An updated revision of *Pimelea* sect. *Heterolaena* (Thymelaeaceae), including two new taxa

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Abstract

Rye, B.L. An updated revision of *Pimelea* sect. *Heterolaena* (Thymelaeaceae), including two new taxa. *Nuytsia* 13 (1): 159–192 (1999). The taxonomy of *Pimelea* sect. *Heterolaena* (Endl.) Benth. (Thymelaeaceae) is updated to include data that have accumulated during the last decade. Two new taxa, *Pimelea neokyrea* Rye and *P. rosea* subsp. *annelsii* Rye, are named, bringing the total number recognized in the section to 15 species and five non-typical subspecies. Both of the new taxa and also *Pimelea ciliata* subsp. *longituba* Rye are included on the official list of Western Australian taxa with conservation priority, as they are either very geographically restricted or known from very few collections. These three taxa are illustrated. Descriptions and a key are provided for all named members of sect. *Heterolaena*, and the authorship of the section is discussed.

Introduction

Since the revision of Western Australian Thymelaeaceae (Rye 1988) was published eleven years ago, many new collections have been made and well over a thousand specimens of the family have been incorporated at PERTH. These additional specimens have increased the known geographical ranges of many of the taxa and provided a more detailed picture of many other aspects of their biology. About two years after the Western Australian revision, a flora treatment for all Australian members of the Thymelaeaceae was published (Rye 1990), presenting selected data from the revision but adding very little new information on the Western Australian taxa.

Among the recent collections of *Pimelea* Banks & Sol. ex Gaertn., are some specimens of two new taxa in section *Heterolaena*, a species group endemic to the south-west of Western Australia. This paper updates the taxonomic revision of this plant group to include the two new taxa and incorporate other new data, as well as correcting errors in earlier treatments. In particular, both the revision (Rye 1988) and the "Flora of Australia" account (Rye 1990) have significant defects in their keys in relation to the species of sect. *Heterolaena*. In addition to providing a more reliable key to all taxa of the section, the current paper cites a selection of new specimens, gives revised geographical distributions and habitat descriptions, and indicates both flowering and fruiting times. It also gives brief descriptions, omitting some of the less important characters covered previously, but including some significant new characters.

Methods

All measurements of morphological characters were made from dried specimens. Only the larger leaves and stamens on each specimen were measured. Where possible, anther colour and seed characters have been added to the descriptions of each taxon, but these characters should be treated with caution as there are often few specimens with mature seeds and anther colour is sometimes based on very few records. Conservation status has only been included for taxa warranting inclusion as Declared Rare or Priority Flora or known from few localities. All other taxa are known from at least 15 localities, usually including nature reserves, and do not appear to be at risk at present. An explanation of the conservation codes applied to the Western Australian flora is given at the end of each *Nuytsia* issue.

A few PERTH specimens were selected for citation under each taxon. These are mainly recent collections, mostly from new localities, or older specimens that have only recently been incorporated or reidentified. Distribution maps have been updated, with each symbol representing the occurrence of the taxon in a quarter degree latitude by a quarter degree longitude area.

Section description

Pimelea sect. **Heterolaena** (Endl.) Benth. (Bentham 1873: 8). – *Pimelea* b. *Heterolaena* Endl. (Endlicher 1837: 331). – *Pimelea* sect. *Pimelea* [as *Eupimelea nom. inval.*] § *Heterolaena* (Endl.) Meisn. (Meisner 1857: 497). – *Banksia* sect. *Heterolaena* [as *Heteroclaena*] (Endl.) O. Kuntze (Post & Kuntze (1903: 59). *Type: Pimelea rosea* R. Br., lectotype, *fide* Rye (1988: 227).

Heterolaena C.A. Mey. (Fischer, Meyer & Ave-Lallemant 1845: 47–48). *Type: Heterolaena spectabilis* (Lindl.) Fisch. & C.A. Mey. [= *Pimelea spectabilis* Lindl.].

Very small to tall *shrubs* or rarely small *trees*, often with a lignotuber 3–15 mm diam.; stems largely glabrous but with small tufts of white to ferruginous or reddish hairs associated with the axillary buds in at least the uppermost axils below each inflorescence. *Leaves* opposite-decussate, very shortly petiolate to sessile. *Inflorescence* erect or sometimes pendulous, usually globular, head-like, the short pedicels being concealed; involucral bracts usually 4, sessile, glabrous outside or rarely with a few hairs towards base; pedicels densely covered by long hairs, together with the receptacle forming a flat disc-like to narrowly conic structure that persists after the involucral bracts and fruits have been shed. *Flowers* large or medium-sized, bisexual or rarely female, protandrous, white to deep pink or pale yellow, hairy outside, glabrous inside or with hairs restricted to the throat and sepals. *Floral tube* with long hairs (usually mixed with much shorter hairs) occurring above or on upper part of the swollen base, glabrous at extreme base, the whole tube and attached floral parts persistent in fruit in most taxa, but the upper half shed in two taxa. *Ovary* glabrous. *Fruit* dry, shed enclosed in the base of the floral tube, the wall usually green and flexible at first, sometimes becoming hard. *Seed* narrowly to broadly ovoid and very slightly to distinctly compressed, somewhat lop-sided as the apex is recurved towards abaxial surface; exocarp and endocarp membranous, reticulate-patterned, white to golden brown and often translucent or becoming transparent, the exocarp usually golden brown along abaxial line; mesocarp hard and brittle, very finely reticulate, black. *Cotyledons* (where known) narrow.

Notes. Currently 15 species are recognized in sect. *Heterolaena*, all from the south-west of Western Australia. Most plants are single-stemmed at the base but mature plants are generally capable of resprouting from a lignotuber after fire or other damage to the main stem, resulting in a multi-stemmed

shrub. Stems are usually glabrous except near each inflorescence where the uppermost axils usually have hairs associated with the axillary bud. Very rarely there are also hairs on the internodes, occurring in a strip extending vertically above each of the axils of the node but not in the intermediate areas.

Most of the taxa could be regarded as gynodioecious or gynomonoecious or a combination of both states, but female plants or flowers are rare in comparison with the bisexual ones. All descriptions below of flowers or floral organs refer only to bisexual flowers. Female flowers differ from the bisexual ones in having small abortive anthers on shorter filaments, the staminodes invariably being shorter than the sepals. They also tend to have a shorter floral tube and more prominently exserted style, with the stigma often broader.

All flowers have a long slender tube and basal nectar that is accessible to insects with a long slender proboscis. They appear to be pollinated primarily by butterflies, although moths might also be of importance. Keighery (1975) recorded a total of six species of butterflies feeding from flowers of three members of sect. *Heterolaena*. Three species of butterflies were recorded visiting a population of *Pimelea ciliata* [as *P. rosea*], four species visiting a population of *P. ferruginea* and one species visiting two populations of *P. spectabilis*, which has particularly large flowers and may therefore be specialized for the larger butterflies.

Involucral bracts are usually in two pairs, occasionally in three pairs but then with the outermost pair of bracts usually more leaf-like than the others and not included in the descriptions given for the bracts below, or rarely in a single pair and then with two broad, somewhat bract-like leaves directly below. Descriptions of flower colour refer only to the predominant colour visible from the top of the open flowers, i.e. the upper surface of the sepals. Predominantly white-flowered taxa are often pink or yellowish in bud and partially coloured so in flower. Many of the taxa have orange anthers, which often become brown in dried material, but a few taxa have yellow or cream anthers.

Young seedlings have not been examined in this study but cotyledon shape may be significant and should be studied further. Meyer (1845) indicated that the species he placed in *Heterolaena* have narrow cotyledons while some other species groups have broad cotyledons, and Bentham (1873) reported narrow cotyledons in *P. ferruginea* and *P. spectabilis*, the only two taxa for which he had examined mature seeds.

Seed and fruit characters cannot be used as primary key characters because there are seldom mature fertile fruits present on the specimens, but they often differ significantly from species to species. These characters were omitted from the revision (Rye 1988) mainly because of the acute shortage of mature fruiting material at that time.

The following characters are relatively uncommon in sect. *Heterolaena* and so are useful in distinguishing the few taxa possessing them: leaf margins incurved; involucral bracts almost fully hairy inside; flowers circumscissile; floral tube with all hairs appressed to antrorse, or with the large hairs more or less restricted to the swollen base, or with retrorse to reflexed hairs on the swollen base; anthers subsessile and introrse.

Key to species and subspecies

Drawing up a reliable key for this species group is difficult because of the great variability of the more useful characters within some of the taxa. There may be occasional atypical specimens which will not key successfully on all characters for a particular lead.

Excluding the newly discovered *Pimelea neokyrea*, all species belonging to *Pimelea* sect. *Heterolaena* are keyed under couplets 11–26 in Rye (1988: 144–145). Couplet 12 of this key is misleading, as *Pimelea brevistyla* is incorrectly keyed under the second alternative and three of the species keyed only under the first alternative of having leaf margins "flat to incurved" actually have recurved leaf margins, although not as prominently recurved as most of the taxa keyed only under the second alternative of leaf margins "recurved to revolute". The new key given below overcomes this shortcoming and other more minor inaccuracies in the previous key, and also differs from the earlier key in its inclusion of infraspecific taxa.

1. Leaves sessile, the base slightly stem-clasping. Involucral bracts more or less circular. (Shark Bay to Mingenew) ..... **P. sessilis**

1. Leaves all or mostly with a petiole 0.2–2 mm long, not stem-clasping. Involucral bracts usually narrowly to broadly ovate, sometimes more or less elliptic or obovate

2. Stamens much shorter than sepals, subsessile (filament 0.1–0.4 mm long); anther 0.5–0.7 mm wide. Leaves with the margins distinctly incurved or inrolled, often tending to become linear

3. Involucral bracts 12–20 mm long. Floral tube 11–15 mm long. Sepals 4.5–6 mm long. (Darling Range) ..... **P. brevistyla** subsp. **brevistyla**

3. Involucral bracts 7–11 mm long. Floral tube 8–11 mm long. Sepals 3–4 mm long. (Wubin to Lake Carmody) ..... **P. brevistyla** subsp. **minor**

2. Stamens much shorter than to greatly exceeding sepals, usually with a filament 0.7–8 mm long but occasionally subsessile in *P. brevifolia*, which has the anther 0.2–0.4 mm wide. Leaves with the margins incurved to revolute but never inrolled, if tending to become linear then the margins revolute

4. Swollen base of floral tube with the lowest hairs reflexed to retrorse, these retrorse hairs usually extending higher but sometimes becoming more or less patent towards summit of floral tube, sometimes mixed with some larger patent to antrorse hairs in distal half of tube

5. Inner involucral bracts glabrous or with very few hairs inside. (Darling Range) ..... **P. rara**

5. Inner involucral bracts appressed-hairy inside (but often with a narrow glabrous margin)

6. Involucral bracts with distinct pink to reddish margins or margins indistinct in colour. Flowers not circumscissile. (Geographe Bay to Mt Manypeaks) .... **P. hispida**

6. One or both pairs of involucral bracts with distinct yellow margins. Flowers circumscissile. (Perth to Albany) ..... **P. lanata**

4. Swollen base of floral tube glabrous or with appressed to widely antrorse or more or less patent hairs throughout, often with a mixture of large and minute hairs especially towards the summit of tube

7. Flowers with hairs at throat and on base of each sepal
   8. Flowers with a ring of long retrorse hairs in the throat and also antrorse hairs on base of each sepal. Floral tube either circumscissile or glabrous on swollen base
      9. Floral tube circumscissile; swollen base of floral tube with minute hairs 0.1–0.4 mm long and often a few larger hairs towards summit. (Mount Barker to East Mt Barren) ..... **P. lehmanniana** subsp. **lehmanniana**
      9. Floral tube persistent; swollen base glabrous. (Darling Range to Mount Barker) ..... **P. lehmanniana** subsp. **nervosa**
   8. Flowers with antrorse to patent hairs in the throat and inside of sepals. Floral tube persistent; swollen base of floral tube with fine minute hairs 0.1–0.3 mm long and sometimes a few large hairs towards summit. (Darling Range to Fitzgerald River National Park) ..... **P. spectabilis**
7. Flowers glabrous inside
   10. Leaves with upper surface convex, the margins incurved
      11. Floral tube with long hairs on swollen base only or mainly there but also extending for a short distance onto slender portion of tube. (Lake Grace to Albany, Norseman and Israelite Bay) ..... **P. brevifolia** subsp. **brevifolia**
      11. Floral tube with long hairs all or mainly on slender portion, sometimes also on summit of swollen base of tube. (Wubin to Lake Grace and Coolgardie) ..... **P. brevifolia** subsp. **modesta**
   10. Leaves with upper surface concave, the margins recurved or revolute
      12. Floral tube with the longer hairs widespread or at least extending through distal half of swollen base to half way up the slender portion of tube; hairs of upper part of tube mostly more or less patent
         13. Leaves 3–11 mm long, with a distinct mucro. Flowers with the slender portion of tube 1.5–4.5 mm long, the largest hairs 0.4–2.5 mm long, and anthers 0.3–0.6 mm long. (Wagin to Israelite Bay) ..... **P. brachyphylla**
         13. Leaves 5–24 mm long, scarcely mucronate. Flowers with the slender portion of tube 4–9 mm long, the largest hairs 1.5–3 mm long, and anthers 0.5–1.1 mm long. (Wilroy to Moorine Rock) ..... **P. avonensis**
      12. Floral tube with a belt of long spreading or antrorse hairs restricted to less than half of the swollen base and/or less than half of the slender portion of tube; hairs of the upper part of floral tube mostly antrorse or appressed
         14. Leaf apex acute at 75–105 degrees or obtuse, not mucronate or with a short broad mucro
            15. Inner bracts 6–12 mm long. Flowers usually distinctly pink; slender portion of floral tube 4–8 mm long. Seed rather dull, commonly 2.3–2.6 x 1.1–1.3 mm. (South-west coast and islands) ..... **P. ferruginea**
            15. Inner bracts 13–20 mm long. Flowers white to yellow; slender portion of floral tube 9–14 mm long. Seed shiny, commonly 2.3–2.8 x 0.7–1.1 mm. (Shark Bay to Pinjarra) ..... **P. leucantha**

14. Leaf apex tapered at 30–60 degrees, usually with a rather narrow mucro or slender point
    16. Outer bracts ciliate. Floral tube with long hairs absent from swollen base or only present on summit. Stamens slightly to greatly exceeding sepals; filament 2.5–4.5 mm long
        17. Slender portion of floral tube 4.5–8(9) mm long. Sepals white or pale pink on upper surface. (Wongan Hills to Scott River to Porongurup Range) ..... **P. ciliata** subsp. **ciliata**
        17. Slender portion of floral tube 8–11 mm long. Sepals medium pink on upper surface. (Yallingup to Margaret River) ..... **P. ciliata** subsp. **longituba**
    16. Outer bracts glabrous and/or floral tube with long hairs extending onto distal half of swollen base. Stamens usually distinctly shorter than sepals; filament 0.7–2.5 mm long, possibly sometimes longer in *P. neokyrea*
        18. Large hairs of floral tube extending from summit of swollen portion to about half way up the slender portion. Sepals white to pale yellow on upper surface. (Dongolocking to Cranbrook) ..... **P. neokyrea**
        18. Large hairs of floral tube extending from near the middle of swollen portion onto basal part of slender portion. Sepals usually pale to deep pink on upper surface
            19. Largest hairs of floral tube mostly occurring on swollen base, 1–1.5 mm long. (Mount Barker to Hay River) ..... **P. rosea** subsp. **annelsii**
            19. Largest hairs of floral tube about equally common on swollen base and lowest part of slender portion of tube, 2–3 mm long. (Swan Coastal Plain to Mt Manypeaks area) ..... **P. rosea** subsp. **rosea**

Species descriptions

Pimelea avonensis Rye (Rye 1988: 239–240). *Type:* Fowlers Gully, 2 km south of Wongan Hills – Piawaning road on Wilding Rd, western side of Wongan Hills, Western Australia, 14 September 1983, *K.F. Kenneally* 8808 (*holo:* PERTH 01603469; *iso:* CANB, K, MEL, PERTH 01603477, 01603485).

Illustration. Rye (1988: Figure 54).

Shrub 0.3–1.2 m high; stems with dense axillary hair tufts present throughout but tending to become less conspicuous in lower axils. *Leaf blades* linear or narrowly ovate to narrowly obovate, 5–24 x 0.5–3.5 mm; margins recurved or revolute; apex narrowly obtuse, without a mucro. *Inflorescence* erect. *Involucral bracts* ovate or broadly ovate, often pink- or red-tinged; outer bracts usually glabrous, rarely ciliate and partially appressed-hairy inside; inner bracts 6–12 mm long, often appressed-hairy inside, sometimes ciliate. *Flowers* white or pink-tinged, glabrous inside, persistent in fruit; swollen base of floral tube with more or less patent hairs 0.2–0.4 mm long, mixed with long hairs almost throughout or in distal half; slender portion of floral tube 4–9 mm long, with more or less patent hairs

1.5–3 mm long mixed with much smaller hairs in basal half and usually extending to near summit of tube, with widely antrorse or tangled hairs mostly 0.5–1 mm long in distal half. *Stamens* shorter than to slightly exceeding sepals; filament 1.5–3 mm long; anther orange, 0.5–1.1 mm long. *Seed* almost ovoid, 3.0–3.3 x *c.* 1.4 mm, rather dull greyish black, the exocarp impressed in a reticulate pattern onto the black mesocarp.

Selected specimens examined. WESTERN AUSTRALIA: S side Raywood Homestead, off Lampard Rd, Coorow Shire, 4 Sep. 1995, *F. Falconer* 41; 7 km N of Perenjori, 19 Aug. 1994, *E.D. Kabay* 374; Koolanooka Hills, 18 km E of Morawa, 15 Aug. 1990, *G.J. Keighery & J.J. Alford* 2019; 25 km NW of Mt Woodward, 30 Sep. 1982, *K.R. Newbey* 9538; Mollerin Rock, Reserve No. 769, 30 July 1988, *B.H. Smith* 1053.

Distribution and habitat. Extends from Wilroy south-east to near Moorine Rock in the South West Botanical Province. Occurs mainly in sandy soils, often in open woodlands or shrublands. (Figure 1A)

Phenology. Flowers: July to October. Fruits: August to November. Mature seeds were examined on *R.J. Cranfield* 4806.

Breeding system. Female specimen examined: *J. Taylor* 2190 *& P. Ollerenshaw.*

Notes. Very closely related to *Pimelea brachyphylla*, which has the same type of indumentum on the floral tube but differs in its distinctly mucronate leaves and usually has distinctly shorter leaves and flowers. *P. avonensis* has also been confused with *P. ciliata* and *P. leucantha* but tends to have the hairs on the floral tube more silky, and the small hairs of the upper tube are spreading, not appressed or closely antrorse as in the other two species. In *P. avonensis* the long hairs usually continue higher up the slender portion of the floral tube, although not on the type specimen illustrated in Rye (1987: Figure 54), and always extend well down onto the swollen base of the floral tube.

Two isolated records from "near York" and Dongolocking Reserve reported in Rye (1987) are no longer included in the species' distribution; the former record was based on an old collection with a vague and perhaps misleading locality, while the latter is now regarded as belonging to the newly named species *P. neokyrea*. The entire distribution map given in Rye (1987: Figure 57) for *P. avonensis* was accidently reproduced one degree too far north.

Pimelea brachyphylla Benth. (Bentham 1873: 11). – *Banksia brachyphylla* (Benth.) Kuntze (Kuntze 1891: 583). *Type:* South-west of Western Australia, 1848, *J. Drummond* 5: 429 (*lecto:* K, *fide* Rye (1988: 259); *isolecto:* MEL).

Illustration. Rye (1988: Figure 71).

Shrub or undershrub 0.1–1 m high; stems with dense axillary hair tufts sometimes tending to become less conspicuous in lower axils. *Leaf blades* elliptic-oblong to linear, 3–11 x 1–3 mm; margins revolute; apex recurved, mucronate. *Inflorescence* erect. *Involucral bracts* ovate to obovate or broadly so, with a reddish margin or more widespread reddish colouration; inner bracts 4–9 mm long, often partially appressed-hairy inside, often ciliate. *Flowers* white or rarely pale yellow, glabrous inside, persistent in fruit, the floral tube usually rather uniformly hairy, its largest hairs 0.4–2.5 mm long; swollen base of floral tube with antrorse to patent hairs 0.1–0.3 mm long, mixed with longer hairs at least in distal half; slender portion of floral tube 1.5–4.5 mm long, with widely antrorse to patent hairs throughout, the largest hairs occurring throughout or extending most of the length of floral tube.

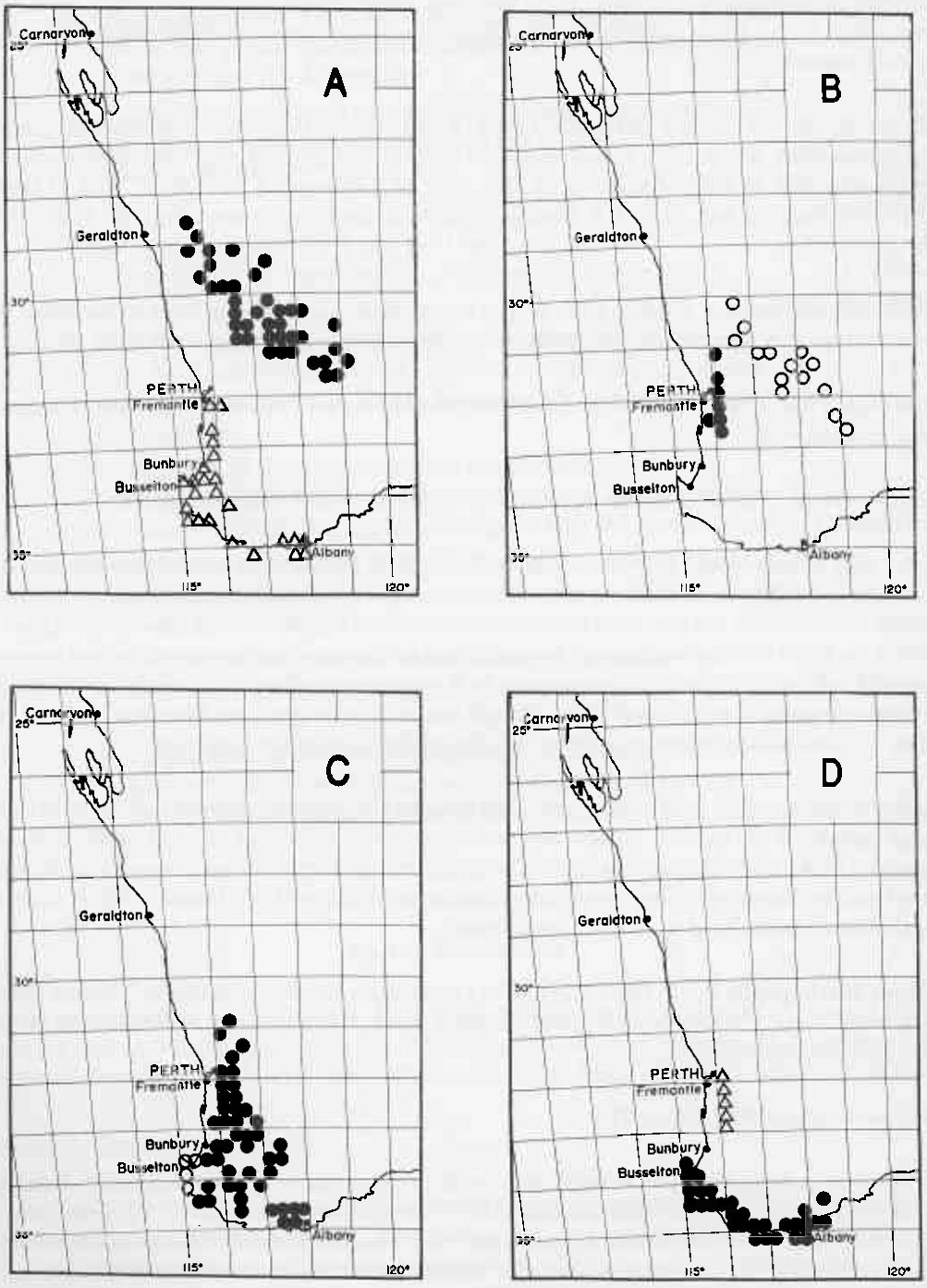

Figure 1. Geographical distributions. A – *Pimelea avonensis* ● and *P. lanata* △ ; B – *Pimelea brevistyla* subsp. *brevistyla* ● and *P. brevistyla* subsp. *minor* O ; C – *Pimelea ciliata* subsp. *ciliata* ● and *P. ciliata* subsp. *longituba* O ; D – *Pimelea hispida* ● and *P. rara* △ .

Stamens about as long as or exceeding sepals; filament 1–3.5 mm long; anther orange, 0.3–0.6 mm long. *Seed* almost ovoid, 1.7–2.8 x 0.7–1.3 mm, whitish or golden brown over shiny black.

Selected specimens examined (typical variant). WESTERN AUSTRALIA: 117.5 km S of Balladonia, 19 Aug. 1995, *R.J. Cranfield* 10146; Woogenellup Rd Reserve near Chester Pass Rd, 30 Sep. 1990, *E.J. Croxford* 6358; West Hill, 14 May 1996, *R. Davis* 751; Gnarming, 12 Sep. 1994, *D. Quicke* KKQ7.

Selected specimens examined (large variant). WESTERN AUSTRALIA: Hellfire Bay, Cape Le Grand National Park, 24 Sep. 1985, *M. Carter* 229; 6.2 km SE of Mt Drummond, Fitzgerald River National Park, 12 Nov. 1986, *K.R. Newbey* 11403; 32 miles [54 km] from Ravensthorpe, 27 Aug. 1965, *E. Wittwer* 413.

Distribution and habitat. Extends from near Wagin east to Israelite Bay and from Gnarming (near Kulin) south to the South Stirlings area in the South West Botanical Province. Occurs in a variety of soils, in mallee woodlands or shrublands. (Figure 2A)

Phenology. Flowers: mainly July to early October. Fruits: mainly August to November. Mature seeds of the typical variant were seen on *W.E. Blackall* 1012, *E.M. Bennett* 3013, *H. Eichler* 20380, *A.S. George* 6864 & 9854, *E.D. Kabay* 824 and *B.L. Rye* 82030. Mature seeds of the large variant were seen on *A.E. Orchard* 1672 and *K.R. Newbey* 11403 & 11417.

Breeding system. Female specimen examined: *K.R.Newbey* 11417. Some specimens (e.g. *M.A. Burgman* 2520 & *S. McNee*), have inflorescences with the outermost flowers female and the rest bisexual.

Notes. Closely related to *Pimelea avonensis*, differing as noted under that species and also apparently in its smaller, more shiny seeds. Seed differences need confirmation, however, as only one specimen with mature seeds has been examined in *P. avonensis*. *Pimelea brachyphylla* appears to show much better seed set than *P. avonensis*.

Pimelea brachyphylla has two main variants, which intergrade. In the typical variant the leaves are mostly very small and are closely clustered below each inflorescence although sometimes longer and more distant elsewhere on the plant, the flowers are small and the seeds (where known) are 1.7–2.3 x 0.7–1.0 mm. A variant with larger and more distant leaves, larger flowers tending to have longer hairs on the floral tube, and seeds 2.3–2.8 x 1.1–1.3 mm, is much less common but is scattered across most of the southern part of the species distribution. Only this large variant could be confused with *P. avonensis*.

Pimelea brevifolia R. Br. (Brown 1810: 359). – *Calyptrostegia brevifolia* (R. Br.) C.A. Mey. (Meyer 1845: 74). – *Banksia brevifolia* (R. Br.) Kuntze (Kuntze 1891: 583). *Type:* King George Sound, Western Australia, December 1801, *R. Brown* (*holo:* BM).

Shrub 0.1–1 m high; stems with inconspicuous hairs in uppermost axils below each inflorescence, becoming glabrous in lower axils. *Leaf blades* narrowly elliptic to obovate, 4–16 x 1–6 mm; margins incurved; apex acute or obtuse, often mucronate. *Inflorescence* erect. *Involucral bracts* narrowly to broadly ovate or obovate to broadly elliptic, sometimes reddish at base or apex, glabrous or rarely ciliate towards base; inner bracts 5–12 mm long. *Flowers* white or cream, glabrous inside, persistent in fruit; slender portion of floral tube 2–7 mm long. *Stamens* shorter than sepals; filament 0.3–1.5 mm long; anther orange, 0.4–1.1 mm long. *Seed* almost ovoid or narrowly ovoid, whitish to golden brown over shiny black.

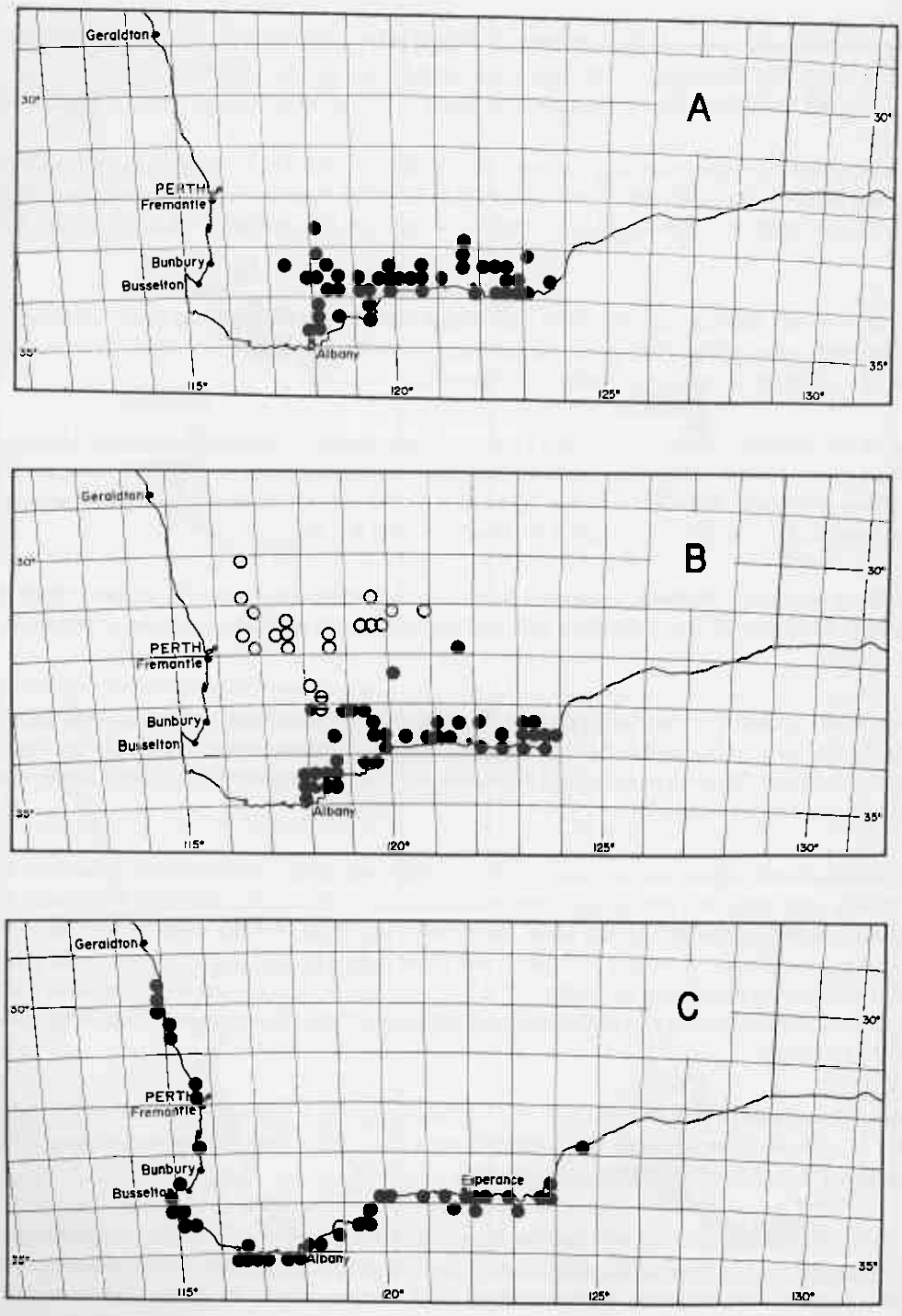

Figure 2. Geographical distributions. A – *Pimelea brachyphylla*; B – *Pimelea brevifolia* subsp. *brevifolia* ●, *P. brevifolia* subsp. *modesta* O and both subspecies or intermediates ⊖ ; C – *Pimelea ferruginea*.

Distribution and habitat. Distributed in the South West Botanical Province and South-western Interzone, extending from near Wubin south to Albany, south-east to Israelite Bay and east to Coolgardie. (Figure 2B)

Notes. Two subspecies are recognized in *Pimelea brevifolia*, the main differences between them relating to the shape of the bracts and the density, position and orientation of the long and short hairs on the floral tube. They appear to be almost parapatric, with one intermediate specimen (*B.G. Muir* 361) collected from North Tarin Rock Reserve, where their known ranges slightly overlap. The distribution of the typical subspecies is now known to be more extensive than was indicated in Rye (1988, 1990).

The type subspecies is sometimes very similar to *Pimelea rosea* subsp. *annelsii* in its floral tube indumentum and short stamens, but the latter taxon tends to have longer leaves and flowers and can be readily distinguished by its recurved leaf margins and pink flower colour. Subsp. *modesta* is more likely to be confused with *Pimelea brachyphylla*, which can be readily distinguished by its recurved to revolute leaf margins. Both subspecies of *P. brevifolia* resemble *P. brevistyla* in their incurved leaf margins, and subsp. *brevifolia* sometimes also in having subsessile introrse anthers, but there are significant differences as discussed under *P. brevistyla*.

Of all the species currently placed in sect. *Heterolaena*, *Pimelea brevifolia* possibly shows the greatest approach to sect. *Calyptrostegia*. In the southern part of its range, *Pimelea brevifolia* can be confused with an extreme variant of one of the species in the latter section, *P. angustifolia* R. Br. This variant of *P. angustifolia* is similar to subsp. *brevifolia* in having small leaves and flowers and its floral tube only moderately densely hairy, but still has more densely hairy flowers than subsp. *brevifolia* and has a more uniform indumentum of large hairs on the swollen base of the floral tube. Also, the inner involucral bracts are glabrous inside in subsp. *brevifolia* but hairy inside at least towards the base in *P. angustifolia*. In the Albany–Stirling Range area, the two taxa can be distinguished by the leaf apex, which has a distinct subterminal thickening terminating in a point in subsp. *brevifolia* but not in *P. angustifolia*, and in all areas *P. angustifolia* tends to have inflorescences less erect (i.e. more horizontal or nodding) than those of subsp. *brevifolia*, and leaves larger and more elongate.

The clearest difference between *P. angustifolia* and *P. brevifolia* is that the flowers are circumscissile in the former and not circumscissile in the latter, a very obvious difference once the fruiting stage is reached. If the current placement of the two species in different sections is correct, then some of the morphological similarities must be superficial or convergent. If instead it results from a very close relationship between these two taxa, then the separation of the two sections is called into doubt.

a. Pimelea brevifolia R. Br. subsp. **brevifolia**

Illustration. Rye (1988: Figure 69).

Inner involucral bracts ovate or broadly ovate. *Floral tube* with the larger hairs restricted to swollen base of tube or occurring on distal half of swollen base and on base of slender portion, the largest hairs antrorse to patent and 0.4–2.5 mm long, almost completely glabrous to moderately densely hairy on the slender portion, sometimes also with short hairs on the swollen base; hairs of the distal third of tube appressed to antrorse or rarely patent, mostly 0.2–0.4 mm long. *Stamens*: filament 0.3–1.1 mm long; anther 0.6–1.1 mm long. *Seed* 2.5–3.0 x 0.8–1 mm.

Selected specimens examined. WESTERN AUSTRALIA: Mt Ragged, 25 Sep. 1995, *S. Barrett* 489; Rest area beyond Washpool Rd, near Kamballup, 24 Oct. 1991, *E.J. Croxford* 1509; Bremer Bay Rd, E of Dillon Rd, 11 Oct. 1992, *E.J. Croxford* 6593.

Distribution and habitat. Extends along the south coast from the Albany area east to Israelite Bay and inland to Lake Grace and to north of Norseman. Occurs in sandy soils or sometimes clay, often with laterite or granite, recorded in a variety of shrublands, often dominated by mallees or other *Eucalyptus* species.

Phenology. Flowers: July to October. Fruits: August to November. Mature seeds were observed on *N.N. Donner* 3043.

Breeding system. A few specimens, such as *C.A. Gardner* 14100, have a few of the outermost flowers of each inflorescence female and the rest bisexual.

Notes. Pimelea brevifolia subsp. *brevifolia* is very variable, with eastern specimens from Esperance east to Cape Arid tending to have a less hairy upper portion to the floral tube than western specimens and with the long hairs completely or almost completely restricted to the swollen base and sometimes occurring almost throughout the base. Western specimens, especially in the north-west, tend to have the long hairs beginning higher on the swollen base and extending onto the base of the slender portion of tube. The stamens always have a short filament (0.3–0.5 mm long) on the eastern specimens, some of which reach the extent of having subsessile, almost fully introrse anthers, while on the western specimens the stamens vary more, with the filament (0.3)0.5–1.1 mm long.

A few specimens, notably *N. Hoyle* 1059, have very little differentiation between the largest and shortest hairs of the floral tube.

b. Pimelea brevifolia subsp. **modesta** (Meisn.) Rye (Rye 1988: 258–259). – *Pimelea modesta* Meisn. (Meisner 1848: 268–269). *Type:* South-west, Western Australia, 1843–1844, *J. Drummond* 3: 238 (*iso:* K, MEL, NY).

Illustration. Rye (1988: Figure 70).

Inner involucral bracts usually obovate to broadly elliptic. *Floral tube* moderately densely hairy on slender portion with widely antrorse to patent hairs 0.8–1.5 mm long usually mixed with shorter hairs on the basal part of slender portion, usually also extending onto the summit of the swollen base but fewer there than on slender portion, also with short antrorse hairs on the swollen base; hairs of the distal third of tube patent or rarely antrorse and mostly 0.3–0.5 mm long. *Stamens*: filament 0.7–1.5 mm long; anther 0.4–0.7 mm long. *Seed c.* 2.6 x 1.3 mm.

Selected specimen examined. WESTERN AUSTRALIA: Muntadgin, Aug. 1947, *T.W. Stone & E.T. Bailey* 447.

Distribution and habitat. Extends from near Wubin south to York, south-east tc near Kulin and east to Coolgardie. Occurs in shrublands on sand, sometimes with laterite.

Phenology. Flowers: August to October. Fruits: September to October. Mature seeds were examined on *H. Demarz* 5251.

Breeding system. Female specimens examined: *R.J. Cranfield* 2439, *H. Demarz* 5251 (also a bisexual specimen on same sheet) and *P. Roberts* 193.

Conservation status. This taxon is probably not at risk at present since it has been recorded from a fairly large range, but needs to be monitored because its range is mainly in the wheatbelt and most populations may have been cleared. It does not appear to have been collected since 1983 and is not known from any nature reserves.

Notes. The old specimen cited above was included in Rye (1987) but with the first of the collectors' names omitted. Specimens from the north-western areas tend to have broader leaves and bracts, more hairy floral tubes and anthers with a narrower connective than south-eastern specimens, which become more similar to subsp. *brevifolia*. Subsp. *modesta* is distinguished from subsp. *brevifolia* primarily by having the large hairs of the floral tube located mainly above the swollen base, also in its usually obovate to broadly elliptic (rather than ovate or broadly ovate) inner bracts.

Pimelea brevistyla Rye (Rye 1984: 1–4). *Type:* Glenburn Rd, *c.* 0.8 km west of Moola Rd, Glen Forrest, Western Australia, 6 October 1983, *N. Cohen* 1002 (*holo:* PERTH 01603507; *iso:* CANB, K, MEL, NSW).

Shrub usually 0.3–1.3 m high; stems with axillary hair tufts absent except for inconspicuous ones in the uppermost axils below each inflorescence. *Leaf blades* linear to narrowly ovate; margins incurved or inrolled; apex narrowly obtuse, occasionally slightly mucronate. *Inflorescence* erect. *Involucral bracts* ovate or broadly ovate, paler than leaves and usually yellowish; outer bracts glabrous outside, sometimes ciliate, occasionally hairy inside; inner bracts glabrous outside or occasionally hairy on the apical point, appressed-hairy inside at least towards apex, densely ciliate. *Flowers* white or cream, sometimes hairy along the midvein on the inside of each outer sepal, persistent in fruit; swollen base of floral tube largely glabrous to largely covered with patent to retrorse hairs 0.1–0.2 mm long; slender portion of floral tube 6–12 mm long, the proximal half with a belt of more or less patent hairs 2–5 mm long (the longest hairs at least 2.5 mm long) mixed with minute hairs 0.1–0.3 mm long, the distal half with hairs 0.2–1 mm long, the longer hairs antrorse. *Stamens* much shorter than sepals; filament 0.1–0.4 mm long; anther orange, 0.8–1.8 x 0.5–0.7 mm, introrse.

Distribution and habitat. Extends from Wubin south to North Dandalup River and south-east to near Lake Carmody in the South West Botanical Province. Occurs in lateritic or granitic habitats. (Figure 1B)

Phenology. Flowers: August to October. Fruits: September to November. Mature seeds were examined on *D.J.E. Whibley* 4726.

Breeding system. All specimens examined are bisexual.

Notes. Pimelea brevistyla is a very distinctive species and can be recognized readily from all other members of sect. *Heterolaena* except *P. brevifolia* by its subsessile strictly introrse anthers. Most specimens of *P. brevifolia* have longer filaments and semi-latrorse anthers, but those with subsessile introrse anthers can still be readily distinguished from *P. brevistyla* by the glabrous or subglabrous inner surface of their bracts and by the antrorse hairs on the swollen base of their floral tube. *Pimelea brevifolia* usually has distinctly smaller leaves and flowers than *P. brevistyla* and its leaves are usually obovate to elliptic rather than narrowly ovate, never becoming linear by the inrolling of the margins.

From the few mature seeds that have been examined in this species, *P. brevistyla* appears to be similar to *Pimelea spectabilis* in having a relatively thick and shiny brown exocarp. Most members of sect. *Heterolaena* have a very thin membranous exocarp, which is sometimes impressed onto the mesocarp.

Previously the known ranges of the two subspecies of *P. brevistyla* were separated by a fairly large disjunction (see Rye 1987: Figure 58). A recent collection from about midway across the disjunction (*J.R. Wheeler* 2316) has bridged the gap in distribution, but not in morphology, between the two subspecies.

a. Pimelea brevistyla Rye subsp. **brevistyla**

Illustration. Rye (1984: Figure 1).

Shrub (0.3)0.5–1.3 m high. *Leaf blades* 15–28 x 1.5–4(5) mm. *Involucral bracts* 12–20 mm long. *Floral tube* 11–15 mm long. *Sepals* 4.5–6 mm long. *Seed* not seen at maturity.

Selected specimens examined. WESTERN AUSTRALIA: Walk track above falls, S side of river, Serpentine National Park, 9 Aug. 1990, *B. Evans* 45; 85 km N of Midland, Perry Rd, 2 km E of Great Eastern Highway, 3 Sep. 1984, *J.R. Wheeler* 2316.

Conservation status. Although only recorded from about nine localities, this taxon does not appear to be at risk at present. If surveys were to be carried out for it, the subspecies would almost certainly be found from many additional localities on the Darling Range.

Distribution and habitat. Apparently restricted to Darling Range, extending from north of Bindoon south to Serpentine Falls.

b. Pimelea brevistyla subsp. **minor** Rye (Rye 1988: 242–244). *Type:* Great Eastern Highway, 4.1 km west of Hines Hill, Western Australia, 27 August 1983, *N. Cohen* 1025 (*holo:* PERTH 01603515; *iso:* CANB, K, MEL, NSW).

Illustrations. Rye (1988: Figure 59) and Rye (1990: Figure 79D,E).

Shrub (0.2)0.3–0.9 m high. *Leaf blades* 8–18 x 1.5–3(4) mm. *Involucral bracts* 7–11 mm long. *Floral tube* 8–11 mm long. *Sepals* 3–4 mm long. *Seed* almost ovoid, 3.0–3.3 x *c.* 1.4 mm, shiny brown over black.

Selected specimens examined. WESTERN AUSTRALIA: 45 km SE of Hyden along road to Lake King, 13 Oct. 1991, *W. Greuter* 22764; Off Goldfields Rd, Merredin, 13 Aug. 1997, *A. Gundry* 121; 9 km E of Wyalkatchem, 10 Oct. 1989, *B. Nordenstam & A. Anderberg* 508; Wongan Hills Experimental Farm, Reserve 18672, Craig Rd, *c.* 6.5 km N of Wongan Hills, 10 Oct. 1985, *C.M. Parker & P.J. Poli.*

Distribution and habitat. Occurs in the central wheatbelt, extending from Wubin south-east to near Lake Carmody (east of Hyden).

Pimelea ciliata Rye (Rye 1984: 6–9). *Type:* Glenburn Rd, *c.* 0.8 km west of Moola Rd, Glen Forrest, Western Australia, 6 October 1983, *N. Cohen* 1001 (*holo:* PERTH 01603965; *iso:* CANB, K, MEL, NSW, PERTH 01603566).

Shrub usually 0.5–1 m high; stems with axillary hair tufts present throughout but tending to become less conspicuous in lower axils. *Leaf blades* ovate to almost linear, 8–22 x 1–5(7) mm; margins recurved to revolute; apex acute, usually distinctly mucronate. *Inflorescence* erect. *Involucral bracts* ovate or broadly ovate, usually with a pinkish base, sometimes largely reddish, ciliate, rarely partially hairy inside; inner bracts 8–13 mm long. *Flowers* white or pink, glabrous inside, persistent in fruit; swollen base of floral tube with more or less patent hairs 0.1–0.4 mm long, occasionally with a few long hairs at summit; slender portion of floral tube 4.5–11 mm long, with widely antrorse to patent hairs 2–5 mm long in basal half, usually mixed with minute hairs, and with antrorse hairs mostly 0.3–1 mm long in distal half. *Stamens* slightly to much longer than sepals; filament 2.5–4.5 mm long; anther orange (0.5)0.7–1.2(1.4) mm long.

Distribution and habitat. Occurs in the South West Botanical Province, extending from Wongan Hills to the south-west corner of the State and south-east to Porongurup Range. Occurs mainly on relatively elevated areas such as Darling Range, in heavy soils often in lateritic and granitic habitats. (Figure 1C)

Notes. The common name White Banjine has sometimes been applied to this species, but possibly also sometimes to related species, and is somewhat misleading as the species often has pink flowers. It is closely related to *Pimelea neokyrea* and *P. rosea*; see notes under those species for a discussion of the differences between them. It has also often been confused with *P. avonensis* and *P. leucantha*, both of which differ in their more obtuse leaves.

Two subspecies are recognized. These are geographically distinct but show habitat similarities especially in respect to soil type and typography.

a. Pimelea ciliata Rye subsp. **ciliata**

Illustration. Rye (1988: Figure 60).

Flowers white or pale pink; slender portion of floral tube 4.5–8(9) mm long. *Seed* almost ovoid, 3–3.5 x 1.1–1.4 mm, dull greyish black, the exocarp impressed in a reticulate pattern onto the black mesocarp. (Figure 3A,B)

Selected specimens examined (typical variant). WESTERN AUSTRALIA: Off Yarra Rd, 4.8 km NW of Mt Yetar, 5 Nov. 1996, *M.G. Allen* 45; Fowlers Gully, Wongan Hills, 14 Sep. 1983, *N. Cohen* 1028; 29 km W of Woodanilling on Robinson Rd, 5 Oct. 1988, *J.M. Fox* 88/188 (ex CANB).

Selected specimens examined (southern variant). WESTERN AUSTRALIA: 14.5 km WSW of Tenterden, near Lake Nunijup, 10 Aug. 1993, *A.R. Annels* 3491; Sheepwash Nature Reserve, SE of Mount Barker, 16 Aug. 1993, *B.G. Hammersley* 900; Scott National Park, 30 Oct. 1990, *C.J. Robinson* 338.

Distribution. Extends from Wongan Hills south-south-west to Scott River National Park, south to near Lake Muir, and south-east to Porongurup Range.

Phenology. Flowers: August to November. Fruits: September to January. Mature seeds were observed on *H.J. Anderson* 28, *R. Davis* 4556, *H. Demarz* 398 and *S. Patrick* 86.

Breeding system. Female specimens examined: *A.R. Annels* 4014, *R. Helms* 11 Sep. 1897 and *M. Koch* 2455 (also a bisexual specimen on same sheet). A few specimens (e.g. *J. Seabrook* 182), have inflorescences with some of the outermost flowers female and the rest bisexual.

Notes. This subspecies is much more widespread and variable than the other subspecies. Most specimens from near Perth and northwards have flowers white at maturity, but white-flowered specimens become gradually less common and pale pink-flowered ones more common towards the south and east of the subspecies' range, with all specimens from the far south-east apparently having pale pink flowers. There is also a tendency for specimens in the southern part of the range to differ from those in the northern part of the range in having shorter and more elliptic leaves, and longer hairs on the swollen base of the floral tube. Some of the specimens occurring furthest inland have the smallest flowers found in this subspecies.

Throughout the subspecies' distribution some specimens have few or no minute hairs occurring in the central part of the band of long hairs on the floral tube, although most specimens do have minute hairs throughout the band.

A specimen from Sampsons Brook (*G.F. Berthoud* 25 Oct. 1902) has particularly large leaves and flowers, the largest leaf 7 mm wide and the largest flowers with the slender portion of the floral tube 9 mm long.

b. Pimelea ciliata subsp. **longituba** Rye (Rye 1988: 246–247). *Type:* Jindong, south of Busselton, Western Australia, 20 October 1950, *R.D. Royce* 3402 (*holo:* PERTH 01603973; *iso:* CANB, MEL).

Flowers medium pink; slender portion of floral tube 8–11 mm long. *Seed* not seen at maturity. (Figure 3C–E)

Selected specimens examined. WESTERN AUSTRALIA: Yelverton Forest, 23 km NW of Margaret River, 7 Nov. 1989, *G.J. Keighery* 10984; Forest Grove Block, SE of Witchcliffe, 30 Oct. 1996, *G.J. Keighery* 14616.

Distribution. Occurs in a small area extending from Yallingup south to near Witchcliffe and east to Ambergate.

Phenology. Flowers: September to November. Fruits: October to December.

Breeding system. One specimen, *J.E. Whibley* 5044, has inflorescences with the outermost flowers female and the rest bisexual.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Three. This subspecies has been collected from at least six localities and while not known from any nature reserves, is found in areas managed for conservation. Its known range is *c.* 50 km long.

Pimelea ferruginea Labill. (Labillardiere 1805: 10, t. 5). – *Banksia ferruginea* (Labill.) Kuntze (Kuntze 1891: 583). *Type:* "Van-Leuwin" [Actually collected at Esperance], Western Australia, 11–18 December 1792, *J.J.H. de Labillardière* (*iso:* MEL).

Pimelea decussata R.Br. *nom. illeg.* (Brown 1810: 360). – *Heterolaena decussata* (R. Br.) C.A. Mey. *nom. illeg.* (Meyer 1845: 73). *Type:* King George Sound, Western Australia, December 1801, *R. Brown* (*holo:* BM).

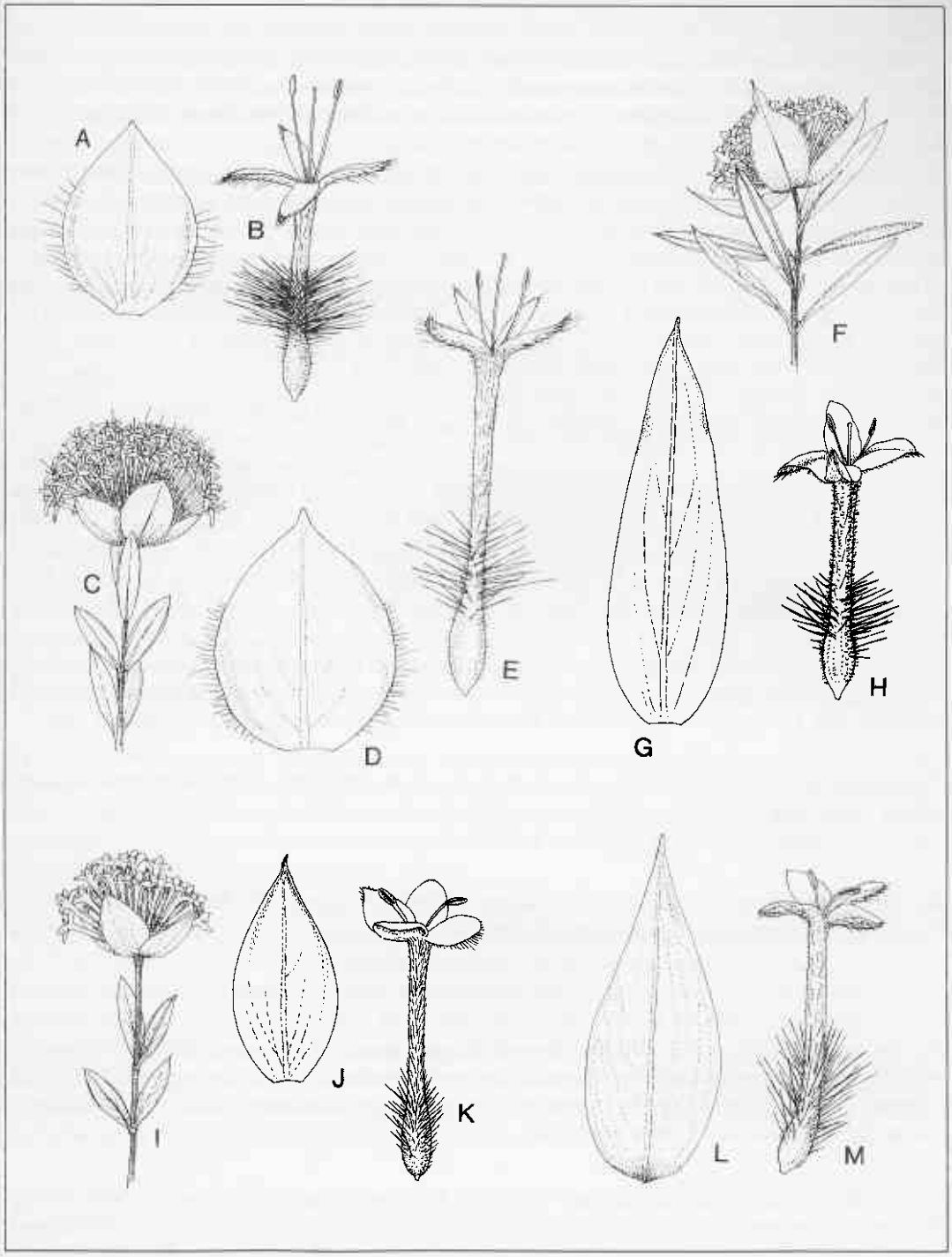

Figure 3. A,B. *Pimelea ciliata* subsp. *ciliata*. A – bract (x3), B – flower (x3.5); C–E. *Pimelea ciliata* subsp. *longituba*. C – flowering branch (x1), D – bract (x3), E – flower (x3.5); F–H. *Pimelea neokyrea*. F – flowering branch (x1), G – bract (x3), H – flower (x3.5); I–K. *Pimelea rosea* subsp. *annelsii*. I – flowering branch (x1), J – bract (x3), K – flower (x3.5); L, M. *Pimelea rosea* subsp. *rosea*. L – bract (x3), M – flower (x3.5). Drawn from *W. Greuter* 22685 (A, B), *R.D. Royce* 2484 (C–E), *G.J. Keighery* 6336 (F–H), *A. Strid* 20396 (I–K) and *B.J. Keighery & N. Gibson* 394 (L, M).

Illustration. Rye (1988: Figure 62).

Shrub 0.3–1.5 m high; stems with reddish hair tufts in uppermost axils but hairs often absent from lower axils, often also hairy on the internodes especially the uppermost ones below each inflorescence, the internode hairs extending above each axil to the next internode but absent from the strips in between. *Leaf blades* more or less elliptic or narrowly elliptic, 5–17 x 1.5–6.5 mm; margins recurved; apex often minutely mucronate. *Inflorescence* erect. *Involucral bracts* broadly ovate or rarely ovate, usually partially pink to deep pink throughout, sometimes with a few hairs at extreme base inside, usually ciliate on lower margins; inner bracts 6–12 mm long. *Flowers* white to deep pink-purple, usually pale to medium pink, glabrous inside, persistent in fruit; swollen base of floral tube with more or less patent hairs 0.1–0.5 mm long mixed with long hairs in distal half; slender portion of floral tube 4–8 mm long, with widely antrorse to patent hairs 1.5–3 mm long mixed with minute hairs in basal half and with antrorse hairs mostly 0.4–0.8 mm long in distal part. *Stamens* usually longer than sepals; filament 1.5–3.5 mm long; anther with orange cells and a pink connective, 0.6–1.4 mm long. *Seed* almost ovoid, 2.3–2.6 x 1.1–1.3 mm, rather dull greyish black, the exocarp tending to be impressed in a reticulate pattern onto the black mesocarp. **Coastal Banjine**

Selected specimens examined. WESTERN AUSTRALIA: 3 km S of Grey on track to Wedge Island, 30 Aug. 1988, *K. Hill* 2952 (ex NSW); Shire View Hill Reserve 11930, Nowergup, 21 Oct. 1993, *B.L. Keighery & N. Gibson* 554; Tagon Bay, Cape Arid National Park, 16 Oct. 1991, *W. Greuter* 22883; Between Point Irwin and The Gap, Walpole–Nornalup National Park, 9 Aug. 1992, *J.R. Wheeler* 3078; Walking trail on Martins Tank Lake, Yalgorup National Park, 20 Oct. 1994, *A. Worz* 04.10.20.06.

Distribution and habitat. Extends around the coast from Cliff Head to near Point Culver in the South West Botanical Province. Occurs close to the coast in very low to medium-height shrublands, on hills or slopes with a rocky substrate usually of limestone or granite, or on sand dunes. (Figure 2C)

Phenology. Flowers: July to February, especially September to November. Fruits: September to March. Mature seeds were observed on *T.E.H. Aplin* 2543, *D. Churchill* 39, *R.J. Cranfield* 1146, *J. Everett* 1473, *C.A. Gardner* 13800 and *J.R. Knox* 661201.

Breeding system. Some specimens (e.g. *D. Edinger* 158 and *E.D. Kabay* 604), have inflorescences with the outermost flowers female and the rest bisexual.

Notes. This attractive species is one of the most common *Pimelea* species in cultivation, favoured because of its dense domed growth habit, with very close patent leaves in an obvious opposite-decussate arrangement, and prolific pink flowers. It can generally be distinguished from other species by its distinctive growth form but occasionally in the wild produces more straggly growth with longer internodes and with the leaves often antrorse. The normal domed habit is evidently well suited to its coastal habitat in low windswept shrublands.

As listed among the doubtful names in Rye (1990: 209), three varieties based on cultivated material have been named under the illegitimate synonym *Pimelea decussata*. These varieties are probably all variants of *P. ferruginea* but there is insufficient information to be certain. The species has a considerable range around the coast, with specimens from the south-west corner and south coast tending to have leaves either longer or broader than those from the west coast, and with specimens from the far south-west near Augusta tending to have the longest stamens. Specimens from both ends of the range nearly always have both pairs of bracts ciliate whereas those from some other parts of the range fairly often have the outer pair or both pairs glabrous.

Nearly all specimens on the west coast from Yalgorup northwards have hairs on several to many internodes below each inflorescence. While members of sect. *Heterolaena* commonly have axillary tufts of hairs and occasionally are sparsely hairy on the peduncle, an extension of these hairs up along the stems often for several internodes below each inflorescence is unique to *P. ferruginea*. This character is uncommon in specimens from the far south-west and south coast however.

Pimelea hispida R. Br. (Brown 1810: 360). – *Heterolaena hispida* (R. Br.) C.A. Mey. (Meyer 1845: 73). – *Banksia hispida* (R. Br.) Kuntze (Kuntze 1891: 583). *Type:* King George Sound, Western Australia, December 1801, *R. Brown* (*holo:* BM).

Illustrations. Rye (1988: Figure 67) and Rye (1990: Figure 79F).

Shrub 0.4–1.5 m high; stems with axillary hairs present throughout but tending to become less conspicuous in lower axils. *Leaf blades* more or less elliptic, 9–34 x 2–9 mm; margins recurved or sometimes incurved; apex obtuse to mucronate. *Inflorescence* erect. *Involucral bracts* usually ovate or broadly ovate, usually with a deep pink apex or margin to deep pink throughout, sometimes green throughout, glabrous outside; outer bracts partially appressed-hairy inside; inner bracts 6–16 mm long, appressed-hairy inside, usually ciliate. *Flowers* very pale to deep pink, possibly very rarely white, glabrous inside, persistent in fruit; swollen base of floral tube with retrorse hairs 0.2–0.6 mm long usually throughout but rarely becoming patent in distal half, mixed with large patent or retrorse hairs towards summit; slender portion of floral tube 7.5–12 mm long, with widely antrorse to patent hairs 2.5–5 mm long mixed with minute hairs in basal half, the distal half with medium-sized antrorse or somewhat tangled hairs usually mixed with a few larger hairs 1.5–3 mm long. *Stamens* longer or sometimes shorter than sepals; filament 1.5–3 mm long; anther with orange cells and a pink conective, 0.6–1.4 mm long. *Seed* almost ovoid or broadly ovoid, 2.0–2.6 x 1.3–1.6 mm, whitish over shiny black.

Selected specimens examined. WESTERN AUSTRALIA: E end of ridge, Mt Manypeaks, 22 Nov. 1994, *S. Barrett* 167; 33°44'45"S, 115°03'59"E, 4 Dec. 1996, *N. Casson & A. Annels* SC 36.4; Wye Flats, South Coast Highway, 15 Nov. 1980, *E.J. Croxford* 1322; North Marbellup, W of Albany, 25 Nov. 1980, *D. Davidson s.n.*; 1.3 km S of Schroeder Rd and Great North Rd intersection, 12 Dec. 1996, *C. Godden & D. Bright* SC 83.4.

Distribution and habitat. Extends from Geographe Bay around the coast to Mt Manypeaks and inland to Stirling Range in the South West Botanical Province. Occurs on seasonally waterlogged flats and on coastal sand dunes. (Figure 1D)

Phenology. Flowers: September to January, especially October to December. Fruits: October to February. Mature seeds were observed on *A.R. Annels* 651, *N. Casson & B. Evans* SC139.6, *C. McChesney & C. Day* W10.3, *P. Ellery & C. Day* P155.7, *L. Graham* 615, *E.D. Kabay* 1405, *R.D. Royce* 8114 and *J.R. Wheeler* 3628 *& S.J. Patrick.*

Breeding system. Female specimen examined: *S.W. Jackson* Dec. 1912 (also bisexual specimens on same sheet).

Notes. Pimelea hispida seems to have a less variable flowering period than its closest relative *P. lanata*, with its main flowering time earlier, and tends to have larger flowers with shorter anthers. The two taxa can be readily distinguished by the bracts, which have a distinct yellow border in *P. lanata* but not in *P. hispida*, and also by the circumscissile flowers of *P. lanata* having the floral tube more slender

below and rather suddenly expanded above the circumscission point whereas the non-circumscissile flowers of *P. hispida* show a more gradual expansion from the base to the summit of the floral tube. In comparison with *P. hispida*, *P. lanata* has a harder fruit wall and its seed is significantly shorter although of a similar width.

Pimelea hispida shows great variablility in its leaf margins, which range from distinctly incurved to distinctly recurved. The swollen base of the floral tube is very densely covered at first by hairs mostly 0.2–0.5 mm long and some larger hairs, the smaller hairs usually reflexed to retrorse but occasionally only the lowest ones reflexed as in *J.R. Wheeler* 3390 and the rest more patent. Retrorse to reflexed hairs often extend onto the lower half of the slender portion of the floral tube as well but commonly the hairs become patent to antrorse in this area.

Pimelea lanata R. Br. (Brown 1810: 360). – *Calyptrostegia lanata* (R. Br.) Endl. (Endlicher 1848: 61). – *Pimelea hispida* var. *lanata* (R. Br.) Diels & E. Pritz. (Diels & Pritzel 1904: 394). *Type:* King George Sound, Western Australia, December 1801, *R. Brown* (*holo:* BM).

Illustrations. Rye (1988: Figure 68) and Rye (1990: Figure 79G–I).

Shrub or small *tree* 0.7–4 m high; stems with axillary hairs present and sometimes dense throughout but sometimes tending to become less conspicuous in lower axils. *Leaf blades* ovate to narrowly obovate, 9–25 x 2–9(11) mm; margins incurved; apex minutely apiculate or mucronate. *Inflorescence* erect. *Involucral bracts* ovate or broadly ovate, green with a distinctive yellow marginal border 0.5–1.5 mm wide (the border obvious on at least two of the four bracts) and sometimes tinged deep pink towards apex, glabrous outside; outer bracts partially appressed-hairy inside; inner bracts 5–14 mm long, appressed-hairy inside, ciliate on at least part of the margin. *Flowers* white or pale pink, possibly rarely medium pink, glabrous inside, tardily circumscissile 1–3 mm above the swollen base of tube in fruit; swollen base of floral tube densely covered by retrorse hairs 0.2–0.4 mm long, mixed towards the summit with some large hairs; slender portion of floral tube 4.5–8 mm long, with widely antrorse to patent hairs 2–4 mm long concentrated in basal half and mixed with minute hairs, the distal half less densely hairy with medium-sized antrorse hairs, often mixed with a few larger hairs. *Stamens* longer than sepals; filament 2.5–4.5 mm long; anther with a pink connective, 1.0–1.6 mm long. *Seed* almost ovoid, 3.3–4.0 x 1.3–1.6 mm, whitish to golden brown over shiny black.

Selected specimens examined. WESTERN AUSTRALIA: 550 m N of Sabina Rd on Jalbaragup Rd, 80 m W of Jalbaragup Rd, 8 Jan. 1997, *N. Casson & B. Evans* SC147.1; Youngs Siding, W of Albany, 15 Jan. 1977, *E.J. Croxford* 23; 3 km N along Linfarne Rd from intersection with Gibellini Rd [W of Palgarup], 19 Feb. 1997, *C. Day & A. Annels s.n.*; 21 km along Windy Harbour Rd, S of Northcliffe, 12 Jan. 1995, *E.D. Kabay* 1361; Anstey Rd, Forrestdale, 9 Nov. 1990, *G.J. Keighery* 11816.

Distribution and habitat. Extends around the coast from Perth to Albany and inland to near Manjimup in the South West Botanical Province. Occurs in swampy areas on coastal plains. (Figure 1A)

Phenology. Flowers and fruits: all year, especially December to February. Mature seeds were observed on *D. Churchill* 27/12/1957, *E.D. Kabay* 1361, *K.R. Newbey* 1240, *C.J. Robinson* 420 and *R.D. Royce* 6799.

Breeding system. All specimens examined are bisexual.

Notes. Atypical of sect. *Heterolaena* in having circumscissile flowers. Some specimens with immature fruits appear to have non-circumscissile flowers but the circumscission is always evident in mature fruits. At full maturity the ovary wall often forms a particularly hard case about the seed in this species.

Pimelea lanata has commonly been confused with *P. hispida*, but differs as indicated under that species. It also shows some similarities to *P. lehmanniana*, *P. sessilis* and *P. rara* but is readily distinguished from all these species.

Northern specimens, occurring from Perth to Harvey, have narrower leaves and bracts than those from elsewhere in the species' distribution, with specimens from near the south coast tending to have the largest and broadest leaves.

Pimelea lehmanniana Meisn. (Meisner 1845: 603). – *Calyptrostegia lehmanniana* (Meisn.) Endl. (Endlicher 1848: 61). – *Banksia lehmanniana* (Meisn.) Kuntze (Kuntze 1891: 583). *Type:* "Mt Wuljenup" [Willyung Hill], Western Australia, 14 October 1840, *L. Preiss* 1271 (*lecto:* LD, *fide* Rye (1988: 228); *isolecto:* MEL, NY).

Shrub 0.2–1.2 m high; stems with axillary hairs present in uppermost axils but absent or few and inconspicuous in lower axils. *Leaf blades* with margins slightly to prominently recurved; apex acute, mucronate. *Involucral bracts* ovate or broadly ovate, often yellowish or reddish; outer bracts often partially hairy inside; inner bracts (8)10–22 mm long, partially or almost fully hairy inside, sometimes ciliate. *Flowers* with a ring of long reflexed hairs in the throat and with somewhat shorter antrorse to patent hairs on the base of each sepal and sometimes extending along midvein to about the centre of each sepal. *Stamens* longer than sepals, usually much longer; anther probably pale yellow. *Seed* not seen at maturity.

Distribution. Distributed in the South West Botanical Province, extending from the part of Darling Range closest to Perth south-south-west to Yelverton, south-east to near Albany and from there inland to Stirling Range and east to East Mt Barren. (Figure 4A)

Notes. Although numerous specimens are in mature fruit, no mature seeds were observed. Bentham (1873) similarly failed to find mature seeds in this species. The closest relative is probably *Pimelea spectabilis*, which commonly produces fertile fruits.

The distribution data given in Rye (1988, 1990) for the two subspecies of *P. lehmanniana* are misleading. Recent collections have extended the known ranges of the two taxa, which now appear to be parapatric or have a slight area of overlap in range rather than being allopatric. A single specimen of somewhat intermediate morphology is *A.R. Annels* 4189 from near Mount Barker, which has a few small hairs towards the summit of the swollen base of the flower but otherwise appears to match subsp. *nervosa*.

a. Pimelea lehmanniana Meisn. subsp. **lehmanniana**

Illustrations. Rye (1988: Figure 49) and Rye (1990: Figure 79A).

Leaf blades narrowly ovate to narrowly obovate or ovate to obovate, 10–26 x 2–7 mm. *Inflorescence* pendulous. *Flowers* white to pale yellow, tardily circumscissile 1.5–3 mm above the swollen base of tube in fruit; swollen base of floral tube with coarse, more or less patent hairs

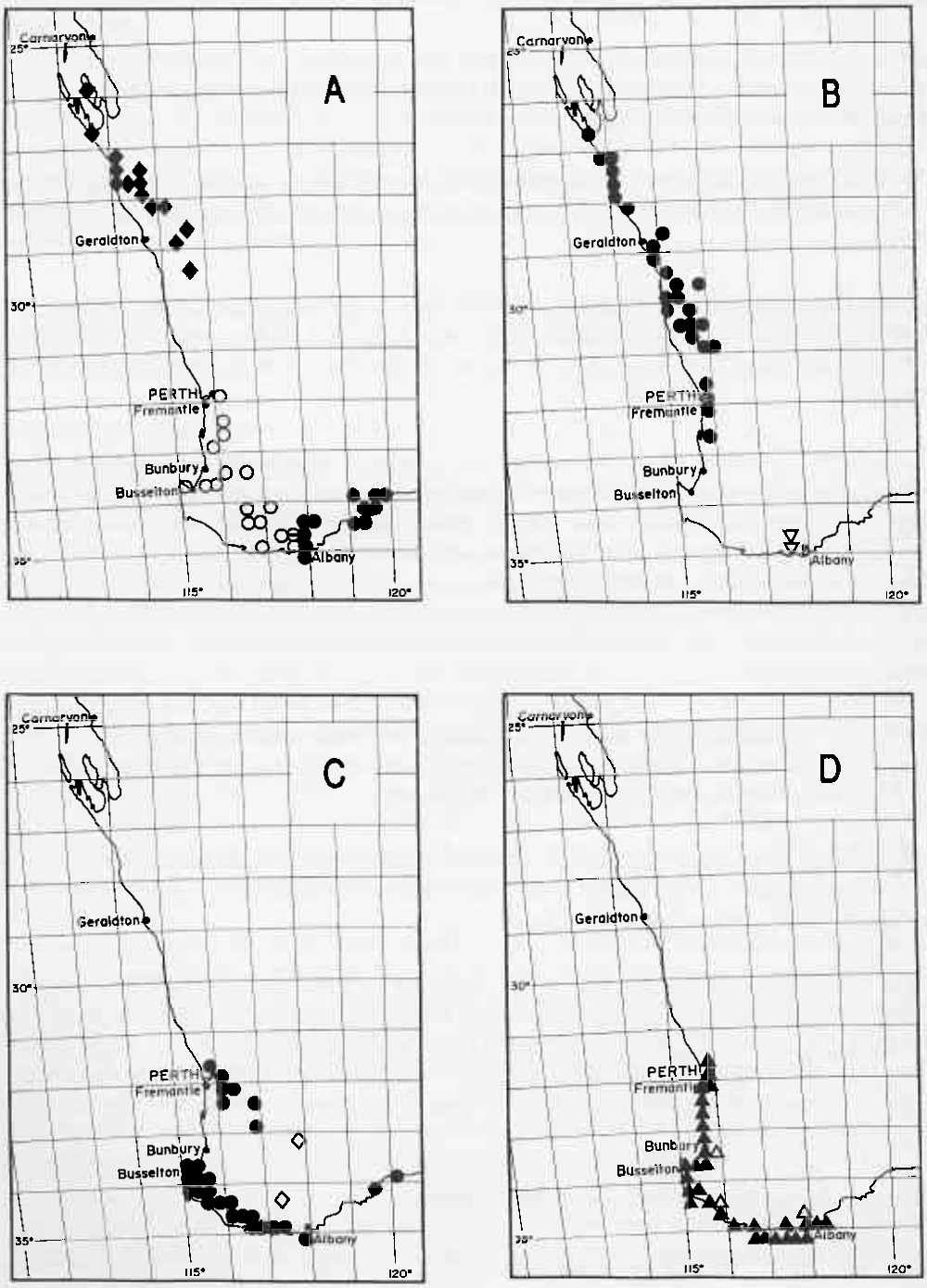

Figure 4. Geographical distributions. A – *Pimelea lehmanniana* subsp. *lehmanniana* ●, intermediate ⊖, subsp. *nervosa* ○ and *P. sessilis* ◆; B – *Pimelea leucantha* ◉ and *P. rosea* subsp. *annelsii* ▽; C – *Pimelea neokyrea* ◇ and *P. spectabilis* ●; D – *Pimelea rosea* subsp. *rosea*, coastal populations ▲ and inland populations △.

0.1–0.4 mm long and often a few much larger hairs towards summit; slender portion of floral tube 4.5–9 mm long, with widely antrorse to patent hairs 2–5.5 mm long on basal half and smaller antrorse hairs on distal half. *Stamens* with a filament 4–7 mm long; anther 0.7–1.2 mm long.

Selected specimens examined. WESTERN AUSTRALIA: South Stirlings rubbish reserve, Chillinup Rd, 28 Aug. 1985, *E.J. Croxford* 4204; Stirling Range Drive, *c.* 16 km from E junction, 1 Nov. 1994, *A. Worz s.n.*

Distribution and habitat. Extends from near Mount Barker and Albany east to East Mt Barren. Occurs mostly on rocky hillsides or ridges, often with quartzite or laterite.

Phenology. Flowers: August to October. Fruits: September to November.

Breeding system. Female specimens examined: *A.M. Ashby* 578 and *W. Rogerson* 262 (also a bisexual specimen on same sheet).

b. Pimelea lehmanniana subsp. **nervosa** (Meisn.) Rye (Rye 1988: 232). – *Pimelea lehmanniana* var. *nervosa* Meisn. (Meisner 1848: 270). *Type:* South-west, [Western Australia], 1843–1844, *J. Drummond* 3: 284 *ex parte* (*iso:* NY).

Illustration. Rye (1988: Figure 50).

Leaf blades narrowly ovate to narrowly obovate or rarely ovate, 15–34 x 2.5–10 mm. *Inflorescence* erect or pendulous. *Flowers* white or creamy white, persistent in fruit; swollen base of floral tube glabrous; slender portion of floral tube 6.5–11 mm long, with widely antrorse to patent hairs 3–6 mm long towards (but usually not quite reaching) base and smaller antrorse hairs on distal half. *Stamens* with a filament 4.5–8 mm long; anther 1.2–1.5 mm long.

Selected specimens examined. WESTERN AUSTRALIA: Walpole, 5 Dec. 1989, *A.R. Annels* 950; Reserve 22492, 5 km SE of Mount Barker, 16 Nov. 1993, *A.R. Annels* 4189; Spencer Road Reserve, 12 km W of Narrikup, 15 Nov. 1986, *E.J. Croxford* 5470; Carbanup River townsite, 2 Nov. 1993, *G.J. Keighery* 11766.

Distribution and habitat. Extends from Gooseberry Hill (an eastern suburb of Perth) south-south-west to Yelverton and south-east to Walpole and the Mount Barker area. Occurs on Darling Range and in other hilly areas, commonly recorded with laterite or gravel, often in vegetation dominated by Jarrah (*Eucalyptus marginata*) and/or Marri (*Corymbia calocephala*).

Phenology. Flowers and fruits: September to December.

Breeding system. All specimens examined are bisexual.

Notes. Differs from subsp. *lehmanniana* in its fully persistent rather than circumscissile flowers, glabrous swollen base of floral tube and larger anthers. It tends to have larger flowers and longer leaves while subsp. *lehmanniana* tends to have more yellowish flowers and the inflorescences are consistently pendulous, but these characters show too much overlap to be of use in keying the two taxa.

Pimelea leucantha Diels (Diels & Pritzel 1904: 393). *Type:* Lower Greenough River, north of "Bukara" [Bookara], Western Australia, 10 September 1901, *L. Diels* 4238 (*holo:* B destroyed; *iso:* PERTH (ex B) 01604090).

Pimelea rosea var. *calocephala* Meisn. (Meisner 1845: 602–603). *Type:* near "Lake Keiermulu" [Leederville area], Western Australia, 4 October 1839, *L. Preiss* 1267 (*lecto:* LD, *fide* Rye (1988: 238); *isolecto:* MEL, NY).

Illustration. Rye (1988: Figure 53).

Shrub 0.4–2 m high; stems with axillary hair tufts absent except for uppermost axils below each inflorescence. *Leaf blades* usually linear to narrowly ovate or narrowly elliptic, 12–28 x 1–5 mm; margins recurved, often becoming revolute; apex narrowly obtuse, not or scarcely mucronate. *Inflorescence* erect or somewhat pendulous. *Involucral bracts* ovate or broadly ovate, sometimes yellowish and often pink-tinged; outer bracts glabrous or ciliate; inner bracts 13–20 mm long, often ciliate, sometimes slightly hairy inside. *Flowers* white to yellow, usually pale yellow, glabrous inside, persistent in fruit; swollen base of floral tube with patent to antrorse hairs 0.1–0.3 mm long, mixed with long hairs in distal half or towards summit; slender portion of floral tube 9–14 mm long, with a mixture of widely antrorse to patent hairs 2.5–5.5 mm long and minute hairs in basal half and with antrorse hairs mostly 0.5–1 mm long in distal half. *Stamens* usually shorter than sepals; filament 1–2.5 mm long; anther 0.7–1.3 mm long. *Seed* almost narrowly ovoid or ovoid, 2.3–2.8 x 0.7–1.1 mm, whitish over shiny black.

Selected specimens examined. WESTERN AUSTRALIA: Erindale Rd, Warwick, Nov. 1979, *P. Bridgewater*; 50 km E of Eneabba on Eneabba–Winchester road, 22 Aug. 1983, *I.R. Dixon*; Barberton West Rd, W of Moora, 2 Oct. 1988, *E.A. Griffin* 5421; 4.5 km from New Norcia, 1 Nov. 1990, *E.A. Griffin* 5969; 29 km SW of Cooloomia Homestead, 23 Aug. 1983, *S.D. Hopper* 3318; Nine Mile Lake Nature Reserve, SW of Pinjarra, 20 Sep. 1995, *G.J. Keighery* 13639.

Distribution and habitat. Distributed in the South West Botanical Province, extending along the west coast from Tamala Station south to Nine Mile Lake Nature Reserve (south-west of Pinjarra) and extending inland to Three Springs and near New Norcia. Occurs in deep sand or in sand over rock, the rock usually sandstone or limestone but sometimes laterite. Recorded in Jarrah (*Eucalyptus marginata*) and/or *Banksia* woodlands in the southern part of its range; further north recorded in *Eucalyptus todtiana* woodlands or in vegetation dominated by other eucalypts or various tall shrub or small tree species. (Figure 4B)

Phenology. Flowers: August to early November. Fruits: September to November. Mature seeds were observed on *J.S. Beard* 6882 and *W.E. Blackall* 2775.

Breeding system. Some specimens (e.g. *E.A. Griffin* 3374), have inflorescences with the outermost flowers female and the rest bisexual or produce occasional female inflorescences as well as bisexual inflorescences, while *G.J. Keighery* 13693 appears to be almost entirely female.

Notes. Recent collections have extended the known range of the species both northwards and southwards. One of the specimens cited here (*P. Bridgewater* Nov. 1979) was previously misidentified as *P. rosea*, with which it overlaps in range on the coastal plain between Lake Pinjar and Pinjarra. *P. rosea* can be readily distinguished from *P. leucantha* by its more pointed leaves and pink flower colour.

More commonly, *P. leucantha* has been confused with *P. avonensis* and *P. ciliata*. Apart from the differences already described in the notes under those two species, *P. avonensis* has shorter flowers than *P. leucantha* and *P. ciliata* generally has more prominently ciliate bracts and longer stamens than *P. leucantha*.

Specimens from Perth southwards tend to have relatively large flowers with short anthers on a relatively long filament compared with northern specimens. Specimens from north of Geraldton tend to have a deeper yellow colour to the flowers and shorter broader leaves than those further south. One of the specimens from Kalbarri (*R.C. Wemm* 2100) has particularly broad leaves, with bract-like leaves directly below the inflorescences up to 6.5 mm wide.

Pimelea neokyrea Rye, *sp. nov.*

Differt a *Pimelea ciliata* bracteis exterioribus plus elongatis eciliatis, a *Pimelea rosea* colore florum et positione elatiore pilorum longorum supra tubum florale.

Typus: near Dongolocking [precise locality withheld], Western Australia, 25 August 1983, *G.J. Keighery* 6336 (*holo:* PERTH 03407373).

Shrub 0.3–0.9 m high; stems glabrous except for very inconspicuous hair tufts in axils immediately below inflorescences. *Petioles* 0.5–1 mm long. *Leaf blades* narrowly ovate to very narrowly elliptic, 12–23 x 2–6 mm; margins recurved; apex acute, mucronate. *Involucral bracts* narrowly ovate or ovate, often with a yellowish to reddish base; outer bracts glabrous; inner bracts 15–18 mm long, glabrous inside, sometimes ciliate. *Inflorescence* erect. *Flowers* white or possibly sometimes pale yellow, glabrous inside, persistent in fruit; swollen base of floral tube with more or less patent hairs 0.2–0.3 mm long, with a few long hairs at summit; slender portion of floral tube 7–8 mm long, with widely antrorse to patent hairs 2–3 mm long mixed with minute hairs in basal portion and with antrorse to patent hairs mostly 0.3–1 mm long in distal portion. *Sepals c.* 3 mm long. *Stamens* shorter than sepals; filament 1.8–2.5 mm long; anther 0.6–0.7 mm long. *Seed* not seen at maturity. (Figure 3F–H)

Other specimens examined. WESTERN AUSTRALIA: W of Cranbrook [precise locality withheld], 23 Sep. 1993, *A.R. Annels* 3856; W of Cranbrook [precise locality withheld], 15 Sep. 1984, *E.J. Croxford* 3670.

Distribution and habitat. Recorded from near Dongolocking and from west of Cranbrook in the South West Botanical Province. At the former locality the species was recorded growing under trees in mallee heath on a flat site with "white sandy loam clay". At the latter locality it was recorded on the upper slope of a hill with quartzite and gravel, and the vegetation was apparently dominated by *Eucalyptus marginata*. (Figure 4C)

Phenology. Flowers: August to October. Fruits: September to October.

Breeding system. All specimens examined are bisexual.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. Known from only three specimens, two collected very close to one another and possibly at the same locality, and the other specimen from a reserve *c.* 130 km away.

Etymology. From the Greek words *neos* – recent and *kyreo* – light upon, referring to the recent discovery that this taxon was a distinct species. A single specimen (*G.J. Keighery* 6336) was available at the time the genus was revised in Western Australia (Rye 1988) and this was incorrectly placed under *P. avonensis*.

Notes. Closely related to *Pimelea ciliata* and *P. rosea*, being somewhat intermediate in morphology, for example in having stamens shorter than the sepals as in *P. rosea* but with a longer filament and shorter anther more akin to the sizes found in *P. ciliata*. Its distribution of long hairs on the floral tube is also intermediate but closer to that of *P. ciliata*. *P. neokyrea* is also distinguished from *P. rosea* by its inland rather than coastal distribution and its white or yellowish rather than pink flowers. According to the label on *E.J. Croxford* 3670 this specimen of *Pimelea neokyrea* has yellow flowers, but it is only in bud so the open flowers may still be white.

In *P. ciliata* there are two or occasionally three pairs of ciliate bracts whereas the new species has at most one pair of ciliate bracts, and the outer bracts of *P. neokyrea* are longer and narrower than the second pair of bracts in *P. ciliata*. In the area where the two species overlap in range, *P. neokyrea* can also be distinguished from *P. ciliata* by its longer leaves and white or yellowish flowers, but these differences are not reliable elsewhere.

Pimelea rara Rye (Rye 1984: 9–10). – *Pimelea lehmanniana* var. *?ligustrinoides* Benth. (Bentham 1873: 9). *Type:* Swan River, Western Australia, *J. Drummond* 1: *s.n.* (*lecto:* K, *fide* Rye (1984: 9); *isolecto:* K, NY).

Illustrations. Rye (1984: Figure 4). A close-up photograph of the inflorescence is reproduced in Hopper *et al.* (1990: 93).

Shrub commonly 0.2–0.35 m high, with decumbent stems often longer than this; stems with axillary hairs absent or few and inconspicuous in lower axils. *Leaf blades* usually narrowly obovate, 15–37 x 4–8 mm; margins recurved; apex usually obtuse with a short thick mucro. *Inflorescence* erect but often at an angle to an almost horizontal stem. *Involucral bracts* ovate or broadly ovate, usually the same colour as the leaves; outer bracts glabrous; inner bracts 11–17 mm long, ciliate at least at centre of each margin, sometimes sparsely hairy towards base inside. *Flowers* white, sometimes with a ring of short hairs inside at the throat, persistent in fruit; swollen base of floral tube densely covered by retrorse to reflexed hairs mostly 0.3–0.5 mm long; slender portion of floral tube 3.5–7 mm long, usually with retrorse to reflexed hairs on basal part, with widely antrorse to patent hairs 1.3–3 mm long, often mixed with much shorter relexed to patent hairs, on central portion or reaching either to the base or to the summit, sometimes with somewhat smaller and more antrorse hairs towards summit. *Stamens* much longer than sepals; filament 4–6 mm long; anther orange, 0.9–1.4 mm long. *Seed* almost ovoid, 2.6–3.3 x 1.5–1.6 mm, whitish to golden brown over shiny black. **Summer Pimelea**

Selected specimens examined. WESTERN AUSTRALIA: Ellis Brook Valley Reserve, 8 Feb. 1997, *H. Bowler* 478; Lockwood Rd, N of Perth Observatory, 15 Jan. 1987, *L. Graham s.n.*; Nanga Rd, 0.45 km S of Nanga Brook Rd, E of Waroona, 13 Feb. 1998, *F. & J. Hort* 124; Douglas Rd, W of junction of Old Canning Rd, 22 Jan. 1991, *J.L. Robson* 6.

Distribution and habitat. Restricted to Darling Range, recorded from Parkerville south to near Nanga (east of Waroona) in the South West Botanical Province. Occurs in lateritic soil in Jarrah forest. (Figure 1D)

Phenology. Flowers: December to January. Fruits: January to February. Mature seeds were observed on *H. Bowler* 478 and *F. & J. Hort* 124.

Breeding system. All specimens examined are bisexual.

Conservation status. CALM Conservation Codes for Western Australian Flora: Declared Rare. Over 1000 plants are known from more than ten main sites extending about 100 km along the Darling Range. Before recent surveys of this species commenced in 1987, *P. rara* had not been collected for over 65 years, probably because of its summer flowering time as well as its restricted range and its tendency to be largely hidden by the dense shrubs with which it occurs. It may also flower less regularly than other *Pimelea* species, with flowering probably enhanced by disturbance (*F. Hort* pers. comm.).

Notes. This distinctive species has an unusual growth habit with decumbent straggling branches interwoven with shrubs of other species. Perhaps its closest relative is *P. lehmanniana*, which lacks the retrorse hairs on the base of the floral tube and never has small hairs mixed with the large patent hairs of the floral tube.

Pimelea rosea R. Br. (Brown 1810: 360). – *Heterolaena rosea* (R. Br.) C.A. Mey. (Meyer 1845: 73). – *Banksia rosea* (R. Br.) Kuntze (Kuntze 1891: 583). *Type:* King George Sound, Western Australia, December 1801, *R. Brown* (*holo:* BM).

Shrub 0.3–1 m high; stems with axillary hairs not prominent, absent or becoming few and inconspicuous in lower axils. *Leaf blades* narrowly ovate to narrowly obovate; margins recurved or revolute; apex acute to slender-pointed. *Inflorescence* erect. *Involucral bracts* usually narrowly ovate or ovate, rarely broadly ovate, with a yellowish to reddish base; outer bracts usually glabrous, rarely with a few cilia, which are generally concentrated towards base; inner bracts often ciliate, glabrous inside or with a few hairs usually restricted to near the base. *Flowers* usually medium pink to deep red-purple, occasionally pale pink and possibly rarely white, glabrous inside, persistent in fruit; swollen base of floral tube with minute hairs, which are mixed with longer hairs in distal half; slender portion of floral tube 6–10 mm long, with relatively large antrorse to patent hairs near the base and antrorse hairs usually 0.3–1 mm long on remainder. *Stamens* usually distinctly shorter than sepals, rarely about as long as or slightly exceeding sepals; filament 0.7–2 mm long; anther with gold (yellow-orange) cells and a yellow connective, 0.7–1.4 mm long. **Rose Banjine**

Distribution and habitat. Occurs in the South West Botanical Province, extending around the coast from west of Lake Pinjar to Cheyne Beach and inland to Mount Barker. (Figure 4B,D)

Notes. One of the specimens previously cited for this species (*P. Bridgewater* Nov. 1979) has now been redetermined as *Pimelea leucantha*. The newly cited specimens include a few that extend the known range of the species inland to near Dardanup and to east of Lake Jasper.

The closest relative appears to be *Pimelea neokyrea*, and another close relative is *P. ciliata*. Differences between *P. rosea* and the former species are described under that species. *Pimelea rosea* differs from *P. ciliata* in usually having longer, more yellowish anthers on shorter filaments, having the long hairs of the floral tube borne in a lower position on the floral tube and in its shiny black seed. The two taxa generally occur in different areas, *P. rosea* being more coastal and generally in more sandy soils than *P. ciliata*, but there is some overlap in their known ranges between Bunbury and Porongurup Range.

Seed set is particularly good in *Pimelea rosea* and seems to far outdo any other species in section *Heterolaena*. Together with the attractive bright pink flowers, this high fertility may have contributed to making the species one of the earliest Pimeleas to have been cultivated.

Two varietal names have been published under *Pimelea rosea*. One of these, *Pimelea rosea* var. *calocephala* Meisn., is a synonym of *Pimelea leucantha*. The other, *Pimelea rosea* var. *hendersonii* (Graham) Meisn. (Meisner 1857: 503), appears from its description to be a variant of *P. rosea* but cannot be definitely identified as there does not appear to be any type material. It was based on cultivated specimens, with no type cited, and there was no illustration.

Two subspecies are now recognized. Near Albany, they appear to slightly overlap in range but not in habitat.

a. Pimelea rosea subsp. **annelsii** Rye, *subsp. nov.*

Differt a subsp. *rosea* floribus minus dense pilosis, pilis majoribis tubum florale brevioribus et ad basim floris multo proxime positis.

Typus: Reserve 25638, 2 km south-west of Narrikup, Western Australia, 29 September 1993, *A.R. Annels* 3961 (*holo:* PERTH 04297768; *iso:* CANB, MJP *n.v.*).

Shrub 0.3–0.8 m high. *Leaf blades* 6.5–15 x 1–3.5 mm; margins recurved or revolute; apex acute or slightly mucronate. *Inflorescence* erect. *Involucral bracts* often yellowish towards the base or deep purplish to red-tinged at apex; outer bracts usually glabrous, rarely with a few cilia or partially hairy inside; inner bracts 7–13 mm long, sometimes ciliate towards base and partially to sparsely hairy inside. *Floral tube*: swollen base with a few antrorse hairs mostly 0.2–0.4 mm long towards base, becoming replaced by antrorse hairs 1–1.5 mm long in distal half; slender portion 6–8 mm long, with a few antrorse hairs 1–1.5 mm long at extreme base. *Seed* not seen at maturity, 2.5–2.7 mm long when still immature. (Figure 3I–K)

Other specimens examined. WESTERN AUSTRALIA: 400 m W of Mount Barker on Blue Lakes Rd, 27 Sep. 1991, *A.R. Annels* 1751a; Near NE corner of Hay Location 6634, 14 Nov. 1991, *A.R. Annels* 1948; Reserve 22492, 7.5 km SE of Mount Barker, 21 Sep. 1993, *A.R. Annels* 3754; 17.5 km W of Narrikup, 29 Sep. 1993, *A.R. Annels* 3986; Carbarup Rd, near railway, Mount Barker, 9 Sep. 1983, *E.J. Croxford* 2552; Albany–Pemberton road, Sep./Oct. 1963, *D.M. Dorrien-Smith s.n.*; 3 km W of Mount Barker on road to Denmark, 22 Sep. 1982, *A. Strid* 20396.

Distribution and habitat. Restricted to a small area from Mount Barker south-south-west to near the junction of Hay and Mitchell Rivers and south-south-east to Narrikup. Occurs in sandy soils often with laterite or lateritic gravel, in woodlands usually dominated by both Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*). (Figure 4B)

Phenology. Flowers: September to November. Fruits: recorded November.

Breeding system. One specimen, *A.R. Annels* 1948, has inflorescences with the outermost flowers female and the rest bisexual.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Three. Known from seven collections, at least two of which are on reserves, with a distributional range of over 30 km.

Etymology. Named after Tony Annels, a CALM officer based at Manjimup, who has made extensive collections in south-western Australia, including a majority of the cited specimens of subsp. *annelsii*.

Notes. This subspecies and *Pimelea brevifolia* subsp. *brevifolia* have been confused because their leaves can be of a similar size and shape, and also the type and distribution of hairs on the floral tube of the two taxa can be similar, but *P. rosea* subsp. *annelsii* can be readily distinguished by its recurved leaf margins and larger pink flowers with a usually more densely hairy floral tube.

Subsp. *annelsii* can be distinguished from subsp. *rosea* by its less densely hairy flowers with the large hairs of the floral tube occurring lower on the tube and forming a pure band, not mixed with small hairs except towards the base of the band, these long hairs also being shorter and more appressed than in subsp. *rosea*. It has a more inland distribution than subsp. *rosea*, whose only reported record inland from the south coast is a single unconfirmed record from Porongurup Range, and differs in habitat, although there are a few occurrences of subsp. *rosea* on a similar habitat in other areas.

Subsp. *rosea* tends to have longer more spreading leaves than subsp. *annelsii*, the apex often prominently recurved and generally with a prominent terminal point, and longer involucral bracts, which usually lack the reddish apical margins common in subsp. *annelsii*. There is too much overlap in these characters, however, for them to be useful in keying the two taxa.

b. Pimelea rosea R. Br. subsp. **rosea**

Illustration. Rye (1988: Figure 61).

Shrub 0.3–1 m high. *Leaf blades* 9–30 x 1.5–5 mm; apex often prominently recurved, usually distinctly mucronate or with a slender point 0.3–0.6 mm long. *Involucral bracts* narrowly ovate or ovate, with a yellowish to reddish base; outer bracts usually glabrous, rarely with a few cilia, which are generally concentrated towards base; inner bracts 9–16 mm long, often ciliate, glabrous inside or with a few hairs towards base. *Floral tube*: swollen base with more or less patent hairs mostly 0.2–0.3 mm long mixed with long widely antrorse to patent hairs in distal half; slender portion 6–10 mm long, with widely antrorse to patent hairs 2–3 mm long mixed with usually numerous minute hairs in basal half. *Seed* almost ovoid, 2.1–3.0 x 1.1–1.5 mm, shiny golden brown over shiny black. (Figure 3L,M)

Selected specimens examined (coastal or near-coastal localities). WESTERN AUSTRALIA: 10.35 km W along Lake Jasper track from Vasse Highway, 2 Feb. 1997, *E. Bennett & C. Day* P19.3; 4 km WSW of Nanarup Beach, 12 Dec. 1996, *R. Davis* 1824; Cheyne Beach, 19 Sep. 1985, *H.A. Froebe & R. Classen* 850.

Specimens examined (inland localities). WESTERN AUSTRALIA: Porongurup Range, 14 Sep. 1939, *A.B. Cashmore* 67; Lake Jasper track, 2 Nov. 1997, *R.J. Cranfield* 11589; 10 km W of Donnybrook, *P.A. Jurjevich* 1733; Banksia Rd, Dardanup, 24 Oct. 1985, *L. Nunn* 466.

Distribution and habitat. Extends around the coast from west of Lake Pinjar to Cheyne Beach (*c.* 10 km east of Mt Manypeaks). Occurs mainly on sand dunes, deep sand or sandy clay on coastal plains or on limestone or granite close to the coast. There are also a few inland records, all cited above, three from sandy soil with laterite in the extreme south-west and one record, presumably on granite, from Porongurup Range. The subspecies often occurs in Tuart (*Eucalyptus gomphocephala*) woodlands

near the west coast from Geographe Bay northwards, and it is sometimes associated with watercourses or seasonally waterlogged depressions along the south coast. (Figure 4D)

Phenology. Flowers: July to December, especially September to November. Fruits: recorded September to January. Mature seeds were observed on numerous specimens from throughout the geographical range.

Breeding system. One specimen, *B.J. Keighery & N. Gibson* 437, has inflorescences with the outermost flowers female and the rest bisexual.

Notes. There is a slight tendency for specimens from the west coast to have larger flowers than those from the south coast but there is considerable variability in this character in both areas. The overall stamen length does not vary greatly throughout the geographical range as specimens with long anthers tend to have short filaments and those with short anthers tend to have long filaments.

A few specimens (e.g. *D. Churchill* 16) occasionally produce rather elongate inflorescences with the receptacle and attached pedicels up to 21 mm long.

Pimelea sessilis Rye (Rye 1988: 232–234). *Type:* 0.7 km south of Kalbarri–Ajana road on track to Meanarra Hill, Kalbarri National Park, Western Australia, 28 September 1985, *N. Hoyle* 527 (*holo:* PERTH 01604546; *iso:* CANB, MEL).

Illustrations. Rye (1988: Figure 51) and Rye (1990: Figure 79B).

Shrub 0.15–0.4 m high; stems with dense axillary hair tufts throughout. *Leaves* usually narrowly ovate to broadly elliptic, 6–19 x 3–9 mm; margins recurved or revolute; apex usually broadly obtuse and with a short thick mucro. *Inflorescence* usually horizontal to pendulous. *Involucral bracts* more or less circular (broadly elliptic to depressed ovate or circular), often yellowish, not ciliate; inner bracts 8–12 mm long, appressed-hairy inside. *Flowers* white to pale yellow, glabrous inside, persistent in fruit; swollen base of floral tube with patent or reflexed hairs mostly 0.2–0.4 mm long and also some larger more or less patent hairs in upper half; slender portion of floral tube 6–8.5 mm long, with widely antrorse to patent hairs 2–3.5 mm long on basal half and often extending higher, and usually with a few smaller antrorse hairs towards summit. *Stamens* longer than sepals; filament 2–4 mm long; anther bright yellow, 0.7–1.2 mm long. *Seed* almost narrowly ovoid, *c.* 3.3 x 1 mm, shiny black.

Selected specimens examined. WESTERN AUSTRALIA: Murchison House Station, N side of State Barrier Fence, 47.3 km W of North West Coastal Highway, 27 Aug. 1991, *A.H. Burbidge* 4404; No. 1 Tank [just N of Murchison River on North West Coastal Highway], *C.A. Gardner s.n.*; NE of Yandanooka, 21 Oct. 1992, *E.A. Griffin* 7328; 0.8 km along the road from Denham to Monkey Mia, Peron Peninsula, 4 Nov. 1989, *M.E. Trudgen* 7175.

Distribution and habitat. Distributed mainly in the far north of the South West Botanical Province, with one record from the Eremean Botanical Province. Extends from Peron Peninsula (Shark Bay area) south-east to Yandanooka (Mingenew area). Occurs in sand in shrublands, the sand commonly yellow or red, the dominant species sometimes including *Actinostrobus*. (Figure 4A)

Phenology. Flowers and fruits: August to October. Mature seeds were observed on *M.E. Phillips* 68 1242.

Breeding system. Female specimen examined: *A.S. George* 1503.

Notes. Readily distinguished from other *Pimelea* species by its somewhat stem-clasping leaves. It shows the closest approach to *P. lanata* in its leaves, axillary hairs and bract indumentum, and the closest approach to *P. rara* in its floral indumentum.

Recent collections have extended the known range of this species northwards into the Eremean Botanical Province as well as southwards. No other members of the sect. *Heterolaena* have been recorded from so far north, although *P. leucantha* is known from Tamala Station just south of the border of the Eremean.

Pimelea spectabilis Lindl. (Lindley 1840: 41). – *Heterolaena spectabilis* (Lindl.) Fisch. & C.A. Mey. (Fischer, Meyer & Ave-Lallemant 1845: 48). – *Banksia spectabilis* (Lindl.) Kuntze (Kuntze 1891: 583). *Type:* South-west, Western Australia, 1839, *J. Drummond* 1: *s.n.* (*lecto:* CGE, *fide* Rye (1988: 236)); South-west, Western Australia, *J. Mangles* (*syn:* CGE).

Illustrations. Rye (1988: Figure 54) and Rye (1990: Figure 79C). A close-up photograph of the inflorescence is reproduced in Figure 49 of "Flora of Australia" Volume 18.

Shrub usually 0.3–2 m high; stems with axillary hairs present throughout but tending to become less conspicuous in lower axils. *Leaf blades* narrowly or very narrowly elliptic, 18–55 x 2.5–7 mm; margins slightly to distinctly recurved; apex acute, with a slender mucro. *Inflorescence* pendulous or sometimes fairly erect. *Involucral bracts* ovate or broadly ovate, often reddish or yellowish, sometimes partially hairy inside; inner bracts 18–30 mm long, sometimes ciliate. *Flowers* usually white, sometimes pale yellow or pink-tinged, densely hairy in the throat with somewhat tangled antrorse to patent hairs, also hairy on the inside of each sepal at least along the midvein, persistent in fruit; swollen base of floral tube with fine more or less patent hairs 0.1–0.3 mm long and often a few much larger hairs towards summit; slender portion of floral tube 10–17 mm long, with widely antrorse to patent hairs 4–7 mm long on basal half, all or the upper long hairs intermixed with minute hairs, and with medium-sized antrorse hairs on distal half. *Stamens* slightly to much longer than sepals; filament 3–8 mm long; anther cream, 1.0–1.8 mm long. *Seed* ovoid but distinctly compressed, 3.4–4.2 x 1.6–2.3 mm, shiny brown over black. **Bunjong**

Selected specimens examined. WESTERN AUSTRALIA: Thumb Peak, 15 Nov. 1995, *S. Barrett* 430; Whicher Rd, 1 km W of intersection with Hill Rd, 7 Jan. 1997, *N. Casson & B. Evans* SC141.2; Boyagin Rock Reserve, 30 Sep. 1994, *E.D. Kabay* 756; Small peak NW of Thumb Peak, 9 Oct. 1974, *K.R. Newbey* 4853; 20 km NE of Denmark, 1 Nov. 1983, *K.R. Newbey* 9811; Dryandra State Forest, 25 Sep. 1987, *D.M. Rose* 311.

Distribution and habitat. There are three areas of occurrence in the South West Botanical Province, the first a northern area from Mundaring south-east to Dryandra State Forest, the second from Cape Naturaliste south-east to Albany and the third in Fitzgerald River National Park. In the first two areas, the species occurs mainly in sand with gravel or lateritic rocks, commonly in Jarrah (*Eucalyptus marginata*) forest, sometimes with other eucalypts also present, or sometimes in Karri (*Eucalyptus diversicolor*) forest. In the eastern area, i.e. Fitzgerald River National Park, the species occurs on the upper rocky slopes and summits of hills, recorded in low shrublands with outcropping quartzite. (Figure 4C)

Phenology. Flowers: mainly September to December, probably also August. Fruits: mainly September to January. Mature seeds were examined on *N. Casson, P. Ellery & C. McChesney* SC70.2 & SC70.4, *D.B. Foreman* 1494, *C.A. Gardner* 13666 and *T.A. Halliday* 283. This species appears to produce viable seeds far more regularly than its close relative *P. lehmanniana.*

Breeding system. Female specimen examined: *A.R. Annels* 2768.

Notes. Distinguished from its closest relative, *Pimelea lehmanniana*, as indicated in the key. *Pimelea spectabilis* can usually also be readily distinguished by having minute hairs intermixed with the long hairs of the floral tube and tends to have larger flowers and more densely hairy sepals than *P. lehmanniana.*

There are several geographical trends in morphological variation in this species. Specimens from the northern area from Mundaring to Dryandra State Forest tend to have the inflorescences more erect, sepals relatively densely hairy inside and relatively short hairs on the floral tube when compared with specimens from the south coast. Specimens from the Margaret River area are usually similar to the northern specimens in most characters but tend to have relatively few minute hairs intermixed with the long hairs of the floral tube, the minute hairs being present in the upper part but often absent in the middle or lower part of the long hair 'belt' on the slender part of the floral tube. Specimens from the eastern area in Fitzgerald River National Park have relatively short leaves and short anthers on long filaments compared with specimens from other areas; they have pendulous inflorescences and tend to have pale yellow flowers, with the sepals sometimes almost glabrous inside. In other areas the flowers are white and sometimes pink-tinged.

Discussion

Pimelea is currently divided into four large sections, sect. *Pimelea*, sect. *Calyptrostegia* (C.A. Mey.) Benth., sect. *Epallage* (Endl.) Benth. and sect. *Heterolaena*, and also several small sections. Of the large sections, *Heterolaena* is the least variable and most restricted, occurring only in temperate south-west of Australia. Each of the other three large sections extends across Australia, occurring in arid and temperate areas as well as alpine and/or tropical areas. Although smaller than these three sections overall, *Heterolaena* is a prominent group in south-western Australia, where it accounts for a third of the *Pimelea* species.

Sect. *Heterolaena* appears to be closest to sect. *Calyptrostegia* but some characters present in all or most members of sect. *Heterolaena* (lack of circumscission, glabrous ovary and recurved leaf margins) suggest a relationship with sect. *Pimelea*, in which these characters are commonly or occasionally present. The boundaries of all sections need to be reassessed, particularly with regard to the placement of the New Zealand species, which are now being studied by Colin Burrows (pers. comm.) at the University of Canterbury, Christchurch, New Zealand. Further study could possibly result in sect. *Heterolaena* being combined with sect. *Calyptrostegia*. However sect. *Heterolaena* is a convenient grouping of very similar species, all of which appear to have their closest relatives within the group.

When first described by Endlicher (1837), *Heterolaena* was an infrageneric category of unspecified rank. Recent publications have disagreed as to the authorship of the recombination to the rank of section as listed below.

1. *Pimelea* sect. *Heterolaena* (Endl.) F. Muell. in Rye (1988, 1990).

2. *Pimelea* sect. *Heterolaena* (Endl.) Benth. in Chapman (1991: 2268). Authorship of the group was also mistakenly given earlier in the same work (Chapman 1991: 1587) as *Pimelea* sect. *Heterolaena* (C.A. Mey.) Meisn.

Although Mueller (1868: 159) was the first to use the name *Heterolaena* as a section of *Pimelea,* he made no reference to a basionym. His recombination is therefore not validly published under the requirements of the Botanical Code up to the Tokyo Congress of 1998. Currently, the first valid publication of sect. *Heterolaena* is considered to be by Bentham (1873) in Volume 6 of "Flora Australiensis", so the second of the choices listed above is adopted here. However, a proposal put forward by Zijlstra & Brummitt (1998) for the 1999 Congress would, if accepted, make Mueller's recombination valid.

Meyer's publication of the generic name *Heterolaena* on 28 March 1845 with the type species specified as *Heterolaena decussata* (Meyer 1845) was apparently preceded shortly after 20 January 1845 (Stafleu & Cowan 1976: 836) by publication of the same generic name but with *Heterolaena spectabilis* the only species mentioned (Fischer, Meyer & Avé-Lallemant 1845). Applying current nomenclatural standards, Meyer's choice of type species in the later publication (which was followed by Chapman 1991: 1587), must now be considered to be incorrect and *Heterolaena spectabilis* must be taken to be the type species for the genus.

Although Meyer (1845) was undoubtedly intending his genus *Heterolaena* to include about half of the species in the *Pimelea* group *Heterolaena* Endl., with the other half of the species placed in his new genus *Calyptrostegia* C.A. Mey., his initial publication of the genus (in Fischer, Meyer & Avé-Lallemant 1845) referred only to a species described by Lindley (1840) and did not list any of the species that Endlicher had included in the group. Also he did not specify that Endlicher's infrageneric name was being used as a basionym for the genus *Heterolaena*, and he used completely different characters to circumscribe it. Therefore the generic name must be treated as being new rather than a recombination of the earlier name, although Meyer clearly did not derive the name *Heterolaena* independently. Authorship of the generic name has often been given incorrectly, for example as *Heterolaena* Fisch. & C.A. Mey. in Domke (1934) and Rye (1988).

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