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A Taxonomic Review of South African Indigenous Meliaceae Using Molecular Systematics and Anatomical Data

Mariam Oyefunke Oyedeji Amusa [1], Ross Dylan Stewart [2,†], Michelle van der Bank [2] and Ben-Erik van Wyk [1,*]

[1] Department of Botany and Plant Biotechnology, University of Johannesburg, P.O. Box 524, Auckland Park 2006, South Africa; oyedejiamusa@gmail.com
[2] African Centre for DNA Barcoding (ACDB), Department of Botany and Plant Biotechnology, University of Johannesburg, P.O. Box 524, Auckland Park 2006, South Africa; mvdbank@uj.ac.za (M.v.d.B.); ross.d.stewart@gmail.com (R.D.S.)
* Correspondence: bevanwyk@uj.ac.za; Tel.: +27-11-559-2412
† Current address: Department of Biological & Agricultural Sciences, Sol Plaatje University, Kimberley 8301, South Africa.

Abstract: The Meliaceae are broadly distributed worldwide, with about 50 genera and over 1400 species. There are 11 genera in South Africa, with 13 indigenous and three naturalized species. Considering the diversity of the indigenous species of this family in South Africa and the lack of recent studies encompassing these species, a taxonomic revision of the South African indigenous species of Meliaceae is presented here. Phylogenetic analysis, anatomical data, herbarium collections, and online data sources were used in this study. The results confirm the monophyly of Melioideae and Swietenioideae. The incongruence of *Turraea* previously reported was resolved in this study. Most representative genera of South African Meliaceae were recovered monophyletic with strong support. However, multiple samplings of species and including more markers could provide a better understanding of the relationships among South African species of Meliaceae. The review of the taxonomy of the South African Meliaceae, and especially the study of diagnostic characters and hitherto recorded natural distributions, have value in providing an up-to-date inventory of the indigenous genera and species and an easy means of identifying the taxa. Anatomical characters may be of systematic value to explore higher-level relationships in the family. This study is a contribution to tropical botany and to a more comprehensive database for the Meliaceae.

Keywords: molecular phylogeny; taxonomy; anatomy; geographical distribution; diagnostic characters; Meliaceae; South Africa

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1. Introduction

The family Meliaceae is characterized by simple, imparipinnate or paripinnate compound leaves, stamens that unite to form a cylindrical tube, and syncarpous, apparently bisexual flowers borne in panicles, cymes, spikes, or clusters. Meliaceae are reported to be highly diverse in terms of seed, floral, and fruit morphology, containing side-by-side arrays of derived fruits with arillate seeds connected by intermediates, minute and structurally complex flowers, and large, moth-pollinated flowers with slender staminal tubes up to 150 mm long [1–3]. Hence, the taxonomic history of the family has been a source of systematic difficulty [1]. The uncertainty in the family regarding the number of genera, their circumscriptions, and the best way to accommodate them into tribes and subfamilies might be a result of the rambling and frequently reticulate nature of variation based on several parallel evolutionary trends observed in the flowers and fruits [1]. The use of a combination of several characters has been reported to be a more reliable diagnostic tool for most genera and tribes within the family than the use of single characters [3]. The Meliaceae consist of four subfamilies, of which there are two major ones (Swietenioideae and Melioideae): the Swietenioideae have woody septicidal capsules with multiple winged seeds per locule,

while the Melioideae are characterized by indehiscent berries with one or two seeds in each locule or by loculicidal capsules [1,3–5].

The Swietenioideae also differ from Melioideae anatomically by having broad heterocellular rays, scarce axial parenchyma, and crystals in ray cells [1,6–8]. After the first comprehensive monograph on Meliaceae by Pennington and Styles [1], several studies have culminated in taxonomic revisions of genera in this family [9–11].

The secondary xylem of Swietenioideae is uniform and different from that of Melioideae, whereas they have mostly similar pollen, which confirms the decision to treat them as subfamilies [1]. These hypotheses were confirmed by Muellner et al. [3] using molecular data, recognizing the two main subfamilies and supporting the monophyly of Meliaceae with Melioideae and Swietenioideae as sister groups and their taxonomic rank as subfamilies. Pennington and Styles [1] stated in their study that *Capuronianthus* J.-F.Leroy and *Quivisianthe* Baill. provided connecting links between Melioideae and Swietenioideae, and they are different from each other as well as the two large subfamilies, hence their establishment as new subfamilies (Capuronianthoideae and Quivisianthoideae). Muellner et al. [3] stated that this hypothesis could not be justified using DNA data, as they reported *Capuronianthus* and *Quivisianthe* embedded in Swietenioideae and Melioideae, respectively, in their study. Their study also confirms the close relationship of *Quivisianthe* to *Ekebergia* Sparrm., the placement of *Xylocarpus* J.Koenig and *Carapa* Aubl. in Swietenioideae, and a close relationship between *Toona* (Endl.) M.Roem. and *Cedrela* P.Browne, forming a monophyletic clade.

Since the work of Pennington and Styles [1], there have been several phylogenetic analyses of the Meliaceae as a result of re-evaluations of morphological characters and new datasets of phylogenetic characters [2–4,12–23]. Molecular data by Muellner et al. [3] supported the stability of the Melieae represented by *Melia azedarach* L. and *Azadirachta indica* A. Juss. There is not much evidence to evaluate the monophyly of other tribes, but the close relationship between Aglaieae and Guareeae (Melioideae), a possible monophyletic Cedreleae, and the lack of monophyly in Trichilieae (Melioideae) and Swietenieae (Swietenioideae) were reported by Muellner et al. [3] in their molecular study. In 2008, Muellner et al. [4] assessed the circumscription of Melioideae and its tribes and reported the monophyly of Aglaieae, Sandoriceae, and Melieae, an isolated position for Vavaeeae, the placement of *Pterorhachis* Harms and *Quivisanthe* in Melioideae, and a close relationship between Turraeeae and Trichilieae.

South African genera of Meliaceae belong to three tribes, two of which are accommodated in the subfamily Melioideae (Turraeeae and Trichilieae) and the other one in Swietenioideae (Swietenieae). However, since White [9] and White and Styles [24], there has been no other published work covering all the species in South Africa. Hence, there is a need for a country-based reassessment to update data on diagnostic characteristics and the natural distribution area of each taxon. The present study aims at assessing phylogenetic relationships to provide further resolution between genera and species of indigenous South African Meliaceae using DNA sequence data from three gene regions: plastid genes *rbcLa*, *matK*, and nuclear *26S* rDNA. Also, to present a taxonomic synopsis of the genera belonging to the family Meliaceae in South Africa, including an identification key to all the genera and species, with information on habitat, major diagnostic morphological and anatomical characters, phenology, and geographical distribution.

2. Materials and Methods

2.1. Molecular Phylogeny

DNA sequences of *rbcLa*, *matK*, and *26S* were analyzed from 31 genera (of about 50) and 40 species (of about 1400), encompassing representatives of all four subfamilies. The choice of genes was based on the study of Muellner et al. [3], which allowed us to add to established datasets. The datasets included the following DNA-sequence sampling: *rbcLa*, 76 individuals (9 newly sequenced here, 64 downloaded from GenBank); *matK*, 57 individuals (8 newly sequenced here, 47 downloaded from GenBank);

26S, 33 individuals (2 newly sequenced here, 24 downloaded from GenBank). Representatives of the closely related families Rutaceae, Sapindaceae, and Simaroubaceae were used as outgroups [3,25,26]. Voucher information and GenBank accession numbers are listed in Table 1.

Table 1. List of taxa of Meliaceae used in this study. For each sequence and accession number, a voucher number and herbarium information are provided (includes extract from Muellner et al., 2003). – = No sequence available; Asterix (*) = samples sequenced in this study.

Subfamily	Tribe	Species	Voucher No.	GenBank Accession Numbers		
				rbcLa	*matK*	*26S*
Melioideae	Turraeeae	*Calodecaryia crassifolia* Leroy	Chase 2855	AY128216	–	–
		Munronia pinnata (Wall.) Theob.	Chase 2858	AY128237	–	–
		Nymania capensis Lindb.	Chase 270	AY128238	AY128197	AY128167
		Nymania capensis Lindb. *	IMH and BEVW 29–16a	OM992099	OM992108	ON003595
		Nymania capensis Lindb. *	IMH and BEVW 29–16b	OM992100	OM992109	–
		Nymania capensis Lindb. *	IMH and BEVW 29–16c	OM992101	OM992110	–
		Nymania capensis Lindb.	OM1096	JX572794	JX518038	–
		Turraea sericea Sm.	Chase 1623	AY128245	AY128203	AY128172
		Turraea floribunda Hochst. *	KK154–17	OM992102	–	–
		Turraea floribunda Hochst.	OM3278	JQ025100	JX517433	–
		Turraea nilotica Kotschy and Peyr.	OM1491	JX573070	JX517345	–
		Turraea nilotica Kotschy and Peyr.	OM1497	JF265640	JF270981	–
		Turraea obtusifolia Hochst. *	KK162–17	OM992103	OM992111	–
		Turraea obtusifolia Hochst.	OM744	JF265641	JF270982	–
	Melieae	*Azadirachta indica* A.Juss.	Chase 1307	AY128214	AY128179	AY128149
		Azadirachta indica A.Juss.	Samuel 5	AY128215	AY128180	AY128150
		Melia azedarach L.	Chase 2867	AY128234	AY128193	AY128164
		Melia dubia Cav.	Samuel3	AY128235	AY128194	AY128165
	Trichilieae	*Cipadessa baccifera* Miq.	Chase 1310	AY128224	AY128184	AY128155
		Cipadessa baccifera Miq.	Samuel 7	AY128225	AY128185	AY128156
		Ekebergia capensis Sparrm.	Chase 3310	AY128228	–	AY128159
		Ekebergia capensis Sparrm. *	KK161–17	OM992104	OM992112	–
		Ekebergia pterophylla	OM3263	JX572545	JX517845	–
		Malleastrum mandenense Leroy	Cheek et al. 3-17-5	–	AY128192	–
		Trichilia dregeana Sond. *	KK155–17	OM992105	OM992113	–
		Trichilia dregeana Sond.	OM1793	JF265635	JF270976	–
		Trichilia emetica Vahl	Chase 552	AY128244	AY128202	AY128171
		Trichilia emetica Vahl *	KK156–17	OM992106	OM992114	–
		Trichilia emetica Vahl	OM1178	JF265636	JF270977	–
		Trichilia emetica Vahl	OM2103	JQ025100	JQ025007	–
		Walsura tubulata Hiern	Chase 1314	AY128246	AY128204	AY128173
		Pseudobersama mossambicensis (Sim) Verdc.	OM2645	JX572888	JX517407	–
	Aglaieae	*Aglaia eleagnoidea* Benth.	Samuel 4	AY128209	–	AY128144
		Aglaia elliptica Blume	Chase 1305	AY128210	AY128177	AY128145
		Aglaia sp. R1	Samuel 1	AY128211	–	AY128146
		Aglaia sp. R2	Samuel 2	AY128212	–	AY128147
		Aphanamixis polystachya (Wall.) R.N.Parker	Chase 2109	AY128213	AY128178	AY128148
		Aphanamixis polystachya (Wall.) R.N.Parker	HJL3701	MT933756	MW044151	–
		Aphanamixis polystachya (Wall.) R.N.Parker	HJL3702	MT933757	MW044152	–
		Aphanamixis polystachya (Wall.) R.N.Parker	J398	KR528733	KR530368	–
		Lansium domesticum Correa	Chase 2113	AY128232	AY128191	AY128163
	Guareeae	*Chisocheton macrophyllus* King	Chase 1309	AY128221	AY128183	AY128153
		Dysoxylum gaudichaudianum (A.Juss.) Miq.	Chase 1312	AY128227	AY128187	AY128158
		Dysoxylum sp.	Chase 1311	AY128226	AY128186	AY128157
		Guarea glabra Vahl	Chase 336	AY128229	AY128188	AY128160
		Guarea glabra Vahl	BioBot00780	JQ592725	JQ588345	–
		Heckeldora staudtii (Harms) Staner	Chase 3311	AY128230	AY128189	AY128161
		Synoum glandulosum (Sm.) A.Juss.	Chase 3314	AY128242	–	–

Table 1. *Cont.*

Subfamily	Tribe	Species	Voucher No.	GenBank Accession Numbers		
				rbcLa	*matK*	*26S*
		Synoum glandulosum (Sm.) A.Juss.	1076420307	KM895969	KM894804	–
Capuronianthoideae		*Capuronianthus mahafalensis* Leroy	Fosberg 52439	AJ402935	–	–
		Capuronianthus mahafalensis Leroy	MWC2856	AY128218	–	–
		Capuronianthus mahafalensis Leroy	MWC3815	AY128217	–	–
Quivisianthoideae		*Quivisianthe papinae* Baill.	Phillipson 1650	AY128239	–	–
Swietenioideae	Cedreleae	*Cedrela odorata* L.	Chase 2112	AY128220	AY128182	–
		Cedrela odorata L.	BioBot00500	JQ592711	JQ588334	–
		Toona sp.	Chase 664	AY128243	AY128201	AY128170
	Swietenieae	*Chukrasia tabularis* A.Juss.	Chase 1308	AY12822	–	–
		Chukrasia tabularis A.Juss.	Samuel 9	AY128222	–	AY128154
		Chukrasia tabularis A.Juss.	HJL8501	MT933788	MW044225	–
		Entandrophragma caudatum (Sprague) Sprague *	OM3352	OM992107	OM992115	ON003596
		Entandrophragma caudatum (Sprague) Sprague	OM1342	JX572558	JX517565	–
		Entandrophragma caudatum (Sprague) Sprague	OM794	JF265412	JF270762	–
		Khaya anthotheca (Welw.) C.DC.	Chase 2859	AY128231	AY128190	AY128162
		Khaya anthotheca (Welw.) C.DC.	OM2604	JX572704	JX517573	–
		Neobeguea sp.	Cheek et al. 3-25-1	–	AY128196	–
		Schmardaea microphylla Karst. ex C. Muell.	Chase 746	AY128240	AY128199	AY128168
		Swietenia macrophylla King	Chase 250	AY128241	AY128200	AY128169
		Swietenia macrophylla King	BioBot02252	JQ592737	JQ588351	–
		Lovoa swynnertonii Baker f.	Chase2860	AY128233	–	–
	Xylocarpeae	*Carapa guianensis* Aubl.	Chase 2111	AY128219	AY128181	AY128151

Total genomic DNA was extracted from 0.1–0.3 g of silica dried leaves with the addition of polyvinyl pyrolidone (2% PVP) to reduce the effect of high polysaccharide concentrations in the samples according to the 2× CTAB (hexadecyltrimethylammonium bromide) method [27]. The DNA was precipitated using ethanol and stored at −20 °C for a minimum of two weeks [28]. DNA extracts were further purified and concentrated using QIAquik silica columns (Qiagen Inc., Hilden, Germany) according to the manufacturers' protocol for cleaning polymerase chain reaction (PCR) products. The total genomic DNA (tDNA) was extracted and stored at −80 °C in the DNA bank of ACDB (African Centre for DNA Barcoding, University of Johannesburg, South Africa).

Primers used for PCR of the cpDNA *rbcLa*, *matK,* and *26S* regions were according to Muellner et al. [3]. ReadyMix Master (Advanced Biotechnologies, Epson, Surrey, UK) was used in performing all the PCRs. An additional component, bovine serum albumin (3.2% BSA), was added to reduce problems with secondary structure, stabilize the enzymes, and improve annealing [29]. The PCR amplifications were performed using either the 9800 Fast Thermal Cycler or the GeneAmp PCR System 9700 machine. Programs used for PCR amplification are as follows: (a) for *rbcLa,* pre-melt at 94 °C for 60 s, denaturation at 94 °C for 60 s, annealing at 48 °C for 60 s, extension at 72 °C for 60 s (for 28 cycles), followed by a final extension at 72 °C for 7 min; (b) for *matK,* the procedure consisted of pre-melt at 94 °C for 3 min, denaturation at 94 °C for 60 s, annealing at 52 °C for 60 s, extension at 72 °C for 2 min (for 30 cycles), final extension at 72 °C for 7 min; and (c) for *26S,* the procedure consisted of pre-melting at 94 °C for 3 min, denaturation at 94 °C for 60 s, annealing at 55 °C for 60 s, extension at 72 °C for 3.5 min (for 30 cycles), and final extension at 72 °C for 5 min.

Cycle sequencing reactions were carried out in a GeneAmp PCR System 9700 thermal cycler using the ABI PRISM® Bigdye® Terminator v3.1 Cycle Sequencing Kits (ThermoFisher Scientific, Waltham, MA, USA). To remove excess dye terminators, cycle sequencing products were precipitated in ethanol and sodium acetate. After which, they were suspended in 10 µL HiDi formamide prior to sequencing on ABI (ThermoFisher Scientific, Waltham, MA, USA) 3130XL genetic analyzer.

Raw sequences were trimmed, assembled, and edited using Geneious v 8.1.9 (https://www.geneious.com (accessed on 21 October 2018)) [30], alignment was done

with MAFFT v 7.017 [31] and then visually checked for any inconsistencies in order to minimize nucleotide mismatches [32,33]. Individual markers were then concatenated into a combined partitioned alignment using Geneious.

Maximum Parsimony (MP)—Phylogenetic analyses were conducted for all the data sets using the MP algorithm of PAUP* [34]. A heuristic search with 1000 random sequence additions was used to carry out tree searches. Ten trees were retained per replicate, with tree-bisection-reconnection (TBR) branch swapping in effect. Bootstrap percentage (BP) values were used to determine support at nodes [35].

Maximum Likelihood (ML)—The data were analyzed using RAxML 7.2.8 [36] with rapid bootstrap analysis (200 replicates) and searched for the best-scoring maximum likelihood tree in the same run with a GTR + Γ + I substitution model.

Bayesian Inference (BI)—The BI [37] analysis was conducted using MrBayes v.3.2.6 plugin within Geneious 8.19 (Biomatters, Ltd., Auckland, New Zealand) [38–40]. DNA evolutionary models were obtainable using "-TESTONLY" in IQTree2 [41,42] under the corrected Akaike Information Criterion [43–45]. For *rbcLa,* the model K2P + Γ + I was selected, and for *matK* TVM + Γ was selected, and for *26S* TIM2 + Γ + I was selected. A partition analysis was run for the combined data since different models were selected for the respective genes. Four chains were run for 1,000,000 Markov Chain Monte Carlo (MCMC) generations, and trees were sampled every 100 generations; the burn-in was set to 1000. The stationarity of the Bayesian runs was examined on Tracer v1.71 [46], and the ESS values were above 200 and the average standard deviation of split frequencies approached zero.

2.2. Taxonomic Treatment

The taxonomy study was based on a review of relevant literature, anatomical study of specimens, and morphological analysis of specimens housed in the South African National Biodiversity Institute (SANBI) herbarium in Pretoria (PRE), the SANBI herbarium (Natal Herbarium) in Durban (NH), the Bews herbarium, University of KwaZulu-Natal in Pietermaritzburg (NU), and the CE Moss herbarium, University of the Witwatersrand, in Johannesburg (J). Nomenclatural data were extracted from relevant literature, mainly from Tropicos (http://www.tropicos.org/, (accessed on 21 January 2019)), IPNI (http://www.ipni.org/, (accessed on 21 January 2019)), Flora Zambesiaca, and the Flora of southern Africa. Images of the type specimens examined are available online at JSTOR (http://plants.jstor.org, (accessed on 28 January 2019)). Important characters for correct identification of the species are included in the taxon descriptions. Anatomical characters were studied and included. Measurements of morphological characters, information on habitat and ecology of the speciesh as well as phenology, were documented from herbarium sheets as well as published literature. Data for distribution ranges and localities for all species studied were gathered from herbarium specimens according to the system of Leistner and Morris [47]. The distribution of each species is presented on a southern Africa base map (obtained from SANBI), where the basic unit of a 4-digit number represents a one-degree square of latitude and longitude. Each degree square is divided into four quadrants which are denoted with capital letters A, B, C, and D, respectively, in a top-to-bottom, and left-to-right arrangement. The conservation status of species studied was assessed based on the Red List of South African Plants online (http://redlist.sanbi.org/species.php?species=950-1,950-3,953-1,956-1,957-1,957-3,957-5,957-7,957-9,961-1,961-3, (accessed on 28 January 2019); [48]). Modifications were proposed only when new locality details became available. As is customary for taxonomic revisions, references given in abbreviated form in the formal taxonomic treatments are not included in the reference list.

3. Results and Discussion

3.1. Phylogenic Analysis

3.1.1. Sequence Characteristics

Among the regions, *26S* contained the lowest number of potentially parsimony-informing characters (8%); *rbcLa* contained 10%; and *matK* contained 21%. Statistics for the MP analyses are shown in the Supporting Information (Table S1). Individual gene trees generated using MP, ML, and BI (trees not shown) were largely congruent (no topological incongruences: >80% bootstrap values and/or 0.95 PP) and were thus combined into a single dataset. Also, combining independent molecular data sets has been reported to improve levels of support as well as provide phylogenetic and taxonomic resolution at different levels [49–52].

Results obtained using MP and ML analyses generated a similar topology to those from BI, with only minor changes due to a lack of support for some lineages. The MP and ML results are presented in Table S1 and Figure S1. The combined data set is the basis of our discussion.

3.1.2. Combined Dataset—Parsimony and BI Analyses

In total, 503 most-parsimonious trees were found, with 837 steps and a consistency index (CI) of 0.668 and a retention index (RI) of 0.823 (Table S1). One of the most parsimonious trees is shown in Figure S1 and is congruent with the majority tree from BI (Figure S1).

Within the Melioideae, the tribe Melieae is strongly supported (Group 4; PP = 1.00, MLB = 100, MPB = 97) as monophyletic. The tribes Turraeeae and Trichilieae resolved within a polytomy along with *Calodecaryia crassifolia* Leroy, *Cipadessa baccifera* (Roxb. Ex Roth) Miq., *Malleastrum mandenense* Leroy, and *Muronia pinnata* (Wall.) W.Theob. *Pseudobersama mossambiscensis* (Sim) Verdc. is recovered as paraphyletic, with *Nymania* Lindb. being sister to *Trichilia* P.Browne of the tribe Trichilieae, although with no support. The unresolved *Aphanamixis* Blume (represented by *A. polystachya* (Wall.) R.Parker) shows a close relationship with *Lansium* Corrêa and *Aglaia* Lour. of the tribe Aglaieae (although not supported). Group 3 containing *Ekebergia* and *Quivisianthe* forms a sister lineage to groups 1 and 2 containing Trichilieae, Gauareeae, and Turraeeae (PP = 0.99, MLB = 85, MPB < 50%).

Within the Swietenioideae (Group 5), the relationship of *Entandrophragma* C. DC. to other members of the Swietenieae is not resolved. Within the Swietenieae, *Schmardaea* H. Karst. is recovered as sister to the grouping *Chukrasia* A.Juss. (PP = 0.99, MLB = 75, MPB = 73). The relationships among the rest of the species within the Swietenioideae remain unresolved.

Representatives of the genera *Trichilia* (PP = 0.98, MLB = 96, MPB = 91), *Aglaia* (PP = 0.96, MLB = 63, MPB < 50%), and *Melia* L. (PP = 1.00, MLB = 100, MPB = 100) included in this study were recovered as monophyletic with strong to moderate support.

The combined phylogeny tree recovered in this study supports the two main lineages, Melioideae and Swietenioideae. However, *Quivisianthe* and *Capuronianthus* are embedded in Melioideae and Swietenioideae, respectively. *Quivisianthe* forms a clade with *Ekebergia*, a member of Trichilieae with strong support (PP = 1.00, MLB = 100, PP = 83), which may infer a further investigation of this genus (*Quivisianthe*). This study does not justify the establishment of the two new subfamilies (Capuronianthoideae and Quivisanthoideae), which corroborate the work of Muellner et al. [3].

The South African indigenous species of Meliaceae include 12 species distributed in six genera (*Ekebergia*, *Entandrophragma*, *Nymania*, *Pseudobersama*, *Trichilia*, and *Turraea*). The genus *Xylocarpus* J.Koen, represented by one species (*Xylocarpus granatum* J. Koen.), does not have a viable population in South Africa and is known from a single individual tree near the Mozambique border. It has nevertheless been included in the taxonomic revision. All analyses revealed that some of the South African genera are not monophyletic, which implies that these genera need to be reinvestigated using more samples and markers. *Entandrophragma caudatum* (Sprague), which happens to be the only South African indige-

nous species of the tribe Swietenieae, subfamily Swietenioideae, was shown to be sister to the mahogany group (*Khaya*, *Swietenia,* and *Carapa*). The paraphyly of the tribe Swietenieae as observed in this study corroborates the previous findings of Muellner et al. [3]. The historical stability of Melieae within the Melioideae was also strongly recovered in this study (Figure S1). The genus *Entandrophragma* was poorly resolved, which suggests sampling and investigation of other species in this genus for better resolution.

Muellner et al. [3] observed a close affinity between *Walsura* (tribe Trichilieae) and *Turraea* (tribe Turraeeae), which they thought was not based on morphological evidence. Interestingly, this study presented a distant relationship between these taxa and presented *Turraea* with nested *Calodecaryia crassifolia* as a single clade with strong support (PP = 1.00, MLB = 98, PP = 95). The phylogenetic result presented here supports the inclusion of the two monogeneric subfamilies *Capuronianthus* and *Quivisanthe* into the two main subfamilies Swietenioideae and Melioideae, respectively. This corroborates the work of Muellner et al. [3,13]. The pattern of relationships among tribes proposed by Pennington and Styles [1], based on secondary xylem characters, was not recovered in this study, although Sandoriceae and Vavaeeae were not represented in this study.

3.2. Taxonomy

The genera of the South African Meliaceae have the following characters in common: (1) woody trees, shrubs, or shrublets; (2) flowers regular; (3) calyx imbricate; (4) petals free; (5) stamens united into a staminal tube; (6) ovary superior with one or more ovules in each locule; style simple; (7) wood diffuse-porous; (8) and vessels rounded to slightly angular in outline, fibers non-septate, and prismatic crystals present in chambered axial parenchyma cells.

The indigenous genera of the South African Meliaceae are distinguished from each other by the following characters: (1) large inflated fruit capsule with valves separating near the apex; (2) leathery or woody fruit capsule with valves separating at the base, upright, and square ray composition in bark radial section; (3) cup-shaped staminal tube with all filaments united and fruit a drupe and the presence of radial secretory canals in radial bark sections; (4) filaments with appendages and capsule without appendages, unicellular trichomes on the periderm; (5) capsule covered with anther-like appendages; and (6) seeds with a terminal wing.

3.2.1. Family Description (Based on Dyer, 1975)

Trees, shrubs, or shrublets are monoecious or dioecious. Leaves are mostly alternate, simple, 2–many-pinnate, or 1–3-foliolate, without stipules. Flowers are bisexual or unisexual, mostly paniculate, less often fascicled, or solitary. Calyx 4–5-fid or -partite, mostly imbricate. Petals (3–) 4–5 (6–7), contorted or imbricate. The disc is almost invariably present. Stamens (4–) 8–10 (12–20); filaments free or united. Ovary superior, mostly 2–5-locular, rarely 6-, 10-, or 12-locular, with 1–many ovules in each locule; style simple; stigma discoid, capitate, or sometimes lobed. Fruit a capsule, drupe, or berry; seeds 1–several, in each locule, sometimes winged, sometimes arillate.

3.2.2. Key to the Genera of South African Meliaceae (*Naturalized)

1a Leaves imparipinnate, simple, or 2–3-pinnate; fruit, a drupe, a berry, or a loculicidal capsule; seeds not winged, often arillate.

2a Leaves are simple.

3a Stamens free almost to the base; fruit a papery capsule; valves separating near the apex—***Nymania.***

3b Stamens completely united almost to the apex; fruit a leathery or woody capsule; valves separating to the base—***Turraea.***

2b Leaves compound.

4a Leaves 2–3-pinnate; fruit a drupe—***Melia.****

4b Leaves regularly 1-pinnate; fruit, a capsule or drupe.

5a Staminal tube cup-shaped, filaments completely united; fruit a drupe—***Ekebergia.***

5b Staminal tube elongated, filaments united in lower halves or two-thirds, fruit a capsule.

6a Filaments with paired appendages at apex; capsule with 2–3 (4) leathery valves, without appendages—***Trichilia.***

6b Filaments without appendages; capsule with four or five woody valves, covered with conspicuous ridges and antler-like appendages—***Pseudobersama.***

1b Leaves paripinnate; fruit an elongated or globose capsule; seeds usually winged, not arillate.

7a Leaves with 1–3 pairs of leaflets; fruit a large globose capsule (ca. 100 mm in diameter); seeds not winged—***Xylocarpus.***

7b Leaves with more than three pairs of leaflets; fruit elongated (or if globose, then up to 60 mm in diameter); seeds winged.

8a Flowers with an androgynophore, petals fused; stamens 5, free.

9a Androgynophore much longer than ovary; first seedling leaflets entire—***Cedrela.****

9b Androgynophore shorter than or same length as ovary; first seedling leaflets lobed—***Toona.****

8b Flowers without an androgynophore, petals free; stamens 8–10, filaments partly or completely united.

10a Capsule globose or subglobose; seeds orbicular to suborbicular, completely winged—***Khaya.****

10b Capsule elongated; seeds with a terminal wing—***Entandrophragma.***

* The naturalized species are *Melia azedarach* L., *Cedrela odorata* L., and *Khaya nyasica* Stapf ex Baker f. [=*Khaya anthotheca* Auct. non (Welw.) C.DC.].

3.2.3. Taxonomic Treatment of Indigenous Genera

Genus *Ekebergia*

Ekebergia Sparrm. in Kongl. Vetensk. Acad. Handl. 40: 282 (1779); Sonder in Fl. Cap. 1: 247 (1860); White and Styles in F.Z. 2: 315 (1963); White in Bothalia 16 (2): 155 (1986); White and Styles in Fl. SA. 18 (3): 51 (1986); Leistner, Seed Pl. S. Afr.: 259 (2000); Coates Palgrave, Trees Southern Afr.: 451 (2002). Type species: *Ekebergia capensis* Sparrm.

Deciduous trees or shrubs. **Leaves:** imparipinate; leaflets are entire, subopposite, or opposite; leaf rachis occasionally winged. **Flowers:** unisexual, in axillary panicles. **Calyx:** short, 4–5-lobed, obtuse, imbricate in aestivation. **Petals** 4–5, barely elongated than the calyx, imbricate in aestivation, elliptical or oblong. **Stamens** 10 (occasionally 9) united in a campanulate 10-toothed antheriferous short tube; anthers sessile. **Ovary:** 4–5-celled, sessile, surrounded by an annular disc; ovules in pairs in each locule; style short, thick; stigma discoid, obscurely four or five-lobed. **Fruit:** (dry berry), globose, 4–5-celled. **Seeds:** mostly one per locule, exalbuminous; cotyledons thick, fleshy; radicle superior.

Key to the species

1a. Leaf petiole and rachis not winged; prismatic crystals in ray cells of bark—***E. Capensis.***

1b. Leaf petiole and rachis winged; prismatic crystals absent from ray cells of bark—***E. pterophylla.***

Ekebergia capensis

Ekebergia capensis Sparrm. in Kongl. Vetensk. Acad. Handl. 40: 282 (1779); Thunb., Fl. Cap. 542 (1823); Sonder in Fl. Cap. 1: 247 (1860); Pappe, Silv. Cap. 1: 6 (1862); C. DC. in Monogr. Phan. 1: 641 (1878); Butt-Davy, Fl. Transv. 2: 487 (1932); White and Styles in F.Z. 2: 315 (1963); Ross, Fl. Natal 216 (1972); Palmer and Pitman, Trees S. Afr. 2: 1065 (1973); White in Bothalia 16: 155 (1986); White and Styles in Fl. SA. 18 (3): 51 (1986). Type: South Africa, Western Cape, 'ad Cap. B.-Spei', without date, *Sparrman s.n.* (S-image!, holotype).

Ekebergia buchananii Harms in Engl. Bot. Jahrb. 23: 164 (1896). Type: Nyasaland, 1891, *Buchanan 39* (B, holotype†; K, isotype).

Ekebergia meyeri Presl ex C. DC. in Monogr. Phan. 1: 642 (1878); Sim in For. Fl. Port. E. Afr. 26: 20 (1909); Bak. in Journ. Linn. Soc. Bot. 40: 38 (1911); Eyles in Trans. Roy. Soc. S.

Afr. 5: 389 (1916); Garcia in Fl. Mocamb. 2: 141 (1954). Type: South Africa, KwaZulu-Natal, Port Natal, in Waldern und Holzungen, April 1838, *Drège b* (S).

Ekebergia mildbraedii Harms in Notizbl. Bot. Gart. Berlin-Dahlem 7: 229 (1917); Staner and Gilbert, F.C.B. 7: 210 (1958); White in Bothalia 16 (2): 155 (1986). Type: Cameroon, Sanga, Übergangs grenze der Hylaea südlich des Sanaga zwischen Jaunde und Dengdeng unweit der Vereinigung von Lom und Djerem. Etwa, ca 121 mi [195 km] NO Jaunde, May 1914, *Mildbraed 8479* (K-image!, holotype).

Ekebergia ruppeliana (Fresen.) A. Rich. in Tent. Fl. Abyss. 1: 105 (1847); Oliv. in F.T.A. 1: 333 (1868); C. DC. in Monogr. Phan. 1: 643 (1878); Gűrke in Engl. Pflanzenw. Ost-Afr. 231 (1895); Lebrun in Ess. For. Reg. Mont. Cong. Or. 2: 112 (1935); Brenan in T.T.C.L. 315 (1949); Eggeling and Dale, Indig. Trees Uganda Prot. 174 (1952); Staner and Gilbert, F.C.B. 7: 208 (1958); Dale and Greenway, Kenya Trees and Shrubs 267: 54 (1961). Type: Ethiopia, Abessinien, auf dem Wege von Halei nach Temben, May 1832, *Ruppell s.n.* (FR).

Ekebergia senegalensis Juss. in Mém. Mus. Hist. Nat. 19: 234 (1830); Exell and Mendonca, C.F.A. 2: 316 (1951); Keay in F.T.W.A. edn 2.1: 705 (1958); Staner and Gilbert, F.C.B. 7: 208 (1958); Styles in E. Afr. Agr. Forestry J. 39: 410 (1974); White in Bothalia 16 (2): 155 (1986). Type: Angola, Distr. Golungo Alto. Sobati de Quilombo, July 1856, *Welwitsch 1704* (BM).

Trichilia ekebergia E.Mey. ex Sond. in Harv. and Sond. Fl. Cap. 1: 246 (1860). Type: South Africa, no date, *Drège s.n.* (BM).

Trichilia rueppelliana Frensen. in Mus. Senckenb. 2: 278 (1837). Type: Ethiopia, Abessinien, auf dem Wege von Halei nach Temben, May 1832, *Ruppell s.n.* (FR).

Large, evergreen (sometimes semi-deciduous) tree, up to 35 m tall; crown moderately dense, somewhat flattened; bole straight (sometimes bent), up to 1.2 m in diameter. **Bark:** surface smooth but rough and scaly in older trees; inner bark reddish (sometimes with white bands); twigs with conspicuous whitish lenticels; cortex with ideoblast cells; dilatation of cortical tissue is by anticlinal division of the cortical parenchyma and collenchyma cells as well as tangential stretching of cells forming strands of 2–11 cells, crystals in phelloderm cells, crystals in axial parenchyma, crystals in ray cells, fibers present in secondary phloem, canal in rays. **Wood:** diffuse-porous, vessels slightly angular or rounded in outline, solitary, few, and in radial multiples of 2–4, intervessel pits alternate, small to medium, 4.4–7.7 µm in diameter; fibers non-septate; axial parenchyma scanty paratracheal, up to 12 cells wide; prismatic crystals present in chambered axial parenchyma cells; rays mostly biseriate. **Leaves:** imparipinnately compound with 3–7 pairs of leaflets, petiolate, lateral leaflets opposite, ovate to lanceolate, leaflets 20–120 × 20–50 mm, petioles thick at base, 30–120 mm long, **petiolules:** 5–15 mm long, rachis up to 230 mm long, stipules absent, leaflet base acute, leaflet apex acuminate. **Inflorescence:** a 6–10-flowered or six multi-flowered panicle or raceme. **Flowers:** unisexual, regular, small, ca.6 mm in diameter, greenish-white; sepals 5, fused, ca. 2–3 mm long, densely pubescent; petals 5, free, up to 7 mm long, imbricate, tomentose; stamens 5, with filaments joined forming cup-shaped tube; anthers sessile, usually on the tube; ovary superior, sessile, with two ovules in each locule; style single, up to 10 mm long, stigma 4–5-lobed; male flowers with undeveloped ovary; female flowers with non-dehiscing anthers. **Fruit:** a drupe, fleshy, up to 30 mm in diameter, globose to ellipsoid, ripens from green to pink to deep red, 2–4-seeded. **Seeds:** 5–10 mm long, not arillate, dark brown (Figure 1).

Distribution and ecology

The species grows in riverine forests, wooded grassland, and savanna woodlands from sea level to about 3000 m. It is mostly found in Limpopo, Gauteng, Mpumalanga, KwaZulu-Natal, the Western Cape, and the Eastern Cape provinces in South Africa (Figure 2). It is also found in Eswatini, Zimbabwe, Zambia, Sudan, Ethiopia, the Congo, and Uganda.

Figure 1. Diagnostic features of *Ekebergia capensis.* (**A**) Large evergreen tree up to 35 m tall. (**B**) Buttress or fluted root system. (**C1**) Glossy compound leaves with terminal leaflet. (**C2**) Ovate to lanceolate leaflets with acuminate apex. (**C3**) Leaf with long rachis [200–230 mm long]. (**D**) Rough bark. (**E**) Crystals in ray cells, shown with an arrow (bark tangential section). (**F**) Crystals lining the walls of secondary phloem fibers, shown with an arrow (bark cross section). The scale bar represents 100 µm. Photos by *D. Becking*–www.inaturalist, (accessed on 26 March 2019), (**A**,**B**); *B.-E. Van Wyk* (**C**,**D**), and *M. O. Oyedeji Amusa* (**E**,**F**).

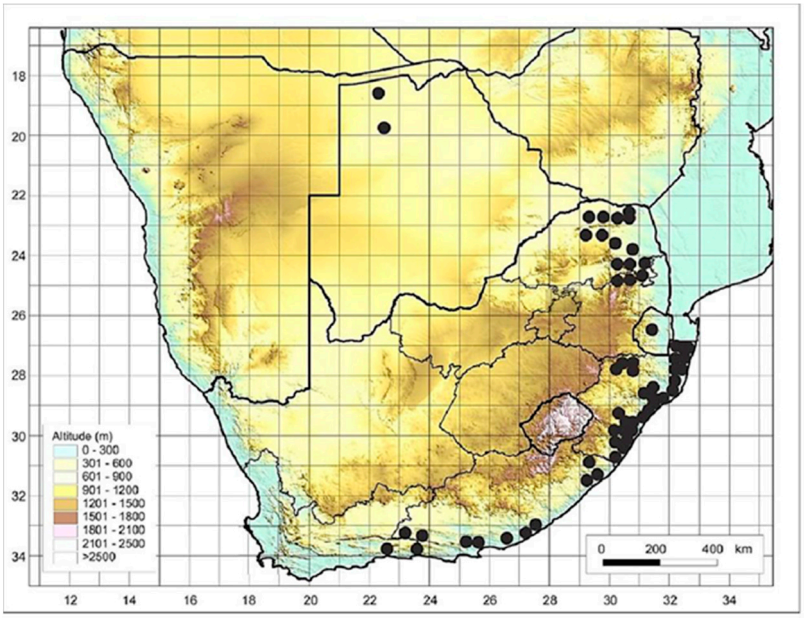

Figure 2. Recorded geographical distribution of *Ekebergia capensis* in the Flora of the southern Africa region (base map obtained from the South African National Biodiversity Institute).

Diagnostic characters

Ekebergia capensis is similar to *E. pterophylla* in that the leaves are compound with opposite leaflets ending with a single terminal leaflet. *Ekebergia capensis* is readily distinguished by its rough light grey to almost black bark with some buttress roots at the base and the glossy green, ovate to lanceolate leaflets, 20–120 × 20–50 mm long, rachis 200–230 mm long, not winged or only very slightly winged, and the presence of prismatic crystals in ray cells. In *P. pterophylla,* the leaflets are leathery, elliptic to narrowly obovate, 30–50 × 20–30 mm, and crystals are absent from the ray cells (bark tangential section).

Conservation status

Least concern (http://redlist.sanbi.org/species.php?species=961-1, (accessed on 26 March 2019)). Our observations support this assessment because the species is very widely distributed.

Phenology

The species flowers in the summer months (September to December), and fruits ripen between November and April.

Specimens examined

Botswana. **1822 (Kangara):** Gomare, fringing forest, near store (–AC), June 1946, *Miller B/431* (PRE), Seronga, Okavango River (–CA), 27 September 1954, *Story 4758* (PRE). **1922 (Nokaneng):** Dikgathong, Thaoge River (–CD), 29 October 1975, *Smith 1471* (PRE).

South Africa. LIMPOPO: **2229 (Waterpoort):** Zoutpan farm, kloof behind homestead, lower slopes of berg (–CD), November 1932, *Obermeyer, Schweickerdt, and Verdoorn 112* (PRE); Makuleke (–CD), 26 October 1932, *Lang s.n.* (NH), Soutpansberg, Wyllie's Poort, Ingwe Motel near Wyllie's Poort (–DD), 8 January 1963, *De Winter 7816* (PRE). **2230 (Messina):** Sibasa, Thohoyandou, onder kranse (–CC), 21 November 1975, *Van der Waal 11* (PRE); Lake Fundudzi, between Thomason's store and lake (–CD), December 1928, *Hutchinson 2165* (PRE); Kruger National Park, NW of Punda Milia, Shipudza (–DB), November 1966, *Van Wyk 46027* (PRE). **2327 (Ellisras):** Langs pad vanaf Mudzinga-spruit op pad na Seville, farm Seville 250 MT (–DD), 3 November 1979, *Van Wyk 2938* (PRE). **2329 (Polokwane):** Zoutpansberg, foothills in ravine (–AA), 10 January 1955, *Mogg 24553* (PRE); Makhado, Bluegumspoort, ca 12.4 mi [20 km] from main road to Messina on northern slopes of Zoutpansberg (–BB), 1 February 1978, *Pienaar 1204* (PRE). **2330 (Tzaneen):** Letaba, Duiwelskloof, Modjadjis Reserve near Duiwelskloof (–CA), 15 April 1937, *Krige 39* (PRE); Polokwane, between Malati and Malopene (–DD), 22 October 1938, *Acocks and Hafström 1092* (PRE). **2430 (Pilgrim's Rest):** The Downs (–AA), March 1940, *Renny 64* (PRE); Letaba, Lekgalameetse, on the farm Malts 65 KT (–AA), 30 November 2017, *Turpin 1660* (J); Lekgalameetse Nature Reserve, Schelem, along main road towards Malta, near Selati River, steep slope (–AB), 5 December 1984, *Stalmans 304* (PRE); Pilgrims Rest, Mariepskop (–DB), 2 December 1959, *Van der Schijff 4714* (PRE). **2431 (Acornhoek):** Timbavati Game Reserve, Kempiana farm, on dry riverbank (–AD), 13 August 1978, *Kruger 299* (PRE); Timbavati Nature Reserve, Spring Valley, ca 124.3 mi [200 km] from Mwauwe stream (–CB), 19 November 1982, *Zambatis 1510* (PRE). **2531 (Komatipoort):** Mbombela, Crocodile Valley Estate near Waterfall (–CA), 12 November 1973, *Onderstall 129* (PRE); Barberton, Highland Creek (–CC), 29 January 1890, *Galpin 786* (PRE).

MPUMALANGA: **2430 (Pilgrim's Rest):** Olifants Camp, Kruger National Park (–BD), 31 December 1984, *Schijf 1220* (J); Mariepskop, rain forest near sawmill (–DB), 1 April 1959, *Van der Schijff 4650* (PRE); Blyderivierspoort Nature Reserve, Swadini (–DB), 8 October 1987, *Raal 1693000* (J); White River, Kruger National Park, Skukuza (–DC), 29 December 1984, *Schijf 1221* (J). **2531 (Komatipoort):** Kruger National Park, boskloof in Shabin (–AA), 9 October 1954, *Van der Schijff 3908* (PRE); Bushbuck Ridge Nature Reserve (–CC), 25 September 2011, *Balkwill and McCallum 12570* (J); Songimvelo Game Reserve, Dundar Valley (–CC), 26 September 1999, *Balkwill, McCallum, and Campbell-Young 11059* (J); ca 3 mi [4.8 km] from Shia-lo-Ngubu Dam towards Louws Creek (–CD), 10 November 1973, *Nel 349* (PRE).

KWAZULU-NATAL: **2632 (Bela vista):** Charter's Creek, Lake St Lucia (–AD), 1 January 1967, *Hitchins 245* (NH, NU); Ndumo Game Reserve, Usutu riverine woodland

(–CD), 1 November 1969, *Moll 4236* (NH); Sihandla riverbank (–DD), 26 November 1967, *Moll and Strey 3912* (NH); Kosi Bay, NW of Lake Nhlange (–DD), 26 October 1989, *Ward 2622* (NH); Kosi Bay, NW side of Lake Nhlange (–DD), 19 July 1986, *Venter 11540* (NH). **2730 (Vryheid):** Utrecht, Donkerhoek (–AD), 17 September 1963, *Devenish 1039* (PRE); Pongola Bush Nature Reserve, above Uitvlugt farm (–BC), 9 October 1990, *Glen 2358* (PRE). **2731 (Louwsburg):** Ingwavuma, summit of mountains near Magistrate Court (–AA), 23 September 1943, *West 2109* (NH); Ingwavuma, Ndumu Game Reserve (–AA), 14 January 1964, *Tinley 853* (NH, NU); uPhongolo Municipality, ± 300 m S of Mthembu Store, eMboloba (–AC), 21 February 2007, *Keswa 1757* (NH); Ngotshe, Pongola town (–BC), 25 October 2001, *Meyer BP00979* (PRE); Mpondwane, eastern slopes of Lebombo Mountains (–BD), 18 November 2001, *Vahrmeijer HV00273* (PRE); Craigadam farm, Itala Nature Reserve (–CB), 19 January 1978, *McDonald 487* (PRE, NU); Ndumu Game Reserve, Usutu River Forest (–DC), 10 September 1970, *Pooley 841* (NH, NU). **2732 (Ubombo):** Mandozi, ca 10.8 mi [17.4 km] from Manzengwenya on road to Mbazwana (–BC), 26 October 1966, *De Winter and Vahrmeijer 8539* (PRE); Tembe Elephant Park (–AC), *Ward 1070* (NH); Lake Sibaya area (–BC), 10 April 1958, *Tinley 210* (PRE, NU); Lake Sibaya area (–BC), 11 January 1964, *Strey 5128* (NH, NU); Manzengwenia (–BC), 10 December 1964, *Vahrmeijer and Tòlken 248* (NH); Sodwana Bay, edge of swamp forest (–DA), 17 September 1965, *Vahrmeijer 1153* (PRE); Sodwana Nature Reserve (–DA), 16 October 2001, *Schuhardt DS00216* (PRE). **2830 (Dundee):** Dundee, hill above reservoir (–AA), 26 November 1955, *Edwards 1078* (PRE, NU); Oudeni, Gonzaga Mission (–DB), 8 September 1939, *Gerstner 3550* (PRE); Krantzkop, a few miles from Jamesons Drift (–DD), 22 March 1956, *Edwards 1285* (PRE, NU). **2831 (Nkandla):** Hlabisa, Charter's Creek (–BB), 14 October 1963, *Barker 10018* (NH); Nkandla Forest, ca 14.7 mi [23.7 km] from Nkandla hotel on road to Eshowe (–CA), 10 April 1964, *De Winter 8266* (PRE); Nkandla Forest (–CA), 18 August 1987, *Cunningham 1987* (NU); Silverglen Nature Reserve (–CC), 7 March 1994, *Anna Jäger 18* (NU); Silverglen Nature Reserve (–CC), May 2010, *Amoo 23* (NU); ca 4 mi [6.4 km] N of Nkwalini (–DA), 9 October 1946, *Acocks 12958* (PRE); Ngoye Forest (–DC), 11 October 1984, *Jordaan 396* (NH); Mtunzini (–DD), 17 February 1961, *Wells and Edwards 32* (NH). **2832 (Mtubatuba):** Hluhluwe Game Reserve (–AA), 27 June 1967, *Wearne 86* (NH, NU); Hluhluwe Game Reserve (–AA), 13 November 1953, *Ward 1697* (NH, NU); St Lucia, western shores, Nyalazi Forest Station (–AB), 11 March 1982, *Nicholas and Van Wyk 1254* (NH); Nyalazi State Forest, Kentron (–AB), 8 October 1986, *MacDevette 1136* (NH, NU); Hlabisa, St Lucia Estuary, edge of Kululu Lake (–AD), 28 November 1965, *Moll 2808* (PRE, NU); Maphelane Nature Reserve road, S of NPB office, dune forest (–AD), 23 October 1985, *Fokkens 19* (NH); Nseleni Village, Nseleni Nature Reserve, NE of reserve and staff quarters complex (–CA), 8 November 2000, *Ngwenya 1835* (PRE); Mbonambi Village (–CA), 13 December 2007, *Nkuna and Mabatha 2339* (PRE); Richards Bay, Kleiklipklofie, 500 m from beach (–CC), 17 October 2001, *Meyer 3971* (PRE). **2930 (Pietermaritzburg):** Lions River, Karkloof, Ehlatini farm (–AC), 10 February 1967, *Moll 3435* (NH, NU); Silverglen Nature Reserve, E of Umlazi Nursery (–CD), 28 August 1985, *Buthelezi 589* (NH); Camperdown, Umgeni Dam (–DA), 20 May 1965, *Moll 1724* (PRE, NU); Umlaas Valley (–DA), 13 Nov, 1933, *Forbes 1181* (NH); near Chakaskraal at the edge of the bush on top of a rocky bank (–DB), September 1916, *Thode s.n.* (NH); Shongweni Dam (–DC), 21 February 41966, *Morris 710* (NH); Umlaas Valley (–DC), 13 November 1933, *Smuts and Gillet s.n.* (NH); Silverglen Nature Reserve, next to resource centre (–DD), 12 March 1996, *Crouch 742* (NH); Westville North (–DD), 11 September 1966, *Coleman 332* (NH); Kranzkloof Nature Reserve (–DD), 2 3 July 2001, *Grace 5* (NU). **2931 (Stanger):** ca 25 mi [40.2 km] from Tongaat (–AC), 8 February 1965, *Moll 1525* (NH, NU); Stanger, Ballito, Rainfarm Game Reserve (–AC), 15 December 2015, *Cheek 2426* (NH); Lower Tugela, New Guelderland (–AD), June 1966, *Stewart 33* (PRE); New Guelderland, 5 miles from the sea (–AD), March 1966, *Stewart 6* (NH); Amatigulu Nature Reserve, Trail 2 (–BA), 4 December 2015, *Steyn 2184* (PRE); Inanda, Saunders Park south, Tongaat River (–CA), *Ward 5848* (PRE, NU); Port Zimbali, dune forest (–CA), 5 September 1985, *MacDevette 322* (NH, NU); Musgrave road, Branksome Towers (–CC), 1 December 1983, *Adamson s.n.* (NH).

3030 (Port Shepstone): Mapumulo (–AA), 15 May 1987, *Cunningham 2695* (NU); KwaDumisa, ± 600 m NE of eMphambanyoni Sowing Centre, eMphambanyoni (–AB), 20 July 2006, *Keswa 857* (NH); Dumisa, 400 m NE of Vulamehlo Community Poultry Project, Mphambanyoni (–AB), 28 July 2006, *Keswa 921* (NH); Gilbraltar, outcrop of Table Mountain Sandstone, at top of Umzimkulu Gorge (–AC), 13 March 1973, *White 10527* (NH); Hlutankungu, Dumisa (–AD), 25 September 1912, *Rudatis 1681* (NH); South coast, Mkomazi River, Delos Estate 10342 (–BA), 6 September 1994, *Ward 12666* (NH, NU); Friedennau, Alexandra City (–BC), 10 September 1910, *Rudatis 862* (NH); Ngome, edge of golf course (–BD), 21 December 1960, *Mauve 4106* (PRE); Scottburgh, in die bosse van die kusgordel (–BD), 26 May 1941, *Goossens 1708* (PRE); Ntimbankulu/Dweshula, near foot path to Mabhaleni Village, Ntimbankulu Forest (–CB), 15 February 2001, *Ngwenya 2064* (NH); Umzimkulu Gorge, Gibraltar (–CB), 13 March 1973, *White 10527* (PRE); Umtamvuna Nature Reserve, below Aerodrome (–CC), 15 October 1983, *Abbott 1421* (NH); South coast, Palm Beach (–CD), 5 January 1981, *Schrire 566* (NH); Alfred, Uvongo Hills Forests (–CD), 17 October 1973, *Mogg 38276* (PRE). **3130 (Port Edward):** Mzamba Casino, floodplain of Mzamba River, on the road to the pump house (–AA), 8 January 1993, *Abbott and Arkell 19* (NH).

WESTERN CAPE: **3322 (Oudtshoorn):** Wilderness, The Lakes, road to Rondevlei (–DC), 26 January 2001, *Meyer BP00442* (PRE). **3323 (Willowmore):** near Keurbooms River (–AB), 27 February 1984, *Linger 83* (PRE); Keurbooms River (–DD), 11 November 1894, *Schlechter 5942* (PRE); Keurbooms Strand (–DD), November 1961, *Taylor 2913* (PRE).

EASTERN CAPE: **3029 (Bizana):** ca 5 mi [8 km] from Bizana on Kokstad road (–BD), 19 December 1944, *Acocks 10943* (PRE). **3129 (Port St. Johns):** Transkei, Umsikaba River, Ndindini (–BD), 10 November 1970, *Strey 10123* (PRE); 2nd Beach (–DA), 12 May 2002, *Schuhardt DS02955* (PRE); Intafufu River (–DA), 11 October 1968, *Mill 425* (PRE). **3323 (Humansdorp):** Tsitsikamma National Park, kampeerterrein (–DC), 7 January 1960, *Brand 165* (PRE). **3325 (Uitenhage):** Winterhoek Mountain, Essenwood (–CA), 12 September 1930, *Fries, Norlindh, and Weimarck 869* (PRE); Van Stadensrivier Reserve (–CA), 22 April 2002, *Potgieter FP00739* (PRE); Baakens River, just below Mangold Park (–DC), 6 August 1974, *Olivier 1101* (PRE). **3326 (Grahamstown):** Kenton-on-Sea, Bloukrans (–DA), 15 March 2002, *Potgieter FP00582* (PRE); Port Alfred, Kenton-on-Sea, top of dune (–DA), 23 May 1991, *Steel 770* (PRE); **3327 (Peddie):** Kaffraria, East London West; wooded kloof beyond lighthouse (–BB), 22 December 1900, *Galpin 5842* (PRE); East London coast (–BB), April 1897, *Sim 2152* (PRE); Kleinemonde, Brink's plot (–BB), 8 January 1984, *Eales 10* (PRE).

Eswatini. **2631 (Mbabane):** Manzini, Timbutini (–AD), 22 November 1963, *Compton 31785* (PRE), Hlatikulu, hills to N of Grand Valley Road, at the foot of hill up to Hlatikulu (–CD), 30 July 1981, *Prior 485* (PRE).

Ekebergia pterophylla

Ekebergia pterophylla (C. DC.) Hofmeyr in Journ. Bot. 63: 57 (1925); White in Bothalia 16 (2): 157 (1986); White and Styles in Fl. SA. 18 (3): 53 (1986). Type: South Africa, near 'Gwenberg', Medley ('Imley') Wood 1022 (G, holotype; K, isotype).

Trichilia alata N.E.Br., Bull. Misc. Inform. Kew 1896 (117–118): 160 (1896). White in Bothalia 16 (2): 157 (1986). Type: KwaZulu-Natal, Groenberg (not located), Wood 1043 (K, lectotype; NH! (2x), isolectotypes). [Lectotype designated by White in Bothalia 16 (2): 157 (1986)].

Trichilia pterophylla C. DC. in Bull. Herb. Boissier 2: 581 (1894); White in Bothalia 16 (2): 157 (1986). Type as above.

Small, sturdy, deciduous shrub or tree, up to 10 m tall; crown flat; bole straight in a sheltered position; young branches stout and thick. Bark surface smooth but rough and mottled in older trees; inner bark brownish (sometimes with white bands); twigs with reduced or no lenticels; pith with prismatic crystals and druses; cortex with ideoblast cells; dilatation of cortical tissue is by anticlinal division of the parenchyma and cortical collenchyma cells as well as tangential stretching of cells forming strands of 2–11 cells; phelloderm cells with crystals; axial parenchyma with crystals; fibers absent in secondary phloem ray cells without crystals; canal in rays. **Wood:** diffuse-porous, vessels slightly angular or rounded in outline, solitary, few, and in radial multiples of 2–4, intervessel pits

alternate, minute, 2.7–3.8 µm in diameter; fibers non-septate; axial parenchyma scanty paratracheal, up to 5 cells wide; prismatic crystals present in chambered axial parenchyma cells; rays mostly uniseriate. **Leaves:** imparipinnate, leathery compound with 2–3 pairs of leaflets, petiolate, lateral leaflets opposite, elliptic to narrowly obovate, leaflets 30–50 × 20–30 mm, leaflet base acute, leaflet apex narrowly tapered to rounded and may be notched; petioles broadly winged, petiole 20–30 mm long, **petiolules:** absent; rachis broadly winged; stipules absent; margin entire, extends down to rachis and rolled under. **Flowers:** unisexual, in panicles, small, ca. 30 mm in diameter, white or slightly pink, sweetly scented, star-shaped in compact clusters; sepals 4–5, ca. 2–4 mm long; petals 4–5, imbricate; stamens 10, united or joined connate, anthers sessile; ovary superior, 4–5-celled, sessile, with two ovules in each locule, surrounded by an annular disc; style short and thick, up to 7 mm long, stigma obscurely 4–5-lobed, male flowers with undeveloped ovary, female flowers with non-dehiscing anthers. **Fruit:** a drupe, fleshy, up to 10 mm in diameter, globose, ripens from green to dull yellow, red, or black, mostly 1-seeded, indehiscent. **Seeds:** one or two, without arils. (Figure 3).

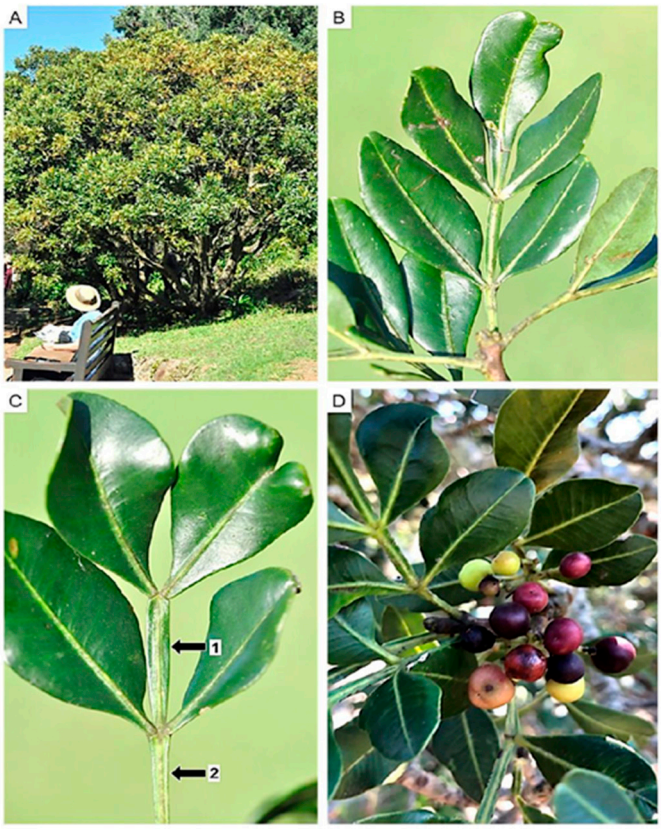

Figure 3. Diagnostic features of *Ekebergia pterophylla*. (**A**) Small tree with a flat crown up to 10 m tall. (**B**) Compound leaves with the leaflets elliptic to narrowly obovate, leathery, with a rounded to notched apex. (**C1**) Winged rachis. (**C2**) Winged petiole. (**D**) Fleshy, globose, dull yellow, red, or black fruit. Photos by *D. Becking*–www.inaturalist, (accessed on 26 March 2019) (**A**); *B.-E. Van Wyk* (**B**,**C**); and *T. Van der Merwe* (**D**).

Distribution and ecology

The species grows in montane and coastal forests, amongst rocks on outcrops or in ravines, open woodland, forest margins, and sometimes close to the escarpment below an elevation of 2000 m. It is distributed in Limpopo, Mpumalanga, KwaZulu-Natal, and Eastern Cape Provinces in South Africa. It is also found in Eswatini (Figure 4).

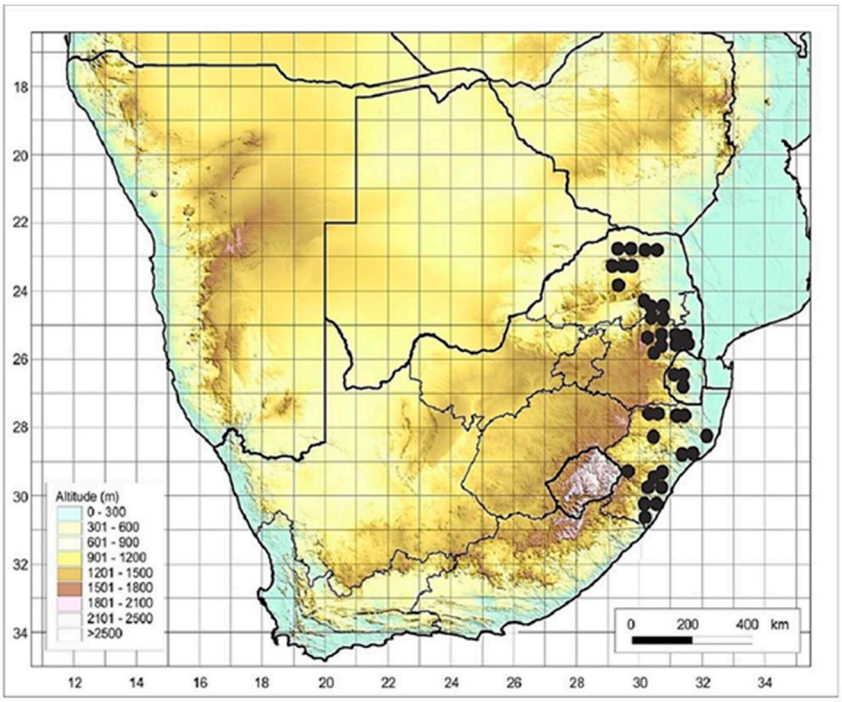

Figure 4. Recorded geographical distribution of *Ekebergia pterophylla*. (Base map obtained from the South African National Biodiversity Institute).

Diagnostic characters

Ekebergia pterophylla is similar to *E. capensis* in that the leaves are compound with opposite leaflets ending with a single terminal leaflet. *E. pterophylla* is readily distinguished by its broadly winged rachis and petiole, lack of petiolules, leathery, elliptic to narrowly obovate leaflets, 30–50 × 20–30 mm vs. non-winged petiole, presence of petiolules, and glossy, ovate to lanceolate leaflets, 20–120 × 20–50 mm in *E. capensis*.

Conservation status

Least concern (http://redlist.sanbi.org/species.php?species=961-3, (accessed on 26 March 2019)). As shown in the distribution map (Figure 4), the plant is widely distributed, so we agree with this assessment.

Phenology

The species flowers during the late winter to spring months (July to November) and fruits between December and May.

Specimens examined

South Africa. LIMPOPO: **2229 (Waterpoort):** Soutpansberg, Makhado, plaas Wellington, noordekant van plaas (–DC) 25 March 1994, *Rossouw 215* (PRE); Soutpansberg, Masekwaspoort road (–DD), 15 May 1994, *Balkwill 9113* (J); N of the Soutpansberg, on Fife farm 790 MS, on road to "Budworth", slopes below south-facing cliffs (–DD), 14 May 1994, *Cron 293* (J). **2230 (Messina):** Makhado, ca 9.3 mi [15 km] NE of Makhado on the Witvlag road, Studholme farm (–CC), 4 April 1997, *Burgoyne 6177* (PRE); Thononda, naby Kruin (–CD), 5 October 1981 *Van Wyk and Theron 4630* (PRE). **2329 (Polokwane):** Blaauwberg, near Malebochs kraal on hill side (–AA), 27 April 1954, *Codd 8705* (PRE); Llewellyn, 35 LS farm, behind homestead (–AB), 20 July 1981 *Venter 6194* (PRE); Happy Rest, ca 13 mi [20.9 km] W of Makhado (–BA), 28 February 1946, *Gerstner 6027* (PRE); Lajuma Research Centre (–BA), 28 October 2015, *Balkwill, Reddy and Oosthuizen 13673* (J); ca 8 mi [12.9 km] N of Makhado, near Mount Summit (–BB), 27 August 1961, *Van Vuuren 1250* (PRE); The Downs (–CD), December 1918, *Rogers 22010* (PRE). **2430 (Pilgrim's Rest):** Lekgalameetse Nature Reserve, The Downs, The Knuckles (–AA), 17 April 1986, *Stalmans 1267* (PRE).

MPUMALANGA: **2430 (Pilgrim's Rest):** Blyde River, Drie Rondawels (–DA), 9 October 1971, *Jordaan 114* (PRE); Mariepskop, on Blyderivier road (–DB), 28 May 1960, *Van*

der Schijff 5120 (PRE); Ohrigstad Dam Nature Reserve (–DC), 20 January 1976, *Theron 3432* (PRE); Kowyns Pass, Graskop (–DD), 10 September 1963, *Rauh* and *Schlieben 9723* (PRE); Fairy Land Private Nature Reserve (–DD), 14 April 1979, *Dyer s.n* (J). **2530 (Mashishing):** Buffelskloof Nature Reserve, top of gorge, open woodland (–AD), 12 December 1996, *Crouch 747* (PRE); Montrose Falls (–BC), 2 April 1944, *Mogg 30429* (PRE); Starvation Creek Nature Reserve, teen rand van eskarpement (–DA), 27 October 1977, *Kluge 1096* (PRE); Buffelskloof Nature Reserve, krantz edge (–DA), 12 June 2002, *Crouch 945* (NH); Kaapsehoop, Berlin (–DB), 25 April 1923, *Hofmeyr 8* (PRE); Witklip, Klipkop, 19 September 1973, *Kluge 221* (PRE); Barberton, valley above Agnes Mine (–DD), 1 November 1986, *Cadman 3627* (J). **2531 (Komatipoort):** Sabie Hoek Forest (–AA), 27 January 1906, *Burtt Davy 5217* (PRE); Krokodilpoort, Beacon Hill (–AC), 11 May 1972, *Nel 210* (PRE); Nelspruit, on the farm Moederlief 209 JU (–CA), 30 April 2014, *Buthelezi 9* (J); Havelock Mine (–CC), October 1955, *Miller 3079* (PRE); Barberton, on the farm Dycedale 368 JU (–CC), 23 November 2013, *Balkwill, Reddy, McCallum and Cron 12826* (J); Barberton Mountainlands Reserve, Wonder Scheur 362 JU (–CC), 10 November 2014, *Balkwill, Mbatha, Oosthuizen, McCallum and Adebowale 13146* (J); SW of Shiyalongubo Dam wall (–CD), 1 February 2004, *McMurtry 11660* (PRE).

KWAZULU-NATAL: **2730 (Vryheid):** Utrecht (–AD), July 1922, *Thode A219* (PRE); Grootspruit, near Grootspruit on hill (–BC), 3 February 1968, *Strey 8048* (PRE). **2731 (Louwsburg):** On quartzite ridge (–CA), 6 November 1964, *MacDevette 760* (NH); near Louwsburg, Ngotshe, edge of krantz (–CB), 12 October 1946, *Acocks 13033* PRE. **2830 (Dundee):** ca 19 mi [30.6 km] from Nqutu on Qudeni road (–BA), 20 November 1957, *Edwards 2204* (PRE, NU). **2831 (Nkandla):** Babanango, Scheepershoek NHS, Mahlanganeni River valley (–AC), 11 June 1993, *Scott-Shaw 5668* (NU); Mtunzini, Ngoye Forest Reserve, eastern section (–DC), 5 October 1992, *Williams 927* (NH); Ngoye Forest Reserve (–DC), 21 November 1990, *Ngwenya 3327* (NH); Ngoye Forest (–DC), September 1969, *Garland 327* (NH); Ngoye Forest (–DC), 12 October 1984, *Jordaan 420* (NH); Mtunzini, Ngoye Forest Reserve (–DC), 23 February 1961, *Well and Edward 134* (NU); Ngoye Forest Reserve, rocky outcrop on top of spur (–DD), 21 November 1990, *Hutchings 3327* (NH); Mtunzini, Ubisana Valley (–DD), 17 August 1964, *Venter 1694* (NH). **2832 (Mtubatuba):** Hluhluwe Game Reserve (–AA), 28 November 1959, *Ward 3341* (NH, NU). **2929 (Underberg):** Hlatikulu (–BA), 16 October 1959, *Compton 29240* (NH). **2930 (Pietermaritzburg):** KwaSangwana, edge of cliff (–BC), *Ngwenya 598* (NH); Little Noodsberg (–BD), October 1989, *Scott-Shaw 2127* (NU); Noodsberg, Ozwatini plateau, forest margin (–BD), 13 October 1989, *Williams 515* (NH); Mapumulo, on the Ozwatini Plateau (–BD), 13 October 1989, *Balkwill 4940* (J); Cato Ridge, Mkabela, near Ekuthuleni, forest margin (–DA), 10 October 1989, *Williams 377* (NH); Craig Lea farm, Table Mountain Sandstone, at top of cliffs of small uninhabited tributary valley of Ngeni Valley, open bushland among rocks (–DA), 24 February 1973, *White 10308* (NH); New Hanover, near Ekuthuleni, Windy Hill (–DA), 10 October 1989, *Balkwill 4706* (J); Greater Durban area, Inanda Mission Reserve 4579, Armstrong Hill, Showe Forest (–DB), 16 July 1991, *Ward 12083* (NH); Hammarsdale (–DC), 4 July 1928, *Forbes 299* (NH); Ismont Krantz, TMS (–DC), 26 January 1969, *Strey 8359* (NH); Winston Park, Ntendeni Hill (–DD), 29 August 1971, *Ward 7187* (NU). **3030 (Port Shepstone):** Alexandria, Dumisa Station, Umgaye (–AD), 21 July 1911, *Rudatis 1431* (PRE); Oribi Gorge Hotel, forest outskirts near waterfall (–CA), 13 August 1953, *Story 4147* (PRE); Oribi Gorge Natuurreservaat, op rand van afgrond naby bopunt van viewpoint wandelpad (–CA), 6 December 1975, *Van Wyk and Venter 1294* (NU); Umtamvuna Tributary (–CB), 3 February 1966, *Nicholson 329* (NH); Izotsha River Gorge, TMS outcrop at top of cliffs (–CB), 13 March 1973, *White 10523* (NH); Beacon Hill (–CB), 1 January 1967, *Strey 7231* (NH); Umtamvuna Forest Reserve (–CC), 11 October 1969, *Strey 9152* (NH, NU); Beacon Hill, ca 15.5 mi [25 km] from Port Edward (–CC), 14 July 1976, *Venter 1017* (PRE); Paddock, Ngotshe Falls (–CC), 21 June 1963, *Nicholson 42* (NH); ca 5 mi [8 km] NW of Uvongo, kloof forest on TMS (–CD), 2 January 1970, *Moll 4934* (NH); Izotsha, TMS krantzes (–CD), 13 March 1973, *Strey 11118* (NH, NU); Mgongongo, kloof forest, top of cliffs (–CD), 19 January 1969, *Strey 8335* (NH, NU). **3130 (Port Edward):** Beacon Hill, cliff bush (–AA), 8 February 1972, *Strey 10627* (PRE, NU); Umtamvuna Nature Reserve (–AA),

25 January 1985, *Abbott 2501* (NH); Umtamvuna Valley, Umtamvuna Nature Reserve (–AA), 14 April 1988, *Harte 216* (J).

Eswatini. **2631 (Mbabane):** Dalriach, amongst rocks (–AC), 18 October 1958, *Dlamini 46043* (PRE); Sibebe Hill, ca 4.3 mi [7 km] NE of Mbabane (–CB), 12 September 1979, *Prior 306* (PRE); near Hlatikulu (–CD), 16 October 1959, *Compton 29240* (PRE); Abens farm (–CD), 23 October 1956, *Compton 26109* (NH).

Genus *Entandrophragma*

Entandrophragma C. DC. in Bull. Herb. Boissier 2 (9): 582 (1894); Exell and Mendonca, C.F.A. 2: 308 (1951); Staner and Gilbert, F.C.B. 7: 180 (1958); White and Styles in F.Z. 2: 289 (1963); White in Bothalia 16 (2): 152 (1986); White and Styles in Fl. SA. 18 (3): 59 (1986); Leistner, Seed Pl. S. Afr.: 259 (2000); Coates Palgrave, Trees Southern Afr.: 445 (2002). Type species: *Entandrophragma angolense* (Welw. ex C. DC.) C. DC.

Large, deciduous tree. **Leaves:** paripinnate, leaflets entire, crowded at the tips of branches, glabrous or slightly pubescent. **Flowers:** unisexual, in axillary panicles. **Calyx:** 5, saucer-shaped, lobed, lobes obtuse. **Petals:** 5, free, contorted, longer than the calyx; stamens 10, filaments united into an urceolate tube, deeply lobed; anthers 10, borne on short filaments on the margin of the tube; ovary 5-locular, subglobose, each loculus with 4–12 pendulous ovules, disc 10 or 20, ovary connected to base of staminal tube with short ridges; style short, cylindrical, stigma discoid with 5 radiating stigmatic lobes. **Fruit** large, 5-angled, woody, pendulous, elongated, cigar-shaped, septifragal capsule, valves open from apex or base or from the apex and base simultaneously, columella massive, softly woody. **Seeds:** 3–9 per locule, with a terminal wing; cotyledons thin; radicle laterally exserted.

The species

Entandrophragma caudatum (Sprague) Sprague in Kew Bull. 1910: 180 (1910); Sprague in Hook., Ic. Pl. 31: t. 3023 (1915); Bremek. and Oberm. in Ann. Transv. Mus. 16: 420 (1935); Harms in Notizbl. Bot. Gart. Berl. 14: 443–4 (1939); Mill. in Journ. S. Afr. Bot. 18: 39 (1952); Pardy in Rhod. Agr. Journ. 52: 515 cum photogr. (1955); Williamson in Useful Pl. Nyasal. 55 (1956); Palgrave in Trees of Central Afr. 218 cum photogr. et Table (1957); White in Bothalia 13 (2): 162 (1986). Type: South Africa, Limpopo, Waterpoort (2229): Soutpansberg (–CD), 1907, *Bailey 2926* (K-image!, holotype).

Pseudocedrela caudata Sprague in Bull. Misc. Inform. Kew 1908 (4): 163 (1908). Type: as above.

Medium to large, evergreen (semi-deciduous to deciduous) tree, 20–30 m tall; crown round; bole straight, up to 2 m in diameter; young branches pale-brown, pubescent. **Bark** thick, rough, grey to brown, flaking in large irregular scales to reveal a buff surface with speckled to round patches; twigs thick. **Leaves** paripinnately compound with 6–9 pairs of leaflets, petiolate, puberulous to tomentose, crowded at the end of branches, leaflets opposite, ovate to lanceolate, leaflets 100–110 × 30–40 mm, leaflet base obtuse to rounded, leaflet apex narrowly acuminate, leaflet abaxial surface light green, leaflet adaxial surface dark green; petioles thick at base, 20–40 mm long; **petiolules:** 5–20 mm long; rachis up to 150 mm long. **Flowers:** unisexual in axillary panicles, small, ca. 20 mm in diameter, pale green to green arising from the axils of leaves; sepals 5-lobed, 3–4 mm long; petals 5, yellowish, 5–6 mm long, tomentose to pubescent; stamens 10, fused into an urceolate tube as long as petals, staminal tube 3–5 mm long; ovary superior, subglobose, 4–5-locular, 2–10 ovules in two rows in each locule; style short, up to 5 mm long, stigma cylindrical, discoid with up to five glowing stigmatic lines. **Fruit:** large, a woody banana-like capsule, up to 160 mm long and up to 40 mm in diameter; pendulous, shiny, and ripens from dark green to brownish; the fruit splits into five valves that curve back, exposing the winged seeds attached to the central column. **Seeds:** 80–100 × 10–20 mm, 3–6 per locule, with a terminal thin wing (Figure 5).

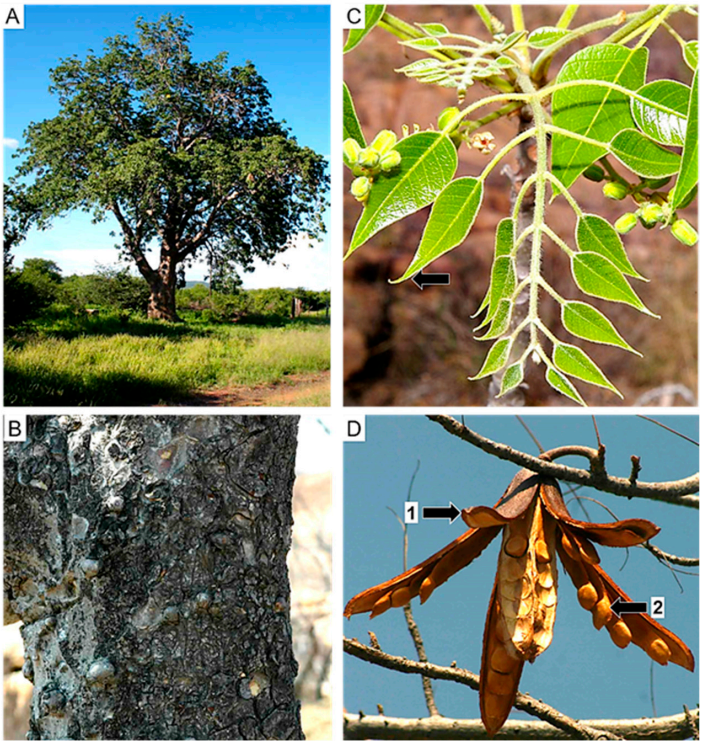

Figure 5. Diagnostic features of *Entandrophragma caudatum.* (**A**) Medium to large evergreen tree with a round crown up to 30 m tall. (**B**) Rough, flaking bark. (**C**) Ovate to lanceolate compound leaf with leaflets having tailed tips. (**D1**) Woody banana-like capsule which splits into 5 valves and curves back from the thickened tip (**D2**) Winged seed. Photos by *B. Wursten*–www.inaturalist, (accessed on 26 March 2019) (**A**,**B**,**D**) and *L. Loffler*–www.inaturalist, (accessed on 26 March 2019) (**C**).

Distribution and ecology

The species grows in various types of bushland forest, mountain slopes, rocky hillsides, low-lying river valleys, and in open woodland at an elevation of 60–660 m. It is mostly found in Limpopo, Mpumalanga, and KwaZulu-Natal provinces in South Africa. It is also found in Angola, Botswana, Eswatini, Malawi, Namibia, Zambia, and Zimbabwe (Figure 6).

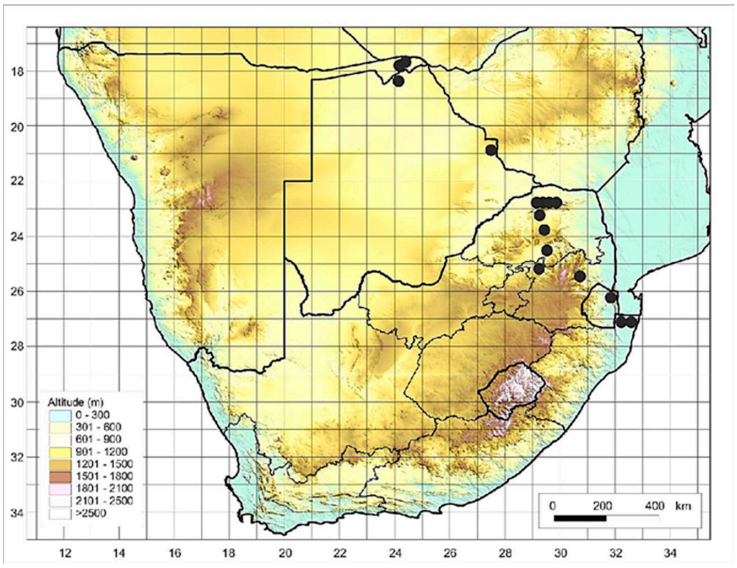

Figure 6. Recorded geographical distribution of *Entandrophragma caudatum* in the Flora of the southern Africa region. (Base map obtained from the South African National Biodiversity Institute).

Diagnostic characters

Entandrophragma caudatum is similar to *E. spicatum* in that the barks are rough and flaking and the leaves compound. *E. caudatum* is readily distinguished by its 6–9 pairs of ovate to lanceolate, 100–110 × 30–40 mm leaflets with conspicuous tips, winged seeds attached to a central column vs. 3–7 pairs of oblong to obovate, 90–110 × 50–70 mm leaflets, and non-winged seeds in *E. spicatum*.

Conservation status

Least concern (http://redlist.sanbi.org/species.php?species=953-1, (accessed on 26 March 2019)), however, it is a protected tree in South Africa. The species is widely distributed over a large part of southern tropical Africa, so the assigned conservation status is correct. Our observations suggest the plant should be protected in South Africa, as it is found in relatively few localities.

Phenology

The species flowers in spring and early summer (September to December) and fruits between April and June.

Specimens examined

Namibia. **1724 (Katima Mulilo):** Eastern Caprivi, 5 mi [8 km] W of town along north border (–AD), 28 August 1967, *Von Breitenbach 1225* (PRE); Mazumina, opening in Baikiaea Forest (–CC), 22 February 1971, *Geldenhuys 206* (PRE). **1725 (Livingston):** Caprivi Strip, Impalila Island (–CC), 19 February 1969, *De Winter 9241A* (PRE); Impalila Island (–CC), 9 November 2001, *Curtis 1436* (PRE).

Botswana. **1824 (Kachikau):** Northern Goha Hills, northern face (–AC), 19 May 1977, *Smith 2053* (PRE). **2027 (Plum tree):** koppies near Tsessebe Camp (–DA), 18 April 1931, *Pole-Evans 3250 (48)* (PRE).

South Africa. LIMPOPO: **2229 (Waterpoort):** Blouberg Nature Reserve, Auf der Haard farm 445 MS (–CC), 7 December 1990, *Archer 511* (PRE); Zoutpan farm near first plateau on lower slopes of mountain (–CD), November 1932, *Obermeyer*, *Schweickerdt* and *Verdoorn 306* (PRE); Waterpoort (–DC), 30 June 1930, *Legat 7665* (PRE); Western Soutpansberg, NW of Makhado, Leshiba Wilderness area, Hamasha Bush Camp (–DC), 17 November 2016, *Bester 13538* (PRE); Wyllie's Poort PO, krantzes in poort (–DD), 11 May, 1973, *Van Graan* and *Hardy 507* (PRE); Soutpansberg, Wyllie's Poort PO (–DD), 18 November 1964, *Vahrmeijer and Joynt 177* (PRE); NE of Masekwaspoort above great North Road, Masekwaspoort (–DD), 12 April 1966, *Scheepers* and *Schlieben 3* (PRE); Wyllie's Poort PO, opposite side to south entrance to tunnel (–DD), 8 December 1960, *Hardy 400* (PRE); Soutpansberg, N of Soutpansberg, farm Davenham 740 MS (–DD), 8 May 1991, *House 0068* (J). **2329 (Polokwane):** Glenferness Dam (–AA), 31 December 1990, *Hardy 7236* (PRE); Senwabarwana, Glenferness Dam (–AA), 4 December 1990, *Balkwill, Balkwill, Barlow-Kearsley, Cron and Gesell 6012* (J); Glenferness (–CD), 30 April 1961, *Strey* and *Schlieben 8647* (PRE). **2429 (Zebediela):** Potgietersrust, Riebeek West (–CD), January 1940, *McDonald 214* (PRE); Vaalwater (–CD), 1 May 1983, *Opperman s.n.* (PRE); ca 47.2 mi [76 km] W of Potgietersrust on Marken road (–DA), August 1975, *Nel 51767* (PRE).

MPUMALANGA: **2531 (Komatipoort):** Dzuweni, teen rant (–BD), 19 February 1954, *Van der Schijff 1308* (PRE).

KWAZULU-NATAL: **2632 (Bela Vista):** Ingwavuma, Ndumo Game Reserve (–CC), 8 March 1973, *White 10488* (PRE); Ndumo Game Reserve (–CC), 27 October 1955, *Hancock 30* (PRE); Ndumo Game Reserve (–CC), 11 July 1955, *Ward 2657* (NH); Ndumo Game Reserve (–CC), 29 February 1956, *Ward 2975* (NH); Ndumo Game Reserve (–CD), 14 November 1968, *Hitchins 331* (PRE); Ndumo Game Reserve, ca 0.6 mi [1 km] S of Nyamite pan, Nyamiti pan (–CD), 12 June 1972, *Stephen and Dutton* 789 (PRE); Ndumo (–CD), September 1966, *Jenkins 56649* (PRE).

Eswatini. **2632 (Bela Vista):** Lebombo Mountains, NE of Mhlumeni borderpost, Mbuluzi gorge (–AA), 30 October 1977, *Culverwell 1095* (PRE).

Genus *Nymania*

Nymania Lindb. in Not. Sällsk. Fauna Fl. Fenn. Förh. 9: 290 (1868); Marloth in F.S.A. 2 (1): 112 (1925); Verdoorn in the flowering plants of Africa 37: 1454 (1965); Dyer, Gen. 1: 299 (1975); Pennington and Styles in Blumea 22: 460 (1975); White in Bothalia 16 (2): 146 (1986); White and Styles, F.S.A. 18 (3): 39 (1986); Archer in Strelitzia 10: 354 (2000); Archer in Strelitzia 14: 630 (2003). Type species: *Nymania capensis* (Thunb.) Lindb.

Aitonia Thunb. in Physiogr. Sälsk. Handl. 1 (3): 166 (1776); Thunb. *Nova genera Plantarum* 1:52 (1782); Thunb. in Fl. Cap. 1: 508 (1823); Sond in Fl. Cap. 1: 243 (1860); White in Bothalia 16 (2): 146 (1986). Type species: *Aitonia capensis* Thunb.

Shrub or small tree. **Leaves:** simple, entire, spirally arranged in fascicles on short lateral shoots. **Flowers:** bisexual, solitary, axillary; calyx 4-lobed near the base; petals four, free, imbricate; stamens eight, filaments distinctly curved, fused near the base, without appendages, anthers glabrous, fixed dorsally towards the base, versatile; ovary 4-lobed, with four locules, loculi with two collateral ovules; disc thin, partially joined to the base of the staminal tube; style long, slender, with simple, minute, scarcely expanded style head. **Fruit:** a papery, inflated, deeply lobed capsule, laterally compressed with wing-like locules. **Seeds:** reniform; testa thick, woody, minutely verrucose, pubescent; cotyledon flat, slender, collateral; radicle superior, short.

The species

Nymania capensis (Thunb.) Lindb. in Not. Sällsk. Fauna Fl. Fenn. Förh. 9: 290 (1868); White in Bothalia 16 (2): 146 (1986); White and Styles, F.S.A. 18 (3): 40 (1986). Type: South Africa, without specific locality, no date, *Thunberg s.n.* (UPS-image!, holotype).

Aitonia capensis Thunb. in Physiogr. Sälsk. Handl. 1:166 (1776). Type: As for *Nymania capensis.*

Woody shrub or slender (single-stemmed) tree, up to 4 m tall; bole straight; branches rigid. **Bark:** surface smooth but rough with regular flakes on older trees; inner bark whitish; twigs with lenticels; pith with prismatic crystals and druses; cortex without ideoblast cells, dilatation of cortical tissue is by anticlinal division of the parenchyma and cortical collenchyma cells as well as tangential stretching of cells forming strands of 2–7 cells; phelloderm cells with crystals; axial parenchyma with crystals; fibers absent in secondary phloem; ray cells with crystals. **Wood:** diffuse-porous, vessels slightly angular or rounded in outline, numerous, solitary, in radial to diagonal multiples of 4–7, very narrow, tangential to dendritic pattern, intervessel pits alternate, minute, 2.7–5.1 μm in diameter; fibers non-septate; axial parenchyma scanty paratracheal, diffuse, in solitary strands near the vessels, in strands of 2–6 cells wide; rays mostly 1–2-seriate. **Leaves:** simple, small, alternate, entire, stiff, leathery, growing in tufts along the branches, oblanceolate, 5–20 × 1–4 mm, dull green, slightly pubescent, sessile, leaf base acuminate, leaf apex acuminate. **Flowers:** solitary, bisexual, borne on pedicels in leaf axils, in panicles, small, ca. 25 mm in diameter, white to red to pink, papery; sepals 4-lobed near the base, ca. 1–3 mm long; petals 4, imbricate; stamens 8, inserted at the base of the disc, filaments curved, fused at the base, anthers medifixed; ovary superior, sessile, 4-lobed, four locules with each containing two collateral ovules; style longer than stamen, style head simple, minute, scarcely expanded, ca. 8 mm long, stigma simple. **Fruit:** an inflated capsule, large, conspicuous, loculicidal, papery, up to 40 mm in diameter, deeply lobed with four horizontally flattened wing-like expansions, ripens from carmine to silvery gray. **Seeds:** borne in a papery, inflated capsule are distinctive, pea-shaped, and dark brown (Figure 7).

Distribution and ecology

The species grows in hot, dry, rocky habitats near dry, sandy rivers. It is endemic to South Africa and Namibia. It is mostly found in the Northern Cape, Western Cape, and Eastern Cape provinces in South Africa. It occurs in southern Namibia, Namaqualand, the Richtersveld, Bushmanland, Ceres Tanqua Karoo, Worcester Robertson Karoo, and the Little Karoo in South Africa (Figure 8).

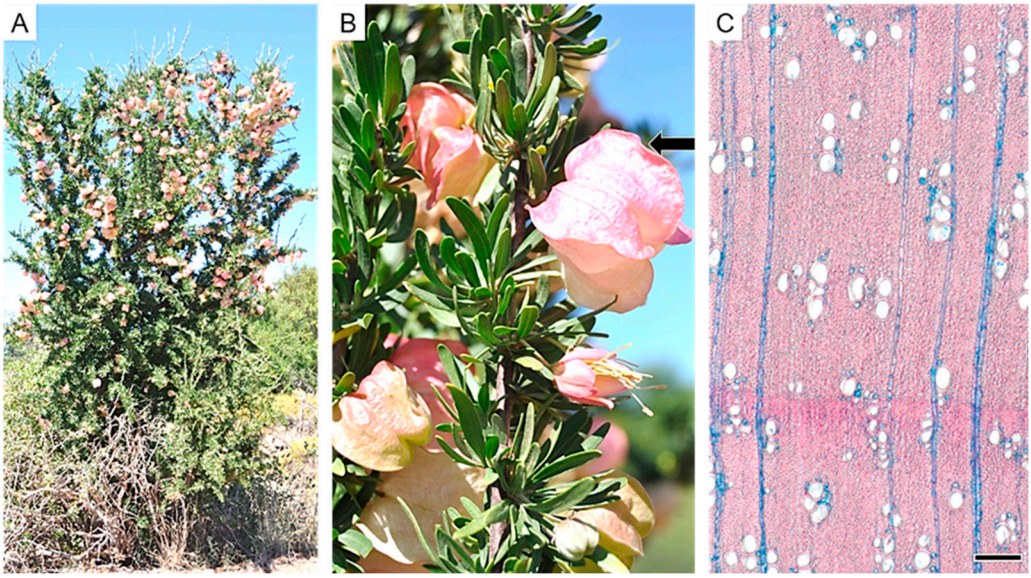

Figure 7. Diagnostic features of *Nymania capensis.* (**A**) Woody shrub up to 4 m tall. (**B**) Large, conspicuous, papery fruit. (**C**) Numerous and narrow [24–44 µm in tangential diameter] vessels [wood cross section]. The scale bar represents 100 µm. Photos by *B.-E. Van Wyk* (**A**,**B**) and *M. O. Oyedeji Amusa* (**C**).

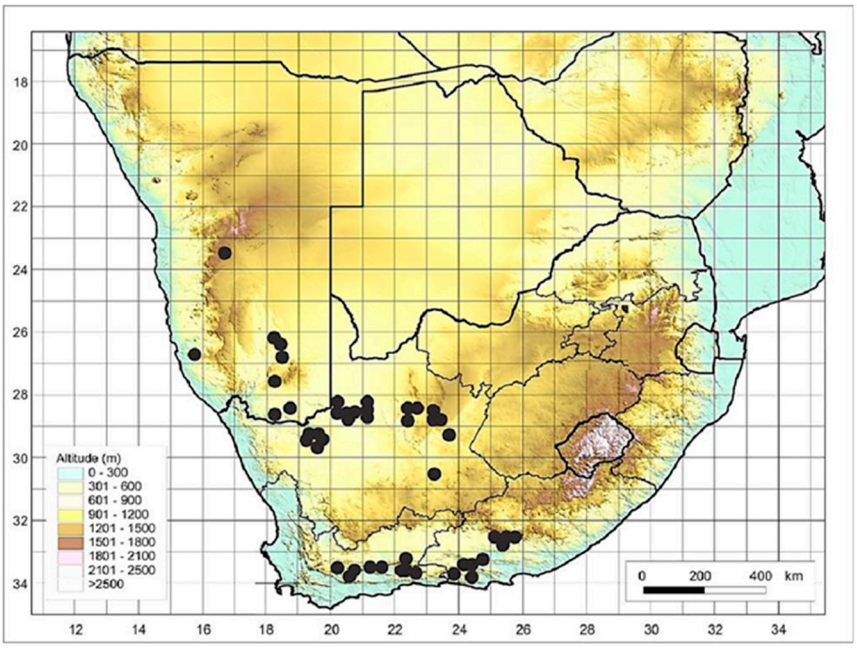

Figure 8. Recorded geographical distribution of *Nymania capensis.* (Base map obtained from the South African National Biodiversity Institute).

Conservation status

Least concern (http://redlist.sanbi.org/species.php?species=956-1, (accessed on 26 March 2019)). Our observations confirm that the plant is very widely distributed in Namibia and the southwestern parts of South Africa.

Phenology

The species flowers in the winter months (June to August) and fruits between September and November.

Diagnostic characters

Nymania capensis is the only species in the genus *Nymania,* and it is readily identified by the small, simple leaves and the shape and color of its bladdery fruit. The wood is distinct in having numerous and narrow 24–44 μm (in tangential diameter) vessels (wood cross section). The species is referred to as "klapper" or "klapperbos" because the capsules are sometimes popped for fun.

Specimens examined

Namibia. **2316 (Nauchas):** Ohangwena, Hardap, Rehoboth to Kobos (–BD), 22 May 1995, *Van Slageren and Strohbach MSMS 046* (PRE); ca 9.3 mi [15 km] W of Rehoboth (–BD), 25 April 1976, *Plowes 7162* (PRE). **2615 (Luderitz):** Namusberge, ca 9.3 [15 km] from Rosh Pinah, Spitskop farm (–DD), 30 October 1983, *Leuenberge, Raus,* and *Schiers 3263* (PRE). **2618 (Keetmanshoop):** Itzawisis KEE 9 farm, Gully (–AA), 13 May 1963, *Giess, Volk,* and *Bleissner 6875* (PRE); Great Karasberg, ca 30 mi [48.3 km] S of Narubis on road to Grunau flats and low rantjies at foot of mountain (–AD), 29 April 1955, *De Winter 3319* (PRE); ca 3.4 mi [5.5 km] N of Narubis along Karasburg to Keetmanshoop highway (–DC), 3 February 1974, *Davidse* and *Loxton 6309* (PRE). **2718 (Grunau):** Klein Karas (–CA), 3 August 1923, *Dinter 4822* (PRE). **2818 (Warmbad):** bank of streamlet ca 20 mi [32.2 km] on Good House Road (–BD), 24 July 1937, *Galpin 14142* (PRE); Keimas WAR 99 farm, below Glimmerschieferkuppe (–CC), 25 May 1972, *Giess* and *Muller 1215* (PRE).

South Africa. NORTHERN CAPE: **2816 (Oranjemund):** Namakwaland, Richtersveld National Park (–BB), 3 August 1998, *Brand 30* (PRE); Richtersveld, Numees Mine, SE-facing gulley, rocky dry watercourse (–BD), 27 August 1987, *Pienaar 963* (PRE). **2817 (Vioolsdrif):** Richtersveld National Park, NE region (–AA), 8 July 1980, *Van Wyk BSA123* (PRE); Richtersveld, ca 22 mi [35.4 km] S of Kuboos (–AC), 21 July 1948, *Reynolds 5436* (PRE); Richtersveld, abandoned farm, ca 18 mi [29 km] from Eksteenfontein on road to Mount Stewart, rocky slopes (–CB), 29 August 1987, *Germishuizen 4586* (PRE); ca 20 mi [32.2 km] beyond Vioolsdrif on way to Stinkfontein (–CD), 12 May 1969, *Werger 400* (PRE). **2820 (Kakamas):** On road from Upington to Namibian border post, at Naroegas (–AA), 17 December 1992, *Jordaan 2588* (PRE); Gordonia, Riemvasmaak (–AD), 8 August 1989, *Balkwill and Balkwill 4526* (J); Augrabies Falls National Park (–CA), 22 August 2005, *Mothogoane 592* (PRE); Augrabies Falls National Park, along entrance road (–CB), 10 October 2011, *Du Plessis 31* (PRE); Besiespoort farm, ca 15.7 mi [25.3 km] N of Kakamas-Keimoes road (–DA), 1 August 1984, *Steiner 664* (PRE); Keimoes, ca 2.2 mi [3 5 km] from Keimoes on road to Kakamas (–DB), 22 June 1999, *Meyer 2077* (PRE); Kenhardt, Letterkop Botanical Reserve, bergkamp (–DC), 12 July 1946, *Wasserfall 1059* (PRE). **2821 (Upington):** 22 mi [35.4 km] N of Upington (–AA), 25 April 1928, *Pole-Evans 2123* (PRE); ca 21.7 mi [35 km] from Upington to Keetmanshoop (–AC), 14 July 1985, *Joffe 38* (PRE); Namaqualand, Orange River, 13 mi [20.9 km] from Upington (–CA), 19 July 1967, *Van der Schijff 6922* (PRE). **2822 (Glen Lyon):** Langeberg range, Dunmurray (–BC), 22 March 1920, *Pole-Evans* 86 (PRE); Sunnyside Hill (–BD), 1 April 1989, *Saaiman 380* (PRE); Hay, Langeberg Mountains, Excelsior 0.286 on rocky slopes and summit of Langeberge (–CD), 8 July 1936, *Acocks 497* (PRE). **2823 (Griekwastad):** Postmasburg, 11 miles NW of Witsands (–AC), 24 July 1958, *Leistner 1169* (PRE); Griqua Town, naby Griekwastad (–CC), 26 April 1961, *Mostert 1310* (PRE); Herbert, Campbell Tweefontein, below escarpment edge (–DC), 14 May 1955, *Van Eck 17* (PRE). **2919 (Pofadder):** Boomrivier farm (–AB), 7 June 2005, *Mnengwane 18* (PRE, NU); Gemsbokvlakte (–BA), 16 July 1988, *Dean 550* (PRE). **2922 (Prieska):** Orange River Valley, ca 13 mi [20.9 km] E of Draghoender Station (–AC), 15 May 1946, *Codd 1219* (PRE); Niekerkshoop farm, Maritz Dam (–BD), 1983, *Gubb KMG12814* (PRE); ca 8 mi [12.9 km] NW of Prieska (–DA), 13 May 1961, *Schlieben 8782* (PRE). **2923** (Douglas): Herbert, outside Douglas (–BB), September 1946, *Brueckner 749* (PRE). **3023 (Britstown):** ca 63 mi [101.4 km] W of Britstown (–CA), 19 October 1928, *Pole-Evans 2308* (PRE).

WESTERN CAPE: **3320 (Montagu):** ca 25 mi [40.2 km] NE of Montagu Dam (–CA), 21 November 1968, *Van Breda 4132* (PRE); ca 24.9 mi [40 km] W of Ladismith near turn-off to Plathuis (–DB), 14 September 1988, *Hilton-Taylor 2314A* (PRE); Touwsberg, Zorgvliet farm (–DB), 5 October 1993, *Bredenkamp 779* (PRE); between Barrydale and Ladismith

(–DC), 1 May 1974, *Goldblatt 1695* (PRE); Overberg, Barrydale (–DC), 27 November 1936, *Phillips 2026* (J). **3321 (Ladismith):** Sevenweekspoort (–AD), 31 October 1980, *Van Wyk 358* (PRE); in Huisrivier Pass, between Ladismith and Calitzdorp (–BC), 25 November 2000, *Van Wyk EVW0144* (PRE); Touwsberg, NW side of Touwsberg farm, Rietfontein 139 (–BC), 6 October 1993, *Bredenkamp 851* (PRE). **3322 (Oudtshoorn):** Cango Caves, hillsides and open flats (–AC), 13 January 1929, *Mogg 11844* (PRE); Schoemanspoort, ca 0.6 mi [1 km] N of Schoemanshoek on slopes of gorge (–AD), 22 October 1989, *Greuter 22149* (PRE); Turnoff to Zebra, Succulent Karoo, edge of dirt road (–AD), 28 September 2002, *Mucina 280902/10* (PRE); De Rust, Aangenaam farm (–BC), 3 April 1973, *Dahlstrand 2401* (PRE); Along George-Oudtshoorn Road (–CA), 27 July 1965, *Kirkman 3008* (PRE); between Oudtshoorn and George, ca 5 mi [8 km] S of Oudtshoorn (–CA), 31 January 2001, *Meyer BP00506* (PRE); Cango Caves (–CB), 29 June 1941, *Phillips and Rensberg 2027* (J); Volmoed, ca 37.3 mi [60 km] beyond Hartenbosch on road to Calitzdorp, near Volmoed (–CC), 7 December 1976, *Venter 1412* (PRE); Uniondale, Kamanassie Mountain, at Voorzorg Poort (–DA), 5 October 1989, *Van Tonder 33* (PRE).

EASTERN CAPE: **3225 (Somerset East):** Pearston, Buffelshoek Nek, foot of pass (–AC), 26 October 1945, *Story 81* (PRE); Klein Visrivier Valle, Buffelsfontein (–CB), August 1967, *Van der Walt 165* (PRE); De Toekomst (–DA), November 1930, *Long 84* (PRE). **3323 (Willowmore):** ca 40.4 mi [65 km] from Willowmore to Port Elizabeth, into Baviaanskloof Nature Reserve, Gruisbult farm (–DB), 8 November 1999, *Nienaber EN731* (PRE). **3324 (Steytlerville):** Noorspoort farm of George Craven, picnic area (–AD), 9 November 2004, *Bredenkamp 3198* (PRE). **3325 (Port Elizabeth):** Kommadagga (–BB), 7 October 1975, *Bayliss BRI B6077* (PRE); Bottom of Suurberg Pass (–BC), 16 August 1973, *Bayliss BRI B478* (PRE); Great Winterhoek mountains, Uitenhage, Coega catchment basin, Groendal Wilderness Reserve, Prentice Kraal farm (–CB), 15 September 1976, *Scharf 1942* (PRE); Settlers Park Nature Reserve (–DC), 12 July 2002, *Potgieter FP01324* (PRE).

Genus *Pseudobersama*

Pseudobersama Verdc. in Journ. Linn. Soc., Bot 55: 504 (1956); White and Styles in F.Z. 2: 304 (1963); White and Styles in Fl. SA. 18 (3): 57 (1986); Leistner, Seed Pl. S. Afr.: 260 (2000). Type species: *Pseudobersama mossambicensis* (Sim) Verdc.

Small to medium-sized, deciduous shrub or tree; young branches reddish brown; slightly hairy. **Leaves:** imparipinnate; leaflets entire. **Flowers:** unisexual, in axillary thyrses. **Calyx:** cup-shaped, 5-toothed. **Petals:** 5, imbricate; stamens 11–12, filaments connate at the base up to two-thirds of their length; anthers pubescent, dorsifixed; staminodes 12; ovary 4–5-celled, ovoid, slightly lobed, densely hirsute; ovules in pairs in each locule; style short, stigma capitate. **Fruit:** a loculicidal capsule, 4–5, thick, woody valves, anther-like appendages. **Seeds** small, partly covered by a bright red aril.

The species

Pseudobersama mossambicensis (Sim) Verdc, in J. Linn. Soc., Bot 55: 504 (1956); Dale and Greenway, Kenya Trees and Shrubs 270 (1961); White and Styles in F.Z. 2: 304 (1963); White in Bothalia 16 (2): 161 (1986); White and Styles in F.S.A. 18 (3): 57 (1986). Type: Mozambique, without specific locality, *Sim 5204* (not located, herbarium unknown); Figure 23 in Sim (1909), iconotype. [Note: lectotype (iconotype) designated by White in Bothalia 16 (2): 161 (1986).

Bersama mossambicensis Sim in For. Fl. Port. E. Afr. 34: 23 (1909); Brenan in T.T.C.L. 324 (1949). Type: As above.

Small to medium-sized evergreen tree, up to 20 m tall; bole small, straight; young branches reddish brown; slightly hairy. **Bark:** surface smooth, green to grayish, slightly pubescent in younger stems but rough in older trees. **Wood:** diffuse-porous, vessel rounded to slightly angular in outline, numerous, narrow, solitary, and in short radial multiples of 2–4, intervessel pits alternate; fibers non-septate; axial parenchyma scanty paratracheal, diffuse in aggregates in narrow discontinuous lines of 1–2 cells wide; prismatic crystals present in chambered axial parenchyma cells; rays mostly uniseriate. **Leaves:** alternate, imparipinnately compound with 8–16 pairs of leaflets, petiolate, lateral leaflets alternate to

nearly opposite, oblong to elliptic, 30–140 × 10–50 mm, leaflet base cuneate, leaflet apex bluntly acuminate, lower surface pubescent along the midrib; petioles 30–50 mm long; **petiolules:** 5–7 mm long; rachis up to 250 mm long; stipules absent. **Inflorescence:** a 6–12-flowered, axillary cyme. **Flowers:** unisexual, regular, in axillary pedunculated, ca. 7 mm in diameter, white; sepals 5, fused, ca. 2–3 mm long; petals 5, free, up to 6 mm long, glabrous; stamens 3–4 mm long, fused in lower half forming a tube, pubescent towards the tip; ovary superior, ovoid, pubescent, 5-locular with two ovules in each locule; style short, up to 3 mm long, stigma obscurely lobed; male flowers with undeveloped ovary; female flowers with non-dehiscing anthers. **Fruit:** a woody capsule, up to 50 mm in diameter, globose to ellipsoid, covered with anther-like appendages, red, dehiscing with 5 woody valves, up to 10-seeded. **Seeds:** 5–7 mm long, glossy dark brown or black, covered by a bright red aril (Figure 9).

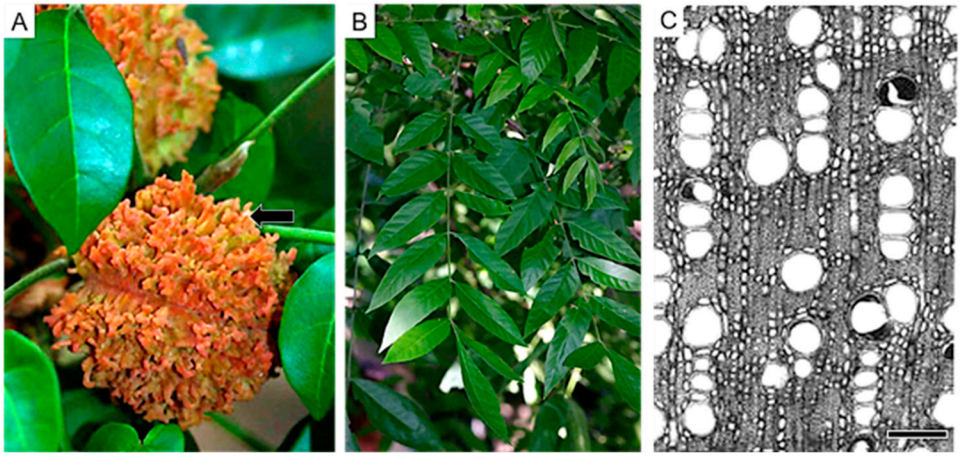

Figure 9. Diagnostic features of *Pseudobersama mossambicensis.* (**A**) Woody fruit covered with red anther-like appendages. (**B**) Compound leaf with oblong to elliptic leaflets [30–140 × 10–50 mm]. (**C**) Numerous (80–110 per sq. mm) and narrow (20–40 µm in tangential diameter) vessels arranged in radial rows of 2–5 [wood cross section]. The scale bar represents 100 µm. Photos by *B. Wursten*–www.inaturalist, (accessed on 20 January 2019) (**A**,**B**) and *P. Gasson* (**C**).

Distribution and ecology

The species grows in lowland coastal forest and woodland. It is mostly found in the understorey of moist forest types and in forest margins from sea level to about 500 m. It occurs from KwaZulu-Natal in South Africa (Figure 10) to Mozambique and further north to Tanzania and Kenya.

Diagnostic characters

Pseudobersama mossambicensis is the only species in the genus. It is similar to *Trichilia* species in having leaves that are compound, with alternate to opposite leaflets ending with a single terminal leaflet. *Pseudobersama mossambicensis* is readily distinguished by its woody capsule covered with anther-like red appendages, which is very large in relation to its small seeds. The wood has numerous (80–110 per sq. mm) and narrow (20–40 µm) (in tangential diameter) vessel elements. *Trichilia* species differ in having large seeds and wood with few 20–30 per sq. mm and wider 23–192 µm (in tangential diameter) vessel elements.

Conservation status

Near threatened, according to the IUCN criteria [53,54]. Our observations indicate that the plant is relatively rare in South Africa because it occurs in a very small geographical area. Fortunately, it occurs in nature reserves, where it is protected.

Phenology

The species flowers in the summer months (November to January) and fruits between February and September.

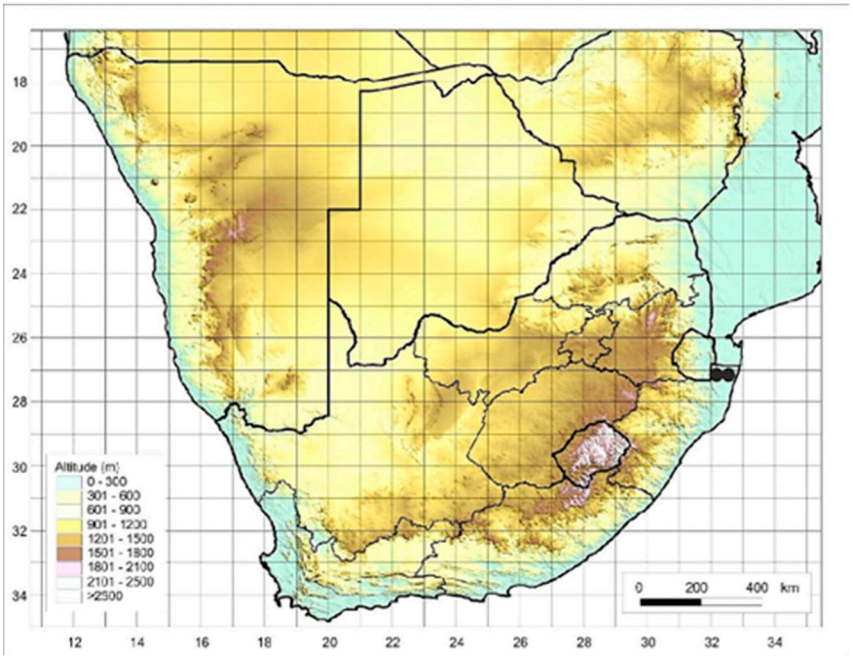

Figure 10. Recorded geographical distribution of *Pseudobersama mossambicensis* in the flora of the southern Africa region. (Base map obtained from the South African National Biodiversity Institute).

Specimens examined

South Africa. KWAZULU-NATAL: **2632 (Bela vista):** Tembe Elephant Reserve (–CD), 18 June 1984, *Ward 726* (NH); Tembe Elephant Park (–CD), 11 January 1987, *Ward 1868* (NH); Kosi Bay Nature Reserve (–DD), 1 December 2002, *Styles 1389* (NU). **2731 (Louwsburg):** Ingwavuma, Sihangwana (–AB), 1981, *Cunningham 387* (NU); Manguzi Forest, W of Maputa (–BB), 21 November 1958, *Tinley 321* (NH, NU); Manguzi Forest (–DC) July 1923, *Boocock 16* (PRE); Manguzi Forest; NE Tongaland, Kozi lake system area (–DD), 27 July 1959, *Tinley 456* (NH, NU); Manguzi Forest (–DD), 19 May 1939, *Curson 46091* (PRE).

Genus *Trichilia*

Trichilia Browne in Civ. Nat. Hist. Jamaica 278 (1756); Sonder in Fl. Cap. 1: 246 (1860); Staner and Gilbert, F.C.B. 7: 157 (1958); White and Styles in F.Z. 2: 297 (1963); De Wilde in Meded. Land. Sch. Wagen. 68 (2): 1–207 (1968); Pennington and Styles in Blumea 22: 467 (1975); White and Styles in F.S.A. 18 (3): 53 (1986); White in Bothalia 16 (2): 157 (1986); Leistner, Seed Pl. S. Afr.: 260 (2000); Coates Palgrave, Trees Southern Afr.: 453 (2002). Type species: *Trichilia hirta* L.

Deciduous trees, shrubs, or suffrutices. **Leaves:** imparipinnate, leaflets entire, alternate, rarely trifoliolate or unifoliolate. **Flowers:** unisexual, in cymose panicles. **Calyx:** short, 4–5-lobed or toothed. **Petals:** 4–5, much elongated than the calyx, imbricate, oblong or ovate; stamens 10, filaments connate in the lower half, free part heavily villous, with a pair of agile appendages at the apex; ovary small, occasionally adnate to disc, 2–4-celled, two collateral ovules in each cell; style short or long, continuous with the ovary; stigma capitate, 2–4-lobed; disc fused to base of staminal tube. **Fruit:** a loculicidal capsule, 2–4-celled, 3-valved septiferous, 1–2 seeds in each locule. **Seeds:** large, covered by red fleshy aril; cotyledons thick and short; radicle immersed.

Key to the species

1a Fruit with a distinct neck up to 10 mm long; leaf apex rounded; 13–16 pairs of narrowly spaced side veins on leaflets; flower densely pubescent; tree of lower-rainfall woodland and riverine thickets; ideoblast cells in the bark cortex—***T. Emetica.***

1b Fruit without a distinct neck; leaf apex acute to acuminate; 8–12 pairs of widely spaced side veins on leaflets; flower sparsely pubescent; tree of high-rainfall montane forest; ideoblast cells absent from bark cortex—***T. dregeana.***

Trichilia dregeana

Trichilia dregeana Sond. in Fl. Cap. 1: 246 (1860); White and Styles in F.Z. 2: 298 (1963); Ross, Fl. Natal 216 (1972); Styles in E. Afri. Agric. Journ. 39: 418 (1974); White in Bothalia 16: 158 (1986); White and Styles in F.S.A. 18 (3): 55 (1986); Styles and White in Fl. Eth. 3: 483 (1990). Type: South Africa, KwaZulu-Natal, Stanger (2931): Port Natal, *Gueinzius s.n.* (TCD-image!, lectotype; G; K; PRE!; S; SAM). [Note: lectotype designated by De Wilde, 1968].

Trichilia chirindensis Swynnerton and Bak. in Journ. Linn. Soc. Bot. 40: 39–41 (1911); Eyles in Trans. Roy. Soc. S. Afr. 5: 390 (1916); Brenan in T.T.C.L. 319 (1949). Type: Zimbabwe, Chirinda Forest, 22 September 1905, *Swynnerton 1* (BM).

Trichilia dregeana Sond. var. *oblonga* Harv. ex Sond. in Fl. Cap. 1: 246 (1860) Type: South Africa, KwaZulu-Natal, Stanger (2931): Port Natal, no date, *Sanderson s.n.* (TCD-image!, holotype).

Trichilia dregei E. Mey., Zwei Pflanzengeogr. Docum. 1: 227, nomen (1843); Harms in Nat. Pflanzenf. 2nd ed. 19B1: 110. 1940. Type: South Africa, KwaZulu-Natal, Stanger (2931): Port Natal Durban, no date, *Drège 39* (holotype in P, not seen).

Trichilia schliebenii Harms in Notizbl. Bot. Gart. Berl. 11: 1070 (1934). Type: Tanzania, Bezirk Morogor: Uluguru-Gebirge, Nordwestseite, Nebelwald, 11 March 1933, *Schlieben 3636* (MA).

Trichilia splendida A. Chev. Bull. Soc. Bot. Fr. 58, Mémoires 8d: 147 (1911); Staner in Bull. Jard. Bot. Brux. 16: 159 (1941); Keay in F.W.T.A. 1: 705 (1958); Staner and Gilbert, F.C.B. 7: 165 (1958). Type: Guinea, Guinée Française: Cercle du Kissi, Kissidougou, February 1909, *Chevalier 20708* (P).

Trichilia strigulosa Welw. ex C. DC. in Monogr. Phan. 1: 658 (1878); Exell and Mendonça in C.F.A. 2: 314–15 (1951). Type: Angola, Golungo Alto: Sporadica, Prope Undella, April 1856, *Welwitsch 1311* (BM-image!, holotype).

Trichilia umbrosa Vermoes. in Rev. Zool. Bot. Afr. 10, Suppl. Bot. 53 (1922). Type: Congo, the Democratic Republic, 4 April 1919, *Vermoesen 1948* (BR-image!, lectotype).

Trichilia vestita C. DC. in Bull. Herb. Boiss. 4: 428 (1896). Type: Angola, Golungo Alto. Prope, October 1855, *Welwitsch 1309/10* (BM).

Large, evergreen tree, up to 40 m tall; crown largely dense; bole straight (sometimes buttressed); up to 2 m in diameter. **Bark:** surface grey to grey-brown, smooth but rough and mottled with pink in older trees; inner bark cream-coloured, rapidly turning pink to reddish brown; twigs with reduced lenticels; pith without prismatic crystals and druses; cortex without ideoblast cells; dilatation of cortical tissue is by anticlinal division of the parenchyma and cortical collenchyma cells as well as tangential stretching of cells forming strands of 2–11 cells; phelloderm cells with crystals; axial parenchyma with crystals; fibers present secondary phloem; ray cells with crystals, rays without canal. **Wood:** diffuse-porous, vessel rounded in outline, few, solitary, in clusters of 2–4 or in radial multiplies of 2–4, 23–192 μm in diameter, intervessel pits alternate, minute, 2.2–3.9 μm in diameter; fibers non-septate; axial parenchyma scanty paratracheal, diffuse, confluent, in narrow bands of three cells wide, axial parenchyma cells chambered without crystals; rays 1–2-seriate. **Leaves:** imparipinnately compound with 2–5 pairs of leaflets ending with a single terminal leaflet, petiolate, lateral leaflets opposite or alternate, obovate to oblanceolate, leaflets 180–200 × 60–90 mm, dark glossy green above, lighter below, distinctly broadest near apex, lateral veins 8–12 pairs, leaflet base rounded to obtuse, leaflet apex acute to acuminate and sometimes notched, margin entire and slightly rolled under; petioles thick at base, pubescent, 130–160 mm long, petiolules 10–20 mm long, pubescent; rachis thick at base, pubescent; stipules absent. **Inflorescence:** a multi-flowered or few-flowered panicle, sometimes many-flowered in males but always few-flowered in female inflorescences. **Flowers:** unisexual, creamy-white to velvety, sweetly scented; sepals 5, cup-shaped, ca. 3.5–7.5 mm long; petals 5, up to 24 mm long, imbricate, pubescent; stamens 10, united into a tube, single

pistil in female flowers; ovary superior, 3-celled, pubescent, with 1–2 ovules in each locule, disc fused to base of terminal tube; style short, up to 6 mm long, stigma capitate, 2–4-lobed, male flowers with rudimentary ovary, female flowers with non-dehiscing anthers. **Fruit:** a woody capsule, up to 32 mm in diameter, globose, on a short, stout stalk without a distinct neck attaching to the stalk, 3-lobed, up to 6-seeded. **Seeds:** large, black, covered by a bright red aril (Figure 11).

Figure 11. Diagnostic features of *Trichilia dregeana.* (**A**) Evergreen tree with a large spreading crown up to 40 m tall. (**B**) Creamy-white and velvety flowers with short style. (**C1**) Leaflet with 8–12 widely spaced pairs of side veins. (**C2**) Pubescent petioles. (**D**) Compound leaf with acute to acuminate leaflets distinctly broadest near the apex. (**E1**) Fruit on a short, stout stalk without a distinct neck attaching to the stalk. (**E2**) Black seed covered with red aril. Photos by *J.H. Burring*–www.inaturalist (accessed on 20 January 2019) (**A**); *Tovervisje*–www.inaturalist (**B**); *D. Becking*–www.inaturalist (**C**); *J.M.K*–www.inaturalist (**D**) and *B. Dupont*–www.inaturalist (**E**).

Distribution and ecology

The species is a fast-growing, frost-sensitive tree found in coastal and montane evergreen forests, mainly on mountain slopes. It grows up to 1220 m above sea level. It is found in the Limpopo, Mpumalanga, KwaZulu-Natal, and Eastern Cape provinces of South Africa (Figure 12), but also occurs in Angola and the DRC, as well as Eswatini, Mozambique, Zimbabwe, Tanzania, Kenya, and Ethiopia. It grows in high-rainfall areas and is often found outside the natural habitat because of its ornamental uses.

Diagnostic characters

Trichilia dregeana is similar to *T. emetica* in that the leaves are imparipinnate, compound, and spirally arranged with opposite leaflets, ending with a single terminal leaflet. *Trichilia dregeana* is readily distinguished by the 8–12 pairs of side veins on its leaflets, the acute to acuminate leaflets, the down-curved leaf apex, and the fruit without a distinct neck attaching to the stalk. *Trichilia emetica* has 13–16 pairs of side veins on the leaflets, rounded leaflet apices, and a distinct neck joining the fruit capsule to the stalk.

Conservation status

Least concern (http://redlist.sanbi.org/species.php?species=950-1, (accessed on 28 March 2019)). Our observations from the map (Figure 12) indicate that the plant is widely distributed.

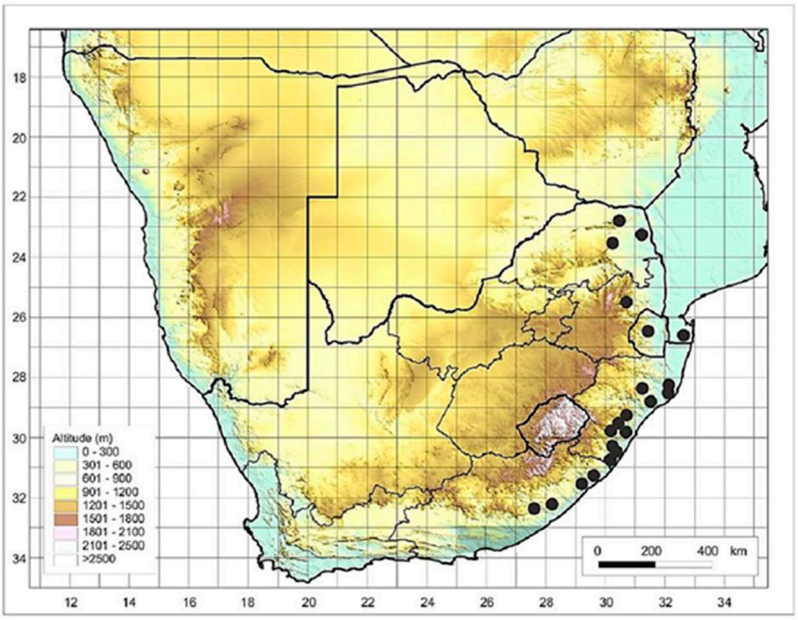

Figure 12. Recorded geographical distribution of *Trichilia dregeana* in the Flora of the The southern Africa region. (Base map obtained from the South African National Biodiversity Institute).

Phenology

The species flowers during the spring to early summer months (October to December) and fruits between December and May.

Specimens examined

South Africa. LIMPOPO: **2230 (Messina):** Sibasa, Pepiti Falls (–CD), 19 September 1934, *Pole-Evans 3757* (PRE). **2330 (Tzaneen):** Duiwelskloof, Westfalia Estate office (–CA), 25 October 1963, *Scheepers 1234* (PRE); Westfalia Estate, near rain gauge (–CA), 29 May 1966, *Scheepers 1251* (PRE). **2331 (Phalaborwa):** PWD works area, ca 8.7 mi [14 km] S of Phalaborwa (–AA), 2 October 1984, *Retief 267* (PRE).

MPUMALANGA: **2530 (Mashishing):** Mbombela (–BD), 17 July 1906, *Legat 2831* (PRE). **2531 (Komatipoort):** White River, ca 2.6 mi [4.2 km] from Kaapmuiden turnoff, Boondocks Lodge (–CA), 15 October 2014, *Balkwill, Mbatha, and Oosthuizen 13078* (J).

KWAZULU-NATAL: **2632 (Bela Vista):** Maputa, Nkanini (–DD), 21 September 1965, *Vahrmeijer 1222* (PRE). **2831 (Nkandla):** St. Lucia Estuary Forest, S of township (–BB), February 1965, *Tinley 1086* (NU); Lower Nkandla Forest (–CA), 18 June 1956, *Edwards 1445* (PRE, NU); Machubeni Village, NW of Reserve office complex, Nkandla Forest Reserve (–CA), 15 May 2001, *Ngwenya 2210* (PRE); Entabeni, Native Trust Ground (–DC), May 1943, *Loock 9498* (PRE); Mthunzini, Oyameni village c. 200 m from Chief Ranger's residence, Ngoye Forest Reserve (–DD), 19 September 2002, *Ngwenya 2695* (NH). **2832 (Mtubatuba):** Hluhluwe Game Reserve, Emabomvini (–AA), 8 August 1970, *Bourquin 774* (PRE); St Lucia Estuary (–AB), 28 November 1965, *Moll 2801* (NH, NU); Richards Bay, Harbour (South), approach Cut Dune (–CC), 13 August 1996, *Ward 13789* (NH). **2930 (Pietermaritzburg):** Pinetown, Hillcrest, Tunzini road (–BB), 13 July 1964, *Ross 1271* (NH, NU); City Centre, Methodist church Longmarket Street, opposite 20th Century (–CB), 30 September 1981, *Nicholas 1124* (NH, NU); Camperdown, Umgeni Dam (–DA), 20 May 1965, *Moll 1731* (PRE, NU); Isipingo, near Umlaas River (–DD), 26 April 1949, *Ward 856* (PRE, NU). **2931 (Stanger):** Durban, Pigeon Valley, left side of entrance to Pigeon Valley (–CC), 12 November 1964, *Thorns 5348* (PRE, NU); Durban Botanic Gardens (–CC), 27 September 1964, *Strey 5340* (NH). **3030 (Port Shepstone):** Ezinqoleni, ca. 40 m south of Oribi Gorge, hutted camp reservoir (–AC), 16 September 2006, *Ngwenya 1028* (NH); Dumisa, Fairfield (–AC), December 1945, *Bayer 1400* (PRE, NU); Umtamvuna bridge, riverbank bush (–BC), 26 December 1966, *Strey 7122* (NH, NU); Thuthwini, Ntimbankulu/Dweshula, near foot path to Mabheleni village

through Ntimbankulu Forest (–CB), 12 February 2001, *Ngwenya 1980* (NH); Shelly Beach hinterland (–CD), 9 September 1967, *Strey 7672* (NH, NU).

EASTERN-CAPE: **3129 (Port St. Johns):** Near Mbotyi Forest (–BC), 22 May 1970, *Jenkins SN4* (PRE); Lusikisiki, Lupatana Forest (–BD), 12 December 1986, *Van Wyk and Mathews 7916* (NH); Goss Point, riverine forest (–BD), 10 November 1970, *Strey 10151* (NH); ca 10 mi [16.1 km] from Port St. Johns on road to Lusikisiki (–DA), 20 May 1970, *Jenkins SN3* (PRE); Ntafufu Forest (–DA), 10 May 1969, *Strey 8511* (NH). **3227 (Stutterheim):** near Komga (–DB), January 1890, *Flanagan 459* (PRE). **3228 (Butterworth):** Kentani Hill, Nomakeye (–AA), 12 July 1966, *Strey 6611* (PRE).

Eswatini. **2631 (Mbabane):** Manzini, Timbutini (–AD), 28 September 1961, *Compton 30756* (PRE).

Trichiliaemetica

Trichilia emetica Vahl, Symb. Bot. 1: 31 (1790); Oliver in Fl. Trop. Afr. 1: 335 (1868); C.D.C. in A. and C.CD., Mon. Phan. 1: 660 (1878); Gűrke in P.O.A. C: 231 (1895); Harms in Engl. Nat. Pflanzenf. 3 (4): 305 (1896); Bak. in J.L.S. 37: 133 (1905); Holland in The Useful Pl. of Nigeria, Kew Bull., add. series 9 (1): 146 (1908); Engler in Engl. and Drude, Veg. der Erde, 9, Die Pflanzenw. Afr. 3 (1): 821 (1915); Vermoesen in Rev. Zool. Afr. 10, Suppl. Bot.; 34 (1922); Harms in Nat. Pflanzenf. 2 (19B1): 109 (1940); Staner in Bull. Jard. Bot. Brux. 16 (2-3): 175 (1941); Andrews in Fl. Pl. Anglo-Egyp. Sudan 2 (331): 123 (1952); Eggeling and Dale, Indig. Trees Uganda Prot. 2: 195 (1952); Dalziel in Useful Pl. W. Trop. Afr. 328 (1955); White and Styles in F.Z. 2: 299 (1963); De Wilde in Meded. Land. Sch. Wagen. 68: 50 (1968); Styles in E. Afri. Agric. Journ. 39: 418 (1974); White in Bothalia 16 (2): 158 (1986); White and Styles in F.S.A. 18 (3): 57 (1986); Styles and White in Fl. Eth. 3: 483 (1990).

Trichilia emetica Vahl subsp. *emetica*, Persoon in Syn. Pl. 1: 468 (1805); Oliver in Trans. Linn. Soc. of London 29 (1): 44 (1872); Schweinfurth in Bull. Herb. Boiss. 7 (2): 295 (1899); Schinz and Junod in Mém. Herb. Boiss. 10: 44 (1900); Giubs in Bot. Journ. Linn. Soc. 37: 435 (1906); Monro in Proceed. Rhod. Sei. Ass. 8 (2): 67 (1908); Sim in For. Fl. and For. Res. Port. E. Afr. 26: 15 (1909); Legat in Kew Bull. 53 (1910); Engler in Engler and Drude, Veg. der Erde, 9, Die Pflanzenw. Afr. 3 (1): 821 (1915); Eyles in Trans. Roy. Soc. S. Afr. 5: 389 (1916); De Wildeman in Contr. Fl. Kat. 105 (1921); Vermoesen in Rev. Zool. Afr. 10 (1): B34 (1922); Gossweiler in Fl. Exot. Angol. in Agronomia Angolana 1: 121 (1950); Exell and Mendonça in C.F.A. 2: 314 (1951); Miller in Journ. S. Afr. Bot. 18:40 (1952); Pardy in Rhod. Agr. Journ. 51 (6): 492 (1954); Dale and Greenway, Kenya Trees and Shrubs 272 (1961); White and Styles in F.Z. 2 (1): 299 (1963). Type: Yemen, Hadie mountain, *Forsskâl 478* (C-image!, holotype; isotype in BM).

Mafureira oleifera Bertol. in Mem. Acc. Sci. Bol. 2: 269 (1850). Type: Mozambique, Fornasini (P).

Trichilia roka Chiov. in Flora Somala 2: 131 (1932); Brenan in Mem. N.Y. Bot. Gard. 3: 235 (1953); Garcia in Contr. Conhec. Fl. Moçamb. 2: 142 (1954); Williamson in Useful Pl. Nyasal. 119 (1956); Keay in F.W.T.A. 1: 705 (1958); Staner and Gilbert, F.C.B. 7: 163 (1958). Type: Same *T. emetica*.

Trichilia umbrifera Swynn. and Bak. in Journ. Linn. Soc., Bot. 40: 39 (1911). Type: Mozambique, Lower Umswirizwi, 300 m, 1 November 1905, *Swynnerton 148* (BM; K).

Medium to large, evergreen tree, up to 30 m tall; crown largely dense, wide spreading in the open; bole straight, sometimes fluted; young branches longitudinally striped. **Bark:** surface smooth to slightly rough, dark grey to brown, unevenly fissured; inner bark whitish to brownish; twigs with conspicuous lenticels; pith without prismatic crystals and druses; cortex with round-shaped scattered ideoblast cells; dilatation of cortical tissue is by anticlinal division of the parenchyma and cortical collenchyma cells as well as tangential stretching of cells forming strands of 2–10 cells; phelloderm cells without crystals; axial parenchyma with crystals; fibers present in secondary phloem; ray cells with crystals; rays without canal. **Wood:** diffuse-porous, vessel rounded in outline, few, wide, 23–192 μm in diameter, solitary, in clusters of 2–4 or in radial multiples of 2–4, intervessel pits alternate, minute, 2.2–3.9 μm in diameter, helical thickenings on vessel walls;

fibers non-septate; axial parenchyma scanty paratracheal, diffuse, confluent, and in narrow bands of three cells wide, prismatic crystals absent in chambered axial parenchyma cells; rays1–2-seriate. **Leaves:** imparipinnately compound with 2–6 pairs of leaflets ending with a single terminal leaflet, petiolate, lateral leaflets nearly opposite to opposite, elliptic to obovate, leaflets 120–150 × 50–60 mm, leaflet base rounded, leaflet apex rounded to pointed, lateral veins 13–16 pairs; margin entire, rolled under and sometimes undulating; petioles densely pubescent, 130–180 mm long; petiolules densely pubescent, 5–6 mm long; rachis densely pubescent; stipules absent. **Inflorescence:** a multi-flowered, condensed panicle. **Flowers:** unisexual, green to creamy green, sweetly scented, produced in tight clusters; sepals 5, cup-shaped, ca. 2–5 mm long, pubescent; petals 5, free, creamy green to yellow, ca. 10–16 mm long, imbricate, pubescent; stamens 10, filaments united at the base with anthers attached in the middle, pubescent; ovary superior, 3–4-celled, sessile, with two ovules in each locule, densely pubescent; style short, up to 8 mm long; stigma globose, 2–4-lobed, male flowers with simple ovary, female flowers with non-dehiscing anthers. **Fruit:** a dehiscent capsule, up to 26 mm in diameter, globose, 3-lobed, differentiated from a 5–10 mm long neck, up to 6-seeded. **Seeds:** large, black, nearly covered by a bright red aril (Figure 13).

Figure 13. Diagnostic features of *Trichilia emetica.* (**A**) Evergreen medium to large tree with a dense spreading crown up to 30 m tall. (**B1**) Compound leaf with elliptic to obovate leaflets and rounded apex. (**B2**) Fruit with distinct neck attached to the stalk. (**C**) Leaflet with 13–16 closely spaced pairs of side veins. (**D**) Densely pubescent green to creamy-green flower. (**E**) Black seeds nearly covered with bright red aril. (**F**) Ideoblast cells in the cortex of the bark (cross section). The scale bar represents 100 µm. Photos by *A. Deacon*–www.inaturalist, (accessed on 20 January 2019) (**A**); *L. Loffler*–www.inaturalist (**B**); *D. Becking*–www.inaturalist (**C**–**E**); and *M.O. Oyedeji Amusa* (**F**).

Distribution and ecology

The species grows in riverine forest and at medium-to-low-elevation woodland and forest fringes, as well as in coastal forests, from sea level to elevations between 1700 and 2000 m. It is found in the Limpopo, Mpumalanga, and KwaZulu-Natal provinces in South Africa (Figure 14), from where the distribution extends to Namibia, Botswana, Eswatini, and Mozambique, and further north to West, Central, and East Africa, as well as Yemen.

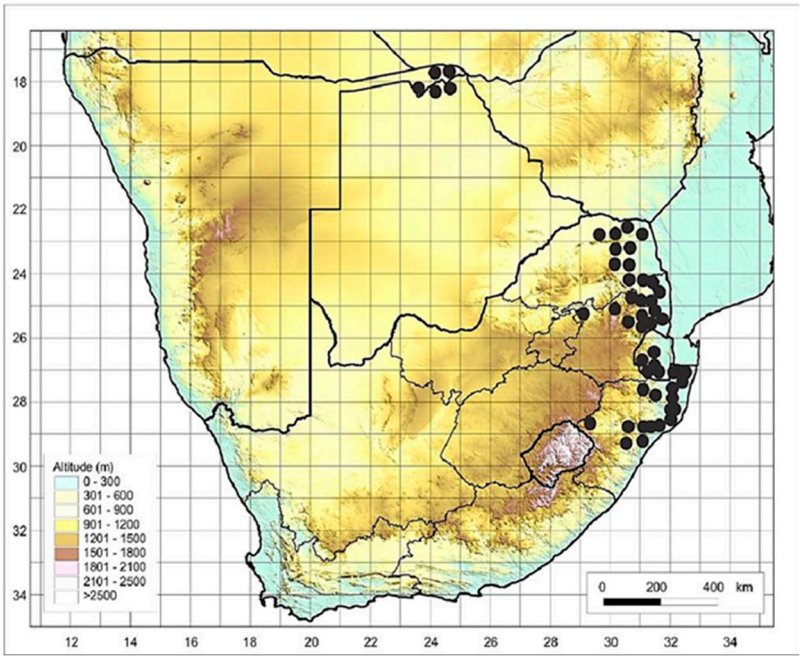

Figure 14. Recorded geographical distribution of *Trichilia emetica* in the Flora of the southern Africa region. (Base map obtained from the South African National Biodiversity Institute).

Diagnostic characters

Trichilia emetica is similar to *T. dregeana* in that the leaves are imparipinnate, compound, and spirally arranged with opposite leaflets, ending with a single terminal leaflet. *Trichilia emetica* is readily distinguished by the presence of 13–16 pairs of side veins on its leaflets, rounded leaflet apices, the presence of a distinct neck joining the fruit capsule to the stalk, and the presence of ideoblast cells in the cortex of the bark (cross section). *Trichilia dregeana* has 8–12 pairs of side veins on the leaflets, acute to acuminate leaflet apices, fruit on a short, stout stalk without a distinct neck attaching to the stalk, and an absence of ideoblast cells in the cortex of the bark (cross section).

Conservation status

Least concern (http://redlist.sanbi.org/species.php?species=950-3, (accessed on 28 March 2019)). The tree has an exceptionally wide distribution throughout tropical Africa.

Phenology

The species flowers during the late winter to spring months (August to November) and fruits between December and April.

Specimens examined

Namibia. **1823 (Siambisso):** Caprivi Strip, E of river, Cuando River (–BA), October 1945, *Curson 1184* (PRE). **1725 (Livingstone):** Eastern Caprivi, Mpilila Island, Chobe River (–CC), 15 January 1959, *Killick and Leistner 3388* (PRE). **1724 (Katima Mulilo):** Anthill on Zambezi flood plain (–AD), 27 August 1967, *Von Breitenbach 1217* (PRE).

Botswana. **1824 (Kachikau):** Northern Linyanti River, Shaile hunters camp airstrip (–AA), 20 January 1979, *Smith 2623* (PRE); ca 6 mi [9.7 km] S of Kachikau and ca 30 mi [48.3 km] N of Goha (–AB), 8 July 1837, *Erens 360* (PRE); Shaile Camp, edge of Linyati R. floodplain (–AB), 12 July 1977, *Edwards and Ward* 4532 (NU). **1724 (Katima Mulilo):** Chobe River, ca 50 mi [80.5 km] N of Kachikau (–DD), 12 July 1937, *Erens 4201* (PRE). **1725 (Livingstone):** Bechuanaland Protectorate area, Kasane Rapids, on banks of the Chobe River (–CC), 26 July 1950, *Robertson and Elffers 52* (PRE).

South Africa. LIMPOPO: **2229 (Waterpoort):** Soutpansberg, Franzhoek farm (–DD), 20 July 1935 *Galpin 14949* (PRE). **2230 (Messina):** Sibasa, Tate Vondo Forest Reserve (–CD), 3 November 1976, *Hemm 11* (PRE); Thengwe, near road at Thengwe location (–DA), 15 December 1979, *Netshiungani 1144* (PRE). **2231 (Pafuri):** Kruger National Park, Punda

Milia, near Kamp (–CA), 2 February 1962, *Ihlenfeldt 2297* (PRE). **2330 (Tzaneen):** Klein Letaba River, ca 5 km E of Giyani (–BC), 3 May 1977, *Liengme 101* (PRE); Klein Letaba River at Giyani (–BD), 14 May 1981, *Liengme 577* (PRE); Letaba, Duiwelskloof, Westfalia, petrol pumps (–CA), 5 June 1958, *Scheepers 358* (PRE); Letaba River, op pad na die eiland vanaf Tzaneen (–CD), 29 November 1974, *Pienaar 503* (PRE); Great Letaba River, ca 50 mi [80.5 km] N of Gravelotte STA (–DA), 28 July 1934, *Galpin 13866* (PRE). **2430 (Pilgrim's Rest):** Ngwabitsi River, gentle slope (–BD), 22 August 1985, *Krynauw 736* (PRE); ca 12.4 mi [20 km] SW of Marulaneng, Blydeberg Nature Reserve (–BD), 10 October 1987, *Balkwill and Cadman 3791* (J). **2431 (Acornhoek):** Avoca, near Barberton (–AD), 17 September 1890, *Galpin 1060* (PRE); ca 12 mi [19.3 km] from Newington to Bushbuck ridge (–CC), 19 March 1972, *Buitendag 915* (PRE).

MPUMALANGA: **2430 (Pilgrim's Rest):** Picnic places near bridge in Erasmus Pass (–BC), 7 January 1063, De *Winter 7806* (PRE); Swadini Blydepoort Dam, below dam wall, next to Blyde River (–DB), 10 September 2002, *Male JM00240* (PRE). **2431 (Acornhoek):** Timbavati Game Reserve, Kempiana farm (–AD), 10 March 1970, *Porter 300* (PRE); Satara rest camp (–BD), 6 April 1990, *Du Toit 231* (PRE); Bushbuckridge, Township Ga-Moreku (–CB), 21 January 2019, *Shai 15* (PRE). **2530 (Mashishing):** Lowveld Botanical Garden, Mbombela (–BD), 17 March 2002, *Meyer 1* (PRE). **2529 (Witbank):** Loskop Dam, Olifants River, near Groblersdal (–AD), 25 January 1990, *Van Vreden 19* (PRE). **2531 (Komatipoort):** Kruger National Park, rest camp of Pretoriuskop (–AB), 1 October 1950, *Van Zinderen Bakker 313* (PRE); Nelspruit, on the farm Okkernootboom (–AC), 1 September 1988, *Barker 23* (J); Plaston next to Mvangatini village, ca 1.2 mi [2 km] before the village (–AC), 12 January 2010, *Lukhele UPP083* (PRE); Barberton, Sheba Siding (–CA), 11 November 1931, *Galpin 3066* (PRE); between Louws Creek and Adamanda mine (–CB), 8 July 1906, *Burtt Davy 2821* (PRE); Barberton (–CC), November 1931, *Smith 7068* (PRE); Komati River (–DB), 20 July 1935, *Nel 154* (PRE).

KWAZULU-NATAL: **2632 (Bela vista):** Itala Nature Reserve, Ongegund section (–AD), 20 July 1982, *Porter and Ward 138* (NH); Ndumo Game Reserve (–CD), 4 October 1988, *Ward 2398* (NH). **2731 (Louwsburg):** Pongola, KwaBhembe, ca 0.6 mi [1 km] from the W of Mlomokazulu high school (–AC), 9 December 2006, *Magubane 1430* (NH); Flats E of Pongola Poort (–BD), 21 January 1964, *Huntley 785* (NH, NU); Umfolozi, between Black Umfolosi and Nongoma (–DC), 16 August 1945, *Acocks 11675* (PRE). **2732 (Ubombo):** 10 mi [16 km] from Ingwavuma to Ndumo, riverbank (–AA), 20 November 1967, *Moll and Strey 3704* (NH); Ingwavuma, Tembe Elephant Park (–AB), 4 September 1985, *Ward 1026* (NH); I. D. C. Rice project site, ca 1.2 mi [2 km] from Phelandaba turn-off on Mbazwana road (–BA), 4 December 1985, *Germishuizen 3620* (NH); Manzengwenya, ca 1.8 mi [3 km] S of De Wets Bay (–BB), 24 June 1986, *MacDevette 864* (NH); Lake Sibayi eastern shore (–BC), 4 December 1969, *Moll 4917* (NH); Pongola River near Tobotini (–BC), 10 April 1966, *Strey 6600* (NH); Ndumo Game Reserve (–BC) 16 September 1971, *Pooley 1449* (NH, NU); Mkuze Game Reserve near Mkuze River (–CA), 18 September 1962, *Gush 26* (PRE, NU); Mkuzi Game Reserve (–CA), 26 September 1976, *Goodman 772* (NU); between Mkuze and Hluhluwe on N2, farm iNtendele (–CC), 8 October 2001, *Meyer P00958* (PRE); Sodwana State Forest, forest patch near chief's kraal (–DA) 6 October 1986, *MacDevette 1208* (NH, NU). **2830 (Dundee):** Nquthu, B 1060 eMondlo, Engodini Village (–BA), 11 January 2002, *Madi 55* (NH); ca 11 mi [17.7 km] from Kranskop on Middeldrift road (–DD), 20 June 1964, *Edwards 3326* (PRE, NU). **2831 (Nkandla):** Nkandla, Middeldrift (–CC), 9 June 1956, *Edwards 1413* (PRE, NU); Hamewith near Mtunzini (–DC), 1 May 1919, *Mogg 4447* (PRE); Mtunzini, Umlazi Nature Reserve (–DD), 15 September 1962, *Ward 4311* (PRE, NU); Babanango (–DD), 19 April 1926, *Watt and Breyer-Brandwijk 1171* (PRE). **2832 (Mtubatuba):** Hluhluwe Game Reserve (–AA), 25 August 1955, *Ward 2689* (NU); Mansiya/Nyimane, Hluhluwe Game Reserve (–AA), 8 October 1971, *Hitchins 355* (NH, NU); Ncemane (–AB), 22 January 1949, *Bayer 1463* (NU); ca 49.7 mi [80 km] from Mbazwana to Hluhluwe (–AB), 8 December 2001, *Schuhardt DS00807* (PRE); St Lucia Forest Station, garden (–AC), 18 July 1965, *Pegel 28* (NH); Richards Bay camping sites (–AC), 10 July 1965, *Venter 1941* (NH); Hlabisa, Palm Ridge

farm (–AC), 22 April 1968, *Harrison 518* (NH); St. Lucia Hotel (–AD), 21 October 1964, *Strey 5376* (NH); Dukuduku State Forest, St. Lucia (–AD), 12 October 1983, *Nicholas 1635* (NH, NU); Inkuhlu (Ixolo), St. Lucia (–AD), 22 September 1986, *Cunningham 2143* (NH, NU); Dukuduku State Forest, near Futululu (–AD), 3 September 1986, *MacDevette 1044* (NH, NU); On Richards Bay road, near Ensileni River (–BC), 15 July 1951, *Lawn 2085* (PRE); North coast, Lake Nhlabane area (–CB), 27 October 1991, *Ward and Rajh 11419* (NH, NU). **2930 (Pietermaritzburg):** Umvoti Valley, SW of Mapumulo (–BA), February 1965, *Moll 529* (PRE). **2931 (Stanger):** ca 16 mi [25.7 km] from Stanger on Noodsberg to Waterberg road (–AC), 18 June 1964, *Edwards 3317* (PRE); Sinkwazi strand, south part of urban area (–AD), December 1973, *Grobbelaar 806* (PRE); Amatikulu Nature Reserve, coastal woodland on riverbank (–BA), 20 September 1987, *Ward 2134* (NH); Verulam (–CA), 14 September 1965, *Moll 2020* (PRE, NU).

Eswatini. **2531 (Komatipoort):** Piggs Peak, near Lomati River (–CD), 29 June 1959, *Compton 28968* (PRE). **2631 (Mbabane):** Manzini, Mpisi, rocky hill (–BC), 20 December 1961, *Compton 31147* (PRE); Hlatikulu, Usutu Poort, riverside (–CA), 30 October 1961, *Compton 30927* (PRE); ca 9 mi [14.5 km] N of Sitobela (–DC), 30 April 1957, *Murdoch 159* (PRE). **2731 (Louwsburg):** Nsoko, Canterbury farm (–BB), 2 July 1966, *Bayliss 3474* (PRE).

Genus *Turraea*

Turraea L. in Mant. Pl. 2: 150 (1771); Exell and Mendoca in C.F.A. 2: 318 (1951); White and Styles in F.Z. 2: 307 (1963); Killick in Flower. Pl. Afr. 38: 1499 (1967); White and Styles in F.S.A. 18 (3): 41 (1986); Pennington and Styles in Blumea 22: 454 (1975); White in Bothalia 16 (2): 161 (1986); White in Flower. Pl. Afr. 50: 1962 (1988); Williams in Bothalia 19: 31 (1989); Leistner, Seed Pl. S. Afr.: 260 (2000). Type species: *Turraea virens* L.

Small to medium tree (usually suffruticose, sometimes deciduous). **Leaves:** simple (seldom compound), petiolate, or subsessile. **Flowers:** bisexual, in short axillary panicles, solitary or fasciculate; calyx 5-lobed or toothed, cup-shaped; petals 5, long, imbricate or contorted; stamens 10–20, filaments connate into a long, slender tube widening upwards, sometimes with notched lobes, anthers shortly apiculate; ovary sessile, occasionally ribbed, with (3)4–10(20) locules, with two collateral, oblique or superposed ovules in each locule; disc small, annular or absent; style exserted, filiform, stigma discoid, capitate, or globose. **Fruit:** a (3)4–10(20)-valved, woody or leathery, loculicidal capsule with 1–2 seeds in each locule. **Seeds:** red or black, fleshy, and covered by a red or orange aril.

Key to the species

1a Woody shrubs or trees; leaves simple; style-head distinctly wider than the style (section *Turraea*).

2a Petals short, less than 25 mm long; flower clusters at the tip of the shoot—***T. nilotica.***

2b Petals long, more than 35 mm long; absence of clustered flowers at the tip of the shoot.

3a Leaf less than 50 mm long; white, non-scented flowers; crystals in ray cells—***T. obtusifolia***.

3b Leaf 50–120 mm long; light green-scented flowers; no crystals in ray cells—***T. floribunda.***

1b Suffrutices; leaves simple or compound; style-head only slightly wider than the style [section *Nurmonia* (Harms) F.White].

4a Leaves simple; calyx lobes linear; petals oblong—***T. pulchella.***

4b Leaves compound, trifoliolate, or imparipinnate; calyx lobes oblong; petals broadly obovate—***T. streyi.***

Turraeafloribunda

Turraea floribunda Hochst. in Flora 27 (1): 297 (1844); C. DC. in Monogr. Phan. 1: 445 (1878); Bak. in Journ of Bot. 41: 12 (1903); Brenan in T.T.C.L. 320 (1949); Stapf in Curtis's bot. Mag. 1: 8944 (1923); Eggeling and Dale, Indig. Trees Uganda Prot. 200 (1952); Staner and Gilbert, F.C.B. 7: 154 (1958); Dale and Greenway, Kenya Trees and Shrubs 274 (1961); White and Styles in F.Z. 2: 314 (1963); Killick in Flower. Pl. Afr. 38 (1967); Palmer and Pitman in Trees S. Afr. 2:

1061 (1973); White and Styles in F.S.A. 18 (3): 45 (1986); White in Bothalia 16 (2): 151 (1986). Type: South Africa, KwaZulu-Natal, Pietermaritzburg (2930): Umlaas River (–CD), 10 January 1839, *Krauss 342* (TUB-image!, holotype; G, K, M, W, isotypes).

Turraea heterophylla sensu Sond. in Fl. Cap. 1: 245 (1860); sensu Medley Wood, Natal Plants 3, t. 246 (1902).

Deciduous shrub or small tree, up to 10 m tall; crown round; young branches loosely branched, pubescent, single or multi-stemmed, sometimes scrambling. **Bark:** surface smooth to slightly rough with boat-shaped elongated fissures, light grey to brown; inner bark creamy to brownish; twigs with conspicuous lenticels; pith with prismatic crystals and druses; cortex with ideoblast cells; dilatation of cortical tissue is by anticlinal division of the parenchyma and cortical collenchyma cells as well as tangential stretching of cells forming strands of 2–7 cells; phelloderm cells with crystals; axial parenchyma with crystals; fibers present in secondary phloem; ray cells without crystals, rays without canal. **Wood:** diffuse-porous, vessels slightly angular or rounded in outline, numerous, solitary, in clusters of 3–5, or in radial to diagonal multiples of 2–6, intervessel pits alternate, minute, 2.3–4.1 μm in diameter, with slit-like to oval apertures mostly united in grooves; fibers non-septate; axial parenchyma scanty paratracheal, diffuse, vasicentric, confluent, aliform, in bands up to 10 cells wide, prismatic crystals absent in chambered axial parenchyma cells; rays 1–2-seriate. **Leaves:** simple, rarely compound, alternate, ovate to lanceolate, 25–120 × 10–70 mm, petiolate, noticeable herring-bone venation on both sides, margin entire, leaf base acute, leaf apex acuminate; petioles pubescent, 8–10 mm long; stipules absent. **Inflorescence:** a (2–)3–18-flowered false raceme. **Flowers:** bisexual, axillary or solitary, small, ca. 25 mm in diameter, light green, sweetly scented, in tight clusters at the end of the slim branches; sepals five, cup-shaped, small, densely pubescent; petals five, light green, ribbon-like; stamens 10, united into a thin, white tube slightly shorter than the petals; anthers form a ring at the tip of the staminal tube, forming a knob-like head; ovary sessile, 4–10-locular, with two ovules in each locule, pubescent, intensely sulcate, and transversely ribbed; style projects beyond the anthers, up to 20 mm long. **Fruit:** a segmented capsule with 5–10 segments, woody, up to 26 mm in diameter, dark brown or black. **Seeds:** small, glossy, orange to red, and borne on the opened woody star-shaped fruit (Figure 15).

Figure 15. Diagnostic features of *Turraea floribunda.* (**A**) Tough shrub or small tree with round crown up to 10 m tall. (**B1**) Densely pubescent twig. (**B2**) Pubescent leaf and petiole. (**C**) Herring-bone venation on the leaf. (**D**) Orange to red glossy seeds borne on large woody star-shaped fruit. (**E**) Light green flowers with narrow petals. Photos by *B.-E. Van Wyk* (**A**,**D**); *L. Mhlongo* (**B**); *Magdastlucia*—www.inaturalist (accessed on 20 January 2019) (**C**) and *P. Vos*–www.inaturalist (**E**).

Distribution and ecology

The species grows in open woodland, coastal bush, riverine forest, dune forest, and secondary forest from sea level to about 750 m. It is found in the Gauteng, KwaZulu-Natal, and Eastern Cape provinces in South Africa (Figure 16) and also in Eswatini (not shown in the map) and further north to Kenya and Uganda.

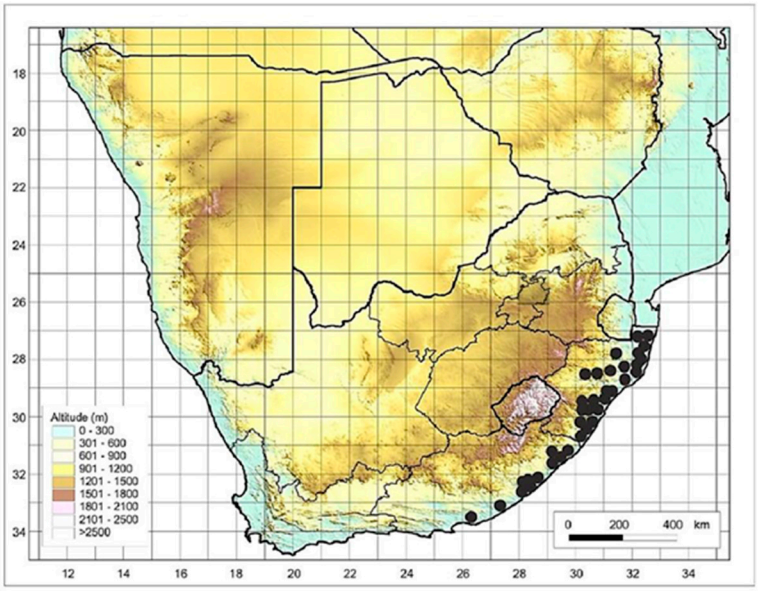

Figure 16. Recorded geographical distribution of *Turraea floribunda* in the Flora of the the southern Africa region (Base map obtained from the South African National Biodiversity Institute).

Diagnostic characters

Turraea floribunda is similar to *T. obtusifolia* in that the leaves are simple and mostly in fascicles. *Turraea floribunda* is readily distinguished by a noticeable herring-bone venation on both sides of the leaf: light green flowers with long, narrow, and sweet-scented petals vs. white flowers with wide, non-scented petals in *T. obtusifolia.*

Conservation status

Least concern (http://redlist.sanbi.org/species.php?species=957-1, (accessed on 26 March 2019)). The plant is widely distributed, and the conservation assessment agrees with our observations.

Phenology

The species flowers during the spring and summer months (September to February) and fruits between February to July.

Specimens examined

South Africa. KWAZULU-NATAL: **2731 (Louwsburg):** Ngotshe, Ngome forest margin (–CD), 27 July 1944, *Gerstner 4874* (PRE). **2732 (Ubombo):** Gwaliweni Forest (–AC), 19 November 1982, *Abbott 532* (NH); Jozini to Hlatikulu Forest (–AC), 18 November 2016, *Balkwill and McCallum 13932* (J); Ingwavuma (–AD), 15 November 1938, *Gerstner 4116* (NH); Sibayi Nature Reserve; ca 4.3 [7 km] SW of Mabibi (–BC), 9 February 2018, *Bester 14098* (PRE); Lake Sibiya, East Shore (–BC), 3 December 1982, *Ward 286* (NH); Kosi Bay Coastal Forest Reserve, Lake Sibaya, eastern side of Sibaya along road between lake and first dune (–BC), 24 August 1994, *Lubbe 250* (NH); Jozini Dam, on N side of valley (–BD), December 1964, *Wearne 26* (NH, NU). **2830 (Dundee):** Manzengwenya, coastal forest (–DA), 19 March 1965, *Vahrmeyer 446* (NH); Mfongosi, in kloofs and fertile valleys (–DB), 4 April 1926, *Watt and Breyer-Brandwijk 1095* (PRE). **2831 (Nkandla):** ca 3 mi [4.8 km] E of Biyela store (–AC), 10 October 1946, *Codd 1897* (PRE); Hlabisa, Hluhluwe Game Reserve, Hluhluwe River (–BB), 29 July 1983, *Phelan 707* (NU); Umfolozi River (–BD), 22 October 1910, *Rudatis 1213* (PRE); Mtunzini, Siyayi Lagoon, NE side, full shade (–DD), 14 February 1986, *Venter 11474* (PRE);

ca 3 mi [4.8 km] from Mandeni, off Tugela road (–DD), 23 November 1956, Edwards 1625 (NU). **2832 (Mtubatuba):** Hluhluwe Game Reserve, Egodeni (–AA), 19 March 1972, *Hitchins 790* (PRE, NU); Hluhluwe Game Reserve (–AA), 22 April 1959, *Guy 107* (NH, NU); Lake St. Lucia, Charter's Creek (–AB), 15 March 1967, *De Winter 8729* (PRE); Edge of Lake Futululu (–AC), 25 November 1965, *Moll 2751* (NH, NU); Mapelane (–AD), 25 February 1982, *Gordon 44* (NH, NU); N coast of St. Lucia system (sensu lato), Mapelane Nature Reserve (–AD), 19 April 2008, *Nkuna and Mabatha 2382* (PRE); Lake Bhangazi (south) area, eastern side of lake (–BA), 15 February 1997, *Ward 13915* (PRE); Kwambonambi, Amangwe Forest (–CA), 18 August 1982, *Von Breitenbach PRF 19580* (PRE); Richards Bay village area (–CC), 15 June 1969, *Venter 5539* (PRE). **2930 (Pietermaritzburg):** Botanic Gardens Estate, Pietermaritzburg (–CB), 22 October 1996, *Stielau 247* (NH); Hela Mountains Game Valley Estates (–CC), 4 October 1982, *Schrire 961* (NH); Camperdown, Nagle Dam, upper limit of bush (–DA), 14 May 1957, *Wells 1278* (PRE); Nshongweni Dam (–DC), 22 February 1966, *Morris 795* (PRE); Elsinore farm, Hope Valley (–DC), 27 September 1994, *Sikhakhane 455* (NH); Silverglen Medicinal Plant Nursery (–DD), 17 June 2003, *Sewram 10* (NH); Burman Bush Nature Reserve (–DD), 30 May 1986, *Nicholas and Ngwenya 2193* (NH). **2931 (Stanger):** Lower Tugela, S of Umvoti road at roadside (–AB), 24 September 1962, *Johnson 1460* (NH); New Guelderland Stasie (–AD), 11 January 1967, *Stewart 102* (NH); Hawaan Forest, ca 6.2 mi [10 km] N of Durban, Umhlanga Rocks (–CA), 22 May 1976, *du Toit 1196* (NH); North coast, Umhlanga Rocks, Hawaan Forest (E), Umhlanga Lagoon Nature Reserve (–CA), 19 May 1990, *Ward 10921* (NH, NU); Durban, Burman Bush Nature Reserve (–CC), 30 May 1986, *Ngwenya 278* (NH); Scout Camp grounds, Burman Bush, Durban (–CC), 2 April 1984, *Bodenstein 75* (NH). **3030 (Port Shepstone):** Dumisa Stasie, Ellismere Umgayi (–AD), 22 October 1910, *Rudatis 1213* (PRE); Umbogintwini (–BB), 6 January 1980, *Van Wyk and Botha 3313* (PRE); Mtwalume, Koelwaters (–BC), 7 February 1975, *Badenhorst 41* (PRE); Oribi Flats (–CA), 10 October 1996, *Edwards 1317* (NH, NU); Oribi Gorge Nature Reserve, N of plains (–CB), 9 January 1981, *Balkwill and Crankshaw 80/101* (J); Umtamvuna Nature Reserve, below Aerodrome (–CC), 15 October 1983, *Abbott 1420* (NH); Uvongo, Skyline farm, rolling grassland hills with forest in depressions (–CD), 26 July 1966, *Mogg 38493* (PRE).

EASTERN CAPE: **3129 (Port St. Johns):** Lusikisiki, NW facing slope at Ndindindi Forest, Mkumbeni Location (–BC), 16 March 1994, *Wopula 134* (NH); Mkambati Game Reserve (–BD), 15 January 1997, *Sebothoma 152* (PRE); Ntafufu River, N of Port Johns (–CA), 10 May 1969, *Strey 8512* (PRE); Thembuland, Coffee Bay (–CC), 5 November 1919, *Tyson 10* (PRE). **3228 (Butterworth):** Dwesa Nature Reserve (–BD), 17 November 1977, *Jacot Guillarmod 7882* (PRE); Amathole, SE of Idutywa, Dwesa Nature Reserve (–BD), 19 October 1987, *Fishwick 37* (J); Kentani, Kei Hills (–CB), November 1900, *Pegler 727* (PRE); Umzimvubu District, Silaka Nature Reserve, ca 2.8 mi [4.5 km] SW of Port St. Johns (–CB), 26 January 2016, *Bester 13446* (PRE); Willowvale, Qora River Mouth, northern bank of estuary above boat houses (–CC), 6 November 1991, *Cloete 1261* (NH); Silaka Reserve, along road below main gate (–DA), 3 October 1992, *Cloete 2075* (NH); **3326 (Grahamstown):** Alexandria, NE of Woody Cape (–CB), 4 August 2007, *Pienaar 0008* (PRE). **3327 (Peddie):** E of East London (–BB), November 1961, *Smith 46011* (PRE).

Turraea obtusifolia

Turraea obtusifolia Hochst. in Fl. Zonas Vida Ecuador 27: 296 (1844); White and Styles in F.S.A. 18 (3): 45 (1986); White in Bothalia 16 (2): 149 (1986). Type: South Africa, KwaZulu-Natal, Stanger (2931): Natal Bay (–CC), 7 January 1839, *Krauss 308* (TUB-image!, holotype; G, K, isotypes).

Turraea oblancifolia Bremek. in Ann. Transvaal Mus. 15: 245 (1933). Type: South Africa, Limpopo, Waterberg (2428): between Warmbaths and Nylstroom (–AD), 15 January 1931, *Bremekamp and Schweickerd 4* (PRE-image!, holotype; K, isotype).

Semi-evergreen (sometimes deciduous) shrub, scrambling shrub, or small tree, up to 5 m tall. **Bark:** surface smooth, grey, pubescent; inner bark brownish; twigs with brown lenticels; branches glabrous; pith without prismatic crystals and druses; cortex without ideoblast cells; dilatation of cortical tissue is by anticlinal division of the parenchyma

and cortical collenchyma cells as well as tangential stretching of cells forming strands of 2–5 cells; phelloderm cells with crystals; axial parenchyma with crystals; fibers absent in secondary phloem; ray cells with crystals; rays without canal. **Wood:** diffuse-porous, vessel rounded to slightly angular in outline, numerous, solitary, in clusters of 3–5, or in radial to diagonal multiples of 2–6, intervessel pits alternate, minute, 2.3–4.1 µm in diameter, with slit-like to oval apertures commonly united in grooves; axial parenchyma scanty paratracheal in solitary strands near the vessel; prismatic crystals absent in chambered axial parenchyma cells; fibers non-septate; rays 1–2-seriate. **Leaves:** simple, alternate, mostly in fascicles, variable in size and shape, oblanceolate to obovate, 20–50 × 8–25 mm, sometimes with two lobes at the tip, lower surface glabrous, glossy green, leaf base decurrent, leaf apex acute to acuminate; petiole very short or subsessile, 2–30 mm long, pubescent; stipules absent. **Inflorescence:** a 1–3-flowered axillary raceme. **Flowers:** bisexual, large, ca. 38 mm long, white; sepals 5-lobed, long, ca. 3–5 mm long, pubescent; petals 5, white, ligulate, narrow, 30–35 × 6 mm, glabrous, longer than staminal tube; stamens 10, united into a thin, white tube slightly shorter than the petals; anthers oblong, apiculate; ovary 5-locular, sessile, glabrous; style short, exserted, up to 5 mm long. **Fruit:** a segmented capsule with 5–10 segments, woody, up to 15 mm in diameter, green. **Seeds:** small, orange to red, kidney-shaped, covered by a fleshy, white aril (Figure 17).

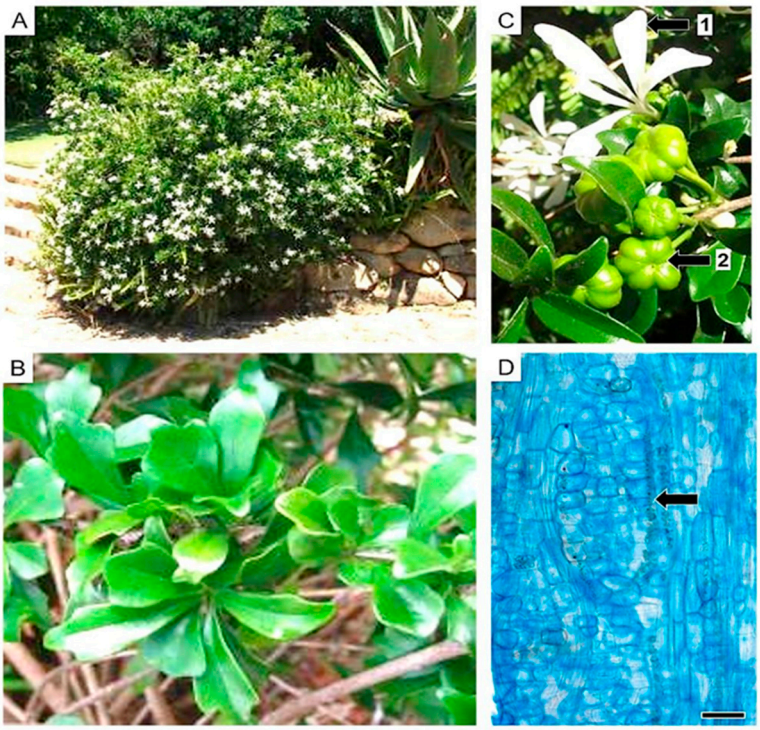

Figure 17. Diagnostic features of *Turraea obtusifolia.* (**A**) Scrambling, semi-evergreen shrub up to 5 m tall. (**B**) Variable leaves, which are sometimes lobed. (**C1**) White flowers with wide petals. (**C2**) Green, woody, segmented fruit. (**D**) Crystals in rays, shown by the arrow (bark tangential section). The scale bar represents 100 µm. Photos by *A. Notten*—www.inaturalist (accessed on 20 January 2019) (**A**–**C**) and *M.O. Oyedeji-Amusa* (**D**).

Distribution and ecology

The species grows in coastal forest, coastal dunes, woodland, wooded grassland, and bushland among rocks, from sea level to elevations of 1400 m. It can be found in Limpopo, North-West, Gauteng, Mpumalanga, KwaZulu-Natal, and Eastern Cape provinces in South Africa and Eswatini (Figure 18), as well as in Mozambique and Zimbabwe.

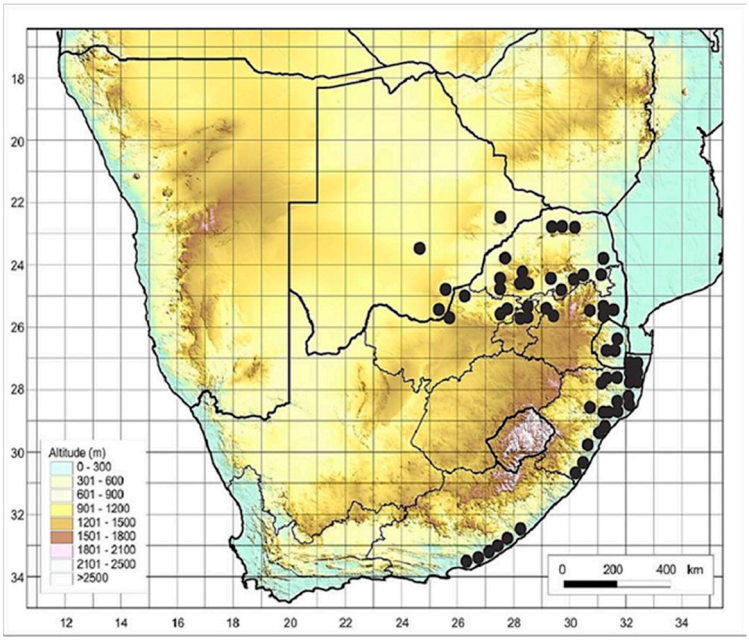

Figure 18. Recorded geographical distribution of *Turraea obtusifolia* in the Flora of the the southern Africa region. (Base map obtained from the South African National Biodiversity Institute).

Diagnostic characters

Turraea obtusifolia is similar to *T. floribunda* in that the leaves are simple and mostly in fascicles. *Turraea obtusifolia* is readily distinguished by its glossy, glabrous, oblanceolate to obovate leaves (20–50 × 8–25 mm, which might be lobed), white non-scented flowers, and presence of crystals in ray cells (bark tangential section) vs. ovate to lanceolate 25–120 × 10–70 mm leaves, light green scented flowers, and lack of crystals in ray cells (bark tangential section) in *T. floribunda*.

Conservation status

Least concern (http://redlist.sanbi.org/species.php?species=957-5, (accessed on 28 March 2019)). Our observations indicate that the plant is very widely distributed.

Phenology

The species flowers during the summer months (December to February) and fruits between January and June.

Specimens examined

Botswana. **2227 (Palapye):** Selebi (–BB), December 1977, *Kerfoot and Falconer 39* (PRE). **2324 (Lephepe):** Kweneng, between Molepolole and Botlapatlou in river where rock engravings are found (–BC), 10 December 1986, *Barnard 211* (PRE). **2425 (Gaborone):** SE Botswana, Mokolodi Village, Mokolodi Reserve, ca 9.3 mi [15 km] S of Gaborone (–DD), 21 November 1996, *Cole 1176* (PRE). **2525 (Mafeking):** Kenye, Kenye Hospital (–AB), 3 June 1990, *Hartley 1031* (J); Ramathlabama on Ghanzi road (–DA), 24 March 1976, *Du Preez and Steenkamp 58* (PRE).

South Africa. LIMPOPO: **2229 (Waterpoort):** Little Leigh farm, ca 12.4 mi [20 km] NW of town, Soutpansberg (–DD), 1 May 2000, *Meyer 2819* (PRE), N of Soutpansberg, farm Davenham 740 MS (–DD), 8 May 1991, *Balkwill 6334* (J). **2230 (Messina):** Beacons Field, 212 MT, S of Mauluma, suid van randjie (–CC), 3 November 1979, *Van Wyk 3001* (PRE). **2327 (Ellisras):** Mogol Nature Reserve (–DD), February 1981, *Fourie 2627* (PRE). **2330 (Tzaneen):** Gravelotte, Eden 757 LT (–DC), 15 February 1987, *De Villiers 50* (PRE). **2331 (Phalaborwa):** Skiettocht Military Base (–CC), 11 March 1991, *Manning 714* (PRE). **2427 (Thabazimbi):** On Kareehoek farm, at the S foot of the Kranzberg between quartzite boulders (–BC), 9 May 1977, *Venter 1955* (PRE); ca 18.6 mi [30 km] W of Vaalwater, Welgevonden Estate (–BD), 6 March 1993, *Balkwill and Sebola 8023* (J); W of Vaalwater, on the farm Onvermoeid 246 KQ (–BD), 11 March 1990, *Balkwill, Gesell and Williamson 5489* (J); ca 18.6 mi [30 km]

W of Vaalwater, farm Van der Waltsdrift (–BD), 27 March 1989, *Balkwill 4358* (J); ca 11 mi [17.7 km] NW of Rooiberg Tin Mine on road to Thabazimbi (–DC), 5 March 1948, *Codd 3756* (PRE). **2428 (Nylstroom):** N of Naboomspruit, Heinrichan LePhalala farm, central part of farm (–AB), 24 June 1993, *Burgoyne 1610* (PRE); Geelhoutkop (–AD), January 1918, *Breijer TRV 17826* (PRE); Mr Wilsons farm, ca 1.2 mi [2 km] along Warmwater Bronne turnoff, ca 7.5 mi [12 km] from Nylstroom (–CB), 6 February 1972, *Stirton 5* (PRE). **2430 (Pilgrim's Rest):** Near Penge Mine, Sakarora waterfall (–AD), *Burrows 3575* (J); Hoedspruit, Lissataba Private Nature Reserve, tussen klippe (–BC), 1 January 1987, *Van Heerden 749* (PRE); Sekukuni, Driekop farm (–CA), 26 February 1936, *Barnard 489* (PRE); Lydenburg, Steelpoort (–CB), 24 April 1999, *Dehning 45* (J). **2431 (Acornhoek):** Klaserie Private Nature Reserve, Dover 33 KU farm (–AA), 30 January 1980, *Zambatis 922* (PRE).

NORTH WEST: **2426 (Mochudi):** Ga-suping, Logaga 124 KP (–CC), 20 February 1985, *Krynauw 204* (PRE). **2525 (Mafeking):** Bophuthatswana, Motswedi Kloof (–BD), 1 January 1978, *Peeters, Gericke and Burelli 545* (PRE). **2526 (Zeerust):** Pilanesberg National Park, GA-Malau picnic site (–BB), 6 January 1991, *Glen 2485* (J).

GAUTENG: **2527 (Rustenburg):** De Wildt, near Pretoria (–DB), December 1928, *Murray 638* (PRE); Hekpoort, in valley (–DC), 1 February 1959, *Repton 5233* (PRE). **2528 (Pretoria):** Hebron (–AA), April 1933, *Dehnke TRV 31994* (PRE); Magaliesberg (–CA), 22 July 1976, *Van Son 52174* (PRE); Pretoria National Botanical Garden, W of restrooms on N side of ridge (–CB), 21 September 2018, *Bester 14245* (PRE). **2529 (Witbank):** Dennilton, in vicinity of Bundu Inn Caravan Park in light shade of larger trees (–AC), 15 November 1977, *Pienaar 1193* (PRE).

MPUMALANGA: **2429 (Zebediela):** Farm Uitvlugt 887 KS, foot of Thaba Ya Sekhukhune Mountains, Steelpoort River Valley near future dam wall (–DD), 13 March 2007, *Sachse 437* (PRE). **2431 (Acornhoek):** Kruger National Park. Nkhuhlu exclosures, Skukuza, Sabie River (–DD), 22 March 2011, *Van Coller, Siebert and Siebert 4425* (PRE). **2529 (Witbank):** SE of Loskopdam Nature Reserve (–AD), 13 December 2001, *Potgieter FP00190* (PRE). **2530 (Mashishing):** Driekop farm, Sekukuniland (–AB), 4 January 1939, *Mogg and Barnard 605* (PRE); Mbombela, Lowveld Botanical Garden side (–BD), 6 December 1969, *Buitendag 381* (PRE). **2531 (Komatipoort):** ca 4 mi [6.4 km] N of Brits on quartzite koppie (–AC), 6 December 1934, *Mogg 14601* (PRE); Near Impala Siding, between Barberton and Komati Poort (–BC), 8 January 1929, *Hutchinson 2493* (PRE); Malelane (–CB), December 1924, *Murphy TRV26125* (PRE); Barberton between Malelane and Hector Spruit (–CC), 8 January 1929, *Pole-Evans 24* (PRE).

KWAZULU-NATAL: **2632 (Bela vista):** Ingwavuma, Ndumo Game Reserve (–CC), 11 February 1960, *Tinley 574* (PRE, NU); Ingwavuma, Ndumu Hill, Ndumu Game Reserve (–CD), 15 February 1969, *Pooley 384* (NH, NU). **2731 (Louwsburg):** uPhongolo, ± 400 m W of Ivy's Tuck Shop, eNcotshane (–BC), 16 February 2007, *Keswa 1707* (NH); Jozini, Kwaliweni Forest, semi-shade, slope 5 deg (–BD), 21 February 1986, *Venter 11580* (PRE); Itala Nature Reserve, Mtunzini contour path (–CB), 10 December 1987, *MacDevette 2225* (NH, NU); Nongoma, ca 3.1 mi [5 km] W of Nongoma at disused coal mine near Vuna River (–CD), 28 March 1985, *Reid 1074* (PRE). **2732 (Ubombo):** Lebombo Mountains (–AA), 26 January 1963, *Strey 4804* (PRE); Lebombo bushveld alongside road from Josini to Hlatikulu (–AC), 6 January 1986, *Ward 1298* (NH); Lebombo Mountains, ca 11.8 mi [19.0 km] N of Josini (–AC), 28 November 1978, *Tölken and Germishuizen* 5791 (NH); Kosi Bay, N of Banga Nek (–BB), 24 June 1986, *Buthelezi 667* (NH); Near Manzengwenya Inspection Quarters (–BB), 29 November 1969, *Moll 4808* (NH); Lebombo Mountain, along road between Jozini and Hlatikula (–BC), 13 March 1993, *Van Wyk 737* (NH); Mkuze Game Reserve (–BC), 29 January 1982, *Bamps 7071* (PRE); Ingwavuma, Manzengwenya, Sibayi Coastal Woodland (–BD), 16 December 1984, *Ward 896* (NH); Josini Mountain slopes (–CA), 14 May 1970, *Strey 9795* (NH); Top of Jozini Pass opposite trading store (–CA), 18 February 1982, *Reid 496* (PRE); Makowe Hills (–CC), 24 November 1960, *Wells 2127* (NH); Sodwana Nature Reserve (–DA), 17 October 2001, *Schuhardt DS00229* (PRE). **2830 (Dundee):** Mfongosi (–DB), 22 June 1956, *Edwards 1495* (PRE, NU). **2831 (Nkandla):** Hlabisa, Hluhluwe Game Reserve,

Vumbe stream bed (–BB), 1 November 1983, *Phelan 734* (NU); Umfolozi Game Reserve, Thoboti camp area (–BD), 14 March 1966, *Mthonti 13* (NH, NU); Umfolosi Game Reserve, Rustic Camp N aspect, open park-like vegetation, on rocky slope (–CC), 17 January 1981, *Nichols 416* (NH); Eshowe (–CD), 28 January 1951, *Lawn 1909* (NH); Hlabisa, E. shores, St. Lucia dune forest, N of Bangazi (–CD), 12 January 1978, *Pooley 2071* (NU); Ngoye Forest, seaward side of forest (–DC), 19 February 1961, *Wells and Edwards 77* (PRE); Ngoye Forest (–DC), 5 January 1986, *Cunningham 2335* (NH); Ngoye Forest, outside northern boundary (–DC), 12 October 1984, *Buthelezi 472* (NH); Mtunzini, Ngoye Forest Reserve (–DC), 8 February 1963, *Huntley 267* (NU); Ngoye Forest Reserve (–DC), 30 March 1984, *Balkwill, Cadman, Edwards, Getliffe and Meyer 1338* (J); Ngoye Forest Reserve, eastern section (–DD), 8 December 1993, *Williams 1110* (NH). **2832 (Mtubatuba):** Hluhluwe Game Reserve (–AA), 20 July 1961, *Hitchins 56* (PRE); St Lucia Estuary, Sugarloaf campsite (–AD), 16 February 1986, *Venter 11482* (PRE); Maphelane Nature Reserve (–AD), 2 July 1986, *MacDevette 932* (NU); Maphelane Nature Reserve (–AD), 15 January 1985, *Gordon 159* (NH); Cape Vidal, dune forest (–BA), 23 February 1982, *Gordon 20* (NH); Hlabisa, Cape Vidal, dune forest (–BA), 3 June 1982, *MacDevette 326* (NH, NU). **2930 (Pietermaritzburg):** Nursery in Silverglen Nature Reserve, Chatsworth, Durban (–DD), 17 January 2005, *Styles 2262* (NH). **2931 (Stanger):** Ballitoville coastal forest, N of stream (–CA), 17 April 1986, *MacDevette 758* (NH, NU); Hawaan Forest, S bank of Umhlanga River (–CA), 18 February 1970, *Ross and Moll 2309* (NH); Balitoville, Zimbali Dune Forest (–CA), 1 July 1985, *MacDevette 280* (NH, NU); Umgeni, Durban (–CC), 9 February 1914, *Medley-Wood I2573* (PRE, NU). **3030 (Port Shepstone):** Sea Park (–CB), 25 November 1968, *Strey 8065* (NH); Uvongo Nature Reserve, ca 190 mi [305.8 km] from Nicholson Wandelpad aan regterkant (–CD), 14 July 1976, *Venter 1035* (PRE); Hibberdene, behind first dune, coastal forest (–DA), 26 March 1976, *Mogg 36964* (PRE).

EASTERN CAPE: **3129 (Port St. Johns):** Mgwelyana (Kambati), dune bush (–BD), 20 May 1969, *Strey 8660* (NH); Coffee Bay, near coast (–CC), November 1919, *Tyson 30* (PRE); Mtata mouth, first kloof on S bank (–CC), 8 January 1985, *Abbott 2396* (NH); Transkei, farm Hluleka near Ngqeleni (–CD), 5 January 1968, *De Winter 8861* (PRE). **3227 (Stutterheim):** Amalinda (–DD), 1 January 1954, *Nanni 97* (PRE). **3228 (Butterworth):** Willowvale, Qora River Mouth, N bank of estuary (–AD), 21 December 1991, *Cloete 1531* (NH); Quora Mouth, dune bush (–BC), 25 March 1973, *Strey 11186* (NU); Elliotdale, Bashee River Mouth, forest edge, N of estuary (–BD), 19 December 1991, *Cloete 1484* (NH); Kentani coast (–CB), December 1913, *Pegler 337* (PRE); Qora River Mouth, dunes at river mouth (–DD), 13 September 2001, *Rourke 2210* (PRE). **3326 (Grahamstown):** Alexander Fontein near chicken farm (–CB), 13 October 1954, *Johnson 1063* (PRE); Kenton-on-Sea, Bushmans River mouth (–DA), December 1949, *Leighton 3136* (PRE); Port Alfred, West slopes (–DB), October 1916, *Tyson TRV 17229* (PRE). **3327 (Peddie):** Kidds Beach (–BA), December 1943, *Giffen FH1793* (PRE); East London, ca 13.8 mi [22.2 km] from East London on Kidds Beach/Peddie Road (–BA), 21 July 1955, *Comins 1265* (PRE); East London, Bulura (–BB), 5 May 1972, *Von Gadow 59* (PRE).

Eswatini. **2631 (Mbabane):** Lubombo Mountains, ca 10.6 mi [17 km] N of Siteki on Siteki/Mhlume road between Groenpan and Cyrildene farms (–BD), 2 May 1976, *Culverwell 16* (PRE); Hlatikulu, Ingwavuma Port hillside (–CD), 13 November 1959, *Compton 29436* (PRE). **2531 (Komatipoort):** Tshaneni, Lowveld near homestead (–DC), 20 December 1969, *Barrett 401* (PRE).

Turraea nilotica

Turraea nilotica Kotschy and Peyr. in Plantae Tinneanae 12: 6 (1867); Oliv. in F.T.A. 1: 331 (1868); C. DC. in Mon. Phan. 1: 445 (1878); Gűrke in Engl. Pflanzenw. Ost-Afr. 231 (1895); Monro in Proc. Rhod. Sci. Ass. 7: 68 (1908); Sim, For. Fl. Port. E. Afr. 25 (1909); Eyles in Trans. Roy. Soc. S. Afr. 5: 388 (1916); Brenan in T.T.C.L. 321 (1949); Suesseng. and Merxm. in Proc. and Trans. Rhod. Sci. Ass. 43: 109 (1951); Garcia in Contr. Conhec. Fl. Moçamb. 2: 140 (1954); Pardy in Rhod. Agr. Journ. 52: 38 (1955); Williamson in Useful Pl. Nyasal. 120 (1956); Palgrave in Trees of Central Afr. 231 (1957); Dale and Greenway, Kenya

Trees and Shrubs 275 (1961); White, F.F.N.R. 182 (1962); White in Bothalia 16 (2): 149 (1986); White and Styles in F.S.A. 18 (3): 43 (1986). Type: Somalia, Rive del Giuba a Ferdadale, 21 October 1913, *Paoli 981* (FT-image! syntype).

Turraea randii Baker f. in Journ. Bot. 37: 427 (1899); Gibbs in Journ. Linn. Soc., Bot. 37: 435 (1906). Type: Zimbabwe, Salisbury, July 1898, *Rand 562* (BM).

Turraea tubulifera C. DC. in Ann. Conserv. Jard. Bot. Genève, 10: 133 (1907). Type: Tanzania, Tanganyika, Zanguebar Bagamoyo, no date, *Sacleux 471* (H).

Shrub or small deciduous tree, up to 10 m tall; young branches pubescent and smooth in older trees. **Bark:** surface pubescent in younger stem, smooth to cork-like and flaking with age; twigs with conspicuous whitish lenticels. **Leaves:** simple, elliptic to obovate, 100–160 × 80–120 mm, alternate, pubescent with curved edges, margin entire and rolled below, venation conspicuous below, petiolate, leaf base cuneate, leaf apex tapering to rounded; petioles pubescent, 15–18 mm long, stipules absent. **Inflorescence:** a 5–18-flowered, sessile or subsessile fascicle in the axils of fallen leaves. **Flowers:** in axillary clusters, small, ca. 25 mm in diameter, greenish white to yellow with age, sweetly scented; sepals 5, ca. 3 mm long, denticulate, puberulous; petals 5, 13–24 × 3–5 mm, greenish white turning yellow with age, sparsely puberulous; stamens 10, united into a long, thin white staminal tube, staminal tube pubescent, as long as anthers; ovary sessile, 4–10 locules, with two ovules in each locule; style exserted, projects beyond the staminal tube. **Fruit:** a segmented capsule with 5–10 segments, glabrous, thinly woody, and up to 13 mm in diameter. **Seeds:** black, 5 × 3 mm, kidney-shaped, and covered by orange to red arils (Figure 19).

Figure 19. Diagnostic features of *Turraea nilotica*. (**A**) Clusters of flowers at the tip of the shoot. (**B1**) Long style and staminal tube broadened at the tip. (**B2**) Greenish white to slender yellow petal. (**C**) Cork-like flaking bark. (**D**) Simple, alternate, elliptic to obovate [100–160 × 80–120 mm] leaves. (**E**) Black seed covered with orange to red arils. Photos by *S. Holt*—www.inaturalist (accessed on 20 January 2019) (**A**,**E**); *B. Wursten*—www.inaturalist (**B**); and *P. Luraschi*—www.inaturalist (**C**,**D**).

Distribution and ecology

The species grows in bushland and scrub woodland below an elevation of 800 m. It is found in the Limpopo and Mpumalanga provinces in South Africa and in Botswana (Figure 20). It also occurs in Mozambique, Zimbabwe, Malawi, Uganda, Kenya, Ethiopia, and Sudan.

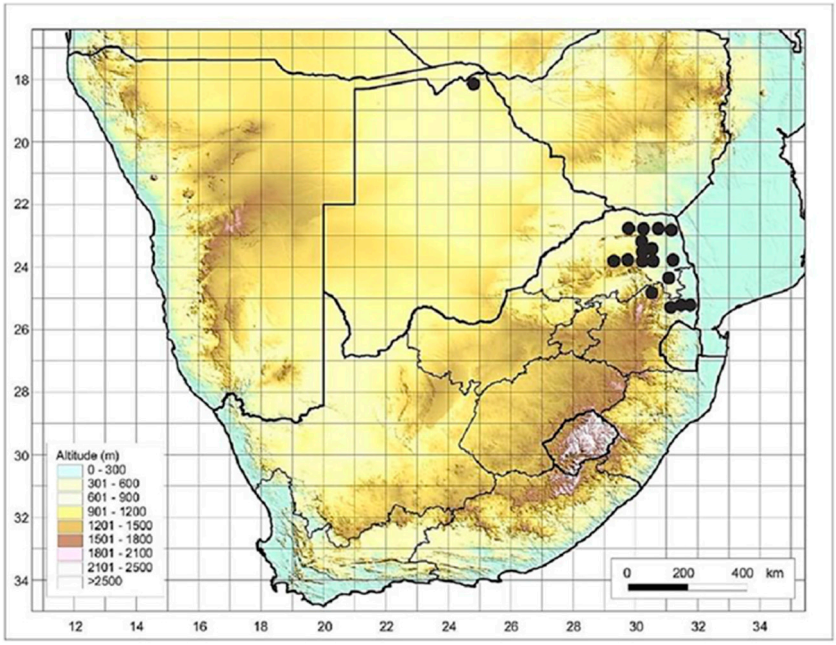

Figure 20. Recorded geographical distribution of *Turraea nilotica* in the flora of the the southern Africa region. (Base map obtained from the South African National Biodiversity Institute).

Diagnostic characters

Turraea nilotica can be distinguished from *T. obtusifolia* and *T. floribunda* by the shorter petals (up to 22 mm long) and the staminal tube that is distally expanded (petals more than 30 mm long and the staminal tube not expanded at the tip in the other two species above). It is also superficially similar to *Vangueria infausta* in that the leaves are simple, pubescent, and elliptic to obovate in shape. *Turraea nilotica* Is readily distinguished by its alternatively arranged leaves, slender petals, and exerted style, which is approximately twice the length of the staminal tube vs. opposite leaves, wide petals, and a short style in *V. infausta.*

Conservation status

Least concern (http://redlist.sanbi.org/species.php?species=957-3, (accessed on 28 March 2019)). Our observations indicate that the plant is not very widely distributed in South Africa, but it occurs in large parts of eastern Africa.

Phenology

The species flowers during the winter and spring months (June to October) and fruits between September and February.

Specimens examined

Botswana. **1724 (Katima Mulilo):** Kabulabula, Chobe River, Bechuanaland North (–DD), July 1930, *Van Son TRV 28944* (PRE).

South Africa. LIMPOPO: **2229 (Waterpoort):** Soutpansberg, Free State Mine (–DD), July 1917, *Breijer TRV 17571* (PRE). **2230 (Messina):** Musunda near road to Musunda Village (–DE), 2 October 1979, *Khorommbi 1005* (PRE); Vuvha (–CD), 7 October 1981, *Van Wyk and Theron 4943* (PRE); Musunela (–DB), 10 July 1981, *Netshiungani 1448* (J). **2231 (Pafuri):** Kruger National Park, Punda Milia, Sjantangalane area (–CA), 19 October 1966, *Van Wyk 4748* (PRE). **2328 (Baltimore):** Senwabarwana, Blouberg Nature Reserve (–BB), 28 July 1973, *Davidson s.n.* (J). **2329 (Polokwane):** Buffelshill (–CD), November 1918, *Rogers TRV 18935* (PRE); Munnik (–DE), 18 January 1946, *Gerstner 5807* (PRE). **2330 (Tzaneen):** Elim (–AA), June 1930, *Obermeyer 507* (PRE); Koedoes River Valley, on ridge (–CA), September 1923, *Keet 1188* (PRE); Moeketsi, 9 min NW of Mooketsi on Soekmekaar road (–CA), 21 August 1968, *Leistner, Thom and Gillham 3286* (PRE); E of Tzaneen on road to Gravelotte (–CD), 15 September 1972, *Van Vuuren 1823* (PRE); Hans Merensky Nature Reserve, ex Transvaal Nature Conservation Herbarium (–DA), 16 September 1969, *Oates 32* (PRE); Kruger National Park, Rubbervale

(–DC), 3 October 1932, *Lang TRV 32116* (PRE). **2331 (Phalaborwa):** Silonque plot 2, ca 6.2 mi [10 km] N of Phalaborwa at foot of Masakoleng outcrop (–CC), 21 October 1987, *Retief 643* (PRE). **2431 (Acornhoek):** Klaserie, Guernsey farm (–AC), 13 June 1971, *Burger 43* (PRE); Ba-Phalaborwa, E of Klaserie, Umbabat Bushveld (–CA), 2 October 1990, *Shackleton 715* (J).

MPUMALANGA: **2430 (Pilgrim's Rest**): ca 12.4 mi [20 km] from Hoedspruit farm called Trekkers, on slope of Blyde River Canyon Mountain, ca 9.3 mi [15 km] from Swadini (–BD), 3 October 2002, *Male JM00274* (PRE); Escarpment joining N. section of Drakensberg, Chester farm (–BD), 16 September 1984, *Rushworth 34* (NU); Klaserie, on road to Mariepskop (–DB), 17 November 1987, *Venter 12688* (NU). **2431 (Acornhoek):** Pilgrims Rest near Bushbuck Ridge P.O. (–CC), 18 August 1946, *Acocks 12892* (PRE); Lothian (–CC), August 1923, *Keet 1258* (PRE). **2530 (Mashishing):** Mbombela, Lowveld Botanical Garden, garden side (–BD), 6 October 1969, *Buitendag 144* (PRE); Mashishing, Lowveld Botanical Garden, garden side central area (–BD), 24 September 1970, *Buitendag 680* (PRE). **2531 (Komatipoort):** Shabin, Kruger National Park (–AA), 20 August 1952, *Van der Schijff 710* (PRE); Kruger National Park near Pretoriuskop gate (–AA), 28 August 1950, *Codd 6117* (PRE); Kruger National Park (–AA), 14 January 1952, *Van der Schijff 176* (PRE); Kruger National Park, Pretoriuskop, Pretoriuskop and neighbourhood (–AB), 26 October 1950, *Story 3908* (PRE); Hazyview township, about 50 m W of the Hazyview residential area, turn-off on the Hazyview-Skukuza Road (–BA), 4 October 2000, *Schmidt 2631* (PRE).

Turraea pulchella

Turraea pulchella (Harms) T.D.Penn. in Blumea 22 (3): 454 (1975); White and Styles in F.S.A. 18 (3): 47 (1986). Type: South Africa, Eastern Cape, Butterworth (3228): Transkei, near Kentani (–CB), March 1903, *Pegler 730* (B, holotype†; Kentani District, 305 m, fl.fr. 15 Oct. 1904, *Pegler 730* (K-image!, neotype, designated by White (1986); BOL, GRA, PRE!, SAM, isoneotypes).

Nurmonia pulchella Harms. in Ber. Deutsch. Bot. Ges. 35: 81 (1917). Type: Same as for *Turraea pulchella*.

[Note: *Pegler 370* in the Berlin herbarium was previously designated as type, but it was destroyed during WWII, so White (1986) chose *Pegler 370* in the Kew Herbarium as neotype, with the explanation that there is no definite evidence that it is a duplicate of the Berlin specimen, even though it bears the same collector's number].

Shrublet, up to 0.3 m tall; rootstock strong, woody; branchlet strong, woody. **Leaves:** simple, setulose, ovate with the broadest part close to the leaf apex, shallowly lobed in the upper half, 25–30 × 10–17 mm, alternate, petiolate, pubescent, margin entire, leaf base acute, leaf apex obtuse; petioles 5–8 mm long; stipules absent. **Inflorescence:** a (2–)3–18-flowered false raceme. **Flowers:** bisexual, axillary or solitary, white, spicy fragrance, produced in 2–3 cymules; sepals free, small, hispidulous; petals 5, oblong, white, pubescent; stamens 10, united into a staminal tube which splits at the tip, as long as anthers; anthers apiculate; ovary sessile, 5-locular, with two ovules in each locule, pubescent; style up to 20 mm long, head capitate with 5 stigmatic lobes at the tip. **Fruit:** a segmented capsule with 5 segments, thinly woody, up to 10 mm in diameter (Figure 21).

Distribution and ecology

The species grows on the boundaries between grassland and thicket (Valley Bushveld) above river gorges or on top of the sandstone plateau at elevations between 300 and 650 m. It is found in KwaZulu Natal and the Eastern Cape Province in South Africa (Figure 22).

Diagnostic characters

Turraea pulchella is similar to *T. streyi* in that the leaf surfaces are setulose and flowers occur in cymules. *Turraea pulchella* is readily distinguished by its simple ovate leaves, larger flowers, and style head, which is differentiated into 5 stigmatic lobes and oblong petals vs. compound, mostly trifoliolate and lobed leaves, smaller flowers, a less differentiated style head, and obovate petals in *T. streyi*.

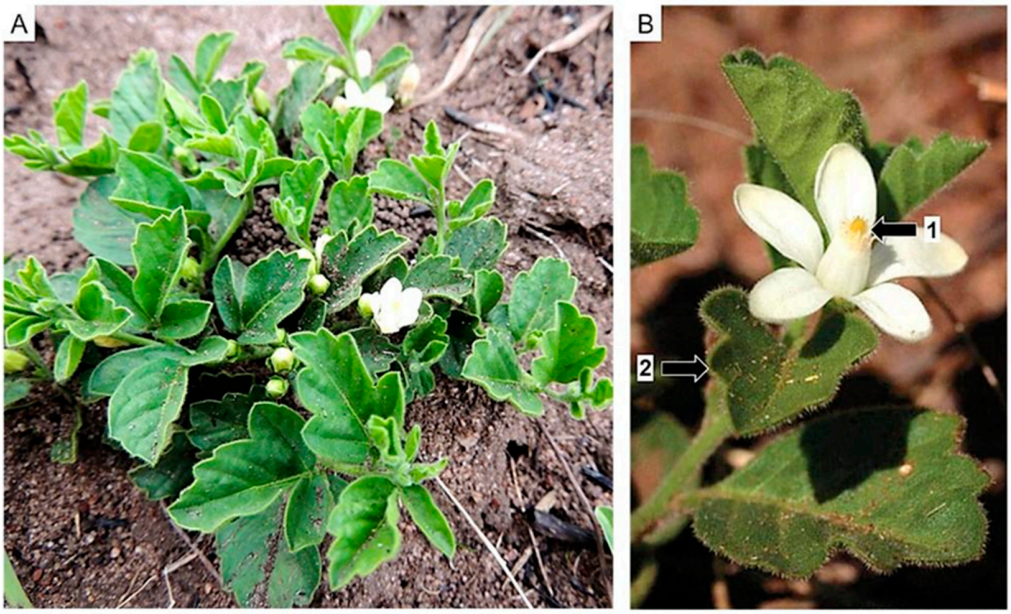

Figure 21. Diagnostic features of *Turraea pulchella.* (**A**) Shrublet up to 0.3 m tall. (**B1**) White flower with differentiated style-head. (**B2**) Simple, ovate leaf with the broadest part close to the leaf apex. Photos by *Graham*—www.inaturalist (accessed on 20 January 2019) (**A**) and *P. Wragg*—www.inaturalist (**B**).

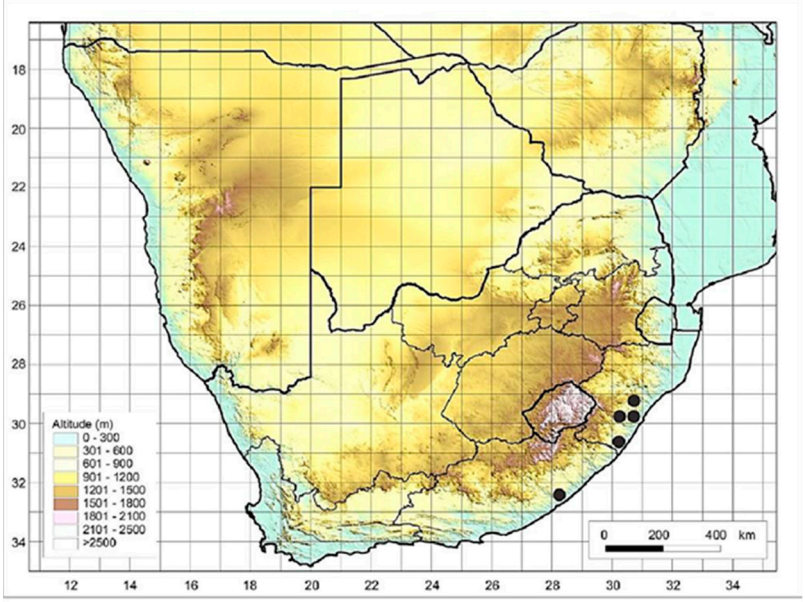

Figure 22. Recorded geographical distribution of *Turraea pulchella*. (Base map obtained from the South African National Biodiversity Institute).

Conservation status

Vulnerable (http://redlist.sanbi.org/species.php?species=957-7, (accessed on 28 March 2019)). Our observations from the map (Figure 22) support the status of the plant as vulnerable.

Phenology

The species flowers during the late spring to summer months (September to March).

Specimens examined

South Africa. KWAZULU-NATAL: **2930 (Pietermaritzburg):** Krantzkloof Nature Reserve (–DA), 2000, *Scott-Shaw 10363* (NU); Matabetule Plateau (–DB), 22 Oct, 1987, *Williams 45* (NH); Inanda, Matabetule Plateau (–DB), 27 November 1987, *Williams 84* (NH);

Matabetule Plateau, c. 20 km NW of Durban (–DB), 18 September 1987, *Williams 36* (NH); Matabetule Plateau (–DB), 15 February 1988, *Williams 217* (NH); Inanda, Greater Durban Metropolitan area, Hammarsdale area, Hector (ESKOM) (–DC), 9 December 1995, *Ward 13427* (NH); eThekwini, Tabankulu Hill (W of Shongweni exit from N3, with cane watch tower) (–DC), 3 January 2006, *Wragg 1469* (NU); Pinetown, Marianhill (–DD), 29 September 1994, *Ngwenya 1290* (N, PRE). **3030 (Port Shepstone):** Mzamba, E of Greenville Mission on slopes above Umtamvuna, on level ground above Umtamvuna River (–CC), 10 January 1995, *Abbott 6659* (NH).

EASTERN CAPE: **3228 (Butterworth):** Kentani Valley (–CB), October 1911, *Pegler 730* (NH).

Turraea streyi

Turraea streyi F. White and Styles in Bothalia 16 (2): 153 (1986); White and Styles in F.S.A. 18 (3): 47 (1986). TYPE: South Africa, KwaZulu-Natal, Port Shepstone (3030): St Michael's-on-Sea, Deppe's farm, a heavily browsed 'bush' in bushveld (–CD), 19 Sept 1966, *Strey 6876* (PRE!, holotype; NH!, NU, isotypes).

A multi-stemmed rhizomatous suffutex, up to 0.75 m tall, branchlets setulose. **Leaves:** imparipinnately compound, mostly trifoliolate, alternate, with 2–5 divisions, the leaflets lobed, with rounded to acute apices, 50–70 × 8–20 mm, surface setulose, green, petiole very short, sessile, 2–20 mm long, stipules absent. **Flowers:** in 2–3-flowered cymules, sepals 3–5 mm long, hispidulous; petals 5, broadly obovate, white, glabrous, 90–110 × 20–40 mm; staminal tube, up to 9 mm long, pubescent; ovary 5-locular, with two collateral ovules in each locule, pubescent; style short, slightly exserted, up to 10 mm long, pubescent. **Fruit:** a segmented capsule, with 5–10 segments, woody, up to 13 mm in diameter. (Figure 23).

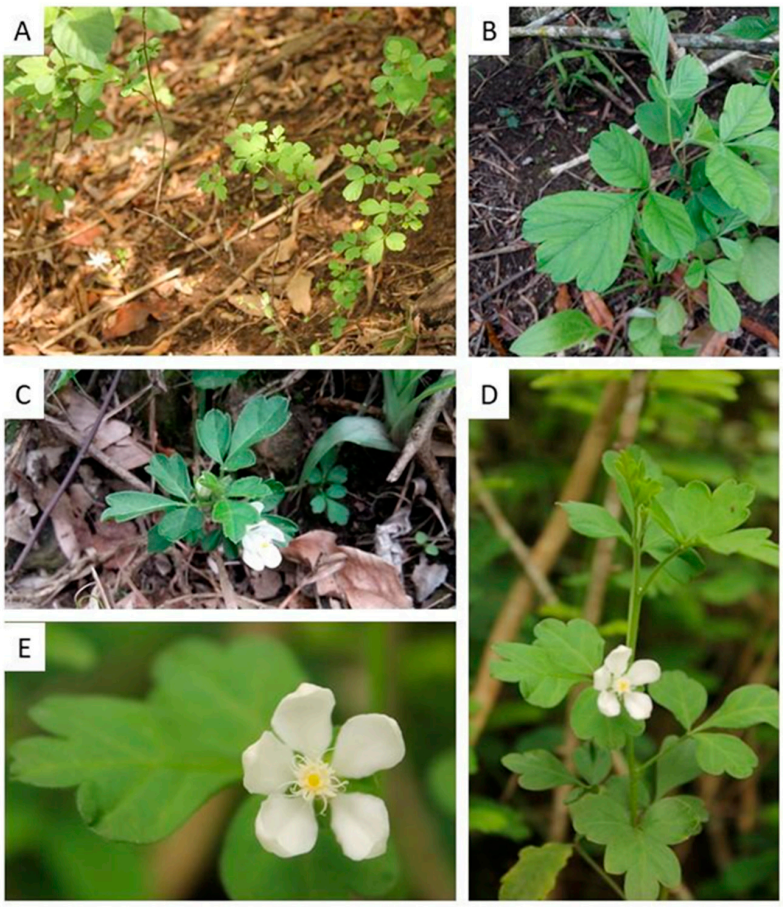

Figure 23. Diagnostic features of *Turraea streyi.* (**A**) Thin-stemmed, rhizomatous suffrutex. (**B**) Trifoliate leaves with dentate apices. (**C**,**D**) Twigs with flowers. (**E**) Flower. Photos by *L.S. Mhlongo*, taken near Amandawe.

Distribution and ecology

The species grows at the margins of scrub forest, bushland, and coastal grassland at elevations between 30 and 100 m. It is found between Port Shepstone and Stanger in KwaZulu-Natal (Figure 24). It is now also known from a large population of ca. 60 to 80 individuals in a new locality, ca. 20 km north of Amandawe (ca. 15 km south of the Umkomaas River towards Amandawe). A few plants have also been found in Amandawe Village (see below). Amandawe is situated ca. 7 km east of Scottburgh and ca. 60 km south of Durban.

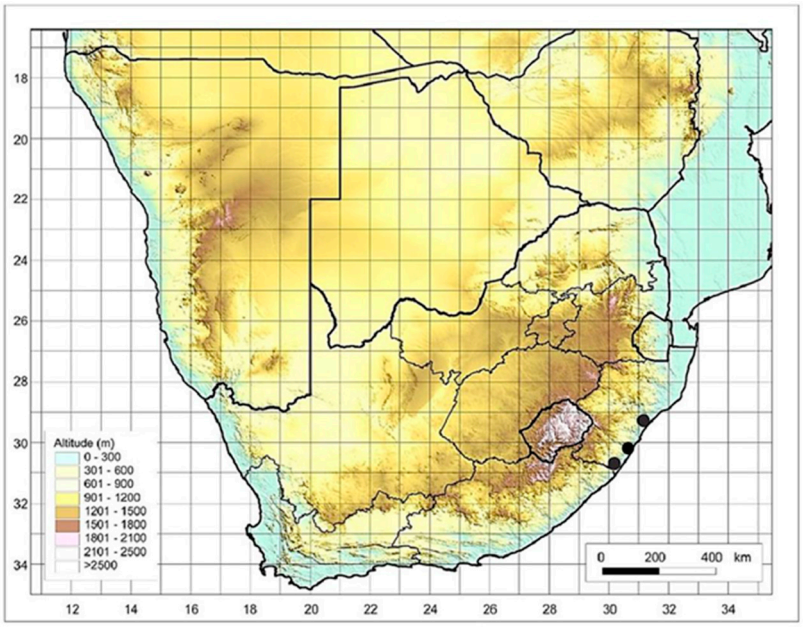

Figure 24. Recorded geographical distribution of *Turraea streyi*. The recently discovered new populations are indicated at 3030BA. (Base map obtained from the South African National Biodiversity Institute).

Conservation status

The current status of the species is given as Critically Endangered (Possibly Extinct, http://redlist.sanbi.org/species.php?species=957-9, (accessed on 28 March 2019)). This assessment was based on the fact that the two known wild subpopulations have completely disappeared due to the encroachment of invasive alien plants and that only a small subpopulation of three introduced (planted) individuals exists near the type locality. The assessment concluded that there is not much hope of finding the plant elsewhere in its former range [55,56]. Recently, however, the two new populations referred to above were discovered by Mr. Lloyd Mhlongo, a PhD botany student at the University of Johannesburg [57]. This means that the conservation status needs to be reassessed. According to the criteria of the IUCN [53,54], the species remains critically endangered.

Diagnostic characters

Turraea streyi is similar to *T. pulchella*—both species are small suffrutices with setulose leaf surfaces and white flowers borne in 1–3-flowered cymules. *Turraea streyi* is readily distinguished by its compound leaves (usually trifoliate but sometimes with five leaflets), the smaller size of the flowers, and broad, obovate petals (simple leaves, larger flowers, and oblong petals are diagnostic for *T. pulchella*).

Specimens examined

South Africa. KWAZULU-NATAL: **2931 (Stanger):** King Hamlyn's farm (–AD), 19 September 1971, *Moll 5502* (NH). **3030 (Port Shepstone):** Ca. 20 km north of Amandawe (–BA), *Grieve KWG2973* (NH); Uvongo Road (–CD), 1 October 1987, *Williams 44* (NH); Uvongo Road (–CD), 27 November 1969, *Strey 9288* (NH); St. Michael's-on-Sea, Deppe's farm next to "Skyline" (–CD), 1 October 1987, *Williams 43* (NH); Deppe's farm, next to

"Skyline", St. Michael's-on-Sea (–CD), 10 December 1968, *Ross 1853* (NH); Port Shepstone, St Michael-on-Sea. Deppe's farm (–CD), 19 September 1966, *Strey 6876* (NH, NU).

Genus *Xylocarpus*

Xylocarpus J. Koen. in Naturforsch. 20: 2 (1784); Harms in Engl. and Prantl, Nat. Pflanzenf. 2nd ed. 81 (1940); Coates Palgrave, Trees Southern Afr.: 447 (2002); Boon, Pooley's Trees of Eastern S. Afr.: 224 (2010). Type species: *Xylocarpus granatum* J. Koen.

Medium-sized to large, monoecious tree. **Leaves:** paripinnate, leaflets entire, 1–4 pairs, glabrous. **Flowers:** unisexual, with well-developed vestiges of the opposite sex present in axillary panicles. **Calyx:** 4-lobed, valvate. **Petals:** four, free, longer than the calyx, spreading in open flowers, contorted in bud; staminal tube urceolate, stamens eight, anthers eight, terminated by eight appendages; disc large, red, cushion-shaped, fused to ovary; ovary 4-locular, each loculus with 2–4 ovules; style short, style-head discoid, upper surface with four radiating stigmatic grooves. **Fruit:** a large, leathery, pendulous, septifragal capsule, dehiscing by four valves; columella vestigial, septa thin, ultimately breaking down. **Seeds:** large, 8–18 per locule, tetrahedral or pyramidal, without wing; testa corky; endosperm absent; cotyledons fused together; radicle above the helium.

The species

Xylocarpus granatum J. Koen. in Naturforsch. 20: 2 (1784); A. Juss. in Mém. Mus. Hist. Nat. Par. 19: 244 (1830); Parkinson in Indian Forester, 60: 138 (1934); Ridl. in Kew Bull. 1938: 288 (1938); Burtt Davy in Journ. S. Afr. Bot. 6: 31 (1940); Coates Palgrave, Trees Southern Afr.: 447 (2002); Boon, Pooley's Trees of Eastern S. Afr.: 224 (2010). Type: Australia, New South Wales, Endeavour River, 1770, *Joseph Banks* (BM).

Carapa moluccensis Lam.in Encycl. [J. Lamarck et al.] 1 (2): 621 (1785). Oliv. in F.T.A. 1: 337 (1868); Sim, For. Fl. Port. E. Afr.: 27 (1909). Type: India, Sundribuns, 13 April 1893, *Heinig s.n.* (P-image! Lectotype).

Carapa obovata Blume, Bijdr. Fl. Ned. Ind. 4: 179 (1825); Baill. in Grandid. Hist. Nat. Pl. Madag. 3: 260 (1886). Type: Indonesia, Java, no date, *Blume s.n.* (L).

Xylocarpus benadirensis Mattei in Boll. Ort. Bot. Palermo, 7: 99 (1908); Gomes e Sousa, Dendrol. Moçamb., 2: 103 cum Table (1949); Dale and Greenway, Kenya Trees and Shrubs: 276 (1961). Type: from Somalia.

Xylocarpus obovatus (Blume) Spreng., Syst. Veg., ed. 16 [Sprengel] 4 (2): 147 (1827); Chiovenda, Fl. Somala, 2: 131 (1932). Glover, Prov., Check-List Brit. and It. Somal.: 187 (1947). Type: Thailand, Central, Saraburi, Me Nam Sak, ad flumen Me nam in regno Siasnico, June 1868, *Pierre 4304* (L-image! isotype).

Medium-sized to large, evergreen (much-branched and briefly deciduous) tree, 5–20 m tall; crown spreading; bole not prominent, up to 10 m in diameter; branchlets reddish-brown. **Bark:** smooth, yellow to brown to green, and flakes with age. **Leaves:** paripinnately compound with 1–4 pairs of leaflets, petiolate, leaflets opposite, elliptic to obovate, 50–120 × 30–50 mm, leaflet base narrowly or broadly cuneate, leaflet apex rounded, venation prominent on both sides, margin entire, rolled under; petioles glabrous, 80–90 mm long; **petiolules:** 3–6 mm long; rachis up to 90 mm long. **Inflorescence:** a 2–3-flowered cyme in lax racemes. **Flowers:** unisexual, in axillary sprays, sweetly scented, ca. 14 mm in diameter, whitish to pale pink; sepals 4-lobed, 3–4 mm long; petals 4, 5–7 mm long, glabrous; staminal tube 3–5 mm long, glabrous; ovary small, less than 1 mm in diameter; style long, up to 6 mm long. **Fruit:** a round leathery capsule, large, up to 200 mm in diameter, obscurely 4-sulcate, opening to release 8–16 closely packed brown seeds. **Seeds:** many, 40–80 mm long (Figure 25).

Distribution and ecology

The species is found in the mud of mangrove swamps, usually towards their upper limits. It occurs from the South African border with Mozambique (Figure 26) along the east coast of Mozambique, Kenya, Madagascar, Mafia, Pemba, Somalia, Tanzania, Zanzibar, and throughout the Old-World tropics to Australia, Fiji, and Tonga.

Figure 25. Diagnostic features of *Xylocarpus granatum.* (**A**) Small to medium-sized evergreen tree with many branches, up to 20 m tall. (**B**) Brown, flaked bark. (**C**) Paripinnate leaf with a small number of oblong-elliptic to obovate leaflets. (**D**) White to pink flowers with four sepals. (**E1**) Green, round leathery capsule (unripe). (**E2**) Brown, leathery capsule (ripe). (**F**) Septifragal capsule, dehiscing by four valves. (**G**) Large, tetrahedral, or pyramidal seeds of irregular shape. Photos by *R.C.J. Ward* (**A**); *I. Cowan* (**B**); *W. McCleland* (**C**); *E. Setiawan* (**D**,**G**); *Oldman 19510* (**E1**), *Bidault* (**E2**) and *C.W. Gan* (**F**) (All photos from—www.inaturalist (accessed on 20 January 2019)).

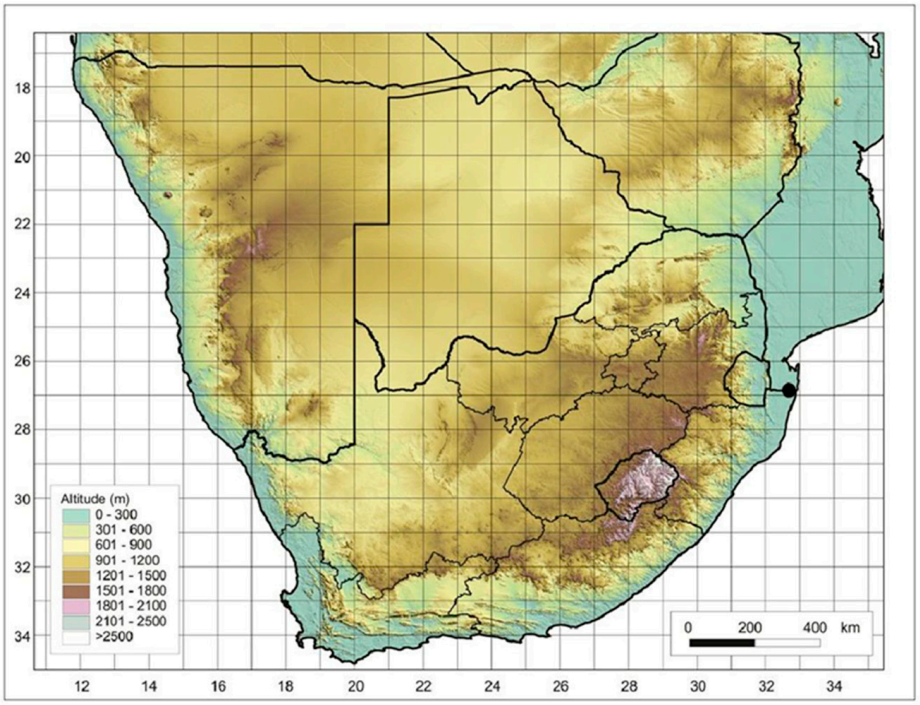

Figure 26. Recorded geographical distribution of *Xylocarpus granatum* in the Flora of the southern Africa region (a single individual tree has been recorded near Kosi Bay, at 2632DD). (Base map obtained from the South African National Biodiversity Institute).

Diagnostic characters

The species is easily distinguished by the paripinnate leaves with only a few (1–4) pairs of leaflets and the large, globose, leathery fruit capsules with closely packed large seeds.

Conservation status

This species was not assessed for the South African National Red List, following the IUCN regional guidelines for inclusion in regional Red Lists [53,54]. It occurs only near Kosi Bay, where a single individual plant has been recorded. Because it is not a viable population and has not yet reproduced since it was first discovered in 1995, it has not been assessed.

Phenology

The species flowers in the summer (November to January), and fruits ripen between February and September.

Specimens examined

South Africa. KWAZULU-NATAL: **2632 (Bela Vista):** Maputaland. Kosi System. Enkovukeni (Tidal Basin) (–DD), 28 November 1995, *Ward 13407* (NH, PRE).

4. Conclusions

The results confirmed the monophyly of Melioideae and Swietenioideae. The incongruence of *Turraea* previously reported was resolved in this study. Most representative genera of South African Meliaceae were recovered monophyletic with strong support. A distant relationship between *Walsura* and *Turraea* was recorded. The present study is the most recent investigation displaying better resolution within Melioideae. However, further research into the systematics of the family is required. It is recommended to sample species in multiples and include more markers to provide a better understanding of the relationships within the South African species of Meliaceae.

The revision of the taxonomy, diagnostic characters, and recorded geographical distributions has value, not only in facilitating the identification of southern African indigenous genera and species of the Meliaceae but also in providing an up-to-date inventory of the diversification of the family in the subcontinent. The discovery of a relatively large population of the rare *Turraea* streyi (previously thought to possibly be extinct) is noteworthy. The southern African members would benefit from a more focused phylogenetic study of the species and their respective sister species. This study is a contribution to tropical botany and to a more comprehensive database for the Meliaceae. The study of the South African taxa of the family has also resulted in a better understanding of anatomical characters that may have value in exploring higher-level relationships in the family as a whole.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/d16020113/s1, Table S1: The statistics of the partitions from the data that was used for the tree; Figure S1: The Bayysian inference tree of the combined sequence data set of 70 Meliaceae accessions. The posterior probability (PP) values and maximum likelihood bootstrap (MLB) values are above the branches, while the maximum parsimony bootstrap (MPB) values are below. The numbers one through five indicate groups that are discussed above. The names highlighted in green are the South African indigenous species, subfamilies, and tribes after Pennington and Styles [1].

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