A Guide to Wild Macadamia Conservation

Macadamias naturally occur in the coastal subtropical rainforests of north-east New South Wales and south-east Queensland, with a tiny outlier population in central Queensland. There are four macadamia species, all are native only to Australia and all are threatened in the wild. Two species produce edible nuts and are cultivated widely.

This guide provides information on key threats to all four species and suggests management actions to assist conservation of wild macadamias and their habitat by private and public land managers and catchment, Landcare or bushcare groups.

It is not intended to provide advice here on macadamia management for nut production, though there are some common principles. For information on orchard management, contact the Australian Macadamia Society or relevant government horticulture service.

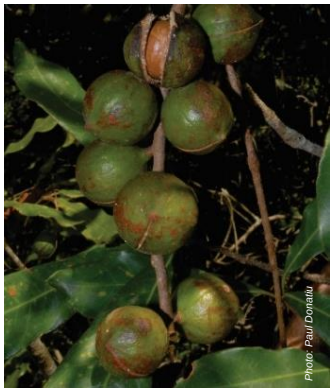
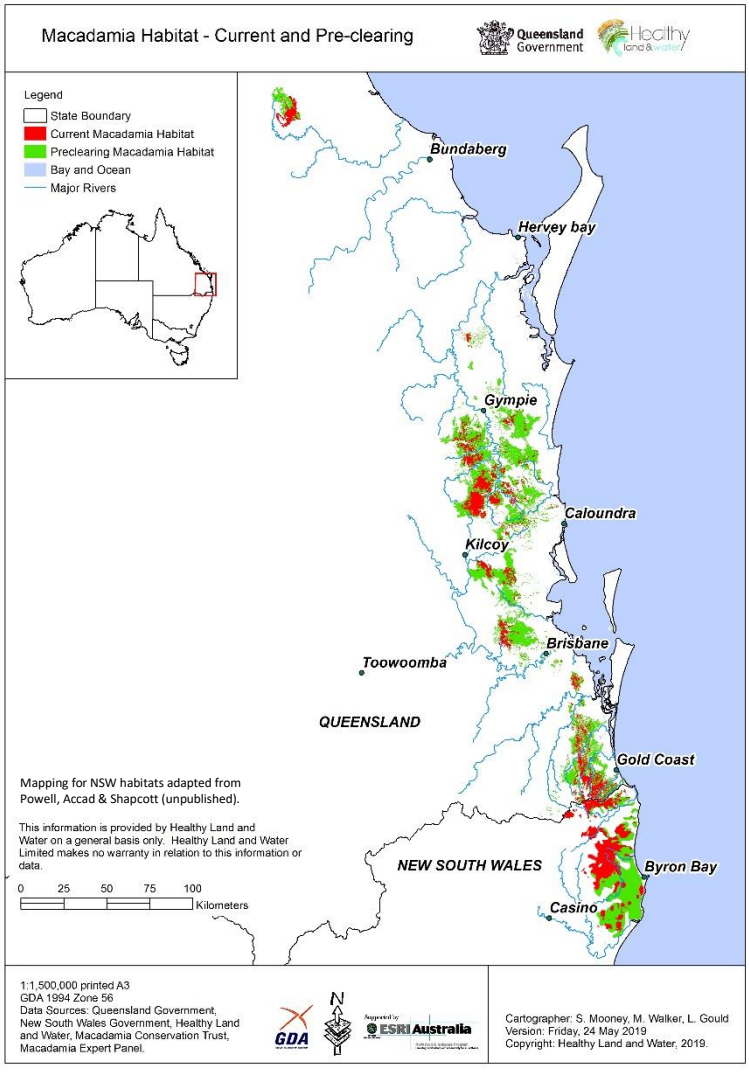


Photo: Paul Donatiu

Why are 'wild' macadamias important?

Wild macadamias and their habitats have declined substantially since European arrival in Australia. This reduces each species' viability and impacts other plants, animals and ecosystems. There is an associated loss of cultural heritage and a threat to the gene bank of the global macadamia industry. Australian legislation[1] and an international treaty[2] require the conservation of wild macadamias.

Indicative mapping of macadamia habitat (below) illustrates the extent of preclearing habitat lost, aids conservation of current remnant habitat and guides research and recovery.



What is a 'wild' macadamia?

A 'wild' macadamia is a tree (or its immediate descendent) sourced directly from original macadamia habitat – whether that habitat still exists or not – and is not the product of any breeding program for commercial cultivation. If a macadamia tree meets any of the following criteria, it is *likely* to be a 'wild' tree:

- Tree of any size or age, growing in remnant rainforest habitat (see map)
- Older tree growing in rainforest regrowth
- Old or veteran tree (growing prior to 1940) found anywhere

Genetic testing is the only certain way of determining whether macadamia is of 'wild' origins, however, all Bulberin Nut (*Macadamia jansenii*) and Gympie Nut (*M. ternifolia*) trees are likely to be 'wild' trees as neither species has been cultivated or planted extensively.

For the two commercially grown macadamia species – Queensland Nut (*M. integrifolia)* and, to a lesser extent, Rough-shelled Bush Nut (*M. tetraphylla)* – however, determining if a tree is 'wild', requires understanding of its provenance or parentage. Planting of these valuable food trees – initially by Indigenous Australians and substantially more following European arrival – in areas outside of their natural habitat and distribution has added complexity to their conservation.

These plantings and Australia's first macadamia orchards were established from the nuts of macadamia trees growing either in their natural habitat (i.e., growing in the wild) or from trees left behind following habitat clearing for settlement and agriculture; these are considered transplanted, 'wild' trees.

In the 1870s, however, nuts from a few macadamia trees were taken to Hawai'i where, in the absence of diseases and pests, the industry flourished. Cultivars and hybrids were established with higher yields and thinner shells. The progeny of these trees was brought back to Australia in the 1940s to improve the local industry and planted widely in backyards and orchards. These trees are not 'wild' trees.

Threats to Macadamias

What are the threats to macadamia habitat?

Habitat loss
Up to 80% of macadamia habitat and 30-50% of macadamia populations, have been lost since European arrival. Clearing for development, agriculture and infrastructure is still occurring. Some macadamia habitats are listed as threatened under legislation.

Habitat fragmentation
Fragmentation, the loss of habitat connectivity, increases susceptibility to fire and weed invasion and limits pollen exchange and genetic transfer between macadamia populations.

Weeds
Weeds degrade habitat and change ecosystem structure and composition. Exotic vines such as Cat's claw creeper (*Dolichandra unguis-cati*) and Madeira vine (*Anredera cordifolia*) invade intact habitats, destroy canopy trees and form dense groundcover that prevents natural regeneration. Other weeds such as Lantana (*Lantana camera*) and introduced grasses, e.g., Green Panic (*Megathyrsus maximus*), increase fire risk within and surrounding macadamia habitats.

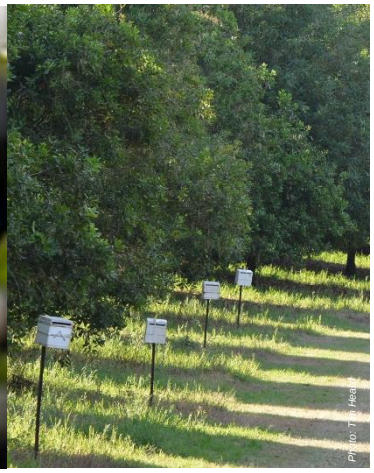
Altered fire regimes
Whilst rainforest habitats are relatively fire resistant, they can become susceptible to fire due to surrounding flammable weeds, prolonged drought stress and above average temperatures, or reduced canopy, such as that caused by vine weeds. This is exacerbated if habitat remnants are located upslope of fire-prone landscapes.

Unmanaged livestock
Livestock can modify the structure and composition of macadamia habitats, as well as increase fire risk through introducing and spreading exotic pasture grasses.

Climate change
The increased temperature and more variable rainfall predicted through climate change will place additional stress on macadamia habitat structure and composition, increasing fire and potentially weed risks.

Cat's claw creeper, an invasive vine weed, smothers trees and the ground, turning habitat into virtual wasteland (below).

Lowland subtropical rainforest (above) is the primary habitat for macadamias. Up to 80% has been cleared since European arrival and clearing is still occurring.



Native bees (above left) are efficient macadamia pollinators. Installing a native bee hive near macadamia trees (as is often done in orchards, above right), improves nut production.

Chewed nut shells (below left) are evidence of rat predation. Attracting barn owls by installing nest boxes (below right) can reduce nut predation and increase chances of germination.

Threats to Macadamias

What are the threats to 'wild' trees?

Wild macadamia trees either within or outside of their natural habitat face similar, and some different, threats to their habitat, which need specific action.

Weeds

Exotic vines such as Cat's claw creeper (*D. unguis-cati*) and Madeira vine (*A. cordifolia*) can smother and kill even mature macadamia trees. In the understorey, these vines and other weeds, such as Coral berry (*Rivina humilis*), can form a dense groundcover that blocks macadamia germination and seedling growth.

Fire

Macadamia trees are sensitive to fire. Established trees may survive low intensity fires by resprouting or suckering but can be killed by high intensity fires.

Climate change

Predictions of higher autumn temperatures and reduced summer rainfall as a result of climate change are anticipated to decrease the number of macadamia flowers produced and the number of nuts reaching maturity, reducing the reproductive capacity of macadamia populations, especially those occupying the warmer, drier end of climate gradients.

Small population size

Reduced pollen flow between macadamia populations diminishes genetic robustness, causes inbreeding and decreases flower and seed production.

Genetic dilution

Cultivated macadamia trees in backyards and orchards may reduce the robustness of populations of wild *M. integrifolia*, *M. ternifolia* and *M. tetraphylla*. Cultivated trees are less genetically diverse, so the transfer of pollen from these trees to wild trees may weaken the genetic constitution of any resulting seedlings.

Limited reproductive capacity

In the wild, limited flowering, poor pollination, low seed production, high seed predation and limited seed dispersal reduce regeneration and population growth.

Root-rot fungus

Root-rot fungus (*Phytophthora* species) is a serious threat to wild macadamia populations, though the extent of its impact is unknown. Within the macadamia industry, *P. cinnamomi* is widespread and has devastating impact, causing stem canker, root rot, tree decline, dieback and potentially tree death.

Pest Animals

Predation on nuts by Black Rats (*Rattus rattus*) and Feral Pigs (*Sus scrofa*) is extensive and reduces regeneration of wild trees. Feral pigs also damage trees and spread *P. cinnamomi*.

What's being done?

Since 2006, the Macadamia Conservation Trust and Healthy Land and Water have been working together to improve knowledge of wild macadamias and coordinate species recovery.

Key achievements include:

- Formation of the Macadamia Conservation Trust conservation and research committee, with representatives from University of Queensland, Southern Cross University, University of the Sunshine Coast, QAAFI, Australian Macadamia Society, SOWN and macadamia growers
- Development of the "Southern Macadamia Species Recovery Plan (2009) and revision of the recovery plan (released for consultation in 2019)
- Surveys of wild macadamia populations
- Creation of replica populations of *M. jansenii* to conserve genetic diversity
- Discovery of new wild populations of macadamia
- Realisation of the potential significance of transplanted, wild trees in backyards
- The development of genetic markers and genomic resources to improve biological knowledge and for studies of population structure, gene flow and hybridisation
- Habitat mapping to assist with protection and guide conservation and research in Queensland
- Weed and fire management at key sites
- Propagation workshop for native plant nurseries
- Active participation and funding support from the Australian macadamia industry in the conservation of wild trees
- Collaboration with local governments in macadamia conservation
- "Wild Macadamia Hunt" citizen science project (www.hlw.org.au/macadamias)

Macadamia plantings in secure and well-visited sites, such as the Lismore Botanic Gardens (below), increases community awareness and protects genetic diversity.

Taking Action

Actions for habitat

Conservation of macadamia habitat provides the best outcome for wild macadamias and provides multiple benefits, by conserving other native species, ecosystem function and landscape connectivity.

Macadamia habitat is best conserved through the following actions:

- Notify governments and land managers of the location of macadamia habitat
- Identify and monitor weed and fire risks
- Control weeds, particularly high fire risk species, invasive vines and other 'transformer' weeds
- Introduce biocontrol agents for weeds such as Cat's claw creeper in difficult to access areas
- Limit fire encroachment through appropriate management of adjoining areas or the establishment of firelines and/or firebreaks to protect rainforest habitat
- Restore or extend habitats by planting wild macadamias and other local rainforest species sourced from native plant nurseries
- Create connectivity between fragmented rainforest habitats by planting native forests
- Talk to your neighbours and community about the status of wild macadamias and the importance of rainforest habitats

Actions for wild trees

Macadamia trees are long-lived, can maintain themselves via coppicing and can grow outside their natural habitats.

The survival of individual macadamia trees and local populations can be assisted by the following actions:

- Notify governments of the location of wild macadamia trees
- Control weeds, pests and fire
- Remove fuel loads beneath wild trees
- Eradicate invasive vines
- Remove soil and seeds from footwear, equipment and vehicles before visiting wild trees
- Restore or plant native habitat around existing wild trees
- Buy macadamia trees from native plant nurseries and ensure they are of 'wild' origins
- Plant macadamias in canopy gaps and on forest margins to promote flowering
- Plant macadamias within 3km of each other as "stepping stones" to improve pollen transfer
- Encourage insect pollinators by providing water, planting flowering plants and/or installing native bee hives near macadamias
- Work with your neighbours to control Feral Pigs and Black Rats

Support and further information

Your local natural resource management organisation, Landcare, catchment or bushcare group or Land for Wildlife officer may be able to provide support with macadamia conservation.

Useful websites:

www.wildmacadamias.org.au

www.hlw.org.au/macadamias

www.lfwseq.org.au

www.environment.gov.au/biodiversity

www.australianmacadamias.org

References

[1] Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, Queensland *Nature Conservation Act 1992* and *New South Wales Biodiversity Conservation Act 2016*

[2] International Treaty on Plant Genetic Resources for Food and Agriculture

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*Queensland Nut (*M. integrifolia*) in full bloom is a rare sight in the wild; this species is the foundation of a thriving commercial industry but is threatened in the wild.*