SSWEC123

Ecological Consequences of Invasion by *Melaleuca quinquenervia* in South Florida Wetlands: Paradise Damaged, Not Lost[1]

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This document gives an overview of the background and current approaches to Melaleuca quinquenervia *infestations in south Florida. The question is whether melaleuca will cause south Florida's ecological paradise to be lost, or only damaged.*

Introduction

Wetlands of the greater Everglades/south Florida ecosystem have been drained, filled, and developed for the past century to such an extent that critical functions: water purification, aquifer recharge, and diversity of wildlife habitats have been diminished.

Prevention of further loss and degradation of wetlands is an essential component of plans to restore the south Florida ecosystem (Davis and Ogden 1994; Science Sub-group 1993; Science Sub-group 1994). Invasion by non-native (exotic) species contributes to degradation of undeveloped wetlands, and should be curtailed helping infested areas return to a more natural state.

Although invasion of natural systems by alien species is a serious—if not catastrophic—threat to the ecological integrity of south Florida, urban development is a greater threat. Development eliminates wetlands, and developed areas contribute to degradation of adjacent natural areas. They do this by associated storm water runoff, pollution, habitat fragmentation, and hydrological disruption.

These areas also serve as staging grounds for invasions by numerous exotics, including other undesirable plants as well as feral animals, which are inevitably associated with development.

Melaleuca Invasion

Melaleuca quinquenervia is the most prominent of 60 exotic plant species invading many natural wetland and upland areas, including the Everglades, now a United Nations World Heritage site and UNESCO Man and Biosphere Reserve. *Melaleuca quinquenervia*, now present on 450,000 acres of south Florida, threatens efforts to preserve and restore this precious resource. Recent studies show that many melaleuca infestations have increased 50-fold over the past 25 years (Laroche and Ferriter 1992). Heavily infested sites can contain as many as 31,000 trees and saplings per acre.

Melaleuca infests pine flatwoods, hardwood bottomlands, cypress forests, freshwater marshes, sawgrass prairies, and mangrove communities—as well as improved pasture, natural rangeland, idle farmland, urban, and other areas (DiStefano and Fisher 1983; Ewel et al. 1976; Hofstetter

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and Sonenshein 1990; Myers 1983; Myers 1984; Richardson 1977; Woodall 1983).

Melaleuca control efforts within the state cost more than $2.2 million annually (Laroche 1994). An economic study commissioned by the Florida Department of Environmental Protection (DEP) stated that the unbridled spread of melaleuca would severely restrict use of south Florida's parks and recreation areas by local residents and tourists. Potential losses to the local economy were estimated at about $168.6 million annually (Diamond et al. 1991).

A multi-agency task force organized by the Exotic Pest Plant Council convened in 1990 (and in 1994) to develop a comprehensive plan for managing melaleuca-infested wetlands. The task force consisted of scientists and resource managers representing key federal, state, and local agencies charged with protecting and managing the wetlands that encompass Florida's Everglades. This group noted that, while eradication of melaleuca was impossible, its continued spread could be curtailed, and infested areas could be restored (Laroche 1994).

This task force recommended a strategy to manage melaleuca by first treating single trees (especially those most distant from primary stands) to begin creating melaleuca-free buffer zones. They observed that neglecting these outlying individuals ensures unchecked spreading resulting primarily from coalescence of small heads at the periphery of infested areas. Hence, the value of controlling a single tree increases exponentially as one moves from the center of a dense stand outward towards the periphery of scattered individual trees.

Contrarily, any plan or effort that concentrates on the removal of the central densest portions of a melaleuca infested area provides little overall benefit in terms of precluding expansion. Melaleuca "management" plans which tout the replacement of dense melaleuca stands with urban development have another disadvantage: they thwart ecosystem restoration options.

CONSEQUENCES WITHIN INVADED ECOSYSTEMS

There is no doubt that invasive, non-native plant and animal species pose a significant threat to the ecological integrity, meaning structure and function, of natural areas (Coblenz 1990; Schmitz and Brown 1994). (Ecosystem *structure* refers to tangible features: soil, water, plants, and animals. Ecological *functions* are defined as the interrelationships or exchange of energy and materials between components of a system.) Invasion by alien species can cause:

- Displacement of native species.
- Reduction in wildlife habitat value.
- Alteration in hydrology.
- Modification of soil resources.
- Changes in fire regimes.

Although detailed quantitative studies of the ecological effects of invasive species in south Florida have not been performed (Science Sub-group 1994), two recent reports published by DEP (Schmitz and Brown 1994) and the Exotic Pest Plant Council (Laroche 1994) provide excellent qualitative summaries of the ecological impacts of melaleuca. In brief, melaleuca has caused all of these impacts.

Displacement of Native Plant Species

Melaleuca forests have displaced natural plant communities in south Florida (DiStefano and Fisher 1983; Ewel et al. 1976; Hofstetter and Sonenshein 1990; Myers 1983; Myers 1984; Richardson 1977; Woodall 1983). In the Everglades region, graminoid (grass and sedge) marshes are the predominant plant community affected. Forming dense stands that shade out native wetland species, melaleuca forms monospecific forest stands where graminoid marshes once stood.

Although differences in plant species' composition and structure between marsh and melaleuca forest are obvious, what are other ecological effects of this transition? In particular, is the characterization of melaleuca habitats as biological deserts with no value as wildlife habitat accurate?

Loss of Wildlife Habitat

Mazzotti et al. (1981) and Ostrenko and Mazzotti (1981) trapped small mammals in a variety of habitats in the east Everglades, including areas contaminated to varying degrees by melaleuca and casuarina. Within this region, melaleuca habitats had fewer small mammals than native hammock communities trapped previously by Smith and Vrieze (1979). Melaleuca habits had *higher* numbers when compared to casuarina habitats or to the sawgrass prairies being invaded. Ostrenko and Mazzotti (1981) observed predators of small mammals (including a barn owl and an endangered indigo snake) in melaleuca habitats. Based on these observations, the authors concluded that although non-native plant communities were not good habitats for wildlife, they should not be classified as biological deserts.

Since Mazzotti et al. (1981), Ostrenko and Mazzotti (1981) and Smith and Vrieze (1979) sampled in habitats that varied in degree of flooding, habitat structure, and species composition, it is not possible to critically assess factors that resulted in differences in habitat occupancy of Everglades rodents. Sowder and Woodall (1985) trapped small mammals in habitats more representative of the pine flatwoods region in southwestern Florida. Three sites were forested, one was ruderal; all had a similar hydroperiod. These authors found greater numbers of small mammals in a cypress strand than a melaleuca head, which they attributed to greater ground cover in the cypress habitat. No small mammals were captured in another melaleuca head and a powerline transmission corridor. Sowder and Woodall (1985) concluded that utilization of a particular melaleuca habitat by small mammals may depend on the area in which it is located than on characteristics of the melaleuca habitat itself.

Schortemeyer et al. (1981) conducted wildlife surveys (primarily birds) in melaleuca heads scattered in a freshwater prairie. A total of 2,752 sightings of 30 species of birds were made. Most of these sightings were of incidental activities: feeding and nesting were the least common activities. Schortemeyer et al. concluded that although their results partially dispel the notion that melaleuca habitats form a biological desert, the tendency of melaleuca to displace native plant communities makes it undesirable for wildlife.

The contention that melaleuca eliminates all value of a wetland as fish and wildlife habitat is simply not true: The impacts of melaleuca invasion on wetland wildlife depends on the degree of infestation, and on the quality of surrounding areas. Even extensive monocultures support some levels of wildlife activity (Mazzotti et al. 1981; Ostrenko and Mazzotti 1981).

Scattered exotic trees can add habitat diversity to a graminoid wetland (marsh) community. Example: endangered snail kites perch on melaleucas more frequently than chance would dictate (Bennett et al. 1988). Small, dense islands of exotics in a sea of less-disturbed marsh habitat can provide essential cover for wildlife, which then forage in less-impacted areas.

This explanation should not be interpreted as a testimonial for non-native species. (We are not advising anyone to provide snail kite perches by planting melaleuca.) But it is an acknowledgment that a few, scattered trees may enhance rather than diminish the current ability of an area to support fish and wildlife. However, as dominance by melaleuca increases the ecological value of a marsh is diminished. Yet, the invaded marshes retain their essential functions and characteristics as graminoid wetlands until canopy closure ensures transition to monospecific melaleuca forest stands. Further, even at 100% dominance some wildlife habitat values remain. Thus, characterizing melaleuca-infested wetlands as ecologically valueless, biological deserts is inaccurate.

Water and Soil Resources

Does invasion by melaleuca alter wetland hydrology? This is a difficult question to answer because so many factors (including human manipulation) simultaneously impact wetland hydrology. Melaleuca seems to thrive best in areas of peat soils and shortened hydroperiods, which encourage germination and growth of seedlings. Resulting infestations are hypothesized to dry out wetlands because of an increase in evapotranspiration rates. This hypothesis is based on measurements of transpiration rates across the surface of individual leaves and an estimate of total leaf area in mature melaleuca stands (Hofstetter 1991b in Laroche 1994). Studies of whole trees or entire forests are lacking, but the south Florida Water Management District (SFWMD) hopes to use such methods to test this hypothesis in the near future.

Melaleuca stands may alter wetland hydrology by changing soil topography. The continual rain of leaf and branch litter from the forest canopy, combined with the absence of fire may create an elevated tree island where none existed before (Laroche 1994). We suggest that dense melaleuca forests may alter hydrology (depth and period of flooding) by building land, and, perhaps, by increasing transpiration rates. Predicting consequences of hydrologic changes, however, is unwise given the lack of studies 1) measuring the magnitude and duration of any such changes, and 2) relating these factors to other forces affecting wetland hydrology.

Fire

The amount of available fuel for ground fires increases as melaleuca invades sawgrass marshes (Flowers 1991). Compared to freshwater marshes, fires in melaleuca forests burn at higher temperatures, which can dry out and ignite surface organic soils (Hofstetter and Sonenshein 1990). Highly volatile oils in melaleuca leaves contribute to intense crown fires that spread rapidly over an invaded landscape (Wade 1981). The ecological ramifications of these different fire patterns are not, as yet, fully understood.

Melaleuca Wetlands and the Restoration of South Florida

Perhaps the most valuable ecological function of melaleuca-infested wetlands is their potential role in current efforts to restore the Everglades ecosystem and establish a sustainable south Florida. Even without restoration or enhancement, melaleuca wetlands still serve by maintaining water supplies and providing flood management for growing urban populations. Restored wetlands can increase the spatial extent and habitat diversity of the current Everglades system. Restoration of ecological and hydrological conditions and connectivity of degraded wetlands on the edge of the Everglades is crucial to the restoration of the greater Everglades/south Florida Ecosystem (Davis and Ogden 1994; Science Sub-group 1993; Science Sub-group 1994).

The Future

The subtitle of this document "Paradise Damaged, Not Lost" provides an apt description of the ecological condition of south Florida as a whole. In spite of drainage, development, and invasion by alien species, south Florida has proven to be remarkably resilient. Land- and water-use planning, hydrological restoration, and management of invasive non-native species are the key ingredients of a successful ecosystem restoration program (Science Sub-Group 1994).

No other invasive exotic has such a clearly articulated management plan as *Melaleuca quinquenervia*. The "Melaleuca Management Plan for Florida" (Laroche 1994) is a synthesis of years of research and practical experience in melaleuca biology and management. This plan provides a realistic, holistic strategy for melaleuca management in the state. One of its main objectives is to coordinate with—and support the goals of—the south Florida Ecosystem Task Force.

Managing melaleuca will be expensive, time-consuming, and risky; but it is no exaggeration to say that the restoration of this unique, internationally significant wetland system depends on it. Two noteworthy public-private partnerships may provide an example of how recovery of melaleuca degraded wetlands can be integrated with Everglades restoration and economic sustainability.

First, the Lake Belt Plan (Larsen and Assoc. 1992) is a coordinated development plan to rock-mine, mitigate, restore, and protect wetlands in 54,000 acres of Dade county. This effort is under evaluation by federal, state, regional, and local agencies. Currently, most of the proposed Lake Belt area can be described as wetland, with varying levels of degradation ranging from stands of dense melaleuca to relatively undisturbed prairie. The plan's purpose to join public and private interests by encouraging economic development while providing large scale recreational, water supply, and wetland benefits.

Second, the Florida Wetlandsbank in Pembroke Pines, Broward county, is a 358-acre site infested with invasive exotics, overrun by all-terrain vehicles and littered by trash dumping (Florida Wetlandsbank undated). A restoration, enhancement, and monitoring program is being developed through a cooperative agreement with the city of Pembroke Pines and with e private-sector support. This for-profit ecological restoration project by private interests on public land will be funded by selling mitigation "credits" to developers from the "bank".

Summary

Today in Florida, a combination of integrated pest management, ecosystem restoration, and public-private partnerships is beginning to be applied to achieving the goal of the Melaleuca Task Force (Laroche 1994):

"…to protect the integrity of Florida's natural ecosystem from the biological degradation caused by the invasion of melaleuca."

Public awareness and participation will be essential components of this and all efforts to rehabilitate and restore south Florida's ecological paradise, before we lose it entirely.

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