

## Two new, glaucous-leaved species of *Isopogon* (Proteaceae: Proteoideae: Leucadendreae) from south-western Australia

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### Abstract

Hislop, M. & Rye, B.L. Two new, glaucous-leaved species of *Isopogon* (Proteaceae: Proteoideae: Leucadendreae) from south-western Australia. *Nuytsia* 20: 169–181 (2010). Two new species and two new subspecies with simple, flat, glaucous leaves are described: *Isopogon panduratus* Hislop & Rye, *I. panduratus* subsp. *palustris* Hislop & Rye, *I. pruinus* Hislop & Rye and *I. pruinus* subsp. *glabellus* Hislop & Rye. Their distributions are mapped and the first three are illustrated. The four new taxa belong in a species group that includes *Isopogon axillaris* R.Br. and *I. buxifolius* R.Br. *s. lat.* *Isopogon panduratus* subsp. *palustris* has conservation priority.

### Introduction

*Isopogon* R.Br. ex J. Knight is a moderately large genus belonging to the subfamily Proteoideae and occurring in southern mainland Australia and on islands in the Bass Strait. The genus was until recently included in the tribe Conospermeae, but as a result of a comprehensive molecular analysis of the family, utilizing published and unpublished DNA sequence data from several genomic regions, it has been transferred to a newly described tribe, Leucadendreae (Weston & Barker 2006).

Foreman's treatment (1995) of *Isopogon* in Volume 16 of *Flora of Australia* was curtailed by ill health caused in part by an allergic reaction to contact with the two proteaceous genera, *Isopogon* and *Petrophile*, that were then the subject of his research (Alex George, pers. com.). It is probable that he would have recognised additional species had he been able to complete his revision of the genus prior to publication of the flora treatment. As it was however he retained the pre-existing, taxonomic status quo in the most complex group of western species, those with simple, thick, flat leaves allied to *Isopogon buxifolius*. This did not adequately reflect the group's diversity and led him to circumscribe some species, especially *I. buxifolius* very broadly, while at the same time leaving numerous specimens largely unresolved. Foreman was clearly unsure what to do with the glaucous-leaved specimens now attributable to the two species described below. He annotated these in a variety of ways, sometimes identifying them as named species such as *I. axillaris* or *I. polycephalus*, at other times using informal names or indicating affinities only, e.g. '*Isopogon* sp. 2', '*I. attenuatus complex*' or '*I. polycephalus variant*'. Bentham (1870) included the simple, flat-leaved species in section *Hypsanthus* (Endl.) Benth, however it is clear that this subgeneric grouping, at least as applied by Bentham, is an artificial one.

It was not long after the flora treatment of *Isopogon* appeared that its limitations became apparent. Even before its publication, the name *Isopogon* sp. Watheroo (D. Foreman 477) had been added to the Census of Western Australian Plants by ecologist E.A. (Ted) Griffin for a species with glaucous leaves that he had observed while working on vegetation surveys of the Geraldton sandplains. In its original application that name was restricted to populations occurring north of Perth and included collections of a second taxon that was later segregated as *I.* sp. Badgingarra (A.S. George 14200). These northern taxa are described here as the two subspecies of *Isopogon panduratus* Hislop & Rye. The concept of *I.* sp. Watheroo was later expanded to include plants with a generally similar morphology from the central and south-eastern wheatbelt which are described below as *I. pruinosus* Hislop & Rye.

Apart from the taxa treated in this paper, an additional five informal names have been allocated to new Western Australian members of the genus, four of which apply to other species from the *Isopogon buxifolius* group. These will be described in a separate paper.

## Methods

This study was based on an examination of collections housed at PERTH. All measurements were obtained from dried specimens. Although the leaves of members of the simple, flat-leaved group are often distinctly narrowed towards the base, there is no corresponding change in tissue type that would indicate the presence of a petiole. They are therefore considered here to be essentially sessile, and the leaf length was therefore measured from the apex to the point of attachment. The inflorescence-subtending leaves grade into involucre bracts across several very short, spirally-arranged nodes. There are several whorls of involucre bracts and the outer was considered to begin with the first bract lacking any terminal herbaceous appendage (i.e. vestigial leaf lamina). Measurements were taken, and observations made, of the outer and innermost whorls. The tepal limb was measured from the point of insertion of the filament to the tepal apex, excluding the hair tuft. Most species in the simple, flat-leaved group (including the two described here) have the distinctively shaped pollen presenter which is characteristic of the genus. This comprises four, more or less, well-defined zones. The style expands gradually into the usually, narrowly obovoid, basal portion of the pollen presenter, which terminates abruptly in a narrow constriction. Above the constriction is a short bulge, and above that a tapering, usually longitudinally grooved and viscid, portion referred to here as the receptor. It is to the receptor that most of the pollen adheres in newly opened flowers. At the apex of the receptor is the rather dilated stigma. Four separate measurements of the pollen presenter were included in the descriptions below: the length of basal portion (from the point at which the style expands to the base of the constriction), the length of the receptor (from the top of the bulge to the stigma inclusive), the length of the pollen presenter in its entirety and the width at its widest point (which is either at the top of the basal portion or the bulge). The distribution maps were compiled using DIVA-GIS Version 5.2.0.2 and based on PERTH specimen data.

## Taxonomy

### ***Isopogon panduratus* Hislop & Rye, *sp. nov.***

*Isopogon axillari* affinis sed inflorescentiis grandioribus floribus numerosis, pollinis praebitoris longioribus, pilis tepalorum longioribus densioribus differt.

*Typus*: Garabaldi Willis Rd, [Tathra National Park], 1.6 km S of Eneabba–Carnamah Rd, [E of Eneabba], Western Australia, 16 July 2000, *M. Hislop* 2041 (*holo*: PERTH 05815266 (sheet 1), PERTH 05815274 (sheet 2); *iso*: CANB, MEL).

Robust, spreading *shrubs* to *c.* 2.0 m high and 1.5 m wide, with a fire-sensitive rootstock. Young *branchlets* distinctly ribbed to almost smooth, pale brown to reddish-brown, the older wood grey, with a sparse to moderately dense indumentum of soft, variously orientated, straight or  $\pm$  curled, tubercle-based hairs often of mixed lengths, the longest to *c.* 1.2 mm long. *Leaves* simple, entire, usually glaucous at least when fresh, variously orientated between patent and steeply antrorse; apex mucronate; lamina narrowly obovate in the upper 2/3–3/4 of its length, above a long attenuate, petiole-like portion which gradually expands again towards the base, 35–125(–150) mm long, 3–19 mm wide,  $\pm$  flat to shallowly or deeply concave adaxially, straight to prominently incurved along the longitudinal axis, thick, with indistinct venation, apart sometimes from the midrib,  $\pm$  hairy when young with a similar tubercle-based indumentum to that of the branchlets, but soon glabrescent, leaving the surfaces finely tuberculate. *Inflorescence* globose or depressed-globose, 18–30 mm diam., (30–)40–70(–105)-flowered, terminal or axillary, sessile, subtended by, and the basal portion partially obscured by, the expanded leaf bases, solitary or several grouped together in clusters. *Involucral bracts* in 3–5 whorls; the outer bracts broadly ovate, ovate or obovate, 6.8–12.5 mm long, 3.3–6.7 mm wide, abaxial surface appressed-hairy throughout or at least in upper half, whitish if densely hairy but otherwise often purple-tinted, the colour fading to brown in old dried specimens, adaxial surface with a zone of appressed hairs towards the apex, otherwise glabrous, apex mucronate or obtuse, margins ciliate; the inner bracts narrowly obovate or narrowly panduriform, 9.1–13.5 mm long, 1.3–2.3 mm wide, abaxial surface densely appressed-hairy in upper 1/2–2/3, either glabrous below or with a few coarse crinkled hairs, adaxial surface with a zone of appressed hairs towards the apex, glabrous below, apex acute, margins ciliate, usually throughout, but sometimes only in the upper half. *Cone scales* very narrowly panduriform, usually wider towards the apex, 9.4–13.9 mm long, 0.7–1.3 mm wide, abaxial surface with a strongly dimorphic indumentum, densely appressed-hairy on the expanded upper portion, much less hairy to  $\pm$  glabrous on the narrower, central portion, with a zone of coarser, more spreading, crinkled hairs towards the base, adaxial surface densely appressed-hairy on the upper portion,  $\pm$  glabrous, or with just a few hairs below, apex acute, margins usually ciliate throughout with straight, fine hairs above and crinkled, coarse ones below. *Perianth tube* slightly expanded about the ovary, otherwise filiform, glabrous, pale pink, 18–27 mm long; *lobes* pale pink, 4.4–6.1 mm long, the limb slightly darker, 2.3–3.1 mm long, with a tuft of straight, white hairs at the apex, 0.5–1.1 mm long, from which a row of marginal hairs usually extend to a point at least a third the way down the limb. *Anthers* 1.9–2.5 mm long. *Style* glabrous, 15–25 mm long. *Pollen presenter* (3.2–)3.4–4.7 mm long, 0.35–0.50 mm wide; the base narrowly obovoid, 1.0–2.1 mm long, densely papillate with retrorse white or yellow papillae, 0.08–0.20 mm long; the constriction usually prominent, papillate or  $\pm$  glabrous; the bulge prominent with the same indumentum as the base or occasionally almost glabrous; the receptor 1.7–2.2 mm, tapering gradually towards the stigma, viscid, glabrous throughout or with some papillae towards the base. *Stigma* prominently dilated, cupular. *Cones* globose or depressed-globose, 9–16 mm long, 10–18 mm wide. *Nuts* ovoid, 3.2–3.7 mm long, 1.3–1.6 mm wide, with long, spreading hairs throughout, the longest of these (4–5 mm long) at the base, becoming progressively shorter towards the apex.

*Etymology*. The epithet is derived from the Latin *pandura* (a musical instrument similar to a fiddle), in reference to the shape of the inner involucral bracts, cone scales and the very broad-based leaves subtending the inflorescences.

*Affinities.* *Isopogon panduratus* is unlikely to be confused with any other species of *Isopogon* in the northern sand-plains. It is most similar to *I. pruinosus* Hislop & Rye (described below) and *I. axillaris*, which occur respectively, well to the south-east and south of the range of *I. panduratus*.

*Isopogon pruinosus* can be distinguished by its smaller inflorescences with fewer, shorter flowers and generally shorter cone scales with a monomorphic or weakly dimorphic indumentum. Additionally the perianth limb of *I. pruinosus* is glabrous below the apical tuft whereas in *I. panduratus* sparse hairs extend along the margins of the limb below the tuft for at least a third of its length (in all, or at least some flowers). There is also a foliar difference. Although both species usually have conspicuously glaucous leaves when live, once dried this character becomes much less apparent in *I. panduratus* with the excrescence often observable only under magnification. By contrast in *I. pruinosus* the prominent white excrescence apparently persists indefinitely, unless the leaves have been physically abraded.

*Isopogon axillaris* from the wet, far south-west corner of Western Australia is readily separated by its non-glaucous leaves which are unexpanded towards the base, and in having a fewer-flowered inflorescence (to *c.* 20-flowered) and tepals with longer, more widely distributed hairs.

*Notes.* Two subspecies are recognised. They differ mainly in foliar morphology and ecological preference.

#### Key to subspecies of *Isopogon panduratus*

1. Mature leaves 7–19 mm wide, flat or shallowly concave; outer involucre bracts hairy for most (2/3–3/4) of their length, with marginal cilia mostly in more than one layer, the longest ones (0.4–)0.5–0.7 mm long (uplands mostly from NE of Eneabba to S of Watheroo)..... subsp. **panduratus**
- 1: Mature leaves 3–8 mm wide, deeply concave; outer involucre bracts glabrous in basal half, with marginal cilia mostly in a single layer, 0.3–0.5 mm long (seasonal wetlands on coastal plain from NE of Cervantes to the Cooljarloo area) ..... subsp. **palustris**

#### a. *Isopogon panduratus* Hislop & Rye subsp. **panduratus**

*Isopogon* sp. Watheroo (D. Foreman 477) *p.p.*, in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 497 (2000).

Robust, spreading *shrubs* usually 0.5–1.5 m high, with one record of 1.9m, commonly 1–1.5 m wide but up to 3 m. *Branchlets* usually with a dense indumentum directly below each flower head; hairs 0.5–1.2 mm long. Mature *leaves* flat or shallowly concave, 50–150 mm long, 7–19 mm wide. *Outer involucre bracts* usually with a dense indumentum of white antrorse-appressed hairs on abaxial surface, with hairs extending over the upper two thirds to three quarters of the bract length, and with appressed hairs over part of adaxial surface, margins densely hairy with more than one series of cilia, the longest ones (0.4–)0.5–0.7 mm long. (Figure 1 A–K)

*Other specimens examined:* WESTERNAUSTRALIA: 10 miles [*c.* 16 km] W of Winchester on Eneabba Rd, W of Carnamah, 24 Aug. 1965, *A.C. Beaglehole* 12096 (NSW, PERTH); Location 10903, First North Rd, 5 km from Eneabba–Three Springs Rd, 14 Dec. 2002, *J. Borger* BB 94 (PERTH); Turkey Flat Rd, W side, N of Antonio Rd turnoff [SW of] Three Springs, May 2005, *J. Borger* TF 1 (PERTH); Watheroo West Rd, Coomallo, 31 May 1972, *S.J.J. Davies s.n.* (PERTH); 20 miles [*c.* 32 km] W of

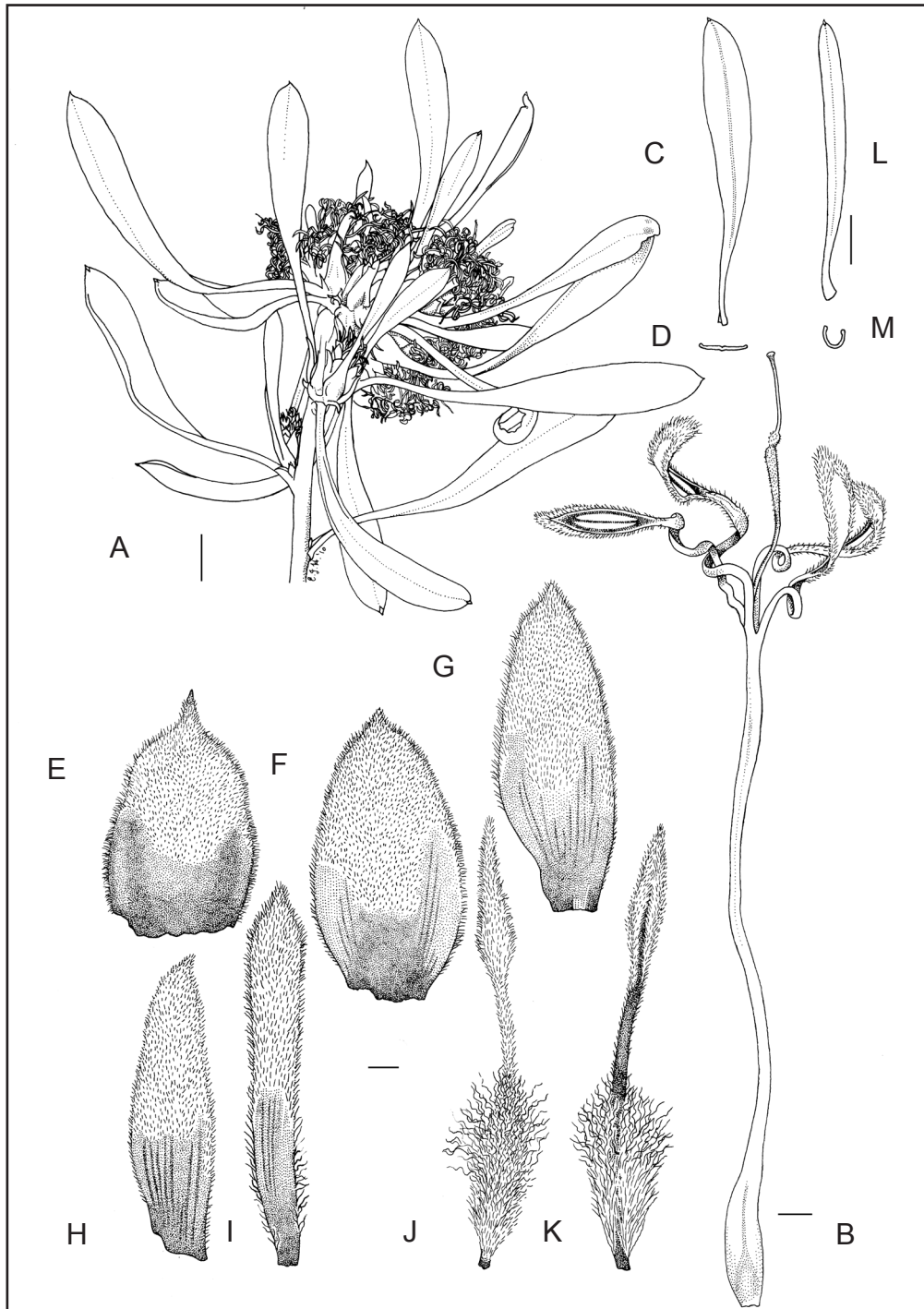


Figure 1. A–K. *Isopogon panduratus* subsp. *panduratus*. A – flowering branchlet; B – flower; C – leaf, abaxial surface; D – leaf section; E – outer involucral bract, abaxial surface; F–H – intermediate involucral bracts, abaxial surface; I – inner involucral bract, abaxial surface; J – cone scale, abaxial surface; K – cone scale, adaxial surface; L–M. *Isopogon panduratus* subsp. *palustris*. L – leaf, abaxial surface; M – leaf section. Scale bars: A, C, D, L & M = 10 mm; B, E, F, G, H, I, J & K = 1 mm. Drawn by Ellen Hickman from *M. Hislop* 2041 (A–K), *M. Hislop* 3797 (L, M).



Three Springs, 24 Aug. 1972, *H. Demarz* 3905 (PERTH); Marchagee Track *c.* 27 km E of Brand Highway, 1 Sep. 1984, *D.B. Foreman* 477 (CANB, K, NSW, PERTH); 40–45 km SW of Three Springs on Eneabba Rd, 4 Sep. 1984, *D.B. Foreman* 543 (CANB, PERTH); Hill River (near Jurien), June 1943, *C.A. Gardner s.n.* (PERTH); W from Winchester, July 1965, *C.A. Gardner s.n.* (PERTH); Alexander Morrison National Park, 7 Sep. 1979, *E.A. Griffin* 2195 (MEL, PERTH); Hill off Brand Highway, 7 km S of Jurien turnoff, 25 July 1980, *E.A. Griffin* 2762 PERTH); SE corner of Reserve no. 31030, S of Eneabba, 5 Aug. 1981, *E.A. Griffin* 3154 (PERTH); Hi Vallee property, Warradarge, W boundary track of main bush block, *c.* 250 m S of NW corner, 15 July 2001, *M. Hislop, F. & J. Hort* MH 2257 (PERTH); Marchagee Track, 23 km E of Brand Highway, 9 June 2002, *M. Hislop* 2693 (PERTH); Boothendarra Nature Reserve, off Boothendarra Rd, 5.2 km E of Dewar Rd, NE of Badgingarra, 16 Aug. 2008, *M. Hislop* 3802 (CANB, MEL, PERTH); Big Soak Plain [S of Alexander Morrison National Park], 1981, *Hood s.n.* (PERTH); Watheroo National Park, W of Watheroo, 5 Oct. 1971, *R.D. Royce* 9610 (PERTH); 35 km W of Watheroo, 2 Nov. 1974, *D.J.E. Whibley* 4979 (AD, PERTH).

*Distribution and habitat.* The main area of distribution is on the uplands of the Dandaragan Plateau between Wotto Nature Reserve, NE of Eneabba and Watheroo National Park (Figure 2), with apparent outliers further south. These outliers are discussed under the notes heading below.

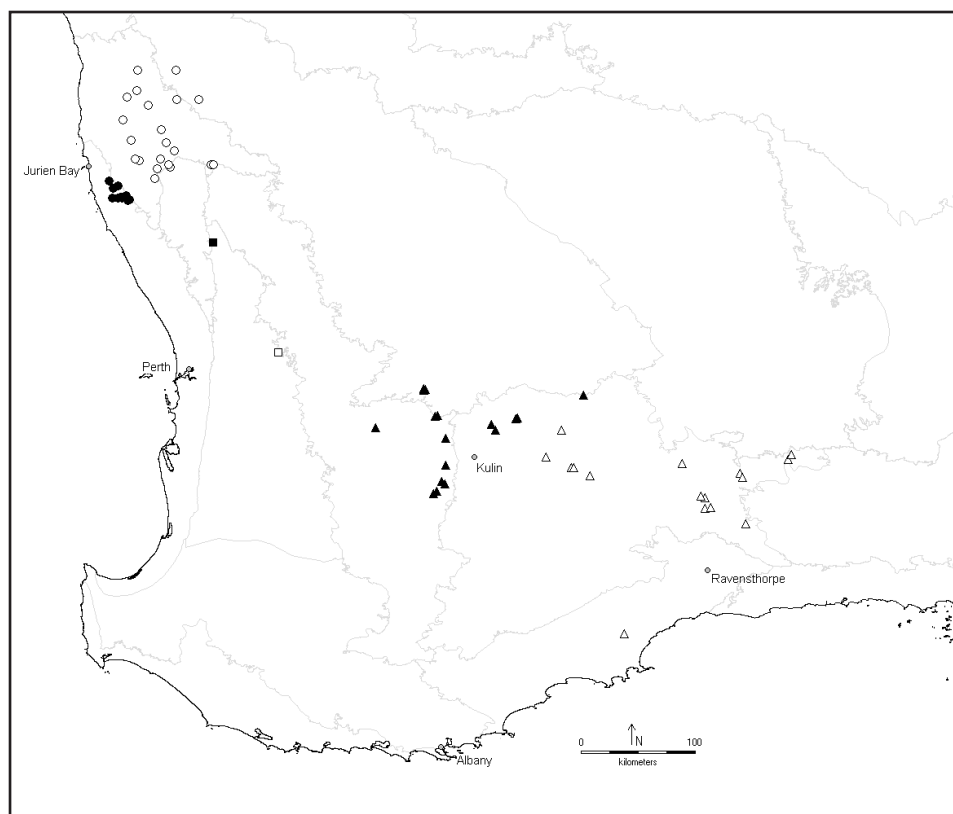


Figure 2. Distribution of *Isopogon panduratus* subsp. *panduratus* (○), *I. panduratus* subsp. *palustris* (●), *I. pruinus* subsp. *pruinus* (▲) and *I. pruinus* subsp. *glabellus* (△) in south-west Western Australia. Also mapped are the two anomalous specimens of *Isopogon panduratus* mentioned in the text, i.e. *E.A. Griffin* 5368 (■) and *F. & J. Hort* 1767 (□).

It grows as a component of species-rich heath, less often *Banksia* woodland, usually in shallow sandy soils over laterite, but sometimes also in deep white sand.

*Phenology.* The main flowering period is between June and August.

*Conservation status.* Although subsp. *panduratus* does not have a wide distribution in the Geraldton sandplains, it is locally common and is known to occur in a number of National Parks and Nature Reserves. It is therefore not recommended at this stage, for inclusion on the Department of Environment and Conservation's Priority list.

*Notes.* There are two rather anomalous collections at the Western Australian Herbarium from localities well to the south of the species' main area of distribution. The first of these (*E.A. Griffin* 5368) was collected from private property south-east of Dandaragan where it was apparently growing in a seasonal dampland. Despite the habitat, the foliar character is that of the typical subspecies and not subsp. *palustris*. The specimen is anomalous in having a shorter pollen presenter (3.2 mm) than has been otherwise recorded for the species and in the almost complete absence of marginal hairs on the perianth limb. The second outlier (*F. & J. Hort* 1767) is a single roadside plant from a locality north-west of York, which is typical of subsp. *panduratus* except for its non-glaucous leaves and unusually large dimensions. The plant was said to be almost 2 m tall and 3 m across, which is well beyond the usual size range for the typical subspecies.

These two specimens are not assigned here to subspecies and are indicated by their own icons on the distribution map (Figure 2).

**b. *Isopogon panduratus* Hislop & Rye subsp. *palustris* Hislop & Rye, subsp. nov.**

A subsp. *pandurato* foliis angustioribus profunde concavis, et postea anthesi differt.

*Typus:* south-west of Badgingarra, Western Australia [precise locality withheld for conservation reasons], 15 Aug. 2008, *M. Hislop* 3797 (*holo:* PERTH 07978057; *iso:* CANB, MEL).

*Isopogon* sp. Badgingarra (A.S. George 14200), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed January 2009]

Robust, spreading *shrubs* usually 0.7–2.0 m high, commonly 0.5–1.5 m wide. *Branchlets* usually with a sparse indumentum or glabrous directly below each flower head; hairs 0.4–0.8 mm long. Mature *leaves* deeply concave, 50–80(–100) mm long, 3–8 mm wide. *Outer involucral bracts* glabrous or with a sparse to moderately dense indumentum on abaxial surface, with hairs restricted to the upper half (often occurring in a small, subapical patch), and glabrous or with a sparse to moderately dense indumentum of appressed hairs over distal part of adaxial surface, with a single series of cilia along the lateral margins but sometimes with more cilia at apex, the longest cilia 0.3–0.5 mm long. (Figure 1 L–M)

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 17 Sep. 1976, *J.S. Beard* 7849 (PERTH); 5 Nov. 1975, *A.S. George* 14200 (PERTH); 17 Oct. 1996, *A.S. George & J.P. Rourke* ASG 17300 (PERTH); 13 Dec. 2006, *A. Harris* LCS 13191 (PERTH); 15 Aug. 2008, *M. Hislop* 3796 (CANB, PERTH); 15 Aug. 2008, *M. Hislop* 3798 (PERTH); 16 Aug. 2008, *M. Hislop* 3800 (CANB, NSW, PERTH); 12 Sep. 2004, *G.J. Keighery & B.J. Keighery* 465 (CANB,

MEL, PERTH); 30 Oct. 1999, *C. MacPherson s.n.* (PERTH); 12 Feb. 2002, *S. McNee s.n.* (PERTH); 31 Oct. 2000, *P. Smith & W. Bancroft s.n.* (PERTH); 26 Nov. 1988, *M. Trudgen s.n.* (PERTH); 1 Oct. 1976, *M. Wittwer* W 1836 (PERTH); 12 Nov. 2008, *G. Woodman & B. Taylor* OPP 18 (PERTH).

*Distribution and habitat.* Restricted to the coastal plain from north-east of Cervantes south to the Cooljarloo area, north-west of Cataby (Figure 2). In this area it grows in winter-wet sands or sandy loams in heathland communities often dominated by *Banksia telmatiaea*, *Regelia ciliata*, *Beaufortia squarrosa* and *Hakea obliqua* subsp. *parviflora*.

*Phenology.* The main flowering period is between August and October.

*Etymology.* The subspecific epithet is from the Latin *paluster* (belonging to a marsh), a reference to the habitat to which this plant is restricted.

*Conservation status.* The known distribution of this taxon is no more than 30 km (north–south axis) by 20 km (east to west) which includes one confirmed occurrence in Wongonderrah Nature Reserve. Within this area it tends to occur in discrete stands and is often locally common. Threatening processes may include a local spread of the rootrot pathogen *Phytophthora cinnamomi* or the too frequent occurrence of fire. Much of the subspecies' known range also occurs in an area subject to mining development for mineral sands. A systematic search of seasonal wetlands further south, between Cooljarloo and the Moore River, may well be productive in terms of identifying new populations of this taxon. Recently assessed as Priority Two under the Conservation Codes for Western Australian Flora (Smith 2010), under the name *Isopogon* sp. Badgingarra (A.S. George 14200).

*Notes.* Young plants of subsp. *palustris* have more or less flat leaves, like the typical subspecies, but gradually assume the characteristic, deeply concave foliage as the plants mature.

In addition to the foliar differences, the two subspecies can generally be separated by their indumentum. Branchlets of subsp. *palustris* usually have a shorter and sparser indumentum, occasionally more or less glabrous, and hairs on the outer involucre bracts are restricted to the upper half (often occurring only as a small subapical patch), whereas those of the typical subspecies occupy the upper two thirds to three quarters of the bract length. The ciliate margin of the involucre bracts is multi-layered in the typical subspecies but single-layered in the subsp. *palustris*.

There may also be a difference in stature between the two at maturity. Heights of 1.8 or 2 m have been recorded for subsp. *palustris*, but there are no records (apart from the anomalous southern outlier mentioned above) of the typical subspecies growing higher than 1.5 m. Finally there is a difference in flowering time, with the typical subspecies in full flower between June and August and subsp. *palustris* from August to October.

### **Isopogon pruinosus** Hislop & Rye, *sp. nov.*

*Isopogon pandurato* affinis sed inflorescentia parvior, floribus paucioribus brevioribus, pilis perianthii ad caespes terminalem restrictis differt.

*Typus:* Boolanelling Nature Reserve, Copestakes Rd, Bruce Rock, Western Australia, 4 Aug. 2009, *F. Hort, J. Hort & B. Hort* 3425 (*holo:* PERTH 08130884; *iso:* CANB, MEL).



*Isopogon* sp. Watheroo (D. Foreman 477) *p.p.*, in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 497 (2000).

Compact, spreading *shrubs* to 2.0 m high and 2.0 m wide, with a fire-sensitive rootstock. *Young branchlets* not or scarcely ribbed, pale brown, reddish-brown or yellow-brown, becoming grey on older wood, with an indumentum of tubercle-based hairs, usually early glabrescent, leaving the surface finely tuberculate, less often the indumentum persistent,  $\pm$  dimorphic, the shorter layer moderately dense, crisped, and overtopped by a much sparser layer of long, straight, appressed hairs to *c.* 2 mm long. *Leaves* simple, entire, usually glaucous with a persistent, white excrescence, shallowly to steeply antrorse; apex mucronate; lamina narrowly obovate in the upper 2/3–3/4, then tapering gradually to a petiole like portion which expands again slightly at the base, 30–85 mm long, 6–20 mm wide, usually  $\pm$  flat or very shallowly concave adaxially, straight or slightly incurved along the longitudinal axis, thick, the venation obscure except for the midrib and occasionally some secondary venation, sparsely hairy with tubercle-based hairs on young growth, but quickly glabrescent leaving the surfaces of mature leaves finely tuberculate. *Inflorescence* globose or broadly ellipsoid, 15–25 mm diam., (11–)16–32-flowered, terminal or axillary, sessile, usually partially obscured by the subtending leaf bases, solitary or sometimes in small clusters. *Involucral bracts* in 3–4 whorls; the outer bracts ovate or broadly ovate, 5.9–10.5 mm long, 3.1–4.6 mm wide, abaxial surface either densely appressed-hairy for at least the upper 3/4, or glabrous throughout (very occasionally largely glabrous but with a patch of sparse hairs towards the apex), adaxial surface glabrous, apart from a zone of appressed hairs towards the apex, apex mucronate, margins ciliate; the inner bracts, narrowly ovate or narrowly elliptic, often rather asymmetric ( $\pm$  falcate), 6.9–10.5 mm long, 0.9–1.8 mm wide, abaxial surface varying from densely appressed-hairy over most of its length to  $\pm$  glabrous, adaxial surface glabrous apart from a zone of appressed hairs towards the apex, apex acute, margins ciliate throughout. *Cone scales* very narrowly ovate, very narrowly elliptic, very narrowly panduriform or  $\pm$  linear, 6.4–10.5 mm long, 0.7–1.1 mm wide, abaxial surface either with a monomorphic indumentum of dense, silky antrorse hairs throughout or with a weakly dimorphic indumentum of straight, fine hairs in the upper 1/3–1/2 and coarser,  $\pm$  crinkled hairs below, adaxial surface glabrous apart from a zone of hairs towards the apex, apex acute, margins ciliate throughout. *Perianth tube* slightly expanded above the ovary, otherwise filiform, glabrous, pink, 9–20 mm long; *lobes* pink, 4.6–6.4 mm long, the limb 1.9–3.2 mm long, with an apical tuft of straight, white hairs, 0.5–1.2 mm long. *Anthers* 1.6–2.4 mm long. *Style* glabrous, 6–17 mm long. *Pollen presenter* 3.5–5.2 mm long, 0.30–0.55 mm wide; the base narrowly obovoid 1.4–2.7 mm long, densely papillate with retrorse white or yellow papillae, 0.08–0.20 mm long, the constriction usually prominent, papillate or  $\pm$  glabrous; the bulge prominent, papillate with the same indumentum as the base or somewhat sparser; the receptor 1.5–2.3 mm long, tapering gradually towards the stigma, viscid, glabrous throughout or with some papillae towards the base. *Stigma* dilated, cupular. *Cones* globose, 8–12 mm long, 8–12 mm wide. *Nuts* ovoid, 3.0–3.6 mm long, 1.1–1.5 mm wide, with spreading hairs throughout, the longest of these (4–5 mm long) at the base, becoming progressively shorter towards the apex.

*Etymology.* The epithet is derived from the Latin *pruinus* (frosted, covered with hoar frost), a reference to the persistent, white excrescence which is generally a feature of this species.

*Affinities.* Most likely to be confused with either *Isopogon panduratus* from the Geraldton sandplains (distinguishing features between the two are discussed under that species) or the taxon currently known by the phrase-name *I. sp. Fitzgerald River* (D.B. Foreman 813), which has a contiguous distribution to the south. The latter differs in its narrower pollen presenter with shorter, less dense papillae and a shorter receptor, and in its narrower, outer involucral bracts and non-glaucous aspect. *I. sp. Fitzgerald River* (D.B. Foreman 813) was included by Foreman within in his concept of

*Isopogon buxifolius* R Br. *s. lat.* but all of that species' infraspecific taxa have shorter leaves and smaller, often differently shaped pollen presenters.

*Notes.* Two more or less parapatric subspecies are recognised, the typical one with densely hairy bracts occurring in the northern and western part of the species range and the atypical one with the outer bract surface glabrous occurring in the south-east. One specimen of the latter from Hyden (*M. Barrow* 81), just south of the known range of subsp. *pruinus*, has a very sparse indumentum on a central to distal patch on some of its bracts. Although there is only one character difference between the two variants of *I. pruinus*, it causes a striking difference in their appearance and is clearly geographically based.

### Key to subspecies of *Isopogon pruinus*

- 1 Outer and intermediate involucre bracts densely hairy on the abaxial surface (Kwolyin area south to Harrismith and eastwards to NE of Hyden)..... subsp. **pruinus**
- 1: Outer and intermediate involucre bracts glabrous on abaxial surface or occasionally with a few hairs towards apex (Lake Grace area to Hyden to Frank Hann National Park)..... subsp. **glabellus**

### a. *Isopogon pruinus* Hislop & Rye subsp. **pruinus**

*Isopogon* sp. Watheroo (D. Foreman 477) *p.p.*, in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 497 (2000).

*Outer and intermediate involucre bracts* with a dense indumentum of white, antrorse-appressed hairs on abaxial surface. (Figure 3)

*Other specimens examined.* WESTERN AUSTRALIA: 9 km NE of Kondinin trig. point, 28 Jan. 1979, *B. Barnsley* 958 (CANB, NSW, PERTH); Corrigin Reserve, 5 June 1998, *E. Bennett* AS 10.15 (PERTH); Boolanelling Nature Reserve [N of Corrigin], 3 Sep. 1998, *E. Bennett* BO 6.4 (PERTH); VCL No. 9, Site 2, S of Harrismith townsite, 23 Nov. 1999, *E. Bennett & T. Sleep* 9.037 (PERTH); Dudinin, Jitarning Kulin shire, July 1994, *D. Cook* KKD 1A (PERTH); Along track which branches S off Kulin–Dudinin Rd, 2.6 km E of Dudinin, 7 May 1997, *R. Davis* 3146 (PERTH); Jingaring Nature Reserve [E of Pingelly], 30 June 1998, *R. Davis* 6370B (PERTH); Private property near Sedgewick Rd, NE of Hyden, 19 Aug. 2001, *J.M. Flint* 258 (PERTH); Anderson Rock Rd, S of Mount Walker bin [E of Narembeen], 18 Aug. 2002, *J.M. Flint* 302 (PERTH, CANB); 11 km NW of Jitarning, 20 Nov. 1985, *D.B. Foreman* 1120 (MEL, PERTH); Quadrat 12, Taylor's property 'Woodford', between Tincurrin Line Rd and Harrismith South Rd, approx. 3 km SSW of Harrismith, 30 Aug. 1998, *A.G. Guinness et al.* WOOD 12/09 (PERTH); Bendering Nature Reserve, 27 Aug. 1983, *G.J. Keighery* 6264 (PERTH); On N side of Bendering Reserve Rd, 3.45 km E of Greay Rd, North Karlgarin Nature Reserve [ENE of Kondinin], 22 Sep. 1997, *G.J. Keighery & N. Gibson* 5794 (PERTH); Corrigin town reserve, 13 July 1999, *K. Macey* 2 (PERTH); Middleton Rd, 5 km E of Corrigin South Rd, on road above location 19769, 19 May 1997, *C. Rogers* 432 (PERTH); Boolanelling Nature Reserve, Kwolyin, 19 Sep. 2000, *J.E. Wajon* 270 (PERTH).

*Distribution and habitat.* Distributed in the central wheatbelt of Western Australia south of the Great Eastern Highway, from west of Corrigin to north of Hyden (Figure 2). Grows in sandy soils, mostly over gravel, in heath or open mallee woodland.

*Phenology.* Flowers mainly between June and September.

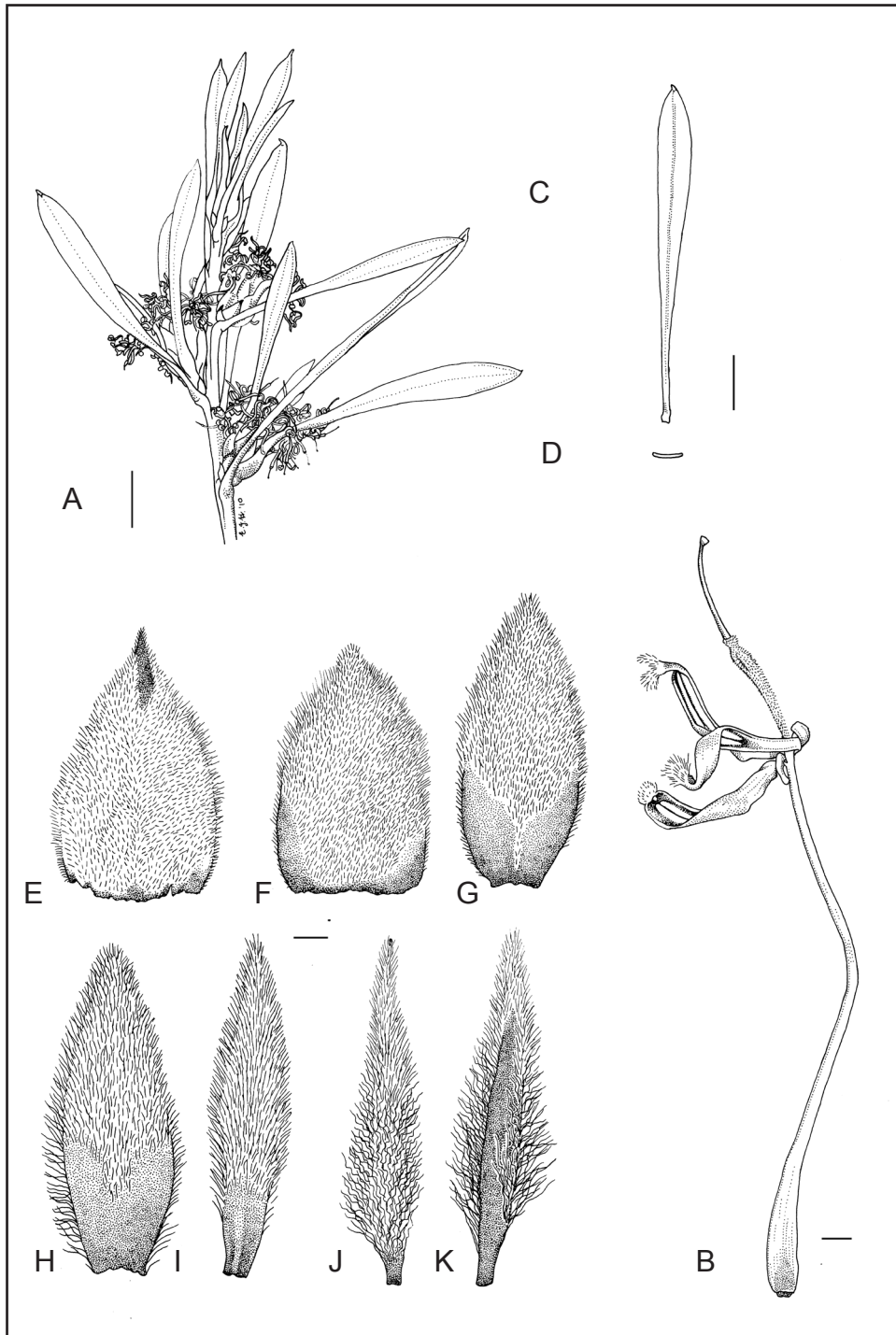


Figure 3. *Isopogon pruinosus* subsp. *pruinosus*. A – flowering branchlet; B – flower; C – leaf, abaxial surface; D – leaf section; E – outer involucral bract, abaxial surface; F–H – intermediate involucral bracts, abaxial surface; I – inner involucral bract, abaxial surface; J – cone scale, abaxial surface; K – cone scale adaxial surface. Scale bars: A, C & D = 10 mm; B, E, F, G, H, I, J & K = 1 mm. Drawn by Ellen Hickman from *J.M. Flint* 302.

*Conservation status.* The subspecies appears locally common across its range and populations are conserved in a number of Nature Reserves. No conservation coding is recommended here.

*Notes.* A variant of the typical subspecies which occurs in the Harrismith area (e.g. *E. Bennett & T. Sleep* 9.037) at the south-eastern limit of its range, apparently lacks the pruinose leaf coating which is characteristic of the species.

**b. *Isopogon pruinus* Hislop & Rye subsp. *glabellus* Hislop & Rye**

A subsp. *pruinusum* bracteis involucrali glabris vel fere glabris differt.

*Isopogon* sp. Watheroo (D. Foreman 477) *p.p.*, in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 497 (2000).

*Illustration:* R.M. Sainsbury (1987:11) [as *Isopogon axillaris*]

*Typus:* 20 miles [c. 32 km] E of Pingaring, Western Australia, 29 May 1969, *A.S. George* 9345 (*holo:* PERTH 04229215; *iso:* AD, BRI, CANB, K, MEL).

*Outer and intermediate involucral bracts* glabrous on abaxial surface or occasionally with a few hairs towards the apex.

*Other specimens examined.* WESTERN AUSTRALIA: 90 Mile Tank, between Salmon Gums and Lake King, 18 June 1974, *T.E.H. Aplin* 5898 (CANB, K, PERTH); Hyden, 8 Sep. 1966, *M. Barrow* 81 (PERTH); Dragon Rocks Nature Reserve, 18 Aug. 1998, *M. Braimbridge & C. Godden* DS 8.11 (PERTH); 16.25 km NNE of Coujinup Hill [NE of Ravensthorpe], 11 Aug. 1983, *M.A. Burgman & S. McNee* MAB 1958 (PERTH); 0.6 km E of the 90 Mile Tank on the Lake King–Norseman Rd, 113 km NE of Lake King, 16 June 2006, *G. Byrne* 2086 (CANB, PERTH); Dragon Rocks Nature Reserve no. 36128, S boundary, 7 June 1991, *A.M. Coates* 2293 (PERTH); 13 km N of Mt. Maxwell [N of Bremer Bay], 13 May 1996, *R. Davis* RD 719 (PERTH); Lake King–Norseman Rd, 30.1 km E of Ladyman Rd, Frank Hann National Park, 16 May 2002, *M. Hislop & F. Hort* MH 2594 (CANB, PERTH); N of Digger Rock [Digger Rocks, E of Varley], 10 Dec. 1964, *F. Lullfitz* 4000 (PERTH); Frank Hann National Park, 11 July 1978, *D. Monk* 45 (PERTH); ‘Buckleys Breakaway’, 56 km E of Kulin, 5 July 1997, *S. Murray* 263 (CANB, MEL, PERTH); 10 km SSE of Mt Gibbs, Frank Hann National Park, c. 35 km ENE of Lake King, 22 July 1979, *K. Newbey* 5434 (PERTH).

*Distribution and habitat.* Occupies the south-eastern portion of the species’ range, from south-west of Hyden to the eastern end of Frank Hann National Park, with an apparent outlier well to the south in the Fitzgerald River National Park (Figure 2). There appears to be no difference in habitat preference between the two subspecies.

*Phenology.* The main flowering period is between June and September.

*Etymology.* From the Latin *glabellus* (without hairs), a reference to the glabrous or almost glabrous involucral bracts.

*Conservation status.* The distribution of subsp. *glabellus* extends from the relatively well-vegetated south-eastern part of the wheatbelt eastwards to beyond the agricultural zone. In this area it is known to occur in several Nature Reserves and National Parks. No conservation coding is recommended here.

*Notes.* There are two problematic collections from the southern edge of the subspecies' range (*D.B. Foreman* 783 from east of Lake Grace and *D.B. Foreman* 794 from south-east of Lake King). In regard to some critical aspects of their morphology they approach the unnamed taxon, *Isopogon* sp. Fitzgerald River (*D.B. Foreman* 813), discussed under the Affinities heading above. Both lack the pruinose leaf texture of *I. pruinosus* and while their involucre bract character is of that species, the morphology of the pollen presenter is somewhat intermediate with *I. sp.* Fitzgerald River (*D.B. Foreman* 813). Although these specimens are tentatively ascribed here to *I. pruinosus*, subspecific rank has not been applied and they are not included in the distribution maps. Their status will need to be reviewed when *I. sp.* Fitzgerald River (*D.B. Foreman* 813) is formally circumscribed.

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