Systematics of New Zealand *Pimelea* (Thymelaeaceae)

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Abstract

Pimelea Banks and Sol. ex Gaertn. is a genus of shrubs, sub-shrubs and herbs belonging to the eudicot family Thymelaeaceae. First described 1769, the genus initially contained four species but has since grown to contain 126 species which are distributed around Australia, New Zealand and Lord Howe Island. New Zealand has 35 endemic *Pimelea* species, and numerous subspecies bringing the total to 51 taxa which are distributed across the North and South Islands, as well as offshore.

The most recent revision of the genus *Pimelea* was conducted by Colin Burrows throughout a series of five papers published from 2008 to 2011. Burrows (2011), as well as Motsi (2010), theorized that New Zealand's *Pimelea* initially originated from Australia. Motsi (2010) went on to hypothesise that these species were monophyletic and that the diversity present occurred via speciation and radiation. The conclusions drawn by these two papers, however, have their limitations. Burrows (2011) based his solely on the morphology of species across New Zealand *Pimelea*, while Motsi (2010) only studied the molecular sequences of four New Zealand *Pimelea* species. Burrows, throughout a number of his papers, also studied the molecular systematics of *Pimelea* and attempted to organize its taxonomy but similarly only based his findings on morphological traits.

This project has four key aims, the first is to assemble and review the literature currently available about *Pimelea* and in particular, the New Zealand *Pimelea.* Due to the absence of previous research which considers both morphology and molecular phylogenetics of *Pimelea*, this project will include all New Zealand *Pimelea* taxa and will use both morphological traits and molecular analysis of the DNA sequence variation off the nuclear ribosomal inter transcriber spacer regions (ITS). Using these, this research intends to 1) test the classification of the genus sensu Burrows, 2) infer biogeographic relationships between *Pimelea* species within New Zealand and 3) infer the number of colonization events of *Pimelea* in New Zealand and hence test its monophyly.

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"If we treat people as they are, we make them worse. If we treat people as they ought to be, we help them become what they are capable of becoming"

-Johann Wolfgang van Goethe

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Chapter One: Thesis introduction

1.1 Overview

The Thymelaeaceae (Malvales) includes about 898 species of shrub, subshrub and perennial herb species (Stevens, 2001 onwards; Rogers, 2009). Originally Heywood et al. (2007) recognized four subfamilies, Thymelaeoideae, Aquilariodeae, Gonystyloideae and Gilgiodaphnoideae (Rogers, 2009), however, the most recent classification of this family by Stevens (2001, onwards) recognizes the genus *Tepuianthus* Maguire & Steyermark, and two subfamilies, Octolepidoideae Gilg and Thymelaeoideae Burnett. The two subfamilies are further segregated with Octolepidoidae containing eight genera and Thymelaeoideae containing another 44, equating to 52 genera in total (Stevens, 2001 onwards; Rogers, 2009). The family is distributed worldwide (excluding Antarctica) and shows significantly higher concentrations of species and higher floral diversity in tropical and temperature areas such as South Africa and Australia (Van der Bank et al. 2002). Thymelaeaceae typically display fibrous bark, with entire leaves and parallel venation (Herber, 2003). Flowers are typically large, with an unpleasant odour and are arranged in heads (Herber, 2003). Fruits are drupes or capsules, and are typically fleshy (Herber, 2003). Fruits and seeds of the Thymelaeaceae family are dispersed via wind, or animal vectors and insect species, such as butterflies and long tongued bees, are the sole pollinators (Herber, 2003). Australia is inhabited by species from nine of the 52 genera, while in comparison New Zealand only has species from two, *Kelleria* Hook. Endl and *Pimelea* Sol. ex Gaertn.

The genus *Pimelea* belongs to the subfamily Thymelaeoideae *(*Burrows, 2008) and is distributed across Australia, Lord Howe Island, and New Zealand, including some offshore islands (Fig. 1.1). There are an estimated 126 species of *Pimelea* (Burrows, 2008), 74 which are endemic to Australia, one which is endemic to Lord Howe Island and 51 taxa are endemic to New Zealand (Burrows, 2008). Four *Pimelea* species in Australia toxic, containing the

toxin simplexin which is responsible for the illness "St George Disease" and causes the death of cloven-hoof, grazing livestock (Freeman et al. 1979; Zayed, 1982; Fletcher et al. 2009). In New Zealand, only two species of *Pimelea* are toxic, *P. prostrata* (J.R. Forst. et G.Forst) and *P. villosa* (Sol. ex sm.) These two species contain the toxin prostratin, which is considered an irritant, however, is lethal in high dosages (Cashmore, 1976; Zayed, 1982).

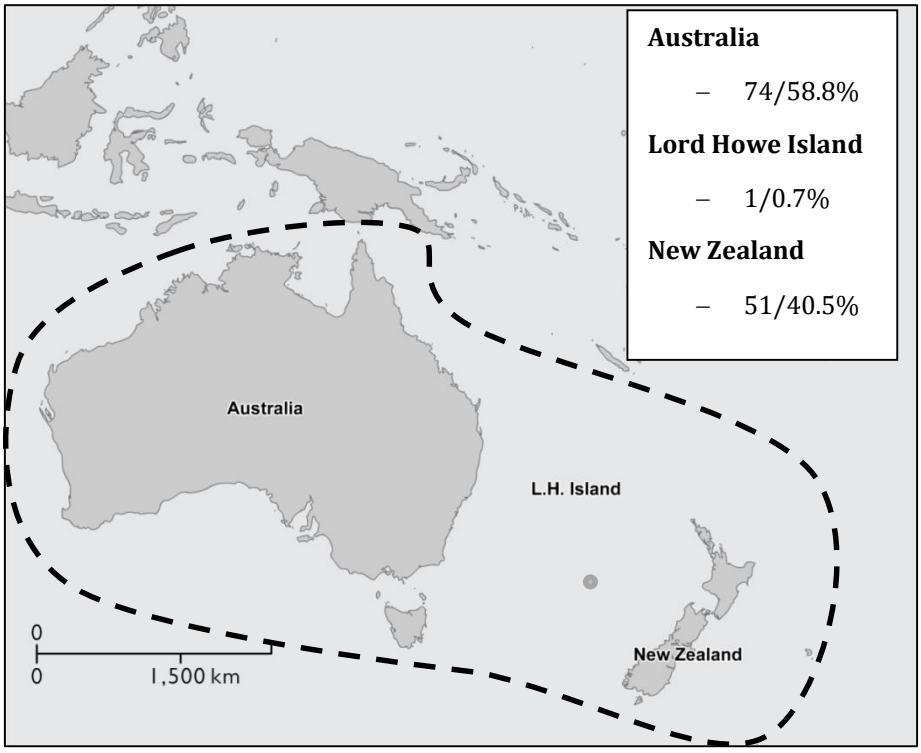

Fig. 1.1: Land distribution of the genus *Pimelea* in the Southern Pacific Ocean as displayed by the dashed line. The legend shows the number of *Pimelea* species endemic to each region and the total percentage of *Pimelea* species present (de Lange et al. 2012).

The common name for the genus in New Zealand is the New Zealand daphne, an otherwise misleading title as *Daphne* is a separate genus of the family Thymelaeaceae.

New Zealand species of *Pimelea* are distributed to sandy dune, alpine and grassland habitats across the North, South and offshore islands (Rye and Heads, 1990; Burrows, 2011b). Species endemic to New Zealand range from

prostrate shrublets to tall shrubs up to a height of 2 metres. Stems are always brown, however the presence of pubescence on the stem can vary dramatically.

Leaves are consistently entire, and range in shape from elliptic and ovate, to lunate. These are arranged in a decussate, opposite pattern along the stem. Leaf size ranges greatly across species. Node buttresses, present below the leaf axil, range from short to long, and can also be either narrow or thick. Leaves vary in their amount of pubescence; some are glabrous while others are densely covered. Corolla are tube-like and contain a star-shaped hypanthium, petals are brown, white or cream colouration. Fruits are either dry and achene-like, or fleshy and berry-like (Burrows, 2008).

New Zealand *Pimelea* have a gynodiecious breeding system, with individual flowers either being hermaphrodites or fertile females (Burrows, 1960; 2001). A typical population of *Pimelea* species often displays a 10:1 to 20:1 ratio of females to hermaphrodites (Burrows, 1960).

Figure 1.2: A: *Pimelea gnidia* (J.R. Forst et G.Forst.) displaying the prostrate shrub habit of the species. Photo by ©Jeremy Rolfe (used with permission). B: *Pimelea urvilleana* (A. Rich) subsp. *urvilleana* displaying the typical dull colour petals and fleshy fruit of *Pimelea*. C: *Pimelea acra* (C.J. Burrows et de Lange) displaying the descussate, opposite leaf structure and entire leaf margins. Elliptic to ovate shape of the leaves also visible. All photos used with permission of ©Jeremy Rolfe.

Research into the systematics of New Zealand *Pimelea* is of urgency as according to de Lange et al. (2012), 49% of New Zealand *Pimelea* taxa are considered to be threatened or at risk. An additional 27% of species are considered "data deficient", where there is insufficient information on the species to allow a conservation status to be determined (de Lange et al. 2012). The decline in New Zealand *Pimelea* species has been attributed to recruitment failure, habitat destruction, invasive species invasion and habitat destruction (Burrows, 2009b). Human settlement of lowland zones has forced many of the taxa to become restricted to isolated areas across New Zealand. These areas are typically climatic extremes, including wind driven shrublands, coastal dunes and mountainous zones.

Colin Burrows published five papers from 2008 to 2011, which attempted to determine origin, describe new species and revise the taxonomy of *Pimelea* (Burrows, 2008; 2009a; 2009b; 2011a; 2011b). From his revision, Burrows used differing character traits to assign the 51 *Pimelea* into 3 groups – A, B and C. Furthermore, he catorgorized C into subgroups C(i), C(ii) and C(iii) (Burrows, 2008; 2009a; 2009b; 2011a; 2011b). However, using only

interspecific and intraspecific morphological variation to deduce conclusions limited his findings as New Zealand *Pimelea* are taxonomically difficult to classify. This is due to a high degree of interspecific hybridisation, overlapping species boundaries and the presence of multiple character states for single characters (Burrows, 2008). Furthermore, Peter de Lange (Department of Conservation, pers. comm., 18 December 2014), suggests that in some instances what Burrows observed in these papers as separate species' was actually morphologically different sun and shade variants of a single species of *Pimelea*.

The number of colonization events from Australia onto New Zealand by *Pimelea* is also unresolved. Motsi et al. (2010) and Burrows (2011b) give conflicting theories about the number of colonization events they believed to have occurred. Analysing both the ITS region of *Pimelea* and the morphological variation using cluster analysis will enable better understanding of the evolutionary history of the genus within New Zealand as well as provide a more robust classification.

1.2 Research objectives

The aim of this thesis research is to determine the origin(s) of the native New Zealand genus *Pimelea* and test the classification proposed by Burrows. This will be addressed by the following three objectives:

1. Assemble and review the current literature on *Pimelea*.
2. Use morphological characters and DNA sequence variation to
    a. Test the classification *sensu* Burrows.
    b. Infer relationships between *Pimelea* species within New Zealand.
    c. Determine number of colonization events of *Pimelea* in New Zealand.

1.3 Thesis outline

These research objectives listed in 1.2 are addressed in Chapters two and three. Chapter 3 is written as an independent article to be submitted for publication in journals such as Australian Systematic Botany.

Chapter one: Thesis introduction

Chapter two: Literature review of *Pimelea*

This chapter aims to assemble and review the primary literature associated with the topic and identifies key knowledge gaps to be addressed within the thesis. In particular, this chapter will focus on the work and theories put forward by Colin Burrows.

Chapter three: Testing Burrows' classification of New Zealand *Pimelea* using morphological characters and molecular phylogenetics

This chapter will use both statistical analysis of the morphology and DNA sequence variation of the internal transcribed spacer (ITS) region to test the current classification of *Pimelea* in New Zealand, infer relationships and infer the origin of New Zealand *Pimelea*. This chapter is intended for submission to the journal Australasian Systematic Botany.

Chapter four: Synthesis

Provides a summary of the key findings and conclusions drawn by the paper, discussion of their implications and future research recommendations.

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Chapter Two: Literature review

2.1 History of New Zealand

2.1.1 Geological formation

Prior to the Cretaceous period, the continent Zealandia was situated on the Pacific-facing side of the supercontinent Gondwana (Kamp, 1986; Cooper and Millener, 1993; Laird and Bradshaw, 2004). Around 130 million years ago, this supercontinent began to shift and break apart due to tectonic changes in the Earth's crust (Kamp, 1986; Cooper and Millener, 1993; Laird and Bradshaw, 2004; Campbell and Hutching, 2007; Graham, 2008). During the late Cretaceous period (82 mya), development of the Australia-Pacific plate boundary caused Zealandia to begin to separate from what was to become Australia, South America and Antarctica (Molnar et al. 1975; Wallis and Trewick, 2009). This separation ceased around 60 million years ago, by which time Zealandia was beginning to stretch and thin (Laird and Bradshaw, 2004). At this point, Zealandia became completely isolated from all other land masses (Waters and Craw, 2005).

2.1.2 Oligocene drowning and New Zealand biota

Over the following 44 million year period, Zealandia had thinned so significantly that it, at least part of the landmass, had become submerged beneath the Pacific Ocean (Wallis and Trewick, 2009). Significant re-emergence only began taking place after the re-occurrence of collision tectonic activity along the plate boundary around 23 million years ago in the Miocene period (Wallis and Trewick, 2009). Around 93% of the original Zealandia continent still remains submerged beneath the Pacific Ocean (Fig. 2.1) with New Zealand having only been estimated to have been submerged for around two million years. (Wallis and Trewick, 2009).

Figure 2.1: Map of Zealandia (shaded) showing New Zealand, New Caledonia, and Lord Howe Island (Wallis and Trewick, 2009).

During New Zealands drowning, it is debated as to whether the land mass was completely submerged or whether small islands remained above marine level and acted as "safe havens" for the flora and fauna (e.g. Cooper, 1989; Cooper and Millener, 1993; Cooper and Cooper, 1995; Campbell and Hutching, 2007; Wallis and Trewick, 2009). Complete submergence would have had a catastrophic outcome on the flora and fauna present, and has left open two possible hypotheses for the origin of New Zealands current biota, long distance dispersal and vicariance (Cox, 1998). Other research claims that the overwhelming geological evidence such as marine sediments, wave-cut surfaces and marine incursion (LeMasurier and Landis, 1996; Turnbull et al. 1975; Campbell and Landis, 2003; Waters and Craw, 2005), and the molecular evidence that "Gondwanan" biota arrived after the Oligocene drowning indicates very strong support of New Zealand being submerged entirely. If New Zealand was completely submerged, the only possibility for the biota present today was that they arrived via long distance dispersal. Around 23 mya, the time that Australia and South America began to drift from Antartica, a phenomena named the West-wind drift was formed (Winkworth et al. 2002). This wind current, caused cyclonic flow of air currents to travel from Australia to New Zealand and has been considered

responsible for the mediation of movement around the Southern Hemisphere (Winkwoth et al. 2002; Sanmartin et al. 2007). The theory put forth is that if New Zealand was completely submerged, this wind current would have been responsible for the re-colonization of New Zealands biota. Testing of animals, insects, pollen and spores in New Zealand has indicated that present day species share strong Australian and New Caledonian affinities (Winkworth et al. 2002). This provides evidence for long distance dispersal in that the West-wind drift is allowing for the dispersal of plant and animal species from Australia, via New Caledonia, to New Zealand (Winkworth et al. 2002).

Alternatively, if complete submergence did not occur, then it is possible that some species present in New Zealand today are relicts from Gondwana. Some argue that species such as *Agathis australis* (kauri), *Fuscospora* and *Lophozonia* (southern beeches), *Dinornithidae* (moa), *Apteryx* (kiwi) and *Sphenodon* (tuatara) could not have reached New Zealand via long distance dispersal and therefore must have remained here over the drowning (Cox and Moore, 1973; Bunce et al. 2009).

2.1.3 New Zealand climate history

During this time of geological shifting, the climate of New Zealand was altered dramatically. Prior to the Cretaceous period (>145mya, New Zealand was exposed to subtropical/tropical conditions, with slight warming occurring only during the Eocene (56 mya – 33mya) and Miocene (23mya – 5.3 mya) (Winkworth et al., 2002) until the onset of climatic cooling during the beginning of the Pliocene period (5.3mya – 2.8mya) (Lee et al. 2001). Around 150,000 years ago, during the Pleistocene (2,588,000ya – 11,700ya), periodic glaciation occurred causing a cycle of warming and moistening to then cooling and drying (Wallis and Trewick, 2009). This cooling correlated with a catastrophic increase in species extinction and a great loss of floral diversity (Lee et al. 2001). This glacial period finally settled around 14,000 years ago and was then followed by warm and moist conditions until cooler, drier conditions finally settled (Winkworth et al., 2002).

2.2 Characteristics of New Zealand flora

According to Mildenhall (1980) during the later Cretaceous periods (145mya – 65mya), increased rainfall caused bryophyte species to dominate the New Zealand landscape. As warming occurred, angiosperms began to rapidly evolve until the Oligocene drowning. During the late Miocene (23mya – 5.3 mya), herbaceous taxa and angiosperm families started to rapidly radiate across the now re-emerged landscape with significant evolution and extinction occurring (Mildenhall, 1980). All remaining open niches were quickly colonized by evolving floral pollen species (Mildenhall, 1980).

Sixty million years of geological isolation and the colonization by highly dispersible species (McGlone et al. 2001) has left New Zealand's with one of the highest plant endemism rates, in the world, with no fewer than 80% of all land plant species being endemic to New Zealand (Millener, 1960; Mildenhall, 1980). This isolation, plus New Zealand's rich history of tectonic activity has meant that in comparison to other island countries, such as Japan and New Caledonia, New Zealand has a significantly lower number of species and higher rate of hybridization (Millener, 1960; Mildenhall, 1980).

One particular characteristic of the New Zealand flora is the small, structurally simple, or unspecialized, white flowers that are present on a large number of angiosperms (Castro and Robertson, 1997). In a study undertaken by Godley (1979), it was found that of 649 native New Zealand species, 60.6% of these had white or light yellow colouration. These characters make New Zealand flowers generalists and in particular, make them more suitable to be pollinated by a wide range of different species. In areas of the world where insects are the main pollinators, 'entomophilous' flowers are often prevalent. Entomophilous flowers tend to grow in heads, are sweetly scented and are cream, white or green in colour (Castro and Robertson, 1997). In contrast, in areas where birds are the main pollinators, flowers tend to be larger, with vivid red, orange and yellow colouration (Castro and Robertson, 1997). Godley (1979) witnessed that the key native pollinators in New Zealand are seven bird species, one bat species, 16

butterfly species and 40 short-tongued bee species and that to complement this, flowers tend to be entomophilous.

2.3 Current state of New Zealand flora

At present, Mabberley (2008) estimated that the New Zealand angiosperms are comprised of 271,500 living species classified among 204 families. Of these, an estimated of these, 82% are endemic (Breitwieser et al. 2012). In a study by de Lange and coworkers (2004), 792, or 34%, of New Zealand's total indigenous vascular flora had a conservation status with 4 taxa extinct, 122 taxa acutely threatened, 96 taxa chronically threatened, 499 taxa at risk, 45 taxa having insufficient data and an additional 208 taxa listed as taxonomically indeterminate.

2.4 Thymelaeaceae

One family within the angiosperms is Thymelaeaceae, which contains an estimated 898 species (Stevens, 2001 onward; Rogers, 2009) of shrubs, subshrubs and perennial herbs. The family was established in 1789 by Antoine Laurent de Jussieu and is dispersed worldwide, excluding Antarctica and the Arctic. Members have fibrous bark and entire leaves which are usually clustered (Stevens, 2001 onwards; Herber, 2003). Leaf phyllotaxy is either alternate or opposite and leaves display parallel pinnate venation (Herber, 2003). Inflorescences are unisexual or hermaphroditic and present in heads with fruits being present as fleshy drupes or capsules (Herber, 2003). Tropical and temperate zones typically have greater frequency of individual species per population and higher floral diversity, with Australia and Africa having particularly high individual species numbers (Van der bank et al. 2002). Pollination usually occurs via wind or animal vectors, and many members are toxic (Herber, 2003). The family initially was divided into four subfamilies, Thymelaeoideae, Aquilariodeae, Gonystyloideae and Gilgiodaphnoideae (Heywood, 1993). However, after revision Herber (2003) decided on only two subfamilies, Octolepidoidae and Thymelaeoideae, and these were used by Takhtajan (2009). The octolepidoidae contains around eight genera which are usually trees and rarely shrubs (Takhtajan, 2009).

The Thymelaeoideae contain 40 genera and are typically trees or shrubs (Takhtajan, 2009).

2.5 The genus *Pimelea*

Classified within Thymelaeoideae is the genus *Pimelea*, containing an estimated 126 described species and distributed across Australia, New Zealand and Lord Howe Island (Burrows, 2008). Of these 126 species, 73 are endemic to Australia, 51 to New Zealand and one to Lord Howe Island (Burrows, 2008). The genus is named from the greek term 'Pimele' translating to "fat", in reference to its oily seeds.

2.5.1 Ecology and Morphology

In New Zealand, species are distributed across coast, alpine and shrubland environments, with offshore islands having a particularly high number of species present (Burrows, 2008; 2011a).

Leaves are always entire, structured in a decussate, opposite arrangement (Burrows, 2008). Leaf shape varies between lunate, ovate and elliptic and rarely vary in colour. Upon drying, however, some leaves display a blue-green colouration (Burrows, 2008). Leaf venation is often very prominent and is parallel pinnate in form (Herber, 2003). Leaf petioles are short in length, from sessile to a few millimetres. Pubescence on the leaf surface differs between species, with both density of pubescence and the leaf surface that the pubescence is located differing. Pubescence density can range from glabrous to dense, and location can be either abaxial, adaxial, both or none (Burrow, 2011b). Plant form ranges from cushion-like prostrate shrubs to upright shrubs (Burrows, 2008) usually taking on a "twiggy" appearance.

Flowers are either hermaphrodites, or fertile females (Burrows 1960) with dull yellow to white colouration. (Burrows, 2011). According to Burrows (1960), a typical population of *Pimelea* species can range from a 10:1 to a 20:1 ratio of females to hermaphrodites. Researchers (Carlquist, 1966; Ross, 1970) have stated that the ratio of females to hermaphrodites may indicate that *Pimelea* is evolving a dioecious breeding system. Others (Thompson, 1880; Cheeseman, 1925) believe that *Pimelea* has already evolved a polygamo-dioecious system. Fruits are either drupe-like and fleshy or

achene-like and dry (Burrows, 2008). Fruits also occur in a range of colours including white, pink, red, purple and black (Burrows, 2008).

2.5.2 Pollination

Due to the simple and unspecialized structure of the flowers of *Pimelea*, they are able to be pollinated by a number of species. These may include bees, butterflies, small lizards and birds. A dissertation by Burrows (1960) observed bees, flies, butterflies and moths acting as pollinators. Only a single study has been conducted on *Pimelea* pollination in New Zealand by Dawson et al. (2005) who deemed insects the main pollinators of the genus.

2.5.3 Conservation

Of the 51 New Zealand taxa, 49% are considered to be threatened or at risk de Lange et al. (2012). A further 27% are stated to be data deficient, where there is insufficient data available to assign a conservation status to the species (de Lange et al. 2012). This has been attributed to habitat destruction and settlement of lowland zones greatly restricting the available habitat of the genus (Walker et al. 2004).

2.5.4 Toxicity

Across the genus, a number of species of *Pimelea* are considered toxic to introduced cloven hoofed mammals. This toxicity is likely to have evolved as a means of chemical defence against marsupials in Australia and herbivorous insects, fungi and bacteria in New Zealand (Wittstock and Gershenzon, 2002). The majority of Australian species contain the toxin simplexin, which causes St George disease (Freeman et al. 1979; Fletcher et al. 2009). St George disease causes fluid swelling, decreased appetite, diarrhoea, weight and in some instances, death (Freeman et al. 1979; Fletcher et al. 2009). Two New Zealand species are known to be toxic upon consumption, *P. prostrata* (C.J.Burrows) and *P. villosa* (Sol ex Sm.)(Burrows, 2008). These species contain the toxin prostratin, while less toxic then simplexin, causes the illness commonly referred to as Strathmore (Cashmore, 1976; Zayed, 1982). Strathmore has been shown to cause irritation n cloven-hoofed mammals and in cases of over-consumption, the death of cattle (Cashmore, 1976; Zayed,

1982). However, synthesised prostratin has shown great benefits in the medical field and has been used as a treatment for HIV (Wender et al. 2008). Isolated in 1976 by Hecker, it acts by entering cells and down-regulating CD4 and CXCR4 receptors and thereby preventing the excessive growth of tumours (Wender et al. 2008).

2.6 The history and systematics of *Pimelea*

Four species of *Pimelea* were initially identified by Solander in New Zealand during 1770, while he was aboard James Cook's Endeavour (Burrows, 2008). In his unprinted manuscript titled "*Primitiae Florae Novae Zelandiae sive catalogus Plantarum in Eahei No Mauwe and T'avai Poenammoo"*, Solander identified *P. villosa, P. laevigata* (Cheeseman)*, P. axillaris* (Banks and Sol. ex Wikstr.) and *P. longifolia* (Sol. ex Wikstr.) along his travels. Sydney Parkinson, an artist also aboard the Endeavour, painted these species, thus allowing them to later be re-classified as *P. arenaria, P. prostrata, P. tomentosa* ((J.R.Forst. et G.Forst.) Druce), and *P. longifolia* respectively.

Fig. 2.2: Water colour paintings completed by Sydney Parkinson in 1770. From left to right: (top) *P. villosa* (now *P. arenaria), P. laevigata* (now *P. prostrata)* (bottom) *P. axillaris* (now *P. tomentosa), P. longifolia.*

On James Cook's second journey on the Endeavour, he was accompanied by father and son J.R and J.G.A Forster. They too witnessed the species identified by Solander, as well as identifying a new *Pimelea* species not observed in the prior journey, *Pimelea gnidia* (J.R.Forst. et G.Forst.) Willd.. Upon publication of their findings, Forster and Forster chose to no longer use the genus name proposed by Solander, and instead reclassified the genus as *Banksia* (Forster

and Forster, 1776). Of those species originally identified by Solander, Forster and Forster reclassified *P. longifolia, P. tomentosa* and *P. prostrata* as being members of this new genus, and therefore these were renamed to *Banksia longifolia, Banksia tomentosa* and *Banksia prostrata* with their new fifth species also being classified as *Banksia gnidia.* In 1782, J.G.A Forster wrote an independent publication in which he reclassified *Banksia tomentosa* as *Banksia pilosa* (Forster, 1782). Linneaus, one of the founders of bionomial nomenclature, was then given the oppoturnity to choose which of the genus names he wanted to use, *Pimelea* or *Banksia* (Linnaeus, 1782). Instead, Linnaeus chose to shift all five members of *Banksia* into the existing genus *Passerina*.

In his 1788 published book "De fructibus et seminibus plantarum", Gaertner established which species were to be classified to the genus *Pimelea* and the genus *Banksia. Pimelea* was to contain those species commonly referred to as riceflowers, and *Banksia* was to contain those species commonly referred to as bottlebrush. After establishing this change, Gaertner then retook the name *Pimelea* and reclassified those members that had been shifted from *Banksia* to *Passerina* back into the genus *Pimelea*.

After 1788, numerous more species were added to the genus *Pimelea*. Hooker (1853; 1867) described four new species *P. buxifolia* (Hook.f.)*, P. lyallii* (Hook.f.) *, P. sericeovillosa* (Hook.f.) subsp. *sericeovillosa* and *Pimelea traversii* (Hook.f.) subsp. *traversii* while Kirk (1880; 1884) added *P. suteri* (Kirk). Between 1886 and 1890, Colenso classified 13 more species into *Pimelea*, these included *P. microphylla* (Colenso) and *P. urvilleana*. Cheeseman (1906) described *P. aridula* (Cheeseman), while Cockyane (1921) and Petrie (1912; 1917) identified a few other *Pimelea* species. In 1961, Allan revised the genus, adding *P. psuedolyallii* (Allan) and *P. concinna* (Allan), and stating that those *Pimelea* species identified by Colenso were either unresolved forms or hybrid species. The last classification of the 20th century was by Burrows (1962) who recognized a final two new species.

2.6.1 Treatment of *Pimelea* by Colin Burrows

In 2008, Colin Burrows published the first of what was to be a series of five papers undertaking a revision of the taxonomic treatment of New Zealand *Pimelea*. His aim was to use the character traits of *Pimelea* to develop a comprehensive set of papers (Burrows, 2008). Prior to Burrows 21st century publications, 19 species of *Pimelea* had been identified (Burrows, 2008).

On observation of *Pimelea*, Burrows recognized 51 species and subspecies and divided the genus into five informal groupings based on character trait differences (Burrows, 2008; 2009a; 2009b; 2011a; 2011b). Groups "A", "B". "C(i)", "C(ii)" and "C(iii)" all displayed different character traits for particular characters (Table 2.1). Group "A", or as Burrows referred to "the *P. gnidia*" group, consisted of larger erect shrub species (Burrows, 2008). Flowers were always larger than 9mm in size and pink-magenta in colour with dry fruit (Burrows, 2008). Lack of pubescence on either leaf side was a major feature of this group and leaves were always downturned (Burrows, 2008). Also of note was the blue-green colouration that the leaves turned upon drying and that the stomata on the leaves were distributed abaxially only (Burrows, 2008). These character traits were also observed in some Australian species (Burrows, 2008).

Group B was described by Burrows as the "least well understood" of the 3 major groups, A, B and C (Burrows, 2009a). Flowers in this group were always smaller than 7mm in length (Burrows, 2009a). Similar to group A, lack of pubescence was a distinguishing feature with leaves ranging from flat to adaxially concave (Burrows, 2009a). Stomata on the leaves were difficult to observe and required the use of sodium hydroxide to view abaxially, however were mainly only distributed adaxially (Burrows, 2009a).

Group C contains within it all species that display leaf pubescence at any position on their leaves (Burrows, 2011b). Leaf size and the amount of pubescence of present on the leaf varies significantly (Burrows, 2011b). Flowers will typically lie between the range of 7mm to 9mm, but outlying species are present (Burrows, 2011b). Fruit colour and type vary greatly, and can be dry or fleshy and red, yellow, black, or white. Group C(i) varies from

the others in that leaf pubescence is present abaxially only. The side on which Group C (ii) leaf pubescence is present varies greatly and Group C (iii) has leaf pubescence present both adaxially and abaxially among its species.

Table 2.1.: Table detailing the species present in Burrows (2011b) informal groups (A, B, C(i), C(ii), C(iii)) and their most significant differentiating character traits. Left column are the various characters observed.

	A	B	C (i)	C (ii)	C (iii)
Abaxial leaf surface hair	Glabrous	Glabrous	Dense	Significant variation Glabrous – Dense	Sparse-Dense
Adaxial leaf surface hair	Glabrous	Glabrous	Glabrous	Significant variation Glabrous – Dense	Sparse-Dense
Stomatal distribution	Abaxially	Adaxially	Abaxially and Adaxilly	Abaxially and Adaxilly	Abaxially and Adaxilly
Anther Dehiscence type	Latrose	Semilatrose	Semilatrose	Latrose/Semilatrose	Semilatrose
Flower length	>9mm	<7mm	7-9mm	7-9mm	7-9mm
Fruit type	Dry	Fleshy	Fleshy	Fleshy	Fleshy
Species	*Pimelea buxifolia* *Pimelea gnidia* *Pimelea longifolia* *Pimelea poppelwellii* *Pimelea traversii* subsp. *borea* *Pimelea traversii* subsp. *exedra* *Pimelea traversii* subsp. *traversii*	*Pimelea actea* *Pimelea carnosa* *Pimelea eremitica* *Pimelea orthia* *Pimelea prostrata* subsp. *prostrata* *Pimelea prostrata* subsp. *seismica* *Pimelea prostrata* subsp. *thermalis* *Pimelea prostrata* subsp. *ventosa* *Pimelea prostrata* subsp. *vulcanica* *Pimelea sporadica* *Pimelea telura* *Pimelea urvilleana* subsp. *nesica* *Pimelea urvilleana* subsp. *urvilleana* *Pimelea xenica*	*Pimelea acra* *Pimelea ignota* *Pimelea lyallii* *Pimelea microphylla* *Pimelea tomentosa* *Pimelea villosa*	*Pimelea cryptica* *Pimelea declivis* *Pimelea dura* *Pimelea mesoa* subsp. *macra* *Pimelea mesoa* subsp. *mesoa* *Pimelea nitens* *Pimelea notia* *Pimelea oreophilla* subsp. *ephaistica* *Pimelea oreophilla* subsp. *hetera* *Pimelea oreophilla* subsp. *lepta* *Pimelea oreophilla* subsp. *oreophila* *Pimelea pseudolyallii* *Pimelea suteri*	*Pimelea hirta* *Pimelea sericevillosa* subsp. *alta* *Pimelea sericevillosa* subsp. *pulvanaris* *Pimelea sericevillosa* subsp. *sericeovillosa* *Pimelea aridula* *Pimelea concinna* *Pimelea barbata* subsp. *barbata* *Pimelea barbata* subsp. *omoia* *Pimelea mimosa*

In discerning the morphological differences between species, Burrows (Burrows, 2008; 2009a; 2009b; 2011a; 2011b) noted what he believed to be a high degree of interspecies hybridization occurring. This was observed by "parent" species being present in a habitat as well as "intermediate" species which expressed traits from two different parent species (Burrows, 2008; 2009a). Burrows believed that in the past, isolating mechanisms like dense forestry had kept segregated different species of *Pimelea* and allowed distinct morphological characters to evolve (Burrows, 2008). However, disturbance of the habitat like volcanism and human interference caused these mechanisms to be destroyed (Burrows, 2008). This destruction allowed previously isolated *Pimelea* species to inhabit the same habitat, and allowed both small and large scale hybridization to occur (Burrows, 2008). Due to how easily Burrows believed *Pimelea* hybridized, his papers theorized that the colonization of the genus in New Zealand must have been recent (Burrows, 2011b). Two different types of hybrids were recognized, the first was stable hybrids, which Burrows recognized as independent species capable of reproducing (Burrows 2011a; 2011b). These species are listed in table 2.2.

Table 2.2: Parent species and the stable hybrids produced from these species (Burrows, 2011a).

Parent species	Stable hybrid
Pimelea oreophila* subsp. *hetera **X** ***Pimelea sericeovillosa* subsp. *sericeovillosa***	*Pimelea mesoa* subsp. *mesoa*
Pimelea prostrata* subsp. *prostrata **X** ***Pimelea sericeovillosa* subsp. *sericeovillosa***	*Pimelea dura*
Pimelea prostrata* subsp. *prostrata **X** ***Pimelea oreophila* subsp. *lepta***	*Pimelea notia*
Pimelea concinna **X** ***Pimelea psuedolyallii***	*Pimelea nitens* subsp. *nitens*

The second type of observed hybrids were un-stable hybrids. These hybrids were only present within the habitat of their parent species and were infertile and incapable of being sustained. These hybrids in particular and the variation among species gave Burrows (2011b) some difficulty as they blurred the line of species boundaries and made identifying species based on morphology more problematic. In these instances, Burrows used Anderson's (1953) pictorialized scatter diagram method to portray the different characters within a population, and then made arbitrary decisions made to determine species boundaries. The disadvantage of this however, is that Anderson's method involves the researcher to assign numerical values to traits and while two species may score similarly numerically, they can still be phenotypically different (Anderson, 1953).

2.7 Proposed origin and colonization of *Pimelea* in New Zealand

Two key papers have been published regarding the origin and colonization of New Zealand *Pimelea*. Motsi et al. (2010) used *rbc*L, *trn*L-F, *rps*16 and ITS sequencing in order to try and assess the taxonomic status of the Australian

Pimelea and *Thecantes.* However, four New Zealand *Pimelea* were also included into the study, *P. orongo, P. concinna* (Allan)*, P. suteri* (Kirk) and *P. buxifolia* (Hook.f.). After sequencing the specimens and placing them into a statistical tree, it was observed that New Zealand species formed a clade which was nested into the Australian species (Fig. 2.3). Also noticeable was that *P. alpina* ex Meisn, an Australian alpine species, was strongly supported as a sister clade to the New Zealand clade (Motsi et al. 2010). From this, Motsi et al. (2010) hypothesised that not only was the New Zealand *Pimelea* originally from Western Australia, where *P. alpina* is present, but also that only a single colonization event dispersed *Pimelea* into New Zealand. This hypothesis would imply that all morphological variation between the New Zealand species was due to rapid speciation upon colonization of New Zealand, rather than multiple dispersal events. Motsi et al. (2010) did however state that their findings were limited as of the 19 New Zealand *Pimelea* species known in 2010, the authors only sequenced four.

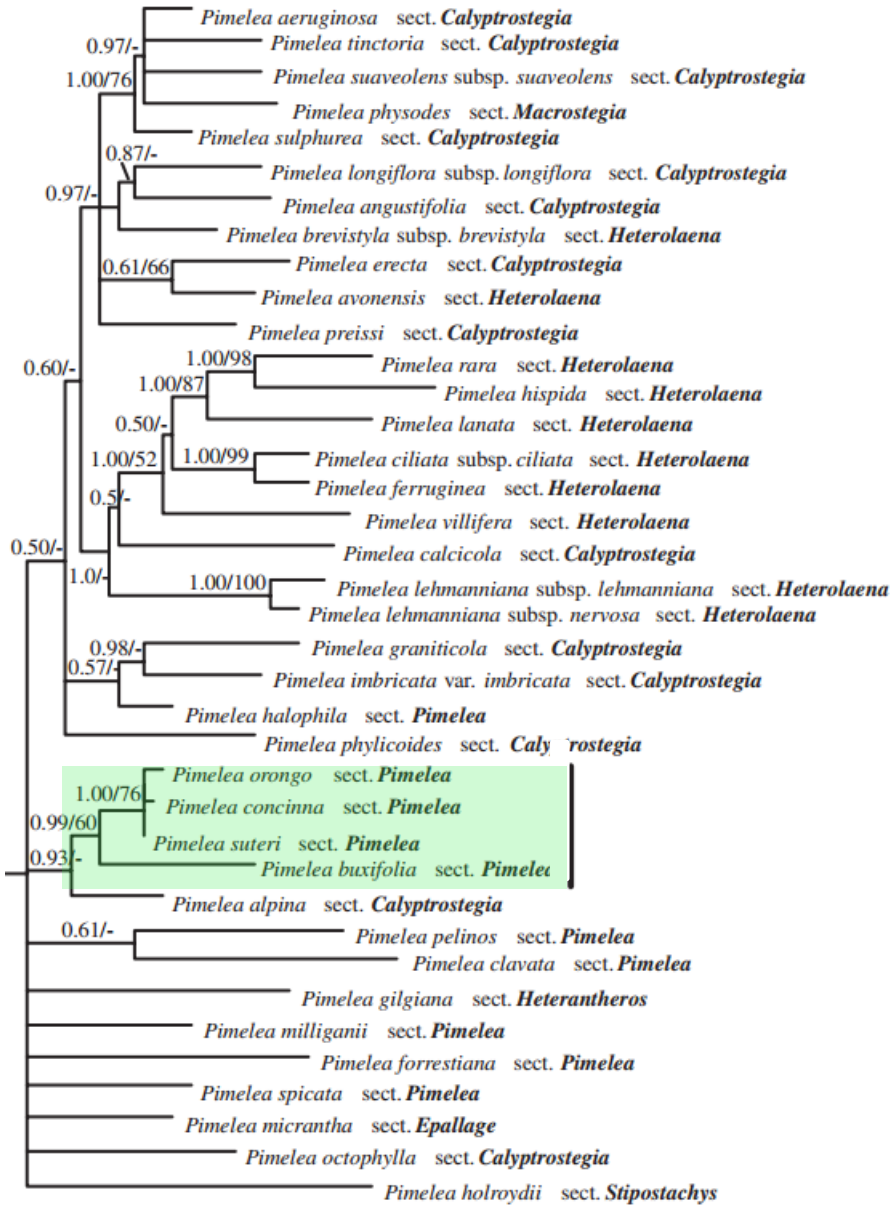

Fig. 2.3: Phylogenetic tree from Motsi et al. (2010) depicting the four New Zealand species of *Pimelea* (green box) contained within the Australian species of *Pimelea.* Above the branches are the bootstrap probabilities/posterior probabilities.

Similarly, Burrows (2011b) stated that it was likely the New Zealand *Pimelea* originated from Australia as all characters displayed in the New Zealand species were already present in the Australian species. However, Burrows (2011b) believes that due to his observance of three (A, B and C) divergent groups within the genus, there may have been three separate dispersal events.

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Chapter Three: Testing Burrows' classification of New Zealand *Pimelea* using molecular and morphological analyses

This chapter has been prepared in the form of a manuscript to be submitted to Australasian Journal of Systematic Botany. As such, some material from previous chapters may be repeated here.

Talissa Squire, MSc student, performed the modular analyses and made the morphological observations on herbarium specimens. The manuscript was drafted by TS.

Dr Chrissen Gemmill, chief supervisor, developed the research plan, and provided supervision and support relating to all the molecular analyses and collection of morphological data. CG provided detailed comments and revisions on all aspects of the manuscripts.

Steven Millar, co-supervisor, conducted to all statistical analysis of the morphological data and contributed to revisions of draft manuscripts.

3.1 Abstract

Pimelea Banks and Sol. ex Gaertn. is a genus of shrubs, sub-shrubs and herbs belonging to the eudicot family Thymelaeaceae. Members of this genus are distributed throughout Australia, Lord Howe Island and the New Zealand archipelago. Much of the previous research on the New Zealand members of this genus was conducted by Colin Burrows between 1960 and 2011. He used morphological and ecological traits to make three broad informal groupings. He also hypothesised three separate colonization events of the New Zealand members of this genus. The goal of this study was to test Burrows' classification and hypothesis of origins using DNA sequence variation of the nuclear ribosomal internal transcriber spacer (ITS) regions in concomitantly with linear discriminant analysis of key morphological characters and character state data. Bayesian analysis of the ITS matrix strongly supports New Zealand *Pimelea* as a monophyletic group (0.98 PP), and sister to Australian *P. alpina* (1 PP). The phentic groupings proposed by Burrows were not supported by either the molecular or the morphological analysis. However, there was a correlation between morphologoically defined clusters and phylogenetically defind clades.

Keywords: New Zealand, Australia, ITS, monophyletic, speciation, dispersal.

3.2 Introduction

Thymelaeaceae Jussieu (Malvalves) is an angiosperm family distributed worldwide and includes around 898 species of shrub, sub-shrub and perennial herbs (Stevens, 2001 onwards; Rogers, 2009). Initially believed to be comprised of four subfamilies, the family was later revised to contain three groups, the genus *Tepuianthus* Maguire & Steyermark, and the two subfamilies Octolepidoideae Gilg and Thymelaeoideae Burnett (Stevens, 2001 onwards; Takhtajan, 2009). Within these three groups there are 46-50 genera and approximately 891 species in total. Thymelaeoideae is the larger of these two families, containing around 44 genera (Stevens, 2001 onwards; Rogers, 2009). One of the largest genera within the subfamily Thymelaeoideae is *Pimelea* (Sol ex. Gaertn), a genus of prostrate and erect shrubs, with 126 species currently recognized (Burrows, 2008). Of these, 35 species (plus numerous subspecies) are endemic to New Zealand with the remainder being distributed across Australia and Lord Howe Island. South Australian regions tend to have the largest number of *Pimelea* species due to the tropical climate (Threlfal, 2006). In New Zealand the genus inhabits a range of habitats including coastal, shrubland and alpine zones (Burrows, 2008) reaching from the tip of the North Island, to Stewart Island in the south and offshore island groups including Three Kings and Chatham Islands. It is likely that *Pimelea* once inhabited an even wider range of environments across New Zealand, however, habitat destruction and settlement of lowland zones greatly restricted the available habitat of the genus (Walker et al. 2004).

The genus is named from the greek term 'Pimele' translating to "fat", in reference to its oily seeds. All members of the genus *Pimelea* in New Zealand have entire leaf margins and a decussate, opposite leaf arrangement. Leaves vary in shape, from elliptic and ovate to lunate. Leaf pubescence varies dramatically, from densely covered abaxial and adaxial leaf surfaces to entirely glabrous. According to Burrows (2011b) node buttress type can vary significantly in form, from narrow to thick and short to long and are a key

diagnostic character. Corollas are tube-like and have a hypanthium shaped like that of a star and are lightly coloured (cream, yellow, white, pink) (Fig. 3.1). Fruits can be either fleshy drupes or dry achenes (Burrows, 2008). The breeding system of *Pimelea* is gynodioecious, with flowers presenting as hermaphrodites or fertile females (Burrows, 1960). *Pimelea* are pollinated by insect species including bees, flies, butterflies and moths (Burrows, 1960).

Fig. 3.1: A: *Pimelea mimosa* (C.J. Burrows) displaying the entire, decussate leaf structure. Leaves are sparsely hairy adaxially, and densely hairy abaxially. White flowers are typical of many *Pimelea* species. B: *Pimelea orthia* (C.J.Burrows et Thorsen) with glabrous leaves and fleshy fruit. C: *Pimelea barbata* subsp. *barbata* (C.J.Burrows) with densely hairy abaxial and adaxial leaf surfaces. All photos used with permission of ©Jeremy Rolfe.

Of the 51 New Zealand *Pimelea* taxa, 76% have a conservation status (de Lange et al. 2012). While 27% are considered data deficient, an additional 49% as classified as threatened or at risk (de Lange et al. 2012). Of these, four taxa are nationally critical (de Lange et al. 2012). Walker and co-workers (2004) attributed this to habitat destruction and the settlement of lowland zones. Regardless of the cause, it is clear that these taxa are in need of further study so that accurate conservation status can be applied and appropriate conservation management plans implemented,

The majority of previous research on New Zealand *Pimelea* was conducted by Colin Burrows between 1960 and 2011. In his earliest works, Burrows (1960; 1962) focussed predominantly on the high rate of gynodioecy in natural

breeding populations of *Pimelea* and on the taxonomy of a very limited number of species. In 2008, Burrows began a series of papers where he used both morphological and ecological observations in an attempt to create a comprehensive classification of the 51 *Pimelea* taxa recognized (2008; 2009a; 2009b; 2011a; 2011b). Burrows, went on to classify the 32 *Pimelea* species, and 19 subspecies into three morphologically-based broad groups, A, B and C, with group C being further divided into three smaller groups C(i), C(ii) and C(iii) based primarily on characters such as the distribution of hairs on the leaf surfaces, node buttress type, flower size and fruit types (Appendix 1). Burrows hypothesised that each of his primary New Zealand groups represented a separate individual colonization event into New Zealand (Burrows, 2011b).

Molecular phylogenetic work and parsimony analysis by Motsi et al. (2010) support a single dispersal event to New Zealand from Australia, and was dispersed to New Zealand via the West Wind drift. However, the focus of their study was on the Australian species and included only four New Zealand taxa.

A key observation of Burrows' studies was the high rate of interspecific hybridisation that occurred within the genus in New Zealand both stable and unstable. The four stable putative hybrids observed were: *P. mesoa* subsp. *mesoa* (C.J.Burrows), *P. dura* (C.J.Burrows), *P. notia* (C.J.Burrows et Thorsen) and *P. nitens* subsp. *nitens* (C.J.Burrows et Courtney) (Burrows, 2011b). Burrows' conclusions were based on the sympatry of three taxa within a habitat, two with distinct morphological traits, and a third with intermediate traits of both other two species (Burrows, 2011b). In some instances, Burrows (2008) stated that unstable hybrid species were present in the absence of parents species however, Peter de Lange (Department of Conservation, pers. comm., 18 December 2014) suggests that these may have been morphologically varying sun and shade species of a single species of *Pimelea.* This hybridization, which may have occurred with the destruction of isolating mechanisms such as forestry or due to the young age of the NZ flora (Burrows, 2011b), blurred species boundaries. Additionally, due to the

similarity of these taxa, potential for phenotypic plasticity, especially for species with broad distributions across the length of New Zealand, a complimentary approach using approach using molecular genetics and analyses of morphological characters may be of great benefit.

We took a holistic approach, combining analysis of sequence variation of the nuclear ribosomal internal transcribed spacers (ITS) with linear discriminant analysis of key morphological characters. We use these data to test Burrows' hypotheses, specifically the phenetic classification of Burrows, which divides the New Zealand *Pimelea* into three main groups, and that these are each a distinct lineage resulting from separate colonization events from Australia.

3.3 Materials and methods

3.3.1 Molecular analyses

Leaf material for DNA analyses was extracted from fresh material collected by Steve Pratt and Graeme Jane in to silica gel, or from herbarium specimens with permission of Allan Herbarium (CHR) and the University of Waikato Herbarium (WAIK) (Detailed information on these specimens can be found in Table 3.2).

DNA extraction of samples was undertaken using a Bioline ISOLATE II plant DNA kit according to the manufacturer's instructions, however, incubation time was increased to 3 hours.

PCR was performed in a total reaction volume of 21 µL consisting of: 13.1µL MilliQ water, 0.24 µM of each primer, 1.2X MyTaq™ Buffer (Bioline), 0.01% bovine serum albumin (BSA), 0.05U of MyTaq™ Polymerase (Bioline), and 2.0 µL unquantified total genomic DNA. The entire ITS region was amplified (ITS-1, 5.8s, ITS-2) using primers ITS4 (White et al. 1990) and ITSHp5 (Gemmill et al. 2002). PCR was conducted using an Eppendorf Mastercycler® Pro Thermalcycler under the following touch-down profile: Initial denature 94°C for 5 min, followed by 6 cycles of 94°C for 30 sec, with the annealing temperature decreasing by 0.5°C on every cycle from 57°C down to 54°C, and

extension at 72°C for one min. After this, 30 cycles of 94°C for 30 sec, 54°C for 30 sec, and 72°C for 1 minute with a final extension of 72°C for 10 min.

PCR products were visualised via gel electrophoresis of 1% agarose gels with 0.5X TBE buffer. These were run for 40 minutes at 44 volts, and then viewed using an Innotech Alphaimager™. Presence of a single band around 700bp, with no contamination in the negative sample was considered a successful PCR. Samples were purified using a standard ExoSAP method, using 5 µl of PCR product, 0.2 µl Exo (Exonuclease I; Global Science and Tech Ltd.), and 0.1 µl SAP (Shrimp Alkaline Phosphate; Global Science and Tech Ltd.). and heated in an Eppendorf Mastercycler® Pro Thermalcycler for 15 minutes at 37°C and then increased to 80°C for 15 minutes. All sequencing was conducted at the University of Waikato DNA Sequencing Unit using a 3130XL Genetic Analyzer System. This was fitted with 50cm capillary arrays (Life Technologies Corporation) and DNA templates were prepared using Big Dye v3.1® terminator chemistry (Life Technologies Corporation).

Initial editing and alignment of sequences was undertaken using Sequencher® v 5.4 (Gene Codes Inc., Ann Arbor, MI). Sequences were confirmed as *Pimelea*, and not foreign contaminates, by comparing sequences to those in the NCBI GenBank database and using the BLASTn search algorithm (Altschul et al. 1990). The Australian species included in the study were retrieved from GenBank (Sayers et al. 2009). The MUSCLE alignment algorithm (Edgar, 2004) as implemented in SeaView (Gouy et al. 2010) was used to optimize the multiple sequence alignment. The graphic user interface BEAUti ver. 1.6.1 (Drummond and Rambaut, 2007) was used to generate an XML file, which was then analysed using Bayesian Inference methods in BEAST ver. 1.6.1 (Drummond and Rambaut, 2007). The following parameters were used: Model, GTR; Length of chain, 50,000,000; Echo state every, 5000; Log parameters, 5000. Tracer (Rambaut and Drummond, 2007) was used to visualise the BEAST output and ensure the search reached convergence. TreeAnnotator v.1.7.4 (Drummond and Rambaut, 2007) and FigTree (Rambuat, 2006) were used to visualise the clade credibility tree and posterior probabilities.

Table 3.1: Species used in this study, their region of origin and their sources. XXXXXX, these sequences will be deposited at GenBank and uploaded to BOLD.

	Genbank accession number	Herbarium voucher	Reference
Australia			
Pimelea gilgiana E.Pritz	FJ572710		Motsi et al. 2010
Pimelea alpina (Meisn.)	FJ572728		Motsi et al. 2008
Pimelea ammocharis F.Muell	FJ605463		Motsi et al. 2008
Pimelea angustifolia R.Br	FJ572726		Motsi et al. 2008
Pimelea avonensis Rye	FJ572735		Motsi et al. 2008
Pimelea axiflora subsp. alpina Rye	GQ205171		Motsi, 2009
Pimelea axiflora subsp. Pubescens Rye	GQ205173		Motsi, 2009
Pimelea biflora N.A.Wakef.	GQ205186		Motsi, 2009
Pimelea brevistyla Rye	FJ572736		Motsi et al. 2010
Pimelea calicola Rye	FJ572722		Motsi et al. 2010
Pimelea ciliata subsp. ciliata Rye	FJ572737		Motsi et al. 2010
Pimelea curviflora subsp. sericea R.Br	GQ205182		Motsi, 2009
Pimelea curviflora subsp. divergens R.Br	GQ205183		Motsi, 2009
Pimelea curviflora subsp. gracillis R.Br	GQ205181		Motsi, 2009
Pimelea curviflora subsp. subglabrata R.Br	GQ205180		Motsi, 2009
Pimelea decora	FJ572732		Motsi et al. 2008
Pimelea drupacea Labill.	GQ205174		Motsi, 2009
Pimelea erecta Rye	FJ572721		Motsi et al. 2008
Pimelea ferruginea Labill.	FJ605464		Motsi et al. 2010
Pimelea flava subsp. dichotoma Schltdll.	GQ205164		Motsi, 2009
Pimelea flava subsp. flava Schltdll.	GQ205163		Motsi, 2009
Pimelea granticola Rye	FJ572718		Motsi et al. 2008
Pimelea haematostachya	FJ572733		Motsi et al. 2008
Pimelea hispida R. Br.	FJ572738		Motsi et al. 2008
Pimelea humulis R. Br.	GQ205198		Motsi, 2009
Pimelea imbricata subsp. imbricata R. Br.	FJ572719		Motsi et al. 2008
Pimelea lanata R. Br.	FJ572739		Motsi et al. 2010
Pimelea lehmanniana subsp. nervosa Meisn.	FJ572734		Motsi et al. 2008
Pimelea linifolia Sm.	XXXXXXXX		
Pimelea longiflora subsp. longiflora Muell.	FJ572724		Motsi et al. 2008
Pimelea microcephala subsp. microcephala R. Br.	GQ205166		Motsi, 2009
Pimelea milliganii Meisn.	FJ572712		Motsi et al. 2010
Pimelea octophylla R. Br.	FJ572717		Motsi et al. 2008
Pimelea pauciflora R. Br.	GQ205168		Motsi, 2009
Pimelea physodes Hook.	FJ687339		Motsi et al. 2010
Pimelea preissii Meisn.	FJ572725		Motsi et al. 2010
Pimelea sericostachya subsp. sericostachya Domin.	FJ572714		Motsi et al. 2008
Pimelea spicata R. Br.	FJ572713		Motsi et al. 2010
Pimelea spinescens subsp. pubiflora Rye	GQ205170		Motsi, 2009
Pimelea stricta Meisn.	FJ649628		Motsi et al. 2008

Pimelea suaveolens subsp. suaveolens Meisn.	FJ572731		Motsi et al. 2008
Pimelea sulphurea Meisn.	FJ572727		Motsi et al. 2008
Pimelea tinctoria Meisn.	FJ572730		Motsi et al. 2008
Pimelea villifera Meisn.	FJ572720		Motsi et al. 2010
Thecanthes punicea R. Br.	AM162502		Motsi & van der Bank, 2005
Thecanthes sanguinea Muell.	AM162503		Motsi & van der Bank, 2005

New Zealand

Pimelea acra C.J. Burrows et de Lange	XXXXXXXX	
Pimelea actea C.J.Burrows	XXXXXXXX	
Pimelea aridula Cheeseman	XXXXXXXX	CHR519163
Pimelea barbata subsp. barbata C.J.Burrows	XXXXXXXX	CHR221088
Pimelea barbata subsp. omoia C.J.Burrows	XXXXXXXX	CHR510478
Pimelea buxifolia Hook.f.	XXXXXXXX	CHR417606
Pimelea carnosa C.J.Burrows	XXXXXXXX	CHR495070
Pimelea concinna Allan	XXXXXXXX	CHR607780
Pimelea cryptica C.J.Burrows et Enright	XXXXXXXX	CHR518408
Pimelea declivis C.J.Burrows	XXXXXXXX	CHR393969
Pimelea dura C.J.Burrows	XXXXXXXX	CHR258516
Pimelea eremitica C.J.Burrows	XXXXXXXX	WAIK12490
Pimelea gnidia (J.R.Forst. et G.Forst.) Willd.	XXXXXXXX	WAIK20144
Pimelea hirta C.J.Burrows	XXXXXXXX	CHR402383a
Pimelea ignota C.J.Burrows et Courtney	XXXXXXXX	CHR482591
Pimelea longifolia Sol. ex Wikstr.	XXXXXXXX	WAIK2857
Pimelea lyallii Hook.f.	XXXXXXXX	CHR364057
Pimelea mesoa subsp. macra C.J.Burrows	XXXXXXXX	CHR467766
Pimelea mesoa subsp. mesoa C.J.Burrows	XXXXXXXX	CHR173448
Pimelea microphylla Colenso	XXXXXXXX	CHR358836
Pimelea mimosa C.J.Burrows	XXXXXXXX	CHR221446
Pimelea nitens subsp. aspera C.J.Burrows et Courtney	XXXXXXXX	CHR393895
Pimelea nitens subsp. nitens C.J.Burrows et Courtney	XXXXXXXX	CHR389290
Pimelea notia C.J.Burrows et Thorsen	XXXXXXXX	WAIK5746
Pimelea oreophila subsp. ephaistica C.J.Burrows	XXXXXXXX	CHR510402
Pimelea oreophila subsp. hetera C.J.Burrows	XXXXXXXX	WAIK17768
Pimelea oreophila subsp. lepta C.J.Burrows	XXXXXXXX	CHR45500
Pimelea oreophila subsp. oreophila C.J.Burrows	XXXXXXXX	CHR404491
Pimelea orthia C.J.Burrows et Thorsen	XXXXXXXX	CHR418057
Pimelea poppelwellii Petrie	XXXXXXXX	CHR431250
Pimelea prostrata subsp. prostrata (J.R.Forst. et G.Forst.) Willd.	XXXXXXXX	CHR389314
Pimelea prostrata subsp. seismica C.J.Burrows	XXXXXXXX	WAIK20889
Pimelea prostrata subsp. thermalis C.J.Burrows	XXXXXXXX	WAIK15112
Pimelea prostrata subsp. ventosa C.J.Burrows	XXXXXXXX	CHR610179
Pimelea prostrata subsp. vulcanica C.J.Burrows	XXXXXXXX	WAIK14431
Pimelea pseudolyallii Allan	XXXXXXXX	CHR402098
Pimelea sericeovillosa subsp. alta C.J.Burrows	XXXXXXXX	CHR395249
Pimelea sericeovillosa subsp. pulvinaris C.J.Burrows	XXXXXXXX	WAIK17260

Pimelea sericeovillosa subsp. sericeovillosa Hook.f.	XXXXXXXX	WAIK18315
Pimelea sporadica C.J.Burrows	XXXXXXXX	CHR153919
Pimelea suteri Kirk	XXXXXXXX	CHR514960
Pimelea telura C.J.Burrows	XXXXXXXX	CHR475019
Pimelea tomentosa(J.R.Forst. et G.Forst.) Druce	XXXXXXXX	WAIK9058
Pimelea traversii subsp. borea C.J.Burrows	XXXXXXXX	CHR607779
Pimelea traversii subsp. exedra C.J.Burrows	XXXXXXXX	CHR514969
Pimelea traversii subsp. traversii Hook.f.	XXXXXXXX	WAIK17242
Pimelea urvilleana subsp. nesica C.J.Burrows	XXXXXXXX	WAIK15168
Pimelea urvilleana subsp. urvilleana A.Rich.	XXXXXXXX	WAIK15168
Pimelea villosa Sol. ex Sm.	XXXXXXXX	WAIK14712
Pimelea xenica C.J.Burrows	XXXXXXXX	CHR525117

South Africa

Gnidia aberrans C.H.Wright	AM159508	Rautenbach et al. 2005
Gnidia anomala Meisn.	AM158940	Rautenbach et al. 2005
Gnidia bakeri Gilg	AM159510	Rautenbach et al. 2005
Gnidia bojeriana Decne. Ex Cambess	AM159511	Rautenbach et al. 2005
Gnidia caffra Meisn.	AM396520	Rautenbach et al. 2005
Gnidia calocephala C.A.Mey	AM396521	Rautenbach et al. 2005
Gnidia carinata Thunb.	AJ549499	van der Bank et al. 2004
Gnidia coriacea Meisn.	AM159512	Rautenbach et al. 2005
Gnidia danguyana Leandri	AM159513	Rautenbach et al. 2005
Gnidia decaryana Leandri	AJ744926	van der Bank et al. 2004
Gnidia denudata Lindl.	AJ744918	Rautenbach et al. 2005
Gnidia dumetorum Leandri.	AM159515	Rautenbach et al. 2005
Gnidia galpinii C.H.Wright	AM159516	Rautenbach et al. 2005
Gnidia gilbertae Drake	AJ744927	van der Bank et al. 2004
Gnidia humulis Meisn.	AM159517	Rautenbach et al. 2005
Gnidia kraussiana Meisn.	AM159518	Rautenbach et al. 2005
Gnidia madagascariensis Lam.	AM159519	Rautenbach et al. 2005
Gnidia phaeotricha Gilg	AM159520	Rautenbach et al. 2005
Gnidia pinifolia L.	AM159521	Rautenbach et al. 2005
Gnidia racemosa Thunb.	AM159522	Rautenbach et al. 2005
Gnidia renniana Hillard and B.L.Burtt	AM396522	Rautenbach et al. 2005
Gnidia sericocephala Gilg ex Engl.	AM159523	Rautenbach et al. 2005
Gnidia setosa Thunb.	AM159524	Rautenbach et al. 2005
Gnidia squarrosa Lineaus	AM159525	Rautenbach et al. 2005
Gnidia wilmsii C.H.Wright	AM159527	Rautenbach et al. 2005

3.3.3 Morphological analyses

All morphological observations and measurements were undertaken in the University of Waikato Herbarium using herbarium specimens listed in appendix 2. Overall, 51 New Zealand *Pimelea* taxa (species and subspecies) and one Australian *Pimelea* species were observed.

Those characters which were used by Burrows (2008) for partitioning *Pimelea* taxa in to groups (Appendix 1) and were able to be observed on herbarium sheets were measured. These included leaf tip, shape, margin, leaf and flower tube length, leaf width, petiole length, leaf and flower hair density, leaf hair location, internode length, node buttress type and bark hair density,

Other characters such as leaf arrangement and leaf margins were measured, however were identical across all species. Character information such as stomatal density, fruit colour, fruit type, plant habit, plant sex and plant height were attempted to be determined however they were unable to be observed on herbarium specimens.

In order to attempt to acquire a broad and random range of observations of each species, the following method was used. For each New Zealand species and subspecies of *Pimelea*, and a single Australian species, three random herbarium specimens were selected. For those taxa that were rare or represented by less than three specimens could not be acquired, only those available were observed. The number of available specimens of each taxa for observation are listed in appendix 2. On each herbarium specimen, three random leaves and three random flowers were chosen to be measured (Appendix 2).

Herbarium specimens were viewed using an Olympus Stereoscope, where characters measurements were made, an Olympus reticle Stereomicroscope was attached to the Stereoscope. The degree of hairiness of some character traits were made after Burrows', where dense is equivalent to <10% of the underlying organ being visible, moderate 10-90% of the underlying organ was visible; sparse >90% of the underlying organ was visible and glabrous indicated no hair was present.

The morphological data contains both discreet character state data and averaged values for continuous morphological characters which makes assessing the similarity between specimens difficult. Hill and Smith (1976) propose an algorithm for computing pairwise distances between individuals based on qualitative and quantitative characters. Hill and Smith (1976) distances were obtained using the ade4 library v.1.7-2 (Dray and Dufour, 2007) in R v.3.2.2. However, to use the k-means clustering method to identify groups with similar traits, it was necessary to project the resulting distance matrix onto a set of axes. We achieved this using multidimensional scaling (mds) resulting in 20 dimensions, where each dimension represents a variable, with a measurement for each specimen on that variable.

The variables created from the mds were calculated to recreate the ordinal relationships between specimens in the distance matrix as closely as possible, not with any intrinsic biological meaning. Therefore, we used linear discriminant analysis (lda) to find the linear combinations of the mds variables that provided the best distinction between the groups of specimens identified as genetic clades. While this will result in clusters which have memberships that are more like the clades than clustering on the raw mds variables. We used simulations to show that the improved congruence between the clusters based on these lda variables derived from morphometric measurements and the clades identified through genetics cannot be ascribed to using lda alone, suggesting there is indeed some morphological basis to the groups identified through genetics.

3.4 Results

3.4.1 Molecular results

In our analysis of 51 sequences, we recovered 524 bp of aligned sequence for the ITS matrix. Of this, 46 sites (11%) were variable with 20 autapomorphies *(P. longifolia* (Sol ex. Wikstr.) 5, *P. buxifoliai* (Hook.f.) 3, *P. villosa* (Sol ex. Sm) 6, *P. poppelwellii* (Petrie) 3, *P. lyallii* (Hook.f.) 1, *P. actea* (C.J.Burrows) 1, *P. eremitica* (C.J.Burrows) 1, *P. tomentosa* ((J.R.Forst. et G.Forst.) Druce) 1) and 24 informative sites (Appendix 3). Of the 51 New Zealand taxa, a number shared identical ITS sequences (Appendix 4). These have been condensed down to identical sequences, here referred to as haplotypes as follows, Haplotype 1 (15 taxa), Haplotype 2 (2 taxa), Haplotype 3 (7 taxa), and Haplotype 4 (11 taxa) (Table 3.2). A fifth haplotype groups, Haplotype 5, consists of two Australian species, *P. lehmanniana* subsp. *lehmanniana* and *P. lehmanniana* subsp. *meiocephala.*

Table 3.2: Identical ITS sequences or "haplotypes" observed in NZ *Pimelea*; A * indicates putative hybrid. Species labelled in red are those that have sequence variation between subspecies.

	Haplotype 1	**Haplotype 2**	**Haplotype 3**	**Haplotype 4**
Species	*P. acra* *P. aridula* subsp. *oliga* *P. barbata* subsp. *omioa* *P. concinna* *P. hirta* *P. ignota* *P. microphylla* *P. nitens* subsp. *aspera* *P. nitens* subsp. *nitens* *P. oreophila* subsp. *ephastica* *P. oreophila* subsp. *hetera* *P. prostrata* subsp. *thermalis* *P. prostrata* subsp. *vulcanica* *P. psuedolyallii* *P. sericeovillosa* subsp. *pulvanaris*	*P. traversii* subsp. *exedra* *P. traversii* subsp. *traversii*	*P. barbata* subsp. *barbata* *P. carnosa* *P. orthia* *P. prostrata* subsp. *prostrata* *P. prostrata* subsp. *seismica* *P. urvilleana* subsp. *nesica* *P. urvilleana* subsp. *urvilleana*	*P. aridula* subsp. *aridula* *P. cryptica* *P. declivis* *P. dura* * *P. mesoa* subsp. *macra* *P. mesoa* subsp. *mesoa* * *P. notia** *P. oreophila* subsp. *oreophila* *P. prostrata* subsp. *ventosa* *P. sericeovillosa* subsp. *sericeovillosa* * *P. suteri*

The clade credibility tree (Figure 3.2) resolves two main strongly supported clades. The first clade (0.97 PP) consists of the South African *Gnidia*, in which

the majority of relationships are resolved and highly supported. The second clade is highly supported (0.98 PP) and consists of the New Zealand and Australian *Pimelea* and *Thecanthes*. Australian *Thecanthes*, *P. decora* (Domin.) and *P. haematostachya* (F.Muell.) form a well-supported sister group (0.93 PP) to all remaining *Pimelea* taxa. Overall, the relationships among many of the Australian taxa are well resolved and highly support. For taxa with more than a single sequence, subspecies were resolved as monophyletic for *P. flava* (Schltll) (0.9 PP), but not for *P. axiflora* (Rye) and *P. imbricata* (R. Br). The New Zealand taxa are nested well within the Australian taxa and form a strongly supported clade (0.98 PP), with Australian *P. alpina* (Meisn.) identified as a sister group to the NZ subclade (1.0 PP). Within the Australian taxa, for *P. curviflora* (R.Br) of the four subspecies, three are resolved within a single subclade, while the fourth *P. curviflora* subsp. *divergens* is contained within another highly supported subclade.

Within the New Zealand clade *P. buxifolia* is shown highly supported (0.84 PP) as a sister clade to the remaining NZ taxa which form two main clades, referred to as Clade 1 and Clade 2. Within Clade 1 and Clade 2 further highly supported subclades are present, labelled 1(i), 1(ii), 1(iii), 2(i), 2(ii) and 2(iii). In total, 7 supported relationships were identified within the ITS clade credibility tree for the New Zealand taxa. Four of the species with two subspecies formed highly supported sister relationships (*P. nitens* (C.J.Burrows et Courtney), *P. urvilleana* (C.J.Burrows), *P. mesoa* (C.J.Burrows), *P. traversii* (C.J.Burrows) (Table 3.2, Figure 3.3). However, we also observed five species, each with two or more subspecies, which displayed different sequence types for at least one of the subspecies: *P. aridula* subsp. *oliga* (Cheeseman) and *P. aridula* subsp. *aridula* (Cheeseman), *P. barbata* subsp. *barbata* (C.J.Burrows) and *P. barbata* subsp. *omoia* (C.J.Burrows), *P. oreophila* subsp. *lepta* (C.J.Burrows) and *P. oreophila* subsp. *oreophila* (C.J.Burrows), all *P. sericeovillosa* subspecies and all five *P. prostrata* subspecies. The only exceptions to this were *P. prostrata* subsp. *prostrata* ((J.R.Forst. et G.Forst.) Willd.) and *P. prostrata* subsp. *seismica* (C.J.Burrows) (both Haplotype 3) and, *P. prostrata* subsp. *vulcanica* (C.J.Burrows) and *P.*

prostrata subsp. *thermalis* (C.J.Burrows) (both Haplotype 2) which shared a haplotype.

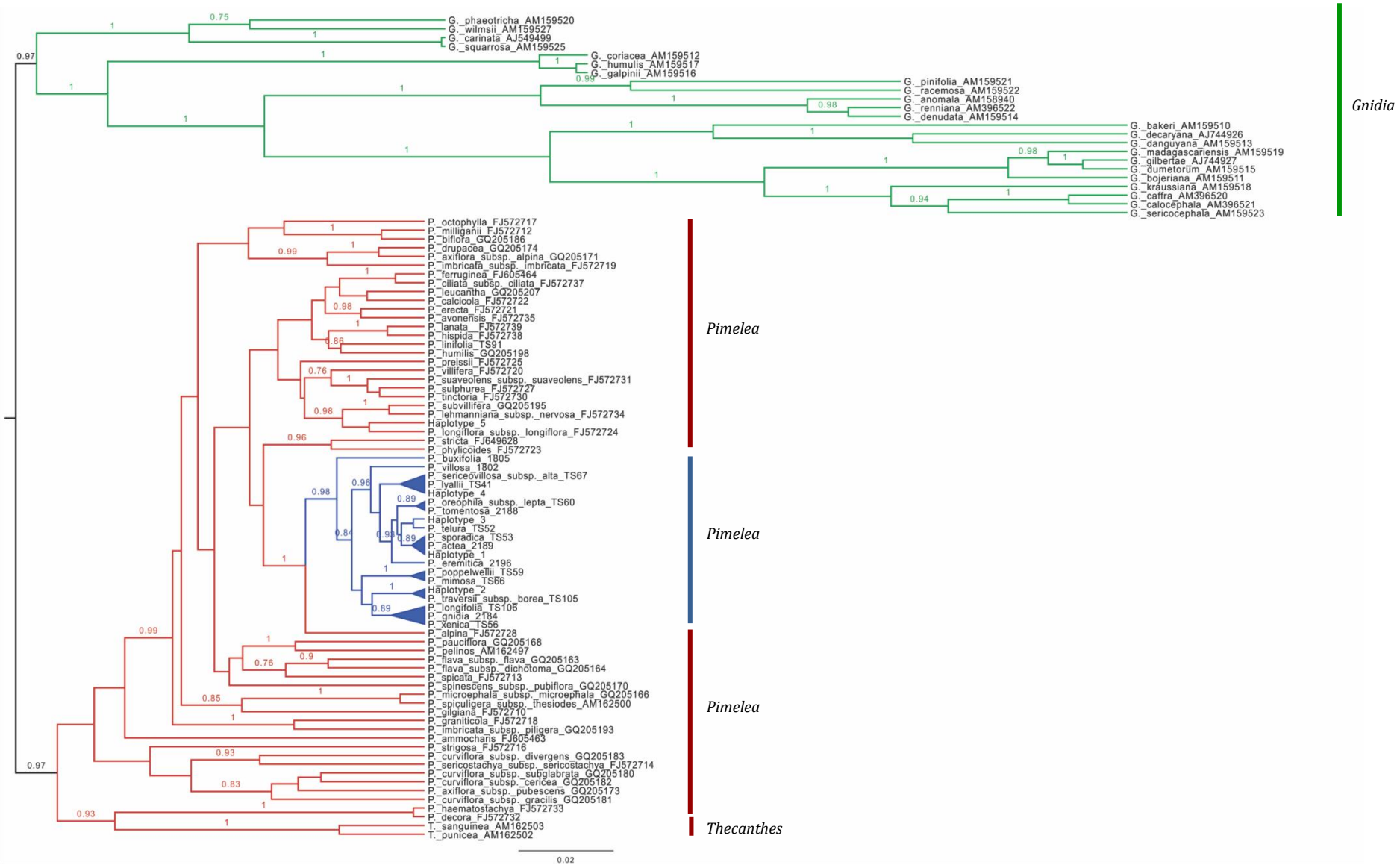
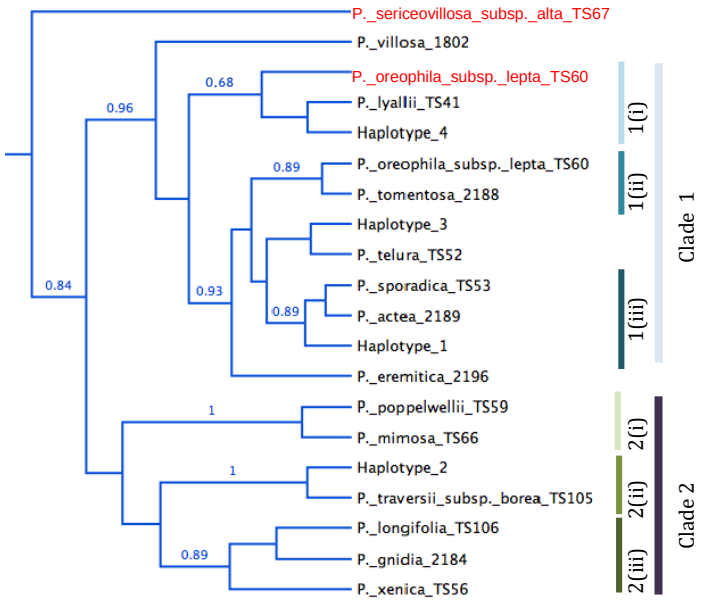


Fig. 3.2: Bayesian ITS clade credibility tree displaying all New Zealand *Pimelea* taxa, 52 Australian *Pimelea* species, 24 *Gnidia* species and 2 *Thecanthes* species (Blue = New Zealand taxa, red = Australian taxa, green = South African taxa). Posterior probabilities of <0.75 have been omitted. See table 3.1 for haplotype species.



Distribution	Clade	Burrows group	Conservation status
N	Sister	A	NT
N S C	1	C(i)	AR
S	1(i)	C(i)	AR
S	1(i)	C(i)	AR
Haplotype 4			
S	1(ii)	C(ii)	NT
N S	1(ii)	C(ii)	NV
Haplotype 3			
T	1	B	AR
N	1(iii)	B	AR
N S	1(iii)	B	NC
Haplotype 1			
N	1	B	NC
S	2(i)	A	AR
N	2(i)	C(iii)	NC
Haplotype 2			
S	2(ii)	A	DD
S	2(iii)	A	AR
N S	2(iii)	A	NT
N	2(iii)	B	AR

Species Name	Distribution	Haplotype	Clade	Burrows group	Conservation status
P. declivis	S	4	1(i)	C(ii)	DD
P. mesoa subsp. *mesoa*	S	4	1(i)	C(ii)	NT
P. oreophila subsp. *oreophila*	S	4	1(i)	C(ii)	NT
P. cryptica	N	4	1(i)	C(ii)	DD
P. prostrata subsp. *ventosa*	S	4	1(i)	B	DD
P. notia	S	4	1(i)	C(ii)	NT
P. dura	S	4	1(i)	C(ii)	DD
P. aridula subsp. *aridula*	S	4	1(i)	C(iii)	AR
P. mesoa subsp. *macra*	S	4	1(i)	C(ii)	NV
P. sericeovillosa subsp. *sericeovillosa*	S	4	1(i)	C(iii)	AR
P. suteri	S	4	1(i)	C(ii)	AR
P. carnosa	T N S	3	1	B	NT
P. urvilleana subsp. *nesica*	N	3	1	B	NT
P. urvilleana subsp. *urvilleana*	N	3	1	B	DD
P. prostrata subsp. *prostrata*	N S	3	1	B	NT
P. prostrata subsp. *seismica*	N S	3	1	B	DD
P. orthia	N	3	1	B	DD
P. barbata subsp. *barbata*	N	3	1	C(ii)	AR
P. sericeovillosa subsp. *pulvanaris*	S	1	1(iii)	C(iii)	AR
P. aridula subsp. *oliga*	S	1	1(iii)	C(iii)	NV
P. oreophila subsp. *hetera*	S	1	1(iii)	C(ii)	NT
P. ignota	S	1	1(iii)	C(i)	NC
P. oreophila subsp. *ephastica*	N	1	1(iii)	C(ii)	DD
P. hirta	N	1	1(iii)	C(ii)	DD
P. barbata subsp. *omioa*	N	1	1(iii)	C(ii)	AR
P. prostrata subsp. *vulcanica*	N	1	1(iii)	B	DD
P. concinna	S	1	1(iii)	C(iii)	NT
P. acra	N	1	1(iii)	C(i)	AR
P. microphylla	N	1	1(iii)	C(i)	AR
P. psuedolyallii	S	1	1(iii)	C(ii)	AR
P. prostrata subsp. *thermalis*	N	1	1(iii)	B	DD
P. nitens subsp. *aspera*	S	1	1(iii)	C(ii)	AR
P. nitens subsp. *nitens*	S	1	1(iii)	C(ii)	DD
P. traversii subsp. *exedra*	S	2	2(ii)	A	DD
P. traversii subsp. *traversii*	S	2	2(ii)	A	NT

Fig. 3.3: ITS clade credibility tree showing only New Zealand *Pimelea.* Clades, as discussed in text, are colour coded. Distribution, phylogenetic clade, Burrows' group, and conservation status are shown to the right. Species with identical sequences (haplotypes) are expanded on the right. Abbreviations are as follows: N, North Island; S, South Island, T, Three Kings; C, Chatham Islands; NT, Not threatened; AR, At risk; NV, Nationally vulnerable; NC, Nationally Critical; DD, Data deficient.

3.4.2 Morphological results

All morphological observation measurements are listed in Appendix 2. The presence of branch and branchlet hairs ranged from sparse to dense. Observations of the node buttress, a trait Burrows believed was vital to the *Pimelea* genus yielded little information. The four types of node buttresses observed by Burrows were unable to observed on the herbarium specimens. Leaf shape ranged from lanceolate to elliptic. The majority of taxa had acute to obtuse leaf tips, with a small proportion having acuminate tips. Leaf length and width varied among taxa, from a length of 0.2 cm up to 8.8 cm. Some species such as *P. longifolia* have significant intraspecific variation in leaf length and width. Density of leaf surface pubescence varied significantly, from glabrous adaxially and abaxially, to densely covered. Floral tube length ranged from 0.2 cm to 1 cm. Every specimen displaying flowers had tube hair present, ranging from sparse to densely covered. Petiole length ranged from sessile to 3.1cm. Internode length ranged downward of 0.9cm.

Each individual data point in the graph of the linear discriminant analysis (Figure 3.4) also in colour coded to correspond to the molecular clades as defined in Figure 3.4, while the symbols represent each of Burrows' groups. Success of the statistical analyses was measured based on how many taxa, based on the morphological data matrix, were categorized in the same clades observed by the molecular analysis. A 95% similarity rate between morphological clusters and phylogenetic clades was observed for the seven highly supported clades (Appendix 5). The average success rate using the technique used here but with arbitrary clade labels was only 63.7%, and never as high or higher than the observed 95% in 1000 simulations. The groupings (Figure 3.4) proposed by Burrows are vastly dissimilar in comparison to both the phylogenetic clades observed (colour) and the morphological clusters observed (convex hull).

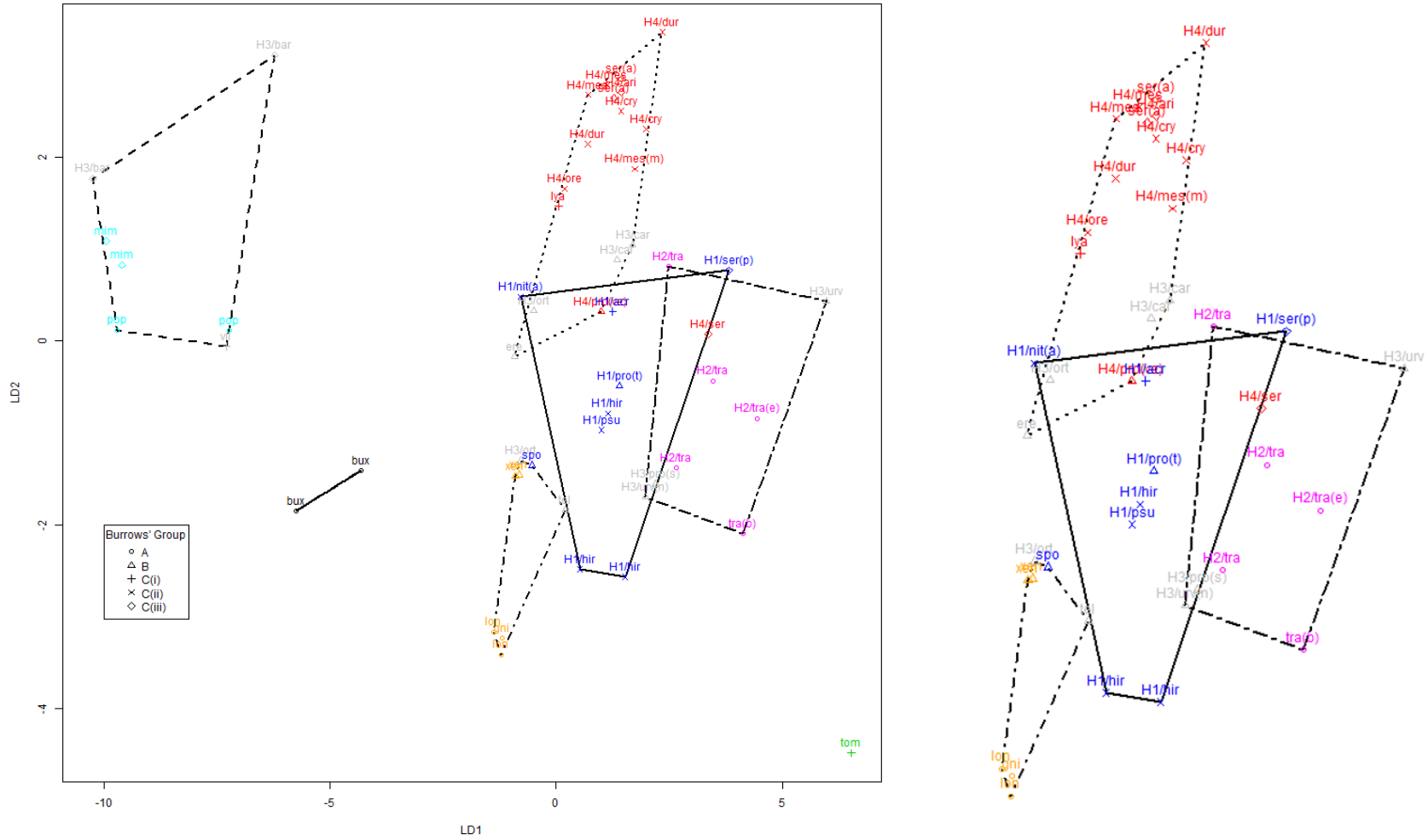


Fig. 3.4: Plotted graph of all herbarium specimens observed. Label names are the haplotype/species epithet, colour indicates the phylogenetic clades (with grey indicating no clade), symbols indicate Burrows groupings, and the convex hulls indicate the clustering of morphological traits based on the LDA. Figure on the right is the condensed clusters enlarged.

3.5 Discussion

Overall, the ITS clade credibility tree is highly supported and well resolved for both the Australia and South African taxa (Figure 3.2). The South African *Gnidia* appeared as a monophyletic clade in our study; however, we recognize that as the genera *Passerina* was absent this is unlikely to be accurate (See Motsi et al. 2010 for non-monophyletic *Gnidia*). The highly supported *Thecanthes* – *Pimelea* sister clade (0.93 PP) was also observed in Motsi et al. (2010). Not all taxa sequenced in Motsi et al. (2010) were used in this study and therefore this study is not congruent with Motsi et al. (2010).

Overall, New Zealand *Pimelea* were moderately well resolved, however, there were a large proportion of identical sequences (68%, see Appendix 4) and a low level of sequence variation with 11% of the aligned ITS New Zealand matrix having variable sites (Appendix 3). This low variation is typical of insular flora that have evolved relatively recently (*Corynocarpus* Wagstaff & Dawson, 2000; *Metrosideros* Wright et al. 2000; *Pittosporum* Gemmill et al, 2002; *Scrophulariaceae* Wagstaff et al, 2002; *Gaultheria* Bush et al. 2009; *Sapotaceae* Swenson et al. 2014). Gemmill et al. (2002) also found identical sequences for all eleven morphologically distinct species of Hawaiian *Pittosporum*, supporting a very recent radiation for this group.

Based on the ITS clade credibility tree New Zealand *Pimelea* are a strongly supported (0.98 PP) monophyletic group and sister to the Australian alpine species, *P. alpina.* This suggests a phyletic radiation in New Zealand, following a single colonization event from Australia. Our finding is in congruent with that of Motsi et al. (2010), but contrary to Burrows' (2011b) hypothesis of three colonization events. It is noteworthy that the sister species of New Zealand taxa to Australian alpine taxa has been observed in other genera, such as McGlone et al. (2001).

Within the New Zealand taxa, *P. buxifolia* is sister to two clades, Clade 1 and Clade 2 (Figure 3.3). Clade 1 contains clades 1(i), 1(ii) and 1(iii). Clade 2 contains the highly supported 2(i), 2(ii) and 2(iii). Morphologically, *P. buxifolia* was the only species with no abaxial and adaxial leaf hair, an average leaf length of >9mm and an average flower tube length of <7mm.

Clade (i) consisted of those species with an average leaf length of between 3mm – 9mm with very short (<0.8mm) to sessile petioles and a range hair presence on both the adaxial and abaxial leaf side. Clade (ii) consisted of only *P. oreophila* subsp. *lepta* and *P. tomentosa*, two species that have minimal similarities such as *P. oreophila* having a small 0.5cm leaf length and moderate hair presence on branches, while *P. tomentosa* had leaf lengths of up to 2.3cm and densely hairy branches. This however, may due to sample size as only one specimen of *P. oreophila* subsp. lepta was able to be observed, and this specimen had no flower present. Clade 1(iii) consisted of *P. sporadica, P. actea* and Haplotype 1. These taxa had leaves with a length of >11mm, with little to no hair present on the adaxial leaf surface. Species within this clade were typically underrepresented, with few herbarium specimens available. Clade 2(i) consisted of two species, *P. poppelwellii* and *P. mimosa,* both of which had petiole lengths of longer than 1mm, however, while *P. poppelwellii* was glabrous, *P. mimosa* had hairs present both adaxially and abaxially. Clade 2(ii) contained only *P. trarversii* subspecies, all of which had small leaves (<4.5mm), short to sessile petioles and no adaxial or abaxial leaf hair. Clade 2(iii) was the most morphologically diverse group. While *P. gnidia* was underrepresented, with only a single herbarium specimen available, *P. xenica* was the species that was acutely different than the other two. The species within this clade leaf lengths ranged from 52mm to 3.5mm, with no leaf hair and remarkably variable petiole, internode and flower tube lengths.

The groups delimited by Burrows (2008, 2009a, 2009b, 2011a, 2011b) were not supported by the molecular (Figure 3.3) or morphological (Figure 3.4) analyses in this study. Burrows (2008) stated that the *P. traversii* subspecies were unique, and this was supported by the *P. traversii* subspecies being put in a highly supported (1 PP)(Figure 3.3).

Based on intraspecific sequence variation, we have identified 15 subspecies as a priority for further study and potential taxonomic revision, these are: *P. aridula* subsp. *oliga* and *P. aridula* subsp. *oliga*, *P. barbata* subsp. *barbata* and *P. barbata* subsp. *omoia, P. oreophila* subsp. *lepta* and *P. oreophila* subsp.

oreophila, all *P. sericeovillosa* subspecies and all five *P. prostrata* subspecies. Four of these subspecies are also distributed in different regions than remaining subspecies (Figure 3.4). This suggests that these 15 taxa may not be conspecific. Four of these subspecies: *P. aridula* subsp. *oliga, P. prostrata* subsp. *thermalis*, *P. prostrata* subsp. *vulcanica* and *P. prostrata* subsp. *prostrata* are synonymous with other taxa: *P. aridula* subsp. *aridula* was previously described by Cheeseman as a subspecies of *P. lyallii,* to which it shares a clade with (Figure 3.3).

Due to the putative recency of the genus in New Zealand, there is a higher likelihood of hybridization being able to occur. Of the four stable putative hybrids suggested by Burrows (2011b): *P. mesoa* subsp. *mesoa*, *P. dura, P. notia* and *P. nitens* subsp. *nitens*, only *P. nitens* subsp. *nitens* was in the same clade as both its hypothesised parent species, *P. concinna* and *P. psuedolyallii*. Morphologically, *P. nitens* subsp. *nitens* was observed as having similar leaf traits to *P. concinna*, however, the herbarium specimen observed did not have flowers present. Two other proposed hybrids, *P. mesoa* subsp. *mesoa* and *P. dura* were in a clade with one of their proposed parent species, *P. sericeovillosa* subsp. *sericevillosa* and *Pimelea notia*, however, was not in a clade with its hypothesised parent species.

As shown in Figure 3.3, 10 of the subspecies displaying intraspecific sequence variation, 2 proposed putative hybrids and an additional 26 taxa have an assigned conservation status. Until taxonomic revisions are undertaken to resolve and correctly classify these taxon, accurate conservation statuses cannot be applied. This prevents DOC and other conservationists from being unable to undertake appropriate conservation management plans.

Within the Australian taxa, *P. curviflora* subsp. *divergens, P. axiflora* and *P. imbricata* were identified as requiring further study and potential taxonomic revision. These taxa were classified in a different clade due to their intraspecific sequence variation. Haplotype 5, consisting of two *P. lehmanniana* subspecies was put in a clade with the remaining *P. lehmanniana* subspecies.

The priority of future research should focus on revising those subspecies that had sequence variation and were unlikely to be conspecific. Expanding the sample size to allow for multiple sequences per taxa would be of great benefit, with a focus on those taxa that are widely distributed. The use of additional markers, such as psbA-trnH, and population level analyses, such as microsats, may allow for greater resolution of the New Zealand clade. Obtaining and observing the morphological traits of a larger number of individuals per taxa will allow for the reduction of bias due to outliers, such as occurred with *P. longifolia*. Research should also aim to investigate the putative widespread hybridization and extent of introgressions using multiple population samples, chromosome counts, trnH-psbA sequences, and fine scale microsatellite analyses of all sympatric individuals within a population and between populations. The use of fresh specimens, as opposed to herbarium specimens used in this study will allow for a more accurate measure and assessment of some traits, particulary the presence of pubescence. In addition to further taxonomic study of these taxa, much more ecological work is clearly required as little is known about pollination and role of animals such as lizards in the dispersal of the fruits (Burrows 2008). This study is the first of its kind to undertake the phylogenetic analysis of all New Zealand *Pimelea* taxa and to rigourously test the monophyly of the New Zealand genus. The use of sophisticated statistical analyses on the morphological traits of individual taxa has also been a first. This has laid the foundation for a more accurate taxonomic classification of the New Zealand *Pimelea* with clear implications for future conservation efforts.

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Chapter Four: Synthesis

4.1 Main findings

This study confirmed the conclusions of Motsi et al. (2010), that New Zealand *Pimelea* are a strongly supported monophyletic group. Unlike the conclusions drawn by Burrows (2011b) of three colonization events, this research supports a single colonization event with *Pimelea* evolving from a single Australian ancestor species. As in Motsi et al. (2010), *P. alpina* was sister to the remaining New Zealand taxa.

Morphological and molecular analyses suggest seven highly supported clades within the New Zealand taxa, as opposed to the five suggested by Burrows (2011b). These seven clades have few similarities to the morphological clades suggested by Burrows (2011b). Linear discriminant analysis showed a strong correlation between the genetic clades and the phonetic clusters produced by morphological observations.

A large proportion (68%) of the *Pimelea* taxa share an identical ITS sequence with other NZ taxa. Sequence variation occurred among subspecies indicating they may not be conspecific.

4.2 Future research

The priority of future research should focus on revising those subspecies that had sequence variation and were unlikely to be conspecific. Expanding the sample size to allow for multiple sequences per taxa would be of great benefit, especially for those taxa that are widely distributed. The use of additional markers, such as *psbA-trnH,* and population level analyses, such as microsats, may allow for greater resolution of the New Zealand clade. Obtaining and observing the morphological traits of a larger number of individuals per taxa will allow for the reduction of bias due to outliers, such as occurred with *P. longifolia*. The use of fresh specimens, as opposed to herbarium specimens used in this study will allow for a more accurate measure of some traits, mainly the presence of pubescence. More ecological research is also required,

at present little is know about pollination and the role of lizards and such in fruit dispersal. Research should also aim to investigate the putative widespread hybridization and extent of introgressions using multiple population samples, chromosome counts, trnH-psbA sequences, and fine scale microsatellite analyses of all sympatric individuals within a population and between populations.

The results of this study have added to current knowledge on the evolution of the New Zealand flora. The study is the first of its kind to undertake the phylogenetic analysis of all New Zealand *Pimelea* taxon and to rigorously test the monophyly of the genus. The use of statistical analyses on the morphological traits of individual taxa has also been a first. This has laid the foundation for a complete taxonomic revision of the New Zealand *Pimelea* with clear implications for future conservation efforts.

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Appendices

Appendix 1

Table extracted from Burrows (2011b). Shows species assigned to each informal groups and distinguishing character trait measurements.

Pimelea species	(a) Leaf hair density	(b) Leaf stomatal distribution	(c) Node buttress type	(d) Maximum length ♀ flowers (mm)	(e) Anther dehiscence type	(f) Fruit type	(g) Ripe fruit colour
Group A	Glabrous leaves						
longifolia [1]	–	ab.	w. int.	15	lat.	dry	brown
gnidia [1, 2, 3]	–	ab.	w. int.	9	lat.	dry	brown
buxifolia [1, 2]	–	ab.	lun.	10	lat.	dry	brown
traversii s.l. [1, 2]	–	ab.	w. int. or p. int	9	lat.	dry	brown
poppelwellii [1, 2]	–	ab.	w. int.	13	lat.	dry	brown
Group B							
prostrata s.l	–	ad., ab.	lun. or elong.	4.8	s. lat.	fl.	white
orthia s.l.	–	ad., ab.	lun. or elong.	3.2	s. lat.	fl.	white
xenica	–	ad., ab.	lun. or elong.	4	s. lat.	fl.	white
urvilliana s.l.	–	ad.	lun.	3.8	s. lat.	fl.	white
actea [4]	–	ad.	p. int	3	s. lat.	fl.	white
telura [4, 5]	–	ad.	lun.	5	s. lat.	fl.	white
carnosa	–	ad.	lun.	4.2	s. lat.	fl.	white
sporadica	–	ad.	lun.	4	s. lat.	fl.	white
eremitica [3]	–	ad.	lun.	6	s. lat.	fl.	white (pink)
Group C (i)	Abaxially hairy leaves						
tomentosa [1, 3, 5]	mod.	ad., ab.	lun.	5.5	int.	fl.	white, yellow, red, black[7]
villosa s.l. [1, 5]	dense	ad., ab.	lun.	7	int.	fl.	white, red, black[7]
lyallii	dense	ad., ab.	lun.	5	int.	fl.	white
microphylla [1]	sparse	ad., ab.	p. int.	3.2	int.	fl.	white, pink
acra [3]	sparse–mod.	ad.	lun.	5.5	s. lat.	fl.	red
ignota	sparse	ad., ab.	p. int.	7.5	int.	fl.	white
Group C (ii)							
suteri	sparse	ad., ab.	lun. or elong.	4.5	int.	fl.	red
pseudolyallii	dense	ad., ab.	lun.	6	int.	fl.	red
oreophila s.l.	sparse–mod.	ad., ab.	lun. or elong. (rarely p. int)	6	int.	fl.	red
mesoa s.l. [6]	dense	ad., ab.	lun. or elong.	6	int.	fl.	red, orange
dura [6]	dense	ad., ab.	lun. or elong.	4	int.	fl.	pink, yellow
notia [6]	sparse	ad., ab.	lun. or elong.	4	int.	fl.	orange
declivis	sparse–mod.	ad., ab.	lun. or elong.	6	int.	fl.	red
cryptica	sparse	ad., ab.	lun. or elong.	5	int.	fl.	pink
nitens s.l. [6]	dense	ad., ab.	lun.	6	int.	fl.	red
hirta	mod.	ad., ab.	lun.	6	int.	fl.	red
Group C (iii)	Abaxially and adaxially hairy leaves						
sericeovillosa s.l.	dense ab. sparse–mod. ad.	ad., ab.	lun.	4	int.	fl.	yellow, pale orange
aridula s.l. [1]	dense ab. mod.–dense ad.	ad., ab.	lun.	6.5	int.	fl.	dry
concinna	dense ad. ab.	ad., ab.	lun.	6	int.	fl.	red
barbata s.l.	dense ab. mod.–dense ad.	ad., ab.	lun.	6.5	int.	fl.	red
mimosa	dense ad. ab.	ad., ab.	lun.	6	int.	fl.	red

Note: ab., abaxial; ad., adaxial; elong., elongated part way along internode; fl., fleshy; int., introrse; lat., latrorse; lun., lunate; mod., moderately dense; p. int., strips along whole internode; s. lat., semilatrorse; w. int., whole internode. [1]Some individuals have minor pink or reddish colouration of style portion of flower tube (ovary portion is red for many species). [2] Blue–green colour often evident on dried leaves. [3] Some individuals have circumscissile flowers. [4]Flower gender bisexual (all other species gynodioecious). [5] Some individuals have cream or yellowish flowers. [6] Postulated to have a homoploid, 'stable hybrid' origin. [7] 'Black' is actually dark purplish–black.

Appendix 2

Table of character trait measurements and observations taken in this study.

Species	Collection number	Burrows group	Leaf tip	Leaf shape	Leaf length (mm)			Average leaf length	Leaf width (mm)			Average leaf width	Abaxial leaf hair	Adaxial leaf hair	Petiole length			Average petiole length	Tube length			Average tube length	Flower hair	Internode length			Average internode length	Node buttress type	Bark hair
P. longifolia	WAIK22426	A	Acuminate - Acute	Elliptic	29.3	35.4	24.0	**29.6**	10.1	10.4	7.5	**9.3**	None	None	3.1	3.0	3.3	**3.1**	10.0	10.0	10.0	**10.0**	Moderate tube	9.8	6.0	5.0	**6.9**	C	
P. longifolia	WAIK11297	A	Acuminate	Lanceolate	79.5	88.2	79.2	**82.3**	12.9	12.1	12.3	**12.4**	None	None	4.0	3.5	3.0	**3.5**	10.0	9.5	10.0	**9.8**	Dense tube	9.0	9.0	9.0	**9.0**	C	
P. longifolia	WAIK2857	A	Acuminate - Acute	Elliptic - Lanceolate	39.4	51.1	35.5	**42.0**	13.9	16.1	11.6	**13.9**	None	None	3.5	3.5	3.0	**3.3**				**0.0**	No flower present	5.5	5.0	6.0	**5.5**	C	
P. gnidia	WAIK20144	A	Acute	Elliptic - Lanceolate	13.9	14.1	13.5	**13.8**	4.9	3.0	5.1	**4.3**	None	None	1.1	1.4	1.3	**1.3**	7.1	7.4	7.4	**7.3**	Dense tube	2.3	3.0	3.2	**2.8**	A	
P. buxifolia	WAIK5554	A	Acute	Elliptic	11.4	9.4	12.0	**10.9**	3.5	3.2	5.1	**3.9**	None	None	1.6	1.4	1.4	**1.5**				**0.0**	No flower present	6.0	5.5	6.0	**5.8**	A	Moderate branchlets
P. buxifolia	WAIK3130	A	Acute	Elliptic	9.4	7.3	9.1	**8.6**	5.0	3.9	4.2	**4.4**	None	None	1.3	1.4	1.3	**1.3**	8.6	8.1	7.9	**8.2**	Dense tube	1.4	1.6	1.5	**1.5**	A	Moderate branchlets
P. buxifolia	CHR417606	A	Acute	Elliptic	9.1	6.2	9.1	**8.1**	4.9	3.4	3.5	**3.9**	None	None	1.4	1.6	1.7	**1.6**	10.1	9.8	9.7	**9.9**	Dense tube	1.6	1.6	1.8	**1.7**	A	Moderate branchlets
P. traversii* subsp. *borea	CHR607779	A	Acute - Obtuse	Ovate	6.0	6.0	7.0	**6.3**	3.2	3.5	5.0	**3.9**	None	None	0.5	0.6	0.7	**0.6**	2.5			**2.5**	Dense tube	1.9	1.7	1.7	**1.8**	A	Dense branchlets
P. traversii* subsp. *exedra	CHR514969	A	Obtuse	Elliptic	2.9	3.7	4.9	**3.8**	1.5	2.1	2.7	**2.1**	None	None	0.0	0.0	0.0	**0.0**	7.2	6.8	7.0	**7.0**	Dense tube	1.0	1.0	1.0	**1.0**	A	
P. traversii* subsp. *traversii	WAIK17242	A	Obtuse	Elliptic	3.5	3.4	5.0	**4.0**	2.0	2.9	3.3	**2.7**	None	None	0.0	0.0	0.0	**0.0**	4.0	4.4	4.3	**4.2**	None	1.1	1.2	1.4	**1.2**	C	
P. traversii* subsp. *traversii	CHR420886	A	Obtuse	Ovate	5.5	4.9	4.5	**5.0**	5.2	3.6	3.2	**4.0**	None	None	0.0	0.0	0.0	**0.0**	3.6	3.5	3.2	**3.4**	Dense tube	1.1	1.2	1.1	**1.1**	C	
P. traversii subsp. traversii	CHR546214	A	Obtuse	Ovate	4.1	4.2	4.3	**4.2**	3.2	3.2	3.1	**3.2**	None	None	0.0	0.0	0.0	**0.0**	7.1	5.1	4.3	**5.5**	Dense tube	1.6	1.4	1.4	**1.5**	C	Sparse branchlets
P. poppelwellii	CHR431250	A	Acute - Acute	Elliptic	6.7	7.1	7.5	**7.1**	3.8	3.4	4.2	**3.8**	None	None	1.5	1.5	1.5	**1.5**	9.2	10.0	9.8	**9.7**	None	1.5	1.6	2.1	**1.7**	C	
P. poppelwellii	CHR395337	A	Acute	Elliptic	5.9	8.9	6.6	**7.1**	3.6	4.8	3.8	**4.1**	None	None	1.4	1.5	1.4	**1.4**	9.0	10.1	9.9	**9.7**	None	1.7	1.8	2.0	**1.8**	C	
P. prostrata* subsp. *prostrata	CHR517588	B	Acute	Elliptic	3.7	2.7	3.6	**3.3**	1.4	1.6	1.9	**1.6**	None	None	0.5	0.5	0.4	**0.5**				**0.0**	No flower present	1.5	2.0	1.6	**1.7**	A	Dense branchlets
P. prostrata* subsp. *prostrata	CHR497458	B	Acute	Elliptic	3.0	2.5	2.5	**2.7**	1.9	1.5	1.3	**1.6**	None	None	0.3	0.4	0.3	**0.3**				**0.0**	No flower present	0.8	0.8	0.8	**0.8**	A	Dense branchlets
P. prostrata* subsp. *prostrata	CHR419757	B	Acute	Elliptic	3.4	4.0	2.5	**3.3**	1.6	1.9	1.6	**1.7**	None	None	1.3	1.0	0.9	**1.1**				**0.0**	No flower present	1.6	1.0	1.4	**1.3**	A	Dense branchlets
P. prostrata* subsp. *seismica	CHR473370	B	Acute	Lanceolate	7.0	6.9	7.5	**7.1**	1.7	2.4	2.9	**2.3**	None	None	0.4	0.5	0.4	**0.4**				**0.0**	No flower present	3.0	3.2	2.9	**3.0**	A	Dense branchlets
P. prostrata* subsp. *seismica	CHR469823	B	Acute	Ovate	4.5	3.9	3.9	**4.1**	2.5	2.0	2.4	**2.3**	None	None	0.3	0.3	0.3	**0.3**	2.0	2.2	2.3	**2.2**	Dense tube	1.5	1.6	1.2	**1.4**	A	Dense branchlets
P. prostrata* subsp. *thermalis	CHR469714	B	Acute	Ovate	5.0	5.2	5.4	**5.2**	1.9	1.8	2.3	**2.0**	None	None	0.4	0.6	0.4	**0.5**	5.0	4.8	4.8	**4.9**	Dense tube	2.1	2.5	2.1	**2.2**	A	Sparse branchlets
P. prostrata* subsp. *ventosa	CHR610179	B	Acute	Elliptic	5.0	6.0	6.0	**5.7**	1.9	2.4	3.0	**2.4**	None	None	0.5	0.5	0.6	**0.5**	3.1	3.2	3.0	**3.1**	Dense tube	1.8	1.8	1.5	**1.7**	A	Moderate branchlets
P. prostrata* subsp. *vulcanica	CHR570001	B	Acute	Lanceolate - Ovate	4.8	3.4	5.4	**4.5**	2.5	0.9	2.6	**2.0**	None	None	0.4	0.3	0.4	**0.4**				**0.0**	No flower present	1.3	1.5	1.5	**1.4**	A	Sparse branchlets
P. orthia	CHR214265	B	Acute	Elliptic	4.1	5.8	5.1	**5.0**	2.3	2.2	2.0	**2.2**	None	None	0.4	0.2	0.0	**0.2**	4.3	4.1	4.5	**4.3**	Dense tube	0.4	0.5	0.5	**0.5**	A	Dense branchlets
P. orthia	CHR276397	B	Acute	Elliptic	6.5	6.1	6.2	**6.3**	2.7	1.9	2.4	**2.3**	None	None	0.2	0.5	0.6	**0.4**	4.2	4.1	4.6	**4.3**	Dense tube	0.4	0.4	0.5	**0.4**	A	Moderate branchlets
P. xenica	CHR192372	B	Acute	Elliptic	4.2	4.0	3.0	**3.7**	1.9	1.6	1.5	**1.7**	None	None	0.2	0.2	0.3	**0.2**	5.0	5.1	4.7	**4.9**	Dense tube	1.5	1.4	1.2	**1.4**	A	Dense branchlets
P. xenica	CHR91207	B	Acute	Elliptic	4.1	3.2	4.3	**3.9**	1.9	2.0	1.8	**1.9**	None	None	0.2	0.2	0.2	**0.2**	4.9	4.8	4.9	**4.9**	Dense tube	1.3	1.5	1.2	**1.3**	A	Dense branchlets
P. urvilleana* subsp. *nesica		B	Acute - Obtuse	Elliptic	3.2	5.8	4.6	**4.5**	1.9	3.6	3.4	**3.0**	None	None	0.9	0.6	0.8	**0.8**	3.0	3.9	4.0	**3.6**	Dense tube	1.0	1.1	1.1	**1.1**	A	Dense branchlets
P. urvilleana* subsp. *urvilleana	WAIK2793	B	Acute - Obtuse	Ovate - Elliptic	4.5	4.7	4.0	**4.4**	2.6	3.0	1.8	**2.5**	None	None	0.4	0.4	0.3	**0.4**				**0.0**	No flower present	2.9	2.9	3.0	**2.9**	A	Dense branchlets
P. urvilleana* subsp. *urvilleana	WAIK12115	B	Acute	Ovate	2.1	2.4	3.6	**2.7**	1.8	2.0	2.2	**2.0**	None	None	0.3	0.4	0.3	**0.3**				**0.0**	Dense tube				**0.0**	A	Dense branchlets

P. urvilleana* subsp. *urvilleana	WAIK15168	B	Acute - Obtuse	Ovate - Elliptic	1.6	2.1	2.5	**2.1**	1.0	1.4	1.7	**1.4**	None	None	0.3	0.3	0.3	**0.3**	1.7	1.7	1.6	**1.7**	Dense tube	0.7	1.7	0.9	**1.1**	A	Dense branchlets
P. actea	WAIK477435	B	Acute - Obtuse	Ovate - Elliptic	2.7	3.5	3.1	**3.1**	1.4	1.9	1.8	**1.7**	None	None	0.5	0.5	0.3	**0.4**				**0.0**	No flower present	0.5	1.8	1.5	**1.3**	D	
P. actea	CHR568144	B	Acute	Elliptic	3.4	3.1	3.6	**3.4**	2.0	2.1	1.9	**2.0**	None	None	0.4	0.4	0.4	**0.4**				**0.0**	No flower present	1.0	1.0	1.0	**1.0**	C	
P. telura	CHR475019	B	Acute	Elliptic	9.1	7.9	8.3	**8.4**	4.9	3.2	3.5	**3.9**	None	None	1.0	1.1	0.9	**1.0**	3.1	2.2	2.9	**2.7**	Dense tube	1.0	1.5	1.6	**1.4**	A	Dense brachlets
P. carnosa	CHR495070	B	Acute	Elliptic	2.0	2.4	2.0	**2.1**	0.9	1.0	1.0	**1.0**	None	None	0.2	0.2	0.2	**0.2**				**0.0**	No flower present	0.4	0.4	0.5	**0.4**	A	Moderate branchlets
P. carnosa	CHR518743	B	Acute	Elliptic	2.2	2.4	2.4	**2.3**	0.9	1.0	1.1	**1.0**	None	None	0.3	0.3	0.2	**0.3**	1.9	1.8	2.2	**2.0**	Dense tube	0.5	0.5	0.5	**0.5**	A	Moderate branchlets
P. carnosa	CHR466150	B	Acute	Elliptic	3.1	2.9	2.4	**2.8**	1.5	1.8	1.4	**1.6**	None	None	0.3	0.4	0.3	**0.3**	2.5	2.2	2.3	**2.3**	Dense tube	0.6	0.6	0.5	**0.6**	A	Moderate branchlets
P. sporadica	CHR482591	B	Acute	Elliptic	5.9	12.1	7.0	**8.3**	3.2	6.1	4.0	**4.4**	None	None	0.9	0.8	1.0	**0.9**				**0.0**	No flower present	3.7	3.6	3.0	**3.4**	A	Moderate branchlets
P. sporadica	CHR192470	B	Acute	Elliptic	6.0	5.9	4.2	**5.4**	2.3	3.1	2.0	**2.5**	None	None	0.6	0.7	0.7	**0.7**				**0.0**	No flower present	1.1	1.4	1.6	**1.4**	A	Dense branchlets
P. sporadica		B	Acute	Elliptic	3.6	3.8	3.8	**3.7**	1.9	1.9	2.1	**2.0**	None	None	0.4	0.3	0.4	**0.4**	4.3	3.9	3.9	**4.0**	Dense tube	0.8	0.9	0.7	**0.8**	A	Dense branchlets
P. eremitica	WAIK12490	B	Acute	Elliptic	8.0	8.0	8.0	**8.0**	1.8	2.8	2.7	**2.4**	None	None	0.8	0.8	0.8	**0.8**	5.0	5.0	4.9	**5.0**	Dense tube	1.6	0.6	1.3	**1.2**	A	Moderate branchlets
P. tomentosa	WAIK9480	C(i)	Obtuse	Elliptic	15.0	21.0	13.0	**16.3**	3.0	4.0	3.0	**3.3**	Sparse	None	0.5	0.5	0.7	**0.6**	5.0	5.0	5.0	**5.0**	Dense tube	3.0	3.0	3.0	**3.0**	A	Dense branchlets
P. tomentosa	WAIK9058	C(i)	Obtuse	Elliptic	24.0	24.0	22.0	**23.3**	5.0	4.0	4.6	**4.5**	Sparse	None	1.2	1.0	0.9	**1.0**				**0.0**	No flower present	4.6	6.0	5.0	**5.2**	A	Dense branchlets
P. tomentosa	WAIK9124	C(i)	Obtuse	Elliptic	16.0	16.0	17.6	**16.5**	3.0	3.0	3.0	**3.0**	Moderate	None	0.8	0.7	0.8	**0.8**				**0.0**	No flower present	5.5	4.0	4.0	**4.5**	A	Dense branchlets
P. villosa	WAIK22673	C(i)	Acute	Elliptic	5.9	4.6	4.4	**5.0**	3.4	2.8	3.4	**3.2**	Moderate	None	0.5	0.5	0.5	**0.5**	3.6	3.7	4.0	**3.8**	Dense tube	1.9	2.0	1.7	**1.9**	A	Dense branchlets
P. villosa	WAIK22672	C(i)	Acute	Elliptic	5.2	6.0	5.4	**5.5**	3.4	3.5	3.0	**3.3**	Moderate	None	0.4	0.3	0.3	**0.3**				**0.0**	No flower present	2.0	2.1	1.8	**2.0**	A	Dense branchlets
P. lyallii	CHR364057	C(i)	Acute	Ovate - Elliptic	5.5	4.9	6.8	**5.7**	2.3	2.4	2.6	**2.4**	Dense	None	0.7	0.6	0.4	**0.6**	4.4	4.2	4.8	**4.5**	Dense tube	0.8	0.8	0.8	**0.8**	A	Dense branchlets
P. lyallii	CHR92028	C(i)	Acute	Ovate - Elliptic	6.8	5.4	5.0	**5.7**	3.7	2.1	2.2	**2.7**	Dense	None	0.5	0.6	0.4	**0.5**				**0.0**	No flower present	0.9	0.8	1.0	**0.9**	A	Dense branchlets
P. microphylla	CHR402205	C(i)	Acute - Obtuse	Ovate	1.9	3.5	2.8	**2.7**	0.8	1.3	1.1	**1.1**	None	None	0.1	0.2	0.1	**0.1**				**0.0**	No flower present	0.4	0.4	0.3	**0.4**	A	None
P. acra	CHR469709	C(i)	Acute	Ovate - Ellliptic	9.4	9.2	7.5	**8.7**	3.6	3.4	2.2	**3.1**	Sparse	None	0.5	0.4	0.5	**0.5**	5.0	4.6	5.1	**4.9**	Dense tube	1.4	1.7	1.9	**1.7**	A	Moderate branchlets
P. acra	CHR394223	C(i)	Acute	Ovate	6.8	5.0	6.8	**6.2**	2.3	2.2	2.4	**2.3**	Sparse	None	0.4	0.4	0.5	**0.4**				**0.0**	No flower present	1.0	1.2	1.5	**1.2**	A	Moderate branchlets
P. ignota	CHR482591	C(i)	Acute	Elliptic	11.2	7.9	5.3	**8.1**	5.5	5.2	4.2	**5.0**	None	None	0.5	0.5	0.6	**0.5**				**0.0**	No flower present	1.3	1.6	1.4	**1.4**	A	Moderate branchlets
P. suteri	CHR514960	C(ii)	Acute	Lanceolate	4.0	4.1	4.2	**4.1**	0.5	0.7	0.5	**0.6**	Sparse	None	0.4	0.4	0.3	**0.4**				**0.0**	No flower present	0.4	0.5	0.4	**0.4**	A	Moderate branchlets
P. psuedolyallii	WAIK16961	C(ii)	Acute	Elliptic	9.8	7.2	4.3	**7.1**	3.1	2.2	1.7	**2.3**	Dense	None	0.0	0.0	0.0	**0.0**	4.9	5.1	5.4	**5.1**	Moderate tube	3.0	1.9	2.2	**2.4**	A	Moderate internodes
P. psuedolyallii	CHR402098	C(ii)	Acute	Elliptic	10.5	9.8	12.0	**10.8**	5.0	5.1	4.0	**4.7**	Dense	None	0.0	0.0	0.0	**0.0**				**0.0**	No flower present	4.0	3.5	2.0	**3.2**	A	Moderate branchlets
P. oreophila* subsp. *ephaistica	CHR510402	C(ii)	Acute	Lanceolate	3.5	3.1	4.3	**3.6**	1.2	1.1	1.0	**1.1**	None	None	0.3	0.5	0.3	**0.4**				**0.0**	No flower present	0.8	0.8	0.9	**0.8**	A	Sparse branchlets
P. oreophila* subsp. *hetera	CHR393834	C(ii)	Acute - Obtuse	Ovate	2.8	3.6	3.5	**3.3**	1.1	1.3	1.4	**1.3**	Moderate	Sparse	0.2	0.1	0.3	**0.2**				**0.0**	No flower present	1.1	0.8	0.6	**0.8**	A	Dense branchlets
P. oreophila* subsp. *lepta	CHR455500	C(ii)	Acute	Ovate - Ellliptic	3.3	5.9	5.9	**5.0**	1.7	1.4	3.0	**2.0**	Moderate	None	0.6	0.6	0.6	**0.6**				**0.0**	No flower present	3.0	3.5	3.2	**3.2**	A	Moderate branchlets
P. oreophila* subsp. *oreophila	CHR404491	C(ii)	Acute	Elliptic	4.6	5.1	5.3	**5.0**	2.0	2.6	2.0	**2.2**	None	None	0.3	0.4	0.4	**0.4**	4.0	4.5	4.1	**4.2**	None	1.0	1.0	1.1	**1.0**	A	None
P. mesoa* subsp. *macra	CHR467766	C(ii)	Obtuse	Ovate - Ellliptic	5.2	4.9	4.8	**5.0**	1.5	1.5	1.6	**1.5**	Moderate	None	0.3	0.3	0.2	**0.3**	4.0	4.5	5.1	**4.5**	Dense tube	0.7	0.6	0.7	**0.7**	A	Sparse branchlets
P. mesoa* subsp. *mesoa	CHR384204	C(ii)	Acute - Obtuse	Elliptic	4.3	4.5	4.5	**4.4**	2.0	2.3	1.9	**2.1**	Dense	None	0.0	0.0	0.0	**0.0**	5.2	5.3	5.6	**5.4**	Dense tube	1.1	1.3	1.2	**1.2**	A	None
P. mesoa* subsp. *mesoa	CHR173448	C(ii)	Acute - Obtuse	Elliptic	4.2	4.3	3.9	**4.1**	2.4	2.1	2.3	**2.3**	Dense	None	0.0	0.0	0.0	**0.0**	6.1	6.0	5.4	**5.8**	Dense tube	1.1	1.5	1.1	**1.2**	A	None
P. dura	CHR182194	C(ii)	Acute	Ovate - Ellliptic	2.9	2.1	2.1	**2.4**	1.8	1.2	1.3	**1.4**	Sparse	None	0.0	0.0	0.0	**0.0**	2.3	2.5	3.1	**2.6**	Sparse tube	0.2	0.3	0.2	**0.2**	A	Sparse branchlets

P. dura	CHR258516	C(ii)	Acute	Elliptic	3.2	3.6	2.9	**3.2**	1.5	1.0	1.2	**1.2**	Sparse	None	0.0	0.0	0.0	**0.0**	2.9	2.3	2.6	**2.6**	Sparse tube	0.3	0.3	0.2	**0.3**	A	Sparse branchlets
P. notia	WAIK5746	C(ii)	Obtuse	Elliptic	4.0	3.2	3.5	**3.6**	2.0	1.5	1.5	**1.7**	Sparse	None	0.0	0.0	0.0	**0.0**				**0.0**	No flower present	0.4	0.3	0.3	**0.3**	A	Moderate branchlets
P. notia	CHR593737	C(ii)	Obtuse	Elliptic	3.2	3.1	3.5	**3.3**	1.5	1.4	1.9	**1.6**	Sparse	None	0.0	0.0	0.0	**0.0**				**0.0**	No flower present	0.2	0.3	0.2	**0.2**	A	Sparse branchlets
P. declivis	CHR393969	C(ii)	Acute	Lanceolate	9.3	8.7	7.8	**8.6**	2.0	2.0	2.1	**2.0**	Moderate	Sparse	0.7	0.8	1.0	**0.8**				**0.0**	No flower present	2.1	2.3	2.5	**2.3**	A	Moderate branchlets
P. cryptica	CHR620751	C(ii)	Acute	Elliptic	4.5	5.5	3.5	**4.5**	2.0	3.8	1.9	**2.6**	None	None				**0.0**	2.7	2.9	3.0	**2.9**	Moderate tube	1.2	0.9	1.0	**1.0**	A	None
P. cryptica	CHR518408	C(ii)	Acute	Elliptic	7.9	6.1	7.3	**7.1**	2.0	2.2	1.9	**2.0**	None	None				**0.0**	2.9	3.5	2.9	**3.1**	Dense tube	2.9	3.5	2.9	**3.1**	A	Sparse internodes
P. nitens* subsp. *aspera	CHR393895	C(ii)	Acute - Obtuse	Ovate	6.1	4.3	5.0	**5.1**	2.0	2.0	2.3	**2.1**	Dense	Sparse	0.5	0.5	0.5	**0.5**	5.0	5.2	6.0	**5.4**	Dense tube	2.0	2.1	2.1	**2.1**	A	Dense branchlets
P. nitens* supsp. *nitens	CHR401767	C(ii)	Acute - Obtuse	Ovate	6.1	6.0	4.8	**5.6**	3.4	3.4	2.4	**3.1**	Dense	Sparse	0.6	0.5	0.5	**0.5**				**0.0**	No flower present	2.8	2.7	2.4	**2.6**	A	Dense branchlets
P. hirta	CHR402383a	C(ii)	Acute	Ovate	3.2	4.1	3.3	**3.5**	2.0	2.9	2.1	**2.3**	Sparse	None	0.3	0.1	0.2	**0.2**	3.9	3.8	3.9	**3.9**	Dense tube	0.7	0.9	0.7	**0.8**	A	Dense branchlets
P. hirta	CHR402383b	C(ii)	Acute	Ovate	5.1	4.9	5.2	**5.1**	2.9	2.5	2.5	**2.6**	Sparse	None	0.3	0.3	0.2	**0.3**	3.7	3.2	3.8	**3.6**	Dense tube	1.0	0.7	0.8	**0.8**	A	Moderate branchlets
P. hirta	CHR260348	C(ii)	Acute	Ovate	4.3	6.2	5.3	**5.3**	1.9	3.1	2.4	**2.5**	Sparse	None	0.4	0.5	0.3	**0.4**	2.6	3.4	3.0	**3.0**	Dense tube	1.9	1.4	1.2	**1.5**	A	Dense branchlets
P. sericeovillosa* subsp. *alta	CHR472016	C(iii)	Acute	Elliptic	4.6	4.6	4.8	**4.7**	1.9	2.0	2.5	**2.1**	Dense	None	0.3	0.4	0.4	**0.4**	1.6	2.0	1.9	**1.8**	Dense tube	1.0	1.2	1.0	**1.1**	A	Moderate branchlets
P. sericeovillosa* subsp. *alta	CHR472017	C(iii)	Acute	Elliptic	4.1	3.5	4.0	**3.9**	1.5	1.5	1.9	**1.6**	Dense	None	0.2	0.2	0.3	**0.2**	1.8	1.7	1.9	**1.8**	Dense tube	1.0	1.0	1.0	**1.0**	A	Moderate branchlets
P. sericeovillosa* subsp. *pulvinaris	CHR570342	C(iii)	Acute	Ovate	4.0	3.9	4.0	**4.0**	1.2	1.3	1.3	**1.3**	Dense	None	0.0	0.0	0.0	**0.0**	0.6	0.6	0.8	**0.7**	Dense tube	2.5	2.6	2.6	**2.6**	A	Dense branchlets
P. sericeovillosa* subsp. *sericeovillosa	WAIK18315	C(iii)	Obtuse	Elliptic	6.0	5.0	5.0	**5.3**	3.0	2.5	3.0	**2.8**	Dense	Sparse				**0.0**	3.0	5.0	4.0	**4.0**	Dense tube	1.0	1.1	1.2	**1.1**	A	Dense branchlets
P. aridula	WAIK16856	C(iii)	Acute	Elliptic	10.8	13.8	14.0	**12.9**	2.8	2.9	3.1	**2.9**	Dense	Dense	0.6	0.8	0.6	**0.7**	3.9	5.0	5.8	**4.9**	Dense tube	0.5	0.5	0.6	**0.5**	A	Dense branchlets
P. aridula	WAIK16856	C(iii)	Acute	Elliptic	6.0	6.9	5.3	**6.1**	3.1	2.2	1.2	**2.2**	Dense	Dense	0.5	0.4	0.6	**0.5**				**0.0**	No flower present	0.5	0.6	0.4	**0.5**	A	Moderate internodes
P. aridula	CHR395617	C(iii)	Acute	Elliptic	7.6	6.0	6.0	**6.5**	2.2	2.0	2.4	**2.2**	Dense	Sparse	0.5	0.5	0.7	**0.6**				**0.0**	None	0.6	0.6	0.8	**0.7**	A	Moderate internodes
P. concinna		C(iii)	Acute	Ovate - Elliptic	4.2	5.3	5.0	**4.8**	2.0	2.2	2.1	**2.1**	Dense	Sparse	0.6	0.3	0.7	**0.5**				**0.0**	No flower present	1.0	1.1	1.4	**1.2**	A	Moderate internodes
P. concinna		C(iii)	Acute	Ovate	5.5	6.0	5.5	**5.7**	2.8	3.3	3.2	**3.1**	Dense	Sparse	0.7	0.3	0.4	**0.5**				**0.0**	No flower present	0.6	0.6	0.8	**0.7**	A	Dense branchlets
P. barbata* subsp. *barbata	CHR221088	C(iii)	Acute	Ovate	5.0	5.6	5.2	**5.3**	2.9	3.3	3.5	**3.2**	Moderate	None	0.4	0.5	0.4	**0.4**	4.6	4.0	4.0	**4.2**	Dense tube	1.5	1.7	1.2	**1.5**	C	Sparse branchlets
P. barbata* subsp. *arbata	CHR221089	C(iii)	Acute	Ovate	6.9	6.1	5.9	**6.3**	2.9	3.8	3.2	**3.3**	Dense	Sparse	0.3	0.4	0.3	**0.3**	3.4	3.9	3.2	**3.5**	Dense tube	1.4	1.6	1.4	**1.5**	C	Moderate branchlets
P. barbata* subsp. *omoia	CHR510478	C(iii)	Acute	Ovate	11.1	9.1	11.0	**10.4**	3.8	2.9	4.0	**3.6**	Sparse	Dense	1.0	1.1	0.9	**1.0**				**0.0**	No flower present	5.0	5.1	4.7	**4.9**	A	Moderate branchlets
P. mimosa	CHR282959	C(iii)	Acute	Lanceolate	15.9	15.8	14.2	**15.3**	4.1	3.8	3.7	**3.9**	Moderate	Sparse	1.0	1.0	1.1	**1.0**	4.5	5.6	5.4	**5.2**	Dense tube	3.7	3.6	3.7	**3.7**	A	Dense branchlets
P. mimosa	CHR165551	C(iii)	Acute	Lanceolate	13.6	15.0	15.6	**14.7**	3.0	3.9	3.0	**3.3**	Moderate	Sparse	1.0	1.2	1.0	**1.1**				**0.0**	No flower present	2.0	2.1	2.5	**2.2**	A	Dense branchlets
P. mimosa	CHR221446	C(iii)	Acute	Lanceolate	11.1	14.8	16.2	**14.0**	3.5	4.0	4.1	**3.9**	Moderate	Sparse	1.0	1.2	1.4	**1.2**	5.1	5.2	5.3	**5.2**	Dense tube	5.0	5.1	4.7	**4.9**	A	Dense branchlets
P. linifolia	WAIK19779	AUST	Acute	Lanceolate	14.4	11.2	16.5	**14.0**	2.2	2.7	2.6	**2.5**	None	None	0.8	1.1	0.9	**0.9**	10.1	12.2	11.3	**11.2**	Dense tube	6.3	6.1	5.8	**6.1**	C	None

Appendix 3

Aligned sequence summary of the 51 New Zealand *Pimelea* taxa sequenced.

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>P. poppelwellii TS59  #1          ----------Â ----T----------
>P. sericeovillosa sub.#1          ----------Â ----------
>Haplotype 1           #1          ----------Â ----------
>P. oreophila subsp. l.#1          ----------Â ----------T------
>P. longifolia TS106   #1          ----------C:-Â ----------
>Haplotype 3           #1          ----------Â ----------
>Haplotype 4           #1          ----------Â ----------
>P. lyallii TS41       #1          ----------Â ----------
>P. xenica TS56        #1          ----------Â ----------
>P. sporadica TS53     #1          ----------Â ----------
>P. gnidia 2184        #1          ----------C:-Â ----------
>Haplotype 2           #1          ----------Â ----------
>P. traversii subsp. b.#1          ----------Â ----------
>P. mimosa TS66        #1          ----------Â ----T----------
>P. telura TS52        #1          ----------Â ----------
>P. buxifolia 1805     #1          ----------Â ----------
>P. tomentosa 2188     #1          ----------Â ----------T------
>P. villosa 1802       #1          ----------Â ----------T------
>P. actea 2189         #1          ----------Â ----------
>P. eremitica 2196     #1          ----------Â ----------
                                   ........................................
 PIMELEA THECANTHES GN.#1          TGAGCGGTGCCGCAAGG:TCÂ CCATCCCTCTCGACCGGCCC
                                   ----------**- ----*--------*------

>P. poppelwellii TS59  #41         --T-------A---------Â ----------
>P. sericeovillosa sub.#41         ----------Â ----------
>Haplotype 1           #41         ----------Â -------T----------
>P. oreophila subsp. l.#41         ----------Â -------T----------
>P. longifolia TS106   #41         ----------Â ----C----------
>Haplotype 3           #41         ----------Â -------T----------
>Haplotype 4           #41         ----------Â ----------
>P. lyallii TS41       #41         ----------Â ----------
>P. xenica TS56        #41         ----------Â ----------
>P. sporadica TS53     #41         ----------Â -------T----------
>P. gnidia 2184        #41         ----------Â ----------
>Haplotype 2           #41         ----------Â ----------
>P. traversii subsp. b.#41         --------T----------Â ----------
>P. mimosa TS66        #41         --T-------A---------Â ----------
>P. telura TS52        #41         --------G----------Â -------T----------
>P. buxifolia 1805     #41         ----------Â ----------
>P. tomentosa 2188     #41         ----------Â -------T----------
>P. villosa 1802       #41         ---------T----------Â ----------
>P. actea 2189         #41         ----------Â -------T----------
>P. eremitica 2196     #41         ---------T----------Â -------T----------
                                   ........................................
 PIMELEA THECANTHES GN.#41         CAGCGGCCACGATAACAAACÂ CCCGGCGCAAATTGCGCCAA
                                   --*-----***--------- ----*--*------------

>P. poppelwellii TS59  #81         ----------Â ----------
>P. sericeovillosa sub.#81         ----------Â ----------
>Haplotype 1           #81         ----------Â ----------
>P. oreophila subsp. l.#81         ----------Â ----------
>P. longifolia TS106   #81         ----------Â ----------
>Haplotype 3           #81         ----------Â ----------
>Haplotype 4           #81         ----------Â ----------
>P. lyallii TS41       #81         ----------Â ----------
>P. xenica TS56        #81         ----------Â ----------
>P. sporadica TS53     #81         ----------Â ----------
>P. gnidia 2184        #81         ----------Â ----------
>Haplotype 2           #81         ----------Â ----------
>P. traversii subsp. b.#81         ----------Â ----------
>P. mimosa TS66        #81         ----------Â ----------
>P. telura TS52        #81         ----------Â ----------
>P. buxifolia 1805     #81         ----------:G-----GÂ A----------
>P. tomentosa 2188     #81         ----------Â ----------
>P. villosa 1802       #81         ----------Â ---------T-------T--
>P. actea 2189         #81         ----------Â ----------
>P. eremitica 2196     #81         ----------Â -----A----------
                                   ........................................
 PIMELEA THECANTHES GN.#81         GGAACTTTGATCA:GCTATAÂ CGTCTGCCCCGGGCACCCAG
                                   ------------**-----* *----*---*-------*--

>P. poppelwellii TS59  #121        ----------:TÂ ----------G
>P. sericeovillosa sub.#121        ----------Â ------T----------
>Haplotype 1           #121        --------T---------:TÂ ----------
>P. oreophila subsp. l.#121        ----------Â ----------
>P. longifolia TS106   #121        ----------Â ----------
>Haplotype 3           #121        ----------Â ----------
>Haplotype 4           #121        ----------Â ----------
>P. lyallii TS41       #121        ----------Â ----------
>P. xenica TS56        #121        ----------Â ----------
>P. sporadica TS53     #121        ----------:TÂ ----------
>P. gnidia 2184        #121        ----------:TÂ ----------
>Haplotype 2           #121        ------G----------Â ----------
```

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>P. traversii subsp. b.#121      ------G-------------Â --------------------
>P. mimosa TS66        #121      ------------------:TÂ --------------------G
>P. telura TS52        #121      --------------------Â --------------------
>P. buxifolia 1805     #121      -G------------------Â ---C--T-------------
>P. tomentosa 2188     #121      --------------------Â --------------------
>P. villosa 1802       #121      -------------A------Â --------------------
>P. actea 2189         #121      ------------------:TÂ --------------------
>P. eremitica 2196     #121      --------------------Â --------------------
                                 ........................................
 PIMELEA THECANTHES GN.#121      AAATGGAGCGCTTGGGGTC:Â GGGTGTCATATGTAATCCAA
                                 -*----*-*----*----** ---*--*------------*

>P. poppelwellii TS59  #161      --------C-----------Â --------------------
>P. sericeovillosa sub.#161      --------------------Â --------------------
>Haplotype 1           #161      --------------------Â --------------------
>P. oreophila subsp. l.#161      --------------------Â --------------------
>P. longifolia TS106   #161      --------------------Â --------------------
>Haplotype 3           #161      --------------------Â --------------------
>Haplotype 4           #161      --------------------Â --------------------
>P. lyallii TS41       #161      --------------------Â --------------------
>P. xenica TS56        #161      --------------------Â --------------------
>P. sporadica TS53     #161      --------------------Â --------------------
>P. gnidia 2184        #161      --------------------Â --------------------
>Haplotype 2           #161      --------------------Â --------------------
>P. traversii subsp. b.#161      --------------------Â --------------------
>P. mimosa TS66        #161      --------------------Â --------------------
>P. telura TS52        #161      --------------------Â --------------------
>P. buxifolia 1805     #161      --------------------Â --------------------
>P. tomentosa 2188     #161      --------------------Â --------------------
>P. villosa 1802       #161      --------------------Â --------------------
>P. actea 2189         #161      --------------------Â --------------------
>P. eremitica 2196     #161      --------------------Â --------------------
                                 ........................................
 PIMELEA THECANTHES GN.#161      AACGACTCTCGGCAACGGATÂ ATCTTGGCTCTCGCATCGAT
                                 --------*----------- --------------------

>P. poppelwellii TS59  #201      --------------------Â --------------------
>P. sericeovillosa sub.#201      --------------------Â --------------------
>Haplotype 1           #201      --------------------Â --------------------
>P. oreophila subsp. l.#201      --------------------Â --------------------
>P. longifolia TS106   #201      --------------------Â --------------------
>Haplotype 3           #201      --------------------Â --------------------
>Haplotype 4           #201      --------------------Â --------------------
>P. lyallii TS41       #201      --------------------Â --------------------
>P. xenica TS56        #201      --------------------Â --------------------
>P. sporadica TS53     #201      --------------------Â --------------------
>P. gnidia 2184        #201      --------------------Â --------------------
>Haplotype 2           #201      --------------------Â --------------------
>P. traversii subsp. b.#201      --------------------Â --------------------
>P. mimosa TS66        #201      --------------------Â --------------------
>P. telura TS52        #201      --------------------Â --------------------
>P. buxifolia 1805     #201      --------------------Â --------------------
>P. tomentosa 2188     #201      --------------------Â --------------------
>P. villosa 1802       #201      --------------------Â --------------------
>P. actea 2189         #201      --------------------Â --------------------
>P. eremitica 2196     #201      --------------------Â --------------------
                                 ........................................
 PIMELEA THECANTHES GN.#201      GAAGAACGTAGCGAAATGCGÂ ATACTTGGTGTGAATTGCAG
                                 -------------------- --------------------

>P. poppelwellii TS59  #241      --------------------Â --------------------
>P. sericeovillosa sub.#241      --------------------Â --------------------
>Haplotype 1           #241      --------------------Â --------------------
>P. oreophila subsp. l.#241      --------------------Â --------------------
>P. longifolia TS106   #241      --------------------Â --------------------
>Haplotype 3           #241      --------------------Â --------------------
>Haplotype 4           #241      --------------------Â --------------------
>P. lyallii TS41       #241      --------------------Â --------------------
>P. xenica TS56        #241      --------------------Â --------------------
>P. sporadica TS53     #241      --------------------Â --------------------
>P. gnidia 2184        #241      --------------------Â --------------------
>Haplotype 2           #241      --------------------Â --------------------
>P. traversii subsp. b.#241      --------------------Â --------------------
>P. mimosa TS66        #241      --------------------Â --------------------
>P. telura TS52        #241      --------------------Â --------------------
>P. buxifolia 1805     #241      --------------------Â --------------------
>P. tomentosa 2188     #241      --------------------Â --------------------
>P. villosa 1802       #241      --------------------Â --------------------
>P. actea 2189         #241      --------------------Â --------------------
>P. eremitica 2196     #241      --------------------Â --------------------
                                 ........................................
 PIMELEA THECANTHES GN.#241      AATCCCGTGAACCATCGAGTÂ CTTTGAACGCAAGTTGCGCC
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>P. poppelwellii TS59  #281      --------------------Â --------------------
>P. sericeovillosa sub.#281      --------------------Â --------------------
>Haplotype 1           #281      --------------------Â --------------------
>P. oreophila subsp. l.#281      --------------------Â --------------------
>P. longifolia TS106   #281      --------------------Â --------------------
>Haplotype 3           #281      --------------------Â --------------------
>Haplotype 4           #281      --------------------Â --------------------
>P. lyallii TS41       #281      --------------T-----Â --------------------
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>P. xenica TS56        #281
>P. sporadica TS53     #281
>P. gnidia 2184        #281
>Haplotype 2           #281
>P. traversii subsp. b.#281
>P. mimosa TS66        #281
>P. telura TS52        #281
>P. buxifolia 1805     #281
>P. tomentosa 2188     #281
>P. villosa 1802       #281
>P. actea 2189         #281
>P. eremitica 2196     #281

 PIMELEA THECANTHES GN.#281

>P. poppelwellii TS59  #321
>P. sericeovillosa sub.#321
>Haplotype 1           #321
>P. oreophila subsp. l.#321
>P. longifolia TS106   #321
>Haplotype 3           #321
>Haplotype 4           #321
>P. lyallii TS41       #321
>P. xenica TS56        #321
>P. sporadica TS53     #321
>P. gnidia 2184        #321
>Haplotype 2           #321
>P. traversii subsp. b.#321
>P. mimosa TS66        #321
>P. telura TS52        #321
>P. buxifolia 1805     #321
>P. tomentosa 2188     #321
>P. villosa 1802       #321
>P. actea 2189         #321
>P. eremitica 2196     #321

 PIMELEA THECANTHES GN.#321

>P. poppelwellii TS59  #361
>P. sericeovillosa sub.#361
>Haplotype 1           #361
>P. oreophila subsp. l.#361
>P. longifolia TS106   #361
>Haplotype 3           #361
>Haplotype 4           #361
>P. lyallii TS41       #361
>P. xenica TS56        #361
>P. sporadica TS53     #361
>P. gnidia 2184        #361
>Haplotype 2           #361
>P. traversii subsp. b.#361
>P. mimosa TS66        #361
>P. telura TS52        #361
>P. buxifolia 1805     #361
>P. tomentosa 2188     #361
>P. villosa 1802       #361
>P. actea 2189         #361
>P. eremitica 2196     #361

 PIMELEA THECANTHES GN.#361

>P. poppelwellii TS59  #401
>P. sericeovillosa sub.#401
>Haplotype 1           #401
>P. oreophila subsp. l.#401
>P. longifolia TS106   #401
>Haplotype 3           #401
>Haplotype 4           #401
>P. lyallii TS41       #401
>P. xenica TS56        #401
>P. sporadica TS53     #401
>P. gnidia 2184        #401
>Haplotype 2           #401
>P. traversii subsp. b.#401
>P. mimosa TS66        #401
>P. telura TS52        #401
>P. buxifolia 1805     #401
>P. tomentosa 2188     #401
>P. villosa 1802       #401
>P. actea 2189         #401
>P. eremitica 2196     #401

 PIMELEA THECANTHES GN.#401
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Appendix 4

Pairwise distance matrix of the 131 *Pimelea, Thecanthes* and *Gnidia* sequences

		1	2	3	4	5	6	7	8
1	P. preissii FJ572725	-							
2	P. imbricata subsp. piligera G	0.06836	-						
3	G. dumetorum AM159515	0.15128	0.16305	-					
4	G. bojeriana AM159511	0.15910	0.17833	0.03690	-				
5	G. gilbertae AJ744927	0.14616	0.16063	0.02304	0.03231	-			
6	G. caffra AM396520	0.16404	0.17332	0.10419	0.09216	0.09962	-		
7	G. sericocephala AM159523	0.16846	0.18756	0.10638	0.09657	0.10872	0.06178	-	
8	G. madagascariensis AM159519	0.14936	0.16643	0.03466	0.04617	0.03458	0.11359	0.11811	-
9	G. calocephala AM396521	0.17622	0.18545	0.11803	0.10595	0.11346	0.02288	0.07551	0.12743
10	G. decaryana AJ744926	0.18283	0.18518	0.13515	0.13954	0.13049	0.13943	0.15306	0.15016
11	G. racemosa AM159522	0.12297	0.13198	0.15151	0.14014	0.13289	0.14419	0.15778	0.14043
12	G. danguyana AM159513	0.18039	0.18053	0.11980	0.13601	0.12910	0.14969	0.16092	0.13914
13	G. bakeri AM159510	0.16944	0.19075	0.13303	0.13786	0.14045	0.15900	0.16142	0.14068
14	G. denudata AM159514	0.12137	0.14308	0.16603	0.15695	0.15439	0.15189	0.16575	0.15034
15	G. denudata AJ744918	0.11870	0.14037	0.16367	0.15447	0.15200	0.15176	0.16330	0.14793
16	G. pinifolia AM159521	0.13791	0.15879	0.15495	0.15342	0.14784	0.15012	0.15918	0.16056
17	G. renniana AM396522	0.12307	0.13709	0.17197	0.16993	0.16242	0.17905	0.18584	0.16071
18	P. poppelwellii TS59	0.05661	0.06588	0.14851	0.15649	0.14341	0.17108	0.17039	0.15169
19	P. spinescens subsp. pubiflora	0.07492	0.08495	0.17132	0.17756	0.16362	0.18163	0.18557	0.16987
20	P. pelinos AM162497	0.07130	0.08054	0.16709	0.17483	0.16705	0.17971	0.17955	0.16533
21	P. spicata FJ572713	0.05683	0.07048	0.17372	0.18031	0.16828	0.17974	0.17856	0.17253
22	P. urvilleana subsp. nesica TS	0.04481	0.06118	0.14359	0.15153	0.13859	0.16119	0.16064	0.14192
23	P. sericeovillosa subsp. alta	0.04955	0.05882	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
24	P. carnosa TS51	0.04481	0.06118	0.14359	0.15153	0.13859	0.16119	0.16064	0.14192
25	G. aberrans AM159508	0.05666	0.07071	0.15116	0.15903	0.15347	0.16871	0.16342	0.15195
26	P. oreophila subsp. lepta TS60	0.05190	0.06353	0.14600	0.15397	0.14097	0.16854	0.16793	0.14435
27	P. longifolia TS106	0.05666	0.06824	0.15576	0.16381	0.15064	0.17351	0.17273	0.15415
28	P. flava subsp. dichotoma GQ20	0.05679	0.07114	0.15495	0.16328	0.14989	0.17253	0.16932	0.15340
29	P. sericeovillosa subsp. pulvi	0.04955	0.06118	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
30	P. declivis 2194	0.04719	0.05882	0.14598	0.15399	0.14090	0.16368	0.16299	0.14434
31	G. setosa AM159524	0.05420	0.07059	0.15092	0.15876	0.15323	0.16840	0.16555	0.15169
32	P. mesoa subsp. mesoa TS47	0.04719	0.05882	0.14598	0.15399	0.14090	0.16368	0.16299	0.14434
33	P. lyallii TS41	0.04482	0.06118	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
34	P. xenica TS56	0.04720	0.05882	0.15088	0.15892	0.14579	0.16863	0.16793	0.14929
35	P. lyallii GQ205218	0.04756	0.06158	0.14967	0.15769	0.14452	0.16743	0.16671	0.14794
36	P. urvilleana subsp. urvillean	0.04481	0.06118	0.14359	0.15153	0.13859	0.16119	0.16064	0.14192
37	P. oreophila subsp. oreophila	0.04719	0.05882	0.14598	0.15399	0.14090	0.16368	0.16299	0.14434
38	P. cryptica 2192	0.04719	0.05882	0.14598	0.15399	0.14090	0.16368	0.16299	0.14434
39	P. prostrata subsp. prostrata	0.04493	0.05891	0.14398	0.15192	0.13897	0.16167	0.16106	0.14230
40	P. prostrata subsp. seismica 2	0.04481	0.06118	0.14359	0.15153	0.13859	0.16119	0.16064	0.14192
41	P. orthia TS55	0.04481	0.06118	0.14359	0.15153	0.13859	0.16119	0.16064	0.14192
42	P. sporadica TS53	0.04718	0.05882	0.14600	0.15397	0.14097	0.16365	0.16305	0.14435
43	P. prostrata subsp. ventosa TS	0.04719	0.05882	0.14598	0.15399	0.14090	0.16368	0.16299	0.14434
44	P. barbata subsp. barbata TS50	0.04481	0.06118	0.14359	0.15153	0.13859	0.16119	0.16064	0.14192
45	P. notia TS33	0.04719	0.05882	0.14598	0.15399	0.14090	0.16368	0.16299	0.14434
46	P. gnidia 2184	0.04720	0.05882	0.14604	0.15404	0.14096	0.16373	0.16305	0.14441
47	P. aridula subsp. oliga 2183	0.04955	0.06118	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
48	P. oreophila subsp. hetera 219	0.04955	0.06118	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
49	P. ignota TS57	0.04955	0.06118	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
50	P. oreophila subsp. ephaistica	0.04955	0.06118	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
51	P. hirta TS32	0.04955	0.06118	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
52	P. barbata subsp. omoia TS29	0.04955	0.06118	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
53	P. prostrata subsp. vulcanica	0.04955	0.06118	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
54	P. traversii subsp. exedra TS6	0.04955	0.06118	0.14850	0.15655	0.14340	0.16625	0.16552	0.14689
55	P. traversii subsp. traversii	0.04955	0.06118	0.14850	0.15655	0.14340	0.16625	0.16552	0.14689
56	P. flava subsp. flava GQ205163	0.06321	0.07299	0.15831	0.16689	0.15607	0.17656	0.17319	0.15428
57	P. concinna 1806	0.04955	0.06118	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
58	P. traversii subsp. borea TS10	0.05190	0.06353	0.15101	0.15905	0.14594	0.16873	0.16557	0.14942
59	P. mimosa TS66	0.05188	0.06118	0.14855	0.15649	0.14351	0.17103	0.17038	0.14687
60	P. acra 2182	0.04955	0.06118	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
61	P. telura TS52	0.05190	0.06353	0.15092	0.15891	0.14589	0.16858	0.16306	0.14932
62	P. microphylla TS58	0.04955	0.06118	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
63	P. buxifolia 1805	0.05663	0.06588	0.14863	0.15667	0.14357	0.16868	0.16790	0.14711
64	P. psuedolyallii TS46	0.04955	0.06118	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
65	P. dura TS31	0.04719	0.05882	0.14598	0.15399	0.14090	0.16368	0.16299	0.14434
66	P. prostrata subsp. thermalis	0.04955	0.06118	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
67	P. nitens subsp. aspera 2197	0.04955	0.06118	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
68	P. tomentosa 2188	0.05426	0.06353	0.14851	0.15647	0.14351	0.17101	0.17039	0.14688
69	P. nitens subsp. nitens TS48	0.04955	0.06118	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
70	P. alpina FJ572728	0.05202	0.06624	0.16111	0.16910	0.15592	0.17890	0.18311	0.15940
71	P. villosa 1802	0.06602	0.06824	0.15576	0.16366	0.15084	0.18071	0.18022	0.15414
72	P. actea 2189	0.04955	0.06118	0.14841	0.15642	0.14335	0.16611	0.16546	0.14678
73	P. eremitica 2196	0.05661	0.06353	0.15321	0.16365	0.15064	0.17335	0.17279	0.15403
74	P. pseudolyallii GQ205212	0.05005	0.06212	0.15095	0.15915	0.14582	0.16889	0.16822	0.14929
75	P. haematostachya FJ572733	0.09277	0.11052	0.17881	0.18763	0.17545	0.19829	0.19197	0.18500
76	T. punicea AM162502	0.12294	0.13204	0.16353	0.15934	0.15860	0.18376	0.18574	0.16923
77	P. stricta FJ649628	0.04508	0.05891	0.14870	0.15909	0.14591	0.16893	0.16580	0.14930
78	P. axiflora subsp. pubescens G	0.05105	0.06113	0.13696	0.13817	0.13279	0.15302	0.14972	0.13745
79	P. octophylla FJ572717	0.07096	0.06385	0.16141	0.17452	0.16118	0.18382	0.18795	0.16232
80	P. ferruginea FJ605464	0.04086	0.07396	0.15532	0.16205	0.14980	0.16644	0.16525	0.15409
81	P. erecta FJ572721	0.06155	0.08757	0.16415	0.17241	0.15906	0.18212	0.18139	0.16261
82	P. suaveolens subsp. suaveolen	0.04482	0.07067	0.15364	0.16655	0.15092	0.17130	0.17549	0.15909
83	P. decora FJ572732	0.08064	0.10166	0.16646	0.17437	0.16132	0.18422	0.17871	0.17201
84	P. sericostachya subsp. serico	0.09194	0.09655	0.15125	0.15180	0.14621	0.17598	0.17820	0.14681
85	T. sanguinea AM162503	0.12085	0.12054	0.16072	0.16140	0.16064	0.18584	0.18857	0.16639
86	P. imbricata subsp. imbricata	0.04585	0.04823	0.13943	0.15187	0.14157	0.16272	0.16414	0.14249

87	P. milliganii FJ572712	0.05436	0.05668	0.14893	0.16218	0.15336	0.16919	0.17062	0.15232
88	P. linifolia TS91	0.03773	0.05412	0.14115	0.15154	0.13846	0.16125	0.16550	0.14184
89	P. strigosa FJ572716	0.09972	0.09719	0.16901	0.17448	0.16882	0.18918	0.19115	0.16722
90	P. curviflora subsp. divergens	0.08254	0.07529	0.16285	0.16351	0.15537	0.16827	0.17524	0.15616
91	G. galpinii AM159516	0.10389	0.10837	0.14370	0.14435	0.12893	0.14668	0.15350	0.13232
92	G. humulis AM159517	0.10388	0.10837	0.14129	0.14191	0.12655	0.14909	0.15594	0.12989
93	P. curviflora subsp. subglabra	0.07243	0.08939	0.15273	0.15606	0.14746	0.17299	0.16722	0.15110
94	G. coriacea AM159512	0.10860	0.11543	0.14609	0.14188	0.13140	0.14912	0.15592	0.13470
95	P. curviflora subsp. gracilis	0.06841	0.07294	0.14115	0.14669	0.13840	0.15870	0.15337	0.14420
96	P. ammocharis FJ605463	0.07938	0.07735	0.16522	0.17347	0.16014	0.17304	0.17989	0.16849
97	G. wilmsii AM159527	0.09243	0.08775	0.15405	0.15474	0.15138	0.16924	0.17130	0.14983
98	P. curviflora subsp. cericea G	0.08018	0.09644	0.15299	0.15599	0.14536	0.17303	0.16760	0.15352
99	P. gilgiana FJ572710	0.08797	0.08772	0.14740	0.16014	0.14967	0.17493	0.17698	0.14313
100	P. lehmanniana subsp. nervosa	0.04022	0.06135	0.15640	0.16196	0.15131	0.15949	0.15884	0.15479
101	P. calcicola FJ572722	0.04248	0.06122	0.15584	0.16143	0.14839	0.16138	0.16084	0.15183
102	P. avonensis FJ572735	0.03320	0.05943	0.14772	0.15584	0.14261	0.15775	0.15513	0.14557
103	P. sulphurea FJ572727	0.03773	0.05885	0.14848	0.15655	0.14099	0.15896	0.15839	0.14675
104	P. tinctoria FJ572730	0.04963	0.06615	0.14140	0.14933	0.13397	0.15375	0.15584	0.13948
105	P. humilis GQ205198	0.04726	0.06160	0.13708	0.14017	0.12697	0.15733	0.16376	0.13029
106	P. leucantha GQ205207	0.03771	0.06118	0.15088	0.15649	0.14576	0.15881	0.15583	0.14915
107	P. angustifolia FJ572726	0.02611	0.04999	0.14465	0.15262	0.13948	0.15039	0.15893	0.14289
108	P. ciliata subsp. ciliata FJ57	0.03065	0.06118	0.14104	0.14662	0.13587	0.15147	0.15079	0.13931
109	P. mesoa subsp. macra TS86 TS1	0.04719	0.05882	0.14598	0.15399	0.14090	0.16368	0.16299	0.14434
110	P. suteri TS45	0.04726	0.05889	0.14399	0.15197	0.13893	0.16394	0.16330	0.14231
111	P. aridula subsp. aridula TS84	0.04719	0.05882	0.14598	0.15399	0.14090	0.16368	0.16299	0.14434
112	P. sericeovillosa subsp. seric	0.04719	0.05882	0.14598	0.15399	0.14090	0.16368	0.16299	0.14434
113	P. hispida FJ572738	0.03107	0.05716	0.14467	0.15022	0.14212	0.16037	0.16197	0.14079
114	P. lanata FJ572739	0.04986	0.06650	0.15597	0.16402	0.15401	0.16394	0.17100	0.15429
115	P. phylicoides FJ572723	0.05712	0.07113	0.15730	0.16719	0.15447	0.17670	0.17781	0.15899
116	P. villifera FJ572720	0.05190	0.06353	0.14585	0.15387	0.14322	0.15870	0.15808	0.13930
117	P. biflora GQ205186	0.04618	0.04832	0.13730	0.14270	0.13536	0.15534	0.15467	0.13344
118	P. pauciflora GQ205168	0.06869	0.07812	0.16892	0.17684	0.16882	0.18647	0.19351	0.16725
119	P. graniticola FJ572718	0.06382	0.04479	0.16579	0.17616	0.16079	0.16636	0.18303	0.15945
120	P. axiflora subsp. alpina GQ20	0.06612	0.06613	0.15649	0.16929	0.15621	0.18150	0.18096	0.15963
121	P. spiculigera subsp. thesiode	0.06383	0.06139	0.15382	0.16902	0.15608	0.17385	0.18062	0.15451
122	P. drupacea GQ205174	0.06908	0.05985	0.15585	0.16572	0.15087	0.17694	0.17469	0.15661
123	P. brevistyla subsp. brevistyl	0.03069	0.05450	0.14679	0.15483	0.14163	0.15470	0.15891	0.14510
124	P. subvillifera GQ205195	0.03065	0.05647	0.14842	0.15648	0.14332	0.15643	0.15577	0.14682
125	P. longiflora subsp. longiflor	0.04054	0.06700	0.14995	0.16033	0.14702	0.16056	0.16276	0.14829
126	G. squarrosa AM159525	0.10142	0.10588	0.15810	0.15882	0.16041	0.15369	0.16299	0.15403
127	G. carinata AJ549499	0.10131	0.10587	0.15810	0.15884	0.16040	0.15372	0.16308	0.15401
128	P. microephala subsp. microeph	0.06647	0.06409	0.15718	0.17247	0.15945	0.17483	0.18165	0.15791
129	G. phaeotricha AM159520	0.10190	0.09206	0.16824	0.16658	0.16796	0.17132	0.17064	0.16166
130	G. anomala AM158940	0.12577	0.14757	0.14325	0.13591	0.13097	0.14320	0.15279	0.13847
131	G. kraussiana AM159518	0.16025	0.16612	0.08461	0.07024	0.08224	0.06805	0.07492	0.09165

		9	10	11	12	13	14	15	16
9	G. calocephala AM396521	-							
10	G. decaryana AJ744926	0.15338	-						
11	G. racemosa AM159522	0.15583	0.16212	-					
12	G. danguyana AM159513	0.16360	0.06932	0.17170	-				
13	G. bakeri AM159510	0.16905	0.13311	0.16709	0.13651	-			
14	G. denudata AM159514	0.16358	0.17910	0.09097	0.19377	0.17516	-		
15	G. denudata AJ744918	0.16349	0.17835	0.09331	0.19118	0.17238	0.00233	-	
16	G. pinifolia AM159521	0.15722	0.16376	0.09007	0.18547	0.17148	0.10284	0.10749	-
17	G. renniana AM396522	0.19564	0.19270	0.11425	0.19748	0.17962	0.03345	0.03827	0.11671
18	P. poppelwellii TS59	0.18321	0.18013	0.12717	0.18236	0.17644	0.14330	0.14068	0.13973
19	P. spinescens subsp. pubiflora	0.19180	0.18269	0.13505	0.19416	0.19264	0.15447	0.15168	0.14806
20	P. pelinos AM162497	0.19195	0.18637	0.14308	0.17949	0.18219	0.14916	0.14635	0.16045
21	P. spicata FJ572713	0.19567	0.19117	0.14213	0.19900	0.20008	0.15240	0.14938	0.15596
22	P. urvilleana subsp. nesica TS	0.17332	0.17264	0.12003	0.17524	0.16655	0.12875	0.12612	0.13268
23	P. sericeovillosa subsp. alta	0.17824	0.17269	0.11511	0.17516	0.17168	0.12878	0.12618	0.13268
24	P. carnosa TS51	0.17332	0.17264	0.12003	0.17524	0.16655	0.12875	0.12612	0.13268
25	G. aberrans AM159508	0.18085	0.17521	0.12998	0.17305	0.16919	0.12877	0.12608	0.14991
26	P. oreophila subsp. lepta TS60	0.18067	0.17512	0.11757	0.17761	0.17415	0.13126	0.12864	0.13513
27	P. longifolia TS106	0.18564	0.18274	0.11992	0.18481	0.17405	0.13357	0.13100	0.13722
28	P. flava subsp. dichotoma GQ20	0.18487	0.18056	0.13617	0.18499	0.17373	0.14522	0.14253	0.14867
29	P. sericeovillosa subsp. pulvi	0.17824	0.17760	0.11511	0.17998	0.17168	0.12878	0.12618	0.13268
30	P. declivis 2194	0.17581	0.17517	0.11265	0.17753	0.16921	0.12630	0.12373	0.13023
31	G. setosa AM159524	0.18053	0.17494	0.12978	0.17279	0.16888	0.12852	0.12585	0.14707
32	P. mesoa subsp. mesoa TS47	0.17581	0.17517	0.11265	0.17753	0.16921	0.12630	0.12373	0.13023
33	P. lyallii TS41	0.17824	0.17760	0.11021	0.17516	0.16664	0.12878	0.12618	0.13268
34	P. xenica TS56	0.18076	0.17777	0.11500	0.18242	0.16913	0.12862	0.12602	0.13230
35	P. lyallii GQ205218	0.17972	0.17696	0.11602	0.17727	0.17071	0.13208	0.12953	0.13627
36	P. urvilleana subsp. urvillean	0.17332	0.17264	0.12003	0.17524	0.16655	0.12875	0.12612	0.13268
37	P. oreophila subsp. oreophila	0.17581	0.17517	0.11265	0.17753	0.16921	0.12630	0.12373	0.13023
38	P. cryptica 2192	0.17581	0.17517	0.11265	0.17753	0.16921	0.12630	0.12373	0.13023
39	P. prostrata subsp. prostrata	0.17385	0.17313	0.11774	0.17575	0.16700	0.12912	0.12645	0.13301
40	P. prostrata subsp. seismica 2	0.17332	0.17264	0.12003	0.17524	0.16655	0.12875	0.12612	0.13268
41	P. orthia TS55	0.17332	0.17264	0.12003	0.17524	0.16655	0.12875	0.12612	0.13268
42	P. sporadica TS53	0.17578	0.17512	0.11757	0.17761	0.16912	0.13126	0.12864	0.13513
43	P. prostrata subsp. ventosa TS	0.17581	0.17517	0.11265	0.17753	0.16921	0.12630	0.12373	0.13023
44	P. barbata subsp. barbata TS50	0.17332	0.17264	0.12003	0.17524	0.16655	0.12875	0.12612	0.13268
45	P. notia TS33	0.17581	0.17517	0.11265	0.17753	0.16921	0.12630	0.12373	0.13023
46	P. gnidia 2184	0.17587	0.17286	0.11500	0.17759	0.16652	0.12862	0.12602	0.13230
47	P. aridula subsp. oliga 2183	0.17824	0.17760	0.11511	0.17998	0.17168	0.12878	0.12618	0.13268
48	P. oreophila subsp. hetera 219	0.17824	0.17760	0.11511	0.17998	0.17168	0.12878	0.12618	0.13268
49	P. ignota TS57	0.17824	0.17760	0.11511	0.17998	0.17168	0.12878	0.12618	0.13268
50	P. oreophila subsp. ephaistica	0.17824	0.17760	0.11511	0.17998	0.17168	0.12878	0.12618	0.13268
51	P. hirta TS32	0.17824	0.17760	0.11511	0.17998	0.17168	0.12878	0.12618	0.13268
52	P. barbata subsp. omoia TS29	0.17824	0.17760	0.11511	0.17998	0.17168	0.12878	0.12618	0.13268
53	P. prostrata subsp. vulcanica	0.17824	0.17760	0.11511	0.17998	0.17168	0.12878	0.12618	0.13268
54	P. traversii subsp. exedra TS6	0.17838	0.17775	0.11757	0.18002	0.16676	0.13114	0.12855	0.13486
55	P. traversii subsp. traversii	0.17838	0.17775	0.11757	0.18002	0.16676	0.13114	0.12855	0.13486
56	P. flava subsp. flava GQ205163	0.18913	0.17376	0.12950	0.18124	0.17763	0.14344	0.14075	0.14238
57	P. concinna 1806	0.17824	0.17760	0.11511	0.17998	0.17168	0.12878	0.12618	0.13268
58	P. traversii subsp. borea TS10	0.18085	0.17780	0.12006	0.18257	0.16925	0.13366	0.13104	0.13729
59	P. mimosa TS66	0.18316	0.18011	0.12238	0.18247	0.17154	0.13845	0.13581	0.13964
60	P. acra 2182	0.17824	0.17760	0.11511	0.17998	0.17168	0.12878	0.12618	0.13268
61	P. telura TS52	0.18071	0.17519	0.11756	0.18253	0.17407	0.13124	0.12864	0.13509
62	P. microphylla TS58	0.17824	0.17760	0.11511	0.17998	0.17168	0.12878	0.12618	0.13268
63	P. buxifolia 1805	0.18081	0.17531	0.11495	0.17779	0.16412	0.12372	0.12117	0.13217
64	P. psuedolyallii TS46	0.17824	0.17760	0.11511	0.17998	0.17168	0.12878	0.12618	0.13268
65	P. dura TS31	0.17581	0.17517	0.11265	0.17753	0.16921	0.12630	0.12373	0.13023
66	P. prostrata subsp. thermalis	0.17824	0.17760	0.11511	0.17998	0.17168	0.12878	0.12618	0.13268
67	P. nitens subsp. aspera 2197	0.17824	0.17760	0.11511	0.17998	0.17168	0.12878	0.12618	0.13268
68	P. tomentosa 2188	0.18314	0.17765	0.12008	0.18016	0.17663	0.13379	0.13115	0.13758
69	P. nitens subsp. nitens TS48	0.17824	0.17760	0.11511	0.17998	0.17168	0.12878	0.12618	0.13268
70	P. alpina FJ572728	0.18398	0.18552	0.12265	0.18761	0.18214	0.13876	0.13618	0.14273
71	P. villosa 1802	0.18796	0.18735	0.12993	0.18510	0.17421	0.13858	0.13591	0.14742
72	P. actea 2189	0.17824	0.17760	0.12001	0.17998	0.17168	0.13376	0.13116	0.13758
73	P. eremitica 2196	0.18549	0.18251	0.12248	0.18244	0.17664	0.13612	0.13349	0.13771
74	P. pseudolyallii GQ205212	0.18129	0.18095	0.11943	0.18319	0.17463	0.13119	0.12857	0.13762
75	P. haematostachya FJ572733	0.20630	0.19996	0.15045	0.19230	0.21032	0.15741	0.15442	0.16717
76	T. punicea AM162502	0.19110	0.18563	0.15931	0.18062	0.18935	0.16818	0.16548	0.17150
77	P. stricta FJ649628	0.18112	0.17545	0.12027	0.17769	0.17707	0.13379	0.13118	0.13778
78	P. axiflora subsp. pubescens G	0.16335	0.16438	0.10589	0.16459	0.15552	0.11391	0.11133	0.11931
79	P. octophylla FJ572717	0.20094	0.19625	0.13517	0.17876	0.18989	0.14682	0.14422	0.14737
80	P. ferruginea FJ605464	0.17964	0.18830	0.13325	0.19014	0.18437	0.13530	0.13248	0.14411
81	P. erecta FJ572721	0.18454	0.19177	0.14035	0.19613	0.19543	0.13689	0.13699	0.14080
82	P. suaveolens subsp. suaveolen	0.18349	0.18335	0.13991	0.18287	0.17977	0.14878	0.14607	0.14735
83	P. decora FJ572732	0.19146	0.18586	0.13766	0.18094	0.19713	0.14398	0.14121	0.15298
84	P. sericostachya subsp. serico	0.18328	0.16580	0.13226	0.15872	0.17638	0.15808	0.15529	0.15220

85	T. sanguinea AM162503	0.19320	0.18250	0.15713	0.18525	0.19908	0.17326	0.17045	0.16634
86	P. imbricata subsp. imbricata	0.17287	0.16942	0.11709	0.16719	0.16574	0.12903	0.12635	0.13035
87	P. milliganii FJ572712	0.18143	0.18387	0.12292	0.17585	0.17279	0.13704	0.13451	0.13525
88	P. linifolia TS91	0.17339	0.17035	0.11759	0.17024	0.16440	0.12616	0.12355	0.13010
89	P. strigosa FJ572716	0.19648	0.19787	0.15762	0.19787	0.19728	0.16632	0.16363	0.16510
90	P. curviflora subsp. divergens	0.17804	0.17998	0.11981	0.18231	0.18897	0.14078	0.13805	0.13733
91	G. galpinii AM159516	0.16367	0.17052	0.11278	0.17063	0.16626	0.11105	0.11101	0.11953
92	G. humulis AM159517	0.16609	0.17291	0.11519	0.17306	0.16871	0.10853	0.10848	0.12191
93	P. curviflora subsp. subglabra	0.18549	0.18621	0.12875	0.18085	0.17698	0.14028	0.13759	0.14135
94	G. coriacea AM159512	0.16611	0.17286	0.11517	0.17312	0.16633	0.11349	0.11338	0.12185
95	P. curviflora subsp. gracilis	0.16596	0.17034	0.11758	0.16306	0.17152	0.13595	0.13328	0.12755
96	P. ammocharis FJ605463	0.18319	0.18287	0.15096	0.18585	0.18829	0.15751	0.15944	0.15877
97	G. wilmsii AM159527	0.17904	0.18123	0.12333	0.17149	0.16276	0.13922	0.13646	0.15013
98	P. curviflora subsp. cericea G	0.18280	0.18484	0.13708	0.18933	0.18881	0.14058	0.13798	0.14952
99	P. gilgiana FJ572710	0.18715	0.16913	0.13550	0.17433	0.18701	0.15080	0.14869	0.14533
100	P. lehmanniana subsp. nervosa	0.16676	0.17377	0.11797	0.17615	0.16698	0.12964	0.12694	0.13578
101	P. calcicola FJ572722	0.16861	0.16786	0.12485	0.17767	0.17918	0.13615	0.13346	0.13260
102	P. avonensis FJ572735	0.17037	0.17699	0.12376	0.17718	0.17252	0.12032	0.11756	0.13371
103	P. sulphurea FJ572727	0.17112	0.17556	0.12251	0.18252	0.16927	0.13124	0.12860	0.13475
104	P. tinctoria FJ572730	0.16590	0.16353	0.12239	0.16841	0.16199	0.13384	0.13114	0.13250
105	P. humilis GQ205198	0.16694	0.16671	0.11814	0.16403	0.16809	0.12446	0.12180	0.13073
106	P. leucantha GQ205207	0.17094	0.17017	0.12491	0.17021	0.16916	0.12858	0.12593	0.12981
107	P. angustifolia FJ572726	0.16263	0.17111	0.10594	0.17122	0.16963	0.11466	0.11469	0.12585
108	P. ciliata subsp. ciliata FJ57	0.16361	0.16999	0.11994	0.17246	0.16677	0.12359	0.12103	0.12992
109	P. mesoa subsp. macra TS86 TS1	0.17581	0.17517	0.11265	0.17753	0.16921	0.12630	0.12373	0.13023
110	P. suteri TS45	0.17610	0.17321	0.11278	0.17570	0.16943	0.12646	0.12388	0.13049
111	P. aridula subsp. aridula TS84	0.17581	0.17517	0.11265	0.17753	0.16921	0.12630	0.12373	0.13023
112	P. sericeovillosa subsp. seric	0.17581	0.17517	0.11265	0.17753	0.16921	0.12630	0.12373	0.13023
113	P. hispida FJ572738	0.17273	0.16945	0.12150	0.16864	0.16747	0.12242	0.11971	0.13899
114	P. lanata FJ572739	0.17376	0.17770	0.12841	0.18053	0.16701	0.12958	0.12691	0.14599
115	P. phylicoides FJ572723	0.19281	0.19202	0.13437	0.19349	0.18703	0.14475	0.14186	0.15264
116	P. villifera FJ572720	0.17084	0.17993	0.12240	0.17975	0.17671	0.12617	0.12355	0.14209
117	P. biflora GQ205186	0.16557	0.17184	0.10920	0.16402	0.16442	0.12499	0.12218	0.12600
118	P. pauciflora GQ205168	0.20360	0.18353	0.14508	0.17398	0.18737	0.14656	0.14375	0.15993
119	P. graniticola FJ572718	0.17600	0.19517	0.12983	0.18763	0.18882	0.13614	0.13339	0.14957
120	P. axiflora subsp. alpina GQ20	0.18878	0.18065	0.14250	0.18319	0.18668	0.15127	0.14860	0.15256
121	P. spiculigera subsp. thesiode	0.18602	0.17798	0.13266	0.18307	0.18400	0.14621	0.14348	0.14972
122	P. drupacea GQ205174	0.18931	0.17473	0.13385	0.17423	0.17981	0.14422	0.14123	0.15269
123	P. brevistyla subsp. brevistyl	0.16692	0.17309	0.11049	0.17059	0.16968	0.11920	0.11924	0.12813
124	P. subvillifera GQ205195	0.16856	0.17283	0.11507	0.17504	0.17168	0.12147	0.11884	0.13245
125	P. longiflora subsp. longiflor	0.17294	0.17870	0.11634	0.17878	0.17762	0.12761	0.12564	0.13650
126	G. squarrosa AM159525	0.16592	0.18239	0.14672	0.18269	0.17823	0.14310	0.14039	0.15149
127	G. carinata AJ549499	0.16593	0.18239	0.14671	0.18273	0.17818	0.14310	0.14040	0.15145
128	P. microephala subsp. microeph	0.18709	0.18360	0.13582	0.18819	0.18759	0.14949	0.14674	0.15276
129	G. phaeotricha AM159520	0.17621	0.18699	0.13502	0.18043	0.18113	0.13903	0.13636	0.14488
130	G. anomala AM158940	0.15556	0.16136	0.09096	0.17185	0.17278	0.01246	0.01728	0.09076
131	G. kraussiana AM159518	0.07739	0.15552	0.14630	0.15879	0.15094	0.15651	0.15410	0.15328

		17	18	19	20	21	22	23	24
17	G. renniana AM396522	-							
18	P. poppelwellii TS59	0.14235	-						
19	P. spinescens subsp. pubiflora	0.16054	0.08030	-					
20	P. pelinos AM162497	0.14310	0.08072	0.09298	-				
21	P. spicata FJ572713	0.14834	0.06232	0.08847	0.08415	-			
22	P. urvilleana subsp. nesica TS	0.12778	0.02118	0.07269	0.06890	0.04916	-		
23	P. sericeovillosa subsp. alta	0.12782	0.02118	0.07275	0.07143	0.05421	0.00941	-	
24	P. carnosa TS51	0.12778	0.02118	0.07269	0.06890	0.04916	0.00000	0.00941	-
25	G. aberrans AM159508	0.13294	0.06130	0.07529	0.07853	0.07299	0.05422	0.05422	0.05422
26	P. oreophila subsp. lepta TS60	0.13026	0.02353	0.07511	0.07381	0.05683	0.00706	0.00706	0.00706
27	P. longifolia TS106	0.13264	0.02824	0.07519	0.06906	0.06175	0.02118	0.01647	0.02118
28	P. flava subsp. dichotoma GQ20	0.14422	0.05700	0.06805	0.06475	0.04225	0.04501	0.04971	0.04501
29	P. sericeovillosa subsp. pulvi	0.12782	0.02118	0.07275	0.07143	0.05421	0.00471	0.00471	0.00471
30	P. declivis 2194	0.12538	0.01882	0.07038	0.06906	0.05158	0.00706	0.00235	0.00706
31	G. setosa AM159524	0.13267	0.05882	0.07280	0.07606	0.07025	0.05176	0.05176	0.05176
32	P. mesoa subsp. mesoa TS47	0.12538	0.01882	0.07038	0.06906	0.05158	0.00706	0.00235	0.00706
33	P. lyallii TS41	0.12782	0.02118	0.07275	0.06665	0.05421	0.00941	0.00471	0.00941
34	P. xenica TS56	0.12768	0.01882	0.06558	0.06430	0.05158	0.01176	0.00706	0.01176
35	P. lyallii GQ205218	0.13120	0.02132	0.06839	0.07184	0.04679	0.00948	0.00473	0.00948
36	P. urvilleana subsp. urvillean	0.12778	0.02118	0.07269	0.06890	0.04916	0.00000	0.00941	0.00000
37	P. oreophila subsp. oreophila	0.12538	0.01882	0.07038	0.06906	0.05158	0.00706	0.00235	0.00706
38	P. cryptica 2192	0.12538	0.01882	0.07038	0.06906	0.05158	0.00706	0.00235	0.00706
39	P. prostrata subsp. prostrata	0.12811	0.01886	0.07045	0.06916	0.04934	0.00000	0.00710	0.00000
40	P. prostrata subsp. seismica 2	0.12778	0.02118	0.07269	0.06890	0.04916	0.00000	0.00941	0.00000
41	P. orthia TS55	0.12778	0.02118	0.07269	0.06890	0.04916	0.00000	0.00941	0.00000
42	P. sporadica TS53	0.13026	0.01882	0.07032	0.07129	0.05169	0.00235	0.00706	0.00235
43	P. prostrata subsp. ventosa TS	0.12538	0.01882	0.07038	0.06906	0.05158	0.00706	0.00235	0.00706
44	P. barbata subsp. barbata TS50	0.12778	0.02118	0.07269	0.06890	0.04916	0.00000	0.00941	0.00000
45	P. notia TS33	0.12538	0.01882	0.07038	0.06906	0.05158	0.00706	0.00235	0.00706
46	P. gnidia 2184	0.12768	0.01882	0.06558	0.06173	0.05158	0.01176	0.01176	0.01176
47	P. aridula subsp. oliga 2183	0.12782	0.02118	0.07275	0.07143	0.05421	0.00471	0.00471	0.00471
48	P. oreophila subsp. hetera 219	0.12782	0.02118	0.07275	0.07143	0.05421	0.00471	0.00471	0.00471
49	P. ignota TS57	0.12782	0.02118	0.07275	0.07143	0.05421	0.00471	0.00471	0.00471
50	P. oreophila subsp. ephaistica	0.12782	0.02118	0.07275	0.07143	0.05421	0.00471	0.00471	0.00471
51	P. hirta TS32	0.12782	0.02118	0.07275	0.07143	0.05421	0.00471	0.00471	0.00471
52	P. barbata subsp. omoia TS29	0.12782	0.02118	0.07275	0.07143	0.05421	0.00471	0.00471	0.00471
53	P. prostrata subsp. vulcanica	0.12782	0.02118	0.07275	0.07143	0.05421	0.00471	0.00471	0.00471
54	P. traversii subsp. exedra TS6	0.13024	0.02118	0.07281	0.07141	0.05420	0.01412	0.00941	0.01412
55	P. traversii subsp. traversii	0.13024	0.02118	0.07281	0.07141	0.05420	0.01412	0.00941	0.01412
56	P. flava subsp. flava GQ205163	0.14263	0.05846	0.07164	0.07374	0.05147	0.05106	0.05105	0.05106
57	P. concinna 1806	0.12782	0.02118	0.07275	0.07143	0.05421	0.00471	0.00471	0.00471
58	P. traversii subsp. borea TS10	0.13271	0.02353	0.07518	0.07375	0.05682	0.01647	0.01176	0.01647
59	P. mimosa TS66	0.13753	0.00471	0.07531	0.07598	0.05705	0.01647	0.01647	0.01647
60	P. acra 2182	0.12782	0.02118	0.07275	0.07143	0.05421	0.00471	0.00471	0.00471
61	P. telura TS52	0.13025	0.02353	0.07517	0.07378	0.05683	0.00706	0.00706	0.00706
62	P. microphylla TS58	0.12782	0.02118	0.07275	0.07143	0.05421	0.00471	0.00471	0.00471
63	P. buxifolia 1805	0.12271	0.03294	0.07310	0.07619	0.06207	0.02588	0.01647	0.02588
64	P. psuedolyallii TS46	0.12782	0.02118	0.07275	0.07143	0.05421	0.00471	0.00471	0.00471
65	P. dura TS31	0.12538	0.01882	0.07038	0.06906	0.05158	0.00706	0.00235	0.00706
66	P. prostrata subsp. thermalis	0.12782	0.02118	0.07275	0.07143	0.05421	0.00471	0.00471	0.00471
67	P. nitens subsp. aspera 2197	0.12782	0.02118	0.07275	0.07143	0.05421	0.00471	0.00471	0.00471
68	P. tomentosa 2188	0.13275	0.02588	0.07749	0.07616	0.05944	0.00941	0.00941	0.00941
69	P. nitens subsp. nitens TS48	0.12782	0.02118	0.07275	0.07143	0.05421	0.00471	0.00471	0.00471
70	P. alpina FJ572728	0.13798	0.04251	0.07349	0.08370	0.06251	0.03541	0.03071	0.03541
71	P. villosa 1802	0.13266	0.03765	0.08958	0.07841	0.07264	0.02588	0.02118	0.02588
72	P. actea 2189	0.13274	0.02118	0.07275	0.07368	0.05421	0.00471	0.00941	0.00471
73	P. eremitica 2196	0.13023	0.02824	0.08005	0.07375	0.05967	0.01176	0.01176	0.01176
74	P. pseudolyallii GQ205212	0.13031	0.02385	0.07361	0.07448	0.04730	0.00950	0.00708	0.00950
75	P. haematostachya FJ572733	0.15899	0.09790	0.11132	0.11115	0.10607	0.09779	0.09014	0.09779
76	T. punicea AM162502	0.17188	0.11794	0.13229	0.14005	0.13128	0.11559	0.11324	0.11559
77	P. stricta FJ649628	0.13300	0.04008	0.06107	0.06679	0.03860	0.03535	0.03537	0.03535
78	P. axiflora subsp. pubescens G	0.11820	0.04621	0.07526	0.07166	0.05396	0.03664	0.04156	0.03664
79	P. octophylla FJ572717	0.14065	0.06620	0.07321	0.08834	0.07039	0.05433	0.05904	0.05433
80	P. ferruginea FJ605464	0.13966	0.05116	0.06692	0.07450	0.05652	0.03832	0.04321	0.03832
81	P. erecta FJ572721	0.13868	0.06628	0.08503	0.07883	0.07319	0.05911	0.06150	0.05911
82	P. suaveolens subsp. suaveolen	0.15018	0.05655	0.06514	0.08098	0.06474	0.05179	0.05179	0.05179
83	P. decora FJ572732	0.14548	0.09224	0.10216	0.09986	0.09653	0.08752	0.08048	0.08752
84	P. sericostachya subsp. serico	0.16205	0.10363	0.10706	0.10926	0.09962	0.09655	0.09655	0.09655
85	T. sanguinea AM162503	0.16967	0.11583	0.13252	0.12605	0.12405	0.11353	0.11112	0.11353
86	P. imbricata subsp. imbricata	0.12809	0.04097	0.06703	0.06814	0.04782	0.03380	0.03367	0.03380
87	P. milliganii FJ572712	0.13106	0.04962	0.07574	0.07181	0.05945	0.04246	0.03775	0.04246
88	P. linifolia TS91	0.12049	0.04235	0.05094	0.05938	0.05180	0.03059	0.03529	0.03059
89	P. strigosa FJ572716	0.16543	0.09712	0.10431	0.10037	0.10451	0.09241	0.09240	0.09241
90	P. curviflora subsp. divergens	0.14484	0.08000	0.09500	0.09502	0.08616	0.07765	0.07294	0.07765
91	G. galpinii AM159516	0.11267	0.10836	0.12651	0.11423	0.12501	0.10130	0.09659	0.10130
92	G. humulis AM159517	0.11019	0.10836	0.12649	0.11419	0.12509	0.10130	0.09659	0.10130
93	P. curviflora subsp. subglabra	0.13937	0.07740	0.08619	0.08808	0.08832	0.07002	0.06522	0.07002
94	G. coriacea AM159512	0.11505	0.11306	0.13139	0.10938	0.12520	0.10600	0.10130	0.10600
95	P. curviflora subsp. gracilis	0.13020	0.06824	0.08273	0.08323	0.06762	0.06118	0.05647	0.06118
96	P. ammocharis FJ605463	0.15132	0.08712	0.10120	0.10262	0.07794	0.07972	0.07976	0.07972
97	G. wilmsii AM159527	0.13830	0.10183	0.10833	0.10750	0.11600	0.09234	0.09232	0.09234
98	P. curviflora subsp. cericea G	0.14961	0.08231	0.09001	0.09512	0.08861	0.07525	0.07054	0.07525
99	P. gilgiana FJ572710	0.14785	0.07824	0.10507	0.10294	0.07386	0.07363	0.06884	0.07363

100	P. lehmanniana subsp. nervosa	0.13359	0.04965	0.07299	0.07629	0.04671	0.04256	0.04259	0.04256
101	P. calcicola FJ572722	0.14007	0.05186	0.05093	0.06664	0.05709	0.04007	0.04481	0.04007
102	P. avonensis FJ572735	0.12200	0.04754	0.06364	0.05513	0.04719	0.03564	0.04043	0.03564
103	P. sulphurea FJ572727	0.13529	0.04238	0.05094	0.06420	0.05698	0.03529	0.03529	0.03529
104	P. tinctoria FJ572730	0.13789	0.04965	0.06313	0.06669	0.05776	0.04258	0.04495	0.04258
105	P. humilis GQ205198	0.12360	0.04498	0.06626	0.06947	0.05256	0.03785	0.04260	0.03785
106	P. leucantha GQ205207	0.13265	0.04706	0.05102	0.06423	0.04675	0.03529	0.04000	0.03529
107	P. angustifolia FJ572726	0.11641	0.03548	0.05136	0.06442	0.04672	0.02836	0.02842	0.02836
108	P. ciliata subsp. ciliata FJ57	0.12777	0.04000	0.05840	0.06180	0.04917	0.02824	0.03294	0.02824
109	P. mesoa subsp. macra TS86 TS1	0.12538	0.01882	0.07038	0.06906	0.05158	0.00706	0.00235	0.00706
110	P. suteri TS45	0.12555	0.01884	0.07049	0.06913	0.05166	0.00706	0.00235	0.00706
111	P. aridula subsp. aridula TS84	0.12538	0.01882	0.07038	0.06906	0.05158	0.00706	0.00235	0.00706
112	P. sericeovillosa subsp. seric	0.12538	0.01882	0.07038	0.06906	0.05158	0.00706	0.00235	0.00706
113	P. hispida FJ572738	0.12666	0.04537	0.05398	0.06515	0.05006	0.03585	0.03824	0.03585
114	P. lanata FJ572739	0.13127	0.05468	0.06834	0.07449	0.06274	0.04759	0.04760	0.04759
115	P. phylicoides FJ572723	0.14381	0.04729	0.07390	0.07708	0.05969	0.03905	0.03892	0.03905
116	P. villifera FJ572720	0.13509	0.05176	0.08009	0.07849	0.06209	0.04471	0.04471	0.04471
117	P. biflora GQ205186	0.12137	0.04132	0.06003	0.06143	0.04799	0.03410	0.02920	0.03410
118	P. pauciflora GQ205168	0.14063	0.07816	0.07067	0.05965	0.07626	0.07101	0.06630	0.07101
119	P. graniticola FJ572718	0.13024	0.06610	0.09010	0.08091	0.06818	0.05902	0.05432	0.05902
120	P. axiflora subsp. alpina GQ20	0.15032	0.06381	0.08551	0.08579	0.05793	0.05198	0.05673	0.05198
121	P. spiculigera subsp. thesiode	0.14519	0.06135	0.08312	0.08091	0.06567	0.05428	0.05429	0.05428
122	P. drupacea GQ205174	0.13857	0.06459	0.09353	0.07928	0.06630	0.05256	0.06220	0.05256
123	P. brevistyla subsp. brevistyl	0.12102	0.03547	0.05363	0.06238	0.04908	0.02834	0.02838	0.02834
124	P. subvillifera GQ205195	0.12548	0.04471	0.06304	0.06872	0.04392	0.03294	0.03765	0.03294
125	P. longiflora subsp. longiflor	0.13181	0.04545	0.05169	0.07721	0.05253	0.03827	0.03824	0.03827
126	G. squarrosa AM159525	0.14717	0.09647	0.12387	0.10921	0.10692	0.08941	0.08941	0.08941
127	G. carinata AJ549499	0.14717	0.09640	0.12378	0.10919	0.10685	0.08933	0.08933	0.08933
128	P. microephala subsp. microeph	0.14840	0.06410	0.08342	0.08135	0.06354	0.05696	0.05699	0.05696
129	G. phaeotricha AM159520	0.13798	0.10160	0.10764	0.10734	0.11494	0.09219	0.08746	0.09219
130	G. anomala AM158940	0.03677	0.14030	0.15591	0.14880	0.15729	0.12800	0.12801	0.12800
131	G. kraussiana AM159518	0.17711	0.15937	0.17825	0.17968	0.17837	0.15411	0.15923	0.15411

		25	26	27	28	29	30	31	32
25	G. aberrans AM159508	-							
26	P. oreophila subsp. lepta TS60	0.05657	-						
27	P. longifolia TS106	0.06128	0.01882	-					
28	P. flava subsp. dichotoma GQ20	0.06165	0.05206	0.05207	-				
29	P. sericeovillosa subsp. pulvi	0.05422	0.00235	0.01647	0.04971	-			
30	P. declivis 2194	0.05187	0.00471	0.01412	0.04736	0.00235	-		
31	G. setosa AM159524	0.00237	0.05412	0.05882	0.05923	0.05176	0.04941	-	
32	P. mesoa subsp. mesoa TS47	0.05187	0.00471	0.01412	0.04736	0.00235	0.00000	0.04941	-
33	P. lyallii TS41	0.05422	0.00706	0.01647	0.04971	0.00471	0.00235	0.05176	0.00235
34	P. xenica TS56	0.05186	0.00941	0.00941	0.04265	0.00706	0.00471	0.04941	0.00471
35	P. lyallii GQ205218	0.05466	0.00941	0.01894	0.04552	0.00706	0.00471	0.05221	0.00471
36	P. urvilleana subsp. urvillean	0.05422	0.00706	0.02118	0.04501	0.00471	0.00706	0.05176	0.00706
37	P. oreophila subsp. oreophila	0.05187	0.00471	0.01412	0.04736	0.00235	0.00000	0.04941	0.00000
38	P. cryptica 2192	0.05187	0.00471	0.01412	0.04736	0.00235	0.00000	0.04941	0.00000
39	P. prostrata subsp. prostrata	0.05195	0.00473	0.01890	0.04515	0.00237	0.00474	0.04949	0.00474
40	P. prostrata subsp. seismica 2	0.05422	0.00706	0.02118	0.04501	0.00471	0.00706	0.05176	0.00706
41	P. orthia TS55	0.05422	0.00706	0.02118	0.04501	0.00471	0.00706	0.05176	0.00706
42	P. sporadica TS53	0.05187	0.00471	0.01882	0.04736	0.00235	0.00471	0.04941	0.00471
43	P. prostrata subsp. ventosa TS	0.05187	0.00471	0.01412	0.04736	0.00235	0.00000	0.04941	0.00000
44	P. barbata subsp. barbata TS50	0.05422	0.00706	0.02118	0.04501	0.00471	0.00706	0.05176	0.00706
45	P. notia TS33	0.05187	0.00471	0.01412	0.04736	0.00235	0.00000	0.04941	0.00000
46	P. gnidia 2184	0.05186	0.01412	0.00941	0.04265	0.01176	0.00941	0.04941	0.00941
47	P. aridula subsp. oliga 2183	0.05422	0.00235	0.01647	0.04971	0.00000	0.00235	0.05176	0.00235
48	P. oreophila subsp. hetera 219	0.05422	0.00235	0.01647	0.04971	0.00000	0.00235	0.05176	0.00235
49	P. ignota TS57	0.05422	0.00235	0.01647	0.04971	0.00000	0.00235	0.05176	0.00235
50	P. oreophila subsp. ephaistica	0.05422	0.00235	0.01647	0.04971	0.00000	0.00235	0.05176	0.00235
51	P. hirta TS32	0.05422	0.00235	0.01647	0.04971	0.00000	0.00235	0.05176	0.00235
52	P. barbata subsp. omoia TS29	0.05422	0.00235	0.01647	0.04971	0.00000	0.00235	0.05176	0.00235
53	P. prostrata subsp. vulcanica	0.05422	0.00235	0.01647	0.04971	0.00000	0.00235	0.05176	0.00235
54	P. traversii subsp. exedra TS6	0.05424	0.01176	0.01647	0.04973	0.00941	0.00706	0.05176	0.00706
55	P. traversii subsp. traversii	0.05424	0.01176	0.01647	0.04973	0.00941	0.00706	0.05176	0.00706
56	P. flava subsp. flava GQ205163	0.05582	0.05347	0.05342	0.03171	0.05105	0.04862	0.05337	0.04862
57	P. concinna 1806	0.05422	0.00235	0.01647	0.04971	0.00000	0.00235	0.05176	0.00235
58	P. traversii subsp. borea TS10	0.05659	0.01412	0.01882	0.05209	0.01176	0.00941	0.05412	0.00941
59	P. mimosa TS66	0.05659	0.01882	0.02353	0.05219	0.01647	0.01412	0.05412	0.01412
60	P. acra 2182	0.05422	0.00235	0.01647	0.04971	0.00000	0.00235	0.05176	0.00235
61	P. telura TS52	0.05659	0.00471	0.01882	0.05209	0.00235	0.00471	0.05412	0.00471
62	P. microphylla TS58	0.05422	0.00235	0.01647	0.04971	0.00000	0.00235	0.05176	0.00235
63	P. buxifolia 1805	0.06133	0.02353	0.02824	0.05694	0.02118	0.01882	0.05882	0.01882
64	P. psuedolyallii TS46	0.05422	0.00235	0.01647	0.04971	0.00000	0.00235	0.05176	0.00235
65	P. dura TS31	0.05187	0.00471	0.01412	0.04736	0.00235	0.00000	0.04941	0.00000
66	P. prostrata subsp. thermalis	0.05422	0.00235	0.01647	0.04971	0.00000	0.00235	0.05176	0.00235
67	P. nitens subsp. aspera 2197	0.05422	0.00235	0.01647	0.04971	0.00000	0.00235	0.05176	0.00235
68	P. tomentosa 2188	0.05892	0.00235	0.02118	0.05442	0.00471	0.00706	0.05647	0.00706
69	P. nitens subsp. nitens TS48	0.05422	0.00235	0.01647	0.04971	0.00000	0.00235	0.05176	0.00235
70	P. alpina FJ572728	0.06144	0.03306	0.03780	0.05251	0.03071	0.02835	0.05899	0.02835
71	P. villosa 1802	0.06598	0.01882	0.03294	0.06161	0.02118	0.01882	0.06353	0.01882
72	P. actea 2189	0.05422	0.00706	0.02118	0.04971	0.00471	0.00706	0.05176	0.00706
73	P. eremitica 2196	0.06128	0.00941	0.02353	0.05688	0.00706	0.00941	0.05882	0.00941
74	P. pseudolyallii GQ205212	0.05729	0.00478	0.01902	0.04558	0.00475	0.00473	0.05483	0.00473
75	P. haematostachya FJ572733	0.09785	0.09785	0.09794	0.09851	0.09531	0.09275	0.09511	0.09275
76	T. punicea AM162502	0.11348	0.11796	0.11799	0.11466	0.11561	0.11325	0.11087	0.11325
77	P. stricta FJ649628	0.04973	0.03773	0.04249	0.03334	0.03537	0.03302	0.04727	0.03302
78	P. axiflora subsp. pubescens G	0.05374	0.04406	0.04885	0.04412	0.04156	0.03904	0.05128	0.03904
79	P. octophylla FJ572717	0.07573	0.05668	0.06610	0.05937	0.05433	0.05668	0.07326	0.05668
80	P. ferruginea FJ605464	0.04606	0.04574	0.05053	0.04338	0.04321	0.04068	0.04345	0.04068
81	P. erecta FJ572721	0.07106	0.05913	0.06387	0.05713	0.06150	0.05915	0.06864	0.05915
82	P. suaveolens subsp. suaveolen	0.05894	0.04944	0.05885	0.04973	0.05179	0.04944	0.05652	0.04944
83	P. decora FJ572732	0.08770	0.08757	0.08762	0.09054	0.08522	0.08287	0.08517	0.08287
84	P. sericostachya subsp. serico	0.10142	0.09890	0.10832	0.07876	0.10126	0.09890	0.10131	0.09890
85	T. sanguinea AM162503	0.11141	0.11590	0.11588	0.11259	0.11352	0.11114	0.10880	0.11114
86	P. imbricata subsp. imbricata	0.04836	0.03115	0.04109	0.04132	0.03367	0.03129	0.04586	0.03129
87	P. milliganii FJ572712	0.05915	0.04011	0.04481	0.04749	0.03775	0.03540	0.05668	0.03540
88	P. linifolia TS91	0.04714	0.03765	0.03765	0.03322	0.03529	0.03294	0.04471	0.03294
89	P. strigosa FJ572716	0.09488	0.09004	0.09476	0.08345	0.09240	0.09003	0.09238	0.09003
90	P. curviflora subsp. divergens	0.08483	0.07529	0.08000	0.07367	0.07294	0.07059	0.08235	0.07059
91	G. galpinii AM159516	0.11332	0.10365	0.10365	0.10675	0.10130	0.09894	0.11073	0.09894
92	G. humulis AM159517	0.11332	0.10365	0.10365	0.10675	0.10130	0.09894	0.11073	0.09894
93	P. curviflora subsp. subglabra	0.07761	0.06762	0.06757	0.06287	0.06522	0.06282	0.07508	0.06282
94	G. coriacea AM159512	0.11801	0.10836	0.10836	0.10684	0.10600	0.10365	0.11544	0.10365
95	P. curviflora subsp. gracilis	0.07305	0.05882	0.06353	0.05473	0.05647	0.05412	0.07059	0.05412
96	P. ammocharis FJ605463	0.08466	0.08696	0.09183	0.06811	0.08457	0.08218	0.08218	0.08218
97	G. wilmsii AM159527	0.08780	0.09470	0.09230	0.09105	0.09232	0.08995	0.08765	0.08995
98	P. curviflora subsp. cericea G	0.08243	0.06821	0.07289	0.06188	0.07054	0.06819	0.07997	0.06819
99	P. gilgiana FJ572710	0.08072	0.06646	0.07823	0.06461	0.06884	0.06643	0.07822	0.06643

100	P. lehmanniana subsp. nervosa	0.05443	0.04495	0.04973	0.05238	0.04259	0.04024	0.05196	0.04024
101	P. calcicola FJ572722	0.04718	0.04716	0.05190	0.04267	0.04481	0.04247	0.04477	0.04247
102	P. avonensis FJ572735	0.04529	0.04281	0.04759	0.03820	0.04043	0.03805	0.04287	0.03805
103	P. sulphurea FJ572727	0.04244	0.03765	0.04235	0.03793	0.03529	0.03294	0.04003	0.03294
104	P. tinctoria FJ572730	0.05202	0.04258	0.05205	0.04294	0.04495	0.04260	0.04961	0.04260
105	P. humilis GQ205198	0.05678	0.04023	0.04971	0.04305	0.04260	0.04024	0.05437	0.04024
106	P. leucantha GQ205207	0.03771	0.04235	0.04706	0.03320	0.04000	0.03765	0.03529	0.03765
107	P. angustifolia FJ572726	0.03794	0.03077	0.03559	0.04046	0.02842	0.02606	0.03550	0.02606
108	P. ciliata subsp. ciliata FJ57	0.03535	0.03529	0.04000	0.03557	0.03294	0.03059	0.03294	0.03059
109	P. mesoa subsp. macra TS86 TS1	0.05187	0.00471	0.01412	0.04736	0.00235	0.00000	0.04941	0.00000
110	P. suteri TS45	0.05193	0.00238	0.01416	0.04744	0.00235	0.00000	0.04947	0.00000
111	P. aridula subsp. aridula TS84	0.05187	0.00471	0.01412	0.04736	0.00235	0.00000	0.04941	0.00000
112	P. sericeovillosa subsp. seric	0.05187	0.00471	0.01412	0.04736	0.00235	0.00000	0.04941	0.00000
113	P. hispida FJ572738	0.01658	0.03824	0.04306	0.03600	0.03824	0.03586	0.01419	0.03586
114	P. lanata FJ572739	0.02622	0.04998	0.05476	0.04777	0.04760	0.04522	0.02383	0.04522
115	P. phylicoides FJ572723	0.06577	0.04151	0.04123	0.05000	0.03892	0.03632	0.06308	0.03632
116	P. villifera FJ572720	0.04714	0.04235	0.05176	0.05685	0.04471	0.04235	0.04471	0.04235
117	P. biflora GQ205186	0.05085	0.03165	0.03654	0.03660	0.02920	0.02674	0.04836	0.02674
118	P. pauciflora GQ205168	0.06871	0.07338	0.07340	0.05501	0.07103	0.06867	0.06628	0.06867
119	P. graniticola FJ572718	0.07560	0.05667	0.06141	0.06906	0.05432	0.05196	0.07315	0.05196
120	P. axiflora subsp. alpina GQ20	0.07335	0.05436	0.06384	0.05023	0.05673	0.05437	0.07085	0.05437
121	P. spiculigera subsp. thesiode	0.06140	0.05665	0.05903	0.05723	0.05429	0.05194	0.05895	0.05194
122	P. drupacea GQ205174	0.07399	0.05497	0.06946	0.06026	0.05738	0.05979	0.07150	0.05979
123	P. brevistyla subsp. brevistyl	0.04012	0.03074	0.03552	0.03818	0.02838	0.02603	0.03769	0.02603
124	P. subvillifera GQ205195	0.04951	0.04000	0.04471	0.04500	0.03765	0.03529	0.04706	0.03529
125	P. longiflora subsp. longiflor	0.05043	0.04064	0.04544	0.04112	0.03824	0.03584	0.04797	0.03584
126	G. squarrosa AM159525	0.10137	0.08706	0.08706	0.10673	0.08941	0.08706	0.09882	0.08706
127	G. carinata AJ549499	0.10132	0.08698	0.08701	0.10664	0.08933	0.08698	0.09877	0.08698
128	P. microephala subsp. microeph	0.06406	0.05935	0.06177	0.05274	0.05699	0.05463	0.06161	0.05463
129	G. phaeotricha AM159520	0.08981	0.08982	0.09218	0.09765	0.08746	0.08510	0.08729	0.08510
130	G. anomala AM158940	0.12802	0.13053	0.13288	0.14467	0.12801	0.12549	0.12774	0.12549
131	G. kraussiana AM159518	0.15741	0.16164	0.16932	0.16627	0.15923	0.15682	0.15703	0.15682

		33	34	35	36	37	38	39	40
33	P. lyallii TS41	-							
34	P. xenica TS56	0.00706	-						
35	P. lyallii GQ205218	0.00473	0.00941	-					
36	P. urvilleana subsp. urvillean	0.00941	0.01176	0.00948	-				
37	P. oreophila subsp. oreophila	0.00235	0.00471	0.00471	0.00706	-			
38	P. cryptica 2192	0.00235	0.00471	0.00471	0.00706	0.00000	-		
39	P. prostrata subsp. prostrata	0.00710	0.00945	0.00715	0.00000	0.00474	0.00474	-	
40	P. prostrata subsp. seismica 2	0.00941	0.01176	0.00948	0.00000	0.00706	0.00706	0.00000	-
41	P. orthia TS55	0.00941	0.01176	0.00948	0.00000	0.00706	0.00706	0.00000	0.00000
42	P. sporadica TS53	0.00706	0.00941	0.00711	0.00235	0.00471	0.00471	0.00000	0.00235
43	P. prostrata subsp. ventosa TS	0.00235	0.00471	0.00471	0.00706	0.00000	0.00000	0.00474	0.00706
44	P. barbata subsp. barbata TS50	0.00941	0.01176	0.00948	0.00000	0.00706	0.00706	0.00000	0.00000
45	P. notia TS33	0.00235	0.00471	0.00471	0.00706	0.00000	0.00000	0.00474	0.00706
46	P. gnidia 2184	0.01176	0.00471	0.01185	0.01176	0.00941	0.00941	0.00945	0.01176
47	P. aridula subsp. oliga 2183	0.00471	0.00706	0.00706	0.00471	0.00235	0.00235	0.00237	0.00471
48	P. oreophila subsp. hetera 219	0.00471	0.00706	0.00706	0.00471	0.00235	0.00235	0.00237	0.00471
49	P. ignota TS57	0.00471	0.00706	0.00706	0.00471	0.00235	0.00235	0.00237	0.00471
50	P. oreophila subsp. ephaistica	0.00471	0.00706	0.00706	0.00471	0.00235	0.00235	0.00237	0.00471
51	P. hirta TS32	0.00471	0.00706	0.00706	0.00471	0.00235	0.00235	0.00237	0.00471
52	P. barbata subsp. omoia TS29	0.00471	0.00706	0.00706	0.00471	0.00235	0.00235	0.00237	0.00471
53	P. prostrata subsp. vulcanica	0.00471	0.00706	0.00706	0.00471	0.00235	0.00235	0.00237	0.00471
54	P. traversii subsp. exedra TS6	0.00941	0.00706	0.01176	0.01412	0.00706	0.00706	0.01180	0.01412
55	P. traversii subsp. traversii	0.00941	0.00706	0.01176	0.01412	0.00706	0.00706	0.01180	0.01412
56	P. flava subsp. flava GQ205163	0.05105	0.04377	0.04919	0.05106	0.04862	0.04862	0.04872	0.05106
57	P. concinna 1806	0.00471	0.00706	0.00706	0.00471	0.00235	0.00235	0.00237	0.00471
58	P. traversii subsp. borea TS10	0.01176	0.00941	0.01412	0.01647	0.00941	0.00941	0.01416	0.01647
59	P. mimosa TS66	0.01647	0.01412	0.01655	0.01647	0.01412	0.01412	0.01414	0.01647
60	P. acra 2182	0.00471	0.00706	0.00706	0.00471	0.00235	0.00235	0.00237	0.00471
61	P. telura TS52	0.00706	0.00941	0.00941	0.00706	0.00471	0.00471	0.00473	0.00706
62	P. microphylla TS58	0.00471	0.00706	0.00706	0.00471	0.00235	0.00235	0.00237	0.00471
63	P. buxifolia 1805	0.02118	0.01882	0.02131	0.02588	0.01882	0.01882	0.02361	0.02588
64	P. psuedolyallii TS46	0.00471	0.00706	0.00706	0.00471	0.00235	0.00235	0.00237	0.00471
65	P. dura TS31	0.00235	0.00471	0.00471	0.00706	0.00000	0.00000	0.00474	0.00706
66	P. prostrata subsp. thermalis	0.00471	0.00706	0.00706	0.00471	0.00235	0.00235	0.00237	0.00471
67	P. nitens subsp. aspera 2197	0.00471	0.00706	0.00706	0.00471	0.00235	0.00235	0.00237	0.00471
68	P. tomentosa 2188	0.00941	0.01176	0.01176	0.00941	0.00706	0.00706	0.00708	0.00941
69	P. nitens subsp. nitens TS48	0.00471	0.00706	0.00706	0.00471	0.00235	0.00235	0.00237	0.00471
70	P. alpina FJ572728	0.03071	0.02835	0.02861	0.03541	0.02835	0.02835	0.03318	0.03541
71	P. villosa 1802	0.02118	0.02353	0.02356	0.02588	0.01882	0.01882	0.02357	0.02588
72	P. actea 2189	0.00941	0.01176	0.00950	0.00471	0.00706	0.00706	0.00237	0.00471
73	P. eremitica 2196	0.01176	0.01412	0.01414	0.01176	0.00941	0.00941	0.00943	0.01176
74	P. pseudolyallii GQ205212	0.00708	0.00945	0.00481	0.00950	0.00473	0.00473	0.00717	0.00950
75	P. haematostachya FJ572733	0.09531	0.09278	0.09079	0.09779	0.09275	0.09275	0.09547	0.09779
76	T. punicea AM162502	0.11561	0.10853	0.11627	0.11559	0.11325	0.11325	0.11345	0.11559
77	P. stricta FJ649628	0.03537	0.03302	0.03092	0.03535	0.03302	0.03302	0.03310	0.03535
78	P. axiflora subsp. pubescens G	0.04156	0.03918	0.03677	0.03664	0.03904	0.03904	0.03675	0.03664
79	P. octophylla FJ572717	0.05904	0.05668	0.05256	0.05433	0.05668	0.05668	0.05214	0.05433
80	P. ferruginea FJ605464	0.04321	0.04067	0.03835	0.03832	0.04068	0.04068	0.03839	0.03832
81	P. erecta FJ572721	0.06150	0.05915	0.05952	0.05911	0.05915	0.05915	0.05937	0.05911
82	P. suaveolens subsp. suaveolen	0.05179	0.04944	0.04750	0.05179	0.04944	0.04944	0.04956	0.05179
83	P. decora FJ572732	0.08522	0.08287	0.08577	0.08752	0.08287	0.08287	0.08534	0.08752
84	P. sericostachya subsp. serico	0.09655	0.09890	0.09320	0.09655	0.09890	0.09890	0.09691	0.09655
85	T. sanguinea AM162503	0.11352	0.10642	0.11419	0.11353	0.11114	0.11114	0.11133	0.11353
86	P. imbricata subsp. imbricata	0.03367	0.03129	0.03146	0.03380	0.03129	0.03129	0.03376	0.03380
87	P. milliganii FJ572712	0.03775	0.03540	0.03582	0.04246	0.03540	0.03540	0.04026	0.04246
88	P. linifolia TS91	0.03529	0.02824	0.03562	0.03059	0.03294	0.03294	0.03066	0.03059
89	P. strigosa FJ572716	0.09240	0.09005	0.08609	0.09241	0.09003	0.09003	0.09027	0.09241
90	P. curviflora subsp. divergens	0.07294	0.07059	0.07585	0.07765	0.07059	0.07059	0.07546	0.07765
91	G. galpinii AM159516	0.10130	0.09894	0.10218	0.10130	0.09894	0.09894	0.10158	0.10130
92	G. humulis AM159517	0.10130	0.09894	0.10218	0.10130	0.09894	0.09894	0.10158	0.10130
93	P. curviflora subsp. subglabra	0.06044	0.05804	0.06349	0.07002	0.06282	0.06282	0.06778	0.07002
94	G. coriacea AM159512	0.10600	0.10365	0.10693	0.10600	0.10365	0.10365	0.10631	0.10600
95	P. curviflora subsp. gracilis	0.05647	0.05412	0.05926	0.06118	0.05412	0.05412	0.05896	0.06118
96	P. ammocharis FJ605463	0.08457	0.08219	0.07849	0.07972	0.08218	0.08218	0.08009	0.07972
97	G. wilmsii AM159527	0.08759	0.08759	0.09101	0.09234	0.08995	0.08995	0.09013	0.09234
98	P. curviflora subsp. cericea G	0.07054	0.06349	0.06869	0.07525	0.06819	0.06819	0.07306	0.07525
99	P. gilgiana FJ572710	0.06884	0.06875	0.06686	0.07363	0.06643	0.06643	0.07140	0.07363
100	P. lehmanniana subsp. nervosa	0.04259	0.04024	0.04296	0.04256	0.04024	0.04024	0.04030	0.04256
101	P. calcicola FJ572722	0.04481	0.04247	0.04527	0.04007	0.04247	0.04247	0.04024	0.04007
102	P. avonensis FJ572735	0.04043	0.03808	0.04088	0.03564	0.03805	0.03805	0.03577	0.03564
103	P. sulphurea FJ572727	0.03529	0.03294	0.03562	0.03529	0.03294	0.03294	0.03302	0.03529
104	P. tinctoria FJ572730	0.04495	0.04260	0.04533	0.04258	0.04260	0.04260	0.04256	0.04258
105	P. humilis GQ205198	0.04260	0.04024	0.04305	0.03785	0.04024	0.04024	0.03800	0.03785
106	P. leucantha GQ205207	0.04000	0.03765	0.04037	0.03529	0.03765	0.03765	0.03542	0.03529
107	P. angustifolia FJ572726	0.02842	0.02606	0.02871	0.02836	0.02606	0.02606	0.02610	0.02836
108	P. ciliata subsp. ciliata FJ57	0.03294	0.03059	0.03324	0.02824	0.03059	0.03059	0.02829	0.02824
109	P. mesoa subsp. macra TS86 TS1	0.00235	0.00471	0.00471	0.00706	0.00000	0.00000	0.00474	0.00706
110	P. suteri TS45	0.00235	0.00471	0.00473	0.00706	0.00000	0.00000	0.00475	0.00706
111	P. aridula subsp. aridula TS84	0.00235	0.00471	0.00471	0.00706	0.00000	0.00000	0.00474	0.00706
112	P. sericeovillosa subsp. seric	0.00235	0.00471	0.00471	0.00706	0.00000	0.00000	0.00474	0.00706
113	P. hispida FJ572738	0.03824	0.03588	0.03862	0.03585	0.03586	0.03586	0.03584	0.03585
114	P. lanata FJ572739	0.04760	0.04524	0.04798	0.04759	0.04522	0.04522	0.04527	0.04759
115	P. phylicoides FJ572723	0.03892	0.03633	0.03395	0.03905	0.03632	0.03632	0.03654	0.03905
116	P. villifera FJ572720	0.04471	0.04235	0.04516	0.04471	0.04235	0.04235	0.04247	0.04471
117	P. biflora GQ205186	0.02920	0.02682	0.02686	0.03410	0.02674	0.02674	0.03178	0.03410
118	P. pauciflora GQ205168	0.07103	0.06395	0.06472	0.07101	0.06867	0.06867	0.06877	0.07101
119	P. graniticola FJ572718	0.05432	0.05196	0.05697	0.05902	0.05196	0.05196	0.05676	0.05902
120	P. axiflora subsp. alpina GQ20	0.05673	0.05437	0.05243	0.05198	0.05437	0.05437	0.05211	0.05198
121	P. spiculigera subsp. thesiode	0.05429	0.04957	0.05477	0.05428	0.05194	0.05194	0.05201	0.05428
122	P. drupacea GQ205174	0.06220	0.05985	0.06265	0.05256	0.05979	0.05979	0.05275	0.05256
123	P. brevistyla subsp. brevistyl	0.02838	0.02603	0.02867	0.02834	0.02603	0.02603	0.02609	0.02834
124	P. subvillifera GQ205195	0.03765	0.03529	0.03801	0.03294	0.03529	0.03529	0.03304	0.03294
125	P. longiflora subsp. longiflor	0.03824	0.03595	0.02892	0.03827	0.03584	0.03584	0.03597	0.03827
126	G. squarrosa AM159525	0.08941	0.08706	0.09246	0.08941	0.08706	0.08706	0.08971	0.08941
127	G. carinata AJ549499	0.08933	0.08698	0.09238	0.08933	0.08698	0.08698	0.08963	0.08933
128	P. microephala subsp. microeph	0.05699	0.05226	0.05269	0.05696	0.05463	0.05463	0.05469	0.05696
129	G. phaeotricha AM159520	0.08746	0.08746	0.09068	0.09219	0.08510	0.08510	0.09009	0.09219
130	G. anomala AM158940	0.12801	0.12779	0.13152	0.12800	0.12549	0.12549	0.12832	0.12800
131	G. kraussiana AM159518	0.15923	0.16181	0.16051	0.15411	0.15682	0.15682	0.15448	0.15411

		41	42	43	44	45	46	47	48
41	P. orthia TS55	-							
42	P. sporadica TS53	0.00235	-						
43	P. prostrata subsp. ventosa TS	0.00706	0.00471	-					
44	P. barbata subsp. barbata TS50	0.00000	0.00235	0.00706	-				
45	P. notia TS33	0.00706	0.00471	0.00000	0.00706	-			
46	P. gnidia 2184	0.01176	0.00941	0.00941	0.01176	0.00941	-		
47	P. aridula subsp. oliga 2183	0.00471	0.00235	0.00235	0.00471	0.00235	0.01176	-	
48	P. oreophila subsp. hetera 219	0.00471	0.00235	0.00235	0.00471	0.00235	0.01176	0.00000	-
49	P. ignota TS57	0.00471	0.00235	0.00235	0.00471	0.00235	0.01176	0.00000	0.00000
50	P. oreophila subsp. ephaistica	0.00471	0.00235	0.00235	0.00471	0.00235	0.01176	0.00000	0.00000
51	P. hirta TS32	0.00471	0.00235	0.00235	0.00471	0.00235	0.01176	0.00000	0.00000
52	P. barbata subsp. omoia TS29	0.00471	0.00235	0.00235	0.00471	0.00235	0.01176	0.00000	0.00000
53	P. prostrata subsp. vulcanica	0.00471	0.00235	0.00235	0.00471	0.00235	0.01176	0.00000	0.00000
54	P. traversii subsp. exedra TS6	0.01412	0.01176	0.00706	0.01412	0.00706	0.01176	0.00941	0.00941
55	P. traversii subsp. traversii	0.01412	0.01176	0.00706	0.01412	0.00706	0.01176	0.00941	0.00941
56	P. flava subsp. flava GQ205163	0.05106	0.04863	0.04862	0.05106	0.04862	0.04377	0.05105	0.05105
57	P. concinna 1806	0.00471	0.00235	0.00235	0.00471	0.00235	0.01176	0.00000	0.00000
58	P. traversii subsp. borea TS10	0.01647	0.01412	0.00941	0.01647	0.00941	0.01412	0.01176	0.01176
59	P. mimosa TS66	0.01647	0.01412	0.01412	0.01647	0.01412	0.01412	0.01647	0.01647
60	P. acra 2182	0.00471	0.00235	0.00235	0.00471	0.00235	0.01176	0.00000	0.00000
61	P. telura TS52	0.00706	0.00471	0.00471	0.00706	0.00471	0.01412	0.00235	0.00235
62	P. microphylla TS58	0.00471	0.00235	0.00235	0.00471	0.00235	0.01176	0.00000	0.00000
63	P. buxifolia 1805	0.02588	0.02353	0.01882	0.02588	0.01882	0.02353	0.02118	0.02118
64	P. psuedolyallii TS46	0.00471	0.00235	0.00235	0.00471	0.00235	0.01176	0.00000	0.00000
65	P. dura TS31	0.00706	0.00471	0.00000	0.00706	0.00000	0.00941	0.00235	0.00235
66	P. prostrata subsp. thermalis	0.00471	0.00235	0.00235	0.00471	0.00235	0.01176	0.00000	0.00000
67	P. nitens subsp. aspera 2197	0.00471	0.00235	0.00235	0.00471	0.00235	0.01176	0.00000	0.00000
68	P. tomentosa 2188	0.00941	0.00706	0.00706	0.00941	0.00706	0.01647	0.00471	0.00471
69	P. nitens subsp. nitens TS48	0.00471	0.00235	0.00235	0.00471	0.00235	0.01176	0.00000	0.00000
70	P. alpina FJ572728	0.03541	0.03306	0.02835	0.03541	0.02835	0.03308	0.03071	0.03071
71	P. villosa 1802	0.02588	0.02353	0.01882	0.02588	0.01882	0.02824	0.02118	0.02118
72	P. actea 2189	0.00471	0.00235	0.00706	0.00471	0.00706	0.01176	0.00471	0.00471
73	P. eremitica 2196	0.01176	0.00941	0.00941	0.01176	0.00941	0.01882	0.00706	0.00706
74	P. pseudolyallii GQ205212	0.00950	0.00713	0.00473	0.00950	0.00473	0.01424	0.00475	0.00475
75	P. haematostachya FJ572733	0.09779	0.09523	0.09275	0.09779	0.09275	0.09010	0.09531	0.09531
76	T. punicea AM162502	0.11559	0.11324	0.11325	0.11559	0.11325	0.10853	0.11561	0.11561
77	P. stricta FJ649628	0.03535	0.03300	0.03302	0.03535	0.03302	0.03302	0.03537	0.03537
78	P. axiflora subsp. pubescens G	0.03664	0.03910	0.03904	0.03664	0.03904	0.03918	0.04156	0.04156
79	P. octophylla FJ572717	0.05433	0.05198	0.05668	0.05433	0.05668	0.05668	0.05433	0.05433
80	P. ferruginea FJ605464	0.03832	0.04077	0.04068	0.03832	0.04068	0.04067	0.04321	0.04321
81	P. erecta FJ572721	0.05911	0.06146	0.05915	0.05911	0.05915	0.05673	0.06150	0.06150
82	P. suaveolens subsp. suaveolen	0.05179	0.04944	0.04944	0.05179	0.04944	0.04944	0.05179	0.05179
83	P. decora FJ572732	0.08752	0.08515	0.08287	0.08752	0.08287	0.08041	0.08522	0.08522
84	P. sericostachya subsp. serico	0.09655	0.09890	0.09890	0.09655	0.09890	0.09890	0.10126	0.10126
85	T. sanguinea AM162503	0.11353	0.11115	0.11114	0.11353	0.11114	0.10642	0.11352	0.11352
86	P. imbricata subsp. imbricata	0.03380	0.03373	0.03129	0.03380	0.03129	0.03385	0.03367	0.03367
87	P. milliganii FJ572712	0.04246	0.04011	0.03540	0.04246	0.03540	0.04011	0.03775	0.03775
88	P. linifolia TS91	0.03059	0.03294	0.03294	0.03059	0.03294	0.02824	0.03529	0.03529
89	P. strigosa FJ572716	0.09241	0.09004	0.09003	0.09241	0.09003	0.08532	0.09240	0.09240
90	P. curviflora subsp. divergens	0.07765	0.07529	0.07059	0.07765	0.07059	0.07529	0.07294	0.07294
91	G. galpinii AM159516	0.10130	0.10365	0.09894	0.10130	0.09894	0.09894	0.10130	0.10130
92	G. humulis AM159517	0.10130	0.10365	0.09894	0.10130	0.09894	0.09894	0.10130	0.10130
93	P. curviflora subsp. subglabra	0.07002	0.06762	0.06282	0.07002	0.06282	0.06281	0.06522	0.06522
94	G. coriacea AM159512	0.10600	0.10836	0.10365	0.10600	0.10365	0.10365	0.10600	0.10600
95	P. curviflora subsp. gracilis	0.06118	0.05882	0.05412	0.06118	0.05412	0.05882	0.05647	0.05647
96	P. ammocharis FJ605463	0.07972	0.08214	0.08218	0.07972	0.08218	0.08219	0.08457	0.08457
97	G. wilmsii AM159527	0.09234	0.08997	0.08995	0.09234	0.08995	0.08759	0.09232	0.09232
98	P. curviflora subsp. cericea G	0.07525	0.07290	0.06819	0.07525	0.06819	0.06819	0.07054	0.07054
99	P. gilgiana FJ572710	0.07363	0.07124	0.06643	0.07363	0.06643	0.07351	0.06884	0.06884
100	P. lehmanniana subsp. nervosa	0.04256	0.04020	0.04024	0.04256	0.04024	0.04024	0.04259	0.04259
101	P. calcicola FJ572722	0.04007	0.04244	0.04247	0.04007	0.04247	0.04247	0.04481	0.04481
102	P. avonensis FJ572735	0.03564	0.03804	0.03805	0.03564	0.03805	0.03808	0.04043	0.04043
103	P. sulphurea FJ572727	0.03529	0.03294	0.03294	0.03529	0.03294	0.03294	0.03529	0.03529
104	P. tinctoria FJ572730	0.04258	0.04258	0.04260	0.04258	0.04260	0.04260	0.04495	0.04495
105	P. humilis GQ205198	0.03785	0.04023	0.04024	0.03785	0.04024	0.04024	0.04260	0.04260
106	P. leucantha GQ205207	0.03529	0.03765	0.03765	0.03529	0.03765	0.03765	0.04000	0.04000
107	P. angustifolia FJ572726	0.02836	0.02600	0.02606	0.02836	0.02606	0.02606	0.02842	0.02842
108	P. ciliata subsp. ciliata FJ57	0.02824	0.03059	0.03059	0.02824	0.03059	0.03059	0.03294	0.03294
109	P. mesoa subsp. macra TS86 TS1	0.00706	0.00471	0.00000	0.00706	0.00000	0.00941	0.00235	0.00235
110	P. suteri TS45	0.00706	0.00471	0.00000	0.00706	0.00000	0.00943	0.00235	0.00235
111	P. aridula subsp. aridula TS84	0.00706	0.00471	0.00000	0.00706	0.00000	0.00941	0.00235	0.00235
112	P. sericeovillosa subsp. seric	0.00706	0.00471	0.00000	0.00706	0.00000	0.00941	0.00235	0.00235
113	P. hispida FJ572738	0.03585	0.03583	0.03586	0.03585	0.03586	0.03588	0.03824	0.03824
114	P. lanata FJ572739	0.04759	0.04521	0.04522	0.04759	0.04522	0.04524	0.04760	0.04760
115	P. phylicoides FJ572723	0.03905	0.03646	0.03632	0.03905	0.03632	0.03127	0.03892	0.03892
116	P. villifera FJ572720	0.04471	0.04235	0.04235	0.04471	0.04235	0.04235	0.04471	0.04471
117	P. biflora GQ205186	0.03410	0.03165	0.02674	0.03410	0.02674	0.03177	0.02920	0.02920
118	P. pauciflora GQ205168	0.07101	0.06866	0.06867	0.07101	0.06867	0.06395	0.07103	0.07103
119	P. graniticola FJ572718	0.05902	0.05667	0.05196	0.05902	0.05196	0.05669	0.05432	0.05432
120	P. axiflora subsp. alpina GQ20	0.05198	0.05436	0.05437	0.05198	0.05437	0.05437	0.05673	0.05673
121	P. spiculigera subsp. thesiode	0.05428	0.05192	0.05194	0.05428	0.05194	0.04957	0.05429	0.05429
122	P. drupacea GQ205174	0.05256	0.05497	0.05979	0.05256	0.05979	0.05985	0.05738	0.05738
123	P. brevistyla subsp. brevistyl	0.02834	0.02599	0.02603	0.02834	0.02603	0.02603	0.02838	0.02838
124	P. subvillifera GQ205195	0.03294	0.03529	0.03529	0.03294	0.03529	0.03529	0.03765	0.03765
125	P. longiflora subsp. longiflor	0.03827	0.03587	0.03584	0.03827	0.03584	0.03595	0.03824	0.03824
126	G. squarrosa AM159525	0.08941	0.09176	0.08706	0.08941	0.08706	0.08706	0.08941	0.08941
127	G. carinata AJ549499	0.08933	0.09168	0.08698	0.08933	0.08698	0.08698	0.08933	0.08933
128	P. microephala subsp. microeph	0.05696	0.05460	0.05463	0.05696	0.05463	0.05226	0.05699	0.05699
129	G. phaeotricha AM159520	0.09219	0.08982	0.08510	0.09219	0.08510	0.09221	0.08746	0.08746
130	G. anomala AM158940	0.12800	0.13053	0.12549	0.12800	0.12549	0.12779	0.12801	0.12801
131	G. kraussiana AM159518	0.15411	0.15667	0.15682	0.15411	0.15682	0.15914	0.15923	0.15923

		49	50	51	52	53	54	55	56
49	P. ignota TS57	-							
50	P. oreophila subsp. ephaistica	0.00000	-						
51	P. hirta TS32	0.00000	0.00000	-					
52	P. barbata subsp. omoia TS29	0.00000	0.00000	0.00000	-				
53	P. prostrata subsp. vulcanica	0.00000	0.00000	0.00000	0.00000	-			
54	P. traversii subsp. exedra TS6	0.00941	0.00941	0.00941	0.00941	0.00941	-		
55	P. traversii subsp. traversii	0.00941	0.00941	0.00941	0.00941	0.00941	0.00000	-	
56	P. flava subsp. flava GQ205163	0.05105	0.05105	0.05105	0.05105	0.05105	0.05105	0.05105	-
57	P. concinna 1806	0.00000	0.00000	0.00000	0.00000	0.00000	0.00941	0.00941	0.05105
58	P. traversii subsp. borea TS10	0.01176	0.01176	0.01176	0.01176	0.01176	0.00235	0.00235	0.05348
59	P. mimosa TS66	0.01647	0.01647	0.01647	0.01647	0.01647	0.01647	0.01647	0.05356
60	P. acra 2182	0.00000	0.00000	0.00000	0.00000	0.00000	0.00941	0.00941	0.05105
61	P. telura TS52	0.00235	0.00235	0.00235	0.00235	0.00235	0.01176	0.01176	0.05348
62	P. microphylla TS58	0.00000	0.00000	0.00000	0.00000	0.00000	0.00941	0.00941	0.05105
63	P. buxifolia 1805	0.02118	0.02118	0.02118	0.02118	0.02118	0.02118	0.02118	0.05838
64	P. psuedolyallii TS46	0.00000	0.00000	0.00000	0.00000	0.00000	0.00941	0.00941	0.05105
65	P. dura TS31	0.00235	0.00235	0.00235	0.00235	0.00235	0.00706	0.00706	0.04862
66	P. prostrata subsp. thermalis	0.00000	0.00000	0.00000	0.00000	0.00000	0.00941	0.00941	0.05105
67	P. nitens subsp. aspera 2197	0.00000	0.00000	0.00000	0.00000	0.00000	0.00941	0.00941	0.05105
68	P. tomentosa 2188	0.00471	0.00471	0.00471	0.00471	0.00471	0.01412	0.01412	0.05590
69	P. nitens subsp. nitens TS48	0.00000	0.00000	0.00000	0.00000	0.00000	0.00941	0.00941	0.05105
70	P. alpina FJ572728	0.03071	0.03071	0.03071	0.03071	0.03071	0.03073	0.03073	0.05126
71	P. villosa 1802	0.02118	0.02118	0.02118	0.02118	0.02118	0.02588	0.02588	0.06810
72	P. actea 2189	0.00471	0.00471	0.00471	0.00471	0.00471	0.01412	0.01412	0.05105
73	P. eremitica 2196	0.00706	0.00706	0.00706	0.00706	0.00706	0.01647	0.01647	0.05839
74	P. pseudolyallii GQ205212	0.00475	0.00475	0.00475	0.00475	0.00475	0.01187	0.01187	0.05164
75	P. haematostachya FJ572733	0.09531	0.09531	0.09531	0.09531	0.09531	0.09525	0.09525	0.10942
76	T. punicea AM162502	0.11561	0.11561	0.11561	0.11561	0.11561	0.11090	0.11090	0.11242
77	P. stricta FJ649628	0.03537	0.03537	0.03537	0.03537	0.03537	0.03537	0.03537	0.03663
78	P. axiflora subsp. pubescens G	0.04156	0.04156	0.04156	0.04156	0.04156	0.04146	0.04146	0.04546
79	P. octophylla FJ572717	0.05433	0.05433	0.05433	0.05433	0.05433	0.05904	0.05904	0.06337
80	P. ferruginea FJ605464	0.04321	0.04321	0.04321	0.04321	0.04321	0.04326	0.04326	0.04653
81	P. erecta FJ572721	0.06150	0.06150	0.06150	0.06150	0.06150	0.06152	0.06152	0.06598
82	P. suaveolens subsp. suaveolen	0.05179	0.05179	0.05179	0.05179	0.05179	0.05179	0.05179	0.05584
83	P. decora FJ572732	0.08522	0.08522	0.08522	0.08522	0.08522	0.08521	0.08521	0.09790
84	P. sericostachya subsp. serico	0.10126	0.10126	0.10126	0.10126	0.10126	0.10126	0.10126	0.08748
85	T. sanguinea AM162503	0.11352	0.11352	0.11352	0.11352	0.11352	0.10879	0.10879	0.11264
86	P. imbricata subsp. imbricata	0.03367	0.03367	0.03367	0.03367	0.03367	0.03368	0.03368	0.04221
87	P. milliganii FJ572712	0.03775	0.03775	0.03775	0.03775	0.03775	0.03776	0.03776	0.04636
88	P. linifolia TS91	0.03529	0.03529	0.03529	0.03529	0.03529	0.03529	0.03529	0.03893
89	P. strigosa FJ572716	0.09240	0.09240	0.09240	0.09240	0.09240	0.09242	0.09242	0.09472
90	P. curviflora subsp. divergens	0.07294	0.07294	0.07294	0.07294	0.07294	0.07294	0.07294	0.07547
91	G. galpinii AM159516	0.10130	0.10130	0.10130	0.10130	0.10130	0.10132	0.10132	0.11915
92	G. humulis AM159517	0.10130	0.10130	0.10130	0.10130	0.10130	0.10132	0.10132	0.11918
93	P. curviflora subsp. subglabra	0.06522	0.06522	0.06522	0.06522	0.06522	0.06525	0.06525	0.05897
94	G. coriacea AM159512	0.10600	0.10600	0.10600	0.10600	0.10600	0.10602	0.10602	0.11683
95	P. curviflora subsp. gracilis	0.05647	0.05647	0.05647	0.05647	0.05647	0.05647	0.05647	0.06087
96	P. ammocharis FJ605463	0.08457	0.08457	0.08457	0.08457	0.08457	0.08457	0.08457	0.08188
97	G. wilmsii AM159527	0.09232	0.09232	0.09232	0.09232	0.09232	0.09469	0.09469	0.09087
98	P. curviflora subsp. cericea G	0.07054	0.07054	0.07054	0.07054	0.07054	0.07055	0.07055	0.06569
99	P. gilgiana FJ572710	0.06884	0.06884	0.06884	0.06884	0.06884	0.07113	0.07113	0.07319
100	P. lehmanniana subsp. nervosa	0.04259	0.04259	0.04259	0.04259	0.04259	0.04259	0.04259	0.05862
101	P. calcicola FJ572722	0.04481	0.04481	0.04481	0.04481	0.04481	0.04481	0.04481	0.04134
102	P. avonensis FJ572735	0.04043	0.04043	0.04043	0.04043	0.04043	0.04040	0.04040	0.04414
103	P. sulphurea FJ572727	0.03529	0.03529	0.03529	0.03529	0.03529	0.03529	0.03529	0.04144
104	P. tinctoria FJ572730	0.04495	0.04495	0.04495	0.04495	0.04495	0.04501	0.04501	0.05127
105	P. humilis GQ205198	0.04260	0.04260	0.04260	0.04260	0.04260	0.04262	0.04262	0.05406
106	P. leucantha GQ205207	0.04000	0.04000	0.04000	0.04000	0.04000	0.04000	0.04000	0.04377
107	P. angustifolia FJ572726	0.02842	0.02842	0.02842	0.02842	0.02842	0.02841	0.02841	0.04146
108	P. ciliata subsp. ciliata FJ57	0.03294	0.03294	0.03294	0.03294	0.03294	0.03294	0.03294	0.04134
109	P. mesoa subsp. macra TS86 TS1	0.00235	0.00235	0.00235	0.00235	0.00235	0.00706	0.00706	0.04862
110	P. suteri TS45	0.00235	0.00235	0.00235	0.00235	0.00235	0.00706	0.00706	0.04868
111	P. aridula subsp. aridula TS84	0.00235	0.00235	0.00235	0.00235	0.00235	0.00706	0.00706	0.04862
112	P. sericeovillosa subsp. seric	0.00235	0.00235	0.00235	0.00235	0.00235	0.00706	0.00706	0.04862
113	P. hispida FJ572738	0.03824	0.03824	0.03824	0.03824	0.03824	0.03825	0.03825	0.03940
114	P. lanata FJ572739	0.04760	0.04760	0.04760	0.04760	0.04760	0.04759	0.04759	0.05139
115	P. phylicoides FJ572723	0.03892	0.03892	0.03892	0.03892	0.03892	0.03896	0.03896	0.05837
116	P. villifera FJ572720	0.04471	0.04471	0.04471	0.04471	0.04471	0.04471	0.04471	0.05832
117	P. biflora GQ205186	0.02920	0.02920	0.02920	0.02920	0.02920	0.02920	0.02920	0.03756
118	P. pauciflora GQ205168	0.07103	0.07103	0.07103	0.07103	0.07103	0.07105	0.07105	0.06343
119	P. graniticola FJ572718	0.05432	0.05432	0.05432	0.05432	0.05432	0.05196	0.05196	0.07554
120	P. axiflora subsp. alpina GQ20	0.05673	0.05673	0.05673	0.05673	0.05673	0.05675	0.05675	0.05853
121	P. spiculigera subsp. thesiode	0.05429	0.05429	0.05429	0.05429	0.05429	0.05429	0.05429	0.05610
122	P. drupacea GQ205174	0.05738	0.05738	0.05738	0.05738	0.05738	0.06216	0.06216	0.06665
123	P. brevistyla subsp. brevistyl	0.02838	0.02838	0.02838	0.02838	0.02838	0.02838	0.02838	0.04144
124	P. subvillifera GQ205195	0.03765	0.03765	0.03765	0.03765	0.03765	0.03765	0.03765	0.05105
125	P. longiflora subsp. longiflor	0.03824	0.03824	0.03824	0.03824	0.03824	0.03831	0.03831	0.04488
126	G. squarrosa AM159525	0.08941	0.08941	0.08941	0.08941	0.08941	0.08941	0.08941	0.11435
127	G. carinata AJ549499	0.08933	0.08933	0.08933	0.08933	0.08933	0.08936	0.08936	0.11424
128	P. microephala subsp. microeph	0.05699	0.05699	0.05699	0.05699	0.05699	0.05701	0.05701	0.05619
129	G. phaeotricha AM159520	0.08746	0.08746	0.08746	0.08746	0.08746	0.08978	0.08978	0.09539
130	G. anomala AM158940	0.12801	0.12801	0.12801	0.12801	0.12801	0.13035	0.13035	0.14057
131	G. kraussiana AM159518	0.15923	0.15923	0.15923	0.15923	0.15923	0.15950	0.15950	0.17013

		57	58	59	60	61	62	63	64
57	P. concinna 1806	-							
58	P. traversii subsp. borea TS10	0.01176	-						
59	P. mimosa TS66	0.01647	0.01882	-					
60	P. acra 2182	0.00000	0.01176	0.01647	-				
61	P. telura TS52	0.00235	0.01176	0.01882	0.00235	-			
62	P. microphylla TS58	0.00000	0.01176	0.01647	0.00000	0.00235	-		
63	P. buxifolia 1805	0.02118	0.02353	0.02824	0.02118	0.02353	0.02118	-	
64	P. psuedolyallii TS46	0.00000	0.01176	0.01647	0.00000	0.00235	0.00000	0.02118	-
65	P. dura TS31	0.00235	0.00941	0.01412	0.00235	0.00471	0.00235	0.01882	0.00235
66	P. prostrata subsp. thermalis	0.00000	0.01176	0.01647	0.00000	0.00235	0.00000	0.02118	0.00000
67	P. nitens subsp. aspera 2197	0.00000	0.01176	0.01647	0.00000	0.00235	0.00000	0.02118	0.00000
68	P. tomentosa 2188	0.00471	0.01647	0.02118	0.00471	0.00706	0.00471	0.02588	0.00471
69	P. nitens subsp. nitens TS48	0.00000	0.01176	0.01647	0.00000	0.00235	0.00000	0.02118	0.00000
70	P. alpina FJ572728	0.03071	0.03308	0.03779	0.03071	0.03308	0.03071	0.03784	0.03071
71	P. villosa 1802	0.02118	0.02824	0.03294	0.02118	0.02353	0.02118	0.03765	0.02118
72	P. actea 2189	0.00471	0.01647	0.01647	0.00471	0.00706	0.00471	0.02588	0.00471
73	P. eremitica 2196	0.00706	0.01882	0.02353	0.00706	0.00941	0.00706	0.02824	0.00706
74	P. pseudolyallii GQ205212	0.00475	0.01422	0.01901	0.00475	0.00717	0.00475	0.02396	0.00475
75	P. haematostachya FJ572733	0.09531	0.09778	0.09783	0.09531	0.09780	0.09531	0.09779	0.09531
76	T. punicea AM162502	0.11561	0.11325	0.11322	0.11561	0.11796	0.11561	0.11561	0.11561
77	P. stricta FJ649628	0.03537	0.03772	0.03535	0.03537	0.03773	0.03537	0.04245	0.03537
78	P. axiflora subsp. pubescens G	0.04156	0.04386	0.04139	0.04156	0.04397	0.04156	0.05129	0.04156
79	P. octophylla FJ572717	0.05433	0.06140	0.06144	0.05433	0.05669	0.05433	0.06380	0.05433
80	P. ferruginea FJ605464	0.04321	0.04580	0.04604	0.04321	0.04579	0.04321	0.05099	0.04321
81	P. erecta FJ572721	0.06150	0.06387	0.06390	0.06150	0.06387	0.06150	0.06866	0.06150
82	P. suaveolens subsp. suaveolen	0.05179	0.05414	0.05417	0.05179	0.05414	0.05179	0.05888	0.05179
83	P. decora FJ572732	0.08522	0.08756	0.08987	0.08522	0.08756	0.08522	0.08756	0.08522
84	P. sericostachya subsp. serico	0.10126	0.10361	0.09890	0.10126	0.10361	0.10126	0.10128	0.10126
85	T. sanguinea AM162503	0.11352	0.11114	0.11111	0.11352	0.11587	0.11352	0.11818	0.11352
86	P. imbricata subsp. imbricata	0.03367	0.03606	0.03612	0.03367	0.03606	0.03367	0.04096	0.03367
87	P. milliganii FJ572712	0.03775	0.04011	0.04487	0.03775	0.04011	0.03775	0.04487	0.03775
88	P. linifolia TS91	0.03529	0.03765	0.03765	0.03529	0.03765	0.03529	0.04235	0.03529
89	P. strigosa FJ572716	0.09240	0.09477	0.09239	0.09240	0.09479	0.09240	0.09718	0.09240
90	P. curviflora subsp. divergens	0.07294	0.07529	0.07529	0.07294	0.07529	0.07294	0.08000	0.07294
91	G. galpinii AM159516	0.10130	0.10367	0.10365	0.10130	0.10367	0.10130	0.09429	0.10130
92	G. humulis AM159517	0.10130	0.10367	0.10365	0.10130	0.10367	0.10130	0.09429	0.10130
93	P. curviflora subsp. subglabra	0.06522	0.06766	0.07254	0.06522	0.06765	0.06522	0.07258	0.06522
94	G. coriacea AM159512	0.10600	0.10837	0.10836	0.10600	0.10837	0.10600	0.09665	0.10600
95	P. curviflora subsp. gracilis	0.05647	0.05882	0.06353	0.05647	0.05882	0.05647	0.06353	0.05647
96	P. ammocharis FJ605463	0.08457	0.08695	0.08464	0.08457	0.08696	0.08457	0.08710	0.08457
97	G. wilmsii AM159527	0.09232	0.09707	0.09709	0.09232	0.09470	0.09232	0.09706	0.09232
98	P. curviflora subsp. cericea G	0.07054	0.07291	0.07762	0.07054	0.07290	0.07054	0.07761	0.07054
99	P. gilgiana FJ572710	0.06884	0.07350	0.07351	0.06884	0.07119	0.06884	0.07822	0.06884
100	P. lehmanniana subsp. nervosa	0.04259	0.04494	0.04491	0.04259	0.04495	0.04259	0.04969	0.04259
101	P. calcicola FJ572722	0.04481	0.04716	0.04714	0.04481	0.04716	0.04481	0.05188	0.04481
102	P. avonensis FJ572735	0.04043	0.04278	0.04280	0.04043	0.04278	0.04043	0.04750	0.04043
103	P. sulphurea FJ572727	0.03529	0.03765	0.03767	0.03529	0.03533	0.03529	0.04235	0.03529
104	P. tinctoria FJ572730	0.04495	0.04738	0.04493	0.04495	0.04736	0.04495	0.05220	0.04495
105	P. humilis GQ205198	0.04260	0.04497	0.04023	0.04260	0.04497	0.04260	0.04506	0.04260
106	P. leucantha GQ205207	0.04000	0.04235	0.04235	0.04000	0.04235	0.04000	0.04706	0.04000
107	P. angustifolia FJ572726	0.02842	0.03077	0.03071	0.02842	0.03077	0.02842	0.03553	0.02842
108	P. ciliata subsp. ciliata FJ57	0.03294	0.03529	0.03529	0.03294	0.03529	0.03294	0.04000	0.03294
109	P. mesoa subsp. macra TS86 TS1	0.00235	0.00941	0.01412	0.00235	0.00471	0.00235	0.01882	0.00235
110	P. suteri TS45	0.00235	0.00941	0.01412	0.00235	0.00471	0.00235	0.01886	0.00235
111	P. aridula subsp. aridula TS84	0.00235	0.00941	0.01412	0.00235	0.00471	0.00235	0.01882	0.00235
112	P. sericeovillosa subsp. seric	0.00235	0.00941	0.01412	0.00235	0.00471	0.00235	0.01882	0.00235
113	P. hispida FJ572738	0.03824	0.04063	0.04060	0.03824	0.04063	0.03824	0.04544	0.03824
114	P. lanata FJ572739	0.04760	0.04997	0.04993	0.04760	0.04997	0.04760	0.05473	0.04760
115	P. phylicoides FJ572723	0.03892	0.04154	0.04196	0.03892	0.04156	0.03892	0.04696	0.03892
116	P. villifera FJ572720	0.04471	0.04706	0.04706	0.04471	0.04706	0.04471	0.05176	0.04471
117	P. biflora GQ205186	0.02920	0.03155	0.03646	0.02920	0.03166	0.02920	0.03651	0.02920
118	P. pauciflora GQ205168	0.07103	0.07340	0.07341	0.07103	0.07340	0.07103	0.07109	0.07103
119	P. graniticola FJ572718	0.05432	0.05431	0.06138	0.05432	0.05667	0.05432	0.06139	0.05432
120	P. axiflora subsp. alpina GQ20	0.05673	0.05910	0.05908	0.05673	0.05910	0.05673	0.06386	0.05673
121	P. spiculigera subsp. thesiode	0.05429	0.05665	0.05663	0.05429	0.05665	0.05429	0.06137	0.05429
122	P. drupacea GQ205174	0.05738	0.06457	0.05979	0.05738	0.05975	0.05738	0.06935	0.05738
123	P. brevistyla subsp. brevistyl	0.02838	0.03073	0.03070	0.02838	0.03073	0.02838	0.03551	0.02838
124	P. subvillifera GQ205195	0.03765	0.04000	0.04000	0.03765	0.04000	0.03765	0.04471	0.03765
125	P. longiflora subsp. longiflor	0.03824	0.04070	0.04069	0.03824	0.04063	0.03824	0.04554	0.03824
126	G. squarrosa AM159525	0.08941	0.09176	0.09176	0.08941	0.09176	0.08941	0.09176	0.08941
127	G. carinata AJ549499	0.08933	0.09173	0.09170	0.08933	0.09170	0.08933	0.09176	0.08933
128	P. microephala subsp. microeph	0.05699	0.05936	0.05933	0.05699	0.05936	0.05699	0.06417	0.05699
129	G. phaeotricha AM159520	0.08746	0.09212	0.09685	0.08746	0.08980	0.08746	0.08744	0.08746
130	G. anomala AM158940	0.12801	0.13292	0.13780	0.12801	0.13050	0.12801	0.12278	0.12801
131	G. kraussiana AM159518	0.15923	0.16201	0.15927	0.15923	0.16172	0.15923	0.16179	0.15923

		65	66	67	68	69	70	71	72
65	P. dura TS31	-							
66	P. prostrata subsp. thermalis	0.00235	-						
67	P. nitens subsp. aspera 2197	0.00235	0.00000	-					
68	P. tomentosa 2188	0.00706	0.00471	0.00471	-				
69	P. nitens subsp. nitens TS48	0.00235	0.00000	0.00000	0.00471	-			
70	P. alpina FJ572728	0.02835	0.03071	0.03071	0.03541	0.03071	-		
71	P. villosa 1802	0.01882	0.02118	0.02118	0.02118	0.02118	0.04498	-	
72	P. actea 2189	0.00706	0.00471	0.00471	0.00941	0.00471	0.03543	0.02588	-
73	P. eremitica 2196	0.00941	0.00706	0.00706	0.01176	0.00706	0.03777	0.02353	0.01176
74	P. pseudolyallii GQ205212	0.00473	0.00475	0.00475	0.00713	0.00475	0.02888	0.01918	0.00954
75	P. haematostachya FJ572733	0.09275	0.09531	0.09531	0.10037	0.09531	0.09582	0.10794	0.09782
76	T. punicea AM162502	0.11325	0.11561	0.11561	0.12032	0.11561	0.12079	0.12738	0.11561
77	P. stricta FJ649628	0.03302	0.03537	0.03537	0.04008	0.03537	0.03785	0.04949	0.03537
78	P. axiflora subsp. pubescens G	0.03904	0.04156	0.04156	0.04647	0.04156	0.04406	0.04893	0.04156
79	P. octophylla FJ572717	0.05668	0.05433	0.05433	0.05904	0.05433	0.06178	0.07086	0.05433
80	P. ferruginea FJ605464	0.04068	0.04321	0.04321	0.04826	0.04321	0.04871	0.06109	0.04321
81	P. erecta FJ572721	0.05915	0.06150	0.06150	0.06148	0.06150	0.05947	0.07333	0.06382
82	P. suaveolens subsp. suaveolen	0.04944	0.05179	0.05179	0.05179	0.05179	0.05436	0.06358	0.05179
83	P. decora FJ572732	0.08287	0.08522	0.08522	0.08991	0.08522	0.09030	0.09695	0.08752
84	P. sericostachya subsp. serico	0.09890	0.10126	0.10126	0.10126	0.10126	0.09234	0.09420	0.10126
85	T. sanguinea AM162503	0.11114	0.11352	0.11352	0.11825	0.11352	0.12336	0.12534	0.11352
86	P. imbricata subsp. imbricata	0.03129	0.03367	0.03367	0.03118	0.03367	0.03865	0.04541	0.03623
87	P. milliganii FJ572712	0.03540	0.03775	0.03775	0.04246	0.03775	0.04046	0.04957	0.04246
88	P. linifolia TS91	0.03294	0.03529	0.03529	0.04000	0.03529	0.03777	0.04706	0.03529
89	P. strigosa FJ572716	0.09003	0.09240	0.09240	0.08769	0.09240	0.09279	0.09002	0.09240
90	P. curviflora subsp. divergens	0.07059	0.07294	0.07294	0.07765	0.07294	0.06858	0.08000	0.07765
91	G. galpinii AM159516	0.09894	0.10130	0.10130	0.10600	0.10130	0.10878	0.11073	0.10600
92	G. humulis AM159517	0.09894	0.10130	0.10130	0.10600	0.10130	0.10878	0.10838	0.10600
93	P. curviflora subsp. subglabra	0.06282	0.06522	0.06522	0.07002	0.06522	0.07040	0.07737	0.06999
94	G. coriacea AM159512	0.10365	0.10600	0.10600	0.11071	0.10600	0.11347	0.11543	0.11071
95	P. curviflora subsp. gracilis	0.05412	0.05647	0.05647	0.06118	0.05647	0.05899	0.06824	0.06118
96	P. ammocharis FJ605463	0.08218	0.08457	0.08457	0.08933	0.08457	0.08270	0.09657	0.08457
97	G. wilmsii AM159527	0.08995	0.09232	0.09232	0.09707	0.09232	0.09982	0.09474	0.09232
98	P. curviflora subsp. cericea G	0.06819	0.07054	0.07054	0.07057	0.07054	0.07299	0.08000	0.07524
99	P. gilgiana FJ572710	0.06643	0.06884	0.06884	0.06886	0.06884	0.07365	0.08076	0.07361
100	P. lehmanniana subsp. nervosa	0.04024	0.04259	0.04259	0.04730	0.04259	0.05464	0.05432	0.04259
101	P. calcicola FJ572722	0.04247	0.04481	0.04481	0.04951	0.04481	0.04728	0.06125	0.04481
102	P. avonensis FJ572735	0.03805	0.04043	0.04043	0.04519	0.04043	0.04783	0.05476	0.04043
103	P. sulphurea FJ572727	0.03294	0.03529	0.03529	0.04000	0.03529	0.04255	0.05179	0.03529
104	P. tinctoria FJ572730	0.04260	0.04495	0.04495	0.04495	0.04495	0.05688	0.05676	0.04495
105	P. humilis GQ205198	0.04024	0.04260	0.04260	0.04258	0.04260	0.04289	0.04967	0.04260
106	P. leucantha GQ205207	0.03765	0.04000	0.04000	0.04471	0.04000	0.04718	0.05647	0.04000
107	P. angustifolia FJ572726	0.02606	0.02842	0.02842	0.03312	0.02842	0.03330	0.04267	0.02842
108	P. ciliata subsp. ciliata FJ57	0.03059	0.03294	0.03294	0.03765	0.03294	0.04014	0.04941	0.03294
109	P. mesoa subsp. macra TS86 TS1	0.00000	0.00235	0.00235	0.00706	0.00235	0.02835	0.01882	0.00706
110	P. suteri TS45	0.00000	0.00235	0.00235	0.00473	0.00235	0.02843	0.01657	0.00708
111	P. aridula subsp. aridula TS84	0.00000	0.00235	0.00235	0.00706	0.00235	0.02835	0.01882	0.00706
112	P. sericeovillosa subsp. seric	0.00000	0.00235	0.00235	0.00706	0.00235	0.02835	0.01882	0.00706
113	P. hispida FJ572738	0.03586	0.03824	0.03824	0.04062	0.03824	0.04077	0.05022	0.03824
114	P. lanata FJ572739	0.04522	0.04760	0.04760	0.05236	0.04760	0.05482	0.05950	0.04760
115	P. phylicoides FJ572723	0.03632	0.03892	0.03892	0.04409	0.03892	0.04741	0.05464	0.03892
116	P. villifera FJ572720	0.04235	0.04471	0.04471	0.04471	0.04471	0.05665	0.05647	0.04471
117	P. biflora GQ205186	0.02674	0.02920	0.02920	0.03401	0.02920	0.03142	0.03892	0.03416
118	P. pauciflora GQ205168	0.06867	0.07103	0.07103	0.07574	0.07103	0.06884	0.08283	0.07103
119	P. graniticola FJ572718	0.05196	0.05432	0.05432	0.05902	0.05432	0.05934	0.06134	0.05904
120	P. axiflora subsp. alpina GQ20	0.05437	0.05673	0.05673	0.05436	0.05673	0.05918	0.06850	0.05673
121	P. spiculigera subsp. thesiode	0.05194	0.05429	0.05429	0.05900	0.05429	0.05206	0.07077	0.05429
122	P. drupacea GQ205174	0.05979	0.05738	0.05738	0.05497	0.05738	0.06949	0.06932	0.05738
123	P. brevistyla subsp. brevistyl	0.02603	0.02838	0.02838	0.03309	0.02838	0.03562	0.04263	0.02838
124	P. subvillifera GQ205195	0.03529	0.03765	0.03765	0.04235	0.03765	0.04487	0.05412	0.03765
125	P. longiflora subsp. longiflor	0.03584	0.03824	0.03824	0.04302	0.03824	0.04088	0.05269	0.03824
126	G. squarrosa AM159525	0.08706	0.08941	0.08941	0.08941	0.08941	0.10134	0.09882	0.09412
127	G. carinata AJ549499	0.08698	0.08933	0.08933	0.08936	0.08933	0.10125	0.09877	0.09403
128	P. microephala subsp. microeph	0.05463	0.05699	0.05699	0.06170	0.05699	0.04994	0.07350	0.05699
129	G. phaeotricha AM159520	0.08510	0.08746	0.08746	0.09217	0.08746	0.09493	0.09444	0.09221
130	G. anomala AM158940	0.12549	0.12801	0.12801	0.13312	0.12801	0.13818	0.13807	0.13307
131	G. kraussiana AM159518	0.15682	0.15923	0.15923	0.16414	0.15923	0.17243	0.17390	0.15923

		73	74	75	76	77	78	79	80
73	P. eremitica 2196	-							
74	P. pseudolyallii GQ205212	0.01194	-						
75	P. haematostachya FJ572733	0.09273	0.09412	-					
76	T. punicea AM162502	0.11797	0.12006	0.13157	-				
77	P. stricta FJ649628	0.03773	0.03354	0.08551	0.10401	-			
78	P. axiflora subsp. pubescens G	0.04162	0.03945	0.07138	0.10413	0.03682	-		
79	P. octophylla FJ572717	0.05673	0.05517	0.10089	0.13519	0.04979	0.05155	-	
80	P. ferruginea FJ605464	0.05095	0.04116	0.09777	0.11785	0.03346	0.04488	0.05601	-
81	P. erecta FJ572721	0.06862	0.05776	0.09288	0.14496	0.05468	0.06409	0.08074	0.04842
82	P. suaveolens subsp. suaveolen	0.05888	0.04774	0.08772	0.12528	0.04262	0.05359	0.06387	0.03799
83	P. decora FJ572732	0.08283	0.08877	0.00250	0.12332	0.07849	0.06811	0.09253	0.08674
84	P. sericostachya subsp. serico	0.10361	0.09624	0.10558	0.13246	0.07781	0.05667	0.09722	0.10460
85	T. sanguinea AM162503	0.11117	0.11774	0.12152	0.04253	0.10181	0.10893	0.12846	0.11331
86	P. imbricata subsp. imbricata	0.04079	0.02936	0.08828	0.11297	0.02898	0.03288	0.04849	0.03116
87	P. milliganii FJ572712	0.04016	0.03603	0.09053	0.11617	0.03556	0.03436	0.04492	0.04064
88	P. linifolia TS91	0.03294	0.03824	0.08510	0.10380	0.02829	0.03178	0.05203	0.03068
89	P. strigosa FJ572716	0.09002	0.08919	0.10368	0.14268	0.07122	0.05171	0.08796	0.09874
90	P. curviflora subsp. divergens	0.07529	0.07649	0.10801	0.11802	0.05893	0.04933	0.07806	0.08667
91	G. galpinii AM159516	0.10365	0.10527	0.10807	0.15845	0.10860	0.07043	0.10638	0.11208
92	G. humulis AM159517	0.10365	0.10527	0.10801	0.15847	0.10858	0.07044	0.10638	0.11215
93	P. curviflora subsp. subglabra	0.06280	0.06598	0.09788	0.12641	0.05567	0.03257	0.07480	0.06944
94	G. coriacea AM159512	0.10836	0.11002	0.11041	0.15612	0.10858	0.07777	0.11114	0.11721
95	P. curviflora subsp. gracilis	0.05412	0.05974	0.07477	0.11565	0.04479	0.03454	0.06624	0.06876
96	P. ammocharis FJ605463	0.08702	0.08119	0.08997	0.14570	0.06790	0.05522	0.08007	0.08547
97	G. wilmsii AM159527	0.09235	0.09627	0.11935	0.12839	0.08777	0.07565	0.09530	0.09773
98	P. curviflora subsp. cericea G	0.07289	0.06233	0.09813	0.12736	0.05891	0.04620	0.08265	0.06632
99	P. gilgiana FJ572710	0.07121	0.06515	0.11156	0.13534	0.06409	0.07894	0.07622	0.08443
100	P. lehmanniana subsp. nervosa	0.04966	0.04088	0.09052	0.11839	0.04039	0.04916	0.06867	0.04353
101	P. calcicola FJ572722	0.05186	0.04777	0.08976	0.12040	0.03555	0.04909	0.05923	0.03077
102	P. avonensis FJ572735	0.04522	0.04110	0.08339	0.12144	0.03591	0.03704	0.05726	0.02601
103	P. sulphurea FJ572727	0.04238	0.03815	0.09023	0.11103	0.03076	0.04144	0.05676	0.02312
104	P. tinctoria FJ572730	0.05199	0.04561	0.09814	0.11360	0.04036	0.05157	0.06660	0.03614
105	P. humilis GQ205198	0.04968	0.04332	0.10370	0.11872	0.04267	0.04429	0.05951	0.04133
106	P. leucantha GQ205207	0.04706	0.04285	0.08756	0.11322	0.03073	0.04395	0.05203	0.02321
107	P. angustifolia FJ572726	0.03321	0.03126	0.08022	0.10896	0.02370	0.03462	0.04770	0.02310
108	P. ciliata subsp. ciliata FJ57	0.04000	0.03584	0.09022	0.10855	0.02831	0.03661	0.05203	0.00779
109	P. mesoa subsp. macra TS86 TS1	0.00941	0.00473	0.09275	0.11325	0.03302	0.03904	0.05668	0.04068
110	P. suteri TS45	0.00941	0.00474	0.09298	0.11344	0.03310	0.03911	0.05684	0.04074
111	P. aridula subsp. aridula TS84	0.00941	0.00473	0.09275	0.11325	0.03302	0.03904	0.05668	0.04068
112	P. sericeovillosa subsp. seric	0.00941	0.00473	0.09275	0.11325	0.03302	0.03904	0.05668	0.04068
113	P. hispida FJ572738	0.04538	0.04107	0.08364	0.10487	0.02879	0.04180	0.05755	0.02303
114	P. lanata FJ572739	0.05471	0.05047	0.09815	0.11149	0.03825	0.05917	0.06926	0.03866
115	P. phylicoides FJ572723	0.04146	0.03683	0.09435	0.12414	0.02616	0.04302	0.05492	0.04746
116	P. villifera FJ572720	0.05176	0.04544	0.10052	0.12033	0.04490	0.04895	0.06850	0.04070
117	P. biflora GQ205186	0.02915	0.02710	0.07706	0.10857	0.02198	0.01782	0.03168	0.03609
118	P. pauciflora GQ205168	0.07339	0.06954	0.09819	0.12816	0.05238	0.07101	0.06674	0.06649
119	P. graniticola FJ572718	0.05665	0.05521	0.10809	0.12999	0.06150	0.05910	0.07122	0.07176
120	P. axiflora subsp. alpina GQ20	0.06379	0.05298	0.10336	0.12792	0.04969	0.05394	0.06417	0.05642
121	P. spiculigera subsp. thesiode	0.05665	0.05743	0.10343	0.11343	0.04255	0.05903	0.06411	0.06673
122	P. drupacea GQ205174	0.05973	0.06082	0.10366	0.13139	0.05979	0.05451	0.06040	0.06452
123	P. brevistyla subsp. brevistyl	0.03318	0.03128	0.08006	0.11109	0.02366	0.03444	0.04762	0.02307
124	P. subvillifera GQ205195	0.04471	0.03824	0.08503	0.11561	0.03307	0.03664	0.05904	0.02829
125	P. longiflora subsp. longiflor	0.04548	0.03400	0.08873	0.11981	0.02643	0.04228	0.05059	0.02315
126	G. squarrosa AM159525	0.09176	0.08866	0.11837	0.14639	0.09905	0.08494	0.11101	0.10396
127	G. carinata AJ549499	0.09168	0.08858	0.11830	0.14633	0.09895	0.08490	0.11096	0.10383
128	P. microephala subsp. microeph	0.05933	0.05534	0.10076	0.11608	0.04039	0.05670	0.06688	0.06688
129	G. phaeotricha AM159520	0.08510	0.09148	0.10620	0.14450	0.08295	0.06640	0.08310	0.09947
130	G. anomala AM158940	0.13550	0.13292	0.15410	0.16285	0.13312	0.11788	0.14859	0.13427
131	G. kraussiana AM159518	0.16652	0.16219	0.19141	0.18198	0.16240	0.14500	0.18499	0.16901

		81	82	83	84	85	86	87	88
81	P. erecta FJ572721	-							
82	P. suaveolens subsp. suaveolen	0.04967	-						
83	P. decora FJ572732	0.08544	0.08053	-					
84	P. sericostachya subsp. serico	0.10921	0.09434	0.09950	-				
85	T. sanguinea AM162503	0.14071	0.12326	0.11647	0.13518	-			
86	P. imbricata subsp. imbricata	0.04859	0.03355	0.08243	0.08254	0.10841	-		
87	P. milliganii FJ572712	0.05946	0.04492	0.08555	0.09238	0.10457	0.02192	-	
88	P. linifolia TS91	0.05203	0.04473	0.07573	0.08478	0.09694	0.03625	0.03545	-
89	P. strigosa FJ572716	0.09536	0.08291	0.10007	0.07334	0.13579	0.07340	0.07607	0.08055
90	P. curviflora subsp. divergens	0.10185	0.08721	0.09463	0.06120	0.12061	0.07011	0.07325	0.06588
91	G. galpinii AM159516	0.11614	0.11316	0.10178	0.11073	0.15869	0.09927	0.09686	0.09424
92	G. humulis AM159517	0.11614	0.11316	0.10177	0.11073	0.15871	0.09925	0.09686	0.09424
93	P. curviflora subsp. subglabra	0.09212	0.07716	0.08726	0.07475	0.12429	0.06429	0.05809	0.05323
94	G. coriacea AM159512	0.12086	0.11789	0.10174	0.11076	0.15637	0.10611	0.10162	0.09895
95	P. curviflora subsp. gracilis	0.07580	0.06363	0.06390	0.06358	0.11349	0.05309	0.05202	0.04941
96	P. ammocharis FJ605463	0.08530	0.07983	0.08500	0.08487	0.13642	0.07266	0.07046	0.06781
97	G. wilmsii AM159527	0.11693	0.09725	0.10730	0.08528	0.12396	0.08020	0.07859	0.07818
98	P. curviflora subsp. cericea G	0.08049	0.06602	0.08990	0.07775	0.12989	0.06234	0.06612	0.05877
99	P. gilgiana FJ572710	0.08103	0.08549	0.10488	0.09959	0.12370	0.05595	0.06662	0.07349
100	P. lehmanniana subsp. nervosa	0.06417	0.05203	0.07836	0.09707	0.11637	0.04125	0.05226	0.04495
101	P. calcicola FJ572722	0.04027	0.04010	0.07775	0.08949	0.11124	0.03648	0.04976	0.03303
102	P. avonensis FJ572735	0.02874	0.04042	0.07182	0.09067	0.11467	0.03440	0.03807	0.02621
103	P. sulphurea FJ572727	0.04726	0.01647	0.07814	0.08973	0.10889	0.03127	0.03781	0.02826
104	P. tinctoria FJ572730	0.05217	0.02602	0.08539	0.08285	0.10904	0.03602	0.05232	0.04019
105	P. humilis GQ205198	0.05238	0.04970	0.09037	0.07124	0.11902	0.03887	0.04999	0.02839
106	P. leucantha GQ205207	0.04255	0.03532	0.07571	0.08481	0.11115	0.03382	0.04486	0.02824
107	P. angustifolia FJ572726	0.04513	0.03309	0.06902	0.09014	0.10453	0.02685	0.03100	0.02137
108	P. ciliata subsp. ciliata FJ57	0.04019	0.03297	0.07809	0.09187	0.10646	0.02887	0.03780	0.02118
109	P. mesoa subsp. macra TS86 TS1	0.05915	0.04944	0.08287	0.09890	0.11114	0.03129	0.03540	0.03294
110	P. suteri TS45	0.05704	0.04723	0.08304	0.09693	0.11130	0.02883	0.03551	0.03300
111	P. aridula subsp. aridula TS84	0.05915	0.04944	0.08287	0.09890	0.11114	0.03129	0.03540	0.03294
112	P. sericeovillosa subsp. seric	0.05915	0.04944	0.08287	0.09890	0.11114	0.03129	0.03540	0.03294
113	P. hispida FJ572738	0.04340	0.03352	0.07215	0.08405	0.10513	0.03188	0.04321	0.02393
114	P. lanata FJ572739	0.05745	0.05232	0.08830	0.09751	0.11172	0.04875	0.05466	0.04048
115	P. phylicoides FJ572723	0.06542	0.05218	0.08592	0.09668	0.12215	0.04282	0.04698	0.03112
116	P. villifera FJ572720	0.05677	0.04005	0.08759	0.10363	0.11355	0.03620	0.05192	0.04706
117	P. biflora GQ205186	0.05405	0.04100	0.07322	0.05959	0.09886	0.02017	0.00945	0.02435
118	P. pauciflora GQ205168	0.06918	0.06868	0.09279	0.09701	0.11415	0.06065	0.06202	0.04975
119	P. graniticola FJ572718	0.07840	0.07330	0.09480	0.09683	0.11845	0.05525	0.05462	0.05194
120	P. axiflora subsp. alpina GQ20	0.06421	0.05915	0.09501	0.09688	0.12579	0.02173	0.04754	0.05436
121	P. spiculigera subsp. thesiode	0.08076	0.07094	0.09018	0.09443	0.10669	0.04844	0.05933	0.04484
122	P. drupacea GQ205174	0.07472	0.07194	0.09106	0.09799	0.12448	0.03479	0.05548	0.05494
123	P. brevistyla subsp. brevistyl	0.04507	0.03078	0.06892	0.09003	0.10668	0.02678	0.03089	0.02367
124	P. subvillifera GQ205195	0.04965	0.04238	0.07334	0.08949	0.11355	0.03386	0.04246	0.03059
125	P. longiflora subsp. longiflor	0.04819	0.03590	0.08165	0.09627	0.11998	0.03192	0.03850	0.03599
126	G. squarrosa AM159525	0.11604	0.10837	0.11118	0.11778	0.14674	0.08703	0.09914	0.09647
127	G. carinata AJ549499	0.11590	0.10824	0.11107	0.11763	0.14663	0.08701	0.09907	0.09640
128	P. microephala subsp. microeph	0.07885	0.06646	0.09271	0.09013	0.10934	0.04624	0.05736	0.04747
129	G. phaeotricha AM159520	0.11447	0.10175	0.09510	0.09448	0.14004	0.08274	0.07598	0.08271
130	G. anomala AM158940	0.12918	0.14605	0.14061	0.16005	0.16531	0.12838	0.13614	0.12531
131	G. kraussiana AM159518	0.17581	0.17005	0.18264	0.16652	0.18389	0.15685	0.16289	0.15451

		89	90	91	92	93	94	95	96
89	P. strigosa FJ572716	-							
90	P. curviflora subsp. divergens	0.08050	-						
91	G. galpinii AM159516	0.10677	0.10361	-					
92	G. humulis AM159517	0.10676	0.10361	0.00236	-				
93	P. curviflora subsp. subglabra	0.07265	0.05799	0.09649	0.09651	-			
94	G. coriacea AM159512	0.11380	0.10361	0.01179	0.01415	0.09657	-		
95	P. curviflora subsp. gracilis	0.07340	0.04941	0.08712	0.08712	0.03624	0.08712	-	
96	P. ammocharis FJ605463	0.07781	0.08231	0.10411	0.10406	0.08316	0.10897	0.07023	-
97	G. wilmsii AM159527	0.09997	0.09703	0.10674	0.10676	0.08540	0.11149	0.07812	0.09029
98	P. curviflora subsp. cericea G	0.08746	0.06819	0.10107	0.10107	0.04095	0.10110	0.04938	0.09456
99	P. gilgiana FJ572710	0.10261	0.08772	0.11866	0.11868	0.09468	0.11864	0.08295	0.08986
100	P. lehmanniana subsp. nervosa	0.09766	0.07572	0.10893	0.10893	0.07285	0.11136	0.06391	0.08240
101	P. calcicola FJ572722	0.09249	0.07535	0.11088	0.11088	0.07734	0.11558	0.05418	0.07985
102	P. avonensis FJ572735	0.08157	0.07852	0.09508	0.09511	0.06600	0.09988	0.05487	0.06636
103	P. sulphurea FJ572727	0.07823	0.07072	0.09661	0.09661	0.06304	0.10131	0.05422	0.07507
104	P. tinctoria FJ572730	0.08564	0.07325	0.10172	0.10172	0.07301	0.10173	0.05669	0.08490
105	P. humilis GQ205198	0.08094	0.06399	0.08995	0.08997	0.07298	0.09475	0.05916	0.07798
106	P. leucantha GQ205207	0.08051	0.07059	0.09420	0.09420	0.07247	0.09891	0.04941	0.07256
107	P. angustifolia FJ572726	0.08126	0.06642	0.09268	0.09268	0.05843	0.09743	0.04983	0.06393
108	P. ciliata subsp. ciliata FJ57	0.08765	0.07294	0.09659	0.09659	0.06530	0.10130	0.05647	0.07504
109	P. mesoa subsp. macra TS86 TS1	0.09003	0.07059	0.09894	0.09894	0.06282	0.10365	0.05412	0.08218
110	P. suteri TS45	0.08798	0.07071	0.09915	0.09915	0.06294	0.10386	0.05422	0.08237
111	P. aridula subsp. aridula TS84	0.09003	0.07059	0.09894	0.09894	0.06282	0.10365	0.05412	0.08218
112	P. sericeovillosa subsp. seric	0.09003	0.07059	0.09894	0.09894	0.06282	0.10365	0.05412	0.08218
113	P. hispida FJ572738	0.07691	0.06915	0.10036	0.10036	0.06600	0.10512	0.05492	0.07133
114	P. lanata FJ572739	0.09560	0.07364	0.11405	0.11405	0.07815	0.11402	0.06182	0.07334
115	P. phylicoides FJ572723	0.08309	0.07076	0.10949	0.10957	0.06027	0.11480	0.05697	0.08791
116	P. villifera FJ572720	0.08998	0.08000	0.10834	0.10834	0.07245	0.11304	0.06824	0.08452
117	P. biflora GQ205186	0.05436	0.04450	0.07752	0.07750	0.03024	0.08002	0.02461	0.05763
118	P. pauciflora GQ205168	0.09284	0.09234	0.11137	0.11137	0.08733	0.11136	0.07578	0.08028
119	P. graniticola FJ572718	0.09736	0.07315	0.10155	0.10155	0.08006	0.10382	0.07081	0.07765
120	P. axiflora subsp. alpina GQ20	0.09040	0.09209	0.11123	0.11121	0.08727	0.11592	0.06613	0.08231
121	P. spiculigera subsp. thesiode	0.09500	0.06849	0.11336	0.11335	0.07518	0.11335	0.06371	0.09180
122	P. drupacea GQ205174	0.09635	0.08856	0.09795	0.09799	0.08599	0.10272	0.06447	0.08075
123	P. brevistyla subsp. brevistyl	0.07879	0.06632	0.09249	0.09249	0.05597	0.09727	0.04745	0.06610
124	P. subvillifera GQ205195	0.08769	0.06824	0.09894	0.09894	0.06521	0.10365	0.05647	0.06759
125	P. longiflora subsp. longiflor	0.08443	0.07914	0.10492	0.10729	0.06169	0.10969	0.06241	0.07128
126	G. squarrosa AM159525	0.10186	0.10588	0.10845	0.10845	0.11595	0.11081	0.09882	0.11118
127	G. carinata AJ549499	0.10180	0.10579	0.10843	0.10843	0.11587	0.11080	0.09872	0.11109
128	P. microephala subsp. microeph	0.09064	0.06877	0.11396	0.11395	0.07289	0.11396	0.06397	0.08755
129	G. phaeotricha AM159520	0.08559	0.07319	0.10170	0.10168	0.07514	0.10166	0.06372	0.09962
130	G. anomala AM158940	0.16864	0.14247	0.11242	0.10986	0.13965	0.11479	0.13531	0.15734
131	G. kraussiana AM159518	0.19052	0.16399	0.14190	0.14427	0.15940	0.14165	0.14682	0.16900

		97	98	99	100	101	102	103	104
97	G. wilmsii AM159527	-							
98	P. curviflora subsp. cericea G	0.09701	-						
99	P. gilgiana FJ572710	0.10743	0.08521	-					
100	P. lehmanniana subsp. nervosa	0.10463	0.07324	0.08117	-				
101	P. calcicola FJ572722	0.09952	0.07300	0.07835	0.04502	-			
102	P. avonensis FJ572735	0.09114	0.06175	0.07432	0.03582	0.02149	-		
103	P. sulphurea FJ572727	0.08779	0.05890	0.07829	0.03545	0.02362	0.02376	-	
104	P. tinctoria FJ572730	0.09752	0.06375	0.07371	0.04275	0.03071	0.03332	0.01421	-
105	P. humilis GQ205198	0.09294	0.06628	0.06674	0.05463	0.04264	0.03349	0.03789	0.04037
106	P. leucantha GQ205207	0.08996	0.06818	0.07112	0.04019	0.01887	0.01900	0.01882	0.02363
107	P. angustifolia FJ572726	0.08365	0.06142	0.06931	0.02154	0.02605	0.01913	0.01647	0.03078
108	P. ciliata subsp. ciliata FJ57	0.08764	0.06111	0.07348	0.03310	0.02127	0.01669	0.01650	0.02834
109	P. mesoa subsp. macra TS86 TS1	0.08995	0.06819	0.06643	0.04024	0.04247	0.03805	0.03294	0.04260
110	P. suteri TS45	0.09009	0.06600	0.06429	0.04032	0.04255	0.03813	0.03300	0.04038
111	P. aridula subsp. aridula TS84	0.08995	0.06819	0.06643	0.04024	0.04247	0.03805	0.03294	0.04260
112	P. sericeovillosa subsp. seric	0.08995	0.06819	0.06643	0.04024	0.04247	0.03805	0.03294	0.04260
113	P. hispida FJ572738	0.08127	0.06424	0.06736	0.03841	0.02398	0.02176	0.02143	0.03326
114	P. lanata FJ572739	0.08807	0.07594	0.07402	0.05028	0.04053	0.03838	0.03566	0.04507
115	P. phylicoides FJ572723	0.10118	0.06533	0.08679	0.05218	0.05238	0.04519	0.03700	0.05069
116	P. villifera FJ572720	0.09233	0.07288	0.07826	0.04023	0.04719	0.04286	0.02826	0.03311
117	P. biflora GQ205186	0.07066	0.04125	0.05372	0.04153	0.03932	0.03207	0.03148	0.04162
118	P. pauciflora GQ205168	0.10486	0.09000	0.08581	0.07380	0.06156	0.05273	0.05684	0.06404
119	P. graniticola FJ572718	0.09264	0.08727	0.07131	0.05683	0.06621	0.05252	0.05676	0.06390
120	P. axiflora subsp. alpina GQ20	0.09746	0.08501	0.07370	0.06415	0.05438	0.05258	0.05677	0.05693
121	P. spiculigera subsp. thesiode	0.09260	0.08018	0.06175	0.05938	0.05434	0.05963	0.05670	0.06156
122	P. drupacea GQ205174	0.09124	0.09079	0.07704	0.06713	0.05980	0.05083	0.06230	0.06004
123	P. brevistyla subsp. brevistyl	0.08348	0.05906	0.07148	0.02381	0.02605	0.02144	0.01417	0.02861
124	P. subvillifera GQ205195	0.09707	0.06582	0.07828	0.01420	0.03068	0.02137	0.02588	0.03782
125	P. longiflora subsp. longiflor	0.09668	0.06474	0.07213	0.03375	0.03610	0.03154	0.02640	0.04097
126	G. squarrosa AM159525	0.08765	0.11754	0.11379	0.10406	0.10604	0.09990	0.10364	0.10396
127	G. carinata AJ549499	0.08755	0.11742	0.11371	0.10397	0.10592	0.09979	0.10352	0.10385
128	P. microephala subsp. microeph	0.09307	0.07576	0.06444	0.06210	0.05698	0.06234	0.05692	0.06187
129	G. phaeotricha AM159520	0.05706	0.09200	0.10706	0.09270	0.09012	0.08624	0.09227	0.09965
130	G. anomala AM158940	0.14068	0.13748	0.14333	0.13372	0.13315	0.12193	0.13048	0.13318
131	G. kraussiana AM159518	0.15751	0.16699	0.18057	0.15748	0.16198	0.15147	0.15727	0.15144

	105	106	107	108	109	110	111	112
105 P. humilis GQ205198	-							
106 P. leucantha GQ205207	0.03309	-						
107 P. angustifolia FJ572726	0.03338	0.02118	-					
108 P. ciliata subsp. ciliata FJ57	0.03076	0.01412	0.01414	-				
109 P. mesoa subsp. macra TS86 TS1	0.04024	0.03765	0.02606	0.03059	-			
110 P. suteri TS45	0.03804	0.03771	0.02614	0.03065	0.00000	-		
111 P. aridula subsp. aridula TS84	0.04024	0.03765	0.02606	0.03059	0.00000	0.00000	-	
112 P. sericeovillosa subsp. seric	0.04024	0.03765	0.02606	0.03059	0.00000	0.00000	0.00000	-
113 P. hispida FJ572738	0.02882	0.01433	0.01686	0.01431	0.03586	0.03585	0.03586	0.03586
114 P. lanata FJ572739	0.04768	0.02848	0.03115	0.02859	0.04522	0.04526	0.04522	0.04522
115 P. phylicoides FJ572723	0.05073	0.04720	0.03406	0.03952	0.03632	0.03639	0.03632	0.03632
116 P. villifera FJ572720	0.05205	0.03765	0.03077	0.03294	0.04235	0.04015	0.04235	0.04235
117 P. biflora GQ205186	0.03448	0.03396	0.02214	0.02894	0.02674	0.02683	0.02674	0.02674
118 P. pauciflora GQ205168	0.05734	0.05207	0.05264	0.05685	0.06867	0.06876	0.06867	0.06867
119 P. graniticola FJ572718	0.05237	0.06138	0.04789	0.05904	0.05196	0.05200	0.05196	0.05196
120 P. axiflora subsp. alpina GQ20	0.05468	0.04959	0.05227	0.05200	0.05437	0.05215	0.05437	0.05437
121 P. spiculigera subsp. thesiode	0.05944	0.05663	0.04756	0.05429	0.05194	0.05200	0.05194	0.05194
122 P. drupacea GQ205174	0.05295	0.05484	0.05529	0.05728	0.05979	0.05762	0.05979	0.05979
123 P. brevistyla subsp. brevistyl	0.03559	0.02118	0.00000	0.01412	0.02603	0.02611	0.02603	0.02603
124 P. subvillifera GQ205195	0.04019	0.02588	0.01190	0.01882	0.03529	0.03537	0.03529	0.03529
125 P. longiflora subsp. longiflor	0.04592	0.03120	0.01208	0.02404	0.03584	0.03592	0.03584	0.03584
126 G. squarrosa AM159525	0.08768	0.09647	0.09507	0.08941	0.08706	0.08500	0.08706	0.08706
127 G. carinata AJ549499	0.08761	0.09637	0.09497	0.08931	0.08698	0.08493	0.08698	0.08698
128 P. microephala subsp. microeph	0.06211	0.05929	0.05026	0.05696	0.05463	0.05470	0.05463	0.05463
129 G. phaeotricha AM159520	0.08559	0.08265	0.08113	0.08510	0.08510	0.08532	0.08510	0.08510
130 G. anomala AM158940	0.12349	0.12780	0.11603	0.12271	0.12549	0.12570	0.12549	0.12549
131 G. kraussiana AM159518	0.15268	0.15723	0.15071	0.15227	0.15682	0.15701	0.15682	0.15682

	113	114	115	116	117	118	119	120
113 P. hispida FJ572738	-							
114 P. lanata FJ572739	0.01214	-						
115 P. phylicoides FJ572723	0.04455	0.06081	-					
116 P. villifera FJ572720	0.03108	0.04291	0.04964	-				
117 P. biflora GQ205186	0.03473	0.04406	0.03204	0.04618	-			
118 P. pauciflora GQ205168	0.05041	0.05726	0.07662	0.07811	0.04888	-		
119 P. graniticola FJ572718	0.05758	0.06190	0.06889	0.06139	0.04395	0.07830	-	
120 P. axiflora subsp. alpina GQ20	0.05034	0.06906	0.06632	0.06141	0.04608	0.08073	0.07339	-
121 P. spiculigera subsp. thesiode	0.04311	0.05473	0.05826	0.06375	0.04650	0.07115	0.05920	0.05919
122 P. drupacea GQ205174	0.05593	0.07466	0.07242	0.06684	0.05376	0.08172	0.06703	0.01926
123 P. brevistyla subsp. brevistyl	0.01930	0.03334	0.03160	0.02842	0.02205	0.05488	0.05233	0.05219
124 P. subvillifera GQ205195	0.02628	0.04284	0.04433	0.03529	0.03151	0.06630	0.05432	0.05673
125 P. longiflora subsp. longiflor	0.02910	0.04354	0.03427	0.04073	0.02950	0.06025	0.06269	0.05794
126 G. squarrosa AM159525	0.08341	0.09954	0.10996	0.09647	0.08701	0.12074	0.10378	0.10632
127 G. carinata AJ549499	0.08332	0.09946	0.10989	0.09635	0.08696	0.12064	0.10369	0.10628
128 P. microephala subsp. microeph	0.04574	0.05738	0.05592	0.06398	0.04428	0.06909	0.06183	0.05707
129 G. phaeotricha AM159520	0.08131	0.09751	0.09953	0.09930	0.05387	0.10689	0.08754	0.10198
130 G. anomala AM158940	0.12158	0.12894	0.14369	0.12533	0.12393	0.14601	0.14544	0.15081
131 G. kraussiana AM159518	0.15555	0.16465	0.17621	0.15926	0.14558	0.18483	0.17435	0.17486

	121	122	123	124	125	126	127	128
121 P. spiculigera subsp. thesiode	-							
122 P. drupacea GQ205174	0.06469	-						
123 P. brevistyla subsp. brevistyl	0.04976	0.05538	-					
124 P. subvillifera GQ205195	0.05665	0.05968	0.01416	-				
125 P. longiflora subsp. longiflor	0.05528	0.06835	0.01206	0.02398	-			
126 G. squarrosa AM159525	0.10617	0.10471	0.09905	0.09412	0.10981	-		
127 G. carinata AJ549499	0.10610	0.10468	0.09895	0.09403	0.10974	0.00000	-	
128 P. microephala subsp. microeph	0.00712	0.06738	0.05234	0.05934	0.05571	0.10876	0.10869	-
129 G. phaeotricha AM159520	0.09254	0.09313	0.08088	0.08747	0.09151	0.06843	0.06837	0.09541
130 G. anomala AM158940	0.14556	0.14619	0.11834	0.12539	0.12672	0.14957	0.14957	0.14895
131 G. kraussiana AM159518	0.17681	0.17017	0.15298	0.15205	0.16119	0.15613	0.15622	0.17775

Appendix 5

Seven genetic clades identified by the linear discriminant analysis. Green indicates those taxa not included in the analysis; yellow indicates taxa that were not catorgorized into the same clades as determined by the ITS clade credibility tree.

Clade 6

Species.name	Clade	Burrows.group
tra(b)	6	A
tra(e)	6	A
tra	6	A
tra	6	A
tra	6	A
urv(n)	<NA>	B
urv	<NA>	B
ser	2	C(iii)

Clade 3

Species.name	Clade	Burrows.group
tom	3	C(i)

Clade 7

Species.name	Clade	Burrows.group
lon	7	A
lon	7	A
gni	7	A
ort	<NA>	B
xen	7	B
xen	7	B
tel	<NA>	B
spo	4	B

Clade 5

Species.name	Clade	Burrows.group
pop	5	A
pop	5	A
vil	<NA>	C(i)
bar	<NA>	C(iii)
bar	<NA>	C(iii)
mim	5	C(iii)
mim	5	C(iii)

Clade 1

Species.name	Clade	Burrows.group
bux	1	A
bux	1	A

Clade 4

Species.name	Clade	Burrows.group
pro(s)	<NA>	B
pro(t)	4	B
acr	4	C(i)
psu	4	C(ii)
nit(a)	4	C(ii)
hir	4	C(ii)
hir	4	C(ii)
hir	4	C(ii)
ser(p)	4	C(iii)

Clade 2

Species.name	Clade	Burrows.group
pro(ve)	2	B
ort	<NA>	B
car	<NA>	B

car	<NA>	B
ere	<NA>	B
lya	2	C(i)
ore	2	C(ii)
mes(m)	2	C(ii)
mes	2	C(ii)
mes	2	C(ii)
dur	2	C(ii)
dur	2	C(ii)
cry	2	C(ii)
cry	2	C(ii)
ser(a)	2	C(iii)
ser(a)	2	C(iii)
ari	2	C(iii)