

REVISION OF *MECONOPSIS CASTANEA* (PAPAVERACEAE) AND ITS ALLIES¹

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Abstract. *Meconopsis castanea* and the related *M. georgei* and *M. bijiangensis* are revised, and a related new species, *M. atrovinosa*, is described and illustrated. A distribution map of the treated species is provided.

Keywords: *Meconopsis atrovinosa*, *Meconopsis bijiangensis*, *Meconopsis castanea*, *Meconopsis georgei*, section *Racemosae*, series *Racemosae*

The identification of *Meconopsis castanea* H. Ohba, T. Yoshida & H. Sun (Papaveraceae) has been confused by various botanists. Taylor (1934) treated *M. castanea* in a broad sense (including its hybrids) as *M. lancifolia* (Franch.) Franch. ex Prain var. *solitariifolia* Fedde, which belongs in section *Forrestianae* C.Y. Wu & H. Chuang. However, *M. lancifolia* differs from *M. castanea* of section *Racemosae* C.Y. Wu & H. Chuang in many features. C. Grey-Wilson (2014) treated *M. castanea* as a form of *M. georgei* G. Taylor. *M. castanea*, however, differs from *M. georgei* not only in flower color but in the inflorescence and other features mentioned below, making it reasonable and proper to treat it as distinct from the latter.

The confusion of *Meconopsis castanea* with *M. lancifolia* and *M. georgei*, and occasionally with Myanmar plants of *M. bijiangensis* H. Ohba, T. Yoshida & H. Sun, is partly due to ambiguity of the localities of specimens collected from 1921 to 1932, especially those of G. Forrest.

On specimens of *Meconopsis castanea sensu lato* collected by G. Forrest, the localities were written as Mekong [Lancang Jiang, 澜沧江]-Salwin [Nu Jiang, 怒江] divide, or Fuchuan Shan [富川山]; on specimens collected by J. F. Rock, who followed G. Forrest's routes, the localities were written as Mount Fu-Chuan, west of the Mekong-Salwin divide and west of Wei-hsi [Weixi, 维西], or Fuchuan range, Mekong-Salwin divide and west of Wei-hsi. The specimen of *G. Forrest 30101* wrongly records the locality as Fuchuan Shan, Mekong-Yangtze [Jinsha Jiang, 金沙江] divide. In fact, Fuchuan Shan is not part of the Mekong-Yangtze divide, but in the Mekong-Salwin divide. On these specimens, the flower color was given as pale to dark purplish rose and blue or deep purple crimson by G. Forrest and pale blue, bluish purple, and red or dark purple by J. F. Rock.

Although the name Fuchuan (富川) is not shown on maps published in China, it is shown on sheet 2 of the maps accompanying Rock (1947) to be a large village located around 26°55'57"N, 99°08'32"E, on the eastern foot of Biluo

Xueshan (碧罗雪山), or the southern part of Nu Shan (怒山), or in the Mekong-Salwin divide.

Fuchuan had been a prosperous village at the junction of trade routes supplied with many forest products such as timber, walnuts, medicinal plants, and lacquerware in the days when Forrest and Rock visited and before the modern motor road was constructed along the bottom of the Lancang Jiang valley. From Fuchuan to the west, a well-trodden path connects to Lumadeng (鹿马登), which is located near the bottom of Nu Jiang valley via Xinhua (新化) village and the pass on the main ridge of Biluo Xueshan. No other path, except for narrow, tricky footpaths, crossed the main ridge of Biluo Xueshan in the region west of Weixi. "Fuchuan Shan" on Forrest's specimens is considered to refer to the mountainous area around the pass (Fig. 1, 2).

Meconopsis georgei G. Taylor was also collected by Forrest and Rock in a region similar to where *M. castanea sensu lato* was collected. The localities given for *M. georgei* by Forrest were written on the specimen as Fuchuan Shan, Mekong-Yangtze [mistaken for Salwin] divide, or simply as Wei-hsi area; those collected by Rock were written as Fuchuan range, west of the Mekong-Salwin divide and west of Wei-hsi. The flower color was given as clear primrose-yellow on *Forrest 30100*, and yellow on *Rock 22696*. Taylor (1934) recognized these specimens as being a distinct species, *M. georgei* G. Taylor, and different from *M. castanea sensu lato*, which he treated as *M. lancifolia* (Franch.) Franch. ex Prain var. *solitariifolia* Fedde. He (Taylor, 1934) wrote in a note under *M. georgei*, "The specific epithet commemorates George Forrest, who discovered the species in the Fu-chuan mountains in 1931 during his last expedition. It was collected the following year by Rock in the same mountains, and specimens have also been sent to this country by Forrest's native collectors. As seed accompanied these collections it may be hoped that the species, which in nature grows on scree, will become established in gardens. It is quite unlike the other yellow-

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¹ Comments in the text placed in between square brackets are by the authors.

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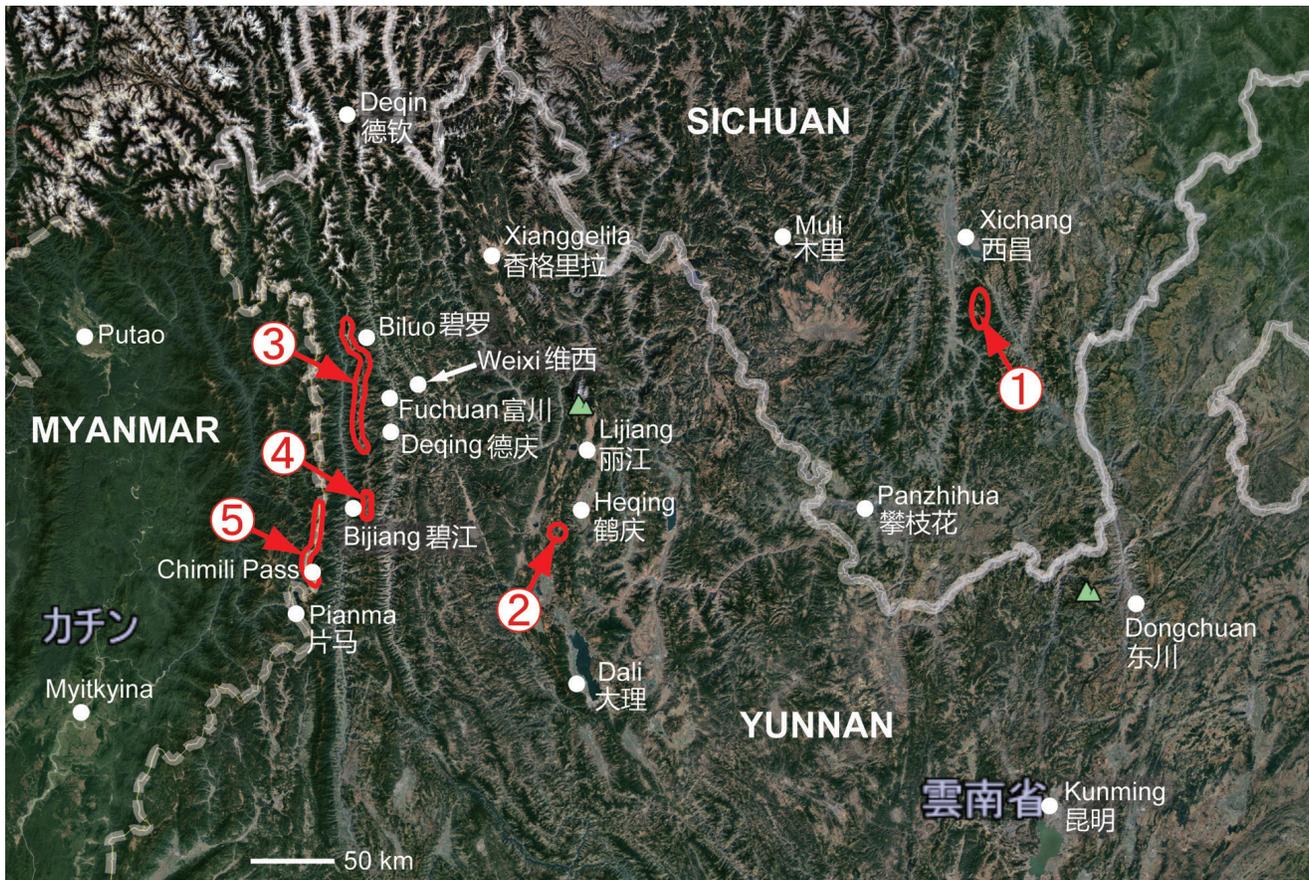


FIGURE 1. Distribution map of *Meconopsis castanea* H. Ohba, T. Yoshida & H. Sun and allies based on Google Earth with supposed delineations of five regions that each include the locality of at least one specimen of the species. Region 1: SW Sichuan, Luoji Shan; Region 2: NW Yunnan, Heqing Xian; Region 3: NW Yunnan, Fugong Xian and Weixi Xian, Biluo Xueshan (southern part of Nu Shan); Region 4: NW Yunnan, Bijiang region, Biluo Xueshan (southernmost part of Nu Shan); Region 5: NE Myanmar, Kachin State, western slopes of Gaoligong Shan around Chimili Valley, and NW Yunnan, Bijiang region, Gaoligong Shan. Treated species with their distribution regions: *M. atrovinosa* T. Yoshida & H. Sun (Regions 1, 2); *M. bijiangensis* H. Ohba, T. Yoshida & H. Sun (Regions 4, 5); *M. castanea* H. Ohba, T. Yoshida & H. Sun (Region 3); *M. georgei* G. Taylor (Region 3).

flowered members of the genus in having harsh prickles, while the flowers are borne on comparatively long pedicels arising near the base of the stem.

In the summer of 2008, one of us (Yoshida) crossed Biluo Xueshan by following narrow footpaths between Laowo (老窝), west of Deqing (德庆) on the eastern flank of Biluo Xueshan, and Fugong (福贡), located near the bottom of the Nu Jiang gorge, and collected the type specimens of *Meconopsis castanea*, T. Yoshida K3, on the western side of the main ridge. The flowers of these plants were dark red.

In the following summer of 2009, Yoshida visited the pass on the route between Xinhua (新化), located west of Fuchuan village, and Luomadeng, located on the eastern bank of the Nu Jiang, and collected specimens (T. Yoshida K20) of *Meconopsis* aff. *castanea*. Most plants in the population around the pass were on the eastern side of the pass, but some plants were also close to the pass on the western side. The flowers of this population were pale purplish blue, pale pink or whitish, occasionally deep red, with populations of

plants with different flower colors growing together. No plants of *M. georgei* with yellow flowers were found around the pass.

In 2011, Yoshida visited Biluo Xueshan by following narrow footpaths from Tuobaluo (托八洛), west of Biluo Cun (碧罗村), and collected specimens (T. Yoshida K68) of *Meconopsis castanea* on west- or south-facing gentle slopes on the main ridge of Biluo Xueshan. The flowers of those plants were dark red.

On the basis of our collaborative studies of the specimens, photographs, literature, and geography of *Meconopsis castanea* sensu lato, we have determined that T. Yoshida K20 is a hybrid between *M. castanea* and *M. georgei* and that many of the specimens collected by Forrest and Rock on Fuchuan Shan and on Biluo Xueshan west of Weixi are also hybrids between the two species, although it is difficult to distinguish hybrids from *M. castanea* in old specimens.

The specimens of the taxa treated below were assigned to regions to generate the distribution map (Fig. 1).

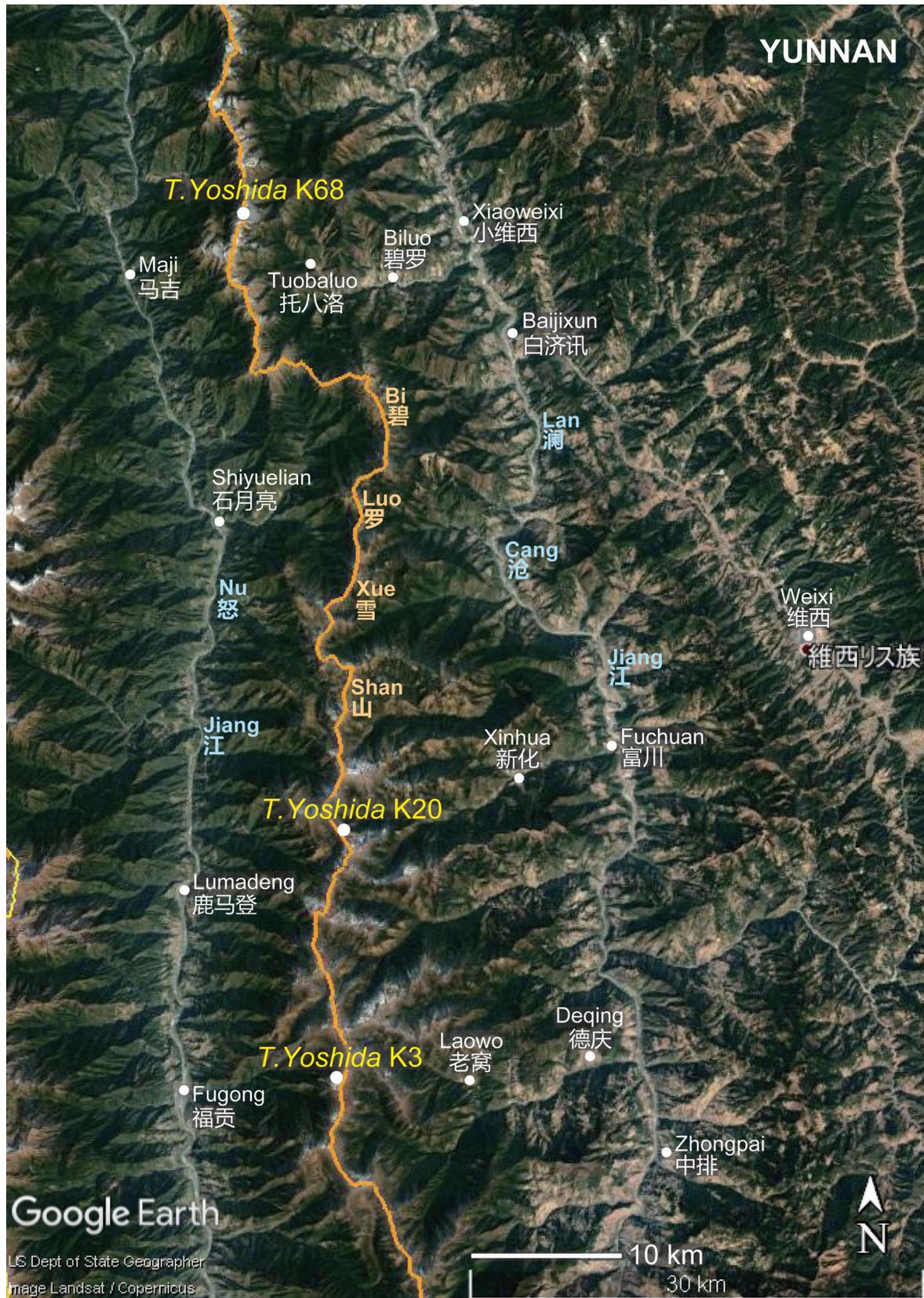


FIGURE 2. Enlarged map of Region 3 based on Google Earth with specimen localities of *Meconopsis castanea* H. Ohba, T. Yoshida & H. Sun, *T. Yoshida K3* and *K68*, and its hybrid with *M. georgei* G. Taylor, *T. Yoshida K20*.

TAXONOMY

Meconopsis section Racemosae C.Y. Wu & H. Chuang series ***Racemosae*** C.Y. Wu & H. Chuang, *Acta Bot. Yunnan.* 2 (4): 374 (1980), emend. excl. series *Grandes*.

The section *Racemosae* and the series *Racemosae* were revised by C. Grey-Wilson in *The Genus Meconopsis—Blue Poppies and Their Relatives* (2014: 45).

Herbs, monocarpic, most parts prickly with spine-like hairs. Inflorescence a raceme, usually simple, or occasionally scapose (*M. horridula*) or subscapose (*M. georgei* and *M. horridula*), ebracteate except lowermost flowers. Petals 4–9, blue, mauve, purple, pink, or occasionally dark purple, dark red, yellow, or white. Filaments filiform or thickly filiform,

similar to or darker than petals in color, occasionally with whitish vascular bundles protruding from apex (*M. elongata* and *M. atrovinosa*).

Thirteen species are included in series *Racemosae*: *M. atrovinosa* T. Yoshida & H. Sun, *sp. nov.*; *M. bijiangensis* H. Ohba, T. Yoshida & H. Sun; *M. castanea* H. Ohba, T. Yoshida & H. Sun; *M. elongata* T. Yoshida, R. Yangzom & D.G. Long; *M. georgei* G. Taylor; *M. horridula* Hook. f. & Thomson; *M. lhasaensis* Grey-Wilson; *M. merakensis* T. Yoshida, R. Yangzom & D.G. Long; *M. prainiana* Kingdon-Ward; *M. prattii* Prain; *M. racemosa* Maxim.; *M. rudis* (Prain) Prain; and *M. zhondianensis* Grey-Wilson.

KEY TO *MECONOPSIS CASTANEA* AND RELATED SPECIES

- 1a. Inflorescence subscapose, with short rachis and long ascending pedicels; petals yellow, apex triangular, acute or acuminate. *M. georgei*
 1b. Inflorescence racemose; petals blue, mauve, purple, pink, or occasionally dark purple, dark red, or white, apex rounded or obtuse. 2
 2a. Flowers deeply cup-shaped; petals 4, rarely 5 or 6, mauve or pale purple; capsules 2.0–4.7 cm long *M. bijiangensis*
 2b. Flowers dish-, bowl-, or cup-shaped; petals (4–)5–9, maroon, dark red, dark wine-colored, or dark purple; capsules 1.5–3.0 cm long 3
 3a. Prickles pale brown or reddish-brown, not tinged dark purple at base; margin of lamina coarsely and irregularly crenate, toothed or lobed; petals 4 or more; anthers orange; capsules 2–3 cm long *M. castanea*
 3b. Prickles pale yellowish green, tinged dark purple at base; margin of lamina usually entire; petals 5 or more; anthers dull yellow tinged dark purple; capsules 1.5–2.0 cm long *M. atrovinosa*

Meconopsis georgei G. Taylor, *The Genus Meconopsis* 86. 1934. TYPE: CHINA. NW Yunnan, Fugong Xian (福贡县): Fuchuan Shan [富川山], Mekong-Yangtze [mistake for Salwin] divide, 12,000–13,000 ft, July–August, 1931, *G. Forrest 30100* (Holotype: E; Isotype: BM). Fig. 1–5.

Herbs, monocarpic, 15–32 cm tall. Taproot elongate, to 10 cm long or more, 5–10 mm across, contracted at junction with stem. Most parts of plant prickly; prickles to 5 (–7) mm long. Stem (below lowermost flower) simple, 1.5–6.0 cm long, mostly underground. Leaves alternate on short stem, petiolate; petiole membranous, linear or broadly linear, 3–7 cm long, 1–4 mm wide; lamina oblanceolate, lanceolate, or oblong, occasionally linear-oblong, or elliptic or ovate on lowest leaves, 1.5–11.0 cm long, 0.5–2.0 cm wide, base attenuate or occasionally cuneate, margin entire or occasionally coarsely crenate or toothed, apex acute, acuminate or occasionally obtuse. Inflorescence subscapose with short rachis and long ascending pedicels, ebracteate except for a few flowers near base of inflorescence; rachis 2–5 mm across near base in dried specimens; bracts similar to leaves but with shorter petiole; pedicels 5–15 cm long. Flowers 5–9, 3-dimensional shape unknown. Calyx 0.8–1.5 cm long. Petals (4 or)5–8, yellow, rhombic-elliptic or obovate, 2.5–3.3 cm long, 0.8–1.7 cm wide, base cuneate, margin irregularly denticulate near apex, apex triangular, acute or acuminate. Stamens numerous; filaments filiform, 7–12 mm long; anthers oblong, 0.8–2.0 mm long, color unknown. Ovary ovoid, 7–12 mm long, with dense ascending prickles; style 2–6 mm long in flower; stigma capitate, 1.0–1.8 mm across. Capsules ellipsoid, 1.7–2.4 cm long, 6–15 mm across, with dense prickles; carpels 3–5, often 4, dehiscent in upper 1/5–1/4.

Distribution: CHINA. NW Yunnan: Fugong Xian (福贡县), Fuchuan Shan [富川山], or Biluo Xueshan (碧罗雪山), 3600–4350 m.

Habitat: open stony alpine meadows (according to Forrest); in scree (according to Rock).

Specimens examined: CHINA. NW Yunnan, Fugong Xian, Biluo Xueshan, **Region 3:** Fuchuan Shan, Mekong-Yangtze divide, lat. 27°N, long. 99°30'E. [Fuchuan Shan is not on the Mekong-Yangtze divide, but on the Mekong-Salwin divide as indicated on Rock's specimens, *J. F. Rock 22696, 23287*], July–August 1931, *G. Forrest 30100* (BM, E); Wei-hsi area, 1931, *G. Forrest 30595* (BM, E); Fuchuan range, west of the Mekong-Salwin divide and west of Wei-hsi, alt. 13,500–14,500 ft, May–June, 1932, *J. F. Rock 22696* (BM, K); same locality, August–September 1932, *J. F. Rock 23287* (K).

Meconopsis bijiangensis H. Ohba, T. Yoshida & H. Sun, *J. Jap. Bot.* 84 (5): 294. 2009. TYPE: CHINA. NW Yunnan, Fugong Xian (福贡县): Bijiang (碧江) region, Biluo Xueshan (碧罗雪山), around the head of Pi-he (匹河) valley, 3700–4000 m, 8 July 2008, *T. Yoshida K1* (Holotype: KUN; Isotypes: KUN, TI). Fig. 1, 6–10.

Homotypic Synonym: *M. bijiangensis* H. Ohba, T. Yoshida & H. Sun subsp. *chimaliensis* Grey-Wilson, *The Genus Meconopsis—Blue Poppies and Their Relatives* (2014: 271).

Herbs, monocarpic, 15–40 cm tall in flower. Taproot elongate, to 15 cm long or more, 5–13 mm across. Most parts of plant prickly; prickles pale brown or amber, to 4 mm long, moderately stiff, borne on raised, rounded, or elliptical pustules tinged dark purple. Stem (below lowermost flower) simple, 3–10 cm long, 5–12 mm across. Basal leaves petiolate; petiole membranous, broadly linear, 3–10 cm long, 2–4 mm wide; lamina ovate or lanceolate, 2.5–10.0 cm long, margin coarsely crenulate or subentire. Stem leaves and bracts short petiolate or sessile; lamina linear-oblong with parallel sides, 5–15 cm long, 7–17 mm wide, base attenuate,



FIGURE 3. Holotype of *Meconopsis georgei* G. Taylor, *G. Forrest 30100* (E) from “Fu-chuan Shan,” with note “Flowers clear primrose-yellow.”



FIGURE 4. Isotype of *Meconopsis georgei* G. Taylor, G. Forrest 30100 (BM), with apex of petal magnified.



FIGURE 5. Fruiting specimen of *Meconopsis georgei* G. Taylor, J. F. Rock 23287 (K), collected on “Fuchuan range, west of the Mekong-Salwin divide and west of Wei-hsi.”



FIGURES 6–9. **6.** *Meconopsis bijiangensis* H. Ohba, T. Yoshida & H. Sun at the type locality. Photograph by T. Yoshida, July 8, 2008. **7.** *Meconopsis bijiangensis* H. Ohba, T. Yoshida & H. Sun at the type locality. Photograph by T. Yoshida, July 8, 2008. **8.** Habitat of *Meconopsis bijiangensis* H. Ohba, T. Yoshida & H. Sun at the type locality. Photograph by T. Yoshida, July 8, 2008. **9.** Dead plant of *Meconopsis bijiangensis* H. Ohba, T. Yoshida & H. Sun with previous year's capsules at the type locality. Photograph by T. Yoshida, July 8, 2008.



FIGURE 10. Type specimen of *Meconopsis bijiangensis* H. Ohba, T. Yoshida & H. Sun subsp. *chimiliensis* Grey-Wilson, R. J. Farrer 1159 (E), collected in NE Myanmar, Chimili Valley, Hpawshi Bum, with provisional name *M. "cyanochlora"* by the collector.

margin coarsely crenate or toothed, sometimes undulate, occasionally subentire, apex obtuse to acute, upper surface dark green, somewhat shiny, sometimes tinged dark purple along margin, lower surface somewhat paler, both surfaces with dense patent prickles. *Inflorescence* a simple raceme occupying most of plant above ground, ebracteate except on lowermost third to fifth; *pedicels* 2–12 cm long in flower, to 15 cm long in fruit, densely prickly. *Flowers* 7–12, often 10, deeply cup-shaped, usually nodding. *Calyx* 1.2–1.7 cm long, with dense spreading prickles. *Petals* 4, rarely 5 or 6, pale mauve or pale purple, rounded, broadly ovate or elliptic, 2.0–3.5 cm long, 1.7–3.5 cm wide, margin entire, sometimes denticulate and minutely undulate near apex, apex rounded or obtuse. *Stamens* numerous; *filaments* somewhat darker than petals, filiform, 7–10 mm long; *anthers* orange, ellipsoid or oblong, 1.5–2.0 mm long. *Ovary* ellipsoid, 5–10 mm long, with dense ascending prickles. *Style* 2.5–5.0 mm long, to 7 mm long in fruit. *Stigma* capitate, 1.0–1.5 mm across. *Capsules* cylindrical-ellipsoid, narrowly ellipsoid or narrowly obovoid, 2.0–4.7 cm long, 6–13 mm across, 3- to 4-grooved, with dense spreading prickles shorter than those on stem. *Seeds* black, reniform, 2.0–2.3 mm long, longitudinally wrinkled or obscurely pitted.

Distribution: CHINA. NW Yunnan: Bijiang (碧江) region, Biluo Xueshan (between 26°37'24"N, 99°00'48"E and 26°31'10"N, 99°00'35"E) and Gaoligong Shan (高黎贡山). MYANMAR. Kachin State: western slopes of Gaoligong Shan around Chimili valley, 3500–4000 m.

Habitat and ecology: on Biluo Xueshan, *Meconopsis bijiangensis* is often gregarious on west-facing (Nu Jiang side), gentle, stony alpine slopes near the main ridge, sometimes among dwarf shrubs of *Rhododendron*, just above the steep head of valleys where ascending foggy winds from the southwest summer monsoon gather and swiftly flow over the slopes and bring moisture to the plants growing there; rooting in thick, dry, peaty soils derived from half-decomposed mosses and other plants. Alpine meadows, moors, or rarely rocky places, according to the specimen, *R. J. Farrer 1159*, collected in Chimili, NE Myanmar.

Additional specimens examined: MYANMAR. Kachin State, western slopes of Gaoligong Shan around Chimili valley, **Region 5:** Hpawshi Bum, 11,000–12,500 ft, 1 August 1919, *R. J. Farrer 1159* (E) [The plant was referred as “a new Poppy” in E. H. M. Cox’s *Farrer’s Last Journey* (1926: 131)]; western flank of Chimi-li, N’Maikha-Salwin divide, 26°23'N, 98°48'E, 11,000–12,000 ft, June 1924, *G. Forrest 24655* (E); same locality, August 1924, *G. Forrest 24886* (E, K); western flank of N’Maikha-Salwin divide, N of the Chimi-li, 26°35'N, 98°48'E, 12,000–13,000 ft, June 1925, *G. Forrest 26831* (BM, E, K); western flank of N’Maikha-Salwin divide, 26°24'N, 98°48'E, 12,000 ft, June 1925, *G. Forrest 26902* (BM, E, K); same locality, October 1925, *G. Forrest 27277* (E, K); western flank of the N’Maikha-Salwin divide, N of the Chimili, 26°35'N, 98°48'E, 12,000–13,000 ft, at the same location as *G. Forrest 26831*, October 1925, *G. Forrest 27284* (E, K); Chimili, 1931, *G. Forrest 29934* (BM, E). CHINA. NW Yunnan, Bijiang region, Gaoligong Shan, **Region 5:** Bijiang Gaoligong Shan (碧江高黎贡山), on the main ridge of the range running along the boundary

between China and Myanmar (中缅国界境山背上), 14 July 1978, *Bijiang Research Team* (碧江考查队) 1135 (KUN). NW Yunnan, Bijiang region, Biluo Xueshan, **Region 4:** Bijiang Biluo Xueshan (碧江碧罗雪山), near Jiumingfang (救命房附近), 4250 m, 12 September 1964, *Sugong Wu* (武素功) 8832 (KUN) [The roots are used for an indigenous drug with a name of Paoshen, 泡参, according to the note]; Bijiang Xian (碧江县), Biluo Xueshan Longtan (碧罗雪山龙潭), 3900–4000 m, 16 June 1978, *Nujiang Research Team* (怒江考查队) 0848 (KUN); around the head of Pi-he (匹河) valley, 3700–4000 m, 8 July 2008, *T. Yoshida K1* (KUN, TI).

Bijiang region refers to the former Bijiang Xian (碧江县). In 1986 the northern part of Bijiang Xian was incorporated in Fugong Xian and the southern part was incorporated in Lushui Xian.

Gaoligong Shan runs along the boundary between Kachin State, Myanmar, and Fugong Xian (福贡县) and Lushui Xian (泸水县) in Yunnan, China. The location of Chimili, on specimens collected by G. Forrest and R. J. Farrer, appears on the map on the front page of F. Kingdon-Ward’s (1949) *Burma’s Icy Mountains* as “Chimeli” Pass, which is located on the boundary between Myanmar (Burma) and China, as indicated here in Fig. 1.

Grey-Wilson (2014) described *Meconopsis bijiangensis* subsp. *chimiliensis* Grey-Wilson in his monograph of *Meconopsis* for the population of *M. bijiangensis* in Myanmar on the basis of differences in diagnostic characters from the typical plant that include greater height, larger leaves with longer petioles, and relatively narrower fruit capsules. However, plants within a population can vary continuously and are not distinguishable from typical plants as different taxa. Grey-Wilson, in his monograph of *Meconopsis* (2014: 276), wrongly indicated the distribution of *M. bijiangensis* subsp. *chimiliensis* to be west of N’Maikha, a tributary of the Irrawaddy (Ayeyarwady), far from the boundary between Myanmar and China. There are no mountains taller than 3000 m elevation where *M. bijiangensis* can grow in the region marked by him.

Meconopsis castanea H. Ohba, T. Yoshida & H. Sun, *J. Jap. Bot.* 84 (5): 300. 2009. TYPE: CHINA. NW Yunnan, Fugong Xian (福贡县): S of Laowo Shan (老窝山) on Biluo Xueshan (碧罗雪山), between 26°55'35"N, 98°57'56"E and 26°56'11"N, 98°58'58"E, 3650–4000 m, 17 July 2008, *T. Yoshida K3* (Holotype: KUN; Isotypes: KUN, TI). Fig. 1–2, 11–16.

Homotypic synonym: *M. Georgei* G. Taylor forma *castanea* Grey-Wilson, *The Genus Meconopsis—Blue Poppies and Their Relatives* 274. 2014.

Herbs, monocarpic, 20–40 cm tall in flower, to 50 cm or more in fruit. *Taproot* elongate, 10–25 cm long, 5–10 mm across. Most parts of plant moderately or densely prickly; *prickles* pale brown or reddish-brown, to 4(–5) mm long, moderately stiff, without blackish spots at base. *Stem* (below lowermost flower) simple, 2.5–10.0 cm long, 4–7 mm across. *Basal leaves* petiolate; *petiole* membranous, broadly linear, 3–7 cm long, 2.5–4.0 mm wide; *lamina* ovate, elliptic or lanceolate, 3–5 cm long, margin coarsely



FIGURES 11–12. **11.** *Meconopsis castanea* H. Ohba, T. Yoshida & H. Sun at the type locality, 4000 m elevation. Photograph by T. Yoshida, July 17, 2008. **12.** *Meconopsis castanea* at the type locality, 3650 m elevation. Photograph by T. Yoshida, July 16, 2008.

crenulate, or subentire in smaller leaves. *Stem leaves and bracts* short petiolate or sessile; *lamina* ovate, lanceolate, oblanceolate, oblong, or more often linear-oblong, 5–12 cm long, 5–20 mm wide, base attenuate, margin coarsely and irregularly crenate, toothed or lobed, apex obtuse or acute, upper surface green, lower surface somewhat paler, whitish in dried specimens, both surfaces with spreading prickles, somewhat densely so on upper surface. *Inflorescence* a simple raceme occupying most of plant above ground, ebracteate except in lower half; *rachis* 4–7 mm across near base in dried flowering specimens; *pedicels* 2.5–7.0 cm long in flower, to 15 cm long in fruit. *Flowers* 6–10, often 8, dish- or cup-shaped, usually half nodding. *Calyx* 10–14 mm long, with dense spreading prickles. *Petals* 5–9, occasionally 4, maroon, dark red or dark reddish-purple, obovate, rounded, ovate, elliptic, 2.5–3.5 cm long, 1.3–2.5 cm wide, margin entire, sometimes denticulate near apex, apex rounded or obtuse. *Stamens* numerous; *filaments* darker than petals, filiform, 7–10 mm long; *anthers* orange, oblong, 1.7–2.0 mm long. *Ovary* ellipsoid, 5–8 mm long, with dense ascending prickles; *style* 2–5 mm long in flower, to 7 mm long in fruit; *stigma* capitate, 1.5–2.5 mm across. *Capsules* obovoid, ellipsoid or cylindrical-ellipsoid, 2–3 cm long, 6–10 mm across, with dense spreading prickles.

Distribution: CHINA. NW Yunnan: Fugong Xian (福贡县) and Weixi Xian (维西县), Biluo Xueshan (碧罗雪山),

or the southern Nu Shan (怒山), 3650–4150 m elevation.

Habitat and ecology: on steep boulder slopes partly covered with mosses or stony alpine slopes thinly covered with lichens, mosses, and other dwarf plants exposed to wet summer monsoon; rooting deeply into blackish muddy soil among stones.

Additional specimens examined: CHINA. NW Yunnan, Biluo Xueshan, Fugong Xian and Weixi Xian, **Region 3:** Mekong-Salwin divide, 27°30'N, 98°56'E, 13,000 ft, July 1921, *G. Forrest 19490* (BM); same locality, July 1921, *G. Forrest 19790* (BM, E); west of Tuobaluo (托八洛) and Biluo Cun (碧罗村), on the boundary between Fugong Xian and Weixi Xian, 27°25'31"N, 98°54'55"E, 3850–3950 m, 22 July 2011, *T. Yoshida K68* (KUN).

Forrest 19490 and *19790* were collected in the same locality. If the coordinates recorded on the specimens are accurate, the location is on the northern periphery of the distribution of *Meconopsis castanea*, indicated as Region 3 in Fig. 1.

Forrest 19790 (E) is unusually branched at the base with 5 flowering branches (Fig. 16). As already suggested by C. Grey-Wilson (2014: 274) in his monograph of the genus, the branching may be due to damage of the young shoot. However, such branching sometimes occurs in *Meconopsis elongata* T. Yoshida, R. Yangzom & D.G. Long of series *Racemosae*, which is somewhat related to *M. castanea*.



FIGURE 13. *Meconopsis castanea* H. Ohba, T. Yoshida & H. Sun (*T. Yoshida K68*) on Biluo Xueshan, west of Tuobaluo and west of Biluo Cun, 3800 m elevation. Photograph by T. Yoshida, July 22, 2011.



FIGURES 14–15. **14.** Habitat of *Meconopsis castanea* H. Ohba, T. Yoshida & H. Sun at the type locality, 3750 m elevation. Photograph by T. Yoshida, July 17, 2008. **15.** Habitat of *Meconopsis castanea* (T. Yoshida K68), on west-facing slope of Biluo Xueshan, west of Tuobaluo and west of Biluo Cun, 3900 m elevation. Photograph by T. Yoshida, July 22, 2011.



FIGURE 16. Specimen of *Meconopsis castanea* H. Ohba, T. Yoshida & H. Sun, *G. Forrest* 19790 (E), an odd plant unusually branched from base of stem, collected on "Mekong-Salwin divide, 27°30'N, 98°56'E."

These species have a tendency for unusual branching.

C. Grey-Wilson (2014) treated *Meconopsis castanea* as a form of *M. georgei* G. Taylor. However, *M. castanea* is a distinct species, different from the related *M. georgei* in being larger, to 40 cm tall in flower (to 32 cm tall in flower in the latter), having the margin of the lamina coarsely and irregularly crenate, toothed, or lobed or occasionally subentire (usually entire in the latter), in the racemose inflorescence with elongate thicker rachis to 7 mm across in flower and shorter pedicels to 7 cm long in flower (subscapose with a short, narrower rachis to 5 mm across in flower and long ascending pedicels, to 15 cm long in flower, in the latter), dark red petals (yellow in the latter) with margin usually entire (irregularly denticulate near the apex in the latter) and apex rounded or obtuse (triangular-acute or acuminate in the latter) and the capsules larger, to 3.0 cm long (to 2.4 cm long in the latter).

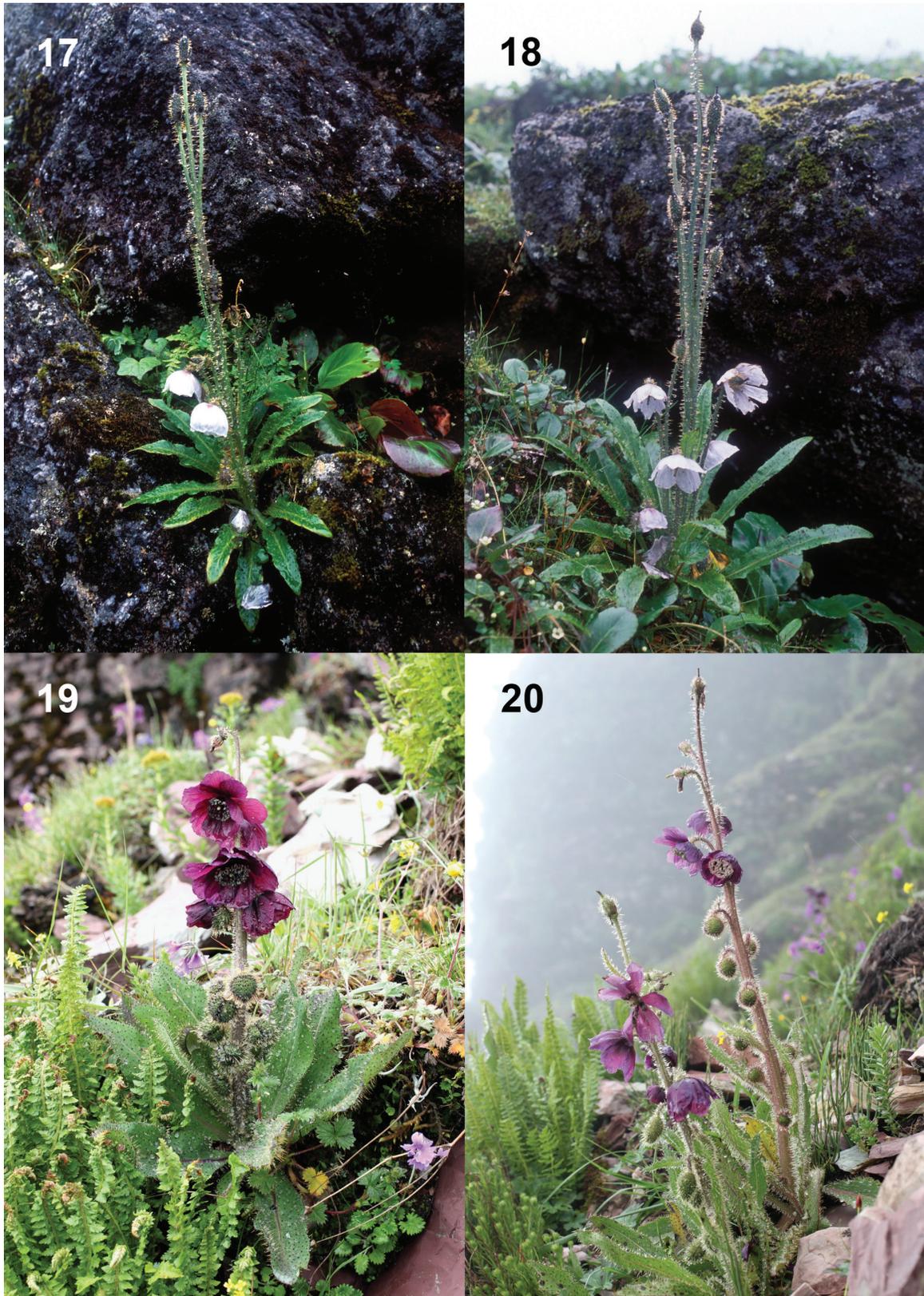
Additional specimens examined of *Meconopsis castanea sensu lato* (including hybrids with *M. georgei*): CHINA. NW Yunnan, Biluo Xueshan, Fugong Xian or Weixi Xian, **Region 3:** Fuchuan Shan (富川山), 1931, *G. Forrest 30099* (BM, E) [Petals blue according to note]; Fuchuan Shan, Mekong-Yangtse [mistake for Salwin] divide, 27°N, 99°30'E, 13,000 ft, July–August, 1931, *G. Forrest 30101* (BM, E) [petals deep purple crimson according to note]; Ma-k'a-ho, Wei-hsi [Weixi, 维西], July 1932, *McLaren "D" Collection 134* (E); Mount Fu-Chuan [富川], southwest of Wei-Hsi [维西, Weixi], Mekong-Salwin divide, 4450 m, May–June 1928, *J. F. Rock 17029* (E) [Flower color is pale blue according to the note]; Fuchuan range, west of the Mekong-Salwin divide and west of Wei-hsi, 13,500–14,500 ft, May–June 1932, *J. F. Rock 22697* (E) [Flower color bluish purple and red according to note]; same locality and date, *J. F. Rock 22699* (BM, E, K) [Flower color is dark purple according to the note]; same locality, August–September 1932, *J. F. Rock 23253* (BM, E); same locality and date, *J. F. Rock 23286* (E); mountain of Weixi region (维西后山), Fuchuan Shan (富川山), without collection number and date, *KUN No. 0201676* (KUN) [Flower color deep red according to note]; mountain of Weixi region (维西后山), without collection number and date, *KUN No. 0201677* (KUN); same locality, *KUN No. 0201689* (KUN); mountain of Weixi region (维西后山), Fuchuan Shan (富川山), without collection number and date, *KUN No. 0201693* (KUN) [Flower color deep red according to note]; around pass on main ridge of Biluo Xueshan, west of Xinhua (新化) and west of Fuchuan (富川), 27°04'14"N, 98°58'36"E, 3650–3850 m, 23 July 2009, *T. Yoshida K20* (KUN) [Flower color pale purplish blue, pale pink, or whitish, occasionally deep red]. Fig. 2, 17, 18.

Meconopsis atrovinosa T. Yoshida & H. Sun, *sp. nov.* TYPE: CHINA. SW Sichuan: Luoji Shan (螺髻山), near boundary of Xichang Shi (西昌市), Puge Xian (普格县) and Dechang Xian (德昌县), 27°36'02"N, 102°20'45"E, 4000 m, 1 July 2013, *T. Yoshida K90* (Holotype: KUN; Isotypes: E, TI); same locality, 2 September 2012, *T. Yoshida K80* (Paratypes: E, KUN, TI). Fig. 1, 19–23.

Meconopsis atrovinosa resembles *M. castanea* H. Ohba, T. Yoshida & H. Sun, but differs from the latter in having

prickles tinged dark purple at the base (usually not tinged at the base in the latter), the lamina elliptic, oblong, or oblanceolate, margin usually entire (often linear-oblong, margin coarsely and irregularly crenate, toothed or lobed in the latter), the flowers 7–25 (6–10 in the latter), the petals 5 or more (4 or more in the latter), the anthers dull yellow tinged dark purple (orange in the latter), the capsules to 2 cm long (to 3 cm long in the latter). *Meconopsis atrovinosa* resembles *M. racemosa* Maxim. and *M. prattii* Prain, but differs from these species in the prickles tinged dark purple at the base (usually not tinged at the base in these species), the petals dark wine colored or dark purple (bluish purple in these species), the filaments similar to or darker than the petals, thickly filiform, occasionally with whitish vascular bundles protruding from the apex (similar to petals in color, filiform, without whitish vascular bundles protruding from the apex in these species), the anthers dull yellow tinged dark purple (yellow or orange in these species), the capsules larger, to 2.0 cm long (to 1.7 cm long in *M. racemosa*, to 1.5 cm long in *M. prattii*). *Meconopsis atrovinosa* resembles *M. elongata* T. Yoshida and R. Yangzom & D.G. Long (Yoshida et. al., 2016) especially in the thick, darker filaments with the whitish vascular bundle protruding from the apex, but differs from the latter in petal color (pale blue or pink in the latter), the whitish vascular bundle of filaments inconspicuously protruding to 0.8 mm from the apex (conspicuously protruding to 2 mm from the apex in the latter), the anthers tinged dark purple (not tinged in the latter), and shorter capsules to 2.0 cm long (to 3.5 cm long in the latter).

Herbs, monocarpic, 25–47 cm tall in flower, to 60 cm tall in fruit. *Taproot* elongate, to 30 cm long or more, 7–11 mm across. Most parts of plant densely prickly; *prickles* pale yellowish green, uneven in length, to 4(–5) mm long, rather thin but hard, base broadened and unequally tinged dark purple. *Stem* (below lowermost flower) simple, 2.3–5.0(–8.0) cm long, 7–9 mm across. *Leaves* crowded near base of stem, petiolate; *petiole* broadly linear, 3–6 cm long, 2–4 mm wide; *lamina* elliptic, oblong, or oblanceolate, 5–13 cm long, 1.5–3.0 cm wide, base cuneate or attenuate, margin usually entire, sometimes coarsely toothed or sinuate, apex obtuse, acute or acuminate, both surfaces with patent prickles. *Upper leaves (bracts)* shortly petiolate or sessile; *lamina* oblong or oblanceolate, 2–5 cm long, 7–12 mm wide. *Inflorescence* a simple raceme occupying most of plant above ground, upper half to two-thirds of flowers ebracteate; *pedicels* 1.5–5.0 cm long in flower, to 18 cm long in fruit; rachis and pedicels densely hairy with patent prickles. *Flowers* 7–25, nodding or half nodding, dish- or bowl-shaped, occasionally cup-shaped, 2.5–3.5 cm across. Calyx 10–15 mm long; petals 5–7(–9), dark wine colored or dark purple, occasionally chocolate colored, or rarely red (*R. C. Ching 23487* from Heqing), obovate or broadly obovate, 1.7–3.0 cm long, 1–2 cm wide, margin subentire, sometimes irregularly crenulate, apex obtuse or rounded; *stamens* numerous; *filaments* similar to or darker than petals in color, thickly filiform, 7–11 mm long, occasionally with whitish vascular bundles protruding to 0.8 mm beyond apex; *anthers* dull yellow tinged dark purple to various degrees or often entirely dark purple, 1.0–1.5 mm



FIGURES 17–20. **17.** *Meconopsis castanea* H. Ohba, T. Yoshida & H. Sun \times *georgei* G. Taylor (*T. Yoshida K20*) with whitish flowers; east side of Biluo Xueshan, west of Xinhua and west of Fuchuan, 3800 m elevation. Photograph by T. Yoshida, July 23, 2009. **18.** *Meconopsis castanea* \times *georgei* (*T. Yoshida K20*) with palest purple flowers, on east side of Biluo Xueshan, west of Xinhua and west of Fuchuan, 3800 m elevation. Photograph by T. Yoshida, July 23, 2009. **19.** *Meconopsis atrovinosa* T. Yoshida & H. Sun at the type locality. Photograph by T. Yoshida, June 30, 2013. **20.** *Meconopsis atrovinosa* at the type locality. Photograph by T. Yoshida, June 30, 2013.

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FIGURES 21–22. **21.** Habitat of *Meconopsis atrovinosa* T. Yoshida & H. Sun at the type locality. Photograph by T. Yoshida, July 1, 2013. **22.** Habitat of *Meconopsis atrovinosa* T. Yoshida & H. Sun on northern ridge of Luoji Shan, 3750 m elevation. Photograph by T. Yoshida, July 2, 2013.

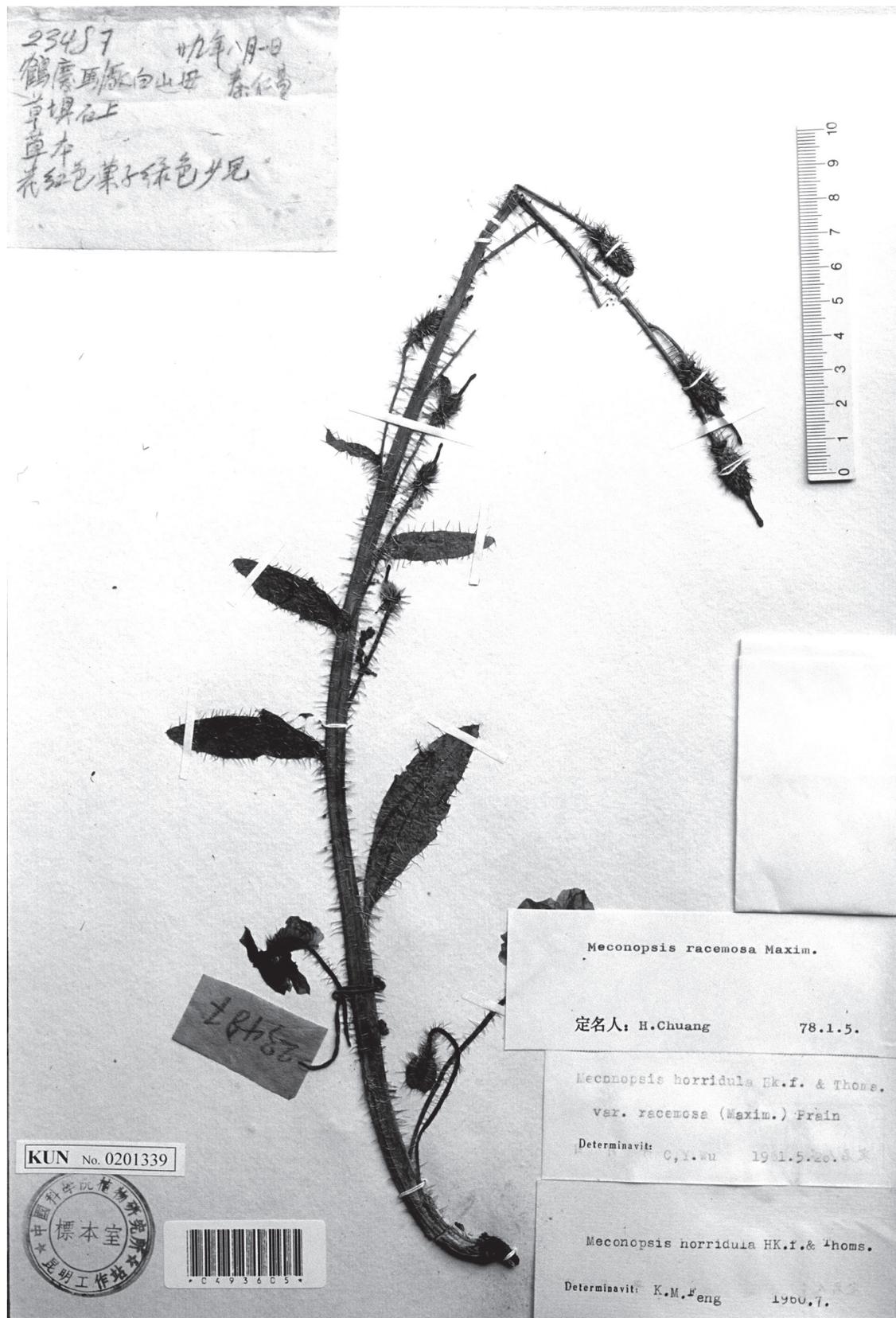


FIGURE 23. Specimen of *Meconopsis atrovinosa* T. Yoshida & H. Sun, R. C. Ching 23487 (KUN), collected at Machang Baishanmu, Heqing Xian, northwest Yunnan; with red flowers and green fruit according to note on label.



FIGURES 24–27. **24.** *Meconopsis atrovinosa* T. Yoshida & H. Sun (*T. Yoshida K80a*) at the type locality. Taproots of twin plants are partly fused. Photograph by T. Yoshida, September 2, 2012. **25.** Specimen of twin plants of *Meconopsis atrovinosa* T. Yoshida & H. Sun (*T. Yoshida K80a*) with partly fused taproots. **26.** Branched plant of *Meconopsis elongata* T. Yoshida, R. Yangzom & D.G. Long at the type locality, west of Tsubjo La, Haa district, western Bhutan, 4100 m elevation. Photograph by T. Yoshida, July 8, 2015. **27.** Branched plant of *Meconopsis elongata* on the eastern side of Yaktu La, Haa district, western Bhutan, 4250 m elevation. The plant has two branches from base of stem; flowering branch on left is again two-branched in inflorescence. Photograph by T. Yoshida, July 11, 2015.

long; *ovary* ovoid, 4–7 mm long, with dense ascending prickles; *style* 2–3 mm long in flower, to 7 mm long in fruit, 4- to 6-ridged; *stigma* capitate, 0.7–1.5 mm across, lobes (rays) 4–6, 0.5–2.0 mm long. *Capsules* elliptic-ovoid or ellipsoid, 1.5–2.0 cm long, 6–10 mm across, 4- to 6-ridged, with dense patent prickles; prickles on capsules rather short, with enlarged dark purple base before maturity.

Distribution: CHINA. SW Sichuan: Xichang Shi, Puge Xian and Dechang Xian, Luoji Shan. NW Yunnan: Heqing Xian (鹤庆县), around Machang (马厂). 3700–4100 m elevation.

Habitat and ecology: with grasses, herbs, and mosses on west-facing, rarely east-facing, alpine slopes on calcareous mountains; rooting deeply in blackish loam among iron-rich, reddish mudstone and limestone.

Etymology: specific epithet “atrovinosa” derives from the dark-wine-colored petals.

Additional specimens examined: CHINA. SW Sichuan, Luoji Shan, **Region 1:** 27°36'02"N, 102°20'45"E, 4000 m, 2 September 2012, *T. Yoshida K80* (E, KUN, TI); same locality, 1 July 2013, *T. Yoshida K90* (E, KUN, TI). NW Yunnan, Heqing Xian, **Region 2:** Heqing Machang Baishanmu (鹤庆马厂白山母), 1 August 1940, *R. C. Ching* (秦仁昌) 23487 (KUN) [Flowers red (花红色) according to note] (Fig. 23).

Meconopsis atrovinosa was collected only once in Region 2 by R. C. Ching in 1940. The locality “Machang (马厂),” where *R. C. Ching* 23487 was collected, is a flat pastureland for horses surrounded by mountains less than 3800 m elevation located around 26°28'38"N, 100°03'14"E in the northwestern part of Heqing Xian. One of us (Yoshida) explored the region in the summer of 2018 for *Meconopsis atrovinosa*, and *M. lancifolia* Franch. subsp. *lancifolia*. Yoshida rediscovered *M. lancifolia* subsp. *lancifolia* at the type locality, Yen-tze-hay, or Ma-er Shan (马耳山), some 20 km south of Machang earlier in 2108. It was the first collection in some 130 years after Delavay’s collections. *Meconopsis betonicifolia* was first collected by Delavay near Machang, but Yoshida was unable to find it.

Meconopsis atrovinosa is rarely branched at the base. One example has the taproots of two plants in fruit partly fused, as shown in Fig. 24 and 25. Such plants branched at the base have also been observed in *M. castanea* (Fig. 16) and *M. elongata* (Fig. 26–27). Further studies are needed to clarify the phenomenon and to compare them with other characteristics. As mentioned in the diagnosis, *M. atrovinosa* resembles *M. elongata* from western Bhutan, some 2,000 km west of *M. elongata*. Related taxa, as well as *M. castanea*, may occur between the two distribution areas.

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