

A review of *Myriophyllum callitrichoides* (Haloragaceae)

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Abstract

Barrett, M.D., Moody, M.L. & Barrett, R.L. A review of *Myriophyllum callitrichoides* (Haloragaceae). *Telopea* 24: 207–211 (2016). The taxonomic status of *Myriophyllum callitrichoides* Orch. in Western Australia is reviewed. On the basis of new collections made across the Kimberley, a previously unknown taxon with unique mericarp ornamentation is documented, here described as the new species *Myriophyllum foveicola* M.D.Barrett, M.L.Moody & R.L.Barrett. *Myriophyllum foveicola* deserves the same rank as the two previously described taxa, although we prefer to treat them at the rank of species. The previously recognised *M. callitrichoides* subsp. *striatum* Orchard is elevated to species rank as *Myriophyllum striatocarpum* M.D.Barrett, M.L.Moody & R.L.Barrett *nom. nov.* (non *M. striatum* Orchard). Both species are endemic to the Kimberley region of Western Australia. The three species now recognised in the *M. callitrichoides* complex have morphological, ecological and / or geographic distribution to support their status as species. The two Western Australian species are of conservation significance. Illustrations are provided for both of the Kimberley species.

Introduction

Myriophyllum callitrichoides Orchard (1974) is an unusual aquatic plant found only in shallow rockpools in northern Australia, a habitat with transient and irregular hydroperiod that experiences multiple flooding / drying cycles per season, and requires extraordinary resilience to persist in the seed bank (Cross et al. 2015a, b). Plants of *M. callitrichoides* are annual, and possess dimorphic stems and leaves; the basal leaves are thick and spongy and are restricted to a short spongy stem, while upper leaves occur in floating rosettes on numerous long filiform stems. In addition to plant architecture, fruit are also unique within the genus *Myriophyllum* in having divergent mericarps that are cruciform and connate only at their bases (vs mericarps when more than one parallel and connate for > half their length in other *Myriophyllum*), erect subulate styles (sessile to shortly clavate in most other *Myriophyllum*), and unusual in having strictly hermaphroditic flowers (at least some flowers unisexual in most other species), states which prompted van der Meijden (1975) to establish a new genus *Vinkia* Meijden for *M. callitrichoides*. However, the genus *Vinkia* is not currently recognised. *Myriophyllum callitrichoides* has yet to be included in phylogenetic analyses (eg. Moody and Les 2007, 2010; Chen et al. 2014) to establish its synonymy, however ongoing research suggests it is included within *Myriophyllum* subg. *Brachythecum* (Moody and Les 2010; Moody, unpublished data).

Orchard (1986), in a revision of the Australian species of *Myriophyllum*, recognised two subspecies within *M. callitrichoides*, based on anther number, leaf dimension and fruit ornamentation differences. The two subspecies were considered geographically disjunct; *M. callitrichoides* subsp. *callitrichoides* from Western Arnhem Land and *M. callitrichoides* subsp. *striatum* Orchard from the north-west Kimberley. With the collection of further material, the leaf dimension differences between the subspecies described by Orchard (1986, 1990) have proven insufficient to distinguish these taxa. For example, Cowie et al. (2000) describe a larger size range for leaves of *M. callitrichoides* subsp. *callitrichoides* that completely encompasses the range reported by Orchard (1986) for both *M. callitrichoides* subsp. *callitrichoides* and *M. callitrichoides* subsp. *striatum*.

Even at the time of Orchard's 1986 revision, *M. callitrichoides* was poorly known, and the Kimberley *M. callitrichoides* subsp. *striatum* was known only from the type collection. Through extensive collecting across the Kimberley we have confirmed that all Kimberley material has 8 anthers (matching subsp. *striatum*), but discovered two types of mericarp ornamentation within Kimberley material, (1) the wholly striate mericarps typical of *M. callitrichoides* subsp. *striatum*, and (2) wholly verrucose mericarps distinct from either of the described subspecies, known informally in Western Australia by the phrase name *M. sp.* (Harding Range, *M.D. Barrett & R.L. Barrett MDB 1825*). In the north-west Kimberley, e.g. near Theda Station homestead and near the Lawley River mouth, plants containing one or other of the fruit types occur within 100–1000 m of each other, but so far they have not been found growing in the same rockhole, nor is there any evidence of hybridisation. The two forms at Theda differ in their seed dormancy and response to wetting/drying cycles (Cross et al. 2015a), suggesting a subtle ecological shift between them. We here recognise these forms formally as species. Other taxa in *Myriophyllum* differ by similar variation in mericarp ornamentation (e.g. *M. filiforme* and *M. costatum*; *M. echinatum*, *M. drummondii* and *M. limnophilum*), which have been corroborated in recent phylogenetic analyses (Moody and Les 2010; Chen et al. 2014). Consequently we describe the unnamed form with completely verrucose mericarps as the new species *M. foveicola* M.D.Barrett M.L.Moody & R.L.Barrett, and raise *M. callitrichoides* subsp. *striatum* to species rank. Unfortunately, the epithet *striatum* is preoccupied at species rank by *Myriophyllum striatum* Orchard (1986), a species only distantly related to the *M. callitrichoides* complex. We therefore provide the name *Myriophyllum striatocarpum* M.D. Barrett, M.L. Moody & R.L. Barrett as a nom. nov. for *M. callitrichoides* subsp. *striatum* at species rank, and provide a series of comparative photos (Figure 1F–I). Under this new taxonomy, *M. callitrichoides* sensu stricto is confined to Western Arnhemland in the Northern Territory.

Methods

Descriptions are based primarily on dried herbarium specimens although fresh field or cultivated material, or material preserved in 70% ethanol was also utilised. To produce Scanning Electron Microscope (SEM) images, dry material was mounted on stubs using double-sided or carbon tape with conductive carbon paint, coated with gold using an EMITECH K550X Sputter Coater and imaged at high vacuum and high voltage (15 KVa) using a Jeol JCM 6000 NeoScope bench-top SEM at Kings Park and Botanic Garden.

Taxonomy

Myriophyllum callitrichoides Orchard, Trans. R. Soc. S. Aust. 98: 173-177 (1974).

Vinkia callitrichoides (Orchard) Meijden, *Blumea* 22 (1975) 253, postscript.

Vinkia natans Meijden, *Blumea* 22 (1975) 251-253, nom. inval.

With the elevation of *M. callitrichoides* subsp. *striatum* to species rank, the autonym *M. callitrichoides* subsp. *callitrichoides* is superfluous.

Myriophyllum foveicola M.D.Barrett M.L.Moody & R.L.Barrett, **sp. nov.**

Type: Australia: Western Australia: Near Mt Agnes, [precise locality withheld for conservation reasons], 28 March 2010, *M.D. Barrett & R.L. Barrett MDB 2868* (holo: PERTH 08613699, iso: CANB, DNA).

Myriophyllum sp. Harding Range (*M.D.Barrett & R.L. Barrett MDB 1825*), Western Australian Herbarium, in FloraBase, <http://florabase.dpaw.wa.gov.au> [accessed 01 March 2014].

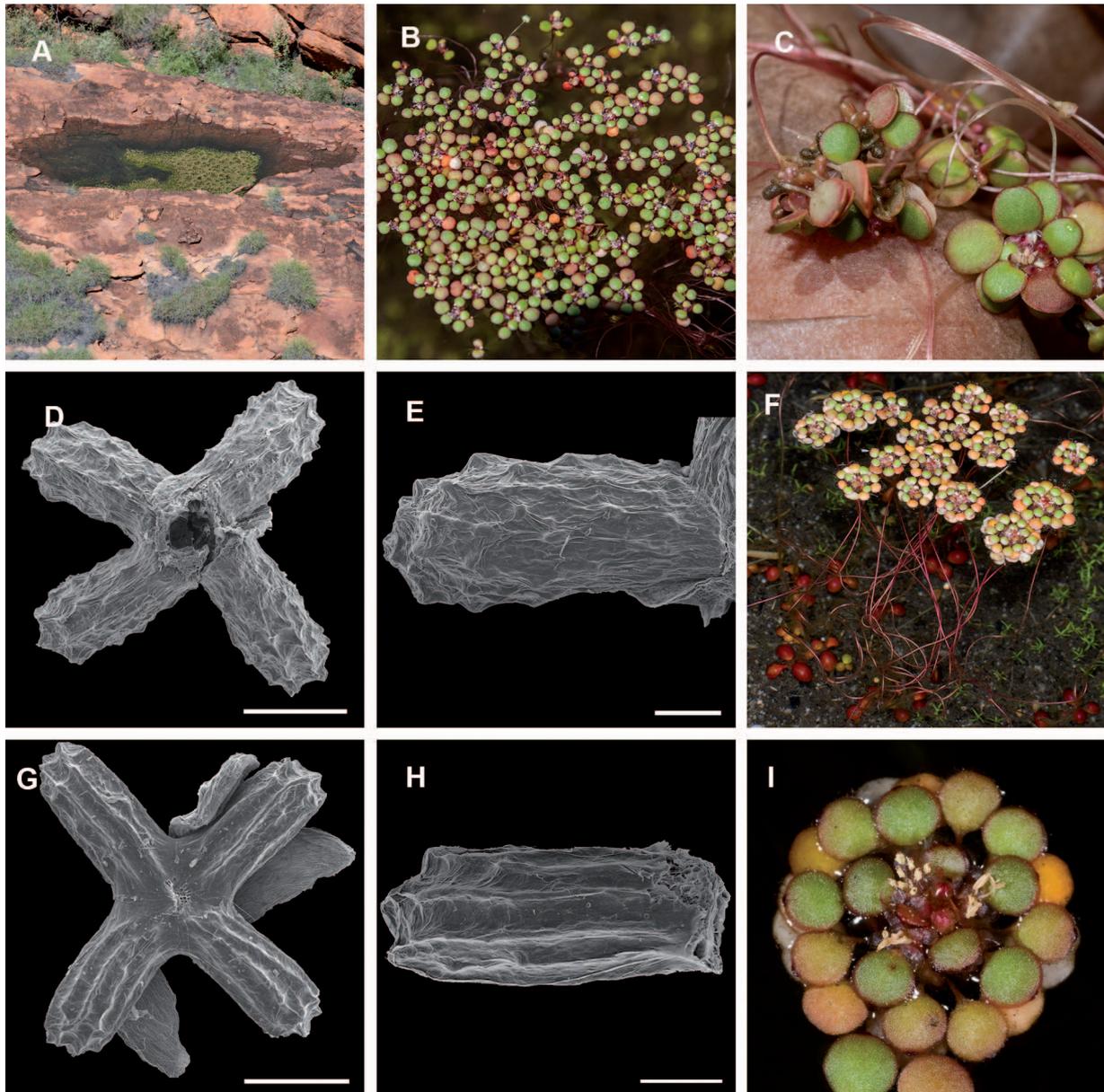


Figure 1. *Myriophyllum foveicola*. **a.** habitat; **b.** habit of floating leaves; **c.** floating leaf rosettes showing fruit held below leaves and flowers held above leaves; **d.** SEM of fruit with four fused verrucose mericarps; **e.** SEM of single verrucose mericarp. *M. striatocarpum*. **f.** habit with submerged leaves and floating leaves; **g.** SEM of fruit with four fused striate mericarps; **h.** SEM of single striate mericarp; **i.** floating leaf rosette with flowers. Scale bars = 500 μ m (D, G); 200 μ m (E, H). Images from M.D. Barrett, R.L. Barrett & B.M. Anderson MDB 4281 (A–E) and M.D. Barrett & R.L. Barrett MDB 2896 (E). Photographs by R.L. Barrett (A, C, F, I); M.D. Barrett (B, D, E, G, H).

Weak annual aquatic herb 20–40 cm tall; stems and leaves dimorphic. Primary stems thick, fleshy, ascending, rooting at base, 10–45 mm tall, 2–3 mm diam., not or sparsely branched; leaves of primary stems alternate, succulent, obovate to shortly spatulate, 1.5–9 mm long, 1.2–4.0 mm wide, widest in upper half, tapering to 0.5–1.2 mm towards base, entire, slightly recurved, tip rounded with a dark brown terminal gland. Leaves flanked by 2 minute, filiform, deciduous, black-tipped hydathodes on stem at base of petiole. Secondary stems filiform, 1 per main stem branch, arising from axils of the upper primary leaves, 15–35 cm long, 0.2–0.4 mm diam., unbranched for most of length, at apex with a short zone (0.5–5 mm long) of dense short axillary branches, from axils of distant, alternate to subopposite bract-like, subulate, reduced leaves 0.2–0.5 mm long, each branch a single slightly thickened internode 0.5–1.5 mm long, terminating in a flower subtended by 2 opposite bracteoles and a fully formed floating leaf. Emergent floating leaves closely clustered at tips of secondary stems forming ‘rosettes’, alternate, petiolate, lamina thin, fleshy-succulent, circular to broadly ovate, 1.3–3.0 mm long, 1.2–2.8 mm wide, entire, tip rounded with black apical gland (often bluntly recurved and gland oriented on the lower side), base abruptly tapered to petiole, veins indistinct, \pm parallel; petiole 1–2.5 mm long, with 2 black, filiform hydathodes at base. Plants monoecious, flowers bisexual, borne singly at apex of

short branches and in axils of emergent floating leaves, sessile, flanked by 2 filiform ± crisped bracteoles 0.2–0.8 mm long with a tapering apex, hydathodes not found. Sepals 4, narrowly obovate, 0.3 mm long, 0.2 mm wide, entire, apex obtuse. Petals 4, 0.9–1.0 mm long, 0.7–0.8 mm wide, broadly obovate with rounded apex, slightly hooded, not keeled, non-unguiculate, persistent. Stamens uniformly 8, filaments 0.6–1.0 mm long; anthers elliptic, 0.6–0.8 mm long, 0.20–0.25 mm wide, not or very minutely apiculate. Styles 4, filiform, 0.8–1.1 mm long, erect, stigma occupying entire length, non-fimbriate. Ovary obturbinate, c. 0.5 mm long, c. 1.8 mm wide, 4-locular. Fruit red-brown to dark brown, cruciform, straddling the petiole, mericarps 4, diverging downwards and outwards at c. 30–70°. Mericarps fused only at bases, separating freely at maturity, narrowly obovoid to cylindrical, 1.0–1.8 mm long, 0.4–0.6 mm wide, verrucose over whole surface, verrucae sometimes slightly elongated longitudinally and aligned longitudinally, especially when immature, but lacking longitudinal striations even at base. **Figure 1A–E.**

Distribution: Endemic to the Kimberley Region, from Kimbolton Station north east to Theda Station, and a single isolated record in the Parker Range, East Kimberley. This range is more widespread, incorporating a wider rainfall gradient than either of the related taxa *M. callitrichoides* and *M. striatocarpum*.

Habitat: Entirely restricted to small, shallow rockholes (up to c. 10 m across) on sheeting sandstone, or once found in a rockhole on granite (R.L. Barrett RLB 2126).

Flowering and fruiting: recorded January to April.

Additional specimens: WESTERN AUSTRALIA: [localities withheld for conservation reasons]: 19 January 2007, M.D. Barrett & R.L. Barrett MDB 1825 (PERTH); 29 Mar. 2010, M.D. Barrett & R.L. Barrett MDB 2888 (PERTH); 29 Mar. 2010, M.D. Barrett & R.L. Barrett MDB 2889 (PERTH); 29 Mar. 2010, M.D. Barrett & R.L. Barrett MDB 2892 (PERTH); 30 Mar. 2010, M.D. Barrett & R.L. Barrett MDB 2945 (PERTH); 30 Mar. 2010, M.D. Barrett & R.L. Barrett MDB 2956 (PERTH); 12 Mar. 2001, R.L. Barrett RLB 2126 (PERTH); 19 Jan. 2010, R.L. Barrett, M. Maier & P. Kendrick RLB 6260 (PERTH); 24 Jan. 2010, R.L. Barrett & M.D. Barrett RLB 6402 (PERTH); 25 Jan. 2010, R.L. Barrett & M.D. Barrett RLB 6423 (PERTH); 7 Apr. 2013, M.D. Barrett, R.L. Barrett & B.M. Anderson MDB 4281 (PERTH).

Etymology: The epithet is derived from Latin *fovea*, a small pit, and *-cola*, dweller, in reference to the specific habitat in rockpools. The vernacular name Warty Rockpool Milfoil is recommended, along with Striped Rockpool Milfoil for *M. striatocarpum* and Kakadu Rockpool Milfoil for *M. callitrichoides*.

Conservation status: *Myriophyllum foveicola* is listed by Jones (2015) as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *M. sp.* Harding Range (M.D. Barrett & R.L. Barrett MDB 1825).

Notes: Seeds of *M. foveicola* were found to germinate in high numbers after 2 and 3 years of simulated annual inundation / drought cycles by Cross et al (2015a, fig. 4), while seeds of co-occurring *M. striatocarpum* had a very low rate of emergence after the second year. These data suggest that *M. foveicola* seeds may be more resilient than *M. striatocarpum* to poor seasons that provide sufficient rainfall to germinate seeds, but insufficient rain to maintain rockpool levels through to flowering. This is in agreement with the observed greater climatic envelope for *M. foveicola*, which occurs widely through the Kimberley including the drier central and east Kimberley, while *M. striatocarpum* is apparently restricted to the highest-rainfall zone of the north-west Kimberley. On the Mitchell Plateau, *M. striatocarpum* co-occurs with *Nymphoides astoniae* M.D. Barrett & R.L. Barrett, a species also restricted to rockhole habitats in the high rainfall zone of the north-west Kimberley (Barrett and Barrett 2015).

Myriophyllum striatocarpum M.D. Barrett, M.L. Moody & R.L. Barrett, **nom. et stat nov.**

Basionym: *Myriophyllum callitrichoides* subsp. *striatum* Orchard, *Brunonia* 8(2): 252 (1986), non *Myriophyllum striatum* Orchard, *Brunonia* 8(2): 243 (1986). Type: Mitchell River, Western Australia, 22 February 1980, C.R. Dunlop 5261 (holo: HO 34156; iso: DNA, MEL, NSW, PERTH 01000268).

Conservation status: *Myriophyllum striatocarpum* is listed by Jones (2015) as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *M. callitrichoides* subsp. *striatum*.

Key to species of the *Myriophyllum callitrichoides* complex

1. Stamens 4; mericarps weakly and irregularly striate with sharp downward pointing verrucosities in distal half *M. callitrichoides*
- 1: Stamens 8 2

2. Mericarps strongly striate lacking sharp verrucosities, or a few weak verrucosities occasionally present at extreme apex *M. striatocarpum*
- 2: Mericarps lacking striations, entirely verrucose *M. foveicola*

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