

Kelp is disappearing from parts of the West Coast. These scientists are trying to save it

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Climate

Marine heat waves are a prime reason the giant underwater forests are at risk



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Sunlight shines through bull kelp near Port McNeill, B.C., on northern Vancouver Island. While this kelp forest remains healthy, others on the West Coast have been disappearing due to marine heat waves and other stressors. (Jackie Hildering)



Early in Chris Neufeld's scientific career, he studied creatures that depend on the kelp forests of the wild West Coast: native snails, invasive crabs and the barnacle's legendary penis.

The kelp itself was "really just the backdrop," floating at the surface in photos of his fieldwork, he said.

Until it started disappearing.

"Since 2016, that kelp forest that's in the background of the photo I often show is gone," said Neufeld, a research scientist at the Bamfield Marine Sciences Centre in Barkley Sound on Vancouver Island where he's now project lead on the Kelp Rescue Initiative.

The problem is bigger than one kelp bed, or even one coast. Marine heat waves — including the longest ever recorded, nicknamed "the Blob," which heated up the northeast Pacific from 2014 to 2016 — are making it harder for cold-water-loving kelp to survive, with major losses documented from California to Australia.

A recent study by Neufeld and colleagues published in Ecological Applications looked at giant kelp and bull kelp forests in Barkley Sound that had been stable for at least four decades. Since the Blob, they found 40 per cent of those kelp beds have gone "locally extinct" — and not grown back.

"It's been really hard to see these things happening within our lifetimes," Neufeld said.



A before-and-after view of a bull kelp bed in Barkley Sound, B.C. The dark circles in the top image are the bulbs of bull kelp. Research by Sam Starko, Chris Neufeld and colleagues showed 40 per cent of the kelp beds they surveyed disappeared during the marine heat wave known as 'the Blob.' (Sam Starko)

Far from a backdrop, kelp forests provide shelter and food for dozens of species, including iconic ambassadors of marine life like whales and sea otters. Salmon hide from predators among the fronds; herring lay their eggs. Where kelp has disappeared, important fisheries like abalone have collapsed.

Last week, the chair of the Intergovernmental Panel on Climate Change, Hoesung Lee, spoke about the "high risk" to kelp forests of "irreversible phase shifts" and biodiversity loss as global warming makes marine heat waves more frequent and intense.

The Kelp Rescue Initiative is among the groups studying what we can do now to help the kelp — especially as people look to the algae as a possible ally against carbon emissions.

An undersea cathedral

Not everyone shares the passion for the brown, slippery fronds that sometimes wash up on shore.

But look below the surface, where the giant canopy-forming kelps tower in cold, dark water, and there's an undersea forest that's full of life that, for divers like Jackie Hildering, inspires awe.

"You are truly in this otherworldly place," said Hildering, co-founder of the Marine Education and Research Society in Port McNeill on Vancouver Island.



Go underwater, and kelp forests create what marine educator Jackie Hildering describes as an 'otherworldly place,' inspiring awe. (Jackie Hildering)

"It's the equivalent of a church or cathedral in the sense of the largeness and importance it has."

Historically, kelp has dominated about a quarter of coastlines worldwide, creating biodiversity hot spots and buffering land from storms. Limpets and crabs graze on the kelp while seals play between the waving fronds.

"It is just truly a forest with layer upon layer of life in it," Hildering said.

So it's been with alarm that biologists are documenting locations with rapid, recent decline.



A school of baby salmon swim through a forest of bull kelp. Kelp forests provide shelter for fish, and herring lay their eggs on the kelp's leaf-like blades. (Fernando Lessa)

What's hurting kelp

The world's oceans are seeing both gradual warming and more extreme and frequent "marine heat waves" — a term that only showed up in the scientific literature in the 2010s.

Julia Baum, a marine ecologist and professor at the University of Victoria, describes marine heat waves as a "knockout punch" for coastal ecosystems.

In Barkley Sound, the recent study found most kelp was wiped out in warmer inshore waters, where surface temperatures reaching 22 C were logged — some five degrees hotter than anything recorded on the outer coast.

Kelp starts to die when surface temperatures hit 18 or 20 C, said Neufeld, who is also an adjunct professor at the University of B.C. Okanagan.

"Those heat waves directly threaten kelp forests by just making the water too hot."



Billions of sunflower stars died from sea star wasting disease over the last decade, all but wiping out the renowned predator. Warming waters are believed to have made that worse. (Donna Gibbs/Vancouver Aquarium in Schultz et al. 2016)

There are also indirect effects. During the marine 2014-2016 heat wave, the West Coast saw mass die-offs of sea stars — including about 90 per cent of sunflower stars, a strong predator. They eat sea urchins, which in turn eat kelp.

If there are other urchin predators, like sea otters, that's less of a problem; where Hilderling lives, she says kelp seems to be doing fine or even increasing in places.

But without those predators, the urchins take over — mowing down kelp forests to create what are known as "sea urchin barrens."



Where there are no predators, like sunflower stars or sea otters, to prey on sea urchins, they eat through kelp forests — creating what are known as 'urchin barrens.' It's difficult for kelp to re-establish where these herbivores cover the ocean floor. (Fernando Lessa)

In California, this combination led to the loss of more than 90 per cent of the bull kelp from 300 kilometres of coastline in one year — 2014 — according to a study in Nature's Scientific Reports.

Satellite images show some rebound since 2020, and a small-scale effort to remove urchins has shown promise. But the forests are still nowhere near the pre-heat wave abundance.

'Future-proofing' kelp

Watching the kelp disappear from places in B.C., Neufeld and other researchers teamed up to launch the Kelp Rescue Initiative last year, backed by philanthropist Jonathan Page and a consortium of five western Canadian universities out of Bamfield.

They want to figure out what kind of restoration is likely to succeed in the reality of warmer waters — something Baum, a scientific adviser to the initiative, calls "future-proofing kelp."

"We can't just, you know, start farming kelp in areas where it disappeared. If the reason it disappeared was climate change, then we're likely going to have the same outcome."

Part of that work means travelling the coast of Vancouver Island, often with local First Nations guardians or guides, on what Neufeld calls a "treasure hunt" to find kelp forests that still exist.



Sam Starko, a marine biologist and post-doctoral fellow at the University of Western Australia, gathers kelp blades in Barkley Sound, B.C., as part of the research he co-authored on how kelp fared during 'the Blob' marine heat wave. (Chris Neufeld)

On boats or even paddleboards, researchers are gathering fronds and packing them in silica for sequencing and genetic analysis at the University of Victoria, with more than 800 samples collected so far.

"The goal there is to really understand the patterns of genetic diversity," said Neufeld.

Some kelp beds are dwindling, down to 50 or 100 individuals, said Neufeld, and may soon disappear — so the researchers are preserving that diversity for now in a "biobank" at Simon Fraser University.

Other kelp beds seem to be doing well, and those may hold natural genetic variation that will be useful in future restoration work.

"Which kelp forests ... harbour important genetic diversity in resisting future heat waves or resisting predation by sea urchins?"



Chris Neufeld, seen among intertidal kelps, is project lead on the Kelp Rescue Initiative and a research scientist at the Bamfield Marine Sciences Centre in Barkley Sound, B.C. After watching kelp beds disappear near Vancouver Island during the marine heat wave, he is researching how to restore the important ecosystems. (Goya Ngan)

The blue carbon question

Just as warmer waters make it tougher for kelp to survive in temperate latitudes, enthusiasm has been brewing about whether kelp itself could help with climate change.

The Intergovernmental Panel on Climate Change (IPCC) recognizes other coastal vegetation — tidal marshes, sea grasses and mangroves — as "blue carbon" ecosystems. In other words, places that could be considered climate change mitigators in themselves, able to store what the IPCC estimates would be 0.5 per cent of global emissions annually.

Kelp is not on that list, despite scientific analyses showing it can sequester carbon and what's been described as a "global push" to get kelp restoration and farming recognized as a form of carbon offsetting.



A healthy giant kelp forest in Barkley Sound seen from above. Kelp covers an estimated quarter of the world's coastlines, but is being threatened by warming waters in temperate latitudes. (Fernando Lessa)

"There's a lot of excitement right now about the potential for kelp to be a form of blue carbon," Baum said.

"As scientists, we want to ensure that ... something is not being promoted as a climate solution that actually doesn't hold up."

(While kelp definitely sucks up carbon as it photosynthesizes, and grows quickly, the debate is essentially about how effectively the algae stores it. Kelp isn't long-lived like an old-growth stand of trees, so when it dies, there are questions about how much ends up sinking to the deep ocean or another carbon store, versus, say, rotting on the beach.)

Baum is leading a project called Blue Carbon Canada to figure out what kind of potential the ecosystems on Canada's three coasts, which form the longest coastline in the world, have to absorb greenhouse gas emissions. That includes seagrass, salt marshes and exploring what role kelp may play.

"We desperately need to be mitigating climate change," said Baum. "We need to understand all the different ways that we can do that."

Wherever the carbon analysis lands, the importance of kelp forests — and their precarity — is already established.

"There's a need for urgent action," said Neufeld. "To me, there's such a strength in being able to focus all [our efforts] on solutions."



Fronds of giant kelp float on the surface of an inlet in Barkley Sound, B.C. (Chris Neufeld)

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