Can the Use of Surrogate Wrack Promote Survival and Growth of Planted *Uniola paniculata* and Dune Building?

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Questions or Comments?
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Introduction

Increasing stresses on coastal dune ecosystems requires the use of more effective restoration strategies. To promote dune building or maintain dune structure perennial grasses such as *Uniola paniculata* (sea oats) and *Panicum amarum* (bitter panicum) are often installed after existing dunes have been fragmented or destroyed.

Vegetative wrack, defined as beach litter consisting of "algae, grasses, driftwood, fruits, seeds, and carrion, along with cultural litter" that accumulates at the high tide line or as a result of overwash during storm surges is often considered an important marine subsidy for near shore waters and terrestrial coastal communities. Wrack may provide a nutrient supply, protection, a method to retain soil moisture, an obstacle to promote sand accumulation, and a highly heterogeneous surface to catch seeds and therefore increase species diversity and richness. The seagrass component of vegetative wrack acts as a nitrogen source for coastal foredune vegetation while brown algae, another component found in wrack, can also be an important supplier of nitrogen and phosphorus (Williams and Feagin, 2012).

To determine the feasibility of using vegetative wrack and or similar cost-effective organic substances in coastal dune revegetation/ restoration projects to (1) increase the survival, (2) accelerate the growth of coastal dune plant species, and (3) enhance dune building through sand accumulation, we applied a layer of wheat straw to our planting sites. We anticipated increases in survival and growth of planted species and increases in sand accumulation when using wheat straw as a surrogate wrack.

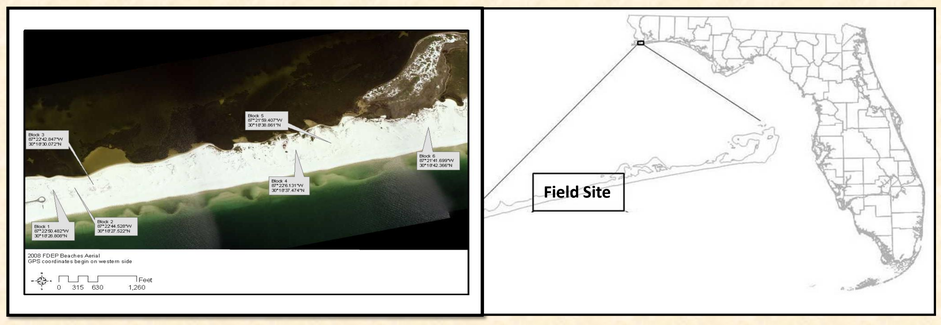

Figure 1. Field site indicating the location of the six replicate sites within Gulf Islands National Seashore Johnson Beach, Perdido Key, Florida.

Methods

Study Site. The study was conducted in Gulf Islands National Seashore (30.306'N, 87.381'W; elevation 0.91 m) located on Perdido Key, Florida about 24 km southwest of Pensacola (Figure 1). Dominant species of the site were *Uniola paniculata, Panicum amarum, Iva imbricata* (beach elder), *Schizachyrium maritimum* (Gulf bluestem), and *Oenothera humifusa* (seabeach evening primrose). Total monthly precipitation ranged from a high of 43 cm in June 2012 to a low of 0.02 cm in October 2011 (NOAA, 2013).

Experimental Design. Planting sites were located on six randomly selected sites with at least 150 m of non-vegetated sand flat parallel to the gulf/bay without dunes on the roadless portion of Perdido Key. Approximately 1000 plugs of *U. paniculata* (spaced approximately 32 cm apart in straight lines) were planted within 21 m × 4 m plots. These plots were divided into subplots two weeks later and one subplot at each site received five bales of wheat straw while the remaining subplot remained bare. This surrogate wrack layer measured approximately 8 inches in depth.

Uniola survival and growth. Survival was evaluated one and six months after planting. Tiller number, tiller height, and basal width were determined prior to aboveground biomass harvest (five plants per subplot) four and six months after planting. Two years after planting, aboveground biomass was harvested from three 0.5 m^2 quadrats within each subplot and inflorescences counted.

Sand Accumulation. Dune profiling was determined by measuring sand accumulation across the centerline of each subplot on a 60 cm interval using a meter stick and line level four, eight, and 28 months after wheat straw application.

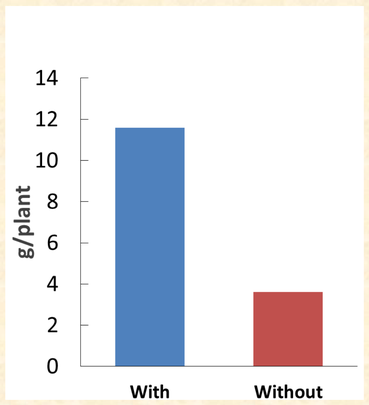

Figure 2. Year one *Uniola paniculata* (sea oats) biomass (g/plant) with and without surrogate wrack.

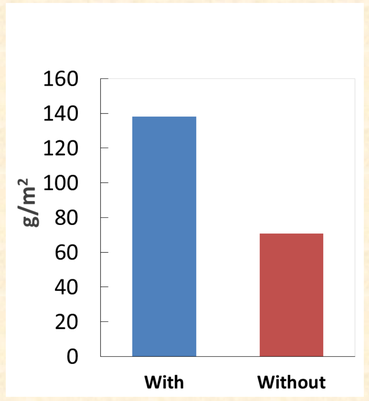

Figure 3. Year two *Uniola paniculata* (sea oats) biomass (g/m^2) with and without surrogate wrack.

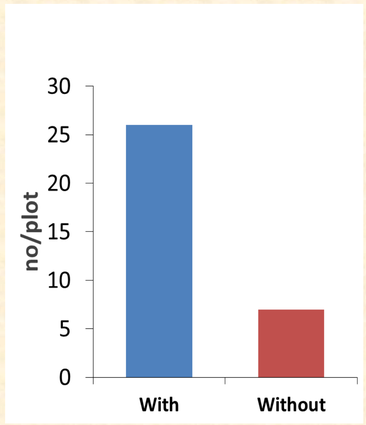

Figure 4. *Uniola paniculata* (sea oats) inflorescence number/plot with and without surrogate wrack.

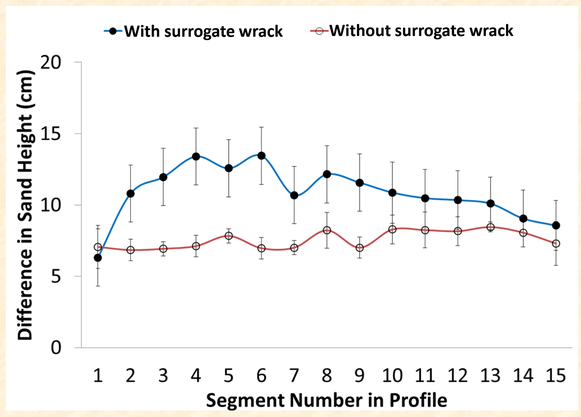

Figure 5. Mean change (±1 standard error, n=6) in sand height (cm) over a 4-month time period (August to December 2010) by 60 cm segments across *Uniola paniculata* (sea oats) plantings with surrogate wrack (8 inches of wheat straw mulch) or without surrogate wrack; segment 1 was outside the plot area and represents bare sand with no sea oats.

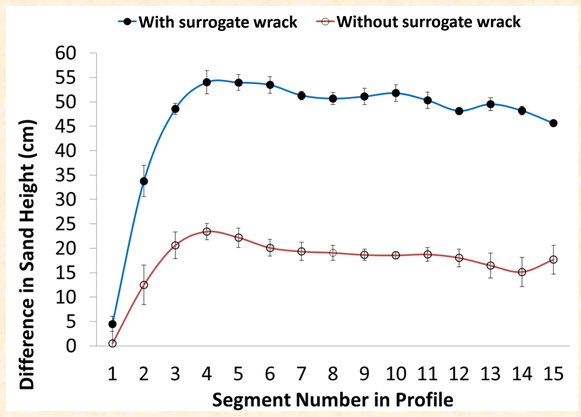

Figure 6. Relative sand height (±1 standard error, n=6) (cm) 2 years after planting (August 2012) by 60 cm segments across *Uniola paniculata* (sea oats) plantings with surrogate wrack (8 inches of wheat straw mulch) or without surrogate wrack; segment 1 was outside the plot area and represents bare sand with no sea oats.

Results

Plant Growth

- *U. paniculata* survival (> 97%) did not differ with or without surrogate wrack.
- Six months after planting all growth measures (mean tiller height, mean tiller number, mean plant width, and mean aboveground biomass) were significantly greater for *U. paniculata* planted with surrogate wrack than without surrogate wrack.
- Two years after planting, above ground biomass remained greater with surrogate wrack than without surrogate wrack (Figures 2 & 3).
- Inflorescence number was also greater with surrogate wrack than without (Figure 4).

Sand Accumulation

- The artificial dune built by the planting reached approximately 0.5 m above the surrounding sand (no plants) two years after planting.
- Sand accumulation was notably greater with surrogate wrack than without wrack eight months after planting although not significantly different (Figure 5).
- Two years after planting, the relative difference in mean sand accumulation (18 cm) between plots with and without surrogate wrack was significantly greater for *U. paniculata* with surrogate wrack than without (Figures 6 & 7).

Figure 7. Sand accumulation and presence of inflorescences with and without surrogate wrack.

Discussion

- Surrogate wrack may have held precipitation near the surface and increased available moisture.
- Increased moisture may contribute to increased growth of *U. paniculata* with surrogate wrack.
- Increased nutrients from the surrogate wrack (wheat straw) may contribute to increased growth of *U. paniculata.*

Implications for Practice

- Surrogate wrack such as wheat straw can potentially benefit coastal dune restoration by increasing the rate of growth of dune grasses such a *U. paniculata*
- Surrogate wrack used with *U. paniculata* improves sand accumulation and therefore, wrack could be used to assist dune building
- Surrogate wrack can be used to accelerate sexual maturity (flowering) of transplanted *U. paniculata*
- Surrogate wrack has the potential for use in dune restoration worldwide

Literature Cited

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