

Paperbark (*Melaleuca quinquenervia*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, March 2012
Revised, March 2018
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Photo: F. & K. Starr (2006). Available: https://commons.wikimedia.org/wiki/File:Starr_061206-1983_Melaleuca_quinquenervia.jpg. (March 2018).

1 Native Range and Status in the United States

Native Range

From CABI (2018):

“*M. quinquenervia* is a native of the coastal region in eastern Australia, from near Sydney (New South Wales) to Cape York (northern Queensland). It occurs mainly in a belt within 40 km of the sea. This species extends into southern Papua New Guinea and Irian Jaya, Indonesia, and has an

extensive distribution in New Caledonia, especially on the north-west of the island (Blake, 1968; Holloway, 1979; Cherrier, 1981). In Australia and Papua New Guinea, *M. quinquenervia* is generally confined to the lowlands (below 100 m), but in New Caledonia it forms extensive stands in uplands to an altitude of 900-1000 m. *M. quinquenervia* remains fairly common throughout its natural range and currently there are no general conservation concerns. It has been introduced to other parts of Australia (Royal Botanic Gardens Sydney, 2007) and also to many other parts of the world, and is very likely to be under-recorded in the distribution table, especially in Africa and Asia.”

From Swearingen and Barger (2016):

“Trop. Asia, Australasia, & Pacific-New Caled.”

Status in the United States

CABI (2018) lists the presence of *M. quinquenervia* in California, Florida, Louisiana, and Texas.

From Dray et al. (2006):

“Confirmed United States collections include specimens from California, Florida, Hawaii, Louisiana, Texas, and Puerto Rico (Morton 1966, Blake 1968, Little et al. 1974).”

Means of Introductions in the United States

From Swearingen and Barger (2016):

“*Melaleuca quinquenervia* [...] was first introduced into the United States in southern Florida in the early 1900s for landscaping and ‘swamp drying’ purposes.”

From CABI (2018):

“It is thought to have been introduced as an agricultural windbreak, soil stabiliser and as an ornamental. In 1936, seeds were scattered from an aeroplane to forest the Everglades (Westbrooks, 1998). The species escaped cultivation on seasonally wet sites and has since assumed weed status (Ruskins, 1983). According to Cost and Craver (1982) it then covered 186,000 ha or about 6% of the land in southern Florida. Since 2000, its range has increased and it now covers over 200,000 hectares (Anon, 2003). The species was also introduced into California (as *Metrosideros quinquenervia* by Coronado Nurseries, San Diego) at about the same time as it was introduced in Florida, and was sold in the California landscaping trade early in the twentieth century (Dray et al., 2006). In Hawaii, it is recorded that two million trees have been planted on State Forest Reserve alone, first cultivated in 1920 with seeds from Florida, and is now naturalized in undisturbed mesic forest (altitude 30-890 m) (Binggeli, 1997). However, USDA-NRCS (2007) only records presence on mainland USA in Louisiana and Florida.”

Remarks

From Dray et al. (2006):

“Scientific names under which *M. quinquenervia* was imported into the United States include: *Metrosideros quinquenervia* Cav., *Melaleuca leucadendron* (L.) L., *Melaleuca viridiflora* (L.f.) Byrnes, and *Cajeputi leucadendra* (Stickm.) Rusby. Common names for *M. quinquenervia* include niaouli, paperbark, broad-leaved paperbark, five-veined paperbark, broad-leaved tea tree, Belbowrie, punk tree, and cajeput (Meskimen 1962, Morton 1966, Blake 1968, Boland et al. 1984, Craven 1999). This latter name more properly applies to the related species *M. cajeputi* Powell.”

From CABI (2018):

“In mainland USA [...] it is a declared noxious weed in several other states under various classifications (USDA-NRCS, 2007).”

From Serbesoff-King (2003):

“It is classed as a Federal Noxious Weed in the United States and as a Prohibited Aquatic Plant and Noxious Weed in the state of Florida. In the continental United States, melaleuca has been recorded from Louisiana, Texas and California.”

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2018):

“Kingdom Plantae
Subkingdom Viridiplantae
Infrakingdom Streptophyta
Superdivision Embryophyta
Division Tracheophyta
Subdivision Spermatophytina
Class Magnoliopsida
Superorder Rosanae
Order Myrtales
Family Myrtaceae
Genus *Melaleuca*
Species *Melaleuca quinquenervia* (Cav.) S.T. Blake – bottle brush tree, cajeput tree, melaleuca, niaouli, paperbark, punktree”

“Taxonomic Status: accepted”

Size, Weight, and Age Range

From Swearingen and Barger (2016):

“*Melaleuca quinquenervia* is a tall (up to 80 ft. [24.4 m]), evergreen tree in the eucalyptus family [...]”

“The alternate leaves are gray-green, oval, 1-4 in. (2.5-10.2 cm) long [...]”

From CABI (2018):

“A small to medium-sized tree, commonly 8-12 m tall, but ranging over 4-25 m depending on local growing conditions.”

Environment

From Dray (2006):

“It encroaches upon a variety of habitats: freshwater marshes (including sawgrass prairies), cypress swamps, pine flatwoods, hardwood hammocks, salt marshes, mangrove forests (occasionally), and is particularly prominent along ecotones (Myers and Ewel 1990).”

From CABI (2018):

“In its native range Australia, *M. quinquenervia* normally grows on level or gently undulating coastal lowlands. It grows along streams, fringing tidal estuaries and frequently forms pure stands in freshwater swamps. It often occurs close to the beach and will tolerate wind-blown salt. The best-developed stands of *M. quinquenervia* occur as open-forest or woodland on favourable sites, but elsewhere are reduced to low woodland or tall shrubland. It is usually the dominant species, and frequently occurs in more or less pure stands. Most natural vegetation in southern Florida can be invaded by *M. quinquenervia*, but invasion is more common on marshes and wet savannas than on forested sites (Geary, 1988).”

Climate/Range

CABI (2018) lists *M. quinquenervia* showing a preference for > 0°C to < 18°C in tropical and warm climates. Range is listed -8°N to -34°S.

Distribution Outside the United States

Native

From CABI (2018):

“*M. quinquenervia* is a native of the coastal region in eastern Australia, from near Sydney (New South Wales) to Cape York (northern Queensland). It occurs mainly in a belt within 40 km of the sea. This species extends into southern Papua New Guinea and Irian Jaya, Indonesia, and has an extensive distribution in New Caledonia, especially on the north-west of the island (Blake, 1968; Holloway, 1979; Cherrier, 1981). In Australia and Papua New Guinea, *M. quinquenervia* is generally confined to the lowlands (below 100 m), but in New Caledonia it forms extensive

stands in uplands to an altitude of 900-1000 m. *M. quinquenervia* remains fairly common throughout its natural range and currently there are no general conservation concerns. It has been introduced to other parts of Australia (Royal Botanic Gardens Sydney, 2007) and also to many other parts of the world, and is very likely to be under-recorded in the distribution table, especially in Africa and Asia.”

From Swearingen and Barger (2016):

“Trop. Asia, Australasia, & Pacific-New Caled.”

Introduced

CABI (2018) lists fifty-eight Asian, African, Central American and Caribbean, South American, European, and Oceanic countries where *M. quinquenervia* has been introduced.

Means of Introduction Outside the United States

From CABI (2018):

“*M. quinquenervia* seeds are dispersed locally by wind and water. Large numbers of seeds are stored on the tree in the fruiting capsules and are released when fire or other disturbance occurs (PIER, 2007). Long-distance movement has been via international introductions throughout the tropics mainly as an ornamental, but also for windbreaks or for other agroforestry purposes.”

Short Description

From CABI (2018):

“*M. quinquenervia* is a long-lived, moderately fast-growing tropical tree. As with all species in the genus, it does not develop resting buds and grows whenever conditions are favourable.”

“A small to medium-sized tree, commonly 8-12 m tall, but ranging over 4-25 m depending on local growing conditions. The stem is moderately straight to crooked, the crown is narrow and open, or fairly dense. The thick, pale-coloured bark is made up of many papery layers that split and peel, and on large trunks becomes rough and shaggy.”

From Masterson (2011):

“*Melaleuca*, *Melaleuca quinquenervia*, is a fast-growing and hardy tree with a slender crown and a layered, peeling paper-like white bark somewhat resembling that of a birch tree. Branches occur at irregular intervals off of the main trunk. *Melaleuca* leaves are 10-15 cm long, evergreen, lanceolate, simple and short-stalked, parallel-veined, alternate in arrangement, and aromatic when crushed. The flowers are small and white, with multiple stamens, arranged in bottlebrush-shaped clusters at the branch tips.”

Biology

From CABI (2018):

“*Melaleuca* spp. have hermaphrodite, protandrous flowers and are pollinated mainly by insects, but also by birds and small mammals. They appear to be obligate outcrossers, with over 90% outcrossing in *M. alternifolia* (Butcher et al., 1992). The fruiting capsules of *M. quinquenervia* contain large numbers of seeds which can be stored and released in the event of fires or other disturbances, and seeds may remain on trees for more than 10 years. Seeds remain viable in the soil for between up to 2-3 years, less on seasonally and permanently flooded sites (Van et al., 2005).”

Human Uses

From CABI (2018):

“*M. quinquenervia* can be used for windbreaks and may have a role in erosion control on degraded and poor soils (Doran and Turnbull, 1997). Rates of litter fall beneath *M. quinquenervia* on a floodplain and riparian site were found to be high, with slow rates of litter decay, indicating that such woody wetlands act as nutrient sinks (Greenway, 1994). This species is a popular ornamental tree for damp conditions and birds are attracted to the fragrant blossoms, and a red-flowering form makes an excellent feature plant for use in landscaping (Wrigley and Fagg, 1993).”

“The wood has been used for a wide range of purposes including mine timbers, fence posts and rails, flooring, house timbers and pulp (Ruskins, 1983). Investigations into utilization of the wood (and bark) are detailed by Huffman (1981). The wood is an excellent fuel, and makes good quality charcoal. Durability of untreated posts in the ground is high during the first year, but replacement is necessary after about 3 years (Cherrier, 1981). Mulch is prepared from wood chips of *M. quinquenervia* in Florida (Anon, 1993) and has also been used successfully as a replacement for pine bark in potting media for the horticultural industry (Brown and Duke, 2001). The bark is resistant to mildew, and consequently it is used to insulate the walls of cold storage rooms and has been used to stuff pillows and its water resistance makes it useful for caulking boats (Geary, 1988).”

“*M. quinquenervia* is a good source of nectar and pollen for bees. It is a major source of honey in Australia and Florida, USA (Robinson, 1981; Clemson, 1985; Geary, 1988). The dark amber honey has a strong caramel flavour and aroma, and is often of low density (Blake and Roff, 1958; Clemson, 1985).”

“The natural stands of *M. quinquenervia* on New Caledonia are the source of Niaouli oil which is produced by hydrodistillation of leaves. Niaouli oil contains 60% 1,8-cineole, and is used mainly to treat pulmonary infections, especially colds and bronchitis. Details of the production process are provided by Valet et al. (1998). Current annual output of this oil in New Caledonia is 7-10 tonnes, of which 19% is exported (Valet et al., 1998). An additional use of Niaouli oil is as a mosquito repellent, and Amer and Mehlhorn (2006) found it was the third most effective of over 40 plant extracts tested against *Aedes*, *Anopheles* and *Culex* mosquitoes, being 100% effective for 8 hours. In addition, Moharram et al. (2003) isolated four polyphenolic acid derivatives and

three ellagitannins from the leaves for the first time, and observed effects of some on reducing blood sugar levels in mice. It appears that further investigations into the chemical composition of *M. quinquenervia* extracts and their potential effects and uses is merited.”

“Tea tree oil, an essential oil widely and increasingly available in Europe and North America as a natural disinfectant, is produced from *M. alternifolia* in Australia, though studies have been undertaken to assess whether other species including *M. quinquenervia* may also be suitable. Of the species and chemotypes evaluated by Doran et al. (2007), *M. quinquenervia* showed potential for commercial production of trans-nerolidol, a compound used in perfumery. It had a very high survival rate (96%) and yields could be expected to improve dramatically from the average 100 kg/ha per harvest achieved in trials with further research into selection of seed source, control of insect damage and breeding for genetic improvement. Trials in Benin by Gbenou et al. (2007) also showed promise for year-round production of Niaouli oil.”

Diseases

None reported.

Threat to Humans

From GISD (2018):

“As *melaleuca* populations expand in southern Florida and the human population increases the risk of fire and loss of human life and property increases (Laroche 1999).”

3 Impacts of Introductions

From Swearingen and Barger (2016):

“*Melaleuca quinquenervia* aggressively invades a variety of wetland habitats including sawgrass marshes, wet prairies, and aquatic sloughs. It often forms impenetrable thickets, reduces biodiversity, displaces native vegetation and reduces the value of these habitats for wildlife. It also accelerates the loss of groundwater due to increased evapotranspiration.”

From Turner et al. (1997):

“*Melaleuca quinquenervia* can invade many anthropogenic areas such as canal banks, roadsides, pastures, and urban areas. More troubling however is the ability of the tree to invade most wetland natural areas in south Florida, both disturbed and undisturbed (Austin, 1978; Hofstetter, 1991; Bodle et al., 1994). As stated by Hofstetter (1991), the tree has invaded virtually all types of communities in south Florida, including those where vegetative components appear to be healthy and presumed to be comparable to historical vigor. *Melaleuca quinquenervia* is considered the greatest exotic weed threat to wetlands in south Florida (Laroche, 1994). It invades herbaceous wetlands including sawgrass prairies and other types of freshwater marshes (Laroche, 1994), converting them to forested woodlands, an ecologically radical transformation. The tree also invades native forested wetlands, including cypress swamps, pine flatwoods, hardwood bottomlands, and mangrove swamps (Laroche, 1994) *Melaleuca quinquenervia* is a severe threat to such renowned natural areas as Big Cypress National Preserve and the

Everglades. Everglades National Park is one of only three reserves recognized to be of such international importance as to be placed on three different lists of internationally critical sites: The International Biosphere Reserve, World Heritage, and Ramsar (Maltby and Dugan, 1994).”

From CABI (2018):

“Due to the severe consequences of its invasive behaviour, which carry economic, environmental, social and biodiversity impacts, exotic plantings in other locations should be monitored for early signs of invasiveness and introductions should be subject to thorough risk assessments which take into account local environmental conditions.”

From GISD (2018):

Ecosystem Change: *Melaleuca* threatens the integrity of subtropical freshwater ecosystem processes in Florida (Dray & Center 1994, in Lopez-Zamora Comerford & Muchovej 2004) by altering soil chemistry, reducing de-composition rates and modifying hydrology and fire regime. *Melaleuca* also reduces species biodiversity and alters species composition.

Reduction in Native Biodiversity: *Melaleuca* forests provide limited food and habitat value for native wildlife and can reduce indices of native species in Florida wetlands by as much as 80% (Dray et al 2006; Bodle et al., 1994, O’Hare & Dalrymple, 1997, in Dray et al. 2009; Porazinska Pratt & Giblin-Davis 2007). Decreases in diversity of native plant biodiversity have also been linked with *melaleuca* in the Bahamas.

Habitat Alteration: *Melaleuca* is contributing to significant habitat loss in the Everglades National Park by converting fire-maintained sawgrass communities into *Melaleuca* forest (Turner *et al.* 1998, in Munger 2005).

Displacement: *Melaleuca* displaces pond cypress (*Taxodium ascendens*) (Myers 1975 1983, Ewel 1986, in Rayamajhi *et al.* [2008]), slash pine (*Pinus elliotii*) and sawgrass (*Cladium jamaicensis*) (Bodle *et al.*, 1994, in Tipping *et al.* 2008).

Competition: *Melaleuca* is competitively superior to most native vegetation occurring in the Florida Everglades (Turner *et al.* 1998, in Pratt *et al.* [2005]). It is fire-adapted, herbivore-adapted and produces seeds and roots prolifically.

Inhibits the Growth of Other Species: Allelochemicals present in roots can have a detrimental effect on the soil biota (Porazinska Pratt & Giblin-Davis 2007).

Economic: Balciunas and Center (1991, in Serbesoff-King 2003) reported that by the year 2010, close to \$2 billion would be lost due to the *melaleuca* invasion in southern Florida. Financial losses included \$1 billion in tourism to the Everglades NP, \$250 million in tourism to the rest of south Florida, \$250 million in recreation, \$250 million due to fires, \$1 million in control efforts, \$10 million due to loss of endangered species and \$1 million to nursery growers.

Agricultural: In one study 18 economic arthropod pests were collected from *M. quinquenervia* (Costello *et al.* 2008).

Human Health: As *melaleuca* populations expand in southern Florida and the human population increases the risk of fire and loss of human life and property increases (Laroche 1999).

Modification of Hydrology: A stand of *melaleuca* may transpire more water than the sawgrass communities it replaces (Hofstetter 1991a, in Laroche 1999).

Modification of Fire Regime: Ground fires, high temperatures, rapid spread rates and abundant smoke, all present in burning *melaleuca* stands, present new risks for wildlife in the Everglades

wetlands (Flowers 1991, in Laroche 1999).

Modification of Nutrient Regime: The rate of decomposition of melaleuca litter is slower than that of native plants (Van & Rayamajhi, Unpub. Data, in Rayamajhi *et al.* [2006]).”

4 Global Distribution



Figure 1. Known global distribution of *Melaleuca quinquenervia*. Map by GBIF Secretariat (2018). Occurrences in the northeastern United States and any marine occurrences were excluded from the climate matching analysis because they do not represent established populations.

5 Distribution Within the United States

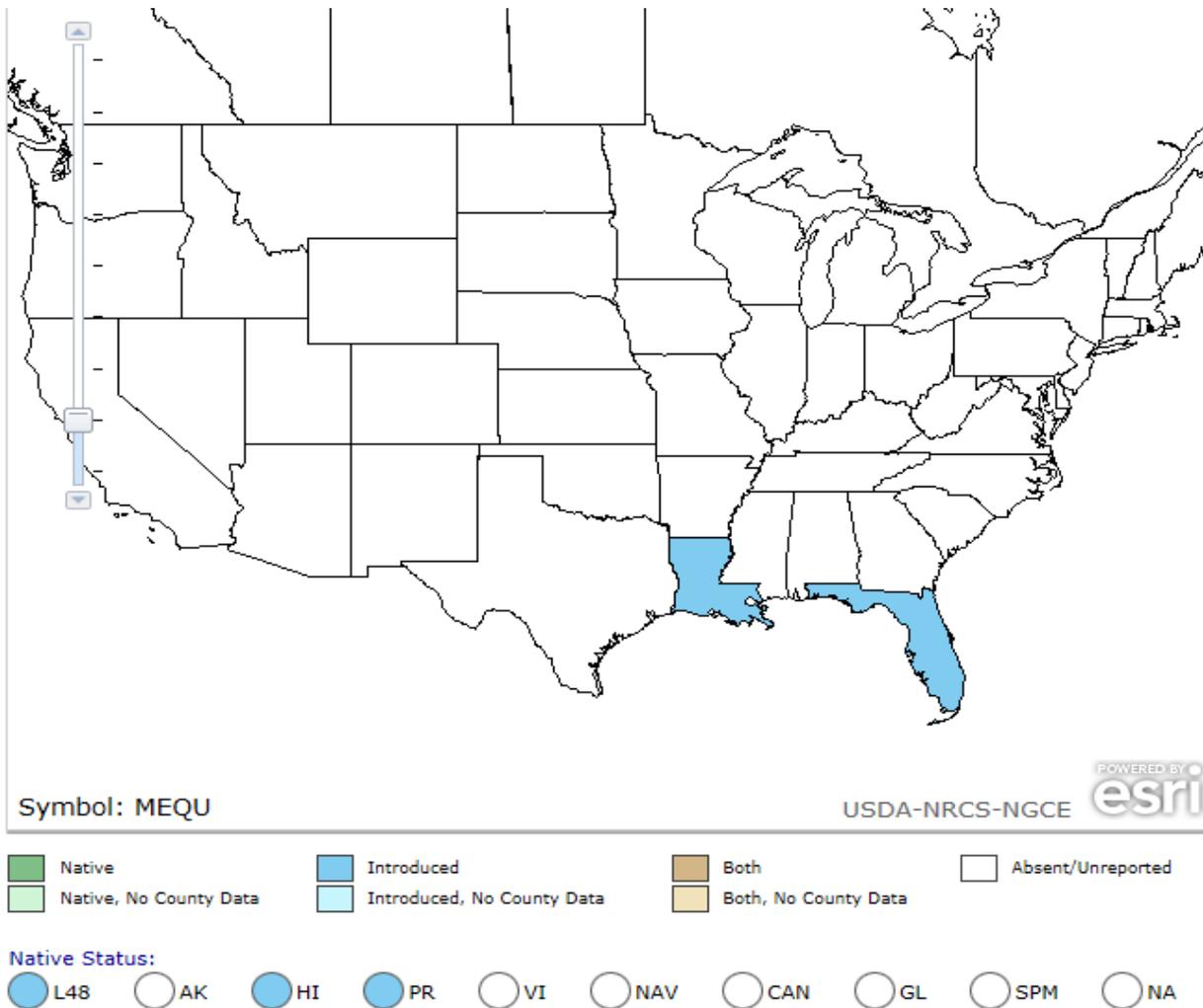


Figure 2. Distribution of *Melaleuca quinquenervia* in the United States. Map from USDA NRCS (2018). Map does not show parts of introduced range in California, Hawaii, or Texas.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match (Sanders et al. 2014; 16 climate variables; Euclidean Distance) for *Melaleuca quinquenervia* within the contiguous United States is high overall. The Climate6 proportion for this species is 0.120. The range of proportions classified as high match is ≥ 0.103 . High matches were located in Florida, southern Texas, Arizona, and southern and central California. Medium matches covered most of the remainder of the contiguous United States, except for low match areas in northern New England, the north-central region, the northeastern Rocky Mountains, and parts of the Pacific Northwest.

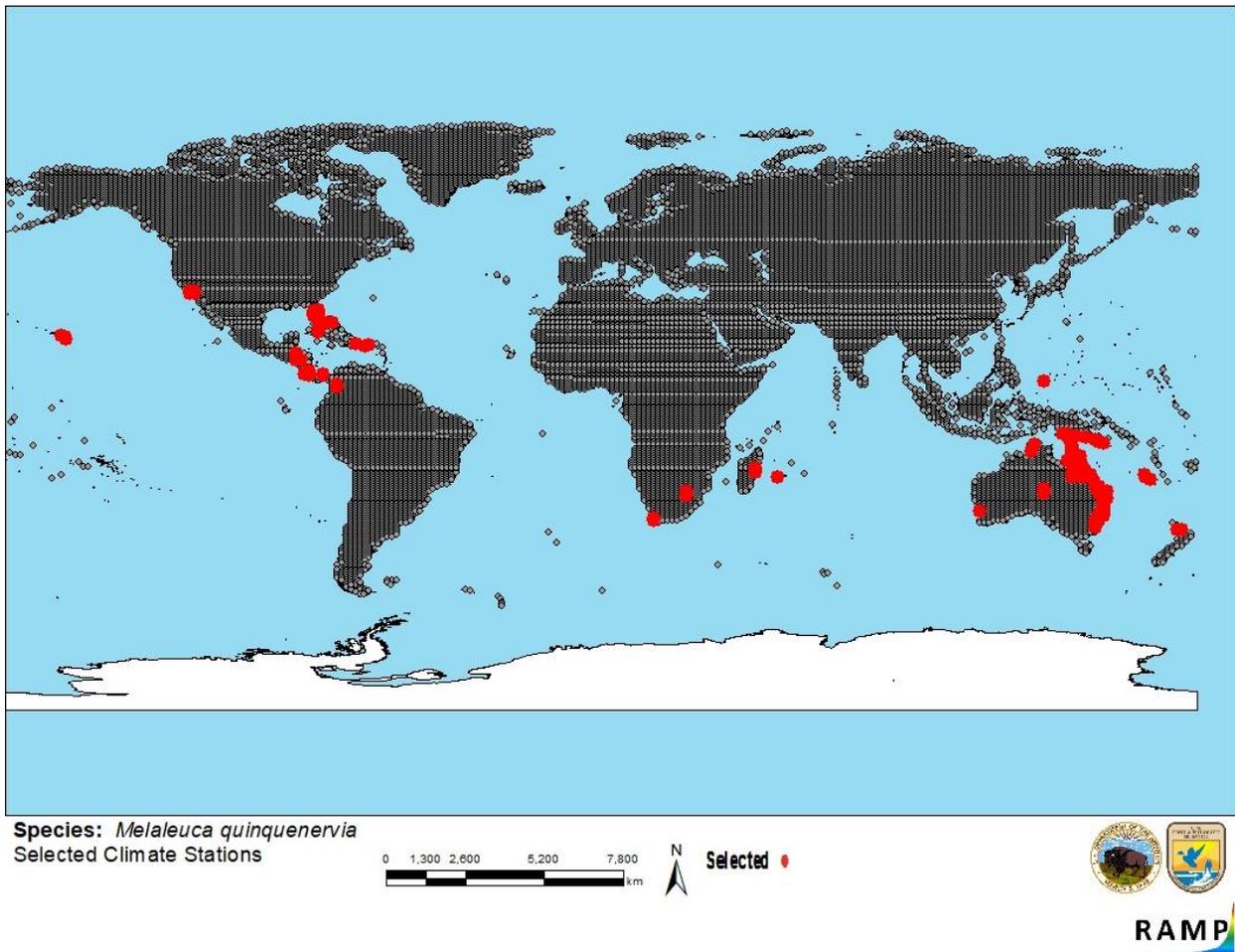


Figure 3. RAMP (Sanders et al. 2014) source map showing weather stations selected as source locations (red) and non-source locations (gray) for *Melaleuca quinquenervia* climate matching. Source locations from GBIF Secretariat (2017).

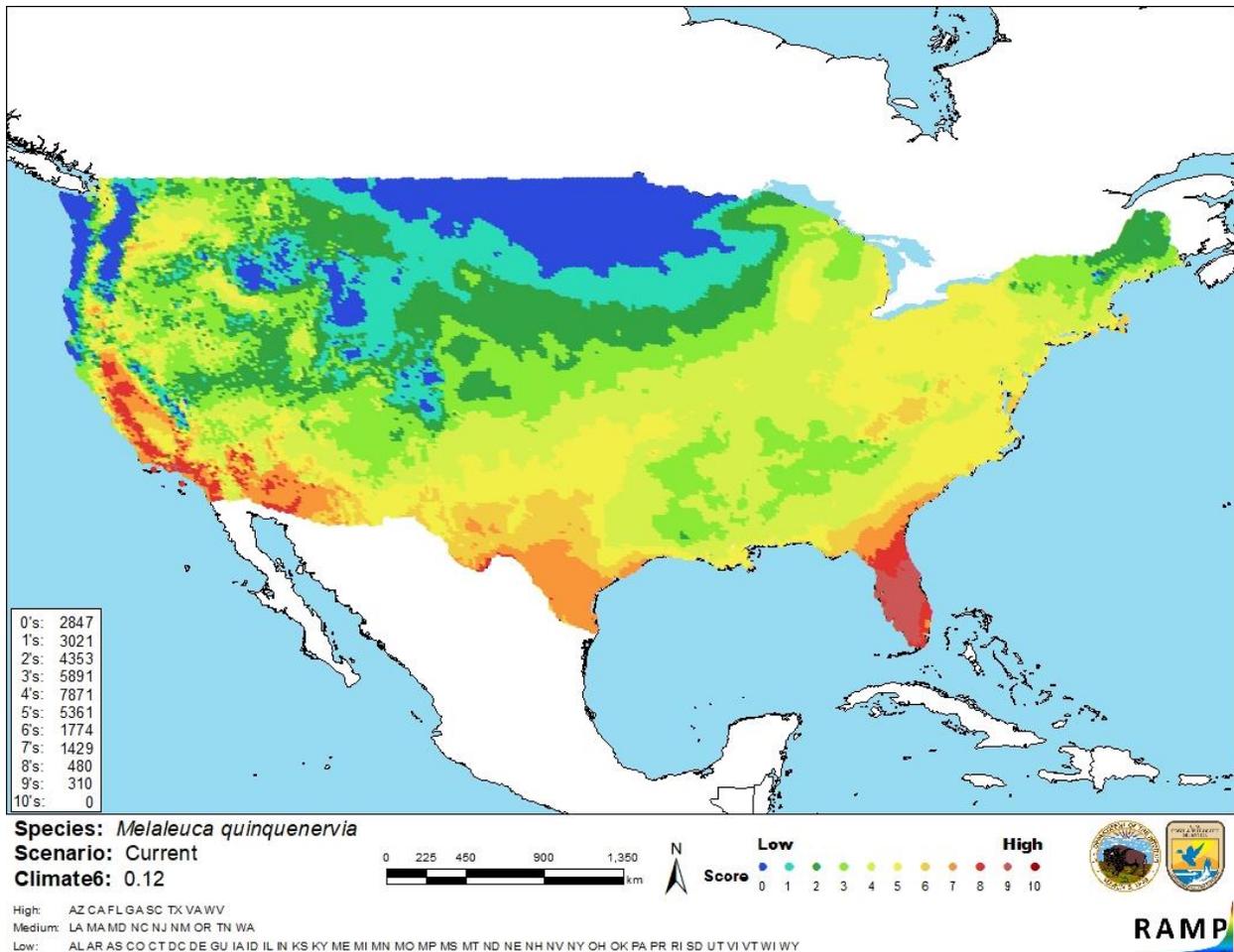


Figure 4. Map of RAMP (Sanders et al. 2014) climate matches for *Melaleuca quinquenervia* in the contiguous United States based on source locations reported by GBIF Secretariat (2017). Counts of climate match scores are tabulated on the left. 0=Lowest match, 10=Highest match.

The “High”, “Medium”, and “Low” climate match categories are based on the following table:

Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)	Climate Match Category
$0.000 < X < 0.005$	Low
$0.005 < X < 0.103$	Medium
≥ 0.103	High

7 Certainty of Assessment

Information on the biology, ecology, distribution, and impacts of introduction for *Melaleuca quinquenervia* is readily available for review. Although many occurrences of *M. quinquenervia* have been reported from numerous countries across the world, the distribution may be broader than currently documented. Given pervasiveness of information available, certainty of assessment for *Melaleuca quinquenervia* is high.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Melaleuca quinquenervia is a tree species native to Tropical Asia, Australasia, and Pacific-New Caledonia. Distribution across the world has greatly expanded from introductions of the species as an ornamental, use as windbreaks, and other agroforestry purposes. While distribution is unclear, *M. quinquenervia* has been reported in nearly sixty countries across the globe. The species has provided some ecological and economic benefits in some of these areas, but ultimately is considered highly invasive. Impacts include the formation of impenetrable thickets, reduction of biodiversity, displacement of native vegetation, diminishment of habitats for wildlife, loss of groundwater due to increased evapotranspiration, as well as negative social and economic impacts. Currently established in Florida and Louisiana, its presence within the United States poses a direct threat to unique locations such as the Everglades, and a threat to native species within these areas. Climate match within the contiguous United States is high overall and over 30 states could provide favorable habitat. Given the high history of invasiveness, numerous negative impacts of introduction, and high climate match, the overall risk of *Melaleuca quinquenervia* in the contiguous United States is high.

Assessment Elements

- **History of Invasiveness (Sec. 3): High**
- **Climate Match (Sec. 6): High**
- **Certainty of Assessment (Sec. 7): High**
- **Overall Risk Assessment Category: High**

9 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

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10 References Quoted But Not Accessed

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

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