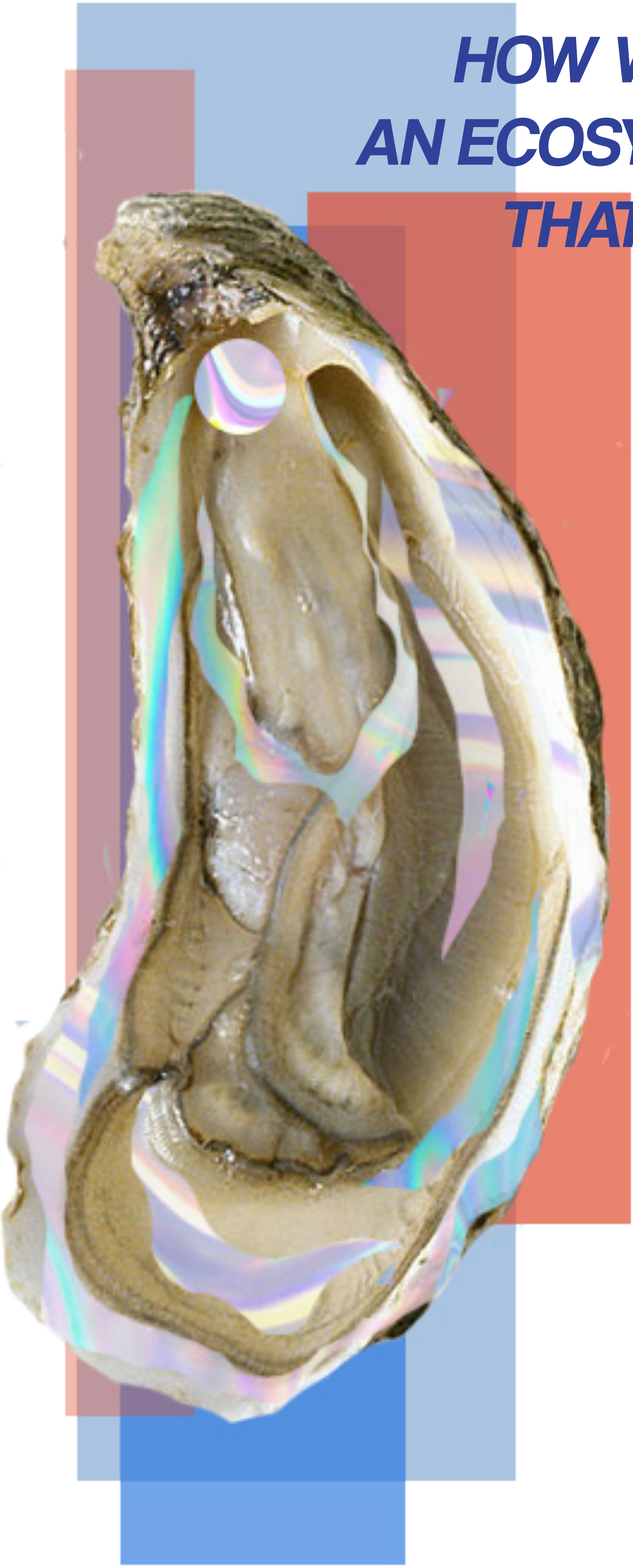

HOW WE CAN RESTORE AN ECOSYSTEM ENGINEER THAT FIGHTS CLIMATE CHANGE

by THUY-TIEN BUI

Served on platters around the world is a food that may be an effective defense against climate change. Although often overlooked, this modest yet remarkable rock of an animal plays a vital role in marine ecosystems. It filters our waters, agglomerates into reef habitat for hundreds of species, facilitates carbon sequestration, and provides a natural defense against the rising sea. These ecosystem services are all credited to one humble and seemingly simple bivalve: the oyster.

In large part due to overharvesting, habitat loss, and disease, an estimated 85% of wild oyster reefs have disappeared since the late 19th century, placing them among the most threatened marine habitats on Earth. With climate change expected to increase sea level rise and coastal erosion, communities are trying to restore oyster reefs to build coastal resilience in the face of global change.

Oysters survive by sticking together — literally. During reproduction, oysters spawn tiny larvae that float along the water column before permanently attaching to older and even dead oysters. At this stage, the larvae are known as "spat" and they continue to grow in the same spot for the rest of their lives. Generation after generation, spat will grow on top of other oysters, eventually building up three-dimensional reef habitats.

"These habitats can provide a lot of benefit with reducing wave energy and preventing flooding," explained Marilyn Latta, a project manager at the State Coastal Conservancy. Oyster reefs capture the impact of the wave's force, pushing part of the wave back to the ocean and allowing the rest to approach the shore more gently. Although oyster reefs won't stop a storm surge, they help limit the damage and slow down erosion in the long run. This is especially important in areas like San Diego and San Francisco, where rising ocean levels erode the shoreline and push the entire coast back.

The current short-term solution to this long-term problem is concrete seawalls that are built to shield the coast from forceful waves. However, man-made seawalls need to be periodically repaired and rebuilt to keep up with rising sea levels. Growing oysters on top of man-made structures or even mounds of recycled oyster shells makes breakwaters more adaptable to sea level rise. “We call this green infrastructure,” said Latta. “Oysters have a lot of biological glue just by forming habitat over that concrete structure and there is a good chance that you’re going to strengthen it and maybe result in less maintenance over time because it’s more self-sustaining.”

In addition to engineering ecosystems, oysters also facilitate carbon sequestration. While oysters release carbon dioxide when they respire, they also store carbon in their shells as they form. A more indirect way oysters help remove carbon absorbed by the ocean is by filter feeding. An adult oyster can filter up to 50 gallons of water a day, dumping out organic matter such as algae and nitrogen to the ocean floor and expelling clean water. This improves water clarity, which allows sunlight to penetrate and sea grasses to grow. Sea grasses, like eel grass, remove carbon dioxide from the water through photosynthesis and store it in its roots even after it dies.

Oyster reefs were hugely abundant along the east and west coast of the US from the 1600s through the 1800s. Wild oyster beds dominated New York Harbor and the Chesapeake Bay, with reefs so large that ships had to navigate around them. Needless to say, this isn’t the case today. Oysters were nearly harvested to extinction and their habitat was scraped away and destroyed from dredging, pollution, and urbanization. Further declines initiated in the 1900s when diseases were introduced by non-native oysters and parasites in the water column, causing extensive mortalities along the east coast and later along the west.

However, global causes of oyster decline do not necessarily translate to local scales. Tessa Getchis, an aquaculture extension specialist with the Connecticut Sea Grant and University of Connecticut Extension Program, explained, “Historically, we’ve seen changes to oyster habitat from overfishing and pollutants, but that is sort of a 200 year history. Those aren’t the recent impacts we’ve seen to these beds.” Getchis described extreme rainfall events and storms as the looming natural threats to oysters in Connecticut. Sedimentation from strong river flows and runoff covers or sometimes buries shellfish in sediment, preventing oyster larvae from attaching to other shells. “Because most of our natural beds have been harvested to some degree, the [growth] rate of the bed is not is not able to outpace the rate of sedimentation,” said Getchis. “And that’s really the challenge.”

The good news is, in places like Connecticut, oyster populations have remained stable and efforts are underway to rehabilitate shellfish beds for harvest and recreation. Connecticut Sea Grant and their partners are working on a project to help inform restoration decision-making in Long Island Sound. By analyzing environmental conditions and human use patterns through Geographic Information System maps, the project seeks to identify suitable areas for shellfish restoration.

“We have two types of what we call ‘natural beds’,” Tessa Getchis explained. “Undesignated natural beds are beds that are not used for the purpose of aquaculture. They’re left untouched, but we haven’t mapped them. Designated natural beds are large and very important natural beds that serve the purpose of providing seed for oyster aquaculture.” One goal of this restoration plan is to map undesignated natural beds and understand their status to help rehabilitate them. “We want to develop management practices for them going into the future — so deciding what sort of substrate and quantities of substrate to add, and numbers of broodstock that we would plant in those areas,” said Getchis.

On the west coast, the San Francisco Bay Living Shorelines Project has been piloting oyster restoration efforts in the Bay Area for over a decade. “So living shorelines, that’s a restoration design approach that strategically cites habitat treatments in order to achieve both physical and biological benefits,” explained project manager Marilyn Latta. The project constructed oyster and eelgrass reefs at two sites in 2012 to reinforce the shoreline, minimize coastal erosion, and increase biodiversity and habitat for aquatic plants and wildlife. “Having oysters and eelgrass in the same project area is really helpful because it increases the biodiversity of the site,” said Latta. “But it’s better to have a good space between them because oyster reefs actually limit where eelgrass can grow and spread.”

Within five years of the San Francisco Bay Living Shorelines Project, over 4 million native oysters have settled at the project’s sites. “We had an increase of more than 10 taxa using the site,” said Latta. So it was roughly a hundred species when you consider all of the invertebrates, seaweeds, fish, birds, and mammals that were using the site.” The results of the project also showed significant physical benefits. “We saw a 30% reduction in wave energy at the site during certain times,” explained Latta. “Our hope is that [oyster reefs] continue to provide healthy, sustainable habitat over the long term.”

Although we may never be able to restore oyster reefs to their original state, ongoing restoration efforts give us hope for a sustainable future. As the climate crisis continues, communities are looking for innovative ways to build resilience. In coastal areas, including many bays in California, the answer lies in an unassuming creature with a powerful function. While oyster restoration is not a simple task, the benefits they provide — whether it is reducing wave impacts, offsetting nutrient inputs, or increasing the health and biodiversity of bays — make the challenge worthwhile.

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