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A PRELIMINARY STUDY OF THE SEEDLING LIFE STAGE OF BAY LAVENDER (*TOURNEFORTIA GNAPHALODES*) ON SAN SALVADOR ISLAND: LIFE IS TOUGH ON THE BEACH

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ABSTRACT

In this study, we observed the seed and seedling life history stages of Bay Lavender, *Tournefortia gnaphalodes* (L.) R. Br. ex Roem. & Schult. (Boraginaceae), within a Sand Strand-*Uniola* plant community at East Beach, on San Salvador Island, The Bahamas, from June to December 2010. Sand Strand-*Uniola* plant communities grow on the dunes that form along the island's coast, and include pioneer plants that colonize the routinely disturbed foredune. These pioneer plants, including Bay Lavender, serve an important role in stabilizing the shoreline. This study sought to understand how Bay Lavender seedlings germinate and survive in the harsh shoreline environment.

In the laboratory, a controlled germination study was conducted in petri plates to compare germination rates of Bay Lavender fruits sown in either sand or a mixture of sand and *Sargassum*. During the observational period of one week, none of the fruits germinated, suggesting a low rate of germination or a time of germination longer than one week. Comparisons of germination rate based on growing medium could therefore not be made. Observations in the field, however, suggest that seedlings rooted in a mixture of sand and *Sargassum* have higher survivorship than those growing in loose sand.

Field observations were performed during a second part of the study, in which seedlings were tagged in five plots on East Beach. Growth data was collected from the seedlings in these plots in June, July and December. From June to July, seedling survivorship was 84%, and the seedlings grew an average of 2.6 cm and averaged 12 new leaves. Both survivorship and growth rate varied by plot. None of the seedlings survived to December.

The above plots were paired with similar-sized plots close to adult plants to determine whether adult plants act as nurse plants, which could provide some protection to young seedlings and increase their chance of survival. The plots near to the adult plants had an average density of 0.93 seedlings/m2, while the plots farther from the adult plants had an average density of 1.26 seedlings/m2. This suggests that adult Bay Lavender plants do not provide protection for seedlings.

INTRODUCTION

Bay Lavender, *Tournefortia gnaphalodes* (L.) R. Br. ex Roem. & Schult. (Boraginaceae), is one of the dominant shrubs that grows in a Sand Strand-*Uniola* plant community (Figure 1). East Beach is the most expansive Sand Strand-*Uniola* community on San Salvador Island, The Bahamas (Smith 1986). Because of its position on the northeast side of the island, it is regularly exposed to high winds and waves, and is vulnerable to storm surges. Plants that colonize the foredune, such as Bay Lavender, are therefore ecologically important because of the role they play in stabilizing the coastline and dunes.

We observed Bay Lavender seedlings growing in what appeared to be a natural nursery on East Beach. Some of the seedlings were growing where clumps of *Sargassum* were buried by sand. Because soil moisture is one of the limiting factors of seedling recruitment in dune systems (Maun 1994), we hypothesized that the *Sargassum* was absorbing water, which would benefit seedlings and increase germination rates. Thus, the first part of our study focused on the role of *Sargassum* in seedling recruitment.

Though there are other Sand Strand-*Uniola* communities on the island, East Beach appeared to be the only location where a large number of Bay Lavender seedlings were growing in close proximity to one another at the time we surveyed the island. This observation prompted the second part of this study, in which we collected seedling density, growth and survivorship data in an effort to explain how establishment occurs in Bay Lavender.

We initially hypothesized that an abundance of large Bay Lavender adults was creating a more favorable environment for seedlings on East Beach by acting as nurse plants. Nurse plants are adult plants that provide seedlings with some shelter from harsh environments, and these commensalistic relationships are often found in arid or semi-arid biomes (Flores and Jurado 2003). We therefore expected to find higher seedling densities in close proximity to adult plants compared with seedling densities in areas farther away from adult plants. The growth and survivorship data was collected to further our knowledge of the Bay Lavender life cycle, of which little is known, and to provide a basis for future studies.

Figure 1. Adult Bay Lavender plant flowering in June.

METHODS

We began this study on May 25, 2010, with initial data collected on May 26 and June 2. Subsequent data was collected July 18 and December 2. To begin, we collected Bay Lavender fruits from adult plants on East Beach and planted them in the lab in two different mediums—sand or a sand and *Sargassum* mixture—to study the effect of growing medium on seedling recruitment. We collected ten fruits from each of five different adult Bay Lavender plants growing on the East Beach foredune. The fruits were only collected if they were brown in color, indicating that they were ripe, and only if they were attached to the adult plant, indicating that they were still viable.

In the lab at the Gerace Research Centre on San Salvador, ten plastic petri dishes (10 cm diameter, 1.5 cm deep) were prepared for planting with two different treatments. For treatment one, five of the petri dishes were filled with sand collected from East Beach. For treatment two, five petri dishes were filled first with sand, and then dry *Sargassum* that was also collected from East Beach. Five fruits from each adult

Bay Lavender plant were included in each treatment. The petri dishes were watered just enough to moisten the soil, then placed outside in an uncovered tray. The petri dishes were checked daily and watered when the planting medium became dry.

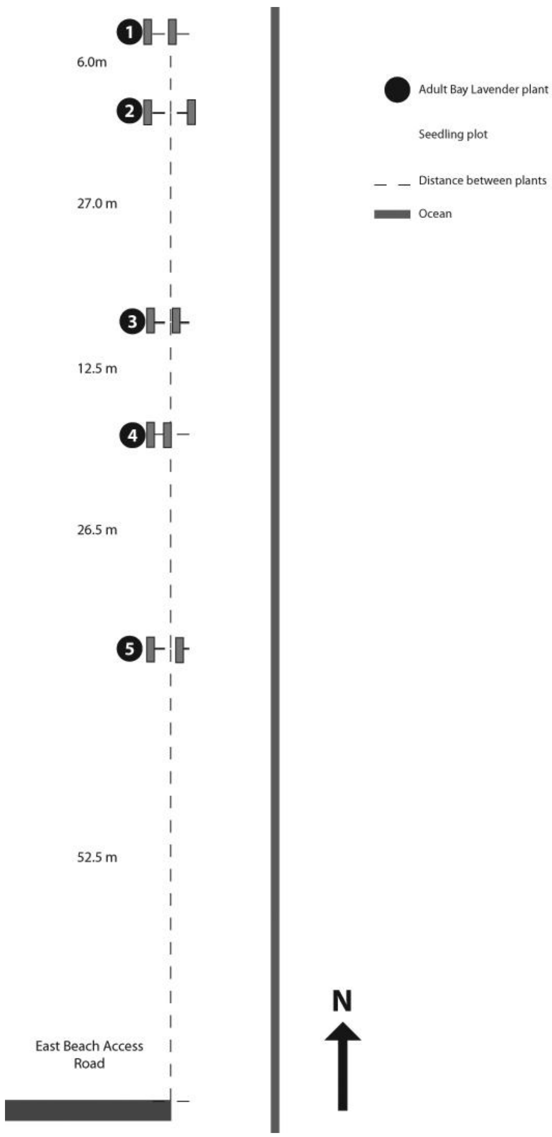

Figure 2. East Beach Bay Lavender adult plants (1-5) and nearby seedling plot pairs. Plots in a pair were 1-5 meters apart.

To test the hypothesis that adult Bay Lavender plants were acting as nurse plants, we established five plot pairs on East Beach. The location of the plots was chosen by tagging five adult Bay Lavender plants in the area where we had observed seedlings. The plots were 3m by 1m, with the 3m side running parallel to the ocean and the 1m side running perpendicular to the ocean (Figure 2). At each of the five adult plants, one plot was marked immediately next to the plant on the ocean side. Each of these plots was paired with a plot further away from the plant, the location being determined by the seedling closest to the ocean which marked the southeast corner of the far plot (Figure 2). We then counted the number of seedlings in each plot and calculated the average seedling density per meter. We used a one-way ANOVA to test for statistical differences between treatments (Systat 12).

Growth data was also collected in the five plots that were furthest from the mature plants. The height and number of leaves for each seedling were recorded. Subsequent height and leaf count data were collected in July and December, from which we calculated average height and leaf growth rates for the plots. We also measured seedling survivorship in each plot and calculated the average survivorship of seedlings at this location.

RESULTS

None of the fruits in either growing medium germinated during the week long experiment, so there was no way to test for differences in germination rates between the sand-only and the sand-*Sargassum* treatments.

The seedling density portion of the study revealed that plots closest to the adult Bay Lavender plants had lower average seedling density than those farther from the adult plants (Figure 3), but the difference is not statistically significant (F-ratio = 0.509, df = 1, p = 0.496).

The average seedling survivorship from June to July was 84% (+/- 10%), but all seedlings were gone from all plots in December. Because all seedlings were gone by December, we calculated the average changes in height and leaf number from June to July 2010 only. Overall, the seedlings averaged a +2.6 cm (+/- 0.60 cm) change in height (Figure 4) and an average leaf count increase of 11.8 leaves (+/- 3.4 leaves) (Figure 5).

DISCUSSION

The results of the germination portion of this study suggest that Bay Lavender has a germination time requirement longer than one week, or other requirements that were unknown at the time of the test. The lack of germination in any of the fruits made it impossible to compare the effects of growing medium on seedling recruitment, and further lab and field tests need to be conducted in the future to determine if and how growing medium affects germination. However, the field observation that a greater number of Bay Lavender seedlings were growing in places where the soil consisted of a sand and *Sargassum* mixture suggests that either seedling germination or establishment is affected by the growing medium.

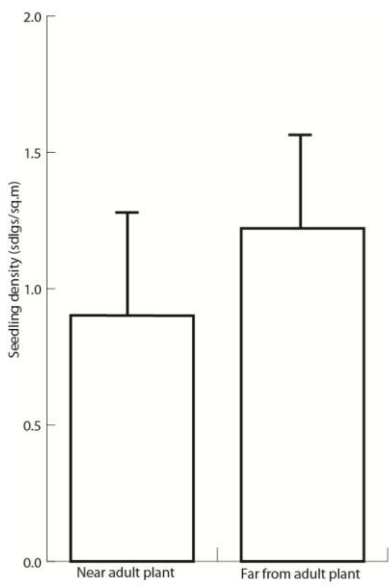

Figure 3. Average seedling density of near and far plots, with standard error bars.

Results from the seedling density portion of the study suggest that there is a small, statistically insignificant difference between seedling density close to adult Bay Lavender plants and seedling density farther from adult plants (Figure 3). However, the seedling density was greater in plots farther from the adult plants. This does not support our hypothesis that adult Bay Lavender plants were acting as nurse plants for the seedlings.

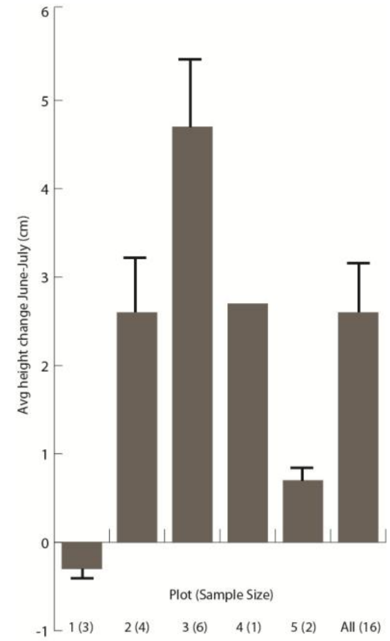

Figure 4. Average seedling height change from June to July, with standard error bars. Sample sizes are indicated in parentheses.

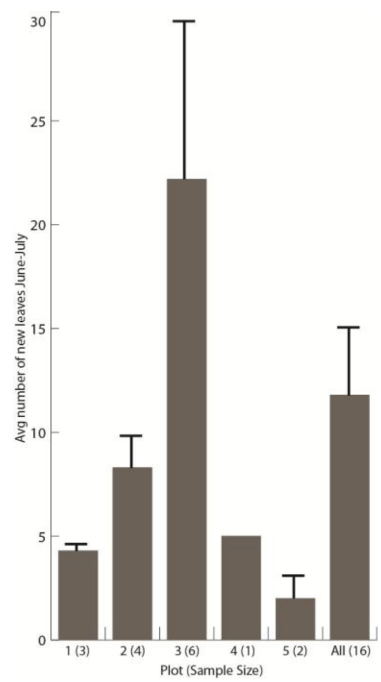

Figure 5. Average seedling leaf change from June to July, with standard error bars. Sample sizes are indicated in parentheses.

Growth data collected from the Bay Lavender seedlings suggest that seedlings can grow quickly, increasing as much as 8 cm in height and growing 58 new leaves with five branches over one month. However, there is a great deal of variation in growth rate, with other individuals losing 0.6 cm of height, possibly due to sand buildup, and growing as few as four leaves with one branch. Though our germination study was inconclusive, we believe that substrate may influence growth rate as well as survivorship.

Seedlings of a number of dune plants, including Bay Lavender, Southern Sea Rocket (*Cakile lanceolata* (Willd.) O.E. Schutz, Brassicaceae) and Inkberry (*Scaevola plumieri* (L.) Vahl, Goodenaceae), tended to cluster in areas with a sand-*Sargassum* substrate mixture (personal observations). Variation in seedling growth rates (Figures 4 and 5) may be related to substrate, although this was not tested. This leads us to suggest that further study be undertaken to understand the relationship between substrate and Bay Lavender seedling growth. Other studies have already suggested that, in addition to increasing substrate moisture, the *Sargassum* may be acting as a fertilizer, increasing nutrient content available in the substrate (Sivasankari et al. 2006).

Survivorship also varied greatly by plot, with some plots achieving only 50% survivorship while others had 100% survivorship between June and July. This could be due to a number of reasons, including soil composition, wind and wave patterns, as well as foot traffic. The 0% survivorship from July to December could be attributed to a severe storm that drastically changed the profile of East Beach and buried some of the established adult Bay Lavender plants with sand (Figures 6 and 7). Events like this reveal the ultimate vulnerability of the seedlings in a harsh environment where wind, waves and heat make it difficult for seedlings to survive to adulthood.

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Figure 6. East Beach profile in June.

Figure 7. December change in East Beach profile due to storm.

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