Cost-Effective Mapping of Invasive Plants Using Systematic Reconnaissance Flights (SRFs)

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Why SRFs?

The quarantine strategy is recognized as one of the most effective strategies for controlling invasive plant populations. The quarantine strategy as described by Woodall 1981 is where the least-infested areas (outliers) are addressed first in order to stop the progression of the existing population.

Detection of individual trees and scattered small clusters is imperative for the success of the quarantine strategy. Attempts to map individual trees and small clusters of invasive plants in south Florida such as *Melaleuca quinquenervia* through remote sensing have not been successful. For example, in 1988 efforts to detect Melaleuca from false color infrared (1:10,000) in Everglades National Park showed that Melaleuca had a distinctive signature and could be identified on the imagery; however, imagery was not successful at locating individual trees and small clusters (Rose and Doren 1988).

Systematic aerial surveys or systematic reconnaissance flights (SRFs) have been widely used to estimate species abundance and distribution of biological populations. SRFs have shown to be particularly practical when a study area is large or remote (Quang and Lanctot 1991). In Florida, SRFs have been shown to be the most practical and cost effective method to map individual populations of invasive plants.

History of SRFs in Florida

In 1980, the U.S. Forest Service (Cost and Craver1980) conducted the initial SRFs for invasive plant mapping in south Florida, covering over seven million acres. The goal of the survey was to map the distribution of Melaleuca in south Florida. The survey used east–west transect lines spaced at five mile intervals across southern Florida to sample Melaleuca distribution. The survey used a Cessna Sky Master flying at 500 ft above ground level (agl). Two observers on either side of the aircraft classified the vegetation on one acre plots using an aiming device at five second intervals. A navigator was used, in addition to the observers and the pilot.

In 1990, Big Cypress National Preserve (BCNP) started an SRF program to document the spatial distribution of invasive plants with an emphasis on Melaleuca. The distribution maps could be used for treatment prioritization and to provide exact locations for control crews. Due to the prolific nature of the tree and the limited budget to control the trees, the SRF program had to ensure 100% coverage of BCNP, with a maximized tree recovery rate. Additionally the program would need to be set up so that the work could easily be reproduced to document control success.

All previous SRFs that had been conducted relied on statistical extrapolation of the results from a limited number of transects. BCNP wanted 100% coverage in order to accu-

rately determine the extent of Melaleuca and other exotic plant species that could be detected from the air. The survey used east–west transects spaced at 1,000-m intervals to assure 100% coverage (census). Two observers on either side of the aircraft recorded invasive plants detected within a half-kilometer of the aircraft. When an invasive plant was sighted by one of the observers, the pilot is directed to deviate from the transect, in order to directly fly over each target. Once over the target the position is entered into the GPS and the species/density recorded. The pilot then re-establishes the aircraft on the flight line. The annual SRFs revealed that Melaleuca reached the height of its infestation in 1992. Melaleuca at varying densities occupied 186 square miles (482 sq km) (Snyder et al. 2003). In 2003, the Melaleuca control program at BCNP completed the initial treatment of all detected Melaleuca. The success of the program can be attributed to accurate distribution maps produced by SRF. In 1999, Everglades National Park and Loxahatchee National Wildlife Refuge (NWR) also began to utilize 1-km-transect SRFs to map invasive plant species.

In 1993, the SFWMD began conducting biannual SRF in order to document the status, distribution, rates of expansion, and habitat preferences of all targeted invasive plants in southern Florida (eight million acres). The SRFs used east–west transects spaced at 2.5-mile intervals across southern Florida to sample invasive plant distribution. Two observers flying at 500 ft agl classified the vegetation on one acre plots using an aiming device at eight second intervals. Species and density information were recorded on a GPS.

In 1999, the South Florida Water Management District (SFWMD), NPS, and Loxahatchee NWR, at the recommendation of the South Florida Ecosystem Restoration Task Force's Nuisance Exotic Weed Task Team (NEWTT), began to conduct the biannual surveys collaboratively by nesting the surveys. The SFWMD began using 4-km transects, and the NPS and Loxahatchee NWR continued using 1-km transects with the transects overlapping over federal lands (Ferriter and Pernas 2005). By combining resources, the NPS, Loxahatchee NWR, and the SFWMD can maximize efficiency and ensure compatible data sources.

By 2005, the scope of the SFWMD SRFs had expanded to include almost the entire state of Florida (20 million acres) with funding assistance from the U.S. Department of Agriculture's Areawide Management and Evaluation of Melaleuca program (TAME). TAME is an area-wide pest management program designed to promote long-term, biologically based management for the invasive Melaleuca problem in southern Florida.

Due to its large geographical extent, and the fact that the survey is only flown in the winter months to optimize plant detection, the SRFs have been compartmentalized. Portions of the state are flown each year in an alternating regional design to allow for complete coverage of the study area. Past survey results (1993–2005) are available for viewing and download at http://tame.ifas.ufl.edu/ (Ferriter and Pernas 2005).

Conclusions

SRFs are a fast, accurate, and cost-effective method for mapping selected invasive plant species over large areas. SRFs can either provide land managers with detailed maps of invasive plant distribution, or provide land managers with broad-scale species distribution information. Average costs for SFWMD surveys, including initial equipment purchases, have been $0.005 per acre.

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