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How do You Solve a Problem Like Spartina?

Alameda-based marine research suggests a promising outlook for the Bay's once-threatened aquatic environment.

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Whitney Thornton pauses on her walk along the Bayview Marsh behind Bayview Avenue to peer into a small, plastic cage protecting young wetland plants from the elements. From the shoreline, the cages, planted at seemingly random spots in the shallow water, look like traps for catching fish, clams, or perhaps crabs. But Thornton isn't looking for dinner. Instead, this marine biologist is developing new methods of restoring wetlands damaged by invasive Spartina, or cordgrass.

Alameda, in fact, is the subject of three research projects into native plant restoration, as well as a participant in a long-term Spartina eradication program. The studies essentially measure the health of the complex and rich world of the watery environment at Alameda's shorelines, a microcosm of Bay aquatic life. The developing evidence presents a hopeful future for the Bay's wetlands, one in which the invasive species have been eradicated and the natives flourish once again.

"So many new areas have opened up," says Thornton, a senior staff biologist with the State Coastal Conservancy's Invasive Spartina Project, which oversees and coordinates the efforts of a half-dozen regional organizations and agencies battling cordgrass in the Bay. "It's fantastic to see how fast native species are coming in. It's hopeful; it's beautiful. I take a lot of pride in it."

The picture hasn't always been this rosy. Over the last several decades, Alameda, like many other parts of the San Francisco Bay, has suffered an invasion by Spartina alterniflora, a species of cordgrass native to the East Coast. The U.S. Army Corps of Engineers first planted it in the Alameda Creek Flood Control Channel in Hayward as part of an experimental bank restoration project in the 1970s. By the early 2000s, the unintended consequences of this planting were clear: The invasive cordgrass, which had hybridized with a native cordgrass, had spread rapidly around the Bay, bringing with it unprecedented environmental havoc. At the time, the biologists who planted it "had no idea what negative effects the East Coast cordgrass would have in San Francisco Bay," says Marilyn Latta, a project manager with the State Coastal Conservancy.

Invasive Spartina is deceptively attractive, growing in lush, green meadow-like stands that look natural, even healthy. But the non-native plant causes multiple problems. Healthy wetlands have different zones, or elevations, within which different plant species grow. Invasive Spartina grows in all the zones, which means it can rapidly overwhelm native plants such as pickleweed and native cordgrass. This can result in a devastating loss of foraging and nesting habitat for native and migratory birds, as well as other endangered species, like the salt marsh harvest mouse. Invasive Spartina also clogs up flood control channels, which can cause coastal flooding—a fact that is somewhat ironic, given that the original patch of Spartina was planted to keep flood control channels open. And because the non-native cordgrass produces about 20 times as much pollen as native cordgrass, it spreads across waterways at an alarming rate.

"It is because of this very high productivity and ability to grow just about anywhere in the tidal spectrum that the Spartina hybrid swarm may be the most significant threat to San Francisco Bay's marsh ecosystem since human development," Peggy Olofson, director of the Invasive Spartina Project, or ISP, wrote in the 2004–2005 winter issue of The Tideline, a newsletter of the San Francisco Bay National Wildlife Refuge Complex. Indeed, by 2004, biologists were estimating that half of the bay's 19,000 acres of tidal flats could be infested with cordgrass by 2014—a terrifying prospect, given that 85 percent of San Francisco Bay's natural marshes had been lost since the 1800s.

The ISP began trying to eradicate non-native cordgrass in Alameda in 2005 by applying herbicide. At the time, the Spartina had infested about 21 acres along Crab Cove, Crown Beach, Elsie Roehmer Marsh, the East Shore area, Bay Farm Island as well as Coast Guard Island. The eradication has not been easy. Non-native cordgrass can only be treated when it's alive, roughly between June and October—it dies back in the winter. Within that window, the herbicide has to be applied at low tide (so that the chemicals can dry and be absorbed by the plant), during the day, and on a day when there is no wind. "And every year, it seems, we run into some logistical challenges with a program this big," Latta says, "like problems with state funding, or scheduling, or permits."

One of the trickiest problems is balancing the need to eradicate the invasive cordgrass with the need to protect the endangered California Clapper Rail, a chicken-sized shore bird whose numbers have plummeted in recent decades due to loss of its marshland habitat but which now nests in the hybrid. The long-term plan, Latta notes, is to support the Clapper Rail by creating other kinds of habitat, such as building artificial floating islands and earthen "high-tide refuge islands." In the meantime, nine cordgrass sites in the Bay can't be treated, because they are Clapper Rail nesting sites. That's good for the birds in the short term, as the species only lives in parts of the San Francisco Bay, Monterey Bay, and Munro Bay, but it means invasive Spartina is still flowering and spreading its pollen.

Still, the treatment has had a huge effect in Alameda: More than 90 percent of the non-native Spartina has been eradicated, leaving less than half an acre still infested. "The city of Alameda has been a fantastic partner," Latta says. "They've done tremendous public outreach and education about this. They are wonderful to work with."

Baywide, all 24,000 acres of tidal marsh and 20,000 acres of mudflat had been affected, resulting in a net of 800 acres of cordgrass. Of that, just 39 acres remained last year. "That's 96 percent eradication," Latta says. "It's a huge accomplishment that includes the hard work of many partners baywide."

Eventually, wetland restoration could help fill in vegetation where it is needed, but figuring out what will grow when and where is still being worked out. That's why Thornton, who also is a researcher at San Francisco State University, has for three years been working on experimental plantings of native Pacific cordgrass, Spartina foliosa, along the Bayview Marsh. "Plants grown locally generally have a better chance of surviving than those taken from far away," she explains. She has tried transplanting native cordgrass plants from several marshes into four different elevations along Bayview Marsh, with limited success. But as it turns out, the limits are as illuminating as the successes.

Thornton, an exuberant 31-year-old who frequently apologies for getting "carried away" when she's talking about wetlands, has long been drawn to ecosystems that seem inhospitable to plant life, such as the desert, wetlands, and high alpine areas. "There are so many cool adaptations that make plants able to live in harsh conditions, and the more I learn, the more I find beauty in these strange ecosystems," she says. "Salt marshes are one of the toughest environments for plants, because in these systems, they have to deal both with salt stress and the stress of daily changes in water level." On the Bayview Marsh, she's finding that both wave action and goose grazing can decimate young plants. But being surrounded by pickleweed helps protect them, as can surrounding them with plastic caging. Thornton also is learning that plants from some sources survive better than plants from others, and that natives planted in some marsh elevations (the middle two) survive better than those planted either high on the shore (where it's dry and salty) or in deeper water (where they get waterlogged and suffer from a lack of oxygen). "Little tiny steps in elevation can have a big influence on plant communities," Thornton says. "That's what's so interesting about these experiments."

Luckily, other areas around the San Francisco Bay are having more success with restoration. "The invasive cordgrass has been such a problem," says Thornton, who is working on seven sites around the Bay. "I take pride in the fact that I'm helping to solve the problem and restore native marshes."

Along that same stretch of wetland, Ted Grosholz, a professor in the department of environmental science and policy at UC Davis, has been studying how the marsh is recovering, now that the hybrid Spartina has been eradicated. Drawing on data collected 10 years ago when the marsh was overgrown with the non-native species, Grosholz is following two processes on the marsh: first, the marsh's return to unvegetated mudflat (which provides habitat for shorebirds, crabs, fish, and other species that cannot feed in salt marsh vegetation); and second, at higher tidal elevations, the return of native plants (such as native Spartina and pickleweed). Both processes, if successful, will be signs of wetland recovery.

What Grosholz has noticed is that the transition to marine mudflats is happening quickly along the marsh. But the transition to native salt marsh is happening more slowly, he says. The return of the mudflats is very good news, because even though this might make the shoreline area look kind of barren, these areas support a whole web of marine life, from the microalgae on the mud's surface to the small invertebrates that feed on it and the fish, crabs, and shorebirds that, in turn, feed on the invertebrates. As part of his research, Grosholz is tracking the abundance and diversity of the invertebrates, as well as what he calls the "biogeochemistry" of the mud itself, because that affects which species can live there.

Further west, along the farthest stretch of Crown Beach, Katharyn Boyer, a San Francisco State University professor of ecology, and her graduate student (and now research tech) Stephanie Kiriakopolos are studying a meadow of eelgrass (Zostera marina), a willowy green plant that grows under the water and provides prime habitat for invertebrates, fish, and shellfish. Most eelgrass in the San Francisco Bay is perennial. Alameda's is unusual in that it is mostly annual—it flowers, sets seed, and disappears by December of each year, only to sprout again (from seed) in the spring. The primary reason for this, Kiriakopolos and Boyer have found, is that Canada geese eat the eelgrass so far down every year, even getting at the root mass, or rhizome, that the plants can't survive. Oddly, when Brant geese eat eelgrass in other locations, they simply snip off the leaves, which helps the eelgrass to grow more vigorously, whereas Canada geese seem to be more aggressive and opportunistic.

The finding is noteworthy because it marks the first time that researchers have discovered a system in which seasonal predation (i.e., goose grazing) actually helps a plant thrive as an annual, rather than resulting in its destruction. In fact, Crown Beach has the only eelgrass known to follow this annual pattern in the entire San Francisco Bay.

Eelgrass is important because, like mudflats, it provides habitat to algae, small invertebrates, and fish, which, in turn provide food for larger invertebrates, fish and birds. "It is also valued for stabilizing sediments and for sequestering carbon," Boyer notes. Recently Boyer and Kiriakopolos expanded their Alameda project to participate in a global effort to identify factors that influence growth of eelgrass. Other sites under study in this Zostera Experimental Network are in Japan, Finland, and British Columbia, as well as elsewhere in the United States. This project, conducted in 2012 and 2013, compared the roles of nutrient pollution, small invertebrate grazers, and Canada geese in the growth and life history (annual or perennial) of the plants.

The fact that Alameda has become the focal point of three major studies is, of course, exciting. "But it's also a good reminder of how very rich and valuable our coastline could and should be," Boyer says. "The accessibility of this shoreline and the spectacular habitats present provide an unparalleled opportunity to increase our understanding of the inner workings of bay environments."