Item 5

Staff Recommendation
June 14, 2022

Informational and Action Items: Update on Mendocino County Kelp Forest Restoration Project and Consideration and Approval of Disbursement of Funds for Enhanced Kelp Canopy Monitoring

Michael Esgro, Senior Biodiversity Program Manager & Tribal Liaison

RECOMMENDED ACTION: Staff recommends that the Ocean Protection Council approve the disbursement of up to $650,000 to the University of California Los Angeles to continue the development of a novel, remote-sensing based approach for kelp canopy monitoring and mapping.

LOCATION: Statewide

STRATEGIC PLAN GOALS AND OBJECTIVES:
Goal 3: Enhance Coastal and Marine Biodiversity, Objective 3.2: Restore and Protect Kelp Ecosystems

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EXHIBITS:

Exhibit A: Mendocino County Kelp Forest Restoration Project final report

Exhibit B: Letters of support

FINDINGS AND RESOLUTION:

Staff recommends that the Ocean Protection Council adopt the following resolution pursuant to Sections 35500 et seq. of the Public Resources Code:

"The California Ocean Protection Council (OPC) hereby approves the disbursement of up to $650,000 to the University of California Los Angeles (UCLA) to continue the development of a novel, remote-sensing based approach for kelp canopy monitoring and mapping. This authorization is subject to the condition that

prior to disbursement of funds, UCLA shall submit for the review and approval of the Executive Director 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

In recent years, California's coast has been devastated by climate-driven declines in kelp. Kelp loss, particularly in northern California, has resulted in significant negative impacts on biodiversity and ecosystem services. Protecting and restoring kelp forests is a top priority for state resource managers, and in the past three years, OPC, the California Department of Fish and Wildlife, and California Sea Grant have invested heavily in research and pilot projects to monitor kelp forest health, better understand drivers of kelp loss and persistence, and test kelp restoration approaches. This staff report provides an update on one of those projects — a unique restoration effort in Mendocino County that has achieved success by directly engaging local communities — and recommends the disbursement of funding to continue development of a novel approach for kelp monitoring.

Restoration of Northern California bull kelp forests: project update. In 2020, OPC approved funding to support removal of purple urchins in support of bull kelp restoration at two sites in Mendocino County: Noyo Bay and Albion Cove. This project directly engaged commercial red urchin fishermen, whose livelihoods have been significantly impacted by kelp collapse. Over the course of two years, fishermen were able to remove nearly 50,000 pounds of urchin from the restoration sites, successfully reducing urchin densities below the threshold expected to facilitate a shift from urchin barren back to kelp forest. Urchin removals appear to have had a positive impact on kelp recovery: scientific monitoring documented a limited, but statistically significant increase in bull kelp density at the Noyo Bay restoration site. This project demonstrates that commercial urchin fishermen can be extremely effective at clearing urchin barrens, and that urchin removals may facilitate kelp recovery.

Enhanced Kelp Canopy Monitoring. Historically, aerial surveys were the primary method of monitoring kelp canopy off the California coast. However, aerial surveys are expensive and have considerable logistical constraints. Remote sensing may provide a more cost-effective and reliable strategy for long-term kelp canopy monitoring. Pilot work supported by OPC shows that maps of kelp canopy derived from high-resolution PlanetScope satellite imagery match well with maps derived from aerial surveys. The project recommended here would support next steps in developing this novel approach, including: 1) creating seasonal, statewide, high-

resolution maps of kelp canopy from 2016-2023, 2) developing a fully automated approach for processing large amounts of PlanetScope imagery, 3) using PlanetScope imagery to analyze kelp canopy dynamics, with a focus on the north coast, and 4) developing a method for monitoring kelp at very small spatial scales using ultra high-resolution SkySat imagery.

BACKGROUND & PROJECT DETAILS:

California's kelp forests are among the most productive and biodiverse ecosystems on the planet. Both giant kelp and bull kelp are foundational species that provide a variety of ecological functions and ecosystem services. Globally, kelp forests naturally fluctuate from year to year, and the dramatic interannual variability of kelp on the California coast has been well documented. However, in general, California's nearshore environment has supported healthy kelp forests for decades, prior to a marine heatwave in the Northeast Pacific that started in 2014 and persisted through 2016. As a result of that heatwave, bull kelp forests in northern California were decimated. Surveys conducted by the California Department of Fish and Wildlife (CDFW) and The Nature Conservancy show that more than 95% of the bull kelp canopy off Mendocino and Sonoma Counties was lost between 2014 and 2019[1].

Kelp declines on the north coast have been attributed to a "perfect storm" of changing ocean conditions, including warm waters, the emergence of sea star wasting disease (which resulted in the loss of an estimated 5.75 billion predatory sunflower stars[2]), and an explosion in kelp-eating purple sea urchin populations, which have grazed kelp forests down to bare rock and turned once-lush reefs into "urchin barrens." Although kelp has resurged in some places on the north coast[3] due to cooler ocean temperatures in 2020-2021, this recovery has been limited overall, potentially due in part to the persistence of urchin barrens.

In contrast to the devastation observed on the north coast, patterns in giant kelp along California's central coast are more complex. Kelp has persisted in some locations but appears to have declined in others; one area of particular concern is the Monterey Peninsula, where a substantial amount of kelp has been lost since 2014. In southern California, kelp declined following the onset of the marine heatwave, but these losses were within the normal range of variability and kelp quickly recovered, except for some locations in the Channel Islands that appear to have transitioned to urchin barrens.

[1] 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.
[2] https://www.nature.org/en-us/newsroom/california-sea-star-endangered/
[3] https://www.sfchronicle.com/climate/article/Satellite-images-show-kelp-forest-has-doubled-in-16589392.php

Protecting and restoring kelp forests across the state is a top priority for OPC. Together with CDFW, California Sea Grant, and other partners, OPC has recently initiated several pilot projects to monitor kelp forest ecosystems, better understand drivers of kelp loss and persistence, and test potential kelp restoration approaches. These efforts represent an investment of more than $3 million over the last three years. Additionally, in 2021, OPC released an Interim Kelp Action Plan[4], which lists key strategic actions for protecting and restoring California's kelp forests in the face of changing ocean conditions.

This staff report provides an update on a unique, community-based kelp restoration pilot project and recommends funding to continue development of a novel approach for kelp canopy monitoring. Both projects are responsive to priorities listed in the Interim Kelp Action Plan and will significantly advance California's efforts to ready our state's iconic yet vulnerable underwater forests for climate change.

Restoration of Northern California bull kelp forests: project update

In 2020, OPC approved $499,951[5] (with an additional investment of $117,013[6] in 2021) to fund removal of purple urchins in support of bull kelp restoration at two sites in Mendocino County: Noyo Bay and Albion Cove. This project directly engaged commercial red urchin fishermen, whose livelihoods have been significantly impacted by kelp collapse, and was intended to provide a scientific basis for evaluating the efficacy of large-scale urchin removal as a kelp restoration tool on California's north coast. It represented a unique and unprecedented collaboration between state government, nonprofit organizations, and local communities.

Despite challenges posed by the COVID-19 pandemic, fishermen were able to remove nearly 50,000 pounds of urchin from the two restoration sites over the course of two years, successfully reducing urchin densities below two individuals per square meter (the threshold expected to facilitate a shift from urchin barren back to kelp forest) and maintaining these low densities over the duration of the study (Fig 1). Specifically, from July 2020 to December 2021, 13 commercial fishermen removed nearly 32,000 pounds of purple urchin from Noyo Bay and 13,600 pounds of purple urchin from Albion Cove.

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4 https://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20210216/Item7_KelpActionPlan_ExhibitA_FINAL.pdf

5 https://opc.ca.gov/webmaster/ftp/pdf/agenda_items/20200226/Item%205_Kelp-Staff-Recommendation-Final.pdf

6 https://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20210615/Item7a_UrchinRemoval_consent_FINAL.pdf

Urchin removals appear to have had a positive impact on kelp recovery. Following removals, ecological monitoring surveys documented a statistically significant increase in bull kelp density at the Noyo Bay restoration site relative to an unmanipulated control site. However, in absolute terms, this increase was limited, and continued monitoring at both restoration and control sites through the end of 2022 will provide a clearer assessment of restoration efficacy.

This project demonstrates that commercial urchin fishermen can be extremely effective at clearing urchin barrens and maintaining low urchin densities over time, and that removals may facilitate kelp recovery. It also provides insight into costs, logistical considerations, and best practices associated with this restoration method; for example, meaningful engagement with local communities and adaptive, collaborative decision-making emerged as critical factors in supporting project success. As California moves forward with the development of a kelp restoration "toolkit," a key priority listed in the Interim Kelp Action Plan, urchin removal by commercial fishermen should be considered a viable restoration option if kelp recovery continues at the two pilot study sites. Next steps will include exploring the feasibility of scaling up this work to other sites on the north coast and beyond.

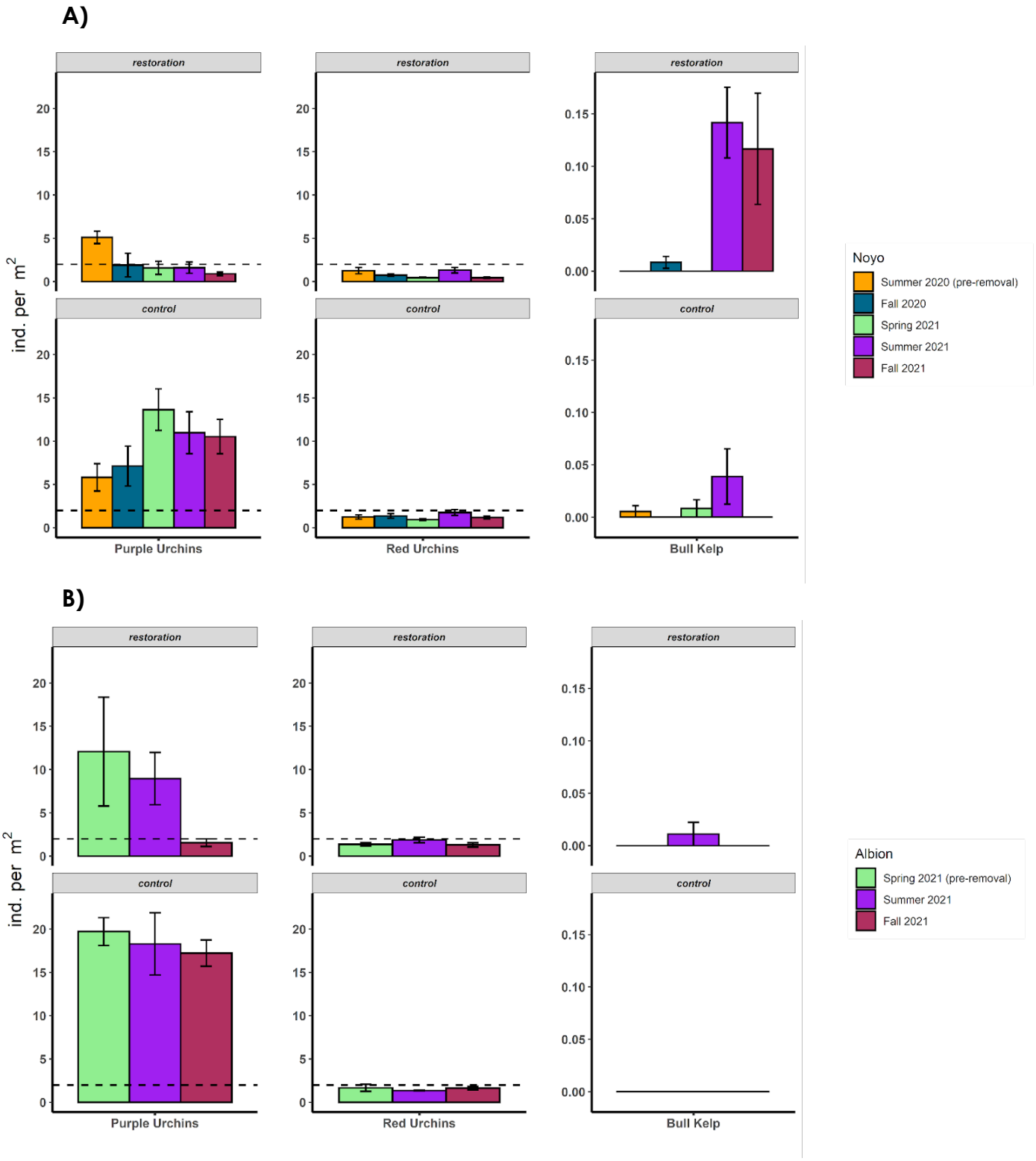

Figure 1. Density of purple urchins, red urchins, and bull kelp at A) the Noyo Bay restoration site and associated control site and B) the Albion Cove restoration site and associated control site. At both sites, commercial urchin fishermen were able to reduce total urchin density to under 2 individuals per square meter, and maintain these low densities over time. At the Noyo Bay restoration site, urchin removals resulted in a limited, but statistically significant increase in bull kelp density. Figure adapted from Exhibit A.

Enhanced Kelp Canopy Monitoring

Project Description

Historically, aerial surveys were the primary method of monitoring kelp canopy off the California coast. However, aerial surveys are expensive and have considerable logistical constraints; due to funding limitations, frequent cloud interference, and a lack of available contractors, CDFW has not conducted aerial surveys of kelp canopy since 2016. This impairs the ability of resource managers to obtain a consistent and timely understanding of kelp abundance and distribution statewide. Remote sensing techniques may provide a more cost-effective and reliable strategy for long-term kelp canopy monitoring.

In 2019, OPC funded The Nature Conservancy and UCLA to explore this question by comparing aerial surveys of the north coast to high-resolution (3 meter) PlanetScope satellite imagery of the same area. UCLA developed a semi-automated method for mapping giant and bull kelp canopy from PlanetScope imagery and found that these maps matched well with maps derived from aerial surveys. This indicates that high-resolution satellite imagery holds promise as a kelp monitoring and mapping tool.

The next steps in developing this novel methodology are to: 1) use PlanetScope data to create seasonal maps of kelp canopy for the entire state of California from 2016-2023, 2) develop a fully automated approach for processing large amounts of satellite imagery, 3) use PlanetScope data to analyze kelp canopy dynamics, with a focus on the north coast, and 4) develop a method for mapping kelp using ultra-high resolution SkySat imagery. Staff recommends that OPC provide funding to UCLA to pursue these tasks, which are described in more detail below.

1) *Use PlanetScope data to create seasonal maps of kelp canopy for the entire state of California from 2016-2023.* UCLA will apply existing methods, developed through pilot work previously funded by OPC, to process and analyze PlanetScope data to create seasonal (twice yearly) kelp canopy maps for the entire coast of California from 2016-2023. These maps will fill a crucial knowledge gap for resource managers.

2) *Develop a fully automated approach for processing large amounts of satellite imagery*. Recent advances in machine learning have enabled researchers to create automated approaches for processing large amounts of satellite imagery. UCLA will recruit a postdoctoral researcher with a background in machine learning to refine and fully automate existing methods, which will dramatically reduce the time, effort, and cost required to create kelp canopy maps.

3) *Use PlanetScope data to analyze kelp canopy dynamics, with a focus on the north coast*. PlanetScope imagery can provide valuable insight into kelp canopy dynamics. UCLA will use this dataset to document trends in kelp persistence and recovery, identify potential kelp refugia, and explore factors that promote kelp resilience (e.g., water temperature, nutrients, urchin density, habitat quality, marine protected areas).

4) *Develop a method for mapping kelp using ultra-high resolution SkySat imagery*. SkySat is an ultra-high resolution (0.5 meter) dataset that begins to approach the resolution provided by drone imagery. Although such high-resolution imagery is not needed for large-scale statewide maps, it may be useful for monitoring at smaller spatial scales, e.g., assessing kelp recovery at individual restoration sites. UCLA will create small-scale maps for selected sites, including restoration sites in Mendocino County, to explore the utility of this approach.

Taken together with long-term, but lower-resolution, satellite imagery from the Landsat platform, advances in the use of PlanetScope and SkySat imagery will provide a complete suite of spatial resolution needed for resource managers to understand the historical dynamics of kelp, current statewide trends, and the local dynamics of kelp at key sites. This will provide critical information necessary to inform the state's adaptive management approaches to protect and restore kelp forest habitat in California.

About the Grantee

UCLA is a public research university in Los Angeles, California. The lead investigator on this project, Dr. Kyle Cavanaugh, is an Associate Professor with the UCLA Department of Geography and the UCLA Institute of the Environment & Sustainability. Dr. Cavanaugh studies the drivers and consequences of changes in coastal foundation species. Much of his research utilizes remote sensing techniques to document ecological change over large spatial and temporal scales.

Project Timeline

- Summer 2022: funding awarded
- Fall 2022: grant agreement executed
- Fall 2022—Spring 2023: develop method for mapping kelp using SkySat
- Fall 2022—Fall 2024: create statewide maps of kelp canopy
- Fall 2022—Fall 2024: develop automated approach for image processing
- Spring 2023—Summer 2025: analyze kelp canopy dynamics
- Summer 2025: grant completion date; all grant deliverables due to OPC

PROJECT FINANCING:

Staff recommends that OPC authorize encumbrance of up to $650,000 to UCLA for enhanced kelp canopy monitoring.

Ocean Protection Council	$650,000
TOTAL	**$650,000**

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 California 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).

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.