Phytotaxa 374 (3): 241–248
http://www.mapress.com/j/pt/

Article

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

https://doi.org/10.11646/phytotaxa.374.3.5

A new species of *Ochna* (Ochnaceae) from the Barberton Mountains of Mpumalanga, South Africa

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Abstract

Ochna barbertonensis is described as a new species from the Barberton Mountains in Mpumalanga, South Africa. The new species is characterised by its suffrutescent habit, elongate-deltoid stipules sometimes with broadened base, mucronate leaf tip and high anther to filament ratio, where the anthers are ca. two times longer than the filaments. It is placed within sect. *Ochna* due to its poricidal anthers and subglobose drupes, attached at the base. It is most likely to be confused with the superficially similar suffrutescent species *Ochna confusa*, but that species has longitudinal anther dehiscence and anthers shorter than the filaments. The new species occurs within well protected nature reserves, but is only known from five collections with an Extent of Occurrence (EOO) of 34 km^2, making it a 'Rare' species under the Red List of South African Plants. A species description, illustration and distribution map are provided.

Keywords: anthers, buzz-pollination, conservation, sepals, serpentine, suffrutex, taxonomy

Introduction

The genus *Ochna* Linnaeus (1753: 513), also known as 'Mickey Mouse Plants' (Christenhusz *et al*. 2017), is characterized by the enlarged, persistent sepals becoming bright red in fruit and black drupes sitting on an accrescent red receptacle (torus). *Ochna* is differentiated from the morphologically similar genus *Brackenridgea* Gray (1854: 361) (Verdcourt 2005) by having stipules entire to fringed and yellow petals, versus stipules that are laciniate to deeply divided and white to pink petals in *Brackenridgea* (Robson 1963, Verdcourt 2005, Amaral & Bittrich 2014). The two genera differ from other members of the subtribe Ochninae (Schneider *et al.* 2014), such as the Old World tropical genus *Campylospermum* van Tieghem (1902: 35), by having 12 or more stamens, versus 8–10 stamens in the other genera (Robson 1963, Vercourt 2005, Amaral & Bittrich 2014). Schneider *et al.* (2014) placed *Ochna* closest to *Rhabdophyllum* van Tieghem (1902: 201) in a molecular analyses based on five DNA loci (ITS, *matK, ndhF*, *rbcL, trnL-F*). However, this disagrees with Bissiengou (2014), which inferred *Ochna* as sister to *Brackenridgea* based on chloroplast markers (*matK, rbcL*, *trnL, trnL-F*) as well as widely used morphological evidence. Further study into the genera of subtribe Ochninae and sister clades to *Ochna* is needed.

Ochna is an Old World genus of mainly trees, shrubs and shrublets comprising ca. 85 species (Du Toit & Obermeyer 1976, Verdcourt 2005, Amaral & Bittrich 2014). It is predominantly found in continental Africa and Madagascar, with one species also occurring in Mauritius and four in Asia (Verdcourt 2005). Within Tropical Africa, *Ochna* has been treated in various Flora accounts (notably Robson 1963, Bamps & Farron 1967, Du Toit & Obermeyer 1976, Verdcourt 2005). For southern and South Tropical Africa, twelve species were recognised in the *Flora of Southern Africa* (Du Toit & Obermeyer 1976); three species in the *Flora of Swaziland* (Compton 1976); 31 species in *Flora Zambesiaca* (Robson 1963) and 22 tree species in the *Trees of Southern Africa*, two of which are yet to be formally described (Coates Palgrave 2002). Although the genus is fairly well documented at a regional scale, species delimitation within the group is more problematic and many Flora accounts are still incomplete. For example, the *Flora of Tropical East Africa* lists 47 species, 13 of which are not formally described and many are only known from one collection (Verdcourt 2005).

A sectional division of the genus was proposed by Robson (1963) in *Flora Zambesiaca*, where he recognized

Accepted by Ronell Klopper: 9 Oct. 2018; published: 7 Nov. 2018

three sections based on differences in drupelet shape and attachment position and in anther dehiscence. Section *Renicarpus* has reniform drupelets attached in the centre, whilst sects. *Ochna* and *Schizanthera* have ellipsoid or subglobose drupelets attached at or close to the base. These latter two sections differ in sect. *Ochna* having anthers with poricidal dehiscence, whilst sect. *Schizanthera* has anthers with longitudinal dehiscence; both anther dehiscence types are recorded in sect. *Renicarpus*. Evidently, a key character for the identification of *Ochna* species lies within anther morphology of which the poricidal anthers have developed (potentially on more than one occasion if the infrageneric classification is correct) as an adaption to buzz-pollination (Matthews *et al.* 2012, Schneider *et al.* 2014). However, as *Ochna* species are very often collected in fruit due to the conspicuous brightly-coloured persistent calyx and torus, the anthers are not easily observed in numerous specimens, which has often left species delimitation incomplete.

There is a vital need for a more detailed study of the genus at continental and global scales, in order to better delimit the species, study their relationships and, in turn, assess the conservation importance and priorities within the group. This is demonstrated through the number of new species known or suspected, but still not formally described. This work forms part of a larger study into the evolutionary history and taxonomy of the genus, which will incorporate phylogenomic sequencing techniques to better understand the evolution of key character traits and their influence on speciation (T. Shah *et al*., unpublished data).

In 2012, the first collection of a potentially new species of *Ochna* was made from the Songimvelo Nature Reserve, in Mpumalanga province, South Africa. The reserve is situated near the border of Swaziland (eSwatini) and lies within the Barberton Centre of Endemism (Williamson 2016). In 2013 and 2017, additional collections were made from the neighbouring reserve, Barberton Nature Reserve phase 3, a newly designated World Heritage Site recognised for the presence of the Barberton Greenstone Belt geological formation (Oosthuizen 2017). The Greenstone Belt boasts numerous serpentine outcrops that give rise to serpentine-derived soils, low in calcium and nutrient content, with high concentrations of nickel and chromium and poor water holding capacity (Harrison *et al.* 2006, Williamson & Balkwill 2015). The harsh soil environment created by these physical and chemical properties only allow for serpentine-tolerant species to colonise, which in turn may lead to ecological speciation resulting in plant species restricted to these sites (Kruckeberg 1986, Rajakaruna 2004, Williamson 2016). Some examples include *Berkheya coddii* Roessler (1959: 231), *Brachystelma dyeri* Balkwill & Balkwill (1988: 61) and *Indigofera crebra* Brown (1925: 150) (Williamson & Balkwill 2015).

One of the current authors (JB) attempted to identify the initial specimen of this *Ochna* species at the BNRH herbarium and by referencing the *Flora of Southern Africa* account of the genus. At first, it was considered to be a form of *Ochna confusa* Burtt Davy (1926: 238), another suffrutescent species in the region that also occurs widely across Africa from Tanzania to northern South Africa. However, further collections showed distinct morphological traits, and with further investigation and careful comparison to *Ochna confusa* and other potentially confusing taxa within the range and more widely in southern Africa, it was found to be a distinct morphological entity. As a result a new species from South Africa is described, and a table of morphological characters, distribution map and taxonomic description are provided below.

Throughout Africa, many *Ochna* species are known to have highly restricted ranges. In Mozambique, for example, *Ochna dolicharthros* Crawford & Darbyshire (2015: 70) is only known from coastal woodland in Palma district of Cabo Delgado and *Ochna beirensis* Robson (1962: 17) is known only from deciduous woodland and coastal scrub in the Beira district of Sofala, whilst in Tanzania, *Ochna polyarthra* Verdcourt (2005: 16), is known only from the type specimen from Kisarawe Forest Reserve. These range restricted species are of high conservation concern especially with an increasing rate of habitat loss. Many endemic species are only known from a few collections and occupy specific habitats. Therefore, understanding and documenting these species is highly important for their protection and in turn the protection of their habitat.

Materials and Methods

Morphological characters were measured on herbarium specimens at the Kew herbarium (K) and from high resolution scans from the Buffelskloof Nature Reserve herbarium (BNRH) using ToupTek ToupView version: x64 (2016). The new species was compared to other *Ochna* species with similar habit and/or overlapping geographical distribution. The terminology is according to Beentje (2010) and herbarium acronyms follow Index Herbariorum (Thiers 2018) except for Barberton Mountainlands Herbarium, which is not officially registered, but abbreviated as BMLH. An exclamation mark (!) is used to indicate a specimen that has been seen and an (*) for specimens digitally seen. Detailed

measurements are based primarily on *J.E.Burrows & S.M.Burrows 13729* and *Oosthuizen 2575*. A provisional species conservation assessment was made using the IUCN Red List categories and criteria (IUCN 2012); Extent of Occurrence (EOO) and Area of Occupancy (AOO) were calculated using the GeoCat tool (Bachman *et al.* 2011). The assessment has not yet been submitted to the IUCN.

Results

Ochna barbertonensis belongs to sect. *Ochna* due to its poricidal anthers and subglobose drupes, attached at the base (Robson 1963). It is characterised by its suffrutescent habit, variable stipules, mucronate leaf tip and high anther to filament ratio where the anthers are ca. two times longer than the filaments. Superficially, *Ochna barbertonensis* most closely resembles *O. confusa* due to its suffrutescent habit. However, the two species are not closely related and fall within different sections in the genus, as *O. confusa* has longitudinal anther dehiscence and belongs to sect. *Schizanthera.* The new species is also compared to *Ochna natalitia* (Meisner 1843: 58) Walpers (1843: 826) (Table 1), a potentially more closely related species with respect to the *Flora of Southern Africa* (Du Toit & Obermeyer 1976). The two species fall within sect. *Ochna,* due to both having poricidal anthers and a style fused to the apex with five spreading stigma lobes. However, besides these similarities, they differ significantly by *Ochna natalitia* being a tree of up to 10 m tall, with larger leaves (26–100 × 10–37 mm) with an obtuse apex without an extended mucronate tip, and by having anthers slightly shorter than the filaments.

TABLE 1. Comparison of diagnostic characters between *Ochna barbertonensis* and two morphologically similar species.

Characters	*O. barbertonensis*	*O. confusa*	*O. natalitia*
Habit	Suffrutex	Suffrutex or dwarf shrub	Tree
Size	Up to 0.2 m tall	Up to 1 m tall	Up to 10 m tall
Young leaves	Reddish brown	Brown	Dark coppery-red
Leaf apex	Acute or rarely obtuse, mucronate for up to 2.5 mm	Acute, mucro absent	Obtuse (with or without mucro)
Leaf size (length × width)	21–47 × 9–15(–18) mm	60–90 × 15–25 mm	26–100 × 10–37 mm
Stipules	Variable, linear to elongate-deltoid, fringed, variable in position	Elongate-deltoid, intrapetiolar	Elongate-deltoid, intrapetiolar
Pedicel length at anthesis	Up to 17 mm	Up to 12 mm	10–20 mm
Pedicel length in fruit	12–18 mm (only young fruit seen)	9–12 mm	12–25 mm
Inflorescence	Racemes	Pseudo-umbels	Racemes or pseudo-umbels
Anther dehiscence	Poricidal	Longitudinal	Poricidal
Anther length	2–4 mm	1–2 mm	2–3 mm
Anther:Filament ratio	2:1	1:2	5:7
Filament length	1–3 mm	2–5 mm	3–4 mm
Style and stigma	Style fused to apex, with five spreading or recurved stigma lobes	Style fused, stigma capitate	Style fused to apex, with five spreading flattened stigma lobes

Taxonomy

Ochna barbertonensis T.Shah *sp. nov.* (Figs. 1 and 2)

Diagnosis:—*Ochna barbertonensis* is most similar to *Ochna confusa* Burtt Davy with regards to its dwarf suffrutescent habit, narrowly elliptic leaf shape and serrulate leaf margin. However, it differs significantly in floral morphology: *Ochna confusa* has longitudinal anther dehiscence, an anther to filament ratio of 0.5:1 and a capitate stigma, whilst *Ochna barbertonensis* has poricidal anther dehiscence, anthers almost twice as long as the filaments and a style apex of 5 free, recurved lobes. In addition *Ochna confusa* has a large lignotuber with more robust erect branching, whilst *Ochna barbertonensis* has a thick horizontal woody rhizome with well-spaced, slender annual stems. (See Table 1.)

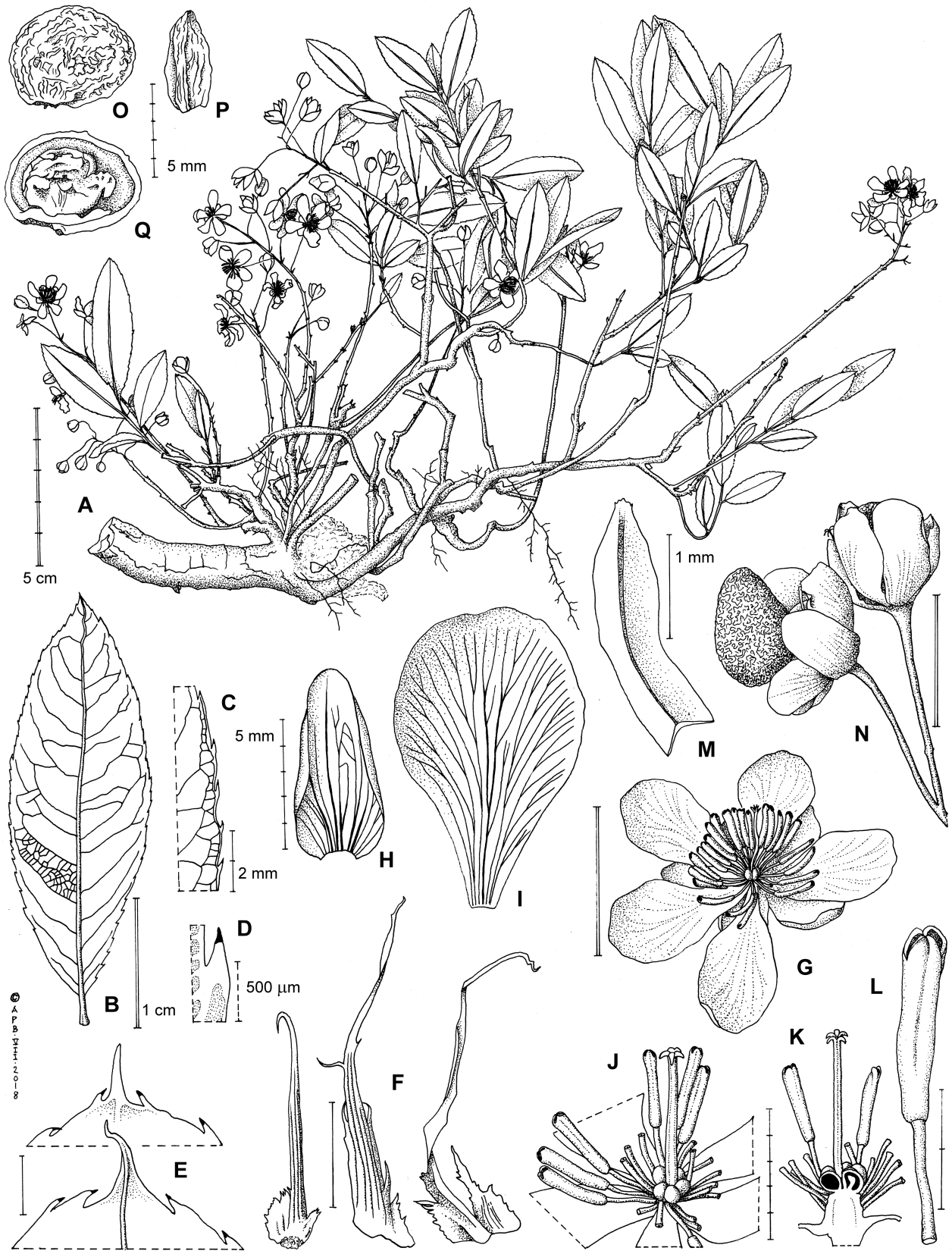

FIGURE 1.—*Ochna barbertonensis*. A. Habit. B. Abaxial leaf surface. C. Detail of adaxial leaf margin. D. Detail of single serrulation showing mucronate tip. E. Two leaf apices: adaxial above, abaxial below. F. Three stipules. G. Open flower. H. Inner surface of sepal showing natural curvature. I. Inner surface of petal. J. Details of inner flower organs: gynobasic style, stigma lobes and anthers. K. Cross-section showing receptacle and ovules. L. Stamen. M. Scale. N. Immature fruits with persistent (not reflexed) sepals. O–P. Immature drupe. Q. Cross-section of single seeded fruit. Drawn by Andrew Brown from *J.E.Burrows & S.M.Burrows 13729* (A–M) and *Oosthuizen 2575* (N–Q).

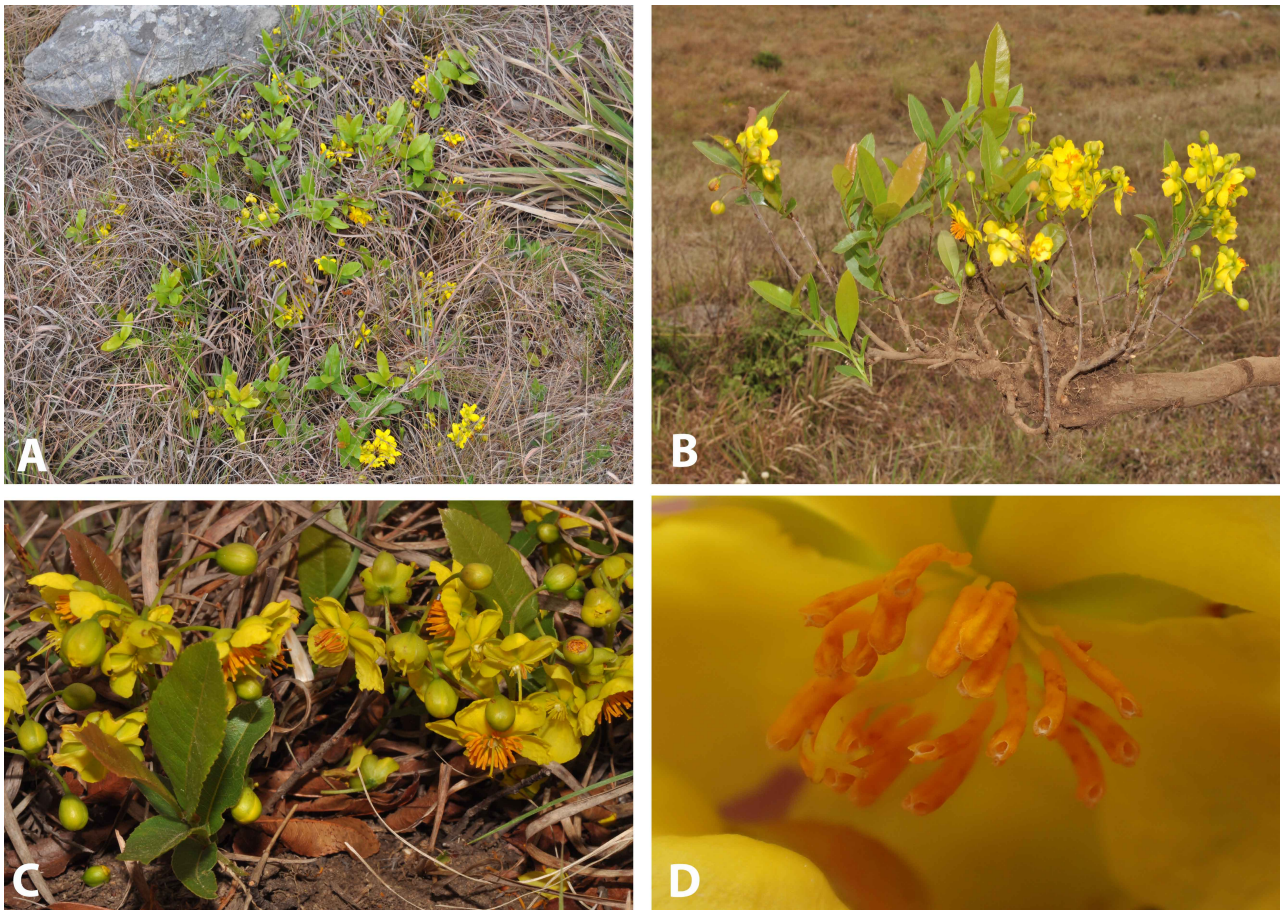

FIGURE 2.—Photographs of *Ochna barbertonensis* in the field. A. Showing the grassland habitat. B. Showing suffrutescent habit. C. Flowers. D. Close of up of the flower showing poricidal anthers and style. Photos: John Burrows.

Type:—SOUTH AFRICA. Mpumalanga Province. Bearded Man, extreme eastern corner of Songimvelo Nature Reserve on border of Swaziland [eSwatini], above Satico Plantations, 1279 m, 26 September 2013*, J.E.Burrows & S.M.Burrows 13729* (holotype: K!; isotypes: BNRH, LYD, PRE).

Geoxylic suffrutex with thick horizontal *rhizome*, 2 cm thick, bearing multiple erect annual shoots up to ca. 20 cm tall. *Branches* grey, glabrous, lenticellate, sometimes peeling off in thin papery pieces, cylindrical; leafy branchlets brown, puberulent. *Leaves* lamina green when mature, reddish brown when young, glabrous, blade narrowly elliptic, 21–47 mm long, (6–)9–15(–18) mm wide, apex acute or sometimes obtuse, often with a conspicuous mucro extending up to 2.5 mm long, more so in young leaves, base attenuate to obtuse, margins serrulate with teeth incurving often ending in darkened mucronate tips, venation conspicuous, midrib raised abaxially and adaxially, lateral veins prominent extending to leaf margin, 10–14 pairs, tertiary veins reticulate, conspicuous; petioles up to 2 mm long. *Stipules* lateral to the petiole, sometimes nearly fused at base, semi-persistent, variable, linear to elongate-deltoid sometimes with broadened base, margins fringed, up to 5(–6.5) mm long. *Inflorescences* terminal, on leafless shoots from rhizomatous base, 2- to 9-flowered, condensed racemes, total inflorescence length 1.0–3.5 cm, inflorescence axes puberulent, pale green, total length of pedicels (4–)9–17 mm long at anthesis, length of pedicels below articulation point 2.5–6.0 mm, articulated mostly in proximal half; scales present on pedicels, translucent brown with darkened central line, linear-ensiform, navicular, caducous, 1.2–3.0 mm long; pedicels 12–18 mm long in immature fruit. *Sepals* 5, green, narrowly ovate to ovate, 5–7 mm long, 2–4 mm wide at anthesis; deep red, extending to 7–9 mm long in fruit, not reflexed (only immature fruits seen). *Petals* 5, bright yellow, obovate, clawed, concave when live, 6.0–10.5 mm long, 3.5–6.0 mm wide, glabrous. *Stamens* many, more than 10, filaments 1–3 mm long, anthers 2–4 mm long, apically biporose. *Carpels* 5, styles gynobasic, united almost to the apex, 2.5–4.5 mm long, apices free with five spreading or recurved stigma lobes. *Drupelets* (immature) black, subglobose, attached at base, ca. 6 mm long, ca. 8 mm wide.

Distribution:—*Ochna barbertonensis* is confined to the Barberton Centre of Endemism (Van Wyk & Smith 2001: 116), Mpumalanga, South Africa at an elevation of 1104–1320 m (Fig. 3).

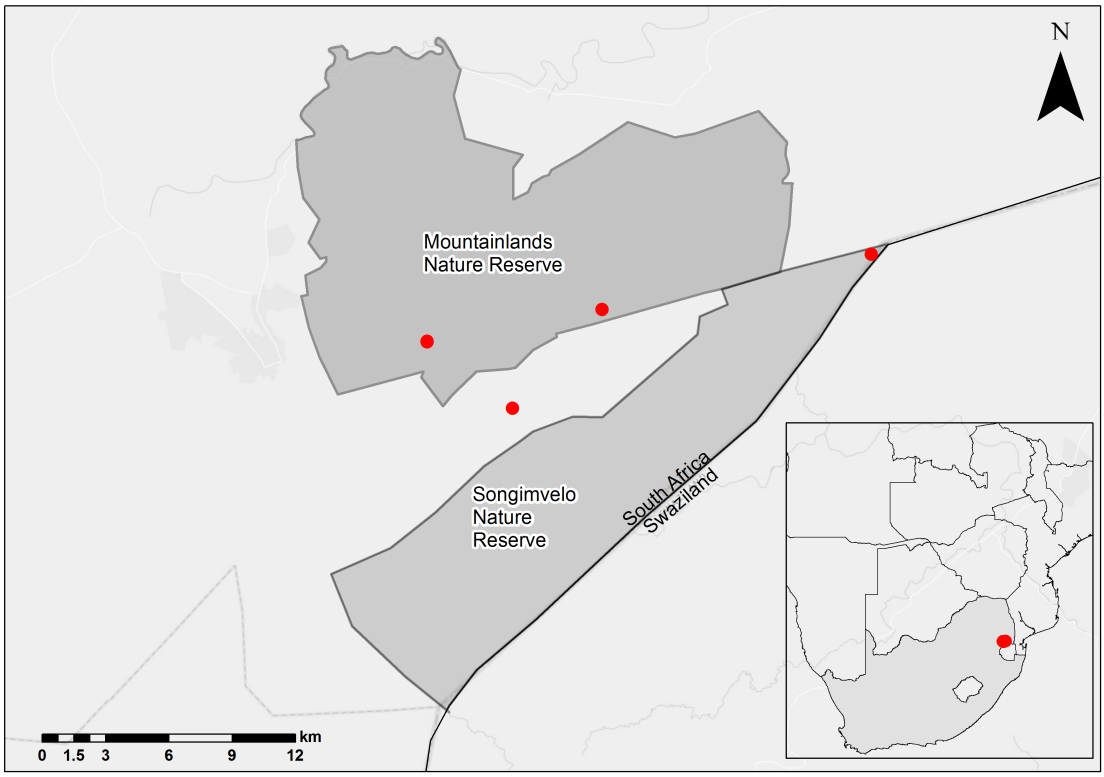

FIGURE 3.—Distribution map of *Ochna barbertonensis* in South Africa. Red circles represents the known species distribution based on herbarium specimens.

Habitat & Ecology:—The species grows on reddish clay-loams in short Barberton Montane Grassland (Mucina & Rutherford 2006), which is usually burnt at least every second year. The geology is predominantly derived from shales, conglomerates, sandstones and siltstones of the Moodies Group of the Barberton Greenstone Belt (Brandl *et al*. 2006). Associated geoxylic suffrutices growing with it are *Parinari capensis* Harvey (1862: 597) subsp. *capensis* and sometimes *Elephantorrhiza elephantina* (Burchell 1824: 236) Skeels (1910: 29).

Conservation Status:—Least Concern (LC). *Ochna barbertonensis* is only known from five collections within the Barberton Nature Reserve Phase 3 (Barberton Mountainlands Nature Reserve), the Songimvelo Nature Reserve and one collection from Shiyalongubo road where it is confined to a grassy verge between the road and a pine plantation. It has an estimated Extent of Occurrence (EOO) of 34 km^2 and Area of Occupancy (AOO) of 16 km^2, the latter using the standard 2 × 2 km grid cell recommended by the IUCN Standards and Petitions Subcommittee (2017). The Barberton Mountainlands Nature Reserve is a protected and well managed area, where the grasslands undergo rotational burning every three to four years and is irregularly grazed by herbivores. These conservation management practices favour this species and its associated habitat (D. Oosthuizen pers. comm.). The Songimvelo Nature Reserve forms part of the Lubombo Transfrontier Conservation Area established in June 2000, which is protected as a peace park between Swaziland and South Africa (Smith *et al.* 2008). Therefore, although the geographic range of the species falls within the threatened categories (IUCN 2012), the species is well protected and currently there are no immediate threats. However, due to its restricted distribution and its presence close to a road at one of its localities, it has the potential to fall into a threatened category if a threat arises in the future. It is therefore essential to continuously monitor this species. Furthermore, this species qualifies as 'Rare' under the Red List of South African Plants (SANBI 2011) by having a restricted range of <500 km^2, whilst not being exposed to any direct or plausible potential threat and so not qualifying for a threatened category under the IUCN criteria.

Phenology:—Collected in flower between September and November. Collected with immature fruit in October. The Barberton Greenstone Belt has a summer rainfall pattern mainly from November to March, the flowering time of *Ochna barbertonensis* may correspond with early rains (Changwe & Balkwill 2003, Williamson & Balkwill 2015).

Etymology:—The specific epithet refers to the Barberton Centre of Endemism to which the plant is restricted.

Additional specimens examined (Paratypes):—SOUTH AFRICA. Mpumalanga: Barberton Nature Reserve phase 3, Airstrip between Dycedale 368JU and Wonderscheur 362JU, 1104 m, 21 October 2017, *Oosthuizen 2575*

(BMLH!); Shiyalongubo road embankment, straight section uphill and west of turnoff to remnants of Twello forestry station, Twello 373JU, close to boundary of Zeist 363 junction, 1198 m, 1 November 2017, *Oosthuizen & Froneman 2630* (BMLH*); Barberton Mountainlands Private Nature Reserve, 1100 m, 28 October 2012, *Turpin & von Staden 548* (BNRH!); Barberton Mountainlands Private Nature Reserve, Shiyalongubo Gate on track leading W along fence, 1320 m, 10 November 2012, *J.E.Burrows & S.M.Burrows 13080* (BNRH!, J).

Acknowledgments

We thank Barbara Turpin, manager of the Buffelskloof Herbarium (BNRH), for her help in scanning specimens and for personally delivering a loan specimen to Kew; Delia Oosthuizen for providing access to the Barberton Mountainlands Private Nature Reserve, collections, frequent visits back to the site, her extremely useful photographs and knowledge of the region. We also thank Andrew Brown for his beautiful line drawing of the new species. Two anonymous reviewers are thanked for suggesting improvements to the manuscript.

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