GLOBAL INVASIVE SPECIES DATABASE

FULL ACCOUNT FOR: ***Melaleuca quinquenervia***

Melaleuca quinquenervia 简体中文 正體中文

System: Terrestrial

Kingdom	Phylum	Class	Order	Family
Plantae	Magnoliophyta	Magnoliopsida	Myrtales	Myrtaceae

Common name

melaleuca (English, Puerto Rico), cajeput (English), Mao-Holzrose (German), paper bark tree (English), five-veined paperbark tree (English), punk tree (English), itahou (English), niaouli (English, New Caledonia), capeputi (English), kinindrano (English, Madagascar), balsamo de cayeput (English), oli (English, Madagascar), aceite de cayeput (English), ahambo (English, Madagascar), white bottlebrush tree (English), paperbark teatree (English), belbowrie (English), niaouli (French), Japanese paper wasp (English), broad-leaved paperbark tree (English), corcho (English), numbah (English), kayu putih (English), bottle brush tree (English), broadleaf teatree (English), broadleaf paperbark tree (English)

Synonym

Metrosideros quinquenervia , Cav.
Metrosideros coriacea , Poir.
Melaleuca leucadendron , var. *coriacea* Poir.
Melaleuca leucadendron , **?** *angustifolia* L.f.
Melaleuca viridiflora , var. *angustifolia* L.f.
Melaleuca viridiflora , var. **?** *rubriflora* Brongn. & Gris
Melaleuca rubriflora , Vieillard ex Brongn. & Gris
Melaleuca leucadendron , var. *rubriflora* Brongn. & Gris
Melaleuca maideni , R.T. Baker
Melaleuca smithii , R.T. Baker
Melaleuca leucadendron , var. *albida*

Similar species

Summary

The broad-leaved paperbark tree or melaleuca (*Melaleuca quinquenervia*) can reach heights of 25 meters and hold up to 9 million viable seeds in a massive canopy-held seed bank. This fire-resistant wetland-invader aggressively displaces native sawgrass and pine communities in south Florida, alters soil chemistry and modifies Everglades ecosystem processes. Melaleuca is notoriously difficult to control, however, bio-control (integrated with herbicidal and other methods) holds a promising alternative to traditional control methods.

view this species on IUCN Red List

Species Description
The Australian broad-leaved paperbark tree (herein referred to as \"melaleuca\") is a member of the Myrtaceae family, which comprises about 4000 to 5000 tropical and temperate species (Watson & Dallwitz 1992, in Dray Bennett & Center 2006). Recent research incorporating DNA studies has resulted in an improved classification of the family (Wilson *et al*. 2005). Earlier classifications in which a primary division was based on the possession of dry or fleshy fruit are not congruent with the evolutionary relationships shown by analysis of DNA sequence data.*Melaleuca*, which now includes *Callistemon*, belongs to the tribe Melaleuceae (Craven 2006, Wilson *et al*. 2005). \r\n
Melaleuca can reach 25 meters in height and grow to 90 centimeters in diameter. It is easily recognised by its spongy flaking bark (white, cream, orange-cream, fawn-grey or dark grey in colour (Craven, in press), lanceolate five-veined leaves, and clusters of woody seed capsules (Laroche 1999). Its white papery bark resembles birch and its white flower clusters resemble bottlebrush (Gioeli & Neal 2004). Its white tufted inflorescences are indeterminate, two to five centimeters long and arranged in bottlebrush-like spikes (Holliday 1989, in Center *et al*. 2006). Flowers of *M. quinquenervia*, like most Myrtaceae, have numerous stamens on a cup-shaped hypanthium surrounding the ovary. Myrtaceae leaves are simple and entire and the plants are usually aromatic (Laroche 1999); some have an intense citrus-like or eucalyptus oil odour when crushed (FLEPPC Undated).Within the spike-like inflorescence, flowers are clustered in threes; and secrete nectar, which collects within the base of the hypanthium; the stamens are arranged in five bundles each bundle consisting of five to ten fused stamens; the petals and filaments are usually white or creamish (Laroche 1999, L. Craven, pers. comm.). The capsular fruits, 2.7-4mm long, may persist for several years (Meskimen 1962, in Center *et al*. 2006). Please see the *Melaleuca Management Plan 1999*) for botanical illustrations of *M. quinquenervia* (page 10).

Notes
M. quinquenervia is a member of the Myrtaceae (myrtle family) which also includes the *Eucalyptus* (gum) genus (Laroche 1999). Melaleuca (Myrtaceae) is the second largest genus in the Myrtaceae family and is represented by up to 250 species (Barlow 1986, in Turner *et al*. 1998), including a number of undescribed species.\r\n\r\n
M. quinquenervia is part of the broad-leaved *Melaleuca leucadendra*-complex, which contains 15 species that are endemic to the Australian-Tasmanian region (Craven 1999, in Wineriter *et al*. 2003). The name *Melaleuca* comes from the Greek, meaning black and white, presumably referring to the white bark, often charred black by fire (Debenham, 1962, in Turner *et al*. 1998).

Lifecycle Stages
Melaleuca trees may reach 90 years and still remain fertile (Serbesoff-King 2003).
Seedling and Sapling Stages: Seedlings appear to be less tolerant of harsh environmental conditions than are the seeds (Woodall 1983, in Turner *et al*. 1998). Melaleuca seeds germinate upon moist soils, usually within a few days of wetting, and may remain viable up to six months under water or in wet soils (Meskimen 1962, Myers 1975, in Laroche 1999). Seeds may germinate while completely inundated (Lockhart 1995, in Laroche 1999). Meskimen (1962, in Laroche 1999) found a trend for germination to occur more in sun than in shade. Rarity of seedlings within dense stands of melaleuca may be from either shading or allelopathic effects of melaleuca litter (DiStefano & Fisher 1983, in Laroche 1999). Seedlings less than several weeks or months old may die from fire or if soils are dry (Myers 1975, 1983) Droughts severe enough to lower the water table by one meter will also kill the seedlings (Woodall 1981a, in Turner *et al*. 1998). Seedlings are also less tolerant of fires, as they have a thinner, insulating bark layer (Woodall 1981a, in Turner *et al*. 1998). Soon after seedlings are able to withstand extreme conditions ranging from fire to total immersion for months (Meskimen 1962, in Laroche 1999). Young saplings and seedlings respond to inundation by changing leaf shapes. Leaves become more linear when meristems are deeply flooded, and more rounded when the meristem is nearer to the water surface (Laroche 1999). This adaptation may enable better light or nutrient utilisation, or help the saplings to survive flooding (Lockhart, 1996).

Uses
Worldwide, many of the 4000-5000 Myrtaceae species are cultivated as ornamentals or as sources of fruits, spices, aromatic oils or timber (Laroche 1999). The thick, spongy bark has historically been used as fruit-packing, bedding material and insulation (von Mueller 1888, Morton 1966, in Dray Bennett & Center 2006).
Ornamental/landscaping: *Melaleuca* spp. are often planted as ornamentals, for screening, for their interesting bark and for their showy flowers (Turner *et al*. 1998). The small crown and distinctive bark have made it a popular ornamental tree (Greary Undated). It is widely cultivated for erosion control, windbreaks and watershed cover (Little & Skomen 1989, in Munger 2005).
Wood products: The medium-density wood is difficult to season and tends to warp, but it finishes well as a cabinet wood (Greary Undated). Without preservative treatment it makes a poor fence post and a major deterrent to use is the high bark-to-wood ratio (Greary Undated). Melaleuca has been used extensively for carpentry and joinery work and is used for structural timber, fuel, pulpwood and insulation/stuffing and for traditional dwellings in its native New Caledonia. The bark is useful for its insulating properties and as a mulch and potting medium (Greary Undated; Brown & Duke 2000, in Munger 2005). Cutting and chipping operations are currently utilising melaleuca wood for landscape mulching and boiler fuel in Florida (Stocker 1999).
Honey-making: In Florida, the abundant flowering crop has been important to the apiary industry to sustain bee colonies and as a source of honey (Greary Undated). While melaleuca is believed to be an important component of Florida's beekeeping industry (a source of nectar for honey, package bees, and wax) there are no indications that flowers are a limiting factor for bees (Diamond *et al*. 1991, in Laroche 1999).
Essential oils: Essential oils are extracted from its leaves, twigs and seeds by hydrodistillation from plantations in New Caledonia (Doran & Turnball 1997, Doran 1999 in Ireland 2002) and Madagascar (Ramanoelina *et al*. 2008). Essential oils constitute a principal antiseptic component in some commercial disinfectants (Dray *et al*. 2006).

Habitat Description
In its native range melaleuca occurs in seasonally and permanently inundated wetlands along the eastern coast of Queensland and New South Wales, Australia (11ºS to 34ºS) (Holliday 1989, in Burrows & Balcunas 1997; Boland *et al*. 1987, in Center *et al*. 2006). Australian habitats that support melaleuca populations include low-lying coastal wetlands behind heath-dominated headlands, riparian zones, brackish estuaries, mangrove swamps (Rayamajhi *et al*. 2002), *Melaleuca* swamp forest, monsoon scrub, littoral rainforest, grassland, open forest, low shrubland on coastal dunes and lagoon margins (Craven, In press). In its invaded territories, melaleuca can infest relatively drier areas (Buckingham 2000) and invades a variety of forested and non-forested natural communities, including: freshwater marshes, wet grasslands, sawgrass prairies, disturbed cypress forests, wet pine flatwoods, Miami rock ridge pinelands, longleaf-slash pine, hardwood hammocks, salt marshes and mangroves.
In general, xeric communities such as scrub tend to be resistant, but not immune, to melaleuca invasion (Laroche 1999). Favourable moisture conditions are found in pine flatwood depressions and the broad ecotones where pine and dwarf pond cypress mix (Duever *et al*. 1986, in Munger 2005). Melaleuca is tolerant of fire, seasonal drought and seasonal flooding (see Gomes & Kozlowski 1980; Geary & Woodall 1990). Melaleuca can grow in sites that are nutrient-poor such as pine savannas or wet prairies (Woodall 1981) due to its ability to send vertical roots straight down to the water table (Munger 2005).
As observed in Florida, Pratt (2005b) suggests wetlands that experience moderate to short hydroperiods are the most vulnerable to invasion by melaleuca. Melaleuca invades disturbed land such as abandoned farmlands, depressions in stump-harvested pinelands, road/canal wetland construction sites, improved pasture, natural rangeland and urban areas (Duever *et al*. 1986, Myers 1983 1984, in Munger 2005). Undisturbed ecosystems can be resistant, but not immune to, melaleuca invasion (Ewel *et al*. 1976, in Laroche 1999); however, in south Florida melaleuca has invaded essentially every existing community (Laroche 1999).
In Australia melaleuca occurs on sand, sandy loam, sandstone, laterite over sand, silty soil and serpentine substrates (Craven, In press), in New Guinea on highly organic, alluvial clays and in New Caledonia on well-drained slopes, ridges in the uplands (Geary Undated) and on flat, poorly drained soils (L. Craven, pers. comm.). Melaleuca establishes best on sandy soils but it can survive on nearly any soil type in south Florida (Ewel 1986, Hofstetter 1991, in Munger 2005). It is commonly found in Everglades ecosystems characterised by high organic soils (Pratt *et al*. 2004) or limestone-derived soils (Geary & Woodall 1990). Although melaleuca is found in soils of high pH plants may perform better in slightly acidic soils (Kaufman 1999, in Munger 2005). Melaleuca in Hawaii grow well on calcareous beach sand and on soils derived from basalt ash and lava rock of pH 4.5–5.5 (Geary 1998, in Geary Undated). According to Woodall (1981) a map of soil pH cannot be used to predict melaleuca invasion.
In its native habitat melaleuca is found mainly from sea level to 100m, but occasionally at elevations of 1000m (Geary Undated). Most of southern Florida, where melaleuca readily invades, is less than 8m above sea level (Geary & Woodall 1990). In its native habitat mean annual rainfall ranges from 900–1250 mm; mean monthly temperatures range from 5°C –32°C and in the southernmost part of its range, a few light frosts occur per year (Geary Undated). Where frequent freezing temperatures become common, melaleuca becomes less invasive (Munger 2005).The tree grows successfully in its introduced range where rainfall is 5000mm and a winter maximum occurs (Geary 1998, in Geary Undated).

Reproduction
Melaleuca trees may flower within three years of germination, sometimes in the first year, and produce seed as many as five times per year (Meskimen 1962, in Laroche 1999; Meskimen 1962, in Turner *et al*. 1998). In Florida, synchronised flowering events occur during winter (from November to January) and to a lesser degree in the summer (although a small proportion may reproduce at non-synchronised intervals) (Meskimen 1962). Bursts of vegetative growth generally occurring after flowering (between January and February) (Laroche 1999). In wet years, flowering and growth can be extended from July to April to with several flowering cycles (Laroche 1999). The number of capsular fruit produced per centimeter of infructescence is greater among populations in it's introduced range (eg: Puerto Rico and Florida) than in it's native range (Pratt *et al*. 2005b; Pratt *et al*. 2007). Reproduction occurs along flower-bearing branch segments; persistent capsular fruits arise from flowers and are arranged in clusters, which may remain attached to the trunks, branches or twigs for up to ten years (Laroche 1999; Meskimen 1962, in Center *et al*. 2006). Melaleuca has two reproduction possibilities due to the fact that seed retention extends beyond seed ripening; first, a low-level, virtually continuous seed release ensures that at least some of the seeds on the ground near the tree will be fresh, thus allowing the species to exploit all reproduction opportunities no matter how short they are in duration; second, retention of seeds allows for a potential mass seed release if some natural catastrophe kills the tree (Woodall 1983, in Laroche 1999).
Melaleuca is an extremely prolific seed producer. Capsules each contain 200 to 350 minute seeds (Meskimen 1962), and the canopy of a 21 meter high tree may produce 34 kg of mature capsules that contain up to 100 million seeds (Rayamajhi *et al*. 2002b, in Serbesoff-King 2003; Van Rayamajhi & Center 2005). Studies have shown that of these 10% to 15% contain embryos and of these embryonic seeds 62% are viable (Rayachhetry *et al*. 1998 , in Serbesoff-King 2003), giving a total potential 9 million viable seeds per mature large tree; and one hectare may store as many as 25 billion seeds; this represents a massive canopy-held seed bank (Rayamajhi Unpub. Data, in Center *at al*. 2006). Results from seed burial tests indicate that seed viability is decreased by about 50% after eight months in the soil (Laroche 1999). Most buried seeds lose viability after about 1.5 years at seasonally flooded and permanently flooded sites, whereas seeds buried at non-flooded sites survived over a period up to 2 to 2.3 years (Van, Rayamajhi and Center 2005).
The seed capsule must be dry before the seed will be released; anything that disrupts vascular connections thereby causing the capsules to desiccate and open will stimulate melaleuca seed release (Center *et al*. 2006). Desiccation can be caused by stem growth, cutting or breaking of the stem, fire damage, frost damage, self pruning due to shade, natural death of the tree or herbicide application (Laroche 1999; Woodall 1982, in Munger 2005).
Melaleuca trees resprout and coppice readily (Conde *et al*. 1981, Hofstetter 1991, in Serbesoff-King 2003) following man-made cutting or natural damage. Extensive rooting and sprouting can occur from a fallen or cut tree (Serbesoff-King 2003). Melaleuca logs used as fence-posts frequently sprout new growth (Laroche 1999; Munger 2005).
Melaleuca is pollinated by a variety of insects, most commonly honeybees, however, seed fertility is low. Pollination within the same flower results in reduced fruit set compared with pollination between flowers, promoting out-crossing. Flowering and seed production are less on shaded branches than on emergent canopy branches (Meskimen 1962, in Munger 2005).

General Impacts
For a detailed account of the impacts of *M. quinquenervia* please read: *Melaleuca quinquenervia* (Broad-Leaved Paperbark) Impacts Information. The information in this document is summarised below.
Melaleuca is the most problematic invasive plant species in Florida because of its wide distribution range, prolific seed production and potential impact on human health (Fuller 2005). Melaleuca threatens the preservation of critical wildlife habitat in southern Florida including in the Florida Everglades National Park. Despite control efforts melaleuca still occurred in around 170 000 hectares of southern Florida in 1997, representing 6% of the total region (Bodle & Van 1999, in Rayamajhi *et al*. 2007; Laroche 1999).
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*. 2008b), slash pine (*Pinus elliottii*) 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*. 2005b). 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*. 2006b).

Management Info
For a detailed account of managment of *M. quinquenervia* please read: *Melaleuca quinquenervia* (Broad-leaved Paperbark) Management Information. The information in this document is summarised below.
Current management methods for melaleuca include herbicides, manual removal of plants, prescribed fires and bio-control.
Preventative Measures: Preventative measures are the best form of weed control. Education on the potential threats posed by melaleuca on invaded ecosystems should be targeted at the nursery industry and the general public.
Monitoring and Mapping: Model projections suggest there is considerable scope for further invasion of melaleuca under current climate conditions, with the highest risk areas occurring in Southeast Asia, the Caribbean, South and Central America and the Gulf coast in southern USA.
Physical:\nMechanical removal using heavy equipment is not appropriate in most natural areas because of disturbances to soils and non-target native vegetation; however, this method of control can be applied along canal and utility rights-of-way (Laroche 1999).
Physical: Physical methods also include the use of prescribed fire and of flooding More information is needed on the timing of prescribed burning, and constraints to this method include impacts on non-target species, the triggering of mass seed release by trees and liability concerns (Turner et al. 1998).
Chemical/Herbicidal Control: Exotic woody vegetation is most frequently managed by herbicides (Laroche 1999). Hexazinone and tebuthiuron are most effective in the control of melaleuca (Laroche 1999), however, they are no longer allowed to be applied directly to water in Florida (Laroche 1998a, in Serbesoff-King 2003). Current chemical control recommendations for melaleuca include low volume applications of glyphosate for control of saplings, and aerial or individual stem (girdle) applications of imazapyr alone, or in combination with glyphosate for mature trees (Langeland and Stocker 1997, in Stocker 1999).
Biological control: The lack of a long-lived soil seed bank (Van *et al*. 2005, in Center *et al*. 2007) makes M. quinquenervia vulnerable to herbivore-mediated reductions in fitness and delays in reproductive maturation. As canopy-held seed banks continue to diminish over time (Pratt *et al*. 2005), seedling suppression is predicted to have long-term effects on plant density. Two bio-control agents, the Australian melaleuca snout weevil (*Oxyops vitiosa*) and the Australian melaleuca psyllid (*Boreioglycaspis melaleucae*), have been approved by the USDA for use against melaleuca (Cuba *et al*. 2003, Wineriter *et al*. 2003, in Gioeli & Neal 2004) and have been released in the field. Research is being conducted on at least six other potential bio-control agents, including leaf, stem tip, and flower bud feeders (Burrows & Balciunas 1997 1998, Turner *et al*. 1998, in Stocker 1999). \n
Legislative: Melaleuca is on both the United States' Federal Noxious Weed List and the Florida Prohibited Aquatic Plant List (Class I Prohibited aquatic plant) (Florida Department of Environmental Quality). \n
Integrated management: As a result of the implementation of the integrated *Melaleuca Management Plan 1999* almost 100 000 acres of natural area have been cleared of melaleuca (Laroche 1994).
The Areawide Management Evaluation of Melaleuca quinquenervia (TAME) aims to demonstrate the effectiveness of integrated control of melaleuca in invaded habitats in the United States and elsewhere.

Pathway
Melaleuca quinquenervia has been internationally disseminated over the course of the last century for ornamental, revegetation, and agroforestry purposes (Turner *et al*. 1998, Serbesoff-King 2003, Dray 2003, in Pratt *et al*. 2005b).

Principal source: Pacific Island Ecosystems at Risk (PIER).

Compiler: IUCN/SSC Invasive Species Specialist Group (ISSG)

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ALIEN RANGE

[1] ANTIGUA AND BARBUDA
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[1] SAINT LUCIA
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Summary: The gall-forming Fergusonina/Fergusobia association is being considered as a potential biocontrol agent of *Melaleuca quinquenervia* in Florida, where it has become a serious weed. This paper reports observations on the development of Fergusonina/Fergusobia galls on *M. quinquenervia* in coastal and sub-coastal south-eastern Queensland and northern New South Wales. The morphology of the gall and the relationship between gall size and numbers of developing cavities and insects are described. Nematodes were found in cavities containing first and second or early third stage fly larvae. Eight species of hymenopteran parasitoids were reared from galls.

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Summary: This compilation of information sources can be sorted on keywords for example: Baits & Lures, Non Target Species, Eradication, Monitoring, Risk Assessment, Weeds, Herbicides etc. This compilation is at present in Excel format, this will be web-enabled as a searchable database shortly. This version of the database has been developed by the IUCN SSC ISSG as part of an Overseas Territories Environmental Programme funded project XOT603 in partnership with the Cayman Islands Government - Department of Environment. The compilation is a work under progress, the ISSG will manage, maintain and enhance the database with current and newly published information, reports, journal articles etc.
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