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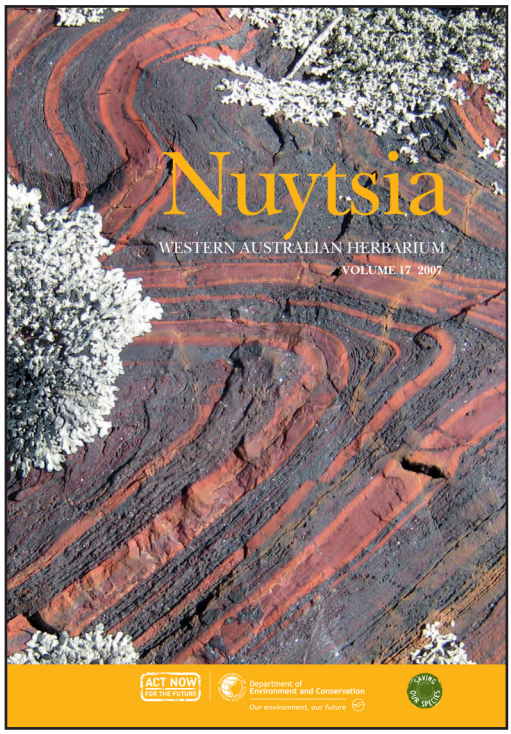

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New species of *Andersonia* (Ericaceae) of conservation concern

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New species of *Andersonia* (Ericaceae) of conservation concern

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Abstract

Lemson, K.L. New species of *Andersonia* (Ericaceae) of conservation concern. *Nuytsia* 17: 195–214 (2007). Six new species of *Andersonia* R.Br. – *A. annelsii* Lemson, *A. ferricola* Lemson, *A. geniculata* Lemson, *A. redolens* Lemson, *A. hammersleyana* Lemson and *A. pinaster* Lemson – are described, mapped and illustrated.

Introduction

Andersonia R.Br. (Ericaceae subfamily Styphelioideae) is endemic to the South-West Botanical Province of Western Australia, and currently consists of 22 recognised taxa (Watson 1962) and approximately 16 undescribed species (Western Australian Herbarium 1998–; Lemson 2001). Species of *Andersonia* occur throughout the south-west of Western Australia in open habitats on sandy soils, although a number are found on granite outcrops, in laterite derived clays and loams, and in sandy peat soils at the margins of swamps. A significant number of recognised species are included on the Declared Rare and Priority Flora List of the Department of Environment and Conservation (DEC), and this is also true of the undescribed taxa (Atkins 2006).The inadequacy of the alpha taxonomy of *Andersonia* has been known for some time (Lemson 1996, 2001), and is highlighted by assessment of the susceptibility of epacrids to species of *Phytophthora* and ongoing management actions by the DEC. Since the last published revision (Watson 1962) almost 1700 specimens have been collected and lodged at the Western Australian Herbarium (PERTH), some of which represent new taxa. This paper describes six of these new species, which are of particular concern from a conservation perspective.

Methods

All collections available at PERTH were consulted. Floral features were studied in three to five flowers from each specimen of the new taxa and in five flowers from selected specimens of known species. Measurements were made using hand-held digital calipers. Measurements of leaf length were complicated by the fact that leaves in a number of species twist longitudinally through 90 to 360 (or more) degrees, sometimes also twist laterally, and are sometimes undulate at the margins and arch to various degrees from the stem. Given the toughness of the leaves, it was not possible to flatten them or to straighten bent or twisted leaves, even in rehydrated materials. Length was therefore measured from the point of insertion along the longest straight axis to the apex; thus, measurements of strongly undulate or twisted leaves represent an estimate of size.

Distribution maps were created using DIVA-GIS freeware and are based on PERTH specimen data. They include Version 6.1 Interim Biogeographic Regionalisation for Australia (IBRA) boundaries (Department of the Environment and Water Resources 2007).

Terminology. General botanical terms follow Stearn (1992) and, particularly for the indumentum, Harris and Harris-Woolf (1994). *Andersonia* has a number of distinctive features (Brown 1810; Bentham 1868; Watson 1962; Lemson 1996, 2001). All species have spirally arranged sessile leaves with a distinctive, decurrent sheathing base. The tissue of the leaf base is continuous with the stem cortex and this layer is lost when the leaf abscises, leaving the stem surface smooth and without scars. The lengths and proportions of sheath and blade vary among species. The sheath and lamina were distinguished by removing leaves from the stem and locating the point at which the torn adaxial tissue was replaced by intact epidermis.

I have previously addressed the difficulties caused by the mixture of terms that have been used to describe inflorescences and the leaves associated with them in *Andersonia* (Lemson 1996, 2001). Terminology used herein is drawn from the application of terms and characterisations devised by Briggs and Johnson (1979) and Grimes (1992, 1995, 1996, 1999). Flowers are non-pedicellate and may be axillary or terminal on woody stems. In the former case, the flowers occur in the axils of pherophylls (bracts of Watson (1962), floral leaves of Bentham (1868)), which may or may not be modified in shape and size. Each flower is subtended by paired, keeled and often folded floral prophylls (bracteoles of both Bentham (1868) and Watson (1962)). Terminal flowers are preceded on the stem by a series of small, modified leaves with sterile axils termed metaxyphylls (also referred to as bracteoles by Watson (1962), but not by Bentham (1868)), which grade in shape from leaf-like to sepal-like acropetally. Where the stem terminates in a flower, the apex is referred to as anthotelic, while an apex that has no terminal flower is termed blastotelic. In the current context blastotelic implies that the apex ceases growth (anauxotelic *sensu* Briggs & Johnson (1979)) as this condition obtains in all species of *Andersonia* (Lemson (2001), *contra* Watson (1962)).

The flowers of all *Andersonia* species have free sepals which are usually petaloid but may resemble the metaxyphylls. The corolla is sympetalous, forming a cylindrical, campanulate or urceolate tube which separates into five lobes in the upper part, but the proportions formed by tube and lobes vary among species. The adaxial surface is usually hairy on either or both of the tube and lobes, but the abaxial surface is glabrous. The androecial filaments are apopetalous, with the anthers versatile and positioned at various heights within or above the corolla tube. In some species, the filaments elongate at anthesis. To avoid confusion caused by the various combinations of stamen length, corolla length and revolution of the corolla lobes, the following descriptions are used: *included* refers to stamens that are positioned entirely within the corolla tube, lying below the point at which the corolla separates into lobes; *manifest* (Hermann & Palser 2000) refers to stamens in which the tips of the anthers are positioned above the bases of the lobes (i.e. above the tube proper), but which remain shorter than the total length of the corolla; and *exserted* refers to stamens that have a length greater than that of the corolla. Manifest anthers are almost always only partially visible in intact flowers after anthesis. A distinction is made between manifest anthers that are obscured or hidden by the erect bases of the corolla lobes and those which are exposed by the spreading of the corolla lobes, and this is indicated in the species description. Elongation of filaments at anthesis is also indicated. The same terms are also applied to the gynoecium.

Taxonomy

Andersonia annelsii Lemson, *sp. nov.*

Andersoniae aristatae Lindl. adsimilis, a qua differt foliis ovatis vel circularibus et acuminatis non-aristatis et glaucis, corollae lobis tubo brevioribus villosi vel lanatis, staminum filamentis corolla brevioribus non exertis.

Typus: Manjimup area, Western Australia [precise locality withheld for conservation purposes], 12 October 1990, *G.J. Keighery* 11902 (*holo*: PERTH 1713914).

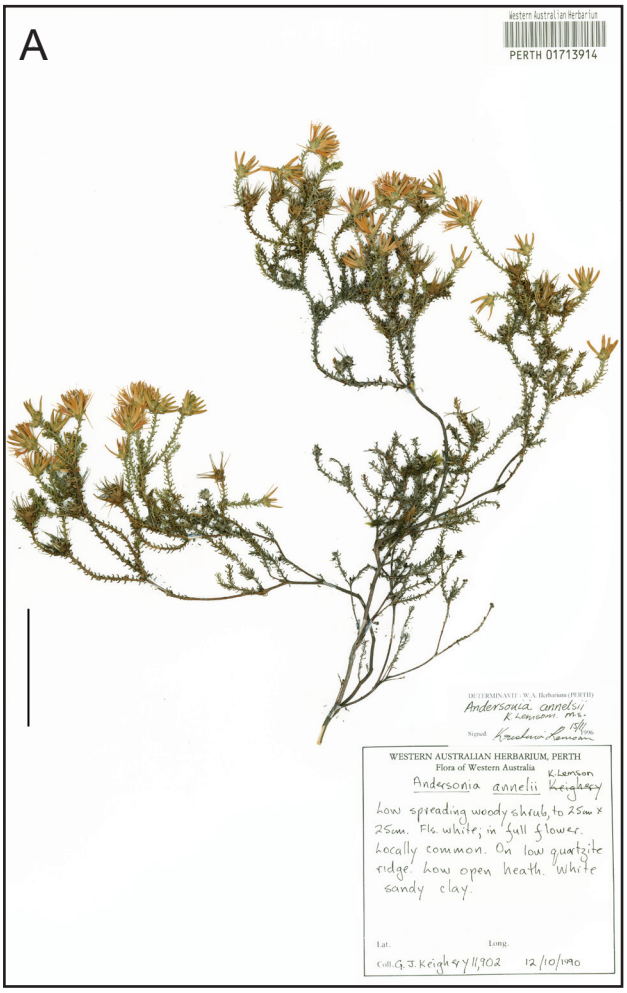
Andersonia annelsii Lemson ms, in G. Paczkowska & A.R. Chapman, West. Austral. Fl.: Descr. Cat. p. 232 (2000), *nom. inval.*

A low *shrub*, 15–25 cm high, 15–25 cm wide. *Stems* decumbent, blastotelic. *Leaves* squarrose, not twisted, widely ovate to circular, 2–5 mm long, adaxial surface shortly velutinous, rarely minutely strigillose, usually glaucescent, abaxially strigillose, usually glaucous, margins entire, not hyaline; apex acuminate, mucronate; sheath up to 1/4 of the lamina length, glabrous, usually glaucescent. *Flowers* axillary, in clusters of 3–8. *Pherophylls* leaf-like, erect, not twisted, widely ovate to almost circular, up to 1/4 calyx length, 2.0–5.0 mm long, adaxial surface shortly strigillose, abaxial surface shortly papillate or glabrous, margins erose, ciliate and hyaline near the base, apex shortly acuminate. *Floral prophylls* green in the upper half, cream in the lower half and on the marginal flanges, erect, folded and keeled, ovate, often almost as long as the pherophyll, 2.0–4.0 mm long, glabrous throughout or papillate abaxially, margins entire, glabrous, apex acuminate, mucronate, trigonous. *Calyx* yellow to pink in bud, white to cream at anthesis; *sepals* linear, 10.0–12.0 mm long, apex broadly acute, glabrous, margins entire. *Corolla* white, exceeding the calyx in open flowers, 11.0–14.0 mm long; *tube* cylindrical, sparsely hairy above the ovary; *lobes* recurved to revolute after anthesis, shorter than the tube, 4.0–5.0 mm long, lanate almost to the apex, apex acute. *Stamens* 9.0–11.0 mm in open flowers, elongating at anthesis; *anthers* white or yellow, manifest and exposed by the spreading corolla lobes, linear, 3.0–4.0 mm long, pollen yellow; *filaments* white, straight, linear at first but becoming filiform with elongation, 3–4 times the length of the anther after anthesis, cylindrical, glabrous. *Hypogynous disc* 5-lobed, the lobes rounded and often retuse, 0.2–0.5 mm long. *Gynoecium* 10.0–12.0 mm long, not elongating at anthesis; *ovary* usually pink, globular to napiform, 0.9–1.0 mm long, 1.0–1.2 mm wide, locules rounded, papillate; *style* white, linear to filiform, often coiled or bent near the base, scabrous or strigillose below the stigma; *stigma* manifest and exposed, truncate; *ovules* 12–15 per locule. (Figure 1A–D)

Specimens examined. WESTERN AUSTRALIA: [localities withheld] 14 Oct. 1982, *A.R. Annels* 1687 (PERTH 01735829); 12 Oct. 1990, *A.R. Annels* 1244 (PERTH 04572041); 21 Oct. 1994, *A.R. Annels & R.W. Hearn* ARA 4718 (PERTH 04251822); 18 Oct. 2004, *S. Clark* 146 (PERTH 06935796); 18 Oct. 2004, *S. Clark* 147 (PERTH 06935788); 18 Oct. 2004, *S. Clark* 148 (PERTH 06935826); 18 Oct. 2004, *S. Clark* 150 (PERTH 06935818); 29 Nov. 2004, *S. Clark* 181 (PERTH 06874231).

Distribution. Known from a single locality in Tone-Perup Nature Reserve, east of Manjimup (Figure 1E).

Habitat. *Andersonia annelsii* grows in white or grey sandy loam associated with granite monadnocks and boulders. It occurs in low heath in open patches of mixed *Eucalyptus marginata* and *Corymbia calophylla* forest, associated with *Kunzea micrantha*, *Pericalymma ellipticum*, *Allocasuarina huegelii* and *Bossiaea aquifolium*.



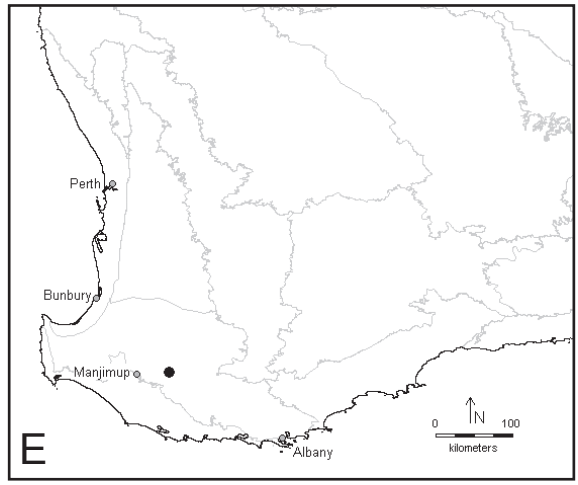


Figure 1. *Andersonia annelsii*. A – holotype; B – whole flower; C – flower with three sepals and two corolla sections removed, showing the morphology and relative positions of the gynoecium and androecium; D – morphology of leaves; E – distribution in south-west Western Australia. Scale bars: A = 5 cm; B, C = 4 mm; D = 5 mm. Photographs from *A.R. Annels and R.W. Hearn* ARA 4718.

Flowering period. All flowering collections have been made in October.

Conservation status. Declared Rare Flora under the Western Australian Wildlife Conservation Act 1950 (Atkins 2006). All collections have been made from a single population of approximately 300 mature plants. Further survey is required to establish the distribution, population size and phenology of this species.

Etymology. The specific epithet is given in honour of Mr A. R. (Tony) Annels, whose contribution to knowledge of the flora of the southern forests of Western Australia has been substantial.

Affinities. *Andersonia annelsii* is morphologically similar to *A. aristata* Lindl., but differs in a number of vegetative and floral features. In contrast to *A. annelsii*, the leaves of *A. aristata* are terete-subulate from a short, pubescent sheath, and are not glaucous. The floral prophylls are strongly naviculate rather than folded as in *A. annelsii*. Major floral differences lie in the proportional lengths of the corolla tube and lobes and the extent of filament and style elongation at anthesis. The margins of the sepals of both species become inrolled as the sepals age and dry, a feature noted by Watson (1962) to be characteristic of *A. aristata*. The sepals of *A. annelsii* turn purple as fruit set begins, but this has not been observed in *A. aristata*. In *A. aristata* the corolla lobes more or less equal the tube in length, and the filaments and style both elongate considerably as anthesis occurs, so that the anthers and stigma are exserted some distance beyond the corolla and calyx. This differs from *A. annelsii*, wherein the corolla lobes are shorter than the tube, the filaments elongate only slightly at anthesis so that the anthers remain manifest, and the style does not elongate at all when the flower opens. The corolla of *A. aristata* is more densely hairy than in *A. annelsii*, the anthers are oblong, and there is a larger number of ovules in each loculus (12–15 as opposed to 8–10 in *A. annelsii*). While some populations of *A. aristata* occur in similar soils and habitats to *A. annelsii*, *A. aristata* is also found on ironstone gravel and in damp clays and winter-wet depressions. The differences in floral morphology may be related to pollination and the relationship between the two species is worthy of further study.

Andersonia ferricola Lemson, *sp. nov.*

Andersoniae involucratae Sond. affinis, sed floribus malvinis, sepalis 8.0 vel 9.0 mm longis, corolla 7.8 vel 9.00 mm longa calycem subaequitanti vel longiore, limbi lobis arcte revolutis, corollae tubo sparsim lanuloso non glabro.

Typus: base of Whicher Range, Western Australia [precise locality withheld for conservation purposes], 11 November 1993, *B.J. Keighery & N. Gibson* 227B (*holo*: PERTH 04305671, upper centre fragment with the collectors' tag attached; *iso*: PERTH 04305671, upper left, lower left and centre right fragments).

Andersonia ferricola Lemson ms, in G. Paczkowska & A.R. Chapman, West. Austral. Fl.: Descr. Cat. p. 233 (2000); J. Wheeler, N. Marchant & M. Lewington, Fl. South West 2: 591 (2002), *nom. inval.*

Andersonia sp. Ironstone (B.J. Keighery and N. Gibson 227), Western Australian Herbarium, in FloraBase, http://florabase.dec.wa.gov.au [accessed June 2007].

Illustration. Wheeler *et al.* (2002), p. 591.

A straggling *shrub* to 50 cm high. *Stems* blastotelic. *Leaves* spreading to recurved, undulate, strongly twisted, narrowly ovate, the largest 8.0–15.0 mm long, adaxial surface glabrous or very sparsely lanulose, abaxial surface sparsely lanulose, margins minutely dentate to ciliate, not hyaline; apex acute to broadly attenuate; sheath short, up to 1/5 lamina length, sparsely lanulose. *Flowers* axillary, aggregated into compact, globular groups of up to 30. *Pherophylls* leaf-like, erect with recurved tips, twisted, circular, shorter than the calyx, 5.0–7.5 mm long, sparsely lanulose throughout, sometimes glabrous adaxially, margins ciliate, not hyaline, apex attenuate. *Floral prophylls* green in the upper half, cream below, narrowly ovate with wide hyaline flanges, folded and flattened, keeled, up to 3/4 length of the sepals, 6.0–7.0 mm long, adaxial surface glabrous, abaxially lanulose or villous, keel ciliate, margins usually ciliate, apex attenuate, trigonous. *Calyx* pale lilac, sometimes green in the lower half, turning white with age or drying; *sepals* arched outwards from the corolla, very narrowly ovate to linear, 8.0–9.0 mm long, adaxial surface glabrous, abaxially sparsely lanulose or rarely glabrous, apex broadly acute, margins ciliate and with a broad hyaline flange below the middle. *Corolla* pale lilac, white with age or drying, elongating slightly at anthesis to equal or slightly exceed the calyx, 7.8–9.0 mm long; *tube* cylindrical, sparsely lanulose in the upper 1/5 to 1/4; *lobes* spreading, with tightly revolute tips in fresh materials, curled or erect in dry specimens, much shorter than the tube, 2.2–3.0 mm long, sparsely lanulose over the lower 3/4 to 7/8, apex broadly acute. *Stamens* 6.6–8.0 mm long, not elongating at anthesis; *filaments* straight, oblong with the apex tapering sharply behind the anther, 2.5–3 times longer than the anther, flattened, adaxial surface lanate, abaxially glabrous; *anthers* white, manifest, fusiform to linear, usually arched laterally and almost falcate, 2.0–2.5 mm long, pollen white. *Hypogynous disc* 5-lobed, the lobes rounded; ± 0.5 mm long. *Gynoecium* 7.9–9.0 mm, not elongating at anthesis, usually equal with the corolla; *ovary* globular to oblongoid, 1.0–1.3 mm long,1.0–1.2 mm wide, glabrous; *style* white, linear, usually not coiled near the base, glabrous; *stigma* manifest and exposed, truncate; *ovules* 3–5 per locule. (Figure 2A–E)

Specimens examined. WESTERN AUSTRALIA: [localities withheld] 12 Dec. 1995, *J.A. Cochrane* JAC 1847 (PERTH 04210492); 16 May 1992, *B.J. Keighery & G.J. Keighery* 3 (PERTH 04282132); 15 Oct. 1992, *B.J. Keighery & N. Gibson* 251 (PERTH 04305701); 16 Oct. 1992, *B.J. Keighery & N. Gibson* 669 (PERTH 04305698).

Distribution. All collections have been made in a small area south-east of Busselton (Figure 2F).

Habitat. Grows in dense low heath on winter wet ironstone flats, in skeletal white sand over massive ironstone (ferricrete).

Flowering period. October and November.

Conservation status. DEC Conservation Codes for Western Australian Flora: Priority One (Atkins 2006). The species occurs in a restricted and threatened community considered to be among the most threatened in Western Australia (Gibson *et al.* 2000).

Etymology. The epithet is derived from the Latin *ferreus* (iron) and -*icola* (dweller) and refers to the species' ironstone habitat.

Affinities. Specimens of *A. ferricola* have variously been included within *A. latiflora* (F.Muell.) Benth. and *A. involucrata* Sond., which latter shares with *A. ferricola* a noticeable musky 'rodent' odour when in flower. However, *A. involucrata* has white flowers which are much smaller, with the calyx 3–3.5 mm long and noticeably longer than the corolla (2.5–3 mm long). The corolla lobes are usually

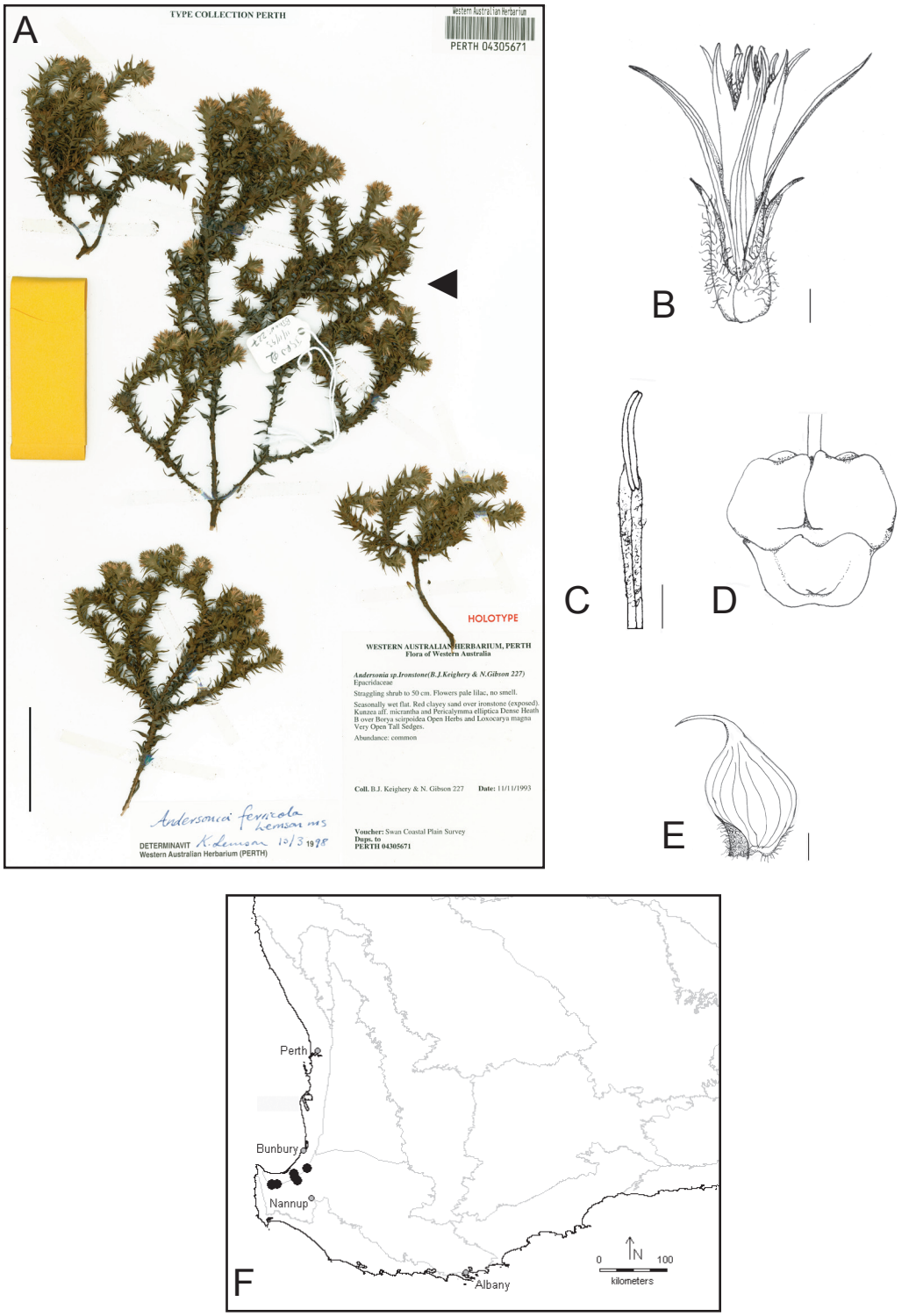


Figure 2. *Andersonia ferricola*. A – type gathering, the holotype is indicated with a black arrow; B – whole flower with floral prophylls; C – stamen, adaxial view; D – ovary, lateral view; E – prophyll, adaxial view; F, distribution in south-west Western Australia. Scale bars: A = 5 cm; B–E = 1 mm. Drawings from *J.A. Cochrane* JAC 1847.

erect to incurved, and hairless or sparsely hairy in the lower third. The stamens of *A. involucrata* are also much smaller (1.0–4.0 mm long), with linear anthers that do not arch laterally. The species also has a pubescent ovary. *Andersonia ferricola* and *A. latiflora* differ in flower colour, with the latter having a creamy white calyx and corolla. In *A. latiflora* the corolla has spreading to recurved lobes that are densely hairy below the middle, the staminal filaments are very narrowly cylindrical, the style is scabrous and the ovary surface papillate to minutely puberulent.

Notes. Two of the specimens examined have hairless, shiny leaves, but there is insufficient material at PERTH to adequately assess the level of within-population variation in this and other features of the species. The flowers usually have a strong musky mouse-like odour when fresh. The biology and relationships of *A. ferricola* are worthy of further study, as the community type in which it is found is of very limited distribution and known to include a number of restricted endemics with disjunct distributions.

Andersonia geniculata Lemson, *sp. nov.*

Ob filamentis geniculatis bipartitis hirsuti inter omnes species *Andersoniae* peculiaris.

Typus: east of Thompson Road, 150 m, 4.2 km north of Beardmore Road, 21 km due north of Walpole, Western Australia, 14 September 1994, *A.R. Annels & R.W. Hearn* ARA 4409 (*holo*: PERTH 04251741, *iso*: MEL).

Andersonia geniculata Lemson ms, in G. Paczkowska & A.R. Chapman, West. Austral. Fl.: Descr. Cat. p. 233 (2000); J. Wheeler, N. Marchant & M. Lewington, Fl. South West 2: 591 (2002), *nom. inval.*

Andersonia sp. Beardmore Rd (Annels and Hearn 4409), Western Australian Herbarium, in FloraBase, http://florabase.dec.wa.gov.au [accessed June 2007].

Illustration. Wheeler *et al.* (2002) p. 591.

A low domed or cushion-like *shrub,* 5–20 cm high x 20 cm wide. *Stems* blastotelic. *Leaves* widely spreading, twisted, arched laterally, linear or very narrowly ovate, the longest 7–11 mm long; lamina concave below, flattened in the upper half, glabrous, margins entire or minutely erose, not hyaline; apex acuminate; sheath very short, glabrous. *Flowers* axillary, in clusters of 5–10. *Pherophylls* leaf-like, widely spreading, twisted, narrowly ovate, equal to or longer than the calyx, 8.0–11.0 mm, glabrous, margins minutely ciliate, hyaline, apex attenuate. *Floral prophylls* cream to white, erect, ovate, concave and keeled, 6.0–8.0 mm long, adaxially hairy, abaxial surface and keel glabrous, margins ciliate. *Calyx* creamy white, sometimes suffused with green; *sepals* narrowly ovate, 8.0–10.5 mm, glabrous, margins entire, hyaline, apex acute. *Corolla* white, equal to or only just shorter than the calyx, 7.5–10.5 mm long; *tube* ovoid to cyathiform, glabrous; *lobes* erect with only the tips widely spreading, linear, longer than the tube, 4.6–5.8 mm long, adaxial hairs forming a dense band at the lobe base and sparse or absent above, tips glabrous, apex narrowly acute, margins revolute. *Stamens* 5.5–8.5 mm long, not elongating at anthesis; *filaments* white, articulated below the middle, bent inwards sharply at the articulation, with the upper half erect or curving outwards from the style and the lower part slightly incurved and appressed to the ovary, with the margins of adjacent filaments often touching or overlapping, the upper section narrowly ovate and the lower a short cylindrical stalk, about 3 times the length of the anther, the upper portion more or less flattened in TS and the lower cylindrical, adaxial surface of the upper section densely lanate in a tuft just above the articulation, abaxial surface and lower portion

glabrous; *anthers* yellow, manifest, exposed by the revolute corolla lobe margins, oblong, 1.6–3 mm long, emarginate, pollen yellow. *Hypogynous disc* 5-lobed, the lobes rounded; 0.3–1.1 mm long. *Gynoecium* 8.2–11.0 mm long, elongating slightly at anthesis, equal with or marginally longer than the corolla; *ovary* green or cream, globular to slightly oblate, 1.0–2.5 long, 1.0–2.6 mm wide, locule apices rounded, glabrous; *style* pink, linear, not coiled or bent, smooth; *stigma* manifest, clavate, separating into very short erect lobes*; ovules* 9–11 per locule. (Figure 3A–E)

Selected specimens examined. WESTERN AUSTRALIA: 26 km NW of Walpole, 50 m along Beardmore Road from Southwest Highway, JO 9389, 29 Aug. 1989, *A.R. Annels* 795 (PERTH 02299178); South West Highway, 500 m N of Beardmore Road, 16 Sep. 1994, *A.R. Annels & R.W. Hearn* 4443 (PERTH 04251814); Nicol Road, about 100 m S of firebreak, 3.9 km W of Thompson Road, 12 km NW of Mount Frankland, 7 Oct. 1996, *A.R. Annels & R.W. Hearn ARA* 5797 (PERTH 04299310); Centre Road, 1.7 km W of Angove Road (*c*. 2 km E of Deep River), 9 Oct. 1996, *M.D. Carter* 611 (PERTH 04620984); 20 km S of Mount Burnside, 8 Sep. 1995 *R.J. Cranfield* 10372 (PERTH 04439090); Sharpe Block, on track constructed around *Thelymitra jacksonii* exclusion for WCP 08 burn, Oct. 2002, *G. Freebury* 82 (PERTH 06463797); Beardmore Road, 0.60 km E of South West Highway, 30 Sep. 1996, *M.S. Graham & M.D. Carter* MSG 613 (PERTH 04606191); Pingerup Road, 3.80 km N of Chesapeake Road, 10 Nov. 1996 *M.S. Graham* 752 (PERTH 04606477); Pingerup Road, 5.35 km NE of Marron Road, 10 Nov. 1996 *M.S. Graham* 753 (PERTH 04606485); extension Beardmore Road and South-Western Highway, 25 km N of Walpole, 13 Sep. 1990 *G.J. Keighery* 11484 (PERTH 01203533); road (closed) to Granite Peak, about 1 hour's walk from closure point, 15 Sep. 1994, *K.L. Lemson* 597 (PERTH 06329136); NW of Walpole on South Western Highway, 500 m N from the Beardmore Road intersection in drain by the side of the road, 19 Sep. 1994, *K.L. Lemson* 623 (PERTH 06328628); 500 m W from Beardmore Road on South Western Highway, 16 Sep. 1994, *K.L. Lemson* 625 (PERTH 06329209); Angove Rd, S of Quinn Road Keystone Block, 1 Nov. 2004, *T.M. Llorens* 4 (PERTH 07153783); Walpole-Nornalup National Park, junction of Circular Pool Road and Creek Road to Sapper Bridge, 29 Oct. 1992, *J.R. Wheeler* 3479 (PERTH 05214793).

Distribution. Occurs in several populations between Manjimup and Walpole (Figure 3F).

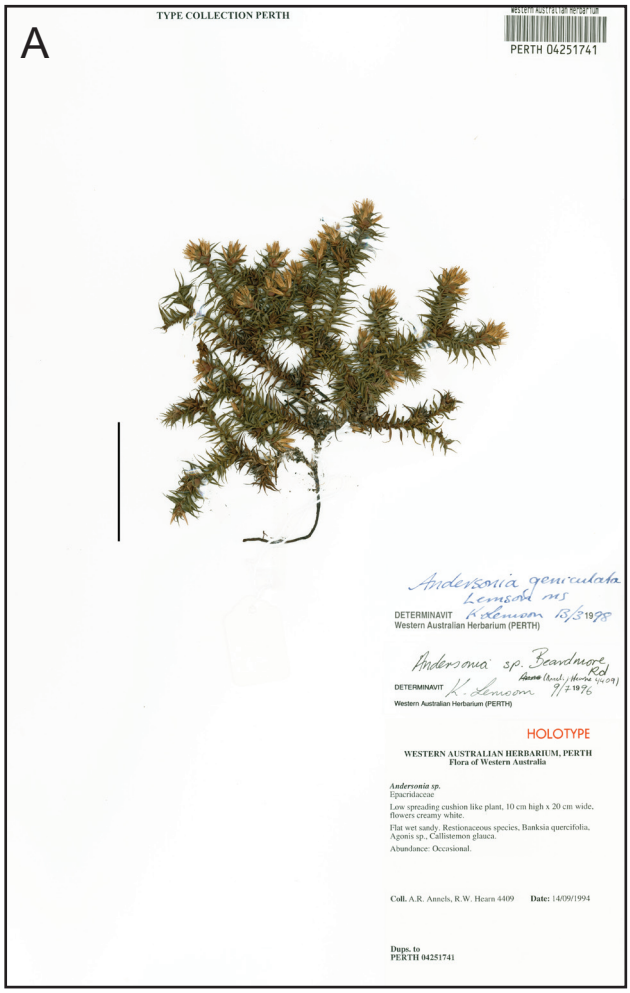
Habitat. Found in open low sedgeland on the margins of swamps, winter wet grey sands or peaty flats, with *Agonis parviceps* and mixed sedges; low rises in winter wet swamps on peaty sands over granite; and open areas in the understorey of open mixed forest of *Eucalyptus megacarpa* and *E. marginata* over *Kingia australis*, *Agonis parviceps*, *Eutaxia* spp. and mixed sedges.

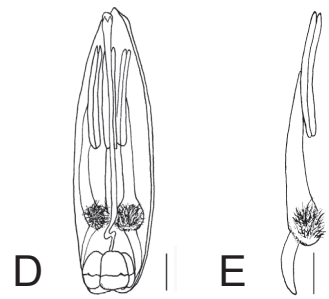
Flowering period. Late August to early November.

Conservation status. *Andersonia geniculata* is not currently considered rare or threatened, but continued monitoring is recommended. The species occurs in habitats known to be susceptible to infection by *Phytophthora* spp.

Etymology. The epithet is derived from the Latin *geniculatus* (with bended knee) and refers to the articulation and posture of the staminal filaments.

Affinities. *Andersonia geniculata* is superficially similar to *A. setifolia* Benth. in habit but is easily distinguished in having white flowers, bright yellow anthers and by its unique staminal filaments. The leaves form a windmill pattern when viewed from the apex of the stem, due to the unusual arched leaves.





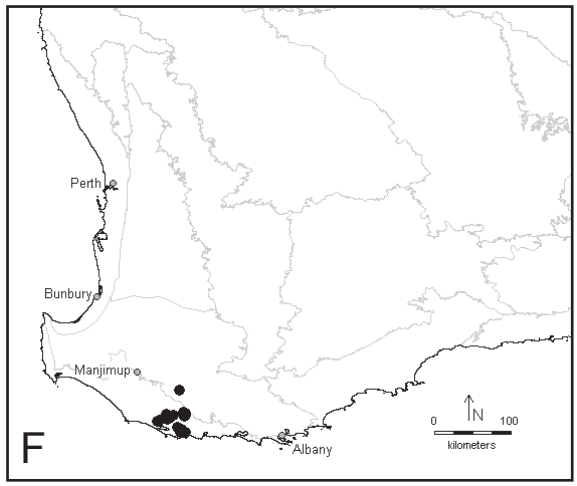


Figure 3. *Andersonia geniculata*. A – holotype; B – inflorescence just before anthesis; C – corolla, intact, showing the positions of the lobe margins and anthers; D – corolla just before anthesis, with two segments removed to show the gynoecium and androecium; E – stamen; F – distribution in south-west Western Australia. C–E scale bars = 1 mm, drawn from Beardmore Road population.

Andersonia redolens Lemson, *sp. nov.*

Andersoniae sprengelioides R.Br. affinis sed floribus redolentibus eburneis, corollae lobis tubis longiore, filamentis anguste ovatis paginis abaxialis papillosis.

Typus: Frankland National Park, Western Australia [precise locality withheld for conservation purposes], 14 September 1994, *A.R. Annels & R.W. Hearn* ARA 4408 (*holo*: PERTH 04251776; *iso*: PERTH 06329012, PERTH 06328385).

Andersonia redolens Lemson ms, in G. Paczkowska & A.R. Chapman, West. Austral. Fl.: Descr. Cat. p. 233 (2000); J. Wheeler, N. Marchant & M. Lewington, Fl. South West 2: 592 (2002), *nom. inval.*

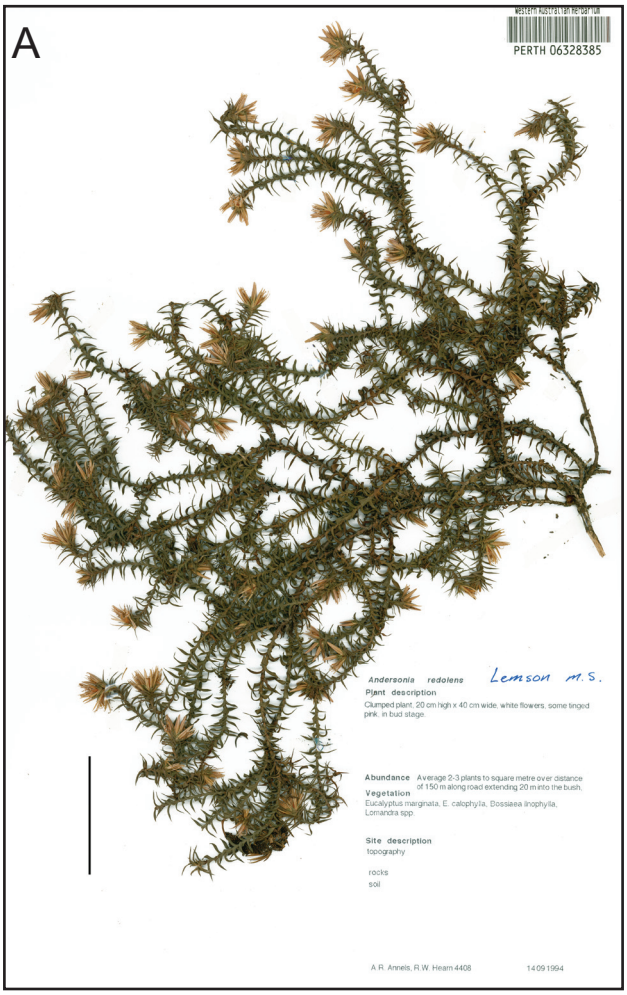
Andersonia sp. Collis Rd (GWJ 5A), Western Australian Herbarium, in FloraBase, http://florabase.dec.wa.gov.au [accessed June 2007].

Illustration. Wheeler *et al.* (2002) p. 592.

An open *shrub* 30 cm high, up to 50 cm wide. *Stems* decumbent, blastotelic. *Leaves* spreading, twisted, narrowly ovate to almost linear, the longest 6.9–15.0 mm long, 1.0–3.0 mm wide, adaxial surface glabrous or minutely scabrous, glossy in fresh materials, abaxial surface shortly and sparsely pubescent, glossy, margins ciliate, not hyaline; apex acute; sheath to 1/2 the lamina length, sparsely pubescent. *Flowers* axillary, in oblong groups of 3–10, the groups usually pendant. *Pherophylls* leaf-like, erect to spreading, twisted, ovate, 6.0–8.0 mm long, glabrous, margins ciliate, apex attenuate. *Floral prophylls* green with cream hyaline flanges, ovate, folded and keeled, up to 1/3 the length of the calyx, 4.5–5.5 mm long, surfaces sparsely pubescent, the abaxial surface sometimes glabrous, keel sparsely ciliate, margins sparsely ciliate, apex trigonous, mucronate. *Calyx* pink in bud, pale pink or creamy-white suffused with pink in open flowers; *sepals* narrowly ovate, 8.0–11.5 mm long, glabrous, or with the abaxial surface very sparsely hairy near the middle, margins ciliate, not hyaline, apex narrowly acute to narrowly acuminate. *Corolla* white or cream, often suffused with pink, just shorter than the calyx, 7.0–10.6 mm long; *tube* cylindrical or very narrowly urceolate, pilose above the ovary; *lobes* erect at the base and widely spreading to recurved above, longer than the tube, 4.5–6.6 mm long, pilose over the lower 3/4–7/8 with the hairs forming a distinct tuft, apex acute. *Stamens* 6.5–8.0 mm long, not elongating at anthesis; *filaments* white, straight, lanceolate or narrowly ovate, 2–3 times the length of the anther, flattened, adaxial surface pilose, abaxial surface glabrous or minutely papillate, margins ciliate; *anthers* white or violet, manifest, narrowly oblong, 2.2–3.2 mm long, pollen red or purple. *Hypogynous disc* 5-lobed, the lobe apices acuminate, 0.65–0.85 mm long, almost as high as the ovary. *Gynoecium* 6.9–10.2 mm long, not elongating at anthesis, about equal to or only slightly less than the corolla; *ovary* cream, globular, the apex rounded or somewhat depressed, 0.9–1.1 mm long, papillate; *style* white, linear, not usually coiled near the base, minutely setulose-strigillose; *stigma* manifest, exposed by the spreading corolla lobes, truncate, the lobes hardly separating; *ovules* 4–6 per locule. (Figure 4A–D)

Specimens examined. WESTERN AUSTRALIA: [localities withheld] 17 Nov. 2003, *G. Freebury* 83 (PERTH 06463754); 25 Sep. 2002, *G. Freebury* 67 (PERTH 06463843); 8 Sep. 1996, *B.G. Hammersley* 1623 (PERTH 04627229); 2 Feb. 2003, *E.D. Middleton* EDM 573 (PERTH 06905633); 7 Dec. 1989, *G. Wardell-Johnson* GWJ5A (PERTH 02299151).

Distribution. Known only from the type locality north of Walpole and one other site nearby (Figure 4E).



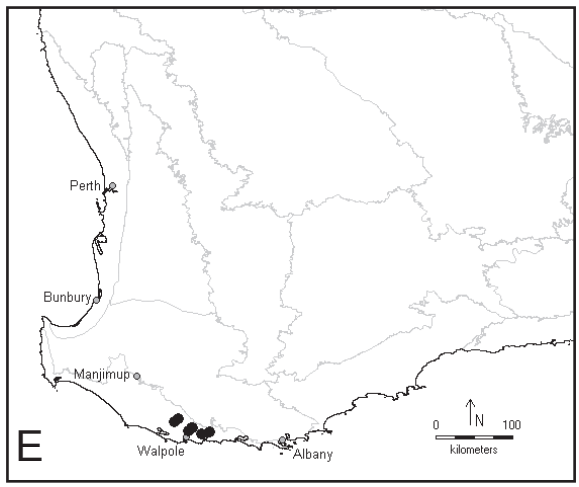


Figure 4. *Andersonia redolens*. A – holotype; B – whole flower, with pherophyll and floral prophylls; C – corolla, with two segments removed to show the gynoecium and androecium; D – stamen; E – distribution in south-west Western Australia. Scale bars: A = 5 cm; B–D = 2 mm.

Habitat. Occurs on the margins of swamps and in sands and coarse loamy sands with laterite-derived gravel, in open *Eucalyptus marginata* - *Corymbia calophylla* woodland over *Agonis linearifolia*, *Bossiaea linifolia* and *Lomandra* spp.

Flowering period. September and October.

Conservation status. DEC Conservation Codes for Western Australian Flora: Priority One (Atkins 2006). Further survey is required to establish the geographical distribution of this species.

Etymology. The species epithet is from the Latin *redolens* (scented) and refers to the sweet, honey like fragrance of the flowers.

Affinities. Specimens of *A. redolens* have variously been included in *A. lehmanniana* Sond., *A. sprengelioides* R.Br. and *A. longifolia* (Benth.) L.Watson but can be distinguished from all three by several characteristics. In fresh material, differences in calyx and corolla colour are most obvious, with *A. sprengelioides* having concolorous mauve calyx and corolla and *A. lehmanniana* a bright blue corolla and pink calyx. There have been no confirmed fresh collections of *A. longifolia* for many years, however, collecting notes state that the flowers were cream at the time of collection. In *A. lehmanniana* the fresh corolla is strongly urceolate, with short, densely pubescent lobes that close the corolla around the protruding stigma and which are initially revolute, becoming deflexed. *Andersonia sprengelioides* also has corolla lobes that are shorter than the tube, and linear staminal filaments. Most specimens of *A. sprengelioides* have flowers smaller than *A. redolens*, with the exception of a few collections from Esperance and further east, at the limit of the range of *A. sprengelioides* and far outside that of *A. redolens*. Stamen features also separate *A. redolens* from *A. lehmanniana* and *A. longifolia*. Short, spatulate stamens with hairs on the broadened upper portion and small (*c*. 1 mm), ellipsoid anthers characterise *A. lehmanniana*, while *A. longifolia* has linear anthers that are almost as long as the fusiform filaments. Watson (1962) notes that the filaments of *A. longifolia* are canaliculate in transverse section. Less obvious differences exist in stigma morphology (truncate in *A. redolens*, capitate in *A. lehmanniana* and clavate in *A. longifolia* and *A. sprengelioides*) and ovary shape (globular in *A. redolens* and *A. longifolia*, somewhat angular in *A. lehmanniana* and *A. sprengelioides*), while differences in vegetative characters exist mainly in maximum leaf length (9–10 mm in *A. lehmanniana* and *A. sprengelioides*, and 15–17 mm in *A. redolens* and *A. longifolia*). The habit of *A. redolens* is generally more open than any of these other species, and the aggregations of flowers are commonly pendant.

Notes. The flowers emit a sweet honey-like perfume that is especially noticeable at dawn and dusk.

Andersonia hammersleyana Lemson, *sp. nov.*

Andersoniae caeruleae R.Br. adsimilis, sed foliis linearibus vel aristatis floribus longioribus, sepalis albis vel chloro-albis glabris, corolla cylindrica vel anguste urceolata caelicolore sine rosea, limbi lobis tubo brevioribus.

Typus: Mount Lindesay National Park, north of Denmark, Western Australia [precise locality withheld for conservation purposes], 3 September 1990, *B.G. Hammersley* 335 (*holo*: PERTH 04102711).

Andersonia hammersleyana Lemson ms, in G. Paczkowska & A.R. Chapman, West. Austral. Fl.: Descr. Cat. p. 233 (2000); J. Wheeler, N. Marchant & M. Lewington, Fl. South West 2: 590 (2002), *nom. inval.*

Andersonia sp. Mt Lindesay (B.G. Hammersley 335), Western Australian Herbarium, in FloraBase, http://florabase.dec.wa.gov.au [accessed June 2007].

Illustration. Wheeler *et al.* (2002) p. 590.

Erect or decumbent *shrub*, 50–100 cm high. *Stems* anthotelic. *Leaves* erect to slightly spreading, twisted, linear to narrowly ovate, the longest 12.0–20.0 mm long, adaxial surface pubescent or papillate, abaxially pilose, pubescent or papillate, margins ciliate, hyaline near the base; apex attenuate; sheath pubescent. *Flowers* terminal, not aggregated into dense conflorescences, each preceded by 8–12 metaxyphylls. *Metaxyphylls* erect, twisted, narrowly ovate grading to linear acropetally, the uppermost equal to or even exceeding the sepals, 8.0–16.0 mm long, margins hyaline near the base, apex acute to acuminate. *Calyx* greenish-white, turning pink on aging or drying, the sepals resembling the uppermost metaxyphylls in shape and texture; *sepals* narrowly or very narrowly ovate to linear, 12–16.5 mm long, glabrous, margins entire or sparsely ciliate, hyaline over most of their length, apex narrowly acute. *Corolla* bright blue, 12–16 mm long; *tube* narrowly urceolate to almost cylindrical, sparsely pilose above the ovary; *lobes* erect at the base and spreading above, narrowly triangular to linear, shorter than or just equal to the tube, 6–8 mm long, thickly pubescent, the hairs forming a distinct tuft or beard at the arch of the lobe, tips glabrous, apices narrowly acute or narrowly acuminate. *Stamens* 7.0–10.0 mm long, not elongating at anthesis; *filaments* straight or slightly sinuous, white, linear, 4–5 times the length of the anther, flattened, adaxial surface sparsely hairy on the upper half, abaxial surface glabrous or with a few scattered hairs; *anthers* red or violet, manifest, oblong, 1.5–2.5 mm long, pollen yellow. *Hypogynous disc* of 5 free scales, oblong to ovate with the apex retuse or cleft, *c*. 1 mm long. *Gynoecium* 12.0–16.0 mm long, not elongating at anthesis, about equal to the corolla; *ovary* cream-green, turbinate, 1.5–2 mm long, 1.6–2.1 mm wide, the apex slightly flattened, pilose to hispid on the upper surface and sides of the locules; *style* white, often purplish near the apex, narrowly linear to filiform, often curved or coiled near the base, sparsely sericeous over the lower 4/5; *stigma* manifest and exposed by the spreading corolla lobes, lobulate, the lobes short and spreading; *ovules* 7–9 per locule. (Figure 5A–E)

Selected specimens examined. WESTERN AUSTRALIA: [localities withheld] Oct. 1936, *Anonymous s.n.* (PERTH 02120348); 19 June 1991, *A.R. Annels* 1607 (PERTH 03176037); 13 Nov. 1977, *A.R. Annels* 1928 (PERTH 03131491); 20 Aug. 1993, *J.A. Cochrane* 405 (PERTH 03199800); 15 Feb. 1994, *J.A. Cochrane* 985 (PERTH 03481069); 2 Aug. 1990, *B.G. Hammersley* 307 (PERTH 01214519); 3 Sep. 1990, *B.G. Hammersley* 334 (PERTH 04102681); 3 Sep. 1990, *B.G. Hammersley* 339 (PERTH 04102762); 1 Aug. 1999, *B.G. Hammersley* 2221 (PERTH 05503167); 21 Oct. 2002, *E.D. Middleton* 539 (PERTH 06905943); 21 Oct. 2002, *E.D. Middleton* 541 (PERTH 06905927); 29 Sep. 2005, *E.F. Shedley* 054 (PERTH 07310587); 20 Oct. 2005, *E.F. Shedley* 059 (PERTH 07310730); 19 Oct. 2005, *E.F. Shedley* 060 (PERTH 07310722); 20 Oct. 2005, *E.F. Shedley* 061 (PERTH 07310714).

Distribution. Near Mount Lindesay, north of Denmark (Figure 5F).

Habitat. Occurs in open jarrah woodland in laterite-derived gravelly loam and metagranitic soils over outcropping granite.

Flowering period. Flowering specimens have been collected from August to October.

Conservation status. DEC Conservation Codes for Western Australian Flora: Priority Two (Atkins 2006).

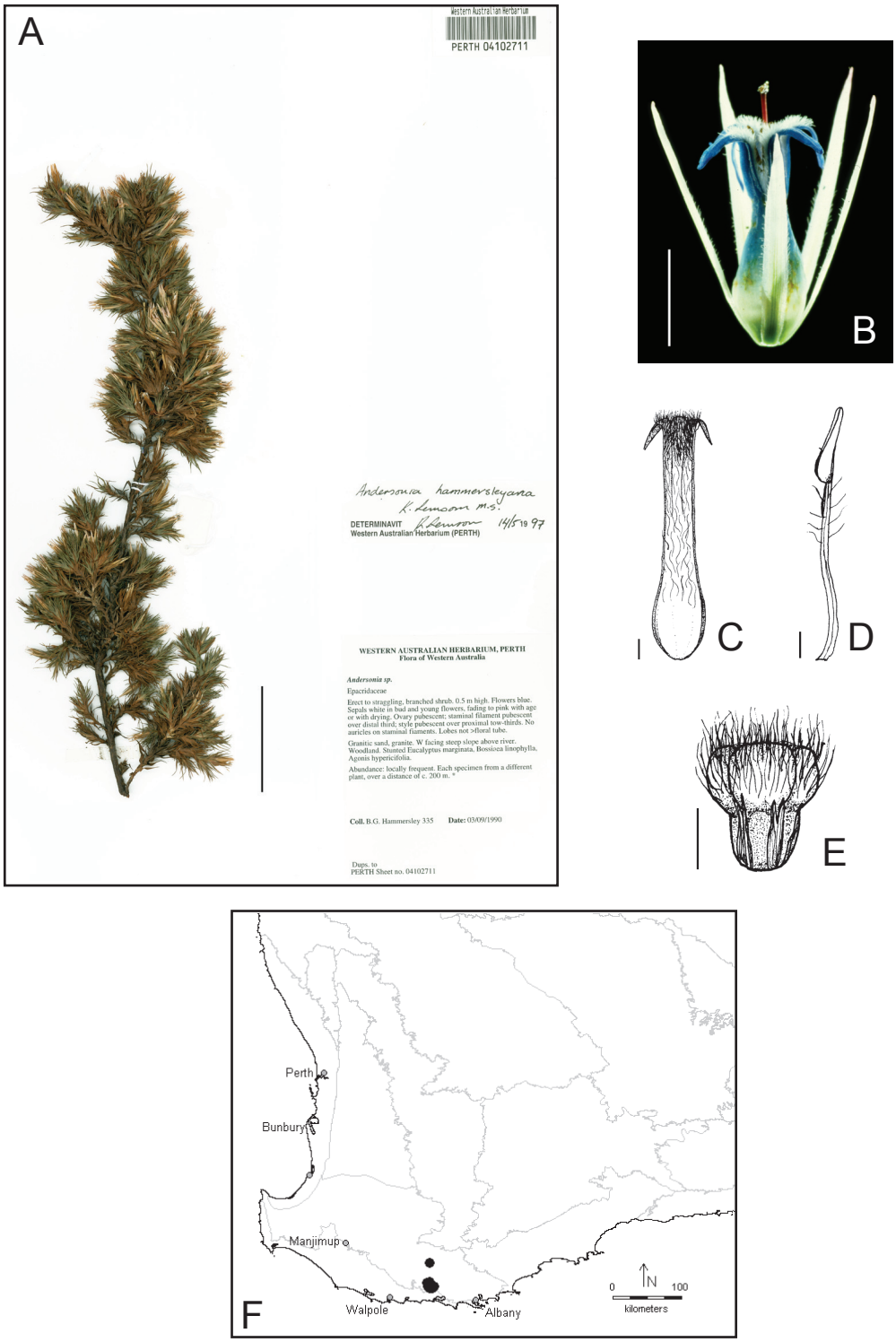


Figure 5. *Andersonia hammersleyana*. A – holotype; B – whole flower; C – section of the corolla, showing the distribution of hairs; D – stamen; E – ovary; F – distribution in south-west Western Australia. Scale bars: A = 5 cm; B = 5 mm; C–E = 1 mm. Photograph from *K.L. Lemson* 686; drawings from *B.G. Hammersley* 2221.

Etymology. The species epithet honours the late Dr Brenda Hammersley who made a significant contribution to our knowledge of the flora of the Denmark Shire.

Affinities. Specimens of *A. hammersleyana* have previously been included within *A. caerulea* (Watson 1962), which is widely distributed and highly variable in habit. However, the flowers of *A. caerulea* are smaller than those of *A. hammersleyana*, with a pink, pubescent calyx and a strongly urceolate corolla that is usually blue, but which may grade into pink or white at the base. The metaxyphylls of *A. caerulea* are usually spreading and shorter than the calyx of the flower above. The corolla lobes of *A. caerulea* are equal with the tube in length, the staminal filaments are adaxially pubescent and ciliate and the style has stiff, erect hairs. *Andersonia hammersleyana* is also similar to *A. auriculata* L.Watson, from which it differs in having plants that are generally larger and more upright in habit, corolla lobes that are shorter than the tube and staminal filaments which lack the distinctive lobes that define *A. auriculata*.

Notes. *Andersonia hammersleyana* appears to be part of a suite of taxa that are intermediate between *A. caerulea* and *A. auriculata*, the taxonomic boundaries of which are yet to be fully resolved.

Andersonia pinaster Lemson, *sp. nov.*

Andersoniae auriculatae L.Watson affinis sed staminum filamentis valde convexis, non auriculatis et glabris.

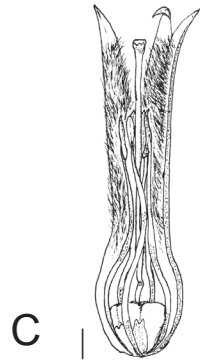
Typus: near Betty's Beach, *c*. 30 km E of Albany, Western Australia [precise locality withheld for conservation purposes], 7 August 1986, *G.J. Keighery* 8229 (*holo*: PERTH 01026046, left hand fragment; *iso*: PERTH 01026046, right hand fragment).

Andersonia pinaster Lemson ms, in A. Brown, C. Thomson-Dans & N. Marchant, West. Austral. Threatened Fl.: 188 (1998); G. Paczkowska & A.R. Chapman, West. Austral. Fl.: Descr. Cat. p. 233 (2000), *nom. inval.*

Andersonia sp. Two Peoples Bay (G.J. Keighery 8229), Western Australian Herbarium, in FloraBase, http://florabase.dec.wa.gov.au [accessed June 2007].

Illustration. Brown *et al.* (1998) p. 188.

Erect, stiff pine-like *shrub* with extremely dense foliage, 50–100 cm high. *Stems* anthotelic. *Leaves* erect to spreading, twisted, narrowly ovate to almost linear, the longest 10–20 mm long, papillate, margins minutely denticulate, ciliate near the base, not hyaline, apex attenuate, sheath glabrous. *Flowers* terminal, hidden among long metaxyphylls, and often not visible until anthesis; subtended by 10–12 long metaxyphylls. *Metaxyphylls* leaf-like, erect, the uppermost appressed to the calyx before anthesis, spreading slightly after anthesis, narrowly ovate, 9.5–15.0 mm long, decreasing in size acropetally, the last about equal to or slightly shorter than the sepals, scabrous to papillate or sparsely pubescent, margins erose, hyaline, apex narrowly acute. *Calyx* green, of a similar texture to the uppermost metaxyphylls; *sepals* narrowly ovate, 9.5–14.0 mm long, glabrous, margins entire or minutely serrulate, not hyaline, apex narrowly acute. *Corolla* bright blue, about equal to the calyx, 9.5–14.0 mm long; *tube* narrowly urceolate, sparsely pubescent in the upper 1/3; *lobes* erect at the base with widely spreading tips, much longer than the tube, 5.8–8 mm long, thickly hairy over the lower 3/4, the hairs forming a distinct tuft about 1/4 of the length below the tip, tip glabrous, apex acute.



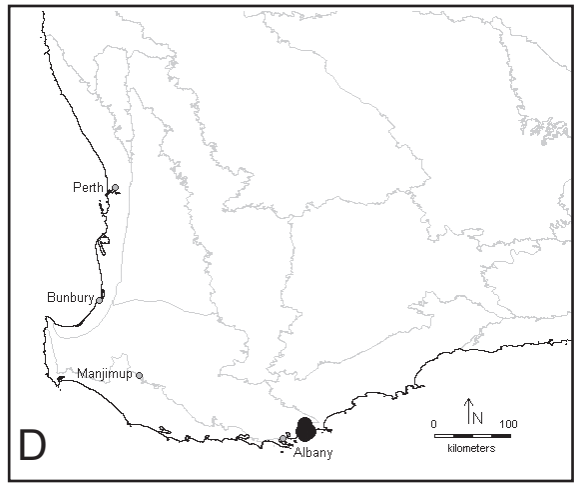


Figure 6. *Andersonia pinaster*. A – type gathering, the holotype is indicated with a black arrow; B – whole flower surrounded by metaxyphylls, note that the sepals are almost indistinguishable from the uppermost metaxyphylls; C – corolla, with 2.5 segments removed, showing the gynoecium and androecium; D – distribution in south-west Western Australia. Scale bars: A = 5 cm; B = 2 mm; C = 1 mm. Photograph from *K.L. Lemson s.n.*; drawing from the holotype.

Stamens 6.2–10.0 mm long, not elongating at anthesis; *filaments* white, curved outwards near the base and inwards in the upper half, linear, sometimes slightly flared near the base but without lobes, 3–4 times the anther length, flattened, glabrous or rarely with a very few scattered adaxial hairs; *anthers* white, manifest but hidden by the erect lobe bases and thick corolla hairs, oblong, 1.3–2.0 mm long, pollen yellow, often adhering in a large clump around the style. *Hypogynous disc* of 5 free scales, the scales oblong with acute, acuminate or cusped apices, 0.5–0.8 mm long. *Gynoecium* 9.0–12.0 mm long, not elongating at anthesis, shorter than the corolla; *ovary* green, globular, 1.5–2 long, 1.5–2 mm wide, the apex rounded, glabrous to very shortly papillate; *style* white, linear, sometimes slightly widened in the middle and often coiled or bent near the base, sparsely sericeous or pilose; *stigma* manifest, exposed by the spreading corolla lobes, lobulate; *ovules* 5 per locule. (Figure 6A–C)

Specimens examined. WESTERN AUSTRALIA: [localities withheld] 15 Feb. 1994, *J.A. Cochrane* 973 (PERTH 3481050); 25 Jan. 2005, *J.A. Cochrane* 5289 (PERTH 7042531); 18 Jul. 1987, *E.J. Croxford* 5888 (PERTH 3229092); 20 April 1996, *E.J. Croxford* 7398 (PERTH 5634059); 28 Aug. 1986, *G.J. Keighery* 8339 (PERTH 1112295); 27 Nov. 1986, *G.J. Keighery* 8701 (PERTH 1112309); 13 Dec. 1992, *M. MacDonald* 1484 (PERTH 3125831); 2 Nov.1967, *K.R. Newbey* 2659 (PERTH 2120313); 21 Jan. 1995, *D. Papenfus* 022 (PERTH 4077431); 6 Oct. 1992, *G. Wardell-Johnson & A.R. Annels* ARA 2547 (PERTH 4437225); 20 Aug. 1992, *R.T. Wills s.n.* (PERTH 6532365).

Distribution. Known only from Two Peoples Bay Nature Reserve east of Albany (Figure 6D).

Habitat. Coastal low heath in grey metagranitic peaty sand over granite.

Flowering period. July to September

Conservation status. Declared Rare Flora under the Western Australian Wildlife Conservation Act 1950 (Atkins 2006). *Andersonia pinaster* occurs within a single nature reserve and is threatened by *Phytophthora cinnamomi*.

Etymology. The species epithet refers to the habit of mature plants, which resembles a small, dense pine tree.

Affinities. This species resembles *A. auriculata* and larger forms of *A. caerulea*, but can be distinguished on both vegetative and floral characteristics. The major difference with *A. auriculata* is the presence of lobed staminal filaments in that species, but plants of *A. auriculata* are also smaller than *A. pinaster*, and the flowers are generally not hidden by long metaxyphylls before anthesis. *Andersonia caerulea* can be differentiated by its much smaller flowers with a pink, pubescent calyx and blue to pink, strongly urceolate corolla, ciliate staminal filaments and dark red or purple anthers.

Acknowledgements

I extend my thanks to the Director and staff at the Western Australian Herbarium (PERTH) for access to collections, equipment and assistance; Roger Hearn, Tony Annels and the late Dr Brenda Hammersley for assistance in the field and for collecting on my behalf; Alex George and the Latin Lesson team for assistance with diagnoses; and Juliet Wege for her patience and assistance with the preparation of the manuscript and figures. This work was supported at various times by the Australian Biological Resources Study, a PhD scholarship from The University of Western Australia and the Centre for Ecosystem Management at Edith Cowan University.

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