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Four new Western Australian species related to *Hibbertia axillibarba* (Dilleniaceae)

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Abstract

Hibbertia axillibarba was described in 2000 as a short-range endemic species known only from South Ironcap, a semi-arid, banded ironstone hill in the Western Australian southern Goldfields. Subsequently, several specimens collected from sandplain habitats in the Western Australian wheatbelt, varying from close to, to distant from, South Ironcap, were determined as *H. aff. axillibarba* or *H. cf. axillibarba* at the Western Australian Herbarium. Close study of these specimens has shown that none matches *H. axillibarba*, which on current knowledge remains endemic on South Ironcap; instead, they comprise three distinct species, which are described here as *Hibbertia arenicola* K.R.Thiele, *H. erioclada* K.R.Thiele and *H. elachophylla* K.R.Thiele & T.Hammer. A fourth new species, *H. lanulipes* K.R.Thiele, is included in this paper as it is likely to be related to the others, despite being morphologically quite different from them. None of these species is widespread and some are likely to be rare and restricted.

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Introduction

Hibbertia axillibarba J.R.Wheeler was described based on four specimens, all from the summit and upper slopes of South Ironcap, a banded ironstone hill *c*. 40 km north of Lake King, Western Australia (Wheeler, 2000). Since publication, three further specimens have been collected, all from South Ironcap, where it is locally common.

After the publication of *H. axillibarba*, several *Hibbertia* specimens collected from sandplains in the Western Australian wheatbelt in the general vicinity of South Ironcap were determined at the Western Australian Herbarium as *H. aff. axillibarba* or *H. cf. axillibarba*. However, none of these matches *H. axillibarba*, and close morphological examination shows that the specimens comprise two distinct taxa, which are named here as *H. arenicola* K.R.Thiele and *H. erioclada* K.R.Thiele. These specimens were not included in the original circumscription or description of *H. axillibarba*.

A third taxon, named here as *H. elachophylla* K.R.Thiele & T.Hammer, was first collected '[b]etween Bencubbin and Koorda' by W.E. Blackall in 1937 and provisionally assigned as *H. aff. axillibarba* by one of us (KRT) while

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assessing the other specimens. Its identity and location remained uncertain until TAH located a specimen at AD (AD99029007) collected in 1987 by B.H. Smith from Narkal, a locality on the railway line connecting Bencubbin and Koorda.

Field work between 2017 and 2021 has confirmed that all three species are consistent and distinct from each other and from *H. axillibarba*.

The fourth species dealt with in this paper, named here as *H. lanulipes* K.R.Thiele, is based on a few collections made between North Tarin Rock Nature Reserve and Lake Grace. It is morphologically very different from the other taxa and from *H. axillibarba*, and was originally identified in the Western Australian Herbarium as *H. stowardii*, a species which is widespread in the Western Australian wheatbelt. However it differs significantly from *H. stowardii* in several taxonomically important characters, and is likely to be more closely related to the other taxa in this paper than it is to *H. stowardii*.

As well as morphology, support for the close relationship of the taxa dealt with here has been provided by an (unpublished) hybrid bait-capture molecular phylogeny of *Hibbertia* being developed by the authors of this paper. More detailed evidence of their relationships to each other and to other taxa awaits completion and publication of that phylogeny.

Methods

This study is based on examination of all relevant material held at PERTH and AD, augmented by extensive field work by KRT.

In the descriptions, the terms hypopetiole and epipetiole are here introduced to accommodate an unusual petiolar morphology characteristic of *Hibbertia*. In this genus, the petiole comprises two distinct sections separated by an abscission line, the sections often having distinctly different indumentum and texture. The hypopetiole is basal, and is often only clearly discernable as petiolar in very young, expanding leaves, where it is clearly free of the stem. As the leaf matures the hypopetiole often thickens and becomes woody, remaining after leaf shed (which involves abscission between the hypopetiole and epipetiole) as a persistent woody 'peg' on the stem.

The epipetiole is distal. It may grade into the leaf lamina or be distinct from it. In some species the epipetiole and hypopetiole are of similar lengths (that is, the abscission zone is close to the half way mark) while in others the epipetiole is very short, when it may be almost obscured by the base of the leaf lamina. In the species described in this paper the epipetiole, though short, is densely pubescent while the hypopetiole and leaf lamina are ± glabrous.

Analogous or homologous morphologies may also be found elsewhere in flowering plants (e.g., in some genera of Fabaceae, Violaceae and Phyllanthaceae, R. Barrett *pers. comm.*). Detailed developmental studies are needed to elucidate their ontogeny and homology; these are outside the scope of the present study and the terms are used here strictly for morphological convenience.

The species described in this paper are included in draft keys to *Hibbertia* in Australia and Western Australia, at https://keybase.rbg.vic.gov.au/keys/show/13127 and https://keybase.rbg.vic.gov.au/keys/show/1762 respectively.

Taxonomy

Hibbertia arenicola K.R.Thiele, *sp. nov.*

Type: Western Australia: Lake King-Norseman Road c. 82 km from Lake King, 15 Sept. 2021, *K.R. Thiele* 5748 (*holo*: PERTH 9369074; *iso*: AD, CANB).

Spreading to straggling *shrubs* to 0.5 m high, multi-stemmed at base and resprouting after fire; young branchlets comprising densely packed, thickened, pubescent, persistent leaf bases (hypopetioles). *Leaves* mostly crowded at the apices of short-shoots, erect at first then spreading, oblong, 4–8 mm long, 1.4–2 mm wide, the margins strongly recurved to the thickened, prominent midrib, obscuring the abaxial lamina; petiole 0.8–1.5 mm long, the hypopetiole thickened, dark brown, glabrous to sparsely pubescent especially on the margins, forming a thickened peg on the stem surface when the leaf is mature, the epipetiole very short, densely curled-pubescent; adaxial lamina not tuberculate, glabrous except for dense, curled-woolly hairs at base (sometimes sparsely hairy throughout when very young); abaxial lamina (visible only by dissection) densely pubescent; abaxial midrib broad, level with or bulging above the margins, glabrous, often with a narrow, central, yellowish sclerenchymatous stripe bordered on either side by green mesophyll; apex obtuse and pungently apiculate. *Flowers* sessile, terminal on short-shoots, closely subtended by crowded leaves; flower-subtending bracts 6 or 7, reddish brown, scarious (the apex often pale and indurate), narrowly triangular, narrowly acute, the primary bract 2.5–3.5 mm long. *Sepals* ovate, 5–5.5 mm long, moderately to densely appressed-pubescent; midribs prominent; outer sepals pungently acuminate to shortly mucronate; inner sepals similar to the outer but less acuminate and broader. *Petals* 5, yellow, obovate, 5.5–8 mm long, deeply emarginate. *Stamens* 10, all on one side of the gynoecium and curving over it like a hand of bananas; filaments *c*. 0.5 mm long; anthers rectangular, *c*. 2 mm long, dehiscing by introrse, longitudinal slits. *Staminodes* absent. *Carpels* 2; ovaries compressed-globular, densely pubescent; styles curving excentrically from the carpel apex, 1.2–1.8 mm long. *Ovules* 4 per carpel. *Fruiting carpels* and seeds not seen.

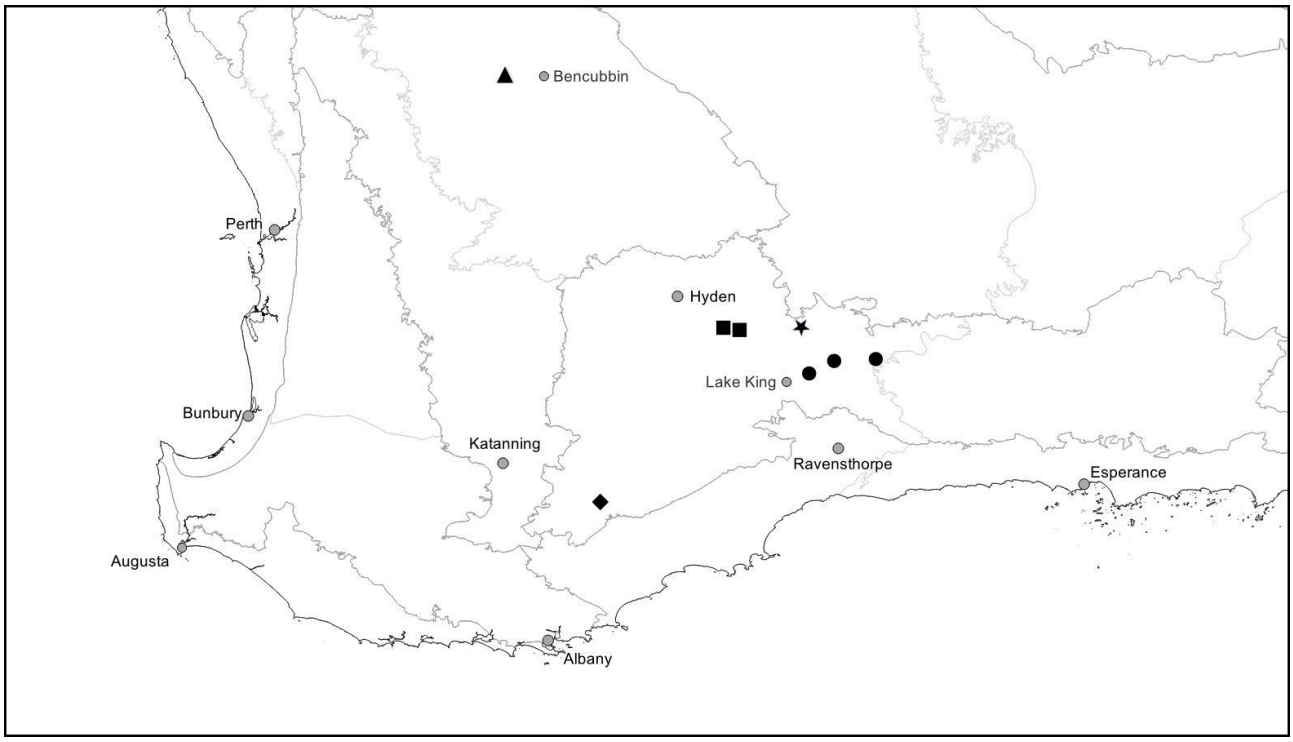

Figure 1. Distributions of the species dealt with in this paper: star—*H. axillibarba*; circles—*H. arenicola*; squares—*H. erioclada*; diamond—*H. lanulipes*; triangle—*H. elachophylla*.

Other specimens examined. WESTERN AUSTRALIA: (All PERTH): Mount Gibbs (7313691), Frank Hann National Park (3094065, 9261958, 9261990), near Lake Ace Nature Reserve (6232949).

For full specimen details, see the following batch search of the ALA for the above set of specimens: https://biocache.ala.org.au/occurrence/search?q=qid%3A1695029886183&qualityProfile=ALA&disableQualityFilter=scientificname#tab_mapView

Diagnostic features. May be discriminated from all other species of *Hibbertia* in Western Australia that have pungent, non-tuberculate, ericoid leaves by the combination of sessile flowers with shortly pungent, silky sepals, ten stamens, and four ovules per carpel.

Phenology. Flowering specimens have been collected in June, August and September.

Distribution and habitat. Occurs in south-western Western Australia, where known from a few scattered localities between Lake King and 90 Mile Tank in Frank Hann National Park. Occurs on undulating plains on sandy, loamy or somewhat clayey soils over laterite, in proteaceous-myrtaceous kwongan heath dominated by species of *Allocasuarina*, *Hakea*, *Melaleuca*, *Micromyrtus*, *Beaufortia*, *Banksia, Leptospermum*, *Isopogon*, *Petrophile* and *Callitris*.

Conservation status. Hibbertia arenicola is known from only three localities, one of which is in a conservation reserve. Its conservation status should be assessed.

Etymology. From the Latin *arena* (sand) with the suffix *-cola* (a dweller, inhabitant), in reference to the sand-plain habitat, in contradistinction to the rocky upland occupied by *H. axillibarba*.

Notes. Hibbertia arenicola and *H. erioclada* are superficially similar, sharing leaves densely crowded at the apices of short-shoots, leaving closely overlapping, peg-like hypopetioles when they are shed, and with margins recurved to abut the very broad midribs. The former has distinctly pungent sepals and glabrous hypopetioles and leaf laminas (sepals in *H. erioclada* are obtuse and apiculate, the hypopetioles are densely pubescent, and the leaf laminas are hairy and only tardily glabrescent). *Hibbertia axillibarba* is also superficially similar, but the midribs in that species are rather weak and the leaf margins are recurved to each other (at least when dried) so that the midrib is hidden (while in *H. arenicola* and *H. erioclada* the leaf margins are recurved to and closely abut the broad, prominent midrib).

Hibbertia erioclada K.R.Thiele, *sp. nov.*

Type: Western Australia: Intersection of Kulin-Holt Rock Road and Lily McCarthy Road, 17 Sept. 2021, *K.R. Thiele* 5757 (*holo*: PERTH 9369279; *iso*: AD, CANB).

Fig. 2.

Spreading to straggling *shrubs* to 0.4 m high, multi-stemmed at base and probably resprouting after fire; young branchlets comprising densely packed, thickened, densely white-pubescent, persistent leaf bases (hypopetioles). *Leaves* mostly crowded at the apices of

Figure 2. *Hibberia erioclada*, *K.R.Thiele* 5757.

short-shoots, erect at first then spreading, oblong, 5–8 mm long, 1.5–2 mm wide, the margins strongly recurved to the thickened, prominent midrib, obscuring the abaxial lamina; hypopetiole thickened, dark brown, densely pubescent (tardily glabrescent), forming a thickened peg on the stem surface when the leaf is mature; epipetiole very short, densely woolly-pubescent; adaxial lamina not tuberculate, sparsely hairy (tardily glabrescent); abaxial lamina (visible only by dissection) densely pubescent; abaxial midrib broad, level with or bulging above the margins, glabrous, often with a narrow central, yellowish sclerenchymatous stripe bordered on either side by green mesophyll; apex obtuse and pungently apiculate. *Flowers* sessile, terminal on short-shoots, closely subtended by crowded leaves; flower-subtending bracts 6–11, reddish brown, scarious, narrowly triangular, the primary bract 2.5–3.5 mm long. *Sepals* ovate, 5.5–6.5 mm long, moderately to densely appressed-pubescent; midribs prominent; outer sepals shortly acuminate; inner sepals similar to the outer but less acuminate and broader. *Petals* 5, yellow, obovate, 7–10 mm long, deeply emarginate. *Stamens* 10, all on one side of the gynoecium and curving over it like a hand of bananas; filaments *c.* 0.5 mm long; anthers rectangular, 1.8–2.2 mm long, dehiscing by introrse, longitudinal slits. *Staminodes* absent. *Carpels* 2; ovaries compressed-globular, densely pubescent; styles curving excentrically from the carpel apex, 2–2.2 mm long. *Ovules* 4 per carpel. *Fruiting carpels* and seeds not seen.

Other specimens examined. WESTERN AUSTRALIA: (All PERTH): Kulin - Holt Rock (6232914, 6232922).

For full specimen details, see the following batch search of the ALA for the above set of specimens: https://biocache.ala.org.au/occurrences/search?q=qid:1687433977986&qualityProfile=ALA&disableQualityFilter=scientific-name#tab_mapView

Diagnostic features. May be discriminated from all other species of *Hibbertia* in Western Australia that have pungent, non-tuberculate, ericoid leaves by the combination of sessile flowers with broad, shortly acuminate, silky sepals, ten stamens, and four ovules per carpel.

Phenology. Flowering specimens have been collected in September.

Distribution and habitat. Occurs in south-western Western Australia, where known from a few scattered localities between Kulin and Holt Rock. Occurs on plains on grey sandy-clay soils over laterite, in tall proteaceous-myrtaceous shrub-heath dominated by species of *Allocasuarina*, *Hakea*, *Banksia*, *Melaleuca*, *Leptospermum*, *Isopogon*, *Petrophile* and *Callitris*.

Conservation status. Hibbertia erioclada is known from only a few localities in a restricted area, none of which is in a conservation reserve. Its conservation status should be assessed.

Etymology. From the Greek *erion* (wool) and *klados* (a branch, twig or stem), in reference to the white-woolly young stems (with rather tightly packed, woolly, peg-like persistent hypopetioles).

Notes. *Hibbertia erioclada* and *H. arenicola* are superficially similar; see notes to *H. arenicola* for key differences. *Hibbertia axillibarba* is also superficially similar, but the leaf midribs in that species are rather weak and the leaf margins are recurved to each other (at least when dried) so that the midrib is hidden (while in *H. erioclada* the leaf margins are recurved to and closely abut the broad, prominent midrib).

Hibbertia elachophylla K.R.Thiele & T.Hammer, *sp. nov.*

Type: Western Australia: Narkal, between Bencubbin and Koorda, c. 100 m E of the junction of Narkal North

Figure 3. *Hibbertia elachophylla*, *K.R. Thiele* 5697.

Road and Narkal Road, along the track parallel to the rail line, 19 Aug. 2021, *K.R. Thiele* 5697 (*holo*: PERTH 9428119; *iso*: AD, CANB, MEL).

Fig. 3

Spreading to straggling *shrubs* 0.2–0.3(–0.5) m high, rather intricately but openly branched, multi-stemmed at base and probably resprouting after fire; young branchlets sparsely white-woolly at first, soon glabrous. *Leaves* mostly crowded at stem apices, erect at first then spreading, oblong, 2–3(–5) mm long, 0.6–1.2 mm wide, the margins revolute and meeting each other, obscuring the abaxial lamina and the rather weak, sunken midrib; petiole 0.6–1 mm long, the hypopetiole dark, ± glabrous and forming a peg on the stem when the leaves are mature, the epipetiole very short and densely white-woolly; adaxial lamina minutely muricate, glabrous except at the base where there are dense, curled-woolly, white hairs when young; abaxial surface and midrib (usually visible by dissection only) densely white-woolly; apex obtuse and pungently apiculate. *Flowers* sessile, terminal on short-shoots, closely subtended by crowded leaves; flower-subtending bracts 5–8, reddish brown, scarious, triangular, acute, the primary bract 2–2.5 mm long, the secondary bracts smaller. *Sepals* ovate, 4–5 mm long, sparsely to moderately pubescent with flexuose, sub-appressed to spreading hairs; midribs not prominent; outer sepals pungently acuminate to shortly mucronate; inner sepals similar to the outer but less acuminate and broader. *Petals* 5, yellow, obovate, 6–9 mm long, deeply emarginate. *Stamens* 10, all on one side of the gynoecium and curving over it like a hand of bananas; filaments 0.5–0.8 mm long; anthers rectangular, 1.5–2 mm long, dehiscing by introrse, longitudinal slits. *Staminodes* absent. *Carpels* 2; ovaries compressed-globular, densely pubescent; styles curving excentrically from the carpel apex, 1.2–1.5 mm long. *Ovules* 4 per carpel. *Fruiting carpels* and seeds not seen.

Other specimens examined. WESTERN AUSTRALIA: (All PERTH): Between Bencubbin and Koorda (3069745, 6232957, 9428127).

For full specimen details, see the following batch search of the ALA for the above set of specimens: https://biocache.ala.org.au/occurrence/search?q=qid%3A1710635504518&qualityProfile=ALA&disableQualityFilter=scientificname#tab_mapView

Diagnostic features. May be discriminated from all other species of *Hibbertia* in Western Australia by the combination of very small (2–3(–5) mm long) ericoid leaves with margins that recurve to each other, hiding the midrib, 10 stamens, and 4-ovulate carpels.

Phenology. Flowering specimens have been collected from mid-August to early October.

Distribution and habitat. Occurs in south-western Western Australia, where known only from the area around Narkal, between Bencubbin and Koorda. Occurs in low, open mallee-heath on a yellow sandplain.

Conservation status. Hibbertia elachophylla is known from only two localities, one of which is in a conservation reserve. Its conservation status should be assessed.

Etymology. From the Greek *elachys* (small, short) and *phyllon* (a leaf), in reference to the notably small leaves of the species.

Notes. *Hibbertia elachophylla* has unusually small leaves, but in other respects is morphologically fairly similar to *H. arenicola* and *H. erioclada*. Those species differ in having leaves with a robust midrib that the recurved margins tightly abut, rather than a weak, sunken midrib. *Hibbertia axillibarba* differs in having longer leaves and larger flowers with 2-ovulate carpels.

Hibbertia lanulipes K.R.Thiele, *sp. nov.*

Type: Western Australia: Gravel pit off Griffin Reward Road just N of the Dumbleyung-Lake Grace road, 15 Sept. 2019, *K.R. Thiele* 5577 (*holo*: PERTH 9262008; *iso*: AD, CANB, K, MEL).

Erect *shrubs* to 0.5 m high, multi-stemmed at base and probably resprouting after fire; young branchlets glabrous. *Leaves* scattered, spreading, oblong, (3–)4–6(–8) mm long, 1–1.2 mm wide, the margins strongly recurved to the prominent midrib, obscuring the abaxial lamina; petiole 0.5–1 mm long, the hypopetiole glabrous, dark brown, persistent as a woody peg on the stem, the epipetiole very short and densely woolly; adaxial lamina not tuberculate, minutely muricate, glabrous except at the very base where white-woolly; abaxial lamina (visible only by dissection) densely pubescent; abaxial midrib glabrous, minutely papillate laterally where it abuts the margins, rounded, ± level with the margins, with an obscure, pale sclerenchymatous central stripe bordered on either side by chlorenchyma; apex obtuse and shortly pungent-apiculate. *Flowers* sessile, terminal and terminating short-shoots; flower-subtending bracts 2 or 3, with a broadened pale base and a reddish-brown, scarious, narrowly triangular, acute lamina, the primary bract *c*. 1.5 mm long. *Sepals* broadly ovate to broadly elliptic, *c*. 5 mm long, the outer glabrous, the inner with sparse, minute substellate hairs where covered by the outer in bud; midribs not prominent; outer sepals shortly acuminate; inner sepals similar to the outer but less acuminate and broader. *Petals* 5, yellow, obovate, *c*. 7 mm long, broadly emarginate. *Stamens* 10, all on one side of the gynoecium and curving over it like a hand of bananas; filaments *c*. 0.7 mm long; anthers rectangular, *c*. 2 mm long, dehiscing by introrse, longitudinal slits. *Staminodes* absent. *Carpels* 2; ovaries compressed-globular, densely pubescent; styles curving excentrically from the carpel apex, *c*. 1.8 mm long. *Ovules* 4 per carpel. *Fruiting carpels* and seeds not seen.

Other specimen examined: near North Tarin Rock Nature Reserve, 28 July 1997, *M.S. Graham* 765 (PERTH 05051290).

Diagnostic features. May be discriminated from all other Western Australian *Hibbertia* species with stamens on one side of two pubescent carpels and shortly pungent glabrous leaves with the margins meeting the midrib below by the combination of densely woolly epipetioles, sessile flowers with glabrous outer sepals, and 4-ovulate carpels.

Phenology. The type specimen was flowering in mid-September.

Distribution & habitat. Occurs in south-western Western Australia, where currently known only from North Tarin Rock Nature Reserve and Neendaling west of Lake Grace, occurring in open shrub-mallee on white or brown sandy loam over laterite.

Conservation status. Hibbertia lanulipes is not currently known from land managed for conservation (although one occurrence is close to the boundary of a nature reserve); its conservation status should be assessed in the field.

Etymology. From the Latin *lanula* (diminutive of wool) and *pes* (a foot), in reference to the densely woolly epipetioles.

Notes. Hibbertia lanulipes is superficially similar to *H. stowardii*, sharing with it glabrous, smooth, ericoid leaves that are oblong in outline before contracting abruptly to a shortly pungent apex, and sessile flowers with ten stamens and no staminodes. However, *H. stowardii* has two ovules per carpel (four in *H. lanulipes*) and the epipetiole is quite glabrous.

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