

# Heavy rain altering SF Bay's salinity, threatening wild California oysters

By **GRETCHEN LANG**

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This winter's robust rainfall has filled California's rivers and reservoirs to bursting and sent millions of cubic feet of freshwater pouring into San Francisco Bay. While that's good news for ending the state's drought, scientists say it's bad news for marine creatures, such as wild oysters, that need a salty bay to survive.

With saline levels at unprecedented lows, scientists at the Romberg Tiburon Center for Environmental Studies, who have been studying native Olympia oyster populations in Richardson Bay and at San Rafael's China Camp State Park, are expecting the worst.

"I would expect that most oysters have likely perished at China Camp State Park, but we won't know for certain until we get out there for surveys this upcoming spring," says biologist Brian Cheng. Cheng is a postdoctoral fellow at the Smithsonian Environmental Research Center, and he is lead author of a recently published paper on the effects of freshwater on oysters at the state park.

Olympia oysters have been a vital part of the bay ecosystem for thousands of years. They filter toxins from bay water and help build reefs that can protect the shoreline from erosion and sea-level rise. Native oyster populations have faced numerous challenges over the years, from ravenous gold miners who stripped them from the shoreline to Gold Rush mining sediment that clogged the bay to more modern-day pollution. Various government and environmental groups have dedicated themselves to the oysters' restoration.

"Native oysters are a part of what makes this region unique," says ecologist Andy Chang, program leader for the Smithsonian research center's Marine Invasions Lab at Romberg. "There's been a lot of interest in conserving and restoring the oyster population."

Only a few years back, China Camp was home to the largest Olympia oyster colony from Mexico to Alaska, Chang says. At one point, scientists counted 180 oysters per square foot.

Then came winter 2010-2011. That season brought many heavy downpours from the type of storm known as an atmospheric river, or "pineapple express." These storms tend to bring days of heavy rain. When scientists went out to survey their field site at China Camp in spring 2011, they found nearly every oyster had died.

Smithsonian scientists, along with researchers from the National Estuarine Research Reserve at the Romberg center, analyzed water samples from the site and discovered the storms correlated with very low saline levels, no doubt caused by huge amounts of freshwater running into the bay.

Earlier laboratory experiments had already shown that oysters cannot survive in water with a saline level below 6 parts per square unit.

Oysters confronted with freshwater will try to clamp their shells shut and keep the water out, Chang says. But with their shells shut, they can't eat, breathe or expel waste.

"They can hold their breath for about eight days," he says, "but they can't hold on much longer than that."

The scientists published their research last fall in *Proceedings of the Royal Society B*, a biology research journal.

"This mass die-off of native oysters coincided with a series of atmospheric rivers and the resulting long period of low salinity at China Camp," wrote Anna Deck, a biologist with the Estuarine Research Reserve, in a summary of their findings. "This research shows the biological impacts of atmospheric rivers on natural ecosystems."

The China Camp colony had slowly recovered over the past six dry years, but water samples taken there this

January and at another colony site off Strawberry's Brickyard Park don't bode well for the native oyster populations there. At the Strawberry site, the surface water salinity was measured at only 2.5 parts per square unit.

"We have seen two extended periods of low salinity in January," Deck says. "We can't say what's going to happen, but it's not looking good for the oysters."

Other species that might be affected by the freshwater in the bay this year include sponges, barnacles, anemones and mussels, Chang says.

Scientists say that even if the North Bay populations crash, there is hope that native oysters in other parts of the bay, especially the South Bay where there is less freshwater inflow, might survive and help to recolonize the sites in the North Bay. Oyster larvae can travel long distances in the water to new sites, but this could take years and there are no guarantees, they say.

While the native oyster populations might rebound in the short term, the outlook for the species' long-term survival is far from clear, scientists say.

Climatologists predict an increasing number of atmospheric-river-type storms as the planet continues to warm, bringing heavy rain and low bay salinity. More frequent storms means oysters may have less time to rebuild their colonies, scientists say.

"In one sense, oysters have evolved to live with that cycle of wet and dry. It's something that the population could be expected to live with," Chang says. "But what we are now changing is the frequency of (these storms), how often they occur. The key is how much time will the oysters have in between to recover."

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