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THE NATURAL HISTORY OF BAHAMIAN DUNE PLANTS: IMPORTANCE IN COASTAL CONSERVATION

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ABSTRACT

Coastal dunes are considered to be "natural coastline protection systems." In the Bahamas and elsewhere they are threatened by burning, overgrazing, trampling, invasive species and habitat development. Dune maintenance and restoration require knowledge of the natural history and ecology of dune vegetation. Little is known of the breeding systems and pollinators of dune vegetation, especially dune shrubs, which stabilize the foredunes and dune proper. We have been studying the reproductive biology of a group of dune shrubs on San Salvador Island, Bahamas. Our preliminary results indicate some shrubs may be self-fertile while others appear to be obligate outcrossers. Additionally, our recent surveys of the island demonstrate a marked increase in one invasive species that may pose a threat to native dune vegetation.

INTRODUCTION

Coastal dunes are reported to be "natural coastline protection systems" (Sealey 2006). Dune vegetation fixes sand and prevents it from spreading inland. Dunes store fresh water and provide a natural sea wall against storms (Sealey 1990). In the Bahamas and elsewhere, dunes are threatened by a number of human activities, including burning, overgrazing by livestock, trampling, and habitat development, as well as invasive species that are intentionally and unintentionally spread by humans (U.S. Fish and Wildlife Service 1999, Hammerton 2001, Sealey 2001, Environmental Bay of Plenty Regional Council 2009, Finkle and Elliott this volume). Dune vegetation is preferable to sea walls in protecting dunes. Sea walls offer limited protection and are costly and often ephemeral (Sealey 2006), whereas stable dunes protect the coastal environment from high winds and hurricanes. Dune plants are generally very hardy plants, which gather sand, shelter birds and withstand wind and waves; they are, however, very sensitive to heavy vehicle traffic (Sealey 2006, Environmental Bay of Plenty Regional Council 2009).

Coastal and island communities have recognized the importance of protecting and restoring coastal dunes to their natural vegetation (Craig 1984, Kass 2005, Sealey 2006). Planting native vegetation is the best method for dune construction, improvement and repair (Texas General Land Office 2003). Endangered dune plants are protected along Florida's coastline and many other coastal areas. Once dune plants are protected, monitoring of their populations and understanding their reproductive biology is needed to aid conservation efforts (Center for Plant Conservation 2010), as is the case with other endangered species.

Little is known about the reproductive ecology of dune vegetation, especially dune shrubs, which stabilize the foredunes and dune proper. Here we present a preliminary study of the reproductive biology of three co-flowering native dune shrubs, Bay Lavender [*Tournefortia gnaphalodes* (L.) R. Br. Ex Roem & Schult. (Syn. *Mallotonia gnaphalodes* (L). Britt), Family: Boraginaceae], Bay Cedar (*Suriana maritima* L., Family: Surianaceae) and Ink Berry (*Scaevola plumieri* (L.) Vahl, Family: Goodeniaceae) on San Salvador Island, Bahamas. We also present a list of floral visitors (apparent pollinators) to these species and discuss their potential influence on the reproductive success of the three plant species. Co-flowering plant species could attract more pollinators than any single species would if it flowered alone. This could increase reproductive success for all the plant species. Conversely, co-flowering plant species might compete for pollinator services, particularly if pollinators are scarce, and could reduce the species' reproductive success. Additionally, we discuss our recent plant surveys of the island, which demonstrate a marked increase in the invasive species White Ink Berry [*Scaevola taccada* (Gaertn.) Roxb., Family: Goodeniaceae], a species that may pose a threat to native Ink Berry dune populations (Finkle and Elliott this volume).

MATERIALS AND METHODS

Study Plants

Three of the four plants included in this study are native to the Bahamas: Bay Lavender [*Tournefortia gnaphalodes* (L.) R. Br. Ex Roem & Schult. (Syn. *Mallotonia gnaphalodes* (L). Britt), Family: Boraginaceae] (see plant description in Correll and Correll, pg. 1208 and Kass 2005, pg. 80); Bay Cedar (*Suriana maritima* L.), Family: Surianaceae (see plant description in Kass 2005, p. 36); and Ink Berry [*Scaevola plumieri* (L.) Vahl, Family: Goodeniaceae] (see plant description in Kass 2005, p. 108). The fourth species, White Ink Berry [*Scaevola taccada* (Gaertn.) Roxb., Family: Goodeniaceae], is an invasive in the Bahamas (see plant description in Eshbaugh & Wilson 1985). Field work was performed on San Salvador Island during the following time periods: 28 January–10 February 2004; March 2004; 20–28 May 2004; 25 January–10 February 2006; 28 November–17 December 2007; 19 May–2 June 2008; and July 2008. Lee Kass and Nancy Elliott conducted all fieldwork with assistance from Bob Hunt, Susan Danforth, Adam Finkle, Stephanie Bjork and Blair Elmendorf.

Plant surveys

Bay Lavender. Plants growing on the dunes along Graham's Harbor near the GRC were surveyed during Jan/Feb 2004, Jan/Feb 2006 and Nov/Dec 2007. Plants were permanently tagged and the presence of flower buds, open flowers, and fruits were recorded.

Bay Cedar. Plants growing on the dunes along Graham's Harbor near the GRC and along the trail leading to Reckley Hill Pond were surveyed during Mar 2004, Jan/Feb 2006 and Nov/Dec 2007. Plants were permanently tagged and the presence of flower buds, open flowers, and fruits were recorded.

Ink Berry. Plants growing on the dunes along Grahams' Harbor near the GRC were surveyed during Nov/Dec 2007, and May/June 2008. Plants were permanently tagged and the presence of flower buds, open flowers, and fruits were recorded.

White Ink Berry. The number of plants growing near the Queen's Highway was estimated by surveys performed during May-Jul 2008, using the Queen's Highway as a transect line around the entire island.

Flower longevity and fruit development

Flowers of all four species were covered with mesh bags and followed to determine floral longevity and to describe fruit development (Bay Lavender, 10 plants; Bay Cedar, 5 plants; Ink Berry, 4 plants; White Ink Berry, 2 plants). Flowers of Bay Lavender and Bay Cedar were covered during Jan/Feb 2006 and 2007, while flowers of Ink Berry were covered during Nov/Dec 2007 and flowers of White Ink Berry were covered during May/Jun 2008. Final fruit set was recorded for all species.

Additional flowers on Bay Lavender (5 Plants, 18 inflorescences) and Bay Cedar (10 flowers) were covered and followed during Jan/Feb 2006 to describe floral development, both *in situ* and in the laboratory using dissecting and compound microscopes.

Pollination biology

Preliminary pollination studies were performed on Bay Lavender during Jan/Feb 2004 (1 Plant, 5 inflorescences per treatment) and 2006 (10 plants, 64 covered inflorescences, 413 buds; 74 inflorescences, 581 buds or open flowers), on Bay Cedar during Jan/Feb 2006 (5 Plants, 24 covered buds, 28 open flowers), and on Ink Berry during Nov/Dec 2007 (4 plants, 26 covered buds, 34 open flowers). Two treatments were performed for each plant: an auto-pollinated treatment to determine whether the flowers could be pollinated without visitation from insects; and an open-pollinated treatment to determine the frequency of pollination under natural conditions. For the auto-pollinated treatment, unopened inflorescences or individual floral buds were tagged and covered with mesh bags and the flowers were allowed to develop within the bags. For the open-pollinated treatment, opened inflorescences or individual flowers were tagged and allowed to receive visits from pollinators. At the end of each research period, all tagged flowers were removed and the developing fruits were examined and their numbers recorded.

Nectar production

To determine the volume of nectar produced, flowers of Bay Lavender (10 flowers), Bay Cedar (30 flowers) and Ink Berry (5 flowers) were probed for nectar using either 1 or 3 µL capillary pipettes.

Floral visitors

Animal visitors to flowers (apparent pollinators) were observed and recorded at all four species. Floral visitors were observed and recorded at Bay Lavender during Jan/Feb 2004 and 2006 along the beach at Graham's Harbor near the GRC and at French Bay (2004 only). Floral visitors were observed and recorded at Bay Cedar during May 2004 and Jan/Feb 2006 along the beach at Graham's Harbor near the GRC and along the trail to Reckley Hill Pond (2006 only). Floral visitors were observed and recorded at Ink Berry and White Inkberry May-Jul 2008. All insect visitors were identified using the collection in the repository at the GRC, Elliott (1993) and/or confirmed by Nancy Elliott. Flower visitors to the four plant species were compared to determine whether any of the plants were sharing apparent pollinators.

RESULTS

Plant Surveys

We observed a flowering peak in January/February 2006 and fewer flowers in November/December 2007 for Bay Lavender and Bay Cedar. We observed peak flowering for Ink Berry in November/December 2007, some flowers in May/early June 2008 and in July 2008. Invasive Ink Berry was observed to be in full flower in May/June 2008.

Floral longevity

Flower descriptions (Correll and Correll 1982, Kass 2005) generally do not provide floral longevity– the time of bud opening to flower wilting and fruit development. Our observations on floral longevity of the three native dune shrubs are described here.

Bay Lavender. Bay Lavender is reported to flower throughout the year in the Bahamas (Correll and Correll 1982, p. 1208). Flower buds and flowers of Bay Lavender are arranged in tight clusters along a slightly curved inflorescence (Kass 2005 p. 80; Figures 1, 2 & 3). Over a period of days, the flowers open in sequence from the base of the inflorescence towards the tip (Figure 1). Flower petal colors change from white to pink to brown as flowers age (Figure 1) over the course of a week.

The male and female reproductive structures (pistil and stamens) are enclosed tightly by the corolla tube (petal tube) and the calyx; therefore, they cannot be seen without cutting the flower open. There are no nectar glands (personal observations; also see floral diagram Fig 519, p. 1209, Correll and Correll 1982). Newly opened flowers were visited by butterflies, moths (Figure 2), bees, wasps and flies.

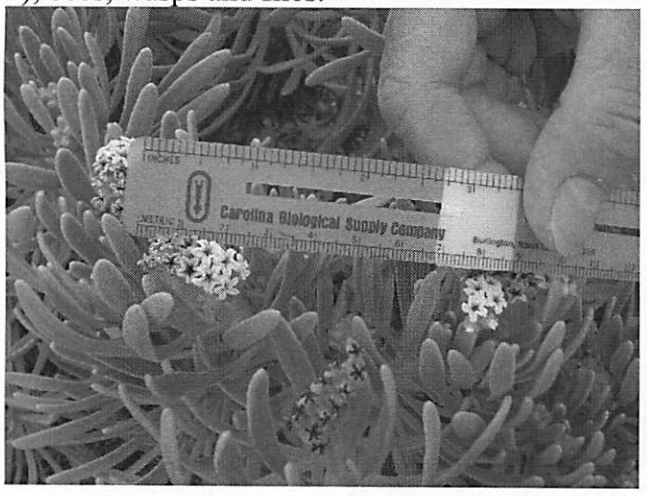

Figure 1. Leaves and floral inflorescences of Bay Lavender. Flowers open over a period of days. Flower petal colors change from white to pink to brown as flowers age. Note fresh flowers between 1.5 and 2.5 cm area under ruler. Older brown flowers on left side of this inflorescence. (February 2006, photo by R. Hunt).

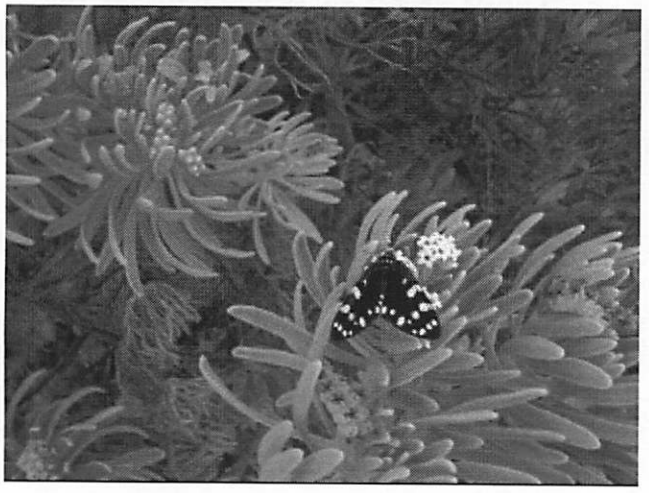

Figure 2. Composia fidelissima *visits Bay Lavender inflorescence. Note unopened buds on inflorescence upper left. (February 2006, photo by R. Hunt).*

As fruits form within each flower, corollas rise above the calyx (sepals) indicating fruit set (Figure 3). We cut open all tagged flowers to determine if ovaries had enlarged, which was an indication of fruit development. Fruits develop on naturally pollinated plants and on plants from which pollinators were excluded. Only a few flowers had aborted, which could be observed externally by withered flowers that did not show rising corollas. Seed germination has been reported to be limited and most plants are propagated from cuttings (Nellis 1994). Plants were beginning to flower when we began our study in November and were still flowering when we left in mid-December.

Figure 3. "Rising corollas" (below centimeter numbers 1 and 2 on ruler) on Bay Lavender indicate fruit set. (February 2006, photo by R. Hunt).

Bay Cedar. Bay Cedar is reported to flower sporadically throughout the year in the Bahamas (Correll and Correll 1982, p. 735). Flower buds and flowers of Bay Cedar are arranged in small clusters on short branched flower stalks (Kass 2005 p. 36; Figure 4). Flowers are open for only one day. The five petals are ephemeral and fall from the flower after a few hours. If nothing visits the flower the stamens move close to the

stigma and appear to deposit pollen before falling from the flower. The calyx then closes around the 5 pistils, which makes it difficult to determine if the flower is in bud or in fruit. In a day or so the fertilized flower begins to angle downward with respect to the vertical stem and the fertilized ovaries within the enclosed calyx begin to enlarge as the sepals begin to turn yellow. Flowers are visited by butterflies, moths, bees, wasps, flies, and beetles. Fruits (Figure 5) develop over a period of weeks. Plants set fruit even if pollinators are excluded.

Figure 4. Bay Cedar habit, flower, buds and developing fruits (hanging down). Reprinted from Kass 2005; illustration by Anthony Kowalski.

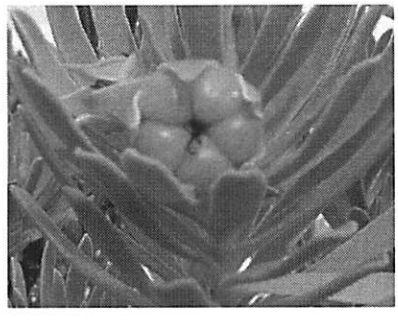

Figure 5. Green developing fruits of Bay Cedar. As fruits mature they will turn orange/brown. (February 2006, photo by R. Hunt).

Ink Berry. Ink Berry is reported to flower throughout the year in the Bahamas (Correll and Correll 1982, p. 1438). Flower buds and flowers of Ink Berry are found in clusters on the tips of short branches (Kass 2005, p. 108; Figure 7). We observed peak flowering in November/December 2007, sporadic flowering in May/June 2008, and increased flowering in July, 2008. Large yellow buds striped with purple are an indication that the flower will open within a day. Flowers open over a period of days. DAY 1: Flower opens, petals curve away from the style, anthers are already open (dehisced) and yellow pollen can be observed in the anthers. The style is recurved within the base of the floral cup. It is topped by a pollen cup termed an indusium, which is covered with short hairs, and collects the pollen in a clump as it unfolds. At this point the stigma is hidden below the indusium and cannot be seen. (Some floras describe the stigma as "below" the indusium while others describe the stigma as "above" the indusium. Clearly, the stigma is below the indusium before emerging from the indusium.). The dehisced anthers fall from the newly opened flower within hours of opening. If nothing visits the flower the pollen falls from the cup within a day. DAY 2: The stigma emerges through the indusium, is slightly yellow to beige in color and extends out from the indusium approximately 1mm. DAY 3: The stigma is exerted from the indusium about 2 mm and is creamy white (Figure 6). Day 4: The corolla curls, and the stigma fades (Figure 6).

Figure 6. Ink Berry: Mature flower (center) with fully open white petals, stigma protruding from indusium; wilting flower (right) with closed corolla and drying stigma; "striped bud" (left of mature flower) about to open; orange aborting fruit (left); and green developing fruit (above aborting fruit). (December 2007, photo by R. Hunt).

Fruits develop on naturally-pollinated plants but not on plants from which pollinators were excluded. If the flower is pollinated, the ovary enlarges to form a black fruit (Figure 7) that may take weeks to develop. If the flower is un-pollinated the ovary turns orange (Figure 6) and falls. We have not yet determined the time of stigmatic receptivity and plan to investigate this in future studies.

Figure 8. Ink Berry: Mature Fruit. (December 2007, photo by R. Hunt).

Fruit set and fruit development

In 2004 we made preliminary studies of Bay Cedar and Bay Lavender on San Salvador. Data collected in 2004 [March, Bay Lavender] and [April/May, Bay Cedar] and in Jan/Feb 2006 and in Nov/Dec 2007 indicated that the plants can self-pollinate and self-fertilize. Both Bay Cedar and Bay Lavender develop (set) fruits on inflorescences covered to exclude visitors.

Our preliminary studies of the floral development of Ink Berry (Nov/Dec 2007, May/July 2008) and invasive White Ink Berry in May/July 2008 indicate the plants do not set fruit when floral visitors are excluded. It appears that cross-pollination is required for the plants to set fruit. The flowers that were covered to exclude pollinators aborted, following withering of the floral cup. The green ovaries turned from green to orange and fell off within a day or two.

Nectar Production

Only one Bay Lavender flower, of dozens of flowers probed with a 1 μL capillary pipette, contained nectar. The pipettes were usually covered with pollen when withdrawn from the flowers.

Nectar collected from bagged Bay Cedar flowers in December 2007 was very viscous and ranged in amount from 0 to 1μL per flower. Ants and thrips were observed in flowers with low nectar measurements.

In November/December 2007, five Ink Berry flowers were probed on one plant with a 3 μL capillary pipette and the amount of nectar ranged from 0 to 0.2 μL. Two flowers were observed to contain ants and many ants were visible on the plant's stems.

Floral Visitors

We observed 37 species of insect and one bird visiting dune shrubs in 2004, 2005, 2006 and 2008 (Table 1). Each plant species, however, also received visits from at least one animal species that visited only flowers on that species. Bees, wasps, flies, butterflies and moths visited and probed Bay Lavender flowers for extended periods of time in January/February 2006. Bees, wasps, flies and moths visited Bay Cedar flowers in January/February 2004, January/February 2006 and March 2005. Butterflies, bees, wasps, and flies and were observed on flowers of Ink Berry and White Ink Berry; in addition, one bird visited the White Ink Berry. We also observed and collected a beetle visitor on Ink Berry. The insect was identified as a member of the family Oedemeridae (Peter Fraissinet, L.H. Bailey Hortorium, Cornell University), but has not yet been identified to species. Four insect species were observed visiting all four plant species, but most insect species visited a subset of the plants. The only insect species that visited Ink Berry and White Ink Berry also visited Bay Lavender and Bay Cedar.

Distribution of Invasive White Ink Berry

Our survey of White Ink Berry along the Queen's Highway in May/June 2008, located most invasive Ink Berry plants in front yards. Surveys along the beach at Lindsay Reef found many young and mature plants a short distance from people's homes along the beach above high tide. We were told that the White Ink Berry is common at Club Med and that workers take pieces of the plant home to plant (confidential personal communication to Lee Kass and Nancy Elliott, May 2008).

DISCUSSION AND CONCLUSIONS

San Salvador Island Dune Shrubs

Dune plants are important for preserving dunes and preventing erosion. We studied the reproductive biology of three co-flowering dune shrubs, Bay Lavender, Bay Cedar and Ink Berry, which stabilize the fore-dunes along the coastline of San Salvador Island (see plant communities maps in Smith 1993 and Kass 2005) and which afford protection to coastal roads and inland areas in the Bahamas and elsewhere (Sealey 2006). In 2004, we made preliminary studies of Bay Cedar and Bay Lavender on San Salvador. Data collected at that time indicated that both these plants may be self fertile, even though we observed many visitors (pollinators) to these species. Expanded studies in Jan/Feb 2006 indicated that the plants can self pollinate and self fertilize. Covered inflorescences were developing fruit by the end of the study period. Future studies should allow fruits to develop fully to be tested for viability because it is known that self fertilized fruits often abort early or are not viable when germination studies are made.

In November-December 2007, and in the summer of 2008, we studied the native Ink Berry recording its floral longevity, and fruit set. In May-July 2008 we studied the invasive White Ink Berry, recording its fruit set. Preliminary data indicate that covered inflorescences do not set fruit and we plan to hand pollinate flowers to establish that cross-pollination is required for the plants to set fruit. Fruits on naturally pollinated Ink Berry plants appear to require more time to develop than do fruits on the invasive White Ink Berry species. Studies on more fruits are necessary before we can know the exact time from fruit set to full ripening.

Many dune plants are endangered and have been protected; Bay Lavender is reported to be a protected plant in Florida. In 2007, we first noted the spread of White Ink Berry, an invasive species, growing along the beaches of San Salvador. This invasive was first seen in the Bahamas about 30 years ago (Eshbaugh and Wilson 1985), has spread rapidly on Andros Island Bahamas and excludes native Ink Berry and other dune plants (Jim Hickey to L. Kass and The Bahamas National Trust Science Advisory Committee, personal communication, 5 December 2007). We first observed White Ink Berry planted as an ornamental in Cockburn Town in 1992 (Kass 2005) and in 2008, NE and LK began monitoring its floral visitors (Table 1) and its distribution along San Salvador Island beaches (Kass and Elliott personal observations, May/June 2008; Finkle and Elliott this volume). The threat to native dunes by White Ink Berry and by other invasive species (i.e., *Casuarina*) must be monitored and if possible eradicated (see Finkle and Elliott this volume).

Floral visitors

Seventeen of the 39 animal species observed visiting the flowers of the four dune plant species visited two or more plant species (Table 1), so the plants could be competing for pollination services from some of the floral visitor species. Each plant species, however, also received visits from at least one animal species that only visited flowers on that plant species. Dependent on the relative abundances of apparent pollinator species and how faithful individual animals are to particular plant species while foraging, the plant species could also be facilitating one another by attracting more pollinators to the area. Additional simultaneous studies are necessary to clarify the relationships between these plant species.

Lepidopterans and dipterans generally appeared to prefer Bay Lavender and Bay Cedar, but the two *Scaevola* species did receive visits from species within each of these insect orders. Bay Lavender and Bay Cedar also received visits from more pollinator species than either *Scaevola* species, which is not surprising, given the unusual form of the *Scaevola* flowers. The effect of the invasive White Ink Berry on community pollination dynamics cannot be determined based on these preliminary data. White Ink Berry received visits from all four identified bee species; bees are often efficient pollinators and could increase the reproductive success of the invasive White Ink Berry, which produces a large number of flowers. The only insect species that visited both the native Ink Berry and the invasive White Ink Berry also visited Bay Lavender and Bay Cedar, suggesting that these animals might be generalist pollinators. However, two of the three animal species are bees (*Megachile poeyi alleni, Xylocopa cubaecola*), and given their efficiency at pollination, the reproductive success of White Ink Berry could be greater relative to the native Ink Berry due to greater floral production in White Ink Berry. Additional studies are necessary to determine whether White Ink Berry has a negative effect on the native Ink Berry through their shared pollinators.

Nectar

Since we found no nectar in all but one Bay Lavender flower we asked why butterflies would be probing these flowers for extended periods. Beverly Rathcke informed us (B. Rathcke to Lee Kass personal communication, 31 December 2006) that the genus *Tournefortia* is known to have pyrrolizidine alkaloids and some lepidopteran adults collect these and convert them to sex pheromones (known in Danainae, Ithominae and Arctiidae). This may be what the floral visitors to Bay Lavender are seeking. These alkaloids are also sequestered by some caterpillars and apparently are used as an anti-predator defense. Heliconiine butterflies are known to collect and eat pollen but are the only ones so far reported to do this (Robert Dirig to Lee Kass, personal communication, 1 February 2006).

Flowers of Bay Cedar and native Ink Berry were examined and found to contain nectar. Ants or thrips were often present in flowers with a reduced amount of nectar. To gain an accurate measurement for nectar in these flowers ants and other nectar thieves must be precluded from entering flowers. We plan to conduct such an investigation in the future.

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Table 1. Visitors to Bay Lavender (Tournefortia gnaphalodes, *Tg,) and Bay Cedar* (Suriana maritima, *Sm) during January/February 2004 (LK, BH, SD), March 2005 (NE, SB, BE), January/February 2006 (LK, BH), question marks (?) following names are tentative identifications; Visitors to Ink Berry* (Scaevola plumieri, *Sp) and White Ink Berry* (Scaevola taccada, *St), May/June 2008 [LK/NE], July/August 2008 [NE, AF]. [superscripts = years of observations, i.e., 2006=superscript 6].*

	Bay Lavender	Bay Cedar	Ink Berry	White Ink Berry
Lepidoptera (Butterflies)				
Hesperiidae				
Hylephila phyleus	Tg[6]			
Polygonus leo savignyi		Sm[6]		
Urbanus proteus (?)	Tg[6]			
Lycaenidae				
Strymon acis armouri	Tg[6]	Sm[6]		
Leptotes cassius theonus		Sm[6]		
Pieridae				
Ascia monuste eubotea	Tg[6]	Sm[5]		
Phoebis agarithe antillia		Sm[5]		
Kricogonia lyside		Sm[5]		St[8]
Eurema messalina		Sm[6]		St[8]
Heliconiidae				
Agraulis vanillae	Tg[6]	Sm[5,6]	Sp[8]	
Dryas iulia	Tg[6]	Sm[5]		
Nymphalidae				
Euptoieta hegesia	Tg[6]			
Junonia everete	Tg[6]			
Unidentified orange butterfly				St[8]
Lepidoptera (Moths)				
Arctiidae				
Empyreuma sp.		Sm[6]		
Composia fidelissima	Tg[6]	Sm[6]		
Hymenoptera (Bees)				
Halictidae				
Agapostemon columbi		Sm[6]		St[8]
Unidentified halictid			Sp[8]	
Megachilidae				
Megachile poeyi alleni	Tg[4,6]	Sm[4,5,6]	Sp[8]	St[8]
Anthophoridae				
Centris versicolor				St[8]
Xylocopa cubaecola	Tg[6]	Sm[5,6]	Sp[8]	St[8]

Continued on next page

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	Bay Lavender	Bay Cedar	Ink Berry	White Ink Berry
Hymenoptera (Wasps)				
Tiphiidae				
Myzinum Sp.1		Sm[6]		
Myzinum Sp. 2		Sm[6]		
Scoliidae				
Campsomeris t.trifasciata	Tg[6]	Sm[5,6]	Sp[8]	St[8]
Eumenidae				
Pachodynerus sp.		Sm[6]		
Vespidae				
Polistes bahamensis picturatus		Sm[6]	Sp[8]	
Polistes major		Sm[5]		
Pompilidae				
Anoplius fulgidus			Sp[8]	
Diptera (Flies)				
Asilidae				
Proctacanthus lerneri	Tg[4,6]	Sm[6]		
Bombyliidae				
Ligyra cereberus	Tg[4,6]	Sm[5]		
Syrphidae				
Copestylum eugenia	Tg[4,6]	Sm[6]		
Palpada albifrons	Tg[6]	Sm[4]		St[8]
Small unknown		Sm[6]		
Calliphoridae				
Callitraga macellaria	Tg[4]			
Small unknown fly		Sm[6]	Sp[8]	
Coleoptera (Beetles)				
Oedemeridae				
Paroxacis undescribed species			Sp[8]	
Unknown genus		Sm[6]		
Class Reptilia (Birds)				
Coereba flaveola [Bananaquit]				St[8]