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

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Key words

Copperbelt
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IUCN
Katanga
Rubiaceae
Zambia

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 it 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.Johnst., 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 (Govarts 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 Didr., 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 Geophila obvallatae (Schumach. & Thonn.) Didr. sed ab illa differt propter fructus rubros (versus caeruleos), corollarum tubos intra solummodo ad antherarum altitudinem pilosos (id est glabros super antheris) atque calycis truncatos (versus calcym lobos bene effectos in G. obvallata).

Typus: Schmitz 2303 (holo BR), D.R.Congo, Elisabethville [= Lubumbashi], 19 April 1949.

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: Malaise & Goetghebeur 1032, BR; f, g: Kassner 3545, HBG).](image-url)
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; involucres consisting of two unequal pair of bracts, the outer bracts broader and slightly to strongly bilobed, the inner ones narrowly elliptic and entire; involucral 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 Zambezan 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); Musoashi-Kimpe, env. mi-chemin, 1350 m, 21 May 1985, Malaisse & Goethethebus 1032 (BR, MO); Lubumbashi, Sâlesiens 930 (BR); 20 km SE de Mwadingusha, 5 May 1959, Schmitz 6451 (BR). — Zambia, Copperbelt province, Ndola, 3 June 1962, Fanashawe 6955 (K, NDO); Chichele forest reserve near Ndola, 1370 m, 30 Mar. 1972, Komas 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 Zambezan 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 Geophila 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, Geophila 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 Geophila obvaldata, 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 (Verd court 1989). Geophila erythrocarpa is most similar to G. obvaldata subsp. icoides (K.Schum.) Verd. 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. obvaldata vs red in G. erythrocarpa), hair pattern on the petiole (in two rows in G. obvaldata vs all-around in G. erythrocarpa), calyx morphology (deeply lobed in G. obvaldata vs truncate in G. erythrocarpa), shape of the involucral bracts (entire in G. obvaldata vs deeply lobed in G. erythrocarpa), and hair pattern of the corolla tube (hairy above insertion of anthers up to corolla lobes in G. obvaldata 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 involucral 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 Zambezan 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. lancifolia 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. ascheroniana Büttner should be reduced to synonymy under G. renaris and G. obvaldata 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 obvaldata (Schumach. & Thonn.) Didr.
Table 1  Key morphological characters and distribution of the Geophila species now recognized from D.R.Congo and Zambia.

<table>
<thead>
<tr>
<th>Character</th>
<th>G. afzelii</th>
<th>G. erythrocarpa</th>
<th>G. ingens</th>
<th>G. lancistipula</th>
<th>G. obvallata</th>
<th>G. renaris</th>
<th>G. repens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hairiness petiole</td>
<td>Hairy all-round</td>
<td>Hairy all-round</td>
<td>Hairs in 2 rows</td>
<td>Hairs in 2 rows</td>
<td>Hairs in 2 rows</td>
<td>Hairy all-round</td>
<td>Hairy all-round or hairs in two rows</td>
</tr>
<tr>
<td>Stipules</td>
<td>Bifid</td>
<td>Entire</td>
<td>Bifid</td>
<td>Bifid</td>
<td>Entire</td>
<td>Bifid</td>
<td>Entire</td>
</tr>
<tr>
<td>Leaf apex</td>
<td>Acute</td>
<td>Rounded</td>
<td>Acute</td>
<td>Variable</td>
<td>Rounded</td>
<td>Variable</td>
<td></td>
</tr>
<tr>
<td>Involucre</td>
<td>Present with several pairs</td>
<td>Present with two pairs of involucral bracts</td>
<td>Absent; bracts entire</td>
<td>Absent; bracts entire or hairs in two rows</td>
<td>Present with two pairs of involucral bracts</td>
<td>Absent; bracts entire</td>
<td></td>
</tr>
<tr>
<td>Calyx</td>
<td>Subtruncate</td>
<td>Deeply lobed</td>
<td>Deeply (often unequally) lobed</td>
<td>Deeply lobed</td>
<td>Deeply lobed</td>
<td>Subtruncate</td>
<td></td>
</tr>
<tr>
<td>Corolla inside</td>
<td>Zone of hairs around insertion point of anthers</td>
<td>Zone of hairs around insertion point of anthers</td>
<td>Zone of hairs around insertion point of anthers</td>
<td>Zone of hairs above insertion point of anthers</td>
<td>Zone of hairs above insertion point of anthers</td>
<td>Glabrous</td>
<td></td>
</tr>
<tr>
<td>Fruit colour</td>
<td>Red</td>
<td>Dark blue</td>
<td>Blue to blackish</td>
<td>Blue</td>
<td>Red</td>
<td>Red</td>
<td></td>
</tr>
<tr>
<td>Dorsal surface of pyrene</td>
<td>Not rugose; 4 sharply flattened ribs</td>
<td>Verrucose to rugose; 4 flattened ribs</td>
<td>Verrucose to rugose; 4 flattened ribs</td>
<td>Verrucose to rugose; 4 flattened ribs</td>
<td>Verrucose to rugose; 4 flattened ribs</td>
<td>Verrucose to rugose; 4 flattened ribs</td>
<td></td>
</tr>
<tr>
<td>Ventral surface pyrene</td>
<td>Two ventral grooves</td>
<td>Flat</td>
<td>Flat</td>
<td>Flat</td>
<td>Flat</td>
<td>Flat</td>
<td></td>
</tr>
<tr>
<td>Distribution (in terms of phytochoria)</td>
<td>Widespread in tropical Africa</td>
<td>Lower Guinea and Pantropical region</td>
<td>Lower Guinea and Congolian subcentre of endemism</td>
<td>Lower Guinea and Congolian subcentre of endemism</td>
<td>Lower Guinea and Zambezian regional transition zone</td>
<td>Lower Guinea regional centre of endemism</td>
<td></td>
</tr>
</tbody>
</table>

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