Managing for resilience in the face of climate change: a scientific approach to targeted oyster restoration in San Francisco Bay and Elkhorn Slough, CA

A project funded by the National Estuarine Research Reserve System Science Collaborative

EARLY FEEDBACK FROM END-USERS AND RESULTING ADAPTATION OF PROJECT DESIGN

Kerstin Wasson, Elkhorn Slough National Estuarine Research Reserve

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EXECUTIVE SUMMARY

The goal of our collaborative science project is to provide restoration planning tools to help those engaged in Olympia oyster restoration, policy or strategic planning to choose sites for restoration that will prove sustainable in the face of climate change. Our work will also shed light on likely impacts of selected climate-related stressors, and will determine whether resilience can be enhanced by decreasing exposure to other anthropogenic stressors.

Our interdisciplinary team sought early feedback from end-users on the design of project. We sent an electronic survey to people engaged in some aspect of Olympia oyster restoration and presented our project at an oyster working group meeting and in interviews with key participants. We synthesized the results from the 48 survey respondents. Our project team thoroughly reviewed the input, and adapted the project design in response. The feedback and our response to the major components of the survey is summarized below.

Focus of new science: All of our proposed focus questions for new scientific inquiry scored as moderately to very important for designing sustainable restoration strategies. The top-scoring focus areas were understanding how climate-related stressors affect oyster growth and survival, and identifying which sites have the lowest stressor levels and thus are most likely to support successful restoration projects. These top focus areas are closely aligned with the original focus of the proposed science – lab experiments to examine stressor impacts and field monitoring to characterize stressors.

Stressors: The top four stressors of concern for end-users were acidification, sedimentation, low salinity, and high temperature. Our project team will focus on the latter three of these; extensive acidification studies on Olympia oysters have been completed recently and are expensive, and will not be conducted as a part of this project. Low oxygen and invasive species also scored quite high, and will be included in our investigations. For testing effects of multiple stressors, combinations involving temperature and other stressors were mostly commonly identified as important. Combinations of temperature, low oxygen, and low salinity will be examined by our multiple stressor experiments.

Sites: The final selection of sites in the San Francisco Bay and Elkhorn Slough estuary was informed by feedback from end-users. Many of our originally proposed sites ranked high with survey respondents, but some additional sites will also be included to accommodate end-user priorities, increase community involvement, and link current restoration project work to this study.

Information products and restoration planning tools: Respondents ranked scientific publications as by far the most important product for capturing lessons learned from this project. Our project team had not included this as an original end product in the proposal, assuming that publications were more suited to academic scientists than applied end-users, but will gladly accommodate this feedback. In terms of restoration planning tools, interactive maps and decision-support tools for site selection ranked highest. The project team will prepare these as final products for the project.

Additional end-users to engage: Respondents provided numerous suggestions for additional organizations and types of end-users to engage in this project. We have taken the majority of these suggestions and included representatives from these organizations or groups in our project database. These new end-users will be engaged through email updates and will be invited to participate in workshops and product evaluations.

Respondent attributes: The majority of the 48 respondents were employed by federal agencies or non-profit organizations, although state agencies, academic institutions, and the private sector were also well represented. About half the respondents work in the San Francisco Bay region, which is appropriate since this is the nexus of Olympia oyster restoration in the state. Another 35% work either in Elkhorn Slough or in a broader region of California. The remainder works elsewhere in the Pacific range of the Olympia oyster. About half of respondents work directly on some aspect of Olympia oyster restoration. The majority of these are engaged in strategic planning for restoration and oyster science.

Future engagement: Most respondents indicated they would like to receive email updates, including email links to final project products. We will therefore send them (and everyone in our project database) regular emails, as well as links to final products. The majority would also like to attend a midpoint and final workshop. We will thus invite end-users to both workshops. Some end-users also indicated that they would like to be involved in design of the science, and in field monitoring. These participants have been invited to contribute to designing the field and laboratory science and in monitoring.

PROJECT BACKROUND

An interdisciplinary team from the California Coastal Conservancy, UC Davis and the San Francisco and Elkhorn Slough National Estuarine Research Reserve initiated a three-year project funded by the National Estuarine Research Reserve System Science Collaborative in November 2011. This project will characterize stressor levels at multiple sites at two California estuaries (San Francisco Bay, Elkhorn Slough), assess oyster populations at these sites and connectivity between them, and examine impacts of individual and combined stressors in laboratory experiments. The goal is to improve sustainability of Olympia oyster restoration in the face of climate change, by providing restoration planning tools. In particular, the tools will identify sites most likely to support sustainable restoration projects, and will indicate whether reduction of some existing stressors will enhance resilience to climate-related stressors. End-users engaged in oyster restoration, planning, permitting or policy will be engaged heavily throughout the project, to ensure that management needs inform the science, and science feeds back into improved management.

END-USER FEEDBACK

The project team sought early feedback to shape the focus areas of the new science to be generated and the design of the tools to be created as final products. Critical end-users engaged in work related to Olympia oyster restoration (in the realms of policy, on-the-ground restoration, science, funding, and strategic planning) were identified by the project team. A SurveyMonkey tool was developed to obtain early feedback from these end-users on project design and implementation. The survey was sent to end-users on 12/13/2011, and closed on 1/17/2012.

The responses to each of the seven areas of question are summarized below for all 48 respondents. In addition, a filter was applied to the results, to examine only those responses of the 22 respondents who indicated that they are actively engaged in some aspect of Olympia oyster restoration (rather than more broadly involved in related coastal habitat conservation and planning). The scores and responses of these "Olympia oyster respondents" are provided in blue font to distinguish them from those of the total respondent pool.

While this document focuses on the feedback received via the SurveyMonkey tool, it also incorporates as parenthetical notes feedback received on the project at a meeting of the San Francisco Bay Native Oyster Working Group on 11/15/2011.

PROJECT ADAPTATION IN RESPONSE TO FEEDBACK

The interdisciplinary team of principal investigators carefully reviewed the end-user feedback. Then, the team met on 2/1/2012 and thoroughly considered how project scope, methods, and final products should be adapted to reflect the feedback received. Overall, the end-user feedback validated and supported the general approach and outcomes developed in the original grant proposal for the project, so no major shifts in direction were made. However, many substantial modifications to specific plans for topical foci, stressors, sites, and final products were made in response to feedback. These adaptations of the project design in response to end-user feedback are summarized in each section below.

1. FOCUS OF NEW SCIENCE: QUESTIONS ABOUT OYSTERS AND CLIMATE CHANGE

We asked end-users to evaluate the importance of eight questions for designing sustainable oyster restoration strategies.

The scale ranged from 1=not important to 3=moderately important to 5= very important.

All eight questions scored between 3.8 and 4.0 on average, indicating that end users found them **all to range from moderate to very important**.

The scores for all eight questions are shown below, in order from highest to lowest.

		Rating Average
1	How do climate-related stressors affect Olympia oyster growth and survival?	4.04 (4.05)
2	Which sites currently have lowest stressor levels and thus might support the most successful oyster restoration projects, now and in the future?	4.02 (4.14)
3	If other stressors are reduced, could this increase oyster resilience to climate related stressors?	3.89 (3.76)
4	How can Olympia oyster restoration most effectively be integrated into multi-objective projects (such as shoreline protection) in the face of climate change?	3.89 (3.73)
5	How can understanding population connectivity be used to determine likely sources and sinks for larval recruitment and inform selection of restoration sites in the face of climate change?	3.85 (4.05)
6	What is the RELATIVE impact of climate-related vs. non-climate related stressors on Olympia oysters?	3.83 (3.50)
7	How will climate-related stressors INTERACT with non-climate-related stressors?	3.81 (3.50)
8	What ecosystem services do Olympia oyster restoration projects provide and how might these be altered by climate change?	3.79 (3.77)

For the total respondents, questions 1 & 2 clearly ranked the highest. For the Olympia oyster respondents, question 5 also ranked very high, and the ranking of questions 1 & 2 was reversed. These three top questions are closely aligned with the general focus of the original grant proposal – understanding how climate stressors will affect oyster growth and survival, identifying sites most likely to be successful, and exploring connectivity. So the main focus of the project will remain as proposed, given this feedback.

There was not much spread in scores for other questions, providing little guidance for relative allocation to these different areas. Three of these other questions (3, 6, 7) were an important part

of the original plan, but did not receive top scores. So efforts could potentially be scaled back in these areas. However, answering these questions seems like an important component of the top scoring questions.

Two of the questions (4, 8) were not part of the original plan, and seem fairly tangential to the main focus of the project, but were included in the survey because they had been raised as important issues in discussions with end-users. These questions did not receive top scores; the project focus will not be changed to incorporate them.

One respondent provided an additional question which we had not listed, namely "which climate stressors are most impactful?" (e.g. role of sea level rise might be low, but increased storminess high)". This question differs from our Question 1, which focuses on how climate stressors affect oysters. To a limited extent, our lab experiments will be able to shed light on this question (we can compare affects of a few different climate-related stressors that we are testing). However, we recognize that it would also be helpful for end-users such as the one who raised this point if we summarized existing literature more broadly evaluating climate stressors and impacts on shellfish. Our PI team had undergone this process prior to selecting key climate stressors to focus on, and we should make this process more transparent for end-users. We will therefore add a literature review to our final products, summarizing existing knowledge on this question of which stressors are likely to have greatest impacts on oysters.

2. MULTIPLE STRESSORS AND CLIMATE CHANGE

We asked end-users to evaluate the importance of obtaining new information about 11 stressors for informing oyster restoration strategies. We indicated they could give stressors a high rank either because they pose a high threat (now or in future), and/or because they think there are critical information gaps about that stressor that must be filled.

The scale ranged from 1=not important to 3=moderately important to 5= very important.

The stressors scored between 2.6 and 4.4 on average, indicating that they differed in importance to end-users. The scores for all 11 questions are shown below, in order from highest to lowest.

		Rating average
1	acidification	4.16 (4.41)
2	sedimentation	4.14 (4.27)
3	low salinity	3.93 (3.90)
4	high temperature	3.93 (3.86)
5	low dissolved oxygen	3.80 (3.59)
6	contaminants/pollutants	3.72 (3.50)
7	overgrowth by invasive competitors	3.68 (3.59)
8	eutrophication	3.67 (3.32)
9	effects of invasive predators	3.61 (3.64)
10	disease	3.36 (3.36)
11	human harvesting	2.65 (2.59)

The top stressor identified by survey participants was acidification, a climate-related stressor resulting from increased carbon dioxide concentrations. Our investigative team considered this feedback at length when determining which stressors to include in laboratory experiments and monitoring. In the end, we decided not to pursue acidification. First of all, the cost of manipulating and of monitoring acidification is extremely high, and pursuing this would have been nearly impossible with current budgeting. Secondly, two graduate students at UC Davis are in the process of completing and publishing extensive experiments of acidification effects on Olympia oysters. The surveyed end-users were probably not aware of this work, since it has not been published. Third, our expert opinion is that while acidification has garnered extensive press recently and thus caught the attention of the surveyed end-users, it may not pose a major risk of mortality to estuarine oysters, such as the Olympia, since they are adapted to tolerating a wide range of pH conditions over the seasons and indeed over diurnal cycles, and the predicted decrease in average ocean pH falls well within this tolerated range. This is consistent with the results of the recent graduate research on acidification and oysters, which largely demonstrated sub-lethal effects. As a part of the commitment to summarizing literature on known effects of different climate-related stressors on oysters (described at the end of the previous section), we will ensure that the new research on acidification effects on oysters is incorporated in the final products for this project, even though we will not be conducting any new research in this area.

The second highest ranking stressor was sedimentation, which may be affected by climate change (due to increased storminess) as well as other anthropogenic alterations (such as hydrological modifications and land use changes). The next highest ranked stressors were low salinity and high temperature, both of which can be directly affected by predicted climate change trends. The ranking for the top four stressors was identical for the Olympia oyster respondents as for the total respondents. Our investigative team will focus laboratory experiments and field monitoring on three of these four top ranked stressors (all except acidification), in direct response to this end-user feedback.

A series of other stressors receive moderate scores: low oxygen, contaminants, invasive competitors and predators, and eutrophication. The rank ordering of these stressors differed somewhat for the Olympia oyster respondents. Our budget is not sufficient for monitoring contaminants, which are expensive to characterize. However, we will include low oxygen in the laboratory experiments, and will monitor oxygen, invasive competitor cover, and indicators of eutrophication (chlorophyll concentrations in the water column and algal cover in field transects) in the field. We have thus aligned our science priorities closely with those of the participating end-users.

Disease and human harvesting received lower scores. These were not originally addressed in our proposal and the survey results confirm that they do not need to be included. However, respondent Jim Moore commented in the survey that there is high prevalence of *Bonamia exitiosa* at Elkhorn Slough in late summer, and that he is interested in interactions of disease and high temperature. He is potentially interested in doing histology/PCR on oysters that survive vs. die in high temperature experiments, and even offered that he has the capacity in his containment facility to hold oysters at elevated vs. ambient temperatures. So some aspect of disease – climate change interactions may be incorporated.

Three additional stressors of potential importance were identified by users in the "other" category: effects of flow rate, predation by native species, and effect of sea level rise. (At the

11/15/2011 SFB oyster working group meeting, participants also mentioned increased wave action resulting from increased storminess as a potential climate-related stressor to consider.) We will not be directly examining these additional stressors, but will include consideration of sea level rise effects in our synthesis of climate change impacts to be included in the final products.

In terms of stressor combinations of interest, top combinations listed in response to this open-ended question were temperature x acidification, temperature x salinity, and temperature x dissolved oxygen. However 10 other combinations were provided, so it seems that all sorts of stressor combinations are of interest to end-users. We will focus on temperature x dissolved oxygen, and then examine subsequent effects of low salinity on these same oysters in our multiple stressor experiments.

3. SITE SELECTION

We asked end-users to select those sites they considered to be critical for the purpose of oyster restoration and implementation.

SAN FRANCISCO BAY

The percentage of end-users identifying a site as critical varied greatly across the nine sites we provided.

1	China Camp, North Bay	70% (73%)
2	Angel Island, Central Bay	70% (67%)
3	Berkeley, Central Bay	65% (60%)
4	Oyster Point, South Bay	57% (67%)
5	Point San Quentin, North Bay	52% (60%)
6	Coyote Point, South Bay	52% (47%)
7	Dumbarton Pier, South Bay	48% (40%)
8	Point Orient, North Bay	44% (53%)
9	Brickyard Park, Richardson Bay	39% (40%)

China Camp, Angel Island, Berkeley and Oyster Point were all selected by a clear majority of respondents. Point San Quentin, Coyote Point, and Dumbarton Pier also scored well. There was lower interest in Point Orient and Brickyard Park, although in the comments one respondent favored Brickyard Park because of its proximity to the Arambaru restoration area (and offered to collaborate in the project if there is a site near Aramburu). The ranking of sites by Olympia oyster respondents was broadly similar, with the biggest difference being that Point Orient ranked higher among this group.

In the "other" category, three respondents suggested Point Pinole. One suggested Point San Pablo eelgrass beds, and another Bair Island. Two respondents suggested that a site on the eastern shoreline of the South Bay might be helpful; one of these suggested Bay Farm Island. One respondent cautioned that the Dumbarton Pier is slated for removal.

(At the 11/15/2011 SF working group meeting, The Watershed Project's proposed Point Pinole oyster reef site was also recommended, along with two sites included in the Coastal

Conservancy's San Francisco Bay Living Shorelines: Near-shore Linkages Project (Eden Landing Ecological Reserve in Hayward and the The Nature Conservancy property at San Rafael). In addition, one participant suggested inclusion of muted tidal lagoons such as Sailing Lake.)

Our investigative team incorporated this feedback into the final selection of sites. The top ranking sites are all being included, with the exception that Sausalito is being used as a more accessible replacement for nearby Angel Island. Point Pinole, Arambaru Island and Eden Landing have been added in response to participant feedback, and will be monitored in collaboration with some of the participants. We will work with The Watershed Project staff and volunteers at the Point Pinole site, Richardson Bay Audubon staff and volunteers at the Arambaru Island site, and the San Francisco Bay Living Shorelines consultants at the Eden Landing Ecological Reserve site.

ELKHORN SLOUGH

The percentage of end-users identifying a site as critical varied greatly across the nine sites we provided.

1	Kirby Park	75% (50%)
2	Whistlestop Lagoon	75% (50%)
3	South Marsh	75% (50%)
4	Bennett Slough West	50% (25%)
5	Hudson Landing	42% (50%)
6	Azevedo Pond North	42% (50%)
7	Vierras	42% (25%)
8	North Marsh	33% (25%)
9	Moss Landing Harbor South	33% (0%)

Kirby Park, Whistlestop Lagoon, and South Marsh clearly were selected by the greatest number of respondents and should be given serious consideration by the project team. Bennett Slough West, Hudson Landing, Azevedo Pond North and Vierras also were of interest to many respondents. North Marsh and Moss Landing Harbor South were of low interest. Only two Olympia oyster respondents scored Elkhorn sites, so these results should probably not be given much weight. However, they reflect generally similar patterns, except that Bennett Slough is ranked lower, and Hudson and Azevedo higher. Only one respondent suggested additional sites, namely unspecified tidal creeks along the main channel. Given the limited feedback, our investigative team will use the same sites as originally proposed, because there is excellent existing water quality monitoring data for these spots and because they provide a good representation of varying conditions throughout the estuary.

4. INFORMATION PRODUCTS AND RESTORATION PLANNING TOOLS

We solicited information from end-users on the types of restoration planning tools and data products that would be most useful to them in planning and implementing oyster restoration projects.

FORMAT OF INFORMATION FOR LESSONS LEARNED

We asked end-users to score a variety of potential formats according to how useful they would be for work they do related to oyster restoration.
The scale ranged from 1=not useful to 3=moderately useful to 5= very useful.

All eight questions scored between 3.3 and 4.4 on average, indicating that end users found them **all to range from moderate to very useful**.

The scores for all five formats are shown below, in order from highest to lowest.

		Rating Average
1	Scientific journal publication	4.37 (4.41)
2	Brief written guidelines or summaries	4.24 (4.36)
3	In-person workshop or training	3.93 (3.76)
4	Interactive website	3.63 (3.76)
5	Web-based seminar or training (webinar)	3.33 (3.29)

Scientific publications received the highest rating, which is perhaps surprising since conventional wisdom is that managers and policy-makers are too busy to review the primary literature. One of two respondents who provided additional comments summarized this view point as follows. "Peer-reviewed scientific journals are the best because the articles published are among the most objective. THEN, communicating via outreach should follow." In the original proposal, our project team had not included scientific publications as a targeted end-point because we thought that publications would not be the currency favored by managers. Given the results above, we will now commit to submitting at least one manuscript to a peer-reviewed scientific journal within six months of completing the grant-funding.

Brief written guidelines or summaries scored second highest, again as somewhat of a surprise to the project team. In person training came next. Scoring considerably lower was an interactive website or web-based training. However the second respondent to provide additional comments favored web-based mapping and suggested collaborating with TNC on preparing such products. In the final question in the survey, this respondent indicated that TNC has a template for decision-support tools for multi-objective projects, and offered to collaborate on this. The scoring of formats was very similar for Olympia oyster respondents, except that interactive websites received the same average score as in-person training.

Given this feedback, we will continue to plan to produce an array of final products, including brief written guidelines, a final training, and an interactive website. We will explore the possibility of using existing templates from TNC for decision-support tools.

TYPES OF RESTORATION PLANNING TOOLS

We asked end-users to score five potential types of products according to how useful they would be for any work they do related to oyster restoration.

The scale ranged from 1=not useful to 3=moderately useful to 5= very useful.

All eight questions scored between 3.8 and 4.4 on average, indicating that end users found them **all to range from moderate to very useful**.

The scores for all five products are shown below, in order from highest to lowest.

		Rating Average
1	Interactive maps (highlighting existing oyster populations, recruitment levels, population connectivity, and stressor levels at different sites)	4.41 (4.41)
2	Decision support tools for determining which sites are most likely to support sustainable oyster restoration projects	4.28 (4.29)
3	Brief written summaries of impacts of stressors on oysters (relative impacts of climate vs. other anthropogenic stressors, and interactions between them)	4.05 (4.09)
4	Brief user guides summarizing lessons learned regarding benefits of reducing other stressors to enhance resilience to climate change	4.03 (4.05)
5	Longer written technical report or scientific publication summarizing complete results of this project	3.98 (3.77)

Oddly, these results contrast greatly from those in the previous question. In this case, scientific publications and technical reports were ranked lowest, while interactive maps received by far the highest score. Decision support tools ranked second, followed by brief written summaries and user guides, with considerably lower scores. The ranking of options was identical for the Olympia oyster respondents.

We had intended these two questions to be highly related, asking end-users about their preferred format and content for the final information. But somehow they must have read the questions as referring to different uses for the information. They seem to value scientific publications as a desired format to capture information, but not as a restoration planning tool. Again, as in response to the previous question, the result of this feedback is that our project team will produce a variety of products, with some representation of all of the above categories, for the end-users. Our greatest investment will be in the top-ranked interactive maps.

A number of respondents provided thoughtful additions in the comment box. One respondent indicated that s/he would find our products most helpful if linked to formats/inputs/outputs of other climate planning initiatives, such as the Climate Adaptation Knowledge Network (cakex.org), The Natural Capital Project (naturalcapitalproject.org), and CA Energy Commission PIER work on ecosystem adaptation to climate change. This is something our project team will explore when developing templates for final products.

Another respondent indicated that a useful product could be a summary of relevant lessons learned (about response to stressors) from oysters elsewhere, in the form of a brief literature

review. We will include this as a part of the literature review on climate-stressors in the longer technical summary report.

Another respondent suggested doing public outreach on our findings by including signage at kiosks or information sites near existing restoration projects. Other respondents indicated a need for restoration planning tools or documents which are not directly related to the focus of this grant proposal, but represent a need for more basic restoration planning guidance among this community of end-users. For instance, various respondents identified the need for restoration basic user-guides to doing restoration (where to get substrate, how to construct, how to deploy, which permits are needed, contacts at relevant agencies, etc.). Another mentioned the need from a political/funding perspective for documents clearly summarizing both the monetary costs and ecosystem benefits of the restoration. All of these additional requests are beyond the scope and funding of the current project.

5. IDENTIFYING KEY END-USERS

We asked respondents to identify additional end-users that we should collaborate with during this project. This question was organized by region. Respondents provided extensive suggestions which were compiled into tabular format and reviewed by our project team. Since this was simply a listing, no information was obtained from the survey to prioritize the potential additions. The collaborative lead and project team added the majority of the organizations suggested by respondents to the project email database, so they will receive future email updates and workshop invitations. The updated list of organizations included in this database is summarized in Appendix 1.

The following comments were provided in response to the open-ended question about additional end-users to include:

> "City Government agencies such as the San Francisco Environment (http://www.sfenvironment.org/index.html). Cities are the anthropocentric sources, working directly with agencies early on will help inform them about directions they should take on their policies and programs and can help garner support early on for restoration projects."
>
> "It would be useful to reach out not only to the traditional end users supporting restoration, but also to the design community who would be responsible for developing engineering solutions to climate-related shoreline structure improvements."
>
> "I think joining with NOAA for a marine conference for shellfish or sea level rise would be a great way to engage groups interested in both oysters and large scale marine health would be an excellent way to distribute information at the end of this effort."
>
> "Farmers/ranchers, large-areas-of-land owners ought to be involved in this process or learning about the results, directly -- not in a form of being told what they're doing wrong, but in an invitation to be part of solutions. An emphasis on land-sea connections would help native oyster restoration."

(At the 11/15/2011 SF Bay working group, participants also recommended engaging marine construction companies, such as seawall builders and dredging companies.)

Our project team has incorporated selected representatives of each of the above groups (city governments, NOAA, farmers, marine construction and engineering companies) into the end-user database (Appendix 1). However, thorough outreach to and engagement of these stakeholders is beyond the scope of our project, and we doubt that such groups would be interested in being heavily involved in our objectives (asssesing climate change impacts on oysters and identifying sustainable restoration sites). Our project team members would be glad to make presentations about aspects of our findings most relevant to these groups as a part of initiatives led by other organizations.

6. INFORMATION ABOUT RESPONDENTS

We asked respondents for information about themselves, to understand the community being surveyed. Respondent identities and email addresses were reviewed by the project team.

RESPONDENT ORGANIZATIONS

In terms of the organization(s) they work for, the response was as follows:

		Response Percent
1	Federal agency	34% (33%)
2	Non-profit organization	26% (24%)
3	Private sector	16% (24%)
4	Academic institution	16% (5%)
5	State agency	13% (19%)

Thus the majority of respondents were employed by federal agencies or non-profit organizations. For the Olympia oyster respondents, a higher percentage were employed in the private sector and by state agencies, and a lower percentage by academic institutions.

RESPONDENT GEOGRAPHIC REGIONS

In terms of the geographic region where they work, the response was as follows:

San Francisco Bay	53% (55%)
Elkhorn Slough	10% (0%)
California (more broadly than just SFB or ES)	25% (23%)
Oregon	3% (4%)
Washington	8% (14%)
Pacific coast region	3% (4%)

Thus, the 78% of respondents were either from the San Francisco bay area or work in a broader region in California. This composition seems very appropriate for questions about Olympia oyster restoration in California, which is most intensively being pursued in San Francisco Bay, with smaller pilot initiatives elsewhere in the state. The geographic distribution of respondents

was similar for Olympia oyster respondents, except that none are based around Elkhorn Slough (because K. Wasson is the only person active in oyster restoration at this estuary, and as a project PI, did not fill out a survey).

DIRECT INVOLVEMENT WITH OLYMPIA OYSTER RESTORATION

We asked respondents whether they were directly involved in some aspect of Olympia oyster restoration (research, monitoring, on-the-ground restoration, strategic planning, policy, or funding). About equal numbers said yes and no (yes 52.5%, no 47.5%).

Of those respondents who said that they were directly involved in Olympia oyster restoration, their areas of involvement were as follows:

	Response Percent
Engage in strategic planning for oyster restoration	48%
Conduct science on oysters (research or monitoring)	40%
Carry out hands-on oyster restoration implementation	32%
Develop policy relevant to oyster restoration	20%
Fund oyster restoration projects	20%
Regulate or permit oyster restoration projects	16%
Other (various misc. responses)	16%

Thus end-users who partake in strategic planning for restoration and in oyster science were particularly well represented. Since only 5% of these respondents are employed by academic institutions, we can infer that the oyster science is of a fairly applied nature. Our collaborative will attempt to engage more end-users in some of the other categories, especially those conducting hands-on restoration and those developing policy, since these comprise part of the intended audience of the grant proposal. As mentioned previously, part of our collaborative goals for this project are to increase interest and involvement in native oyster protection and restoration, as currently there is a fairly limited group of individuals and groups engaged in native oyster efforts in San Francisco Bay and Elkhorn Slough.

7. FUTURE ENGAGEMENT

We asked respondents how they would like to be engaged in the project in the future. Their answers were as follows:

		Response Percent
1	Email distribution of links to final products	90% (91%)
2	Regular email updates about project progress	82% (77%)
3	Final workshop training users on restoration planning products	69% (64%)
4	Midpoint workshop to evaluate progress and provide feedback	66% (68%)
5	Field monitoring	30% (23%)
6	Design of experiments and monitoring	30% (27%)

Given these results with email updates scoring highest, our project team is committed to sending email updates to everyone who provided their name (as well to broader our broader mailing list). Since a majority of respondents also expressed interest in attending workshops, we will use the same email list to invite them to two workshops, which we will hold near the project midpoint and near the end of the project.

A smaller number of respondents expressed interest in being involved in design of experiments and in monitoring. These respondents were sent a draft summary of field and laboratory science plans and were invited to provide input. A small group of respondents (with considerable overlap with the previous group) also expressed interest in assisting with the field monitoring. These end-users (representing The Watershed Project, Richardson Bay Audubon Center, San Francisco State University, and the San Francisco Shorelines Project are actively collaborating in the project by helping to collect data as well as by eventually using the lessons learned to inform their restoration projects.

(At the 11/15/2011 SF Bay working group meeting, there was some discussion of coordination and participation in monitoring. The Watershed Project indicated that it has many volunteers that would be available to participate in monitoring. Various participants noted the importance of developing standardized monitoring for central California and ideally the entire coast-wide range of the Olympia oyster, as well as a publically accessible, searchable central database of monitoring data.)

The survey asked whether anyone wanted to further discuss input to this project in a follow-up telephone call. Only one respondent said yes; he was contacted by a project team member and his input is reflected in this document.

APPENDIX 1. ORGANIZATIONS CURRENTLY REPRESENTED IN EMAIL MAILING LIST FOR OYSTER RESILIENCE PROJECT.

Aquarium of the Bay

Battelle

Bay Conservation and Development Commission

BayKeeper

Bodega Marine Laboratory

Bodega Marine Reserve

California Academy of Sciences

California Coastal Commission

California Coastal Conservancy

California Department of Fish and Game

California Department of Transportation

California State Lands Commission

California State University, East Bay

California State University, Monterey Bay

Center for Collaborative Policy (Sacramento State University)

Center for Ecosystem Management and Restoration

Central Coast Regional Water Quality Control Board

Central Coast Wetlands Group

City of Oakland

City of Palo Alto

City of San Jose

City of San Rafael

Dixon Marine

Drakes Bay

Ducks Unlimited

Dutra Group

East Bay Regional Park District

Elkhorn Slough Foundation

Elkhorn Slough National Estuarine Research Reserve

Environ

Environmental Protection Agency

ESA PWA

Giacomini Wetlands

Golden Gate National Parks Association

Hog Island Oyster Company

Humboldt Bay Subtidal Goals

Institute for Fisheries Resources

Invasive Spartina Project

Isla Arena Consulting

Jerico

Kier and Associates

LSA Associates

MARE

Marin Audubon

Marin County Open Space District

Marine Science Institute

Maristics

Monterey Bay National Marine Sanctuary

Moss Landing Marine Laboratories

National Fish and Wildlife Foundation

National Park Service

Natural Resources Defense Council

NOAA Coastal Services Center

NOAA National Marine Fisheries Service

NOAA Restoration Center

Oakland Museum

Ocean Protection Council

Oxnard College

Padilla Bay National Estuarine Research Reserve

Point Reyes Bird Observatory

Polson Engineering

Puget Sound Restoration Fund

Restoration Design Group

Richardson Bay Audubon

San Francisco Bay Joint Venture

San Francisco Bay National Estuarine Research Reserve

San Francisco Bay Regional Water Quality Control Board

San Francisco Estuary Institute

San Francisco Estuary Project

San Francisco State University

San Jose State University

Save The Bay

Smithsonian Environmental Research Center

South Bay Salt Ponds

Stanford University

The Bay Institute

The Nature Conservancy

The Watershed Project

Tomales Oyster Company

University of California Extension/ Sea Grant

University of California, Davis

University of California, Santa Cruz

University of San Francisco

URS

US Army Corps of Engineers

US Bureau of Reclamation

US Fish and Wildlife Service

US Geological Survey

Wetlands and Water Resources

Wetlands Research Associates