

Project Title:

CHARACTERIZATION OF DUNE VEGETATION AND SEEDLING
REGENERATION ON SANTA ROSA ISLAND

Report for work conducted – September 2008 - December 31, 2010

Cooperative Agreement Gulf Coast CESU: H5000 02-0271

Task Agreement No. J5320 08 0A53

University of Florida, partner: H5000 07 0510

University of Florida Project Number: 00070019

Principal Investigator: Deborah L Miller

Co-Principal Investigator: Mack Thetford

Co-Principal Investigator: Kimberly Bohn

TABLE OF CONTENTS

LIST OF FIGURES	3
LIST OF TABLES.....	4
LIST OF APPENDICES.....	6
EXECUTIVE SUMMARY	11
INTRODUCTION	13
RESEARCH OBJECTIVES:	17
STUDY AREA	18
METHODS.....	22
CROSS-ISLAND TRANSECTS.....	22
REMNANT DUNES- 2004 AND 2010	23
MARITIME FOREST - SHRUBBY FLATWOODS.....	25
<i>UNIOLA PANICULATA</i> INFLORESCENCE DENSITY AND SEED PRODUCTION.....	27
SEEDLING TRANSECTS.....	28
FRUIT DENSITY (<i>QUERCUS</i>) AND FREQUENCY (OTHERS)	29
ANALYSIS.....	30
RESULTS.....	30
ALONGSHORE AND CROSS-ISLAND VEGETATION	30
PCA and CCA Analysis.....	30
Foliar cover (%).....	33
CROSS-ISLAND WOODY SPECIES EGLIN AFB	36
REMNANT DUNES - 2004 AND 2010.....	37
MARITIME FOREST – SHRUBBY FLATWOODS	39
<i>UNIOLA PANICULATA</i> –INFLORESCENCE AND SEED PRODUCTION.....	41
SEEDLING TRANSECTS.....	42
FRUIT DENSITY (<i>QUERCUS</i>) AND FREQUENCY (OTHERS).....	44
DISCUSSION.....	48
CROSS-ISLAND AND ALONGSHORE TEMPORAL AND SPATIAL VARIATION.....	48
REMNANT DUNES	51
MARITIME FOREST- SHRUBBY FLATWOODS.....	53
<i>U.PANICULATA</i> SEED PRODUCTION AND SEEDLING ESTABLISHMENT	55
FRUIT DENSITY (<i>QUERCUS</i> ACORNS) AND FRUIT FREQUENCY	57
LITERATURE CITED	60
ACKNOWLEDGMENTS.....	174

List of Figures

Figure 1.	Location of Santa Rosa Unit (SRU) of Gulf Island National Seashore (GINS) and restricted access (RA) and limited access (LA) areas of Eglin Air Force Base (EAFB) on Santa Rosa Island (SRI), Florida.....	65
Figure 2.	Location of cross-island transects, sampled dunes, shrubby flatwoods (open canopy pine forest), and seedling transects (overwash areas and dune remnants) on the Santa Rosa Unit of Gulf Island National Seashore on Santa Rosa Island, FL. (section 1, numbered from East to West, transects and numbers correspond to tables and appendices; aerial photos taken in 2009.).....	66
Figure 3.	Location of seedling (overwash areas and dune remnants) and woody vegetation transects in limited access areas of Eglin Air Force Base on Santa Rosa Island, FL. (Eastern Section; aerial photos taken in 2007.).....	70
Figure 4.	Location of seedling transects (overwash areas and dune remnants) in open access areas of Eglin Air Force Base on Santa Rosa Island, FL. (Eastern section; aerial photos taken in 2007.)...	72
Figure 5.	Principal Component Analysis (PCA) of vegetation in cross-island sections (section 1-6) and alongshore types (narrows, intermediates and headlands) on the Santa Rosa Unit of Gulf Islands National Seashore on Santa Rosa Island Florida. See appendix AH for species identity.....	74
Figure 6.	Canonical Component Analysis (CCA) of vegetation in cross-island sections (section 1-6) and alongshore types (type- narrows, intermediates and headlands) on the Santa Rosa Unit of Gulf Islands National Seashore on Santa Rosa Island Florida. See appendix AH for species identity.....	75

List of Tables

Table 1.	Indicator species for cross-island sections (1 nearest to the Gulf - 6 farthest from the Gulf), and p values.....	76
Table 2.	Mean foliar cover (%) by species for Narrows, Intermediate, and Headlands of the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida. Mean weighted by Narrows and Headlands site frequency.....	77
Table 3.	Mean foliar cover (%) by species at 100m intervals, south to north (distance from gulf) (averaged across Narrows, Intermediate and Headlands), for Narrows sites, Intermediate sites, and for Headlands of the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida and average across Narrows, Intermediate, and Headland sites.....	78
Table 4.	Comparison of Beach Mice (<i>Peromyscus polionotus</i>) habitat types on cross-island transects for years 1991 and 2008 on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	81
Table 5.	Mean woody species density (plant/m ²) and maximum height (m) by distance from the gulf on Eglin Air Force Base, Santa Rosa Island, Florida.....	82
Table 6.	Mean (n=6) woody species density (plant/m ²) and maximum height (m) (2000 and 2008) on Eglin Air Force Base, Santa Rosa Island, Florida.....	85
Table 7.	Mean foliar live and dead cover (%) for five frontal dune remnants on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida now classified in 2010 as incipient dunes post hurricanes Opal, Ivan, and Dennis.....	86
Table 8.	Mean foliar cover (%) of frontal dunes (2004) compared to same location where incipient dunes (2010) are now found on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	88
Table 9.	Mean foliar cover (%) of frontal dunes sampled in 2004 and 2010 on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	89

Table 10.	Mean foliar live and dead cover (%) for each remaining established frontal dune (remnant), and averaged for all dunes in 2010 post hurricanes Opal and Ivan on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa, Florida.....	90
Table 11.	Mean foliar live and dead cover (%) of each remaining established scrub and grassy back-barrier dunes in 2010 on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	93
Table 12.	Mean density (plants/ha), height (m) and basal area (m ² /ha) of live and dead woody species for two forested (shrubby flatwoods) back-island sections on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	98
Table 13.	Mean foliar live and dead cover (%) (2010) for vegetation 1m or less in height by species (woody and herbaceous) for two forested (shrubby flatwoods) back barrier sections of the Santa Rosa Unit in Gulf Island National Seashore, Santa Rosa Island, Florida.....	99
Table 14.	<i>Uniola paniculata</i> inflorescence density, spikelet number, seed number and seed class for plots containing plants along three overwash transects on GUINS.....	100
Table 15.	Mean <i>Uniola paniculata</i> seedling density (seedling/m ²) for June to Sept. 1997 through 2009, and Nov. 2009 for each transect on limited access areas (Okaloosa County) and restricted access areas(Santa Rosa County) of Eglin Air Force Base, Santa Rosa Island, Florida.....	101
Table 16.	Mean <i>Uniola paniculata</i> seedling density (seedling/m ²) for June to Sept. 1997 through 2009, and Nov. 2009 across transects on limited access areas (Okaloosa County) and restricted access areas(Santa Rosa County) of Eglin Air Force Base, Santa Rosa Island, Florida.....	102
Table 17.	Mean <i>Uniola paniculata</i> seedling density (seedlings/m ²) for July to August and Nov. for 2008, 2009 and 2010 in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	103
Table 18.	Mean seedling density (seedling/m ²) for June to Sept. 1997 through 2009, and Nov. 2009 on limited access areas (Okaloosa County)	

	and restricted access areas (Santa Rosa County) of Eglin Air Force Base, Santa Rosa Island, Florida.....	104
Table 19.	Seedling mean density (seedling/m ²) for 2007 thru 2010 for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	108
Table 20.	Dune area (ha), acorns/tree, tree density (trees/m ²) and estimated acorn density (acorns/m ²) for Sand Live Oak (<i>Quercus geminata</i>) and Myrtle Oak (<i>Quercus myrtifolia</i>) on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	111
Table 21.	Mean frequency (%) of occurrence by species for all dunes in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	112

List of Appendices

Appendix A.	Dates, names, Saffir/Simpson Hurricane Scale category maximum and landfall values, and landfall location of storms from 1995 to 2009.....	113
Appendix B.	Cross-island transect coordinates (UTM) from East to West on the Santa Rosa Unit of Gulf Island National Seashore, and limited access areas of Eglin Air Force Base, Santa Rosa Island, Florida.....	114
Appendix C.	Established remnant-dune transect coordinates (UTM) from East to West on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	115
Appendix D.	Open canopy Pine Maritime coordinates (UTM) for density plots and cover transects on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	116
Appendix E.	<i>Uniola paniculata</i> seedling transect coordinates (UTM) from East to West on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.	117
Appendix F.	<i>Uniola paniculata</i> seedling transect coordinates (UTM) for overwash and remnant frontal dune sites on limited access areas (Okaloosa) and restricted access areas(Santa Rosa) of Eglin Air Force Base, Santa Rosa Island, Florida.....	118

Appendix G. General Field notes (estimation of plant density, dune observations, etc.) for the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	119
Appendix H. General fruiting and flowering field notes for the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	121
Appendix I. Mean density (plant/m ²) and maximum height (m) of each plant species present (2010) on incipient dune, once an established frontal dune, post hurricanes Opal and Ivan on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	128
Appendix J. Mean density (plant/m ²) and maximum height (m) of each remaining established frontal dune post hurricanes Opal and Ivan on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	130
Appendix K. Mean density (plant/m ²) and maximum height (m) of each remaining established scrub dune post hurricanes Opal and Ivan on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	134
Appendix L. <i>Uniola paniculata</i> seedling density (seedling/m ²) July 17-30, 1997 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites on limited access areas (Okaloosa County) and restricted areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.....	150
Appendix M. <i>Uniola paniculata</i> seedling density (seedling/m ²) June 18-25, 1998 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites on limited access areas (Okaloosa County) and restricted areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.....	151
Appendix N. <i>Uniola paniculata</i> seedling density (seedling/m ²) July 27, 1999 through October 1,1999 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites on limited access areas (Okaloosa County) and restricted areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.....	152
Appendix O. <i>Uniola paniculata</i> seedling density (seedling/m ²) August 24-30, 2000 by 5m intervals, south to north (distance from gulf) for overwash areas and Frontal Dune remnant sites on limited access	

areas (Okaloosa County) and restricted areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.....	153
Appendix P. <i>Uniola paniculata</i> seedling density (seedling/m ²) July 9-17, 2007 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	154
Appendix Q. <i>Uniola paniculata</i> seedling density (seedling/m ²) June 24, 2008 through July 30, 2008 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa, Florida.....	155
Appendix R. <i>Uniola paniculata</i> seedling density (seedling/m ²) July 01, 2008 Through August 6, 2008 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal duneremnant sites on limited access areas (Okaloosa County) and restricted access areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.....	156
Appendix S. <i>Uniola paniculata</i> seedling density (seedling/m ²) August 18, 2009 through September 09, 2009 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites on limited access areas (Okaloosa County) and restricted access areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.....	157
Appendix T. <i>Uniola paniculata</i> seedling density (seedling/m ²) November 24, 2009 Ythrough December 01, 2009 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites on limited access areas (Okaloosa County) and restricted access areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.....	158
Appendix U. <i>Uniola paniculata</i> seedling survival (%) August 2009 to November 2009, by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites on limited access areas (Okaloosa County) and restricted access areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida....	159
Appendix V. <i>Uniola paniculata</i> seedling survival (%) (data collected in August 2009 and November 2009) by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the	

Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	160
Appendix W. <i>Uniola paniculata</i> seedling density (seedling/m ²) November 23-24, 2009 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	161
Appendix X. <i>Uniola paniculata</i> seedling density (seedling/m ²) July 16, 2009 Through August 6, 2009 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	162
Appendix Y. <i>Uniola paniculata</i> seedling recruitment density (seedling/50m ²) after July 2009 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	163
Appendix Z. <i>Uniola paniculata</i> seedling recruitment density (seedling/50m ²) after July 2009 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites on limited access areas (Okaloosa County) and restricted access areas (Santa Rosa County) of Eglin Air Force Base, Santa Rosa Island, Florida.....	164
Appendix AA. <i>Uniola paniculata</i> seedling survival (%), July 2010 to November 2010, by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	165
Appendix AB. <i>Uniola paniculata</i> seedling recruitment density (seedling/50m ²) after June 4, 2010 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	166
Appendix AC. <i>Uniola paniculata</i> density (seedling/m ²) October 30, 2010 through November 20, 2010 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	167

Appendix AD. <i>Uniola paniculata</i> density (seedling/m ²) June 4, 2010 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	168
Appendix AE. Mean temperature (°C), precipitation (cm), wind speed (km/hr) and wind gust (km/hr), dew point (°C), sea level pressure (hPa), and total degree days (heating, cooling, and growing) for March through November for years 1997 through 2000, and 2007 through 2010.....	169
Appendix AF. <i>Uniola paniculata</i> density (seedling/m ²) of seedlings established in 2010(1st yr) and remaining in 2011 (2nd yr) by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	171
Appendix AG. Mean frequency (%) of fruit occurrence by species for the 18 dunes sampled in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.....	172
Appendix AH. Scientific names for the letter codes used in the PCA (Figure 5) and CCA graphs (Figure 6).	173

Executive Summary

The overarching goal of this study was to characterize vegetation along environmental gradients after hurricane impact on the Santa Rosa Unit of Gulf Islands National Seashore on Santa Rosa Island, Florida. Vegetation was quantified on remnant fore dunes (gulf-side dunes) in 2004 prior to hurricane Dennis in 2005. The dune transects surveyed in 2004 were resampled during this study to quantify changes associated with hurricane Dennis and subsequent vegetation recovery. Remnant interior and sound-side dunes (backbarrier dunes) delineated using a Trimble GPS in 2004 were surveyed for vegetation during this study (2008-2010). Additional alongshore and cross-island variation in vegetation was quantified and compared to prior studies conducted on Santa Rosa Island and nearby Perdido Key, Florida before increased hurricane activity in 1995. Fruit and flower production was also quantified in respect to variation in island environmental gradients.

The data collected in this study provides a baseline for comparison to changes that will occur with sea level rise and future hurricane activity. This study also documents changes in vegetation and dune occurrence as the result of increased frequency and intensity of tropical storms in the last 15 yrs. We found that while more than 70% of gulf-side foredunes on SRI (Pries et al. 2008; Houser et al. 2007) were lost prior to hurricane Dennis (2005) and Katrina (2005), an additional 33% of remaining remnant dunes completely collapsed as a result of direct wave erosion and the transfer of sediment to the back of the barrier island by overwash from Tropical Storm Arlene and hurricanes Dennis and Katrina (2005). Dunes with woody vegetation are more resistant to storm surge (Salenger 2000) which suggests at least 7 of the remaining 10 gulf-side remnants found on SRU, because of the lack of woody plants, are likely to collapse with the next large storm surge of a magnitude equal to Opal, Ivan or Dennis.

Recent storms have killed woody vegetation and pushed perennial grasses, particularly *U. paniculata* 200-400m or more from Gulf mean high water (MHW) or buried them too deep to recover. As a result, remnant fore dunes (Gulf-side dunes) occur on less than 25% of SRU and incipient dunes occur much further inland than the original frontal dune ridge. Prior to the increased storm activity fore dunes (Gulf-side dunes) dominated by *U. paniculata* with woody species on dune crest or on the back slope of fore dunes were found 25-100m MHW (Burkhalter 1987; Looney and Gibson 1992) now remnant dunes begin at 100-200m MHW with incipient dunes found 200-400m MHW. This impact is greater in the narrowest parts of the island as also suggested by Houser (2007).

Revegetation of areas where large dunes were previously found or gulfward of the previous dune ridge has not occurred because of limited seedling establishment. In the narrow parts of the island, *U. paniculata* remains the dominant species which suggests dune rebuilding will occur. Frequent overwash and below average rainfall is also limiting seedling establishment the entire width of the island in narrow sections of the Santa Rosa Unit. However, road debris

appears to be impacting reestablishment of vegetation and recovery of dunes over much of SRU

On wider sections of the Santa Rosa Unit, remnant dunes remain in the interior and sound-side of the islands (backbarrier). Our study agrees with the conclusions of Houser et al. (2008a), the recovery of these back barrier dunes are also in question on the SRU portion of SRI. We documented continued erosion of remnants with herbaceous and woody vegetation cover reduced by 39% and 34% respectively 6 years after Ivan's storm surge. From 25-50% of the previously vegetated area of remaining remnant dunes eroded from 2004-2010. Some of this loss was also associated with storms of 2005 and 2006. Above and belowground plant parts stabilize dunes and reduce erosion and with the reduction and lack of recovery of dune vegetation on these dunes, erosion continues through the actions of wind and water. With continued frequent storms with return interval of less than 6 years, regeneration of *Quercus* species and possibly other woody species will be reduced or may not occur. Exposure to drying winds and salt-spray will continue to reduce live canopy of sound-side dunes (backbarrier) and potentially reduce fruit production.

Vegetation changes in maritime forest on Santa Rosa Island were also evaluated in this study. The "forest" on Santa Rosa Island consists of an open canopy of *P. elliotii* and may be more accurately classified as Flatwoods by the Florida Natural Areas Inventory. The midstory and groundcover of the Flatwoods vary with the topographic location of *P. elliotii* on the sound side of the island. *Quercus* spp. and *Ilex vomitoria* are found as dominant species in the mid-story of drier, slightly elevated sites and on interior and sound-side dunes. *Baccharis halimifolia* dominates lower, depressed sites with a denser canopy of *P. elliotii*. We found *P. elliotii* were killed by overwash that ponds in depressed sites and although regeneration occurs, repeated overwash kills seedlings and saplings. This pattern of regeneration and repeated overwash kills suggest *P. elliotii* will disappear from the lowest sites on SRI with storm overwash return interval of less than 8-10yrs. However, *P. elliotii* mortality was low on slightly higher low dunes on the sound-side and *P.elliotii* may remain the dominant canopy trees even with frequent overwash.

Road debris is impacting most of the Santa Rosa Unit of Gulf Island National Seashore. This man-made influence should be considered when developing management actions for this barrier island ecosystem. Sea-level rise and increased frequency of hurricane overwash threaten the stability of this system. Strategies such as restoration plantings should be considered to counteract the effects of man-made impediments to the redevelopment of dunes.

Introduction

Recent studies suggest vegetation patterns on barrier islands are driven by two contrasting mechanisms: steep environmental gradients largely established by dune development and distance from maritime influence, and overwash disturbances which kill existing vegetation and weaken environmental gradients (Ehrenfeld 1990; Stallins and Parker 2003). Gradients of salt spray, sand movement, soil moisture and soil quality are stressors repeatedly identified as important determinants of plant distribution in these landscapes (Barbour 1990; Ehrenfeld 1990; Oosting and Billings 1942; van der Valk 1974). Large frontal dunes (foredunes) and secondary dunes (back-barrier dunes) ameliorate maritime influences with salt spray and sand movement generally highest in the beach-foredune and diminishing with increasing distance from the gulf. Improved soil moisture and soil quality are also found landward of incipient and established foredunes (Barbour 1990; Ehrenfeld 1990; Hesp 1991; Martin 1959; Oosting and Billings 1942; van der Valk 1974). In contrast, hurricane overwash alters or eliminates dune structure, selectively kills vegetation and as a result environmental gradients across barrier islands are altered. Throughout a single barrier islands landscape, interplay of steep environmental gradients and disturbance patches may define the pattern of vegetation and influence potential recovery patterns and rates for future storm events (Stallins and Parker 2003).

Impacts of extreme storms on barrier islands are controlled largely by the height and extent of gulf-side dune development in relation to storm surge; elevation and the presence and relative location of interior and sound-side dunes

(back-barrier dunes), which can vary considerably alongshore (Morton 2002; Pries et al. 2008; Sallenger 2000; Thieler and Young 1991; Houser et al. 2007). Overwash penetration is reduced and sediment is deposited on the shoreface with the presence of large, wide gulf-side dunes or where gulf-side and interior and sound-side dunes are closely spaced, a situation analogous to a large, wide gulf-side foredune. The ability of coastal dunes to recover and the morphological response to the next storm depends on the reestablishment of sufficient vegetation to promote sediment deposition and stabilization (Snyder and Boss 2002) and the availability of sediment from the overwash (Armon 1979; Leatherman 1979; Houser et al. 2007) and beach face (Psuty 1992).

Recovery and stabilization of species composition further inland in forest communities will also depend on the interaction of storm severity and frequency across environmental gradients (Stallins and Parker 2003). A shift in species composition may occur where storm intensity and frequency have altered what were steep environmental gradients. For instance, it has been suggested that in the slash pine scrub system, pine regeneration is actually dependent on overwash burying or killing competing shrub and oak vegetation and creating suitable seedbed conditions (Clewell 1986). Slash pine, which is fairly intolerant of shade and competition, will fare well if it can establish quickly after disturbance. However, regeneration responses may shift as more overstory trees are impacted by high intensity storms and seed banks of new competing species are pushed further inland.

Although twenty eight tropical cyclones of hurricane intensity passed within 125 miles of Santa Rosa Island (SRI), Florida from 1886-1993 (NOAA 2005) sufficient storm surge to breach the gulf-side, frontal dune did not occur for 48 years (1927 to 1975). Prior to 1975, along shore gulf-side dune development was continuous with dune height averaging 3m (Stone and Stapor 1996). Storm surge from direct or near direct hits by Category 3 (Saffir Simpson Scale) hurricanes (1995 Hurricane Opal, 2004 Hurricane Ivan and 2005 Hurricane Dennis) have repeatedly overwashed the island, eliminating established dunes at multiple locations along the island's entire length, increasing alongshore and transverse (across island) variation in dune morphology, height and vegetation. This increased frequency and intensity of hurricane impacts has altered vegetation patterns and environmental gradients along the Northern Gulf coast providing a unique opportunity to evaluate the variation of overwash impacts on vegetation communities and evaluate recovery processes.

Houser et al. (2008 a) found along shore variation in dune morphology on Santa Rosa Island is correlated to the offshore bathymetry, island width and historical rates of shoreline retreat. Areas with little to no dune development before recent Hurricanes were associated with narrow portions of the island and a trough of a shore-oblique ridge on the inner-shelf. Overwash penetration was larger in these areas and island breaching was common. In contrast, large dunes are found on the widest sections of the island (the sound-side cusped headlands) and are adjacent to the crest of a shore-oblique ridge. These areas have smaller overwash penetration distances. In addition, plant species are

ecological engineers of dune systems and provide both negative and positive feedback to physical factors influencing response to extreme storm events. Certain plant species facilitate rapid dune growth and resist overwash events while other species may reinforce the spread of overwash events by limiting the height of dune redevelopment following overwash (Stallins and Parker 2003). Documentation of vegetation in association with variation in island geomorphology as identified by Houser et al. (2007) and remaining dune structures following recent hurricane overwash will allow for better temporal and spatial prediction of recovery and susceptibility to future extreme storms.

Few studies have documented plant colonization following large storms or beach nourishment projects (Cousens 1988; Mendelssohn et al. 1991). In most cases these studies are of short duration and do not follow vegetation succession more than 3-4 years. The availability of a vegetation description for Santa Rosa Island dune system (Burkhalter 1987; Johnson et al. 1992; Miller unpublished data) prior to recent extreme storms affords a unique opportunity to assess community and landscape-level survival of vegetation and plant regeneration across the disturbance, environmental gradients found throughout the island. Vegetation regeneration may include seed production, dispersal, germination and establishment and regrowth of surviving perennial vegetation. Continual documentation of the regeneration potential (seed production, dispersal and viability) and patterns of regeneration (germination and regrowth of perennials and germination of annuals) for major plant species across all vegetation zones

are needed to develop predictive models that can estimate vegetation and dune recovery rates under varying storm frequencies and intensities.

Research objectives:

1. To characterize and compare vegetation found along gradients of hurricane impact including the width of the island at headlands (wider portions of island) and narrows (narrower portions of the island between headlands).
2. To characterize species cover and determine % survival of woody vegetation on established- remnant gulf-side dunes, back-barrier dunes (interior and sound-side) and in back-barrier pine savannah 3-6 yrs after Hurricane Ivan.
3. To evaluate spatial (alongshore and across island) and temporal (after Hurricane Opal vs after Hurricanes Ivan and Dennis) changes in species composition where possible.
4. To document plant in situ seed production and seedling establishment of dominant species found in all vegetation zones located on Santa Rosa Island 3-5 yrs after Hurricane Ivan.
5. To quantify frequency of flower and fruit production associated with island environmental gradients.

Study Area

Dune vegetation was characterized alongshore and cross-island on the approximately 11km Santa Rosa Unit (SRU) of Gulf Islands National Seashore (GINS) found between Navarre Beach and Pensacola Beach on SRI, Florida (Figures 1 and 2). Additional long-term vegetation sampling is on-going on the approximately 20km section of Eglin Air Force Base (AFB) on SRI east of Navarre Beach and some of the results from that sampling were presented here for comparison with SRU (Figures 3 and 4). The total length of SRI is approximately 78km. SRU contains one recreation site with bathrooms and covered picnic areas, several small parking lots and a paved road for visitors but otherwise is undeveloped. In general, the section of SRI managed by Eglin AFB is wider (N to S) than the Santa Rosa Unit of GINS (Figure 1) and contains several military structures and a paved road for military traffic but otherwise is undeveloped.

Santa Rosa Island's topography, dune morphology and plant communities have undergone considerable alteration between 1994 and 2010. Prior to 1995, a continuous gulf-side frontal (foredune) dune ridge approximately 75m from the Gulf of Mexico dominated by grasses but stabilized with woody vegetation (mixed grass/woody dune) occurred alongshore the length of SRI. The gulf-side, frontal dune ridge reached heights of 10m in some places with mean dune height across the island of 3.8m (Stone et al. 2004). This ridge influenced the sand budget, wind speeds, salt spray, soil moisture, topography and therefore plant communities found landward of this dune ridge. The interior of the island, from

gulf-side dunes to sound-side woody dunes, forest or marsh, consisted of a mosaic of landscape elements including a grassy dune mosaic, dune/swale mosaic and swale/dune mosaic and woody scrub dunes. On the backside of the barrier island, Santa Rosa Sound also influences environmental conditions and therefore flora and fauna and consist of woody scrub dunes, maritime forest (shrubby flatwoods) and fringing marshes. A complete description of Santa Rosa Island's geomorphology prior to most recent hurricanes can be found in Stone et al. (2004).

Repeated storm surge has reconfigured the SRI landscape. Between 1995 and 2005, three hurricanes made landfall on SRI and four others made landfall within 150km (NOAA 2005). Storm surge associated with Hurricanes Opal and Erin (1995), Ivan (2004) and Dennis (2005) collapsed large sections of the frontal dune ridge (Miller et al. 2001; Pries et al. 2008). Interior and sound-side woody scrub dunes were also scarped or collapsed. Sand was deposited in the interior of the island or offshore. After hurricane Opal the frontal dune ridge was discontinuous alongshore. Hurricane Ivan (2004) further reduced the average elevation of the island within the area of the gulf-side dune ridge to 2.3m and remnants of the dune ridge remained only where a large dune was present before the storm (Houser et al. 2008a). As a result, the gulf side is now characterized by remnants of the fragmented gulf-side, frontal dune ridge (remnant established dune = mixed grassy/woody dunes), redeveloping grassy dunes and variously sized overwash sand flats with incipient dunes between remnant dunes. Sand flats may also extend midway or more across the island

in narrow sections of SRU and can be sparsely vegetated with small incipient dunes. Landscape elements landward of the fragmented gulf-side frontal dune (interior and sound side) vary widely on SRI and include woody scrub dunes that were scarped by storm surge and are continuing to erode as a result of wind erosion (Houser et al. 2008 b), extensive grassy dune fields, sand flats with incipient dunes, low dune/swale mosaics, swale/low dune mosaics, grassy interdunes and sandy interdunes. Sand was also deposited in and around swales altering swale area and the configuration of the swale/dune mosaic.

Alongshore differences in dune morphology and the mechanisms that create these differences for SRU have been described by Houser et al. (2007, 2008a, 2008b). Sections of SRU with little to no dune development are found on the narrowest sections of SRI between cusped headlands. We will refer to them as narrows. Cusped headlands occur on wider portions of the island with remnants of large, mixed grass/woody dunes and woody scrub dunes from the gulf side to the sound side. Areas between headlands and narrows will be referred to as intermediates. To best characterize the variation in vegetation, we focused cross-island sampling on narrows, intermediates and headlands.

Vegetation on SRI varies along environmental gradients associated with dune topography, distance from the gulf, disturbance gradients and age of dunes. Plants associated with the beach, also referred to as the strand, on the gulf side include *Cakile constricta* (Coastal searocket), *Iva imbricata* (Marsh elder), *Uniola paniculata* (Sea oats) and *Panicum amarum* (Bitter panicgrass). Grassy gulf-side dunes are dominated by *Uniola paniculata* and *P. amarum* while

grassy dunes in the interior, sound side and in association with swales may also be dominated by *Schizachyrium maritimum* (Maritime bluestem) and *Spartina patens* (Marshhay cordgrass). Mixed grass and woody dunes (established dunes) may have a considerable component of *U. paniculata* with *S. maritimum* increasing as maritime influence such as salt spray and sand movement decreases. Woody species frequently found on mixed dunes and scrub dunes are *Ilex vomitoria* (Yaupon), scrub oaks (*Quercus geminata* and *Q. myrtifolia*), *Ceratiola ericoides* (Florida rosemary), *Chrysoma pacuiflosculosa* Michx. (Woody goldenrod) and *Pinus clausa* (Sand pine). The island landscape not only consists of dune systems but wetlands and savannah/forest as well. Non-contiguous forest, better described as shrubby pine-flatwoods because of the open canopy of slash pine and well developed midstory of shrubs such as *Ilex glabra* (Inkberry) and *Baccharis halimifolia* (Salt marsh elder) and *Quercus geminata* (Sand live Oak) (Johnson et al. 1992; Clewell 1986), occur infrequently on the sound side. Ephemeral wetlands referred to as swales are found between dunes. These wetlands vary in size, hydroperiod and species composition. Fringe tidal marshes occur on the margin of the sound/bay side of the island.

During storms, perennial grasses are pushed inland and sometimes buried by collapsing dunes. Where sand burial is shallow grasses survive and incipient-dunes redevelop around these grasses rapidly but where burial is greater than the threshold for grass survival large gaps of bare sand flats remain. Reestablishment of vegetation after Opal, Ivan and Dennis has been further hindered by overwash associated with high tides and storm surge from

Hurricanes (H) and tropical storms (T.S.): H. Earl Sept, 3 1998, T.S. Georges Sept. 30, 1998, T.S. Helene Sept 22, 2000, T.S. Alice June 12, 2001, T.S. Barry Aug. 6, 2001, T.S. Hannah Sept 15, 2002, H. Ivan Sept16, 2004, T.S. Arlene June 13, 2005, H. Dennis July 10, 2005, H. Katrina Aug 29, 2005, T.S. Alberto June 13, 2006, T.D. 10 Sept 2007, T.S. Fay Aug 2, 2008, H. Ike Sept 13, T.S. Claudette Aug 11-16, 2009, H. Ida Nov 4-10 2009, (Appendix A).

Methods

Cross-island transects

Herbaceous and woody transects – In 2010, 6 permanent transects were established alongshore from Navarre Beach to Pensacola Beach (in SRU of GINS), two transects were placed in separate headlands, 2 transects were placed in separate intermediates and 2 transects were placed in separate narrows (Figure 2; Appendix B). Transects ran the width of the island from the mean high-tide line (MHW) of the Gulf to the mean high-tide line (MHW) on the Sound. These transects were sampled for percent cover of woody and herbaceous species. Percent cover of bare sand and road debris were determined separately along these same transects.

Woody transects Eglin AFB - In 2001, six transects extending across SRI from the Gulf to the Sound were established every 0.5 miles from Navarre beach east for 4 miles on Eglin AFB. Six of these transects were randomly selected and sampled for percent cover by species of woody vegetation. Four of these transects were relocated and resampled in 2008 or 2009 (Figure 3). The

remaining transects were damaged by road, parking lot and building construction.

Foliar cover (%) was determined using the line-intercept method. The length of the line (transects) covered (m) by herbaceous and woody vegetation (SRU of GINS, 2008 and 2010 and EGLIN 2001 and 2008) (Figure 2 and 3; Appendix B) below and above the line was recorded along each transect for each species. Species, bare sand, water and gravel lengths for each transect were divided by the total transect length and multiplied by 100 to obtain percent cover for each transect. For each 100m section from Gulf to Sound, total length for each species, bare sand, water and gravel was divided by the length of the transect section (100) and multiplied by 100 to obtain a percent cover for that cross-island section. Total woody cover and herbaceous cover are simply the total of all species for each growth form and therefore with overlapping canopies totals could be more than 100%. However, non-vegetated cover was determined separately and thus total vegetation cover without overlap was calculated as 100 minus non-vegetated cover (total of sand, gravel, road, open water).

Remnant Dunes- 2004 and 2010

Between Navarre and Pensacola beach (SRU) all established remnant dunes on the Gulf side were sampled for *Uniola paniculata*, total woody cover, herbaceous cover and bare sand in 2004 as described above after Hurricane Ivan but before Dennis and Katrina (Figure 2; Appendix C). These dunes were resampled in 2010 using transect locations and the protocol described by Pries (unpublished data 2004) but with the addition of foliar cover (%) determined by

species. Interior and sound-side scrub dunes were not sampled after hurricane Ivan but percent cover by species was determined for gulf-side remnant dunes in addition to all interior and sound-side scrub dunes in 2010. Maximum height of woody species along transects on each dune was also recorded. Total woody cover, herbaceous cover and non-vegetated cover were calculated as described previously.

Six remnant foredunes were lost in hurricanes subsequent to the 2004 sample and portions of the remaining foredunes also collapsed. Transects were reestablished and percent cover by species, non-vegetated cover, total woody and herbaceous cover and total vegetation cover without overlap were determined on incipient grassy dunes developing at the location of these collapsed dunes. A new recreation area was established in the location of Dune 40 hence the dune was lost (Figure 2 Section 3).

Foliar cover (%) of vegetation was again sampled with the line-intercept method. Three transects spaced 20m apart were run perpendicular to the longest axis of each dune with the middle transect located approximately at the center of the dune. Lengths (m) of the line covered by foliage of herbaceous vegetation and woody vegetation by species were recorded along each transect. These lengths were divided by the total length of the transect and multiplied by 100 to obtain percent cover. Mean foliar cover (%) by species and functional plant group (woody, herbaceous) and bare sand were determined by averaging values for the three transects. Total foliar cover (%) was determined by subtracting the total of sand, gravel and road from 100.

The belt transect method was used to collect all density data. Transects were established on the western or sound side of each cover transect and ran the entire length of the cover transect. Stem density was recorded for each species except *U. paniculata* within 10m long by 5m wide contiguous quadrats for the entire length of the transect. Within each quadrat the total number of stems by species was recorded for herbaceous and woody vegetation. *U. paniculata* stem density was counted in 5m by 5m quadrats nested at the beginning of each 10m by 5m quadrat. Mean density of the three transects for each dune by species and by location along the transect was determined prior to final analysis.

Maritime Forest - Shrubby Flatwoods (FNAI 1990)

Two areas of open canopy forest separated from each other by scrub dunes were located in the SRU of GINS (Figure 2; Appendix D). These areas were dominated by open canopies of slash pine and midstories of shrubs. Both areas were sampled for foliar cover (%) of understory, midstory and canopy by species, density of live and dead trees, saplings and shrubs of the midstory and canopy woody species.

Foliar (%) cover was determined by the line-intercept method. Three transects were run the entire North (Sound-side) to South (Gulf-side) width of each flatwoods area. One transect was established approximately in the middle of the flatwoods and two additional transects were randomly placed on either side of the middle transect within the boundaries of the flatwoods. The length (m) for herbaceous vegetation and woody vegetation by species along each

transect were recorded, divided by the total length of the transect and multiplied by 100 to obtain a percent cover by species. The three individual transects for each scrubby flatwoods were averaged by species prior to final analysis. Total woody cover, herbaceous cover and no-vegetated cover were calculated as previously described.

Tree, sapling and shrub density for each flatwoods site were determined through quadrat sampling. Along each cover transect two or three (depending on the width of the flatwoods) 100m² plots (10m by 10m), were established to determine the density of tree species. The northern edge of the plot was placed at the edge of Santa Rosa Sound, and the middle of the plot was approximately in the middle of the flatwoods. Within each plot, the number of live and dead sapling and canopy pine trees were counted. Percent of dead needles per tree was estimated April 27, 2009 and November 11, 2010 in these same plots and the number of cones per tree were to be counted in the late spring early summer. However, no cones were noted throughout the duration of the study (2009 and 2010). Pines and oaks were defined as saplings if their height was less than 1.4m or if DBH was 4cm or less. A 2m by 2m subplot was nested in the northwest corner of each 10m by 10m quadrat. Numbers of shrubs of each species were counted in each subplot. Prior to final analysis, mean density (#/m²) by species was determined.

Uniola paniculata Inflorescence Density and Seed Production

Uniola paniculata inflorescence data was determined along the same belt transects used to quantify seedling density (Appendix E). At each 5m by 20m subplot where *U. paniculata* inflorescences appeared within the belt transects, distance from the Gulf and number of inflorescence within each 5m by 20m subplots were recorded. In addition, the embryo dune nearest (within 100m) to each distance where inflorescences were found was selected for collection of inflorescence. The approximate area of the embryo dune, total number of inflorescences on the dune, and foliar cover (%) of *Uniola paniculata* was recorded. Foliar cover (%) was estimated in a 1m² quadrat placed approximately in the middle of the embryo dune (Daubenmire 1959). A maximum of 10 inflorescences were collected from within the 1m² quadrat and each placed into a separate paper bag to determine seed production characteristics of inflorescence.

The number of spikelets was counted and seeds were removed by hand, counted and recorded per inflorescence. Seeds were separated into classes of mature, immature or those with signs of herbivory. The mean number of spikelets per inflorescence and the number of seeds per inflorescence were counted. The estimated number seeds/spikelet were calculated as mean number of seed per inflorescence divided by the number of spikelets per inflorescence. The percentage of seeds within each seed class was calculated and all data are reported from each site and at various distances from the gulf.

Seedling Transects

In 1996 two randomly located 10m wide transects were established at 6 sites where frontal dunes collapsed as a result of hurricane Opal (no frontal dunes present) and 6 adjacent sites with remnant frontal dunes and well developed back-barrier dunes on the eastern section of SRI managed by Eglin AFB (Figures 3 and 4; Appendix F). At that time narrows and headlands were not identified as important to overwash penetration and thus, areas without frontal dunes may represent a combination of narrows and headlands. Transects ran from the Gulf's mean high tide line (MHW; mean high water line) landward 60m. In early summer of each year (1997 through 2000), along each transect, contiguous 10m by 5m quadrats were sampled for seedlings. Seedling survival was assessed for each quadrat in the fall of each year. Transects were lengthened to extend 100m landward from the Gulf in 2001. Seedling density and survival, species composition, cover and density were reassessed in 2001.

In 2008, transects were relocated at 3 of the original six Eglin sites and extended to include the entire island width for comparison to transects established in 1996. In addition, 2 new belt transects were established at GINS in 2007 that extended the entire width of the island. In 2008, additional belt transects were established east and west of the 2007 transects in each overwash site. These transects extended from MHW to 100m. In addition, in 2008 three new transects extending from MHW to 100m were established in an additional overwash site on GINS. Seedling establishment and survival was determined annually in 2008, 2009 and 2010 for most sites (Eglin and GINS).

Nesting bird activity in some years and some locations limited resampling (Figures 2 ; Appendix E). At each GINS site, a belt transect with a length of 100m was established in front of remnant frontal dunes when present. At narrows, 2 transects with a length of 100m and 1 transect running the width of the island were used. Belt transects began at the Gulf mean high tide and ran due north. Seedling counts by species were conducted in each 5m long by 10m wide sections of the 100m belt transects. Seedling counts by species were conducted in each 5m long by 2m wide sections of the transects from 100m landward of the Gulf to the mean high tide line on the sound side of the island.

Fruit density (Quercus) and Frequency (others)

Quantification of fruiting and acorn production was limited to 2010 because of the lack of consistent production in the previous years. Notes describing the occurrence of fruiting and acorn production from 2008-2010 can be found in the appendix (Appendix G & H). Three transects equally distributed along the longest axis of each scrub dune were established to determine acorn density for *Quercus* spp. and fruiting frequency for other species in 2010 (Figure 2). Each transect was stratified into front, middle, and back-dune positions and plants of each species located nearest to the line in each dune position were chosen for data collection. Acorn number was recorded for each dominant stem. When multiple dominant stems were present the number of dominant stems was recorded and a single representative dominant stem was subsampled for acorn number. Presence or absence of fruit for all other species was recorded for the

closest individual of each species. For the dioecious species *Ilex vomitoria* and *Ceratiola ericoides* the two closest plants within the same area were sampled.

Analysis

Principal Components Analysis (PCA) and Canonical Components Analysis (CCA) were used to visualize the relationships of vegetation assemblages alongshore and cross-island unconstrained and constrained by relationships to environmental gradients. The environmental gradients cross-island was represented by distance from the Gulf which is a surrogate for decreasing aerosol salt, decreasing wind speed, decreasing sand movement and decreasing overwash frequency. Environmental gradients alongshore were related to difference in island width. Indicator analysis (PCORD) was used to identify the faithfulness of occurrence of species in relation to the assemblage of species found cross-island and alongshore.

Results

Alongshore and Cross-Island Vegetation

PCA and CCA Analysis

Diagrams developed from Principal Components Analysis (PCA) and Canonical Components Analysis (CCA) differed in their representation of spatial relationships of vegetation assemblages alongshore (headlands, intermediate and narrows) and cross-island (sections with increasing distance from the Gulf) (Figures 5 and 6). The PCA analysis is unconstrained by environmental factors

and as such provides a less “biased” view of vegetation relationships. The first two PCA axes explained 35% of the variation (22% first axis and 13% second axis) but the first 7 axes contributed significantly ($P < 0.05$) towards explaining the variation in vegetation. The PCA analysis indicates distance from the Gulf (determined sequential in 100m increments) had the greatest effect in determining the distribution of vegetation on the island regardless of alongshore variation. There was no separation along either PCA axis in relation to island width or distance from the Gulf for vegetation 0 to 300m from the Gulf as indicated by the tight clustering of vegetation samples in species space for headlands, intermediate and narrows (Figure 5). Overwash appears to be the driving force regardless of island width 0 to 300m from the Gulf MHW. However, variation alongshore was apparent for the Northern 33-50% of the island. Variation cross-island was least for narrows as noted by the closer association of all narrows plots with each other compared to headlands or intermediates in both PCA and CCA diagrams. Vegetation located 301 to 400m from the Gulf MHW in headlands also did not differ from vegetation near the Gulf. The dominant species within the first 400m for headlands and narrows was *U. paniculata*. However, vegetation in intermediates 300 to 400m from the Gulf MHW was similar to headlands and narrows at 401 to 500m. In intermediates, a diversity of perennial grasses including *S. patens*, *S. maritimum*, *U. paniculata* and *P. amarum* co-dominated 300 to 400m from the Gulf MHW. Headlands and intermediates different from each other and from narrows along the Northern third of the island as indicated by the wide separation among segments. CCA

analysis also confirms the greater strength of distance from the Gulf in determining vegetation assemblages.

Vegetation directly on the Sound, varied considerably alongshore as indicated by the separation along both axes (300 to 500m narrows and 400 to 600m headlands and intermediates). Vegetation along Santa Rosa Sound for headlands (500 to 600m) included a fringe of coastal marsh dominated by *Juncus romerianus*, *Spartina patens* and *B. halimifolia* preceded by varying amounts of scrub dune and maritime forest with *Quercus geminata* and *Ilex vomitoria* as dominants. Sand flats with colonizing grasses and *Chamaesyce bombensis* best characterized the vegetation located along the Sound in narrows although a slender, fringe of coastal marsh with *B. halimifolia* was found in one narrows.

The indicator analysis identifies the faithfulness of occurrence of species in relation to an assemblage of species. Only two species were significant indicators of alongshore variation in vegetation. *Schizicharium maritimum* ($P=0.04$) was an indicator of headlands while *Chamaesyce bombensis* ($P=0.09$) was a weak indicator of narrows. *S. maritimum* is commonly found on back-slopes and crest of established dunes and is considered a good consolidator of established, stable dunes. Established dunes some as tall as 10m were more prevalent on headlands. *C. bombensis* is a sprawling, forb often found on interdunal flats with little vegetation and in partially-sand filled dry swales. These two species contrast the more stable environment associated with headlands and the more dynamic environment associated with narrows.

Indicator analysis identified 12 species as significantly or marginally significantly associated with distance from the Gulf and thus, environmental factors such as salt spray, wind speed etc. that change with distance from the Gulf (Table 1). Nine of the indicator species were most highly associated with the vegetation found along the Sound on headlands. Two species, *Odontonychia corymbosa* and *Physalis angustifolia*, were most highly associated with the Sound of narrows and intermediates.

Foliar cover (%)- Overall mean foliar cover averaged across headlands, intermediate and narrows was 30.4% and varied from a low of 0.7% within the first 100m of the Gulf to a high of 98.2% in the fringe marsh along Santa Rosa Sound (Table 2). *U. paniculata* was the only species found within 100m of the Gulf MHW along transects. However, *Cakile constricta* was also noted infrequently adjacent to transects. *Panicum amarum*, *Iva imbricata*, *Oenothera humifusa*, *Schizachyrium maritimum*, and *Heterotheca subaxillaris* along with *U. paniculata* occurred from 101 to 200m. Species richness increased to 15 from 201 to 300m, to 19 from 301 to 400m, to 30 from 401 to 500m and declined to 23 from 501 to 600m.

Overall mean foliar cover of 15.5% for *U. paniculata* and 11.2% for *S. patens* was greater than that of all other herbaceous or woody species (Table 2). *U. paniculata* cover varied cross-island and alongshore but because one of the transects crossing the headland intersected a densely vegetated, grassy, remnant dune beginning at 122m MHW and extending to 200m MHW from the gulf the greatest cover of 63.9% was found 101 to 200m from the Gulf MHW on

headland transects (Table 3). Incipient dune development also occurred beginning at 254m for one of the headland transects. For the narrows, *U. paniculata* cover of 23.1% and 36.7% was greatest 201 to 400m from Gulf MHW. Incipient dunes dominated by *U. paniculata* first occurred in narrows at 226m and 419.45 from GMHW. Similar to narrows, in intermediates, *U. paniculata* cover of 32.03% was greatest 201 to 300m from Gulf MHW with the first occurrence of incipient dune at 264m and 326m from GMHW. High cover of *U. paniculata* was associated with incipient and remnant dune development. Thus, incipient dune development and remnants were more frequently found nearer the Gulf in headlands. There was a more pronounced decline of *U. paniculata* cover from the center of the island to the sound side for headlands and intermediates compared to narrows. *S. patens* cover ranged from 0-13.95 for the southern half of the island and increased to 0-53.2% for the northern half of the island (Table 3). Cover of *S. patens* was greater for headlands than intermediates and narrows for the southern half of the islands, greater on intermediates 300 to 400m from Gulf MHW compared to narrows or headlands and greater on narrows at 400 to 500m from GMHW compared to headlands and intermediates. Portions of SRI designated as narrows and intermediates are not wider than 500m and thus the most northern sections (501 to 600m) of headlands could not be compared with narrows or intermediates. This section (501 to 600m) contained the greatest cover (%) of *S. patens* for headlands and for any other position on the island.

Cover of woody plants was greatest for headlands and lowest for narrows (Table 2). Total woody cover of 11.6% within headlands near Santa Rosa Sound (501-600m) consisted of overlapping cover of *I. vomitoria* (5.3 %) and *Q. geminata* (6.3%) (Table 3). For intermediates, total cover of woody vegetation did not exceed 5% with highest values near Santa Rosa Sound. For narrows, total cover of woody vegetation also did not exceed 4.2% for any 100m section with the highest cover 301 to 400m from Gulf MHW. Cover of bare sand on average was 48%, with the lowest cover in intermediates (Table 2). Bare sand exceeded 67% cover within narrows for the southern half of the island. Cover of bare sand for intermediates was lowest 200 to 400m from Gulf MHW. Bare sand exceeded 88% for headlands 0 to 100m and 301 to 400m from Gulf MHW but bare sand was less than 2% for headlands near Santa Rosa Sound (Table 3).

Habitat types for beach mice were defined and transects were sampled by Gore and others in 1991 (Gore and Shaefer 1993) (pre-hurricane) and resampled in 2010 by Gore and Wilkinson. We choose to sample a subset of those established by Gore in 1991 for our more detailed vegetation sampling in 2010. Table 4 presents the change from 1991 (pre-hurricanes) to 2008 in the occurrence of habitat types for beach mice on the same cross-island transects sampled in 2010 by species. This data confirms the loss of backdune, gulf-side, frontal dune (primary dune) and swale (portion of original swale filled with sand) and an increase in sand flat.

Cross-Island Woody Species Eglin AFB

Woody plants located on Eglin AFB in 2000 were buried or killed 100 m further inland of the Gulf by hurricanes in 2004-2005 (Table 5). In 2000, woody plants were recorded beginning 101 m landward of the Gulf but in 2008 woody plants were not found until > 201m from the Gulf. Only *Chrysoma pauciflosculosa* was found between 201 to 300m on SRU in 2010 (Table 3). *Chrysoma pauciflosculosa*, *Rubus spp.*, *B. halmifolia*, *Smilax spp.*, *Ilex glabra*, *Polygonella polygama* and *Ilex vomitoria* had the highest stem densities in 2000 (Table 6). The greatest changes in density were for *Ceratiola ericoides* (0.009-0.46/m²), *Ilex vomitoria* (0.035-0.20/m²), *Q. geminata* (0.001-0.025/m²) and *Smilax spp.* (0.040-0.14/m²). These density changes were artifacts of sampling. These species were partially buried by sand in association with storm surge in 2004 and 2005. The individual stems that were sampled in 2000 were partially covered by sand and many individual branches appeared above the sand surface making it difficult to differentiate the location of the original stems. These branch densities are reported here but these branches are probably attached to the single stems counted in 2000. Three species sampled in 2000 were no longer found in 2008 (*Morella cerifera*, and *Vaccinium*). Slight changes in the location of transects between 2000 and 2008 may account for some of these changes. Seedlings of *C. ericoides* have been noted 2-3 years after each storm (Opal, Ivan and Dennis) and thus the increase in density of this species may be seedlings added to the density associated with the counting of branches. Seedlings of *Q. geminata* and *I. vomitoria* were noted only rarely on the edge of

swales or in low spots between established trees but seedlings were so few and infrequently encountered that this should not account for the change in density noted. Density changes were noted only on scrub dunes located on the sound side of the island. Future sampling will clarify changes in woody species density by separation of seedlings from established plants.

Remnant Dunes - 2004 and 2010

Five frontal dune remnants surveyed in 2004 collapsed during Hurricane Dennis (Figure 2 Section 1 and 2; dunes 24, 28, 31, 33, and 37) and are now in the earliest stages of redevelopment (incipient dunes). Before Dennis, mean cover was 19.1% for *U. paniculata*, 22% for total herbaceous and less than 1% for woody species on these remnants (Tables 7 and 8). Post Dennis, road debris covered 0 to 58% of the area previously occupied by remnants. *U. paniculata* with mean foliar cover of 0.4% was the only vegetation present along line-transects on these collapsed dunes in 2010. However, belt transects (cover greater area than line transect) of these same areas found small amounts (0.001-0.009 plant/m²) of *Chamaescyce bombensis*, *Ipomoea imperati*, *Oenothera humifusa* and *Panicum amarum* (Appendix I).

A portion of the additional 10 frontal remnants characterized in 2004 also collapsed during subsequent overwash in 2005 (Table 9, Appendix J????). However, at least some section(s) of each dune with a height of over 2m remained. Hurricane Dennis reduced plant cover on these dunes with a decrease in total herbaceous cover from 17.1% in 2004 to 6.7% in 2010 and a

decrease in total woody species cover from 5% to 1.7% in 2010 (Tables 9 and 10). *U. paniculata* was the dominant species in 2004 with cover of 12.4% and remained the dominant species in 2010 with cover of 4.6%. For four of these dunes, plant cover was replaced by road debris and for the remainder, bare sand replaced vegetation or there was little to no change. Cover of road debris averaged 7.6% over the 10 dune fragments. Cover of bare sand increased from 1.9-20.1% and averaged 75.4%. Species richness remained high with 21 species present. Woody plants were found on 3 of the remaining 10 remnants. Prior to Dennis 6 of these dunes had woody vegetation.

Interior and sound-side dunes (back-barrier dunes) landward of gulf-side remnants were scarped by Hurricane Dennis's storm surge and strong winds continue to erode them. On these dunes less than 9% cover of *U. paniculata* remained in 2010 (Table 11). Mean cover of *S. maritimum* at 6.8% was similar to that of *U. paniculata*. Mean cover of woody species averaged 6.6%. However, woody cover of less than 3.6% occurred on 14 of the 24 dunes. Species richness of back-barrier dunes was much higher than that of frontal remnants with a total of 50 species identified. Woody species with the greatest mean foliar cover and density of live stems were *Quercus geminata*, *Quercus myrtifolia*, *Ilex vomitoria* and *Magnolia grandiflora* (Table 11 and Appendix K). Live and dead foliar cover of *Q. geminata* was greater than that of other woody species. Bare sand averaged 66% on these dunes.

Maritime Forest – Shrubby Flatwoods (FNAI 1990)

The only tree species over 3 m tall found on flat to low dunes (less than 1 m in height) and slightly depressed sites immediately adjacent to the sound was *Pinus elliotii*. These maritime forests are better described as flatwoods (FNAI 1990) dominated by an open canopy of *P. elliotii* and found on SRU headlands and intermediates. Of the two sites surveyed, the percent mortality of *Pinus elliotii* in the canopy was much greater on site 1 than site 2. On site 1 100% of the canopy of *P. elliotii* was dead while only 57% was dead on site 2 (Table 12). Dead needles on live saplings were found only at site 1. Percent of dead needles on saplings was 30%, 5%, 5%, 90%, 3%, and 10% (mean of 24%).

Regeneration of *P. elliotii* after hurricane Opal (1995) (represented by saplings less than 1.4 m tall) and death of saplings in association with Ivan and Dennis also differed between sites. A larger proportion of saplings were dead on Site 1 with densities of 6 live saplings/ha and 59 dead saplings/ha. There were no dead saplings on site 2 but 400 live saplings/ha. Stumps of *P. elliotii* represent trees killed by Hurricane Opal. Number of stumps was 229 /ha on site 1 and 100/ ha on site 2. Site 1 appears to have had greater density of *P. elliotii* before Hurricane Opal compared to site 2 but hurricanes over the last 15 yrs have shifted the density so that site 2 has a greater density of *P. elliotii* compared to site 1.

The topography of Site 1 consisted of a slightly elevated area sloping into a depressed area below the surrounding landscape immediately along the sound. Overwash from recent hurricanes would have remained trapped for

longer periods of time in the depressed portion of the site. The dead *P. ellioti* were located in this depressed area. The elevation of site 2 was not depressed and as a result storm overwash drained quickly and did not pond on any part of this site.

Richness of woody species over 1m in height also varied between sites. *Ilex vomitoria* and *B. halimifolia* were the only woody species over 1 m tall at site 2 while both of these species along with 6 additional woody species were found on site 1. Density of *Q. geminata* and *Ilex vomitoria* were greater than that of the other 6 species. *B. halimifolia* dominated the understory of the depressed area of site 1 while the elevated portion of the site had woody species similar to those found on sound-side remnant scrub dunes. The density of dead *Q. geminata* was considerably less than that of live *Q. geminata* and similar to that noted on remnant sound-side dunes. Average bare sand was 12% for both sites.

These sites varied considerably in cover of vegetation less than 1 m in height as well which may also be reflective of the differences in topography between the two sites. *Spartina patens* and *Scleranthus annuus* with cover of 48 and 34% respectively were dominant herbaceous species for both sites (Table 13). *Juncus romerianus* cover of 15% on site 1 compared to the lack of *J. romerianus* on site 2 indicates at least a portion of site 1 was a wetland and lower in elevation than site 2. Woody species of *Baccharis halimifolia* and *Quercus geminata* with foliar cover of 31 and 34.39%, respectively, were dominant species for site 1 while *B. halmifolia* was not present on site 2 and *Ilex vomitoria* with cover of 21.72%, *Rubus spp.* with cover of 10.27% and *Vitis rotundifolia*

with cover of 7.14% dominated the woody ground cover of site 2. Dead cover of *Pinus elliotti* was 33% for site 1 while *P. elliotti* less than 1m tall was absent on site 2. Cover of smilax spp. was also much greater on site 2 at 52.3% compared to 2% on site 1.

Uniola paniculata –Inflorescence and Seed Production

Inflorescence production varied with overwash site and distance from the Gulf (Table 14 and Figure 2). Site 1 was located in a headland with remnant gulf-side interior and sound-side dunes. *U. paniculata* inflorescences were found from 90 to 240m from the GMHW. Sites 2 and 3 were located in narrows with little to no vegetation other than *U. paniculata*. Inflorescences for site 2 were recorded from 221 to 380m from the GMHW while at site 3 inflorescences were recorded from 111 to 180m from the GMHW. Overall, the greatest density of inflorescences was noted at 221 to 230m from the GMHW at site 2 (3.1 infl./m²) with the next highest density only 0.85 infl./m² at 231 to 240m from the GMHW on site 2. Inflorescence structure varied also by overwash site with 143 to 338 spikelets/inflor. for site 1 and 300 to 393 and 224 to 464 spikelets/inflor. for sites 2 and 3 (narrows). More interesting was the change in inflorescence structure and seed production within each site. Number of spikelets was greater within inflorescence situated closer to the Gulf. The least seed production (0.69 to 1.49 seeds/spikelet) was in site 1 associated with the headland. Seed production was highest at 90-200m from the GMHW and then dropped to below 1 seed/spikelet from 201 to 240m from the GMHW. Seed production in narrows was higher than that of headlands at similar distances from the Gulf with 1.8 seeds/spikelet at 221

to 230m from the GMHW and 1.4-1.8 seeds/spikelet at 361-380m from the GMHW on site 2. The greatest seed production was noted at 161-170m from the GMHW at site 3. Interestingly, the proportion of seeds graded as mature and immature generally differed very little from the overall mean of 14% with a notable exception of the most northern collection at site 1 (27%) and the most southern collection at site 3 (22%). These differences may simply reflect differences in phenology and flowering dates for the plants at those locations. Less than 1% of seeds had signs of herbivory. The greatest seed production occurred between 101 and 300m from the GMHW while no inflorescences were collected beyond 400m from the GMHW.

Seedling Transects

Seedling recruitment and survival of *Uniola paniculata* varied by year. (Tables 15 to 17; Appendix L to AD). Rainfall variation from year to year in spring and summer was also apparent and may have contributed to variation in seedling recruitment (Appendix AE). Spring and early summer (March-July) rainfall was lowest in 1999 and 2007. Rainfall data for spring of 2000 was unavailable but Aug. through Nov. rainfall in 1999 and 2000 was lower than all other years. Seedlings were not present in 1996 after Hurricane Opal (1995) or in 2005 and 2006 after hurricanes Ivan (2004) and Dennis (2005). Survival of seedlings through the summer and fall of a given year of more than 1% did not occur in 6 of the 8 years sampled. Seedlings were lost in most years because of the high frequency of overwash associated with tropical storms. In most years and locations seedling density midsummer was generally 0.01-0.04/m². When

sampling was completed in June of 2008 seedling density was $0.321/\text{m}^2$ and 2010 when seedling density was $0.209/\text{m}^2$ for SRU. However, survival of seedlings was nearly 0% for 2008 because of storm surge overwash in August. Of the 8 years of sampling, only in 2010 did survival exceed 1% with mean survival of seedlings at 22% (Table 15).

Recruitment of *U. paniculata* seedlings may occur some years throughout the spring, summer and fall. Because of overwash in late summer and/or early fall in most years recruitment of seedlings was not noted after July. However, there was no overwash in 2010 and recruitment after July was quantified in the November sample (Appendix Z to AB). Seedlings have been noted as early as March suggesting recruitment of sea oats may occur throughout the growing season. It also appears the Deep Horizon oil spill clean-up potentially affected seedlings after the November sample because resampling in the May of 2011 in one overwash (three other transects were occupied by nesting birds) and in front of two remnant dunes found mean density of seedlings quantified in November greatly reduced from $.031\text{--}0.128/\text{m}^2$ to less than $0.001/\text{m}^2$ (Appendix AF). Transects did not appear to have tar balls or oil beyond 10m landward of the Gulf prior to the November sampling but clean-up crews worked much higher above the GMHW throughout the winter and early spring.

Seedling density was not consistently different with width of island (narrows vs. headlands), presence of remnants or with accessibility of the public. Survival of seedlings in 2009 on portions of Eglin with limited access did not differ from survival on portions of Eglin with restricted access. However, in some years

there appeared to be an impact of foot traffic on seedlings nearest the Gulf particularly where visitors were concentrated in front of remnant dunes. Seedling density in front of remnants at SRU was less than in overwash sites in 2008 but greater than in the overwash sites in 2010 otherwise there were no differences in recruitment between remnant (most often in headlands) and overwash sites (narrows and others). *U. paniculata* seedlings were not found on overwash sites landward of 301m on Eglin and landward of 401m on GINS (Table 18 and 19).

Occurrence of seedlings for species other than *U. paniculata* cross-island was highly variable (Tables 18 and 19). Seedlings of 17 species were found. *Cakile constricta*, *P. amarum*, *S. maritimum*, *Iva imbricata* were found most frequently within 50m of the Gulf. However, seedlings of each of these species were not found every year of the survey. *Cakile* was found in low numbers near the Gulf and the sound of narrow sections of the islands but was absent beyond 100m landward of the Gulf on wider section of the islands (Table 19 remnants). On Eglin there were no seedlings 201 to 700m from the Gulf when a remnant frontal dune was present. On overwash sites, seedling density and frequency of *Cnidoscolus stimulosus* was the highest compared to all other species from 200 to 500m from the Gulf.

Fruit Density (Quercus) and Frequency (others)

Acorn and fruit production were erratic from 2008-2010 (Appendix AG). Quantification of fruit and acorn production was not practical until 2010. Estimated acorns/tree varied within and between *Quercus* species (Table 20, Figure 2). *Q. geminata* was present on all 18 dunes sampled although no *Q.*

geminata occurred within the belt transects of dunes 21 and 11. *Q. geminata* with acorns were found on all but three of the 18 dunes (Dunes 11, 15, and 18). Dunes 11 and 15 are very small, with little woody vegetation and situated toward the Gulf side of the island and highly exposed to salt spray and wind. In contrast, Dune 18 is the last dune west of a headland and the woody vegetation is highly exposed on the south side. Higher density of *Q. geminata* trees was found on dunes located central to the headlands with steep slopes on the sound side of the dune (Dunes 41, 13, and 38) or where deep bowl-like areas occurred providing protection from wind and salt spray (Dunes 17 and 16). Interestingly, the greatest acorn production per tree was associated with Dunes 9, 13, 16, and 14 and the least acorn production on Dunes 11, 12, and 15 all of which are situated within the same headland. Dune 13 is the central-most dune associated with this headland and is characterized as narrow and parallel to the coast with a very steep slope on the north side behind the ridge.

Estimated acorn density demonstrates the interaction of the increased tree density and higher acorn yields per tree for dunes situated central to the headlands (Dunes 26, 41, 44, 13, and 16) as well as for larger dunes on the margin of the headland (Dunes 17 and 9) with bowl-like areas providing added protection of *Q. geminata*. The greatest estimated acorn density was for Dune 13 which is central to the largest headland and represents the central dune of a series of large intact dunes to the east and west of Dune 13.

Although *Q. myrtifolia* trees were less common than *Q. geminata*, *Q. myrtifolia* with acorns were located similarly to that of *Q. geminata* with acorns in

relation to wind and salt spray exposure. *Q. myrtifolia* trees were present on only seven of the 18 dunes sampled, absent on the 6 eastern most dunes sampled and present on the most western dunes sampled. *Q. myrtifolia* with acorns were present also on dune 9 although no trees occurred within the belt transect. On Dunes 18, 7, 6, and 13 trees were associated with back slopes while on Dunes 5, 9, and 14 trees were associated with deep bowl-like areas. The greatest acorn production per tree occurred on the most central of the dunes within the headlands (Dunes 7 and 13). Acorn production was common for *Q. myrtifolia* on all dunes where trees occurred. Estimated acorn density for *Q. myrtifolia* exceeded estimated acorn density for *Q. geminata* for four of the five dunes where both species occurred (Table 20).

The frequency of fruiting for 11 other woody species varied across the island (Table 21; Appendix AH). A majority of the 18 dunes sampled had 6 or more of the 11 woody species present. However, only eight of these dunes had fruit on at least half of the species present. Dunes with the highest proportion of species with fruit present included Dunes 26, 17, 5, 7, 6, 9, 16, and 14. With the exception of Dune 26, these are the same dunes where acorn production was greater for *Quercus*. Notably absent from the list is Dune 13 where ten of the 11 woody species were present but only three were producing fruit in spite of a high production of acorns for both *Quercus* species. The tall narrow shape of this particular dune restricts many of the woody plants to the back slope which does not provide for the diversity of growing locations for which the additional 11 woody species are associated.

The highest frequency of fruit presence was for *Serenoa repens* at 66% which may be a function of the compact nature of the plant and a compact inflorescence structure which helps protect flowers and fruit from environmental stresses. Fruiting frequency of *Crataegus* also exceeded 60% with plants primarily in protected areas of dunes central to headlands. Fruiting frequency was high for both *Ilex vomitoria* (49%) and *Ilex glabra* (50%) and for *Magnolia grandiflora* (41%) with *Ilex vomitoria* fruiting on 12 of the 15 dunes where it was present. Smaller dunes such as Dune 12 had none of the 11 woody species present and only non-fruiting *Smilax* was present on Dune 15. Dunes with the highest number of fruiting woody species were Dunes 5, 6 and 14. Dunes 5 and 14 are the two largest remaining dunes, are oriented northwest to southeast and contain a variety of open and vegetated areas and bowl-like depressions with steep slopes while Dune 6 is intermediate in size, U-shaped and has open and vegetated areas on the south side and a rather large area of protected interior slopes on the north side of the dune.

Discussion

Cross-Island and Alongshore Temporal and Spatial Variation

As a result of the increased frequency and intensity of tropical storms in the last 15 yrs more than 70% of gulf-side foredunes on SRI (Pries et al. 2008; Houser et al. 2007) have been lost, and woody vegetation and perennial grasses, particularly *U. paniculata* have been killed by saltwater overwash, pushed 100-400m or more from Gulf MHW or buried too deep to recover. Perennial herbaceous vegetation can recover through rhizome expansion after overwash but not if rhizomes remain exposed for more than a week (Miller et al. 2003) or sediment deposition exceeds the burial threshold (Seliskar, 1994). Woody vegetation can also survive burial by developing adventitious roots and altered biomass allocation to elongate horizontally in response to burial but death occurs when the burial threshold is surpassed or when woody plants are exposed to higher wind speeds and increased aerial salt spray (Dech and Maun 2006, Conner et al 2005). Extended saturation of soils by salt water can lead to death of woody species. In addition, poor seedling establishment has stalled incipient dune development for most of GINS Santa Rosa Unit.

Opal in 1995 initially fragmented a fairly continuous gulf-side frontal dune ridge on SRI leaving a discontinuous frontal dune backed by hummocky back barrier dunes (interior and sound-side remnants) and maritime forest (headlands) on the SRU of SRI (Houser et al. 2008a). Subsequent storms in 2004 and 2005 as described by Houser et al. (2008b) have changed the headlands to washover terraces and narrows (between headlands) to washover corridors. The

magnitude of landscape and vegetation change resulting from recent storm surge can be best illustrated by comparing our vegetation surveys to those conducted on SRI (Burkhalter 1987) and nearby Perdido Key Florida (Gibson and Looney 1992) prior to the recent increased hurricane intensity and frequency. The beach strand (back-beach) ended and gulf-side dunes began at approximately 50 m from the GMHW (Burkhalter 1987) and continued to 100m from the GMHW on SRI in 1979 while on Perdido Key (Gibson and Looney 1992) dunes began at 24m from the GMHW and established, incipient (developing) and low dunes were described to 180m of the GMHW in 1989. *U. paniculata* cover varied from 4.8% on the dune edge to 41.5% on the dune crest on SRI in 1979 (Burkhalter 1987) but species other than *U. paniculata*, many burial-intolerant but dune stabilizing, dominated landward 100m of the GMHW. In contrast, 6 years after hurricane Ivan, the back beach or “strand” with no dune development extended to 200-400m of the GMHW or more in the narrowest section of the SRU and to 100-200m of the GMHW if remnant dunes were present (predominately headlands) pre and post Ivan.

The lack of dunes and dune vegetation from to 200-400m of the GMHW is the result of greater overwash penetration as described by Houser et al. (2008a) in the narrowest section of the island and to a lack of vegetation recovery from seedlings because of subsequent, frequent overwash from additional storms (2005, 2006, 2007, 2009) documented in our study. Spatial variations in vegetation reflects cross-island environmental gradients (Ehrenfeld 1990) altered to a large extent by post hurricane morphology (Stallins and Parker, 2003 Houser

2007) whereas reestablishment and development of vegetation cover is in response to the frequency of disturbance (Houser et al. 2009). For the first 100-400m from the GMHW, as a result of repeated overwash penetration and dune breaching, the alongshore dune morphology consists of a mosaic of remnant dunes of various ages and sand flats with some incipient dune development (Houser et al. 2008a, Stallins and Parker, 2003). In narrows, rhizomes of *Uniola paniculata* pushed 222-419m landward were able to reestablish in patches and begin the process of dune redevelopment, however; this redevelopment was less obvious in headlands and intermediates where large interior and back-barrier dunes persisted (Houser et al. 2009) and where remnants collapsed during hurricane Dennis. Where remnants collapsed deep burial of rhizomes occurs resulting in lack of *U. paniculata* reestablishment and expansion. In addition, road debris has covered the sand where remnants once stood further altering dune redevelopment.

It has been suggested that barrier islands exist in different stable states driven by overwash frequency and amplitude and reinforced by vegetation as a driver of dune elevation (Stallins 2005; Stallins and Parker 2003). A dominance of burial tolerant, non-dune building plants perpetuates a low elevation island dominated by frequent overwash. In contrast, dominance of dune building and non-burial tolerant plants perpetuates dune and swale topography and deflects dune breaching and overwash penetration. Pries et al. (2008) proposed that SRI may be undergoing a state change to one where overwash disturbances are driving island dynamics more so than cross-island environmental gradients. The

distribution of *Uniola paniculata* and lack of zonation cross-island suggest overwash is the dominant vegetation structuring force in narrows of SRU. However, the dominance or co-dominance of *U. paniculata*, the most wide-spread dune building species along the Gulf coast, suggests the potential for dune building remains good in narrows. Although narrow section of SRI remain well adapted to a high frequency of storms, as suggested by Houser et al. (2009), recovery is rapid but the dunes will remain small and discontinuous and will remain susceptible to greater storm surge penetration in the future. Our data agrees with that of Houser et al. (2008a) suggesting that the foredune on SRI will recover in both height and alongshore extent particularly in headlands but only if hurricane frequency allows.

Remnant Dunes

Gibson and Looney (1992) further described the profile of the Perdido Key, Florida the island located immediately west of SRI prior to the increase in hurricane activity as consisting of 7 vegetation types. With the exception of wet swales, similar vegetation types were found in our study for the SRU unit of SRI. However, Gibson and Looney reported back slope vegetation on the sound sides of dunes at 84m+, and wooded dunes from 280m+ N from the GMHW. Similar vegetation types were reported by Burkhalter (1987) but his study was located on one of the widest sections of SRI with well developed interior woody dunes. In our study these vegetation types were not found in narrows and were reduced by hurricane storms of 2004 and 2005 in headlands and intermediates. Back slope vegetation was not found until 200m from the GMHW or more. In addition to the

loss of back-barrier dunes documented by Pries et al (2008) in association with hurricane Ivan (2004), we found further erosion and vegetation loss of interior and sound-side dunes 5 years after the storms of 2004 and 2005. An additional 33% of remaining individual remnant dunes completely collapsed as a result of direct wave erosion and the transfer of sediment to the backbarrier by overwash from Tropical Storm Arlene, Dennis (2005) and Katrina (2005). Dunes with woody vegetation are more resistant to storm surge suggesting that at least 7 of the remaining 10 gulf-side remnants found in headlands on SRU because of their lack of woody plants are likely to collapse with the next large storm surge of a magnitude equal to Opal, Ivan or Dennis (Salenger 2000). Wind and water erosion of remnants is continuing as herbaceous and woody vegetation cover remain reduced by 39% and 34% respectively 6 years after Ivan's storm surge. After hurricane Hugo (1989) on a South Carolina barrier island, *Quercus virginiana* density and basal area were reduced by 33% and 28.5% but tree canopy continued to decline for years after initial impacts of the hurricane presumably because of increased exposure to ocean-strength salt spray (Conner et al 2005). Similar loss of *Quercus geminata* and *Quercus myrtifolia* has been noted on SRI and this decline appears to be continuing. In addition, reduced acorn production with wind and salt spray exposure seen in our study further suggest *Quercus* spp. may decline with increasing storm frequency. Consistent acorn production was not observed until 5 years after Dennis and germination and establishment of acorns has been noted rarely on SRI. Our study agrees with the conclusions of Houser et al. (2008a), the recovery of

backbarrier dunes is in question on the SRU portion of SRI. Above and belowground plant parts stabilize dunes and reduce erosion and with their reduction dune remnants continue to erode though the actions of wind and water (Houser et al. 2008a). In addition, erosion may increase as remnants are further fragmented and reduced in size. Factors that limit sediment supply, including human-altered features, can delay post hurricane dune recovery and can potentially lead to a destabilization of the remnant dunes.

Revegetation of the areas where large dunes were previously found has been delayed by lack of regeneration of vegetation located on collapsed dunes and limited seedling establishment. As noted with hurricane Opal, where large dunes collapsed and sand more than 1 m in depth is deposited in close proximity to the original dune, sea oats are buried too deep to regenerate and revegetation requires seedling establishment. In addition sand accumulation and seedling establishment appear to be reduced in areas where road debris was deposited and sites where dunes stood until 2005 and overwash flats are covered by debris on SRU. Road debris appears to be seriously impacting dune recovery.

Maritime Forest- Shrubby Flatwoods (FNAI 1990)

Extended exposure in low lying areas of the Maritime forest to repeated storm overwash resulted in 100% death of *P. elliotii* canopy trees however, where trees were located in well-drained low sound-side dunes death was reduced by almost 50%. *P. elliotii* in swales found on other sections of SRI also suffered 100% death of canopy trees (unpublished data). Increased mortality of

P. elliottii in lower lying areas of the Florida Keys has also been reported with salt water overwash of hurricanes (Sah et al. 2010). The resilience of *P. elliotti* was similar to that reported for *Pinus taeda* on a South Carolina barrier island where stem density of *P. taeda* was much greater 7 years after hurricane Hugo than pre-hurricane because of seedling establishment (Conner et al 2005). *Pinus elliottii* saplings of an age corresponding to reestablishment after each storm surge were noted however, these saplings were also killed where storm surge ponded. New cones were not recorded during the six years of this study. Most *Pinus* species are five years old or older before they flower and even ramets from mature trees usually grow 2 to 3 years before flowering (Varnell et al. 1966). Flower production increases slowly and erratically for another 2 to 5 years after the tree first flowers.

P. elliottii density has already been altered in low lying sites on SRU. With continued frequent (return interval of less than 8-10 years) overwash, *P. elliotti* may disappear from the lowest sites on SRI but may remain on slightly higher low dunes on the sound-side. Even without frequent overwash, these areas will be extremely sensitive to sea level rise and salt water intrusion. The maritime forest (flatwoods) on much of SRI has undergone a rapid change and the response of the understory is still uncertain. Immediately after Hurricane Dennis an increase in *B. halimifolia* was noted in swales and low-lying maritime forest. *B. halimifolia* was also noted to increase from a pre-storm density of 0.1 stems/ha to 445.5 stems/ha 9 years after Hurricane Hugo (Connor et al 2005).

U. paniculata Seed Production and Seedling Establishment

Inflorescence density and seed production varied alongshore and cross-island. Highest inflorescence density for *U. paniculata* in our study was found far (260+m) landward of that associated with less disturbed sites both on SRI and in other studies. Also, greater inflorescence density and seed production were not always associated with *U. paniculata* nearest to the shore. Gormally and Donovan (2010) found higher flowering of *U. paniculata* within 10m of MHW. Increased flowering has been attributed the fertilizer effect of salt spray (Ehrenfeld 1990). Salt spray is not only a stressor but the main source of nutrients for dune plants. Although salt spray decreases exponentially with distance from its source, dune morphology also alters salt spray penetration. With the loss of dunes on SRI, particularly in narrows, salt spray penetration is greater which may account for greater seed production in narrows than intermediates or headlands at similar distances from the Gulf. Also, seed production in our study varied inconsistently with distance from the Gulf in narrows with little to no decrease in seeds/spikelet with distance but in the wider part of the island where remnant dunes altered salt spray penetration from the Gulf and the Sound greater number of spikelets per inflorescence and seed per spikelet were found nearer the Gulf. Seed production on SRI varied from 0.69-2.22 seeds/spikelet and was similar to studies from the Carolinas that found an average of about 2-2.4 seeds/ spikelet (Wagner 1964; Westra and Loomis 1966). Studies further west in Louisiana where *U. paniculata* is not the dominant dune

species found much lower numbers of seeds/spikelet than SRI or the Carolinas at 0.091-0.002 (Hester and Mendelssohn 1987).

Density of seedlings of *U. paniculata* is dependent upon seed production, competition, microclimate and macroclimate (Woodhouse et al. 1968; Ehrenfeld 1990). The density of *U. paniculata* seedlings on SRI in mid-late summer was greater in years with higher June rainfall. However, rainfall in other spring and summer months could not be used to explain results. Seedlings may succumb to desiccation during periods of prolonged drought and do not tolerate prolonged flooding with sea water. Overwash in 1995, 2004 and 2005 resulted in uprooting and reburying of adult sea oats. This exposure to salt water and disruption of roots and rhizomes may have diminished inflorescence and seed production for several years. Extreme tides and storm surge in all years of this study except 2010 buried and washed-out seedlings in the late summer or fall and sometimes in early summer. As seen in our study, Cousens (1988) also reported a 2 year lag in the appearance of seedlings after hurricane overwash. Seedlings do not tolerate complete burial, exposure to salt water or desiccating winds and do not become completely established until the second growing season (Ehrenfeld 1990). Survival is low in areas with rapid accumulation or erosional processes (Woodhouse 1968). Late fall, winter and spring wind speeds are higher on SRI than summer. With the added loss of dune topography seedling loss to erosion processes may have occurred not only in association with overwash but throughout the winter months. The survival of 22% of seedlings in 2010 at least until November is encouraging to future *U. paniculata* spread and dune growth.

However, man-made disturbances such as those associated with beach clean-up for whatever purpose could negatively affect natural survival of seedlings into their second year as noted by the loss of large numbers of the 2010 seedlings in the winter of 2011. In general, dunes become large enough to trap considerable sand three to five years after seedling establishment (Woodhouse 1968). It will take reduced frequency of low-level overwash and human disturbance for 3 to 5 years to see widespread incipient dune development.

Fruit density (Quercus Acorns) and Fruit Frequency

Acorn frequency and density was not sufficient to quantify for either *Quercus* until 4 yrs after Hurricane Dennis. Irrespective of impacts from hurricanes, variability in seed production may occur differently among the two *Quercus* species from year to year reflecting the differences in reproductive phenology of the species (Abrahmson and Layne 2003). *Q. geminata* is a member of the white oak group with staminate floral buds initiating in the spring of the year prior to flowering and pistillate buds initiating in the late summer of the year prior to flowering. The following year, catkins are produced in spring which if fertilized will develop fruit in the fall of the same year making this a 2 year cycle of acorn production (Abrahmson and Layne 2003). *Q. geminata* is viviparous indicating that the growth of the embryo is continuous while on the parent plant (Leck and Outred 2008).

Q. myrtifolia, a member of the red oak group, initiates staminate and pistillate floral buds with the same seasonality as *Q. geminata*. However, fruit

development and maturation for *Q. myrtifolia* occurs in the fall of the year following spring flowering making *Q. myrtifolia* acorn production a 3 year cycle. In contrast to members of the white oak group, members of the red oak group generally have a dormancy period before germination can occur (Hopper et al. 1985). When the impacts of canopy damage and removal from a hurricane are combined with the two and three year timeline for acorn production, a 4 year delay in acorn production for both *Q. geminata* and *Q. myrtifolia* is not surprising given the reproductive phenology of the species. This observed 4 year delay in acorn production also suggests a minimum frequency of 5 years between storms would be necessary to allow for successful recruitment of *Quercus* from natural acorn production.

A notable pattern in our study was reduced acorn production in association with exposure to higher wind speeds and salt spray. Reduced acorn production with increasing exposure to sea breezes has also been reported for *Quercus dentata* (Masaka and Sato 2002). Hurricanes have been shown to affect fruit set of woody species on islands through resource limitation and indirectly through reducing bird pollinators and causing pollination limitation of fruit set (Rathcke 2000). The less than 100% frequency of seed production for most of the woody plants may have occurred as a result of the hurricane effects and altered environments post hurricane.

When intact acorns are available, safe sites must be present for successful germination. Safe sites are zones with favorable resources such as water and oxygen, a favorable light source and absence of predators (Harper

1977). On SRI the two *Quercus* species were observed rarely as seedlings. The seedlings which have been detected are near established scrub dunes at lower elevations with flatter slopes (such as the toe of a dune) sometimes on the edge of or in shallow, interdunal swales. At such sites, seedlings are within the proximity of a mature individual of the same species and herbaceous vegetation is lacking (Personal Observation). This suggests that the previous description fulfills the safe site requirements for *Q. geminata* and *Q. myrtifolia*.

An increase in the number of tropical storms on the Gulf coast could contribute to the decline in oak regeneration. In addition to periodic natural disturbances such as storm events, oak regeneration can be affected by climate change. Low lying barrier islands are particularly vulnerable to a suite of climate change impacts including sea level rise, increase in the intensity of storms and shifts in species composition of biological communities. Within 130 years the global atmospheric concentration of CO₂ has increased by 37% from 270 PPM in 1870 to 370 PPM in 2000 (Tangley 2001). In a laboratory experiment, increased levels of CO₂ significantly increased reproductive output and biomass of *Q. myrtifolia* and did not increase either reproductive output or biomass of *Q. geminata*. Having accelerated the recruitment of *Q. myrtifolia*, increased CO₂ levels will lead to a scrub oak system with lower diversity (Stiling et al. 2004). Thus, understanding of the germination ecology of these species is essential to their conservation.

Literature Cited

- Abrahamson, W.G. and J.N. Layne (2003). Long-term patterns of acorn production for five oak species in xeric Florida uplands. *Ecology*. **84**:2476-2492.
- Armon, J.W. (1979). Landward sediment transfers in a Transgressive Barrier Island System, Canada. *Barrier Islands from the Gulf of St. Lawrence to the Gulf of Mexico* (ed S.P. Leatherman), pp. 65-80. Academic Press, New York.
- Barbour, M.G. (1990). The coastal beach plant syndrome, Guelph, Ontario, Canada.
- Burkhalter, J.R. (1987). An ecological study of coastal strand vegetation on the western end of Santa Rosa Island near Pensacola, Florida. MS Thesis, University of West Florida, Pensacola.
- Clewell, A.F. (1986). Natural setting and vegetation of the Florida panhandle. An account of the environments and Plant communities of Northern Florida, West of the Suwannee River. U.S. Army Corps of Engineers, Final Report. COESAM/PDEI-86/001.
- Conner, W.H., W.D. Mixon II, and G.W. Wood (2005). Maritime forest habitat dynamics on Bulls Island, Cape Romain National Wildlife Refuge, SC, following Hurricane Hugo. *Forest Ecology and Management*. **212**:127-134.
- Cousens, M.I. (1988). Phytosociology and hurricane-initiated revegetation on Perdido Key, Gulf Island National Seashore, Final Report to the U.S. Department of the Interior. National Park Service, Southeast Regional Office, Atlanta, Georgia.
- Daubenmire, R. (1959). A canopy-coverage method of vegetation analysis. *Northwest Science*. **33**:43-64.
- Dech, J.P., and M.A. Maun (2006). Adventitious root production and plastic resource allocation to biomass determine burial tolerance in woody plants from central Canadian coastal dunes. *Annals of Botany*. **98**:1095-1105.
- Ehrenfeld, J.G. (1990). Dynamics and processes of Barrier Island vegetation. *Reviews in Aquatic Sciences*. **2**:437-480.
- Florida Natural Areas Inventory (FNAI) (1990). Guide to the natural communities of Florida. Florida Natural Areas Inventory and Florida Department of Environmental Resources Management; Tallahassee, Florida.
- Gibson, D.J., and P.B. Looney (1992). Seasonal Variation in Vegetation Classification on Perdido Key, a Barrier Island off the Coast of the Florida Panhandle. *Journal of Coastal Research*. **8**:943-956.

- Gore, J.A., and T.L. Schaefer (1993). Distribution and conservation of the Santa Rosa beach mouse. *Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies*. **47**:378-385.
- Gormally, C.L., and L.A. Donovan (2010). Responses of *Uniola paniculata* L. (Poaceae), an essential dune-building grass, to complex changing environmental gradients on the coastal dunes. *Estuaries and Coasts*. **33**:1237-1246.
- Harper, J.L. (1977). *Population biology of plants*. Academic Press, London.
- Hopper, G.M., D.W. Smith, and D.J. Parrish (1985). Germination and seedling growth of northern red oak – effects of stratification and pericarp removal. *Forest Science*. **31**:31-39.
- Hesp, P.A. (1991). Ecological processes and plant adaptations on coastal dunes. *Journal of Arid Environments*. **1**:271-274
- Hester, M.W., and I.A. Mendelssohn (1987). Seed Production and Germination Response of Four Louisiana Populations of *Uniola paniculata* (Gramineae). *American Journal of Botany*. **74**:1093-1101.
- Houser, C., S. Hamilton, K. Meyer-Arendt, and J. Oravetz (2007). EOF analysis of barrier island morphological change during Hurricane Ivan. *Coastal Sediments '07*.
- Houser, C., C. Hapke, and S. Hamilton (2008 a). Controls on coastal dune morphology, shoreline erosion and barrier island response to extreme storms. *Geomorphology*. **100**:223–240.
- Houser, C., C. Hobbs, and B. Saari (2008 b). Posthurricane airflow and sediment transport over a recovering dune. *Journal of Coastal Research*. **24(4)**:944-953.
- Houser, C. and S. Hamilton (2009). Sensitivity to post-hurricane beach and dune recovery to hurricane frequency. *Earth Surface Processes and Landforms*. **34**:613-628.
- Johnson, A.F., J.W. Muller, and K.A. Bettinger (1992). An assesment of Florida's remaining coastal upland natural communities: Panhandle. *Florida Natural Areas Inventory*, Tallahassee, Florida.
- Leatherman, S.P. (1979). *Barrier islands from the Gulf of St. Lawrence to the Gulf of Mexico*. Academic Press, New York.
- Leck, M.A. and H.A. Outred (2008). Seedling natural history. In: M.A. Leck, V.T. Parker and R.L. Simpson, (eds) *Seedling Ecology and Evolution*. pp. 17-42.
- Martin, W.E. (1959). The vegetation of Island Beach State Park, New Jersey. *Ecological Monographs*. **29**:1-46.

Masako, K., and H. Sato (2002). Acorn production by Kashiwa oak in a coastal forest under fluctuating weather conditions. *Canadian Journal of Forest Research*. **32**:9-15.

Mendelssohn, I.A., Hester, M.W., F.J. Monteferrante, and F. Talbot (1991). Experimental dune building and vegetative stabilization in a sand-deficient barrier island setting on the Louisiana coast, USA. *Journal of Coastal Research*. **7**:137-149.

Miller, D., M. Thetford, and L. Yager (2001). Evaluation of sand fence and vegetation for dune building following overwash by hurricane Opal on Santa Rosa Island, Florida. *Journal of Coastal Research*. **17**:936-948.

Miller, D. L., L. Yager, M. Thetford, and M. Schneider (2003). Potential use of *Uniola paniculata* rhizome fragments for dune restoration. *Restoration Ecology*. **11**:359-369.

Morton, R.A. (2002). Factors controlling storm impacts on coastal barriers and beaches - A preliminary basis for near real-time forecasting. *Journal of Coastal Research*. **19**:486-501.

National Oceanic and Atmospheric Administration (NOAA). (2005). Continental United States landfalling hurricanes 1950-2004. <http://www.nhc.noaa.gov/gifs/hur5005>.

Oosting, H.J. and W.D. Billings (1942). Factors effecting vegetational zonation on coastal dunes. *Ecology*. **23**:131-142.

Pries, A.J., D.L. Miller, and L.C. Branch (2008). Identification of structural and spatial features that influence storm-related dune erosion along a barrier-island ecosystem in the Gulf of Mexico. *Journal of Coastal Research*. **24**:168-175.

Psuty, N. (1992). Spatial variation in coastal foredune development. *Coastal Dunes: Geomorphology, Ecology and Management for Conservation* (eds R. Carter, T. Curtis & M. Sheehy-Skeffinton), pp. 3-13. The Hague, Balkema.

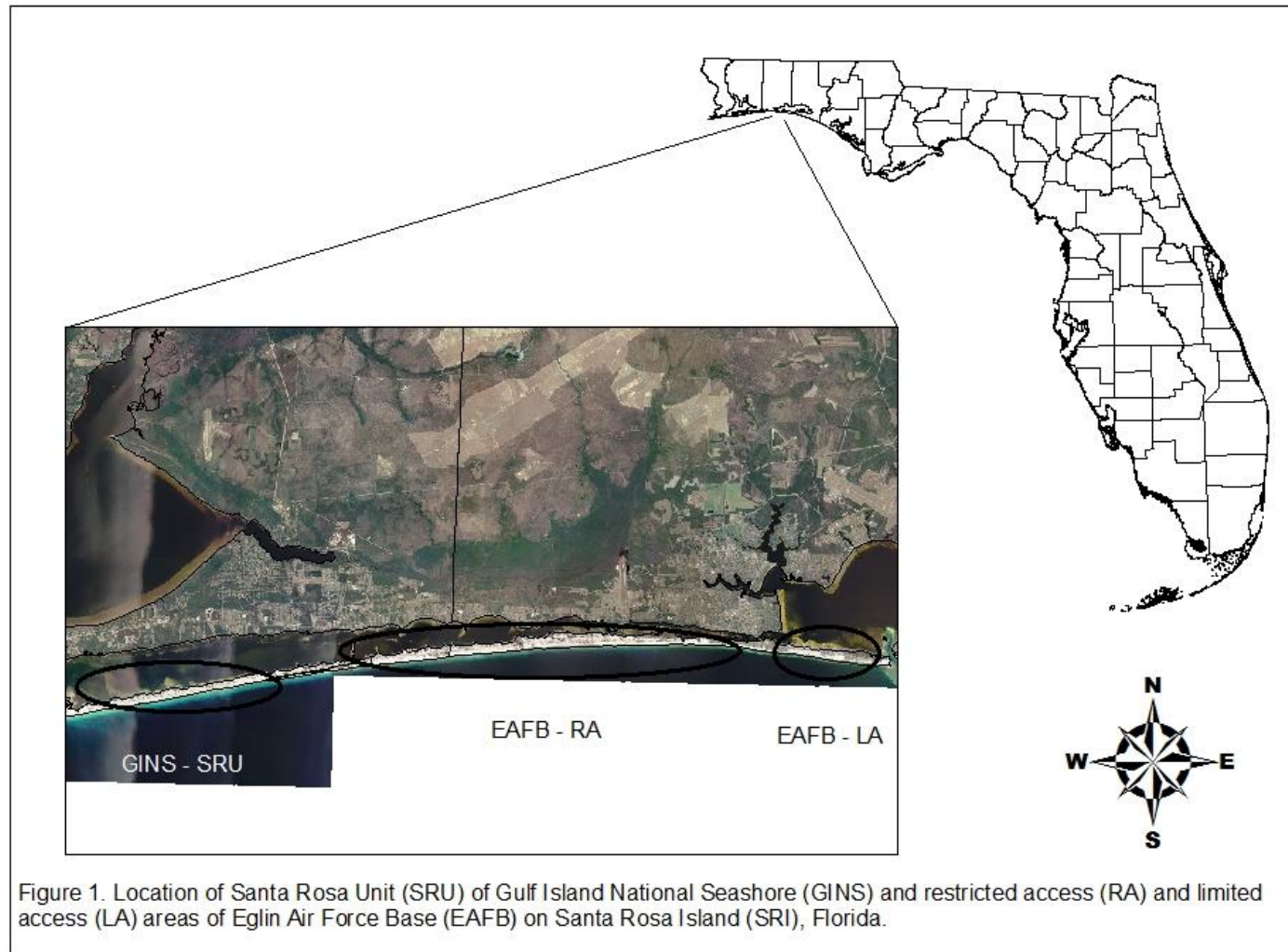
Rathcke, B.J. (2000). Hurricane causes resource and pollination limitation of fruit set in a bird-pollinated shrub. *Ecology*. **81**:1951-1958.

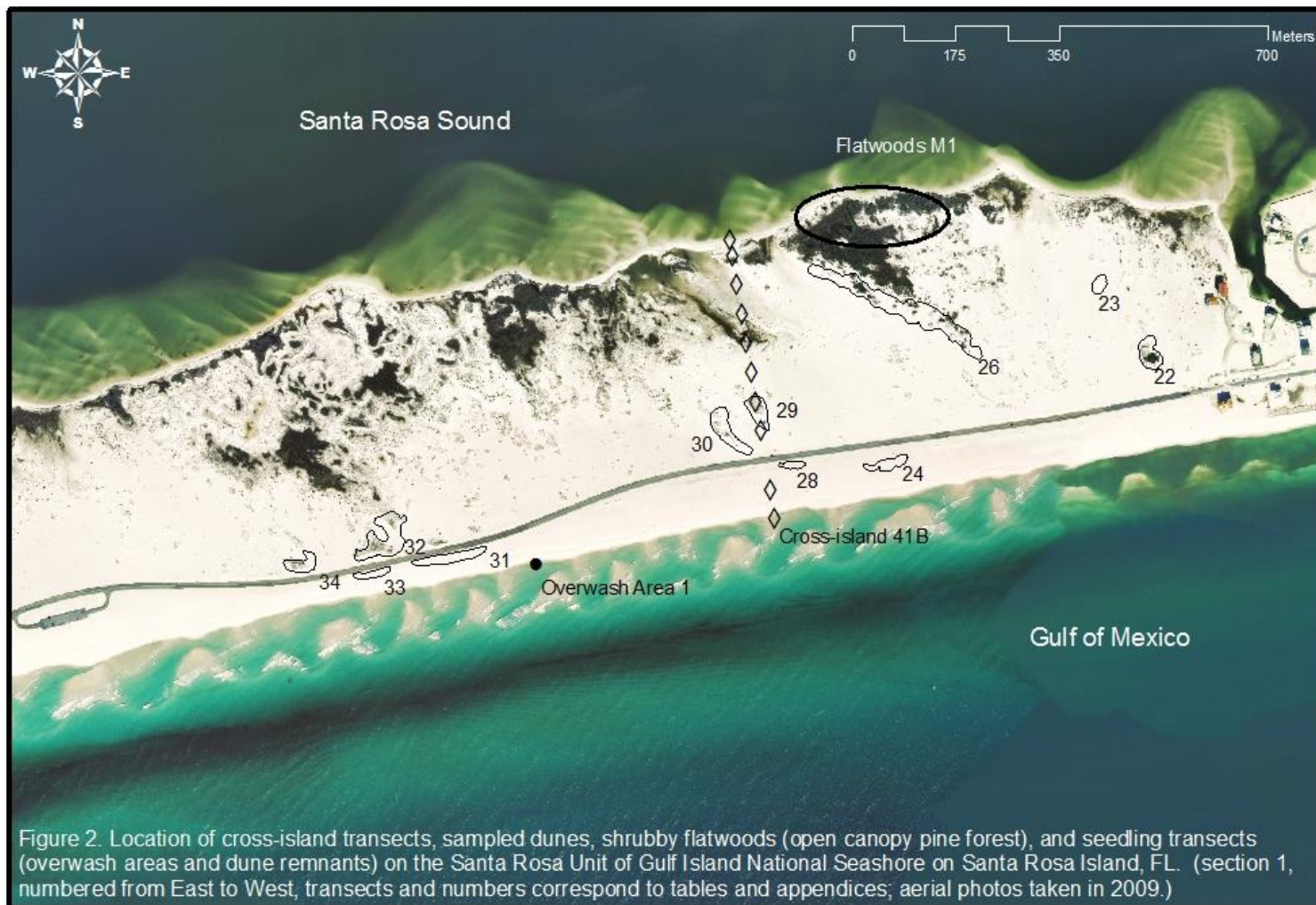
Sah, J. P., M.S. Ross, J.R. Snyder, and D.E. Ogurcak (2010) "Tree Mortality following Prescribed Fire and a Storm Surge Event in Slash Pine (*Pinus elliottii* var. *densa*) Forests in the Florida Keys, USA," *International Journal of Forestry Research*, vol. 2010, Article ID 204795, 13 pages.

Sallenger, Jr., A.H. (2000). Storm impact scale for Barrier Islands. *Journal of Coastal Research*. **16**:890-895.

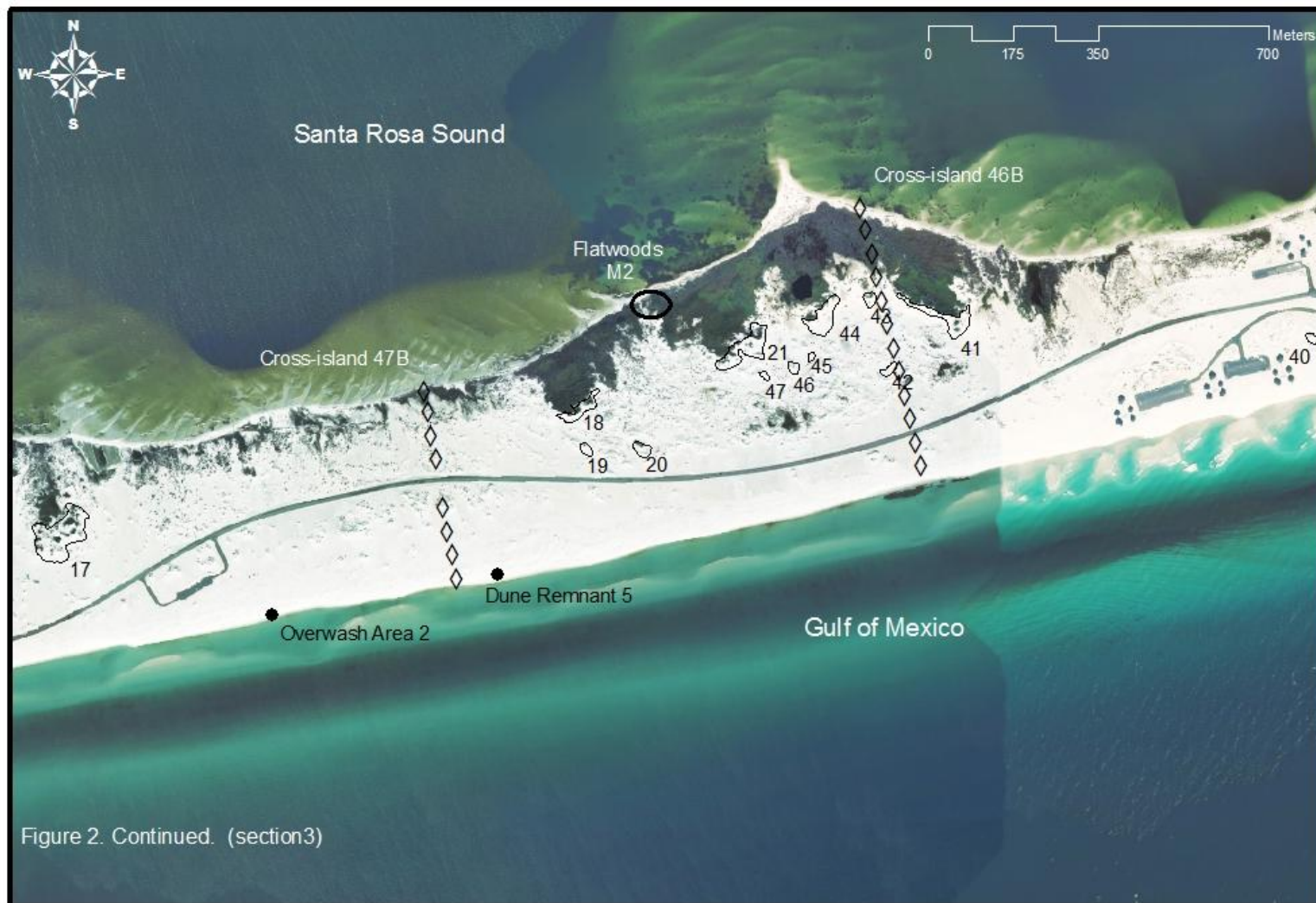
- Seliskar (1994). The Effect of Accelerated Sand Accretion on Growth, Carbohydrate Reserves, and Ethylene Production in *Ammophila breviligulata* (Poaceae). *American Journal of Botany*. **81**:536-541.
- Seliskar, D.M. (1995). Coastal dune restoration: a strategy for alleviating the dieout of *Ammophila breviligulata*. *Restoration Ecology*. **3**:54-60.
- Snyder, R.A. and C.L. Boss (2002). Recovery and stability in Barrier Island plant communities. *Journal of Coastal Research*. **18**:530-536.
- Stallins, J.A. (2005). Stability domains in Barrier Island dune systems. *Ecological Complexity*. **2**:410-430.
- Stallins, J.A. and A.J. Parker (2003). The influence of complex systems interactions on barrier island dune vegetation pattern and process. *Annals of the Association of American Geographers*. **93**:13-29.
- Stiling, P., D. Moon, G. Hymus, and B. Drake (2004). Differential effects of elevated CO₂ on acorn density, weight, germination, and predation among three oak species in a scrub-oak forest. *Global Change Biology*. **10**:228-232.
- Stone, G.W. and F.W. Stapor Jr (1996). A near shore sediment transport model for the northeast Gulf of Mexico coast, U.S.A. *Journal of Coastal Research*. **12**:786-792.
- Stone, G.W., B. Liu, D.A. Pepper, and P. Wang (2004). The importance of extratropical and tropical cyclones on the short-term evolution of barrier islands along the northern Gulf of Mexico, USA. *Marine Geology*. **210**:63-78.
- Tangley, L. (2001). Greenhouse effects - High CO₂ levels-may give fast-growing trees an edge. *Science*. **292**:36-37.
- Thieler, E.R. and R.S. Young, R.S. (1991). Quantitative evaluation of coastal geomorphic changes in South Carolina after Hurricane Hugo. *Impacts of Hurricane Hugo: September 10-22, 1989* (eds C.W. Finkl & O.H. Pilkey), pp. 187-800.
- van der Valk, A.G. (1974). Mineral cycling in coastal foredune plant communities in Cape Hatteras National Seashore. *Ecology*. **55**:1349-1358.
- Varnell, R.J., A.E. Squillace, and G.W. Bengtson (1967). Variation and heritability of fruitfulness in slash pine. *Silvae Genet.* **16**:125-128.
- Wagner, R.H. (1964). The Ecology of *Uniola paniculata* L. in the Dune-Strand Habitat of North Carolina. *Ecological Monographs*. **34**:79-96.
- Westra, R.N. and W.E. Loomis (1966). Seed Dormancy in *Uniola paniculata*. *American Journal of Botany*. **53**:407-411.

Woodhouse W.W., E.D. Seneca, and A.W. Cooper (1968). Use of sea oats for dune stabilization in the southeast. *Shore Beach*. **36**:15-21

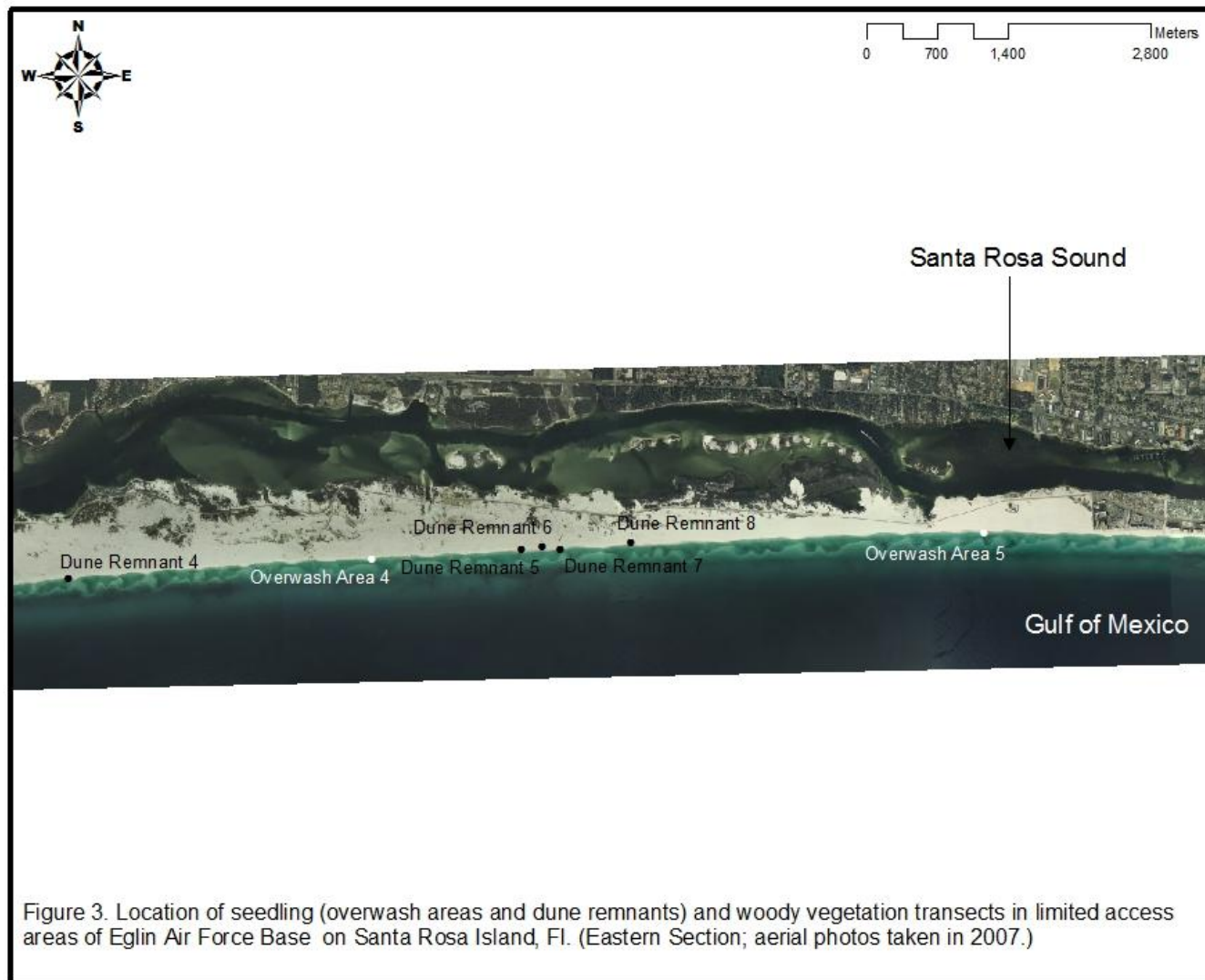


















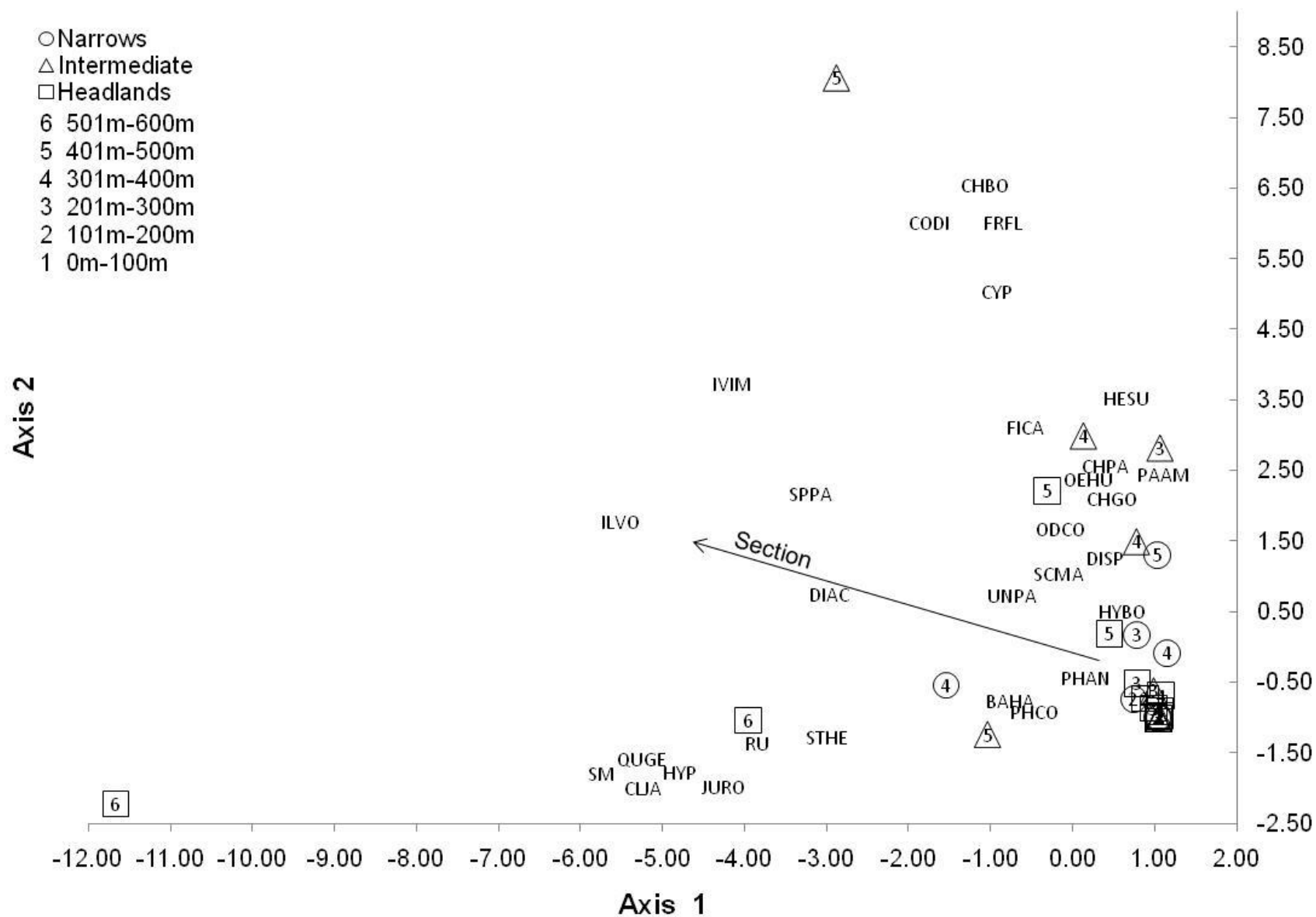


Figure 5. Principal Component Analysis (PCA) of vegetation in cross-island sections (section 1-6) and alongshore type (narrows, intermediates and headlands) on the Santa Rosa Unit of Gulf Islands National Seashore on Santa Rosa Island Florida. Appendix AH for species identity.

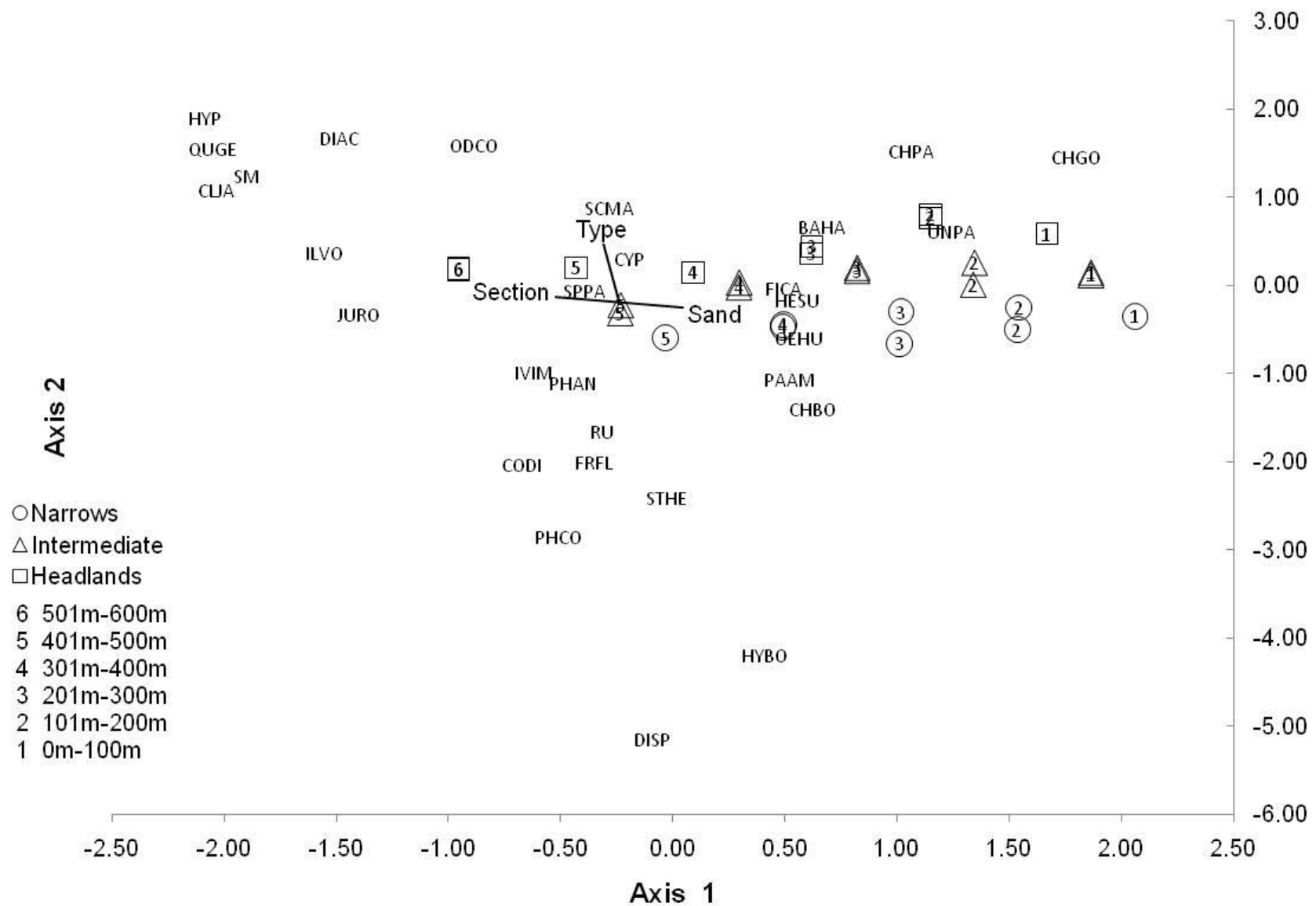


Figure 6. Canonical Correspondence Analysis (CCA) of vegetation in cross-island sections (section 1-6) and alongshore types (type- narrows, intermediates and headlands) on the Santa Rosa Unit of Gulf Islands National Seashore on Santa Rosa Island Florida. See appendix AH for species identity.

Table 1. Indicator species for cross-island sections (1 nearest to the Gulf - 6 farthest from the Gulf), and p values.

Species	Section	p value
<i>Baccharis halimifolia</i>	6	0.0090
<i>Cladium jamaicense</i>	6	0.0716
<i>Hypericum spp.</i>	6	0.0032
<i>Ilex vomitoria</i>	6	0.0054
<i>Juncus roemerianus</i>	6	0.0094
<i>Odontonychia corymbosa</i>	6	0.0150
<i>Physalis angustifolia</i>	5	0.0172
<i>Quercus geminata</i>	6	0.0730
<i>Rubus spp.</i>	6	0.0098
<i>Schizachyrium maritimum</i>	5	0.0464
<i>Smilax spp.</i>	6	0.0028
<i>Spartina patens</i>	6	0.0100

Table 2. Mean foliar cover (%) by species for Narrows, Intermediate, and Headlands of the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida. Mean weighted by Narrows and Headlands site frequency.

	Narrows	Intermediate	Headlands	Mean
Species	n=2	n=2	n=2	n=6
<i>Agrostis hyemalis</i>	0	0	0.1	t
<i>Balduina angustifolia</i>	0	0	0.1	t
<i>Baccharis halimifolia</i>	0	0.7	1.4	0.7
<i>Centella asiatica</i>	0	t	0	t
<i>Chamaesyce bombensis</i>	1.3	2.2	t	1.2
<i>Chrysoma pauciflosculosa</i>	0	0.7	0	0.2
<i>Chrysopsis gossypina hyssopifolia</i>	0	t	t	t
<i>Commelina diffusa</i>	0	0.2	0	t
<i>Cladium jamaicense</i>	t ^z	0	2.5	0.9
<i>Cyperus</i> spp.	0.7	2.7	2.6	2.0
<i>Dichanthelium aciculare</i>	0	0	t	t
<i>Distichlis spicata</i>	1.4	t	0	0.5
<i>Eragrostis virginica</i>	0	t	0	t
<i>Eupatorium capillifolium</i>	0	0	0.1	t
<i>Fimbristylis castanea</i>	0	1.2	0	0.4
<i>Froelichia floridana</i>	0	0.3	t	t
<i>Heterotheca subaxillaris</i>	0.9	4.6	1.1	2.2
<i>Hydrocotyle bonariensis</i>	1.9	0.4	t	0.8
<i>Hypericum</i> spp.	0	0	0.4	0.1
<i>Ilex vomitoria</i>	0	0.5	0.9	0.5
<i>Ipomoea imperati</i>	0	t	0	t
<i>Ipomoea pes-caprae</i>	0	t	0	t
<i>Ipomoea</i> spp.	0	0.3	1.1	0.5
<i>Iva imbricata</i>	t	t	t	t
<i>Juncus marginatus</i>	2.2	0	0	0.7
<i>Juncus roemerianus</i>	0	8.1	8.8	5.6
<i>Odontonychia corymbosa</i>	0	t	0.3	t
<i>Oenothera humifusa</i>	1.2	4.7	0.3	2.1
<i>Panicum amarum</i>	4.2	2.4	3.5	3.4
<i>Phragmites communis</i>	0	0.2	0	t
<i>Physalis angustifolia</i>	0	0.3	0.1	0.1
<i>Polygonella polygama</i>	0	0.2	0	t
<i>Polypogon monspeliensis</i>	0	0	0.7	0.2
<i>Quercus geminata</i>	0	0	1.1	0.4
<i>Rubus</i> spp.	1.0	0	0.5	0.5
<i>Schizachyrium maritimum</i>	0.5	3.4	5.5	3.1
<i>Serenoa repens</i>	0	0.3	0	0.1
<i>Sesuvium portulacastrum</i>	0	0	0.2	t
<i>Smilax</i> spp.	t	t	3.0	1.0
<i>Solidago</i> spp.	0	t	0	t
<i>Spartina patens</i>	5.8	14.4	13.4	11.2
<i>Strophostyles helvola</i>	0.2	t	t	t
<i>Uniola paniculata</i>	16.6	10.1	19.8	15.5
<i>Uniola paniculata</i> inflorescence	0.3	0.3	0.7	0.5
Total Foliar Cover	22.3	29.4	39.6	30.4
Total Herbaceous	37.2	56.3	61.1	51.5
Total Woody	t	2.2	3.8	2.0
Total Woody Vines	1.0	t	1.8	0.9
Bare Sand	52.9	41.4	50.7	48.3
Standing Water	0	0.2	0	t
Road	2.3	2.1	2.9	2.5
Road Debris	22.4	26.9	6.8	18.7

^zt equals a trace amount of less than 0.1

Table 3. Mean foliar cover (%) by species at 100m intervals, south to north (distance from gulf) (averaged across Narrows, Intermediate and Headlands), for Narrows sites, Intermediate sites, and for Headlands of the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida and average across Narrows, Intermediate, and Headland sites.

Species	Distance from Gulf															
	0m-100m								101m-200m							
	Narrows (n=2)		Intermediate (n=2)		Headlands (n=2)		Mean (n=6)		Narrows (n=2)		Intermediate (n=2)		Headlands (n=2)		Mean (n=6)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Agrostis hyemalis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Balduina angustifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Centella asiatica</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Chamaesyce bombensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Chrysoma pauciflosculosa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Chrysopsis gossypina hyssopifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cladium jamaicense</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Commelina diffusa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cyperus spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dichanthelium aciculare</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Distichlis spicata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Eragrostis virginica</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Eupatorium capillifolium</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Fimbristylis castanea</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Froelichia floridana</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0.8	0	0.3	0
<i>Hydrocotyle bonariensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hypericum spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea imperati</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0	0	0	t	0	0	0	0	0	t	0
<i>Juncus marginatus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Juncus roemerianus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Odontonychia corymbosa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Oenothera humifusa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0	0.1	0
<i>Panicum amarum</i>	0	0	0	0	0	0	0	0	0	0	0.7	0	0.7	t	0.5	t
<i>Phragmites communis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Physalis angustifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Pinus elliotti</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Polygonella polygama</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Polypogon monspeliensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Quercus geminata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rubus spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	0	0	0	0	0	0	0	0	0	0	0	0	2.3	0	0.8	0
<i>Serenoa repens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sesuvium portulacastrum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Smilax spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Solidago spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Spartina patens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Strophostyles helvola</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Uniola paniculata</i>	t ^z	y	1.2	-	0.8	-	0.7	-	4.8	-	t	-	63.9	-	22.9	-
<i>Uniola paniculata</i> inflorescence	0	-	0	-	0	-	0	-	0	-	0	-	1.0	-	0.3	-
Unknown (dead woody)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Foliar Cover	t		1.2		0.8		0.7		4.8		0.8		30.4		12.0	
Total Herbaceous	t	0	1.2	0	0.8	0	0.7	0	4.8	0	0.8	0	69.0	t	24.8	t
Total Woody	0	0	0	0	0	0	0	0	0	0	0	0	0	0	t	0
Total Woody Vines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bare Sand	100		94.9		99.2		98.0		67.6		41.1		11.3		40.1	
Standing Water	0		0		0		0		0		0		0		0	
Road	0		0		0		0		5.2		5.3		17.6		9.4	
Road Debris	0		3.9		0		1.3		22.4		52.7		40.6		38.6	
^z t equals a trace amount of less than 0.1																
^y Data not available																

Table 3. Continued.

Species	Distance from Gulf															
	201m-300m								301m-400m							
	Narrows (n=2)		Intermediate (n=2)		Headlands (n=2)		Mean (n=6)		Narrows (n=2)		Intermediate (n=2)		Headlands (n=2)		Mean (n=6)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Agrostis hyemalis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Balduina angustifolia</i>	0	0	0	0	0	0	0	0	0	0	1.2	0	0	0	0.4	0
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Centella asiatica</i>	0	0	0	0	0	0	0	0	0	0	0.4	0	0	0	0.1	0
<i>Chamaesyce bombensis</i>	2.8	0	2.2	0	t	0	1.7	0	2.1	0	3.3	0	0	0	1.8	0
<i>Chrysopsis gossypina hyssopifolia</i>	0	0	0.2	0	0	0	t	0	0	0	0	0	0	0	0	0
<i>Chrysoma pauciflosculosa</i>	0	0	3.3	0	0	0	1.1	0	0	0	0	0	0	0	0	0
<i>Cladium jamaicense</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Commelina diffusa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cyperus spp.</i>	0	0	5.8	0	0	0	1.9	0	3.5	0	1.6	0	0	0	1.7	0
<i>Dichanthelium aciculare</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Distichlis spicata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Eragrostis virginica</i>	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	t	0
<i>Eupatorium capillifolium</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Fimbristylis castanea</i>	0	0	0	0	0	0	0	0	0	0	5.1	0	0	0	1.7	0
<i>Froelichia floridana</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0	0	1.5	0	0	0	0.5	0	3.2	0	18.2	3.7	0	0	7.1	1.2
<i>Hydrocotyle bonariensis</i>	0	0	t	0	0	0	t	0	5.2	0	0.3	0	0	0	1.8	0
<i>Hypericum spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea imperati</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	0	0	0.3	0	0	0	0.1	0	0	0	0	0	0	0	0	0
<i>Ipomoea spp.</i>	0	0	0	0	0	0	0	0	0	0	1.4	0	0	0	0.5	0
<i>Iva imbricata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Juncus marginatus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Juncus roemerianus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Odontonychia corymbosa</i>	0	0	t	0	0	0	t	0	0	0	0	0	0	0	0	0
<i>Oenothera humifusa</i>	0.9	0	6.2	0	t	0	2.4	0	1.8	0	15.5	0	0	0	5.8	0
<i>Panicum amarum</i>	0.5	0	2.3	0	7.5	0	3.4	0	0.9	t	5.9	t	8.4	0.3	5.0	0.1
<i>Phragmites communis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Physalis angustifolia</i>	0	0	t	0	0	0	t	0	0	0	0	0	0	0	0	0
<i>Pinus ellioti</i>	0	0	0	0	0	1.1	0	0.4	0	0	0	0	0	0	0	0
<i>Polygonella polygama</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Polypogon monspeliensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Quercus geminata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rubus spp.</i>	0	0	0	0	0	0	0	0	4.0	0	0	0	0	0	1.3	0
<i>Schizachyrium maritimum</i>	0	0	2.7	0	0.9	0	1.2	0	1.9	0	7.9	0	1.5	0	3.8	0
<i>Serenoa repens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sesuvium portulacastrum</i>	0	0	0	0	0	0	0	0	0	0	1.7	0	0	0	0.5	0
<i>Smilax spp.</i>	0	0	0	0	0	0	0	0	0.2	0	t	0	0	0	t	0
<i>Solidago spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Spartina patens</i>	0	0.6	1.5	0	13.9	0	5.2	0.2	7.9	0	51.9	0	0	0	19.9	0
<i>Strophostyles helvola</i>	0	0	0	0	0	0	0	0	0.7	0	0	0	0	0	0.2	0
<i>Uniola paniculata</i>	23.1	-	32.0	-	23.4	-	26.2	-	36.7	-	11.1	-	11.1	-	19.6	-
<i>Uniola paniculata</i> inflorescence	1.3	-	0.6	-	2.7	-	1.5	-	0.3	-	0.8	-	0.7	-	0.6	-
Unknown (dead woody)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Foliar Cover	24.4		23.7		34.3		27.4		30.6		78.7		11.2		40.2	
Total Herbaceous	28.6	0.6	58.6	0	48.5	0	45.2	0.2	64.0	t	125.3	3.8	21.7	0.3	70.3	1.4
Total Woody	0	0	0.2	0	0	1.1	0.1	0.4	0	0	1.2	0	0	0	0.4	0
Total Woody Vines	0	0	0	0	0	0	0	0	4.2	0	t	0	0	0	2.1	0
Bare Sand	54.1		5.4		65.7		41.7		9.9		10.0		88.8		36.2	
Standing Water	0		0		0		0		0		1.0		0		0.3	
Road	0		5.3		0		1.8		5.2		0		0		1.7	
Road Debris	21.6		65.7		0		29.1		54.4		10.3		0		21.6	

Table 3. Continued.

Species	Distance from Gulf									
	401m-500m								501m-600m ^x	
	Narrows (n=2)		Intermediate (n=2)		Headlands (n=2)		Mean (n=6)		Headlands (n=2)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Agrostis hyemalis</i>	0	0	0	0	0	0	0	0	0.7	0
<i>Balduina angustifolia</i>	0	0	2.2	0	t	0	0.7	0	8.2	0.5
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0.9	0
<i>Centella asiatica</i>	0	0	0	0	0	0	0	0	0	0
<i>Chamaesyce bombensis</i>	1.9	0	5.7	0	t	0	2.6	0	0.4	0
<i>Chrysopsis gossypina hyssopifolia</i>	0	0	0	0	t	0	t	0	0	0
<i>Chrysoma pauciflosculosa</i>	0	0	0	0	0	0	0	0	0	0
<i>Cladium jamaicense</i>	0.8	0	0	0	0	0	0.3	0	15.0	0
<i>Commelina diffusa</i>	0	0	1.1	0	0	0	0.4	0	0	0
<i>Cyperus spp.</i>	0	0	6.0	0	11.8	0	5.9	0	3.5	0
<i>Dichanthelium aciculare</i>	0	0	0	0	t	0	t	0	t	0
<i>Distichlis spicata</i>	14.2	0	0.3	0	0	0	4.8	0	0	0
<i>Eragrostis virginica</i>	0	0	0	0	0	0	0	0	0	0
<i>Eupatorium capillifolium</i>	0	0	0	0	0	0	0	0	0.8	0
<i>Fimbristylis castanea</i>	0	0	0.8	0	0	0	0.3	0	0	0
<i>Froelichia floridana</i>	0	0	1.4	0	t	0	0.5	0	0	0
<i>Heterotheca subaxillaris</i>	1.7	0	3.0	1.4	6.0	4.6	3.6	2.0	0	0
<i>Hydrocotyle bonariensis</i>	8.8	0	1.5	0	t	0	3.4	0	0	0
<i>Hypericum spp.</i>	0	0	0	0	0	0	0	0	2.6	0
<i>Ilex vomitoria</i>	0	0	2.7	0	0	0	0.9	0	5.3	0
<i>Ipomoea imperati</i>	0	0	t	0	0	0	t	0	0	0
<i>Ipomoea pes-caprae</i>	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea spp.</i>	0	0	0	0	0	0	0	0	6.4	0
<i>Iva imbricata</i>	0	0	0.1	0.6	0	0	t	0.2	t	0
<i>Juncus marginatus</i>	21.7	0	0	0	0	0	7.2	0	53.0	0
<i>Juncus roemerianus</i>	0	0	40.5	0	0	0	13.5	0	0	0
<i>Odontonychia corymbosa</i>	0	0	t	0	1.5	0	0.5	0	0	0
<i>Oenothera humifusa</i>	6.3	0	1.7	0	1.7	0	3.2	0	0	0
<i>Panicum amarum</i>	38.5	0	3.0	0.5	4.0	0	15.2	0.2	0.5	1.0
<i>Phragmites communis</i>	0	0	0.9	0	0	0	0.3	0	0	0
<i>Physalis angustifolia</i>	0	0	1.2	0	0.7	0	0.6	0	0	0
<i>Pinus ellioti</i>	0	0	0	0	0	0	0	0	0	0
<i>Polygonella polygama</i>	0	0	1.0	0	0	0	0.3	0	0	0
<i>Polypogon monspeliensis</i>	0	0	0	0	0	0	0	0	3.9	0
<i>Quercus geminata</i>	0	0	0	0	0.2	t	t	t	6.3	1.5
<i>Rubus spp.</i>	0	0	0	0	0	0	0	0	3.1	0
<i>Schizachyrium maritimum</i>	0.3	0	6.5	0	24.6	0	10.5	t	3.6	0
<i>Serenoa repens</i>	0	0	0	0	0	0	0	0	1.2	0
<i>Sesuvium portulacastrum</i>	0	0	0	0	0	0	0	0	0	0
<i>Smilax spp.</i>	0	0	0	0	2.2	0	0.7	0	15.7	0
<i>Solidago spp.</i>	0	0	0.5	0	0	0	0.2	0	0	0
<i>Spartina patens</i>	38.5	0	18.8	1.4	13.1	0	23.5	0.5	53.2	3.8
<i>Strophostyles helvola</i>	0	0	0.2	0	0	0	t	0	0.3	0
<i>Uniola paniculata</i>	16.3	-	6.1	-	5.0	-	9.1	-	14.5	-
<i>Uniola paniculata</i> inflorescence	0	-	0	-	t	-	t	-	0	-
Unknown (dead woody)	0	0	0	1.2	0	0	0	0.6	0	0
Total Foliar Cover	87.5		58.8		62.85		69.7		98.2	
Total Herbaceous	149.1	0	100.2	3.3	68.6	4.6	105.9	2.6	156.7	4.8
Total Woody	0	0	5.955	1.8	0.2	0	2.1	0.6	23.5	2.0
Total Woody Vines	0	0	0	0	2.2	0	0.7	0	18.9	0
Bare Sand	4.2		39.1		37.15		26.8		1.8	
Standing Water	0		0		0		0		0	
Road	0		0		0		0		0	
Road Debris	8.3		2.2		0		3.5		0	

^xNo Narrows or Intermediate in the 500m - 600m distance because no narrows or intermediate sites were that wide (N to S).

Table 4. Comparison of Beach Mice (*Peromyscus polionotus*) habitat types on cross-island transects for years 1991 and 2008 on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Transect ID	Back Dune Areas (m)		Disturbed Coastal Habitat Areas (m)		Marsh Areas (m)		Primary Dune Areas (m)		Roads/Developed Areas (m)	
	1991	2008	1991	2008	1991	2008	1991	2008	1991	2008
41	223	165		352			27	50	9	23
44	230		18				19		23	22
46	161	119		136	0	261	17		19	26
47	339	149							16	48
48	332	392	48		125	47	35		15	53
49	131	159			12		45		18	46
Table 4. Continued										
Transect ID	Sand Flat Areas (m)		Swale Areas (m)		Water Body Areas (m)					
	1991	2008	1991	2008	1991	2008				
41		219	340	142		19				
44	17	588	249	240						
46	18	356	416	227						
47	21	500	142	55						
48	72	296	65	171		15				
49	19	508	362							
² Habitat types defined by Gore et al 1991.										

Table 5. Mean woody species density (plant/m²) and maximum height (m) by distance from the gulf on Eglin Air Force Base, Santa Rosa Island, Florida.

	0-100m						101-200m					
	2000		2008				2000		2008			
	Plant/m ²	Max ht (m)	Plant/m ²		Max ht (m)		Plant/m ²	Max ht (m)	Plant/m ²		Max ht (m)	
Species	Alive		Alive	Dead	Alive	Dead	Alive		Alive	Dead	Alive	Dead
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ceratiola ericoides</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Chrysoma pauciflosculosa</i>	0	0	0	0	0	0	0.09	0.05	0	0	0	0
<i>Conradina canescens</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ilex glabra</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Myrica cerifera</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Pinus elliotti</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Polygonella polygama</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Quercus geminata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Smilax spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Vaccinium arboreum</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Vitis rotundifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0

Table 5. Continued.

	201-300m							301-400m					
	2000		2008					2000		2008			
	Plant/m ²	Max ht (m)	Plant/m ²		Max ht (m)			Plant/m ²	Max ht (m)	Plant/m ²		Max ht (m)	
Species	Alive		Alive	Dead	Alive	Dead		Alive		Alive	Dead	Alive	Dead
<i>Baccharis halimifolia</i>	0.24	0.09	0	0	0	0		0.12	0.05	0.002	0	0.03	0
<i>Ceratiola ericoides</i>	0.04	0.08	0	0	0	0		0	0	0	0	0	0
<i>Chrysoma pauciflosculosa</i>	0.31	0.08	0	0	0	0		3.14	0.29	0	0	0	0
<i>Conradina canescens</i>	0	0	0	0	0	0		0	0	0	0	0	0
<i>Ilex glabra</i>	0	0	0	0	0	0		0.09	0.12	0	0	0	0
<i>Ilex vomitoria</i>	0	0	0	0	0	0		0.01	0.05	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0		0	0	0.003	0	0.01	0
<i>Myrica cerifera</i>	0	0	0	0	0	0		0	0	0	0	0	0
<i>Pinus elliotti</i>	0	0	0	0	0	0		0	0	0	0	0	0
<i>Polygonella polygama</i>	0	0	0	0	0	0		0.23	0.07	0	0	0	0
<i>Quercus geminata</i>	0	0	0	0	0	0		0	0	0	0.01	0	0.05
<i>Smilax spp.</i>	0.01	0.03	0	0	0	0		0	0	0	0	0	0
<i>Vaccinium arboreum</i>	0	0	0	0	0	0		0	0	0	0	0	0
<i>Vitis rotundifolia</i>	0	0	0	0	0	0		0	0	0	1.48	0	0.06

Table 5. Continued.

	401-500m						501-600m ^z					
	2000		2008				2000		2008			
	Plant/m ²	Max ht (m)	Plant/m ²		Max ht (m)		Plant/m ²	Max ht (m)	Plant/m ²		Max ht (m)	
Species	Alive		Alive	Dead	Alive	Dead	Alive		Alive	Dead	Alive	Dead
<i>Baccharis halimifolia</i>	0.01	0.05	0.33	0	0.62	0	0.06	0.43	0.03	0	0.09	0
<i>Ceratiola ericoides</i>	0.01	0.04	0	0	0	0	0	0	4.11	0	0.26	0
<i>Chrysoma pauciflosculosa</i>	4.01	0.33	0.01	0.07	0.01	0.21	0.40	0.13	0.54	0.41	0.09	0.26
<i>Conradina canescens</i>	0.20	0.12	0.003	0	0.04	0	0	0	0.10	0	0.17	0
<i>Ilex glabra</i>	0.03	0.03	0.46	0	0.06	0	0.30	0.38	0	0	0	0
<i>Ilex vomitoria</i>	0.08	0.06	0.98	0.05	0.35	0.16	0.17	0.63	0.01	0.04	0.19	0.19
<i>Iva imbricata</i>	0.03	0.23	0.08	0	0.16	0	0.17	0.23	0.09	0	0.11	0
<i>Myrica cerifera</i>	0	0	0	0.003	0	0.08	0.07	0.18	0	0.01	0	0.12
<i>Pinus ellioti</i>	0	0	0	0.03	0	0.52	0.02	2.44	0.03	0.10	0.75	0.68
<i>Polygonella polygama</i>	0.03	0.05	0	0	0	0	0.04	0.01	0.31	0.20	0.20	0.17
<i>Quercus geminata</i>	0.003	0.58	0.01	0.03	0.09	0.26	0.01	0.43	0.21	0.01	0.41	0.63
<i>Smilax spp.</i>	0.13	0.11	0.43	0.08	0.28	0.15	0.11	0.13	0.50	0.02	0.74	0.09
<i>Vaccinium arboreum</i>	0	0	0	0	0	0	0.03	0.08	0	0	0	0
<i>Vitis rotundifolia</i>	0	0	0.03	2.12	0.13	0.09	0	0	0	0	0	0
^z Only 4 transect were over 500m in length												

Table 6. Mean (n=6) woody species density (plant/m²) and maximum height (m) (2000 and 2008) on Eglin Air Force Base, Santa Rosa Island, Florida.

Species	2000		2008	
	Plant/m ²	Max ht (m)	Plant/m ²	Max ht (m)
<i>Baccharis halimifolia</i>	0.078	0.083	0.070	0.138
<i>Ceratiola ericoides</i>	0.009	0.022	0.456	0.028
<i>Chrysoma pauciflosculosa</i>	1.429	0.150	0.062	0.012
<i>Conradina canescens</i>	0.035	0.024	0.011	0.025
<i>Ilex glabra</i>	0.052	0.067	0.093	0.012
<i>Ilex vomitoria</i>	0.035	0.089	0.197	0.092
<i>Iva imbricata</i>	0.023	0.066	0.027	0.041
<i>Myrica cerifera</i>	0.007	0.019	0	0
<i>Pinus elliotti</i>	0.002	0.271	0.003	0.083
<i>Polygonella polygama</i>	0.055	0.025	0.034	0.023
<i>Quercus geminata</i>	0.001	0.164	0.025	0.064
<i>Smilax spp.</i>	0.040	0.040	0.135	0.135
<i>Vaccinium arboreum</i>	0.003	0.008	0	0
<i>Vitis rotundifolia</i>	0	0	0.005	0.026

Table 7. Mean foliar live and dead cover (%) for five frontal dune remnants (gulf side) on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida now classified in 2010 as incipient dunes post hurricanes Opal, Ivan, and Dennis.

Species	Mean		Dune 24		Dune 28	
	Live	Dead	Live	Dead	Live	Dead
<i>Chamaesyce bombensis</i>	0	0	0	0	0	0
<i>Chrysoma pauciflosculosa</i>	0	0	0	0	0	0
<i>Chrysopsis gossypina hyssopifolia</i>	0	0	0	0	0	0
<i>Conyza bonariensis</i>	0	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0	0	0	0	0	0
<i>Hydrocotyle bonariensis</i>	0	0	0	0	0	0
<i>Ipomoea imperati</i>	0	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	0	0	0	0	0	0
<i>Ipomoea spp.</i>	0	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0
<i>Oenothera humifusa</i>	0	0	0	0	0	0
<i>Panicum amarum</i>	0	0	0	0	0	0
<i>Physalis angustifolia</i>	0	0	0	0	0	0
<i>Polygonella polygama</i>	0	0	0	0	0	0
<i>Quercus geminata</i>	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	0	0	0	0	0	0
<i>Spartina patens</i>	0	0	0	0	0	0
<i>Smilax spp.</i>	0	0	0	0	0	0
<i>Uniola paniculata</i>	0.4	- ^z	t ^y	-	0	-
<i>Uniola paniculata</i> inflorescence	0	-	0	-	0	-
<i>Vitis rotundifolia</i>	0	0	0	0	0	0
Unknown (dead woody)	0	0	0	0	0	0
Total Foliar Cover	0.4		t		0	
Total Herbaceous	0.4	0	t	0	0	0
Total Woody	0	0	0	0	0	0
Total Woody Vines	0	0	0	0	0	0
Bare Sand	67.6		100.0		64.6	
Road Debris	32.1		0		35.4	

^zData not available.

^yt equals a trace amount of less than 0.1

Table 7. Continued

Species	Dune 31		Dune 33		Dune 37	
	Live	Dead	Live	Dead	Live	Dead
<i>Chamaesyce bombensis</i>	0	0	0	0	0	0
<i>Chrysoma pauciflosculosa</i>	0	0	0	0	0	0
<i>Chrysopsis gossypina hyssopifolia</i>	0	0	0	0	0	0
<i>Conyza bonariensis</i>	0	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0	0	0	0	0	0
<i>Hydrocotyle bonariensis</i>	0	0	0	0	0	0
<i>Ipomoea imperati</i>	0	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	0	0	0	0	0	0
<i>Ipomoea spp.</i>	0	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0
<i>Oenothera humifusa</i>	0	0	0	0	0	0
<i>Panicum amarum</i>	0	0	0	0	0	0
<i>Physalis angustifolia</i>	0	0	0	0	0	0
<i>Polygonella polygama</i>	0	0	0	0	0	0
<i>Quercus geminata</i>	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	0	0	0	0	0	0
<i>Spartina patens</i>	0	0	0	0	0	0
<i>Smilax spp.</i>	0	0	0	0	0	0
<i>Uniola paniculata</i>	t	-	0.6	-	1.4	-
<i>Uniola paniculata</i> inflorescence	0	-	0	-	0	-
<i>Vitis rotundifolia</i>	0	0	0	0	0	0
Unknown (dead woody)	0	0	0	0	0	0
Total Foliar Cover	t		0.6		0.8	
Total Herbaceous	t	0	0.6	0	1.4	0
Total Woody	0	0	0	0	0	0
Total Woody Vines	0	0	0	0	0	0
Bare Sand	43.4		49.7		80.5	
Road Debris	56.5		49.7		18.7	

Table 8. Mean foliar cover (%) of frontal dunes (gulf side)(2004) compared to same location where incipient dunes (2010) are now found on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Dune ID	<i>Uniola paniculata</i>		Total Herbaceous		Total Woody		Bare Sand		Road Debris	
	2004	2010	2004	2010	2004	2010	2004	2010 ^y	2004	2010
24	17.4	t ^z	19.6	0	t	0	80.3	100.0	0	0
28	10.7	0	20.1	0	0	0	79.9	64.6	0	35.4
31	22.3	t	23.6	t	0	0	76.4	34.0	0	57.5
33	23.5	0.6	25.0	0.6	0	0	75.0	43.8	0	55.1
37	21.6	1.4	21.9	1.4	0	0	78.1	79.5	0	18.7
All	19.1	0.4	22.0	0.4	t	0.00	78.0	64.4	0	33.3

^zt equals a trace amount of less than 0.1

^ySome of the bare sand has been covered with road debris

Table 9. Mean foliar cover (%) of frontal dunes sampled in 2004 and 2010 on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Dune ID	<i>Uniola paniculata</i>		Total Herbaceous		Total Woody		Bare Sand		Road Debris	
	2004	2010	2004	2010	2004	2010	2004	2010 ^y	2004	2010
22	14.6	3.9	17.0	7.8	21.8	14.2	61.2	64.6	0	7.4
29	14.4	6.9	33.2	11.1	0	0	66.8	59.6	0	23.7
30	8.6	5.5	13.6	6.2	0	t ^z	86.4	42.8	0	35.7
32	19.6	6.7	30.2	14.6	0	0	69.8	59.2	0	8.7
35	21.3	4.1	23.4	6.1	1.10	0	75.5	78.4	0	0
39	9.1	0.2	9.1	0.2	0	0	90.9	99.3	0	0
20	8.9	4.1	10.5	4.4	10.3	2.6	79.2	81.7	0	0
19	11.8	6.5	13.6	7.9	0.7	0	85.7	88.2	0	0
8	6.4	1.5	11.5	1.8	15.5	0	73.0	92.9	0	0
10	8.8	7.0	8.8	7.3	0	0	91.2	87.6	0	0
All	12.4	4.6	17.1	6.7	4.9	1.7	78.0	75.4	0	7.6

^zt equals a trace amount of less than 0.1

^ySome of the bare sand has been covered with road debris

Table 10. Mean foliar live and dead cover (%) for each remaining established frontal dune (remnant), and averaged for all dunes in 2010 post hurricanes Opal and Ivan on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa, Florida.

	Mean								
	Dune Total		Dune 22		Dune 29		Dune 30		
Species	Live	Dead	Live	Dead	Live	Dead	Live	Dead	
<i>Chamaesyce bombensis</i>	0	0	t	0	0	0	0	0	
<i>Chrysoma pauciflosculosa</i>	t ^z	0	0	0	0	0	0	0	
<i>Chrysopsis gossypina hyssopifolia</i>	0.2	0	0.6	0	1.6	0	0	0	
<i>Conyza bonariensis</i>	t	0	0.3	t	0	0	0	0	
<i>Heterotheca subaxillaris</i>	t	t	0.6	0.3	0	0	0	t	
<i>Hydrocotyle bonariensis</i>	t	0	0	0	0	0	0	0	
<i>Ipomoea imperati</i>	t	0	0	0	0	0	0	0	
<i>Ipomoea pes-caprae</i>	0.1	t	0.2	0	0.2	0	0	0	
<i>Ipomoea spp.</i>	t	0	0.3	0	0	0	0	0	
<i>Iva imbricata</i>	t	0	0	0	0	0	t	0	
<i>Oenothera humifusa</i>	0.1	t	0	0	t	0	0.2	0	
<i>Panicum amarum</i>	0.2	t	1.2	0.2	0.5	0	t	0	
<i>Physalis angustifolia</i>	t	0	0.2	0	0	0	0	0	
<i>Polygonella polygama</i>	t	t	t	0.2	0	0	0	0	
<i>Quercus geminata</i>	0.8	t	6.3	0	0	0	0	0	
<i>Schizachyrium maritimum</i>	1.0	0.2	0.5	0	1.5	t	0.3	0	
<i>Spartina patens</i>	0	t	0	0	0	0	0	0	
<i>Smilax spp.</i>	0.4	0.1	3.7	1.0	0	0	0	0	
<i>Uniola paniculata</i>	4.6	^y	3.9	-	6.9	-	5.5	-	
<i>Uniola paniculata</i> inflorescence	0.1	-	t	-	0.3	-	t	-	
<i>Vitis rotundifolia</i>	0.4	0	4.0	0	0	0	0	0	
Unknown (dead woody)	0	0.2	0	1.9	0	0	0	0	
Total Foliar Cover	5.8		21.9		10.8		1.5		
Total Herbaceous	6.7	0.3	7.8	0.5	11.1	t	6.2	t	
Total Woody	0.8	0.2	6.3	2.1	0	0	t	0	
Total Woody Vines	0.8	0.1	7.8	1.0	0	0	0	0	
Bare Sand	86.7		70.6		65.6		62.8		
Road Debris	7.6		7.4		23.7		35.7		
^z t equals a trace amount of less than 0.1									
^y Data not available.									

Table 10. Continued.

	Dune 32		Dune 35		Dune 39		Dune 20		
Species	Live	Dead	Live	Dead	Live	Dead	Live	Dead	
<i>Chamaesyce bombensis</i>	0	0	0	0	0	0	0	0	
<i>Chrysoma pauciflosculosa</i>	0	0	0	0	0	0	0.6	0	
<i>Chrysopsis gossypina hyssopifolia</i>	0.1	t	0	0	0	0	0.1	0	
<i>Conyza bonariensis</i>	0	0	0	0	0	0	0	0	
<i>Heterotheca subaxillaris</i>	t	0	t	0	0	0	0.1	0	
<i>Hydrocotyle bonariensis</i>	t	0	0.2	0	0	0	0	0	
<i>Ipomoea imperati</i>	0	0	0	0	0	0	0	0	
<i>Ipomoea pes-caprae</i>	0.9	t	t	0	0	0	0	0	
<i>Ipomoea spp.</i>	0	0	0	0	0	0	0	0	
<i>Iva imbricata</i>	0	0	0	0	0	0	0	0	
<i>Oenothera humifusa</i>	1.0	0.1	0.1	0	0	0	0	0	
<i>Panicum amarum</i>	t	0.0	0.6	0.3	0	0	0	0	
<i>Physalis angustifolia</i>	0.3	0	0	0	0	0	0	0	
<i>Polygonella polygama</i>	0	0	0	0	0	0	0	0	
<i>Quercus geminata</i>	0	0	0	0	0	0	1.9	0.6	
<i>Schizachyrium maritimum</i>	5.2	0.3	1.0	0.1	0	0	t	t	
<i>Spartina patens</i>	0	0	0	t	0	0	0	0	
<i>Smilax spp.</i>	0	0	0	0	0	0	0.1	0.2	
<i>Uniola paniculata</i>	6.7	-	4.1	-	0.2	-	4.1	-	
<i>Uniola paniculata</i> inflorescence	0.2	-	0.003	-	0	-	t	-	
<i>Vitis rotundifolia</i>	0	0	0	0	0	0	0	0	
Unknown (dead woody)	0	0	0	0	0	0	0	0	
Total Foliar Cover	12.1		1.6		0		4.3		
Total Herbaceous	14.6	0.5	6.1	0.4	0.2	0	4.4	0.1	
Total Woody	0	0	0	0	0	0	2.4	0.6	
Total Woody Vines	0	0	0	0	0	0	0.1	0.2	
Bare Sand	79.2		98.4		99.8		95.7		
Road Debris	8.7		0		0		0		

Table 10. Continued.

	Dune 19		Dune 8		Dune 10		
Species	Live	Dead	Live	Dead	Live	Dead	
<i>Chamaesyce bombensis</i>	0	0	0	0	0	0	
<i>Chrysoma pauciflosculosa</i>	0	0	0	0	0	0	
<i>Chrysopsis gossypina hyssopifolia</i>	0	0	0	0	0	0	
<i>Conyza bonariensis</i>	0	0	0	0	0	0	
<i>Heterotheca subaxillaris</i>	0	0	0	0	0	0	
<i>Hydrocotyle bonariensis</i>	0	0	0	0	0	0	
<i>Ipomoea imperati</i>	0.1	0	0	0	0	0	
<i>Ipomoea pes-caprae</i>	t	0	0	0	0	0	
<i>Ipomoea spp.</i>	0	0	0	0	0	0	
<i>Iva imbricata</i>	0	0	0	0	0	0	
<i>Oenothera humifusa</i>	0	0	0	0	0	0	
<i>Panicum amarum</i>	0	0	0	0	t	0	
<i>Physalis angustifolia</i>	0	0	0	0	0	0	
<i>Polygonella polygama</i>	0	0	0	0	0	0	
<i>Quercus geminata</i>	0	0	0	0	0	0	
<i>Schizachyrium maritimum</i>	0.9	1.2	0.1	0	0	0	
<i>Spartina patens</i>	0	0	0	0	0	0	
<i>Smilax spp.</i>	0	0	0	0	0	0	
<i>Uniola paniculata</i>	6.5	-	1.5	-	7.0	-	
<i>Uniola paniculata</i> inflorescence	0.2	-	0.2	-	0.2	-	
<i>Vitis rotundifolia</i>	0	0	0	0	0	0	
Unknown (dead woody)	0	0	0	0	0	0	
Total Foliar Cover	1.8		1.1		2.5		
Total Herbaceous	7.9	1.2	1.8	0	7.3	0	
Total Woody	0	0	0	0	0	0	
Total Woody Vines	0	0	0	0	0	0	
Bare Sand	98.2		98.9		97.6		
Road Debris	0		0		0		

Table 11. Mean foliar live and dead cover (%) of each remaining established scrub and grassy back-barrier dunes in 2010 on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Species	Mean									
	Dune total		Dune 23		Dune 26		Dune 38		Dune 41	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Balduina angustifolia</i>	0.2	0	0	0	0	0	0	0	0	0
<i>Baccharis halimifolia</i>	t ^z	0	0	0	0	0	1.0	0	0	0
<i>Ceratiola ericoides</i>	t	t	0	0	0	0	0	0	0	0
<i>Chamaesyce bombensis</i>	0.2	t	0	0	t	0	0.9	0	t	0
<i>Chrysoma pauciflosculosa</i>	0.4	0.1	0	0	0	0.2	0	0	0.1	0
<i>Chrysopsis gossypina hyssopifolia</i>	0.6	t	0	0	0.6	t	0	0	1.0	0
<i>Cladium jamaicense</i>	t	0	0	0	0	0	0	0	0	0
<i>Cnidoscolus stimulosus</i>	t	0	0	0	t	0	0	0	0	0
<i>Conradina canescens</i>	t	t	0	0	0	0	0	0	0	0
<i>Crataegus michauxii</i>	0.3	t	0	0	0	0	0	0	0	0
<i>Crotalaria rotundifolia</i>	t	0	0	0	0	0	0	0	0	0
<i>Cyperus spp.</i>	0.1	t	0	0	0	0	0	0	0	0
<i>Dichanthelium aciculare</i>	0.1	0	0	0	0	0	0	0	0	0
<i>Eupatorium capillifolium</i>	t	0	0	0	0	0	0	0	0.8	0
<i>Froelichia floridana</i>	t	0	0	0	0	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0.7	t	t	0	0.5	t	0.8	0	0.1	0
<i>Hydrocotyle bonariensis</i>	t	0	0	0	0.1	0	0	0	t	t
<i>Ilex glabra</i>	t	0	0	0	0	0	0	0	0	0
<i>Ilex glabra</i> canopy	t	0	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i>	0.6	t	0	0	0	0	2.1	0	0	0
<i>Ilex vomitoria</i> canopy	0.2	0	0	0	0	0	0	0	0	0
<i>Ipomoea imperati</i>	t	0	0	0	0.3	t	0	0	0	0
<i>Ipomoea pes-caprae</i>	0.4	0	0	0	t	0	0	0	0.2	0
<i>Ipomoea spp.</i>	t	0	0	0	0	0	0	0	0.6	0
<i>Iva imbricata</i>	t	0	0	0	0	0	0	0	0	0
<i>Juncus roemerianus</i>	t	t	0	0	0	0	1.3	0.9	0	0
<i>Juncus scirpoides</i>	t	0	0	0	0	0	0	0	0	0
<i>Magnolia grandiflora</i>	0.6	0.1	0	0	0	1.5	0	0	0	0
<i>Magnolia grandiflora</i> canopy	0.9	t	0	0	0	0	0	0	0	0
<i>Odontonychia corymbosa</i>	0.2	t	t	0	0.1	0	t	0	0	0
<i>Oenothera humifusa</i>	0.2	t	0	0	t	0.2	1.9	0	0.7	0
<i>Panicum amarum</i>	1.2	0.9	0	0	0.4	1.9	0	0	1.5	1.4
<i>Persea borbonia</i>	t	0	0	0	0	0	0	0	0	0
<i>Physalis angustifolia</i>	0.1	0	0	0	0.1	0	0	0	0	0
<i>Pinus elliotii</i>	0	t	0	0	0	t	0	0	0	0
<i>Pinus elliotii</i> canopy	0	t	0	0	0	0	0	0	0	0
<i>Polygonella polygama</i>	0.1	t	0	0	0	0	0	0	0	0
<i>Pteridium aquilinum</i>	0	t	0	0	0	0	0	0	0	0
<i>Quercus geminata</i>	1.3	0.5	0	0	0.3	0.1	3.7	1.7	1.8	0.4
<i>Quercus geminata</i> canopy	1.1	0.2	0	0	0	0	1.9	0	2.2	0.6
<i>Quercus myrtifolia</i>	0.6	0	0	0	0	0	0	0	0	0
<i>Quercus myrtifolia</i> canopy	0.6	0	0	0	0	0	0	0	0	0
<i>Quercus nigra</i>	t	0	0	0	0	0	0	0	0	0
<i>Rhus copallinum</i>	t	0	0	0	0	0	0	0	0	0
<i>Rubus spp.</i>	0.2	0	0	0	0	0	5.4	0	0	0
<i>Schizachyrium maritimum</i>	6.8	0.6	0	0	6.1	1.5	0.4	0	10.4	t
<i>Scleranthus annuus</i>	t	0	0	0	0	0	0	0	0.2	0
<i>Serenoa repens</i>	0.5	t	0	0	0.3	0	0	0	0	0
<i>Sideroxylon lanuginosum</i>	t	0	0	0	0	0	0	0	0	0
<i>Smilax spp.</i>	0.7	0.1	0	0	0	0	0.2	0.2	2.4	0
<i>Spartina patens</i>	1.7	0.4	0	0	0.2	t	14.6	5.5	t	0
<i>Strophostyles helvola</i>	t	0	0	0	0	0	0	0	0	0
<i>Toxicodendron radicans</i>	0.4	0	0	0	0	0	0.6	0	5.1	0
<i>Tradescantia hirsutiflora</i>	t	0	0	0	0.2	0	0	0	0.2	0
<i>Uniola paniculata</i>	8.9	y	0.7	-	6.9	-	11.1	-	1.5	-
<i>Uniola paniculata</i> inflorescence	0.3	-	0	-	t	-	0.2	-	0.1	-
<i>Vitis rotundifolia</i>	0.4	0	0	0	0.8	0	0	0	4.0	0
Unknown (dead woody)	0	t	0	0	0	0	0	0	0	0
Unknown (dead woody) canopy	0	t	0	0	0	0	0	0	0	0
Total Canopy Cover	2.9	0.3	0	0	0	0	1.9	0	2.2	0.6
Total Foliar Cover	31.5		0.4		22.1		38.6		25.0	
Total Herbaceous	22.0	2.1	0.8	0	15.5	3.8	31.5	6.3	17.2	1.5
Total Woody	4.4	0.7	0	0	0.6	1.8	7.3	1.7	7.0	0.4
Total Woody Vines	1.3	0.1	0	0	0.8	0	5.7	0.2	6.4	0
Bare Sand	65.8		63.6		77.9		35.5		75.0	
Road Debris	2.7		36.0		0		26.0		0	
^z t equals a trace amount of less than 0.1										
^y Data not available.										

Table 11. Continued.

Species	Dune 42		Dune 43		Dune 44		Dune 45		Dune 46	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Balduina angustifolia</i>	0	0	0	0	0	0	0	0	0	0
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0	0
<i>Ceratiola ericoides</i>	0	0	0	0	0	0	0	0	0	0
<i>Chamaesyce bombensis</i>	t	0	0	0	t	0	0	0	0	0
<i>Chrysoma pauciflorescens</i>	0	0	0	0	0	0	0	0	0	0
<i>Chrysopsis gossypina hyssopifolia</i>	0	0	0	0	1.3	0	0	0	0	0
<i>Cladium jamaicense</i>	0	0	0	0	0	0	0	0	0	0
<i>Cnidoscolus stimulosus</i>	0	0	0	0	0	0	t	0	0	0
<i>Conradina canescens</i>	0	0	0	0	0	0	0	0	0	0
<i>Crataegus michauxii</i>	0	0	0	0	0	0	0	0	0	0
<i>Crotalaria rotundifolia</i>	0	0	0	0	0	0	0	0	0	0
<i>Cyperus</i> spp.	0	0	0	0	1.1	0	0	0	0	0
<i>Dichanthelium aciculare</i>	0	0	0	0	0	0	0	0	0	0
<i>Eupatorium capillifolium</i>	0	0	0	0	0	0	0	0	0	0
<i>Froelichia floridana</i>	0	0	0	0	t	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0	0	0	0	1.9	0	0	0	0	0
<i>Hydrocotyle bonariensis</i>	0	0	0	0	t	0	0	0	0	0
<i>Ilex glabra</i>	0	0	0	0	0	0	0	0	0	0
<i>Ilex glabra</i> canopy	0	0	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i>	0	0	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i> canopy	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea imperati</i>	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	0	0	0	0	0.2	0	0	0	0	0
<i>Ipomoea</i> spp.	0	0	0	0	0	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0	0	0	0	0
<i>Juncus roemerianus</i>	0	0	0	0	0	0	0	0	0	0
<i>Juncus scirpoides</i>	0	0	0	0	0	0	0	0	0	0
<i>Magnolia grandiflora</i>	0	0	0	0	0	0	0	0	0	0
<i>Magnolia grandiflora</i> canopy	0	0	0	0	0	0	0	0	0	0
<i>Odontonychia corymbosa</i>	0	0	0.1	0	0	0	0	0	0	0
<i>Oenothera humifusa</i>	0	0	0	0	t	0	0	0	0	0
<i>Panicum amarum</i>	3.1	0.3	0.3	0.3	2.7	1.4	1.3	0.4	0	0.9
<i>Persea borbonia</i>	0	0	0	0	0	0	0	0	0	0
<i>Physalis angustifolia</i>	0	0	0	0	0	0	0	0	0	0
<i>Pinus elliotii</i>	0	0	0	0	0	0	0	0	0	0
<i>Pinus elliotii</i> canopy	0	0	0	0	0	0	0	0	0	0
<i>Polygonella polygama</i>	0	0	0	0	0	0	0	0	0	0
<i>Pteridium aquilinum</i>	0	0	0	0	0	0	0	0	0	0
<i>Quercus geminata</i>	0	0	0.7	0.3	0.1	0	0	t	0	0
<i>Quercus geminata</i> canopy	0	0	0	0	0	0.6	0	0	0	0
<i>Quercus myrtifolia</i>	0	0	0	0	0	0	0	0	0	0
<i>Quercus myrtifolia</i> canopy	0	0	0	0	0	0	0	0	0	0
<i>Quercus nigra</i>	0	0	0	0	0	0	0	0	0	0
<i>Rhus copallinum</i>	0	0	0	0	0	0	0	0	0	0
<i>Rubus</i> spp.	0	0	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	0	0	1.1	0	9.3	t	1.0	0	0	0
<i>Scleranthus annuus</i>	0	0	0	0	0	0	0	0	0	0
<i>Serenoa repens</i>	0	0	0.3	0	0.3	0	0	0	0	0
<i>Sideroxylon lanuginosum</i>	0	0	0	0	0	0	0	0	0	0
<i>Smilax</i> spp.	0	0	1.2	0	0	0	0	0	0	0
<i>Spartina patens</i>	8.4	t	0	0	0.7	0	0	0	0	0
<i>Strophostyles helvola</i>	0	0	0	0	0	0	0	0	0	0
<i>Toxicodendron radicans</i>	0	0	0	0	0	0	0	0	0	0
<i>Tradescantia hirsutiflora</i>	0	0	t	0	0	0	0	0	0	0
<i>Uniola paniculata</i>	6.6	-	4.2	-	29.7	-	6.5	-	3.3	-
<i>Uniola paniculata</i> inflorescence	4.1	-	t	-	0.5	-	0.6	-	t	-
<i>Vitis rotundifolia</i>	0	0	1.0	0	0	0	0	0	0	0
Unknown (dead woody)	0	0	0	0	0	0	0	0	0	0
Unknown (dead woody) canopy	0	0	0	0	0	0	0	0	0	0
Total Canopy Cover	0	0	0	0	0	0.6	0	0	0	0
Total Foliar Cover	18.4		4.6		43.5		4.1		2.9	
Total Herbaceous	22.2	0.4	5.8	0.3	47.5	1.5	9.4	0.4	3.3	0.9
Total Woody	0	0	1.0	0.3	0.4	0	0	t	0	0
Total Woody Vines	0	0	2.2	0	0	0	0	0	0	0
Bare Sand	81.6		95.4		56.5		95.9		97.1	
Road Debris	0		0		0		0		0	

Table 11. Continued.

Species	Dune 47		Dune 21		Dune 18		Dune 17		Dune 5	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Balduina angustifolia</i>	0	0	0	0	0.5	0	0.2	0	2.8	0
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0	0
<i>Ceratiola ericoides</i>	0	0	0	0	0	0	0	0	0	0
<i>Chamaesyce bombensis</i>	0	0	0	0	0.4	0	t	0	t	0
<i>Chrysoma pauciflorescens</i>	0	0	0	0	0.9	0	0.8	0	0.9	t
<i>Chrysopsis gossypina hyssopifolia</i>	0	0	1.9	0.2	0.7	0.2	1.3	t	2.5	t
<i>Cladium jamaicense</i>	0	0	0	0	0	0	0	0	0	0
<i>Cnidioscolus stimulosus</i>	0	0	t	0	t	0	t	0	t	0
<i>Conradina canescens</i>	0	0	0	0	0	0	0.7	0	0.2	0.2
<i>Crataegus michauxii</i>	0	0	0	0	t	0	0.5	0	0.7	0
<i>Crotalaria rotundifolia</i>	t	0	0	0	0	0	0	0	0	0
<i>Cyperus</i> spp.	0	0	t	0	0	0	0	0	0.2	0
<i>Dichanthelium aciculare</i>	0	0	0	0	1.8	0	t	0	t	t
<i>Eupatorium capillifolium</i>	0	0	0	0	0	0	0	0	0	0
<i>Froelichia floridana</i>	0	0	0.1	0	0	0	0.2	0	t	0
<i>Heterotheca subaxillaris</i>	0	0	0.6	0	0.4	t	0.6	0	t	0
<i>Hydrocotyle bonariensis</i>	0	0	0	0	0.1	0	t	0	0	0
<i>Ilex glabra</i>	0	0	0	0	0.9	0	0	0	0	0
<i>Ilex glabra</i> canopy	0	0	0	0	0	0	0.6	0	0	0
<i>Ilex vomitoria</i>	0	0	0	0	1.3	0.4	0.2	0	0.4	t
<i>Ilex vomitoria</i> canopy	0	0	0	0	0	0	0	0	5.7	0
<i>Ipomoea imperati</i>	0	0	0	0	t	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	0	0	0.2	0	1.5	0	0.7	0	0.2	0
<i>Ipomoea</i> spp.	0	0	0	0	0.2	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0	0	0	0	0
<i>Juncus roemerianus</i>	0	0	0	0	0	0	0	0	0	0
<i>Juncus scirpoides</i>	0	0	0	0	0.4	0	0	0	0	0
<i>Magnolia grandiflora</i>	0	0	0	0	0	0	0	0	0	0
<i>Magnolia grandiflora</i> canopy	0	0	0.3	0	2.7	t	0	0	5.2	1.8
<i>Odontonychia corymbosa</i>	0	0	0.2	0	t	0	0.2	0	0.1	0
<i>Oenothera humifusa</i>	0	0	0.1	0	t	0	0.9	t	0.1	0
<i>Panicum amarum</i>	2.6	3.2	9.1	5.8	0.3	0	0.9	t	0.1	0
<i>Persea borbonia</i>	0	0	0	0	0	0	0	0	t	t
<i>Physalis angustifolia</i>	0	0	0.9	0	0.6	0	0	0	t	0
<i>Pinus elliotii</i>	0	0	0	0	0	0	0	0	0	0
<i>Pinus elliotii</i> canopy	0	0	0	0	0	0	0	0	0	0
<i>Polygonella polygama</i>	0	0	0	0	t	0	t	0	1.5	0.6
<i>Pteridium aquilinum</i>	0	0	0	0	0	0	0	0	0	0
<i>Quercus geminata</i>	0	0	0	0.5	4.1	0.3	3.8	3.1	2.0	0.9
<i>Quercus geminata</i> canopy	0	0	0	0.8	0	0	5.4	0	0	0
<i>Quercus myrtifolia</i>	0	0	0	0	0.2	0.1	0	0	t	0
<i>Quercus myrtifolia</i> canopy	0	0	0	0	4.7	0	0	0	1.0	0
<i>Quercus nigra</i>	0	0	0	0	0	0	0	0	2.2	0
<i>Rhus copallinum</i>	0	0	0.6	0	0	0	0	0	0	0
<i>Rubus</i> spp.	0	0	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	0	0	10.8	0	12.4	4.5	13.5	t	18.2	t
<i>Scleranthus annuus</i>	0	0	0	0	0	0	0	0	0	0
<i>Serenoa repens</i>	0	0	0	0.3	1.7	0.1	0	0	0	0
<i>Sideroxylon lanuginosum</i>	0	0	0	0	0	0	0	0	0.5	0
<i>Smilax</i> spp.	0	0	t	0	0.9	0	1.3	0.5	4.7	1.0
<i>Spartina patens</i>	0	0	t	0.2	1.5	0	t	0	0	0
<i>Strophostyles helvola</i>	0	0	0	0	0	0	0	0	0	0
<i>Toxicodendron radicans</i>	0	0	2.3	0	0	0	0	0	0.5	0
<i>Tradescantia hirsutiflora</i>	0	0	0	0	0	0	0	0	t	0
<i>Uniola paniculata</i>	1.6	-	17.7	-	15.3	-	4.2	-	6.4	-
<i>Uniola paniculata</i> inflorescence	t	-	0.2	-	t	-	t	-	0.2	-
<i>Vitis rotundifolia</i>	0	0	0.5	0	0	0	t	0	0	0
Unknown (dead woody)	0	0	0	t	0	t	0	0	0	0
Unknown (dead woody) canopy	0	0	0	0.6	0	0	0	0	0	0
Total Canopy Cover	0	0	0.3	1.4	7.5	0.1	6.0	0	12.0	1.8
Total Foliar Cover	2.6		43.1		47.6		28.2		51.1	
Total Herbaceous	4.4	3.2	41.9	6.2	36.1	4.8	22.7	0.2	31.6	0.2
Total Woody	0	0	2.9	0.9	9.1	1.0	5.5	3.1	6.2	1.1
Total Woody Vines	0	0	0.5	0	0.9	0	1.3	0.5	4.7	1.0
Bare Sand	97.4		56.9		52.4		71.8		48.9	
Road Debris	0		0		0		0		0	

Table 11. Continued.

Species	Dune 7		Dune 6		Dune 9		Dune 11		Dune 13	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Balduina angustifolia</i>	0	0	0.0	0	0	0	0	0	0	0
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0	0
<i>Ceratiola ericoides</i>	1.5	0	0	0	0	0	0	0	0	0
<i>Chamaesyce bombensis</i>	1.0	0.2	0.1	0	t	0	0	0	t	0
<i>Chrysoma pauciflorescens</i>	0	0	0.5	0.7	5.2	0	0	0	0.4	0
<i>Chrysopsis gossypina hyssopifolia</i>	0.3	0	0.7	0.7	t	t	0	0	1.2	t
<i>Cladium jamaicense</i>	0	0	0.1	0	0	0	0	0	0	0
<i>Cnidioscolus stimulosus</i>	0	0	0	0	0.2	0	0.3	0	0	0
<i>Conradina canescens</i>	0	0	0	0	0	0	0	0	0	0
<i>Crataegus michauxii</i>	0.7	0	4.0	0.3	t	0	0	0	0	0
<i>Crotalaria rotundifolia</i>	0	0	0	0	0	0	0	0	0	0
<i>Cyperus</i> spp.	0	0	t	0	0	0	0	0	0	0
<i>Dichanthelium aciculare</i>	0	0	0.2	0	0	0	0	0	0.4	0
<i>Eupatorium capillifolium</i>	0	0	0	0	0	0	0	0	0	0
<i>Froelichia floridana</i>	0	0	t	0	0	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	t	0	4.4	0.2	0.4	0	0.2	0	1.0	t
<i>Hydrocotyle bonariensis</i>	0	0	t	0	t	0	0	0	0	0
<i>Ilex glabra</i>	0	0	0	0	0	0	0	0	0.5	0
<i>Ilex glabra</i> canopy	0	0	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i>	0.3	0	2.7	0.6	0.8	0.2	0	0	0	0
<i>Ilex vomitoria</i> canopy	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea imperati</i>	0	0	0.1	0	t	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	3.0	0	1.1	t	0.9	0	t	0	0.3	0
<i>Ipomoea</i> spp.	0	0	t	0	0	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0	0	0	0	0
<i>Juncus roemerianus</i>	0	0	0	0	0	0	0	0	0	0
<i>Juncus scirpoides</i>	0	0	0	0	0	0	0	0	0	0
<i>Magnolia grandiflora</i>	t	0	1.3	0	0.1	0	0	0	0	0
<i>Magnolia grandiflora</i> canopy	8.5	0	3.7	t	0.3	0	0	0	0	0
<i>Odontonychia corymbosa</i>	t	0	0.3	t	0.1	0	0.5	0	0.6	t
<i>Oenothera humifusa</i>	0	0	t	0	0	0	0	0	0.5	t
<i>Panicum amarum</i>	0	0	t	2.1	1.8	t	t	0	0	0
<i>Persea borbonia</i>	0	0	0.5	0	0	0	0	0	0	0
<i>Physalis angustifolia</i>	0	0	0.1	0	0	0	0	0	0.2	0
<i>Pinus elliotii</i>	0	0	0	t	0	0.3	0	0	0	0
<i>Pinus elliotii</i> canopy	0	0	0	0	0	0	0	0	0	0
<i>Polygonella polygama</i>	0.4	0	0.3	0	0.7	0	0	0	0	0
<i>Pteridium aquilinum</i>	0	0	0	0.2	0	t	0	0	0	0
<i>Quercus geminata</i>	1.6	0	3.4	t	0.4	0.3	0	0.1	0	0.5
<i>Quercus geminata</i> canopy	2.9	0	1.1	t	5.2	0	0	1.3	7.2	0
<i>Quercus myrtifolia</i>	0	0	0	0	0	0	0	0	0.3	0
<i>Quercus myrtifolia</i> canopy	4.9	0	0	0	0	0	0	0	2.1	0
<i>Quercus nigra</i>	0	0	0	0	0	0	0	0	0	0
<i>Rhus copallinum</i>	0	0	0	0	0	0	0	0	0	0
<i>Rubus</i> spp.	0	0	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	14.4	0	13.7	0.4	4.7	0.9	9.6	0.8	6.2	3.1
<i>Scleranthus annuus</i>	0	0	0.2	0	0	0	0	0	0	0
<i>Serenoa repens</i>	1.0	0	2.7	0	0	0	1.4	t	4.9	0
<i>Sideroxylon lanuginosum</i>	0	0	0	0	0	0	0	0	0	0
<i>Smilax</i> spp.	0.6	0.9	1.5	0	0.4	t	1.1	0	0.1	0
<i>Spartina patens</i>	0	0	0	0	0	0	0	0	0	0
<i>Strophostyles helvola</i>	0	0	0	0	0	0	0	0	0.1	0
<i>Toxicodendron radicans</i>	0	0	0.9	0	0	0	0	0	t	0
<i>Tradescantia hirsutiflora</i>	0	0	0.2	0	0	0	0	0	0	0
<i>Uniola paniculata</i>	12.9	-	12.0	-	10.6	-	17.3	-	5.9	-
<i>Uniola paniculata</i> inflorescence	0	-	t	-	0.2	-	t	-	t	-
<i>Vitis rotundifolia</i>	1.2	0	0.5	0	0	0	0	0	0	0
Unknown (dead woody)	0	0.2	0	t	0	t	0	0	0	t
Unknown (dead woody) canopy	0	0	0	0	0	0	0	0	0	0
Total Canopy Cover	16.3	0	4.8	0.1	5.5	0	0	1.3	9.3	0
Total Foliar Cover	45.7		50.4		20.6		25.5		29.8	
Total Herbaceous	31.7	0.2	33.6	3.4	19.0	1.0	27.9	0.8	16.6	3.2
Total Woody	3.2	0.2	12.0	1.3	6.5	0.8	1.4	0.1	6.1	0.5
Total Woody Vines	1.8	0.9	2.0	0	0.4	t	1.1	0	0.1	0
Bare Sand	54.3		49.6		79.5		74.5		70.2	
Road Debris	0		0		0		0		0	

Table 11. Continued.

	Dune 12		Dune 15		Dune 16		Dune 14	
Species	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Balduina angustifolia</i>	0	0	0	0	0	0	0.2	0
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0
<i>Ceratiola ericoides</i>	0	0	0	0	0	1.3	0	0
<i>Chamaesyce bombensis</i>	t	0	0	0	0.1	0	0.6	0
<i>Chrysoma pauciflorescens</i>	0	2.1	0	0	0	0	t	0
<i>Chrysopsis gossypina hyssopifolia</i>	0	0	0	0	2.5	0.1	0.3	0
<i>Cladium jamaicense</i>	0	0	0	0	0	0	0	0
<i>Cnidioscolus stimulosus</i>	0	0	0	0	0	0	0	0
<i>Conradina canescens</i>	0	0	0	0	0	0	t	0
<i>Crataegus michauxii</i>	0	0	0	0	0	0	0	0
<i>Crotalaria rotundifolia</i>	0	0	0	0	0	0	0	0
<i>Cyperus</i> spp.	0	0	0	0	0	0	1.4	0.4
<i>Dichanthelium aciculare</i>	0	0	0	0	0.4	0	0	0
<i>Eupatorium capillifolium</i>	0	0	0	0	0	0	0	0
<i>Froelichia floridana</i>	0	0	0	0	0	0	t	0
<i>Heterotheca subaxillaris</i>	2.4	1.1	0	0	1.0	0.5	0.8	0.2
<i>Hydrocotyle bonariensis</i>	0	0	0	0	0.3	0	t	0
<i>Ilex glabra</i>	0	0	0	0	0	0	0	0
<i>Ilex glabra</i> canopy	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i>	0	0	0	0	0	0	0.6	0
<i>Ilex vomitoria</i> canopy	0	0	0	0	0	0	0	0
<i>Ipomoea imperati</i>	0	0	0	0	0	0	t	0
<i>Ipomoea pes-caprae</i>	0	0	0.1	0	0.2	0	0.9	0
<i>Ipomoea</i> spp.	0	0	0	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0	0.3	0
<i>Juncus roemerianus</i>	0	0	0	0	0	0	0	0
<i>Juncus scirpoides</i>	0	0	0	0	0	0	0.4	0
<i>Magnolia grandiflora</i>	0	0	0	0	0	0	0	0
<i>Magnolia grandiflora</i> canopy	0	0	0	0	0	0	0	0
<i>Odontonychia corymbosa</i>	3.0	0.6	0	0	0.1	0.2	0.4	t
<i>Oenothera humifusa</i>	0.2	0	0	0	0.1	0	0.8	t
<i>Panicum amarum</i>	0.1	0	0	0	1.9	2.0	0.6	0.1
<i>Persea borbonia</i>	0	0	0	0	0	0	0	0
<i>Physalis angustifolia</i>	0	0	0.3	0	t	0	t	0
<i>Pinus elliotii</i>	0	0.7	0	0	0	0	0	0
<i>Pinus elliotii</i> canopy	0	0.9	0	0	0	0	0	0
<i>Polygonella polygama</i>	0	0	0	0	0	0.2	0	0
<i>Pteridium aquilinum</i>	0	0	0	0	0	0	0	0
<i>Quercus geminata</i>	0	0.9	0.9	0	6.5	0.3	0	0
<i>Quercus geminata</i> canopy	0	0	0	0	0	0.9	0	0
<i>Quercus myrtifolia</i>	0	0	0	0	0	0	0	0
<i>Quercus myrtifolia</i> canopy	0	0	0	0	0	0	0	0
<i>Quercus nigra</i>	0	0	0	0	0	0	0	0
<i>Rhus copallinum</i>	0	0	0	0	0	0	0	0
<i>Rubus</i> spp.	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	7.4	0.8	0.5	0	8.2	0.7	7.6	0.9
<i>Scleranthus annuus</i>	0	0	0	0	0.4	0	0	0
<i>Serenoa repens</i>	0	0	0	0	0	0	0	0
<i>Sideroxylon lanuginosum</i>	0	0	0	0	0	0	0	0
<i>Smilax</i> spp.	t	0	0	0	0.2	t	0.7	0
<i>Spartina patens</i>	9.0	0.7	0	0	2.3	1.2	1.2	0.8
<i>Strophostyles helvola</i>	0	0	0	0	0	0	0	0
<i>Toxicodendron radicans</i>	0	0	0	0	0	0	0	0
<i>Tradescantia hirsutiflora</i>	0	0	0	0	0	0	0	0
<i>Uniola paniculata</i>	11.5	-	3.5	-	11.6	-	3.7	-
<i>Uniola paniculata</i> inflorescence	0.5	-	0.6	-	0.2	-	0.3	-
<i>Vitis rotundifolia</i>	0	0	0	0	0	0	0	0
Unknown (dead woody)	0	0	0	0	0	0	0	0
Unknown (dead woody) canopy	0	0	0	0	0	0	0	0
Total Canopy Cover	0	0.9	0	0	0	0.9	0	0
Total Foliar Cover	29.8		4.9		39.1		21.8	
Total Herbaceous	34.1	3.2	4.9	0	29.5	4.6	19.2	2.5
Total Woody	0.0	3.7	0.9	0	6.5	0.3	0.9	0
Total Woody Vines	t	0	0	0	0.2	t	0.7	0
Bare Sand	70.2		95.1		60.9		78.2	
Road Debris	0		0		0		0	

Table 12. Mean density (plants/ha), height (m) and basal area (m²/ha) of live and dead woody species for two forested (shrubby flatwoods) back-island sections on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Species	Overall Flatwoods						Site 1						Site 2					
	Density		Mean		Basal Area		Density		Mean		Basal Area		Density		Mean		Basal Area	
	Plants/ha		Height		(m ² /ha)		Plants/ha		Height		(m ² /ha)		Plants/ha		Height		(m ² /ha)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
Trees																		
<i>Magnolia grandiflora</i>	0	0.50	0	5.05	0	0.0005	0	1.00	0	5.05	0	0.001	0	0	0.00	0	0	0
<i>Pinus ellioti</i>	300	609.50	2.03	5.46	1	5.9050	0	419.00	0	7.39	0	0.177	600	800	2.03	3.52	2.47	11.63
<i>Pinus ellioti</i> saplings ^z	203	29.50	0.79	0.51	0	0.0049	6.00	59.00	0.86	0.51	0.0001	0.010	400	0	0.71	0	0.72	0
Shrubs																		
<i>Baccharis halmifolia</i>	3488	0	2.12	0	- ^y	-	1975.31	0	2.67	0	-	-	5000	0	1.57	0	-	-
<i>Ceratiola ericoides</i>	319	76.54	0.38	0.54	-	-	637.04	153.09	0.38	0.54	-	-	0	0	0	0	-	-
<i>Chrysoma pauciflosculosa</i>	165	0	0.54	0	-	-	330.86	0	0.54	0	-	-	0	0	0	0	-	-
<i>Conradina canescens</i>	1220	150.62	0.48	0.70	-	-	2439.51	301.23	0.48	0.70	-	-	0	0	0	0	-	-
<i>Ilex glabra</i>	652	0	0.76	0	-	-	1303.70	0	0.76	0	-	-	0	0	0	0	-	-
<i>Ilex vomitoria</i>	3146	74.07	1.87	2.03	-	-	3792.59	148.15	2.51	2.03	-	-	2500	0	1.23	0	-	-
<i>Polygonella polygama</i>	316	0	0.45	0	-	-	632.10	0	0.45	0	-	-	0	0	0	0	-	-
<i>Quercus geminata</i>	370	19.75	1.09	3.28	-	-	740.74	39.51	1.09	3.28	-	-	0	0	0	0	-	-
<i>Pinus ellioti</i> stumps ^x	-	164.50	-	0.83	-	-	-	229.00	-	1.32	-	-	-	100	-	0.34	-	-
^z Sapling is a tree that has a height less than 1.4m or a DBH of 4cm or less.																		
^y Data not available																		
^x A <i>Pinus ellioti</i> stump is classified as having a broken trunk and a height less than 1.4m.																		

Table 13. Mean foliar live and dead cover (%) (2010) for vegetation 1m or less in height by species (woody and herbaceous) for two forested (shrubby flatwoods) back barrier sections of the Santa Rosa Unit in Gulf Island National Seashore, Santa Rosa Island, Florida.

Species	Site 1		Site 2		Mean Flatwoods	
	Live	Dead	Live	Dead	Live	Dead
<i>Baccharis halimifolia</i>	31.0	1.4	0	0	15.5	0.7
<i>Centella asiatica</i>	0.9	0	0	0	0.4	0
<i>Chamaesyce bombensis</i>	4.0	0	0.28	0	2.1	0
<i>Chrysopsis gossypina hyssopifolia</i>	0.1	0	0	0	t ²	0
<i>Cladium jamaicense</i>	0.7	0	0	0	0.37	t
<i>Conyza bonariensis</i>	t	33.3	0	0	t	16.7
<i>Balduina angustifolia</i>	0.8	0	0	0	0.4	0
<i>Cyperus spp.</i>	7.2	1.2	0	0	3.6	0.6
<i>Dichanthelium aciculare</i>	2.4	33.3	0	0	1.2	16.7
<i>Distichlis spicata</i>	0.3	0.1	0	0	0.2	t
<i>Eleocharis geniculata</i>	1.9	0	4.65	0	3.3	0
<i>Eucephalus spp.</i>	0.1	0.3	0	0	t	0.1
<i>Eustachys petraea</i>	0.4	0	0	0	0.2	0
<i>Fimbristylis castanea</i>	11.0	33.3	0	0	5.5	16.7
<i>Heterotheca subaxillaris</i>	0.3	0	0	0	0.2	t
<i>Hydrocotyle bonariensis</i>	2.0	33.3	34.03	0	18.0	16.7
<i>Ilex vomitoria</i>	13.7	0.3	21.72	t	17.7	0.2
<i>Juncus marginatus</i>	1.9	0	0	0	1.0	0
<i>Juncus roemerianus</i>	15.1	4.8	0	0	7.5	2.4
<i>Juncus scirpoides</i>	0.9	0	0	0	0.4	0
<i>Lachnanthes caroliana</i>	1.2	0	0	0	0.6	0
<i>Magnolia grandiflora</i>	0.1	0	0	0	t	0
<i>Myrica cerifera</i>	0.2	0	2.04	0	1.1	0
<i>Odontonychia corymbosa</i>	0.8	0	0	0	0.4	0
<i>Oenothera humifusa</i>	0.3	t	0	0	0.1	t
<i>Panicum amarum</i>	0.5	0.5	0.66	0.21	0.6	0.4
<i>Physalis angustifolia</i>	0.3	0.4	2.06	0	1.2	0.2
<i>Pinus ellioti</i>	0.8	33.3	0	0	0.4	16.7
<i>Polygonella polygama</i>	0	0	0	0	t	0
<i>Pteridium aquilinum</i>	0	0	0.68	0	0.3	0
<i>Quercus geminata</i>	34.4	0.7	3.12	0	18.8	0.4
<i>Rubus spp.</i>	8.7	t	10.3	0	9.5	t
<i>Sabatia stellaris</i>	0.4	0	0	0	0.2	0
<i>Schizachyrium maritimum</i>	13.5	0.2	7.17	0	10.4	t
<i>Scleranthus annuus</i>	34.6	0	32.6	0	33.6	0
<i>Smilax spp.</i>	2.0	0.2	52.3	0	27.2	t
<i>Solidago sempervirens</i>	3.9	t	t	0	2.0	t
<i>Spartina patens</i>	32.4	1.3	63.9	0	48.1	0.6
<i>Toxicodendron radicans</i>	1.9	0	0	0	1.0	0
<i>Uniola paniculata</i>	4.1	2.2	18.9	0.7	11.5	1.4
<i>Vitis rotundifolia</i>	1.9	0	7.1	0	4.5	t
Unknown (dead woody)	33.3	0.01	0	0	16.7	t
Total Foliar Cover	87.8		87.6		87.7	
Total Herbaceous	142.2		164.2		153.2	
Total Woody	115.5		27.6		71.4	
Total Woody Vines	12.6		69.7		41.1	
Bare Sand	12.2		12.4		12.3	
² t equals a trace amount of less than 0.1						

Table 14. *Uniola paniculata* inflorescence density, spikelet number, seed number and seed class for plots containing plants along three overwash transects on GUINS.

Site	Distance	Density	Inflorescence			seeds/ spikelet	Seed class (%)		
		Inflorescence s/ m ²	n	Spikelets/ inflorescence	Seeds/ inflorescence		Mature	Immature	Herbivory
1	090-95	0.5	10	262	337	1.29	88.6	11.1	0.2
1	111-120	0	0	-	-	-	-	-	-
1	161-170	0.2	6	338	360	1.07	86.8	13.1	0.1
1	171-180	0	0	-	-	-	-	-	-
1	191-200	0.15	3	243	363	1.49	85.8	13.9	0.4
1	201-210	0.5	2	268	185	0.69	89.7	10.3	0
1	221-230	0	0	-	-	-	-	-	-
1	231-240	0.85	2	143	124	0.87	71.8	27.4	0
1	361-370	0	0	-	-	-	-	-	-
1	371-380	0	0	-	-	-	-	-	-
2	090-95	0	0	-	-	-	-	-	-
2	111-120	0	0	-	-	-	-	-	-
2	161-170	0	0	-	-	-	-	-	-
2	171-180	0	0	-	-	-	-	-	-
2	191-200	0	0	-	-	-	-	-	-
2	201-210	0	0	-	-	-	-	-	-
2	221-230	3.1	8	393	702	1.79	91.6	8.3	0.1
2	231-240	0	0	-	-	-	-	-	-
2	361-370	0.15	2	304	428	1.41	86.4	13.6	0
2	371-380	0.3	9	300	546	1.82	87.7	12.3	0.1
3	091-95	0	0	-	-	-	-	-	-
3	111-120	0.55	4	324	418	1.29	78.1	21.9	0
3	161-070	0.05	1	464	1028	2.22	96	3.9	0.1
3	161-170	0	0	-	-	-	-	-	-
3	171-180	0.1	2	224	349	1.56	83	15.8	1.3
3	191-200	0	0	-	-	-	-	-	-
3	201-210	0	0	-	-	-	-	-	-
3	221-230	0	0	-	-	-	-	-	-
3	231-240	0	0	-	-	-	-	-	-
3	361-370	0	0	-	-	-	-	-	-
3	371-380	0	0	-	-	-	-	-	-
Transects without <i>Uniola paniculata</i> for all three transects omitted from the table.									

Table 15. Mean *Uniola paniculata* seedling density (seedling/m²) for June to Sept. 1997 through 2009, and Nov. 2009 for each transect on limited access areas (Okaloosa County) and restricted access areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.

Overwash Areas, Central Beach Island, Frontal														
	Access Limited				Access Restricted								Mean per Year (m ²)	
	Area ID				Area ID									
Year	1	2	3	4	1	2	3	4	5	6	7	8		
	Overwash Areas													
1997 (July 17)	0.037	0.112	0.018	- ^z	-	-	-	0.014	0.008	0.018	-	-	0.035	
1998 (June 18)	0.024	0.011	0	-	-	-	-	0.014	0.044	0.004	-	-	0.016	
1999 (Sept 27)	0.035	0.039	0.045	-	-	-	-	0.039	0.026	0.015	-	-	0.033	
2000 (Aug 30)	0.018	0.024	0.031	-	-	-	-	0.039	0.026	-	-	-	0.028	
2008 (July 1)	0.197	0.056	0.090	-	-	-	-	0.220	0.097	0.051	-	-	0.118	
2009 (Sept 01)	0.072	0.029	0.049	-	-	-	-	0.054	0.185	0.020	0.079	-	0.067	
2009 (Nov 24)	0.025	0.005	0.011	-	-	-	-	0.005	0.036	0.003	0.042	-	0.018	
	Frontal Dune Remnants													
1997 (July 17)	0.019	0.036	0.091	-	-	-	-	0.017	0.012	0.014	-	-	0.032	
1998 (June 18)	0.045	0.027	0	-	-	-	-	0.101	0.009	0.139	-	-	0.054	
1999 (Sept 27)	0.032	0.056	0.049	-	-	-	-	0.015	0.041	0.004	-	-	0.033	
2000 (Aug 30)	0.031	-	-	-	-	-	-	-	-	-	-	-	0.031	
2008 (July 1)	0.057	0.031	0.072	0.167	-	-	-	-	1.001	0.284	1.151	0.292	0.382	
2009 (Sept 01)	0.003	0.034	0.042	-	0.017	0.017	-	0.009	0.022	0.009	0.122	0.096	0.034	
2009 (Nov 24)	0.001	0	0	-	0	0.002	-	0.004	0.009	0.002	0	0.059	0.006	

^zData not available

Table 16. Mean *Uniola paniculata* seedling density (seedling/m²) for June to Sept. 1997 through 2009, and Nov. 2009 across transects on limited access areas (Okaloosa County) and restricted access areas (Santa Rosa County) of Eglin Air Force Base, Santa Rosa Island, Florida.

Year	Overwash Access		Remnants Access		Mean per Year (m ²)
	Limited	Restricted	Limited	Restricted	
1997 (July 17)	0.056	0.014	0.049	0.014	0.033
1998 (June 18)	0.011	0.021	0.024	0.083	0.035
1999 (Sept 27)	0.039	0.027	0.046	0.020	0.033
2000 (Aug 30)	0.024	0.033	0.031	- ^z	0.029
2008 (July 01)	0.114	0.122	0.082	0.682	0.250
2009 (Sept 01)	0.050	0.085	0.026	0.042	0.051
2009 (Nov 25)	0.014	0.022	0.000	0.011	0.012

^zData not available

Table 17. Mean *Uniola paniculata* seedling density (seedlings/m²) for July to August and Nov. for 2008, 2009 and 2010 in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

	Narrows				Remnants					Mean per Year (m ²)
	Area ID			Mean	Area ID				Mean	
Year	1	2	3	(n-3)	1	3	5	6	(n=4)	
2008 (June 24)	+ ^z	0.322	0.449	0.39	- ^y	0.261	-	-	0.26	
2008 (Nov) ^x	+	0	0	0	-	0	-	-	0	
2009 (July 16)	0.047	0.044	0.029	0.04	0.092	0.124	0.062	0.018	0.07	
2009 (Nov 23)	0.006	0.007	0.003	0.01	0.020	0.041	0.000	0.002	0.02	
2010 (June 4) ^w	-	0.104	0.240	0.17	0.353	0.204	-	-	0.28	
2010 (Nov 20)	0.027	0.025	0.019	0.02	0.100	0.128	0.053	0.017	0.07	

^zTransect # 1 in 2008 is not the same transect in 2009 & 2010.

^yData not available.

^xStorm overwash removed or buried all seedlings in August.

^wJuly 2010 Overwash 3 has data for one transect only because of bird nesting on the other two transects

Table 18. Mean seedling density (seedling/m²) for June to Sept. 1997 through 2009, and Nov. 2009 on limited access areas (Okaloosa County) and restricted access areas (Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.

	0-50m											
	Access Limited						Access Restricted					
Species	1997	1998	1999	2000 ^z	2008	2009	1997	1998	1999	2000 ^y	2008 ^x	2009 ^w
	Overwash											
<i>Cakile constricta</i>	0	0	0.001	0.001	0	0	0.002	0.003	0	0.053	0	0
<i>Cnidoscolus stimulosus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cyperus spp.</i>	0	0	0	0	0.003	0	0	0	0	0	0	0
<i>Diodia teres</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hydrocotyle bonariensis</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0	0	0	0.001	0	0.002	0
<i>Lezpedeza repens</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Lyonia lucida</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Milk weed</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Odontonychia corymbosa</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Oenothera humifusa</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Panicum amarum</i>	0	0	0.0187	0.011	0	0	0.001	0.003	0.025	0.100	0.026	0
<i>Schizachyrium maritimum</i>	0	0	0.0273	0	0.007	0	0	0	0.009	0	0	0
<i>Smilax spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Uniola paniculata</i>	0.042	0.008	0.048	0.027	0.161	0.023	0.016	0.022	0.033	0.042	0.158	0.033
	Remnant											
<i>Cakile constricta</i>	0.001	0	0.001	0.004	0	0	0	0.001	0	- ^v	0	0
<i>Cnidoscolus stimulosus</i>	0	0	0	0	0	0	0	0	0	-	0	0
<i>Cyperus spp.</i>	0	0	0	0	0	0	0	0	0	-	0	0
<i>Diodia teres</i>	0	0	0	0	0	0	0	0	0	-	0	0
<i>Hydrocotyle bonariensis</i>	0	0	0.001	0	0	0	0	0	0	-	0	0
<i>Iva imbricata</i>	0	0	0.001	0	0	0	0	0	0	-	0.0004	0
<i>Lezpedeza repens</i>	0	0	0	0	0	0	0	0	0	-	0	0
<i>Lyonia lucida</i>	0	0	0	0	0	0	0	0	0	-	0	0
<i>Milk weed</i>	0	0	0	0	0	0	0	0	0	-	0	0
<i>Oenothera humifusa</i>	0	0	0	0	0	0	0	0	0	-	0.009	0
<i>Panicum amarum</i>	0.001	0	0.010	0.006	0	0	0	0.002	0.005	-	0.096	0
<i>Odontonychia corymbosa</i>	0	0	0	0	0	0	0	0	0	-	0	0
<i>Schizachyrium maritimum</i>	0	0	0.008	0	0	0	0	0	0.020	-	0.001	0
<i>Smilax spp.</i>	0	0	0	0	0	0	0	0	0.001	-	0	0
<i>Uniola paniculata</i>	0.073	0.031	0.06	0.037	0.093	0.0003	0.013	0.068	0.029	-	0.709	0.011
^z The number of overwash transects for access limited (n=3) and access restricted (n=1) differ in 2000												
^y The number of remnant transects for access limited (n=1) and access restricted (n=0) differ in 2000												
^x The number of remnant transects for access limited (n=3) and access restricted (n=5) differ in 2008												
^w The number of remnant transects for access limited (n=4) and access restricted (n=5) differ in 2009												
^v Data not available												

Table 18. Continued

	51-100m											
	Access Limited						Access Restricted					
Species	1997	1998	1999	2000	2008	2009	1997	1998	1999	2000	2008	2009
	Overwash											
<i>Cakile constricta</i>	0	0	0	0	0	0	0	0.001	0	0.002	0	0
<i>Cnidoscolus stimulosus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cyperus spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Diodia teres</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hydrocotyle bonariensis</i>	0	0	0	0	0	0	0	0.001	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Lezpedeza repens</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Lyonia lucida</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Milk weed</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Odontonychia corymbosa</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Oenothera humifusa</i>	0	0	0	0	0	0	0	0	0	0	0.056	0
<i>Panicum amarum</i>	0	0	0.006	0.002	0	0	0	0.003	0.011	0.037	0.001	0.001
<i>Schizachyrium maritimum</i>	0.003	0	0.004	0.001	0	0	0	0.021	0.008	0	0	0
<i>Smilax spp.</i>	0	0	0	0	0	0	0	0.021	0.001	0	0	0
<i>Uniola paniculata</i>	0.076	0.016	0.027	0.02	0.048	0.005	0.011	0.02	0.018	0.019	0.072	0.01
	Remnant											
<i>Cakile constricta</i>	0	0.006	0	0	0	0	0	0.00733	0	-	0	0.005
<i>Cnidoscolus stimulosus</i>	0	0	0	0	0	0	0	0	0	-	0	0
<i>Cyperus spp.</i>	0	0	0	0	0	0	0	0	0	-	0	0
<i>Diodia teres</i>	0	0	0	0	0	0	0	0	0	-	0	0
<i>Hydrocotyle bonariensis</i>	0	0	0	0	0	0	0	0	0	-	0	0
<i>Iva imbricata</i>	0	0.001	0	0	0	0	0	0	0	-	0.0004	0
<i>Lezpedeza repens</i>	0	0	0	0	0	0	0	0	0	-	0	0
<i>Lyonia lucida</i>	0	0	0	0	0	0	0	0	0	-	0	0
<i>Milk weed</i>	0	0	0	0	0	0	0	0	0	-	0	0
<i>Oenothera humifusa</i>	0	0	0	0	0	0	0	0	0	-	0.001	0
<i>Panicum amarum</i>	0	0.013	0.002	0	0	0	0	0.001	0.001	-	0.007	0
<i>Odontonychia corymbosa</i>	0	0	0	0	0	0	0	0	0	-	0	0
<i>Schizachyrium maritimum</i>	0	0	0.001	0	0	0	0	0	0	-	0	0
<i>Smilax spp.</i>	0	0	0	0	0	0	0	0	0.001	-	0	0
<i>Uniola paniculata</i>	0.015	0.015	0.025	0.021	0.066	0	0.017	0.106	0.008	-	0.643	0.011

Table 18. Continued

	101-200m [†]			201-300m			301-400m	
	Access Limited	Access Restricted		Access Limited	Access Restricted		Access Limited	Access Restricted
Species	2008	2008		2008	2008		2008	2008
	Overwash							
<i>Cakile constricta</i>	0	0		0	0		0	0
<i>Cnidoscolus stimulosus</i>	0	0		0.013	0		0.432	0
<i>Cyperus spp.</i>	0	0		0.167	0		0	0
<i>Diodia teres</i>	0	0		0	0		0	0
<i>Hydrocotyle bonariensis</i>	0	0		0	0		0	0
<i>Iva imbricata</i>	0	0		0	0		0	0
<i>Lezpedeza repens</i>	0	0		0.003	0		0.578	0
<i>Lyonia lucida</i>	0	0		0	0		0	0
<i>Milk weed</i>	0	0		0	0		0	0
<i>Odontonychia corymbosa</i>	0	0		0	0		0	0
<i>Oenothera humifusa</i>	0	0		0	0		0	0
<i>Panicum amarum</i>	0	0		0	0		0	0
<i>Schizachyrium maritimum</i>	0	0		0	0		0	0
<i>Smilax spp.</i>	0	0		0	0		0	0
<i>Uniola paniculata</i>	0.195	0		0.035	0		0	0
	Remnant							
<i>Cakile constricta</i>	0	0		0	0		0	0
<i>Cnidoscolus stimulosus</i>	0	0		0	0		0	0
<i>Cyperus spp.</i>	0	0		0	0		0	0
<i>Diodia teres</i>	0	0		0	0		0	0
<i>Hydrocotyle bonariensis</i>	0	0		0	0		0	0
<i>Iva imbricata</i>	0	0		0	0		0	0
<i>Lezpedeza repens</i>	0	0		0	0		0	0
<i>Lyonia lucida</i>	0	0		0	0		0	0
<i>Milk weed</i>	0	0		0	0		0	0
<i>Oenothera humifusa</i>	0	0		0	0		0	0
<i>Panicum amarum</i>	0	0		0	0		0	0
<i>Odontonychia corymbosa</i>	0	0		0	0		0	0
<i>Schizachyrium maritimum</i>	0	0		0	0		0	0
<i>Smilax spp.</i>	0	0		0	0		0	0
<i>Uniola paniculata</i>	0	0		0	0		0	0

[†] Seedling data on transects longer than 100m was only collected in 2008

Table 18. Continued

	401-500m			501-600m			601-700m	
	Access Limited	Access Restricted		Access Limited	Access Restricted		Access Limited	Access Restricted
Species	2008	2008		2008	2008		2008	2008
	Overwash							
<i>Cakile constricta</i>	0.010	0		0.002	0		0	0
<i>Cnidoscolus stimulosus</i>	0.002	0		0.413	0		0.750	0
<i>Cyperus spp.</i>	0	0		0	0		0	0
<i>Diodia teres</i>	0.002	0		0.020	0		0	0
<i>Hydrocotyle bonariensis</i>	0	0		0	0		0	0
<i>Iva imbricata</i>	0	0		0.002	0		0	0
<i>Lezpedeza repens</i>	0	0		0	0		0.020	0
<i>Lyonia lucida</i>	0	0		0.005	0		0	0
<i>Milk weed</i>	0	0		0	0		0	0
<i>Odontonychia corymbosa</i>	0	0		0.008	0		0	0
<i>Oenothera humifusa</i>	0	0		0	0		0	0
<i>Panicum amarum</i>	0	0		0	0		0	0
<i>Schizachyrium maritimum</i>	0	0		0	0		0	0
<i>Smilax spp..</i>	0	0		0	0		0	0
<i>Uniola paniculata</i>	0							
	Remnant							
<i>Cakile constricta</i>	0	0		0	0		0	0
<i>Cnidoscolus stimulosus</i>	0	0		0	0		0	0
<i>Cyperus spp.</i>	0	0		0	0		0	0
<i>Diodia teres</i>	0	0		0	0		0	0
<i>Hydrocotyle bonariensis</i>	0	0		0	0		0	0
<i>Iva imbricata</i>	0	0		0	0		0	0
<i>Lezpedeza repens</i>	0	0		0	0		0	0
<i>Lyonia lucida</i>	0	0		0	0		0	0
<i>Milk weed</i>	0	0		0	0		0	0
<i>Oenothera humifusa</i>	0	0		0	0		0	0
<i>Panicum amarum</i>	0	0		0	0		0	0
<i>Odontonychia corymbosa</i>	0	0		0	0		0	0
<i>Schizachyrium maritimum</i>	0	0		0	0		0	0
<i>Smilax spp..</i>	0	0		0	0		0	0
<i>Uniola paniculata</i>	0	0		0	0		0	0

Table 19. Seedling mean density (seedling/m²) for 2007 thru 2010 for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

	0-50m									51-100m							
	Overwash Areas				Frontal Dune Remnant					Overwash Areas				Frontal Dune Remnant			
	2007 (n=1)	2008 (n=3)	2009 (n=3)	2010 (n=4)	2007 (n=1)	2008 (n=3)	2009 (n=4)	2010 (n=2)		2007 (n=1)	2008 (n=3)	2009 (n=3)	2010 (n=4)	2007 (n=1)	2008 (n=3)	2009 (n=4)	2010 (n=2)
Species	(n=1)	(n=3)	(n=3)	(n=4)	(n=1)	(n=3)	(n=4)	(n=2)		(n=1)	(n=3)	(n=3)	(n=4)	(n=1)	(n=3)	(n=4)	(n=2)
<i>Balduina angustifolia</i>	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
<i>Cakile constricta</i>	0	0.004	0.0002	0.001	0	0	0	0.006		0	0	0	0.0002	0	0	0.001	0.01
<i>Chamaesyce polygonifolia</i>	0	0	0	0	0	0	0	0.001		0	0	0	0.0067	0	0	0.001	0.001
<i>Cyperus spp.</i>	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
<i>Dichanthelium aciculare</i>	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0.001	0
<i>Hydrocotyle bonariensis</i>	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
<i>Ipomoea spp.</i>	0	0	0.0002	0	0	0	0.001	0		0	0.002	0	0	0	0	0	0.001
<i>Iva imbricata</i>	0	0.021	0.001	0	0	0.006	0.001	0.006		0	0.001	0	0.0091	0	0.001	0.001	0.002
<i>Lyonia lucida</i>	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
<i>Oenothera humifusa</i>	0	0	0	0	0	0.001	0	0		0	0	0.0002	0	0	0	0	0
<i>Panicum amarum</i>	0	0.051	0.001	0.009	0	0.041	0	0.001		0	0.003	0.0016	0.0029	0	0.003	0	0.001
<i>Physalis angustifolia</i>	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	0	0.002	0	0	0	0	0	0		0	0	0	0	0	0	0.001	0
<i>Smilax spp.</i>	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
<i>Spartina patens</i>	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
<i>Uniola paniculata</i>	0.04	0.8	0.008	0.038	0.05	0.301	0.006	0.08		0.03	0.035	0.002	0.033	0.004	0.149	0.02	0.069

Table 19. Continued

Species	101-200						201-300m					
	Overwash Areas				Frontal Dune Remnant		Overwash Areas				Frontal Dune Remnant	
	2007 (n=1)	2008 (n=3)	2009 (n=3)	2010 (n=4)	2007 (n=1)	2008 (n=3)	2007 (n=1)	2008 (n=3)	2009 (n=3)	2010 (n=4)	2007 (n=1)	2008 (n=3)
<i>Balduina angustifolia</i>	0	0	0	0	0	0	0	0	0.002	0	0	0
<i>Cakile constricta</i>	0	0	0.001	0	0	0	0	0	0	0	0	0
<i>Chamaesyce polygonifolia</i>	0	0	0	0	0	0	0	0	0.002	0.012	0	0
<i>Cyperus spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dichanthelium aciculare</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hydrocotyle bonariensis</i>	0	0	0	0	0	0	0.01	0	0	0	0.01	0
<i>Ipomoea spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0.0002	0	0	0	0	0	0	0	0
<i>Lyonia lucida</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Oenothera humifusa</i>	0	0	0.018	0	0	0.003	0	0.003	0	0.009	0	0
<i>Panicum amarum</i>	0	0.007	0.001	0	0	0	0	0.002	0.001	0.001	0	0
<i>Physalis angustifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	0	0	0.001	0	0	0	0	0.008	0.001	0	0	0
<i>Smilax spp.</i>	0	0	0	0	0	0	0.01	0	0	0	0	0
<i>Spartina patens</i>	0.01	0.01	0.007	0	0	0	0	0.01	0	0	0	0
<i>Uniola paniculata</i>	0.18	0.17	0.04	0.013	0	0	0.06	0.04	0.01	0.003	0	0

^yremnant dune transects in 2009 and 2010 were not run longer than 100m

Table 19. Continued

	301-400m							401-500m					
	Overwash Areas				Frontal Dune Remnant			Overwash Areas				Frontal Dune Remnant	
	2007	2008	2009	2010	2007	2008		2007	2008	2009	2010	2007	2008
Species	(n=1)	(n=3)	(n=3)	(n=4)	(n=1)	(n=3)		(n=1)	(n=3)	(n=3)	(n=4)	(n=1)	(n=3)
<i>Balduina angustifolia</i>	0	0	0.001	0	0	0		0	0	0	0	0	0
<i>Cakile constricta</i>	0	0	0	0	0	0		0	0	0.001	0	0	0
<i>Chamaesyce polygonifolia</i>	0	0	0.009	0.007	0	0		0	0	0	0	0	0
<i>Cyperus spp.</i>	0	0.017	0	0	0	0		0	0	0	0	0	0
<i>Dichanthelium aciculare</i>	0	0.005	0	0	0	0		0	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0	0.088	0	0	0	0		0	0	0	0	0	0
<i>Hydrocotyle bonariensis</i>	0.01	0	0	0	0	0		0	0	0	0	0	0
<i>Ipomoea spp.</i>	0	0	0	0	0	0		0	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0		0	0	0	0	0	0
<i>Lyonia lucida</i>	0	0.005	0	0	0	0		0	0	0	0	0	0
<i>Oenothera humifusa</i>	0	0.008	0.008	0.001	0	0		0	0	0.004	0	0	0
<i>Panicum amarum</i>	0	0	0.002	0	0	0		0	0	0	0	0	0
<i>Physalis angustifolia</i>	0	0	0.004	0	0	0		0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	0	0	0.003	0	0	0		0	0	0	0	0	0
<i>Smilax spp.</i>	0.01	0	0	0	0	0		0	0	0	0	0	0
<i>Spartina patens</i>	0	0	0	0	0	0		0	0	0	0	0	0
<i>Uniola paniculata</i>	0	0.01	0.05	0	0	0		0	0	0	0	0	0

Table 20. Dune area (ha), acorns/tree, tree density (trees/m²) and estimated acorn density (acorns/m²) for Sand Live Oak (*Quercus geminata*) and Myrtle Oak (*Quercus myrtifolia*) on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Dune ID	Area (ha)	Estimated acorn production ^z				Tree density		Estimated acorn density ^y	
		Acorns/tree (n)				Trees/m ²		Acorns/m ²	
		Q. <i>geminata</i>		Q. <i>myrtifolia</i>		Q. <i>geminata</i>	Q. <i>myrtifolia</i>	Q. <i>geminata</i>	Q. <i>myrtifolia</i>
26	0.8213	8	9	- ^x	0	0.104	0	0.832	-
38	0.0883	1	3	-	0	0.312	0	0.312	-
41	0.3055	5	8	-	0	0.618	0	3.089	-
43	0.0597	3	2	-	0	0.070	0	0.210	-
44	0.2916	9	2	-	0	0.089	0	0.800	-
21	0.4367	6	2	-	0	0	0	-	-
18	0.1832	0	7	12	5	0.021	0.0601	0	0.7216
17	0.7869	6	9	-	0	1.090	0	6.540	-
5	1.9449	2	5	1	2	0.082	0.2067	0.164	0.2067
7	0.2253	5	8	102	3	0.136	0.148	0.680	15.096
6	0.4899	1	9	4	5	0.161	0.05	0.161	0.2
9	0.8024	23	7	11	5	0.058	0	1.334	-
11	0.2048	0	4	0	1	0	0	-	0
13	0.1108	38	8	51	3	0.299	0.133	11.362	6.783
12	0.0985	1	2	-	0	0.010	0	0.010	-
15	0.2128	0	2	-	0	0.052	0	0	-
16	0.2464	15	3	-	0	0.252	0	3.780	-
14	2.1091	45	6	1	2	0.002	0	0.094	-
All	0.5232	9	18	23	18				

^zEstimated acorn production (acorns/tree) = acorn production of sample stem X number of stems.

^yEstimated acorn density (Acorns/m²) = Estimated acorn production X Tree density.

^xNo trees available to count.

Table 21. Mean frequency (%) of occurrence by species for all dunes in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Species	All Dunes	n
<i>Ceratiola ericoides</i>	26.0	42
<i>Crataegus michauxii</i>	62.5	15
<i>Ilex glabra</i>	50.0	2
<i>Ilex vomitoria</i>	49.2	97
<i>Magnolia grandiflora</i>	41.3	55
<i>Persea borbonia</i>	9.5	23
<i>Rhus copallinum</i>	0	13
<i>Serenoa repens</i>	66.2	54
<i>Sideroxylon lanuginosum</i>	0	47
<i>Smilax spp.</i>	15.4	76
<i>Vitis rotundifolia</i>	12.3	71

Appendix A. Dates, names, Saffir/Simpson Hurricane Scale category maximum and landfall values, and landfall location of storms from 1995 to 2009.

Date	Name	Type	Saffir/Simpson Hurricane Scale		Landfall Location
			Max Category	Landfall Category	
August 5, 1995	Erin	Hurricane	2	2	Pensacola Beach, FL
October 4, 1995	Opal	Hurricane	4	3	Pensacola Beach, FL
July 19, 1997	Danny	Hurricane	1	1	Mallet Point, AL, near Mobile Bay
September 30, 1998	Georges	Hurricane	4	2	Biloxi, MS (dissipated over FLorida Panhandle, storm surge up to 3m)
June 11, 2001	Allison	Tropical storm	Tropical storm	Tropical depression	Morgan City, LA
September 11, 2001	Gabrielle	Hurricane	1	Tropical storm	Venice, FL (strong surf for AL & FL)
August 12, 2004	Bonnie	Tropical storm	Tropical storm	Tropical storm	Just south of Apalachicola, FL (1.2m storm surge)
July 5, 2005	Cindy	Hurricane	1	1	Grand Isle, LA
August 29, 2005	Katrina	Hurricane	5	3	Buras, LA
September 22, 2007	# Ten	Tropical depression	Tropical depression	Tropical depression	Near Fort Walton Beach, FL (waves of about 1.5m)
August 23, 2008	Fay	Tropical storm	Tropical storm	Tropical storm	Carrabelle, FL (barely stayed onshore while passing Panama City, FL)
September 13, 2008	Ike	Hurricane	4	2	Galveston, TX
November 10, 2009	Ida	Hurricane	2	Tropical storm	Dauphin island, AL

Appendix B. Cross-island transect coordinates (UTM) from East to West on the Santa Rosa Unit of Gulf Island National Seashore, and limited access areas of Eglin Air Force Base, Santa Rosa Island, Florida.

SRU of GINS			EAFB		
ID	X Coordinate	Y Coordinate	ID	X Coordinate	Y Coordinate
41B-1	507029	3360214	7A	522588	3362630
41B-2	507037	3360165	7B	522588	3362430
41B-3	507045	3360116	7C	522588	3362260
41B-4	507053	3360067	7D	522588	3362130
41B-5	507061	3360017	6A	521785	3362535
41B-6	507069	3359968	6B	521785	3362335
41B-7	507077	3359919	6C	521785	3362175
41B-8	507085	3359869	6D	521785	3362035
41B-9	507093	3359820	4A	517426	3362059
41B-10	507101	3359771	4B	517426	3361859
44A-1	504164	3359566	4C	517426	3361659
44A-2	504172	3359516	4D	517426	3361459
44A-3	504181	3359467	3A	517054	3361993
44A-4	504189	3359418	3B	517054	3361793
44A-5	504197	3359369	3C	517054	3361593
44A-6	504206	3359319	3D	517054	3361393
44A-7	504214	3359270	2A	516256	3361929
44A-8	504222	3359221	2B	516256	3361729
46B-1	502128	3359361	2C	516256	3361529
46B-2	502139	3359312	2D	516256	3361329
46B-3	502151	3359263	1A	515072	3361755
46B-4	502162	3359215	1B	515072	3361555
46B-5	502173	3359166	1C	515072	3361355
46B-6	502184	3359118	1D	515072	3361155
46B-7	502196	3359069			
46B-8	502207	3359020			
46B-9	502218	3358972			
46B-10	502229	3358923			
46B-11	502240	3358874			
46B-12	502252	3358826			
46B-13	502263	3358777			
47B-1	501236	3358937			
47B-2	501244	3358888			
47B-3	501253	3358839			
47B-4	501261	3358790			
47B-5	501269	3358740			
47B-6	501277	3358691			
47B-7	501286	3358642			
47B-8	501294	3358593			
48B-1	500237	3358923			
48B-2	500246	3358874			
48B-3	500255	3358824			
48B-4	500263	3358775			
48B-5	500272	3358726			
48B-6	500281	3358677			
48B-7	500289	3358628			
48B-8	500298	3358579			
48B-9	500306	3358529			
48B-10	500315	3358480			
48B-11	500324	3358431			
49B-1	499252	3358600			
49B-2	499262	3358551			
49B-3	499272	3358503			
49B-4	499282	3358454			
49B-5	499293	3358405			
49B-6	499303	3358356			
49B-7	499313	3358307			
49B-8	499324	3358258			
49B-9	499334	3358209			

Appendix C. Established remnant-dune transect coordinates (UTM) from East to West on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Back Barrier Scrub Dunes			Remnant Frontal Dunes		
Dune ID	X Coordinate	Y Coordinate	Dune ID	X Coordinate	Y Coordinate
23	507645	3360172	22	507728	3359462
26	507296	3360133	24	507290	3359462
38	504089	3359475	28	507128	3359462
41	502282	3359143	29	507069	3359462
42	502198	3359019	30	507012	3359462
43	502147	3359171	31	506553	3359462
44	502052	3359131	32	506447	3359462
45	502018	3359047	33	506425	3359462
46	501990	3359024	35	505557	3359462
47	501928	3359002	37	505250	3359462
21	501877	3359081	39	503460	3359462
18	501562	3358946	20	501675	3358862
17	500498	3358681	19	501559	3358863
5	500211	3358585	8	499727	3358380
7	500054	3358647	10	498832	3358252
6	499958	3358580			
9	499007	3358417			
11	498771	3358439			
13	498540	3358450			
12	498535	3358310			
15	498428	3358259			
16	498360	3358383			
14	498293	3358270			

Appendix D. Open canopy Pine Maritime coordinates (UTM) for density plots and cover transects on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Flatwoods ID	Density Plots				Cover Transects					
	100m ² Plot		4m ² Plot		"A"		"B"		"C"	
	X Coordinate	Y Coordinate	X Coordinate	Y Coordinate	X Coordinate	Y Coordinate	X Coordinate	Y Coordinate	X Coordinate	Y Coordinate
M1	507251	3360306	507251	3360306	507368	3360318	507303	3360316	507242	3360306
	507251	3360257	507251	3360262	507368	3360304	507303	3360306	507242	3360293
	507251	3360209	507298	3360262	507368	3360290	507303	3360283	507242	3360282
	507303	3360209	507298	3360306	507368	3360286	507303	3360260	507242	3360262
	507354	3360209					507303	3360237	507242	3360252
	507354	3360757					507303	3360209	507242	3360239
	507354	3360306					507303	3360182	507242	3360226
	507303	3360306					507303	3360161	507242	3360204
									507242	3360187
M2	501702	3359179	501702	3359179	501712	3359199	501681	3359179	- ^z	-
	501702	3359169	501702	3359177	501712	3359186	501681	3359164	-	-
	501712	3359169	501704	3359177	501712	3359179	501681	3359163	-	-
	501712	3359179	501704	3359179	501712	3359174	501681	3359155	-	-
	501670	3359164	501670	3359164	501712	3359169	501681	3359154	-	-
	501670	3359154	501670	3359162	501712	3359167	501681	3359152	-	-
	501681	3359154	501672	3359162	501712	3359157			-	-
	501681	3359164	501672	3359164	501712	3359150			-	-
^z No transect "C" in Flatwoods M2										

Appendix E. *Uniola paniculata* seedling transect coordinates (UTM) from East to West on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Narrows			Remnant		
Transect	X Coordinate	Y Coordinate	Transect	X Coordinate	Y Coordinate
1.1	506627	3359679	Rem 1	499746	335291
1.2	506699	3359694	Rem 3	498116	3357992
1.3	506777	3359714	Rem 5	501378	3358592
2.1	500875	3358495	Rem 6	497660	3357878
2.2	500915	3358503			
2.3	500959	3358512			
3.1	497620	3357877			
3.2	497655	3357885			
3.3	497721	3357903			

Appendix F. *Uniola paniculata* seedling transect coordinates (UTM) for overwash and remnant frontal dune sites on limited access areas (Okaloosa) and restricted access areas(Santa Rosa) of Eglin Air Force Base, Santa Rosa Island, Florida.

Transect	Access Limited		Transect	Access Restricted	
ID	X Coordinate	Y Coordinate	ID	X Coordinate	Y Coordinate
Overwash Sites					
1.2	543269	3362047	4.1	528159	3362572
1.3	543156	3362048	4.2	528104	3362578
2.1	542140	3362184	4.3	528073	3362628
2.2	542107	3362190	5.1	534211	3362830
2.3	542073	3362197	5.2	534165	3362835
3.1	541084	3362313	5.3	534110	3362834
3.2	541038	3362319	6.1	523764	3362251
3.3	540613	3362352	6.2	523721	3362243
			6.3	523684	3362239
			7.1	515342	3361204
			7.2	515280	3361200
			7.3	515213	3361189
Remnant Frontal Dune Sites					
1	543618	3361990	1	523588	3362233
1.1	543603	3362044	2	523823	3362256
2	542196	3362170	4	525128	3362379
2.1	542121	3362247	5	529591	3362655
3	540557	3362357	6	529797	3362666
			7	529961	3362669
			8	530677	3362708

Appendix G. General Field notes (estimation of plant density, dune observations, etc.) for the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Field notes:

Dune 26 general estimation for plant density per dune (i.e. #/0.8213 ha): *Quercus geminata* 325-400, *Chrysoma pauciflosculosa* 75-125, *Ceratiola ericoides* 150-175, *Smilax* spp. 25-50, *Magnolia grandiflora* 125-150, *Serenoa repens* 5-10bases / 50-60leaves.

Dune 41 general estimation for plant density per dune (i.e. #/0.3055ha): *Vitis rotundifolia* 175-200, *Toxicodendron radicans* 425-450, *Serenoa repens* 50-75bases / 500-750leaves, *Quercus geminata* 250-275, *Smilax* spp. 125-150, *Cratageous michauxii* 100-125, *Magnolia grandiflora* 50-75, *Pteridium aquilinum* 20-30, *Chrysoma pauciflosculosa* 175-200, *Ilex vomitoria* 75-100.

Dune 7 general estimation for plant density per dune (i.e. #/0.2253ha): *Chrysoma pauciflosculosa* 250-300, *Cratageous michauxii* 25-50, *Quercus geminata* 200-215, *Ilex vomitoria* 50-75, *Magnolia grandiflora* 250-300, *Ceratiola ericoides* 50-75, *Toxicodendron radicans* 50-75, *Polygonella polygama* 200-250.

Dune 6 is a large dune (0.4899ha), since transects run perpendicular to dune length, the front part of dune is not represented by transects. A large section of the dune on the bayside is still attached by a 10m wide and 5m high washout. Center of dune has an area where the top has collapsed and washed out. Dune has a large bowl shaped blow out in the center on the north side of dune. Dune has a drainage roughly in the center of the dune. West side of dune washed away. There is a vegetated bowl shaped blow out on the SW side of dune following the direction of the dune length. Found a NPS tag number on dune (#PPFiveB). General estimation for plant density per dune (i.e. #/0.4899ha): *Quercus geminata* 875-925, *Chrysoma pauciflosculosa* 650-700, *Polygonella polygama* 175-225, *Smilax* spp. 370-425, *Cratageous michauxii* 500-550, *Toxicodendron radicans* 125-150, *Ilex vomitoria* 775-825, *Serenoa repens* 350-400 leaves, *Vitis rotundifolia* 125-150, *Magnolia grandiflora* 425-475, *Quercus myrtifolia* 200-250, *Persea borbonia* 425-450, *Conradina canescens* 125-150, *Ceratiola ericoides* 675-725, *Opuntia humifusa* 150-175.

Dune 9 is a large dune and has two large bowl shaped blow outs (east and west sides), and one washout, roughly in the center of the dune, that runs through it (not completely washed out, still at least 2-3m tall). Part of the upper SW side of the dune has collapsed and washed away. The west side blow out, leads into a drainage. General estimation for plant density per dune (i.e. #/0.08024ha): *Serenoa repens* 55-75bases, *Chrysoma pauciflosculosa* 450-475, *Magnolia grandiflora* 100-150, *Persea borbonia* 150-200, *Ilex vomitoria* 300-375, *Quercus geminata* 150-200, *Polygonella polygama* 275-325, *Smilax* spp. 50-100, *Quercus myrtifolia* 25-50, *Ceratiola ericoides* 25-50, *Conradina canescens* 25-50, *Cratageous michauxii* 125-150, *Pteridium aquilinum* 50-75, *Vitis rotundifolia* 15-25, *Toxicodendron radicans* 75-125, *Myrica cerifera* 5-10, *Prunus caroliniana* 5-10.

Appendix G. Continued.

Dune 11 is now split into two dunes (East dune is 3m away from rest of dune). East dune is about 40m² in size and has a height of about 10m. The west dune is a still a medium size dune. General estimation for plant density per dune (i.e. #/ 0.2048ha): *Chrysoma pauciflosculosa* 50-75, *Ilex glabra* 50-75, *Quercus geminata* 50-75, *Serenoa repens* 10-15bases, *Ilex vomitoria* 50-75

On dune 44 between transect "B" and "C"; there is an "L" shaped washout. The "L" shape points toward transect "C". It is about 3m wide by 15m long (roughly about 20-30 unknown roots are visible).

Dune 30 has a crescent shaped washout (on southern side) depression (roughly 3.5m wide by 20m long). The tips of the crescent shape point are located on the east side of the dune. The crescent shape was filled in by 2011, not certain if it was natural or manmade. A piece of asphalt (road) was found half way up the dune on the gulf side of the dune. Dune is surrounded by road debris.

Dune 39 has a washout almost splitting the dune in two (roughly 1m deep by 1m wide). Wind fences (two rows) are located on the eastern side of the dune. The washout was filled in by 2011 (natural or manmade), and the drift fences were almost completely covered by 2011 (natural or manmade).

Dune 29 is almost split into two dunes (small front and large back). Top section of dune collapsed creating the small front and large back section. Dune almost completely surrounded by road debris.

Appendix H. General fruiting and flowering field notes for the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Gulf Island National Seashore Flowering & Fruiting Notes

Seed and Fruit information:

Species	Winter 08/09	Spring 09	Summer 09	Fall 09	Winter 09
<i>Quercus geminata</i>	trace (1-2) ^z	none	none	none	trace (1-2)
<i>Quercus myrtifolia</i>	none	none	none	none	trace (2-4)
<i>Ilex vomitoria</i>	trace (5)	none	none	none	trace (2-5)
<i>Chrysoma pauciflosculosa</i>	none	none	none	none	none
<i>Vitis rotundifolia</i>	trace (1-2)	none	none	none	none
<i>Smilax spp.</i>	trace (1-2)	none	none	none	none

^z Trace equals no more than 5 fruits/acorns on a plant.

Seed and Fruit information (continued):

Species	Winter 09	Spring 4/5/10	Summer 10	Fall 10	Winter 10
<i>Quercus geminata</i>	trace (1-2)	none			See data
<i>Quercus myrtifolia</i>	trace (2-4)	none			See data
<i>Ilex vomitoria</i>	trace (2-5)	none			See data
<i>Chrysoma pauciflosculosa</i>	none	flowering(1plant)			See data
<i>Vitis rotundifolia</i>	none	none			See data
<i>Smilax spp.</i>	none	none			See data

2008/2009 Notes:

Hydrocotyle bonariensis was fruiting on 12/18/08, *Quercus geminata* acorns (25 acorns per meter square) found on the ground under one plant on 12/17/08, *Smilax spp.* and *Ilex vomitoria* had trace amounts of fruits on 1/5/09.

April 5, 2010 Notes:

Information on Non-sampled Dunes (dunes without established transects) – Starting close to Western Entrance to the park (first large dunes);

Appendix H. Continued

<u>Species</u>	<u>Information</u>
<i>Quercus geminata</i>	No acorns, new leaf growth
<i>Chrysoma pauciflosculosa</i>	None flowering
<i>Smilax spp.</i>	No fruit, new leaf growth
<i>Magnolia grandiflora</i>	none flowering
<i>Ilex vomitoria</i>	Fruiting (5m x 10m patch size)
<i>Tradescantia hirsutiflora</i>	Flowering (6 plants)
<i>Conradina canescens</i>	Flowering (0.5m x 0.5m patch size)
<i>Vitis rotundifolia</i>	No Fruit, new leaf growth
<i>Toxicodendron radicans</i>	Fruiting (1-5 plants)

<u>Species</u>	<u>Information</u>
<i>Chrysoma pauciflosculosa</i>	Flowering (1 plant – only ¼ of plant with flowers)
<i>Ilex vomitoria</i>	Fruiting (10m x 10m patch), 25-50% of plants; 1 plant had 3 berries (1 red and 2 orangish red)
<i>Vitis rotundifolia</i>	No Fruit, new leaf growth
<i>Smilax spp.</i>	Possible fruit (1 vine with 25 clusters with 4 per cluster)
<i>Quercus geminata</i>	Catkins (10m x 10m patch)
<i>Tradescantia hirsutiflora</i>	Flowering (7 plants)
<i>Crataegus michauxii</i>	Flowering (5m x 10m patch, and 0.5m x 1m patch)

Information on Sampled Dunes (dunes with established transects) – Starting close to Western Entrance to the park (5 largest);

<u>Species</u>	<u>Information</u>
<i>Tradescantia hirsutiflora</i>	Flowering (2 plants)
<i>Ilex vomitoria</i>	Fruiting (0.5m x 1m patch, 5m x 5m patch, 10m x 15m patch), 25-50% of plants on dune with possible new fruit/flowers/leaves.
<i>Conradina canescens</i>	Flowering (1plant, 0.5m x 0.5m patch)
<i>Sideroxylon lanuginosum</i>	Flowering (5m x 5m patch)

<u>Species</u>	<u>Information</u>
<i>Tradescantia hirsutiflora</i>	Flowering (13 plants)
<i>Vitis rotundifolia</i>	No Fruit, new leaf growth (all muscadine leaves are out)
<i>Ilex vomitoria</i>	Flowering (0.5m x 0.5m patch), 75-95% of plants on dune with possible new fruit/flowers/leaves. . 1 plant had berries (red and orangish red, 50 total berries)
<i>Toxicodendron radicans</i>	Fruiting
<i>Quercus geminata</i>	New leaf growth, catkins (10m x 10m patch, 10m x 10m patch, 20m x 20 m patch) 25% -50% of plants with catkins. Found acorn caps (5caps per meter square) under one tree.

Appendix H. Continued.

<u>Species</u>	<u>Information</u>
<i>Magnolia grandiflora</i>	Flowering (aprox. 5-10 flowers in a 3m x 4m patch), new leaf growth
<i>Conradina canescens</i>	Flowering (0.5m x 0.5m patch)
<u>Species</u>	<u>Information</u>
<i>Tradescantia hirsutiflora</i>	Flowering (7 plants)
<i>Conradina canescens</i>	Flowering (60 total plants), 13 plants in a 20m x 20m patch, 12 plants/bundles in a 15m x 20m patch, 2 plants in a 20m x 10m patch, 26 plants in a 20m x 25m patch
<i>Quercus geminata</i>	New leaf growth, catkins (20m x 20 m patch) 50% -75% of plants with catkins.
<u>Species</u>	<u>Information</u>
<i>Ilex vomitoria</i>	Fruiting (10m x 15m patch, 1m x 2m patch)
<i>Quercus geminata</i>	New leaf growth, pollon racemes 50% -75% of plants with pollen racemes.
<i>Conradina canescens</i>	Flowering (3 total plants/bundles in a 2m x 3m
<i>Tradescantia hirsutiflora</i>	Flowering (7 plants)
<u>Species</u>	<u>Information</u>
<i>Crataegus michauxii</i>	Flowering (0.5m x 2m patch, 0.5m x 2m patch, 1m x 1m patch, 10m x 10m patch, 1.5m x 1.5m patch)
<i>Toxicodendron radicans</i>	Fruiting
<i>Quercus geminata</i>	New leaf growth, pollon racemes 50% -75% of plants with pollen racemes.
<i>Tradescantia hirsutiflora</i>	Flowering (8 plants)
<i>Conradina canescens</i>	Flowering (33 total plants/bundles), 15 plants/bundles in a 20m x 20m patch
<i>Cnidoscolus stimulosus</i>	Flowering (8 plants)

May 11, 2010 Notes:

Information on Sampled Dunes (dunes with established transects)

<u>Species</u>	<u>Information</u> (dune 43)
<i>Cnidoscolus stimulosus</i>	Flowering (90% of plants), (number class ² = 125-150)
<i>Oenothera humifusa</i>	Flowering (3% of plants)
<i>Vitis rotundifolia</i>	Flowering (60% of plants)
<i>Ilex vomitoria</i>	Flowering (5% of plants) or fruiting
<i>Serenoa repens</i>	Flowering (1% of plants)
<i>Tradescantia hirsutiflora</i>	Flowering (1% of plants), (number class = 25-50)

² Number class is a general estimate on the number of plants per dune.

Appendix H. Continued.

<u>Species</u>	<u>Information</u> (dune 42)
<i>Cnidoscolus stimulosus</i>	Flowering (80% of plants), (number class = 75-100)
<i>Vitis rotundifolia</i>	Flowering (95% of plants)
<i>Serenoa repens</i>	Flowering (3% of plants)
<i>Tradescantia hirsutiflora</i>	Flowering (1% of plants), (number class = 15-25)
<i>Smilax spp.</i>	Flowering (1% of plants)

<u>Species</u>	<u>Information</u> (dune 41)
<i>Cnidoscolus stimulosus</i>	Flowering (70% of plants), (number class = 75-100)
<i>Serenoa repens</i>	Flowering (3% of plants)
<i>Vitis rotundifolia</i>	Flowering (90% of plants)
<i>Smilax spp.</i>	Flowering (15% of plants)
<i>Oenothera humifusa</i>	Flowering (5% of plants)
<i>Toxicodendron radicans</i>	Fruiting (10% of plants)
<i>Tradescantia hirsutiflora</i>	Flowering (5% of plants), (number class = 25-50)
<i>Magnolia grandiflora</i>	Flowering (2% of plants)

<u>Species</u>	<u>Information</u> (dune 21)
<i>Tradescantia hirsutiflora</i>	Flowering (75% of plants), (number class = 25-50)
<i>Cnidoscolus stimulosus</i>	Flowering (90% of plants), (number class = 125-150)
<i>Magnolia grandiflora</i>	Flowering (5%-10% of plants)
<i>Smilax spp.</i>	Flowering (80% of plants)
<i>Persea borbonia</i>	Flowering (20% of plants)
<i>Quercus geminata</i>	Flowering (15% of plants)
<i>Serenoa repens</i>	Flowering (3% of plants)
<i>Cakile lanceolata</i>	Flowering (1% of plants)
<i>Asclepias humistrata</i>	Flowering (100% of plants), (number class = 1-5)
<i>Vitis rotundifolia</i>	Flowering (90% of plants)
<i>Hydrocotyle bonariensis</i>	Flowering (35% of plants), (number class = 75-100)

<u>Species</u>	<u>Information</u> (dune 7)
<i>Magnolia grandiflora</i>	Flowering (10% of plants)
<i>Cnidoscolus stimulosus</i>	Flowering (50% of plants), (number class = 125-150)
<i>Smilax spp.</i>	Flowering (10% of plants)
<i>Tradescantia hirsutiflora</i>	Flowering (20% of plants), (number class = 15-20)
<i>Vitis rotundifolia</i>	Flowering (80% of plants)
<i>Quercus geminata</i>	Flowering (40%-50% of plants)

<u>Species</u>	<u>Information</u> (dune 5)
<i>Magnolia grandiflora</i>	Flowering (10%-15% of plants)
<i>Hydrocotyle bonariensis</i>	Flowering (15% of plants), (number class = 75-100)
<i>Oenothera humifusa</i>	Flowering (5% of plants)
<i>Tradescantia hirsutiflora</i>	Flowering (95% of plants), (number class = 60-75)

Appendix H. Continued.

<u>Species</u>	<u>Information</u>
<i>Physalis angustifolia</i>	Flowering (20% of plants)
<i>Cnidoscolus stimulosus</i>	Flowering (90% of plants), (number class = 172-200)
<i>Asclepias humistrata</i>	Flowering (7 plants)
<i>Smilax spp.</i>	Flowering (90% of plants)
<i>Toxicodendron radicans</i>	Fruiting (15% of plants)
<i>Persea borbonia</i>	Flowering (80% of plants)

<u>Species</u>	<u>Information (dune 6)</u>
<i>Magnolia grandiflora</i>	Flowering (15% of plants)
<i>Tradescantia hirsutiflora</i>	Flowering (95% of plants), (number class = 125-150)
<i>Cnidoscolus stimulosus</i>	Flowering (90% of plants), (number class = 100-125)
<i>Asclepias humistrata</i>	Flowering (22 plants)
<i>Smilax spp.</i>	Flowering (50% of plants)
<i>Physalis angustifolia</i>	Flowering (50% of plants)
<i>Vitis rotundifolia</i>	Flowering (90% of plants)
<i>Juniperus virginiana</i>	Fruiting (95% of plants)

May 20, 2010 Notes:

Information on Sampled Dunes (dunes with established transects)

<u>Species</u>	<u>Information (dune 16)</u>
<i>Vitis rotundifolia</i>	Flowering (90% of plants)
<i>Hydrocotyle bonariensis</i>	Flowering (50% of plants), (number class = 175-200)
<i>Odontonychia corymbosa</i>	Flowering (100% of plants), (number class = 5-10)
<i>Tradescantia hirsutiflora</i>	Flowering (30% of plants), (number class = 75-100)
<i>Magnolia grandiflora</i>	Flowering (10% of plants)
<i>Oenothera humifusa</i>	Flowering (50% of plants), (number class = 5-10)

<u>Species</u>	<u>Information (dune 13)</u>
<i>Oenothera humifusa</i>	Flowering (60% of plants)
<i>Odontonychia corymbosa</i>	Flowering (90% of plants), (number class = 5-10)
<i>Cnidoscolus stimulosus</i>	Flowering (100% of plants), (number class = 5-10)
<i>Tradescantia hirsutiflora</i>	Flowering (50% of plants), (number class = 5-10)
<i>Magnolia grandiflora</i>	Flowering (1% of plants)
<i>Vitis rotundifolia</i>	Flowering (5% of plants)
<i>Physalis angustifolia</i>	Flowering (90% of plants), (number class = 5-10)

<u>Species</u>	<u>Information (dune 20)</u>
<i>Oenothera humifusa</i>	Flowering (30% of plants)

Appendix H. Continued.

<u>Species</u>	<u>Information</u> (dune 14)
<i>Tradescantia hirsutiflora</i>	Flowering (50% of plants), (number class = 125-150)
<i>Magnolia grandiflora</i>	Flowering (1% of plants)
<i>Oenothera humifusa</i>	Flowering (1% of plants),
<i>Vitis rotundifolia</i>	Flowering (95% of plants)
<i>Cakile lanceolata</i>	Flowering (1% of plants)
<i>Scleranthus annus</i>	Flowering (100% of plants), (number class = 1-5)
<i>Odontonychia corymbosa</i>	Flowering (100% of plants), (number class = 25-50)
<i>Spartina patens</i>	Flowering (40% of plants), (number class = 150-175)
<i>Hydrocotyle bonariensis</i>	Flowering (3% of plants), (number class = 200-250)
<i>Cnidoscolus stimulosus</i>	Flowering (50% of plants), (number class = 200-225)
<i>Smilax spp.</i>	Flowering (10% of plants)
<i>Asclepias humistrata</i>	Flowering (75% of plants), (number class = 5-10)
<i>Physalis angustifolia</i>	Flowering (1% of plants), (number class = 5-10)
<i>Quercus geminata</i>	30% of plants with catkins.

July 15, 2010 Notes:

Information on Sampled Dunes (dunes with established transects)

<u>Species</u>	<u>Information</u> (dune 5)
<i>Ipomoea stolonifera</i>	Flowering (50% of plants)
<i>Oenothera humifusa</i>	Flowering (30% of plants)
<i>Hydrocotyle bonariensis</i>	Flowering (1% of plants)
<i>Tradescantia hirsutiflora</i>	Flowering (2% of plants)
<i>Cnidoscolus stimulosus</i>	Flowering (50% of plants)
<i>Callicarpa Americana</i>	Flowering (60% of plants)
<i>Magnolia grandiflora</i>	Flowering (2% of plants)
<i>Vitis rotundifolia</i>	Fruiting (30% of plants)
<i>Odontonychia corymbosa</i>	Flowering (95% of plants), (number class = 200-225)
<i>Crataegus michauxii</i>	Flowering (10% of plants), Fruiting (5% of plants)
<i>Physalis angustifolia</i>	Flowering (75% of plants)
<i>Quercus geminata</i>	Fruiting (60% of plants)

Random dune 5 notes: *Quercus geminata* with acorns, and fruiting on SW side of dune.

Vitis rotundifolia fruit is green, *Physalis angustifolia* is fruiting. *Vitis rotundifolia* / *Quercus geminata* in small depression on top of dune is fruiting.

<u>Species</u>	<u>Information</u> (dune 7)
<i>Odontonychia corymbosa</i>	Flowering (1% of plants)
<i>Callicarpa americana</i>	Flowering (50% of plants)
<i>Cnidoscolus stimulosus</i>	Flowering (40% of plants)
<i>Quercus myrtifolia</i>	Fruiting (60% of plants)
<i>Crataegus michauxii</i>	Flowering (50% of plants)
<i>Magnolia grandiflora</i>	Flowering (1% of plants)

Appendix H. Continued.

Random dune 7 notes: *Quercus myrtifolia* with acorns, north side of transect "b" in bowl depression, mostly west side of dune.

<u>Species</u>	<u>Information</u> (dune 6)
<i>Vitis rotundifolia</i>	Fruiting (5% of plants), back bowl has fruit
<i>Odontonychia corymbosa</i>	Flowering (60% of plants)
<i>Cnidoscolus stimulosus</i>	Flowering (15% of plants)
<i>Tradescantia hirsutiflora</i>	Flowering (1% of plants)
<i>Crataegus michauxii</i>	Flowering (5% of plants), Fruiting (20% of plants)
<i>Quercus myrtifolia</i>	Fruiting (50% of plants), NE side of dune has acorns
<i>Magnolia grandiflora</i>	Flowering (1% of plants)
<i>Quercus geminata</i>	Fruiting (20% of plants), NW side of dune
<i>Oenothera humifusa</i>	Flowering (2% of plants)
<i>Smilax spp.</i>	Flowering (1% of plants)
<i>Callicarpa americana</i>	Flowering (70% of plants)
<i>Ilex vomitoria</i>	Fruiting (25% - 50% of plants)
<i>Physalis angustifolia</i>	Flowering (2% of plants)
<i>Hydrocotyle bonariensis</i>	Flowering (2% of plants)

Appendix I. Mean density (plant/m²) and maximum height (m) of each plant species present (2010) on incipient dunes (established frontal dunes before 2005) post hurricanes Opal and Ivan on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Species	Mean Dune				Dune 24				Dune 28			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cakile constricta</i>	0.0003	0	0.020	0	0	0	0	0	0.0013	0	0.020	0
<i>Chamaesyce bombensis</i>	0.0005	0	0.0117	0	0	0	0	0	0.0027	0	0.012	0
<i>Chrysoma pauciflosculosa</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Chrysopsis gossypina hyssopifolia</i>	0.0003	0	0.0003	0	0.0013	0	0.0003	0	0	0	0	0
<i>Cnidoscolus stimulosus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Conyza bonariensis</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cyperus spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dichanthelium aciculare</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Froelichia floridana</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hydrocotyle bonariensis</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ilex glabra</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea imperati</i>	0.0005	0	0.030	0	0.0027	0	0.030	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Odontonychia corymbosa</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Oenothera humifusa</i>	0.0013	0	0.008	0	0	0	0	0	0.0027	0	0.009	0
<i>Panicum amarum</i>	0.0087	0.0024	0.052	0.035	0.0027	0	0.095	0	0.0253	0.0093	0.23	0.05
<i>Physalis angustifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Polygonella polygama</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Quercus geminata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Scleranthus annus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Smilax spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Spartina patens</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Tradescantia hirsutiflora</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Uniola paniculata</i>	0.5210	^{-z}	0.183	-	0.3600	-	0.181	-	0.3213	-	0.2382	-
<i>Uniola paniculata</i> inflorescence	0	-	0	-	0	-	0	-	0	-	0	-
<i>Vitis rotundifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
^z Data not available												

Appendix I. Continued

Species	Dune 31				Dune 33				Dune 37			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cakile constricta</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Chamaesyce bombensis</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Chrysoma pauciflosculosa</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Chrysopsis gossypina hyssopifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cnidoscolus stimulosus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Conyza bonariensis</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cyperus spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dichanthelium aciculare</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Froelichia floridana</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hydrocotyle bonariensis</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ilex glabra</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea imperati</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Odontonychia corymbosa</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Oenothera humifusa</i>	0	0	0	0	0	0	0	0	0.0040	0	0.0067	0
<i>Panicum amarum</i>	0.003	0	0.07	0	0	0	0	0	0.012	0.003	0.030	0.020
<i>Physalis angustifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Polygonella polygama</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Quercus geminata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Scleranthus annuus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Smilax spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Spartina patens</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Tradescantia hirsutiflora</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Uniola paniculata</i>	1.052	-	0.146	-	0.6480	-	0.2014	-	0.2240	-	0.1467	-
<i>Uniola paniculata</i> inflorescence	0	-	0	-	0	-	0	-	0	-	0	-
<i>Vitis rotundifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0

Appendix J. Mean density (plant/m²) and maximum height (m) of each remaining established frontal dune post hurricanes Opal and Ivan on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Species	Mean Dune				Dune 22				Dune 29			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Baccharis halimifolia</i>	0.001	0	0.033	0	0	0	0	0	0.0093	0	0.0333	0
<i>Cakile constricta</i>	0.006	0.001	0.017	0.046	0	0	0	0	0	0	0	0
<i>Chamaesyce bombensis</i>	0.083	0.001	0.005	0	0.4067	0.0067	0.0100	0.0033	0.2360	0	0.008	0
<i>Chrysoma pauciflosculosa</i>	0.015	0	0.205	0	0	0	0	0	0	0	0	0
<i>Chrysopsis gossypina hyssopifolia</i>	0.040	0	0.033	0	0.1840	0	0.0588	0	0.1520	0	0.055	0
<i>Cnidioscolus stimulosus</i>	0.001	0	0.037	0	0.0120	0	0.0200	0	0	0	0	0
<i>Conyza bonariensis</i>	0.036	0	0.067	0	0.4000	0	0.0673	0	0	0	0	0
<i>Cyperus spp.</i>	0.002	0	0.033	0.033	0	0	0	0	0	0	0	0
<i>Dichanthelium aciculare</i>	0.001	0	0.030	0	0.0093	0	0.0300	0	0	0	0	0
<i>Froelichia floridana</i>	0.002	0	0.244	0	0	0	0	0	0.0040	0	0.230	0
<i>Heterotheca subaxillaris</i>	0.097	0.009	0.056	0.080	0.3373	0.0680	0.0320	0.1271	0.0600	0.0147	0.016	0.117
<i>Hydrocotyle bonariensis</i>	0.255	0.015	0.017	0	0	0	0	0	0	0	0	0
<i>Ilex glabra</i>	0.001	0	0.113	0	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i>	0.009	0	0.163	0	0	0	0	0	0	0	0	0
<i>Ipomoea imperati</i>	0.001	0	0.008	0	0	0	0	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	0.064	0.002	0.014	0	0.1427	0	0.0044	0	0.2640	0	0.003	0
<i>Ipomoea spp.</i>	0.029	0	0.037	0	0.3147	0	0.0367	0	0	0	0	0
<i>Iva imbricata</i>	0.006	0	0.092	0	0	0	0	0	0	0	0	0
<i>Odontonychia corymbosa</i>	0.001	0	0.020	0	0	0	0	0	0	0	0	0
<i>Oenothera humifusa</i>	0.104	0.010	0.036	0.023	0.0760	0	0.0367	0	0.1453	0	0.046	0
<i>Panicum amarum</i>	0.099	0.060	0.297	0.201	0.2027	0.0133	0.2917	0.0867	0.0120	0	0.122	0
<i>Physalis angustifolia</i>	0.029	0.001	0.023	0	0.0227	0	0.0242	0	0	0	0	0
<i>Polygonella polygama</i>	0.023	0.002	0.192	0.101	0.1133	0.0053	0.0867	0.0950	0	0	0	0
<i>Quercus geminata</i>	0.022	0.004	0.628	0.501	0.0147	0.0093	0.7641	0.6358	0	0	0	0
<i>Schizachyrium maritimum</i>	0.676	0.225	0.147	0.096	1.1253	0.0107	0.2413	0.0967	1.4160	0.0453	0.150	0.110
<i>Scleranthus annuus</i>	0.001	0	0.004	0	0.0080	0	0.0042	0	0	0	0	0
<i>Smilax spp.</i>	0.014	0.007	0.471	0.364	0.0933	0.0800	0.7112	1.0160	0	0	0	0
<i>Spartina patens</i>	0.005	0.002	0.074	0.046	0	0	0	0	0	0	0	0
<i>Tradescantia hirsutiflora</i>	0.000	0	0.028	0	0	0	0	0	0	0	0	0
<i>Uniola paniculata</i>	2.398	^z	0.287	-	2.4153	-	0.2410	-	3.9033	-	0.2260	-
<i>Uniola paniculata</i> inflorescence	0.253	-	0.648	-	0.0680	-	0.5411	-	0.2307	-	0.8110	-
<i>Vitis rotundifolia</i>	0.006	0	0.482	0	0.0680	0	0.4821	0	0	0	0	0
^z Data not available												

Appendix J. Continued.

Species	Dune 30				Dune 32				Dune 35			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cakile constricta</i>	0	0	0	0	0.0185	0	0.0152	0	0.0008	0	0.0048	0
<i>Chamaesyce bombensis</i>	0.0547	0	0.004	0	0.1973	0	0.0028	0	0	0	0	0
<i>Chrysoma pauciflosculosa</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Chrysopsis gossypina hyssopifolia</i>	0	0	0	0	0.0822	0	0.0293	0	0.0142	0	0.0213	0
<i>Cnidoscolus stimulosus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Conyza bonariensis</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cyperus spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dichanthelium aciculare</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Froelichia floridana</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0.0200	0.0040	0.028	0.0580	0.6233	0.0055	0.0476	0.0469	0.0040	0.0013	0.0050	0.0530
<i>Hydrocotyle bonariensis</i>	0	0	0	0	2.4174	0.1651	0.0261	0.0037	0.3847	0	0.0070	0
<i>Ilex glabra</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea imperati</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	0.0053	0	0.015	0	0.1486	0.0187	0.0340	0.0032	0.1213	0	0.0244	0
<i>Ipomoea spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Iva imbricata</i>	0.0680	0	0.17	0	0.0007	0	0.0144	0	0	0	0	0
<i>Odontonychia corymbosa</i>	0	0	0	0	0.0074	0.0006	0.0195	0.0027	0	0	0	0
<i>Oenothera humifusa</i>	0.0413	0	0.030	0	0.6791	0.1053	0.0639	0.0332	0.1017	0.0080	0.0504	0.0120
<i>Panicum amarum</i>	0.0320	0.0067	0.200	0.075	0.1043	0.1238	0.1598	0.2408	0.4713	0.4975	0.2734	0.4184
<i>Physalis angustifolia</i>	0	0	0	0	0.2925	0.0115	0.0557	0.0145	0.0042	0	0.0113	0
<i>Polygonella polygama</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Quercus geminata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	0.1627	0	0.113	0	2.6989	1.0549	0.1784	0.1125	1.4593	0.1273	0.0984	0.0851
<i>Scleranthus annuus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Smilax spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Spartina patens</i>	0	0	0	0	0.0036	0.0036	0.0527	0.0373	0.0483	0.0158	0.0950	0.0538
<i>Tradescantia hirsutiflora</i>	0	0	0	0	0.0024	0	0.0282	0	0	0	0	0
<i>Uniola paniculata</i>	3.2060	-	0.2260	-	3.2987	-	0.5831	-	3.4807	-	0.2462	-
<i>Uniola paniculata</i> inflorescence	0.0827	-	0.6660	-	0.4057	-	0.5972	-	0.1790	-	0.4837	-
<i>Vitis rotundifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0

Appendix J. Continued.

Species	Dune 39				Dune 20				Dune 19			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cakile constricta</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Chamaesyce bombensis</i>	0	0	0	0	0.0160	0	0.001	0	0	0	0	0
<i>Chrysoma pauciflosculosa</i>	0	0	0	0	0.1653	0	0.2050	0	0	0	0	0
<i>Chrysopsis gossypina hyssopifolia</i>	0	0	0	0	0.0067	0	0.035	0	0	0	0	0
<i>Cnidoscolus stimulosus</i>	0	0	0	0	0	0	0	0	0.0040	0	0.053	0
<i>Conyza bonariensis</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cyperus spp.</i>	0	0	0	0	0.0227	0.0027	0.033	0.033	0	0	0	0
<i>Dichanthelium aciculare</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Froelichia floridana</i>	0	0	0	0	0.0200	0	0.258	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0	0	0	0	0.0040	0	0.123	0	0.0080	0	0.178	0
<i>Hydrocotyle bonariensis</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ilex glabra</i>	0	0	0	0	0.0093	0	0.1133	0	0	0	0	0
<i>Ilex vomitoria</i>	0	0	0	0	0.0987	0	0.1633	0	0	0	0	0
<i>Ipomoea imperati</i>	0	0	0	0	0	0	0	0	0.0080	0	0.007	0
<i>Ipomoea pes-caprae</i>	0	0	0	0	0.0067	0	0.010	0	0.0067	0	0.010	0
<i>Ipomoea spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Odontonychia corymbosa</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Oenothera humifusa</i>	0	0	0	0	0.0853	0	0.016	0	0.0067	0	0.020	0
<i>Panicum amarum</i>	0.017	0.004	0.459	0.130	0.2240	0.0160	0.448	0.253	0.0040	0	0.153	0
<i>Physalis angustifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Polygonella polygama</i>	0	0	0	0	0.1373	0.0133	0.2967	0.1067	0	0	0	0
<i>Quercus geminata</i>	0	0	0	0	0.2320	0.0347	0.4917	0.3655	0	0	0	0
<i>Schizachyrium maritimum</i>	0	0	0	0	0.0413	0.0307	0.102	0.078	0.3160	1.2027	0.177	0.093
<i>Scleranthus annuus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Smilax spp.</i>	0	0	0	0	0.0640	0.0013	0.2317	0.0767	0	0	0	0
<i>Spartina patens</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Tradescantia hirsutiflora</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Uniola paniculata</i>	0.339	-	0.121	-	2.7287	-	0.3150	-	3.0133	-	0.2420	-
<i>Uniola paniculata</i> inflorescence	0	-	0	-	0.2267	-	0.7450	-	0.1907	-	0.6640	-
<i>Vitis rotundifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0

Appendix J. Continued.

Species	Dune 8				Dune 10			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0
<i>Cakile constricta</i>	0.0040	0	0.023	0	0.0347	0.0120	0.023	0.046
<i>Chamaesyce bombensis</i>	0	0	0	0	0.0040	0	0.001	0
<i>Chrysoma pauciflorescens</i>	0	0	0	0	0	0	0	0
<i>Chrysopsis gossypina hyssopifolia</i>	0	0	0	0	0	0	0	0
<i>Cnidioscolus stimulosus</i>	0	0	0	0	0	0	0	0
<i>Conyza bonariensis</i>	0	0	0	0	0	0	0	0
<i>Cyperus spp.</i>	0	0	0	0	0	0	0	0
<i>Dichanthelium aciculare</i>	0	0	0	0	0	0	0	0
<i>Froelichia floridana</i>	0	0	0	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0.0040	0	0.017	0	0	0	0	0
<i>Hydrocotyle bonariensis</i>	0	0	0	0	0	0	0	0
<i>Ilex glabra</i>	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i>	0	0	0	0	0	0	0	0
<i>Ipomoea imperati</i>	0.0013	0	0.008	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	0.0027	0	0.013	0	0	0	0	0
<i>Ipomoea spp.</i>	0	0	0	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0	0	0
<i>Odontonychia corymbosa</i>	0	0	0	0	0	0	0	0
<i>Oenothera humifusa</i>	0	0	0	0	0.0040	0	0.023	0
<i>Panicum amarum</i>	0	0	0	0	0.0227	0	0.570	0
<i>Physalis angustifolia</i>	0	0	0	0	0	0	0	0
<i>Polygonella polygama</i>	0	0	0	0	0	0	0	0
<i>Quercus geminata</i>	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	0.1920	0	0.117	0	0	0	0	0
<i>Scleranthus annuus</i>	0	0	0	0	0	0	0	0
<i>Smilax spp.</i>	0	0	0	0	0	0	0	0
<i>Spartina patens</i>	0	0	0	0	0	0	0	0
<i>Tradescantia hirsutiflora</i>	0	0	0	0	0	0	0	0
<i>Uniola paniculata</i>	1.7327	-	0.4580	-	1.9200	-	0.2090	-
<i>Uniola paniculata</i> inflorescence	0.8733	-	0.5790	-	0.2080	-	0.7480	-
<i>Vitis rotundifolia</i>	0	0	0	0	0	0	0	0

Appendix K. Mean density (plant/m²) and maximum height (m) of each remaining established scrub dune post hurricanes Opal and Ivan on the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Species	Dune Mean				Dune 23				Dune 26			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Asclepias humistrata</i>	0.003	0.0001	0.007	0.016	0	0	0	0	0	0	0	0
<i>Baccharis halimifolia</i>	0.001	0	0.626	0	0	0	0	0	0	0	0	0
<i>Balduina angustifolia</i>	0.692	0.0047	0.045	0.006	0	0	0	0	0	0	0	0
<i>Ceratiola ericoides</i>	0.134	0.0072	0.302	0.362	0	0	0	0	0	0	0	0
<i>Chamaesyce bombensis</i>	0.559	0.0001	0.011	0.00180	0.0178	0	0.001	0	0.3511	0.0022	0.008	0.003
<i>Chrysoma pauciflosculosa</i>	0.224	0.0159	0.315	0.430	0	0	0	0	0.1360	0.0200	0.16	0.22
<i>Chrysopsis gossypina hyssopifolia</i>	0.279	0.0095	0.088	0.029	0	0	0	0	0.0467	0	0.097	0
<i>Cnidoscolus stimulosus</i>	0.046	0	0.047	0	0	0	0	0	0.0489	0	0.073	0
<i>Conradina canescens</i>	0.033	0	0.247	0	0	0	0	0	0	0	0	0
<i>Crataegus michauxii</i>	0.031	0.0010	0.622	0.812	0	0	0	0	0	0	0	0
<i>Crotalaria rotundifolia</i>	0.005	0	0.021	0	0	0	0	0	0	0	0	0
<i>Cyperus spp.</i>	0.097	0.0100	0.048	0.020	0	0	0	0	0.0400	0.0022	0.093	0.060
<i>Dichanthelium aciculare</i>	0.034	0.0417	0.026	0.00130	0	0	0	0	0.0067	0	0.030	0
<i>Eupatorium capillifolium</i>	0.0001	0	0.154	0	0	0	0	0	0	0	0	0
<i>Froelichia floridana</i>	0.085	0.0014	0.076	0.00050	0	0	0	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0.230	0.0199	0.094	0.066	0.0278	0	0.137	0	0.8189	0.2678	0.044	0.099
<i>Hydrocotyle bonariensis</i>	0.125	0.0577	0.023	0.008	0	0	0	0	0.2722	0	0.017	0
<i>Ilex glabra</i>	0.005	0.0009	0.368	0.203	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i>	0.058	0.0026	0.795	0.685	0	0	0	0	0	0	0	0
<i>Ipomoea imperati</i>	0.006	0.0029	0.018	0.00243	0	0	0	0	0.0800	0.0544	0.017	0.003
<i>Ipomoea pes-caprae</i>	0.256	0.0060	0.027	0.002	0	0	0	0	0.0356	0	0.083	0
<i>Ipomoea spp.</i>	0.014	0	0.037	0	0	0	0	0	0	0	0	0
<i>Iva imbricata</i>	0.008	0	0.138	0	0	0	0	0	0	0	0	0
<i>Juncus roemerianus</i>	0.009	0.0046	0.318	0.192	0	0	0	0	0	0	0	0
<i>Juncus scirpoides</i>	0.074	0.0027	0.101	0.039	0	0	0	0	0	0	0	0
<i>Juniperus virginiana</i>	0.0001	0	2.223	0	0	0	0	0	0	0	0	0

Appendix K. Continued.

Species	Dune Mean				Dune 23				Dune 26			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Magnolia grandiflora</i>	0.058	0.0051	1.827	1.659	0	0	0	0	0	0.0040	0	0.22
<i>Odontonychia corymbosa</i>	0.076	0.0004	0.039	0.018	0.0122	0	0.020	0	0.0067	0	0.038	0
<i>Oenothera humifusa</i>	0.184	0.0163	0.056	0.030	0.0067	0.0056	0.052	0.001	0.3611	0.1444	0.052	0.056
<i>Opuntia humifusa</i>	0.003	0	0.053	0	0	0	0	0	0	0	0	0
<i>Panicum amarum</i>	0.450	0.3012	0.282	0.221	0.0122	0.0056	0.347	0.157	1.1467	1.3911	0.671	0.732
<i>Persea borbonia</i>	0.002	0.0000	0.764	0.890	0	0	0	0	0	0	0	0
<i>Physalis angustifolia</i>	0.059	0.0025	0.026	0.021	0	0	0	0	0.2900	0	0.059	0
<i>Pinus ellioti</i>	0.000	0.0019	0	0.598	0	0	0	0	0	0.0200	0	0.88
<i>Polygonella polygama</i>	0.086	0.0193	0.320	0.298	0	0	0	0	0.0120	0	0.07	0
<i>Pteridium aquilinum</i>	0.000	0.0063	0.139	1.175	0	0	0	0	0	0	0	0
<i>Quercus geminata</i>	0.146	0.0399	0.984	0.965	0	0	0	0	0.1040	0.0640	0.56	0.38
<i>Quercus myrtifolia</i>	0.047	0.0013	1.493	1.123	0	0	0	0	0	0	0	0
<i>Quercus nigra</i>	0.001	0	0.920	0	0	0	0	0	0	0	0	0
<i>Rhus copallinum</i>	0.002	0	0.801	0	0	0	0	0	0	0	0	0
<i>Rubus spp.</i>	0.007	0	0.080	0	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	4.602	1.7205	0.202	0.098	0.0467	0.0067	0.115	0.133	4.6444	2.1189	0.307	0.223
<i>Scleranthus annuus</i>	0.005	0	0.013	0	0	0	0	0	0	0	0	0
<i>Serenoa repens</i>	0.139	0.0007	0.913	0.220	0	0	0	0	0.0640	0	0.32	0
<i>Smilax spp.</i>	0.070	0.0260	0.705	0.692	0	0	0	0	0.0080	0.0080	0.10	0.07
<i>Spartina patens</i>	0.495	0.3111	0.170	0.156	0.0311	0.0067	0.197	0.063	1.2467	0.4722	0.450	0.318
<i>Strophostyles helvola</i>	0.001	0	0.076	0	0	0	0	0	0	0	0	0
<i>Toxicodendron radicans</i>	0.076	0.0021	0.400	0.1067000	0	0	0	0	0	0	0	0
<i>Tradescantia hirsutiflora</i>	0.028	0	0.055	0	0	0	0	0	0.1833	0	0.107	0
<i>Uniola paniculata</i>	2.011	- ^z	0.292	-	0.07593	-	0.14700	-	0.58806	-	0.25500	-
<i>Uniola paniculata inflorescence</i>	0.406	-	0.617	-	0.0022	-	0.280	-	0.04833	-	0.44300	-
<i>Vitis rotundifolia</i>	0.039	0	0.577	0	0	0	0	0	0.0200	0	0.18	0
Unknown woody	0.000	0.0042	0	0.205	0	0	0	0	0	0	0	0
^z Data not available												

Appendix K. Continued.

	Dune 38				Dune 41				Dune 42			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
Species	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Asclepias humistrata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Baccharis halimifolia</i>	0.0040	0	1.35	0	0	0	0	0	0	0	0	0
<i>Balduina angustifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ceratiola ericoides</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Chamaesyce bombensis</i>	0.4190	0	0.019	0	0.1219	0	0.0057	0	0	0	0	0
<i>Chrysoma pauciflosculosa</i>	0	0	0	0	0.3422	0.0333	0.36	0.24	0	0	0	0
<i>Chrysopsis gossypina hyssopifolia</i>	0	0	0	0	0.0947	0.0133	0.0633	0.0420	0	0	0	0
<i>Cnidioscolus stimulosus</i>	0	0	0	0	0	0	0	0	0.004	0	0.0267	0
<i>Conradina canescens</i>	0.0027	0	0.23	0	0	0	0	0	0	0	0	0
<i>Crataegus michauxii</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Crotalaria rotundifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cyperus spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dichanthelium aciculare</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Eupatorium capillifolium</i>	0	0	0	0	0.0033	0	0.1540	0	0	0	0	0
<i>Froelichia floridana</i>	0	0	0	0	0.0293	0	0.0524	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0.1490	0.0093	0.173	0.148	0.0710	0	0.0446	0	0	0	0	0
<i>Hydrocotyle bonariensis</i>	0.0665	0.0048	0.031	0.013	0.0591	0.0924	0.0064	0.0036	0	0	0	0
<i>Ilex glabra</i>	0.0013	0	0.06	0	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i>	0.1560	0.0240	0.07	0.43	0	0	0	0	0	0	0	0
<i>Ipomoea imperati</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	0	0	0	0	0.0120	0.0037	0.0030	0.0011	0	0	0	0
<i>Ipomoea spp.</i>	0	0	0	0	0.0200	0	0.0280	0	0	0	0	0
<i>Iva imbricata</i>	0.0010	0	0.007	0	0	0	0	0	0	0	0	0
<i>Juncus roemerianus</i>	0.2080	0.1107	0.318	0.192	0	0	0	0	0	0	0	0
<i>Juncus scirpoides</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Juniperus virginiana</i>	0	0	0	0	0	0	0	0	0	0	0	0

Appendix K. Continued.

Species	Dune 38				Dune 41				Dune 42			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Magnolia grandiflora</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Odontonychia corymbosa</i>	0	0	0	0	0.0270	0	0.0169	0	0	0	0	0
<i>Oenothera humifusa</i>	0.6455	0.0010	0.187	0.019	0.0296	0.0056	0.0411	0.0389	0	0	0	0
<i>Opuntia humifusa</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Panicum amarum</i>	0.0533	0.0124	0.149	0.041	0.5345	0.2446	0.2782	0.1405	0.909	0.547	0.3520	0.2900
<i>Persea borbonia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Physalis angustifolia</i>	0.0552	0	0.103	0	0.0015	0	0.0027	0	0	0	0	0
<i>Pinus ellioti</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Polygonella polygama</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Pteridium aquilinum</i>	0	0	0	0	0.0067	0	0.22	0	0	0	0	0
<i>Quercus geminata</i>	0.3120	0.1040	0.55	0.56	0.6178	0.1489	1.20	4.19	0	0	0	0
<i>Quercus myrtifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Quercus nigra</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rhus copallinum</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rubus spp.</i>	0.1680	0	0.08	0	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	0.6829	0.1109	0.222	0.062	1.6981	0.5796	0.2714	0.0923	0.531	0.200	0.0667	0.0500
<i>Scleranthus annuus</i>	0	0	0	0	0.0490	0	0.0149	0	0	0	0	0
<i>Serenoa repens</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Smilax spp.</i>	0.0480	0.0120	0.30	0.05	0.1156	0.0444	0.53	0.13	0.004	0	0.10	0
<i>Spartina patens</i>	0.0667	0.0389	0.462	0.272	0.0825	0	0.0810	0	1.416	0.501	0.3020	0.2108
<i>Strophostyles helvola</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Toxicodendron radicans</i>	0.0200	0	0.32	0	0.7644	0	0.40	0	0	0	0	0
<i>Tradescantia hirsutiflora</i>	0	0	0	0	0.0207	0	0.0154	0	0	0	0	0
<i>Uniola paniculata</i>	2.82210	-	0.324	-	0.27027	-	0.22910	-	0.85333	-	0.24830	-
<i>Uniola paniculata inflorescence</i>	0.17556	-	0.610	-	0.01936	-	0.24240	-	0.701	-	0.6989	-
<i>Vitis rotundifolia</i>	0	0	0	0	0.5978	0	1.50	0	0	0	0	0
Unknown woody	0	0	0	0	0	0	0	0	0	0	0	0

Appendix K. Continued.

Species	Dune 43				Dune 44				Dune 45			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Asclepias humistrata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Balduina angustifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ceratiola ericoides</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Chamaesyce bombensis</i>	0.0120	0	0.0020	0	0.417	0	0.018	0	0.0029	0	0.0029	0
<i>Chrysoma pauciflorescens</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Chrysopsis gossypina hyssopifolia</i>	0.0143	0	0.0500	0	0.318	0	0.179	0	0	0	0	0
<i>Cnidioscolus stimulosus</i>	0.0131	0	0.0534	0	0.033	0	0.062	0	0.0026	0	0.0056	0
<i>Conradina canescens</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Crataegus michauxii</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Crotalaria rotundifolia</i>	0.0027	0	0.0030	0	0	0	0	0	0	0	0	0
<i>Cyperus spp.</i>	0	0	0	0	0.238	0	0.029	0	0.0341	0	0.0452	0
<i>Dichanthelium aciculare</i>	0	0	0	0	0.005	0	0.010	0	0	0	0	0
<i>Eupatorium capillifolium</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Froelichia floridana</i>	0	0	0	0	0.038	0	0.049	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0.0103	0	0.0671	0	0.226	0	0.134	0	0	0	0	0
<i>Hydrocotyle bonariensis</i>	0.0667	0.0048	0.0443	0.0043	0.064	0	0.029	0	0	0	0	0
<i>Ilex glabra</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea imperati</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	0.0610	0	0.0400	0	0.020	0	0.027	0	0	0	0	0
<i>Ipomoea spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Juncus roemerianus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Juncus scirpoides</i>	0	0	0	0	0.002	0	0.020	0	0	0	0	0
<i>Juniperus virginiana</i>	0	0	0	0	0	0	0	0	0	0	0	0

Appendix K. Continued.

	Dune 43				Dune 44				Dune 45			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
Species	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Magnolia grandiflora</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Odontonychia corymbosa</i>	0.0192	0	0.0393	0	0.036	0	0.023	0	0.0010	0	0.0057	0
<i>Oenothera humifusa</i>	0.0236	0	0.0384	0	0.022	0	0.025	0	0.0238	0.0010	0.0100	0.0029
<i>Opuntia humifusa</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Panicum amarum</i>	0.7114	1.0070	0.4777	0.4146	0.503	0.609	0.320	0.241	0.9988	0.0734	0.3122	0.1043
<i>Persea borbonia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Physalis angustifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Pinus ellioti</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Polygonella polygama</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Pteridium aquilinum</i>	0	0.0033	0	2.03	0	0	0	0	0	0	0	0
<i>Quercus geminata</i>	0.0700	0.0267	0.50	0.92	0.0889	0.0033	0.225	0.052	0	0.0240	0	0.34
<i>Quercus myrtifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Quercus nigra</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rhus copallinum</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rubus spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	0.2552	0.2610	0.1171	0.0871	2.229	0.731	0.301	0.072	0.4070	0.0660	0.0932	0.0394
<i>Scleranthus annuus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Serenoa repens</i>	0.1067	0	0.54	0	0.1474	0.39	0.323	0.120	0	0	0	0
<i>Smilax spp.</i>	0.0300	0	0.13	0	0.03311	0.0080	0.221	0.128	0	0	0	0
<i>Spartina patens</i>	0	0	0	0	0.167	0	0.074	0	0.0889	0	0.0367	0
<i>Strophostyles helvola</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Toxicodendron radicans</i>	0	0	0	0	0.1222	0.0500	0.352	0.107	0	0	0	0
<i>Tradescantia hirsutiflora</i>	0	0	0	0	0.005	0	0.096	0	0	0	0	0
<i>Uniola paniculata</i>	0.43238	-	0.23270	-	1.60722	-	0.51300	-	1.60212	-	0.25350	-
<i>Uniola paniculata inflorescence</i>	0.09667	-	0.82940	-	0.72262	-	1.03900	-	0.7729	-	1.0894	-
<i>Vitis rotundifolia</i>	0.0567	0	0.23	0	0.0373	0	0.100	0	0	0	0	0
Unknown woody	0	0	0	0	0	0.0249	0	0.524	0	0	0	0

Appendix K. Continued.

Species	Dune 46				Dune 47				Dune 21			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Asclepias humistrata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Balduina angustifolia</i>	0	0	0	0	0	0	0	0	0.015	0	0.031	0
<i>Ceratiola ericoides</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Chamaesyce bombensis</i>	0	0	0	0	0.0089	0	0.0057	0	0.057	0	0.019	0
<i>Chrysoma pauciflosculosa</i>	0	0	0	0	0	0	0	0	0.0211	0	0.0667	0
<i>Chrysopsis gossypina hyssopifolia</i>	0	0	0	0	0	0	0	0	0.330	0.038	0.072	0.019
<i>Cnidoscolus stimulosus</i>	0.0040	0	0.061	0	0	0	0	0	0.048	0	0.067	0
<i>Conradina canescens</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Crataegus michauxii</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Crotalaria rotundifolia</i>	0	0	0	0	0.0500	0	0.0275	0	0	0	0	0
<i>Cyperus spp.</i>	0	0	0	0	0	0	0	0	0.093	0.051	0.022	0.019
<i>Dichanthelium aciculare</i>	0	0	0	0	0	0	0	0	0.005	0	0.027	0
<i>Eupatorium capillifolium</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Froelichia floridana</i>	0	0	0	0	0	0	0	0	0.222	0	0.158	0
<i>Heterotheca subaxillaris</i>	0	0	0	0	0	0	0	0	0.040	0	0.068	0
<i>Hydrocotyle bonariensis</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ilex glabra</i>	0	0	0	0	0	0	0	0	0.0027	0.0017	0.1640	0.1450
<i>Ilex vomitoria</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea imperati</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	0	0	0	0	0.0011	0	0.0033	0	0.164	0.052	0.025	0.003
<i>Ipomoea spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Juncus roemerianus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Juncus scirpoides</i>	0	0	0	0	0.1240	0	0.1600	0	0	0	0	0
<i>Juniperus virginiana</i>	0	0	0	0	0	0	0	0	0	0	0	0

Appendix K. Continued.

Species	Dune 46				Dune 47				Dune 21			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Magnolia grandiflora</i>	0	0	0	0	0	0	0	0	0.0867	0.0253	0.6500	0.8405
<i>Odontonychia corymbosa</i>	0.0080	0	0.065	0	0	0	0	0	0.056	0	0.031	0
<i>Oenothera humifusa</i>	0	0	0	0	0.0036	0.0011	0.0250	0.0183	0.029	0.002	0.027	0.018
<i>Opuntia humifusa</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Panicum amarum</i>	0.3053	0.3880	0.287	0.293	1.8587	0.5487	0.5260	0.6118	1.004	0.590	0.467	0.265
<i>Persea borbonia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Physalis angustifolia</i>	0.0040	0	0.013	0	0	0	0	0	0.015	0	0.033	0
<i>Pinus ellioti</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Polygonella polygama</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Pteridium aquilinum</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Quercus geminata</i>	0	0	0	0	0	0	0	0	0	0.0200	0	0.4488
<i>Quercus myrtifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Quercus nigra</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rhus copallinum</i>	0	0	0	0	0	0	0	0	0.0200	0	0.3000	0
<i>Rubus spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	0	0	0	0	0.0424	0.0011	0.0633	0.0233	2.504	1.217	0.309	0.148
<i>Scleranthus annuus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Serenoa repens</i>	0	0	0	0	0	0	0	0	0.4122	0	0.7766	0
<i>Smilax spp.</i>	0	0	0	0	0	0	0	0	0.0153	0	0.2487	0
<i>Spartina patens</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Strophostyles helvola</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Toxicodendron radicans</i>	0	0	0	0	0	0	0	0	0.2144	0	0.1754	0
<i>Tradescantia hirsutiflora</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Uniola paniculata</i>	1.20533	-	0.16200	-	0.41763	-	0.20070	-	1.20952	-	0.30800	-
<i>Uniola paniculata inflorescence</i>	0.2720	-	0.776	-	0.0080	-	0.2820	-	0.29973	-	0.68400	-
<i>Vitis rotundifolia</i>	0	0	0	0	0	0	0	0	0.03589	0	0.08875	0
Unknown woody	0	0	0	0	0	0	0	0	0	0.0289	0	0.3135

Appendix K. Continued.

Species	Dune 18				Dune 17				Dune 5			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Asclepias humistrata</i>	0	0	0	0	0	0	0	0	0.0613	0	0.0057	0
<i>Baccharis halimifolia</i>	0.0160	0	0.4572	0	0	0	0	0	0	0	0	0
<i>Balduina angustifolia</i>	0.2116	0	0.0449	0	0.1406	0	0.0497	0	15.7549	0	0.0697	0
<i>Ceratiola ericoides</i>	0	0	0	0	0.77	0	0.536	0	0	0	0	0
<i>Chamaesyce bombensis</i>	0.7667	0	0.0133	0	0.0915	0	0.0061	0	6.6270	0	0.0073	0
<i>Chrysoma pauciflosculosa</i>	0.5747	0	0.4173	0	0.61	0	0.339	0	1.1662	0.1242	0.45979	0.47167
<i>Chrysopsis gossypina hyssopifolia</i>	0.1979	0.0071	0.1334	0.0429	0.1026	0	0.1177	0	5.2294	0.1529	0.1673	0.0126
<i>Cnidioscolus stimulosus</i>	0.0608	0	0.0440	0	0.0210	0	0.0076	0	0.6010	0	0.0426	0
<i>Conradina canescens</i>	0.0960	0	0.2160	0	0.13	0	0.423	0	0.4686	0	0.36809	0
<i>Crataegus michauxii</i>	0.0560	0	0.3420	0	0.05	0	0.534	0	0.1266	0	0.69467	0
<i>Crotalaria rotundifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cyperus spp.</i>	0.0071	0	0.1043	0	0	0	0	0	1.1431	0.0333	0.0093	0.0030
<i>Dichanthelium aciculare</i>	0.0479	0	0.0298	0	0.0006	0	0.0036	0	0.2696	1.0000	0.0131	0.0013
<i>Eupatorium capillifolium</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Froelichia floridana</i>	0.0421	0	0.0322	0	0.0090	0	0.0689	0	1.6392	0.0333	0.0801	0.0005
<i>Heterotheca subaxillaris</i>	0.1851	0.0079	0.0902	0.0154	0.1246	0	0.0398	0	1.4005	0.0167	0.0568	0.0025
<i>Hydrocotyle bonariensis</i>	0.4574	0.0750	0.0117	0.0142	0	0	0	0	0	0	0	0
<i>Ilex glabra</i>	0.0933	0.0027	0.8159	0.3240	0.01	0	0.702	0	0	0	0	0
<i>Ilex vomitoria</i>	0.2973	0	0.7779	0	0.16	0	0.673	0	0.5587	0.0190	1.85053	0.66930
<i>Ipomoea imperati</i>	0.0028	0	0.0058	0	0	0	0	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	0.1510	0.0037	0.0206	0.0011	0.1316	0	0.0220	0	4.2980	0.0559	0.0151	0.0018
<i>Ipomoea spp.</i>	0.0405	0	0.0700	0	0	0	0	0	0.2225	0	0.0181	0
<i>Iva imbricata</i>	0	0	0	0	0.19	0	0.379	0	0	0	0	0
<i>Juncus roemerianus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Juncus scirpoides</i>	0.0500	0	0.0322	0	0	0	0	0	0	0	0	0
<i>Juniperus virginiana</i>	0	0	0	0	0	0	0	0	0.0015	0	2.22250	0

Appendix K. Continued.

Species	Dune 18				Dune 17				Dune 5			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Magnolia grandiflora</i>	0.3587	0.0253	1.2719	0.6975	0	0	0	0	0.4221	0.0203	2.65380	2.90432
<i>Odontonychia corymbosa</i>	0.0301	0	0.0299	0	0.0279	0	0.0491	0	0.9480	0	0.0468	0
<i>Oenothera humifusa</i>	0.3094	0.0046	0.0330	0.0067	0.0594	0.0147	0.0477	0.0147	1.5642	0.0755	0.0482	0.0087
<i>Opuntia humifusa</i>	0	0	0	0	0	0	0	0	0.0676	0	0.06500	0
<i>Panicum amarum</i>	0.1250	0.1542	0.2714	0.1510	0.1293	0.1150	0.0714	0.0788	0.0833	0	0.0665	0
<i>Persea borbonia</i>	0	0	0	0	0	0	0	0	0.0022	0	0.31000	0
<i>Physalis angustifolia</i>	0.0417	0	0.0107	0	0	0	0	0	0.3922	0.0588	0.0047	0.0012
<i>Pinus elliotti</i>	0	0	0	0	0	0.001	0	0.114	0	0	0	0
<i>Polygonella polygama</i>	0.14267	0.0520	0.20500	0.1280	0.04	0.004	0.515	0.317	1.2666	0.3444	0.59116	0.61500
<i>Pteridium aquilinum</i>	0.0013	0.1200	0.0580	0.1843	0	0	0	0	0	0	0	0
<i>Quercus geminata</i>	0.1693	0.0400	0.6530	0.0720	1.09	0.32	1.409	0.543	0.0818	0.0201	1.60677	2.63629
<i>Quercus myrtifolia</i>	0.6013	0.0160	0.7323	0.4351	0	0	0	0	0.2067	0.0148	1.41981	1.93350
<i>Quercus nigra</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rhus copallinum</i>	0.0120	0	0.3510	0	0	0	0	0	0.0059	0	1.75260	0
<i>Rubus spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	2.5935	2.2033	0.2776	0.1617	0.9856	0.2507	0.2627	0.0711	69.5471	23.9848	0.3134	0.0919
<i>Scleranthus annuus</i>	0.0048	0	0.0129	0	0	0	0	0	0.0333	0	0.0035	0
<i>Serenoa repens</i>	0.5480	0.0013	0.4373	0.1560	0.001	0	0.496	0	0.0052	0	1.93040	0
<i>Smilax spp.</i>	0.2040	0.0053	0.7547	0.3251	0.31	0.11	0.795	0.794	0.4556	0.3013	1.62294	1.71963
<i>Spartina patens</i>	0.1736	0	0.0725	0	0.0741	0.0741	0.0433	0.0456	0	0	0	0
<i>Strophostyles helvola</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Toxicodendron radicans</i>	0.1040	0	0.1540	0	0	0	0	0	0.5401	0	0.92025	0
<i>Tradescantia hirsutiflora</i>	0	0	0	0	0	0	0	0	0.4196	0	0.0163	0
<i>Uniola paniculata</i>	0.90089	-	0.32140	-	0.26544	-	0.20420	-	26.04571	-	0.35480	-
<i>Uniola paniculata inflorescence</i>	0.07593	-	0.43470	-	0.02672	-	0.20650	-	3.59436	-	0.65090	-
<i>Vitis rotundifolia</i>	0	0	0	0	0.01	0	0.111	0	0.0526	0	1.49515	0
Unknown woody	0	0.0067	0	0.0820	0	0.01	0	0.036	0	0	0	0

Appendix K. Continued.

	Dune 7				Dune 6				Dune 9			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
Species	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Asclepias humistrata</i>	0	0	0	0	0.0010	0.0021	0.0044	0.0163	0	0	0	0
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Balduina angustifolia</i>	0	0	0	0	0.2040	0.1121	0.0521	0.0064	0.0300	0	0.0193	0
<i>Ceratiola ericoides</i>	0.0440	0	0.21	0	0.134	0.001	0.4000	0.6200	0	0	0	0
<i>Chamaesyce bombensis</i>	0.0040	0	0.003	0	0.6281	0.0010	0.0120	0.0006	0.4108	0	0.0200	0
<i>Chrysoma pauciflorescens</i>	0.5160	0	0.32	0	0.773	0.070	0.47956	0.8710	0.047	0	0.239	0
<i>Chrysopsis gossypina hyssopifolia</i>	0.0693	0	0.046	0	0.1256	0.0047	0.1090	0.0157	0.0230	0	0.0756	0
<i>Cnidioscolus stimulosus</i>	0.0120	0	0.065	0	0.0113	0	0.0113	0	0.1191	0	0.0546	0
<i>Conradina canescens</i>	0	0	0	0	0.048	0	0.3383	0	0	0	0	0
<i>Crataegus michauxii</i>	0.0280	0	0.85	0	0.396	0.002	1.2219	1.23460	0	0.001	0	1.000
<i>Crotalaria rotundifolia</i>	0.0147	0	0.015	0	0	0	0	0	0.0281	0	0.0149	0
<i>Cyperus spp.</i>	0	0	0	0	0.0348	0.0180	0.0409	0.0077	0	0	0	0
<i>Dichanthelium aciculare</i>	0	0	0	0	0.0459	0	0.0338	0	0	0	0	0
<i>Eupatorium capillifolium</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Froelichia floridana</i>	0	0	0	0	0.0136	0	0.0250	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0.02767	0.0000	0.05900	0	0.7662	0.0462	0.1111	0.0832	0.0426	0	0.0417	0
<i>Hydrocotyle bonariensis</i>	0.1493	0.0320	0.042	0.010	0.3897	0.0763	0.0140	0.0048	0.2133	0.0894	0.0042	0.0008
<i>Ilex glabra</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i>	0.0080	0	0.45	0	0.176	0.020	1.6506	0.9550	0.003	0	0.990	0
<i>Ipomoea imperati</i>	0	0	0	0	0.0243	0	0.0139	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	0.3253	0	0.020	0	0.1718	0.0019	0.0264	0.0022	0.1986	0	0.0495	0
<i>Ipomoea spp.</i>	0	0	0	0	0.0288	0	0.0400	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Juncus roemerianus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Juncus scirpoides</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Juniperus virginiana</i>	0	0	0	0	0	0	0	0	0	0	0	0

Appendix K. Continued.

Species	Dune 7				Dune 6				Dune 9			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Magnolia grandiflora</i>	0.3360	0.0080	2.17	1.80	0.187	0.007	2.0151	2.0526	0.001	0	2.200	0
<i>Odontonychia corymbosa</i>	0.0240	0	0.027	0	0.0396	0	0.0088	0	0.0007	0	0.0200	0
<i>Oenothera humifusa</i>	0.0373	0	0.040	0	0.2573	0.0249	0.0386	0.0188	0.1172	0	0.0665	0
<i>Opuntia humifusa</i>	0	0	0	0	0.001	0	0.0800	0	0	0	0	0
<i>Panicum amarum</i>	0.0720	0.0707	0.140	0.110	0.0743	0.1544	0.0895	0.0871	0.3245	0.0563	0.1287	0.0726
<i>Persea borbonia</i>	0	0	0	0	0.04585	0.0004	1.56000	0.8900	0	0	0	0
<i>Physalis angustifolia</i>	0.0067	0	0.023	0	0.0093	0	0.0100	0	0.0114	0	0.0204	0
<i>Pinus ellioti</i>	0	0	0	0	0	0.002	0	0.6000	0	0.003	0	1.002
<i>Polygonella polygama</i>	0.3280	0.0080	0.45	0.29	0.073	0.023	0.3667	0.3300	0.108	0	0.415	0
<i>Pteridium aquilinum</i>	0	0	0	0	0	0.025	0	2.3050	0	0.002	0	0.180
<i>Quercus geminata</i>	0.1360	0.0160	1.29	0.58	0.161	0.006	1.0533	0.7833	0.058	0.001	1.597	1.200
<i>Quercus myrtifolia</i>	0.1480	0	1.70	0	0.050	0	2.1867	0	0	0	0	0
<i>Quercus nigra</i>	0.0040	0	0.16	0	0.009	0	1.6800	0	0	0	0	0
<i>Rhus copallinum</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rubus spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	2.2827	0.8000	0.113	0.072	1.5993	0.6064	0.2203	0.0343	3.5009	1.3865	0.1710	0.1199
<i>Scleranthus annuus</i>	0	0	0	0	0.0074	0	0.0111	0	0	0	0	0
<i>Serenoa repens</i>	0.3467	0	1.22	0	0.383	0.008	1.1362	0.4025	0	0.001	0	0.260
<i>Smilax spp.</i>	0.1280	0.0280	2.01	0.25	0.117	0.040	1.0963	1.8699	0.019	0.009	0.383	0.462
<i>Spartina patens</i>	0	0	0	0	0	0	0	0	0.3719	0	0.0896	0
<i>Strophostyles helvola</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Toxicodendron radicans</i>	0.0200	0	0.40	0	0.039	0	0.6200	0	0	0	0	0
<i>Tradescantia hirsutiflora</i>	0	0	0	0	0.0509	0	0.0203	0	0	0	0	0
<i>Uniola paniculata</i>	1.24400	-	0.32700	-	1.17647	-	0.33450	0	1.84923	-	0.30940	-
<i>Uniola paniculata inflorescence</i>	0.20533	-	1.09700	-	0.09865	-	0.69660	0	0.35976	-	0.85980	-
<i>Vitis rotundifolia</i>	0.0480	0	1.13	0	0.053	0	0.7646	0	0	0	0	0
Unknown woody	0	0.0040	0	0.04	0	0.0004	0	0.1000	0	0.001	0	0.300

Appendix K. Continued.

Species	Dune 11				Dune 13				Dune 12			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Asclepias humistrata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Balduina angustifolia</i>	0.0033	0	0.023	0	0.0067	0	0.0550	0	0.0107	0	0.038	0
<i>Ceratiola ericoides</i>	0.103	0	0.07000	0	1.568	0.138	0.4450	0.3750	0	0	0	0
<i>Chamaesyce bombensis</i>	0.9611	0	0.011	0	0.6858	0	0.0131	0	0.9600	0	0.017	0
<i>Chrysoma pauciflosculosa</i>	0	0	0	0	0.336	0	0.6650	0	0	0.08	0	0.630
<i>Chrysopsis gossypina hyssopifolia</i>	0	0	0	0	0.0813	0	0.1095	0	0	0	0	0
<i>Cnidioscolus stimulosus</i>	0.0756	0	0.132	0	0.0343	0	0.0683	0	0.0107	0	0.017	0
<i>Conradina canescens</i>	0	0	0	0	0.017	0	0.1000	0	0	0	0	0
<i>Crataegus michauxii</i>	0	0	0	0	0.004	0	0.2300	0	0.01	0	0.880	0
<i>Crotalaria rotundifolia</i>	0.0056	0	0.020	0	0.0117	0	0.0460	0	0	0	0	0
<i>Cyperus spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dichanthelium aciculare</i>	0	0	0	0	0.2198	0	0.0688	0	0.1933	0	0.030	0
<i>Eupatorium capillifolium</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Froelichia floridana</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Heterotheca subaxillaris</i>	0.1056	0.0222	0.051	0.070	0.3224	0.0200	0.1806	0.0418	0.6067	0.0213	0.176	0.054
<i>Hydrocotyle bonariensis</i>	0.1344	0.0300	0.018	0.008	0.0144	0	0.0100	0	0.1067	0.0320	0.030	0.007
<i>Ilex glabra</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ilex vomitoria</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea imperati</i>	0.0122	0.0133	0.020	0.003	0.0083	0	0.0475	0	0	0	0	0
<i>Ipomoea pes-caprae</i>	0.0333		0.018	0	0.2372	0	0.0468	0	0.0093	0	0.023	0
<i>Ipomoea spp.</i>	0	0	0	0	0.0220	0	0.0273	0	0	0	0	0
<i>Iva imbricata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Juncus roemerianus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Juncus scirpoides</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Juniperus virginiana</i>	0	0	0	0	0	0	0	0	0	0	0	0

Appendix K. Continued.

Species	Dune 11				Dune 13				Dune 12			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Magnolia grandiflora</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Odontonychia corymbosa</i>	0.0144	0	0.040	0	0.0927	0.0017	0.0978	0.0225	0.0227	0	0.046	0
<i>Oenothera humifusa</i>	0.1933	0.0033	0.132	0.013	0.2568	0.0107	0.0781	0.0138	0.2320	0.0307	0.125	0.100
<i>Opuntia humifusa</i>	0	0	0	0	0.0067	0	0.0150	0	0	0	0	0
<i>Panicum amarum</i>	0.3333	0.2222	0.243	0.183	0.0256	0.0256	0.1033	0.0567	0.0907	0.0387	0.222	0.102
<i>Persea borbonia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Physalis angustifolia</i>	0.4589	0	0.022	0	0.02500	0.0133	0.02750	0.0400	0.0040	0	0.040	0
<i>Pinus elliotti</i>	0	0	0	0	0	0	0	0	0	0.02	0	0.942
<i>Polygonella polygama</i>	0	0	0	0	0.003	0	0.3300	0	0	0	0	0
<i>Pteridium aquilinum</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Quercus geminata</i>	0	0.045	0	1.72000	0.299	0.032	3.0941	0.7517	0.01	0.04	0.970	1.427
<i>Quercus myrtifolia</i>	0	0	0	0	0.133	0.001	1.4242	1.0000	0	0	0	0
<i>Quercus nigra</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rhus copallinum</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rubus spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	0.9478	0.5400	0.161	0.093	7.4879	1.8076	0.3447	0.1684	2.4880	1.6760	0.224	0.131
<i>Scleranthus annuus</i>	0	0	0	0	0.0253	0	0.0080	0	0	0	0	0
<i>Serenoa repens</i>	0.462	0.006	1.28111	0.30250	0.859	0.001	1.5833	0.0800	0	0	0	0
<i>Smilax spp.</i>	0.012	0	1.22000	0	0.054	0	1.8277	0	0.05	0.05	0.927	2.464
<i>Spartina patens</i>	0	0	0	0	0	0	0	0	4.7080	4.7533	0.229	0.157
<i>Strophostyles helvola</i>	0	0	0	0	0.0236	0	0.0760	0	0	0	0	0
<i>Toxicodendron radicans</i>	0	0	0	0	0.005	0	0.2600	0	0	0	0	0
<i>Tradescantia hirsutiflora</i>	0	0	0	0	0.0013	0	0.0740	0	0	0	0	0
<i>Uniola paniculata</i>	0.89481	-	0.35600	-	0.9239	-	0.2808	-	0.55467	-	0.46900	-
<i>Uniola paniculata inflorescence</i>	0.1556	-	0.103	-	0.02856	-	0.38620	-	0.4187	-	1.080	-
<i>Vitis rotundifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
Unknown woody	0	0.008	0	0.07500	0	0	0	0	0	0.02	0	0.490

Appendix K. Continued.

Species	Dune 15				Dune 16				Dune 14			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Asclepias humistrata</i>	0	0	0	0	0	0	0	0	0.001	0	0.01	0
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0.0004	0	0.070	0
<i>Balduina angustifolia</i>	0	0	0	0	0.1316	0	0.0586	0	0.09	0	0.05	0
<i>Ceratiola ericoides</i>	0	0	0	0	0.6040	0.0347	0.15	0.09	0	0	0	0
<i>Chamaesyce bombensis</i>	0.0364	0	0.0085	0	0.3402	0	0.0136	0	0.50	0	0.02	0
<i>Chrysoma pauciflosculosa</i>	0	0	0	0	0.8320	0.0560	0.17	0.15	0.0246	0	0.099	0
<i>Chrysopsis gossypina hyssopifolia</i>	0.0013	0	0.0100	0	0.0022	0	0.0333	0	0.07	0.01	0.05	0.04
<i>Cnidoscopus stimulosus</i>	0	0	0	0	0	0	0	0	0.0004	0	0.0013	0
<i>Conradina canescens</i>	0	0	0	0	0.0267	0	0.23	0	0.0013	0	0.072	0
<i>Crataegus michauxii</i>	0	0	0	0	0.0653	0.0213	0.22	0.20	0	0	0	0
<i>Crotalaria rotundifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cyperus spp.</i>	0	0	0	0	0.0844	0.0033	0.0325	0.0017	0.66	0.13	0.05	0.03
<i>Dichanthelium aciculare</i>	0	0	0	0	0.0033	0	0.0233	0	0.02	0	0.02	0
<i>Eupatorium capillifolium</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Froelichia floridana</i>	0	0	0	0	0	0	0	0	0.05	0	0.15	0
<i>Heterotheca subaxillaris</i>	0.0078	0	0.0096	0	0.2676	0.0091	0.1342	0.0743	0.32	0.03	0.17	0.08
<i>Hydrocotyle bonariensis</i>	0	0	0	0	0.6942	0.6793	0.0510	0.0194	0.31	0.27	0.02	0.003
<i>Ilex glabra</i>	0	0	0	0	0.0107	0.0173	0.10	0.14	0	0	0	0
<i>Ilex vomitoria</i>	0	0	0	0	0.0093	0	0.33	0	0.0317	0	0.367	0
<i>Ipomoea imperati</i>	0	0	0	0	0	0	0	0	0.01	0.001	0.004	0.0013
<i>Ipomoea pes-caprae</i>	0.0322	0.0017	0.0075	0.0025	0.0544	0	0.0225	0	0.20	0.02	0.01	0.002
<i>Ipomoea spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Iva imbricata</i>	0.0010	0	0.0329	0	0	0	0	0	0.0008	0	0.133	0
<i>Juncus roemerianus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Juncus scirpoides</i>	0	0	0	0	1.2222	0	0.2167	0	0.37	0.07	0.077	0.039
<i>Juniperus virginiana</i>	0	0	0	0	0	0	0	0	0	0	0	0

Appendix K. Continued.

Species	Dune 15				Dune 16				Dune 14			
	Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)		Plant/m ²		Max ht (m)	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
<i>Magnolia grandiflora</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Odontonychia corymbosa</i>	0.0027	0	0.0244	0	0.0602	0	0.0981	0	0.40	0.01	0.06	0.01
<i>Oenothera humifusa</i>	0.0132	0.0067	0.0049	0.0086	0.0798	0.0373	0.0603	0.1380	0.15	0.02	0.05	0.03
<i>Opuntia humifusa</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Panicum amarum</i>	0.1623	0.0511	0.1340	0.1083	0.6220	0.4222	0.3533	0.3750	0.38	0.21	0.48	0.25
<i>Persea borbonia</i>	0	0	0	0	0	0	0	0	0.0063	0	0.423	0
<i>Physalis angustifolia</i>	0.0650	0	0.0238	0	0.0187	0	0.0209	0	0.01	0	0.01	0
<i>Pinus elliotii</i>	0	0	0	0	0	0	0	0	0	0.0004	0	0.050
<i>Polygonella polygama</i>	0	0	0	0	0.0907	0.0307	0.13	0.11	0.0008	0	0.123	0
<i>Pteridium aquilinum</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Quercus geminata</i>	0.0520	0	0.18	0	0.2520	0.0467	0.58	0.57	0.0021	0.0008	0.277	0.197
<i>Quercus myrtifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Quercus nigra</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rhus copallinum</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rubus spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Schizachyrium maritimum</i>	0.1426	0.0695	0.0512	0.0256	2.1956	1.6133	0.1731	0.1210	3.62	1.05	0.26	0.13
<i>Scleranthus annuus</i>	0	0	0	0	0.0033	0	0.0267	0	0	0	0	0
<i>Serenoa repens</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Smilax spp.</i>	0	0	0	0	0.0293	0.0107	0.25	0.17	0.0250	0	0.173	0
<i>Spartina patens</i>	0	0	0	0	1.9124	0.5147	0.1852	0.0980	1.24	0.94	0.15	0.08
<i>Strophostyles helvola</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Toxicodendron radicans</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Tradescantia hirsutiflora</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Uniola paniculata</i>	0.97065	-	0.25850	-	0.93422	-	0.34830	-	1.18	-	0.2887	-
<i>Uniola paniculata inflorescence</i>	0.8527	-	0.4596	-	0.2013	-	0.7482	-	0.19	-	0.4874	-
<i>Vitis rotundifolia</i>	0	0	0	0	0	0	0	0	0.0250	0	0.168	0
Unknown woody	0	0	0	0	0	0.0013	0	0.09	0	0	0	0

Appendix L. *Uniola paniculata* seedling density (seedling/m²) July 17-30, 1997 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites on limited access areas (Okaloosa County) and restricted areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.

Distance From Gulf (m)	Overwash Areas									Frontal Dune Remnants								
	Access Limited				Access Restricted				Total Mean (n=6)	Access Limited				Access Restricted				Total Mean (n=6)
	Transect ID				Transect ID					Transect ID				Transect ID				
	1 (n=4)	2 (n=4)	3 (n=4)	Mean (n=3)	4 (n=4)	5 (n=4)	6 (n=4)	Mean (n=3)		1 (n=4)	2 (n=4)	3 (n=4)	Mean (n=3)	4 (n=4)	5 (n=4)	6 (n=4)	Mean (n=3)	
0-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-25	0	0	0	0	0.02	0	0	0.01	0.003	0	0	0	0	0	0	0	0	0
25-30	0	0.03	0	0.01	0.05	0	0	0.02	0.01	0	0.01	0	0.002	0	0	0.02	0.005	0.003
30-35	0	0.07	0	0.02	0.13	0.01	0.01	0.05	0.03	0.03	0	0.19	0.07	0.04	0	0	0.01	0.04
35-40	0.09	0.44	0.01	0.18	0.01	0.02	0.02	0.01	0.10	0.01	0.07	0.94	0.34	0.07	0	0.06	0.04	0.19
40-45	0	0.12	0.23	0.11	0	0.05	0.14	0.06	0.09	0.02	0.31	0.29	0.20	0.01	0	0.02	0.01	0.11
45-50	0.02	0.20	0.08	0.10	0.01	0.01	0.02	0.01	0.05	0.07	0.17	0.12	0.12	0.05	0.14	0.01	0.06	0.09
50-55	0.13	0.04	0	0.06	0	0.01	0.06	0.02	0.04	0.16	0.08	0.03	0.09	0.13	0.06	0	0.06	0.07
55-60	0.12	0.07	0	0.06	0	0.06	0.01	0.02	0.04	0.04	0	0	0.01	0.01	0	0.03	0.01	0.01
60-65	0.24	0.44	0	0.23	0	0	0.07	0.02	0.12	0.01	0	0	0.003	0.01	0	0.05	0.02	0.01
65-70	0.04	0.31	0.01	0.12	0.01	0	0.01	0	0.06	0	0	0	0	0	0	0.01	0.002	0.001
70-75	0	0.02	0	0.01	0.02	0	0.01	0.01	0.01	0	0	0	0	0	0	0.04	0.01	0.01
75-80	0	0.03	0	0.01	0	0	0	0	0.004	0	0	0	0	0	0	0.04	0.01	0.01
80-85	0	0.17	0	0.06	0.01	0	0	0	0.03	0	0	0	0	0	0	0	0	0
South to North Mean/line	0.04	0.11	0.02	0.056	0.01	0.01	0.02	0.014	0.035	0.02	0.04	0.09	0.049	0.02	0.01	0.01	0.014	0.032

Appendix M. *Uniola paniculata* seedling density (seedling/m²) June 18-25, 1998 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites on limited access areas (Okaloosa County) and restricted areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.

Distance From Gulf (m)	Overwash Areas									Frontal Dune Remnants								
	Access Limited				Access Restricted				Total Mean (n=6)	Access Limited				Access Restricted				Total Mean (n=6)
	Transect ID				Transect ID					Transect ID				Transect ID				
	1 (n=2)	2 (n=1)	3 (n=2)	Mean (n=3)	4 (n=2)	5 (n=2)	6 (n=2)	Mean (n=3)		1 (n=4)	2 (n=4)	3 (n=4)	Mean (n=3)	4 (n=4)	5 (n=4)	6 (n=4)	Mean (n=3)	
0-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-20	0	0	0	0	0.02	0	0	0.01	0.003	0	0	0	0	0	0	0	0	0
20-25	0	0	0	0	0	0	0	0	0	0	0.01	0	0.002	0	0	0	0	0.001
25-30	0	0.12	0	0.04	0	0	0	0	0.02	0	0.05	0	0.02	0	0	0	0	0.01
30-35	0	0	0	0	0	0.01	0	0.003	0.002	0.05	0.17	0	0.07	0	0	0	0	0.04
35-40	0.01	0	0	0.003	0.08	0.01	0.01	0.03	0.02	0	0.19	0	0.06	0.08	0	0.01	0.03	0.05
40-45	0.02	0	0	0.01	0	0.06	0	0.02	0.01	0.39	0	0	0.13	0.39	0	0.08	0.16	0.14
45-50	0.10	0	0	0.03	0.00	0.45	0.01	0.15	0.09	0.03	0.02	0	0.02	0.20	0	1.27	0.49	0.25
50-55	0.03	0	0	0.01	0.00	0.14	0	0.05	0.03	0.11	0	0	0.04	1.00	0.02	0.72	0.58	0.31
55-60	0.01	0	0	0.003	0.01	0.04	0.02	0.02	0.01	0.08	0.01	0	0.03	0.02	0	0.01	0.01	0.02
60-65	0.05	0	0	0.02	0.01	0.03	0.01	0.02	0.02	0.04	0	0	0.01	0.00	0.04	0	0.01	0.01
65-70	0.18	0	0	0.06	0.03	0.01	0	0.01	0.04	0.01	0	0	0.003	0.03	0.10	0.07	0.07	0.04
70-75	0	0.06	0	0.02	0.09	0	0	0.03	0.03	0	0	0	0	0	0	0.15	0.05	0.03
75-80	0	0	0	0	0	0	0	0	0	0.06	0	0	0.02	0	0	0.06	0.02	0.02
80-85	0	0	0	0	0	0	0.02	0.01	0.003	0	0	0	0	0	0	0	0	0
South to North Mean/line	0.02	0.01	0	0.011	0.01	0.04	0.004	0.021	0.016	0.05	0.03	0	0.024	0.10	0.01	0.14	0.083	0.054

Appendix N. *Uniola paniculata* seedling density (seedling/m²) July 27, 1999 through October 1,1999 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites on limited access areas (Okaloosa County) and restricted areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.

Distance From Gulf (m)	Overwash Areas									Frontal Dune Remnants								
	Access Limited				Access Restricted				Total Mean (n=6)	Access Limited				Access Restricted				Total Mean (n=6)
	Transect ID				Transect ID					Transect ID				Transect ID				
	1 (n=2)	2 (n=1)	3 (n=2)	Mean (n=3)	4 (n=2)	5 (n=2)	6 (n=2)	Mean (n=3)		1 (n=4)	2 (n=4)	3 (n=4)	Mean (n=3)	4 (n=4)	5 (n=4)	6 (n=4)	Mean (n=3)	
0-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-15	0	0	0	0	0	0	0	0	0	0	0.03	0	0.01	0.01	0	0	0.003	0.01
15-20	0.07	0.02	0	0.03	0	0.04	0	0.01	0.02	0.05	0.27	0	0.11	0.10	0.02	0.02	0.05	0.08
20-25	0.15	0.34	0.14	0.21	0.03	0.22	0.01	0.09	0.15	0.15	0.50	0.01	0.22	0	0	0	0	0.11
25-30	0.02	0.14	0.20	0.12	0.04	0.17	0.01	0.07	0.10	0.11	0	0.07	0.06	0	0.12	0	0.04	0.05
30-35	0.02	0	0	0.01	0.08	0	0.11	0.06	0.04	0.06	0.05	0	0.04	0.01	0	0	0.003	0.02
35-40	0.01	0.02	0	0.01	0.24	0	0	0.08	0.05	0.04	0.11	0.01	0.05	0	0.05	0	0.02	0.04
40-45	0.15	0.02	0.02	0.06	0	0	0.01	0.00	0.03	0.13	0.00	0.17	0.10	0.01	0.48	0	0.16	0.13
45-50	0.12	0	0	0.04	0.01	0.01	0	0.01	0.02	0	0	0.05	0.02	0.02	0.02	0	0.01	0.02
50-55	0.02	0	0.22	0.08	0.07	0.01	0.04	0.04	0.06	0	0	0.18	0.06	0.04	0.01	0	0.02	0.04
55-60	0.03	0	0.02	0.02	0	0	0.01	0.003	0.01	0	0	0.26	0.09	0	0	0.01	0.003	0.05
60-65	0	0	0.06	0.02	0.10	0	0.03	0.04	0.03	0	0	0.09	0.03	0.06	0	0.04	0.03	0.03
65-70	0	0	0.10	0.03	0.09	0	0.03	0.04	0.04	0	0	0	0	0	0	0	0	0
70-75	0	0.10	0	0.03	0	0	0	0	0.02	0	0	0	0	0	0	0	0	0
75-80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80-85	0	0.02	0	0.01	0	0	0	0	0.003	0	0	0	0	0	0	0	0	0
South to North Mean/line	0.035	0.039	0.045	0.039	0.039	0.026	0.015	0.027	0.033	0.032	0.056	0.049	0.046	0.015	0.041	0.004	0.020	0.033

Appendix O. *Uniola paniculata* seedling density (seedling/m²) August 24-30, 2000 by 5m intervals, south to north (distance from gulf) for overwash areas and Frontal Dune remnant sites on limited access areas (Okaloosa County) and restricted areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.

Distance From Gulf (m)	Overwash Areas								Frontal Dune Remnants
	Access Limited				Restricted Access			Total Mean (n=5)	Access Limited
	Transect ID				Transect ID				Transect ID
	1 (n=2)	2 (n=4)	3 (n=4)	Mean (n=3)	4 (n=4)	5 (n=4)	Mean (n=2)		1 (n=2)
0-5	0	0	0.03	0.01	0.01	0.01	0.01	0.01	0.01
5-10	0.02	0.02	0.02	0.02	0.03	0.01	0.02	0.02	0.04
10-15	0.03	0.06	0.01	0.03	0.16	0.10	0.13	0.08	0.05
15-20	0	0	0.03	0.01	0.14	0	0.07	0.04	0.05
20-25	0.03	0.04	0.03	0.03	0.01	0.03	0.02	0.03	0.05
25-30	0.02	0.05	0	0.02	0.04	0.10	0.07	0.04	0.05
30-35	0.01	0.08	0	0.03	0.11	0.03	0.07	0.05	0.03
35-40	0.01	0.04	0.06	0.03	0.03	0.01	0.02	0.03	0
40-45	0.08	0.02	0.14	0.08	0.03	0.01	0.02	0.05	0.04
45-50	0.01	0.01	0.02	0.01	0.02	0	0.01	0.01	0.05
50-55	0	0.02	0.01	0.01	0	0.02	0.01	0.01	0.08
55-60	0	0.01	0.01	0.003	0.03	0.04	0.03	0.02	0.03
60-65	0.05	0.01	0.03	0.03	0	0.05	0.03	0.03	0.03
65-70	0.04	0.05	0.06	0.05	0.02	0.05	0.03	0.04	0
70-75	0	0.04	0.06	0.03	0.03	0	0.01	0.02	0.01
75-80	0	0.01	0.05	0.02	0.05	0	0.02	0.02	0
80-85	0	0	0	0	0.01	0	0.003	0.001	0
South to North Mean/line	0.02	0.02	0.03	0.024	0.04	0.03	0.033	0.028	0.03

Appendix P. *Uniola paniculata* seedling density
 (seedling/m²) July 9-17, 2007 by 5m intervals, south to north
 (distance from gulf) for overwash areas and frontal dune
 remnant sites in the Santa Rosa Unit of Gulf Island National
 Seashore, Santa Rosa Island, Florida.

Distance	Overwash	Frontal Dune	East to West
From	Areas	Remnants	Mean per
Gulf (m)	(n=1)	(n=1)	Segment (m ²)
0-5	0	0	0
5-10	0.02	0	0.01
10-15	0.10	0.10	0.10
15-20	0.04	0.10	0.07
20-25	0.02	0.68	0.35
25-30	0	0.04	0.02
30-35	0	0	0
35-40	0.04	0	0.02
40-45	0.16	0	0.08
45-50	0.02	0	0.01
50-55	0.02	0	0.01
55-60	0.14	0.04	0.09
60-65	0.04	0	0.02
65-70	0.08	0	0.04
70-75	0.02	0	0.01
75-80	0	0	0
80-85	0	0	0
85-90	0	0	0
90-95	0	0	0
95-100	0	0	0
South to North			
Mean/line	0.04	0.05	0.04

Appendix Q. *Uniola paniculata* seedling density (seedling/m²) June 24, 2008 through July 30, 2008 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa, Florida.

Distance From Gulf (m)	Overwash Areas				Frontal Dune Remnants			
	Transect ID ^z			Mean (n=3)	Transect ID ^z			Mean (n=3)
	1	2.2 ^y	3.2 ^y		2	3 ^y	4	
0-5	0	0	0	0	0	0	0	0
5-10	0.10	0	0	0.033	0	0.08	0	0.027
10-15	0.58	0.02	0.08	0.227	0	1.22	0.14	0.453
15-20	5.92	0.16	0.10	2.060	0	0.94	1.32	0.753
20-25	1.54	1.16	4.54	2.413	0	0	1.98	0.660
25-30	0.68	3.26	3.46	2.467	0	0	2.32	0.773
30-35	0.66	0.52	0.78	0.653	0	0.02	0.58	0.200
35-40	0.16	0.18	0	0.113	0	0.08	0.12	0.067
40-45	0	0.10	0	0.033	0	0.04	0	0.013
45-50	0	0	0	0	0	0.10	0.08	0.060
50-55	0	0	0	0	0	0.40	0.14	0.180
55-60	0	0	0	0	0.12	0.14	0.12	0.127
60-65	0	0	0	0	0.10	1.46	0.58	0.713
65-70	0	0	0.02	0.007	0.04	0.70	0.40	0.380
70-75	0	0	0	0	0.02	0.04	0.16	0.073
75-80	0	0	0	0	0	0	0	0
80-85	0	0	0	0	0.04	0	0	0.013
85-90	0	0	0	0	0	0	0	0
90-95	0	0.26	0	0.087	0.02	0	0	0.007
95-100	0	0.78	0	0.26	0	0	0	0
South to North Mean/line	0.482	0.322	0.449	0.41767	0.017	0.261	0.397	0.225

^z Transect ID is not consistent from year to year

^y Transects 2.2, 3.2 and Remnant 3 are the same for years 2009 and 2010

Appendix R. *Uniola paniculata* seedling density (seedling/m²) July 01, 2008 through August 6, 2008 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal duneremnant sites on limited access areas (Okaloosa County) and restricted access areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.

Distance From Gulf (m)	Overwash Areas									Frontal Dune Remnants										
	Access Limited				Access Restricted				Total Mean	Access Limited				Access Restricted				Total Mean		
	Transect ID				Transect ID					Transect ID				Transect ID						
	1 (n=3)	2 (n=4)	3 (n=2)	Mean (n=3)	4 (n=3)	5 (n=5)	6 (n=1)	Mean (n=3)		1 (n=2)	2 (n=1)	3 (n=1)	4 (n=1)	Mean (n=4)	5 (n=1)	6 (n=1)	7 (n=1)		8 (n=1)	Mean (n=4)
0-5	0	0.01	0	0.00	0	0	0	0.00	0.002	0	0	0	0	0	0	0	0	0	0	0
5-10	0.01	0.02	0	0.01	0.01	0	0	0.00	0.01	0	0	0	0	0	0	0.06	0.02	0.06	0.04	0.02
10-15	0.01	0.05	0	0.02	0.04	0	0.02	0.02	0.02	0.03	0.14	0.36	0	0.13	0.16	0.26	0.08	0.42	0.23	0.18
15-20	0.11	0	0.04	0.05	0.21	0.20	0.14	0.18	0.11	0.03	0.10	0.64	0	0.19	0.24	0.82	0.26	0.06	0.35	0.27
20-25	0.30	0.56	0.12	0.33	0.60	0.99	0.14	0.58	0.45	0.07	0.06	0.12	0	0.06	0.28	0.32	0.42	0.02	0.26	0.16
25-30	1.11	0.17	0.02	0.43	0.61	0.19	0.54	0.45	0.44	0.35	0.02	0	0.56	0.23	0.32	0.32	1.76	0.02	0.61	0.42
30-35	1.14	0	0.06	0.40	0.01	0.06	0.02	0.03	0.22	0.15	0	0.10	0.64	0.22	0.32	0.50	2.86	0.12	0.95	0.59
35-40	0.37	0.01	0.14	0.17	0.06	0.05	0	0.04	0.10	0.23	0	0	0	0.06	1.48	1.50	2.30	0.32	1.40	0.73
40-45	0.13	0	0.19	0.11	0.21	0.12	0	0.11	0.11	0.04	0	0	0	0.01	1.38	0.88	4.30	0.62	1.80	0.90
45-50	0.05	0	0.22	0.09	0.51	0	0	0.17	0.13	0.02	0	0	0.04	0.02	0.30	0.10	3.78	1.70	1.47	0.74
50-55	0.05	0	0.07	0.04	0.67	0.01	0	0.23	0.13	0.02	0	0	0	0.01	0.04	0.04	2.46	0.50	0.76	0.38
55-60	0.01	0	0.06	0.02	0.39	0.01	0	0.13	0.08	0	0	0	0	0	0.06	0.02	0.92	0.14	0.29	0.14
60-65	0.03	0	0.07	0.03	0.19	0	0	0.06	0.05	0	0	0	0.60	0.15	1.92	0	0.28	0.42	0.66	0.40
65-70	0.03	0	0.18	0.07	0.06	0.01	0	0.02	0.05	0	0.16	0	1.00	0.29	1.86	0	0.12	0.14	0.53	0.41
70-75	0	0.02	0.08	0.03	0.07	0	0	0.02	0.03	0	0	0	0	0	8.20	0	0	0.24	2.11	1.06
75-80	0.01	0.04	0	0.02	0.02	0	0	0.01	0.01	0	0.02	0	0	0.01	0.46	0	0	0.18	0.16	0.08
80-85	0	0.07	0.28	0.12	0.08	0	0	0.03	0.072	0.03	0.02	0	0	0.01	0	0	0	0	0	0.01
South to North Mean/line	0.20	0.06	0.09	0.114	0.22	0.10	0.05	0.122	0.118	0.06	0.03	0.07	0.17	0.082	1.00	0.284	1.151	0.292	0.682	0.382

Appendix S. *Uniola paniculata* seedling density (seedling/m²) August 18, 2009 through September 09, 2009 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites on limited access areas (Okaloosa County) and restricted access areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.

Distance From Gulf (m)	Overwash Areas										Frontal Dune Remnants													
	Access Limited					Access Restricted					Access Limited				Access Restricted								Total Mean	
	Transect ID				Mean	Transect ID				Mean	Transect ID				Mean	Transect ID								
	1 (n=2)	2 (n=4)	3 (n=3)	Mean (n=3)		4 (n=3)	5 (n=3)	6 (n=3)	7 (n=3)		Mean (n=4)	1 (n=2)	2 (n=1)	3 (n=1)		Mean (n=3)	1 (n=1)	2 (n=1)	4 (n=1)	5 (n=1)	6 (n=1)	7 (n=1)		8 (n=1)
0-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-10	0	0	0.01	0.004	0.01	0	0	0.02	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-15	0	0	0	0	0.09	0	0.01	0.26	0.09	0.05	0	0	0	0	0.10	0	0	0	0	0	0.04	0.02	0.01	0
15-20	0	0	0.03	0.01	0.07	0	0.14	0.74	0.24	0.12	0	0.02	0	0.01	0	0	0	0.10	0	0.40	0.22	0.10	0.05	0
20-25	0	0	0.04	0.01	0.37	0	0.02	0.28	0.17	0.09	0	0.08	0.12	0.07	0	0	0.18	0.02	0	1.28	0.16	0.23	0.15	0
25-30	0.49	0	0.24	0.24	0	0.38	0.03	0	0.10	0.17	0	0.16	0.56	0.24	0	0	0	0.32	0.08	0.04	0.44	0.13	0.18	0
30-35	0.65	0.01	0.17	0.28	0	1.08	0	0	0.27	0.27	0.02	0.26	0.16	0.15	0	0	0	0	0.04	0.02	0	0.01	0.08	0
35-40	0.28	0.13	0.13	0.18	0	0.91	0	0	0.23	0.20	0.03	0.08	0	0.04	0	0	0	0	0	0	0	0	0.02	0
40-45	0	0.20	0.18	0.13	0	0.83	0	0	0.21	0.17	0.01	0	0	0.003	0	0	0	0	0	0.08	0.06	0.02	0.01	0
45-50	0	0.11	0.10	0.07	0.01	0.03	0	0	0.01	0.04	0	0	0	0	0	0	0	0	0.02	0	0.16	0.03	0.01	0
50-55	0	0.03	0	0.01	0.01	0.00	0	0	0.002	0.01	0	0	0	0	0	0	0	0	0	0	0.22	0.03	0.02	0
55-60	0	0.01	0	0.003	0.10	0.01	0.01	0	0.03	0.02	0	0	0	0	0	0	0	0	0.04	0.14	0.06	0.03	0.02	0
60-65	0.01	0.02	0	0.01	0.05	0.01	0.01	0	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0.02	0.003	0.001	0
65-70	0	0.02	0	0.005	0.08	0.01	0	0	0.02	0.01	0	0	0	0	0	0.02	0	0	0	0.22	0.20	0.06	0.03	0
70-75	0	0	0	0	0.03	0.04	0	0.06	0.03	0.02	0	0	0	0	0	0.08	0	0	0	0.24	0.28	0.09	0.04	0
75-80	0	0	0	0	0.01	0.07	0	0.03	0.03	0.01	0	0.02	0	0.01	0.24	0.06	0	0	0	0	0.06	0.05	0.03	0
80-85	0	0	0.01	0.002	0.03	0.09	0.01	0.04	0.04	0.02	0	0.04	0	0.01	0	0.04	0	0	0	0	0	0.01	0.01	0
85-90	0	0.01	0	0.003	0.04	0.11	0.01	0.07	0.06	0.03	0	0.02	0	0.01	0	0.12	0	0	0	0	0	0.02	0.01	0
90-95	0	0.04	0.03	0.02	0.03	0.09	0.01	0.01	0.04	0.03	0	0	0	0	0	0.02	0	0	0	0	0	0.003	0.001	0
95-100	0	0.02	0.04	0.02	0.13	0.06	0.16	0.08	0.11	0.06	0	0	0	0	0	0	0	0	0	0.02	0	0.003	0.001	0
South to North Mean/line	0.07	0.03	0.05	0.050	0.05	0.19	0.02	0.08	0.085	0.067	0.003	0.03	0.04	0.026	0.02	0.02	0.01	0.02	0.01	0.12	0.10	0.042	0.034	0

Appendix T. *Uniola paniculata* seedling density (seedling/m²) November 24, 2009 through December 1, 2009 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites on limited access areas (Okaloosa County) and restricted access areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.

Distance From Gulf (m)	Overwash Areas										Frontal Dune Remnants												
	Access Limited				Access Restricted						Access Limited				Access Restricted								Total Mean (n=10)
	Transect ID				Transect ID					Transect ID				Transect ID									
	1 (n=2)	2 (n=4)	3 (n=3)	Mean (n=3)	4 (n=3)	5 (n=3)	6 (n=3)	7 (n=3)	Mean (n=4)	Total Mean (n=7)	1 (n=2)	2 (n=1)	3 (n=1)	Mean (n=3)	1 (n=1)	2 (n=1)	4 (n=1)	5 (n=1)	6 (n=1)	7 (n=1)	8 (n=1)	Mean (n=7)	
0-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-15	0	0	0	0	0	0	0	0.03	0.01	0.003	0	0	0	0	0	0	0	0	0	0	0	0	0
15-20	0	0	0	0	0	0	0.03	0.63	0.17	0.08	0	0	0	0	0	0	0	0	0	0	0	0	0
20-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.44	0.06	0.03	
25-30	0.01	0	0.03	0.01	0	0.01	0.01	0.01	0.01	0.01	0.01	0	0	0.003	0	0	0	0	0	0	0.20	0.03	0.02
30-35	0.18	0	0.01	0.06	0	0.36	0	0.01	0.09	0.06	0	0	0	0	0	0	0	0.02	0	0	0.02	0.01	0.00
35-40	0.31	0	0.02	0.11	0	0.13	0	0	0.03	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0
40-45	0	0.05	0.07	0.04	0.01	0.07	0	0	0.02	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0
45-50	0	0.01	0.00	0.003	0.01	0	0	0	0.002	0.002	0	0	0	0	0	0	0	0	0	0	0.06	0.01	0.00
50-55	0	0	0.01	0.004	0.02	0.01	0	0	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0.10	0.01	0.01
55-60	0	0	0	0	0.01	0	0	0	0.003	0.002	0	0	0	0	0	0	0.02	0.02	0.04	0	0.02	0.01	0.01
60-65	0	0	0	0	0	0	0.01	0	0.003	0.002	0	0	0	0	0	0.02	0	0	0	0	0.04	0.01	0.004
65-70	0	0.02	0	0.01	0	0.01	0	0	0.002	0.004	0	0	0	0	0	0.02	0.04	0.14	0	0	0.16	0.05	0.03
70-75	0	0	0	0	0.01	0.03	0	0.01	0.01	0.01	0	0	0	0	0	0	0.02	0	0	0	0.14	0.02	0.01
75-80	0	0	0	0	0.01	0.03	0	0.04	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0
80-85	0	0	0	0	0.01	0	0.01	0	0.003	0.002	0	0	0	0	0	0	0	0	0	0	0	0	0
85-90	0	0	0.01	0.004	0.01	0.03	0	0.04	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0
90-95	0	0.01	0.05	0.02	0.01	0.03	0	0.01	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0
95-100	0	0.01	0.03	0.01	0	0.03	0	0.05	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0
South to North Mean/line	0.03	0.005	0.01	0.014	0.01	0.04	0.003	0.04	0.022	0.015	0.001	0	0	0.0002	0	0.002	0.004	0.01	0.002	0	0.06	0.011	0.006

Appendix U. *Uniola paniculata* seedling survival (%), August 2009 to November 2009, by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites on limited access areas (Okaloosa County) and restricted access areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.

Distance From Gulf (m)	Overwash Areas										Total Mean	Frontal Dune Remnants												Total Mean
	Access Limited				Access Restricted							Access Limited				Access Restricted								
	Transect ID				Transect ID							Transect ID				Transect ID								
	1 (n=4)	2 (n=5)	3 (n=4)	Mean (n=3)	4 (n=3)	5 (n=3)	6 (n=3)	7 (n=3)	Mean (n=4)	1 (n=2)		2 (n=1)	3 (n=1)	Mean (n=3)	1 (n=1)	2 (n=1)	4 (n=1)	5 (n=1)	6 (n=1)	7 (n=1)	8 (n=1)	Mean (n=7)		
0-5																								
5-10			0	0	0			0	0	0														
10-15					0		0	10	3	3				0							0	0	0	0
15-20			0	0	0		24	86	36	18		0		0			0		0		0	0	0	0
20-25			0	0	0		0	0	0	0		0	0	0		0	0		0	100	25	13	13	
25-30	2		8	5		2	25		13	9		0	0	0			0	0	0	45	11	6	6	
30-35	28	0	3	10		33			33	22	0	0	0	0				0	0		0	0	0	
35-40	100 ^z	0	12	37		15			15	26	0	0		0									0	
40-45		26	31	28		8			8	18	0			0					0	0	0	0	0	
45-50		10	0	5	100	0			50	27								0		38	19	19	19	
50-55		0		0	100				100	50										45	45	45	45	
55-60		0		0	13	0	0		4	2								100	0	33	44	44	44	
60-65	0	0		0	0	0	100		33	17										100	100	100	100	
65-70		100		100	0	50			25	63					100				0	80	60	60	60	
70-75					40	67		11	39	39					0				0	50	17	17	17	
75-80					100	50		100	83	83		0		0	0	0				0	0	0	0	
80-85			0	0	25	0	50	0	19	9		0		0		0					0	0	0	
85-90		0		0	17	25	0	60	25	13		0		0		0					0	0	0	
90-95		29	100	64	40	31	0	100	43	53					0						0	0	0	
95-100		33	50	42	0	56	0	58	28	35									0		0	0	0	
South to North Mean/line	32	18	19	23	29	24	20	43	29	26	0	0	0	0	0	17	0	0	25	0	41	19	9	
^z when survival is 100% recruitment possible after July see appendix Z																								

Appendix V. *Uniola paniculata* seedling survival (%) (data collected in August 2009 and November 2009) by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Distance From Gulf (m)	Overwash Areas													Frontal Dune Remnants				
	Transect ID			Mean (n=3)	Transect ID			Mean (n=3)	Transect ID			Mean (n=3)	Total Mean (n=3)	Transect ID				Mean (n=4)
	1-1	1-2	1-3		2-1	2-2	2-3		3-1	3-2	3-3			1	3	5	6	
0-5																		
5-10																		
10-15							0	0	0			0	0					
15-20							0	0	0			0	0		0			0
20-25	100 ^z	100		100		0	31	15	0			0	38	0				0
25-30	0	0		0		0		0		26	0	13	4	0		0		0
30-35	0			0	0			0		0		0	0	0		0	0	0
35-40	0			0	0	0		0					0				0	0
40-45	0			0	0			0					0					
45-50	0			0									0					
50-55		17	0	8	0			0					4		0			0
55-60		0		0									0		19			19
60-65	0	0	0	0									0	0	0			0
65-70	0		0	0									0	0	0			0
70-75	33	0	0	11		0		0					6	0				0
75-80	0	27		14							0	0	7					
80-85														100	100			100
85-90			0	0									0					
90-95	0	0	0	0									0	0	0			0
95-100	0			0			0	0					0	0	0	0		0
South to North Mean/line	11	18	0	10	0	0	8	3	0	13	0	4	6	11	15	0	0	9
^z when survival is 100% recruitment possible after August see appendix Y																		

Appendix W. *Uniola paniculata* seedling density (seedling/m²) November 23-24, 2009 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

	Overwash Areas													Frontal Dune Remnants				
Distance													Total	Transect ID				Mean
From	Transect ID			Mean	Transect ID			Mean	Transect ID			Mean	Mean					
Gulf (m)	1-1	1-2	1-3	(n=3)	2-1	2-2	2-3	(n=3)	3-1	3-2	3-3	(n=3)	(n=3)	1	3	5	6	(n=4)
0-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-15	0	0	0	0	0.02	0	0	0.01	0	0	0	0	0.002	0	0	0	0	0
15-20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-25	0.12	0.02	0	0.05	0	0	0.32	0.11	0	0	0.02	0.01	0.05	0	0	0	0	0
25-30	0	0	0	0	0	0	0	0	0.04	0.1	0	0.05	0.02	0	0	0	0	0
30-35	0	0	0	0	0	0.04	0	0.01	0	0	0	0	0.004	0	0	0	0	0
35-40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.12	0	0	0.03
40-45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.12	0	0	0.03
45-50	0	0.04	0	0.01	0	0	0	0	0	0	0	0	0.004	0	0	0	0	0
50-55	0	0.02	0	0.01	0	0	0	0	0	0	0	0	0.002	0	0	0	0	0
55-60	0.02	0	0.02	0.01	0	0	0	0	0	0	0	0	0.004	0	0.16	0	0	0.04
60-65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65-70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70-75	0.04	0	0	0.013	0	0	0	0	0	0	0	0	0.004	0	0	0	0	0
75-80	0	0.06	0	0.02	0	0	0	0	0	0	0	0	0.007	0	0.04	0	0	0.01
80-85	0	0	0	0	0.02	0	0	0.01	0	0	0	0	0.002	0.08	0.18	0	0	0.07
85-90	0	0	0	0	0	0	0	0	0	0	0	0	0	0.24	0.08	0	0	0.08
90-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95-100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South to North																		
Mean/line	0.009	0.007	0.001	0.006	0.002	0.002	0.016	0.007	0.002	0.005	0.001	0.003	0.005	0.016	0.035	0	0	0.013

Appendix X. *Uniola paniculata* seedling density (seedling/m²) July 16, 2009 through August 6, 2009 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Distance From	Overwash Areas												Total	Frontal Dune Remnants				
	Transect ID			Mean	Transect ID			Mean	Transect ID			Mean	Mean	Transect ID				Mean
Gulf (m)	1-1	1-2	1-3	(n=3)	2-1	2-2	2-3	(n=3)	3-1	3-2	3-3	(n=3)	(n=3)	1	3	5	6	(n=4)
0-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-15	0	0	0	0	0	0	0.14	0.05	0.08	0	0	0.03	0.02	0	0	0	0	0
15-20	0	0	0	0	0	0	0.86	0.29	0.58	0	0	0.19	0.16	0.06	0	0	0	0.02
20-25	0.12	0.02	0	0.05	0	0.06	1.04	0.37	0.54	0	0	0.18	0.20	0	0	0	0	0
25-30	0.12	0.02	0	0.05	0	0.32	0	0.11	0	0.38	0.02	0.13	0.10	0	0.14	0	0	0.04
30-35	0.78	0	0	0.26	0.02	0	0	0.01	0	0.10	0	0.03	0.10	0	1.08	0.08	0	0.29
35-40	0.06	0	0	0.02	0.10	0.02	0	0.04	0	0	0	0	0.02	0	0	0.28	0	0.07
40-45	0.26	0	0	0.09	0.02	0	0	0.01	0	0	0	0	0.03	0	0	0	0	0
45-50	0.22	0	0	0.07	0	0	0	0	0	0	0	0	0.02	0	0	0	0	0
50-55	0	0.12	0.02	0.05	0.04	0	0	0.01	0	0	0	0	0.02	0.08	0	0	0	0.02
55-60	0	0.08	0	0.03	0	0	0	0	0	0	0	0	0.01	0.84	0	0	0	0.21
60-65	0.10	0.02	0.04	0.05	0	0	0	0	0	0	0	0	0.02	0.70	0	0	0	0.18
65-70	0.06	0	0.06	0.04	0	0	0	0	0	0	0	0	0.01	0.30	0	0	0	0.08
70-75	0.12	0.06	0.12	0.10	0	0.02	0	0.01	0	0	0	0	0.04	0	0	0	0	0
75-80	0.02	0.22	0	0.08	0	0	0	0	0	0	0.02	0.01	0.03	0	0	0	0	0
80-85	0	0	0	0	0	0	0	0	0	0	0	0	0	0.02	0	0	0	0.005
85-90	0	0	0.06	0.02	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
90-95	0.02	0.02	0.02	0.02	0	0	0	0	0	0	0	0	0.01	0.34	0	0	0	0.09
95-100	0.04	0	0	0.01	0	0	0.02	0.01	0	0	0	0	0.01	0.14	0.02	0	0	0.04
South to North																		
Mean/line	0.096	0.028	0.016	0.047	0.009	0.021	0.103	0.044	0.060	0.024	0.002	0.029	0.040	0.124	0.062	0.02	0	0.051

Appendix Y. *Uniola paniculata* seedling recruitment density (seedling/50m²) after July 2009 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Distance From	Overwash Areas													Frontal Dune Remnants				
	Transect ID			Mean	Transect ID			Mean	Transect ID			Mean	Total Mean	Transect ID				Mean
Gulf (m)	1-1	1-2	1-3	(n=3)	2-1	2-2	2-3	(n=3)	3-1	3-2	3-3	(n=3)	(n=3)	1	3	5	6	(n=4)
0-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-15	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
15-20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-25	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
25-30	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0
30-35	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0
35-40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	2
40-45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	2
45-50	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50-55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55-60	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60-65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65-70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70-75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75-80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1
80-85	0	0	0	0	1	0	0	0	0	0	0	0	0	0	8	0	0	2
85-90	0	0	0	0	0	0	0	0	0	0	0	0	0	12	4	0	0	4
90-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95-100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South to North Mean/line	0.05	0.10	0.05	0.067	0.10	0.10	0.00	0.067	0.10	0.00	0.05	0.050	0.061	0.60	1.30	0.00	0.00	0.475

Appendix Z. *Uniola paniculata* seedling recruitment density (seedling/50m²) after July 2009 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites on limited access areas (Okaloosa County) and restricted access areas(Santa Rosa County) of Eglin Air Force Base , Santa Rosa Island, Florida.

Access Areas (Channel Seaburg) and Restricted Access Areas (Channel Seaburg) of Light in Force Case, Channel Seaburg, Alaska																									
Distance From Gulf (m)	Overwash Areas											Frontal Dune Remnants													
	Access Limited					Access Restricted				Total		Access Limited					Access Restricted								Total
	Transect ID					Transect ID						Transect ID					Transect ID								
	1	2	3	Mean		4	5	6	7			Mean	Mean	1	2		3	Mean	1	2	4	5	6	7	
	(n=4)	(n=5)	(n=4)	(n=3)	(n=3)	(n=3)	(n=3)	(n=3)	(n=4)	(n=7)	(n=2)	(n=1)	(n=1)	(n=3)	(n=1)	(n=1)	(n=1)	(n=1)	(n=1)	(n=1)	(n=1)	(n=1)	(n=7)	(n=10)	
0-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
10-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
15-20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
20-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
25-30	0	0	0	0	0	0	0	0	0.7	0.17	0.08	0	0	0	0	0	0	0	0	0	0	0	0	0	
30-35	0	0	0	0	0	0	0	0	0.7	0.17	0.08	0	0	0	0	0	0	0	1.00	0	0	1.00	0.29	0.14	
35-40	1.5	0	0	0.50	0	0	0	0	0.00	0.25		0	0	0	0	0	0	0	0	0	0	0	0	0	
40-45	0	0	0	0	0.7	0	0	0	0.17	0.08		0	0	0	0	0	0	0	0	0	0	0	0	0	
45-50	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	
50-55	0	0	0	0	0.7	0	0	0	0.17	0.08		0	0	0	0	0	0	0	0	0	0	0	0	0	
55-60	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	1.00	1.00	0	0	0	0.29	0.14	
60-65	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	1.00	0	0	0	0	1.00	0.29	0.14	
65-70	0	0.3	0	0.08	0	0	0	0	0	0.04		0	0	0	0	0	0	2.00	7.00	0	0	0	1.29	0.64	
70-75	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	1.00	0	0	0	0	0.14	0.07	
75-80	0	0	0	0	0	0	0	0.7	0.17	0.08		0	0	0	0	0	0	0	0	0	0	0	0	0	
80-85	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	
85-90	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	
90-95	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	
95-100	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	
South to North Mean/line	0.08	0.01	0	0.029	0.07	0.00	0.00	0.10	0.042	0.035		0	0	0	0	0	0.05	0.20	0.45	0	0	0.10	0.114	0.057	

Appendix AA. *Uniola paniculata* seedling survival (%), July 2010 to November 2010, by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Distance From Gulf (m)	Overwash Areas					Frontal Dune Remnants		
	Transect ID				Mean (n=4)	Transect ID		Mean (n=2)
	2-1	2-2	2-3	3-3		1	3	
0-5							0	0
5-10				0	0		0	0
10-15				0	0		0	0
15-20			0	0	0	100	0	50
20-25	0	5	0	100	26.4	10	0	5
25-30	0	0	0		0	1.7	0	0.9
30-35	0		0		0	0	100	50
35-40	0	0	0		0	0	22.5	11.3
40-45		66.7	90	0	52.2		27.3	27.3
45-50	5.1	0	100		35.0		17.6	17.6
50-55	0				0	100	0	50
55-60	100 ^z	100			100	100		100
60-65	100	0		0	33.3			
65-70	53.8	0			26.9	32.3		32.3
70-75	100			0	50	13.6		13.6
75-80						0		0
80-85	0				0	0		0
85-90				0	0	0		0
90-95	20				20	46.7		46.7
95-100	0				0	0		0
South to North Avg/ line	23.2	21.5	27.1	12.5	21.1	28.9	15.2	22.0

^zwhen survival is 100% recruitment possible after July see Appendix AB.

Appendix AB. *Uniola paniculata* seedling recruitment density (seedling/50m²) after June 4, 2010 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Distance From Gulf (m)	Overwash Areas					Frontal Dune Remnants		
	Transect ID				Mean (n=4)	Transect ID		Mean (n=2)
	2-1	2-2	2-3	3-3		1	3	
0-5	0	0	0	0	0	0	0	0
5-10	0	0	0	0	0	0	0	0
10-15	0	0	0	0	0	0	0	0
15-20	0	0	0	0	0	24	0	9.00
20-25	0	0	0	3	0.75	0	0	0
25-30	0	0	0	0	0	0	0	0
30-35	0	0	0	0	0	0	1	0.50
35-40	0	0	0	0	0	0	0	0
40-45	0	0	0	0	0	0	0	0
45-50	0	0	0	0	0	0	0	0
50-55	0	0	- ^z	0	0	1	0	0
55-60	8	3	-	0	2.50	2	0	1.00
60-65	3	0	-	0	0.75	0	-	0
65-70	0	0	-	0	0	0	-	0
70-75	1	0	-	0	0	0	-	0
75-80	0	0	-	0	0	0	-	0
80-85	0	0	-	0	0	0	-	0
85-90	0	0	-	0	0	0	-	0
90-95	0	0	-	0	0	0	-	0
95-100	0	0	-	0	0	0	-	0
South to North Avg/ line	0.60	0.15	0	0.15	0.200	1.35	0.08	0.525

^zData not available because shorebird nesting prevented sampling

Appendix AC. *Uniola paniculata* density (seedling/m²) October 30, 2010 through November 20, 2010 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Distance From Gulf (m)	Overwash Areas											Frontal Dune Remnants				
	Transect ID									Mean (n=9)		Transect ID				Mean (n=4)
	1-1	1-2	1-3	2-1	2-2	2-3	3-1	3-2	3-3			1	3	5	6	
0-5	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0
5-10	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0
10-15	0	0	0	0	0	0	0	0	0	0		0.48	0	0	0	0.12
15-20	0	0.02	0	0	0.02	0	0	0.08	0	0.01		0.52	0	0	0.02	0.14
20-25	0	0	0	0	0.2	0	0.08	0	0.56	0.17		0.06	0	0.54	0.02	0.16
25-30	0	0	0	0	0	0	0.1	0	0.02	0.03		0.02	0	0.18	0.06	0.07
30-35	0.12	0	0	0	0	0	0	0	0	0.02		0	0.06	0.22	0	0.07
35-40	0.04	0	0	0	0	0	0	0	0	0.01		0	0.32	0	0	0.08
40-45	0	0	0	0.02	0.04	0.18	0.02	0	0	0.03		0	0.54	0	0	0.14
45-50	0.08	0	0.04	0.04	0	0.04	0	0	0	0.10		0	0.14	0.02	0	0.04
50-55	0.08	0	0	0	0.04	0	0	0	0	0.05		0.02	0	0	0	0.01
55-60	0	0.2	0	0.2	0.1	0	0	0	0	0.04		0.08	0	0.02	0	0.03
60-65	0.04	0	0.02	0.14	0	0	0.04	0	0	0.02		0.12	0	0.08	0	0.05
65-70	0.08	0	0.06	0.14	0	0	0.04	0	0	0.05		0.24	0.36	0	0	0.15
70-75	0.08	0	0	0.02	0	0.04	0	0	0	0.02		0.28	0.14	0	0	0.11
75-80	0.02	0	0	0	0	0.04	0	0	0	0.01		0.02	0.26	0	0	0.07
80-85	0.02	0.12	0	0	0	0.04	0	0	0	0.03		0	0.2	0	0	0.05
85-90	0	0.02	0.48	0	0	0.06	0.04	0	0	0.07		0	0.44	0	0	0.11
90-95	0	0	0.06	0.06	0	0.06	0.18	0	0	0.04		0.16	0.1	0	0.24	0.13
95-100	0	0.06	0	0	0.02	0.02	0	0	0	0.02		0	0	0	0	0
South to North Avg/ line	0.028	0.021	0.033	0.031	0.021	0.024	0.025	0.004	0.029	0.024		0.100	0.128	0.053	0.017	0.076

Appendix AD. *Uniola paniculata* density (seedling/m²) June 4, 2010 by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Distance	Overwash Areas											Frontal Dune Remnants				
From	Transect ID									Mean		Transect ID				Mean
Gulf (m)	1-1	1-2	1-3	2-1	2-2	2-3	3-1	3-2	3-3	(n=9)		1	3	5	6	(n=4)
0-5	- ^z	-	-	0	0	0	-	-	0	0		0	0.02	-	-	0
5-10	-	-	-	0	0	0	-	-	0.02	0		0	0.02	-	-	0
10-15	-	-	-	0	0	0	-	-	0.66	0		0	0.08	-	-	0.04
15-20	-	-	-	0	0	0.18	-	-	3.54	0.93		0.04	0.3	-	-	0.17
20-25	-	-	-	0.68	1.1	0.38	-	-	0.5	0.67		0.4	0.18	-	-	0.29
25-30	-	-	-	0.18	0.54	0.08	-	-	0	0.20		1.16	0.04	-	-	0.60
30-35	-	-	-	0.1	0	0.08	-	-	0	0.05		0.16	0.04	-	-	0.10
35-40	-	-	-	0.02	0.02	0.7	-	-	0	0.19		0.1	0.8	-	-	0.45
40-45	-	-	-	0	0.06	0.2	-	-	0.02	0.07		0	1.76	-	-	0.88
45-50	-	-	-	0.78	0.02	0.04	-	-	0	0.21		0	0.38	-	-	0.19
50-55	-	-	-	0.3	0	0	-	-	0	0.08		0.02	0.46	-	-	0.24
55-60	-	-	-	0.04	0.04	0	-	-	0	0.02		0.04	0	-	-	0.02
60-65	-	-	-	0.08	0.08	0	-	-	0.02	0.05		0	0	-	-	0.00
65-70	-	-	-	0.26	0.02	0	-	-	0	0.07		0.62	0	-	-	0.31
70-75	-	-	-	0.02	0	0	-	-	0.02	0.01		1.18	0	-	-	0.59
75-80	-	-	-	0	0	0	-	-	0	0.00		0.72	0	-	-	0.36
80-85	-	-	-	0.08	0	0	-	-	0	0.02		0.7	0	-	-	0.35
85-90	-	-	-	0	0	0	-	-	0.02	0.01		0.44	0	-	-	0.22
90-95	-	-	-	0.1	0	0	-	-	0	0.03		0.3	0	-	-	0.15
95-100	-	-	-	0.06	0	0	-	-	0	0.02		1.18	0	-	-	1
South to North Avg/ line	-	-	-	0.135	0.094	0.083	-	-	0.240	0.138		0.353	0.204	-	-	0.279
^z Data not available because shorebird nesting prevented sampling																

Appendix AE. Mean temperature (°C), precipitation (cm), wind speed (km/hr) and wind gust (km/hr), dew point (°C), sea level pressure (hPa), and total degree days (heating, cooling, and growing) for March through November for years 1997 through 2000, and 2007 through 2010.

Year	Mean Temperature (°C)			Precipitation (cm)			Wind (km/hr)				Dew Point (°C)			Sea Level Pressure (hPa)			Total Degree Days		
	Temperature (°C)			Precipitation (cm)			Speed		Gust		Dew Point (°C)			Pressure (hPa)			Heating	Cooling	Growing
	Max	Min	Mean	Max	Mean	Total	Max	Mean	Max	Mean	Max	Min	Mean	Max	Min	Mean	(base 65)	(base 65)	(base 50)
March																			
1997	23	14	18	3.07	0.25	7.70	39	13	51	35	22	-6	14	1029	1001	1018	66	79	478
1998	18	9	14	9.42	0.71	22.23	58	14	74	35	21	-10	9	1036	998	1018	265	23	263
1999	19	9	14	7.82	0.46	14.40	51	13	66	37	20	-5	9	1026	1001	1018	224	4	244
2000	- ^z	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2007	21	10	16	2.77	0.13	3.99	45	5	63	34	21	-11	10	1031	1002	1022	173	16	314
2008	20	9	14	2.01	0.13	3.81	45	13	60	35	21	-10	9	1031	1002	1019	219	16	270
2009	22	12	17	2.08	0.23	7.09	48	13	84	37	23	-9	13	1030	1000	1020	125	42	399
2010	19	8	13	4.57	0.33	10.26	50	11	98	34	18	-8	8	1027	1001	1015	279	6	205
April																			
1997	22	13	18	4.50	0.38	11.20	53	14	72	35	22	-6	22	1026	1001	1015	78	42	412
1998	24	15	19	3.02	0.20	6.15	122	16	63	35	23	-2	14	1024	1005	1015	53	109	513
1999	25	17	21	1.98	0.08	2.54	100	13	58	35	23	-1	17	1026	1000	1017	42	168	574
2000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2007	23	13	18	3.76	0.28	8.20	48	10	61	34	22	-8	12	1026	1003	1017	100	74	436
2008	24	14	19	2.74	0.15	4.24	35	11	53	34	22	-2	14	1026	1009	1017	58	78	481
2009	24	14	19	5.92	0.43	12.88	39	13	53	35	22	-10	14	1026	999	1017	54	101	505
2010	25	14	19	4.52	0.25	7.67	35	11	47	34	22	1	14	1028	1003	1017	27	83	501
May																			
1997	27	17	22	2.90	0.36	11.23	35	11	50	35	24	2	18	1054	1001	1017	10	219	671
1998	30	19	25	4.22	0.15	4.85	188	10	45	32	26	11	20	1020	1005	1014	0	359	822
1999	27	17	22	1.09	0.18	5.13	180	10	58	37	29	4	18	1021	1007	1016	3	220	678
2000	28	21	24	0.00	0.00	0.00	35	13	42	34	27	1	20	1022	1010	1016	0	326	757
2007	28	17	22	0.03	0.00	0.03	35	6	48	34	22	1	16	1025	1012	1017	0	232	694
2008	28	19	23	2.67	0.15	5.11	42	11	51	34	25	5	18	1020	1006	1014	0	285	755
2009	29	22	25	5.97	0.28	8.94	47	16	63	35	24	3	19	1022	1007	1015	0	384	845
2010	29	22	25	5.82	0.43	13.16	42	11	58	34	25	6	21	1024	1007	1016	0	388	851
June																			
1997	29	22	25	4.01	0.38	11.48	34	11	48	35	26	10	22	1021	1000	1014	0	360	814
1998	33	24	28	2.13	0.10	2.97	159	13	58	35	27	12	23	1022	1007	1016	0	535	983
1999	29	22	26	3.96	0.36	10.46	93	11	42	34	28	14	22	1021	1011	1017	0	419	861
2000	31	23	27	6.65	0.38	8.31	47	11	55	39	29	2	23	1023	1000	1018	0	329	648
2007	31	22	27	1.73	0.15	4.22	37	6	51	34	26	13	24	1024	1006	1015	0	450	899
2008	31	23	27	4.42	0.46	14.07	39	8	64	32	24	13	22	1024	1010	1017	0	467	919
2009	33	23	28	5.08	0.33	9.70	34	8	84	35	28	16	22	1018	1005	1013	0	522	972
2010	32	24	28	8.66	0.64	18.85	39	10	63	39	27	18	23	1021	1009	1016	0	530	978
July																			
1997	31	23	27	7.98	0.69	20.98	100	10	80	39	27	19	24	1057	1000	1016	0	502	971
1998	34	24	29	5.38	0.69	21.11	208	10	55	34	28	7	24	1021	1005	1016	0	587	1057
1999	31	23	27	1.19	0.13	4.09	103	10	77	43	27	17	23	1023	1010	1018	0	492	962
2000	34	24	29	3.73	0.30	9.68	37	10	47	34	28	10	23	1020	977	1015	0	607	1071
2007	31	23	27	5.00	0.43	13.23	39	5	66	35	25	18	22	1021	1010	1016	0	495	960
2008	32	23	27	2.84	0.38	11.68	32	6	51	34	26	14	22	1022	1011	1017	0	504	967
2009	32	23	27	3.43	0.46	14.27	37	8	60	35	27	15	23	1023	1008	1016	0	498	969
2010	33	26	29	1.65	0.13	3.51	42	10	51	32	27	20	24	1022	1008	1017	0	592	1041

^z Weather data not available.

Appendix AE. Continued

Year	Mean Temperature (°C)			Precipitation (cm)			Wind (km/hr)				Dew Point (°C)			Sea Level Pressure (hPa)			Total Degree Days		
	Temperature (°C)			Precipitation (cm)			Speed		Gust		Dew Point (°C)			Pressure (hPa)			Heating	Cooling	Growing
	Max	Min	Mean	Max	Mean	Total	Max	Mean	Max	Mean	Max	Min	Mean	Max	Min	Mean	(base 65)	(base 65)	(base 50)
August																			
1997	31	22	27	2.92	0.30	9.19	164	10	45	35	27	13	22	1022	1011	1017	0	477	945
1998	33	26	28	2.82	0.18	5.74	35	10	76	42	28	18	24	1060	1000	1016	0	567	1030
1999	32	24	28	3.81	0.38	11.91	80	8	66	43	28	18	24	1049	1001	1014	0	548	1014
2000	31	24	28	0.18	0.03	0.36	55	8	29	29	27	21	24	1021	1002	1017	0	217	411
2007	32	24	28	1.78	0.13	4.06	45	3	61	34	28	21	24	1020	1010	1015	0	554	1016
2008	31	23	27	7.39	0.64	19.48	40	10	69	35	26	14	23	1020	1001	1013	0	480	943
2009	31	23	27	1.45	0.28	9.04	45	8	58	35	27	14	23	1022	1012	1017	0	495	957
2010	32	25	28	9.88	1.22	37.67	47	10	71	37	28	19	24	1022	1008	1014	0	570	1032
September																			
1997	32	21	26	3.18	0.18	5.21	37	10	42	35	26	13	21	1020	1006	1014	0	430	882
1998	30	24	27	13.03	1.55	46.18	74	18	108	40	29	20	24	1020	998	1012	0	473	924
1999	29	19	24	0.43	0.03	0.89	108	11	50	34	28	-1	18	1040	1006	1014	0	334	788
2000	30	22	26	3.40	0.30	9.40	48	13	66	35	27	9	21	1020	1000	1014	0	413	861
2007	30	22	26	3.00	0.41	12.14	39	8	51	34	27	9	21	1025	1008	1016	0	402	851
2008	30	22	26	7.49	0.41	12.27	55	14	84	37	27	6	21	1022	1005	1015	0	417	869
2009	31	23	27	4.37	0.43	12.90	53	11	64	35	26	8	23	1019	1009	1015	0	448	899
2010	31	22	26	1.07	0.05	1.91	37	8	48	34	26	9	21	1021	1002	1015	0	433	881
October																			
1997	26	14	20	1.88	0.13	4.14	50	13	82	37	24	2	15	1043	1000	1017	70	162	557
1998	28	18	23	0.41	0.03	0.86	159	10	48	37	31	2	19	1029	1011	1019	6	281	739
1999	26	15	21	2.49	0.15	4.62	103	11	51	34	25	-5	16	1027	1010	1018	59	163	577
2000	27	14	21	0.00	0.00	0.00	32	10	48	37	26	-3	14	1030	1002	1021	49	164	577
2007	27	17	22	22.56	1.52	47.42	40	14	63	35	26	5	16	1026	1007	1016	30	241	676
2008	25	14	19	6.76	0.53	16.69	71	11	86	35	27	-3	14	1033	1010	1020	72	146	539
2009	27	18	22	4.90	0.58	17.70	40	13	64	35	27	1	18	1028	1005	1016	45	242	647
2010	28	14	21	0.33	0.03	0.58	35	10	40	32	25	1	13	1025	1009	1017	14	148	599
November																			
1997	19	8	14	7.47	0.58	17.65	29	11	45	32	23	-5	9	1033	999	1017	263	11	216
1998	23	15	19	4.27	0.25	7.90	34	10	45	34	23	3	16	1028	1002	1019	58	106	497
1999	22	8	16	0.94	0.05	1.88	138	10	42	32	22	-6	9	1034	1010	1021	172	18	298
2000	20	11	15	2.21	0.30	9.04	39	11	51	35	24	-8	11	1034	1006	1019	256	82	311
2007	22	9	16	0.00	0.00	0.00	35	8	60	34	23	-6	9	1028	1013	1021	166	20	306
2008	21	8	14	2.82	0.15	4.75	34	10	53	35	22	-8	9	1035	1000	1020	238	21	258
2009	21	10	16	6.63	0.36	10.31	48	10	69	37	23	-1	11	1027	1018	1004	157	12	309
2010	22	11	17	22.99	0.86	26.26	37	11	55	35	22	-4	12	1031	1004	1019	146	53	365

Appendix AF. *Uniola paniculata* density (seedling/m²) of seedlings established in 2010 (1st yr) and remaining in spring 2011 (2nd yr) by 5m intervals, south to north (distance from gulf) for overwash areas and frontal dune remnant sites in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Distance From Gulf (m)	Overwash Areas								Frontal Dune Remnants					
	Transect ID								Transect ID					
	2.1		2.2		2.3		Mean (n=3)		1		3		Mean (n=3)	
	2010 1st yr	2011 2nd yr	2010 1st yr	2011 2nd yr	2010 1st yr	2011 2nd yr	2010	2011	2010 1st yr	2011 2nd yr	2010 1st yr	2011 2nd yr	2010	2011
0-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-15	0	0	0	0	0	0	0	0	0.48	0	0	0	0.24	0
15-20	0	0	0.02	0	0	0	0.01	0	0.52	0	0	0	0.26	0
20-25	0	0	0.20	0.02	0	0	0.07	0.01	0.06	0	0	0	0.03	0
25-30	0	0	0	0	0.18	0.06	0.06	0	0.02	0	0	0	0.01	0
30-35	0	0	0	0	0.04	0	0.01	0	0	0	0.06	0	0.03	0
35-40	0	0	0	0	0	0	0	0	0	0	0.32	0	0.16	0
40-45	0.02	0	0.04	0	0	0	0.02	0	0	0	0.54	0	0.27	0
45-50	0.04	0	0	0	0	0	0.01	0	0	0	0.14	0	0.07	0
50-55	0	0	0.04	0	0	0	0.01	0	0.02	0	0	0	0.01	0
55-60	0.2	0	0.1	0	0.04	0	0.11	0	0.08	0	0	0	0.04	0
60-65	0.14	0.02	0	0	0.04	0	0.06	0.01	0.12	0.02	0	0	0.06	0.01
65-70	0.14	0	0	0	0.04	0	0.06	0	0.24	0	0.36	0	0.30	0
70-75	0.02	0	0	0	0.06	0	0.03	0	0.28	0	0.14	0	0.21	0
75-80	0	0	0	0	0.06	0	0.02	0	0.02	0	0.26	0	0.14	0
80-85	0	0	0	0	0.02	0	0.01	0	0	0	0.2	0	0.10	0
85-90	0	0	0	0	0	0	0.00	0	0	0	0.44	0	0.22	0
90-95	0.06	0	0	0	0	0	0.02	0	0.16	0	0.1	0	0.13	0
95-100	0	0	0.02	0	0	0	0.01	0	0	0	0	0	0	0
South to North Avg/ line	0.031	0.001	0.021	0.001	0.024	0.003	0.025	0.002	0.100	0.001	0.128	0	0.114	0.001

Appendix AG . Mean frequency (%) of fruit occurrence by species for the 18 dunes sampled in the Santa Rosa Unit of Gulf Island National Seashore, Santa Rosa Island, Florida.

Species	Dune 26	n	Dune 38	n	Dune 41	n	Dune 43	n	Dune 44	n	Dune 21	n	Dune 18	n	Dune 17	n	Dune 5	n
<i>Ceratiola ericoides</i>	25.0	8	-	-	-	-	-	-	-	-	-	-	0	1	50.0	12	25.0	4
<i>Crataegus michauxii</i>	-	-	-	-	-	-	-	-	-	-	-	-	50.0	2	0	1	100.0	1
<i>Ilex glabra</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	1	-	-
<i>Ilex vomitoria</i>	0	1	75.0	4	33.3	6	0	2	-	-	75.0	4	42.9	7	66.7	3	50.0	14
<i>Magnolia grandiflora</i>	50.0	6	-	-	0	1	0	1	-	-	100.0	1	57.1	7	0	1	14.3	7
<i>Persea borbonia</i>	-	-	-	-	-	-	-	-	-	-	-	-	0	4	0	1	33.3	3
<i>Rhus copallinum</i>	-	-	-	-	-	-	-	-	-	-	0	2	0	1	-	-	-	-
<i>Serenoa repens</i>	50.0	2	-	-	66.7	6	50.0	2	100.0	2	42.9	7	16.7	6	0	1	66.7	6
<i>Sideroxylon lanuginosum</i>	-	-	-	-	0	3	-	-	0	1	0	6	0	4	0	2	0	7
<i>Smilax spp.</i>	25.0	4	0	3	0	6	0	1	66.7	3	0	2	0	6	50.0	8	28.6	7
<i>Vitis rotundifolia</i>	50.0	4	0	3	0	7	0	2	0	3	0	4	0	3	42.9	7	0	7

Appendix AG . Continued.

Species	Dune 7	n	Dune 6	n	Dune 9	n	Dune 11	n	Dune 13	n	Dune 12	n	Dune 15	n	Dune 16	n	Dune 14	n
<i>Ceratiola ericoides</i>	25.0	4	33.3	3	-	-	-	-	0	2	-	-	-	-	50.0	6	0	2
<i>Crataegus michauxii</i>	0	4	100.0	1	-	-	-	-	100.0	2	-	-	-	-	100.0	2	50.0	2
<i>Ilex glabra</i>	-	-	-	-	-	-	-	-	0	1	-	-	-	-	-	-	-	-
<i>Ilex vomitoria</i>	25.0	4	45.5	11	43.8	16	100.0	1	50.0	10	-	-	-	-	66.7	3	63.6	11
<i>Magnolia grandiflora</i>	55.6	9	71.4	7	22.2	9	-	-	0	2	-	-	-	-	100.0	1	66.7	3
<i>Persea borbonia</i>	-	-	33.3	3	0	9	0	1	-	-	-	-	-	-	-	-	0	2
<i>Rhus copallinum</i>	-	-	0	4	0	3	-	-	0	3	-	-	-	-	-	-	-	-
<i>Serenoa repens</i>	-	-	100.0	1	66.7	3	100.0	7	100.0	6	-	-	-	-	100.0	2	66.7	3
<i>Sideroxylon lanuginosum</i>	0	2	0	3	0	8	0	1	0	4	-	-	-	-	0	2	0	4
<i>Smilax spp.</i>	25.0	4	37.5	8	0	7	0	2	0	5	0	1	-	-	0	2	28.6	7
<i>Vitis rotundifolia</i>	0	6	16.7	6	37.5	8	0	2	0	4	-	-	-	-	0	1	50.0	4

Appendix AH Scientific names for the letter codes used in the PCA graph (Figure 5) and CCA graph (Figure 6).

Species Code	Scientific Name
BAHA	<i>Baccharis halimifolia</i>
CHBO	<i>Chamaesyce bombensis</i>
CHPA	<i>Chrysoma pauciflosculosa</i>
CHGO	<i>Chrysopsis gossypina hyssopifolia</i>
CLJA	<i>Cladium jamaicense</i>
CODI	<i>Commelina diffusa</i>
CYP	<i>Cyperus spp.</i>
DIAC	<i>Dichanthelium aciculare</i>
DISP	<i>Distichlis spicata</i>
FICA	<i>Fimbristylis castanea</i>
FRFL	<i>Froelichia floridana</i>
HESU	<i>Heterotheca subaxillaris</i>
HYBO	<i>Hydrocotyle bonariensis</i>
HYP	<i>Hypericum spp.</i>
ILVO	<i>Ilex vomitoria</i>
IVIM	<i>Iva imbricata</i>
JURO	<i>Juncus roemerianus</i>
ODCO	<i>Odontonychia corymbosa</i>
OEHU	<i>Oenothera humifusa</i>
PAAM	<i>Panicum amarum</i>
PHCO	<i>Phragmites communis</i>
PHAN	<i>Physalis angustifolia</i>
QUGE	<i>Quercus geminata</i>
RU	<i>Rubus spp.</i>
SCMA	<i>Schizachyrium maritimum</i>
SM	<i>Smilax spp.</i>
SPPA	<i>Spartina patens</i>
STHE	<i>Strophostyles helvola</i>
UNPA	<i>Uniola paniculata</i>

Acknowledgments

This work would not have been possible without generous access to field sites and invaluable logistical support on the ground provided by Riley Hoggard and Mark Nicholas of Gulf Islands National Seashore, Bruce Hagedorn and Bob Miller of Eglin Air Force Base. The dedication and hard work of many field technicians through blistering heat were critical to the completion of this report, including Lesley Atwood, Megan Abney, Tyler Barry, Megan Brown, Gina Duke, Kelvin Johnson, Stella Jones, Justin McKeithen, Brandon Miller, Brittany Miller, Jubal Porter, Matthew Shawyer, Matthew Smidt, Sara Lumban Tobin, and Wes Woodham. In particular, Sean Claypool played a critical role in this project by training field personnel, providing dependable assistance in the field and assisted with the substantial task of editing this report. We feel fortunate to have had wonderful collaborators in Jeff Gore, Elliot Wilkins and Alex Pries. We greatly appreciate the efforts of the staff in the Department of Wildlife Ecology and Conservation and West Florida Research and Education Center at the University of Florida, including Sherry Davis, Merniece Johnson, Kelly Cunningham, Monica Lindberg and Caprice McRae, and their supreme patience and efforts to facilitate both funding and support of employees. Funding for this project was provided primarily by the Department of Interior, National Park Service, Gulf Islands National Seashore.