Item 5

Staff Recommendation
February 26, 2020

Urchin Removal to Support Potential Kelp Forest Recovery

Michael Esgro, OPC Marine Ecosystems Program Manager

RECOMMENDED ACTION: Staff recommends that OPC approve the disbursement of $499,951 to Reef Check Foundation to fund removal of purple urchins by commercial fishermen, as well as associated ecological monitoring, in support of kelp forest recovery on California's north coast.

LOCATION: Mendocino County, California

STRATEGIC PLAN OBJECTIVE(S): 3.2: Restore and protect kelp ecosystems

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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 projects are consistent with the purposes of Division 26.5 of the Public Resources Code, the Ocean Protection Act; and
> 2) The proposed projects are not 'legal projects' that trigger 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 $499,951 to Reef Check Foundation to fund removal of purple urchins by commercial fishermen, as well as associated ecological monitoring, in support of kelp forest recovery on California's north coast.
> This authorization is subject to the condition that prior to disbursement of funds, Reef Check Foundation 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:

California's north coast has recently been devastated by unprecedented declines in bull kelp (*Nereocystis luetkeana*). This decline has been attributed to a "perfect storm" of changing ocean conditions, including persistent warm water temperatures and an explosion in purple sea urchin (*Strongylocentrotus purpuratus*) populations, which have grazed kelp forests down to bare rock and turned once-lush reefs into "urchin barrens." Bull kelp is a foundational species for northern California marine ecosystems, and the shift from healthy bull kelp forests to unproductive urchin barrens has caused significant loss of kelp forest ecosystem services on the north coast, including the collapse of the recreational red abalone and commercial red sea urchin fisheries. Without intervention, additional negative cascade effects are anticipated over time.

Evidence suggests that purple urchin removal can serve as an effective method of kelp forest restoration. This project will pay commercial red urchin divers, who have largely been unable to fish since the collapse of their fishery in 2015, to remove purple urchins at three sites in Mendocino County: Noyo Bay, Caspar Cove, and Portuguese Beach. Reef Check California, a nonprofit organization working to ensure the long-term sustainability of California's nearshore rocky reefs and kelp forests, will manage this project in collaboration with OPC, the California Department of Fish and Wildlife, and academic partners. The efficacy of urchin removal as a kelp restoration tool will be assessed by comparing key ecological metrics before and after restoration efforts as well as between restoration sites and unmanipulated reference sites.

In close collaboration with the California Department of Fish and Wildlife, this project will provide a scientific basis for evaluating the efficacy of large-scale purple urchin removal as a kelp restoration tool on California's north coast, directly informing future management actions as California seeks to protect its iconic underwater forests in the face of changing ocean conditions. Furthermore, by directly engaging stakeholders who have been severely impacted by this crisis, this project will provide significant social and economic benefit to Mendocino County and the broader north coast community.

PROJECT SUMMARY:

Background

California's north coast has recently been devastated by unprecedented declines in bull kelp. Aerial surveys conducted by the California Department of Fish and Wildlife (CDFW) showed a 93% loss of kelp cover in Sonoma and Mendocino Counties from 2013-2014, with an additional 33% loss from 2014-2015. Growth of new kelp has been extremely limited since 2015 (Fig 1).

This decline has been attributed to a "perfect storm" of changing ocean conditions. Starting in 2014, water temperatures along the northern California coast increased dramatically due to an anomalous mass of warm water in the North Pacific known as "The Blob," which was followed by severe El Nino conditions that caused warm waters to persist through mid-2016. Bull kelp is highly sensitive to changes in temperature and can dissolve when water temperatures are more than a few degrees above normal. In addition, warm water holds fewer nutrients than cold water, which severely limits the ability of new kelp to establish and grow. Increased sea surface temperatures have also been implicated in the spread of sea star wasting disease, a mysterious disease that was first reported in 2014 and subsequently ravaged sea star populations along the U.S. west coast. Sea stars are a major predator of purple sea urchins, which in turn eat kelp. With no sea stars to keep them in check, purple urchin populations have exploded, grazing kelp forests down to bare rock and turning once-lush reefs into "urchin barrens."

Bull kelp is a foundational species for northern California marine ecosystems. Bull kelp forms complex biogenic habitat, modifies light levels and sedimentation, attenuates wave energy, sequesters carbon, and serves as a major food source for numerous ecologically and economically important species. The shift from healthy bull kelp forests to unproductive urchin barrens has caused significant loss of kelp forest ecosystem services, especially in Mendocino and Sonoma Counties. Populations of red abalone, California's only remaining abalone fishery ($44 million non-market value[1]), have declined so substantially that the red abalone fishery was closed in 2017 and will remain closed until at least 2021. The commercial red urchin fishery ($3 million ex-vessel value[2]) collapsed in 2015 as red urchins were unable to compete for resources with the hardier purples. Without intervention, additional negative ecological and economic impacts are anticipated over time.

In 2018, in response to direction from CDFW, the Greater Farallones Association convened a multi-stakeholder working group to develop options for addressing bull kelp loss. This effort resulted in the development of the Sonoma-Mendocino Bull Kelp Recovery Plan[3]. One of the primary recommendations in the Recovery Plan is the establishment of a

[1] Reid J, Rogers-Bennett L, Vasquez F, Pace M, Catton CA, Kashiwada JV, Taniguchi IK. The economic value of the recreational red abalone fishery in northern California. California Fish and Game. 2016 Jun 1;102(3):119-30.
[2] https://cdfwmarine.wordpress.com/2016/03/30/perfect-storm-decimates-kelp/
[3] https://farallones.org/wp-content/uploads/2019/06/Bull-Kelp-Recovery-Plan-2019.pdf

network of bull kelp spore refuges along the Mendocino and Sonoma coastlines. Because bull kelp is an annual species reliant on a robust spore bank, further losses of remaining bull kelp patches will significantly limit the capacity for bull kelp recovery. This is especially concerning given the nonlinear dynamics of kelp forest ecosystem states – forests can rapidly transform into urchin barrens, but once established, urchin barrens can persist indefinitely as alternative stable states. Therefore, preventing further decline of bull kelp spore sources and creating areas suitable for kelp regrowth is a critical first step for kelp recovery on the north coast.

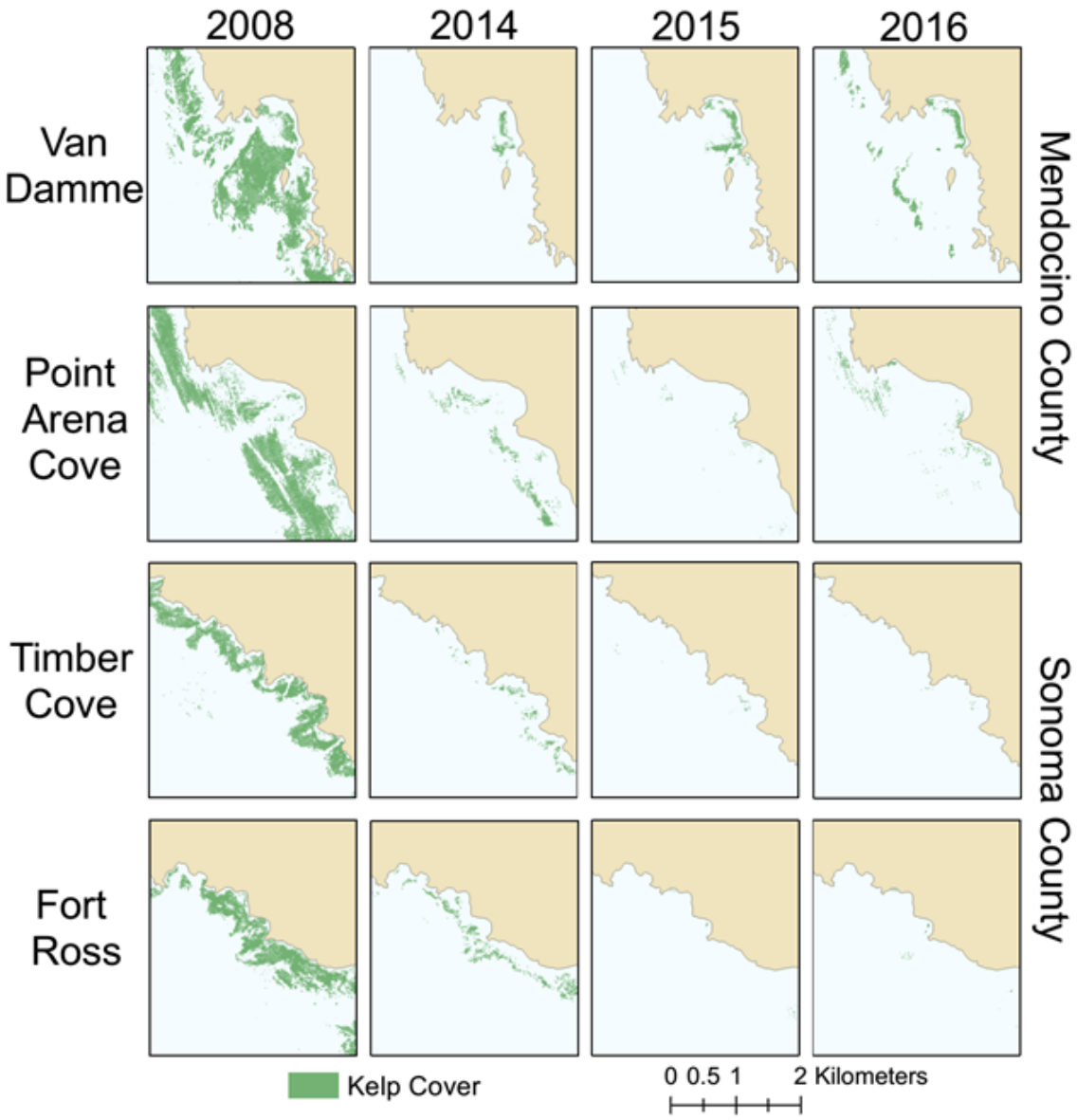

Figure 1. Kelp cover at various sites in Mendocino and Sonoma Counties, derived from CDFW aerial surveys conducted in 2008 and from 2014-2016. From Rogers-Bennett & Catton 2019[4].

[4] Rogers-Bennett L, Catton CA. Marine heat wave and multiple stressors tip bull kelp forest to sea urchin barrens. Scientific reports. 2019 Oct 21;9(1):1-9.

Evidence suggests that urchin removal can serve as an effective method of kelp restoration. Since 2013, the Bay Foundation has successfully restored and maintained 61.5 hectares of giant kelp (*Macrocystis pyrifera*) off the Palos Verdes Peninsula in southern California by clearing urchin barrens and maintaining urchin densities at less than 2 individuals per square meter. Since 2017, ecologists have worked with government, industry, and indigenous partners in Gwaii Haanas, British Columbia to cull urchins in the low intertidal and shallow subtidal, successfully facilitating kelp regrowth in a 20-hectare area along three miles of coastline.

In close collaboration with CDFW, project will establish three kelp restoration sites in Mendocino County (Fig 2) at which purple urchins will be removed by commercial urchin divers over the course of one year. The efficacy of urchin removals as a kelp restoration tool will be assessed by comparing key ecological metrics before and after restoration efforts as well as between restoration sites and unmanipulated reference sites.

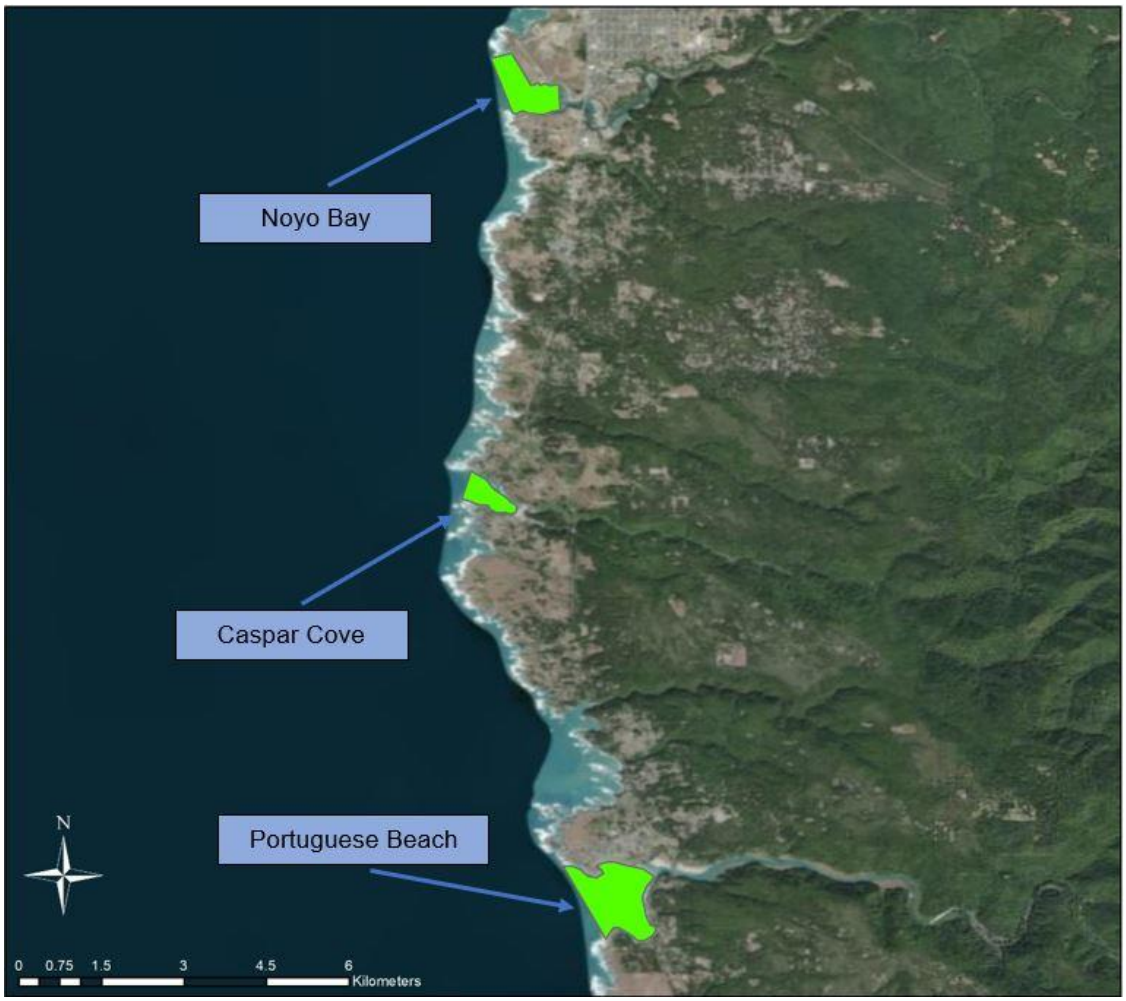

Figure 2. Kelp restoration sites in Mendocino County.

Project Tasks

This project will pay commercial red urchin divers, who have largely been unable to fish since the collapse of the red urchin fishery in 2015, to remove purple urchins at three sites in Mendocino County: Noyo Bay, Caspar Cove, and Portuguese Beach. OPC funding will support overarching project design, management, and monitoring, as well as urchin removals at Noyo Bay and Caspar Cove. Match funding from CDFW and the Watermen's Alliance, a nonprofit organization of recreational fishermen, will support urchin removals at Portuguese Beach.

Reef Check California, a nonprofit organization working to ensure the long-term sustainability of California's nearshore rocky reefs and kelp forests, will manage this project. Reef Check will perform the following tasks:

First, in collaboration with OPC and CDFW, as well as academic partners, Reef Check will develop an appropriate experimental design, including robust monitoring protocols, to ensure that this effort produces scientifically reliable data that can inform future management decisions regarding kelp forest restoration.

Second, Reef Check will establish target restoration locations at each of the three sites. At each targeted location, areas of approximately 7-15 acres will be defined by a semi-permanent matrix of cable transects and buoys. These markers, along with specified compass headings, will provide clearly defined 30 m by 30 m squares in which commercial divers will focus removal efforts. This systematic approach will also allow Reef Check to efficiently assign work areas to commercial fishermen.

Third, Reef Check will oversee removals of purple urchin by commercial divers. At each restoration location, Reef Check will assign commercial urchin divers to predetermined 30 m by 30 m squares. Within these squares, divers will use permitted urchin harvest methods to reduce purple urchin densities to 0-2 individuals per square meter. Maintenance of target urchin densities at each site will occur via a "sweeper" diver on an ongoing basis after the initial clearance efforts are complete. Reef Check and OPC/CDFW have worked with commercial divers to estimate workload based on habitat complexity, substrate type, current urchin densities, and effort data from pilot urchin removals conducted in Sonoma and Mendocino in 2018. Divers will be paid a flat rate of $500/day for urchin removals. Harvested urchins will be landed and used for compost.

Fourth, Reef Check will conduct quality control monitoring to ensure that commercial divers are achieving desired results. Quality control monitoring will be conducted by Reef Check staff divers within two weeks following the removal of urchins at the restoration sites, to account for the behavioral responses of urchins post-clearing. Quality control monitors will estimate remaining urchin densities and identify areas that might have been missed by commercial divers. If found, these areas will be marked using buoys or by taking GPS coordinates. Once target urchin densities have been reached, commercial

fishermen will maintain these densities throughout the duration of the project and quality control surveys will be conducted bi-monthly.

Finally, Reef Check will conduct pre- and post-restoration ecological surveys to assess ecosystem response to urchin removal. Reef Check staff and volunteer divers will collect data on bull kelp density, other algal species density, fish and invertebrate density, and community composition using Reef Check's kelp forest monitoring protocol as it is used statewide for marine protected area monitoring. To detect restoration effects, Reef Check will use a before-after-control-impact (BACI) sampling design in which data will be collected both before and after urchin removals as well as inside and outside restoration sites (i.e. each restoration site will have an associated unmanipulated reference site). Reference sites will be selected so that they are as similar as possible to restoration sites in terms of habitat distribution, presence of canopy and understory algae in 2019, wave exposure, freshwater input, and biological composition. Post-restoration surveys will be conducted in summer 2020, fall 2020, and spring 2021

As part of this project, Reef Check will also provide a subaward to the Noyo Center for Marine Science. The Noyo Center, located in Fort Bragg, has been leading community engagement and outreach efforts to support bull kelp recovery in Mendocino and Sonoma Counties since 2018. During initial work conducted ahead of this project, the Noyo Center also played a key role in organizing pilot commercial diver urchin removal activities, monitoring diver effort and commercial catch of urchins, and coordinating the beneficial use of harvested urchins. In close collaboration with Reef Check, the Noyo Center will continue to conduct dockside monitoring of commercial urchin catch, help coordinate beneficial use of urchins, and conduct community outreach highlighting the role of this project in kelp restoration.

This project has the potential to significantly improve our understanding of the ecological and economic crisis that has devastated California's north coast in recent years. In particular, the project will provide a scientific basis for evaluating the efficacy of large-scale purple urchin removal as a kelp restoration tool on California's north coast, directly informing future management actions as California seeks to protect its iconic underwater forests in the face of changing ocean conditions. Furthermore, by directly engaging stakeholders who have been severely impacted by this crisis, this project will provide significant social and economic benefit to Mendocino County and the broader north coast community.

Site Description

Bull kelp collapse has had the most severe ecological and economic effects in Mendocino and Sonoma Counties. This project will target three restoration sites in Mendocino County: Noyo Bay, Caspar Cove, and Portuguese Beach. These sites were chosen strategically based on ecological significance, historical persistence of kelp, cultural/economic importance, and logistical considerations such as accessibility, exposure, and diver safety.

All three of these sites are suggested as candidate sites for kelp restoration in the Sonoma-Mendocino Bull Kelp Recovery Plan.

Sonoma County sites were not considered for inclusion in this initial restoration effort as the majority of north coast commercial red urchin divers are based in Fort Bragg. This greatly increases the cost and logistical difficulty associated with commercial urchin removals at Sonoma sites compared to Mendocino sites. However, should this project prove successful, expansion into Sonoma County could be considered at a future date.

About the Grantee
Founded in 1996 by a marine ecologist, Reef Check Foundation is an international 501(c)3 nonprofit dedicated to the conservation of the world's tropical and temperate reef systems through grassroots research, conservation, and education. Reef Check has built a global network of volunteers that monitor reefs worldwide. With a staff of 10 employees, Reef Check coordinates coral reef conservation in over 50 countries and territories, as well as temperate rocky reef and climate change monitoring in California.

Since 2005, Reef Check California (RCCA) has worked to ensure the long-term sustainability of California's nearshore rocky reefs and kelp forests. RCCA trains recreational scuba divers to monitor and protect reefs through scientific data collection and conservation in their local communities. It is now the largest statewide citizen science monitoring program for California's marine protected areas (MPAs) and nearshore rocky reef ecosystems, training over 300 volunteers each year and conducting surveys at 100 sites statewide. RCCA was involved in California's MPA baseline monitoring program in all Marine Life Protection Act study regions as MPAs were implemented and is currently one of the collaborators in the statewide long-term monitoring of California's MPA network.

Project Timeline
- February 2020: grant awarded
- March—April 2020: target restoration locations established at Noyo Bay, Caspar Cove, and Portuguese Beach, pre-restoration ecological surveys conducted
- April 2020: initial commercial removals and associated quality control monitoring efforts begin at targeted restoration locations
- Spring 2020—Spring 2021: commercial removals and quality control monitoring continue
- Summer 2020: First post-restoration ecological survey conducted
- Fall 2020: Second post-restoration ecological survey conducted
- Spring 2021: Third post-restoration ecological survey conducted
- Ongoing: outreach efforts, community engagement

PROJECT FINANCING:

Staff recommends that OPC authorize encumbrance of up to $499,951 to Reef Check Foundation to conduct the project summarized above.

Ocean Protection Council	$499,951
California Department of Fish and Wildlife	$75,000
Watermen's Alliance	$60,000
TOTAL	**$634,951**

The anticipated source of funds will be OPC's FY 2018/2019 appropriation of Proposition 68 funds (Chapter 9 – Ocean, Bay, and Coastal Protection). Per OPC's Proposition 68 Grant Guidelines, this funding source prioritizes projects intended to conserve, protect, and restore marine wildlife and healthy ocean and coastal ecosystems.

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 reduce purple urchin grazing pressure on bull kelp ecosystems in northern California.*
(B) Improve the management of fisheries: *This project will improve our understanding of urchin removal as a kelp restoration tool, directly informing management of fisheries associated with kelp forest ecosystems.*
(C) Foster sustainable fisheries: *The restoration of kelp forest ecosystems has the potential to promote the recovery of economically important fisheries on the north coast, including the recreational red abalone fishery and the commercial red sea urchin fishery.*
(D) Improve coastal water quality: *Improved understanding of the drivers of kelp forest loss will assist managers in strengthening the nexus between kelp forest health and water quality.*
(E) Allow for increased public access to, and enjoyment of, ocean and coastal resources: *The restoration of kelp forest ecosystems has the potential to increase both consumptive and nonconsumptive recreational activities on the north coast, including fishing and diving, which have been severely negatively impacted by kelp collapse.*
(F) Improve management, conservation, and protection of coastal waters and ocean ecosystems: *Information from this project will directly inform the adaptive management of kelp forest ecosystems statewide, especially in the face of changing ocean conditions and other climate-driven threats.*
(G) Provide monitoring and scientific data to improve state efforts to protect and conserve ocean resources: *This project will provide a robust scientific basis for evaluating the efficacy of purple urchin removal as a kelp restoration tool, directly informing future management actions.*

(H) Protect, conserve, and restore coastal waters and ocean ecosystems: *This project seeks to restore approximately 50 acres of kelp forest habitat across three sites in Mendocino County.*
(I) Address coastal water contamination from biological pathogens: *Improved understanding of the drivers of kelp forest loss will assist managers in strengthening the nexus between kelp forest health 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 kelp forests statewide.*

By directly engaging OPC and the California Department of Fish and Wildlife, this project will promote the coordination of state programs and activities that protect ocean resources.

CONSISTENCY WITH OPC'S STRATEGIC PLAN:

This project implements Objective 3.2: Restore and protect kelp ecosystems. Specifically, this project will address two key action items in OPC's draft 2020-2025 Strategic Plan under Objective 3.2: 1) Fund research and monitoring to investigate critical knowledge gaps regarding kelp forest ecosystem protection and recovery, and 2) Support and coordinate local science projects and volunteer restoration efforts.

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.