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GOVERNMENT OF WESTERN AUSTRALIA

Nomination *(to be completed by nominator)*

Current conservation status	
Name of ecological community:	Shrublands and woodlands on Muchea Limestone of the Swan Coastal Plain
Other names:	Muchea Limestone community
Description:	**Shrublands and woodlands on Muchea Limestone of the Swan Coastal Plain** The community occurs on the heavy soils of the eastern side of the Swan Coastal Plain between Beermullah and Wokalup. It is defined on the basis of geomorphology, specifically substrates with a limestone influence. Many of the species are commonly associated with the limestone soils that occur on the coast, and do not generally occur further inland. Typical and common native species in areas of best developed limestone are: the tree *Casuarina obesa* (swamp sheoak); the mallees *Eucalyptus decipiens* (redheart) and *Eucalyptus foecunda* (narrow-leaved red mallee); the shrubs *Melaleuca huegelii* (chenille honey-myrtle), *Alyogyne huegelii* (lilac hibiscus), *Grevillea curviloba* (endangered) and *Grevillea evanescens* (priority 1), *Melaleuca systena* (narrow-leaved paperbark); and the herb *Thysanotus arenarius* (fringed lily). Where the limestone substrate is less well developed and limestone may occur as nodules or chunks, the flora assemblages can be influenced by other characteristics of the substrate, such as clay content, with the presence of calcicoles such as *Thysanotus arenarius, Gahnia trifida* (coast saw-sedge), *Eremophila glabra* (tar bush) and *Melaleuca brevifolia* (mallee honey-myrtle), providing evidence of the limestone influence. *Melaleuca huegelii* shrublands, *Eucalyptus decipiens* mallee, *Casuarina obesa* woodlands and *Melaleuca brevifolia*, *Melaleuca systena* or *Melaleuca viminea* shrublands are recorded on Muchea Limestone. The limestone substrate upon which this community occurs has been preferentially targeted for clearing for access to limestone.
Nomination for:	Listing ☒ 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	16/07/2000	Endangered	2 (a), (d) and (e) under EPBC Act criteria
Western Australia	TEC list: WA Minister ESA list in policy	6/11/2001	Endangered	EN B) ii) under previous ranking criteria developed in WA
	Priority list		1 ☐ 2 ☐ 3 ☐ 4 ☐	
Other State/Territory				

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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 3 table 'IUCN Red List Criteria for ecosystems version 2.2'.*	Endangered A3; B1b; B2b

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 EN-CR**
	Justification of assessment under Criterion A.	For criteria A and B, the ecosystem is assumed to collapse when the mapped distribution declines to zero. IRP (2000) The Muchea Limestone soil type mainly occurs on the eastern side of the Swan Coastal Plain, an area that is approximately 97% cleared (Department of Conservation and Land Management (CALM) 1990) as the heavy soils were useful for agricultural purposes. An additional impact on the community has been the mining of the limestone. It is assumed that the reduction in extent of native vegetation on the vegetation complexes that support the community is indicative of the level of clearing of this community. The statistical data for clearing of vegetation complexes are provided in Government of Western Australia (2019). The Muchea Limestone community occurs within the Mungala complex (90% cleared), Yanga complex (84% cleared), Southern River complex (82% cleared), Guildford complex (95% cleared) and the Bassendean central and south complex (73% cleared). The level of clearing in the relevant complexes therefore ranges from 73% to 95% (Government of Western Australia 2019). The timing of the clearing is not known so is inferred to be since 1750. Based on the above assumptions, the community plausibly meets EN to CR under criterion A3. The community plausibly meets the threshold for criterion EN under A3 for which the reduction in geographic distribution is ≥ 70% since approximately 1750. CR is also plausible

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		under A3, for which the threshold the reduction in geographic distribution is ≥90% since 1750. Only a portion of the distribution of the community has been subject to a decline in vegetation complexes that meets the criteria for critically endangered (≥90% since 1750). A rank of EN under A3 is more robust. • **Plausibly meets EN to CR under criterion A3** (EN is considered more robust).
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.	• B1: EOO is 3176.57 km^2 (≤20,000km^2 - the threshold for EN). • B2: AOO is 8 x 100km^2 (occupies eight 10x10 km^2 grid cells which is ≤20 – the threshold for EN). • b): Continuing or inferred threatening processes that are likely to cause continuing declines in the next 20 years include land clearing, altered hydrology (declining groundwater levels and quality), weed invasion, grazing by native or introduced fauna, and altered fire regimes. • Estimated to occur at 13 threat-defined locations based on occurrences in close-proximity that are likely to be affected by localised threats such as bushfires, and impacts to local aquifers. Does not meet criteria for B1c, B2c, or Vulnerable under B3 as there are more than 10 threat-defined locations. • **Meets criteria for Endangered B1b; B2b**
C.	Environmental degradation of abiotic variable *(Evidence of decline over 50-year period)*	☐ **C1** ☐ **C2** ☐ **C3**
	Justification of assessment under Criterion C.	• C1, C2: Altered hydrology in the form of declining groundwater or altered seasonality of surface water is a significant abiotic variable affecting the community. Collapse in this context is assumed conservatively if the watertable depth fell to about 10.5 m below ground surface based on the maximum water depth accessed by deep rooted phreatophytic taxa in nearby areas. • There are inadequate quantitative data to indicate if the community meets the minimum proportion of the extent (≥30%) or proportional severity of disruption of abiotic processes (≥30%) over any 50-year period, or threshold

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		proportion of the extent (≥50%) or proportional severity of disruption of abiotic processes (≥50%) since 1750 to meet criterion C. • **Insufficient evidence exists to indicate 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.	• D1, D2: Weed invasion is a significant biotic variable affecting the community. The severity of weed invasion associated with collapse is uncertain, but it is assumed conservatively that the community reaches a collapsed state when only 10% (plausible range 0–20%) of the vegetation cover is native plant species. • Decline in vegetation condition between subsequent surveys is indicated in some occurrences (see table below, Occurrences BOOT01, PASSMORE01, CAROUSEL01, BRENTWD15) but was not recorded for all occurrences of this ecological community. • Systematic quantitative monitoring data indicative of changes in weed levels were not available to support assessment against criterion D. • Insufficient quantitative data are available for weed invasion that would indicate if the community meets thresholds for extent (≥30%) or proportional severity of disruption of abiotic processes (≥30%) over any 50-year period, or threshold proportion of extent (≥50%) or proportional severity of disruption of biotic processes (≥50%) since 1750 to meet criterion D. • **Insufficient quantitative evidence to indicate if community meets criterion D**
E.	Quantitative analysis *(statistical probability of ecosystem collapse)*	• No quantitative estimates of the risk of ecosystem collapse has been completed. • Unable to assess

Reasons for change of status

Genuine change ☐ New knowledge ☐ Previous mistake ☐ Review/Other ☒

Provide details: The community was initially ranked as Vulnerable using ranking criteria developed in WA that do not match 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	3176.57 km^2	AOO	8 x 10 km^2 grid cells (10x10km grid method).
No. locations	16 mapped occurrences	Severely fragmented	Yes ☒ No ☐ Unknown ☐

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Current known area	196.1 ha
Pre-industrialisation extent or its former known extent (if known)	Based on 73-95% clearing, estimated original area is 726ha to 3920ha.
Estimated percentage decline	Level of clearing of vegetation complexes ranges that support the community ranges from 73% to 95% (Government of Western Australia 2019).

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Table 1: Summary assessment against IUCN RLE Criteria

Criterion	Rank indicated	Overall conclusion
A1	-	• Available data do not indicate if community meets criterion
A2a	-	• Available data do not indicate if community meets criterion
A2b	-	• Available data do not indicate if community meets criterion
A3	EN-CR	• Historical decline of more than ≥73 to 95% in geographic distribution • Plausibly meets Cr to EN but EN is more robust
B1a	-	• EOO is 3176.57 km² ≤20,000km² • There is no appropriate data to indicate decline in a measure of spatial extent, environmental quality or disruption to biotic interactions that would meet minimum thresholds of the criterion (VU) • Does not meet criterion
B1b	EN	• EOO is 3176.57 km² ≤20,000km² • Threatening processes likely to cause continuing decline include land clearing, altered hydrology, weed invasion, grazing, altered fire regimes. • Meets criterion for EN
B1c	-	• EOO is 3176.57 km² ≤20,000km² • Ecosystem exists at more than 10 threat-defined locations • Does not meets criterion
B2a	-	• AOO is eight grid cells • Inadequate data available to indicate decline in a measure of spatial extent, environmental quality or disruption to biotic interactions • Does not meet criterion
B2b	EN	• AOO is eight grid cells • Threatening processes likely to cause continuing decline include altered hydrology, weed invasion, grazing, altered fire regimes. • Meets criterion for EN
B2c	-	• AOO is eight grid cells • Ecosystem exists at more than 10 threat-defined locations • Does not meet criterion
B3	-	• Ecosystem exists at more than 10 threat-defined locations • Does not meet criterion
C1	-	• Inadequate evidence to indicate if community meets the minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over past 50 years to meet VU.
C2	-	• Inadequate evidence to indicate if 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	-	• Inadequate evidence to indicate if 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	-	• Inadequate evidence to indicate if 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.
D2	-	• Inadequate evidence to indicate if 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.

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D3	-	• Inadequate evidence 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.
		EN to CR are plausible under A3. Meets EN under B1b and B2b. Plausible range of rank: EN to CR. The vegetation clearing data that support a plausible rank of CR under A3 only cover part of the known distribution of the community, so EN under A3 is more robust. Community is close to meeting rank of critically endangered. *The highest risk category obtained by any of the assessed criteria will be the overall risk status of the ecosystem'* (IUCN RLE Guidelines V1.1 page 42). **Plausibly meets EN under A3, B1b and B2b.**

Table 2: 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 required
2. VINESSE	Reserves, freehold and other public lands. DBCA Nature Reserve, R49300	05/12/2001	Good 10%, Excellent 90%	36.3	Clearing (past), weed invasion, too frequent fire, trampling, rubbish dumping (present, future)	Weed control
3. BOOT01	Bootine Nature Reserve R 45035	2/09/2016	Good 50% Excellent 50%.	64.9	Weed invasion, grazing by cattle (present)	Fence maintenance, weed control
5. BEER01	Freehold McVee Rd Beermullah, Shire of Gingin	Surveys 2005, 2007, 2017	Very Good 100% in 1995, 2001 and 2007, Good-Very Good (2017)	7.2	Weed invasion (present, future)	Weed control
6. mypearce01	Freehold - Pearce Airforce Base: Commonwealth Government of Defence	7/1//2002	Good 90% Excellent 10%	13.0	Clearing, too frequent fire, grazing, weed invasion (past, present, future)	Weed control
7. PIN01	Freehold Beermullah Rd Gingin	25/5/2007 Floristic plot established. Survey of	Excellent 100%	4.8	Weed invasion, grazing by native or introduced species, too	Fencing maintenance required

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		extend and condition 2017	Very Good-Excellent		frequent fire (present, future)	
8. KEMERTON01	Freehold National Park	2003, 2005, rescoring of flora plots 13/11/2003	100% Excellent in 2003 and 2005	41.2	Clearing, grazing, weed invasion, hydrological changes (past, present, future), hydrological change (future), feral pigs (present – new issue)	Weed control, feral pig management, monitor hydrology
9 PASSMORE01	WA Planning Commission	Surveys 2002, 2004, and 2015 of condition, threats and extent	Very good 40%, Excellent 50%, Degraded 10%	16.3	Weed invasion, recreational impacts, rubbish dumping, too frequent fire (past, present, future)	Control weeds, manage fire
10 CAROUSEL01	Freehold private; and Western Power.	2004, 2008, 2019 surveys of vegetation extent and condition.	100% Excellent in 2004. 2019: Completely Degraded 25%, Degraded 10%, Good 15%, Very Good 20%, Excellent 30%	5.7	Weed invasion, rubbish dumping too frequent fire (past, present, future)	Remainder of site requires fencing, weed control, fire management
12 BROOKRD04	Freehold Brook Rd Kenwick,	2010 survey of extent and condition	100% Very Good	0.44	Grazing, too frequent fire (past, present, future)	Manage fire
14 BRENTWD09	Freehold Brentwood Rd Kenwick,	Surveys in 2007, 2008 and 2015.	50% Good, 25% Degraded 25% Very Good	1.31	Weed invasion, too frequent fire (past, present)	Weed control, fire management
15 BRENTWD15	Freehold	Surveys in 2007 and 2008, 2014 -	50% Good 50% Very Good	1.1	Weed invasion, grazing, (present), potential hydrological change (future)	Weed control, fencing, monitor hydrology

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16 BROOKRD20	Freehold Brook Road Kenwick,	Surveys 2007, 2014	100% Good	0.9	Clearing (past); weed invasion, grazing, hydrological change (present, future)	Weed control, fencing, monitor hydrology
17 BRENTWD26	Freehold	Survey in 2008, 2014	100% Good	0.7	Clearing (past, future), weed invasion, grazing (present, future)	Weed control, fencing
19 Kenwick02	Freehold Bickley Rd Kenwick VAC Reserve	Surveys in 2013	100% Degraded	0.3	Weed invasion, fire (present, future), partial clearing (past)	Weed control, fire management
20 BICKLEYRD05	Freehold VAC Reserve City of Gosnells	Surveys 2009, 2013 establishment of floristic plot	Very Good 50%, Excellent 50%	1.8	Clearing (past), weed invasion, grazing, too frequent fire (present, future) Highly impacted by industrialisation and groundwater decline.	Weed control, fire management, fencing
22 MUCHEA01	Crown Reserve (R 2336) Conservation and Parks Commission	14/7/1995 Survey of extend and condition 3/6/2016	100% Very good Good- Very Good	0.1	Clearing (past), weed invasion, grazing, too frequent fire (present, future)	Weed control, fire management, fencing

#Condition categories (from Keighery 1994; Government of Western Australia 2000):

- 'Excellent' - Vegetation structure intact, with disturbance only affecting individual species, weeds are non-aggressive species
- 'Very Good' - Vegetation structure altered, obvious signs of disturbance eg: from repeated fires, dieback, logging, grazing.
- '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.
- 'Degraded': Basic vegetation structure severely impacted by disturbance such as partial clearing, dieback, logging and grazing. Scope for regeneration but not to a state approaching good condition without intensive management.
- 'Completely degraded': 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.

APPENDIX 1 THREATS

Clearing

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Clearing for agriculture has been extensive on the heavy soils on the eastern side of the Swan Coastal Plain, where the Muchea Limestone soils occur. About 97% of all vegetation in the area was cleared historically (CALM 1990), and this community has suffered almost total destruction and severe fragmentation

Occurrences are now known from north of Gingin to Kemerton. The community occurs on soils mapped as Muchea Limestone or Plain limestone deposits in the Urban Geology Map Series (Anon 1976 a and b, 1977, 1978; Gozzard, 1982 a and b, 1983 a and b, 1986). The soils are frequently mounded up above the surrounding area and are likely to reflect areas of spring activity in the past, where carbonates have precipitated out of solution (McArthur and Bettenay 1960). The community was historically targeted for limestone resource so the level of clearing of the Muchea Limestone community may differ to other substrate types that occur on the eastern side of the Swan Coastal Plain.

Large areas of historically cleared and grazed Muchea Limestone substrate that occur as limestone outcropping are evident in the Gingin area ([1] [redacted] pers. obs.). Bush Forever (2000) Volume 2 refers to the System 6 update (1996) locating "vegetated areas of Muchea Limestone (presumed extinct in Gibson *et al*. 1994) and identified with these limestones (Keighery and Keighery 1995)". Gibson *et al*. (1994) refers to presumed destroyed community types; "*Several community types appear to have been totally destroyed in the study area over the last 100 years. It is difficult to know exactly what has been lost however in several case(s) the remaining native species or early botanical accounts indicate total community loss. For example, Gozzard (1982b) maps a small area of Muchea limestone (Qpm) as occurring in the Bullsbrook area. A careful search found no significant remnant vegetation on public lands. The few native species still occurring on this geology suggests it supported a significantly different community type than anything found on other remnants in the area today. It appears that the community may have been dominated by a suckering form of* Acacia saligna. *All occurrences of this geology on private lands appear to have been mined or converted to pasture or both.*"

Historically, the Muchea Limestone soils have been extensively mined for limestone. Plants that are obligate calcicoles are unlikely to regenerate once the limestone is removed from the soil profile.

The occurrence in Yurine Swamp, which is now a Nature Reserve, has been highly altered by mining.

Weed invasion

Disturbances such as fires and grazing can predispose areas to weed invasion if weed propagules are present. All of the occurrences of this community are close to weed sources such as urban or agricultural areas and are vulnerable to weed invasion following any disturbance. Weeds are also likely to be favoured by increased nutrient levels from animal droppings, as local species are generally adapted to more impoverished soils.

Hydrological changes

Muchea limestone relies on seasonal inundation of fresh water, either by surface flow or in some case in contact with groundwater. The community contains limited surface water during the wetter months in areas where it is seasonally inundated. This occurs on the heavier soils in particular.

A trend of falling water tables in the general area of the community is evident since around 1976 (Greay 1993). Altered surface flow and/or alteration of the height of the local water table may change the seasonality or depth of ponding. Dependence on surface and groundwater is of concern as community will likely be impacted by hydrological change across its range. Changes to the water table could have further implications for salinisation, particularly where groundwater is close to the surface and contains saline water. Areas overlying fresh groundwater on the Swan Coastal Plain are probably associated with low risk of salinisation (Davidson 1995). Saline soils were, however, recorded from the reserve on Bootine Road (occurrence 3 in Table 2). There are major horticulture proposals in Gingin that will likely be associated with groundwater decline, or rise with clearing, and salinization.

Pollution of the surface waters with animal droppings or fertilisers increases nutrient levels and hence favours weed invasion.

Grazing

[1] Valerie English; Principal Ecologist DBCA Kensington

Grazing of native vegetation causes alterations to species composition through selective removal of edible species, the introduction and enhancement of weeds by the addition of dung, and through trampling and general disturbance. Cattle have been recorded in some occurrences, and feral animals such as rabbits (*Oryctolagus cuniculus)* and pigs (*Sus scrofa*) that also been recorded in the community disturb the vegetation by grazing and burrowing.

Most occurrences have been subject to some degree of historical grazing by stock or rabbits, and some are subject to occasional stray cattle.

Altered fire regimes

Bushfires or prescribed burns need to occur at appropriate intervals, and possibly at the appropriate season and intensity, to sustain the integrity of plant communities.

Too frequent fire can increase the risk of invasive weeds establishing within small bushland remnants (Abbot and Burrows 2003). It is likely that the fire regime in the remnants that containing the community has been modified to more frequent fires, especially hot burns, since European settlement. Occurrence 10 in particular has been subject to recent frequent fires, and an associated major increase in weeds.

The risk of fire is generally increased by the presence of grassy weeds in the understorey, as they are likely to be more flammable than many of the original native species in the herb layer. Many of the occurrences have not been burnt recently.

Burrows (2008) notes that there is no single optimum fire regime that will meet all management objectives, but that there are fire regimes that can be applied based on available evidence. Burrows (2008) recommended fire regimes based on vital attributes, regimes that provide for diversity of frequency, season and intensity, and provide habitat diversity, and a fine-grain mosaic of habitats. Burrows suggested that if these fire regimes are implemented in an adaptive management framework, they provide good data and can lead to better fire management.

Drying climate

Drying climate is likely to result in declining rainfall in the south west of the state (from NCCARF website accessed 27 March 2019:

https://www.nccarf.edu.au/sites/default/files/attached_files_publications/PDF%20Report%20Card%20Low%20Res.pdf).

Declining rainfall will likely result in declining groundwater levels, influx of fresh groundwater, and subsequent changes as follows:

- Reduction in rainfall by 2030 by 2-14% (median 8%). Southwest to predicted to experience some of the largest reductions in rainfall in all of Australia
- Reduction in runoff by 10-42% (median 25%) by 2030
- Decline in groundwater levels by 2030 (extractive yields may decrease by a third to a half in some areas).

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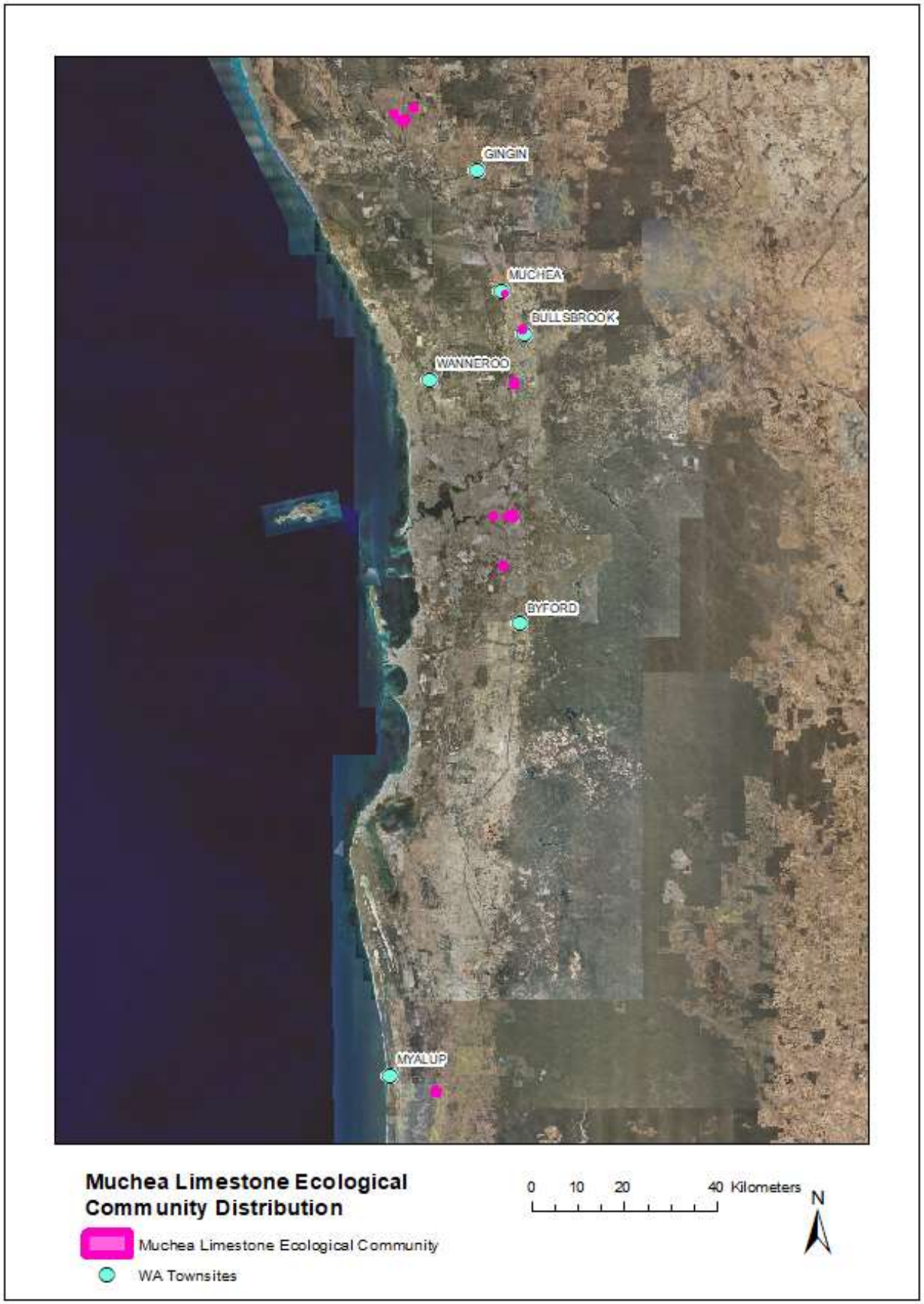
APPENDIX 2: Distribution of the shrublands and woodlands on Muchea Limestone of the Swan Coastal Plain community



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APPENDIX 3 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 km²	≤ 20,000 km²	≤ 50,000 km²
	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:

	≥ 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:

	≥ 90	≥ 70	≥ 50
≥ 90	CR	EN	VU
≥ 70	EN	VU	

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		≥ 50	VU		
D. Disruption of biotic processes or interactions over ANY of the following time periods:					
			Relative severity (%)		
		Extent (%)	≥ 80	≥ 50	≥ 30
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:	≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
			≥ 80	≥ 50	≥ 30
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	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
			≥ 90	≥ 70	≥ 50
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	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