The Minister's delegate approved this Conservation Advice on 15/07/2016.

Conservation Advice

Andersonia axilliflora

giant andersonia

Conservation Status

Andersonia axilliflora (giant andersonia) is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act). The species is eligible for listing as prior to the commencement of the EPBC Act, it was listed as Endangered under Schedule 1 of the *Endangered Species Protection Act 1992* (Cwlth).

The species is listed as Critically Endangered under the Western Australian (WA) *Wildlife Conservation Act 1950.* The species is part of the Eastern Stirling Range Montane Heath and Thicket ecological community, which is listed as Endangered under the EPBC Act.

The main factors that are the cause of the species being eligible for listing in the Endangered category are its very specific and restricted geographic range (area of occupancy less than 500 km^2 and extent of occurrence less than 5000 km^2), small population size and continuing decline due to the threat of infection from *Phytophthora cinnamomi* and the threat from too frequent fires.

Description

The giant andersonia is a slow growing robust shrub that grows 2-3 m tall in the family Ericaceae (Western Australian Herbarium 1998; Brown et al., 1998). The erect branchlets are covered in distinctive overlapping triangular-shaped leaves (3 cm long); the leaves are broad where they attach to the stem, tapering to a point at the tip. Flowers form at the end of the branchlets, concealed beneath creamy-white floral leaves of the flower calyx that also taper to a sharp point. Hidden beneath the floral leaves are up to 30 small (1 cm long) cream-coloured flowers (Robinson & Coates 1995; Brown et al., 1998).

Distribution

The giant andersonia only occurs in the eastern peaks montane habitat of the Stirling Range National Park, south-western WA. The species grows on shallow soil over schist (Barrett 1999; Evans et al., 2003) or quartzite rock, on rocky slopes, outcrops and ledges (Western Australian Herbarium 1998). The giant andersonia is an indicative species of the Eastern Stirling Range Montane Heath and Thicket ecological community; a dense heath or thicket with scrub vegetation, which is found at high altitudes (750–1080 m above sea level).

In 2003 there were 11 giant andersonia populations occurring on the upper slopes and summits between Mt Success and Ellen Peak (Evans et al., 2003). Across these 11 populations there were an estimated 440 mature plants and 660 juvenile plants. The 11 populations may previously have occurred as three larger populations (Evans et al., 2003), however fires and dieback caused by *P. cinnamomi* infection have caused further fragmentation of the species' distribution.

Relevant Biology/Ecology

The genus *Andersonia* is endemic to WA, with the greatest species diversity in the Albany district of south-western WA. Plants of the species flower between October and November (Evans et al., 2003) and like other *Andersonia* species, are probably pollinated by insects, with the exception of two species that are pollinated by birds (Keighery 1996). At one population a

beetle was observed pollinating giant andersonia plants (Evans et al., 2003). Seed is fine (unlike many other Ericaceae that have woody drupaceous fruits) and is probably dispersed by gravity or wind (Keighery 1996). Ericaceae with fine seed are usually highly responsive to smoke application under nursery or field conditions.

Field observations following fires in 1991 and 2000 showed that adult and juvenile giant andersonia plants were killed in the fires, but that seed germination was stimulated (Evans et al., 2003). Eight years post the 1991 fire the population size comprised fewer than 200 mature plants that had survived the fires and more than 700 juveniles that had germinated post-fire (Evans et al., 2003). The mature plants were greater than 1 m in height, whereas the juveniles were 20-40 cm high and had not reached sexual maturity (i.e. had not flowered and set seed). Some plants in one population flowered for the first time nine years post-fire, but juveniles from other populations had not flowered 11 years post-fire (Evans et al., 2003).

Two years after the 2000 fire, the species population size comprised an estimated 440 mature plants and 660 juveniles; the high number of juveniles indicated that the soil seed bank may have contained seeds that had not germinated following the 1991 fire or that the soil seed-bank had been replenished. In addition to fires in 1991 and 2000, previous fires in the species' range occurred in 1972 and during the 1950s.

Evans et al. (2003) suggested that seeds may remain viable in the soil for long periods and that there may be dormancy mechanisms or physical attributes that prevent all seed germinating in response to one fire event. The nature and mechanism of response to fire, particularly seed longevity in the soil needs further investigation. Over 8500 seeds were collected between October 1996 and February 1997 by the then Department of Conservation and Land Management's Threatened Flora Centre to study the species germination requirements. In 2003, the Botanic Gardens and Parks Authority had one giant andersonia plant, and were attempting tissue culture trials and seed germination trials (Evans et al., 2003).

Giant andersonia adult and juvenile plants are highly susceptible to the effects of *P. cinnamomi* infection, which kills plants by attacking the root systems (DPaW 2016, Commonwealth of Australia 2014). The pathogen is an introduced moisture dependent microorganism that in undisturbed habitats spreads through root to root contact and free water flow; as such it spreads quickly downhill but can move upslope too (Evans et al., 2003), which is an important consideration for the protection of the giant andersonia that occur on slope and summit montane habitat. The disease is spread between locations through the transportation of soil containing the microorganisms or spores.

Up to 80 percent of the Stirling Range National Park is infected with *P. cinnamomi* (DPaW 2016). In 2003 all 11 populations of giant andersonia were considered threatened by the effects of *P. cinnamomi* infection (referred to as dieback (Evans et al., 2003) and most populations occurred in areas known to be affected. It is not clear from Evans et al. (2003) if any giant andersonia populations are free from the disease. To control the dieback effects of *P. cinnamomi* infection on the giant andersonia, aerial spraying of phosphite was implemented in 1997. Post-spraying monitoring in 2000 indicated that juvenile plants were more likely to have survived in populations that were sprayed compared to those not sprayed (Evans et al., 2003). In 2003, it was proposed that the then Department of Conservation and Land Management would continue aerial spraying of phosphite at giant andersonia sites as part of their phosphite programme (Evans et al., 2003). Fire and *P. cinnamomi* infection both kill adult and juvenile plants. Field observations suggest that the plants are increasingly susceptible to the effects of *P. cinnamomi* infection following a fire (Evans et al., 2003).

Threats

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

Threat factor	Threat type and status	Evidence base
Disease		
Infection and spread of *P. cinnamomi* (or other fungal pathogens)	known current	In 2003 all 11 giant andersonia populations were threatened by *P. cinnamomi* infection, and most populations occurred in areas known to be infected by the pathogen (Evans et al., 2003). Infection is spread between sites via the movement of soil or water containing microbes or spores (Commonwealth of Australia 2014). The likelihood that the disease is spread by people is greater in the absence of appropriate hygiene measures, or if people leave designated walking tracks or camping areas. Water or equipment used to put out fires may also contain pathogen microbes or spores that could be inadvertently transported to the species habitat.
Fire		
Too frequent burning	potential	Fire kills plants above the ground and stimulates the germination of seedlings. Plants are slow-growing, not reaching sexual maturity until eight or more (11) years post-fire. The soil seed bank may be drastically depleted if the interval between fires is less than the time required for plants to reach maturity and replenish the seed bank (Evans et al., 2003) leading to localised extirpation and on-going decline in plant numbers.
Habitat loss and fragmentation		
Recreational and management activities	potential	Damage to plants by trampling or the spread of *P. cinnomomi* may occur if people leave designated walking tracks (e.g. the Ridge Walk) or camping areas.
Invasive species		
Predation by unknown vector	potential	In 2003 the leaves of some individual plants were reported to have been eaten by an unknown browser (Evans et al., 2003). Rabbits (*Oryctolagus cuniculus*) and unmanaged goats (*Capra hircus*) may occur in the Stirling Range National Park (Department of Conservation and Land Management 1999).

Conservation Actions

Conservation and Management priorities

Disease

- Provided that the aerial application of phosphite to the giant andersonia has been found to effectively mitigate the effects of infection by *P. cinnamomi*, continue its implementation at a regime appropriate for the species if the information is available, or

else as advised by the Western Australian Department of Parks and Wildlife, the Dieback Working Group (2008) and the Commonwealth of Australia (2014).

- Continue to implement suitable hygiene protocols including shoe/boot cleaning measures (brushes and methylated spirits) for park visitors and management/ research staff to protect known populations from further outbreaks of *P. cinnamomi* infection, and provide/maintain suitable hygiene facilities for people to use on the Ridge Walk track and before entering the giant andersonia habitat (see Dieback Working Group 2008 for guidance).
- Maintain the Ridge Walk walking track to avoid the occurrence of water pooling or mud forming that facilitates the easy transportation of wet soil along the track.

Fire

- Fires must be managed to ensure that prevailing fire regimes do not disrupt the life cycle of the giant andersonia, that they support rather than degrade the habitat necessary to the threatened species, that they do not promote invasion of exotic species, and that they do not increase impacts of grazing/predation.
- Physical damage to the habitat and individuals of the threatened species must be avoided during and after fire operations.
- Critically, planned fires should not be applied to populations of this species without detailed means to remove any chance of fires re-occurring within the time interval necessary to replenish the soil seed bank (8-11 years).
- Aerosol smoke be investigated as a means for small plot regeneration particularly where dieback has resulted in death of the parent plants. Noting that phosphite application will be necessary to protect the plants.

Breeding, propagation and other ex situ recovery action

- To manage the risk of losing genetic diversity, promote ex situ conservation. Continue investigations into seed germination and propagation from cuttings with Kings Park and Botanic Gardens and the Western Australian Government's Threatened Flora Seed Centre. See guidelines for plant germplasm conservation in Australia (ANPC 2009).
- Store seed in seed banks for long-term conservation and to manage the potential risk that natural soil seed bank becomes depleted (e.g. Western Australian Government's Threatened Flora Seed Centre or the Australian National Botanic Gardens National Seed Bank).

Habitat loss and fragmentation

- To manage the risk of people damaging individual plants, use signage, pamphlets and education programmes to encourage visitors to keep to designated walking tracks and camping areas to reduce the likelihood that plants are inadvertently trampled.
- Ensure that all monitoring and management activities are planned and include measures to avoid impact to the giant andersonia plants, including limiting the time that people spend in the habitat so that activities are conducted by personnel that are appropriately trained and experienced in working in similarly remote and rugged terrain.

Invasive species (including threats from grazing and/or predation)

- If grazing by introduced herbivores (e.g. rabbits or goats) is confirmed, implement measures to remove these introduced herbivores, consistent with the Threat

Abatement Plan for competition and land degradation by unmanaged goats (DEWHA, 2008) and the Threat Abatement Plan for competition and land degradation by rabbits (DEWHA, 2008). All measures should be consistent with hygiene protocols for limiting the spread of *P. cinnamomi*.

Stakeholder Engagement

- Continue to communicate the need to avoid spreading *P. cinnamomi* to Stirling Range National Park visitors (bushwalkers, rock climbers and campers) and management staff (including fire and threatened species management or research) through the use of signage, pamphlets and education programmes.
- Fire management authorities and land management agencies should be supplied with maps indicating the location of giant andersonia, and field markers should be installed to reduce the risk of damage to giant andersonia plants.
- To promote conservation outcomes for the species, maintain or continue to encourage formal links with local naturalist groups, the Wildflower Society of Western Australia, and interested individuals.
- Review the information sheet that was prepared in 2003 (Evans et al., 2003).

Survey and Monitoring priorities

- Monitor *P. cinnamomi* infection in the giant andersonia populations in order to:
  - Identify if there are any areas not infected that may require enhanced protection against the spread of the disease.
  - Adaptively manage the impact of the disease (i.e. phosphite application and hygiene protocols) to maximise the species' chances of long term-survival and minimise any detrimental effects of spraying phosphite.
- Monitor the size and structure and reproductive status of populations at different stages in the fire cycle, taking opportunities to monitor after planned and unplanned fires (where they occur) and improve understanding of the fire response of the species.
- Precise fire history records must be kept for the habitat and extant populations (confirmed and suspected) of the giant andersonia.
- Continue to assess population size, distribution, ecological requirements and the relative impacts of threatening processes by conducting, establishing and maintaining a monitoring programme based on these data.
- Conduct targeted surveys throughout the range of the giant andersonia to better define its distribution and abundance. Undertake survey work to locate and map any additional populations in potentially suitable habitat.

Information and research priorities

- Continue to investigate the biology of germination and recruitment from the soil seed bank, particularly in relation to fire, to promote adaptive management.
- Improve understanding of the mechanisms of response to different fire regimes and identify appropriate fire regimes for conservation of the giant andersonia by undertaking appropriately designed experiments in the field and/or laboratory employing the use of aerosol smoke for in situ treatments. Note: fine seeded Ericaceae usually respond to applications of smoke under laboratory and nursery conditions.

- Where appropriate, use understanding and research on fire responses among related (e.g. *Andersonia* spp) or functionally similar species to develop fire management strategies for conservation.
- Acquire the following baseline information on all populations: population size, distribution, threats and their impacts. Prioritise management actions at all populations based on the currency, degree and nature of threats.
- Investigate the pollination of the species to enhance the species conservation management.
- Investigate track materials and draining mechanisms that may aid in preventing erosion to the Ridge Walk track and avoid water draining freely downhill (see Dieback Working Group 2008).

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