CALFED Progress Report
California Sea Grant College Program

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ProjectYear_2A: 2nd

ProjectNo_2C: R/SF-37PD

TypeQuestionnaire_2B: Interim Questionnaire

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Project Information

ProjectNo_2C: R/SF-37PD StartDate_3a: 5/1/2009 EndDate_3b: 12/31/2011
ProjectTitle_4: Frequency, Distribution, and Ecological Impact of Cryptic Hybrid Invaders: Management Tools for ERadication of Invasive Spartina

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Project Objectives: Please type your responses, and answer the questions in a style appropriate for laymen.

ProjectObjectives_10

Spartina alterniflora x foliosa is a noxious weed of San Francisco estuary salt marshes. It outcompetes native Spartina, fills in open mudflats and tidal channels, and colonizes the high intertidal, displacing native flora and fauna. It is a hybrid of the native S. foliosa and the introduced S. alterniflora, and while many hybrids are visibly larger than the native Spartina foliosa, some individuals may blend in with the native population. CALFED, the California Coastal Conservancy, and other government agencies fund that Invasive Spartina Project (ISP) with the goal of eradicating all non-native Spartina from the region. The ISP is concerned about the high number of plants that are identified in the field as native but are genotyped in the laboratory as hybrids. These "cryptic hybrids" may evade control efforts. The goals of this project are:

1. To determine the frequency of morphologically cryptic hybrids; that is, plants that are genetically hybrid but which are physically indistinguishable from the native population.
2. To improve the methods used in genotyping Spartina, and to determine how often the differences between field and laboratory identification are due to errors in laboratory genotyping.
3. To determine if cryptic hybrids pose the same ecological problems as the larger, morphologically evident hybrids.

Summary of progress in meeting each of these goals and objectives

ProgressSummary_11

1. To determine if differences between field and laboratory identification are due to overlapping morphology in native and hybrid Spartina, I randomly sampled and measured 96 plants in four marshes. For the genetic testing I classified plants into three groups: pure native (0% of genetic markers were exotic), low-percent hybrids (10-30% of genetic markers were exotic), and high-percent hybrids (40-60% of markers were exotic). 25% of samples were hybrids; of those, 75% were low-percent hybrids, and 25% were high-percent hybrids. Morphological measurements showed that high-percent hybrids were clearly distinct from natives. However, low-percent hybrids look very similar to natives and many cannot be distinguished either by visual identification, nor by quantitative measurements coupled with statistical analysis.
2. To improve the method for genotyping Spartina and establish the rate of false positives (native plants that are genotyped as hybrids), I tested a newer, more reliable method for identifying hybrids: using microsatellite markers in conjunction with a population assignment software program, STRUCTURE. Past genotyping of Spartina was done with RAPD markers, a method that is now considered less reliable than newer approaches. My results showed that RAPDs were usually correct, although they did falsely identify 3% of native samples as hybrids. The high concordance between microsatellites and RAPDs suggests that most disagreements between genetic and field identification are due to the overlap in morphology between low percent hybrids and natives. There were no false negatives (samples that were identified by RAPDs as native when they were in fact hybrid). However, my work thus far has focused mainly on high percent hybrids and sites with relatively little interspersion of hybrids and natives; further comparing the reliability of RAPDs and microsatellites in more difficult circumstances may show that RAPDs do sometimes falsely identify low-percent hybrids as native.
3. The principal problems posed by large, evident hybrids are that they outcompete native Spartina, and they are capable of growing higher and lower in the intertidal than the native. However, we do no know whether cryptic hybrids will behave more like the robust, high-percent hybrids, or if they resemble native Spartina closely in their ecology as well as their morphology. To investigate this question, I have planted 150 genets of varying percent hybridity and morphology in plots from the low to the high intertidal. I am still in the process of measuring the relative fitness and competitive ability of each genet; I will have final results in fall 2011.

PROJECT MODIFICATIONS: Please explain any substantial modifications in research plans, including new directions pursued. Describe major problems encountered, especially problems with experimental protocols and how they were resolved. Describe any ancillary research topics developed.

Modifications_12

This project has been modified in two major ways since its inception. First, I originally planned to explore objective 3 with a mesocosm experiment because I thought I would be unable to obtain permission to plant hybrid Spartina in the field. However, by working with the Invasive Spartina Project and East Bay Regional Parks District, I was able to obtain permission to conduct the experiment in the field. This will yield more realistic results than a mesocosm experiment.

The second major modification is I added more treatments to the field experiment. I originally planned to explore only the ability of cryptic hybrids to spread in the low intertidal. I added plots in the high intertidal so I could also test their ability to spread in the high intertidal, where hybrids can potentially displace native pickleweed and grindelia.

BENEFITS AND APPLICATIONS: Suggest the relevance of these new findings to management. Describe any accomplishment, that is significant effects your project has had on resource management or user group behavior. CALFED is looking for "management cue" (see http://science.calwater.ca.gov/pdf/soemgmtcues.pdf).

BenefitsApplic_13

1. The results from Objective 1 indicate that visual identification in the field of low-percent hybrids can be difficult, if not impossible. However, managers can be reasonably confident that they are able to field-identify high-percent hybrids. Low-percent hybrids may escape control efforts; further exploration of the potential ecological impacts of low-percent hybrids (Objective 3) is needed to determine if low-percent hybrids are an ecological threat, or a relatively benign addition to local salt marshes.
2. The Invasive Spartina Project is now using microsatellites in conjunction with STRUCTURE in place of the old method of using RAPD markers. The ISP and I continue to work together to improve their methods for genotyping.
3. The results of Objective 3 will help managers decide if low-percent hybrids pose and ecological risk to salt marshes. It may turn out that plants below a certain threshold of percent hybridity are so similar to native plants that they can be considered an acceptable addition to the ecosystem.

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PUBLICATIONS: List any publications, presentations, or posters that have resulted from this funded research. Give as many details as possible, including status of paper (e.g., in review; in press), journal name, conference location and date of presentation. Please note (as outlined in the conditions of the award) that each fellow is required to submit an abstract for an oral or poster presentation at each State of the Estuary conference and CALFED Science Conference during the duration of the fellowship.

Publications_14

COOPERATING ORGANIZATIONS: List those agencies and/or persons who provided financial, technical or other assistance to your project since inception. Describe the nature of their collaboration.

CoopOrganiz_15

Invasive Spartina Project provided assistance with locating samples, use of a GPS unit, and obtaining permits.
East Bay Regional Parks District gave permission for use of their land for the field experiment.
Debra R. Ayres, Christina Sloop, and Michael Blum provided assistnace with genetic methods.

AWARDS: List any special awards or honors that you, or mentor or members of the research team, have received during the duration of this project.

Awards_16

KEYWORDS: List keywords that will be useful in indexing your project.

Keywords_17

Spartina, cordgrass, salt marsh, San Francisco Bay, tidal wetlands, invasive species, hybrids, molecular ecology

PATENTS: List any patents associated with your project.

Patents_18

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Additions: Additional information can be added here. Please begin the text with the number of the question you are adding to.

Additions_19