



A revision of the *Crepidorhopalon whytei* complex (*Linderniaceae*) in eastern Africa

I. Darbyshire¹, B. Wursten², Q. Luke³, E. Fischer⁴

Key words

Chimanimani
hepperi
IUCN Red List assessment
Kwale
Namuli
Nguru
taxonomy

Abstract The *Crepidorhopalon whytei* (*Linderniaceae*) species complex is revised using morphological analyses. Based primarily on variations in indumentum, floral morphology, corolla colour and seed morphology, four species are formally recognised within this group in eastern Africa. *Crepidorhopalon whytei* s.str. is widespread in the highlands of eastern Africa, extending from South Sudan and Ethiopia in the north through to western Tanzania in the south. A new combination in *Crepidorhopalon* is made for *Lindernia flava* (= *C. flavus*), which is confined to the Manica Highlands of the Mozambique-Zimbabwe border. Two new species are described, *C. namuliensis* which is known only from Mt Namuli in northern Mozambique and *C. kwaleensis* which is known only from the coastal lowlands of southeast Kenya. A fifth, imperfectly known species is documented from the Nguru Mountains of Tanzania where it is so far known from a single collection. Three names are lectotypified. The habitat requirements and distribution are documented and the extinction risk is assessed for each species. *Crepidorhopalon flavus* is assessed as globally Vulnerable and *C. kwaleensis* as globally Endangered, while *C. namuliensis* and *C. whytei* are currently considered to be of Least Concern, although the latter is declining markedly in parts of its range. The botanical importance of the key sites for the newly recognised taxa is discussed.

Published on 30 July 2019

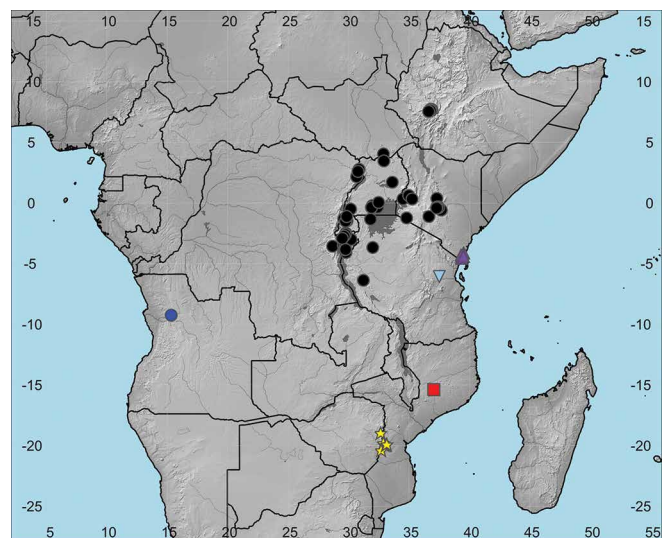
INTRODUCTION

The genus *Crepidorhopalon* Eb.Fisch. (Fischer 1989) in the family *Linderniaceae* comprises species with a combination of aulacospermous seeds, generally non-rosulate habit, and the presence of anatomically complex multicellular clavate hairs on the lower lip of the corolla (Fischer 1989, 1992, Fischer et al. 2014). In the few species that have a rosulate habit, notably *Crepidorhopalon welwitschii* (Engl.) Eb.Fisch., *C. malaissei* Eb.Fisch. and *C. robynsii* Eb.Fisch., this is the result of a condensed main stem, with single flowers in the axils of leaf-like bracts rather than with lateral bracteate inflorescences in the leaf axils as in *Craterostigma* Hochst. or *Linderniella* Eb.Fisch., Schäferh. & Kai Müll. In the 'Flora of Tropical East Africa' account of the *Scrophulariaceae* (Ghazanfar et al. 2008), *Crepidorhopalon* was not upheld, and species that had previously been transferred to that genus were treated in the genera *Lindernia* All. and *Torenia* L. However, molecular studies (Rahmanzadeh et al. 2005, Fischer et al. 2013) support the morphological evidence for recognition of *Crepidorhopalon* as a distinct genus, and it is now widely accepted (e.g., African Plant Database, continuously updated, Stevens 2001 onwards).

Crepidorhopalon is currently recorded from tropical Africa, where 30 species are known, and from a single species on Madagascar (African Plants Database, continuously updated). The centre of diversity for the genus is in the Haut Katanga area of the Democratic Republic of the Congo where 19 species are found (Fischer 1999). As in other genera of *Linderniaceae*, many species of *Crepidorhopalon* are highly range-restricted,

for example *C. chironioides* (S.Moore) Eb.Fisch. and *C. symonsii* Eb.Fisch., respectively restricted to the Kundelungu Mountains and the Upemba region of D.R. Congo (Fischer 1989, 1992) and *C. mutinondoensis* Eb.Fisch. & I.Darbysh., known only from the Mutinondo Wilderness Area in eastern Zambia (Fischer et al. 2014). Many species occur in seasonally wet flushes over rock or in more permanently marshy areas.

One of the more frequently encountered and well-known species of the genus is *Crepidorhopalon whytei* (Skan) Eb.Fisch. which is a widespread trailing or scrambling herb of upland marshes and seepage areas in eastern Africa (Fischer 1992, 1999, Philcox & Ghazanfar 2008 as *Lindernia whytei*). The main range of this species is from Ethiopia and South Sudan



Map 1 Distribution of species in the *Crepidorhopalon whytei* complex: *C. whytei* (●); *C. namuliensis* (■); *C. flavus* (★); *C. sp. aff. whytei* (▼); *C. kwaleensis* (▲); '*Lindernia gossweileri*' (●).

¹ Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE, United Kingdom; corresponding author e-mail: i.darbyshire@kew.org.

² Herbarium, Nieuwelaan 38, Meise 1860, Belgium.

³ East African Herbarium, National Museums of Kenya, P.O. Box 45166, Nairobi 00100, Kenya.

⁴ Institut für Integrierte Naturwissenschaften – Biologie, Universität Koblenz-Landau, Universitätsstraße 1, 56070 Koblenz, Germany.

through Uganda, eastern D.R. Congo and Kenya to Rwanda, Burundi and western Tanzania (Map 1), where it has blue or purple flowers (Fig. 1a–c). However, Philcox (1990) included both *Lindernia flava* S.Moore, described from Mozambique and Zimbabwe, and *L. gossweileri* S.Moore, described from Angola, within a broader circumscription of *C. whytei* although noted that these taxa have yellow flowers. He said: “unfortunately,

I have seen only two collections from the Flora Zambesiaca area and one, *Walters 2788*, lacks any descriptive notes while the other, *Goldsmith 72/68*, cites the flowers as being yellow”. This was in addition to the two syntypes of *L. flava*, both of which are cited as having yellow flowers. Philcox went on to say that, despite this flower colour difference, “I do not hesitate to widen the range of colour in my description to include both extremes”



Fig. 1 *Crepidorhopalon whytei* and allies. a–c. *Crepidorhopalon whytei*, Butare, Rwanda; d–e. *C. namuliensis*, Mt Namuli, Mozambique; f–h. *C. flavus*, foothills of the Chimanimani Mountains, Mozambique. — Photos: a–c. E. Fischer; d–g. B. Wursten; h. I. Darbyshire.

(p. 63). Philcox's approach has been followed in subsequent publications (e.g., Fischer 1992).

Recent field observations around the foothills of the Chimani Mountains (Darbyshire and Wursten, pers. obs.), have demonstrated that the populations in this area consistently have corollas with a bright yellow lower lip (the upper lip is typically yellow-brown or purplish tinged) – see Fig. 1f–h. Other collections from the region, not seen by Philcox for Flora Zambesiaca (*Biegel 3583, Pope & Müller 1295*) also support this observation. These populations are found in low- to mid-altitude marshy sites, usually less than 1 100 m a.s.l. Plants from the core range of *C. whytei* in East Africa never have yellow flowers and are found at higher altitude sites, over 1 100 m a.s.l. These observations led the current authors to a renewed interest in the *C. whytei* group.

As herbarium material from across the range of *C. whytei* s.l. was reviewed, three further interesting taxa were uncovered. The first is a species discovered during recent surveys on Mt Namuli in northern Mozambique which, while close to *C. whytei* and found in a similar ecological niche, has several diagnostic characters (Downes & Darbyshire 2017). The second is a species from the coastal lowlands of Kenya in Kwale District that has been named as *C. whytei* in the past but has several distinct characters as well as being ecologically separated from true *C. whytei*. The third is a small-flowered taxon known only from a single collection from the Nguru Mountains of Tanzania – the only record of the *C. whytei* complex in the ancient Eastern Arc mountain chain of East Africa. A synoptic revision of the *C. whytei* complex has therefore been conducted in order to delimit the taxa in this challenging group.

MATERIALS & METHODS

This study is based primarily upon the investigation by the first author (I.D.) of specimens from a range of herbaria, most notably the collections at K and BM but with consultation of relevant specimens (either physically or digitally) from BR, L, LMA, P, SRGH and WAG. Further, it builds upon the monographic work on African *Linderniaceae* conducted by the final author here (E.F.) who studied specimens of this species complex from a range of other herbaria (B, BRLU, BRVU, M, MJG – see Fischer 1992). The LISC herbarium (IICT/University of Lisbon), important for historical specimens from Mozambique, is currently being rehoused at the Museum of the University of Lisbon (MUHNAC) and so some of the Mozambican specimens of *Crepidorhopalon* were not available for study but we were kindly sent images of some relevant specimens by Dr Maria Romeiras at MUHNAC. Photographs of the species in the field were also consulted wherever available. Abbreviations for herbaria follow the standard form listed on Index Herbariorum (Thiers, continuously updated), except for the fledgling herbarium of the Micaia Foundation (<http://micaia.org>, last accessed May 2019) at Ndzou Camp in Moribane Forest Reserve which is listed as 'Ndzou'. Only specimen duplicates that have been seen by one or more of the authors are cited; duplicates that have not been seen are not listed except where they have been sought for and not located (marked as '[not found]'), and except for isotype specimens that have not been seen (marked as '[not seen]'). Those for which only online images have been seen are marked with an asterisk (*); these were accessed via JSTOR Global Plants (<https://plants.jstor.org/>, last accessed May 2019), or via online herbarium catalogues. Only a maximum of three specimens per country are cited for *Crepidorhopalon whytei*; all material seen is cited for the other taxa. All measurements were made on dried material except for those of the flowers, which were soaked in Aerosol OT 5 % solution prior to dissection and measurement.

Table 1 The main morphological characters separating species in the *Crepidorhopalon whytei* complex.

Character	<i>C. whytei</i>	<i>C. namuliensis</i>	<i>C. flavus</i>	<i>C. sp. aff. whytei</i> (= <i>Manktelow et al. 91081</i>)	<i>C. kwaleensis</i>
Corolla colour: lower lip	Blue or purple with white patches in the mouth	White or tinged pale blue with a yellow patch in the mouth	Yellow	Unknown	Purple with white patches in the mouth
Indumentum of pedicels and calyces and fertile portion of stems (excluding calyx lobe margins)	Largely glabrous or with short eglandular hairs; with or without scattered (sub)sessile glands	Glandular-pubescent	Glabrous or with few sessile glands	Glabrous or with few sessile glands on young stems	Glabrous or with few sessile glands on young stems
Bracts	Either foliaceous or ± much-reduced, then ovate-acuminate to linear-lanceolate	Foliaceous	Foliaceous or ± much-reduced, then ovate-acuminate to lanceolate-acuminate	Foliaceous	[Except proximal-most pairs] lanceolate or linear-lanceolate
Anterior stamen spur length	0.5–1.2 mm	1.2–1.75 mm	0.5–0.8 mm	± 0.8 mm	1.8–2.4 mm
Seed characteristics	Ellipsoid or subquadrangular, with longitudinal ridges and furrows and with faint horizontal ribs	Ellipsoid, with longitudinal ridges and furrows	Ellipsoid, with longitudinal ridges very shallow and inconspicuous	Unknown	Sub-square in face view, circular in lateral view, with a row of subcircular depressions (and with one longitudinal furrow on the posterior side)
Altitude range	1100–2250 m	1730–1870 m	330–1130(–1340) m	1940–2010 m	5–230 m

The categories and criteria of the IUCN Red List of Threatened Species (IUCN 2012) are used to assess the conservation status (extinction risk) of each species. Extent of occurrence (EOO) and area of occupancy (AOO) were calculated using the GeoCat tool (Bachman et al. 2011), last accessed May 2019. The species distribution map was produced using SimpleMapp (Shorthouse 2010).

RESULTS

Based on detailed morphological analyses, we formally recognise four species within the *Crepidorhopalon whytei* complex in eastern Africa and informally recognise a fifth, imperfectly known species (Table 1). *Crepidorhopalon whytei* s.str. is widespread in the highlands of eastern Africa, extending south as far as western Tanzania; it is somewhat variable in corolla size and bract morphology but these differences appear to be clinal. The other three species are highly range-restricted: *C. flavus* (S.Moore) I.Darbysh. & Eb.Fisch. is confined to the Manica Highlands of the Mozambique-Zimbabwe border, centred on the Chimanimani massif, *C. namuliensis* I.Darbysh. & Eb.Fisch. is known only from Mt Namuli in northern Mozambique, *C. kwaleensis* I.Darbysh. & Eb.Fisch. is known only from the coastal lowlands of Kenya in Kwale County and the imperfectly known species is so far recorded only from a single collection from the Nguru Mountains of Tanzania (Map 1).

Crepidorhopalon whytei, *C. flavus* and *C. namuliensis* are clearly closely related and, while easily separable morphologically (Table 1 and key below), the rank at which to recognise these taxa is open to debate. However, in view of their wide geographic separation, and the expected ensuing genetic isolation, coupled with the consistent morphological differences, we choose to recognise them as distinct species rather than subspecies. This decision is in keeping with the established convention within African *Linderniaceae* of recognising all distinct taxa at species rank (see, e.g., Fischer 1992). Based on differences in seed morphology, *C. kwaleensis* is easily separated from *C. whytei*, *C. flavus* and *C. namuliensis*; it has previously also been confused with *C. hepperi* Eb.Fisch. from western Tanzania, which is therefore included in the key to species in the Taxonomic Account presented below.

TAXONOMIC ACCOUNT

Key to the *Crepidorhopalon whytei* complex

1. Corolla lacking short glands on external surface of tube; imperfectly known species from the Nguru Mountains of Tanzania *C. sp. aff. whytei*
1. Corolla with short glands conspicuous on distal portion of tube externally 2
2. Lower lip of corolla yellow; seeds with only shallow, almost imperceptible longitudinal furrows; restricted to the Manica Highlands of Mozambique and Zimbabwe *C. flavus*
2. Lower lip of corolla blue, purple or white; seeds either with conspicuous longitudinal furrows or subcircular depressions 3
3. Lower lip of corolla white or at most tinged pale blue; calyces, pedicels and distal internodes with numerous glandular hairs; restricted to Mt Namuli, Mozambique *C. namuliensis*
3. Lower lip of corolla deep blue or purple; calyces, pedicels and distal internodes largely glabrous or with eglandular hairs, sometimes with scattered (sub)sessile glands but these inconspicuous 4
4. Seeds not longer than wide, with subcircular depressions along the face (Fig. 2l–k, 4i); spurs of anterior pair of sta-

- mens markedly long and slender, 1.8–2.4 mm long; restricted to Kwale region, Kenya *C. kwaleensis*
4. Seeds ± longer than wide, with longitudinal furrows along the face (Fig. 2a–c, g–h); spurs of anterior pair of stamens shorter and less slender, 0.5–1.2 mm long 5
5. Stems procumbent, scrambling, trailing or at most weakly decumbent; calyces with lobes longer than tube; plants of highland marshes and flushes, widespread in eastern Africa *C. whytei*
5. Stems ± erect; calyces with tube longer than or equal to lobes; plants of seasonally wet grassland and miombo woodland in western Tanzania *C. hepperi*

Crepidorhopalon whytei (Skan) Eb.Fisch. — Fig. 1a–c, 2a–c

Fischer (1989) 444; (1992) 165, t. 85, 86; (1999) 110, pl. 44; (2006) 270, f. 160.25; Darbyshire et al. (2015) 329. — *Lindernia whytei* Skan in Hemsley & Skan (1906) 340; Malaise (1985) 402; Philcox & Ghazanfar (2008) 70, pro maj. parte; Agnew (2013) 300. — Type: *Whyte s.n.* (lecto K [K000379658], chosen here), Kenya, 1st and 2nd days' march from Mumias, fl. 7 fr. 6–7 Dec. 1898. Additional syntypes: *Hannington s.n.* (K), Tanzania, Msalala, fl. without date [1894]; *Scott-Elliot 7225* (K [K000379657]), Kenya, Nandi Country, fl. Dec. 1893 – see note.

Torenia mildbraedii Pilg. (in Mildbraed & Pilger 1911: 285). — Type: *Mildbraed 701* (B destroyed; lecto K [K000379666], chosen here), Luhondo Valley, fl. 13 Aug. 1907 – see note.

Annual or perennial herb, with procumbent, scrambling, trailing or at most weakly decumbent stems up to 60 cm long or more; stems brittle, markedly 4-angular, winged along the angles, glabrous to sparsely or rarely more densely pale eglandular-pubescent, distal internodes sometimes with scattered (sub)sessile glands; internodes often long, the leaves widely spaced. *Leaves* sessile, broadly ovate to suborbicular, 7–31 by 5.5–29 mm, base rounded or shallowly cordate, margin serrulate with 2–8(–10) teeth per margin, these sometimes minute, apex acute or obtuse; primary venation palmate, with 5 or 7 main veins from base; surfaces glabrous except sometimes for short hairs along margin towards base and/or on main veins beneath, rarely pubescent throughout, surfaces also with sunken glands drying brown, most visible on lower surface. *Flowers* either axillary and solitary or together forming a lax terminal raceme (this depending on size of bracts); bracts either foliaceous throughout or rapidly reducing in size distally, then ovate-acuminate to linear-lanceolate, 1.5–7.5 by 0.6–6(–9.5) mm, margin toothed or entire; bracteoles absent; pedicels 1.2–7.5 mm long, glabrous or with (sub)sessile glands, rarely eglandular-pubescent. *Calyx* 5–10.5(–14) mm long, lobes linear-lanceolate, somewhat unequal in length, longest lobes 3–7.5(–10.5) mm long, apices divergent to recurved at maturity, each lobe 1-veined and with hyaline margin, external surface glabrous except for short pale eglandular hairs along lobe margins and sometimes extending onto tube, rarely eglandular-pubescent throughout, with or without scattered (sub)sessile glands. *Corolla* 10.5–24 mm long, lower lip blue or purple with white patches in the mouth, or very rarely individuals within a population pure white (*Napier 5349*), external surface glandular-puberulous mainly on tube, upper lip usually with pale eglandular hairs; tube (5.7–)7–11 mm long, cylindrical but slightly contracted in midpoint and widened at mouth, internal surface with 4 lines of subsessile glands in proximal half; upper lip ovate, 3–6.5 mm long, apex emarginate or rounded, internal surface with numerous minute glands; lower lip 5–12 mm long, 3-lobed, median lobe rounded-obovate, 4–7.5 by 5–7 mm, margins of lobes somewhat irregular, bosses on palate of lower lip with blunt-tipped multicellular hairs. *Stamens* 4, ventral stamens spurred, spurs clavate, 0.5–1.2 mm long, papillate, filaments above spurred portion 3.8–7 mm long; posterior stamens with filaments 1.1–3 mm long; anthers of the two pairs of stamens adhering, thecae 0.7–1 mm long.

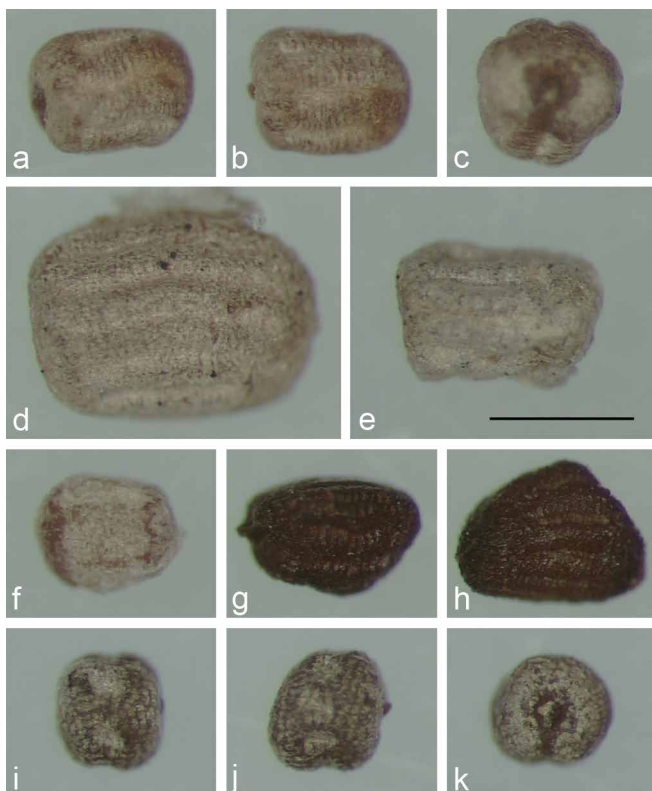


Fig. 2 Seeds of *Crepidorhopalon whytei* and allies. a–c. *Crepidorhopalon whytei* (E. Brown 343, Uganda); d–e. *C. namuliensis* (Patel 7319, Mozambique); f. *C. flavus* (Goldsmith 72/68, Zimbabwe); g–h. *C. hepperi* (Bidgood et al. 6937, Tanzania); i–k. *C. kwaleensis* (Luke 2899, Kenya). — Scale bar = 0.5 mm.

Ovary \pm 1.4 mm long; style 5.5–9 mm long; stigma fan-shaped and minutely fringed. *Capsule* narrowly ellipsoid to lanceoid, brown, \pm equal in length to calyx or slightly longer, 7–13 mm long, apex somewhat tapered, surface glabrous; seeds ellipsoid or subquadrangular \pm 0.6–0.85 by 0.35–0.5 mm, with longitudinal ridges and furrows and with faint horizontal ribs.

Distribution & Ecology — *Crepidorhopalon whytei* is widespread in East Africa, extending from southwest Ethiopia and southern-most South Sudan, through Uganda, Kenya, eastern D.R. Congo, Rwanda and Burundi to northern and western Tanzania (Map 1). It occurs in upland marshes, seepage areas, stream and pool margins at 1100–2250 m elevation.

Selected specimens seen. BURUNDI, route Karuzi-Muhinga, étang Nzi-bariba, fl. & fr. 9 Jan. 1958, *Van der Ben 1780* (BR, K); Mwaro Prov., Mwaro, fl. & fr. 10 Jan. 1968, *Lewalle 2685* (BR, K); Bubanza Prov., route Rwegura-Ndora, fl. 19 Oct. 1976, *Reekmans 5438* (BR, K). — D.R. CONGO, Aru-Mahagi, fl. & fr. Aug. 1931, *Lebrun 3728* (BR, K); Munagana, fl. & fr. 1934, *De Witte 1872* (BR, K); terr. Mahagi, Nioka-La Korda, fl. 2 Dec. 1957, *Bamps 78* (BR, K). — ETHIOPIA, Kaffa, near Sombo, fl. & fr. 13 Nov. 1960, *Mooney 8612* (K); about 7 km along the road from Jimma to Bonga, fl. & fr. 20 June 1969, *J.J.F.E. de Wilde 5267* (BR, K, M, P, WAG*); Kochi, about 5 km E of Jimma along road to Addis Ababa, fl. & fr. 2 Jan. 1973, *Friis et al. 2060* (K). — KENYA, South Mt Kenya, between Rupinganzi and Thiba R., fl. 16 Sept. 1951, *Davis 60* (K); bridge over Gathiba R. below Kamweti Forest Station, fl. 9 Aug. 1971, *Robertson 1565* (K); Western Province, Mumias, fl. & imm. fr. 11 May 1979, *Bridson 80* (K). — RWANDA, Rugezi, terr. Bumiba, fl. 7 fr. 6 Oct. 1958, *Van der Ben 2349* (BR, K); Butare Préfecture, Rubona, centre I.S.A.R., fl. 22 Oct. 1974, *Troupin 15499* (BR, K); Butare, domaine de l'I.N.R.S., fl. 9 June 1978, *Raynal 20379* (K, P). — SOUTH SUDAN, Imatong Mts, between Gilo and Mt Konoro, fl. 18 Nov. 1980, *Friis & Vollesen 316* (K). — TANZANIA, Bukoba, fl. June 1931, *Haarer 2035* (K); Bukoba, fl. & fr. 18 Jan. 1959, *Lind 2373* (K); Kahama Dist., fl. 16 June 1975, *Kahuranga et al. 2781* (K).

Conservation — *Crepidorhopalon whytei* is a widespread species with an EOO of 854 750 km² and is known from numerous localities. It would therefore qualify as of Least Concern under criterion B of IUCN (2012). That said, there are serious

threats to its habitats in parts of its range, and the species is rapidly decreasing at least in Rwanda and Burundi. While the species was widespread in swamps around Butare (Central Rwanda, Southern Province, Huye district) between 1984 and 1998, the intensive agricultural land use has led to a major decline of the populations, and the species has now almost disappeared (E. Fischer, pers. obs.). If the same situation is true across the species' range then it could qualify as threatened under IUCN criterion A.

Notes — *Crepidorhopalon whytei* is rather variable in flower size and inflorescence form. Plants from the Lake Victoria basin (Uganda, West Kenya, North Tanzania, e.g., E. & C. *Godman 87*, BM) have the smallest corollas and generally have more clearly developed racemes as the bracts are \pm much-reduced in size in comparison to the proximal leaves. Those from the central Kenyan Highlands (e.g., *Davis 60*, BM) have the largest corollas and have foliaceous bracts, hence the racemes are leafy and the flowers appear to be axillary. Similar plants to these Kenyan populations are found elsewhere in this species' range, for example in Ethiopia and along the Albertine Rift. However, there are also populations that are intermediate between the two forms, particularly in Uganda and neighbouring regions, and it has not been possible to separate any clear infraspecific taxa on the basis of flower and bract size.

Richards & Arasululu 26150 (K) from the Uruwira-Mpanda road in southwest Tanzania is unusual in having markedly long calyces, 12.5–14 mm long with lobes 8.5–10.5 mm long, compared to typical *C. whytei* with calyces 5–10.5 mm and lobes 3–7.5 mm long. This plant is otherwise a good match for other material of *C. whytei*. It would be interesting to see more material from western Tanzania to confirm if this difference is consistent; if so, it might be considered a regional subspecies.

Plants of *C. whytei* are usually subglabrous or sparsely pubescent but occasional more densely pubescent plants are recorded across its range (e.g., *Bagshawe 1476a*, BM). The corolla usually has conspicuous eglandular hairs on the external surface of the upper lip but these can be absent in some populations, most notably in the isolated Ethiopian populations around Jimma; these plants are otherwise a close match for typical *C. whytei*.

Skan (in Hemsley & Skan 1906) cited three specimens in the protologue of *Lindernia whytei*; *Whyte s.n.* is here selected from among these as the lectotype as it is an informative specimen and it was Whyte's collection of this species that led Skan to choose the epithet. The holotype of *Torenia mildbraedii* is believed to have been destroyed in the bombing of the Berlin Herbarium; the extant duplicate at K comprises a small section of a leafy branch with a flower bud, a terminal branch section with immature leaves and an accompanying illustration of a dissected flower. This specimen is here selected as the lectotype of *T. mildbraedii*.

Crepidorhopalon namuliensis I. Darbysh. & Eb. Fisch., sp. nov. — Fig. 1d–e, 2d–e, 3

Closely resembling *Crepidorhopalon whytei* but differing in the inflorescence and distal internodes having a conspicuous glandular-pubescent indumentum (vs inflorescence and stems essentially glabrous or eglandular-pubescent only, sometimes with scattered (sub)sessile glands); in the lower lip of the corolla being white or at most tinged pale blue (vs lower lip of corolla blue, purple or mauve); and in having the combined characters of axillary inflorescences and foliaceous bracts with corollas 13.5–16.5 mm long (in *C. whytei*, if the bracts are foliaceous and so the flowers appear axillary, then the corolla is 16–24 mm long). — Type: *Patel 7319* (holo K; iso LMA), Mozambique, Zambezia Prov., Namuli Mt, Muretha Plateau, fl. & fr. 25 May 2007.

Etymology. *Crepidorhopalon namuliensis* is named after Mt Namuli, a key locality for plant diversity and endemism in Mozambique and the only known site for this species.

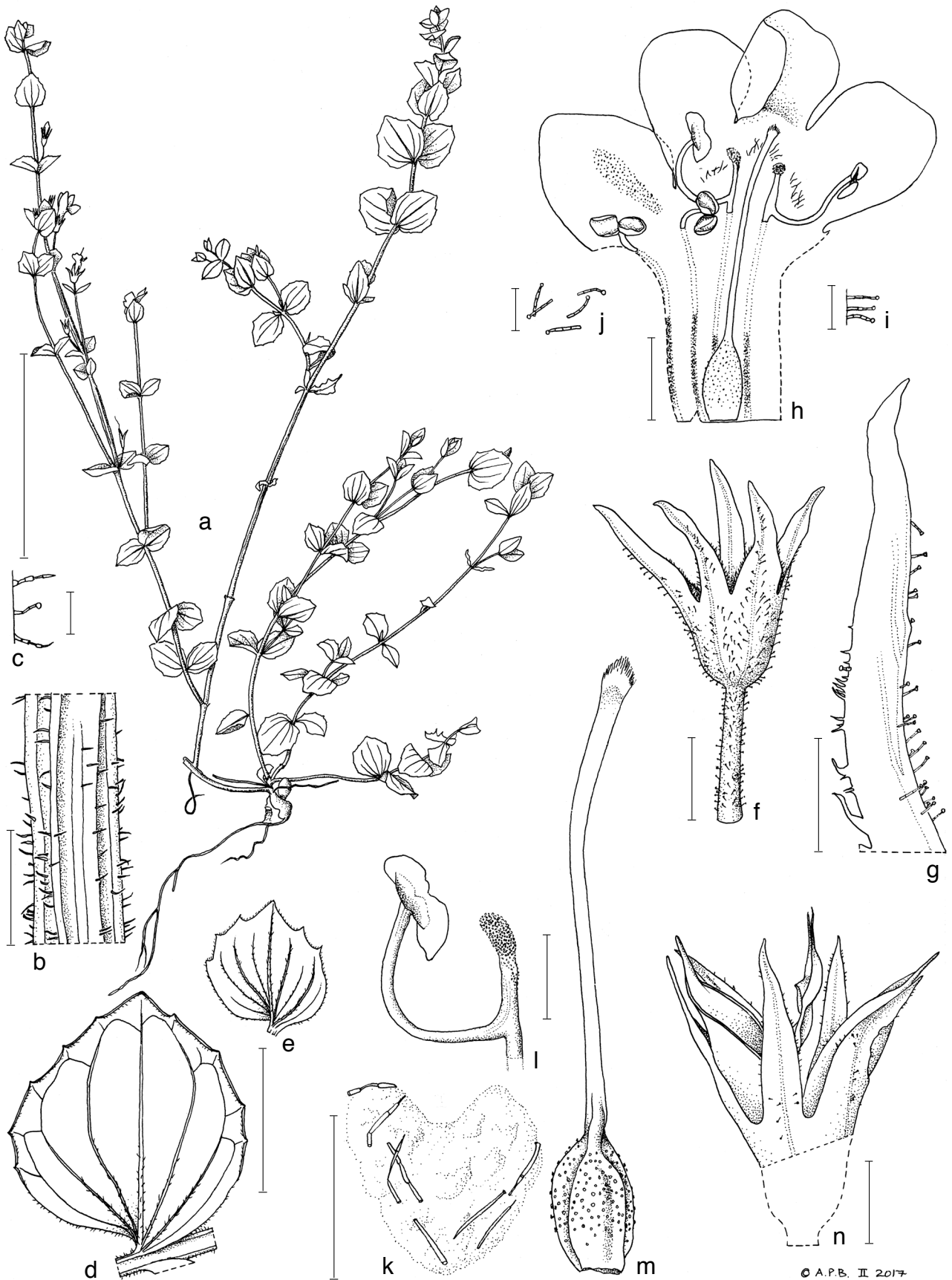


Fig. 3 *Crepidorhpalon namuliensis* I.Darbysh. & Eb.Fisch. a. Habit; b. stem indumentum; c. detail of eglandular and glandular stem hairs; d. mature leaf, abaxial surface; e. bract, abaxial surface; f. pedicel and calyx; g. side view of calyx lobe showing marginal glandular hairs and hairs along midrib; h. dissected corolla with androecium; i. detail of hairs on exterior of corolla tube; j. detail of hairs on exterior of lower corolla lip; k. detail of palate of lower corolla lip; l. anterior stamen; m. pistil; n. mature fruit within calyx (a: *Mphamba et al.* 3, K; b–n: *Patel* 7319, K). — Scale bars: a = 3 cm; b, f, h, n = 2 mm; c, i–j = 250 μ m; d–e = 1 cm; g, k–m = 1 mm. — Drawn by Andrew Brown.

Perennial herb, with numerous stems radiating from a central rootstock, at first erect but becoming scrambling or trailing, up to 50 cm long or more; stems brittle, markedly 4-angular, somewhat winged along the angles, with short spreading or ascending multicellular eglandular hairs and short spreading glandular hairs, the gland tip orange, becoming sparse on mature stems; internodes of fertile leafy stems 10–22 mm long when mature, those of sterile stems sometimes much longer. *Leaves* sessile, broadly ovate, 9–20 by 8–18 mm, base rounded or shallowly cordate, margin serrate or shallowly so with 2–5 teeth per margin, apex acute or obtuse; primary venation palmate, with 5 or 7 main veins from base; sparsely puberulous with glandular and eglandular hairs mainly on margin and main veins beneath, surfaces also with sunken glands drying brown, most visible on lower surface. *Flowers* axillary, solitary; bracts foliaceous, only slightly reducing in size distally; bracteoles absent; pedicels 2.7–5.5(–6.5) mm long, shortly glandular-pubescent. *Calyx* 5–7.8 mm long, lobes lanceolate, somewhat unequal in length, longest lobes 3.3–4.2 mm long, apices can become divergent at maturity, 5-veined, somewhat hyaline between the veins, external surface shortly glandular-pubescent, margins of lobes eglandular-pubescent. *Corolla* 13.5–16.5 mm long, tube and upper lip whitish to purple, lower lip white or at most tinged pale blue, with (?or without) a yellow patch in the mouth, external surface glandular-puberulous, upper lip also with pale longer eglandular hairs; tube 7.5–8.5 mm long, cylindrical but slightly contracted in midpoint where 1.3–2 mm wide and widened at mouth where 2–4 mm wide, internal surface with 4 lines of subsessile glands in proximal half; upper lip ovate, 3.5–5 by 4–5 mm, apex emarginate, internal surface with numerous minute glands; lower lip 6.5–8.5 mm long, 3-lobed, median lobe rounded-obovate, 3.7–4 by 4.5–5.3 mm, lateral lobes rounded-elliptic, 4–4.5 by 4.2–5 mm, margins of lobes somewhat irregular, bosses on palate of lower lip with blunt-tipped multicellular hairs. *Stamens* 4, ventral stamens spurred, spurs clavate, 1.2–1.75 mm long, papillate, filaments above spurred portion 4–4.3 mm long; posterior stamens with filaments 1.3–2 mm long; anthers of the two pairs of stamens adhering, thecae 0.7–0.9 mm long. *Ovary* 1.3–1.7 mm long, with sessile glands on surface; style 6.7–8.3 mm long; stigma fan-shaped and minutely fringed. *Capsule* ellipsoid, brown, ± equal in length to calyx or slightly shorter, to 7.5 mm long, apex acute; seeds ± 1–1.15 by 0.75 mm, with longitudinal ridges and furrows.

Distribution & Ecology — *Crepidorhopalon namuliensis* is apparently endemic to Mt Namuli in Zambezia Province of northern Mozambique. It occurs in montane grassland at 1730–1870 m elevation, favouring damp ground over rock where it can be associated with typical seepage assemblages including *Cyperus*, *Xyris*, *Pimpinella* and *Senecio* species together with *Loudetia simplex* (Nees) C.E.Hubb. (fide *Mphamba* 3).

Additional specimens seen. MOZAMBIQUE, Zambezia Prov., Namuli Mt, Muretha Plateau, fl. & imm. fr. 24 May 2007, *T. Harris* 158 (K, LMA [not found]); Namuli Mt, Muretha Plateau, Mukocha Forest, fl. 28 May 2007, *Timberlake* 5063 (K, LMA [not found]); Namuli Mt, Muretha Plateau, fl. 17 Nov. 2007, *Mphamba* 3 (K, LMA); below base of Namuli Peak, Serra de Gurue, fl. 25 Apr. 2008, *Würsten* 186 (BR).

Conservation — This species has been assessed as of Least Concern (Matimele et al. 2017). Although it is known only from Mt Namuli there are no known threats to this species or its habitat at present as the montane grasslands of Namuli are not subject to settled agriculture and the human impact is low. However, this species and the other Namuli grassland endemics should be carefully monitored as any disturbance or change to this habitat could quickly result in them becoming threatened with extinction. The impact from deliberate dry season burning should be carefully monitored in particular.

Notes — This species is separated from other members of the *Crepidorhopalon whytei* complex primarily by having a conspicuous glandular indumentum and pale corollas. In addition, the internodes of the majority of the stems are rather short such that the plants appear more densely leafy than is seen in other taxa within this complex. The corollas are typically smaller than those of forms of *C. whytei* that have foliaceous bracts, but they fall well within the overall range of corolla size in *C. whytei* (see Note to that species).

Mt Namuli is emerging as a site of high importance for plant diversity and endemism, with 14 strict endemic species and two strict endemic subspecies now known. Most of these taxa, such as *Coleus caudatus* E. Downes & I. Darbysh. and *Crotalaria namuliensis* Polhill & T. Harris, are restricted to the montane grassland and wet flushes where *Crepidorhopalon namuliensis* is found (Harris et al. 2011, Downes & Darbyshire 2017). These habitats are particularly rich in flowering herbs and geophytes during the main rainy season (J. Timberlake, pers. comm., based on observations made on Mt Namuli in Feb. 2017), a time when there has been almost no botanical collecting on Namuli to date, hence the chances of discovering further new endemic species at this site are high (Downes & Darbyshire 2017). This locality is certain to qualify as an Important Plant Area (IPA) under the ongoing programme of IPA identification in Mozambique (see <https://www.kew.org/science/projects/tropical-important-plant-areas-tipas-mozambique>; Darbyshire et al. 2017).

Crepidorhopalon flavus (S. Moore) I. Darbysh. & Eb. Fisch., *comb. nov.* — Fig. 1f–h, 2f

Lindernia flava S. Moore in J. Linn. Soc., Bot. 40: 153 (1911). — Type: *Swynnerton* 1966 (lecto BM [BM000930712], chosen here; isolecto K [K000379639]), Zimbabwe, near Chirinda, fl. 14 June 1906.

Lindernia whytei sensu auct.: Philcox (1990) 62, p.p.; Philcox & Ghazanfar (2008) 70, p.p.

Perennial herb, trailing or scrambling, laxly branched; stems brittle, markedly 4-angular, winged along the angles, glabrous or with few short eglandular hairs above each node, distal internodes sometimes with few sessile glands; internodes of leafy stems (9–)28–70 mm long when mature. *Leaves* sessile, broadly ovate, 9.5–22 by 6–20 mm, base rounded or shallowly cordate, margin serrate or shallowly so with 1–4 teeth per margin, apex acute or obtuse; primary venation palmate, usually with 5 main veins from base; glabrous except for few eglandular hairs on margin towards leaf base, surfaces also with sunken glands drying brown, most visible on lower surface. *Flowers* axillary, solitary, one flower per node, usually together forming a lax raceme; bracts either foliaceous or reducing in size and relative width distally, distal pairs of bracts often lanceolate-acuminate or ovate-acuminate, 2–6 by 0.7–4.5 mm, the pairs often markedly uneven in size, the bract subtending the flower smaller and narrower; bracteoles absent; pedicels 2–7.5(–10.5) mm long, glabrous, with sparse sessile glands. *Calyx* 5–9.5 mm long, lobes lanceolate, somewhat unequal in length, longest lobes 3.2–6.5 mm long, becoming divergent at maturity and with apices somewhat recurved, 5-veined, tubular portion hyaline between the veins, margins of lobes eglandular-pubescent towards base, elsewhere glabrous, with few sessile glands. *Corolla* 10–14 mm long, tube and upper lip yellow-brown or upper lip slightly purple-tinged, lower lip bright yellow, external surface glandular-puberulous, upper lip with pale longer eglandular hairs; tube 5.7–8.5 mm long, cylindrical towards base where 0.9–1.2 mm wide, widened towards mouth where 2–2.5 mm wide, internal surface with 4 lines of subsessile glands in proximal half; upper lip ovate, 2.3–3.5 by 2.3–3 mm, apex emarginate, internal surface with numerous

glands; lower lip 4.3–6 mm long, 3-lobed, median lobe rounded-obovate, 2.5–3.5 mm long and wide, lateral lobes somewhat smaller, bosses on palate of lower lip with blunt-tipped multicellular hairs. *Stamens* 4, ventral stamens with clavate spurs, 0.5–0.8 mm long, papillate, filaments above spurred portion 2.7–3.5 mm long; posterior stamens with filaments 1.2–1.4 mm long; anthers of the two pairs of stamens adhering, thecae 0.6–0.9 mm long. *Ovary* 1.1–1.4 mm long, with sessile glands on surface; style 4–6 mm long; stigma fan-shaped and minutely fringed. *Capsule* narrowly ellipsoid or more gradually tapered, brown, \pm equal in length to calyx, 5.5–9.5 mm long; seeds ellipsoid, \pm 0.5–0.6 by 0.45–0.5 mm, longitudinal ridges very shallow and inconspicuous.

Distribution & Ecology — This species is recorded in swamps, riverbanks and seasonally wet open grassland with sand-rich peaty soils, including swampy clearances in forest, at 330–1130(–1340) m elevation.

Additional specimens seen. MOZAMBIQUE, Manica Prov., Mt Maruma, fl. & fr. 13 Sept. 1906 [syntypes], *Swynnerton 1922* (BM, K); Dombe, entre Chissanto e Zinesse, fl. & fr. 24 Nov. 1965, *Pereira & Marques 876* (BR, WAG*); E of Makurupini R., fl. 11 June 1971, *Biegel 3583* (WAG*); Sussendanga Dist., eastern foothills of Chimanimani Mts, c. 28 km W of Dombe, fl. & fr. 25 Apr. 1974, *Pope & Müller 1295* (K); Chimanimani Mts foothills, near Zomba Community, Magorogodo hill, fl. 27 Oct. 2013, *Würsten & Dondeyne BE875* (BR); Chimanimani foothills, Maronga, Wandowani, W of Comeni's compound, fl. 14 Nov. 2015, *Darbyshire 895* (K, LMA, Ndzou); Maronga, between Comeni's compound and Murere River, fl. 15 Nov. 2015, *Darbyshire sight record*. – ZIMBABWE, Manicaland Prov., Melsetter [Chimanimani], fl. 7 fr. 1 Oct. 1919, *Walters 2728* (K); *ibid.*, *Walters 2758* (K); Umtali [Mutare], fr. Oct. 1937, *Brain s.n. in SRGH 10828* (SRGH*) – see note; Tarka Forest Reserve, banks of Chisengu R., fl. & fr. May 1968, *Goldsmith 72/68* (K, P*).

Conservation — *Crepidorhopalon flavus* is a highly range-restricted species, known only from the southern Manica Highlands of the Mozambique-Zimbabwe border region, where it is centred on the foothills of the Chimanimani Mountains. The EOO is 4440 km², or only 646 km² if the Walters and Brain specimens are excluded in view of the fact that it is unclear as to whether the former was collected near Chimanimani town or in the Chimanimani Mountains and there is some uncertainty over the latter collection (see note). Six to eight locations are defined based on threats. Those sub-populations that lie within the formally protected areas of the Chimanimani Mts – the Chimanimani National Park in Zimbabwe and the Chimanimani National Reserve in Mozambique – are likely to be secure. The only activity recorded recently in the seasonal wetlands within the National Reserve was cutting of grass for thatching (I. Darbyshire, pers. obs.) and this is unlikely to impact the *Crepidorhopalon* significantly. However, the majority of locations lie outside of these protected areas and there has been much disturbance and destruction of natural habitats within its range due to high human population pressure and continued expansion of subsistence agriculture. This includes areas of seasonally wet soils which, away from areas of quartzite, are fertile and so favoured for cultivation (B. Würsten, pers. obs.). Some sub-populations may also have been impacted by artisanal gold mining activities along some of the rivers and streams in the southern foothills of the Chimanimani Mountains. With a continuing decline in extent and quality of habitat inferred, and with fewer than 10 locations known within an EOO of considerably less than 20 000 km², this species is assessed as Vulnerable under criterion B1 – VU B1ab(iii).

Notes — In view of the consistently different flower colour, coupled with the marked range (and hence genetic) disjunction and differing habitat requirements of the Zimbabwe/Mozambique plants, it is considered most appropriate to reinstate *Lindernia flava* as a good species and the new combination in *Crepidorhopalon* is made here. This species is otherwise very similar to *C. whytei* although the seeds differ slightly in having

almost imperceptible longitudinal furrows, these being clearly visible in *C. whytei* (see Fig. 2).

In the specimen citations under *Lindernia whytei*, Philcox (1990) wrongly attributes *Swynnerton 1922* as having been collected from 'serra do Gúruè, E of Picos Namuli, near source of R. Malema, c. 1800 m'; it was actually collected from Mt Maruma in Manica Province. The specimen *Brain s.n.* at SRGH does not have any flowers and there are no notes on flower colour; it is recorded from further north than the other collections and at a higher altitude (the maximum elevation recorded above). It is strange that this species has not been re-recorded from the well-botanised area around Mutare but there is no reason to doubt the provenance of this specimen. Further material from the Mutare area would be useful to confirm the identity of this specimen.

When describing *Lindernia flava*, Moore (1911) noted the close similarity to his *L. gossweileri* S. Moore (1907: 87) from near Capopa in Malange Province, Angola (Map 1), but said that they differ in *L. gossweileri* having calyces divided to the base and having a larger corolla with a longer tube and with the lips almost equal in size rather than markedly unequal. To our knowledge, *L. gossweileri* has never been recollected in Angola and the type specimen (*Gossweiler 1086*, BM [BM000930701], K [K000379630]) is rather scanty, such that it is difficult to draw firm conclusions on its relationship to *C. flavus*. However, the differences noted by Moore seem to be rather minor and that of differing flower size and proportions may not be of great significance in view of the differences in flower size recorded in other species of *Crepidorhopalon* including *C. whytei*. Therefore, it is possible that these two yellow-flowered taxa represent a single species, although the extreme range disjunction seems improbable. More material from Angola is needed for confirmation, but if they do prove to be the same species then *L. gossweileri* would have nomenclatural priority and the epithet is unoccupied in *Crepidorhopalon*.

The wet grasslands in the foothills of the Chimanimani Mountains, the stronghold for this species, are of wider botanical interest as they hold several interesting species besides *C. flavus*. Of particular note is *Mesanthemum africanum* Moldenke which is endemic to the Chimanimani Mountains, occurring in damp sites on quartzitic sands both at higher altitudes and (at much lower abundance) in the foothills, probably a result of small populations being established from seed washed down along rivers from the high massif. During surveys of the Maronga area of Mozambique in 2015, *C. flavus* was found growing alongside two species of *Xyris* (*Xyridaceae*). The first of these proved to be *X. angularis* N.E.Br. (*Darbyshire 918*), a widespread West African species that had not previously been recorded from Mozambique but is known from the Zimbabwe side of Chimanimani (Lock 2010); the Chimanimani population is a significant outlier for this species. The second *Xyris* species collected (*Darbyshire 938*) is an unmatched, potentially new species. The first Mozambican records of *Edrastima angolensis* (K.Schum.) Neupane & N.Wilkstr. (*Darbyshire 920*) in the *Rubiaceae* and *Fimbristylis aphylla* Steud. in the *Cyperaceae* (*Darbyshire 926*) were also made at the same wetland site (Timberlake et al. 2016).

***Crepidorhopalon* sp. aff. *whytei* (= *Manktelow et al. 91081*)**

Straggling herb, stems markedly 4-angular, glabrous except for inconspicuous sessile orange glands. *Leaves* sessile, broadly ovate, 11.5–17 by 8–13.5 mm, base rounded or subcordate, margin with 2–3 teeth along each margin, apex acute or obtuse; primary venation palmate, with 5 main veins from base; surfaces glabrous except for sunken glands drying brown, most conspicuous on lower surface. *Flowers* axillary, solitary; bracts

foliaceous, only slightly reducing in size distally; bracteoles absent; pedicels 6–11 mm long, glabrous. *Calyx* 6.5–8.5 mm long, lobes lanceolate, somewhat unequal in length, longest lobes 4.5–5.5 mm long, becoming recurved at maturity, surfaces glabrous. *Corolla* 8.5–10 mm long, colour unknown, external surface glabrous; tube 4.5–6 mm long, cylindrical, ± 1.4 mm wide centrally; upper lip rounded-ovate, 1.8–2.6 mm long, margin irregular, internal surface with minute glands; lower lip ± 3.8 mm long, 3-lobed, median lobe rounded-obovate, ± 2.3 mm long, margins of lobes somewhat irregular, bosses on palate of lower lip with blunt-tipped multicellular hairs. *Stamens* 4, ventral stamens spurred, spurs shortly clavate, ± 0.8 mm long, papillate, filaments above spurred portion ± 4 mm long; posterior stamens with filaments ± 0.7 mm long; anthers of the two pairs of stamens adhering, thecae ± 0.5 mm long. *Ovary* not seen; style ± 5 –5.5 mm long; stigma fan-shaped and minutely fringed. *Capsule* not seen.

Distribution & Ecology — Known only from a single collection from the Nguru Mts where it was recorded from the ericaceous shrub zone growing with *Xerophyta* sp. at 1940–2010 m elevation.

Specimens seen. TANZANIA, Morogoro, Nguru Mts, on top of Kwasenjuga, 2.5 km S Maskati Mission, fl. 1 Feb. 1991, *Manktelow et al.* 91081 (K).

Note — The specimen cited is close to forms of *C. whytei* with leafy bracts, but differs in having very small corollas to only 10 mm long with the tube only 4.5–6 mm long and lacking conspicuous short glands on the external surface of the distal portion of the tube. Unfortunately, the flower colour is not recorded on the specimen label, but the flowers have dried rather pale compared to specimens of typical *C. whytei* which often retain some of their colour. It is possible that the flowers were yellow as in *C. flavus*, or white as in *C. namuliensis* but it differs from both those species in having smaller flowers which lack conspicuous short glands on the external surface of the distal portion of the tube, and also differs from the latter in lacking glandular hairs on the stems, pedicels and calyces. More material is needed to investigate this population further. However, the isolated location is notable, and the Nguru Mountains – a part of the ancient Eastern Arc mountain chain – contain many endemic and near-endemic species, for example *Impatiens messumbaensis* G.M. Schulze in *Balsaminaceae* (Grey-Wilson 1982), *Pilea nguruensis* Friis & I. Darbysh. in *Urticaceae* (Friis et al. 2015) and *Streptocarpus bambuseti* B.L. Burt. *S. burttianus* Pócs and *S. stomandrus* B.L. Burt. in *Gesneriaceae* (Darbyshire 2006).

Crepidorhopalon kwaleensis I. Darbysh. & Eb. Fisch., *sp. nov.*
— Fig. 2i–k, 4, 5

Most similar to *Crepidorhopalon whytei* but differing in the anterior pair of stamens having markedly longer, slender spurs 1.8–2.4 mm long (vs spurs 0.5–1.2 mm long), in the seeds being no longer than wide and with subcircular depressions on the surface (vs seeds longer than wide, with longitudinal furrows on the surface), and in the plants being erect or decumbent (vs procumbent, scrambling, trailing or at most weakly decumbent in *C. whytei*). Also potentially confused with *C. hepperi* Eb. Fisch. but again differing in the longer and more slender staminal spurs (these 0.5–0.7 mm long in *C. hepperi*), the differing seeds (those of *C. hepperi* similar to *C. whytei* but more angular and with more conspicuous minute transverse furrows perpendicular to the longitudinal furrows – Fig. 2), and in having usually more broadly ovate leaves with length : width ratio 0.9–1.4 : 1 (vs leaves ovate to lanceolate, length : width ratio 1.35–3.4(–4.9) : 1 in *C. hepperi*). — Type: *Luke 3796* (holo K; iso EA [not located], MO [not seen], US [not seen]), Kenya, Kwale County, Majoreni area, 5 km NE, fl. & fr. 18 Aug. 1993.

Etymology. *Crepidorhopalon kwaleensis* is named after Kwale County of Kenya, where this species is endemic.

Lindernia whytei sensu auct.: *Luke* (2005) 90; *Philcox & Ghazanfar* (2008) 70, p.p. quoad *Drummond & Hemsley 4007*.

Lindernia hepperi sensu *Philcox & Ghazanfar* (2008) 72, p.p. quoad spec. ex Kenya.

Annual (possibly sometimes short-lived perennial) *herb*, with one to few stems from a small rootstock, erect or becoming scrambling or trailing, up to 20–40 cm long, branching in proximal half; stems markedly 4-angular, winged along the angles, proximal portions of stems pilose with \pm numerous pale multicellular eglandular hairs 0.3–1 mm long, sometimes with few interspersed glandular hairs, hairs becoming more sparse distally, fertile portions of stems (raceme rachis) \pm glabrous except for inconspicuous sessile orange glands; internodes of fertile leafy stems 16–44(–90) mm long when mature. *Leaves* sessile, broadly ovate, 12.5–18 by 9–16 mm, base rounded or subcordate, margin with 3–5 minute teeth along each margin, apex acute, attenuate or obtuse; primary venation palmate, with 5 or 7 main veins from base; \pm sparsely eglandular pilose on margin and main veins beneath, surfaces also with sunken glands drying brown, visible on lower surface. *Flowers* held in a lax terminal raceme, each inflorescence node single-flowered; proximal-most pair of bracts ovate to suborbicular and acuminate, 3.8–7.5 by 2.2–6 mm, rapidly reducing upwards where lanceolate or linear-lanceolate, 1.5–2.7 by 0.3–0.8 mm; bracteoles absent; pedicels 1.5–2.8 mm long, glabrous. *Calyx* 3.7–5.5 mm long, lobes lanceolate, somewhat unequal in length, longest lobes 2–4 mm long, apices can become divergent at maturity, 5-veined, hyaline between the veins, surfaces glabrous. *Corolla* (8–)10.5–12 mm long, purple, lower lip with white patches in the mouth, external surface glandular-puberulous; tube 5.2–6 mm long, cylindrical, ± 1.5 mm wide centrally, internal surface with 4 lines of subsessile glands in proximal half; upper lip ovate, (2–)2.5–4.3 mm long, apex slightly emarginate, internal surface with minute glands; lower lip (3.5–)5–6 mm long, 3-lobed, median lobe rounded-obovate, 3–3.5 mm long, lateral lobes elliptic-obovate, 2.3–3.5 mm long, margins of lobes somewhat irregular, bosses on palate of lower lip with blunt-tipped multicellular hairs. *Stamens* 4, ventral stamens spurred, spurs linear-clavate, 1.8–2.4 mm long, apex papillate, filaments above spurred portion ± 4 mm long; posterior stamens with filaments ± 2 mm long; anthers of the two pairs of stamens adhering, thecae 0.45–0.7 mm long. *Ovary* not seen; style ± 4.5 mm long; stigma fan-shaped and minutely fringed. *Capsule* narrowly ellipsoid to ovoid with a gradually tapered apex, green-brown, longer than calyx, 5–9 mm long; seeds sub-square in face view and circular in lateral view, ± 0.4 –0.5 mm diam, with a row of subcircular depressions and with a marked longitudinal furrow on the posterior side.

Distribution & Ecology — *Crepidorhopalon kwaleensis* is known only from the coastal lowlands of southeast Kenya in Kwale County. It occurs in seepage areas and pools in grassland, palm swamps and grassland along forest margins, at 5–230 m elevation. At one site, it was found growing along the margin of a pond used by mammals as a watering hole (*Drummond & Hemsley 4007*).

Additional specimens seen. KENYA, Mwasangombe Forest, 15 miles SW of Kwale, fl. & fr. 27 Aug. 1953, *Drummond & Hemsley 4007* (K); Kwale County, Gazi village N, fl. & fr. 12 Oct. 1991, *Luke 2899* (EA [not located], K); near Lunguma, fl. & imm. fr. 20 Aug. 1994, *Luke & Gray 4061* (EA [not located], K); Majoreni area, 5 km NE, fl. & fr. 18 Aug. 1993, *Luke 3796* (EA [not located], K); Ramisi-Lungalunga Rd before Majoreni turn-off, fl. 20 Dec. 2018, *Luke et al.* 18735 (EA).

Conservation — Based on the occurrence records cited above and two additional sight records (Q.L.), this species has an EOO of 691 km² and an AOO of 28 km². The area in which most of the localities are found (near Majoreni) is undergoing rapid habitat conversion to sugar plantations and maize fields (see Fig. 5d), with some sub-populations almost certainly having been lost. The forest patch that adjoined the most northern

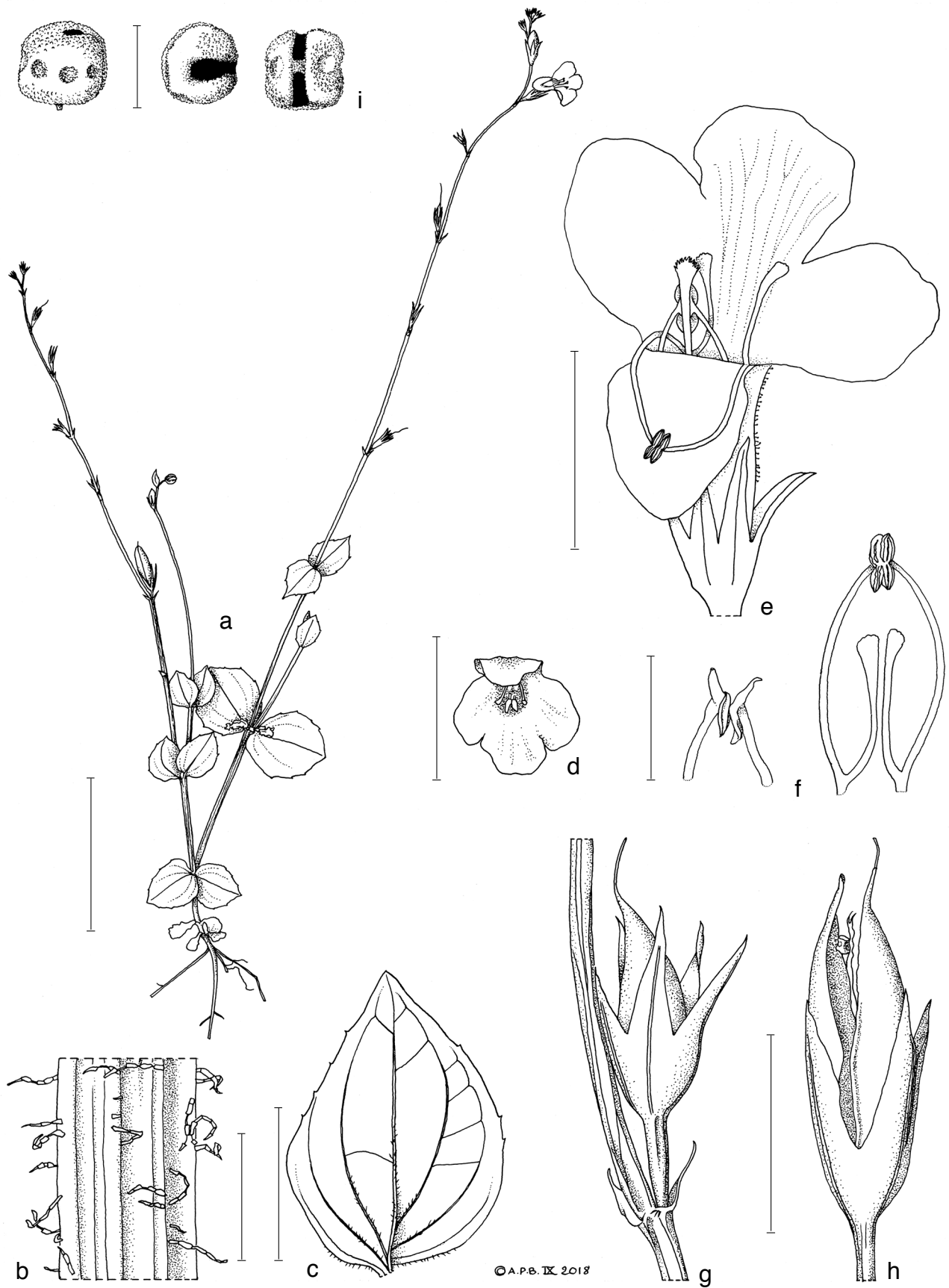


Fig. 4 *Crepidorhopalon kwaleensis* I. Darbysh. & Eb. Fisch. a. Habit; b. stem indumentum; c. mature leaf, abaxial surface; d. flower, face view; e. flower, posterior view with upper lip folded back to show stamens and stigma; f. stamens, anterior pair to the right; g. partial inflorescence with bracts, calyx and immature fruit; h. mature fruit in calyx; i. seeds in (l to r) anterior, apical and posterior views (a, e–f, h: Drummond & Hemsley 4007, K; b–c, g, i: Luke 3796, K, d from photo by Q. Luke). — Scale bars: a = 3 cm; b = 1 mm; c, d = 1 cm; e, g–h = 5 mm; f = 2 mm; i = 500 μ m. — Drawn by Andrew Brown.



Fig. 5 *Crepidorhopalon kwaleensis*. a–b. Habit; c. detail of flowers showing long abaxial staminal appendages; d. recent destruction of habitat for *C. kwaleensis* near Majoreni, Kwale County. — Photos: W.R.Q. Luke.

record (Kaya Lunguma) has been destroyed. There is only one locality inside a protected area (Mwasagombe Forest, now believed to be inside the Shimba Hills National Reserve) but it has not been recollected there since 1953. With four threat-defined locations identified, this species is assessed as Endangered under criterion B – EN B1ab(i,ii,iii,iv,v) + B2ab(i,ii,iii,iv,v).

Notes — This species is most easily recognised by the combination of the long slender spurs on the anterior pair of stamens, longer than in the other species of the *C. whytei* complex, and in the striking seeds that are no longer than wide and with subcircular depressions, rather than \pm longer than wide and with longitudinal furrows on the surface in other members of this group (all species have a more marked longitudinal furrow on the posterior side). It is otherwise similar to forms of *C. whytei* that have a racemose inflorescence due to the bracts being markedly reduced in relation to the cauline leaves, but the growth habit is more erect or decumbent than in *C. whytei* where the stems are trailing.

In the ‘Flora of Tropical East Africa’ account of *Lindernia* (Philcox & Ghazanfar 2008), material here assigned to this new taxon was treated under two different species – *L. whytei* and *L. hepperi*. *Crepidorhopalon hepperi* is easily separated from *C. whytei* due to its more erect, short, much-branched habit, narrower leaves, smaller flowers and calyces with the lobes usually shorter than the tube. However, *C. kwaleensis*

does superficially look somewhat intermediate between these two species, but clearly differs from both in the stamen and seed characters mentioned above. It additionally differs from *C. hepperi* in having broader leaves; although the leaf shape in *C. hepperi* is somewhat variable, it typically has lanceolate or more narrowly ovate leaves.

The coastal lowlands of southeast Kenya are known for their botanical interest, with a variety of endemic and range-restricted species. These include species restricted to similar habitats to *C. kwaleensis*. For example, the pteridophyte *Marsilea fadeniana* Launert is known only from seasonal waterholes and dry riverbeds around Kwale (Launert 2003), while in the Cyperaceae, *Cyperus boreobellus* Lye is restricted to damp soils over rock and small pools in the Kwale region and *Bulbostylis afroorientalis* (Lye) R.W.Haines is known with certainty only from the seasonally wet grasslands of this region (Hoenselaar et al. 2010).

Acknowledgements We thank Andrew Brown for producing the illustrations of the new species. Raneesh Prakesh (BM), Peris Kamau (EA), Maria Romeiras (LISC), Inês Chelene (LMA) and Anthony Mapaura (SRGH) are thanked for checking and (where appropriate) providing access to the relevant herbarium specimens at their institutions. We are grateful to Stephen Manktelow (Swedish Species Information Centre, Agricultural University of Sweden, Uppsala) for checking his notes on his collection of *Crepidorhopalon* sp. aff. *whytei* from the Nguru Mountains in Tanzania. I.D. would also like to thank Federico

Fabriani (K) for his assistance with the use of the microscope camera set-up when taking images of the seeds of *Crepidorhopalon*. Fieldwork on Mt Namuli in 2007 that resulted in the discovery of *Crepidorhopalon namuliensis* was sponsored by the Darwin Initiative award 15/036: 'Monitoring and Managing Biodiversity Loss in South East Africa's Montane Ecosystems' completed in 2009. Fieldwork conducted by I.D. in the foothills of the Chimanimani Mountains in 2015 was sponsored by the Darwin Initiative award 2380: 'Balancing Conservation and Livelihoods in the Chimanimani Forest Belt, Mozambique' completed in 2016.

REFERENCES

- African Plant Database. [continuously updated]. African Plant Database (version 3.4.0). Conservatoire et Jardin botaniques de la Ville de Genève and South African National Biodiversity Institute, Pretoria. Accessed September 2018, from <http://www.ville-ge.ch/musinfo/bd/cjb/africa/>.
- Agnew ADQ. 2013. Upland Kenya wild flowers and ferns: a flora of the flowers, ferns, grasses and sedges of highland Kenya. East Africa Natural History Society, Nairobi.
- Bachman S, Moat J, Hill AW, et al. 2011. Supporting red list threat assessments with GeoCAT: Geospatial conservation assessment tool. *ZooKeys* 150: 117–126.
- Darbyshire I. 2006. Gesneriaceae. In: Beentje HJ, Ghazanfar SA (eds), *Flora of Tropical East Africa*. Royal Botanic Gardens, Kew.
- Darbyshire I, Anderson S, Asatryan A, et al. 2017. Important plant areas: revised selection criteria for a global approach to plant conservation. *Biodiversity and Conservation* 26: 1767–1800.
- Darbyshire I, Kordofani M, Farag I, et al. 2015. The plants of Sudan and South Sudan, an annotated checklist. Royal Botanic Gardens, Kew.
- Downes E, Darbyshire I. 2017. *Coleus namuliensis* and *Coleus caudatus* (Lamiaceae): a new species and a new combination in the Afromontane flora of Mozambique and Zimbabwe. *Blumea* 62: 168–173.
- Fischer E. 1989. *Crepidorhopalon*, a new genus within the relationship of *Craterostigma*, *Torenia*, and *Lindernia* (Scrophulariaceae) with two new or note-worthy species from Central and South Central Africa (Zaire, Zambia). *Feddes Repertorium* 100: 439–450.
- Fischer E. 1992. Systematik der afrikanischen Lindernieae (Scrophulariaceae). *Tropische und Subtropische Pflanzenwelt* 82: 1–365.
- Fischer E. 1999. Scrophulariaceae (première partie). In: Bamps P (ed), *Flore d'Afrique Centrale (Congo Kinshasa, Rwanda & Burundi)*: 1–217. Jardin Botanique National de Belgique, Meise.
- Fischer E. 2006. Scrophulariaceae. In: Hedberg I, Ensermu Kelbessa, Edwards S, et al. (eds), *Flora of Ethiopia and Eritrea, Volume 5*: 235–308. The National Herbarium, Addis Ababa University and The Department of Systematic Botany, Uppsala University.
- Fischer E, Darbyshire I, Bingham MG. 2014. A new species of *Crepidorhopalon* (Linderniaceae) from the Mutinondo Wilderness, Zambia. *Phytotaxa* 181: 171–178.
- Fischer E, Schäferhoff B, Müller K. 2013. The phylogeny of Linderniaceae – The new genus *Linderniella*, and new combinations within *Bonnaya*, *Craterostigma*, *Lindernia*, *Micranthemum*, *Torenia* and *Vandellia*. *Willdenowia* 43: 209–238.
- Friis I, Darbyshire I, Wilmot-Dear CM, et al. 2015. *Pilea nguruensis* (Urticaceae), a new species from the Eastern Arc Mountains, central Tanzania. *Kew Bulletin* 70: 24 (5 pages).
- Ghazanfar SA, Hepper FN, Philcox D. 2008. Scrophulariaceae. In: Beentje H, Ghazanfar SA (eds), *Flora of Tropical East Africa*. Royal Botanic Gardens, Kew.
- Grey-Wilson C. 1982. Balsaminaceae. In: Polhill RM (ed), *Flora of Tropical East Africa*. Balkema, Rotterdam.
- Harris T, Darbyshire I, Polhill R. 2011. New species and range extensions from Mt Namuli, Mt Mabu and Mt Chipirone in northern Mozambique. *Kew Bulletin* 66: 241–251.
- Hemsley WB, Skan SA. 1906. Scrophulariaceae. In: Thiselton-Dyer WT (ed), *Flora of Tropical Africa* 4 (2): 261–462. Reeve & Co., London.
- Hoenselaar K, Verdcourt B, Beentje H. 2010. Cyperaceae. In: Beentje H (ed), *Flora of Tropical East Africa*. Royal Botanic Gardens, Kew.
- IUCN. 2012. IUCN Red List Categories and Criteria. Version 3.1. Second Edition. IUCN Species Survival Commission, Gland, Switzerland & Cambridge, United Kingdom. Available at: <https://portals.iucn.org/library/node/10315>.
- Launert E. 2003. Marsileaceae. In: Beentje H, Ghazanfar SA (eds), *Flora of Tropical East Africa*. Balkema, Lisse.
- Lock JM. 2010. Xyridaceae. In: Timberlake JR, Martins ES (eds), *Flora Zambesiaca*, Vol. 13, Part 4: 1–33.
- Luke Q. 2005. Annotated checklist of the plants of the Shimba Hills, Kwale District, Kenya. *Journal of East African Natural History* 94: 5–120.
- Malaise P. 1985. Scrophulariaceae. In: Troupin G (ed), *Flore du Rwanda. Spermatophytes* Vol. 3: 383–412. Musée Royal de l'Afrique Centrale, Tervuren.
- Matimele HA, Darbyshire I, Timberlake J, et al. 2017. *Crepidorhopalon* sp. nov. The IUCN Red List of Threatened Species 2017: e.T108613519-A108620114. Available at: <http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T108613519A108620114.en>. Downloaded on 9 Nov. 2018.
- Mildbraed J, Pilger R. 1911. Scrophulariaceae. In: Mildbraed J (ed), *Wissenschaftliche Ergebnisse der Deutschen Zentral-Africa-Expedition, 1907–1908. Band II, Botanik*: 285–290. Klinkhardt & Biermann, Leipzig.
- Moore S le M. 1907. *Alabastra Diversa*. Part XIV. New or little-known African Gamopetalae. *Journal of Botany* 45: 87–98.
- Moore S le M. 1911. Gamopetalae. In: A contribution to our knowledge of the Flora of Gazaland: being an account of collections made by C.F.M. Swynerton, Esq., F.L.S. *Journal of the Linnean Society, Botany* 40: 77–180.
- Philcox D. 1990. Scrophulariaceae. In: Launert E, Pope GV (eds), *Flora Zambesiaca*, Vol. 8, Part 2. *Flora Zambesiaca Managing Committee*, London.
- Philcox D, Ghazanfar SA. 2008. *Lindernia*. In: Beentje H, Ghazanfar SA (eds), *Flora of Tropical East Africa. Scrophulariaceae*: 67–91. Royal Botanic Gardens, Kew.
- Rahmanzadeh R, Müller KF, Fischer E, et al. 2005. Linderniaceae and Gratiolaceae (Lamiales) are further lineages distinct from Scrophulariaceae. *Plant Biology* 7: 67–78.
- Shorthouse DP. 2010. SimpleMappr, an online tool to produce publication-quality point maps. Available at: <http://www.simplemappr.net>. Accessed 14 Jan. 2019.
- Stevens PF. 2001 onwards. Angiosperm phylogeny website. Version 14, July 2017 [and continuously updated since]. <http://www.mobot.org/MOBOT/research/APweb/>.
- Thiers B. [continuously updated]. Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Accessed Sept. 2018, from <http://sweetgum.nybg.org/science/ih/>.
- Timberlake J, Darbyshire I, Cheek M, et al. 2016. Plant conservation in communities on the Chimanimani footslopes, Mozambique. Report prepared for Darwin Initiative Award 2380: Balancing Conservation and Livelihoods in the Chimanimani Forest Belt, Mozambique. Royal Botanic Gardens, Kew.