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South African Journal of Botany 73 (2007) 1–21

SOUTH AFRICAN
JOURNAL OF BOTANYwww.elsevier.com/locate/sajb

A taxonomic revision of *Bonatea* Willd. (Orchidaceae: Orchidoideae: Habenariinae)

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Received 23 February 2006; accepted 31 May 2006

Abstract

The diagnostic characters for *Bonatea* Willd. (Orchidaceae) are re-evaluated. The genus is distinguished from *Habenaria* by the possession of a galeate rostellum, which is clearly separated from the vertical anthers, and a tooth in the spur mouth (secondarily lost in *Bonatea rabaiensis* (Rendle) Rolfe). Morphological evidence suggests that *Bonatea bracteata* G.McDonald and McMurtry and *Bonatea tentaculifera* Summerh. are better placed in *Habenaria*, where *B. bracteata* is treated as a synonym of *Habenaria transvaalensis* Schltr., and *B. tentaculifera* is renamed *Habenaria bonateoides* M.Ponsie. A taxonomic revision and key to the species of *Bonatea* is presented. Fourteen species are recognized, ten of which are found in South Africa. Full descriptions are provided with diagnostic characters and distribution maps. *Bonatea eminii* (Kraenzl.) Rolfe, known from a single collection destroyed in Berlin, is closely allied to *Bonatea steudneri* (Rchb.f.) T.Durand and Schinz but is excluded from the revision due to insufficient information.

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Keywords: *Bonatea*; *Habenaria*; Orchidaceae; Orchidoideae; Taxonomic revision

1. Introduction

The genus *Bonatea* Willd., a member of subtribe Habenariinae (Orchidoideae), was named in honour of Giuseppe Antonio Bonato (Willdenow, 1805). *Bonatea* species are found mainly in forest and savannah, and the genus is most diverse on the eastern seaboard of southern Africa, extending through east Africa into Sudan, with one species in Yemen. Recent treatments of southern African (Schelpe and Linder, 1999) and east African (Summerhayes, 1968) members of *Bonatea* recognize a total of 15 species and two varieties.

The genus *Bonatea* has had an uncertain history, with most species having been included within *Habenaria* at one time or another. Reichenbach (1881) and Pfitzer (1888) reduced *Bonatea* to a section of *Habenaria*, renaming *Bonatea speciosa*, the type of the genus, *Habenaria bonatea* in commemoration of its earlier identification. *Bonatea* is undoubtedly closely related to *Habenaria* and has been traditionally distinguished from it

by a suite of characters, including a galeate median rostellum lobe, the presence of a tooth in the spur mouth, clavate stigmas, and the basal fusion of the lip with the lateral sepals, lower lobe of the petals and stigmatic processes (Rolfe, 1898, 1913; Summerhayes, 1949; Williamson, 1977; Stewart, 1996; la Croix and la Croix, 1997; Schelpe and Linder, 1999). With the exception of the galeate rostellum, however, these characters also occur sporadically in *Habenaria*.

It has been suggested that *Bonatea* is merely a specialized section of *Habenaria* (Kurzweil and Weber, 1992), and that retaining the genus as distinct may render *Habenaria* paraphyletic (Schelpe and Linder, 1999). Higher level phylogenetics of the Habenariinae are being explored (Dressler, 1993; Batsman et al., 2003) and only a broad consideration of *Habenaria* will resolve the circumscription and taxonomic status of *Bonatea*. Irrespective of the final taxonomic status of *Bonatea*, either as a genus or as an infrageneric taxon within *Habenaria*, the taxon needs to be adequately circumscribed morphologically. A thorough study of the morphology of *Bonatea* and selected *Habenaria* species was thus undertaken in order to identify characters that uniquely diagnose *Bonatea*. A complete species-level revision was also undertaken.

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2. Materials and methods

Herbarium specimens of *Bonatea* were loaned and digital images of type specimens were obtained from the following herbaria: BLFU, BM, BOL, BR, EA, FT, GLOW, GRA, J, K, KEI, KMG, LYD, NBG, NH, NU, P, PRE, PRU, PUC, S, SAM, STE, TCD, UNIN, UPS and W. These formed the basis of a morphological and distributional study aimed at reassessing generic and species limits.

Vegetative and floral characters were recorded. Flowers from selected species of *Bonatea* and *Habenaria* were rehydrated and dissected in order to examine the fine structure of the gynostemium (Figs. 1 and 2). The literature was consulted to determine the structure of the rostellum in other African *Habenaria* species (Summerhayes, 1968; Williamson, 1977, 1980; la Croix and Cribb, 1995). Rostellum morphology of *Bonatea tentaculifera* Summerh. was reconstructed from herbarium sheet drawings (Summerhayes K79099 (K)), from digital images of the type material housed at K, and from pressed

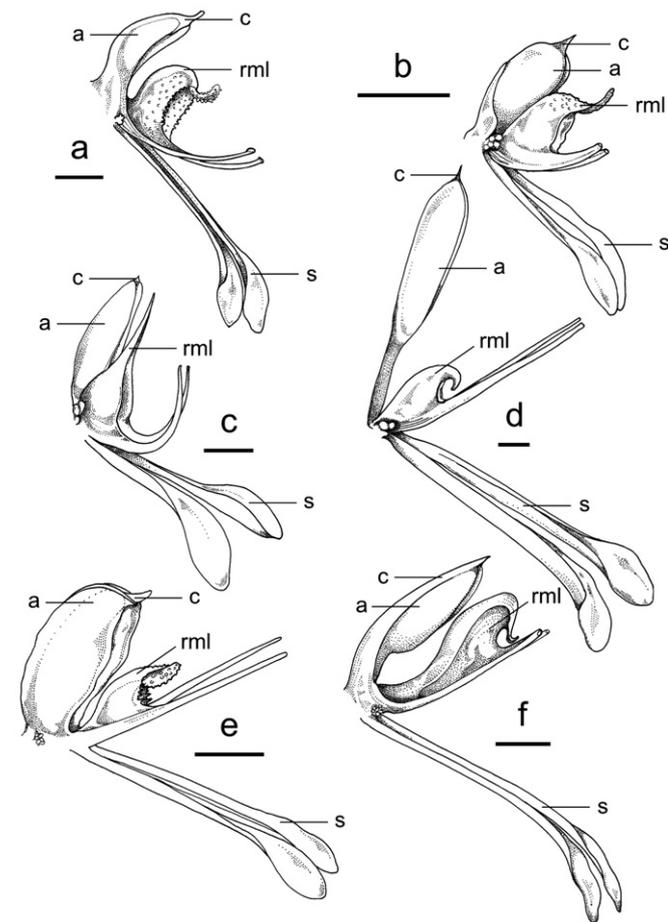


Fig. 1. Rostellum morphology of selected *Bonatea* species: (a) *Bonatea speciosa* [Carnegie s.n. (NU)], (b) *Bonatea cassidea* [O'Connor 32 (NU)], (c) *Bonatea pulchella* [Mogg 28138 (J)], (d) *Bonatea lamprophylla* [O'Connor 604 (NU)], (e) *Bonatea volkensiana* [Bally 9222 (EA)], (f) *Bonatea rabaiensis* [Jeffery K238 (PRE)]. Scale bar = 3 mm. a = anther sac, c = connective, rml = rostellum median lobe, s = stigmatic process. Illustration by T. J. Edwards.

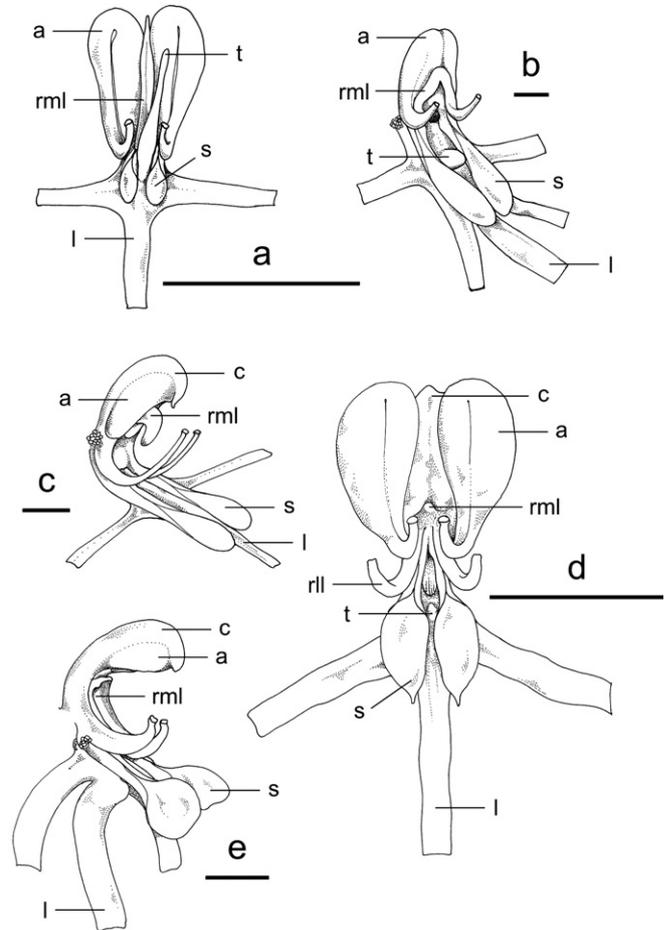


Fig. 2. Rostellum morphology of selected *Habenaria* species: (a) *Habenaria arenaria* [Ward 5713 (NU)], (b) *Habenaria bonateoides* [Amiyo s.n. (NU)], (c) *Habenaria transvaalensis* [O'Connor 453 (NU)], (d) *Habenaria malacophylla* [Stewart 1736 (NU)] and (e) *Habenaria barbertoni* [O'Connor 615 (NU)]. Scale bar = 2 mm. a = anther sac, c = connective, l = lip, rml = rostellum median lobe, rll = rostellum lateral lobe, s = stigmatic process, t = tooth. Illustration by T. J. Edwards.

specimens at NU (Botha s.n.; Amiyo s.n.). All measurements were made using a digital caliper.

3. Results and discussion

Bonatea is almost restricted to the mainland of Africa, with a single species in Yemen. Whereas African *Habenaria* species are largely restricted to grassland habitats, *Bonatea* species, including *Bonatea bracteata* G.McDonald and McMurtry and *B. tentaculifera*, occur mostly in scrub forest or woodland (Linder et al., 2005), in well drained, loose sandy soils and humus. Species of *Bonatea* typically have large (40–260 × 20–50 mm), elongated, obovoid tubers in clusters of (2–)3–11. *B. bracteata* is anomalous in having small (15–35 × 10–25 mm), solitary, ovoid tubers. This species and *B. tentaculifera* are distinct in producing stolons, reminiscent of forest-dwelling *Habenaria* species such as *Habenaria malacophylla* Rchb.f. The multiple, elongate, obovoid tubers of *B. tentaculifera* conform to the typical pattern of *Bonatea*. Leaves in *Bonatea* species range from oblanceolate or obovate to broadly-elliptical

in shape, with *Bonatea lamprophylla* J.L. Stewart having diagnostic glossy dark green, cordate leaves with undulate margins. *Bonatea polypodantha* (Rchb.f.) L. Bolus and *Bonatea pulchella* Summerh. are distinct from other *Bonatea* species in their basal rosette of leaves. The leaves of *Bonatea stereophylla* (Kraenzl.) Summerh. and *Bonatea porrecta* (Bolus) Summerh. are dry and withered at flowering, a trait also sometimes observed in *Bonatea saundersioides* (Kraenzl. and Schltr.) Cortesi and *Bonatea cassidea* Sond.

Bonatea species flower in summer, autumn or spring. Plants in the field do not always flower every year, and several seasons may lapse before they recommence flowering. The floral bracts of *Bonatea* species sheath the pedicels and ovary base, except in *B. bracteata* and *B. tentaculifera*, which have flat floral bracts. *B. cassidea*, *B. porrecta*, *Bonatea rabaiensis* (Rendle) Rolfe, *B. saundersioides*, *B. stereophylla* and *Bonatea steudneri* (Rchb.f.) T. Durand and Schinz typically have the bracts withered and dry at flowering. The flowers are green and white in colour, with the exception of *B. stereophylla*, which is recorded as having greenish yellow flowers and a yellowish stem. All species have a cucullate dorsal sepal, which is fused to the upper lobes of the deeply divided bifid lateral petals. The lip is always deeply trifid. All species have auricles present on the anther base.

Many of the floral characters used to delimit *Bonatea* are not unique to the genus as it is currently circumscribed. Thus the tooth that occurs in the spur throat is absent from *B. rabaiensis* and also *B. bracteata*, where the rostellum was misinterpreted as a spur tooth (McDonald, 1991). Moreover, a tooth is present in *Habenaria arenaria* Lindl. and *H. malacophylla*. It is possible that the spur tooth has evolved more than once. The tooth in *B. tentaculifera*, *H. arenaria* and *H. malacophylla* (Fig. 2) is distal to the spur throat, projecting at the split of the lip, and it is thus possibly independently derived from those found in other species of *Bonatea*. Floral development studies are required to confirm this.

Critical differences in the rostellum between *Bonatea* and *Habenaria* (Figs. 1 and 2; see also Williamson, 1977, 1980; Kurzweil, 1989; Kurzweil and Weber, 1992) separate *B. bracteata* and *B. tentaculifera* from the remaining *Bonatea* species. Kurzweil and Weber (1992) noted the galeate rostellum median lobe as a consistent character delimiting *Bonatea*, although they suggested that the character is inadequate support for generic circumscription. Diversification in the shape of the rostellum has occurred within *Bonatea*, resulting in rostrate rostellum median lobes in *B. polypodantha*, *B. pulchella* and *B. stereophylla*. The remaining species of *Bonatea* have distinctly galeate rostellums. In addition, the anther thecae of *Bonatea* are vertical and diverge from the rostellum, whereas all southern African species of *Habenaria* have short anthers that are slightly arcuate and flank the rostellum. This pattern is found in *B. bracteata* and *B. tentaculifera*, which also lack the galeate median rostellum lobe. Furthermore, little fusion exists between the stigmatic processes and either the lateral sepals or the anterior petal lobes in *B. bracteata* and *B. tentaculifera*. The margin of the median rostellum lobe is smooth in *B. bracteata*, *B. polypodantha*, *B. pulchella*, *B. stereophylla* and *B. tentaculifera*, but ciliate in the remaining species.

All species are strongly fragrant at night and have cryptic green sepals and white petals (Fig. 3) that characterise crepuscular and nocturnal pollination systems. *Bonatea speciosa* (L.f.) Willd. is the only species in which detailed studies of hawkmoth pollination have been carried out (Johnson and Liltved, 1997).

On morphological evidence it is necessary to exclude *B. bracteata* and *B. tentaculifera* from *Bonatea* and place them within *Habenaria*. *Bonatea* in the narrow sense is thus diagnosed by sheathing floral bracts; extensive fusion of the lip with the stigmatic processes, lateral sepals and the lower petal lobes; a tooth in the spur mouth (secondarily lost in *B. rabaiensis*); vertical anther thecae that diverge from the rostellum; and a galeate to rostrate median rostellum lobe. The latter three characters are apomorphies for the genus, suggesting that the lineage as here defined is monophyletic. A phylogenetic analysis of *Habenaria* will provide a better insight into the evolution of these characters and the taxonomic status of *Bonatea*.

4. Taxonomic revision

Bonatea Willdenow in Sp. Pl. 4: 43 (1805); Rolfe in Fl. Trop. Afr. 7: 252 (1898); Rolfe in Fl. Cap. 5: 138 (1913); Schelpe in An introduction to the South African orchids: 74 (1966); Summerhayes in Fl. Trop. E. Afr., Orchid.: 136 (1968); Williamson in The Orchids of S. Centr. Afr.: 68 (1977); Stewart et al. in Wild Orch. South Africa: 97 (1982); la Croix and Cribb in Flora Zambesiaca, Orchidaceae 11: 43 (1995); Stewart in Orchids of Kenya: 92 (1996); Cribb and Thomas in Flora of Ethiopia and Eritrea: 231 (1997); la Croix and la Croix in African orchids in the wild and in cultivation: 153 (1997); Schelpe and Linder in Orchids of southern Africa: 136 (1999). Type species: *B. speciosa* (L.f.) Willd.

Habenaria Willd. sect. *Bonatea* (Willd.) Kraenzlin in Bot. Jahrb. Syst. 16: 56 (1893). Type species: *H. bonatea* Rchb.f., nom. illegit. superfl. (= *B. speciosa* (L.f.) Willd.).

Erect, decumbent or scandent terrestrial herbs; tubers multiple, clustered, elongate-oblong, tomentose; stem unbranched, slender to robust. Leaves sheathing, cauline or basal, oblanceolate or obovate to broadly-elliptical, sometimes withered at flowering. Inflorescence terminal, elongate, racemose, 2- to many-flowered, lax to dense; bracts ovate to lanceolate, sheathing. Flowers green and white (rarely greenish yellow), resupinate; sepals unequal, free, dorsal sepal galeate, lateral sepals oblique, reflexed, united basally with lower petal lobes, lip and stigmatic processes; petals deeply bipartite, upper petal lobe erect, linear, generally adpressed to margin of dorsal sepal to form a hood, lower petal lobe linear to broadly oblanceolate, adnate to base of lip and stigmatic arms; lip adnate to base of column, produced at base into descending spur, usually with tooth at mouth (absent in *B. rabaiensis*), tripartite from short, narrow base, lateral lobes linear to broadly oblanceolate, median lobe shorter than lateral lobes, filiform to narrowly-oblong, spur short or long, cylindrical, apex clavate. Column short. Anther erect, loculi slightly divergent, canals usually elongate, adnate to lateral lobes of rostellum; staminodes lateral, small, auriculate, rugulose; pollinaria 2, pollinia sectile, caudicles long, slender, viscidia small, discoid,

terminal. *Stigmatic processes* 2, elongate, adnate to base of lip, clavate to spatulate; *rostellum* 3-lobed, median lobe narrowly-cucullate to rostrate, lying well forward of anthers, lateral lobes well-developed. *Capsules* oblong to obovate.

Key to species

1a. Leaves in a basal rosette	(2)
1b. Leaves cauline, not in a basal rosette	(3)
2a. Spur 20–47 mm long	2. <i>B. polypodantha</i>
2b. Spur 53–70 mm long	3. <i>B. pulchella</i>
3a. Spur >74 mm	(4)
3b. Spur <69 mm	(5)
4a. Lip lateral lobes 35–60 mm long	5. <i>B. steudneri</i>
4b. Lip lateral lobes 106–135 mm long	6. <i>B. lamprophylla</i>
5a. Leaves withered at flowering time	(6)
5b. Leaves not withered at flowering time	(7)
6a. Lip median lobe straight; rostellum elongate-rostrate	1. <i>B. stereophylla</i>
6b. Lip median lobe geniculate; rostellum cucullate	7. <i>B. porrecta</i>
7a. Tooth lacking in spur mouth	4. <i>B. rabaiensis</i>
7b. Tooth present in spur mouth	(8)
8a. Rostellum lateral lobes longer than median lobe	8. <i>Bonatea volkensisiana</i>
8b. Rostellum lateral lobes shorter than median lobe	(9)
9a. Leaves linear-lanceolate; rostellum median lobe narrowly cucullate; bracts dry at anthesis	(10)
9b. Leaves ovate, oblong or broadly lanceolate; rostellum median lobe cucullate; bracts green at anthesis	(11)
10a. Lower petal lobes (13–)16–24 × 0.5–2.0(–3.0) mm; lip lateral lobes 0.5–2.0 mm wide	12. <i>B. saundersioides</i>
10b. Lower petal lobes 8–15(–19) × (1.5–)3.0–8.0 mm; lip lateral lobes (1.5)2.0–6.5 mm wide	13. <i>B. cassidea</i>
11a. Clavate apex of spur >15 mm long; lower petal lobe >2 mm wide; lower petal lobes projecting forwards and deflexed	11. <i>B. speciosa</i>
11b. Clavate apex of spur <15 mm long; lower petal lobe <2 mm wide	(12)
12a. Lower petal lobe (18–)24–43 × 0.5–2.0 mm, projecting forwards and ascending; stigmatic processes (11–)15–22 mm long	9. <i>Bonatea antennifera</i>
12b. Lower petal lobes 11–24(–28) × 0.5–2.0(–2.5) mm, spreading horizontally; stigmatic processes 8–15 mm long	10. <i>Bonatea boltonii</i>

4.1. *Bonatea stereophylla*

B. stereophylla (Kraenzl.) Summerhayes in Kew Bull. 4: 430 (1949); Summerhayes in Fl. Trop. E. Afr.: 140 (1968). *Habenaria stereophylla* Kraenzlin in Bot. Jahrb. Syst. 30: 280 (1901b); Kraenzlin in Orchid. Gen. Sp. 1, 15: 950 (1901a). Type: Tanzania, Mt. Rungwe, Umuamba, flat slopes of the Kiwira Valley, 1500 m, Goetze 1339 (B†, holo.).

Habenaria polychlamys Schlechter in Bot. Jahrb. Syst. 53: 508 (1915). Type: Tanzania, Njombe District, Tandala, Ukinga mountains, on mountain meadows, 2100 m, April 1913, Stolz 2242 (B†, holo.; K!, iso.).

Erect, decumbent or scandent terrestrial herbs, 500–700 mm tall; *tubers* 2, spreading, elongate-oblong, tomentose. *Stem* robust, 490–695 × 8–10 mm. *Leaves* withered at flowering, 15–20, dense, lower sheathing, oblong, acute, 50–60 mm broad. *Inflorescence* cylindrical, 150 × 80 mm, dense, 10–20-flowered; *bracts* sometimes withered at flowering, lanceolate to ovate-lanceolate, acuminate, 30–40 mm long. *Flowers* spreading, greenish yellow, pedicel and ovary sub-erect, 30–35 mm long. *Dorsal sepal* green, erect, elliptical-lanceolate, galeate, acuminate, 20–25 × 8–10 mm; *lateral sepals* green, patent, decurved, narrowly-triangular, acuminate to apiculate, base oblique, 20 × 4 mm, adnate to lip and stigmatic processes for 3–4 mm. *Petals* upper lobe erect, linear, acute to acuminate, 18–20 × 1.5–2.0 mm, adnate to dorsal sepal, lower lobe weakly falcate, linear, acuminate, 17–27 × 1 mm, adnate to claw of lip for 2–3 mm. *Lip* claw 4.5–6.0 mm, median lobe descending, straight, linear, acute to acuminate, 15–21 × 1 mm, lateral lobes descending, linear, tips curved, apiculate, 21–25 × 1 mm; spur toothed, curved, 28–35 mm long, clavate apex 18–25 mm long. *Anther* erect, acute, 12 mm long, canals slender, 8–10 mm long. *Stigmatic processes* clavate, projecting forwards and sometimes deflexed, 15–16 mm long, base adnate to lip. *Rostellum* 3-lobed, base auriculate, median lobe elongate-rostrate, acute, margin smooth, 8–11 mm long, lateral lobes linear, fused to anther canals, sub-erect to 45°, sub-parallel or slightly divergent, 4–6 mm long. Flowering period: April.

4.1.1. Distribution and habitat

B. stereophylla is restricted to southwest Tanzania (Fig. 4k), where it occurs in grassland, up to approximately 2100 m altitude.

4.1.2. Discussion

B. stereophylla is known from only two collections. The species is characterised by its yellowish stem and greenish yellow flowers (Kraenzlin, 1901b; Schlechter, 1915) with a distinctively large tooth >5 mm long in the spur mouth, narrowly-triangular lateral sepals, straight lip median lobe, and elongate-rostrate rostellum median lobe. The leaves of *B. stereophylla* are dry at flowering, a trait shared with *B. porrecta*, and occasionally observed in *B. saundersioides* and *B. cassidea*. Its closest allies are probably *B. polypodantha* and *B. pulchella*, both of which possess a narrowly-triangular, rostrate rostellum median lobe.

4.2. *Bonatea polypodantha*

B. polypodantha (Rchb.f.) L. Bolus in Fl. Pl. South Africa 8: sub t. 302 (1928); Stewart et al. in Wild Orch. South. Africa: 102, pl. 10.8 (1982); la Croix and la Croix in African orchids in the wild and in cultivation: 155 (1997); Schelpe and Linder in Orchids of southern Africa: 142 (1999). Ill.: McDonald in Fl. Pl. Africa, t. 2072 (1993). *Habenaria polypodantha* Rchb.f. in Otia Bot. Hamburg. 2: 97 (1881); Bolus in J. Linn. Soc., Bot. 19: 340 (1882); Kraenzlin in Bot. Jahrb. Syst. 16: 70 (1893); Rolfe in Fl. Cap. 5, 3: 127 (1913). Ill.: Bolus in Ic. Orch. Austr. Afr. 3: t. 23 (1913). Type: South Africa, [KwaZulu-Natal], without precise locality or date, Gerrard 1554 (K!, holo.; BOL!, iso.).

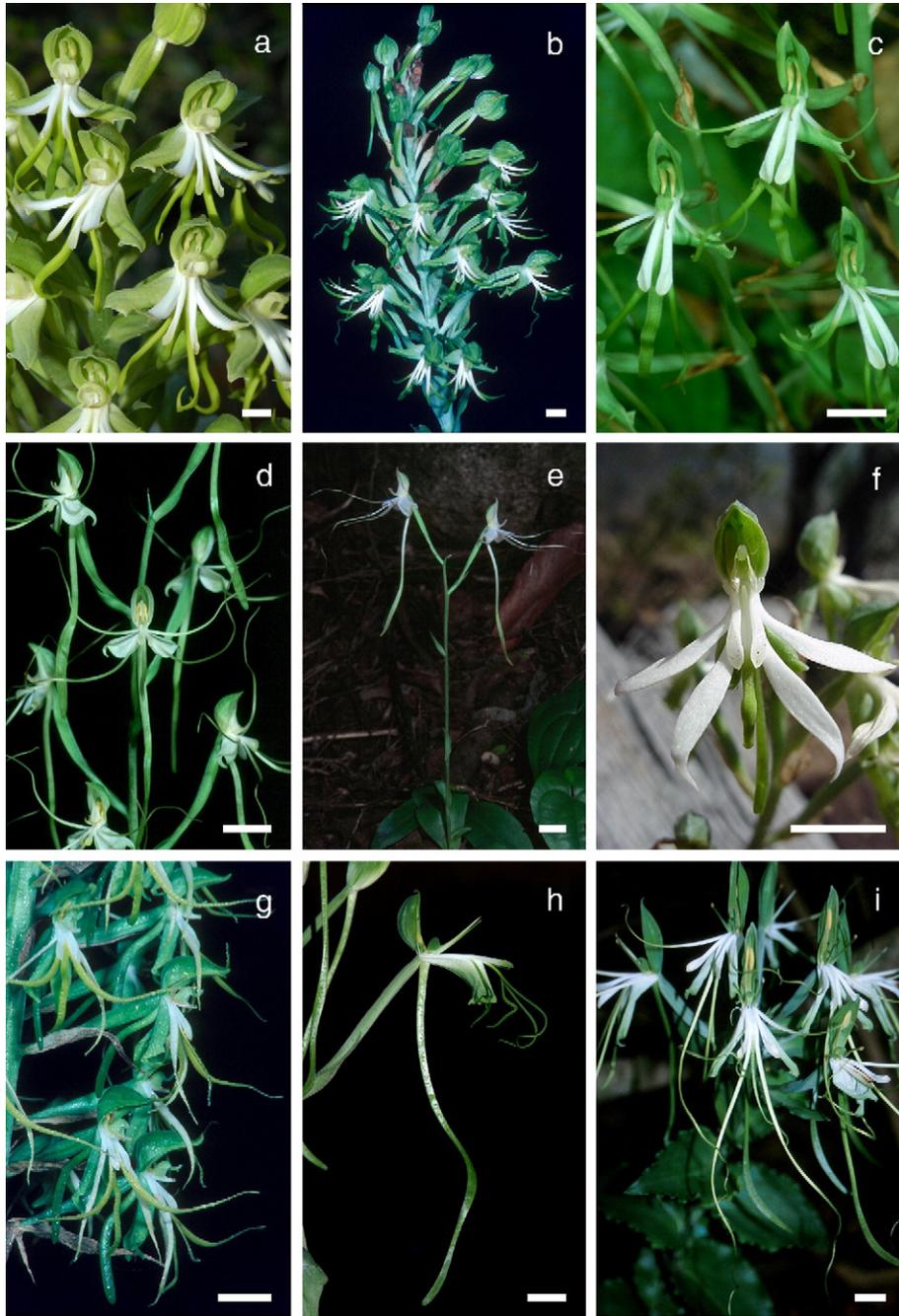


Fig. 3. Floral morphology of selected *Bonatea* species: (a) *Bonatea speciosa*, (b) *Bonatea antennifera*, (c) *Bonatea porrecta*, (d) *Bonatea polypodantha*, (e) *Bonatea pulchella*, (f) *Bonatea cassidea*, (g) *Bonatea saundersioides*, (h) *Bonatea steudneri*, (i) *Bonatea lamprophylla*. Scale bars = 10 mm. Photographs by Steve Johnson, except (b+g) Doug McMurtry, (f) Gareth Chittenden, and (i) Mark Botha.

Bonatea insignis (Schltr.) Summerhayes in Kew Bull. 7: 463 (1951). *Habenaria insignis* Schlechter in Bot. Jahrb. Syst. 20, Beibl. 50: 1, 32 (1895); Rolfe in Fl. Cap. 5, 3: 127 (1913). Type: South Africa, [Limpopo], Maila's Kop, 2400–2500 ft, 16 February 1894, Schlechter 4517 (B†, holo.; BOL!, PRE!, iso.).

Erect, decumbent or scandent terrestrial herbs, 44–330 mm tall; tubers 1–3, spreading, elongate-oblong, tomentose. Stem slender, 34–325 × 1.5–3.5 mm. Leaves 4–8, margins entire, smooth; basal leaves 1–3, dense, sheathing, lanceolate to broadly-elliptical, acute, 21–157 × 8–36 mm, middle leaves 2–5, lax, cauline, narrowly-lanceolate to lanceolate, acuminate, 11–

29 × 3–12 mm. Inflorescence cylindrical, 42–172 × 39–95 mm, lax, 2–12-flowered; bracts similar to upper leaves, sheathing, lanceolate, acuminate to apiculate, 9.0–30.5 × 2–6 mm. Flowers spreading, pale green and white, pedicel and ovary sub-erect to erect, 19–36 mm long. Dorsal sepal pale green, erect, narrowly-elliptical, galeate, acute, 7–11 × 2.5–5.0 mm; lateral sepals pale green to white, patent, ovate, acuminate to apiculate, base oblique, 6–10 × 3.5–7.0 mm, adnate to lip and stigmatic processes for 2–5 mm. Petals pale green to white, upper lobe erect, linear, acute to acuminate, 7.0–12.0 × 0.5–1.5 mm, adnate to dorsal sepal, lower lobe spreading horizontally, weakly

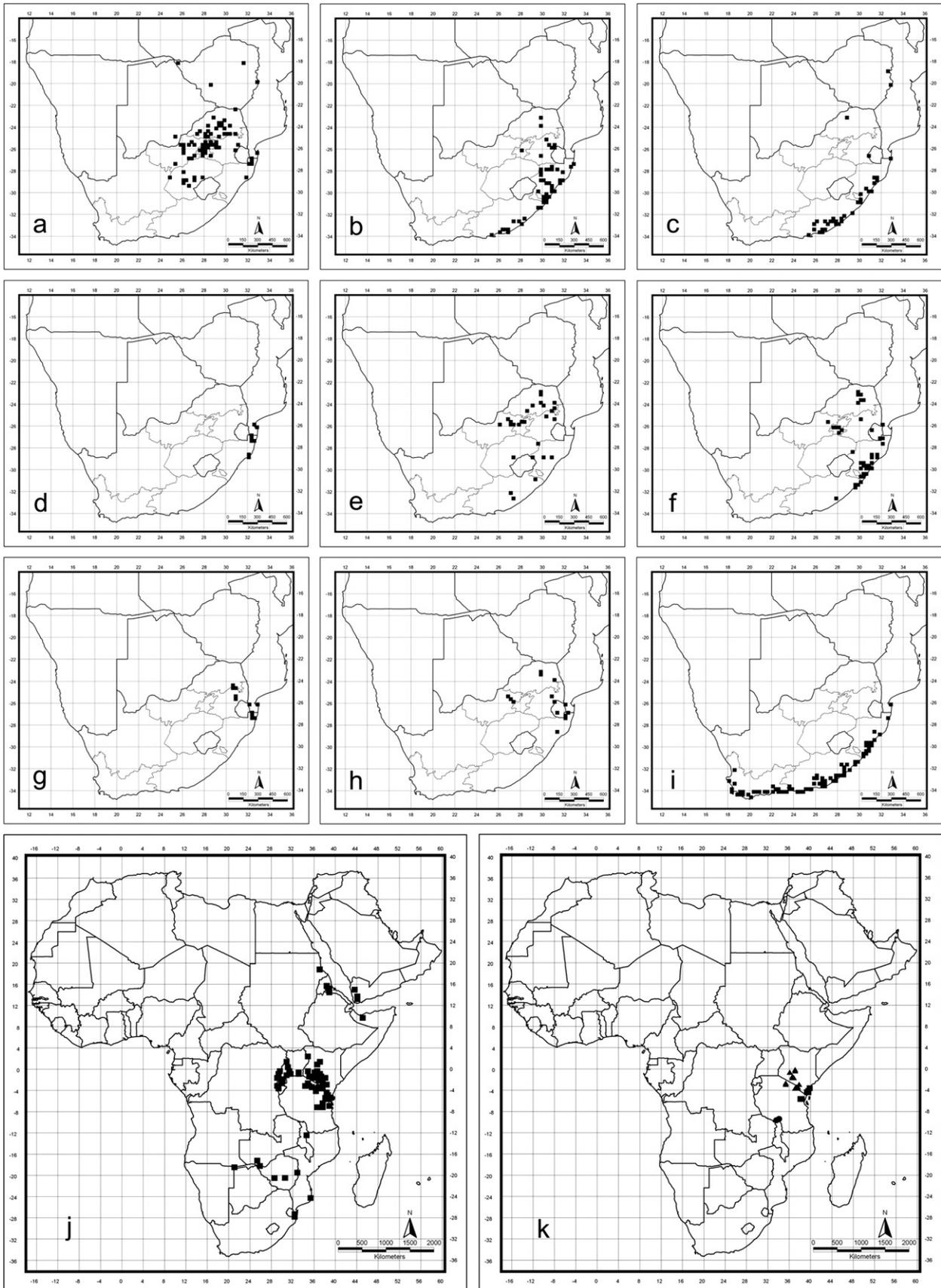


Fig. 4. Distribution of (a) *Bonatea antennifera*, (b) *Bonatea boltonii*, (c) *Bonatea cassidea*, (d) *Bonatea lamprophylla*, (e) *Bonatea polypodantha*, (f) *Bonatea porrecta*, (g) *Bonatea pulchella*, (h) *Bonatea saundersioides*, (i) *Bonatea speciosa*, (j) *Bonatea steudneri*, (k: ▲) *Bonatea volkensiana*, (k: ■) *Bonatea rabaiensis*, (k: ●) *Bonatea stereophylla*.

deflexed, linear-falcate, tips curved, acuminate to apiculate, 22.5–35.5 × 0.5–1.0 mm, adnate to claw of lip for 1.5–5.0 mm. *Lip* pale green to white, claw 3.5–8.5 mm, median lobe descending, curved forward, linear, acute to acuminate, 11–22 × 0.5–1.5 mm, lateral lobes descending, strongly divergent, linear-falcate, tips curved, acuminate to apiculate, 25–48 × 0.5–1.5 mm; spur toothed, (20–)31–47 mm long, clavate apex 10.5–23.0 mm long, sometimes bent forward. *Anther* erect, acute, 3.0–4.5 mm long, canals slender, 4.0–7.5 mm long. *Stigmatic processes* clavate, projecting forwards and deflexed, sub-parallel, 6–11 mm long, base adnate to lip. *Rostellum* 3-lobed, base auriculate, median lobe narrowly triangular-rostrate, acuminate, margin smooth, 2.5–6.5 mm long, lateral lobes linear, fused to anther canals, sub-erect to 45°, sub-parallel, 2–5 mm long. Flowering period: January to April.

4.2.1. Distribution and habitat

B. polypodantha is restricted to South Africa, where it is widespread in the eastern part of the country, from Stutterheim in the Eastern Cape, through KwaZulu-Natal, Free State, North-West, Gauteng and Mpumalanga to Waterpoort in the Limpopo Province (Fig. 4e). It occurs in a variety of habitats, in grassland, savannah, forest and thicket, from 700–2000 m altitude.

4.2.2. Discussion

B. polypodantha and *B. pulchella* are distinct from other *Bonatea* species in their basal rosette of leaves. Along with *B. stereophylla*, they are the only *Bonatea* species to have rostrate median rostellum lobes. *B. polypodantha* most closely resembles *B. pulchella* in appearance and floral structure, but is smaller with shorter spurs (20–47 mm vs 53–70 mm long). Other differences are discussed under *B. pulchella*.

4.2.3. Additional specimens examined

4.2.3.1. South Africa. Eastern Cape.—3029 (Kokstad): Rode, Bushveld Valley, (-CD), *Acocks 22114* (PRE). 3227 (Stutterheim): near junction of Swart Kei River and white Kei River, (-AA), *Galpin 8180* (PRE). **Free State.**—2827 (Senekal): Korannaberg, Van Soelenshoek Farm, (-CD), *du Preez* (NBG). **Gauteng.**—2528 (Tshwane): Bon Accord, (-CA), *Mogg s.n.* (PRE); Zeekoegat Farm, (-CA), *Schweickhardt 1061* (PRE); Zeekoegat Farm, (-CA), *Vogts s.n.* (PRE); Roodeplaatdam Nature Reserve, (-CB), *Van Rooyen 3444* (PRU). **KwaZulu-Natal.**—2830 (Dundee): Weenen Nature Reserve, (-CC), *Edwards 1626* (NU); near Kranskop, (-DD), *Incken 27* (NH). **Limpopo.**—2229 (Waterpoort): Rushton, (-DD), *Raal 259* (LYD; PRE). 2429 (Zebediela): Highland Mountains, Highland 60 Farm, (-AA), *Venter s.n.* (PRE); Highland Mountains, Portugal 55 Farm, (-AA), *Venter 12400* (UNIN); Mokopane, Swartkrans, Makapaan's Valley, (-AA), *Balkwill 4422* (J). 2430 (Pilgrim's Rest): Mampaskloof 10 Farm, along Mohlapitse River, (-AA), *Burrows 3497* (J). **Mpumalanga.**—2430 (Pilgrims Rest): Blyde River Canyon, (-DB), *Ubbink 158* (PUC). 2530 (Lydenburg): Vaalhoek to Ohriststad road, (-AB), *Meeuse 10032* (PRE). 2531 (Komatipoort): Krokodilpoort, (-AC), *Breyer 13843* (PRE).

North West.—2526 (Zeerust): Malopo's Oog, (-CC), *Buys 436* (PRE; PUC); Malopo's Oog, (-CC), *Repton 3760* (PRE). 2527 (Rustenburg): Kroondal, Bergheim Farm, (-CD), *Kroker s.n.* (J); Magaliesberg, (-DC), *Venter 615* (PRE); Hartebeespoort Dam, Dr. Brassy's Farm, (-DD), *Mogg 34056* (PRE); Krugersdorp, Gladysvale Farm, (-DD), *Rodin 3897* (PRE).

4.3. *Bonatea pulchella*

B. pulchella Summerhayes in *Kew Bull.* 17: 529, fig. 9 (1964); Stewart et al. in *Wild Orch. South. Africa:* 102, pl. 10.9 (1982); la Croix and Cribb in *Flora Zambesiaca, Orchidaceae* 11: 46, fig. 16 (1995); la Croix and la Croix in *African orchids in the wild and in cultivation:* 156 (1997); Schelpe and Linder in *Orchids of southern Africa:* 142 (1999). Ill.: *Schelpe in Fl. Pl. Africa, t. 1823* (1981). Type: Mozambique, [Maputo], Inhaca Island, Ponta Rasa, on calcareous rocks covered by dunes, in dense coastal forest, 10 July 1957, *Barbosa 7646* (K!, holo.).

Erect, decumbent or scandent terrestrial herbs, 98–322 mm tall; *tubers* 1–3, spreading, elongate-oblong, tomentose. *Stem* slender, 88–317 × 1.5–3.5 mm. *Leaves* 5–9, margins entire, smooth; basal leaves 2–5, dense, sheathing, lanceolate to broadly-elliptical, acute, 27–113 × 12–44 mm, middle leaves 2–4, lax, cauline, narrowly-lanceolate to lanceolate, acuminate, 13–39 × 2–9 mm. *Inflorescence* cylindrical, 62–155 × 48–116 mm, lax, 2–11-flowered; *bracts* similar to upper leaves, sheathing, lanceolate, acuminate to apiculate, 11.5–28.0 × 2.0–5.5 mm. *Flowers* spreading, pale green and white, pedicel and ovary sub-erect to erect, 27.0–44.5 mm long. *Dorsal sepal* pale green, erect, narrowly-elliptical, galeate, acute, 10.0–15.5 × 3.0–5.5 mm; *lateral sepals* pale green to white, patent, ovate, acuminate to apiculate, base oblique, 9.5–14.5 × 6–8 mm, adnate to lip and stigmatic processes for 4.0–6.5 mm. *Petals* pale green to white, upper lobe erect, linear, acute to acuminate, 9.0–15.0 × 0.5–1.5 mm, adnate to dorsal sepal, lower lobe spreading horizontally, weakly deflexed, weakly to strongly falcate, linear, tip sometimes curved, acuminate to apiculate, 36–50 × 0.5–1.0 mm, adnate to claw of lip for 2.5–5.5 mm. *Lip* pale green to white, claw 5.5–15.0 mm, median lobe descending, curved forward, linear, weakly to strongly falcate, acute to acuminate, 21.5–38.0 × 0.5–1.5 mm, lateral lobes descending, strongly divergent, linear, weakly to strongly falcate, tips curved, acuminate, 36.0–57.5 × 0.5–1.0 mm; spur toothed, 53–70 mm long, clavate apex 15.5–24.0 mm long. *Anther* erect, acute, 3–5 mm long, canals slender, 7.0–11.5 mm long. *Stigmatic processes* clavate, projecting forwards and deflexed, sub-parallel, 8.5–14.0 mm long, base adnate to lip. *Rostellum* 3-lobed, base auriculate, median lobe narrowly-triangular rostrate, acuminate, margin smooth, 5–9 mm long, lateral lobes linear, fused to anther canals, sub-erect to 45°, sub-parallel, 4–6 mm long. Flowering period: April to July.

4.3.1. Distribution and habitat

B. pulchella is narrowly distributed in the northeastern parts of southern Africa, ranging from Ubombo on the coastal plain of northern KwaZulu-Natal and southern Mozambique, inland to Nelspruit in Mpumalanga and Pilgrims Rest in the Limpopo

Province (Fig. 4g). It occurs in coastal dune forest, grassland and savannah, from near sea level to 1700 m altitude.

4.3.2. Discussion

B. pulchella is closely allied to *B. polypodantha* but has fewer, larger flowers in which the petal and lip lobes, spur and stigmatic arms are relatively longer. *B. pulchella* is mainly found in dune forest and riverine scrub in deep shade, and while *B. polypodantha* has a similar preference for shady riverine scrub, it is also found in grassland and thorn scrub habitats. The taxa sometimes occur sympatrically in Mpumalanga and Limpopo provinces. They flower at different times, with *B. polypodantha* flowering from January to April and *B. pulchella* from April to July. The hawkmoth *Hippotion osiris* Dalman (Sphingidae), with a proboscis length of 70 mm, is a possible pollinator as a specimen was caught in the vicinity of *B. pulchella* plants in Nelspruit (S.D. Johnson, unpublished data).

4.3.3. Additional specimens examined

4.3.3.1. *Mozambique*. —**2632** (Bela Vista): Inhaca Island, (-BB), Mogg 29486 (J); Inhaca Island, Ponta Torres, (-BB), Mogg 28138 (J; PRE); Inhaca Island, (-BB), Moss 20791 (PRE); Inhaca Island, (-BB), Moss s.n. (J; PRE); Inhaca Island, (-BB), Van der Horst s.n. (J); Inhaca Island, (-BB), Weintraub s.n. (J).

4.3.3.2. *South Africa*. **Limpopo**.—**2430** (Pilgrims Rest): Abel Erasmus Pass, (-DA), Strey 3237 (PRE); Abel Erasmus Pass, (-DA), Strey 3789 (PRE). **Mpumalanga**.—**2530** (Lydenburg): Lowveld Botanical Gardens, northeast corner riverside trail, (-BD), Buitendag 1044 (GLOW; PRE); Lowveld Botanical Gardens, near Crocodile waterfall, (-BD), Van Jaarsveld 468 (GLOW); Lowveld Botanical Gardens, (-BD), Van Jaarsveld 2154 (NBG).

4.4. *Bonatea rabaiensis*

B. rabaiensis (Rendle) Rolfe in Fl. Trop. Afr. 7: 253 (1898); Summerhayes in Fl. Trop. E. Afr.: 139 (1968); Stewart in Orchids of Kenya: 93 (1996); Cribb and Thomas in Flora of Ethiopia and Eritrea: 232 (1997). *Habenaria rabaiensis* Rendle in J. Linn. Soc., Bot. 30: 390 (1895). Type: Kenya, Rabai Hills near Mombasa, 1886, Taylor s.n. (BM!, holo.).

Erect, decumbent or scandent terrestrial herbs, 200–593 mm tall; tubers 2–4, spreading, elongate-oblong, tomentose. Stem slender, 195–583 × 1.5–6.0 mm. Leaves 3–10, lax, cauline, lower sheathing, blades reduced, oblanceolate to elliptical-lanceolate, acute, mucronate, margins entire, smooth, 40–138 × 14–46 mm. Inflorescence cylindrical, 65–143 × 58–131 mm, lax, 1–7-flowered; bracts sometimes withered at flowering, similar to upper leaves, sheathing, lanceolate to ovate-lanceolate, apiculate, 15.5–38.5 × 4.0–11.5 mm. Flowers spreading, green and white, pedicel and ovary sub-erect, 31–47 mm long. Dorsal sepal green, erect, elliptical to oblong-ovate, galeate, acute to acuminate, 13.5–22.0 × 5.5–7.5 mm; lateral sepals

green, projecting forwards, strongly deflexed, ovate-lanceolate, apiculate, base oblique, margins weakly to strongly revolute, 10.5–19.0 × 6–9 mm, adnate to lip and stigmatic processes for 6.0–10.5 mm. Petals upper lobe erect, linear, acute to acuminate, 13.5–19.5 × 0.5–2.0 mm, adnate to dorsal sepal, lower lobe spreading horizontally, weakly to strongly deflexed, linear-falcate, tip curved, acuminate to apiculate, 15.0–31.5 × 0.5–1.5 mm, adnate to claw of lip for 4–10 mm. Lip green, claw 10.0–18.5 mm, median lobe descending, geniculate, apically recurved, linear-lanceolate to narrowly-oblong, acute to acuminate, 9.0–16.5 × 0.5–1.5 mm, lateral lobes descending, diverging, linear-falcate, tips curved, acuminate, 17.0–33.5 × 0.5–1.5 mm; spur toothless, 49–68 mm long, clavate apex 20–31 mm long. Anther erect, apiculate, 4.5–10.0 mm long, canals slender, 10–17 mm long. Stigmatic processes clavate, projecting forwards and deflexed, sub-parallel, 14.5–18.5 mm long, base adnate to lip. Rostellum 3-lobed, base auriculate, median lobe cucullate, apex incurved, apiculate, margin ciliate, 6.5–9.5 mm long, lateral lobes linear, fused to anther canals, projecting forwards to sub-erect to 45°, sub-parallel, 2.0–3.5 mm long. Flowering period: May to June, rarely to August.

4.4.1. Distribution and habitat

B. rabaiensis is restricted to coastal east Africa in Tanzania and Kenya (Fig. 4k), where it occurs in forest and thicket at 50–750 m altitude.

4.4.2. Discussion

B. rabaiensis is the only species of *Bonatea* lacking a tooth in the mouth of the spur. This species has forward-projecting, strongly deflexed lateral sepals, similar to *B. steudneri*, but can be differentiated by the fewer, smaller flowers, which have shorter rostellum lateral lobes (2.0–3.5 mm vs 6.0–15.5 mm). The allopatric species *B. stereophylla* and *Bonatea volkensiana* (Kraenzl.) Rolfe are easily distinguished by their shorter spurs (28–35 mm and 23–36 mm respectively).

4.4.3. Additional specimens examined

4.4.3.1. *Kenya*. —**0339** (Kilifi): Watamu, Sokoke Forest, (-BD), Jeffery K238 (EA; PRE); Kaya Rabai, (-DC), Luke and Robertson 2285 (EA); Mwachi Forest Reserve, (-DC), Robertson and Luke 6210 (EA). **0439** (Kwale): Shimba Hills, Makadara Forest, (-AB), Magogo and Glover 1045 (BR; EA; PRE); Mwachi Forest Reserve, (-BA), Robertson and Luke 5890 (EA).

4.4.3.2. *Tanzania*. —**0538** (Tanga): Kideleko, Handeni (-AC), Greenways and Hoyle 8327 (EA; PRE).

4.5. *Bonatea steudneri*

B. steudneri (Rchb.f.) T. Durand and Schinz in Consp. Fl. Afr. 5: 90 (1895); Rolfe in Fl. Trop. Afr. 7: 253 (1898); Summerhayes in Kew Bull. 17: 531 (1964); Summerhayes in Fl. Trop. E. Afr., Orchid.: 137, fig. 24 (1968); Piers in Orch. E. Afr.: 37, fig. 6–7 (1968); Stewart and Campbell in Orchids Trop.

Afr.: 56, tab. 16 [photo] (1970); Lewalle in Bull. Jard. Bot. Nat. Belg. 42: 244 (1972); Williamson in Orchids S. Centr. Afr.: 68, fig. 31 [1] (1977); la Croix and Cribb in Flora Zambesiaca, Orchidaceae 11: 43, fig. 15, pl. 2 (1995); Stewart in Orchids of Kenya: 93 (1996); Cribb and Thomas in Flora of Ethiopia and Eritrea: 232 (1997); la Croix and la Croix in African orchids in the wild and in cultivation: 157 (1997); Schelpe and Linder in Orchids of southern Africa: 143 (1999). *Habenaria steudneri* Reichenbach in Otia Bot. Hamburg.: 101 (1881); Kraenzlin in Bot. Jahrb. Syst. 16: 57 (1893); Kraenzlin in Orchid. Gen. Sp. 1, 3: 179 (1897). Type: Eritrea, Bogos, Keren, *Steudner 700* (B†, holo.; W!, part of holo.).

Bicornella arabica Deflers in Voy. Yemen: 208, t. 6 (1889). *Habenaria arabica* (Deflers) Kraenzlin in Orchid. Gen. Sp. 1, 3: 184 (1897). *Bonatea arabica* (Deflers) Cortesi in Ann. Bot. (Rome) 2: 363 (1905). Type: Yemen, near Ibb, 1650 m, 1887, *Deflers 659* (P!, lecto., selected here).

Habenaria ecaudata Kraenzlin in Pflanzenw. Ost-Afrikas, C: 152 (1895); Kraenzlin in Orchid. Gen. Sp. 1, 14: 887 (1900); Rolfe in Fl. Trop. Afr. 7: 249 (1898). Type: Tanzania, Kilosa District, Usagara, near Mtondwe, *Stuhlmann 8282* (B†, holo.).

Habenaria kayseri Kraenzlin in Bot. Jahrb. Syst. 19: 246 (1894); Kraenzlin in Orchid. Gen. Sp. 1, 3: 183 (1897). *Bonatea kayseri* (Kraenzl.) Rolfe in Fl. Trop. Afr. 7: 255 (1898); Robyns and Tournay in Fl. Spermat. Parc Nat. Albert 3: 428, t. 59 (1955). Type: Tanzania, Usambara Mountains, Mlalo, frequently in area on stones, March 1893, *Holst 2443* (B†; K!, lecto., selected here).

Habenaria phillipsii Rolfe in Bull. Misc. Inf. Kew 1895: 227 (1895); Kraenzlin in Orchid. Gen. Sp. 1, 3: 183 (1897). *Bonatea phillipsii* (Rolfe) Rolfe in Fl. Trop. Afr. 7: 254 (1898). Type: Somalia, Golis Range at Dara-as, in deep gorge near water, June 1895, *Lort Phillips s.n.* (K!, holo.).

Bonatea pirottae Cortesi in Ann. Bot. (Rome) 2: 362 (1905). *Habenaria pirottae* (Cortesi) Schlechter in Bot. Jahrb. Syst. 53: 508 (1915). Type: Eritrea, Amasen, Monti Arbaroba e Mahdet, 2200 m, 6 January 1901, *Pappi 3392* (FT!, lecto., selected here).

Bonatea sudanensis Rolfe in Bull. Misc. Inform. Kew 1910: 162 (1910). *Habenaria sudanensis* (Rolfe) Schlechter in Bot. Jahrb. Syst. 53: 508 (1915). Type: Sudan, Erkowit, February 1908, *Sillitoe 1464* (K!, holo.).

Bonatea ugandae Rolfe ex Summerhayes in Bull. Misc. Inform. Kew 1931: 383 (1931). Type: Uganda, Busoga District, Jinja, 3900 ft, May 1904, *E. Brown 50* (K!, holo.).

Bonatea ugandae Rolfe nom. nud. in Orchid Rev. 14: 365, 368 (1906).

Erect, decumbent or scandent terrestrial herbs, 415–981 mm tall; tubers 1–6, spreading, elongate-oblong, tomentose. Stem robust, 405–976 × 4.0–15.5 mm. Leaves 7–20, lax to dense, cauline, lower sheathing, blades reduced, oblong-lanceolate to ovate-elliptical, acuminate, margins entire, smooth to undulate, 56–154 × 16–56 mm. Inflorescence cylindrical, 92–304 × 120–289 mm, lax, 5–35-flowered; bracts sometimes withered at flowering, similar to upper leaves, sheathing, lanceolate to ovate-lanceolate, apiculate, 24.5–50.5 × 5.5–15.0 mm. Flowers spreading, green and white, pedicel and ovary, sub-erect, 44–

80 mm long. Dorsal sepal green, erect, narrowly-elliptical, galeate, acute to acuminate, 19–25 × 5.5–9.0 mm; lateral sepals green, projecting forwards, weakly to strongly deflexed, ovate-lanceolate, acuminate to apiculate, base oblique, margins weakly to strongly revolute with acute tooth on lower margin, 17.5–27.5 × 8.5–12.5 mm, adnate to lip and stigmatic processes for 7.0–17.5 mm. Petals upper lobe green, erect, linear, acute to acuminate, 18–26 × 0.5–2.0 mm, adnate to dorsal sepal, lower lobe white with green tip, spreading horizontally, strongly deflexed, linear-falcate, acuminate to apiculate, 39–75 × 0.5–2.0 mm, adnate to claw of lip for 5.0–15.5 mm. Lip green, claw 14.0–36.5 mm, median lobe descending, geniculate, apically recurved, linear-lanceolate to narrowly-oblong, acute to acuminate, 22–43 × 1.0–2.5 mm, lateral lobes descending, diverging, linear-falcate, tips curved, acuminate, 35.5–60.0 × 0.5–2.0 mm; spur toothed, 75–230 mm long, clavate apex 22–49 mm long. Anther erect, acute, 7.5–11.5 mm long, canals slender, 18.5–26.0 mm long. Stigmatic processes clavate, projecting forwards and deflexed, sub-parallel, 24.5–33.5 mm long, base adnate to lip. Rostellum 3-lobed, base auriculate, median lobe cucullate, apex incurved, apiculate, margin ciliate, 6–10 mm long, lateral lobes linear, fused to anther canals, projecting forwards to sub-erect 45°, sub-parallel, 6.0–15.5 mm long. Flowering period: March to August, rarely to February.

4.5.1. Distribution and habitat

B. steudneri is the most widespread species in the genus, ranging from the Pongola floodplain in northern KwaZulu-Natal, South Africa, through Mozambique, Zimbabwe, Namibia, Zambia, Malawi, Tanzania, Kenya, Rwanda, Congo, Uganda, Somalia, Ethiopia, Eritrea, Sudan to Yemen (Fig. 4j). It occurs in a variety of habitats, in grassland, savannah, thicket and forest margins, up to 2800 m altitude.

4.5.2. Discussion

B. steudneri is often found in drier habitats, in open grassland, on rocky slopes and at the edges of forest and savannah thicket. The species is variable in the length of the perianth segments, especially the petal- and lip-lobes, and of the spur, which varies from 75–230 mm across its wide geographic range. The basal fusion of the lip with the stigmatic processes, lateral sepals and lower petal lobes is also variable, ranging between 7.0 and 17.5 mm. The evident variation in the length of the claw and lobes of the lip cast doubt on the use of this character to distinguish *B. eminii* (Kraenzlin, 1894; Rolfe, 1898), based on a single specimen (*Stuhlmann 420*) from Tanzania (see Excluded Species).

In northern KwaZulu-Natal, South Africa, the species is most likely to be confused with *B. lamprophylla*, which has spurs of comparable length, 92–131 mm long, and similar cucullate rostellum median lobe with incurved apex and ciliate margins. However *B. steudneri* has slightly smaller flowers and differs in its forward projecting, strongly deflexed lateral sepals and shorter lip lateral lobes (35.5–60.0 mm vs 106–135 mm).

Fig. 24C in Schelpe and Linder (1999) is incorrectly labelled as *B. steudneri* and more closely approximates *Bonatea boltonii* (Harv.) Bolus, but there is no voucher reference to confirm this.

4.5.3. Additional specimens examined

4.5.3.1. *Yemen*. —**1344** N (Ibb): near Ibb, (-AA), *Deflers* 665 (P).

4.5.3.2. *Eritrea*. —**1538** N (Asmara): Amasen, Asmara, (-DA), *Baldrati* D66 (FT); Amasen, Asmara, (-DA), *Tellini* 962 (FT). **1438** N (Asmara): Amasen, Dongollo presso Ghinda, (-BD), *Pappi* 4514 (FT).

4.5.3.3. *Kenya*. —**0238** (Kitui): Ikutha, Wakamba Reserve, Matuba River, (-CB), *Evans and Pole-Evans* 1109 (PRE).

4.5.3.4. *Tanzania*. —**0234** (Musoma): Serengeti Central Plain, northeast boundary, (-BD), *Greenway and Turner* 10700 (PRE). **0438** (Lushoto): West Usambaras, Muyombo, (-AB), *Williams* 57 (PRE). **0538** (Tanga): East Usambaras, Lewa, (-AB), *Mohamedi* 9107 (PRE); East Usambaras, Amani, Bomole Mountain, (-BA), *Greenway* 3386 (PRE); East Usambaras, Amani, Bomole Mountain, (-BA), *Verdcourt* 278 (PRE); Tongwe Mountains, (-BC), *Verdcourt and Greenway* 263 (PRE).

4.5.3.5. *Zimbabwe*. —**1725** (Zambezi): Victoria Falls, (-DD), *Hall* 11 (NBG); Victoria Falls, (-DD), *Mainwaring* 3014 (NBG). **2028** (Bulawayo): Bulawayo, (-BA), *Eyles and Johnson* 1064 (GRA).

4.5.3.6. *Mozambique*. —**2335** (Inhambane): Govuro, Nova Mambone, Sabi River, (-CD), *Thompson s.n.* (J).

4.5.3.7. *South Africa*. **KwaZulu-Natal**. —**2632** (Bela Vista): Tembe Elephant Park, (-CD), *Ward* 2735 (NH). **2732** (Ubombo): on road from Tshongwe to Mbazwana, (-AD), *Venter* 12969 (PRE; UNIN).

4.6. *Bonatea lamprophylla*

B. lamprophylla J.L. Stewart in Amer. Orchid Soc. Bull. 47: 995 (1978); Stewart et al. in Wild Orch. South. Africa: 97, pl. 10.1 (1982); Schelpe and Linder in Orchids of southern Africa: 136 (1999). Type: South Africa, [KwaZulu-Natal], [Mabibi] Beach, growing in dune forest in deep shade on top of road, September–October 1971, *Jepe s.n.* (NU!, holo.).

Erect, decumbent or scandent terrestrial herbs, 518–1054 mm tall; *tubers* 1–6, spreading, elongate-oblong, tomentose. *Stem* robust, 508–1049 × 5.5–12.5 mm. *Leaves* glossy, 5–15, lax, cauline, lower sheathing, blades reduced, cordate, acuminate, margins entire, undulate, 56–121 × 28–63 mm. *Inflorescence* cylindrical, 111–215 × 103–236 mm, lax, 5–16-flowered; *bracts* similar to upper leaves, sheathing, ovate-lanceolate, acuminate, 33–71 × 9.5–29.0 mm. *Flowers* spreading, green and white, pedicel and ovary sub-erect, 51.5–87.0 mm long. *Dorsal sepal* green, erect, narrowly-elliptical, galeate, acute to acuminate, 28.5–34.0 × 5.5–8.0 mm; *lateral sepals* green, patent, strongly deflexed, oblong-lanceolate, acuminate, base oblique, margins strongly revolute with acute tooth on lower margin, 28.5–33.5 × 9–13 mm, adnate to lip and stigmatic processes for

8–11 mm. *Petals* upper lobe green, erect, linear, acute to acuminate, 27.5–32.5 × 0.5–1.5 mm, adnate to dorsal sepal, lower lobe white with green tip, spreading horizontally, weakly deflexed, linear-falcate, acuminate to apiculate, 34.5–54.0 × 0.5–1.5 mm, adnate to claw of lip for 3.5–6.5 mm. *Lip* green, claw 17.5–22.5 mm, median lobe descending, geniculate, linear, acute to acuminate, 32–47 × 0.5–1.5 mm, lateral lobes descending, diverging, linear, tips curved, acuminate, 106–135 × 0.5–1.0 mm; spur toothed, 92–131 mm long, clavate apex 29–59 mm long. *Anther* erect, acute, 9.5–12.5 mm long, canals slender, 25.0–32.5 mm long. *Stigmatic processes* clavate, projecting forwards and deflexed, weakly divergent, 20.5–27.0 mm long, base adnate to lip. *Rostellum* 3-lobed, base auriculate, median lobe cucullate, apex incurved, apiculate, margin ciliate, 6.5–10.0 mm long, lateral lobes linear, fused to anther canals, sub-erect to 45°, sub-parallel, 14.0–17.5 mm long. Flowering period: September to November.

4.6.1. Distribution and habitat

B. lamprophylla is restricted to the coastal plain in eastern southern Africa, from Richards Bay in northern KwaZulu-Natal to southern Mozambique (Fig. 4d), where it occurs in savannah and coastal dune forest, from near sea level to 170 m altitude.

4.6.2. Discussion

B. lamprophylla is a striking species with the largest flowers in the genus. It is found almost exclusively in dune and riverine forest, normally in shade. Molecular study suggests that *B. lamprophylla* is most closely allied to *B. steudneri* (Ponsie, 2006). The taxa are also morphologically similar but *B. lamprophylla* can be easily distinguished by its exceptionally long lateral lip lobes (106–135 mm vs 35.5–60.0 mm). Vegetative specimens are easily distinguished as the glossy dark green, cordate leaves with undulate margins of *B. lamprophylla* contrast with the dull oblong-lanceolate to ovate-elliptical green leaves of *B. steudneri*.

4.6.3. Additional specimens examined

4.6.3.1. *Mozambique*. —**2532** (Maputo): Maputo Bay, Costa da Sol, (-DC), *Daintree s.n.* (PRE). **2632** (Bela Vista): Inhaca Island, Hlangwini swamp, (-BB), *Mogg* 30071 (J); Inhaca Island, near lighthouse, (-BB), *Mogg* 27678 (J; PRE); Inhaca Island, Ponte Torres, (-BB), *Mogg* 27633 (J).

4.6.3.2. *South Africa*. **KwaZulu-Natal**. —**2732** (Ubombo): Lake Sibaya, (-BC), *Jepe s.n.* (PRE); Lake Sibaya, Drum Island, (-BC), *Lubbe* 376 (NH; PRU); Mabibi Beach, (-BC), *Jepe s.n.* (PRE); Lake Sibaya, Mabibi Beach, in heavy shade in dune forest and at roadside, (-BC), *Jepe s.n.* (BOL; K). **2832** (Mtubatuba): Lower Umfolosi, Latu, Nseleni River, (-CA), *O'Connor* 604 (NU).

4.7. *Bonatea porrecta*

B. porrecta (Bolus) Summerhayes in Kew Bull. 4: 430 (1949); Stewart et al. in Wild Orch. South. Africa: 100, pl. 10.3

(1982); la Croix and Cribb in Flora Zambesiaca, Orchidaceae 11: 46 (1995); la Croix and la Croix in African orchids in the wild and in cultivation: 156 (1997); Schelpe and Linder in Orchids of southern Africa: 139 (1999). *Habenaria porrecta* Bolus in J. Linn. Soc., Bot. 25: 167, fig. 5 (1889); Kraenzlin in Bot. Jahrb. Syst. 16: 71 (1893); Rolfe in Fl. Cap. 5, 3: 134 (1913). Type: South Africa, [KwaZulu-Natal], [Durban], without precise locality or date, *Gueinzus s.n.* (K1, lecto., selected here).

Erect, decumbent or scandent terrestrial herbs, 85–560 mm tall; *tubers* 1–10, spreading, elongate-oblong, tomentose. *Stem* slender to robust, 80–550 × 1.5–6.5 mm. *Leaves* sometimes withered at flowering, 5–16, lax to dense, cauline, lower sheathing, blades reduced, lanceolate to narrowly-oblong, acute to acuminate, margins entire, smooth to undulate, 39–131 × 7–25 mm. *Inflorescence* cylindrical, 41–237 × 50–131 mm, lax to dense, 3–36-flowered; *bracts* sometimes withered at flowering, similar to upper leaves, sheathing, ovate-lanceolate to ovate-oblong, apiculate, 12–33 × 4.5–10.0 mm. *Flowers* spreading, green and white, pedicel and ovary sub-erect, 21.5–39.5 mm long. *Dorsal sepal* green, erect, elliptical-ovate, galeate, acute to acuminate, 8.5–15.0 × 3–5 mm; *lateral sepals* green, patent, slightly deflexed, widely oblong-ovate, acute to apiculate, base oblique, margins weakly to strongly revolute with acute tooth on lower margin, 8.0–14.5 × 4.5–8.5 mm, adnate to lip and stigmatic processes for 3.5–7.5 mm. *Petals* upper lobe green, erect, narrowly-falcate, acute to acuminate, 6.5–16.0 × 0.5–2.0 mm, adnate to dorsal sepal, lower lobe white with green tip, spreading horizontally, weakly deflexed, weakly to strongly falcate, linear, tip curved, acuminate, 12.5–24.5 × 0.5–1.5 mm, adnate to claw of lip for 2.0–5.5 mm. *Lip* green, claw 6–13 mm, median lobe descending, geniculate, sometimes apically recurved, linear-lanceolate to narrowly-oblong, acute to acuminate, 10.5–20.0 × 1.0–2.5 mm, lateral lobes descending, diverging, linear-falcate, tips curved, acuminate, 14–29 × 0.5–2.0 mm; spur toothed, 24–43 mm long, clavate apex 6.5–21.5 mm long. *Anther* erect, acute, 3.5–6.0 mm long, canals slender, 6–12 mm long. *Stigmatic processes* clavate to spatulate, projecting forwards and deflexed, sub-parallel, 8.5–15.5 mm long, base adnate to lip. *Rostellum* 3-lobed, base auriculate, median lobe cucullate, acute to acuminate, margin ciliate, 2–5 mm long, lateral lobes linear, fused to anther canals, projecting forwards to sub-erect 20°, weakly divergent, 2.0–5.5 mm long. Flowering period: June to September, rarely October.

4.7.1. Distribution and habitat

B. porrecta is scattered through the eastern half of southern Africa, from Stutterheim in the Eastern Cape through KwaZulu-Natal, Swaziland, Mpumalanga, Gauteng and North-West to Waterpoort in the Limpopo Province. It is recorded just inside Mozambique along the Lebombo Mountains (Fig. 4f). The species occurs in savannah, grassland, forest and thicket, from near sea level to 1800 m altitude. Schelpe and Linder (1999) record collections from southeast Botswana but we have not verified these.

4.7.2. Discussion

Ponsie (2006) found *B. porrecta* to be embedded within the *B. speciosa* complex (traditionally comprising *Bonatea anten-*

nifera Rolfe, *B. boltonii* and *B. speciosa*). *B. porrecta* is sympatric with all three taxa but differs in having the leaves withered at flowering time. *B. porrecta* resembles *B. boltonii* in flower size, the horizontally spreading lower petal lobes, and spur morphology (both species average 35 mm for total spur length and 11 mm for the clavate apex). The rostellum in *B. porrecta* is however diminutive (2–5 mm vs 5–9 mm), with the free portion of the rostellum lateral lobes 2.0–5.5 mm (vs 2.0–3.5 mm for *B. boltonii*) and generally ≥ the length of the rostellum median lobe. The stigmatic processes are also predominantly clavate for *B. porrecta* and spatulate for *B. boltonii*.

B. porrecta can also be confused with *B. saundersioides*, which has a similar perianth and may also have the leaves dry at flowering. It differs in the erect (vs sub-erect) dorsal sepal, straight spur with a clavate apex 1/4–1/3 of spur length (vs curved spur with clavate apex 1/2–2/3 of spur length). In addition, the rostellum lateral lobes of *B. saundersioides* are shorter than the median rostellum lobe.

Kurzweil and Weber (1992) misidentified *Bayliss s.n.* (BOL_p 736 (spirit material)) as *B. porrecta*. The specimen drawn in Fig. 1 (Kurzweil and Weber, 1992) is *B. saundersioides*. Schelpe and Linder (1999) similarly misidentify *B. saundersioides* in fig. 24D as *B. porrecta*.

4.7.3. Additional specimens examined

4.7.3.1. South Africa. **Eastern Cape.**—**3129** (Port St. Johns): Lusikisiki, (-BC), *Behr s.n.* (NBG); Cutweni, along Myekane River, (-BD), *vanWyk 8463* (NH; PRU); Mkambati, (-BD), *O'Connor 406* (KEI, NU); Mount Suillivan, (-DA), *Balkwill, Norris, Manning and Hutchings 1892* (NU). **3227** (Stutterheim): Prospect Siding, (-DB), *Flanagan s.n.* (PRE). **Gauteng.**—**2627** (Potchefstroom): Krugersdorp, Waterval 74 Farm, Olifant's Klip, (-BA), *Gilliland s.n.* (J); Linden, (-BB), *von Maltitz s.n.* (J); Northcliff, Calodenron kop, (-BB), *Gilliland s.n.* (J); Randburg, Robindale, (-BB), *Reddy, Reddy and Reddy 2133* (PRE). **2628** (Johannesburg): Kensington, rocky koppie, (-AA), *Strang s.n.* (J); Melville Koppies Nature Reserve, (-AA), *Schijf 60* (J); Observatory, (-AA), *Moss 3617* (J); Witwatersrand, Windsor Park, (-AA), *Barlett s.n.* (J, PRE); Suikerbosrand Reserve, (-CA), *Davidson 3163* (J). **KwaZulu-Natal.**—**2731** (Louwsburg): Ingwavuma bush, (-BB), *Roberts s.n.* (PRE). **2732** (Ubombo): Ingwavuma, (-AA), *Compton 19713* (GRA); Ingwavuma, (-AA), *Ward 2381* (NH); Mkuze, (-CA), *Strey 5308* (NH); Ubombo, (-CA), *O'Connor 513* (NU); Ubombo, (-CA), *Stewart 1731* (NU). **2829** (Harrismith): Doornhoek, (-AD), *Garbutt 17* (NU). **2831** (Nkandla): Tugela, (-CC), *Butcher s.n.* (NH); Umhlatuzi Valley on Empangeni Road, (-DC), *Lawn 1620* (NH). **2930** (Pietermaritzburg): Scottsville, (-AC), *Daffey s.n.* (NU); Umgeni Valley, (-AC), *Forbes 1254* (NH); Albert Falls, (-AD), *Commis 478* (NU); World's View, (-CB), *Lawson 1110* (NH); Illovo, Stoney Hill, (-CC), *O'Connor 435* (NU); Camperdown, Nagle Dam, (-DA), *Wells 1641* (NU); Inchanga, (-DA), *Alexander 30* (NU); Inchanga, (-DA), *Alexander 31* (NU); Ndwedwe, (-DB), *Thomas 17* (NU); Botha's Hill, (-DC), *Chamier 8* (NU); Botha's Hill,

(-DC), *Schelpa* 3 (NU); Kloof, (-DD), *Rennie s.n.* (NU); Kloof, Quarry slopes, (-DD), *Manning 263* (NU); Merbank, (-DD), *Forbes 670* (NH); New Germany, (-DD), *Thode 4159* (NH); Durban, Green Vale, (-DD), *Plant 52* (K). **2931** (Stanger): Springfield, (-AC), *Moonsamy s.n.* (NH); Durban, (-CC), *Wood 5992* (NH); Durban, (-CC), *Wood 7168* (NH). **3030** (Port Shepstone): Dumisa, (-AD), *Rudatis 1087* (NH); Pennington, (-BC), *Anderson s.n.* (NH); Rondebosch, (-CB), *Rosenbrock s.n.* (GRA). **3130** (Port Edward): Mr Niemalk's Farm, in cracks in rock, (-AA), *O'Connor 405* (NU). **Limpopo.**—**2229** (Waterpoort): Makhado, Wyllie's Poort, (-DD), *Van Wyk s.n.* (PRE). **2329** (Polokwane): Makhado, (-BB), *Breyer 24387* (PRE); Haenertsburg, Iron Crown Mountain, (-DD), *Venter s.n.* (UNIN); Houtboschdorp, Mabal's location, Ga-Maidula Hill, (-DD), *Venter 13542* (PRE; UNIN). **2330** (Tzaneen): Loutpansberg, Elim, (-AA), *Obermeyer 540* (PRE); Krantzkop, (-CA), *Thode 5000* (NH); Letaba, Modjadje, (-CB), *Compton 18083* (GRA).

4.7.3.2. *Swaziland.* —**2631** (Mbabane): Mbalaleni, (-AC), *Karsten s.n.* (PRE).

4.8. *Bonatea volkensiana*

B. volkensiana (Kraenzl.) Rolfe in *Fl. Trop. Afr.* 7: 253 (1898); Robyns and Tournay in *Fl. Spermat. Parc Nat. Albert 3*: 426 (1955); Summerhayes in *Fl. Trop. E. Afr.*: 139 (1968); Stewart in *Orchids of Kenya*: 94 (1996). *Habenaria volkensiana* Kraenzlin in *Bot. Jahrb. Syst.* 19: 244 (1894); Von Götzen in *Durch Afr. Von Ost nach West*: 376 (1895). Type: Tanzania, Kilimanjaro, Kwa Ngowe, many in sandy, grassy hills of landscape, east of Marangu up to Rombo, an area of Kenya at Kwa Iletto, 1450 m, June 1893, *Volkens 342* (B†, holo.; BM!, iso.).

Erect, decumbent or scandent terrestrial herbs, 210–660 mm tall; *tubers* 2–10, spreading, elongate-oblong, tomentose. *Stem* slender to robust, 205–650 × 2.5–10.5 mm. *Leaves* 7–15, lax to dense, cauline, lower sheathing, blades reduced, lanceolate to oblanceolate, acute to acuminate, margins entire, smooth to undulate, 27–123 × 10–41 mm. *Inflorescence* cylindrical, 89–221 × 55–123 mm, lax to dense, 6–27-flowered; *bracts* similar to upper leaves, sheathing, lanceolate to ovate-lanceolate, apiculate, 16–35 × 5–12 mm. *Flowers* spreading, green and white, pedicel and ovary sub-erect to erect, 25–43 mm long. *Dorsal sepal* green, erect, elliptical-lanceolate, galeate, acute to acuminate, 13.0–18.5 × 4–8 mm; *lateral sepals* green, patent, strongly deflexed, widely oblong-ovate, acute to apiculate, base oblique, margins weakly revolute with acute tooth on lower margin, 11.5–17.5 × 5.5–9.5 mm, adnate to lip and stigmatic processes for 4.5–8.0 mm. *Petals* upper lobe green, erect, linear, acute to acuminate, 12.5–19.5 × 0.5–2.0 mm, adnate to dorsal sepal, lower lobe white with green tip, projecting forwards, ascending, weakly divergent, linear-falcate, tip curved, acuminate, (21–)25–38.5 × 0.5–1.5 mm, adnate to claw of lip for 3–6 mm. *Lip* claw 10.0–14.5 mm, median lobe green, descending, geniculate, sometimes apically recurved, linear-lanceolate to narrowly-oblong, acute to acuminate, 11.5–25.0 × 1.0–2.5 mm, lateral lobes white with green

tips, projecting forward, ascending, diverging, linear-falcate, tips curved, acuminate, (16.5–)20–32.0 × 0.5–1.5 mm; spur toothed, 23–36 mm long, clavate apex 8.0–16.5 mm long. *Anther* erect, acute, 5–8 mm long, canals slender, 9.0–14.5 mm long. *Stigmatic processes* clavate to spatulate, projecting forwards and deflexed, sub-parallel, 11.5–18.0 mm long, base adnate to lip. *Rostellum* 3-lobed, base auriculate, median lobe cucullate, acute to acuminate, margin ciliate, 3.0–5.5 mm long, lateral lobes linear, fused to anther canals, sub-erect to 45°, sub-parallel, 4.5–7.0 mm long. Flowering period: rarely January to February, March to June.

4.8.1. *Distribution and habitat*

B. volkensiana has been recorded inland from northeastern Tanzania and southwestern Kenya (Fig. 4k), where it occurs in grassland and savannah, 1000–2400 m altitude.

4.8.2. *Discussion*

B. volkensiana is widespread in the drier regions of Kenya and Tanzania, in bush or rocky grassland. The species is allopatric with coastal populations of *B. rabaiensis* and occasionally sympatric with *B. steudneri* (Donnelly 13799 (EA)) but no hybrids have been recorded. In flower *B. volkensiana* is distinguished from *B. steudneri* by its shorter spurs (23–36 mm vs 75–230 mm).

Morphologically, *B. volkensiana* is embedded within the *B. speciosa* complex (Ponsie, 2006), and most closely resembles *B. antennifera*. The taxa differ in rostellum structure: in *B. volkensiana* the median lobe is smaller (3.0–5.5 mm vs 7.5–11.5 mm), with the free portion of the lateral lobes 4.5–7.0 mm (vs 2.0–5.5 mm) and generally ≥ the length of the median lobe.

4.8.3. *Additional specimens examined*

4.8.3.1. *Kenya.* —**0037** (North Nyeri): Laikipia, Nanyuki, (-CC), *Bullid 1584* (EA). **0036** (Nakuru): Lion Hill, (-AC), *Hingley 230* (EA). **0037** (Nyeri): Naro Moru River Lodge, (-AA), *Gilbert 4999* (EA). **0136** (Nairobi): Kiambu, Muguga, (-BA), *Greenway 18568* (EA); Langata, (-BC), *Archer s.n.* (EA); Kirichwa Kubwa, (-BC), *Bally 9222* (EA); Nairobi, (-BD), *Donnelly 13799* (EA). **0237** (Machakos): Chyulu Hills, North, (-DB), *Bally 855* (EA); Chyulu Hills, North, (-DB), *Bally 1096* (EA).

4.8.3.2. *Tanzania.* —**0235** (Masai): Barafu Kopjes, (-AD), *Turner 13990* (EA); Musoma, Gol Kopjes, (-CB), *Greenway and Turner 13357* (EA; PRE). **0337** (Moshi): Mount Kilimanjaro, (-AB), *Haarer 550* (EA).

4.9. *Bonatea antennifera*

B. antennifera Rolfe in *Gard. Chron.* 3: 450 (1905); Rolfe in *Fl. Cap.* 5, 3: 142 (1913); la Croix and Cribb in *Flora Zambesiaca*, *Orchidaceae* 11: 45 (1995); la Croix and la Croix in *African orchids in the wild and in cultivation*: 154 (1997). Ill.: Verdoorn in *Fl. Pl. Africa*, t. 1405 (1964). *Habenaria antennifera* (Rolfe) Schlechter in *Bot. Jahrb. Syst.* 53: 508 (1915), nom. illegit., non

H. antennifera A.Richard in *Ann. Sc. Nat. Ser. 2*, 14: 268 (1840). *Bonatea speciosa* var. *antennifera* (Rolfe) Sommerville in *Contr. Bolus Herb.* 10: 157 (1982); Stewart et al. in *Wild Orch. South. Africa*: 99, pl. 10.2b (1982); Schelpe and Linder in *Orchids of southern Africa*: 139 (1999). Type: [Zimbabwe], without precise locality or date, *Munro s.n.* (K!, holo.).

Habenaria macrorchis Schlechter [as *H. macrocorchis* in Schelpe and Linder in *Orchids of southern Africa*: 139 (1999)] in *Ann. Transvaal Mus.* 10: 245 (1924), nom. illegit. superfl.

Erect, decumbent or scandent terrestrial herbs, 260–1258 mm tall; tubers 1–12, spreading, elongate-oblong, tomentose. *Stem* robust, 255–1250 × 3.5–11.0 mm. *Leaves* 6–21, lax to dense, cauline, lower sheathing, blades reduced, oblong-lanceolate to oblong-ovate, acute to acuminate, margins entire, smooth to undulate, 42–190 × 10–53 mm. *Inflorescence* cylindrical, 38–339 × 79–181 mm, lax to dense, 4–44-flowered; *bracts* similar to upper leaves, sheathing, ovate-lanceolate to ovate-oblong, acuminate to apiculate, 19.5–50.5 × 6.0–14.5 mm. *Flowers* spreading, green and white, pedicel and ovary sub-erect, 26.5–60.5 mm long. *Dorsal sepal* green, sub-erect to erect, elliptical to oblong-ovate, galeate, acute to acuminate, 14–23 × 5.0–8.5 mm; *lateral sepals* green, patent, strongly deflexed, oblong-lanceolate to ovate, acute to apiculate, base oblique, margins weakly to strongly revolute with acute tooth on lower margin, 13–26 × 5–10 mm, adnate to lip and stigmatic processes for 4.5–9.5 mm. *Petals* upper lobe green, erect, narrowly-falcate, acute to acuminate, 13–24 × 1.0–3.5 mm, adnate to dorsal sepal, lower lobe white with green tip, projecting forwards, ascending, weakly divergent, linear-falcate, tip curved, acuminate to apiculate, (18–)24–43 × 0.5–2.0 mm, adnate to claw of lip for 2.5–6.5 mm. *Lip* claw 6.0–14.0 mm, median lobe green, descending, geniculate, sometimes apically recurved, linear-lanceolate to narrowly-oblong, acute to acuminate, 15.0–33.5 × 1.0–3.5 mm, lateral lobes white with green tips, projecting forward, ascending, diverging, linear-falcate, tips curved, acuminate, 17.5–44.5 × 0.5–2.0 mm; spur toothed, 27–44 (–58) mm long, clavate apex 8.0–15.0 (–18.5) mm long. *Anther* erect, acute, 4.5–7.5 mm long, canals slender, 10–14 mm long. *Stigmatic processes* clavate to spatulate, projecting forwards and deflexed, sub-parallel, (11.0–)15.0–21.5 mm long, base adnate to lip. *Rostellum* 3-lobed, base auriculate, median lobe cucullate, acute to acuminate, margin ciliate, 7.5–11.5 mm long, lateral lobes linear, fused to anther canals, slightly deflexed to sub-erect 45°, sub-parallel, 2.0–5.5 mm long. Flowering period: March to May, rarely to July.

4.9.1. Distribution and habitat

B. antennifera is widespread throughout northwestern South Africa in KwaZulu-Natal, Free State, Northern Cape, North-West, Gauteng, Mpumalanga and Limpopo provinces. It has also been recorded in southeastern Botswana, southern Mozambique and from scattered populations in Zimbabwe (Fig. 4a). It occurs in grassland, savannah and forest fringes, from near sea level to 1700 m altitude.

4.9.2. Discussion

Taxonomic controversy has surrounded the circumscription of *B. antennifera*, *B. boltonii* and *B. speciosa*, which are mor-

phologically similar. Indecision over the limits of these taxa has resulted in their inclusion within a broadly circumscribed *B. speciosa* (Sommerville, 1982; Schelpe and Linder, 1999). On the basis of variation in the lower petal lobe, Sommerville (1982) and Schelpe and Linder (1999) recognized a single species, *B. speciosa* with two varieties (var. *speciosa* (L.f.) Willd. and var. *antennifera* (Rolfe) Sommerville), and conflated *B. boltonii* within the typical variety. By contrast, la Croix and Cribb (1995) recognize *B. antennifera* as a distinct species.

Molecular data suggest a closer alliance between *B. boltonii* and *B. antennifera* than either of these entities have with *B. speciosa* (Ponsie, 2006). This is in conflict with the conflation of *B. boltonii* and *B. speciosa* under the typical variety (Schelpe and Linder, 1999). Results from Principle Components Analyses and scatter plots (Ponsie, 2006), point to the existence of three morphologically distinct and diagnosable species within *B. speciosa sensu* Schelpe and Linder.

B. antennifera is distributed mainly in the north and north-eastern interior of South Africa, usually in open grassland and dry woodland areas. Populations of *B. antennifera* from northern KwaZulu-Natal are atypical, flowering from June to July and producing markedly elongate spurs of 51–58 mm (typical flowering is from March to May and spur length 27–44 mm). The claw of the lip and basal fusion of the lip with the stigmatic processes, lateral sepals and lower petal lobes, as well as stigmatic process and rostellum lateral lobe length, fall within the maximum size range for the species. The rostellum lateral lobes are distinctive in posture being sub-erect to 45°, rather than projecting forwards. A specimen of *B. antennifera* from Zimbabwe (*Munro s.n.* (K)) has similar rostellum lateral lobe posture (sub-erect to 45°) and an average spur length of 44 mm.

B. antennifera and *B. speciosa* are largely allopatric, being constituents of savannah and coastal dune forest vegetation types, respectively, but both overlap with *B. boltonii*. The three species also differ in their peak flowering period, with most populations of *B. antennifera* flowering from March to May, *B. speciosa* from June to December, and *B. boltonii* from December to March. Despite the overlapping distribution and flowering times, no intermediate forms have been observed, even in mixed populations (*Flanagan 647* (GRA)).

Quantitatively, *B. antennifera* and *B. boltonii* are distinguished by a critical divide occurring at 15 mm for stigmatic process length and 24 mm for lower petal lobe length, with *B. boltonii* falling below the divide. Posture of the lower petal lobes and lip lateral lobes are also significantly different in the species—both projecting forward, ascending in *B. antennifera*, whilst horizontally spreading lower petal lobes and descending lip lateral lobes occur in *B. boltonii*. *B. speciosa* is distinct from *B. antennifera* and *B. boltonii* with respect to its longer clavate spur apex ((13.5–)15.0–32.0 mm) in combination with its wider lower petal lobes ((1.5–)2.0–5.5 mm). The lower petal lobe posture projects forward and is weakly to strongly deflexed, with descending lip lateral lobes.

B. antennifera and *B. volkensiana* bear a close resemblance but differ in rostellum structure. *B. antennifera* has a larger median lobe (7.5–11.5 mm vs 3.0–5.5 mm) with the free portion of the lateral lobes being comparatively shorter (2.0–5.5 mm vs 4.5–

7.0 mm). These taxa are allopatric, with *B. antennifera* occurring south of Hwange and Marondera in Zimbabwe, whilst *B. volkensiana* is only known from collections in Tanzania and Kenya.

4.9.3. Additional specimens examined

4.9.3.1. *Botswana*. —**2425** (Kanye): Kanye, (-CD), *Hansen 3406* (PRE).

4.9.3.2. *South Africa*. **Free State**.—**2826** (Brandfort): Bez Valley, Langemanskop, (-AA), *Atkinson 10* (J); Krugersdrift-dam Nature Reserve, Deelkop, (-CC), *Muller 1761* (PRE); Glen Agricultural College, (-CD), *Zietsman and Zietsman 359* (PRE). **2827** (Senekal): Winburg, (-CA), *Kok 22* (BLFU); Korannaberg, (-CC), *du Preez 699* (BLFU). **2926** (Bloemfontein): Botanic Gardens, (-AA), *Rossouw 26* (BLFU); near residence of the state president, (-AA), *Hanekom 884* (PRE); Wintervally, (-AA), *Müller 533* (NBG; PRE); Melville, (-BC), *Macnae 1347* (NBG). **Gauteng**.—**2528** (Tshwane): Tswaing Saltpan, Meteorite crater 50 km north of Tshwane, (-AC), *Van Rooyen and Schultze 4274* (PRU); Tshwane, (-CA), *without collector PRU s.n.* (PRU); Riviera Public School, (-CA), *Smith 6024* (PRE); Botanic Garden of BRI, (-CB), *Oliver 7674* (PRE; STE); Fairy Glen, (-CB), *Moss 11265* (J); Roodeplaatdam Nature Reserve, (-CB), *Van Rooyen 3443* (PRU); Val De Grace, Moreleta, (-CB), *Brusse 1933* (PRE); Fountains Valley, (-CC), *Bremekamp s.n.* (PRU); Fountains Valley, (-CC), *de Wit s.n.* (PRU); Fountains Valley, (-CC), *Leendertz 123* (PRE); Fountains Valley, (-CC), *Wasserfall and Collett s.n.* (PRE); Groenkloof Valley, (-CC), *Howlett s.n.* (PRE); Groenkloof Valley, (-CC), *Codd 3772* (PRE); Halfway House, (-CC), *Strater 14* (J); Irene, Jan Smut's Farm, Koppie Smuts, (-CC), *Salm 24* (J); Waterkloof, (-CC), *Hayes-Palmer s.n.* (NBG); Lynwood, (-CD), *Pole-Evans 112* (PRE); Premier mine, (-DA), *Frames s.n.* (PRE). **2627** (Potchefstroom): Randpark, (-BA), *Van Jaarsveld 1848* (NBG); Waterval, (-BA), *Mogg 23304* (J); Zwartkrans, (-BA), *Franklin 28* (J); Honeydew, (-BB), *Bartlett s.n.* (J); Roodepoort, (-BB), *Behr 447* (NBG); Thornbush Farm, (-BB), *Bartlett and Mogg s.n.* (J); Eikenhof, Grasmere-Eikenhof Road, Klip River Mountain, (-BD), *Hartzer 188* (PRE); Vereeniging, Langerand Hills, Houtkop 3, (-DB), *Mogg 21061* (J). **2628** (Johannesburg): Bryanston, (-AA), *Gilliland s.n.* (J, PRE); Johannesburg, (-AA), *Moss 11266* (J); Melville Koppies Nature Reserve, (-AA), *Lucas 204* (J); Moffat Park, (-AA), *Cron and Balkwill 261* (J); Blue Moon Hotel, (-AA), *Bartlett s.n.* (J); Morningside, Koppies road, (-AA), *Moss s.n.* (J); Morning side, Luluwe, (-AA), *Moss s.n.* (J); Koppie in Mondeor, (-AC), *Ludick 7* (PRU); Heidelberg, Kuilfontein Farm, (-DA), *Mogg 37600* (PRE). **KwaZulu-Natal**.—**2632** (Bela Vista): Ingwavuma, Ndumu Game Reserve, (-CD), *Pooley 1398* (NU). **2732** (Ubombo): Ingwavuma, Makanes drift, Pongola river, (-AB), *O'Connor 512* (NH); Ubombo, across river from Jozini, (-AC), *O'Connor 510* (NU). **2831** (Nkandla): Empangeni, (-DB), *Lawn 1557* (NH). **Limpopo**.—**2230** (Musina): Venda, Ha Makuya, (-BD), *Netshiungani 1416* (PRE). **2328** (Baltimore): Soutpansberg, Blaauwberg, (-BB), *Meeuse 10342* (PRE); Mokopane, Kwarriehoek, (-CD), *Steyn 67* (PRE). **2329**

(Polokwane): Bandelierkop, (-BD), *Riley s.n.* (NBG); Moletsi, Mmadadikoti, (-CB), *Makgaka 101* (PRE); Sandrivierspoort, Rietpol Farm 858 LS, (-DA), *Fourie 1130* (PRE); 18 km east of Polokwane on the road to Tzaneen, (-DC), *Van Vuuren s.n.* (UNIN); outside Polokwane on the road to Tzaneen, (-DC), *Van Vuuren 1461* (PRE); University of the North campus, (-DC), *Bredenkamp 1085* (PRE; UNIN). **2330** (Tzaneen): Letsitele, Janetsi Farm on road from Letsitele to Giyani, (-CD), *Jacobsen 5312* (PRE). **2427** (Thabazimbi): Kranzberg, Thabazimbi to Matlabas road, (-BC), *Venter 1906* (PRE). **2428** (Modimolla): Waterberg, Kareefontein, (-CA), *Leistner 192* (PRE); Bela-Bela, Zwartkloof Private Nature Reserve, (-CC), *Venter 11624* (UNIN); Waterberg, Bela-Bela, (-CD), *Leipoldt s.n.* (PRE); Waterberg, Mookgophong, (-DA), *Galpin M328* (PRE). **2429** (Zebediela): Wolkberg, Paardevlei 201 KS Farm, (-BB), *Balkwill 1595* (NU). **2430** (Pilgrim's Rest): Steelpoort Railway Station, (-CA), *Pole-Evans 4698* (PRE). **Mpumalanga**.—**2429** (Zebediela): Lydenburg, Parys Farm, (-DB), *Barnard 385* (PRE). **2430** (Pilgrim's Rest): Blydepoort rest camp, on the way to Lydenburg, (-DB), *Feijter 94* (PUC). **2529** (Witbank): Bundu Inn, (-AC), *Wentzel 4* (PRU); Middelburg, (-CD), *King s.n.* (PRE). **2531** (Komati-poort): 28 Rhenosterkop JU 195, (-CA), *Onderstall 1061* (GLOW). **2630** (Carolina): Lochiel, (-BB), *Moss and du Toit 20718* (J). **North West**.—**2525** (Mafeking): Rietpoort, (-DB), *Goossens 1524* (PRU; PUC). **2526** (Zeerust): Vergenoegd on road to Mafeking, (-CA), *Van der Meulen 440FM103* (PRE); Malopo's Oog, (-CC), *Botha 2658* (PUC); Zwarttruggens, (-DA), *Sutton 819* (PRE). **2527** (Rustenburg): between Rustenburg and Magaliesberg, (-CA), *Schlotfeldt s.n.* (NBG); Rustenburg, (-CA), *Rogers 18723* (PRE); Brits, (-DB), *Bischoff s.n.* (PRU); Hartebeestpoort dam, (-DD), *Bremekamp s.n.* (PRE); Hartebeestpoort dam, (-DD), *Erens s.n.* (PRE). **2626** (Klerksdorp): Lichtenburg, (-AA), *Kuun 23* (PRU; PUC); Lichtenburg, Hakboslaagte, (-AC), *Kinges 1509* (PRE; PRU); Klerksdorp, (-DC), *Convent 19* (GRA); Potchefstroom, (-DD), *Schweick-erdt 1069a* (PRE). **2627** (Potchefstroom): Dassiesrand, (-CA), *Westhuizen 647* (PUC); Experimental Farm, (-CA), *Theron 2* (PRE); Gerhardminnebron Eye, (-CA), *Louw 1392* (PUC); Potchefstroom, (-CA), *McLea 3038* (SAM); Potchefstroom, (-CA), *Theron 298* (PUC); Potchefstroom, (-CA), *Theron 1439* (PRU); Potchefstroom, (-CA), *Theron 1547* (PRU; PUC); Potchefstroom, (-CA), *Ubbink 48* (PUC); Ventersdorp road alongside Potchefstroom Military camp, (-CA), *Venter 191* (PRE). **Northern Cape**.—**2824** (Kimberly): Riverton, (-DB), *Tafscolt s.n.* (KMG).

4.10. *Bonatea boltonii*

B. boltonii (Harv.) Bolus in *J. Linn. Soc., Bot.* 19: 340 (1882); Rolfe in *Fl. Cap.* 5, 3: 140 (1913). *Habenaria boltonii* Harv. in *Thes. Cap.* 1: 55, fig. 1 (1859); Kraenzlin in *Bot. Jahrb. Syst.* 16: 142 (1893). *Habenaria bonatea* Rchb.f. var. *boltonii* (Harv.) Bolus in *Ic. Orch. Austr. Afr.* 2: t. 45 (1911), nom. illegit. superfl. Type: South Africa, [Eastern Cape], near Grahamstown without precise locality or date, *Bolton s.n.* (TCD!, holo.).

Erect, decumbent or scandent terrestrial herbs, 100–750 mm tall; tubers 1–8, spreading, elongate-oblong, tomentose. *Stem* robust, 95–740 × 3.5–11.0 mm. *Leaves* 5–13, lax to dense,

cauline, lower sheathing, blades reduced, oblong-lanceolate to widely-ovate, acute to acuminate, margins entire, smooth to undulate, 19–178 × 9–40 mm. *Inflorescence* cylindrical, 74–191 × 67–132 mm, lax to dense, 3–20-flowered; *bracts* similar to upper leaves, sheathing, ovate-lanceolate to ovate-oblong, acuminate to apiculate, 16.5–43.5 × 6.0–17.0 mm. *Flowers* spreading, green and white, pedicel and ovary sub-erect, 30–59 mm long. *Dorsal sepal* green, sub-erect to erect, elliptical-ovate, galeate, acute to acuminate, 12.5–18.5 × 4–7 mm; *lateral sepals* green, patent, slightly deflexed, oblong-lanceolate to oblong-ovate, acute to apiculate, base oblique, margins weakly to strongly revolute with acute tooth on lower margin, 10.0–20.5 × 4–8 mm, adnate to lip and stigmatic processes for 4.0–6.5 mm. *Petals* upper lobe green, erect, narrowly-falcate, acute to acuminate, 9.5–18.0 × 1–4 mm, adnate to dorsal sepal, lower lobe white with green tip, spreading horizontally, weakly deflexed, weakly to strongly falcate, linear to linear-lanceolate, tip curved, acuminate, 11.0–24(–27.5) × 0.5–2.0(–2.5) mm, adnate to claw of lip for 1.5–4.0 mm. *Lip* green, claw 6.5–12.0 mm, median lobe descending, geniculate, sometimes apically recurved, linear-lanceolate to narrowly-oblong, acute to acuminate, 7–27 × 1–3 mm, lateral lobes descending, diverging, falcate, linear-lanceolate, tips curved, acuminate, 10.5–32.0 × 0.5–3.0 mm; spur toothed, 27–51 mm long, clavate apex 7.0–14.5 mm long. *Anther* erect, acute, 4.5–7.0 mm long, canals slender, 6.5–11.0 mm long. *Stigmatic processes* spathulate, projecting forwards and deflexed, sub-parallel, 8.5–15.0 mm long, base adnate to lip. *Rostellum* 3-lobed, base auriculate, median lobe cucullate, acute to acuminate, margin ciliate, 5–9 mm long, lateral lobes linear, fused to anther canals, projecting forwards to sub-erect 20°, sub-parallel, 2.0–3.5 mm long. Flowering period: rarely August to November, December to March.

4.10.1. Distribution and habitat

B. boltonii is restricted to the eastern parts of South Africa, ranging from Grahamstown in the Eastern Cape, through KwaZulu-Natal, into Mpumalanga and to Polokwane in the Limpopo Province (Fig. 4b). It occurs in grassland, savannah and dunes, from near sea level to 1900 m altitude.

4.10.2. Discussion

Plants of *B. boltonii* are generally short in stature and grow in full sun or rarely in forest and thicket. This taxon is sympatric with *B. antennifera* and *B. speciosa*, and can reach comparable heights when growing in tall vegetation such as forest margins and mixed grassland.

B. boltonii and its close allies (*B. antennifera*, *B. porrecta*, *B. speciosa* and *B. volkensiana*) share similar floral configuration but subtle differences in the petal- and lip-lobes, rostellum structure, and spur distinguish them. *B. boltonii* can be easily distinguished by its horizontally spreading lower petal lobes and descending lateral lip lobes from *B. antennifera* and *B. volkensiana*, which have forward projecting, ascending lateral lip lobes and lower petal lobes. *B. porrecta* is deciduous and has a smaller rostellum median lobe (2–5 mm vs 5–9 mm), with the free portion of the rostellum lateral lobes 2.0–5.5 mm (vs 2.0–3.5 mm) and generally \geq the length of the rostellum median

lobe. *B. speciosa* has a longer clavate spur apex ((13.5–)15.0–32.0 mm vs 7.0–14.5 mm) and wider lower petal lobes ((1.5–)2.0–5.5 mm vs 0.5–2.0(–2.5) mm). The lower petal lobe in *B. speciosa* projects forward and is weakly to strongly deflexed, with descending lip lateral lobes.

Harvey (1859) describes the petals of *B. boltonii* as bipartite, although the figure shows simple petals. This error was perpetuated by Kraenzlin (1893) in his *Monograph*, pp 142.

4.10.3. Additional specimens examined

4.10.3.1. South Africa. **Eastern Cape.**—**3129** (Port St. Johns): Lusikisiki, Mlambomkulu River, 2.5 km upstream from coast, (-BC), Van Wyk and Matthews 7818 (KEI; NH; PRU); Mkambati Nature Reserve, (-BD), Jordaan 975 (NH). **3227** (Stutterheim): Komga, Kei Hills, (-DB), Flanagan 647 (SAM; PRE). **3228** (Butterworth): Kentani, (-AD), Pegler 299 (PRE); Kwelega River, (-CC), Potts 1822 (BLFU). **3326** (Grahamstown): Cold Spring, (-AD), Glass s.n. (SAM); Grahamstown, (-BC), Black 30 (PRE); Kaif Hill, (-BC), Noel 1131 (GRA); Mountain Drive, Dassie Kranz, (-CA), Peter 475 (NU); Bathurst, Barvel Park, (-DB), Norton s.n. (NBG). **Gauteng.**—**2628** (Johannesburg): Johannesburg, (-AA), Holden s.n. (PRE). **KwaZulu-Natal.**—**2729** (Volksrust): Zinnia, (-DD), Smit 1373 (PRU). **2730** (Vryheid): Tendeka, (-DB), Mattison 20 (NU); Klipspruit, (-DC), Breyer 16956 (PRE); Vryheid, (-DD), Jansen s.n. (NH). **2732** (Ubombo): Kosi Bay Coastal Forest Reserve, Manzengwenya, (-BD), Lubbe 327 (NH; PRU). **2829** (Harrismith): Biggarsberg, One Tree Hill Farm, One Tree Hill, (-BB), Sikhakhane 580 (NH; PRE); Ladysmith, Doornkraal Farm, Colling's Pass road, (-BD), Robbeson 240 (PRU); Estcourt, (-DD), Green 192 (NH); Estcourt, Krans above Bushmans River, (-DD), Acocks 10142 (NH). **2830** (Dundee): Scottspoort, near Weenen, (-CC), Thode 3889 (NH). **2831** (Nkandla): Hlabisa, Palm Ridge Farm, (-BB), Harrison 214 (NH; PRE); Ngoye Forest Reserve, (-DC), Williams 1069 (NH); Mtunzini, (-DD), Wood 12227 (J; NH). **2929** (Underberg): Polela, Glengariff Lot7, (-DC), Rennie 1301 (NU). **2930** (Pietermaritzburg): Craigieburn Dam, (-AB), Greene 1020 (NH); Greytown, (-BA), Wylie s.n. (NH); Pinetown, (-DD), Wood s.n. (SAM). **2931** (Stanger): Durban, Brighton Beach, (-CC), Nair 9 (UDW); The Bluff, spring grassland, (-CC), Hennessy 143 (UDW); Treasure Beach, (-CC), Gathiram 10 (UDW); Treasure Beach, (-CC), Gathiram 15 (UDW). **3030** (Port Shepstone): St. Michaels-on-Sea, (-AB), Hall s.n. (NU); St. Michaels-on-Sea, (-AB), O'Connor 198 (NU); St. Michaels-on-Sea, (-AB), O'Connor 565 (NU); St. Michaels-on-Sea, (-AB), O'Connor s.n. (NU); Highflats, (-AC), Walsh 24 (NU); past St. Faith's Mission on road to Highflats, (-AC), Germishuizen 1795 (PRE); Fairfield, Dumisa, (-AD), Rudatis 1203 (NH); Kelso Junction, (-BC), Pellew 31 (NU); Oriibi upstream of Hoopoe Falls, (-CA), Glen 273 (J; Umtamvuna Herbarium); Port Shepstone, (-CB), Moss 10631 (J); Port Shepstone, (-CB), Prosser 1426 (J); Munster, (-CC), Mgemmmell s.n. (BLFU); Munster, (-CC), Thomas 1 (NU); turnoff to Oriibi Gorge Hotel, on road to Paddock, (-CD), Germishuizen 1668 (PRE); Uvongo, (-CD), Melvin s.n. (NH).

Limpopo.—**2329** (Polokwane): Houtboschberg, (-DD), *Schlechter 4381* (PRE); Houtbosdorp, Zaagkuil farm, (-DD), *Venter 10483* (PRE; UNIN). **Mpumalanga.**—**2530** (Lydenburg): Kwagershoek Farm, (-AB), *Obermeyer 349* (PRE); Godwane, (-DA), *Rogers s.n.* (PRE). **2531** (Komatipoort): 8 Highlands, Uitkyk road, (-CA), *Onderstall 1307* (PRE); Barberton, (-CC), *Culver 18* (J); Barberton, (-CC), *Schlieben 9592* (PRE); Barberton, Berea Hill, (-CC), *Galpin 769* (GRA; PRE). **2629** (Bethal): Ermelo, (-DB), *Hardeman s.n.* (NBG).

4.11. *Bonatea speciosa*

B. speciosa (L.f.) Willdenow in Sp. Pl. 4: 43 (1805); **Bolus in J. Linn. Soc., Bot. 19: 340** (1882); **Stewart et al. in Wild Orch. South Africa: 99** (1982); la Croix and Cribb in *Flora Zambesiaca, Orchidaceae 11: 45* (1995); la Croix and la Croix in *African orchids in the wild and in cultivation: 157* (1997); Schelpe and Linder in *Orchids of southern Africa: 137* (1999). Ill.: *Schelpe in An introduction to the South African orchids: 74, pl. 35* (1966). *Orchis speciosa* Linnaeus in *Suppl. Pl.: 401* (1781). Type: South Africa, [Western Cape], Cape of Good Hope, without precise locality or date, *Herbarium Thunberg 21246* (UPS!, lecto.).

Habenaria bonatea Reichenbach in *Otia Bot. Hamburg.: 101* (1881), nom. illegit. superfl.; Kraenzlin in *Bot. Jahrb. Syst. 16: 57* (1893); *Schlechter in Bot. Jahrb. Syst. 20, Beibl. 50: 32* (1895); **Bolus in Ic. Orch. Austr. Afr. 2: t. 44** (1911); **Bolus in The orchids of the Cape Peninsula: t. 15** (1918). Type: as above.

Habenaria bonatea Pfitzer in *Engl. and Prantl, Naturl. Pflanzenfam. 2, 6: 95* (1888), nom. illegit. superfl. Type: as above.

Habenaria robusta N.E. Brown in *Gard. Chron., n.s., 24: 307* (1885), nom. illegit., non *H. robusta* Welw. ex *Reichenbach in Flora 50: 102* (1867). Type: as above.

Bonatea densiflora Sonder in *Linnaea 19: 80* (1847); Kraenzlin in *Bot. Jahrb. Syst. 16: 68* (1893). *Habenaria densiflora* (Sond.) *Reichenbach in Ann. Bot. Syst. 1: 797* (1849); **Bolus in J. Linn. Soc., Bot. 19: 340** (1882). Type: South Africa, [Eastern Cape], Balfour, Kat River near to the Missionary Institution, 2000–3000 ft, June, *Ecklon and Zeyher s.n.* (S!, holo.).

Erect, decumbent or scandent terrestrial herbs, 95–957 mm tall; *tubers* 1–8, spreading, elongate-oblong, tomentose. *Stem* robust, 90–950 × 2.5–14.0 mm. *Leaves* 4–19, lax to dense, cauline, lower sheathing, blades reduced, oblong-lanceolate to obovate, acute to acuminate, margins entire, smooth to undulate, 26–155 × 110–67 mm. *Inflorescence* cylindrical, 63–286 × 66.5–165.0 mm, lax to dense, 1–41-flowered; *bracts* similar to upper leaves, sheathing, ovate-lanceolate to ovate, acuminate to apiculate, 15–53 × 6–23 mm. *Flowers* spreading, green and white, pedicel and ovary sub-erect, 24–64 mm long. *Dorsal sepal* green, sub-erect to erect, elliptical to oblong-ovate, galeate, acute to acuminate, 15–25 × 4.5–9.5 mm; *lateral sepals* green, patent, slightly deflexed, oblong-lanceolate to ovate, acute to apiculate, base oblique, margins weakly revolute with acute tooth on lower margin, 14.0–29.5 × 5.5–12.5 mm, adnate to lip and stigmatic processes for 5.0–13.5 mm. *Petals* upper lobe green, erect, narrowly-falcate, acute to acuminate, 13–26 × 1.0–3.5 mm, adnate to dorsal sepal, lower lobe white with green tip, projecting forwards, weakly to strongly deflexed, weakly to strongly

divergent falcate, linear to lanceolate, tip curved, acute to acuminate, (16–)19–39 × (1.5–)2.0–5.5 mm, adnate to claw of lip for 3.5–9.8 mm. *Lip* green, claw 9.0–25.5 mm, median lobe descending, geniculate, apically recurved, linear-lanceolate to narrowly-oblong, acute to acuminate, 9.0–27.5 × 0.5–3.0 mm, lateral lobes descending, diverging, falcate, linear-lanceolate, tips curved, acuminate, 11.5–39.0 × 1–4 mm; spur toothed, 20–57 mm long, clavate apex (13.5–)15.0–32.0 mm long. *Anther* erect, acute, 5.0–8.5 mm long, canals slender, 9.5–16.5 mm long. *Stigmatic processes* clavate to slightly spatulate, projecting forwards and deflexed, sub-parallel, (11.5–)14.0–27.5 mm long, base adnate to lip. *Rostellum* 3-lobed, base auriculate, median lobe cucullate, acute to acuminate, margin ciliate, 5.0–11.5 mm long, lateral lobes linear, fused to anther canals, slightly deflexed to sub-erect 45°, sub-parallel, 2.5–7.0 mm long. Flowering period: June to December, rarely to March.

4.11.1. Distribution and habitat

B. speciosa occurs along the seaboard of southern Africa, from Lambert's Bay in the Western Cape Province, through the Eastern Cape and KwaZulu-Natal provinces to southern Mozambique, extending shortly inland, especially in the Eastern Cape (Fig. 4i). It occurs in a variety of habitats, in grassland, savannah, forest, thicket, fynbos and nama-karoo, from sea level to 1300 m altitude.

4.11.2. Discussion

B. speciosa is a morphologically variable species with an extended flowering period. The variation in spurs length within the species (20–57 mm long) may be the result of local adaptation to different pollinators across its geographic range. **Johnson and Liltved (1997)** documented pollination of *B. speciosa* populations in the Goukamma Nature Reserve, Western Cape, by the hawk-moths *Theretra capensis* (L) and *Hyles lineata livornica* (Esper).

Populations of *B. speciosa* and *B. antennifera* from northern KwaZulu-Natal and southern Mozambique flower between June and July, and have relatively few (5–7 and 7–20, respectively), large flowers and lax inflorescence. In these populations of *B. speciosa* the rostellum lateral lobes are atypical, being sub-erect to 45° rather than projecting forwards and the spur length falls within the maximum range for the species (45–57 mm). Similarly, populations of *B. antennifera* from the area have atypical rostellum lateral lobes, and spurs 51–58 mm long (typically 27–44 mm). This geographic trend of accentuated spur lengths also occurs in *B. lamprophylla*, *B. pulchella* and *B. steudneri* (92–131 mm, 53–70 mm and 75–230 mm in length, respectively). See also the discussions under *B. antennifera* and *B. boltonii*.

4.11.3. Additional specimens examined

4.11.3.1. *Mozambique.* —**2632** (Bela Vista): Inhaca Island, (-BB), *Mogg 29486* (J); Inhaca Island, (-BB), *Moss s.n.* (J); Inhaca Island, (-BB), *Weintraub s.n.* (J); Inhaca Island, (-BB), *Wolfowitz 5* (J).

4.11.3.2. *South Africa. Eastern Cape.*—**3128** (Umtata): Elliotdale, (-DC), *Gordon-Gray 571* (NU). **3129** (Port St.

Johns): Lusikisiki, (-BC), *Kelly 17* (NBG); Makweni River Mouth near Goss Point, (-BD), *Venter 939* (PRE); Port St. Johns, (-DA), *Bayliss 7077* (NBG); Port St. Johns, (-DA), *Schelppe 2* (NU). **3226** (Fort Beaumont): Fish River Rand, (-CC), *Hutton 496* (GRA). **3227** (Stutterheim): Yellowwoods, (-CD), *Sim 808* (NU); Komga, Kei Hills, (-DB), *Flanagan 647* (SAM; PRE); Nahoon, (-DD), *Peter 240* (NU). **3228** (Butterworth): Kei Mouth, (-BC), *Flanagan 239* (GRA); Kei Mouth, (-BC), *Flanagan 810* (GRA); Komga, (-CA), *Flanagan 239* (PRE); Black Rock Cove, (-CB), *Pegler 1435* (PRE); Wavecrest, (-DA), *Lubke s.n.* (GRA). **3229** (Talemofu): Hole-in-the-wall, (-AA), *Hutchings 1062* (KEI). **3325** (Port Elizabeth): Sandflats, (-BD), *Flanagan 239* (SAM); Uitenhage, (-CD), *Pappe s.n.* (SAM); Port Elizabeth, (-DC), *Drege 96* (GRA); Redhouse, (-DC), *Paterson 12287* (PRE). **3326** (Grahamstown): Howieson's Poort, (-AD), *MacOwan s.n.* (SAM); Brakkloof, (-BA), *White s.n.* (GRA); Fish River, Bathurst, (-BB), *Davies s.n.* (GRA); Amos Kloof, (-BC), *Galpin 295* (PRE); Featherstone Kloof, (-BC), *Roux s.n.* (NBG); Signal Hill, (-BC), *Dieterlen 29* (NBG); University of Rhodes, (-BC), *Noel 7311* (GRA); Grahamstown, (-BD), *Bolus s.n.* (NBG); Grahamstown, (-BD), *Glass 470* (NBG); Boknes Strand, (-DA), *Burrows 3315* (GRA); Kenton On Sea, (-DA), *Muirhead s.n.* (GRA); Kowie, (-DB), *Fatherstone s.n.* (GRA); Kowie, (-DB), *Tyson s.n.* (PRE); Port Alfred, (-DB), *Dold 1229* (GRA); Port Alfred, (-DB), *Sole s.n.* (GRA); Port Alfred, (-DB), *Tyson H12978* (PRE); Port Alfred, near Kowie River, (-DB), *Edwards 205* (NU). **3327** (Peddie): Christmas Rock, (-BA), *Werner s.n.* (NBG); Kaysers Beach, (-BA), *Norris s.n.* (NBG); East London, (-BB), *Batten s.n.* (NBG; STE); East London, (-BB), *Carter s.n.* (NBG); East London, (-BB), *Galpin 1877* (PRE); East London, (-BB), *Gane 301* (GRA); East London, (-BB), *Rattray 150* (GRA); East London, (-BB), *Thode 7707* (STE). **3424** (Humansdorp): Klipdrift, (-BA), *Jeppe s.n.* (PRE). **KwaZulu-Natal.**—**2831** (Nkandla): Mtunzini, (-DD), *Lawn 953* (NH). **2930** (Pietermaritzburg): Cato Ridge, (-DA), *Carnegie s.n.* (NU); Drummond, (-DA), *O'Connor 515* (NU); Drummond, (-DA), *Strey 6487* (NH; PRE); Inanda, (-DB), *Wood s.n.* (SAM); Isipingo, (-DD), *Forbes and Obermeyer 51* (NH; PRE); Isipingo, (-DD), *Moss 3615* (J); Isipingo, (-DD), *Ward 913* (PRE); Pinetown, (-DD), *Gibson s.n.* (NU). **2931** (Stanger): Stanger Beach, (-AD), *Pentz 371* (PRE); The Bluff, (-CC), *Franks s.n.* (NH); The Bluff, (-CC), *Wood 12226* (NH); Durban, (-CC), *Sanderson 1037* (NH); Durban Country Club Golf Course, (-CC), *Ward 12594* (NH). **3030** (Port Shepstone): Amanzimtoti, (-BB), *Adams 211* (NU); Amanzimtoti, (-BB), *without collector NH 17185* (NH); Isipingo Beach, (-BB), *Ward 913* (NU); Lower Umkomaas, (-BB), *Thode 5770* (NH); Clanshal, (-BC), *Nixon 19* (NU); Park Rynie, (-BC), *Newmark 11* (NU); Sawoti, Impambinyoni Valley, (-BC), *King 115* (NU); Umkomaas, (-BC), *Aubrey s.n.* (NU); Scottburgh, (-BD), *Ball 743* (PRE); Izotsha, Gayridge Park, (-CB), *Melvin s.n.* (Umtamvuna Herbarium); Beach Terminus, (-CD), *Thode 4995* (NH); Margate, (-CD), *Fisher 313* (NU); Margate, (-CD), *Cohen s.n.* (NBG); Marina Beach, (-CD), *Dunstan s.n.* (GRA); Marina Beach, (-CD), *McNeil 112* (NU); Mpenjati Nature Reserve, (-CD), *von Fintel 560* (NH); Ramsgate, (-CD), *Coleman 882* (NH). **Western**

Cape.—**3318** (Cape Town): Hopefield, sand dunes near Langebaan, (-AA), *Chater s.n.* (STE). **3322** (Oudtshoorn): Oudtshoorn, (-CA), *Taylor s.n.* (PRE); George, (-CD), *Stephany s.n.* (PRE); George, Saasveld, scrub forest adjoining stream, (-DC), *Lange 15* (PRE); George, Saasveld, roadside forest edge, (-DC), *Morze 2035* (PRE); George, Wilderness, (-DC), *Van Niekerk 194* (PRE). **3323** (Willowmore): Nature's Valley, (-DC), *Bower 605* (PRE); Storms River, (-DD), *Taylor 3749* (NBG). **3418** (Simonstown): Karbonkelberg near Houtbay, (-AB), *Stokoe 13731* (PRE); Llandudno near Sandy Bay, (-AB), *Kurzweil HK859* (NBG); Muizenberg Vlei, (-AB), *Tapscott s.n.* (SAM); Betty's Bay, (-BD), *Boucher 2421* (STE); Betty's Bay, (-BD), *Martin 229* (NBG); Betty's Bay, Dawid-skraal, (-BD), *Ebersohn 287* (NBG). **3419** (Caledon): Palmiet River, (-AA), *Compton 14103* (NBG); Caledon, (-AB), *Radloff s.n.* (STE); Hermanus, (-AC), *Marloth 7681* (PRE); Hermanus, (-AC), *Rogers 22604* (PRE); Hermanus, Riviera, (-AC), *Purchell s.n.* (SAM); Mosselrivier, (-AD), *Bccquet 17870* (PRE); Kleinmond, (-BD), *Cloete s.n.* (SAM). **3420** (Bredasdorp): Swellendam, Kimko Farm, (-AB), *Swart s.n.* (STE); Zuurbak, (-BA), *Galpin 4590* (PRE); Heidelberg, (-BB), *Kramer s.n.* (PRE); Heidelberg, (-BB), *without collector STE 17225* (STE); De Mond, Heuningnes River mouth, (-CA), *Boucher 1678* (STE). **3421** (Riversdale): Riversdale, (-AB), *Barker s.n.* (NBG); Kleinplaats near Albertinia, (-BA), *Muir 1231* (PRE). **3422** (Mossel Bay): Brak River, (-AA), *Van der Byl 13376* (PRE); Pinedew Farm, (-BA), *Hugo 1952* (PRE; STE); Platbank, (-BB), *Hugo 1977* (STE); Sedgfield, (-BB), *Morze 2030* (PRE); Sedgfield, (-BB), *McWade s.n.* (NBG). **3423** (Knysna): Lake Pleasant, (-AA), *Chater s.n.* (STE); Knysna Heads, (-AA), *Thomas s.n.* (NBG); Plettenberg Bay, (-AB), *Rogers 17243* (GRA; J; STE).

4.12. *Bonatea saundersioides*

B. saundersioides (Kraenzl. and Schltr.) Cortesi in *Ann. Bot. (Rome)* 2: 363 (1905); Stewart et al. in *Wild Orch. South Africa*: 100, pl. 10.5 (1982); la Croix and la Croix in *African orchids in the wild and in cultivation*: 156 (1997); Schelpe and Linder in *Orchids of southern Africa*: 140 (1999). *Habenaria saundersioides* Kraenzl. and Schltr. in *Orchid. Gen. Sp.* 1, 3: 181 (1897); Schlechter in *Ann. Transvaal Mus.* 10: 245 (1924). *Bonatea saundersioides* (Kraenzl. and Schltr.) Rolfe in *Fl. Cap.* 5, 3: 140 (1913), nom. illegit. superfl. Type: South Africa, [Mpumalanga], Barberton, Umvoti Creek, 3000 ft, April–May, *Culver 30* (K!, holo.; BOL!, iso.).

Habenaria umvotensis Rolfe in *Fl. Cap.* 5, 3: 133 (1913). Type: South Africa, [Mpumalanga], Barberton, Umvoti Creek, 3000 ft, April–May, *Culver 30* (BOL!, K!, syn.); South Africa, [Mpumalanga], Barberton, Umvoti Creek, shady places amongst rocks in wooded ravines, 3000 ft, May–June, *Galpin 954* (BOL!, K!, PRE!, syn.).

Erect, decumbent or scandent terrestrial herbs, 200–600 mm tall; tubers 1–8, spreading, elongate-oblong, tomentose. Stem slender to sturdy, 195–595 × 2.5–8.5 mm. Leaves sometimes withered at flowering, 5–12, lax, cauline, lower leaves intermediately basal, sheathing, lanceolate to narrowly-elliptical, acute to

apiculate, margins entire, smooth, 54–193 × 7–28 mm. *Inflorescence* cylindrical, 65–262 × 52–95 mm, lax to dense, 5–41-flowered; *bracts* sometimes withered at flowering, similar to upper leaves, sheathing, ovate-lanceolate, apiculate, 17.5–30.5 × 4.0–8.5 mm. *Flowers* spreading, green and white, pedicel and ovary projecting forwards to sub-erect, 16–29 mm long. *Dorsal sepal* green, sub-erect, elliptical-oblong, galeate, acute to acuminate, 8.5–15.0 × 3.0–5.5 mm; *lateral sepals* green, patent, strongly deflexed, ovate-lanceolate, acuminate to apiculate, base oblique, margins weakly to strongly revolute with small acute tooth on lower margin, 10–15 × 3.5–6.5 mm, adnate to lip and stigmatic processes for 2.5–5.5 mm. *Petals* upper lobe green, erect, linear, acute to acuminate, 8–14 × 0.5–1.5 mm, adnate to dorsal sepal, lower lobe white, spreading horizontally, strongly deflexed, weakly to strongly falcate linear to linear-lanceolate, tip curved, acuminate to apiculate, (13–)16–24 × 0.5–2.0(–3.0) mm, adnate to claw of lip for 2.5–4.5 mm. *Lip* claw 4.5–9.0 mm, median lobe green, descending, geniculate, sometimes apically recurved, linear, acute, 8.5–20.0 × 0.5–1.5 mm, lateral lobes green to white, descending, diverging, weakly to strongly falcate, linear, tips curved, acuminate to apiculate, 14–34 × 0.5–2.0 mm; spur toothed, curved, 16–30 mm long, clavate apex 9.5–24.0 mm long. *Anther* erect, acute, 3.0–5.5 mm long, canals slender, 5.0–8.0 mm long. *Stigmatic processes* clavate, projecting forwards and deflexed, weakly divergent, 4.5–9.0 mm long, base adnate to lip. *Rostellum* 3-lobed, base auriculate, median lobe narrowly-cucullate, apiculate, margin ciliate, 4.0–6.5 mm long, lateral lobes linear, fused to anther canals, projecting forwards to sub-erect 45°, sub-parallel, 1.0–2.5 mm long. Flowering period: rarely March to May, June to August.

4.12.1. Distribution and habitat

B. saundersioides is restricted to the northeastern portion of southern Africa, occurring from Nkandla in KwaZulu-Natal, through Swaziland, with scattered populations in Mpumalanga, North-West and Limpopo provinces (Fig. 4h). It occurs in savannah and forest, from near sea level to 1400 m altitude. The species may extend into Mozambique, but the area is poorly botanised.

4.12.2. Discussion

B. saundersioides is found in shady habitats within riverine forest and savannah of the northeasterly parts of South Africa. It is closely allied to *B. cassidea*, both species sharing intermediately basal lower leaves, desiccated floral bracts at flowering, narrowly-cucullate median rostellum lobes, and curved spurs where the clavate apex comprises 1/2–2/3 of the total spur length. *B. saundersioides* has longer and narrower lower petal lobes ((13–)16–24 × 0.5–2.0(–3.0) mm) than *B. cassidea* (8–15(–19) × (1.5–)3.0–8.0 mm). This species also has narrower lip lateral lobes (0.5–2.0 mm vs (1.5)2.0–6.5 mm). Colour variation occurs in the perianth of *B. saundersioides* with either green or white lip lateral lobes.

4.12.3. Additional specimens examined

4.12.3.1. *South Africa*. **KwaZulu-Natal**.—**2632** (Bela Vista): Ingwavuma, Mahemane, Ndumo Game Reserve, (–CD), *Pooley*

633 (NU). **2732** (Ubombo): Ingwavuma, Mzinyeni Pan, (–AA), *O'Connor 511* (NU). **Limpopo**.—**2329** (Polokwane): Makhado, (–BB), *Bartlett s.n.* (J); Morbeng, (–BD), *Botha s.n.* (PRE). **North West**.—**2527** (Rustenburg): Rietfontein Farm, (–CA), *Bartlett s.n.* (J; PRE).

4.12.3.2. *Swaziland*.—**2631** (Mbabane): Hlatikulu, Sibowe River, (–CD), *Compton 28930* (PRE). **2632** (Mhlume): Ngwenya Causeway, (–AA), *Bayliss 3485* (PRE); Ngwenya Causeway, (–AA), *Bayliss B/S6* (PRE).

4.13. *Bonatea cassidea*

B. cassidea **Sonder in Linnaea** 19: 81 (1847); **Stewart et al. in Wild Orch. South. Africa**: 101, pl. 10.6 (1982); la Croix and Cribb in *Flora Zambesiaca, Orchidaceae* 11: 46 (1995); la Croix and la Croix in *African orchids in the wild and in cultivation*: 155 (1997); Schelpe and Linder in *Orchids of southern Africa*: 141 (1999). Ill.: **L. Bolus in Fl. Pl. South Africa, t. 302** (1928). *Habenaria cassidea* (Sond.) **Reichenbach in Ann. Bot. Syst.** 1: 797 (1849); **Bolus in J. Linn. Soc., Bot.** 19: 340 (1882); **Brown in Gard. Chron.** 24: 307 (1885); **Kraenzlin in Bot. Jahrb. Syst.** 16: 80 (1893). Type: South Africa, [Eastern Cape], Uitenhage, Olifantshoek near Bushmans River, September, *Ecklon and Zeyher s.n.* (S!, holo.).

Bonatea darwinii **Weale in J. Linn. Soc., Bot.** 10: 470 (1869). Type: South Africa, [Eastern Cape], Bedford, Kagaberg, *Weale s.n.* (PRE!, lecto.; SAM!, isolecto.).

Habenaria saundersiae **Harvey in Thes. Cap.** 2: 29, fig. 147 (1863); **Bolus in J. Linn. Soc., Bot.** 19: 340 (1882); **Kraenzlin in Bot. Jahrb. Syst.** 16: 57 (1893), syn. nov. *Bonatea saundersiae* (Harv.) **T. Durand and Schinz in Consp. Fl. Afr.** 5: 89 (1895); **Stewart et al. in Wild Orch. South. Africa**: 101 (1982); Schelpe and Linder in *Orchids of southern Africa*: 141 (1999). Type: South Africa, [KwaZulu-Natal], [Durban], without precise locality or date, *Saunders sub Wheelwright s.n.* (TCD!, holo.).

Erect, decumbent or scandent terrestrial herbs, 100–640 mm tall; *tubers* 1–8, spreading, elongate-oblong, tomentose. *Stem* slender, 95–630 × 1.5–5.0 mm. *Leaves* sometimes withered at flowering, 5–13, lax, cauline, lower leaves intermediately basal, sheathing, narrowly-obovate to oblanceolate, acute to acuminate, margins entire, rarely undulate, 20–250 × 4–19 mm. *Inflorescence* cylindrical, 40–212 × 34–64(–80) mm, lax to dense, 3–35-flowered; *bracts* sometimes withered at flowering, similar to upper leaves, sheathing, linear-oblong to ovate-lanceolate, apiculate, 10–25 × 2.5–7.5 mm. *Flowers* spreading, green and white, pedicel and ovary sub-erect to erect, 14–32 mm long. *Dorsal sepal* green, sub-erect to erect, elliptical-oblong, galeate, acute to acuminate, 7.0–13.5 × 3–5 mm; *lateral sepals* green, patent, strongly deflexed, oblong-lanceolate to ovate, acute to apiculate, base oblique, margins weakly to strongly revolute with small acute tooth on lower margin, 7.0–15.5 × 2.0–6.5 mm, adnate to lip and stigmatic processes for 3–6 mm. *Petals* upper lobe green or white, erect, linear, acute to acuminate, 6–14 × 0.5–2.0 mm, adnate to dorsal sepal, lower lobe white, spreading horizontally, weakly to strongly deflexed, falcate, lanceolate to widely-obovate, tip curved, acute to apiculate, 8.5–15.0(–19.0) × (1.5–)3.0–8.0 mm, adnate to

claw of lip for 1–5 mm. *Lip* claw 3–9 mm, median lobe green or white, descending, weakly to strongly geniculate, filiform to linear, acute, 5.5–17.0×0.5–2.0 mm, lateral lobes white, descending, diverging, falcate, narrowly to broadly-oblongate, tips curved, apiculate, 6.5–21.0×(1.5)2.0–6.5 mm; spur toothed, curved, 12–26 mm long, clavate apex 8–17 mm long. *Anther* erect, acute, 2.5–5.5 mm long, canals slender, 3.5–5.5(–9.5) mm long. *Stigmatic processes* clavate, projecting forwards and deflexed, weakly divergent, 3.5–7.0(–10.5) mm long, base adnate to lip. *Rostellum* 3-lobed, base auriculate, median lobe narrowly-cucullate, apiculate, margin ciliate, 3.0–5.5 mm long, lateral lobes linear, fused to anther canals, sub-erect to 45°, sub-parallel, 0.5–2.0(–6.5) mm long. Flowering period: July to September.

4.13.1. Distribution and habitat

B. cassidea ranges from Port Elizabeth in the Eastern Cape along the coast and near interior of South Africa as far north as Kosi Bay, with scattered records in Swaziland, Limpopo Province and the eastern highlands of Zimbabwe (Fig. 4c). It occurs in *Acacia* savannah, forest and thicket, from near sea level to 1500 m altitude.

4.13.2. Discussion

B. cassidea grades in morphology from the Eastern Cape through to northern KwaZulu-Natal, with the lip median lobe and upper petal lobes changing from white to green, and the lower petal lobes and lip lateral lobes decreasing in width. Little is known about the pollinators of *B. cassidea*, except for remarks by Weale (1869) regarding visits by the Skipper Butterfly *Gomalia elma* Trimen.

B. cassidea is closely allied to *B. saundersioides*, which together form the *B. cassidea* complex. *B. cassidea* can be differentiated from *B. saundersioides* by its shorter and wider lower petal lobes, (<15×>3 mm vs >16×<2 mm), and its wider lip lateral lobes (<2 mm vs <2 mm).

B. saundersiae was recognized as a separate species based on its reduced rostellum median lobe (Weale, 1869), markedly longer rostellum lateral lobes (Rolfe, 1913), and fewer, larger flowers, with more arched lateral lobes and falcate tips (Schelpe and Linder, 1999). Morphometric analyses (Ponsie, 2006), places *B. saundersiae* within the morphological range of *B. cassidea* for all characters except the length of the rostellum lateral lobes (0.5–2.0 vs 4.5–6.5 for *B. saundersiae*). Populations classified as *B. saundersiae* occur in the middle of the geographic range of *B. cassidea*. We therefore prefer to regard *B. saundersiae* as representing an unusual local ecotype of *B. cassidea* that is restricted to the Umbilo River in KwaZulu-Natal. In his initial description of *B. saundersiae*, Harvey (1863) misdiagnosed the upper and lower petal lobes as undivided.

4.13.3. Additional specimens examined

4.13.3.1. *South Africa. Eastern Cape.*—**3129** (Port St. Johns): Hluleka, (-CD), *Germishuizen 1212* (PRE). **3226** (Fort Beaufort): Bedford, shady places, (-CA), *Weale s.n.* (BOL; GRA); Hogsback, (-DB), *Giffen 86* (PRE). **3227** (Stutterheim): Bolo Reserve, (-BC), *Holmes s.n.* (GRA); Pirie, (-CB), *Watson*

3 (PRE); King Williams Town, Kei Road, (-CC), *Johnston s.n.* (NBG); King Williams Town, Kei Road, (-DA), *Ranger 53* (PRE); Embaleni, Kei Road, (-DB), *Ranger s.n.* (GRA). **3228** (Butterworth): Kentani, (-AD), *Pegler 780* (GRA; SAM); Kei Mouth, (-CB), *Flanagan 857* (NU; PRE; SAM); Gonubie, Bushview, (-CC), *Howe s.n.* (GRA). **3325** (Port Elizabeth): Uitenhage, (-CD), *Crundall s.n.* (PRE). **3326** (Grahamstown): Glenstone, (-BC), *Acocks 23917* (PRE); Alexandria, (-CB), *Wells 3071* (PRE); Bathurst, Hopewell, (-DA), *Acocks 16128* (PRE); Albany settlement, Lushington Valley Farm, (-DB), *MacOwan 1529* (PRE; SAM). **3327** (Peddie): Buffalo River, (-BB), *Dodd s.n.* (GRA); Buffalo River, near 2nd Creek, (-BB), *Dodd 7935* (GRA; PRE); Buffalo River, (-BB), *Galpin 6534* (PRE); East London, (-BB), *Dodd 25800* (PRE). **KwaZulu-Natal.**—**2831** (Nkandla): Empangeni, Heatonville, (-CB), *Venter 1084* (PRE); Empangeni, Umhlatuzi Valley, (-DC), *Lawn 1570* (NH); Empangeni, Umhlatuzi Valley, (-DC), *Lawn 1619* (NH). **2930** (Pietermaritzburg): Camperdown, Nagel Dam, (-DA), *Wells 1598* (NU; PRE); Umbilo River, (-DD), *without collector NH 12392* (NH); Umbilo River, Cowies Hill, bank at waterfall, (-DD), *Sanderson 822* (NH). **3029** (Kokstad): Harding, near Pondo Memorial, (-DD), *Abbott 7001* (NH). **3030** (Port Shepstone): Ixopo, Watervale Farm, (-AA), *O'Connor 32* (NU); small streambed above Horseshoe Dam, (-CA), *Nicholson 1762* (PRE; Umtamvuna Herbarium).

4.14. Excluded species

Bonatea eminii (Kraenzl.) Rolfe in Fl. Trop. Afr. 7: 254 (1898); Summerhayes in Flora of Tropical East Africa: 140 (1968). *Habenaria eminii* Kraenzlin in Bot. Jahrb. Syst. 19: 245 (1894). Type: Tanzania, Dodoma District, Uyansi, [Punguli], in the Mgunda-Mkali, 24 km southwest of Itigi on the central Tanzanian railway, 14 July 1890, *Stuhlmann 420* (B†, holo.).

The type of *B. eminii* was destroyed during the bombing of Berlin in World War II. From the description it is clear that the taxon is closely allied to, if not conspecific with, *B. steudneri*. Morphologically it falls within the range of *B. steudneri* except for the lip in which only the front quarter or fifth is divided into three subequal lobes. However, insufficient data is available to verify it as a distinct species or recognize it as an aberrant form of *B. steudneri*.

4.14.1. *Habenaria transvaalensis*

H. transvaalensis Schlechter in Bot. Jahrb. Syst. 20, Beibl. 50: 6, 32 (1895); Rolfe in Fl. Cap. 5, 3: 126 (1913); Stewart et al. in Wild Orch. South. Africa: 88 (1982); Manning in Orchids of southern Africa: 120 (1999). Type: South Africa, [Mpumalanga], in shrubby vegetation around Barberton, 5000 ft, 17 January 1892, *Thorncroft 466* (B†, holo.; NH!, iso.).

Bonatea bracteata G.McDonald and McMurtry in South African Orchid Journal 22: 29 (1991); la Croix and la Croix in African orchids in the wild and in cultivation: 154 (1997); Schelpe and Linder in Orchids of southern Africa: 139 (1999), syn. nov. Type: South Africa, [KwaZulu-Natal], Nkandla, Qudeni, Gonzaga Forest in bush, 6000 ft, 2 March 1935, *Gerstner 588* (PRE!, holo.; NH!, iso.).

Bonatea liparophylla Schelpe nom. nud. in Stewart et al. in Wild Orch. South. Africa: 100, pl. 10.4 (1982).

The rostellum structure of *H. transvaalensis* (Fig. 2c) is typical for *Habenaria* in lacking a free, galeate median lobe. In addition, solitary tubers and stolons are not recorded from *Bonatea*. The taxon *B. bracteata* is regarded as conspecific with *H. transvaalensis*.

4.14.2. *Habenaria bonateoides*

H. bonateoides M.Ponsie, nom. nov. pro *B. tentaculifera* Summerhayes in Kew Bull. 4: 431 (1949); Summerhayes in Fl. Trop. E. Afr.: 141 (1968); Stewart in Orchids of Kenya: 93 (1996). Type: Kenya, Nairobi, [Nairobi] [National] Park in forest, 1650 m, 14 April 1945, Mountford in Bally B4403 (K!, holo.).

The rostellum structure of *H. bonateoides* (Fig. 2b) is typical of *Habenaria* and necessitates the transfer of this species from *Bonatea*. A new species epithet was chosen for *B. tentaculifera* to avoid confusion with the species epithet derived from the basionym *Habenaria tentaculigera* Rchb.f. [Rule 64.3 Confusingly similar names based on different types]. The specific epithet 'bonateoides' accentuates the resemblance to, and the initial placement of, the species within *Bonatea*.

Acknowledgements

We gratefully acknowledge the Board of Trustees of Royal Botanical Gardens, Kew, as well as the staff of BM, BOL, BR, FT, GRA, K, PRE, P, S, TCD, UPS and W herbaria for providing digital images. Doug McMurtry is thanked for his involvement in renaming *B. bracteata*. Mark Botha, Professor Kevin Kirkman and Tlaa Amiyo are thanked for their assistance in resolving questions surrounding *H. bonateoides*. Doug McMurtry, Gareth Chittenden and Mark Botha are thanked for their photographic contributions. We owe a debt of gratitude to many enthusiastic amateur botanists and orchid hobbyists who assisted us in this research. John Manning is thanked for his insightful suggestions during the editing of this manuscript. The NRF and the Gay Langmuir Trust are acknowledged for financial support.

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