Title
Estimating the Impact of Invasive Spartina densiflora on Primary Productivity in Humboldt Bay

Permalink
https://escholarship.org/uc/item/2f05550r

Author
Purcell O'Dowd, Alison

Publication Date
2012-04-15

Project Information

Year	
Number R/ANS-213	**Grant No.:** NA10OAR4170060
	Start Date: 7/1/2010 **Completion Date:** 3/31/2012
Title Estimating the Impact of Invasive *Spartina densiflora* on Primary Productivity in Humboldt Bay	

Project Leader

Last Purcell O'Dowd   **First** Alison   **Init**

Institution Humboldt State University

Department Environmental Science and Management

Address 1 Harpst Street

City Arcata   **State** CA   **Zip** 95521

Phone (707)826-3438   **Fax**

Email Alison.ODowd@humboldt.edu

Position Title

Project Leader

Project Hypothesis

Invasive dense-flowered cordgrass (*Spartina densiflora*) is impacting the primary productivity of Humboldt Bay salt marshes.

Project Goals and Objectives

1. Establish an accurate measurement of the impact of *S. densiflora* on primary productivity within a Humboldt Bay salt marsh.
2. Develop a method for the calculation of primary productivity that would allow for accurate estimation of primary productivity using selected metrics that can be sampled efficiently over a much larger sampling area.
3. Inform managers, decision makers, educators, and the public about the impact of invasive *S. densiflora* on the native Humboldt Bay ecosystem via outreach and educational opportunities.

Briefly describe project methodology

Portable in-situ closed-chamber atmospheric carbon dioxide flux measurements combined with biomorphometrics and biomass analysis were used to obtain a clear assessment of the impact of *S. densiflora* on the primary productivity of a Humboldt Bay salt marsh. Atmospheric carbon dioxide flux measurements were used to obtain values of net ecosystem exchange, ecosystem respiration, and gross primary productivity. Biomass analyses were used to obtain values of net primary productivity.

Every three months for a duration of one year aboveground and belowground biomass samples were collected. California Conservation Corps crews and Humboldt State University student volunteers assisted with large scale sample collections. In addition to carbon content, the following measurements of vascular plant species present in collected biomass samples were obtained: stem density, aboveground height, and volume. These data were used to create biomorphometric regression analyses that provided a non-destructive estimate of volume measurements within sampled plots.

During the same period that biomass samples were obtained, atmospheric carbon dioxide flux measurements in light and dark conditions were also obtained in sampled plots. In addition, the following measurements were obtained in each sampled plot: photosynthetically active radiation, air temperature, relative humidity, stem density of vascular plants, aboveground height of vascular plants, and cover class assessments of halophytes.

Using these data, we constructed models based on multivariate regression that can be used to predict primary productivity values. Our regression models can be used in a larger study to accurately measure the primary productivity of the salt marshes of Humboldt Bay and adjacent estuaries.<

Describe progress and accomplishments toward meeting goals and objectives.

All goals and objectives have been accomplished.

PROJECT MODIFICATIONS: Explain briefly any substantial modifications in research plans, including new directions pursued and ancillary research topics developed. Describe major problems encountered and how they were resolved.

We obtained yearly net primary productivity measurements using biomass analyses. However, we determined that an estimation of all annual primary productivity measurements would not be feasible due to the incredibly large sample size that would be required for statistical analysis of the yearly variation of all autotrophs present in sampled plots; therefore, estimates of yearly net ecosystem exchange, ecosystem exchange, and

gross primary productivity were not generated by this study. In lieu of yearly estimation of these primary productivity measurements, we elected to focus our efforts on four analyses carried out every three months during a period of one year. These data allowed for a comparison of relative primary productivity in *S. densiflora* dominated as well as native plant dominated sample plots. We feel that this information will provide valuable insight into the impact of *S. densiflora* on the primary productivity of Humboldt Bay salt marshes.

Due to the large change in photosynthesis rates observed in-situ in sample plots as a result of temporal variation in atmospheric conditions, we elected to measure carbon dioxide concentration changes in two chambers at the same time instead of using one chamber in different locations at different times. Using two chambers allowed for simultaneous measurement of *S. densiflora* dominated as well as native plant dominated sample plots.

Due to the extremely large sample size that would be required to obtain statistically significant measurements of primary productivity at different elevations within a salt marsh, all samples were located at a uniform elevation that included *S. densiflora* dominated areas as well as native plant dominated areas.

PROJECT OUTCOMES: Briefly describe data, databases, physical collections, intellectual property, models, instruments, equipment, techniques, etc., developed as a result of this project and how they are being shared.

1. We discovered that *S. densiflora* decreases net primary productivity at our study site.

2. We discovered that *S. densiflora* decreases net ecosystem exchange at our study site.

3. We discovered that less photosynthetically acitive radiation reaches benthic macroalgae in areas dominated by *S. densiflora* at our study site.

4. We discovered that less benthic macroalgae was present in areas dominated by *S. densiflora* at our study site.

5. We discovered that benthic macroalgae cover was a strong predictor of net ecosystem exchange at our study site.

IMPACTS OF PROJECT: Briefly describe how this project has contributed to a discipline; to developing human resources; to developing physical, institutional or information resources; technology transfer; and society beyond science and technology. Please notify CASG of impacts that occur after your project ends; CASG may contact you after your project ends to learn about additional impacts that occur over time.

1. A better understanding of the impact of invasive *S. densiflora* on the primary productivity of Humboldt Bay salt marshes.

2. Development of methods for the estimation of the impact of *S. densiflora* on the primary productivity of salt marshes in Humboldt Bay and adjacent estuaries.

3. Humboldt Bay *S. densiflora* primary productivity impact data could be used for an evaluation of the impact of *S. densiflora* on the Humboldt Bay carbon budget and other ecosystem services worth millions of dollars.

4. Humboldt Bay *S. densiflora* primary productivity impact data could influence management decisions related to *S. densiflora*. The eradication of *S. densiflora* from Humboldt Bay could cost between four and eight million dollars, therefore information related to the impact of *S. densiflora* could have a significant economic impact if it influenced management decisions.

BENEFITS, COMMERCIALIZATION, AND APPLICATION OF PROJECT RESULTS: Please list any companies, agencies, organizations or individuals who have used your project results, scientific/technical advice, etc., and provide names, emails and phone numbers. Briefly describe how results were used and quantify results and socioeconomic benefits, if possible.

An understanding of the impact of invasive *S. densiflora* on the primary productivity of Humboldt Bay salt marshes will greatly benefit regional management decision processes and provide valuable advances in the understanding of the impact of invasive species in general. The methods that were developed for this project are invaluable for a further evaluation of *S. densiflora* primary productivity impacts throughout Humboldt Bay and adjacent estuaries. In addition, in-situ evaluation of changes to primary productivity at a finer scale that that provided by gas flux tower measurements or spectral imagery is a relatively poorly developed field that will most likely be used increasingly in the future, therefore refinements of methods will be helpful to future researchers.

ECONOMIC BENEFITS generated by discovery, exploration and development of new, sustainable coastal, ocean and aquatic resources (i.e., aquaculture, marine natural products, foods, pharmaceuticals).

Issue-based **forecast capabilities** to predict the impacts of a single ecosystem stressor, developed and used for management (i.e., climate change, extreme natural events, pollution, invasive species, and land resource use).

The models developed by this study allow for analyses of the impact of S. *densiflora* throughout Humboldt Bay and adjacent estuaries. Additionally, the results of this study, when combined with the results of related studies of *S. densiflora* in Humboldt Bay, produce a much better understanding of the role of *S. densiflora* in the ongoing modification of Humboldt Bay.

Tools, technologies and **information services** developed (i.e., land cover data, benthic habitat maps, environmental sensitivity index maps, remove sensing, biosensors, AUVs, genetic markers, technical assistance, educational materials, curricula, training).

Publications (list in appropriate category below) Each listing should be a stand-alone bibliographic reference, including all authors' names. For each Publication type, specify title, authors, date and journal details, where appropriate (repeat headers as necessary).

Technical Reports

Title	Authors	Date

Conference Papers, Proceedings, Symposia

Peer-reviewed journal articles or book chapters

Non-peer Reviewed Reprints

Publications, Brochures, Fact Sheets

Books & Monographs

Handbooks, Manuals, Guides

Electronic publications: (non-print formats).

Maps, Charts, Atlases

Theses, dissertations

Newsletters, periodicals

Program reports (annual/biennial, strategic plans, implementation plans)

Educational Documents

Topical Websites and Blogs

Miscellaneous documents (not listed above).

MEDIA COVERAGE: Select 'Yes' or 'No'. If yes, describe any radio, TV, web site, newspaper, magazine coverage your project has received. Send original clippings or photocopies to the Sea Grant Communications Office.

None at this time.

MEDIA NOTES: Brief description of the type media coverage your project has received.

DISSEMINATION OF RESULTS: List any other ways in which results of your project have been disseminated. Indicate targeted audiences, location, date and method.

Results of this study will be sent in an advisory letter to the management decisions of the Humboldt Bay National Wildlife Refuge in Loleta (California), the California Coastal Conservancy in Oakland (California), and H.T. Harvey and Associates in Arcata (California).

Additionally, Humboldt State University students and California Conservation Corps workers who assisted with this project function as vectors for the dissemination of information throughout the local community. Additional outreach takes place at volunteer and educational activities regarding *S. densiflora* in Humboldt Bay, such as the annual People for Pickleweed *S. densiflora* removal event that is organized by the Humboldt Bay National Wildlife Refuge and Friends of the Dunes.

WORKSHOPS AND PRESENTATIONS: A brief description of location, date, time, topic, number of attendees and name of presenter.

"A Research Design to Estimate the Contribution of *Spartina densiflora* to Net Primary Productivity of Humboldt Bay's Salt Marshes" was presented at the Symposium on the Control of Invasive *Spartina densiflora* and Restoration of Native Salt Marshes in Eureka (California) June 30, 2010. The presentation was given by Luc Lagarde at 3:30pm to 200 - 300 attendees, and addressed the intricacies of selecting appropriate methods for primary productivity research.

"Net ecosystem production alteration resulting from invasion of *Spartina densiflora*" was presented at the Humboldt Bay Spartina Symposium in Arcata (California) Dec 1, 2011. The presentation was given by Luc Lagarde at 3:50pm to 150 - 250 attendees, and addressed the methods employed by this study and some preliminary study results. A video of this presentation can be seen at the following URL: http://humboldt. edu/environment/humboldt-bay-spartina-symposium.

COOPERATING ORGANIZATIONS: List those (e.g., county or state agencies, etc.) who provided financial, technical or other assistance to your project since its inception. Describe the nature of their cooperation.

Federal Organizations

<p>The United State Fish and Wildlife Service (USFWS) is currently conducting a pilot study to determine efficient methods for eradication of invasive *Spartina densiflora* from the Humboldt Bay National Wildlife Refuge (HBNWR). The results of this project to evaluate the impact of *S. densiflora* on the primary productivity of a Humboldt Bay salt marsh will provide information for the management decisions and recommendations

Regional Organizations

None at this time.

State Organizations

The Humboldt Bay Harbor, Recreation and Conservation District is currently assisting with the pilot study eradication of *S. densiflora* from the HBNWR, this organization will be advised regarding potential effects of eradication to the primary productivity of the salt marshes present within the HBNWR.

Nongovernment Organizations

None at this time.

International Organizations

None at this time.

Industry Organizations

None at this time.

Academic Organizations

Humboldt State University students are involved with the collection of biomass measurements as part of a course in Applied Ecological Restoration. These students learn about the science of biomass measurements as well as the effects of invasive *S. densiflora* on Humboldt Bay.

Sea Grant Organizations

None at this time.

Other Organizations

None at this time.

INTERNATIONAL IMPLICATIONS: Does your project involve any colleagues overseas or have international implications?

Spartina densiflora is currently invading coastal estuaries throughout the world, most notably in Western Europe, North America, and South America. Our research results regarding the impact of *S. densiflora* on the primary productivity of a Humboldt Bay salt marsh will have implications for restoration and management activities throughout all of the areas affected by invasive *S. densiflora*. The results of this study will also provide valuable information for management decisions in other countries regarding areas that are impacted by invasive Spartina species.

AWARDS: List any special awards or honors that you, or any co-project leaders, have received during the duration of this project.

None at this time

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

Spartina densiflora, invasive species, Humboldt Bay, net primary productivity, net ecosystem exchange

PATENTS: Please list any patents or patent licenses that have resulted from this project, and complete the patent statement form available on the web site.

None

NOTES: Please list any additional information in the notes area

FOR ALL STUDENTS SUPPORTED BY THIS GRANT, PLEASE LIST:

Volunteer Count 5

Graduate Student Info

Last Name Lagarde

First Name Luc

Middle Initial

Contact Email e_mail_luc@yahoo.com

Contact Phone (707)268-0943

Institution Humboldt State University

Department

Degree Program

Thesis Title

Supported by Sea Grant

Start Date 4/15/2012

End Date 4/15/2012