Taxonomic Revision of the Temperate Woody Bamboo Genus *Kuruna* (Poaceae: Bambusoideae: Arundinarieae)

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Taxonomic Revision of the Temperate Woody Bamboo Genus *Kuruna* (Poaceae: Bambusoideae: Arundinarieae)

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Abstract—Previous molecular phylogenetic analyses based on plastid DNA sequence data supported the recognition of *Kuruna* as a new temperate woody bamboo (Arundinarieae) genus, representing the twelfth major linage of Arundinarieae. *Kuruna* is distinguished by a combination of vegetative and reproductive characters including features of rhizomes, branching and synflorescences. Here seven species, distributed in Sri Lanka and southern India, are included in this genus: *Kuruna debilis*, *K. densifolia*, *K. floribunda*, *K. scandens*, *K. walkeriana*, ***K. wightiana*** (here transferred to *Kuruna*), and the newly described ***K. serrulata***. This revision includes an updated description of the genus, detailed descriptions for all seven species, line illustrations for all species, and a morphological key for their identification.

Keywords—*Arundinaria*, *Kuruna serrulata*, southern India, Sri Lanka, taxonomy.

The subfamily Bambusoideae (Poaceae) comprises three tribes: tropical woody bamboos (Bambuseae), temperate woody bamboos (Arundinarieae), and herbaceous bamboos (Olyreae). Arundinarieae, which includes approximately 550 species, is strongly supported as monophyletic by a significant amount of molecular evidence (Bamboo Phylogeny Group 2012; Kelchner et al. 2013; Attigala et al. 2014). Temperate woody bamboos are characterized by the presence of leptomorph, monopodial rhizomes (pachymorph in some species), basipetal vegetative branch development and tetraploidy ($2n = 48$) (Bamboo Phylogeny Group 2012) and 12 major lineages are found in Arundinarieae based on molecular phylogenetic studies (Triplett and Clark 2010; Zeng et al. 2010; Yang et al. 2013; Attigala et al. 2014; Ma et al. 2014).

Arundinaria Michaux is the oldest generic name within the tribe and over 400 species have at one time or another been classified within it. But previous studies revealed that *Arundinaria* s. s. is composed of only three species from North America: *A. gigantea* (Walter) Muhl. (type), *A. tecta* (Walter) Muhl. and *A. applachiana* Triplett, Weakley & L. G. Clark (Triplett and Clark 2010). Thus, a taxonomic revision is needed for the temperate woody bamboo species traditionally considered as *Arundinaria*, especially those from south Asia, Africa and Madagascar. In a recent study based on plastid DNA sequence data we recognized the Sri Lankan temperate woody bamboos (Clade XII) as the new genus *Kuruna* Attigala, Kathriarachchi & L. G. Clark and made new combinations to accommodate the five known *Arundinaria* species belonging to this clade (Attigala et al. 2014) (Fig. 1).

Here we present updated morphological descriptions for *Kuruna* and for all five reported Sri Lankan temperate woody bamboo species (Soderstrom and Ellis 1988) as well as a newly described species from Sri Lanka. This revision also includes the south Indian temperate woody bamboo *Arundinaria wightiana* Nees, which we here transfer to *Kuruna* based on morphological similarities, as this species has not yet been sampled in any molecular phylogenetic analyses. A morphological key to all seven *Kuruna* species is included, all these species are illustrated to show their diagnostic characters, and the distributions for all species are mapped (Fig. 2).

Materials and Methods

Field observations and collections of all six Sri Lankan *Kuruna* species were made primarily by LA. Standard collection procedures for bamboos suggested by Soderstrom and Young (1983) were followed and therefore complete specimens were collected, including branch complements, culm leaves, culm nodes, and internodes. Rhizomes were collected only for the new species due to collection permit restrictions. Authors followed McClure (1973) and Soderstrom and Ellis (1988) for definitions of structures and morphological terminology. The morphological descriptions were based on detailed study of the collected specimens, direct examination of herbarium specimens (ISC, K, MO, PDA, and US) (Thiers 2014), and information from published literature (Soderstrom and Ellis 1988; Seethalakshmi and Muktesh Kumar 1998; Clayton et al. 2006 onwards; Muktesh Kumar 2011). The morphological comparison and measurement of the structures were performed using a Leica S6D (Leica Microsystems Inc., Buffalo Grove, Illinois) stereoscopic microscope. Culm leaf sheaths and blades were measured separately. Foliage leaf length was measured from the base of the pseudopetiole to the tip of the blade and leaf width was measured at the widest point. For all measurements for which a mean was reported (e.g. internode length, wall thickness, lacuna size, culm leaf sheath length, foliage leaf blade length, width, etc.), 10 measurements were taken per collection and averaged. The range was reported within parentheses and represents the range of variation within each species for that structure. As a standardized estimation of culm wall thickness, the ratio between two times the culm wall thickness and culm diameter was calculated (Bamboo Phylogeny Group 2005–2006). Spikelets were dissected in Pohl's solution (Pohl 1965). Spikelet length was measured from the base of glume I to the very tip of the longest part of the spikelet. The species are illustrated in Figs. 3–14. Illustrations of *K. debilis* (Figs. 3, 4), *K. densifolia* (Figs. 5, 6), *K. floribunda* (Figs. 7, 8), *K. scandens* (Fig. 9), and *K. walkeriana* (Figs. 11, 12) were taken directly from Soderstrom and Ellis (1988) and additional illustrations were included for diagnostic structures/characters not previously illustrated for these species (Fig. 14). Further, new illustrations were made for the newly described species (Fig. 10), and the south Indian *K. wightiana* (Fig. 13).

The previous investigation of the Sri Lankan temperate woody bamboos by Soderstrom and Ellis (1988) is very thorough, but we found that some of the fine details are missing or misrepresented in some of their illustrations. In Figs. 3i and 4a of *K. debilis* and Fig. 7e of *K. floribunda*, the supranodal ridge is not distinctly illustrated. See Fig. 14F and 14A for illustrations of the conspicuous supranodal ridge of *K. debilis* and *K. floribunda*, respectively. In addition, the palea tips of *K. scandens* (Fig. 9i) and *K. walkeriana* (Fig. 12h) are shown as biapiculate, when they are actually acute, and in Fig. 7a of *K. floribunda*, the foliage leaf blade apex shows a distinct constriction despite there being none in living plants or herbarium specimens we observed. These inaccuracies are pointed out in the figure captions.

Each species was given an International Union for Conservation of Nature (IUCN) Red List category according to the criteria established

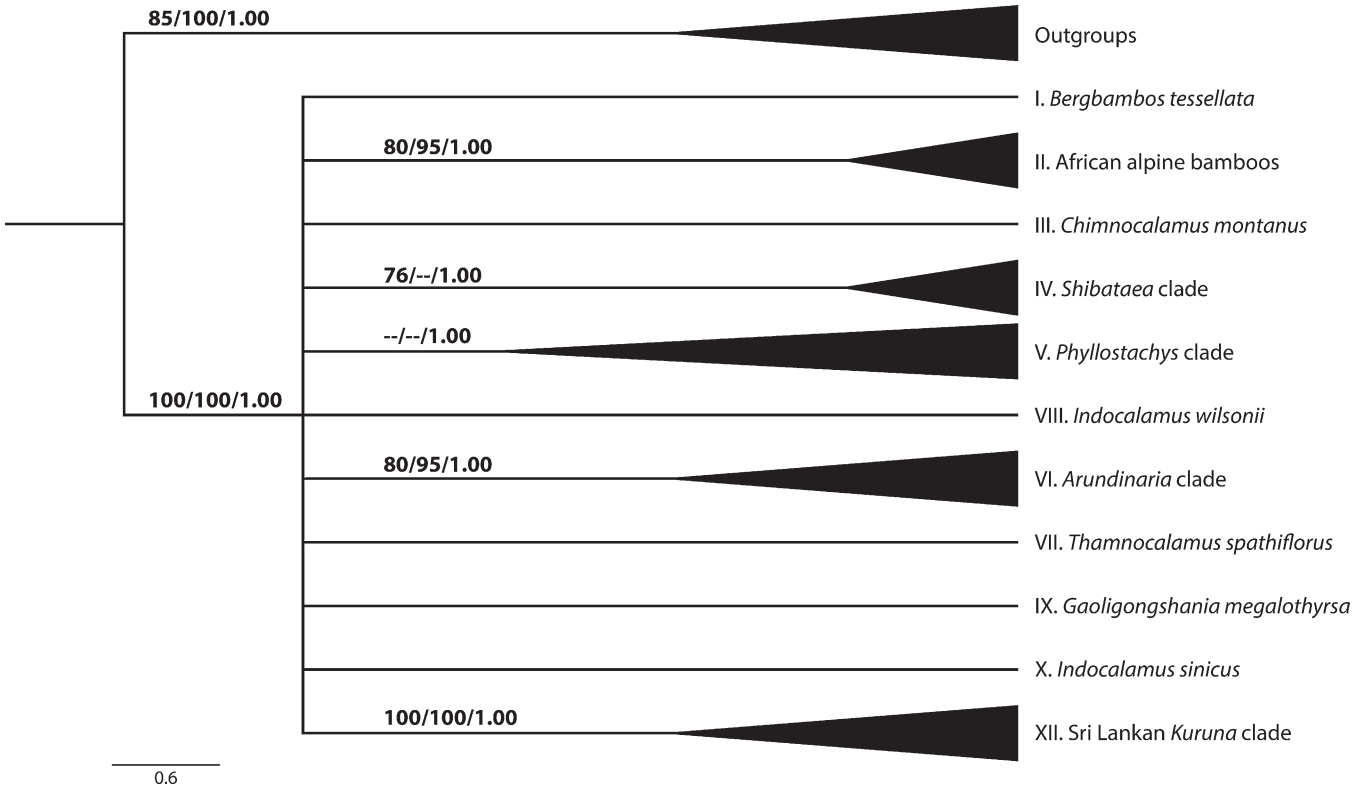

Fig. 1. Summarized strict consensus tree redrawn from Attigala et al. (2014), based on five plastid regions (*rps16-trnQ, trnC-rpoB, trnD-trnT, trnT-trnL, ndhF 3′*). Numbers indicate bootstrap values ≥ 70% from maximum parsimony and maximum likelihood analyses and posterior probabilities ≥ 0.95 from the Bayesian inference analyses, respectively. Triangles indicate only where multiple species were sampled per clade and are not proportional to the number of species found in each clade. Note: Clade XI (consisting of the single species *Ampelocalamus calcareus*) was not included in Attigala et al. (2014) due to its recent discovery (Yang et al. 2013) and the lack of material for comparable sequencing.

by the IUCN Red List Categories and Criteria at regional and national levels, Version 4.0 (IUCN 2012). This assessment is based on observations by the corresponding author during a field trip in 2010 to Sri Lanka. Nevertheless, we recommend that population surveys be undertaken to support a better extinction risk assessment of all these *Kuruna* species.

Results and Discussion

Distribution and biogeography—All the Sri Lankan species of *Kuruna* occur in upper montane forests and open montane grasslands in the central province of Sri Lanka while the Indian *Kuruna* species are distributed in the mountains of south India, mainly the Western Ghats (Fig. 2). Of the seven *Kuruna* species, two species are shared between Sri Lanka and south India (*K. floribunda* and *K. walkeriana*), three species are endemic to Sri Lanka (*K. densifolia*, *K. scandens* and *K. serrulata*) and one species is endemic to south India (*K. wightiana*). There is not enough information yet to determine if *K. debilis* is endemic to Sri Lanka, because there are unconfirmed reports of this species in south India (Muktesh Kumar 2011). To date, there are no biogeographical studies available for *Kuruna*. Myers et al. (2000) showed that the moist rain forests of the Western Ghats of peninsular India and the rain forests of southwest Sri Lanka together are considered a refugium of the relict biota of the former Indian plate, which was gradually isolated from other continents for a period of over 25 million years in the mid-Paleocene to late Eocene era (60–35 million years). However, Sri Lanka remained in full contact with India until the last major sea level rise 6000 yr ago, which separated these two countries by the narrow and shallow Palk Strait (McLoughlin 2001). Linder et al. (1997) proposed an Indian – Sri Lankan – Madagascan – southern Africa biogeographical pattern for *Crinipes* (Poaceae: Arundinoideae). Thus, given the geographic history of Sri Lanka and India, further studies of *Kuruna* in a biogeographic context could reveal similar biogeographical patterns and insights into dispersal events between Sri Lanka and India. But a formal biogeographical analysis awaits a robust phylogeny of Arundinarieae.

Morphology—The major defining morphological characters of all seven *Kuruna* species are compared and summarized in Table 1.

Habit—The habits exhibited by *Kuruna* species are mainly of two types. *Kuruna debilis* and *K. scandens* are scandent or clambering with sparse culms. The vine-like long primary and secondary branches of *K. debilis* are supported by trees and shrubs and hang from them. *Kuruna scandens* on the other hand starts off with erect culms which then become arching and scandent. However, the other five species are mainly erect and shrubby with densely packed culms.

Rhizomes—All *Kuruna* species have pachymorph culm bases with short necks (Figs. 4h, 6j and 8i). Among the seven species of *Kuruna*, *K. densifolia* is the only one with rhizomes producing thick primary roots with air canals (Fig. 6l) due to their occurrence in cold, standing water in swampy open grasslands (wet patana) such as the Horton Plains of Sri Lanka. *Bergbambos tessellata* (Nees von Esenbeck) Stapleton is another temperate woody bamboo species from South Africa,

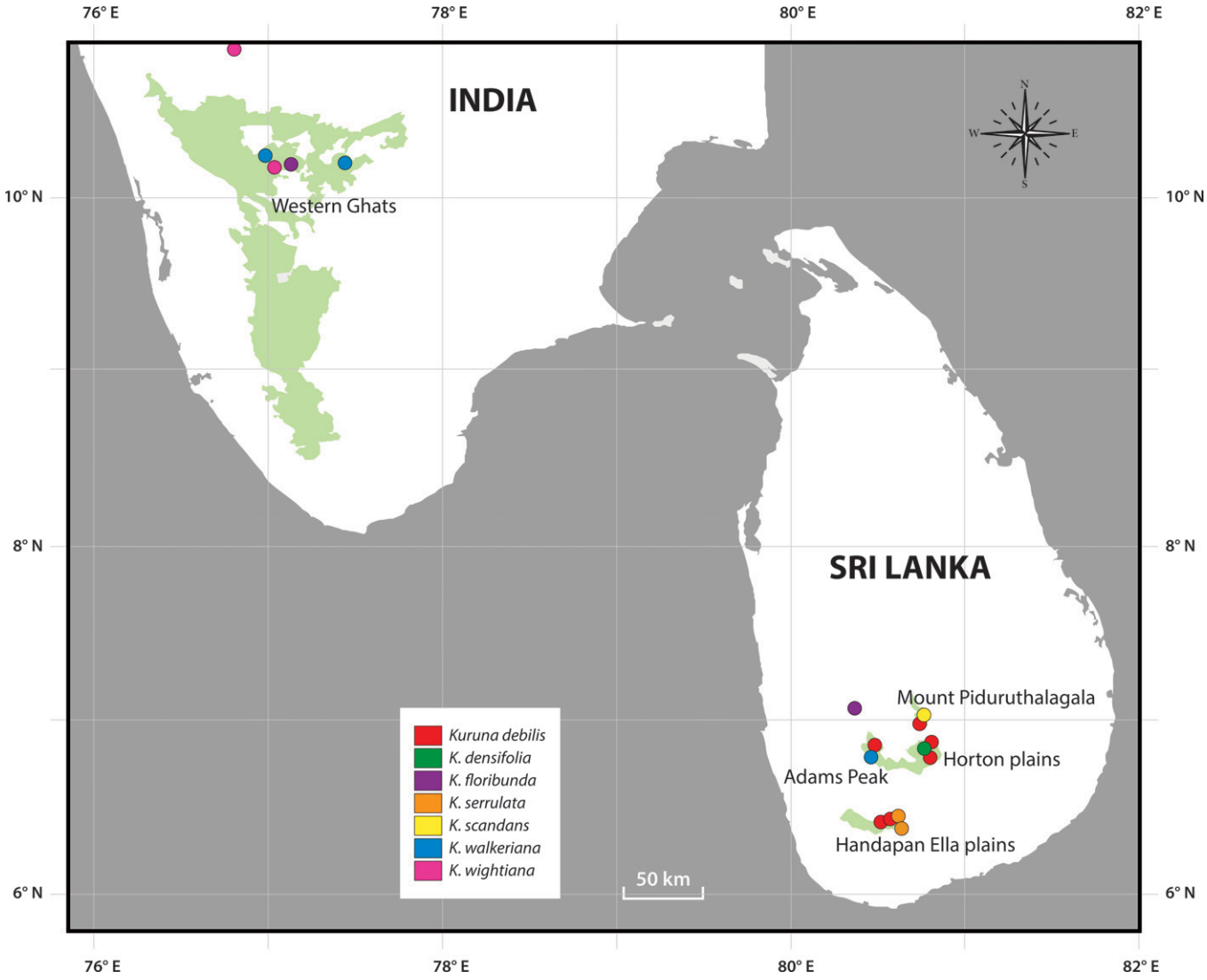

FIG. 2. Distribution of *Kuruna* in Sri Lanka and India.

which occurs in similar wet swampy habitats, and possesses root air canals (Soderstrom and Ellis 1982). However, the rhizomes of *K. densifolia* do not have air canals like *Arundinaria tecta* and *A. appalachiana*, which grow in wet or swampy habitats in the southeastern U. S. A. (Triplett et al. 2006).

CULMS—The culm internodes are usually hollow in *Kuruna*, with a well-defined cavity indicating that the internodes developed as hollow from the beginning, and exhibit moderately thick to thick walls. However, *K. serrulata* has both hollow and solid culm internodes. Further, a conspicuous supranodal ridge is present in *K. debilis*, *K. floribunda* and *K. wightiana*, while the other four species lack a conspicuous supranodal ridge. All *Kuruna* species possess unique internode colors and patterns (Table 1). All have light green to dark green culm internodes (except *K. serrulata* is greenish-brown and *K. densifolia* maroon) when they are young but turn mainly maroon, yellowish-brown or brownish-dark green when they are old. Glabrous or hirsute to scaberulous culm internodes are seen in *Kuruna*. *Kuruna floribunda* and *K. scandens* have a ring of purple hairs at the summit of each internode and hirsute internodes with white hairs respectively when they are young, but the internodes become glabrous with age. *Kuruna wightiana* is the only species that retains scaberulous culm internodes throughout its entire life time. Also, both *K. floribunda* and *K. serrulata* have purple black or black specks on their young culm internodes, which is a characteristic feature that can be used to differentiate these two species from the rest.

BRANCHING PATTERN—All *Kuruna* species have intravaginal branch development beginning with a single primary branch per node derived from a single bud per node. In all species, the primary branch produces from its basal nodes two (three) lateral secondary branches (except in *K. scandens* with three to four secondary branches) arising almost simultaneously. However, *K. densifolia*, *K. scandens*, *K. serrulata*, and *K. walkeriana* go on to form dense clusters of tertiary branches due to the rebranching of the secondary branches as they mature.

CULM LEAVES—Deciduous and persistent culm leaves are both found in *Kuruna*. Persistent culm leaves are seen in *K. densifolia*, *K. scandens* and *K. serrulata* whereas deciduous culm leaves are common in the other four species. The abaxial indument of the culm leaf sheath is also another important character in *Kuruna*. Of the seven *Kuruna* species, *K. serrulata* and *K. densifolia* are the only species with abaxially

TABLE 1. Morphological comparison of the seven described *Kuruna* species. "?" indicates unknown character states. SI = south India; SL = Sri Lanka.

Character	*K. debilis*	*K. densifolia*	*K. floribunda*	*K. scandens*	*K. serrulata*	*K. walkeriana*	*K. wightiana*
Habitat	Understory	Open grasslands	Understory	Understory	Open rocky plains	Understory	Understory
Distribution	Upper mountain slopes in Central province of Sri Lanka & reported from the Western Ghats region of south India	Horton Plains (wet patanas) of Sri Lanka	Mountains in south central Sri Lanka & Western Ghats region of Kerala, south India	Summit, Mount Piduruthalagala of Sri Lanka	Handapan Ella plains of Sri Lanka	Upper montane zone in Central province of Sri Lanka & Palani Hills, south India	Mountains of south India
Elevation (m)	1,500–2,500	2,000–2,300	1,000–1,900 (SL) 1,600–2,200 (SI)	2,100–2,500	1,200–1,400	1,400–2,400	1,800–2,500
Vegetative characters							
Primary root air canals	Absent	Present	Absent	Absent	Absent	Absent	Absent
Habit and culm arrangement	Scandent/clambering, culms sparse	Erect, culms dense	Erect & shrubby, culms sparse	Scandent, culms dense	Erect & shrubby, culms dense	Erect & shrubby, culms dense	Erect & shrubby, culms dense
Culm internodes	Hollow	Hollow	Hollow	Hollow	Usually hollow (sometimes solid)	Hollow	Hollow
Culm internode indument	Glabrous	Glabrous	Summit of each internode bearing a ring of purple hairs when young & glabrous with age	Hirsute with white hairs when young & glabrous or scabrid with age	Glabrous	Glabrous	Scaberulous
Internode color when young	Light green	Maroon to maroon green	Light green & spotted with purplish-black specks	Light green	Greenish-brown & spotted with black specks	Light green	Dark green
Internode color when mature	Brownish-dark green	Yellowish-brown	Light green	Maroon to yellowish-maroon	Dark maroon	Brownish-dark green	Yellowish-brown
Nodal line diameter	Greater than the adjacent internodes	More or less the same as the adjacent internodes	Greater than the adjacent internodes	Greater than the adjacent internodes	Greater than the adjacent internodes	Greater than the adjacent internodes	Greater than the adjacent internodes
Supranodal ridge	Conspicuous	Inconspicuous	Conspicuous	Inconspicuous	Inconspicuous	Inconspicuous	Conspicuous
Culm leaves	Deciduous with development of branches	Persistent	Deciduous	Persistent	Persistent	Deciduous	Deciduous
Culm leaf sheath abaxial surface	Hispid with non-irritating white hairs	Glabrous	Sparsely hirsute with maroon hairs	Hispid with non-irritating dark brown appressed hairs	Glabrous	Hispid with non-irritating white hairs	Hispid with golden brown irritating hairs
Number of leaves per complement	7–10	5–10	6–10	4–8 (10)	6–7	6–14	6–9
Foliage leaf blade shape	Linaer or linear-lanceolate	Narrowly triangular	Lanceolate	Narrowly oblong	Lanceolate	Cordate & clasping at the base	Ovate-lanceolate
Foliage leaf blade margin	Green & glabrous	Green & antrorsely scabrous	Green & sparingly antrorsely scabrous	Green & glabrous (except slightly scabrid toward the base)	Distinctly pale yellow with antrorse sharp trichomes on the leading margin	Green & antrorsely scabrous	Green & scabrous
Foliage leaf margin width (mm)	Ca. 0.1	0.2 (0.2–0.3)	Ca. 0.1	Ca. 0.1	0.3 (0.2–0.5)	0.17 (0.1–0.3)	Ca. 0.1
Foliage leaf length (cm)	5 (3.5–7.4)	3 (2.5–3.8)	13 (6.7–17)	3.1 (2.1–4.5)	9.2 (5.5–12.8)	5.5 (3.2–9.4)	9 (2.5–18.2)
Foliage leaf fimbriate auricles	Present	Absent	Absent	Absent	Absent	Absent	Absent

(*Continued*)

TABLE 1. (CONTINUED).

Character	*K. debilis*	*K. densifolia*	*K. floribunda*	*K. scandens*	*K. serrulata*	*K. walkeriana*	*K. wightiana*
Foliage leaf sheath summit	Fimbriate	Fimbriate	Fimbriate	Ciliate	Fimbriate with white silky fimbriae	Fimbriate with white silky fimbriae	Fimbriate with light brown long fimbriae
Reproductive characters							
Synflorescence with pulvinate branches	Present	Absent	Present	Present	?	Present	Present
Number of fertile florets per spikelet	2	1	4–6	2	?	3–4	2–3
Palea apex	Acute	Biapiculate	Biapiculate	Acute	?	Acute	Biapiculate
Palea sulcus	Well developed for the full length	Present only toward the apex	Well developed for the full length	Well developed for the full length	?	Well developed for the full length	Well developed for the full length
Number of stigmas	2	2	2	2	?	2–3	3

glabrous culm leaf sheaths. In contrast, *K. debilis*, *K. floribunda*, *K. scandens*, *K. walkeriana* and *K. wightiana* have abaxially hispid culm leaf sheaths.

SYNFLORESCENCES—Synflorescences are known for all *Kuruna* species except *K. serrulata*. Synflorescences are racemose or paniculate usually with pulvinate branches (except in *K. densifolia*). Also, all of these species have multiple fertile florets per spikelet, except *K. densifolia* which has only one fertile floret per spikelet.

PALEA TIPS—Two types of palea tips, acute or biapiculate, are observed in *Kuruna*. Acute tips are characteristic of *K. debilis*, *K. scandens* and *K. walkeriana* while biapiculate tips are seen in *K. densifolia*, *K. floribunda* and *K. wightiana*.

***Phenology*—**Very little is known about flowering cycles in *Kuruna*, except that there are no reports of gregarious monocarpy. Flowering cycles in woody bamboos are inferred based on a combination of flowering dates as documented by herbarium specimens sorted by location/population, label information describing the extent of flowering and personal observations (i.e. Guerreiro 2013). Due to the sporadic nature of herbarium voucher collections and the lack of label information, clear flowering patterns could not be inferred for any of the six species of *Kuruna* for which flowering material is known and we were unable to confidently determine the actual flowering intervals of these species. However, for four species, we suggest possible flowering patterns though these could change with more information about flowering events. We suggest that *K. wightiana* may be an annual or sporadic bloomer, while *K. floribunda*, *K. scandens* and *K. walkeriana* have relatively long flowering cycles. Unfortunately, we are unable to suggest anything about flowering behavior for *K. debilis* and *K. densifolia* due to insufficient herbarium records or label data. No flowering material has been collected for *K. serrulata*.

TAXONOMIC TREATMENT

KURUNA Attigala, Kathriarachchi & L. G. Clark, Phytotaxa 174 (1): 199. 2014— *Kuruna debilis* (Thwaites) Attigala, Kathriarachchi & L. G. Clark

Culm bases pachymorph, short-necked, two or more tillers per culm base present. Culms woody, erect, shrubby or scandent, tillering; midculm internodes usually hollow, terete to flattened or shallowly sulcate above the branches, glabrous, all internodes more or less equally elongated along the culm, ratio of 2 times wall thickness: culm diameter thin to very thick (ratio 0.2–1), lacuna greater than 1/3 of the diameter of the culm; nodes solitary, nodal line horizontal; supranodal ridge mostly inconspicuous or less commonly conspicuous. Culm leaves clearly differentiated from the foliage leaves; girdle present as a band at least 1 mm wide; sheaths usually abaxially hispid, sheath apex usually symmetrically concave, fimbriate, sheath summit extension present; outer ligule absent; blades usually reflexed, sessile, more or less narrowly triangular. Branching pattern intravaginal. Branch complement derived from one bud per node and borne on a promontory; bud prophyll margins unitary, free; primary branch one per node, two to several compressed proximal internodes at its base; primary branch initiation with 2(–3) secondary branches arising almost simultaneously, secondary branches subequal to the primary axis, developing from the second or third compressed internodes and above the primary axis; central

primary branch smaller in diameter than the main culm; leaf branch apex growth indeterminate. Foliage leaves per branch complement 3–many, all with a sheath and a blade; sheaths usually strongly keeled at least near the summit, ciliate or fimbriate (with fimbriate auricles in *K. debilis*); blades tessellate, erect, midrib centric. Synflorescences paniculate or racemose, with 1–2 orders of branching, open, terminating the leafy branches, spatheate bracts at the base and subtending bracts both absent. Spikelets purplish, pedicellate, laterally compressed, consisting of two glumes, usually 2–6 female fertile florets per spikelet (but only 1 in *K. densifolia*); rachilla extension hairy, bearing a rudimentary floret, shorter than or equal to about half the length of a fertile floret; glumes shorter than the spikelet, unawned; lemmas unawned; paleas 2-keeled, the keels usually winged, apex biapiculate or acute, sulcus usually well developed for the full length (except *K. densifolia*). Lodicules 3, more or less subequal, ciliate; stamens 3, filaments free, anther apex lobes rounded, anther connective lower than the apical anther lobes; stigmas 2(–3), plumose. Fruit a basic caryopsis with a linear hilum as long as the fruit.

Etymology—The generic name *Kuruna* is derived from the common name in Sinhalese of the native Sri Lankan *Arundinaria* group, "KuruUna". "Kuru" means dwarf and "Una" means bamboo.

Distribution and Habitat—*Kuruna* occurs in warm temperate and montane regions (both forests and open grasslands) of Sri Lanka (Soderstrom and Ellis 1988) and the Western Ghats of India (Seethalakshmi and Muktesh Kumar 1998). All *Kuruna* species, except *K. densifolia* and *K. serrulata*, are part of the understory vegetation of montane forests, whereas *K. densifolia* inhabits open montane grasslands and *K. serrulata* occurs in open rocky plains with shallow soil covers. We note that although Muktesh Kumar (2011) has reported *K. debilis*, *K. floribunda*, and *K. walkeriana* as being distributed in south India we were unable to examine specimens from this region, as these were not available through loans from India and no duplicates were available in K or US or other herbaria.

Comments—*Kuruna* differs from *Arundinaria* s. s. by its pachymorph culm bases with short necks, culm leaves usually abaxially hispid, culm leaf girdles ca. 1 mm wide, culm leaf auricles absent and the palea apex biapiculate to acute. The following characters differentiate *Kuruna* from other "*Arundinaria*" groups (*Bergbambos*, African alpine bamboos, *Thamnocalamus* and *Yushania)*: pachymorph culm bases with short necks, unicaespitose clumps, culm leaf girdles present as a band ca. 1 mm wide, usually abaxially hispid culm leaves, persistent foliage leaf sheaths and complete branch sheathing, palea apex biapiculate (sinus shallow) to acute and undivided, and the absence of both spatheate empty bracts at the base of the synflorescence and subtending bracts (Attigala et al. 2014).

The key provided here for *Kuruna* is mainly based on vegetative characters and an online web based multi-access key will be available soon for these species (Attigala et al. in prep.).

Key to the Species of *Kuruna*

1. Plants clambering or scandent; culm leaf blades reflexed . . . 2
   2. Supranodal ridge conspicuous; foliage leaf fimbriate auricles present . . . *Kuruna debilis*
   2. Supranodal ridge inconspicuous; foliage leaf fimbriate auricles absent . . . *Kuruna scandens*
1. Plants erect; culm leaf blades erect to slightly spreading . . . 3
   3. Primary roots with air canals; nodal line diameter more or less the same as the adjacent internodes; plants of open grasslands (Patana bogs) . . . *Kuruna densifolia*
   3. Primary roots lacking air canals; nodal line diameter greater than the adjacent internodes; plants of forest understory or rocky mountain plains . . . 4
      4. Culm leaf sheaths abaxially glabrous; foliage leaf blade margins distinctly pale yellow with sharp trichomes on the leading margin . . . *Kuruna serrulata*
      4. Culm leaf sheaths abaxially hispid; foliage leaf blade margins green with scabrous leading margin . . . 5
         5. Foliage leaf blades more or less cordate, clasping at the base, thick and leathery; glume apex acute . . . *Kuruna walkeriana*
         5. Foliage leaf blades linear-lanceolate, not clasping at the base, thin and chartaceous; glume apex mucronate . . . 6
            6. Culm leaf sheath apex more or less horizontal; palea keel wings absent; stigmas 3 . . . *Kuruna wightiana*
            6. Culm leaf sheath apex symmetrically concave; palea keel wings present; stigmas 2 . . . *Kuruna floribunda*

KURUNA DEBILIS (Thwaites) Attigala, Kathriarachchi & L. G. Clark, Phytotaxa 174 (1): 200. 2014— *Arundinaria debilis* Thwaites, Enum. Pl. Zeyl. 37. 1864; *Indocalamus debilis* (Thwaites) Alston, Suppl. Fl. Ceylon 6: 342. 1931.—TYPE: SRI LANKA. *C. P. 1* (lectotype designated by Soderstrom and Ellis 1988: PDA; isolectotypes: K!, 3 sheets, US!).

Culms ca. 4.5 m long, ca. 5.5 (4–9) mm in diameter, habit vine-like, scandent or clambering, sparse; internodes 12.9 (7.5–17) cm long, wall thickness 1.4 (1–2) mm, terete, hollow, ratio of 2 times wall thickness; culm diameter 0.3–0.7, lacuna size 2.7 (1–5) mm, light green when young, becoming brownish- dark green with age, glabrous, flattened behind the branch complement on larger culms but the sulcus not prominent; nodal line diameter greater than the adjacent internodes, supranodal ridge conspicuous. Culm leaves deciduous with development of branches; sheaths 12.8 (9–15.2) cm long, abaxially hispid with non-irritating white hairs, apex fimbriate, symmetrically concave; auricles absent; inner ligule a short truncate pubescent rim, papery; blades 3–4 cm long, 3–6 mm wide, narrow, ca. 1/5 the length of the sheath, caducous, reflexed. Bud prophyll with white-pilose keels, primary branch producing 2 secondary branches, all three developing in an even row, and each with several short internodes at the base, initially erect then spreading. Foliage leaves 7–10 per complement; sheaths closely overlapping, summit fimbriate; fimbriate auricles present, more or less equal on both sides of the blade base; inner ligules ca. 0.4 (0.3–0.6) mm long; outer ligule a minute ciliolate rim; blades 5 (3.5–7.4) cm long, 0.4 (0.3–0.6) cm wide, L:W = 11.8 (7.9–17.6), linear or linear-lanceolate, hirtellous on both surfaces, not manifestly tessellate on either surface, apex acuminate, base narrowly cuneate, margins ca. 0.1 mm wide, green, entire, pseudopetiole ca. 0.5 mm long. Synflorescences

2–6 cm long, 2–3 cm wide, paniculate, with stiff ascending or spreading pulvinate branches. Spikelets 1–1.5 cm long, 2 fertile florets per spikelet, one rudimentary apical sterile floret; glumes early deciduous, ovate, glabrous, apices acute, 8-nerved, glume I 4–5.5 mm long, glume II 5.4–6.8 mm; fertile lemma 7–10.2 mm long, lanceolate-ovate, apex mucronate, 6-nerved, glabrous; palea lanceolate-ovate, 2-keeled, keel wings present, apex acute, sulcus well developed for the full length; lodicules ca. 2 mm long, rhomboid, margins ciliate, the anterior pair many-nerved, nerves extending almost to the tip, the posterior one fewer-nerved and shorter; anthers yellow, ca. 5 mm long, basifixed, developing before the gynoecium; ovary with one style and 2 plumose stigmas. Fruit unknown. Figures 3, 4, 14F.

Distribution and Habitat—The species grows in the understory of the cool upper mountain slopes of the Central Province, Sri Lanka, at elevations of 1,500–2,500 m. Muktesh Kumar (2011) reported that *K. debilis* has been located recently in the Kerala part of the Western Ghats, India, but provided no documentation.

Phenology—This species has been reported to bloom annually by Soderstrom and Ellis (1988), but they themselves regarded this as doubtful. They argued that it is likely that many years occur between the establishment of an individual and its flowering, but that individual clumps in flower may belong to different populations or cohorts. Based on flowering collections from the Horton Plains, the *K. debilis* populations there bloomed in 1968, 1969, 1974, 1975, 1976 and 1978 (no collections in 1977). This species was collected in flower in 1974 from another location (*Davidse & Sumithraarachchi 8666*), suggesting a possible gregarious flowering event. The 1984 flowering collection is from yet another locality. From the 2010 Attigala collections, only one population from Adam's Peak was in bloom (*Attigala et al. 163*) and none of the 2010 Attigala collections of *K. debilis* from Horton Plains were from flowering plants. Therefore, it is difficult to confidently predict the actual flowering interval or behavior of this species.

Comments—*Kuruna debilis* is the only *Kuruna* species with fimbriate foliage leaf auricles. The deciduous, chartaceous glumes of the spikelets of this species are also distinctive. This is a locally common, scandent bamboo with branches that hang from small trees and other vegetation, sometimes covering them densely.

IUCN Red List category—In 2010, several highly fragmented populations of *K. debilis* were observed. Thus, we suggest that this species should be placed in the *Endangered [EN B1 ab(iii)c(iii)]* category based on the IUCN criteria: Extent of occurrence (EOO) < 5,000 km^2 with severely fragmented locations less than five, continuing decline observed in quality of habitat and extreme fluctuation in the number of subpopulations.

Additional Specimens Examined—SRI LANKA. DISTRICT KANDY: Rangala Hill, E of Kandy, 2,000 m, 03 Nov 1969, *Soderstrom* & *Kulatunge 1771* (PDA, US); trail to Adam's Peak from Moray Estate, 26 Oct 1975, *Sohmer* & *Sumithraarachchi 9896* (MO, PDA, US); Knuckles conservation area, Thangappuwa, 1,400 m, 16 Feb 1995, *Jayasuriya 8694* (PDA); Northern slopes of Adams peak, along the main trail, 1,650 m, 21 Nov 1974 (fl), *Davidse & Sumithraarachchi 8666* (MO, US); East path up Adams peak, 1,615 m, 26 Oct 1978, *Fosberg 58115* (US, MO); Peak wilderness above Devonford and Maratenne estates, 1,650 m, 15 Aug 1984, *Jayasuruya et al. 2815* (MO); Adams peak (Hatton side), Palabaddala road, N6 48.737, E80 29.869, 1,916 m, 11 Jun 2010, *Attigala et al. 158* (ISC, K, PDA, US); Adams peak (Hatton side), Palabaddala road, N6 48.737, E80 29.869, 1,916 m, 11 Jun 2010, *Attigala et al. 159* (ISC, K, PDA, US); Adams peak (Hatton side), Palabaddala road, N6 48.648, E80 29.776, 1,945 m, 11 Jun 2010, *Attigala et al. 160* (ISC, K, PDA, US); Adams peak (Hatton side), Palabaddala road, N6 48.548, E80 29.893, 2,096 m, 11 Jun 2010, *Attigala et al. 161* (ISC, K, PDA, US); Adams peak (Hatton side), Palabaddala road, N6 48.617, E80 30.032, 2,151 m, 11 Jun 2010 (fl), *Attigala et al. 163* (ISC, K, PDA); Adams peak (Hatton side), Palabaddala road, N6 49.195, E80 29.885, 2,151 m, 11 Jun 2010 (fl), *Attigala et al. 165* (ISC, K, PDA). DISTRICT NUWARA EILYA: Pattipola, on road to Horton Plains, 1,920 m, 08 Jul 1967, *Mueller-Dombois* & *Comanor 67070824* (PDA); Horton Plains at Big World's End Drop, 2,120 m, 17 Oct 1974 (fl), *Davidse 7645* (MO, PDA, US); Pidurutalagala, 2,000 m, 20 Apr 1970, *Gould 13518* (PDA, US); Horton Plains, 2,500 m, 24 Apr 1970, *Gould 13572* (PDA, US); Hakgala, 6 km E of Nuwara Eliya, 2,000 m, 05 May 1970, *Gould* & *Cooray 13748* (PDA, K); Horton Plains, 2,200 m, 30 Oct 1976 (fl), *Jayasuriya 2385* (K, MO, PDA, US), *2388* (MO, PDA, US); 10 km N of Nuwara Eliya, 1,500 m, 17 May 1968 (fl), *Koyama 13622* (PDA); Nuwara Eliya, lower slopes of Pidurutalagala, 1,890 m, 03 Nov 1969, *Soderstrom* & *Kulatunge 1606* (PDA, US); Nuwara Eliya Woods, 1,890 m, 05 Nov 1969 (fl), *Soderstrom* & *Kulatunge 1612* (PDA, US); road from Diyagama Tea Estate to Horton Plains, *Sohmer* & *Sumithraarachchi 9992* (PDA, MO); Nuwara Eliya, 1,830 m, *s. d., Soderstrom 2550* (US); Agra-Bopat PR. Approach: Bopatalawa, Menik Palama, 1,705 m, 28 Jan 1995, *Jayasuriya 8639* (PDA); Peak Wilderness Sanctuary, trail from Rajamalai to Adam's Peak, 1,725 m, 15 Sep 1995, *Jayasuruya & Karunaratne 9109* (PDA); Kandapola, Sita Eliya forest, Nuwara Eliya Range, 07 Sep 1994, *Jayasuriya 8224* (PDA), Kikiliyamana PR, Nuwara Eliya Range, 09 Oct 1994, *Jayasuriya 8290* (PDA); MAB reserve along road to Horton Plains, 2,400 m, 15 Jul 1978 (fl), *Meijer 1980* (US, MO); Ceylon, *s. d., Thwaites 01* (US); Pidurutalagala mountain, 15 Aug 1978, *Meijer 1959* (US, MO); Northern slopes of Pidurutalagala mountains, 29 Oct 1975, *Sohmer & Sumithraarachchi 10163* (MO, K); Haputala range, Ohiya, 1,840 m, 27 Sep 1978 (fl), *Soderstrom 2553* (K, US); World's end road, Horton Plains, 30 Jul 1975 (fl), *Sumithraarachchi & Sumithraarachchi DBS 953* (K); Horton Plains, 28 Sep 1978 (fl), *Soderstrom 2557* (MO, US); Pidurutalagala mountain, N6 58.824, E80 46.146, 1,958 m, 27 May 2010, *Attigala et al. 120* (ISC, K, PDA); Pidurutalagala mountain, N6 58.716, E80 46.359, 2,001 m, 27 May 2010, *Attigala et al. 121* (ISC, K, PDA); Horton Plains, N6 51.016, E80 48.982, 1,929 m, 28 May 2010, *Attigala et al. 123* (ISC, K, PDA); Horton Plains, N6 50.963, E80 48.881, 1,871 m, 28 May 2010, *Attigala et al. 124* (ISC, K, PDA); Horton Plains, N6 47.643, E80 48.309, 2,130 m, 28 May 2010, *Attigala et al. 130* (ISC, K, PDA); Horton Plains, N6 47.858, E80 49.832, 2,150 m, 28 May 2010, *Attigala et al. 133* (ISC, K, PDA). DISTRICT RATNAPURA: Trail to Gongala, above estate, 1,225 m, 28 Aug 1984 (fl), *Jayasuruya et al. 2899* (MO); Handapan Ella plains, above Eggbirth tea estate, N6 26.736, E80 36.459, 1,251 m, 04 Jun 2010, *Attigala et al. 148* (ISC, K, PDA, US); Handapan Ella plains, Hellundeniya, near pichchamal aara, N6 26.657, E80 36.102, 1,232 m, 04 Jun 2010, *Attigala et al. 154* (ISC, K, PDA, US).

KURUNA DENSIFOLIA (Munro) Attigala, Kathriarachchi & L. G. Clark, Phytotaxa 174 (1): 200. 2014— *Arundinaria densifolia* Munro, Trans. Linn. Soc. London 26(1): 32. 1868; *Chimonobumbusa densifolia* (Munro) Nakai, J. Arnold Arbor. 6: 151. 1925.— TYPE: SRI LANKA. "Ceylon" T.T.[Banks] in swamps, *Watson 25* (holotype: K).

Rhizomes with thick primary roots with air cavities, root system completely submerged to ca. 0.33 m deep in standing water. Culms 2–2.5(–3) m tall, 4.6 (3–6) mm in diameter, erect, dense; internodes 7.2 (3.3–13.3) cm long, wall thickness 1 mm, terete, hollow, ratio of 2 times wall thickness: culm diameter 0.3–0.7, lacuna size 2.6 (1–4) mm, maroon to maroon-green when young, becoming yellowish-brown with age, glabrous; nodal line diameter more or less the same as the adjacent internodes, supranodal ridge inconspicuous. Culm leaves persistent, indurate, appressed to the culm, glabrous; sheaths 4.4 (2.3–6) cm long, abaxially glabrous, apex more or less horizontal; auricles absent; inner ligule a membranous rim less than 0.5 mm long, ciliolate on the margin; blades 1–2 cm long, 2–5 mm wide, narrowly triangular, ca. 1/3 to more than 1/2 as long as the sheath, erect to slightly spreading. Bud prophyll brown with white-ciliate keels; primary branch producing 2 secondary branches, all 3 branching in rapid succession giving rise to a cluster of many subequal branches strongly appressed to the culm, erect. Foliage leaves 5–10 per complement; sheaths closely overlapping, summit

FIG. 3. *Kuruna debilis*: a. Flowering branch (early stage) (×0.6). b. Flowering branch (mature stage) (×0.6). c. Leaf complement (×0.6). d. Leaf ligule (×7). e. Young culm with culm leaves in place (×0.6). f. Culm leaf (lamina abscissed) (×1.2). g. Summit of culm leaf sheath (abaxial view) (×1.2). h. Summit of culm leaf sheath (adaxial view) (×1.2). i. Young culm bud (×3.5). (Illustrations by G. B. Threlkeld, all drawings based on *Soderstrom & Kulatunge 1606*). Note: Supranodal ridge is not distinctly illustrated in i; see Fig. 13F.

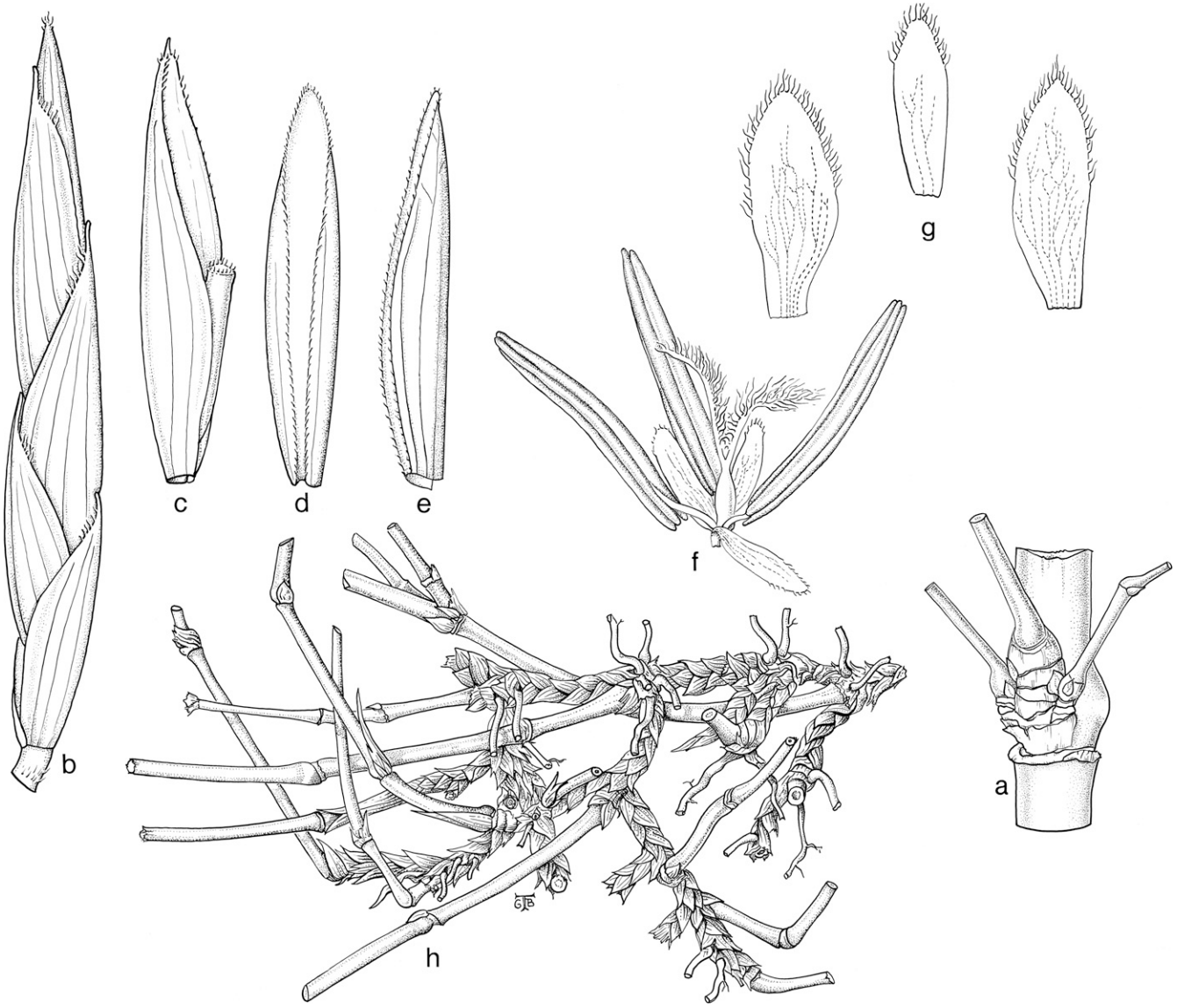

FIG. 4. *Kuruna debilis*: a. Branch complement (×3.5). b. Spikelet (×3.5). c. Lemma with rachilla internode (×7). d. Palea (facing the keels) (×7). e. Palea (lateral view) (×7). f. Flower (×15). g. Lodicules (×15) h. Rhizome (×0.6). (Illustrations by G. B. Threlkeld, all based on *Soderstrom & Kulatunge 1606*). Note: Supranodal ridge is not distinctly illustrated in a; see Fig. 13F.

fimbriate; auricles absent; inner ligules a minute ciliolate membrane; outer ligule a minute ciliolate rim; leaf blades 3 (2.5–3.8) cm long, 0.3 (0.3–0.4) cm wide; L:W = 9.2 (7.8–11), stiff, narrowly triangular, glabrous on both surfaces, tessellate on both surfaces but not always manifest, apex acuminate, base obtuse, margins 0.2 (0.2–0.3) mm wide, green, antrorsely scabrous, trichomes ca. 0.2 mm long, pseudopetiole ca. 1 mm long. Synflorescences ca. 3.5 cm long, ca. 1 cm wide, paniculate, with stiff non-pulvinate branches, glabrous. Spikelets ca. 1 cm long, one fertile floret per spikelet, one rudimentary apical sterile floret; glumes ovate-triangular, apex mucronate, with the single scabrid midnerve, glume I 4.5–6 mm long, glume II 6–7 mm long; fertile lemma 8–10 mm long, lanceolate, apex mucronate, 7-nerved, scabrid; palea 7.5–8.5 mm long, lanceolate-ovate, 2-keeled, keel wings present, apex biapiculate, sulcus present only towards the apex; lodicules ca. 2 mm long, rhomboid, glabrous except for a few hairs at the summit, the anterior pair with several branching vascular traces, the posterior with fewer traces; anthers pale yellowish, ca. 4–5 mm long, basifixed, developing before the gynoecium; ovary with one style and 2 plumose stigmas. Caryopsis brown, with a persistent style. Figures 5, 6, 14B–C.

Distribution and Habitat—This bamboo is found in the open grasslands of Horton Plains (wet patanas), Sri Lanka, where it often forms dense thickets and grows in cold, standing water at ca. 2,000–2,300 m elevation.

Phenology—Of the specimens examined, flowering specimens were collected in 1890, 1967, 1969, 1970, 1973, 1974 and 1978. Only three collections, from 1975, 1993 and 2010, were without flowers. Almost all of these flowering collections are populations from Horton Plains. Hence, based on these collection records, *K. densifolia* could be an annual bloomer or at least some portion of its population is always in flower, as has been reported for the high elevation, clump-forming woody bamboo *Chusquea subtessellata* in Costa Rica (Horn and Clark 1992). However, the collection records and label data are insufficient to confidently predict the actual flowering cycle of this species.

FIG. 5. *Kuruna densifolia*: a. Leafy branch (×0.6). b. Whorl of branches on young culm (×0.6). c. Branch whorl detail (×0.6). d. Leaf complement (×0.6). e. Leaf ligule (×7). f. Culm leaf (adaxial view to show ligule) (×1.7). g. Culm leaf (abaxial view) (×1.7). h. Mid-culm bud (×1.7). i. Flowering branches (×1.1). (Illustrations by G. B. Threlkeld, based on *Soderstrom & Kulatunge 1656*).

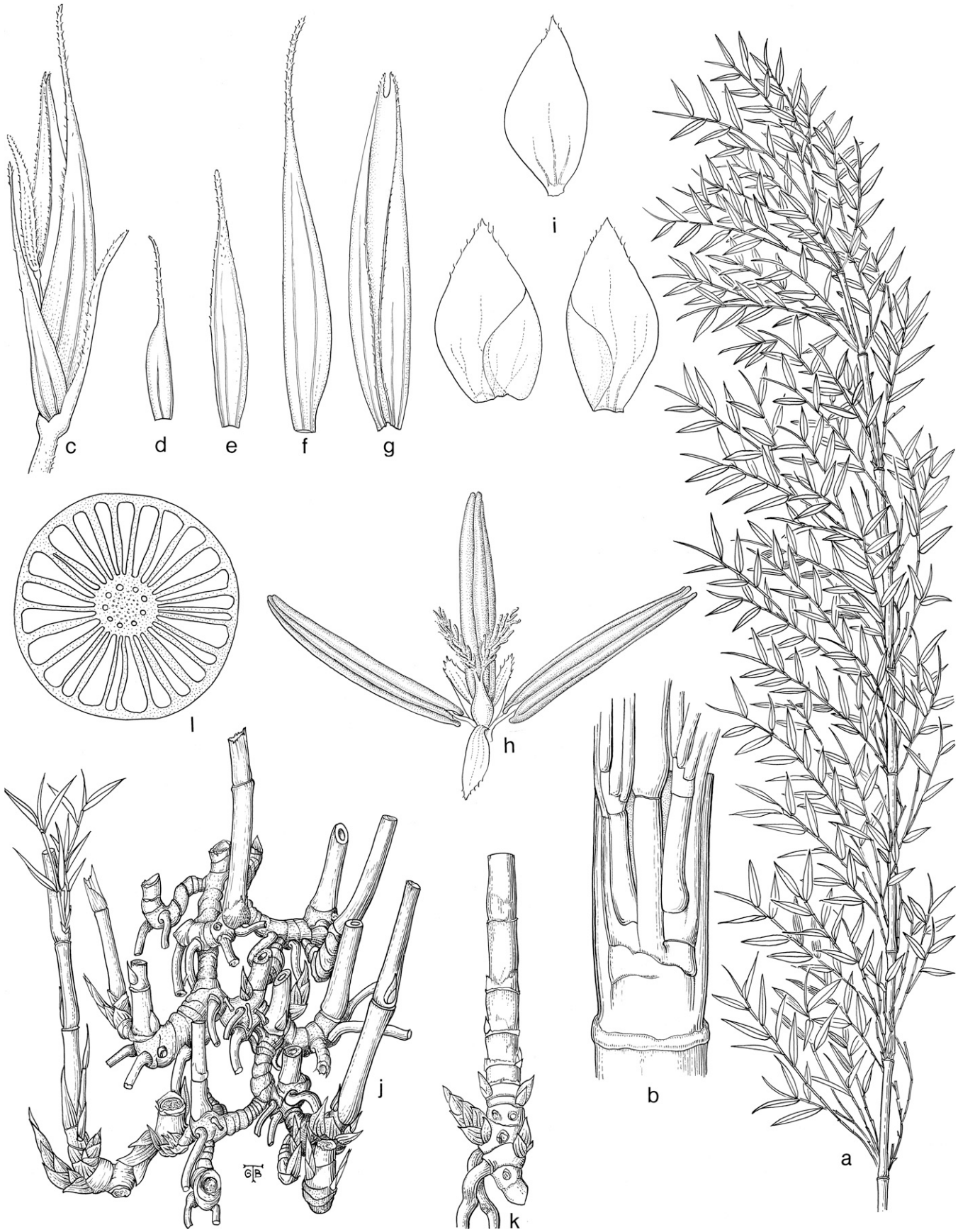

FIG. 6. *Kuruna densifolia*: a. Vegetative culm (×0.3). b. Branch complement (×3.5). c. Spikelet (×7). d. Lower glume (×7). e. Upper glume (×7). f. Lemma (×7). g. Palea (×7). h. Flower (×7). i. Lodicules (×l.5). j Rhizome (×0.6). k. Rhizome bud pattern (×0.6). l. Primary root (cross section) (×3.5). (Illustrations by G. B. Threlkeld, based on *Soderstrom & Kulatunge 1656*).

Comments—In terms of number of florets per spikelet, this species is the most reduced within the genus, with the spikelet containing a single fertile floret and a reduced floret above (or only the rachilla extension); it is also the only species of the genus that lacks pulvinate synflorescence branches. The roots produce air canals and the dense rhizome bases grow in cold water. Also, these bamboos of the wet patanas are adapted to the reduction of transpiration and protection of new growth from intense illumination by densely produced foliage, dense branching, densely packed plume-like culms and thick leaves (Soderstrom and Ellis 1988).

Seethalakshmi and Muktesh Kumar (1998) and Muktesh Kumar (2011) reported that *K. densifolia* in India is restricted to south India (Anamudi Hills) and in the southern Western Ghats it grows in Eravikulam and Anamudi from 2,000–2,695 m. However, based on the descriptions and illustrations, we believe that this entity is likely not the same as the *K. densifolia* found in Sri Lanka. Unfortunately, it is difficult to come to a conclusion without seeing the actual Indian *K. densifolia* specimens.

IUCN Red List category—As this species is confirmed to occur only in the open grasslands of Horton Plains, we suggest the *Critically Endangered [CR B1 ab(iii)]* category based on the IUCN criteria: Extent of occurrence (EOO) < 100 km^2 with number of locations 1 and continuing decline observed in quality of habitat.

Additional Specimens Examined—SRI LANKA. DISTRICT NUWARA ELIYA: Horton Plains, Reflection Lake, 2,300 m, 27 Jan 1970 (fl), *Clayton 5486* (PDA, US); along road from Pattipola, 2,175 m, 07 Oct 1967 (fl), *Comanor 451* (PDA, US); Horton Plains, grasslands and forest behind Farr Inn, 2,120 m, 17 Oct 1974 (fl), *Davidse 7600* (MO, PDA, US); meadow N of Farr Inn, 2,300 m, 10 May 1970, *Gould & Cooray 13780* (PDA, US); below resthouse at Ohiya Road, 2,130 m, 09 Jul 1967, *Mueller-Dombois & Comanor 67070915* (US); 18 Mar 1904, *Nock s. n.* (PDA); Horton Plains, 2,195 m, 11 Nov 1969 (fl), *Soderstrom & Kulatunge 1656* (MO, PDA,US); road from Diyagama Tea Estate to Horton Plains-Ohiya Road, 27 Oct 1975, *Sohmer & Sumithraarachchi 9991* (PDA, US), 9993 (MO, PDA, US); Horton Plains, Ohiya road, 28 Oct 1975, *10051* (PDA, MO); Kandepola forest reserve, along loop road, 30 Nov 1973 (fl), *Sohmer et al. 8337* (MO); Horton Plains, 15 Sep 1890 (fl), *Trimen 29* (US); World's End, Bogawanthalawa foot path, 07 Oct 1973, *Waas 169* (PDA, US); Horton Plains, 2,200 m, 29 Mar 1993, *Weerasinghe & Jayasekara s.n.*(PDA); Horton Plains, 2,160 m, 27 Sep 1978 (fl), *Soderstrom 2556* (US); MAB Reserve along road to Horton Plains, 2,300 m, 15 Jul 1978 (fl), *Meijer 1986* (MO, US); Horton Plains, 2,000 m, 04 Dec 1970, *Larsen AAU70–29474* (MO); Horton Plains, N6 50.341, E80 48.729, 2,174 m, 29 May 2010, *Attigala et al. 125* (ISC, K, PDA); Horton Plains, N6 50.300, E80 48.660, 2,173 m, 29 May 2010, *Attigala et al. 126* (ISC, K, PDA); Horton Plains, N6 49.532, E80 48.372, 2,142 m, 29 May 2010, *Attigala et al. 127* (ISC, K, PDA); Horton Plains, N6 47.986, E80 48.386, 2,120 m, 29 May 2010, *Attigala et al. 128* (ISC, K, PDA); Horton Plains, N6 47.913, E80 48.334, 2,119 m, 29 May 2010, *Attigala et al. 129* (ISC, K, PDA); Horton Plains, N6 47.643, E80 48.309, 2,120 m, 29 May 2010, *Attigala et al. 130* (ISC, K, PDA); Horton Plains, N6 48.440, E80 48.391, 2,135 m, 29 May 2010, *Attigala et al. 131* (ISC, K, PDA); Horton Plains, N6 47.666, E80 49.556, 2,119 m, 29 May 2010, *Attigala et al. 132* (ISC, K, PDA).

KURUNA FLORIBUNDA (Thwaites) Attigala, Kathriarachchi & L. G. Clark, Phytotaxa 174 (1): 200. 2014— *Arundinaria floribunda* Thwaites, Enum. Pl. Zeyl. 375. 1864; *Indocalamus floribundus* (Thwaites) Nakai, J. Arnold Arbor. 6: 148. 1925.— TYPE: SRI LANKA. Maturatte district, 1520 m, *Thwaites s. n.*, in 1853, *C. P. 2624* (holotype: PDA; isotypes: K! 2 sheets, US!).

Culms ca. 2.5 m tall, 6.2 (3–10) mm in diameter, erect, shrubby, sparse; internodes 18.4 (7–30) cm long, wall thickness 1 mm, terete, hollow, ratio of 2 times wall thickness: culm diameter 0.2–0.7, lacuna size 4.2 (1–8) mm, light green and spotted with purplish-black specks when young, becoming lighter in color with age, summit bearing a ring of purple hairs when young, glabrous when older; nodal line diameter greater than the adjacent internodes, supranodal ridge conspicuous. Culm leaves deciduous; sheaths 10.5 (7.1–16.1) cm, abaxially sparsely hirsute throughout with maroon hairs, apex symmetrically concave; auricles absent; inner ligule a short membrane, ca. 0.5 mm long, abaxially puberulent; blades 3 cm long, 2–3 mm wide, ca. linear-lanceolate, ca. 1/3–1/4 as long as the sheath, initially erect, becoming reflexed. Primary branch producing 2 secondary branches, followed by other branches from these axes to form a whorl of usually 5 more or less equal branches, the latter occasionally rebranching but at maturity the whole branch complement not crowded. Foliage leaves 6–10 per complement; sheath summit fimbriate; auricles absent; inner ligule a minute short rim; outer ligule a minute ciliolate rim; blades 13 (6.7–17) cm long, 1.3 (0.9–1.8) cm wide; L:W = 10.9 (6.7–14.2), lanceolate, glabrous on both surfaces, tessellate on both surfaces, apex acuminate, base attenuate, margins ca. 0.1 mm wide, green, glabrous or sparingly antrorsely scabrous, trichomes ca. 0.1 mm long, pseudopetiole 2.6 (1–4) mm long. Synflorescences 15–20 cm long, 8–10 cm wide, paniculate, branches pulvinate, glabrous, spreading. Spikelets 2.5–3.5 cm long, 4–6 fertile florets per spikelet, one rudimentary apical sterile floret; glumes glabrous, with a few cilia on the upper edges, apex mucronate, glume I 3.8–5.6 mm long, ovate-triangular, 5-nerved, glume II 5.5–6.1 mm long, ovate-lanceolate, 7-nerved; fertile lemma 8.5–10 mm long, ovate-lanceolate, apex mucronate, 7- or 8-nerved, scabrous; palea 3.8–6.3 mm long, lanceolate, 2-keeled, keel wings present, apex biapiculate, sulcate between the keels, sulcus well developed for the full length; lodicules 1.5–2 mm long, anterior pair rhomboid, narrowed at the base, posterior lanceolate, all apically ciliate; anthers orange-yellow, ca. 4.3–6 mm long, basifixed; ovary not found. Fruit unknown. Figures 7, 8, 14A.

Distribution and Habitat—This bamboo is distributed in the understory of montane forests of south-central Sri Lanka at ca. 1,000–1,900 m elevation. Individual plants of *K. floribunda* were scattered throughout the closed forest associated with *Cupressus*. This species is also found in the Western Ghats region of Kerala (Rao 1914) and Munnar on the way to Anamudi and Berijam from 1,600–2,200 m of south India (Muktesh Kumar 2011).

Phenology—The only flowering specimen collected was from 1910 and other flowering specimens have not been seen. Thus, at least in the most recent two decades this species has remained vegetative and we hypothesize that it has an extended flowering cycle.

Comments—The presence of a thick, prominent supranodal ridge and small clumps with culms 2–3.5 m tall with the internodes somewhat scabrous and speckled with purplish markings are the most diagnostic characteristics of this species. As noted in Soderstrom and Ellis (1988) and based on our own collections, this species does not occur in abundance. We were able to collect only two populations in 2010, which were persisting in deforested regions.

IUCN Red List category—Based on our observations in 2010, we suggest the *Critically Endangered [CR B1 ab(i,iii)]* category for *K. floribunda* based on the IUCN criteria: Extent of occurrence (EOO) < 100 km^2 with number of locations 1, continuing decline observed in EOO and quality of habitat.

FIG. 7. *Kuruna floribunda*: a. Leaf complement (×0.6). b. Leaf ligule (×3.5). c. Culm leaf in place (×0.6). d. Culm leaf sheath (outside view) (×3.5). e. Bud on young culm (×1.7). f. Branching, early stage (×1.7). g. Branch complement (×1.7). (Illustrations by G. B. Threlkeld, based on *Soderstrom & Kulatunge 1658*). Note: No distinct constriction at the apex of the foliage leaf blade, as shown in a, occurs in the actual species, and the supranodal ridge is not distinctly illustrated in e. See Fig. 13A for supranodal ridge.

FIG. 8. *Kuruna floribunda*: a. Inflorescence (×0.6). b. Spikelet (glumes missing) (×3.5). c. Lower glume (×7). d. Upper glume (×7). e. Lemma (×7). f. Palea (×7). g. Flower (×7). h. Lodicules (×15). i. Rhizome (×0.6). (Illustrations by G. B. Threlkeld, all based on *Jowitt s.n.*, 28 Feb 1902, except i, based on *Soderstrom & Kulatunge 1658*).

Additional Specimens Examined—SRI LANKA. DISTRICT BADULLA: between Ohiya and Boralanda, 1,890 m, 13 Nov 1969, *Soderstrom & Kulatunge 1658* (K, PDA, US). DISTRICT RATNAPURA: Sinharaja, Handapan ella plains, above Ilumbakanda Estate, 1,250 m, 14 Jan 1993, *Jayasuriya & Wijesinghe 7094* (PDA); Wewiyathalawa-Kithulgala, N7 03.049, E80 24.009, 1,167 m, 20 Jun 2010, *Attigala et al. 135* (ISC, K, PDA); Wewiyathalawa-Kithulgala, N7 02.967, E80 24.085, 1,212 m, 20 Jun 2010, *Attigala et al. 139* (ISC, K, PDA); Handapan Ella OSF, approach from Botivatenna on Rakwana- Pothupitiya Road, 1,100 m, 13 Feb 1994, *Jayasuruya 8024* (PDA). DISTRICT KEGALLE: Amanawala-Ampane PR, Kitulgala Range, 1,100 m, 22 Nov 1994, *Jayasuriya & Wijesinghe 8574* (PDA). DISTRICT NUWARA ELIYA: Haputala range, forests near Ohiya, 1,780 m, 27 Aug 1978, *Soderstrom 2555* (US). DISTRICT NOT GIVEN: top of Naminabuli, 24 Oct 1910 (fl), *Willis 103* (US).

KURUNA SCANDENS (Soderstrom & Ellis) Attigala, Kathriarachchi & L. G. Clark, Phytotaxa 174 (1): 200. 2014— *Arundinaria scandens* Soderstrom & Ellis, Smithsonian Contr. Bot. 72: 20. 1988.— TYPE: SRI LANKA. summit of Pidurutalagala, Sep 1881, *Beddome s. n.* (Holotype: PDA, US 2903434 (frag.)!).

Culms ca. 7–8 m long, ca. 3.6 (2.5–7) mm in diameter, at first erect, then arching and clambering, dense, clumps of 100–200 culms; internodes 9.8 (8.7–10.8) cm long, wall thickness 1.1 (1–2) mm, terete, hollow, ratio of 2 times wall thickness: culm diameter 0.5–0.8, lacuna size 1.4 (0.5–3) mm, light green when young, becoming maroon to yellowish-maroon with age, hirsute with white hairs when young, glabrous or scabrid with age; nodal line diameter greater than the adjacent internodes, supranodal ridge inconspicuous. Culm leaves persistent, sheaths 5.3 (3.8–6.5) cm long, abaxially hispid with non-irritating dark brown appressed hairs, apex symmetrically concave; auricles absent; inner ligule a rounded membrane ca. 1.7 mm long with an irregularly toothed margin; blades 10–12 cm long, ca. 2.5 mm wide, narrowly oblong, ca. 1/8–1/10 the length of the sheath, caducous, reflexed. Bud prophyll with dark brown pilose keels; primary branch producing 3 or 4 secondary branches developing shortly after the main axis has elongated, the secondary branches in turn producing tertiary branches at their nodes, the whole ultimately resulting in a dense cluster of long, widely divergent branches, enveloped at the base by the persistent sheath. Foliage leaves 4–8(–10) per complement; sheaths closely overlapping, summit ciliate; auricles absent; inner ligule 0.9 (0.7–1.2) mm long, an irregular, erose membrane, glabrous; outer ligule absent; blades 3.1 (2.1–4.5) cm long, 1.0 (0.5–1.5) cm wide; L:W = 3.7 (2.5–5.3), narrowly oblong, glabrous, strongly tessellate on both surfaces, apex acute, base rounded, margins ca. 0.1 mm wide, green, entire (except slightly scabrid toward the base), pseudopetiole 1.2 (1–2) mm long. Synflorescences 6–7 cm long, ca. 6 cm wide, paniculate, with stiff ascending or spreading pulvinate branches, glabrous. Spikelets ca. 1.2 cm long, 2 fertile florets per spikelet, one rudimentary apical sterile floret; glumes ovate-triangular, abaxially glabrous, adaxially puberulent on the upper part, apices mucronate, glume I 2.7–3.6 mm long, glume II 3.9–4.5 mm; fertile lemma 6.3–7.5 mm long, ovate-lanceolate, apex mucronate, 7-nerved, abaxially glabrous, adaxially puberulent on the upper part; palea broad, strongly 2-keeled, keel wings present, 2 nerves in each wing, 3 nerves between the keels, apex acute, sulcus well developed for the full length; lodicules 1.6–1.7 mm long, margins ciliate; anthers pale yellow, ca. 5 mm long; ovary with one style and 2 plumose stigmas. Fruit unknown. Figures 9, 14E.

Distribution and Habitat—This species is endemic to the summit of Mount Piduruthalagala, Sri Lanka, where it occurs in the forest understory from ca. 2,100–2,500 m (summit).

Phenology—Flowering specimens were collected in 1887 and a collection by Thwaites (*Thwaites 3860*) is of unknown date. However, records show a collection of *Panicum stenostachyum* Thwaites (*Thwaites 3845*) from Sri Lanka in 1964 (Tropicos 2015), so we infer that the *Thwaites 3860* specimen could have been collected around 1964. Though there are limited collections of this species, none of the most recent collections (from 1978 and 2010) consist of flowering material and thus it seems likely that this species also flowers at long intervals.

Comments—Soderstrom and Ellis (1988) found that this species replaces *K. debilis* on Mount Pidurutalagala at elevations above 2,100 m. But according to our observations, *K. scandens* is now restricted only to the peak of Mount Pidurutalagala, due to an excessive amount of human interference with its habitat, and this single population seems to be declining rapidly.

IUCN Red List category—Since this species is endemic to Mount Piduruthalagala, Sri Lanka, we propose the *Critically Endangered [CR B1 ab(i,iii,v)]* category for *K. scandens* based on the IUCN criteria: Extent of occurrence (EOO) < 100 km^2 with number of locations 1, continuing decline observed in EOO, quality of habitat and number of mature individuals.

Additional Specimens Examined—SRI LANKA. DISTRICT KANDY: Knuckles Mountains, Mar 1887 (fl), *Ferguson 312* (US). DISTRICT NUWARA ELIYA: Piduruthalagala, 2,347 m, 26 Oct 1978, *Soderstrom & Kulatunge 1608* (K, PDA, US); Piduruthalagala, 2,650 m, 16 Feb 1978, *Clayton 5756* (PDA, US); Piduruthalagala, 2,347 m, 26 Oct 1978, *Soderstrom 2550* (K, US); Ceylon, *s. d.* (fl), *Thwaites 3860* (US); Piduruthalagala mountain top, N7 02.967, E80 24.085, 2,511 m, 31 Jun 2010, *Attigala et al. 166* (ISC, K, PDA); Piduruthalagala mountain top, N7 02.967, E80 24.085, 2,511 m, 31 Jun 2010, *Attigala et al. 167* (ISC, K, PDA).

Kuruna serrulata Attigala, Kathriarachchi & L. G. Clark, sp. nov. — TYPE: SRI LANKA. Handapan Ella plains, above the Eggbirth estate, N6 26.739, E80 36.470, 1,245 m, 04 Jan 2010, *L. Attigala, N. de Silva and A. de Silva 149* (Holotype: PDA!, isotypes: ISC!, K!)

Culms 1.0–1.5 m long, 7 (5–10) mm in diameter, erect, shrubby, dense; internodes 12.9 (9.2–24) cm long, wall thickness 1 (1–3) mm, terete, internodes usually hollow (sometimes solid), ratio of 2 times wall thickness: culm diameter 0.2–1, lacuna size 5 (2–6) mm, greenish-brown and spotted with black specks when young, becoming dark maroon with age glabrous; nodal line diameter greater than the adjacent internodes, supranodal ridge inconspicuous. Culm leaves persistent; sheaths 5.8 (5–7.3) cm long, abaxially glabrous, apex more or less horizontal; auricles absent; inner ligule a minute ciliate membrane; blades 1.8–3.4 cm long, ca. 0.5 mm wide, narrowly ovate, ca. 1/2 the length of the sheath, erect to slightly spreading. Primary branch producing 2 lateral branches, followed by rebranching of the lateral branches giving rise to a complement of 10–20 subequal branches. Foliage leaves 6–7 per complement; sheath summit fimbriate with white silky fimbriae; auricles absent; inner ligules minute, truncate; outer ligule a short inconspicuous rim; blades 9.2 (5.5–12.8) cm long, 1 (0.6–1.4) cm wide; L:W = 7.2 (5.8–10.8), lanceolate, thick and leathery, strongly tessellate on both surfaces, apex acuminate, base obtuse, margins 0.3 (0.2–0.5) mm wide, distinctly pale yellow with antrorse sharp trichomes on the leading margin, trichomes ca. 0.6 mm long, pseudopetiole 1.6 (1–3) mm long. Synflorescences unknown. Figure 10.

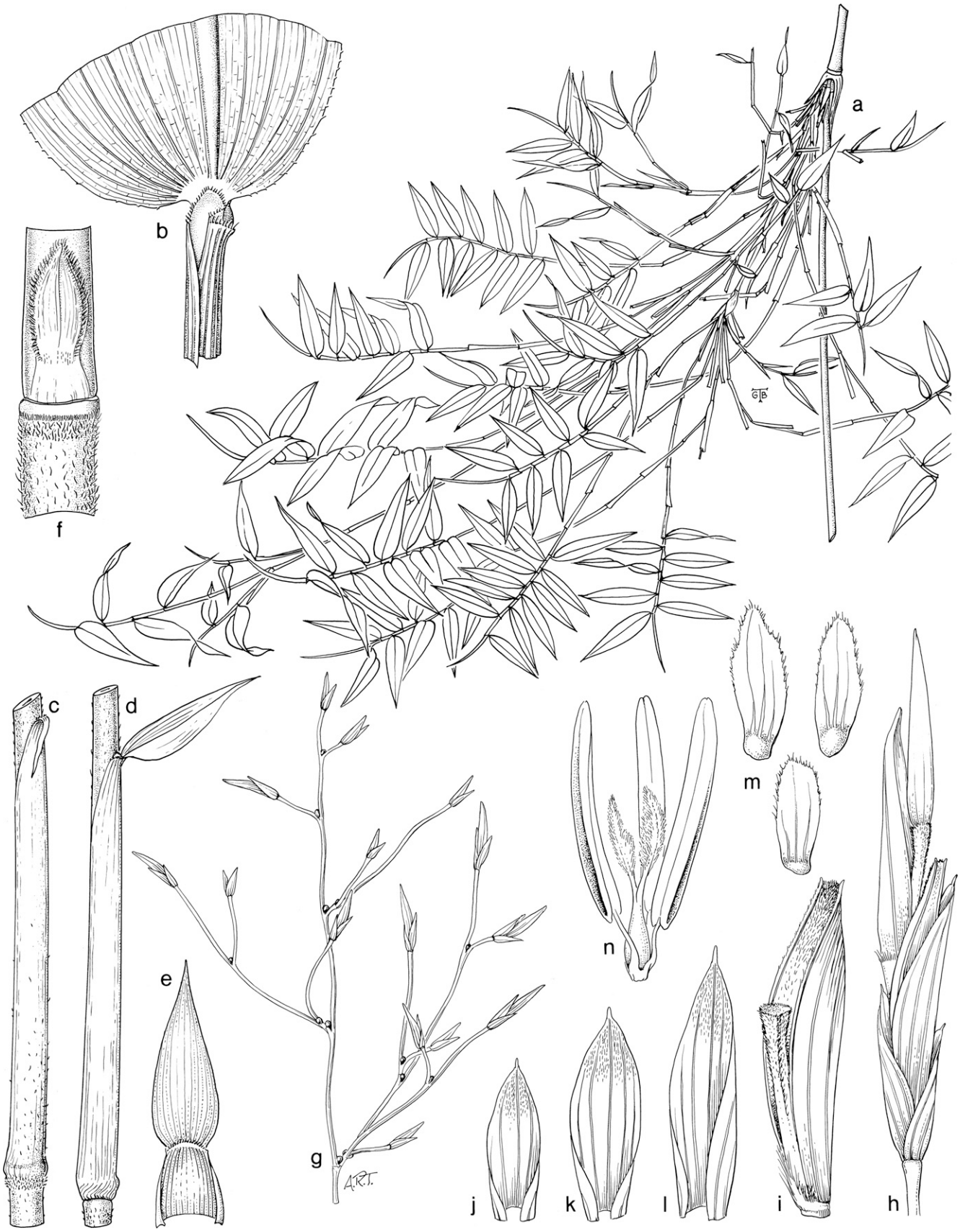

FIG. 9. *Kuruna scandens*: a. Leafy branch habit (×0.3). b. Foliage leaf ligule (×3.4). c. Young culm leaf in place (×0.6). d. Older culm leaf in place (×0.6). e. Culm leaf, adaxial view to show ligule (×0.6). f. Young culm bud (×1.1). g. Inflorescence (×1.1). h. Spikelet (×7). i. Floret, showing palea and rachilla segment (×8.5). j. Lower glume (×8.5). k. Upper glume (×8.5). l. Lemma (×8.5). m. Lodicules (×14). n. Androecium and gynoecium (×8.5). (Illustrations by G. B. Threlkeld, a–f based on *Soderstrom & Kulatunge 1608*, g–n on *Beddome s.n.*, Sep 1881). Note: Palea tips are shown as biapiculate in i, but they are actually acute.

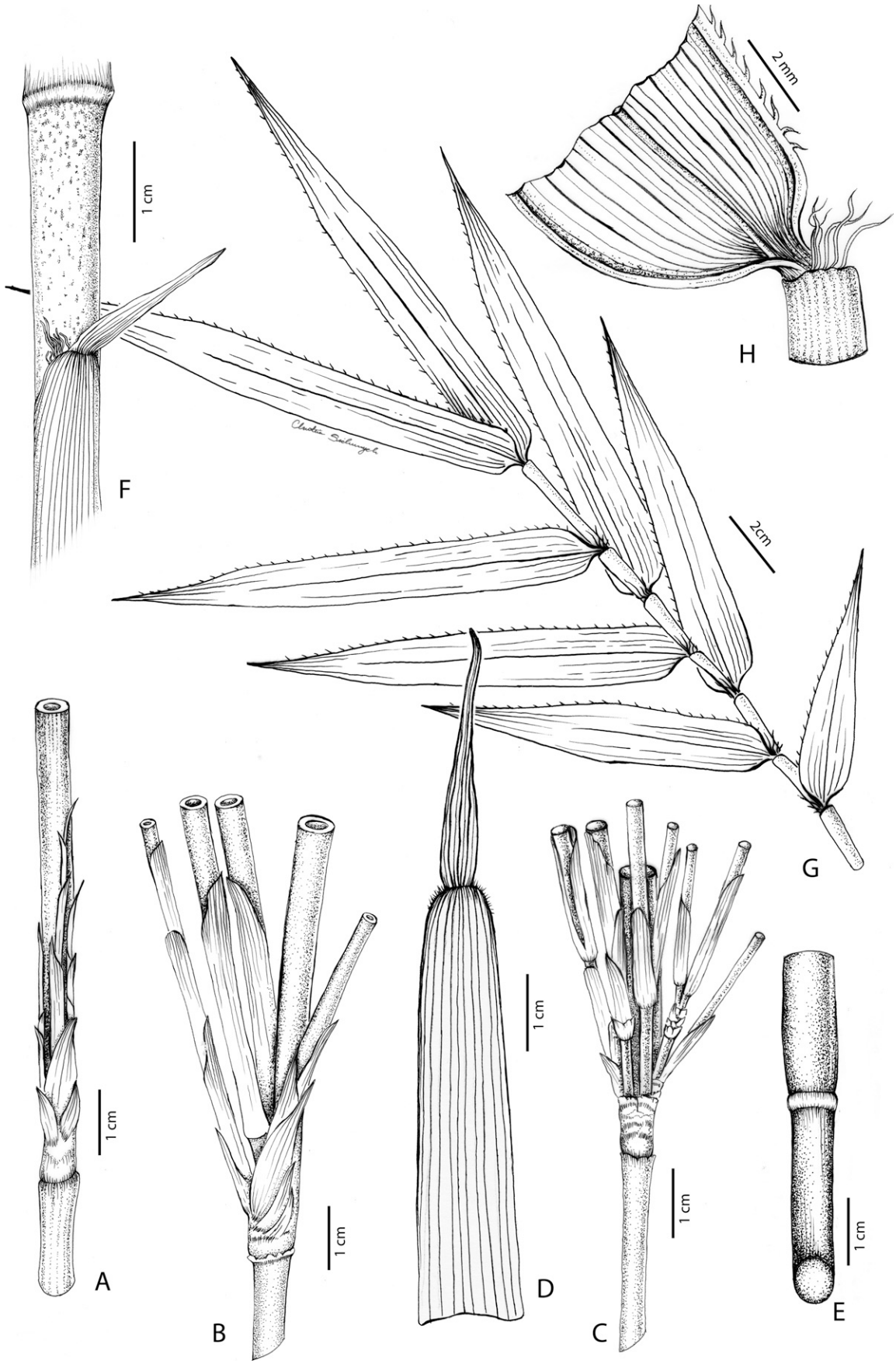

FIG. 10. *Kuruna serrulata*: A. Branching, early stage. B. Intermediate branch complement. C. Mature branch complement. D. Culm leaf. E. Solid culm. F. Older culm leaf in place. G. Leaf complement. H. Foliage leaf summit and leaf margin trichomes. (Illustrations by C. Sidorowych. A based on *Attigala et al. 150*; C, F based on *Attigala et al. 149*; B, D–E, G–H based on *Attigala et al. 152*).

Etymology—*Kuruna serrulata* is named for the presence of distinct sharp trichomes on the leading margin of the foliage leaf blades.

Distribution and Habitat—The species is distributed mainly in open rocky montane plains with shallow soil cover of Handapan Ella plains of the southern province of Sri Lanka, at an elevation of ca. 1,200–1,400 m.

Phenology—All collections of this species to date are vegetative.

Comments—This species is unique due to the presence of distinct sharp trichomes on the leading margin of the foliage leaves and distinctly pale yellow foliage leaf margins. Further, though this species usually possesses hollow internodes, it sometimes has solid internodes too. However, we were unable to identify a clear pattern between hollow and solid culms. Although this species resembles both *K. walkeriana* and *K. floribunda* in certain respects, we here recognize it as a new species because of its distinct habitat (open rocky montane plains) and a unique combination of characters, particularly the unusual color and serration of the foliage leaf blade margins.

IUCN Red List category—We saw several fragmented populations of *K. serrulata* in 2010. Hence, we suggest the *Endangered [EN B1 ab(i, iii)]* category based on the IUCN criteria: Extent of occurrence (EOO) < 5000 km^2 with severely fragmented locations less than five and continuing decline observed in quality of habitat.

Additional Specimens Examined—Hayes Estate, Gongala. On top of the rocky mountain, N6 23.099, E80 39.344, 1,307 m, 03 Jan 2010, *Attigala et al. 146* (ISC, K, PDA); Handapan Ella plains, above the Eggbirth estate, N6 26.721, E80 36.236, 1,225 m, 04 Jan 2010, *Attigala et al. 150* (ISC, K, PDA); Handapan Ella plains, Hellundeniya, near pichchamal ara, N6 26.657, E80 36.102, 1,232 m, 04 Jan 2010, *Attigala et al. 152* (ISC, K, PDA); Handapan Ella plains, Hellundeniya, near pichchamal ara, N6 26.657, E80 36.102, 1,232 m, 04 Jan 2010, *Attigala et al. 153* (ISC, K, PDA).

KURUNA WALKERIANA (Munro) Attigala, Kathriarachchi & L. G. Clark, Phytotaxa 174 (1): 200. 2014— *Arundinaria walkeriana* Munro, Trans. Linn. Soc. London 26(1): 21. 1868—TYPE: *Mrs. Walker 96* (lectotype designated by Soderstrom and Ellis 1988: K, isolectotype: K!)

Culms ca. 2 m long, 4.1 (3–6) mm in diameter, erect, shrubby, dense; internodes 10.2 (5.5–15.3) cm long, wall thickness 1.2 (1–1.5) mm, terete, hollow, ratio of 2 times wall thickness: culm diameter 0.5–0.8, lacuna size 1.8 (1–3) mm, light green when young, becoming brownish-dark green with age, glabrous; nodal line diameter greater than the adjacent internodes, supranodal ridge inconspicuous. Culm leaves deciduous; sheaths 5.9 (5.4–6.5) cm, abaxially hispid with non-irritating white hairs, at the base densely hirsute and remaining as a hairy ring after the sheath falls, apex symmetrically concave; auricles absent; inner ligule membranous; blades 2–3 cm long, ca. 0.5 mm wide, narrowly ovate, ca. 1/3 the length of the sheath, reflexed. Primary branch producing 2 lateral branches, quickly followed by the development of tertiary branches to produce a complement of up to 30 branches, these rarely re-branching, but continuing in length to ca. 40 cm, with 10–20 leaves, with production of new leaves and shedding of old blades, covered by only hard, persistent, overlapping sheaths. Foliage leaves 6–14 per complement; sheath summit fimbriate with white silky fimbriae; auricles absent; inner ligule 1.1 (0.7–1.2) mm long; outer ligule absent; blades 5.5 (3.2–9.4) cm long, 1.5 (0.8–2.4) cm wide; L:W = 3.9 (2.4–5.8), more or less cordate, glabrous, clasping at the base, thick and leathery, tessellate on both surfaces, apex acute, base rounded, margins 0.2 (0.1–0.3) mm wide, green, antrorsely scabrous, trichomes ca. 0.1 mm long, pseudopetiole 1.5 (1–3) mm long. Synflorescences 20–30 cm long, 20–30 cm wide, paniculate, smaller on the leafy branches, the branches glabrous, pulvinate, spreading. Spikelets 14–20 mm long, 3–4 fertile florets per spikelet, one rudimentary apical sterile floret; glumes ovate-lanceolate, abaxially glabrous, ciliate on the margins, apices acute, 7-nerved, glume I ca. 5.8 mm long, glume II ca. 6.5 mm; fertile lemma ca. 7.3 mm long, ovate, apex acute, 9-nerved, ciliate on the upper margin; palea lanceolate-ovate, 6–7 mm long, 2-keeled, 2 broad keel wings present, apex acute, sulcus well developed for the full length; lodicules ca. 1.4 mm long, lanceolate, upper margins ciliate, many-nerved; anthers orange, ca. 5 mm long; ovary with a one style and 2–3 plumose stigmas. Fruit an ellipsoid caryopsis, ca. 5 mm long with a short beak (the persistent base of the style), embryo basal, ca. 1/5 the length of the fruit. Figures 11, 12, 14D.

Distribution and Habitat—The species is endemic to the upper montane zone of the Central Province of Sri Lanka and occurs as an understory species at ca. 1,400–2,400 m elevation. It is also reported from southern India, particularly in the Palani Hills, Agasthyamala and Eravikulam (Seethalakshmi and Muktesh Kumar 1998; Muktesh Kumar 2011).

Phenology—Flowering specimens have been collected only in September of 1980 and none of the other collections (from 1969, 1970, 1977, 1985 and 2010) was flowering. Thus, this species likely flowers at long intervals.

Comments—The thick, leathery cordate-shaped clasping foliage leaves are characteristic of this species. *Kuruna walkeriana* was misidentified as *K. wightiana* in several herbarium specimens from Sri Lanka. To our knowledge and from previous studies (Soderstrom and Ellis 1988; Muktesh Kumar 2011), *K. wightiana* is only reported from southern India (see below).

IUCN Red List category—During 2010, we found *K. walkeriana* only in the Adam's Peak region. Thus, we suggest the *Critically Endangered [CR B1 ab(i,iii)]* category for this species based on the IUCN criteria: Extent of occurrence (EOO) < 100 km^2 with number of locations 1 and continuing decline observed in EOO and quality of habitat.

Additional Specimens Examined—SRI LANKA. DISTRICT KANDY: Knuckles Mountains, 1,800 m, 19 May 1970, *Gould & Balakrishnan 13897* (PDA, US); Knuckles, on mountain range N. of Kaluphane, 1,740 m, 17 Sep 1977, *Meijer 1342* (US). DISTRICT NUWARA ELIYA: on the way to Adam's Peak from Halton side, near Edikatupane, 2,330 m, 05 Dec 1969, *Soderstrom & Kulatunge 1772* (K, PDA, US); Above Indikatupahana, southern slope of Peak Wilderness Sanctuary above Sri Palabaddala, 1,450 m, 01 Mar 1985, *Jayasuriya & Gunatilleke 3175* (PDA, MO); Ceylon, 2,195 m, 15 Sep 1890 (fl), *Gamble* (K); Adam's peak, road to Palabaddala, near Indikatupahana, 2,151 m, 12 Jun 2010, *Attigala et al. 162* (ISC, K, PDA); Adam's peak, road to Palabaddala, near Indikatupahana, 2,091 m, 12 Jun 2010, *Attigala et al. 162B* (ISC, K, PDA).

Kuruna wightiana (Nees) Attigala, Kathriarachchi & L. G. Clark, comb. nov. *Arundinaria wightiana* Nees, Linnaea 9(4): 482. 1834. *Indocalamus wightianus* (Nees) Nakai, J. Arnold Arbor. 6: 149. 1925. *Yushania wightiana* (Nees) R.B. Majumdar, Fl. Ind. Enum.: Monocot. 283. 1989. — TYPE: INDIA. Nilgiri, *Wright 1797* (lectotype designated by Muktesh Kumar 2011: CAL, isolectotype: K!, 2 sheets)

Culms ca. 8 m long, ca. 9 (5–11) mm in diameter, erect, shrubby, dense; internodes ca. 30 cm long, wall thickness 2 (1–2) mm, terete, hollow, ratio of 2 times wall thickness: culm diameter 0.4, lacuna size 5 (3–7) mm, dark green when

FIG. 11. *Kuruna walkeriana*: a. Culm leaf in place (×1.2). b. Leaf complement (×0.6). c. Culm leaf (adaxial view) (×1.7). d. Rhizome bud pattern (×1.2). e. Mature branch complement (×3). f. Leaf ligule, side view (×7). g. Bud on new culm (×3). h. Leaf ligule, front view (×6). i. Young branch complement (×1.2). (Illustrations by G. B. Threlkeld, based on *Soderstrom & Kulatunge 1772*).

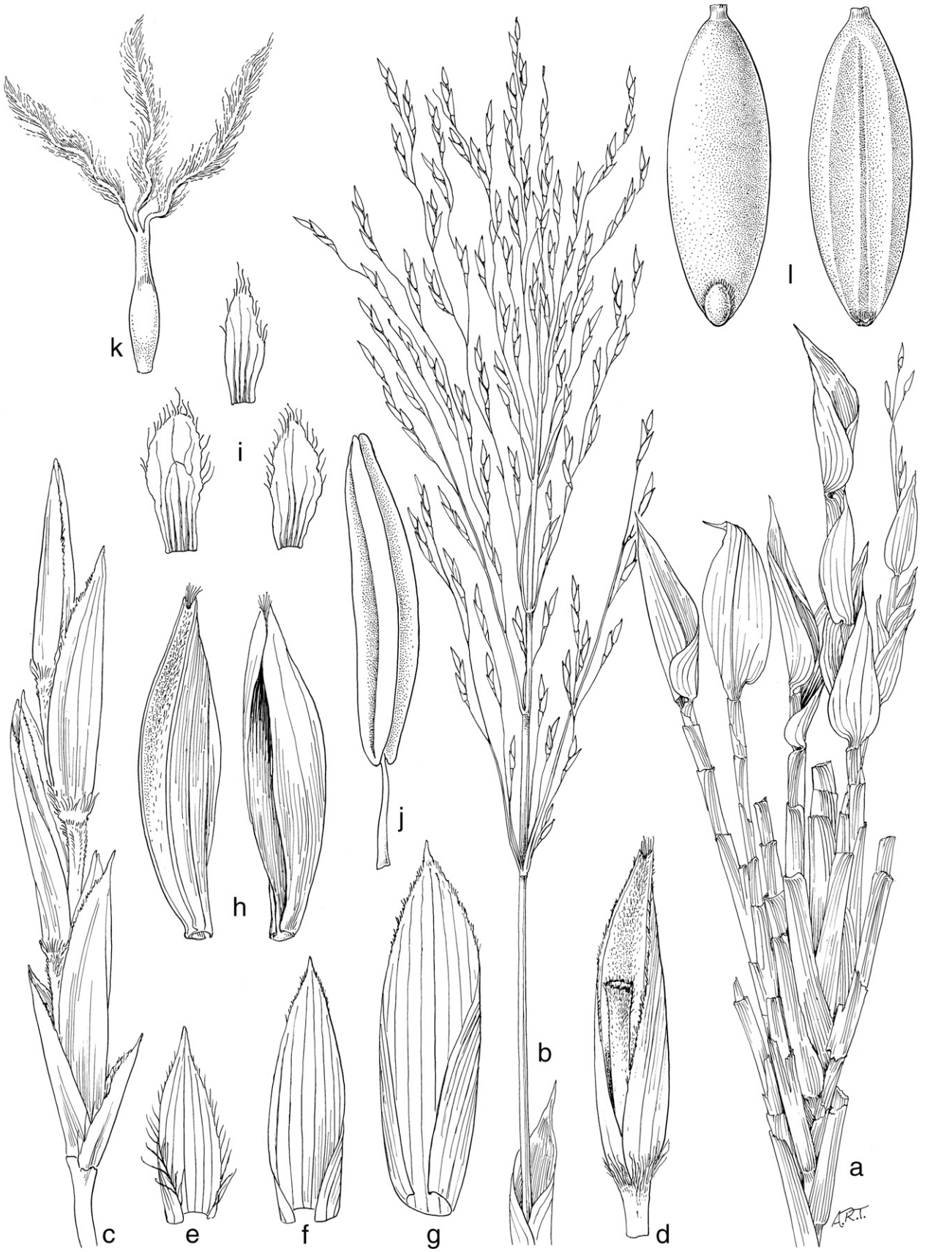

FIG. 12. *Kuruna walkeriana*: a. Vegetative branches (×0.6). b. New inflorescence recently emerged from subtending sheath (×0.6). c. Spikelet (×7). d. Floret (×11). e. Glume I (×11). f. Glume II (×11). g. Lemma (×11). h. Palea, side view showing keels and frontal view (×11). i. Lodicules, lower anterior pair and upper posterior (×1.5). j. Anther (×15). k. Gynoecium (×15). l. Caryopsis, embryo view and hilum view (×11). (Illustrations by G. B. Threlkeld; a, b, l based on *Ferguson s.n.* in 1887, Knuckles Mountains; all others based on specimens from Dumbanagala, Rangala, 28 Sep 1888, *s. coll.*). Note: Palea tips are shown as biapiculate in h, but they are actually acute.

FIG. 13. *Kuruna wightiana*: A. Culm leaf. B. Flowering branch. C. Intermediate branch complement. D. Mature branch complement. E. Foliage leaf summit. F. Foliage leaf complement. G. Spikelet. H. Lemma. I. Palea. (Illustrations by C. Sidorowych. D based on *Soderstrom 2541*, E–F based on *Gamble 13359*, all others based on *Gamble 20733*).

young, becoming yellowish-brown with age, scaberulous; nodal line diameter greater than the adjacent internodes, supranodal ridge conspicuous. Culm leaves deciduous; sheaths 13.2 (8.8–19.2) cm long, abaxially hispid with golden brown irritating hairs, at the base densely hirsute, apex more or less horizontal; blades 3.8 (2.5–4) cm long, 0.5 (0.3–0.6) cm wide, narrowly ovate, ca. 1/5–1/4 the length of the sheath, reflexed; auricles absent; inner ligule short ciliolate. Primary branch producing 2 (–3) lateral branches, quickly followed by development of basal buds to produce ca. 6–12 smaller subequal branches [sometimes up to 50 subequal branches fide Muktesh Kumar (2011)]. Foliage leaves 6–9 per complement; sheath summit fimbriate with light brown long (ca. 1 cm) fimbriae; auricles absent, inner ligules truncate; outer ligule a minute glabrous rim; blades 9 (2.5–18.2) cm long, 1.2 (0.6–1.9) cm wide; L:W = 7.6 (4.2–9.6), ovate-lanceolate, tessellate on both surfaces, apex acuminate, base obtuse, margins ca. 0.1 mm wide, green, antrorsely scabrous, trichomes ca. 0.2 mm long, pseudopetiole 1.5 (0.5–3) mm long. Synflorescence 10–15 cm long, 3–12 cm wide, paniculate, branches with prominent pulvini, spreading. Spikelets 1.5–2 cm long, 2–3 fertile florets per spikelet, one rudimentary apical sterile floret; glumes oblong, abaxially glabrous, ciliate at the tips, apices acute, 6–7-nerved, glume I ca. 3 mm long, glume II ca. 3.5 mm; fertile lemma 4–5 mm long, ovate, apex mucronate, 7–11 nerved; palea lanceolate, 0.4–0.5 cm long, 2-keeled, keel wings absent, ciliate on the keels, apex biapiculate, sulcus well developed for the full length; lodicules ca. 1.4 mm long, upper margins ciliate, 3–7 nerved; stamens 3, brown, basifixed; ovary with a one style and 3 plumose stigmas, ovoid-oblong. Caryopsis, 2.5–3 mm long, ellipsoid, acute, sulcate on hilar side. Figure 13.

Distribution and Habitat—This species is endemic to the mountains of southern India. It is widely distributed in the Nilgiri Biosphere Reserve and is frequent in the understory of upper slopes of the hills above 1,800–2,400 m. In the Kerala region this species is located in the Palghat and Munnar forests (Seethalakshmi and Muktesh Kumar 1998; Muktesh Kumar 2011).

Phenology—This species is reported to flower annually without dying after flowering (Tewari 1992; Seethalakshmi and Muktesh Kumar, 1998). However, based on the specimens that we have seen from the Nilgiri district, a flowering specimen was collected in 1889, with vegetative specimens from 1883 and 1978, suggesting either a long flowering cycle or, more likely, insufficient herbarium records to infer flowering frequency and behavior.

Comments—This species possesses a set of characters that exclude it from *Arundinaria* s. s. For example, *Arundinaria* s. s. has leptomorph culm bases, glabrous culm leaves, usually well-developed auricles and poorly developed or absent girdles while *K. wightiana* possesses pachymorph culm bases, hispid culm leaves with golden brown irritating hairs, auricles absent and girdles present as a band at least 1 mm wide. The morphology of *K. wightiana* is consistent with *Kuruna*, so we here make the formal transfer. Within *Kuruna*, morphological comparison of *K. wightiana* with *K. debilis* and *K. floribunda* from Sri Lanka shows some resemblance among the three species based on the presence of a well-developed supranodal ridge, abaxially hispid culm leaves, and fimbriate culm leaf and foliage leaf sheath summits. The irritating golden brown hairs on the abaxial surface of the culm leaf sheath, the scaberulous culm internodes, and consistently 3 stigmas

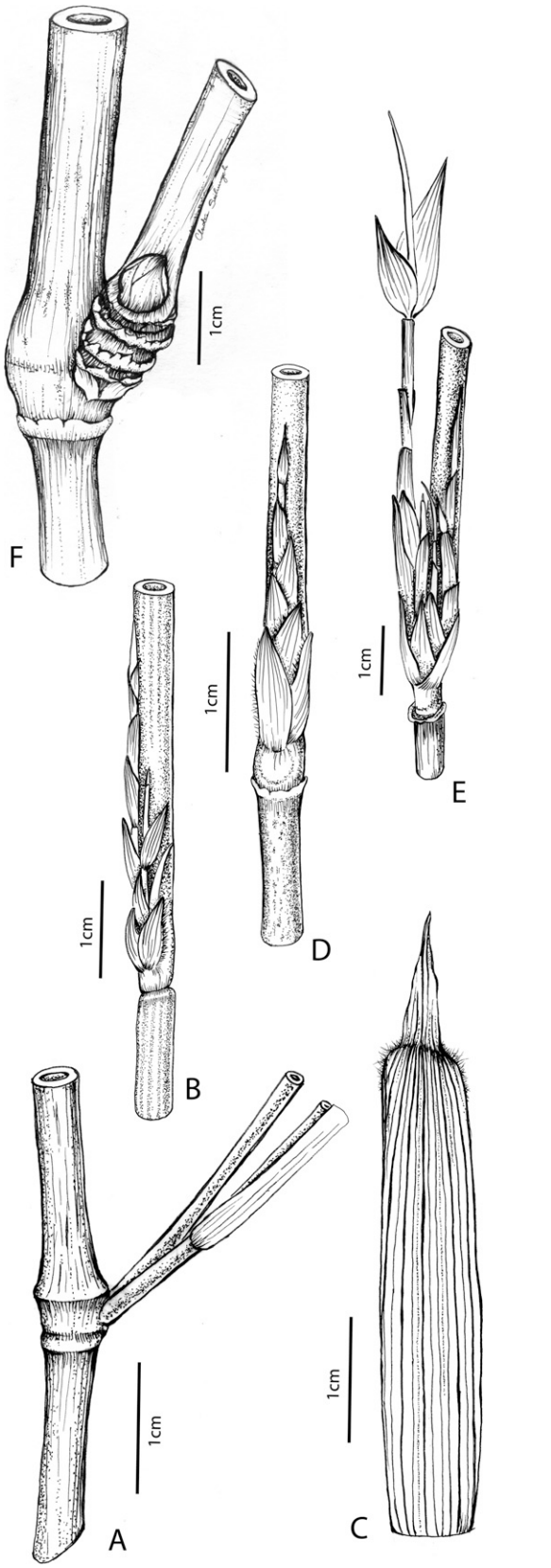

FIG. 14. A. *Kuruna floribunda*, distinct supranodal ridge. B. *K. densifolia*, early stage of branch complement. C. *K. densifolia*, culm leaf. D. *K. walkeriana*, early stage of branch complement. E. *K. scandens*, early stage of branch complement. F. *K. debilis* early stage of branching. (Illustrations by C. Sidorowych; A based on *Attigala et al. 139*, B–C based on *Attigala et al. 129*, D based on *Attigala et al. 162*, E based on *Attigala et al. 166* and F based on *Attigala et al. 124*).

differentiate this species from the rest of *Kuruna*. So far, this is the only *Kuruna* species that is endemic to India, although a thorough investigation of Indian temperate woody bamboos might reveal additional endemic taxa. Further, though the inclusion of the south Indian temperate woody bamboo *Arundinaria wightiana* in *Kuruna* is based only on morphology, the close geographical proximity of the Western Ghats of India (where this species occurs) to Sri Lanka and its similar habitat to other species of the genus, support the decision to transfer *Arundinaria wightiana* to *Kuruna*. However, this species needs further study in a molecular analysis.

***IUCN Red List category*—**Since *K. wightiana* was not collected in southern India during 2010 and authors have not seen this species in wild, we suggest the *Data Deficient (DD)* category for this species.

***Additional Specimens Examined*—**INDIA: Kodaikanal taluk Kodai-Berijam road, fire tower, 2,400 m, 17 Dec 1989 (fl), *Periyanayagam 53985* (K); Nilgiri district, 2,134 m, Nov 1883, *Gamble 13359* (K); Nilgiri district, 2,438 m, May 1889 (fl), *Gamble 20733* (K); Nilgiri district, 2,286 m, Jan 1889 (fl), *Gamble 20332* (K); Nilgiri hills, near Ootacamund on road towards Naduvattam, Tamil Nadu, 17 Sep 1978, *Soderstrom 2541* (K).

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