



Why California Needs to Strengthen Marine Aquaculture to Endure Climate Change

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Half of all seafood is farmed. Currently, one out of every five U.S. fish catches are products of *marine aquaculture* — a term about this kind of farming, the growing and harvesting of edible sea life like shellfish and seaweed. Aquaculture takes place in both land-based and ocean water facilities and makes up important parts of the economies of both the state California and the United States as a whole.

Marine aquaculture faces challenges. Between 2006 and 2008, oyster growers along the U.S. Pacific coast saw dramatic juvenile oyster die-offs. Farmers spent thousands of dollars to filter out bacteria, but the oysters continued to die. It was not until Whiskey Creek Hatchery in Netarts Bay, Oregon sent water samples to a local ocean chemist that farmers discovered the oysters were dying because of *ocean acidification*. How does this process work? Oceans become more acidic, less oxygen-filled, and less productive for farming seafood when they absorb the excess carbon dioxide and heat produced by greenhouse gas emissions from human activities. These emissions have been increasing over the past century, and California is among the first coastal zones around the world that will experience the severe effects of changing ocean chemistry. Dramatic changes in the ocean's composition will impact the environment, coastal communities, and industries dependent on ocean resources.

Because their state is on the frontlines of climate change, Californians have the opportunity to build strong aquaculture practices to support the state economy in challenging times.

Opportunity in California's Aquaculture

Shellfish aquaculture began in California in the 1850s and now spans the entire coast. U.S. aquaculture was, for some time, stigmatized by poor management decisions, however, recent investment in aquaculture research has led to advances in technology and practice that have greatly reduced the local impact and enhanced the profitability of marine aquaculture.

The main products of California's marine aquaculture are oysters, clams, abalone, and mussels. Despite the U.S. industries' geographic spread, 90 percent of U.S. seafood is imported from international waters. The demand for imported fish, coupled with the fact that aquaculture is the fastest growing sector in the global food industry, creates an important opportunity for the growth of U.S. seafood.

Seafood is low in fat and cholesterol, is a source of high-quality protein, vitamins, micronutrients, and heart-healthy omega-3 fatty acids, and is a popular dietary option the world over. With the global population expected to reach nine billion by the year 2050, smart investment in U.S. marine aquaculture could help boost the economy by feeding the planet's rapidly growing population a nutrient-rich, American-grown food.

California as a Global Aquaculture Leader

Worldwide demand for shellfish has increased rapidly over the past 25 years. Over 14 million tons of oysters, clams, mussels, and scallops were produced in 2015 alone. Currently, more than 300 commercial shellfish farms operate along the West Coast of the United States, supporting nearly 4,000 jobs.

Shellfish, one of California's marine aquaculture products, are vulnerable to dissolving as the ocean becomes more acidic. To ensure U.S. marine aquaculture can continue to supply healthy food to the world and support coastal economies around the country, scientists, policymakers, and other civic leaders must work to understand and mitigate the impacts of climate change on these coastal industries.

California ranks as the world's fifth largest economy and the nation's leading state in agriculture production. Further, nearly 85% of California residents live or work in one of the state's 19 coastal counties. California is already considered a leader in addressing pollution and climate change, and is well-positioned to be a global and domestic leader in sustainable marine aquaculture production during this era of rapid environmental change.

Next Steps

To bolster the California and U.S. economy from the detrimental effects of climate change policymakers, researchers, and members of coastal communities should:

- Establish regional monitoring efforts in California to understand whether local activities are enhancing the impacts of climate change on the coastal ocean.
- Identify California communities and shellfish aquaculture operations that are most vulnerable to the consequences of climate change.
- Invest in research that supports the development of sustainable aquaculture practices that accommodate but do not exacerbate the effects of climate change.

Read more in Priya Shukla and Matthew S. Edwards, “Elevated pCO₂ is Less Detrimental than Increased Temperature to Early Development of the Giant Kelp, *Macrocystis pyrifera* (Phaeophyceae, Laminariales)” *Phycologia*, 56, no. 6 (2017): 638-648.