Scientists grappling with persistent and alarming collapse of North Coast's bull kelp forests

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THE PRESS DEMOCRAT
April 9, 2021

Five years after marine scientists first sounded the alarm about a sudden collapse of the bull kelp forest off the Northern California coast, the state of the ocean offers little prospect of recovery any time soon.

Where lush stands of leafy kelp once swayed amid the waves, providing cover to young finfish and forage for abalones and other creatures on the ocean floor, a stark new world has materialized — one dominated by millions of voracious purple sea urchins that have stripped the ocean floor down to rock in some places. Were a tender frond of new kelp to sprout, it wouldn't stand a chance of surviving long.

The barrens left behind are a stark and alarming contrast to what is typically one of the most thriving marine environments — seasonal kelp forests that support a rich ecosystem with life stretching from the sea floor to the surface, and up the food chain, supporting recreational and commercial fisheries and home to some of the North Coast's most iconic wildlife, including abalone and sea otters.

The kelp forests also are a key barometer for the wider health of the world's oceans, and without some recovery, their future as biodiverse stores for marine life and people hangs in the balance.

Dan Furr and his daughter Chelsea, 13, of Woodland, prepare to snorkel in Gerstle Cove on the Sonoma coast at Salt Point, Saturday, March 13, 2021. Very little bull kelp remains in the cove, (Kent Porter / The Press Democrat) 2021

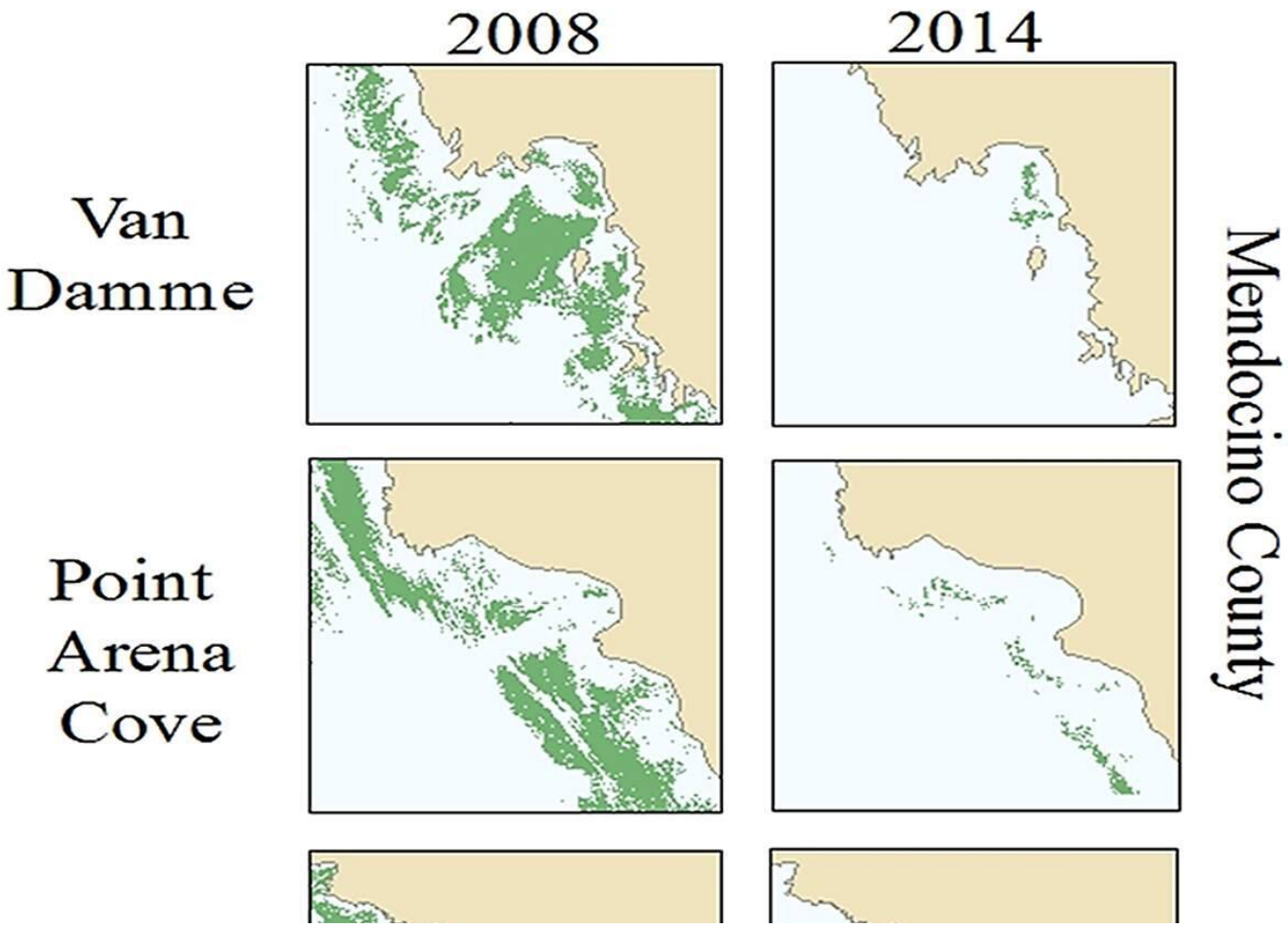
Laura Rogers-Bennett, a veteran biologist who works out of the UC Davis-Bodega Marine Lab, likened the kelp forest to a great floating woodlands stretching hundreds of miles along the coast.

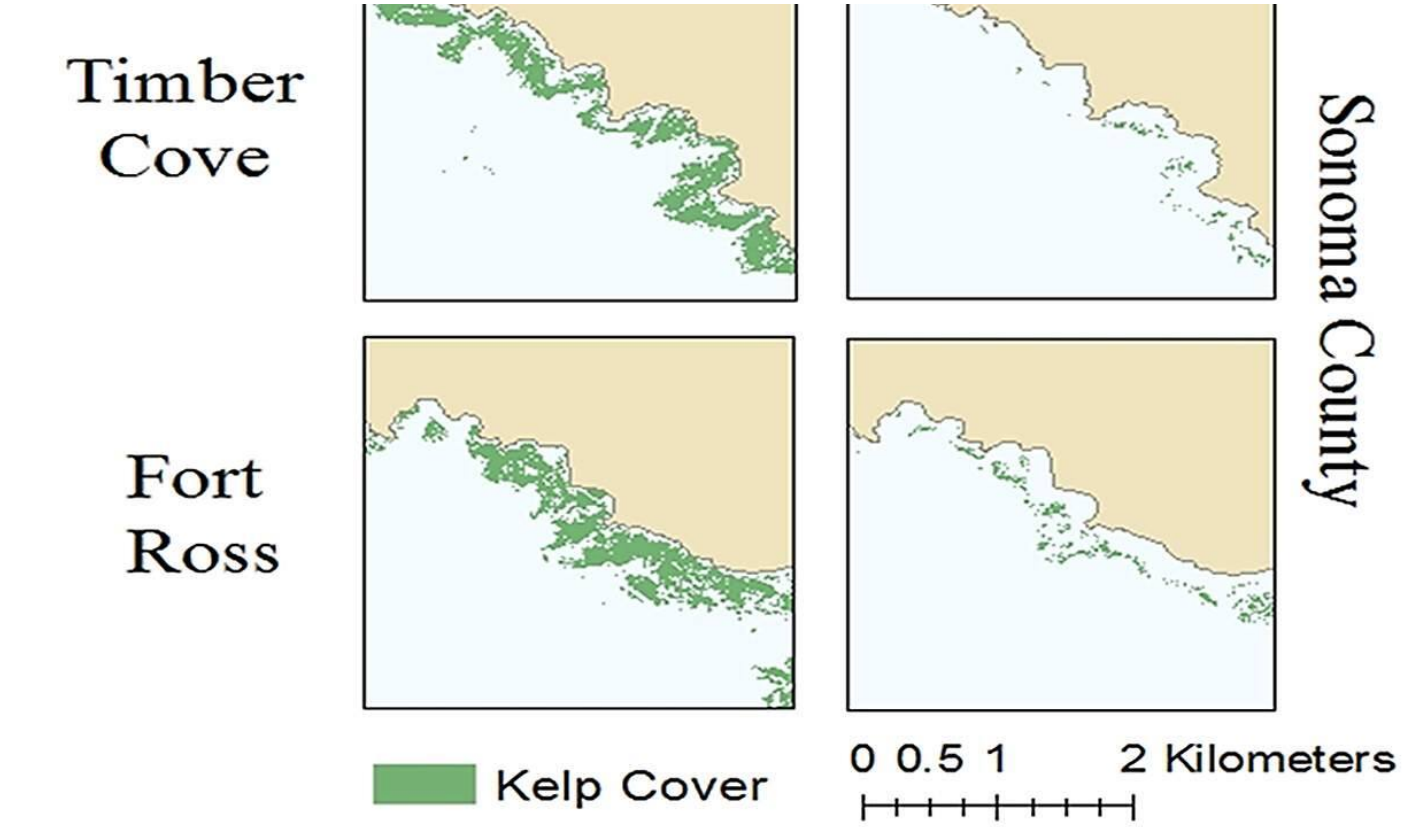
"To lose 95% of your forest in a year and a half, that's a catastrophe, an ecological disaster, and it's had so much socioeconomic impacts, as well," she said.

Experts are honing in on strategies to preserve remnant bull kelp that long flourished up and down the North Coast, hoping it may allow them to restore some portion of what once existed, when the time is right. Those pioneering efforts could also serve as model strategies for emerging urchin barrens around the world.

In labs around the West Coast, experiments are underway testing the feasibility of kelp cultivation and seed banking that might allow humans to boost natural recovery of the kelp forest at some point. Scientists elsewhere are breeding giant sunflower sea stars that might offset billions lost to Sea Star Wasting Syndrome, restoring a key predator of native purple urchins that have since multiplied so astonishingly. Others are trying to better understand the full dynamics of the ecosystem and how the transformation might be reversed.

It's a daunting challenge, drawing on the talents of government, academic and nonprofit scientists, as well as commercial and recreational divers desperate to ensure the offshore waters of the future offer some sliver of the opportunities they have in decades past.





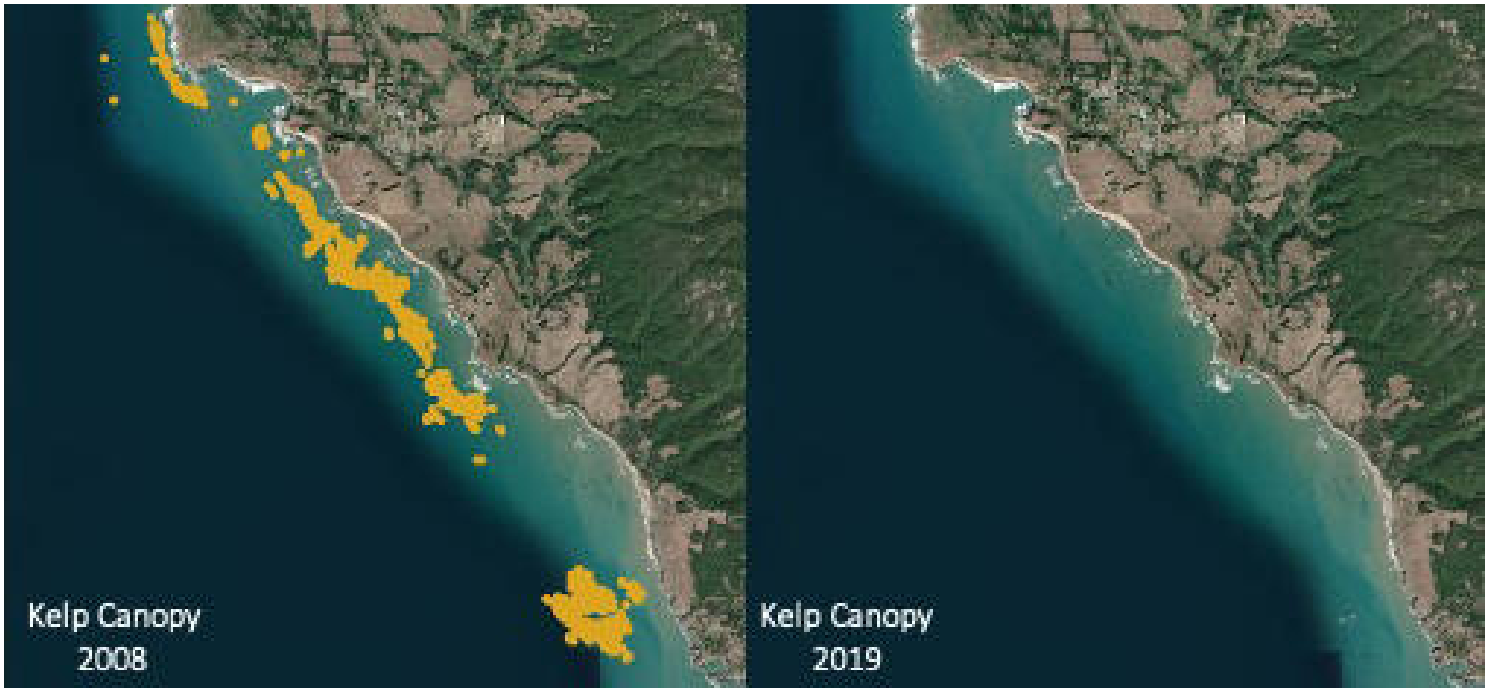
Comparison of Kelp cover at four important abalone fishery sites in 2008 and 2014. Green indicates kelp canopy observed. Maps created from aerial surveys of the coast conducted by CDFW.

"It's worth remembering that California has some of the best kelp ecologists in the world, so if we can't figure out how to do this, it can't be done," said James Ray, kelp restoration coordinator at the Department of Fish and Wildlife. "It's hard to know what the future environment is going to look like, but we're not going to go quietly into the night."

Multiple, interrelated factors led to decimation of kelp and allowed the simultaneous explosion of native purple urchins. And many studies indicate that, though the shift from kelp forest to urchin barren came rapidly, existing urchin densities mean there could be an extended period before any reversal.

Scientists nonetheless see promise in research underway that offers hope of restoring selective islands of kelp forest in the short-term — refuges that would allow for banking spores and preserving the species for the long-haul, until conditions might allow more extensive recovery.

The state of California also has assumed a more direct role in the response, including funding and project management. The Department of Fish and Wildlife and the Ocean Protection Council, a state agency, are developing a blueprint for long-term action that they hope to have finalized next year. Their interim plan, "a starting point for discussion," is an effort to assemble a variety of strategies to apply toward the problem.



Satellite images from 1985 to 2019 show a more than 95% decline of the iconic bull kelp forest along California's North Coast. A recent study demonstrates the key role in the kelp collapse played by the near extinction of the sunflower sea star, a critical predator of purple sea urchins, which since 2013 have exploded to about 60 times earlier population densities and grazed bull kelp and other plant life down to bare rock on much of the ocean floor. The bull kelp, which are annual plants, were much more resilient during earlier warm water periods, but will be challenged in their recovery this time because of the millions of urchins that now cover the ocean floor. (Meredith McPherson, U.C. Santa Cruz)

They include everything from farming bull kelp to produce genetically diverse spores for planting in the ocean, to culling and trapping the purple urchins, to captive breeding of the huge sunflower sea stars that once kept the urchins in check. All already are at various stages of development.

A Perfect Storm, And Then Some

A recent study out of UC Santa Cruz says more than 95% of the iconic bull kelp off the coasts of Sonoma and Mendocino county has vanished since 2013, reinforcing findings from scientists at the UC Davis — Bodega Marine Lab who, in 2016, described a "Perfect Storm" of environmental factors leading to the kelp forest collapse.

The ecological shift began in 2011 with a toxic algal bloom centered off Fort Ross that killed large numbers of abalone and other invertebrates.

In 2013, Sea Star Wasting Syndrome was first observed, leading to mass mortality among sea star species, most especially the huge sunflower sea star, or Pycnopodia helianthoides — fast-moving behemoths that can get as big as a trash can lid and grow up to 2 dozen arms. About 5.75 billion are estimated to have died, landing them in December on the list of critically endangered species by the International Union for Conservation of Nature.

In 2014, a marine heat wave known as "the Warm Blob" spread down the western coast of North America, suppressing the nutrient-rich, cold upwelling off the North Coast, weakening kelp. In the absence of predatory sunflower sea stars, purple urchins began to explode in number, grazing down bull kelp as the blob overlapped with a 2-year El Nino event in 2015-16 that extended warm ocean conditions.

The decimation of bull kelp and competition from urchins has killed off many Northern California red abalones, closing the $44 million recreational abalone fishery since 2018. The state Fish and Game Commission has just extended the closure until at least April 1, 2026, though recovery of the abalone stocks is expected to take far longer.

The collapse of kelp has similarly set the commercial red urchin fishery in substantial decline.

Mike Esgro, marine ecosystems manager for the Ocean Protection Council, calls that slate of steps the "restoration tool kit"

"We've got our work cut out for us, but we feel as optimistic as we could feel given the severity of the situation," Esgro said.

Marine changes spur collapse

News of the bull kelp's demise on the North Coast first made headlines in March 2016, a result of conclusions drawn by two scientists working on the Sonoma Coast out of the Bodega Marine Lab: Rogers-Bennett and Cynthia Catton, who has since moved on to work for the Department of Natural Resources in Washington state.

Based in part on aerial surveys of the kelp canopy, they estimated bull kelp along the coasts of Sonoma and Mendocino counties had declined by 93% compared with earlier, peak years, like 2008.

The cause was successive, large-scale environmental stressors that included the 2013 arrival of Sea Star Wasting Syndrome and the "Warm Blob," a marine heat wave that spread down the West Coast in 2014 and overlapped in 2015 with a two-year El Niño.

A healthy bull kelp forest as viewed off Pescadero Point in San Mateo County. (Steve Lonhart, National Oceanic and Atmospheric Administration/Monterey Bay National Marine Sanctuary)

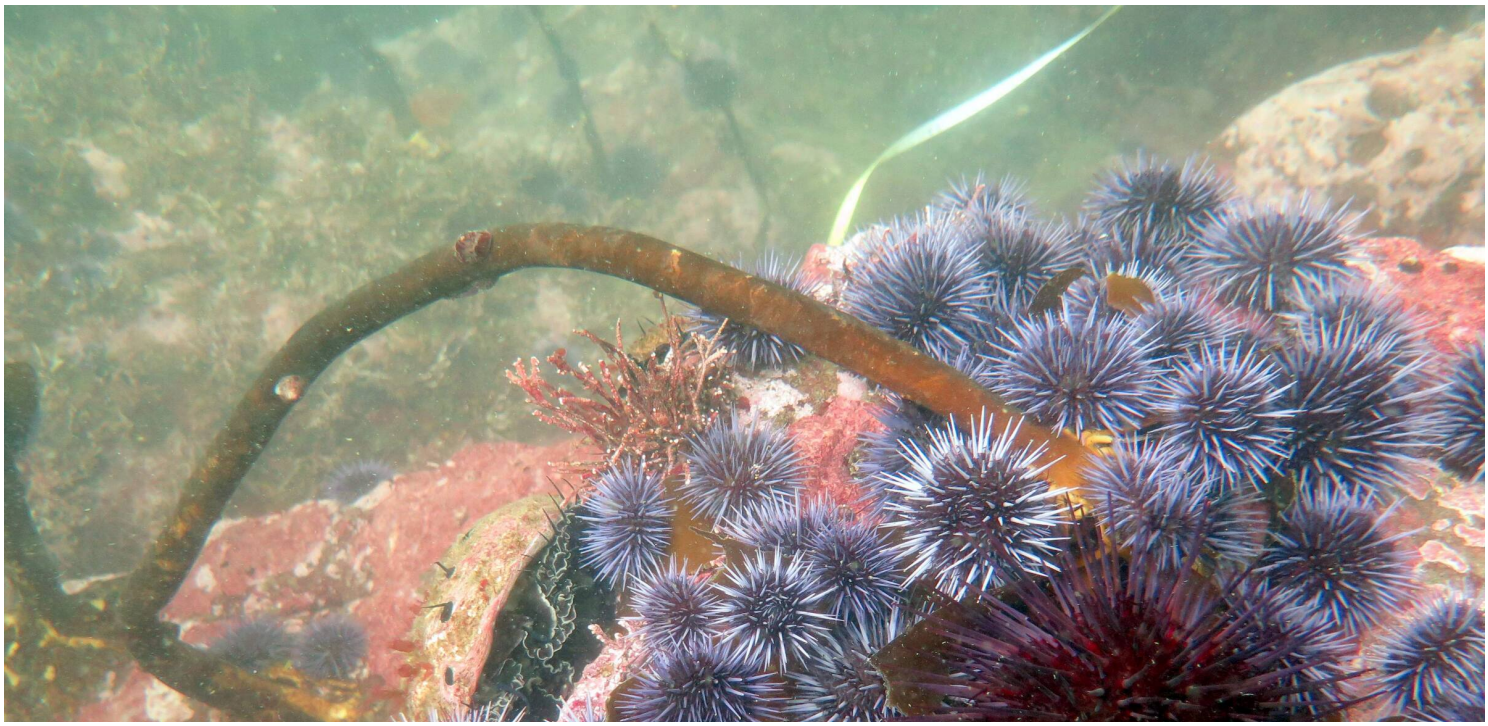
Atmospheric conditions associated with the blob suppressed the cold, nutrient-rich upwelling that had historically supported a famously productive ecosystem, weakening the bull kelp just as purple urchin densities were multiplying amid the demise of sunflower sea stars.

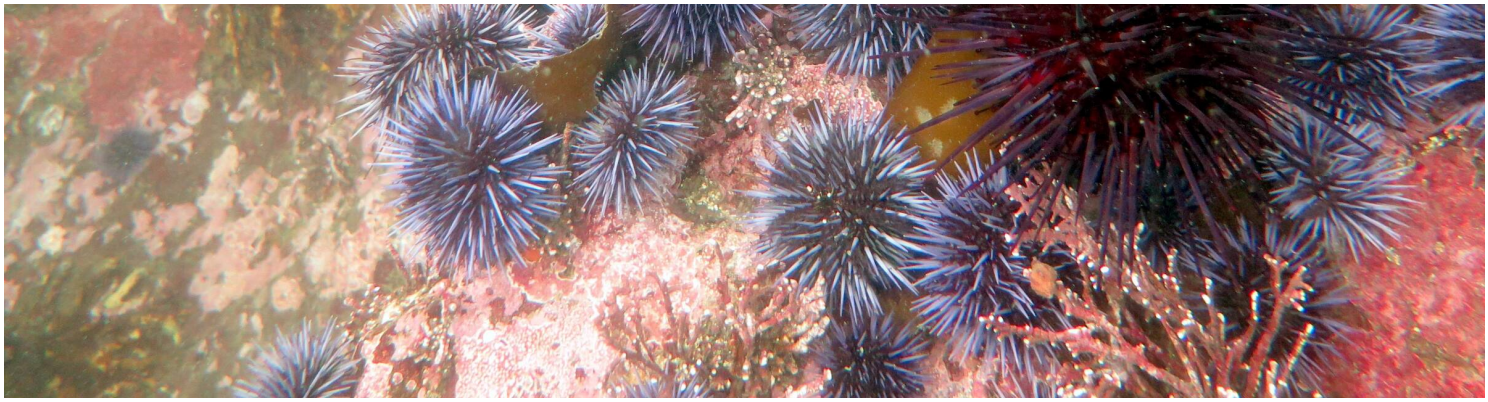
Scientists now estimate as many as 5.75 billion of the huge sea stars died, allowing purple urchins to reach numbers 60 times earlier population densities.

The result was near-complete collapse of underwater forests along more than 200 miles of coastline, as urchins consumed all the fleshy algae they could find and, exhausting that, began chewing through the rock-hard coralline algae on the seafloor.

Vast numbers of prized red abalones — the basis of a $44 million recreational fishery — withered or died, out-competed by the urchins. The commercial red urchin fishery centered off the Mendocino Coast dissipated, as well.

Abalone, said Rogers-Bennett, can handle a year without kelp, "but when you have three years or four years or, in our case, seven years of no food for them?





Large aggregations of purple urchins are wiping out kelp forests, creating pink barrens and out-competing other species such as abalone for space and food.

Rapid, vast loss of bull kelp

By 2019, the loss in coastal kelp forest was estimated above 95%, according to a recent UC Santa Cruz study that used satellite images going back to 1985. Scientists have found a few patchy areas between Timber Cove and Sea Ranch rebounded very slightly in 2020, as water temperatures cooled, Esgro said.

Over three decades, the study showed, bull kelp strength varied year to year within a certain range, but generally has been resilient to periods of marine warming in the past.

But the disappearance of the giant sea star altered the ecosystem too substantially for it to rebound naturally this time around, putting such relentless grazing pressure on marine plant life in the region that scientists suspect the canopy-forming algae will be hard-pressed to recover fully.

Unlike the giant kelp that dominates coastal waters south of Monterey Bay, bull kelp is an annual species, meaning each plant lives and dies in the same year. It grows from a root-like "holdfast" reaching 30-to-60-feet to the ocean surface. There, a buoyant, bulbous structure and many long, green blades form the canopy visible from above.

The plants need to be present year-to-year to release their spores to propagate each new generation.

The forest's rapid disappearance on the North Coast has upended the ecosystem it helps support.

Morgan Murphy-Cannella, who works with Reef Check California in Fort Bragg, and is part of an urchin-clearing project in Noyo Harbor begun last year, took her first dive off the Mendocino Coast in 2013 and recalled a 3-dimensional, underwater world that harbored diverse life throughout the water column. She swam among abalones, crabs, colorful nudibranchs and rock fish, with the kelp "towering over you," swaying in the light.

Then a recent-college grad, she left the country for a bit, and returned to an urchin barren, "like someone just cleared out the forest and rolled out a purple carpet, and that's all you could see."

"It was really sad to see, and it happened so fast."

Unusual foraging behavior near Elk in Mendocino County, a large red abalone climbs a bare kelp stalk while trying to reach fronds that are not there.

Divers enlisted in kelp campaign

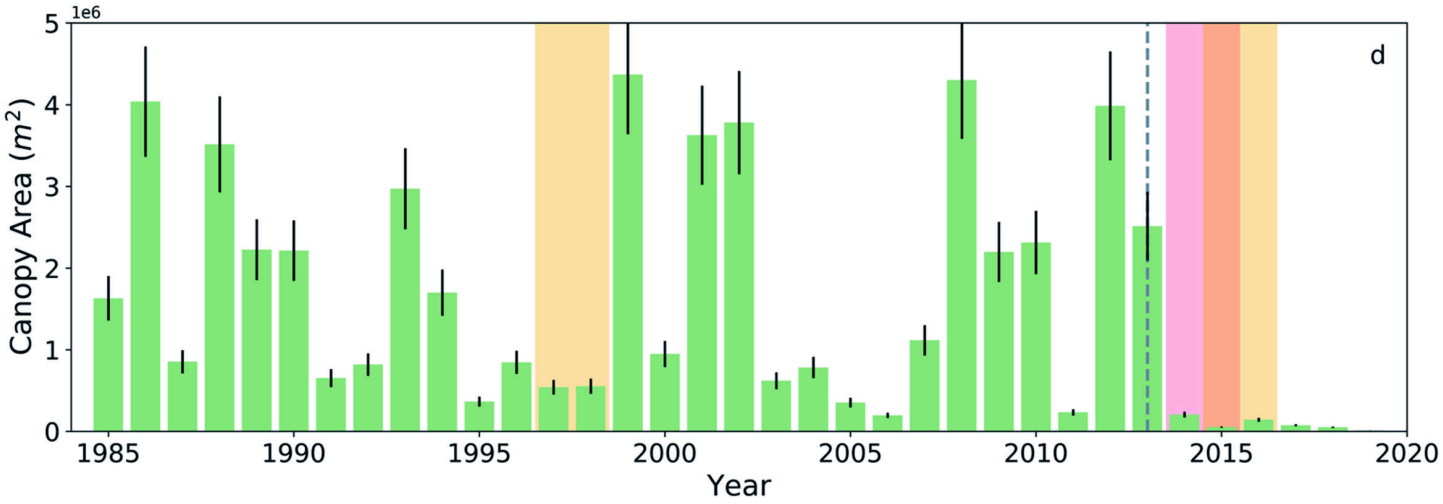
Rogers-Bennett, who holds dual appointments at Fish and Wildlife and the Bodega Marine Lab, has been integrally involved with study of both kelp-loss and sea star wasting.

She has seen no shift in local sea life more dramatic than the chain reaction that decimated bull kelp forests on the North Coast.

"For somebody who has been studying this for 20 years, it's been overwhelming to see this cascading change right before my very eyes," she said. "None of this was predictable. We had no idea this was going to happen."

Recreational divers were among the first to mobilize — members of the Watermen's Alliance, a coalition of spearfishing clubs claiming more than 1,000 members throughout California. They were devastated by suspension of the 2018 abalone season, a sport fishery rooted in North Coast traditions and one now set to remain closed through at least 2026.

They turned their frustration to ridding the ocean of purple urchins, successfully lobbying the state twice for expanded catch limits that allowed them to organize mass culling events beginning in 2018. They also have raised tens of thousands of dollars to pay commercial red urchin divers to collect the smaller purple ones, instead, harvesting them from designated areas to see if they could clear room for kelp to regrow. There has never been a viable market for "the purples," and is even less of one now, given how little they have to eat, though a few commercial divers say they are managing to sell some, while others are simply working to help restore the ecosystem.



Satellite images from 1985 to 2019 show a more than 95% decline of the iconic bull kelp forest along California's North Coast. The first shaded yellow area reflects warm ocean conditions during the 1997-'98 El Nino. Shaded pinkish-red reflects the 2014-'15 "Warm Blob." Orange from 2015 to '16 signifies the blob's overlap with another El Nino, with yellow finishing out 2015-'16 with the El Nino. The dashed line in 2013 marks the first observations of Sea Star Wasting Syndrome, which has led to the functional extinction of sunflower sea stars in Northern California. They are critical predators of purple sea urchins, which have since exploded to about 60 times earlier population densities and grazed bull kelp and other plant life down to bare rock on much of the ocean floor. (Meredith McPherson, U.C. Santa Cruz)

The state Fish and Game Commission last year also decided recreational divers could smash and kill purple urchins on site in Caspar Cove, on the Mendocino Coast, as well as on Tanker Reef in Monterey Bay.

But the coronavirus pandemic has interfered with divers' plans to travel to the coast and take advantage of the new authorization, so once restrictions are lifted, "it's going to be a lot of work" to mobilize volunteers and make up for time lost, said Watermen's Alliance President Josh Russo, a Suisun City resident.

The culling work has a solid precedent to follow. Over 27 days last summer and fall, commercial divers in Fort Bragg's Noyo Harbor scooped out more than 13 tons of purple urchins — part of a 10-acre experiment to see what it would take to clear an area to a minimum density of urchins that might allow kelp to become reestablished.

The study, conducted by ReefCheck, was underwritten by the state to formalize some earlier work done by the Watermen's Alliance and Noyo Marine Center. Participants plan to resume work there this spring, maintaining the cleared area and launching a new site in Albion, Murphy-Cannella said.

Plans also are afoot to experiment with seeding and planting bull kelp in the Noyo test site from specimens cultured in a lab. Other researchers are studying heat-tolerant strains and spore dispersal, seed-banking and genomics, site selection and optimization.

Still other scientists are examining urchin reproduction, looking to understand how the spiny creatures respond to starvation and temperature changes, as well as their entangled relationship with kelp and sea stars.

Sunflower sea stars have been successfully reared and spawned in captivity at the University of Washington, in partnership with The Nature Conservancy, though it's unclear if enough of them could be bred and successfully planted in the ocean to make a difference, said ecologist Tristin McHugh, kelp project director with The Nature Conservancy.

Prototype urchin traps are being developed and permitted right now, as well, that could be tested this spring, McHugh said.

"There has been so much momentum in understanding kelp restoration and what it means to lose kelp," she said. "If I had told myself two years ago this is where we'd be, I wouldn't believe it."

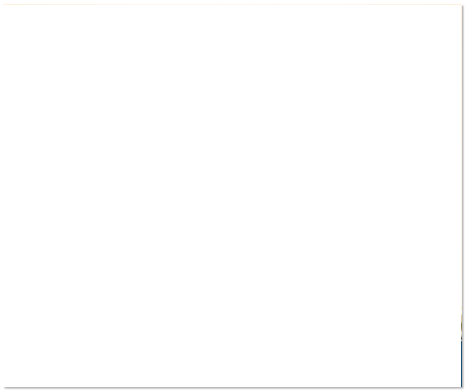
Chelsea Furr, 13, and her father Dan Furr with Eddie Kennedy of Woodland, relax after snorkeling in Gerstle Cove on the Sonoma coast at Salt Point, Saturday, March 13, 2021. Very little bull kelp remains in the cove, (Kent Porter / The Press Democrat) 2021

Local work, global importance

Still, many questions remain about the cost and logistical feasibility of existing proposals, as well as certain ethical considerations about human intervention in marine ecosystems, McHugh said.

Over the past two years, $3 million has been invested in research projects that included the Noyo Harbor culling, which required 49 individual boat days and covered just 10 acres. What would it cost to scale that up to a network of oases large and diverse enough to ensure survival of the species?

And even if it's determined sunflower sea stars can be bred and reintroduced to the natural environment, there may be reasons not to interfere, McHugh said.



"How do you do this," she said, in a way "that's cost effective and ethical?"

The hope, though, is to establish models that might address kelp loss around the planet, most of it recent and presenting the same questions and unknowns as are occurring here, Ray said. In a warming world, it's not just about restoring the status quo but about managing kelp forests for resilience, he said.

"Ideally, you are able to intervene as early as possible, but at the same time, it's sort of a question again of understanding when and where to intervene, with what tools?" he said. "There' no model for this. Kelp has been lost all over the world, but it's all been relatively recent, and as of yet, nobody has a better plan or response system set up, and they're all dealing with sort of the same questions that we're dealing with, like, 'What is the best response? Where do we put our limited dollars to make this work?' "

Rogers-Bennett, who has been at the forefront of efforts to save the white abalone, a species on the brink of extinction, said she worries that the overall urgency and investment in the bull kelp collapse needs to be greater to match the scope of the problem.

"What we're not seeing is that quick response, those resources to respond to this disaster," she said.

"I think if it happened on land with redwoods, I think we would see a lot more response. But it's sort of out of sight, out of mind, so it's harder to get people to recognize just what a huge impact this is."

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Mary Callahan

Environment and Climate Change, The Press Democrat

I am in awe of the breathtaking nature here in Sonoma County and am so grateful to live in this spectacular region we call home. I am amazed, too, by the expertise in our community and by the commitment to protecting the land, its waterways, its wildlife and its residents. My goal is to improve understanding of the issues, to find hope and to help all of us navigate the future of our environment.

When it comes to the environment in Sonoma County, what are you concerned or wondering about? Do you have solutions to share? Submit your thoughts below to help us craft our reporting in the region.

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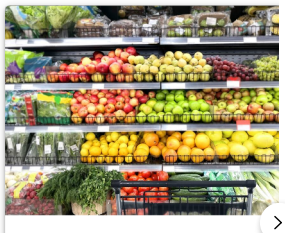

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