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# Northernmost Limit of *Rhizophora mangle* (Red Mangrove; Rhizophoraceae) in St. Johns County, Florida

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ABSTRACT

The northernmost record of *Rhizophora mangle* (red mangrove), recently vouchered from Fort Matanzas National Monument in St. Johns County, Florida, is discussed in reference to the ecology, morphology, and preservation of the species.

## INTRODUCTION

The native distribution of *Rhizophora mangle* (red mangrove) is along the coasts of the Atlantic Ocean (both coasts of north central Florida to eastern Brazil) and Pacific Ocean (Mexico to northern Chile; Tomlinson 1986); this species has also been introduced to other areas, such as Hawaii and Tahiti. The northern limit of red mangrove is dynamic: the distribution moves northward through occasional drift establishment, with range retraction caused by occasional frosts and/or severe winters (Graham 1964). *Rhizophora mangle* reaches the limit of its northern range in Florida (Figure 1A), previously vouchered as far north as ca. 29°98′N along the Gulf Coast in Wakulla County (Wunderlin and Hansen 2003). This fifty-year-old collection of a "solitary" seedling from Mashe Island (*Earle & Branham s.n.*, March 1955; FLAS) is a waif that likely did not survive the next winter (or subsequent winters). Currently, the species is well documented up to Volusia County (ca. 29°03′N) on the east coast (e.g., *Baltzell 8301*; *Hayne s.n.*; *Judd 3174, 3261*; *Kirkman 1198*; *Prichard 913*; all FLAS), and to Cedar Key, Levy County (ca. 29°14′N), on the Gulf Coast, now restricted to North Key (*Sprenkle & Judd 348*; FLAS) and Seahorse Key (*Davis s.n.*; *Ford s.n.*; *Ward 3268*; *Warren s.n.*; all FLAS), where the plants are in reproductive condition (W. Judd, pers. obs.). However, red mangrove no longer grows along the causeway (Florida State Road 24) to Cedar Key (W. Judd, pers. obs.), as vouchered by R. K. Godfrey in 1955 (*Godfrey 52829*; FLAS).

"Mangrove" is a general term applied to tropical trees that grow in tidally flooded ground along coastal banks; more specifically, those characterized by branches that spread and send down roots, thus forming multiple trunks and causing a thick growth (Davis 1940, Zomlefer 1994) that stabilizes shorelines (see Danielsen et al. 2005, Dahdouh-Guebas et al. 2005). *Rhizophora mangle* prefers soils with the salinity of seawater and is restricted to coastal environments, particularly low-energy, protected, intertidal sites along heavily silted shores (Stern and Voigt 1959, Morrow and Nickerson 1973). Although usually small to medium sized trees (average 20 m tall, 30 cm dbh), plants are shrubby towards their northern limits on both Florida coasts (Tomlinson 1980). The most characteristic feature of the species is the branched and arching prop (aerial) roots that arise from the main trunk or from large branches. These stilt-like roots function in gas exchange (via lenticels) to the absorptive underground root system (Gill and Tomlinson 1972).

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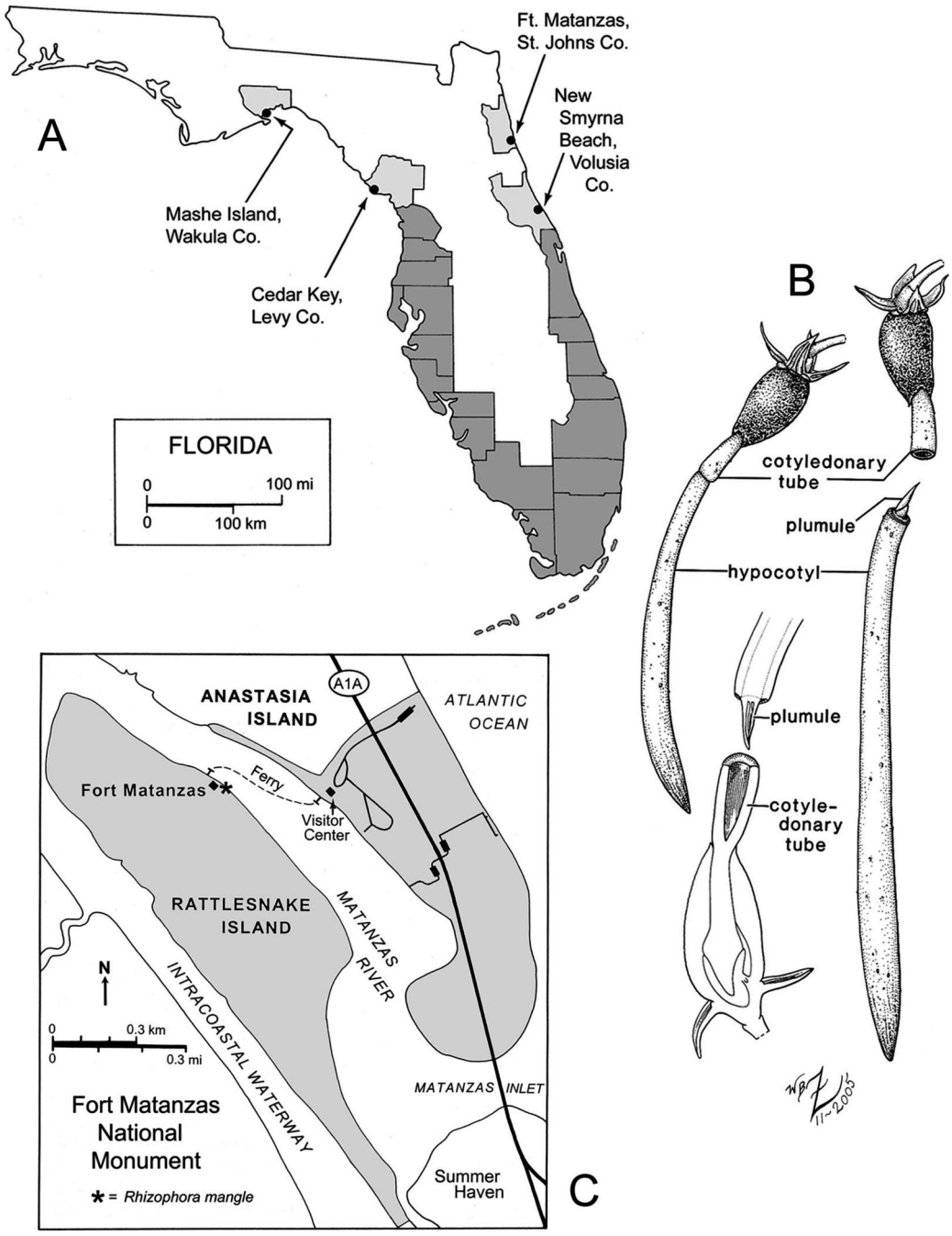


Figure 1. Location of *Rhizophora mangle* in St. Johns County, Florida, and diagrams of propagule. A. County distribution of *R. mangle* in Florida with northernmost vouchers (St. Johns and Volusia; Wakulla and Levy Counties) plotted. Modified from Wunderlin and Hansen (2006). B. Propagule of *R. mangle*, ×½ longitudinal section, ×⅔. From Zomlefer (1994). C. Site on Rattlesnake Island, Fort Matanzas National Monument (National Park Service property shaded). Modified from Zomlefer et al. (2004).

*Rhizophora mangle* is viviparous: the seeds germinate while on the parent tree (and without undergoing a dormant period). Therefore, the unit of dispersal is a seedling. The conspicuous pendulous seedlings usually remain attached to the tree for nine to ten months (Rabinowitz 1978) and after dropping, are distributed by tidal currents (frequently over great distances; Bowman 1917, Davis 1940). At the time of release, the propagule has a large hypocotyl averaging 25 cm long (Figure 1B) that contains abundant food reserves enabling seedlings to retain viability for at least one year (Sussex 1975) and rapidly curves during establishment, bringing the shoot apex to an erect position (Egler 1948).

## METHODS

Plant specimen vouchers, collected using standard field and herbarium techniques (under National Park Service [NPS] collecting permit #FOMA-2003-SCI-0005), are deposited at GA and the herbarium facilities at Museum of the Timucuan Ecological and Historic Preserve (Jacksonville, Florida), the repository of a duplicate set of the recent survey of Fort Matanzas National Monument by Zomlefer et al. (2004).

## RESULTS AND DISCUSSION

*Rhizophora mangle* L. (RHIZOPHORACEAE)—**St. Johns County:** St. Augustine Beach, Fort Matanzas National Monument, Rattlesnake Island, ca. 50 m southwest of Fort Matanzas, 29°42′N, 81°14′W, salt marsh dominated by *Spartina alterniflora, D. Parker s.n.* (GA), 23 March 2005. [Same locale] 29°42.94′N, 81°14.35′W, [same habitat], *D. E. Giannasi & W. B. Zomlefer 1574* (FLAS, GA, USF; herbarium at Museum of the Timucuan Ecological and Historic Preserve, Jacksonville, Florida), 29 Sept. 2005. Ca. 40 m northwest of Fort Matanzas, adjacent to ferry dock, 29°42.93′N, 81°14.36′W, small sandy beach area with *Avicennia germinans, D. E. Giannasi & W. B. Zomlefer 1575* (GA), 29 Sept. 2005.

*Significance.* These collections comprise the northernmost record (29°42.94′N) known for extant *Rhizophora mangle* (red mangrove). The species is established in the salt marsh adjacent to Fort Matanzas on northeastern Rattlesnake Island along the Matanzas River in Fort Matanzas National Monument, Florida (Figure 1A, 1C). The park, administered by the National Park Service (NPS), is located 14 mi (22.5 km) south of St. Augustine along Florida State Road A1A in St. Johns County. A colony of six non-reproductive juvenile plants (to 1 m tall, Figure 2A, 2B) was discovered in March 2005 by David Parker (former Site Supervisor and Chief of Resource Management, NPS), one year after our 2003–04 vascular plant survey of that area (Zomlefer et al. 2004). In September 2005, Giannasi and Zomlefer subsequently confirmed this population of now eight shrubs (to 1.5 m tall) bearing a few flowers (*Giannasi & Zomlefer 1574*), as well as several scattered seedlings (ca. 0.75 m tall; *Giannasi & Zomlefer 1575*), all growing along tidal creeks dominated by *Spartina alterniflora*, *Batis maritima*, *Sarcocornia perennis*, and *Avicennia germinans* (Figure 2C). After an exhaustive search along the eastern shoreline of Anastasia Island, directly across from the fort (Figure 1C), we were unable to confirm unsubstantiated reports (R. Bryant, pers. comm.) of red mangrove seedlings occurring there: all shrubby trees and seedlings of this coast comprised *Avicennia germinans* (black mangrove), which looks somewhat similar to red mangrove, especially the juveniles.

Since the woody plants may grow up to 1.5 m per year, the saplings at Fort Matanzas were likely a year old when first collected (*Parker s.n.*). At that time these saplings had their first tier of branches and had produced the first aerial roots from the main stem (Figure 2A). Six months later, the larger shrubs produced a few flowers (*Giannasi & Zomlefer 1574*, Figure 2C)—not unexpected since flowering has been reported in plants as short as 0.5–1.0 m tall (Gill and Tomlinson 1969, Tomlinson et al. 1979).

The young plants at Fort Matanzas are on a barrier island that is buffered from extreme cold temperatures by Anastasia Island and the Matanzas River on the eastern coast, and the Intracoastal Waterway along the west (Figure 1C). In addition, this population is protected and closely monitored by NPS resource managers. The majority of NPS land on Rattlesnake Island is closed to the public, and Fort Matanzas is only accessible for brief (ca. 45 min) guided tours via


Figure 2. Photographs of *Rhizophora mangle*. A. Close-up of a sapling with first tier of prop roots, ca. $\times^{1}/_{20}$ (*Parker s.n.*; GA). B. One non-reproductive bush (left) in salt marsh southwest of Fort Matanzas (upper right), northern Rattlesnake Island, ca. $\times^{1}/_{40}$ (*Parker s.n.*). C. Flowering shrub and two seedlings (at right), ca. $\times^{1}/_{30}$ (*Zomlefer & Giannasi 1574*; GA; herbarium at Timucuan Ecological and Historic Preserve).

a forty-two passenger boat that crosses the river eight times daily from the visitor center on Anastasia Island (National Park Service 2006). The mangrove species of Florida (*Avicennia germinans*, *Laguncularia racemosa*, and *Rhizophora mangle*) are also protected by state law [State of Florida 2006: e.g., statutes 161.053(1)(c), 403.9321-403.9333]. Thus, this colony of red mangroves has potential to persist and spread.

Discoveries such as this are expected given the dynamic nature of the northern limit of *Rhizophora mangle*, especially during periods of mild winters, and the potential for long distance dispersal of the hardy viviparous seedlings by oceanic currents. Therefore, a study of coastal habitats of peninsular Florida north of Flagler County (on the Atlantic side) and north of Levy County (along the Gulf coast) may reveal more small populations of this species. Other islands of the Cedar Key system (Levy County) also need careful survey for red mangrove.

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Foreground: *Borrichia frutescens*; immediate background: *Spartina alterniflora* and *Batis maritima*; across the tidal creek: *Avicennia germinans* (darker, taller, shrubby trees) and a few *R. mangle* (lighter colored, shorter, shrubs); far background (upper left): Matanzas River and Anastasia Island. Photo credits: A, B: David Parker; C: W.B. Zomlefer.

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