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Title

Assessing selected Pacific Oyster stocks for disease resistance in Tomalas Bay, California

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Author

Friedman, Carolyn

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Project Information

Year _____ **Grant No.:** N/A
Number R/AQ-145PD **Start Date:** 04/01/2008 **Completion Date:** 02/28/2009
Title "ASSESSING SELECTED PACIFIC OYSTER STOCKS FOR DISEASE RESISTANCE IN TOMALES BAY, CALIFORNIA"

Project Leader

Last Friedman **First** Carolyn **Init** S
Institution University of Washington
Department School of Aquatic and Fishery Sciences
Address 1122 NE Boat Street
City Seattle **State** WA **Zip** 98195
Phone (206) 543-9519 **Fax** (206) 616-8689
Email carolynf@u.washington.edu
Position Title Associate Professor

Project Leader

Project Hypothesis

- "1) Stocks of Pacific oyster stocks surviving mortality events in Tomales Bay, California may be resistant to the oyster herpesvirus (OshV)
- 2) Progeny of these survivors (see 1) may provide disease resistant oyster seed

Project Goals and Objectives

"The goal of this project was to identify Pacific oyster stocks resistant to OshV to provide a solution for seed losses that have hampered oyster culture in Tomales Bay since 1993. Potentially OshV resistant Pacific oyster seed was produced from survivors of past Tomales Bay mortality events (2000, 2001, and/or 2003). The objective of this project was to plant and monitor these potentially OshV resistant stocks for mortality, OshV presence, OshV viral load, and growth versus a typical hatchery stock commonly used by the oyster culture industry.

Briefly describe project methodology

"Pacific oysters that survived the 2000, 2001, and/or 2003 mortality events in Tomales Bay were collected from Tomales Bay in December of 2007 and used as broodstock. Broodstock were conditioned and strip-spawned using conventional methods; three family groups were created and maintained as individual families (Tomales Bay Survivors or TBS). Oysters, produced in a similar fashion as above, were donated by Taylor Resources, Inc. (control OshV-susceptible commercial oysters).

Seed Pacific oysters (described above) were outplanted in early June 2008. Triplicate bags of each stock were planted at two sites in Tomales Bay at the +1 tidal height on metal racks elevated 0.3 m above the substrate. To include all TBS families, two densities of animals were used, 500 and 100; control oysters were planted at these same two densities. Temperature was recorded at each site using iButton (Maxim Incorporated, formerly Dallas Semiconductor Incorporated). Mortality, growth, and OsHV load were quantified monthly from June-September (when mortality typically occurs in Tomales Bay). Mortality was quantified by enumerating the number of dead oysters out of a random sample of 100 oysters per bag. Twelve oysters per bag were collected for morphometric measurements including weight and shell height. Of these twelve oysters, four were stored in 95% ethanol for OsHV specific QPCR analysis, four in RNA later, and four were fixed for routine paraffin histology.

"

Describe progress and accomplishments toward meeting goals and objectives.

"TBS families experienced low mortality from June to September; however the hatchery control died consistently over the summer of unknown causes. However, control oysters were seed that had survived an epidemic of vibriosis and cohorts planted elsewhere showed similarly poor survival. Both TBS families and their controls had low OsHV copy number (e.g. <500 copies per mg), except for the last sample period where one TBS family at each site had higher gene copy numbers (26,666 copies per mg and 51,162 copies per mg, respectively). It is currently unknown what OsHV copy number causes mortality in oysters, but most of these samples indicate low copy number based on the copy number we commonly observe in moribund seed and larval oysters tested in our laboratory. Samples were selected for histological processing including pre-outplant samples of all groups. No morphological abnormalities were seen in TBS pre-outplant samples, but tissue abnormalities were seen in the pre-outplant control group. Abnormalities, however, were minimal: Two of 30 animals examined had bacterial infections. Selected samples of the control group taken during the experiment showed no abnormalities; however this could be due to the collection of samples after the mortality event.

Low mortality in TBS families indicate potential for using OsHV selected stocks in Tomales Bay. However, as the control oysters died of unknown causes (cohorts of the same stock also died at another field site in Washington state), these data do not represent typical seed performance and did not serve as good controls. However, samples collected 3 wks after the mortality event from farm-planted oyster seed at sites adjacent to our racks and those located several miles away during summer 2008 farm mortalities had much higher viral loads (e.g. 2,000-20,000 gene copies per mg). The two farm `controls' were of similar or larger sizes than our oysters and were planted in Tomales Bay in late spring (ie May 2008), ~ 1 mo prior to our oysters. Typically smaller, new plants survive OsHV less well than do those planted earlier and at a larger size in a given year (Burge et al. 2006, 2007). These data suggest that OsHV was involved in farm mortalities and was present in the bay. In addition, these data suggest that the TBS families have the potential to enhance OsHV survival in affected embayments. Given that TBS families were not market size by September 2008, they need to be monitored further for growth, mortality, and utility as a farm product.

An additional five families were created and planted in October of 2008. Individual farms will maintain families in the field to further judge whether TBS families are selected for disease resistance.

"

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.

"The loss of the control group was unfortunate but samples collected during farm mortalities indicates the involvement of OsHV in these mortalities and the presence of the virus in the bay. Losses of the control group occurred when farm mortalities/OsHV presence had already occurred so the control group could not be replaced.

"

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.

"We produced eight Pacific oyster families from oysters that had survived up to six years of OsHV-disease selection. Although OsHV-induced losses are typically highest in the early life stages (larval and early juvenile), some losses have occurred in adult oysters (e.g. early-mid 1990s in Tomales Bay and 2008 in France). All of our produced families are being shared with oyster industry partners in Tomales Bay, California (Hog Island Oyster Company and Tomales Bay Oyster Company). In addition, Dr. Paul Olin assisted us in the hatchery and field components of this project and is aware of our progress.

"

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.

Tomales Bay, California.

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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.

"Our preliminary project results indicate that selected Pacific oyster stocks may help alleviate farm mortalities and could provide a secure seed supply for Tomales Bay growers (e.g. Hog Island Oyster Company or Tomales Bay Oyster Company). Additionally, Chris Starbird of Starbird Mariculture has indicated interest in starting a small hatchery to continue to provide seed for growers in Tomales Bay.

Hog Island Oyster Company
 Contact: Terry Sawyer
 terry@hogislandoysters.com
 (415) 663-9218 extension 203

Tomales Bay Oyster Company
 Contact: Drew Alden
 tboc2@saber.net
 (415) 663-1242

Starbird Mariculture
 Contact: Chris Starbird
 Chrisstarbird@gmail.com
 415-517-5111

"

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

"Our family lines have great potential to enhance the economy of oyster farmers in impacted locations by increasing yield of planted oysters. Prior to 1993, Tomales Bay growers experienced 65-85% survival over an 18 month culture cycle. After the emergence of OsHV in Tomales Bay, oyster survival over the initial summer after planting ranged from 10-35%. Thus being able to enhance oyster survival is crucial for this important industry.

"

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).

"N/A

"

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

"N/A

"

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
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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.

"Name of publication/radio station, etc:

City:

State:

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.

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

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

N/A

Regional Organizations

N/A

State Organizations

Seed were produced at the UC Davis - Bodega Marine Laboratory

Nongovernment Organizations

N/A

International Organizations

N/A

Industry Organizations

"Industry

Academic Organizations

N/A

Sea Grant Organizations

N/A

Other Organizations

N/A

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

"This project has international implications as losses of seed oysters have been associated with OsHV in other countries. We routinely share information with researchers in France (e.g. Dr. Tristan Renault), who is the work authority on OsHV.

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

N/A

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

"Tomales Bay, oyster mortality, selected oysters, oyster herpesvirus, OsHV"

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.

N/A

NOTES: Please list any additional information in the notes area

FOR ALL STUDENTS SUPPORTED BY THIS GRANT, PLEASE LIST:

Volunteer Count

Graduate Student Info

Last Name	Burge	First Name	Colleen	Middle Initial	A
Contact Email		Contact Phone			
Institution	University of Washington				
Department	School of Aquatic and Fishery Sciences				
Degree Program					
Thesis Title	"Summer seed mortality and oyster herpes infections of the Pacific oyster, Crassostrea gigas in Tomales Bay, California "				
Supported by Sea Grant	Yes	Start Date	4/1/2008	End Date	2/28/2009