



Conservation Advice for *Leucopogon obtectus* (Hidden Beard- heath)

In effect under the *Environment Protection and Biodiversity Conservation Act 1999* from 29 September 2021.

This document provides a foundation for conservation action and further planning.



Leucopogon obtectus (Hidden Beard-heath) © Copyright, Prof Kingsley Dixon (from WA Herbarium)

Conservation status

Leucopogon obtectus (Hidden Beard-heath) is listed in the Endangered category of the threatened species list under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwth) (EPBC Act) effective from 16 July 2000.

The species is eligible for listing because prior to the EPBC Act, it was listed as Endangered under the Endangered Species Protection Act 1992 (Cwlth).

The main factors that make the species eligible for listing in the Endangered category are a very low number of mature individuals.

Species can also be listed as threatened under state and territory legislation. For information on the current listing status of this species under relevant state or territory legislation, see the Species Profile and Threat Database.

Species information

Taxonomy

Leucopogon obtectus was formally renamed *Styphelia obtecta* following molecular analysis by Crayn et al. (2020) of *Styphelia* and related genera.

Description

The Hidden Beard-heath is an erect, open shrub growing to about 1.5 m tall with a few long branches that are completely covered by foliage. The broad, almost heart-shaped, stalkless leaves overlap, concealing the stem. The leaves are a pale bluish-green colour, rigid and concave and end in a small sharp point. The leaves are about 1 cm long and 1 cm wide and have fine lines. Two or three creamy yellow flowers are held on very short stalks in each leaf axil. Each flower has six petals, united to form a tube towards the base. The fruits are smooth, green and egg-shaped, with each fruit holding a single seed (Brown et al. 1998).

Distribution

The Hidden Beard-heath is endemic to Western Australia (WA). It has been recorded from Alexander Morrison National Park at the south-eastern end of its known distribution to just north of Nature Reserve 39744 at the northern end, over a distance of about 60 km. However, most subpopulations occur over an area of about 30 km extending from southeast to northwest of Eneabba, which is located about 300 km north of Perth. There is a single unconfirmed record of a subpopulation 40 km south of Eneabba (DEC 2006). The species is known from five subpopulations, with an estimated total population size of around 500 individuals (DEC 2006) (Table 1).

Table 1 Summary of Hidden Beard-heath subpopulations (adapted from DEC 2006)

Population /subpopulation	Shire (Local Government Area)	Land Status	Management Agency	Year & No. plants	Condition/notes
1a. N of Eneabba	Irwin	Road Reserve	Main Roads WA	1993 2 2000 2 2009 2 2013 0	Poor. 2013 survey may have been in incorrect location. Further surveys required to determine if 2012 bushfire killed existing two plants and/or stimulated recruitment.

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1b. N of Eneabba	Irwin	Unallocated Crown Land	Unallocated ¹	1995 2 2009 0	Healthy (1995). Unknown following 1998 – 2002 burns/wildfires
1c. N of Eneabba	Carnamah	Nature Reserve	Conservation Commission	1981 14 1995 12 1998 50 2009 32	Healthy (1981). Unknown following 1998 – 2002 burns/wildfires
1d. N of Eneabba	Three Springs	Road Reserve	Main Roads WA	1992 Not found 1998 2 2009 0	Not recorded 1998. Unknown following 1998 – 2002 burns/wildfires
1e. N of Eneabba	Carnamah	Nature Reserve	Conservation Commission	1981 25 1998 22 2009 25	Healthy (1981). Unknown following 1998 – 2002 burns/wildfires
1f. N of Eneabba	Carnamah	Unallocated Crown Land	Unallocated	1992 22 1998 269 2009 230	Healthy (1992). Unknown following 1998 – 2002 burns/wildfires
1g. N of Eneabba	Three Springs	Unallocated Crown Land	Unallocated	1998 1	Unknown following 1998 – 2002 burns/wildfires
2. S of Eneabba	Carnamah	Unallocated Crown Land	Unallocated	1998 5 2009 4 2018 0	Healthy
3a. S of Eneabba	Carnamah	Unallocated Crown Land	Unallocated	1982 15 1998 44 [33] ² 1999 8 2009 105	Healthy (pre mining rehab – various years 1987 2004)
3b. S of Eneabba	Carnamah	Unallocated Crown Land	Unallocated	1999 6 2009 3	Moderate. Undisturbed (2004)
3c. S of Eneabba	Carnamah	Nature Reserve	Conservation Commission	1998 1 1999 16 [8] 2000 1	Healthy (pre mining rehab – various years 1991 2004)

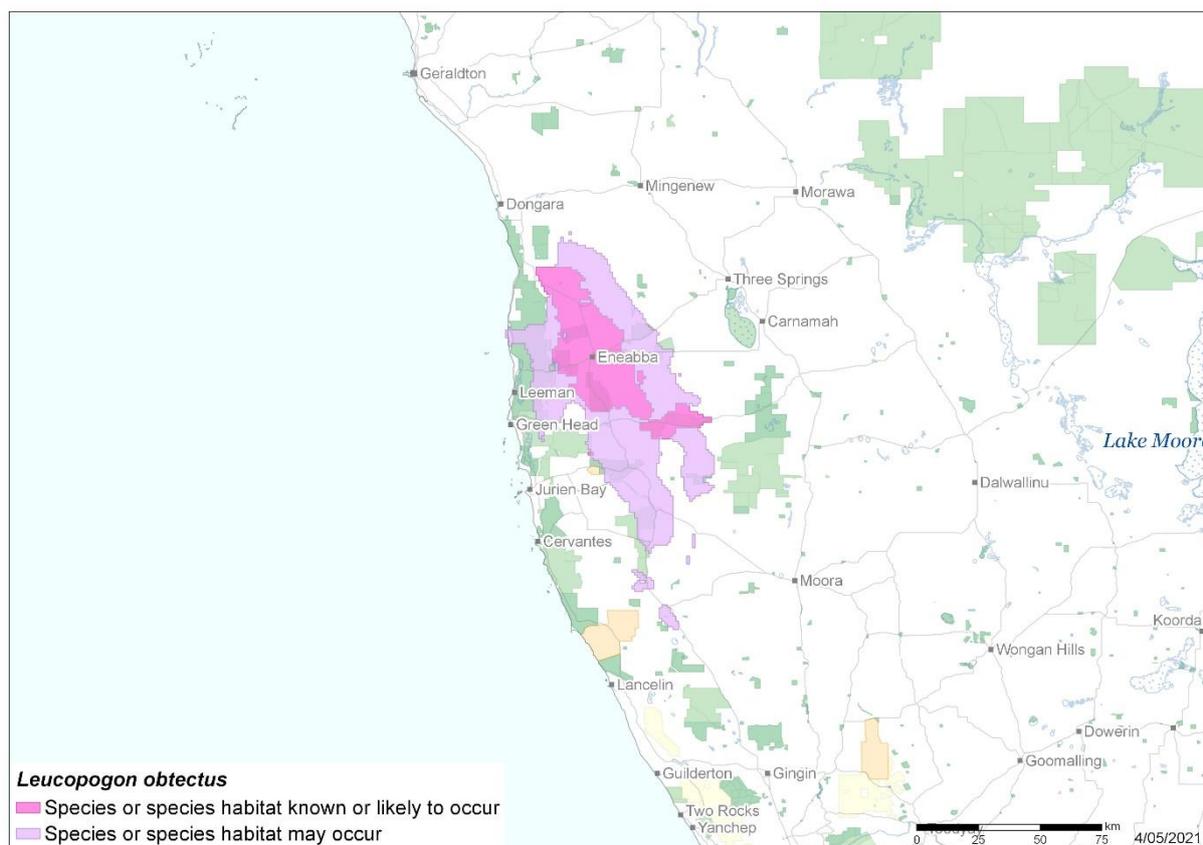
¹ The Department for Environment and Conservation (DEC) is the management agency for fire prevention, feral animals and weeds in areas of Unallocated Crown Land in WA.

² Numbers in [brackets] = number of live plants removed during mining operations.

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				2009	26	
3d. S of Eneabba	Carnamah	Nature Reserve	Conservation Commission	1991 1999 2009	2 (4) 8 [5] 13	Healthy (1981 & 1988 - pre mining rehab -2004 in some areas)
3e. S of Eneabba	Carnamah	Road Reserve	Main Roads WA	1999 2009	1 1	Not recorded
3f. S of Eneabba	Carnamah	Nature Reserve	Conservation Commission	1998 1999 2009	2 3 5	Healthy (1998) post 1977/79 rehab in some areas
3g. S of Eneabba	Carnamah	Road Reserve	Main Roads WA	1999 2009	1 1	Not recorded
4a. SE of Eneabba	Coorow	National Park	Conservation Commission	1991 1998 2009	0 3 3	Healthy (1987)
4b. SE of Eneabba	Coorow	National Park	Conservation Commission	1998 2009	2 1	Not recorded
5. S of Eneabba	Dandaragan	Nature Reserve	Conservation Commission	1998 2009	1 1	Healthy (1998)

Map 1 Modelled distribution of Hidden Beard-heath



Source: Species distribution data Species of National Environmental Significance database, base map Geoscience Australia.

Caveat: The information presented in this map has been provided by a range of groups and agencies. While every effort has been made to ensure accuracy and completeness, no guarantee is given, nor responsibility taken by the Commonwealth for errors or omissions, and the Commonwealth does not accept responsibility in respect of any information or advice given in relation to, or as a consequence of, anything containing herein.

Species distribution mapping: The species distribution mapping categories are indicative only and aim to capture (a) the specific habitat type or geographic feature that represents to recent observed locations of the species (known to occur) or preferred habitat occurring in close proximity to these locations (likely to occur); and (b) the broad environmental envelope or geographic region that encompasses all areas that could provide habitat for the species (may occur). These presence categories are created using an extensive database of species observations records, national and regional-scale environmental data, environmental modelling techniques and documented scientific research.

Cultural and community significance

The cultural significance of the Hidden Beard-heath is not well understood, although Kwongan vegetation in which the species is found has a long and profound history of use and management by Indigenous Australians. Occurrence of the Hidden Beard-heath to the north and immediately south of Eneabba in the Local Government Areas of Iriwn, Three Springs and Carnamah occur on the lands of Traditional Owners of the Yamatji Nation (Bundi Yamatji Aboriginal Corporation - NNTT 2020a). Occurrence in the Local Government Areas of Coorow and Dandaragan occur on the lands of Traditional Owners of the Noongar Nation -Yued People (NNTT 2020b).

According to the Department of Indigenous Affairs Aboriginal Heritage Sites Register, no sites of Aboriginal significance are known at or near subpopulations of Hidden Beard-heath (DEC 2006).

Relevant biology and ecology

Habitat ecology

The Hidden Beard-heath is restricted to Kwongan vegetation, where it grows as a taller component of species rich low open heath in open scattered populations. It grows mainly on the crests and upper slopes of relictual dunes (or more rarely in interdunal swales) comprised of grey-white or pale yellow sands (Brown et al. 1998). Associated species include *Xylomelum angustifolium* (Sandplain Woody Pear) and *Xanthorrhoea preissii* (Balga) (DEC 2006). Other species that compose these heaths and may potentially be associated with the Hidden Beard-heath are outlined in Griffin et al. (1981), Hnatiuk & Hopkins (1981), Hopkins et al. (1981), Griffin (1994) and Mucina et al. (2014).

Reproductive ecology and biology

The Hidden Beard-heath flowers from October to November. The species is a relatively short-lived disturbance opportunist. It germinates in response to habitat disturbance but is killed by fire, regenerating from seed rather than resprouting from lignotuberous/perennial root stock (Brown et al. 1998). It is therefore likely that the species recruits only from seed stored in the soil (DEC 2006).

Although fire is thought to be a stimulus for germination in the Hidden Beard-heath, further research is required to determine the exact role of fire and other disturbances in germination and recruitment. The Hidden Beard-heath is thought to be both insect and bird pollinated (DEC 2006).

Single age, undisturbed stands of mature plants that are associated with mine rehabilitation plots established in the mid-1980s are showing evidence of senescence. A number of plants in these stands that were recorded as alive in 1998 have since died, suggesting that the life span of individuals may be no more than 20 years (DEC 2006). Zawko et al. (2001) notes that following initial establishment, seedling recruitment of the Hidden Beard-heath is extremely rare. Natural seed-set does not appear to be prolific (DEC 2006) suggesting that it may take some years for soil seed reserves to accumulate. There is a risk of rapid depletion if seed reserves are subject to frequent disturbance such as fire, which results in the species not reaching sexual maturity.

The Hidden Beard-heath is part of the Australian family Ericaceae, many members of this family are difficult to propagate and seed germination rates are very low. Although some species may occasionally be propagated from cuttings, they rarely establish successfully under cultivation (Leigh et al. 1984). The Hidden Beard-heath is dependent on forming symbioses with mycorrhizal fungi, and an absence of such mycorrhizae has been suggested as a possible factor in the poor survival of micropropagated plants (DEC 2006). Staff from the WA Botanic Gardens and Parks Authority (BGPA) have successfully isolated and maintained cultures of appropriate mycorrhizal fungi for future work in examining their role in the long-term establishment of transplanted seedlings (DEC 2006).

Studies by the BGPA found there is a high level of genetic variability amongst individual plants but no significant subpopulation differentiation. It has been suggested that the species comprises a single genetically diverse group associated with an outcrossing reproductive strategy (mating of unrelated individuals). Zawko et al. (2001) also found that despite small subpopulation sizes, genetic diversity was extremely high in the species. This has implications

for restoration management, and it has been suggested that using seeds collected from natural subpopulations enables high genetic diversity and outbreeding processes in restored subpopulations to be maintained (Zawko et al. 2001). Recruitment from the soil seed bank appears to have been sufficient to replenish a similar degree of genetic diversity in post mine rehabilitated subpopulations when compared with undisturbed natural subpopulations (Zawko et al. 2001).

Habitat critical to the survival

Due to the species eligibility for listing (small population size), all habitat is considered critical to the survival of the species.

No Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat.

Important populations

In this section, the word population is used to refer to subpopulation, in keeping with the terminology used in the EPBC Act and state/territory environmental legislation.

There is sufficient evidence through the species eligibility for listing, to declare all populations/the national population as important populations of this species under particular pressure of survival and which therefore require protection to support the recovery of the species.

Threats

The main threats to the Hidden Beard-heath are habitat loss or modification, seed predation and disease. The threat of dieback caused by *Phytophthora cinnamomi* may interact with bushfire, with the effects of dieback on root health potentially more pronounced directly after fire (Moore et al. 2015).

The species is potentially threatened by weeds, although the 2006 Recovery Plan (DEC 2006) noted that most subpopulations were largely weed-free. The Recovery Plan also notes that the native *Acacia blakelyi* is a significant increaser species on recently rehabilitated mined land and, may limit the establishment of other local native species. There is no information on whether weeds or *Acacia blakelyi* are directly affecting the Hidden Beard-heath and as such these threats have not been included in Table 2.

Table 2 Threats impacting Hidden Beard-heath

Threat	Status and severity ^a	Evidence
Habitat loss, disturbance or modification		
Mining and exploration	Timing: historical/current Confidence: known Consequence: major Trend: static Extent: across part of its range	Mining leases and mineral and petroleum exploration licenses cover habitat containing most of the known occurrences of the Hidden Beard-heath. Mining has been active in the area of occupancy of the species and reduces the species' available natural habitat and constitutes a significant threat (DEC 2006). One subpopulation (pop. 3) is largely the result of the species re-establishing in the area after mine

Threat	Status and severity ^a	Evidence
		site rehabilitation activities, presumably due to the soil stored seed bank (DEC 2006).
Road, rail and firebreak maintenance	Timing: historical/current Confidence: known Consequence: moderate Trend: static Extent: across part of its range	Road, rail and firebreak maintenance threatens all road and rail reserve subpopulations (subpopulation 1a, 1d, 1c, 1g, 3e, 3g and 4b) and subpopulations that may occur on private property. Threats include grading, chemical spraying, construction of drainage channels and mowing of roadside vegetation. At least one example of plant death from local flooding, as a result of habitat modification, has been documented (DEC 2006). Several of these actions also encourage weed invasion. Natural gas pipeline Station No.1 is located within subpopulation 1c and an access track from Beekeepers Rd to the station also runs through the subpopulation. Activities associated with this access facility presents threats with respect to introduction and spread of weeds and soil borne disease (DEC 2006).
Lack of disturbance	Timing: current Confidence: inferred Consequence: major Trend: unknown Extent: across part of its range	As noted under the biology and ecology section, the Hidden Beard-heath is a disturbance opportunist. Few seedlings or juvenile plants have been observed in association with mature living plants. Subpopulations in a rehabilitated area of a mineral sand mine are showing signs of senescence and little evidence of recruitment after 20 years (DEC 2006). Therefore, lack of appropriate disturbance may be a threat to the persistence of the species.
Inappropriate fire regimes	Timing: current Confidence: inferred Consequence: major Trend: increasing Extent: across part of its range	Although the species was not substantially impacted by the 2019–20 bushfires with less than 1% of modelled distribution burnt (DAWE 2020), the Hidden Beard-heath is at risk from future bushfire events. Increased intensity/frequency of bushfires may affect the viability of subpopulations. Although fire is the stimulus for germination and occasional fires are needed for reproduction and maintenance of subpopulations, the soil stored seed bank has the potential to be depleted if fires reoccur before regenerating or juvenile plants reach maturity (DEC 2006). Several subpopulations of Hidden Beard-heath were impacted by fires between 1998 and 2002, however

Threat	Status and severity ^a	Evidence
		the condition of these subpopulations is unknown.
Herbivory		
Seed predation	Timing: historical/current Confidence: known Consequence: minor Trend: unknown Extent: unknown	Seed examined during surveys conducted by BGPA staff in the 1980s showed apparent high levels of predation with estimates of up to 80% of seed predated. Predator damage included signs of borers and small larvae within mature fruit from which the endosperm had presumably been consumed (DEC 2006). This is a threat to maintenance of a viable soil seed bank. However, these observations represent one season's data, derived mainly from mine rehabilitation sites where most seed collections took place (DEC 2006). Further research is required to determine if this is typical of all subpopulations, including those in undisturbed natural habitats.
Disease		
Phytophthora dieback caused by the introduced soil-borne pathogen <i>Phytophthora cinnamomi</i> and other <i>Phytophthora</i> spp.	Timing: future Confidence: suspected Consequence: severe Trend: unknown Extent: across the entire range	<i>Phytophthora cinnamomi</i> is an introduced soil-borne pathogen which infects a large range of plant species, and which may contribute to plant death when other stresses are present such as waterlogging, drought and bushfire (DoEE 2018). Phytophthora related dieback has been recorded within the vicinity of the species' habitat and is known to affect heathland plants associated with the Hidden Beard-heath (DEC 2006). Although the Hidden Beard-heath is presumed to be susceptible to <i>Phytophthora</i> related dieback (Brown et al. 1998), the degree of susceptibility is unknown. Mining and exploration activities also have the potential to exacerbate and spread dieback (DEC 2006).

Status—identify the temporal nature of the threat;

Confidence—identify the extent to which we have confidence about the impact of the threat on the species;

Consequence—identify the severity of the threat;

Trend—identify the extent to which it will continue to operate on the species;

Extent—identify its spatial content in terms of the range of the species.

Each threat has been described in Table 2 in terms of the extent that it is operating on the species. The risk matrix (Table 3) provides a visual depiction of the level of risk being imposed by a threat and supports the prioritisation of subsequent management and conservation actions. In preparing a risk matrix, several factors have been taken into consideration, they are: the life

stage they affect; the duration of the impact; and the efficacy of current management regimes, assuming that management will continue to be applied appropriately. The risk matrix and ranking of threats has been developed in consultation with experts and available literature.

Table 3 Hidden Beard-heath risk matrix

Likelihood	Consequences				
	Not significant	Minor	Moderate	Major	Catastrophic
Almost certain	Low risk	Moderate risk	Very high risk Road, rail and firebreak maintenance	Very high risk Mining and exploration Inappropriate fire regimes	Very high risk
Likely	Low risk	Moderate risk	High risk	Very high risk Lack of disturbance	Very high risk
Possible	Low risk	Moderate risk Seed predation	High risk	Very high risk Phytophthora dieback	Very high risk
Unlikely	Low risk	Low risk	Moderate risk	High risk	Very high risk
Unknown	Low risk	Low risk	Moderate risk	High risk	Very high risk

Priority actions have been developed to manage the threats where the risk was deemed to be ‘very high’ or ‘high’. For those threats with an unknown or low risk outcome (green and blue shading) it may be more appropriate to identify further research or maintain a watching brief.

Conservation and recovery actions

Primary conservation objective

By 2030, the population of the Hidden Beard-heath will have increased in abundance and viable subpopulations are sustained in habitats where threats are managed.

Conservation and management priorities

Habitat loss, disturbance and modification

- Ensure land managers are aware of the species’ occurrence and provide protection measures against known and potential threats. In particular, ensure managers associated with the natural gas pipeline Station No 1 and access track within subpopulation 1c are aware of the species’ presence and implement the appropriate fire preparedness and dieback management protocols
- Secure subpopulations on unallocated crown land under formal conservation reserves.
- Ensure that occurrences of Hidden-Beard heath and habitat critical to its survival are protected from any damage that may arise from mining , mineral exploration and petroleum exploration activities carried out by proponents or operators.
- Rehabilitate areas disturbed by mining and exploration, ensuring that existing Hidden Beard-heath subpopulations and their habitat are fully restored.

- Install and/or replace Threatened Flora³ markers at subpopulations which are at risk of disturbance from road and firebreak maintenance operations. This includes subpopulations 1a, 1d and 3g on the Brand Highway, and subpopulation 1c on Beekeepers Road.
- Develop and implement a fire management strategy, based on fire ecology research. This strategy should include recommendations on prescribed fire frequency and intensity, precautions to prevent frequent fire, a strategy for responding to bushfire and methods of construction and maintenance of firebreaks to protect reproductively immature plants.

Herbivory

- Develop and implement measures to mitigate the impact of seed predation (if occurring in disturbed habitats at levels detrimental to the species), taking into consideration potential impacts of mitigation measures on Hidden Beard-heath and the surrounding environment.

Disease

- Implement a *Phytophthora cinnamomi* management plan to ensure that:
 - the pathogen is not introduced into uninfected subpopulations (e.g. by contaminated water used for firefighting, or contaminated gravel used in road maintenance or through minerals and petroleum exploration activity),
 - the spread of the pathogen in areas outside of, but adjacent to, subpopulations of the Hidden Beard-heath is mitigated,
 - potential translocation sites are free of, and do not become infected by, *P. cinnamomi*, and
 - mitigation measures (e.g. treatment with phosphite) are implemented, if required and appropriate in species rich heath habitats.
- Refer to existing guidelines and management plans, e.g. the *Threat abatement plan for disease in natural ecosystems caused by Phytophthora cinnamomi* (DoEE 2018).
- Ensure that appropriate hygiene protocols are adhered to when entering or exiting the known location of the species, such as those outlined in Podger et al. (2001).

Breeding, seed collection, propagation and other ex situ recovery action

- To manage risk of losing genetic diversity, collect seed, vegetative and mycorrhizal material and store in appropriate institutions. Develop techniques and protocols for storing and maintaining these materials as living ex situ collections.

³ Threatened Flora markers are used in WA and are two standardised yellow markers at either end of a site, which are bent to face towards each other, indicating that Threatened Flora may occur anywhere between the markers, from the road's running surface to the fence. They alert people working in the vicinity to the presence of Threatened Flora, and the need to avoid work that may damage vegetation in the area (DBCA 2018).

- If deemed appropriate (i.e. if attempts to stimulate regeneration are not successful), undertake conservation translocations in suitable habitat with secure land tenure to increase the number of subpopulations, in accordance with the *Guidelines for the Translocation of Threatened Plants in Australia* (Commander et al. 2018).
- Investigate alternative methods to ex situ propagation. For example, seedbank augmentation from relocated topsoil or harvested vegetation, accompanied by appropriate germination stimuli.

Stakeholder engagement/community engagement⁴

- Seek input from and involve Traditional Owners that have an active interest in areas that are habitat for Hidden Beard-heath in research and management activities
- Engage with land management agencies to encourage ongoing management and conservation of subpopulations in state conservation areas and other land tenures. The reservation status of the land parcels that support subpopulations 1f and 3a (Unallocated Crown Land) and subpopulations 1c, 1e and 3c (class C Nature Reserve) should be reviewed, and the possibility of additional protection through the reserve system investigated.
- Engage with private landowners who have subpopulations of Hidden Beard-heath on their properties and explore options for establishing a conservation covenant. Where a covenant is not accepted, registration through the Land for Wildlife Scheme may be promoted (DEC 2006).

Survey and monitoring priorities

- Map habitat critical to the species' survival (as described earlier in this document).
 - Conduct population surveys during the flowering period of the species (October to March). Particular attention should be given to surveying subpopulation 1 north of Eneabba to ascertain its current status following fires that have occurred in the area. Other areas of likely habitat should also be surveyed periodically, particularly areas that have been disturbed by fire which may stimulate recruitment from a latent seedbank.
 - Undertake annual monitoring of factors such as habitat degradation (including weed invasion), population stability (expansion or decline), recruitment, longevity and observations of pollinator activity, grazing, seed production and seed predation.
 - Monitor fire occurrence and frequency in relation to known or likely areas of occupancy for the species, including:
 - monitoring and determining the impact of occasional and concurrent fires on known subpopulations and their subsequent recovery, and
-

- monitoring the impact of fires on possible recruitment of Hidden Beard-heath subpopulations from latent seed bank reserves in areas where plants have died.
- Status of soil seedbanks should be monitored for all subpopulations where inappropriate disturbance may be:
 - diminishing reserves though repeated (germination) stimulation without replenishment, or
 - gradual decline through loss of viability of seed not exposed to required germination stimuli.
- Monitoring programs should be required by the environmental regulators and undertaken by mining business and corporations responsible for rehabilitation of disturbed habitat. Similarly, environmental regulators should require monitoring programs for habitats supporting the Hidden Beard-heath impacted by mineral and petroleum exploration activities.

Information and research priorities

- Research and develop techniques for facilitating in-situ recruitment of Hidden Beard-heath subpopulations, including:
 - Where a significant proportion of the species occurrence shows signs of senescence with little recruitment, consider experimental disturbance trials. The purpose of such trials would be to ascertain those methods which are most effective in facilitating in situ recruitment. These trials may include the application of prescribed fire.
 - If a fire trial is found to be necessary, it should be undertaken with care and its impact limited to a small area. As fire has the potential to encourage the invasion of weeds, effective follow-up weed control will need to be undertaken as necessary.
 - Monitoring of trials should include documenting the response of associated species and any negative impacts such as the level of weed invasion. Monitoring of regeneration should continue for at least three years and preferably until it is established that the regenerated plants have reached reproductive maturity and are actively contributing to the soil stored seed bank.
- Determine the extent of seed predation on all subpopulations and its impact on the maintenance of a viable soil stored seed bank.
- Develop research techniques for propagating plants suitable for translocation. This may involve:
 - improving the current low ex-situ germination rate of seed,
 - improving the survival of plants generated from micro-propagated tissue material, and
 - establishing the symbiotic requirements for long-term survival of propagated plants at translocation sites.
- Investigate the ecological requirements of the Hidden Beard-heath that are relevant to effective management, including:
 - soil stored seed bank dynamics, such as seed bank location, viability, replacement or reduction,
 - the role of various disturbances (including fire), competition, rainfall and grazing in germination and recruitment,

- pollination biology and requirements,
- the reproductive strategies, phenology and seasonal growth of the species,
- characterisation of fungal symbionts and their presence at existing and potential Hidden Beard-heath sites, and
- required levels of genetic diversity and minimum viable subpopulation size.

Links to relevant implementation documents

Hidden Beard Heath (*Leucopogon obtectus*) Interim Recovery Plan 2006-2011. Interim Recovery Plan No. 227.

Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (2018)

Conservation Advice references

Brown A, Thomson-Dans C & Marchant N (Eds) (1998) *Western Australia's Threatened Flora*. Department of Conservation and Land Management, Western Australia.

Commander LE, Coates D, Broadhurst L, Offord CA, Makinson RO & Matthes M (2018) *Guidelines for the translocation of threatened plants in Australia Third Edition*. Australian Network for Plant Conservation, Canberra.

Crayn DM, Hislop M & Puente-Lelièvre C (2020) A phylogenetic recircumscription of *Styphelia* (Ericaceae, Epacridoideae, Styphelieae). *Australian Systematic Botany* 33, 137–168.

DAWE (Department of Agriculture, Water and the Environment) (2020) *Interim assessment list of plants*. Research for the Wildlife and Threatened Species Bushfire Recovery Expert Panel, Canberra.

DBCA (Department of Biodiversity, Conservation and Attractions) (2018) *Declared rare flora and road maintenance*. Western Australia Department of Biodiversity, Conservation and Attractions. Accessed: 31 November 2020. Available at: <https://www.dpaw.wa.gov.au/images/documents/conservation-management/off-road-conservation/rcc/Declared%20Rare%20Flora%20and%20road%20maintenance%20018.pdf>

DEC (Department of Environment and Conservation) (2006) *Hidden Beard Heath (Leucopogon obtectus) Interim Recovery Plan 2006-2011. Interim Recovery Plan No. 227*. Department of Environment and Conservation, Perth, Western Australia.

DoEE (Department of Energy and Environment) (2018) *Threat abatement plan for disease in natural ecosystems caused by Phytophthora cinnamomi*. Department of Energy and Environment, Canberra.

Griffin EA (1994), Floristic survey of Northern sandplains between Perth and Geraldton. Department of Agriculture and Food, Western Australia, Perth. Report 144. <https://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?article=1128&context=rmt>

Griffin EA, Hopkins AJM & Hnatiuk RJ (1981) Regional variation in mediterranean-type shrublands near Eneabba, south-western Australia. *Vegetatio* 52, 103-127

- Hnatiuk RJ & Hopkins AJM (1981) An ecological analysis of kwongan vegetation south of Eneabba, Western Australia. *Australian Journal of Ecology* 6: 423-438.
- Hopkins AJM & Hnatiuk RJ (1981) *An ecological survey of the kwongan south of Eneabba, Western Australia*. Department of Fisheries and Wildlife.
- Keighery GJ (1988) *Dieback briefing paper. I, Epacridaceae*. Department of Conservation and Land Management, Perth, Western Australia.
- Leigh J, Boden R & Briggs J (1984) *Extinct and Endangered Plants of Australia*. The Macmillan Co. of Australia Pty Ltd, Hong Kong.
- Moore N, Barrett S, Howard K, Craig MD, Bowen B, Shearer B & Hardy G (2015) Time since fire and average fire interval are the best predictors of *Phytophthora cinnamomi* activity in heathlands of south-western Australia. *Australian Journal of Botany* 62, 587–593.
- Mucina L, Laliberte E, Thiele KR, Dodson JR & Harvey J (2014) Biogeography of kwongan; Origins, diversity, endemism and vegetation patterns. In: Lambers, H. (ed.), *Plant life on the sandplains in Southwest Australia, a global biodiversity hotspot*. UWA Publishing, Crawley,
- NNTT (National Native Title Tribunal) (2020a) Native Title Determination Details - WCD2020/001 - Yamatji Nation. Accessed: 13 July 2021. Available at: http://www.nntt.gov.au/searchRegApps/NativeTitleClaims/Pages/Determination_details.aspx?NNTT_Fileno=WCD2020/001
- NNTT (National Native Title Tribunal) (2020b) Application Details - WC1997/071- Yued. Accessed: 13 July 2021. Available at: http://www.nntt.gov.au/searchRegApps/NativeTitleClaims/Pages/details.aspx?NTDA_Fileno=WC1997/071
- Podger FD, James SH, & Mulcahy MJ (2001) *Phytophthora cinnamomi* and Disease Caused By It- A protocol for identifying 'Protectable Areas' and their priority for management. Draft report prepared for Department of Parks and Wildlife. Accessed: 31 November 2020. Available at: www.dpaw.wa.gov.au/images/documents/conservation-management/pestsdiseases/disease-riskareas/Protecting_the_Protectable_and_Protocols_for_Defining_Protectable_Areas.pdf
- Zawko G, Krauss SL, Dixon KW & Sivasithamparam K (2001) Conservation genetics of the rare and endangered *Leucopogon obtectus* (Ericaceae). *Molecular Ecology* 10, 2389-2396.

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