Lobelia fenshamii N.G.Walsh & Albr. and *L. fontana* Albr. & N.G.Walsh (Campanulaceae: *Lobelioideae*), two new species endemic to artesian springs in central and south-western Queensland

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Summary

Albrecht, D.E., Walsh, N.G., Jobson, R.W. & Knox, E.B. (2020). *Lobelia fenshamii* N.G.Walsh & Albr. and *L. fontana* Albr. & N.G.Walsh (Campanulaceae: *Lobelioideae*), two new species endemic to artesian springs in central and south-western Queensland. ***Austrobaileya* 10(4): 583–593**. *Lobelia fenshamii* and *L. fontana*, endemic to artesian springs in central and south-western Queensland, are described and illustrated, with notes on distribution, habitat, conservation status and features distinguishing them from closely related species of *Lobelia* and *Isotoma*.

Key Words: Campanulaceae; *Lobelioideae*; *Lobelia*; *Isotoma*; *Lobelia fenshamii*; *Lobelia fontana*; *Isotoma fluviatilis*; Australia flora; Queensland flora; new species; taxonomy; conservation status; artesian springs

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Introduction

Although *Isotoma* (R.Br.) Lindl. is currently recognised as distinct from *Lobelia* L. in Australia (CHAH 2020), recent molecular data (Knox *et al.* 2006; Antonelli 2008; Knox & Li 2017; E.B. Knox unpubl. data) place *Isotoma* species and many southern hemisphere *Lobelia* species in a predominantly Australasian clade that originated in Australia. Lammers (2011) assigned species in this clade to *Lobelia* section *Hypsela* (C.Presl) Lammers although he did not provide combinations for those species of *Isotoma* lacking available names in *Lobelia*. Further sampling and analyses are underway to improve the phylogenetic resolution and resolve generic limits prior to making nomenclatural changes. In the absence of a final resolution on the status of *Isotoma*, Heenan *et al.* (2008) described three new species from New Zealand in *Lobelia* despite them all having an entire or weakly cleft corolla tube, a feature traditionally regarded a characteristic of *Isotoma*. Albrecht *et al.* (2018) adopted a similar approach when describing *Lobelia claviflora* Albr. & R.W.Jobson, a species with a weakly cleft corolla tube. For consistency the two new species described herein are named as species of *Lobelia* rather than *Isotoma*, while acknowledging that the generic limits of *Lobelia* and status of *Isotoma* are still not fully resolved.

The two new species are artesian spring endemics and have highly restricted distributions. The ecology of springs of the Great Artesian Basin has received considerable study in recent years, with numerous endemic species of flora and invertebrate fauna identified (e.g. Commonwealth of Australia 2014; Fensham *et al.* 2016b). The number and quality of intact springs has been dramatically reduced since European settlement because of groundwater extraction, and it is believed that the extinction of endemic plants and animals

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has occurred (Rossini *et al.* 2018). While the capping of bores that have historically depleted the aquifer has partly been completed, the security of remaining functional springs remains threatened by continuing damage by stock, feral animals (e.g. pigs) and, potentially, mining and coal-seam gas extraction (Fensham *et al.* 2010). These artesian spring-fed ecosystems are listed as Endangered under the Australian *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) with any proposed developments requiring referral (Doody *et al.* 2019). Consequently, there is a conservation imperative for as-yet undescribed species to be elucidated to assist future actions that may serve to secure or enhance remaining springs.

Materials and methods

The descriptions are based on fresh, field-collected plants, herbarium specimens and transplants grown in cultivation at the Alice Springs Desert Park (ASDP) nursery, Australian National Botanic Gardens (ANBG) nursery, and a private garden in Sydney. Floral measurements were taken from fresh, spirit or rehydrated material. Hypanthium features were assessed at flowering stage unless otherwise stated. Corolla tube length was measured from the corolla base (where it becomes distinct from the hypanthium) to the sinuses between the three lobes of the lower lip, thus including the proximal part of the lower lip where the three lobes are fused. The length of the upper two corolla lobes was measured as the distance between the tip of the lobe and sinus between the upper (2-lobed) and lower (3-lobed) lips. The length of the lateral lobes of the lower lip was measured as the distance between tip of the lobe and sinus between the lateral and central lobe of the lower lip. The length of staminal filaments was measured as the distance between the points where they join the anther tube and hypanthium. All dimensions are inclusive, *viz.* 1.0–1.7 is given as 1–1.7.

Taxonomy

1. Lobelia fenshamii N.G.Walsh & Albr. **sp. nov.** with affinity to *Isotoma fluviatilis* (R.Br.) F.Muell. ex Benth., differing in its smaller, slightly more actinomorphic corollas that lack both contrasting yellow–green patches in the throat and a contrasting darker transverse colour band towards the base of the lower 3 lobes, shorter calyx lobes, almost entirely connate staminal filaments that are wholly free of the corolla and indehiscent fruits. Also with affinity to *Lobelia fontana*, but differing in its smaller corollas, shorter hypanthium, shorter calyx lobes, shorter anther tube, absence of bracteoles, shorter and differently shaped fruits that tend to be downturned into the soil, and seeds with a vermiculate surface pattern. It superficially resembles *Lobelia irrigua* R.Br. but that species has unisexual flowers, a deeply cleft corolla tube, shortly connate staminal filaments, longer fruits and seeds with a reticulate-alveolate surface pattern. **Typus:** Queensland. MITCHELL DISTRICT: Myross, E of Aramac, 15 May 2000, *R.J. Fensham 3883* (holo: BRI).

Isotoma sp. (Myross R.J. Fensham 3883); Forster (2007: 41, 2010: 36, 2018, 2020); CHAH (2020).

Herbaceous semi-aquatic rhizomatous perennial *forb*, completely prostrate and loosely mat-forming or ascending slightly (to *c.* 4 cm high), rooting at the nodes. *Stems* terete, zig-zagged, glabrous, often spongy or hollow. *Leaves* distichous, alternate, sessile or with a petiole-like base to *c.* 2.5 mm long; lamina narrowly to broadly elliptic, ovate or obovate (often markedly different leaf shapes occurring synchronously on the same plant), flat or convex, rather thick-textured and rigid, 1.5–6(–10) mm long, 0.6–2(–6) mm wide, l:w ratio 1.4–3:1, pale green to yellowish green, glabrous, with 1-few minute embedded marginal glands on each side, margin entire or minutely indented corresponding with position of a gland, apex obtuse to rounded, usually with a minute embedded apical gland, base attenuate or rather abruptly tapered to a petiole-like base. *Flowers* bisexual, solitary in axils. *Bracteoles* absent. *Pedicels* 2–8 mm long (3–10 mm in fruit), not or barely exceeding subtending leaf in flower, up to *c.* twice as long as leaf in fruit, glabrous, widely spreading or reflexed when fruiting, tending to bury the fruit into the substrate. *Hypanthium*

obconical to obovoid or ellipsoid, 1.5–2.1 mm long, 1–1.4 mm wide, glabrous. *Calyx lobes* erect in flower and fruit, triangular, 0.3–0.6 mm long and wide, glabrous, entire. *Corolla* almost actinomorphic, rotate to campanulate, very weakly 2-lipped, 1.5–2.8 mm long, wholly and evenly white to pale cream or rarely with pinkish veins on abaxial side of lobes; corolla lobes linear-lanceolate to triangular, 1.3–1.6 mm long, 0.6–0.8(–1.1) mm wide, spreading with slightly recurved acute tips, glabrous; tube 0.5–1.3 mm long, expanding slightly from base, *c.* 1.5 mm diam. at throat, slightly to distinctly longer than calyx lobes, not or weakly cleft on dorsal side to within 0.5–1 mm of base, glabrous or with a few spreading hairs internally towards base. *Staminal filaments* 0.7–1(–1.2) mm long, connate for all but up to 0.2 mm at base, attached at apex of hypanthium, entirely free from the corolla tube, glabrous. *Anther tube* more than half to almost fully exserted beyond dorsal corolla tube sinus, 0.7–1 mm long, greyish-blue or purplish, glabrous except around the apical orifice, two ventral anthers each with an apical seta 0.2–0.3 mm long and an associated tuft of finer hairs 0.1–0.2 mm long, dorsal anthers glabrous apically. *Style* glabrous; stigmatic lobes 2, elongate-hemispherical. *Fruit* obovoid to broadly ellipsoid or globose, slightly compressed laterally, 2–3 mm long, 1.4–2.7 mm wide, glabrous, inconspicuously veined; apical portion raised 0.5–0.7 mm above the rim of the hypanthium, apparently indehiscent and releasing seeds through rupture or rotting of the thin walls; persistent calyx lobes erect, not accrescent. *Seeds c.* 20 per capsule, ellipsoid to broadly ellipsoid, slightly compressed, 0.5–0.7 mm long, (0.25–)0.3–0.45 mm wide, pale to mid-brown; testa with a network of wavy ridges (vermiculate). **Figs. 1 & 2**.

***Additional specimens examined*: Queensland.** South Kennedy District: 'Doongmabulla' NW of Clermont, Feb 1999, *Fensham 3336* (BRI). Mitchell District: Edgbaston, E of Aramac, Feb 1998, *Fensham 3334* (BRI); Edgbaston, Aramac, Mar 1995, *Chuk E10 & Wylks* (BRI); First Spring, Edgbaston Reserve, E of Aramac, Apr 2012, *Bean 31636* (BRI). Warrego District: Yowah Creek Springs, Bundoona, Feb 2005, *Fensham 5233* (BRI); *ibid*, Dec 2012, *Silcock 1430* (IND, MEL); *ibid*, Jun 2015, *Silcock s.n.* (MEL); *ibid*, May 2017, *Albrecht 15027* (CANB).

***Distribution and habitat*:** *Lobelia fenshamii* occurs at two spring complexes in central Queensland (near Barcaldine and near Clermont) and one in south-central Queensland (near Eulo). These sites are in the Mitchell Grass Downs, Desert Uplands and Mulga Lands bioregions (Department of the Environment and Energy 2013) respectively.

Lobelia fenshamii is confined to shallow pools and seepage areas formed from artesian springs. The associated vegetation is sedgy grassland or shallow aquatic herbland with commonly associated species including *Cyperus laevigatus* L., *Eragrostis fenshamii* B.K.Simon, *Eriocaulon carsonii* F.Muell., *Fimbristylis dichotoma* (L.) Vahl, *F. ferruginea* (L.) Vahl, *Myriophyllum artesium* Halford & Fensham, *Sporobolus pamelae* B.K.Simon and *Utricularia fenshamii* R.W.Jobson. The soils are neutral-alkaline clayey sands and remain permanently wet.

***Phenology*:** Flowers have been noted all year round.

***Notes*:** *Lobelia fenshamii* has been informally known as *Isotoma* sp. (Myross R.J.Fensham 3883) (Forster 2007, 2010, 2018, 2019), sharing with other species of *Isotoma* an entire, or very shortly cleft corolla tube. Preliminary molecular data indicate that *L. fenshamii* is sister to *L. fontana* (described herein) (Knox *et al.*, unpublished data). It most resembles *Isotoma fluviatilis* (with three subspecies currently recognised) and *Lobelia fontana*, in having flowers with an entire (or very nearly entire) corolla tube and prostrate, mat-forming habit. The generally wet habitat is common to all three species. It differs from all three subspecies of *I. fluviatilis* in its slightly more actinomorphic, smaller corollas (1.5–2.8 mm long, vs. 3–16 mm long for *I. fluviatilis*) that lack both contrasting yellow–green patches in the throat and a contrasting darker transverse colour band towards the base of the lower 3 lobes, shorter calyx lobes (0.3–0.6 mm long, vs. (0.5–)0.7–2.5 mm long), almost entirely connate staminal filaments (vs. connate for less than half their length) that are wholly free of the corolla (vs. adnate for 0.9-4 mm) and in its indehiscent (vs. dehiscent) fruits. Further differences are apparent for individual

Fig. 1. ***Lobelia fenshamii***, showing flowers, immature fruits and leaf variation (cultivated plant ex *Albrecht 15027*, CANB). Photo: D. Albrecht.

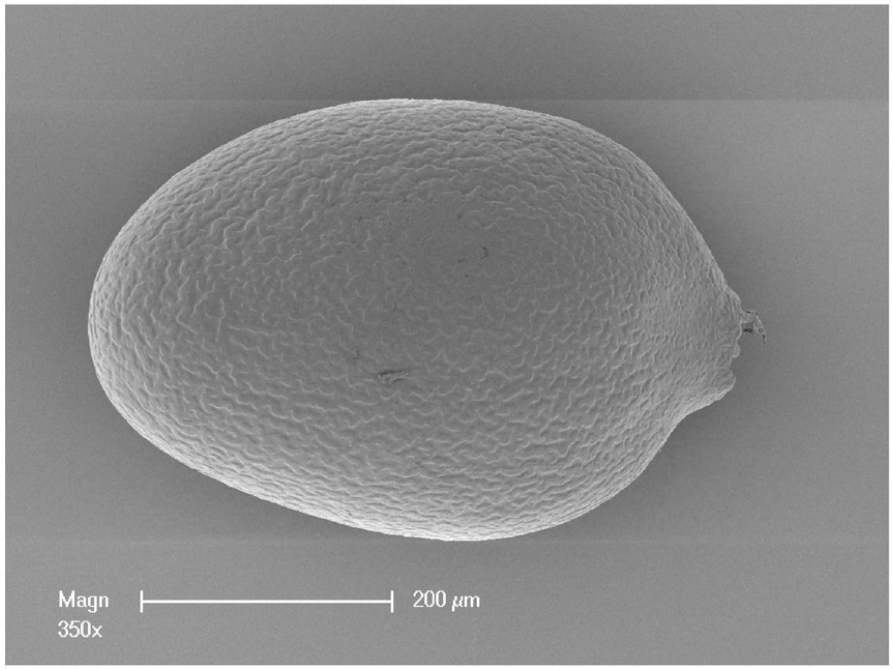

Fig. 2. ***Lobelia fenshamii*** seed (population voucher *Silcock s.n.*, MEL).

subspecies of *I. fluviatilis*; for example, flowers are unisexual in subsp. *fluviatilis* (vs. bisexual in *L. fenshamii*) and the lower three corolla lobes have conspicuous spreading hairs on the adaxial surface in *I. fluviatilis* subsp. *australis* McComb and *I. fluviatilis* subsp. *borealis* McComb (vs. glabrous in *L. fenshamii*). All populations of *I. fluviatilis* are at least 650 km away from the closest population of *L. fenshamii*. *Lobelia fenshamii* differs from *L. fontana* in its smaller corollas (1.5–2.8 mm long, vs. 6–9.5 mm long), shorter hypanthium (1.5–2.1 mm long, vs. 3.5–7 mm long), shorter calyx lobes (0.3–0.6 mm long, vs. 1.1–1.8 mm long), shorter anther tube (0.7–1 mm long, vs. 1.5–2 mm long), absence of bracteoles (vs. present but minute), shorter and differently shaped fruits (2–3 mm long and obovoid to broadly ellipsoid or globose, vs. > 4.5 mm long and obconical) that tend to be downturned into the soil rather than prostrate on it and seeds with a vermiculate (vs. areolate) surface pattern. *Lobelia fenshamii* superficially resembles some forms of the variable *L. irrigua*, but that species has unisexual flowers, a deeply cleft corolla tube, shortly connate staminal filaments, longer fruits (5–8 mm long) and seeds with a reticulate-alveolate surface pattern.

***Conservation status*:** *Lobelia fenshamii* is known from three localities, none larger than 6 km^2; *c.* 100 km north of Barcaldine ('Edgbaston' and adjacent 'Myross'), *c.* 165 km NW of Clermont ('Doongmabulla') and *c.* 35 km NE of Eulo ('Yowah Creek'). The distance between the northernmost and southernmost localities is about 665 km. Eighteen subpopulations are distributed between Edgbaston/Myross (14) and Doongmabulla (4), while the Yowah Creek locality consists of a single subpopulation, but is the largest of all the subpopulations. There have been extensive surveys of springs of the Great Artesian Basin suggesting further populations are unlikely to be found, but it is likely that other populations existed prior to stocking and establishment of bores (Commonwealth of Australia 2014; Fensham *et al.* 2016b).

The Myross and Yowah Creek subpopulations occur on properties managed primarily for cattle. The Doongmabulla property is also managed for stock but the subpopulations are protected by a Nature Refuge Agreement. The subpopulations located on the Bush Heritage Australia property 'Edgbaston' are managed for conservation (R. Fensham pers. comm.).

Approximately half of the artesian springs recorded from Queensland have ceased to flow since European settlement due to water extraction through artificial bores, including many in the Barcaldine supergroup, which includes Doongmabulla and Edgbaston (Fensham *et al.* 2016a; Fahey *et al.* 2019). A government bore-capping program has helped to reduce the dramatic decline in functional springs; however, the exact outcomes of this program have not been evaluated (GABCC 2014). An impending threat to the Doongmabulla population is potential draw-down associated with the development of the Adani Carmichael Mine (Fensham *et al.* 2016b; Currell *et al.* 2017).

Although apparently not grazed, *Lobelia fenshamii* may become trampled into the ground where the population density of cattle or goats is high and/or concentrated on springs. Pigs remain a minor threat at some sites. Applying IUCN criteria (IUCN 2012), the risk assessment produces a result for *L. fenshamii* of **Endangered** (EN, B2ab), based on Area of Occupancy (AOO) <250 km^2, fragmented occurrence – fewer than 10 locations, and projected continuing reduction in area of occupation, number of subpopulations and mature individuals. This species is currently listed as **Vulnerable** under the Queensland *Nature Conservation Act 1992.*

Attempts to cultivate the species have been successful in the short, but not long term. It is recommended that seeds are collected and stored in a recognised seed bank, and that research is undertaken to understand germination requirements.

***Etymology*:** The specific epithet honours Dr Rod Fensham of the Queensland Herbarium (BRI) and Department of Biological Sciences, The University of Queensland (UQ), whose outstanding ecological research on artesian springs has been instrumental in drawing attention to the importance of conserving these unique environments.

2. Lobelia fontana Albr. & N.G.Walsh **sp. nov.** with affinity to *Isotoma fluviatilis*, differing in its corolla lacking both contrasting yellow-green patches in the throat and a contrasting darker transverse colour band towards the base of the lower 3 lobes (rarely a very faint pinkish line transverses the base of the central lobe of the lower lip), often longer hypanthium, staminal filaments connate for greater than half their length and indehiscent fruits. Also with affinity to *Lobelia fenshamii*, differing in its larger corolla, longer hypanthium, longer calyx lobes, longer anther tube, presence of minute bracteoles, longer obconical fruits that tend to be prostrate on the soil surface and seeds with a different surface pattern. **Typus:** Queensland. Gregory North District: Elizabeth Springs, *c.* 100 km SE of Boulia, 24 February 1999, *R.J. Fensham 3676* (holo: BRI [1 sheet & spirit material]).

Isotoma sp. (Elizabeth Springs R.J.Fensham 3676); Forster (2018, 2020).

Herbaceous semi-aquatic rhizomatous perennial *forb*, prostrate and mat-forming, rooting at the nodes. *Stems* terete, straight to weakly zig-zagged, glabrous. *Leaves* distichous, alternate, sessile or with a petiole-like base to *c.* 2.5 mm long; lamina obovate or elliptic, rarely ovate, flat, rather thick-textured, 4–13.5 mm long, (1.5–)2–6.5(–7.2) mm wide, l:w ratio 1.5–2.5:1, glossy green, glabrous, margins entire or with few minute inconspicuous teeth or indentations, the teeth or indentations corresponding with position of a gland, apex obtuse to rounded, with a minute embedded apical gland, base attenuate or gradually tapered to a petiole-like base. *Flowers* bisexual, solitary in axils. *Bracteoles* linear, 0.1–0.3 mm long, inconspicuous at base of pedicel. *Pedicels* 2.5–13 mm long, not or scarcely elongating in fruit, shorter or longer than subtending leaf, glabrous, tending to be prostrate in fruit. *Hypanthium* cylindric-obconical to obconical, narrowed abruptly just below calyx lobes, 3.5–7 mm long, 1.7–2.5 mm wide, glabrous. *Calyx lobes* erect in flower and fruit, narrowly triangular to triangular, 1.1–1.8 mm long, glabrous, entire. *Corolla* very weakly zygomorphic, almost actinomorphic, very weakly 2-lipped, 6–9.5 mm long, wholly and evenly white to pale cream except for an inconspicuous green region at the base of the tube internally, rarely with either a very faint pinkish tinge on the external surface of the tube or lobes, a faint touch of pink near the sinuses between the lobes or a very faint pinkish transverse line across the base of the central lobe of the lower lip; upper lip 2-lobed, the lobes triangular-lanceolate to elliptic, 4–6.2(–7.2) mm long, 1–2 mm wide, spreading with recurved acute tips, glabrous; lower lip 3-lobed, the lobes basally fused for (0–)0.3–1.3 mm above sinus with upper lip, lobes triangular, broadly lanceolate or elliptic, 3.7–6.5 mm long, 1–2.2 mm wide, spreading with recurved acute tips, glabrous; tube 2.3–3.5 mm long, 1.2–1.8 mm diameter at base broadening to 1.5–3 mm diameter at apex, weakly cleft on dorsal side to within 2–3.2 mm of base, glabrous externally, with spreading to reflexed hairs towards the base internally. *Staminal filaments* 3–4.2 mm long, connate distally for (1.5–)2–3.5 mm, although the connate part readily splitting between the filaments, adnate to the base of the corolla tube for 0.2–1.7 mm, glabrous or with sparse inconspicuous hairs on inner surface. *Anther tube* fully exserted beyond dorsal corolla tube sinus, 1.5–2 mm long, greyish-blue to purplish or yellow-brown, glabrous except around the apical orifice, two ventral anthers each with an apical seta 0.25–0.5 mm long and an associated tuft of finer hairs 0.05–0.2 mm long, dorsal anthers glabrous apically. *Style* glabrous; stigmatic lobes 2, elongate-hemispherical. *Fruit* obconical, not or slightly compressed laterally, 4.5–5.5 mm long (but possibly up to *c.* 8 mm), 2.2–2.5 mm wide, glabrous, veins not evident; apical portion raised 0.6–1.3 mm above the rim of the hypanthium, apparently indehiscent and releasing seeds through rupture or rotting of the fruit walls; persistent calyx lobes erect,

Fig. 3. ***Lobelia fontana***, showing flowers and immature fruits (population voucher *Fensham 6411*, BRI). Photo: S. Peck.

Fig. 4. ***Lobelia fontana*** flower (cultivated plant ex *Jobson 2626*, NSW). Photo: A.E. Orme.

Fig. 5. ***Lobelia fontana*** immature fruit with withered corolla (cultivated plant ex *Jobson 2626*, NSW). Photo: A.E. Orme.

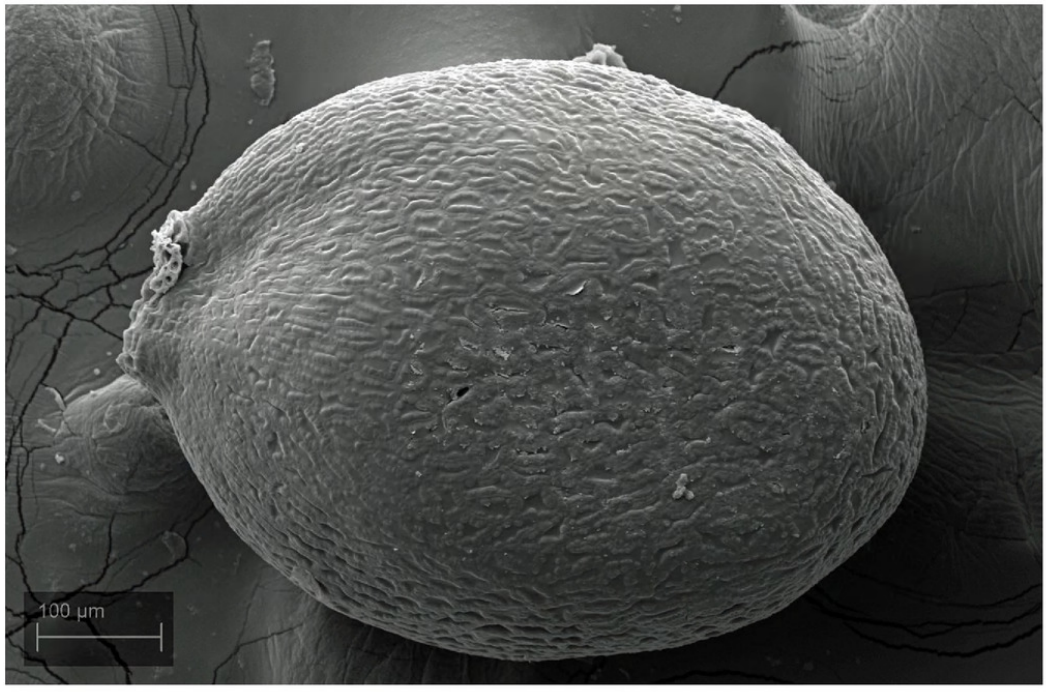

Fig. 6. ***Lobelia fontana*** seed (population voucher *Jobson 2626*, NSW).

not accrescent. *Seeds* mid-brown, ellipsoid to broadly ellipsoid, slightly compressed, 0.55–0.6 mm long, *c.* 0.45 mm wide; testa with a network of ridges enclosing irregular spaces (areolate). **Figs. 3–6**.

***Additional specimens examined*: Queensland.** GREGORY NORTH DISTRICT: Elizabeth Springs, Mar 2014, *Fensham 6411*, (BRI); *ibid*, Apr 2015, *Jobson 2626* (NSW).

***Distribution and habitat*:** *Lobelia fontana* is known only from Elizabeth Springs in central western Queensland (SE of Boulia) in the Mitchell Grass Downs bioregion (Department of the Environment and Energy 2013). This population is very isolated with no other Campanulaceae: *Lobelioideae* recorded within at least a 150 km radius of Elizabeth Springs.

Lobelia fontana is restricted to seepage areas formed from artesian springs. It occurs in sedgy grassland, particularly where the vegetation is short, and is commonly associated with *Eragrostis fenshamii*, *Cyperus laevigatus*, *Eriocaulon carsonii*, *Fimbristylis dichotoma* and *Utricularia ameliae* R.W.Jobson. The soils are mineralised clayey sands and remain permanently wet.

***Phenology*:** Flowers have been noted from October to May; however, observations are limited and it may have a more extended flowering season.

***Notes*:** *Lobelia fontana* has been informally known as *Isotoma* sp. (Elizabeth Springs R.J. Fensham 3676) (Forster 2018, 2020), sharing with other species of *Isotoma* a very shortly cleft corolla tube. Preliminary molecular data indicate that *L. fontana* is sister to *L. fenshamii* (Knox *et al.*, unpublished data). It most resembles *Isotoma fluviatilis* (with three subspecies currently recognised) and *Lobelia fenshamii* (described herein), in having flowers with a very weakly cleft corolla tube and prostrate, mat-forming habit. The generally wet habitat is common to all three species. It differs from all three subspecies of *I. fluviatilis* in its corolla lacking both contrasting yellow-green patches in the throat and a contrasting darker transverse colour band towards the base of the lower three lobes (rarely a very faint pinkish line traverses the base of the central lobe of the lower lip), often longer hypanthium (3.5–7 mm long, vs. 1–4.5 mm long in *L. fluviatilis*), staminal filaments connate for greater than half their length (vs. connate for less than half their length) and indehiscent (vs. dehiscent) fruits. Further differences are apparent for individual subspecies of *I. fluviatilis*, for example flowers are unisexual in *I. fluviatilis* subsp. *fluviatilis* (vs. bisexual in *Lobelia fontana*) and the lower three corolla lobes have conspicuous spreading hairs on the adaxial surface in *I. fluviatilis* subsp. *australis* and *I. fluviatilis* subsp. *borealis* (vs. glabrous in *L. fontana*). The nearest population of *I. fluviatilis* to Elizabeth Springs is *c.* 1200 km to the south east. *Lobelia fontana* differs from *L. fenshamii* in its larger corollas (6–9.5 mm long, vs. 1.5–2.8 mm long), longer hypanthium (3.5–7 mm long, vs. 1.5–2.1 mm long), longer calyx lobes (1.1–1.8 mm long, vs. 0.3–0.6 mm long), longer anther tube (1.5–2 mm long, vs. 0.7–1 mm long), presence (vs. absence) of minute bracteoles, longer differently shaped fruits (> 4.5 mm long and obconical, vs. 2–3 mm long and obovoid to broadly ellipsoid or globose) that tend to be prostrate on the soil surface rather than downturned into the soil and seeds with surface ridges that are not strongly wavy (vs. vermiculate). The nearest population of *L. fenshamii* to Elizabeth Springs is at Edgbaston *c.* 500 km due east south east.

The description of *Lobelia fontana* is based on rather limited material, especially with respect to fruits and seeds.

***Conservation status*:** *Lobelia fontana* is known from a single location and is the most restricted of all Queensland artesian spring endemics. Its extent of occurrence is estimated to be as low as 0.09 km^2, with the largest patch being only *c.* 25 m^2 (S. Peck pers. comm., 2010). Determining the number of plants present is difficult due to the growth habit of the species and molecular techniques may be required to establish how many genotypes are contained in the population. A working estimate of < 100 individuals is presently being used. The entire population occurs within the Elizabeth Springs Conservation

Park, which is fenced to exclude livestock and feral pigs. However, the fence has been breached on at least one occasion and it is unlikely that difficulties in maintaining secure fencing will be overcome in the foreseeable future (R. Fensham pers. comm.). Digging by pigs remains a potential significant threat as a single serious event could render the species extinct. Regular checks for fence breaches and pig damage within the conservation park should continue indefinitely and management actions undertaken immediately as required. Applying IUCN criteria (IUCN 2012), the risk assessment produces a result for *L. fontana* of **Critically Endangered** (CR). *Lobelia fontana* qualifies as CR based on B2ab (AOO < 10 km^2, known to exist at a single location, and projected continuing decline in area of occupation, quality of habitat and mature individuals) and C2aii (population size < 250 mature individuals, with a projected decline in population size, and all mature individuals occurring in a single population). This species is currently listed as **Endangered** under the Queensland *Nature Conservation Act 1992*.

Attempts to cultivate *Lobelia fontana* have achieved similar results to those for *L. fenshamii* with some short, but not long-term success. It is recommended that seeds are collected and stored in a recognised seed bank as a matter of urgency, and that research is undertaken to understand germination requirements.

***Etymology*:** The specific epithet is from the Latin *fons*, spring of water, in reference to the artesian spring habitat of this species.

Acknowledgements:

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References:

Albrecht, D.E., Jobson, R.W., Walsh, N.G., & Knox, E.B. (2018). *Lobelia claviflora* (Campanulaceae: Lobelioideae), a new species from northern New South Wales, Australia. *Telopea* 21: 121–127.

Antonelli, A. (2008). Higher level phylogeny and evolutionary trends in Campanulaceae subfam. Lobelioideae: Molecular signal overshadows morphology. *Molecular Phylogenetics and Evolution* 46: 1–18.

Chah (2020). *Australian Plant Census*. https://biodiversity.org.au/nsl/services/apc, accessed 24 February 2020.

Commonwealth of Australia (2014). *Ecological and hydrogeological survey of the Great Artesian Basin springs - Springsure, Eulo, Bourke and Bogan River supergroups. Volume 1: history, ecology and hydrogeology*. Report, prepared by UniQuest for the Department of the Environment, Commonwealth of Australia.

Currell, M.J., Werner, A.D., Mcgrath, C., Webb, J.A. & Berkman, M. (2017). Problems with the application of hydrogeological science to regulation of Australian mining projects: Carmichael Mine and Doongmabulla Springs. *Journal of Hydrology* 548: 674–682.

Department Of The Environment And Energy (2013). *Australia's bioregions (IBRA), IBRA7*. Commonwealth of Australia. http://www.environment.gov.au/land/nrs/science/ibra, accessed 11 July 2018.

Doody T.M., Hancock P.J. & Pritchard J.L. (2019). *Information Guidelines Explanatory Note: Assessing groundwater-dependent ecosystems*. Report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment and Energy, Commonwealth of Australia 2019. http://www.iesc.environment.gov.au/system/files/resources/422b5f66-dfba-4e89-adda-b169fe408fe1/files/information-guidelines-explanatory-note-assessing-groundwater-dependent-ecosystems.pdf, accessed 6 March 2020.

Fahey, P.S., Fensham, R.J., Laffineur, B & Cook, L.G. (2019). *Chloris circumfontinalis* (Poaceae): a recently discovered species from the saline scalds surrounding artesian springs in north-eastern Australia. *Australian Systematic Botany* 32: 228–242.

Fensham, R.J., Ponder, W. & Fairfax, R. (2010). *Recovery plan for the community of native species dependent on natural discharge of groundwater from the Great Artesian Basin*. Report to Department of Environment, Water, Heritage and the Arts, Canberra. Queensland Department of Environment and Resource Management: Brisbane.

Fensham, R.J., Silcock, J.L., Powell, O.C. & Habermehl, M.A. (2016a). In search of lost springs: A protocol for locating active and inactive springs. *Groundwater* 54: 374–383.

Fensham, R.J., Silcock, J.L., Laffineur, B. & Macdermott, H.J. (2016b). *Lake Eyre Basin Springs Assessment Project: Hydrogeology, cultural history and biological values of springs in the Barcaldine, Springvale and Flinders River supergroups, Galilee Basin springs and Tertiary springs of western Queensland*. Report to Office of Water Science, Department of Science, Information Technology and Innovation: Brisbane.

Forster, P.I. (2007). Campanulaceae. In P.D. Bostock & A.E. Holland (eds.), *Census of the Queensland Flora 2007*, pp. 41–42. Queensland Herbarium, Environmental Protection Agency: Brisbane.

—— (2010). Campanulaceae. In P.D. Bostock & A.E. Holland (eds.), *Census of the Queensland Flora* 2010, pp. 36–37. Queensland Herbarium, Department of Environment and Resource Management: Brisbane.

—— (2018). Campanulaceae. In P.D. Bostock & A.E. Holland (eds.), *Census of the Queensland Flora 2018*. Queensland Department of Environment and Science: Brisbane. https://www.data.qld.gov.au/dataset/census-of-the-queensland-flora-2018, accessed 10 October 2019.

—— (2020). Campanulaceae. In G.K. Brown & P.D. Bostock (eds.), *Census of the Queensland Flora 2019*. Queensland Department of Environment and Science: Brisbane. https://data.gov.au/dataset/ds-qld-11b7b05a-5975-4595-a8ad-c065d3a60704/details?q=, accessed 1 March 2020.

Gabcc (2014). *Great Artesian Basin resource study 2014*. Great Artesian Basin Consultative Council: Canberra, ACT.

Heenan, P.B., Knox, E.B., Courtney, S.P., Johnson, P.N. & Dawson, M.I. (2008). Generic placement in *Lobelia* and revised taxonomy for New Zealand species previously in *Hypsela* and *Isotoma*. *New Zealand Journal of Botany* 46: 87–100.

Iucn (2012). *IUCN Red List Categories and Criteria*. Version 3.1, 2nd ed. https://portals.iucn.org/library/sites/library/files/documents/RL-2001-001-2nd.pdf, accessed 4 December 2019.

Knox, E.B., Muasya, A.M. & Phillipson, P.B. (2006). The Lobeliaceae originated in southern Africa. In S.A. Ghazanfar & H.J. Beentje (eds.), *Taxonomy and ecology of African plants, their conservation and sustainable use*, pp. 215–227. Proceedings of the 17th AETFAT Congress, Addis Ababa, Ethiopia. Royal Botanic Gardens, Kew: UK.

Knox, E.B. & Li, C. (2017). The East Asian origin of the giant lobelias. *American Journal of Botany* 104: 924–938.

Lammers, T.G. (2011). Revision of infrageneric classification of *Lobelia* L. (Campanulaceae: Lobeliodeae). *Annals of the Missouri Botanical Garden* 98: 37–62.

Rossini, R.A., Fensham, R.J., Stewart-Koster, B., Gotch, T. & Kennard, M.J. (2018). Biogeographical patterns of endemic diversity and its conservation in Australia's artesian desert springs. *Diversity and Distributions* 24: 1199–1216.