Item 8b

Staff Recommendation
November 13, 2019

Improved connectivity modeling for California's MPA network

Michael Esgro, OPC Marine Ecosystems Program Manager

RECOMMENDED ACTION: Staff recommends that OPC approve the disbursement of $473,098 to the University of California Santa Cruz for the development of model-derived connectivity metrics for the assessment of California's marine protected area (MPA) network.

LOCATION: Statewide

STRATEGIC PLAN OBJECTIVE(S): This project implements the following objectives within OPC's 2012-2017 Strategic Plan:
Objective 8.1: Support effective implementation of MPAs consistent with the Marine Life Protection Act (MLPA) through strategic partnerships.
Objective 8.2: Coordinate MLPA implementation with other ocean management agencies to improve management effectiveness.

EXHIBITS:

Exhibit A: Letters of Support

FINDINGS AND RESOLUTION:

Staff recommends that the Ocean Protection Council (OPC) adopt the following findings:

> "Based on the accompanying staff report and attached exhibit(s), OPC hereby finds that:
> 1) The proposed project is consistent with the purposes of Division 26.5 of the Public Resources Code, the Ocean Protection Act; and
> 2) The proposed project is not a 'legal project' that triggers the California Environmental Quality Act (CEQA) pursuant to Public Resources Code section, section 15378."

Staff further recommends that OPC adopt the following resolution pursuant to Sections 35500 *et seq.* of the Public Resources Code:

> "OPC hereby approves the disbursement of up to $473,098 to the University of California Santa Cruz to implement the development of model-derived connectivity metrics for the assessment of California's marine protected area (MPA) network.
>
> This authorization is subject to the condition that prior to disbursement of funds, the University of California Santa Cruz shall submit for the review and approval of the Executive Director of the OPC detailed work plans, schedules, staff requirements, budgets, and the names of any contractors intended to be used to complete the projects, as well as discrete deliverables that can be produced in intervals to ensure the projects are on target for successful completion. All projects will be developed under a shared understanding of process, management and delivery."

EXECUTIVE SUMMARY:

The Marine Life Protection Act (MLPA) requires that California's marine protected areas (MPAs) be designed and managed as an ecologically cohesive network. California's MPAs have shown early evidence of ecological connectivity, which is influenced by both oceanographic forcing (e.g. currents) and attributes unique to individual species, such as life history traits and mortality rates. However, resource managers currently lack a comprehensive understanding of how the effects of protection are influencing connectivity and network-scale dynamics. To address this knowledge gap, this project will build on an existing population connectivity model specific to California, which was originally created to inform the spatial design of California's long-term MPA monitoring program. Based on key priorities outlined in the state's MPA Monitoring Action Plan, the grantee will add a demographic component to the model to include the effects of MPA protection, and population dynamics in general, in model outputs. This updated model will more accurately identify the separate and combined contributions of MPAs to ecological connectivity across the statewide network, providing resource managers with an improved understanding of network-wide performance and helping to ensure a successful management review of the MPA network in 2022.

PROJECT SUMMARY:

Background

In 2012, California completed the implementation of a science-based and stakeholder-driven marine protected area (MPA) network that spans the state's entire 1,100-mile coastline and protects 16% of state waters. The network consists of 124 individual MPAs that have varying levels of protection, including some reserves that prohibit all "take" within their boundaries; it is the largest network of its kind in North America and one of the largest in the world.

The design of California's MPA network was driven by goals identified in the Marine Life Protection Act (MLPA), which focus on protecting, conserving, and restoring marine ecosystems. Goal 6 of the MLPA states that California's MPAs should be "designed and managed, to the extent possible, as a network" (Fish and Game Code Title 14 §2853(b)(6))[1].To achieve this goal, the MPA planning process included the development of guidelines for the size and spacing of MPAs, based on best available knowledge of home ranges and dispersal distances for important nearshore species. These guidelines were intended to ensure the conservation of species with varying movement patterns—a key advantage of networked protected areas.

Most marine species have a two-phase life cycle in which individuals begin their lives as planktonic larvae or algal spores, and eventually settle out of the plankton and "recruit" to suitable habitat where they grow into adults. MPA size and spacing guidelines attempted to ensure that populations would be ecologically connected by larval dispersal across the statewide network, and early evidence suggests that the network has been effective at meeting this goal. For example, a recent genetic study demonstrated connectivity among kelp rockfish populations on California's central coast, providing direct evidence that larvae produced within California's MPAs are exported both to neighboring MPAs as well as to nearby areas where fishing is permitted[2].

Connectivity is influenced by multiple factors, including oceanographic forcing (e.g. currents) as well as traits unique to individual species (e.g. pelagic larval duration, or how long individuals remain in the plankton before recruiting). Since 2016, researchers at the University of California Santa Cruz have been working in partnership with the state to develop a statewide California Connectivity Population Model (CCPM) to help inform the prioritization of MPAs for long-term monitoring. The CCPM has allowed researchers to

[1] http://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=FGC&division=3.&title=&part=&chapter=10.5.&article=

[2] Baetscher DS, Anderson EC, Gilbert-Horvath EA, Malone DP, Saarman ET, Carr MH, Garza JC. Dispersal of a nearshore marine fish connects marine reserves and adjacent fished areas along an open coast. Molecular ecology. 2019 Apr;28(7):1611-23. Available from https://www.researchgate.net/profile/Diana_Baetscher/publication/330995810_Dispersal_of_a_nearshore_marine_fish_connects_marine_reserves_and_adjacent_fished_areas_along_an_open_coast/links/5cca383592851c8d2213fad9/Dispersal-of-a-nearshore-marine-fish-connects-marine-reserves-and-adjacent-fished-areas-along-an-open-coast.pdf

model the movement of larvae, represented by particles, in nearshore environments, represented by three-dimensional spatial cells. It also allows for the assessment of recruitment "success" (i.e. how many individuals recruit to suitable habitat). The CCPM currently considers the following factors:

- *Oceanographic forcing* via a statewide regional ocean model system (ROMS). This ocean circulation model tracks the movement of particles through cells in a series of time steps. Particle movement is based on oceanographic current data averaged over a 15-year period (1999-2013) as well as simulated tidal currents.
- *Species-habitat associations* via species distribution models created from physical habitat data. These submodels allows for the consideration of known species-habitat associations in determining larval recruitment success. However, they currently provide only binary habitat classification (rock vs. sediment).
- *Key life history traits*, such as pelagic larval duration.

The CCPM can be used to generate estimates of larval contribution from individual cells, number of links between cells, and diversity of links between cells. This makes it a powerful tool for assessing the importance of MPAs as sources or sinks of larval organisms, as well as for predicting population connectivity across California's MPA network. However, to date, the CCPM has not taken MPA effects *themselves* into account. This is a key knowledge gap that limits the informative potential of the model. In addition, the CCPM is currently confined to California state boundaries, which does not allow for the consideration of ecoregion-scale dynamics.

This project will create an Integrated Connectivity Population Model (ICPM) that builds on the existing CCPM by incorporating a demographic submodel that will account for the effects of protection, and population dynamics in general, on larval movement. It will also expand the model to adjacent areas (Mexico to the south and Oregon to the north) to account for larval input from beyond state boundaries and recognize the contributions of California's MPAs to populations in these adjacent areas.

Project Tasks

This project will accomplish the following tasks:

First, lead investigators will build the ICPM by creating a demographic submodel and integrating it into the existing CCPM. The submodel will describe both short-term (<15 years) and long-term (>15 years) population dynamics of simulated organisms in each model cell, including changes in population dynamics expected as a result of MPA protection. Key demographic parameters to be considered include adult fishing mortality, larval survival rates, and density-dependent growth, survival, and reproduction.

Second, the lead investigators will improve the resolution of species distribution models by replacing the current binary sediment/rock classification with 2-meter resolution habitat maps from the recently completed California Seafloor Mapping Project.

Third, the lead investigators will use the ICPM to perform analyses to answer key MPA monitoring questions identified in California's MPA Monitoring Action Plan (Action Plan)[3]. Such questions will include: what are short-term trajectories in species abundance and biomass across the MPA network? Do some MPAs or groups of MPAs show faster rates of positive change than others? Do model results match long-term MPA monitoring data? The ICPM will also be used to explore metapopulation dynamics across the MPA network. Finally, finer-resolution habitat maps will be used to more accurately assess habitat representation across the statewide MPA network.

Site Description

This project is statewide in scope and will encompass the three coastal regions identified in the Action Plan:

- North: California/Oregon border to San Francisco Bay, including the Farallon Islands
- Central: San Francisco Bay to Point Conception
- South: Point Conception to the U.S./Mexico border, including the Channel Islands

About the Grantee

The lead researchers on this project, based at the University of California Santa Cruz and Oregon State University, bring decades of experience in relevant disciplines, including: marine population and community ecology, population connectivity modeling using ROMS-based models, and MPA network science. They have been involved in the development of this model since 2016 and have worked closely with the state, in particular the California Department of Fish and Wildlife, to ensure that model design and outputs directly inform state priorities. The researchers are also intimately familiar with California's MPA network, having been involved with the design and monitoring of the network since the passage of the MLPA in 1999.

[3] https://www.wildlife.ca.gov/Conservation/Marine/MPAs/Management/monitoring/action-plan

Project Timeline

November 2019: grant awarded
November 2019 – August 2020: collect and create datasets
March 2020 – December 2020: generate species distribution models
August 2020 – August 2021: constructed integrated model
May 2021 – December 2021: run integrated model
January 2022 – March 2022: review model outputs
January 2022 – November 2022: draft and review final products, generate reports and publications

PROJECT FINANCING:

Staff recommends that OPC authorize encumbrance of up to $473,098 to the University of California Santa Cruz to conduct the project summarized above.

Ocean Protection Council	$473,098
TOTAL	**$473,098**

The anticipated source of funds will be from the FY 19/20 General Fund appropriation for MPA monitoring. As directed by the MPA Statewide Leadership Team Work Plan, OPC has worked with the California Department of Fish and Wildlife and other partners statewide to implement a partnership-based monitoring program to assess MPA network performance. In 2015, the California state legislature allocated a $2.5 million annual General Fund appropriation to the Secretary for Natural Resources to support the MPA Monitoring Program. Through a collaborative process between the Leadership Team and the Secretary, the initial spending of this appropriation to support MPA monitoring was approved by the Secretary in early 2016. This initial spending focused on: maintaining required scientific tools to conduct monitoring and increasing scientific capacity within the state; continuing ongoing monitoring statewide in subtidal and intertidal habitats; and ensuring the completion of the first five-year management reviews for all regions. Since the initial spending in FY15/16, subsequent spending has focused on creating a long-term monitoring program for the state to ensure the state is well prepared for the upcoming management review of the MPA network in 2022. The project summarized above is consistent with the goals of the state's MPA monitoring program.

CONSISTENCY WITH CALIFORNIA OCEAN PROTECTION ACT:

The proposed project is consistent with the Ocean Protection Act, Division 26.5 of the Public Resources Code, because it is consistent with trust-fund allowable projects, defined in Public Resources Code Section 35650(b)(2) as projects which:

(A) Eliminate or reduce threats to coastal and ocean ecosystems, habitats, and species: *This project will help to ensure that existing protections are being effectively implemented.*
(B) Improve the management of fisheries: *Improved understanding of population connectivity for fished species will directly inform fisheries management in California.*
(C) Foster sustainable fisheries: *Expected ecological benefits from MPA networks include benefits to fished populations.*
(D) Improve coastal water quality: *Improved understanding of network-scale MPA effects will assist managers in strengthening the nexus between MPA protection and water quality.*
(E) Allow for increased public access to, and enjoyment of, ocean and coastal resources, of those resources: *Increased understanding of California's MPA network will help ensure continued access by the public.*
(F) Improve management, conservation, and protection of coastal waters and ocean ecosystems: *Information from this project will directly inform the adaptive management of California's MPA network.*
(G) Provide monitoring and scientific data to improve state efforts to protect and conserve ocean resources: *This project will provide a novel tool for detection and assessment of MPA effects at a network-wide scale.*
(H) Protect, conserve, and restore coastal waters and ocean ecosystems: *Worldwide, MPAs have been shown to protect, conserve, and restore some species and habitats. Early evidence indicates that California's MPA network is conferring similar conservation benefits.*
(I) Address coastal water contamination from biological pathogens: *Improved understanding of network-scale MPA effects will assist managers in strengthening the nexus between MPA protection and water quality.*
(J) provide funding for adaptive management, planning coordination, monitoring, research, and other necessary activities to minimize the adverse impacts of climate change on California's ocean ecosystem: *Information from this project will directly inform the adaptive management of California's MPA network, as well as improving the state's understanding of potential climate change impacts to oceans and coasts.*

By directly engaging OPC, the California Department of Fish and Wildlife, and the California Fish and Game Commission, as well as the MPA Statewide Leadership Team, the researchers leading this project will promote the coordination of state programs and activities that protect ocean resources.

CONSISTENCY WITH OPC'S STRATEGIC PLAN:

This project implements the following objectives within OPC's 2012-2017 Strategic Plan:
Objective 8.1: Support effective implementation of MPAs consistent with the Marine Life Protection Act (MLPA) through strategic partnerships.
Objective 8.2: Coordinate MLPA implementation with other ocean management agencies to improve management effectiveness.

COMPLIANCE WITH THE CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA):

The proposed project is categorically exempt from review under the California Environmental Quality Act ("CEQA") pursuant to 14 Cal. Code of Regulations Section 15306 because the project involves only data collection, research and resource evaluation activities that will not result in a serious or major disturbance to an environmental resource. Staff will file a Notice of Exemption upon approval by the OPC.