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Cover image - Patch reef near the wall off Grotto Beach (photo by Lee Florea).

Preliminary investigation of plant-pollinator interactions on Rum Cay, The Bahamas

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1. Abstract

This preliminary study was the first comprehensive survey of plant-pollinator interactions in coastal plant communities on Rum Cay, The Bahamas. Its purpose was identification of pollination mutualists and determination of the relative importance of plant and animal species there. The study focused on shrub-thicket and coppice-thicket communities within 200 m of the coastline, but also included surveys in beach-foredune communities. Here we describe interactions between plants and their floral visitors during two time periods in 2013, early June and early December. Some plant and animal species were expected to be active during both periods, others during only one. Seasonality requires simultaneous activity of plants and their pollinators in order for each partner to acquire necessary resources, pollination services for plants and pollen or nectar resources for insects. Organisms with less restricted activity periods either: 1) need partners that are also active more frequently during the year, or 2) need to be more generalist in meeting their resource needs. For this preliminary study, the relative importance of plant and pollinator species was estimated by the number of interaction partners and whether they were active during both periods. We identified a total of 47 plant species in flower, representing 15 families. While 18 plant species (38% of species observed) were in flower during both time periods, there were more in flower during June (38) than during December (25). The legume family (Fabaceae) was represented by the largest number of species (11); other families represented by four or more species included Malvaceae,

Rubiaceae, Verbenaceae, Convolvulaceae, and Euphorbiaceae, although the latter included four species from the same genus, *Croton*. We observed at least 43 insect species representing 15 families, with 16 species (37% of species observed) active during both time periods. In contrast to the plant species, the same number of insect species (30) were active during June and December. The most common visitors were bees, wasps, and butterflies, but flies and diurnal moths were also observed during both periods. Survey results are compared with published records for other Bahamian islands.

2. Introduction

As a nation of islands, The Bahamas has a long coastline – and a proportionally large fraction of its land mass supports coastal plant communities. These communities are important ecologically and economically, and are subjected to both natural and human-induced disturbances. An understanding of pollination dynamics is necessary for successful conservation efforts in these communities (Kearns et al. 1998) because most plant species in Bahamian coastal communities rely on animal pollinators for cross pollination. Some species are capable of self-pollination, but cross-pollination increases genetic diversity and thus the likelihood that populations will persist in stochastic environments.

As part of a broader investigation of ecological interactions in coastal plant communities on Bahamian islands, we conducted the first comprehensive survey of plant-pollinator interactions on Rum Cay. Here we compare the results of this survey with previous studies on San Salvador Island

(Landry et al. 2013, Landry et al. 2014), which is approximately twice the size of Rum Cay (White 1998). We are planning additional studies on differently-sized islands near the same latitude.

3. Methods

We made observations along the south coastal road on Rum Cay on June 1-6 and December 9-12, 2013. Flowering intensity was estimated for each species presenting flowers. Plants in flower were observed during ten minute intervals, and we identified and recorded the activities of animals that visited the flowers. We also recorded incidental observations between watches. We made 78 timed ten-minute watches and 110 incidental observations on plants in flower between 0800 and 1830 hrs in June, and 78 timed watches and 152 incidental observations between 0900 and 1630 hrs in December. The insect specimens will ultimately be deposited in the Bahamian National Entomological Collection in Nassau.

4. Results

40 plant species representing 16 families were flowering in June, and 25 species representing 9 families were flowering in December; of these, 17 species representing 9 families were flowering during both visits (Table 1). We recorded a total of 144 visits to flowers in June (Table 2) and 554 in December (Table 3). The most common visitors were bees (Hymenoptera; Fam.: Apidae, Halictidae, and Megachilidae). The large carpenter bee, *Xylocopa cubaecola* (Fam. Apidae) made visits to at least ten species of plants in six plant families; two species of bees in the family Megachilidae (*Megachile alleni* and *M. bahamensis*) each visited plants in five families, but the sweat bee, *Agapostemon columbi* (Fam. Halictidae), visited only one species, *Corchorus hirsutus*. Butterflies (Lepidoptera) made 89 floral visits in December. The most frequent visits by butterflies were to *Stachytarpheta jamaicensis*

by *Agraulis vanillae* (Fam. Heliconiidae) and *Urbanus proteus* (Fam. Hesperidae). In June we observed a total of 13 visits by butterflies to *Croton lucidus* and *C. eluteria*, which were not flowering in December.

5. Discussion

Most floral visitors on Rum Cay were similar in occurrence and relative abundance to published records from San Salvador (Landry et al. 2013), with a few exceptions. The megachilid bee, *Megachile bahamensis*, which usually occurs in low numbers on San Salvador, was seen visiting flowers of some species in large numbers in December, including 155 visits made to the flowers of several *Croton* species. *Xylocopa cubaecola* is active on both islands, but in December it visited the flowers of only six species in ten days on San Salvador (Landry et al. 2014), whereas we saw it visiting ten species within four days on Rum Cay (Tables 2 and 3). Elliott et al. (1980) reported the butterfly *Urbanus proteus* in several habitats on San Salvador, although it has not been reported there for several years. In December on Rum Cay, we saw 20 individuals on *Stachytarpheta jamaicensis*. The vine *Galactia striata* also occurs on San Salvador (Smith, 1993), but in lower frequency than we observed on Rum Cay in December, where it received many visits by three bee species (Table 3). There was far less human-induced disturbance in the area surveyed on Rum Cay, which may account for differences in the plant-pollinator community.

6. Acknowledgements

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Table 1. Plant species in flower during June and December. Flower intensity codes: ABUND = very common and widely distributed; CMN = frequent and widely distributed; INFREQ = infrequent but widely distributed; RESTR = restricted distribution but local frequent; and RARE = infrequent and restricted distribution.

Plant Family	Plant Species	Flowering intensity – JUN	Flowering intensity – DEC
Apocynaceae	<i>Echites umbellata</i> Jacq.	RARE	
	<i>Pentalinon luteum</i> (L.) B.F. Hansen & Wunderlin	INFREQ	
Asteraceae	<i>Ambrosia hispida</i> Pursh	RESTR	
	<i>Bidens alba</i> DC.	INFREQ	
	<i>Gundlachia corymbosa</i> (Urb.) Britt.	RESTR	
Bignoniaceae	<i>Tabebuia bahamensis</i> (Northrup) Britt.	RESTR	
Brassicaceae	<i>Cakile lanceolata</i> (Willd.) O.E. Schulz	RESTR	
Casuarinaceae	<i>Casuarina equisetifolia</i> L.	CMN	
Convolvulaceae	<i>Evolvulus</i> sp.	INFREQ	INFREQ
	<i>Ipomoea pes-caprae</i> (L.) R.Br.	RESTR	
	<i>Jacquemontia cayensis</i> Britt.		CMN
	<i>Jacquemontia havanensis</i> (Jacq.) Urb.		RARE
Euphorbiaceae	<i>Merremia dissecta</i> (Jacq.) Hall. f.	RESTR	
	<i>Croton discolor</i> Willd.	CMN	
	<i>Croton eluteria</i> (L.) Sw.	CMN	
	<i>Croton linearis</i> Jacq.	CMN	
	<i>Croton lucidus</i> L.	CMN	
	<i>Phyllanthus epiphyllanthus</i> L.	RARE	
Fabaceae	<i>Croton</i> sp. (<i>linearis/discolor</i> intermediates)	CMN	CMN
	<i>Acacia choriophylla</i> Benth.	RESTR	
	<i>Calliandra haematomma</i> (Bert.) Benth.	RESTR	
	<i>Cassia</i> sp.		RARE
	<i>Centrosema virginianum</i> (L.) Benth.	RARE	INFREQ
	<i>Chamaecrista lineata</i> (Sw.) Greene	CMN	CMN
	<i>Galactia striata</i> (Jacq.) Urb.	RARE	ABUND
	<i>Leucaena leucocephala</i> (Lam.) DeWit	CMN	RARE
	<i>Mimosa bahamensis</i> Benth.		RESTR
	<i>Pithecellobium keyense</i> Britt. ex Britt. & Rose		RARE
	<i>Stylosanthes hamata</i> (L.) Taub.	CMN	CMN
	Undetermined tree	RESTR	
	Gentianaceae	<i>Eustoma exaltatum</i> L.	RESTR
Goodeniaceae	<i>Scaevola taccada</i> (Gaertn.) Roxb.	RESTR	
Malvaceae	<i>Corchorus hirsutus</i> L.	RESTR	RESTR
	<i>Melochia tomentosa</i> L.	RESTR	RESTR
	<i>Sida acuta</i> Burm.	INFREQ	
	<i>Sida</i> sp.		INFREQ
Passifloraceae	<i>Waltheria bahamensis</i> Britt.		INFREQ
	<i>Passiflora suberosa</i> L.	RESTR	RARE
Rubiaceae	<i>Turnera ulmifolia</i> L.	CMN	CMN
	<i>Casasia clusiifolia</i> (Jacq.) Urb.	INFREQ	
Solanaceae	<i>Cordia bahamensis</i> Urb.	RESTR	RESTR
	<i>Ernodea littoralis</i> Sw.		RARE
	<i>Rachicallis americana</i> (Jacq.) O. Ktze.	RESTR	
Surianaceae	<i>Solanum bahamense</i> L.	CMN	CMN
Verbenaceae	<i>Suriana maritima</i> L.	RARE	
	<i>Lantana bahamensis</i> Britt.	INFREQ	RESTR
	<i>Lantana involucrata</i> L.	ABUND	ABUND
	<i>Stachytarpheta jamaicensis</i> (L.) Vahl	CMN	CMN

Table 2. Insects observed making floral visits to plant species in June. ***Croton linearis*, *C. discolor*, or intermediate.

Insect Order and Family	Insect Visitor	Plant species visited												
		<i>Casasia chasifolia</i>	<i>Casuarina equisetifolia</i>	<i>Chamaecrista lineata</i>	<i>Corchorus hirsutus</i>	<i>Cordia bahamensis</i>	<i>Croton eluteria</i>	<i>Croton lucidus</i>	<i>Croton</i> sp. **	<i>Gundlachia corymbosa</i>	<i>Lantana involucrata</i>	<i>Melochia tomentosa</i>	<i>Pentalimon lutea</i>	<i>Solanum bahamense</i>
<u>Diptera</u>														
Bombyliidae	<i>Chrysanthrax maculipennis</i>									1				
	<i>Exoprosopa</i> sp.					1		3						
Syrphidae	<i>Copestylum eugenia</i>							1						
Undetermined	Small fly							1						
<u>Hymenoptera</u>														
Apidae	<i>Centris versicolor</i>					3					46			
	<i>Xylocopa cubaecola</i>		1			2	1	2			1	1	4	1
Eumenidae	<i>Pachodynerus</i> sp.								1					
Halictidae	<i>Agapostemon columbi</i>				37			2	1					
	<i>Dialictus</i> sp.				7									
Megachilidae	<i>Megachile alleni</i>				11			1		1				
Undetermined	Black bee										1			
<u>Lepidoptera</u>														
Arctiidae	<i>Composia fidelissima</i>								1		1			
Heliconiidae	<i>Agraulis vanillae</i>		1			1								
Hesperiidae	<i>Ephyriades brunnea</i>							2	4			1		
Lycaenidae	<i>Leptotes cassius</i>							4	2					
	<i>Strymon acis</i>										1			
Nymphalidae	<i>Euptoieta hegesia</i>										1			
	<i>Junonia genoveva</i>								1					
	<i>Memphis intermedia</i>							1	1					
Pieridae	<i>Ascia monuste</i>							1			1			
	<i>Kricogonia lyside</i>										1			1
	<i>Phoebis agarithe</i>	1												

Table 3. Insects observed making floral visits to plant species in December. ***Croton linearis*, *C. discolor*, or intermediate.

Insect Order and Family	Insect Visitor	Plant species visited																	
		<i>Calliandra haenatomma</i>	<i>Cassia</i> sp.	<i>Centrosema virginianum</i>	<i>Corchorus hispidus</i>	<i>Cordia bahamensis</i>	<i>Croton</i> sp. **	<i>Galactia striata</i>	<i>Jacquemontia cayensis</i>	<i>Lantana bahamensis</i>	<i>Lantana involucrata</i>	<i>Leucaena leucocephala</i>	<i>Melochia tomentosa</i>	<i>Pithecellobium keyense</i>	<i>Solanum bahamense</i>	<i>Stachytarpheta jamaicensis</i>	<i>Sylosanthes hamata</i>	<i>Turnera ulmifolia</i>	<i>Waltheria bahamensis</i>
<u>Diptera</u>																			
Syrphidae	<i>Copestylum eugenia</i>										2								
	<i>Palpada albifrons</i>									1									
<u>Hymenoptera</u>																			
Apidae	<i>Centris versicolor</i>						1	3		1		13		4					
	<i>Xylocopa cubaecola</i>		6	2			1	44	6	1	14		8		55	25	1	1	
Eumenidae	<i>Pachodynerus cubensis</i>	1	2																
	<i>Pachodynerus scrupeus</i>		1																
	<i>Zethus bahamensis</i>											1							
Halictidae	<i>Agapostemon columbi</i>				54														
	<i>Dialictus</i> sp.				1														
Megachilidae	<i>Coelioxys</i> sp.										3								
	<i>Megachile alleni</i>				54	1	11				5	1							
	<i>Megachile bahamensis</i>				42		155	19			20	2			5				
Sphecidae	<i>Cerceris watlingensis</i>						1												
Tiphidae	<i>Myzinum</i> sp.				1		1												
<u>Lepidoptera</u>																			
Arctiidae	<i>Composia fidelissima</i>										1		2						
Heliconiidae	<i>Agraulis vanillae</i>									2					41		1		
Hesperiidae	<i>Ephyriades brunnea</i>										5	1			2				
	<i>Urbanus proteus</i>														20				
Lycaenidae	<i>Leptotes cassius</i>	1						1			1				1				
Nymphalidae	<i>Euptoieta hegesia</i>														5				1
Pieridae	<i>Eurema chamberlaini</i>														2				
	<i>Kricogonia lyside</i>										1								

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