Biodiversity Assessment:
Margaret River Montessori School

Property Summary
Property location: Lot 298 Clarke Rd, Margaret River
Catchment: Yalgardup Brook/ Margaret River
Date of assessment: October 2021
Present at Assessment: Drew McKenzie
Property Area: 2ha
Area of native remnant vegetation: ~ 1 ha

MARGARET RIVER montessori SCHOOL

Nature Conservation MARGARET RIVER REGION

FOR Nature INSPIRATION • CONNECTIONS • KNOWLEDGE

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1. Introduction

The following report has been prepared by Nature Conservation Margaret River Region in collaboration with the Margaret River Montessori School as part of the 'For Nature' Landholder Stewardship Program.

The report provides a brief description of the biodiversity values of the property including remnant vegetation and waterways on the property and identifies management issues needing to be addressed to protect and improve biodiversity values. Additionally, this plan supports and provides details to enable the integration of Wetland and Bushland Management Actions into educational structure and curriculum for the whole school body.

This report is based upon the values of the site at the time of the assessment. It should be noted that the report does not include a comprehensive flora and fauna survey and is limited by the seasonality (Spring) and duration of the site visit. The recommendations are based upon a 5 year time horizon for the plan.

2. Property in a landscape context

The property is located on Clarke Rd in the Yalgardup Brook and Margaret River catchment. It is comprised of one lot:

- Lot 298 Clarke Rd, Margaret River.

The property is surrounded by a mix of residential, commercial lands, playing fields and remnant vegetation. Significant tracts of private remnant vegetation exist to the west and south of the property.

The assessment focused on the remnant vegetation surrounding the central buildings.

3. Biodiversity assets

The property is a mixture of remnant vegetation, wetlands, school buildings, play areas and landscaping.

The remnant vegetation on the property was mapped by Havel & Mattiske (2000) for 'Vegetation Mapping of the South West Forest Regions of Western Australia'. It should be noted that this vegetation mapping was undertaken on a regional scale. It doesn't always accurately describe vegetation complexes on a local scale. The mapping described the following vegetation complexes on site.

Cowaramup wet (C1) – This complex is described as a "Open to tall open forest of *Eucalyptus marginata subsp. marginata-Corymbia calophylla-Banksia grandis* on lateritic uplands in the hyperhumid zone."

Remnant vegetation on the property have been assessed for condition using the Keighery vegetation condition scale (see Figure 1). The remnant vegetation on site ranges from very good to degraded. This scale is provided in Appendix 1.

It is noted that the critically endangered Western Ringtail Possums has been previously recorded on site and dreys and scat were noted and recorded on site during the assessment.

4. Management issues and advice

4.1 Environmental weeds

Priority environmental weeds that are highly invasive and have the potential to impact on biodiversity if they spread are shown in Figure 2. The remnant vegetation is largely free of excessively established high priority environmental weeds and control activities currently required to protect biodiversity are relatively minor and hence considered to be at manageable levels. If left too long these aggressive, high priority species are likely to replace native vegetation and require significantly more work. Control methods are provided in Appendix 4.

Amongst the high priority weeds be controlled are the following:

Watsonia (Watsonia sp)

Native to South Africa, it is now a common in the south west and serious weeds of roadsides, watercourses and railway lines, often invading bushland. Watsonia flowers in spring and early summer. It was the most widespread of the environmental weeds on the property and was found throughout the bushland.

Sydney golden wattle (*Acacia longifolia*)

A few mature Sydney golden wattle were recorded throughout the bushland as shown on Figure 2. This species is highly invasive, has very long lived seeds and can significantly alter vegetation communities and habitat values where it becomes established. This plant flowers from June through to August.

It is noted that, as is often the case, one of the Sydney Golden Wattles immediately to the south of the buildings had a Western Ringtail Possum drey located in it and shouldn't be disturbed.

Arum lily (*Zantedeschia aethiopica*)

One of the highest priority environmental weeds within the Capes, there was only a few plants observed during the assessment making control a very high priority.

Wavy Gladioli
(*Gladiolus undulatus*)

Wayy Gladioli were observed scattered through the bushland and wetland edge. Wavy Gladioli is spreading rapidly through the Capes and is definitely considered a high priority environmental weed.

Tambookie Grass
(*Hyparrhenia hirta)*

Tambookie Grass is considered as a high priority weed within the Capes and is spreading rapidly especially along road verges and slightly open or degraded vegetation. It is starting to get established along the northern verge.

4.2 Wetland Supplementary Planting revegetation

The wetland area has been heavily disturbed in the past but has been subject to some successful revegetation effort approximately 7 years ago. The central portion of the wetland is challenging for planting due to the extended period of relatively deep standing water over winter. In order to address this, planting should occur very early in the season,eg late March or early April or very late in the season as the water recedes at the end of Spring.

Supplementary planting would help provide additional benefits in terms of habitat for wildlife, water quality and aesthetics.

Appendix 3 contains a suggested species list for revegetation including a section specifically targeted for the riparian portions of the site.

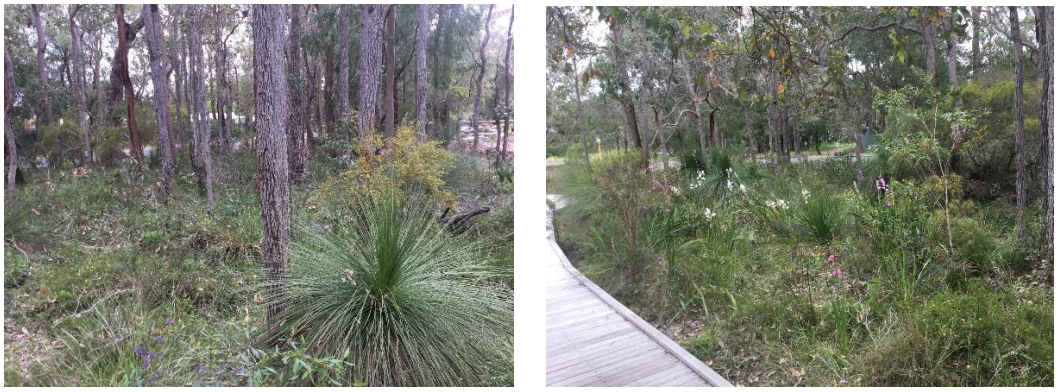
4.3 Remnant vegetation enhancement

The remnant vegetation stand assessed contains patches ranging from degraded through to very good condition.

Regeneration actions have the potential to significantly improve the condition and habitat value of these remnants. Primary actions to consider to assist the regeneration of these areas include:

- Control of priority environmental weeds within the remnants;
- Gradual, staged revegetation of areas mapped as degraded; and
- Regenerative burning and small rake and pile burns incorporated into fire management planning.

Small patch of degraded condition vegetation (adjacent Betts St)



Very good vegetation condition (with diverse native understorey note the presence of Watsonia even within these areas)

4.4 Phytophthora dieback and other plant diseases

Phytophthora cinnamomi is a soil borne pathogen causing the disease known as ‘dieback disease' or ‘jarrah dieback'. Early settlers introduced the pathogen into Australia and it has long been recognized as a serious threat to the flora of Western Australia. It has a wide host range and the name ‘jarrah dieback' is misleading as it can kill many species in the forest, woodland and sandplain communities in the south-west of Western Australia. Up to 22% of the plant species of the southwest may be susceptible.

The spread of this pathogen is facilitated by the movement of soil, plant material or water that is infested with spores, particularly under warm, moist conditions.

The presence of *Phytophthora* dieback can be difficult to determine without testing soil and plant samples. Plants susceptible to dieback (indicator species) are used to assess potential dieback presence (see Appendix 3).

Whilst occasional specimens of dieback susceptible species existed within the bushland they were largely isolated and susceptible indicator species were largely absent from the bushland. It is noted that significant areas of the remnant vegetation have had the understorey somewhat depleted making dieback interpretation difficult. However, it is suspected that dieback is likely present through the majority of the bushland. The eastern most corner contains a number of indicator species and may in fact be dieback free. No active dieback ‘fronts’ were observed during the site assessment.

Testing of soil and plant samples would be required to definitively confirm dieback presence. (Note: negative test results do not definitively rule out Phytophthora).

Recommended management in regard to *Phytophthora* dieback:

Recommendations in this case relate to minimising the spread and possible introduction of *Phytophthora cinnamomi*. Consider the following:

- Consider dieback testing and mapping to confirm the suspected dieback observations
- Consider treating the dieback susceptible species eg) Bull Banksia just south of the school buildings
- Monitor the eastern corner for any suspected dieback deaths
- Do not introduce or spread materials that may contain *Phytophthora cinnamomi* such as gravel, soil and mulch. Dieback-free gravel may be available. Crushed limestone does not harbour *Phytophthora cinnamomi*;
- Buy plants from NIASA accredited nurseries. Do you know if your local nursery or garden centre is accredited? If they are not accredited have they got procedures in place that minimise the threat of taking dieback home to your garden? For an up-to-date list of accredited nurseries in your area go to www.ngia.com.au/accreditation/niasa.asp
- Don't spread soil or mud around bushland in for example, footwear or tyres, in particular during spring & autumn; and
- Stick to tracks & paths when walking and using vehicles.

See the Dieback Working Group website at https://www.dwg.org.au/ for detailed information on testing for dieback and treatment options.

The fungal pathogen *Quambalaria coyrecup (*Marri Canker) is contributing to the decline in marri trees throughout the Margaret River region and was observed to be impacting some of the Marri’s through the property.

There is currently no definitive recommendations on management to protect trees from marri decline. Undertaking management that will protect and enhance the environmental conditions surrounding affected marri trees may help. This includes restricting stock access, planting and supporting understorey species and allowing a build up of leaf litter where appropriate. Fungicide and nutrient treatments, as outlined in Appendix 4, can also be used to boost the defences of marri trees.

4.5 Feral animal control

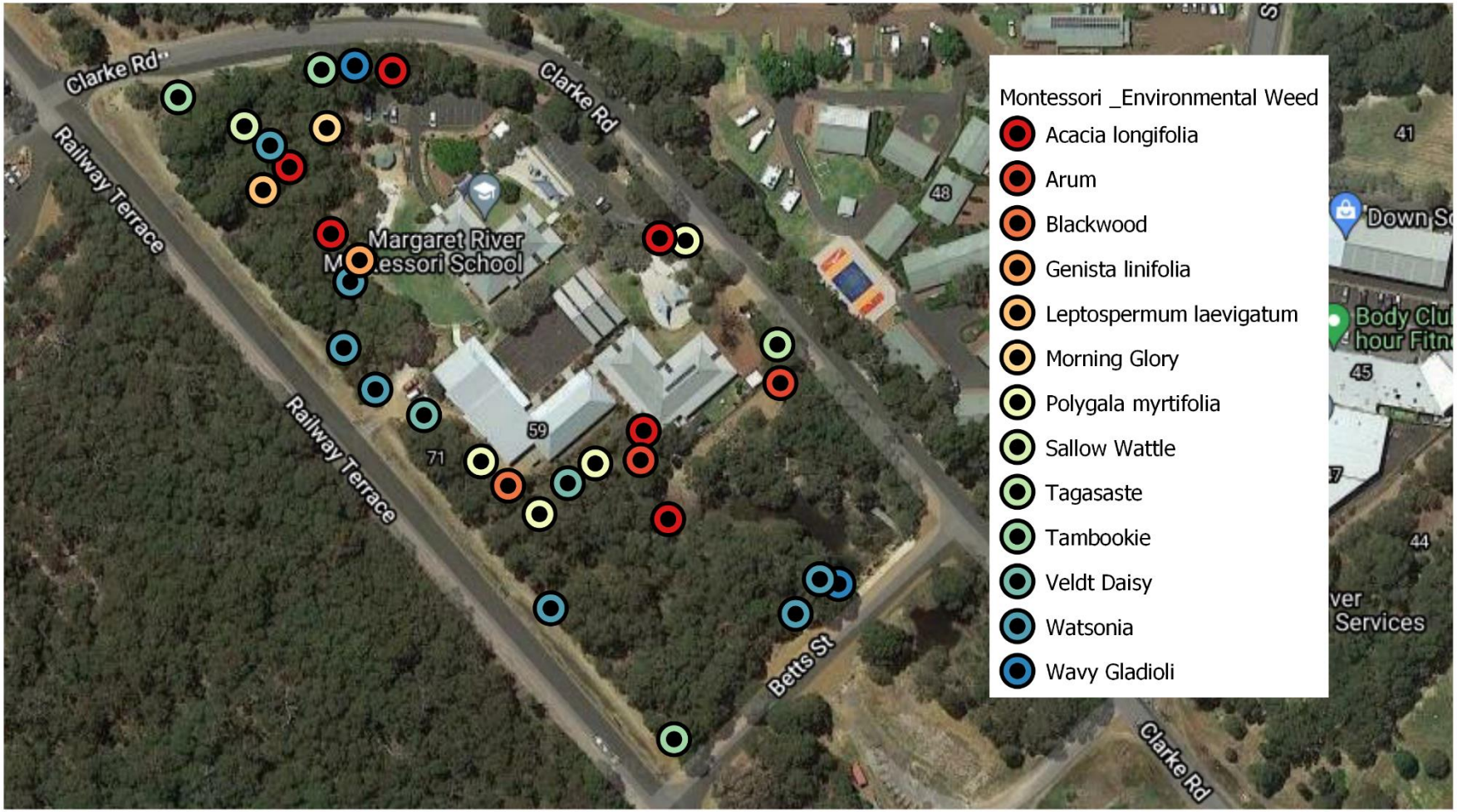
Foxes and cats are likely to utilise the bushland. Feral animal control, particularly if done on a broader landscape scale,in conjunction with surrounding landholders is likely to have a positive impact on native fauna. This would be very difficult to achieve within the setting of the school.

Information on trapping feral cats using cage traps is included in Appendix 5.

5. Table of management actions

Property area/activity	Action proposed (see Figures 1 and 2)	Estimated Cost /year	Priority
Weed control	Progressively eradicate the small amount of arum lily from the bushland.	$50	Very High
	Eradicate the relatively isolated woody weeds from the bushland including Sydney Golden Wattle, Blackwood, Sallow Wattle, Tagasaste, Victoria Teatree, Polygala and Genista	$750/$250	Very High
	Progressively control Watsonia from the bushland	$1000/$250	Very High
	Progressively control a range of other isolated priority weeds including Wavy gladioli, Tambookie, Morning Glory and Veldt Daisy.	$500/$250	Very High
Wetland supplementary planting	Continue staged ongoing revegetation of the wetland area with local native species	$500 per year	High
Remnant vegetation understorey enhancement	Undertake supplementary understorey planting and revegetation of the small degraded area of the southern remnant	$100	Moderate
Phytophthora *dieback, Marri Canker and other plant diseases*	Undertake hygiene management to minimise the spread and possible introduction of *Phytophthora cinnamomi*.	-	Very High
	Consider testing of any sudden deaths of indicator species to confirm presence	$500	Very High
	Consider phosphite treatment of key susceptible individual plants/ species	$500 per year	Moderate
	Monitor for Marri Canker and its spread and level of impact, manage for general health of remnant bushland and consider fungicide, nutrient implant or new treatments emerging following current research.	-	High

SCALE	Figure 1: Indicative Vegetation Condition	
0 50 100 m	Margaret River Montessori	



SCALE

0 50 100 m

Figure 2: Priority Environmental Weeds- point locations

Margaret River Montessori

APPENDIX 1: NATIVE PLANT SPECIES NOTED ON SITE

Family	Species	Common Name
Asparagaceae	*Thysanotus spp*	Fringed lily
Asteraceae	*Osteospermum ecklonis*	
Celastraceae	*Tripterococcus brunonis*	Yellow candles
Colchicaceae	*Burchardia congesta*	Milkmaids
Cyperaceae	*Baumea vaginalis*	Sheath twig rush
Dasypogonaceae	*Lomandra purpurea*	Purple mat rush
Dennstaedtiaceae	*Pteridium esculentum*	Bracken fern
Dilleniaceae	*Hibbertia cuneiformis*	Cutleaf hibbertia
Dilleniaceae	*Hibbertia hypericoides*	
Dilleniaceae	*Hibbertia cunninghamii*	
Droseraceae	*Drosera pallida*	Pale Rainbow
Epacridaceae	*Astroloma ciliatum*	Candle cranberry
Epacridaceae	*Leucopogon verticillatus*	Tasslebush
Euphorbiaceae	*Phyllanthus calycinus*	False boronia
Fabaceae	*Bossiaea linophylla*	
Fabaceae	*Bossiaea ornata*	Broadleaved Brown Pea
Fabaceae	*Chorizema nanum*	
Fabaceae	*Daviesia decurrens*	Prickly Bitter Pea
Fabaceae	*Daviesia cordata*	Bookleaf
Fabaceae	*Hardenbergia comptoniana*	Native wisteria
Fabaceae	*Hovea elliptica*	Tree hovea
Fabaceae	*Hovea chorizemifolia*	Holly leaved hovea
Fabaceae	*Kennedia coccinea*	Coral vine
Fabaceae	*Kennedia prostrata*	Running postman
Fabaceae	*Viminaria juncea*	Swishbush
Goodeniaceae	*Scaevola calliptera*	
Haemodoraceae	*Anigozanthos flavidus*	Tall kangaroo paw
Haemodoraceae	*Conostylis laxiflora*	Cottonhead
Hemerocallidaceae	*Johnsonia lupulina*	Hooded lilly
Iridaceae	*Patersonia umbrosa*	Yellow flags
Iridaceae	*Patersonia occidentalis*	Purple Flags
Juncaceae	*Juncus pauciflorus*	
Lobeliaceae	*Lobelia alata*	
Menyanthaceae	*Ornduffia parnassifolia*	
Mimosaceae	*Acacia divergens*	
Mimosaceae	*Acacia myrtifolia*	
Mimosaceae	*Acacia pulchella*	Prickly moses
Mimosaceae	*Acacia urophylla*	Netvein wattle
Myrtaceae	*Agonis flexuosa*	WA peppermint
Myrtaceae	*Corymbia calophylla*	Marri
Myrtaceae	*Eucalyptus marginata*	Jarrah
Myrtaceae	*Melaleuca rhaphiophylla*	Swamp Paperbark
Myrtaceae	*Taxandria parviceps*	Fine teatree
Orchidaceae	*Thelymitra macrophylla*	Scented sun orchid
Poaceae	*Tetrarrhena laevis*	Forest ricegrass
Polygalaceae	*Comesperma confertum*	
Polygalaceae	*Polygala myrtifolia*	Butterfly bush
Proteaceae	*Banksia grandis*	Bull banksia
Proteaceae	*Hakea amplexicaulis*	Prickly hakea
Proteaceae	*Hakea lissocarpha*	Honeybush

Proteaceae	*Grevillea quercifolia*	Oak leaf grevillea
Phylanthaceae	*Phyllanthus calycinus*	False Boronia
Restionaceae	*Meeboldina scariosa*	Velvet Rush
Rubiaceae	*Opercularia hisidula*	Hispid stinkweed
Rutaceae	*Philotheca spicata*	Pepper and salt
Stylidiaceae	*Stylidium amoenum*	Lovely Trigger Plant
Tremandraceae	*Tremandra stelligera*	
Thymelaeaceae	*Pimelea rosea*	Rose Banjine
Xanthorrhoeaceae	*Xanthorrhoea preissii*	Balga
Zamiaceae	*Macrozamia riedlei*	Zamia palm

APPENDIX 2: VEGETATION CONDITION ASSESSMENT SCALE

Keighery vegetation condition scale[1]

This vegetation condition scale is well used across Western Australia and grades vegetation condition from pristine to completely degraded as described below:

CONDITION	DESCRIPTION
Pristine	Pristine or nearly so, no obvious signs of disturbance
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non aggressive
Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas re often described as 'parkland cleared' with the flora composing weed or crop species with isolated native trees or shrubs.

[1] Described in Keighery, B.J. (1994) Bushland Plant Survey. A guide to plant community survey for community. Wildflower Society of WA (Inc.), Nedlands, Western Australia.

APPENDIX 3: SPECIES FOR CONSIDERATION IN FUTURE WETLAND SUPPLEMENTARY PLANTING

Plant name	Common name	Planting zone
Wetland		
Machaerina vaginalis		Wetland centre
Machaerina preissii		Wetland edges
Alternanthera nodiflora	Common Joyweed	Wetland edges
Beaufortia sparsa	Swamp Bottlebrush	Wetland edges
Lepidosperma effusum	Sword sedge	Wetland edges
Meeboldina scariosa	Velvet rush	Wetland edges
Centella asiatica	Centella	Wetland edges

APPENDIX 4: RECOMMENDED METHODS FOR WEED CONTROL

Species	Some suggested methods of management and control*
Arum lily *Zantedeschia aethiopica*	Spray with with Chlorosulfuron 1g/ 10L plus wetting agent. Follow up for several years. Spring control
Watsonia *Watsonia spp*	Hand pull small areas. Wipe individual leaves with 10% Weedmaster Duo. Late Spring control
Kikuyu *Pennisetum clandestinum*	Spray with 1% Weedmaster Duo 360g/L (non selective) or Fusilade 10ml/L plus wetting agent; repeat 2-3 times over the growing season.
Couch *Cynodon dactylon*	Spray with 1% Weedmaster Duo 360g/L or Fusilade 10ml/L plus wetting agent; repeat 2-3 times over the growing season.
Wavy gladiolus *Gladiolus undulatus*	Wipe individual leaves with 10% Weedmaster Duo. Late Spring control Late Spring. DO NOT HAND PULL AS THIS CAN SPREAD THE CORMS.
Tambookie grass *Hyparrhenia hirta*	Cut/dig out small populations; spray with 1% Weedmaster Duo 360g/L between Nov and Mar. Spray seedlings at 5 leaf stage with Fusilade at 20mL/10L
Juncus microcephalus	Hand pull/dig isolated plants. Spray in warm growing months 2% Weedmaster Duo 360g/L
Veldt Daisy *Osteospermum ecklonis*	Manual removal
Woody Weeds	
Sydney golden wattle *Acacia longifolia*	Hand pull seedlings; cut and paint (Wipe cut stump with Vigilant Gel)) mature plants. Monitor for future seedlings especially after fire. NOTE WESTERN RINGTAIL POSSUM DREY IN ONE PLANT -SHOULD NOT BE REMOVED!
Victorian Teatree *Leptospermum laevigatum*	Hand pull small seedlings; cut and paint large plants– Wipe cut stump with Vigilant Gel.
Broombush *Genista linifolia*	Manual removal – bag seeds, monitor for future seedlings
Butterfly bush *Polygala myrtifolia*	Hand pull small seedlings; cut and paint large plants– Wipe cut stump with Vigilant Gel.

APPENDIX 5: OPPORTUNITIES FOR THE STUDENT BODY AND THE CURRICULUM TO INCORPORATE ELEMENTS OF THE BUSHLAND MANAGEMENT

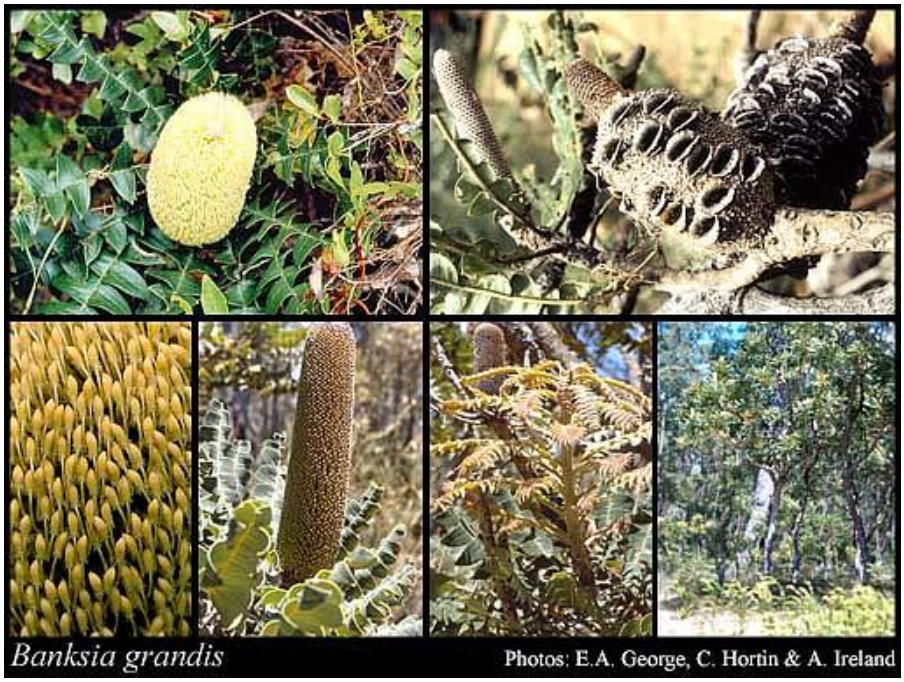
Topic	Elements
BUSHLAND ACTIONS	
Plant identification	1. Develop digital or real (with collectors license) herbarium of key plant species within the grounds including weed species
Bushland Monitoring	1. Establish 5m x 5m quadrats within portions of the bushland and regularly monitor vegetation within these. Of particular value to monitor the impacts of burning etc
Dieback/ disease treatment and protection	1. Identification and flagging of priority tree species for injection treatment eg) Bull Banksia, Jarrah, Snottygobble etc 2. Undertaking phosphite injection treatment of priority species under close supervision and safety equipment. 3. Undertake Phosphite/ Medicap implants of Marri and monitor the impacts and/ or success and averting Marri Canker
Photo point monitoring	1. Establish photo point monitoring sites and seasonally photograph and assess changes
Environmental weed control	1. Undertake strategic manual control of high priority weeds where safe to do so as per mapping in Figure 2 and control methodology detailed in Appendix 4 2. Monitor effectiveness of control and re-emergence of seedlings. 3. Undertake annual weed mapping to monitor for new infestations of weeds arriving or spreading within the site and to map the progressive control of existing species.
Revegetation	1. Assistance with planting 2. Undertaking ongoing monitoring of revegetation and natural regeneration success. 3. Implementing adaptive management and supplementary planting 4. Spring flora survey of bushland to expand species list.
Fire management	1. Monitor post fire regeneration and different fire responses of different plants 2. Monitor weed response (and subsequent control) following fire
Fauna	1. Monitoring and surveying for native and introduced fauna including tracks, scats, scratching etc 2. Potential for the installation of ‘sandpads’ for monitoring tracks 3. Development of a database of monitoring data 4. Undertake camera trapping to develop an inventory of fauna utilising the bushland 5. Undertake an annual Western Ringtail Possum (and other species potentially frogs and bats) nightstalks to engage the students in the species, its ecology and how bushland management actions can assist. 6. Consider the installation and regular monitoring of ‘Cockatube’ Black cockatoo nesting tubes 7. Develop ongoing monitoring of frogs utilising the wetland – Frogwatch has a number of resources available to assist in this: https://museum.wa.gov.au/explore/frogwatch
Water quality and wetland health	1. Regular and storm based monitoring of basic water quality parameters eg) turbidity. (Turbidity can be visually monitored using Turbidity tubes for no cost) 2. Regular monitoring of macro-invertebrate communities.

	3. Development of database of all monitoring data to facilitate analysis of trends and adaptive management where required.
Educational signage /posters development	1. Potential for the development of interpretive signage or posters by the students. Potential topics include: • Nyoongar seasons and bushfood/ medicinal plants within the school bushland; • Macroinvertebrate indicators of water quality and ecological health; • Urban stormwater cycle, management, treatment and potential impacts on downstream communities; • Frogs of the wetland; • Birds of the bushland; • Reptiles of the bushland; • Mammals of the bushland; • Plant responses to fire; • Iconic flora or fauna species within the site eg) Western Ringtail Possum or Marri, Black Cockatoo Species

APPENDIX 6: COMMON PLANTS SUSCEPTIBLE TO PHYTOPHTHORA DIEBACK IN JARRAH FOREST.

Allocasuarina fraseriana - sheoak
Banksia grandis - bull banksia
Eucalyptus marginata - jarrah
Hakea trifurcate - two-leaf hakea
Hibbertia hypercoides - buttercups
Hovea elliptica – tree hovea
Leucopogon verticellatus - tassel flower
Macrozamia reidlei - zamia palm
Patersonia umbrosa - yellow flag
Patersonia occidentalis yellow flag
Persoonia elliptica – spreading snotty gobble
Persoonia longifolia - snotty gobble
Podocarpus drouynianus – emu plum
Xanthorrhoea gracilis - slender grasstree
Xanthorrhoea preisii - grasstree

Images of plants susceptible to Phytophthora dieback (from https://florabase.dpaw.wa.gov.au)

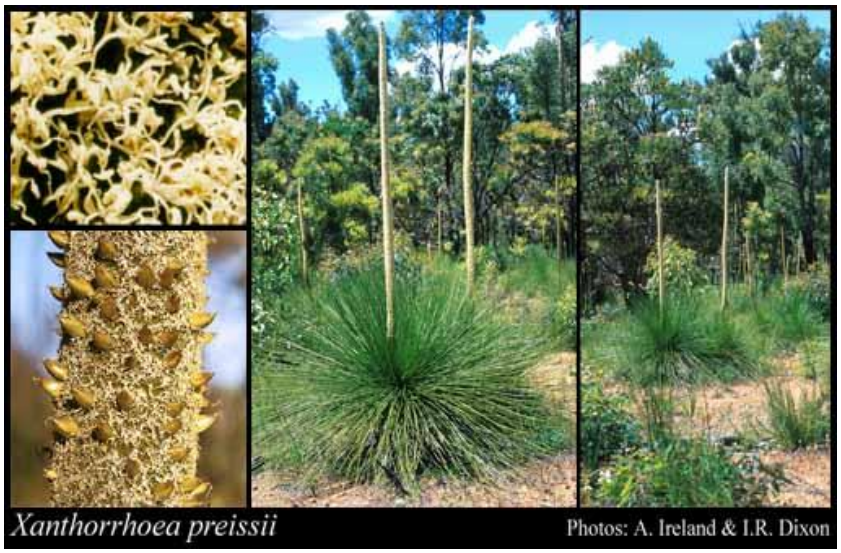


Eucalyptus marginata subsp. *marginata* Photos: A. Ireland & D.J. Rooks

Macrozamia riedlei Photos: C.A. Gardner & M. Seale

Persoonia longifolia Photos: E.P. Hodgkin & A. Ireland

Xanthorrhoea gracilis Photos: A. Ireland



Xanthorrhoea preissii Photos: A. Ireland & I.R. Dixon

Podocarpus drouynianus Photos: L. Anderson, J.C. Morgan & J. Scott

APPENDIX 7: MARRI DECLINE INFORMATION SHEET

MARRI DECLINE

Nature Conservation Information Sheet

What is marri canker disease?

A severe canker disease caused by the fungal pathogen *Quambalaria coyrecup* is contributing to the decline in marri trees (*Corymbia calophylla*) in the Margaret River region. The fungus enters through wounds or cracks in the bark and results in the death of areas of bark and the cortex tissue below. The infected area develops an unsightly canker which often exudes a large amount of kino (gum), staining the branch or trunk red. Cankers can occur on the trunk, branches or twigs of the trees and can result in limb fall and even death of the whole tree if the canker ringbarks the limb or trunk.

A second fungal pathogen *Quambalaria pitereka* is also known to cause leaf, shoot and flower blight in marri trees in the Margaret River region. This fungus affects the leaves, flower buds, flowers and fruit.

Native trees do best when growing in healthy bushland. They rely on complex interactions with the soil and other plants and animals. When these interactions are disturbed trees are more susceptible to attack from insects and plant pathogens. An accumulation of environmental stress factors such as climate change, drought, loss of native understorey, fire, changes to soil composition and structure, overabundance of insect pests, and other plant pathogens means marris are more susceptible to disease.

The diseases also affects other *Corymbia* species including amenity planted red flowering gum (*Corymbia ficifolia*).

Researchers at Murdoch University's Centre for Excellence for Climate Change, Woodland & Forest Health are currently undertaking research to improve understanding about the underlying causes and practical management solutions to marri decline in south west WA. Their research includes:

- The establishment of treatment trials to investigate the efficacy of fungicide and nutrient treatments in controlling disease development; and
- Providence trials to select disease resistant strains of marri for future plantings.

Canker disease can be recognised by the following identifying symptoms

The bark surrounding the affected area cracks and is eventually shed. Large amounts of kino (gum) are produced, staining the limb or trunk dark red.

Large target-like lesions are formed as a result of a progressive 'tug-of-war'. The tree produces a defence response that 'walls off' the diseased region, but with time the fungus manages to penetrate this barrier and reinvades.

The pathogen *Quambalaria coyrecup*is sometimes observed sporulating on the diseased area. This contains many, millions of spores that can be spread by rain splash, wind, insects and pruning.

Once the disease has progressed to the point of girdling the host, it has effectively ringbarked the tree resulting in the death of the affected limb or the entire tree if the trunk has been girdled.

Look-alike symptoms

Damage to marri trees may not always be a fungal related canker. Marri trees also ooze red kino from wounds, insect damage and branch stubs. They often have small cracks that ooze kino, and while in some cases these cracks can develop into cankers, in many instances the tree will callus these off, and all trace of them eventually disappears. Borer damage caused by Eucalyptus long-horned borer (*Phorocantha semipunctata*) and Bullseye borer (*P. ancanthocera*) can resemble a canker, but on closer inspection you may see frass or evidence of an emergence hole. Extensive borer damage that has led to branch and tree death is easily determined by the presence of borer galleries that become visible as the bark drops.

What you can do

There is currently no definitive recommendations on management to protect trees from marri decline. Undertaking management that will protect and enhance the environmental conditions surrounding affected marri trees may help. This includes restricting stock access, planting understorey species, mulching and watering where appropriate. Fungicide and nutrient treatments, as outlined below, can also be used to boost the defences of marri trees.

Phosphite is a systemic, biodegradable fungicide that protects plants against disease by boosting the plant's own natural defences. Phosphite is environmentally safe, inexpensive and has a very low toxicity to animals. Phosphite needs to enter a plant's water transport system in order for it to be effective. This can be done by injecting phosphite into trees, or spraying the leaves of understorey plants. Go to https://www.natureconservation.org.au/wp-content/uploads/2019/03/Phosphite-injection-using-chemjet-syringes.pdf for instructions on using phosphite. Depending on how it is applied, phosphite can provide protection for vulnerable plants to disease for up to five years.

Medicap nutrient implants provide the tree with a slow release nutrient that benefits the tree over a long period of time, with the aim of improving plant vigour and general health. The nutrient implants are delivered directly into the tree and are designed to remain safely within the tree with the contents delivered systemically throughout the tree with sap flow. Medicap nutrient implants can be purchased from http://arborcarbon.com.au/services.html

Australian Government | National Landcare Program