Tomales Bay Native Oyster Restoration
Sanctuary Response to SAC Recommendations

Policy and Planning (PP)

PP1 (Partner) The Sanctuary will work with partners, and pursue funding, to compile and analyze existing data focused on the ecology or habitat of the native Tomales Bay oyster, *Ostrea lurida*, to better understand why, where, and by how much the Tomales Bay *Ostrea lurida* population needs to be enhanced to ensure it functions optimally into the future.

PP2 (Partner) Using the information collected, the Sanctuary will work with partners, and pursue funding, to conduct a Tomales Bay habitat assessment to better understand current conditions, to inform regional prioritization, to develop focused collaborations, and to clarify the type and extent of management required. The Sanctuary in collaboration with its partners will estimate the cost of implementing the identified management actions. This will help focus future proposals and priorities for Tomales Bay partners interested in implementing a specific management action to benefit the Tomales Bay *Ostrea lurida* population.

PP3 (Partner) The Sanctuary will work with partners, and pursue funding, to develop maps that highlight 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 from the Sanctuary Advisory Council through the Working Group will be used.

PP4 (Forward) Conduct a Programmatic Cultural Resource Assessment to map where and what type of cultural resources exist within Tomales Bay. This is a critical complement to knowing where the oyster populations are currently or have been located. The outcome from the assessment will guide the final selection and prioritization of restoration sites, and the selection of restoration techniques most appropriate for a given area.

PP5 (Lead, modified) Use the Site Selection Criteria for *Ostrea lurida* in Tomales Bay (see Appendix) to prioritize pilot sites and to identify additional potential restoration sites. Together, they will form a network of sites within Tomales Bay to support habitat connectivity and to be developed as part of a Strategic Resilience Plan for *Ostrea lurida* in Tomales Bay. When replacing or modifying existing structures in Tomales Bay, consider the use of materials that would support native oysters. If structures must be placed in Tomales Bay, the primary purpose must be to support restoration of ecosystem functions in the sanctuary. Sites should

Commented [SH1]: "Champions" removed from all recommendations, will be reviewed and included in a future action plan

Commented [SH2]: Each strategy is labeled as either "Partner" – implementation will be with others; "Lead" – the Sanctuary will implement; "Forward" – we will send the strategy to another agency to implement

Deleted: 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, repairing, replacing, or modifying existing future artificial structures so as to optimize the provision of oyster habitat in Tomales Bay.

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.

PP6 (Lead) Based on information from PP1-5, develop a 10 year Strategic Resilience Plan for *Ostrea lurida* in Tomales Bay. This plan should 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.

PP7 (Partner, modified) Work with West Marin Interagency Committee 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 on Tomales Bay native oyster restoration.

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PP8 (Lead) Based on information from PP1 and PP2, the sanctuary will communicate to partners the need for research to assess the interaction of eelgrass and *Ostrea lurida*, to be used to inform all phases of future restoration projects.

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Population Enhancement (PE)

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PE1 (Lead) As part of the Strategic Resilience Plan (PP6) and informed by the research strategies, 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 that may negatively impact sensitive habitats, like eelgrass, inadvertently lead to proliferation of invasive species and/or cause damage to natural or cultural resources will be avoided.

Phase 1: Implement and monitor pilot restoration projects 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 are intended to experiment with a range of restoration and monitoring methods to help project managers better understand the most effective methods to use at each pilot site in Tomales Bay. Evaluate pilot restoration projects against project-specific success criteria prior to Phase 2.

Phase 2: Implement demonstration projects (approx. 3 years after phase 1) in areas where pilot restoration projects were deemed successful based on the identified success criteria, incorporating lessons learned from the pilot

restoration projects. Evaluate demonstration projects against predetermined success criteria prior to Phase 3.

***Phase 3*:** Strategically implement a large-scale restoration project (approximately 4 years after Phase 2) and monitor for evaluation approximately 3 years later. The goal of evaluation will be to meet the *Ostrea lurida* population target that ensures the population is sustainable over time.

PE2 (Lead, new) 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, as part of its permitting process, will require that all incidental consequences of the activity be considered. The Sanctuary will require appropriate mitigation measures (beyond the expected benefits of the project itself), consistent with NOAA mitigation policies and procedures.

Address Existing and Future Threats (T)

While the only stressors considered significant problems in Tomales Bay were predation by drills, low water temperatures, and acidification (Wasson et. al 2015), it is important that all sites targeted for restoration receive a quantitative assessment to identify all non-native species that might be present and need to be managed prior to implementing projects to enhance the Tomales Bay population of *Ostrea lurida*.

T1 (Lead) The Strategic Resilience Plan (PP6) will include strategies to manage threats (including but not limited to the invasive oyster drill) to mitigate negative impacts on the sustainable population of *Ostrea lurida*, as well as the overall ecosystem function of Tomales Bay. The plan will determine the feasibility of removing the bat ray exclosure fence posts that currently serve as habitat for the invasive oyster drills. The plan will include a focused reduction of drills near pilot restoration project sites.

Monitoring and Evaluation of *Ostrea lurida* Restoration (ME)

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ME1 (Partner) The Sanctuary will work with partners to 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.

ME2 **(Forward)** 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.

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Research and Data Needs to inform *Ostrea lurida* Restoration (RD)

RD1 **(Forward, new)** Assess abundance and distribution of *O. lurida* in Tomales Bay and compare with other bays along the west coast.

RD2 **(Forward, new)** Assess abundance and distribution of invasive species, determine which ones may proliferate with the various seabed disturbances that will be necessary to implement this plan.

RD3 **(Forward)** Develop a comprehensive, consistent collection of data that will inform 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).

RD4 **(Partner)** The sanctuary will work with partners, and pursue funding, to 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.

RD5 **(Partner, new)** The sanctuary will work with partners to ensure the Strategic Resilience Plan (PP6) is climate-informed and actions are resilient to projected climate impacts, including ocean acidification, freshwater changes, sediment dynamics, and sea level rise to predict what may inhibit growth and sustainability.

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Deleted: **3**: 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.

RD6 **(Forward)** Quantify the ecosystem services provided by a restored *Ostrea lurida* population to Tomales Bay (for example, food provisioning to the surrounding community, habitat provisioning, and positive effects on other species).

RD7 **(Forward)** Characterize 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.

RD8 **(Forward)** Characterize 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 human-made existing substrate.

RD9 **(Forward)** 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?

Outreach for *Ostrea lurida* Restoration in Tomales Bay (O)

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O1 **(Lead, modified)** To support oyster restoration activities in Tomales Bay, develop a restoration outreach strategy that targets the following audiences:

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1. The communities surrounding Tomales Bay.
2. Recreational users and providers in Tomales Bay.
3. Agencies and decision-makers for actions in Tomales Bay.
4. Scientists that conduct research in Tomales Bay.

O2 **(Lead, modified)** Develop outreach messages and materials that are tailored to identified target audiences.

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O3 **(Lead, modified)** Investigate the feasibility of developing a Tomales Bay Community-based volunteer Oyster Restoration Program by engaging with the identified audiences (O1) 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. The Community-based volunteer Oyster Restoration Program could include:

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1. Monitoring:
   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.

O4 (Partner) The sanctuary will work with partners to 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.