

Abridged Threatened Species Nomination Form

For nominations/assessments under the Common Assessment Method (CAM) where supporting information is available, but not in a format suitable for demonstrating compliance with the CAM, and assessment against the IUCN Red List threat status.

Cover Page *(Office use only for Assessment)*

Species name (scientific and common name):	<i>Pityrodia</i> sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4)
Nomination for (addition, deletion, change):	Addition
Nominated conservation category and criteria:	EN: B1ab(ii,iii,v)+2ab(ii,iii,v)

Scientific committee assessment of eligibility against the criteria:		
This assessment is consistent with the standards set out in Schedule 1, item 2.7 (h) and 2.8 of the Common Assessment Method Memorandum of Understanding.		Yes <input type="checkbox"/> No <input type="checkbox"/>
A.	Population size reduction	•
B.	Geographic range	•
C.	Small population size and decline	•
D.	Very small or restricted population	•
E.	Quantitative analysis	•

Outcome:			
<i>Scientific committee Meeting date:</i>			
<i>Scientific committee comments:</i>			
<i>Recommendation:</i>			
<i>Ministerial approval:</i>		<i>Date of Gazettal/ Legislative effect:</i>	

Nomination/Proposal summary *(to be completed by nominator)*

Current conservation status				
Scientific name:	Pityrodia sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4)			
Common name:	None			
Family name:	Lamiaceae	Fauna <input type="checkbox"/>	Flora <input checked="" type="checkbox"/>	
Nomination for:	Listing <input checked="" type="checkbox"/>	Change of status/criteria <input type="checkbox"/>	Delisting <input type="checkbox"/>	
1. Is the species 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	State / Territory in which the species occurs	Date listed or assessed (or N/A)	Listing category i.e. critically endangered or 'none'	Listing criteria i.e. B1ab(iii)+2ab(iii)
International (IUCN Red List)				
National (EPBC Act)	1.			
State / Territory	1. WA	2015	Endangered	B1ab(ii,iii,v)+2ab(ii,iii,v)
	2.			
	3.			
Consistent with Schedule 1, item 2.7 (h) and 2.8 of the Common Assessment Method Memorandum of Understanding, it is confirmed that:				
<ul style="list-style-type: none"> this assessment meets the standard of evidence required by the Common Assessment Method to document the eligibility of the species under the IUCN criteria; 			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	
Comments:				
<ul style="list-style-type: none"> surveys of the species were adequate to inform the assessment; 			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	
Comments:	More intensive surveys of the known occurrences were undertaken in September 2015. The number of mature individuals has risen from the 2013 estimate of 2,039 to an estimated 9,291 mature individuals. No new occurrences were discovered in the 2015 surveys, but existing occurrences were more accurately delineated.			
<ul style="list-style-type: none"> the conclusion of the assessment remains current and that any further information that may have become available since the assessment was completed supports or is consistent with the conclusion of the assessment. 			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	
Comments:	Assessment is consistent and criteria remains current.			

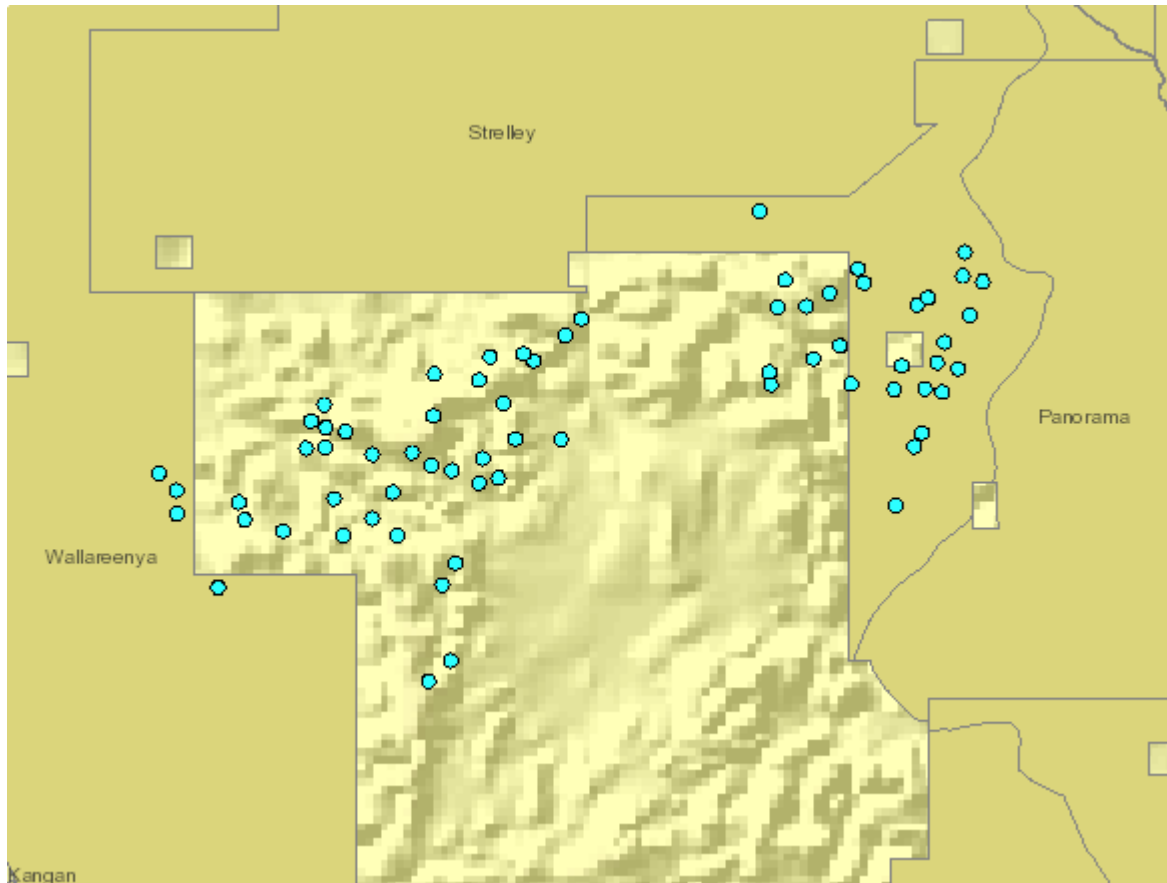
Nominated national conservation status: category and criteria		
Presumed extinct (EX) <input type="checkbox"/> Critically endangered (CR) <input type="checkbox"/> Endangered (EN) <input checked="" type="checkbox"/> Vulnerable (VU) <input type="checkbox"/>		
None (least concern) <input type="checkbox"/> Data Deficient <input type="checkbox"/> Conservation Dependent <input type="checkbox"/>		
What are the IUCN Red List criteria that support the recommended conservation status category?	EN: B1ab(ii,iii,v)+2ab(ii,iii,v)	
Eligibility against the IUCN Red List criteria (A, B, C, D and E)		
<i>Provide justification for the nominated conservation status; is the species eligible or ineligible for listing against the five criteria. For delisting, provide details for why the species no longer meets the requirements of the current conservation status.</i>		
A.	Population size reduction (evidence of decline)	<ul style="list-style-type: none"> The total number of mature individuals has risen from 2,039 (assessed in 2015) to 9,291 as a result of further survey. Does not meet criteria
B.	Geographic range (EOO and AOO, number of locations and evidence of decline)	<ul style="list-style-type: none"> (B1) EOO is 466.9 km² using Minimum Convex Polygon (MCP) which was calculated by drawing a polygon around the area of presumed suitable habitat. This value was based on the 2015 survey data that provided a more accurate estimate than the 2013 data that gave an EOO of 338.6km². (B2) AOO 152 km² using the 2km x 2km grid method. (a) Known from 70 subpopulations, within a restricted area west of Marble Bar in the Pilbara. None of the subpopulations are located in secure tenure and all occur on mineralised deposits with active mining exploration and subject to a potential threat from mining. Regarded as one location based on the threat of potential mining activity. (b) Continuing decline observed and projected: (ii) (iii) (v) The species occurs within the development envelopes of three separate mining projects. Each of these has proposed at some stage to clear native vegetation and remove individuals of <i>Pityrodia</i> sp. Marble Bar. In January 2015, FMG received approval for the North Star Magnetite Project. The exact number of plants that will be removed during the implementation of this project cannot be predetermined, but is likely to be around 300 individuals at this site (~3% of total population). Further decline in population size and area of occupancy are anticipated in the future with the development of the other mining projects. Meets criteria for Endangered B1ab(ii,iii,v)+B2ab(ii,iii,v)
C.	Small population size and decline (population size, distribution and evidence of decline)	<ul style="list-style-type: none"> The total number of mature individuals has increased from 2,039 (assessed in 2015) to 9,291 as a result of further survey. The exact number of plants that each proponent will be removing from their tenement during project development and operation cannot be predetermined, but is likely to be around 300 individuals (~3% decline). Regardless, approval of each mine results in the IUCN criteria for continuing decline being met.

		<ul style="list-style-type: none"> Three subpopulations contain >1,000 individuals. Largest subpopulation contains 3,036 individuals (33%). Does not meet criteria
D.	Very small or restricted population (population size)	<ul style="list-style-type: none"> (D) Known from up to 9,291 mature individuals. Does not meet criteria
E.	Quantitative analysis (statistical probability of extinction)	<ul style="list-style-type: none"> No information to assess.
Summary of assessment information		
EOO	466.9 km ² (MCP)	AOO 152 km ² (2x2km grid) Generation length Unknown
No. locations	1	Severely fragmented
No. subpopulations	70	No. mature individuals
Percentage global population within Australia		100
Percentage population decline over 10 years or 3 generations		Unknown
Threats <i>(detail how the species is being impacted)</i>		
Threat <i>(describe the threat and how it impacts on the species. Specify if the threat is past, current or potential)</i>	Extent <i>(give details of impact on whole species or specific subpopulations)</i>	Impact <i>(what is the level of threat to the conservation of the species)</i>
Mining <ul style="list-style-type: none"> The species occurs within the development envelopes of three separate mining projects 1) Fortescue Metal Group's North Star Magnetite Project, 2) Atlas Iron's Abydos Ore Project Stage 2, and 3) Venturex's Sulphur Springs Project. Mining will result in clearing of vegetation including the removal of individual plants and subpopulations of <i>Pityrodia</i> sp. Marble Bar. Current, future	Whole population	Catastrophic
Loss of genetic diversity and fragmentation <ul style="list-style-type: none"> Loss of individuals resulting from mining may impact on the species genetic flow and variation between the disjunct east and west subpopulations. Future	Whole population	Severe
Weeds <ul style="list-style-type: none"> Mining has the potential to introduce weeds (such as buffel grass) into disturbed landscapes. Weeds suppress early plant growth by competing for soil moisture, nutrients and light, as well as increase the fire hazard due to the easy ignition of high fuel loads. Future	Whole population	Severe

<p>Altered fire regimes</p> <ul style="list-style-type: none"> <i>Pityrodia</i> sp. Marble Bar appears to resprout from woody rootstock following fire, including high intensity fire, and also produces seedlings adjacent to resprouting individuals. If fire frequency is increased the soil seed bank could be depleted before juvenile plants have reached maturity. <p>Past, current and future</p>	Whole population	Severe
Management and Recovery		
Is there a Recovery Plan (RP) or Conservation Management Plan operational for the species?		Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
<p><i>List all relevant recovery or management plans (including draft, in-preparation, out-of-date, national and State/Territory recovery plans, recovery plans for other species or ecological communities, or other management plans that may benefit or be relevant to the nominated species).</i></p>		
<p><i>List current management or research actions, if any, that are being undertaken that benefit the conservation of the species.</i></p> <ul style="list-style-type: none"> Monitoring and surveys have been carried out to determine plant numbers and impact of threats. 		
<p><i>List further recommended management or research actions, if any, that would benefit the conservation of the species. Please ensure that this section addresses all identified threats.</i></p> <p>Management</p> <ul style="list-style-type: none"> Monitor subpopulations for evidence of weeds, grazing, or changes in plant or site health; Ensure input into regulatory processes to reduce long term impacts from mining activities to ensure viability of subpopulations; Investigate the potential for reservation of land; Liaise with station owners to protect the remnant vegetation on which the species occurs, including through the placement of covenants on properties; Undertake surveys in areas of potentially suitable habitat; Collect and store seed; Develop and implement a fire management strategy, including the need for, and method of, the construction and maintenance of firebreaks; Control infestations of weeds that might impact the species and its habitat if noted. <p>Research</p> <ul style="list-style-type: none"> Research biology and ecology of the species, with a focus on longevity, response to threats and disturbances, and reproductive biology; Assessment of genetic differences and gene flow within and between the different-sized clusters of individuals across the species' range, and particularly across the 5km wide gap that divides the broader population. 		
Nomination prepared by:		
Contact details:		
Date submitted:	8/12/2016	

If the nomination has been refereed or reviewed by experts, please provide their names and contact details:

Location of *Pityrodia* sp. Marble Bar subpopulations with land tenure (pastoral stations deep yellow, unallocated Crown land pale yellow)



Summary of subpopulation information (detailed information to be provided in the relevant sections of the form)						
Location or Subpopulation (include coordinates)	Land tenure	Survey information: Date of survey and No. mature individuals	Area of subpopulation	Site / habitat Condition	Threats (note if past, present or future)	Specific management actions
<p>Subpopulations 1 to 71*</p> <p>*All subpopulations occur on UCL except:</p> <p>Wallareenya Pastoral Lease LPL N-050365: Subpopulations 6, 7, 42, 43</p> <p>Panorama Pastoral Lease PL N-050454: Subpopulations 28, 33, 34, 36, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71</p>	UCL, pastoral lease	<p>2007*: 257</p> <p>2010*: 67</p> <p>2011*: 463</p> <p>2012*: 686</p> <p>2013*: 856</p> <p>2013 : 2,039 (cumulative)</p> <p>2015: 9,291</p> <p>(counts include known and new individuals)</p> <p>* surveys not complete and represent different subpopulations</p>	152 km ² (using 2kmx2km grid system)	Excellent	<p>Mineral exploration (present, future)</p> <p>Altered fire regimes (past, present, future)</p> <p>Weeds (future)</p> <p>Loss of genetic diversity (future)</p> <p>Climate change (future)</p>	<p>Secure land through acquisition</p> <p>Reduce impacts from mining activities</p> <p>Undertake weed control</p> <p>Undertake further investigations into reproductive strategies</p> <p>Collect seed</p> <p>Investigate gene flow and variation, inbreeding and outcrossing rates</p> <p>Undertake further surveys</p>



Department of
Parks and Wildlife



Form to nominate a Western Australian species for listing as threatened, change of category or delisting 2015.

SECTION 1. NOMINATION					
1.1. Nomination for:					
Flora <input checked="" type="checkbox"/>	Fauna <input type="checkbox"/>	as: Threatened / DRF <input checked="" type="checkbox"/> Change of category <input type="checkbox"/> Delisting <input type="checkbox"/>			
1.2. Scientific Name This name will be used to identify the species on all official documentation. Use the approved name used by the Western Australian Museum or Herbarium, if possible.					
<i>Pityrodia</i> sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4)					
1.3. Common Name If the species has a generally accepted common name, please show it here.					
N/A					
1.4. Family Name					
Lamiaceae					
1.5. Current Conservation Status. If none, type 'None'.					
	IUCN Red List Category e.g. Vulnerable		IUCN Red List Criteria e.g. B1ab(iv); D1		
International IUCN Red List					
National EPBC Act 1999					
State of Western Australia					
State of WA Priority	1 <input checked="" type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>
1.6. Nominated Conservation Status.					
	IUCN Red List Category e.g. Vulnerable		IUCN Red List Criteria e.g. B1ab(iv); D1		
State of Western Australia	Endangered		B1ab(ii,iii,v)+B2ab(ii,iii,v)		
State of WA Priority	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>
Is the species listed as 'Threatened' in any other Australian State or Territory? If Yes, list these States and/or Territories and the status for each.					
No <input checked="" type="checkbox"/> Yes <input type="checkbox"/> Details:					
1.7. Reasons for the Nomination. Briefly summarise the reasons for the nomination in dot points. Please include details relevant to the IUCN Category and each Criteria.					
<i>Pityrodia</i> sp. Marble Bar has a specific and restricted habitat and a restricted distribution of c. 20 x 33 km, which spans three mining project areas - Fortescue Metal Group's (Fortescue) North Star magnetite project, Atlas Iron's Abydos Ore Stage 2 project, and Venturix's (formerly Panorama's) Sulphur Springs mine.					
<i>Pityrodia</i> sp. Marble Bar does not occur in any conservation reserves.					

Pityrodia sp. Marble Bar has an area of occupancy of <20km² (conservatively estimated as 11.2km²) and an extent of occurrence of 338.6km², and its population size is currently estimated at 2,039 individuals. Under IUCN guidelines it is known from only a single locality.

Under a no mining/no disturbance scenario *Pityrodia* sp. Marble Bar is currently meets listing as Threatened Flora - Vulnerable (VU) under IUCN criterion D2. However, both North Star and Abydos Stage 2 have been given conditional approval and a decline in population size and area of occupancy are anticipated, and an increase in fragmentation between western and eastern subpopulations is also likely.

North Star and Abydos Stage 2 have proposed to remove 158 plants and 143 plants from their tenements respectively, equalling 301 plants, which represents a reduction in population size of 8% to 1,881 individuals and a reduction in the area of occupancy to 10.304km². With this loss of plants and/or habitat the following IUCN criterion would be met: Endangered B1ab(ii,iii,v)+B2ab(ii,iii,v) – Extent of Occurrence estimated as >100km² but <5,000km², area occupancy estimated at >10 km² but less than 500km², known from less than 5 locations, and with a decline in area of occupancy, extent of habitat and number of individuals.

As current conditions on both projects state that no plants of *Pityrodia* sp. Marble Bar can be impacted without CEO approval, the exact number of plants that each proponent will be removing from their tenement during project development and operation cannot be determined. Regardless, approval of each mine results in the IUCN criteria for Endangered being met through projected decline.

SECTION 2. SPECIES

2.1. Taxonomy.

Describe the taxonomic history, using references, and describe the key distinguishing features that can be used to separate this taxon from closely related taxa. Include details of the type specimen, changes in taxonomy, scientific names and common names used for the species.

First recorded from Panorama Station to the east of North Star during surveys from 2002 and 2007 for the Panorama (now Venturex) Sulphur Springs project (proposed zinc, copper and lead mine) (Trudgen et al. 2002; Trudgen 2006, 2007, cited in Matiske 2007).

Collected again in 2010 and taken to the Western Australian Herbarium for identification, the taxon was recognised as distinct by ID botanist M. Hislop who noted that the closest relative was likely to be *P. obliqua* from the Kimberley region. The informal name *P. sp. Marble Bar* (G. Woodman & D. Coultas GWDC Opp 4) was then placed on the census of Western Australian plants to accommodate these new collections.

The two vouchered specimens (G. Woodman & D. Coultas GWDC Opp 3 [PERTH 08253757]; G. Woodman & D. Coultas GWDC Opp 4 [PERTH 08253749]) were collected from outside the conservation estate during a mineral lease exploration survey and *P. sp. Marble Bar* was given a conservation listing of Priority One.

Pityrodia sp. Marble Bar can be separated from *P. obliqua* by its leaves having longer, denser hairs that obscure the tertiary leaf veins (veins obvious in *P. obliqua*), less tapering calyx lobes which are 7–8mm long (vs 5–6mm long in *P. obliqua*), longer flowers (15–18mm long vs 12–15 mm long), longer anthers (pollen sacs) (1.7–2mm vs 1–1.3mm) and a larger, broader ovary.

Is this species conventionally accepted? If no, explain why. For example, is there any controversy about the taxonomy? For undescribed species, detail the location of voucher specimens (these should be numbered and held in a recognised institution and be available for reference purposes).

No ☐ Yes ☒

This species is undescribed; however, taxonomists at the Western Australian Herbarium accept it as recognisably different from all others. The voucher specimen for this informally named species, G. Woodman & D. Coultas GWDC Opp 4, is held at the Western Australian Herbarium (PERTH 08253749).

The entity first collected from the Panorama Project (Sulphur Springs) in surveys from 2002 and

2007 was informally named " <i>Pityrodia</i> sp. Panorama" by botanical consultant M.E. Trudgen, but no specimens were ever lodged at the Herbarium so this name was never placed on the census of Western Australian plants, and was never accessible through FloraBase (Western Australian Herbarium 1998–). This taxon is now recognised as being the same as <i>P. sp. Marble Bar</i> (M.E. Trudgen, pers. comm.) and all records under the former name have been transferred to <i>P. sp. Marble Bar</i> .
Describe any known hybridisation with other species in the wild, indicating where this occurs and how frequently.
None noted.
2.2. Description Describe the physical appearance, habit, behaviour/dispersion and life history. Include anatomy or habit (e.g. size and/or weight, sex and age variation, social structure) and dispersion (e.g. solitary, clumped or flocks etc), and life history (eg short lived, long lived, geophytic, etc).
<p>Many-branched shrub to 2m tall with opposite, grey, densely hairy leaves and large, pink, tubular flowers that have darker pink markings in the lower lobe and in the throat and a darker pink calyx. Flowers appear from July to September.</p> <p>Plants are uncommon through the landscape, usually occurring as isolated clumps of individuals on very steep sandstone slopes. Most populations are small (<10 plants), although some contain relatively large numbers of individuals (>200 plants) (Woodman Environmental Consulting 2013). Dispersion through the landscape is dictated by the availability of suitable habitat.</p> <p><i>Pityrodia</i> sp. Marble Bar is a long-lived species. It resprouts from woody rootstock following fire, even high-intensity fire, with seedlings also observed at a number of locations adjacent to re-sprouting individuals (Woodman Environmental Consulting 2013).</p>
2.3. Distribution Describe the distribution of the species in Australia and, if possible, provide a map.
Only known from the Pilbara bioregion of Western Australia where it occurs over an area of c. 35km east–west x 20km north–south, c. 45km due west of Marble Bar (Figure 1).
2.4. Habitat Describe the non-biological habitat (e.g. aspect, topography, substrate, climate) and biological habitat (e.g. vegetation type, associated species, sympatric species). If the species occurs in various habitats (e.g. for different activities such as breeding, feeding, roosting, dispersing, basking etc) then describe each habitat. Note if the habitat has a special defining characteristic. If possible estimate the area of habitat, or the relative abundance of the habitat, and note if a critical habitat requirement (eg breeding habitat) is restricted in its availability to the species.
Non-biological habitat
Recorded from rocky conglomerate (usually sandstone) and granitic hill slopes with a (mostly) southerly or easterly aspect and skeletal, brown, sandy loam, within the Capricorn Land System.
Biological habitat
Tall shrubland of <i>Terminalia canescens</i> and <i>Acacia tumida</i> var. <i>pilbarensis</i> over hummock grassland of <i>Triodia longiceps</i> , with <i>Eriachne mucronata</i> and <i>Sarcostemma viminale</i> subsp. <i> australe</i> (Western Australian Herbarium 1998–).
Does the (fauna) species use refuge habitat e.g. in times of fire, drought or flood? Describe this habitat.
N/A
Is the species part of, or does it rely on, a listed threatened ecological community? Is it associated with any other listed threatened species?
No.

2.5. Reproduction

Provide an overview of the breeding system.

For fauna: Provide an overview of the breeding system and breeding success, including: when does it breed; what conditions are needed for breeding; are there any breeding behaviours that may make it vulnerable to a threatening process?

For flora: When does the species flower and set fruit? Is the seed produced viable? What conditions are needed for this? What is the pollinating mechanism? If the species is capable of vegetative reproduction, a description of how this occurs, the conditions needed and when. Does the species require a disturbance regime (e.g. fire, ground disturbance) in order to reproduce?

Flowers appear from July to September and are most likely insect pollinated; fruiting period is not documented. Seed is viable and seedlings have been observed adjacent to resprouting plants in the post-fire landscape. No studies have been performed to determine whether fire or other disturbance is necessary for germination. No observations of vegetative reproduction have been made in this woody shrub species.

2.6. Population dynamics

Provide details on ages of sexual maturity, extent of breeding success, life expectancy and natural mortality. Describe population structure (presence of juveniles/seedlings, mature and senescing individuals). Estimate generation length.

Unknown; no records of population structure or dynamics in available survey data

Questions 2.7 and 2.8 apply to fauna nominations only

2.7. Feeding

Summarise food items or sources and timing/availability.

N/A

Briefly describe feeding behaviours, including those that may make the species vulnerable to threatening processes.

N/A

2.8. Movements

Describe any relevant daily or seasonal pattern of movement for the species, including relevant arrival/departure dates if migratory. Provide details of home range/territories.

N/A

SECTION 3. INTERNATIONAL CONTEXT

For species that are distributed both in Australia and in other countries.

3.1. Distribution

Describe the global distribution.

N/A

Provide an overview of the global population size, trends, threats and security of the species outside of Australia.

N/A

Explain the relationship between the Australian population and the global population. What percentage of the global population occurs in Australia? Is the Australian population distinct, geographically separate or does part, or all, of the population move in/out of Australia's jurisdiction? Do global threats affect the Australian population?

N/A

SECTION 4. CONSERVATION STATUS AND MANAGEMENT

Conservation status and management information is required for the national extent of the species, however, greater detail is expected for the WA occurrences. If the taxon is considered to be endemic to Western Australia, please provide supporting evidence.

4.1. Population

What is the total national/State population size in terms of number of mature individuals? Has the number of individuals been counted, or is this an estimate? Provide details of the method

of determining the number of individuals. Are there other useful measures of population size and what are they? Or if these are unavailable, provide an estimate of abundance (e.g. scarce, locally abundant etc).

Note: The term 'population' is used in a specific sense in the Red List Criteria that is different to its common biological usage. Population is here defined as the total number of mature individuals of the taxon. In the case of taxa obligately dependent on other taxa for all or part of their life cycles, biologically appropriate values for the host taxon should be used. (IUCN 2001)

The total known *Pityrodia* sp. Marble Bar population size was estimated to be 2,039 plants from 628 records obtained from multiple sources (Western Australian Herbarium 1998–; Trudgen 2007; ecologia 2012a, 2012b; Woodman 2012 2013; DPaW 2015) during a desktop assessment of the species' abundance and distribution (Fortescue Environment 2014). Where different surveys at any location returned different values, the highest count was taken to calculate the total number of plants (Appendix 1).

It is proposed to conduct further survey for *Pityrodia* sp. Marble Bar based on the results of MaxEnt habitat modelling (Fortescue Environment 2014). It is thought that additional plants are likely to be found in the areas of potentially suitable habitat identified (ecologia 2012; Woodman 2013); however, the subpopulations are likely to be small (Woodman 2013) and will not significantly increase the overall population size of *P. sp.* Marble Bar.

How many subpopulations or locations do you consider the species occurs in and why?

Note: 'Subpopulations' are defined as geographically or otherwise distinct groups in the population between which there is little demographic or genetic exchange (typically one successful migrant individual or gamete per year or less). 'Locations' are defined as a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present. The size of the location depends on the area covered by the threatening event and may include part of one or many subpopulations. Where a taxon is affected by more than one threatening event, location should be defined by considering the most serious plausible threat. (IUCN 2001) Refer to Red List Guidelines 9.0

Across its range *Pityrodia* sp. Marble Bar is known from 36 discrete sites or loci (Fortescue Environment 2014; Appendix 1; Figure 2); these are defined as being separated from one another by >500m under Department of Parks and Wildlife guidelines. Under IUCN guidelines this species occurs at one location.

Provide locations of: captive/propagated occurrences or *ex situ* collections; recent re-introductions or introductions to the wild; and sites for proposed re-introductions or introductions. Have these sites been identified in recovery plans?

No *ex situ* collections have been made and this species has not been included in any translocation or reintroduction programmes. No recovery plans exist for this species.

For flora, and where applicable, for fauna, detail the location, land tenure, estimated number of individuals, area of occupancy, and condition of site for each known date, location or occurrence. More specific detail is expected for WA occurrences for taxa that are not endemic to WA.

The records presented below are from the Western Australian Herbarium (1998–). Surveyed sites and numbers of plants per population locus are shown in Appendix 1 and mapped in Figure 2. Additional geocode records are held in the external databases of environmental consultancies and mining companies but can be visualised in Figures 1 and 2.

Date of survey	Location Description (include coordinates of the site)	Land status	Number of mature individuals at location	Area of occupancy at location	Condition of site
03/08/2010	c. 5km S of Strelley St'n southern boundary, c. 15km W of Panorama St'n	Unallocated Crown Land (UCL)	c. 27	Not recorded.	Not recorded but description implies good.

	western boundary, just E of the Strelley River; c. 90km SSE of Port Hedland 21° 8' 16.2" S 119° 7' 39.9"E (GDA94)				
30/08/2010	c. 7km S of Strelley St'n southern boundary, c. 12km E of Wallareenya St'n eastern boundary, E of the Strelley River; c. 90km SSE of Port Hedland 21°11'20.4" S 119°4'1.6" E (GDA94)	UCL	c. 50	Not recorded.	Not recorded but description implies good.
04/07/2011	North Star 21°8'9.5" S 119°7'46.9" E (GDA94)	UCL	19	Not recorded.	Not recorded but description implies good.
04/07/2011	North Star 21°8'10.7" S 119°7'46.7" E (GDA94)	UCL	13	Not recorded.	Not recorded but description implies good.

What is the total area of occupancy (in km²) for the species; explain how it was calculated and datasets used. If an accurate estimate is unavailable, provide a range of values or a minimum or maximum area estimate. Where separate breeding habitat is applicable, if possible, also provide area of breeding habitat.

The total area of occupancy for *Pityrodia* sp. Marble Bar is <20km² and is conservatively estimated as 11.2km² (Department of Parks and Wildlife 2015). This was calculated from the available information, using the mapped plant occurrence at a scale of 400x400m for each distinct data point.

What is the extent of occurrence (in km²) for the species; explain how it was calculated and datasets used. If an accurate estimate is unavailable, provide a range of values or a minimum or maximum area estimate.

Pityrodia sp. Marble Bar has an extent of occurrence of 338.6km² with the furthest locations approximately 33km from each other (Fortescue Environment 2014). This value was calculated from all available collection and survey data for the species, including records in the Threatened and Priority Flora (TPFL) database (Department of Parks and Wildlife 2015) and the Western Australian Herbarium (1998–), and in Trudgen (2007), ecologia Environment (2012a, 2012b) and Woodman Environmental Consultancy (2012, 2013) during a desktop assessment of the species' abundance and distribution (Fortescue Environment 2014).

In order to direct future detailed survey for *Pityrodia* sp. Marble Bar, MaxEnt modelling of potentially

suitable habitat was undertaken by ecologia Environment to identify high and low priority search areas. Modelling suggested that there is 141.96km² of potentially suitable habitat in the region, the majority of which is located in and around known *P. sp. Marble Bar* localities, or in almost contiguous landforms, with small areas further from the known locations, particularly along a range approximately 50km north of Nullagine (Fortescue Environment 2014). Until these areas are surveyed, however, it cannot be assumed that there will be an increase in the extent of occurrence of this species.

Identify important occurrences necessary for the long-term survival and recovery of the species? This may include: key breeding populations, those near the edge of the range of the species or those needed to maintain genetic diversity.

Any loss of individuals of a species that qualifies for listing as Rare Flora must be regarded as detrimental to its viability through loss of genetic diversity. It has been noted that there is considerable variation in the size of subpopulations, which can vary from a more typical value of c. 10 plants to >200 plants (Woodman Environmental Consultancy 2013). Targeted survey for *P. sp. Marble Bar* (ecologia Environment 2012b) also identified that some subpopulations contain a significant proportion of the individuals from a local area, i.e. within the North Star survey area 47% of individuals occur at a single locus and over 91% of individuals occur at the five most populous loci; outside the survey area over 44% of plants occur at a single locus, which is situated on the Sulphur Springs lease (ecologia Environment 2012b). The potentially differing genetic structures of small vs large subpopulations needs to be investigated and taken into account when planning conservation actions.

Is the distribution of the species severely fragmented? Why?

Not currently. However, there is a natural disjunction of 5km+ between western and eastern subpopulations related to their restriction to the Capricorn Land System, which is broadly intruded into by areas of the Black, Rocklea and Granitic Land Systems at this point. Although there is a bridge of Capricorn Land System between the two population areas, no plants of *P. sp. Marble Bar* have been collected there to date.

The Abydos Stage 2 project proposed to remove 143 individuals (7% of the total population) of *P. sp. Marble Bar* in a narrow bridge of the Capricorn Land System in the northern area of the western subpopulations. If permitted this would increase the gap between the western and eastern subpopulations further. The Department of Parks and Wildlife advised the EPA that because *P. sp. Marble Bar* occurs only on specialist habitat in a linear arrangement along south-facing, rocky conglomerate and granite slopes, the proposed clearing may impact the connectivity between the eastern and western parts of the population through creating a barrier to insect pollinators.

Is the taxon subject to extreme fluctuations? If so, provide evidence.

No. Populations of large shrub taxa are highly unlikely to display extreme fluctuations in size or distribution.

Has there been any known decline in the species within WA or nationally, or is this likely in the future? – provide details in relation to the elements detailed below, including how the decline has been measured or inferred. Is there a presumption of continuing decline? If so, provide details of the decline and how it relates to the specific Red List Categories and Criteria version 3.1.

Note: A continuing decline is a recent, current or projected future decline (which may be smooth, irregular or sporadic) which is liable to continue unless remedial measures are taken. Fluctuations will not normally count as continuing declines, but an observed decline should not be considered as a fluctuation unless there is evidence for this. (IUCN 2001) Refer to Red List Guidelines 9.0

A decline in *Pityrodia sp. Marble Bar* is very likely in the future. *Pityrodia sp. Marble Bar* occurs within the development envelopes of three separate mining projects 1) Fortescue Metal Group's North Star Magnetite Project, 2) Atlas Iron's Abydos Ore Project Stage 2, and 3) Venturex's Sulphur Springs Project (Figure 1). Each of these has proposed at some stage to clear native vegetation and remove individuals of *Pityrodia sp. Marble Bar*; Sulphur Springs is not expected to impact any plants in its current operation. The local and regional impact of this has been stated to be Low for North Star and Atlas under conditional permits; however, the close proximity of these projects to one

another and their overlap with the population of *Pityrodia* sp. Marble Bar is likely to have a cumulative impact on this species over time.

Has there been a decline in the size of the population (number of mature individuals)?

Not to date, but there will be a decline.

Recent surveys associated with mineral development projects have resulted in an increase in the number of *Pityrodia* sp. Marble Bar individuals known as these surveys have concentrated on areas of suitable habitat. Prior to the North Star Flora and Vegetation Survey (ecologia Environment 2012a) *Pityrodia* sp. Marble Bar was known from only two locations with an estimated 77 plants; botanical survey of the development area located an additional 610 plants (ecologia Environment 2012a) with a further 654 plants located during a targeted survey for the species (ecologia Environment 2012b). Of note is that even though the number of plants of *Pityrodia* sp. Marble Bar increased significantly its extent of occurrence did not, despite best efforts to locate significant new populations, and the species' distribution remained highly localised to an area c. 20 km N–S and 30 km E–W, centred on the North Star development area.

There will inevitably be a decline in the size of the population with the recent approval of two mining projects that overlap with *P. sp. Marble Bar*'s area of occupancy. Each gained conditional approval in 2014 after modifying their original proposals, with the avoidance of or minimisation of impact on *P. sp. Marble Bar* being a principal condition.

Fortescue's North Star project originally anticipated removing 158 plants from its mine development envelope and 225 plants from its water corridor development envelope; this would have resulted in the loss of 71% of *P. sp. Marble Bar* plants occurring in the North Star survey area and 18% of the total population. A parallel proposal to remove 143 individuals on Atlas Iron's Abydos Stage 2 tenement would have had a cumulative impact of removing c. 80% of the local population and 25% of the total population.

Following environmental review Fortescue have committed to modifying the water corridor development envelope to avoid plants of *Pityrodia* sp. Marble Bar as much as is practicable, reducing their impact on the population of *Pityrodia* sp. Marble Bar to the removal of 8% of the total population. Atlas have received Commonwealth approval to clear vegetation on their tenement, conditional upon there being no clearing of or within 10m of *Pityrodia* sp. Marble Bar individuals without approval. As such the current clearing impact to the species is significantly less than had been estimated, but in conjunction with North Star could still potentially result in the loss of 15.6% of the total population (301 plants).

- can the rate of population size reduction be determined over the last 10 years or 3 generations (whichever is the longer)? If so, state whether the determination is based on quantitative data (observed), estimated (provide data and calculations), inferred or suspected.

No. Recent surveys for *Pityrodia* sp. Marble Bar have resulted in an increase in the number of individuals known. Prior to the North Star Flora and Vegetation Survey (ecologia Environment 2012a) *P. sp. Marble Bar* was known from only two locations with an estimated 77 plants; botanical surveys of areas of suitable habitat then located an additional 610 plants (ecologia Environment 2012a) and a further 654 plants (ecologia Environment 2012b). Of note is that even though the number of plants increased significantly, their extent of occurrence did not and the species' distribution remained highly localised.

- can the rate of population size reduction be estimated for the next 10 years or 3 generations and in any 10 year or 3 generation period (up to a maximum of 100 years into the future)? If so, state how the reduction is estimated (provide data and calculations), inferred or suspected.

No. Any future reduction in population size will be determined by the conservation status of *Pityrodia* sp. Marble Bar. If the Minister approves listing as Rare Flora then the rate of decline will be slowed, as a number of conservation conditions to ensure the continued viability of the species will be enforced.

Has there been a decline in the number of locations, extent of occurrence or area of occupancy?

Not to date, but between them North Star and Abydos Stage 2 propose to remove individuals from

the northern area of the western group of subpopulations (Figure 1), which will result in a decline in the extent of occurrence and area of occupancy.
Has there been a decline in the area or quality of habitat?
Not to date, but 100s of hectares of habitat are proposed to be cleared.
4.2. Survey effort Describe the methods to conduct surveys. For example, season, time of day, weather conditions; length, intensity and pattern of search effort (including where species not encountered); any limitations and expert requirements.
A number of general and targeted surveys have been conducted over the project areas and further afield, and additional survey of areas of suitable habitat across the Capricorn Land System are proposed. Surveys have been conducted by experienced botanists at times when the species has been flowering and also when it has been sterile. Plants are readily recognisable by their habit and leaves, and flowers are not considered necessary to identify the species correctly. Prior to commencing field survey, assessment of locations likely to contain suitable habitat have been conducted based on interpretation of aerial imagery, land systems, landform and aspect. Survey effort has typically involved one to three people performing a preliminary assessment of likely habitat from vehicle tracks using binoculars, then traversing the study area on foot, either discounting potential sites or counting individuals encountered and recording the GPS co-ordinates of each plant or clump of individuals. Binoculars have frequently been used to survey steep terrain as plants of <i>P. sp. Marble Bar</i> are distinctive and easily detectable in the landscape. Survey periods have ranged from nine to 12 days. Limitations to survey include access issues (few vehicle tracks, different tenures) and rough terrain.
Provide details on the distinctiveness and detectability of the species, or the distinctiveness of its habitat, that would assist survey success.
Plants of <i>Pityrodia</i> sp. Marble Bar are easy to detect shrubs up to 2m tall and are highly visible in the landscape due to their distinctively shaped, silvery leaves and large, showy flowers. The use of binoculars to detect and count plants in difficult to access areas assisted survey success. <i>Pityrodia</i> sp. Marble Bar is restricted to a specific habitat which focusses search effort and has allowed MaxEnt modelling to predict areas where additional plants may be found (see below).
Has the species been reasonably well surveyed? Provide an overview of surveys to date (include surveys of known occurrences and surveys for additional occurrences) and the likelihood of its current known distribution and/or population size being its actual distribution and/or population size. Include comments on potential habitat and surveys that were conducted, but where the species was not present/found.
Yes. Surveys include those of Trudgen (2007), ecologia Environment (2012a, 2012b) and Woodman Environmental Consultancy (2012, 2013). During assessment of development proposals for the adjacent North Star and Abydos Stage 2 projects a concern expressed by the EPA regarded the cumulative impacts of their parallel proposals. A targeted survey across the mining tenements of all proponents in the area was therefore requested of Fortescue to establish distributions and determine density of plants in the immediate area. This flora study overlapped actively explored areas of the Abydos and Venturex projects and helped to consolidate data. In order to direct future detailed survey for <i>P. sp. Marble Bar</i> , MaxEnt modelling of potentially suitable habitat was undertaken by ecologia Environment to identify high and low priority search areas. Modelling suggested that there is 141.96km ² of potentially suitable habitat in the region, the majority of which is located in and around known <i>P. sp. Marble Bar</i> localities, or in almost contiguous landforms, with small areas further from the known locations, particularly along a range approximately 50km north of Nullagine (Fortescue Environment 2014).

4.3. Threats

Identify past, current and future threats indicating whether they are actual or potential. For each threat describe:

- how and where they impact this species**
- what the effect of the threat(s) has been so far (indicate whether it is known or suspected)**
- present supporting information/research**
- does it only affect certain populations?**
- what is its expected effect in the future (is there supporting research/information; is the threat only suspected; does it only affect certain populations?).**

Pityrodia sp. Marble Bar was first located during survey associated with the development of a resources extraction project (Panorama; Sulphur Springs) and the species is directly threatened by proposals to expand (Abydos Stage 2) and develop (North Star) mining activities within its range. Threats include native vegetation clearing (removal of individual plants and subpopulations), mining activities (loss of substrate and habitat), and the introduction of weeds (including buffel grass) into disturbed landscapes. These threats are actual.

If implemented as proposed the impacts of the North Star and Abydos Stage 2 projects would result in the removal of 301 plants (8% of the total population). Recent advice from the Department of Mines and Petroleum to the EPA suggests that it is unlikely that the Venturex (was Panorama) Sulphur Springs Project, for which a native vegetation clearing permit has already been issued, will not impact on any individuals of *Pityrodia* sp. Marble Bar due to a change in operations from an open cut to an underground mine (Department of Parks and Wildlife 2015).

All records of *Pityrodia* sp. Marble Bar occur within c. 22 km of the North Star and Abydos Stage 2 mine developments with proposals to remove plants affecting those individuals in the North Star mine development envelope and the northern part of Abydos' operations (Figure 1).

If possible, provide information threats for each current occurrence/location:

Location	Past threats	Current threats	Potential threats	Management requirements (see section 4.4)
North Star mine development envelope	158 plants to be removed (8% total population) as part of open cut mine and infrastructure development	158 plants to be removed (8% total population) Loss of habitat Invasive weeds	Additional plants to be removed Loss of habitat Invasive weeds	1) 'P. sp. Marble Bar Mine Infrastructure Plan' 2) 'P. sp. Marble Bar Regional Survey Plan' 3) 'P. sp. Marble Bar Research and Conservation Plan' (if listed as rare Flora)
North Star water corridor development envelope	225 plants to be removed (11% total population) as part of water corridor infrastructure development	Some plants (# not specified) to be removed (where avoidance is not possible)		1) Condition: no plants to be removed where practicable 2) 'Linear Infrastructure and Borefield Alignment Plan'
Abydos Stage 2 development envelope	143 plants to be removed (7% total population)	Some plants (# not specified) to be removed with	Additional plants to be removed Loss of habitat	1) Condition: no clearing of or within 10m of plants of P. sp.

		approval of CEO	Invasive weeds	Marble Bar without CEO approval
Sulphur Springs	Plants (# not specified) to be removed as part of open cut mine development (721 plants occur in the vicinity)	None. No plants proposed to be removed as operations changed to underground mining		
Identify and explain why additional biological characteristics particular to the species are threatening to its survival (e.g. low genetic diversity). Identify and explain any models addressing the survival of the species.				
<p><i>Pityrodia</i> sp. Marble Bar is most likely pollinated by insects based on the shape of its flowers and the 'nectar guide' markings on the flowers' lower lobe and inside the throat. Currently, the sites at which <i>P. sp.</i> Marble Bar occurs are separated into two discrete clusters in the landscape separated by a gap of c. 5km: sites 1–19, 29–31 are on the west of the gap and sites 20–28, 32–36 are in the east (Figure 2). This patterning is a result of the species' habitat specificity as plants are restricted to steep, rocky conglomerate and granitic slopes of the Capricorn Land System which flanks an intervening area that is part of the Black, Granitic and Rocklea Land Systems (Figure 2). Insect movement across this 5km gap is unlikely and this could have significant implications for gene flow across the population. Further fragmentation of the population is likely to exacerbate this.</p>				
4.4. Management Identify key management documentation for the species e.g. recovery plans, conservation plans, threat abatement plans etc.				
<p>As <i>Pityrodia</i> sp. Marble Bar is recognised as being eligible for listing as Rare Flora the EPA and the Commonwealth adopted a precautionary approach in assessing original and revised development proposals, and set down a number of conditions to minimise the loss of this species' viability in giving development and clearing approval.</p> <p>For example, in conditionally approving the North Star project, the EPA required that a number of threat abatement plans be put in place. Firstly, a '<i>Pityrodia</i> sp. Marble Bar Mine Infrastructure Plan' must be prepared and submitted to the CEO before any disturbance to plants occurs. It must demonstrate that the mine and associated infrastructure are located so as to avoid or minimise direct and indirect loss, it must accurately show the final positions of all infrastructure within the mine envelop, and it must be approved and implemented prior to any disturbance to plants. Secondly, a '<i>Pityrodia</i> sp. Marble Bar Regional Survey Plan' must be prepared, submitted and approved before any disturbance to plants occurs. This survey plan should identify all areas of potential habitat for <i>Pityrodia</i> sp. Marble Bar with the aim of undertaking additional surveys to confirm population size and distribution in order to clarify the species' conservation status. Thirdly, in the event that <i>Pityrodia</i> sp. Marble Bar is listed as Rare Flora, a '<i>Pityrodia</i> sp. Marble Bar Research and Conservation Plan' must be prepared, submitted, approved and implemented. This research plan should aim to investigate key aspects of the species' biology focussing on conservation measures (e.g. habitat specificity, seed and germplasm collection, translocation trials to establish the likelihood of post-mining rehabilitation and monitoring to determine success of conservation actions). This plan appears to focus on ex situ conservation measures rather than research into key in situ conservation concerns, such as investigating genetic diversity and structure across the local and regional population. Lastly, production of a 'Linear Infrastructure and Borefield Alignment Plan' is also specified. This plan must identify the location of any significant flora in the water corridor envelope and design infrastructure to avoid damaging or removing plants.</p> <p>Commonwealth conditions on the Abydos Stage 2 project include a current requirement that there is no clearing of or within 10m of plants of <i>Pityrodia</i> sp. Marble Bar without specific approval of the CEO pending the assessment of this species' conservation status and likelihood of it being listed as Rare Flora.</p>				

Does this species benefit from the management of another species or community? Explain.	
No.	
How well is the species represented in conservation reserves or covenanted land? Which of these are actively managed for this species? Provide details.	
<i>Pityrodia</i> sp. Marble Bar does not occur in any conservation reserves or covenanted land.	
Are there any management or research recommendations that will assist in the conservation of the species? Provide details.	
Assessment of genetic differences and gene flow within and between the different-sized clusters of individuals (i.e. clusters of few vs abundant plants) across the species' range, and particularly across the 5km wide gap that divides the broader population, would assist in the conservation of the species' genetic diversity. This type of research may occur as part of North Star's 'P. sp. Marble Bar Management and Research Plan', but design and implementation of this is contingent on P. sp. Marble Bar being gazetted as Rare Flora.	
4.5. Other	
Is there any additional information that is relevant to consideration of the conservation status of this species?	
<p>Under a no mining/no disturbance scenario <i>Pityrodia</i> sp. Marble Bar is currently meets listing as Threatened Flora as Vulnerable under IUCN criterion D2 based on its small area of occupancy and being restricted to a single location that could quickly experience decline. However, both North Star and Abydos Stage 2 have been given conditional approval and a decline in population size and area of occupancy are anticipated, and an increase in fragmentation between western and eastern subpopulations is also likely.</p> <p>North Star and Abydos Stage 2 have proposed to remove 158 plants and 143 plants from their tenements respectively, equalling 301 plants, which represents a reduction in population size of 8% to 1,881 individuals and a reduction in the area of occupancy to 10.304km². With this loss of plants and/or habitat the following IUCN criterion would be met: Endangered B1ab(ii,iii,v)+B2ab(ii,iii,v) – Extent of Occurrence estimated as >100km² but <5,000km², area occupancy estimated at >10 km² but less than 500km², known from less than 5 locations, and with a decline in area of occupancy, extent of habitat and number of individuals.</p> <p>As current conditions on both projects state that no plants of <i>Pityrodia</i> sp. Marble Bar can be impacted without CEO approval, the exact number of plants that each proponent will be removing from their tenement during project development and operation cannot be determined. Regardless, approval of each mine results in the IUCN criteria for Endangered being met through projected decline.</p> <p>Earlier advice from the Department of Parks and Wildlife to the EPA that the species would be eligible for listing as Critically Endangered B2(a)(b) if either one of the two projects was approved was based on the smaller population size recognised at the time (1,934 individuals) and higher number of plants proposed to be removed (Department of Parks and Wildlife 2014).</p>	
SECTION 5. NOMINATOR	
Nominator(s) name(s)	
Organisation(s)	
Address(s)	
Telephone number(s)	
Email(s)	
Date	30/01/2015
If the nomination has been refereed or reviewed by experts, provide their names and contact details.	

SECTION 6. REFERENCES

What references or sources did you use to prepare your nomination? Include written material, electronic sources and verbal information. Include full references, address of web pages and the names and contact details of authorities with whom you had verbal communications.

Department of Parks and Wildlife (2014). Letter of advice (07/02/2014) to OEPA on the impacts of the North Star magnetite project on *Pityrodia* sp. Marble Bar.

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ecologia Environment (2012a). North Star flora and vegetation assessment. Report prepared for Fortescue Metals Group Ltd.

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Environmental Protection Authority (2014). Report and recommendations of the Environmental Protection Authority: North Star Magnetite Project: Fortescue Metals Group Iron Bridge (Aus) Pty Ltd. Report 1514, June 2014.

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Mattiske EM (2007). A review of the flora and vegetation and an assessment of the groundwater dependent ecosystems in the Panorama Project survey area. Report prepared for URS Australia Pty Ltd on behalf of CBH Resources.

Trudgen ME, Morgan BM & Griffin EA (2002). A flora and vegetation survey of the proposed mine areas and access road for the Panorama Project. Report prepared for Astron Environmental.

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Woodman Environmental Consulting (2013). Abydos direct shipping ore project stage 2 flora and vegetation studies. Report prepared for Atlas Iron.

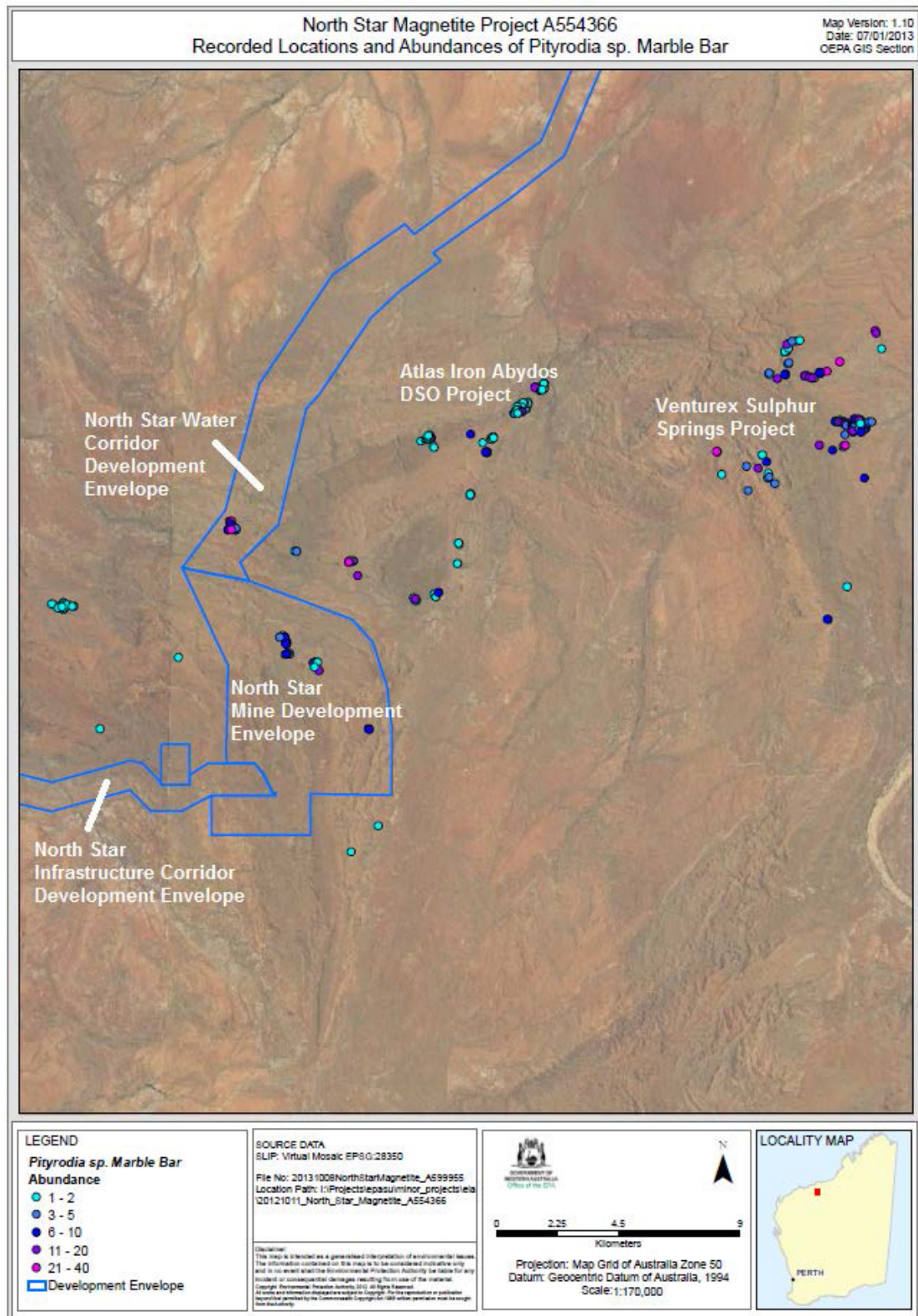


Figure 1. Distribution of plants of *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4), c. 45 km west of Marble Bar, showing overlap with current mining projects. Plants are proposed to be removed from the North Star mine development envelope and from the northern part of the Abydos DSO project. No plants are proposed to be removed from Sulphur Springs. Figure from Environmental Protection Authority (2014).

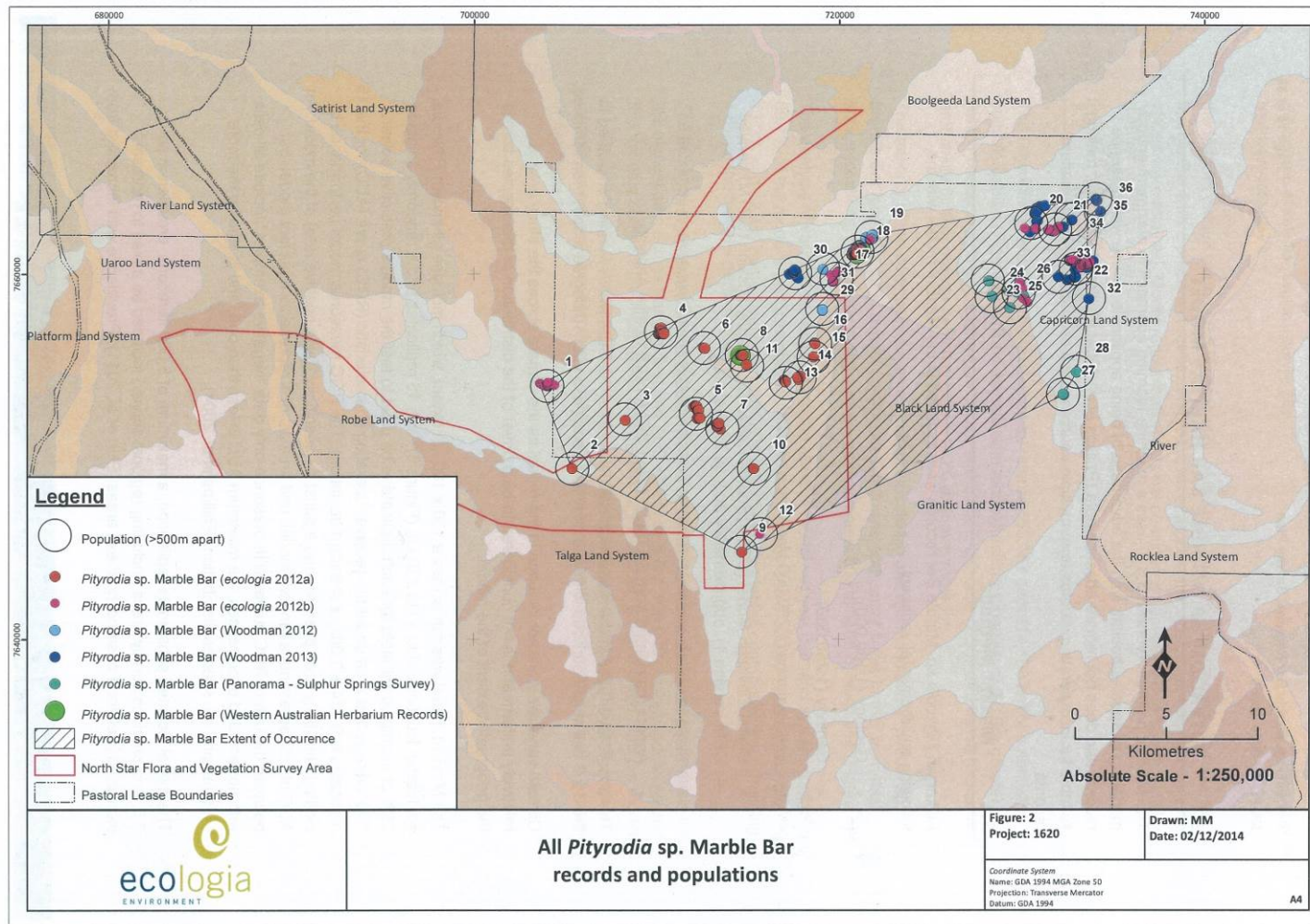


Figure 2. Distribution of *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4) population loci referred to in Table 1, indicating source of data. The distribution of the Capricorn Land System is also shown. Figure from Fortescue Environment (2014).

Appendix 1. Previous records of *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4). For the purposes of calculating the number of plants in each population (where 'population' here means clusters of plants separated by >500m), the highest count from any given survey has been taken. Table reproduced from Fortescue Environmental (2014).

Population	WA Herbarium		Trudgen (2007)		<i>ecologia</i> (2012a)		<i>ecologia</i> (2012b)		Woodman (2012)		Woodman (2013)		Total #
	Sites	#	Sites	#	Sites	#	Sites	#	Sites	#	Sites	#	
1							53	115					115
2					1	1							1
3					1	1							1
4					15	254							254
5					16	80							80
6					2	5							5
7					13	65							65
8	3	50			9	68							68
9					1	2							2
10					1	12							12
11					2	12							12
12							1	1					1
13					7	27							27
14					3	9							9
15					1	3							3
16					2	2							2
17							14	43			1	9	43
18	3	59			39	69	28	29	4	30	20	73	73
19							2	2	9	80	9	23	80
20			1	6			6	19			15	92	92
21			2	10			13	20			4	66	66
22							220	438			63	524	524
23			2	241									241
24			1										
25			1										
26			5				6	21					
27			2										
28			1										
29									3	3			3
30											22	160	160
31									1	6			6
32											1	6	6
33											1	19	19
34											1	30	30
35											2	38	38
36											1	1	1
Total	4	109	15	257	113	610	343	688	17	119	140	1,041	2,039