Item 7

Staff Memo
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Interim Kelp Action Plan

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LOCATION: Statewide

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

EXHIBITS:
Exhibit A: Interim Action Plan for Protecting and Restoring California's Kelp Forests

EXECUTIVE SUMMARY AND GOAL OF DISCUSSION:

Kelp forests are fundamental to California's marine biodiversity and its ocean economy. Both giant kelp, a perennial alga that dominates in southern and central California, and bull kelp, an annual alga that dominates in northern California, are foundational species that provide a variety of ecological functions and ecosystem services. In general, California's nearshore environment has supported healthy kelp forests for decades; satellite imagery dating back to 1984 shows significant interannual variability but a stable overall trend in kelp canopy area across the state prior to the onset of a marine heatwave in 2014. That marine heatwave had variable effects on kelp in each of California's major geographic regions. Bull kelp forests in northern California were devastated, experiencing greater than 95% loss in kelp canopy from 2014 to 2019 and limited recovery in 2020. Giant kelp forests in central California have exhibited patchy declines since 2014, but no discernible region-wide trend. The marine heatwave generally had no strong effects on giant kelp forests in southern California.

Given the ecological and socioeconomic importance of kelp, the severity of kelp declines on the north coast, and the anticipated impacts of changing ocean conditions, the protection and restoration of California's kelp forests has emerged as a top priority for OPC and the California Department of Fish and Wildlife. Efforts initiated in 2019 and 2020 are providing resource managers with critical monitoring data, an enhanced understanding of the drivers of kelp loss and persistence, and science-based evaluations of potential kelp restoration approaches. However, significant knowledge gaps remain. In support of OPC's Strategic Plan to Protect California's Coast and Ocean 2020-2025, (Objective 3.2, Target 3.2.1), the Interim Kelp Action Plan (Action Plan) is intended to summarize current state-supported kelp research and restoration efforts, as well as other relevant efforts in

California and globally; highlight key knowledge gaps; and outline priorities for action in kelp research and monitoring, policy development, restoration, and community engagement. Those priorities include: completing pilot efforts; developing science-based metrics for tracking kelp forest ecosystem health; implementing statewide kelp forest monitoring based on those metrics; initiating the development of a kelp restoration and management plan, which will include a restoration "toolkit"; and engaging with California's coastal communities and Native American Tribes.

OPC has developed the Action Plan to serve as a starting point for discussion between resource managers, the academic community, California Native American Tribes, coastal stakeholders (including the diving and fishing communities), and members of the public. This discussion item is intended to provide the Council with a venue for open dialogue regarding the priorities, knowledge gaps, and next steps outlined in the Action Plan. OPC staff will build on this discussion by offering opportunities for engagement on the Action Plan throughout 2021, and a final version will be presented to the Council for consideration and possible adoption in Spring 2022. That version will incorporate results from research and restoration projects currently underway, as well as scientific, Tribal, and public input.

BACKGROUND:

California's iconic kelp forests are among the most productive and biodiverse ecosystems on the planet. Both giant kelp, a perennial alga that dominates in southern and central California, and bull kelp, an annual alga that dominates in northern California, are foundational species that provide a variety of ecological functions and ecosystem services. Kelp is also critical to the well-being of California's coastal residents, including California Native American Tribes, and the state's $44 billion ocean economy. Kelp supports a variety of commercially and recreationally important fisheries, is harvested commercially for human consumption and as feed for aquaculture operations, and offers unparalleled opportunities for skin and scuba diving, kayaking, surfing, and wildlife viewing.

Globally, kelp forests naturally fluctuate from year to year, and the significant interannual variability of kelp canopy area on the California coast has been well documented. However, in general, California's nearshore environment has supported healthy kelp forests for decades; satellite imagery dating back to 1984 shows a stable overall trend in kelp canopy area across the state prior to a marine heatwave in the Northeast Pacific that started in 2014 and persisted through 2016.

Bull kelp forests in northern California were devastated by the marine heatwave. The sudden decline of bull kelp (greater than 95% loss during the 2014-2019 period) has been attributed to a "perfect storm" of changing ocean conditions in this region. Warm, nutrient-poor waters reduced kelp productivity and constrained the ability of new kelp to establish and grow. Just prior to the marine heatwave, sea star populations were decimated by Sea Star Wasting Syndrome, a disease resulted in the disappearance of the sunflower star, a

predominant urchin predator, from California waters. In the absence of sunflower stars, purple sea urchin populations exploded in northern California, grazing once-lush kelp forests down to bare rock or “urchin barrens”; warm waters may have increased purple urchin recruitment in this region. Even as the marine heatwave has subsided, purple urchin densities remain up to 60 times higher than normal levels at many locations on the north coast. Drone surveys conducted along the Mendocino and Sonoma coast in fall 2020 have documented bull kelp at locations from which it has been absent since 2014. However, a potentially depleted spore bank, the persistence of urchin barrens, the local extinction of the sunflower star, and the lack of other urchin predators in northern California will likely constrain the ability of the system to naturally recover to pre-2014 levels.

In contrast to the devastation observed on the north coast, patterns in giant kelp abundance along California’s central coast are more complex. In general, from 2014-2019, central California has been characterized by patchy kelp distribution, with no discernible overall trend. Kelp has persisted in some locations but appears to have declined in others; one area of particular concern is the Monterey Peninsula, where kelp has exhibited significant losses since 2014. In contrast to the region-wide dynamics on the north coast, factors at smaller spatial scales likely drive kelp persistence on the central coast. These factors include temperature, local urchin densities, and the foraging behavior of sea urchins and southern sea otters.

In general, the 2014-2016 marine heatwave had no strong effects on giant kelp in southern California. Kelp canopy area in southern California declined following the onset of the marine heatwave in 2014, but these losses were within the normal range of variability and kelp quickly recovered. As with the central coast, smaller-scale factors likely drive kelp abundance on the south coast; in particular, the presence of urchin predators such as California Sheephead and California spiny lobsters may provide kelp forests with a measure of functional redundancy that has increased the resilience of these systems to the loss of the sunflower star. Furthermore, wave disturbance is consistently lower in southern California than in central or northern California, potentially contributing to kelp persistence.

Given the ecological and socioeconomic importance of kelp, the severity of the crisis on the north coast, and the anticipated impacts of changing ocean conditions, the protection and restoration of California’s kelp forests has emerged as a top priority for OPC and the California Department of Fish and Wildlife (CDFW). In support of OPC’s Strategic Plan to Protect California’s Coast and Ocean 2020-2025 (Objective 3.2, Target 3.2.1), the Interim Kelp Action Plan (Action Plan) is intended to summarize current state-supported kelp research and restoration efforts, as well as other relevant efforts in California and globally; highlight key knowledge gaps; and outline priorities for action in kelp research and monitoring, policy development, restoration, and community engagement. OPC developed the Action Plan in close collaboration with CDFW staff, and academic partners provided informal scientific review and feedback.

SUMMARY OF ACTION PLAN CONTENT:

Current Research and Restoration Efforts

OPC and CDFW have recently initiated several 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 in 2019-2020.

The Action Plan provides a summary of these projects and discusses their anticipated results and relevance to management needs. Notable projects include:

- Improved kelp canopy monitoring and mapping using remote sensing techniques.
- Partnership with north coast commercial fishermen to remove urchin in support of kelp restoration at targeted restoration locations in Mendocino County[1].
- Collaboration between scientists, managers, and the recreational dive community to assess in-water urchin culling as a potential kelp restoration approach.
- Launch of the statewide Kelp Recovery Research Program, a unique partnership between state government and California's leading kelp forest scientists that is supporting a suite of six innovative, solutions-oriented kelp research and restoration projects[2].

Knowledge Gaps

The research and restoration efforts described in the Action Plan are exploring a substantial number of knowledge gaps surrounding kelp forest ecosystem dynamics and the efficacy of various restoration approaches. However, the Action Plan notes that resource managers still face a variety of broader scientific, policy, and management questions, including:

- What are the most important indicators of kelp forest ecosystem health?
- How can kelp monitoring results be integrated with environmental datasets to forecast short-term changes in kelp abundance?
- How will kelp distribution change long-term under predicted climate scenarios? What are the potential ecological and socioeconomic effects of these changes?
- What are the most effective and efficient methods of kelp restoration in California? When and where should they be pursued?
- What are the risks and potential unintended consequences of different kelp restoration methods?
- What are the ecological baselines to which resource managers should seek to restore kelp forests? Are these baselines realistic given predicted climate

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

[2] https://opc.ca.gov/webmaster/ftp/pdf/agenda_items/20200619/Item8_KelpRecoveryResearchProgram_FINAL.pdf

scenarios? How do they translate into science-based goals, objectives, and metrics of success for restoration?
- How should kelp protection and restoration efforts be integrated with existing management measures, such as marine protected areas (MPAs)?
- How can resource managers identify reliable funding streams and institutional support to implement kelp restoration and resilience efforts, particularly given the urgency of other resource management needs?
- How can alternative "ways of knowing"—including both local knowledge and indigenous traditional knowledge—complement scientific efforts and contribute to our understanding of kelp resilience?

Priorities for Action

In support of the protection and restoration of California's kelp forests, and to address the knowledge gaps highlighted above, the Action Plan identifies the following priorities for action. OPC views these as efforts that can and should be undertaken collaboratively with agency, Tribal, academic, nongovernmental/nonprofit, and community partners. Lead entities and timelines for individual actions will be identified as the final draft of the Action Plan is developed.

Research and monitoring
- Continue the suite of six Kelp Recovery Research Program projects. Work closely with researchers to ensure that scientific findings contribute to policy and management outcomes, in particular the final draft of this Action Plan and the development of a statewide Kelp Restoration and Management Plan (see below).
- Develop agreed-upon, science-based metrics for tracking kelp forest ecosystem health.
- Develop and implement a standardized statewide kelp monitoring program (including both kelp canopy and subtidal monitoring) to track metrics of kelp forest ecosystem health. Leverage existing monitoring efforts where possible.
- Develop methods to reliably forecast changes in kelp abundance and distribution based on known drivers.
- Initiate scientific projects to better understand the connection between physical oceanography and dispersal/recruitment of kelp forest species.
- Further explore the role of grazer predators in providing kelp forest ecosystem resilience.

Policy development
- Complete Enhanced Status Report (ESR) for bull kelp and giant kelp. The ESR should provide a comprehensive overview of both species and fisheries, along with current management and monitoring efforts and future management needs.
- Initiate the development of a statewide, ecosystem-based Kelp Restoration and Management Plan (KRMP).
- Update commercial harvest regulations for bull kelp and giant kelp.

- Ensure that aquaculture efforts related to kelp restoration (e.g. kelp sporophyte culturing, land-based "ranching" of harvested purple urchin for human consumption, etc.) are consistent with the state's interagency guiding principles for aquaculture and upcoming Aquaculture Action Plan.
- In collaboration with state MPA managers and partners, develop a clear policy outlining the circumstances under which kelp restoration methods could be considered in MPAs.

Restoration

- Continue pilot restoration projects and use results to develop a preliminary kelp restoration "toolkit" for inclusion in the KRMP.
    - The toolkit should consist of kelp restoration options available to resource managers in California, as well metrics of restoration success and a summary of the ecological and socioeconomic conditions under which various options are likely to be most effective.
    - The toolkit should contain methods for evaluating the risks and benefits of restoration actions. A precautionary approach should be adopted, and restoration methods with a high likelihood of unintended ecological consequences should be avoided.
- Engage with the commercial red sea urchin fishery to develop restoration incentives and explore potential markets for purple urchin.
- Engage with the global kelp forest restoration community to share best practices and lessons learned.

Community engagement

- Initiate projects to improve access to kelp forests for Californians from underserved communities, through both field-based and virtual programs.
- Continue engagement with California's Native American Tribes.
    - Ensure that Tribal perspectives are represented in policy and management conversations.
    - Include Tribes in research and monitoring efforts, potentially through California's recently launched Tribal Marine Stewards Network.
    - Begin development of a pathway for the consideration of Indigenous Traditional Knowledge in state policy and management decisions related to kelp.
- Engage stakeholders to ensure California's coastal communities are represented in policy and management discussions, including the development of the KRMP.
- Utilize knowledge and capacity of diving and fishing communities, as well as kelp and algae harvesters, to assist with kelp monitoring and restoration efforts.

NEXT STEPS FOR ACTION PLAN DEVELOPMENT:

OPC has developed the Action Plan to serve as a starting point for discussion between resource managers, the academic community, California Native American Tribes, coastal

stakeholders (including the diving and fishing communities), and members of the public. This discussion item is intended to provide the Council with a venue for open dialogue regarding the knowledge gaps and priorities outlined in the Action Plan. OPC staff will build on this discussion by offering opportunities for engagement on the Action Plan throughout 2021, and a final version will be presented to the Council for consideration and possible adoption in Spring 2022. That version will incorporate results from research and restoration projects currently underway, as well as scientific, Tribal, and public input. Next steps for developing this interim draft into a final plan include:

- Incorporate results from research and restoration projects that are currently underway.
- Incorporate technical guidance and recommendations from the research community, leveraging OPC's partnership with top kelp scientists.
- Solicit Tribal comment to ensure that Tribal perspectives and priorities are reflected in the final Kelp Action Plan.
- Solicit public comment to ensure that the perspectives and priorities of a variety of stakeholders (including commercial and recreational fishermen, divers, ocean business/tourism operators, members of coastal communities, and others) are reflected in the final Kelp Action Plan.