

Ocean Research: Sea Stars protecting kelp forests

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A research team, including a scientist from Oregon State University, has provided the first experimental evidence that a species of endangered sea star protects kelp forests along North America's Pacific Coast by preying on substantial numbers of kelp-eating urchins.

The study, published in *Proceedings of the Royal Society B*, is important because kelp, large algae with massive ecological and economic importance around the world, are under siege from environmental change and overgrazing by sea urchins.

The findings by a collaboration that also featured scientists from the University of Oregon and The Nature Conservancy suggest that the sunflower sea star likely plays a much stronger role in kelp forest health than had been previously thought.

Lab experiments showed that sea stars, known scientifically as *Pycnopodia helianthoides*, consume urchins at rates sufficient to maintain and perhaps reset the health of kelp forests. The authors are calling for active

management and a coordinated sunflower sea star recovery.

“What we saw suggests a clear link between the crash of sea stars, the explosion in sea urchin populations and the decline in kelp,” Oregon State College of Science research associate Sarah Gravem said. “It also points to sea star recovery as a potential key tool for kelp forest recovery.”

Kelp are a foundation species that occupy nearly 50% of the world’s marine ecoregions. They especially thrive in cold water, where they form large aquatic forests that provide essential habitat, food and refuge for many species. Their sensitivity to certain growing conditions means climate change and a warming ocean are particularly problematic for them.

Kelp are often harvested for use in products ranging from toothpaste and shampoos to puddings and cakes, and they also help support nutrient cycling, shoreline protection and commercial fisheries such as rockfish. Economists place kelp’s value in the range of billions of dollars annually.

In 2020, the sunflower sea star was listed as critically endangered by the International Union for Conservation of Nature following a population study led by OSU and The Nature Conservancy.

Populations of the sunflower sea star suffered dramatic downturns because of a marine wildlife epidemic event, referred to as sea star wasting syndrome, that began in 2013, Gravem said.

In the population study, scientists used more than 61,000 population surveys from 31 datasets to calculate a 90.6% decline in sunflower sea stars and estimated that as many as 5.75 billion animals died from the disease, whose cause has not been determined.

Moreover, the research produced no indications of population recovery in any region in the years since the outbreak.

Sunflower sea stars are now nearly absent in Mexico as well as most of the contiguous United States, the scientists say. No stars have been seen in Mexico since 2016, and only a handful have been found in Oregon and California since 2018.

Researchers have thought that the sea star decline helped fuel an explosion in the urchin population in many regions, with an overabundance of urchins placing added pressure on kelp forests already being challenged by marine heat wave events.

But prior to the latest study, the relationship between sea stars, urchins and kelp had not been quantified, Gravem said.

“This study addresses that gap, and the findings are significant and somewhat surprising,” University of Oregon Institute of Marine Biology principal investigator Aaron Galloway said. “We found that these stars are eager consumers of purple urchins and, most importantly, they even eat the nutritionally poor, starving ‘zombie’ urchins.”

Other important predators of purple sea urchins, such as sea otters, are generally known to avoid eating starving urchins from “barrens” – massive underwater carpets of urchins that have devoured their food supply and can live for years in an emaciated state until kelp grow back.

The new study, funded by The Nature Conservancy and the National Science Foundation, shows that a sunflower sea star on average eats about 0.68 sea urchins per day, and that they eat starved urchins, the ones associated with barrens, 21% faster than they consume the well-fed urchins typical of healthy kelp forests.

“Eating less than one urchin per day may not sound like a lot, but we think there used to be over 5 billion sunflower sea stars,” Gravem said. “We used a model to show that the pre-disease densities of sea stars on the U.S. West Coast were usually more than enough to keep sea urchin numbers down and prevent barrens.”

Because sunflower sea star recovery is unlikely to happen in the near term without intervention, Gravem said, researchers have developed a “Roadmap to Species Recovery” that includes the world’s first captive breeding program for the species and a pathway to re-introduction.

Also collaborating on the study were scientists from the University of Washington and Florida State University.

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