National Fish and Wildlife Foundation
Final Programmatic Report

Project Name and Number: Seagrass restoration in Tampa Bay: long term studies

Proposal # 10024

Recipient Organization/Agency: University of South Florida

Recipient Organization Web Address: www.usf.edu

Date Submitted: Sept. 29, 2008

1) Summary of Accomplishments

Our study of seagrass restoration at Shell Key provides compelling evidence for the need for long term monitoring to assess the success of a restoration effort. Seagrass cover in restoration plots more than doubled from year 4 to years 5 and 6. After 5-6 years post planting restored areas at Shell Key had close correspondance to biotic characteristics of much longer established beds and seagrass cover. At the Lassing Park restoration site large areas of bare sediment were found in areas previously covered by seagrass but later replaced by blooms of the macroalga, *Caulerpa prolifera*. In contrast, bare sediment areas were not as abundant in natural reference sites where macroalgal blooms had also been present. Thus the restoration site might take longer to recover seagrass cover similar to that observed prior to the alga blooms. Both sets of results indicate that monitoring programs may need to be performed well beyond the typical 3 year period. Finally, video monitoring of seagrass plots can assist in collecting information over large areas.

2) Project Activities & Results

Activity	Project output	Post project outcomes	Indicator
Sample replanted seagrass habitats	Data collected to evaluate time course of restoration of plant coverage and other ecosystem measures	Ability to develop effective coastal management programs	Information made available
Sample replanted seagrass habitats	Data collected to evaluate potential threats to seagrass persistence	Sustained capacity to determine patterns and long term changes in coastal ecosystems	Information made available
Evaluate underwater videography as a monitoring tool	Data collected for large scale assessment of vegetation cover including seagrass and competing macroalgae	Transferability of methodology to other habitats of interest	Use of new techniques
Present results at meetings and in publications	Increased understanding among managers and researchers of timeline of restoration	Ability to develop effective coastal management	5 year data set
Evaluate underwater videography as a monitoring tool	Data collected for large scale assessment of vegetation cover including seagrass and competing macroalgae	Transferability of methodology to other habitats of interest	Comparison of two techniques

Activities

A first objective was to expand our studies of seagrass restoration. We proposed to add Lassing Park, a site of seagrass (*Halodule wrightii*) restoration in 1987, to our assessment of restoration success. Although studies show that the site has developed similarly to that of a reference area, the site experienced sudden and sustained increases in the alga, *Caulerpa prolifera*; our previous studies show this alga can displace seagrass. One concern is whether restored areas, in a way similar to naturally established beds, can withstand challenges from disproportionate increases in a species or disturbances events. The inclusion of the Lassing Park area in our efforts offers an unique opportunity to evaluate whether a restored site exhibits resilience, i.e. maintaining seagrass, perhaps the ultimate test of restoration success.

The second objective of this study was to continue long term assessment of Shell Key plots, taking advantage of the protocols we have established and resources in place, assessing whether/when the restored plots develop measures of plant abundance that mimic reference conditions. We also proposed some additional measures of seagrass structure/function by assessing epiphyte cover on seagrass blades and abundance of infauna in restored vs. reference sites. Using information gathered from these efforts we can provide unique data that are currently unavailable but critical for supporting restoration as a useful management approach.

Discrepancies between the activities conducted during the grant and the activities

To date we have completed all our proposed samplings of both Shell Key and Lassing Park. Video sampling on one date at Lassing Park was unsuccessful because cameras were found to be inoperable and after much testing of the video recording system, the camera ultimately had to be replaced. Likewise sampling in winter months at Shell Key became unfeasible because of poor weather conditions and poor tidal heights that hindered recording of seagrass cover. We collaborated with Dr. Eric Steimle, who also has developed automated monitoring techniques to assess underwater vegetation, and submitted a proposal to Florida Sea Grant to meld our techniques together. This proposal was not funded but we now have a good understanding of what work needs to be done to combine our efforts. Interpretation of video monitoring required more time than we originally expected and therefore while we have completed our data analyses and presented them in this report, we have not yet submitted our work for publication or presented the results. Note also that some of our timetable had to be altered because of issues with getting project monies to USF in a way that allowed us to hire staff to work on the project.

Results

Video recording and assessment of the status of seagrass restoration: Lassing Park

We evaluated the usefulness of using video recordings to assess seagrass distribution at Lassing Park, near St. Petersburg, FL. Lassing Park was the site of a restoration effort in 1987 and we have been following the success of seagrass restoration over 20 years. Two tasks were accomplished: 1) we evaluated how many video frames from underwater mapping were able to be categorized as an overall measure of the efficiency of the methodology and 2) we assessed the status of the seagrass restoration project in 2007 and 2008.

Based on video recordings from April 2008 we determined that 83% of all video frames (n=442) subsampled for the analysis were able to be visually interpreted and presence/absence of seagrass species recorded. Of those frames not interpretable, turbid water caused by sediment resuspension (linked to boat stopping, turning and sled movement) was the main obstacle. Infrequently, pieces of algae were caught on the camera and obstructed the view. Overall we were able to visually identify seagrass in video analysis conducted at this site given the water clarity; an improved number of frames might be interpreted if boat movement is carefully performed.

Underwater filming of seagrass was conducted on 3 different dates at Lassing Park (spring 2007, winter 2008, spring 2008) and a total of 2806 frames were visually interpreted in the laboratory. Using established Braun Blanquet techniques we collected information on the percent cover of all seagrass species and the macroalga, *Caulerpa prolifera,* in each frame. Similarly we also recorded the amount of bare space. Throughout the Lassing Park site, the seagrass *Halodule wrightii* occurred most often with 100% cover, and *Thalassia testudinum* was second most abundant. *Syringodium filiforme* was recorded only infrequently.

Impacts of *Caulerpa prolifera* on a restored seagrass site at Lassing Park

In 2006, *Caulerpa* covered a large area centered on of the site of the original restoration area planted in 1987. In spring 2007 *Caulerpa* abundance dramatically decreased from 32% of the total area of Lassing Park, recorded in 2006, and but a few isolated patches persisted through 2007. Our video analysis conducted in winter 2008 and spring 2008 indicated that no *Caulerpa* was found within the restoration area within which *Caulerpa* was previously recorded and from which video frames were examined. Likewise, no *Caulerpa* was found in any of the video frames that were sampled from nearby reference areas within Lassing Park. In plots where seagrasses, *Thalassia testudinum* and *Halodule wrightii,* were present, their percent cover scores were similar in both restoration and reference sites. Over the three samplings analyzed, the most notable and unexpected result was that, 48-60% of video frames categorized as 100% bare were found within the restoration site while only 15-20% of frames surveyed in the reference site had 100% bare cover. Thus new seagrass recruitment to areas where *Caulerpa* had been established for the previous 3 years appears to be lower in the restored site than in reference areas.

Shell Key Seagrass Restoration

We conducted 3 field surveys of 10 plots into which seagrass (*Halodule wrightii*) was planted in 2002. These plots were originally bare and lacking seagrass cover. Our surveys assessed seagrass cover by using the Braun Blanquet technique at each of 500 points with the 10 plots. These data were then analyzed to determine how much of the plot was covered by seagrass at a BB score that was similar to or exceeded nearby that recorded in natural areas (BB=3).

A number of notable findings are presented in Tables 1-5. Among the plots, there are large differences among seagrass cover. Seven plots had greater than 60% of the 500 points surveyed with BB scores ≥ 3, reflecting levels of seagrass cover similar to that of reference areas (Table 1). Yet some plots remain largely unvegetated. Median BB scores from the winter sampling were sometimes lower than that recorded in previous summer sampling conducted at the same plot, reflecting winter die back of seagrasses at the site.

Those plots with the highest cover scores in 2007-08 had high seagrass cover scores in previous years (2003-06). Total seagrass cover across all plots increased by over 200% in 2007 compared to 2006 when the same plots are examined (Table 2). In 2007-08, however, seagrass cover scores of BB≥ 3 in plots 4 and 5 were recorded at over 70% of locations, a very large increase compared to earlier monitoring levels in 2003-06. Likewise, from 2007-2008 there was generally little change in seagrass cover within plots and across the entire site; in only 1 plot was there a greater than 10% change in percent cover (Table 3). There is a trend for seagrass to lose distinct patch shape after 6 years (number of patches per plot decreases) with plots tending to have one to few very large patch areas covered by seagrass (Table 4).

Additionally, we measured the distance seagrass extended beyond the original dimensions of the 10 plots established in 2002. In summer 2008 at 50 points beyond the plot borders we recorded the distance over which seagrass cover at a BB score of ≥ 3 was present. As shown in Table 5, a total of 5730 m^2 of new seagrass growth was recorded growing beyond the plot dimensions. We had not predicted that this amount of growth beyond plots would be recorded, given our earlier work.

We also examined measures of seagrass abundance (shoot density, aboveground biomass, below ground biomass) in cores taken both within restoration plots of established seagrass cover and in natural references areas of seagrass in 2007 and 2008 (Table 6). In all cases no significant differences were detected among these measures between restored and reference areas. Likewise samples taken in 2007 from 7 additional reference sites within Tampa Bay at similar depths and dominated by *Halodule wrightii* seagrass were also similar to the reference and restored sites at Shell Key. Thus the restored beds resemble a broad group of natural references areas, not only that from Shell Key.

Other measures of ecosystem function: Epiphytes and Infauna

Epiphyte biomass on seagrass blades was generally low but similar to that recorded from blades in the reference area (Table 7). Infauna in restored seagrass beds across all major faunal groups (polychaetes, bivalves, gastropods and “other”) was similar in density from that recorded from natural reference areas, in both 2007 and 2008 (Table 8). However, there were some noted differences in infaunal densities in sites supporting seagrass (either in natural areas or restored plots) versus bare areas. These results suggest that in restored sites, not only are the measures of seagrass abundance similar to that of natural beds, but also that organisms attached to blades or inhabiting the sediments surrounding the plants have attained levels that mirror natural conditions.

3) Lessons Learned

A. Establishment of seagrass at restoration sites may take more than the typical 3 years included in a monitoring program to assess whether it is successful. Even small patches observed in year one can expand into areas of high cover after 5 years as our data show.
B. By including multiple reference sites in a study and not just one located near the restoration site, managers can utilize a broader set of data for judging restoration success. This may be important if reference areas near restoration sites have some unique properties.
C. Collecting detailed spatial information can provide insight into the development of seagrass cover. As shown in this study, arguments can be made to consider the inclusion of seagrass that expanded outside of plots when assessing the amount of seagrass coverage from a restoration effort. Some standardized methodology could be established so that this is conducted in a consistent manner.
D. Video analysis of seagrass distribution and abundance is a tool that allows rapid collection of information over a large area. However a limiting factor is the amount of time required to interpret the video;this needs to be considered when incorporating this technique into a monitoring program.

4) Dissemination

Our work was concluded on June 30, 2008 and we will be presenting our results at the Southeastern Estuarine Research Society meetings in Tampa in fall 2008. Dr. Penny Hall, FWC, will use results to report to a State of Florida working group on seagrass restoration in Fall 2008. Likewise we have a manuscript being developed to describe our results that will be submitted by the end of 2008. We have posted our recommendations for restoration assessment at http://shell.cas.usf.edu/~sbell/index.html.

5) Project Documents

a) Include with your report 2-10 representative photos from the project. Photos need to have a minimum resolution of 300 dpi. These are attached.
b) See attached tables.

POSTING OF FINAL REPORT: *This report and attached project documents may be shared by the Foundation and any Funding Source for the Project via their respective websites. In the event that the Recipient intends to claim that its final report or project documents contains material that does not have to be posted on such websites because it is protected from disclosure by statutory or regulatory provisions, the Recipient shall clearly mark all such potentially protected materials as "PROTECTED" and provide an explanation and complete citation to the statutory or regulatory source for such protection.*