

# Report on First Year Monitoring of Revegetation of the Turtle Pond Mound at Lemon Creek Wildflower Preserve

Prepared by Dana Houkal for Lemon Bay Conservancy

## 1. Introduction

Five earthen mounds of varying size and elevation were created at the Lemon Bay Conservancy's (Conservancy) Lemon Creek Wildflower Preserve (Preserve) in 2020 (Figure 1). These mounds contain soils from upland excavations as well as dredge materials from the hydrologic modifications of ponds and drainage channels. These modifications were made to enhance the aquatic and wetland ecological features of the Preserve.

The natural habitats originally present on and around the Preserve were a mosaic of pine flatwoods, scrub, and oak hammocks in the upland intermingled with freshwater wetlands and streams which graded to brackish and saltwater aquatic habitats closer to the coast. The Preserve was developed into a golf course in the 1970's prior to being acquired by the Conservancy in 2010. Following the hydrologic modification work, the Conservancy began revegetating the Preserve with native species in September 2020.

The mounds at the Preserve are unique features in the otherwise almost flat landscape. These mounds provide opportunities to create unique habitats, but they also pose challenges in terms of revegetation.

The dominant natural soils at the Preserve are primarily the Immokalee Series (34%) and Smyrna Series (60%)<sup>1</sup>. Groundwater in these two series typically occurs at less than 18 inches below ground during the wet season and extends to 40 inches below ground during the dry season. Native vegetation evolved to take advantage of this shallow groundwater. Plants growing on the mounds would need to develop deeper root systems to access groundwater, if it were possible at all. Soils on the mounds are sandy, so rainwater percolation is relatively rapid and moisture retention is limited. Therefore, these soils will rapidly dry in the absence of rain and only drought tolerant plant species will be able to survive and grow on the mounds.

In the summer of 2022, the Turtle Pond Mound (Mound) located just north of Turtle Pond was selected for revegetation. Limited information was available to indicate species suitable for planting on this habitat. Therefore, a variety of potentially adaptable tree, shrub, groundcover and grass species were selected from a local native plant nursery for planting<sup>2</sup>.

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<sup>1</sup> USDA Natural Resource Conservation Service (<https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx>)

<sup>2</sup> Two other plant species were obtained from alternate sources. Seedlings of railroad vine were obtained from Eva Furner and planted in containers at the residence of Dana Houkal prior to field planting. Three-foot-long branch cuttings of gumbo limbo were obtained from large trees at the Preserve's Butterfly Habitat and planted directly in the field.

This monitoring task was established as part of the Turtle Pond Mound revegetation project with the objective of identifying suitable plant species for planting on other mound habitats at the Preserve. This report provides the results of the first year of monitoring. The conclusions and recommendations provided in this report will help guide future mound revegetation work at the Preserve and possibly elsewhere.

## 2. Methods and Materials

Plants were obtained from Sandhill Native Growers, Inc, Arcadia, Florida. Plants were delivered to the Preserve on June 6, 2022 and staged in a shady area adjacent to the Mound. The delivery included:

- South Florida slash pine (*Pinus elliottii* var. *densa*) – 80 plants in 3-gallon containers
- Longleaf pine (*Pinus palustris*) – 20 plants in 3-gallon containers
- Live oak (*Quercus virginiana*) – 40 plants in 3-gallon containers
- Southern red cedar (*Juniperus virginiana* var. *siliciola*) – 20 plants in 3-gallon containers
- Fire Bush (*Hamelia patens*) - 20 plants in 3-gallon containers
- Dune sunflower (*Helianthus debilis*) – 20 plants in 1-gallon containers
- Blanket Flower (*Gaillardia pulchella*) - 20 plants in 1-gallon containers
- Muhly grass (*Muhlenbergia capillaris*) - 20 plants in 1-gallon containers

Plants were in good condition when received and were watered regularly until planted. Irrigation was conducted using a pump and hose system that extracted water from Turtle Pond.

Planting of the Mound was conducted on June 7 – 14, 2022. While most of the plants were planted on and around the Mound, some were planted in other areas of the Preserve. The soil on the top and sides of the Mound was dry at planting time. The planting process consisted of digging a hole with a shovel, filling the hole with irrigation water, adding a small amount of Hydretain Root Zone Moisture Manager, planting the plant, and irrigating the planting hole a second time. Irrigation occurred every 2 to 4 days after planting until June 24. Heavy rains fell on June 26 prompting the suspension of irrigation.

Planting occurred on the top of the Mound, the slopes of the Mound, and on the flats to the northeast and southwest of the Mound. Plantings on the flats were excluded from monitoring because the objective of this monitoring was to assess plant performance on the mound habitat.

A map was made of the planting area using a GoogleEarth® image. Each plant was given a unique number starting at 1 and was assigned a unique color-coded symbol for each species. Plant positions were relative to one another and provided a reasonable framework for relocating each plant. Locating individual plants was relatively easy over most of the Mound, but it was problematic in the south-central slope area due to the high density of plants and weedy plant growth.

Monitoring began on July 2, 2022, about three weeks after planting was completed. The height of trees and shrubs was measured to the nearest three inches with an eight foot long by one inch diameter plastic pole with markings every six inches. Height was measured from the ground to the tallest live point on the plant. The maximum diameter of groundcovers and grasses was measured using the same plastic pole. Monitoring was repeated on November 27, 2022 (the end of the wet season) and again on July 6, 2023 (near the end of the dry season).

Height and diameter measurements were recorded on field data sheets. A missing size measurement signified a dead/missing plant. Measurements were transcribed to a Microsoft Excel® spreadsheet for the calculation of percent survival, mean size, and mean growth for each species and measurement date. Statistics were calculated as follows:

$$\text{Survival (percent)} = (\# \text{live plants at } T_1 \div \# \text{live plants at } T_0) \times 100$$

$$\text{Mean Growth (feet)} = \text{Mean Size at } T_1 - \text{Mean Size at } T_0$$

Where:

$T_1$  = parameter value at time of measurement (i.e., November 2022 or July 2023)

$T_0$  = parameter value at time zero (i.e., July 2022)

During each field monitoring event, the condition of each plant was visually assessed. This included observations on flowering, fruiting, plant vigor, and moisture stress (i.e., wilted leaves and dry/brown leaves).

Total monthly rainfall reported for Venice, FL (the nearest reporting station) for 2021, 2022, and 2023 is shown in Figure 1<sup>3</sup>. Total rainfall for January through June was 12.6 inches in 2021, 16.37 inches in 2022, and 10.6 inches in 2023. Based in this information, the 2022/23 dry season appears to have been be a severe one. Therefore, the 2023 assessment of the Turtle Pond Mound should be a valid indicator of potential plant survival on Preserve mounds.

Hurricane Ian hit Florida on September 28, 2022. Winds in excess of 100 miles per hour and rainfall in excess of 15 inches (recorded September 28-30, 2022) were reported near the Preserve. Only two pine trees planted on the Mound suffered some degree of windthrow and these trees were subsequently staked in a vertical position. One of the staked pine trees died prior to the monitoring performed on 7/6/2023. The heavy rainfall associated with Hurricane Ian would likely have benefited the July 2023 planting on the Mound in terms of prolonging adequate soil moisture conditions.

Rainfall was observed at the Preserve on June 17, 2023 (estimated to be 2-3 inches) and a second rainfall occurred on 6/21/2023 (estimated to be < 1 inch). Rainfall measured in a newly installed rain gauge located adjacent to the work sheds was 2.2 inches on 6/29/23, 0.3 inches on 7/10/23,

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<sup>3</sup> Rainfall data available at <https://www.venicegov.com/government/utilities/rainfall>. High spatial variability in rainfall in southwest Florida means that rainfall at the Preserve can be very different from rainfall in Venice.

0.4 inches on 7/15, and 3.4 inches on 7/18/23. No additional rain was recorded through 7/30/2023.

### 3. Results

Survival, size, and growth data for each species is summarized in Table 1.

Survival was relatively high on 11/27/22, ranging from 79 to 100 percent. Survival decreased significantly for many species by 7/6/2023. The 2022/23 dry season took the heaviest toll on the survival of blanket flower (11 percent survival) and firebush (27 percent survival).

A species-by-species description of performance is summarized below.

- Blanket Flower – This species began to show signs of stress by 11/27/22 and survival on 7/6/23 was extremely low (11%). The two remaining live plants were flowering on 7/6/23. This species is not well suited for planting on the mounds.
- Dune Sunflower – Although survival on 7/6/23 was marginal (59%), several plantings on the south slope were flourishing. Diameter growth of many of the surviving plants was high on 7/6/23 (mean of 5.2 feet). Several plants had spread to cover large areas (Figure 3). This species spreads by underground runners and/or seeds and produced many flowers throughout the year. The two group plantings on the top of the Mound did not fare as well as those on the slopes. One planting located near the bench was dead by 7/6/23 and the planting on the west side of the top of the Mound showed relatively low vigor. Weed competition was an issue on the top and slope of the Mound, but there were several dense plantings on the slope that dominated the weeds. This species is suitable for planting on the tops and slopes of the mounds.
- Firebush – The species was planted on the south slope and at the toe of the south slope. Many plants had fruit on 11/27/22, but shoot dieback was observed on 4 of 14 plants at that time. Although survival was high on 11/27/22, survival had dropped to 27% by 7/6/23. Many of the surviving plants were in poor condition (Figure 4). One surviving plant was flowering on 7/6/23. This species is not well suited for planting on mounds.
- Gumbo Limbo – This species was planted at two locations on the top of the Mound using three 3-foot-long branch cuttings at each location. Survival of the six cuttings was 100% on 7/6/23. The plants in western-most location were most vigorous than those to the east (Figure 5). These two planting locations are close together (approximately 25 feet apart) and the reason for the difference in vigor is unclear. This species is suitable for planting on the tops and presumably the slopes of the mounds.

- Live Oak – This species was planted on the top and slopes of the Mound. Survival on 7/6/23 was high (92%) with only a single dead plant on the top of the Mound. Height growth was minimal on 7/6/23 (0.1 foot or 2% of mean initial height). This species is suitable for planting on the tops and slopes of the mounds.
- Longleaf Pine – This species was planted on the slope and toe of the slope on the southeast corner of the Mound. Survival was adequate (71%). The two dead plants were located higher up the slope and the condition of some of the surviving plants near the toe of the slope was poor (Figure 6). Growth was minimal which may be related to the grass stage<sup>4</sup> of growth form common to this species. Four longleaf pines were also planted on the top of the big mound on 6/22 and survival on 7/23 was 50% with the two live trees showing possible drought stress symptoms (i.e., browning of needles). This species is not well suited for planting on the mounds.
- Muhly Grass – This species was planted on the toe of the south slope of the Mound. Survival on 7/23 was 74%, but this is likely an underestimate as plants in several areas could not be found because they were covered by tall weeds. Many plants had seeds on 11/27/22. This species is suitable for planting on the slopes of mounds.
- Southern Red Cedar – This species was planted on the north slope of the Mound and had 100% survival on 7/6/23. Several plants suffered from weed competition, but mean height growth was good (1.1 feet or 58% of initial mean height). Owing to the north-facing aspect and presence of some shade, the planting area for this species probably suffers less moisture stress than the south facing slope. None-the-less, this species is suitable for planting on mound slopes.
- Railroad Vine – Three seedlings of this species were planted at three locations on the top of the south facing slope. Survival was probably 100%, although the significant shoot growth observed on 7/6/23 made it difficult to differentiate individual plants. Growth was impressive with multiple shoots extending more than 15 or 20 feet from the planting location. Some flowering was observed on 11/27/22 and 7/6/23. Weed competition is an issue. However, plants are currently growing under and over the weeds. Several dense mats of railroad vine have developed that dominate the weeds (Figure 7). This species is suitable for planting on mounds.

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<sup>4</sup> Both longleaf pine and south Florida slash pine have a grass stage of early growth. The grass stage is typified by a short shoot with a crown of densely packed needles that may persist for 2 to 5 years. During the grass stage the plant develops a deep root system and can withstand ground fires. The grass stage is followed by rapid shoot growth which is thought to be another adaptation to fire because the crown attains a height where it is unlikely to be killed by ground fire.

- South Florida Slash Pine – This species was planted on the top and north/south slopes of the Mound. Overall survival was low (54%). However, survival was a significantly lower on the top of the Mound (25% survival) compared to the slopes (66%). Pines surviving on the top of the Mound were in poor condition and showed signs of possible moisture stress (Figure 8). The reason for lower survival on the top of the mound is unclear. A large number of south Florida slash pines were also planted on the north slope of the big mound on 6/22 and survival there appeared to be 100% on 7/23. Height growth on Turtle Pond Mound was minimal on 7/6/23 (0.4 feet or 9% of initial mean height). This species is suitable for planting on mound slopes.

#### 4. Conclusions and Recommendations

Results of the first year of monitoring indicate that 7 of 10 species planted on the Turtle Pond Mound on 6/22 had sufficient survival to be recommended for planting other mounds on the Preserve (dune sunflower, gumbo limbo, live oak, muhly grass, southern red cedar, railroad vine, and south Florida slash pine). Three of 10 species are not well adapted for planting on mounds (blanket flower, fire bush, and longleaf pine).

A second year of monitoring is recommended to confirm first year results. It is important to determine if dune sunflower and railroad vine can withstand continued weed competition, and if gumbo limbo, live oak, southern red cedar, and south Florida slash pine can survive a second dry season. Data on the second year of growth would also be useful. The need for additional monitoring after year two will be assessed based upon second year results.

#### 5. Additional Comments

A variety of different drought tolerant plant species will be planted on Duckweed Pond mound and Moorhen Pond mound in July/August 2023 including beach creeper (*Erdoea littoralis*), seacoast sumpweed (*Iva imbricata*), gopher apple (*Licania michauxii*), white indigo berry (*Randia aculeata*), and Spanish bayonet (*Yucca aloifolia*). A monitoring program will be developed for these plantings to enhance our understanding of suitable species for planting on mounds.

Additional insight into drought tolerant species can be gleaned from an evaluation of plant survival in planting Area D located west of Hosman Pond. Area D was planted in late 2019 and encompasses a slightly elevated berm created by dredging of the adjacent pond. The berm consists of sandy soil that creates a relatively dry/arid habitat. Although the habitat of Area D is not as dry as that of the mounds, species that can survive in Area D could be candidates for planting on the mounds. Survival and height were measured on March 28/30, 2023. Eastern red cedar, south Florida slash pine, and gumbo limbo had good survival in Area D. In addition, red mulberry (*Morus rubra*), strangler fig (*Ficus aurea*), and wild tamarind (*Lysiloma latisiliquum*) showed high survival. Of these three species, wild tamarind is the most drought tolerant and good candidate for planting on mounds.



Figure 1. Map of the Preserve showing mound locations.









Figure 3. Dense stand of dune sunflower growing on the south slope of the mound dominating weed growth (7/17/23).





Figure 4. Firebush growing at the toe of the south slope of the mound in poor condition (7/17/23).



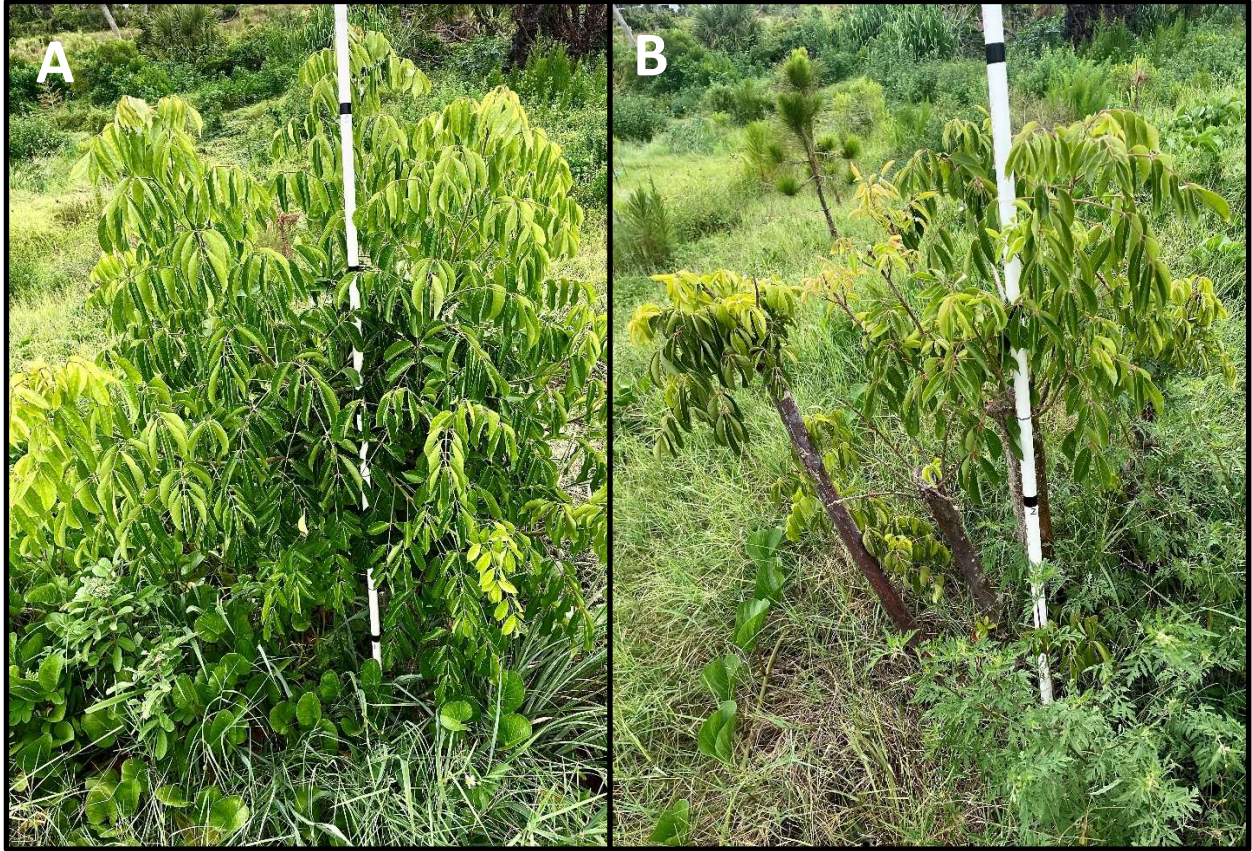


Figure 5. Gumbo limbo growing on the top of the mound, Photograph A is the more vigorous planting and photograph B is the less vigorous planting (7/17/23).





Figure 6. Longleaf pine growing on the toe of the south slope showing signs of moisture stress (7/17/23).





Figure 7. Railroad vine growing at the top of the south slope showing dense growth dominating weed competition (7/17/23).





Figure 8. South Florida slash pine growing on the top of the mound showing possible signs of moisture stress (7/17/23).



Common Name	Scientific Name	# Planted(a) 7/2/22	# Alive 11/27/22	# Alive 7/6/23	% Survival 11/27/22	% Survival 7/6/23	Mean Size 7/2/22 (feet)	Mean Size 11/27/22 (feet)	Mean Size 7/27/23 (feet)	Mean Growth 11/27/22 (feet)	Mean Growth 7/2/22 to 7/27/23 (feet)
Blanket Flower	<i>Gaillardia pulchella</i>	19	15	2	79	11	1.1	1.3	4.0	0.1	2.9
Dune Sunflower	<i>Helianthus debilis</i>	22	18	13	82	59	1.1	3.4	6.3	2.3	5.2
Firebush	<i>Hamelia patens</i>	15	14	4	93	27	2.5	2.3	1.6	-0.1	-0.9
Gumbo Limbo	<i>Bursera simaruba</i>	2	2	2	100	100	3.3	3.5	4.3	0.3	1.0
Live Oak	<i>Quercus virginiana</i>	12	12	11	100	92	4.7	4.6	4.8	-0.1	0.1
Longleaf Pine	<i>Pinus palustris</i>	7	7	5	100	71	2.2	2.3	2.5	0.1	0.3
Muhly Grass	<i>Muhlenbergia capillaris</i>	19	17	12	89	63	0.5	0.9	2.7	0.4	2.2
Southern Red Cedar	<i>Juniperus virginiana</i> var. <i>silicicola</i>	7	7	7	100	100	1.9	2.3	3.1	0.4	1.1
Railroad Vine	<i>Ipomoea pes-caprae</i>	8	8	8	100	100	0.5	10.0	16.3	9.5	15.8
South Florida Slash Pine	<i>Pinus Elliottii</i> var. <i>densa</i>	26	25	14	96	54	4.4	4.6	4.8	0.2	0.4

Notes:

(a) This is the number planted on the mound. Plants were also planted on the flats surrounding the mound and elsewhere on the Preserve.