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Yasunia (Lauraceae), a New Genus with Two Species from Ecuador and Peru

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Abstract. A new genus of the Lauraceae, *Yasunia* van der Werff, is described. It consists of two undescribed species, *Y. quadrata* van der Werff and *Y. sessiliflora* van der Werff, known from lowland rainforest in Ecuador and Peru. The new genus is closely related to *Beilschmiedia* Nees, but differs in its conspicuous, pubescent staminodia, exserted stamens, and reduced number of stamens. The relationships of the new genus and its placement in the Cryptocaryeae are discussed.

Key words: Ecuador, IUCN Red List, Lauraceae, Peru, *Yasunia*.

With some regularity, undescribed species are found among the Lauraceae specimens sent to the Missouri Botanical Garden as gifts for identification. New genera, however, are not encountered frequently. It was, therefore, a surprise to receive specimens representing two undescribed species that could not be accommodated in any of the known genera of Lauraceae. One of the species was collected in the Amazonian lowlands of Ecuador, the second in the border region of Peru and Brazil, also in lowland rainforest. The first collection of the Ecuadorian species, made in 1993, was largely in bud and had a few young flowers that did not show much detail; it remained among the undetermined specimens. The second collection was initially not recognized as Lauraceae; it has opposite leaves and a large (ca. 6 × 4 cm) fruit without a cupule or remnants of a perianth. Subsequently this species was collected in the 50-ha plot of the Parque Nacional Yasuní from numbered trees; this made recollecting easier, although finding the very small flowers on the tree was still not easy. From these collections, the following picture emerged: a medium-sized tree with opposite leaves; inflorescences 4–5 cm long, with sessile, clustered flowers; flowers with six (very rarely four) small, equal tepals, three (very rarely two) 2-locular stamens, and three (rarely two) thick, columnar staminodia with a conspicuous fringe of hairs at the top; tepals, stamens, and staminodia united at the base and falling off as one unit in old flowers; and large fruit, without remnants of the tepals seated on the pedicel. This combination of characters did not fit in any of the known Neotropical genera of Lauraceae. The absence of a cupule and dehiscing floral parts in old flowers suggested a relationship with *Beilschmiedia* Nees. However, *Beilschmiedia* and related genera (Cryptocaryeae in van der Werff & Richter, 1996, and Chanderbali et al., 2001; *Cryptocarya* group in Rohwer & Rudolph, 2005) have a characteristic inflorescence structure with the lateral flowers of a cyme subopposite (inflorescences type 3 in van der Werff & Richter, 1996), and the flowers of the new species were so densely congested that no branching pattern could be recognized. The collection of the second species, from the upper Río Utiquinia in Ucayali (Peru) near the border with Brazil, was made in 2003. It has dimerous flowers, with four tepals, four 2-locular stamens, and two cylindrical, pubescent staminodia. The floral parts are united at the base and fall off as a unit. The inflorescence is laxer than in the Ecuadorian species and shows the characteristic branching of the *Cryptocarya* R. Br. group. An additional character of both species is found in the stamens: they are longer than the tepals and the anthers are exserted. In most other members of the *Cryptocarya* group, the stamens are typically shorter than the tepals and included in the flowers. The *Cryptocarya* group is represented in the Neotropics by the genera *Beilschmiedia* and *Cryptocarya*. In addition to the exserted stamens, *Cryptocarya* differs from the new genus in having nine stamens and the ovary in fruit fully enclosed in and fused with the accrescent hypanthium. The closest relative of the new genus is *Beilschmiedia*. The differences are as follows: *Beilschmiedia* has flowers with nine stamens and three staminodia or, in the case of *B. hexanthera* van der Werff, six stamens and six staminodia; the locelli are

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introrse on the outer six stamens, extrorse on the inner three, whereas the new genus has flowers with three or four (rarely two) stamens and two or three staminodia. The anthers of the species of the new genus are exserted with large, apical locelli, while those of *Beilschmiedia* species are included in the flowers or rarely have their tips exposed and the locelli are introrse (outer two whorls) or extrorse (inner whorl of stamens).

Yasunia van der Werff, gen. nov. TYPE: *Yasunia sessiliflora* van der Werff.

Hoc genus *Beilschmiediae* Nees fructibus nudis sine cupulis et cymis irregularibus affine, sed ab ea staminibus tribus vel quattuor tepala superantibus atque staminodiis columnaribus pubescentibus recedit.

Trees. Leaves opposite, subopposite, or alternate, entire. Inflorescences in axils of leaves, paniculate; flowers subsessile, clustered, when 3 flowers terminate an inflorescence branchlet, the 2 lateral flowers not strictly opposite. Tepals 6 or 4, wider than long; stamens 3 or 4, filaments very short or lacking, anthers bilocellate, longer than the tepals; staminodia 2 or 3, columnar, the tip densely pubescent; tepals and stamens fused at the base and falling off in old flowers together, leaving the young fruit fully exposed on the pedicel. Mature fruit (known only in *Yasunia sessiliflora*) ellipsoid, ca. 6 × 3.5 cm, scurfy, without remnants of the hypanthium or tepals.

Discussion. A genus of two species, occurring in the Amazonian lowlands of Ecuador and Peru, *Yasunia* is characterized by its flowers with three or four stamens, the floral parts united at the base and falling off as a unit, the distally pubescent columnar staminodia, and the fruits seated fully exposed on the pedicel. Of its two species, one has dimerous flowers, while the second species has trimerous flowers. The generic name refers to the locality where the type species was collected (Parque Nacional Yasuní, in Ecuador).

1. **Yasunia quadrata** van der Werff, sp. nov. TYPE: Peru. Ucayali: Coronel Portillo, cuenca del Río Utiquinia, Quebrada Espjoyacu, afluente de la quebrada Manuela, 07°56.67′S, 73°53.61′W, 30 June 2003 (fls.), *J. G. Graham 2369* (holotype, MO; isotypes, F, MOL). Figures 1, 2A.

Haec species a *Yasunia sessiliflora* van der Werff tepalis 4 (haud 6), staminodiis 2 (haud 3) atque foliis glabris rigidioribus recedit.

Trees, 25–30 m; twigs angular to terete, sparsely appressed pubescent when young, soon becoming glabrous, densely and minutely lenticellate; terminal buds densely appressed pubescent. Leaves opposite or subopposite when young, becoming alternate when old, 7–10 × 3–5 cm, glabrous on both surfaces, young leaves densely gland-dotted on the abaxial surface, the gland dots less visible on older leaves, these stiffly chartaceous, elliptic, pinnately veined, secondary veins poorly visible, 9 to 12 on each side, secondary and tertiary venation weakly raised to immersed, leaf base acute, apex obtuse to rounded, margin slightly revolute toward base; petioles 10–17 mm, flat or somewhat canaliculate. Inflorescences mostly along leafless short shoots in the axils of leaves, rarely single in the axils of leaves, 2.5–7 cm, sparsely appressed pubescent, paniculate, flowers in dense clusters, usually 3 together, but lateral flowers not strictly opposite. Flowers glabrous, funnel-shaped, dimerous, 1–1.2 × ca. 1 mm, tepals 4, ca. 0.5 × 0.5 mm, spreading, stamens 4, sessile, triangular, ca. 0.5 × 1 mm, 2-locular, the cells introrse-apical, large and occupying most of the anther, the basal part pubescent, stamens erect, longer than the spreading tepals, staminodia 2, ca. 0.5 mm, columnar, the apex flat and with a whorl of hairs; 2 globose glands present at the base of the staminodia; pistil glabrous, ca. 1 mm, the receptacle deep, glabrous inside; tepals united in the lower 2/3, falling off together with the stamens in old flowers and leaving the pistil fully exposed on the pedicel. Mature fruit not known.

Discussion. Characteristic for *Yasunia quadrata* are the dimerous flowers with four tepals and four stamens. The stamens are opposite the tepals and represent whorls I and II, while the staminodia represent whorl III. Whorl IV is lacking. It is the only Neotropical species of the Lauraceae with dimerous flowers. It is known only from the type collection made in eastern Peru in the border region with Brazil.

IUCN Red List category. The distribution for the new species is incompletely known, and only a conservation assessment of Data Deficient (DD) can be made following IUCN Red List criteria (IUCN, 2001).

2. **Yasunia sessiliflora** van der Werff, sp. nov. TYPE: Ecuador. Orellana: Parque Nac. Yasuní, 76°30′W, 00°38′S, 200–300 m, 9 June 2009 (fls.), *A. J. Pérez, M. Zambrano & M. Pabón 4230* (holotype, QCA; isotype, MO). Figures 2B, 3.

Haec species a *Yasunia quadrata* van der Werff tepalis 6 (haud 4), staminibus 3 (haud 4) atque foliis tenuioribus recedit.

Figure 1. *Yasunia quadrata* van der Werff. —A. Habit. —B. Inflorescence. C, D. Leaves. —C. Abaxial blade surface. —D. Adaxial blade surface. —E. Flower seen from above. —F. Flower seen from side. —G, H. Staminodes. —I. Stamen. —J. Young fruit. —K. Old flower; detached, basally united tepals seen positioned above the pistil. Drawn from the holotype, *Graham 2369* (MO). No scale bar provided for C, D; same 1-mm scale bar applies to E–I; same 1-mm scale bar applies to J, K.

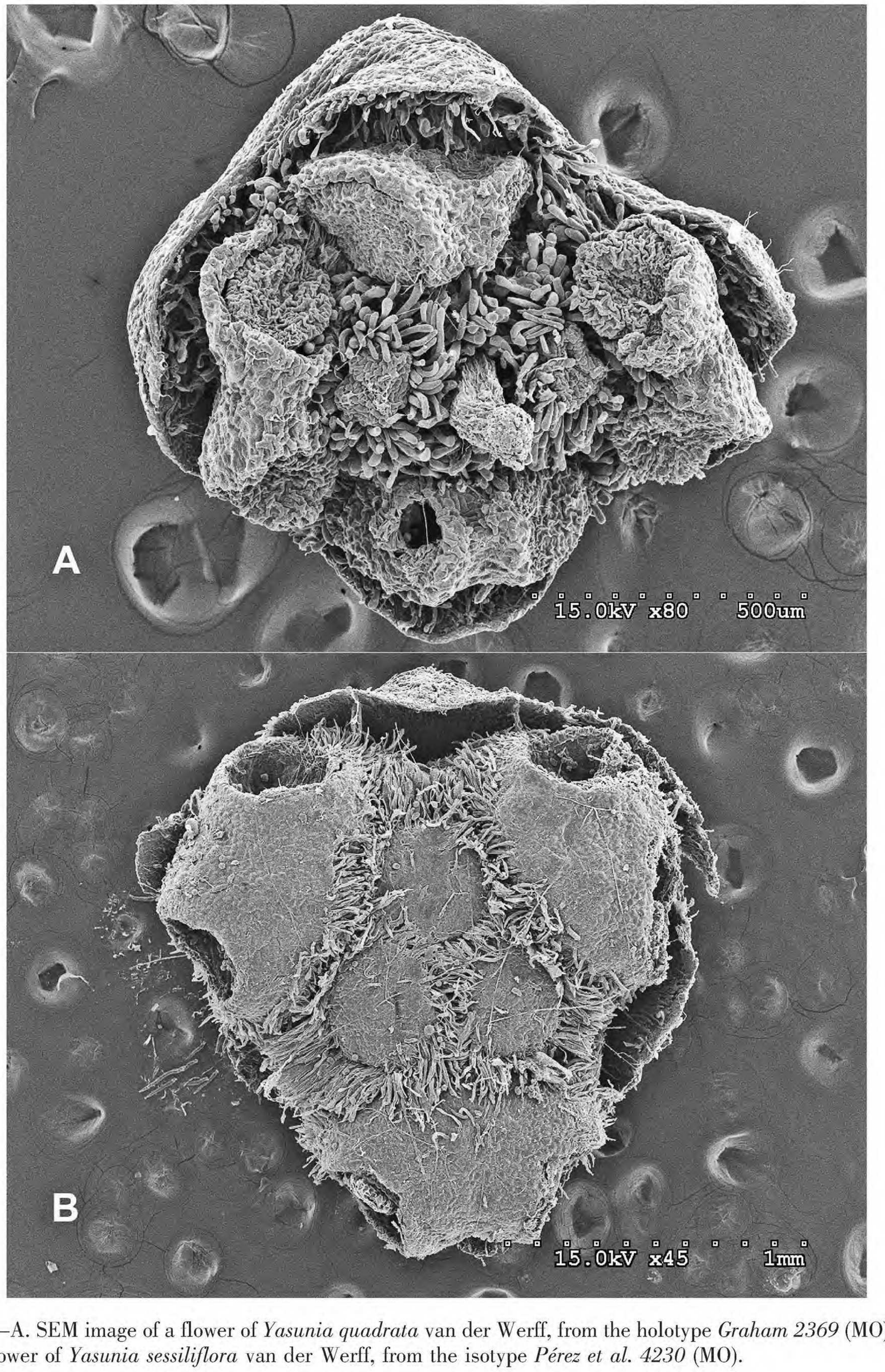

Figure 2. —A. SEM image of a flower of *Yasunia quadrata* van der Werff, from the holotype *Graham 2369* (MO). —B. SEM image of a flower of *Yasunia sessiliflora* van der Werff, from the isotype *Pérez et al. 4230* (MO).

Tree, to 18 m; twigs terete, appressed pubescent when young, becoming glabrous with age; terminal buds densely appressed pubescent. Leaves 11–20 × 5–10 cm, opposite, chartaceous, elliptic to narrowly elliptic, base obtuse to acute, apex acute, adaxial surface glabrous, abaxial surface with some appressed hairs along the major veins, otherwise glabrous, major veins and reticulation slightly raised on the adaxial surface, more prominently so on the abaxial surface; lateral veins 6 to 10 on each side; petioles 7–13 mm, flat above, with a similar indument as the twigs. Inflorescences to 4 cm, paniculate, moderately appressed pubescent, in the axils of leaves. Flowers 1.5–2 mm diam., sessile, grouped in dense clusters, green, shallowly bowl-shaped; tepals equal, 6, rarely 4, united at the base, the free part ca. 0.5–1 mm, spreading to half-erect, appressed pubescent on the outer surface, with a few hairs on the inner surface;

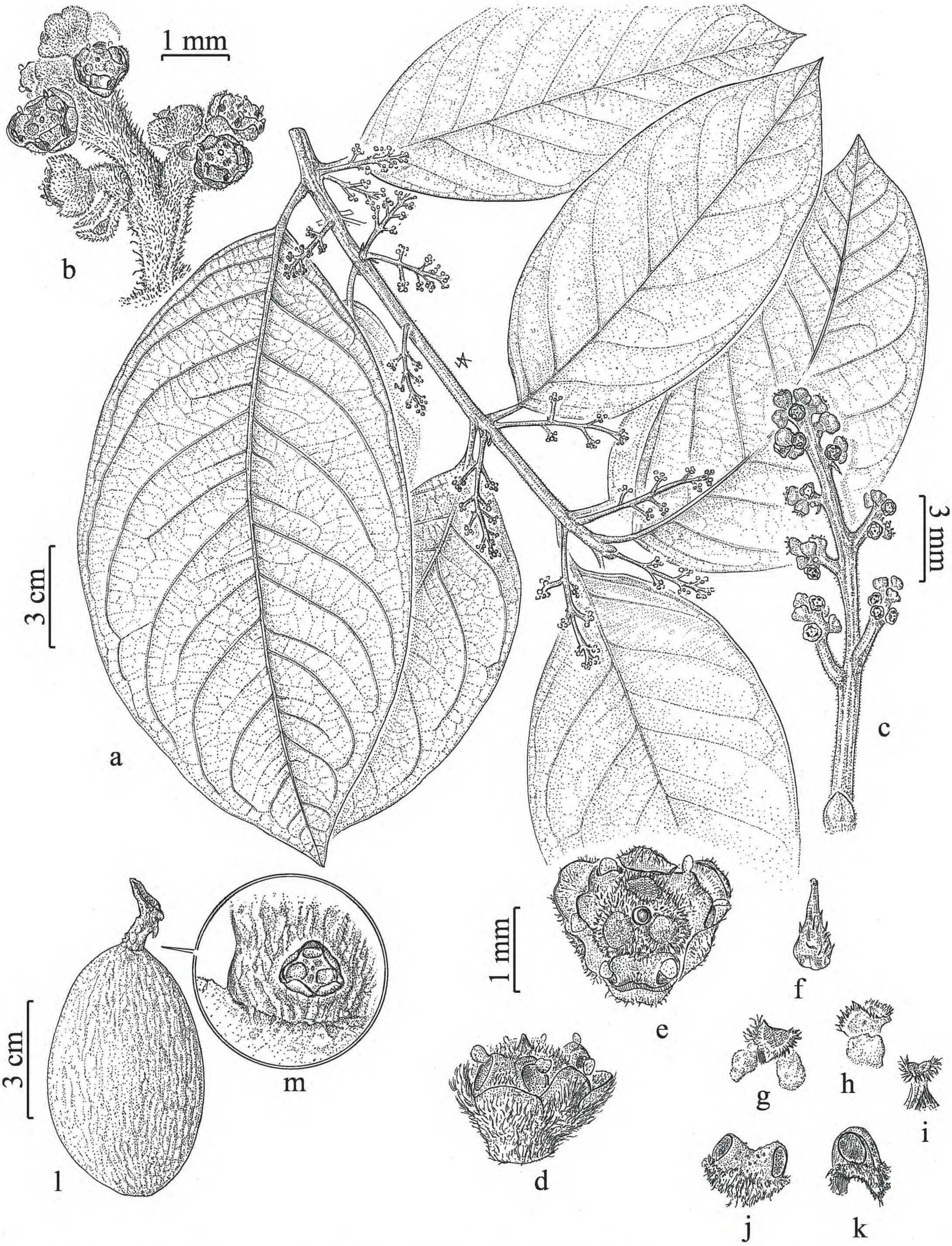

Figure 3. *Yasunia sessiliflora* van der Werff. —A. Habit. —B, C. Details of inflorescences. —D. Flower seen from side. —E. Flower seen from above. —F. Pistil. —G–I. Staminodia. —J. Frontal view of stamen. —K. Side view of stamen. —L. Fruit. —M. Remnant of old flower on pedicel of fruit. A–K from the isotype *Pérez et al. 4230* (MO); L, M from *Neill et al. 11089* (MO).

stamens 3, rarely 2, 2-locular, longer than the spreading tepals; the filaments very short and with a fringe of hairs, the locelli large, lateral-distal; staminodia 3, rarely 2, ca. 0.5 mm, columnar, with a broad, flat top and a ring of hairs distally, readily visible, 2 glands present at the base of the staminodia, partly fused with the receptacle; pistil turbinate, ca. 0.8 mm, with a few hairs near the base, otherwise

glabrous; receptacle shallow, glabrous inside. Fruit ellipsoid, ca. 6 × 4 cm, without remnants of the floral parts, scurfy outside.

Discussion. Characteristic for *Yasunia sessiliflora* are the sessile flowers with three 2-locular stamens, large scurfy fruits, absence of cupule, and opposite leaves. Infrequently, dimerous flowers with two stamens and four tepals occur, and a few flowers with four stamens and eight tepals were present. It is not clear which floral whorls are developed in *Y. sessiliflora*. The stamens are opposite the outer tepals and represent either whorl I or III, while the staminodia, opposite the inner tepals, represent either whorl II or IV. Either way, this is an unusual arrangement. When a whorl of staminodia with glands at the base is present, it represents nearly always whorl III and is thus opposite the outer tepals. The position of the staminodia in *Y. sessiliflora*, opposite the inner tepals, is very rare, if not unique, in the family. Flowers with six tepals and three 2-locular stamens are uncommon among Neotropical Lauraceae and have been reported from four genera, *Licaria* Aubl., *Mezilaurus* Kuntze ex Taub., *Mocinnodaphne* Lorea-Hern., and a few species of *Aiouea* Aubl. (van der Werff, 1991a). None of these have the relatively large, flat-topped staminodia characteristic of *Yasunia*. In addition, *Licaria* species have well-developed, cup-shaped cupules and alternate leaves, although a few species have opposite leaves (Kurz, 2000); *Mezilaurus* species have the fruit subtended by small, plate-like cupules and have clustered leaves (van der Werff, 1987); *Mocinnodaphne* has alternate leaves with domatia in the axils of the basal lateral veins and the fruit subtended by a small cupule; and the *Aiouea* species with three stamens have small cupules and alternate leaves (Renner, 1982).

IUCN Red List category. The distribution for the new species is incompletely known, and only a conservation assessment of Data Deficient (DD) can be made following IUCN Red List criteria (IUCN, 2001).

Paratypes. ECUADOR. **Orellana:** Parque Nac. Yasuní, 1 Nov. 2008, *A. J. Pérez & P. Alvia 4035, 4036, 4037* (all QCA), 26 Sep. 2000, *G. Villa 508* (MO), 1–11 Sep. 1993, *M. Aulestia & J. Andi 383* (MO, QCNE); Pastaza, Río Acaro or Challuayacu, 19 Jan. 1998, *D. Neill, A. Alvarez, H. Vargas & R. Mayanche 11089* (K, MO, QCNE).

Description of Cuticle Features in *Yasunia*

Potameia Thouars is the only other genus in the *Beilschmiedia* group with dimerous flowers. Although the large staminodia of *Yasunia* separate this genus from *Potameia*, a study of the cuticle was undertaken to establish additional differences. Cuticular characters on leaves are known to be useful in defining groups of species or genera of Lauraceae (Nishida & van der Werff, 2007), and this supports combining the two new species into one taxon close to *Beilschmiedia*. *Yasunia quadrata* and *Y. sessiliflora* share common cuticular features, which include the anticlinal cell walls "branched" (straight but with protrusions along the walls) in the adaxial epidermis (Figs. 4-1A, 4-2A), granular periclinal cell walls in the abaxial epidermis (Figs. 4-1B, 4-2B), and stomata with lip-shaped lower ledges (Figs. 4-1B, 4-2B). These features are similar to those of some *Beilschmiedia* species from South America, such as *B. curviramea* (Meisn.) Kosterm. (Figs. 4-3A, 4-3B) (see Nishida & Christophel, 1999). The cuticles of the *Potameia* species have their anticlinal cell walls nonbranched but sinuous and the periclinal walls smooth (Figs. 4-4A, 4-4B), and these characters clearly discriminate the *Potameia* species from the dimerous *Yasunia* species and further support the recognition of *Yasunia* as a genus distinct from *Potameia*.

Pollen in *Yasunia*

In a study of pollen from 17 Neotropical genera, Raj and van der Werff (1988) found that most Neotropical Lauraceae had inaperturate, spheroidal pollen grain ornamented with spinules of varying size and density. *Cryptocarya* is an exception; its pollen has a smooth or wrinkled surface without spinules. The pollen of *Yasunia sessiliflora* is inaperturate, spheroidal, and spinulose like the pollen of the great majority of the Neotropical Lauraceae, but unlike the pollen of *Cryptocarya*.

Discussion

Richter (1981) was the first to place *Cryptocarya*, *Beilschmiedia*, and related genera in one group based on similarities of wood and bark anatomy. Van der Werff and Richter (1996) applied the name Cryptocaryeae to this group of genera and pointed to the characteristic inflorescence structure shared by these genera. They included the following genera in the Cryptocaryeae: *Beilschmiedia*, *Cryptocarya*, *Endiandra* R. Br., *Potameia*, and *Triadodaphne* Kosterm. DNA-based phylogenies (Chanderbali et al., 2001; Rohwer & Rudolph, 2005) confirmed the monophyly of the Cryptocaryeae; these studies included species of *Eusideroxylon* Teijsm. & Binn., *Potoxylon* Kosterm., *Aspidostemon* Rohwer & H. G. Richt., *Cryptocarya*, *Beilschmiedia*, *Endiandra*, and *Potameia*. Within the Cryptocaryeae, two groups of genera can be recognized: the paraphyletic *Cryptocarya* group

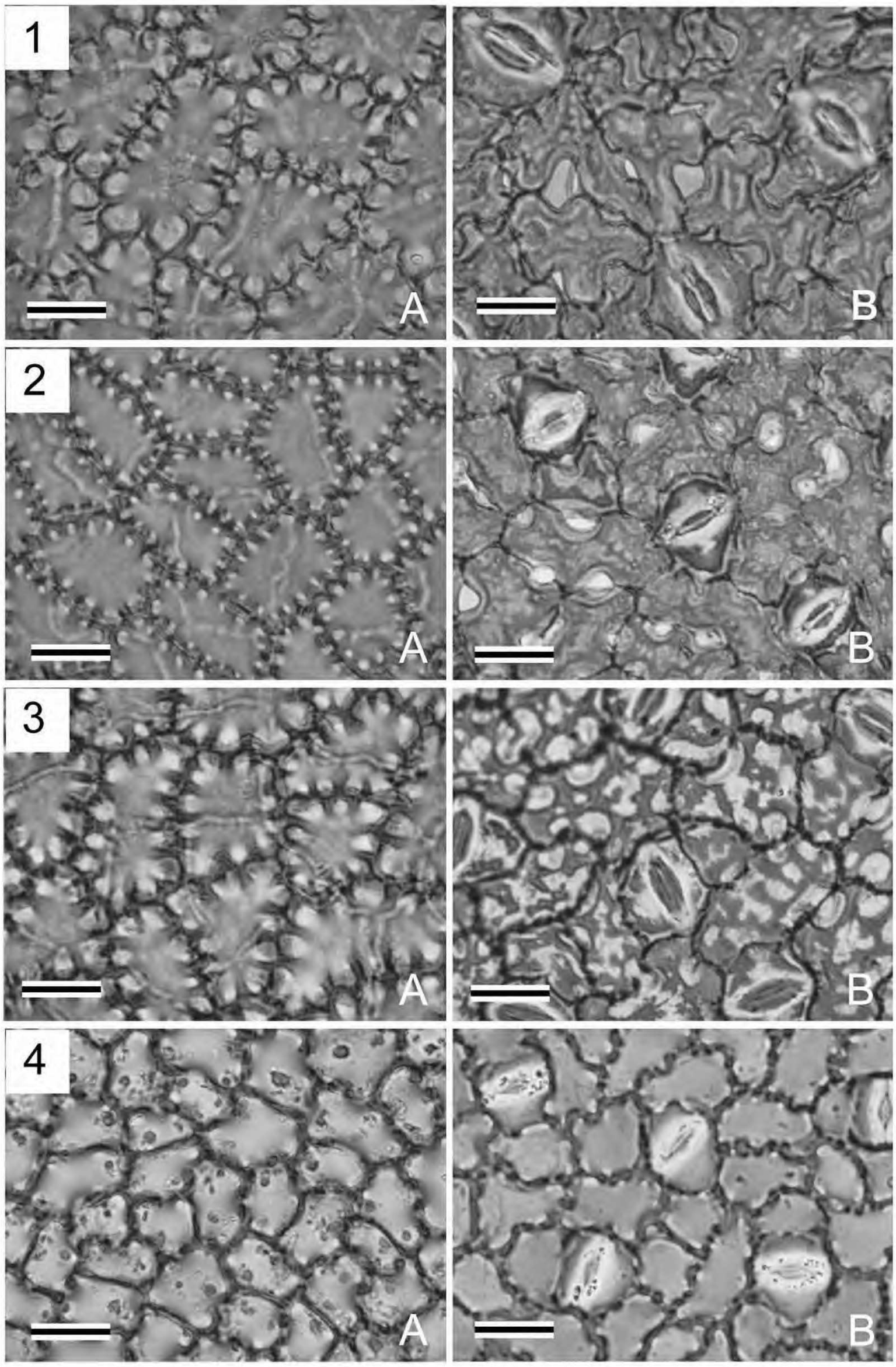

Figure 4. Optical micrographs of the adaxial blade cuticles (A) and abaxial cuticles (B). —1. *Yasunia quadrata* van der Werff (from the type *Graham 2369*, MO). —2. *Yasunia sessiliflora* van der Werff (from *Aulestia & Andi 383*, MO). —3. *Beilschmiedia curviramea* (Meisn.) Kosterm. (from *De la Cruz 2725*, MO). —4. *Potameia micrantha* van der Werff (from *Schatz & Miller 2499*, MO). Scale bars = 20 μm.

(*Cryptocarya*, *Aspidostemon*, *Eusideroxylon*, and *Potoxylon*), characterized by the fruit enclosed by the accrescent receptacle, and the monophyletic *Beilschmiedia* group (*Beilschmiedia*, *Endiandra*, and *Potameia*), characterized by the fruit not enclosed by the receptacle, but seated free on the pedicel with or without remnants of the floral parts at the base of the fruit. In both studies, *Endiandra* and *Potameia* were nested within *Beilschmiedia*, but the number of species sampled was small (in Chanderbali et al., 2001, six species of *Beilschmiedia*, one of *Endiandra*, and two of *Potameia*; in Rohwer & Rudolph, 2005, seven species of *Beilschmiedia*, three of *Endiandra*, and one of *Potameia*). Three small Asian genera with the morphological characters of the *Beilschmiedia* group were not included in the DNA-based phylogenies, but probably belong to this group (*Syndiclis* Hook. f., *Hexapora* Hook. f., and *Sinopora* J. Li, N. H.

Xia & H. W. Li). Species of these genera are rarely collected, and no DNA material was available for the phylogenetic studies. *Beilschmiedia* is the only genus of this group occurring in the Neotropics; the other five genera are known from Madagascar, tropical Asia, Australia, and Oceania. The main characters separating the genera are presented in Table 1. *Triadodaphne* was recognized on the strength of its unequal tepals, with the outer three larger than the inner three. In other characters it does not differ from *Endiandra*, and it is now considered a synonym of *Endiandra* (Rohwer, 1993). *Brassiodendron* C. K. Allen was described by Allen (1942), differing from *Beilschmiedia* and *Endiandra* in having six stamens versus nine stamens in *Beilschmiedia* and three stamens in *Endiandra*. Hyland (1989) studied the six Australian species of the *Beilschmiedia* group with six stamens and placed them in either *Endiandra* or *Beilschmiedia*. Rohwer (1993) recognized *Brassiodendron* as a distinct genus. Because several other genera of Lauraceae include species with nine and six or three and six stamens (van der Werff & Richter, 1996), we follow Hyland and do not recognize *Brassiodendron* as a distinct genus. Of the seven genera listed in Table 1, three are reasonably well known. *Beilschmiedia* is a large, pantropical genus characterized by having nine stamens. A few species placed in *Beilschmiedia* have only six stamens in two whorls; such species are known from Australia (Hyland, 1989), South America (van der Werff, 1995), and Vietnam (an unidentified species, pers. obs.). One species from Madagascar, *B. pedicellata* van der Werff, includes specimens with dimerous flowers and has thus six stamens in three whorls (van der Werff, 2003). *Endiandra* is also well known and restricted to tropical Asia, Australia, and Oceania. It is characterized by having three stamens, but a few species have six stamens in two whorls or are dimerous and have two stamens (Hyland, 1989). The third reasonably well-known genus is *Potameia*, which is endemic to Madagascar. Most species have dimerous flowers with four 2-locular stamens, although one species has four 1-locular stamens (van der Werff, 1991b) and one species has two 1-locular stamens (van der Werff, 1996). These three genera are defined by the number of stamens and whether the flowers are dimerous or trimerous, but each include a number of exceptions. The other three Asian genera included in Table 1 are poorly known, and their character states are taken from the literature. *Syndiclis* (known from Bhutan, China, Thailand, and Vietnam) appears very similar to *Potameia*; the main difference (in addition to the distribution) is the number of staminodia: four in *Syndiclis* and two or none in *Potameia*. There is no consensus on the importance of this difference.

Table 1. Comparison between genera of the *Beilschmiedia* group. Numbers in parentheses indicate less frequent character states.

	Beilschmiedia	*Potameia*	*Endiandra*	*Syndiclis*	*Hexapora*	*Sinopora*	*Yasunia*
Distribution	pantropical	Madagascar	tropical Asia, Oceania	Bhutan, China, Vietnam, Thailand	Malaysia	China	Ecuador, Peru
No. of stamens	9(6)	4(2)	3(6)	4(5 or 6)	6	6	4, 3(2)
Whorls	I, II, III (I, II)	I, II	III (II, III)	I, II (III)	I, II	I, II	I, II
Leaf position	alternate or opposite	alternate	alternate	alternate	alternate	alternate	opposite or alternate
Merosity	trimerous	dimerous	trimerous (rarely dimerous)	dimerous (rarely trimerous)	trimerous	trimerous	dimerous or trimerous
Staminodia shape	stipitiform, often with sagittate apex	stipitiform	stipitiform	stipitiform	thick	thick	thick
Glands enlarged	no	no	sometimes	no	absent	absent	no
Tepals persistent	rarely	yes	rarely	no	yes	yes	no
Stamens	included	included	included or exserted	exserted	exserted	exserted	exserted

Rohwer (1993) treated *Syndiclis* as a synonym of *Potameia*, while Li et al. (2008) recognized *Syndiclis* as distinct. *Hexapora* and *Sinopora* are monotypic, and both have trimerous flowers with six stamens; in *Hexapora* the locelli are extrorse, while in *Sinopora* the locelli are apical. According to the descriptions and illustrations, both *Hexapora* and *Sinopora* have six rather large, pubescent staminodia and floral parts that persist at the base of the fruits (Hooker, 1886; Kochummen, 1989; Li et al., 2008). Like *Hexapora* and *Sinopora*, *Yasunia* has relatively large, pubescent staminodia, but it differs in its number of stamens (three or four vs. six) and in its deciduous perianth parts in the fruiting stage. Staminodia in most Lauraceae are small, stipitiform, or lacking. Conspicuous staminodia are known only in the three small genera related to *Beilschmiedia* (*Hexapora*, *Sinopora*, and *Yasunia*) and *Aspidostemon*, a genus with opposite leaves and fruits fully enclosed by the accrescent hypanthium; it is related to *Cryptocarya* and endemic to Madagascar (van der Werff, 2006).

In conclusion, the genera in the *Beilschmiedia* group are characterized by stamen number, trimerous versus dimerous flowers, deciduous or persistent floral parts in fruit, and shape of stamens and staminodia. However, these characters are variable in the larger genera *Beilschmiedia*, *Endiandra*, and *Potameia*, and to a lesser degree in the small genera *Syndiclis* and *Yasunia*, and these genera are thus poorly defined. Two approaches are possible in this situation. The first, taken here, is to continue recognizing a number of genera in the *Beilschmiedia* group based on the characters given above while accepting that these characters are not exclusive for a particular genus. The second approach is to sink the genera in a greatly expanded *Beilschmiedia* characterized by its inflorescence structure and its fruit seated freely on a pedicel with or without remnants of the perianth at the base. This approach would be in agreement with the DNA-based studies (Chanderbali et al., 2001; Rohwer & Rudolph, 2005), where *Endiandra* and *Potameia* formed clades nested within *Beilschmiedia*. However, this approach has not been taken for three reasons: (1) the number of species of the *Beilschmiedia* group included in those studies is small—18 out of an estimated 380 species; (2) it would require a large number of new combinations and the long-established genera *Endiandra* and *Potameia* would disappear; and (3) it is likely that the merged genera would be recognized as infrageneric taxa. Such a lowering of rank will not substantially increase our understanding of relationships in the *Beilschmiedia* group.

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