

Dungeness crab fishing industry adapts to climate shock event

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An unprecedented marine heat wave that led to a massive harmful algal bloom and a lengthy closure of the West Coast Dungeness crab fishery significantly altered the use of ocean resources across seven California crab-fishing communities.

The delayed opening of the 2015-16 crab-fishing season followed the 2014-16 North Pacific marine heat wave and subsequent algal bloom. The bloom produced high levels of the biotoxin domoic acid, which can accumulate in crabs and render them hazardous for human consumption.

That event, which is considered a “climate shock” because of its severity and impact, tested the resilience of California’s fishing communities, researchers from Oregon State University, the University of Washington and National Oceanic and Atmospheric Administration’s Northwest Fisheries Science Center found.

The study is the first to examine impacts from such delays across fisheries, providing insight into the response by the affected fishing communities, said James Watson, one of the study’s co-authors and an

assistant professor in OSU's College of Earth, Ocean, and Atmospheric Sciences.

When the Dungeness season was delayed, roughly two-thirds of all vessels stopped fishing temporarily while others switched to different fisheries or moved to more favorable locations.

Understanding these impacts and adaptations is critical because the fishing industry is expected to be tested further in the future as the climate warms and climate shock events increase in frequency and intensity, said Watson, who specializes in marine social-ecological systems and understanding complex adaptive systems.

"This work is really about understanding how fishing communities can adapt to climate change," he said. "We found that West Coast fisheries are highly adaptive. Generally, they can take a hit and bounce back, though some communities are more resilient than others."

The findings were published this week by the Proceedings of the National Academy of Sciences. The study's lead author is Mary C. Fisher, who did the work as a research scientist at the Northwest Fisheries Science Center and is now a doctoral student at the University of Washington. Fisher was supported by a National Science Foundation Graduate Research Internship fellowship. Additional co-authors are Stephanie Moore and Jamael Samhouri of NOAA's Northwest Fisheries Science Center and Sunny Jardine of the University of Washington.

The Dungeness crab fishery is vital to many West Coast communities; it accounts for about 26 percent of all fishery revenue in California and supports more than a quarter of all commercial fishing vessels.

To better understand the industry's resilience and adaptability to adversity, the researchers studied the impacts of the marine heat wave and harmful algal bloom on more than 2,500 fishing vessels across seven fishing communities along the California coast, from Crescent City to Morro Bay.

"We wanted to examine the extent to which the Dungeness crab fishery delays affected participation in other fisheries and the duration of those changes," Fisher said.

The researchers found that 71 percent of the California Dungeness crab fishing vessels stopped fishing all together during the season delay. The remainder either moved to locations unaffected by the delay or switched to other types of fishing. Larger vessels fared better during the closures because they were able to more easily travel to new locations.

Fisheries in Central California were more resilient to the closure in part because they had shorter delays and were generally less dependent on Dungeness crab. The fishermen in those communities were typically more flexible in how they fished prior to the 2015-16 season, giving them more options during the closure period.

Vessels in northern California are potentially more prone to falling into a "gilded trap" for Dungeness crab, meaning their deep commitment to Dungeness crab fishing may make it harder for them to adapt if needed to other types of fishing, Watson said.

The delayed opening of the 2015-16 commercial Dungeness season had a significant economic impact on Dungeness crab fishermen and their communities, with the average catch at about 52 percent of the average

over the previous five years.

The researchers did not observe any significant, lasting changes to the Dungeness crab fishing community after the closures were lifted, suggesting that fishing community may mostly return to “normal” fishing practices relatively quickly after a short-term disturbance such as a climate shock.

The most resilient fishermen in the industry leverage strong networks of contacts in different fisheries and have the skills and equipment to fish for different species, Watson said.

“What we don’t know is if there is a tipping point, at which fishing communities can no longer adapt or bounce back,” Watson said. “If they get hit again and again, at what point do they permanently change or leave the industry?”