

# THREATENED SPECIES SCIENTIFIC COMMITTEE

Established under the *Environment Protection and Biodiversity Conservation Act 1999*

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The Minister's delegate approved this Conservation Advice on 13/07/2017.

## Conservation Advice

### *Goodenia integerrima*

gypsum goodenia

#### Conservation Status

*Goodenia integerrima* (gypsum goodenia) is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) effective from the 16 July 2000. The species was eligible for listing under the EPBC Act as on 16 July 2000 it was listed as Vulnerable under Schedule 1 of the preceding Act, the *Endangered Species Protection Act 1992* (Cwlth).

The gypsum goodenia is listed as Endangered in Western Australia under the *Wildlife Conservation Act 1950*.

The main factors that are the cause of the species being eligible for listing in the Vulnerable category are that the species has a small population size and a restricted and fragmented distribution.

#### Description

The gypsum goodenia is a ground-hugging or slightly ascending perennial herb which grows to about 9 cm tall (Brown et al 1998). The linear leaves are 20-65 mm long by 1-2.8 mm wide, are smooth, have recurved margins and are clustered in a whorl. The flowers are approximately 7 mm long with a yellow and brown corolla (group of petals) and are borne on flower stalks to about 8 cm long. Flowers are arranged in subumbels (flower arrangements in which the flower stalks do not quite spread from a central point). Its low-growing habit, yellow flowers with a brown throat, and unusual habitat on rises in salt-lakes distinguish the gypsum goodenia from other species (Brown et al 1998). However, due to its physical size, short flowering period, and response to seasonal environmental changes, gypsum goodenias can be difficult to locate in its natural habitat (Sandow 2012).

#### Distribution

The gypsum goodenia is endemic to south-western Western Australia where it is restricted to Lake King (Brown et al 1998). Matiske Consulting Pty Ltd (1996) suggested that the gypsum goodenia is likely to be a gypsophilic plant species (preferring to grow in gypsum-rich soil) that is unique to the single salt-lake in which it was discovered. Despite extensive surveys of areas of similar habitat in salt-lakes in the region, only four populations of the species are known (DEC 2010-2011), all from Lake King Nature Reserve. Each population occurs on a separate elevated islet in gypsum dunes in the lake over a linear range of approximately 5 km (DEC 2010). During surveys conducted by the Western Australian Department of Environment and Conservation (DEC) in 2010-2011, the total population of the species was estimated to be 1800 mature individuals. The vast majority of the total population occurred in Population 4 with an estimated 1700 mature individuals (DEC 2010-2011). It is possible that there are other small populations on nearby islets (DEC 2010-2011).

Table 1 – Locations of populations of the gypsum goodenia (DEC 2010-2011).

Population	Location in Lake King Nature Reserve
1	In 2010, Population 1 was located approximately 9.7 km west of Lake King township on the northern tip of a north-south oriented islet approximately 50 m south of Newdegate-Ravensthorpe Road.
2	In 2011, Population 2 was located approximately 9 km west of Lake King township on the north-eastern side of an east-west oriented gypsum dune 400-500 m south of Newdegate-Ravensthorpe Road. The population extended from approximately 250 m south to approximately 600 m south-east of an old gypsum mine which is situated on the southern side of Newdegate-Ravensthorpe Road.
3	In 2010, Population 3 was located on an islet within 250 m of the western edge of Lake King, approximately 12.8 km west of Lake King township and extended from 1.3-1.7 km north of Newdegate-Ravensthorpe Road.
4	In 2011, Population 4 was located approximately 8.7 km west of Lake King township and 200 m east of Population 2. The population extended from 250-600 m south of Newdegate-Ravensthorpe Road.

### Relevant Biology/Ecology

The gypsum goodenia grows with samphire species (Chenopodiaceae family) and other dwarf shrub species such as *Pimelea halophila* (Brown et al 1998). Given that the gypsum goodenia occurs on elevated islets in sand dunes in Lake King, the species and its habitat are dependent on stable groundwater levels and, therefore, the maintenance of groundwater recharge in the local catchment (CALM 2003). The species composition and structure of the gypsophilic ecological communities in which the gypsum goodenia populations occur may be influenced by topographical position, particularly the aspect of dune slopes and where the ecological community is situated on a dune (i.e. from swale to top of a dune) (Pueyo et al 2007). In addition, the geographical positions of populations in the landscape appeared to shift in relation to the direction of prevailing winds, the movement of available groundwater in gypsum dunes and localised fluctuations in the distribution of rainfall (Sandow 2012). In 2010, three of the four known populations were found on the western side of islets, which suggested that prevailing south-east winds were influencing groundwater movement, seed dispersal (Sandow 2012) and microhabitats preferred by the species.

The response of the gypsum goodenia to fire is unknown (CALM 2003). The salt pans occurring in the bed of the salt-lake within Lake King Nature Reserve, are largely devoid of vegetative biomass and, therefore, quantities of combustible vegetative material, which may otherwise provide fuel for wildfire, are extremely low. As a result, the salt pans in the lake system form natural barriers which inhibit the spread or intensification of wildfire (Bushfire CRC & AFAC 2009; Dixon pers. comm. 2017) and, therefore, generally provide refuge for the gypsum goodenia and associated ecological communities which occur on intervening, elevated islets (Dixon pers. comm. 2017).

The species flowers from late October to November (DPaW 2016; Paczkowska & Chapman 2000). Corridors of remnant vegetation linking gypsum goodenia populations allow pollinators to move between populations and are, therefore, critical for the long-term survival of the species (CALM 2003).

### Threats

Disturbance and browsing of the gypsum goodenia by rabbits has been a suspected threat to the species in the past and may be a threat in the future. Other potential threats to the species include the loss, fragmentation and degradation of populations or habitat resulting from rising groundwater and increasing salinity; gypsum mining; fires occurring too frequently; and effects

on the species and its environment as a result of climate change (CALM 2003; DEC 2010-2011). These threats and their effects on the species are described in Table 1. The threats outlined below have corresponding conservation management priorities.

Table 1 – Threats impacting the gypsum goodenia in approximate order of severity of risk, based on available evidence.

Threat factor	Threat type and status	Evidence base
Invasive species		
Browsing by rabbits ( <i>Oryctolagus cuniculus</i> )	known past / potential	<p>In 2010-2011, browsing by rabbits was known to be affecting of gypsum goodenia Population 2 (DEC 2010-2011). In late 2011, after rabbits were reported as having been eradicated from the site following 1080 poison baiting as part of DEC's Caring for Our Country 2009 – 2012 Rabbit Control Project and likely predation by foxes (<i>Vulpes vulpes</i>). Population 2 had increased from two mature individuals counted in 2010 to 32 in 2011 (DEC 2010-2011). However, there is a potential for rabbits to return to the site or other parts of Lake King if left uncontrolled.</p> <p>Browsing of gypsum goodenia and other flora species by rabbits may limit the establishment of seedlings thereby limiting natural recruitment. The distribution of rabbit droppings carrying weed seeds and increasing nutrient levels in soils may encourage the growth and spread of weeds. In addition, rabbit warren construction may also adversely affect the gypsum goodenia and its habitat by causing soil disturbance (CALM 2003) and altering groundwater flows in the vicinity of the warren.</p>
Loss, fragmentation or degradation of populations or habitat		
Rising groundwater and increasing soil salinity	potential current	<p>The clearing of vegetation in areas surrounding Lake King for agricultural purposes has led to rising groundwater and increasing salinity of soils in the lake (CALM 2003). While the effect of increasing soil salinity on the gypsum goodenia is unknown, all gypsum goodenia populations occur on rises in samphire flats that are seasonally wet to waterlogged and may be susceptible to rising water tables and increasing (secondary) salinity (CALM 2003).</p>
Gypsum mining	potential future	<p>Gypsum mining formerly occurred within 1 km of two populations (DEC 2010-2011). There is a potential for gypsum extraction and associated activities, such as vehicle usage, to recommence in the region (DEC 2010-2011) and cause direct damage to populations, or adversely affect them through habitat loss, fragmentation or degradation (CALM 2003).</p>

Fire		
Too frequent fire	potential current	While the response of the gypsum goodenia to fire is unknown, wildfires recurring in the same region of Lake King Nature Reserve within a short period may destroy regenerating or juvenile plants in a population before they reach maturity, and produce and release seed (CALM 2003). This, in turn, may reduce or prevent the accumulation of sufficient soil stored seed to allow regeneration in the population, which may limit its ability to persist (CALM 2003). While the spread of wildfire is limited across unvegetated salt pans in Lake King Nature Reserve, Population 3 is located within 250 m of heathy vegetation on the western edge of the salt-lake within the reserve (DEC 2010-2011) and is, therefore, potentially vulnerable to the effects of fire. Nevertheless, the potential for frequent fire to be a threat to the species is currently low (DEC 2010-2011).
Effects on the species and its environment as a result of climate change		
Global climate change	potential current to long-term	<p>In south-west Western Australia, annual mean rainfall is projected to decrease strongly while there is strong confidence in continued substantial increases in projected mean, maximum and minimum temperatures in the region as a result of predicted changes in the state of the global climatic system (CSIRO &amp; BOM 2015). Although extreme rainfall events are predicted to increase, the region is predicted to become drier over the long-term (CSIRO &amp; BOM 2015). This is likely to significantly reduce groundwater recharge in Lake King, thereby lowering the water table under the surface of the dunes and making unavailable the groundwater on which the gypsum goodenia and co-occurring flora species depend for survival (DEC 2010-2011).</p> <p>Other potential adverse effects of a drying climate in the region over the long-term is increased frequency and/or intensity of wildfire (Williams et al 2009), which is likely to kill mature individuals of the gypsum goodenia, and increased salinisation of the gypsum soils in which the species grows (DEC 2010-2011).</p>

## **Conservation Actions**

### **Conservation and Management priorities**

#### Invasive species

- Continue to implement and update a baiting programme in cooperation with relevant land users to control rabbit populations where their presence is identified during regular monitoring of gypsum goodenia populations. If the effect of rabbit activity on gypsum goodenia populations becomes severe, consider installing and maintaining rabbit-proof fences to protect those populations. Refer to the Threat abatement plan for competition and land degradation by rabbits (DoEE 2016).

## Loss, fragmentation or degradation of populations or habitat

- Avoid the removal of gypsum goodenia habitat and other activities associated with gypsum mining, including resource exploration, that are likely to adversely affect the species or its habitat

## Fire

- Fires must be managed in Lake King Nature Reserve to ensure that prevailing fire regimes do not disrupt the life cycle of the gypsum goodenia, that they support rather than degrade the ecological community which supports it, and that they do not promote invasion of introduced flora species.
- The impacts of any occurrences of fire in fire refugia in Lake King Nature Reserve should be investigated (Dixon pers. comm. 2017). Precise fire history records must be kept for all known populations of the gypsum goodenia, their habitats and all areas of potential habitat for the species.

## Effects on the species and its environment as a result of climate change

- Preservation of germplasm is essential to facilitate assisted/migration range shifts in response to climate change, facilitate the expansion of populations with low numbers, insure against potential local extinctions and protect the remaining genetic diversity of the gypsum goodenia. (Note that cuttings can also be used to propagate plants for translocations.)
- Continue to undertake seed banking where storable gypsum goodenia seeds are available. Continue to appropriately source and store seed in the existing long-term seed bank facilities at the Department of Parks and Wildlife (DPaW) Threatened Flora Seed Centre (TFSC) using best-practice seed storage guidelines and procedures to maximise seed viability and germination ability.

## Translocation

- Develop and implement a programme to translocate the species to areas of suitable habitat in order to restore and maintain pollinator movements and the exchange of genetic material between populations of the species. . The translocation protocols recommended by Vallee and colleagues (2004) should be used. Suitable translocation sites should be identified through surveys and predictive distribution modelling.

## Stakeholder Engagement

- Identify, encourage and maintain the involvement of stakeholders, including wildflower societies, local field naturalists, local community, conservation and Landcare groups, and local Community Support Officers in conservation activities, particularly surveys that are supervised by DPaW staff. Continued liaison with the indigenous community will identify areas in which collaboration will assist implementation of conservation actions.
- Train interested stakeholders in survey techniques and identification of the species through community education activities, including (but not limited to) rare flora training, participation in community wildflower shows, and the production and distribution of rare flora newsletters.
- Update a public information sheet that provides essential information about the species and outlines the importance of protecting and monitoring populations, and locating previously undiscovered populations, in order to aid the species' recovery. Information

provided on the sheet should include the species' conservation statuses under Commonwealth and WA legislation, a description of the species, its distribution, threats to the species, and conservation actions undertaken and conservation actions still required.

- Update community information materials (e.g. electronic media, local media, and poster displays and printed distributed through local government libraries, letterbox drops, wildflower shows and other events) to promote and maintain the awareness of the public about the species.

### **Survey and Monitoring priorities**

- Monitor known gypsum goodenia populations, including translocated populations, and their habitats during the species' flowering period. It is preferable to monitor populations on an annual basis.
- During monitoring, collect detailed information on each population, including: seedling recruitment and changes in population numbers and structure; seed production; longevity; pollinator activity; and habitat condition and the status of relevant threats, including groundwater levels, soil salinity and pH levels; evidence of any adverse effects on populations of the species resulting from increasing soil salinity; evidence of damage caused by browsing by rabbits; and the condition of rabbit-proof fences designed to protect gypsum goodenia populations or their habitats. Soil salinity and pH readings should be taken during winter and summer.
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.
- During monitoring, continue to collect seed from all known populations for the purpose of ex situ propagation and cultivation.
- During monitoring of known populations, map the geographical extent of each population for reference during future monitoring.
- Continue to conduct systematic and comprehensive surveys of all suitable habitat within Lake King during the species' flowering period (late October to November) to locate any new or unconfirmed populations of the species. Continue to conduct surveys with the assistance of local volunteers and wildflower society members, in particular the Lakes District Rare Flora Group, and supervision by DPaW staff.

### **Information and research priorities**

- In order to identify sites for further surveys for the gypsum goodenia and identify suitable sites for translocation of individuals, develop predictive models for the geographical distribution of the species based on the environmental conditions of sites of known occurrences. This requires a reasonably sized data-set of species presence information plus the range of environmental variables that are known to influence the species distribution. If these data are not available then a research priority should be to collect and assimilate this information (Phillips et al 2006).
- Research key biological functions of the species, including: the reproductive strategy, phenology and seasonal growth of the species; the pollination biology/ecology of the species, including the habitat requirements and spatial and temporal movement patterns of the species' pollinators; the species' longevity, soil seed bank dynamics and longevity; the effect of rainfall variability and resultant groundwater levels on the distribution of the species; the effect of increasing groundwater salinity on the species; the response of mature and

juvenile individuals of the species to browsing by rabbits or physical damage; population genetic structures, levels of genetic diversity and minimum viable population size.

- Undertake seed germination and/or vegetative propagation trials to determine the requirements for successful establishment. Where appropriate, conduct trials near existing subpopulations in disturbed areas, immediately following weed removal.
- Investigate options for linking, enhancing or establishing additional subpopulations. Undertake a connectivity analysis to prioritise important areas for conservation, the location of critical habitat linkages and barriers to the movement of individuals and gene flow. This requires information on pollinator movement and seed dispersal patterns in the landscape, or genetic diversity in the population (McRae et al 2008).

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