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Genus *Pimelea* (Thymelaeaceae) in New Zealand 2. The endemic *Pimelea prostrata* and *Pimelea urvilliana* species complexes

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Abstract The taxonomy of the glabrous-leaved plants ascribed to *Pimelea prostrata* and *P. urvilliana* (here each regarded as members of a species complex) is examined. The entities that were originally classed under the names *prostrata* and *urvilliana* are identified and the species typified and described.

The *Pimelea prostrata* complex consists of three species: *P. prostrata* (with four additional new subspecies); and the new species *Pimelea orthia* (two subspecies) and *Pimelea xenica*, each from scattered locations in the northern half of the North Island. *Pimelea prostrata* subsp. *prostrata* occurs in scattered places in the southern half of the North Island and very widely in the South Island. The other infraspecific units in *P. prostrata*, each distributed regionally, are subspecies *seismica*, *vulcanica*, *thermalis*, and *ventosa*. *Pimelea orthia* subsp. *orthia* is an inland to near coastal plant whereas subsp. *protea* lives only on coastal dunes.

The *Pimelea urvilliana* complex consists of six species: *P. urvilliana* subspecies *urvilliana* (now only in the Auckland region), with one new subspecies, *nesica* (on islands east of Auckland and Coromandel); the new species *Pimelea carnososa* (coastal sites in North and South Islands); *Pimelea sporadica* (four widely spread sites in the northern half of the North Island); *Pimelea eremitica* (from a single North Auckland location); and two species described in an earlier paper, *Pimelea actea* (from the Manawatu-Wanganui coast) and *Pimelea telura* (Three Kings Islands).

Some of the subspecies of *P. prostrata* are relatively common as is *P. urvilliana* subsp. *nesica* and, locally, *P. carnososa*. None of the other taxa covered here is abundant. *Pimelea urvilliana* subsp. *urvilliana* is particularly scarce and may be extinct on the New Zealand mainland.

Live populations and herbarium specimens include individuals with mixed characters indicating that some taxa cross freely with one another if the opportunity arises. Hybridisation occurs between some members of the *P. prostrata* complex. Hybrids are also found between some members of the *P. urvilliana* complex. Also, certain members of each of these two groups hybridise with one another. Overall, the crossing has generated a high degree of variability in some field populations (“hybrid swarms” and far-reaching introgression) especially among coastal plants. The complex character assortments in some of these populations are recorded, using scatter diagrams and pictographs.

A key for identification of all glabrous-leaved *Pimelea* taxa in New Zealand includes those in the *Pimelea gnidia* group of species as well as the *P. prostrata* and *P. urvilliana* species complexes. Hybrids are not covered in the key, but information to assist in their identification appears in the text.

Keywords New Zealand; Thymelaeaceae; *Pimelea*; glabrous, glaucous leaves; small flowers; fleshy white fruits; taxonomy; typification; species complexes; new species; new subspecies; widespread hybridisation; identification keys

INTRODUCTION

The broad nature of *Pimelea prostrata* and *P. urvilliana*

New Zealand members of the genus *Pimelea* (Thymelaeaceae) include small to medium-sized shrubs with relatively small, glabrous, glaucous, short-petioled leaves, small flowers, and fleshy white fruits (usually exposed when ripe by irregular breakage of the flower tube above the ovary portion).

These occur widely in coastal, low inland, and lower montane regions. Some are prostrate, others of low but decumbent, or suberect to sprawling habit, and a few are stiffly erect. The last formal flora treatment of the plants (Allan 1961, p. 299 ff.) accepted only one entity, *P. prostrata*, at specific rank and treated others, some of which earlier botanists had regarded as distinct species or varieties, as unresolved variants. The taxonomy of these plants has remained unsettled, as there has been little progress on their classification since 1961, despite efforts to recognise some informal units (Druce 1993). However, in the late 20th century, New Zealand botanists recognised two specific taxa (Druce 1993; Parsons et al. 1995), namely, *P. prostrata* (J.R.Forst. et G.Forst.) Willd. (1797) and *P. urvilliana* A.Rich. (1832). Burrows (2008) has recently described two species, *P. actea* and *P. telura*, each with very restricted distribution, but various other unresolved entities remain in the *prostrata-urvilliana* complexes.

All of the plants allied to *P. prostrata* and *P. urvilliana* pose identification difficulties for several reasons. Firstly, neither *P. prostrata* s.s., nor *P. urvilliana* s.s. have been typified. Thus, we have not known to what plants those names apply. Secondly, it is apparent that some entities are distinct enough to be given separate subspecific or specific rank, but efforts of taxonomists so far have not clarified the situation. None of the named infraspecific taxa allied to *P. prostrata* (Hooker 1844, 1853, 1867; Cheeseman 1906, 1925) can be sustained in the original form partly because of the lack of type material or through failure of authors to adequately characterise their taxa. Some of Colenso's (1889, 1890) species belong to the group. Here they are considered to be units of subspecific rank. Thirdly, in some locations there is ample field evidence for interspecific hybridisation between some of the entities. As a result, in some places the field populations contain numerous individuals with mixed character states. In other instances, only occasional putative hybrids appear to be present.

Aim of the study

The aim of this paper is to resolve this complex systematic situation, using orthodox taxonomic methods. The main body of the paper deals with the taxonomy (including typification of both *P. prostrata* and *P. urvilliana*) with descriptions of new taxa and accounts of the hybrid phenomena. Here, the proposal is that there are two multi-specific groups: *P. prostrata* (a complex species) and its close relatives and *P. urvilliana* and its close relatives,

hence the names *P. prostrata* and *P. urvilliana* species complexes.

All of the glabrous-leaved specific taxa of *Pimelea* in New Zealand, including the five species in the *P. gnidia* group, as well as *P. actea* and *P. telura*, are covered in a key to identification. Separate keys are provided for subspecific taxa.

In Burrows (2008) a numbering system for species of *Pimelea* in New Zealand was used, but *P. actea* and *P. telura* were left unnumbered. In the present paper they are numbered to accord with the precedence of their publication in the appropriate species group as 10. (*P. actea*) and 11. (*P. telura*).

METHODS

General

The methodology for taxonomic revision of the genus *Pimelea* in New Zealand (of which the present paper is the second part) was fully outlined in Burrows (2008). The present article uses the same general conceptual approach, terminology, and conventions. Unofficial abbreviations for herbaria are NZFRI (Forest Research Institute, Rotorua), DOC(NM) (Department of Conservation, Nelson-Marlborough), and MTP (Mike Thorsen Private Collection, Dunedin). Standard abbreviations are used for all other herbaria.

The taxonomic framework to be used in a genus such as *Pimelea* that apparently has undergone rapid and relatively recent evolution in New Zealand must be flexible enough to accommodate units between which breeding barriers have not yet become fully developed (cf. Levin 2000). Some of the taxa being considered occupy small areas. Others, at specific rank, are common and widespread. These latter are, in some cases variable to such a degree that discrete, lesser, regional units, each with distinct morphological integrity (subspecies), can be discerned. Some of these are also widespread. Another pattern is occurrence of relatively widely spread species or subspecies with continuous variation through their range and small local variant populations. Further taxonomic subdivision is not warranted in these latter cases, however, as intergrades in character states are evident from population to population. Such variation is normal in phenotypically (and presumably genotypically) labile, wide-ranging plants. In dealing with the taxonomy, the general method was to examine large numbers of relatively recent herbarium specimens from New Zealand herbaria (and smaller numbers of mainly older

specimens from overseas repositories). Some information was gathered during an extended trip to Europe in 1968 and some herbarium loans from Kew and Paris have been obtained recently. Also, high resolution photographs and other kinds of image have recently been transferred, electronically from Kew, British Museum, Linnean Society (London), Paris, Berlin, and Stockholm. Thus, the critical material in overseas locations has been seen. Reference was made, also, to the original descriptions of taxa (see Appendices 1–4 for translations of texts). Wherever possible the herbarium search was augmented by examination of live specimens in the wild or in cultivation. Measurements of dimensions or records of qualitative details were obtained from freshly collected material or from reconstituted organs (dry parts soaked in dilute detergent), as well as from the herbarium sheets. The characters used to define the various taxa are explicit in the descriptions of taxa. They are listed in Burrows (2008). Those most useful for discriminating between taxa are: whole plant habit, branching type; node buttress type; degree of young stem hairiness; relative thickness of leaves, mature leaf sizes, shapes, leaf tip, spacing of leaves and leaf attitude; stomatal presence/absence on abaxial leaf surface; flower sizes; direction of anther dehiscence; fruit shape, colour, and degree of opacity. The distributions of some characters among taxa considered in the present paper are outlined in Table 1 (Conclusions section). Conservation situations for each taxon are briefly considered throughout the taxonomic section and a summary is presented in Table 2 (Conclusions section).

In 1997–99 a small phenetic study was made of some members of the *Pimelea prostrata* and *P. urvilliana* species complexes (Burrows 2001). Chromosome numbers for these plants and others were also obtained (Dawson & Beuzenberg 2000). Live specimens of most of the entities examined in this phenetic study have been maintained up to the present time in a shade house at the Biology School, University of Canterbury glasshouse area. Other cultivars have been examined at the Percy Reserve, Lower Hutt, through the courtesy of plant propagator, Jill Broome.

Hybrid phenomena

As is common among *Pimelea* taxa in New Zealand (Burrows 1958, 2008), in the *P. prostrata* and *P. urvilliana* species groups, some plants in collections and field populations bear features intermediate between those of particular species or subspecies. Sometimes hybrids are few in number

but in other instances the hybridisation is extensive, appears to be deep-seated, and has probably been proceeding for a long time. Variable “hybrid swarms” are present. In some local to regional instances there seems to have been subtle invasion of the populations of one or both parents by parts of the genome of the other (introgression).

The intention here is to record instances of putative hybridisation by noting the presence of individuals with mixed characters (cf. Stace 1975). If the hybrid phenomena are complex, the Anderson (1953) method of pictorialised scatter diagrams is used to depict the assortment of characters in the field populations. As each taxon is covered, the general practice will be to list hybrids that have been recognised, and discuss them. However, the discussion will be held over until the taxonomy of both parent taxa has been dealt with. Cases where this is to apply are marked (X) (i.e., they will be mentioned later, in the appropriate place). Exceptions will be for hybrids with taxa that are not the subjects of this paper. They are considered immediately.

Variation arising from introgression and also ecotypic variation in widespread taxa both create difficult conceptual problems for taxonomists. Nonetheless, a system of classification and appropriate naming is needed. In some instances arbitrary decisions about boundaries between taxa must be made.

TAXONOMY

History of the *Pimelea prostrata* species complex

The specific name originated during Cook’s second voyage to New Zealand in the *Resolution* (1773–74). The botanists were Reinhold and Georg Forster and Anders Sparrman. At Totaranui (also known as Queen Charlotte Sound) they gathered plants that they named *Banksia prostrata*. None of their numerous *B. prostrata* specimens, present now in several herbaria in Britain and mainland Europe (Nicolson & Fosberg 2003), bears a locality notation other than “New Zealand”. However, the Forsters and Sparrman were ashore only at Dusky Sound in Fiordland, south-western South Island, and at Queen Charlotte Sound in Marlborough, north-eastern South Island (Begg & Begg 1969). *Pimelea prostrata* s.l. is known from one recent gathering at Dusky Sound but the Forsters did not see it there; their description is based on material from the Marlborough locality.

Forster & Forster (1776) also did not mention any locality in their initial very brief description of the plant (Appendix 1). The same applies for G. Forster's pencil drawing of *B. prostrata* (Ic. No. 172) (Fig. 1) and his fuller description in 1780 (Appendix 2). In the latter account the habitat of *B. prostrata* is given as "in Novae Zeelandiae montibus aridis" (dry hillsides). Conclusive statements about a specific locality, however, are found in J. R. Forster's journal (translated and edited by M. Hoare 1982). The entry for 22 May 1773, at Queen Charlotte Sound, states:

"When we went down we saw a new plant, very minute and prostrated, which proved to be a species of a new Genus we had called *Banksia* in honour of Joseph Banks Esqu. ...";

and, for 9 June 1773

"The silky *Banksia* is not at all here, though I found a small creeping kind of it on a hill in Long Island."

It is probable that Forster's mention of "the silky *Banksia*" referred to a larger species, *B. tomentosa*, which has hairy leaves, whereas *B. prostrata* and *B. gnidia*, the other two species found by the Forsters, have glabrous leaves. Several other potential localities for *Pimelea (Banksia) prostrata* finds were visited by A. Sparrman and the Forsters during the three periods when the *Resolution* was anchored at Ship Cove (Hoare 1982).

The botanists on Cook's first voyage to New Zealand in the *Endeavour* (1769–70) were Joseph Banks and Daniel Solander. In Solander's handwritten and unpublished manuscript (1769–72) (Appendix 3), he identified two distinct entities within the species that he described as *P. laevigata*. The form α , with glabrous, yellowish-brown branches, was "entirely southern" and came from Motuaro [Motuara I.], Totaranui. The form β (according to Solander's description, with branches densely covered in white hair), came from Teoneroa (Gisborne), Tigadu (Anaura Bay), Tolaga (Tolaga Bay), and Oपुरagi (Mercury Bay) (cf. Begg & Begg 1969). The painting of *P. laevigata* (Ic. No. 157) by Sydney Parkinson, artist on the *Endeavour*, from "Taoneroa" depicts a distinctly different plant from the Queen Charlotte Sound form; here it is presumed to be form β (Fig. 2).

The assumption made here is that the type locality for *P. prostrata* s.s. is Queen Charlotte Sound. The representatives of this species, gathered there during both the *Endeavour* and *Resolution* voyages, came from islands with steep slopes. Motuara and Long

Island are definite localities, but it is likely that the species was also collected on other islands including Arapawa (Beaglehole 1963; Begg & Begg 1969).

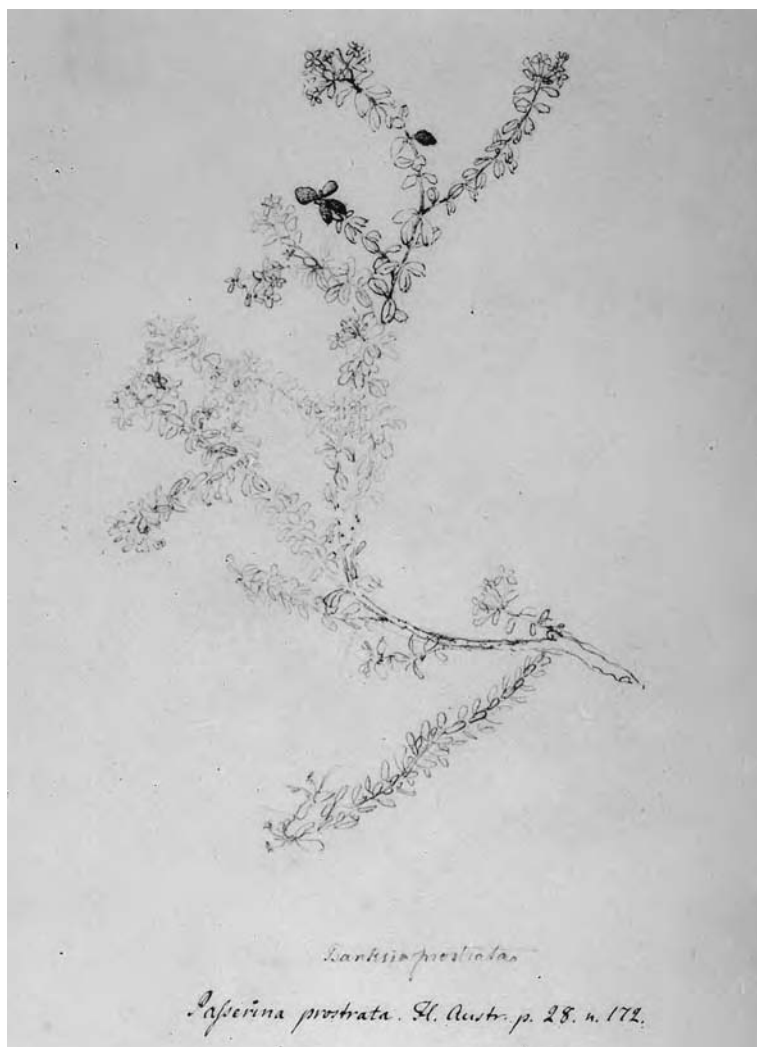
Most specimens of *P. prostrata* s.s. in repositories in Britain and mainland Europe (gathered by the Forsters and Sparrman in Queen Charlotte Sound) have long, trailing stems, with moderately distant leaves that are usually small, broad-elliptic, and relatively thin when dry (Forster & Forster 1776 and Forster 1780 described them as "fleshy", and coastal specimens may be so when fresh). The flowers are small. When they defined their *B. prostrata*, the Forsters indicated no particular specimens. The plants on the sheet chosen below as lectotype for *P. prostrata* are representative of the array of those found in the extensive collections of Forster and Sparrman material in British and European repositories.

Solander's description of *P. laevigata* (Appendix 3) appears to be a composite drawn from at least three entities. One is form α as noted above (i.e., it is *P. prostrata* s.s.). Form β , as depicted in Parkinson's painting, had longer, closer-set leaves than form α and was suberect to erect. Stem hair is not evident on the water-colour image. However, a specimen that matches the Parkinson image is at the Naturhistoriska Riksmuseet, Stockholm (Herb. Alstroemer) S 07-3110 (on obverse "*Pimelea laevigata*, Dr Solander, Nova Zelandia"), also labelled *Pimelea prostrata*, Banks & Soland. var. ! (Fig. 3). It is relatively thick-leaved and its stem hair is white, but only moderately dense. Banks and Solander also gathered some prostrate plants with dense white stem hair (see below in relation to *P. urvilliana* s.l.). Plants like form β are considered here to represent a distinct entity that is to be placed in the *P. urvilliana* species complex (under the name *P. sporadica*, see below). The remainder of the history of the taxon *P. prostrata* s.s. is purely nomenclatural.

The Forster's three *Banksia* species, *B. prostrata*, *B. gnidia*, and *B. tomentosa* (the last was named *B. pilosa*, without any description or explanation, by G. Forster 1780) were shifted by Linnaeus the younger (1782) into an otherwise African genus *Passerina*. First publication of the generic name *Pimelea* that Banks and Solander had chosen for their New Zealand thymelaeaceous plants (for *P. laevigata*) was by Gaertner (1788).

After a short digression when another (invalid) generic name was used for the plant (*Cookia prostrata* Gmel. 1791), the correct and final combination was made by Willdenow (1797) as *Pimelea prostrata* (J.R.Forst. et G.Forst.) Willd. The 14th International Botanical Congress at Berlin in 1988 confirmed

Fig. 1 G. Forster's pencil drawing of *Banksia prostrata* (*Pimelea prostrata*) (Ic. No. 172, 1774). (Image by courtesy of the Natural History Museum, London, 2006).



the specific name *prostrata* (over *laevigata*), and *P. prostrata* as the type species for the genus (ICBN No. 5467, Greuter et al. 1988). The history of other specific entities grouped in the *P. prostrata* species complex will be dealt with in the text below.

Infraspecific categories

Efforts to recognise infraspecific entities in the *Pimelea prostrata* complex began with Banks and Solander as noted above. Hooker (1844) described *P. prostrata* var. *quadrifaria*, which will be considered later, in relation to *P. carnosa* (*P. urvilliana* complex). Hooker (1853) briefly described a “var. β , *repens*”, aligning it with the Forsters’ *P. prostrata*. Hooker’s description for the species as a whole began with

the words “fruticulus polymorphus, procumbens, vel prostratus, rarius erectus”. In Hooker (1867) the name *repens* was not used, but three varieties were listed, “ α , suberect or branches ascending; β , stems diffusely branched, branches spreading; γ suberect” (the last only in South Island mountains). No specimens have been found that relate conclusively to Hooker’s three infraspecific taxa.

In 1906 Cheeseman, under the name *P. laevigata* (= *prostrata*), named and briefly described var. *erecta*, var. *repens*, and var. *alpina*. Cheeseman (1925) used the same three names under the specific name *prostrata*. Allan (1961) did not formally accept any infraspecific entities (other than form *parvifolia*, mentioned below), but, in lengthy



Fig. 2 Sydney Parkinson watercolour of *Pimelea laevigata* form β (Ic. No. 157, 1770). (Image by courtesy of the Natural History Museum, London, 2006).

footnotes, listed the three Cheeseman names and other names including “var. *urvilliana*”, together with some descriptive information. He also listed three Colenso species, *P. rugulosa* (1889), *P. bicolor*, and *P. heterophylla* (1890), as part of the unresolved *P. prostrata* complex. Allan (1961, p. 297) described “form *parvifolia*” and listed a specimen BD (now CHR) 73187 from “near Omarama”, but did not properly typify it. It is here merged with *P. prostrata* subsp. *prostrata*. Further use of the name *P. prostrata* var. *repens* cannot be sustained unless a Hooker reference specimen for it is located that differs from *P. prostrata* subsp. *prostrata*.

The taxonomic status of all infraspecific entities mentioned in the Allan (1961) footnotes for *P. prostrata* is dealt with below except for: *P. prostrata* var. *alpina* Cheeseman (= *P. microphylla*

Colenso), and *P. laevigata* var. *monticola* Petrie, which will both eventually be treated as hairy-leaved entities unrelated to *P. prostrata*; and *P. bicolor* Colenso for which no reference specimens have been found.

Taxonomy of the *Pimelea prostrata* species complex

6. *Pimelea prostrata* (J.R.Forst. et G.Forst.)

Willd. *Spec. Plant.* 1, 51 (1797)

≡ *Banksia prostrata* J.R.Forst. et G.Forst. *Char. Gen. Plant.* 8 (1776).

≡ *Passerina prostrata* (J.R.Forst. et G.Forst.) Linn. f. *Suppl. Plant.* 26 (1782).

≡ *Cookia prostrata* (J.R.Forst. et G.Forst.) Gmel. *Syst. Nat.* 24 (1791).

= *Pimelea laevigata* Sol. ex Gaertn. *Fruct. et Sem.* 1, 186, t.39 (1788), *pro parte*, nom. illeg.

LECTOTYPE (chosen here): Natural History Museum, London, G. Forster’s Herbarium BM 829829, in pencil “*Pimelea prostrata* Linn. f. [sic]” printed “Type Specimen”. [Queen Charlotte Sound, Marlborough, New Zealand, 1773–74]! The five pieces on the sheet are regarded as elements of the lectotype (Fig. 4).

PARALECTOTYPES: Other specimens with syntype status (all from Queen Charlotte Sound, Marlborough, New Zealand) are: Natural History Museum, London, G. Forster Herb. BM 829814 *Passerina prostrata* Forst., *Pimelea prostrata* Linn. f.!; BM 894130, in pencil “*Passerina prostrata* Linn. f.”; BM 829811, 85 *Passerina prostrata* “type specimen”!; Linnean Society, London, Forster collection LINN 689a.2 *Banksia prostrata*, N. Zealand; LINN 40.9/1 *Banksia prostrata* Forst., *Pimelea prostrata* Willd., *Pimelea laevigata* m/s B [Banks] (lower, larger specimen) Forster? fil. [Note—the upper specimen on the sheet, not part of this typification, is LINN 40.9/2, *P. laevigata*, Nova Zeelandia 1769 J.B. [Joseph Banks] gathered during the earlier *Endeavour* voyage—see text below]; Royal Botanic Gardens, Kew, Forster Herbarium (Presented by Corporation of Liverpool, Aug 1885) K 356694 *Passerina prostrata* Forst. *Fl. Ins. Aust.* p.28, *Pimelea prostrata*, Habitat in Nova Zeland!; Naturhistoriska Riksmuseet, Stockholm, (Herb. Gasström) S 07-3108 *Pimelea prostrata* Banks & Soland., [on obverse *Banksia prostrata* e Nova Zelandia, Sparman 4560]!; Botanischen Museum, Berlin-Dahlem, Willdenow Herbar. B 145 *Pimelea prostrata*. The lower specimen on the sheet is

Fig. 3 Specimen of *Pimelea laevigata* form β (S 07-3110) (= *P. sporadica*, see text) gathered by D. Solander. (Image by courtesy of the Naturhistoriska Riksmuseet, Stockholm, 2007).



P. prostrata (J.R.Forst et G.Forst.) Willd. in the sense of the present paper; the upper specimen is not related to the typification of *P. prostrata*. Purportedly it was gathered on Norfolk Island by C. Sprengel, but actually it is from an unknown New Zealand location. It is *Pimelea urvilliana* A. Rich. *Essai Fl. N.Z.* (1832), also in the sense of this paper.

For specimens of *P. laevigata* (Sol. MS form α) gathered at Queen Charlotte Sound by Banks

and Solander during the *Endeavour* voyage see LINN 40.9/2 above and Natural History Museum, London, BM 894151, *Passerina prostrata*, Forst. *Prodr.* p.28, *Pimelea prostrata* Willd. *Sp. Pl.* 1, p. 37, *Pimelea laevigata* Nova Zelandia 1769/1 J.B.D.S. [Joseph Banks, Daniel Solander]! The top right-hand piece on this sheet, BM 894150/2, is labelled Anderson 1775. It was gathered by William Anderson (assistant surgeon), during the *Resolution* voyage.



Fig. 4 Lectotype of *Pimelea prostrata* subsp. *prostrata* (BM 829829). Each piece is regarded as an element of the lectotype. (Image by courtesy of the Natural History Museum, London, 2006).

Information relevant to the typification and definition of *P. prostrata* was outlined in the historical introduction to this part of the paper. Essential additional points are that, although the species is based on specimens from Queen Charlotte Sound, Marlborough, a few similar plants occur along coasts of the southern North Island and in some southern North Island highland places. Otherwise they also occur widely in the remainder of the South Island. All of these are treated here as belonging to *P. prostrata* s.s. Other less similar but related forms (not including Solander's form β) are to be found in many parts of the North Island and in the far

north-west and south-west of the South Island. These regional variants are dealt with below as subspecies of *P. prostrata* (i.e., they constitute, with subsp. *prostrata*, *P. prostrata* s.l.).

MAORI NAMES: Pinatoro, wharengarara.

DESCRIPTION: Small to medium-sized, much-branched, prostrate, decumbent or, rarely, suberect shrubs. Stems slender to moderately stout, flexible to stiff, up to 60 cm long. Branching sympodial and also irregularly lateral. Branchlets uniformly yellowish-brown or brown, smooth or muricate, glabrous (except in leaf axils and on receptacles) or sparsely to moderately densely covered with short,

silky, greyish-white, appressed hair. Internodes 0.5–5 mm long. Older stems glabrate to hairless, grey-brown. Node buttresses short, lunate, or extending part way or completely along the internode, usually not prominent on leafless stems. Leaves decussate, closely spaced or distant, ascendant on youngest stems, then patent or sometimes deflexed, apparently distichous in appressed plants, on short (0.5–2 mm) usually red petioles, sometimes sessile. Lamina glabrous, often glaucous, sometimes red-margined (3–10 × 1.5–4 mm), slightly fleshy when fresh, thin when dry, narrow-elliptic to broad-elliptic, sometimes near-circular, or broad-ovate, or oblong, flat or slightly keeled to adaxially concave; margins may be slightly upturned, tip obtuse or acute, base cuneate, midrib obscure or moderately prominent abaxially, lateral veins obscure. Stomata abundant on both adaxial and abaxial sides.

Inflorescences single, or in small terminal clusters on ends of leading branches, and on shorter lateral branchlets, 5–15-flowered. Involucral bracts 4, usually similar in size to adjacent leaves, or slightly larger. Plants gynodioecious. Flowers white, on very short (0.1–0.2 mm) pedicels, sweet-scented, calyx lobes opening in salverform fashion. Tube and calyx lobes moderately hairy outside, inside hairless or sparsely hairy; lobes opening in salverform fashion. ♀ tube 2–3.5 mm long; ovary portion 1.5–3 mm, often red, wrinkled, calyx lobes 1–1.3 × 0.8–1.2 mm. Staminodes small, near mouth of tube. ♂ tube 4–4.8 mm long; ovary portion 1.8–3 mm; calyx lobes 1.8–2 × 1–1.8 mm. Anther filaments short, inserted at mouth of tube; anther dehiscence semi-latorse. Ovary sparsely to moderately hairy at and below summit. Fruits ovoid to globose, fleshy, white, usually opaque 4–5.5 × 2.8–4.5 mm. The flower tube breaks off irregularly as the fruits ripen. Seeds narrow to broad-ovoid 2–2.5 × 1.4–1.6 mm. Crest thin. Flowering time spring-summer-autumn.

DISTRIBUTION: Collectively the varied manifestations of *P. prostrata* s.l. are widespread, extending from Cape Reinga in the far north of the North Island to islands south of Bluff and penetrating far inland in North and South Islands. However, none reaches altitudes of more than about 1300 m. Reports of the presence of *P. prostrata* on Norfolk Island were held to be erroneous by Green (1990). Norfolk Island was cited as the location for specimens that I have seen in the Naturhistoriska Riksmuseet, Stockholm (S07-3099, Herb. Osbeck; S07-3100, Herb. Swartz). Both are *P. prostrata* subsp. *prostrata* from New Zealand.

6a. *Pimelea prostrata* (J.R.Forst. et G.Forst.) Willd. (1797) subsp. *prostrata*

= *P. laevigata* Sol. ex Gaertn. (1788) *pro parte*, nom. illeg.

= *P. prostrata* forma *parvifolia* Allan (1961). Lectotype (chosen here): CHR 73137, Omarama [North Otago], tussock flats at 400 m, abundant, Inspector of Stock, Kurow, 18 Apr 1950.

DESCRIPTION: A small shrub; stems prostrate, often thin and flexible, creeping on open areas or in low vegetation, pendent on banks, cliffs, up to 30 cm long. Stems may be partially buried on sandy substrates; adventitious roots may develop on these, or on stems in moist habitats. Branching sympodial and lateral. Branchlets uniformly yellowish-brown to brown, usually smooth but sometimes muricate, glabrous except in leaf axils and on receptacles, or sparsely to moderately clad in short, silky hair. Internodes 1–4 mm long. Older stems grey-brown to dark grey. Node buttresses light to medium brown, occupying part or all of the internode; occasionally prominent on leafless branches. Leaves close (exposed or drier sites) or distant (shaded sites), patent, on short red petioles. Lamina glaucous, often red-margined, usually 3–6 × 1.5–4 mm, thin, elliptic to broad-elliptic, flat, tip obtuse. Inflorescences 5–8-flowered, terminal on branchlets. Involucral bracts to 5.6 × 4.2 mm. Flowers relatively sparsely hairy outside, inside hairless, on very short pedicels (0.2 mm). ♀ tube 2.5 mm long, ovary portion red, 2 mm; calyx lobes 1.2 × 1.2 mm; ♂ tube 4.8 mm long, ovary portion 2 mm; calyx lobes 2 × 1.5 mm. Ovary moderately hairy at summit. Fruits broad-ovoid to globose, fleshy, white, opaque 4.2 × 2.8 mm. Seeds narrow-ovoid 2.5 × 1.5 mm, crest very thin. Flowering time spring-summer-autumn (Fig. 5, 6). Chromosomes: $n = 18$ (Burrows 1958, as *P. prostrata*); $2n = 36$ (Dawson & Beuzenberg 2000, p. 8); $2n = 90$ (M. Dawson pers. comm.) (the last two as *P. "Waitaha"*). A polyploid series may be present, but more study is needed to validate this.

REPRESENTATIVE SPECIMENS: NORTH ISLAND: SOUTH AUCKLAND: CHR 62727 Maraeroa, King Country, *M.H. Bannister*, Jan 1947; CHR 389314 Mt Pahiko, Kaimai Ra. 770 m, *A.P. Druce*, Apr 1982. TARANAKI: WELT 53169 *Sphagnum* bog near Holly Flat, Mt Egmont, *E.K. Pickmere*, 24 Mar 1940; CHR 86661 between Pouakai Ra. and Mt Egmont, 895 m, bog, *A.P. Druce*, Jan 1960. AXIAL RANGES: CHR 402246 Westlawn, Kaimanawa Mts, 1100 m, tussock land, *A.P. Druce*, Dec 1984;

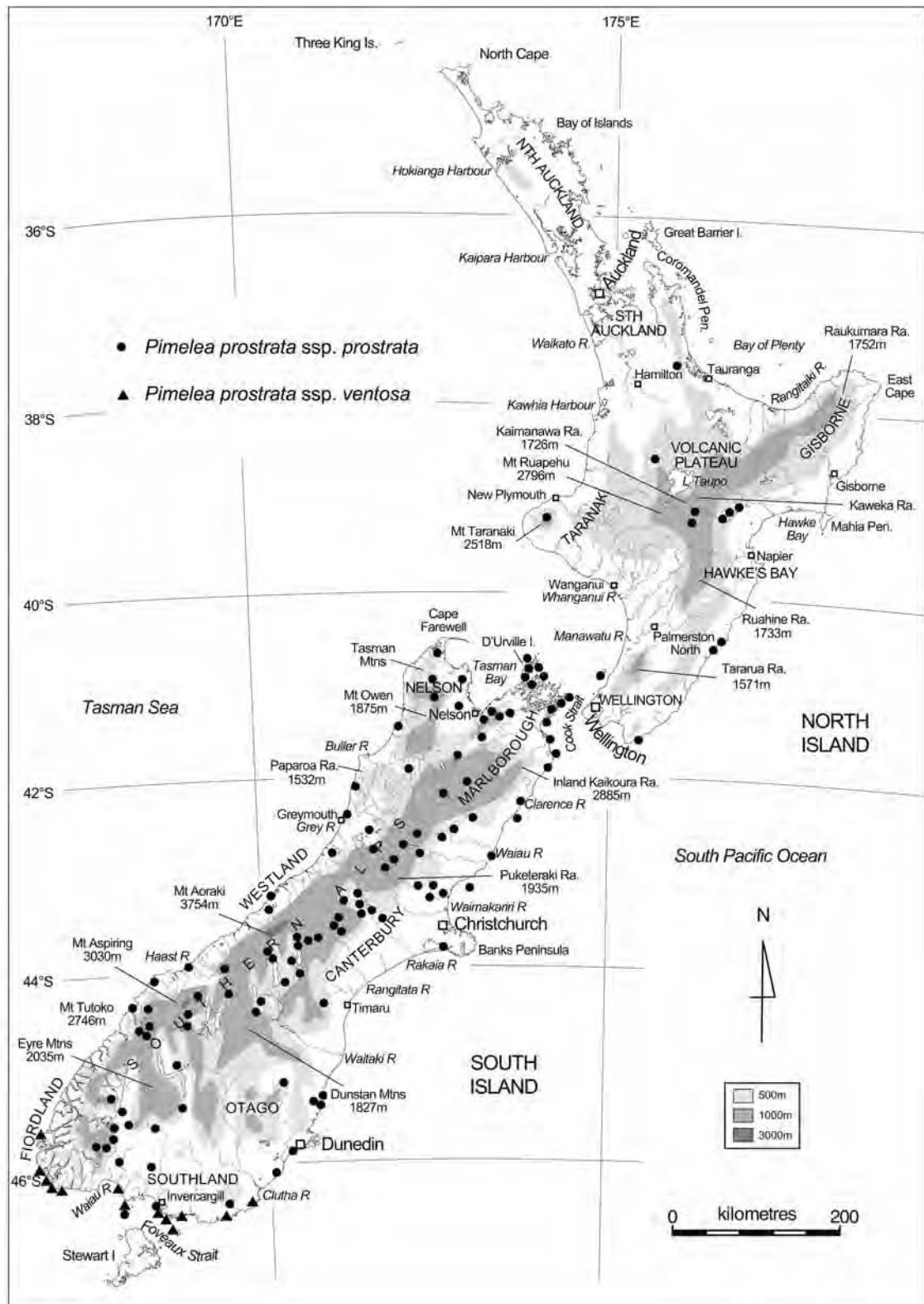


Fig. 5 Habit photograph of *Pimelea prostrata* subsp. *prostrata* with fruit, *Racomitrium* mosses, and *Placopsis* lichen (on stones), South Ashburton River floodplain, Hakatere Station, Canterbury. (C. J. Burrows 2008)

CHR 65286 N.W. Ruahine Ra., Rangitikei R., c. 620 m, tussock land, D.R. McQueen, 7 Apr 1950. HAWKE'S BAY-WAIRARAPA: CHR 216782 Mt Taraponui, Maungaharuru Ra., 1234 m, grassland, A.P. Druce, Apr 1980; CANU 18170 Cape Turnagain, mudstone cliff, D.G. Lloyd, Feb 1967. WELLINGTON: CHR 404537 Kapiti I. east coast, D.R. McQueen, 29 Aug 1947. MARLBOROUGH: CHR 111497 Motungarara I., outer Queen Charlotte Sound, M.E. Gilham, 22 May 1957; DOC(NM) 4520 Arapawa I., Queen Charlotte Sound, near Raukawa Rock 30 m, associates *Einadia triandra*, *Plantago coronopus*, S. Courtney, 9 Dec 1998; CHR 220107 Maud I., Pelorus Sound, rare, outcrops of weathered rock, B.D. Bell, 16 Apr 1971; WELT 15205 Ragged Pt, D'Urville I., W.R.B. Oliver, 12 Feb 1943; AK 303264 Cape Campbell by lighthouse, consolidated Tertiary clay, E.K. Cameron, 9 Jun 2008; CHR 393968 S.W. of Mirza Ck, sand, 6 m, A.P. Druce, Nov 1982; CANU 8818 ridge to Chrome Hill, Wairau Valley (ultramafic), wet ground with *Schoenus*, 1067 m, C.J. Burrows,

Fig. 6 Distribution map for *P. prostrata* subsp. *prostrata* and *ventosa*. ►

Mar 1965; CHR 189095 Alma R., behind Red Gate Hut, Molesworth, L.B. Moore, 12 Feb 1969; CANU 6843 Kaikoura Peninsula, dry limestone hillside, 20 m, C.J. Burrows, Nov 1963. NELSON: CHR 155463 Whanganui Inlet (Westhaven), B. Huggins, V.M. Scott, 1 Feb 1965; CHR 311940 Canaan, Pikipiruna Ra., 730 m, grassland (marble), A.P. Druce, Nov 1976; CHR 389277 above Cobb Reservoir, Cobb Valley, shrubland, A.P. Druce, Mar 1982; CHR 235459 Rainy River Scenic Reserve, 356 m, D. Kelly, G.C. Kelly, Nov 1972; AK 50295 Maitai Valley, T.W. Mellor, Feb 1951; CHR 24304 Dun Mt, L.B. Moore, 12 Feb 1969. WESTLAND: CANU 38809 Upper Taramakau R., floodplain, C.J. Burrows, Jan 1973; CHR 519166 Lower Hokitika R., silty river flat, C.J. Burrows, Feb 1958*; CHR 214854 Waiho Valley, south of



Franz Josef township, *P. Fletcher*, summer 1970–1971*; CHR 108013 Okarito, *M.J.A. Simpson*, 26 Feb 1958*; CHR 223946 Marks Flat, head of Clarke tributary of Landsborough R., *P. Wardle*, 23 Feb 1972; CHR 169518 Okuru, Mussel Point, coastal rocks, *D. Given*, 15 Feb 1964*; CHR 283625 Cascade R. mouth, sand dune, *P.N. Johnson*, 30 May 1977*. CANTERBURY: CHR 109100 Gore Bay, *R. Mason*, 1 Nov 1958; CHR 145557 Motunau I., tussock grassland, *R. Mason*, 5 Oct 1966; OTA 44931 Birdlings Flat, Kaitorete Spit, *B.D. Rance*, 21 Jun 1986 [one piece subsp. *prostrata*, four pieces subsp. *prostrata* × *P. carnosal*]; CHR 301746 Doubtful R., North Canterbury, *H. Talbot*, Jan 1940; CHR 91785 Hanmer, *H.H. Allan*, 23 Oct 1941; CHR 190933 near Weka Pass, North Canterbury, hanging down cliff (limestone), *A.P. Druce*, Nov 1969; CANU 2892 Upper Gorge, Waipara R., river floodplain gravel, *C.J. Burrows*, Mar 1960; CANU 38817 near Hood's Bush, Malvern Hills, in *Leptospermum* scrub, *C.J. Burrows*, Jul 1971; CANU 1004 Cass, Waimakariri Basin, grassland in wet site beside *Schoenus* flush, *C.J. Burrows*, 1957; CANU 38816 tarn margin on moraine downs near Lake Coleridge, *C.J. Burrows*, Apr 1997; CANU 6168 river floodplain of upper Rakaia R., Washbourne Hut, *C.J. Burrows*, Dec 1958; CANU 38814 Blands Bluff, near Mt Somers, on limestone, *B.P.J. Molloy*, 25 Mar 2005; CHR 238594 Hunters Hills, Bluecliffs Station, cliff above creek bed, 300 m, *B.H. MacMillan*, *A. E. Woodhouse*, 14 Dec 1972; CANU 1126 floodplain of Rangitata R., Erewhon, *C.J. Burrows*, Apr 1958; CANU 1140 floodplain of Hooker R., Mt Cook National Park, *C.J. Burrows*, Jan 1956. OTAGO: CHR 320012 Martins Bay, sand dune, *P.N. Johnson*, 10 Dec 1977*; OTA 35070 Upper Olivine R., 1140 m, *A.F. Mark*, *W.G. Lee*, common in wet sites on serpentine, 28 Jan 1974; OTA 31210 Little Red Hill [near Lake Wilmot], raw serpentine, *A.F. Mark*, 9 Dec 1969; CHR 481174 Lake Ohau, dried up lake, *D.R. Given*, 12 Feb 1964; CHR 118996 Ferguson Ck, Hunter Valley, *R. Mason*, 3 Jan 1961; OTA 28661 Jumbo Flat, Wilkin R., 478 m, open valley grassland, *A.F. Mark*, 10 Dec 1968; OTA 20790 Upper Beans Burn Valley, open grassy river flat, 770 m, *A.F. Mark*, *M.L. Burke*, 6 Dec 1967; OTA 3277 Branches Flat, Lower Shotover, gravel floodplain, *P. Wardle*, 27 Jan 1953; CHR 330579 Waipiata, Maniototo Plain, *A. Wall*, Jan 1920; CHR 168566 Moeraki Point, east Otago, cliff, *G.I. Collett*, Dec 1965; OTA 41172 Shag Point, 30 m, *M. Heads*, 4 Dec 1983; CHR 9405 Black Head near Dunedin, *V.D. Zotov*, 9 Jan 1936; OTA 41111

Chrystalls Beach, E. Otago, *M. Heads*, Jul 1979. SOUTHLAND: CHR 91221 Mid Dome, *H.H. Allan*, 21 Jan 1948; CHR 496342 Lake Manapouri, South Arm, raised bog with *Nothofagus* saplings, *B.H. Macmillan*, 16 Nov 1990; CANU 38811 Point Burn, Murchison Mts, gravel stream floodplain, *C.J. Burrows*, Jan 1962; OTA 48109 Borland Bog near Monowai, 180 m, around bog margin, *A. McQueen*, Nov 1996; WELT 6282 Tahakopa, Catlins, Castle Rock limestone hills, *W.R.B. Oliver*, 12 Oct 1953; AK 231670 Dunrobin red tussock covenant, on main Mossburn Rd, *P.J. de Lange*, 9 Feb 1995; CANU 6740 Aparima R., riverbed, *D.G. Lloyd*, 11 Jan 1967; CHR 455498 Tiwai Point, near Bluff, 5 m, *B.D. Rance*, 14 Sep 1985*.

*See the section on hybrids for *P. prostrata* subsp. *ventosa*, below.

DISTRIBUTION: North Island: coastal and a few high level inland sites in South Auckland, Taranaki, Gisborne, Hawke's Bay, eastern Wairarapa, and near Wellington. South Island: coastal, offshore island and inland sites in Marlborough, Nelson, Westland, Canterbury, Otago, Southland (Fig. 6).

HABITAT: A wide range of open sites, including coastal gravel, sand dunes, and mudstone cliffs; on ultramafic rock, mudstone, sandstone, marble, limestone, gravel river floodplains; vegetated places, in open scrub, low grassland, *Schoenus* marsh, *Sphagnum* bog, around tarn margins.

CONSERVATION: The subspecies is plentiful in places and generally not in danger. However, invasion of shorelines or river floodplains by dense weed cover and continuing land development are inimical. Close search of Queen Charlotte Sound islands to track the presence and population health of the subspecies in its type locality is desirable. Local management there and in reserves in some other places may be needed.

ILLUSTRATIONS (other than those noted above): Wilson 1966, fig. 11 (as *P. prostrata*).

HYBRIDS: Crossing is recognised between *P. prostrata* subsp. *prostrata* and each of subsp. *seismica* (X), subsp. *vulcanica* (X), subsp. *thermalis* (X), subsp. *ventosa* (X), *P. carnosal* (X), *P. sp. aff. sericeovillosa*, and *P. oreophila*. In the mountains of Nelson, Canterbury, Otago, and Southland, subsp. *prostrata* sometimes meets *P. oreophila*, a hairy-leaved species. The leaves of *P. oreophila* are narrow-elliptic to narrow-ovate and sparsely hairy on the abaxial side and the acute tips; it has lunate node buttresses and hairy internodes.

In a collection of 20 plants representing parents and hybrids (CANU 1126, 1127, Erewhon, Rangitata Valley, Canterbury, *C.J. Burrows*, Apr 1958) the hybrids have mixed leaf sizes and shapes, and a few with leaves otherwise like those of subsp. *prostrata* have some abaxial leaf hair. Node buttresses vary from elongate to lunate and there is varied hairiness of internodes. The habitat of this small hybrid swarm was on the valley floor at the margin of closed *Festuca novaezelandiae* grassland and open gravel of the river floodplain. At Cass, Waimakariri Basin, Canterbury, Burrows (1958) found evidence of hybridisation between these two on margins of hillside seepages. Similar hybrid populations between these taxa are also known from Harper R., Rakaia catchment, *C. J. Burrows*, May 1958 (CANU 6175); W end L. Sumner N. Canterbury, *C. J. Burrows*, Apr 1962 (CANU 38818); E of Lake Ohau, S. Canterbury, *C. J. Burrows*, Jan 1965 (CANU 9052). All were on valley floors but the habitats varied from river floodplains to marshy hillsides and tarn margins. Hybrids of the same provenance with orange fruits are common in Central Otago (e.g., on the Old Woman Ra., M. Thorsen pers.comm.). A uniform phenotype seems to be present in that region. *Pimelea prostrata* subsp. *prostrata* may be extinct locally.

Crossing between subsp. *prostrata* and *P. cf. sericeovillosa*, another hairy leaved species, is not common. Hybrids have been seen at Cass (Burrows 1958) and at Shale Peak, Waiiau R., N. Canterbury, *C. J. Burrows*, Dec 1963 (CANU 6598). Both were on sites where grassland and scrub had been burnt about a decade earlier.

NOTE: *Pimelea prostrata* subsp. *prostrata* inhabits an extraordinarily wide range of habitats. It must have been even more widespread prior to European settlement and land conversion for farming. Early 20th century records are from locations on the Canterbury Plains, for example. There are many local populations with slightly different leaf sizes and shapes, or with differing node buttress lengths or amounts of stem internode hair. However, close scrutiny shows that such features intergrade from population to population in clinal fashion. Also, within some local populations, stem hairiness may vary considerably. Similar phenotypes to those from the type region can be found in some populations far distant from there. Also, when phenotypically somewhat disparate plants (e.g., from limestone, river floodplain gravel, or tarn margins) have been grown in pots in uniform conditions, the initial morphologic contrasts become less marked (*C. J. Burrows* unpubl. data). In these circumstances it would be unwise

to further subdivide this somewhat variable entity. Nevertheless, polyploid races may occur.

6b. *Pimelea prostrata* subsp. *seismica*

C.J. Burrows, subsp. nov.

DIAGNOSIS: Differt a subsp. *prostrata* in amplitudine ubique grandiore, habitu interdum decumbenti vel suberecto, culmis crassioribus, cinereo-brunneis vel atro-brunneis, foliis majoribus plerumque oblongis, apicibus acutis ornatis anteridibusque nodorum plerumque lunatis. A subsp. *vulcanica* differt foliis pallide viridibus, glaucis, oblongis, ramulisque lateralibus longis flexilibus nullis ramulis secundariis brevibus foliosis, differt autem in insignite sympodiali ramificationis ordinatione.

Differs from subsp. *prostrata* by its larger overall size, sometimes decumbent to suberect habit, stouter, grey-brown to dark-brown stems, larger, usually oblong leaves with acute tips and usually lunate node buttresses. From subsp. *vulcanica* it differs by having light green, glaucous, oblong leaves, and long, flexible lateral branchlets that lack short, leafy secondary laterals and by its otherwise notably sympodial branching pattern.

HOLOTYPE: CANU 38853 Titahi Bay, Wellington, grassland on hillside, *C.J. Burrows*, Aug 1973 (Fig. 7).

ETYMOLOGY: From Greek “seismos” (earthquake); the plant is found around earthquake-prone Wellington.

DESCRIPTION: A small to medium-sized, much-branched, prostrate, sometimes decumbent, low shrub. Main stems to 40 cm long, stout, flexible or stiff. Young stems brown, moderately or very hairy. Branching is both sympodial and lateral and the laterals are few to numerous, long, usually flexible and moderately thick. Internodes 1–5 mm long. Older stems glabrous and grey-brown to dark brown. Node buttresses usually short (0.3 mm) lunate, brown. More elongate node buttresses may occur on the same plants. They are not prominent on leafless stems. Leaves ascendant, then patent to deflexed, on short (0.3–0.5 mm) red petioles. Lamina ovate, elliptic or often oblong, 4–8 × 2.2–3.2 mm, light green, glaucous, acute or sometimes obtuse, flat or slightly adaxially concave, margins slightly upturned, midvein evident abaxially.

Inflorescences terminal on branchlets, 4–6-flowered. Involucral bracts 4, smaller than, or similar in size to adjacent leaves (5 × 3 mm). Flowers white, moderately hairy outside; inside hairless. ♀ tube 3.5 mm long, ovary portion 3 mm, calyx lobes 1.3

× 0.9 mm; ♀ tube 4 mm long, ovary portion 3 mm, calyx lobes 2 × 1 mm. Ovary has sparse hair on summit and to about two-thirds of the way down. Fruits oblate, white, opaque 5.4 × 4 mm. Seeds broad ovoid 2.2 × 1.6 mm. Flowering time spring-summer-autumn. Chromosomes: $2n = 36$ (Dawson & Beuzenberg 2000, p. 8; as *P.* "Ahipara").

REPRESENTATIVE SPECIMENS: NORTH AUCKLAND: CHR 178099 Scott Point, North Cape, consolidated sand, scrub, erect, *G.C. Kelly*, Apr 1967; CHR 469823A Taunganui Point [Spirits Bay], cliff top, 120 m, *A.P. Druce*, Dec 1989; CANU 38880 Gumfields Road near Ahipara, sand on west side of plateau, *C.J. Burrows*, Aug 1997; CANU 38881 Hokianga Harbour, South Head, sand dune, *C.J. Burrows*, Aug 1997; AK 292358 North of Dargaville, Maitahi wetlands, edge of sandstone track in gumland, 40 m, *L.J. Forester*, 17 Dec 1999; CHR 246569 Paparoa Point, Tinopai, Kaipara Harbour, coastal rocks, mat-forming (cultivated), *A.J. Dakin*, 11 Oct 1969; CHR 262542 Anawhata, Waitakere Ra., prostrate shrub on exposed dry clay bank, 125 m, *R. Gardner*, 8 Nov 1974. WELLINGTON: CHR 33516 Muritai, Wellington Harbour, in manuka scrub on dry clay face, with *Acianthus sinclairii*, *Drosera auriculata*, *Cyathodes acerosa*, *Leucopogon fraseri*, *A.J. Healy*, *V. Norman*, 14 Oct 1937; CHR 245561 ridge south-west of Owhiro Bay [Island Bay], *A.P. Druce*, Nov 1972; CANU 19077 north of Plimmerton, 6 m, quarry, coastal shrubs and herbs, scrambling, *P.J. Garnock-Jones*, 1 Feb 1970; AK 237924 between quarry and Red Rocks, *E.K. Cameron*, 3 Oct 1998; WELT 53243 Seatoun, grassy hill slopes, *W.R.B. Oliver*, Mar 1940. NELSON-BULLER: CHR 495440 North-west Nelson, Kaihoka, south-east of Dickens Cottage, *D.R. Given*, 21 Dec 1974; CHR 391180 Westhaven Inlet, hanging down sandy roadside bank, sea level, *G. Brownlie*, 11 Jan 1969; CHR 75108 Lower Moutere Hills, *A.J. Healy*, 5 Mar 1944; CHR 81319 Wilson's Lead Rd, near Westport, north end, roadside, *R. Mason*, *N.T. Moar*, 6 Feb 1953; CHR 92933 Cape Foulwind, *H.H. Allan*, 9 Mar 1941.

DISTRIBUTION: North Cape and near Cape Reinga and scattered places to the south along the west coast of the North Island to Auckland; Wellington. North-west South Island as far south as Cape Foulwind (Fig. 8).

HABITAT: On grassy slopes and in shrublands or dunes, relatively close to the sea, sometimes on cliffs or rock outcrops. A little further inland in western Nelson.

CONSERVATION: The present situation of *P. prostrata* subsp. *seismica* is poorly known. As coastal *Pimelea* forms are vulnerable to disturbance, it is likely that populations near Auckland and in Wellington are severely threatened. A thorough survey is needed to determine the true state of affairs.

ILLUSTRATIONS: Connor 1992, fig. 43, p. 174 (*H. E. Connor* pers. comm.), as *P. prostrata*.

HYBRIDS: Crossing is recognised between *P. prostrata* subsp. *seismica* and each of subsp. *prostrata*, *P. xenica* (X), and *P. carnososa* (X). Occasional subsp. *seismica* × subsp. *prostrata* hybrids occur on the coastline adjacent to Wellington City. They are of overall intermediate size between the two parents. Examples are: CHR 71533 Moa Point, Wellington, coastal, pendent from rock crevice, *B.G. Hamlin*, 15 Dec 1948; CHR 306984 Lyall Bay, greywacke, sandy-shingly soil, coastal, *M.J. Parsons*, 5 Mar 1961. The largest leaves of these plants (5 × 2.5 mm), though smaller than for subsp. *seismica*, exceed the dimensions for large leaves of subsp. *prostrata* in the same region. Most leaves are broad-elliptic or oblong and have acute tips but some have obtuse tips. The leaves are ascendant and on some stems slightly imbricate. Node buttresses are lunate or elongate and young stem internodes are relatively hairy.

6c. *Pimelea prostrata* subsp. *vulcanica*

C.J. Burrows, subsp. nov.

= *P. heterophylla* Colenso *Trans. N.Z. Inst.* 22, 486 (1890). Lectotype (chosen here): Wellington Museum Te Papa Tongarewa, WELT 24339 Ruapehu, *H. Hill*, 1889. Paralectotype: Royal Botanic Gardens, Kew K357072 com. *W. Colenso*, 5/90.

DIAGNOSIS: Differt a subsp. *prostrata* foliis semper angusti-ellipticis, parum carinatis, apicibus acutis ornatis, et a subsp. *thermalis* habitu minus valido, foliis brevioribus et ramulis lateralibus primariis secundariisque brevibus minus foliosis.

Differs from subsp. *prostrata* by its consistently narrow-elliptic, slightly keeled, acute-tipped leaves and from subsp. *thermalis* by a less robust growth habit, smaller leaves, and short, less leafy lateral and secondary lateral branchlets.

HOLOTYPE: CANU 38891 near Rangitaiki; Volcanic Plateau. In open *Dracophyllum subulatum* scrub with *Festuca novaezelandiae*, *Rytidosperma* sp. and abundant lichen ground cover (*Cladia retipora*, *Cladonia* sp.) and mosses (*Racomitrium pruinosum*, *Hypnum cupressiforme*), 750 m, *C.J. Burrows*, 20 Jan 2009 (Fig. 9).

Fig. 7 Holotype of *Pimelea prostrata* subsp. *seismica* (CANU 38853). (Image by courtesy of the Allan Herbarium, CHR, 2007).



ETYMOLOGY: From Latin “Vulcanus” (the god of fire); the plant is found on and near volcanoes.

DESCRIPTION: A small to moderately large, much-branched shrub with prostrate habit. Main stems to 60 cm long, grey-brown, relatively thin and flexible, except near the base. Branching is mainly lateral, with long, thin, flexible branchlets; secondary branchlets on these are short. Young branchlets are only sparsely hairy. Internodes 0.5–4.0 mm long. Older stems glabrous, grey-brown. Node buttresses brown, elongate, usually the whole length of the internode,

with a strip of fine, short hairs between them, not very prominent on leafless stems. Leaves ascendant and imbricate; patent on laxer branchlets, on very short (0.1–0.3 mm) red petioles. Lamina narrow-elliptic, 4–6 × 1.2–2 mm, glabrous, usually glaucous, medium green or sometimes yellowish-green, often red-margined, slightly keeled, acute. Midvein evident abaxially, sometimes reddish. Leaves on the very short lateral branchlets are relatively small. Inflorescences terminal on branchlets, 2–7-flowered. Involucral bracts 4, similar in size to adjacent leaves.

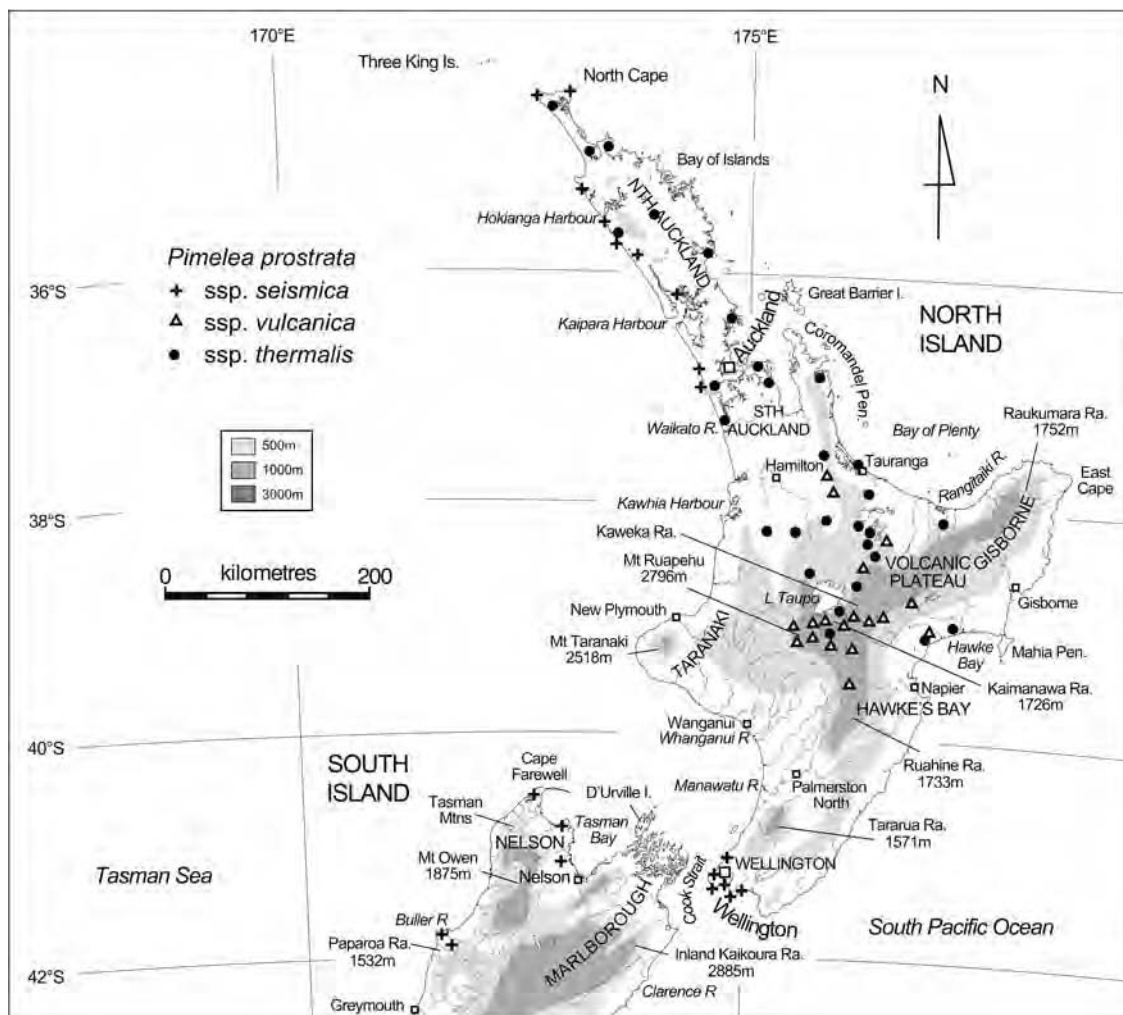


Fig. 8 Distribution map for *Pimelea prostrata* subspp. *seismica*, *vulcanica*, and *thermalis*.

Flowers white, moderately hairy outside; inside hairless or sparsely hairy in upper tube and ovary portion. ♀ tube 2.8 mm long, ovary portion 2.2 mm, calyx lobes 1.7 × 1.1 mm; ♂ tube 4 mm long, ovary portion 1.5 mm, calyx lobes 2 × 1.4 mm. Ovary with sparse hairs at summit and about one-quarter of the way down. Fruits ovoid, fleshy, white, opaque, 4 × 2.5 mm. Seeds narrow-ovoid, 3 × 1.3 mm, thin crest. Flowering time late spring-summer. Chromosomes: $2n = 36$ (Dawson & Beuzenberg 2000, p. 8 ... (as *P.* "Tongariro")).

REPRESENTATIVE SPECIMENS: SOUTH AUCKLAND: CHR 91761 Summit Kaimai Range road, crevices in rock face, *A.J. Healy*, 27 Nov 1945; AK 70125 Eastern

side, Thompsons Track, Kaimai Ra., *P. Hynes*, 9 Oct 1960; CANU 32628 Mt Tarawera summit, volcanic debris, *C.J. Burrows*, Apr 1981. VOLCANIC PLATEAU AND CENTRAL VOLCANOES: NZFRI 24662 Ohaaki Pool sinter flat, 300 m, *B.N. Spring-Rice*, *N.J.D. Sing*, 24 Nov 1994; CHR 570001 near Rangitikei, south of Omeruiti, 640 m, *P.B. Heenan*, 11 Feb 2004; AK 128891 Mangatopopo Valley [Mt Ngauruhoe], *B.S. Parris*, 17 May 1965; CANU 1134 Erua, Volcanic Plateau, *H.D. Gordon*, May 1957; CANU 10854 Onetapu Desert, tussock grassland, 770 m, *M.T. Kalin*, 1 Feb 1967; CHR 471802 Retaruke Valley, Waimarino, beside road, *P.E. Edwards*, Nov 1983. AXIAL RANGES: CANU 1159 Te Hoe R., E. Huiarau Ra., river terrace,

Fig. 9 Holotype of *Pimelea prostrata* subsp. *vulcanica* (CANU 38877). (Image by courtesy of the Allan Herbarium, CHR, 2007).



manuka, kanuka, *J.M. Bamford, P.W. Herrick*, 7 Feb 1961; CANU 38892 Titiokura, Napier-Taupo Rd, 900 m, on limestone outcrops, *C.J. Burrows*, 20 Jan 2009; CHR 90402 Kaimanawa Ra. (no name, date); CHR 65101 N.W. Ruahine Ra., Mangaohane Stm, 800 m, *Festuca* tussock grassland, *A.P. Druce*, 13 Jan 1948. HAWKE'S BAY: AK 213004 Holts Plantation, Tutira, shady banks and road cuttings, *I.L. Barton*, 12 May 1959.

DISTRIBUTION: Isolated occurrences on South Auckland and Taupo district hills; abundant on the

summit of Mt Tarawera, slopes of the central North Island volcanoes, and on plains of the Volcanic Plateau south of Murupara; scattered on Huiarau, Kaimanawa, and north-west Ruahine Ranges (Fig. 8).

HABITAT: Short grassland, shrubland with open grassy areas and sometimes on margins of fine volcanic ejecta patches (scoria, lapillii) and alluvium, colluvium derived from such debris; also on soils derived from tephra, on bared areas in grassland and open scrubland.

CONSERVATION: Plentiful on Mt Tarawera and the lower slopes of the central volcanoes and the plateau surrounding them and well protected in Tongariro National Park. Increased density of woody vegetation such as the weeds *Calluna vulgaris* (heather) and *Pinus contorta* (lodgepole pine) restricts habitat for the *Pimelea*. Occasional, patchy wildfires are probably beneficial for it.

HYBRIDS: Crossing is recognised between *P. prostrata* subsp. *vulcanica* and each of subsp. *prostrata*, subsp. *thermalis* (X), and *P. microphylla*. Plants that appear to be intermediate between subsp. *prostrata* and subsp. *vulcanica* have been found along the Wairarapa coast from Castle Point north to near the Mataikona River. Their leaves are glaucous-green, thin, up to 4 mm long, narrow, closely spaced and obtuse to acute-tipped. The node buttresses are lunate or elongate (to half the length of the internode, which is moderately hairy). Short lateral branches are relatively abundant. Examples are: CHR 91760 Castle Point, V.D. Zotov, 23 Apr 1945; CHR 210788 coastal cliff near Mataikona R., prostrate on cliff face, A.P. Druce, Dec 1970.

Similar plants that resemble subsp. *prostrata* more closely have been found at a higher level in Hawke's Bay (e.g., CHR 358667 Mt Taroponui, Maungaharuru Ra, 1230 m, grassland, A.P. Druce, Apr 1980).

On Mt Ngauruhoe and Ruapehu and the Rangipo Desert occur occasional hybrids between subsp. *vulcanica* and *P. microphylla* (a species with small, leathery leaves that are sparsely hairy when young). The leaves of the hybrids are thinner and narrower than for *P. microphylla*, but closely imbricated and ascendant, as is normal for it. Unlike *P. microphylla*, which has mainly sympodial branching, the hybrids have many short lateral branchlets. Examples are: CHR 65572 Tongariro National Park near Chateau [Mt Ruapehu, c.1100 m], R. Mason, 26 Nov 1948; CHR 32454 Desert Rd summit, E. of Ruapehu, scoria alluvium, c. 1000 m, A.P. Druce, Jan 1974.

ILLUSTRATIONS: Eagle 2006, p. 163 (as *P. prostrata*).

NOTE: The distribution of *P. prostrata* subsp. *vulcanica* closely matches the extent of ignimbrite and tephra deposits from the cataclysmic 1800 yr BP Taupo volcanic eruption (Wilson & Houghton 1993). As for *P. buxifolia* (Burrows 2008), it is likely that the evolution and spread of subsp. *vulcanica* is connected with that event. *Pimelea prostrata* subsp. *vulcanica* may be a derivative from a subsp. *thermalis* population. This hypothesis could be tested

by DNA analysis. This *Pimelea* is clearly at home on young volcanic ejecta. It is abundant on the upper part of Mt Tarawera, which was de-vegetated by the eruption of AD 1886, and on recent scoria and lapilli on Mt Ngauruhoe.

6d. *Pimelea prostrata* subsp. *thermalis*

C.J. Burrows, subsp. nov.

= *P. rugulosa* Colenso *Trans. N.Z. Inst.* 21, 102 (1889). Lectotype (chosen here): Royal Botanic Gardens, Herb. Hort. Kew, K356733 Tahoraiti, S. of Dannevirke, Co. Waipawa [Hawke's Bay]; com. *W. Colenso* 5/90, 1885/88.

DIAGNOSIS: Differt a subsp. *prostrata* forma robustiore foliisque grandioribus ellipticis vel ovatis parum carinatis apicibus acutis ornatis, culmis et nodorum anteridibus atro-brunneis. A subsp. *vulcanica* differt statura plerumque majore et ramulis lateralibus primariis secundariisque abundantibus longis vel brevibus foliosisissimis.

Differs from subsp. *prostrata* by its more robust form and larger, elliptic to ovate, slightly keeled leaves with acute tips, dark brown stems and node buttresses. From subsp. *vulcanica* it differs by its usually larger size and abundant, long or short, primary and secondary, very leafy, lateral branchlets.

HOLOTYPE: CHR 109845 Lake Rotongata, 3.2 km west of Arapuni Lake, R. Mason, N.T. Moar, 28 Nov 1958 (Fig. 10).

ETYMOLOGY: From Greek "thermai" (hot springs); the plant is found in some thermal areas.

DESCRIPTION: A moderately large, much-branched shrub with prostrate habit. Main stems to 60 cm long, dark brown, stout and stiff or flexible. The primary lateral branches are usually long and flexible or sometimes straight and stiff. They usually bear abundant, short, secondary, very leafy laterals. Young branchlets are clad, sparsely, in short hair. Internodes 2–5 mm long, shorter on laterals. Older stems glabrous, dark brown to grey-brown. Node buttresses dark brown, extending the length of the internode, not prominent on leafless stems. Leaves ascendant then patent, on very short (0.1–0.2 mm), often dark red petioles, or sessile. Lamina narrow-elliptic or elliptic to oblong or ovate, 5–8 × 2–3 mm, medium to dull green, sometimes glaucous, slightly keeled, acute. Midvein evident abaxially, sometimes red. Leaves on secondary lateral branchlets relatively small.

Inflorescences terminal on branchlets, 4–6-flowered. Involucral bracts 4, smaller than, the same

Fig. 10 Holotype of *Pimelea prostrata* subsp. *thermalis* (CHR 109845). (Image by courtesy of the Allan Herbarium, CHR, 2007).



size as, or larger than adjacent ordinary leaves (6×2.5 mm). Flowers white, moderately hairy outside; inside hairless. ♀ tube 2.2 mm long, ovary portion 2 mm, calyx lobes 1×0.8 mm; ♂ tube 4 mm long, ovary portion 1.8 mm, calyx lobes 2×1 mm. Ovary sparsely hairy at summit. Fruits ovoid, white, opaque 5×3 mm. Seeds 2.7×1.5 mm. Flowering time spring-summer. Chromosomes: no counts known.

REPRESENTATIVE SPECIMENS: NORTH AUCKLAND: NZFRI 11935 Road to Te Paki Trig, road edge, C.E. Ecroyd, 3 Feb 1982; CHR 84914 Ngawha,

Kaikohe, gumland, in manuka scrub, V.D. Zotov, 26 Nov 1953; AK 117757 Kaimaumuau, Rangaunu Harbour, R. Cooper, 7 Nov 1966; AK 139193 Waipoua State Forest, banks of Waiotane Stm, 10 m, A.E. Wright, 10 Jan 1976; AK 172954 Tawharanui Peninsula [E of Warkworth], 3 m, M.E. Young, 10 Nov 1985; AK 218568 Taitomo I., S. Piha opposite Nun Rock, c. 40 m, E.K. Cameron, 29 Dec 1993; AK 27739 Wesley Spragg Reserve, Huia [Manukau Harbour], K. Wood, 3 Jun 1950; WELT 54213 Waiheke I., coastal scrub, D.R. McQueen, May

1949; SOUTH AUCKLAND-BAY OF PLENTY-VOLCANIC PLATEAU: AK 211493 Raukawakawa, Hunua Ra., coastal rocks, *I.L. Barton*, 29 Jan 1972; AK 266169 Mt Maunganui, *A.G. Simpson*, Jan 1960; AK 291478 Maioro [near Waiuku] W. coast directly W. of Parkinson Lake, sandstone cliff tops, *P.A. Aspin*, 15 Feb 2005; NZFRI 13926 Waipapa Ecological Area, Pureora State Forest, 540 m, *J.R. Leathwick*, 19 Mar 1984; CANU 6769 Tokoroa, *W.B. Silvester*, 1963; CHR 51585 Wharepaina, near Taupo, *H.E. Connor*, 8 Nov 1944; NZFRI 262290 Whakarewarewa Forest Reserve, Rotorua, pendent, hanging over pumice bank, *T.C. Chambers*, 22 May 1949; CHR Akatarewa Springs, *D.R. Given*, 28 Nov 1979; CHR 145667 Lake Ngapouri [Opouri?], near Waiotapu, *R. Mason*, 23 Jan 1963; CHR 8929 Opotiki, *N. Potts*, no date; WELT 39610 Waimarino, *W.R.B. Oliver*, 22 Jan 1954; CHR 133456 Desert Rd, pumice, *J.D. Burrell*, 28 Dec 1948. HAWKE'S BAY: CHR 469714 Southwest of Waikari R., 100 m, manuka scrub, *A.P. Druce*, Dec 1985; CHR 152729 Aropaoanui, *J.A. Langbein*, 1940–43.

DISTRIBUTION: North Auckland Peninsula; South Auckland, including Waikato, King Country, Piako, Bay of Plenty; Rotorua thermal region and northern part of the Volcanic Plateau; Hawke's Bay, mainly inland, sometimes near the coast (Fig. 8).

HABITAT: Gumlands, thermal deposits, old volcanic deposits, short grassland, shrubland.

CONSERVATION: This subspecies has shared the common fate of all sedgeland-grassland-shrubland plants in relatively low altitude and some higher areas of the North Island. Its area has diminished drastically through land development for farming and forestry. An effort is needed to ensure that this once-abundant Northland-South Auckland plant survives in protected areas. Appropriate management may include burning of taller vegetation to allow subsp. *thermalis* to increase.

ILLUSTRATIONS: None known.

HYBRIDS: Crossing is recognised between *P. prostrata* subsp. *thermalis* and each of subsp. *vulcanica*, subsp. *prostrata*, *P. orthia* (X), and *P. xenica* (X). Near Lake Taupo occasional hybrids between subsp. *thermalis* and subsp. *vulcanica* have been found. Isolated hybrids also occur farther east in Hawke's Bay and Wairarapa. The brown-stemmed hybrids have laxer leaf arrangement than is usual for subsp. *vulcanica* (with internodes up to 4 mm long). The largest leaves are longer than those of subsp. *vulcanica*, but narrower than is usual for subsp. *thermalis* (6.5–9.5

× 1.9–2.7 mm). They are elliptic and acute, but blunt-tipped. The many lateral branchlets are not densely leafy. Examples are: CHR 325848 Kaingaroa Plains, W.N.W. of Rangitaiki, 740 m, *A.P. Druce*, Oct 1978; CHR 471802 Retaruke Valley, Waimarino Plain, *P. Edwards*, Nov 1983; CHR 65101 N.W. Ruahine Ra., Manaokane Stm, 800 m, *Festuca* tussock grassland, *A.P. Druce*, 13 Jan 1948; CHR 355720 Wairoa, Hawke's Bay, pasture, *E.M. Mahy*, 8 Jun 1979.

On the coastline extending from Hawke's Bay north to East Cape are relatively large, much-branched and leafy plants with glaucous, broad-elliptic or broad-ovate, obtuse tipped leaves. The extensive primary and secondary lateral branching pattern apparently originates from subsp. *thermalis*, but the leaves resemble those of subsp. *prostrata* in shape and colour, and the largest leaves are smaller than is usual for subsp. *thermalis*. The plants are considered to be hybrids between these two subspecies. Examples are: CHR 159458 Waipatiki Beach north of Napier, coastal cliff, *A.P. Druce*, Jan 1964; CHR 165766 W.S.W. of Opoutama (Mahia Isthmus), cliff top, *A.P. Druce*, Dec 1966; CHR 183263 East Cape Lighthouse, cliff face exposed to wind and salt, *I. Collett*, May 1965.

NOTE: The type specimen for Colenso's *P. rugulosa*, from southern Hawke's Bay (K356733) has flexible, dark brown stems. In a Kew loan to CHR (H 2007/01531, sheets 20–25) the sheets are labelled, in pencil, *P. rugulosa*. Two of them (21, 22) have similar specimens to K356733 and one (23) has an elongated, stiff stem with short, leafy laterals. Sheet 20 has two small pieces of *P. prostrata* subsp. *prostrata* and one of *P. rugulosa*. On sheet 24, as well as *P. rugulosa* (one piece) there are three pieces of *P. prostrata* subsp. *prostrata* and one of *P. oreophila*. On sheet 25 is one piece of *P. rugulosa* and two of *P. orthia*.

It is probable that *P. prostrata* subsp. *thermalis* is the form, "Strathmore Weed", responsible for deaths of horses and cattle through poisoning with a diterpene acetate compound, prostratin (Connor 1992). The subspp. *thermalis* × *vulcanica* hybrids and possibly other *P. prostrata* subspecies may also be poisonous. This compound appears to have potential for pharmacological use (cf. Pettit et al. 1983; N. Perry pers. comm. 1994).

6c. *Pimelea prostrata* subsp. *ventosa*
C.J. Burrows, subsp. nov.

DIAGNOSIS: Differt a subsp. *prostrata* foliis grandioribus crassioribus, nodorum anteridibus

plerumque lunatis et moderate denso indumento constato e pilis tenuibus rigidis in internodiis ramulorum juvenum. Ramuli vetustiores ordinationem propriam muricatum in pagina praebent.

Differs from subsp. *prostrata* by its larger, thicker leaves, usually lunate node buttresses and moderately dense cover of fine, stiff hair on the internodes of young branchlets. Older branchlets have a distinctive muricate surface patterning.

HOLOTYPE: CHR 90403 Spit I., Preservation Inlet, south-west Fiordland, *H.H. Allan*, 26 Jan 1946 (Fig. 11).

ETYMOLOGY: From Latin “ventus” (wind); the plant lives in windy south-west Fiordland and Foveaux Strait locations.

DESCRIPTION: A small to medium-sized, sparsely branched, prostrate shrub with main stems to 30 cm long. Branching both sympodial and lateral but the former is more common. Internodes 1–3 mm long, with a sparse to moderately dense cover of fine but stiff hair. Node buttresses dark brown, short (0.3 mm or sometimes to 0.6 mm), lunate, moderately conspicuous on leafless stems. The internodes of young stems are covered by a brown pellicle which fragments as they grow, leaving a muricate patterning. Leaves ascendant, imbricate, or more distant, on short (0.8–1 mm) red petioles. Lamina broad elliptic to ovate, 4.5–10 × 2.3–4 mm, light green, glaucous, slightly fleshy, adaxially concave or very slightly keeled, margins thickened, often red, upturned; midvein obscure abaxially, obtuse, base cuneate.

Inflorescences terminal, 4–6-flowered. Involucral bracts 4, larger than adjacent leaves (5 × 7 mm). Receptacle very hairy. Flowers white, very hairy outside; inside hairless. ♀ tube 2.5 mm long, ovary portion 2 mm, calyx lobes 1.5 × 1 mm; ♂ tube 4.2 mm long, ovary portion very wrinkled, 2 mm, calyx lobes 3 × 2 mm. Ovary with a tuft of short hair at summit and fewer hairs down to the base. Fruits ovoid to globose, fleshy, white, opaque, 4.9 × 3 mm. Seeds ovoid, 3.2 × 1.8 mm. Flowering time spring–summer–autumn. Chromosomes: no counts known.

REPRESENTATIVE SPECIMENS: FIORDLAND: OTA 41817 Five Finger Pena., Dusky Sound, 2 m; rare as trailing subshrub on sand ridges at Goose Cove, N.E. corner of the Pena., *A.F. Mark*, 16 Nov 1984; CHR 310922 Chalky Island, south-west Fiordland, coastal cliff, *P.N. Johnson*, 30 Nov 1976; CHR 147877 Puysegur Point, S. of Preservation Inlet, *G. Collett*, Dec 1963; CHR 320076 Green Islets [near Grace Burn south-west Fiordland], sand

dune, *P.N. Johnson*, 5 Nov 1977; SOUTHLAND: CANU 1018 Orepuke, sea level, *G. Brownlie*, 17 Oct 1954; OTA 41132 Tiwai Point, Southland, 1 m, *M. Heads*, 27 Nov 1982; CHR 364054 Waituna Lagoon, near face of gravel beach ridge, *P.N. Johnson*, 22 Sept. 1981. SOUTH OTAGO: OTA 3872 Tautuku, Catlins, sand dunes near sea level, *B.F. Slade*, 19 Jan 1957*; OTA 41336 Nugget Point, 10 m, *M. Heads*, 25 Oct 1984*. FOVEAUX STRAIT: CHR 571457 West side Ruapuke Island, steep coastal bank, *H.D. Wilson*, 24 Aug 1983; CANU 8774 Bird Island (near Ruapuke I.), cliff slopes, western side of island, *B.A. Fineran*, 9 Mar 1965; CHR 148745 Centre I., *G.I. Collett*, Mar 1964. * These two specimens show slight signs of introgression by part of the *P. carnosa* genome (see below).

DISTRIBUTION: South-western Fiordland, south coast of Southland and islands in Foveaux Strait, south-eastern Otago (Fig. 6).

HABITAT: Coastal, on rock outcrops, cliffs, sand dunes.

CONSERVATION: The remoteness of some locations for this subspecies and its presence in Fiordland National Park should ensure its protection. A survey of its present situation is needed as it is not well known.

ILLUSTRATIONS: None known.

HYBRIDS: Crossing is recognised between *P. prostrata* subsp. *ventosa* and each of subsp. *prostrata*, *P. carnosa* (X), and *P. lyallii*.

Subtle hybrid patterns are evident for subsp. *ventosa*. The northernmost known location in Fiordland for plants of this subspecies in pure form is at Five Fingers Peninsula (45°35'S). In northern Fiordland at Martins Bay (44°24'S) and in numerous Westland locations north of that, at least to Greymouth, are plants closely resembling subsp. *prostrata* in leaf and plant size. Their receptacles are not very hairy. However, they bear some features like those of subsp. *ventosa* (muricate stem patterning, relatively abundant internode hair). The node buttress types are variable. In some plants they are elongate, in others lunate. A few individuals have been seen with leaves similar in size to those of subsp. *ventosa* from southern Fiordland (e.g., CHR 177159 Cook River flats, South Westland, near Trig JD, pioneer vegetation on riverbed, *J. Fryer*, 11 Dec 1967).

These Westland patterns are interpreted as representing long-term introgressive hybridisation between subsp. *ventosa* and subsp. *prostrata*. Although part of the subsp. *ventosa* genome is



Fig. 11 Holotype of *Pimelea prostrata* subsp. *ventosa* (CHR 90403). Each piece is regarded as an element of the holotype. (Image by courtesy of the Allan Herbarium, CHR, 2008).

evident in the Westland plants it is as though the subsp. *prostrata* genome has gained the ascendancy (possibly because only a small population of subsp. *ventosa* was originally present in northern Fiordland).

On the eastern Southland coast, and on a few islands in Foveaux Strait, some individuals in collections have leaf and whole plant sizes like those of subsp. *prostrata* plants in inland Southland. However, they have muricate stem patterns, hairy internodes, and lunate node buttresses, but not very hairy receptacles. These phenomena are interpreted

in a similar way to those in Westland. The identity of the subsp. *ventosa* genome has largely been “swamped” through the presence of abundant subsp. *prostrata* plants. Unadulterated subsp. *ventosa* is confined mainly to south-western Fiordland, with a few representatives in coastal Southland and on Foveaux Strait islands.

As these introgressed plants in Westland and eastern Southland and adjoining localities closely resemble subsp. *prostrata* they are listed with other members of that taxon, among the representative specimens. All are coastal or near-coastal and they

live on the same kinds of substrates as does subsp. *prostrata* on the east side of the South Island.

In the Southland-South Otago-Stewart I. coastal region a further pattern is the presence of plants like subsp. *ventosa*, but having some hairs on the abaxial leaf surfaces. Examples are: CHR 320120 False Islet, southeast Otago, sand dune, *P.N. Johnson*, 10 Oct 1977; CHR 91783 Chalky Inlet, *H.H. Allan*, 30 Jan 1946; CHR 594377a and b Te Whara Beach,

Preservation Inlet, sand dunes 8 m, *K. Morrison*, 29 Mar 1982; CHR 111442 Ocean Beach, south of the Neck, Stewart I., cliffs, *M.E. Gilham*, 8 Feb 1957; CHR 78062 Tikotatahi Inlet, Stewart I., coastal rocks, *J.F. Findlay*, 29 Dec 1951. These are assumed to be the result of occasional crossing of subsp. *ventosa* with the hairy-leaved sand dune species, *P. lyallii*. At False Islet and Preservation Inlet the two taxa live side by side.

Key to the subspecies of *Pimelea prostrata*

- | | Subspecies |
|---|------------------|
| 1. Node buttresses elongate to full internode length; young stems glabrous to moderately hairy | 2 |
| Node buttresses lunate; young stems relatively densely hairy | 4 |
| 2. Leaf tips obtuse, leaves flat..... | <i>prostrata</i> |
| Leaf tips acute, leaves slightly keeled | 3 |
| 3. Secondary lateral branches short, not conspicuous; true leaves up to 6 mm long, 1.2–2 mm wide..... | <i>vulcanica</i> |
| Secondary lateral branches longer, prominent; true leaves up to 8 mm long, 2–3 mm wide... | <i>thermalis</i> |
| 4. Leaf tips acute; stems of middle age smooth | <i>seismica</i> |
| Leaf tips obtuse; stems of middle age muricate | <i>ventosa</i> |

Incertae sedis and an illegitimate name

The taxonomic position of some named *Pimelea prostrata*-like plants remains unresolved despite careful search in herbaria at BM, K, and in New Zealand. No reference specimen has been found for *Pimelea prostrata* var. *repens* Hook.f. (1853). No Colenso specimen labelled *P. bicolor* (from “open spots, Taupo, County of East Taupo”, Colenso 1889) has been seen. In his paper describing *P. heterophylla*, Colenso (1890) remarked that the latter (from “high up on Mount Ruapehu”) was “closely allied to *P. bicolor* Colenso”. In the present paper, *P. heterophylla* is regarded as a synonym for *P. prostrata* subsp. *vulcanica*. Without further evidence nothing more can be done about *P. prostrata* var. *repens*, and *P. bicolor*.

In the present context, specimens in Cheeseman’s herbarium at AK under the name *P. prostrata* var. *repens* are placed in three of the *P. prostrata* subspecies, *prostrata*, *vulcanica*, and *thermalis*. Cheeseman’s use of the varietal epithet *repens* was illegitimate because of its prior use by Hooker; the taxon is not typified here.

7. *Pimelea orthia* C.J.Burrows & Thorsen, sp. nov.

= *P. laevigata* var. *erecta* Cheeseman *Man. N.Z. Flor.*, 613, (1906). Lectotype (chosen here): AK 5407 (see below).

DIAGNOSIS: Haec species a ceteris speciebus *Pimeleae prostratae* affinis distinguitur, statura ampliore, ramulis rectis primariis rigide erectis vel divergentibus vel prostratis et praeditis ascendentibus gracilibus, longis vel brevibus ramulis lateralibus et foliis relative tenuibus ellipticis plerumque late dissitis et patentibus.

This species is distinguished from others in the *Pimelea prostrata* species complex by its larger size, stiffly erect or divergent to prostrate, straight main branches, with thin, long to short, ascendant lateral branches and relatively thin, elliptic, usually widely spaced, patent leaves.

HOLOTYPE: Auckland Museum, Tamaki Paenga Hira, Cheeseman Herbarium AK 5407 Avondale, near Auckland, *T.F.C.* [*T.F. Cheeseman*] no date. The four pieces on the sheet are all regarded as elements of the holotype (Fig. 12).



Fig. 12 Holotype of *Pimelea orthia* n. sp. (AK 5407). (Image by courtesy of the Auckland Museum, AK, and Allan Herbarium, CHR, 2008).

ETYMOLOGY: From Greek “orthos” (straight), referring to the erect or divergent to prostrate, straight leading stems.

DESCRIPTION: Fastigate to bushy, few to much-branched shrubs, up to 90 cm tall, often shorter, with relatively few, stiffly erect or divergent to prostrate, straight main branches and thin, usually ascendant, lateral branches of varied form. On different plants these may be short and straight, long and straight, or short and repeatedly sympodially branched. Young branchlets clad in

sparse to moderately dense, appressed, grey-white, short, silky hair; internodes 0.5–2.5 mm, older stems glabrous, grey or brown (bark wrinkled on dried specimens). Node buttresses brown, extending part way down or the full length of the internode, not very prominent on leafless stems. Leaves decussate, ascendant, then patent or deflexed, on short (0.5 mm) red petioles, often persistent. Lamina flat to slightly keeled, relatively thin, 5–8 × 2–3 mm (smaller on lateral branchlets), elliptic or ovate, glabrous, glaucous or pale green,

acute, but tip blunt, or obtuse. Stomata abundant on adaxial and abaxial sides.

Inflorescences terminal on main stems or lateral branchlets, 2–12-flowered, loose. Involucral bracts 4, similar in size to adjacent leaves or slightly wider (7 × 3 mm), partly hiding the flowers. Receptacles moderately hairy. Plants gynodioecious. Flowers white on short pedicels (0.8 mm); outside of tube and calyx lobes moderately hairy; inside hairy in upper tube and ovary portion. ♀ tube 2 mm long, ovary portion wrinkled, 1.7 mm long, calyx lobes 1.2 × 1 mm; ♂ tube 3.2 mm long, ovary portion 1.5 mm, calyx lobes 2.7 × 1.4 mm. Anther dehiscence semilatorse. Ovary summit sparsely hairy. Fruits fleshy, ovoid, white, opaque, 5 × 2.9 mm. Seeds broad-ovoid 2.1 × 1.4 mm. Crest thin. Flowering time spring-summer.

DISTRIBUTION: North Auckland: scattered localities from Mangonui to Auckland City. South Auckland-King Country, Coromandel Peninsula, eastern Bay of Plenty. Gisborne-East Cape and near Ngatapa. Hawke's Bay-Mahia Isthmus. There are two subspecies.

7a. *Pimelea orthia* C.J.Burrows & Thorsen subsp. *orthia*

DESCRIPTION: A medium-sized fastigiate shrub, to 80 cm tall, main stems sympodial, erect and straight, with many short or long lateral branches (Fig. 12, 13). Chromosomes: no counts known.

REPRESENTATIVE SPECIMENS: NORTH AUCKLAND AND AUCKLAND CITY: CHR 91770 Ninety Mile Beach, near Waipapakauri, *H.H. Allan*, 12 Dec 1941; AK 216127 Tokerau Beach, Karikari Pen., scrubland, *A.E. Esler, G.B. Rawlings*, 20 Dec 1974; AK 130901 Whangaroa c. 10.5 km due west of Kaeo, *A.E. Orchard*, 14 Oct 1972; AK 138092 Kawerua [N of Waipoua] coastal bank below Kawerua Hut, *A.E. Wright*, 2 Jan 1975; CANU 9249 Araparera, Kaipara Harbour, *L.B. Moore*, 25 Nov 1964; CHR 214265 Waikere Lake, SW of Kaihu, 80 m, relic gumland scrub, *R. Mason, A.E. Esler*, 23 Nov 1970; AK 120199 Okahukura Pen. [Kaipara], *R. Cooper*, 12 Nov 1965; CHR 214140 Pouto, Kaipara Harbour, roadside scrub, *R. Mason, A.E. Esler*, 20 Nov 1970; AK 172953 Te Hana-Tomarata Rd [N of Wellsford], 60 m, on roadside among kumarahou, manuka, straggly bushes about 60 cm tall, *M.E. Young*, 20 Oct 1985; CHR 331094 New Lynn, Auckland, *H. Carse*, 27 Nov 1921. COROMANDEL: CHR 480534 Opito Point, greywacke cliff, *P.J. de Lange, G.M. Crowcroft*, 21 Sep 1992. KING COUNTRY-BAY OF PLENTY:

AK 91241 Kopaki, near Te Kuiti, 185 m, *P. Hynes*, 17 Nov 1962; AK 180732 North end of Waihi Beach, coastal cliff, manuka, *D.J. Court*, 20 Feb 1977; CHR 368633 Wainui, Ohiwa Harbour near Opotiki, roadside bank near oyster farm, *M. Heginbotham*, Aug 1975; CHR 115663 Oruaiti Point, erect in rough grass, *L.B. Moore*, 19 Aug 1960; CHR 192472 Whanarua Bay, coastal rocks, *A.P. Druce*, Feb 1969. GISBORNE: CHR 418057 East Cape, Te Araroa, Te Okauwhenetua high marine terrace, *S. Courtney*, 26 Jan 1984; CHR 171009 Eastwood Hill, near Ngatapa, *W.R. Sykes*, 30 Mar 1966.

DISTRIBUTION: North and South Auckland including King Country, Coromandel, eastern Bay of Plenty-East Cape and Gisborne (Fig. 14).

HABITAT: Usually on leached, infertile soils on sites with an open cover of *Leptospermum scoparium* scrub. Sometimes in grassland, or on dunes.

ILLUSTRATIONS: None known.

HYBRIDS: Crossing is recognised between *P. orthia* subsp. *orthia* and each of *P. prostrata* subsp. *thermalis*, *P. xenica* (X), *P. carnososa* (X), and *P. sporadica* (X). A specimen FRINZ 2799 Waipoua [North Auckland] *K.M. Bibby*, 16 Dec 1949 is considered to be the result of a cross between *P. orthia* and *P. prostrata* subsp. *thermalis*. This appears to be an uncommon natural hybrid.

NOTE: The earlier-gathered specimens of *P. orthia* subsp. *orthia* (18th, 19th, and early 20th centuries, almost all from near Auckland City or further north) appear relatively uniform. Some relatively recently gathered specimens are more variable, probably because there has been introgressive hybridisation with other entities. No absolutely indisputable specimens of *P. orthia* from the North Cape area have been seen by me. However, some of the hybrid specimens from there indicate that it was formerly present.

7b. *Pimelea orthia* subsp. *protea* C.J.Burrows & Thorsen, subsp. nov.

DIAGNOSIS: Differt a subsp. *orthia* in habitu varianti et semper in locis arenosis reperta.

Differs from subspecies *orthia* by its varied growth habit and its restriction to sand dune habitats.

HOLOTYPE: CANU 38899 Mahanga Beach, Mahia Isthmus, 12 m, on stable, well-vegetated sand dunes, *C.J. Burrows*, 18 Jan 2009 (Fig. 15).

ETYMOLOGY: From Greek “Proteus” (mythical figure who could change his shape).

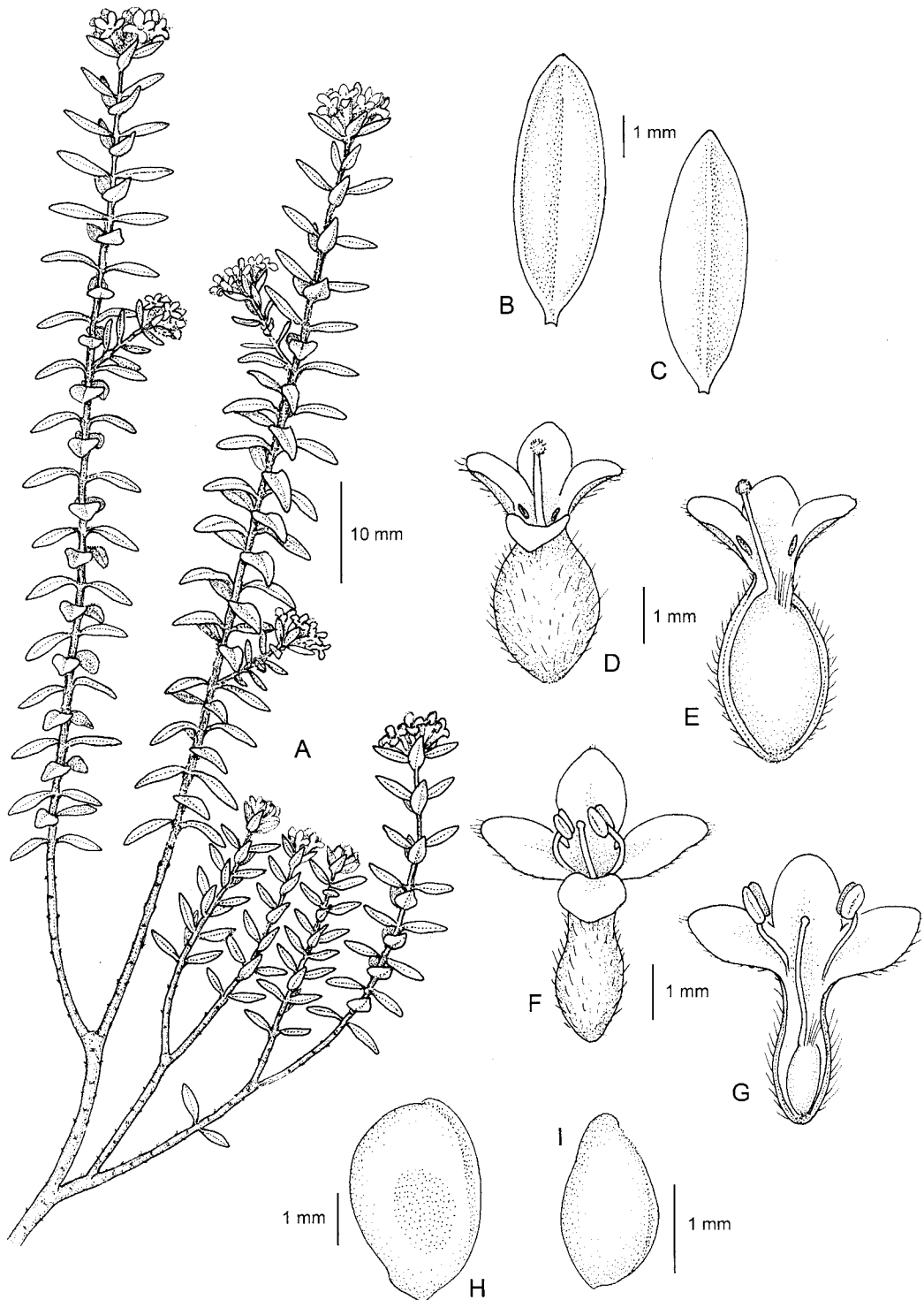


Fig. 13 Habit drawing of *Pimelea orthia* subsp. *orthia* and detail of organs: **A**, branch habit; **B**, leaf adaxial; **C**, abaxial; **D**, ♀ flower; **E**, ♀ flower cut away; **F**, ♀ flower; **G**, ♀ flower cut away; **H**, fruit; **I**, seed. Ink drawing by Rebecca Wagstaff, 2008.

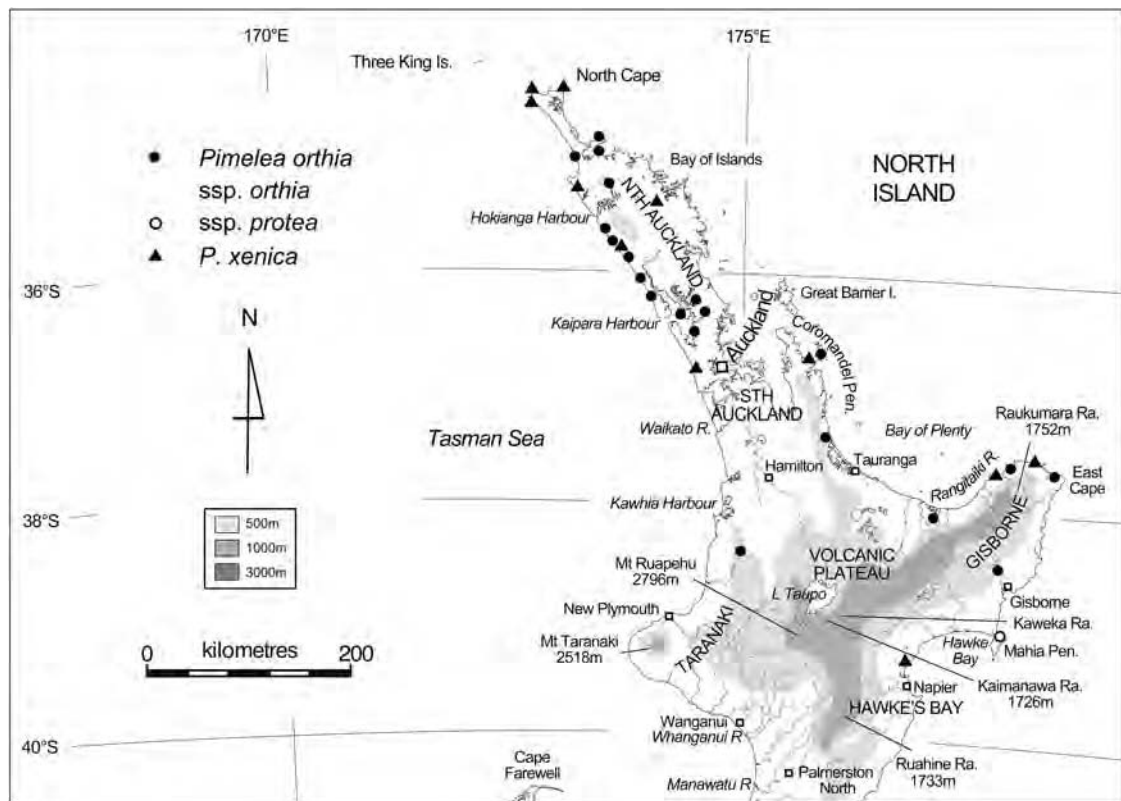


Fig. 14 Distribution map for *Pimelea orthia* and *P. xenica*.

DESCRIPTION: A small to medium-sized, much branched shrub 15–90 cm tall. Leading stems may all be erect on some plants, or erect and also divergent to prostrate around the periphery on others. Terminal, repeatedly sympodial branchlets occur on some plants. In exposed sites, plants are small, low bushes with straight or sometimes crooked, prostrate branches. Chromosomes: no counts known.

REPRESENTATIVE SPECIMENS: HAWKE'S BAY: CHR 572600 Mahanga Beach, Mahia Peninsula, *M. Thorsen*, 10 Dec 2002; CHR 572598b Pukenui Beach, *M. Thorsen*, 19 Aug 2003.

DISTRIBUTION: Mahanga, at the north-west end of the Mahia Isthmus; Pukenui Beach, further east along the isthmus (Fig. 14).

HABITAT: Stable sand dunes with *Ammophila arenaria*, *Spinifex sericeus*, *Lagurus ovatus*, *Cortaderia* sp., *Isolepis nodosa*, *Hypochaeris radicata*, rare *Leptospermum scoparium*, and scattered young *Pinus radiata*.

CONSERVATION: Many old herbarium specimens for *P. orthia* subsp. *orthia* indicate that its area has shrunk drastically in the past century. It is severely threatened by land development and may be on the verge of extinction. Diligent searching is needed to discover and foster remaining populations. If some good populations of *P. orthia* subsp. *orthia* still exist in Northland and eastern Bay of Plenty-Gisborne, they should be protected very carefully. The Mahia populations (subsp. *protea*), likewise, need protection though they appear to be relatively numerous and regenerating. Specimens could be propagated and planted out in sites where they would not be contaminated by crossing with other species.

ILLUSTRATIONS: None known.

NOTE: During field excursions in Auckland province in 1997 and 2008, no live *P. orthia* subsp. *orthia* plants were seen by me and no habit/habitat photograph is available.



Fig. 15 Holotype of *Pimelea orthia* subsp. *protea* (CANU 38899). (Image by courtesy of the Allan Herbarium, CHR, 2009).

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Key to the *Pimelea orthia* subspecies

Subspecies

- 1. Main stems relatively straight, erect, to 80 cm tall; lateral stems long and erect or short and ascendant; habitat infertile, mature, consolidated soils *orthia*
- Main stems straight, erect, to 90 cm tall, or divergent to prostrate; stems long or short and ascendant; habitat relatively unconsolidated sand (may be wet in winter) *protea*

Fig. 16 Holotype of *Pimelea xenica* n. sp. (CHR 130616). (Image by courtesy of the Allan Herbarium, CHR, 2007).



8. *Pimelea xenica* C.J.Burrows, sp. nov.

DIAGNOSIS: Planta erecta relative humilis, differt a *P. orthia* ramulis primariis brevioribus infirmioribus gracilioribus, foliisque minoribus ascendentibus imbricatis. Folia involuta ubi sicca notabilia sunt. A *P. actea* differt floribus femineis hermaphroditisque in eadem planta repertis.

This erect but relatively low-growing plant differs from *P. orthia* by its shorter, weaker, more slender leading branches and its smaller, ascendant, imbricate leaves. Often inrolled leaves, when dry, are

a unique feature. From *P. actea* it differs by having both female and hermaphrodite flowers.

HOLOTYPE: CHR 130616 Above Waipoua Bay [W coast North Auckland] podsolised sandy clay, low scrub, *Leptospermum*, *R. Melville* (5254) [and *L.B. Moore*], 8 Nov 1961 (Fig. 16).

ISOTYPE: Herbarium Kewense, Flora of New Zealand, K356732 Above Waipoua Bay, podsolised sandy clay, low scrub, *Leptospermum*, *R. Melville* (5254) and *L.B. Moore*, 8 Nov 1961.



Fig. 17 Habit and habitat photograph of *Pimelea xenica*, above Te Werahi Beach, near Cape Reinga. (C. J. Burrows, Aug 1997)

ETYMOLOGY: From Greek “xenos” (strange, foreign), referring to the previous lack of recognition of the plant.

DESCRIPTION: A moderately small, erect or suberect shrub, to 30 cm high, stems gracile, fastigiate to sprawling. Branching mainly sympodial with some diffuse lateral. Branchlets moderately densely covered by short to long, greyish-white hair. Internodes 0.5–1.2 mm long. Node buttresses short (0.1–0.8 mm), brown, lunate to slightly elongate, usually visible on young branchlets but not prominent on leafless stems. Older stems glabrate, grey or grey-brown. Leaves decussate, ascendant to patent, on short (0.2–0.5 mm) red petioles. Lamina thin, pliable, with a thickened margin, elliptic to ovate, 4–5.5 × 1.5–2.2 mm, pale green or glaucous, keeled and adaxially concave (dry leaf margins are often curled inward), midvein not plainly evident abaxially, obtuse or acute, base cuneate. Stomata abundant on adaxial and abaxial sides.

Inflorescences terminal on branchlets, 3–5-flowered. Involucral bracts 4, broader than adjacent

leaves (4 × 3 mm), partly hiding the flowers. Receptacles sparsely hairy, pedicels 0.3 mm. Plants gynodioecious. Flowers white, opening in salverform fashion, sparsely covered in short hair outside, inside hairy in upper tube and sparsely so in ovary portion. ♀ tube 3 mm long, ovary portion wrinkled, 2.4 mm long, calyx lobes 1.5 × 1.3 mm; ♂ tube 4 mm long, ovary portion 1.5 mm, calyx lobes 1.8 × 1.5 mm. Anther dehiscence semi-latorse. Ovary with sparse hair on summit and a few short hairs below that. Fruits sub-globose to oblate, fleshy, white, translucent, 5 × 4 mm. Seeds ovoid 2.1 × 1.7 mm, thin crest (Fig. 17, 18). Flowering time spring-summer-autumn. Chromosomes: $2n = 36$ (Dawson & Beuzenberg 2000, p. 8, as *P. “Reinga”*).

REPRESENTATIVE SPECIMENS: NORTH AUCKLAND: CHR 525117 Surville Cliffs, North Cape, *M. Heads*, 5 Oct 1996; CANU 10853 Cape Reinga, coastal scrub, sea level, *M.T. Kalin*, 5 Feb 1967; CANU 38880 Te Werahi Beach, 50 m, bare area on hillside, with manuka scrub, *C.J. Burrows*, Aug 1997; CANU 38843 Gumfields Rd, near Ahipara,

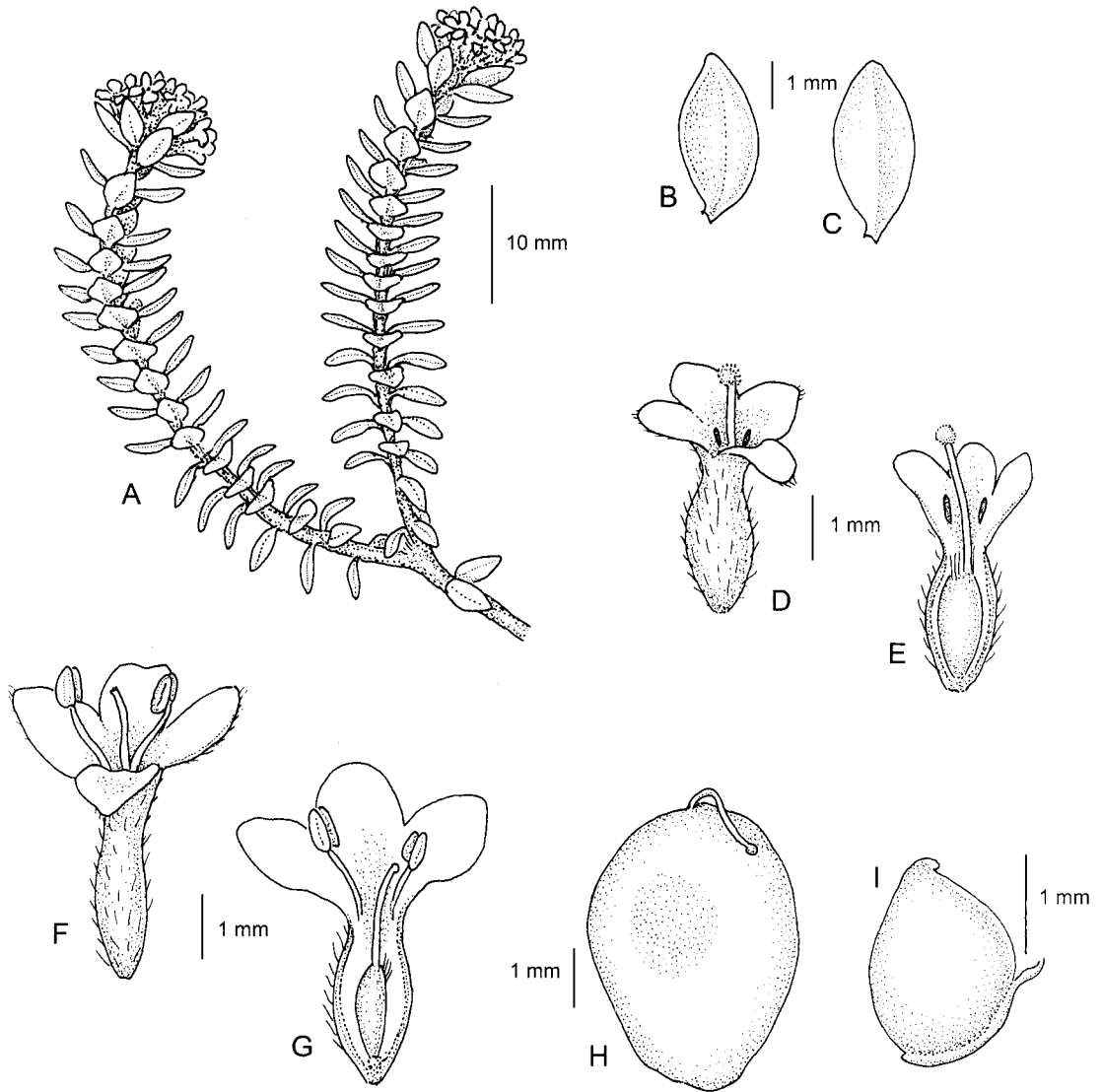


Fig. 18 Habit drawing of *Pimelea xenica* and detail of organs: **A**, branch habit; **B**, leaf adaxial; **C**, abaxial; **D**, ♀ flower; **E**, ♀ flower cut away; **F**, ♀ flower; **G**, ♀ flower cut away; **H**, fruit; **I**, seed. Ink drawing by Rebecca Wagstaff, 2008.

boggy area with short manuka, sedge, c. 200 m, *C.J. Burrows*, Aug 1997; CHR 91207 Hill west of Whangaroa, *H.H. Allan*, 10 Dec 1941; AK 44766 Anawhata Rd, c. 154 m a.s.l., *H.E. Powell*, 2 Jan 1950. SOUTH AUCKLAND: CHR 92927 Kuaotunu Bay, Coromandel, on rock platform, *H.H. Allan*, 22 Jul 1940; CHR 192372 Papatea Bay, Bay of Plenty, coastal rocks, *A.P. Druce*, Dec 1969; GISBORNE: CHR 192385 near Lottin Point [Hicks Bay area], coastal rocks, *A.P. Druce*, Dec 1967. HAWKE'S

BAY: CANU 38847 Tangoio, grassy area, roadside bank, *C.J. Burrows*, Aug 1973.

DISTRIBUTION: North Auckland, scattered locations from Cape Reinga and North Cape south to Anawhata. South Auckland, Coromandel, and eastern Bay of Plenty. Gisborne, near East Cape; Hawke's Bay, Tangoio (Fig. 14).

HABITAT: Low heathland with short *Leptospermum scoparium*, *Leucopogon fasciculatus*, *Ozothamnus*

leptophylla, *Baumea* spp., *Phormium cookianum*, *Hebe* sp., grassy slopes, open banks with bare soil, rock outcrops. Mainly coastal or near-coastal but sometimes further inland.

CONSERVATION: A population very close to the Cape Reinga visitor centre has been destroyed by recent road works. The present situation is not known for other locations. A thorough field survey is needed.

ILLUSTRATIONS: None known.

HYBRIDS: Crossing is recognised between *P. xenica* and each of *P. prostrata* subsp. *seismica*, subsp. *thermalis*, *P. orthia*, *P. carnosa* (X), and *P. sporadica* (X). Near Cape Reinga (two undisturbed locations) *P. xenica* meets *P. prostrata* subsp. *seismica*. The hybrids are prostrate, with ascendant, inrolled leaves on the dried specimens (e.g., CANU 38882 Tapotupotu Bay, near Cape Reinga, steep grassy bank above the sea, C.J. Burrows, Aug 1997). The *Pimelea* populations near North Cape contain some individuals that have few, stiffly erect, sparsely hairy branchlets and ascendant, inrolled leaves, like those of *P. xenica*. They are assumed to be hybrids of *P. xenica* with *P. orthia* (although no specimens of the latter have been seen from the area). An example is CHR 326186 Surville Cliffs, NW of North Cape, 150 m, A.P. Druce, Apr 1979.

At Tangoio, Hawke's Bay, a population of *P. xenica* plants included one large, prostrate individual with ascendant, slightly inrolled leaves and lateral branches with many secondary branchlets (CANU 38854 Tangoio, Hawke's Bay, grassland in small valley near the sea, C.J. Burrows, Aug 1973). This appears to be a hybrid of *P. xenica* with *P. prostrata* subsp. *thermalis*. The leaves are relatively uniform in size, the largest 5 × 2.5 mm.

NOTE: Live specimens of *P. xenica* have concave or slightly keeled to flat leaves. It is only when they are dry that the peculiar inward curling of leaf margins occurs. This species has withstood relatively severe frost in cultivation in a shade house in Christchurch. It is amenable to propagation by cuttings and can be grown in pots (C. J. Burrows unpubl. data).

History of the *Pimelea urvilliana* species complex

Plants described as *P. urvilliana* were gathered during the voyage of the French naval expedition in *l'Astrolabe* (1826–29) under the command of J. S. C. Dumont D'Urville. The botanists included Dumont D'Urville himself, and P. A. Lesson. The botany was written up by A. Richard (1832).

Pimelea specimens from the voyage are housed at the Museum d'Histoire Naturelle in Paris and are labelled *Astrolabe*. Landings were made in Tasman Bay, (Nelson); D'Urville Island near French Pass; Tolaga Bay (Gisborne); Auckland, at the Tamaki Isthmus; Whangarei; Bay of Islands (Dumont D'Urville 1834; Cheeseman 1925).

Tasman Bay, near modern Marahau, is the type locality for *P. urvilliana* as noted by Richard (1832) (cf. Appendix 4) but none of the specimens from the Paris herbarium that I have seen mentions that location. Richard also noted that *P. prostrata* was gathered in the same region. He hinted about uncertainty that *P. urvilliana* and *P. prostrata* were distinct. This may have been because hybrids between the two were present in the area. Some *Astrolabe* specimens at Paris appear to represent such crosses (details are provided below). Specimens of *P. urvilliana* were, however, also gathered at the Bay of Islands, Northland, during the *Astrolabe* expedition. Although J. D. Hooker may have seen the *Astrolabe* material, there is no indication that any New Zealand-based systematists have examined the single, unequivocal *Astrolabe* expedition *P. urvilliana* specimen in the Paris herbarium that could have come from Tasman Bay. All reference to the taxon *P. urvilliana* in the present account from now on is related to that specimen (P 579150) (Fig. 19) or to other closely similar specimens (e.g., Fig. 20).

The subsequent history of *P. urvilliana* in the taxonomic literature has been alternation between acceptance of the species (e.g., by Raoul 1846; Hooker 1867; Cheeseman 1906, 1925; Parsons et al. 1995, the last of these, albeit, in error) and its relegation to being a variety of *P. prostrata* (Meisner 1857; Allan 1961). However, Allan merely listed *P. urvilliana* among many unresolved forms. In the time since Hooker's 1867 account, the details of the descriptions indicate that the identity of *P. urvilliana* s.s. often was being conflated with those of one or more other entities.

Taxonomy of the *Pimelea urvilliana* species complex

9. *Pimelea urvilliana* A. Rich. *Essai Fl. N.Z.* 175 (1832)

≡ *Pimelea prostrata* var. *urvilliana* (A. Rich.) Meisn. in D.C. *Prodr.* 14, 517 (1857).

LECTOTYPE (chosen here): Museum de Histoire Naturelle, Paris, Herbarium A. Richard (Herbier E. Drake) P 579150 *Pimelea urvilliana* nob., Nlle Zelande (*Astrolabe*)! (Fig. 19).

Fig. 19 Lectotype of *Pimelea urvilliana* subsp. *urvilliana* (P 579150). (Loan by courtesy of the Museum de Histoire Naturelle, Paris; image by courtesy of the Allan Herbarium, CHR, 2007).



TYPIIFICATION: Information relevant to the typification and definition of this species is included in the history section above. The lack of locality information is disconcerting, but P 579150 has on its label all of the other critical information; it is an *Astrolabe* specimen, from Richard's herbarium, and beside the name *Pimelea urvilliana* is nob. [= nobis, "to us", indicating Richard's responsibility for the name]. It is assumed here to be the specimen cited by Richard in the protologue as having been gathered in Tasman Bay.

Three other *Astrolabe* specimens from Herb. Mus. Paris are also without locality details (1. Herb. Richard *Pimelea prostrata* Willd., Nlle Zelande, D'Urville; 2. *Pimelea prostrata* Vahl, Nlle Zelande, Voy. de l'Astrolabe 1826–1829, M.A. Lesson; 3. *Pimelea prostrata* Vahl, Nlle Zelande (Astrolabe)). These all appear to be *P. prostrata* subsp. *prostrata* × *P. urvilliana* hybrids. They will be discussed below. A battered specimen from G. Forster's collection in Paris, P 579158, labelled *Banksia prostrata*, also appears to be a *P. prostrata* subsp. *prostrata* ×

Fig. 21 Specimen of *Pimelea urvilliana* subsp. *nesica* gathered by J. Banks and D. Solander from an unknown New Zealand locality in 1769 (Herb. Montin S07-3109). (Image by courtesy of the Naturhistoriska Riksmuseet, Stockholm, 2007).



in the North Island (possibly on an offshore island). The Stockholm specimen was acquired by G. Forster and eventually obtained by Montin (who died in 1785). Various Forster specimens of *P. prostrata* have the same formulaic habitat notation on the sheets. In this case it was taken from Forst. f. (1780) by Montin. These words do not necessarily mean that the plant grew high on mountainsides. All other indications are that both of the *P. urvilliana* subspecies are coastal plants. Specimens from mainland New Zealand and nearby

islands (subsp. *urvilliana*) are relatively uniform. Offshore island plants (subsp. *nesica*) are more variable. Some of them grow on relatively high cliffs and ridges.

The features that distinguish *P. urvilliana* s.s. from *P. prostrata* subsp. *prostrata* are the former's notably sympodial branching; thicker, though flexible young stems, with a dense cover of long white hair; relatively elongated, thicker, slightly keeled, stiff leaves maintained in patent, somewhat distichous ranks and with stomata only on the adaxial side

(sometimes a few abaxially); lunate node buttresses; very hairy receptacles and densely hair-covered outside of flower tubes and calyx lobes. Similar in leaf form to *P. urvilliana* is *P. sporadica*, which, however, has an erect habit and clearly evident decussate leaf arrangement, but not such dense hair on its young stems.

DESCRIPTION: A small to medium-sized, prostrate to decumbent shrub. Stems slender to moderately stout but flexible, up to 40 cm long, ridged when dry. Branching is notably sympodial but there are also long laterals. Branchlets moderately to very densely covered in long, matted, white hair. Internodes on young branchlets 1–5 mm long. Older stems slightly hairy, grey-brown. Node buttresses short (0.3 mm), smooth, black, lunate, masked by hair on young stems, not very prominent on leafless stems. Leaves decussate, but arranged somewhat distichously in appressed plants, ascendant near branchlet tips though relatively distant, patent to deflexed below, on short (0.5 mm) petioles. Lamina 4–8 × 2.5–4 mm, glabrous, thick (almost fleshy) or thinner, medium to light green, glaucous, narrow to broad ovate or oblong, flat to adaxially concave or slightly keeled, with slightly upturned margins. Midrib and lateral veins obscure abaxially, tip obtuse or sometimes acute, base cuneate. Stomata abundant adaxially, none to few, and sunken abaxially.

Inflorescences 5–12-flowered, terminal on branchlets, compact, receptacles very hairy. Involucral bracts 4, similar in size to adjacent leaves, or longer (6 × 4 mm). Plants gynodioecious. Flowers small, white, on very short (0.2 mm) persistent pedicels, very hairy outside, inside sparsely hairy in upper tube and ovary portion; lobes open in salverform fashion. ♀ tube 1.8–3 mm long, ovary portion 2.0–2.5 mm, calyx lobes 1.3 × 0.9 mm; ♂ tube 3.4–3.8 mm long, ovary portion 2–2.5 mm, calyx lobes 2 × 1.6 mm. Stamens on short filaments, fixed near mouth of tube, anther dehiscence semi-latrorse. Ovary with dense tuft of long hair at summit. Fruits fleshy, obovate or sub-globose, white, opaque 5 × 4 mm. Seeds ovoid 1.8–2.5 × 1–1.8 mm, thin crest.

DISTRIBUTION: North Island on the coast of eastern North Auckland (now rare or possibly extinct, but with the genome represented in hybrid populations); near-coastal islands; further offshore islands of eastern North Auckland, Hauraki Gulf, eastern Coromandel, and western Bay of Plenty; rare on mainland Coromandel and eastern Bay of Plenty. On the coasts of Taranaki and Hawke's Bay the genome of the species is now represented only in

hybrid populations. South Island: Tasman Bay and Queen Charlotte Sound, extinct.

There are two subspecies.

9a. *Pimelea urvilliana* A. Rich. subsp. *urvilliana*

DESCRIPTION: A small to medium-sized prostrate shrub; stems moderately stout but flexible, up to 30 cm long. Branching notably sympodial with some laterals. Branchlets densely covered by matted white hair. Internodes 1–3 mm long. Older stems slightly hairy, grey-brown. Node buttresses smooth, black, lunate, masked by hair on young stems. Leaves decussate but usually distichously arranged, ascendant on youngest branchlets, patent later. Lamina 3–6 × 2–3 mm, thick, narrow-elliptic to ovate, flat or slightly keeled. Tip usually obtuse. Stomata abundant adaxially, none or rare abaxially. Abaxial surface glistens.

Inflorescences 5–7-flowered compact, receptacles very hairy. Involucral bracts 4, similar in size to adjacent leaves. Plants gynodioecious. Flowers small, white, outside very hairy, inside sparsely hairy in upper tube. Calyx lobes opening in salverform fashion or ascendant. ♀ tube 1.8 mm long, ovary portion wrinkled, 1.5 mm, calyx lobes 1.2 × 1 mm. ♂ tube 3.8 mm long, ovary portion 2.5 mm, calyx lobes 2 × 1.5 mm. Anther dehiscence semi-latrorse. Ovary with a tuft of long hair on summit. Fruits white, fleshy, opaque 5 × 3.5 mm. Seeds broad ovoid 3 × 1.8 mm. Flowering time summer. Chromosomes: no records known.

REPRESENTATIVE SPECIMENS: 19th century: Royal Botanic Gardens, Kew (K), H 2007/01531, 17, Mt Egmont [1840]. [*E.*] *Dieffenbach!* [Dieffenbach was in New Zealand 1839–41]; Herb. Mus. Paris (P) (Ex Herb. Hook.) Hab. Nov Zelande, coll. J.D.H. [*J.D. Hooker*—Bay of Islands 1841!]; Herb. Mus. Paris (P), Nlle Zelande, collection donne par Sir William Hooker 1854 [Bay of Islands where J. D. Hooker collected in 1841!]; Herb. Mus. Paris, Nouvelle Zelande, Baie des Iles, M.[*E.*] *Raoul*, 1843; AK 15052 Paku, [Tairua], *J. Adams*, [late 19th century].

20th century: NORTH AUCKLAND: AK 44769A near Maukins Nook [S of North Cape], 92 m, *H.E. Powell*, Jan 20 1950; AK 101716 Cavalli Islands, *A.T. Pycroft*, Jan 1932; AK 149390 Cavalli Islands, scattered plants appressed to ground, along summit of northern cliffs, *A.E. Wright*, 28 Dec 1978; CHR 83631 Wainui Beach, Whangaroa County, coastal rock, *L.B. Moore*, 28 Dec 1953; WELT 15197 Long Beach, Bay of Islands, coastal rocks, *W.R.B. Oliver*, 3 Dec 1911; AK 194534 Rat

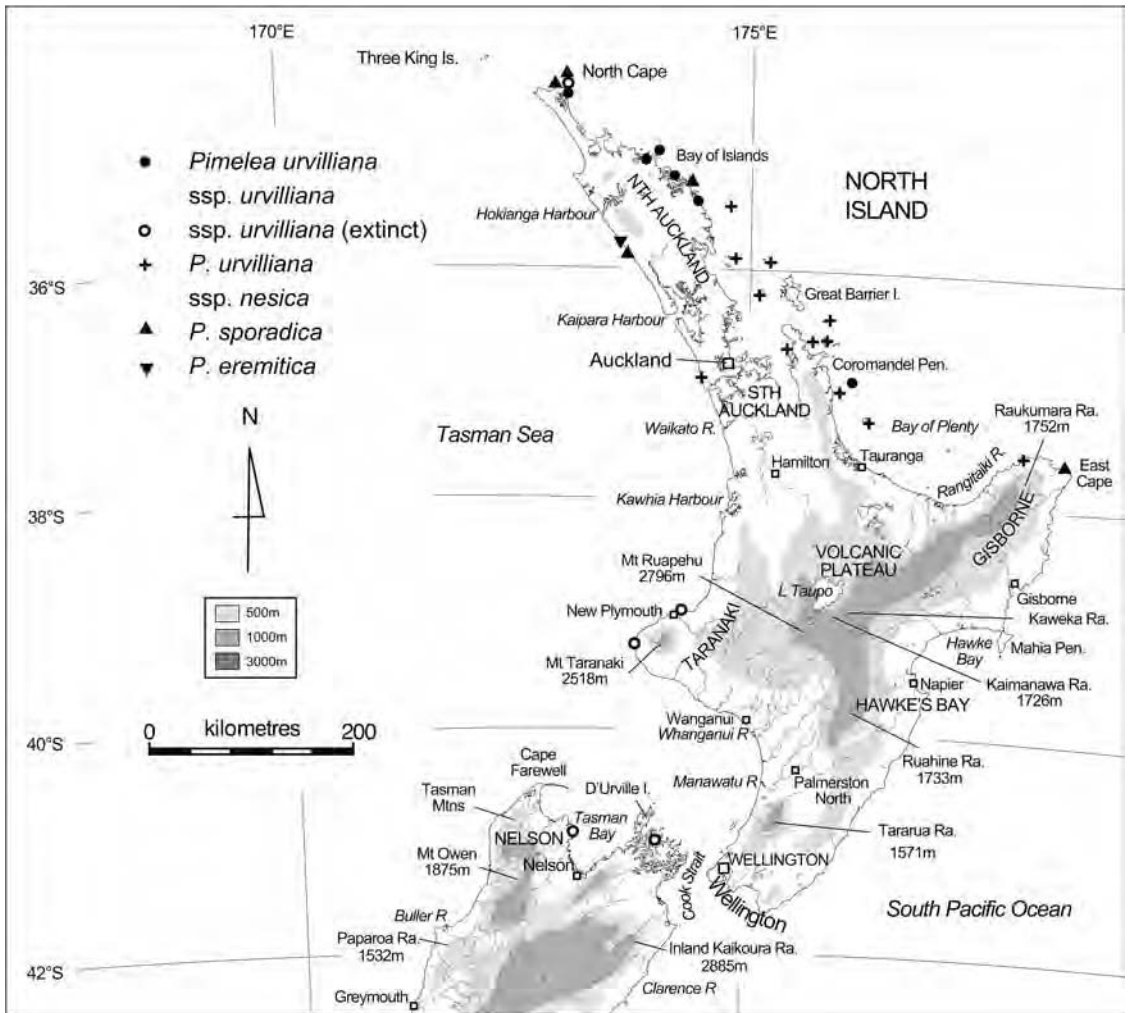


Fig. 22 Distribution map for *Pimelea urvilliana* subsp. *urvilliana* and *nesica* and *P. sporadica* and *P. eremitica*.

I. [islet off N side of Moturoa I.], Bay of Islands, 20 m, G.A. Taylor, 22 Jan 1990; AK 158122 Motutaniwha I., S coast, off Taiwawe Bay [in Helena Bay], P.R. Whitehead, 26 Jan 1982. ALDERMEN ISLANDS: AK 131911 Hongiara, middle chain of Alderman Is., D.J. Court, 19–27 May 1972.

DISTRIBUTION: 18th and 19th centuries (only places that are supported by clearly labelled or otherwise locatable specimens are listed): North Auckland, near Karikari Peninsula; near Whangaroa; Bay of Islands. Taranaki, Egmont Coast. Nelson, Tasman Bay. 20th century: North Auckland, near North Cape; Cavalli

Islands; near Whangaroa; Bay of Islands; Helena Bay; Aldermen Islands (Fig. 22).

HABITAT: Rock outcrops, cliffs, sometimes in scrub.

CONSERVATION: This taxon as a genetically pure entity is close to extinction; urgent remedial action is needed to identify any existing populations and, if possible, save the species.

ILLUSTRATIONS: None known.

HYBRIDS: Old specimens of hybrids between *P. urvilliana* subsp. *urvilliana* and *P. prostrata*



Fig. 23 Holotype of *Pimelea urvilliana* subsp. *nesica* (CHR 22203). Each piece is regarded as an element of the holotype. (Image by courtesy of the Allan Herbarium, CHR, 2007).

subsp. *prostrata* were noted above in the history of taxonomy section for *P. urvilliana*. The plants have very hairy branchlets but the leaves resemble those of subsp. *urvilliana*. Like subsp. *urvilliana* they no longer occur in Nelson and Marlborough. They are not considered further here. Modern populations containing hybrids between subsp. *urvilliana* and both *P. carnososa* (X) and *P. sporadica* (X) have been recognised.

9b. *Pimelea urvilliana* subsp. *nesica*
C.J.Burrows, subsp. nov.

DIAGNOSIS: Differt a subsp. *urvilliana* foliis magis dilute viridibus plerumque grandioribus interdum oblongis, tenuioribus, relative late dissitis, planis vel adaxialiter concavis, sed non carinatis, ramulisque minus dense hirsutis.

Differs from subsp. *urvilliana* by its paler green, usually larger, sometimes oblong, thinner, relatively

widely spaced leaves that are flat or adaxially concave, but not keeled, and by its less densely hairy branchlets.

HOLOTYPE: CHR 22203, Mayor Island [western Bay of Plenty] *R. Mason*, Nov 1936 (Fig. 23).

ETYMOLOGY: From Greek “nesos” (island); the plants grow mainly on offshore islands.

DESCRIPTION: A small to medium-sized prostrate to decumbent shrub with long, often trailing, flexible branches (to 40 cm). Young stems moderately densely covered in white, appressed hair. Branching sympodial and lateral. Internodes up to 3 mm long. Node buttresses short, lunate, black, shining, masked by hair on youngest stems. Old stems glabrate, grey-brown. Leaves ascendant near branchlet tips, then patent to deflexed, often apparently distichous and relatively distant, on short (0.2 mm) sometimes red petioles or sessile. Lamina pale to medium green, glaucous, moderately thin, elliptic, ovate or sometimes oblong, 5–8 × 2–3.5 mm, flat, or slightly adaxially concave, margin thickened, slightly upturned, acute but often blunt-tipped, midvein obscure abaxially. Stomata abundant on adaxial side, none or very few on abaxial side. Abaxial surface glistens.

Inflorescences terminal on branchlets, 4–6-flowered. Involucral bracts 4, about the same size as adjacent leaves. Plants gynodioecious. Flowers white, densely hairy outside, inside some hair near top of ovary portion. ♀ tube 3 mm long, ovary portion 2.5 mm, calyx lobes 1.5 × 0.9 mm; ♂ tube 4.2 mm long, ovary portion 3 mm, calyx lobes 2 × 1.5 mm. Anther dehiscence semi-latrorse. Ovary densely hairy at summit. Fruits subglobose, fleshy, white, opaque, 5 × 4 mm. Seeds ovoid, 2.7 × 1.6 mm. Flowering time spring-summer. Chromosomes: no counts known.

REPRESENTATIVE SPECIMENS: AUCKLAND-HAURAKI GULF: CHR 22244 Rock [stack] opposite the Nun, Piha, on bare exposed rock, *L.B. Moore*, 1 May 1930; AK 101712 Poor Knights Is., *L.M. Cranwell*, *L.B. Moore*, 19 Nov

1933; CHR 183368 Mokohinau Islands, plentiful, *G.I. Collett*, Aug 1965; AK 231859 Gut Rock, N side of Fanal I., Mokohinau Group, *F.J. Brook*, 14 Nov 1996; AK 167427 Little Barrier I., W Landing, *R. Bielecki*, *R. Beever*, 16 Jun 1984; CHR 186968 Coppermine I., Hen & Chickens Group, under kanuka on ridge, *M.A. Ritchie*, *I.M. Ritchie*, 25 Oct 1968; CHR 225585 Motuoruhi, Coromandel Islands, on bank above high tide mark, *A.E. Esler*, 17 Oct 1971; CHR 18667 Whatapuke Island, coastal slopes, on rocky ridge among grasses and flax, *M.A. & I.M. Ritchie*, 27 Oct 1968. EAST OF COROMANDEL-BAY OF PLENTY: CHR 112899 Track to lighthouse, Cuvier Island, *I.A.E. Atkinson*, 17 Jun 1960; CHR 480627 Whangapoua Bay, Coromandel, 1 m, rock stack, 15 m off northern headland, N end of beach, *P.J. de Lange*, 27 Sep 1992; AK 136842 Great Mercury I., just above tide mark, rocky coast, *A.E. Wright*, 15 May 1975; AK 133336 Slipper I. off Tairua, *D.J. Court*, 19 Aug 1973; CHR 368635 Whangaparaoa, eastern Bay of Plenty, on sandy beach foreshore, beside lupins, 2 m, *M. Heginbotham*, Nov 1977.

DISTRIBUTION: West coast of North Island near Auckland City; islands off east coast of North Auckland; in Hauraki Gulf; east of Coromandel; mainland east coast of Coromandel and eastern Bay of Plenty (Fig. 22).

HABITAT: Rock outcrops, sea stacks, cliffs, banks, sandy areas, occasionally in scrub; exposed to salt spray and sometimes on soil enriched by bird excreta.

CONSERVATION: On some islands the plant is well protected and numerous. However, survey is needed to determine the present situation.

ILLUSTRATIONS: None known.

HYBRIDS: Possible crosses between *P. urvilliana* subsp. *nesica* and both *P. carnosa* (X) and *P. sporadica* (X) have been observed. A specimen AK 226288 Red Mercury I., *P. Lynch*, 22 Aug 1971 appears to be a hybrid between the two *P. urvilliana* subspecies.

Key to the *Pimelea urvilliana* subspecies

- | | |
|--|-------------------|
| | Subspecies |
| 1. Leaves relatively short and thick (3–6 mm long), narrow-elliptic to ovate, flat or slightly keeled, tip obtuse; branchlets densely covered in matted white hair | <i>urvilliana</i> |
| Leaves longer and thinner (5–8 mm long), elliptic, ovate or oblong, flat to adaxially concave, tip acute (but blunt-pointed); branchlets less densely hair-covered | <i>nesica</i> |

12. *Pimelea carnos* C.J.Burrows, sp. nov.

DIAGNOSIS: Frutex prostratus insigne sympodiali ramificationis ordinatione praeditus. Differt a *P. prostrata* sens. lat. foliis relative crassis, carnosis, ascendentibus, imbricatis, carinatis. A *P. urvilliana* subsp. *urvilliana* distinguitur pilis moderate densis, brevibus, griseo-albidis in ramulis juvenalibus et foliis late ellipticis vel late ovatis.

A prostrate shrub with notable sympodial branching pattern. Differs from *P. prostrata* s.l. by having relatively thick, fleshy, ascendant, imbricate, keeled leaves. The moderately dense, short, greyish-white hair on young branchlets and broad-elliptic or broad-ovate leaves distinguish it from *P. urvilliana* subsp. *urvilliana*.

HOLOTYPE: CANU 18020 Truman's Track Scenic Reserve, near Punakaiki, Westland; short turf and low herb-shrub vegetation above sea cliffs, exposed to salt spray, 25 m, C.J. Burrows, 4 Jan 1972 (Fig. 24).

ETYMOLOGY: From Latin "carnosus" (fleshy); the leaves are rather thick and fleshy.

DESCRIPTION: A small to medium-sized shrub, prostrate or pendent on banks and cliffs; stems slender to stout, flexible, up to 70 cm long. Branching sympodial and lateral, with some short shoots. Branchlets light brown, moderately densely covered by short, stiff, greyish-white hair. Internodes 1–2 mm long. Older stems slightly hairy to glabrate, light brown to dark grey. Node buttresses short (0.2 mm), dark brown, lunate, masked by hair on young stems, not prominent on leafless stems. Leaves decussate, crowded on young branchlets, imbricate, ascendant, may become patent later, on short (0.5 mm) red petioles. Lamina broad-ovate or broad-elliptic, 3.5–4.9 × 1.5–3.5 mm, glabrous, glaucous, thick, often fleshy, adaxially concave to slightly keeled, midvein evident abaxially, obtuse, base cuneate, sometimes truncate. Stomata abundant on adaxial side, none or rare on abaxial side.

Inflorescences 4–6-flowered, terminal on branchlets. Involucral bracts 4, similar in size to adjacent leaves or larger (5.5 × 3.8 mm). Receptacles moderately hairy. Pedicels 0.2 mm. Plants gynodioecious. Flowers white, fragrant, moderately densely hairy on outside of tube and calyx lobes; inside hairless. Calyx lobes open in salverform fashion. ♀ tube 3 mm, ovary portion 2.2 mm, calyx lobes 1.8 × 1.4 mm; ♂ tube 4.2 mm long, ovary portion 2.5 mm, calyx lobes 2 × 1.8 mm. Anther dehiscence semi-latorse. Ovary sparsely hairy at summit and to one-quarter of the way

down. Fruits broad ovoid, fleshy, white, opaque, 5 × 3.8 mm. Seeds broad ovoid 2.8 × 2 mm. Flowering time spring-summer. (Fig. 25, 26). Chromosomes: $2n = 36$ (Dawson & Beuzenberg 2000, p. 8... as *P. "miko"*).

REPRESENTATIVE SPECIMENS: THREE KINGS ISLANDS: CANU 37473 (= AK 228142 duplicate) Great Island near Bald Hill, associated with and apparently hybridising with *Pimelea* "Three Kings" [= *P. telura*], 189 m, P.J. de Lange, 2 Dec 1995. NORTH ISLAND: NORTH AUCKLAND: AK 216218 Cape Reinga, Te Werahi, 100 m, A.E. Esler, 13 Dec 1994; AK 200897 Surville Cliffs at base, P.J. de Lange, 5 Oct 1990; CHR 259798 Simmonds Islands, Terakautuhaka [near Rarawa], coastal rocks, W.W. Sander, 1 Apr 1974; AK 139782 Whale Island, Moturoa Group [near Karikari Pen.], A.E. Wright, 10 May 1976; NZFRI 21461 Horahora Bar [near Ngunguru], M.D. Wilcox, no date; MTP 003 Ocean Beach near Whangarei, M. Thorsen, 20 Dec 2002; CHR 451257 (= AK 201756 duplicate), Tawhiti Rahi Island, Poor Knights Group, summit ridge above Skull Bay, 60 m, A.E. Wright, 27 Apr 1991; CHR 89191 Little Barrier Island, Awaroa, L.B. Moore, 30 Dec 1941; CANU 38878 Awana Beach, Great Barrier Island, sea cliff, J. Ogden, 29 Oct 1997; CHR 22242 Anawhata, Waitemata County, salt meadow, L.B. Moore, 20 Jul 1930. COROMANDEL: CHR 132541 Ohena Island, I.A.E. Atkinson, 12 Jul 1961. HAWKE'S BAY: CHR 572599 Waikokopu Point, Mahia, M. Thorsen, 20 Aug 2002. TARANAKI: CHR 159541 Kaupokonui Stm, Egmont Coast, sand, A.P. Druce, Feb 1964; CHR 518744 Opunake, Arawhata Rd (W end), flat terraces behind low sea cliff, C. Ogle, 1 Dec 1998. WANGANUI: CHR 90988 south of Waitotara, R. Mason, 11 Jan 1956; AK 277412 Near Kaitoke Prison, coastline sandflat behind coastal cliff, with *Zoysia minima*, S. Courtney, 10 Aug 1985. SOUTH ISLAND: MARLBOROUGH: CHR 166019 Wairau Bar, G.I. Collett, Sep 1965; CHR 216303 N of Ward Beach, on limestone pavement behind beach, W.R. Sykes, 28 Oct 1970. NORTHWEST NELSON: CHR 167671 Wharariki Beach, limestone conglomerate rock, M.J.A. Simpson, 8 Dec 1965; CANU 38879 Paturau, coastal cliff, C.J. Burrows, Oct 1976; CHR 172509 Kahurangi Point, sandy hummocks and sandstone slips, G.I. Collett, Mar 1965. BULLER: CHR 482650 Charleston, W of Parsons Hill, N side Nile R. mouth, D.R. Given, 14 Nov 1974. CANTERBURY: CANU 6033 Kaitorete (Ellesmere) Spit, blowouts and sand flats,

Fig. 24 Holotype of *Pimelea carnosa* n. sp. (CANU 18020). All the pieces are regarded as elements of the holotype. (Image by courtesy of the Allan Herbarium, CHR, 2007).



C.J. Burrows, Nov 1963; OTAGO: CHR 330420 Black Head, Dunedin, *A. Wall*, Jan 1920.

DISTRIBUTION: Three Kings Islands. North Island, widespread but local on mainland coasts and some offshore islands, scarce in some locations, especially in the south. May be extinct as a pure entity near Wellington (see comment on hybrids below). South Island, western Nelson, Buller; scarcer on the east coast with populations on the Wairau Bar, and near Ward, Marlborough; Kaitorete Spit, Canterbury. The old specimen (CHR 330420)

is the only one seen from Otago or Southland that clearly belongs to *P. carnosa*; it may be extinct as a pure entity in those regions (Fig. 27). Recent specimens resembling *P. carnosa* from the southern South Island appear to be introgressed by part of the genome of *P. prostrata* subsp. *ventosa* (see below).

HABITAT: Always near the coast, on cliffs and banks, sometimes on dunes; commonly in short turf on wind- and spray-swept cliff tops together with a range of halophytic plants.



Fig. 25 Habit and habitat photograph of *Pimelea carnosa*, near Green Hill Stm, NW Nelson. (C. J. Burrows, Dec 2007)

CONSERVATION STATUS: Some populations, especially near Cape Reinga and in north-west Nelson-Buller, are vigorous and occur in protected areas, so the species is probably safe from extinction. Nevertheless, it appears to have been lost from some extensive areas of coastline. Trampling, vehicle traffic, weed growth, and land development are adverse. A survey of this species' present situation is needed.

ILLUSTRATIONS: Moore & Irwin 1978, p. 63 (as *P. prostrata*); Eagle 2006, p. 171 (as *P. urvilliana*).

HYBRIDS: Crossing has been recognised between *P. carnosa* and each of *P. prostrata* subsp. *prostrata*, *seismica**, *ventosa*, as well as *P. orthia**, possibly *P. xenica**, *P. urvilliana* subsp. *urvilliana**, subsp. *nesica**, *P. actea**, and *P. telura**. Some hybrids (marked *) appear to occur infrequently as only one or a few individuals have been collected. The other hybrid occurrences, however, are extensive and complex. The cases that appear to reflect occasional crosses are dealt with first.

On the coastline between Cape Reinga and North Cape occur a few *P. carnosa* × *P. prostrata* subsp.

seismica hybrids (e.g., CANU 38886 Tapotupotu Bay, steep bank above the sea, C.J. Burrows, Aug 1997; CHR 469823B Taunganui Point [Spirits Bay], 120 m, A.P. Druce, Dec 1989). Unaffected individuals of both parents live nearby. The hybrids have short, mainly sympodial, moderately hairy branches with long or short internodes and flat to slightly keeled moderately thick, acute-tipped leaves. A few similar hybrid plants have been gathered near Wellington (e.g., CANU 66246 mouth of Makara R., Wellington, coastal hillside, D.G. Lloyd, 30 Jul 1966).

Specimens on three sheets at OTA were gathered by G. T. S. Baylis at North Cape, 11 Dec 1934 (OTA 1838, 1840, 1842). They are judged to be hybrids between *P. carnosa* and *P. urvilliana* subsp. *urvilliana*. Their stems are densely hairy but their leaves are short, ovate, closely spaced, and imbricate.

A mixed sheet, AK 44769, near Maukins Nook, S of North Cape, H.E. Powell, Jan 20 1950, has one piece that seems to be a hybrid between *P. carnosa* and *P. urvilliana* subsp. *urvilliana*, as well as two pieces of subsp. *urvilliana* (see above). Another

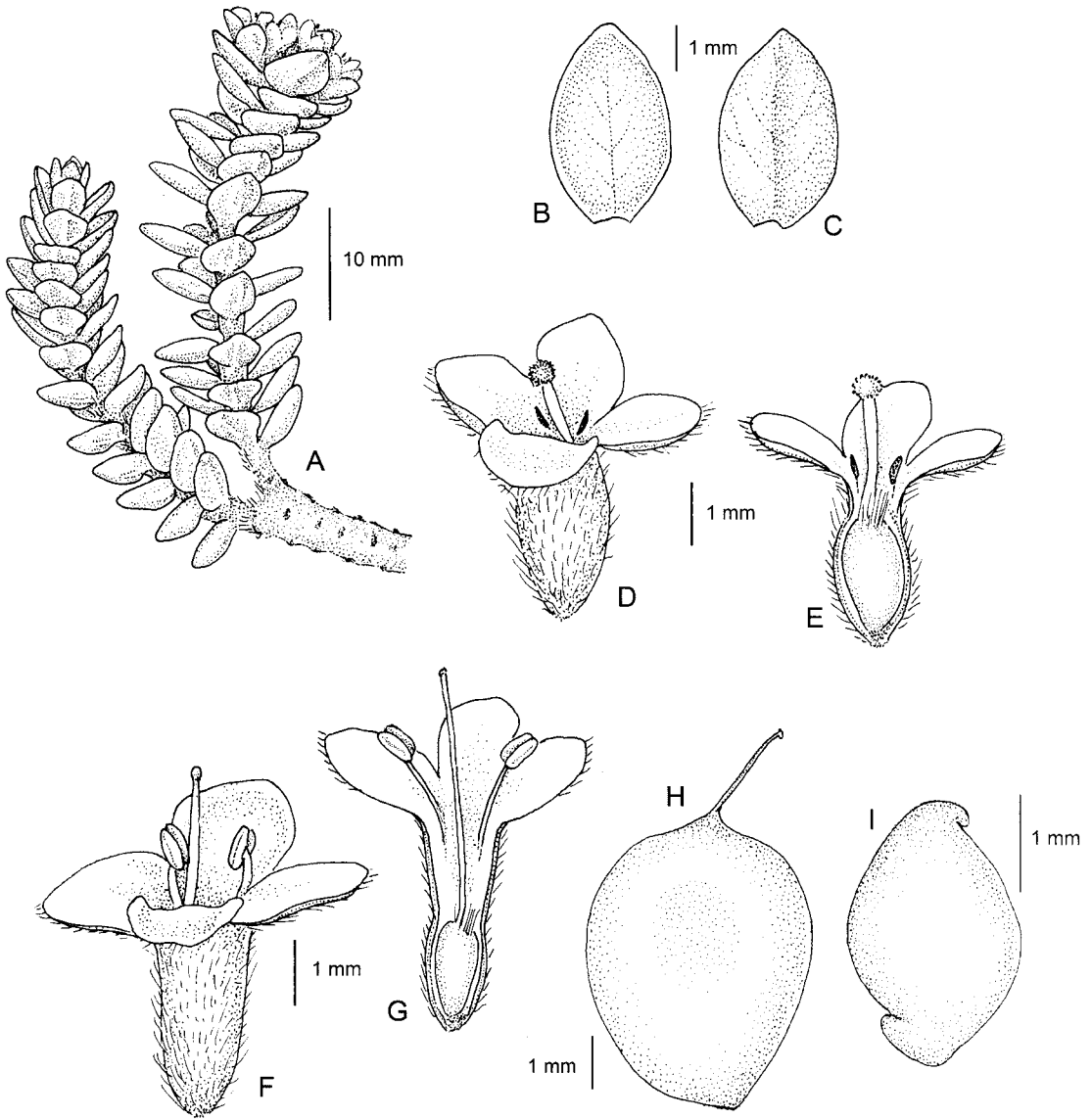


Fig. 26 Habit drawing of *Pimelea carnosa* and detail of organs: **A**, branch habit; **B**, leaf adaxial; **C**, abaxial; **D**, ♀ flower; **E**, ♀ flower cut away; **F**, ♀ flower; **G**, ♀ flower cut away; **H**, fruit; **I**, seed. Ink drawing by Rebecca Wagstaff, 2008.

probable *P. carnosa* × *P. urvilliana* subsp. *urvilliana* hybrid is CHR 65693 near Kaitoke, Great Barrier I., sand dune, *R. Mason*, 26 Dec 1949. This prostrate plant, with many sympodial and lateral branchlets, has relatively small (5 × 2.5 mm) crowded, broad-ovate, but not keeled leaves and very hairy young stems, receptacles, and flowers. Similar plants occur in north-western Taranaki.

Not quite as densely hairy-stemmed *P. carnosa*-like plants with relatively wide leaf-spacing may represent hybrids between *P. carnosa* and *P. urvilliana* subsp. *nesica* (or crossing with subsp. *urvilliana*, then backcrossing to *P. carnosa*). Examples are CANU 38840 Awana Beach, Great Barrier I., pendulous on sea cliff, *J. Ogden*, 29 Oct 1997; and CANU 38888 Smugglers Bay, near Busby

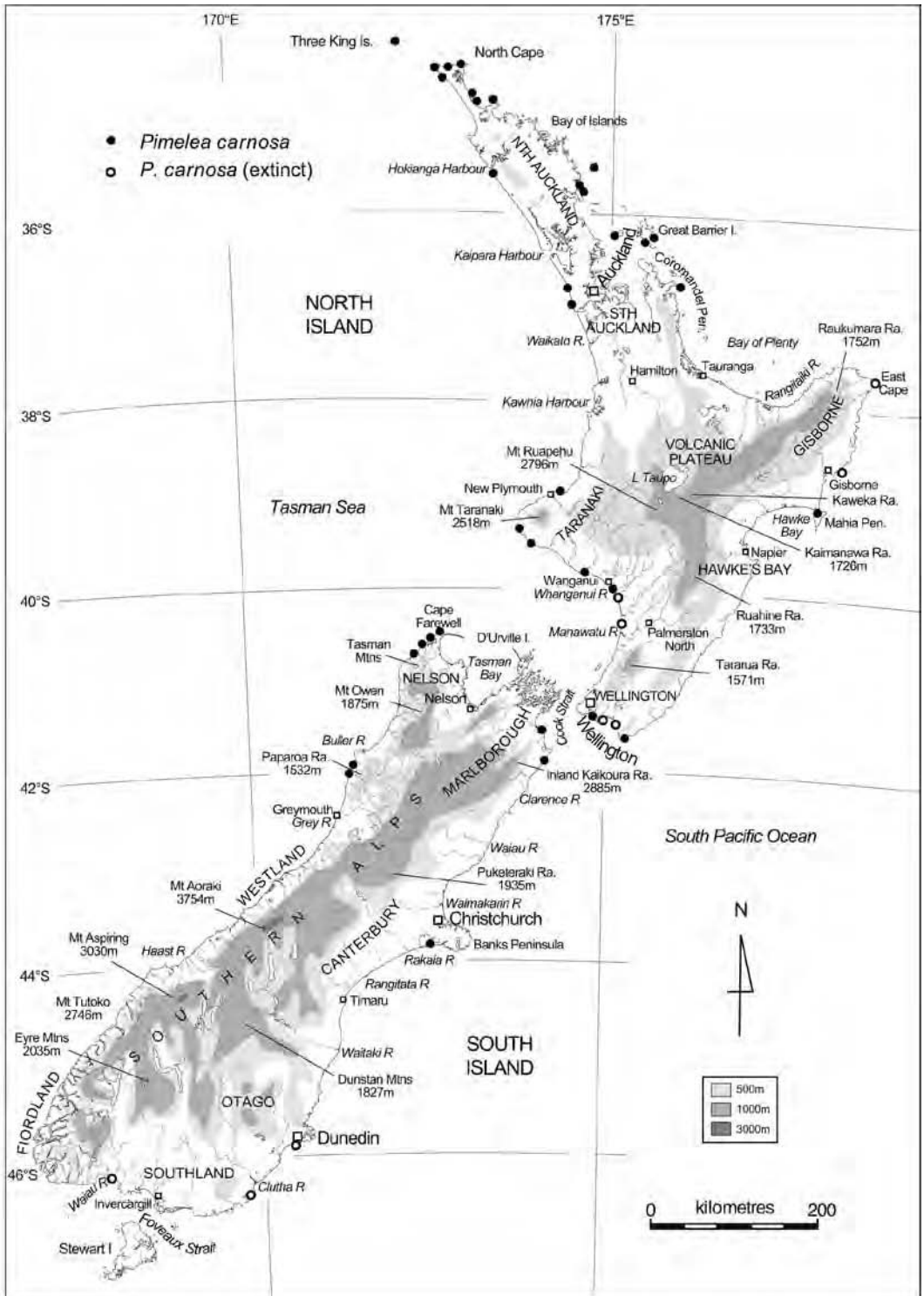


Fig. 27 Distribution map for *Pimelea carnosus*.

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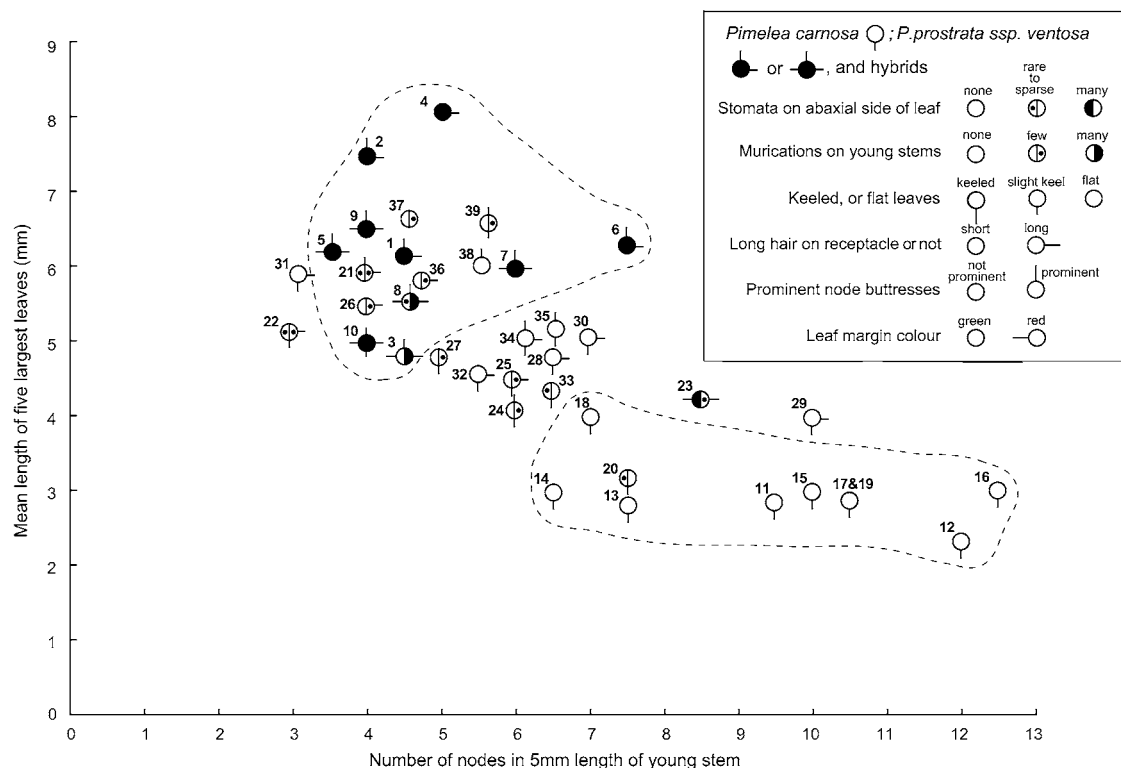


Fig. 28 Hybrids of *Pimelea carnosa* and *P. prostrata* subsp. *prostrata* near Wellington.

Head, North Auckland, bank 5 m above sea level, C.J. Burrows, Aug 1997.

A specimen intermediate between *P. carnosa* and *P. orthia* from the Karikari Peninsula, North Auckland, is AK 35785 East end Merita Bay, dry coastal scrub, R.C. Cooper, 30 Nov 1949. On the sheet is a small piece of *P. orthia*. A larger piece, the hybrid, has the erect habit of *P. orthia* but also ascendant to patent, relatively thick broad-elliptic or ovate leaves with obtuse tips. The hair on young stems is moderately dense. Node buttresses are black and lunate, or slightly longer. Another hybrid between these two species is AK 51585 Crater Rim, Mayor I., P. Hynes, 20 Nov 1959.

Hybrids between *P. carnosa* and both *P. actea* and *P. telura* were noted in Burrows (2008). The “*P. sp. aff. urvilliania*” mentioned in that account is *P. carnosa*. These hybrids will not be considered further here.

In several coastal locations there is evidence for *P. carnosa* × *P. prostrata* subsp. *prostrata* crossing which has given rise to highly variable hybrid

swarms and also to more uniform, introgressed, local populations. Near Wellington City and along the coast eastward to Cape Palliser and from there northward, in Wairarapa at least to Castlepoint, the *Pimelea* populations, on old, raised, gravelly beaches, are extremely variable. There are some plants approaching the form either of *P. carnosa* or subsp. *prostrata*, but generally there is a “hybrid swarm” situation with plants having mixed characteristics of the two parental types. A marker character useful for detecting the influence of subsp. *prostrata* genes in otherwise *P. carnosa*-like plants is the presence of few to moderately numerous stomata on abaxial leaf surfaces. Long leaves on some specimens may indicate the influence of *P. prostrata* subsp. *seismica*. Figure 28 expresses these Wellington hybrid patterns depicted by means of a pictorialised scatter diagram (cf. Anderson 1953). The specimens used in Fig. 28 are listed in Appendix 5. In the Taranaki region, hybridisation between *P. carnosa* and *P. prostrata* subsp. *prostrata* is also evident. Hybrid swarms with phenotypes like those near Wellington and

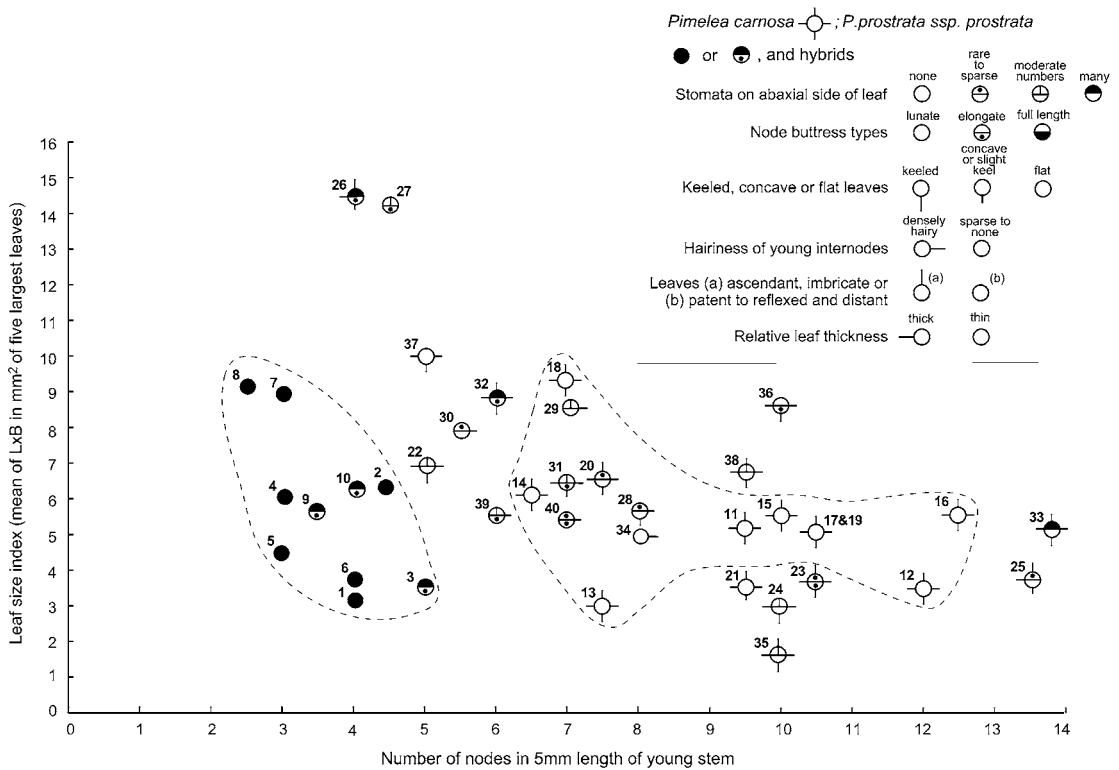


Fig. 29 Hybrids of *Pimelea carnososa* and *P. prostrata* subsp. *ventosa* near Dunedin and in South Otago and Southland.

more uniform (probably introgressed) populations of *P. carnososa*-like plants are present. Introgressed *P. carnososa* × subsp. *prostrata* forms occur also at Kaitorete Spit, Canterbury, and, in the form of scattered individuals, on the coastline East Cape to Gisborne as well as in north-west Nelson near Westhaven and Paturau.

Near Dunedin, in adjacent parts of coastal North and South Otago and along the Southland coast, are populations of plants on dunes, cliffs, and hillsides. They have a very wide array of mixed characters in which *P. carnososa*-like and *P. prostrata* subsp. *ventosa*-like features are represented. Old (19th and early 20th century) and recent gatherings reflect these patterns (Fig. 29, and see Appendix 5). Abaxial stomata are again useful markers, especially in Southland. The muricate stem feature of *P. ventosa*, another marker character, is only weakly represented in the hybrids near Dunedin (and as far north as Oamaru), but is clearly present in the South Otago and Southland populations. The hybridisation has evidently been occurring for a long time and is so

comprehensive that in the Dunedin area the parental characteristics of these two taxa are almost completely intermingled by mutual introgression. It appears that parts of the genomes of *P. prostrata* subsp. *prostrata* and *P. lyallii* are also present in some of the hybrid plants in South Otago and Southland (small, broad-elliptic leaves and leaf hair, respectively).

NOTE: New Zealand botanists in the 20th century generally regarded the entity here described as *P. carnososa* to be an infraspecific unit in the *P. prostrata* complex (cf. Moore & Irwin 1978). It was assumed by some that the name *quadrifaria*, used as a varietal epithet of *P. prostrata* by Hook. f. *Lond. J. Bot.* 3, 416 (1844), applied to this entity. The reference sheet for var. *quadrifaria* at Kew, K356734 has two pieces. The lower piece, on paper glued to the sheet, has the label “93 *Pimelea* sp. nov. *prostrata* var. *quadrifaria*, W. Stephenson, New Zealand, 1843–4”. It has large, broad-elliptic leaves and resembles modern hybrids between *P. carnososa* and *P. prostrata* subsp. *prostrata* near Wellington and elsewhere. The upper piece, labelled in Hooker’s handwriting “N. Zealand

Pimelea”, resembles *P. carnosa*; it is assumed to be from another collection of unknown provenance. According to Hooker (1844), the Stephenson collection was gathered near Wellington. The whole sheet is labelled *P. urvilleana* [sic] A. Rich. The contention here is that use of the name *quadrifaria* as an infraspecific or specific epithet in *Pimelea* cannot be justified because of the likely hybrid status of the reference specimen. Hooker himself did not use it after 1844 (presumably because he had decided that the plants represented *P. urvilliana*).

In recent New Zealand literature, the entity here called *P. carnosa* was confused with *P. urvilliana* subsp. *urvilliana* (the latter a rare plant by at least the mid 20th century). It is treated in that sense in Parsons et al. (1995) and Eagle (2006).

Where its populations are free of contamination by the genomes of other taxa, *P. carnosa* has a distinct and relatively constant morphology. Keeled, imbricate, ascendant leaves, lunate node buttresses, and very hairy young stems are defining characteristics. In local populations variations in leaf size and colour and stem hair density, for example, are no more than would be expected in any geographically wide-ranging species. The variations grade into one another in clinal fashion. Thus, *P. carnosa* is treated here as a moderately variable species without discrete infra-specific units.

Pimelea carnosa must be salt tolerant, as it lives in locations that are affected by salt spray (associated with well-known halophytic plants such as *Apodasmia similis*, *Samolus repens*, *Selliera radicans*, *Isolepis cernua*, and *Plantago triandra* subsp. *masoniae*). The fleshy leaves of *P. carnosa* are assumed here to be a response to the haline conditions. When cultivated in ordinary soil, it develops thinner leaves and wider leaf spacing (C. J. Burrows unpubl. data).

13. *Pimelea sporadica* C.J.Burrows, sp. nov.

= *Pimelea laevigata* Sol. ex Gaertn. *Fruct. et Sem.* 1, 186 t.39 (1788), *pro parte*.

DIAGNOSIS: Planta rigide erecta vel suberecta, a *P. telura* distincta statura brevior et floribus femineis hermaphroditisque relative brevibus, a *P. orthia* ramulorum ordinatione praecipue sympodiali foliisque crassioribus, et a *P. xenica* forma validiore, ramis rigidis et praecipue patenti foliorum dispositione.

This stiffly erect to suberect plant differs from *P. telura* by its smaller size and relatively small female and hermaphrodite flowers, from *P. orthia* by its mainly sympodial branching pattern and thicker

leaves, and from *P. xenica* by its stouter form, stiff branches, and stiffly patent leaf attitude.

HOLOTYPE: CHR 326183 Surville Cliffs, north-west of North Cape, 150 m, scrub on cliff (serpentine), small erect shrub, A.P. Druce, Apr 1979 (Fig. 30).

ETYMOLOGY: From Greek “sporadikos” (scattered); the populations are few and widely spread.

OLD SPECIMEN: Naturhistoriska Riksmuseet, Stockholm (Herb. Alstroemer) S 07-3110 *Pimelea laevigata* Dr Solander, Nova Zelandia (also labelled *Pimelea prostrata* Banks & Soland. var.!) (Fig. 3).

DESCRIPTION: A medium-sized, erect to suberect shrub, to 45 cm high. Branches stiff, divergent. Branching both sympodial and lateral but the former is most notable. Branchlets moderately densely covered by short, grey-white hair. Internodes 1.5–3 mm long. Older stems glabrous, grey-brown. Node buttresses short (0.2 mm) dark brown, lunate, masked by hair on young branchlets, moderately prominent on leafless branches. Leaves decussate, crowded on young branches, ascendant at first, then mainly patent and becoming deflexed, on very short (0.1–0.2 mm) red petioles, or sessile. Lamina relatively thick, stiff, ovate to oblong, 4.5–6.5 × 3–3.7 mm, glabrous, medium-green, glaucous, slightly keeled, or adaxially concave, margins slightly upturned, midvein not plainly evident abaxially, slightly sunken, acute, base cuneate or truncate. Stomata on adaxial surface only. Abaxial surface glistens.

Inflorescences 3–6-flowered, terminal on leading branches, sometimes clustered. Involucral bracts 4, larger than adjacent leaves (7 × 5 mm). Receptacles very hairy, pedicels 0.2 mm, persistent. Plants gynodioecious. Flowers white, covered in short, moderately dense hair outside; inside hairless; calyx lobes opening in salverform fashion. ♀ tube 3 mm long, ovary portion 2.1 mm, calyx lobes 1.2 × 0.8 mm; ♂ tube 4 mm long, ovary portion 2.2 mm, calyx lobes 2.5 × 2 mm. Anther dehiscence semi-latorse. Ovary with a sparse hair-covering at summit. Fruits broad-ovoid, fleshy white, opaque 4.5 × 3.4 mm. Seeds narrow-ovoid 2 × 1.4 mm. (Fig. 31, 32). Flowering time spring-summer-autumn. Chromosomes: no counts known.

REPRESENTATIVE SPECIMENS: NORTH AUCKLAND: CHR 72452 North Cape, M.C. Findlayson, 12 Jun 1944; CHR 174867 Kerr Point, L.J. Dumbleton, Feb 1967; CANU 10850 North Cape, scrub on serpentine belt, M.T. Kalin, 5 Feb 1967; AK 273826 Surville Cliffs, on cliff face, S.A. Brown, Nov 1982; CHR 525124 Surville Cliffs, M. Heads, 20 Jan



Fig. 30 Holotype of *Pimelea sporadica* n. sp. (CHR 326183). Each piece is regarded as an element of the holotype. (Image by courtesy of the Allan Herbarium, CHR, 2007).

1998; CHR 153919 Cape Brett, Bay of Islands, *G.I. Collett*, Sep 1964; CHR 330426 Maunganui Rocks, west coast North Island, sand dune, *H. Carse*, Dec 1926. EAST CAPE: CHR 192470 Hicks Bay, coastal rocks, *A.P. Druce*, Feb 1969.

DISTRIBUTION: North Auckland-North Cape area, Cape Brett, Bay of Islands, near Maunganui Bluff; East Cape at Hicks Bay (Fig. 22).

HABITAT: Rock including ultramafics and sandstone, in scrub, and on dune sand.

CONSERVATION: Relatively recent gatherings from the North Cape region indicate that the population there is vigorous and plants are numerous, but the species is vulnerable because there are at least four other *Pimelea* entities present, some of which hybridise with *P. sporadica*. The few gatherings from other places in the 20th century have been single specimens.

Banks and Solander gathered specimens for their *P. laevigata* form β at four east coast North Island landing places: Te Oneroa (Gisborne), Tigadu



Fig. 31 Habit and habitat photograph of *Pimelea sporadica*, Surville Cliffs, N Auckland. (G. M. Crowcroft, Oct 1990)

(Anaura Bay), Tolaga (Tolaga Bay), and Opuragi (Mercury Bay). Assuming that some or all of the plants gathered belonged to *P. sporadica*, it must be inferred that the species has diminished in those localities since the late 18th century. Cultivation and planting out of *P. sporadica* should be attempted in safe locations without other *Pimelea* species nearby.

ILLUSTRATIONS: Natural History Museum, BM, London, Endeavour Botanical Illustrations; Sydney Parkinson watercolour, NZ3/157, *Pimalea* [sic] *laevigata* (*prostrata*) 1770 [= *Pimelea sporadica*] (Fig. 2).

HYBRIDS: Crossing is recognised in the North Cape area between *P. sporadica* and each of *P. orthia* and *P. xenica*. Although no unadulterated specimens of *P. orthia* have been gathered near North Cape, it was formerly widely distributed in North Auckland (Fig. 14). A gathering presumed to be a *P. sporadica* × *P. orthia* hybrid is CHR 326186 Surville Cliffs, NW of North Cape, 154 m, A.P. Druce, Apr 1979.

The leaves are closely imbricate (internodes 1 mm) and ascendant, but lower leaves are patent. The relatively small, narrow leaves (4 × 2 mm) are ovate. The evident links with *P. orthia* are the stiff and straight branches with not very hairy internodes. Another such gathering is AK 229679 top of Surville Cliffs, c. 200 m, G.A. Taylor, 30 Aug 1990. One piece resembles *P. orthia* slightly. A second piece is like CHR 326186.

A plant regarded here as a hybrid of *P. sporadica* with *P. xenica* is CHR 475130 Surville Cliffs near Ngawhenua Stm, ultramafic rock, P.J. de Lange, G.M. Crowcroft, 30 Jan 1992. Its branches are mainly sympodial and have only moderate amounts of hair on internodes and lunate node buttresses. The leaves are small, ascendant, and imbricate, with inrolled margins.

Among collections from island locations east of the North Auckland peninsula are specimens with foliage and other features like those of *P. urvilliana* subsp. *nesica* but having upright growth form. Some are semi-upright or sprawling, while a few are stiffly

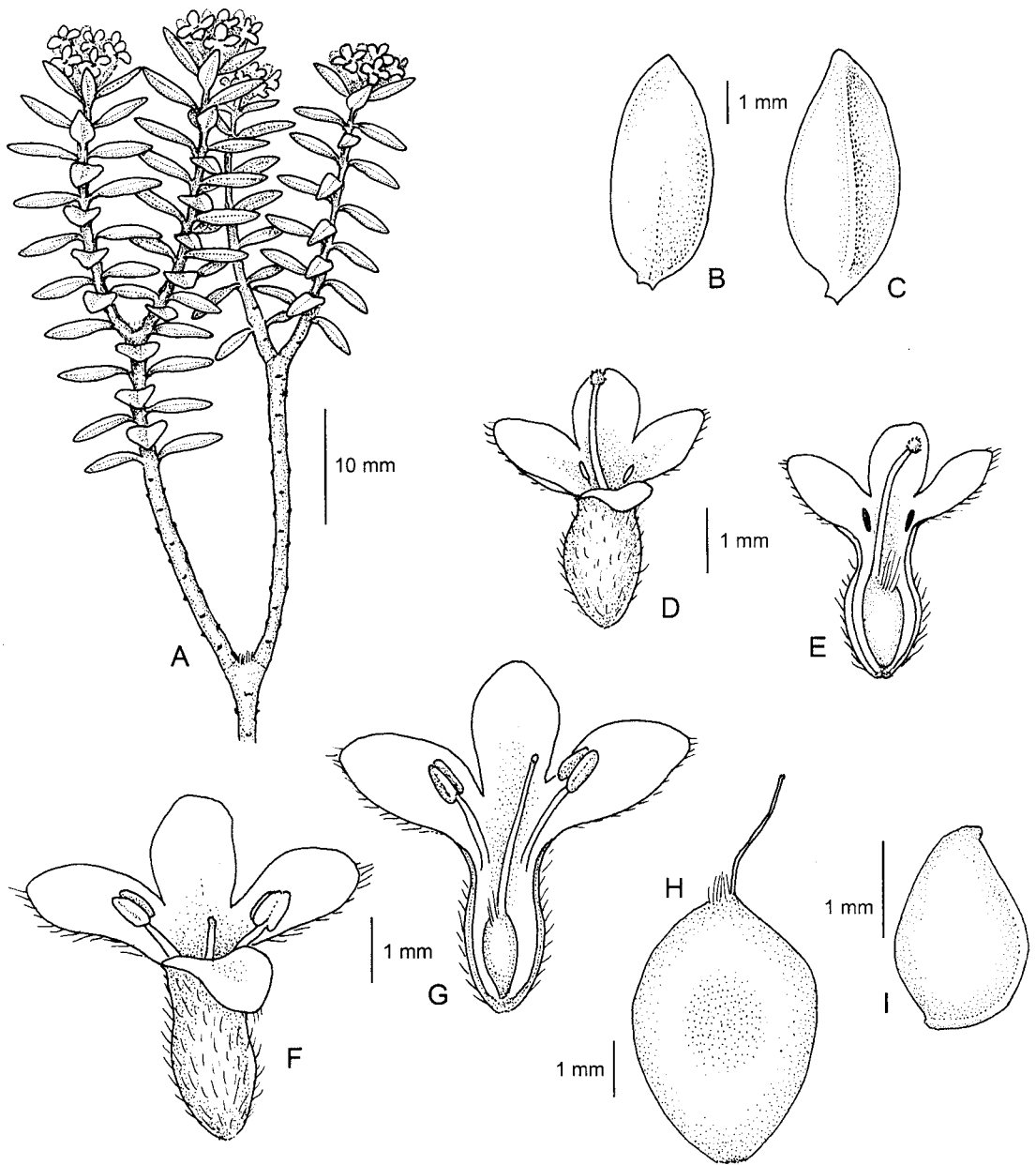


Fig. 32 Habit drawing of *Pimelea sporadica* and detail of organs: **A**, branch habit; **B**, leaf adaxial; **C**, abaxial; **D**, ♀ flower; **E**, ♀ flower cut away; **F**, ♀ flower; **G**, ♀ flower cut away; **H**, fruit; **I**, seed. Ink drawing by Rebecca Wagstaff, 2008.

erect. Examples of the erect plants are: AK 165069 Mokohinau Is., Knight group, Stack H, A.E. Wright, 31 Dec 1983; AK 226976 Mokohinau Is., Hokoromea I., Maori Bay, alt. 20 m, habit an upright bush,

P.J. de Lange, 12 Nov 1993; AK 194570 Black Rocks off Moturoa I., Battleship Rock, A.E. Wright, 24 Jan 1990. The last is very stiffly erect. The upright habit of these plants may originate from crossing of

Fig. 33 Holotype of *Pimelea eremitica* n. sp. (AK 189577). (Image by courtesy of the Allan Herbarium, CHR, 2007).



P. urvilliana subsp. *nesica* with *P. orthia* (although the latter has not been gathered on these islands it may have occurred on them in the past).

NOTE: Although one is erect and the other prostrate, there are some similarities between *P. sporadica* and *P. urvilliana* subsp. *urvilliana*. The oldest surviving clear records of the phenotype of *P. sporadica* (the Parkinson painting of Solander's *Pimelea laevigata*, form β (Fig. 2) and the Stockholm specimen S07-3100) (Fig. 3)) help to establish *P. sporadica* as a distinct entity, but it is closely allied with *P. urvilliana* rather than with *P. prostrata*. *Pimelea sporadica*,

though smaller, is superficially like *P. telura* from the Three Kings Islands (Burrows 2008). However, the flowers of the latter are larger and all perfect, whereas *P. sporadica* is gynodioecious. In the North Cape region *P. sporadica* is often affected by the scrambling stem parasite, *Cassytha paniculata*.

14. *Pimelea eremitica* C.J.Burrows, sp. nov.

DIAGNOSIS: A *P. orthia* distinguenda erectis ramulis lateralibus atque ramulis primariis sympodialibus, a *P. sporadica* ramulis angustioribus, magis numerosis, et a *P. xenica* ramulis rigidis erectis, foliisque



Fig. 34 Habit and habitat photograph of *Pimelea eremitica*, Maunganui Bluff, North Auckland. (C. J. Burrows, Nov 2008)

ascendentibus vel patentibus sed non imbricate vel involutis ubi siccis.

Distinguished from *P. orthia* by its shorter erect lateral, as well as sympodial leading branches, from *P. sporadica* by its thinner, more numerous branches, and from *P. xenica* by its stiff, erect branches and ascendant to patent, but not imbricate or rolled dry leaves.

HOLOTYPE: Auckland Museum, Tamaki Paenga Hira, AK 189577 Maunganui Bluff Scenic Reserve, forming a tight shrub 40 cm in diam. and height, A.E. Wright, 28 Nov 1989 (Fig. 33).

ETYMOLOGY: From Greek “eremos” (solitary); the species is known from only one locality.

DESCRIPTION: A small to medium-sized, erect to suberect shrub, up to 40 cm tall, branching sympodially and with many erect, thin lateral branches. Young branchlets light brown, moderately densely covered with white to grey-white appressed hair. Internodes 1–1.5 mm. Older stems glabrate to hairless, brown to dark grey. Node buttresses usually short (0.2 mm), lunate, sometimes elongate masked by hair on young branchlets, small but

moderately prominent on some leafless branchlets. Leaves decussate, ascendant, becoming patent on larger plants, on short (0.5–1 mm) red petioles, often persistent. Lamina slightly keeled, moderately stiff, 4–6 × 1.5–2 mm, elliptic, glabrous, medium-green, sometimes red-margined, midvein evident abaxially, but not prominent; acute, but blunt tipped, base cuneate. Stomata present on adaxial side only. Abaxial surface glistens.

Inflorescences terminal on leading stems, 1–5-flowered, involucre bracts 4, similar in size to adjacent leaves or wider (7 × 3.5 mm). Plants gynodioecious. Flowers white, on very short pedicels (0.3 mm), circumscissile near base, outside of tube and calyx lobes moderately hairy, inside hairless. ♀ tube 3 mm long, ovary portion 2.6 mm, calyx lobes (ascendant) 2 × 1 mm; ♂ tube 6 mm long, ovary portion 2.5 mm, calyx lobes 3.5 × 2.5 mm. Anther dehiscence semi-latorse. Ovary with short hairs at summit and a few down to base. Fruits ovoid, fleshy, white with pink flush, opaque 4 × 2.7 mm. Seeds 3 × 1.8 mm. Flowering time spring–summer (Fig. 34, 35). Chromosomes: no counts known.

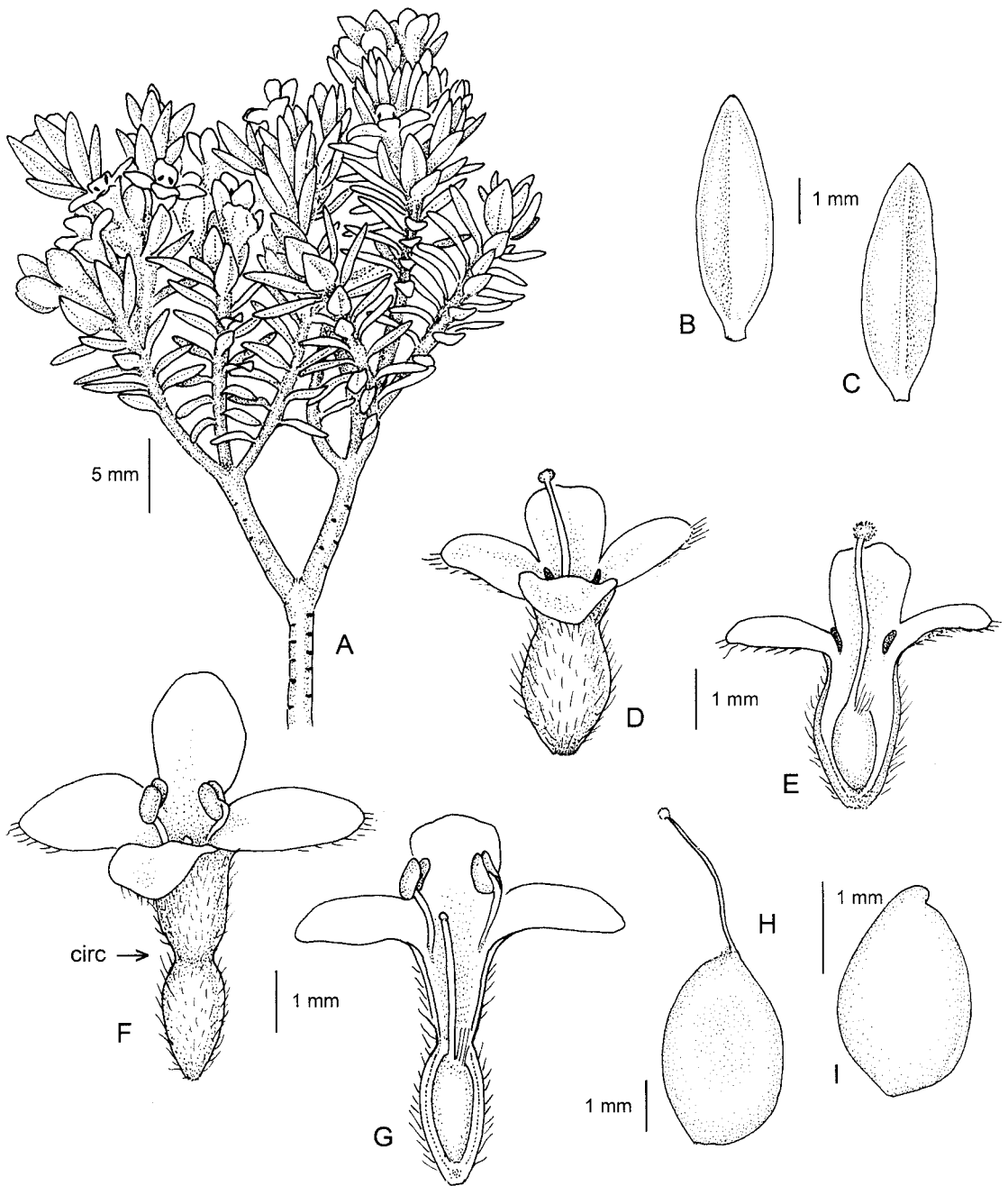


Fig. 35 Habit drawing of *Pimelea eremitica* and detail of organs: **A**, branch habit; **B**, leaf adaxial; **C**, abaxial; **D**, ♀ flower; **E**, ♀ flower cut away; **F**, ♀ flower, circ = circumsissile feature; **G**, ♀ flower cut away; **H**, fruit; **I**, seed. Ink drawing by Rebecca Wagstaff, 2008.

REPRESENTATIVE SPECIMENS: CHR 309150 Maunganui Bluff, rocky outcrop on cliff top, A.E. Esler, A.G. Dobbins, 23 Feb 1977;

AK 221469 Maunganui Bluff, open area on exposed cliff top, c. 35 m, E.K. Cameron, 5748, 28 Nov 1989!

DISTRIBUTION: Maunganui Bluff, west coast of North Auckland near Aranga (Fig. 22).

HABITAT: On exposed summit of basaltic outcrop that descends abruptly to the sea shore and in short exotic grassland beside exposed boulders, with associated low shrubs (*Coprosma* sp., *Helichrysum* sp., *Leucopogon fasciculatus*, *Pomaderris phyllicifolia*) and clumps of *Phormium cookianum*.

CONSERVATION: The single population and its limited size make the future of this species precarious. Cultivation, planting-out, and cautious management to increase numbers are desirable.

ILLUSTRATIONS: None known.

HYBRIDS: One small specimen, CHR 309151 Maunganui Bluff Scenic Reserve, rocky outcrop on cliff top, A.E. Esler, A.G. Dobbins, 23 Feb 1977, has ascendant, closely imbricate leaves. On some of its youngest leaves are a few hairs. This feature may indicate introgressive hybridisation possibly with *P. arenaria*.

NOTE: The few specimens in collections vary in size, presumably through differences in degree of exposure, or substrate conditions. On a visit to the site in November 2008, four hermaphrodite plants, one female, and one without flowers were seen. Viewing plants on the precipice beneath the summit was impossible because of the extreme wind conditions.

Incertae sedis

A genus of three species, *Gymnococca*, was separated off from *Pimelea* by C. A. Meyer (1845). He cited an Australian species as type and listed two other species, *G. microcarpa* and *G. arenaria*, from New Zealand. *Gymnococca microcarpa* was described as being a small shrub with glabrous, fleshy, imbricate leaves, small flowers and white fruits, like *P. prostrata*. No reference specimen was noted. In the circumstances, it is not possible to relate *G. microcarpa* to any of the taxa recognised here, though it may be allied to the *P. urvilliana* group.

CONCLUSIONS

General

The *P. prostrata* and *P. urvilliana* species groups have been the least well understood plants of the genus in New Zealand. This paper sheds light on the systematics of these plants and will be the springboard for other kinds of scrutiny (of their phylogeny,

ecology, and conservation requirements).

Most of the characters used to discriminate between the various taxa are easily observed, but accurate determination of the presence or not of stomata on abaxial leaf surfaces, a valuable means for distinguishing between members of the two species groups, requires clearing of the leaves with sodium hydroxide and microscopic search. However, other defining characters are available (Table 1 and the identification keys).

The array of plants that are here placed in the *P. prostrata* and *P. urvilliana* species groups includes *P. telura* from the Three Kings Islands (*P. urvilliana* group) and *P. actea* a rare plant from dune hollows and other sandy sites in coastal Manawatu and Wanganui (Burrows 2008). *Pimelea actea* is like *P. prostrata* subsp. *prostrata* in leaf form and some stem features, but it grows erect or suberect and has no abaxial stomata on its leaves. Its association appears to be with *P. urvilliana* but it may be a link between the two species groups. These two species are not considered further here.

In future we can expect molecular, cytologic, and other techniques to be used for examination of relationships between taxa in the *P. prostrata* and *P. urvilliana* species groups. So far chromosome counts have not been of much use as a taxonomic tool. The most usual number known for *Pimelea* in New Zealand is $2n = 36$ (Dawson & Beuzenberg 2000). This number (or $n = 18$) has been obtained for *P. prostrata* subspp. *prostrata*, *seismica*, and *vulcanica*, and also for *P. xenica* and *P. carnosia*. A high number ($2n = 90$) was obtained for one provenance of subsp. *prostrata* (M. Dawson pers. comm.) but this needs verification.

Evolution, biogeography, and ecology

It is assumed that the morphologically defined *Pimelea* taxa considered here evolved allopatrically and eventually spread to occupy the areas in which each is now found. The actual circumstances of evolutionary divergence and its timing as well as the reasons for modern distribution patterns cannot be determined from the evidence so far available. Nevertheless, there are some indicative clues that enable hypotheses to be advanced about circumstances leading to isolation of ancestral forms and evolution of modern forms. These clues include:

- (1) The kinds of habitats occupied by the plants today. None of the taxa in the *P. prostrata* group (mainly inland but some coastal) or *P. urvilliana* group (all coastal) are able to live in tall, dense

vegetation. Most grow in really open habitats such as rock outcrops, dunes, or gravel deposits, but some can inhabit low, quite dense plant cover.

- (2) Hybridisation between many of the taxa. This shows that there has been an insufficient period of isolation of the respective “morphotypes” for them to have developed effective breeding barriers. In some instances it is clear that hybridisation has extended well beyond the F1 generation and that hybrids produce viable seeds, but no detailed experimental investigations have been done. Valuable circumstantial evidence about crossing, including occurrence of “marker” characters, is available, however.
- (3) Understanding of the development and nature of the New Zealand landscape in the Pleistocene and Holocene. Some isolation events for the precursors of the modern *Pimelea* species probably occurred during the late Pleistocene. For example, frigid climate, widespread devegetation, and lowered sea level during the last (Otira) glaciation could have separated *Pimelea* populations. Then, in the postglacial period of mild climate, beginning about 12 000 years ago, the sea level rose and extensive forest developed. Coastlines are always relatively open, but open habitats in which these *P. prostrata* and *P. urvilliana* group entities could live would have become fewer and effectively separated by tracts of forest, even along the coastline. Species from the *P. prostrata* group do not usually extend into the open habitats above treeline. However, numerous volcanic eruptions in the central North Island during the past 12 000 years maintained extensive open habitat in that region (Gibb 1986; McKinnon 1997; McFadgen 2007). Also, some outcropping rocks prevent forest occupation of relatively low altitude areas. Dunes and cliff habitats are widespread on the coasts. In the more rugged South Island there have always been extensive areas of seacliffs, dunes, rocky bluffs, and wide gravelly river floodplains.

There is insufficient evidence for making firm decisions about how the subspecies of *P. prostrata* are related to each other. On form alone, subsp. *prostrata*, *ventosa*, and *vulcanica* resemble one another most closely. *Pimelea prostrata* subsp. *thermalis* and *vulcanica* have much in common, and subsp. *seismica* resembles subsp. *prostrata* in some respects.

The proposition that at least some of the entities described here as subspecies of *P. prostrata* could be given species rank was considered and rejected. These entities appear to constitute a distinct natural group. My attitude towards the subspecific category is that it recognises continuing evolution of segments of an original stem species (in the present instance possibly something like subsp. *seismica*) that have been isolated for considerable periods of time (possibly many thousands of years). Raven & Engelhorn (1971) have outlined a logical case for the kind of stance that has been taken here, in relation to their treatment of systematic limits in Australasian *Epilobium*.

In general, the different *P. prostrata* subspecies occupy different regions or different sets of habitat conditions but geographic and ecological separation have broken down to some degree under the influence of natural and human habitat disturbances within the past 2000 years. Further explanation of the relationships between the *P. prostrata* subspecies will require biosystematic experimentation and exploration of their phylogeny using DNA sequencing technology.

Pimelea prostrata s.l. is the most widespread of all the *Pimelea* species in New Zealand (Fig. 6, 8). Collectively, the subspecies are ecologically very versatile. *Pimelea prostrata* subsp. *prostrata* is itself widespread and exceptionally versatile in terms of the kinds of ground conditions occupied (Fig. 6 and relevant text above). It is to be expected that there are numbers of ecotypes of this taxon occupying the different substrates. Although there is broad geographic overlap of subsp. *prostrata* with other subspecies, especially in the southern half of the North Island, it is not often closely contiguous with the others, as it is more of an open ground specialist which probably reached its greatest extent after the end of the Otira glaciation and before the Holocene afforestation. Inland in the North Island it inhabits high-level bogs and short grassland or rock outcrops.

Pimelea prostrata subsp. *vulcanica*, *thermalis*, and *seismica* can be found growing in otherwise unvegetated sites but they are more commonly found in denser vegetation, sometimes scrambling over and among shrubs a decimetre or more tall. They are generally bigger plants than subsp. *prostrata*. It seems likely that their evolution occurred in competition with grasses, sedges, and low shrubs. Each grows in a relatively distinct geographical region. The two that overlap most are subsp. *vulcanica* and *thermalis* (Fig. 8). The former is a volcanic ejecta

Table 1 Character distribution among *Pimelea* taxa covered in this paper.

	Usual plant habit	Sympodial branching prominent	Lateral branching type	Branchlet internode hair	Node buttress type	Relative leaf thickness	Leaf surface	Usual leaf tip	Abundant leaf stomata occurrence	Usual habitats
<i>P. prostrata</i> subsp. <i>prostrata</i>	prostrate or trailing	yes, branchlets short	short, numerous	glabrous to sparse	elongate	thin	flat	obtuse	adaxial, abaxial	open ground or short vegetation, very varied (see text)
subsp. <i>seismica</i>	prostrate, sometimes suberect	yes	few, long, flexible	moderately dense	lunate	thin	flat to adaxially concave	acute	adaxial, abaxial	coastal grassland, cliffs, dunes
subsp. <i>vulcanica</i>	prostrate	no	abundant, long, flexible (very short secondaries)	sparse	elongate	thin	slightly keeled	acute	adaxial, abaxial	grassland, shrubland, scoria
subsp. <i>thermalis</i>	prostrate	no	abundant, stiff (many leafy secondaries)	sparse	elongate	thin	slightly keeled	acute	adaxial, abaxial	sedgeland, grassland, shrubland
subsp. <i>ventosa</i>	prostrate	yes	few, long, flexible	sparse to mod. dense	lunate	mod. thick	adaxially concave to slightly keeled	obtuse	adaxial, abaxial	coastal rock, cliffs, dunes
<i>P. orthia</i> subsp. <i>orthia</i>	erect	yes, main stems few	abundant, short or long, ascendant or erect	moderately dense grey-white	elongate	thin	flat to slightly keeled	acute or obtuse	adaxial, abaxial	grassland, shrubland, rarely dunes
subsp. <i>protea</i>	erect or divergent to prostrate	yes, main stems many	abundant, short or long, ascendant or erect	moderately sparse grey-white	lunate to elongate	thin	flat to slightly keeled	acute	adaxial, abaxial	solely on dunes
<i>P. xenica</i>	spawling to erect	yes	long, few, flexible	moderately dense, grey-white	lunate to slightly elongate	thin	adaxially concave to keeled	obtuse or acute	adaxial, abaxial	grassland, heathland, open banks, rock outcrops
<i>P. urvilliana</i> subsp. <i>urvilliana</i>	prostrate	yes	few, short	very dense, white	lunate	thick	flat or slightly keeled	obtuse	adaxial only	rock outcrops, cliffs, in scrub on coast

subsp. <i>nesifica</i>	prostrate, sometimes erect	yes	long, flexible	dense, white	lunate	mod. thick	flat to adaxially concave	acute	adaxial, very few abaxial	rock outcrops, cliffs, sand, in scrub on coast
<i>P. carnosa</i>	prostrate	yes	few, short	moderately dense, grey-white	lunate	thick	adaxially concave to slightly keeled	obtuse	adaxial, very few abaxial	cliffs, banks, dunes, short turf on coast, rock outcrops
<i>P. sporadica</i>	erect	yes	few, short	moderately dense, grey-white	lunate	thick	adaxially concave to slightly keeled	acute	adaxial only	rock outcrops, (some ultramafic) scrub, dunes, on coast
<i>P. eremitica</i>	erect	yes	many, thin, erect	moderately dense, grey-white	lunate	mod. thick	flat to slightly keeled	acute	adaxial only	rock outcrops above the sea

specialist, which probably evolved in response to the provision of suitable habitat by repeated volcanic activity in the central North Island.

Subspecies *thermalis* lives in areas with scrub, grassland, or sedgeland cover. It is likely to have inhabited the northern margins of the Volcanic Plateau (as well as areas further north and west) before the devastating Taupo eruption (1800 yr BP). Following the eruption, it will have recolonised the area south of the Bay of Plenty, also extending east to Hawke's Bay. Its geographical overlap with subsp. *vulcanica*, thus, is probably relatively recent. The meeting of both subsp. *thermalis* and *vulcanica* with subsp. *prostrata* on the eastern North Island coastline may also be recent.

Subspecies *seismica*, inhabiting near-coastal sites, generally does not appear to live alongside other subspecies of *P. prostrata*, although some of its Northland locations are near those of subsp. *thermalis*, and its Wellington and north-west Nelson locations are close to those of subsp. *prostrata*. The overall distribution pattern of subsp. *seismica*, with a wide gap between Auckland and Wellington and north-west Nelson locations (Fig. 8), is enigmatic. Various other plants have similar distributions (e.g., *Astelia trinervia*, *Libocedrus plumosa*, *Quintinia acutifolia*) but they do not live near Wellington, and the *Quintinia* extends further south to Westland (Wardle 1991, p. 132). For species that live in the Auckland region, with gaps in the southern North Island and populations also in Nelson and Marlborough, the patterns have been ascribed to marine transgression of the Taranaki-Wanganui region in the Pliocene to early Pleistocene, with deposition of soft marine sediments (McGlone 1985). However, the disjunct plant distributions could have been created by late Pleistocene cold episodes or the Kawakawa (22 590 yr BP) and Taupo (1800 yr BP) supervolcanic outbursts (McKinnon 1997).

Pimelea prostrata subsp. *ventosa* probably evolved in the late Pleistocene in the region where it now occurs. Glaciers would have occupied its present Fiordland area until about 15 000 yr BP, but it may have lived on the land exposed by low sea level in glacial times. The introgressed subsp. *prostrata* populations in Westland indicate that subsp. *ventosa* probably also lived in northern Fiordland in post-glacial times.

Pimelea orthia and *P. xenica* are relatively tall members of the *P. prostrata* species group. Before Maori settlement of New Zealand (from about 800 yr BP), they would have occupied unforested habitats of the North Auckland peninsula, Coromandel, Bay

of Plenty, and the east coast from Mahia northward. *Pimelea orthia* probably evolved and lived in a milieu of relatively low vegetation on shorelines, cliffs, and other rock outcrops, sand dunes, and forest margins. *Pimelea xenica* appears to have developed in wetlands with short sedges, infertile heathlands, and shrubby areas maintained by natural disturbance, including thermal areas, landslides, and eroded banks.

The Maori settlers inadvertently created extensive areas potentially suitable for these *Pimelea* species by repeatedly burning forest (Molloy et al. 1963; McGlone 1983; McGlone et al. 1994). Most of the taxa in the *P. prostrata* group probably expanded as a result, and the removal of forest almost certainly allowed certain of these taxa to meet. They would also have met members of the *P. urvilliana* group. The resultant hybridisation was addressed earlier and will be considered only briefly below.

Through the centuries from about AD 800 up to the time of European settlement of New Zealand, the impact of humans on ecosystems in ways that would cause extinctions of *Pimelea* populations was probably minimal, because open, unmanaged habitats were always available. Then, from about AD 1850 onward, the makeover of land for farms, plantation forestry, or human habitation has been so overwhelming that populations of some taxa in the *P. prostrata* group have shrunk drastically.

Among the *P. urvilliana* group taxa, those that must be tolerant of salt spray are: *P. urvilliana* subsp. *urvilliana* and *nesica* and *P. carnososa*. Subsp. *nesica* is also tolerant of exposure to seabird guano. Except for salt tolerance and the presence of subsp. *nesica* mainly on islands, there is not much evidence that hints at the circumstances of evolution of these taxa. *Pimelea eremitica* presumably evolved on the substrate, basaltic rock where it is found and is probably salt tolerant, also, as it is fully exposed to frequent westerly gales. Waves crash onto the rocks at the base of the cliff on which it lives.

Pimelea sporadica is confined to rocky and generally extreme substrates with thin soils (sandstone, basalt, and ultramafics). Many New Zealand coastal areas were closely occupied by Maori settlers, and European settlers also congregated on the coastline, with generally harmful effects on the local *Pimelea* populations. Like *P. urvilliana* subsp. *urvilliana*, *P. sporadica* has experienced severe outcomes from human disturbance in the 19th and 20th centuries.

Of all the *P. urvilliana* group entities, *P. carnososa* seems to be the most resilient and versatile. It

occupies cliffs, gravel, dunes, cliff-top salt marsh turf, and low scrub-herb communities and sometimes very infertile soils on steep slopes. Thus, at one extreme it inhabits very open sites with virtually no other associated species, and at the other it scrambles among low shrubs and tall herbs such as *Phormium cookianum* or *Apodasmia similis*. The species often comes into contact with certain *P. prostrata* group entities as well as with closer relatives. Propinquity may be a main reason why it hybridises with so many other forms.

Hybridisation

A major line of evidence for relatively recent evolution of the taxa in the *P. prostrata* and *P. urvilliana* groups is the ease of hybridisation between many of them. No experimental crossing tests or molecular approaches could be attempted in the present study because of time and financial constraints. Raising most *Pimelea* species from seeds is a slow and difficult matter (Burrows 1958).

It is proposed here that the hybrid phenomena among the *P. prostrata* and *P. urvilliana* groups mainly date from juxtaposition of the various taxa within about the past 800 years. Relatively recent, frequent, and widespread disturbances of ecosystems through human actions have removed barriers that previously kept the various entities apart. However, in the central North Island, the natural disturbance, volcanism, 1800 years ago (and subsequently) must also be invoked as background to hybrid occurrences there. Another exception to human disturbance as a trigger for hybrid events probably applies to the situations in Westland and eastern Otago where introgression of *P. prostrata* subsp. *ventosa* characters into the genomes of each of subsp. *prostrata* and *P. carnososa* may have been occurring for much of the Holocene. Nevertheless, disturbances by human settlement probably have aided the introgressive process.

An important practical issue is the difficulty of identification of hybrids in the field or in herbarium collections. Many putative hybrid combinations were recognised in the text above. However, there are numerous plants of apparent hybrid origin in the collections for which only one of the parents could be ascertained, with certainty.

A striking consequence of the formation of new open habitats such as are created by fire or volcanism is that they allow unadapted hybrids to persist (Anderson 1953; Burrows 1958). Ecosystem disturbance as a cause of extensive hybridisation has been documented for other *Pimelea* taxa, particularly

between *P. oreophila* and *P. aff. sericeovillosa* (Burrows 1958, 1962) and between *P. longifolia* and *P. gnidia* (Burrows 2008).

Despite the instances of hybridisation in the *P. prostrata* and *P. urvilliana* species groups (a kind of breakdown or reversal of the process of species or subspecies evolution), in most parts of the ranges of the various taxa their phenotypes and genotypes are maintained. Thus, the presence of hybrids does not invalidate the taxonomic structure that was presented above for the species or subspecies involved (Levin 2000). Interspecific hybrids are well-known in many other herbaceous and woody angiosperm genera in New Zealand and elsewhere (Anderson 1953; Rechinger 1957; Heiser 1961; Fisher 1965; Stebbins 1969; Stace 1975; Raven & Engelhorn 1971; Smissen & Heenan 2007; Smissen & Breitwieser 2008).

Conservation

The taxa covered in this paper include some that are on the verge of extinction and others that are threatened less severely, to varying degrees (Table 2). Only three taxa are perceived to be not at risk, though the situations of two of them have declined in recent decades.

Five of the taxa in Table 2 appear in the latest published lists of threatened and uncommon plants

as “taxonomically indeterminate” (de Lange et al. 2009, appendix 2). Two are in the “at risk, naturally uncommon” category: *Pimelea* (c) CHR 511713 “tarn” [*P. prostrata* subsp. *prostrata*]; *Pimelea* aff. *tomentosa* (b) AK 130893 Surville Cliffs [*P. sporadica*]. Three are in the “data deficient” category: *Pimelea* (f) AK 189577 Maunganui Bluff [*P. eremitica*]; *Pimelea* aff. *prostrata* CHR 257898 Kaitorete [*P. carnososa*]; *Pimelea prostrata* var. *erecta*, AK 5407 [*P. orthia* subsp. *orthia*].

The absence of other taxa in Table 2 from official lists of endangered species is a direct result of lack of recent taxonomic assessment of these plants. Table 2 is a first approximation towards a classification of all the entities in the *P. prostrata* and *P. urvilliana* species groups in terms of their conservation status. There may be some misclassifications because the individual assessments for some of the respective species are based on limited data. An attempt has been made to follow the criteria used to develop the official lists (Hitchmough et al. 2007).

The Department of Conservation will be the main organisation responsible for conservation management of the plants. The action required for each taxon differs according to the degree of threat to

Table 2 Conservation status and recommended action for taxa in the *Pimelea prostrata* and *P. urvilliana* species groups. 1. Survey of the wild populations. 2. Watching brief and decisions about further action. 3. Rapid remedial treatment. 4. Systematic recovery programme.

Taxon	Assessment using the criteria outlined in Hitchmough et al. (2007)	Specific action needed	
<i>Pimelea prostrata</i>	subsp. <i>prostrata</i> [‡]	Not at risk overall (but declining).	1, 2
	subsp. <i>seismica</i> [‡]	Chronically threatened; serious decline.	1, 4
	subsp. <i>vulcanica</i> [‡]	Not at risk overall (but declining).	1, 2
	subsp. <i>thermalis</i> [‡]	Acutely threatened; nationally endangered.	1, 4
	subsp. <i>ventosa</i> [‡]	At risk; sparse and range restricted (naturally uncommon).	1, 2
<i>Pimelea orthia</i>	subsp. <i>orthia</i>	Acutely threatened; nationally endangered to critical.	1, 3
	subsp. <i>protea</i> [‡]	At risk; range restricted (naturally uncommon).	1, 2, 4
<i>Pimelea xenica</i> [‡]	Chronically threatened; gradual decline.	1, 4	
<i>Pimelea urvilliana</i>	subsp. <i>urvilliana</i> [‡]	Acutely threatened; nationally critical.	1, 3
	subsp. <i>nesica</i> [‡]	Not at risk (but declining).	1, 2
<i>Pimelea carnososa</i>	Chronically threatened; gradual decline.	1, 4	
<i>Pimelea sporadica</i>	Acutely threatened; nationally endangered.	1, 3	
<i>Pimelea eremitica</i> [‡]	At risk; sparse and range restricted (naturally uncommon).	1, 4	
<i>Pimelea actea</i> ^{*‡}	Acutely threatened; nationally critical (naturally uncommon).	1, 3	
<i>Pimelea telura</i> ^{*‡}	At risk; range restricted (naturally uncommon).	1, 2	

*See Burrows (2008) for taxonomy; [‡]Not mentioned in de Lange et al. (2009); [‡]Accords with assessment in de Lange et al. (2009).

its survival. The surviving field populations of all the taxa need to be examined soon because herbarium data (as summarised in the “representative specimen” sections of the paper) are not up to date. Those taxa that, on the basis of recent information, are least at risk need to be kept under observation in case their situations worsen.

The taxa that are most at risk (category 3 in the third column of Table 2) need urgent and bold action to improve conditions for them. The first step in this is identification of all surviving populations of pure genotypes of the respective taxa (i.e., avoiding hybrids). Then, whatever management actions are appropriate need to be taken to enable the plants to increase *in situ*. At the same time, cuttings or seedlings of the plants need to be raised in biosecure glasshouse conditions (to avoid cross-pollination). Young plants can then be planted out into secure natural locations.

Taxa that are threatened and declining but still have moderate numbers in their wild populations (category 4 in Table 2) can be treated in a somewhat more measured way, but again, bold action is needed to improve their lot. Taxa that inhabit grasslands and heathlands may benefit by the use of patchy fires to remove taller vegetation. Some careful experimentation on appropriate management methods will probably be necessary.

The key

*Hybrids between some glabrous-leaved and hairy-leaved species may have a few hairs on their leaves.

1. Leaves always completely glabrous* 2
 Leaves densely to sparsely hairy (at least when young) 15
2. Stomata abundant only on abaxial surface of leaf 3
 Stomata abundant only on adaxial surface or on both adaxial and abaxial surfaces 7
3. Largest leaves at least 4 cm long and 1 cm wide, leaf tips acuminate *P. longifolia*
 Largest leaves less than 4 cm long and 1 cm wide, leaf tips acute or obtuse 4
4. Internode surfaces of young stems completely hair-covered *P. buxifolia*
 Internodes glabrous or only partially hair-covered 5
5. Leaves sessile or nearly so and laminae more or less obovate *P. traversii*
 Leaves with distinct petioles 0.5 mm or more long and laminae oblong, elliptic or ovate 6
6. Leaves oblong, elliptic or ovate, midvein sunken adaxially *P. gnidia*
 Leaves broad-elliptic to broad-ovate, midvein not sunken adaxially *P. poppelwellii*
7. Plants erect or suberect 8
 Plants prostrate to decumbent 13
8. Plants with pliable leaves and stomata on both adaxial and abaxial surfaces 9
 Plants with stiff leaves and stomata only on adaxial surfaces 11
9. Relatively tall, mature plants (to 80 cm) *P. orthia* s.l.
 Shorter mature plants (to 40 cm) 10

KEY TO THE NEW ZEALAND GLABROUS-LEAVED *PIMELEA* SPECIES

The key covers the *Pimelea gnidia* group of five species which have dry fruits and seeds that disperse within the dried flowers (Burrows 2008). It also covers the *P. prostrata* – *P. urvilliana* species groups totalling nine species (*P. actea* and *P. telura* (Burrows 2008) and the seven dealt with in the present paper). All of these nine have small flowers and fleshy white (sometimes pink) fruits with seeds dispersed by animals when the fruits ripen and the bases of flowers rupture to expose them. The key is based on vegetative characters. The sets of subspecies for *P. prostrata* and *P. urvilliana* (this paper) are keyed separately in the text. A key to the subspecies of *P. traversii* is in Burrows (2008).

Note that two species not covered in this key are *P. microphylla* (central North Island volcanoes and adjacent sandstone ranges) and the as yet undescribed *P.* “hidden” (north-west Nelson). Their mature leaves are glabrous but juvenile leaves and involucre bracts almost always bear at least a few hairs. Search with a lens or stereomicroscope is needed to see these. Checks of stomatal presence on leaf surfaces also usually require use of a stereomicroscope and prior chemical clearing of the obscuring internal leaf tissue. Hybrid forms are not included in this key. They are dealt with in the text (and also see Burrows 2008).

10. Plants few-branched, generally erect; leaves flat; in coastal sandy habitats with immature soils; only in Wanganui-Manawatu..... *P. actea*
Plants many-branched, generally upright, but sprawling; leaves flat but often tightly curled when dry; in heathland, gumland, grassland with mature soils; North Auckland, South Auckland, near East Cape, Hawke's Bay *P. xenica*
11. Robust plants with spreading branches (to 1 m tall and wide); leaves adaxially concave; confined to Three Kings Islands..... *P. telura*
Smaller plants (to 40 cm tall) with other growth habits; adaxially concave or keeled leaves; in other locations 12
12. Erect plants with relatively thick (to 4 mm wide), mainly sympodially branched leading stems; leaves adaxially concave or slightly keeled, in scattered sites on northern North Island coasts..... *P. sporadica*
Erect to suberect plants with thin (to 2.5 mm wide), flexible, sympodial and ascendant lateral stems; leaves keeled; confined to Maunganui Bluff summit area, Northland..... *P. eremitica*
13. Leaves relatively thin and pliable with stomata clearly visible on both adaxial and abaxial leaf surfaces; glabrous to sparse or moderate hair covering on young stem internodes *P. prostrata* s.l.
Leaves relatively stiff with stomata only on adaxial leaf surfaces; dense to very dense hair covering on young stem internodes..... 14
14. Leaves stiff, broad-elliptic or broad ovate; internode hair moderately dense, short, grey-white..... *P. carnosa*
Leaves stiff to flexible, elliptic or ovate; internode hair dense, long, bright white..... *P. urvilliana* s.l.
15. Hairy-leaved species, the key to which will appear in a future article.

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Appendix 1 Translation of the original description of *Banksia prostrata* by J.R. Forster et G. Forster in *Characteres Generum Plantarum*... London, 1776).

	From Latin
4. <i>Banksia</i>	[This is the generic description].
Cal.	None.
Cor.	Single-petalled, tubulose. Tube cylindrical.
Limb.	Four-partite, patent-reflexed, lobes oval, equal in size, tube short.
Stam.	Filaments two, filiform inserted at the mouth of the tube, erect, about the length of the corolla limb. Anthers ovate.
Pist.	Ovary ovate. Style filiform, as long as the tube. Stigma moderately large.
Per.	Ovate, unilocular, villose, not dehiscent.
Sem.	Solitary, glabrous, oblong, involucrate.
	[This is the specific description.]
<i>prostrata</i> 3. B.	Leaves ovate-oblong, sessile, fleshy.

Appendix 2 Translation of G. Forster's description of *Banksia prostrata* in *Decas Plantarum Novarum Ex Insulis Maris Australis Nov Act. Kon. Vet. Upsala* 3, 171–186 (1780).

	From Latin
<i>Banksia prostrata</i> 3.	Leaves sessile, ovate-oblong, fleshy.
Stems	Bushy, prostrate, terete, much-branched, scarcely nine inches [=23 cm] long.
Branches	Shrubby, round, thin, dichotomous, greyish, leafy.
Branchlets	The uppermost young ones herbaceous, yellowish.
Leaves	Opposite, sessile, ovate-oblong, obtuse, entire, fleshy, thick, glabrous, patent, often horizontal, decussate, three lines* [6.4 mm] long.
Inflorescence	Terminal, sessile, usually with 10–20 flowers.
Flowers	White, scented, outside silky-hairy, scarcely a quarter inch [=6.4 mm] long when flattened out.
Cal.	None.
Cor.	Tube narrow, long, pilose, limbs four-lobed, oval, horizontal, subrevolute, equal.
Stam.	Filaments two, erect, inserted near the mouth of the corolla and about half as long.
Anthers	Oval, erect.
Pict. Corolla	Ovate, style filiform, as long as the stigma, capitate.
Per.	Ovate, unilocular, without valves, villose, coriaceous, green.
Sem.	Solitary, ovate, acuminate, with a black, glabrous coat

Living in New Zealand on dry hillsides.

[*1 line = $\frac{1}{12}$ inch = 2.12 mm]

Note: Flowers found especially at autumn time, in the months March and April and also flowers can be seen in the spring months of the following year, namely October, for all species and especially for *prostratam* [sic]. Small evergreen shrubs; lowermost old leaves gradually fall whilst new young leaves originate on the forks [of the branches].

Appendix 3 Translation of the description of *Pimelea laevigata* by D.C. Solander in *Primitiae Florae Novae Zelandiae...* 1769–1770 collectarum, pp. 386–7 (unpublished MS at Natural History Museum, London).

	From Latin
DIANDRIA	(with two anthers)
MONOGYNIA	(with one gynoeceium)
PIMELEA	Πίμελη
	[This is the generic description.]
CAL.	None.
COR.	Single-petalled, funnel-shaped, withering but persistent. Tube swollen at the base, narrowed above. Limb flat, four partite, lobes ovate-oblong.
STAM.	Filaments two, filiform, short, inserted at the neck of the corolla where the limbs diverge. Anthers ovate-oblong.
PIST.	Ovary superior, oblong. Style filiform, erect, extending to the stamens. Stigma simple.
PER.	Berry ovate-oblong, unilocular.
SEM.	Single, ovate, hard.
	[This is the specific description.]
<i>laevigata</i> PIMELEA m.	scr. p. 10
α)	Branches glabrous. Fig. pict. Entirely southern.
β)	Branches villous.
Location	In New Zealand in open places near Teoneroa [Gisborne], Tigadu [Anaura Bay], Tolaga [Tolaga Bay], Opuragi [Mercury Bay] and Motuaro [Motuara I.], Totaranui [Queen Charlotte Sound]. Woody.
Shrub	Small, one and a half feet [c. 45 cm], very much branched, diffuse.
Stems	Terete, divaricate; in α) yellowish-brown, hairless except at the divergence of the branches [i.e., the old receptacle], branchlets slightly hairy. In β) hair [on branchlets] densely matted, snow white.
Leaves	Decussate, subsessile, strictly patent, oblong-oval, entire, without hair, flat, subsucculent; glaucous, three or four lines* [i.e., 6.4–8.5 mm] long.
Flowers	Terminal, extending only a little way above the leaves, sessile, capitate. Flower head sessile, multiflowered (12–15 flowers).
Calyx	None.
Corolla	Single-petalled, funnel-shaped, one and a half lines [= 3.18 mm] long, white, persistent, outside of tube hairy, white, swollen [at the base] and narrowed to the neck. Mouth narrow.
Limb	Four-partite, lobes oblong-ovate, obtuse, spreading, flat.
Filaments	Two, short, thread-like, inserted at the upper throat of the corolla where the lobes diverge.
Anthers	Ovate, erect, orange.
Ovary	Superior, oblong, attenuate, glabrous; style filiform, erect, as long as the corolla, inserted laterally on the upper part of the ovary.
Stigma	Simple.
Fruit	Ovate, tapered on both sides, large.
Seed	Single, outer layer thin; hard, fragile, coat black.
[*1 line = 2.12 mm]	

Appendix 4 Translation of the description and observations on *Pimelea urvilliana* by A. Richard in *Essai d'une Flore de la Nouvelle Zélande*, Paris (1832).

From Latin

227. *Pimelea urvilliana*, Nob.

Branches with silky white hair; leaves elliptic, obtuse, glabrous, flowers small, outside hairy, calyx lobes suborbicular, obtuse. Growing in New Zealand at a place called Tasman Bay (D'Urville). Spreading, much-branched shrub with terete dichotomous branches clad in silky, silvery hair.

Leaves opposite, close together, small, barely 3–4 lines [6.4–8.5 mm] long, 2–3 [4.2–6.4 mm] wide, sessile, oval, subobtus, glabrous, entire, coriaceous, almost without visible veins. Flowers small, white, 6–8, crowded in heads near the apex of branchlets; involucre leaves surround the top of the receptacle upon which is silky hair.

Calyx short, monosepalous, somewhat tubular, outside densely hairy, tube barely 1 line [2.12 mm] long, limb, 4-partite, lobes flat, horizontal, suborbicular, obtuse, 1 line long. Stamens 2, short, inserted at mouth, style twice as long as the calyx tube, gracile. Fruit... [i.e., not seen].

From French

Observations

The species for which we are here outlining the description summary is very similar to the preceding one [i.e., *P. prostrata*] of which it possibly is not more than a variety. However, it presents characters peculiar to itself that differentiate it. Thus, the younger branches have instead of simple hairs a dense mat of silky white hair. The flowers are very petite, equally silky on the outside and the calyx lobes are very short, obtuse and rounded.

Appendix 5 Location of specimens in Fig. 28 and 29.

Fig. 28

Pimelea prostrata subsp. *prostrata*

1. CANU 67410 Cape Turnagain, S Hawke's Bay, *D. G. Lloyd*, 17 Feb 1967.
2. MT 0001 Herbertville, S Hawke's Bay, *M. Thorsen*, 15 Jan 2004.
3. CHR 402246 Westlawn, Kaimanawa Mts, 1100 m, *A. P. Druce*, Dec 1984.
4. CHR 366477 Maud I., Pelorus Sound, *C. C. Ogle*, 30 Dec 1979.
5. CHR 90405 S arm Pelorus Sound, Marlborough, near Havelock, *J. A. Hay*, 22 Dec 1949.
6. CHR 330595 Pine Valley, Wairau Valley, Marlborough, *J. McMahon*, Mar 1929.
7. CANU 8818 Chrome Hill, Wairau Valley, Marlborough, *C. J. Burrows*, Mar 1965.
8. CHR 189095 Alma R., Molesworth, Marlborough, *L. B. Moore*, 12 Feb 1969.
9. CHR 120491 Black Hill, Rotoiti, Nelson, *M. J. Simpson*, 16 Feb 1961.
10. CHR 393884 Red Hill, Whangamo, E. Nelson, *A. P. Druce*, Nov 1982.

Pimelea carnosa

11. CHR 180856 W of Cape Farewell, N W Nelson, *A. P. Druce*, May 1968.
12. CHR 167671 Wharariki Beach, NW Nelson, *M. J. Simpson*, 8 Dec 1965.
13. CANU 26063 Paturau, NW Nelson, *C. J. Burrows*, Oct 1976.
14. CHR 177509 Kahurangi Point, NW Nelson, *G. I. Collett*, Mar 1965.
15. CHR 482650 Charleston, Buller, *D. R. Given*, 14 Nov 1974.
16. CHR 90988 S of Waitotara, Wanganui, *R. Mason*, 11 Jan 1956.
17. CHR 159541 Kaupokonui Stn, Taranaki, *A. P. Druce*, Feb 1964.
18. CANU 38878 Awana Beach, Great Barrier I., *J. Ogden*, 29 Oct 1997.
19. CHR 89191B Awaroa Pt, Little Barrier I., *L. B. Moore*, 30 Dec 1941.
20. CHR 451257 Tawhiti Rahu I., Poor Knights, *A. E. Wright*, 27 Apr 1991.

Hybrids

21. CANU 66235 Titahi Bay, Wellington, *D. G. Lloyd*, 29 Jul 1966.
22. CANU 66246 Mouth of Makara R., Wellington, *D. G. Lloyd*, 30 Jul 1966.
23. CHR 221389 Lyall Bay, Wellington, *A. P. Druce*, Sep 1944.
24. CHR 473223 Moa Point, Wellington, *P. J. de Lange*, *G. A. Taylor*, 17 Mar 1991.
25. CHR 472887 Onoke sandspit, Palliser Bay, *P. J. de Lange*, *G. M. Crowcroft*, 14 Sep 1990.

26. CHR 179522 Mataoperu Stm, SW of White Rock, *A. P. Druce*, Nov 1967.
27. CHR 73627 Between Wharepapa Stm and L. Onoke, *J. Hay*, 16 Dec 1951.
28. CHR 73626 Between Wharepapa Stm and L. Onoke, *J. Hay*, 16 Dec 1951.
29. CHR 23458 Palliser Bay, Western Lake Rd, *R. Mason*, 28 Jan 1940.
30. CHR 75680B Between White Rock and Cape Palliser, *J. Hay*, 25 Apr 1952.
31. CHR 87197A Palliser Bay, *P. Harrigan*, 7 Mar 1954.
32. CHR 75682B Between White Rock and Cape Palliser, *J. Hay*, 25 Apr 1952.
33. CHR 75682C Between White Rock and Cape Palliser, *J. Hay*, 25 Apr 1952.
34. CHR 73625B Lake Onoke, Palliser Bay, *J. Hay*, 16 Dec 1951.
35. CHR 179523 Mataoperu Stm, *A. P. Druce*, Nov 1967.
36. CHR 92937 Seatoun, Wellington, *I. W. Davey*, 12 Oct 1938.
37. CHR 28372 Ohariu Bay, Wellington, *R. Mason*, 20 Oct 1940.
38. CHR 330603 Miramar, Wellington, *T. Kirk*, no date.
39. CHR 23777 Castle Point, Wairarapa, *L. B. Moore*, 14 Apr 1940.
40. CHR 497458 Cape Palliser–White Rock, *P. J. de Lange*, *G. M. Crowcroft*, 26 Feb 1998.

Fig. 29*Pimelea prostrata* subsp. *ventosa*

1. OTA 41817 Five Fingers Peninsula, Dusky Sound, *A. F. Mark*, 16 Nov 1984.
2. CHR 90403 Spit I., Preservation Inlet, *H. H. Allan*, 26 Jan 1946.
3. CHR 310922 Chalky I., Preservation Inlet, *P. N. Johnson*, 31 Oct 1976.
4. CHR 147877 Puysegur Point, *G. I. Collett*, Dec 1963.
5. CHR 320076 Green Islets, SW Fiordland, *P. N. Johnson*, 30 May 1978.
6. CANU 8774 Bird I., Foveaux Strait, *B. A. Fineran*, Mar 1964.
7. CHR 148745 Centre I., Foveaux Strait, *G. I. Collett*, Mar 1964.
8. CHR 391168 Orepuke, Southland, *G. Brownlie*, 17 Oct 1984.
9. OTA 41132 Tiwai Point, Southland, *M. Heads*, 27 Nov 1982.
10. CHR 364054 Waituna Lagoon, Southland, *P. N. Johnson*, 22 Sep 1981.

Pimelea carnososa (for fuller citations, see above)

11. CHR 180856 W of Cape Farewell, NW Nelson.
12. CHR 167671 Wharariki Beach, NW Nelson.
13. CANU 26063 Paturau, NW Nelson.
14. CHR 177509 Kahurangi Point, NW Nelson.
15. CHR 482650 Charleston, Buller.
16. CHR 90988 S of Waitotara, Wanganui.
17. CHR 159541 Kaupokonui Stm, Taranaki.
18. CANU 38878 Awana Beach, Great Barrier I.
19. CHR 89181B Awaroa Pt, Little Barrier I.
20. CHR 451257 Tawhiti Rahu I., Poor Knights.

Hybrids

21. CHR 330419 Waikoua R., W Southland, *A. Wall*, Feb 1926.
22. CHR 358018 Orepuke, Southland, *R. Powell*, Jan 1975.
23. CHR 83617 Bluff, *L. B. Moore*, 12 Sep 1953.
24. CHR 353852 Sandfly Bay, Otago Pen., *P. N. Johnson*, 7 March 1982.
25. CHR 211 Hoopers Inlet, Otago Pen., *J. S. Thomson*, Nov 1928.
26. CHR 364270 Quarantine I., Otago Harbour, *P. N. Johnson*, 27 Nov 1981.
27. CHR 420056 Black Head, S of Dunedin, *P. N. Johnson*, 2 Sep 1985.
28. CHR 330420 Black Head, S of Dunedin, *A. Wall*, Jan 1920.
29. CHR 363946A Tunnel Beach, S of Dunedin, *P. N. Johnson*, 19 Jun 1981.
30. CHR 91626 Lawyers Head, Otago Pen., *D. Petrie*, Nov 1892.
31. CHR 76483 Sand dunes, S of Dunedin, *G. Simpson*, Feb 1952.
32. CHR 363946B Tunnel Beach, S of Dunedin, *P. N. Johnson*, 19 Jun 1981.
33. CHR 11615 Karitane, N Otago, *J. S. Thomson*, no date.
34. CHR 11610 Waikouaiti N Otago, *J. S. Thomson*, no date.
35. OTA 1736 Sandymount, Otago Peninsula, *H. M. Aitchison*, 26 Sep 1953.
36. OTA 3871a Tautuku, Catlins, *B. F. Slade*, 19 Jan 1957.
37. OTA 3872 Tautuku, Catlins, *B. F. Slade*, 19 Jan 1957.
38. OTA 41336 Nugget Point, S Otago, *M. Heads*, 25 Oct 1984.
39. OTA 46124 False Islet, S Otago, *M. Heads*, Nov 1986.