Long term monitoring of *Pimelea spinescens* subsp. *spinescens* in Victoria

Monitoring Protocol

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Contents

1. Introduction

This monitoring protocol provides information and procedures for monitoring changes in natural populations *Pimelea spinescens* that are under the influence of different management practices.

This protocol has been prepared to document the aims, rationale and objectives for the monitoring programme. It is intended to be an evolving document to accommodate knowledge gains and refine techniques to minimise time and resources but achieve monitoring objectives over time. This will inform management practices and help modify management techniques during different environmental conditions.

2. Protocol Constituents

This protocol consists of this document and the following Standard Operating Procedures (SOPs):

Guidelines for monitoring *Pimelea spinescens* SOP No: 2.5_02.2014

Pimelea spinescens monitoring field sheet SOP No: 3.5_02.2014

3. Background

3.1 Background, historical practises and monitoring

Pimelea spinescens subspecies *spinescens* (Spiny Rice-flower) is an endemic sub-shrub found only in Victoria, Australia. It is listed as critically endangered under the Commonwealth Environment Protection and Biodiversity Conservation Act of 1999 and also listed as being threatened with extinction under the Victorian Flora and Fauna Guarantee (FFG) Act of 1988 (Department of Sustainability & Environment (DSE) 2007a). It occurs in the Natural Temperate Grasslands and grassy woodlands of the Victorian Volcanic Plains, Victorian Midlands and Riverina (AFG 2007).

Current and historic records of *P. spinescens* are maintained via the Victorian Biodiversity Atlas (VBA) (Department of Sustainability and Environment, 2012). In 2012, this database contained records for the species from 208 sites, including population size estimates for 179 of these sites. Of these, over half (53 %; 95 sites) of the sites supported 50 individual plants or less, and an additional 35 % (63 sites) of the sites were estimated to support 500 individuals or less. Based on VBA records, it is estimated that there are just over 75,000 individual *P. spinescens* plants across the state. But these records are:

- incomplete;
- recorded via varying methods, undermining the accuracy;
- the majority of sites have not had ongoing time series population data documented; and
- As a result, this estimate may be a considerable under- or over-estimate of the true population.

At present there is no standardised method for recording population estimates or individual plant monitoring to identify vital trends such as recruitment and mortality rates.

Pimelea spinescens has been deemed to be at high risk of extinction due to its ongoing reduction in both population size and area (IUCN, 2012) which is compounded by continual fragmentation of habitats leading to a decline in habitat quality over time (Gilpin and Soule, 1986, Debinski and Holt, 1999, Attiwill and Wilson, 2003, Williams, McDonnell *et al.*, 2005a). Efforts to bolster populations using horticultural techniques in nursery settings have been largely unsuccessful (Mueck, 2000, Thomas, 2008) and it is assumed that the best hope for long-term survival of the species is to employ methods that encourage secure wild populations to successfully recruit *in situ.*
The biology of *P. spinescens* is strongly associated with the ecology of the Natural Temperate Grasslands of the Victorian Volcanic Plains. Grassland habitats are relatively treeless areas dominated by perennial grasses. They are a product of the combined factors of geology and climate and are maintained by seasonal events such as droughts, floods, and frequent fire which inhibits tree establishment (Smith and Smith, 1998, Attiwill *et al.*, 2003). Additionally, many of the plants in these grasslands are adapted to grazing (Webb, 1977, 1978). In the absence of burning, grazing or some other form of biomass reduction, the dominant species found in Victoria's

temperate grasslands, *Themeda triandra* (Kangaroo grass) can rapidly out-complete other species through abundant leaf litter production (>11 tonnes/ha over a period of 10 years) (McDougall, 1989). Studies comparing different grassland management regimes have found that no management reduces dominance by native species and that current floristic composition is governed by the management history (Stuwe and Parsons, 1977, Lunt, 1997b, a).

Only five percent of *P. spinescens* populations are found in protected or reserved land tenures (Thomas, 2008) with ~60% found in either rail or road corridors. In the 1980s Victoria's railways were corporatised followed by privatisation in the 1990s and consequently railway reserve management shifted from regular burning to herbicide control, mowing and slashing (Raynor, Marsh *et al.*, 1984, Williams *et al.*, 2005a). Recent research assessing the current state of these railway reserves has found that these management changes have facilitated weed invasions and reduced both the quality and quantity of the grasslands (Williams *et al.*, 2005a, Williams, Morgan *et al.*, 2005b, Williams, Morgan *et al.*, 2006). All *P. spinescens* populations are subject to varying management practices and regimes such as:

- no management;
- mowing (varying frequencies - annually, biannually, every six weeks);
- periodic grazing;
- trampling; and
- burning at varying frequencies (annually, every second, third, fourth year) and timing (spring, early summer and autumn).

Regular biomass reduction is required for the maintenance of grassland dominated by a diversity of native species but the optimal timing and frequency in relation to the prevailing environmental conditions is unknown. The long-term effect of all these current management practices, combinations, frequency and timing on the populations of *P. spinescens* is also unknown. However based on current observations by ecologists, natural ecological processes and/or management practices which maintain species richness within an indigenous grassland and maintain an open grassland structure appear to be beneficial for populations of *P. spinescens* (Reynolds, 2013, S Mueck 2013, pers. comm November). Conversely management practices which result in dense stands of grass appear to result in limited opportunities for recruitment and a gradual population decline.

Regular monitoring of *P. spinescens* populations will identify trends through the prevailing environmental conditions to provide information on how *P. spinescens* is affected over time by current management practices. Understanding how *in situ* populations are responding to current practises will provide an informed basis for future decisions regarding the timing and frequency of management practices.

3.2 Threats

Habitat loss is widely recognised as the greatest contributing factor to the loss of biodiversity (Williams *et al.*, 2005a, Williams *et al.*, 2005b, Lindenmayer and Fischer, 2006, Williams *et al.*, 2006). The Natural Temperate Grasslands of the Victorian Volcanic Plain, which are the stronghold of *P. spinescens*, have undergone substantial reduction and modification, with an estimated 2% of its pre-1750 extent remaining (Department of Natural Resources and Environment, 1997, 2002). Such a large reduction in habitat has resulted in similar reductions in the number and size of populations of *P. spinescens*. Habitat loss is an ongoing threat to this species (DSE 2007b), evidenced by a 30% decrease in grassland remnants (some of which support *P. spinescens*) since the 1980s (Threatened Species Scientific Committee (TSSC), 2003, Williams, Morgan *et al.*, 2005b).
The threatening factors that are cited within the *P. spinescens* National Recovery Plan (Carter and Walsh, 2006) are:

- Ongoing population fragmentation, leading to small populations;
- Weed invasion;
- Road and rail maintenance activities;
- Grazing;
- Inappropriate fire regimes; and
- Changing land use.

Monitoring of these threats in combination with *P. spinescens* population parameters will attempt to identify the impacts of management in combination with the prevailing environmental conditions.

4. Description and identification of *Pimelea spinescens* subsp. *spinescens*

Pimelea spinescens is a subshrub usually forming a dense tuft of short divaricate branches and obtaining a height between 5 to 30 centimetres. Fresh stem growth is not spiny but soft, smooth and almost herbaceous (Figure 1, 2A & 2B), but older stems become woody and often develop spines at their tips. The leaves are a uniform dull green, opposite along the stems, have short petioles and are elliptic, two to ten millimetres long and one to three millimetres wide (Walsh and Entwisle, 1996).

Figure 1 – A mature *P. spinescens* plant with new growth seven months after a fire.

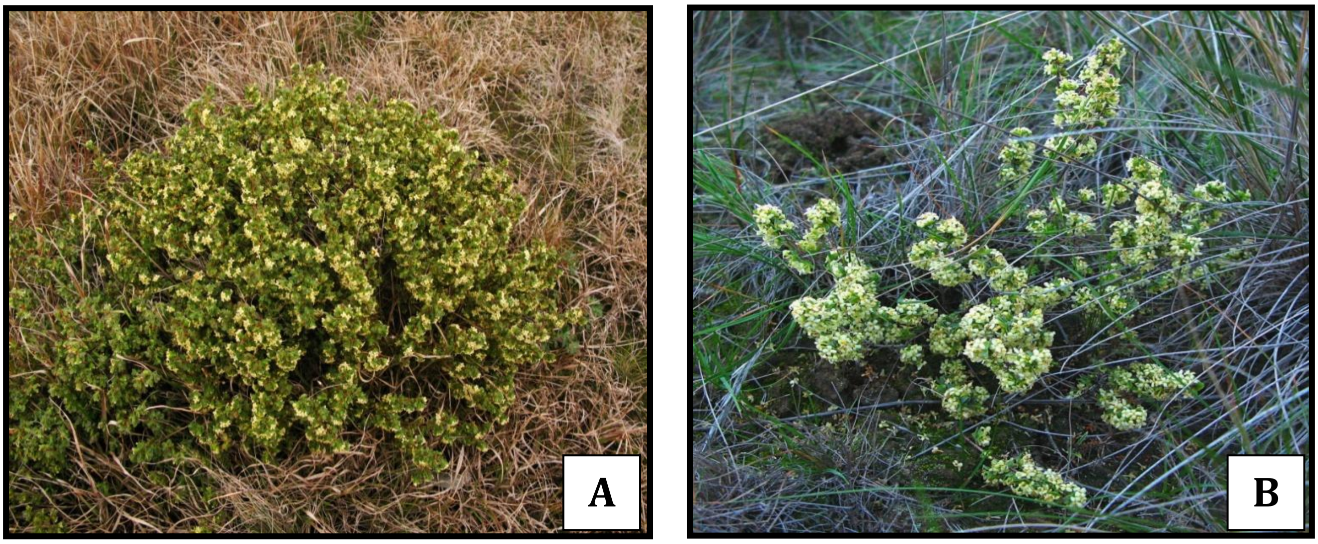

Figure 2A & B – Two examples of mature *P. spinescens* individuals.

The flowers are produced in a terminal compact head. There are between six and twelve flowers per head. The pale yellow to white flowers are glabrous (hairless) and have four rounded, petal-like lobes about 2 mm long.

Unlike the majority of other grassland plants *P. spinescens* flowers over winter from April through to August depending on the prevailing seasonal conditions (Walsh *et al.*, 1996).

Pimelea spinescens is mostly dioecious (i.e. plants are either female or male). Female flowers have a protruding style and small non-functional anthers (figure 3A). Male flowers have two anthers with abundant bright orange pollen (Figure 3B). The fruit is ellipsoid, two to three millimetres long and has a thin, initially fleshy, layer around a slightly woody 'stone' that encloses the single, oily seed (Walsh *et al.*, 1996, Victorian Government Department of Sustainability and Environment, 2008). Germinants can be identified by the presence of their cotyledons (first two leaves) [Figure 3C]. They are small and cryptic *in situ* requiring some time and familiarity to locate and positively identify (Figure 4).

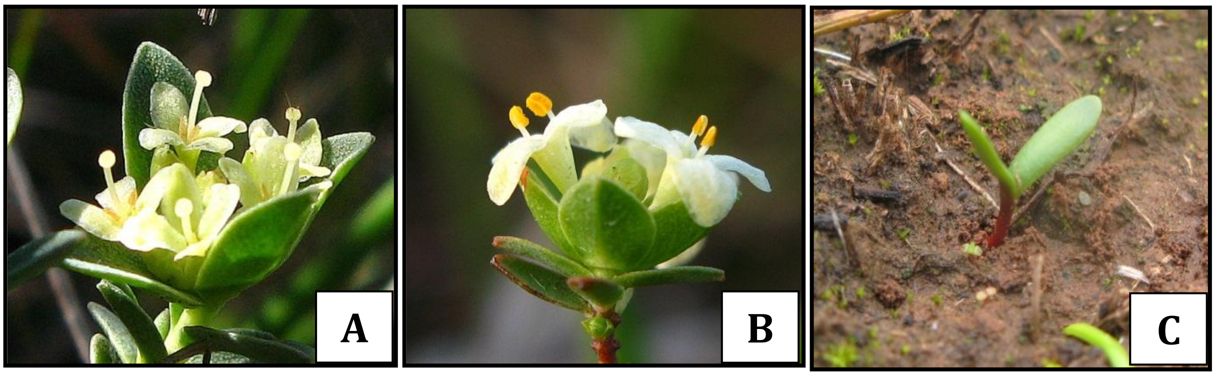

Figure 3 – Sexual morphology of *P. spinescens* flowers: A - Female flowers have an obvious stigma and insignificant stamens with no pollen. B - Male flowers have obvious stamen with distinctive orange pollen. C – A *P. spinescens* germinant *in situ*.

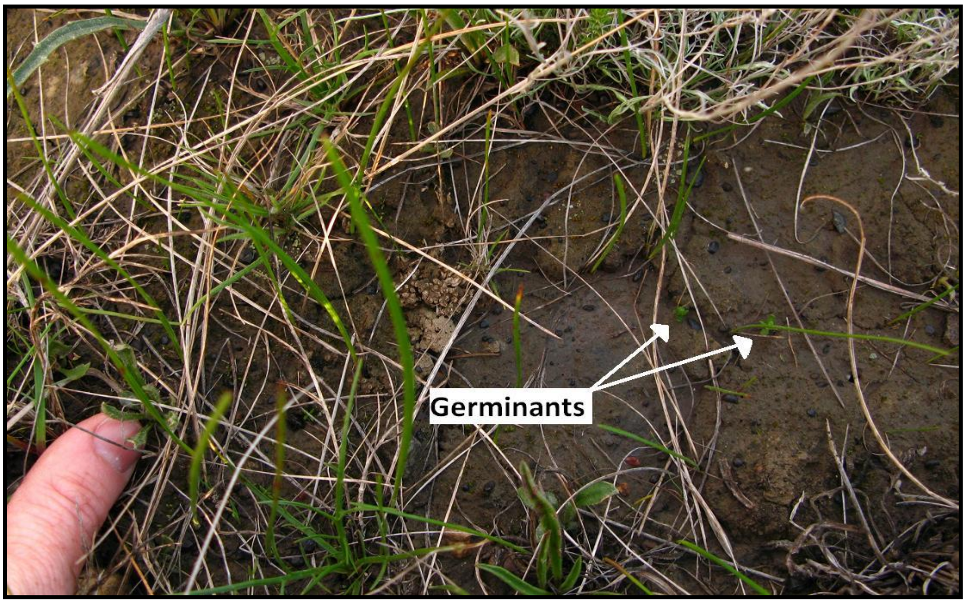

Figure 4 – This picture has two germinants and shows perspective of how small they are.

4.1 Rationale for selecting variables to monitor

The current *Pimelea spinescens* statewide database population records are a summary of what existed at some point in time and its current accuracy is questionable. (e.g. recently a population of ~400 plants previously seen on a roadside in the Campaspe shire in 2006 could not be found in 2013). Currently there is no way of predicting the status of a population of *P. spinescens*. For example is the population decreasing, increasing or static? Population information has been collated by many different methods and little consistent follow-up assessments occur.

By monitoring sites with different management practices a picture can be built as to what sites are vulnerable to being lost and why. A standardised method for monitoring could be used to detect the trend of change in a *P. spinescens* population. Temporal monitoring of numbers of plants and germinants is an important baseline for beginning to understand a population's long term viability (status). Analysing the life stage survival in a time period for a population can build a picture of the natural population growth rate during the prevailing environmental and management conditions.

4.2 Objectives

The overriding objective for *P. spinescens* is what the viability of a population? Important considerations required to build a clearer understanding of *P. spinescens* status and management are:

- To create a consistent approach to monitoring for this species which will allow the Recovery Team to better evaluate the condition of *P. spinescens* across the state, and improve the Recovery Teams ability to develop best management practice for the conservation of the species.
- Gain a better understanding of population dynamics of *P. spinescens* across the state. This information will inform Recovery Team of active threats as well as triggers for management, and information on the variable habitat for this species across the state, which can better inform those wishing to survey other likely habitat areas for this species.
- To monitor land management activities to gain better understanding of best management practice for this species, indicating that this information will be used to adapt management principles and prescribed activity information advised by the Recovery Team.

This protocol will attempt to address and inform these knowledge gaps. It will be updated as information is acquired and when new issues are identified. The questions below are addressing the current issues which will begin to answer this question for this species.

Question		Monitoring information required
1	How to detect mature plant mortality and recruitment in a population?	Repetitive monitoring of a set area within a population to establish trends.
2	Are both sexes adequately represented and what sex ratios exist in a population?	Assess a set area's plant sex.
3	What is the effective population size?	Establish numbers of flowering plants and the percentage flowering in a season.
4	What are the levels of biomass, weeds, bare ground, which impede/facilitate recruitment and mature plant death?	Record percentage cover in relation to mature plants, germinants and their survival over time.

5. Sampling Design

5.1 Rationale for selecting this sampling design

The majority of previous sampling of *P. spinescens* populations has not been collected within standard accepted research parameters. Recent PhD research (Reynolds, 2013) trialed a sampling method which this protocol has taken into account and revised to reflect identified variables which could be used as triggers for changes in plant health.

Sub-sample assessments using randomised transects within a defined polygon presented an accurate, efficient and repeatable method for assessing *P. spinescens* populations. Standardised methods for categorising the life-stages, sex and flowering status of *P. spinescens* plants, and their frequency of occurrence are still required.

To quantify change and understand its causes, effective temporal monitoring must occur both before and after management interventions, and through different environmental conditions (Field, O'Connor *et al.*, 2007, Lindenmayer and Likens, 2009). This type of monitoring will highlight the risks associated with management practices whilst taking into account the local environmental conditions (Mackenzie and Keith, 2009). From this information, population trends can be identified, allowing management practices to be adapted accordingly.

6. Monitoring

6.1 Who should monitor?

INITIALLY – A Department of Environment and Primary Industry Officer (DEPI) or a suitably experienced consultant/expert to supervise the set-up with the group or persons planning to continue the monitoring. Sites should be strategically selected by the PsRT due to management practices, population size, habitat conditions etc.

The initial monitoring set-up will be somewhat consuming (~half a day, 4 hours per site) but once the quadrats and plants are permanently marked, subsequent monitoring will be easier and quicker (~2 hours). Trained volunteers in friends groups or local landholders would be the best option for long-term monitoring.

6.2 Recommended frequency and timing of sampling

Optimal monitoring should occur annually or at least pre and post management events. Trends occur over time and the effects of different management practices and timing on *P. spinescens* populations is unknown.

The optimal time to monitor is:

- During the flowering period (from May till August); and
- At least 6 weeks to a year post a biomass reduction event such as:
    - Fire;
    - Mow;
    - Grazing; or
    - Weed control.

Conducting monitoring following biomass removal and during the flowering season will provide the best chance of locating most individual plants within an area, via their fresh new growth and/or flowers. The best time to monitor for *P. spinescens* following these events will vary depending on the prevailing environmental conditions.

- E.g. if regular precipitation occurs biomass will accumulate quickly and assessment could occur within 4 to 6 weeks but if in drought (infrequent to low precipitation levels) conditions, assessments need to wait for material to grow and may need a delay of up to 6 to 12 months following the biomass reduction event (depending on timing and growth).

7. Field Methods

7.1 Field season preparations, equipment, details of taking measurements and field sheets

Refer to: "Guidelines for monitoring *Pimelea spinescens* No: 2.5_02.2014"

Refer to: "Pimelea field sheet No: 3.5_02.2014"

Permits are required for collection of *P. spinescens* seed or plant material.

7.2 Post-collection processing of samples

The data should be statistically analysed and trends noted. The statistical significance of the analyses will increase as data accumulates due the longevity of the species and current lack of any long-term data sets. It is the role of the Pimelea Conversation Officer to compile and analyse or coordinate the analysis of the data. The data should be used to inform and advise management practices across the species' entire range. Sites should be added as information highlights gaps in data, or deleted if not required (it is anticipated this would be a rare event).

8. End-of-season procedures, data handling, analysis and reporting

8.1 Data storage

The *P. spinescens* data files can be found at:

1. Trust for Nature website
2. SWIFT website; and
3. DEPI's ABC database and Victoria's Biodiversity Atlas (VBA).

8.2 Data entry, verification, editing and archival

Data entry should occur annually and be given to the Pimelea Conservation Officer from various collectors in an electronic and hard copy. The PCO will check authenticity and enter it into the system and also pass on the data to DEPI to update the ABC database (management) and VBA (location and occurrences).

8.3 Recommended reporting schedule

Annual reports will be prepared by collectors and distributed (presented to PsRT) within the same year as data collection and include maps, graphs, figures and other visuals to facilitate comprehension of findings.

Extensive summary reports, including trend analysis, should be completed every five to ten years depending on the rate of change in the monitoring data and the need for summary information to guide resource management (DeBacker *et al*. 2004).

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