Staff Recommendation
September 30, 2025

Item 9

Action Item:
Consideration and Approval of Disbursement of Funds to Support Sunflower Sea Star Reintroduction

Pike Spector, Biodiversity Program Manager

Recommended Action: Authorization to disburse up to $630,014 to support the reintroduction of the Sunflower Sea Star through the following projects:

9.1 Up to $270,000 to The Nature Conservancy to support the captive breeding program, disease sampling, and experimental outplanting

9.2 Up to $118,720 to the California Academy of Sciences to expand the search effort for wild Sunflower Sea Star populations, captive breeding program support, and outreach and education

9.3 Up to $241,294 to the California Department of Fish and Wildlife to support additional capacity at the Shellfish Health Lab

Location: Statewide

Strategic Plan Goals and Objectives: Goal 3: Enhance Coastal and Marine Biodiversity; Objective 3.1: Protect and Restore Coastal and Marine Ecosystems, Objective 3.3 Support Sustainable Marine Fisheries and Thriving Fish and Wildlife Populations,

Equity and Environmental Justice Benefits: Ecosystem stability and resilience in the face of a changing ocean, coastal community benefits, benefits for consumptive and nonconsumptive marine resources users, community science, and meaningful community engagement.

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 California Ocean Protection Act; and
2. The proposed projects are consistent with OPC's General Grant Guidelines, adopted June 2025;
3. The proposed projects are consistent with the Budget Act of 2024, which included a $27.5 million Greenhouse Gas Reduction Fund appropriation for ocean protection and resilience to climate change; and
4. The proposed projects are not 'legal projects' that trigger the California Environmental Quality Act (CEQA) pursuant to Public Resources Code section 21068 and Title 14 of the California Code of Regulations 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 $630,014 to The Nature Conservancy, the California Academy of Sciences, and the California Department of Fish and Wildlife to support the reintroduction of the Sunflower Sea Star.

This authorization is subject to the condition that prior to disbursement of funds, funding recipients 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:

Staff recommends approval of $630,014 to support Sunflower Sea Star reintroduction through captive breeding and experimental outplanting efforts. Once abundant on rocky reefs from Alaska to Baja California, the Sunflower Sea Star (*Pycnopodia helianthoides*) has been nearly wiped out in California. Following the onset of Sea Star Wasting Disease (SSWD) in 2013, kelp forest and intertidal ecosystems have shifted in their community composition and dynamics, likely due to the loss of this key predator. While investments in kelp forest research are accelerating the State's restoration priorities, recent advancements in the Sunflower Sea Star captive breeding program

have begun to pave a path forward for the recovery of the Sunflower Sea Star. A breakthrough discovery, published in summer 2025, has identified *Vibrio pectenicida* as a cause of SSWD, turning the corner for rescuing this species from extinction. However, the presence of *V. pectenicida* has not been tested for in California.

Major research in husbandry and captive breeding programs have ignited hope for the recovery of Sunflower Sea Stars. Alongside the identification of the SSWD pathogen, verified reports of several wild Sunflower Sea Stars from scientific divers in Sonoma and Mendocino Counties suggest that some individuals may be resilient to SSWD. To continue supporting the rehabilitation of this species, collaborative research is underway to identify wild sea stars in the field, prepare captive-bred individuals for trial outplanting experiments, and to bolster the success of current captive breeding programs. However, knowledge gaps remain around the ability of future Sunflower Sea Star generations to inherit resilience to SSWD, the efficacy of crossbreeding disease-resilient stars, and the potential for natural recovery in California. These proposed projects will address these gaps and further advance the recovery of this key species in California's waters.

Project Summary:

Background:

Kelp Forest Status and State Kelp Restoration Efforts: Global kelp populations are generally facing regional and subregional losses, resulting in severe economic and environmental destabilization. Kelp forest decline in California is no exception, but the State has taken bold action to research these declines and recover kelp forests. Recent investments have shown that a combination of grazer suppression and fresh kelp spore delivery may be most effective at preventing kelp forests from declining further and for supporting on-going restoration. While in-water restoration is proving effective, advanced laboratory and modeling studies are guiding future investments and will be integrated into the development of the Department of Fish and Wildlife's statewide Kelp Restoration and Management Plan.

Although work is underway to turn the tide against future kelp forest loss, as of 2024, Northern California kelp forests have yet to recover in an appreciable way since the 2014 marine heatwave, with 96% loss of canopy cover reported in Mendocino and Sonoma counties. Central and Southern California's recovery trajectories have been more varied; regionally Central California's average kelp cover is below 50% of its historic average while the Southern California Bight is below 70% of its historic average. And while the northern Channel Islands have lower than average canopy coverage, consistent with trends in Central California, the southern Channel Islands are experiencing a boom of kelp canopy cover, with some islands supporting more than 100% of their long-term average.

Sea Star Wasting Disease: Like kelp forests, all of California's nearshore rocky reefs are complex habitats driven by many layers of ecological interactions. A voracious marine predator, the Sunflower Sea Star was once abundant in temperate intertidal and subtidal habitats from the Aleutian Archipelago to central Baja California. The onset of SSWD in 2013 caused the collapse of this critical species across its range, with near total extinction in California.

The loss of the Sunflower Sea Star in 2013, combined with marine heatwave from 2014-2016, may have facilitated unprecedented conditions for kelp forest collapse on California's north coast. While the role of Sunflower Sea Stars in controlling sea urchin populations is still being revealed, recent studies have highlighted demonstrable change to rocky reef community composition in the absence of Sunflower Sea Stars. Findings published in 2022, nearly 10 years after the onset of SSWD, estimate that roughly six billion Sunflower Sea Stars were killed by the disease, or almost 95% of their global population (Roadmap to Recovery for the Sunflower Sea Star, TNC 2022).

In partnership with the State of California and other collaborators, The Nature Conservancy recently launched the Pacific Coast Ocean Restoration initiative (PCOR), which directly supports Sunflower Sea Star captive breeding in California. Unprecedented success in this captive breeding program has prompted further action to rescue this species from extinction. In parallel with these efforts, as of summer 2025, research divers have been reporting wild Sunflower Sea Stars in Northern California. Critically, a highly anticipated paper published by the Hakai Institute in summer 2025 identified the bacterium *Vibrio pectenicida* as a cause of SSWD. Despite the unprecedented pace of this discovery, knowledge gaps remain around the presence of *V. pectenicida* in California's waters, the continued success of the captive breeding program, the role that genetics may play in conferring disease resilience, and the efficacy of trial outplanting experiments.

This staff recommendation highlights key next steps to support the success of captive breeding experiments and inform the potential reintroduction of Sunflower Sea Stars to California.

Project Summary:

To fill critical knowledge gaps and to bring the Sunflower Sea Star back from the brink of extinction in California, OPC staff recommend funding the following actions to that together will support the captive breeding program and the potential recovery of this critical species.

9.1 and 9.2 Captive Breeding Program Support

This investment will support a comprehensive analysis of genetic diversity in captive and wild Sunflower Sea Stars, advance husbandry techniques, and provide a robust analysis of disease resilience in captive and wild stars. The success of the first generation of captive-bred stars from

California genetic stock in February 2024 highlighted breakthrough success in animal husbandry techniques. However, these individuals are siblings and therefore have limited capacity to be used in future experiments. To ensure the future success of the captive breeding program, TNC will: work with researchers at the University of California Merced to use cutting edge analyses to explore the genetic variation in the captive population relative to the wild populations in Alaska and Canada (and potentially in California); conduct a gap analysis to determine where (geographically) there are missing genetic samples; and develop and execute a plan for acquiring additional individuals to be used for captive breeding from these locations. Spawning will be induced from newly collected animals and gametes will be cryopreserved for future use.

Research at the Hakai Institute in British Columbia, supported by TNC, is currently underway to determine if disease resilience can be passed from parent to offspring. The degree of disease resilience inherited through parental lineages will inform the future success of potential reintroduction efforts. Results from current experiments will be used to direct crossbreeding experiments at the California Academy of Sciences and the Sunflower Star Laboratory (supported through PCOR).

Support for the continuation of captive breeding experiments will complement PCOR funding and infrastructure and will consist of the following tasks:

- A comprehensive analysis of genetic diversity in captive and wild Sunflower Sea Stars to ensure appropriate genetic diversity in captive broodstock populations.
- Advancement of animal husbandry techniques to better prepare future generations of captive-bred stars for potential outplanting experiments.
- Robust analysis of disease resilience through captive breeding and the integration of these results into future crossbreeding events.

9.2 and 9.3 Natural Species Research and Reintroduction

With this investment, necessary protocols will be established to quantify the presence of SSWD in California's waters, accelerate detection and verification of wild Sunflower Sea Stars, and streamline pathology capacity for future outplanting efforts. The Hakai Institute in partnership with TNC, is currently developing a diagnostic tool for detecting SSWD in water and tissue samples. Funds will support the delivery and application of this tool, and the development of a collaborative survey protocol for sampling the environment and wild-found sea stars along the California coast to detect SSWD. While disease resilience studies and field sampling for SSWD are underway, trial short-term experiments to reintroduce Sunflower Sea Stars to the ocean to assess their response (via cages suspended from buoys) are planned to take place in Monterey in Fall 2025. These "soaks" will provide initial data on the efficacy of this experimental approach, potentially setting the stage for future, larger scale outplanting experiments.

As the captive breeding program is working to increase the number of individuals in captivity in California, recent reports of wild Sunflower Sea Stars have been validated by research divers in Sonoma and Mendocino counties. To support the search for more wild stars, researchers at NOAA's Pacific Marine Environmental Lab (PMEL) have developed an environmental DNA (eDNA) tool to rapidly detect the presence of sunflower stars from water samples. Due to the historic wide-spread range of Sunflower Sea Stars, robust sampling in California is needed to detect wild populations using eDNA and field observations. The identification of wild individuals, especially sexually mature adults, could inform efforts to support the repopulation of this species.

In partnership with the California Academy of Sciences, community science programs will be utilized to expand the breadth and scope of eDNA collections and synthesis. Utilizing the Solstice Sea Star Search and other outreach and engagement pathways, a wider search effort for wild stars will identify locations where disease resilience may be present in natural populations. Sightings of wild stars will be verified opportunistically by field teams from the California Department of Fish and Wildlife (CDFW), the California Academy of Sciences, academic and research institutions, and other appropriate parties; genomic and disease samples will be taken from wild Sunflower Sea Stars to test for the presence of *V. pectinicida* in California. Individuals will be examined by California Academy of Sciences veterinarians and tested for *V. pectinicida*, if deemed heathy and with appropriate permits in place, will be induced to spawn in the field. Gametes collected in this way will be cryopreserved for use in future captive breeding experiments before the individual sea star is returned to the reef.

In order to ensure proper disease testing and monitoring prior to any outplanting efforts, sufficient capacity is needed at CDFW's Shellfish Health Lab at Bodega Marine Laboratory. To increase departmental support for addressing biosecurity/disease concerns and to accelerate the processing time it takes to prepare a candidate individual for outplanting experiments, funds will be provided CDFW to hire a limited term Research Scientist I (Microbiological Sciences) based at the Shellfish Health Lab.

Support for natural species research and reintroduction will consist of the following tasks:

- Range-wide sampling for the presence of *V. pectinicida* in sea water and within wild Sunflower Sea Stars.
- The deployment of eDNA and *in situ* observations for wild populations of Sunflower Sea Stars.
- Design, development, and implementation of trial outplanting experiments.
- Support additional pathology capacity at the Shellfish Health Lab.

Equity and Environmental Justice Benefits:

The restoration of native keystone species on rocky reefs in California will ensure that nearshore ecosystems will retain health and function, directly supporting ecologically, economically, and culturally important species. The inclusion of community science in research and reintroduction of Sunflower Sea Stars fosters stewardship for the coast and ocean, and can support meaningful engagement for underserved communities.

About the Grantees:

9.1. The Nature Conservancy is a nonprofit entity focused on environmental conservation. As conveners of the *Pycnopodia* Recovery Working Group and the Pacific Coast Ocean Restoration Initiative (PCOR), TNC is well poised to aid in the recovery of Sunflower Sea Stars.

9.2. The California Academy of Science is a research institute and natural history museum based in San Francisco, California. As core members of the *Pycnopodia* Recovery Working Group and PCOR, the Academy possesses the technical knowledge and expertise to advance the captive breeding program and engage with members of the community to support the identification of wild sea stars.

9.3 Located at the Bodega Marine Laboratory in Bodega Bay, the CDFW Shellfish Health Laboratory (SHL) monitors and diagnoses known and emerging diseases in wild and farmed shellfish throughout the State of California. SHL staff conduct inspections at, and work closely with shellfish farms, marine aquaria, and research laboratories to prevent the introduction and transfer of disease agents and non-native species. In collaboration with academic institutions and aquaria, the SHL contributes to the recovery of endangered native abalone and sea star populations.

Project Timeline:

Winter 2025 - Late 2027

Project Financing:

Staff recommends that the Ocean Protection Council (OPC) authorize encumbrance of up to $630,014 to The Nature Conservancy, the California Academy of Sciences, and the California Department of Fish and Wildlife to support the reintroduction of the Sunflower Sea Star.

Ocean Protection Council	$630,014
9.1 Nature Conservancy	$270,000
9.2 California Academy of Sciences	$118,720
9.3 California Department of Fish and Wildlife	$241,294
TOTAL	**$630,014**

The anticipated source of funds will be the Budget Act of 2024, Greenhouse Gas Reduction Fund appropriation to OPC (Fiscal Year 2024/2025), which authorizes the distribution of funds for competitive or discretionary projects that advance ocean protection and resilience. The proposed disbursement and anticipated projects support the purpose of this appropriation to inform and advance the restoration and resilience of marine wildlife and 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:

- Eliminate or reduce threats to coastal and ocean ecosystems, habitats, and species.
- Allow for increased public access to, and enjoyment of, ocean and coastal resources, consistent with sustainable, long-term protection and conservation of those resources.
- Improve management, conservation, and protection of coastal waters and ocean ecosystems.
- Provide monitoring and scientific data to improve state efforts to protect and conserve ocean resources.
- Protect, conserve, and restore coastal waters and ocean ecosystems.
- 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.

Compliance with the California Environmental Quality Act (CEQA):

The proposed project is not a legal project that triggers CEQA, 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. If a proposed activity is anticipated to result in a serious or major disturbance to an environmental resource, grantees will be required to obtain applicable permits.