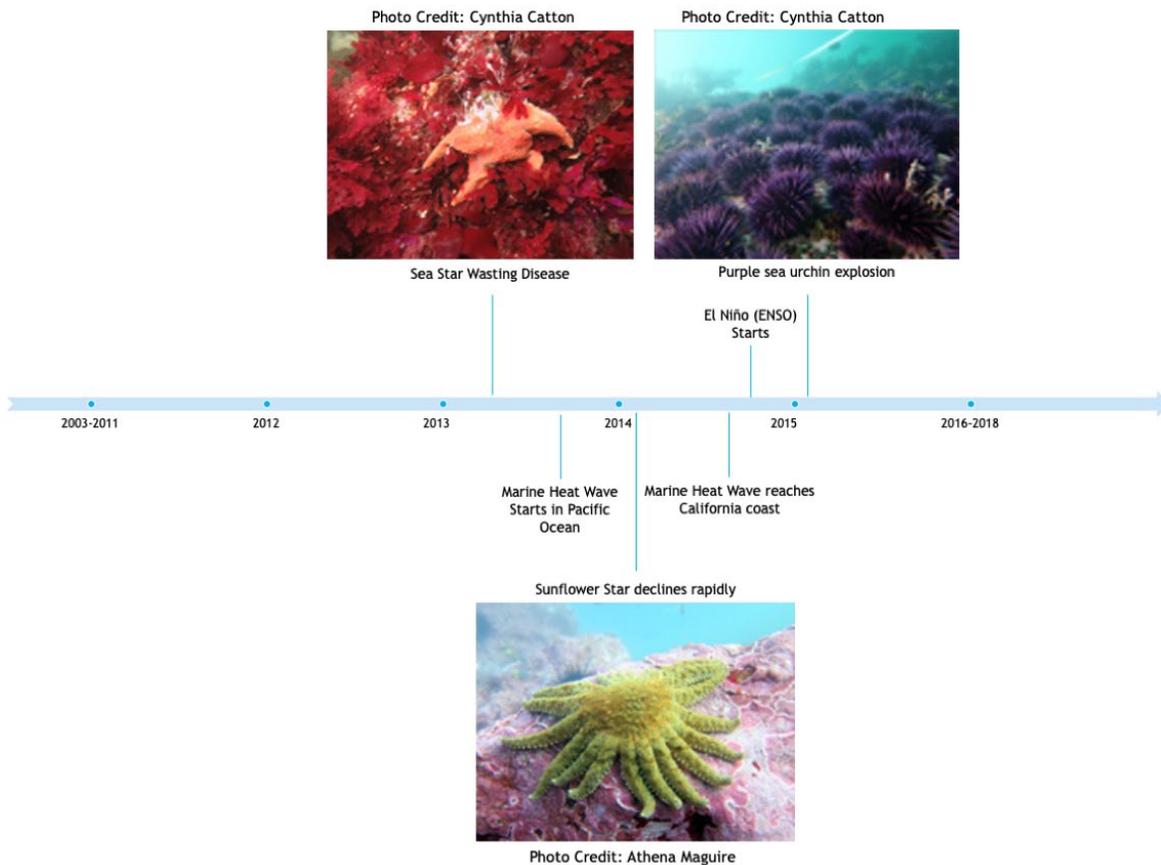


## Falling Stars and Rising Sea Urchin Spells Kelp Forest Disaster for Northern California

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California has been experiencing a cascade of ecological disasters, but they have gone undetected because they are happening underwater and out of sight. Starting in 2013, sea stars got sick and started to melt away suffering from sea star wasting syndrome. After that, a godzilla of a marine heat wave started in 2014 immediately followed by a warm water El Niño (ENSO) in 2015. We are currently facing an unprecedented decline in sea stars and rise in purple sea urchins but what exactly happened? How many sunflower stars and purple sea urchins do we have in the north? And when did these events occur? The answers to these questions might help us craft management solutions to these catastrophic underwater environmental conditions to help bring our lush northern California bull kelp forests back from the brink. Luckily, the California Department of Fish and Wildlife in collaboration with UC Davis' Bodega Marine Lab and Coastal Marine Science Institute have been monitoring kelp forests since 2003 so these data can help to answer some of these critical questions.

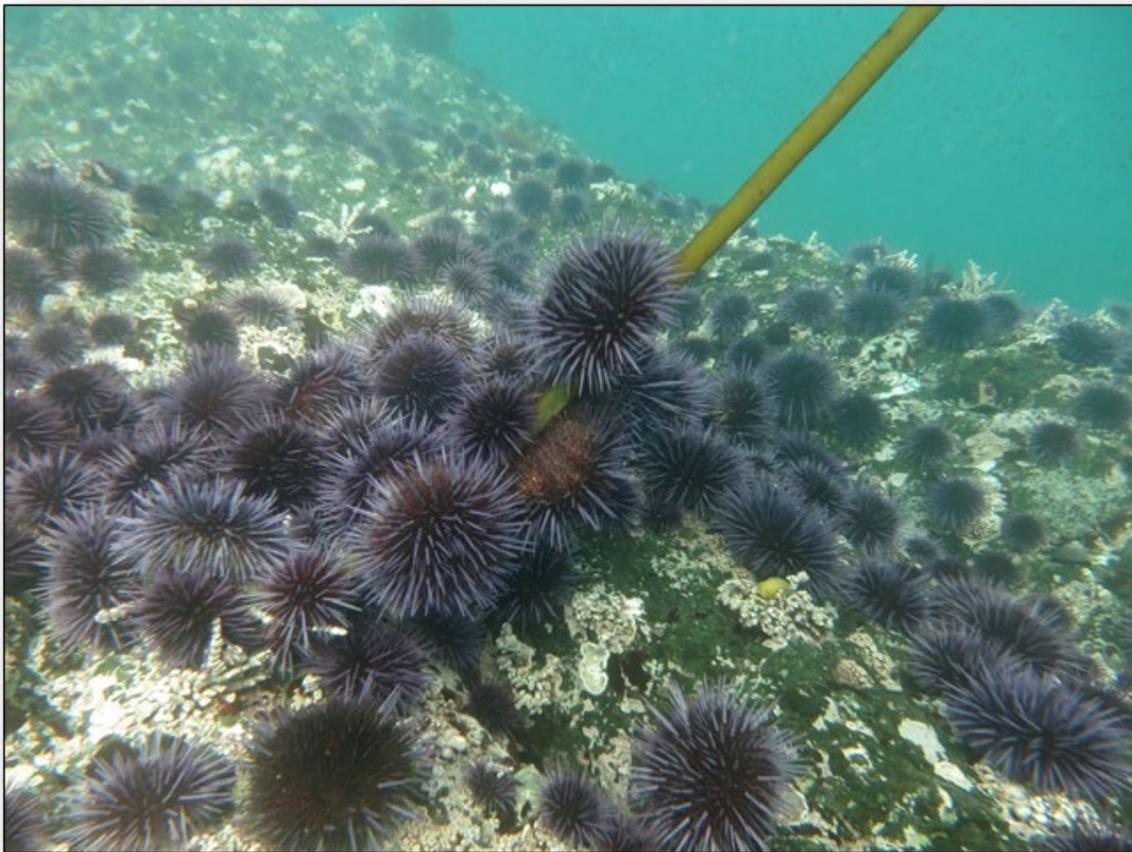


Timeline from 2003-2018 showing climatic conditions and biological responses in northern California.

Sea stars are an important ecosystem predator that may help to control sea urchin populations. Like a puzzle piece, as the sea stars began to decline, the sea urchin filled in their place perfectly and started to grow rapidly. From these data we see that numbers of purple and red sea urchin have decimated kelp forests by eating kelp at the base. Like trees, kelp provide the food and habitat for many other species and is the foundation of the coastal ecosystem. Purple sea urchin numbers in 2016 have increased 50x since their numbers in 2014. What does this mean? Well, the impact of purple sea urchin would be similar to three billion beavers mowing a dense forest down to rocks, going from no damage in 2014 to complete loss in just a few years in 2016. These once forested coastal underwater areas in northern California are now considered urchin barren and void of any lush canopy. After the kelp forests were eaten all that

remains is a carpet of sea urchins that dominate the ocean floor in northern California. The sea urchins have now adopted a more sedentary lifestyle to feed on hard crustose coralline algae and dissolved organics. Their adaptive abilities to switch their diet is impressive, but what is even more outstanding is their ability to still reproduce in such food limited conditions!

Recruitment module surveys conducted at Van Damme State Park from 2001-2019 not only show the presence of lots of adult sea urchins but also baby sea urchins (<0.8 inches), and the monitoring data show that their numbers increased in 2015 and are still high.



Purple sea urchin eating the base of a kelp plant (Photo Credit: Katie Sowul/ California Department of Fish and Wildlife).

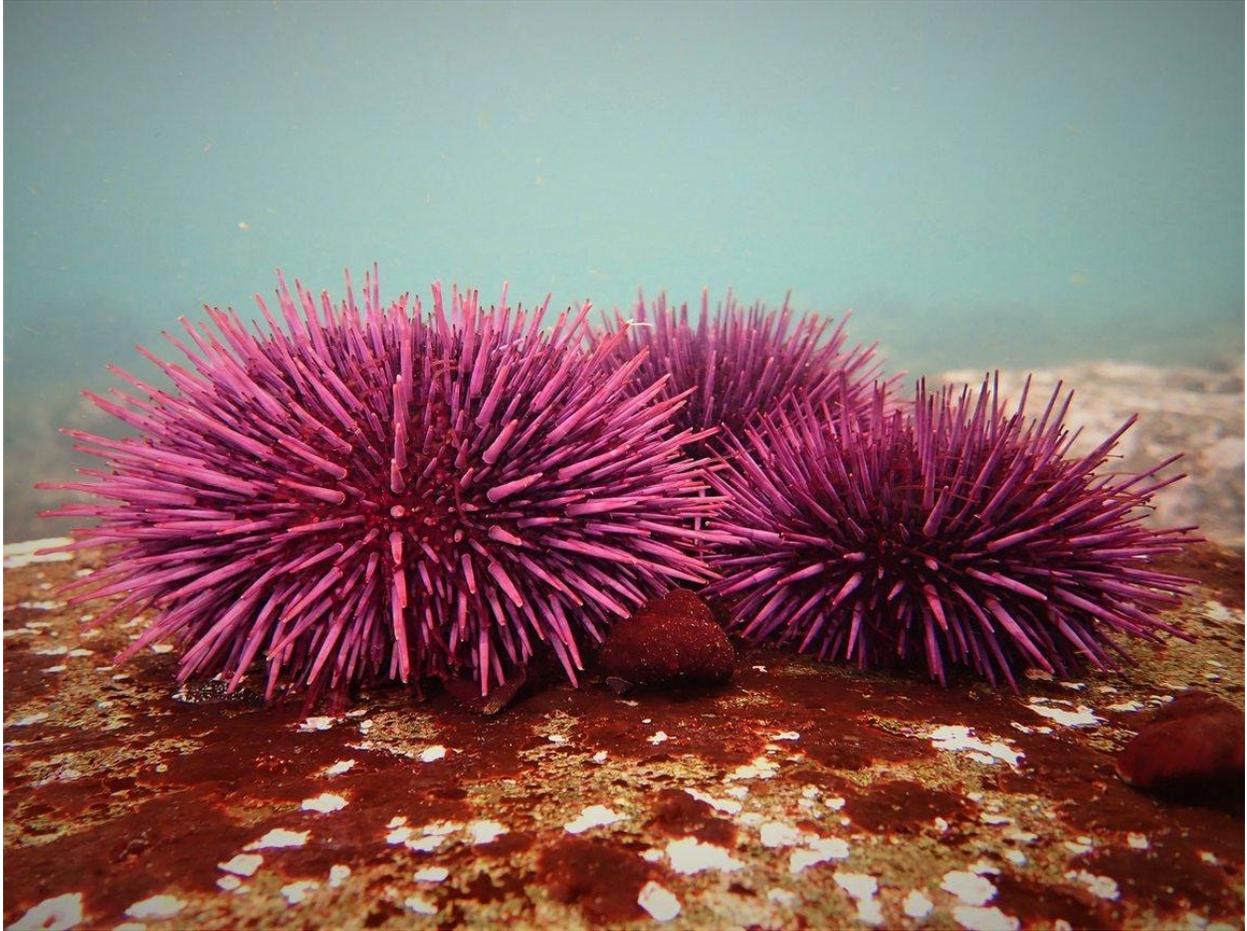
It seems like purple sea urchin are here to stay and with their numbers estimated to be in the billions, yes we estimate more than 3 billion in 2018, action is urgently needed to reduce

their abundances and rebuild the kelp forests. Kelp forests are struggling to rebound from the Marine Heat Wave in 2014, and the billions of sea urchins the smallest stages of the kelp are eaten before they can grow and reproduce. In northern California, The Marine Sanctuary Program has drafted a Bull Kelp Recovery Plan (<https://oceanservice.noaa.gov/ocean/sanctuaries/>) and non-profits like the Noyo Science Center in Mendocino County have set up a Help The Kelp Program (<https://noyocenter.org/help-the-kelp/>).

Recreational sea urchin fishing is one way that communities can help with controlling population growth. The CDFW has just set up a few target locations for recreational sea urchin removal in northern California such as Caspar Cove in Mendocino County. Likewise, commercial divers are working hard to address this problem and were some of the first ones to sound the alarm, but since sea urchins are starving, their gonads are worthless to the commercial markets. One idea being implemented is to collect live empty sea urchins and fatten them up for market sale. This method is called “urchin ranching” and is being piloted by a company called Urchinomics (<https://www.urchinomics.com/>) and shows promise for creating yummy sustainable sea urchin seafood products. Making it commercially feasible to fish high numbers of purple sea urchins might give patches of kelp in coves that people protect the chance they need to come back. By working together we maybe able to creat a network of healthy kelp covered coves that can keep the kelps going until the rest of the ecosystem turns around and the sea urchin numbers decline. Get Involved!

These ecological disasters, that were once out of sight, are now rising to the surface and the action to eradicate the sea urchin growth is needed. With purple sea urchin populations increasing 50 times in number in just a matter of years, it makes you wonder; how far will their number increase? We are above three billion purple sea urchins now, but what will it look like in another three years; will it be another 50-fold increase, or perhaps 100-fold? Will the kelp forests ever be able to grow back? To find the answers to these questions, we must start with

controlling purple urchin populations first and foremost. With new companies and projects on the horizon, we may once again get our underwater forest back.



Three purple sea urchin (Photo Credit: Katie Sowul/ California Department of Fish and Wildlife).