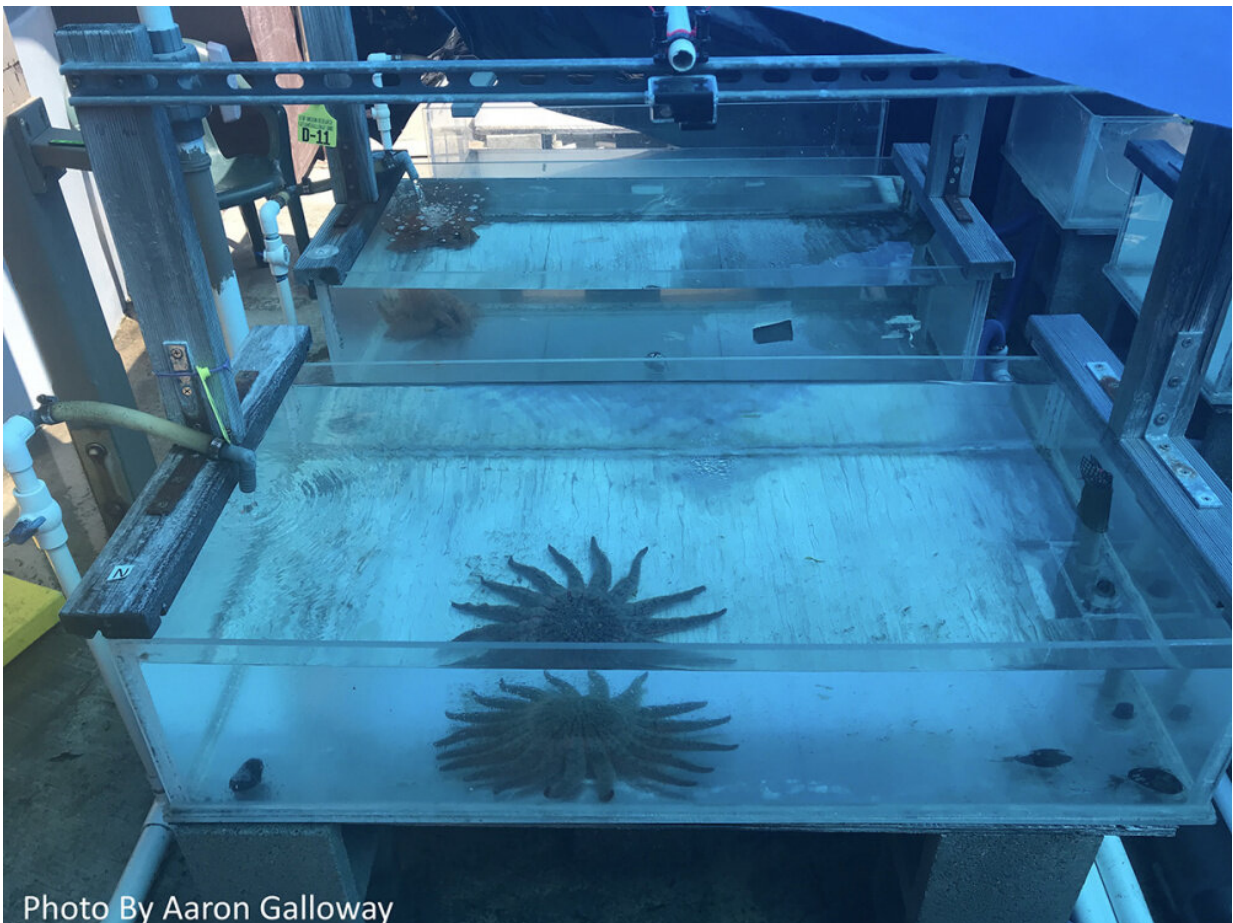


Study: Sunflower sea stars could help bring back kelp forests

February 22 2023, by Laurel Hamers



A sunflower sea star in a lab tank where they are being raised for reintroduction to Northwest coastal waters. Credit: Aaron Galloway

Your average sunflower sea star can munch through almost five purple sea urchins in a week, and they don't seem to be picky about the quality of their food.

That's good news—and valuable data—for efforts to reintroduce these now-endangered predators to coastal ecosystems along the west coast of North America. It suggests that if sunflower sea stars returned to their former habitats, they could help keep hungry urchin populations in check and possibly help restore [kelp forests](#).

A team co-led by Aaron Galloway at the UO's Oregon Institute of Marine Biology published the findings in *Proceedings of the Royal Society B*. Galloway spearheaded the work alongside Sarah Gravem at Oregon State University.

"We show, using the experiments and a population model, that these very large-scale purple sea urchin barrens probably couldn't have developed in the presence of sunflower sea stars," also known by the scientific name *Pycnopodia helianthoides*, Galloway said. "Our findings indicate that if *Pycnopodia* recovers, it should suppress these urchin barrens and help the [kelp](#) forest recover."

Healthy kelp ecosystems are marine biodiversity hot spots. Canopy-forming bull kelp can stretch more than 50 feet up from the [ocean floor](#), creating an underwater forest. Kelp's undulating ribbony fronds provide valuable habitat and food for mammals, fish and invertebrates.

But lately times have been tough for kelp forests. Climate change is warming oceans, and that's stressed the ecosystem from many directions.

Sunflower sea stars—a meter across fully grown, with up to 24 arms—were once a vital part of such habitats. Alongside [sea otters](#), they helped keep sea urchin populations in check. But sea otters were hunted

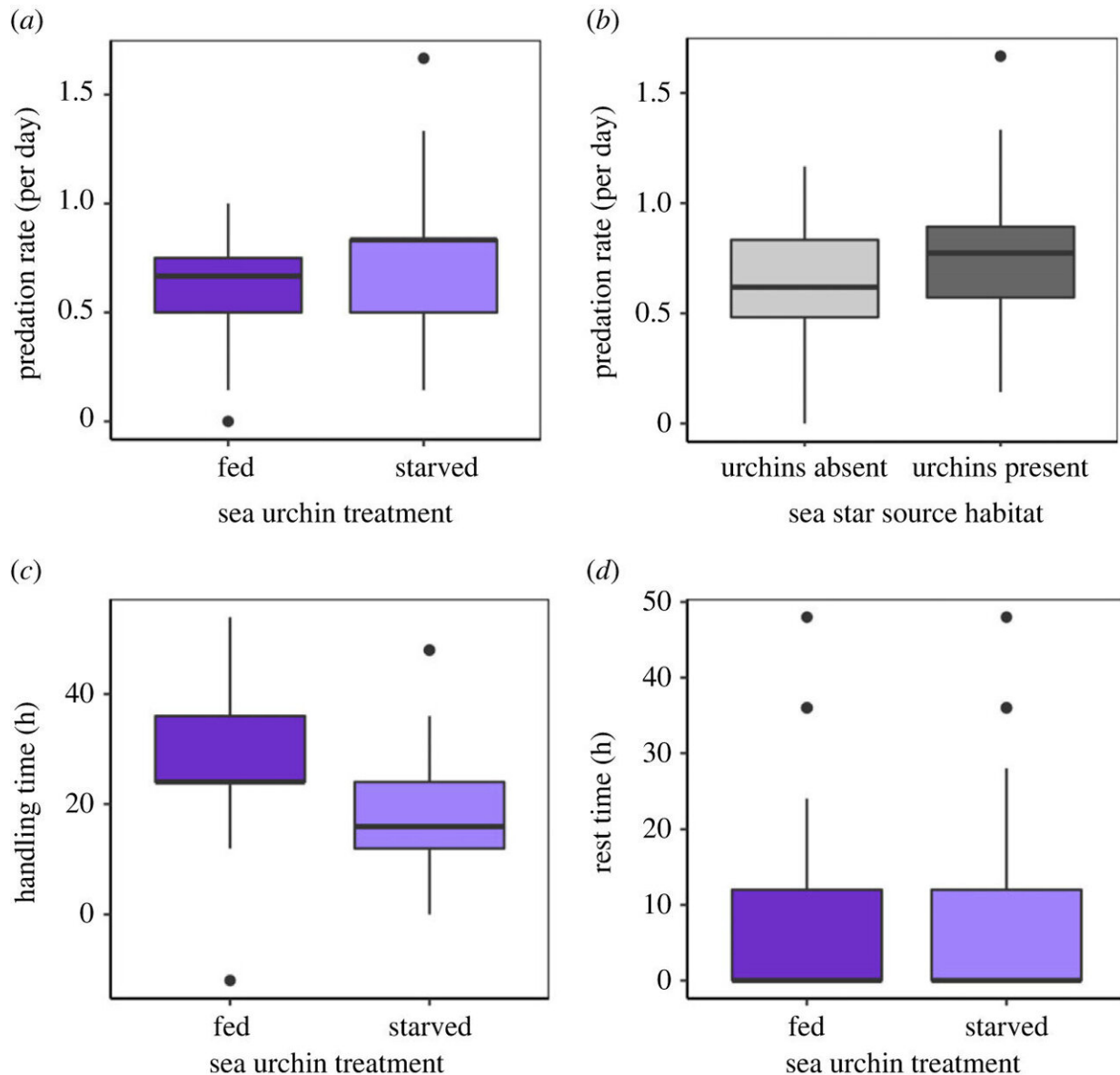
to near extinction in the 1700s and 1800s and now occupy only a tiny fraction of their former range.

And then, over the past decade, [sea star](#) wasting disease—likely triggered by [climate change](#)—wiped out almost all the sunflower sea stars in Oregon and Washington. They're now listed as critically endangered on the International Union for the Conservation of Nature Red List.

In warmer waters without many predators, urchin populations have exploded and devoured the kelp. Over time, the habitat has turned into a barren expanse of spiky urchins. Hotter oceans have also stressed kelp directly, making it even harder for the ecosystem to bounce back.

"Once otters were gone, Pycnopodia were still here. So the fact that more than 90 percent of these sea stars died off was huge," Galloway said. "We've had an unfortunate pile of conditions that have been very bad for kelp forests, made worse by recent marine heat waves"

At Friday Harbor Labs in Washington, efforts are already underway to rear baby sea stars in captivity with the hopes of eventually reintroducing them into the wild. But unknowns remain about sunflower sea star biology and the impact they could have if brought back to their former hunting grounds.



Box plots of predation rates (*a,b*), handling time (*c*; time between capture and egestion) and rest time (*d*; time between egestion and capture of another urchin) by *Pycnopodia helianthoides* during ad libitum laboratory predation trials on the purple sea urchin *Strongylocentrotus purpuratus*. In (*a,c,d*), dark purple are well-fed urchins (mimicking kelp forest urchins), and light purple are experimentally starved urchins (mimicking *S. purpuratus* from urchin barrens). (*b*) The influence of the *Pycnopodia*'s source habitat (either without (light gray) or with (dark gray) *S. purpuratus* present) on its predation rate on *S. purpuratus*. Credit: *Proceedings of the Royal Society B: Biological Sciences* (2023). DOI: 10.1098/rspb.2022.1897

Galloway's team collected sunflower sea stars at sites in the San Juan Islands, where small populations of Pycnopodia sea stars have managed to avoid the wasting disease. Back in the lab at Friday Harbor, they placed the sea stars in tanks and set up feeding experiments.

In one experiment, they put sea stars in a simple maze downstream of healthy urchins and starved urchins. Then they recorded which prey the sea stars chose to pursue.

Healthy urchins contain far more uni, the nutrient-rich gonads that make them a delicacy in some places. Sea otters, the other major urchin predator, quickly learn to avoid the less nutritious starved urchins often found in urchin barrens. But in [lab experiments](#), the sea stars ate both starved and well-fed urchins.

In another experiment, researchers measured how many urchins a sea star ate per day. The answer—about 0.7, or nearly 5 per week—didn't depend on whether the urchins were starved or healthy.

It's an encouraging finding for kelp forest fans.

"If you were to have a sea star dropped into an urchin barren, we have evidence now that suggests they're going to just start eating their way through it," Galloway said.

And modeling work led by study co-author Daniel Okamoto of Florida State University hints at just how big this effect could be in the wild. Even accounting for some sea stars getting eaten or not chowing down on as many urchins as they did in the lab, calculations suggest that sunflower sea stars could play a pivotal role in controlling urchin populations and restoring kelp forests.

When found together, sea otters and sunflower sea stars are a kelp forest predatory dream team. Otters will eat bigger urchins, abalone and snails, but those animals can hide by sneaking into cracks in rocks.

"In a functioning kelp forest ecosystem, Pycnopodia will play an important role in foraging for these herbivores in the cracks," Galloway said. "They can slither into the smallest cracks, and they'll eat the smaller urchins that sea otters won't bother with."

This study suggests that sunflower sea stars could help kelp forests make a comeback even without otters.

With ongoing backing from the Nature Conservancy, Galloway, Gravem and their colleagues will continue to explore the ecological role of Pycnopodia sea stars in future field studies.

"A lot of times as marine ecologists we're working on projects that are neat to a few scientists," Galloway said. "But this has a big conservation implication."

More information: A. W. E. Galloway et al, Sunflower sea star predation on urchins can facilitate kelp forest recovery, *Proceedings of the Royal Society B: Biological Sciences* (2023). [DOI: 10.1098/rspb.2022.1897](https://doi.org/10.1098/rspb.2022.1897)

Provided by University of Oregon

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