

Sanctuary Advisory Council

GREATER FARALLONES NATIONAL MARINE SANCTUARY

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John Berge/Vacant

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Aug 27, 2019

Resolution of the Greater Farallones National Marine Sanctuary Advisory Council to Adopt the Recommendations of the Tomales Bay Native Oyster Restoration Working Group

At its meeting on August 15, 2019, the Greater Farallones National Marine Sanctuary Advisory Council made minor edits (indicated in red in the attachment) to the recommendations of the Tomales Bay Native Oyster Working Group and passed a resolution to adopt those edited recommendations and forward them to the Greater Farallones National Marine Sanctuary Superintendent, along with the working group's meeting notes, for consideration.

Attachment: Recommendations of the Greater Farallones National Marine Sanctuary Advisory Council to the Greater Farallones National Marine Sanctuary

cc: Maria Brown, Greater Farallones National Marine Sanctuary Superintendent

The council is an advisory body to the sanctuary superintendent. The opinions and findings of this letter/publication do not necessarily reflect the position of the sanctuary and the National Oceanic and Atmospheric Administration.

Recommendations of the Greater Farallones National Marine Sanctuary Advisory Council to the Greater Farallones National Marine Sanctuary

08/15/2019

Below are the recommendations of the Greater Farallones National Marine Sanctuary Advisory Council (the council) to the Greater Farallones National Marine Sanctuary (the sanctuary), based on the recommendations of the council's Tomales Bay Native Oyster Restoration Working Group (working group) completed in August 2019.

Text highlighted in yellow indicates changes made by the council on 8/15/19 to the working group's recommendations in the process of preparing these final council recommendations to the sanctuary.

Overview & Purpose

The working group was established by the council on August 29, 2018, was assembled in December 2018 and held two meetings on March 15 and May 15 to evaluate key information for the native oyster *Ostrea lurida* to inform the development of recommendations to restore this species. The purpose of the working group was to: 1) select pilot sites for oyster restoration in Tomales Bay, 2) create recommendations for increasing the Tomales Bay native *Ostrea lurida* population, and 3) explore co-benefits of native oyster restoration such as living shorelines for coastal protection for Tomales Bay communities. As a result of the meetings, the working group solidified a restoration objective focused on native oyster population enhancement and resilience and has provided detailed recommendations to support the implementation of pilot projects to meet this objective, which the council now forwards to the sanctuary. The council acknowledges broader restoration conversations are needed that are outside of the scope of the working group. To support the continued conversation, the council recommends the following actions.

Restoration Objective

Restoration of a sustainable, resilient Tomales Bay native oyster (*Ostrea lurida*) population will provide biotic and abiotic benefits. This nearshore and intertidal foundation species will enhance ecosystem function by providing food and refugia for birds, fish, and invertebrates. The oyster population will enhance ecosystem services that may contribute to coastal protection via oyster reefs that can attenuate wave energy and reduce the rate of coastal erosion.

Recommendation: Tomales Bay Restoration “Policy and Planning” (PP)

PP1: Compile and analyze existing data focused on the ecology or habitat of the native Tomales Bay oyster, *Ostrea lurida*, to better understand if, why, where, and by how much the Tomales Bay *Ostrea lurida* population needs to be enhanced to ensure it functions successfully into the future.

Recommended Champion: UC Davis, Bodega Marine Lab (Ted Grosholz)

PP2: Create a map of Tomales Bay that highlights the limiting factors for *Ostrea lurida* population growth to help guide the selection of pilot and demonstration restoration sites and techniques (e.g. spat vs. built substrate). Data collected as part of the working group will be shared with the champions.

Recommended Champions: UC Davis, Bodega Marine Lab (Ted Grosholz & John Largier), National Park Service, Greater Farallones National Marine Sanctuary

PP3: Conduct a Tomales Bay habitat assessment to better understand current conditions, to inform regional prioritization, to develop restoration collaborations, and to clarify the extent of restoration required, as well as the funding needed for implementation. Refer to working group notes (see Appendix Appendices III, IV) for details on what should be considered in a habitat assessment.

Recommended Champions: UC Davis, Bodega Marine Lab (Ted Grosholz & John Largier), National Park Service, Hog Island Oyster Company, Greater Farallones National Marine Sanctuary

PP4: Conduct a Programmatic Cultural Resource Assessment

Recommended Champions: National Park Service (Paul Engel), State Historical Preservation Office, Tribal Native American Heritage Commission (NAHC), local Tribal groups, Environmental Justice Outreach, community groups/recreation communities.

PP5: Use the Site Selection Criteria for *Ostrea lurida* in Tomales Bay (see Appendix I) developed by the working group to prioritize pilot sites and to identify additional potential restoration sites. Together, they will form a network of restoration sites within Tomales Bay to be developed as part of a Strategic Restoration Plan for *Ostrea lurida* in Tomales Bay. Furthermore, the council encourages the assessment and potential use of artificial hard substrate (e.g. oyster shell structures, non-creosote piling, moorings piers, seawalls, bulkheads) that can act as oyster habitat. Lessons learned from Seattle's fish friendly seawall should be considered when designing, **(Added): repairing, replacing,** or modifying **(Added): existing** future artificial structures so as to optimize the provision of oyster habitat in Tomales Bay. This would support the broader West Coast goals for the restoration of *Ostrea lurida*. Sites should be assigned to a restoration phase (e.g. pilot, demonstration, or large-scale), and the purpose of restoring each site and its success criteria should be clarified before implementation.

Recommended Champions: Greater Farallones Sanctuary, National Park Service, California State Parks, Tomales Bay State Park

PP6: Develop a 10-year Strategic Restoration Plan for *Ostrea lurida* in Tomales Bay. It would outline restoration purposes, purpose-specific success criteria, restoration actions, research, and monitoring variables to ensure future restoration actions are appropriate and successful, and as needed adaptively managed to ensure future success of a resilient Tomales Bay ecosystem.

Recommended Champions: Greater Farallones Sanctuary, National Park Service, California State Parks, Tomales Bay State Park

PP7: Develop an interagency approval process to streamline permitting for future multi-jurisdictional and collaborative restoration projects, especially with regard to identifying regulatory requirements of each agency that may be shared, similar or conflicting, as well as coordinating review responsibilities under NEPA and CEQA. Engage management entities within Tomales Bay watershed to ensure objectives and activities are aligned and inform each other.

Recommended Champions: Greater Farallones National Marine Sanctuary, County of Marin
Jurisdictional Authorities to include in this discussion: California Coastal Commission, California Department of Fish and Wildlife, National Park Service (Point Reyes National Seashore, Golden Gate National Recreation Area), California State Parks, California Department of Public Health, California State Lands Commission, State Water Quality Resources Control Board, County of Marin, US Coast Guard, US Army Corps of Engineers, US Fish and Wildlife Service, National Oceanic and Atmospheric Administration National Marine Fisheries Service

PP8: Establish a committee to serve as long-term advisors on Tomales Bay native oyster, *Ostrea lurida*, restoration.

Recommended Champions: Greater Farallones Association, West Marin Interagency Committee, County

Recommendation: Native oyster, *Ostrea lurida*, “Population Enhancement”

PE1: Undertake phased restoration activities to augment the self-sustaining population of the Tomales Bay native oyster, *Ostrea lurida*, robust enough to be resilient to projected climate-related threats and episodic recruitment and mortality. Oyster restoration activities with potential to negatively impact sensitive habitats, like eelgrass, should be avoided.

Recommended Champions: Greater Farallones Sanctuary, National Park Service

Phase 1: Implement and monitor pilot restoration projects in 2020 at six locations (see Appendix II: Pilot Restoration Site Maps for *Ostrea lurida* in Tomales Bay) to better understand if these locations are appropriate for demonstration projects. Pilot projects should include experimenting with a range of restoration and monitoring methods to help managers better understand what are the most effective methods to use in Tomales Bay. Examples of methods to test are in the working group meeting notes (see Appendices III, IV). Evaluate pilot restoration projects against project-specific success criteria prior to Phase 2.

(Added): To the extent that the pilot sites involve the construction or modification of or otherwise altering the submerged lands of the sanctuary in any way, the sanctuary should, as part of its permitting process, require that all incidental consequences of the activity be considered and require appropriate mitigation measures (beyond the expected benefits of the project itself), as appropriate.

Phase 2: Implement demonstration projects in 2023 in areas where pilot restoration projects were deemed successful based on the identified success criteria and incorporating lessons learned from the pilot restoration projects. Considerations to include when developing a demonstration project are in the working group meeting notes (see Appendices III, IV). Evaluate demonstration projects against predetermined success criteria prior to Phase 3.

Phase 3 Strategically implement a large-scale restoration project in 2027 and monitor for evaluation in 2030. The goal of evaluation will be to meet the *Ostrea lurida* population target that ensures the *Ostrea lurida* population is sustainable over time.

Recommendation: Address Existing and Future “Threats” to *Ostrea lurida* Populations (T)

T1: Develop a plan to manage the invasive oyster drill to mitigate its negative impacts on the sustainable population of *Ostrea lurida*, as well as the overall ecosystem function of Tomales Bay. The plan should include management of the bat ray enclosure fence posts that currently serve as habitat for the drills, as well as focused reduction of drills near pilot restoration project sites.

Recommended Champion: Greater Farallones National Marine Sanctuary

Recommendation: “Monitoring, Evaluation, and Adaptive Management” of *Ostrea lurida* Restoration (ME)

ME1: Develop restoration success criteria and metrics to be included in a Tomales Bay *Ostrea lurida* monitoring plan using NOAA Restoration Center Tier I and Tier II protocols as a guide. Success should be defined and assessed across individual projects, multiple scales (e.g. individual oysters, species that benefit from oysters, and bay-wide), benefits (e.g. *Ostrea lurida* population, community, ecosystem,

biotic/abiotic), and stressors. When tailoring the success criteria to individual projects, consideration should be given to project location, materials used, project-specific goals, and intended benefits to ensure monitoring protocols are developed to effectively assess the project's role in changes to benefits provided.

Recommended Champions: Greater Farallones National Marine Sanctuary, Greater Farallones Association, National Park Service, UC Davis, Bodega Marine Lab, Native Olympia Oyster Restoration Network

ME2: Monitor sediment dynamics in Tomales Bay to quantitatively assess sedimentation changes (e.g. shoreline accretion and erosion) that may be created by pilot *Ostrea lurida* restoration projects.

Recommended Champions: Native Olympia Oyster Restoration Network, San Francisco Regional Water Quality Control Board

Key Players to Consult: Marin Resource Conservation District, Marin Agricultural Land Trust

ME3: All restoration activities should include a maintenance or management plan, including a timeline, and responsible party to optimize the positive impact to the *Ostrea lurida* population over time and minimize the potential for negative impacts at abandoned sites where structures were installed, or materials added.

Recommendation: “Research and Data” Needs to inform *Ostrea lurida* Restoration (RD)

RD1: Develop a consistent funding stream to support comprehensive, consistent collection of data that will inform the development of a population dynamics model of native oyster adults and larvae (e.g. *Ostrea lurida* numbers, larval movement patterns, settlement and recruitment details, and hydrodynamics of Tomales Bay).

Recommended Champions for Funding Stream: Greater Farallones National Marine Sanctuary, National Park Service, and California State Parks

Recommended Champions for Model Development: UC Davis, Bodega Marine Lab (Ted Grosholz, Andy Chang, & John Largier)

RD2: Collect data on recreational use of Tomales Bay, recognizing that currently there is not much known about the recreational use of Tomales Bay and multiple agencies would benefit from having a better understanding of its spatial/temporal use. This will fill important data gaps and ensure the population and Tomales Bay users are more fully understood before launching larger scale restoration.

Recommended Champion: National Park Service, Greater Farallones National Marine Sanctuary, California State Parks (Tomales Bay State Park), and Marin County Parks and Recreation

RD3: Prioritize the need for research to assess the interaction of eelgrass and *Ostrea lurida*, to be used to inform all phases of future restoration projects.

Recommended Champions: UC Davis, Bodega Marine Lab (Ted Grosholz & John Largier)

RD4: Study to quantify the role of *Ostrea lurida* in providing protein to the surrounding community/fishery and the number and type of species that native oysters help support in Tomales Bay. For example, determining what species rely on the oysters? Would their numbers improve if the *Ostrea lurida* population was enhanced?

Recommended Champion: UC Davis Bodega Marine Lab

RD5: Study to understand the existing state of *Ostrea lurida* aquaculture co-benefits in Tomales Bay, as well as incorporating lessons learned into future management actions. Puget Sound Restoration Fund

should be used as an example for the type of studies to conduct.

Recommended Champion: UC Davis Bodega Marine Lab

RD6: Study the type of substrate most effective for *Ostrea lurida* to prosper in different areas of the bay, as well as the most efficient way to introduce and/or enhance the substrate at the project site. From this information, create criteria to guide the implementation of future restoration projects. Criteria should consider bathymetry, site specific objective, and the natural and/or **(Edited): remove man; replace with human**-made existing substrate.

Recommended Champions: UC Davis Bodega Marine Lab, California Coastal Conservancy

RD7: Study to quantify the role of *Ostrea lurida* in providing living shoreline benefits such as reducing coastal erosion, increasing sediment accretion, and protecting other coastal habitats and human assets. The study should include monitoring sediment levels, erosion rates and sedimentation accretion rates at restoration sites and control sites without oyster reefs. How would a robust and resilient native *Ostrea lurida* population affect and protect the bay?

Recommended Champion: County of Marin

Recommendation: “Education and Outreach” for *Ostrea lurida* in Tomales Bay (EO)

EO1: The council recommends that a Tomales Bay restoration education and outreach strategy and program be developed. Program messages should include:

1. The benefits a functional Tomales Bay ecosystem can provide to the surrounding human community, e.g. habitat for nearshore species, food source for predators, including fishermen, mediate salt marsh accretion, mitigate wave and wind energy, and contribute to nearshore coastal shoreline protection.
2. The state of the *Ostrea lurida* population.
3. Threats to the *Ostrea lurida* population and Tomales Bay habitats.
4. What community members can do to help the *Ostrea lurida* population. Such as: (a) establish recruitment collection sites using oyster shell necklaces. (b) Outline the specific actions the community can do to reduce threats to *Ostrea lurida*.

Recommended Champions: National Park, Greater Farallones Association, California State Parks, Native Olympia Oyster Restoration Network

EO2. Outreach could include:

1. Engaging school groups in community science activities and developing educational materials for K-12 teachers.
2. Development of pamphlets for interested public, e.g. kayakers, property owners, aquaculture, etc.
3. Targeting boaters for assistance in monitoring restoration sites.
4. Creation of educational wayside signage for sites in all phases of restoration.
5. Engage diverse communities in recognizing the current and past cultural and economic value of *Ostrea lurida* in Tomales Bay and along the West Coast.

Recommended Champions: National Park, Greater Farallones Association, California State Parks, Native Olympia Oyster Restoration Network

EO3: The council recommends the development of a Tomales Bay Community Science Program with the goal of increasing local community understanding of Tomales Bay ecosystem dynamics, local buy-in of the ecological and economic value of *Ostrea lurida* and increased potential for data collection that will

better inform adaptive restoration of *Ostrea lurida* populations and habitat. Community Science could include assisting with:

1. Monitoring, for example
 - a. Water Quality (salinity, sediment, temperature)
 - b. *Ostrea lurida* population and related threats
 - c. Man-made structures for oysters and oyster drills
2. Removal of non-native oyster drills aligned with California Department of Fish and Wildlife collection permit requirements
3. Fabrication of alternate oyster habitat, e.g. shell mounds, reefballs, habitat suspended from floats or piers, subtidal habitat attached to mooring anchors.
4. Installing appropriate hard substrate that acts as artificial oyster habitat and encourages oysters to recruit.

Recommended Champions: National Park, Greater Farallones Association, California State Parks, Native Olympia Oyster Restoration Network, Point Reyes National Seashore Association, The Watershed Project

EO4: Build and engage multi-organizational collaborations to share information about Tomales Bay *Ostrea lurida* oysters and to facilitate effective management of the oyster population's Tomales Bay ecosystem and surrounding human communities

Recommended Champions: Greater Farallones Association, Tomales Bay Watershed Council, and West Marin Interagency Committee

Appendices

- I. Site Selection Criteria and Descriptions
- II. Proposed Pilot Site Maps
- III. March 15 Working Group Meeting Notes
- IV. May 15 Working Group Meeting Notes
- V. Public Comments on the Tomales Bay Native Oyster Working Group Recommendations

APPENDIX I: Site Selection Criteria and Pilot Restoration Sites

Site Type	Habitat				Co-benefits	
Site Name	Cypress Point	Duck Cove	Pelican Point (South)	North Shell Beach	Marshall Mile	North of Tomasini Pt (CA DFW I.D. M-430-12)
Estimated Latitude	38.16490000 N	38.14630817 N	38.18045180 N	38.12079625 N	38.15872889 N	38.12508363 N
Estimated Longitude	122.90130000 W	122.90248996 W	122.92941720 W	122.87752857 W	122.89549352 W	122.86343539 W
Tomales Bay location (Mid-Bay)	Upper mid-bay; Eastside	Mid mid-Bay; Westside	Upper mid-bay; Westside	Lower mid-bay; Westside	Mid mid-bay; Eastside	Lower mid-bay; Eastside
Size of area to restore	Scalable in area without restrictions of other uses (e.g. moorings, aquaculture)					Scalable in area without restrictions of other uses (especially up-tidal)
Site benefit: maximize habitat success or co-benefit of protection value	Managed retreat of salt marsh	Managed retreat of salt marsh	Habitat	Habitat	Coastal Protection Value - County of Marin Large potential benefits: 1) Large built area and 2) Lots of large private parcels	Coastal Protection Value - County of Marin 1) attenuate waves, 2) aquaculture benefits (use of long line baskets), and 3) filter non-point pollution from watershed.
Impact to recreational use or scenic uses	No recreational use	No recreational use, Locate south of Sacramento Landing to minimize conflict with law enforcement	Moderate to Low recreational use	Moderate to Low recreational use	Summer Recreational visitor use (picnic, fishing, and beer drinking)	Moderate to Low (Hog Island educational group camping)
Susceptibility to harvest	Low	Low	Low	Low	High for tidelands, but low for subtidal areas.	Unknown
Current substrate type	Rocky	Rocky	Cobble, Sandy	Cobble, Sandy	Cobble, Sandy, plus some pilings, seawalls, foundations, and rip-rap	Cobble, Sandy
Threat from nonnative Drills	Not extreme, no drill or minimal	Not extreme, no drill or minimal	Low	Low	Unknown	Moderate
Accessibility • Public • Research	Accessibility: boat or through the Audubon Canyon Ranch property or inland GGNRA property. Public: by boat only and not often. Research: Unknown	Accessibility: Boat only Research and Public access: Rare	Accessibility: Boat only Research and Public access: Minimal	Accessibility: Boat only Research and Public access: Minimal	Accessibility: Shoreline (all groups from tidelands), Private property (get input from Eastern Shore Planning Group and 2 private landowners), and access from the highway South of Marshall Tavern on state-owned land and Audubon Canyon Ranch (all groups). The two private properties further south are undeveloped and not protected from any access with potential prescriptive rights.	Accessibility: Boat and trail Research and public: Moderate for educational purposes, aquaculture use, recreational camping
Research Value	Good habitat (Rocky Point)				Good habitat (cobble, sandy) and possible artificial substrate	Good habitat (cobble, sandy)
Structure addition (type, performance, removable)	Viable to add structure			Viable to add structure (tides dictate barge access times)	Viable to add structure	
Larval Reservoir (aquaculture nearby)	Larval Reservoir (aquaculture to the north)	No	No	No	No aquaculture. Native oysters are found on natural rocky outcroppings, pilings, seawalls, and rip-rap.	Yes (aquaculture)
Impact to sensitive habitat	Minimal Eelgrass conflict	Conflict with Eelgrass minimized compared to Sacramento Landing	Low conflict with eelgrass beds	Low conflict with eelgrass beds	Moderate conflict with eelgrass beds	Low conflict with eelgrass beds as potentially inshore of existing beds.
Maximize nearby habitat protection	Yes (maximize marsh integrity)	Yes (maximize marsh integrity)	Yes (maximize marsh integrity)	Yes (maximize marsh integrity)	No	Yes (maximize marsh integrity)
Community Engagement	Native American Heritage Commission (NAHC), local Tribal groups, Environmental Justice Outreach, community groups/recreation communities				Same as habitat sites plus East Shore Planning Group	Same as habitat sites
Landowner	CA State Lands (H2O side), Audubon Canyon Ranch	CA State Lands, Point Reyes National Seashore	CA State Lands, Point Reyes National Seashore	CA State Lands (H2O side), CA State Parks (Land side)	CA State Lands, Private Parcels abutting (#s 10602012, 10602017 & 10602018); shoreline slightly north is owned by Audubon Canyon Ranch.	CA State Lands (inwater area of Tomales Bay), CA State Parks (upland of Tomales Bay State Park and abutting waters)

Lead Jurisdictional Authority	CA State Lands, GFNMS, CA Coastal Commission, Possibly Audubon Canyon Ranch depending on how close to shore.	NPS, CA State Lands, CA Coastal Commission	NPS, CA State Lands, CA Coastal Commission	NPS, CA State Lands, State Parks, GFNMS, CA Coastal Commission	CA State Lands, CA Coastal Commission, and GFNMS	CA Coastal Commission, GFNMS, CA State Parks, and CDFW if located on M-430-12 OR CA State Lands if located outside of M-430-12.
Consultations and Permitting Considerations	<p>All sites are subject to Coastal Commission permitting or consistency determinations. All sites may be subject to USACE permitting unless USACE cedes authority to another federal agency. USCG would need to permit if navigation issues are presented, however, the recommended locations are currently outside of navigation channels. Duck Cove and Pelican Point sites are over NPS-owned tidal and subtidal areas, but not within the GFNMS; all other sites are subject to GFNMS permitting and not NPS permitting. Marin County permitting may also be applicable. California FGC or State Lands Commission manages experimental oyster growing in Tomales Bay and may specifically have to permit a project at Tomasini Point if located in CDFW Lease I.S. M-430-12. A consultation could be required with National Marine Fisheries Service for groundfish Essential Fish Habitat if there are potential impacts to eelgrass.</p>					

APPENDIX II: Pilot Restoration Site Maps

Tomales Bay Native Oyster Restoration Working Group Final Site Selection Maps

The following maps show the locations that the Tomales Bay Native Oyster Restoration Working Group selected as potential restoration sites on May 15, 2019. These maps were produced as a product of a discussion/decision support tool utilizing GIS layers.

A few things to note about these maps:

1. The Discussion/Decision support tool has many layers that are not shown on these maps. Additional data including bathymetry, sea level rise predictions, coastal access, waterways, etc. is part of a GIS tool that can be available during the August Sanctuary Advisory Council meeting.
2. Data relevant to the scale of each map is shown, therefore if a layer is not on all maps, it is because it is not relevant for all locations.
3. The legend is self-generated from the system and doesn't show all the layers depicted in the map. Text explaining additional layers follows each map.
4. The eelgrass data is depicted with two green colors:
 - a. Light Green- This layer represents the presence and maximum observed extent of eelgrass (*Zostera* sp.) habitat. It is based on California Department of Fish and Wildlife (CDFW) and NOAA survey data. The historic eelgrass distribution of Tomales Bay is based on a composite of survey information derived from aerial overflights conducted in 1992, 2000, 2001, and 2002 by the CDFW. In 2013, the CDFW refined the eelgrass mapping within Tomales Bay by completion of georectification and digitization of eelgrass from photographs taken on June 29, 2010. Groundtruthing of the photographic interpretation was completed from May 13 to July 25, 2013. The NOAA survey data was collected in 2017 by the methods listed below.
 - b. Dark Green – The August 1-9, 2017 eelgrass survey data produced by Merkle and Associates and published by NOAA, Greater Farallones National Marine Sanctuary. It was conducted using a hybrid approach that leveraged the capabilities of vessel-mounted interferometric sidescan sonar (ISS) and, where possible to fly, low-altitude color aerial imagery captured from unmanned aerial vehicles (UAVs) to detect eelgrass throughout its suitable depth range. ISS surveys were conducted primarily during high tides within the deeper subtidal and extreme lower intertidal portions of the bay's channels and flats to capture both eelgrass and bathymetry data. At extreme low tides, low-altitude UAV, color aerial imagery was collected to assess intertidal and shallow subtidal (i.e. less than 3-5ft below mean lower low water) eelgrass distributed over intertidal flats. The data provides a complete synoptic inventory of eelgrass within Tomales Bay during the peak of the eelgrass growing season.

Tomales Bay Native Oyster Restoration Working Group
Final Site Selection Maps

This is a product of the Tomales Bay Native Oyster Restoration Working Group of the Greater Farallones National Marine Sanctuary Advisory Council.

South Pelican Point



5/31/2019, 12:29:46 PM

- Updated Recommended Restoration Sites
- Eelgrass Maximum Observed Extent (CDFW-ds2795)
- Hydrographic Sectors of Tomales Bay (Smith et al. 1989)
- PRNS Offshore Mgmt Area
- Eelgrass (Collected by Merkel Aug. 2017)

1:20,059
0 0.13 0.25 0.5 mi
0 0.2 0.4 0.8 km
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user

Web AppBuilder for ArcGIS
USDA FSA | NOAA / NOS / Special Projects Office | Source: USGS, EPA | marinecadastre.gov | Esri, HERE, Garmin, IPC |

This is a product of the Tomales Bay Native Oyster Restoration Working Group of the Greater Farallones National Marine Sanctuary Advisory Council.

Tomales Bay Native Oyster Restoration Working Group
Final Site Selection Maps

Cypress Point and Marshall Mile



6/3/2019, 11:18:01 AM

Protected Areas (CPAD2017a)

Audubon Canyon Ranch

United States National Park Service



Updated Recommended Restoration Sites

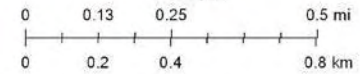


Mooring Zone (February 2018)



Eelgrass (Collected by Merkel Aug. 2017)

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Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user

Web AppBuilder for ArcGIS

USDA FSA | NOAA / NOS / Special Projects Office | Source: USGS, EPA | marinecadastre.gov | Esri, HERE, Garmin, IFC |

Colors missing from the legend: **Light Green**-maximum extent of eelgrass.

This is a product of the Tomales Bay Native Oyster Restoration Working Group of the Greater Farallones National Marine Sanctuary Advisory Council.

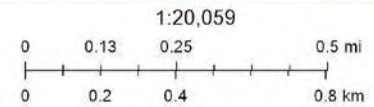
Tomales Bay Native Oyster Restoration Working Group
Final Site Selection Maps

Duck Cove



6/3/2019, 11:08:13 AM

-  Updated Recommended Restoration Sites
-  Mooring Zone (February 2018)
-  Aquaculture in U.S. Coastal and Offshore Marine Waters
-  Eelgrass (Collected by Merkel Aug. 2017)
-  Eelgrass Maximum Observed Extent (CDFW-ds2795)
-  PRNS Offshore Mgmt Area



Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user

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USDA FSA | NOAA / NOS / Special Projects Office | Source: USGS, EPA | marinecadastre.gov | Esri, HERE, Garmin, IPC |

This is a product of the Tomales Bay Native Oyster Restoration Working Group of the Greater Farallones National Marine Sanctuary Advisory Council.

Tomales Bay Native Oyster Restoration Working Group
Final Site Selection Maps

N. Shell Beach and N. of Tomasini Point (430-12)



6/3/2019, 10:46:30 AM

Protected Areas (CPAD2017a)

California Department of Parks and Recreation

United States National Park Service



Updated Recommended Restoration Sites

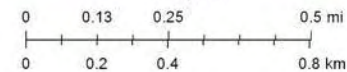


Mooring Zone (February 2018)



Hydrographic Sectors of Tomales Bay (Smith et al. 1989)

1:20,059



Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user

Web AppBuilder for ArcGIS

USDA FSA | NOAA / NOS / Special Projects Office | Source: USGS, EPA | marinedatastore.gov | Esri, HERE, Garmin, IFC |

Colors missing from the legend: **Dark Green** – Eelgrass 2017; **Light Green**-maximum extent of eelgrass; **Peach** –Aquaculture Leases

This is a product of the Tomales Bay Native Oyster Restoration Working Group of the Greater Farallones National Marine Sanctuary Advisory Council.

APPENDIX III: March 15 Working Group Meeting Notes

Tomales Bay Native Oyster Working Group Meeting Summary

March 15, 2019 9-5pm

Participation Guidelines and Expectations

- 1) The Working group is closed to the public to ensure conversations are productive and open for considering all viewpoints and ideas.
- 2) It is critical that you talk with your respective groups to gather ideas and relevant information to weave into our final recommendations.
- 3) All communications about the Working group should be referred to Bibit as the Working group Chair.
- 4) The Working group's role is to consider information provided and share relevant information you have with the group.
- 5) Use information and discussions to craft recommendations for restoration of the Native Olympia oyster in Tomales Bay.
- 6) Recommendations will be presented to the Sanctuary Advisory Council for consideration and final approval on August 15, 2019 at the Half Moon Bay Yacht Club.
- 7) SAC Recommendations will be given to the Greater Farallones National Marine Sanctuary Superintendent.
- 8) The Superintendent will assess the feasibility of each recommendation based on the mission of the NMS system.
- 9) The Superintendent will respond to any recommendations the Sanctuary does not plan to implement with a rationale conveying why the recommendation is not appropriate for the Sanctuary to act upon.
- 10) Please pass all inquiries about the working group to Bibit. She will add them to our Communications Folder and address or pass on to Sanctuary staff.

Tomales Bay Background

- 1) Bay is shallow (20-30 feet deep) - lots of flushing
- 2) Population size: 10,000-1 million
- 3) Little or no recruitment
- 4) Threats: Sedimentation and low salinity, along with oyster drills
 - a) Sedimentation not a problem for Tomales Bay (Ted)
 - b) Salinity changes make Sac landing not a good site, changes can last up to a week. 10 ppt and above ok, below 10 is hard on oysters.
 - c) Oxygen content impacted - runoff in the winter and upwelling in the spring. d) pH
 - e) Back bay - most impacted by runoff ... input from Lagunitas
 - f) Note: stress can limit oyster growth rate (size)
- 5) Future threats: acidification and higher temperatures
- 6) Size specific abundance - varies between sites
- 7) Recruitment varies between mouth to back of the bay - happy at Sacramento Landing a) Outer bay - less recruiting
 - b) Middle part of the bay - highest growth
 - c) Mid-Upper bay - high recruits
 - d) Upper bay (top of the bay) - recruitment issues
 - e) Larval retention - highest at the back of the bay
- 8) Juvenile mortality is constant - more predators further from ocean.

- 9) Native Tomales Bay oyster is only oyster in Tomales Bay, unless it is in a bag.

Terminology Discussion:

- 1) **Restoration** (confirmed we will follow Subtidal Goals language and use this over enhancement): A self-sustaining population of native oysters, *Ostrea lurida*, in Tomales Bay robust enough to be resilient to predicted threats and the 5-6 year episodic recruitment and mortality trends using a combination of a variety of enhancement methods to achieve specific benefits to the coast and system in order to avoid deleterious impacts to other species and habitats.
- 2) **Living Shoreline** (NOAA definition) A protected and stabilized shoreline that is made of natural materials such as plants, sand, or rock (NOAA Ocean Services). It is meant to reduce erosion and provide valuable habitat to enhance coastal resilience (NOAA Fisheries).

- Expect sea level rise to increase the sandbar at the mouth of the bay.
- Rip rap is too unstable of a substrate to work effectively as a substrate for native oysters.

3) **Future WG Discussion Points:**

- a) How do we expect this to relate to coastal shoreline protection? Does it need to be connected?
- b) How does oyster restoration compete with mudflats?

Restoration Goal and Objectives - Future WG Discussion Point: If the objective is to set up a Restoration Program, have a clear goal for the program. It will tie to where and how we decide to restore.

- 1) **Oyster Population Success:** Enough oysters to regenerate and continue through the good and bad years.

a) **Future WG Discussion Point:** What is the estimated population number required for this to happen? How do we determine this? Is there a model we can use? 2) **Ecosystem Level Benefits**

from Successful restoration:

- a) Oysters catalyze building a living shoreline.
- b) Habitat creation and mitigation of marsh loss, e.g. Canyon Ranch
- c) Structure will provide habitat to others, even if oysters die, e.g. reproductive structure for fish eggs.
- d) Food for other species.

3) **Human Benefits (Resilient Ecosystem (or Ecosystem Services)) from successful restoration:**

- a) Coastal shoreline protection would be provided because of the resilient ecosystem. i) Waves ii) Erosion iii) Sea Level Rise iv) SLF - combination of eelgrass and infrastructure
- b) Food
- c) Indirect objective is to improve Water Quality, even though on-the-ground restoration actions cannot be aligned with water quality improvements. NOTE: Messaging as filtration is not appropriate.
- d) **Future WG Discussion Point:** define and/or identify the specific services we wish to promote in recommendations framework.
 - i) If we breakout the services, identify top 3-5 that are most relevant to the question we want to ask or the services with the strongest connection to anticipated on-the-ground restoration actions.

5) **Community Engagement**

- a) Consider focus audience and/or benefit for each audience. Is our goal to provide benefit to each audience?
 - i) Public - education
 - ii) Scientist - function

- iii) Public - engage citizen scientists to help monitor effectiveness and populations
- 6) **Other:**
 - a) **Artificial oyster structures** - provide different benefits and values - depend on location and materials used to create.
 - i) **Example benefits:** attenuate waves, capture sediment
 - ii) Use of construction products that would benefit as oyster habitat too

Recommendation Progress

- 1) Network of multiple restoration sites - permit include all phases (pilot to large scale) - engage regulator early and often - survey areas without information to test recruitment potential . a) Criteria
 - i) Size: 100m (minimum) ii) Existing populations
 - (a) Oysters
 - (b) Eelgrass
 - iii) Ecosystem services (Future WG Discussion Point: WG needs to define measurable ones to focus on)
 - (a) Potential to provide coastal protection in the future (H, M, and L) - Future WG Discussion Point: set criteria/definitions.
 - iv) Biophysical factors
 - (a) Oxygen level (not hypoxic)
 - (b) Temperature
 - (c) Nutrient levels
 - (d) Salinity
 - (e) Ph (lower acidity reduces shell growth)
 - (f) Tidal flushing - changes with seasons
 - v) Tidal elevation vi) Temporal/spatial scale (e.g. resiliency, sustainability, sea level change, management) vii) Reality check:
 - (a) Human access
 - (i) Researchers to understand oyster populations and ecosystem (ii) Educate public
 - (iii) Marinas and boats
 - (b) Signage for restoration/enhancement sites
 - (c) Ownership
 - (d) Permits
 - (e) Are there other conflicts that exist for a specific site?
- b) Goal: 3 Paired sites (W-E) across the bay (see [table](#)) to encourage adaptive restoration and science-based approaches
- c) Phases (Future WG Discussion Point: number - coordinate with name and description)

Information WG Needs

- 1) Site selection decision tree (*would like draft ahead of May 15 meeting, alternative create at mtg.*)
- 2) Updated map with data layers requested ahead of May 15 meeting ([locations from meeting 1](#))
 - a) Eelgrass (seagrass) data to overlay that is up to date (Karen R) – this is important if additional substrate will be added (WG members all echoed this need).
 - b) Land ownership

- c) C-Smart Marin Maps, Vulnerable Areas (Julia/Sage)
 - d) Ocean Solutions (Marilyn's tool) – requested that she send the link to me to share with group
 - e) Marin County GIS (help me define the specific need)
 - f) Oyster site suitability map (bay conditions - substrate and water column, tidal elevation, and sediment) with bathymetry
 - g) Aquaculture Lease Area
 - h) Mooring Zones and Moorings (on private property)
- 3) Tools
- a) COS tool
 - b) P-MAP
 - c) Other suggestions? (Chela/Marilyn - links to tools discussed in meeting)
- 4) Clarification of co-benefits and coastal protection
- 5) Understanding of Regulations and Policy in Tomales Bay 6) Ownership constraints around Tomales Bay

Proposed agenda items for May 15 meeting

- 1) Policy and regulations considerations
- 2) Co-benefits of Living shorelines
- 3) Restoration site selection tools

Individual Homework Assignments, please send to Julia Royster

- 1) **All:**
- a) If restoration and living shoreline definitions captured from in-person meeting do not resonate with you, send Julia alternates to be compiled and shared with WG by April 22.
 - b) [Log native oyster related activities](#) in the Bay by April 22 - proposals, funded, and partners to identify how perceived GAPs may already be in process of being addressed (**note:** click on second tab of google sheet to enter your information).
 - c) Review and suggest edits (using SUGGESTING MODE) to the “TBNORWG Recommendations Framework” (document will be sent to you next week) by **May 6**. This allows me time to update and send out updated draft on May 8 in 2nd meeting packet.
- 2) **Andy Chang:** Send oyster life cycle graphic with identified key points and types of recommended actions to facilitate restoration/enhancement of sustainable oyster populations.
- 3) **Gary Fleener:** Please review draft short sentence and augment as needed.
- a) How will enhancement/restoration efforts compete with commercial oyster farms?
 - i) DRAFT: Native Tomales Bay oyster is only oyster in the Bay, unless it is in a bag, so they will not be competing.
- 4) **Ted Grosholz:** Please draft a short sentence to a paragraph to address 2 misconceptions.
- a) Oysters at mouth have failed to recruit because it is not an ideal location NOT because it has been tried and failed.
 - b) Oysters never existed in Tomales or Drakes Bay - speak to historical populations in these Bays.
- 5) **Marilyn Latta:**
- a) Provide restoration definitions for consideration to finalize our Working Group definition. b) Share the link for the tool you highlighted.
- 6) **Jeremy Lowe:** Please provide a proposed definition for coastal shoreline protection, a clear statement on what “protection” oysters may provide & constraints to realizing this benefit.
- 7) **Julia Royster:**

- a) Have updated map made with data layers discussed and [6 recommended restoration sites](#).
This will be included in Meeting 2 materials to be sent on May 8.
 - b) Send out doodle poll for ½ day meeting between May 27- June 14.
- 8) **Chela Zabin:** share the link for the tool you highlighted.

APPENDIX IV: May 15 Working Group Meeting Notes

May 15, 2019

Meeting 2 Recommendation

COMPILATION DOCUMENT

To DOs in Red

NOTE: GFNMS Can work on items within GFNMS jurisdictions, so if action falls on a different agency's jurisdiction, then GFNMS would reach out to them.

List of Recommendations

- Recreational Data

Ensure talk about scope of restoration and purpose ... Recommendation:

Assess existing data on the native Tomales Bay oyster, *Ostrea lurida*, to determine if the population needs to be restored. (The WG has found enough holes that they are uncertain about if it is needed and if so, what should be the purpose and success criteria for restoration).

Question for the SAC: What is the primary purpose they would like to have oysters restored? (assumption is they want to proceed with restoration of population).

Restoration for protection of habitat and/or cultural resource

(benefit would be to local area where restoration would be conducted)

Restoration to avoid extirpation of the *Ostrea lurida* population in Tomales Bay Restoration to meet the report goal of 1 Million oysters by (assume this is the subtidal goals document)

Recommendation (include time):

Start collecting data now, so that small scale restoration project can be implemented in 2020 and monitoring for 2-3 years, then build demonstration scale projects & monitor/adapt them over next 2-3 years, Around 2029/2030, it would be reasonable to start a large scale restoration project.

- Underlying question to be answered - How big of an area do we want to restore? OR How big of an area "needs" to be restored? Clarify how "needs" is defined.

Site Selection Criteria

- TYPE OF SITES
 - Maximum habitat success (4)
 - Protection value (2)
- CRITERIA (use these to make table of criteria for sites, then plug site name and characteristics of sites listed below; look at habitat &);
 - Don't harm recreational & scenic uses
 - Community engagement (stakeholders)
 - Habitat Engineering required?
 - Removal of drills (and their known habitat, if appropriate, e.g. bat ray posts) \
 - Delineate actions required

- Modest scale (if failures)
 - Location in Bay (midBay to inner)
 - Research value
 - Add structures
 - e.g. reef balls, reef castles, low relief shell beds, cobbles, shell bags
 - removable
 - performance
 - multiple types or one type
 - Larval reservoir
 - Minimize impact to sensitive habitat o Maximize marsh integrity & habitat protection
- **MAPPING NEEDS**
 - State parks (done)
 - Recreational use
 - Substrate data (SLC)
 - Jack will get the Cypress Grove engineering report
- How to choose restoration?
 - Size of restoration area
 - What type of substrate is already at the site & how big is it?
 - Wave energy
 - Identify goal for the site
 - *From Site Selection Flip Chart: eelgrass/oyster interaction and benefit?*
- **SITES—habitat sites**
 - Cypress Point
 - Mid-mid bay East side (pair to Sacramento Landing)
 - Recreational not use
 - Drill not extreme, no drill, or minimal
 - Scalable in area without restrictions of other uses (e.g. aquaculture, mooring)
 - Minimal eelgrass conflict
 - Accessible
 - Public
 - research/monitoring
 - general public limited as on protected lands
 - add structure viable
 - larval reservoir (aquaculture available north)
 - Good habitat (rocky point)
 - Managed retreat
 - Rocky
 - Maximize marsh integrity & habitat protection
 - Jurisdiction: NPS, ACR, GFNMS
 - **Duck Cove** (replaces Sacramento Landing)
 - Mid mid-bay
 - Westside (pair to Cypress Grove)
 - Locate south of pier so minimize conflict with law enforcement
 - Recreational not use
 - Drill not extreme , no drill or minimal
 - Scalable in area without restrictions of other uses 9e.g. aquaculture, mooring)

- Conflict with eelgrass beds and spawning minimized compared to Sacramento Landing
- Accessible
 - Minimal Public
 - research/monitoring good
 - conversion from house inholding to natural area
- add structure viable
- larval reservoir (aquaculture available north)
- Good habitat (cobble, sandy)
- Managed retreat
- Rocky
- Maximize marsh integrity & habitat protection
- NPS jurisdiction, not GFNMS
- Notes: redrocks—herring project (Marilyn); salvage eel grass and not necessarily issue
- **Pelican Point (south)**
 - Upper mid-bay
 - Westside
 - Recreational (moderate to low)
 - Drill low
 - Scalable in area without restrictions of other uses (e.g. aquaculture, mooring)
 - Low conflict with eelgrass beds
 - Accessible
 - Boat only, no road
 - Minimal/research public accessibility
 - add structure viable
 - larval reservoir--no
 - Good habitat (cobble, sandy)
 - Maximize marsh integrity & habitat protection
 - NPS jurisdiction, not GFNMS
- **North Shell Beach** ▪ lower mid-bay
 - Westside
 - Recreational (moderate to low)
 - Drill low
 - Scalable in area without restrictions of other uses (e.g. aquaculture, mooring)
 - Low conflict with eelgrass beds
 - Accessible
 - Boat only, no road
 - Minimal/research public accessibility
 - add structure viable (but need to work with tides to bring in to site via barge)
 - larval reservoir-no
 - Good habitat (cobble, sandy)
 - Maximize marsh integrity & habitat protection
 - Mooring issue not an issue
 - NPS, State Parks, GFNMS jurisdiction

- SITES: Co-Benefit Sites

- **Marshall Mile**
 - Mid mid-bay
 - Eastside
 - Recreational
 - Conflict with eelgrass beds moderate
 - Accessible
 - Private property
 - research/monitoring, need private property permission
 - add structure viable
 - larval reservoir?
 - Good habitat (cobble, sandy)
 - Rocky, cobbly
 - NPS jurisdiction, not GFNMS
 - County of Marin benefit
 - Large built area so large potential benefits
 - Lots of large private parcel
 - Outside mooring site
 - Jurisdiction:
- **Site 430-12? North of Tomasini point**
 - lower mid-bay
 - Eastside
 - Recreational (moderate to low, educational groups with Hog Island, camping)
 - Drill moderate
 - Scaleable in area without restrictions of other uses (especially up-tidal)
 - Low conflict with eelgrass beds as potentially inshore of them
 - Accessible
 - Boat access
 - Public access via trail
 - Research by land or boat add structure viable
 - Good habitat (cobble, sandy)
 - Co-benefits:
 - attenuate waves
 - aquaculture benefits (use of long line baskets)
 - filter non-point pollution from watershed
 - Maximize marsh integrity & habitat protection
 - Large wind issues
 - Jurisdiction
 - Adjacent to multiple aquaculture leases (Hog Island, Tomales Bay, Point Reyes, Marin Oyster Co.)
 - Notes for other groups:
- Physical protection considerations:
 - Substrate increase

- Reef ball benefit physical impacts
- Natural mimicking

Restoration Recommendations

A. Conduct habitat assessment to understand current conditions to inform regional prioritization.

- i. Compile existing data
 - a. C-Smart sites (identified in the process)
 - b. Regional sediment management plan
 - c. Climate vulnerability assessment for habitat (sara did – included recommendations based on beach/dune, rocky intertidal, deep ocean ... habitat. Did not have spatial component)
 - d. Others
- ii. Include attention to Historic Ecology – where feasible
- iii. Future conditions (e.g. sea level rise, temperature changes, ... climate-related changes)
- iv. Prioritization should be integrated across user groups and agencies

B. Conduct Programmatic Cultural Resource Assessment

C. (Develop Plan to ...) ... Restore Native Keystone Species, *Ostrea lurida*, to ensure they can act as ecosystem engineers .. providing habitat for a variety of plants, fish, and wildlife.

- a. Limit any negative impact to existing habitats.

D. Phased Approach (like subtidal goals document):

a. Pilot Small-Scale

i. Test variety of methods, examples include

1. Shell mounds
 2. Reef balls, etc.
 3. Cobble, shell placement
 4. Shell sizes, shell bags from buoys, structures, docks
 5. Monitor, enhance existing hard substrate
- ii. Monitor for 2-3 years, ensuring the inclusion of seasonal/annual recruitment

1. Invasive Species – limit their impact on oysters, and create an invasive species management plan, especially for oyster drill
2. Success of oyster recruitment & survival at the project

b. Demonstration Projects (near places where public partnerships could be built & engage interest in oyster restoration).

- i. Highly visible location
- ii. Adjacent to an oyster farm – increases visibility to the public
- iii. Adjacent to creek mouth to understand the impact of BMPs implemented to manage sediment. (This might not be a good idea, because if the BMP fails, you are exposing yourself to criticism)
- iv. Adjacent to private homeowner

- v. Adjacent to local/state/federal in Interagency Group
- vi. With living shoreline benefit
- c. Sites would be determined based on available information
 - i. If data (group clarify the type of data required): test structures on a 100 foot up to a ¼ acre size after small-scale project
 - ii. If no data, install intertidal/subtidal recruitment collectors (citizen science could help)
- d. Access
 - i. Avoid user conflicts
 - 1. boat/navigation issuers
 - 2. viewshed issues
 - ii. Consider whether to include attention to septic issues/ WQ related to urban/agriculture/agriculture runoff
 - iii. Increase community involvement/education
 - 1. Schools or school kids (necklaces on the half shell to make with kids, then they can off of their dock/docks near them to see if they spat sets on them).
 - 2. Kayak tours – involve boaters in monitoring and fabrication
 - 3. Signage
 - 4. Buoy areas from boats if needed
 - 5. Media
 - 6. Community involvement - use citizen science
 - 7. Involve community in fabrication of reefballs, shell mounds, etc.
 - a. e.g. Inverness Yacht Club
 - 8. Engage underserved and diverse communities
 - 9. Provide opportunity for future environmental justice engagement

E. Protection should be integrated

- a. Id stressor to existing populations
- b. Address stressors
 - i. Low Salinity (becomes a problem after a period of time, oysters can handle it for a little while)
 - ii. Sediment (Walker Creek & Lagunitas) – support the implementation of Sonoma/Marin Sediment Management Plan
 - 1. Bodega WQ monitoring
 - 2. Important for site selection, but not for oyster populations ... also important when determining restoration most appropriate for a site.
 - 3. **Grosholz will supply documentation/draft publication to support it is not a problem for Tomales bay.**
 - iii. Oyster drills
- c. Human uses recreation and harvesting

- d. Assess the potential for coastal protection and the use of living shorelines throughout the bay (may be needed in some places over others)

F. Define metrics of success

- a. X% of oysters per acre
- b. Up to 15% increase in fish use of the site
- c. Size distribution

Monitoring and Research

Use existing resources to inform monitoring:

- NOAA Restoration Center guidance with Tier 1 and Tier 2 considerations for monitoring – Tier 1 is very basic (presence/absence of various species) and appropriate for community involvement; Tier 2 is effectiveness monitoring and costly
- BC to Baja group (Native Oyster Restoration Network) has produced guidance

We need to collect the right data to answer these questions. Ted has been analyzing various sources of data but there's no direct funding to support comprehensive data-collection to develop a clear model. 7-year recruitment cycle, which is about the same as the lifespan. Episodic recruitment

Priority Recommendation: Develop a consistent funding stream to support the comprehensive, consistent collection of data to inform a model of population dynamics of adults and larvae (#s, movement, settlement and recruitment, hydrodynamics) – where are they and where do they go? Figure out how critical the larval dynamics information really is? To answer the following questions:

- What's the current level of the population?
- **ask Ted about what we know already and what we need to know – we know some** larval recruitment patterns, and abundances in some parts of the bay, but what are the specific gaps?
- where do larvae go in the bay? Need more info on supply and transport?
- What do we need to do to make this current population resilient?
- hatchery-assisted restoration – do we need this augmentation? Would amplify the abundance of the natural source supply.
- this depends on what the impediments to recruitment are – supply-limited? Hard substrate limited? Not likely hard substrate limited, as there's lots of that.
- We should then focus research/monitoring on the state of the population and what our actions are doing to impact the population
- How would a robust and resilient native oyster population actually affect the bay? What ecosystem services would be improved? What species rely on oyster beds and are they present in Tomales? Would their #s improve with enhanced native oysters?
- Need to better understand vulnerability to sediment via alluvial input to inform site selection for restoration actions

Who?

- Many of this work is best answered by graduate students.
- Much of the NOAA RC funds are administered through agencies like the Coastal Conservancy or NGOs like The Nature Conservancy.
- Ted Grosholz and his lab.
- Tomales Bay Watershed Council.
- Citizen science funds like BWET to support community engagement.
- Bodega Marine Lab – sole location for aquaculture/hatchery work SF State University – for monitoring.
- The Nature Conservancy – aquaculture is an international priority.

What is Success?

- Timing matters – immediate, or 10 years down the road?
- We need to articulate the why - *Why the native oyster? What are we looking to do in the first place?*
- Ecological services: they provide filtration services, they contribute to a healthy bay, habitat structure
- NOAA RC funds oyster restoration
- Community engagement – restoring a culturally significant resource
- Native oyster may be more resistant to disease and OA as climate continues changing

(PRE-construction/baseline) To monitor:

1. Man-made structures (buoys, pilings, docks) to see if they currently provide habitat for oysters and/or drills, or could be modified to provide oyster habitat.
2. Stressor/impacts monitoring
 - a. Invasive species (oysters)
 - b. Feral *gigas*
 - c. Temperature/salinity – water quality (BML)

(POST-construction) Metrics to assess success of restoration effort – [reference Baggett 2014](#)

1. Success for the individual (increased recruitment, increased population) – exact #s would be informed by modeling of the population
2. Success for other species:
 - a. fisheries (through structure, habitat provision)
 - b. birds
3. Success for the bay system:
 - a. Natural bed structure or created reef structure as habitat
 - b. Water quality via filtration (measure chlorophyll)
4. Physical benefits:
 - a. Reduced erosion
 - b. Adjacent sediment accretion
5. Stressor/impacts monitoring
 - a. Invasive species (oysters)
 - b. Feral *gigas*
 - c. Temperature/salinity – water quality (BML)

Recommendation: Engage with entities that manage the watershed for Tomales Bay to ensure activities are aligned and informed by each other.

Need to consider:

- frequency of monitoring
- seasonality of monitoring
- spatial extent – scope of monitoring
- short vs long-term (over 1 years, 5 years)
- data analysis and sharing – a feedback loop! What do you do with the data once its collected? Consider how to bring it back to the public. Archiving and curating the data.

Follow the model in SF and put out hard substrate

Community Engagement

- Jack will engage local schools, good for media and community engagement, sort of like STRAW

Oceanographic Setting

- Walker Creek
- Creek moths
- Add turbidity sensors and pressure sensors Norht of Tomasini
- Pore size analysis of sediments
- Sediment size for attachment
- Time series monitor turbidity and salintiy, OA
- Larval dynamics—
- Seagrass beds, not nec

APPENDIX V. Public Comments on the Tomales Bay Native Oyster Working Group Recommendations

**VERBAL PUBLIC COMMENT for Tomales Bay Native Oyster Restoration
August 15, 2019**

Commenter: Richard James

Affiliation: Coastodian.org

Issue of interest: Native Oyster augmentation (item on agenda)

Comment Summary: Legacy shellfish gear from late 1800's litters the south Tomales Bay and is now a nursery/habitat center for the Atlantic Oyster Drills. Before placing structures in the bay to help Olympia oyster recruitment, these hundreds of redwood posts need to be removed. These posts also present and hazard to kayakers at certain tide levels.

WRITTEN PUBLIC COMMENT SUBMISSIONS:

**Comments on the Recommendations of the
TOMALES BAY NATIVE OYSTER RESTORATION WORKING GROUP**

To be presented August 15, 2019

8:45AM – 5:00PM

Half Moon Bay Yacht Club 214 Princeton Ave

Half Moon Bay, CA 94019

Comment Deadline: Friday, August 9, 2019, midnight

All written comments received by this deadline are included below, for review and consideration by the Greater Farallones National Marine Sanctuary Advisory Council (GFNMS SAC) in its recommendations to the Greater Farallones National Marine Sanctuary on the topic of Tomales Bay Native Oyster Restoration.

The Tomales Bay Native Oyster Restoration Working Group is a working group convened by the GFNMS SAC in 2018. The working group was completed in 2019 and its recommendations will be presented to the GFNMS SAC at the August 15, 2019 SAC meeting in Half Moon Bay. The recommendations can be viewed online here:

https://farallones.noaa.gov/manage/sac_meetings.html

**Comments of Richard Charter, GFNMS SAC Conservation Seat Primary
re: Tomales Bay Native Oysters**

Tomales Bay native oysters (*Ostrea lurida*) are an important foundation species whose range is now limited due to human activities and climate impacts. The services provided by *Ostrea lurida* include water quality enhancement, providing important habitat, and biodiversity enhancement. All of these attributes merit the consideration of this species for carefully-sited restoration efforts. I believe that there should be continuing support expressed by the Greater Farallones National Marine Sanctuary Advisory Council for further study of the historic range and most promising locations that might offer a template for restoration efforts, and an assessment of what such restoration efforts should entail. Given the possibilities for creating soft-shoreline in the face of sea-level rise, Tomales Bay seems to be of an appropriate scale and in the right location for a series of scaled demonstration projects that can be evaluated and subjected to peer-reviewed scientific scrutiny, so that the results can eventually serve as a model for understanding the full range of benefits that can be anticipated from similar restoration projects elsewhere as well.

Thank you for your kind consideration of these comments.



Save Our Seashore

A 501(c)(3) Charitable Organization (EIN 94-3221625)
Founded in 1993 to Protect Marin County's Ocean, Coasts, Estuaries, Watersheds and Creeks
40 Sunnyside Dr, Inverness, CA 94937 gbatmuirb@aol.com 415-663-1881

August 9, 2019

To: alayne.chappell@noaa.gov:

Re: Gulf of the Farallones Sanctuary Advisory Council Meeting August 15, 2019

Save Our Seashore conditionally supports the recommendations of the Tomales Bay Native Oyster Restoration Working Group (WG), subject to filling the following two deficiencies.

Lack of Data to Support Claim of Biotic Need

Policy and Planning Recommendation #1 states: *“Compile and analyze existing data focused on the ecology or habitat of the native Tomales Bay oyster, *Ostrea lurida*, to better understand if, why, where, and by how much the Tomales Bay *Ostrea lurida* population needs to be enhanced to ensure it functions successfully into the future.”*

This data compilation effort appears incomplete and thus the foundation blocks (inadequate population and recruitment) of the WG recommendations are not supported.

A review of Wasson 2014 and 2015 shows extensive data collection at SF Bay, Elkhorn Slough, Newport, San Diego, Coos Bay and South Slough.

At all sites, population was estimated using field data, e.g. *“At each site, we laid out a 50 X 2 m transect centered near 0 to +0.5 m mean lower low water (MLLW) and then counted the total number of oysters within 30 randomly placed 0.25 m² quadrats along the transect. Density data were also used in calculations for population estimates on hard substrate over a 2 x 150 m area at each site.*

At all sites, recruitment was also estimate using field data, e.g. *“We monitored recruitment by deploying four 15 x 15 cm red unglazed ceramic tiles...”*

But there is no record of any field data collected for use to estimate Tomales Bay populations or recruitment, despite the fact that the deeper coloring in Wasson 2105 Table 1 denotes a higher level of certainty for the Tomales Bay estimates.

Further, Wasson 2015 (Table 1) lists only Kimbro et al 2009 for data supporting its assignment to Tomales Bay of a population estimate of *“<1 million.”* But Kimbro states *“**Olympia oysters occur across broad areas of shoreline (~20 km) in Tomales Bay, with densities of up to 40 oysters 0.06 m⁻².**”* Thus the Kimbro data appears, by an order of magnitude (40/.06) x 20000 = 13 million), to contradict the < 1 million claim.

Further still, Kimbro et al 2009 (Figure 6) shows native oyster size distributions for 9 sites in Tomales Bay. At each of the sites, sizes ranged from ~20 mm to ~60 mm. As Wesson 2014 notes *“when multiple size classes are present, [this is] indicating successful recruitment and survival.”* Consequently the Kimbro size data also appears to contradict the Wasson 2015 claim of *“occasional years with zero or near zero recruitment”* for Tomales Bay native oysters.

Save Our Seashore is not suggesting that the full range of field data (Population, Recruitment and 14 Stressors) that were collected at SF Bay, Elkhorn Slough, Newport, San Diego, Coos Bay

and South Slough also be done at Tomales Bay. But we do believe that these apparent discrepancies in population and recruitment should be resolved by field data before undertaking “restoration” efforts on Tomales Bay native oyster population that may (or may not) need “restoration.”

Lack of Data to Support Claim of Abiotic Benefit

The Coastal Commission [states](#): *Protection strategies refer to those strategies that employ some sort of engineered structure or other measure to defend development (or other resources) in its current location, oftentimes without changes to the development itself. Protection strategies can be further divided into “hard” and “soft” defensive measures or armoring. “Hard” armoring refers to engineered structures such as seawalls, revetments, caissons, and bulkheads that defend against coastal hazards like wave impacts, erosion, and flooding. “Soft” alternatives refer to the creation or enhancement of natural or “green” infrastructure like beaches, dune systems, wetlands, and other systems to buffer coastal areas.*

The distinction between “hard” and “soft” armoring is not mere semantics, but rather is based on a basic principle of physics (“conservation of energy”). Soft armoring (the vegetation and substrate of beaches, dunes, and wetlands) moves under the force of the waves and thus attenuates energy otherwise fully directed to coastal erosion. **Further, such “living shorelines”** have the capacity to re-grow after moving due to wave damage.

Hard armoring (seawalls, revetments, breakwaters) do not move and thus do attenuate wave energy in the same way. Instead hard armoring re-distributes wave energy, reducing wave energy behind the armoring but increasing it around the edges of the armoring. Further, hard armoring is static and neither moves nor regrows after wave damage.

The Coastal Commission is adverse to hard armoring, recognizing that hard armoring does not **solve the problem of rising seas and coastal erosion...instead it creates (temporary) “winner” properties (behind the hard armoring) at the expense of “loser” properties subjected to** increased erosion forces outside the edges of the hard armoring. Often the loser properties are adjacent public lands and beaches as private property owners use hard armoring to protect their property in place rather than raising their structures (“**accommodation**”) or **moving** them back from the coast (“**strategic retreat**”). To protect all properties using hard armoring would result in a wall the length of the California Coast or the length of Tomales Bay.



Save Our Seashore believes that the heavy concrete oyster balls (or large bags of shells) proposed by the WG as a restoration strategy (“**tides dictate barge access times**”) are not **in fact “living shorelines,”** as claimed in the WG recommendations.

These heavy structures will not move to absorb wave energy and to the extent that Olympia oysters may be knocked off the structure and re-grow, the size difference between a new structure and one hosting live oysters will be minimal (Olympias, unlike Virginicas do not form robust reefs)

Thus, these large heavy oyster structures are much more like hard armoring **than “living shorelines” and** will likely protect property behind it only at the expense of adjacent properties.

There are many studies that document the abiotic benefits of true living shorelines and just as many studies that document the quixotic benefits of hard armoring. But little and incomplete data exists on the physical effects of these large heavy oyster structures.

The San Francisco Bay Living Shorelines Key Findings Two Years Post-installation states **“Our reefs achieved a reduction in wave energy (30%) more so than the broad mudflat alone accomplished at mean tide level; however, we are cautious in our interpretation of this result considering we had limited measurements.** (Per Figure 17, only 1½ months of data measured only directly behind the structures at only two sites).

Further, the Key Findings note substantial subsidence of the oyster structures. In Tomales Bay, customary mooring equipment was concrete-filled 55 gallon tanks that soon sank into the mud. There is no data to support the assumption that heavy concrete oyster structures will not also sink into the soft bottom of Tomales Bay and lose their habitat value and well as adding debris to the Bay. The floor of Tomales Bay is littered with good ideas, including substantial amounts of legacy aquaculture debris.

Regardless, WG Recommendation **Appendix 1 shows that all sites proposed are “viable to add structure” with most sites providing a claimed “co-benefit of protection value.”**

The site north of Tomasini Pt may indeed provide “aquaculture benefits” and doing so is fine to the extent this is permitted under CDFW leases and Coastal Commission permits, but there is insufficient data to support the additional claim that these proposed oyster structures **“attenuate waves”** without also damaging adjoining property.

At all sites (except for Marshall), these concrete structures are claimed to **“maximize marsh integrity.”** While that may be true directly behind the structures, the marsh at the edges of these structures will likely suffer greater erosion forces.

And the Marshall site claims no biotic benefit at all but instead the abiotic benefit of attenuating waves on parcel # 106-020-18 which is a 2nd home with an assessed value of \$1,857,100. We are concerned that the financial benefit for this luxury home may come at the expense of **Audubon Canyon Ranch property “slightly north.”**

Save Our Seashore does not want the Marshall mile armoring to be the start of armoring all **along the Tomales Bay shoreline...and the start of lawsuits as early armoring impacts adjoining un-armored property.** To mitigate rising seas, the Coastal Commission proposes raising structures **“accommodation”) or moving them back from the coast (“strategic retreat”),** both of which are potentially viable in Marshall. Hard armoring is not.

Save Our Seashore thus opposes any use of these large heavy barge-installed oyster structures in Tomales Bay until there are definitive studies showing that they provide the claimed abiotic benefits and are considered as fill that must be mitigated at a 2 to 1 ratio in advance of installation. Until those studies are definitive, other methods of created oyster habitat are available and should be used including retrofitting/replacing existing creosote pilings, moorings, piers, seawalls, bulkheads and rip-rap as was done with Seattle’s fish-friendly seawall. Unfortunately the WG only recognizes this potential **“when designing or modifying future artificial structures...”**

Thank you for the opportunity to comment,

Sincerely,  Gordon Bennett, SOS President