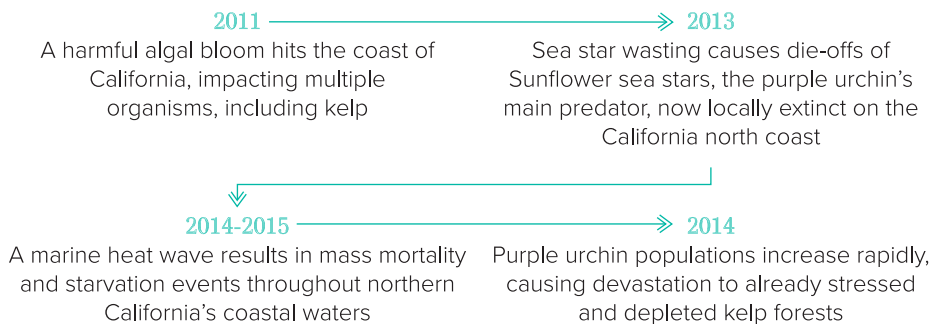


UC Davis is using science to inform the restoration of California's underwater forests.

Kelp forests support some of the most productive fisheries and unique ecosystems in the world. California's kelp forests are particularly unique, as our "redwood forests of the sea" are among the tallest and most productive of the world: northern California's bull kelp grow an average of 4 inches per day and can reach heights over 100 feet.

Kelp Forests in Decline

In 2019, Coastal and Marine Sciences Institute researchers documented interacting environmental stressors that led to the precipitous decline in bull kelp:



The purple urchin population off the California north coast has increased 60-fold, and kelp in the north coast declined dramatically, by 86-97%. As a result, a barren landscape, similar to the aftermath of clear cutting trees, has replaced the once abundant kelp forests.

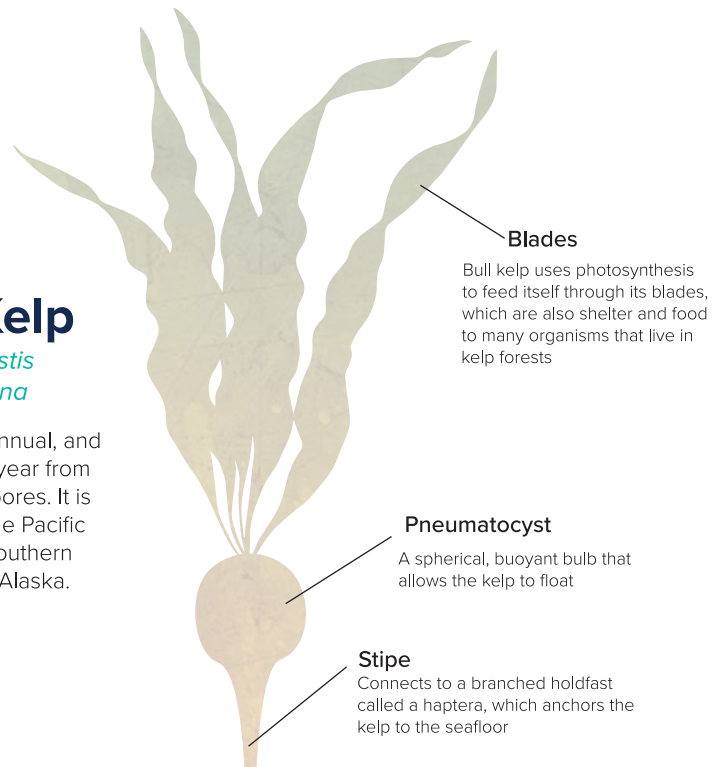
California's Coastal Forests



Bull Kelp

Nereocystis luetkeana

Bull kelp is an annual, and regrows each year from microscopic spores. It is found along the Pacific coast from Southern California to Alaska.



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Who Needs Kelp? We Do!

Kelp forests support California coastal communities by contributing to ecotourism and supporting both commercial and recreational fisheries.

- The recreational fishing industry for red abalone (*Haliotis rufescens*), which eat kelp, is valued at \$44 million, but because of the lack of food, the abalone are starving. Consequently, the industry experienced a reduction in fishing in 2017 and complete closure in 2018.
- The commercial fishery for red urchins (*Mesocentrotus franciscanus*), a distinct species from the purple urchin that also feeds on kelp, was declared a federal fishing disaster in 2019.
- In addition, these underwater forests are biodiversity hotspots, associated with a far greater number of species than urchin-dominated barrens.

Discovering a Road to Recovery

The first step of any effort to restore kelp forests is reducing the purple urchin populations. Government agencies, fishery alliances, non-profits, and citizen groups are organizing to harvest urchins. However, funding these projects is difficult because dormant, empty urchins do not have the “uni” for sushi and purple urchins, unlike the larger red urchins, have no commercial fishery to date. **Even if kelp forests thrive again, the sea life communities that depend on them will likely need some help to bounce back.**

While urchin harvesting is underway based on the best available science, scientists and managers face a number of unknowns:

- Given limited resources, what is the optimal urchin harvest strategy in terms of location, intensity, and timing?
- Can kelp re-seeding, sea star reintroduction, and red abalone reintroduction be successful and improve restoration outcomes?
- How do different government actions and regulations affect restoration success not just for kelp forests, but also for the people that rely on them?
- What restoration actions might most improve resiliency to future marine heat waves?

What are UC Davis Researchers Doing to Aid Restoration Efforts?

Using genomics to measure movement of kelp forest species. UC Davis and partners are currently working through the California Conservation project to conduct a ‘community genomics’ assessment with the goal of choosing restoration sites that maximize connections between restored areas and protect populations that are tolerant to climate change.

Understanding sea urchin population dynamics in a changing ocean. Temperature may affect the quality and quantity of sea urchin eggs, and the behavior of their larvae as they are transported along ocean currents to their final settling places. UC Davis researchers and partners are using climate controlled experiments to predict how purple urchin populations will respond to different circulation patterns and warmer conditions in California’s future ocean.

Developing the science of abalone restoration. Bodega Marine Laboratory (BML) is a member of The White Abalone Recovery Consortium, a team of state, federal, university and private partners improving our understanding of how to raise white abalone in captivity and release them into the ocean. The lessons they are learning about white abalone will inform restoration of red abalone.

Considering the human dimensions of restoration. UC Davis is currently seeking funding to lead a multi-university effort to create a “socio-ecological systems” framework for engaging in proactive restoration that incorporates the human, ecological, and physical components of the system. A key goal of this effort is to identify policy changes that might allow for efficient restoration and a more nimble response to future marine heat waves.

Scaling up kelp cultivation. The low density of kelp is making it difficult for kelp to regenerate and recover, even in areas with urchin removal. To accelerate recovery of bull kelp, UC Davis researchers are developing replanting strategies for kelp at the Bodega Marine Laboratory to support large scale kelp forest restoration efforts.

Expanding the restoration toolkit. UC Davis received seed funding from California Sea Grant and the Ocean Protection Council to lead a multi-university effort to develop the science behind novel restoration approaches, such as more efficient urchin removal techniques, ensuring that remnant kelp patches remain connected within a broader network, introducing heat-tolerant strains of kelp, and the reintroduction of sea stars.



Researched and written by Jane Park

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