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

# Conservation Advice

# *Thomasia* sp. Green Hill (S.Paust 1322)

Green Hill thomasia

## Conservation Status

*Thomasia* sp. Green Hill (S.Paust 1322) (Green Hill thomasia) is listed as Endangered 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 Endangered under Schedule 1 of the preceding Act, the *Endangered Species Protection Act 1992* (Cwlth).

The Green Hill thomasia is listed as Critically Endangered in Western Australian under the *Wildlife Conservation Act 1950.*

The main factors that are the cause of the species being eligible for listing in the Endangered category are that the species has a highly restricted extent of occurrence and small area of occupancy, the total population is small, and the quality of the species' habitat continues to decline (CALM 2003).

## Description

The Green Hill thomasia is a low shrub approximately 40 cm in height with multiple delicate stems that appear to grow from a rootstock (CALM 2003). The leaves are flat, narrowly elliptic and 10 - 13 mm long by 5 mm wide. The inflorescence (arrangement of flowers) is a raceme typically consisting of three flowers. The ribbed calyx (collection of sepals) is mauve with a reddish purple base. The calyx is approximately 7 mm long and is divided for less than half its length into five obtuse arching lobes. The rounded petals and anthers are dark purple to black in colour. The species is inconspicuous when not in flower (CALM 2003).

## Distribution

The Green Hill thomasia is endemic to south-west Western Australia (CALM 2003; DEC 2011). In 2008, it was known from a single population occurring on a privately owned property in the New Norcia area, approximately 130 km north of Perth (DEC 2011). The population consisted of fewer than 100 mature individuals occurring in two subpopulations approximately 1.5 km apart (CALM 2003; DEC 2011). Broun (cited in DEC 2011) noted that apparent individuals observed in their natural habitat may actually have been clumps of multiple individual plants and, if that were the case, it would have been difficult to count the fragile individuals comprising those clumps without damaging them (DEC 2011). Given that clumps of the species have been counted as single individuals in the past, recorded counts may be conservative. As a result, it is unclear whether the total population of mature individuals of the species has grown or declined (DEC 2011).

In 2008, the property on which the two known Green Hill thomasia subpopulations occur is a bush-block consisting entirely remnant open woodland dominated by *Eucalyptus wandoo* (wandoo) on brown sandy clay-loam over laterite (CALM 2003; DEC 2011). The subpopulations occur on the southern edge of the bush block adjacent to agricultural land used for grazing sheep (DEC 2011). Broun observed that both subpopulations grew on moistened ground in the shade of dense 1.5 – 2 m tall thickets of *Melaleuca radula* (graceful honeymyrtle) and *Calothamnus* sp. (one-sided bottlebrush) on the southern slopes of hillocks (DEC 2011). Associated flora species include *Allocasuarina campestris* (shrubby sheoak)*, A*. *humilis* (dwarf sheoak), *Hakea lissocarpha* (honey bush), *Melaleuca systena* (coastal honeymyrtle), *Hibbertia hypericoides* (yellow buttercups), *Xanthorrhoea preissii* (balga), *Grevillea* sp*.*, *Glischrocaryon* sp.

and *Stylidium* sp. (CALM 2003; DEC 2011). Such thickets are unlike surrounding vegetation types and are associated with fresh-water seeps in the abovementioned lateritic landscape (DEC 2011).

### Relevant Biology/Ecology

Little is known about the biology and ecology of the Green Hill thomasia or other species in the genus, *Thomasia* (CALM 2003). The species flowers in October (CALM 2003). There is no information about pollinators. Research on germination rates of seed collected from both subpopulations indicated the seed produced was highly viable (CALM 2003). The germination rate was initially tested using boiling water and resulted in only 20 - 40 percent germination, but subsequent testing with a treatment of nicking the seed coat resulted in 100 percent germination (CALM 2003).

The Green Hill thomasia is known to be able to regenerate from rootstock after being grazed by kangaroos, and probably also following fire (CALM 2003). Grazing affected the species in late winter 1999, but was followed by rapid growth of the plants in the spring of that year (CALM 2003). The response of the species to fire is unknown, but it is likely that the species requires occasional fire for the germination of soil-stored seed (CALM 2003).

Staff at the Department of Parks and Wildlife (DPaW) Threatened Flora Seed Centre (TFSC) tested the viability of seed soon after collection and again after one year in storage. According to Cochrane (cited in CALM 2003), the initial germination rate of fresh seed ranged from 20 - 40 percent, and after one year in storage the germination rate was 100 percent. Burning, smoke-water and soil disturbance may be effective in stimulating the germination of seed (CALM 2003). The species is difficult to propagate from cuttings (CALM 2003). It is likely that occasional disturbances, such as fire, are needed for recruitment of this species (CALM 2003).

Given that the Green Hill thomasia is listed as Endangered, all populations, including any populations translocated to suitable habitat in the future, are considered important populations that are necessary for the survival of the species (CALM 2003). Similarly, all known habitat is considered habitat critical to the survival of the species. Corridors of remnant vegetation linking Green Hill thomasia populations, which are typically situated along road and rail reserves, allow pollinators to move between populations and are also critical for the long-term survival of the species (CALM 2003).

### Threats

The main threat to the species is competition from competition from invasive weeds (CALM 2003). Potential threats to the species are browsing by sheep (*Ovis aries*); firebreak and fence maintenance activities; the influx of pollutants or nutrients into areas of habitat; habitat loss and fragmentation leading to further isolation of subpopulations and reduction in the already limited genetic diversity of the species; and too frequent fire (CALM 2003). These threats and their effects on the species are described in Table 1. The threats outlined below have corresponding conservation management priorities.

Given that the Green Hill thomasia has a highly restricted extent of occurrence and area of occupancy, the number of mature individuals of the species is low, and the quality of the species' habitat continues to decline, the species is susceptible a single catastrophic disturbance event as well as to ongoing known and potential threats.

Table 1 – Threats impacting the Green Hill thomasia in approximate order of severity of risk, based on available evidence.

| Threat factor | Threat type and status | Evidence base |
|---|---|---|
| Invasive species | | |
| Competition from invasive weeds | known current | In 2008, invasive weed species were known to occur in the sheep pastures on the land immediately adjacent to both Green Hill thomasia subpopulations. The ecological comuunities in which both subpopulations were situated were moderately weed infested (CALM 2003; DEC 2011) and no weed control appeared to have been implemented (DEC 2011). This indicated that the bush-block on which the subpopulations occurred was prone to weed invasion from the adjacent pasture (CALM 2003; DEC 2011). Mature individuals appear to cope with weed competition, but the impact on recruitment is likely to be greater as weeds suppress early plant growth by competing for soil moisture, nutrients and light (CALM 2003). |
| Loss, fragmentation or degradation of subpopulations or habitat | | |
| Browsing and trampling by sheep (*Ovis aries*) | potential current | In 2008, farmland adjacent to both Green Hill thomasia subpopulations was periodically grazed by sheep (CALM 2003; DEC 2011). Browsing and trampling by sheep is a potential threat to both subpopulations if the livestock exclusion fence between the adjacent farmland and the private property on which the two subpopulations occur is not adequately maintained (CALM 2003; DEC 2011). |
| Firebreak and fence maintenance activities | potential current | Firebreak and fence maintenance activities threaten individuals of the species that are growing close to the firebreak and fenceline (CALM 2003; DEC 2011). Vehicles turning, grading, and other maintenance activities could affect both Green Hill thomasia subpopulations (CALM 2003; DEC 2011). |
| Transport of pollutants or nutrients into areas of habitat | potential current | Chemical herbicides or fertilisers applied on farmland, or along fencelines, tracks or firebreaks, adjacent to the private property on which the two subpopulations occur have the potential to be transported by wind or groundwater to the areas inhabited by the Green Hill thomasia. As a result of habitat contamination, individuals in either subpopulation or the ecological communities in which they occur may be harmed through poisoning or nutrification, which may cause individual mortality or habitat degradation (CALM 2003; DEC 2011). |
| Habitat loss or fragmentation | potential future | Further habitat removal may occur if the ownership and use of the land on which subpopulations of the species occur changes in the future (CALM 2003). Such loss of habitat may fragment and isolate known subpopulations further reducing the species' genetic diversity, which is likely to be low given that the total population of mature individuals was estimated in 2008 to be fewer than 100 (CALM 2003; DEC 2011). Genetic diversity is necessary to provide a species with the ability to adapt to changing environmental conditions, such as climate (CALM 2003). |

| Threat factor | Threat type and status | Evidence base |
|---|---|---|
| Fire | | |
| Too frequent fire | potential current | Given that Green Hill thomasia seeds are known to germinate following disturbance, the soil seed-bank could be rapidly depleted if fires recurred before regenerating or juvenile plants reached maturity and replenished the soil seed-bank (CALM 2003). Therefore, fires occurring too frequently in the species' area of occurrence may affect the viability of populations and be detrimental to the species' long-term survival. Fire also facilitates the introduction and spread of weeds in burnt areas (CALM 2003). |

## Conservation Actions

### Conservation and Management priorities

Invasive species

- Develop a weed management plan for the Green Hill thomasia describing the most appropriate weed suppression methods, such as hand weeding or localised application of herbicide, for eliminating/suppressing relevant weed species at relevant sites while minimising the risk of incidental impacts on subpopulations of the species or the ecological communities they inhabit.
- Any localised applications of herbicide must be conducted during the appropriate season and during windless conditions to minimise the effect of herbicide on subpopulations of the Green Hill thomasia and their habitat.
- All weed control should be documented in a report on the method, timing and success of the treatment against weeds, and the effect on the species and associated native plant species.

Loss, fragmentation or degradation of subpopulations or habitat

- Continue to liaise with the owners and managers of land on and adjacent to which Green Hill thomasia subpopulations are known to occur to ensure that they are aware of the species' location and threatened status, and continue to implement measures to avoid or mitigate key and potential threats to the species.
- Continue to negotiate for protection of known subpopulations on private land through conservation agreements or covenants between land owners and the Western Australian Government.
- Maintain adequate livestock exclusion fencing to minimize the risk of sheep gaining access to areas inhabited by the Green Hill thomasia. Where livestock exclusion fencing along the boundary between the private property on which the species occurs and the adjacent sheep grazing property cannot be adequately maintained or it loses its effectiveness, installation/maintenance of additional exclusion fencing would be required around each subpopulation on the bush-block.
- Continue to restrict or manage vehicular access in the vicinity of sites where Green Hill thomasia subpopulations are known to occur to prevent accidental damage to known and newly discovered populations. Where necessary, re-route tracks or install and

maintain adequate fencing and lockable gates. Livestock exclusion fencing, as mentioned above, could be installed/maintained to perform both functions of livestock exclusion and controlling vehicular access.

- Continue to prevent accidental damage or removal of Green Hill thomasia subpopulations or habitat occurring adjacent to firebreaks or tracks by installing and maintaining Declared Rare Flora (DRF) markers[1] to alert road maintenance workers.
- Continue to ensure that due care is taken to avoid the airborne drift or leaching through soil of chemicals into Green Hill thomasia habitat resulting from the application of herbicides or fertilisers on land adjacent to those areas where the species is known to occur.

Fire

- Develop a fire management strategy for the Green Hill thomasia based on information gathered through research on the species' fire ecology and consultation with relevant local landholders, scientific experts, the WA Department of Fire and Emergency Services, Bush Fire Brigades to ensure recent scientific and local knowledge is incorporated in the strategy.
- Fires must be managed to ensure that prevailing fire regimes do not disrupt the life cycle of the Green Hill thomasia, that they support rather than degrade the ecological community which supports it, and that they do not promote invasion of introduced flora species.
- Use prescribed fire or other appropriate means to manage changes in the floristic structure or composition of the ecological communities inhabited by the Green Hill thomasia, which may otherwise reduce the suitability of those habitats for the Green Hill thomasia.
- Where appropriate, use physical or chemical weed control methods as an alternative to prescribed fire noting that many invasive species germinate in response to physical disturbance of soils.
- Avoid prescribed burning of Green Hill thomasia habitat between mid-autumn and late spring.
- Physical damage to the habitat and individuals of the Green Hill thomasia must be avoided during and after prescribed burning operations.
- Fire management authorities and land management agencies should use suitable maps and install field markers to avoid damage to the Green Hill thomasia.

Ex situ Strategies

- Preservation of germplasm is essential to insure against potential local extinctions and to protect the remaining genetic diversity of the Green Hill thomasia. Such collections are also needed to propagate plants for translocations. Ex situ seed banks provide an important capacity for medium to long-term storage of diaspores (spores, seeds, dispersal units) of threatened plant species.
- Continue to undertake seed banking where storable Green Hill thomasia seeds are available. Continue to appropriately source and store seed in the existing long-term

[1] DRF markers are used in Western Australia and are two standardised yellow markers at either end of a site, which are bent to face towards each other, indicating that DRF plants may occur anywhere between the markers, from the road's running surface to the fence. They alert people working in the vicinity to the presence of DRF, and the need to avoid work that may damage vegetation in the area (DEC 2013).

seed bank facilities using best practice seed storage guidelines and procedures to maximise seed viability and germination ability.

Translocation

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

Stakeholder Engagement

- Maintain formal links and liaison with stakeholders who are involved in the conservation of the species.
- 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 subpopulations, and locating previously undiscovered subpopulations, in order to aid the species' recovery. Information provided on the sheet should include the species' conservation status 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 Green Hill thomasia subpopulations, including translocated subpopulations, and their habitats during the October flowering period. It is preferable to monitor subpopulations on an annual basis.
- During monitoring, collect detailed information on each subpopulation, including: seedling recruitment and changes in subpopulation numbers and structure; emergence and resprouting success; seed production; statuses of relevant threats; and habitat condition, including weed species present and their abundance; pollinator activity; and longevity of plant clumps.
- Monitor the size and reproductive status of subpopulations at different stages in the fire cycle, taking opportunities to monitor after planned and unplanned fires, when they occur, and improve understanding of the fire response of the Green Hill thomasia. Precise fire

history records must be kept for all known subpopulations of the species, their habitats and all areas of potential habitat for the Green Hill thomasia.

- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.
- During monitoring of known subpopulations, continue to tag all observed individuals of the species using brass plates and record for subsequent identification and cross-reference with seed collections. Record the GPS coordinates and map the locations of each individual clump in each subpopulation so that they can be found when the species is not in flower.
- During monitoring, continue to collect seed from all clumps (noting the identification number of the tagged clump from which seed has been extracted) in each subpopulation for the purpose of ex situ propagation and cultivation.
- Conduct systematic and comprehensive surveys of all potential habitat, with the permission and potential assistance of relevant landholders, to locate any new or unconfirmed subpopulations of the species.

**Information and research priorities**

- In order to identify sites for further surveys for the Green Hill thomasia 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 this data is 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 movement patterns of pollinator species; soil seed bank dynamics; recruitment and resprouting of rootstocks; and the population genetic structure and levels of genetic diversity in order to more precisely assess the species' actual population size and minimum viable population size.
- Undertake seed germination and/or vegetative propagation trials to determine the requirements for successful establishment. Where appropriate, conduct trials soil-stored will be near existing subpopulations in disturbed areas immediately following weed removal.
- In order to develop a fire management strategy for the species, research the species' longevity, seed bank longevity and its fire ecology. Study the species' response to a range of fire regimes, including prevailing fire frequencies and intensities, and identify the optimal fire regime for the species' regeneration, both through vegetative regrowth and seed germination. Where appropriate, apply scientific understanding of fire responses among *Thomasia* species, or functionally similar species.
- 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).

## References cited in the advice


CALM (Department of Conservation and Land Management) (1999) Interim Recovery Plan number 26, 1999-2002. *Thomasia* sp. Green Hill. Department of Conservation and Land Management, Western Australia. Available on the Internet at: https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/recovery_plans/Approved_interim_recovery_plans_/tho_gre_irp132update.pdf.

DEC (Department of Environment and Conservation) (2011) Rare Flora file - CALM 1998F000879, Department of Environment and Conservation, Kensington.

McRae BH, Dickson BG, Keitt TH., & Shah VB (2008) Using circuit theory to model connectivity in ecology and conservation. *Ecology* 10, 2712-2724.

Phillips SJ, Anderson RP & Schapire RE (2006) Maximum entropy modeling of species geographic distributions. *Ecological Modelling.* 190 (3-4) 231-259.

Vallee L, Hogbin T, Monks L, Makinson B, Matthes M & Rossetto M (2004) *Guidelines for the Translocation of Threatened Plants in Australia* (2nd Edition). Australian Network for Plant Conservation Inc., Canberra.