



Geophila erythrocarpa (Rubiaceae), a new species from D.R.Congo and Zambia

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Key words

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Abstract The species *Geophila erythrocarpa* (Rubiaceae) is described and illustrated. The new species is restricted to dry, dense forests of the Katanga province in D.R.Congo and the adjoining Copperbelt province in Zambia. The species is similar to and in the herbarium easily confused with *G. obvallata* from which it most clearly differs in having red instead of blue or black fruits. In flowering state, the two species can be separated by differences in calyx morphology. The new species shares the red-coloured fruits with *G. afzelii*, but differs from this species in the undivided stipules, the fewer-flowered inflorescences with smaller bracts, and details of the leaf coloration. The new species is further compared with all other *Geophila* species reported from Zambia and D.R.Congo whereby *G. obtusifolia* is reduced to synonymy under *G. renaris* and *G. aschersoniana* is reduced to synonymy under *G. obvallata*. An IUCN conservation assessment has been made and the species is provisionally assessed as Endangered, based on its restricted area of occupancy, the small number of known locations, and the continuing decline in extent and quality of its habitat.

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INTRODUCTION

Geophila D. Don is a pantropical genus of creeping herbs and is a typical element of the forest floor in tropical regions. *Geophila* species often form dense mats, sometimes decorated with white flowers or red, blue or black coloured fruits. The genus belongs to the tribe *Palicoureeae* of the *Rubiaceae* family (Robbrecht & Manen 2006). *Palicoureeae* was recently separated from the *Psychotrieae* and includes eight to ten genera depending on generic delimitations. This pantropical tribe has its highest species diversity in the neotropics and is characterized by the combination of solitary anatropous ovules that are attached at the base of the locules, valvate aestivation of the corolla lobes, fleshy drupes, pyrenes with distinct preformed germinations slits and very reduced, pale seed-coats (Robbrecht & Manen 2006). *Geophila* and *Hymenocoleus* Robbr. are the only genera of the tribe with a predominantly herbaceous habit. *Geophila* differs from the African genus *Hymenocoleus* in the absence of a membranous sheath at the inside of the stipules and by the pyrenes ribbed at the dorsal side (Robbrecht 1975). An additional distinguishing character is found in the fruit colour: *Hymenocoleus* fruits are orange while those of *Geophila* are red or blue to black, but never orange.

Geophila comprises about 20 species of which one, i.e. *G. repens* (L.) I.M. Johnston, has an apparently natural pantropical distribution (Piesschaert et al. 1999a, b). Kew's World Checklist of Selected Families reports twelve *Geophila* species from Africa and Madagascar (Govaerts et al. 2010), some of them imperfectly known. For D.R.Congo eight species are listed: *G. afzelii* Hiern, *G. aschersoniana* Büttner, *G. ingens* Wernham, *G. lancistipula* Hiern, *G. obtusifolia* K. Krause, *G. obvallata* Ditr., *G. renaris* De Wild. & T. Durand and *G. repens*. In Zambia, only

three *Geophila* species are known: *G. obvallata*, *G. repens* and an undescribed species *Geophila* sp. A (Verdcourt 1989).

The second author reviewed the paleotropical species of the genus to obtain the degree of Master in Biology and discovered *Geophila* material in BR that could be matched with the *Fanshawe 6855* specimen from Zambia referred to *Geophila* sp. A in *Flora Zambesiaca* (Verdcourt 1989). The additional specimens now allow the formal description of this taxon as *Geophila erythrocarpa* Vanthournout & Dessein.

MATERIAL AND METHODS

Herbarium material of *Geophila* was consulted at BR, HBG, K, MO and WAG. Descriptive terminology for simple symmetrical plane shapes follows Anonymous (1962). Phytogeographical considerations follow White (1979, 1983).

To estimate the conservation status of the species, geo-referenced specimen data were imported into ArcView™ geographic information software to generate the distribution map and to calculate area of occupancy (AOO) and extent of occurrence (EOO) using Cats 1.2 (Moat 2007). The cell area was set to the largest permissible value (cell width = 3.16 km). The AOO and EOO figures were used in conjunction with Google Earth observations and literature data to produce a conservation rating based on the IUCN Red List Categories criteria (IUCN 2001).

DESCRIPTION OF NOVELTY

Geophila erythrocarpa Vanthournout & Dessein, *sp. nov.*

— Fig. 1

Affinis *Geophilae obvallatae* (Schumacher & Thonn.) Ditr. sed ab illa differt propter fructus rubros (versus caeruleos), corollarum tubos intra solummodo ad antherarum altitudinem pilosos (id est glabros super antheris) atque calyces truncatos (versus calycum lobos bene effectos in *G. obvallata*). — Typus: *Schmitz 2303* (holo BR), D.R.Congo, Elisabethville [= Lubumbashi], 19 April 1949.

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Geophila sp. A, Verdcourt (1989).

Etymology. The epithet 'erythrocarpa' refers to the red colour of the fruits, which is the most important character to distinguish the species from *G. obvallata*.

Creeping herb with underground stems rooting at the nodes; stems densely pubescent; leafy and flowering shoots reaching

a height of 4–5 cm. Leaves opposite; petiole 1.5–7 cm long, pubescent all around; blades broadly ovate to circular, 1.5–6.7 by 1.5–7.5 cm, sparsely pubescent above and underneath, rounded at the apex, cordate at the base; venation not very prominent with 3–5 secondary veins at each side of mid-vein and a fine reticulate network of tertiary and quarterly veins. *Stipules* papery, entire but often splitting with age, transversely

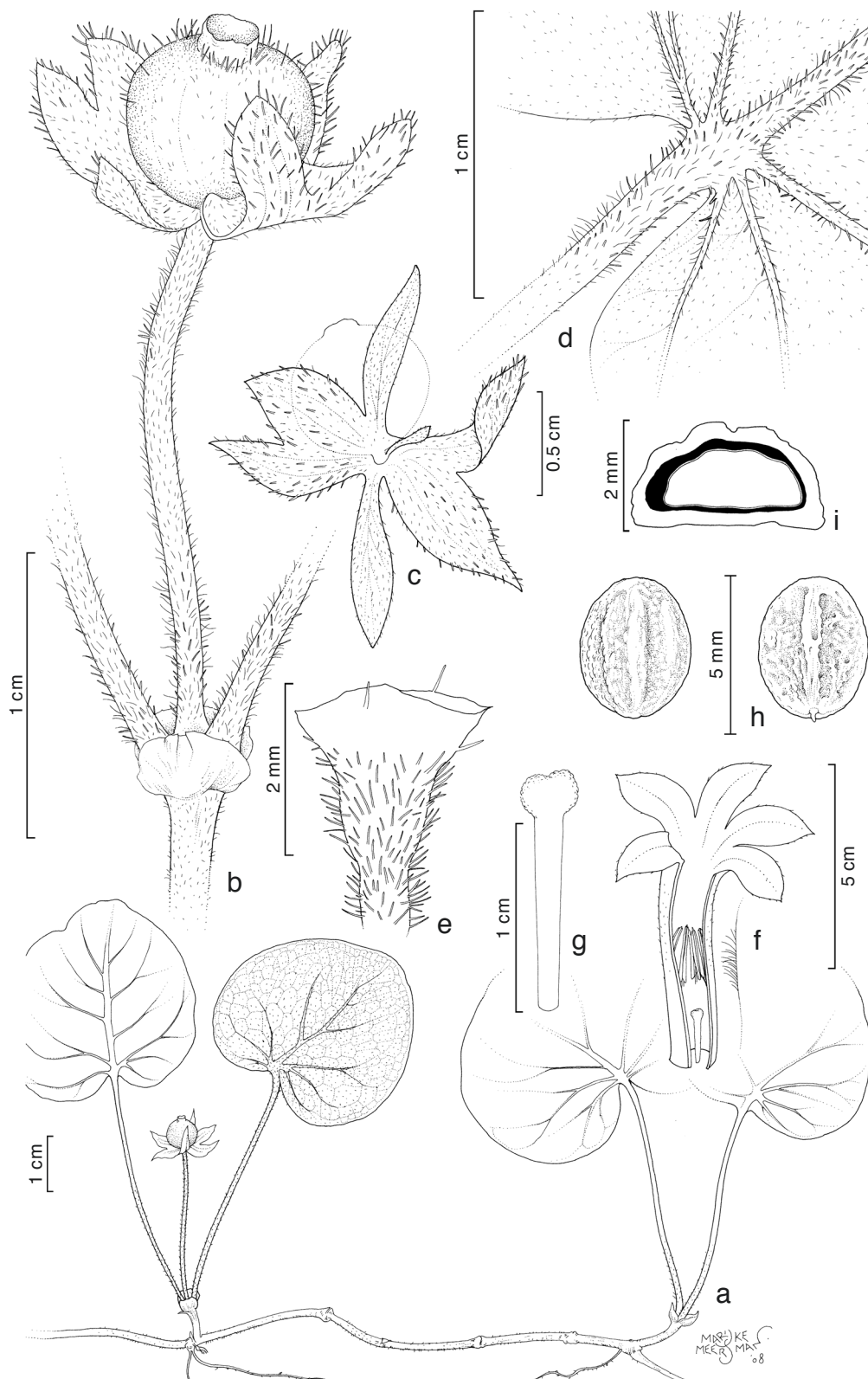


Fig. 1 *Geophila erythrocarpa* Vanthournout & Dessein. a. Habit; b. infructescence; c. detail of involucre seen from above with position of fruit indicated in stippled line; one bracteole inside involucre; d. detail of leaf base and petiole; e. ovary with persistent calyx; f. opened corolla showing position of anthers and style; the line on the right indicates the occurrence of trichomes inside the corolla tube; g. detail of style; h. dorsal (left) and ventral (right) view of the pyrenes; i. transverse section through pyrene (a–d: Schmitz 2303, BR; e, h, i: Malaisse & Goetghebeur 1032, BR; f, g: Kassner 3545, HBG).

elliptic to triangular, 2–3 by 3–5 mm, glabrous. *Flowers* 5-merous, presumably isostylous, 2–3 per inflorescence; peduncle 0.5–5 cm, densely hairy; involucre consisting of two unequal pair of bracts, the outer bracts broader and slightly to strongly bilobed, the inner ones narrowly elliptic and entire; involucre bracts free to variously connate to each other at the base, 7–9 mm long, hairy outside and inside, beset with colleters at the base inside; bracteoles, if present, somewhat spatulate. *Calyx* tube 1–2 mm, glabrous or with a few hairs near the margin, truncate. *Corolla* white; tube cylindrical, c. 5 mm long, sparsely hairy outside, with a band of hairs at and just above the insertion point of the anthers inside; throat appearing glabrous viewed from outside; lobes elliptic, c. 2 mm long, sparsely hairy outside, glabrous inside. *Anthers* narrowly elliptic, c. 1.4 mm long, attached somewhat below the middle of the corolla tube; filaments very short. *Ovary* 1–1.5 mm; style c. 1.3 mm long, included in the corolla tube, positioned below the anthers; stigma shortly bilobed. *Drupes* red, globose, 7–9 mm, sparsely pubescent; pyrenes light brown, elliptic, 3.5–5 by 3–4 mm, bony; dorsal surface with 3–4 dorsal ribs, verrucate to rugose in between the ribs; ventral surface with 2 ventral grooves.

Distribution — Occurring in the Zambezi Regional Centre of Endemism and there restricted to the Katanga Province of D.R.Congo and the adjacent Copperbelt Province of Zambia.

Habitat & Ecology — Forest floor of dry dense forest ('muhulu') and gallery forest; 1150–1370 m.

Vernacular name — Kontumba Tumba (dial. Kisanga; *Nassogne* 89).

Additional specimens examined. D.R.CONGO, Katanga province, Kantu, *Kassner* 3545 (HBG); Lubembe River, 2 Feb. 1908, *Kassner* 2427 (K); Kambove, Jadotville [= Likasi], 1130 m, 6 Apr. 1958, *Nassogne* 89 (BR); Musoshi-Kimpe, env. mi-chemin, 1350 m, 21 May 1985, *Malaisse & Goetghebeur* 1032 (BR, MO); Lubumbashi, *Salésiens* 930 (BR); 20 km SE de Mwadingusha, 5 May 1959, *Schmitz* 6461 (BR). — ZAMBIA, Copperbelt province, Ndola, 3 June 1962, *Fanshawe* 6855 (K, NDO); Chichele forest reserve near Ndola, 1370 m, 30 Mar. 1972, *Kornas* 1480 (K); Njiri Forest, Mufulira, 12 Mar. 1964, *Mutimushi* 689 (K).

Conservation status — Based on the limited area of occupancy the Endangered threshold is met (AOO = 79.88 km²), whereas the Vulnerable threshold is met based on the extent of occurrence (EOO = 18,005 km²). The ecology of the species is dry evergreen forest, often named 'muhulu' in D.R.Congo (Bamps 1975). Muhulu is sometimes described as the climax vegetation of Katanga and other areas of the Zambezi Regional Centre of Endemism with a similar climate (Schmitz 1950, 1962). Muhulu forest is now found in relatively small patches and is easily degraded by human activities such as wood exploitation and fire management. In this context it is noteworthy that the Njiri forest reserve in Zambia, where *G. erythrocarpa* was apparently very common, has been degazetted and that the land has been allocated to squatters. Based on the small number of locations, the patchy occurrence of dry evergreen forest in the area, and the continuous decline of the extent and quality of habitat, *G. erythrocarpa* qualifies for Endangered under criterion B (EN B2ab(iii)).

DISCUSSION

The delimitation and subsequent identification of *Geophila* species is notoriously difficult (Piesschaert et al. 1999a, b), especially when based on herbarium specimens only. There are, however, a number of characters that are fairly stable at species level, i.e. stipule morphology, pubescence pattern on the petioles, pubescence pattern on the inside of the corolla tube, fruit colour and pyrene morphology. Pollen also provides useful taxonomic data, but pollen studies in *Geophila* are often hampered by lack of suitable flowering material (Piesschaert

et al. 1999a) and are of course of little use for routine determinations.

In general appearance, the new species resembles *G. obvallata*, a species distributed from Guinea Bissau to Angola, over D.R.Congo, Sudan, and C.A.R., to eastern Kenya and Tanzania and Mozambique. It is a very variable species with three recognized subspecies with partly overlapping distributions (Verdcourt 1989). *Geophila erythrocarpa* is most similar to *G. obvallata* subsp. *ioides* (K.Schum.) Verdc. and the distribution of the two taxa partially overlaps in Katanga (D.R.Congo) and the Copperbelt (Zambia). The leaf shape and stipule morphology of the two taxa is very alike which gives them a very similar facies in the dry state. Fruit colour (deep blue in *G. obvallata* vs red in *G. erythrocarpa*), hair pattern on the petiole (in two rows in *G. obvallata* vs all-around in *G. erythrocarpa*), calyx morphology (deeply lobed in *G. obvallata* vs truncate in *G. erythrocarpa*), shape of the involucre bracts (entire in *G. obvallata* vs deeply lobed in *G. erythrocarpa*), and hair pattern of the corolla tube (hairy above insertion of anthers up to corolla lobes in *G. obvallata* vs hairy zone limited to area around insertion point of anthers in *G. erythrocarpa*) distinguish the two species (Table 1).

Geophila erythrocarpa also shows similarities with *G. afzelii*, especially in calyx and corolla morphology (Table 1). The pyrenes are also similar, but those of *G. erythrocarpa* are dorsally clearly verrucate to rugose in between the ribs, while those of *G. afzelii* appear smooth in between the ribs under low magnification. A more distinct difference, easily observed in the field, is found in the stipules, which are bifid in *G. afzelii* and entire in *G. erythrocarpa*. Unfortunately this character is often difficult to determine on dry material. Leaves of *G. afzelii* often show a red-purple coloration of the lower surface of the leaves, visible both in living and dry plants, a character absent in *G. erythrocarpa*. Other differences are found in the number of flowers per involucre (many in *G. afzelii*, few in *G. erythrocarpa*) and the involucre bracts (numerous and usually entire, sometimes shortly lobed in *G. afzelii* vs two 2-lobed and two narrowly elliptic bracts in *G. erythrocarpa*). *Geophila afzelii* is essentially a Guineo-Congolian species and is absent from the Zambezi Regional Centre of Endemism.

Geophila erythrocarpa is also easily separated from a third species occurring in the region, *G. repens*, which is a species with inflorescences without involucre.

Five other species are reported from D.R.Congo. *Geophila renaris* differs in the reniform leaves, the bifid stipules, and the 3-lobed bracts, *G. ingens* in the two rows of hairs on the petiole, the bifid stipules, the many-flowered inflorescences, the deeply lobed calyx and the pyrene morphology, and *G. lancistipula* in the two rows of hairs on the petiole, the bifid stipules, the absence of an involucre, the blue flowers and the pyrene morphology (Table 1). The two other species reported from D.R.Congo, i.e. *G. obtusifolia* K.Krause and *G. aschersoniana* Büttner should be reduced to synonymy under *G. renaris* and *G. obvallata* respectively.

Geophila renaris De Wild. & T.Durand.

Geophila obtusifolia K.Krause (1911), *syn. nov.* — Type: *Mildbraed* 3285 (B, not found; BR, fragm.), Aruwimi (D.R.Congo).

The type specimen in B could not be found, but a fragment of this specimen was found in BR. It clearly shows that it is identical to *G. renaris*, described in 1899.

Geophila obvallata (Schumacher. & Thonn.) D.Dr.

Table 1 Key morphological characters and distribution of the *Geophila* species now recognized from D.R.Congo and Zambia.

Characters	<i>G. afzelii</i>	<i>G. erythrocarpa</i>	<i>G. ingens</i>	<i>G. lancistipula</i>	<i>G. obvallata</i>	<i>G. renaris</i>	<i>G. repens</i>
Hairiness petiole	Hairy all-round	Hairy all-round	Hairs in 2 rows	Hairs in 2 rows	Hairs in 2 rows	Hairy all-round	Hairy all-round or hairs in two rows
Stipules	Bifid	Entire	Bifid	Bifid	Entire	Bifid	Entire
# flowers per inflorescence	9–16	2–3	9–15	1–3	4–11	4–5	1–3(–5)
Leaf apex	Acute	Rounded	Acute	Rounded	Variable	Rounded	Variable
Involucre	Present with several pairs of entire or shortly lobed bracts	Present with two pairs of bracts; one pair bilobed, the other pair entire	Present with several pairs of entire bracts	Absent; bracts entire	Present with two pairs of entire bracts	Present with two pairs of deeply 3-lobed bracts	Absent; bracts entire
Calyx	Subtruncate	Truncate	Deeply (often unequally) lobed	Deeply lobed	Deeply lobed	Subtruncate	Deeply lobed
Corolla inside	Zone of hairs around insertion point anthers; throat glabrous	Zone of hairs around insertion point anthers; throat glabrous	Hairs above insertion point of anthers to base of lobes; throat hairy	Zone of hairs around insertion point anthers; throat glabrous	Hairs above insertion point of anthers to base of lobes; throat hairy	Zone of hairs around insertion point anthers; throat glabrous	Glabrous
Fruit colour	Red	Red	Blue to blackish	Blue	Dark blue	Red	Red
Dorsal surface of pyrene under low magnification	Not rugose; 4 sharply delineated ribs	Verrucate to rugose; 3–4 indistinct ribs	Not rugose; 1 rib	Not rugose; 3 very sharp ridges	Verrucate to rugose; 3 faint ribs	Not rugose; 4 flattened ribs	Verrucate to rugose; 1–3 ribs
Ventral surface pyrene	Two ventral grooves	Two ventral grooves	Flat	Flat with indistinct median keel	Flat or with two faint grooves	Two ventral grooves	Flat with indistinct median keel
Distribution (in terms of phytochoria of White 1979, 1983)	Guineo-Congolian regional centre of endemism	Zambezian regional centre of endemism	Lower Guinea and Congolian subcentre of endemism	Lower Guinea subcentre of endemism and Guineo-Congolian /Zambezian regional transition zone	Widespread in tropical Africa	Lower Guinea and Congolian subcentre of endemism	Pantropical

Geophila aschersoniana Büttner (1889), *syn. nov.* — Type: Büttner 147 (B, not found), between Bolobo and Lukolela (D.R.Congo).

The type specimen in B could not be found and was probably destroyed. Its description, however, allows us to reduce the species to *G. obvallata*. According to Büttner, *G. aschersoniana* differs from *G. obvallata* in the presence of inner involucre bracts, which he describes as narrower and often incised at the apex. The involucre bracts of *G. obvallata* are somewhat variable and the description of the bracts of *G. aschersoniana* well falls within the observed bract variation of *G. obvallata*.

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