

## Threatened species nomination

For nominations to the WA Threatened Species Scientific Committee (and the Minister for Environment) to amend threatened species listings under the WA *Wildlife Conservation Act 1950* or their assigned IUCN Red List threat status ranking.

### Cover Page *(Office use only)*

<b>Species name</b> (scientific and common name):	<b><i>Rhizanthella johnstonii</i> (South Coast Underground Orchid)</b>
<b>Nomination for</b> (addition, deletion, change):	<b>Addition</b>
<b>Nominated conservation category and criteria:</b>	<b>Critically Endangered B1ab(iii)+B2ab(iii); D</b>

Scientific committee assessment of eligibility against the criteria:		
<b>A.</b>	Population size reduction	•
<b>B.</b>	Geographic range	•
<b>C.</b>	Small population size and decline	•
<b>D.</b>	Very small or restricted population	•
<b>E.</b>	Quantitative analysis	•

Outcome:			
<i>Scientific committee meeting date:</i>			
<i>Scientific committee comments:</i>			
<i>Recommendation:</i>			
<i>Ministerial approval:</i>		<i>Government Gazette/ Legislative effect:</i>	

# Nomination summary (to be completed by nominator)

Current conservation status				
Scientific name:	<i>Rhizanthella johnstonii</i>			
Common name:	South Coast Underground Orchid			
Family name:	Orchidaceae	Fauna <input type="checkbox"/>	Flora <input checked="" type="checkbox"/>	
Nomination for:	Listing <input checked="" type="checkbox"/>	Change of status <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?		*Currently listed as CR under <i>Rhizanthella gardneri</i> , once <i>Rhizanthella johnstonii</i> is added to the WA Plant census it will be listed as Priority 1.		
Jurisdiction	List or Act name	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			
State of WA	Threatened list	10/4/2018 TSSC	Critically Endangered	B1ab(iii)+B2ab(iii); D
	Priority list	28/03/2018	1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/>	
Other State / Territory				
Nominated conservation status: category and criteria (including recommended categories for deleted species)				
Critically endangered (CR) <input checked="" type="checkbox"/> Endangered (EN) <input type="checkbox"/> Vulnerable (VU) <input type="checkbox"/> Presumed extinct (EX) <input type="checkbox"/>				
Other Specially Protected (Conservation Dependent) <input type="checkbox"/> Priority 1 <input type="checkbox"/> Priority 2 <input type="checkbox"/> Priority 3 <input type="checkbox"/> Priority 4 <input type="checkbox"/> None <input type="checkbox"/>				
<b>What criteria support the conservation status category above?</b> <i>Refer to Appendix A table 'Summary of the five criteria (A-E)' and the check version that can be completed to indicate all criteria options</i>			<b>B1ab(iii)+B2ab(iii); D</b>	
Eligibility against the criteria				
Provide justification for the nominated conservation status; is the species eligible or ineligible for listing against the five criteria. For <b>delisting</b> , provide details for why the species no longer meets the requirements of the current conservation status.				
A.	Population size reduction (evidence of decline)	• Generation length unknown.		

		<ul style="list-style-type: none"> <li>Unable to determine population trend due to this species being subterranean and only able to be counted when in flower, and flowering likely to be dependent on rainfall.</li> <li><b>Insufficient information to assess.</b></li> </ul>
<b>B.</b>	Geographic range ( <i>EOO and AOO, number of locations and evidence of decline</i> )	<ul style="list-style-type: none"> <li>The Extent of Occurrence (EOO) is 8 km<sup>2</sup> (&lt; 100 km<sup>2</sup>).</li> <li>The Area of Occupancy (AOO) is 8 km<sup>2</sup> (&lt; 10 km<sup>2</sup>), calculated using the 2 km by 2 km grid square method. The observed area of actual subpopulations is 0.0925 km<sup>2</sup>.</li> <li>The EOO and AOO calculations do not include the subpopulation at Cheadanup Nature Reserve as the habitat there is no longer considered suitable and this subpopulation has not been observed since 1982.</li> <li>There is a projected decline in the quality of habitat based on the decline (extinction) in one subpopulation and the presence of threatening processes that have also caused habitat decline in the related <i>Rhizanthella gardneri</i>. The habitat of this species is potentially threatened by fire (resulting in an altered habitat), surrounding land use, drying climate, changed hydrology and a decline in the quality and quantity of the associated <i>Melaleuca</i> species (a key habitat characteristic, as <i>R. johnstonii</i> forms a tripartite relationship with <i>Melaleuca</i> spp. and a mycorrhizal fungus).</li> <li>One location. All three subpopulations are located on similar habitat with a 15 km range and subject to the same threatening processes of changed hydrology, fire and climate change.</li> <li><b>Meets criteria for Critically Endangered B1ab(iii) and B2ab(iii)</b></li> </ul>
<b>C.</b>	Small population size and decline ( <i>population size, distribution and evidence of decline</i> )	<ul style="list-style-type: none"> <li>The total number of mature plants when last surveyed in 2017 was nine (&lt;50). The number of mature plants appears to vary from year to year, and flowering has been noted to likely be dependent on rainfall. The ratio of flowering to non-flowering plants is unknown. As this species is subterranean plant counts are only able to undertaken if plants are in flower. Despite this, there are only two subpopulations that currently have plants present, with the largest number of plants ever being recorded at either of these subpopulations being 26.</li> <li>There is no current decline trend in the number of mature individuals due to the varying plant counts.</li> <li><b>Does not meet criteria.</b></li> </ul>
<b>D.</b>	Very small or restricted population ( <i>population size</i> )	<ul style="list-style-type: none"> <li>The total number of mature plants when last surveyed in 2017 was nine, and the maximum recorded is 49 (&lt; 50).</li> <li><b>Meets Critically Endangered D.</b></li> </ul>
<b>E.</b>	Quantitative analysis ( <i>statistical probability of extinction</i> )	<ul style="list-style-type: none"> <li>Generation length unknown.</li> <li>Insufficient information to assess.</li> </ul>
<b>Reasons for change of status</b>		
Genuine change <input type="checkbox"/> New knowledge <input type="checkbox"/> Taxonomic change <input checked="" type="checkbox"/> Previous mistake <input type="checkbox"/> Other <input type="checkbox"/>		

*Provide details:* The subpopulations of this species were previously included in entity *Rhizanthella gardneri*, currently listed as Critically Endangered. The southern subpopulations of *Rhizanthella gardneri* are now considered to be a separate species, *Rhizanthella johnstonii*.

**Summary of assessment information** (detailed information to be provided in the relevant sections of the form)

EOO	8 km <sup>2</sup>	AOO	8 km <sup>2</sup>	Generation length	Unknown
No. locations	1	Severely fragmented	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Unknown <input type="checkbox"/>		
No. subpopulations	3	No. mature individuals	9 (2017)		
Percentage global population within WA			100 %		
Percentage global population within Australia			100 %		
Percentage population decline over 10 years or 3 generations			N/A		

Summary of subpopulation information <i>(detailed information to be provided in the relevant sections of the form)</i>						
Subpopulation location <i>(include coordinates)</i>	Land tenure	Survey information: Date of survey and No. mature individuals	Area of subpopulation	Site / habitat Condition	Threats <i>(note if past, present or future)</i>	Specific management actions
Oldfield River	Unvested Crown Reserve (Parkland) and LGA Road Reserve	1982 4 2002 2 2003 3 2004 26 2005 1 2006 2 2007 3 2008 1 2009 4 2010 1 2014 17 2017 4	0.03 km <sup>2</sup> (3 ha) (Brundrett, 2011).	Pristine (2017)	Drying climate and subsequent effects on habitat, habitat degradation from surrounding land use, inappropriate fire regime, altered hydrology and road and firebreak maintenance.	
Cheadanup Nature Reserve, North-west of Munglinup	Nature Reserve	1981 5 1982 4 2002 0 2003 0 2004 0 2005 0 2006 0 2008 0 2009 0	0 (No plants)	Thought to no longer be suitable for this species after several hot fires within a few years altered the habitat.	Drying climate and subsequent effects on habitat, habitat degradation from surrounding land use, inappropriate fire regime and altered hydrology.	

		2014 0				
Oldfield Location 1002, North-west of Munglinup	Private Property	1981 10 2002 2 2003 2 2004 23 2005 0 2006 7 2007 6 2008 25 2009 22 2010 4 2014 6 2017 5	0.0625 km <sup>2</sup> (6.25 ha) (Brundrett, 2011)	Excellent (2017)	Drying climate and subsequent effects on habitat, habitat degradation from surrounding land use, inappropriate fire regime, altered hydrology and road and firebreak maintenance.	

## Nomination detail

Please refer to the Departments guidelines on nominating species for amendment of the Western Australian threatened species lists at [http://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Threatened\\_Species\\_Nomination\\_Guidelines\\_2014.pdf](http://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Threatened_Species_Nomination_Guidelines_2014.pdf)

For technical information on terminology used in this form, and the intent of information requirements, as they relate to an assessment of this nomination against the IUCN Red List criteria, refer to the 2001 *IUCN Red List Categories and Criteria. Version 3.1*

[http://cmsdocs.s3.amazonaws.com/keydocuments/Categories\\_and\\_Criteria\\_en\\_web%2Bcover%2Bbckcover.pdf](http://cmsdocs.s3.amazonaws.com/keydocuments/Categories_and_Criteria_en_web%2Bcover%2Bbckcover.pdf)

and *Guidelines for Using the IUCN Red List Categories and Criteria Version 11* (February 2014)

<http://cmsdocs.s3.amazonaws.com/RedListGuidelines.pdf>

## Section 1: Taxonomy

1.1 Current taxonomy	
Species name and Author:	<i>Rhizanthella johnstonii</i> , K.W.Dixon & Christenh., <i>sp. nov.</i>
Subspecies name(s) and Author:	N/A
Is the species/subspecies conventionally accepted?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Is there any controversy about the taxonomy?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
If not conventionally accepted and/or if there is any controversy; provide details:	<i>Rhizanthella gardneri</i> has been split into two species in a published paper, which has been accepted by the WA Herbarium. The name <i>Rhizanthella johnstonii</i> was added to the WA plant census in March 2018.
Has the species/subspecies been formally named?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
Has the species/subspecies been recently described?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
If the species has not been formally named or described; is it in the process of being described? Is there an anticipated date for the publication of the description? Has a type specimen been deposited? And if so provide the registration number and where deposited.	
If there are any closely related taxa provide details and include key distinguishing features:	This species differs from <i>Rhizanthella gardneri</i> in having fewer flowers in a smaller capitulum that are white or suffused with a pink blush, much paler than <i>R. gardneri</i> . The bracts are also lighter, white, occasionally tinged purple pink on the margins and apex (Fig. 2). The species is associated with <i>Melaleuca hamata</i> Fielding & Gardner and <i>M. uncinata</i> R.Br. It has a disjunct distribution from <i>R. gardneri</i> , which has a different <i>Melaleuca</i> host preference (Dixon & Christenhusz, 2018).
1.2 Taxonomic history	
Are there recent synonyms for the species?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>

<i>If Yes; provide details of synonyms:</i>	Formerly included in the concept of the species <i>Rhizanthella gardneri</i> from which it has now been formally split.	
Have there been recent changes in the taxonomy or nomenclature?		Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
<i>If Yes; provide details of changes:</i>	Yes, this species was described in a publication in January 2018. Previous to this publication the species was considered to comprise the southern subpopulations of <i>Rhizanthella gardneri</i> (Threatened).	
<b>1.3 Hybridisation</b>		
Is there any known hybridism with other species in the wild?		Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Unknown <input type="checkbox"/>
<i>If Yes; Where does this occur and how frequently?</i>		

## Section 2: Species information

### 2.1 Morphology / physical description

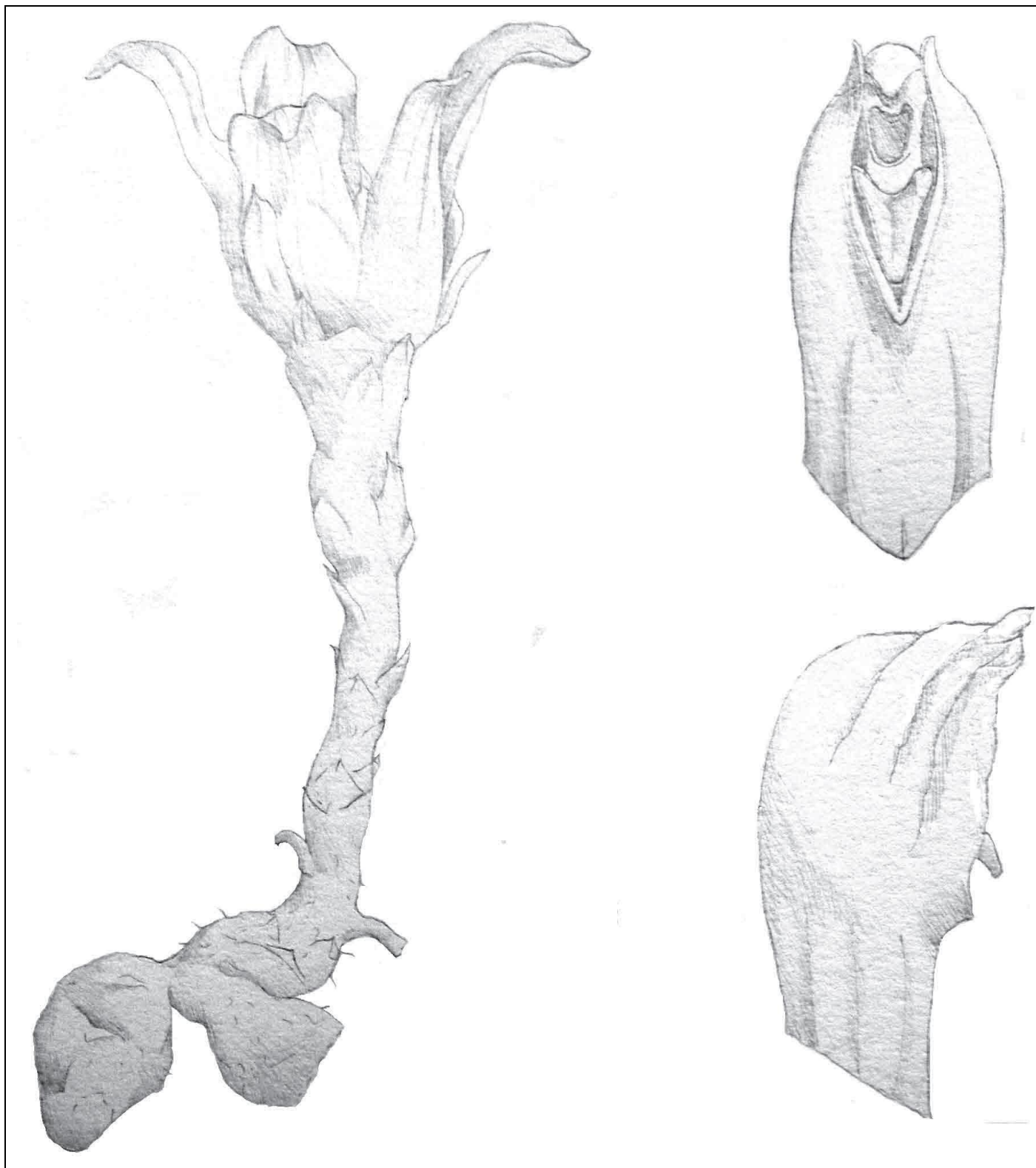
Please see attached paper in which *Rhizanthella johnstonii* has been formally described: Dixon & Christenhusz (2018) Flowering in darkness: a new species of subterranean orchid *Rhizanthella* (Orchidaceae; Orchidoideae; Diurideae) from Western Australia. *Phytotaxa* 334 (1): 075-079.

Photograph of *Rhizanthella johnstonii* from Dixon & Christenhusz (2018) (Figure 2A):



Sketch of *Rhizanthella johnstonii* from Dixon & Christenhusz (2018) (Figure 3), sketch adapted by M. Christenhusz from an anonymous sketch in the herbarium of the Royal Botanic Gardens, Kew:





## Species description:

A description of *Rhizanthella johnstonii* from Dixon & Christenhusz (2018) is as follows:

Holomycotrophic, achlorophyllous, fully subterranean plants. Rhizomes more or less horizontal, upturned to the peduncle, 3.0–4.0 × 0.5 – 1.3 cm, 6–12 cm below the soil surface, swollen at the peduncle base, sparsely hairy, the hairs fine. Bracts few, appressed, broadly triangular, 0.2–0.6 mm, obtuse, but the tip thickened-caniculate. Lateral rhizome branches smaller, arising from a thickened part at the base of the peduncle. Peduncles erect, to 60 mm long, c. 0.3–0.6 mm thick, narrowest below the capitulum, glabrous. Bracts in two spirals, widely spaced, the lowermost appressed, broadly triangular, 0.3–0.4 × c. 10.0 mm, becoming narrowly triangular towards the apex, and there slightly divergent from the peduncle, 10–25 × 3–10 mm, concave, amplexicaul, obtuse with a thick central vein, margins thinner. Inflorescences a terminal capitulum, the receptacle 10–25 mm in diameter. Involucral bracts six to eight, rarely ten, imbricate, forming a cup surrounding the

	<p>flowers, narrowly obovate, 25–35 mm × c. 10 mm, concave at base, apex obtuse but with an apiculum, cream to pale pinkish-cream, with 3–7 simple or singly forked veins. Flowers up to c. 60 per capitulum in 8–12 spiral rows, each row with 6–8 flowers, the innermost not fully developing, all inwardly facing, the outermost flowers opening first. Perianth white but pink suffused, 4–6 mm long, tubular for the lower half, sepals and petals free near the apex but closely imbricate. Lateral sepals broadly triangular, curved forwards, obtuse to acute. Dorsal sepal broadly triangular, cucullate, the margins overlapped by those of the lateral sepals, which are slightly longer. Petals more or less triangular, obtuse, free in the upper part, about 1 mm shorter than the sepals, apices slightly crenulate with the margins flaring. Labellum motile on slender claw of 1–3 mm, erect at the base, strongly curved forward and protruding. More or less obliquely semi-circular with a recurved tip when seen from the side, 1.5–2.0 × 0.7–1.5 mm, deeply channelled, smooth, entire. Column more or less terete, 2.0–2.5 mm. Anther terminal, 0.8–0.9 mm, shortly apiculate, persistent. Stigma 1 mm, cuneate with curved, lateral margins and a small projection at the base. On each side of the column at the upper edge of the stigma there is a small, narrow, obtuse lobe. Ovary elongate, smooth, 5–6 × 4 mm, smaller in inner flowers, enlarging to elongate-ovoid if pollinated (Figs. 2A, 3).</p>
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## 2.2 Biology (provide details)

*Rhizanthella* species are succulent and have a horizontal rhizome 6–12 cm below the surface. The orchid relies on an endophytic mycorrhiza that in turn is an ectomycorrhiza of the roots of local *Melaleuca* (Myrtaceae) species. A capitulum produced below the soil surface is composed of elongate bracts that curve over and enclose c. 60–180 inwardly facing flowers. Flowers are hooded, connate, with an opening facing inwards and a motile labellum. Pollination is by two known agents: fungus gnats and termites. Fruits are indehiscent, fleshy pods on which hundreds of hard, brown spheroid seeds are produced. These are thought to be dispersed by fossorial marsupials that may be attracted to the formalin-like scent emanating from the orchid tissues (Dixon & Christenhusz, 2018).

*Rhizanthella johnstonii* is known to flower between late June to July.

## 2.3 Ecology (provide details)

Plants are holomycotrophic and acquire nutrients from a shared mycorrhizal fungus (*Ceratobasidium* sp.) association with the fine root systems of *Melaleuca hamata* and *M. uncinata* and grow in coarse sandy clay or sandy loam with a thin layer of surface leaf litter. The specialised holomycotrophic association with a fungus that links the orchid to the root system of a specific autotrophic host is key to explaining why *Rhizanthella johnstonii* is restricted to only a few sites. In this tripartite relationship, the autotrophic host provides nutrients and carbon (Bougoure et al., 2010), and thus conservation of the orchid is reliant on ensuring the health of the host species (Dixon & Christenhusz, 2018).

# Section 3: Habitat

## 3.1 Habitat (provide details in response to the question below)

Described the habitat suitable for the species (biological and non-biological). Include descriptions of specific purpose habitat (e.g. foraging, breeding, roosting, seasonal migration, different life stages).	<i>Rhizanthella johnstonii</i> is known to grow in thickets of <i>Melaleuca hamata</i> , <i>M. uncinata</i> and an unnamed <i>Melaleuca</i> species of the <i>M. uncinata</i> complex. It grows in coarse sandy clay or sandy loam with a thin layer of surface leaf litter.
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If the species occurs in a variety of habitats, is there a preferred habitat?			
Does the species use refugia? (include what is it and when is it used)	N/A		
Is the habitat restricted in extent or number of locations?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Unknown <input type="checkbox"/>
If Yes, provide details:	The habitat type that this species occurs in is highly restricted to a narrow band of vegetation along drainage systems on sandy loams between the 350 mm and 400 mm isohyets. It is likely the species may have occurred in higher rainfall zones, but the vegetation has been extensively cleared or is unsuitable habitat (clays, sands or rocky soils) (Dixon & Christenhusz, 2018).		
Is this species reliant on a threatened or priority species or ecological community?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>
If Yes, provide details:			
Are there any other species (sympatric species) that may affect the conservation status of the nominated species?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Unknown <input type="checkbox"/>
If Yes, provide details:	<i>Rhizanthella johnstonii</i> plants are holomycotrophic and acquire nutrients from a shared mycorrhizal fungus ( <i>Ceratobasidium</i> sp.) association with the fine root systems of <i>Melaleuca hamata</i> and <i>M. uncinata</i> .		
What is the area, extent, abundance of habitat?	All remnant vegetation along the Oldfield River and its tributaries near Munglinup containing Broom bush ( <i>Melaleuca</i> ). Surveys in 2008 of a 15 km stretch of the Oldfield River identified vegetation containing six areas of potential habitat in excellent condition. Other areas along the Oldfield River had been recently burnt in 2008 and so could not be assessed.		
What is the quality of habitat?	Assessable areas are generally in excellent condition. Areas that have been burnt are unable to be assessed.		
Is there a decline in habitat area, extent or quality?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Unknown <input type="checkbox"/>
If there is a decline, is the decline continuing?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Unknown <input type="checkbox"/>
Provide details:	<p>Habitat decline has been observed due to:</p> <ul style="list-style-type: none"> <li>Habitat degradation from surrounding land use, including vegetation clearing in the area surrounding the subpopulations of <i>Rhizanthella johnstonii</i> (Department of Environment and Conservation [DEC], 2010).</li> <li>Altered climatic conditions and subsequent effects on habitat. Altered and sporadic climatic conditions resulting in a lack of rainfall at crucial stages of <i>Melaleuca</i> species growth has affected key habitat characteristics. Decreased rainfall leads to a decline in growth and recruitment of the <i>Melaleuca</i> species that <i>Rhizanthella johnstonii</i> is associated with, hence a decline in habitat quality. A key habitat characteristic for this species is the presence of <i>Melaleuca</i> species. This species acquires nutrients from a shared mycorrhizal fungus</li> </ul>		

	<p>(<i>Ceratobasidium</i> sp.) association with the fine root systems of <i>Melaleuca hamata</i> and <i>M. uncinata</i>.</p> <ul style="list-style-type: none"> <li>Inappropriate fire regime. Several hot fires within a few years have altered the habitat at one of the subpopulations. The <i>Melaleuca</i> thickets have not recovered post fire, and as such neither has protective soil leafy layer that is conducive to the soil mycorrhiza.</li> </ul>
What is the critical habitat or habitat important for the survival of the species?	All known habitat for wild subpopulations of <i>Rhizanthella johnstonii</i> is critical to the survival of the species, and all wild subpopulations are important populations. Habitat critical to the survival of <i>R. johnstonii</i> includes the area of occupancy of important subpopulations; areas of similar habitat surrounding and linking subpopulations (these providing potential habitat for subpopulation expansion and for pollinators and seed dispersers); additional occurrences of similar habitat that may contain undiscovered subpopulations of the species or be suitable for future translocations; and the local catchment for the surface and/or groundwater that maintains the habitat of the species.

## Section 4: Survey

4.1 Survey methods (Provide details)	
What survey methods are applicable to the species?	This species is required to be surveyed during its flowering period which is late June to mid-July. Given this species' subterranean habitat, close attention to the ground is required to locate flowering parts in small openings in the soil surface, which can also be obscured from view by being covered with a thin layer of surface leaf litter.
Are there preferred or recommended survey methods that yield better results for the species?	Intensive targeted surveys in suitable habitat or known locations. Care also needs to be taken not to disturb the ground within habitat and damage the plants.
Are there special requirements, techniques, expertise or other considerations that are necessary when surveying for this species?	Yes, any flowers excavated during survey for counting should be re-covered with soil by pressing the bracts into position to re-form the soil free chamber over the flowers (M. Brundrett, 2011).
Are there reasons why the species may not be detected during surveys?	Yes, lower rates of flowering may occur in dry conditions, and extreme difficulty of locating subterranean flowers of this orchid may result in this species not being detected during surveys.
Can the species be identified in the field?	
Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	
Provide details:	Whilst intensive searching is required to locate the flowers of this subterranean species, they are distinctive when located with bracts forming a tulip-like head (capitulum).
Can the species be easily confused within similar species in the field?	
Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Unknown <input type="checkbox"/>	
Provide details:	This is the only underground orchid species known in this area. There are only two <i>Rhizanthella</i> species present in Western Australia, with the other species, <i>Rhizanthella gardneri</i> , having a disjunct distribution approximately 300 km north-west.

List any published survey guidelines, guidance statements, protocols, standard operating procedures or other documents that are relevant to conducting surveys for this species.

#### 4.2 Survey effort

Has the species been well surveyed?

Yes ☒ No ☐

Have targeted surveys been conducted for the species?

Yes ☒ No ☐

Provide details of the successful and unsuccessful surveys undertaken for the species:

For the recovery action "Conduct further surveys" in the Interim Recovery Plan for *Rhizanthella gardneri* (2010-2015) it states that "Further surveys by BGPA, DEC staff and community volunteers have been conducted during the flowering period of the species but no new populations have been found" (DEC, 2010).

In July 2008 a team of volunteers from WA Native Orchid Society Conservation Group (WANOSCG), Mark Brundrett (DBCA Swan Region Ecologist), Emma Massenbauer (Esperance Conservation Officer) and Andrew Brown (WA Herbarium Research Associate and previous DBCA Threatened Flora Coordinator) undertook surveys for *Rhizanthella gardneri* in the area of the Esperance District subpopulations, now considered to be *Rhizanthella johnstonii*. Aerial photography was used to select areas of similar vegetation to the known subpopulations. No new subpopulations were located however six areas of broom bush shrubland (potential habitat) were located (Brundrett, 2011). Known subpopulations were also surveyed at this time, and found to be in flower despite dry conditions in 2008.

In 2009 northern boundaries of unallocated Crown land along the Oldfield River were surveyed and only a small area of suitable habitat was located (Brundrett, 2011).

Preliminary surveys in 1982 near the Cheadanup Nature Reserve subpopulation indicated that potential sites for this species exist within approximately 2 km in from the southern boundary road of the reserve. The condition of the *Melaleuca uncinata* understorey then deteriorates as a response to a drop in rainfall and becomes sparse and less dense than areas further south in the reserve (Department of Biodiversity, Conservation and Attractions [DBCA], 2018).

Despite extensive surveys for this species east and west along the 350-400 mm isohyet band and in drier climes north of the current distribution range, this species has not been located due to a lack of suitable *Melaleuca* thickets, unfavourable soil or unfavourable hydrology (e.g. swamps) (Dixon & Christenhusz, 2018).

#### 4.3 Research (Provide details)

Has the species been well researched?

Yes ☐ No ☐ Partially ☒ Unknown ☐

What research has been or is being conducted?

Research has been conducted on *Rhizanthella gardneri*, of which the southern populations are now considered to be *Rhizanthella johnstonii*. Research has been conducted on:

➤ Carbon and nitrogen supply:

Bougoure, J.J., Brundrett, M.C. & Grierson, P.F. (2010) Carbon and nitrogen supply to the underground orchid, *Rhizanthella gardneri*. *New Phytologist* 186:947–956.

➤ Habitat Characteristics (climate, soil and vegetation):



	<p>Bougoure, J., Brundrett, M. &amp; Brown, A., Grierson, P.F. (2008) Habitat characteristics of the rare underground orchid <i>Rhizanthella gardneri</i>. <i>New Phytologist</i> 56:501-511.</p> <p>➤ <u>Genetic research:</u></p> <p>Genetic variation in <i>Rhizanthella gardneri</i> was examined by BGPA using a non-destructive sampling technique for DNA extraction from floral bract material collected in 2001. Preliminary data indicated that the Northern and Southern populations (i.e. <i>Rhizanthella johnstonii</i>) showed evidence of genetic as well as geographic isolation which may be sufficiently distinct to confer separate taxonomic status. However these data also suggested that further genetic investigations may help to determine the nature and degree of genetic separation between populations (DEC, 2010).</p> <p>Delannoy E, Fuji S, des Francs CC, Brundrett M, Small I. (2011) Rampant gene loss in the underground orchid <i>Rhizanthella gardneri</i> highlights evolutionary constraints on plastid genomes. <i>Molecular Biology and Evolution</i> 28(7):2077-2086.</p> <p>➤ <u>Mycorrhizal fungi relationship:</u></p> <p>Bougoure J, Ludwig M, Brundrett M, Grierson PG. (2009). Identity and specificity of the fungi forming mycorrhizas with the rare myco-heterotrophic orchid <i>Rhizanthella gardneri</i>. <i>Mycological Research</i> 113:1097-1106.</p> <p>Bougoure JJ. (2008). The role of mycorrhizal fungi in nutrient supply and habitat specificity of the rare mycoheterotrophic underground orchid, <i>Rhizanthella gardneri</i>. PhD Thesis (unpublished). University of Western Australia.</p> <p>➤ <u>Germination/Propagation:</u></p> <p>Preliminary in situ seed baiting trials were conducted by the BGPA in 2002. These were not successful and failure of seedlings to develop beyond the germination stage was attributed to a lack of soil moisture. A similar study was attempted in 2003 but failed to produce germination. The trials were again set up in 2005 at all known habitats and including irrigated and non-irrigated sites. Germination occurred but plants did not survive the first summer (DEC, 2010).</p>
What are the knowledge gaps for the species?	Population genetics, pollination, and seed dispersal.
Research recommendations:	<p>Rhizomes of the underground orchid are capable of vegetative division, so it is likely that plants located with a few metres are the same individual or closely related. Consequently, a population genetics study is required to determine the size of individuals of this species and the number present at each location (Brundrett, 2011).</p> <p>Additional research is required to understand pollination, seed dispersal and population genetics of the underground orchid (Brundrett, 2011).</p>
<b>4.4 Monitoring (Provide details)</b>	
Is the species being monitored, either directly (targeted) or indirectly (general monitoring)?	Yes, targeted monitoring is undertaken as part of the Esperance District's Threatened Flora Monitoring program. Last monitored in 2017, and prior to this 2014, and almost annually between 2002-2010.

What methods are used for monitoring?	Intensive searching of all suitable habitat within known populations for flowers of this species can be undertaken if a full survey for the population is required. As ground disturbance from survey effort is thought to be detrimental to this species it is considered appropriate to only conduct a partial survey of plants in some years, assessing the presence/absence of flowering plants within the populations and note any threatening processes.
Monitoring recommendations:	Monitor known populations annually (DEC, 2010).

## Section 5: Geographic range

<b>5.1 Distribution</b>			
What is the current distribution of the species within Western Australia?	One location in the Munglinup area, consisting of three subpopulations, one of which is likely to be extinct.		
What percentage of the species distribution is within WA?	100 %		
What is the current distribution of the species within the other Australian States and Territories?	N/A		
Does the species occur outside of Australia?			Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
If Yes, what percentage of the species distribution is within Australia, or what is the significance of the occurrence in Australia?			
What is the current international trend for the species? (if known)			
<b>5.2 Migration (fauna only)</b>			
Is the species migratory?		Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown <input type="checkbox"/>	
Is the migration within WA or within Australia or international? (include details of migration routes if known)			
<b>5.3 Extent of Occurrence (EOO) within Australia</b>			
What is the current EOO?	8 km <sup>2</sup>		
How has this been calculated?	Using the minimum convex polygon method the EOO is 7.5 km <sup>2</sup> . The EOO however cannot be less than the AOO, and so the AOO value of 8 km <sup>2</sup> is used.		
What is the historical EOO?	26.7 km <sup>2</sup>		
What is the current EOO trend?	Decreasing <input checked="" type="checkbox"/> Increasing <input type="checkbox"/> Stable <input type="checkbox"/> Unknown <input type="checkbox"/>		

<i>Provide details on the current trend – quantify if possible</i>	One subpopulation has been lost (nature reserve subpopulation – not seen since 1982).		
If there has been a change in EOO when did this change occur?	The change occurred after several hot fires at the location of one subpopulation (Brundrett, 2011). The Department's corporate GIS fire history records show that two wildfires have occurred in the area of this subpopulation, one in April 1991 and another in December 2004. It is inferred that the decrease in the area of subpopulations occurred following these fires, approximately 27 years ago. No plants were recorded during monitoring of this subpopulation in 2002. This population has not been re-located despite several surveys. The habitat at this site was again assessed in 2017 however the vegetation composition has changed post-fire and does not contain suitable habitat for <i>R. johnstonii</i> at present.		
Was the change observed, estimated, inferred or projected?	Observed		
If the EOO is decreasing / declining, is it continuing?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/> N/A <input type="checkbox"/>
Is the continuing decline observed, estimated, inferred or projected?			
Is there extreme fluctuation in EOO?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>
<i>If Yes, provide details:</i>			
<b>5.4 Area of Subpopulations within Australia</b> (if not known, go to section 5.5)			
What is the current area of the known subpopulations or occupied habitat?	Estimated to be a total of 0.0925 km <sup>2</sup> (9.25 ha) (Brundrett, 2011).		
How has this been calculated?	This figure has been sourced from Brundrett (2011), a report titled "Wheatbelt Orchid Rescue Project Final Report 6. Population Survey Data for Southern Populations of the Western Underground Orchid ( <i>Rhizanthella gardneri</i> )" in which the area of the subpopulations is called "Core Habitat" and defined "the most essential area (s) for survival of the species as it contains the highest concentrations of and/or the majority of currently known individuals. This is the area where the species is most vulnerable to threats such as disturbance causing changes to associated vegetation. This area is the highest priority for protective or remedial actions in the case of fire, weed outbreaks, animal grazing etc. Multiple separate areas, if defined, should be ranked in order of importance".		
What is the historical area of subpopulations?	Unknown		
What is the current area of subpopulations trend?	Decreasing <input checked="" type="checkbox"/> Increasing <input type="checkbox"/> Stable <input type="checkbox"/> Unknown <input type="checkbox"/>		
<i>Provide details on the current trend – quantify if possible</i>	One subpopulation has not recorded any plants since 1982 (36 years), so the area of this subpopulation has declined to zero.		



If there has been a change in the area of subpopulations when did this change occur?	The change occurred after several hot fires at the location of one subpopulation (Brundrett, 2011). The Department's corporate GIS fire history records show that two wildfires have occurred in the area of this subpopulation, one in April 1991 and another in December 2004. It is inferred that the decrease in the area of subpopulations occurred following these fires, approximately 27 years ago. No plants were recorded during monitoring of this subpopulation in 2002. This population has not been re-located despite several surveys. The habitat at this site was again assessed in 2017 however the vegetation composition has changed post-fire and does not contain suitable habitat for <i>R. johnstonii</i> at present.			
Was the change observed, estimated, inferred or projected? Give details.	Observed			
If the area of subpopulations is decreasing / declining, is it continuing?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>	N/A <input type="checkbox"/>
Is the continuing decline observed, estimated, inferred or projected? Give details.				
Is there extreme fluctuation in the area of subpopulations?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>	
If Yes, provide details:				
<b>5.5 Area of Occupancy (AOO) within Australia</b>				
What is the current AOO (estimated using the 2x2km grid method specified in the IUCN guidelines)?	8 km <sup>2</sup>			
What is the historical AOO?	12 km <sup>2</sup>			
What is the current AOO trend?	Decreasing <input type="checkbox"/>	Increasing <input type="checkbox"/>	Stable <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>
<i>Provide details on the current trend – quantify if possible</i>	One subpopulation has been lost (nature reserve subpopulation), possibly approximately 27 years ago. The other subpopulations appear stable at present.			
If there has been a change in AOO when did this change occur?	The change occurred after several hot fires at the location of one subpopulation (Brundrett, 2011). The Department's corporate GIS fire history records show that two wildfires have occurred in the area of this subpopulation, one in April 1991 and another in December 2004. It is inferred that the decrease in the area of subpopulations occurred following these fires, approximately 27 years ago. No plants were recorded during monitoring of this subpopulation in 2002. This population has not been re-located despite several surveys. The habitat at this site was again assessed in 2017 however the vegetation composition has changed post-fire and does not contain suitable habitat for <i>R. johnstonii</i> at present.			
Was the change observed, estimated, inferred or projected? Give details.	Observed			

If the AOO is decreasing / declining, is it continuing?		Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>	N/A <input type="checkbox"/>
Is the continuing decline observed, estimated, inferred or projected? Give details.					
Is there extreme fluctuation in AOO?		Yes <input type="checkbox"/>	No <input type="checkbox"/>	Unknown <input checked="" type="checkbox"/>	
If Yes, provide details:					
<b>5.6 Number of Locations</b>					
<p><b>'Locations'</b> 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).</p>					
At how many locations does the species occur?		One. The two subpopulations are 15 km apart with the main threatening processes of hydrological change, fire and climate change operating at the landscape scale and potentially able to affect all subpopulations in the one event.			
Has there been a change in the number of locations?		Decrease <input type="checkbox"/> Increase <input type="checkbox"/> No change <input checked="" type="checkbox"/> Unknown <input type="checkbox"/>			
If there has been a change, when did this change occur?					
Was the change observed, estimated, inferred or projected? Give details.					
If the number of locations is decreasing / declining, is it continuing?		Yes <input type="checkbox"/>	No <input type="checkbox"/>	Unknown <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
Is the continuing decline observed, estimated, inferred or projected? Give details.					
Is there extreme fluctuation in the number of locations?		Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>	
If Yes, provide details:					
Does this species occur on any off-shore islands?		Yes <input type="checkbox"/>		No <input checked="" type="checkbox"/>	
If Yes, provide details:					
<b>5.7 Fragmentation</b>					
Is the distribution fragmented?		Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>	
<p>The phrase '<b>severely fragmented</b>' refers to the situation in which increased extinction risks to the taxon results from the fact that most of its individuals are found in small and relatively isolated subpopulations (in certain circumstances this may be inferred from habitat information). These small subpopulations may go extinct, with a reduced probability of recolonization.</p>					

Is the distribution severely fragmented?		Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>
If Yes, provide details:				
<b>5.8 Land tenure</b>				
Is the species known to occur on lands managed primarily for nature conservation? i.e. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation			Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
If Yes; provide details:		Yes, one subpopulation is located within a Nature Reserve. This population however was subject to several hot fires within a few years which severely impacted on the habitat, and the habitat is no longer considered suitable for this species.		
Is the species known to occur on lands that are under threat? i.e. mining tenement, zoned for development			Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
If Yes; provide details:				
Provide details of other land tenures where the species occurs as this relates to the species conservation status		One subpopulation is in the Oldfield River reserve (unvested Crown reserve) which has a level of security as it protects the Oldfield River.		

## Section 6: Population

<p><b>'Population'</b> 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)</p>				
<p><b>'Subpopulations'</b> 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).</p>				
<b>6.1 Subpopulations</b>				
Subpopulation location (include coordinates)	Land tenure	Survey information: Date of survey and No. mature individuals	Area of subpopulation	Site / habitat Condition
Oldfield River	Unvested Crown Reserve (Parkland) and LGA Road Reserve	1982 4 2002 2 2003 3 2004 26 2005 1 2006 2 2007 3 2008 1 2009 4	0.03 km <sup>2</sup> (3 ha) (Brundrett, 2011).	Pristine (2017).

		2010 1 2014 17 2017 4		
Cheadanup Nature Reserve, North-West of Munglinup	Nature Reserve	1981 5 1982 4 2002 0 2003 0 2004 0 2005 0 2006 0 2008 0 2009 0 2014 0 2017 0	0 (No plants)	Thought to no longer be suitable for this species after several hot fires within a few years altered the habitat.
Oldfield Location 1002, North-West of Munglinup	Private Property	1981 10 2002 2 2003 2 2004 23 2005 0 2006 7 2007 6 2008 25 2009 22 2010 4 2014 6 2017 5	0.0625 km <sup>2</sup> (6.25 ha) (Brundrett, 2011)	Excellent (2017).

### 6.2 Population size (Australian context) *(include how numbers were determined/calculated)*

What is the total population size?	9 (2017), but varies with seasonal conditions and survey intensity to a maximum of 49 (2004) and an average annual count for the currently extant subpopulations of 15 plants.
What is the number of subpopulations?	3
What percentage of the population is within WA?	100 %
What percentage of the population is within Australia?	100 %

### 6.3 Population dynamics (Australian context) *(include how numbers were determined/calculated)*

What is the number of mature individuals?	9 (2017); varies with annual average of 15.
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What is the number of immature individuals?	Unknown
What is the number of senescing/past reproductive individuals?	Unknown
What is the maximum number of mature individuals per subpopulation?	5 (2017); highest count recorded was 26 in subpop 1 in 2004.
What is the percentage of mature individuals in the largest subpopulation?	55.5 %
What percentage of mature individuals is within WA?	100 %
What percentage of global mature individuals is within Australia?	100 %
What is the age of sexual maturity?	Unknown
What is the life expectancy?	Unknown
What is the generation length?	Unknown
What is the reproductive capacity? (i.e. litter size or number of seeds)	Approximately 60 flowers per plant (Dixon & Christenhusz, 2018). Pollinated flowers produce a berry-fleshy fruit, which are indehiscent at maturity and contain 20 to 150 seeds (Brundrett, 2011).
What is the reproductive success?	Unknown

#### 6.4 Population trend

What is the current population trend (mature individuals)?	Decreasing <input type="checkbox"/> Increasing <input type="checkbox"/> Stable <input type="checkbox"/> Unknown <input checked="" type="checkbox"/>		
What is the percentage of the population change and over what time period?	Unable to assess. Overall the populations appear to vary in size from year to year, however this may be attributed to survey effort and flowering rates in response to rainfall. One subpopulation has decreased from 4 to 0 plants due to fire regime and habitat alteration.		
How has this been calculated?			
If the trend is decreasing; are the causes of the reduction understood?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Unknown <input type="checkbox"/>
Have the causes of the reduction ceased?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Unknown <input type="checkbox"/>
Are the causes of the reduction reversible?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Unknown <input type="checkbox"/>
Is the reduction continuing (continuing decline)?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Unknown <input type="checkbox"/>
Has the change been observed, estimated, inferred or is it suspected (direct observation, index of abundance appropriate to the species)? Give details			
When was the reduction or is it anticipated to occur?	Past <input type="checkbox"/>	Present <input type="checkbox"/>	Future <input type="checkbox"/>

What is the period of time for the reduction (in years and generations)?			
Are there extreme fluctuations in population size?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>
If Yes, provide details:			
<b>6.5 Translocations and captive/enclosed subpopulations</b>			
Have there been translocations (introduction or re-introduction)?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>
Are there proposed translocations (introduction or re-introduction)?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>
Are there self-sustaining translocated subpopulations?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>
Are there translocated subpopulations that are not self-sustaining?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>
If Yes is the response to any of the four questions above, provide summary details:			
Are there captive/enclosed/cultivated subpopulations?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>
Are there proposed captive/enclosed/cultivated subpopulations?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>
Are there self-sustaining captive/enclosed subpopulations?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>
Are there captive/enclosed subpopulations that are not self-sustaining?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Unknown <input type="checkbox"/>
If Yes is the response to any of the four questions above, provide summary details:			
Other information on translocations and captive/enclosed subpopulations for the species (including failures):	Seeds of this species were used as baits to study <i>in situ</i> germination (placed in mesh pouches in soil) at the Oldfield River population, but germination rates were very low, despite supplemental watering using an irrigation system (Brundrett, 2011).		
<b>6.6 Important subpopulations</b>			
All subpopulations are considered to be important. The species is only known from one location with three subpopulations, and only two subpopulations currently have mature plants present. It is likely that the third subpopulation will never recover and could be considered extinct.			

## Section 7: Threats

### 7.1 Threats (detail how the species is being impacted, i.e. how severe, the extent, evidence of the impact)

Threat (describe how the threat impacts on the species. Include abiotic and biotic causes, human related e.g. exploitation, and biological characteristics of the species e.g. low genetic diversity)	Extent (give details of impact on whole species or specific subpopulations)	Impact (what is the level of threat to the conservation of the species)	Evidence	Time period (past, present, future)
Drying climate and subsequent effects on habitat. Decreased rainfall leads to a decline in growth and recruitment of the <i>Melaleuca</i> species that <i>Rhizanthella johnstonii</i> is associated with, hence a decline in habitat quality. A key habitat characteristic for this species is the presence of <i>Melaleuca</i> species. <i>Rhizanthella johnstonii</i> acquires nutrients from a shared mycorrhizal fungus ( <i>Ceratobasidium</i> sp.) association with the fine root systems of <i>Melaleuca hamata</i> and <i>M. uncinata</i> . A decline in the associated <i>Melaleuca</i> species will also lead to a decline in the protective soil leaf layer conducive to the soil mycorrhiza.	All subpopulations are threatened.	Possibly extreme impact. If the <i>Melaleuca</i> species decline, so too will the numbers of this species present.	In the central wheatbelt subpopulations of the related species <i>Rhizanthella gardneri</i> , altered and sporadic climatic conditions resulting in a lack of rainfall at crucial stages of <i>Melaleuca scalena</i> growth has affected key habitat characteristics, which have resulted in declining <i>Rhizanthella gardneri</i> numbers. Little recruitment of <i>M. scalena</i> is also evident in this area and the once large thickets are becoming smaller and more open (DEC, 2010).  This threat is evident in the subpopulations of <i>Rhizanthella johnstonii</i> , but is less dramatic (DEC, 2010).	Past and potential in the future.
Habitat degradation from surrounding land use. All known subpopulations occur on the edge, or within small patches of natural remnant vegetation and are subject to stresses from surrounding land use.	All subpopulations are threatened.	Moderate Impact, most of the impact has already occurred and future impacts are likely to be gradual.	The three subpopulations occur in a highly cleared landscape. Nearby agricultural land use may result in altered hydrology, increase in weeds, chemical spray drift, etc.	Past, present and future.

Road and firebreak maintenance	The Oldfield River subpopulation and private property subpopulation.	Potentially extreme as habitat is altered and/or degraded.	<p>Part of the Oldfield River population is located on a road reserve, and as such road maintenance activities have the potential to impact this species directly and indirectly (altered hydrology).</p> <p>A survey in 2002 of the Oldfield River subpopulation noted that a 20 metre wide strip of vegetation adjacent to the road had been chained for fire control, presumed in the previous 3-4 years (1998/1999). Then in 2003 part of the Oldfield River population was destroyed by the creation of an emergency fire break in response to a wildfire in 2003.</p>	Past and potential in the future.
Inappropriate fire regime. There is a lack of knowledge of appropriate fire regimes, although past experiences suggest that extreme/high fire intensities may result in a major change in vegetation structure and be catastrophic for this species' survival (DEC, 2010).	All subpopulations are threatened.	Possibly extreme impact. Fire has the potential to alter the habitat so that it is no longer suitable for this species.	After several hot fires within a few years at the Cheadanup Nature Reserve subpopulation, the habitat was altered and is no longer thought to be suitable for this species. This subpopulation has not been seen since these fires. Post fire the <i>Melaleuca</i> species need to regenerate and produce a protective soil leafy layer that is conducive to the soil mycorrhiza (DBCA, 2018).	Past and potential in the future.
Altered hydrology. This can impact this species indirectly through quality of habitat. Altered hydrology may reduce the available water for the associated <i>Melaleuca</i> species and also erode the soil leaf layer.	All subpopulations are threatened.	Possibly extreme impact.	<p>As per above for Drying climate, a reduction in the associated <i>Melaleuca</i> species has seen a reduction in plant numbers of the associated species <i>Rhizanthella gardneri</i>.</p> <p>All subpopulation are located adjacent to drainage lines, and so changes to these drainage lines will impact on the hydrology of the areas of the subpopulations. Changes may occur as a result of adjacent land use to these drainage lines.</p>	Future



## Section 8: Management

<b>8.1 Current management</b>		
Is the species managed?	Yes, directly <input type="checkbox"/>	Yes, indirectly <input type="checkbox"/> No <input checked="" type="checkbox"/>
<i>If Yes; provide details of current or past management actions:</i>		
Does the species benefit from the management of another species or ecological community?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Unknown <input type="checkbox"/>	
<i>If Yes; provide details:</i>		
<b>8.2 Recovery planning</b>		
Is there an approved Recovery Plan (RP) or Interim Recovery Plan (IRP) for the species?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	
<p>Department of Environment and Conservation (2010) Underground Orchid (<i>Rhizanthella gardneri</i>) Interim Recovery Plan 2010-2015. Interim Recovery Plan No. 302. Department of Environment and Conservation, Western Australia.</p> <p>Threatened Species Scientific Committee (2016) Conservation Advice <i>Rhizanthella gardneri</i> Western underground orchid. Canberra: Department of the Environment and Energy. Available from: <a href="http://www.environment.gov.au/biodiversity/threatened/species/pubs/20109-conservation-advice-16122016.pdf">http://www.environment.gov.au/biodiversity/threatened/species/pubs/20109-conservation-advice-16122016.pdf</a>. In effect under the EPBC Act from 16-Dec-2016.</p> <p>Department of Conservation and Land Management (2001) Declared Rare and Poorly Known Flora in the Esperance District. Western Australian Wildlife Management Program No. 21. Department of Conservation and Land Management, Western Australia.</p>		
<b>8.3 Management recommendations</b>		
<p>Management actions undertaken include:</p> <ul style="list-style-type: none"> <li>• Monitoring and surveys have been carried out to determine plant numbers and impact of threats;</li> <li>• Protecting the sites from fire unless required for ecological reasons, and implemented early intervention in any wildfires which may threaten the site;</li> <li>• Surveying for additional subpopulations;</li> <li>• Examination of genetic variation by Botanical Gardens and Parks Authority (BGPA) using a non-destructive sampling technique for DNA extraction from floral bract material collected in 2001;</li> <li>• Collection of seed from Subpopulation 3 in 2003 for storage at BGPA;</li> <li>• Fencing of Subpopulation 6 in 2004;</li> <li>• An irrigation system and a system of logging moisture probes to monitor moisture availability.</li> </ul> <p>Further management actions recommended include:</p> <ul style="list-style-type: none"> <li>• Develop monitoring protocols to reduce impacts during surveys/monitoring. Surveys/monitoring must be conducted by experts using proven techniques tailored to this species' life cycle and undertaken in vegetation types deemed suitable for the species;</li> <li>• Monitoring the subpopulations for population stability, changes in plant or site health, and evidence of rabbit or weed impacts;</li> <li>• Survey potential habitat areas for new subpopulations.</li> </ul>		

- Install rabbit-proof fencing/caging around subpopulations or individuals when required;
- Ongoing liaison with Shire of Ravensthorpe and private property owners to ensure that subpopulations of the species are not accidentally damaged or destroyed, and the habitat is maintained in a suitable condition for the conservation of the species;
- Develop and implement a fire management strategy, including associated weed control measures and the need for and method of the construction and maintenance of firebreak;
- Develop a translocation proposal and select a disease free translocation site;
- Map habitat critical to the survival of the species to facilitate its protection and appropriate management;
- Protect known and potential habitats along the Oldfield River (Subpopulation 3) within an A Class Nature Reserve that includes all vegetation between West Point Road and the South Coast Highway. This vegetation is currently unvested Crown reserves (Brundrett 2011);
- Ensure security of tenure of Subpopulation 5 through a conservation covenant;
- Rehabilitate habitat with local endemics plant species where required;
- Make further collections of seed and associated mycorrhizal fungi and development long-term storage protocols;
- Undertake weed control where required.

#### Research

- Research biology and ecology of the species, with a focus on orchid-fungus relationship, pollination effectiveness, seed viability, conditions required for natural germination, response to threats and disturbances and reproductive biology;
- Determine the reasons for habitat degradation;
- Characterise the effects of seasonal climatic variation to habitat.

## Section 9: Nominator details

<b>Nominator name(s):</b>	
<b>Contact details:</b>	
<b>Date submitted:</b>	February 2018
<i>If the nomination has been refereed or reviewed by experts, please provide their names and contact details:</i>	

## Section 10: References

<p><b>9.1 References</b></p> <p>Brundrett, M. (2011) Wheatbelt Orchid Rescue Project Final Report 6. <i>Population Survey Data for Southern Populations of the Western Underground Orchid (Rhizanthella gardneri)</i>. Wheatbelt Orchid Rescue Project, University of Western Australia.</p> <p>Department of Biodiversity, Conservation and Attractions (DBCA) (2018) Records held in DBCA's Threatened and Priority Flora (TPFL) database and Threatened flora files. Western Australia Department of Biodiversity, Conservation and Attractions (DBCA).</p>
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Department of Environment and Conservation (DEC) (2010) Underground Orchid (*Rhizanthella gardneri*) Interim Recovery Plan 2010-2015. Interim Recovery Plan No. 302. Department of Environment and Conservation, Western Australia.

Dixon, K.W. & Christenhusz, M.J.M. (2018) Flowering in darkness: a new species of subterranean orchid *Rhizanthella* (Orchidaceae; Orchidoideae; Diurideae) from Western Australia. *Phytotaxa* 334 (1): 075-079.