



A new species of *Phyllogeiton* (Rhamnaceae: Rhamneae) from Maputaland, South Africa

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Abstract

Recently the genus *Phyllogeiton* was reinstated to accommodate the two currently recognized species of *Berchemia*, namely *P. discolor* and *P. zeyheri*, which are confined to Africa and Madagascar. In the present contribution a new species, *Phyllogeiton trachybasis*, is described, illustrated, mapped, and compared with the other members of the genus, especially with *P. discolor* with which it has hitherto been confused. An identification key and illustrations are provided for the three species of *Phyllogeiton*. The new species has a restricted range and is presently only known for certain from the KwaZulu-Natal part of the Maputaland Centre of Endemism in South Africa. Known trees of *P. trachybasis* are mostly old and there are no signs of recruitment in nature. Outside conservation areas, the bark of *P. trachybasis* is heavily utilised for biocultural purposes, most probably a main reason for the apparent demise of the species. A preliminary conservation assessment suggests that *P. trachybasis* should be classified as Endangered.

Keywords: bark, *Berchemia*, *Berchemia discolor*, Maputaland Centre of Endemism, medicine, *muti*, *muti*, Rhamnoideae, taxonomy, traditional medicine, *umuthi*

Introduction

Berchemia Neck. ex Candolle (1825: 22), when broadly defined, is a genus of ca. 20–32 species (depending on the authority) belonging to the tribe Rhamneae of the cosmopolitan family Rhamnaceae (Richardson *et al.* 2000, Medan & Schirarend 2004, Chen & Schirarend 2007, Mabberley 2017, POWO 2019). However, a recent molecular phylogenetic study using samples from 21 species of *Berchemia* showed that, if broadly defined, the genus is paraphyletic and that the African species should be removed to form a strongly supported monophyletic *Berchemia* (Huang *et al.* 2021). Morphological and phytogeographical evidence provide additional support for such a recircumscription of the genus (Huang *et al.* 2021). African members of *Berchemia* s.l. are trees with opposite or sub-opposite leaves and reddish or yellowish fruit, whereas the Asian and New World species are climbing or erect shrubs with alternate leaves and red or dark blue fruit (Van Wyk & Van Wyk 2013, Nesom 2016, Huang *et al.* 2021). Huang *et al.* (2021) proposed the reinstatement of the genus *Phyllogeiton* (Weberbauer 1895: 406) Herzog (1903: 168) for the African species of *Berchemia* s.l. Weberbauer (1895) originally proposed the name *Phyllogeiton* for a section of *Berchemia* comprising of a single species, *B. discolor* (Klotzsch 1862: 110, t. 21) Hemsley (1868: 381), on account of, among others, its corymbose inflorescences. Herzog (1903) raised Weberbauer's section to generic level with the recognition of the genus *Phyllogeiton*, a step that was supported by his anatomical studies on *Berchemia* s.l. In the present contribution we follow the proposal to reinstate *Phyllogeiton* for the African species of *Berchemia*. Note that reference to southern Africa refers to the mainland region of the African continent south of the Kunene, Okavango, and Zambezi rivers, a region comprising Namibia, Botswana, Zimbabwe, South Africa, Eswatini, Lesotho, and that part of Mozambique south of the Zambezi River.

Most species of *Berchemia* s.str. are confined to tropical and subtropical East to Southeast Asia (Huang *et al.* 2021). However, the liana *B. scandens* (Hill 1768: 453, t. 20) Koch (1869: 602) occurs in the southeastern United States,

Mexico, and Guatemala. Currently two named species of *Phyllogeiton* are recognized, namely *P. discolor* (Klotzsch 1862: 110, t. 21) Herzog (1903: 169) and *P. zeyheri* (Sonder 1860: 477) Suessenguth (1953: 182). Both species are found in Africa, with *P. discolor* also occurring in Madagascar (Schatz 2001, Nesom 2016, POWO 2019). During the 1950s and most of the 1960s these two species were treated in southern Africa either as members of *Phyllogeiton* (e.g. Palmer 1961, De Winter *et al.* 1966, Smith 1966) or *Berchemia* (e.g. Codd 1951, Phillips 1951, Drummond 1966). However, from the early 1970s until the recent work of Huang *et al.* (2021), they were consistently placed in *Berchemia*, namely as *B. discolor* and *B. zeyheri* (Sonder 1860: 477) Grubov (1949: 374). Hence the work of Huang *et al.* (2021) has merely resulted in the reinstatement of a generic name already used in some of the subcontinent's older tree literature.

Phyllogeiton zeyheri is mainly confined to the northeastern subtropical and tropical parts of southern Africa, as far south as the border between the South African provinces of KwaZulu-Natal and the Eastern Cape (Drummond 1966, Boon 2010). *Phyllogeiton discolor* has a much wider range and occurs from Saudi Arabia to Botswana, Mozambique, Namibia, Zimbabwe, and the northern parts of South Africa, with an outlier distribution on Madagascar (Johnston 1972, Schatz 2001, POWO 2019). In March 1993, while on a botanical excursion to photograph trees for the book *Field guide to trees of southern Africa* (Van Wyk & Van Wyk 1997), biologist Pieter [Piet] van Wyk (1931–2006) encountered an unfamiliar-looking fruiting tree of *Phyllogeiton* in the corridor between Ndumo Game Reserve and Tembe Elephant Park in the northeastern corner of KwaZulu-Natal, South Africa (*Van Wyk BSA748* in Herbs PRE, PRU). Van Wyk was familiar with typical *P. discolor* elsewhere in its range and shared with one of us (AEvW) his suspicion that the plant he had encountered, although reminiscent of *P. discolor*, may well be a new species of *Phyllogeiton*. One of the unusual features of the taxon pointed out by him was its relatively large, though at the time still immature, fruit that were noticeably ribbed longitudinally.

Around the time that Piet van Wyk questioned the taxonomic identity of the *Phyllogeiton* trees he encountered, it also became clear that the northeastern corner of KwaZulu-Natal (known as Maputaland along with the adjacent part of southern Mozambique) formed part of a biogeographical region rich in restricted-range species of plants and animals, subsequently described as the Maputaland Centre of Endemism (Van Wyk 1994, 1996). This led to a critical appraisal of the taxonomic status of various plant taxa in both the South African and Mozambican parts of Maputaland, including the unfamiliar-looking *Phyllogeiton*, as many species in that region seemed to differ morphologically from their congeners elsewhere. A comparative morphological study and further field work confirmed that what in early field guides covering KwaZulu-Natal was treated as *Berchemia discolor* (e.g. Moll 1981, Pooley 1993), indeed represented an undescribed species endemic to the Maputaland Centre. In 2001 the new species was taken up in the Dendrological Society of South Africa's tree list as *Berchemia sp. nov.* (Von Breitenbach *et al.* 2001). The new species is readily distinguishable from *P. discolor* in the field and has been recognized in a number of subsequent publications (e.g. Coates Palgrave 2002, Boon 2010, Van Wyk & Van Wyk 2013, Du Randt 2018, Schmidt 2018). The purpose of the present paper is to formally describe this new species as *Phyllogeiton trachybasis*.

Materials and methods

The description of the new species was prepared by examining specimens of the following herbaria: BNRH (recently incorporated in Herb. J), K, LMA, NH, NU, PCE, PRE, PRU, SDNH, and UDW (abbreviations according to Thiers 2021). One of us (RGCB) visited the distribution area several times to make field and morphological observations. Additional observations were made from a cultivated specimen at the Silverglen Nature Reserve, Durban, South Africa. Many contributors provided useful information and other assistance (see Acknowledgements). Descriptors used to indicate abundance and frequency follow Schmid (1982).

In the section "Additional collections (paratypes)", locality citations were reproduced as per the specimen labels. In some cases the spelling of the locality name was either corrected or an alternative spelling was provided. The correction or alternative spelling is included in square brackets. Specimens are arranged according to the Degree Reference System proposed by Edwards & Leistner (1971). The quarter degree grid reference is supplied between brackets after each locality cited and collections are ordered from north to south, east to west, and then in date order from the oldest to the newest collection. Some quarter degree grid references were corrected and corrections are included in square brackets. The distribution map was compiled from specimen data using ArcGIS software and the centroid grid values of the quarter degree grid system derived from the localities provided. The original base map is based on the GTOPO30 global digital elevation model, and colours were modified in Global Mapper v6.06.

A preliminary conservation assessment was conducted using the standard procedures based on IUCN guidelines (IUCN 2012, IUCN Standards and Petitions Committee 2019). GeoCAT (Bachman *et al.* 2011) was used to estimate Extent of Occurrence (EOO) and Area of Occupancy (AOO) using a 2 km and 5 km cell width.

Taxonomic treatment

Phyllogeiton trachybasis R.G.C.Boon & A.E.van Wyk, *sp. nov.* (Figs 1–4)

Diagnosis:—Morphologically most similar to *Phyllogeiton discolor* from which it differs particularly by the following characters: bark on the bole of mature trees almost black, very rough, exfoliating in large pieces; leaves fresh green and without a bloom, \pm concolorous, apex acuminate; petals spreading to somewhat ascending at anthesis; fruit oblong-ellipsoid, up to 25×19 mm, exocarp often indistinctly longitudinally ribbed, bright orange-yellow; disc-shaped receptacle at point of fruit stalk's attachment to base of fruit plane.

Type:—SOUTH AFRICA. KwaZulu-Natal: Hluhluwe, Bonamanzi Game Park [Reserve], game lodge car park, (2832AA/AB) [2832AB], 5 March 1996, *Abbott 6929* (holotype PRU: 081091; isotypes NH, PCE).

“*Berchemia sp. nov.*” in Coates Palgrave (2002: 669); Boon (2010: 332); Van Wyk & Van Wyk (2013: 410); Du Randt (2018: 316).

“*Berchemia sp. A*” in Schmidt (2018: 546).

Illustrations: Boon (2010: 333, *Berchemia sp. nov.* one photograph in second row from top, two in third row from the top); Van Wyk *et al.* (2011: 125, *Berchemia sp. nov.*); Du Randt (2018: 317, *Berchemia sp. nov.*); Schmidt (2018: 546, *Berchemia sp. A*).

Semi-deciduous, erect tree up to 12(–15) m tall. *Trunk* single-stemmed and forking below 2.5 m or double-stemmed from near ground level, individual stems up to 0.55 m diam. at breast height (dbh). *Bark* very rough at the base of old trees, flaking in large pieces, flakes very often persistent, dark, almost black, sometimes with pale grey patches of crustose lichen, bark on upper bole and large branches thick, grey, tessellate, revealing dark bark below where peeling, fissured but fairly smooth on young branches. *Heartwood* (from dead branch ca. 130 mm in diam.) yellowish brown with a reddish or pinkish tinge towards the sapwood. *Branchlets* pendent, terete to \pm longitudinally ribbed, smooth, lenticellate, initially green, becoming dark brown and then grey, glabrous. *Stipules* intrapetiolar, base broad, apex acute at first but fugacious, 2–3 mm long, green at first, basal remains becoming dark brown. *Leaves* opposite, sub-opposite (or occasionally alternate), distichous, simple, ovate to broadly elliptic, (35–)55–100(–115) \times (20–)30–40(–50) mm, base rounded, apex broadly acuminate, occasionally acute, very occasionally obtuse, glabrous, firmly chartaceous, glossy, pale green at first, becoming fresh green, slightly paler but without a bloom below and very often with a yellowish tinge, margin entire, undulate, venation craspedodromous, usually slightly impressed above and slightly raised below, yellowish and paler than the lamina, principal lateral veins in (6–)7–9(–10) alternate pairs, tertiary venation minutely reticulate. *Petiole* canaliculate above, (7–)11–12(–20) mm long, glabrous. *Inflorescences* axillary (or terminal), flowers solitary or in 2–5(–7)-flowered sub-fascicles. *Flowers* bisexual, actinomorphic, ca. 8 mm diameter, pedicel ca. 10 mm long, receptacle flattish. *Sepals* 1-seriate, 5, free, ascending at anthesis, ovate to deltate, keeled on the adaxial surface, $3.0\text{--}3.5 \times 2.0\text{--}2.5$ mm, pale green to yellow-green, glabrous. *Petals* 1-seriate, 5, free, alternate with sepals, somewhat spreading to ascending at anthesis, narrow and longitudinally folded upwards to clasp the filament, equal in length to sepals or slightly shorter, base unguiculate, apex cucullate, pale green, glabrous. *Stamens* 5, haplostemonous. *Filaments* inserted under the disc, \pm equal in length to and clasped by the petals, whitish. *Anthers* basifixed, extrorse, whitish. *Ovary* superior, 2-locular, largely enveloped by the swollen, pale yellow disc, style apex 2-fid. *Fruit* a drupe, remains of disc and receptacle prominent at the base, oblong-ellipsoid, often faintly ribbed longitudinally, this being more pronounced in young and dry fruit, $18\text{--}25 \times 16\text{--}19$ mm, but often narrower (from ca. 12 mm) in dried material, receptacle at point of fruit stalk's attachment to base of fruit disc-shaped and plane, exocarp glabrous, green ripening bright orange-yellow, mesocarp fleshy, endocarp woody, stone ellipsoid-ovoid, $15\text{--}20 \times 10\text{--}12$ mm.

Phenology:—Flowering is mainly in spring from late October to early December at the same time that the new leaves are produced. Fruits are present from November to May and begin ripening in March.

Distinguishing characters:—The new species is frequently confused with *Phyllogeiton discolor*, but the two species' ranges are allopatric with a gap of ca. 300 km between the closest populations. *Phyllogeiton trachybasis* is easily distinguished from *P. discolor* by usually growing on dry, sandy soils (*vs.* usually adjacent to rivers or on termitaria), bark on the bole of mature trees almost black, very rough, exfoliating in large pieces (*vs.* grey-brown, rough, tessellated), branchlets and leaves glabrous (*vs.* glabrous or minutely and densely pubescent; on leaves pubescence

mainly on the abaxial surface, but the adaxial surface may also be minutely pubescent about the midrib), leaf blade fresh green, without a bloom, \pm concolorous (*vs.* dark green, distinctly paler with a greyish bloom below), leaf apex acuminate (*vs.* acute to obtuse), petals spreading to somewhat ascending at anthesis (*vs.* spreading to reflexed), fruit oblong-ellipsoid (*vs.* slightly or markedly ovoid), up to 25 \times 19 mm (*vs.* up to 20 \times 11 mm), exocarp often indistinctly longitudinally ribbed (*vs.* plane), bright orange-yellow, even when overripe (*vs.* yellow but very often pale yellow; often brownish yellow when overripe), and disc-shaped receptacle at point of fruit stalk's attachment to base of fruit plane (*vs.* concave).

Etymology:—The specific epithet “*trachybasis*” is derived from the Greek *τραχύς*, *trachys*, rough or shaggy, and *βάσις*, *basis*, base or pedestal, referring to the bark towards the base of the trunk in old trees that becomes very thick, rough and flaking in large pieces (Figs 1 & 2A–D). The epithet is used here as a noun in apposition: “the shaggy base” and therefore does not necessarily agree in gender with the genus name.

Distribution:—*Phyllogeiton trachybasis* is only known with certainty from the southern part of the Maputaland Centre of Endemism, an area rich in restricted-range plants and animals (Van Wyk 1996, Van Wyk & Smith 2001). The Maputaland Centre is at the southern end of the tropics in Africa (Van Wyk 1996) and at the northern end of the Maputaland-Pondoland-Albany Hotspot, one of 36 global biodiversity hotspots (Steenkamp *et al.* 2004).

Within the Maputaland Centre, *P. trachybasis* is known from 10 localities in KwaZulu-Natal (Fig. 5). These localities range from Hluhluwe and Lake St Lucia in the south to Tembe Elephant Park and Ndumo Game Reserve just south of the South African and Mozambican border in the north.

There are no specimens of *P. trachybasis* at the Institute for Agricultural Research of Mozambique herbarium (LMA) and its presence in Mozambique needs confirmation. The species is, however, almost certainly present in the far south of Mozambique's Maputo Province considering that trees of the new species were found in Tembe Elephant Park on the South African side directly next to the border between the two countries. A sight record (E. Schmidt, pers. comm.) and information supplied by a traditional healer (C. Hanekom, pers. comm.) suggest that it may occur at the Maputo Special Reserve south of Maputo, but confirmation is required.

Two other possible localities for the new species should be mentioned. The first is ca. 60 km from Caia in Sofala Province, Mozambique, on the EN1 route to Gorongosa (grid 1834BA), where a sterile specimen (*J.E. & S.M. Burrows 8807* in Herb. BNRH) was collected by botanists familiar with the tree. This location is nearly 1000 km north of confirmed localities in KwaZulu-Natal. The second locality is near Siteki in Scarp Forest at an elevation of 450 m in the Lebombo [Lubombo] Mountains of Eswatini (formerly Swaziland), about 40 km north of Ndumo Game Reserve (grid 2631BD). A specimen collected here (*P. & L. Loffler s.n.* in Herb. BNRH) and photographs supplied by L. Loffler appear to match *P. trachybasis*, but the five trees seen were all sterile. Another collection from this same locality is also sterile (*Schmidt 4054* in Ernst Schmidt Private Herbarium). Given that these specimens lack reproductive material, the presence of the species in Mozambique and Eswatini still needs to be confirmed.

Ecology:—*Phyllogeiton trachybasis* is a sub-canopy or canopy tree found mainly on well-drained, deep sandy soils at low elevations to about 100 m above sea level. Trees grow mainly in Tembe Sandy Bushveld (SV1 18) in open to closed woodland (codes of vegetation types follow Mucina & Rutherford 2006 and SANBI 2006–2018). They also grow in Sand Forest (FOz 8) patches in a mosaic with Tembe Sandy Bushveld (Fig. 1). The species may also occur in Western Maputaland Sandy Bushveld (SVI19) at Ndumo Game Reserve, but information recorded on collecting labels is insufficient to confirm its presence in this vegetation type.

Phyllogeiton trachybasis has also been collected between Cape Vidal and Lake Sibaya in dune forest, which is included in the broader category Northern Coastal Forest (FOz 7). The most recent of these collections was in 1997, but the demographics of the species in dune forest are unknown.

Besides its normal sandy habitat, the species was collected once (*Moll 5291* in Herbs K, NH, PRE) in 1971 from riverine forest embedded in Zululand Lowveld (SV1 23). This was on the Mansiya River in the Hluhluwe-iMfolozi Park where the presence of eight trees growing in the river's floodplain was recently confirmed (F. du Randt, S. Louw, and S. Mabongwa, pers. comm.). The new species also apparently occurs occasionally in Scarp Forest (FOz 5). It was collected in this forest type in 1959 in the Hluhluwe-iMfolozi Park on a steep, southwest-facing rocky slope at an elevation of about 500 m (*Ward 2947* in Herb. NU). A visit by F. du Randt, S. Louw, and S. Mabongwa on 18 May 2021 to try and relocate this plant or plants was unsuccessful.

Flowers are visited by honey bees. The fruit is eaten by birds, notably Trumpeter Hornbills, *Bycanistes bucinator* Temminck (1824: livr. 48, pl. 284), at Nibela and Vervet Monkeys, *Chlorocebus pygerythrus* Cuvier (1821: 2) (Pooley 1978, C. Hanekom, pers. comm.), although at Nibela it is reported that monkeys and people don't feed on the fruit (G. Linforth, pers. comm.).



FIGURE 1. *Phyllogeiton trachybasis*, habit and habitat. Mature tree in Sand Forest at Bonamanzi Game Reserve, Hluhluwe, KwaZulu-Natal, South Africa. Photograph: R.G.C. Boon.



FIGURE 2. *Phyllogeiton trachybasis*, bark morphology illustrating variation (A–D) and colour of the wood (E). **A.** Bark on trunk of old, mature tree. **B.** Bark on trunk of relatively young tree (sunny habitat). **C.** Bark on trunk of relatively young tree (shady habitat). **D.** Exceedingly rough and flaking bark on trunk of mature tree. **E.** Finely sanded, untreated wood in transverse section; from dead branch \pm 130 mm in diameter. Photographs: R.G.C. Boon (A, D), F. du Randt (B, C), & D. Bishop (E).

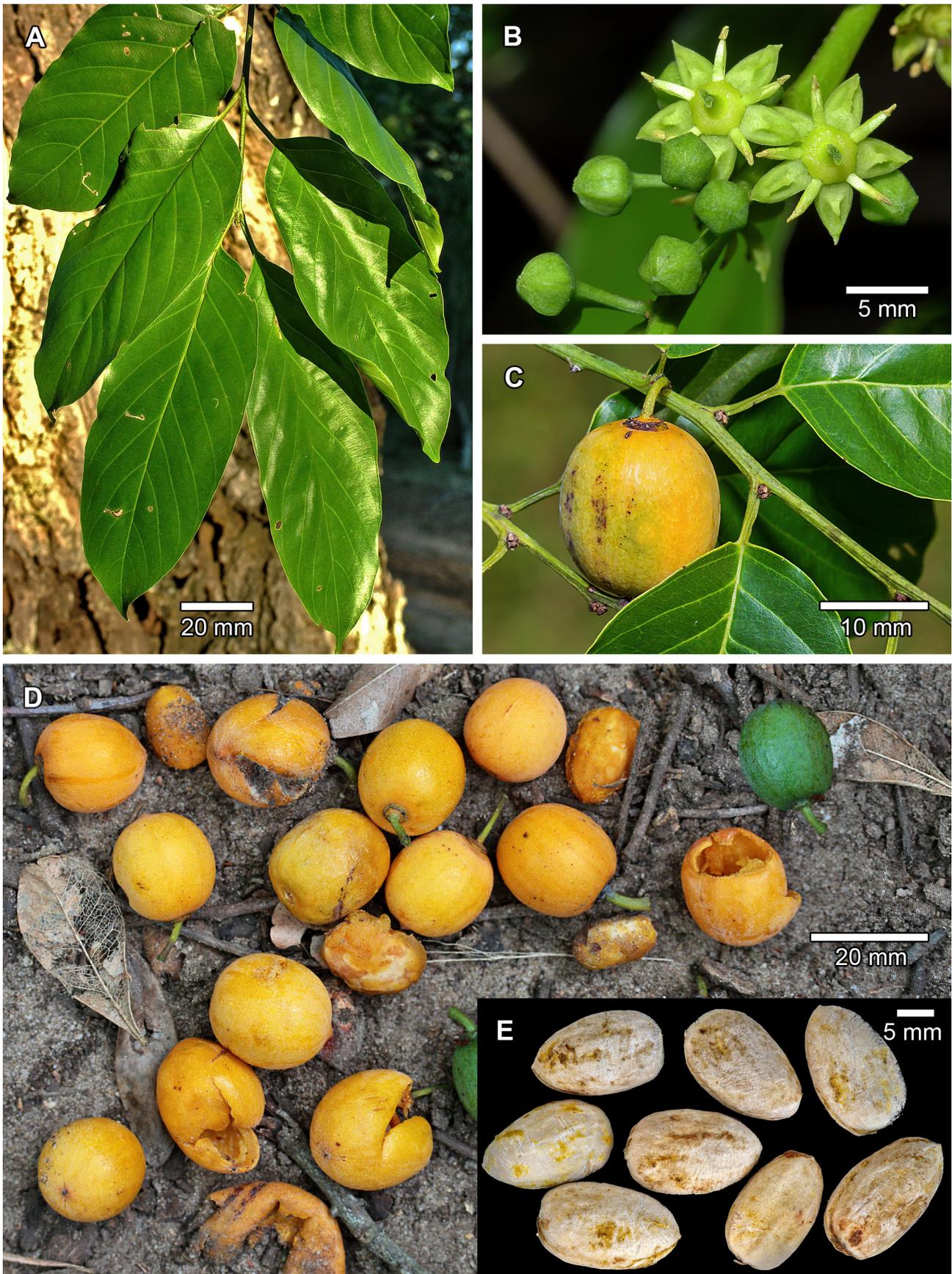


FIGURE 3. *Phyllogeiton trachybasis*, leaf, flower and fruit morphology. **A.** Branchlet with leaves, the latter fresh green, without a bloom and ca. concolorous. **B.** Flowers, open and in bud. **C.** Almost ripe fruit. **D.** Mainly ripe fallen fruits underneath a tree, some with stone removed or otherwise damaged by wildlife. **E.** Cleaned stones. Photographs: R.G.C. Boon (A, C, D), G. Nichols (B), & E. Douwes (E).

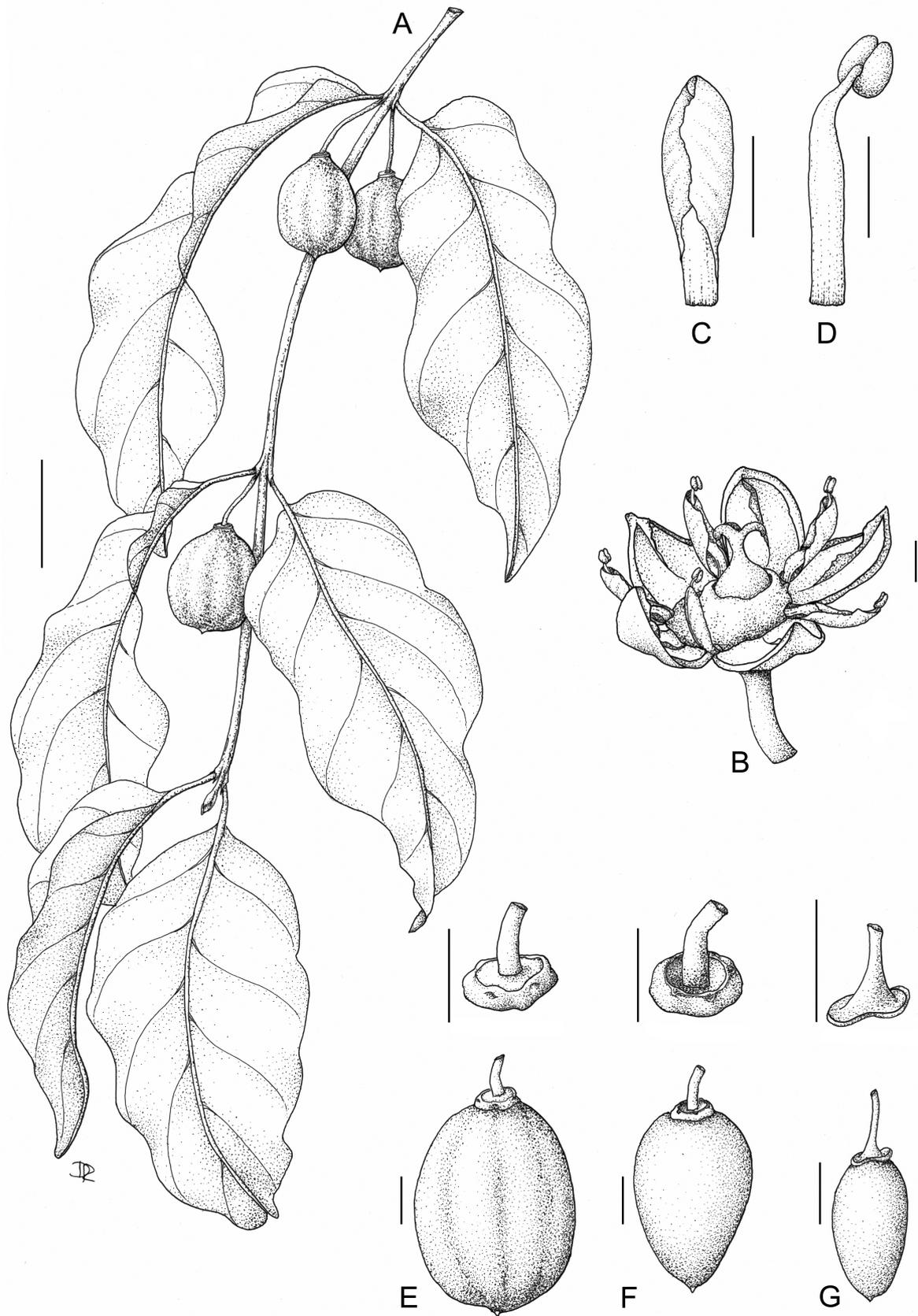


FIGURE 4. *Phyllogeiton trachybasis* (A–E), with fruit of *P. discolor* (F) and *P. zeyheri* (G). **A.** Fruiting branchlet (fruit almost mature). **B.** Flower. **C.** Petal. **D.** Stamen. **E–G.** Comparison of the fruit (bottom) of the three species of *Phyllogeiton*, with corresponding enlarged persistent receptacle and fruit stalk (top). Scale bar = 10 mm (A), 1 mm (B–D), or 4 mm (E–G). Drawings based on photographs and liquid-preserved fresh material deposited in Herb. PRU. Artist: Daleen Roodt.

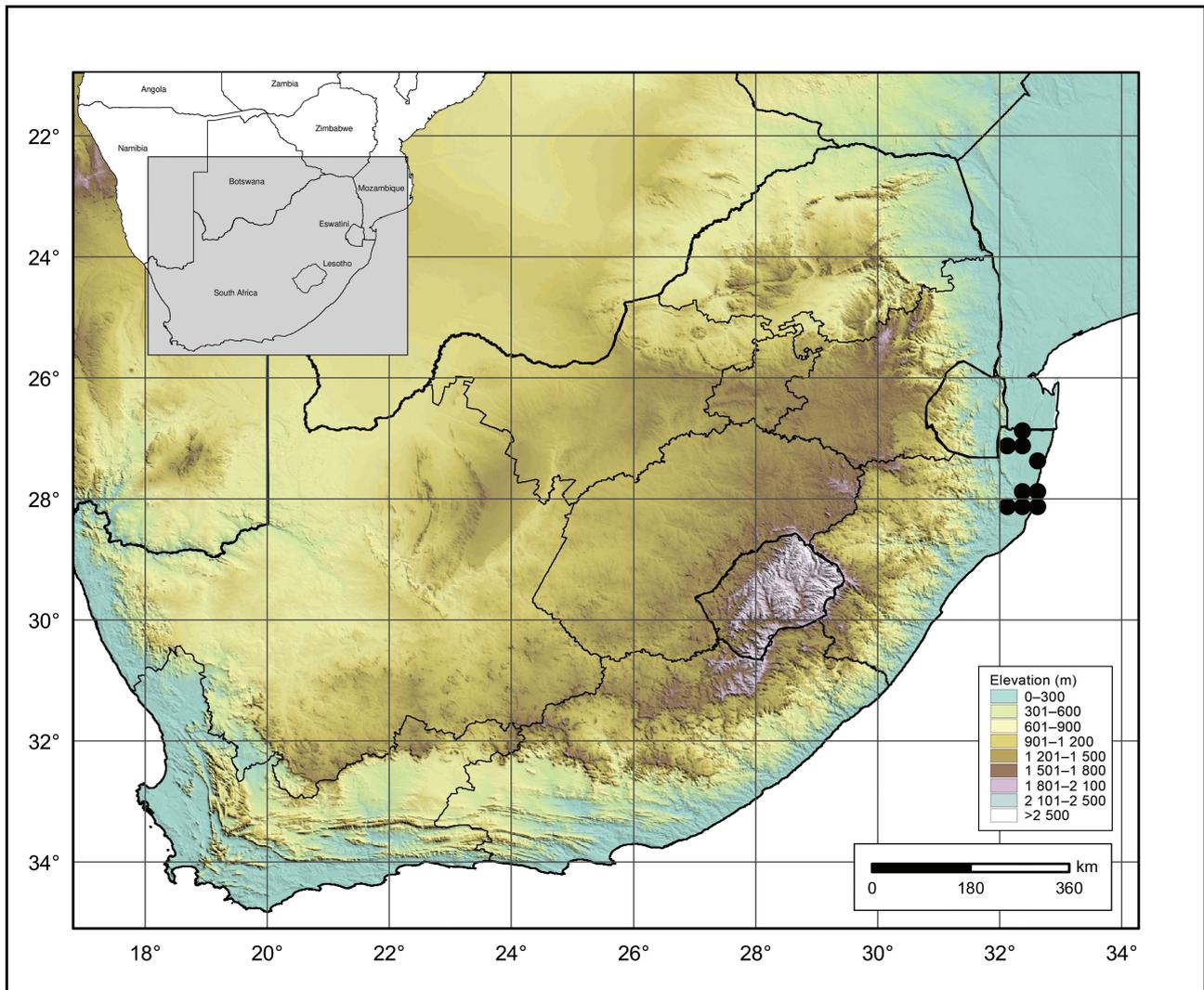


FIGURE 5. Topographical map showing the known distribution (black dots) of *Phyllogeiton trachybasis* in northeastern KwaZulu-Natal, South Africa. Map based on herbarium collections in BNRH, K, NH, NU, PCE, PRE, PRU, and UDW. The insert shows a map of southern Africa with names of countries; the grey rectangle indicates the area depicted by the topographical map.

African Elephants, *Loxodonta africana* Blumenbach (1797: 125), damage trees and this has killed at least one tree at Tembe Elephant Park (C. Hanekom, pers. comm.). Nyala antelope, *Tragelaphus angasii* Angas (1849: 89), quickly removed fresh leaves from a cut branch at Bonamanzi Game Reserve (D. Bishop, pers. comm.) and are therefore suspected to browse on low-growing plants of the species.

No young plants are known in the wild, but the species is, despite the hard endocarp of the stone, easy to grow without any special treatment besides removal of the fleshy part of the pericarp (G. Nichols, pers. comm.). Possible reasons for the apparent lack of recruits are herbivory, disease or that conditions suitable for germination and establishment on sandy soils are rare.

The tree is an occasional host to the epiphytic orchids *Ansellia africana* Lindley (1844: sub t. 12) and *Polystachya concreta* (Jacquin 1760: 30) Garay & Sweet (1974: 206).

Common names:—English and Afrikaans names in use include “sand ivory” and *sandivoor* respectively. These are also the names recommended by the Dendrological Society of South Africa (Von Dürckheim *et al.* 2014).

There are several Zulu names recorded for *Berchemia discolor* in literature pertinent to KwaZulu-Natal (Pooley 1980, Moll 1981, Pooley 1993, Hutchings *et al.* 1996). These names are likely to be applicable to *P. trachybasis*. The name *ubalatsheni* or *ubaletsheni* is recorded in all of these publications and means “marks” or “make marks on the stone or rock” (A. Koopman, pers. comm.). Semantic links to the names *umuma* and *umumu* (Moll 1981, Pooley 1993, Hutchings *et al.* 1996), *uvuka* (Pooley 1993, Hutchings *et al.* 1996), and *umbenduza* (*Tinley 416B* in Herbs NH, NU, PRE) are not clear (A. Koopman, pers. comm.). A herbarium specimen collected at Lake Sibaya bears the name

umadlozane (Cunningham 2200 in Herb. NU), which is derived from the word *amadlozi* and refers to ancestral spirits (A. Koopman, pers. comm.).

The name *umhungu* is used at Nibela, which is at the northern end of Lake St. Lucia near Hluhluwe (G. Linforth, pers. comm.). This name and the similar *umhungulo* (Gerstner 5222 in Herb. PRE) and *umhlungulo* (Hutchings *et al.* 1996) probably mean enticing, alluring, and deceiving (A. Koopman, pers. comm.).

In far northern KwaZulu-Natal an informant, M. Tembe, reports that the names *vukakwabafileyo* or *vukakwabafile* are used (C. Hanekom, pers. comm.). These names mean “to wake up at the place of those who have died” or “arise from the cemetery”, but A. Koopman (pers. comm.) suggests that their correct form may be *vusabafileyo*, which means “wake up the dead or unconscious”.

Conservation status:—The EOO of *P. trachybasis* was estimated at 5951 km². The AOO calculated was 60 km² for the 2 km cell width recommended by the IUCN Standards and Petitions Committee (2019) and 350 km² for a 5 km cell width. The actual AOO probably lies at the lower end of this range, because even the 2 km² cell width includes aquatic environments and unsuitable, degraded or transformed terrestrial habitats. The distinct bark of *P. trachybasis* also means that accessible specimens are unlikely to be overlooked.

The species occurs in 10 severely fragmented populations as defined by the IUCN (2012). *Phyllogeiton trachybasis* may occur in patches too small to support a viable population in the long-term and sub-populations are separated from other suitable habitat by large distances, thus genetic or demographic exchange seems unlikely.

There are 70 known mature individuals in the six sub-populations surveyed during field work, namely at Bonamanzi Game Reserve (35 trees), Tembe Elephant Park and surrounds (15 trees), Hluhluwe-iMfolozi Park (8 trees), Nibela Peninsula (8 trees), False Bay Park (2 trees), and Phinda Private Game Reserve (2 trees). At least eight of these trees are in poor condition and appear to be dying and no young plants (< 10 years old) are known. The smallest (and presumably youngest) known plant is at Bonamanzi Game Reserve and is 4 m tall and has a dbh of 70 mm. The sub-population sizes at Ndlozi Peninsula, Lake Bhangazi South, Sodwana Bay, and Ndumo Game Reserve are unknown. Even if known trees represent only about 10% of the species’ total population, there are likely to be fewer than 700 trees in the wild.

Phyllogeiton trachybasis appears to be almost entirely confined to protected areas. Bark of the few trees growing outside of these areas is heavily used for medicinal purposes, the removal of which kills individuals or limits growth (Cunningham 2200 in Herb. NU; L. Loffler, G. Linforth, C. Hanekom, pers. comm.). Even within some protected areas trees may not be safe from harvesting (Groenewald 2010) or they may be damaged or killed by elephants (C. Hanekom, pers. comm.). It is probable that the current scarcity of trees resulted, at least in part, from the excessive stripping of bark for use in traditional medicine (locally referred to by the generic term *umuthi*, also spelled *muti* or *muthi*) over many years (see under “Uses” below).

Taking into account that the overall number of mature individuals is small, the known sub-populations are very small and the population is declining due to natural mortality, harvesting and lack of recruitment, application of the IUCN Red List Categories and Criteria (IUCN 2012) suggest that the species should be classified as Endangered (EN) B2(v); C2a(i); D. There is an urgent need to survey populations more fully and to try and establish and address the reasons for the lack of recruitment.

Uses:—On the oldest known herbarium specimens of the species (Gerstner 5222 in Herb. PRE), collected at False Bay Park in 1944, it is recorded that a tree had 90% of its bark removed by traditional healers. The label of another specimen collected in 1993 in the corridor between Ndumu Game Reserve and Tembe Elephant Park (Van Wyk BSA748 in Herbs PRE and PRU) reads: “This is a ‘muti’ tree. The old trunk (about 1 m high) is regularly stripped of its bark—in patches”. A collection from dune forest at Lake Sibaya (Cunningham 2200 in Herb. NU) also records that the bark is heavily utilised for medicinal purposes. Trees which may belong to this species observed at Siteki, Eswatini (see under “Distribution” above) were debarked. Bark and the roots are heavily utilised east of Tembe Elephant Park and according to a local resident are mixed with material from other species to treat chest ailments (C. Hanekom, pers. comm.). There are few surviving trees in the community area surrounding Nibela at Lake St. Lucia because they have all been debarked and the majority have already died (G. Linforth, pers. comm.). At Nibela evil spirits are believed to be extracted by boiling and steaming bark, and fruit is used to treat impotence (G. Linforth, pers. comm.). At nearby False Bay Park, bark is used as a love charm (Hutchings *et al.* 1996).

There are no records of the fruit being eaten by humans, which is surprising as the fruits of other *Phyllogeiton* species are popular (e.g. Pooley 1980, Van Wyk & Gericke 2000), with fruit of *P. discolor* even having potential in terms of commercialisation and domestication (Lusepani 1999).

Additional collections (paratypes):—SOUTH AFRICA. **KwaZulu-Natal:** Ndumu [Ndumo] Game Reserve, (2632CD), 9 May 1956, *Hancock 9* (NU!); Ndumu [Ndumo] Game Reserve, (2632CD), 23 February 1959, *Tinley*

416B (NH!, NU!, PRE!); 3 miles S of Makane's Drift, (2632CD), 28 February 1968, *Ross & Moll 1820* (PRE!); Ingwavuma District, Ndumu [Ndumo] Game Reserve, Matini Forest, E. area, (2732AA), 8 February 1964, *Tinley 943* (NH!, NU!); Makatini Flats, Makani's [Makane's] Pont, (2732AA), 26 February 1968, *Venter 4614* (PRE!); Corridor between Ndumu [Ndumo] and Tembe, (2732AB), 15 March 1993, *Van Wyk BSA748* (PRE!, PRU!); Jobe's Kraal, (2732AA), 16 May 1999, *Schmidt 2406* (Ernst Schmidt Herbarium!); Sihangwane Nature Conservation Camp, (2732AB), 9 November 1981, *Cunningham 518* (NU!); Tembe Elephant Park, (2732AB), 23 April 1995, *Van Wyk 12786* (PRU!); Tembe Elephant Reserve [Park], (2732AB), 23 October 1995, *Nichols, Kruger & Symmonds s.n.* (NH!); Tembe Elephant Park, (2732AB), 13 February 1996, *Prozesky 50* (PRU!); Tembe Elephant Park, (2732AB), 10 October 1997, *Matthews 1304* (PRU!); Tembe Elephant Reserve [Park], (2732AB?), 17 January 1999, *Schmidt 2185* (Ernst Schmidt Herbarium!); Tembe Elephant Park, (2732AB), 30 March 2011, *Wright 1* (PRU!); Amanzimnyama Pan area, Lake Sibayi [Sibaya], (2732BC), 15 January 1958, *Tinley 59* (NH!, PRE!); E. side Lake Sibayi [Sibaya], (2732BC), 28 November 1967, *Nicholson 621* (NH!); Sibaya Lake, (2732BC), 28 November 1967, *Strey & Moll 3977* (K!, NH!, PRE!); E. Shores Lake Sibayi [Sibaya], (2732BC), 26 October 1971, *Moll & Nel 5618* (K!, NH!, PRE!); Lake Sibayi [Sibaya], (2732BC), 20 January 1987, *Cunningham 2200* (NU!); False Bay Park, (2732CD), 28 June 1971, *Ward 7114* (NH!, NU!, PRE!, UDW!); False Bay, birds sanctuary, (2732DC), December 1944, *Gerstner 5222* (PRE!); Sodwana State Forest, (2732DC), 16 June 1985, *Gordon 203* (NH!); Sodwana State Forest, south of Air Force camp, (2732DC), 22 December 1985, *Gordon 259* (NH!, PRE!); False Bay Park, near the end of the Mphophomeni Trail, (2732DC), 30 April 2014, *Boon 63* (NH!); Hluhluwe Game Reserve, (2832AA), 7 January 1956, *Ward 2947* (NU!); Hluhluwe Game Reserve, (2832AA), 28 November 1959, *Ward 3327* (PRE!, NU!); Hluhluwe Game Reserve, Monsia [Mansiya] River, (2832AA), 2 March 1971, *Moll 5291* (K!, NH!, PRE!); Bonamanzi Game Ranch [Reserve], 10 km S of Hluhluwe, (2832AA), 22 February 1994, *Abbott 6317* (PCE!, PRU!); Bonamanzi Game Ranch [Reserve], 10 km ESE of Hluhluwe, (2832AA) [2832AB], 5 November 1994, *Abbott 6498* (PCE!, PRU!); Hluhluwe, Bonamanzi Game Park [Reserve], on left of road 150 m beyond Game Lodge turnoff, (2832AA), 5 March 1996, *Abbott 6930* (PCE!, PRU!); Hluhluwe, Bonamanzi Game Ranch [Reserve], (2832AA), 5 March 1996, *Abbott 6931* (PRU!); Hluhluwe, Bonamanzi Game Ranch [Reserve], (2832AA), 5 March 1996, *Abbott 6932* (PRU!); Hluhluwe, Dlozi (or Dhlozi) Plantation, Hlabisa District, (2832AB), 16 January 1963, *Dutton 88* (NH!, NU!); North Coast, St. Lucia system (sensu lato), Lake Bhangazi (South) area, eastern side of lake, 15 February 1997, (2832BA), *Ward 13915* (NH!).

Notes and key to the species of *Phyllogeiton*:—*Phyllogeiton trachybasis* is morphologically most similar to *P. discolor* (Fig. 6), but the species' known ranges are allopatric and *P. trachybasis* is for now considered to be endemic to the Maputaland Centre of Endemism, as well as to KwaZulu-Natal. *Phyllogeiton discolor* has not been collected from KwaZulu-Natal nor has it been recorded from Eswatini (Loffler & Loffler 2005, L. Loffler, pers. comm.). A specimen at Herb. SDNH (*Compton 28939*) tentatively identified as *Berchemia discolor* is of *P. zeyheri* (Fig. 7). There is one correctly labelled *P. discolor* specimen at LMA from the southern part of Mozambique (covered by the provinces of Maputo, Gaza and Inhambane). This specimen was collected at Massingir in Gaza (*Lousã & Rosa 301*), which is about 325 km north of the nearest known *P. trachybasis* plants in KwaZulu-Natal. Specimens at Herb. LMA labelled *B. discolor* from Catuane, which is in Mozambique just north of Ndumo Game Reserve in KwaZulu-Natal, and Namaacha (west of Maputo near the border with Eswatini) are misidentified collections of *P. zeyheri*.

The habitat of the new species and *P. discolor* also differs. *Phyllogeiton trachybasis* prefers sandy soils of Early to Late Pleistocene coastal dunes (Van Wyk & Smith 2001), although it has also been collected from Scarp Forest and once from riverine forest. *Phyllogeiton discolor* also occurs in bushveld (savanna), but is usually found on river banks or termitaria (Coates Palgrave 2002, Schmidt 2018). The two species differ in a number of morphological features including bark, leaf shape, sepal and petal position at anthesis, and fruit size, shape and colour. In addition, *P. trachybasis* has ± concolorous leaves without any bloom and the fruit are often faintly longitudinally ribbed, whereas *P. discolor* has leaves that are distinctly paler due to the presence of a greyish bloom and the fruit surface is plane. Further distinctions, also from *P. zeyheri*, are supplied in the identification key below.

Phyllogeiton discolor (Fig. 6) and *P. zeyheri* (Fig. 7) differ markedly in the colour and fluorescence of their hardwood (Dyer 1988, Dyer *et al.* 2016), a distinction reflected in their English and Afrikaans common names. Known as “red ivory”/*rooi-ivoor*, the heartwood of *P. zeyheri* ranges in colour from pale pink to various shades of bright red and is much sought-after for making furniture and curios (Dyer *et al.* 2016). On the other hand, the heartwood of *P. discolor* (“brown ivory”/*bruinivoor*) is yellowish brown to deep reddish brown. Heartwood of both species fluoresce when viewed under longwave ultraviolet light (ca. 365 nm), a distinction that has been successfully used to confirm the identification of commercial consignments of these two woods (Dyer 1988). *Phyllogeiton zeyheri* has a characteristic orange fluorescence, while *P. discolor* fluoresces with a green colour. Because of its rarity, the colour and fluorescence of the mature heartwood of *P. trachybasis* still needs to be established with certainty. Heartwood in a transverse section

of a long-dead branch (ca. 130 mm in diameter) of this species (Fig. 2E) is yellowish brown with a reddish tinge towards the sapwood, thus bearing a close resemblance to the heartwood of *P. discolor*. The narrow sapwood in this particular branch was bleached to a greyish colour by exposure to the elements and was also extensively damaged by wood boring insects.

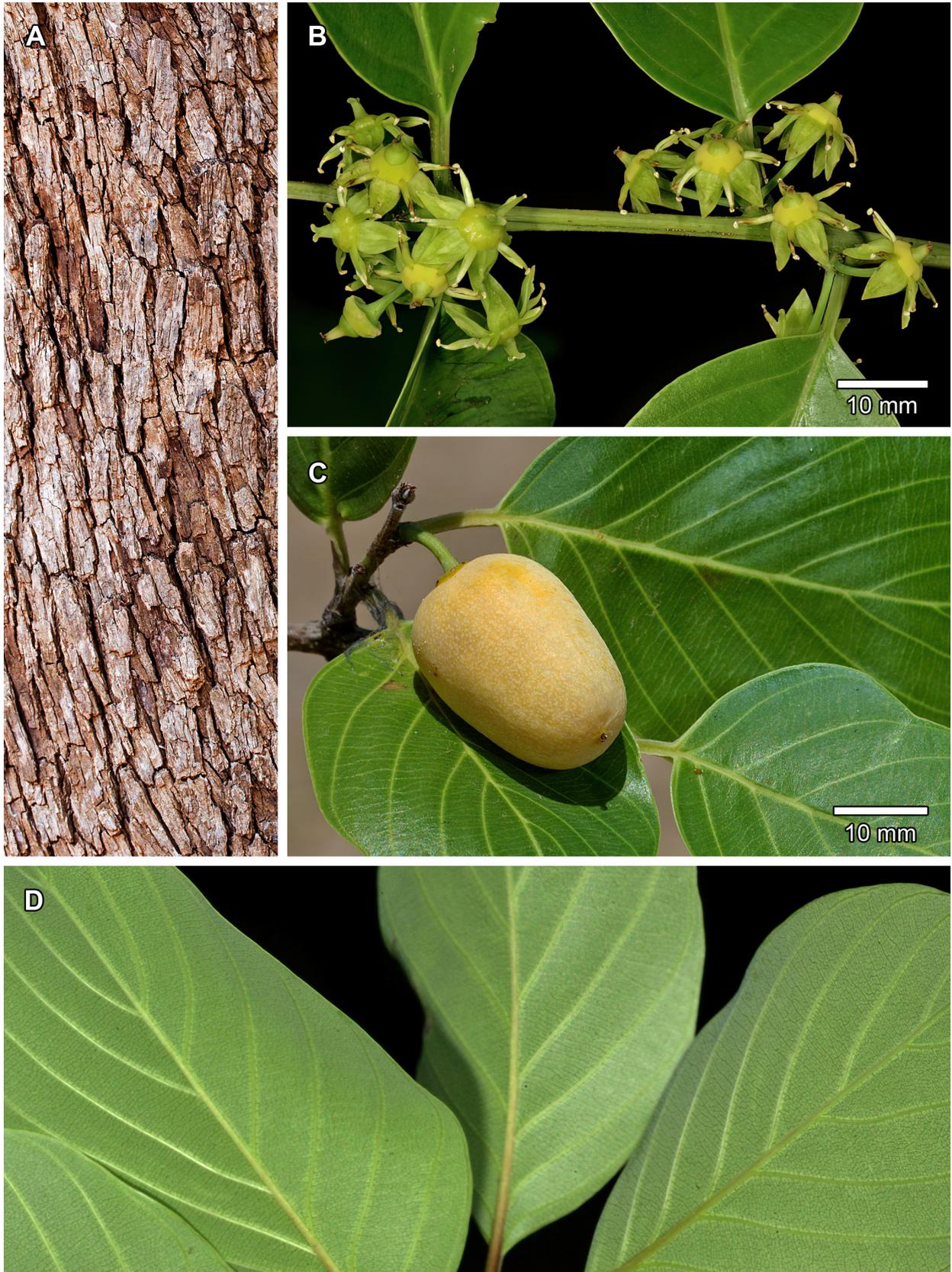


FIGURE 6. *Phyllogeiton discolor*. **A.** Mature bark pattern. **B.** Flowers. **C.** Fruit; note leaves with upper surface of blade glossy and dark green. **D.** Leaves viewed from below, showing a greyish bloom. Photographs: R.G.C. Boon (A, C) & A.E. van Wyk (B, D).

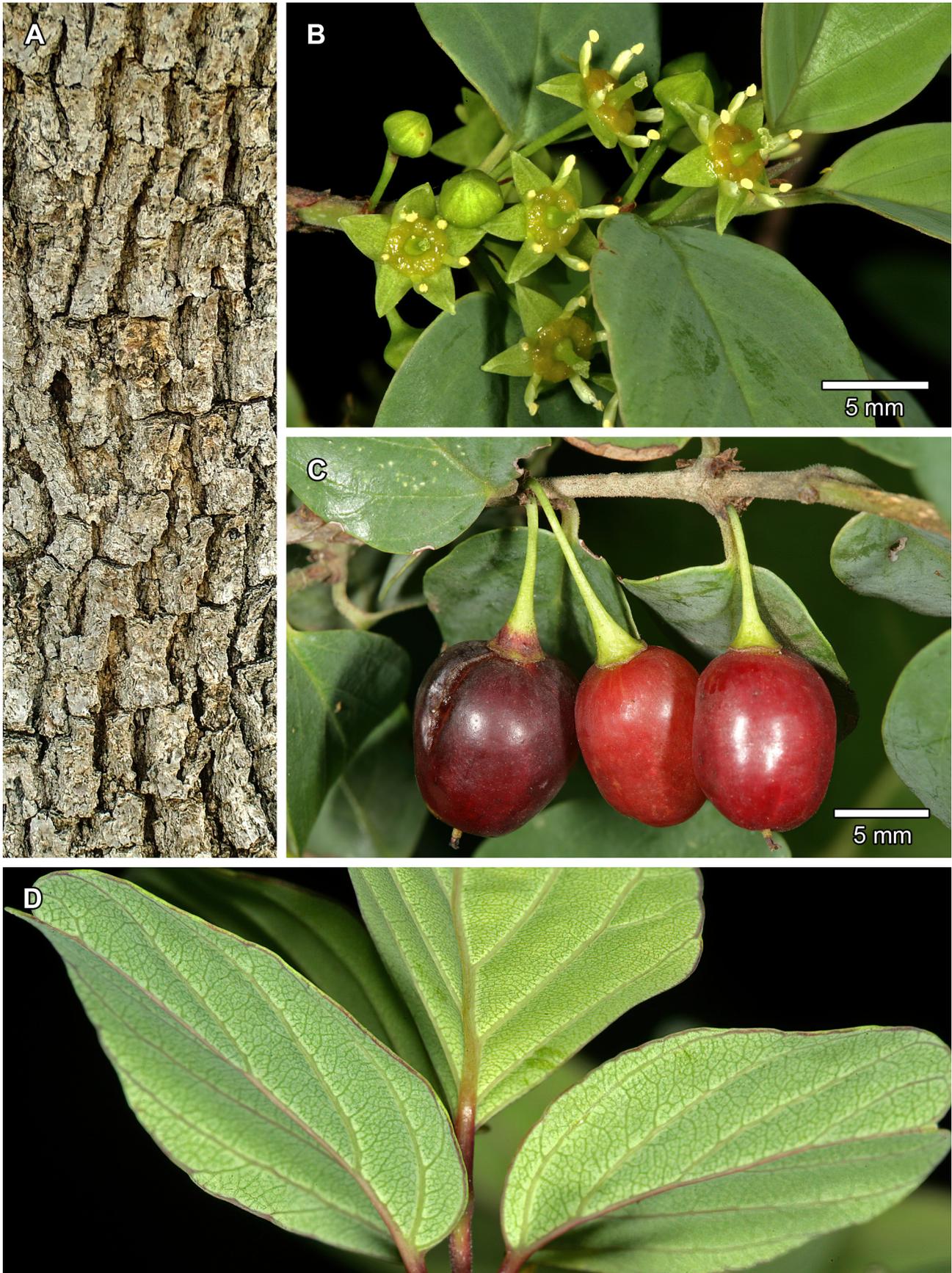


FIGURE 7. *Phyllogeiton zeyheri*. **A.** Mature bark pattern. **B.** Flowers; note leaves with upper surface of blade dull and with a greyish bloom. **C.** Fruit. **D.** Leaves viewed from below, showing a greyish bloom similar to that of the upper surface. Photographs: R.G.C. Boon (A) & A.E. van Wyk (B–D).

Two herbarium collections of *P. trachybasis* refer to ripe purple fruit (*Moll 5291* in Herbs K, NH, PRE) and pink fruit (*Gordon 259* in Herbs NH, PRE). These observations are curious because in all other collections where fruit colour is mentioned it is recorded as yellow, which matches known images and our own field experience with the species.

The conservation outlook for *P. trachybasis* seems poor. There are few known trees, the overall population is fragmented, most sub-populations consist of few individuals, a number of trees are dead or in poor health, and there is an apparent lack of recruitment. Given these population demographics and the excessive and destructive harvesting of bark, traditional biocultural uses of the species are clearly unsustainable. Conservation actions should include ensuring that trees in protected areas are not harvested, supplementing populations with cultivated specimens, and testing whether plants will recruit where browsing mammals are excluded. There is also a need to assess the current situation with trees in the dune forest between Lake Sibayi and Cape Vidal and the population at the Dlozi Peninsula in the iSimangaliso Wetland Park.

Identification key to the species of *Phyllogeiton*

1. Leaf blade usually to 40 × 25 mm; flowers with ovary not immersed in disc; fruit ripening red (very often yellowish in immature fruit), to ca. 13 × 5 mm; receptacle at point of fruit stalk's attachment at base of fruit markedly convex (see Figs 4G & 7C) *P. zeyheri*
- Leaf blade usually to 100 × 40 mm; flowers with ovary immersed in disc; fruit ripening pale yellow, yellow, orange-yellow or brownish yellow, >13 × 5 mm; receptacle at point of fruit stalk's attachment at base of fruit plane or markedly concave (see Figs 4E & F) 2.
2. Bark towards base of trunk on mature trees very rough, flaking in large patches, almost black (sometimes with pale crustose lichen); leaves fresh green and without a bloom, ± concolorous, apex acuminate; flowers with petals spreading to ascending at anthesis; fruit usually ellipsoid, very often slightly ribbed longitudinally, rich orange-yellow, to 25 × 19 mm; receptacle at point of fruit stalk's attachment at base of fruit plane (see Fig. 4E); currently known with certainty only from KwaZulu-Natal, South Africa (Maputaland Centre of Endemism) *P. trachybasis*
- Bark towards base of trunk on mature trees rough, grey-brown, if flaking then in small patches; leaves dark green, distinctly paler with a greyish bloom below, apex acute to obtuse; flowers with petals reflexed at anthesis; fruit usually ovoid, surface plane, pale yellow to yellow, often turning brownish yellow when overripe, to 20 × 11 mm; receptacle at point of fruit stalk's attachment at base of fruit markedly concave (see Fig. 4F); widespread, from southern through central, eastern and northeastern Africa to Arabia, also in Madagascar, but not yet recorded in KwaZulu-Natal, South Africa *P. discolor*

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