

OCEAN STORYTELLING

WRITING GRANT

2022

F I N A L I S T S

Finalist – Elyse De Franco

The light under the old wharf is dim, and the sound of barking sea lions fills the salty air. It's high tide, and water surges around Art Seavey's feet as he tends to his abalone farm, which not too long ago was imperilled by a devastating bacterial infection.

'The abalone would go off feed – and just start to wither,' said Seavey, co-owner of the Monterey Abalone Company. 'And basically once they started withering, it was over.'

Now, two years into a viral pandemic that is plaguing humankind, West Coast scientists are hailing a different kind of virus, one that's helping to protect California's beloved abalone. The little-known virus is shielding the giant sea snails from a deadly pathogen that has threatened their populations up and down the California coast.

'There are some viruses that are good,' said Steffanie Strathdee, co-director of the Center for Innovative Phage Applications and Therapeutics at the UC San Diego School of Medicine. 'You know, sometimes the enemy of my enemy is my friend.'

How a virus became an unexpected ally in the quest to save California's abalone is an intriguing tale – one that captivates scientists as they unravel the mysteries of the natural world.

For millennia, the Golden State's coastline has been home to some of the richest abalone diversity in the world, with seven native species that read like a rainbow: red, green, pink, flat, white, black and pinto. Indigenous people treasured them as an important food source and used their shimmering shells to adorn ceremonial clothing.

Abalone populations exploded after California's sea otters – the mollusks' main predators – were hunted to near extinction by European and Russian settlers in the 18th and 19th centuries.

A thriving commercial fishery emerged. Abalone diving turned into a favourite California pastime as the shellfish became the state's equivalent of Maine's famed lobster. Abalone became renowned for its sweet, delicate flavour and was typically saturated with butter and garlic like a large escargot.

The frenzy for abalone meat, however, nearly depleted all seven species by the mid-1970s, when federal and state agencies stepped in to save the few remaining abalone by restricting harvesting.

A decade later a new threat emerged. Scientists noticed that black abalone in the Channel Islands were shriveling up and dying at a rapid rate. Researchers named the phenomenon Withering Syndrome and identified the culprit as a bacterium that infects the digestive lining of abalone, crippling their ability to absorb food.

The disease quickly spread up the coast, reaching as far north as Bodega Bay. Wherever abalone were found, the bacterium followed.

When the warm waters of the 1997/98 El Niño hit, Withering Syndrome surged.

‘Normally there was a low percentage of animals with clinical signs of disease, around 10 to 20 per cent,’ but during the El Niño ‘almost 70 per cent of the black abalone in the field had clinical signs of disease,’ said Carolyn Friedman, a specialist in marine infectious diseases at the University of Washington who investigated the syndrome.

Not only wild abalone suffered. Abalone farms throughout California watched as their animals, carefully raised for years, perished.

‘The abalone would become weak and fall off and starve to death,’ said Doug Bush, an aquaculture specialist at The Cultured Abalone farm in Goleta. ‘We were just bucketing dead abalone out of here.’

Then about 15 years ago, as suddenly as the disease appeared, another mystery began confounding scientists.

‘An abalone farmer sent me some samples and when I looked at them under the microscope, it seemed like the bacteria were dying,’ said Jim Moore, the now-retired head of the California Department of Fish and Wildlife’s Shellfish Health Laboratory at the Bodega Marine Lab. ‘I called him up and said, “Hey, you must have sent me a sample that you treated with antibiotics.” And he said no, and I thought that was really strange.’

At the same time, Friedman was noticing changes in wild black abalone around the Monterey Peninsula. Using electron microscopy techniques, she found a bacteriophage hijacking the pathogen.

‘I thought it was really interesting and kind of exciting that you have this hyperparasite, a parasite of a parasite,’ Friedman said of her discovery. ‘It’s sort of thought of as a natural therapy.’

Scientists found that the virus infects about 60 per cent of an abalone’s Withering Syndrome bacteria, turning them into little bacteriophage factories. But little more was known, and they weren’t sure whether abalone would continue to die from the bacterial infection when stressed by warmer waters.

It wasn’t until years later when another marine heatwave hit between 2013 and 2016 that the protective effect became clear. Abalone farmers found that the problem of Withering Syndrome virtually disappeared thanks to the virus.

‘We don’t view Withering Syndrome with the same lens as before – as an existential threat to the future of our business,’ Bush said.

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Beyond aiding abalone farms, the virus could also help wild abalone populations recover and survive in the coming years, particularly as climate change raises ocean temperatures.

‘This is really good news for most abalone species,’ said Kristin Aquilino, who raises white abalone at the Bodega Marine Laboratory to replenish wild populations.

Abalone continue to face a number of obstacles, including a devastating loss of their kelp forest habitat. White and black abalone are still listed as endangered, and there are still so few abalone left in the wild that it’s difficult for them to successfully reproduce.

But for now, the virus is keeping the once-deadly bacterial pathogen at bay. ‘There are plenty of other issues,’ said Seavey, the Monterey abalone farmer. ‘But that one has really gotten a lot easier to deal with.’