The Minister's delegate approved this Conservation Advice on 16/12/2016.

Conservation Advice

Xanthorrhoea arenaria

sand grasstree

&

Xanthorrhoea bracteata

shiny grasstree

Introduction

There are three currently recognised species of grasstree in Tasmania, *Xanthorrhoea arenaria* (sand grasstree), *X*. *bracteata* (shiny grasstree) and *X. australis* (southern grasstree). *Xanthorrhoea arenaria* and *X*. *bracteata* are listed as threatened species under the *Environment Protection and Biodiversity Conservation Act* 1999 (Cwlth) (EPBC Act). The southern grasstree, hereafter referred to in this advice by its scientific name, *Xanthorrhoea australis*, is a common species that is widely distributed in southern mainland Australia and Tasmania and is not listed as threatened under the EPBC Act. Subpopulations of *Xanthorrhoea australis* are known to co-occur with subpopulations of the sand grasstree and with subpopulations of the shiny grasstree (ALA 2016; DPIW 2006). In some locations, all three of the Tasmanian grasstree species have been identified. Co-occurrence of two or more of the species can make it challenging to identify individual grasstrees or distinguish the species from each other in the field as grasstrees may exhibit a number of intermediate or combined characteristics of those species present (DPIW 2006).

Conservation Statuses

Xanthorrhoea arenaria

Xanthorrhoea arenaria, the sand grasstree, is listed as Vulnerable under the EPBC Act effective from 16 July 2000. The species is eligible for listing under the EPBC Act as on 16 July 2000 it was listed as Vulnerable under Schedule 1 of the preceding *Endangered Species Protection Act 1992* (Cwlth). The main factors that make the sand grasstree eligible for listing in the Vulnerable category are its limited geographic range and expected continuing decline as a result of ongoing threats.

Xanthorrhoea bracteata

Xanthorrhoea bracteata, the shiny grasstree, is listed as Endangered under the EPBC Act effective from 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 main factors that make the shiny grasstree eligible for listing in the Endangered category are that it has a highly fragmented geographic distribution and continuing decline is expected as a result of ongoing threats.

Species may also be listed as threatened under state and territory legislation. For information on the current listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

Descriptions of the species

Xanthorrhoea arenaria

The sand grasstree has greyish or bluish-green leaves that are 40 – 80 cm long, 2 – 3 mm wide and 1 – 2.5 mm thick (DPIW 2006). The scape (naked stem below the flower spike) is 20 - 60 cm long and 8 - 11 mm in diameter. Flowers are arranged in a spike that is greater than one-third but less than half the length of the flower stem. The fruit is a capsule. Seeds are round or oval and slightly flattened. This species does not have a trunk; the stem and caudex (root) is branched below the ground, and crowns (tufts) arise directly from the ground. It can regenerate from its underground rootstock following disturbance (DPIW 2006).

Xanthorrhoea bracteata

The shiny grasstree is a perennial shrub with leaves 40 - 110 cm long, and 1.5 - 3 mm wide. The flowers are small and white, about 3 mm wide and are organised in tight clusters that are surrounded by brown bracts (leaf-like structures) and floral leaves (leaves that look like petals). The inflorescence (arrangement of flowers) is known as a spike and is usually less than a third the length of the scape (bare stem below the flower head). The fruit is a capsule and the seeds are round or oval and slightly flattened (DPIW 2006).

The challenge in distinguishing the three Tasmanian grasstree species, particularly the shiny grasstree and the sand grasstree, originates from the large degree of morphological variation inherent within each of these species and the considerable overlap of morphological characteristics between them. Unlike *Xanthorrhoea australis*, both the shiny grasstree and the sand grasstree form multiple crowns and lack a single trunk. It is necessary to measure the flower spikes to properly distinguish the shiny grasstree from the sand grasstree (DPIW 2006). Table 1 below outlines the primary distinguishing morphological characteristics and other key attributes of the Tasmanian grasstree species.

Table 1 – Key characteristics of the Tasmanian grasstree species (DPIW 2006).

	Xanthorrhoea bracteata	***Xanthorrhoea arenaria***	***Xanthorrhoea australis***
Trunk	No	No	Trunk to 3 m tall
Crown	Multiple	Multiple	Predominantly single
Inflorescence (flower spike)	Usually less than 1/3 of scape length	> 1/3 but < 1/2 of scape length	2 to 6 times as long as the scape
Leaves	40 – 110 cm long	40-80 cm long	>100 cm long
Scape	Very thin (4 to 9 mm diameter)	Thin to thick (8 to 11 mm diameter)	Thick (18 to 40 mm diameter)
Packing bracts (small bracts situated between the flowers)	Triangular to narrowly triangular and hairless	Tapering to a point – awl-shaped and hairless	Elongated, tapering to a point – awl-shaped and hairless
Sepals (leaf-like structures comprising the outermost part of a flower)	Triangular, beaked (with a tuft of hairs projecting from the tip), without a proboscis (small hairy projection on the upper surface of the beak) and hairless	Triangular to narrowly triangular with very long beak, hairless and with proboscis	Triangular to narrowly triangular with very long beak, hairless and with proboscis

	Xanthorrhoea bracteata	***Xanthorrhoea arenaria***	***Xanthorrhoea australis***
Petals	Bent or curved backward, often without proboscis, hairless except for those at the tips	Erect to slightly recurved with proboscis, hairless except for those at the tips and on proboscis	Erect to slightly recurved with proboscis, hairless except for those at the tips
Habitat	Sandy soils often acid and waterlogged, coastal areas	Sandy heaths	Sandy soils
Tasmanian distribution	Between Asbestos Range and Waterhouse Point in the northeast	Bridport to Coles Bay (northeast to east coast)	Widespread
Flowering time	January to February	June to January	July to December

The challenge in distinguishing Tasmanian grasstree species may be compounded at locations where the plants are all immature and lack a fully developed flower spike or distinguishable floral features, or where the formation of trunks by southern grasstrees is prevented by slashing (DPIW 2006) or browsing by cattle (*Bos taurus*) (Gilfedder pers. comm. 2016). The challenge is compounded by the irregularity in flowering from year to year (DPIW 2006). In addition, while there have been no reports of hybridisation between the sand grasstree and the shiny grasstree (Flora of Australia 1986; North Barker Ecosystem Services 2004 cited in DPIW 2006), reputed hybridisation and introgression between *Xanthorrhoea australis* and the two threatened grasstree species may further complicate species identification where those species may co-occur (DPIW 2006).

Distribution

The sand grasstree and the shiny grasstree are endemic to Tasmania and their distributions overlap (refer to *Species of National Environmental Significance* 10 km gridded maps at: https://www.environment.gov.au/science/erin/databases-maps/snes).

In 2006, there were an estimated 35 subpopulations of grasstrees throughout the north and north-east of Tasmania (DPIW 2006). Over half the number of sites containing sand grasstree and/or shiny grasstree subpopulations occur on private land (DPIW 2006; Schahinger pers. comm. 2016). It is likely that more subpopulations will be discovered on private land over time (Schahinger pers. comm. 2016).

The challenge of identifying individual grasstrees at species level in the field makes it difficult to estimate the species' extent of occurrence, area of occupancy and subpopulation sizes (Bedford 1986; Schahinger et al., 2003, Schahinger pers. comm. 2016). The total size of the populations of the sand grasstree and the shiny grasstree are estimated to be in the thousands but taxonomic verification is required in order to determine subpopulation and geographic estimates for the three species (DPIW 2006; Schahinger pers. comm. 2016). Therefore, until the taxonomy of the Tasmanian grasstree species is resolved, and a field identification system comprising protocols for dealing with hybridisation and species continuums is developed, identifying groups of grasstrees by locality rather than by species is considered more appropriate (DPIW 2006).

Xanthorrhoea arenaria

The sand grasstree occurs in low-lying sandy areas (Bedford 1986) or in sandy heaths (Barker & Johnson 1998; Curtis & Morris 1994) from Narawntapu on the north coast to Coles Bay on the east coast. Most sites occur in the Northern Natural Resource Management region. In 2006, 13 key sand grasstree subpopulations were recognised (DPIW 2006). Several significant subpopulations containing both *Xanthorrhoea australis* and the sand grasstree and potential

hybrids between the two species have since been discovered, including Great Northern Plain, Musselroe, and the Australian Government's Stony Head Military Training Area on Tasmania's northern coast (North Barker Ecosystem Services 2014; Schahinger, pers. comm. 2016).

Xanthorrhoea bracteata

The shiny grasstree occurs within 20 km of the Tasmanian northern and far north-eastern coasts between Narawntapu National Park in the central north coast and Mount William National Park near Musselroe Bay in the north-east of the state. The most significant areas where the species is known to occur are the Narawntapu National Park to George Town region, Stony Head Military Training Area to the Little Pipers River area, the Bridport region, Waterhouse Conservation Area and Cameron Regional Reserve (DPIW 2006).

The shiny grasstree occurs in coastal heathland and coastal *Eucalyptus amygdalina* (black peppermint) - *Allocasuarina littoralis* (black sheoak) forest on sandy soils that are often acidic and waterlogged (DPIW 2006). The shiny grasstree tends to co-occur with the two other Tasmanian grasstree species where there is a gradation in environmental factors such as slope, soils or drainage (DPIW 2006).

Of the six public reserves containing shiny grasstree subpopulations only Mt William National Park is managed primarily for its nature conservation values (DPIW 2006). In 2011, approximately three years after a wildfire burned through an area near the Little Pipers River, a large shiny grasstree subpopulation was discovered on forestry land classed as 'Permanent Timber Production Zone Land' under the *Forest Management Act 2013* (Tasmania) (Rudman pers. obs. 2011 cited by Schahinger pers. comm. 2016). Two relatively small shiny grasstree subpopulations occurring on private land are now managed under conservation covenants, with associated Nature Conservation Plans, in accordance with the *Tasmanian Nature Conservation Act 2002*: one subpopulation near Bellingham consisting of approximately 400 plants, the site essentially being part of the abovementioned Little Pipers River subpopulation; and the other near Greens Beach Road, West Tamar (Rudman pers. comm. 2016).

Relevant Biology/Ecology

The biology and ecology of the three Tasmanian grasstree species is essentially the same, except for the noted differences in the environmental characteristics of habitats in which each species occurs and the differences in their flowering periods, as indicated in Table 1 (DPIW 2006).

Whether a mature individual of a species flowers in a given year is unpredictable (DPIW 2006). Flowering and foliage production in Tasmanian grasstrees increases dramatically after fire (DPIW 2006). This may occur in response to changes in light, competition, temperature, levels of nutrients or other chemical compounds, including smoke (DPIW 2006). It has been suggested that increased flowering tends to be related to the removal of foliage, which motivates the plant to reproduce. Insect attack and other disturbance can also cause individuals to flower (DPIW 2006).

The leaf bases of grasstrees exude a strong smelling-resin that is attractive to insects. This suggests that insects, particularly ants, wasps, bees and beetles, are likely to be the primary pollinators of these grasstree species. Several species of vertebrate, such as honeyeaters, wattle birds and small mammals, also visit grasstree flower spikes to feed on the nectar they produce, and may contribute to pollination (DPIW 2006).

Recruitment is from seed, particularly following fire or soil disturbance, and is known to occur approximately 6 - 12 months after fire (DPIW 2006). The structure of subpopulations indicate that recruitment is linked to such episodic disturbance events. Large numbers of seed are produced (two seeds per capsule on the flower spike) but appear to be viable for only a short period. Seeds germinate easily under the right conditions (as mentioned above) but these may not always be present (DPIW 2006).

Young seedlings are drawn into the ground by contractile roots, possibly to protect the vulnerable apex of the sprouting stem (DPIW 2006). Seedlings are extremely slow-growing and take 2 - 3 years to reach a stage suitable for planting. Conversely, the flower spike of mature plants grows extremely fast. The longevity of the Tasmanian grasstree species is unknown, however individuals can live for up to 300 years (DPIW 2006).

Grasstree species can regenerate from an underground rootstock following disturbance (DPIW 2006). Mature or established grasstrees are able to resprout after severe injury. *Xanthorrhoea australis* can resprout after having the growing tops of their trunks cut off (DPIW 2006) or having been browsed by cattle (Gilfedder pers. comm. 2016). However, it is noted that the sand grasstree and shiny grasstree may not survive such damage (DPIW 2006).

Given that the shiny grasstree is listed as Endangered, any habitat where subpopulations of the species are known to occur is considered 'habitat critical to the survival of the species'. Similarly, all subpopulations of the species are considered to be 'important populations' that are necessary for the species' survival and recovery.

Threats

The known, suspected and potential threats to the sand grasstree and the shiny grasstree are identical. A major limiting factor for the assessment of relative threats and appropriate management actions for these species is the uncertain taxonomic status of the genus *Xanthorrhoea* in Tasmania and the difficulty associated with distinguishing the species in the field. Table 2 outlines the known, suspected and potential threats to the two EPBC Act-listed threatened grasstree species.

Infection and dieback caused by the root-rot fungus, *Phytophthora cinnamomi*, is the single known threat to the survival of these species. Recreational vehicle use, trampling and browsing by livestock and illegal wood collection causing the loss, fragmentation or degradation of habitat are suspected threats. Potential threats are residential development and mining activity (which may directly or indirectly result in habitat loss, fragmentation or degradation) and too frequent or infrequent fires.

Table 2 – Threats impacting the sand grasstree and shiny grasstree in approximate order of severity of risk, based on available evidence.

Threat factor	**Threat type and status**	**Evidence base**
Pathogens		
Dieback caused by *Phytophthora* root-rot	known current	The three Tasmanian grasstree species are highly susceptible to infection with *Phytophthora* root-rot fungus (Forest Practices Authority 2012). The disease is prevalent in much of the species' habitat (DPIW 2006). Factors that may disperse the disease and increase the risk of infection include wet environments, particularly low lying topography, recreational off-road vehicle use and close proximity to vehicle tracks and roads, inappropriate road maintenance practices, infected gravel sources, bushwalkers and illegal wood-harvesting activities.

Threat factor	Threat type and status	Evidence base
Habitat loss, fragmentation or degradation		
Recreational vehicle use	suspected current	The use of recreational vehicles, such as four-wheeled drives (4WDs) and trail bikes, is a popular activity in north-eastern Tasmania. While the Tasmanian grasstree species are known to resprout following severe physical damage, the use of recreational vehicles has the potential to damage the species' habitat adjacent to vehicular tracks. Vehicles are also known to carry and disperse seeds of invasive weeds and plant pathogens, most notably the spores of *Phytophthora* root-rot fungus. Damage to grasstrees is likely to increase the risk of fungal infection (DPIW 2006).
Use of land for livestock grazing	suspected current	Subpopulations on private agricultural land are potentially threatened by trampling and browsing by cattle, though the species' susceptibilities to herbivory are unknown (DPIW 2006). Vegetation clearance as a result of conversion of land for agriculture is also a potential threat to these species (DPIW 2006).
Illegal collection of ornamental plant material	suspected current	Illegal harvesting of foliage or whole individuals of these species for sale to the florist and nursery industries may occur (DPIW 2006).
Illegal firewood collection	suspected current	Illegal firewood harvesting targets forest communities, such as *Eucalyptus amygdalina* (black peppermint) forests, which may result in the loss, fragmentation or degradation of the habitat of both species (DPIW 2006).
Residential development	potential current	Many of the known subpopulations occur on private land and are potentially threatened by land clearance and degradation residential development and associated (DPIW 2006).
Mining development and associated activities	potential current	In 2006, mining activities were occurring in some areas within the distribution of the species, and may be undertaken on private lands and in certain types of reserves (DPIW 2006). The species are, therefore, potentially threatened by land clearing and the indirect effect of vegetation disturbance in relation to mining and associated infrastructural projects.
Fire		
Too frequent fire	potential current	Although grasstrees require fire to induce flowering, subpopulations of the sand grasstree or shiny grasstree are potentially threatened by fires occurring too frequently for successive generations to mature and set seed before being destroyed in the succeeding fire. Too frequent and intense fires, thereby, limit recruitment in affected subpopulations (DPIW 2006).

Conservation Actions

Conservation and Management priorities

Dieback caused by *Phytophthora* root-rot disease

- Apply the appropriate principles and management actions outlined in the following guidance documents to minimise the introduction and spread of *Phytophthora* root-rot disease in locations where the sand grasstree and the shiny grasstree occur:
  - Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (Department of the Environment 2014);
  - Interim Guidelines for the Management of *P. cinnamomi* in Tasmania (Rudman 2004), which provides advice for whether an area should be managed for *Phytophthora* root-rot disease*;*
  - Strategic Regional Plan for the Conservation of Tasmanian Plant Species and Communities Threatened by *P. cinnamomi* (Schahinger et al. 2003), which provides management prescriptions against the spread of *Phytophthora* root-rot fungus at threatened Tasmanian grasstree sites including Badger Hill, Little Boobyalla, Musselroe Bay, Mt William and the Waterhouse Conservation Area;
  - Forest Practices Authority (2012) guidelines on management of *Phytophthora* root-rot in production forest;
  - *Phytophthora cinnamomi* Management Plan for the Stony Head Military Training Area (Delta FM Pty Ltd 2014), which includes measures to prevent dispersal of the pathogen at that site;
- Develop and implement management prescriptions that cater specifically to each grasstree subpopulation, including co-occurring subpopulations of the other Tasmanian grasstree species. These should include recommendations for affected sites and preventative measures for subpopulations that are either free or minimally infected by the root-rot fungus (DPIW 2006); and
- Outline actions to limit the spread of *Phytophthora* root-rot fungus in Nature Conservation Plans for subpopulations that are protected on private land under a conservation covenant.
- Incorporate relevant actions from these site-specific plans into existing, broader plans and guidelines (DPIW 2006), such as national park management plans.
- Consider applying the treatments outlined in Dunstan et al. (2010), to contain and/or eradicate infestations in areas supporting relatively small grasstree subpopulations. Any such proposals for the eradication of root-rot disease should involve careful assessment of the size of the infected area (if too large, the treatments are unlikely to be effective) and the potential for re-incursion (Rudman pers. comm. 2016).
- Incorporate all relevant *Phytophthora* disease control measures into fire management and vehicle access plans for each priority grasstree site, to ensure that appropriate measures are taken to avoid the spread of *Phytophthora* root-rot (for example, when dealing with equipment and machinery).
- Where appropriate, install and maintain signage to inform bushwalkers and recreational off-road vehicle users of the location of local subpopulations of the

species and advertise the *'check, clean, disinfect, dry'* message for preventing the spread of disease in Tasmania's wilderness (NRM South 2010, 2012).

Habitat loss, fragmentation or degradation

- Protect areas of known occurrence and potential habitat from clearing and inappropriate disturbance. In accordance with relevant Commonwealth, state and local government environmental legislation, assess all activities that may result in the direct or indirect removal, fragmentation or degradation of grasstree subpopulations or their habitats.
- Consider registering information about the species' presence on relevant land titles, through mechanisms such as conservation covenants on privately owned land or the creation of private reserves, to help prevent the inadvertent destruction of subpopulations with change of ownership.
- Investigate mechanisms for maintaining beneficial land management practices on private land where grasstree subpopulations are healthy; for example, incentives and voluntary management agreements with the Tasmanian Government.
- Establish and maintain fenced buffer zones around subpopulations of the species, where necessary, to protect of the species.
- Install and maintain signage indicating occurrences of subpopulations of the species (including buffer zones) and the importance of avoiding damage to those subpopulations and their habitats.
- Continue to regulate the collection or disturbance of plant material from threatened species or from vegetation on land reserved under provisions of Tasmanian state legislation.

Fire

- Avoid successive fire intervals that are shorter than the period required to maintain recovery capacity of resprouting individuals.
- Use the information gathered during fire trials (see Information and Research Priorities section below) to design an appropriate fire management program for this species. These requirements may vary across subpopulations; for example, those in coastal heath compared to forest communities.
- Within the Stony Head Military Training Area, apply the guidelines for threatened flora management outlined in the Bushfire Management Plan (GHD 2014).

Stakeholder Engagement

- Continue to notify and maintain awareness of all relevant landholders/managers, local governments, recreational users and local conservation groups about the location of subpopulations of the species, relevant threats, the species' recovery and management requirements, and the responsibilities of land users under Tasmanian and Commonwealth environmental legislation.
- Landowners and managers should particularly be made aware of the threat of *Phytophthora* root-rot and methods for reducing the risk of infection (e.g. see brochures and guidelines prepared by the Forest Practices Authority (2012) and NRM South (2010, 2012).

- Information could also be provided to private landholders about options for conserving threatened species on their land, such as conservation covenants, Land for Wildlife and monitoring/stewardship assistance for covenanted lands, which are part of the Tasmanian government's Private Land Conservation Program (DPIPWE 2016).
- Identify opportunities for, and promote and support, the involvement of community groups and volunteers in recovery activities for the species.
- Continue to educate consumers about the need to avoid purchasing cultivated plants of the species from unlicensed suppliers who may support unlawful collection of vegetative propagation material from wild populations of the species.
- Continue to update available information about the species, including information about its appearance, habitat, threats, recovery actions and the importance of locating, monitoring and protecting populations over the long-term.
- Liaison is required between relevant authorities and private landholders to ensure that any future mining activities are not detrimental to the species (DPIW 2006).

Survey and monitoring priorities

- Continue to conduct systematic and comprehensive surveys of all potential sand grasstree and shiny grasstree habitat to locate any new or unconfirmed subpopulations.
- Assess the species' population size and distribution by undertaking surveys, during the species' flowering period, where possible, and collect data including: the number of individuals; evidence of recruitment; any 'unusual' plants or subpopulations; flower and vegetative characteristics; area of occupancy; and relevant site features (e.g. topography, soil features and ecological community condition).
- Continue to monitor recruitment rates and response(s) of subpopulations to fire, other disturbances and relevant threats, such as *Phytophthora* root-rot disease, agriculture, recreational vehicle use, vegetation clearance, gazing and mining, to inform management of the relevant threats at each site.
- Monitor the progress of recovery at sites where management actions are implemented, including the effectiveness of those actions and the need to adapt them if necessary.
- Continue to survey the extent, spread and impact of *Phytophthora* root-rot within and nearby known grasstree subpopulations, and in suitable habitat for the species.
- Determine whether fire may be an effective tool for managing *Phytophthora* root-rot disease in subpopulations of the species by monitoring regeneration in infected recently burnt grasstree subpopulations.
- Support and enhance existing survey and monitoring prescriptions outlined in management plans for abatement of *Phytophthora* root-rot in Tasmania, including Rudman (2004), Schahinger et al. (2003) and DoE (2014).

Information and research priorities

- Investigate the morphologies of the sand grasstree and the shiny grasstree in order to fill information gaps and better understand the distinguishing characteristics of this species, given their similarity to *Xanthorrhoea australis*. Research is particularly required on the morphologies of the three species' foliar characteristics. While the floral characteristics of these species are well-defined, floral material is not available in some seasons (DPIW 2006).

- Reassess the taxonomy of the genus, *Xanthorrhoea*, and develop a useable field identification system and protocols for dealing with hybridisation and species continuums based on the findings of the reassessment (DPIW 2006).
- Collect specimens from the 'unusual' grasstree subpopulations at Sisters Beach and Arthur River in the north-west of the state, submit to the relevant herbaria and incorporate into a taxonomic review of the genus in Tasmania (DPIW 2006).
- Continue to undertake and/or support research into the extent and impacts of *Phytophthora* root-rot disease on grasstree subpopulations.
- Determine the viability of using phosphonate – a chemical treatment that increases resistance to *Phytophthora* root-rot attack in treated plants – in grasstree subpopulations that are experiencing decline as a result of *Phytophthora* root-rot infection. The use of this chemical as a management tool involves a testing program to determine the right level and method of application and the monitoring of any adverse effects (DPIW 2006).
- Investigate the possibility of using fire as a management tool for Phytophthora root-rot infected grasstree subpopulations.
- Undertake research into the fire ecology of the sand grasstree and the shiny grasstree to determine the optimal fire regime (fire frequency and intensity) for the species. Fire frequency and intensity needs to be such that plants can sufficiently develop to survive the burn, or reproduce to ensure that recruitment can occur (DPIW 2006).

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