Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Nomination *(to be completed by nominator)*

Current conservation status	
Name of ecological community:	*Calothamnus graniticus* subsp. *graniticus* heaths on south west coastal granites
Other names:	Meelup Granites
Description:	The community is known from a narrow band parallel to the western shores of Geographe Bay near Meelup. It occurs in areas of exposed granite outcrops and isolated pockets of shallow gravelly-loam soils predominantly found lower in the landscape, but also in isolated pockets upslope where granite boulders dominate. The distinctive *Calothamnus graniticus* subsp. *graniticus* (one-sided bottle brush; priority 4) forms a dense shrub layer with *Gastrolobium spinosum* (prickly poison), *Allocasuarina humilis* (dwarf sheoak) and *Dodonaea ceratocarpa*. Downslope smaller shrubs include *Boronia tenuis* (blue boronia) (priority 4), *Chorizema aciculare* (needle-leaved chorizema), *Hibbertia hypericoides* (yellow buttercups), *Hibbertia spicata*, *Phyllanthus calycinus* (false boronia), *Thryptomene saxicola* (rock thryptomene) and *Xanthorrhoea preissii* (balga). *Burchardia congesta*, the threatened orchid *Caladenia caesarea* subsp. *maritima* (critically endangered), a fern *Cheilanthes austrotenuifolia*, *Conostylis setigera* (bristly cottonhead), *Laxmannia sessiliflora* (nodding lily), *Lomandra micrantha* (small-flower mat-rush), triggerplants including *Stylidium affine* (queen triggerplant), *Stylidium megacarpum*, *Stylidium repens* (matted triggerplant) and sedges and grasses, *Lepidosperma squamatum*, *Morelotia octandra* and *Neurachne alopecuroidea* (foxtail mulga grass) can also be found in the understorey.
Nomination for:	Listing ☒ **under BC Act** Change of status ☐ Delisting ☐

1. *Is the ecological community currently on any conservation list, either in a State or Territory, Australia or Internationally?* 2. *Is it present in an Australian jurisdiction, but not listed?*	*Provide details of the occurrence and listing status for each jurisdiction in the following table*

Jurisdiction	**List or Act name**	**Date listed or assessed (or N/A)**	**Listing category eg. critically endangered (or none)**	**Listing criteria eg. B1ab(iii)+2ab(iii) (or none)**
National	EPBC Act	N/A	none	none
Western Australia	TEC list: WA Minister ESA list in policy	6/11/2001	Vulnerable	B1b, B2b
	Priority list	N/A	1 ☐ 2 ☐ 3 ☐ 4 ☐	
Other State/Territory		N/A	none	none

Nominated conservation status: category and criteria (include recommended status for deleted ecological communities)

Critically endangered (CR) ☐	Endangered (EN) ☐	Vulnerable (VU) ☒ Collapsed (CO) ☐
Priority 1 ☐	Priority 2 ☐	Priority 3 ☐ Priority 4 ☐ None ☐
What criteria support the conservation status category for listing as a threatened ecological community or collapsed ecological community? *Refer to Section 32 of the Biodiversity Act 2016 for definition of 'Collapsed', and Appendix 4 table 'IUCN Red List Criteria for ecosystems version 2.2'.*	**VU B3**	
Eligibility against the criteria		
*Provide justification for the nominated conservation status; is the ecological community eligible or ineligible for listing against the five criteria. For **delisting**, provide details for why the ecological community no longer meets the requirements of the current conservation status.*		
A.	Reduction in geographic distribution *(evidence of decline)*	☐ **A1** ☐ **A2a** ☐ **A2b** ☐ **A3**
	Justification of assessment under Criterion A.	For criterion A, the community is assumed collapsed when the mapped distribution declines to zero. • There is no evidence that the Meelup Granite community has declined markedly in extent. It is likely to have always been restricted in distribution due to its association with isolated granite outcrops (Webb 2013). There is no evidence of a reduction in the geographic distribution of the community over the past 50 years and the status of the community under Criterion A1 is not threatened. • There is no available evidence that supports an inference that a minimum 30% reduction in geographic distribution has or will occur over any 50-year period, or for a 50% reduction since 1750 (ie. the minimum thresholds to meet the category VU under criterion A). • Although the precise boundaries of the community in 1750 are unknown, based on current aerial photography the community is largely intact. The status of the community is therefore not threatened under Criterion A2 and A3. **Based on available evidence, does not meet criterion A.**
B.	Restricted geographic distribution *(EOO and AOO, number of locations and evidence of decline)*	☐ **B1** (specify at least one of the following): ☐ **a)(i)** ☐ **a)(ii)** ☐ **a)(iii)** ☐ **b)** ☐ **c);** ☐ **B2** (specify at least one of the following): ☐ **a)(i)** ☐ **a)(ii)** ☐ **a)(iii)** ☐ **b)** ☐ **c);** ☒ **B3 (only for Vulnerable Listing)**
	Justification of assessment under Criterion B.	For criterion B, the community is assumed collapsed when the mapped distribution declines to zero.

		• B1: EOO is 10.9 km^2 (≤ 2,000 km^2, which is the threshold for CR). • B2: AOO occupies one 10x10 km^2 grid cell (threshold for CR is a maximum of two grid cells). • a). In the mid-2000s dieback disease was detected in a proportion of the area of 4 occurrences, and over the entire area of 2 occurrences. The current impact of the disease is considered relatively insignificant however. • b) Dieback disease (*Phytophthora* spp.), too frequent fire and weed invasion threaten the community. The current level of impact of these threats is considered relatively trivial (additional detail on threats in Appendix 1). • B3: Known from two threat-defined locations based on presence of two separate clusters of occurrences with separate management regimes that are prone to the impacts of inappropriate fire regimes, dieback disease caused by *Phytophthora cinnamomi* and impacts of recreational users. Community is considered prone to effects of human activities or stochastic events within a very short time period in an uncertain future and thus capable of collapse or becoming CR within a very short time period (meets VU as <5 threat defined locations). • Plausibly meets criteria for Critically Endangered under B1b, B2b but current impacts of observed an inferred threats is considered relatively trivial. • Rank of Vulnerable under B3 considered to be most plausible due to the current relatively low level of threat from inappropriate fire regimes, dieback disease and weed invasion. • **Meets Vulnerable under B3**
C.	Environmental degradation of abiotic variable *(Evidence of decline over 50-year period)*	☐ **C1** ☐ **C2** ☐ **C3**
	Justification of assessment under Criterion C.	For criterion C, collapse of the community is complete loss of fire sensitive shrubs and potential other species that are key to the structure and composition of the community due to the impacts of too frequent or intense fire. The collapse point is conservatively considered to be annual fires as this is expected to result in total loss of fire sensitive shrubs. • C1, C2: Fire frequency and severity are likely to increase with increased temperatures and decreased rainfall with altered climate. • There are inadequate data available to link the frequency or severity of fire to compositional or structural changes in relation to fire sensitive species in the community. No available evidence indicates the community meets the minimum proportion of the extent (≥30%) or proportional severity of disruption of abiotic processes (≥30%) over any 50-year period to meet criteria C1 or C2. • C3: Inadequate data to indicate the extent and severity of impacts of fire on flora composition to determine if community meets the threshold proportion of extent (≥50%)

		or severity of disruption of abiotic processes (≥50%) since 1750 to meet VU. **Inadequate data to indicate if community meets criterion C.**
D.	Disruption of biotic processes or interactions *(Evidence of decline over 50-year period)*	☐ **D1** ☐ **D2** ☐ **D3**
	Justification of assessment under Criterion D.	• A significant biotic variable affecting the community is changes in floristic composition as a result of dieback disease. Collapse under criterion D is defined as loss of all dieback sensitive taxa as a consequence of the disease. • D1, D2: The disease is a potentially a serious threat as there are a high number of susceptible species in the community (Department of Parks and Wildlife, 2016). A significant portion of the park is already infected by dieback (Meelup Regional Park Management Committee, 2007). This disease has the potential to negatively affect the community, however the level of threat is currently considered relatively trivial. • There is inadequate evidence of measurable impacts from disease. There is no quantitative evidence to indicate that the community meets the minimum proportion of the extent (≥30%) or proportional severity of disruption of abiotic processes (≥30%) over any 50-year period to meet criteria D1 or D2. • D3: No data available indicate that the community meets the minimum proportion of the extent (≥50%) or proportional severity of disruption of abiotic processes (≥50%) since ~1750. • **Inadequate data to indicate if community meets criterion D.**
E.	Quantitative analysis *(statistical probability of ecosystem collapse)*	• No quantitative estimates of the risk of ecosystem collapse. • **Unable to assess criterion E.**

Reasons for change of status

Genuine change ☐ New knowledge ☐ Previous mistake ☐ Review/Other ☒
Listing under BC Act

Provide details: The community was initially ranked as vulnerable using ranking criteria developed in WA that differ to those in the IUCN Red List Criteria for Ecosystems (version 2.2).

Summary of assessment information *(provide detailed information in the relevant sections of the nomination form)*

EOO	2.9 km^2	AOO	one 10 x 10 km grid cell
No. occurrences	15	Severely fragmented (justification below)	Yes ☒ No ☐ Unknown ☐
Justification of whether fragmented	Community is naturally fragmentated due to its occurrence in isolated patches of suitable habitat. Occurrences are isolated from one another, and are generally linked by areas of intact native vegetation.		

Current known area	41.5 ha
Pre-industrialisation extent or its former known extent (if known)	~41.5ha.
Estimated percentage decline	Likely 0% decline. Considered to occupy most or all of its former extent

Summary assessment against IUCN RLE Criteria

Criterion	Rank indicated	Overall conclusion
A1	-	• Does not meet criterion A1.
A2a	-	• Does not meet criterion A2a.
A2b	-	• Does not meet criterion A2b.
A3	-	• Does not meet criterion A3.
B1a	-	• EOO is ≤2,000km^2. • No available data indicate a substantial decline in spatial extent, environmental quality or disruption to biotic interactions to support ranking under B1a. • Does not meet criterion.
B1b	-	• EOO is ≤2,000km^2. • Threats from disease, drying and warming climate, altered fire regimes and weed invasion are considered relatively trivial. • Does not meet CR B1b.
B1c	-	• EOO is ≤2,000km^2. • Community exists at two threat-defined locations based on two separate groups of occurrences that are prone to the impacts of fire, but impact of threats is currently considered relatively trivial. • Does not meet criterion.
B2a	-	• AOO is one grid cell. • No available data indicate substantial decline in spatial extent, environmental quality or disruption to biotic interactions to support ranking under B2a. • Does not meet criterion.
B2b	-	• AOO is one grid cell. • Threats from disease, drying and warming climate, altered fire regimes and weed invasion are considered relatively trivial. • Does not meet CR B2b, as overall threats considered 'trivial'.
B2c	-	• AOO is one grid cell. • Community exists at two threat-defined locations based on two separate groups of occurrences that are prone to the impacts of fire, but impacts of threats is currently considered 'trivial'. • Does not meet criterion.
B3	-	• Known from two threat-defined locations and prone to effects of human activities or stochastic events within a very short time period in an uncertain future. • Meets criterion for B3.
C1	-	• No available data indicate community meets minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over past 50 years to meet VU.
C2	-	• No available data indicate community meets the minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over any 50-year period to meet VU.
C3	-	• No available data indicate community meets the minimum thresholds for proportion of the extent (≥50%) or proportional severity of disruption of abiotic processes (≥50%) since 1750 to meet VU.

D1	-	• There is inadequate evidence of measurable impacts to indicate if community meets the minimum thresholds for proportion of the extent (≥30%) or proportional severity of disruption of biotic processes (≥30%) over past 50 years to meet VU.
D2	-	• There is inadequate evidence of measurable impacts to indicate if community meets the minimum thresholds for proportion of the extent (≥30%) or proportional severity of disruption of biotic processes (≥30%) over any 50-year period to meet VU.
D3	-	• There is inadequate evidence of measurable impacts to indicate if community meets the minimum thresholds for proportion of the extent (≥50%) or proportional severity of disruption of biotic processes (≥50%) since 1750 to meet VU.
E	NA	• No quantitative estimates of the risk of ecosystem collapse.
		Plausibly meets criteria for Critically Endangered under B1b and B2b. Rank of Vulnerable under B3 considered to be most plausible and robust. **Meets VU under B3**

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GOVERNMENT OF WESTERN AUSTRALIA

Summary of location (occurrence) information *(provide detailed information in the relevant sections of the nomination form)*						
Occurrence	Land tenure	Survey information: date of survey	Condition	Area of occurrence (ha)	Threats (*note if past, present or future)*	Specific management actions
MEELUP01	Meelup Regional Park, Crown Reserve 21629 for the purpose of Conservation; Recreation. Vested in Shire of Busselton	1995, 2012	100% excellent	3.54	Clearing (future), too frequent fire (present and future), dieback disease (future), recreational activities (past, present and future), grazing (future)	
MEELUP02	”	1995, 2012, 2013	95% excellent	4.39	Clearing (present and future), too frequent fire (present and future), dieback disease (future), recreational activities (past, present and future), grazing (future)	
MEELUP03	”	2009, 2012	100% excellent (estimate)	1.08	Clearing (future), too frequent fire (present and future), dieback disease (future), recreational activities (past, present and future), grazing (future)	
MEELUP04	”	1995, 2009, 2012, 2013	100% excellent	0.75	Clearing (future), too frequent fire (present and future), dieback disease (future), recreational activities (past, present and future), grazing (future)	
MEELUP05	”	1995, 2009, 2012, 2013	100% excellent	5.96	Clearing (future), too frequent fire (present and future), dieback disease (past, present, future), recreational activities (past, present and future), grazing (future)	

MEELUP06	”	1995, 2009, 2012, 2013	100% excellent	11.55	Clearing (future), too frequent fire (present and future), dieback disease (future), recreational activities (past, present and future), grazing (future)	
MEELUP07	”	1995, 2009, 2012, 2013	100% Very Good	2.94	Clearing (future), too frequent fire (present and future), dieback disease (past, present, future), recreational activities (past, present and future), grazing (future)	
MEELUP08	”	2012	100% excellent (estimate)	2.02	Clearing (future), too frequent fire (present and future), dieback disease (future), recreational activities (past, present and future), grazing (future)	
MEELUP9	”	2012	80% excellent (estimate)	0.29	Clearing (present and future), too frequent fire (present and future), dieback disease (future), recreational activities (past, present and future), grazing (future)	
MEELUP10		2012	100% excellent (estimate)	0.13	Clearing (future), too frequent fire (present and future), dieback disease (future), recreational activities (past, present and future), grazing (future)	
MEELUP11	”	2009, 2012, 2013	100% excellent (estimate)	0.24	Clearing (future), too frequent fire (present and future), dieback disease (future), recreational activities (past, present and future), grazing (future)	
MEELUP12	”	2012, 2013	100% Very Good (estimate)	0.46	Clearing (future), too frequent fire (present and future), dieback disease (past, present, future), recreational activities (past, present and future), grazing (future)	
MEELUP13	”	2009, 2012, 2013	100% Very Good (estimate)	3.23	Clearing (future), too frequent fire (present and future), dieback disease (past, present, future), recreational activities (past, present and future), grazing (future)	

MEELUP14	”	2009, 2012, 2013	100% Very Good (estimate)	2.04	Clearing (future), too frequent fire (present and future), dieback disease (past, present, future), recreational activities (past, present and future), grazing (future)	
MEELUP15	”	2009, 2012, 2013	100% Very Good (estimate)	2.84	Clearing (future), too frequent fire (present and future), dieback disease (past, present, future), recreational activities (past, present and future), grazing (future)	

*Condition categories are from Keighery (1994) Vegetation Condition Scale (in Government of WA 2000) are defined below:

Good (‘Pristine’, ‘Excellent’, ‘Very Good’ using Bush Forever (Government of WA 2000) scale): This includes vegetation ranging from ‘Pristine’ - with no obvious signs of disturbance, to ‘Excellent’ - Vegetation structure intact, with disturbance only affecting individual species, weeds are non-aggressive species and ‘Very Good’ - Vegetation structure altered, obvious signs of disturbance eg: from repeated fires, dieback, logging, grazing.

Medium (‘Good’ using Bush Forever (Government of WA 2000) scale): This includes vegetation categorised as ‘Good’ - Vegetation structure altered but retains basic vegetation structure or ability to regenerate it, obvious signs of disturbance are present, from activities including partial clearing, dieback and grazing.

Poor (‘Degraded’ using Bush Forever (Government of WA 2000) scale): This includes vegetation ranging from ‘Degraded’ Basic vegetation structure severely impacted by disturbance, the vegetation requires intensive management, and disturbance such as partial clearing, dieback, logging and grazing, to ‘Completely Degraded’ where vegetation structure is no longer intact and the area is completely or almost completely without native species. These areas are often described as ‘parkland cleared’ with the flora comprising weed or crop species with isolated native shrubs and trees.

Beyond recovery (‘Completely degraded’ using Bush Forever (Government of WA 2000) scale): Vegetation structure is no longer intact and the area is completely or almost completely without native species. These areas are often described as ‘parkland cleared’ with the flora comprising weed or crop species with isolated native shrubs and trees.

Table 1. Known condition of occurrences of *Calothamnus graniticus* subsp. *graniticus* heaths on south west coastal granites.

Condition Ranking (Keighery 1994) from Government of Western Australia 2000	**Hectares**	**IUCN Criteria condition ranking**	**Hectares**
Pristine	0	**Good**	41.5
Excellent	41.5		
Very Good	0		
Good	0	**Medium**	0
Degraded	0	**Poor**	0
Completely degraded	0	**Beyond recovery**	0
Total	41.5	**Total**	41.5

APPENDIX 1 THREATS

Altered fire regimes

Fire is a significant disturbance event that plays an important role in biodiversity patterns and processes (Gole 2006). Fires that occur too often in the landscape may result in the extinction of plant species that either have a long juvenile phase and do not set seed for a long period of time or take numerous years to become fire tolerant. Granite outcrops embedded in south-western Australian forests are of biological and conservation importance, providing habitat for endemic plants and animals and refugia for fire-sensitive taxa (Burrows 2013). An inappropriate fire regime that is too frequent also favours some invasive weeds and has the potential to result in alterations to the structure of the community by replacing the native understorey.

Moore *et al.* (2015) note that it is likely that the predicted longer drier periods will result in more frequent fires, that could exacerbate plant deaths from dieback disease when conditions are warm and wet. The likely increase in *P. cinnamomi* activity post-fire has important implications for the future of plant communities affected by infestation from *P. cinnamomi.*

The Meelup Regional Park Fire Management Plan (Shire of Busselton 2007) details the fire history between 1996 and 2006. The plan outlines a prescribed burn program to exclude area of high conservation value, including habitat of threatened flora and ecological communities as "areas to be excluded from standard fire management practices in the Park."

Disease

Dieback disease caused by *Phytophthora* species has the potential to impact the community as it kills susceptible species and alters the structure of the community. Within this community type there are a number of species which have some susceptibility to *Phytophthora* these include: *Xanthorrhoea preissii*, *Macrozamia riedlei*, *Hakea lissocarpha*, *Banksia grandis*, *Astroloma pallidum* and *Allocasuarina humilis* (Department of Parks and Wildlife 2016). Changes to drainage patterns particularly on slopes can result in erosion and increased soil movement. This will result in further spread and intensify *Phytophthora* issues in the area.

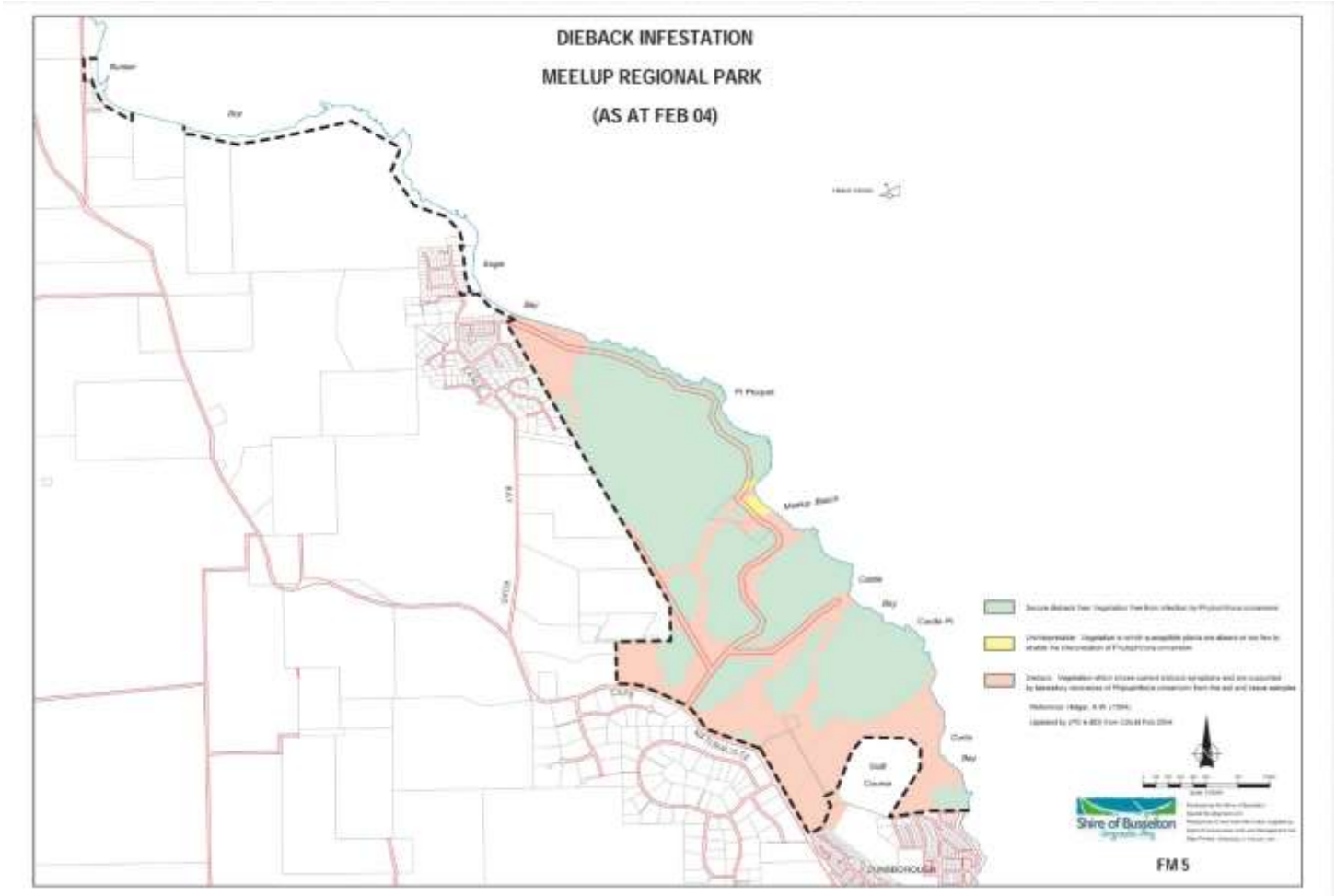
The first mapping on the distribution of *Phytophthora cinnamomi* in Meelup Regional Park was undertaken 1993. Dieback was present at that time, but contained mostly around disturbed areas including carparks, road corridors and riparian zones of Meelup and Dolugup Brooks and surrounding the golf course (Crown Reserve 34894) which is located beyond the southern boundary of the regional park. Meelup Regional Park Management Committee (2008) states that "A large portion of the park is infected by Dieback (*Phytophthora* spp.)" Table 2 demonstrates of presence / absence of dieback in each occurrence surveyed.

Effects of disease are amplified by fire. Moore *et al*. (2007; 2015) note that fire in *Phytophthora* infested communities has the potential to increase both the severity and extent of disease, and impinge on the regeneration capabilities of susceptible species, particularly obligate seeder species. They also note that the latest and average fire interval were closely linked to the percentage of dead and dying susceptible species among sites. This indicates that fire in dieback infected communities has the potential to increase both the severity and extent of the disease. Moore *et al*. (2007; 2015) also found that incidence of disease was considerably higher at all recently burnt sites. Of the 15 occurrences, a proportion of the area of four occurrences, and the entire area of two occurrences was infected with the disease when tested for the disease in 2004, 2006 or 2007.

Table 2. Dieback (*P. cinnamomi*) status of *Calothamnus graniticus* subsp. *graniticus* heaths on south west coastal granites.

Occurrence	Dieback status (*P. cinnamomi*)	Date last surveyed
MEELUP01	Absent	2007
MEELUP02	Absent	2007
MEELUP03	Absent	2007
MEELUP04	Absent	2007
MEELUP05	Present in the north western tip	2007

MEELUP06	Absent	2007
MEELUP07	Present in the northern half	2004 (north) and 2007 (south)
MEELUP08	Absent	2007
MEELUP9	Absent	2007
MEELUP10	Absent	2007
MEELUP11	Absent	2007
MEELUP12	Present in the northern third	2004 (north) and 2007 (south)
MEELUP13	Present in the south western corner	2004 (south west) and 2007 (rest of occurrence)
MEELUP14	Present throughout the occurrence	2004
MEELUP15	Present throughout the occurrence	2004



While aerial cankers and the fungus *Armillaria luteobubalina* are a larger problem in the Meelup Regional Park, they don't appear to be a threat to the Meelup granite community at present (pers comm. [redacted][1]).

[1] DBCA Flora conservation officer, South West Region

Clearing

Clearing of native vegetation results in increased fragmentation, increasing susceptibility to edge effects, and can reduce the viability of remaining patches. There is considerable pressure for the development of reserves that contain the community for recreational purposes (Webb 2013).

Disturbance due to recreational activities

Trampling, removal of vegetation, soil erosion and increased risk of fires can be associated with recreational uses. General disturbance, crushing and clearing of vegetation in this community is likely due the high numbers of visitors to the area (Webb 2013). A walking trail and two roads traverse the community.

Weed invasion

Weeds can have significant impacts through competition with native species, preventing regeneration and altering fire regimes (Hobbs and Mooney 1993). Disturbances such as fires and grazing can predispose areas to weed invasion if weed propagules are present. The high number of visitors to the area increases the risk of weed invasions.

Meelup Regional Park adjoins the towns of Dunsborough and Eagle Bay and farmland to the west. Trails traverse the bushland that contains the community. In summer months the beaches attract many visitors and these factors make the area very vulnerable to trampling and weed infestation (Fisher 2011). A weed survey of the regional park was completed by Meelup Regional Park Management Committee in 2011. It lists the most serious weeds with recommended methods of management. The areas requiring the most management are located along the coastal track that dissects the community. Additional areas requiring weed management include carparks, some of which are adjacent to some occurrences of the community, and the western firebreak alongside farmland and upslope of the community. The management committee employs contractors to control the weeds (Fisher 2011).

Myrtle rust

Myrtle rust is a serious plant disease caused by the introduced fungus *Austropuccinia psidii*. The disease attacks and kills many taxa in the family Myrtaceae including the genera *Eucalyptus, Calothamnus, Melaleuca and Agonis* (https://www.agric.wa.gov.au/plant-biosecurity/myrtle-rust-threat-western-australia). This fungus is not established in Western Australia. As this community is characterised by the genus *Calothamnus*, its' structure and composition have the potential to be seriously threatened by the introduction of the disease.

Warming and drying climate

The community is at risk from a decline in rainfall and increased temperatures in the south west of the state. The tolerance of particular species to changes that may occur in association with changes in rainfall and temperatures is generally unknown. According to the 2016 study by Sudmeyer (2016), climate change predictions for the south west of WA are as follows:

- By 2030, mean annual temperature is projected to increase by 0.5–1.2°C.
- Reduction in rainfall by 2030 by 2-14%, the southwest to predicted to experience some of the largest reductions in rainfall in all of Australia.
- Reduction in runoff by 10-42% (median 24%) by 2030.
- Decline in groundwater levels by 2030 (extractive yields may decrease by a third to a half in some areas).
- Increase in the intensity and frequency of bushfires.

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APPENDIX 2 Distribution of *Calothamnus graniticus* subsp. *graniticus* heaths on south west coastal granites

APPENDIX 3 Review of Meelup granite communities

The plant communities of the Meelup reserves system were originally described and mapped by Keating and Trudgen (1986). They identified the following habitat units which encompass the Meelup granites community:

- AgCg – *Agonis flexuosa*, *Calothamnus graniticus* subsp. *graniticus* closed scrub.
- GH1 – *Calothamnus graniticus* subsp. *graniticus* Open to Closed Heath.
- AgM – *Agonis flexuosa*, *Eucalyptus calophylla* Low Woodland.
- Ah – *Allocasuarina humilis*, *Thryptomene saxicola*, *Dodonaea ceratocarpa*, *Calothamnus graniticus* subsp. *graniticus* low shrubland.
- MGr – *Eucalyptus calophylla* Woodland.

A further review of the floristic values of the Meelup reserve system was undertaken by [redacted] [redacted] The vegetation types identified by Keating and Trudgen were amalgamated into '*Calothamnus graniticus* Closed Heath'.

Big Rock granite

In 2016, a survey of Big Rock reserve revealed similarities to the Meelup granite community, in that it is considered a massive outcropping granite, contained the glabrous form of *Calothamnus graniticus* subsp. *graniticus*, and is on the same side/line of exposed granites within the Leeuwin Block landform (pers comm. [redacted]).

Sugar Loaf granites

The Sugar Loaf granites was originally nominated as an occurrence of the Meelup granites community in 2004 by [redacted], based partly on plant species data collected at the time. Analysis of floristic plot data collected by Gibson and Keighery in 2000 (Lyons *et al*. 2000) did not link Sugar Loaf with the other sites in the Meelup Granite community. Therefore the Sugar Loaf granites were not included as an occurrence of the Meelup granites community. In 2006, the Sugar Loaf granites were recognised as a separate community and nominated as a TEC. The community was considered to be similar to the Meelup granites with *Calothamnus graniticus* subsp. *graniticus* being dominant, although the community is geographically separate and supports different understorey species.

Analyses for Leeuwin Naturaliste National Park granites

The dissimilarity matrix and dendogram performed by [redacted], indicate Big rock is notably differentiated by a group of species, mostly annual herbs, which could represent the herbfield community included in the areas' species list. In regards to Sugarloaf and Meelup, *Calothamnus graniticus* are relatively comparable except for a group of species typically found on limestone soils, which given that it surrounds the Sugarloaf outcrop (but not the Meelup outcrops) is as expected.

It should be noted that:

- the Meelup *C. graniticus* list is a cumulative list of several different outcrops of this vegetation type.
- the other species lists (outside of Meelup *C. graniticus*) are of an entire outcrop, not the different vegetation types within an outcrop. This is not that relevant for Sugar Loaf as it is a very uniform outcrop, but is relevant for Big Rock occurrence, as that has both a *C. graniticus* heath over massive rock and also mossy herbfield vegetation types. These vegetation types are generally separated on that larger rock outcrop. While the analysis is of the whole Big Rock species list, the *C. graniticus* vegetation was separated out from the herbfield.

It is therefore not certain what defines the Meelup granites TEC, the presence of *Calothmanus graniticus* subsp. *graniticus* or a larger species assemblage. If it is the latter then this will be difficult to define as the analyses show the Meelup *C. graniticus* vegetation is more comparable to other outcrops before Sugar Loaf and possibly Big Rock. Further assessment is required to determine whether the community should be described as a Meelup landscape of outcropping granite as the range of unique taxa represented here is remarkable.

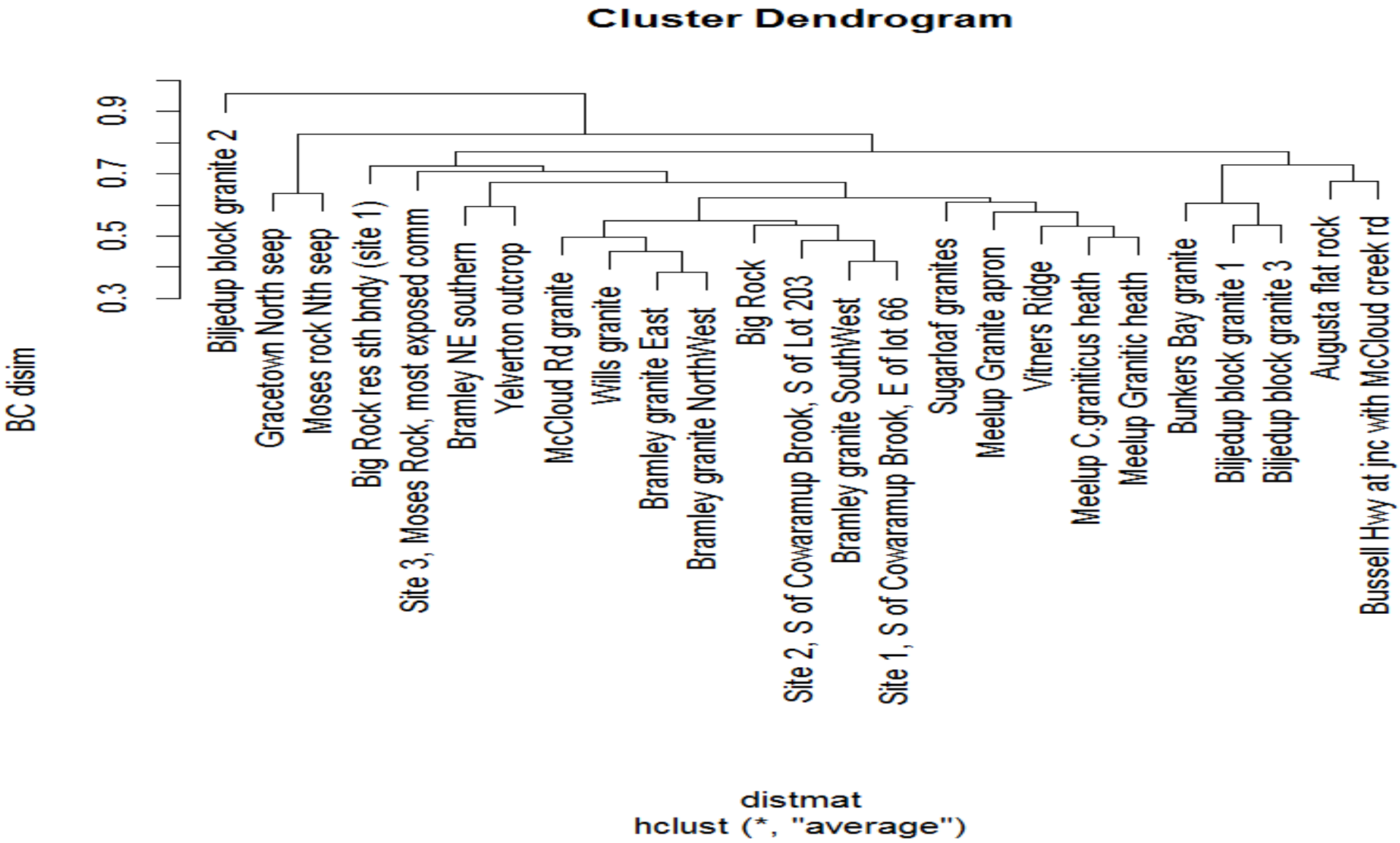
Dissimilarity Matrix ([redacted])

	Bramley granite East	Bramley granite NorthWest	Site 1, S of Cowaramup Brook, E of lot [redacted]	Site 2, S of Cowaramup Brook, S of Lot [redacted]	Wills granite	Bramley granite SouthWest	Meelup C.graniticus heath	Meelup Granite apron	Vitners Ridge	Site 3, Moses Rock, most exposed comm	McCloud Rd granite	Sugarloaf granites	Yelverton outcrop
Big Rock	0.520737327	0.527093596	0.530726257	0.535354	0.538462	0.542857	0.60377359	0.614815	0.626263	0.632184	0.634409	0.634518	0.657895

	Meelup Granitic heath	Site 2, S of Cowaramup Brook, S of Lot [redacted]	Bramley granite SouthWest	Vitners Ridge	Meelup Granite apron	Site 1, S of Cowaramup Brook, E of lot [redacted]	Sugarloaf granites	Bramley granite East	Bramley granite NorthWest	McCloud Rd granite	Big Rock	Wills granite	Big Rock res sth bndy (site 1)
Meelup C.graniticus heath	0.498281787	0.514018692	0.518324607	0.53271	0.538462	0.548718	0.56807512	0.579399	0.579909	0.584158	0.603774	0.625	0.631902

	Meelup C.graniticus heath	Bramley granite SouthWest	Meelup Granite apron	Vitners Ridge	Meelup Granitic heath	Big Rock	Site 2, S of Cowaramup Brook, S of Lot [redacted]	Site 3, Moses Rock, most exposed comm	Bramley granite NorthWest	Bramley granite East	Moses rock Nth seep	Site 1, S of Cowaramup Brook, E of [redacted]	McCloud Rd granite
Sugarloaf granites	0.568075117	0.613636364	0.616236162	0.61809	0.630435	0.634518	0.64824121	0.668571	0.676471	0.678899	0.683761	0.688889	0.700535

Cluster Dendogram for Leeuwin Naturaliste National Park granite species (from Andrew Webb 2020)



APPENDIX 4 IUCN Red List Criteria for ecosystems (version 2.2) (IUCN 2017)

A. Reduction in geographic distribution over ANY of the following time periods:

		CR	EN	VU
A1	Present (over the past 50 years).	≥ 80%	≥ 50%	≥ 30%
A2a	Future (over the next 50 years).	≥ 80%	≥ 50%	≥ 30%
A2b	Future (over any 50 year period including the present and future).	≥ 80%	≥ 50%	≥ 30%
A3	Historic (since 1750).	≥ 90%	≥ 70%	≥ 50%

B. Restricted geographic distribution indicated by EITHER B1, B2 or B3:

		CR	EN	VU
B1	Extent of a minimum convex polygon enclosing all occurrences (Extent of Occurrence)	≤ 2,000 km^2	≤ 20,000 km^2	≤ 50,000 km^2
	AND at least one of the following (a-c):			
	(a) An observed or inferred continuing decline in **EITHER**:			
	i. a measure of spatial extent appropriate to the ecosystem; **OR**			
	ii. a measure of environmental quality appropriate to characteristic biota of the ecosystem; **OR**			
	iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem.			
	(b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years.			
	(c) Ecosystem exists at …	1 location	≤ 5 locations	≤ 10 locations
B2	The number of 10 × 10 km grid cells occupied (Area of Occupancy)	≤ 2	≤ 20	≤ 50
	AND at least one of a-c above (same sub-criteria as for B1).			
B3	A very small number of locations (generally fewer than 5) **AND** prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and thus capable of collapse or becoming Critically Endangered within a very short time period (B3 can only lead to a listing as VU).			VU

C. Environmental degradation over ANY of the following time periods:

C1 The past 50 years based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:

Extent (%)	Relative severity (%) ≥ 80	≥ 50	≥ 30
≥ 80	CR	EN	VU
≥ 50	EN	VU	
≥ 30	VU		

C2 The next 50 years, or any 50-year period including the present and future, based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:

Extent (%)	≥ 80	≥ 50	≥ 30
≥ 80	CR	EN	VU
≥ 50	EN	VU	
≥ 30	VU		

C3 Since 1750 based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:

Extent (%)	≥ 90	≥ 70	≥ 50
≥ 90	CR	EN	VU
≥ 70	EN	VU	
≥ 50	VU		

D. Disruption of biotic processes or interactions over ANY of the following time periods:

D1 The past 50 years based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:

Extent (%)	Relative severity (%) ≥ 80	≥ 50	≥ 30
≥ 80	CR	EN	VU
≥ 50	EN	VU	
≥ 30	VU		

D2	(D2a) The next 50 years, or (D2b) any 50-year period including the present and future, based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table: OR		≥ 80	≥ 50	≥ 30
		≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
D3	Since 1750, based on a change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:		≥ 90	≥ 70	≥ 50
		≥ 90	CR	EN	VU
		≥ 70	EN	VU	
		≥ 50	VU		
E. Quantitative analysis					
			CR	EN	VU
… that estimates the probability of ecosystem collapse to be:			≥ 50% within 50 years	≥ 20% within 50 years	≥ 10% within 100 years