Volume 22: 135–140
Publication date: 16 August 2019
dx.doi.org/10.7751/telopea13458

TELOPEA
Journal of Plant Systematics

The Royal Botanic Gardens & Domain Trust

plantnet.rbgsyd.nsw.gov.au/Telopea • escholarship.usyd.edu.au/journals/index.php/TEL • ISSN 0312-9764 (Print) • ISSN 2200-4025 (Online)

Zieria fordii and *Z. wilhelminae* (Rutaceae), two new and restricted Queensland species segregated from the morphologically similar and widespread *Z. cytisoides*.

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Abstract

Zieria fordii Duretto and *Z. wilhelminae* Duretto (Rutaceae), two species from the Cook and South Kennedy Districts of Queensland and morphologically similar to *Z. cytisoides* Sm., are newly described. Illustrations, an updated key to the genus *Zieria* in Queensland, and information on the distribution, conservation status, and ecology for both species are provided.

Introduction

Zieria cytisoides Sm. (Rutaceae), along with *Z. smithii* Jacks. and *Z. aspalathoides* A.Cunn. ex Benth., is one of the most widespread species of *Zieria*. All three of these species are found from north Queensland (Qld) to Victoria. *Zieria cytisoides* is a morphologically variable species, especially in indumentum density and in the size of the leaflets and flowers (Armstrong 2002; Duretto and Forster 2007; George *et al.* 2013). The species is distinguished from other species in *Zieria* by being erect, having leaves usually with a dense stellate indumentum on both surfaces, though this is variable on the adaxial surface, leaves and inflorescence parts that are not glandular verrucose, sepals that are deltate and densely indumented on the abaxial surface, prominent petals that are significantly longer than the sepals, and hairy fruit.

Plants recently identified as *Zieria cytisoides* from the two northernmost populations, Mount Emerald (c. 50 km SW of Cairns, Cook District, Qld) and Mount Jukes (c. 30 km NW of Mackay, South Kennedy District, Qld), though similar to typical *Z. cytisoides* in being erect and having leaves with a stellate indumentum on both surfaces, differ in other important characteristics. The material from Mount Emerald has narrowly deltate sepals that are slightly shorter to longer than the petals, and the material from Mount Jukes has glandular verrucose leaves and inflorescence parts as well as glabrous fruit. These differences warrant taxonomic recognition and *Z. fordii* Duretto, from Mount Emerald, and *Z. wilhelminae* Duretto, from Mount Jukes, are newly described below.

As circumscribed by Armstrong (2002), who did not cite specimens from either Mount Emerald or Mount Jukes, *Zieria cytisoides* occurs from Capella (c. 250 km SW of Mackay, Qld) to Victoria. The descriptions of *Z. cytisoides* given by Armstrong (2002) and George *et al.* (2013) do not include the diagnostic characters of either *Z. fordii* or *Z. wilhelminae* and accurately describe the variation seen in *Z. cytisoides* and Armstrong's

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circumscription is accepted here. George *et al.* (2013) though, did include Mount Emerald and Mount Jukes in their map of *Z. cytisoides* and list the collection made at Mount Jukes as one of the cited specimens, though they did not comment on morphological difference. *Zieria cytisoides* was not reviewed by Duretto and Forster (2007), who noted the species required critical study, and the collections from Mount Emerald and Mount Jukes were listed as they were not cited by Armstrong (2002) and represented an extension of range.

It is important to note that both *Zieria fordii* and *Z. wilhelminae* are known from very few and relatively recent herbarium collections that were made after 1990. Both species are restricted to fairly accessible areas that are close to large urban centres. *Zieria fordii* was discovered recently in existing herbarium collections when the opportunity arose to look through collections at the Australian Tropical Herbarium (CNS). From this discovery a review of herbarium collections of *Z. cytisoides* held at CNS, the National Herbarium of New South Wales (NSW) and the Queensland Herbarium (BRI) also revealed the presence of morphologically distinctive herbarium specimens assigned here to *Z. wilhelminae*. These serendipitous discoveries highlight the critical need for further general biological exploration and taxonomic work in Australia and the value of existing biological collections in which discoveries such as these are made.

Material and Methods

Specimens of *Zieria cytisoides*, *Z. fordii*, *Z. wilhelminae* and related species housed at the BRI, CNS and NSW were examined, and distinguishing features measured and documented. The holotype of *Z. cytisoides*, held in the Smith Herbarium of the Linnean Society of London (United Kingdom), was viewed online (http://linnean-online.org/smith_herbarium.html; accessed February 2019) to confirm the correct application of that species name.

Taxonomy

Zieria fordii* Duretto, *sp. nov.

Type: QUEENSLAND: Cook District: NW of Emerald near topo "1089" W of Tolga, 17°12'S, 145°24'E, 2 Jan 2009, *A. Ford 5451* (holotype: CNS 129794; isotypes: BRI AQ849111, CANB *n.v.*, HO *n.v.*, MEL 2455181 *n.v.*, NSW 921250).

Diagnosis: Differs from both *Zieria cytisoides* and *Z. wilhelminae* by having sepals slightly shorter to longer and wider than the petals (verses sepals shorter and narrower than petals), and smaller petals (2–2.5 mm long, versus 3.6–6 mm long for *Z. cytisoides*, and 2.5–3 mm long for *Z. wilhelminae*), and additionally, from *Z. wilhelminae* by having branches and inflorescence parts that are not obviously glandular (versus glandular-verrucose) and cocci with a dense stellate indumentum (versus glabrous).

Etymology: *Zieria fordii* is named after Andrew Ford (CSIRO Atherton) whose keen botanical eye, broad knowledge and excellent and numerous herbarium collections have added significantly to our knowledge of the Queensland flora.

Shrub, multi-stemmed, to 1.6 m tall; branches not glandular-verrucose, with a dense stellate indumentum with an occasional long simple hair; stellate hairs with rays to 0.5 mm long; simple hairs to 1 mm long. *Leaves* trifoliate, not glandular-verrucose, with a dense stellate indumentum; petiole to 1.5 mm long; leaflets elliptic to obovate, 9–20 mm long, 3–9 mm wide, secondary veins visible on abaxial surface, margin slightly recurved, tip obtuse. *Inflorescence* axillary, shorter than leaves,1–3-flowered, not glandular-verrucose, with a dense stellate indumentum; peduncle 1–2 mm long; bracts narrow lanceolate, 2–3 mm long, 0.2–0.5 mm wide; pedicels 1–3 mm long. *Flowers* 4-merous. *Sepals* narrow-deltate, 2–4 mm long, 1–1.5 mm wide, abaxial and adaxial surfaces with a dense stellate indumentum. *Petals* white, 2–2.5 mm long, c. 1 mm wide, abaxial surface with a dense stellate indumentum, adaxial surface glabrous apart from being pilose at tip. *Stamens* 4; filaments glabrous. *Ovary* and style with scattered stellate hairs. Cocci with a dense stellate indumentum, c. 3.5 mm long, c. 1.5 mm wide. *Seed* shiny black-grey, c. 2.5 mm long, c. 1.5 mm wide, with faint, longitudinal rows. (Figs 1, 2)

Distribution: The species is confined to Mount Emerald, c. 50 km south-west of Cairns.

Habitat and ecology: *Zieria fordii* is found in exposed heathland with scattered mallee on rhyolite as well as sheltered wet gullies. The species resprouts after fire (A Ford *pers. comm.*).

Flowering and Fruiting: Flowering material has been collected in January to July, and fruiting material in April to July.

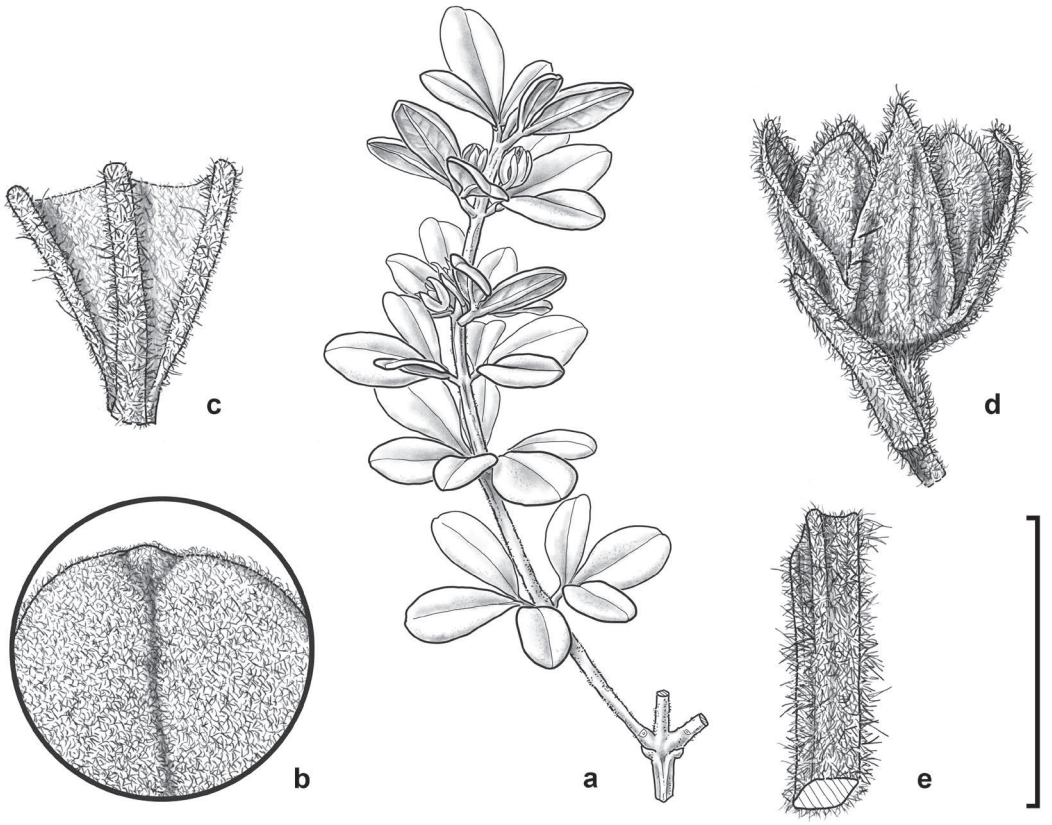


Fig. 1. *Zieria fordii*: a – habit; b – detail of adaxial surface of leaflet; c – detail of abaxial surface of leaflet; d – flower, side view; e – stem. a–e – *Ford 5451* (NSW). Scale bar = 2 cm for a; 0.33 cm for b–e. Illustration: L. Elkan.

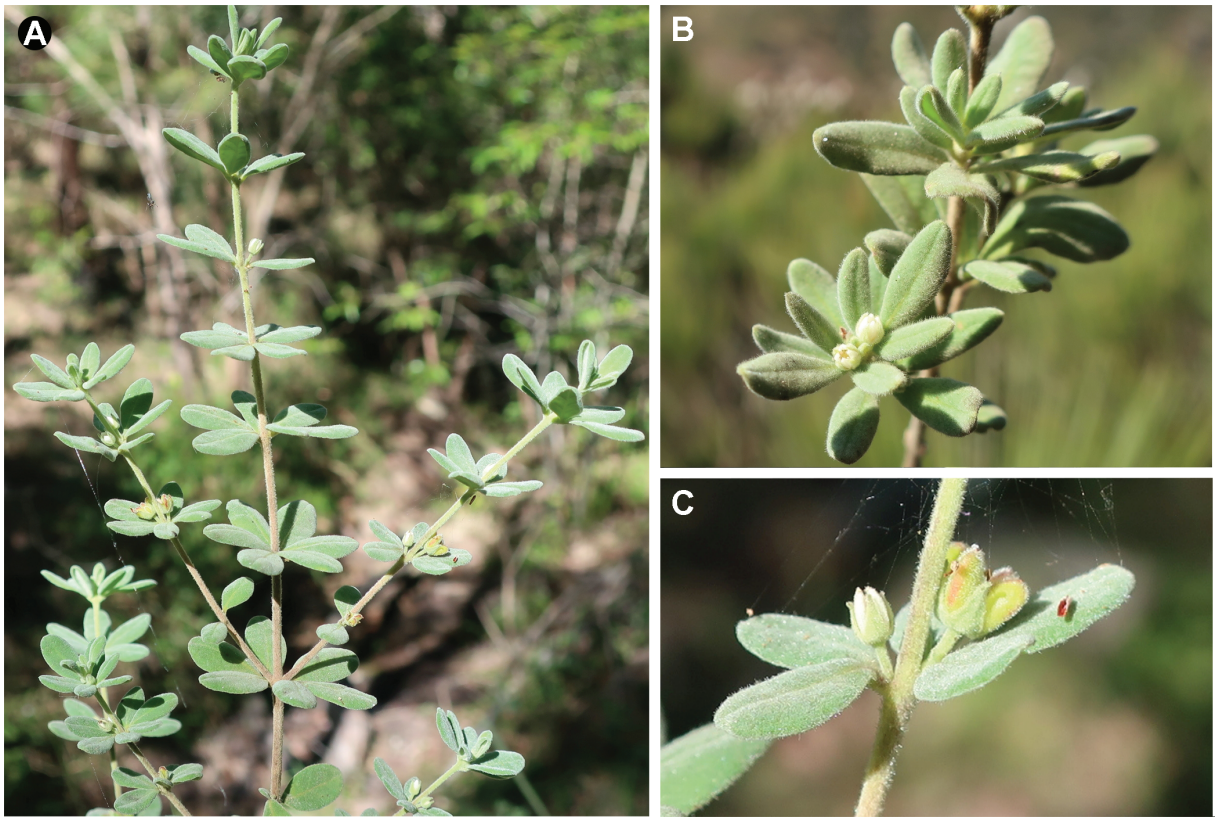


Fig. 2. *Zieria fordii*: a – branch; b – branch with flowers; c – branch with flowers and fruit. a and c – *Ford 6744* (CNS); b – *Ford 6743* (CNS). Photographs: A. Ford.

Conservation status: *Zieria fordii* is not currently listed as a threatened species under Federal or State legislation. The species would probably qualify to be formally listed as a threatened species using IUCN (2017) criteria as it is known from a single population of c. 300 plants (A Ford, *pers. comm.* 2019) that has a restricted geographic distribution. Surveys are required to ascertain the extent and size of the known population, if there are any additional populations, and whether there are any threats to the species. Mount Emerald has a wind power station and any expansion of that facility and associated infrastructure could pose a threat to *Z. fordii*.

Notes: Barrett *et al.* (2014, 2018) included one of the isotypes of *Zieria fordii* (*Ford 5451*, BRI AQ849111; called *Z. cytisoides* AF5451) in their molecular phylogenetic studies using chloroplast or nuclear DNA sequence data. Analysis of chloroplast DNA data resolved *Z. fordii* in a supported sister relationship with *Z. obcordata* (NSW) (Barrett *et al.* 2014), while the nuclear DNA resolved *Z. fordii* sister to *Z. whitei* (NE Qld), again with support (Barrett *et al.* 2018). Barrett *et al.* (2014, 2018) included a specimen of the typical form of *Z. cytisoides* in their analyses as well which came from central New South Wales. Chloroplast DNA data resolved this collection as part of a strongly supported polytomy with *Z. compacta* (SE Qld, NSW) and *Z. odorifera* (NSW), while the nuclear DNA resolved it, with strong support, with *Z. hydroscopica* (SE Qld). The conflict between the two analyses was significant (Barrett *et al.* 2018) and the taxa both *Z. fordii* and *Z. cytisoides* grouped with are not what these species are classified near on morphological grounds (see George *et al.* 2013). Barrett *et al.* (2018) discussed the widespread incongruence between the two datasets and concluded that incomplete lineage sorting, rather than introgression of the chloroplast DNA, would best describe the patterns observed.

Additional specimens seen: QUEENSLAND: Cook District: Mt Emerald, 17°12'S 145°24'E, 24 May 2000, *J. Holmes 177*, (BRI, CNS); Herberton Range, west of Tolga headwater of Rocky Creek, 17°12'S 145°25'E, 22 Apr 2011, *A. Ford 5839* (BRI, CANB *n.v.,* QRS); Great Dividing Range, southern approach to Mt Emerald, west of Tolga, 19 July 2019, *A Ford 6743* (CNS *n.v.* [photograph of plant seen]); Tributary of Rocky Creek, c.1 km east of Mt Emerald, west of Tolga, 19 Jul 2019, *A Ford 6744* (CNS *n.v.* [photograph of plant seen]).

Zieria wilhelminae* Duretto, *sp. nov.

Diagnosis: Differs from both *Zieria cytisoides* and *Z. fordii* by having glandular-verrucose branches and inflorescence parts (verses not glandular-verrucose) and glabrous cocci (versus with a dense stellate indumentum), and additionally from *Z. fordii* by the sepals being much shorter and narrower than the petals (versus slightly shorter to longer and wider).

Type: QUEENSLAND; South Kennedy District: Mount Jukes National Park [now Pioneer Peaks National Park], about 30 km NW of Mackay, 21°00'S 148°57'E, 16 May 1991, *A.R. Bean 3182* (holotype: BRI AQ505570; isotypes: CANB 711967 *n.v.*, MEL 0306828 *n.v.*, NSW 841343).

Etymology: *Zieria wilhelminae* is named after my mother, Wilhelmina (Willy) Duretto (nee Verhey) whose support, encouragement and overall positive attitude is one of the main reasons why I am a practicing systematist today. After emigrating to Australia from the Netherlands with her family, she grew up in Mount Martin in the Mackay area and visited friends who lived nearby at Mount Jukes.

Shrub, multi-stemmed, to 1.2 m tall; branches slightly glandular-verrucose, with a dense stellate indumentum; stellate hairs with rays to 0.1 mm long. *Leaves* trifoliate, slightly to noticeably glandular verrucose, raised glands are especially noticeable on the adaxial surface and on the abaxial midrib, abaxial surface with a dense stellate indumentum, adaxial surface with a moderately dense and minute stellate indumentum, indumentum becoming less dense with age; petiole 6–10 mm long; leaflets elliptic to oblanceolate, 16–33 mm long, 4–8 mm wide, secondary veins visible on abaxial surface, margin slightly recurved, tip acute. *Inflorescence* axillary, shorter than to slightly longer than leaves, glandular verrucose, with a dense stellate indumentum; peduncle 10–25 mm long; bracts narrow lanceolate, 1.5–3 mm long, linear; pedicels 1.5–2 mm long. *Flowers* 4-merous. *Sepals* deltate, 1–1.5 mm long, 1–1.5 mm wide, abaxial and adaxial surfaces with a dense stellate indumentum. *Petals* white, 2.5–3 mm long, c. 1.5 mm wide, abaxial surface with a dense stellate indumentum, adaxial surface glabrous apart from being pilose at tip. *Stamens* 4; filaments glabrous. *Ovary* and style glabrous. Cocci glabrous, 3–3.5 mm long, 1.5–2 mm wide. Mature seed not seen. (Fig. 3)

Distribution: The species appears to be confined to Mount Jukes, Pioneer Peaks National Park, 30 km north-west of Mackay, Queensland.

Habitat: *Zieria wilhelminae* is found on the upper slopes of Mount Jukes, in skeletal soils with *Hibiscus* spp. and *Leptospermum neglectum*.

Flowering and Fruiting: Flowering and fruiting material collected in May.

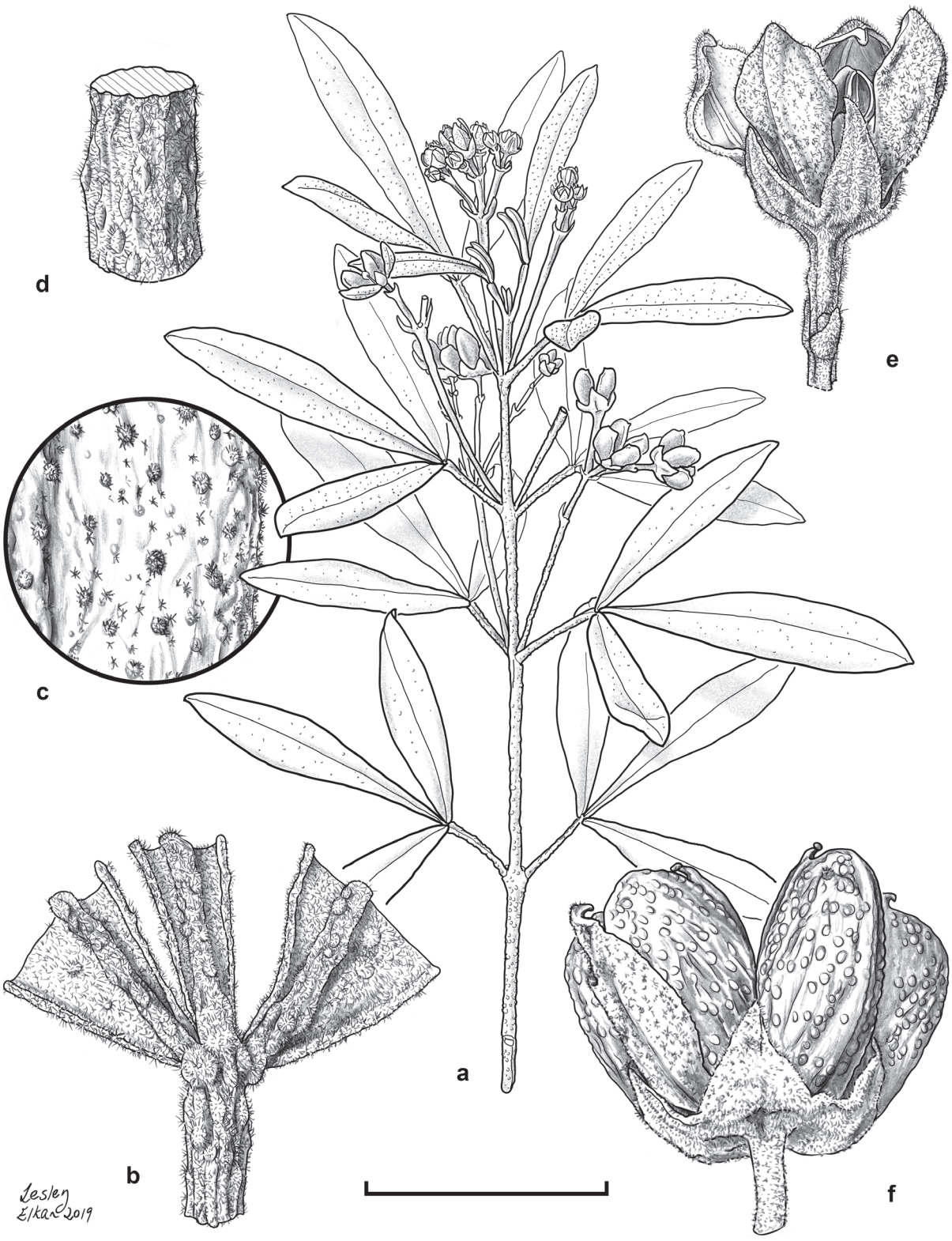


Fig. 3. *Zieria wilhelminae*: a – habit; b – detail of abaxial surface of leaflet; c – detail of adaxial surface of leaflet; d – stem; e – flower, side view; f – fruiting flower. a–e – *Bean 3184* (NSW). Scale bar = 2 cm for a; 0.33 cm for b–f. Illustration: L. Elkan.

Conservation status: *Zieria wilhelminae* is known from a single herbarium collection made in Pioneer Peaks National Park. The species is not currently listed as a threatened species under Federal or State legislation. It would probably qualify to be formally listed as a threatened species using IUCN (2017) criteria as it is known from a single population that has a highly restricted geographic distribution. Collection details associated with the herbarium specimen indicate that the species was common where found. Surveys in the Mount Jukes area are required to ascertain the extent and size of the known population, if there are any additional populations, and if there are any threats to the species.

Specimens: Known from the type material only.

Modified key to the species of *Zieria* found in Queensland, adapted from Duretto and Forster (2007)

Replace couplets 10 and 14 with:

10. Branches, and even the glands usually, densely tomentose 10a

    Young branches glabrescent or with a sparse indumentum between the glands, glands mostly glabrous 11

10a. Leaflets narrowly elliptic, 3.5–5.5 mm wide, tip obtuse; petals c. 2 mm long ..... **33. Z. vagans**

    Leaflets elliptic to oblanceolate, 4–8 mm wide, tip acute; petals 2.5–3 mm long..... **Z. wilhelminae**

14. Sepals slightly shorter to longer and wider than petals, 2–4 mm long; petals 2–2.5 mm long..... **Z. fordii**

    Sepals significantly shorter and narrower than petals, 1–3.5 mm long; petals 2–6 mm long..... 14a

14a. Leaflets elliptic to obovate with a length/width ratio 1.8–3.3, abaxial surface shaggy with hairs to 1 mm long, with prominently raised secondary veins; petals 3.6–6 mm long ..... **11. Z. cytisoides**

    Leaflets narrow-elliptic to oblong with a length/width ratio of 3.7–6, abaxial surface stellate tomentose with hairs less than 0.2 mm long, with obscure or slightly raised secondary veins; petals 2–2.5 mm long..... **32. Z. tenuis**

Acknowledgments

I would like to thank the Directors and staff of BRI, CNS and NSW for access to material, Lesley Elkan for Figures 1 and 3, and Andrew Ford for providing ecological information and photographs for *Z. fordii*.

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Manuscript submitted 29 May 2019, accepted 10 July 2019