 cm, lateral spines 0.5–1 cm, much smaller in older stem c.0.3–0.5 cm. *Leaves* deciduous, thin. *Petiole* absent. *Lamina* obovate, 0.5–2 × 0.4–0.8 cm, base cuneate, apex obtuse, apiculate or mucronate, margin usually entire, sometimes with 1–3(–5) spinulose teeth on each side, dark green above, paler beneath, venation slightly prominent below. *Flowers* solitary, yellow, c.1 cm in diameter. *Pedicel* 0.3–1 cm. *Sepals* in 3 whorls, outer sepals ovate, 3.5–6 × 2.5–4.5 mm; median sepals obovate to broadly obovate, 5–7.5 × 3–5 mm, inner sepals obovate, 6–8.5 × 4–6.5 mm. *Petals* obovate, 5–6.5 × 3–4.5 mm, base cuneate, margin entire, apex notched, 0.5–0.8 mm deep, venation distinct with 1 or 2 pairs of lateral veins; glands obovoid, 0.8–1.5 mm long. *Stamens* 4–5 mm long, connective produced into 2, or sometimes 3, tooth-like appendages, rarely truncate. *Pistil* 3–5 mm long; ovules 3–5. *Berries* red, sub-globose to ellipsoid, 0.5–1 cm long; style 1 mm long.

Phenology. Jun–Aug (fl.); July–Nov (fr.).

Habitat and ecology. In open dry rocky areas with thin soil at c.3600 m altitude.

Distribution. Nepal (Central).

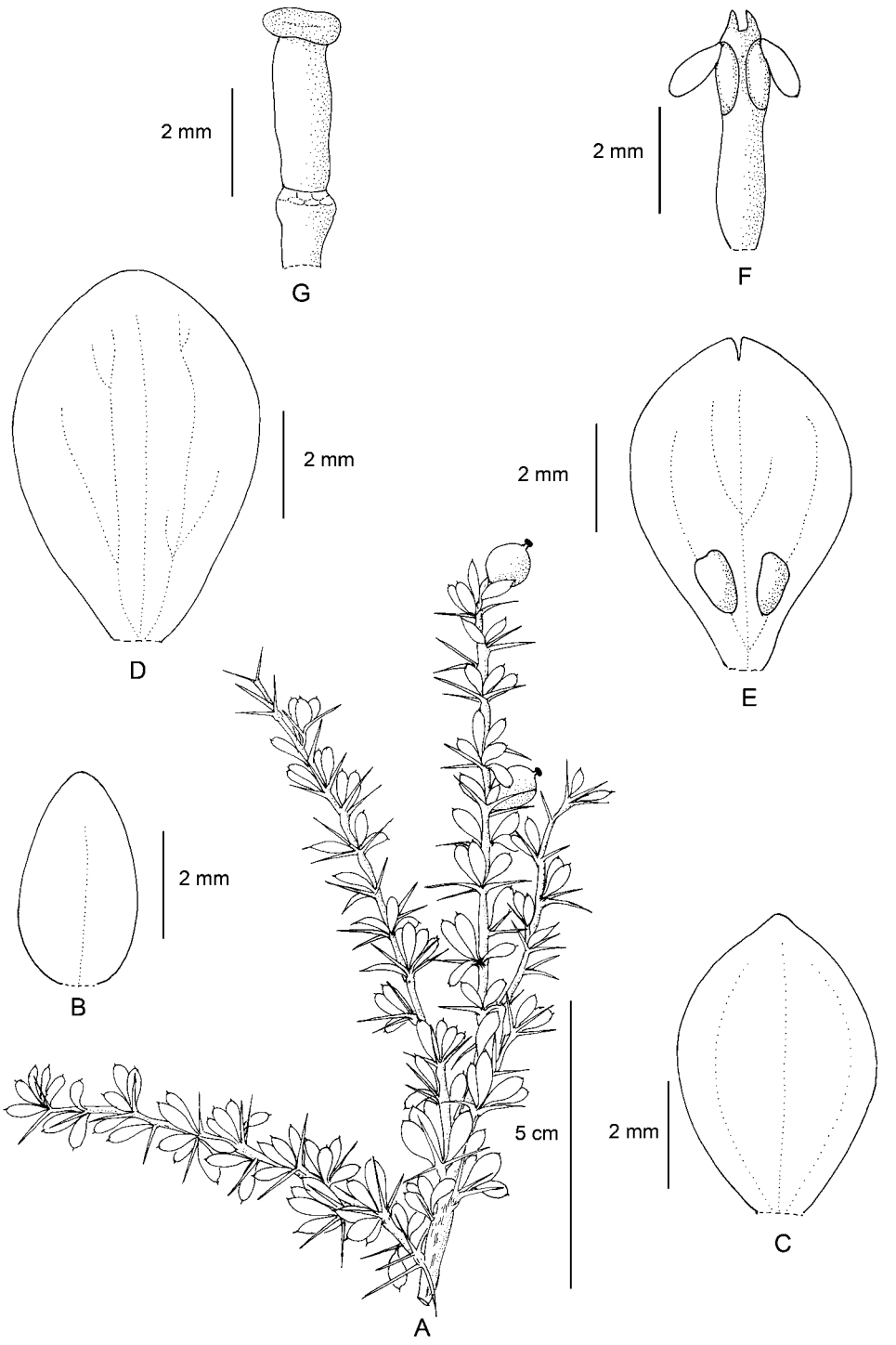

FIG. 17. *Berberis pendryi* Bh.Adhikari, *sp. nov*. A, fruiting branch; B, outer sepal; C, median sepal, D, inner sepal; E, petal; F, stamen; G, pistil (A from *Pendry, Milne* & *Adhikari* EA 28; B–G from *Pendry, Milne* & *Adhikari* EA 34).

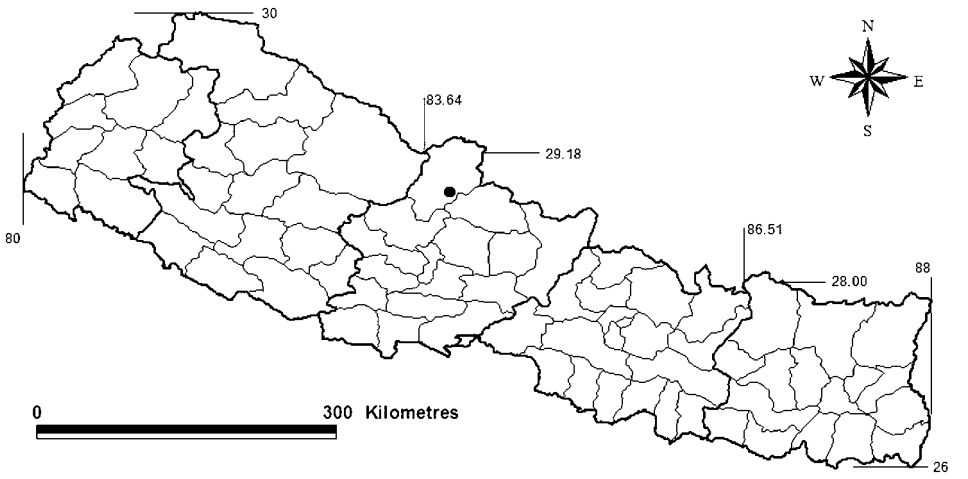

FIG. 18. Distribution of *Berberis pendryi*.

Proposed IUCN conservation status. Data Deficient (DD). Since this species was discovered during this study and is known only from the type locality more data are needed to confirm its status.

Distinguishing features. *Berberis pendryi* is most closely related to *B. tsarica* Ahrendt, from which it differs by its mainly 3-fid spines and distinctly produced bifurcated horn-like connective.

Selected specimens. CENTRAL. Mustang, near Muktinath temple, 3600 m, 28 ix 2006, *Pendry, Milne* & *Adhikari* EA 32 (E, KATH); Mustang, outside of main gate of Muktinath temple, 3600 m, 28 ix 2006, *Pendry, Milne* & *Adhikari* EA 31 (E, KATH).

This species is currently known only from the type locality. It is dedicated to Dr Colin Pendry who supervised the PhD project of the first author and who also led the expedition to the Annapurna region of central Nepal during which this species was discovered.

8. Berberis aristata DC., Syst. Nat. 2: 8 (1821); Hooker & Thomson, Fl. Ind. 1: 222 (1855); Hooker & Thomson in Hooker, Fl. Brit. India 1(1): 110 (1872); Schneider, Bull. Herb. Boissier 2.5: 451 (1905); Chatterjee, Rec. Bot. Surv. India 16(2): 20 (1953); Ahrendt, J. Linn. Soc. Bot. 57: 101 (1961); Tebbs in Hara & Williams, Enum. Fl. Pl. Nepal 2: 29 (1979); Grierson in Grierson & Long, Fl. Bhutan 1(2): 326 (1984); Rao *et al.*, Rheedea 8(1): 24 (1998); Press *et al.*, Annot. Checkl. Fl. Pl. Nepal 25 (2000). – *Berberis chitria* Buch.-Ham. ex Ker Gawl., Bot. Reg. 9: t. 729 (1823), nom. superfl. – Type: Nepal, '*Berberis chitria* Hamilt. Don.'-ex herb. Lambert (lecto BR! [barcode 000000571934], designated here). **Figs 19, 20.**

Berberis ceratophylla G.Don, Gen. Hist. 1: 115 (1831). – Type: not seen.

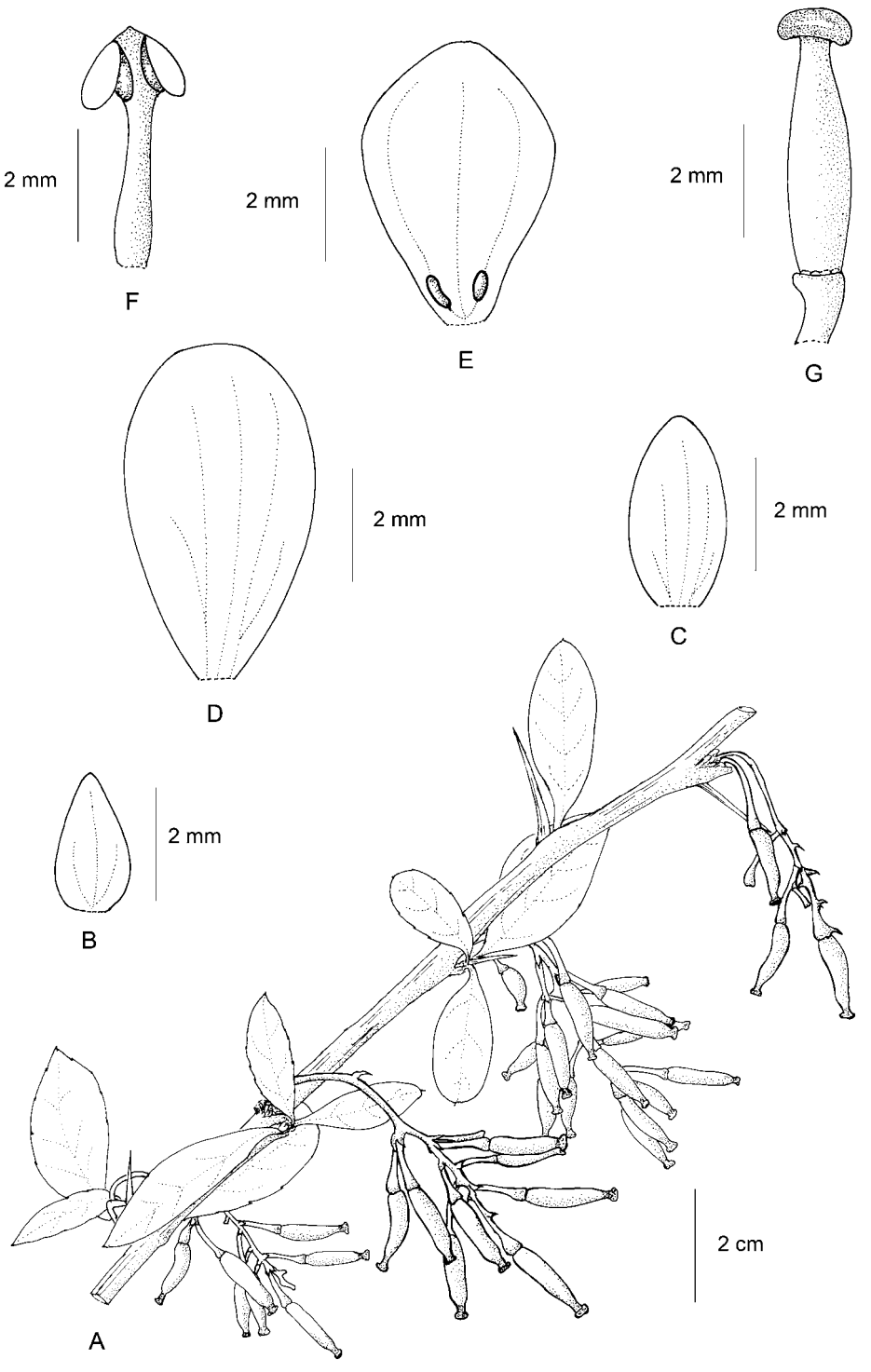

FIG. 19. *Berberis aristata*. A, fruiting branch; B, outer sepal; C, median sepal; D, inner sepal; E, petal; F, stamen; G, pistil (A from *Adhikari* SB 15; B–G from *Proud* 5).

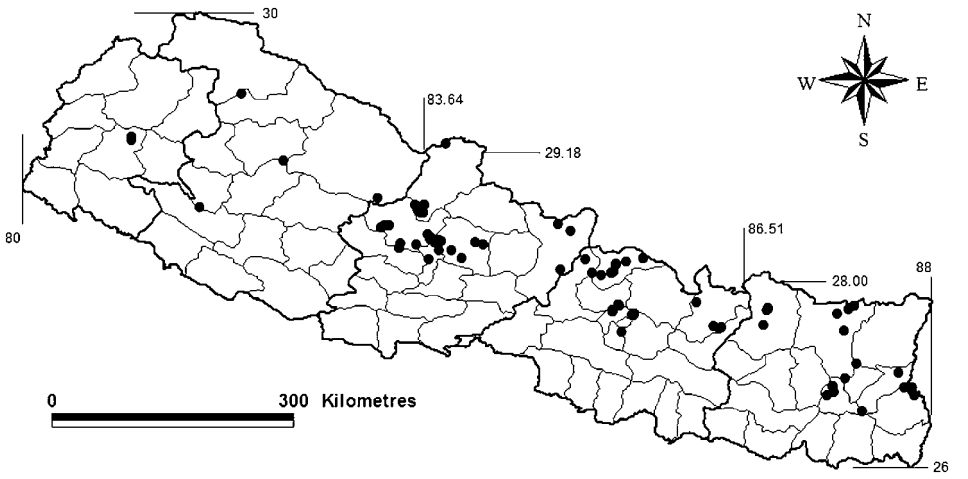

FIG. 20. Distribution of *Berberis aristata*.

Berberis chitria var. *sikkimensis* C.K.Schneid., Bull. Herb. Boissier 2.5: 453 (1905). – *Berberis sikkimensis* (C.K.Schneid.) Ahrendt, J. Bot. 79 (Suppl.): 85 (1942). – Type: India, Larhoery, 9000 ft, 27 viii 1849, *Hooker & Thomson* s.n. (lecto K! [barcode K000077367], designated by Ahrendt (1942: 86); isolecto CGE n.v.).

Berberis sikkimensis var. *baileyi* Ahrendt, J. Linn. Soc. Bot. 57: 99 (1961). – Type: Nepal, Gyang, 3 vi 1935, *Bailey* 47 (holo BM!).

Shrub to 5 m. *Stems* and branches sulcate or angled, glabrous or puberulous, reddish brown. *Internodes* 1–5 cm. *Spines* 3-fid, solitary towards twig apex, strong, usually terete, central spine 1–2 cm, the lateral spines equal to or slightly shorter than the central. *Leaves* deciduous, slightly coriaceous. *Petiole* indistinct. *Lamina* obovate or obovate to narrowly elliptic, 2–6 × 0.5–1.5 cm, base cuneate, apex acute or obtuse, mucronate, margin entire or with 2–10 spinulose teeth on each side, dark green above, paler beneath, venation distinct and slightly raised both sides. *Inflorescence* 4–6 cm long, a pedunculate and sub-paniculate raceme of 10–20 flowers. *Bracts* ovate, reddish brown, 2–2.5 mm long. *Flowers* yellow, c.1 cm in diameter. *Peduncle* 0.5–2 cm, glabrous. *Pedicel* 0.5–1 cm, slightly glaucous. *Sepals* in 3 whorls, outer sepals ovate, 2–3 × 1–2 mm; median sepals elliptic or elliptic obovate, 3–5 × 1.5–3 mm; inner sepals obovate, 6–8.5 × 3–5 mm. *Petals* obovate, 5–8 × 3–5 mm, base cuneate, apex obtuse, rarely notched, 0.2–0.3 mm deep, margin entire, venation distinct with 1 pair of lateral veins; glands elliptic or obovoid, 0.7–1 mm long. *Stamens* 4–5.5 mm long, connectives scarcely produced, tip conical. *Pistil* 5–6 mm long; ovules 3–4. *Berries* greenish purple becoming dark purple to black on ripening, oblong-ovoid, sometimes asymmetric, 8–10 mm long, slightly glaucous; style thick, 1–2.5 mm long.

Phenology. Apr–Jul (fl.); May–Oct (fr.).

Habitat and ecology. Common in forest clearings and disturbed vegetation along forest edges and roadsides at 1300–3400 m altitude.

Distribution. Nepal (Western, Central, Eastern), E Himalaya, W Himalaya.

Proposed IUCN conservation status. Least Concern (LC).

Distinguishing features. *Berberis aristata* is easily identified by its pedunculate and sub-paniculate raceme, and dark purple or black oblong-ovoid berries with a short, thick style.

Selected specimens. WESTERN. Dailekh, 2100 m, 31 vii 1991, *Suzuki et al.* 9194038 (BM). CENTRAL. Kathmandu, Sheopuri, 8000 ft, 6 v 1957, *Proud* 5 (BM, E); Rasuwa, route to Langtang Khola, 9000 ft, 6 vi 1949, *Polunin* 161 (BM, E); Rasuwa, near Dhunche towards Deurali, 1990 m, 19 x 2006, *Adhikari* EL 122 (E). EASTERN. Dhankuta, Hile-Shidua, 2100 m, 12 vii 1991, *Ohba et al.* 9154008 (E); Sagarmatha, Jorsale, 2842 m, 28 ix 2005, *DNEP3* BY207 (E).

Berberis aristata is one of the commonest species of *Berberis* growing in the Himalayas and it shows a great range of variation in shape and size of leaf and inflorescence. Several attempts have been made (Schneider, 1904, 1905; Ahrendt, 1961) to describe new species and varieties based on minor, variable characters, greatly confusing the identity of this species. Several individuals collected during this study, EA 50, 52, 53 and EA2 38, have been identified as putative hybrids between *Berberis aristata* and *B. jaeschkeana* var. *usteriana*. These plants have a long pedunculate or sub-pedunculate inflorescence similar to *Berberis aristata* and leaves similar to those of *B. jaeschkeana* var. *usteriana*.

Berberis aristata was first collected by Francis Buchanan (later Hamilton) most probably from 'Chitlong' (today's Chitlang), central Nepal, on 10 April 1802 (Press & Shrestha, 2000). The first name Francis Buchanan intended for it was *Berberis chitria*, which is probably derived from its local name 'chutro'. He gave his original set of Nepalese collections, along with large collections of drawings and manuscripts of Indian plants, to his friend J. E. Smith, with another set being given to Aylmer Bourke Lambert. De Candolle (1821) described *Berberis aristata* and cited the specimen in Lambert's herbarium with Francis Buchanan's name *Berberis chitria*. Ker Gawler in 1823 (Bot. Reg. 9: t. 729) rejected the first published name, *Berberis aristata*, and restored Francis Buchanan's original name *Berberis chitria*, since when the two names have been a source of confusion, with subsequent authors accepting one or the other or both names as correct. Based on Lambert's materials, together with those of Wallich, D. Don (1825) produced *Prodromus Florae Nepalensis* in which he accepted Francis Buchanan's name *Berberis chitria*. Later, Hooker and Thomson (1855, 1872) accepted *Berberis aristata* as the first validly published name. Schneider (1904, 1905) treated both *Berberis aristata* and *Berberis chitria* as separate species, saying 'Buch-Ham. seems to have distributed other forms under the same name and Lindley described some of this in Bot. Reg. t 729'. Ahrendt (1942, 1961) also accepted both names and treated them as separate species.

Francis Buchanan collected *Berberis* specimens from Chitlang and from the surroundings of Kathmandu valley since he was not permitted to visit other parts of the country during his year-long stay in Nepal. Several populations of *Berberis aristata* from central Nepal and the hills surrounding the Kathmandu valley were examined during this study and it is concluded that there are no other *Berberis* species similar to *B. aristata* growing in this region.

After the death of Lambert, his herbarium was split up and sold at auction. Francis Buchanan's specimens collected from Nepal along with Mysore and Malabar were purchased by Robert Brown for the British Museum and incorporated into their herbarium (Fraser-Jenkins, 2005). However, some of the specimens did not find their way into the collections (Press & Shrestha, 2000) and Francis Buchanan's *Berberis aristata* specimens have not been found in BM. According to Miller (1970), some of the Francis Buchanan specimens were also distributed before the sale and can be found in BR (from Herb. Martius), OXF and P-JU. The Buchanan specimen in BR bears a handwritten label 'Berberis chitria Hamilt. Don. Nepal: Ind. Orient. Lamb', and therefore it appears to have come from Lambert's herbarium, and has been chosen as the lectotype. Another Buchanan specimen of *Berberis aristata* which appears to be a different collection from the BR specimen was found at LINN-SM (herbarium sheet no 622.7) and it is considered likely to be a syntype.

In Don's (1831) description of *Berberis ceratophylla* he cited 'Wall. MSS with native of Nipaul?' in the protologue. Ahrendt (1945b) cited the type as 'Nepal: Wallich, s.n. (Typus Dupl. in Herb. Oxon)' and in 1961 as 'Nepal: Wallich, s.n. (Type, O)'. During this study a Wallich specimen annotated by Ahrendt as a type was found in OXF and this could serve as lectotype or neotype. However, there is no evidence that Don saw this specimen or that it is original material. No other material has been discovered which could be original material and therefore no type has been designated in this study.

Schneider (1905) cited the type for *Berberis chitria* var. *sikkimensis* as 'Diese Form sah ich im Herb. Berlin mit der Etiquette *aristata* var. *parviflora*? Hook. f. et Th. aus Sikkim' in the protologue. However, this specimen was destroyed in World War II. The isotype of this collection in the Kew herbarium was cited by Ahrendt (1942) as a type of *Berberis sikkimensis* (C.K.Schneid.) Ahrendt, thereby effectively lectotypifying it.

Specimens with longer peduncles and sub-paniculate inflorescences are usually identified as *Berberis chitria* corresponding to Ker Gawler's figure (Bot. Reg. t. 729, 1823). Ker Gawler's drawing was from a cultivated plant, with no information on its origin. There are some collections of *Berberis* with longer peduncles growing in the western Himalayas (Kumaon, India) which could be a different species or variety. No specimens of this kind were observed in the field and no such herbarium specimens from Nepal were located. This matter is therefore beyond the scope of this revision.

9. Berberis thomsoniana C.K.Schneid., Bull. Herb. Boissier 2.5: 454 (1905); Ahrendt, J. Linn. Soc. Bot. 57: 106 (1961); Grierson in Grierson & Long, Fl. Bhutan 1(2): 327 (1984); Rao *et al.*, Rheedea 8(1): 27 (1998). – Type: India, Sikkim, *Hooker* s.n. (holo W!; iso K!). **Figs 21, 22.**

Shrub to 3 m. *Stems* and branches sulcate, glabrous, dark grey to greyish yellow, verruculose, young shoots reddish brown. *Internodes* 1.5–4 cm. *Spines* usually 3-fid, smaller and then absent towards the apex of twig, terete or angular, central spine 1–2 cm, lateral spines 0.5–1.2 cm. *Leaves* deciduous, thin or slightly coriaceous. *Petiole* absent or 0.2–1 cm. *Lamina* obovate, 2–4.5 × 1–2 cm, base cuneate or attenuate to a small petiole, apex obtuse, usually mucronate, margin usually entire, sometimes with 2–6 spinulose teeth on each side, green above, paler beneath, venation prominent both sides. *Inflorescence* 2–4.5 cm long, a pedunculate raceme or sub-umbellate raceme of 4–10 flowers, sometimes with a few flowers arising from the base of the rachis. *Bracts* narrowly ovate to triangular, 1.5–2.5 mm. *Flowers* yellow, c.1–1.5 cm in diameter. *Peduncle* 0.2–1 cm, glabrous to puberulous, red. *Pedicel* 1–2 cm, glabrous to puberulous. *Sepals* in 4 whorls, outermost sepals boat-shaped, linear or oblong-ovate, 4–6 × 1–2 mm; outer sepals narrowly ovate, 4.5–7 × 2–4 mm; median sepals broadly obovate-elliptic, 6–8 × 4–6 mm; inner sepals broadly obovate-elliptic, 5–8 × 3–5 mm. *Petals* obovate, 4.5–6.5 × 3.5–5 mm, base cuneate, apex obtuse or emarginate, margin entire, venation distinct with 1 pair of lateral veins; glands obovoid, 0.8–1.3 mm long. *Stamens* 3–4 mm long, connective scarcely produced or not. *Pistil* 3.5–4 mm long; ovules 2–5. *Berries* red, oblong-obovoid, c.1 cm long; style small (less than 0.5 mm) or absent.

Phenology. May–Aug (fl.); Aug–Oct (fr.).

Habitat and ecology. Open hillsides and the edges of oak–*Rhododendron* forest at 3000–3650 m altitude.

Distribution. Nepal (Western, Central, Eastern), E Himalaya.

Proposed IUCN conservation status. Least Concern (LC).

Distinguishing features. *Berberis thomsoniana* is identified by its pedunculate or sub-umbellate raceme and 4 whorls of sepals with the outermost sepals nearly equal to the next outer sepals.

Selected specimens. WESTERN. Rukum, near Seng Khola, 11,000 ft, 6 x 1954, *Stainton, Sykes & Williams* 4706 (BM). CENTRAL. Rasuwa, Langtang Khola, 3180 m, 24 v 1962, *Bowes-Lyon* 148 (BM, E); Rasuwa, near Chandanbari, 3166 m, 19 x 2006, *Adhikari* EL 124 (E). EASTERN. Illam, Jaubari-Jogmai, 2621 m, 18 vi 2007, *LKSRB* 181 (E); Panchthar, Maimajuwa-8, Bharlang, 2904 m, 8 vi 2007, *LKSRB* 17 (E); Sankhuwasabha, north bank of Barun Khola, below Nehe Kharka, 3560 m, 8 x 1991, *EMAK* 583 (E).

Schneider (1905) cited the type as 'Sikkim: c 3000 m (Hooker), *typus* in Herb. Hofm. Wien'. Later, in 1908, he cited Hooker specimen no 39 and Clarke specimen no

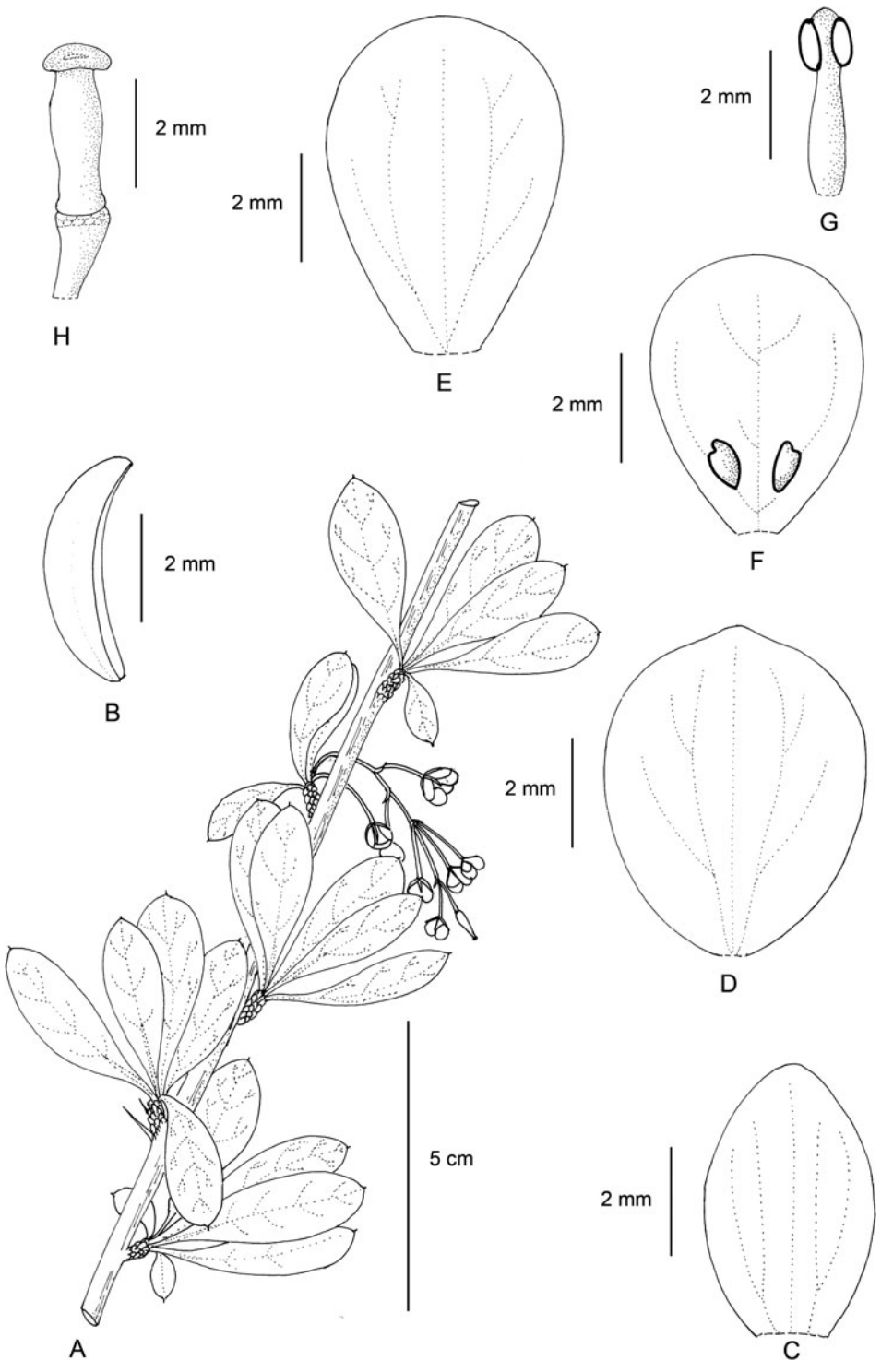

FIG. 21. *Berberis thomsoniana*. A, flowering branch; B, outermost sepal; C, outer sepal; D, median sepal; E, inner sepal; F, petal; G, stamen; H, pistil (A from *LKSR* B46; B–H from *LKSR* B17).

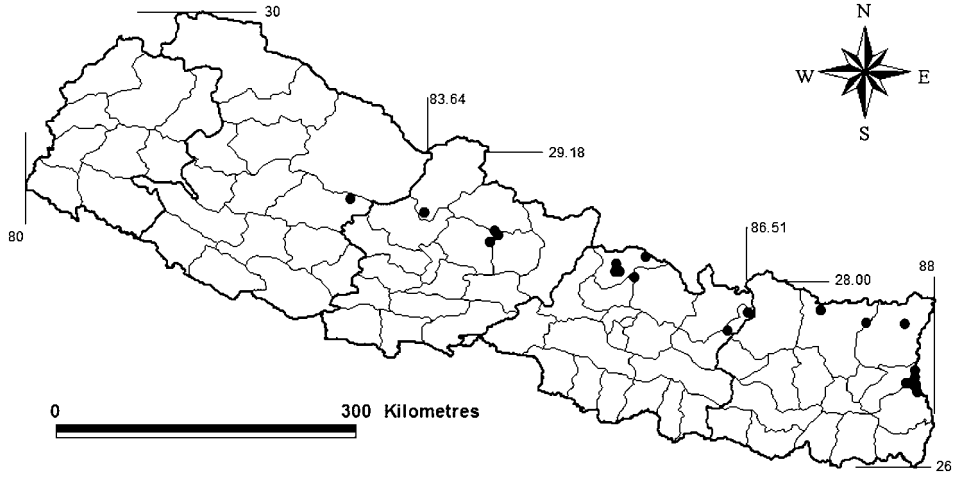

FIG. 22. Distribution of *Berberis thomsoniana*.

27575 a, without distinguishing a type. Ahrendt (1961) identified the type as *Hooker* 39 (K). Hooker's specimen without number in Hofmuseum Wien (W) has been identified as the holotype.

10. Berberis koehneana C.K.Schneid., Bull. Herb. Boissier 2.5: 814 (1905); Chatterjee, Rec. Bot. Surv. India 16(2): 32 (1953); Ahrendt, J. Linn. Soc. Bot. 57: 210 (1961); Tebbs in Hara & Williams, Enum. Fl. Pl. Nepal 2: 30 (1979); Rao *et al.*, Rheedea 8(2): 129 (1998); Press *et al.*, Annot. Checkl. Fl. Pl. Nepal 26 (2000). – Type: India, Kumaon, near Budhi, Byans, *Duthie* 5309 (holo WU!; iso DD n.v., K!). **Figs 23, 24.**

Berberis koehneana var. *auramea* Ahrendt, J. Linn. Soc. Bot. 57: 210 (1961). – Type: Nepal, Langtang, *Polunin* 506 (holo BM!; iso A!, E!).

Shrub to 4 m. *Stems* and branches terete or slightly angled, glabrous, yellow or yellowish brown, verruculose. *Internodes* 1–4 cm. *Spines* usually 3-fid, solitary towards twig apex, strong, terete or angular, central spine 0.5–1.5 cm, the lateral spines equal to or slightly shorter than the central. *Leaves* deciduous, thin or slightly coriaceous. *Petiole* absent or 2–5 mm. *Lamina* obovate, 2–5 × 0.7–1.5 cm, base cuneate, tapering to the small petiole, apex obtuse, rarely acute, usually mucronate, margin usually entire, sometimes with 1–4 spinulose teeth on each side, lustrous green above, paler and papillose beneath, venation prominent both sides. *Inflorescence* (3–)8–16 cm long, a panicle of 15–70 flowers. *Bracts* ovate-triangular, 1.5–3 mm. *Flowers* yellow, c.0.5–1 cm in diameter. *Peduncle* 0.5–4 cm, glabrous, reddish brown. *Pedicel* 0.5–1 cm. *Sepals* in 3 whorls, outer sepals ovate-triangular, 1.5–2.5 × 1–1.5 mm; median sepals elliptic or elliptic-ovate, 2.5–5 × 2–3.5 mm; inner sepals obovate to broadly obovate, 3.5–6.5 × 3.5–4.5 mm. *Petals* obovate, 3.5–6 × 2.5–4.5 mm, base cuneate or slightly

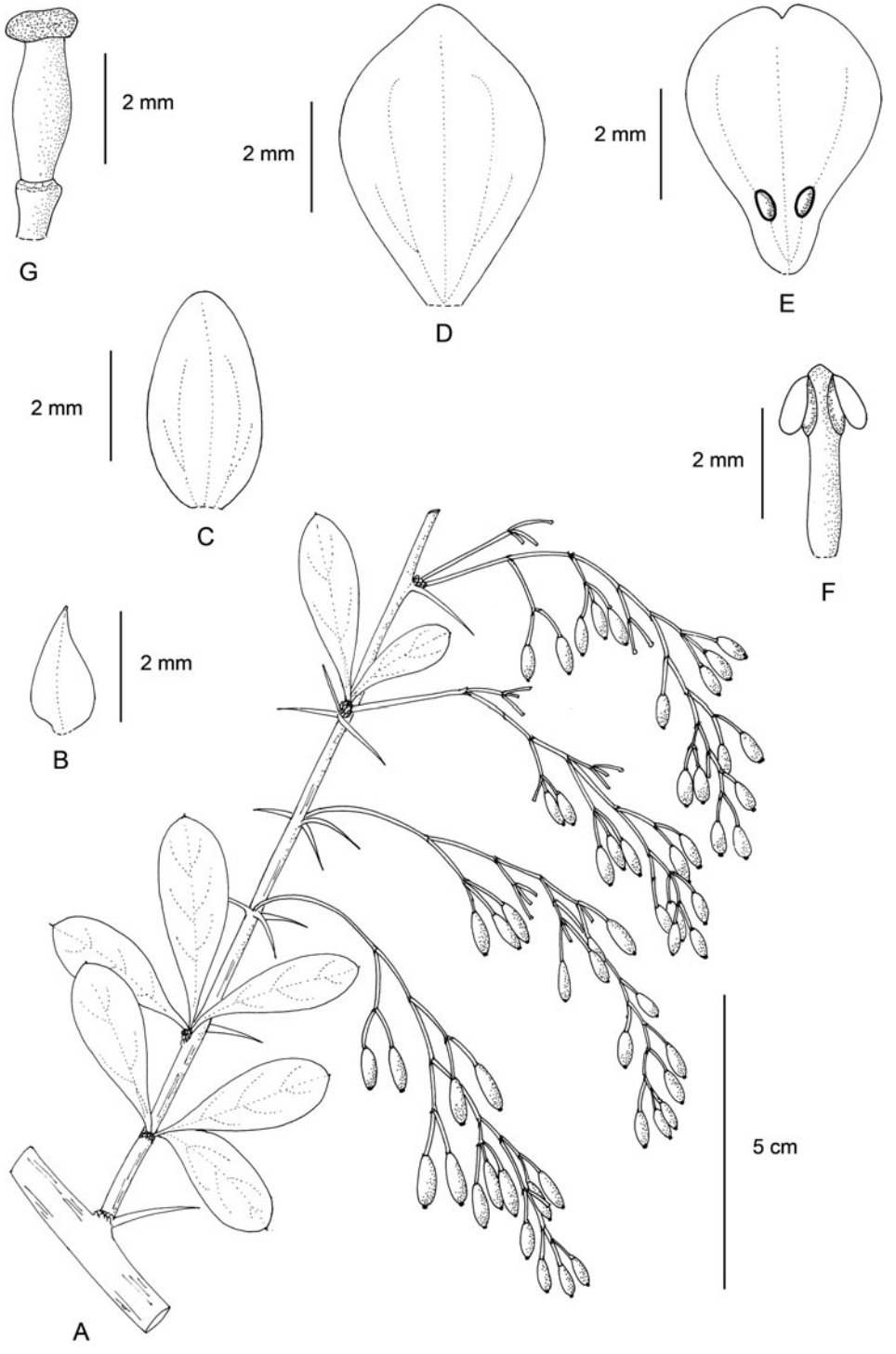

FIG. 23. *Berberis koehneana*. A, fruiting branch; B, outer sepal; C, median sepal; D, inner sepal; E, petal; F, stamen; G, pistil (A from *Stainton, Sykes* & *Williams* 8136; B–G from *Polunin* 506).

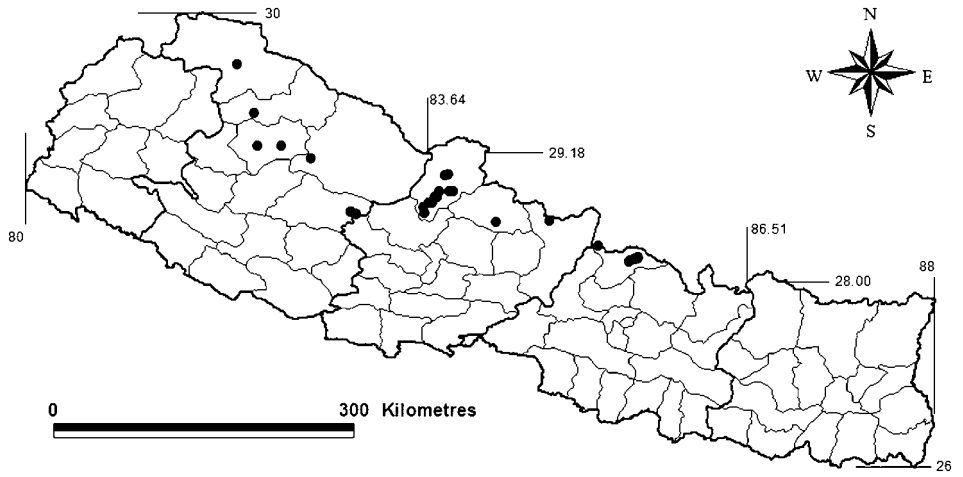

FIG. 24. Distribution of *Berberis koehneana*.

clawed, margin entire, apex notched, 0.3–0.5 mm deep, venation distinct with 1 pair of lateral veins; glands elliptic or elliptic-ovate, 0.5–0.7 mm long. *Stamens* 2–3.5 mm long, connective scarcely produced, tip conical. *Pistil* 2–3.5 mm long; ovules 2–3. *Berries* bright red, oblong-ovoid or ellipsoid, 0.5–1 cm long; style absent.

Phenology. Apr–Aug (fl.); Aug–Oct (fr.).

Habitat and ecology. Dry, open, degraded areas along forest margins, settlements and agricultural lands at 2400–4000 m altitude.

Distribution. Nepal (Western, Central), W Himalaya (Kumaon).

Proposed IUCN conservation status. Least Concern (LC).

Distinguishing features. *Berberis koehneana* is easily identified by its long, paniculate inflorescence with up to 70 flowers and red estylose berries.

Selected specimens. WESTERN. Humla, Dozam, near Simikot, 8500 ft, 4 vi 1952, *Polunin, Sykes & Williams* 4272 (E); Jumla, Bhurchula lekh, 9000 ft, 10 vii 1952, *Polunin, Sykes & Williams* 4514 (E); Rukum, above Ghustung Khola, 10,500 ft, 11 x 1954, *Stainton, Sykes & Williams* 4786 (BM, E). CENTRAL. Mustang, below Muktinath, 3604 m, 16 viii 2007, *Adhikari* EA2 14 (E); Mustang, Kaligandaki Valley, Thinigaon, 3480 m, 26 ix 1954, *Stainton, Sykes & Williams* 8022 (BM, E); Rasuwa, Ghodatabala, 3018 m, 4 viii 2007, *Adhikari* BL2 55 (E).

Ahrendt (1961) described *Berberis koehneana* var. *auramea* from central Nepal on the basis of its yellow stem. Stem colour varies greatly within species and not consistently within any subgroup, so is not considered a reliable character with which to separate taxa. *Berberis koehneana* var. *auramea* is therefore reduced to synonymy.

11. Berberis orthobotrys Bienert ex Aitch. var. **rubicunda** Ahrendt, J. Linn. Soc. Bot. 57: 144 (1961); Rao *et al.*, Rheedea 8(2): 126 (1998). – Type: Nepal, Langtang, *Polunin* 514 (holo BM!; iso E!). **Figs 25, 26.**

Shrub to 3 m. *Stems* and branches terete, glabrous, yellowish grey to black, verruculose, young shoots dark brown, slightly sulcate or angular. *Internodes* 0.7–1.5 cm. *Spines* 3-fid, terete or angled, central spine 0.8–1.5 cm, the lateral spines equal to or slightly shorter than the central. *Leaves* deciduous, slightly coriaceous. *Petiole* absent. *Lamina* obovate or narrowly obovate to narrowly elliptic, 1–2.5 × 0.4–1.5 cm, base cuneate, apex acute or obtuse, mucronate, margin usually entire, sometimes with 1–3 spinulose teeth on each side, green above, slightly papillose beneath, venation sub-conspicuous above, distinct and slightly raised below. *Inflorescence* 1–3 cm long, a shortly pedunculate or sub-umbellate raceme of 2–12 flowers, sometimes with a few flowers arising from the base of the rachis. *Bracts* ovate or oblong-ovate, 1–2 mm. *Flowers* yellow, c.1 cm in diameter. *Peduncle* 0.2–1.2 cm. *Pedicel* 0.3–1.3 cm. *Sepals* in 3 whorls, outer sepals ovate or oblong-ovate, 4–5 × 2–3 mm; median sepals ovate or obovate, 5–7 × 3–5 mm; inner sepals elliptic, broadly obovate to rounded, 6–8 × 4–6 mm. *Petals* obovate, 5.5–6.5 × 3–4.5 mm, base cuneate, apex obtuse, rarely emarginate or crenate, margin entire, venation distinct with 1 pair of lateral veins; glands elliptic, rounded or obovate, 0.5–1 mm long. *Stamens* 4–5 mm long, connective distinctly produced, tip pointed, sometimes with 2–3 tips. *Pistil* 4–5 mm long; ovules (2–)3–4. *Berries* red, ellipsoid to oblong-obovoid, 0.8–1 cm long; style absent.

Phenology. May–Jul (fl.); Aug–Oct (fr.).

Habitat and ecology. Open, exposed areas with *Rhododendron* and *Rosa* species at 2800–4200 m altitude.

Distribution. Nepal (Central, Eastern).

Proposed IUCN conservation status. Data Deficient (DD).

Distinguishing features. *Berberis orthobotrys* var. *rubicunda* is usually identified by the following combination of characters: leaves usually entire; connectives distinctly produced to long pointed tips; berries red, ellipsoid to oblong-obovoid; style absent.

Selected specimens. CENTRAL. Rasuwa, above Langtang, 11,500–12,500 ft, 21 vi 1949, *Polunin* 483 (BM); Rasuwa, Langtang, 11,500 ft, 22 vi 1949, *Polunin* 514 (BM, E); Rasuwa, Langtang-Kyanjin, 3579 m, 3 viii 2007, *Adhikari* BL2 39 (E). EASTERN. Solukhumbu, Tengboche-Deboche, 3750 m, 16 ix 2005, *DNEP3* AY63 (E).

Berberis orthobotrys var. *rubicunda* replaces *B. koehneana* above around 3200 m altitude in central Nepal from where this plant was first described. The specimen *Stainton, Sykes & Williams* 6049 (BM) which was cited by Ahrendt (1961) for *Berberis orthobotrys* var. *orthobotrys* has been identified as *B. thomsoniana* during this study.

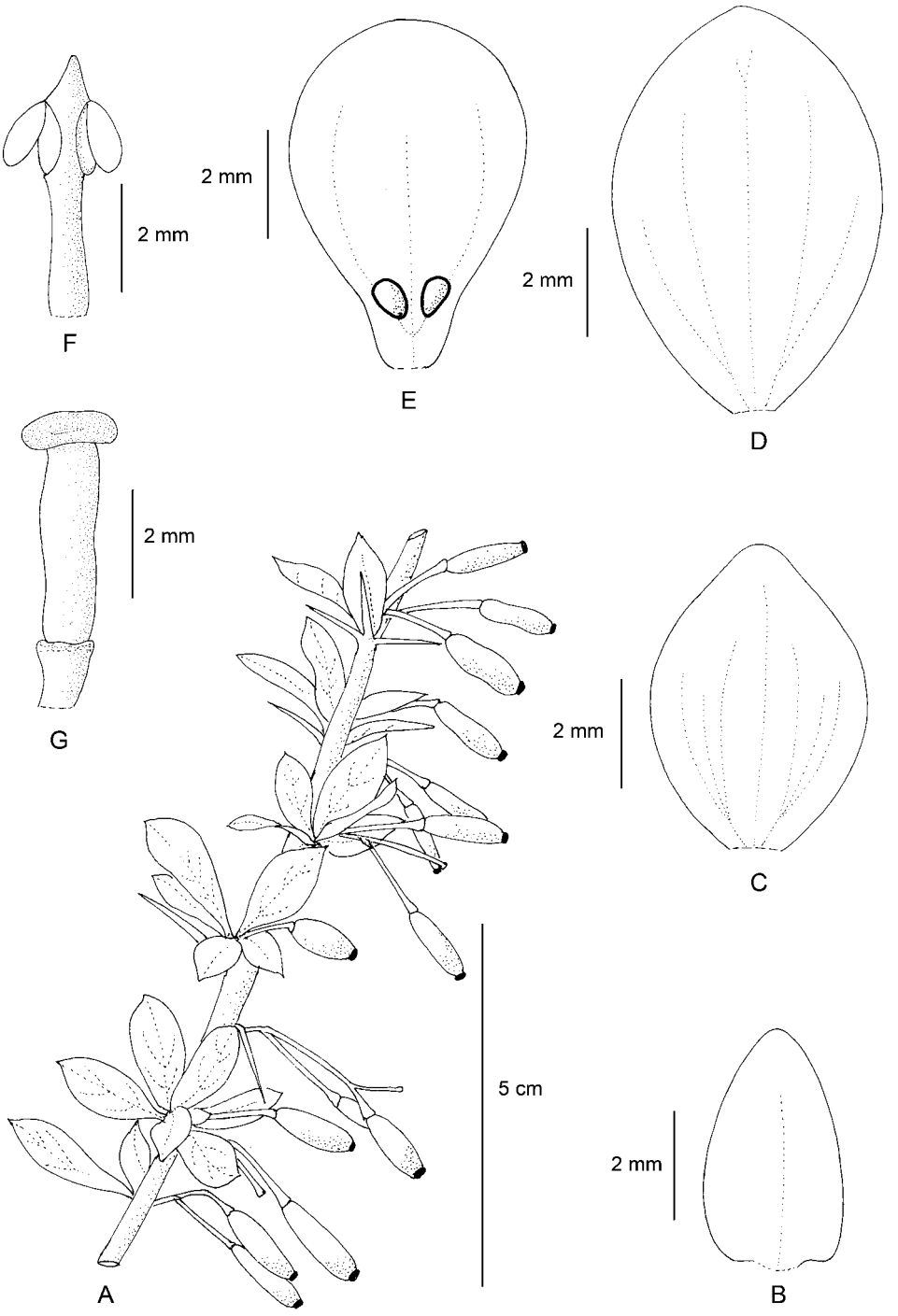

FIG. 25. *Berberis orthobotrys* var. *rubicunda*. A, fruiting branch; B, outer sepal; C, median sepal; D, inner sepal; E, petal; F, stamen; G, pistil (A from *Adhikari* G2; B–G from *Polunin* 514).

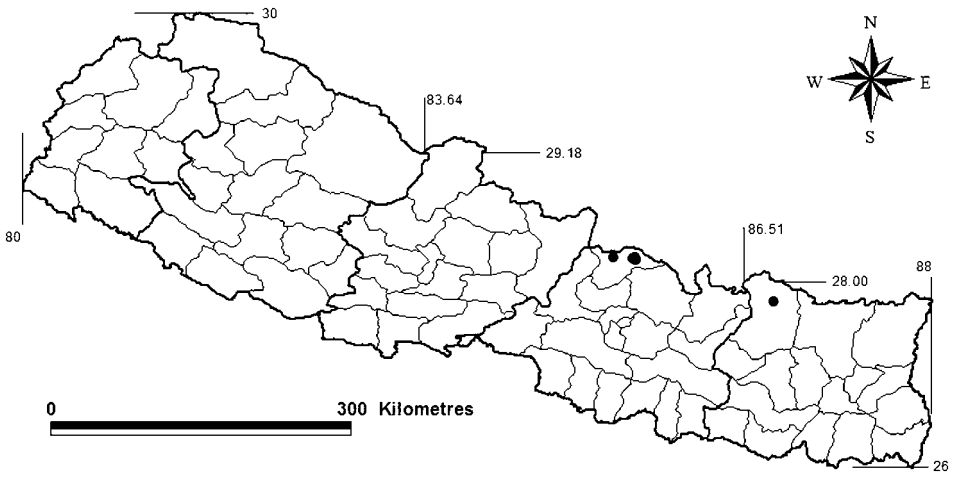

FIG. 26. Distribution of *Berberis orthobotrys* var. *rubicunda*.

Ahrendt (1961) described *Berberis orthobotrys* var. *canescens* based on cultivated material from Sikkim without citing any type material. The Nepalese specimen *Stainton, Sykes & Williams* 8100 (BM), which was assigned to *Berberis orthobotrys* var. *canescens* by Ahrendt (1961), has been identified as *B. jaeschkeana* var. *usteriana* during this study. Therefore, *Berberis orthobotrys* var. *canescens* has not been included in this account.

Berberis orthobotrys is a variable species and has been reported from Afghanistan, Pakistan, Kashmir, Nepal and Tibet. *Berberis orthobotrys* var. *rubicunda* differs from *Berberis orthobotrys* var. *orthobotrys* in its distinctly produced anther connectives, inflorescence with 2–4 flowers, and smaller leaves. *Berberis orthobotrys* var. *rubicunda*, which has been reported only from Nepal, may be a distinct species but a detailed comparison across the entire range of the species is necessary to clarify its status.

12. Berberis hamiltoniana Ahrendt, Gard. Ill. 64: 426 (1944); Chatterjee, Rec. Bot. Surv. India 16(2): 22 (1953); Ahrendt, J. Linn. Soc. Bot. 57: 137 (1961); Tebbs in Hara & Williams, Enum. Fl. Pl. Nepal 2: 30 (1979); Rao *et al.*, Rheedea 8(2): 111 (1998); Press *et al.*, Annot. Checkl. Fl. Pl. Nepal 25 (2000). – Type: Nepal-Jeyjey, 12,500 ft, 19 x 1934, seed producing cultivated plant (holo OXF, lost). Cultivated, *L.A.* 347 (from seed from Jey Jey, Kew 1056/34), fl. 3 vi 1942, 10 vi 1943, fr. 15 x 1943 (neo BM!, first step designated by Ahrendt (1961: 138), of which plant grown from Nepal seed (Kew 1056/34 pro parte), fr. 15 x 1943, specimen no 534, neo BM! [barcode 000554686], second step designated here). **Figs 27, 28.**

Shrub to 4 m. *Stems* and branches terete, glabrous, reddish brown when young becoming grey when older, sparsely verruculose. *Internodes* 1–2(–4) cm. *Spines*

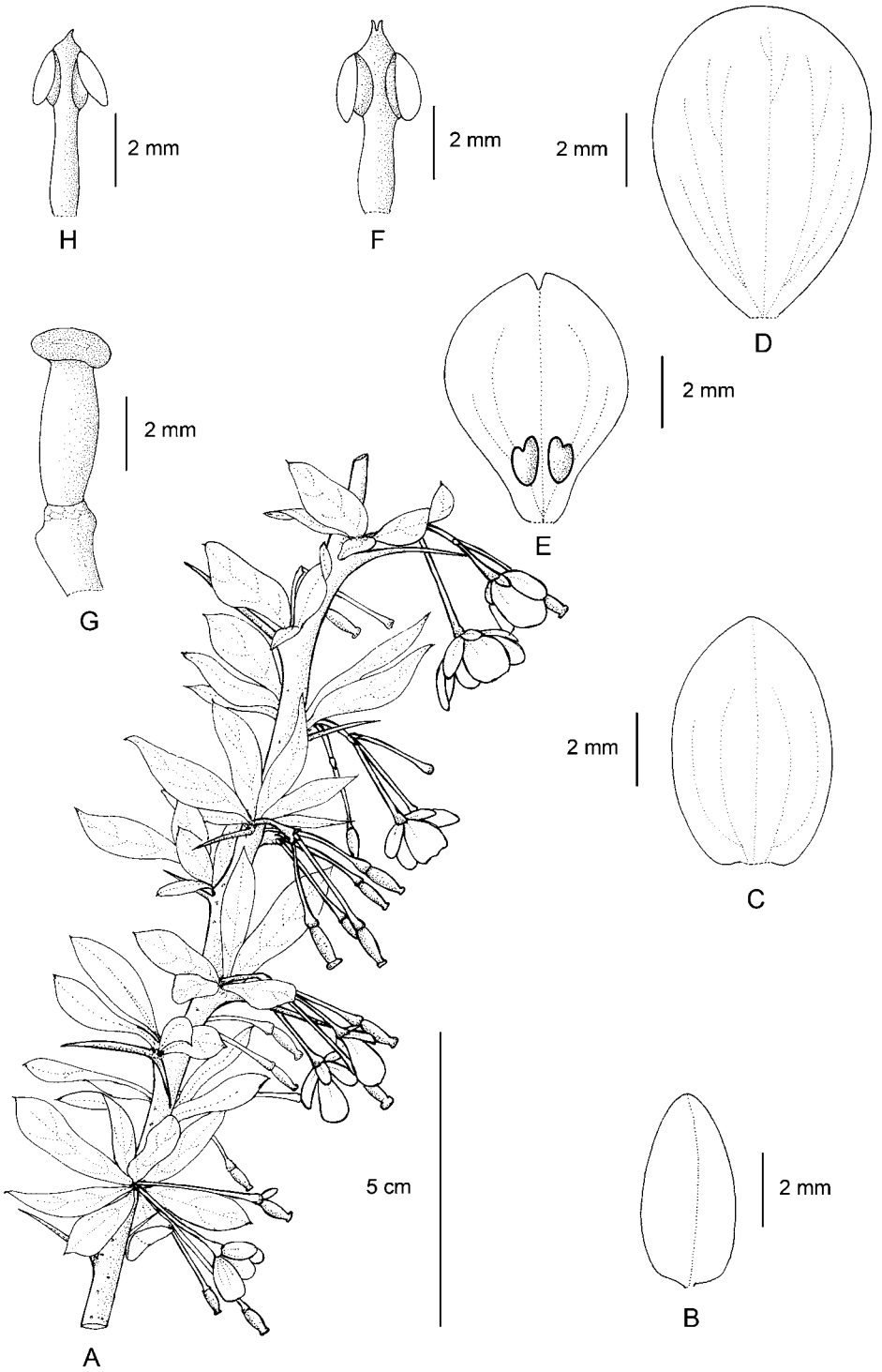

FIG. 27. *Berberis hamiltoniana.* A, flowering branch; B, outer sepal; C, median sepal; D, inner sepal; E, petal; F & H, stamen; G, pistil (A from *JRS* B162; B–G from *Polunin, Sykes* & *Williams* 4579; H from *Lowndes* 941).

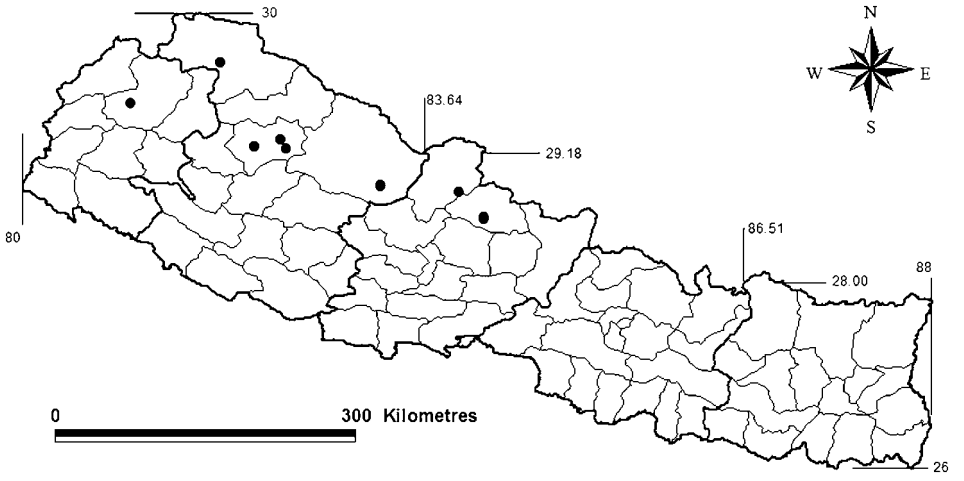

FIG. 28. Distribution of *Berberis hamiltoniana*.

usually 3, solitary towards twig apex, strong, terete or slightly angled, central spine 0.8–1.8 cm, lateral spines 0.5–1.5 cm. *Leaves* deciduous, thinly coriaceous. *Petiole* absent. *Lamina* obovate or narrowly obovate to narrowly elliptic, 2–3.5 × 0.7–1.5 cm, base cuneate, apex obtuse, mucronate, margin usually entire, rarely with 2 or 3 spinulose teeth on each side, dark green above, paler and papillose beneath, venation sub-conspicuous above, prominent and slightly raised below. *Inflorescence* 1.5–4 cm long, an umbellate or sub-umbellate raceme of 3–8 flowers with a few flowers arising from the base of the rachis. *Bracts* ovate-triangular, 1–2.5 mm long. *Flowers* yellow, 1–1.5 cm in diameter. *Peduncle* 0.5–2 cm. *Pedicel* 0.5–2 cm. *Sepals* in 3 whorls, outer sepals ovate or ovate-elliptic, 3.5–5.5 × 2–3 mm; median sepals elliptic or elliptic-obovate, 4.5–7 × 2.5–5 mm; inner sepals broadly obovate, 7–9 × 5–6.5 mm. *Petals* obovate, 5–7 × 3–5 mm, base cuneate, apex notched, 0.2–0.4 mm deep, margin entire, venation distinct with 1 or 2 pairs of lateral veins; glands obovoid-ellipsoid, 0.8–1.5 mm long. *Stamens* 4–5 mm long, connective distinctly produced, tip pointed, sometimes bifurcated. *Pistil* 3.5–4.5 mm long; ovules 3–5. *Berries* red, ovate-ellipsoid, 0.6–1 cm long; style absent.

Phenology. May–Jul (fl.); Jun–Oct (fr.).

Habitat and ecology. Open hillside at 2900–4250 m altitude.

Distribution. Nepal (Western, Central), W Himalaya (Himachal Pradesh).

Proposed IUCN conservation status. Least Concern (LC).

Distinguishing features. *Berberis hamiltoniana* is identifiable by its usually entire leaves, umbellate or sub-umbellate raceme, notched petals and distinctly produced anther connectives.

Selected specimens. WESTERN. Dolpa, near Hurikot, 3030 m, 25 ix 1952, *Polunin, Sykes* & *Williams* 5407 (BM); Humla, below Saathapla towards Rimi, 2640 m, 13 vi 2008, *JRSA* 134 (E); Jumla, Chanki, NW of Jumla, 2580 m, 9 viii 1952, *Polunin, Sykes* & *Williams* 5072 (BM); Jumla, 2420 m, 10 v 1952, *Polunin, Sykes* & *Williams* 930 (BM); Mugu, below Ghuruchi Lagna, 3400 m, 7 vi 2008, *JRSA* 80 (E). CENTRAL. Manang, Marsyangdi River, 11,500 ft, 5 vi 1950, *Lowndes* 941 (BM).

Ahrendt (1944b) cited the type as 'Nepal-Jeyjey, 12500 ft, Oct. 19, 1934, seed producing cultivated plants (Type: Herb. Oxon)' although in 1961 he cited the type as 'Cultivated: L.A. 347 (from seed from Jey Jey, Kew 1056/34), fl. 3 vi 1942, 10 vi 1943; fr. 15 x 1943 (Type, BM)'. No specimen with the date 19 x 1934 has been found in OXF. Two herbarium sheets apparently of the later collection were found in BM with the same annotations but different numbers, 534 and 535. This later typification by Ahrendt (1961) is an effective first step neotypification but, as the collection comprises two herbarium sheets, a second step is also necessary. The specimen numbered 535 was chosen for second step neotypification because the fruiting specimen is in better condition.

13. Berberis petiolaris Wall. ex G.Don, Gen. Hist. 1: 116 (1831); Chatterjee, Rec. Bot. Surv. India 16(2): 16 (1953); Ahrendt, J. Linn. Soc. Bot. 57: 93 (1961); Tebbs in Hara & Williams, Enum. Fl. Pl. Nepal 2: 31 (1979); Rao *et al.*, Rheedea 8(1): 10 (1998); Press *et al.*, Annot. Checkl. Fl. Pl. Nepal 26 (2000). – Type: India, Kumaon, *Wallich* s.n. (lecto CGE! [barcode 12652], designated here). **Figs 29, 30.**

Berberis petiolaris var. *extensa* Ahrendt ex R.R.Rao *et al.*, Bot. Bull. Acad. Sin. 35: 231 (1994). – Type: Nepal, Sialgarhi, *Polunin*, *Sykes* & *Williams* 2066 (holo BM!).

Shrub or small tree to 6 m. *Stems* and branches terete, purplish brown becoming greyish black when older. *Internodes* 2–6 cm. *Spines* absent or solitary, rarely 3-fid, terete. *Leaves* deciduous, papery. *Petiole* 1–3.5 cm. *Lamina* elliptic-rounded or elliptic to broadly obovate, 3–6 × 1–4.5 cm, base cuneate, apex obtuse, margin finely serrate with 10–36 spinules on each side, rarely entire, dull green above, paler beneath, venation prominent both sides. *Inflorescence* 3–5 cm long, a simple pedunculate or sub-umbellate raceme of 3–25 flowers, sometimes fasciculate or with a few flowers arising from the base of the rachis. *Bracts* ovate-triangular, 1–2 mm long. *Flowers* yellow, c.0.5–1 cm in diameter. *Peduncle* 0.5–1.7 cm. *Pedicel* 1–1.5 cm, swollen at the base of the flower. *Sepals* in 3 whorls, outer sepals ovate-triangular, 2–3 × 1–2 mm; median sepals ovate-elliptic, 2.5–4.5 × 1.5–3.5 mm; inner sepals broadly obovate, 4–7 × 2.5–6 mm. *Petals* broadly obovate, 4–8.5 × 4–5.5 mm, base cuneate or slightly clawed, apex obtuse, emarginate or slightly notched, margin entire, venation distinct with 1 pair of lateral veins; glands ovate-elliptic or lanceolate, 1–2 mm long. *Stamens* 4–6 mm long, connective scarcely produced or not. *Pistil* 5–7 mm long; ovules 2–4. *Berries* red, oblong ovoid; style very short or absent.

Distinguishing features. Small, tree-like shrubs with few spines; leaves with distinct long petiole.

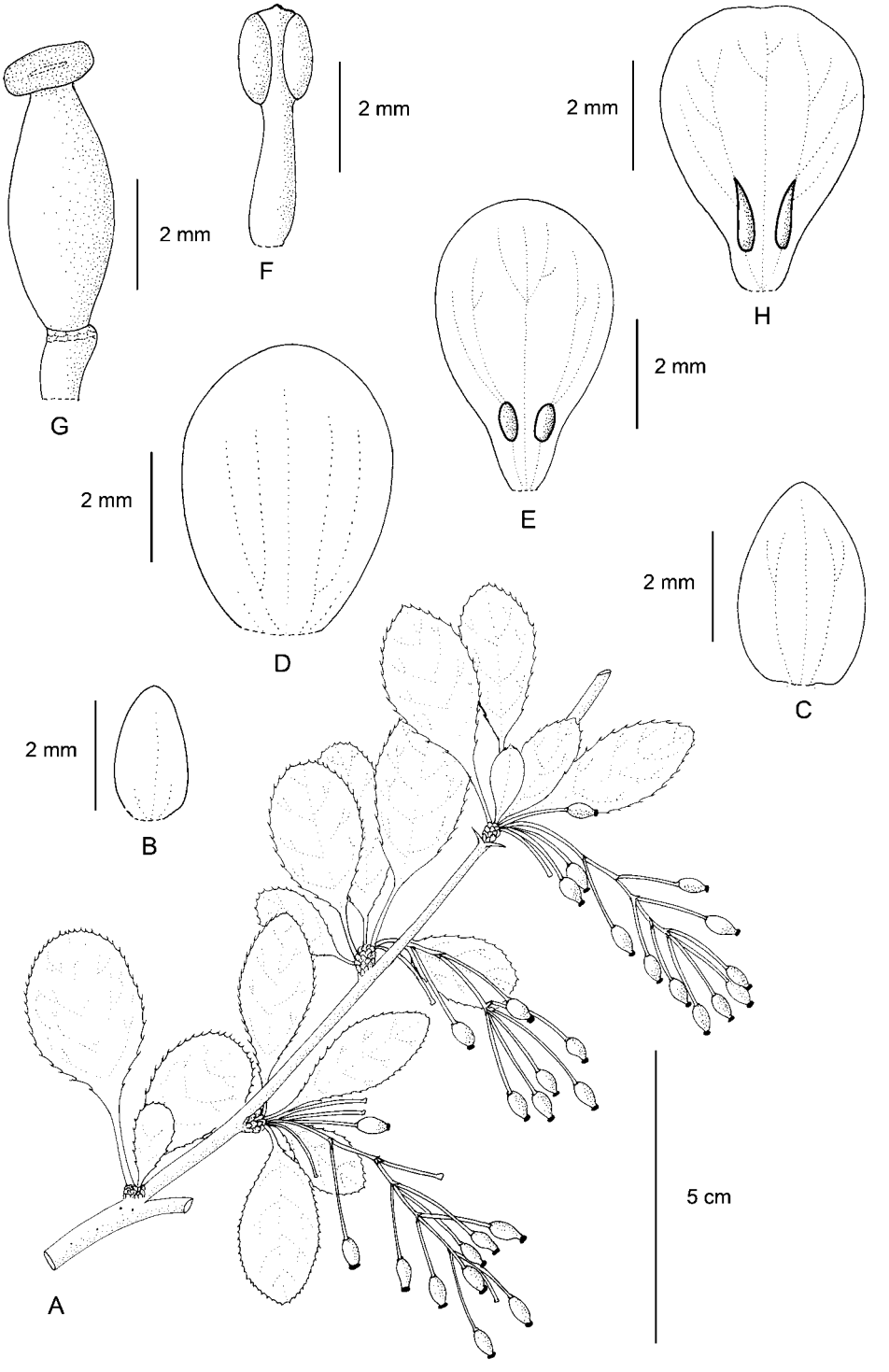

FIG. 29. A–G. *Berberis petiolaris* var. *petiolaris*. A, fruiting branch; B, outer sepal; C, median sepal; D, inner sepal; E, petal; F, stamen; G, pistil (A from *JRS* A122; B–G from *Polunin, Sykes* & *Williams* 2066). H. *Berberis petiolaris* var. *garhwalana*. Petal (from *Dobremez* 1967).

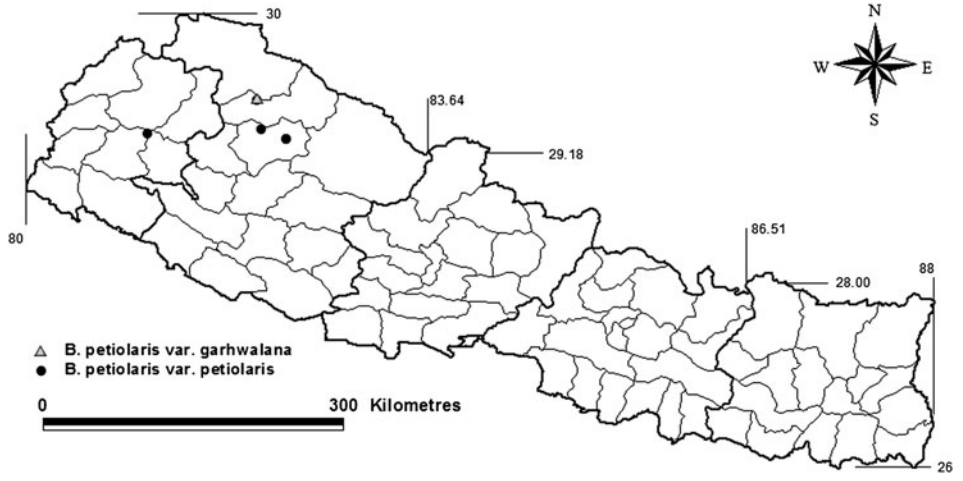

FIG. 30. Distribution of *Berberis petiolaris*.

Key to the varieties of Berberis petiolaris

1a. Inflorescence a 8–25-flowered raceme. Glands ovate-elliptic _____ **13a.** var. **petiolaris**

1b. Inflorescence a 3–9-flowered sub-umbellate raceme. Glands lanceolate _____ **13b.** var. **garhwalana**

13a. Berberis petiolaris var. **petiolaris**

Inflorescence 4–8 cm long, a raceme of 8–25 flowers. Petals with ovate-elliptic glands.

Phenology. Apr–Jun (fl.); Jun–Aug (fr.).

Habitat and ecology. In moist temperate forests at 2700–3500 m altitude.

Distribution. Nepal (Western), W Himalaya (Kumaon).

Proposed IUCN conservation status. Least Concern (LC).

Selected specimens. WESTERN. Jumla, below Khalichaur, 2890 m, 5 vi 2008, *JRSB* 39 (E); Jumla, Sialgarhi, Chudhabise Khola, 3030 m, 19 v 1952, *Polunin, Sykes* & *Williams* 2066 (BM, E); Mugu, Chankheli Lagna, 3330 m, 19 v 1952, *Polunin, Sykes* & *Williams* 4123 (E); Mugu, north of Chankheli Lagna, 3250 m, 12 vi 2008, *JRSA* 122 (E).

George Don (1831) cited only 'Wall. mss.' in the protologue without any reference to a specimen and collection number. Ahrendt (1961) cited the type as 'Nepal 1818, fl. Wallich 1475, part (Type, BM)'. Ahrendt's typification with *Wallich* 1475 is a mistake because *Wallich* 1475 contains two gatherings, 1475.1 (*Berberis angulosa*) from Gosaithan and 1475.2 (*Berberis umbellata*) from Kumaon (also see notes under *B. angulosa*).

Wallich (1829) listed *Berberis petiolaris* under number 1474 which includes four different collections (1474.1–1474.4). The *Berberis petiolaris* specimen in K-W (1474.2, B), which was collected from Kumaon by Robert Blinkworth, is annotated with Wallich's handwriting. When Don described this species he mentioned that it was 'Native of Nipaul?', which indicates that he probably did not see the specimen with the Kumaon annotation. As Don worked for the Royal Horticultural Society, the Wallich specimen of *Berberis petiolaris* from the Lindley herbarium at CGE is the specimen most likely to have been seen by him. Moreover, the specimen lacks any indication of the collecting locality, which might be the reason that Don was unsure of its provenance. Therefore, the Wallich specimen of *Berberis petiolaris* at CGE has been selected for lectotypification.

Rao *et al.* (1994) described *Berberis petiolaris* var. *extensa* based on *Polunin, Sykes & Williams* 2066 from Nepal. On examination of the specimens of *Berberis petiolaris* from Kumaon along with the type of *B. petiolaris* var. *extensa* and other specimens from western Nepal, they were found to be insufficiently different for them to be maintained as different varieties. The characters given by Rao *et al.* (1994) to separate *Berberis petiolaris* var. *extensa* from *B. petiolaris* var. *petiolaris* are entire leaves and uni- or biserrate bracts. The type of *Berberis petiolaris* var. *petiolaris* itself has serrate leaves, and the serration of bracts alone is not sufficient to separate this variety.

13b. Berberis petiolaris Wall. ex G.Don var. **garhwalana** Ahrendt, J. Bot. 79 (Suppl.): 82 (1942); Ahrendt, J. Linn. Soc. Bot. 57: 94 (1961); Rao *et al.*, Rheedea 8(1): 11 (1998). – Type: India, Garhwal, *Strachey & Winterbottom* 5 (holo BM!). **Fig. 29H.**

Inflorescence 3–4 cm long, a sub-umbellate raceme of 3–9 flowers. Petals with lanceolate glands.

Phenology. Apr–Jun (fl.); Jun–Aug (fr.).

Habitat and ecology. In moist temperate forests at c.2700 m altitude.

Distribution. Nepal (Western), W Himalaya.

Proposed IUCN conservation status. Data Deficient (DD). Currently this variety is known from only one locality from western Nepal but it also grows in the western Himalaya. More data from the western Himalaya are needed to confirm its status.

Specimen examined. WESTERN. Doti, Khaptad, 2700 m, 24 iv 1973, *Dobremez* 1967 (BM).

14. Berberis jaeschkeana C.K.Schneid. var. **usteriana** C.K.Schneid., Bull. Herb. Boissier 2.5: 399 (1905); Ahrendt, J. Linn. Soc. Bot. 57: 139 (1961); Tebbs in Hara & Williams, Enum. Fl. Pl. Nepal 2: 30 (1979); Rao *et al.*, Rheedea 8(2): 121 (1998); Press *et al.*, Annot. Checkl. Fl. Pl. Nepal 26 (2000). – Type: India, Kumaon, Byans, *Duthie* 5307 (lecto WU!, designated here; isolecto K!). **Figs 31, 32.**

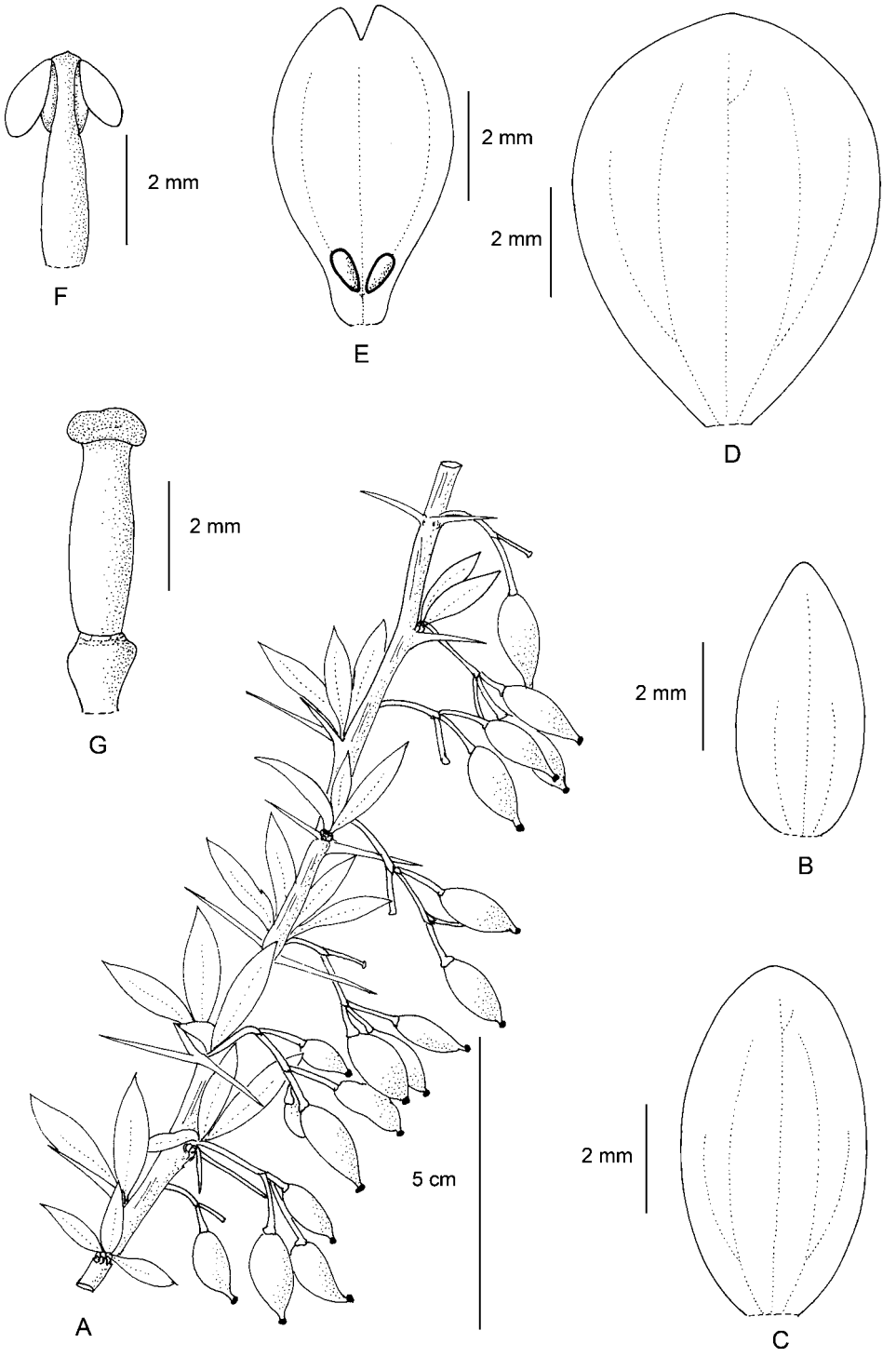

FIG. 31. *Berberis jaeschkeana* var. *usteriana*. A, fruiting branch; B, outer sepal; C, median sepal; D, inner sepal; E, petal; F, stamen; G, pistil (A from *Adhikari* EA2 33; B–G from *Stainton, Sykes* & *Williams* 1225).

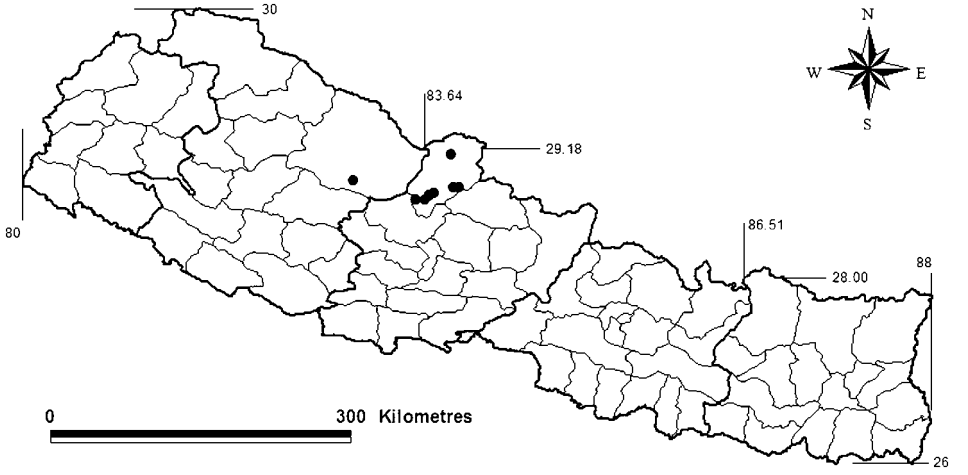

FIG. 32. Distribution of *Berberis jaeschkeana* var. *usteriana*.

Shrub to 2 m. *Stems* and branches terete or angled, glabrous, greyish brown. *Internodes* 1–2 cm. *Spines* usually 3, strong, sulcate, central spine 1–2 cm, the lateral spines equal to or slightly shorter than the central. *Leaves* deciduous, coriaceous. *Petiole* absent. *Lamina* obovate, 1.5–4 × 0.7–1 cm, base cuneate, apex acute or obtuse, tapering to a spine-like mucro, margin entire or with 1–3 spinulose teeth on each side, green above, papillose beneath, venation obscure above, sub-conspicuous below. *Inflorescence* 2–4 cm long, a simple pedunculate raceme or sub-umbellate raceme of 5–15 flowers. *Bracts* ovate-triangular, 1–2 mm long. *Flowers* yellow, c.1 cm in diameter. *Peduncle* 0.3–1 cm, sometimes puberulous. *Pedicel* 0.5–1 cm. *Sepals* in 3 whorls, outer sepals ovate or oblong-ovate, 3–5.5 × 1–3 mm; median sepals obovate-elliptic, 4–7.5 × 2–4 mm; inner sepals broadly obovate, 6–8.5 × 4–6 mm. *Petals* obovate, 5–6 × 3–3.5 mm, base cuneate, apex notched, 0.5–1 mm deep, margin entire, venation distinct with 1 pair of lateral veins; glands ellipsoid or obovate-ellipsoid, 0.8–1 mm long. *Stamens* 3.5–4 mm long, connective scarcely produced or not. *Pistil* 3–4 mm long; ovules 2–4. *Berries* red, 1–1.2 cm long, oblong-ovoid tapering to a small style; style 1–2 mm long.

Phenology. May–Aug (fl.); Jul–Oct (fr.).

Habitat and ecology. In open dry exposed areas at 2600–3800 m altitude.

Distribution. Nepal (Western, Central), W Himalaya.

Proposed IUCN conservation status. Least Concern (LC). This taxon is currently recorded from only a few places in western and central Nepal but is also reported from Jammu Kashmir and Himachal Pradesh.

Distinguishing features. *Berberis jaeschkeana* var. *usteriana* is identifiable by the combination of coriaceous leaves, pedunculate, sub-umbellate racemes and red, oblong-ovoid berries.

Selected specimens. WESTERN. Dolpa, Bheri river, below Tarakot, 9500 ft, 2 vi 1952, *Polunin, Sykes* & *Williams* 1014 (E). CENTRAL. Mustang, Muktinath, 12,500 ft, 9 vi 1954, *Stainton, Sykes* & *Williams* 5694 (BM); Mustang, Thinigaon, Muktinath Himal, 13,000 ft, 20 vi 1954, *Stainton, Sykes* & *Williams* 1225 (BM).

The specimen *JRS* A64, collected during a field trip to western Nepal, is identified as a probable hybrid of *Berberis jaeschkeana* var. *usteriana* and *B. mucrifolia*. It looks similar to *Berberis jaeschkeana* var. *usteriana* in its leaves but differs by its small (less than 1 cm) six-seeded berries.

Ahrendt (1961) and Rao *et al.* (1998b) differentiate *Berberis jaeschkeana* var. *usteriana* from the typical variety mainly by its emarginate petals. All Nepalese specimens examined during this study have emarginate petals, and the Nepalese specimens (*Stainton, Sykes* & *Williams* 4706 and 9353) which were assigned to *Berberis jaeschkeana* var. *jaeschkeana* by Ahrendt (1961) have been re-identified as *Berberis thomsoniana*.

In the protologue Schneider (1905) cited two specimens collected by Duthie (nos 5306 and 5307) from the same locality, Byans, Kumaon. *Duthie* 5307, deposited in WU, has been chosen as the lectotype because the specimen is in better condition than 5306 and there is a duplicate in Kew.

15. Berberis karnaliensis Bh.Adhikari, **sp. nov.**

Species *Berberis jaeschkeana* C.K.Schneid. affinis; spinae 3-fidae, ramuli puberuli, inflorescentiae umbellatae, petala apice incisura, stamina apice leviter producta, ovulis 2–3. – Type: Nepal, Jumla, Bumra, *JRS* A59 (holo E!; iso KATH!). **Figs 33, 34.**

Shrub to 2 m. *Stems* and branches terete or slightly angled, densely puberulous when young becoming less puberulous when older, yellow or yellowish brown, slightly verruculose. *Internodes* 0.5–2.5 cm. *Spines* usually 3, solitary towards twig apex, strong, terete or angular, central spine 1–1.5 cm, the lateral spines equal to or slightly shorter than the central. *Leaves* deciduous, thinly coriaceous. *Lamina* narrowly obovate to narrowly elliptic, 1–3 × 0.3–1 cm, base cuneate, apex acute, rarely obtuse, mucronate, margin usually entire, sometimes with 3–5 spinulose teeth on each side, lustrous green above, paler and slightly papillose beneath, venation sub-conspicuous above, slightly raised and prominent below. *Inflorescence* 2–5 cm long, an umbellate or sub-umbellate raceme of 2–15 flowers. *Bracts* ovate with acuminate apex, 1–1.5 mm. *Flowers* yellow, c.1 cm in diameter. *Peduncle* 1–2.5 cm, glabrous, reddish brown. *Pedicel* 0.5–1.5 cm, glabrous. *Sepals* in 3 whorls, outer sepals ovate, 1.5–2 × 1–1.5 mm; median sepals elliptic or elliptic-ovate, 3–5 × 2–3 mm; inner sepals obovate to broadly obovate, 5–7 × 3–6 mm. *Petals* narrowly obovate to elliptic, 5–7 × 2–4 mm, base cuneate, margin entire, apex notched, 0.8–1 mm deep,

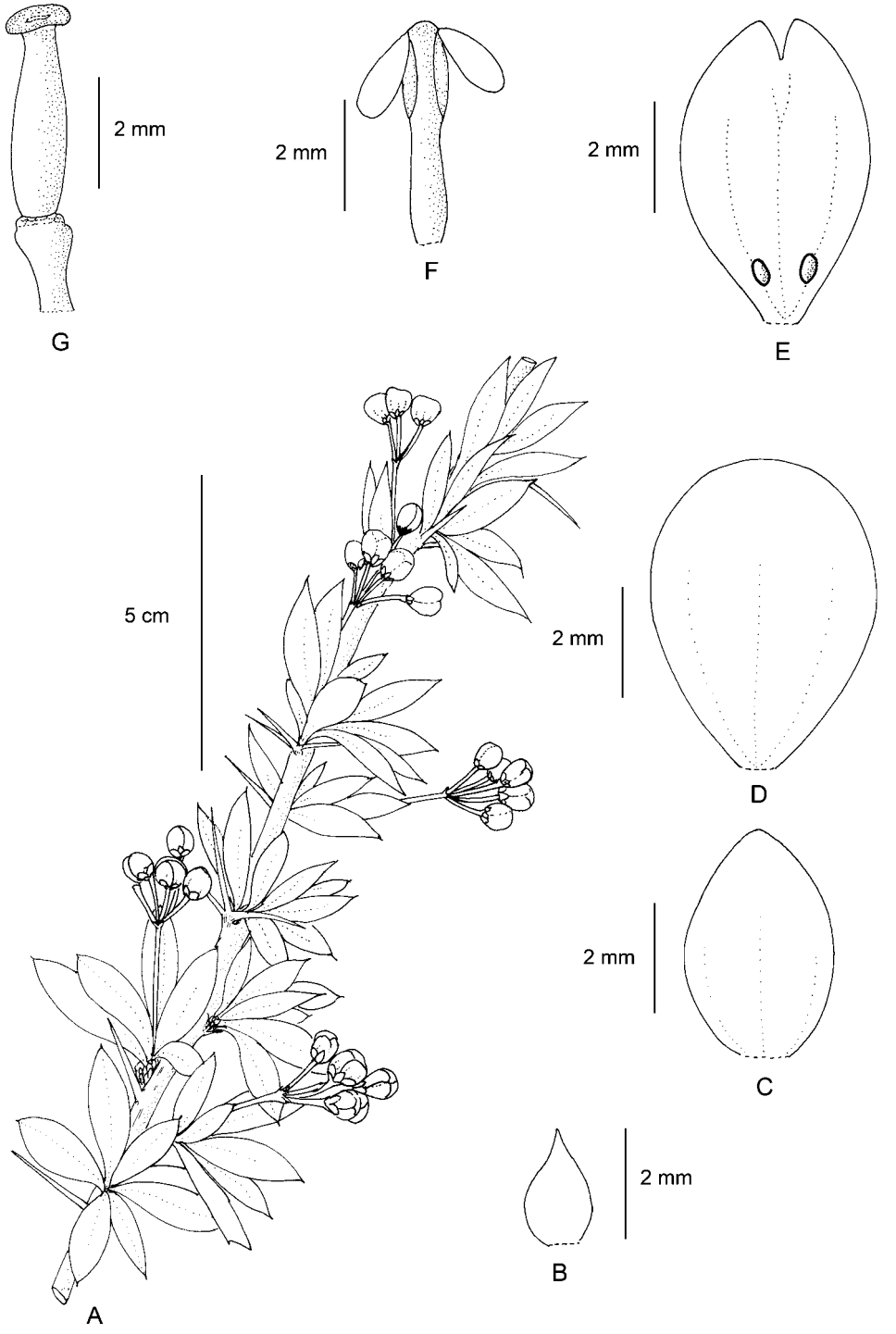

FIG. 33. *Berberis karnaliensis* Bh.Adhikari, *sp. nov*. A, flowering branch; B, outer sepal; C, median sepal; D, inner sepal; E, petal; F, stamen; G, pistil (from *JRS* A59).

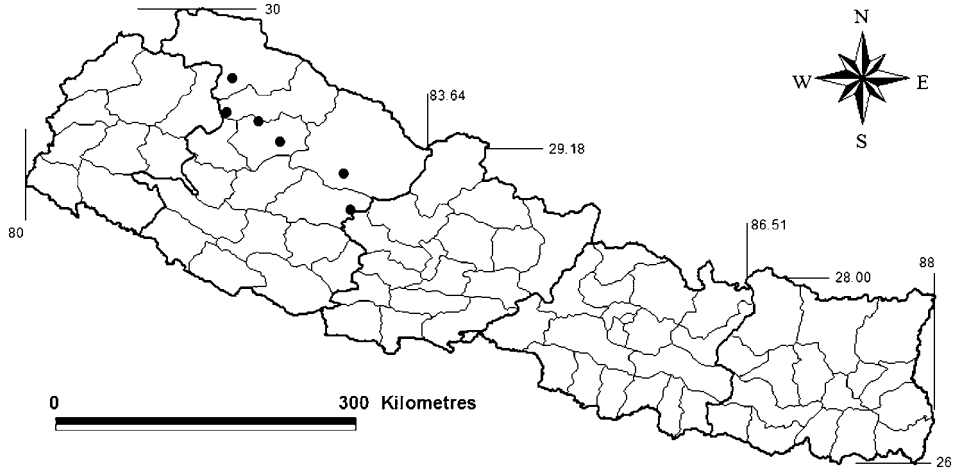

FIG. 34. Distribution of *Berberis karnaliensis*.

venation distinct with 1 pair of lateral veins; glands ellipsoid, 0.5–0.7 mm long. *Stamens* 3–5 mm long, connective slightly produced, tip obtuse or conical. *Pistil* 3–5 mm long; ovules 2–3. *Berries* dark red, oblong-obovoid, 0.8–1 cm long; style 1 mm long.

Phenology. Apr–Jun (fl.); Jun–Oct (fr.).

Habitat and ecology. Common along roadsides and forest margins of *Pinus–Rhododendron* forest in western Nepal at 1800–3400 m altitude.

Distribution. Western Nepal.

Proposed IUCN conservation status. Data Deficient (DD). This species grows commonly in western Nepal and is very likely to be found in similar habitats in the western Himalaya. Therefore, more information from the western Himalaya is needed to confirm its status.

Distinguishing features. *Berberis karnaliensis* is identifiable by its pubescent branches, umbellate or sub-umbellate inflorescences, notched petals and stylose red berries.

Selected specimens. WESTERN. Dolpa, Dunai, 2100 m, 26 iv 1974, *Dobremez* 2781 (E); Dolpa, Kolagaun, 11,000 ft, 3 vi 1952, *Polunin, Sykes & Williams* 1365 (BM); Humla, Unapani-Limne, 1820 m, 15 vi 2008, *JRS* A146 (E); Jumla, Gothichaur-Chutra, 2760 m, 27 ix 1991, *Minaki et al.* 9104265 (E); Mugu, Khater Dara, 1850 m, 21 iv 1952, *Polunin, Sykes & Williams* 834 (E); Rukum, 2700 m, 20 v 1969, *Dobremez* 142 (BM).

This species is recorded from the Karnali and Rapti zones of western Nepal. It is most closely related to *Berberis jaeschkeana* C.K.Schneid. but differs in its densely pubescent branches, long peduncle, umbellate inflorescence and smaller fruits.

16. Berberis virescens Hook.f., Bot. Mag. 116: t. 7116 (1890); Chatterjee, Rec. Bot. Surv. India 16(2): 27 (1953); Ahrendt, J. Linn. Soc. Bot. 57: 125 (1961); Tebbs in Hara & Williams, Enum. Fl. Pl. Nepal 2: 31 (1979); Grierson in Grierson & Long, Fl. Bhutan 1(2): 326 (1984); Rao *et al.*, Rheedea 8(2): 109 (1998); Press *et al.*, Annot. Checkl. Fl. Pl. Nepal 27 (2000). – Type: Sikkim, 1849, *Hooker* s.n. (lecto K!, first step designated by Ahrendt (1961: 125), of which Sikkim, Lachen Valley, 9000 ft, 28 v 1849, *Hooker* s.n., lecto K! [barcode K000340167], second step designated here). **Figs 35, 36.**

Shrub to 3 m. *Stems* and branches terete or slightly angular, reddish brown when young becoming greyish brown and verruculose when older. *Internodes* 1–2 cm. *Spines* 3-fid, strong, terete or angular, central spine 0.8–1 cm, the lateral spines equal to or slightly smaller than the central. *Leaves* deciduous, thin to slightly coriaceous. *Petiole* absent. *Lamina* obovate or narrowly obovate to narrowly elliptic, 0.8–2 × 0.3–1 cm, base cuneate, apex obtuse, mucronate, margin entire or 3–5 spinulose toothed, dark green above, slightly glaucous beneath, venation sub-conspicuous above, prominent below. *Inflorescence* 1–3 cm long, a short condensed raceme or sub-umbellate raceme of 2–8 flowers, rarely fasciculate. *Flowers* yellow, c.0.8 cm in diameter. *Peduncle* 0.2–0.5 cm (if present). *Pedicel* 0.3–1 cm. *Bracts* ovate-triangular, 2–2.5 × 1–1.5 cm. *Sepals* in 3 whorls, outer sepals ovate, 2.5–3.5 × 1–2 mm; median sepals ovate-elliptic, 3.5–5 × 2–3 cm; inner sepals broadly obovate, 7–8 × 5–7 mm. *Petals* obovate-elliptic, 4.5–6 × 2.5–4 mm, base clawed, apex notched, 0.5 mm deep, margin entire, venation distinct with 1 pair of lateral veins; glands ovoid, c.1 mm long. *Stamens* 3–4 mm long, connectives produced, tip obtuse or slightly retuse. *Pistil* 3–4 mm long; ovules 3–4. *Berries* red, oblong-ellipsoid, 8–12 mm long; style very short or absent.

Phenology. Apr–Jun (fl.); May–Oct (fr.).

Habitat and ecology. Open degraded woodland at 3500–4000 m altitude.

Distribution. Nepal (Eastern), E Himalaya (Sikkim, Bhutan).

Proposed IUCN conservation status. Data Deficient (DD).

Distinguishing features. *Berberis virescens* is identified by the following combination of characters: condensed or sub-umbellate raceme, distinctly notched petals and produced anther connective with obtuse or retuse tip.

Selected specimens. EASTERN. Sagarmatha, Solukhumbu, 3700 m, 12 v 2004, *DNEP1* 93 (E); Sagarmatha, Tengboche-Phunki Tenga, 3670 m, 23 v 2004, *DNEP1* 238 (E).

Ahrendt (1961) cited the type as 'Sikkim: 1849, Hooker s.n. (Type, K)' but this is ambiguous as two specimens collected by Hooker in Sikkim in 1849 were found in K: the first collected on 28 May and the second on 6 July. The specimen dated 28 May 1849 was also mentioned by Hooker in his protologue and has therefore been selected for second step lectotypification.

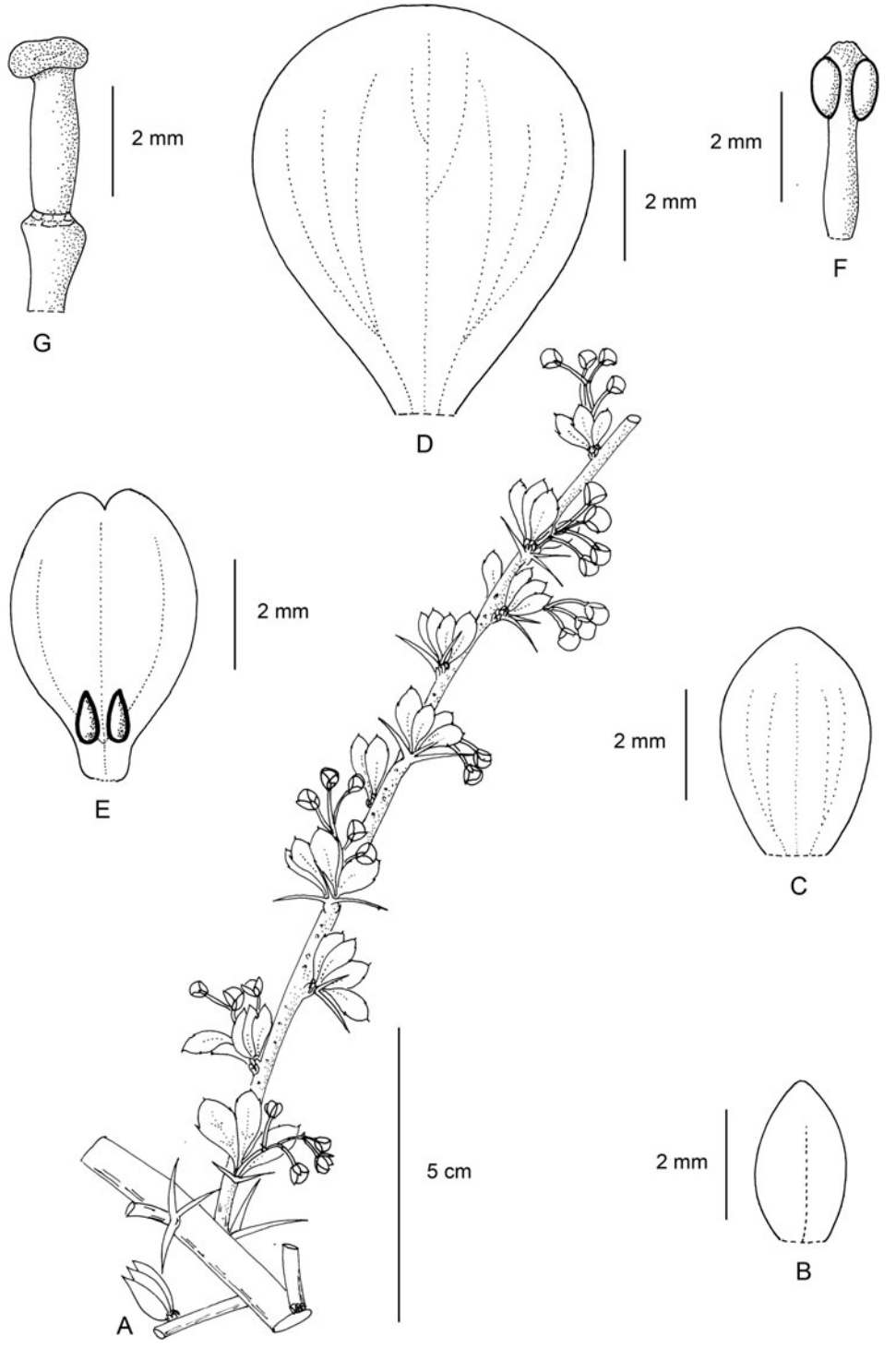

FIG. 35. *Berberis virescens*. A, flowering branch; B, outer sepal; C, median sepal; D, inner sepal; E, petal; F, stamen; G, pistil (A–G from *DNEP1* 238).

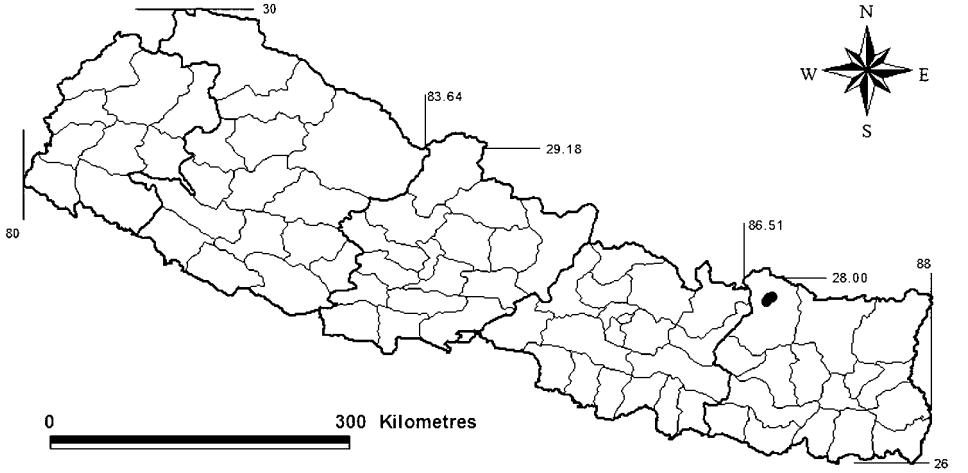

FIG. 36. Distribution of *Berberis virescens*.

17. Berberis asiatica Roxb. ex DC., Syst. Nat. 2: 13 (1821); Don, Prodr. Fl. Nepal 204 (1825); Roxburgh, Fl. Ind. 2: 182 (1832); Hooker & Thomson, Fl. Ind. 1: 224 (1855); Hooker & Thomson in Hooker, Fl. Brit. India 1(1): 110 (1872); Schneider, Bull. Herb. Boissier 2.5: 456 (1905); Chatterjee, Rec. Bot. Surv. India 16(2): 13 (1953); Ahrendt, J. Linn. Soc. Bot. 57: 86 (1961); Tebbs in Hara & Williams, Enum. Fl. Pl. Nepal 2: 29 (1979); Grierson in Grierson & Long, Fl. Bhutan 1(2): 326 (1984); Rao *et al.*, Rheedea 8(1): 52 (1998); Press *et al.*, Annot. Checkl. Fl. Pl. Nepal 25 (2000). – Type: Nepal, *Wallich* s.n. (lecto G-DC! [barcode G00201761], designated here). **Figs 37, 38.**

Shrub to 4 m. *Stems* and branches terete or angled, glabrous, yellowish grey, sparsely verruculose, young shoots slightly sulcate. *Internodes* 1–6 cm. *Spines* usually 3, solitary towards twig apex, strong, terete or angular, central spine 1–2 cm, the lateral spines equal to or slightly smaller than the central. *Leaves* deciduous, leathery. *Petiole* indistinct or up to 0.8 cm. *Lamina* obovate, obovate-elliptic or oblanceolate, 2–6(–9) × 1–3(–5) cm, base cuneate or attenuate to the small petiole, apex obtuse, usually mucronate, margin with 1–4 spinose teeth on each side, rarely entire, light green above, glaucous and papillose beneath, venation reticulate, prominent on both sides. *Inflorescence* 1.5–6 cm long, a fascicle or a condensed epedunculate raceme of 8–20(–35) flowers with a few flowers arising from the base of the rachis. *Bracts* ovate-triangular, 1–2 mm. *Flowers* yellow, 1–1.5 cm in diameter. *Pedicel* 0.5–2 cm, glabrous. *Sepals* in 3 whorls, outer sepals ovate-triangular, 1.5–2.5 × 1–1.5 mm; median sepals ovate, ovate-triangular or elliptic, 2.5–3.5 × 1.5–2.5 mm; inner sepals obovate, oblong-obovate or elliptic, 4.5–6 × 2–4 mm. *Petals* obovate, 4.5–6.5 × 3.5–4.5 mm, base cuneate or slightly clawed, apex slightly emarginate, sometimes obtuse, margin entire, venation distinct with 2 pairs of lateral veins; glands oblong-obovate,

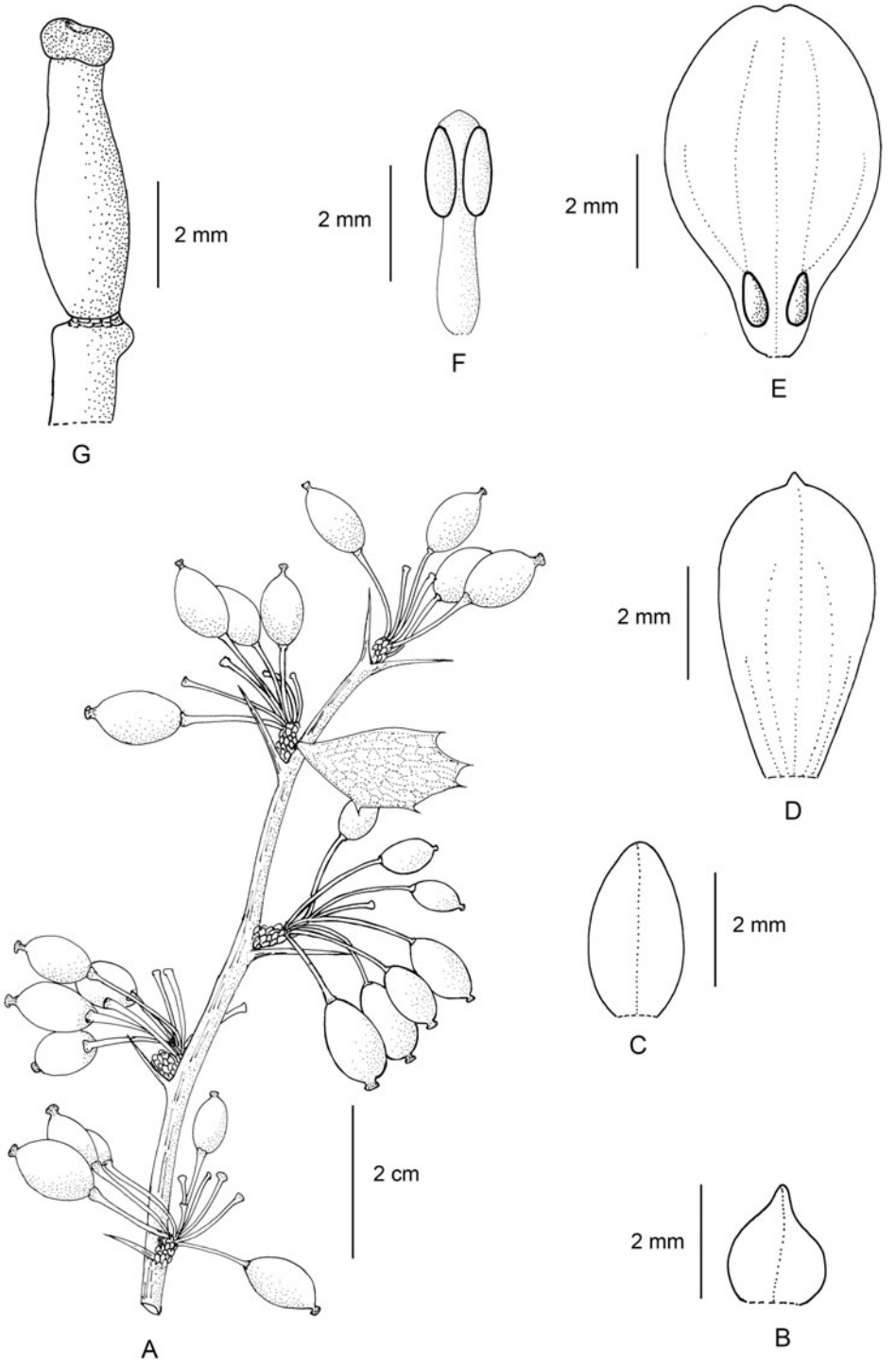

FIG. 37. *Berberis asiatica*. A, fruiting branch; B, outer sepal; C, median sepal; D, inner sepal; E, petal; F, stamen; G, pistil (A from *Adhikari, B.* G2; B–G from *Adhikari, B.* 101).

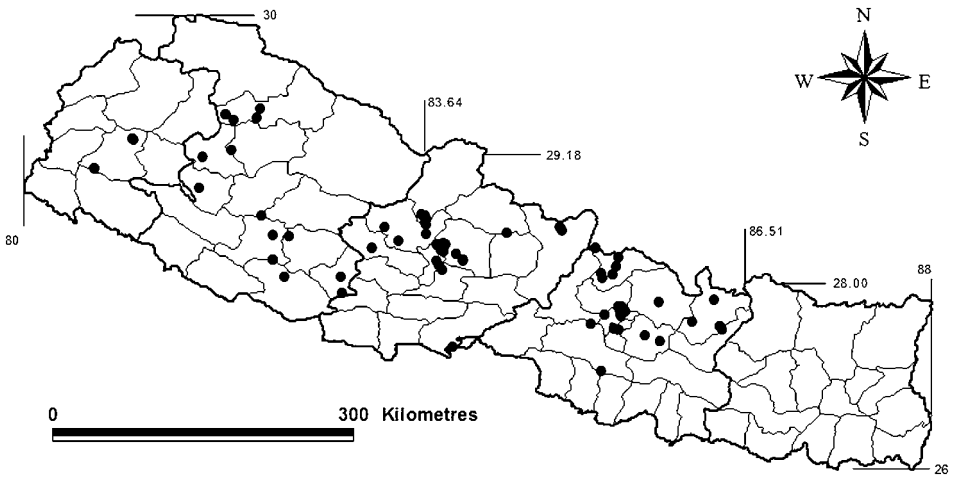

FIG. 38. Distribution of *Berberis asiatica*.

0.8–1.2 mm long. *Stamens* 3.5–5 mm long, connective slightly produced or not, tip obtuse or conical. *Pistil* 4.5–6 mm long; ovules 3–6. *Berries* dark purple, ovoid or globose, 7–10 mm long, glaucous; style 0.5–1.5 mm long.

Phenology. Feb–May (fl.); Mar–Jul (fr.).

Habitat and ecology. Disturbed vegetation beside roads and trails, and forest clearings at 1000–2700 m altitude.

Distribution. Nepal (Western, Central), W Himalaya, Tibetan Plateau.

Proposed IUCN conservation status. Least Concern (LC).

Distinguishing features. *Berberis asiatica* is easily identified by its leathery leaves with distinct reticulate venation and glaucous berries.

Selected specimens. WESTERN. Mugu, above Luma, 2180 m, 11 vi 2008, *JRSA* 108 (E); Mugu, Karkhan, Khater Dara, 2120 m, 24 iv 1952, *Polunin, Sykes & Williams* 836 (BM, E). CENTRAL. Dolkha, Khimti Khola, 8000 ft, 13 iv 1964, *Stainton* 4471 (BM, KATH); Kaski, Ghabung Khola, 5000 ft, 19 v 1954, *Stainton, Sykes & Williams* 5316 (E); Kaski, Lumle, 5600 ft, 15 iii 1970, *Flatt* 163 (BM); Kathmandu, Thankot, 5000 ft, 28 iii 1975, *Stainton* 7327 (E); Myagdi, Lumsum, 1820 m, 22 iii 1974, *Vickery* 407 (BM); Palpa, Bhairabsthan, 1300 m, 5 v 2006, *Adhikari, B.* 101 (E).

De Candolle (1821) stated in the protologue 'hab. in India orientali (Roxb.), in Napaulia (Wallich)'. Ahrendt (1961) cited the type as 'Nepal: 1819, Wallich 1477' but no specimens have been found from Nepal with that date. According to Wallich (1829), *Wallich* 1477 contains two gatherings, 1477.1 from Nepal (Napalia) and 1477.2 from Kumaon. The specimen *Wallich* 1477.1 in the Wallich herbarium (K-W)

is dated 1821 while the other *Wallich* 1477 specimens in MO and E (ex herb. Greville) have no dates, and the specimen in Vienna (W) is dated 1820. A single sheet of *Berberis asiatica* in the de Candolle herbarium (G-DC) has three gatherings from Bengal, Napaul (Nepal) and a leaf specimen from Lambert. The specimen most likely to have been seen by de Candolle was the specimen in G-DC, and therefore this has been chosen as the lectotype. Some early Wallich collections which were actually collected by Edward Gardner and his team (1817–1819) were also distributed to different herbaria under Wallich's name (Fraser-Jenkins, 2005). This specimen was most likely to have been collected by Edward Gardner and his team in 1817–1819 (Fraser-Jenkins, 2005), and the date 1821 on the sheet appears to have been added later in reference to the publication date of a species or may have been copied later from Wallich (1829).

18. Berberis glaucocarpa Stapf, Bot. Mag. 151: sub t. 9102 (1926); Ahrendt, J. Bot. 79 (Suppl.): 101 (1942); Chatterjee, Rec. Bot. Surv. India 16(2): 14 (1953); Ahrendt, J. Linn. Soc. Bot. 57: 90 (1961); Tebbs in Hara & Williams, Enum. Fl. Pl. Nepal 2: 30 (1979); Rao *et al.*, Rheedea 8(1): 57 (1998); Press *et al.*, Annot. Checkl. Fl. Pl. Nepal 26 (2000). – Type: India, Jaunsar, hills between Tons and Gisi rivers, 8000 ft, v 1875, *Brandis* 746 (neo K! [barcode K000644849], designated by Ahrendt (1961: 90)). **Figs 39, 40.**

Shrub to 4 m. *Stems* and branches terete, glabrous, dark grey to greyish yellow, verruculose. *Internodes* 2–4 cm. *Spines* usually 3, solitary towards the apex of twig, strong, terete or angular, central spine 0.8–2 cm, lateral spines 0.5–1.5 cm. *Leaves* deciduous, thinly coriaceous to coriaceous. *Petiole* absent. *Lamina* obovate-oblanceolate, 2–5.5(–7) × 1–3 cm, base cuneate, apex obtuse, usually mucronate, margin usually entire, sometimes with 2–6 spinose teeth on each side, lustrous green above, paler beneath, venation reticulate, prominent both sides. *Inflorescence* 3–6 cm long, a stiff pedunculate raceme of 10–30 flowers, sometimes with a few flowers arising from the base of the rachis. *Bracts* ovate, 1.5–2 mm long. *Flowers* yellow, c.1.5 cm in diameter. *Peduncle* 0.2–1.5 cm. *Pedicel* 0.5–1 cm. *Sepals* in 3 whorls, outer sepals ovate, 4.5–6 × 2–2.5 mm; median sepals ovate-elliptic, 5.5–8 × 3.5–4.5 mm; inner sepals elliptic-orbiculate, 7.5–8.5 × 5–7 mm. *Petals* obovate, 5–7.5 × 4–4.5 mm, base cuneate, margin entire, apex notched, 0.2–0.5 mm deep, venation distinct with 1 pair of lateral veins; glands obovoid, 1–1.5 mm long. *Stamens* 4.5–5.5 mm long, connective distinctly produced, tip obtusely pointed. *Pistil* 3.5–4.5 mm long; ovules 3–4. *Berries* dark purple, oblong-ovoid or ovoid-globose, 0.8–1.2 cm long including style, glaucous; style 0.5–1.5 mm long.

Phenology. May–Jul (fl.); Jun–Oct (fr.).

Habitat and ecology. Along forest edges at 2300–3500 m altitude.

Distribution. Nepal (Western, Central), W Himalaya (Kumaon).

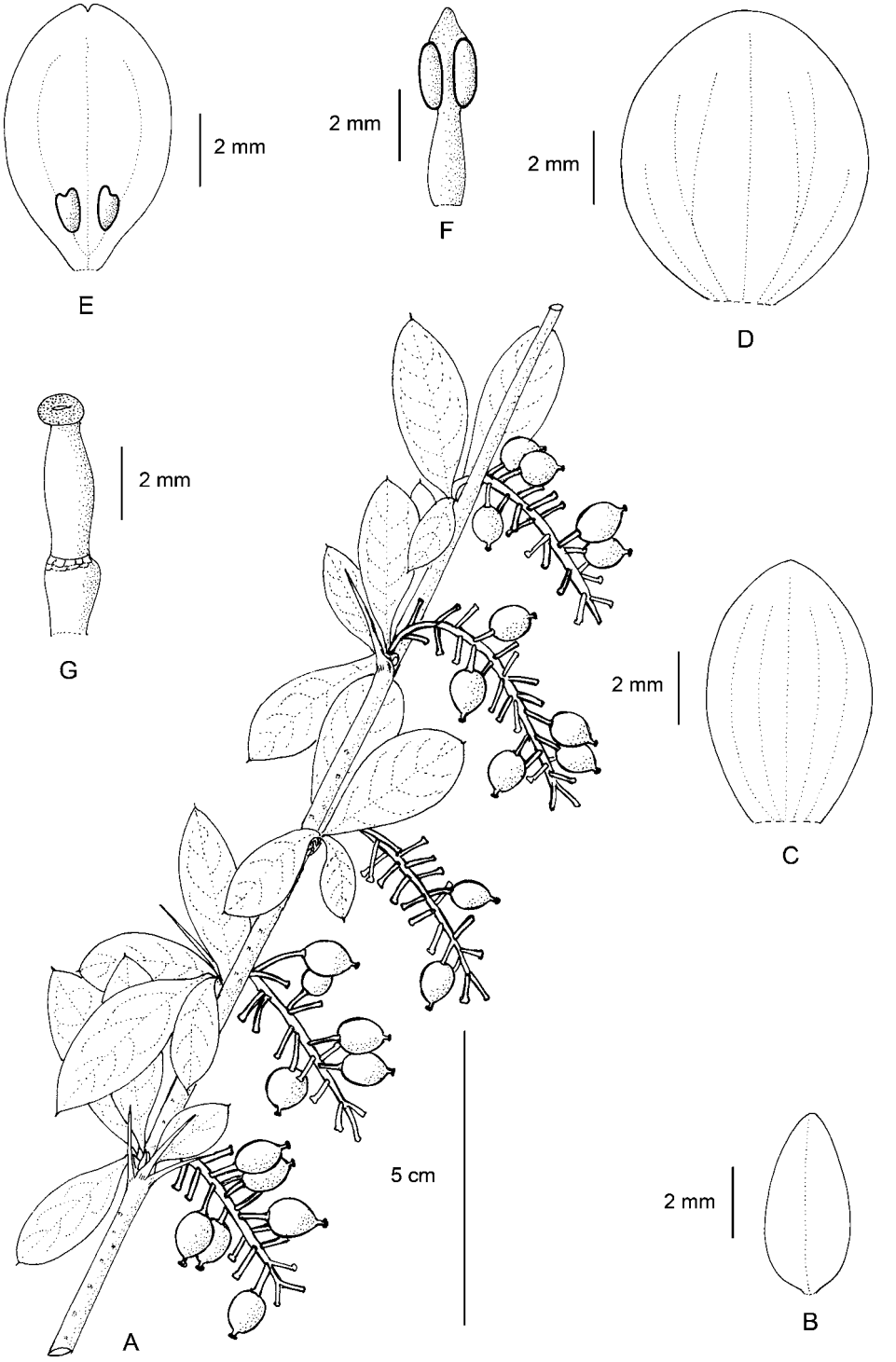

FIG. 39. *Berberis glaucocarpa*. A, fruiting branch; B, outer sepal; C, median sepal; D, inner sepal; E, petal; F, stamen; G, pistil (A from *Polunin, Sykes* & *Williams* 5072; B–G from *JRS* A80).

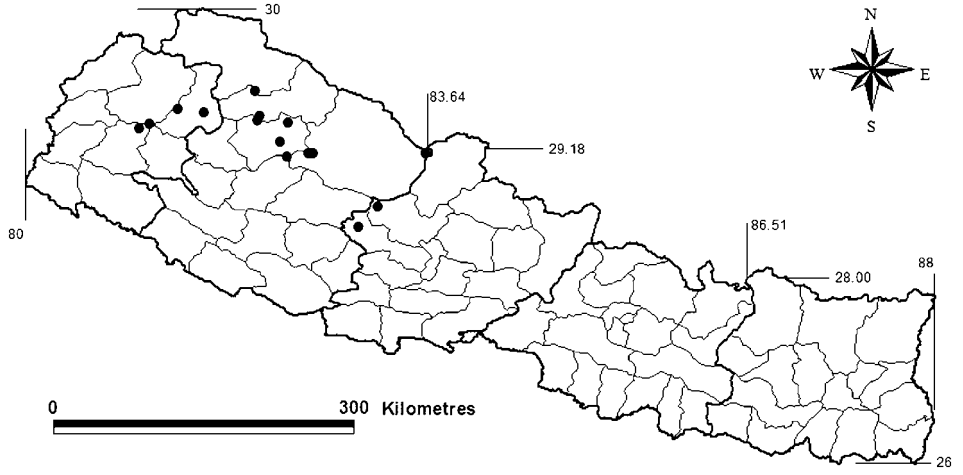

FIG. 40. Distribution of *Berberis glaucocarpa*.

Proposed IUCN conservation status. Least Concern (LC). This species commonly grows in western Nepal, Kumaon and also in Pakistan.

Distinguishing features. *Berberis glaucocarpa* is easily identified by its glaucous berries in stiff racemes and distinctly produced anther connectives.

Selected specimens. WESTERN. Dolpa, near Hurikot, 3030 m, 25 ix 1952, *Polunin, Sykes* & *Williams* 5407 (BM); Humla, below Saatthapla towards Rimi, 2640 m, 13 vi 2008, *JRSA* 134 (E); Jumla, Chanki, NW of Jumla, 2580 m, 9 viii 1952, *Polunin, Sykes* & *Williams* 5072 (BM); Jumla, 2420 m, 10 v 1952, *Polunin, Sykes* & *Williams* 930 (BM); Mugu, below Ghuruchi Lagna, 3400 m, 7 vi 2008, *JRSA* 80 (E). CENTRAL. Baglung, near Sirtibang Lekh, 11,000 ft, 14 x 1984, *Stainton, Sykes* & *Williams* 9024 (E); Myagdi, above Sauwala Khola, 10,500 ft, 13 ix 1954, *Stainton, Sykes* & *Williams* 4376 (E).

Stapf (1926) did not cite reference specimens in the protologue and no collections have been discovered which could serve as original material. Therefore, the type specimen cited by Ahrendt (1961) is an effective neotypification. Two more specimens with the same collection number *Brandis* 746 were found in K but with different dates (June 76, K000644847; Nov 76, K000644848).

19. Berberis wallichiana DC., Prodr. 1: 107 (1824); Don, Prodr. Fl. Nepal 204 (1825); Wallich, Pl. Asiat. Rar. 3: 23, t. 243 (1832); Hooker & Thomson, Fl. Ind. 1: 225 (1855); Schneider, Bull. Herb. Boissier 2.5: 403 (1905); Chatterjee, Rec. Bot. Surv. India 16(2): 10 (1953); Ahrendt, J. Linn. Soc. Bot. 57: 71 (1961); Tebbs in Hara & Williams, Enum. Fl. Pl. Nepal 2: 31 (1979); Rao *et al.*, Rheedea 8(1): 42 (1998); Press *et al.*, Annot. Checkl. Fl. Pl. Nepal 27 (2000). – Type: Nepal, *Gardner* in *Wallich* 1819 (lecto G-DC! [barcode G00201780], designated here; isolecto K!). **Figs 41, 42.**

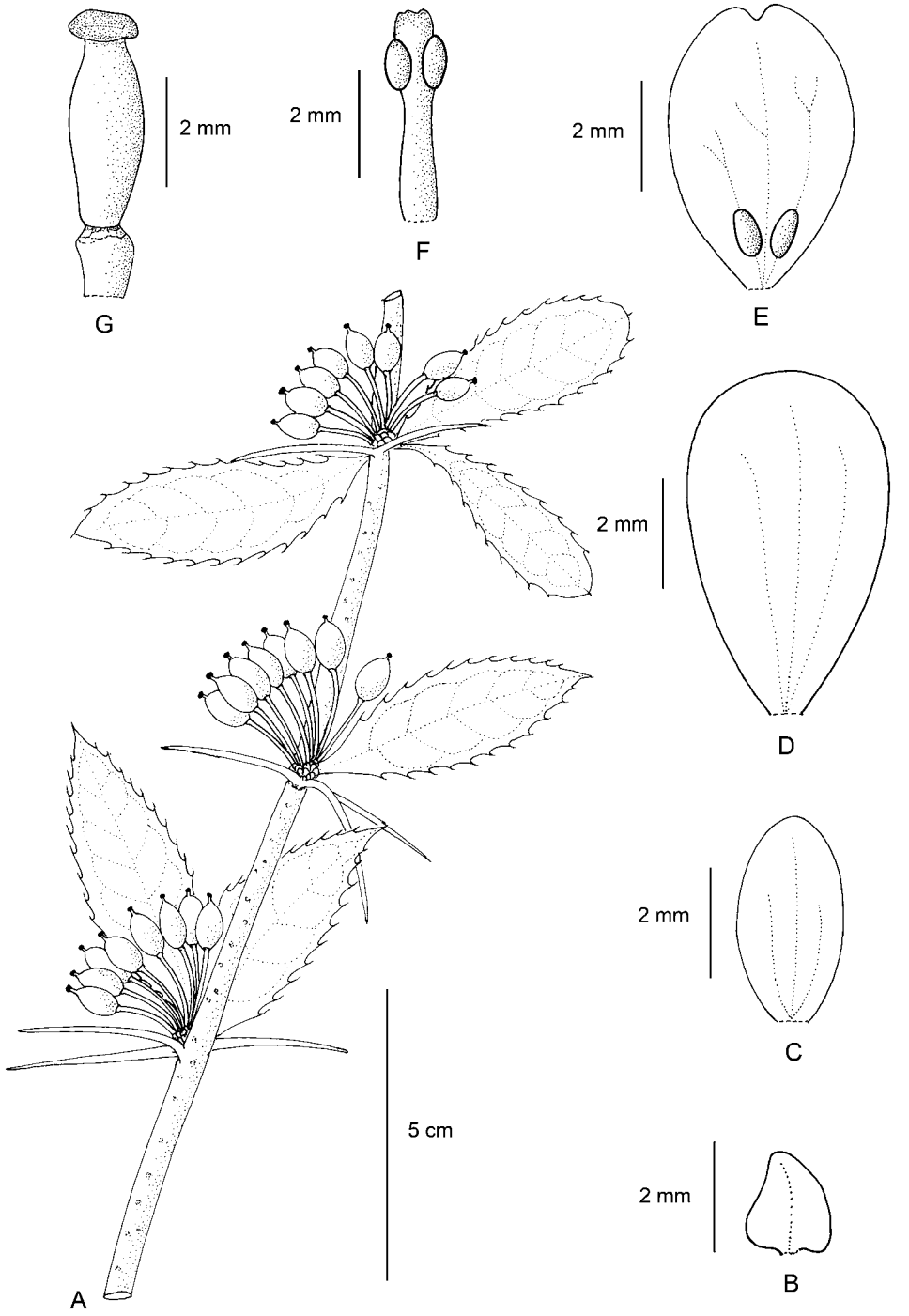

FIG. 41. *Berberis wallichiana*. A, fruiting branch; B, outer sepal; C, median sepal; D, inner sepal; E, petal; F, stamen; G, pistil (A from *Proud* 2; B–G from *Adhikari* G18).

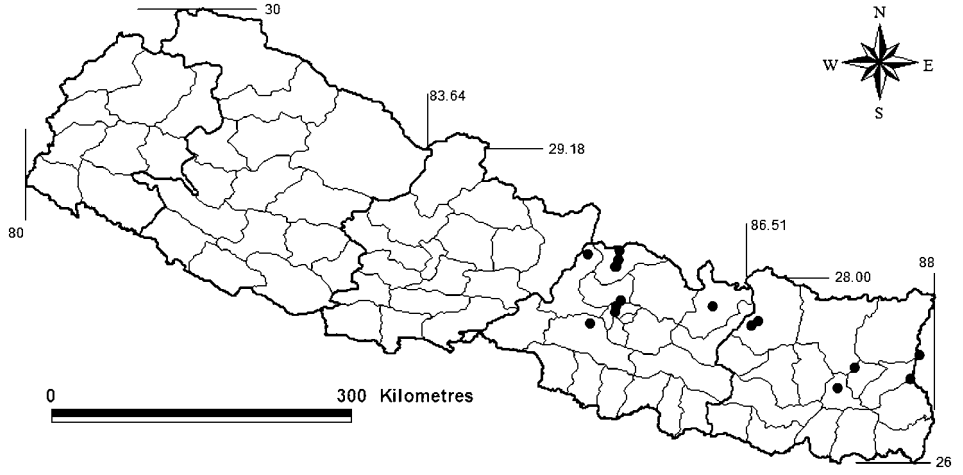

FIG. 42. Distribution of *Berberis wallichiana*.

Berberis poluninii Ahrendt, J. Linn. Soc. Bot. 57: 73 (1961). – Type: Nepal, Timure, Compaling, *Polunin* 746 (holo BM!).

Shrub to 2 m. *Stems* and branches glabrous, terete, dark grey, verruculose, young stems yellowish grey, sulcate or angled. *Internodes* 2–5 cm. *Spines* usually 3-fid, sometimes absent on old stems, terete or sulcate, central spine 1–3 cm, lateral spines 1.5–2 cm. *Leaves* evergreen, coriaceous. *Petiole* absent or 2–5 mm. *Lamina* oblong-lanceolate, 3–8(–11) × 1–2 cm, base cuneate, sometimes attenuate to a small petiole, apex acute to acuminate, mucronate, margin 6–13(–25) spinose-toothed on each side, lustrous green above, paler beneath, venation prominent to sub-conspicuous above, prominent below with distinctly looping closed primary veins. *Inflorescence* a fascicle of 10–25(–30) flowers. *Flowers* yellow, 1–2 cm in diameter. *Pedicel* 0.5–1.5(–4) cm, glabrous or puberulous, dark red. *Sepals* in 3 whorls, outer sepals ovate or ovate-triangular, 1–2.5 × 0.8–2 mm; median sepals ovate or ovate-elliptic, 3.5–4.5 × 1.5–2.5 mm; inner sepals obovate, 6–7 × 3–5 mm. *Petals* obovate, 5–6.5 × 3.5–4.5 mm, base cuneate, apex undulate or notched, 0.5 mm deep, margin entire, venation distinct with 1 pair of lateral veins; glands ovate, 0.8–1.2 mm long. *Stamens* 3.5–4.5 mm long, connective produced, truncate or sometimes slightly bilobed. *Pistil* 4–4.5 mm long; ovule solitary. *Berries* black, ellipsoid, 0.5–1 cm long; style 0.5–1 mm long.

Phenology. Mar–Jun (fl.); May–Nov (fr.).

Habitat and ecology. Edges of *Rhododendron*–oak forests at 2300–3300 m altitude.

Distribution. Nepal (Central, Eastern), E Himalaya, Assam, Burma.

Proposed IUCN conservation status. Least Concern (LC).

Distinguishing features. *Berberis wallichiana* is easily identified by its evergreen habit, pistil with a solitary ovule and black stylose berries in fascicles.

Selected specimens. CENTRAL. Kathmandu, Nangi Dada, 2730 m, 16 iv 1957, *Proud* 3b (E); Rasuwa, Chandanbari, 3300 m, 21 v 2008, *Adhikari* G18 (E); Rasuwa, Khanjing-Sherpagaon, 2295 m, 2 viii 2007, *Adhikari* BL2 24 (E). EASTERN. Dhankuta, above Hille, 2580 m, 13 xi 1975, *Beer* 25741 (BM); Solukhumbu, Junbesi, 2420 m, 24 iv 1974, *Stainton* 6977 (E); Terathum, near Chauki, 2620 m, 26 x 1991, *EMAK* 1066 (E).

Specimens from two different gatherings, *Wallich* 1478 and *Wallich* s.n., 1819, have been cited as the type by different authors (Ahrendt, 1961; Chamberlain & Hu, 1985; Rao *et al.*, 1998a). *Wallich* 1478 is the Wallich (1829) catalogue number and specimens were collected by him in 1821. Early Wallich collections (1817–1819) were actually collected by Edward Gardner and his team (Fraser-Jenkins, 2005) but distributed to different herbaria under Wallich's name. The specimen in the de Candolle herbarium is from Gardner's 1819 collections and has been chosen as the lectotype. As suggested by Fraser-Jenkins (2005), the specimen is cited as *Gardner* in *Wallich* 1819.

Ahrendt (1961) described *Berberis poluninii* based on *Polunin* 746 collected near Timure, central Nepal. Chamberlain & Hu (1985) treated *Berberis poluninii* as a synonym of *Berberis praecipua*. The area around Timure was revisited during this study and all plants from the surrounding area have been identified as *Berberis wallichiana*. The type specimen of *Berberis poluninii* differs from *Berberis wallichiana* only by its slightly smaller leaves and *Berberis poluninii* has therefore been treated as synonym of *Berberis wallichiana*.

20. Berberis hookeri Lem., Ill. Hort. 6: 207 (1859); Schneider, Bull. Herb. Boissier 2.5: 401 (1905); Chatterjee, Rec. Bot. Surv. India 16(2): 8 (1953); Ahrendt, J. Linn. Soc. Bot. 57: 39 (1961); Tebbs in Hara & Williams, Enum. Fl. Pl. Nepal 2: 30 (1979); Grierson in Grierson & Long, Fl. Bhutan 1(2): 326 (1984); Chamberlain & Hu, Notes Roy. Bot. Gard. Edinburgh 42: 536 (1985); Rao *et al.*, Rheedea 8(1): 40 (1998); Press *et al.*, Annot. Checkl. Fl. Pl. Nepal 26 (2000). – Type: Illustration: Illustration Horticole, Planche 207 (1859) (lecto, designated here). **Figs 43, 44.**

Shrub to 1.5 m. *Stems* and branches glabrous, terete, dark grey to greyish yellow, verruculose, young shoots slightly sulcate. *Internodes* 2–5(–8) cm. *Spines* usually 3, strong, terete, central spine 1–2.2 cm, the lateral spines equal to or slightly shorter than the central. *Leaves* evergreen, coriaceous. *Petiole* absent or rarely up to 5 mm. *Lamina* lanceolate-elliptic, rarely obovate, 3–7 × 1–3 cm, base cuneate or attenuate to a small petiole, apex acute, usually mucronate, margin with 2–7(–14) spinose teeth on each side, lustrous green above, paler and sometimes glaucous beneath, venation prominent both sides with distinctly looping closed primary veins. *Inflorescence* a fascicle of 3–8(–11) flowers. *Flowers* yellowish green, c.1.5 cm in diameter. *Pedicel* (0.5–)1–2.5 cm, glabrous. *Sepals* in 4 whorls, outermost sepals ovate-triangular with acute or acuminate apex, 3–4 × 1–1.5 mm; outer sepals ovate or oblong-ovate,

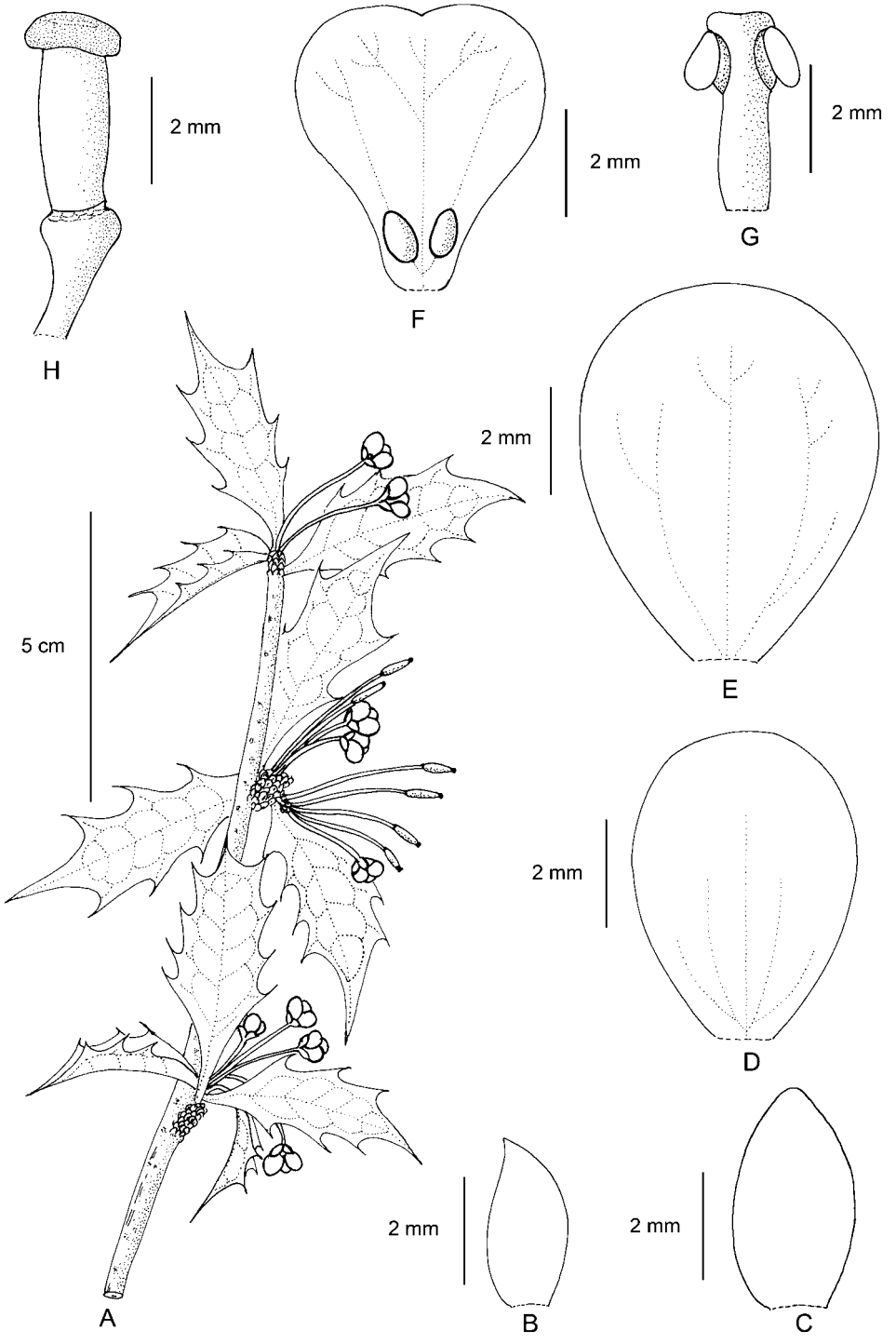

FIG. 43. *Berberis hookeri*. A, flowering branch; B, outermost sepal; C, outer sepal; D, median sepal; E, inner sepal; F, petal; G, stamen; H, pistil (A from *Proud* 1; B–H from *LKSR* B22).

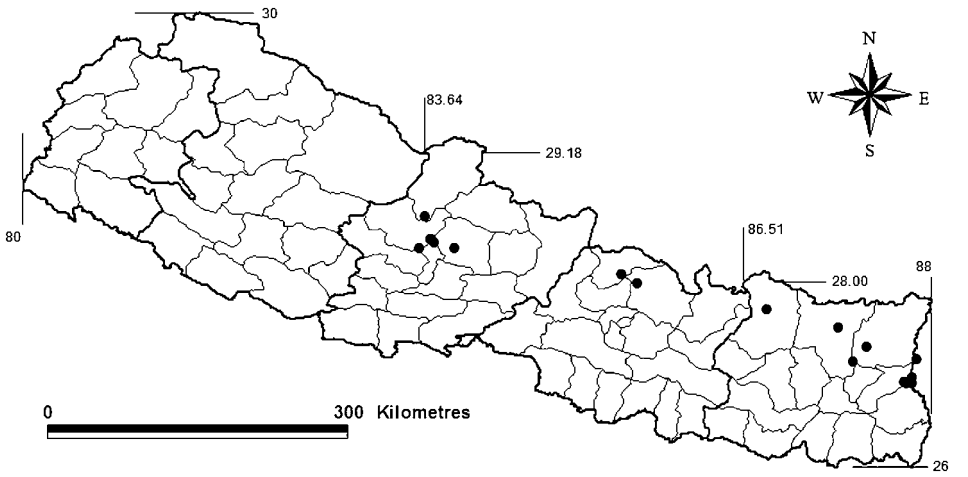

FIG. 44. Distribution of *Berberis hookeri*.

3.5–4.5 × 1.5–2.5 mm; median sepal elliptic-obovate or broadly obovate, 4.5–8 × 3–5.5 mm; inner sepals broadly obovate, 6–9 × 3.5–7.5 mm. *Petals* obovate, 4.5–6.5 × 3.5–6 mm, base cuneate, apex obtuse or emarginate, margin entire, venation distinct with 1 pair of lateral veins; glands ovate, 0.8–1.5 mm long. *Stamens* 3–4.5 mm long, connective produced, truncate or slightly retuse. *Pistil* 3–4.5 mm long; ovules 3–6. *Berries* black, oblong-ovoid, 1–1.5 cm long, glaucous; style absent.

Phenology. May–Jul (fl.); Jul–Oct (fr.).

Habitat and ecology. Open hillsides, edges of evergreen forest at 2000–3400 m altitude.

Distribution. Nepal (Central, Eastern), E Himalaya, Tibetan Plateau, Assam, Burma.

Proposed IUCN conservation status. Least Concern (LC).

Distinguishing features. *Berberis hookeri* is identifiable by its evergreen habit, greenish yellow flowers in fascicles, and glaucous, black, estylose berries.

Selected specimens. CENTRAL. Myagdi, near Kuinekhani, 2730 m, 25 v 1954, *Stainton, Sykes* & *Williams* 2846 (E); Rasuwa, Gosaikund Ridge, 3180 m, 14 v 1960, *Proud* 1 (BM). EASTERN. Panchthar, Sidin-1, Lamapokhari, 3007 m, 8 vi 2007, *LKSRB* 22 (E, TUCH); Taplejung, between Koping and Noondaki, 3000 m, 24 x 1991, *EMAK* 1021 (E); Taplejung, Mewakhola, c.3300 m, 25 x 1971, *Beer, Lancaster* & *Morris* 157 (BM).

Lemaire's (1859) protologue description is based on a cultivated plant for which he did not cite any specimen. Lemaire's illustration has therefore been designated as the lectotype.

Ahrendt (1961) recognised three varieties of *Berberis hookeri*, *Berberis hookeri* var. *viridis*, *B. hookeri* var. *microcarpa* and *B. hookeri* var. *platyphylla*, based mainly on

the size of the fruit and the leaf margin. Chamberlain & Hu (1985) merged all these varieties into *Berberis hookeri* subsp. *hookeri*, and distinguished *Berberis hookeri* subsp. *longipes*. All Nepalese material belongs to *Berberis hookeri* subsp. *hookeri*.

21. Berberis insignis Hook.f. & Thomson, Fl. Ind. 1: 226 (1855); Hooker & Thomson in Hooker, Fl. Brit. India 1(1): 111 (1872); Schneider, Bull. Herb. Boissier 2.5: 401 (1905); Chatterjee, Rec. Bot. Surv. India 16(2): 7 (1953); Ahrendt, J. Linn. Soc. Bot. 57: 36 (1961); Tebbs in Hara & Williams, Enum. Fl. Pl. Nepal 2: 30 (1979); Grierson in Grierson & Long, Fl. Bhutan 1(2): 324 (1984); Chamberlain & Hu, Notes Roy. Bot. Gard. Edinburgh 42: 536 (1985); Rao *et al.*, Rheedea 8(1): 32 (1998); Press *et al.*, Annot. Checkl. Fl. Pl. Nepal 25 (2000). – Type: India, Sikkim, 23 v 1849, *Hooker* s.n. (lecto K! [barcode K000077368], designated by Ahrendt (1961: 37)). **Figs 45, 46.**

Berberis insignis var. *tongloensis* C.K.Schneid., Mitt. Deutsch. Dendrol. Ges. 55: 45 (1942). – Type: India, West Bengal, Darjeeling, Tonglo Ridge, 28 v 1902, *J.H. Lace* 2243 (lecto E! [barcode E00373486], designated here; isolecto CAL! [barcode 0000006779]).

Shrub to 4 m. *Stems* and branches terete, glabrous, grey, young stems reddish brown. *Internodes* 2–7 cm. *Spines* absent or 3, rarely 5, central spine 2–2.5 cm, lateral spines 1–1.5 cm. *Leaves* evergreen, slightly coriaceous. *Petiole* absent or up to 8 mm. *Lamina* oblong or elliptic-lanceolate, 8–17 × 2–4 cm, base cuneate or attenuate to the small petiole, apex acuminate, sometimes acute, margin with 10–26 spinose teeth on each side, green above, paler beneath, venation prominent to sub-conspicuous above, prominent below with distinctly looping closed primary veins. *Inflorescence* a fascicle of 5–25 flowers. *Flowers* yellow, c.1.5–2 cm in diameter. *Pedicel* 0.5–1.5 cm, glabrous. *Sepals* in 4 whorls, outermost sepals broadly ovate, 1.5–3.5 × 1.5–3 mm; outer sepals broadly ovate-rounded, 3–6 × 2.5–4 mm; median sepal broadly ovate or elliptic-ovate, 4–7 × 3.5–4.5 mm; inner sepals broadly obovate or elliptic-rounded, 4–7 × 4–6 mm. *Petals* obovate or narrowly obovate, 4.5–6 × 2.5–4 mm, base cuneate, apex emarginate, margin entire, venation distinct with 1 pair of lateral veins; glands ellipsoid or oblong-obovoid, 1–1.5 mm long. *Stamens* 3–4.5 mm long, connective slightly produced or not, tip obtuse. *Pistil* 3–4 mm long; ovules 2–4. *Berries* black, oblong-obovoid or ellipsoid, c.1 cm long; style absent.

Phenology. Apr–Jun (fl.); Jun–Nov (fr.).

Habitat and ecology. Forest floor in moist evergreen forests at 2000–3400 m altitude.

Distribution. Nepal (Eastern), E Himalaya, Assam, Burma.

Proposed IUCN conservation status. Least Concern (LC). Though this species grows in only a few areas of eastern Nepal, it is common in Sikkim, Arunachal Pradesh, Nagaland and Bhutan.

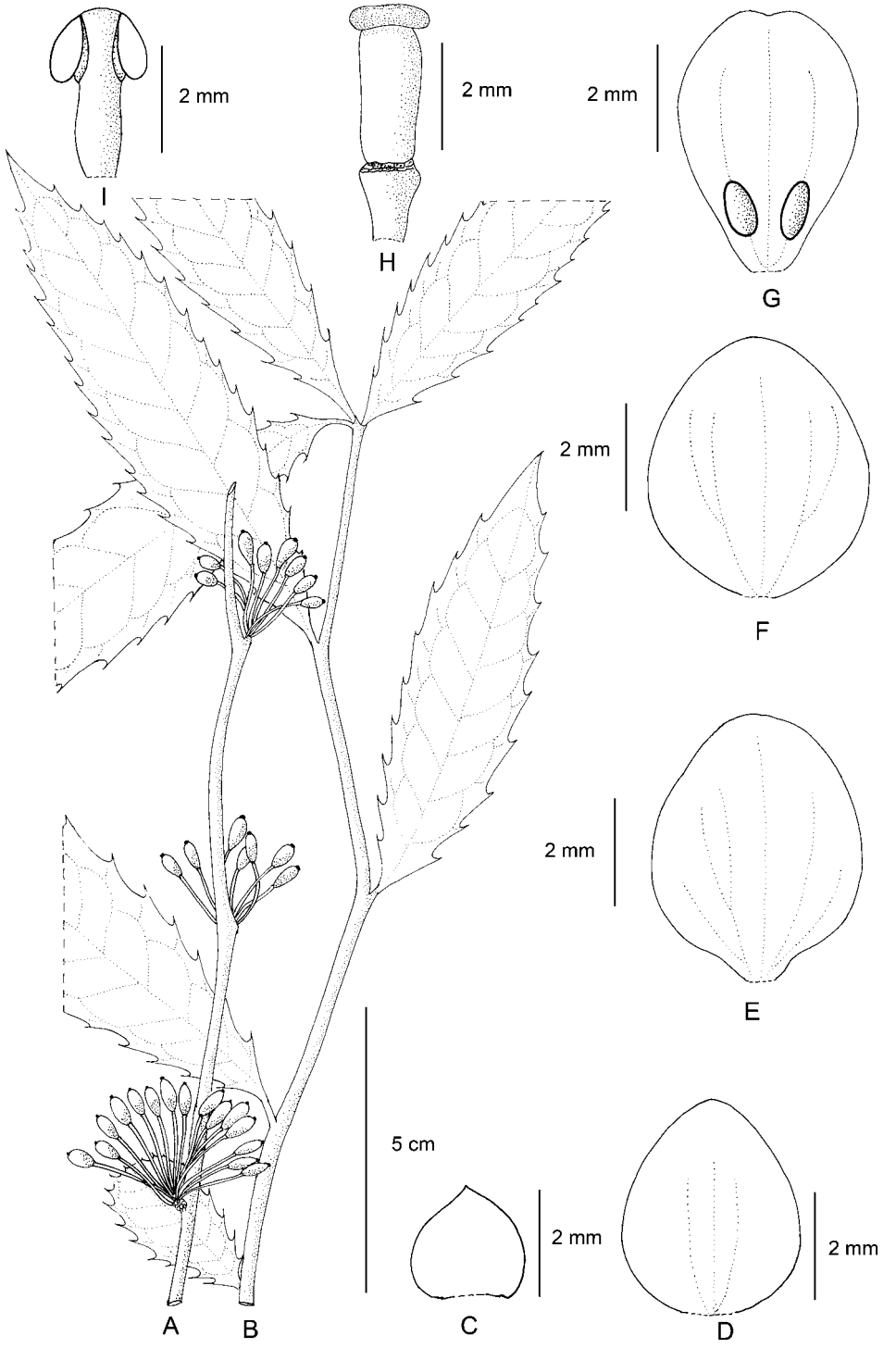

FIG. 45. *Berberis insignis.* A, fruiting branch; B, vegetative branch; C, outermost sepal; D, outer sepal; E, median sepal; F, inner sepal; G, petal; H, stamen; I, pistil (A & B from *EMAK* 875; C–I from *Suzuki et al.* 9263024).

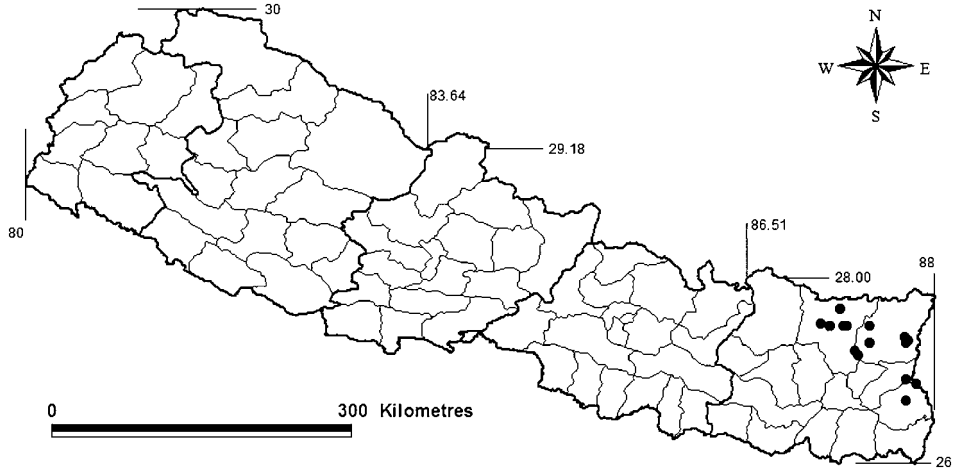

FIG. 46. Distribution of *Berberis insignis*.

Distinguishing features. *Berberis insignis* is easily identified by its large leaves up to 17 cm long, flowers in fascicles and black berries.

Selected specimens. EASTERN. Sankhuwasabha, Arun Valley, Maghang Khola, 3330 m, 1 v 1956, *Stainton* 182 (E); Sankhuwasabha, Milke Bhanjyang, 2420 m, 3 vii 1969, *Williams* 1104 (BM); Sankhuwasabha, west side of Panch Pokhari Khola, 2460 m, 17 x 1991, *EMAK* 875 (E); Taplejung, Mewa Khola, 3030 m, 25 x 1971, *BLM* 145 (BM); Taplejung, Sewaden-Topkegola, 2520 m, 15 v 1992, *Suzuki et al.* 9263064 (E).

Chamberlain & Hu (1985) recognised two subspecies, namely *Berberis insignis* subsp. *insignis* and *B. insignis* subsp. *incrassata*. All the Nepalese material belongs to *Berberis insignis* subsp. *insignis*.

Hooker & Thomson (1855) mentioned three gatherings, that of Griffith from Bhutan and Hooker's own collections from Sikkim and Nepal. Later Ahrendt (1961) cited one of Hooker's specimens as a type, an effective lectotypification.

Schneider (1942) cited *Lace* 2243 as the type for *Berberis insignis* var. *tongloensis* without giving a herbarium location. Chamberlain & Hu (1985) cited the specimen at E as an isotype, but as no lectotype had previously been selected the E specimen is here designated as the lectotype.

EXCLUDED OR UNCERTAIN TAXA

Berberis bhutanensis Ahrendt

Banerji (1964) reported *Berberis bhutanensis* from eastern Nepal. It was later included by Tebbs (1979). However, Banerji (1964) did not cite any reference specimens and this species has not been found during this study. Grierson (1984) treated this species as a synonym of *Berberis griffithiana*.

Berberis coriaria Royle ex Lindl.
Lindley (1841) described *Berberis coriaria* based on a living plant raised from seeds collected by Royle in 1835. This species is closely related to *Berberis glaucocarpa* and could be a variety or hybrid of that species. A detailed study from India is necessary to clarify its status. *Polunin, Sykes & Williams* 5538, the only specimen cited by Tebbs (1979) for this species, has been identified as *Berberis glaucocarpa* in this study.

Berberis edgeworthiana C.K.Schneid.
The only record of *Berberis edgeworthiana* in Nepal comes from a single specimen, *Wyss Dunant* 1097 (BM), cited by Tebbs (1979) but which we have not relocated. In the absence of any other specimens to confirm its presence in Nepal, it has been excluded from this study.

Berberis erythroclada Ahrendt
Berberis erythroclada is easily identified by its 5–7-fid spines and finely serrate leaves. This species is reported from Tibet but has not been found in Nepal during this study. The specimens cited by Tebbs (1979), *Stainton* 1633 and *Proud* 4, have been identified here as *Berberis concinna*.

Berberis hobsonii Ahrendt
Berberis hobsonii is similar to *B. virescens* of Nepal. Of the two specimens cited by Tebbs (1979) from Nepal, *Dobremez* 142 is identified here as *Berberis karnaliensis* and *Stainton* 4267 is more likely to be a hybrid involving *B. karnaliensis* or *B. virescens*. *Berberis karnaliensis* is easily distinguished from the type of *B. hobsonii* by its long pedicellate umbellate and sub-umbellate inflorescence. This species has therefore been excluded from this account of the Nepalese species. Grierson (1984) treated this species as a synonym of *Berberis cooperi* in the Flora of Bhutan.

Berberis khasiana Ahrendt
The record of *Berberis khasiana* in Nepal is based on Tebbs' (1979) identification of *Zimmermann* 852 (BM). However, we have not relocated this specimen at BM and this species is therefore excluded from this study. *Berberis khasiana* is closely related to *B. lycium* and has at times been treated as a synonym of it (Husain & Rao, 1997).

Berberis lycium Royle
Berberis lycium is a western Himalayan species frequently used for its medicinal properties. This species has not been found during field trips to western Nepal and no specimens were found to confirm its presence in Nepal. Specimens which were identified as *Berberis lycium* in the University of Tokyo herbarium (TI) (*TI* 8530125, *TI* 8540194 and *TI* 6306934) have been re-identified during this study as *B. thomsoniana*.

Berberis umbellata Wall ex G.Don
Don (1831) described *Berberis umbellata* based on the name in Wallich (1829) under the number 1475. *Wallich* 1475 contains two different gatherings: 1475.1 is *Berberis*

angulosa collected from Gosaithan, Nepal, whereas 1475.2 is *B. umbellata* and was collected by Robert Blinkworth from Kumaon, India. No specimens of *Berberis umbellata* from Nepal have been found during this study. This species is close to *Berberis hamiltoniana* of Nepal and the species from India need to be revised to clarify its status there. The only specimen cited by Tebbs (1979), *TI* 6306933, was re-identified as *Berberis thomsoniana* in this study.

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This study formed part of the first author's PhD project. We would like to thank Dr Mark F. Watson and Dr David Middleton for their advice on typification. We are grateful to Julian Harber for sharing his expertise on Chinese *Berberis* and also for his help in locating some type specimens, including *Berberis aristata* from BR. Thanks are also due to Dr John David for his help and suggestions on cultivated *Berberis*, and Anshu Bhattarai for her work on *Berberis* collection localities. We are also indebted to the curators of the following herbaria who provided specimens on loan and/or facilities on visits: BM, K, KATH and TUCH. In addition we are grateful to the curators of BR, CGE, G, OXF, TI, W and WU for providing images of *Berberis* specimens. Thanks to John Hunnex and Sven Landrein for their continuous help during several visits by the first author to the Natural History Museum, London and Royal Botanic Gardens Kew. We are also grateful to the reviewers Dr David Chamberlain and Julian Harber for their valuable comments on the manuscript. The project was funded by the University of Edinburgh, the Royal Horticultural Society and the Royal Botanic Garden Edinburgh.

References

Ahrendt, L. W. A. (1941). A survey of the genus *Berberis* L. in Asia. *J. Bot.* 79 (Suppl.): 1–80.

Ahrendt, L. W. A. (1942). A survey of the genus *Berberis* L. in Asia. *J. Bot.* 79 (Suppl.): 81–104.

Ahrendt, L. W. A. (1944a). A survey of the genus *Berberis* L. in Asia. *J. Bot.* 79 (Suppl.): 105–112.

Ahrendt, L. W. A. (1944b). Newcomers to the barberries: II. Old and new species from casual collections. *Gard. Ill.* 64: 425–426.

Ahrendt, L. W. A. (1945a). A survey of the genus *Berberis* L. in Asia. *J. Bot.* 79 (Suppl.): 113–116.

Ahrendt, L. W. A. (1945b). Some new and little known *Berberis* from India. *J. Roy. Asiat. Soc. Bengal (Sci.)* 11: 1.

Ahrendt, L. W. A. (1961). *Berberis* and *Mahonia*: A taxonomic revision. *J. Linn. Soc. Bot.* 57: 1–410.

Airy Shaw, H. K. (1965). Diagnoses of new families, new names, etc., for the seventh edition of Willis's Dictionary. *Kew Bull.* 18: 249–273.

APG II (2003). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG II. *Bot. J. Linn. Soc.* 141: 399–436.

APG III (2009). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. *Bot. J. Linn. Soc.* 161(2): 105–121.

BANERJI, M. L. (1964). Some salient features of East Nepal vegetation. *Candollea* 19: 215–219.

BISTA, M. S., ADHIKARI, M. K. & RAJBHANDARI, K. R. (eds) (2001). *Flowering Plants of Nepal (Phanerogams)*. Bulletin of Department of Plant Resources No. 18. Kathmandu, Nepal: Department of Plant Resources, National Herbarium and Plant Laboratories.

BRITTON, N. L. & BROWN, A. (1913). *An illustrated flora of the Northern United States, Canada and the British Possessions. Ed. 2. Vol. 2*. New York: Charles Scribner's Sons.

CANDOLLE, A. P. DE (1821). *Regni Vegetabilis Systema Naturale. Vol. 2*. Parisiis Sumptibus Sociorum Treuttel et Würtz.

CANDOLLE, A. P. DE (1824). *Prodromus Systematis Naturalis Regni Vegetabilis. Vol. 1*. Parisiis Sumptibus Sociorum Treuttel et Würtz.

CHAMBERLAIN, D. F. & HU, C. M. (1985). A synopsis of *Berberis* section *Wallichianae*. *Notes Roy. Bot. Gard. Edinburgh* 42(3): 529–557.

CHATTERJEE, R. (1953). Studies in Indian Berberidaceae from botanical, chemical and pharmaceutical aspects. *Rec. Bot. Surv. India* 16(2): 1–42.

DERMAN, H. (1931). A study of chromosome number in two genera of *Berberidaceae: Mahonia* and *Berberis*. *J. Arnold Arbor.* 12: 281–287.

DON, D. (1825). *Prodromus Florae Nepalensis*. Londini.

DON, G. (1831). *A general history of the dichlamydeous plants*. London: J.G. and F. Rivington.

FRASER-JENKINS, C. R. (2005). *The First Botanical Collectors in Nepal – The Fern Collections of Hamilton, Gardner and Wallich – Lost Herbaria, Lost Letters and Lost Books Somewhat Rediscovered*. Dehra Dun, India: Bishen Singh Mahendra Pal Singh.

GRIERSON, A. J. C. (1984). Berberidaceae. In: GRIERSON, A. J. C. & LONG, D. G. (eds) *Flora of Bhutan* 1(2): 322–328. Edinburgh: Royal Botanic Garden Edinburgh.

HOOKER, J. D. & THOMSON, T. (1855). *Flora Indica. Vol. 1*. London: W. Pamplin.

HOOKER, J. D. & THOMSON, T. (1872). *Berberis*. In: HOOKER, J. D. (ed.) *Flora of British India* 1(1): 108–112. London: L. Reeve & Co.

HUSAIN, T. & RAO, R. R. (1997). Identity and lectotypification of *Berberis khasiana* Ahrendt. *Rheedea* 7(1): 41–42.

HUTCHINSON, J. (1959). *The Families of Flowering Plants*. Oxford: Clarendon Press.

IUCN (2001). *IUCN Red List Categories and Criteria: Version 3.1*. Gland, Switzerland: IUCN Species Survival Commission, and Cambridge, UK: IUCN.

JUNSHENG, Y. (2011). *Berberis*. In: WU ZHENGYI, RAVEN, P. H. & DEYUAN, H. (eds) *Flora of China* 19: 715–771. Beijing: Science Press, and St Louis: Missouri Botanical Garden Press.

KER GAWLER, J. B. (1823). *Berberis chitria*. Nepal Barberry. *Bot. Reg.* 9: t. 729.

KIM, Y.-D. & JANSEN, R. K. (1994). Characterization and phylogenetic distribution of chloroplast DNA rearrangement in the Berberidaceae. *Pl. Syst. Evol.* 193: 107–114.

LAFERRIERE, J. E. (1997). Transfer of specific and infraspecific taxa from *Mahonia* to *Berberis* (Berberidaceae). *Bot. Zhurn.* 82(9): 96–99.

LANDRUM, L. R. (1999). Revision of *Berberis* (Berberidaceae) in Chile and adjacent southern Argentina. *Ann. Missouri Bot. Gard.* 86(4): 793–834.

LEMAIRE, C. A. (1859). *L'Illustration Horticole. Vol. 6*. Gand, Belgium: Imprimerie et lithographie de F. et E. Gyselnyck.

LINDLEY, J. (1841). *Berberis coriaria*. The Tanner's Berberry. *Edward's Bot. Reg.* 27: t. 46.

LINNAEUS, C. (1753). *Species Plantarum 1*. Stockholm.

MABBERLEY, D. J. (2008). *The Plant-Book*. Cambridge, UK: Cambridge University Press.

MANANDHAR, N. P. (2002). *Plants and People of Nepal*. Portland, OR: Timber Press.
MARROQUIN, J. S. & LAFERRIERE, J. E. (1997). Transfer of specific and infraspecific taxa from *Mahonia* to *Berberis*. *J. Arizona-Nevada Acad. Sci.* 30(1): 53–55.
MILLER, H. S. (1970). The herbarium of Aylmer Bourke Lambert: Notes on its acquisition, dispersal, and present whereabouts. *Taxon* 19(4): 489–553.
PRESS, J. R. & SHRESTHA, K. K. (2000). Collections of flowering plants by Francis Buchanan-Hamilton from Nepal, 1802–1803. *Bull. Brit. Mus., Nat. Hist. (Bot.)* 30(2): 101–130.
PRESS, J. R., SHRESTHA, K. K. & SUTTON, D. A. (2000). *Annotated Checklist of the Flowering Plants of Nepal*. London: The Natural History Museum.
QUATTROCCHI, U. (1947). *CRC World Dictionary of Plant Names*. Boca Raton, FL: CRC Press.
RAO, R. R., HUSAIN, T. & DUTT, B. (1994). An undescribed variety of *Berberis petiolaris* Wall. ex G.Don (Berberidaceae) from the Himalaya. *Bot. Bull. Acad. Sin.* 35: 229–232.
RAO, R. R., HUSAIN, T., DUTT, B. & GARG, A. (1998a). Revision of the family Berberidaceae of India: I. *Rheedea* 8(1): 1–66.
RAO, R. R., HUSAIN, T., DUTT, B. & GARG, A. (1998b). Revision of the family Berberidaceae of the Indian region: II. *Rheedea* 8(2): 109–143.
SCHNEIDER, C. K. (1904). Die Gattung *Berberis* (Euberberis). Vorarbeiten für eine Monographie. *Bull. Herb. Boissier* 2.5: 33–48.
SCHNEIDER, C. K. (1905). Die Gattung *Berberis* (Euberberis). Vorarbeiten für eine Monographie. *Bull. Herb. Boissier* 2.5: 133–148, 391–403, 449–464, 655–670, 800–831.
SCHNEIDER, C. K. (1908). Weitere beitrage zur kenntnis der gattung *Berberis* (Euberberis). *Bull. Herb. Boissier* 2.8: 192–204, 258–266.
SCHNEIDER, C. K. (1942). Die Berberis der section *Wallichianae*. *Mitt. Deutsch. Dendrol. Ges.* 55: 1–60.
STAPF, O. (1926). *Berberis lyciodes*. *Curtis's Bot. Mag.* 151: t. 9102.
TAKHTAJAN, A. (1969). *Flowering Plants: Origin and Dispersal*. Washington, DC: Smithsonian Institute Press.
TEBBS, M. C. (1979). Berberidaceae. In: HARA, H. & WILLIAMS, L. H. J. (eds) *An Enumeration of the Flowering Plants of Nepal. Vol. 2*. London: British Museum (Natural History).
TERABAYASHI, S. (1978). Studies in morphology and systematics of Berberidaceae, II: Floral anatomy of *Mahonia japonica* (Thunb.) DC. and *Berberis thunbergii* DC. *Acta Phytotax. Geobot.* 29: 106–118.
TERABAYASHI, S. (1987). Seedling morphology of the Berberidaceae. *Acta Phytotax. Geobot.* 38: 63–74.
WALLICH, N. (1829). *A Numerical List of dried specimens of plants in the East India Company's Museum*. London.

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