

Hypolytrum goetgheburii (Cyperaceae), a curious new species from miombo woodlands in the Democratic Republic of the Congo

Philippe Thery^{1,*}, Marc Reynders² & Marc S.M. Sosef²

¹24 rue Védrières, 64000 Pau, France

²Meise Botanic Garden, Nieuwelaan 38, 1860 Meise, Belgium

*Author for correspondence: philippethery@orange.fr

Background – The genus *Hypolytrum* is studied during the preparation of the Cyperaceae treatment in *Flore d’Afrique centrale*. It is kept separate from *Mapania* and its African members have been divided amongst three sections.

Methods – Herbarium material from BR and BRLU has been studied. A preliminary IUCN Red List assessment is performed according to the IUCN Guidelines and Criteria.

Results – The new species *Hypolytrum goetgheburii* is described from miombo woodlands in the Democratic Republic of the Congo. It differs from other African species in the genus by forming thick tussocks, having narrow, rigid leaves and spicoids with three male flowers subtended by their floral bracts and a female flower with three stigmas. It occurs in seasonally dry areas with a regular fire regime and seems to be the only African species of that genus occupying such a dry habitat. It is named after the Cyperaceae specialist Prof. em. Dr. Paul Goetghebeur. Following the IUCN Red List criteria, the species is assessed as Vulnerable.

Key words – Botany, Central Africa, Cyperaceae, Democratic Republic of the Congo, *Hypolytrum*, new species, systematics, taxonomy.

INTRODUCTION

The first author is studying several genera of Cyperaceae within the framework of a treatment of that family for *Flore d’Afrique centrale* (Sosef 2016). While working on the genus *Hypolytrum* Pers., a small pile of material was encountered at BR that was annotated back in 1985 by the Cyperaceae specialist Prof. em. Dr. Paul Goetghebeur as representing a new species of that genus. After a closer inspection, it could be confirmed that the material represented a new species of *Hypolytrum* and that, despite its discovery more than 30 years ago, it had never been formally published. Additional material of the same species was discovered at BRLU.

Lye (2011) proposed to include the genus *Hypolytrum* in *Mapania* Aubl. However, this concept is not followed

by other specialists in the family (see for example Alves et al. 2015, Browning & Goetghebeur 2017, Semmouri et al. 2018). As relationships within the tribe Hypolytreae are currently still unclear, it seemed best to maintain *Hypolytrum* and publish the new species in this genus.

In Africa, Nelmes (1955) recognized three sections within *Hypolytrum*: section *Lancifoliae* Nelmes (plants with a single central (terminal) flowering stem that carries five or more leaves and with basal leaves reduced to their sheaths), section *Foliigerae* C.B. Clarke (plants with basal leaves and a single central (terminal) flowering stem that carries one to three leaves) and section *Scaposae* C.B. Clarke (plants with several axillary flowering stems that do not carry leaves or at most a few scales). As sect. *Foliigerae* contains the type species of the genus (*Hypolytrum latifolium* Rich. = *Hypolytrum*

nemorum (Vahl) Spreng.), the autonym sect. *Hypolytrum* is the correct name for this section (Turland et al. 2018).

Interpretation of the floral structures of Mapanioideae, including *Hypolytrum*, has been very controversial. Although not fully resolved, recent ontogenetic studies favour a synanthial interpretation (Prychid & Bruhl 2013). Here we follow the interpretation and terminology of Simpson (1992), see fig. 1.

The aim of this study is to formally describe the new species of *Hypolytrum*, provide notes on its differences with related species, its ecology and distribution, and assess its conservation status.

MATERIAL AND METHODS

This study was performed using herbarium material and applying standard herbarium techniques (de Vogel 1987). Acronyms of institutes holding herbarium collections follow Thiers (continuously updated).

The preliminary IUCN Red List assessment follows the criteria and guidelines of IUCN (IUCN Standards and Petitions Subcommittee 2014). The georeferenced herbarium specimen data were imported into GeoCat (Bachmann et al. 2011) to obtain the necessary assessment figures and a distribution map. After publication, the assessment will be de-

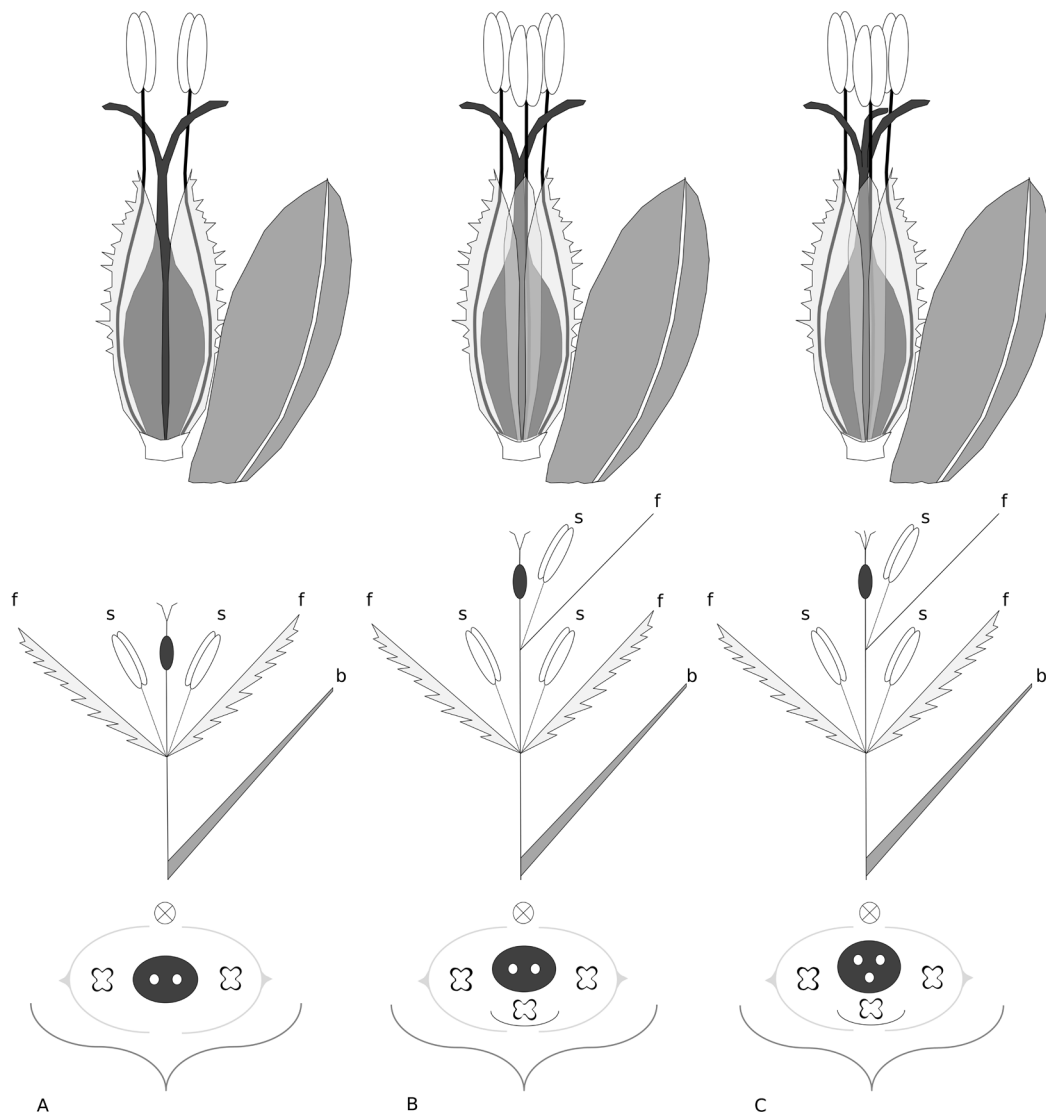


Figure 1 – Models of spicoids found in *Hypolytrum*: A, type with two floral bracts each subtending a stamen and pistils with two stigmata as found in most *Hypolytrum* species (Prychid & Bruhl 2013); B, type with three floral bracts each subtending a stamen and pistils with two stigmata as found in some South American species such as *H. supervacuum*, *H. pulchrum* and *H. paraense*, sometimes a fourth bract and stamen is observed in *H. pulchrum* (Koyama 1970, Alves et al. 2002); C, type with three floral bracts each subtending a stamen and pistils with three stigmata as observed in *H. goetghebeurii*. Interpretation and terminology following Simpson (1992). Abbreviations: b, spicoid bract, s, stamen; f, floral bract. Drawn by Marc Reynders. © Meise Botanic Garden, all rights reserved, used with permission. This image is not covered by the terms of the Creative Commons licence of this publication. For permission to reuse, please contact the rights holder.

livered to the appropriate IUCN Authority (CARLA, Central African plants Red List Authority) through their Species Information System (SIS) for final approval and publication on their Red List website (IUCN 2019).

RESULTS AND DISCUSSION

In the region covered by *Flore d'Afrique centrale* (Democratic Republic of the Congo, Rwanda and Burundi), eight existing species of *Hypolytrum* could be identified. Our material of the new species thus brings the total to nine. This material has a single central flowering stem, with two or three leaves and hence the species would belong to the section *Hypolytrum*. However, our material shows several characteristics in which it deviates from the other species in that section. It is the only African species producing thick tussocks, spicoids with three floral bracts and three anthers and a style with three (not two) stigmas. As all three sections of African *Hypolytrum* also have members on the American continent, most likely multiple dispersal events occurred between both continents. It is therefore not unlikely the closest relatives of exceptional species such as *H. goetghebeurii* are to be found across the ocean.

Amongst the African *Hypolytrum* species, our new species is the one that is best adapted to areas with a seasonally dry climate and exposed to seasonal fires. In the material examined, the outer leaf sheaths are often burned. The thick tussocks and rigid, often inrolled leaves are characteristics frequently observed in sedges growing in similar habitats. For *Hypolytrum* species and for Cyperaceae subfam. Mapanioideae in general, exposed habitats are rather exceptional as most species occur on rainforest floors. However, several *Hypolytrum* species from South America are known to be restricted to open vegetation habitats, such as rocky outcrops, grasslands on sandy soils or transition areas from dry-forest to savanna-like habitats (Koyama 1970, Alves et al. 2002, 2015). All of these species belong to the section *Hypolytrum* including *H. bahiense* M.Alves & W.W.Thomas, *H. leptocalamum* M.Alves & W.W.Thomas, *H. paraensis* M.Alves & W.W.Thomas, *H. pulchrum* (Rudge) H.Pfeiff., *H. rigens* Nees, and *H. supervacuum* C.B.Clarke (Alves et al. 2015). Several of these species exhibit a caespitose habit and inflorescence similar to our new Central African species.

Spicoids with a third stamen and subtending floral bracts are rather exceptional in *Hypolytrum* and previously described from within the same group of South American species mentioned here above (Koyama 1970, Alves et al. 2002, Prychid & Bruhl 2013) (see fig.1).

The style with three (not two) stigmas is probably the most striking unique characteristic of the new species. Most likely these three stigmas represent the plesiomorphic condition in *Hypolytrum* as well as in most other genera of the tribe Hypolytreae. Also, the spicoids with three or more staminate flowers subtended by floral bracts have been considered as basal for *Hypolytrum* and other members of the tribe (see e.g. Koyama 1970). Often, the latter character state is linked to pistils with three stigmata in *Mapania* (see Simpson 1992) and *Principina* Uittien (see Mesterházy & Browning 2014). In addition, the nutlet shape and surface, seems to be reminiscent of the single existing nutlet of *Principina*

grandis Uittien, which is subglobose with an acute base and longitudinally ridged (Mesterházy & Browning 2014), but similar nutlets can be found also in other *Hypolytrum* species such as the ones mentioned above (see e.g. Koyama 1970) as well as in some *Mapania* species (see e.g. Simpson 1992), thus possibly also indicative of a plesiomorphic character state.

Previous molecular studies were not able to resolve the relationships between the genera of the tribe Hypolytreae (see e.g. Simpson et al. 2003, Muasya et al. 2009). Therefore, further (molecular) studies in this tribe and into the taxonomic position of our new species certainly seem worthwhile to investigate the above hypotheses, though are beyond the scope of the present work.

The new species occurs in miombo woodland of what is called the Upper Katanga region (formerly called Shaba), which is well-known for its high level of endemism, often associated with the presence of copper, cobalt and other heavy metals (Malaisse et al. 2016). It is part of the Central Zambebian bioregion which has 23% of endemic plant species (Droissart et al. 2018). Duvigneaud (1958) has divided Upper Katanga into 12 phytogeographical Districts (some with two to four subdistricts) and our material originates from the Haut-Katanga occidental and Haut-Congo districts, with an outlier to the north-east on the Ubwari peninsula. The latter, however, carries the same type of Central Zambebian miombo woodland characteristic for the Upper Katanga region (Devred 1958). It is likely to also occur in north-eastern Angola, where this type of miombo woodland continues (Barbosa 1970).

Hypolytrum goetghebeurii Thery, sp. nov.

Differing from all other Central African *Hypolytrum* species because it forms thick tussocks, has narrow, rigid leaves, an inflorescence often composed of several levels, spicoids with three floral bracts each subtending an anther and a style with three stigmas. – Type: Democratic Republic of Congo, Haut Katanga, rivière Luilu à proximité de sa confluence avec le Lualaba, assez près du barrage de Nzilo (= barrage Delcommune), 10°30'06"S, 25°27'30"E, 25 Nov. 1981, *Malaisse* 12107 (holo-: BR, barcode BR0000024911450; iso-: BR, 3 duplicates, to be distributed to K, L(WAG) and P).

Description – Perennial, fairly robust herb, up to 80 cm tall, forming thick tussocks; rhizome short. Basal leaves many, old sheaths and blades persistent, not or slightly decomposing into fibres; blade linear, 40–65 cm × 6–10 mm, rigid, with its scabrous margins often inrolled. Inflorescence: flowering stem central, solitary, 50–80 cm × 2–3 mm, straight, triquetrous with the angles being scabrous below the inflorescence, thickened at base, carrying 2 or 3 leaves; panicle lax to fairly dense, 3–15 × 3–6 cm, sometimes the lowest node well separated from the remainder; involucre bracts leafy, linear, with acute apex, diminishing in length, the lower c. 25 cm × 2.5–3 mm; lowest panicle branch 8–30 mm long, scabrous. Spike fusiform to almost globose in fruit, 4–8 × 1.7–4.5 mm; spicoid bracts 2–2.5 × 1–1.2 mm, glabrous, reddish brown to dark brown, with a hyaline margin and a narrow central vein ending in a rounded apex or sometimes slightly protruding from it (in old spikes the margins of the spicoid bracts of-

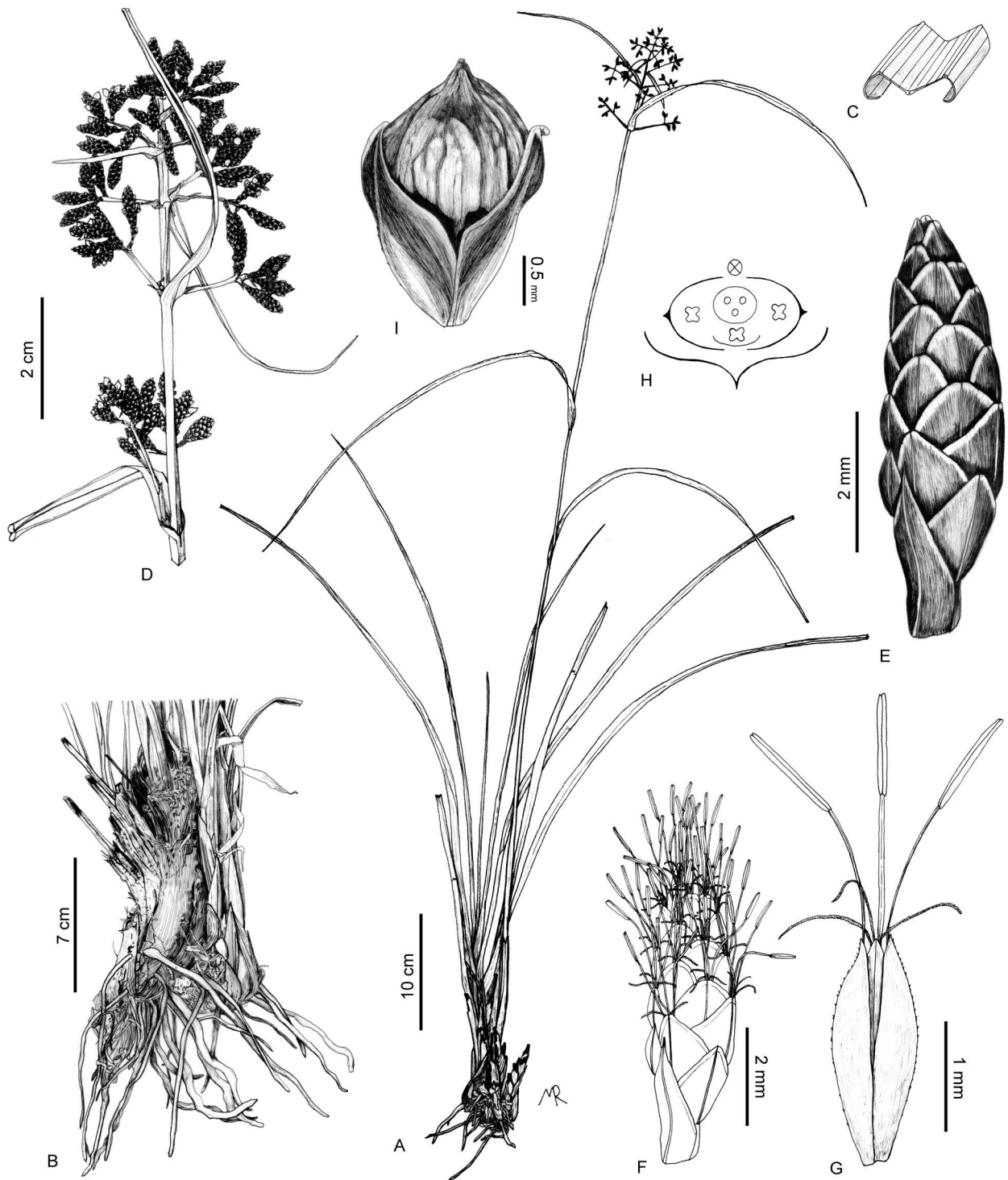


Figure 2 – Morphological characteristics of *Hypolytrum goetgheburii*: A, plant habit; B, plant base; C, section through leaf blade; D, inflorescence; E, spike; F, spike during anthesis; G, spicoid; H, diagram of a single spicoid with its bract; I, nutlet. A, from *Malaisse* 12107 (BR, barcode BR0000023156999); B, from *Malaisse* 12107 (BR, barcode BR0000023157279); C–E & I, from *Malaisse* 12107 (BR, barcode BR0000024911450); F–H from *Ankei Y. & T.* 79/0314 (BR, barcode BR0000024911269). Drawn by Marc Reynders. © Meise Botanic Garden all rights reserved, used with permission. This image is not covered by the terms of the Creative Commons licence of this publication. For permission to reuse, please contact the rights holder.

ten appear torn and withered). **Spicoid**: floral bracts 3, each subtending a stamen, the lower two lateral, narrowly elliptic-ovate, ± 2 mm long, with a weakly dentate keel and membranous margins, the third abaxial, narrow spatulate with acute apex and weak vein; style with 3 stigmas. **Nutlet** obovoid, 2.3×1.3 mm, with strong longitudinal ridges, the upper part inflated at maturity and yellowish, the lower part blackish. Fig. 2.

Distribution – Endemic to the South-East and East of the Democratic Republic of Congo (fig. 3).

Habitat – Shrub and herbaceous savanna, miombo woodland, *Brachystegia* woodland on rocky slope, *Marquesia* woodland on granitic soil, in *Uapaca* woodland, *Pseudoberlinia paniculata* woodland, on rocky soil, on a ridge, on dry reddish soil, at 900–1300 m a.s.l.

Other collections examined – Democratic Republic of Congo: **IX. Lacs Édouard et Kivu**: Ubwari peninsula, $04^{\circ}13'S$, $29^{\circ}13'E$, 27 Oct. 1979, *Ankei Y. & T.* 79/0314 (BR, barcode BR0000024911269); Ubwari peninsula, $04^{\circ}13'S$, $29^{\circ}13'E$, 7 Nov. 1979, *Ankei Y. & T.* 79/0386 (BR, barcode BR0000024911276); Ubwari peninsula, $04^{\circ}13'S$, $29^{\circ}13'E$, 18 Apr. 1947, *Van Meel* 1748 (BR, barcode BR0000024911511). **XI. Haut-Katanga**: Kazia, Katanga prov., $08^{\circ}21'S$, $26^{\circ}57'E$, 25 Jun. 1953, *Desenfans* 3539 (BR, barcode BR0000024911320, BRLU); Katanga, 32 km E de Dilolo-gare, c. $10^{\circ}39'S$, $22^{\circ}37'E$, 27 Aug. 1956, *Duvigneaud* 2523cy (BRLU); Kolwezi Terr., Mutshatsha, c. $10^{\circ}38'S$, $24^{\circ}28'E$, 28 Aug. 1956, *Duvigneaud* 2530cy (BRLU); Katanga, Nzilo, km 7.2 Delcommune - Delmar, c. $10^{\circ}31'S$, $25^{\circ}24'E$, 14 Jun. 1957, *Duvigneaud* 3514cy and 3514Ccy (BRLU); Nzilo (Katanga), c. $10^{\circ}30'S$, $25^{\circ}28'E$, 14 Dec. 1959, *Duvigneaud* 4546cy4 (BRLU); between Nzilo

and Delcommune, c. $10^{\circ}30'S$, $25^{\circ}28'E$, 14 Dec. 1959, *Duvigneaud* 4549cy (BRLU); Delcommune, $10^{\circ}30'S$, $25^{\circ}28'E$, 14 Dec. 1959, *Duvigneaud* 4570cy (BRLU); km 1.5 on road Nzilo to Le Marinelle (Kolwezi terr.), $10^{\circ}30'30''S$, $25^{\circ}27'40''E$, 21 Sept. 1958, *Plancke* 111/1552 (BRLU); km 107 Kolwezi to Kamina, c. $09^{\circ}50'S$, $25^{\circ}20'E$, 05 Apr. 1948, *Schmitz* 1804 (BR, barcode BR0000024911474).

Preliminary IUCN Red List assessment – Vulnerable, VU B2ab(i,ii,iii,iv,v). Having only herbarium record information, Criterion B has been applied. The species has an Extent of Occurrence (EOO) of 113 747 km² which exceeds the upper limit of any threat category under sub-criterion B1. Using the recommended grid cell size of 2×2 km, it has an Area of Occupancy (AOO) of 28 km² which falls within the limits of the Endangered category under sub-criterion B2. The species is known from 13 herbarium collections, collected between 1947 and 1981 in eight different localities of which only one falls within a protected area (Upemba National Park). Looking at the threats, these eight localities comply to six different locations. The three central-south locations are positioned in the Katanga Copperbelt and hence are threatened by mining activities accompanied by deforestation and environmental pollution (Saad et al. 2012, Friends of the Earth Netherlands /Milieudefensie et al. 2015). We therefore infer a future decline in the number of subpopulations and hence in the AOO and EOO, as well as a decline in the area of extent and number of mature individuals. Based on these observations, we assess the species as Vulnerable, VU B2ab(i,ii,iii,iv,v).

Etymology – The species is named after Prof. em. Dr. Paul Goetghebeur of Ghent University, who had initially recognized the material represented a new species, to honour his great work in the Cyperaceae family and for having been the mentor of many other Cyperaceae researchers.

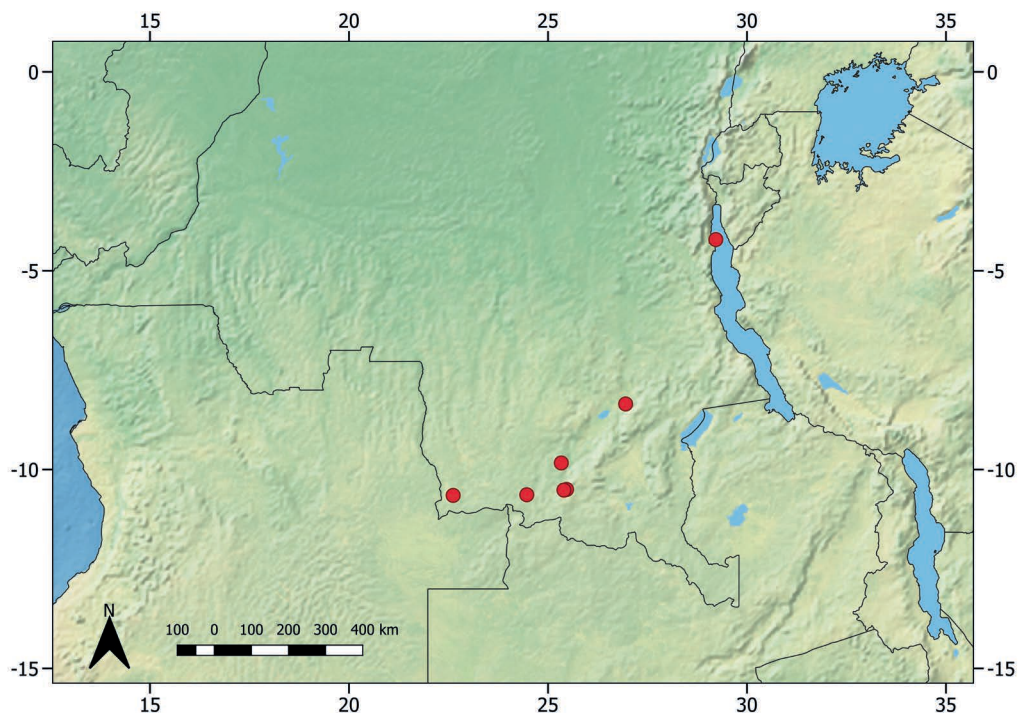


Figure 3 – Map showing the collecting localities of *Hypolytrum goetghebeurii*. Map produced using QGIS (QGIS Development Team 2019).

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