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A new species of *Rhodomyrtus* (Myrtaceae) with brochidodromous venation from north-eastern Queensland, Australia

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Abstract

Rhodomyrtus verecunda A.J.Ford & Peter G.Wilson from north-eastern Queensland, Australia, is formally described and illustrated. Notes on habitat, distribution and conservation status are provided, as are details of how it is distinguishable from *R. macrocarpa*, the only other non-acrodromous species of the genus in the region. A revised key to the species of *Rhodomyrtus* in Australia is also presented.

Introduction

The genus *Rhodomyrtus* (DC.) Rchb. (Myrtaceae) is distributed from India and eastwards through southern Asia to New Caledonia and the Solomon Islands, including eastern Australia (Snow *et al.* 2008). When Scott (1978) revised the genus there were 11 species with several infraspecific taxa recognised. The total number of species has grown steadily since then and it currently stands at 23 species (Snow and Cantley 2010). The island of New Guinea is seen as the centre of diversity (13 spp.), followed by Australia with seven species (Snow *et al.* 2011).

Rhodomyrtus has traditionally been assigned to a broadly defined subtribe Myrtinae within the tribe Myrteae, based on the occurrence of seeds with a hard, bony testa and C-shaped or spiral embryos (e.g. Landrum and Kawasaki 1997). More recently, however, Lucas *et al.* (2019) proposed a new subtribal classification for the Myrteae, with *Rhodomyrtus* and many other Australasian genera (e.g. *Archirhodomyrtus* (Nied.) Burret, *Decaspermum* J.R. & G.Forst., *Gossia* N.Snow & Guymer, *Pilidiostigma* Burret and *Rhodamnia* Jack) placed in a new subtribe Decasperminae E.Lucas & T.Vasc.

The likelihood that *Rhodomyrtus* is not a single lineage has been considered in the literature by several authors (e.g. Wilson *et al.* 2005, Wilson 2011 and Snow *et al.* 2011), with the consensus being that it is probably polyphyletic. However, despite morphological data strongly suggesting polyphyly, current molecular analyses, based on ITS data only, are inconclusive (Snow *et al.* 2011). These molecular analyses show species of *Rhodomyrtus* clustered in two clades intermixed with species of *Octamyrtus* Diels, *Kanakomyrtus* N.Snow and *Archirhodomyrtus*.

Morphological characters thought to be diagnostic of *Rhodomyrtus* by many authors (e.g. Scott 1978, Guymer 1991) have included: 5-merous flowers, axile placentation, baccate fruit and seeds with a sclerotic outer testa separated by a false septa. However, the enigmatic *Rhodomyrtus macrocarpa* Benth. has an ovary reduced to a single loculus with parietal placentation. In the morphology-based phenogram of Snow *et al.* (2011, Fig. 1, p. 393), *R. macrocarpa* is surprisingly sister to *Kanakomyrtus dawsoniana* N.Snow despite the significant floral morphological differences between the two.

Photographs of mature fruit from an unusual species of Myrtaceae from the Cape Tribulation area of north-east Queensland were sent to the first author by Tim Hawkes for identification. Discussions between the two led to a successful outing where specimens with flowers and mature fruit were collected and assessed. Although resembling *R. macrocarpa* in gross morphology, examination of herbarium specimens found significant differences, including the first occurrence of brochidodromous leaf venation within *Rhodomyrtus* in Australia. Both flowering and fruiting material has enabled the confirmation that Hawkes' puzzle represented an undescribed species, which we describe below as *R. verecunda* A.J.Ford & Peter G.Wilson.

Material and Methods

This study of *Rhodomyrtus* was exclusively based on the examination of herbarium specimens held at NSW and CNS including spirit (alcohol) collections at CNS. In addition, fieldwork by the first author enabled the collection of fresh material for morphological assessment and DNA analysis, and pertinent ecological observations and data for conservation assessment.

Taxonomy

Rhodomyrtus verecunda* A.J.Ford & Peter G.Wilson, *sp. nov.

Type: Queensland: Cook District: Daintree National Park, Noah Island on bank of Noah Creek, 13 June 2016, *A. Ford 6569, T. Hawkes* and *B. Gray* (holotype: BRI; isotypes: CNS, MEL, NSW, SING).

Diagnosis: Differs from *Rhodomyrtus macrocarpa* in its leaf venation (brochidodromous versus eucamptodromous), inflorescence type (solitary versus triads or botryoids), hypanthium shape and texture (funnel-shaped and smooth versus cylindrical and ribbed), style length (7.5–8 mm versus 4.5–5 mm), placentation type (axile versus parietal), ovary structure (bilocular versus unilocular) with fewer ovules per flower (4–6 versus numerous).

Large shrubs to small trees 3–5 m tall. Bark flaky (layered), outer blaze fawn, fibrous; a dark brown layer apparent between the dead bark and the living bark layer. *Branchlets* green when freshly expanded, turning brownish and finally creamy to creamy-brown, epidermis glandular especially on youngest growth, moderately sericeous (hairs whitish and antrorse), strongly compressed on youngest growth and becoming terete with age, each side bearing 2 longitudinal grooves separated by a raised midline, swollen at nodes, terminal bud densely sericeous. *Leaves* opposite, decussate, evenly distributed along branchlets, discolorous when fresh but scarcely so when dry, venation brochidodromous (occasionally eucamptodromous proximally), both surfaces matte. Colleters (type "A" stipule sensu Snow *et al.* 2003) deciduous to moderately persistent, *c.* 0.25 mm long, filiform, dark maroon, usually 8 per leaf. Petioles purple, 2.0–4.1 mm long, *c.* 1.5 mm wide (appearing much longer due to the extremely attenuate leaf bases), flat or nearly so adaxially, strongly rounded abaxially, sericeous, longitudinally striated when dry. Leaf blades elliptic-obovate to obovate-spathulate, (38–)48–108 mm long, (12–)18–35 mm wide, length to width ratio 2.1–3.2(–4): 1, coriaceous; base exceedingly attenuate and narrowing very gradually towards the proximal part of petiole, margin flat when fresh but slightly recurved near petiole when dried; apex variable, from shortly acuminate to acute, obtuse or retuse; acumen glabrescent, usually densely clothed in antrorse silky white hairs, containing a single oil gland so that, without magnification, it can resemble a mucro; adaxial surface moderately but persistently sericeous, more densely so on the midvein; midvein slightly raised in a shallow depression when fresh but appearing flush when dry, secondary and tertiary veins ± flush when fresh but strongly raised when dry; abaxial surface sparsely and persistently sericeous, more so proximally and on the midvein; oil glands common, visible with magnification, erupting the surface on both abaxial and adaxial surfaces; midvein strongly raised when fresh or dry, secondary and tertiary veins raised when fresh or dry; 7–11 secondary veins on each side of the midvein, intramarginal vein absent. *Inflorescence* a solitary flower (monad), one per axil; anthopodia present, metaxyphylls absent; peduncles 5.5–7 mm long, *c.* 0.6 mm diameter proximally, angular distally, longitudinally striated when dry, sericeous, moderately clothed in short

white antrorse hairs, oil glands common. Bracteoles 2, 2.1–3.4 mm long, 0.4–0.5 mm wide, oblong, erect in bud, sericeous, moderately clothed in short white antrorse hairs, longitudinally striated, adaxially sulcate, deciduous to moderately persistent, occasionally persisting on immature fruit, oil glands common. *Hypanthium* 6.5–8 mm long, funnel-shaped, moderately and shortly sericeous, smooth (not ribbed), not extending beyond ovary. *Calyx* lobes 5, unequal, green, broadly obtuse, 2.5–3 mm long, 5–6 mm wide, ± reniform, moderately sericeous on both surfaces, becoming tomentose-sericeous towards the margins, ciliate, spreading at anthesis. *Petals* 5, white, 10.5–12 mm long, 10.5–11.5 mm wide, cupular, obovate, prominently glandular, glabrous or nearly so on both surfaces, sparsely sericeous abaxially near apex, ciliate. *Stamens* numerous, 5–7-seriate; filaments filiform 5.6–10.1 mm long, leaving conspicuous scars around the ovary; anthers *c*. 0.4 mm long, ellipsoid, dehiscing through longitudinal slits, basifixed, connective tipped with an apical gland. *Ovary* apex hairy. Style sericeous throughout, 7.5–8 mm long, stigma peltate. Ovary 2-locular; placentation axile; ovules 2–3 per locule, ascending. *Fruit* indehiscent, baccate, the flesh leathery (not 'juicy'), globose-pyriform, 20–21 mm long, 16–16.5 mm diameter, green proximally (lower 25%) and purple-red distally (upper 75%), surface smooth (not ribbed) and puberulent, glandular, calyx lobes erect, peduncle not enlarged or elongating markedly. Seeds 2 per fruit, testa brown with radial markings, bony-fibrous, hemispheroidal, 7.5–8 mm long, 4.5–7 mm wide, the placental face flat; embryo glandular, circinate, radicle longer and thicker than cotyledons. Specific wood density 714 kg/m^3. Fig. 1.

Fig. 1. *Rhodomyrtus verecunda*. A. Habit of flowering branchlet; B. Mature fruit and leaves with purple petioles; C. Riparian habitat along Noah Creek; D. Wind-sheared ridge habitat on Mt Sorrow (Photo Credits; CSIRO, Andrew Ford).

Distribution: *Rhodomyrtus verecunda* is endemic to the Wet Tropics bioregion (Department of Environment 2012) in north-eastern Queensland, Australia, where it is currently only known from a restricted area in the very high rainfall zone (>3000 mm per annum) between the Daintree River, Cape Tribulation and Mt Pieter Botte (north of Cairns) (Fig. 2).

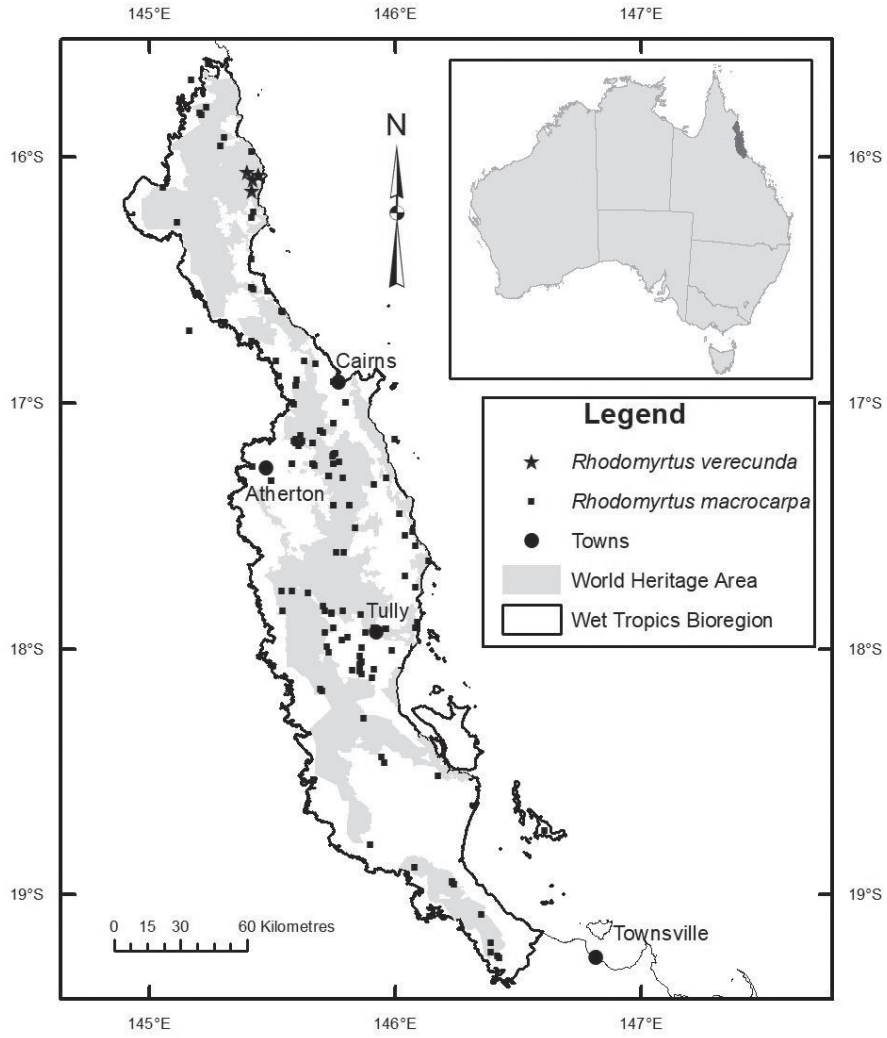

Fig. 2. Distribution of *Rhodomyrtus verecunda* and *Rhodomyrtus macrocarpa* in north-east Queensland, Australia (*R. macrocarpa* occurs from Central Queensland to Cape York and extends into New Guinea, but for comparative purposes only occurrences in north-east Queensland are shown.)

Habitat and Ecology: This species is known from three distinctive rainforest vegetation types:

1. Notophyll rainforest along creekbanks associated with large granite boulders (Fig. 1c). Canopy dominated by *Xanthostemon chrysanthus*. Smaller trees include: *Gymnostoma australianum, Neorites kevediana, Dissiliaria tuckeri, Choriceras majus* and *Atractocarpus sessilis.* Shrubs: *Dinghoua globularis, Phyllanthus hypospodius, Hypsophila dielsiana, Schistocarpaea johnsonii* and *Medicosma sessiliflora*. The ground layer is dominated by *Lomandra hystrix.*
2. Microphyll rainforest on ridges of metasediments (Fig. 1d). Canopy heavily wind-sheared and dominated by: *Ceratopetalum iugumensis, Balanops australiana*, *Elaeocarpus ferruginiflorus*, *Psydrax montigena*, *Musgravea stenostachya*, *Halfordia scleroxyla* and *Trochocarpa bellendenkerensis*. Shrubs and small trees: *Argophyllum cryptophlebum*, *Garcinia brassii*, *Alyxia orophila*, *Pittosporum rubiginosum*, *Wendlandia inclusa*, *Linospadix* sp., *Chionanthus axillaris, Tasmannia membranea*, *Psychotria* spp., *Crispiloba disperma* and *Lenbrassia australiana* var. *glabrescens*. The ground layer is dominated by *Romnalda ophiopogonoides.*
3. Notophyll rainforest associated with granite outcrops, often near creekbanks. Canopy trees include: *Agathis atropurpurea, Sphalmium racemosum, Syzygium hemilamprum* subsp. *orophilum, Niemeyera discolor, Gymnostoma australianum, Sarcopteryx reticulata* and *Sloanea australis.* Shrubs and small trees include: *Phyllanthus hypospodius*, *Medicosma heterophylla, Xanthostemon graniticus, Rhodamnia sessiliflora, Chionanthus axillaris, Atractocarpus hirtus* and *Polyscias bellendenkerensis.*

The recorded altitudinal range is 20–720 m, with most collections above 600m (rainforest types 2 and 3 above).

Phenology: Flowering is recorded for June only, although buds recorded in December and mature fruit is only known from June. Immature fruit has been observed in May, August and September. Given the wide range of observations of fertile material, it is possible that flowering and fruiting occurs sporadically throughout the year and varies significantly between individuals within a population.

Conservation Status: *Rhodomyrtus verecunda* is currently only known from Daintree National Park, between the Daintree River and Cape Tribulation, north of Cairns. Its conservation status has not been assessed formally according to IUCN (2019) guidelines. It is known from five collections representing four locations and its extent of occurrence (EOO) is only 18 km^2. At present, there is no evidence of decline in population size, but further fieldwork is needed desperately to assess recruitment and population numbers from each of the known locations. We recommend a status of *Not Evaluated* (IUCN 2019) until the above information is acquired and related to any possible future threats, including any changes to the highly localised and unique climate that this species inhabits.

Etymology: The epithet *verecunda*, from the Latin *verecundus* (shy, modest, bashful), is a reference to this species being so similar to *R. macrocarpa*, being essentially hidden in plain sight, and having relatively few ovules and seeds compared to most other species of *Rhodomyrtus*.

Affinities: Amongst Australian species, *Rhodomyrtus verecunda* is morphologically closest to *R. macrocarpa* and, in fact, the paucity of anthetic flowering material or collections of mature fruit has resulted in it being included within the concept of *R. macrocarpa* since the 1980s. Both species have bark that is cream-coloured and flaky, and leaves that are elliptic to obovate-spathulate with purple petioles. However, even sterile herbarium material can be readily identified using leaf venation alone. A comparison of diagnostic differences between *R. verecunda* and *R. macrocarpa* is provided in Table 1.

Table 1. Morphological comparison between *Rhodomyrtus verecunda* and *Rhodomyrtus macrocarpa*.

	R. verecunda	*R. macrocarpa*
Leaf venation	brochidodromous	eucamptodromous
Inflorescence type	solitary	triads or botryoids
Hypanthium shape	funnel-shaped	cylindrical
Hypanthium texture	smooth	ribbed
Style length (mm)	7.5–8	4.5–5
Placentation type	axile	parietal
Ovule number per flower	4–6	numerous (c. 20)
Fruit shape	globose-pyriform	ellipsoidal-torulose
Fruit base	cuneate	obtuse

In the wider Australasian region, *R. verecunda* shows some similarity to the pinnatinerved *R. elegans* (Blume) A.J.Scott from New Guinea and the Moluccas, but that species also has eucamptodromous venation. According to the key provided by Snow and Cantley (2010), two recently described species from Papua New Guinea, *R. kaweaensis* N.Snow and *R. mengenensis* N.Snow, appear to show a much closer relationship to *R. verecunda* based on the shared occurrence of terete fruits and brochidodromous venation.

Notes: Embryos of *Rhodomyrtus verecunda* and *R. macrocarpa* are both minutely glandular and strongly circinate, and resemble the embryo illustrated in Landrum and Kawasaki (1997, Fig. 6H). The same embryo type also occurs in *R. guymeriana* N.Snow & J.P.Atwood and *R. elegans* (Snow *et al.* 2008). A membranous layer, resembling a tissue-paper thickness skin, also surrounds the embryo of all four species. A conspicuous vascular core, as illustrated by Landrum and Stevenson (1986, Fig. 1), is clearly seen in an embryo cross section at the swollen end from seeds of *Rhodomyrtus verecunda* and *R. macrocarpa*.

The presence of endosperm in *Rhodomyrtus* previously has only been reported for the New Guinean endemic *Rhodomyrtus guymeriana* (Snow *et al.* 2008), where they record endosperm as "gelatinous but scant". In both *R. macrocarpa* and *R. verecunda* this gelatinous material can be found adjacent to the cotyledonary end of the embryo in fruits that are immature. It is not known whether this endosperm persists in any mature seeds, so we support the position of Snow *et al.* (2008) calling for more detailed studies on the embryology and seed status within *Rhodomyrtus.*

Although the fruit length of *R. verecunda* and *R. macrocarpa* do not overlap (20–21 mm versus 25–60 mm), occasional fruit of *R. macrocarpa* can be shortly ellipsoidal and approach the overall dimensions of *R. verecunda*:

an illustration of *R. macrocarpa* in Cooper (2004; page 354) is much shorter than the others for the same species. This represents a cultivated specimen (at the CSIRO Arboretum, Atherton) and may be interpreted as being somewhat aberrant compared with those seen in the field and on herbarium specimens, since flowers from the same plant have all the critical diagnostic features of *R. macrocarpa* given in Table 1.

Thick staminal scars (remnant filament bases) protrude from the staminal disc. These are more apparent on immature fruit (Lucas *et al.* 2019; Fig 2B1); in the mature fruit the scars resemble shallow pits in the disc.

Although all acrodromous species of *Rhodomyrtus* in Australia are currently being heavily impacted and threatened by Myrtle Rust, limited observations suggest that *R. verecunda* might not be susceptible to this pathogen. Species that were affected by Myrtle Rust, growing in the same area as *R. verecunda*, included: *Lindsayomyrtus racemoides* (Greves) Craven, *Rhodamnia sessiliflora* Benth. and *Rhodomyrtus effusa* Guymer. Further fieldwork is required to confirm this preliminary assessment. Of the other two non-acrodromous species, *R. psidioides* has been impacted severely by Myrtle Rust with some local populations experiencing complete destruction and, as a result, this species has been upgraded to Critically Endangered in both NSW and Queensland under respective state authorities (https://apps.des.qld.gov.au/species-search/details/?id=16290 and http://www.environment.gov.au/biodiversity/threatened/species/pubs/19162-conservation-advice-12122020.pdf), whilst *R. macrocarpa* is regarded as moderately susceptible (Makinson 2018).

Additional specimens seen: QUEENSLAND: Cook District: Daintree National Park, Mt Sorrow Track razorback, 4 km W of Cape Tribulation, 2 Dec 1997, *P. Forster PIF22005, R. Jago and R. Jensen* (BRI, CNS); Timber Reserve 165, Pieter Botte Logging Area, lower slopes of Mt Pieter Botte, 5 Aug 1997, *R. Russell 5* (CNS); head of Roaring Meg Creek–Cape Tribulation, May 1984, *M. Godwin 2583* (CNS); Daintree National Park, Noah Creek adjacent to Noah Island, 13 Jun 2016, *A. Ford AF6570, T. Hawkes and B. Gray* (BRI, CNS, NSW).

Key to the Species of *Rhodomyrtus* in Australia and their distribution within Queensland (modified from Snow and Cantley 2010).

1a. Leaf venation brochidodromous or eucamptodromous (not 3-veined) 2

1b. Leaf venation acrodromous (3-veined) 4

2a. Leaf venation brochidodromous, flowers solitary ..... ***R. verecunda*** (NQ)

2b. Leaf venation eucamptodromous, flowers usually in cymes to/or botryoids 3

3a. Placentation parietal, ovary 1-locular, seeds > 5mm diameter ..... ***R. macrocarpa*** (CQ, NQ, CYP)

3b. Placentation axile, ovary 2 or more locular, seeds < 5mm diameter ..... ***R. psidioides*** (SQ)

4a. Hairs on abaxial leaf surface whitish 5

4b. Hairs on abaxial leaf surface ferrugineous 6

5a. Indumentum of hypanthium and abaxial leaf surface sericeous with all hairs of similar length ..... ***R. canescens*** (NQ)

5b. Indumentum of hypanthium and abaxial leaf surface densely sericeous with additional longer villous hairs ..... ***R. sericea*** (NQ, CQ)

6a. Leaf base cordate to deeply obtuse; scandent, poorly formed shrubs ..... ***R. effusa*** (NQ)

6b. Leaf base cuneate to slightly obtuse; well-formed shrubs and small trees 7

7a. Ovules and seeds in 3–5 (rarely 7) longitudinal rows ..... ***R. trineura*** (CQ, NQ, CYP)

7b. Ovules and seeds in 7–14 longitudinal rows ..... ***R. pervagata*** (NQ)

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