Australian Government
Department of Agriculture, Water and the Environment

Conservation Advice for *Samadera sp. Moonee Creek* (Moonee Quassia)

In effect under the *Environment Protection and Biodiversity Conservation Act 1999* from 23 November 2021.

This document provides a foundation for conservation action and further planning.

Photo of Samadera sp. Moonee Creek (Moonee Quassia) from North Coast Regional Botanic Gardens © Copyright, Fagg, M (1990) (from Australian National Botanic Gardens).

Conservation status

Samadera sp. Moonee Creek (Moonee Quassia) is listed in the Endangered category of the threatened species list under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwth) (EPBC Act) effective from 16 July 2000. The species is eligible for listing because prior to the EPBC Act, it was listed as Endangered under the *Endangered Species Protection Act 1992* (Cwlth).

The main factors that make the species eligible for listing in the Endangered category are a restricted distribution and a limited number of individuals.

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 the Species Profile and Threat Database.

Species information

Taxonomy

Conventionally accepted as *Samadera* sp. Moonee Creek (J.King s.n. Nov. 1949).

Previously, *Samadera sp*. Moonee Creek (J.King s.n. Nov. 1949) was incorrectly identified as *S. bidwillii* (as *Quassia bidwillii*) (Harden 2002). *Quassia bidwillii* is endemic to Queensland.

Description

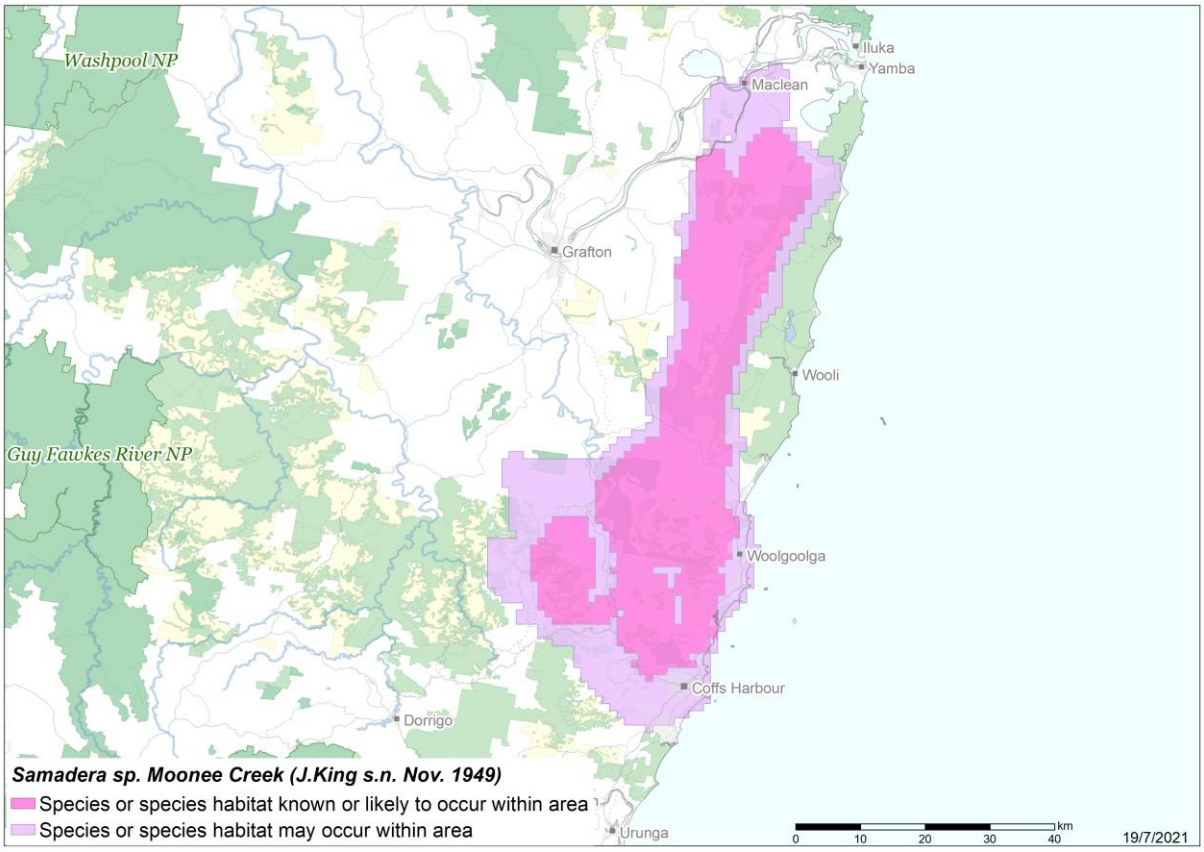
Moonee Quassia is a slender or bushy shrub growing to about 1.5 m tall. Its stems are often kinked, showing periodic halts to growth. It's tough leaves are very narrow, about 10 cm long, and arranged alternately along the stems. They are glossy dark green above and paler below, with numerous veins at a wide angle to the midrib. Flowers are small and green with a red tinge developing into distinctive finely hairy oval shaped fruits 5–10 mm long, made up of one to five radiating segments which are red when mature (NSW OEH 2011).

Distribution

The known subpopulations of Moonee Quassia are distributed within an 80 km zone from Grafton to Coffs Harbour in northern New South Wales (NSW). The Moonee Quassia occurs in two disjunct locations: north of Coffs Harbour, and east of Grafton at Macraes Knob (NSW OEH 2011). North of Coffs Harbour the subpopulation is bounded by Timbertop, Kungala, Woolgoolga and Moonee Beach. The subpopulation at Macraes Knob may now be extinct (NSW OEH 2011) but other subpopulations may occur in the area (Quinn et al. 1995). The known distribution of the species is contained within the catchments of the Orara and Coldstream Rivers (tributaries of the Clarence River), Moonee Creek and Corindi River (NSW DECCW 2005). The species has been recorded from Orara East State Forest (SF), Lower Bucca SF, Wedding Bells SF, Kangaroo East SF, Pine Brush SF, Conglomerate SF, Madman's Creek Flora Reserve, Sherwood Nature Reserve, Bagawa SF (Quinn et al. 1995; NSW DECCW 2005).

The Moonee Quassia is estimated to have 5000–7000 wild individuals, with subpopulations of 3000 each in Orara East SF and Conglomerate SF (NSW DECCW 2005).

Map 1 Modelled distribution of *Samadera* sp. Moonee Creek



Source: Species distribution data Species of National Environmental Significance database, base map Geoscience Australia
Caveat: The information presented in this map has been provided by a range of groups and agencies. While every effort has been made to ensure accuracy and completeness, no guarantee is given, nor responsibility taken by the Commonwealth for errors or omissions, and the Commonwealth does not accept responsibility in respect of any information or advice given in relation to, or as a consequence of, anything containing herein.
Species distribution mapping: The species distribution mapping categories are indicative only and aim to capture (a) the specific habitat type or geographic feature that represents to recent observed locations of the species (known to occur) or preferred habitat occurring in close proximity to these locations (likely to occur); and (b) the broad environmental envelope or geographic region that encompasses all areas that could provide habitat for the species (may occur). These presence categories are created using an extensive database of species observations records, national and regional-scale environmental data, environmental modelling techniques and documented scientific research.

Cultural and community significance

The cultural significance of Moonee Quassia is poorly known. However, the habitats and area in which the Moonee Quassia are found have a long and profound history of management by Indigenous peoples.

Relevant biology and ecology

Habitat ecology

The Moonee Quassia occurs as an understorey shrub most commonly in moist shrubby open eucalypt forest on slopes or riparian rainforest gullies, and occasionally in dry open forest with a heathy understorey (NSW OEH 2011, 2020). Associated soils include metasediments. Sites occur at altitudes of 5–500 m above sea level with a mean annual rainfall of 1500 mm (Quinn et al. 1995).

The habitat of the Moonee Quassia at Moonee and other coastal sites is wet sclerophyll forest, typically comprising canopy species such as *Eucalyptus microcorys* (Tallowwood), *Lophostemon confertus* (Brushbox), *Syncarpia glomulifera* (Turpentine), and *Allocasuarina torulosa* (Forest Oak). This wet forest habitat usually supports a varying density and diversity of rainforest understorey species (NSW DECCW 2005).

The habitat of subpopulations in the Grafton district consists of tall dry Eucalypt forests of *Eucalyptus planchoniana* (Needlebark Stringybark) and *Eucalyptus pyrocarpa* (Large-fruited Blackbutt) above a well developed shrub layer (NSW DECCW 2005).

Co-occurring species include *Boronia umbellate* (Orara Boronia), *Parsonsia dorrigoensis* (Milky Silkpod) and *Niemeyera whitei* (Rusty Plum). Populations of *Eucalyptus rummeryi* (Steel Box), *Austrobuxus swainii* (Pink Cherry) and *Marsdenia liisae* (Large-flowered Milk Vine) have also been recorded in the same area as the Moonee Quassia at Conglomerate State Forest (NSW DECCW 2005).

Reproductive ecology

The Moonee Quassia flowers in November and December. It is not known if this occurs annually. Fruiting takes place in March and April. Flowering is inconsistent within subpopulations and mainly occurs on plants that have access to direct sunlight and/or lateral light across the forest floor (NSW DECCW 2005). Pollination vectors are unknown and it is possible that the species may be capable of self-pollination (NSW DECCW 2005).

Although seedling recruitment of the Moonee Quassia appears minimal at most sites, plants have been observed to occur in clusters that appear to be of a similar age class. It is unclear whether the clusters have resulted from the same germination event, or whether the plants have vegetatively reproduced by means of suckers from buried stems or from the root system (NSW DECCW 2005).

The Moonee Quassia is very slow growing, with some tagged plants remaining in the 0–50 cm height class over a 14 year monitoring period (NSW OEH 2011).

Habitat critical to the survival

Due to the species eligibility for listing (restricted distribution and limited number of individuals), all habitat is considered critical to the survival of the species.

No Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat.

Important populations

In this section, the word population is used to refer to subpopulation, in keeping with the terminology used in the EPBC Act and state/territory environmental legislation.

There is sufficient evidence through the species eligibility for listing, to declare all subpopulations as important populations of this species under particular pressure of survival and which therefore require protection to support the recovery of the species.

Threats

Key threats to this species are habitat loss and modification, and fire related threats, including high frequency and high severity fires, and fire-drought interactions (Table 1). A proportion of the species subpopulation occurs on private properties.

Table 1 Threats impacting Moonee Quassia

Threat	Status and severity [a]	Evidence
Climate Change		
Too frequent and/or severe fires	• Timing: current • Confidence: observed • Consequence: major • Trend: increasing • Extent: across the entire range	The Moonee Quassia has been identified as a high priority species requiring urgent management intervention, following the 2019-20 bushfires which burnt 21% of its range (DAWE 2020). The species' limited distribution predisposes it to risk of subpopulation decline or extinction resulting from high-severity fire in combination with other threats, (DAWE 2020). The effects of fire on the longevity of the soil seed bank are not well understood (NSW DECCW 2005). The Moonee Quassia is thought to be adapted to lower intensity fires as the species has been seen resprouting after low intensity fires, despite losing foliage and some branches (NCC & CEC undated). However, too frequent fires may exhaust the soil seed bank and the ability of mature plants to resprout after fire (OEH 2011). Fire frequencies are expected to be low at some sites due to the naturally slow accumulation of ground layer biomass. The effect of severe and too frequent fires has been known to cause mortality of the Moonee Quassia. For example, high-intensity and too frequent fires were thought to have caused the loss of subpopulations around Pillar Valley (NCC & CEC undated). Too frequent and severe fires also cause a reduction in fruit and seed production (NCC & CEC undated). The Rural Fire Service Threatened Species Hazard Reduction Code requires that there are no fires more than once every 25 years at sites supporting the Moonee Quassia in Pillar Valley to ensure survival of the subpopulations. Landowners in Pillar

Threat	Status and severity [a]	Evidence
		Valley were also advised to follow this guideline (NCC & CEC undated). Climate change projections show that southern Australia is likely to experience increased intensity and frequencies of fire (CSIRO 2015). In 2019-20, following years of drought (DPI 2020), catastrophic bushfire conditions resulted in extensive bushfires across eastern Australia. Fire intensity and severity varied across the bushfire extent, with many patches burning at extreme intensity and severity while others remained unburnt (DPIE 2020). This type of event is increasingly likely to reoccur as a result of climate change.
Decreased rainfall, increased temperatures	• Timing: future • Confidence: suspected • Consequence: moderate • Trend: increasing • Extent: across the entire range	Climate change projections show that southern Australia's climate will get hotter and drier, with time in drought predicted to increase over southern Australia (CSIRO 2015). Such changes in climate are likely to cause forest decline, with drought stress leading to plant mortality (Choat et al. 2012). Furthermore, Moonee Quassia, like other resprouting species, may be subject to threat from fire-drought interactions. Resprouting stems are vulnerable to embolization and drastically lowered xylem hydraulic conductivity during post-fire drought, increasing individual mortality risk (Pratt et al. 2014).
Habitat loss, disturbance and modification		
Timber harvesting and associated roadworks	• Timing: current • Confidence: observed • Consequence: moderate • Trend: unknown • Extent: across part of the range	The Moonee Quassia is known from State Forests within its range, and damage to individuals has been attributed to timber harvesting operations and associated roadworks (NSW DECCW 2005). The State Forests of NSW Threatened Species Licence for Upper North East NSW requires at least 90% of Moonee Quassia individuals in any subpopulation to be protected by an exclusion zone of at least 20 m (FCNSW 2018).

Threat	Status and severity [a]	Evidence
Urban development	• Timing: future • Confidence: suspected • Consequence: moderate • Trend: unknown • Extent: across part of the range	Destruction and fragmentation of habitat associated with clearing and urban development are identified as a significant threat to the species (NSW OEH 2020). The majority of subpopulations of the Moonee Quassia occur in private lands and crown lands (Mathews & Couper 2007) which may be subject to urban development in the future (Mathews & Couper 2007; OEH 2011). The population of the major local government area within the species range, Coffs Harbour, has grown by ~10% from 2009-2019 (ABS 2020) and investigations to further increase the amount of urban land that falls within the species range is underway (NSW PE 2017). Urban development also increases the impacts associated with other threats including habitat fragmentation, pollination, seed dispersal and germination, and weeds.
Introduced species		
Competition with invasive weeds	• Timing: current • Confidence: observed • Consequence: moderate • Trend: unknown • Extent: across the entire range	Weed invasions of natural ecosystems are among the greatest environmental threats now facing temperate Australia (ANBG n.d.). Invasive weeds have the capacity to alter ecosystems and therefore habitat suitability for native species as well as directly outcompete native plants. The Moonee Quassia is known to occur in locations where surrounding vegetation is sparse and there is little or no competition from surrounding plants (NSW DECCW 2005). The major weed species identified for the Moonee Quassia are Lantana (*Lantana camara)* , Groundsel Bush (*Baccharis halimifolia)*, Broad-leaf Paspalum (*Paspalum wettsteinii)* and Ochna/Mickey Mouse plant (*Ochna serrulata)* (Mathews & Couper 2007; OEH 2011). Weed invasion is particularly an ongoing threat for those subpopulations occurring on private land (Wetland Care Australia 2006).

Threat	Status and severity [a]	Evidence
Grazing by livestock	• Timing: current • Confidence: observed • Consequence: moderate • Trend: static • Extent: across part of the range	Grazing by livestock is a threat to subpopulations on private land that run livestock, due to grazing and trampling (Wetland Care Australia 2006).
Overabundant native species		
Insect larval grazing	• Timing: current • Confidence: inferred • Consequence: not significant • Trend: unknown • Extent: across the entire range	The larval stage of the *Atteva albiguttata* moth has been recorded feeding on the flowers of Moonee Quassia (Mathews & Couper 2007). The identification was undertaken by the Australian Museum, which indicated that the larvae of this moth are also known to feed on other plants related to Moonee Quassia in Australia and South America (Britton & Couper 2009). Feeding on flowers could impact seed set and thus seedling establishment, and it is possible that plant growth may be hampered by insects removing new season flush (NSW DECCW 2005).

[a]Timing—identify the temporal nature of the threat;
Confidence—identify the extent to which we have confidence about the impact of the threat on the species;
Consequence—identify the severity of the threat;
Trend—identify the extent to which it will continue to operate on the species;
Extent—identify its spatial content in terms of the range of the species.

Each threat has been described in Table 1 in terms of the extent that it is operating on the species. The risk matrix (Table 2) provides a visual depiction of the level of risk being imposed by a threat and supports the prioritisation of subsequent management and conservation actions. In preparing a risk matrix, several factors have been taken into consideration, they are: the life stage they affect; the duration of the impact; and the efficacy of current management regimes, assuming that management will continue to be applied appropriately. The risk matrix and ranking of threats has been developed in consultation with experts and using available literature.

Table 2. Moonee Quassia risk matrix

Likelihood	Consequences				
	Not significant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain	Low risk	Moderate risk	Very high risk **Decreased rainfall, increased temperatures**	Very high risk **Too frequent and/or severe fires**	Very high risk

Likelihood	Consequences				
	Not significant	**Minor**	**Moderate**	**Major**	**Catastrophic**
			Competition with invasive weeds		
Likely	Low risk	Moderate risk	High risk **Timber harvesting** **Grazing by livestock**	Very high risk	Very high risk
Possible	Low risk **Insect larval grazing**	Moderate risk	High risk **Urban development**	Very high risk	Very high risk
Unlikely	Low risk	Low risk	Moderate risk	High risk	Very high risk
Unknown	Low risk	Low risk	Moderate risk	High risk	Very high risk

Priority actions have been developed to manage threats particularly where the risk was deemed to be 'very high' or 'high'. For those threats with an unknown or low risk outcome it may be more appropriate to identify further research or maintain a watching brief.

Conservation and recovery actions

Primary conservation objective

By 2030, the population of Moonee Quassia will have increased in abundance and viable subpopulations are sustained in habitats, which are managed for ongoing threats.

Conservation and management priorities

Climate change and fire

- Provide maps of known occurrences to local and state Rural Fire Services and seek inclusion of mitigation measures in bushfire risk management plan/s, risk register and/or operation maps. Conduct training for personnel undertaking fire management and hazard reduction burns, to enable them to identify the Moonee Quassia and its habitat.
- Develop and implement a fire management strategy that optimises the survival of the Moonee Quassia during planned burns and bushfires, including:
    - Fires must be managed to ensure that prevailing fire regimes do not disrupt the life cycle of the species, that they support rather than degrade the habitat, and that they do not promote invasion of weeds.
    - Physical damage to the habitat and individual plants must be avoided during and after fire operations.
    - Avoid the use of fire retardants and fire-fighting foams during fire operations.
- Advise the appropriate Bush Fire Management Committee on appropriate fire regimes for the species, including the need to avoid too frequent fires.

- Protect any areas identified as climate change refugia and establish corridors for connectivity of subpopulations of Moonee Quassia to mitigate the effects of climate change.

Habitat loss, disturbance and modifications

- Ensure land managers, local governments, relevant state agencies, fire fighting agencies and utility service providers have access to adequate information regarding the location of the Moonee Quassia (e.g. up-to-date databases of known subpopulations) and are aware of its occurrence.
- Liaise with landowners to encourage entering into voluntary management agreements to maintain or enhance the species and its habitat on unsecured private land.
- Ensure local governments have management plans for undertaking survey protocols for Moonee Quassia for development applications within its range.
- Establish and maintain effective prescriptions in production forests to support subpopulations of Moonee Quassia. This includes, but is not limited to: appropriate levels of logging exclusion; restoring connectivity in subpopulations fragmented by major and minor roads; and, where possible, relocating recreational activities and roads away from habitat.
- Ensure State Forests have Moonee Quassia survey protocols in place for protection of this species pre-timber harvesting.
- Provide physical protection measures against accidental destruction where necessary (e.g. bollards demarcating the extent of a subpopulation).

Introduced species

- Identify and control problem weeds where required, using appropriate methods. Consider the possible disturbance and off-target spraying threats associated with the control method.
- Manage any weed invasions found during subpopulation monitoring. Weeds of concern are those that have the potential to adversely affect recruitment or provide strong competition, such as Lantana, Groundsel Bush, Broad-leaf Paspalum and Ochna/Mickey Mouse plant.
- Implement suitable weed hygiene protocols when undertaking survey, monitoring and management activities. Refer to the *Arrive Clean, Leave Clean Guidelines to help prevent the spread of invasive plant diseases and weeds threatening our native plants, animals and ecosystems* (DotE 2015).
- Liaise with landholders to implement an appropriate management regime, such as livestock exclusion fencing or low stocking density, to minimise the impacts of livestock grazing and trampling on Moonee Quassia.

Overabundant native species

- If impacts are found to be significant, implement mitigation measures to reduce grazing by larvae of the moth *Atteva albiguttata* on the flowers of Moonee Quassia, while minimising adverse impacts on other species and the environment.

Breeding, seed collection, propagation and other ex situ recovery action

- To manage risk of losing genetic diversity, undertake seed collections and store at appropriate institutions. Seeds from as many wild plants as possible across the majority of wild subpopulations should be collected and stored.

- If deemed appropriate, undertake ex situ propagation and conservation translocations in suitable habitat with secure land tenure, to increase the number of subpopulations of Moonee Quassia, in accordance with the *Guidelines for the Translocation of Threatened Plants in Australia* (Commander et al. 2018).

Stakeholder engagement/community engagement

- Conduct a publicity campaign using physical and electronic media to increase local community awareness of the species' conservation.
- Identify and implement opportunities for community involvement in the conservation of the species.
- Liaise with relevant land managers and landowners to ensure that subpopulations are not accidentally damaged or destroyed. The approval and assistance of land managers should also be sought to implement recovery actions.
- Engage and involve Traditional Owners in conservation actions, including the implementation of Indigenous fire management and other survey, monitoring and management actions.

Survey and monitoring priorities

- Conduct surveys for Moonee Quassia in suitable habitat within any proposed development areas. The survey and monitoring plan should follow the methodology previously used for the species as discussed in NSW DECCW (2005).
- Conduct surveys for invasive weeds at known sites of the Moonee Quassia.
- Undertake subpopulation monitoring at known sites to identify trends in health, subpopulation size and habitat condition.
- Survey known subpopulations affected by bushfires to monitor ongoing impacts from fires.
- Conduct surveys for the larval stage of the moth *Atteva albiguttata* at known sites of Moonee Quassia.
- All subpopulations are surveyed to understand impacts of the 2019-20 bushfires and monitored to better understand any ongoing impacts of fire.

Information and research priorities

- Investigate and understand habitat attributes for Moonee Quassia.
- Improve knowledge of the relative impact of different threats to the Moonee Quassia. In particular:
    - Conduct research into the history, effects and responses of Moonee Quassia to fire, to better understand the fire ecology of the species and develop fire management prescriptions.
    - Identify and map areas of suitable habitat under climate change scenarios that may act as refugia.
    - Investigate potential impacts of decreased rainfall and increased temperature, due to climate change, on the viability and persistence of subpopulations.
    - Determine the extent to which weed competition is threatening, or may threaten, subpopulations of the species.

  - Investigate potential interactions or synergies among various threats/disturbances to subpopulations and the species as a whole.
  - Investigate the potential for the larval stage of *Atteva albiguttata* (a moth) to decrease pollination and seed set in individuals and subpopulations of Moonee Quassia.
- Investigate ecological requirements of the Moonee Quassia that are relevant to persistence, including:
  - longevity of the species
  - the subpopulation genetic structure, levels of genetic diversity and minimum viable subpopulation size.

Links to relevant implementation documents

Northern Rivers Regional Biodiversity Management Plan, National Recovery Plan for the Northern Rivers Region (2010)

NSW- Moonee Quassia - profile

NSW Saving Our Species - Moonee Quassia (*Quassia sp. Moonee Creek*)

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Cataloguing data

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