

# 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 16/12/2016.

## Conservation Advice

### *Eucalyptus morrisbyi*

Morrisby's gum

#### Conservation Status

*Eucalyptus morrisbyi* (Morrisby's gum) 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).

Species can 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>.

The main factors that are the cause of the species being eligible for listing in the Endangered category are its very restricted distribution associated with a historic decline of more than 50 percent (TSS 2006), few remaining populations and an imbalance of mature individuals (at least 95 percent in one population and low connectivity). Poor recruitment has been attributed to a combination of threats including high frequency of arson events/lack of appropriately timed disturbance events, drought stress, grazing pressures, agricultural and other human activities including the maintenance of roadside vegetation.

In light of findings by Jones et. al. (2016), particularly around the sharp decline in health of the Calverts Hill population, the species is considered to be undergoing very severe reduction with a high probability of extinction in the near future and should be considered for uplisting as Critically Endangered under the EPBC Act. (Gilfedder pers. comm. 2016).

#### Description

Morrisby's gum is a small tree or mallee that grows to between 6 – 12 m, generally with a stocking of rough bark at the base of the trunk, the upper trunk and branches have smooth bark that is brown, white-grey or pink-grey in colour (TSS 2006). Morrisby's gum is "heteroblastic", meaning younger (juvenile) trees have markedly different structures to adult trees. As a juvenile, Morrisby's gum has bluish-green leaves are covered with a whitish, waxy (or "glaucous"), unstalked and rounded, 2 to 3 cm long and 2 to 4 cm wide, arranged in opposite pairs (TSS 2006). As an adult, Morrisby's gum's leaves are stalked, less waxy, and arranged alternately (TSS 2006).

Morrisby gum's flowers are 5 to 10 cm long and 1.5 to 4 cm wide, short-stalked and white/waxy in appearance. Its flower buds have a pointed flower cap (or "operculum") (TSS 2006). They arise in clusters of three from the points at which the leaves connect to a branch (the "leaf axil"). The woody capsules are cylindrical and glaucous, measuring from 9 to 11 mm long, and 6 mm wide (TSS 2006).

#### Distribution

Morrisby's gum is restricted to two populations on the eastern shore of the River Derwent near Hobart in south-eastern Tasmania (the South Eastern Bioregion and the Southern NRM Region). In 2006 the largest population, (Calverts Hill near Cremorne) included two small remnant stands nearby at Lumeah Point and along Honeywood Drive. A further population in the Government Hills near Risdon (referred to as the Risdon Hills population), exists approximately 20 km away in the Meehan Range (TSS 2006).

In 2006 the total number of mature individuals was approximately 2 000, at least 1 900 of these at Calverts Hill, which was the only population observed to have produced seedlings (TSS 2006). Aerial surveys by Threatened Plants Tasmania (TPT) in April 2016 revealed a drastic reduction in these numbers, with only 4 or 5 live mature individuals present at Calvert's Hill and 300 suppressed juveniles (Gilfedder pers. comm. 2016). TPT surveys of Risdon Hill in the same year found no mature individuals and around 200 juvenile coppice shoots. This decline is estimated to have occurred over five years from 2011 – 2016 (Gilfedder pers. comm. 2016).

Four ex situ representative conservation plantings were planted in 1990 and 1999 in state forest at Geeveston and Meunna, and on private land at Lutana and Boyer respectively (TSS 2006). In 2009, it was found that 94 percent of the original seedlings planted had survived on the Boyer site (Harris Shaw and Crane 2009). The Lutana orchard has been noted as a dry site with poor survival, although the population is protected from hybridisation risk owing to the absence of other proximate Eucalypt species (Jones et. al., 2016). The Geeveston orchard was noted to have a higher survival rate but faced the risk of hybridisation and heavy browsing by *Trichosurus vulpecula* (brush-tail possum) (Jones et. al., 2016).

### Relevant Biology/Ecology

The two primary populations of Morrisby's gum are found in moister aspects on infertile soils on the low rainfall eastern shore of the River Derwent. The Risdon Hill population occurs on Permian mudstones, and exists as part of a community which includes understorey species such as *Acacia dealbata* (silver wattle), *Acacia melanoxylon* (blackwood) and *Acacia verticillata* (prickly moses). The Calverts Hill population occurs on Jurassic dolerite and the nearby remnants on Quaternary sands. It is likely that these two main populations represent remnants of a previously wider distribution along what is now the bed of the River Derwent during times of lowered sea levels (Wiltshire et al., 1991).

Morrisby's gum flowers from February to May and is pollinated by insects and birds (TSS 2006). Recruitment is from primarily from canopy held seed that is released after fire or other disturbance (TSS 2006). As in most eucalypts, seed dispersal is limited, few seedlings being found beyond twice the canopy height of a parent. Trees can also resprout from lignotubers and epicormic buds following fire or other damage (TSS 2006).

At Risdon Hill, stems sampled from over three metres apart have been found to belong to the same individual, demonstrating that the population consists of fewer individuals (genotypes) than indicated by stem counts (TSS 2006). The largest clonal patch sampled was estimated to be over 1,000 years old (Jones et al., 2004). Seedlings of Morrisby's gum take approximately 10 years to produce flowers, a relatively long time for eucalypts.

Genetic studies have revealed high molecular genetic variability within populations (Jones et. al, 2005). Both populations are also genetically distant from each other, with connectivity between them (via pollen transfer) determined to be unlikely (TSS 2006). Studies of the ex situ plantings of Morrisby's gum revealed genetic-based variation that impacted on the extent to which they were browsed by *Trichosurus vulpecula* (brush-tail possum), with the Calverts Hill population being the most susceptible, causing poor growth and delayed ontogenetic transition to the adult foliage. The Risdon Hill population shows the most resistance (Mann et. al., 2012). This genetic-based resistance was found to be related to key physicochemical traits differing between the populations (Mann et. al., 2012).

A study of foliage damage by Gosney et. al., (2014) reveal a likely set of dependent arthropod and fungal species associated with Morrisby's gum (in addition to *T. vulpecula*) that includes *Paropsisterna* spp. (leaf beetle), *Gonipterus scutellatus* (eucalyptus weevil) larvae, *Pachysacca samuelii* (a fungus), *Teratosphaeria* (a fungus), *Hymenoptera* spp. (Ants, bees and wasps), *Acrocercops laciniella* (blackbutt leafminer), *Ctenarytaina eucalypti* (blue gum psyllid), *Hyalinaspis* spp. (clam lerp insects).

It was further evinced that the dependent arthropod and fungal species associated with Morrisby's gum differed in composition and population sizes between the two populations

(Gosney et. al., 2014). Foliage at Risdon Hill demonstrated the largest array of symptoms (thus is likely to have a greater diversity of species); foliage at Calverts Hill demonstrated a greater extent of damage overall but fewer types of damage (suggesting a less diverse dependent community with higher population numbers) (Gosney et. al., 2014). The fungal pathogen *Teratosphaeria* and adult leaf beetle *Paropsisterna* spp. were found to account for the variation in community composition (Gosney et. al., 2014).

Morrisby's gum is known to hybridise with *Eucalyptus viminalis* (white gum) and naturally occurring hybrids have been recognised (TSS 2006).

### Threats

Morrisby's gum is drought sensitive; drying conditions may exacerbate other threat factors for this species including poor seed production, out-competition by other plant species, and/or ability to cope with stresses such as defoliation, browsing, grazing or other damage by native and introduced species. In 2006, it was suggested that the severity of drought stress at Risdon Hill would likely render the population extinct in the near future (TSS 2006). The observed 99.75% decline in mature individuals between 2006 – 2016 (Gilfedder pers. comm. 2016) appears to support this assessment. Fire-related damage also represents a potentially critical threat, eliminating juveniles before they can produce viable seed and further exacerbating competition with fire stimulated species.

Table 1 – Threats impacting Morrisby's gum in approximate order of severity of risk, based on available evidence.

Threat factor	Threat type and status	Evidence base
Climate & climate change		
Drought/drying conditions	known current/future	<p>There are indications that the range of Morrisby's gum has been contracting to wetter gullies since the last glaciation (TSS 2006). Drought stress in response to a series of drought events were observed in the populations in 2006, and indicate that Morrisby's gum is drought sensitive (TSS 2006). In fact, this sensitivity to drying conditions was cited as the cause of the severe decline of the health of the Risdon Hill population as observed in 2006 (TSS 2006).</p> <p>CSIRO's Climate Change in Australia: Southern Slopes Cluster Report (2015) predicts with very high confidence that the Southern Slopes region (which includes Tasmania) will see "continued increases in mean, daily maximum and daily minimum temperatures" and "a substantial increase in the temperature reached on the hottest days, the frequency of hot days and the duration of warm spells". It also predicts with medium confidence that "the frequency and duration of extreme droughts will increase."</p>

Fire		
Fire-related damage	known past/ suspected future	<p>The risk of fire in the vicinity of the Risdon Hills population was identified as high in 2006, due to frequent arson in the area (TSS 2006).</p> <p>The small Risdon population was identified as particularly at risk from fire given the poor health of the population, with few seeds being recorded in 2006 (TSS 2006).</p> <p>Although more recent indications are that fire has not occurred in the gully for at least the last decade (Gilfedder pers. comm. 2016), the poor condition of the populations, (most of which are juveniles), means that any fire event would have a significant negative impact.</p>
Habitat loss and fragmentation		
Clearing and development	known past/ future	<p>Past records indicate a decline of at least 50 percent in the area occupied by the species in the Cremorne area (Calverts Hill and nearby remnants) since European settlement. This decline has been largely due to clearing for agriculture and urban development (TSSC 2006).</p> <p>The stand along Honeywood Drive has been identified as at risk from road maintenance activities and future realignments of the road for access or safety concerns, despite protection as a priority site by the Department of Infrastructure, Energy and Resources (TSS 2006).</p>
Grazing/browsing by introduced species		
Rabbits and sheep	known past/future	<p>Seedling regeneration on what was, until the early 2000s, private land at Calverts Hill has been limited by sheep (<i>Ovis aries</i>) and possibly rabbit (<i>Oryctolagus cuniculus</i>) grazing (TSS 2006). Recruitment of seedlings had already been observed by 2006 following the removal of sheep from the site in 2000 (TSS 2006).</p>
Hybridisation		
<i>Eucalyptus viminalis</i>	known current	<p><i>Eucalyptus morrisbyi</i> is known to hybridise with white gum <i>Eucalyptus viminalis</i> and naturally occurring hybrids have been recognised (TSS 2006).</p> <p>Some mature trees from the Lumeah Point stand appear to be naturally occurring hybrids with <i>Eucalyptus viminalis</i>. Due to pollen swamping, the risk of hybrids occurring is proportionally more likely in such small populations (TSS 2006).</p>
Competition		
Native plants	known current	<p>The Risdon Hill population is in poor health due to a range of other threat factors, which in turn has reduced its ability to compete successfully with other flora (TSS 2006). The previous Recovery Plan (2006) indicated that the Risdon Hill</p>

		<p>population had twice required removal of native competitors in order to ensure its survival.</p> <p>The first such instance was in the in the late 1970s, when the population was threatened by <i>Cassytha pubescens</i> (downy dodder-laurel), a native parasitic vine that is often abundant following fire, which needed to be removed (TSS 2006).</p> <p>In October 2001 the understorey of silver wattle <i>Acacia dealbata</i>, blackwood <i>Acacia melanoxylon</i> and prickly moses <i>Acacia verticillata</i> at the Risdon Hill population was thinned in order to further reduce competition stress on the trees.</p> <p>Removal of wattles was predicted to be an ongoing requirement while other threats on Morrisby's gum reduce its ability to compete with other plant species (TSS 2006).</p>
Grazing/browsing and defoliation by natives		
Native insects	known current	<p>Under stress, the species is susceptible to defoliation through insect damage and this can reduce flowering in subsequent years, resulting in reduced recruitment potential with less seed held in the canopy (TSS 2006).</p> <p><i>Teratosphaeria</i> spp. and <i>Paropsisterna</i> spp. have been well studied in the other <i>Eucalyptus</i> species, with the presence of these organisms having a deleterious effect on plant growth (Gosney et. al., 2014).</p> <p><i>Mnesampela privata</i> (the autumn gum moth) is suspected to be a major cause of Morrisby's gum defoliation (TSS 2006).</p>
<i>Trichosurus vulpecula</i> (brushtail possum)	known current	<p>Browsing has been found to lead to poor growth and delayed ontogenetic transition to adult foliage in Morrisby's gum (Mann et. al., 2012). This has been noted in particular at the Calverts Hill population (Mann et. al., 2012), which are preferentially browsed by <i>T. vulpecula</i> (TSS 2006).</p>

## **Conservation Actions**

### **Conservation and Management priorities**

#### Climate & climate change

- Manual clearing of the undergrowth to reduce competition for soil moisture.
- Irrigation and/or watering systems/water tanks installed in areas where there is evidence of drought stress. This is particularly important for the *Lutana* ex situ planting.
- Translocation planting in wetter gullies.
- The Intergovernmental Panel on Climate Change (IPCC)'s fifth assessment report concludes that 'the human influence on the climate system is clear and is evident from the increasing greenhouse gas concentrations in the atmosphere', such that 'virtually all published papers accept the scientific basis of human-induced climate change (United Nations 2016). Given that a warming, drying climate scenario represents a key threat for this species, it follows that action supporting the mitigation of the human influence

on the warming climate system must therefore be a key conservation action. In light of this, conservationists should advocate continued strong commitments to emissions reduction and offset activities in Australia, which, if implemented, would contribute to the continued survival of the Morrisby's gum by mitigating the advance of warming, drying conditions and its impact on suitable habitat for the species.

#### Fire

- Fires must be managed to ensure that prevailing fire activity, including non-prescribed fire and arson, do not disrupt the life cycle of Morrisby's gum. Fire management should ensure that any use of fire in the habitat supports rather than degrades the habitat necessary to the threatened species, that it does not promote invasion of exotic species, and that fire events do not increase impacts of grazing/predation.
- Avoid use of managed fire research and other activities that impact upon the persistence of the population unless there is evidence to show the impact would be a positive and enduring effect on the species persistence. Ensure that fires do not occur within populations before seedlings have grown to a sufficient size to avoid damage or there is adequate seed held in the canopy.
- Physical damage to the habitat and individuals of the threatened species must be avoided during and after fire operations.
- Fire management authorities and land management agencies should use suitable maps and install field markers to avoid damage to the threatened species.
- Employ fuel load reduction in adjacent paddocks and at strategic locations nearby to reduce the potential adverse impacts of wildfire on the population. Ensure that where fire is used for fuel reduction, these events are well planned and implemented, are of low intensity and do not constitute an increased risk (i.e. there is no likelihood of encroachment of fire into the habitat).
- Non-prescribed fire events (including arson) are known to originate west of the area of occupancy for this species. A firebreak should be maintained along the westerly boundary of the populations (TSS 2006).

#### Habitat loss disturbance and modifications

- Prevent any further clearing or disturbance of habitat for this species.
- Ensure that the relevant management authorities are aware of the existence of stands of Morrisby's gum near roadsides (such as the stand along Honeywood Drive), and that appropriate precautions are taken to prevent disturbance of populations, including disturbance of the habitat that may affect water supply by impacting stream flows, riparian environments or catchments.
- Ensure land managers are aware of the species' occurrence and provide protection measures against key and potential threats.

#### Grazing/browsing by introduced species

- Maintain limits on livestock grazing in the area to continue to facilitate recovery.
- Where evidence of rabbits has been found, consider the construction of barriers to prevent rabbits gaining access to the site as an immediate short-term measure, and implementing rabbit control methods to mitigate impact in the longer term.

## Hybridisation

- Remove hybrid seedlings from sites where hybridisation has occurred and replace where possible with seedlings germinated from seed collected from non-hybridised populations (the collection of seed from wild populations will require a permit issued under provisions of the Tasmanian *Threatened Species Protection Act 1995*).
- The replacement of planted hybrids in the Lumeah Point stand with non-hybrids should be considered.

## Competition

- Manual removal of competitor species can reduce competition for limited water resources, reduce the fuel load for fires, and provide openings for recruitment of seedlings (TSS 2006). It is particularly important for the Geeveston ex situ population, which was identified as likely to require the removal of wattles in the understory (TSS 2006).
- Note that caution should be exercised when engaging in manual removal of competitors, as many invasive species germinate in response to physical disturbance of soils.

## Grazing/browsing and defoliation by natives

- Grazing and browsing by native species should be understood as a threat only in the context of the cumulative impact of a range of other threats that have impacted on the resilience of the Morrisby's gum population (especially drought stress and contraction of suitable habitat). The impact of native insects and herbivores on the species should be closely monitored, with a view to implementing short-term controls on herbivory and defoliation by natives only where there is sufficient evidence to demonstrate that the absence of such controls would have a significant detrimental impact on the potential for Morrisby's gum to recover, or that the native species in question has reached unsustainable proportions due to trophic or other factors.
- As the impact of native browsing and defoliation is to reduce recruitment potential, the key conservation action to address this should be promotion of recruitment via — for example, use of seed propagated in ex situ populations.

## Breeding, propagation and other ex situ recovery action

- In light of Morrisby's gum's precipitate decline and its high risk of extinction in the near future, propagation and ex situ recovery action should be the highest priority action for this species in the immediate term.
- As both populations are highly genetically differentiated, collection of representative seeds from both populations is vital to maintaining the level of genetic diversity represented in this species.
- Stems from which seed is collected should be labelled and mapped so that the source of the seed can be identified, and so that seed collectors avoid collecting seed from the same plants, or from clonal stems arising from the same lignotuber. This will ensure ex situ plantings are representative of the genetic variation in the populations.
- Hybridisation of the ex situ populations should be carefully avoided.

## **Survey and Monitoring priorities**

- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary. This might include an annual assessment of the presence or absence of viable seed in each population, assessments of foliage health and soil moisture.
- More precisely assess ecological requirements (for example, drought tolerance thresholds) as well as the relative impacts of native and introduced species on defoliation.
- Undertake survey work in suitable habitat and potential habitat to locate any additional populations/occurrences/remnants, and to ascertain locations which may be more suitable for translocation should the habitat in existing populations become too dry to sustain the population effectively. Opportunities for flora surveys on private land include those undertaken as part of the covenanting process for the Private Land Conservation Program (PLCP) and surveys conducted as part of the development approval process (TSS 2006).
- Monitor the size and structure and reproductive status of populations, 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 threatened species.

## **Information and research priorities**

- Where appropriate, use understanding and research on fire responses among related (e.g. congeneric) or functionally similar species/ecological communities to develop fire management strategies for conservation.
- Identify optimal fire regimes for regeneration (vegetative regrowth and/or seed germination), and response to other prevailing fire regimes.
- Research the effects of public access where this is likely and the effects are unknown.
- Conduct ecological niche modelling to determine the ecological and environmental indices responsible for a species distribution, and how it may change due to the impending threats (particularly changes to soil moisture and climate). This would also assist in identifying suitable habitat if translocation is to be attempted. Such analysis would require a reasonably high number of presence records, plus the environmental variables located at this site and other sites chosen at random (Guisan et al., 2000).

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