Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Section 1 – Eligibility for Listing		
1. Name of the ecological community		
Russell Range mixed thicket complexes		
2. Listing Category for which the ecological community is nominated		
	WA Minister ESA list in policy	EPBC Act (wholly or as a component)
Current listing category (Please check box)	☐ Critically endangered ☐ Endangered ☒ Vulnerable ☐ Priority 1-4 ☐ Data Deficient ☐ None – not listed	Name: Proteaceae dominated Kwongkan shrublands of the southeast coastal floristic province of Western Australia ☐ Critically endangered ☒ Endangered ☐ Vulnerable ☐ None – not listed
Proposed listing category (Please check box)	☐ Collapsed ☐ CR: Critically endangered ☐ EN: Endangered ☒ VU: Vulnerable ☐ Priority 1-4	
Select one or more of the following criteria under which the community is to be nominated for BC Act listing. (Please check box). For further details on these criteria please refer to the Attachment to this form. The information you provide in Section 3 should support the criteria you select here.	☐ Criterion A – Reduction in geographic distribution ☒ Criterion B – Restricted geographic distribution ☐ Criterion C – Environmental degradation based on change in an abiotic variable ☐ Criterion D – Disruption of biotic processes or interactions based on change in a biotic variable ☐ Criterion E – Quantitative analysis that estimates the probability of ecosystem collapse	

Section 2 – Description, Condition, Threats & Recovery
Please answer all the questions, providing references where applicable. If no or insufficient information exists to answer a question, you must indicate this instead of leaving the question blank. The answers may be provided within this form or as attachments, ensuring that responses clearly indicate which question number they refer to.
Classification
3. What is the name of the ecological community?
Note any other names that have been used recently, including where different names apply within different jurisdictions. For example, is it known by separate names in different States or regions?
Russell Range mixed thicket complexes which includes a component of the Proteaceae dominated Kwongkan shrublands (also referred to as Kwongkan community).

4. What authorities/surveys/studies support or use the name?

The community was originally identified by Beard (1973) and then further defined by Barrett (1996) in a biological survey of mountains of southern Western Australia. The community type has been recognised since the publication of that report and was endorsed as a vulnerable TEC by the WA Minister for Environment in 2001. The ranking criteria developed in WA do not match those used in the International Union for the Conservation of Nature's Red List of Ecosystems Criteria (IUCN RLE) that is now the internationally recognised standard. The community was also listed as endangered as a component of the 'Proteaceae dominated Kwongkan shrublands of the southeast coastal floristic province of Western Australia' under the EPBC Act in 2014, but has not been re-ranked using the new criteria recognised under that Act that also differ from the ranking criteria used for the IUCN RLE.

5. How does the nominated ecological community relate to other ecological communities that occur nearby or that may be similar to it?

Does it intergrade with any other ecological communities and, if so, what are they and how wide are the intergradation zones?
Describe how you might distinguish the ecological community in areas where there is overlap (also see Description section below).

The Russell Range mixed thicket complexes community occurs as a component of the *EPBC* Act listed threatened ecological community (TEC), 'Proteaceae dominated kwongkan shrublands of the southeast coastal floristic province of Western Australia' (EN), listed as Priority 3 ecological community (PEC) in WA.

- Proteaceae dominated kwongkan shrublands of the southeast coastal floristic province of Western Australia, Priority 3 in WA, EN under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).
  Description: Dense, obligate seeding Proteaceae dominated shrublands and kwongkan of the Esperance Sandplains. Areas of the Russell Range mixed thicket complexes community are a component of or overlap/intergrade with the Proteaceae dominated shrubland community on the lower slopes.

Description

6. List the main features that distinguish this ecological community from all other ecological communities.

Characteristic (or diagnostic) features can be biological (e.g. taxa or taxonomic groups of plants and animals characteristic to the community; a type of vegetation or other biotic structure), or associated non-biological landscape characteristics (e.g. soil type or substrate, habitat feature, hydrological feature). Please limit your answer to those features that are specific to the ecological community and can be used to distinguish it from other ecological communities.

The Russell Range mixed thicket complexes community comprises scrub and mallee heath thicket with a suite of endemic species. It occupies the high peak of Mount Ragged, within Cape Arid National Park. The community is commonly found at altitudes of approximately 585 m above sea level but extends to lower altitudes. Several endemic and characteristic species within the community. Four priority flora taxa are endemic to the community including *Banksia prolata* subsp. *archeos*, *Beaufortia raggedensis*, *Rhadinothamnus rudis* subsp. *linearis*, *Darwinia* sp. Mt Ragged (S. Barrett 663) and *Gastrolobium tergiversum*. *Anthocercis viscosa*, although common on granite from Walpole to Cape Arid, is found at the inland or eastern limit of its range on the wave-cut bench on Mt Ragged.

7. Give a description of the biological components of the ecological community.

For instance, what species of plants and animals commonly occur in the community; what is the typical vegetation structure (if relevant).

Mixed thicket vegetation complexes in the Russell Range System was identified by Beard (1973). The vegetation of Mt Ragged occurs within the Russell Range System and is described by Barrett (1996) as open mallee/shrub mallee-heath on the mid to upper slopes. Typical species are *Eucalyptus doratoxylon* (spearwood mallee), *Adenanthos oreophilus*, *Dampiera parvifolia* (many-bracted dampiera), *Dielsiodoxa oligarrhenoides*, *Chorizema nervosum*, *Acacia triptycha*, *Hakea pandanicarpa*, *Daviesia grossa* and the endemic Priority taxa *Banksia prolata* subsp. *archeos* (P2), *Beaufortia raggedensis* (Mt Ragged beaufortia) (P2), *Rhadinothamnus rudis* subsp. *linearis*

(P4), *Darwinia* sp. Mt Ragged (S. Barrett 663) (P2) and *Gastrolobium tergiversum* (P2). Other Priority flora include *Beyeria simplex* (P2), *Dielsiodoxa propullulans* (P2), *Leucopogon apiculatus* (P3), *Styphelia rotundifolia* (P3), *Opercularia hirsuta* (silky-haired stinkweed) (P2), *Scaevola brookeana* (P2), *Gastrolobium pycnostachyum* (Mt Ragged poison) (P2) and *Kennedia beckxiana* (Cape Arid Kennedia) (P4) which occur mainly on the mid-lower slopes. *Anthocercis viscosa* (sticky tailflower) is common on granite on the south coast from Walpole to Cape Arid, and occurs at its inland or eastern limit on Mt Ragged.

Mammals such as the echidna (*Tachyglossus aculeatus*) and a Dasyurid were recorded in the community through diggings and/or scats in Barrett (1996), but neither are common to the community.

Reptiles and amphibians present within the community were *Egernia napoleonis* (south-western crevice skink), *Notechis scutatus occidentalis* (tiger snake), *Limnodynastes dorsalis* (Western Banjo frog), *Neobatrachus kunapalari* (Wheatbelt frog) but all are widespread species.

8. Give a description of the associated non-biological landscape characteristics or components of the ecological community.

For instance, what is the typical landscape in which the community occurs? Note if it is associated with a particular soil type or substrate; what major climatic variables drive the distribution of the ecological community (e.g. rainfall). Note particular altitudes, latitudes or geographic coordinates

The Russell Range mixed thicket complexes community occurs within the Proterozoic Mt Ragged beds which over-lie Middle-Proterozoic granites, gneisses and migmatites of the Albany-Fraser Province (Lowry and Doepel 1974). The beds are composed of a sequence of quartzites, micaceous schists, quartz-pebble conglomerates and acid volcanic rocks exposed as a series of north-easterly trending belts. Mt Ragged is formed of vertically stratified gneiss with a central band of massive quartzite resistant to erosion. At the base is a wave cut platform similar to those around the Barrens of the Fitzgerald River National Park and Peak Charles (Barrett 1996).

Soils are mostly acidic, have a low nutrient status and have been weathered from granitoid or quartzite bedrock. Soil depth is generally shallow with skeletal soils less than 25cm thick common on the upper slopes and peaks, and deeper in areas of more gentle topography (Barrett 1996).

The climate of the area is Mediterranean characterised by mild wet winters and hot dry summers. The weather is controlled by west to east movement of sub-polar depressions, associated with cold fronts throughout the year and troughs during summer. Mean annual rainfall is 268mm, and temperature ranges from a mean winter minimum (coldest month) of 4.8°C (July) to mean summer maximum (hottest month) of 31.3°C (January) (data from Bureau of Meteorolgy (BOM) WA Balladonia station 011017; 115km to the north). The average altitude is 512m above sea level, up to 592m at Mt Ragged (Barrett 1996; Beard 1973).

9. Provide information on the ecological processes by which the biological and non-biological components interact (where known).

The mixed thicket community occurs on the highest peaks of the Russell Range, with characteristic open-mallee/shrub mallee-heath, with many endemic species. Fire regimes play a key role in maintaining the diversity of the system, particularly as many of the rare and restricted flora that ascribe the ecosystem's uniqueness are killed by fire and rely on seedling establishment to maintain their populations. Most of the component species are killed by fire and rely on seeds to regenerate. As a consequence fire intervals are particularly important for the dynamics and persistence of the ecosystem.

Anthropogenic climate change is also a major threat to the Russell Range mixed thicket complexes community. Mean ambient temperatures in southwestern Western Australia have increased during the 20th century and since the 1970s there has been a significant decline in autumn and early winter rainfall (Bates *et al.* 2008). The consensus among global climate models is for a continuation of the present trends with projected increases in temperature of 1–5.5°C and decreases in annual rainfall of 5–60% by 2070 (CSIRO 2007; Bates *et al.* 2008). Because the Russell Range mixed thicket complexes community is restricted to high peaks, there is no bioclimatic zone for component species to move with projected warming and drying.

10. Does the ecological community show any consistent regional or other variation across its extent, such as characteristic differences in species composition or structure?

If so, please describe these.

11. Does the ecological community provide habitat for any listed threatened species and/or endemic species?

If so, please note the species and whether the species is listed on State and/or national lists and the nature of their dependence on the ecological community.

The community contains a number of endemic species including: Priority taxa *Banksia prolata* subsp. *archeos* (P2), *Beaufortia raggedensis* (Mt Ragged beaufortia) (P2), *Rhadinothamnus rudis* subsp. *linearis* (P4), *Darwinia* sp. Mt Ragged (S. Barrett 663) (P2) and *Gastrolobium tergiversum* (P2). Other Priority flora include *Beyeria simplex* (P2), *Dielsiodoxa propullulans* (P2), *Leucopogon apiculatus* (P3), *L. rotundifolius* (P3), *Opercularia hirsuta* (silky-haired stinkweed) (P2), *Scaevola brookeana* (P2), *Gastrolobium pycnostachyum* (Mt Ragged poison) (P2) and *Kennedia beckxiana* (Cape Arid Kennedia) (P4) which occur mainly on the mid-lower slopes.

12. Identify major studies on the ecological community (authors, dates, title and publishing details where relevant).

Barrett, S. (1996) Biological survey of mountains of southern Western Australia. Unpublished report by the Department of Conservation and Land Management for the Australian Nature Conservation Agency.

Beard, J.S. (1973) The vegetation of the Esperance and Malcolm areas, Western Australia: map and explanatory memoir, 1:250,000 series. Vegetation Survey of Western Australia.

Distribution

13. Describe the distribution across WA and nationally.

State the appropriate bioregions where the ecological community occurs. Attach or provide any maps showing its distribution with details of the source of the maps, or explain how they were created and the datasets used.

The community is confined to the Russell Range system, located east of Esperance (see Appendix 1). It comprises of five occurrences within chains running NNE to SSW, including the slopes of Mount Dean, Brooks Peak, Mount Ragged, Mount Esmond and Woolgrah Hill. The community occurs within Cape Arid National Park, Nuytsland Nature Reserve and in an unnamed nature reserve. There are about 2,897ha of the community currently mapped on the DBCA community Database.

14. What is the area of distribution of the ecological community?

For answers to parts a, b, c & d: please identify whether any values represent extent of occurrence or area of occupancy (as described in the Attachment); provide details of the source(s) for the estimates and explain how they were calculated and the datasets used.

144 a. What is the current known area (in ha)? 2,897ha

144 b. What is the pre-industrialisation extent or its former known extent (in ha)? An ecological community is considered to be naturally restricted if it has a pre-industrialisation area of occupancy that is less than 10 000 ha or a pre-industrialisation extent of occurrence that is less than 100 000 ha (refer to the Attachment A) 2,897ha

144 c. What is the estimated percentage decline of the ecological community?

It is not known what the former extent of the Russell Range mixed thicket complexes community is, however, it is thought to occupy most of its former range.

144 d. What data are there to indicate that future changes in distribution may occur?

Climate change trends from National Climate Change Adaptation Research Facility (NCCARF) website (accessed 2019) are likely to result in reduced rainfall; more extreme fire behaviour resulting from higher temperatures and a greater number of severe fire danger days; and promote spread of *Phytophthora cinnamomi* by increasing the periods of warm, moist soil conditions in which the organism is most active and at highest risk of spreading.

Patch size

15. What is the typical size (in ha) for a patch of the ecological community (if known)?

Explain how it was calculated and the datasets that are used. Relevant data includes the average patch size, the proportion of patches that are certain sizes, particularly proportions below 10 ha and below 100 ha, (but also below 1 ha and above 100 ha, for example). This could be presented as the range of patch sizes that comprise 90% of the occurrences.

The Russell Range mixed thicket complexes community was mapped using ArcGIS© and a range of data sources including quadrat and survey data; on ground survey; aerial photography; and topographic maps. Minimum patch

size is 67ha and maximum patch size is 897ha. The mean patch size is 579ha (see table below for patch size proportions).

Table 1. Proportion of occurrences with a certain patch size.

Patch size (hectares)	Number of occurrences
<1	0 (0%)
<10	0 (0%)
<100	1 (20%)
>100	4 (80%)

16. Quantify, if possible, the smallest percentage or area required for a patch of the ecological community to be considered viable.

This refers to the minimum size of a remnant that can remain viable without active management. It may be determined through the requirements for dominant native species, level of species diversity, or the nature of invasive weeds.

All areas of the Russell Rang mixed thicket complexes community have been mapped. There is no minimum area specified for a patch that could remain viable without active management. Patches vary in size and without threatening processes those that are considered in good condition do not require active management.

Functionality

17. Is the present distribution of the ecological community severely fragmented?

If so, what are likely causes of fragmentation?
If fragmentation is a natural or positive characteristic of this ecological community, please explain this and state the reason.
Severely fragmented refers to the situation in which increased extinction risk to the ecological community results from most remnants being found in small and relatively isolated patches.

The Russell Range mixed thicket complexes community is geographically restricted to two chains running NNE to SSW interconnected by the downslope plant community Proteaceae dominated kwongkan shrubland.

18. Has there been a loss or decline of functionally important species?

This refers to native species that are critically important in the processes that sustain or play a major role in the ecological community and whose removal has the potential to precipitate change in community structure or function sufficient to undermine the overall viability of the community.

The flora species within the community are a major part of characterising and differentiating the community. Changes to the floristic composition are likely to occur through the introduction of dieback and change in fire regimes (too frequent fire).

18 a. If yes, which species are affected?

Too frequent fires will affect those species that are fire-sensitive. The fire responses of selected key flora species in the community are listed in Barrett (1996). These include:

Eucalyptus doratoxylon – mature plants survive 100% canopy scorch
Dampiera parvifolia – mature plants survive 100% canopy scorch, resprout from root suckers or rhizomes
Dielsiodoxa oligarrhenoides – mature plants die following 100% leaf-scorch, regeneration from soil-stored seed
Daviesia grossa – mature plants survive 100% canopy scorch, resprout from basal stems buds
Banksia prolata subsp. *archeos* – mature plants survive 100% canopy scorch, propagules present after fire in the form of canopy stored seed
Darwinia sp. Mt Ragged (S. Barrett 663) – mature plants die following 100% leaf-scorch
Leucopogon apiculatus – mature plants die following 100% leaf-scorch, propagules present after fire in the form of soil stored seed
Scaevola brookeana – mature plants survive 100% canopy scorch
Anthocercis viscosa – mature plants die following 100% leaf-scorch.

18 b. How are the species functionally important and to what extent have they declined?

Not known.

Reduction in community integrity

19. Please describe any processes that have resulted in a reduction in integrity and the consequences of these processes, e.g. loss of understorey in a woodland. Include any available information on the rate of these changes.

This recognises that an ecological community can be threatened with extinction through on-going modifications that do not necessarily lead to total destruction of all elements of the community. Changes in integrity can be measured by comparison with a benchmark state that reflects as closely as possible the natural condition of the community with respect to the composition and arrangement of its abiotic and biotic elements and the processes that sustain them. Please provide a description of the benchmark state where available. For further information please refer to the Guidelines.

Extensive changes in the composition of the ecosystem through local extinction or severe reduction in populations of defining plant species particularly in the Proteaceae, Eriacaeae and Fabaceae families may occur through the introduction of dieback disease.

Occurrences of the community that are close to the benchmark state can be characterised by the following:

- few weed taxa, and low weed cover
- all previously recorded natural strata of the vegetation present
- connectivity with other intact vegetation
- Diverse flora (Barrett (1996) recorded average species richness for Mt Ragged of 35.5 species)
- intact populations present in patches where priority flora were historically recorded.

Survey and Monitoring

20. Has the ecological community been reasonably well surveyed?

Provide an overview of surveys to date, including coverage of different land tenure, and the likelihood of the ecological community's current known distribution and/or patch size being a true reflection of its actual distribution (consider area of occupancy and area of extent, including any data on number and size of patches).

An on-ground survey of Mt Ragged was undertaken during the mountain top survey in 1996.

21. Where possible, please indicate areas that haven't been surveyed but may add to the information required in determining the community's overall viability and quality.

Include commentary on issues to do with accessing different land tenures within the area of distribution, including private property, and the likelihood that these areas may include occurrences.

Historically, all peaks within the Russell Range have been surveyed and or subjected to ongoing survey to assess condition, monitor threats and extent of the Russell Range mixed thicket complexes community.

22. Is there an ongoing monitoring program? If so, please describe the extent and length of the program.

Monitoring is undertaken opportunistically by DBCA's Esperance District.

Condition Classes and Thresholds

23. Do you think condition classes/thresholds apply to this ecological community? If not, give reasons.

The Committee recognises that ecological communities can exist in various condition states. In reaching its decision the Committee uses condition classes and/or thresholds to determine the patches that are included or excluded from the listed ecological community (see the Guidelines for details of the process of determining condition classes). Relevant here is recognition of different states following disturbance and the natural recovery of the occurrence towards a higher condition class.

The minimum viable condition for this community to be considered viable is Good Condition. This refers to a patch in which "Vegetation structure altered but retains basic vegetation structure or ability to regenerate it. Obvious signs of disturbance, e.g. from partial clearing, dieback, grazing. Presence of very aggressive weeds" (Keighery (1994) Vegetation Condition Scale (Government of WA 2000)). No minimum patch size is specified, as future viability will depend on management. Very small areas are known to be able to maintain their condition if they are subject to very minimal disturbance.

24. If so, how much of the community would you describe as in relatively <u>good condition</u>,

i.e. likely to persist into the long-term with minimal management?

For the purposes of relating condition to IUCN Criteria, good condition related to WA condition categories 'Very Good to Pristine' as below (see ^ below in Table 2) are considered to be in good condition, so therefore 733ha or

100% of known occurrences (where condition is known) are considered to be in good condition, and contain high native plant species diversity, maintain integrity of vegetation structure, and minimal weed/introduced species cover. Many occurrences are subject to ongoing threats, and all require substantial management to protect from pressures such as spread of introduced species, too frequent fire, and recreation.

Table 2: Vegetation condition of occurrences of Russell Range mixed thicket complexes community

Occurrence number (portion of occurrence estimated as percentage in brackets)	**Total area (ha)***	**Condition when last surveyed**
0	0	^^^Poor ('degraded', 'completely degraded' using Bush Forever (2000) scale)
0	0	^^Medium ('good' using Bush Forever (2000) scale)
1	±733	^Good ('pristine', 'excellent', 'very good' using Bush Forever (2000) scale)
2, 3, 4, 5	±2,164.48	Unknown

25. What features or variables do you consider to be most valuable for identifying a patch of the ecological community in relatively <u>good condition</u>?

Variables for establishing the highest condition class may include: patch size; connectivity; native plant species composition; diversity and cover (for example in overstorey; mid-shrub and/or understorey layers); recognised faunal values; and cover of weeds or other invasive species.

See Section 24 above.

^This includes vegetation ranging from 'Pristine' - with no obvious signs of disturbance and native plant species diversity fully retained or almost so, zero or almost so weed cover/abundance, to 'Excellent' - Vegetation structure intact, with disturbance only affecting individual species, weeds are non-aggressive species, and the area contains high native plant species diversity, with less than 10% weed cover, and 'Very Good' - Vegetation structure altered, obvious signs of disturbance eg: from repeated fires, dieback, logging, grazing, aggressive weeds are present, with moderate native plant species diversity, and typical weed cover is less than 20% (5 – 20%).

26. How much of the community would you describe as in relatively <u>medium condition</u>, i.e. likely to persist into the long-term future with management?

For the purposes of relating condition to IUCN Criteria, medium condition relates to WA condition categories 'Very Good to Good' as below (see ^^below and Table 2 above), so therefore 0ha of known occurrences are considered to be in medium condition, and contain medium plant species diversity, reduced of vegetation structure, and a medium level of weed/introduced species cover.

^^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, grazing, and very aggressive weeds are present, with low native plant diversity (5 – 50%).

27. Please describe how you would identify areas in <u>medium condition</u> using one or a combination of indicators such as species diversity, structure, remnant size, cover of weeds or other invasive species, etc.

See section 26 above.

28. How much of the community would you describe as in relatively <u>poor condition</u>, i.e. unlikely to be recoverable with active management?

For the purposes of relating condition to IUCN Criteria, poor condition in this instance relates to WA condition categories 'Degraded' and 'Completely Degraded', (see ^^^below and Table 2 above), so 0ha of known occurrences are considered to be in poor condition, with vegetation containing minimal native flora, presence of aggressive weeds, and evidence of much disturbance.

^^^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 are present, very aggressive weeds are present at high density, and very low native plant species diversity is observed (20 – 70%) to 'Completely Degraded' where vegetation structure is no longer intact and the area is completely or almost completely without native flora, referred to also as 'Parkland Cleared', with very low to no native species diversity (weed species greater than 70%).

29. Please describe how you would identify areas in poor condition using one or a combination of indicators such as species diversity, structure, remnant size, cover of weeds or other invasive species, etc.

See section 28 above.

Threats

Note: If you plan to identify climate change as a threat to the ecological community, please refer to the Guidelines for information on how this should be addressed.

30. Identify PAST threats to the ecological community indicating whether they are *actual* or *potential*.

Past threats include disturbance through frequent fire, recreational activities and grazing by introduced fauna, all of which are actual threats.

31. Identify CURRENT threats to the ecological community indicating whether they are *actual* or *potential*.

Current threats include disturbance through frequent fire, introduction of dieback disease and recreational activities, all of which are currently actual threats.

32. Identify FUTURE threats to the ecological community indicating whether they are *actual* or *potential*.

Future threats include disturbance through frequent fire, spread of dieback disease and recreational activities, all of which are actual threats. A potential future threat to the community is drying climate.

For each threat describe:

322 a. How the threat has impacted on this ecological community in the past.

Dieback disease

Russell Range is currently free of dieback disease but has the potential to significantly impact populations of dieback susceptible flora. A walk trail leading up to the top of the hill on Mt Ragged is open to the public and is therefore a potential point for introduction of dieback.

Too frequent fire

The community is potentially threatened from more frequent fire due to warmer temperatures and a significant reduction in rainfall which may result in more extreme fire behaviour. The entire range was last burnt by wildfire in 1991 and partly burnt in 2017/2018 (see figure below).

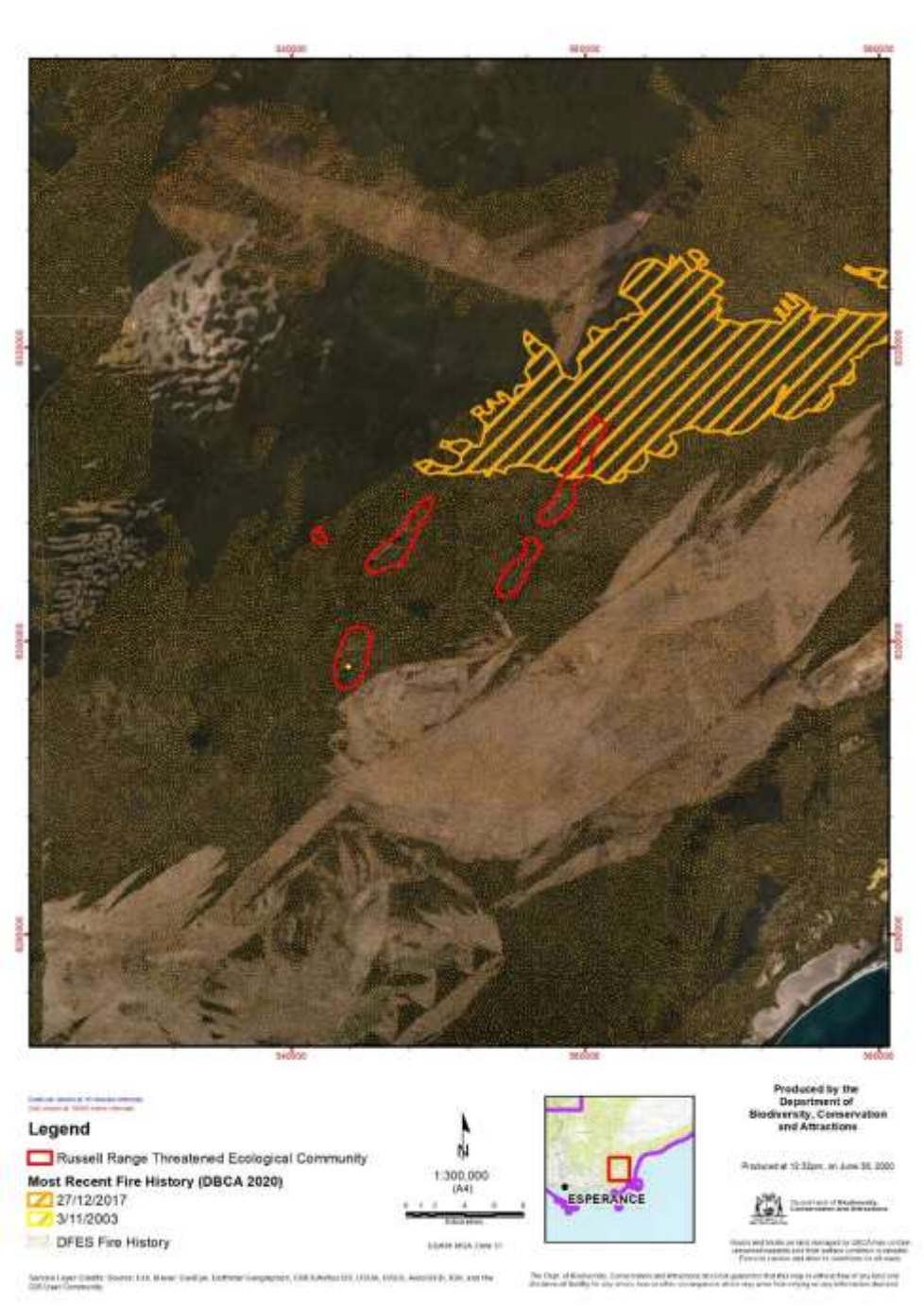

Figure 1. Portion of Russell Range community burnt in 2017/2018 fire.

Recreational activities

Pressure may occur from tourists from weed invasion, rubbish dumping, increased fire and introduction of dieback disease.

Drying and warming climate

Reduced rainfall may lead to more extreme fire behaviour resulting from higher temperatures and a greater number of severe fire danger days, and promote spread of *Phytophthora cinnamomi* by increasing the periods of warm, moist soil conditions in which the organism is most active and at highest risk of spreading.

322 b. What its expected effects are in the future. Include or reference supporting research or information.

- Dieback disease is the most significant threat to the community and will likely result in extensive changes in the composition of the ecosystem through local extinction or severe reduction in populations of defining plant species particularly in the Proteaceae, Eriacaeae and Fabaceae families may occur through the introduction of dieback disease. "The impact of the plant pathogen *P. cinnamomi* and the fungicide phosphite on species assemblages, richness, abundance and vegetation structure was quantified at three sites in Kwongkan communities in the Southwest Australian Floristic Region. Healthy and diseased vegetation treated with phosphite over 7–16 years was compared with non-treated healthy and diseased vegetation. After site differences, disease had the greatest effect on species assemblages, species richness and richness within families. Disease significantly reduced cover in the upper and lower shrub layers and increased sedge and bare ground cover. Seventeen of 21 species assessed from the families Ericaceae, Fabaceae, Myrtaceae and Proteaceae were significantly less abundant in non-treated diseased vegetation. In diseased habitats, phosphite treatment significantly reduced the loss of shrub cover and reduced bare ground and sedge cover" Barrett and Rathbone (2018).
- It is likely that frequent intense fires will continue to threaten the integrity of the community through impacting on species diversity and encouraging weed invasion.
- With increasing population size it is likely that tourists visiting the area will increase, potentially resulting in an increase in weeds, rubbish, fire and the introduction of dieback disease.
- The Russell Range mixed thicket complexes community is at risk from a drying climate with effects such as loss of vegetation from reduced surface water due to reduced rainfall; more extreme fire behaviour resulting from higher temperatures and a greater number of severe fire danger days; and spread of *Phytophthora cinnamomi* by increasing the periods of warm, moist soil conditions in which the organism is most active and at highest risk of spreading. The tolerance of particular species to changes that may occur in association with a drying climate, including changes in rainfall and temperatures, is generally unknown. Climate change predictions for south-western WA are as follows (from NCCARF website: (https://www.nccarf.edu.au/sites/default/files/attached_files_publications/PDF%20Report%20Card%20Low%20Res.pdf); accessed May 2019):
  - Rainfall will reduce by 2-14% (median 8%) by 2030, compared to 1975- 2007 baseline. Southwest is predicted to experience some of the largest reductions in rainfall in all of Australia.
  - Runoff will reduce by 10-42% (median 25%) by 2030, compared to 1975- 2007 baseline.
  - Temperature will increase by 0.5 -2.0ºC by 2030, compared to 1960-1990 baseline.

322 c. Identify whether the threat only affects certain portions or occurrences. Give Details.

Recreational activities has implications for areas of the community that contain a relatively intact ecosystem and likely to affect the Mount Ragged as the walking trail traverses the occurrence. The remaining threats listed above are likely to affect all occurrences. Negative impacts that result from recreational activity include braiding of tracks, erosion, bare-ground occurrences, camp-fire remains, litter and nutrient enrichment of soils and introduction or spread of different isolates of *P. cinnamomi*.

33. Identify any natural catastrophic event/s

Explain its likely impact and indicate the likelihood of it occurring (e.g. a drought/fire in the area every 100 years). Catastrophic events are those with a low predictability that are likely to severely affect the ecological community.

Climate models for southern WA predict warmer temperatures and a significant reduction in rainfall. This may result in loss of vegetation due to changes in the hydrological regime from a decline in rainfall, as well as more extreme fire behaviour, the result of higher temperatures and a greater number of severe fire danger days.

The incidence of more frequent and intense fires is likely. Major fires can occur any time and have potential for major impacts to the structure of the community, increasing weed invasion.

34. Additional biological characteristics

Identify and explain any additional biological characteristics particular to the community or species within it that are threatening to its survival (e.g. low genetic diversity). Identify and explain any models addressing survival or particular features.

34 a. How does it respond to disturbance?

Any disturbance to the community is likely to lead to an increase in the risk of introducing and spreading dieback disease. It is likely this will result in extensive changes in the composition of the ecosystem through local extinction or severe reduction in populations of defining plant species particularly in the Proteaceae, Eriacaeae and Fabaceae families.

Frequent intense fires threaten the integrity of the community through impacting on species diversity and encouraging weed invasion. Recovery of the Russell Range mixed thicket complexes community following fire is likely to be slow as many species are fire-sensitive and much of the soil seedbank is likely to be destroyed by fire.

Drying climate needs to be considered when designing appropriate fire regimes. It is likely that reduced rainfall will cause diminishing growth rates, and plant maturation times may also therefore increase. Longer inter-fire intervals are therefore likely to be desirable.

344 b. How long does it take to regenerate and/or recover?

Unknown

Threat Abatement and Recovery

35. Identify key management documentation available for the ecological community, e.g. recovery plans, biodiversity management programmes, or site specific management plans (e.g. for a reserve).

- Department of the Environment (2014) Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi*. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/threat-abatement-plans/approved. In effect under the EPBC Act from 31 January 2014.
- Department of the Environment (2014) Threat abatement plan for competition and land degradation by rabbits. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/threat-abatement-plans/approved. In effect under the EPBC Act from 31 January 2014.
- Department of Parks and Wildlife (2015) Corporate Policy Statement No. 3 *Management of* Phytophthora *disease*. Department of Parks and Wildlife, Western Australia.

36. Give an overview of how threats are being/potentially abated and other recovery actions underway and/or proposed. Identify who is undertaking these activities and how successful the activities have been to date.

Key measures required to mitigate risks to the ecosystem including minimising the threat of introduction of dieback disease, minimising the impacts from sources other than climatic drying, and managing fire. The lands on which the ecosystem occurs is all within managed national park and a nature reserve, and effective management of threatening processes across the ecosystem's range will require continued funding to abate threatening processes.

37. What portion of the current extent of the ecological community is protected in a reserve set aside for conservation purposes, and what proportions are private land, or other tenure? Give details including the name of the reserves, and the extent the ecological community is protected within these reserves.

The entire extent of the Russell Range mixed thicket complexes community occurs within the Cape Arid National Park (R24047), Nuytsland National Park (R 27632) and an unnamed nature reserve (R41934), both vested in the Conservation and Parks Commission managed by DBCA for the purposes of national park and conservation of flora and fauna.

378 a. Which of the reserves are actively managed?
Note which, if any, reserves have management plans and if they are being implemented.

All occurrences occur on lands managed by Parks and Wildlife Service, South Coast Region, DBCA.

378 b. Give details of any other forms of protection, such as conservation covenants, and whether the protection mechanisms are permanent.

Tenure: A Class Crown reserve (National Park); nature reserve.

378 c. Indigenous interests

Is the nominated ecological community or parts thereof known to occur on any culturally significant sites? If so comment on any issues with respect to aboriginal interests, in particular with regard to management of the ecological community.

No general significance to indigenous people has been identified for the ecological community. An Aboriginal Sites Register is kept by the Department of Aboriginal Affairs and lists one site (artefacts/scatter/quarry/named place/water source) within the vicinity of the occurrence on Mt Ragged.

378 d. Native Title

Do Native Title or Indigenous Protected Areas apply to any parts of the community? If so comment on any issues with respect to exclusive possession and rights to plants and animals, in particular with regard to management of the ecological community.

A native title exists in the entire area containing the Russell Ranges, lodged by the NGADJU people (WCD2014/004) in 2014.

39. Give details of recovery actions that are or could be carried out at the local and regional level, e.g. develop and implement management plan for the control of specific weed species (regional), undertake weeding of known sites (local).

Recovery actions that could be carried out locally include survey for new occurrences, monitoring of condition, mapping of boundaries, management of recreational activities and disease management.

40. Is there an existing support network for the ecological community that facilitates recovery? e.g. an active Landcare group, Conservation Management Network.

DBCA's Esperance District is largely responsible for initiating and guiding actions and securing funds, in liaison with the Esperance District Threatened Flora Recovery Team. Team members include community members, representatives from land care groups, scientific experts and researchers in the fields of conservation biology, botany, ecology. Reports are prepared by the department annually and include review of progress of the recovery plan, implementation of recovery actions and results of analysis of monitoring within an adaptive management framework. Volunteers and recovery team members may assist in a diverse range of on ground activities, including survey and monitoring.

41. Describe methods for identifying the ecological community including when to conduct surveys.

For example, season, time of day, weather conditions; length, intensity and pattern of search effort; and limitations and expert acceptance; recommended methods; survey-effort guide. Include references.

Surveys for the Russell Range mixed thicket complexes community should be conducted in the spring to determine the full suite of native species present. The following should be recorded to identify the community:

- Landform, rock type, soil type and colour, drainage
- Vegetation classification, flora species (as compared to Barrett 1996)
- Condition including vegetation structure. Condition classes will also need to incorporate the fire history, dieback disease presence and the abundance of major weed species.

A flora species list should be compared against that provided in The Mountain Top survey (Barrett 1996).

Data collected should include that outlined on a community Report Form located on the web (refer https://www.dpaw.wa.gov.au/images/documents/plants-animals/monitoring/forms/TEC_Occurrence_Report_Form_v6_July2013.pdf).

42. Are there other any aspects relating to the survival of this ecological community that you would like to address?

Section 3 - Justification for this nomination

In order for the nomination to be considered further, one or preferably more of the following criteria need to be fulfilled and substantiated. A clear case for why the ecological community is eligible for listing under the criteria is required, including evidence as to how it meets the requirements for listing under a particular listing category, e.g. 'David *et al*. (1999) finding of 95% decline in geographic distribution suggests it should be listed as critically endangered'. The type of data available will determine which criteria will be used to justify the application of a listing category.
At least one criterion must trigger the thresholds of a listing category as indicated in the Attachment. Criteria may be of different levels of listing category e.g. Criterion 1 = CR and Criterion 3 = VU.

43. Provide data that demonstrates why the ecological community meets at least one of the following criteria for the nominated listing category.

Please use data provided in previous sections to demonstrate how it specifically meets at least one of the following criteria. Advice on how to interpret the listing criteria is in Attachment A. Provide a response for every sub-criterion.

Criterion A: Reduction in geographic distribution.

Criterion A	
☐ CR ☐ EN ☐ VU ☒ not eligible	☐ **A1** ☐ **A2a** ☐ **A2b** ☐ **A3**

Justification for assessment under Criterion A:

For criteria A and B, the ecosystem was assumed to collapse when the mapped distribution declines to zero.

Russell Range mixed thicket complexes community has not incurred a ≥30% reduction at least in geographic distribution over any 50-year period, or a ≥50% reduction since ~1750 (ie. the minimum requirements to meet the category VU under criterion A).

Does not meet Criterion A.

Criterion B: Restricted geographic distribution.

Criterion B	
☐ CR ☐ EN ☒ VU ☐ not eligible	☐ **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 for assessment under Criterion B:

B1: The extent of a minimum convex polygon enclosing the Russell Range mixed thicket complexes community is 182km^2 (≤2,000km^2, which is less than the threshold for CR).
B2: The Russell Range mixed thicket complexes community is estimated to occupy five 10 × 10km square grid cells (threshold for EN is 20 and for CR is two grid cells).
a): Inadequate data are available to measure decline in spatial extent, environmental quality or disruption to biotic interactions.
b): Current level of impact from dieback disease and fire is minimal.
c): Ecosystem exists at four threat-defined locations based on the distance between occurrences, topography and presence of continuous vegetation in-between, and the potential spread of dieback disease and fire (threshold for CR is one and for EN is five threat-defined locations).
B3: Known from four threat-defined location based on the distance between occurrences, topography and presence of continuous vegetation in-between, which are prone to effects of human activities or stochastic events, such as the introduction of dieback disease and fire, 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 defied locations).

Meets criterion VU B3

Criterion C: Environmental degradation based on change in an abiotic variable.	
Criterion C ☐ CR ☐ EN ☐ VU ☒ not eligible	☐ **C1** ☐ **C2** ☐ **C3**
Justification for assessment under Criterion C: C1, C2, C3: There is a lack of survey and monitoring data available to provide numerical measures of the health of the ecosystem. However, introduction of dieback disease to the soil is likely this will have a severe impact on the community's health and structure. However, it is not possible to predict the extent and relative severity of the impact. No available data support an inference that the community does not meet the minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over any 50-year period to meet VU. Climate change predictions for the south west region of the state show a 2 to 14% reduction in rainfall by 2030 (from NCCARF). It is expected that future changes to community from a decline in rainfall resulting from drying climate, higher water temperatures will impact on the community. Based on lack of historical monitoring data, the likely relative severity of the changes and their impacts on the community is uncertain. **Does not meet criterion C**	
Criterion D: Disruption of biotic processes or interactions based on change in a biotic variable.	
Criterion D ☐ CR ☐ EN ☐ VU ☒ not eligible	☐ **D1** ☐ **D2** ☐ **D3**
Justification for assessment under Criterion D: D1, D2, D3: The most significant biotic variable affecting the community is considered to be the changes in floristic composition as a result of dieback disease. Collapse under criterion D is defined as a decline in vegetation condition to totally degraded (Bush Forever scales; ie beyond recovery) as a consequence of dieback. At present, Russell Range is dieback free, therefore the community is considered to have 0% of its extent subject to disruption of biotic processes with a significant and measurable level of severity in relation to collapse. The community therefore does not meet the minimum thresholds to meet vulnerable under criterion D: ie 30% % of the extent of the community affected to at least 30% severity over any 50-year period; or the minimum proportion of the extent (≥50%) or proportional severity of disruption of biotic processes (≥50%) since ~1750. **Does not meet criterion D**	
Criterion E: Quantitative analysis that estimates the probability of ecosystem collapse.	
Criterion E ☐ CR ☐ EN ☐ VU ☒ not eligible	
Justification for assessment under Criterion E: The ecosystem could not be assessed under Criterion E as no quantitative estimates of the risk of ecosystem collapse have been completed.	

Section 4 – References/Standard of Scientific Evidence/Critical habitat

Note: The opinion of appropriate scientific experts may be cited (with their approval) in support of a nomination. If this is done the names of the experts, their qualifications and full contact details must also be provided in the reference list below. Harvard style of referencing is preferred.

44. Please provide copies of key documentation/references used in the nomination.

Barrett, S. (1996) Biological survey of mountains of southern Western Australia. Unpublished report by the Department of Conservation and Land Management for the Australian Nature Conservation Agency.

Barrett, S. and Rathbone, D. (2018) Long-term phosphite application maintains species assemblages, richness and structure of plant communities invaded by *Phytophthora cinnamomi*. *Austral Ecology* 43(4): 360–374.

Bates, B. C., Hope, P., Ryan, B., Smith, I. and Charles, C. (2008) Key findings for the Indian Ocean Climate Initiative and their impact on policy development in Australia. Climate Change 89: 339–54.

Beard, J.S. (1973) The vegetation of the Esperance and Malcolm areas, Western Australia: map and explanatory memoir, 1:250,000 series. Vegetation Survey of Western Australia.

CSIRO (2007) Climate Change in Australia: Technical Report 2007. CSIRO Bureau of Meteorology, Melbourne.

Government of Western Australia (2000) Bush Forever. Department of Environmental Protection, Perth.

Keighery, B.J. (1994) Bushland Plant Survey. A Guide to Plant Community Survey for the Community. Wildflower Society of Western Australia (Inc.), Nedlands, Western Australia.

Lowry, D.C. and Doepel, J.J.G. (1974) Malcolm-Cape Arid. Geological Survey of Western Australia: 1:250,000 Geological Series Explanatory Notes. Geological Survey of Western Australia.

45. Statement on the Standard of Scientific Evidence

Published data on the Russell Range mixed thicket complexes community was sufficient to apply the Red List of Ecosystem criteria, although there are likely to be inaccuracies in various aspects of the assessment. However, the outcomes of the assessment are robust.

46. Has this document been reviewed and/or have relevant experts been consulted?
If so, indicate by whom and provide their contact details.

Conservation Officer (flora/fauna), DBCA Esperance District

Ecologist, DBCA Species and Communities Program

47. Do you wish to propose any areas of habitat for consideration as Critical Habitat for the nominated community?
If so, refer to Ministerial Guideline No 5 and attached a separate nomination proposal addressing the matters required under that guideline. Indicate location/s including a map, and attached shapefiles.

Section 5 - Nominator Details & Declaration

48. Contact Details

Note: Nominator details are subject to the provision of the *Privacy Act 1988*

Title/Full Name	[redacted]
Organisation or Company name	Department of Biodiversity, Conservation and Attractions
Postal address	17 Dick Perry Avenue, Kensington Post: Locked Bag 104, Bentley Delivery Centre, WA 6983.
Email	[redacted]@dbca.wa.gov.au

Phone	9219 [redacted]
Fax	
49. Declaration	
Signature (Or insert electronic signature)	***I declare that the information in this nomination form and any attachments is true and correct to the best of my knowledge***.
Date signed	

Table 1: Summary assessment against IUCN RLE Criteria

Criterion	Rank indicated	Overall conclusion
A1	-	• Available data do not indicate community meets criterion
A2a	-	• Available data do not indicate community meets criterion
A2b	-	• Available data do not indicate community meets criterion
A3	-	• Available data do not indicate community meets criterion
B1a	-	• EOO is ≤2,000km^2 • No available data indicate decline in spatial extent, environmental quality or disruption to biotic interactions that would meet lowest thresholds of the criterion (VU) • Does not meet criterion
B1b	-	• EOO is ≤2,000km^2 • Current threat from fire and dieback disease is considered 'trivial'; inferred future changes from drying climate • Does not meet criterion B as overall threats are considered 'trivial'
B1c	-	• EOO is ≤2,000km^2 • Ecosystem exists at four threat defined locations based on the topography of occurrences, distance between and potential spread of dieback disease and fire • Does not meet criterion B as overall threats are considered 'trivial'
B2a	-	• AOO is five grid cells • No data available that indicate decline in spatial extent, environmental quality and disruption to biotic interactions that meets minimum thresholds of the criterion (VU) • Does not meet criterion
B2b	-	• AOO is five grid cells • Current threat from dieback and fire considered 'trivial' • AOO indicative of rank EN however does not meet B2b, as overall level of threat is considered 'trivial'
B2c	-	• AOO is five grid cells • Ecosystem exists at four threat-defined locations based on the topography of occurrences, distance between and potential spread of dieback disease and fire • AOO indicative of rank EN however does not meet B2b, as overall level of threat is considered 'trivial'
B3	VU	• Known from four threat-defined locations • Prone to the effects resulting from dieback disease, fire and drying climate • Meets criterion for VU
C1	-	• Does not meet the minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over past 50 years to meet VU.
C2	-	• Does not meet the minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over any 50-year period to meet VU.
C3	-	• Does not meet the minimum thresholds for proportion of the extent (≥50%) or proportional severity of disruption of abiotic processes (≥50%) since ~1750 to meet VU.
D1	-	• Does not meet 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	-	• Does not meet 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	-	• Does not meet 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.
		Meets VU under B3

Section 6 – Completed nomination form checklist

Please check all items on this list have been completed or are included with your nomination.

- ☐ I have read and applied the further information and guidelines for completing this nomination form in Attachment A
- ☐ Nominator details including name, address contact phone number included
- ☐ Name of the EC
- ☐ Any other names it is known by
- ☐ Map included or attached
- ☐ References cited
- ☐ If questions are left unanswered, a statement indicating that insufficient information is available

A description of:

- ☐ Biological components of the ecological community
- ☐ Non biological components of the ecological community
- ☐ Key interactions and functional processes
- ☐ Characters distinguishing it from other ecological communities
- ☐ Key species (dominant, characteristic or diagnostic, threatened etc)
- ☐ Known or estimated current extent of the ecological community
- ☐ Past/current/future threats including actual/potential, how/ where, how being/how could be abated
- ☐ Which listing category/categories it should be listed under and why

How to lodge your nomination

Completed nominations may be lodged either:

1. by email to: **communities.data@dbca.wa.gov.au**

If submitting by email, please also mail hard copies of attachments that cannot be emailed.

OR

2. by mail to: Species and Communities Branch
Department of Biodiversity, Conservation and Attractions, WA Government
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

If submitting by mail, please include an electronic copy on memory stick or CD.

Appendix 1. Russell Range mixed thicket complexes community