Olinia chimanimani (Penaeaceae), a new species endemic to the Chimanimani Mountains of Mozambique and Zimbabwe

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Summary. *Olinia chimanimani* T. Shah & I. Darbysh. is described as a distinct species from the Chimanimani mountains in Mozambique and Zimbabwe, based on morphological evidence. It differs from other species of *Olinia* sect. *Rochetiana* in its smaller leaf size, sessile leaf attachment, glabrous flowers and galled flowers becoming narrowly swollen without prominent tubercles when infected. A species description, key and illustration, distribution map and ecological information are provided. The populations have been studied in the field, and it is only known from two locations. It is potentially under threat from burning due to human activity associated with illegal artisanal mining activity, and thus has been evaluated as Endangered (EN) using the IUCN Red List categories and criteria.

Key Words. conservation, Endangered, IUCN Red List assessment, key, morphology, Oliniaceae, restricted range.

Introduction

The Chimanimani – Nyanga Highlands in Southeast Africa are the most isolated component of the African Great Escarpment (Clark *et al.* 2011) and are noted for their significantly high levels of endemism (Wild 1964). The Chimanimani Mountain range is situated on the border of Zimbabwe and Mozambique (approx. 33°00E, 19°50S) and forms part of the Eastern Afromontane hotspot (BirdLife International 2012). Its relative isolation from other mountains and an unusual underlying geology, with extensive outcrops of nutrient-poor quartzite, have given rise to a biodiversity hotspot with high plant endemism.

The region has been of long-standing interest for botanists, with the majority of information and plant collections derived from the Zimbabwe portion whilst the larger Mozambican side of the massif has been far less well studied. Recent surveys under a Critical Ecosystem Partnership Fund (CEPF) project “*In from the cold: providing the knowledge base for comprehensive biodiversity conservation in the Chimanimani Mountains, Mozambique*” have addressed this gap by facilitating a botanical study of the Mozambique side, resulting in a better understanding of the endemic species, their distribution, threats and conservation status (Timberlake *et al.* 2016). This work has resulted in a comprehensive checklist of species with a restricted distribution occurring on quartzite and scrub above 1200 m, with 74 strict endemic and 19 near-endemic taxa documented (Wursten *et al.* 2017). These recent surveys have also uncovered several potentially new species to science, as well as providing more

collections for species that had previously only been considered to be tentatively distinct and not formally described, such as *Empogona jenniferae* Cheek (Cheek *et al.* in press). The number of endemic plant species on Chimanimani is therefore sure to continue to rise.

The most recent taxonomic revision of the genus *Olinia* Thunb. was carried out by Sebola & Balkwill (2013) supported by a phenetic analysis (Sebola & Balkwill 2009). They recognised ten species divided into two sections; sect. *Olinia* and sect. *Rochetiana*, readily separated by their morphology. Sect. *Olinia* has inconspicuous tertiary veins on the adaxial surface with tertiary veins looping only once at the margin and sect. *Rochetiana*, has conspicuous tertiary venation on the adaxial surface with tertiary veins looping twice at the margin (Sebola & Balkwill 2013). *Olinia* has previously been placed in its own monogeneric family, Oliniaceae (see e.g. Verdcourt 1978; Heywood *et al.* 2007). However, it has recently been transferred to the Penaeaceae family based on molecular evidence, where it is recognised as one of three tribes, Olinieae Horan. alongside Rhynchocalyceae Beusekom and Penaeae DC. (APG IV 2016).

During the first of three CEPF surveys in 2014, two collections of an unusually small-leaved species of *Olinia* were made by the third author of this paper on the Mozambican side of Chimanimani. These specimens were matched to existing specimens from the Chimanimani Mountains in the Kew (K) herbarium. The first ever collection of this small-leaved *Olinia* was made by Hiram Wild (Wild 3606) in 1950 on the Zimbabwe side of the

massif. This specimen, and the later collection Whellan 2203 (K), were recognised by Verdcourt (1978) in the *Flora Zambesiaca* treatment of Oliniaceae as a pathological form of *Olinia vanguerioides* Baker f., but he noted that the specimens had much smaller leaves. Sebola & Balkwill (2013) did not discuss or cite these collections, or a third, flowering specimen Linder 3990 (K) within any of their delimited species. A further botanical expedition to the Chimanimani Mountains in 2016, during which this *Olinia* species was specifically targeted, resulted in additional collections with similar characteristics growing in similar habitats to the older specimens. All the specimens are restricted to higher elevation regions of Chimanimani. These specimens were closely compared with sympatric and morphologically similar species of *Olinia* in order to assess its taxonomic status and it is concluded that the Chimanimani taxon is a distinct species, described here as *Olinia chimanimani* T. Shah & I. Darbysh.

Further, it was brought to light during this study, that whilst Sebola and Balkwill (2013) recognised two sections in *Olinia*, these were not validated according to Article 40.1 of the Botanical Code (ICN, McNeill *et al.* 2012). To rectify this, we validate sect. *Rochetiana* in the taxonomic treatment below.

Material and Methods

Morphological characters for the new species were measured on herbarium specimens at the Kew herbarium. Other herbaria with holdings of Zimbabwean and Mozambican specimens (BM, LMA, SRGH) were checked for additional material of the new species, but none were found. All characters were measured on dry material, except internal floral characters which were measured from a rehydrated flower under a dissecting microscope. Characters deemed to be of taxonomic significance follow the most recent monographic revision of *Olinia* (Sebola & Balkwill 2013) and the terminology is according to Beentje (2010). A species conservation assessment was made using the categories and criteria of IUCN (2012).

Taxonomic Treatment

Olinia* sect. *Rochetiana Sebola & Balkwill ex T. Shah
sect. nov. Type species: *Olinia rochetiana* A. Juss., *Comp. Rend. Hebd. Séances Acad. Sci.* 22: 812 (Jussieu 1846).

<http://www.ipni.org/urn:lsid:ipni.org:names:77178774-1>

Olinia chimanimani T. Shah. & I. Darbysh. **sp. nov.** Type: Zimbabwe, Manicaland, Chimanimani Mountains, at W base of (Pnt.?) 71, Linder 3990 (holotype K! [K000963156]).

<http://www.ipni.org/urn:lsid:ipni.org:names:77178775-1>

Shrub or *small tree* up to 5 m. *Bark* thin, pale grey (white) to brown. *Branchlets* grey to brown, convexly quadrangular with ridges. *Leaves* sessile, simple, entire, opposite except on young (or sapling) branches when ternate, blade coriaceous, obovate to oblanceolate occasionally elliptic, (19.0 –) 25.0 – 40.0 mm long, 10.0 – 25.0 mm wide, base attenuate, apex retuse with short mucro often with pink tinge, margins involute, sometimes with pink tinge, adaxial lamina green, glossy, glabrous, primary vein slightly impressed drying pink at base, secondary venation 6 – 14 pairs, not prominent, tertiary venation conspicuous, abaxial lamina pale green, glabrous, primary vein raised, secondary veins slightly raised, tertiary venation conspicuous. *Inflorescences* terminal compound cymes, total inflorescence length 21 – 48 mm; primary inflorescence unit 0.4 – 1.5 mm long, puberulent; secondary inflorescence unit 2.1 – 4.4 mm long, puberulent; tertiary and quaternary inflorescence units pubescent, pink (Fig. 1). *Bracts* leaf-like in morphology, located on primary and secondary inflorescence axis, variable, 3.3 – 12.5 mm long, 1.6 – 3.6 mm wide. *Flowers* 5-merous, actinomorphic, pinkish when fresh, in groups of three. *Hypanthium* glabrous, narrow, thinly walled, 1.5 – 4.7 mm long. *Sepals* highly reduced and not discernible. *Petals* 5, slightly thick and fleshy, spatulate, 1.2 – 2.25 (– 4.0) mm long, 0.9 – 1.4 mm wide, apex with short mucro, glabrous, pale yellow when dry. *Scales* located on the inside of petals, 0.35 – 1.2 mm long, 0.4 – 0.6 mm wide, densely pubescent on both surfaces. *Stamens* all attached along the same radius of inner hypanthium tube reaching the mouth of the flower, anthers 0.55 – 0.6 mm long. *Ovary* inferior, glabrous, 1.2 – 2.5 mm long, 5-locular; style puberulent, shorter than the floral tube, approx. 0.6 mm; stigma globular. *Galled flowers* somewhat swollen but linear, 2.0 – 3.3 (3.9) mm long, 0.35 – 0.7 (1.65) mm wide, drying dark, without conspicuous tubercles. *Drupes* globose, glabrous, ± 6.0 mm in diam., 5-locular, pinkish, drying pale brown. *Pericarp* thinly fleshy, *endocarp* brown, woody, not smooth. *Seeds* ellipsoid to horse-shoe shaped, smooth, with spiral marking on the surface, ± 2.45 mm diam., usually only one seed per fruit due to abortion of other ovules (only immature seeds seen). Figs 1, 2 and 3.

RECOGNITION. *Olinia chimanimani* has previously been confused with *O. vanguerioides* as their ranges overlap. However, morphologically the two species are clearly distinct. *O. chimanimani* can be distinguished by its smaller leaf size ((19.0 –) 25.0 – 40.1 mm long), sessile leaf attachment, and galled flowers becoming thinly swollen when infected, without prominent tubercles, compared to *O. vanguerioides* which has larger (40.1 – 170.0 mm long), petiolate leaves and flowers forming conspicuous elongate-tuberculate galls when infected.

Fig. 1. Inflorescence arrangement in *Olinia* species, adapted from Sebola & Balkwill (2009).

Additionally, *O. chimanimani* may be confused with *O. huillensis* A. Fern. & R. Fern. and in particular with subsp. *discolor* (Mildbr.) Sebola; however, *O. chimanimani* differs from this taxon in having a leaf texture that is strictly coriaceous, smaller leaves ((19.0 –) 25.0 – 40.0 mm long) with a strictly sessile leaf attachment, smaller petals (1.2 – 2.25 (– 4.0)) mm long, 0.9 – 1.4 mm wide), glabrous inner and outer petal indumentum and strictly glabrous hypanthium indumentum (1.5 – 4.7 mm long). *O. huillensis* subsp. *discolor*, on the other hand, has a variable leaf texture of chartaceous to coriaceous, larger leaves (33 – 77 mm long) with short petiole (1.0 – 5.8 mm long), larger petals ((1.0 –) 2.0 – 2.9 mm long, (1.2 –) 1.5 – 2.8 mm wide), pubescent inner petals often with stiff hairs on the margin of the inner petal, and a pubescent and larger hypanthium ((2.0) 4.5 – 7.0 mm long). Furthermore, the two taxa differ with the gall formation of *O. chimanimani* having smaller linear galls (0.35 – 0.7 (– 1.65) mm wide) and *O. huillensis* subsp. *discolor* has rounded, more swollen galls (1.2 – 2.1 mm wide). Table 1 shows the diagnostic characters to differentiate the two species and *O. huillensis* A. Fern. & R. Fern. s.l., a key to species is found in the Notes section.

DISTRIBUTION. Only known from Chimanimani Mountains on the border of Zimbabwe and Mozambique (Map 1).

SPECIMENS EXAMINED. MOZAMBIQUE. Chimanimani Mts, riverine above Bundi R., galled fl. Dec. 1964,

Whellan 2203 (K!); Manica, Pedza (Peza) mountain in Chimanimani, -19.74400, 33.99764, alt. 1887 m, fr., 18 April 2014, *Matimele* 2082 (K!, LMA); Manica, Nhamudima mountain in Chimanimani, -19.75722, 33.09328, alt. 1673 m, fl. & fr., 21 April 2014, *Matimele* 2094 (K!, LMA); Chimanimani Mts, -19.75747, 33.09236, alt. 1702 m, 4 May 2016, *Shah* 007 (K!, LMA, SRGH); Chimanimani Mts, -19.72530, 33.09201, alt. 1786 m, 6 May 2016, *Shah* 013 (K!, LMA, SRGH); Chimanimani Mts, -19.725195, 33.09177, alt. 1776 m, 6 May 2016, *Shah* 014 (K!, SRGH). **ZIMBABWE.** Mt Peza, among crags, Chimanimani Mts, imm. & galled fl., 15 Oct. 1950, *Wild* 3606 (K!); Manicaland, Chimanimani Mts, W base of (Pnt.?) 71, fl., 20 Nov. 1986, *Linder* 3990 (K! holotype).

HABITAT. This species is found growing in evergreen scrub within rocky quartzite crags and gullies and at the base of quartzite blocks on steep slopes, between 1500 – 1890 m elevation.

CONSERVATION STATUS. *Olinia chimanimani* is restricted to the Chimanimani Mountains on the border of central Zimbabwe and Mozambique and is currently known from eight collections, with the estimated Extent of Occurrence (EOO) and Area of Occupancy (AOO) of 40 and 28 km² respectively (calculated using Geocat 2015). Furthermore, the total area of Chimanimani sandstone/quartzite is approximately 380 km². Of this, the area covered by rocky quartzitic crags and associated grassland, which is the favoured habitat for this species, is approximately 270 km²; this could be taken as the maximum possible AOO for this species. The species is only known from two locations; the Zimbabwean side of the Massif which is fairly well-protected under the Chimanimani National Park (CNP) and the Mozambique portion under the National Reserve of Chimanimani (RNC) with limited protection (Schneider *et al.* 2005). Additionally, although the species occurs in rocky crags, it is highly prone to burning by man, associated with the illegal artisanal mining activity present on the Mozambique side of the Chimanimani massif (Dondeyne *et al.* 2009). This threat has significantly declined since its peak in 2004 – 2005, as gold discoveries have lessened (Timberlake *et al.* 2016). However, if it were to rise again in the future, the increase of human habitation would very likely lead to a further increased frequency of fires, which would almost certainly have an impact upon the species' habitat and number of mature individuals. Severe fire damage was observed on some individuals in 2016. Furthermore, being one of the few woody species occurring at a high altitude, it will burn more easily and may be targeted as a fuel source for the miners. The species was noted to be locally rare in 2016, and with a restricted distribution and a plausible threat to its habitat, it is therefore assessed as **Endangered** (EN B1ab(iii, v) + B2ab(iii, v)).

Fig. 2. A – N *Olinia chimanimani*: A habit; B juvenile shoot showing ternate leaf arrangement; C abaxial leaf surface, conspicuous venation, margins involute; D stem with grooves; E flower; F dissected flower with stamens, style and stigma, reflexed scales, internal view; G enlarged scale outer surface; H anther, lateral view; J anther, face view; K infructescence; L fruit cross-section; M seed; N galled flower. A, C – J from Linder 3990, B from Shah 007, K – M from Matimele 2094, N from Whellan 2203. DRAWN BY ANDREW BROWN.

Fig. 3. Mature fruits of *Olinia chimanimani* photographed in the Chimanmani Mountains. PHOTO: BART WURSTEN (<http://www.mozambiqueflora.com>).

ETYMOLOGY. *Olinia chimanimani* is named for the only mountain range on which the species occurs.

NOTES. This taxon is restricted to the higher elevations of the Chimanmani Mountains. Although once thought to be a pathological form of its close range relative, *Olinia vanguerioides* by Verdcourt (1978) in

Flora Zambesiaca, it is now clear that it is morphologically distinct by having significantly smaller leaves, sessile leaf attachment, smaller flowers and narrow, linear galls that form without tubercles when infected (Table 1). Additionally, Sebola & Balkwill (2009) stated the presence of the variable taxon *O. huillensis*

Table 1. Comparison of diagnostic characters between *Olinia chimanimani* and two closely related species.

Characters	<i>Olinia chimanimani</i>	<i>Olinia vanguerioides</i>	<i>Olinia huillensis</i> s.l.
Leaf shape	obovate to oblanceolate	elliptic	obovate (young) to elliptic
Leaf size (mm)(length)	(19) 25 – 40.1	40.1 – 170	(29) 33 – 77
Leaf size (mm) (width)	10 – 25	20.2 – 44	15 – 29
Leaf texture	coriaceous	coriaceous	chartaceous (sometimes coriaceous)
Leaf attachment	sessile	petiolate	shortly petiolate
Leaf margin	involute, glabrous	involute, pubescent when young	flat to slightly involute, glabrous
Leaf lamina adaxial/ abaxial	glabrous/ glabrous	glabrous/ glabrous (pubescent near petiole)	glabrous/ glabrous
Petal shape	spathulate	spathulate	oblong
Petal apex	mucronate	truncate to shortly apiculate	truncate
Petal size (mm) (length)	1.2 – 2.25 (4)	0.9 – 1.9	(1) 2 – 2.9
Petal size (mm) (width)	0.4 – 0.6	0.5 – 1.1	2 – 3.9
Petal indumentum inner/ outer surface	glabrous/ glabrous	sparsely hairy (young)/ glabrous	pubescent/ glabrous
Hypanthium length (mm)	1.5 – 4.7	1.5 – 5	2 – 6.4
Hypanthium surface	glabrous	glabrous	pubescent
Gall formation	narrow, linear	elongate, tuberculate	swollen, rounded

Map 1. Distribution of *Olinia chimanimani* in southeastern Africa. Red triangle represents the cited collections.

subsp. *discolor* in the Chimanimani Mountains. However, they did not cite any specimens of this taxon from the Chimanimani Mountains, Mozambique or Zimbabwe nor gave any indication of this on the distribution map for subsp. *discolor*. It is possible that the authors included this new taxon within the limits

of *O. huillensis* subsp. *discolor*, although the specimens of the new taxon that were loaned to Sebola (J) at the time of that revision were not annotated as such. However, when closely examined, *O. chimanimani* always has a strictly sessile leaf attachment, glabrous inner and outer petals, a glabrous and smaller hypanthium and linear gall formation, characters that differ from *O. huillensis* including subsp. *discolor*. Table 1 shows the morphological character differences between *O. chimanimani*, *O. vanguerioides* and *O. huillensis* s.l. because the delimitation of *O. huillensis* subsp. *discolor* must necessarily fit within the larger taxonomic concept of *O. huillensis* s.l. Therefore, the subspecies is not included in the table in order to compare taxa at the species level. With recent developments in molecular analysis it would be desirable to carry out Next Generation Sequencing (NGS) to more accurately resolve the species limits within this genus. However, at present, morphological analysis provides the best conclusions for species delimitation. A modified key to the species of *Olinia* sect. *Rochetiana* is presented below to help with the identification of the closely related taxa, a key to the infraspecific taxa of *O. huillensis* s.l. is available in Sebola & Balkwill (2013).

Key to taxa within *Olinia* sect. *Rochetiana* (adapted from Sebola & Balkwill 2009)

1. Leaf lamina narrowly elliptic, 40.1 – 170 × 20.2 – 44 mm; petioles puberulent, 6 – 9 mm long; galled flowers narrow with conspicuous elongate tubercles ***O. vanguerioides***
 Leaf lamina obovate to oblanceolate, (19.0) 25 – 40.1 × 10 – 25 mm; leaves sessile or petioles < 6 mm long; galled flowers either swollen or if narrow and linear then lacking elongate tubercles 2
2. Leaf lamina with conspicuous reticulate venation on both surfaces; leaves strictly sessile; petals 0.35 – 1.2 × 0.4 – 0.6 mm, glabrous on both sides; hypanthium glabrous; galled flowers narrow and linear ***O. chimanimani***
 Leaf lamina with conspicuous reticulate venation on undersurface only; leaves shortly petiolate; petals 3 – 5 × 1 – 2 mm, pubescent on the inside or at least on petal margins; galled flowers swollen 3
3. Leaves somewhat chartaceous; up to 7 inflorescence units along inflorescence axes ***O. huillensis***
 Leaves coriaceous; between 9 – 11 inflorescence units along inflorescence axes 4
4. Leaf lamina discolorous, broader than long; internodes on terminal branches longer than inflorescence axes ***O. ruandensis***
 Leaf lamina concolorous, longer than broad; internodes on terminal branches shorter or equal to inflorescence axes 5
5. Petals 5 on lateral flowers; scales shorter than 1 mm, rarely sealing the hypanthium opening/ throat ***O. rochetiana***
 Petals 4 on lateral flowers; scales longer than 1 mm, often sealing the hypanthium opening/ throat ***O. usambarensis***

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[SiteCollectionDocuments/eastern_afromontane/FinalReport_RBC_ChimanimaniMountains.pdf](#). Toral Shah's participation in the field expedition to the Mozambique Chimanimani in May 2016 was supported by the Bentham-Moxon Trust. Joanna Osborne, Jonathan Timberlake, Anthony Mapaura, Aurelio Banze, Daglasse Muassinar, João Massunde, Bart Wursten, Petra Ballings and all other participants

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