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Nature Conservation Saves for Tomorrow

Survey Report:

Leucopogon fletcheri ssp. fletcheri

White Cross Road Winmalee 2009 – 2018

Blue Mountains Conservation Society Plant Study Group



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TERMINOLOGY

APZ Asset Protection Zone

BMCC Blue Mountains City Council

BMCS Blue Mountains Conservation Society

BOM NSW Bureau of Meteorology

DECCW the former NSW Department of Environment, Climate Change & Water

EEC Endangered Ecological Community

endemic A species natural or restricted to a given region

HR Hazard Reduction burn

GIS Geographic Information System

HSBCC the Hills Shire Bushland Conservation Committee

LEP Local Environment Plan

LGA Local Government Area

NP National Park

OEH NSW Office of Environment & Heritage (formerly DECCW)

ROTAP Rare or Threatened Australian Plant, as per Briggs & Leigh (1996)

THSC The Hills Shire Council (formerly Baulkham Hills Shire Council)

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Introduction

This report is an outcome of the project of the Plant Study Group of the Blue Mountains Conservation Society. The project aims to improve knowledge of the endangered shrub *Leucopogon fletcheri* ssp *fletcheri*, in particular the ecology and conservation management at White Cross Road – the largest remaining population of this species.

Survey at White Cross Road commenced in August 2009 when plants were observed regenerating following hazard reduction burns. Subsequent studies were undertaken in August 2010 and evolved into an annual survey program. A particular focus of this survey has been the response of this species to fire.

The annual survey results have been made available to Blue Mountains City Council, Hills Shire Council, National Parks & Wildlife Service, and to the Royal Botanic Gardens, to assist in understanding the ecology and conservation management of this species.

The survey indicates that the population is highly susceptible to inappropriate fire regimes and has declined under current fire management arrangements. Without change it is likely that the population – the largest remaining in the wild – may be lost.

Key findings to date include:

- Population of adult plants fluctuates greatly
- The species is killed by fire and is an obligate seeder
- Fire is not obligate for seed germination and germination
- There is considerable 'dormancy' (>2 years) post-fire before significant seedling emergence
- Reproductive 'adult' plants do not form until >4 years post-fire and may require >10 years to reach maturity and full seed production
- Reproduction is not constant and flowers can be aborted en-masse during drought conditions (2018)

Species Description

Leucopogon fletcheri ssp. *fletcheri* is a shrub to 1.8m high bearing rows of pendant white flowers between August – October. The species taxonomy and identification are well established (see Powell in Harden (ed) 1992).

Distribution

Records of *Leucopogon fletcheri* ssp. *fletcheri* comprise four meta-populations, being the Hills District, St Albans, Blaxlands Ridge, and the Lower Blue Mountains. One report from the Basin near Campbelltown in 1989 merits further investigation.

Conservation Status

The species is listed as Endangered under the Schedules of NSW Threatened Species Conservation Act 1995. The ROTAP status (Briggs & Leigh 1990) is 2RC- which represents:

- (2) Range under 100km
- (R) Rare but with no current identifiable threat
- (C) known to occur within a proclaimed reserve
- (-) population size [reserved] is unknown

As detailed in this report, the total population size known in reserves is <1000 plants. Reserved populations have been reasonably well surveyed, in contrast to plants on private lands (especially in Winmalee). There is evidence of localised extinctions in the Hills due to inappropriate fire management which is exacerbated by habitat clearing rates in excess of 5% p/a in that area. In the Blue Mountains the principle threats to the species are inappropriate fire management and habitat clearing.

Status of populations

Most populations are small as reported in the Threatened species listing (NSW SC 1999) however work by the authors has determined some populations to comprise at least 500 individuals and the Winmalee meta-population may exceed 3,000 individuals.

The Hills District meta-population is unsecured. The species is found on private land and four properties owned by The Hills Shire Council, all zoned for recreational or residential development purposes. The total regional population is estimated at fewer than 600 individuals, with just 200 plants confirmed by intensive survey from 2008-2009 (Ridgeway, unpublished data). Most populations comprise <20 plants and/or scattered individuals.

The St Albans and Blaxlands Ridge population are poorly studied. The latter is known from a single record by Bob Coveney in 1985. These populations may be very small; further research is needed to clarify these portions of the distribution.

The Lower Blue Mountains meta-population is the subject of the present study. This consists of two key populations.

The first comprises a new discovery by the BMCS Plant Study Group in Blue Mountains National Park at Glenbrook near Red Hands Cave. It is estimated at around 130/140 mature plants with many seedlings growing on an open sandstone ledge on the Campfire Creek walking track circuit, about 1km SE from the Red Hands Cave picnic area, and a single plant growing beside the creek on the Red Hands Track, about 500 metres from the causeway.

The second population stretches 3km along the western side of Winmalee, from the end of White Cross Avenue south to Thomas Aquinas Public School. Visual inspection and spot sampling suggest that the population is largely continuous and of even density across this range. The area near White Cross Road is the subject of the current study. Plants are located across private and National Park tenures. Population size varies according to site management, with a maximum population size of 833 plants counted in 2013.

In summary, the total population of the species is likely to be <6,000 plants. While this study has uncovered previously unrecorded populations in National Parks tenure the overwhelming majority of the species range remains in private tenure. The total population size remains low despite considerable survey in suitable habitat in The Hills and Lower Blue Mountains regions.

Habitat Requirements

The species is restricted to woodland plateau and gentle slopes (Powell in Harden (ed) 1992) bordering the northwest Cumberland Plain.

The final determination notes that the species prefers clay-rich lateritic soils in the Mittagong Formation (NSW SC 1999). This occurs as beds between the Hawkesbury Sandstone and the overlying Ashfield Shales, in the 'Lucas Heights' soil landscape (Bannerman & Hazelton 1990). While this comprises the most populous habitat, the species is also found on the edges of Hawkesbury Sandstone geologies, as far as 250m (the Hills) and 1km (Winmalee) from mapped boundaries of the Mittagong Formation, in the Gynea, Hawkesbury, and Falconbridge landscapes. At Blaxlands Ridge and in the south of the Hills, the species also occurs on the boundary between Hawkesbury Sandstone and the underlying Wianamatta group shales, in the Blacktown and Luddenham soil landscapes.

In the Hills, where species mapping is most progressed, the restriction to shale-influenced sandstones is particularly clear. In view of all the above, the species is considered to be restricted to shallow sandstone soils with minor shale influences, frequently with laterite.

The species is found in two distinct elevation classes. In the Hills, it is found between 50 and 150m elevation; in the Blue Mountains / Blaxland Ridge it is found between 150 and 380m elevation.

Climate within the species range is mild. Rainfall is estimated at between 1050 and 1150mm p/a, with an average minimum temperature of 11°C and maximum of 24°C (BOM, 2006/2010).

Conservation Management Requirements

Very little is known of the species conservation management requirements.

The present study and others in the Hills (using quadrat meanders) indicate a strong preference for track edges and other disturbed sites. In some circumstances the species has responded positively to bushfire however seedlings require many years to mature to seed and frequent fire can lead to

decline or localised extinction. These factors indicate that the species may be a late-order successionalist.

The species does not reproduce by vegetative spread. Flowering and seed-set appear regular and prolific.

While plants have been recorded growing from ant nests, this is not a strong trend. The seeds are very small, and carry no elaiosome. Myrmecochory (ant-dispersal) is not considered likely for this species. The small, dense seeds are unlikely to spread far by wind, and juveniles are typically found within 1-10m of adult plants. The plant may have limited genetic dispersal.

The species has been successfully propagated by both seed and cuttings in private native gardens (T. Cox, pers. com) however no public propagation attempts are known.

Fire ecology of the species is unknown, and is a key subject of the present study in the Blue Mountains. Remnant populations are known from areas burnt between 3 and 19 years previous (Glenbrook - 8/9 years; Kenthurst 3, 16, 17, & 19 years). Plants in The Hills northern population have been subject to wildfire only. These have been burnt at an average interval of once every 10 years since 1980. Plants in Glenbrook were burnt in the 1977/8 and 2001/2 season wildfires. Some plants in Winmalee were burnt in both 2005 and 2009 hazard reduction burns.

Formerly, pollinators for the species were unknown. During the course of this study, pollination was observed by a diverse range of moth, butterfly, bee and fly species. It is likely that the feral European honey bee is a nectar thief on this species however this has yet to be confirmed.

Study Area

The study area contains 5 subpopulations located at the end of White Cross Road, Winmalee.

Location

The study area is located in Winmalee in the lower Blue Mountains, NSW. It includes Blue Mountains National Park, some private land and Council Reserve. Access is gained via the National Park entrance at the end of White Cross Road.

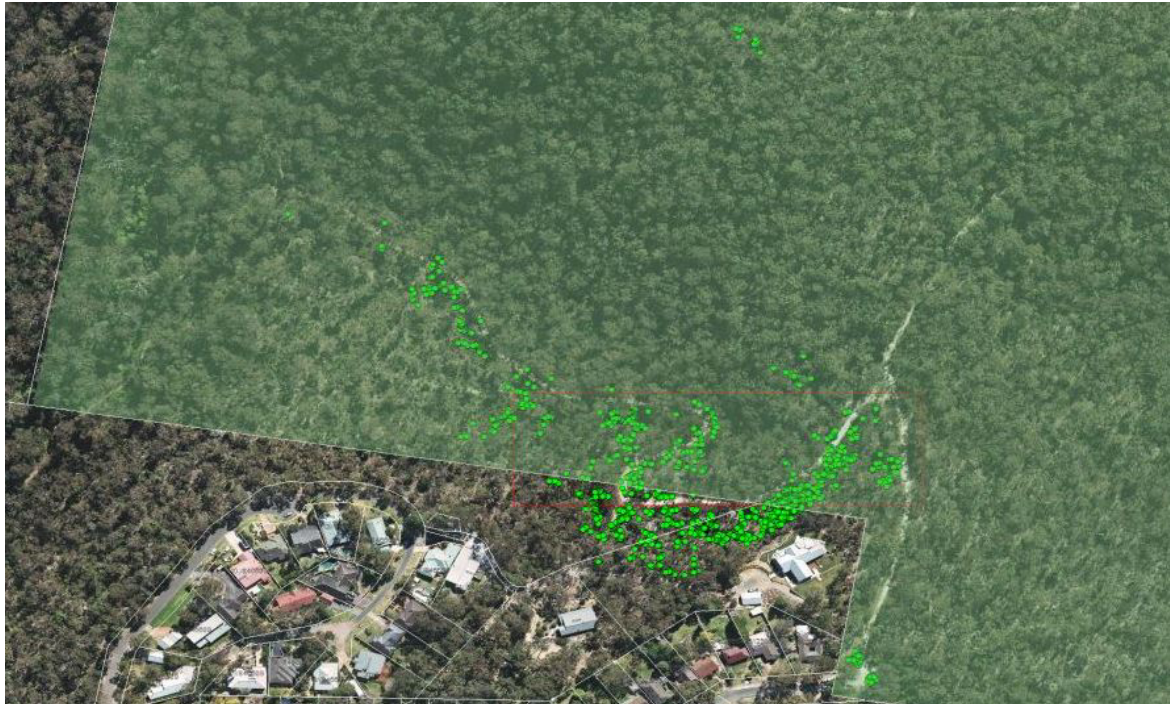


Figure 1 – Site location, tenure and species distribution

Site Tenure

Portions of the study area were gazetted within Blue Mountains National Park in 1967. The boundary of the Park adjoins the parking bay at the end of the street where there is a locked gate. A vehicular track continues further north out onto a ridge. Currently the track is used extensively by walkers and cyclists. There is another track turning west beside a creek which is also used by walkers and cyclists. The vehicular tracks are used by NPWS and the RFS for fire control purposes.

The National Park boundary adjoins three properties:

- 132 White Cross Road is private property and is zoned Living Bushland Conservation (LEP 2005) and proposed E4 Environmental Living (draft LEP2013). Recent residential development of this property resulted in erosion and damage to *Leucopogon fletcheri* ssp. *fletcheri*. Enforcement proceedings by Blue Mountains City Council resulted in amelioration replanting and bank stabilisation and the species appears to be recovering well. The landowner is not receptive to conservation and their property maintenance has repeatedly encroached onto BMCC land. The public delineation of this property boundary is advised.
- 30 Ridge View Close is private property and is zoned Residential Bushland Conservation with 55.47% of the land protected as Environmental Constraint (LEP 1991) and proposed E4 Environmental Living (draft LEP2013).
- 6-26 Ridge View Close is a Public Reserve of Blue Mountains City Council. It is zoned Residential Bushland Conservation (26.25%) and Environmental Protection (75.75%) under LEP 1991, and proposed E2 Environmental Conservation and E3 Environmental Management under draft LEP2013.

Geology & Soils

The site is located on the Hawkesbury Sandstone geology, immediately below a low sandstone crest. The land slopes variably north from 5 to 33%. A small un-named tributary is present and flows into Blue Gum Swamp Creek some 400 metres to the north. Minor to moderate sandstone outcropping is present across the site.

The site is mapped within the edges of three soil landscapes, being the Gymea, Faulconbridge and Hawkesbury soil landscapes (Bannerman & Hazleton 2009), however the profile across the study area has been assessed to consist of Gymea landscape only.

Soils range from shallow earthy sands near the entrance gate to shallow siliceous sands elsewhere. The creek and track have exposed highly weathered minor shale lenses within the parent sandstone. In such areas the soils include a gley (grey-green) sandy acidic type and separate loam (silt-clay) and clay types, generally being found below outcropping sandstone boulders and in fissures. This is characteristic of the Gymea soil landscape.

Climate

The altitude is 380m. The nearest full-data weather station is Springwood, at 325m elevation approx. 6km southwest for which data are presented in Figure 2.

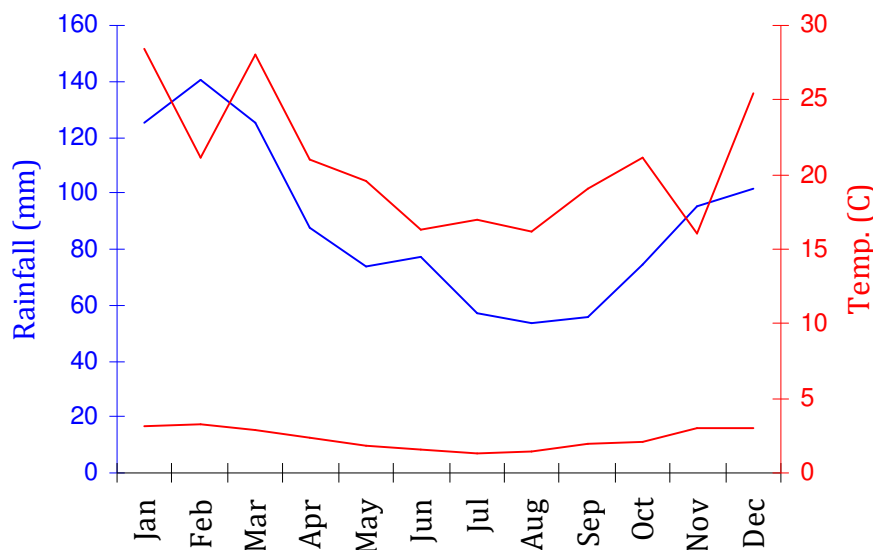


Figure 2 - Average monthly maximum and minimum temperatures (red, right) and monthly total rainfall (blue, left)

Fire & disturbance history

The subject area is designated Bush Fire Prone Land. No wildfire has occurred within the study area in living memory however the site has been regularly burnt for hazard reduction purposes (including back-burning). Known burns occurred in 2005, 2006 and 2009, and 2013. The boundaries of known burns up to 2009 are presented in Figure 3. A wildfire in 2010 was contained at the eastern perimeter of the site and is not relevant to this study.

The 2009 burn was requested by the NPWS and originally rejected by Councils Terrestrial Scientist as it posed a threat to the small population of *Leucopogon fletcheri* ssp. *fletcheri* known at the time.

Subsequent Council field inspection suggested a broader local distribution than was previously assumed and in response Council approved a burn plan to be undertaken in several small patches over a number of years.

A single burn was undertaken across the majority of the site in September 2009. Council established three monitoring grids in the burn area including annual monitoring. Initial recruitment was reported as 'poor' however the full results of this monitoring have not been released.

In July 2013 the trail and edges to 3 m were slashed for fire management purposes by the National Parks & Wildlife service although the existing trail met the relevant width requirements. The NPWS failed to obtain Council permission for work on their land or to undertake a risk assessment for damage to *Leucopogon fletcheri* ssp. *fletcheri*. Survey in August confirmed that this maintenance destroyed at least 61 plants (on the basis of identifiable refuse) with the actual damage estimated at approximately 200 plants or 20% of the population.

Subsequent site meetings were held between the BMCS Plant Study Group, Blue Mountains City Council, National Parks & Wildlife Service, Office of Environment & Heritage and Royal Botanic Gardens. The NPWS committed to improved protection of the population including:

- A halt to any further trail widening
- A commitment to ensure less frequent, smaller burns; and
- Consultation with community and Blue Mountains City Council prior to any works including burns

Shortly after this meeting on 10th Sept 2013 wildfire erupted to the northeast of the subject site. In response the NPWS undertook an emergency hazard reduction burn incorporating the entire site. The burn destroyed 90% of the population at the site.



Figure 3 – Recorded burns to 2009

Vegetation

The study area consists of intact native vegetation bordered by urban development with limited disturbance. The vegetation consists of Sydney Hinterland Transition Woodland, with canopy dominated by *Angophora costata*, *Eucalyptus sparsifolia*, *E. notabilis*, *E. consideniana*, and *E. piperita*. In the northwest this merges into a heath form on steeper terrain with shallower, sandier soils. This is characterised by an open understorey of Banksias, Leptospermums, Epacris and Restionaceae with little to no canopy.

Survey Methodology

The aim of this study is to better understand the ecology of *Leucopogon fletcheri* ssp. *fletcheri* and particularly the impacts of fire.

The site was surveyed during flowering season annually by 'emu parade' in which a group of surveyors spread across the site and recorded all plants between each set of surveyors. Plant positions were recorded on handheld GPS units and coded as either adult or seedling.

Survey was initiated in 2009 however data were not collected for the years 2011 and 2012.

As access arrangements differed from year to year the annual fluctuations of population size were estimated by extracting the records from a representative portion of the site to which permanent access is available. This provides a robust indication of the changes to population size and structure year by year from which the total population size can be extrapolated.

Results

Results are presented for the 2009, 2010, 2013 and 2014 surveys in

Table 1. This includes total counts (reflecting the area available for survey) and counts for the comparative area only (reflecting changes to population size). The distribution of living plants within the comparative area is illustrated in **Error! Reference source not found.** to **Error! Reference source not found.** below while the complete distribution of the species at the site is illustrated in Figure 1.

Table 1 – Annual survey results

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Comparative area (total)	-	-	-	-	91	166	-	-	408	37	784	708	1262	868
Comparative area (adults)	-	-	-	-	-	-	-	-	-	-	13	103	271	739
Comparative area (Seedlings)	-	-	-	-	-	-	-	-	-	-	771	605	991	129
Total count	-	-	-	-	118	426	-	-	833	89				1014
Burns	Wild	Wild	-	-	HR	-	-	-	HR	-	-	-	-	-

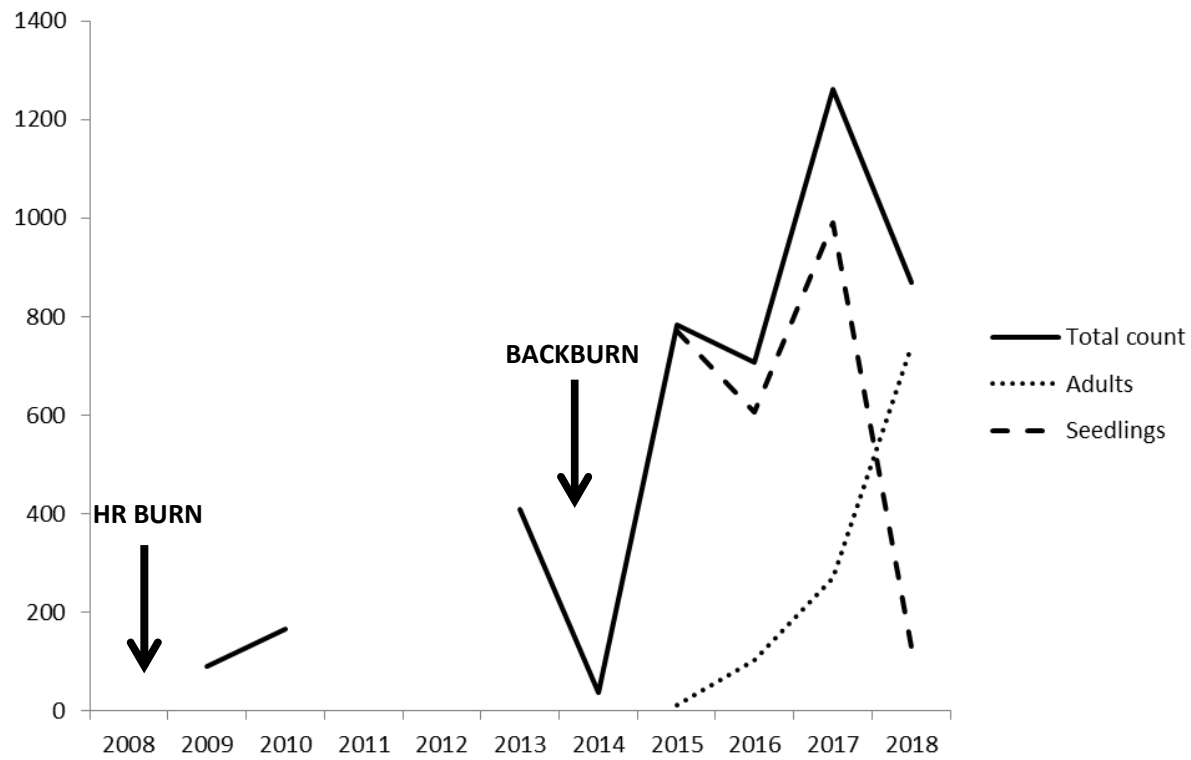


Figure 4 – Annual Survey Results. Seedling emergence peaks 4 years after fire and adult population recovery has not yet peaked five years after 2013 burns

The first years of surveys included adult plants only. Significant seedlings were first evident in the 2010 survey. The survey program was extended in 2014 to include seedlings, allowing a more accurate examination of changes after fire.

The population when surveys began (2008) was severely depleted following the repeated wildfires in 2005, 2006 and 2009.

The population grew until the 2013 burn which resulted in a 91% reduction of the population at the site. The 2014 survey occurred 11 months after the 2013 burns. High mortalities were observed including the death of lightly scorched plants (for example those protected near trail edges). No resprouting was observed.

Following the 2013 fire there was almost no seedling emergence for over 12 months. Seedling emergence then continued and peaked 4 years after fire, declining in the 2018 drought. The adult population did not begin recovery until 2016, and recovery has not yet peaked (five years after 2013 burns).

Reproduction output is not consistent over time. In the 2018 survey during drought conditions the majority of flowers were observed to abort due to insufficient water supply. This exacerbates the species difficulties regenerating after fire.

Discussion

The population occupies an extent of approximately 6 hectares at the site. Within this extent the population size and distribution of plants has been highly variable over time.

Management of the population

Management of the site & population has been poor. There are three key areas of management concern:

- Tenure. The NPWS have repeatedly failed to respond to Council tenure in undertaking works. There have also been issues with one private landowner encroaching on Council tenure.
- Fire management. Hazard reduction burns are being imposed on the population at an average burn regime of just two years – one of the highest frequency regimes ever implemented.
- Trail management. Most plants occur in proximity to the trail edge. Although the trail is already sufficiently wide to meet RFS requirements trail expansion works have been undertaken.

Bushfire response

The extreme variations in population size over time are strongly correlated with burn regimes.

Populations were severely reduced following each burn. By example there were 408 living adults in the comparative area in 2013 but following the burn these reduced to just 37 living adults the following year.

No burnt plants have resprouted, demonstrating the species as an obligate seeder.

Broadly our data demonstrate that the species responds slowly to fire, through regeneration of seed and development to adult plants.

Fire is not necessary for seedling emergence, with seedlings observed to emerge outside the project area in areas long unburnt.

Seedling emergence is slow. Following the 2013 burns it took 2 years before significant seedling emergence, and emergence did not peak until four years after the burn. The decline in seedling germination coincided with extreme drought conditions, and it is possible that post-fire seedling emergence would continue well

The genus is relatively slow growing (5 cm/yr: Ooi et al 2006). Our results concur. Five years after the 2005 burns juveniles were only 5 – 15 cm stem length juveniles. Four years after the 2013 burn similar 15-20 cm 'adults' were just beginning to bear seed, but at a fraction of the scale of mature adults this seed bank is likely to be negligible.

Ooi's estimated growth rates, our observations and our survey data strongly suggest a maturation period greater than 10 years. While the species can persist through repeated short-interval burns this comes with a high probability of extirpation. The species should not be exposed to burns at less than 10 years on the basis of our preliminary data, consistent with the requirements for this species under the *Bush Fire Environmental Assessment Code*.

In recent times fire intervals for this population have been less than 2 years. This was reflected in strong declines to alarmingly small population sizes.

Ooi et al (2006) surveyed four species of *Leucopogon* in Southern Sydney in relation to population-level fire response. They found all species to be obligate seeders with no resprouting abilities. They suggested all four species were tolerant of rather than assisted by fire. High mortality was observed even for very lightly scorched plants. Three factors were identified as key to the survival of these species:

- The use of patchy burns (only possible provided by light burns only)
- The presence of rock outcrops or other topographic features to create patchiness or act as refugia to protect older, seeding individuals, and
- Regeneration of a soil seed bank following disturbance

These data are consistent with the findings of our ongoing survey of *Leucopogon fletcheri* ssp. *fletcheri*. They are also consistent with anecdotal observations of Kenthurst and Glenbrook populations and the 'poor recruitment' observed by Council's three monitoring plots.

As annual survey continues the Plant Study Group hope to investigate the influence of burn seasonality and intensity. At present the impact of these factors cannot be ascertained.

Recommendations

The site contains the largest remaining population of this endangered species and is key to its survival. This is recognised in the identification of the site as a Saving our Species (SOS) priority management site.

Fire management protocols have been repeatedly breached on site. The Bush Fire Environmental Assessment Code Threatened Species Hazard Reduction List - Part 1 – Plants stipulates a 10 year minimum fire interval for the species. In stark contrast the NPWS have implemented a 2 year interval on the site across a number of years. This is not acceptable and has resulted in a severe reduction in the population at the site.

In 2015 the Blue Mountains Conservation Society organised meetings with key stakeholders including:

- NPWS Area Manager - Lower Mountains
- OEH SOS Species Coordinator for *Leucopogon fletcheri* ssp. *fletcheri*
- RFS District Manager – Blue Mountains
- Representatives of the BMCS Plant Study Group

Key recommendations of this meeting were:

1. Installation of signage to demark the boundaries of BMCC land and advise of:
 - a. The land ownership (requiring BMCC consent for NPWS operations)
 - b. The significance of trailside vegetation for the future of *Leucopogon fletcheri* ssp. *fletcheri*
2. Development and implementation of a cross-tenure fire management plan to ensure a suitable fire interval of >10 years in keeping with both our survey findings and the interval stipulated for this species in the RFS *Bush Fire Environmental Assessment Code Threatened Species Hazard Reduction List - Part 1 – Plants*.
3. Commitment from all parties to not undertake any further trail maintenance or hazard reduction burning without full and proper consultation between NPWS, OEH, RFS and the BMCS.

There has been limited action from these meeting to date. No land tenure signage is present. Threatened species roadside signs have been installed according to NPWS requirements.

Further vigilance will be necessary if this population is to persist into the medium to long term future.

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