Assessing Genetic Diversity within Populations of Smooth Cordgrass to Ensure Effective Restoration Efforts

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Project Narrative:

Anthropogenic activity has led to a decrease in the health of our natural surroundings and an extreme loss in biodiversity (Ceballos et al., 2015). In order to maintain the environment in a nearly natural state, conservation efforts are needed and have been implemented. These efforts are human-mediated and aim to restore disturbed ecosystems and slow down environmental damage. In population restoration, the main goal is to conserve the biodiversity within a population. By insuring biodiversity within a population we allow species to have the ability to adapt and persist.

The Indian River Lagoon (IRL) is a unique estuary system that provides habitat to fourteen federally listed threatened or endangered species. However, the shoreline has been degraded through coastal erosion from boat wakes and storms causing negative impacts to the entire system. Because of these negative impacts, the IRL is a focus of many restoration efforts to preserve this biodiverse estuarine ecosystem (Dybas, 2002, Walters et al., 2001). In particular, living shoreline restoration projects are being used to dampen the negative impacts caused by use of the lagoon for recreation.

Most shoreline restoration efforts incorporate the use of natural plants along the shore as a means to slow the loss of soil due to erosion. Ideal plants for this use occur naturally, are native, and are easily reared in captivity for transplantation back into the native environment. However, restoration efforts usually do not take into account the genetic implications of using clonal species to restore ecologically important habitats (Oudot-Canaff et al., 2012). Although clonal plants may be easier to raise with regard to number of individual ramets reared, if the genetic makeup of the transplanted samples is not taken into account then the founded populations are likely to be genetically depauperate (Mckay et al., 2005). When asexual species are restored through clonal methods the efforts will often result in a population which will have low genetic diversity, high inbreeding, and inability to adapt to environmental disturbances (Travis et al., 2004).

Figure 1: Smooth cordgrass that is part of a living shoreline restoration effort in the IRL.

A common species transplanted to aid shoreline restoration in the IRL is *Spartina alterniflora* (smooth cordgrass). Smooth cordgrass is naturally occurring along the shorelines of the IRL and has an extensive rooting capacity which can reduce tidal wave energy, thus decreasing erosion along the shoreline (Mitch et al., 2002, Crossman et al., 1990). Due to *S. alterniflora's* ecological functions and strong influence on other species, smooth cordgrass is considered a keystone species and is used as a reference to determine the health of its ecosystem. This ecological important species typically has high levels of genetic diversity, and can easily adapt within its environment (Novy et al., 2010) and provide favorable habitat for dependent animal communities (Wimp et al. 2004). Overall, preservation of this species in the IRL is necessary to maintain the natural functionality of the IRL (Proffit et al., 2005).

Although smooth cordgrass predominantly reproduces through clonal growth, it has the ability to disperse seeds. Even though recombination is possible within this species, often clonal restoration can lead to inbreeding depression (Travis et al., 2004). Therefore, restoration efforts within the IRL have been designed to include multiple individuals collected from unique locations to try to ensure clonal populations have adequate diversity (Travis et al., 2004).

There is still a potential cost of using greenhouse plants for restoration. In the greenhouse there is relaxed selection pressures, therefore the successful greenhouse individuals might not survive once these individuals are transplanted for restoration. Therefore, it is possible that restored populations over time become genetically depauperate in the IRL due to limited success of genotypes.

This species ecologically functions as a keystone species and has an important role in its ecosystem; the preservation of this species in the IRL is necessary. Overall, this study seeks to assess the ability of our restoration efforts to maintain genetic diversity within restored populations of the IRL. This project will compare genetic diversity among natural, greenhouse grown and restored populations of *S. alterniflora*.

In order to address our question, we collected clippings from 33 individuals of *S. alterniflora* from 10 populations, including five restored populations, four natural populations, and one greenhouse population. The four natural populations that should represent a diversity of naturally occurring smooth cordgrass populations based on collection techniques. Smooth cordgrass that was used to create the restored populations was collected originally from Mosquito Lagoon and then grown for 1-6 months at the UCF Greenhouse before being transplanted back in the IRL as part of a shoreline restoration project. We collected greenhouse samples to determine if *ex situ* rearing reduced natural levels of genetic diversity within populations of smooth cordgrass before transplantation occurs. All samples used in this study were collected under permits obtained by Dr. Linda Walters.

Samples were stored in silica gel to dry the tissue prior to DNA extraction. We extracted DNA using a SeraPure Bead extraction protocol. To assess genetic diversity, we will utilize 12 microsatellite loci that have previously been identified for this hexaploid species (Blum et al. 2004, and Guo et al. 2013). Microsatellite PCR products will be genotyped at the University of Arizona Genetics Core (UAGC). Using these 12 loci, we will be able to estimate genetic diversity within and among populations. From these data, we will be able to assess the health and stability of our restored populations and ensure that our conservation efforts will be successful overtime.

By examining the population genetics of restored and natural populations of smooth cordgrass we will be able to identify a reliable method for selecting transplant individuals for long-term shoreline restoration efforts in the IRL. Through identifying how current restoration efforts are affecting the genetic diversity within the IRL we will be able to assess the effectiveness of our current efforts and rehabilitate any populations with low levels of genetic diversity. Since *S. alterniflora* is ecologically important to the IRL, the diversity within these populations must be maintained to ensure shoreline stability within this ecosystem.

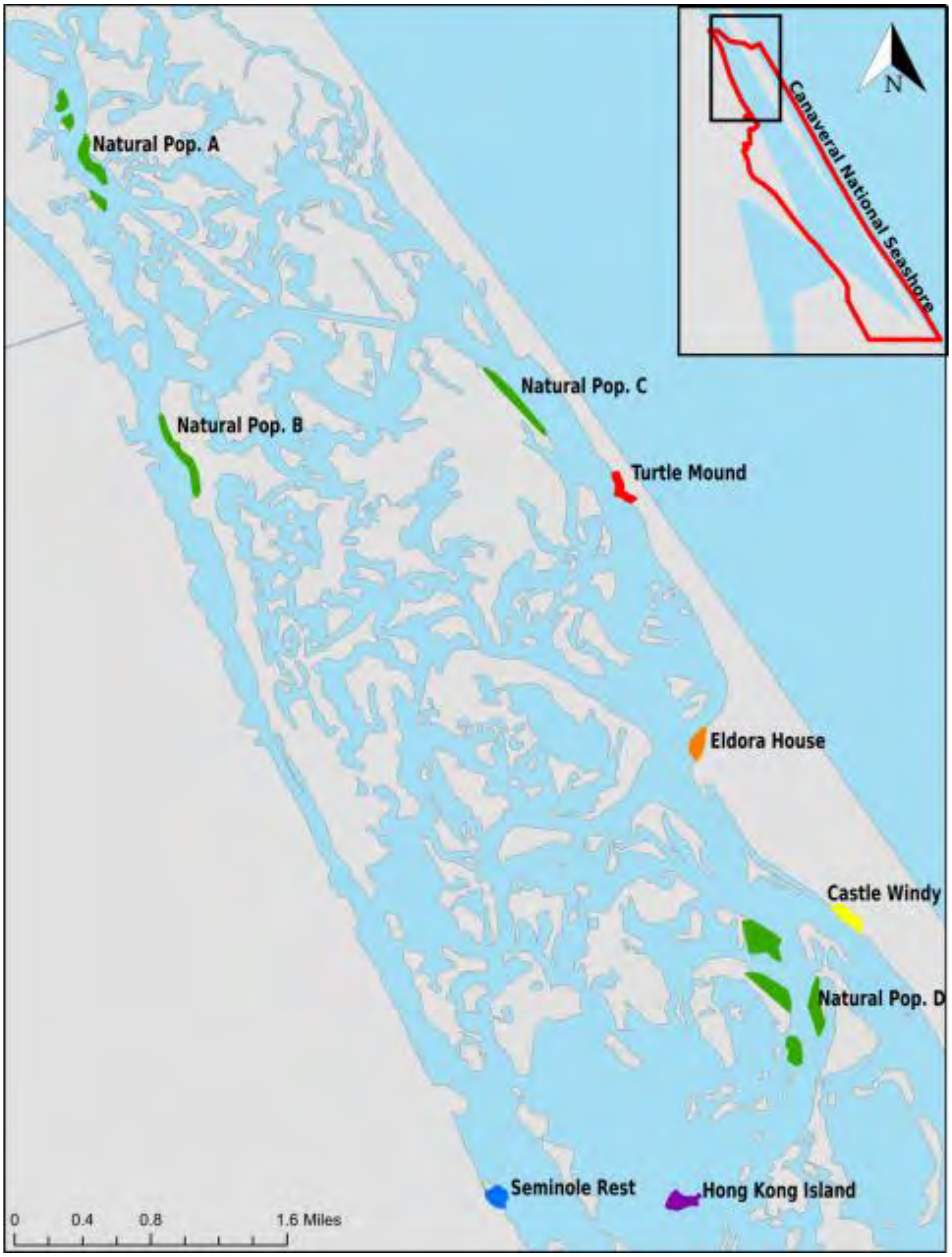

Figure 2: Restored populations and natural populations that have been sampled within the Indian River Lagoon.

Literature Citations:

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Budget:

The sampling portion of this project has been completed, DNA has been extracted from all samples. We have funding to complete genotyping of 9 of our 10 populations for 12 loci. The project lacks sufficient funding to cover the remaining genotyping cost for our greenhouse population. Greenhouse samples will allow us to determine if *ex situ* rearing reduced natural levels of genetic diversity within populations of smooth cordgrass before transplantation occurs. After genotyping, we can use our data to determine levels of genetic diversity in natural, restored, and greenhouse-grown populations. This is the last step before we can use our data to inform our restoration efforts. Therefore, I am requesting funding to support genotyping of our greenhouse samples:

(1 populations) x (33 individuals) = 33 samples

12 loci/ (2 loci per plate via pooling of fluorophores) = 6 genotyping runs

6 genotyping runs x 33 samples (@ $1 per sample) = $198

Total requested: $198