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WEATHER

Fog Cool for Oysters

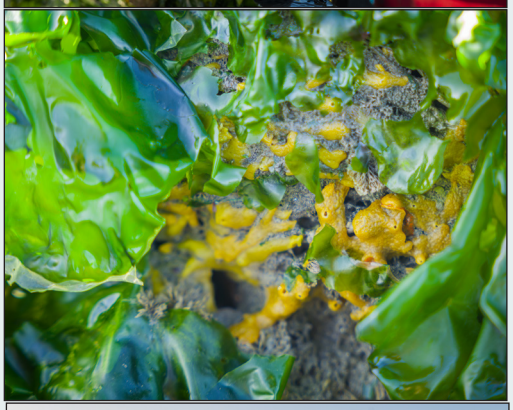
ARIEL RUBISSOW OKAMOTO, REPORTER

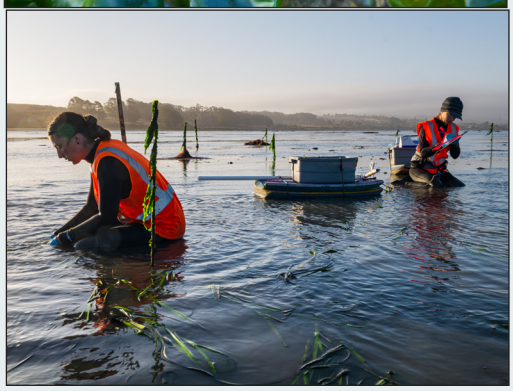
On bright hot days, standing in the shade can feel a lot better than standing in the sun. The same goes for oysters living in the intertidal shallows of San Francisco Bay. When the tide is low, the oysters bake in the sun. During extreme heat events they can even die. But in this coastal region there is one factor that could help mediate the heat: fog. Indeed, over the past year, San Francisco State graduate student Alexandra (Allie) Margulies has been examining fog data and monitoring oyster density at five sites around the Bay, and recruitment at 10 sites, building on a long-term monitoring dataset collected by the San Francisco Bay National Estuarine Research Reserve.

"Fog can help scatter solar radiation," Margulies says. "So the prevalence of fog at some sites versus others may be something we should consider in siting new oyster reefs."

For the last decade, SF State's Estuary and Ocean Science Center, the Coastal Conservancy and other partners have been steadily experimenting with how best to build new oyster reefs in San Francisco Bay. The idea is that oysters are ecosystem engineers, attracting other marine species, and improving habitats and food webs. Early experiments off the Marin shore have now multiplied to include a large, multi-habitat project off the Contra Costa County shore, including not just oyster reefs but also eelgrass beds, tidal marshes, and upland transition zones. This fall, scientists went out to monitor progress at Giant Marsh, including Margulies who volunteered to help with the hard muddy work in the oozes.

"Going out there it was interesting to see how many oysters were living on the north side versus the south side of the oyster castles," she says, referring to one of several reef element designs being tested. "Sunlight from the south is often stronger." Shading from canopies of sea lettuce growing on the new reefs may also help with heat, scientists think.





Top to bottom: 1.) Margulies collecting living samples from the reef balls. 2.) Sea lettuce and sponges (yellow) colonize new oyster habitat. 3.) Monitoring crew check eelgrass planted in association with oyster reef. Photos: Jak Wonderly

Margulies' early findings, comparing East Bay, South Bay, and Marin sites, suggest that conditions may be slightly less foggy the farther sites are from the Golden Gate. But she didn't find much difference between Marin sites such as in Sausalito versus San Rafael. Nor has she yet found a higher density of oysters at sites with higher average fog cover that is statistically significant.

"One interesting thing I found is that even though the amount of fog at China Camp in San Rafael isn't very different, this site had by far the most timepoints that recorded extreme heat," she says. These temperature sensors, referred to as "data loggers," are kept around the elevation where oysters are the densest.

Sites in the northeast Bay near Giant Marsh can also be subject to other extreme conditions — such as the flush of freshwater that poured over the saltwater-adapted oyster species during the atmospheric-river storms of 2017. A lesser 2011 storm caused 97-100% mortality of oysters at some sites. Margulies also found a big die-off in 2016 after a multi-year drought, but she isn't sure of the cause. Oysters do come back, but the ups and downs can be problematic for long-term health.

Fog is certainly a factor for future consideration, as are dramatic salinity and air-temperature fluctuations. The recent heat dome in the Pacific Northwest killed thousands of mussels, for example. United States Geological Survey fog specialist Alicia Torregrosa told Margulies that fog can reduce temperatures on the ground by half a degree per hour of fog cover.

"If certain sites around the Bay provide refuge from extreme weather or conditions, then we can target restoration in those areas to create more stable populations," says Margulies.

DEEPER DIVE

Watch Morning Monitoring at Giant Marsh at: www.youtube.com/watch?v=eXM8O6grJ5o

Bi-coastal Oyster Infrastructure Experiments: www.kneedeeptimes.org/bi-coastal-experiment-with-oysters-and-infrastructure/

G R O U N D W A T E R

Saving Water Under the East Bay

NATE SELTENRICH, REPORTER

It's a matter of semantics as to whether the Bay Area ever really left the drought of 2014-2017 before staring down another, more severe one beginning last year. But a huge lesson for our entire state from that "first" water shortage still being learned today is that more attention must be paid to groundwater.

That's true even in the urban East Bay, where the East Bay Municipal Utilities District (EBMUD) and the City of Hayward are developing a plan to ensure continued sustainable use of freshwater sitting beneath the East Bay flats from Richmond to Hayward.

In September 2014, Governor Jerry Brown signed into law three bills known as the Sustainable Groundwater Management Act. Among other things, the Act requires local water agencies overlying certain groundwater basins to develop plans to make these basins sustainable within 20 years of implementation.

Unlike in the Central Valley and some other parts of the state, groundwater use in the East Bay Subbasin is limited and already considered sustainable, says EBMUD senior civil engineer Brad Ledesma, who is leading the effort. But the district is still working to improve groundwater monitoring and develop for the first time a formal Groundwater Sustainability Plan (GSP) that will guide management of the subbasin for decades to come.

"Right now, pumping is way, way below our estimate of causing any issues," Ledesma says. "There's not enough pumping in the basin to cause undesirable results."

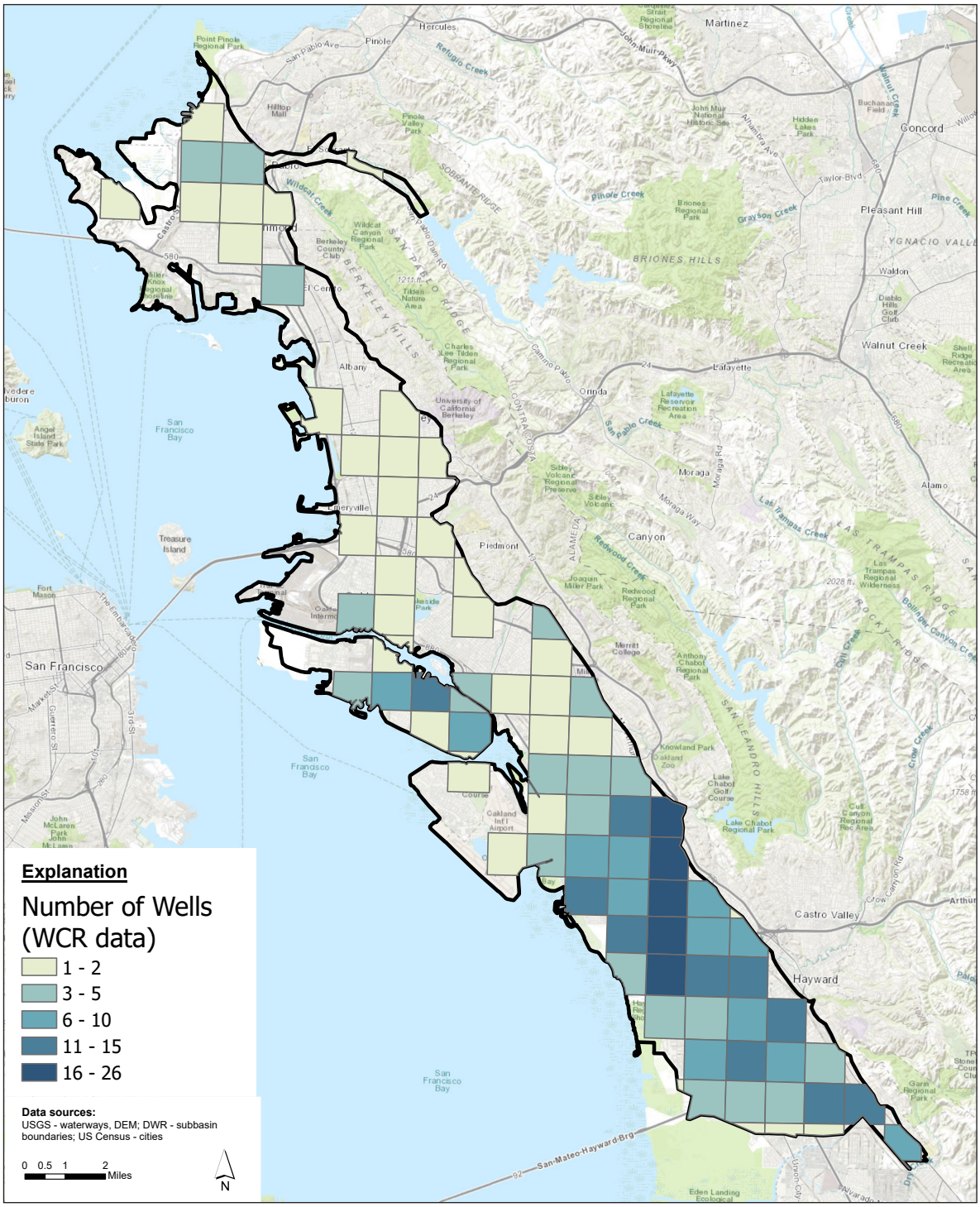
The vast majority of individual water users sitting atop the subbasin get their H2O from EBMUD or Hayward supply sources originating in the Sierra Nevada and local reservoirs. But some do tap into groundwater for irrigation of golf courses, cemeteries, and private residences, he notes, mostly via shallow wells around 20 feet in depth drilled during the 1960s and '70s — though use of the aquifer for drinking water dates to the early 1900s. The relatively few remaining groundwater users are scattered throughout the East Bay Subbasin, but concentrated more heavily in its lower half from southern Oakland to Hayward.

Collectively, all current users of the subbasin extract approximately 3,600 acre-feet of water from the ground each year, or about 1.2 billion gallons.

EBMUD'S Bayside Facility. Photo courtesy EBMUD.

That number is far smaller than the 1960s peak of more than 20,000 acre-feet per year, and easily offset by natural recharge through runoff and rainfall, as well as managed injection during wet years at EBMUD's Bayside Groundwater Facility in San Lorenzo, Ledesma says. Constructed in 2009, the Bayside facility is capable of pumping potable water, primarily sourced from local reservoirs, into the deep aquifer of the East Bay Subbasin, which at that location spans from about 400 to 1,000 feet in depth.

"Sustainable" is a notoriously slippery term in our current era, subject to greenwashing and varied interpretations. For the purposes of the Groundwater Sustainability Plan for the East Bay Subbasin, it refers to the avoidance of six sorts of "undesirable results": chronic lowering of groundwater levels, reduction of groundwater storage, seawater intrusion, degraded water quality, land subsidence, and surface water impacts.



Existing wells in the East Bay Subbasin. Source: Groundwater Sustainability Plan.

Though none of these are currently an issue, many threats lie ahead, most associated with our changing climate. Extended drought could lead to increased pumping from the subbasin, especially if it also reduces storage of surface water in the reservoirs on which EBMUD and its customers now rely. Additionally, sea-level rise could increase the risk of saltwater intrusion into the shallowest part of the subbasin, which reaches from about 200 feet to just 10 feet below the ground surface.

Ledesma acknowledges that while EBMUD currently does not make use of groundwater to service its 1.4 million customers, that could change in the future. "As a district, we're always looking to help diversify our water portfolios, to help harden us against climate change and regulatory changes, and groundwater will potentially be a piece of that," he says.

A draft of the East Bay Subbasin Groundwater Sustainability Plan was released for public review on September 17. Comments are due by November 1, and a final version will be submitted to the California Department of Water Resources by January 1 of 2022.

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ENVIRONMENT

Habitat Tramplers Run Amuck

ALASTAIR BLAND, REPORTER

The water of a small stream in western Sonoma County flows slowly under a highway bridge, coursing its way through private ranchland to the ocean about seven miles away. Ducks paddle among floating vegetation, and an egret tiptoes slowly through the shallows. At the edge of the waterway, called Americano Creek, a cluster of cattle huddles under the willows. They frequent this spot and have trampled the banks to mud. Hoofprints can be seen leading into the water, and cakes of manure fester beside the stream, which meets the Pacific Ocean a few miles south of Bodega Bay.

"With the federal Clean Water Act, the state Clean Water Act, and all the other regulations, you would think this would be prohibited," says Don McEnhill, executive director of the environmental watchdog group Russian Riverkeeper. The organization campaigns to protect Sonoma County salmon and steelhead habitat, which McEnhill says has been degraded by, among other things, cows in the water.

In fact, a suite of federal, state, and local laws ostensibly protect California's watersheds from pollution, and volumes of codes are dedicated specifically to safeguarding streams and rivers from cattle. Yet through a variety of loopholes and exemptions, and possibly agency languor, roaming cows have access to many of the state's waterways.

Here, the animals denude riverbanks, eliminate riparian habitat, and degrade water quality. High concentrations of manure-born bacteria are known to flow from Marin County cattle ranches into the waters surrounding Point Reyes. In the East Bay hills, cattle foul watershed habitat, trample creeks, and erode trails on public lands – damage that local groups have lobbied unsuccessfully to stop. Nitrates, an agricultural byproduct commonly derived from manure that can lead to health problems in humans, taint drinking water systems in the San Joaquin Valley, where feedlots are the suspected source of much of this contamination.

Alan Levine, the secretary of the Redwood Coast Watersheds Alliance, says the California regulators who deal with livestock and farm pollution have historically lagged on cracking down on violators. "It's almost impossible to get agencies to enforce the law unless it's a flagrant, publicly visible violation of the law that they just can't ignore," Levine says.

The North Coast Regional Water Quality Control Board's permitting documents do not prohibit cattle entering waterways. But they state that "[g]razing in riparian areas shall be conducted in a manner that prevents, minimizes, and controls the discharge of waste to surface waters." The same regulations address shoreline vegetation, requiring that "[r]iparian areas are managed in a manner that allows the natural establishment and growth of native vegetation ... to prevent, minimize, and control surface erosion."

Cows enjoy free access to creek near Petaluma's Roblar Road. Photo: Alastair Bland.

But these impacts are almost the status quo for farms across the North Bay. A clear case of cows trampling and denuding a section of Americano Creek was reported to the North Coast Regional board on March 19. Though the board's staff visited the site and corresponded with the farm owners, they took no immediate action to keep their cattle away from the water. In late September, the cows were seen standing in the shade of the creek bed, by then totally dry.

Currently, North Coast region dairy farms are under orders from water quality officials to submit Riparian Management Plans – checklist forms that describe how a farm will sustainably manage cattle near waterways. The rules governing cattle effluent and riparian impacts aren't simple, even for activists familiar with this regulatory terrain. "It is very hard for us to tell what's legal and what's not," McEnhill says. For instance, manure in the water does not necessarily constitute a violation — lab testing of the water is required to determine if water quality

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Don McEnhill by the Russian River. Photo: Alastair Bland

standards have been exceeded. Also, different rules apply to beef and dairy cows, and different rules apply to cows that are considered confined and those that are considered to be free-ranging. In the end, these somewhat arbitrary respective designations may determine whether cow dung in a creek is acceptable or not.

Laurie Taul, an environmental scientist with the San Francisco Bay Regional Water Quality Control Board, says her agency "loosely" manages cattle operations. She describes an overarching framework of rules that encourage but don't require measures aimed at reducing environmental impacts of cows. "We encourage fencing [to keep them away from waterways], providing drinking water away from streams, riparian water management plans, healthy vegetation," she says.

Levine says forcing regulators into action often requires citizen lawsuits. However, going to court over these matters didn't help the Center for Biological Diversity and Alameda Creek Alliance. In the late 1990s, the groups sued the East Bay Regional Park District for allowing grazing on public land without first conducting environmental impact reviews. The suit, which the plaintiffs ultimately lost, alleged that "[l]ivestock grazing threatens sensitive and endangered species of plants and animals, increases erosion, and degrades water quality."

"We submitted mountains of evidence and information and expert testimony that the court refused to consider," recalls Jeff Miller, director of the Alameda Creek Alliance and a senior conservation advocate with the Center for Biological Diversity.

Another lengthy conflict has brewed at Point Reyes National Seashore, where environmental groups have challenged the use of parts of these federally protected public lands as, essentially, a vast farm. The cattle damage creek valleys and gulches and pollute marine zones that drain the peninsula's hills. Point Reyes cows are also alleged by environmentalists to be the source of Johne's disease, a bacterial infection that can kill ungulates and has been found in the local population of Tule elk. Protests and lawsuits against the National Park Service have failed to displace the cattle.

The organization McEnhill works with focuses its watchdog efforts on the Russian River, with an emphasis on rebuilding the shoreline and side-channel habitat so critical to the early life stages of Coho and Chinook salmon and steelhead trout, all of which have slid toward extinction in California's coastal creeks and rivers. McEnhill says livestock in the watershed are not helping.

In the tidal reaches of the Russian River, near where it reaches the ocean, cows graze along the banks and can frequently be seen standing in the water, potentially damaging valuable habitat. "This is right where we're putting so much effort into creating a nursery area for outmigrating salmon," he says.

Levine, a former cattle rancher himself, says many farmers have neglected to put up cheap fencing to protect riparian zones because they know they can get away with it. That cattle denude streams in plain sight of public roads, and in spite of water-quality standards, tells Levine that agency staff are allowing it to happen. "It's not being overlooked," he says. "It's being ignored."

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MONITORING

Tracking Natural Nitrogen Removal

ROBIN MEADOWS, REPORTER

Nitrogen inputs to the San Francisco Bay are among the highest of estuaries worldwide, yet so far have not caused harmful impacts like extreme algal blooms, oxygen depletion, and fish kills. But resistance to this nutrient may not last. Ever since the Gold Rush, excess sediment from pulverized rock has been pouring into the Bay, clouding the water and keeping algae in check by blocking sunlight. Recently, however, that protective sediment has diminished in parts of the Bay, contributing to concerns over nutrient pollution. A new study on a natural nitrogen-removal process is key to predicting whether nitrogen will cause ill effects here, too.

The Bay's nitrogen comes primarily from sewage and, for the most part, this nutrient is not removed by the region's wastewater treatment plants. Nutrient treatment is quite costly and has not been necessary in the region so far. But it may be in the future, as the sediment suspended in the water goes down and the region's population goes up.

"The big question is should we be limiting the nutrients allowed to be discharged into the Bay?" says Tom Mumley, a chemical engineer who is Assistant Executive Officer at the San Francisco Bay Water Board, which regulates water quality in the Bay. "We need data, we want to get the science right."

The fate of nitrogen in the Bay is complex. As various organisms consume this nutrient, it can cycle through a wide range of chemical forms including ammonium and nitrate, and can also be incorporated into protein and DNA. The new research focuses on microbes in Bay sediment that transform nitrate into nitrogen gas, a process called denitrification because the resulting gas rises to the surface and releases harmlessly into the atmosphere.

"Denitrification is a natural remedy to the problem," says project team member Ken Czapla, a biogeochemist at Stanford. "The Bay is helping itself."

That said, denitrification is just one facet of the fate of nitrogen in the Bay. The new study — part of a larger San Francisco Estuary Institute (SFEI)-led effort called the San Francisco Bay Nutrient Management Strategy — will help show how this natural remedy fits into the big picture.

The project — which entails punching sediment cores from the Bay and then bringing them back to the lab for analysis — was all set to go at the end of 2019. Then Covid hit, disrupting the research team's plans. Collaborators on project include Stanford microbial ecologist Chris Francis and University of Maryland biogeochemist Jeff Cornwell.

"Our first big hiccup was finding a boat for safely collecting samples," says project lead Ariella Chelsky, an SFEI environmental scientist, explaining that their usual research vessels are mostly enclosed with tiny decks that don't allow for social distancing. The team scrambled for a back-up boat, ultimately hiring a private barge. "It was mostly open deck and allowed us to social distance," Chelsky recalls. "We were very excited when we found it."

Social distancing on the barge. Photo: Ariella Chelsky

The researchers collected sediment cores in clear tubes at nine sites in the South Bay, which is particularly nitrogen-rich. So far, they've sampled these sites in the winter, spring, and summer, and they plan to collect the final samples this fall. The sites are dotted around the South Bay and range from channels to shoals, which could

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Collecting sediment cores. Photo: Ariella Chelsky

reveal differences in denitrification by location and sediment type. Similarly, quarterly sampling could reveal seasonal differences in denitrification.

The next hurdle was that the team was barred from the Stanford lab originally planned for analyzing the sediment cores. So Chelsky decided to repurpose an SFEI garage into a lab. "It worked out surprisingly well," she says, adding that they left the door open as a Covid precaution.

Stanford's Czapla took the impromptu lab in stride. "We just rigged together stuff and got creative," he says, adding that his doctoral work in salt marshes had taught him to improvise with whatever's at hand. The garage lab is good enough that the researchers plan to continue using it to analyze the final set of sediment cores they collect in November.

Besides determining denitrification rates in the sediment, the researchers want to identify the underlying reasons for differences in those rates. "What's driving the patterns that we see?" Chelsky asks.

While the results aren't in yet, Czapla outlines some likely drivers. For example, denitrification is likely to vary with sediment type. The process only occurs when oxygen is not available, and oxygen penetrates faster and deeper into coarse-grained sediments like sand than into fine-grained sediments like mud. Denitrification is also likely to vary seasonally. The rate depends on temperature, which swung from a winter low of about 56°F to a summer high of about 71°F during sample collection in the Bay.

Field data like those generated by Chelsky, Czapla, and colleagues will help regulators by showing what actually happens to nitrogen after it's discharged into the Bay. In turn, this will let sanitary sewer services install costly nitrogen treatments only if they're actually needed rather than out of an abundance of caution.

"We could go full-throttle and implement traditional nitrogen treatments, but that has about a $12 billion price tag systemwide," says Lorien Fono, an environmental engineer who directs the Bay Area Clean Water Agencies, which was formed by the region's five largest wastewater treatment agencies. "Real-life data will tell us where best to spend limited funds." Other potential approaches for nitrogen control include nature-based solutions, such as creating wetlands to help absorb nutrients from wastewater treatment plant effluent.

Getting an accurate handle on the fate of nitrogen in the Bay will be increasingly important with the projected influx of people to the area. The regional population was 7.7 million in 2020 and is expected to reach 10 million by 2050, according to Plan Bay Area, a government-led effort to guide the region's future. "The nutrients are coming from humans," Mumley points out. "Even if the Bay is okay today, what happens as the population grows?" Nitrogen in the Bay is increasing by about 2 percent a year.

Fono is happy that wastewater agencies and the Water Board are working together to address nitrogen's potential to become a problem in the Bay. "It's special to the Bay Area." More is accomplished here than in places where dischargers and regulators have adversarial relationships, she says. "We all want the same thing — we all want the health of the Bay."

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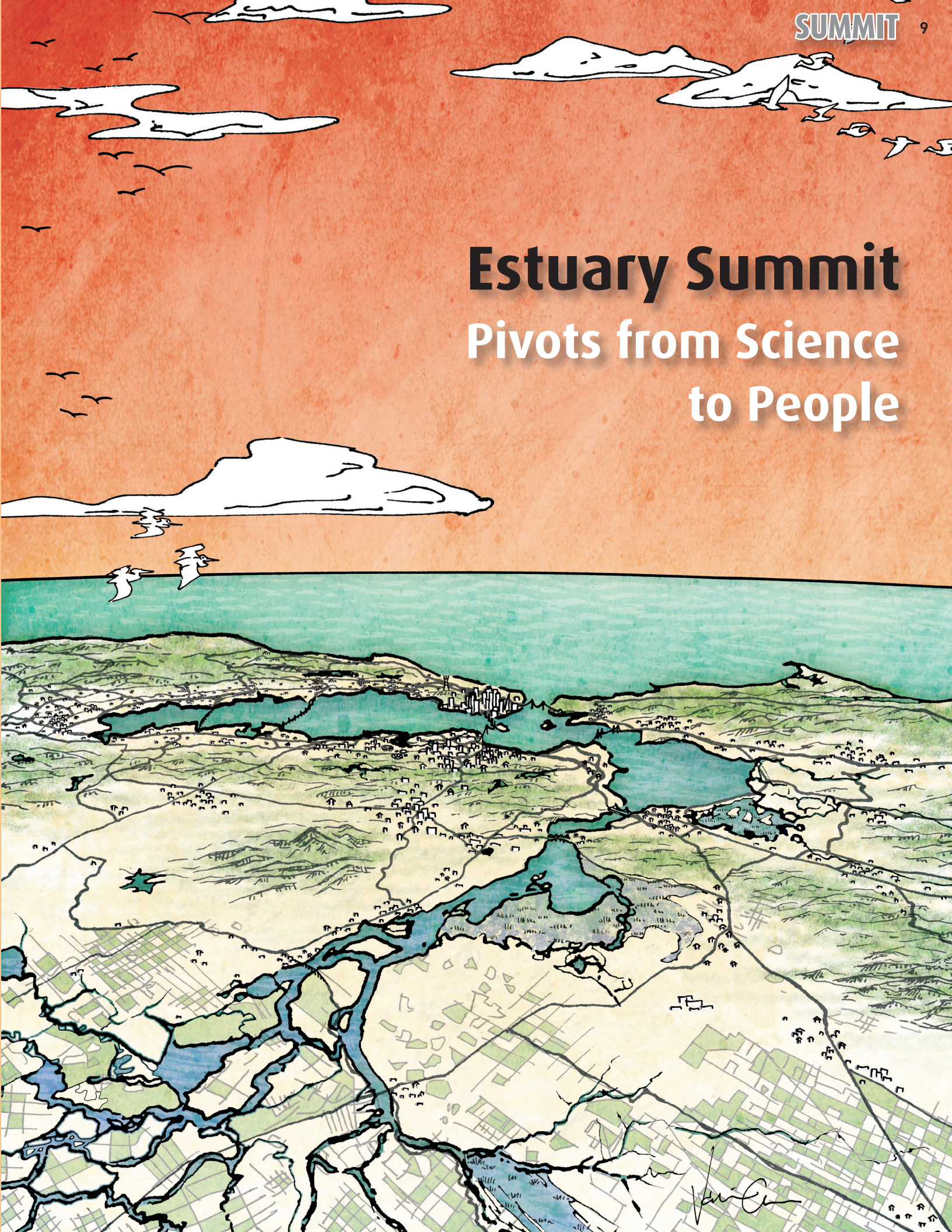
Working in the garage lab. Photos: Ariella Chelsky

Estuary Summit

Pivots from Science to People



Estuary Summit Pivots from Science to People

Estuary News Group Reports

"Make the unseen more visible in your work," urged Amanda Bohl, opening speaker for the largely cameras-off audience of 600 virtually assembled for the 2021 State of the San Francisco Estuary Summit this October.

The Delta Stewardship Council staffer's remarks at the 15th biennial conference, usually a two-day, science and policy-heavy networking event but this year an eight-hour Zoom summit, referred to how many things we all work on or people we work with everyday remain invisible. Some of these often unseen yet important things brought up over the course of the day: the indigenous lands upon which so many efforts to restore the Estuary or "manage" its resources take place; the people in local communities left out of government decision-making about water supply or land use; the long legacy of environmental racism and injustice cutting off many urban neighborhoods from open space...

"Environmental protection or economic advancement is never compromised by the parallel pursuit of equity, in fact it is lifted up when we do those things in tandem," added second speaker Therese McMillan, executive director of the Metropolitan Transportation Commission and Association of Bay Area Governments. "Community engagement is an essential first step."

As the leader of two regional agencies, McMillan took a moment to point to progress on *Plan Bay Area 2050*. Leaping through final approval hoops this fall, the Plan details how regional government, stakeholders and communities hope to balance housing, transportation, and environment in the long-term for the metropolitan Bay Area. For the first time, the plan also addresses sea-level rise, a mounting threat to miles of Bay shorelines that affects many cities and counties.

"The importance of working together on interjurisdictional problems will be key," McMillan said in her talk. As an example, she pointed to innovative work to elevate the North Bay's Highway 37, to protect it from current and future flooding, while still allowing wetlands and habitats to thrive. **ARO**

Adapting Climate Policy

The second session of the summit featured two pre-recorded videos. In the first, Congresswoman Jackie Speier, whose district covers most of the San Francisco peninsula, noted federal appropriations for the San Francisco Estuary have lagged behind comparable programs like Puget Sound and Lake Pontchartrain.

"I was extremely disappointed — no, I am indignant — to see that the San Francisco Bay is getting short-changed yet again," she said. Speier touted the $30 million for the Estuary she helped secure in the current budget bill that is still in negotiations, while acknowledging its fragility. "I have introduced the San Francisco Bay Restoration Act in every Congress since 2010," she said. "And I am hoping this will be the last time."

In the second video, California Department of Natural Resources Secretary Wade Crowfoot continued the budget thread. "In Governor Newsom's budget we have $10 billion allocated for climate resilience," he said, noting how far we've come since a year ago when the previous U.S. president debated the existence of climate change.

Crowfoot listed his agency's other priorities, including looking at how to meet the state's goal of conserving 30% of California's land and coastal waters by 2030, and how to streamline restoration project permitting. "One-third of restoration project budgets can be spent on planning and permitting," he said. "Non-controversial restoration projects can take up to ten years to begin." Crowfoot gave a shout-out to the San Francisco Bay Restoration Regulatory Integration Team, smiling as he stumbled over the acronym (BRRIT) but naming the group a "powerful model" for his initiative to speed up the implementation of restoration projects. **IP**

The Estuary Blueprint

While the State of the Estuary conference and report may be the centerpiece of regular reporting to the public for the San Francisco Estuary Partnership, the *Estuary Blueprint* is its playbook. The playbook is getting an overhaul this year, and third speaker Caitlin Sweeney talked about how the Blueprint's themes offered a roadmap for the rest of the sessions in the day-long summit.

Sweeney is the director of the Partnership, which hosted the summit. The Blueprint is the latest iteration of the Comprehensive Conservation and Management Plan that the Partnership, a federal-state program, is required to update every five years.

Like the summit, said Sweeney, the Blueprint aims to bring diverse voices together and actively support new partnerships. Also like the summit, the Blueprint crosses geographies and communities, identifies and elevates the highest priority actions, and spotlights the nexus of social and ecological resilience.

"The Blueprint offers both a collaborative regional vision and an actionable strategy," Sweeney said. "It walks a line between aspirational and feasible."

She concluded her opening remarks with questions she asked participants to keep in mind throughout the conference, among them: "Where do we want to be in 2050? How do we focus our limited resources on the most urgent areas? And how do we hold ourselves and each other accountable for the future?" **ARO**

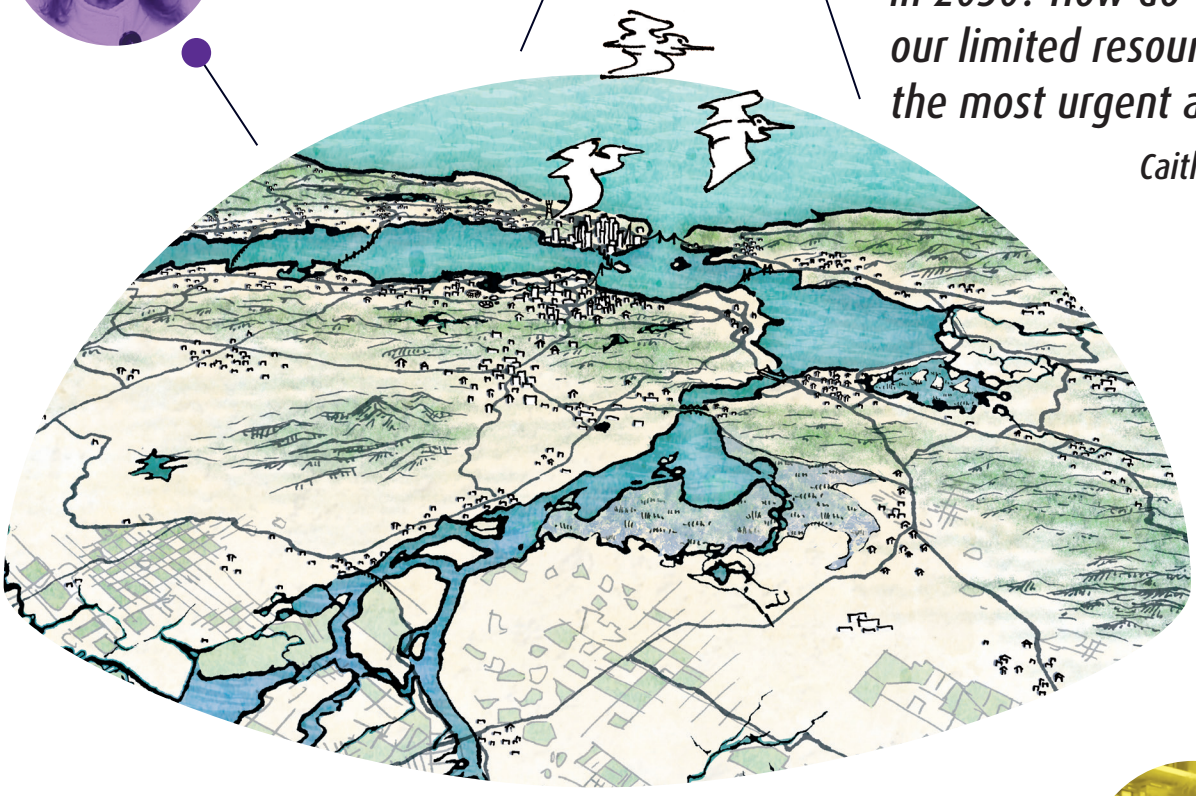
Environmental protection or economic advancement is never compromised by the parallel pursuit of equity.

Therese McMillan
MTC/ABAG

CONGRESSWOMAN JACKIE SPEIER

Where do we want to be in 2050? How do we focus our limited resources on the most urgent areas?

Caitlin Sweeney
SFEP



AMANDA BOHL

One-third of restoration project budgets can be spent on planning and permitting.

Wade Crowfoot
Cal Natural Resources Secretary

Rematriation, Revitalization of Native American Infrastructure

As the federal government debates how to address the nation's aging public works, the October Estuary Summit brought refreshing perspectives from two prominent Native American leaders on ways of thinking about infrastructure.

Corrina Gould, chair and spokesperson for the Confederated Villages of Lisjan and co-director of the Sogorea Te' Land Trust, and Valentin Lopez, chair of the Amah Mutsun Tribal Band and president of the Amah Mutsun Land Trust, shared their insights. They stressed that only when we prioritize the abundant natural resources provided by the land, rather than roads and the electric grid, will we end the pattern of seeking to control and dominate the world around us. By centering native communities in environmental restoration efforts, we can repair both our human connections and those with the land.

Gould opened her session by commenting on the remarkable nature of the summit bringing people together to focus on the health of the San Francisco Estuary. "It's amazing that we're here talking about our traditional homelands, the estuaries: the lungs of this part of the world," she said.

Gould discussed initiatives led by the Sogorea Te' Land Trust, an urban, indigenous, women-led land trust working to return land to indigenous people. In the Sobrante Park neighborhood of East Oakland, the group is restoring a small parcel of land, the first to be returned to the Ohlone people. Planting Justice, a local nonprofit working to create permaculture gardens and provide work opportunities to formerly incarcerated people, has partnered with the Sogorea Te' Land Trust to facilitate this land transfer.

"We have created a space that is not just for indigenous people but for people from all walks of life, to come and begin to feel what it is like to be part of land again," Gould said. This includes the planting of native plants for medicinal use and the weaving of tule reeds into community structures.

Valentin Lopez, chairman of the Amah Mutsun Tribal Band and president of the Amah Mutsun Land Trust, spoke of the key differences between western and indigenous priorities. Native American cultures know that infrastructure encompasses the mountains, rivers, oceans, plants, and wildlife, he said. "We don't need to create infrastructure, we need to restore infrastructure given to us by the Creator."

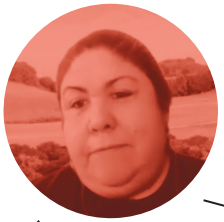
This includes cultural burning, which was used across California for thousands of years as a tool for land management. Scientists are studying the benefits of these low-intensity, controlled burns, which support native species and help prevent the raging, destructive wildfires we increasingly see.

Lopez also emphasized the importance of thinking about the long-term consequences and benefits of our actions. "Whenever we implement anything new we ask ourselves if it will still be good seven generations from now," he said.

As a final parting call to action, Lopez asked that members of the audience "recognize that all restoration efforts must be indigenous-led." He continued: "Every morning when you wake up, you're putting your feet on ground stolen from Native Americans, and we ask you every day to think about how you benefit from that, and how you can help the tribes restore their culture." ED

We don't need to create infrastructure, we need to restore infrastructure given to us by the Creator.

Valentin Lopez
Amah Mutsun Tribal Band



We as California people have prayers for the salmon, we remember them as relatives that come to feed and take care of us.

Corrina Gould
Confederated Villages of Lisjan

Reconnecting Mill Creek to its Watershed

Removal of Mill Creek Dam renews the watershed. Photos Ian Bornarth, courtesy Sempervirens Fund

For thousands of years, Coho salmon and steelhead returned to spawn in the cold waters of Mill Creek, part of the San Vicente watershed in the mountains above Santa Cruz. This ended when a mining and logging company dammed the creek in the early 20th century. Now, an ambitious conservation initiative has succeeded in removing the dam, bringing people together across local land trusts, Native American groups, regional agencies, and researchers from multiple universities. Valentin Lopez, chairman of the Amah Mutsun Tribal Band, spoke about the dam removal in his session of the Estuary Summit.

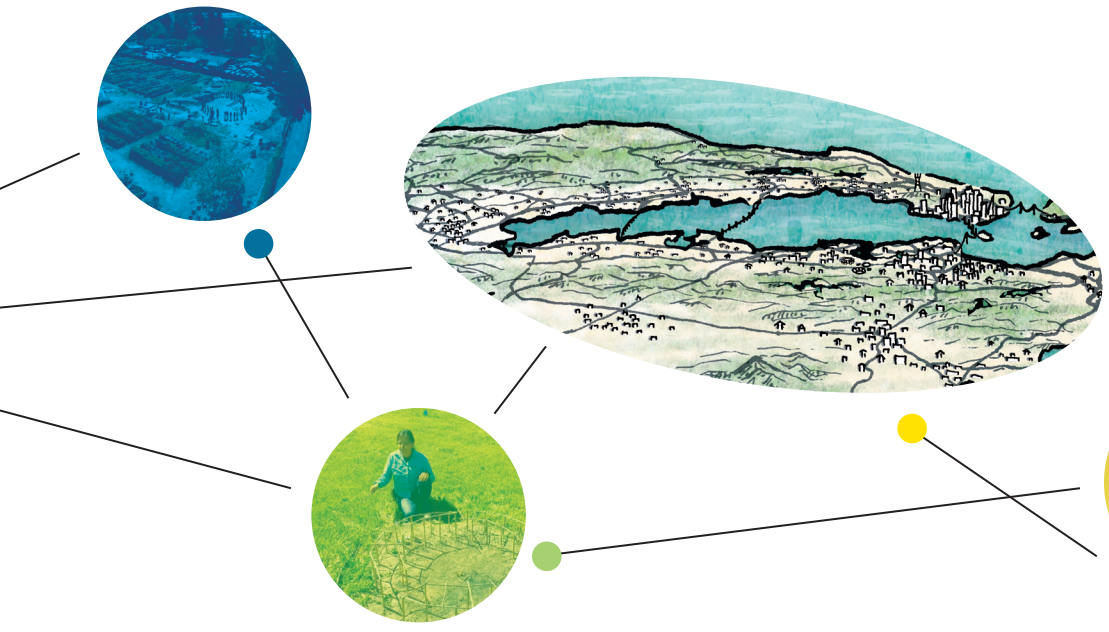
The San Vicente Redwoods is a large stretch of forest sitting above the coastal town of Davenport. Following its 2011 purchase by a coalition including the Sempervirens Fund, Peninsula Open Space Trust, Save the Redwoods League, and Land Trust of Santa Cruz County, efforts have been underway to restore both the forest and the creek. The watershed is considered unique for its accessibility to migratory fish in the Pacific and an underlying karst limestone cave system which produces a high flow of cold water.

But the dam couldn't come down because it supported a pipe bringing water to the town of Davenport. Circumstances changed after the 2020 CZU fire moved through the area, "burning the pipe like a wick, melting it right off the dam," says Matt Shaffer, communications officer with the Sempervirens Fund. The replacement pipeline was moved to a new location, and the groups got the green light to take the dam down.

"We're very glad to have worked on [the dam removal] with other partners," said Valentin Lopez of the Amah Mutsun Land Trust. The Amah Mutsun Tribal Band are the descendants of Mutsun and Awaswas-speaking peoples who occupied much of the current Monterey Bay region. Ongoing restoration, monitoring, and research is needed to restore the watershed's historical role in the ecosystem. "The creek here is spring-fed and we're going to be restoring [salmon] habitat and the spawning beds. This has to happen at many, many other dams," said Lopez.

In the same Estuary Summit session, Corrina Gould, chair and spokesperson for the Confederated Villages of Lisjan, spoke of the importance of rebuilding the relationship between salmon and native people.

"We as California people have prayers for the salmon, we remember them as relatives that come to feed and take care of us," she said. "We have a responsibility to ... welcome them home. We can't do that work because of the culverted rivers and dammed creeks. We have this responsibility, because those salmon don't have a voice, but we as human beings are supposed to make sure that relationship stays strong. What can we do? We can open up those streams and those waterways." **ED**



REMATRIATE:
to restore a people to their rightful place in sacred relationship with their ancestral land.

ALEXANDER TAVIZON

Intersectional Partnerships

Leading off the Estuary Summit's afternoon panel on generating innovative, intersectional partnerships to build climate resilience and climate justice, Melissa Jones, executive director of the Bay Area Regional Health Inequities Initiative, outlined seven best practices for community engagement. These were developed by a local coalition of public health administrators working to eliminate health inequities that Jones directs, under the rubric "Farther Together."

With a view to new federal and state funding streams, Jones advocated prioritizing community-supported resilience efforts and valuing local knowledge and expertise. She quoted Roxana Franco of Nuestra Casa: "Don't hire consultants and then ask us to do the work for free." There's room for improvement on the public side, Jones observed: "A lot of Bay Area jurisdictions aren't using any equity frame at all in competing for federal money. The best tool so far is from Harris County, Texas."

Wetland ecologist Anthony Khalil, from Bayview Hunters Point Community Advocates and Bayview Community Co-op, invoked "three fierce and relentless environmental heroes"—Kenya's Wangari Maathai, Honduran indigenous leader Berta Caceres, and Bayview activist Marie Harrison—as he linked his personal experience with neighborhood youth in a Candlestick Point restoration project to regional and national currents.

"The crucible of 2020 revealed many social and environmental inequities," Khalil said, analogizing the impact of the pandemic to impacts of history and climate change; for the latter, there's no vaccine, no one-shot solution. "In the pandemic, we're asking the most vulnerable folks to shoulder the heaviest load and carry the most water," he added.

Khalil praised the Bay Conservation and Development Commission's recent Bay Plan equity and social justice amendment as a hopeful sign of transformative cultural change within the region's agencies, and shared a quote that sums up his philosophy: "If peace is made on common ground, equity is made on public land."

Joining the summit session from his office at the Bay Area Air Quality Management District, senior policy advisor David Ralston made it clear he'd rather be outside getting his hands dirty. "The most meaningful work agency folks can do is roll up their sleeves, plant some trees, get on the ground," he said. "That's the kind of work that motivates me personally.

In his presentation "Where the Wetlands Meet the Flatlands," Ralston showcased pilot projects in East Oakland aimed at restitching the urban fabric by creating or restoring vital connections between disadvantaged communities and the green infrastructure of creeks and shorelines.

Ralston also explored intersections between air and water, agencies and communities, struggling neighborhoods and abused natural waterways. "The Bay Area Regional Collaborative and the Resilient by Design Challenge (RBD) started my agency's involvement with water and communities," he recalled. "Living green infrastructure needs air and water quality to survive."

We're at a transformative moment, Ralston observed, with an opportunity to redo our infrastructure and break the barriers separating human ecology from the natural environment. Building greenly while avoiding gentrification and the market logic of development will be a challenge.

Three such initiatives are underway in the area around San Leandro Bay, the locale of RBD's Estuary Commons project. "The I-880 corridor from High Street to 98th Avenue contains the worst-off disadvantaged communities in the Bay Area in terms of health outcomes," he said. "They are also subject to sea-level rise and groundwater inundation."

Former wetlands are now filled with gray infrastructure. Hidden urban creeks, like San Leandro/Lisjan Creek, offer a pathway to reconnection: "People will say, 'We don't know about this creek; we don't have access.' But their grandparents may have fished or played in the creek."

Merritt College students, the Indigenous-woman-led Sogorea Te' Land Trust, and others are working to reclaim the creek as a sanctuary. However, the vision of a riparian greenway trail is threatened by plans for a high-speed Capitol Corridor rail line through the neighborhood: "The railroad is refusing to allow a path to go underneath to connect the schools and the neighborhood to the waterfront. If we can't get people to the waterfront, it's not doing us any good," said Ralston.

In East Oakland's Columbia Gardens neighborhood, Brookfield Elementary School sits next to the freeway, with a power transmission line over its playground. Groups like Higher Ground are planting a vegetation buffer along a 400-foot stretch of freeway to mitigate air and water pollution.

A third project envisions pedestrian and bike bridges over 880, providing access to the Martin Luther King Regional Shoreline. That, Ralston acknowledges, will be expensive: "We're trying for state and federal funds to make it happen." It will also require working with CalTrans, an agency that he says is "taking a new tack on realizing equity and trying to heal some of the trauma of those huge infrastructure projects."

Summing up, Ralston described a "confluence of opportunities" for equitable innovation: "Green, living infrastructure—it's about connecting the dots between people and the centers that make them alive."

He saluted another hero, the late community and environmental activist Whitney Dotson, "an inspired fighter" who helped save a Richmond marsh from industrial development. Dotson's lesson: "You have to stay on the ball." JE

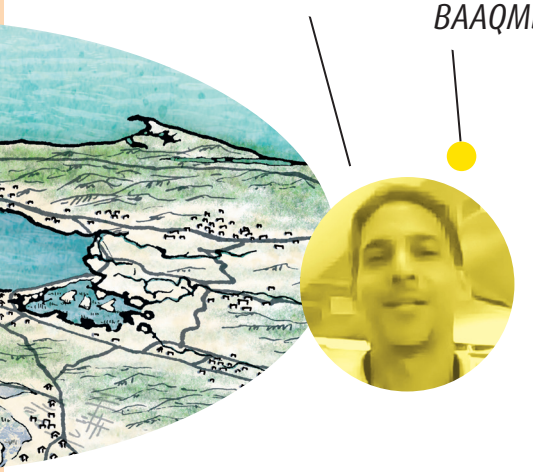
If peace is made on common ground, equity is made on public land.

Anthony Khalil
Bayview Community Coop

MELISSA JONES

Living green infrastructure needs air and water quality to survive.

David Ralston
BAAQMD



Learning from Communities & Youth

As the climate crisis builds and the Bay Area prepares for the challenges ahead, adults look increasingly to young people as a passive font of hope rather than as engaged leaders, said Lil Milagro Henriquez, founder of Oakland-based Mycelium Youth Network. "Too many times we look to young people as inspiration, but then move them out of the way so the adults can get to work," she noted during the afternoon plenary at the Estuary Summit.

Part of the problem, Henriquez explained, is the disconnect between what youth know is going to happen and what adults explain to them, starting from what they are taught about the climate. "Teachers are simply teaching through the trauma" of what are often feelings of fear and hopelessness about climate, she says, "preparing [youth] for a world that doesn't exist anymore."

To combat this trend, Henriquez and the Mycelium Youth Network are engaging at the classroom level in the Bay Area. Mycelium's Climate Resilient Schools Initiative, currently operating at Mission High in San Francisco and MetWest High in Oakland, serves nearly 100 students. Students can apply to join a climate leadership council that, after weeks of meeting other climate leaders and assessing the needs of their community, will plan a project to bolster local climate and cultural resilience.

Henriquez asserted that direct community engagement can be "just enough, just in time," to combat the climate crisis, and her perspective was echoed by other presenters at the afternoon plenary, including Restore the Delta youth Climate Water Advocate Gloria Alonso Cruz.

Alonso Cruz self-describes as a "beginner" environmentalist, though the 21-year-old may be better considered an expert when it comes to witnessing environmental degradation. When her family immigrated from Mexico to southside Stockton seven years ago, her new neighborhood placed in the highest tier for environmental injustices in the state, including the worst exposure to pesticides, ozone, diesel exhaust, and particulate matter, according to a mapping tool from the California Environmental Protection Agency.

"My cultural background and my lived experiences, as well as my experience working with Restore the Delta, have enabled me to spot the challenges to achieving the livability we deserve in Southside Stockton," said Alonso Cruz, one of six college students trained as Climate Water Advocates by the local nonprofit. Over half a year, the young Stocktonians learned about a vast expanse of issues, from harmful algal blooms and fisheries to the fraught world of California water policy, and how to advocate about these issues within their communities.

Darius Waiters, another Climate Water Advocate and lifelong Delta lover, added that "A lot of the environmental racism and environmental justice obstacles are not due to a lack of evidence, or a lack of awareness... [but are] very much due to a lack of value our leaders are placing in the affected communities and the affected resources." Waiters also emphasized how entrenched structural barriers have prevented most of their peers from enjoying the Delta the way they did growing up.

Fellow presenter Phoenix Armenta discussed work being done by the Oakland Shoreline Leadership Academy to engage frontline youth in their own backyards. The Academy "has shown us that young people can be equal partners in creating solutions to our environmental problems if we provide them with the education and resources needed to support their effort," said Armenta.

Academy curriculum consultant Marquita Price also weighed in to discuss her deeply rooted love for the Oakland shoreline, and her project to create a clean-powered transit loop to connect the shoreline to her home in East Oakland. "One thing I like about the academy is being able to connect with other shoreline lovers, of all ages and from other parts of Oakland, and to co-learn about our shore," said Price. "I grew up with the recreation side, and now we're learning about the history and natural side."

Henriquez and Armenta both touched on the exclusion faced by frontline communities of color when addressing climate change. The Academy participants are "the people

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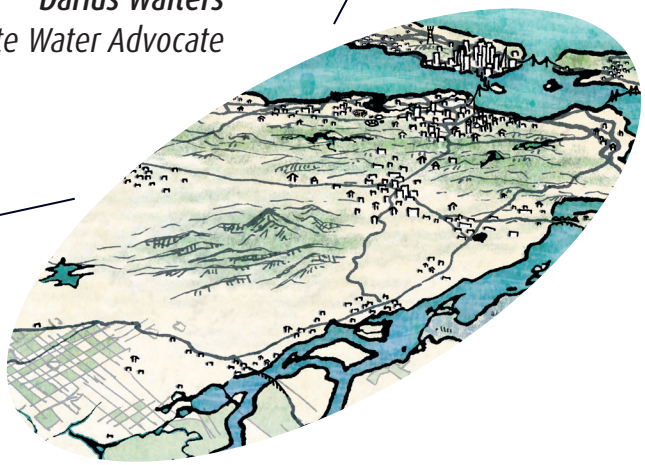
A lot of the environmental racism and environmental justice obstacles are not due to a lack of awareness... [but] to the lack of value our leaders place on the affected communities and the affected resources.

Darius Waiters
Climate Water Advocate


PHEONIX ARMENTA


MARQUITA PRICE


GLORIA ALONSO CRUZ




ROMIE NOTTAGE

When people feel they can do something, it helps lessen doomism.

Lil Milagro Henriquez
Mycelium

Team Tackles Homelessness

"Homelessness is an experience, not an identity," said Romie Nottage at the Summit's afternoon session. Her organization seeks to "provide a path to recover from homelessness" rather than treating homelessness as an end-state of being. The "teams" of Downtown Streets Team are unhoused volunteers that work beautification shifts (cleaning streets and alleyways, for example) for a basic needs stipend (food or transportation assistance) and access to case management. Since 2005, when the program began, team members have on average spent about six months before finding housing and stable employment. By working towards community beautification and building a roadmap to stable, housed living, Downtown Streets Team is "changing the way the unhoused are perceived in the public eye," says Nottage. **MHA**

most affected and least includedin the shoreline planning process," noted Armenta in their presentation.

Young people who are systematically excluded from planning their own future are more likely to feel overwhelmed by the climate crisis, said Lil Henriquez. However, through Mycelium's high school programs, she's seen the benefit that engagement can bring to young people's outlook on the future.

"Take the overwhelming thing and break it down into two to four immediately implementable actions to address adaptation or mitigation," she said, describing the approach the program teaches to participating youth. "When people feel they can do something, it helps lessen the anxiety and doomism."

Young people need to be included in planning our response to climate change, added Phoenix Armenta, reflecting on the essential role youth play in effecting meaningful change. "We can't just pile our hopes onto their shoulders and not give them the tools to make sense of what is happening in the world." **MHA** & **SG**

Closing Thought

At one late-in-the-day final breakout session of the summit, participant Deborah Moore, and environmental advocate, had this to say: "I've been to this conference many times, and this year was really different: it elevated the importance of ceremony, sacredness, and spirituality, emphasized for us the need to yield power, change decision-making, avoid exclusionary expertise. It gave all of us a sense of how if we slow down we can go farther with more people."

Contributing writers: *Ariel Okamoto, Isaac Pearlman, Elyse DeFranco, Joe Eaton, Michael Hunter Adamson & Sierra Garcia. Art: Veronica Chan (p.9), Afsoon Razavi (pp.10-16 summit networks).*

DEEPER DIVE

Summit Recordings

- Morning Session: https://bit.ly/3pwj8Jw
- Afternoon session https://bit.ly/2XDWnrn

RESTORATION

Breaching Season in Full Swing

JOE EATON, REPORTER

In the life of a tidal wetland restoration project, the first levee breach is a major milestone, a kind of graduation. After years of securing funding, navigating the permit process, completing baseline biological surveys, filing endless reports, grading and sculpting the marsh plain, setting out plants —after all that comes the day when the earthen barrier crumbles, the water makes its move, and another marsh can start to regenerate. This fall, that's happening around the Bay Area as three significant projects — Dutch Slough and Lower Walnut Creek in Contra Costa County and Hill Slough in Solano County — renew long-severed connections between water and land.

The three projects involve two state agencies, a county district, and a nonprofit. Dutch Slough is a California Department of Water Resources project on about 1200 acres of former farmland just south of Jersey Island. Lower Walnut Creek, encompassing Pacheco Marsh, is a joint venture between the Contra Costa County Flood Control District and the John Muir Land Trust, and a novel undertaking for both partners. "Flood Control was traditionally a single-purpose district, but more recently has embraced a watershed stewardship role," notes senior civil engineer Paul Detjens.

Land Trust executive director Linus Eukel says 232-acre Pacheco Marsh, at present a degraded seasonal wetland, is the trust's first tidal marsh restoration project. It's envisioned as a refuge for tidal-marsh wildlife when existing marshes are overtaken by sea-level rise. The Hill Slough site, where eight diked ponds managed by the California Department of Fish and Wildlife (CDFW) as waterfowl habitat will be replaced by 649 acres of tidal marsh, is part of the agency's Hill Slough Wildlife Area, near Suisun Bay.

Levee breaches are underway at all three locations: four at Lower Walnut Creek, five at Dutch Slough, thirteen at Hill Slough. Detjens explains what's involved in a typical breach: "We'll be using a large excavator positioned at the side of the last remaining bit of soil in the new channel. The operator will skillfully remove scoops of soil and set it aside until the pressure of the tides takes over and water rushes in. Then the operator removes the remaining soil to make that part of the channel the same size as upstream and downstream."

Sarah Estrella, an environmental scientist with CDFW, says the clustering of breaches reflects regulatory constraints: they have to be completed between September 1 and November 30 to avoid impacts on special-status birds and fish. Tides set further constraints. "We'll do the breaches at Lower Walnut Creek on a high tide to minimize the release of sediment," says Detjens.

Dutch Slough project manager Katherine Bandy says the breaches there will happen on a low, incoming tide, at the time when water elevations in the slough balance with water levels within the site. There's also a turbidity curtain in the slough to minimize the impact of removing the final dirt plug. Supply chain ripple effects complicated the timing of the work at Dutch Slough.

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Amphibious excavator, with a lighter footprint on soggy ground, works Hill Slough breach. Photo: Sarah Estrella.

(L-R) Tour of Dutch Slough in March 2021; Biomonitor Nita Superak flags native Suisun Marsh aster at Hill Slough; Hill Slough breach. Photos: Ken James, DWR & Sarah Estrella, CDFW

Originally, DWR planned to build pedestrian bridges over the breach points before the actual breach, but shortages of construction material forced them to interrupt the bridge-building and complete it after the breach.

Dutch Slough began to change even before the breaches. "As soon as we put water onto the site, wildlife starting showing up," says Bandy. "They wasted no time getting out there. It started at the tail end of 2019 with our irrigation infrastructure — flood irrigation for the tules, drip irrigation for the trees and shrubs. The flood irrigation attracted shorebirds in crazy numbers in the spring of 2020. As the vegetation filled in, we had birds coming into all the vegetation types."

Observers have spotted marsh species like Virginia rail and sora, and the secretive American bittern. Northern harriers and other raptors began cruising for prey. Bandy hopes that special-status birds like the California black rail, historically present at the site, and the Ridgway's rail will put in an appearance. Mammals showed up too: river otters, mink, muskrats, raccoons, coyotes. Even a wandering black bear left its tracks.

As the natural community rebuilds and ecological processes kick in, platoons of researchers will use Dutch Slough as a living laboratory. Some have already done pre-breach baseline surveys; others will watch as things evolve over time. "The US Geological Survey will be out there studying how carbon moves through plants, soils, and water", Bandy explains. "UC Berkeley researchers will be looking at lateral carbon flux. UC Davis and Cramer Fish Sciences will do fish sampling and aquatic food web studies. It all goes hand in hand with our adaptive management policy — marrying science with land management. The research data will help us learn how to better manage the site."

Bandy adds that DWR welcomes any researchers who bring their own funding: "There's a lot of opportunity for whatever people are interested in trying to do with wetland research."

UC Berkeley scientists are also conducting greenhouse gas studies at Hill Slough. Wildlife being monitored there include western pond turtles, a California species of special concern. "We hadn't realized how many turtles there were on the site," says Estrella. The water is too brackish for the exotic red-eared sliders that compete with pond turtles elsewhere. The reptiles are trapped in hoop nets and outfitted with radio transmitters, glued to their shells.

Salt marsh harvest mice are also being studied at the site. Estrella says the restored marsh at Hill Slough will provide habitat connectivity for the mouse, the Ridgway's and California black rails, and two special-status plants, the Suisun thistle and soft bird's-beak. Pacheco Marsh is also salt marsh harvest mouse and black rail habitat; Ridgway's rail is hoped for but not yet confirmed. According to Detjens, Lower Walnut Creek, while not optimal for spawning salmonids, is potentially good rearing habitat for Chinook salmon smolts on their outward migration.

Hill Slough will be open to the public for fishing, birding, and wildlife observation, but, unlike the nearby Grizzly Island Wildlife Area, not for hunting. A two-mile loop trail, connected to Suisun City's Grizzly Island Trail, is already in place. Public access is central to the John Muir Land Trust's plans for Pacheco Marsh, with trails, blinds for birding, and kayak launches. "It will be a wonderful site for birders," says Eukel. There will also be an environmental education center, still in design phase: "There are disadvantaged communities nearby, kids who live in Bay Point who have never been to the Bay. This will help them understand how salt marshes are vital."

Public access at Dutch Slough is farther off: "We're just getting to the phase where we can focus on developing trails and be ready to bring people out," Bandy says. That may happen within the next couple of years. DWR is partnering with the city of Oakley to link a 55-acre city park to the wetlands, and the East Bay Regional Park District plans to extend the Marsh Trail to Dutch Slough.

Estrella has invested nine years at Hill Slough. Her reaction to the project's completion: "It's a big relief." Detjens has led the Lower Walnut Creek project for 18 years. Bandy, who took over as project manager after Patricia Finfrock retired, says she's a relative newcomer to Dutch Slough. "Some people have been working on it for 20 years," she reflects. "Being here at this moment when you're watching it come to life, seeing the animals responding immediately, is so satisfying. It's amazing to be part of it, seeing it happen for real."

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INTERACTIONS

Can Birds and Solar Float on the Same Ponds?

SIERRA GARCIA, REPORTER

In the late 2000s, small-aircraft pilots gliding above the Napa countryside began to notice an odd, glassy glint reflecting off a tennis-court-size patch of land between vineyards. Large solar arrays were less common back then, but the solar panels themselves likely weren't the reason planes doubled back, flying low, for a closer look: it was their placement in the middle of a pond.

Floating solar panels, like the ones Napa's Far Niente winery finished installing in 2009, could be a real windfall for a watery Bay-Delta region seeking carbon-free energy. Secured to buoyant platforms or pontoons, low over the water's surface and at a slight angle, the panels can cover a large area without competing with agriculture or housing for primo sun-drenched land. They slow evaporation from the water sources they cover that might otherwise dwindle to nothing in the summertime. And of course, they make electricity without emitting the planet-heating gases that are deepening droughts, worsening wildfires, and drowning coastlines in California.

With the technology gaining traction, it may not be long before floating solar panels are soaking up the sun atop bodies of water large and small throughout the Delta and San Francisco Estuary. But which sorts of places are best suited for this emerging approach to solar energy?

"It's that old story of location, location, location," says Rebecca Hernandez, an associate professor of ecology and earth sciences at UC Davis who studies interactions between energy infrastructure and ecosystems.

Drawing a parallel to land-based solar, she rattles off two examples of siting with vastly different ecological implications: building solar panels on the roof of a parking garage, or in a natural desert scrubland. It's no hypothetical that California would develop large solar farms on the latter, despite an abundance of sunny parking-garage roofs going unused. Hernandez worries that floating solar could be destined for the same kind of clash in the coming years, and potentially impact vulnerable aquatic and avian species and ecosystems in the race to build renewable energy if siting decisions are not made carefully.

"Birds don't know what [it] is," she adds. "This is the first time in their evolutionary history that they've encountered this really weird, water-looking-like, but very hard material ... on the pond that they used to swim across or fly across." Capping a pond with sheets of gleaming silicon and glass could also impact its ecology by altering water temperature and circulation and affecting the local food web.

Floating solar proponents might point out that the same ecosystems and species that might be disrupted by floating solar arrays also face disruption from a warming and unchecked climate. Carbon-free energy like solar power is a key part of limiting that warming, and it's hard to argue against building more of that energy, and fast.

Complicating the decision-making process about where floating solar should go is that California's aquatic spaces, much like its lands, rarely exist in neat bins of "natural" or "human-made." Constructed reservoirs can still support native species and offer cherished recreational opportunities to human communities, and even a more heavily managed site like a wastewater treatment pond can support wildlife. The small Sonoma County town of Healdsburg boasts the nation's largest floating solar array on its treatment ponds, and Canadian geese there have staked the edge of the array nearest the open water as their own territory—marked by generous splatters of white excrement along those panels.

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Mallard and ducklings join the geese on the city of Healdsburg's wastewater treatment plant power ponds. Photo: Sierra Garcia

Brewer's blackbirds perch on panels at Far Niente Winery in Napa. Photo: Jocelyn Rodriguez

"They're year-long residents, and before we put the solar in, they would hang out on this roadway," says Healdsburg utility director Terry Crowley. "So we're actually kind of happier that they're on that part of it."

Elsewhere, Hernandez says her team has observed some astonishing, even delightful, interactions between wildlife and floating panels. At a Florida research site, otters will play among the arrays while herons strategically hunt off the floats.

And Greg Allen, a Far Niente winemaker and the mastermind behind the winery's first-in-the-world floating solar project, says he still hears frogs chorusing from the irrigation pond that has now been covered with solar panels for well over a decade.

There are still plenty of places floating solar can go that align with the analogue of a parking garage roof more than an undisturbed desert. California's concrete-walled aqueduct system and many wastewater treatment and industrial cooling ponds could be places to start making power and saving water, with minimal disturbance to wildlife habitats.

If floating solar construction accelerates around the San Francisco Estuary, now may be the best and only moment to avoid repeating mistakes made, from an ecological perspective, in the rush to build large solar farms on land. A more cautious approach needn't require stalling floating solar development. But it would likely prioritize areas with less consequential habitat first, by learning where the watery equivalents of "parking garages" are and starting with setting solar panels afloat there. In the meantime, scientists can learn more about whether, and where, more sensitive watery habitats and floating solar can best coexist in peace.

"There is no data out there right now," warns Hernandez. "We are taking a picture of this moving train as it speeds past us."

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(L-R) Bird spotting scope and black phoebe enjoying power panel habitat in Sonoma and Napa; tricolored heron fishing off panel array in Orlando Florida. Photos: Jocelyn Rodriguez

HISTORY

Fish Patrol Still Dangerous Work as CDFW Turns 150

ALETA GEORGE, REPORTER

Lieutenant James Ober worked as a fish biologist with the California Department of Fish and Wildlife for a year before joining its Law Enforcement Division in 2009. "I enjoy interacting with hunters and fishers. Most of them have a great appreciation for the resources and want to protect them," says Ober about being on patrol.

Ober belongs to the tradition of wildlife officers, both personally and professionally. His fifth great grandfather, Edwin H. Ober, was an officer and biologist during the early 20th century, making James the second wildlife officer in his family. Ober is also one of the tens of thousands of officers who have worked to protect the natural resources of the San Francisco Bay since 1871.

This year marks the sesquicentennial of the California Department of Fish and Wildlife (CDFW). The state of California appointed its first Board of Fish Commissioners (today's Fish and Game Commission) in 1870, making it the first wildlife conservation agency in the United States. The following year, the Commission hired two wildlife officers (traditionally called deputies or wardens) to support the laws enacted to protect and preserve the fish in California's waters. "We are the longest, continuously serving statewide peace officers in California, preceding California Highway Patrol by 58 years," says Patrick Foy, captain of CDFW's Law Enforcement Division.

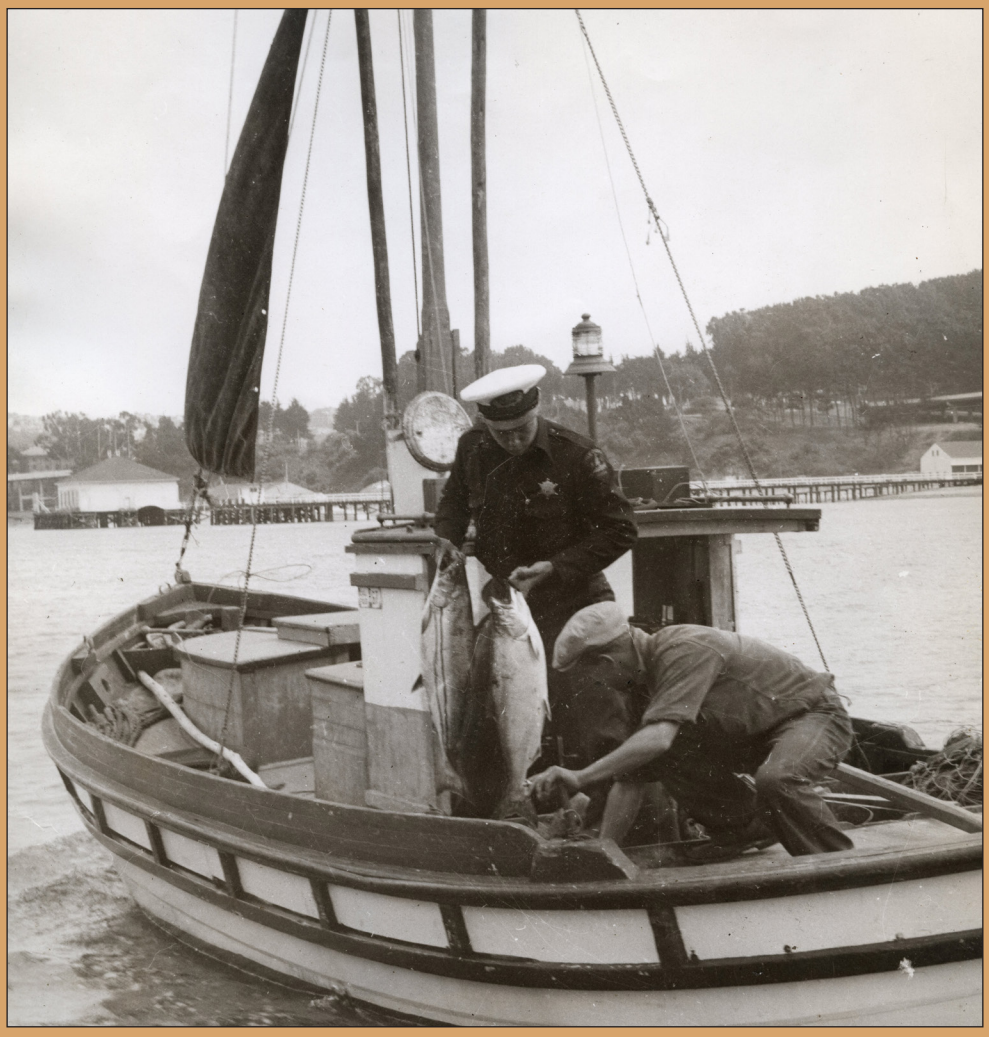
Ober works in CDFW's North Coast District, and his beat of San Francisco and San Mateo counties includes the San Francisco Bay. He and his team patrol the shoreline and piers by vehicle five or six days a week, and about twice a month conduct compliance checks on the Bay in a 26-foot, inflatable Zodiac Hurricane or an 18-foot Boston Whaler Super Sport. Whether on land or water, their job is to ensure that those who are fishing have a license, are taking only their legal limit, and are not taking undersize fish or protected species. They also check that recreational fishers are using required tags, such as those required for sturgeon, and not using an unlawful method of take like a gillnet.

"The vast majority of people fishing in California are law abiding," says Foy. But occasionally a routine compliance check can turn into a verbal or physical confrontation—or worse. Dangerous confrontations are part of the agency's history. "The majority of wardens who lost their lives in the line of duty was in the first 50 years," he notes.

Patrolling in the Age of Sail

In the second half of the 19th century, the San Francisco Bay teemed with fish and fishers. It was still the age of sail, and two-masted ketches and yawls, single-masted sloops, Italian feluccas, Chinese junks, hay scows, and four-masted steel barks laden with wheat harvests crowded the Bay. Wildlife officers dodged boats as they sailed across the water in pursuit of fishers trying to evade arrest. The officers had no radios, and if they carried weapons, they were their own.

Less than a handful of officers covered all of California, but given the fishery action in the Estuary, they



Early California Fish & Game Bureau of Patrol officer inspecting fisherman's catch, likely at Presidio on San Francisco Bay, date unknown. Photo courtesy SF Maritime Historic Park.

spent a good deal of time on San Francisco Bay. In an 1891/92 Fish Commission report, chief of patrol Thomas Tunstead described the qualities required of wildlife officers: "The patrolmen are called upon to undergo all kinds of hardships, to be exposed to wet weather at all times of the day and night, and to come in contact with some of the most brutal and irresponsible classes of men. The position demands shrewdness, bravery, and executive ability of high order."

The most prolific game was Chinook salmon, and most of the fishers on the Bay and in the Sacramento-San Joaquin Delta sold the salmon they caught to canneries and fresh fish markets. The San Francisco market moved up to three million pounds of salmon a year from 1893 to 1898, according to a 1998 paper on the historical abundance of Chinook salmon in California's Central Valley region by Ronald Yoshiyama, Frank Fisher, and Peter Moyle. But the fishers sold most of their snared salmon to canneries, which had an average annual pack of 58,000 cases of canned salmon meat (equivalent to 3.8 million pounds of whole salmon) between 1880 to 1899, reports Yoshiyama. At the height of the fishery in the mid-1880s, an estimated 3,000 fishers on 1,500 boats caught as much as 10.5 million pounds of salmon, numbers that "generally were higher than the total statewide catches made during the most recent several decades," writes Yoshiyama.

By the late 1880s, the Chinook salmon population was shrinking due to overfishing, destruction of habitat, logging, railroad construction, and raw sewage dumped directly into the Bay and the rivers that fed it. As a result, the fishers were more desperate to catch fish, and more willing to break the fish laws enacted by the Commission: no salmon fishing from the end of August to early November; no fishing from sunrise Saturday to sunset Sunday during the open season; and although gillnets had not yet been outlawed, there was a minimum mesh-size requirement.

The fish laws were unpopular with most of the market fishers, and confrontations were the norm. Fishers drew knives and shot at officers from shore. When officers made an arrest, they brought the offender and the evidence (nets and dead fish) into a courtroom, which in some cases was nothing more than a dusty back room in a hotel. Verdicts rarely came back as guilty because the jurors were often other fishers or townspeople who benefited from the economies of the fishery.

With the San Francisco skyline to the west, CDFW patrols the Bay. Photo courtesy CDFW

Violent responses to the fish patrol also occurred on freshwater rivers and streams. Tunstead reported in a 1891-92 report for the Board of Fish Commissioners that after he and a deputy had caught two fishers with an illegal set net staked to the bank of the Russian River, they arrested the offenders and took them before a judge in Guerneville. The jury found them not guilty, even though one of the fishers had admitted to setting the net. An unruly throng of 40 followed the patrol officers to the train station, threatening them all the way. A year later, two deputies found illegal set nets on the Russian River again, and the wife of one of the arrested fishers told the patrol officers, "You will die on the river if you don't leave it and the fishermen alone."

Retired warden Jack Edwards called 1913 the "bloodiest year in the history of California's game wardens" in a 2013 article for CDFW's *Outdoor California* magazine. Although several fatal confrontations that year occurred when officers tried to arrest market hunters on land, a compliance check near San Quentin Point turned fatal when wildlife officers tried to arrest two fishers using an illegal net to catch striped bass. Five other fishers descended on the scene and bludgeoned one of the deputies to death. The second deputy jumped into the water and swam for shore. Officers arrested one fisher, who landed in San Quentin, but the others fled and were not apprehended.

The Pendulum Swings Back

"Officer-involved shootings were far more common in the early days, although the pendulum is unfortunately swinging back into that area of very dangerous encounters on a more frequent basis," Foy says. Since 2005, there has been one officer-involved shooting per year in the state, and last year there were two. (An officer-involved shooting does not necessarily mean that the officer was hit or killed during the incident.) Prior to 2005, the last wildlife officer to lose his life was in the mid-1980s.

Wildlife officer conducting a compliance check aboard a recreational fishing vessel. Photo courtesy CDFW

These days, while the most dangerous encounters are related to compliance checks of cannabis grows with illegal water diversions, there can also be confrontations on the Bay. On the Oyster Point pier earlier this year, an officer asked a fisher for his license. The man had been drinking, and pulled out a knife. The officer called for backup, and a team of three arrested him.

Currently there are 465 wildlife officers that cover 150,000 square miles of California, including the coastline and 200 miles out to sea. Each is a full-fledged peace officer who has had eight and a half months of police academy training. Foy says that in addition to enforcing fishing and hunting laws, the officers enforce commercial fishing regulations for the 66,000 businesses that buy, catch, sell, or process fish. They operate eight aircraft, work with other agencies during fire events, and enforce pollution-control laws that protect drinking water. They also respond to violent crime, domestic violence, stolen vehicles, boating under the influence, reports of weapons and drugs, and human trafficking. Their gear includes two pistols, a traditional police shotgun, a radio with a GPS locator, handcuffs, baton, pepper spray, a taser, and bullet-proof vests.

Foy says the most dangerous part of the job is the unexpected. "You've just finished a contact with five people, with moms and dads and happy, compliant people. Then you get a person who by every indication is just as compliant as the last five, but when you ask for an ID because he doesn't have a fishing license, you learn he is a wanted felon after calling it in. We will literally make an arrest in his boat and take him to jail."

Lieutenant Ober agrees that compliance checks can go awry: "We deal with people who are fishing and also using alcohol or illegal drugs. Then they make poor decisions when we contact them, and they have to be arrested."

Although he was born and raised in Idaho, Ober visited relatives in the Bay Area every summer as a youth and went fishing with his uncle off the Berkeley pier. "I loved the Bay as a kid," he says. "I thought it was very beautiful." He moved to California in 1990 to attend UC Davis and become a fish biologist.

When asked if his fifth great grandfather had anything to do with his chosen line of work, Ober said, "It was independent of him. I want to help protect the resources."

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See anyone poaching or polluting? Call 1-888-334-CALTIP or text 847411.

James Ober's fifth great grandfather, wildlife officer and bighorn sheep expert Edwin Ober, in Big Pine, California, with wife, Peachey, and son, Austin (at left). Front row: Jack and Nettie Porte (listed on the photo as Paiute Indians). Back row: Mrs. and Mr. Callow, Bridget, and unknown. Photo courtesy James Ober.

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