

SAN FRANCISCO

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MARCH 2021
NEWS MAGAZINE
VOL. 30, NO. 1

ONLINE FEATURES
WWW.SFESTUARY.ORG/
ESTUARY-NEWS

EDITOR'S DESK

I'm at a loss for words to describe where we all are today. To my writer's ear, all the words and phrases sound tired: isolation, variant, hard-hit, sorry for your loss, polarized, wreaking havoc



If I hear “wreaking havoc” one more time in association with the pandemic or climate change I'll have to switch to French: “faire des ravages.” Surely we are all *ravaged*. Or in Spanish, “hacer estragos.” The second word means *havoc* but reads like *estranged* to English speakers, another apt word for the otherworldliness of every morning. Sandra Bullock drifting in deep space in the movie *Gravity*. Cut loose and detached.

Let's use these last months of quarantine to think of new words and see with fresh eyes. Repeating these old words makes them more real; we learned that from the echo chamber of social media. Using them over and over, we become parrots. No wonder teens talk about a zombie apocalypse.

In this issue, we use a lot of pretty Estuary management words: *adaptation*, *nature-based engineering*, and *resilience*. These are feel-good words that convey a sense of hope through action. But we need some more ballsy words. The climate isn't just changing. Our food isn't growing. Freedoms are being withdrawn around the world. Drinking water is no longer a given, even in 'Murica. The hollow of inequity isn't being filled fast enough.

Let's use this stall in time to challenge our imaginations. Let's find new words by letting go and grabbing hold. I'm listening for evolution in all this extinction. Tell me more.

Ariel Rubissow Okamoto
Editor

PS: Enjoy the smattering of spring wildflowers throughout the issue!

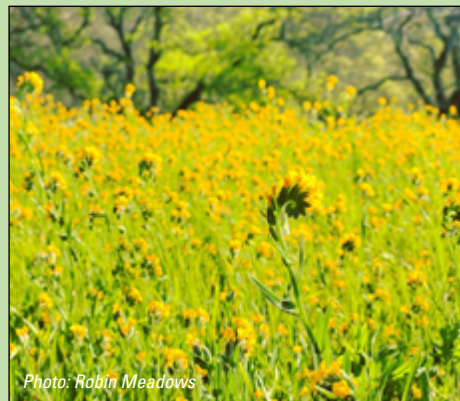
HOUSEKEEPING

Refreshing the Estuary Blueprint

CARIAD HAYES THRONSON, REPORTER

The San Francisco Estuary Partnership's next update to its 2016 Comprehensive Conservation and Management Plan for the Estuary — or Estuary Blueprint — will bring a new focus on equity and environmental justice to ongoing efforts to restore and protect the Bay and Delta.

“We really want to do more to engage communities of color and indigenous communities as partners in our work,” says Partnership director Caitlin Sweeney. “So we are looking at all our actions and initiatives through the lens of environmental justice and racial equity inclusion, as we do with climate change.”



Sweeney says the update's steering committee is taking a multi-pronged approach to integrating equity and environmental justice into the Partnership's work. “We are looking at every single one of the Blueprint's listed actions and asking a series of questions about it,” she says — including questions about the unintended consequences of actions, and where there are opportunities to include equity considerations.

The Blueprint occupies a unique niche in environmental planning, in that it is “the only plan that covers all aspects of environmental protection for both the Bay and the Delta,” says Implementation Committee chair Tom Mumley of the San Francisco Bay Regional Water Quality Control Board. The Blueprint, which is updated every five years, is the product of a collaborative process

that involves more than 70 agencies and organizations. The 2016 update — which reflected a major overhaul of previous versions of the plan — included 32 specific actions tied to both urgent priorities and long-term goals.

This time around, “we're not talking about a comprehensive rewrite, we're looking for strategic improvements,” says Mumley. “It will give us the opportunity, though, to look at better integration of the existing actions and tasks.”

Another new focus is to invite the social sciences into the Bay-Delta management conversation. According to Implementation Committee vice-chair Amanda Bohl of the Delta Stewardship Council, “The social sciences add value to the natural science research that's already going on, and there are a lot of areas where the two can be interacting and connecting better.”

Sweeney adds that a related topic being explored is the overall area of human dimensions. “We understand that the health and vibrancy of our communities is very much tied to the health and vibrancy of our natural systems,” she says, citing proximity to open space and its impact on community health. “We've seen great examples of that during the pandemic, how important it is to get out to open spaces.” Sweeney expects the updated Blueprint to be released in early 2022.

Take Our Survey on the Blueprint

www.surveymonkey.com/r/estuary-blueprint

ESTUARY VOICES MARCH 2021 PODCAST

Turning Up the Volume on the Human Dimension of Estuary Management

With Caitlin Sweeney & Amanda Bohl

LINK: www.sfestuary.org/estuary-news-catching-up-estuary-blueprint-update

R E S T O R A T I O N

Nourishing Encinal Beach

ALETA GEORGE, REPORTER

Before the East Bay Regional Park District completed the Encinal Dune Restoration and Shoreline Stabilization Project in December 2020, this tucked-away beach frequented by locals and harbor seal enthusiasts needed some love. The ice plant that dominated the low-flung dune offered little sustenance to fauna; the beach required more sand; the washed-up creosote-treated timber was strewn about like a giant game of pick-up sticks; and the large, rusty barge that buttressed a short section of the San Francisco Bay Trail had become dangerous.

The nearly two-acre project site in the shape of an arrowhead includes Encinal Beach, the dune behind it, and a short section of the Bay Trail. Encinal Beach and its adjacent dune formed after the U.S. Navy installed a mile-long rock jetty in the 1940s off the southeastern shore of the Naval Air Station, now Alameda Point.

To improve this locally loved site, East Bay Parks came up with a plan to “nourish” the beach and dune into a more natural condition and to improve recreational access. District landscape architect Carmen Erasmus and district fishery biologist Joe Sullivan identified a series of restoration steps and associated materials necessary to achieve these goals.

First the District trucked in medium-grain sand to elevate the beach and reduce the frequency of dune inundation during extreme high tides. At currently predicted estimates of sea-level rise, this measure should last for about 50 years. The nourished beach also improves non-motorized boat launching access to the San Francisco Bay Water Trail.



Mother and son stop on the Bay Trail to study the seals. Photo: Richard Bangert

Oakland’s Hanson Aggregates supplied the beach sand after extracting it from Point Knox Shoal in the San Francisco Bay.

In another important restoration step, the District weeded the ice plant matting the dune, brought in virgin marine sand from the Bay to raise it, and sculpted hillocks to enhance plant and wildlife habitat.

Next, workers seeded the dune hillocks with native plants and grasses such as pink sand verbena, beach evening primrose, and California poppies. As soon as they planted the seeds, rock pigeons swooped in for a feast. “Even with the pigeon

feeding, we are hopeful the area will fill in as designed, given the current new growth,” says Erasmus.

Removing the creosote-treated logs required that East Bay Parks scoop them up and take them to a landfill licensed to handle creosote-contaminated waste. The old barge used for stabilization had become rusty and eroded with sharp edges. “The barge popped right out, and there weren’t any hazardous materials underneath it,” says Sullivan gratefully. After removing the barge, the next step was buttressing a short section of the Bay Trail with riprap

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Photo: Carmen Erasmus



Packed harbor seal float corresponds to herring spawning in December 2019. Photo: Richard Bangert

that Dutra Materials supplied from a San Rafael rock quarry. It was tested and certified as being free of clay and other organic matter. "Replacing the rusty barge with rock provides better habitat for shellfish," says Sullivan.

These improvements brought a total of 340 dump trucks full of sand and rock to the site, according to Erasmus. All the work near the waterline was done at low tide to protect water quality.

East Bay Parks' finishing touches involved improving recreational access and enhancing habitat. Workers repaved a section of the Bay Trail, installed a split-rail fence to protect the dune, and planted coast live oak, toyon, and ceanothus behind the new bathrooms that, along with two new boat launching ramps for motorized vessels, were installed by the City of Alameda.

This project has been on the District's wish list for at least ten years, but funds and permits were difficult to assemble until 2016. The San Francisco Bay Restoration Authority contributed \$450,000 to the \$1.1 million project, using local tax dollars from Measure AA, the San Francisco Bay Clean Water, Pollution Prevention, and Habitat Restoration measure passed by voters in 2016. East Bay Parks, which leases the land from the City of Alameda, matched that amount with funds from Measure WW, approved by voters in Alameda and Contra Costa counties in 2008. A grant from the National Fish and Wildlife Foundation also contributed \$200,000 to the effort.

To report this story, I visited Encinal Beach in February and found people enjoying the site on an unseasonably warm weekday. Kids played on the beach and in the water; kayakers launched from the beach and paddled around Seaplane Lagoon; and masked cyclists, runners, and recreational walkers made good use of the repaved trail.

With more people using the shoreline during the pandemic, the City of Alameda started receiving complaints that some kayakers were paddling too close to the seals.

To check out a rare treat in Seaplane Lagoon, I walked west on the Bay Trail for a short distance to view a harbor seal float anchored 300 feet from the shoreline. The float was installed in 2016 by the Water Emergency Transportation Authority to mitigate the loss of an old wharf used by seals that was being removed for new docks.

I learned from the Alameda Point Harbor Seal Monitors Facebook page that this is the only custom-built haul out designed for harbor seals in the world. The raft has a sloped end to make it easier for the seals to get

out and warm their blubber, something they need to do for survival. Since 2016, volunteer monitors have counted and recorded the number of seals that use the raft daily. When people were social-distancing on December 14, 2020, a record number of 86 seals piled onto the 500-square-foot raft.

With more people using the shoreline during the pandemic, the City of Alameda started receiving complaints that some kayakers were paddling too close to the seals. City managers asked the monitors to help them develop signs to remind paddlers to keep a distance of at least 300 feet from the raft, especially during pupping season from March to July. Unlike the boisterous and seemingly entitled sea lions at San Francisco's Fishermen's Wharf, harbor seals spook easily, and if they continually feel threatened at their haul-out site, they won't return. That loss would be significant, as it is the only spot in the East Bay between Yerba Buena Island and Newark where they haul out. It would also be a loss for people.

"There's a whole universe of wildlife below the water surface, and here you can walk down a public trail and see the seals with your naked eye," says volunteer monitor Richard Bangert. "It helps people connect to the marine ecosystem of the Bay."

Now that the pandemic is sending so many more in search of open air and nature, voters' investments in shoreline improvements are proving more valuable than ever.

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S C I E N C E

Scientists Nail Climate Links to Extreme Events

ROBIN MEADOWS, REPORTER

While a supermajority of Americans finally believe we are warming the world, a 2020 Yale Climate Opinion survey shows that most people still aren't very worried about it. "Climate change is abstract to them," says UCLA climate scientist Daniel Swain. "They don't connect it to their personal lives."

But Californians do. Reeling from a decade of record-shattering drought, heat waves, and wildfires, people in the Golden State overwhelmingly tell Public Policy Institute of California pollsters that the effects of global warming have already begun. Indeed, Swain confirms, researchers can now link climate change with some of today's extreme events beyond a reasonable doubt.

"Climate change is a slow process, it kind of sneaks up on you, but we're at the point where it's not so sneaky: it's here now," says Michael Wehner, a Lawrence Berkeley National Laboratory climate researcher and a lead author on both the latest and the next Intergovernmental Panel on Climate Change reports. "We've been able to quantify effects on the weather, and those have effects on our lives."

Attributing a particular extreme event to climate change is a young field that has seen great gains in a short time. "It all started in 2002, when Myles Allen's house got flooded," Wehner recalls of his colleague at the University of Oxford in England. "He lived too close to a river." Allen was sure climate change had played a part in his predicament, sparking him to pin down global warming's contribution to extreme events.

He got his chance just a year later, when Europe suffered an intense heat wave that withered crops and killed more than 30,000 people: Allen co-authored a 2005 study in the journal *Nature* showing that climate change had doubled the risk of this catastrophe. "This was the first quantitative statement on attribution of extreme events to climate change," Wehner says.



March wildflowers (brodiaea) in Contra Costa County. Photo: Robin Meadows

To assess whether — and how much — climate change influenced an individual event, researchers combine historical trends with climate models. The latter are run both without and with the extra carbon people have pumped into the atmosphere, thus comparing what would have happened without global warming to what actually happened. This shows that climate change already makes some extreme events more severe and/or more likely, even tipping them over the edge between possibility and reality.

The clearer an extreme event's connection with temperature, the higher our confidence in its attribution to climate change. "Any time there's a record heat wave, it has a very distinct human fingerprint," says Swain, lead author of a 2020 primer on attributing extreme events to climate change in the journal *One Earth*. "That's a slam-dunk example."

Next on the confidence scale for individual events are the wild swings in precipitation that cause intense rainstorms at one end and severe droughts at the other. While these events have multiple influences, the climate signal is still relatively easy to tease out. "Hydrological extremes are strongly related to the level of warming," Swain says, telling me this is because a temperature increase of one degree Celsius boosts the atmosphere's capacity to hold water vapor

by seven percent. "Wow!" I exclaim. "That is a wow," he agrees.

This escalating impact of warming on atmospheric moisture worries Swain even more than the warming itself. The 1.3-degree Celsius rise in average global temperature since the 1880s translates to a nearly 10-percent bump in how much water the atmosphere can hold. The impact of this is huge. "It increases the propensity of the atmosphere to act as a sponge and suck up moisture," Swain explains. "A thirstier atmosphere increases the flood risk when it does rain, and also increases drought and wildfire risk."

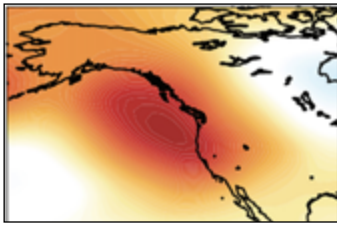
And Wehner thinks climate change may make the atmosphere even thirstier than expected. He and his colleagues discovered that in hurricanes like Katrina and Harvey, the rainiest parts greatly exceeded the seven-percent rule. "Climate change makes the most intense storms more intense, and it's raining more in the most intense storms," he says. Likewise, his current work on atmospheric rivers in California suggests that these storms can also dump even more rain than predicted.

The bottom of the confidence scale for individual extreme events includes wildfires, which are among the trickiest to attribute to climate change. "Wildfires are hard," Wehner says. People affect fire risk in so many ways, from suppression to land-use practices, that it's difficult to pick up on the climate signal for a given conflagration.

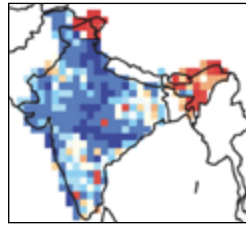
That said, Wehner believes climate change was a factor California's latest and worst wildfire season, when nearly 10,000 fires burned more than 4.2 million acres. In particular, he suspects global warming influenced the lightning complex blazes that raged through the coast ranges flanking the San Francisco Bay, forcing more than 100,000 people to evacuate and shrouding many more in a pall of acrid smoke that spread across the country.

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Step 1: Define the Event



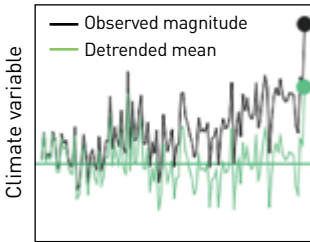
2013 California drought



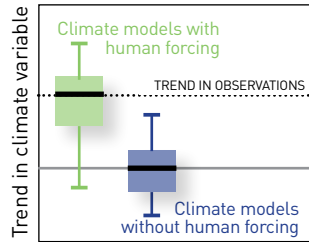
2013 India floods

Step 2: Estimate the Counterfactual

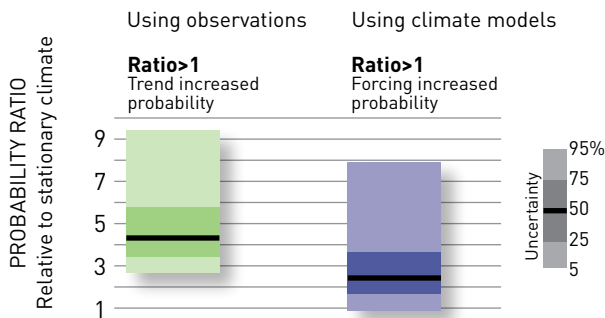
Using observations



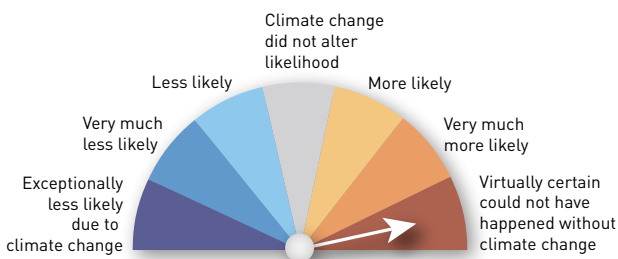
Using climate models



Step 3: Compare Actual and Counterfactual



Step 4: Make Formal Attribution Statement



Comparing the actual (what happened with climate change) to the counterfactual (what would have happened without climate change) shows whether and how much climate change affected the likelihood and/or magnitude of an extreme event.

Source: David Swain

"It's quite obvious to me that fire risk increases with climate change," Wehner says. "Heat dries out plants, leading to an earlier fire season — and if it's flammable earlier, you're going to have more fires."

Mitigating carbon emissions is obviously the only real fix for global warming. But in the meantime, understanding how climate change affects extreme events in specific

places can inform decisions by regional planners and land-use managers, who must adapt to the changes that are already here and prepare for those yet to come. "We certainly know enough to act," Wehner says, noting that he is speaking for himself rather than in any official capacity. "I think we're at that point."

Swain concurs. "It gets a little old as a climate scientist to be constantly delivering bad news," he says. "The good news is there's a lot we can do about it." To help speed that effort, Swain is collaborating with the Nature Conservancy as their first California Climate Fellow.

"We can't stop the extreme events that climate change is forcing, but we can plan for them," says the Nature Conservancy's Dick Cameron, whose focus is managing land to provide climate solutions that benefit both the environment and people.

Ways to accommodate deluges from atmospheric rivers include creating bypasses and restoring wetlands to slow floodwaters down, taming their destructive potential. And we can

get ready for droughts by actively recharging groundwater during wet years as well as by adjusting agricultural practices. Planting cover crops — like the rows of brilliant yellow mustard between wine grape vines — can boost the soil's capacity to retain water.

Another agricultural practice that could be adjusted is overplanting perennial crops like nut trees.

Unlike annual crops, which can be fallowed when water is scarce, nut tree orchards are thirsty even during droughts. But perennials could be capped to keep their water use from outstripping groundwater recharge rates, making these crops sustainable during dry years.

Adaptations to California's new era of mega-wildfires vary by ecosystem and whether or not people live there. In forests, Cameron recommends managing fuel with prescribed burns as well as by thinning small trees and brush. And he recommends defensive measures in populated areas of the coast ranges, where fire is driven by fall winds over chaparral and oak savanna that are basically tinder after the hot, dry summer. Home protections include fire-proof materials and a non-combustible surrounding that serves as a fire break. On a larger scale, riparian zones, vineyards, and orchards can buffer communities by slowing fires.

"The impacts of climate change have come faster and more severely in California than expected," Cameron says. "It's crazy and it's scary." He fears extreme events will soon spiral further out of control. "The atmosphere is loaded for these kind of events — there are time bombs in the system," he says. "We need to make investments to help people and nature adapt."

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CONFERENCES COMING UP

Bay-Delta Science

April 6-9
Remote

State of the Estuary

September 27-28
Remote backbone

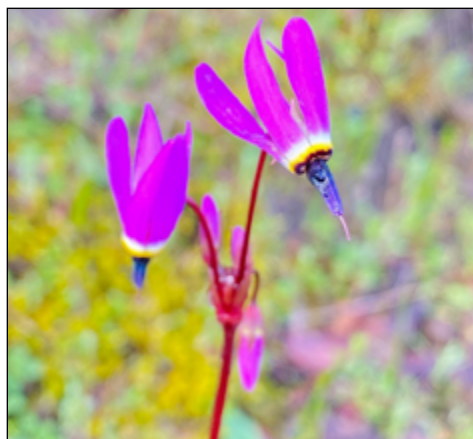
Delta Study Predicts Stronger Floods and Less Water

ISAAC PEARLMAN, REPORTER

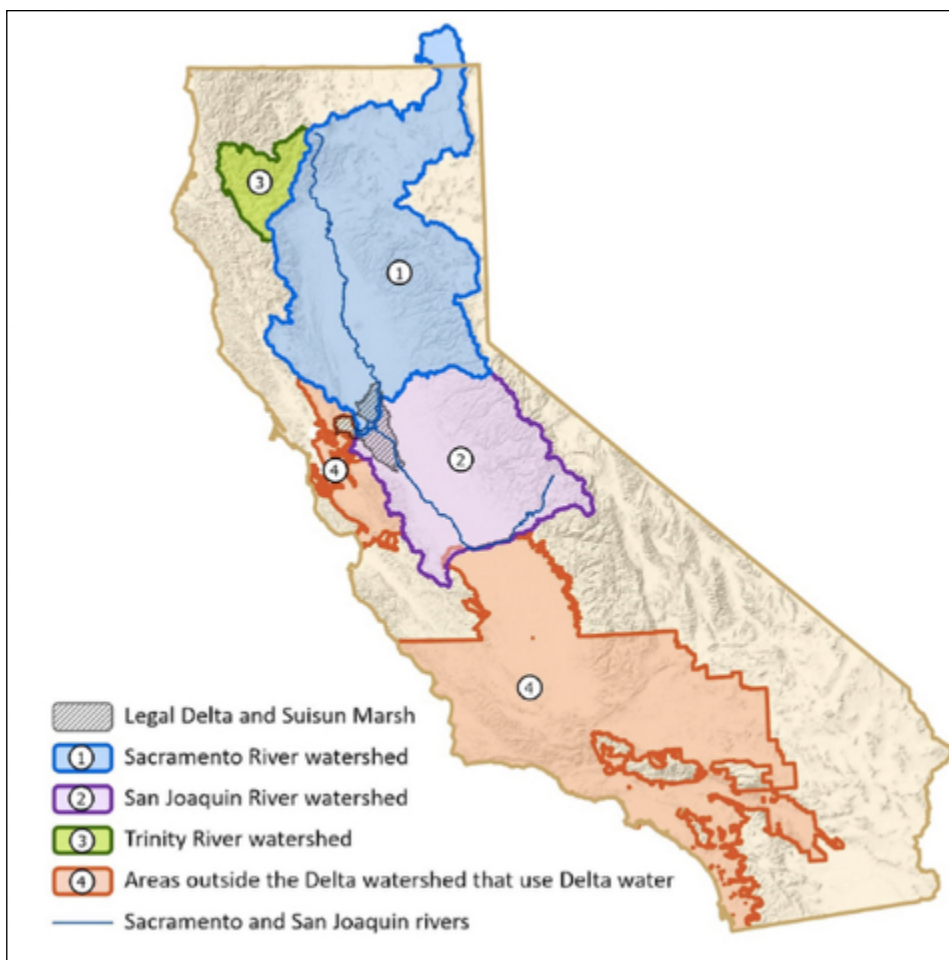
Though most don't realize it, practically all Californians are linked to the Bay-Delta region via its triple function as a source of drinking water for some 27 million Californians, a critical water provider for the Golden State's hefty agricultural industry, and a rich and unique ecosystem. But for those who live in the legal Delta zone — some 630,000 people — the braided weave of the Sacramento and San Joaquin Rivers and their maze of associated wetlands and levees provides a place of home, community, and recreation. And, as a recent study by the Delta Stewardship Council shows, climate change is tugging on the watery thread holding it all together.

"Two-thirds of Californians get their water from here, which is why climate change in the Delta has a large effect on statewide water availability," says Harriet Lai Ross, assistant planning director with the Delta Stewardship Council. "There are over 750 species in the Delta, and we are part of the state's three-trillion-dollar economy. [Our climate study] is the first time we've looked at all of the pieces comprehensively."

The council's overview reveals a grim outlook for the millions of people that are tethered to the region's water: drought similar to that experienced in 2012-2016 will be five to seven times more likely by 2050. This will result in more severe and frequent water shortages and, as the report bluntly states, "lower reliability of Delta water exports."



Shooting stars, spring blooms. Photo: Robin Meadows



This map depicts the Delta (gray hashed area) in the context of its watershed (areas 1-3) and areas outside of the Delta that receive exported Delta water (4).

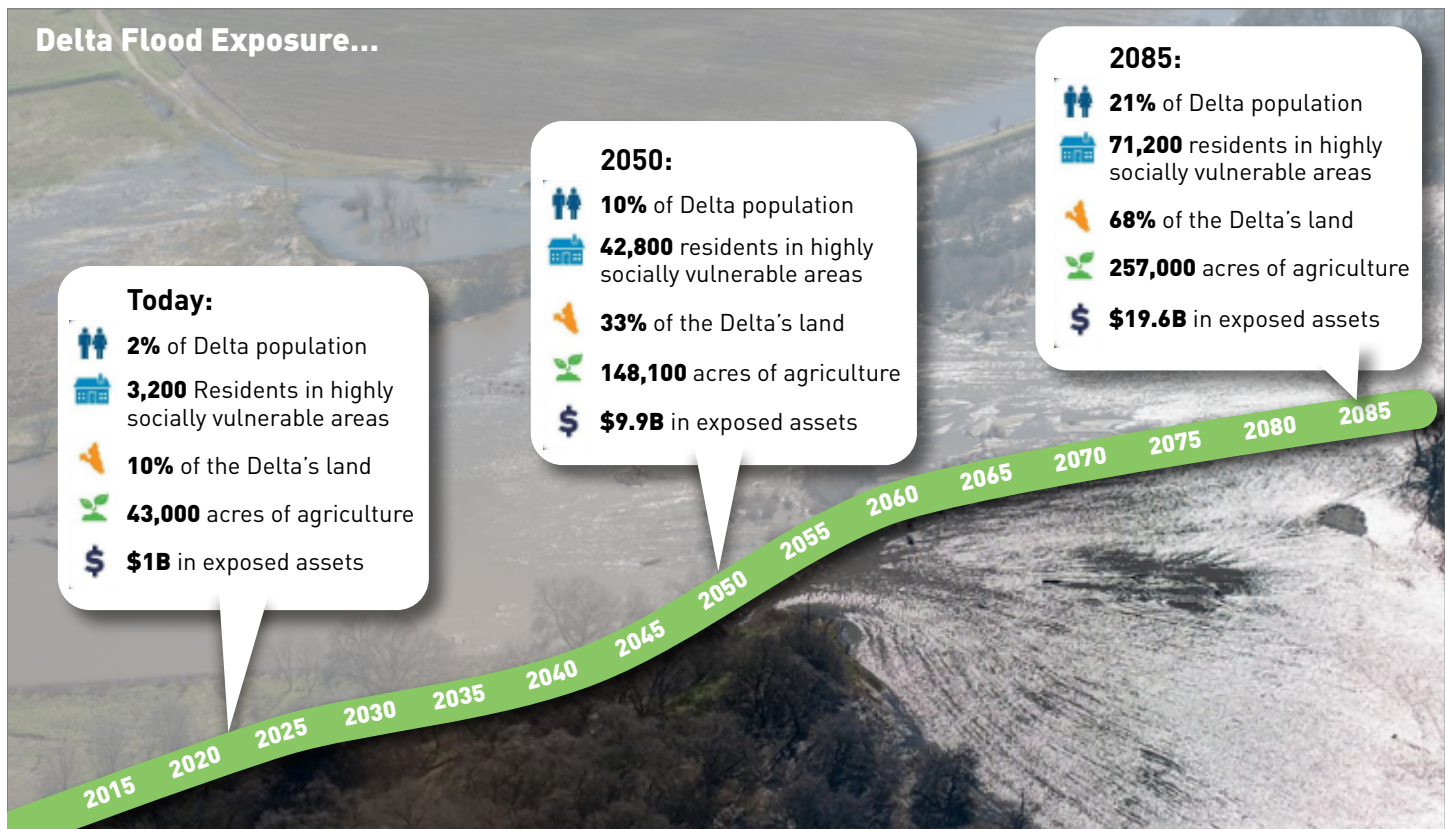
Drought's wet twin, flooding, is also projected to significantly impact the region which acts as a hub where tides, sea-level rise, river inflows, and storm surge all combine to churn the Delta's muddy waters. The highest-flood-risk areas identified in the study include Suisun Marsh and its mosaic of wetlands managed by private duck clubs, the city and Port of Stockton, and subsided Delta islands.

Also at risk is a range of infrastructure including the I-5 freeway, Stockton's Dameron Hospital, historically significant sites like the Sperry Flour Mill and Isleton's Chinese and Japanese commercial districts, and — somewhat ironically, given their role in perpetuating climate change — roughly \$800 million worth of oil and gas pipelines, wells, and stations scattered around the Delta.

But some impacts touch the Delta community in ways more significant than flooded infrastructure does. "The proliferation and increase in harmful algal blooms is a huge change," says Barbara Barrigan-Parrilla, executive director of the nonprofit Restore the Delta. "I work with youth who are saying 'When I grew up I used to go boating, fishing, swimming, but I don't do that anymore,'" she says pointing out that the toxic blooms, exacerbated by warmer temperatures and reduced river flow due to drought, have altered their relationship with the Estuary. "And just think — if young adults are already saying this now, what is it going to be like for their kids?"

As we've seen with the current pandemic, impacts are not felt equally during a disaster. The study found that almost two-thirds of residents at risk of flooding in 2050 are

continued on next page



Flood exposure indicates the Delta-wide people, assets, and resources exposed to flooding by levee overtopping during an event with a 1% annual chance of occurrence given climate conditions at each planning horizon. Graphic adapted from Delta Adapt, Delta Stewardship Council.

“socially vulnerable” — for example, those with asthma who suffer more from wildfire smoke; or families with elderly or young children who require more assistance during an evacuation. Along with minorities, renters, and low-income residents with less access to social services or air conditioning, people in these more-susceptible demographics are hit harder and take longer to recover from a flood or heat event than those in wealthier neighborhoods. The cities of Tracy and Stockton are projected to be hit particularly hard by increasing temperatures, and San Joaquin County (especially Lathrop and Stockton) by increased flooding.

At press time, Ross and her team were collecting public comments on the draft assessment, which will inform the next step to develop and prioritize resilience strategies for the region. According to Ross, key challenges are the usual suspects: lack of funding, and for the Delta Stewardship Council limited authority to implement the necessary changes on the ground which are the purview of a host of agencies ranging from Caltrans to PG&E to local city and county governments.

“I think we know what the answers are,” says Ross about needed climate adaptation actions. “A combination of flood-control improvements, targeted ecosystem restoration, and helping farmers continue to farm where it makes sense to, which is the heritage and primary land use of the Delta.”

Minorities, renters, and low income residents take longer to recover from a flood or heat event.

Barrigan-Parrilla, however, is more frank about the need for action. “I don’t think there is room anymore to allow this to just be a report,” she says. “If this stops at a report and nothing changes it’s going to be hard to maintain the goodwill of the community — especially the younger generation.”

As if to punctuate the study’s findings, in the last few months the U.S. Bureau of Reclamation announced that agricultural water service contractors served by the Central Valley Project will initially receive only 5% of their allocations, and the State Water Project announced an initial estimate of just 10% of historical water deliveries to city and agricultural customers. Even with March rains, the U.S. Drought Monitor reported that 99% of California is “abnormally dry” and 30% is in “extreme” or “exceptional” drought. All of which starkly underlines the first sentence of the 200-page draft report: “The time to act is now.”

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W A T E R S H E D

Sub-Standard Snow

ASHLEIGH PAPP, REPORTER

At a glance, the recent winter storms and inches of snow in the Sierra seem like a reassuring sign: more snow means more snow melt, which means more water moving through our freshwater systems during dry summer months.

But it turns out that there are different types of snow with differing levels of moisture locked up inside — and the latest Sierra snowfall appears to be holding less water than usual. This means the Bay's streams and estuaries could have drier conditions ahead, despite this winter's semi-regular storms.

Typically, snow that falls along the Sierra has a high moisture content because of the mountain range's proximity to the Pacific Ocean, says Dan McEvoy, a regional climatologist with the Western Regional Climate Center in Reno, Nevada. But when storms instead originate in the north and travel over land before hitting the Sierra, a snowflake with more air and less moisture falls.

To quantify the amount of water in snow, researchers calculate the "snow water equivalent," or SWE. "Right now, the entire Sierra is below average for SWE," says McEvoy. Currently, snow in the central Sierra region, from Lake Tahoe to Bridgeport, has about 65 to 75% of its SWE, while the southern Sierra snow holds only 40 to 50% of the moisture compared to historical snow records.

According to McEvoy, it is possible for the water equivalent in Sierra snow to rebound this season, "but the odds are favoring below normal." We'll need to see multiple, significant snow storms delivering water-dense flakes in the next month or so to get the slow-release water that's necessary to sustain normalcy in our estuaries and wetlands.

In general, snow is seen as such a valuable resource in California because it acts as a natural reservoir for water: as temperatures

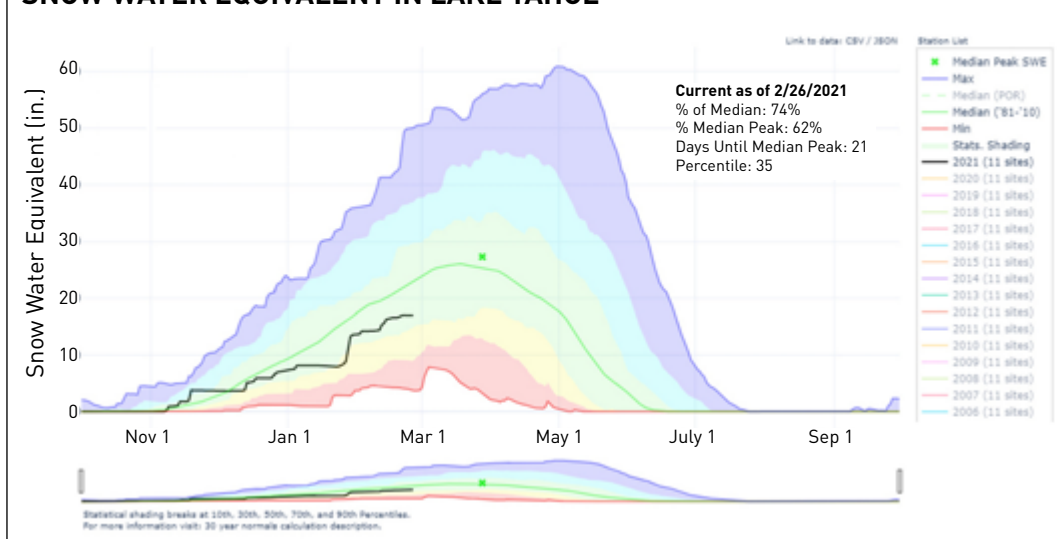
warm throughout the year, water is released little by little. Less water available in the snow that's currently falling in the mountains means less water for all of the systems downhill later this year.

"Less water stored as snow in the Sierra may ultimately mean less water for Bay Area wetlands," says Bea Gordon, a PhD researcher

According to Ajami, much progress has been made in managing the Bay Area's freshwater as one, collective system. "The Bay is in a much better place than it was 20 to 30 years ago, but now the focus needs to be on climate-change impacts and how they are altering the Bay's fragile equilibrium."

Other contributors to that equilibrium are water conservation and recycling programs, activities that Northern California has begun to embrace more seriously as drought conditions have persisted in recent decades.

SNOW WATER EQUIVALENT IN LAKE TAHOE



Source: NRCS

at the University of Nevada, Reno's Hydrologic Sciences department. "If water supplies are reduced, difficult decisions will have to be made about where water goes, particularly when it comes to the environment."

California's freshwater is tightly regulated. From snow in the Sierra to water flowing through the Sacramento River into smaller estuaries, water-infrastructure systems built in the 20th century control where nearly every drop of water flows. But as our climate changes and weather patterns shift, more and more pressure is being placed on our water systems.

"As we get less snow, less melt, and less water, nothing downstream is changing: the people are still there," says Newsha Ajami, director of urban water policy at Stanford University's Woods Institute for the Environment. "One side of the equation is changing but not the other."

Local organizations including the East Bay Municipal Utilities District (EBMUD) are looking at a wide array of future weather scenarios to outline what needs to happen for freshwater to continue flowing to all of the Bay Area. Recent progress for the district includes setting water-use targets for urban suppliers, increasing adoption of recycled water, and focusing on groundwater conservation. (With an eye on the future, the district also recently approved a plan to become carbon-neutral for their water operations by 2030).

"Climate change is a growing threat to our planet and community," says Jolene Bertetto, EBMUD Water Conservation Representative. "It's really about making water conservation a way of life in a state that is drought-prone."

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P O L I C Y

Flow Rules Stalled As Tunnel Advances

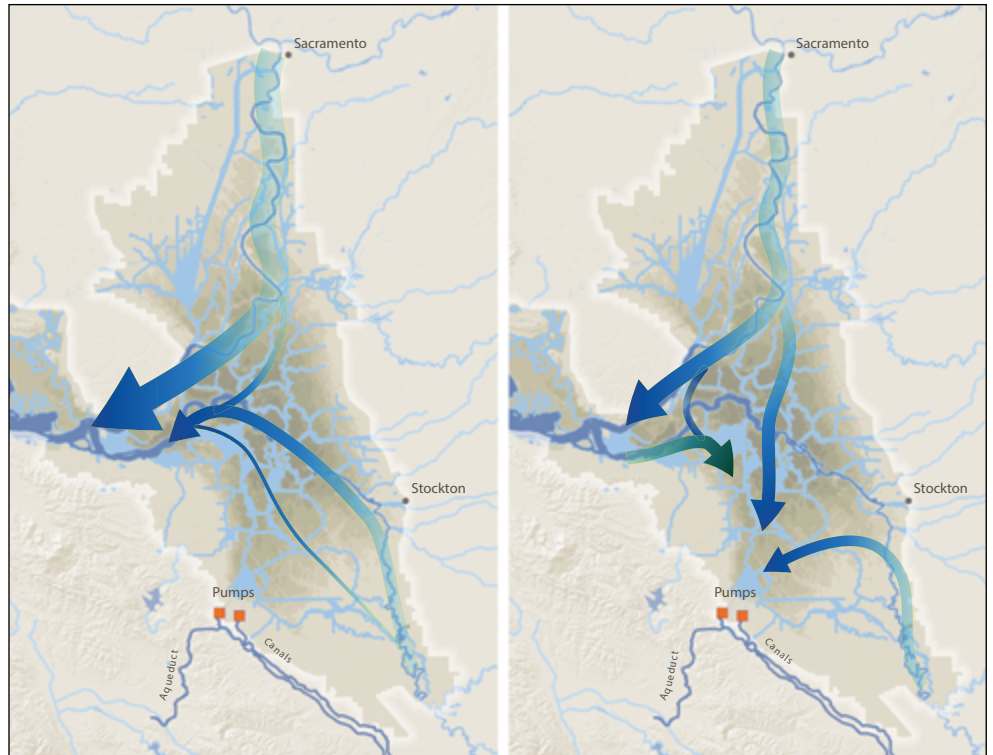
CARIAD HAYES THRONSON, REPORTER

As California stares down the barrel of yet another dry year, alarm bells are already ringing over conditions in the Delta. Environmental groups, fishermen, tribes, and a host of others are calling on the State Water Resources Control Board to complete and implement a long-delayed update to the Water Quality Control Plan for the Bay and Delta (Bay-Delta Plan), to protect the imperiled ecosystem. At the same time, plans for a structure with the potential to divert more water than ever to southern cities and farms are creeping ahead.

By law the Bay-Delta Plan — which establishes minimum flows through the Delta from the Sacramento and San Joaquin Rivers and their tributaries — is supposed to be reviewed every three years; however, parts of the plan have not been amended since 2006. “By some measures we are now 12 years into a triennial review,” says San Francisco Baykeeper’s Jon Rosenfield.

In 2018, the State Board seemed to be on the verge of completing the update: it adopted instream flow objectives for the lower San Joaquin River and its tributaries (known as Phase 1), calling for 30% to 50% of unimpaired flows, and released the framework of a similar plan for the Sacramento River and flows into and through the Delta (Phase 2). However, in an effort to avoid time-consuming litigation and water rights adjudications, the state halted further work on the update, hoping to reach “voluntary settlement agreements” with water users.

These agreements might permit lower instream flows in exchange for “non-flow” measures such as habitat improvements to meet environmental goals that include the Delta Reform Act’s requirement to double populations of endangered Chinook salmon. To date, water users and state agencies, including the departments of Water Resources and Fish and Wildlife, have proposed several voluntary agreement (VA) frameworks; however, none have been submitted to the Board for approval.



These 2018 Delta maps provide a very generalized picture (not for planning or scientific purposes) of 1) flow patterns in absence of pumping, and 2) flow patterns when river inflows are low and pumps are operating. (Patterns may look different under a variety of conditions). Map: Amber Manfree

“The last public presentation of a voluntary agreement proposal that we saw was in February of 2020,” says Rachel Zwillinger of Defenders of Wildlife, one of the NGO’s involved in the discussions.

The stalemate is due at least in part to political skullduggery around new biological opinions (BiOps) for endangered Delta species that would allow increased diversions from the Central Valley Project and deliver on then-President Trump’s promises of more water for agricultural interests. In July 2019, federal scientists completed work on new BiOps (which are required by the federal Endangered Species Act and govern joint operations of the Central Valley Project and the State Water Project) that had been initiated during the Obama administration. Their report found that increased pumping would harm populations of several protected species, including winter-run Chinook, steelhead trout, and orcas, which feed on salmon in the ocean.

However, the U.S. Department of the Interior, under then-Secretary

and former Westlands Water District lobbyist David Bernhardt, suppressed the report, and the team that produced it was replaced with a different team charged with reversing the findings. Final BiOps released later that year found that the Trump plan would not jeopardize endangered fish; California and several environmental groups then sued the administration over the rolled-back protections. (Newly public documentary evidence in the state’s suit seems to confirm what many observers had suspected: the final BiOps process was politically tainted, with scientists sidelined and science buried.) Water users had hoped to use the Trump BiOps as the baseline for voluntary agreement negotiations, but walked away from negotiations when the suit was filed.

Recent State Board meetings have included numerous calls from stakeholders for the Board to move forward with the water quality plan, and one Board member has called for an update. However, upcoming meeting agendas do not include items related to the plan.

“What we’ve seen over the last year is that the Board is just waiting and waiting and waiting for a voluntary agreement that may never arrive,” says Zwillinger. “And in the meanwhile, we’re watching the estuary continue to crash and endangered species sliding closer to extinction.”

Indeed, deeply ominous signs abound. Recent fish sampling programs found only a small handful of Delta smelt, and scientists are openly discussing 2021 as the year the species goes extinct in the wild. As for salmon, the pre-season ocean abundance forecast is only about 271,000 fish — about 200,000 less than in 2020 — indicating that fishermen will face significant restrictions this year, according to John McManus of the Golden State Salmon Association. And last year the Delta was plagued by some of the worst harmful algae blooms ever seen, in part because of inadequate freshwater flows.

“I just can’t stress enough how bad the water quality was here this last year,” says Restore the Delta’s Barbara Barrigan-Parrilla.

Some believe that with a new, much more environmentally friendly federal administration in charge, the water users may have an incentive to come back to the table. One of President Biden’s first actions in office was to initiate a review of Trump administration regulatory actions, specifically identifying the Delta BiOps as warranting quick evaluation. “I understand the water districts are preparing a new VA proposal,” says Rosenfield. Some are suspicious of their motivation, however.

“A fresh VA proposal that may result in negotiations with the state probably won’t do anything other than to create more delay and keep the State Board from moving forward with its regulatory responsibilities in updating the Bay-Delta water quality plan,” says McManus.

Defenders of Wildlife’s Zwillinger thinks it’s time for the Board to make clear that it’s done waiting, and that it plans to protect the estuary — with or without a VA. “It’s very hard to see how the parties will come to the table sufficiently motivated to actually make a deal and cross the finish line without the Board moving forward on updating water quality standards for the Delta,” she says. “There’s no incentive for anybody to have a real conversation about

a voluntary agreement unless there is a meaningful threat that the Board is going to move forward with its process.” Efforts to get a Board comment for this story were unsuccessful.

The water quality plan is not the only process that Delta stakeholders are watching warily. Last year, the Department of Water Resources (DWR) began drafting environmental documents for yet another version of the decades-old scheme to take freshwater out of the Sacramento River and send it directly to the State Water Project, bypassing the Delta. DWR and SWP contractors maintain that the conveyance is needed to ensure a reliable water supply in case the Delta’s aging and fragile levees succumb to sea-level rise or an earthquake. The last effort, known as the California Waterfix, included two tunnels under the Delta and died at the end of the Brown administration; it has since been resurrected as a single tunnel and christened the Delta Conveyance Project.

DWR is evaluating two different alignments and facility sizes capable of pumping between 3,000 and 7,000 cubic feet per second. A Design and Construction Authority (DCA) established by the public water agencies that would build the project is conducting engineering and design work, as well as public participation and stakeholder engagement activities.

Barrigan-Parrilla serves on the DCA’s Stakeholder Engagement Committee, “not because we support the project, but to make sure that [local]

people and groups are not harmed if the project work comes to pass,” she says. She believes the entire project framework is deeply flawed in that it fails to address the Delta’s most pressing issues. “We still have real concerns that because this framework hasn’t been set up correctly, what we’re going end up with is an end product that really isn’t going to change any of the dynamics for people in the community. And more importantly, it’s not going to save the Estuary, it’s not going to save fisheries, and it’s not going to protect us from flood.”

Although few details about the size, pumping capacity, and operations of the tunnel have been finalized, Zwillinger says the most basic problem is one of sequencing, arguing that the water quality plan should be completed before any planning for a tunnel.

“We need the water quality protections for the Delta first, because that’s what tells us how much water we need to flow into and through the Delta to keep the ecosystem healthy,” she says. “Once we know that, we can figure out how much how much water a new Delta conveyance facility can safely remove. But trying to figure out the sizing and operations of the conveyance project before we’ve established safe limitations on how much water can be removed from the system just doesn’t make sense. It’s a recipe for disaster.”

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Spring color in the Delta foothills. Photo: Robin Meadows.

F O L L O W - U P

Dutch Slough Laboratory

JOE EATON, REPORTER

For a hawk's-eye view of one of the Estuary's most ambitious restoration efforts, visit the Dutch Slough Tidal Marsh Habitat Restoration Project's YouTube channel. Drone-shot footage shows what the Department of Water Resources has been doing on 1,200 acres of former wetland, converted to pasture and subsided up to 15 feet, in the West Delta between Big Break and Jersey Island. After moving millions of cubic yards of soil to elevate the marsh plain, a team of engineers, scientists, and contractors led by project managers Katherine Bandy of DWR and Mark Lindley of Environmental Science Associates has carved channels and created a basin-and-range landscape on the Emerson and Gilbert parcels, the western two-thirds of the project site.

"We spent a lot of time studying remnants of historic tidal channel networks, looking at the sinuosity, the radius of bends," Lindley explains. "There wasn't much back-ground to draw on. Then we added in topographic complexity, creating berms along the slough channels to dissipate wave energy and support a variety of plant communities." The berms were built with onsite fill from the channel excavations.

Leading the revegetation effort, DWR senior environmental scientist Molly Ferrell is growing a variety of species including California hibiscus and valley oak for upland scrub and riparian habitats and naked-stem buckwheat for remnant and restored



Photo: Katherine Bandy

sand dunes on the Emerson Parcel, where there's also a working vineyard. For the marsh plain, River Partners grew tule plugs in an on-site irrigated nursery.

"Part of trying to revegetate before breaching the levees is soil stability," says Bandy. "We're encouraging the tules to spread before opening the marsh to tidal action, giving it a head start. With projects further out in the Bay or inland at the right elevation, we could just open the levee and let nature take its course. Dutch Slough needed more human intervention."

The project is on track for five levee breaches later this year, "more or less simultaneously," Bandy adds.

"It's a bit of a dance to make sure we don't breach ourselves into a corner." Work on the easternmost Burroughs Parcel, delayed by uncertainty about funding and development plans for privately owned land next door, is gearing up, with groundbreaking as soon as 2022.

Beyond restoring hydrological and ecological functions and habitat for fish, birds, and

other wildlife, Dutch Slough is envisioned as a living laboratory with an adaptive management framework. "It's designed to further increase our understanding of restoration implementation," Bandy explains. U.S. Geological Survey researchers will study the effects of varying marsh sizes and elevations on wetland formation and carbon cycles. There will also be a recreation component, with eventual trail access linking with the East Bay Regional Park District's trail system.

Bandy, whose career involved mitigation efforts before stepping in when former project manager Patricia Finrock retired, sees Dutch Slough as "a unique opportunity to work on a pure restoration project." Lindley concurs: "It's a really rewarding project. It's amazing we've been able to get it all constructed."

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PRIOR STORY

www.sfestuary.org/estuary-news-big-restoration-experiment-for-dutch-slough/

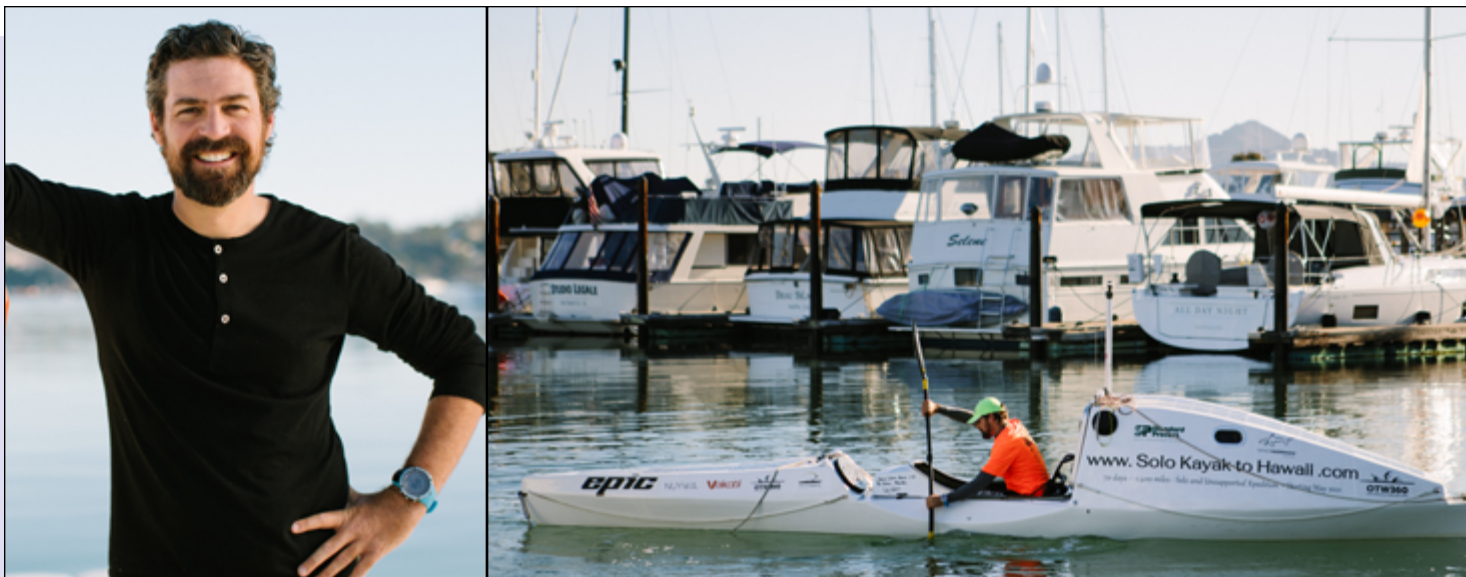


Kayaking to Hawaii

ALASTAIR BLAND, REPORTER

After a French-American resident of Larkspur helped row a small boat from Monterey to Hawaii in 2016, he vowed he'd never undertake such a journey again.

continued on next page



Cyril Derreumaux (left) and in his new vessel in San Francisco Bay (above and p.13). Photos: Teresa Obrien

But Cyril Derreumaux spoke too soon. “My imagination took off, and I started dreaming about doing the same trip again in a kayak,” he says.

Now, after several years of planning, Derreumaux is getting ready to embark. He plans to leave Monterey Bay in a custom-made kayak with no companions in late May and, moving between 40 and 60 miles each day, arrive at the Waikiki Yacht Club in Honolulu ten weeks later.

Or maybe nine. While Derreumaux says he is more interested in the sheer adventure of the voyage than in setting records, he cannot help but think about being the first and the fastest. Specifically, if he finishes the trip in less than 64 days, he’ll have the quickest California-Hawaii kayak crossing under his belt, and the first unassisted.

Derreumaux’s sea voyaging resume is already stacked with achievements. In the past decade he has participated in a number of mid-size races and had a few old-fashioned adventures, including a solo boat-camping trip down the entire length of

the lower Sacramento River. But his greatest and arguably most thrilling trip was five years ago, when he and three teammates rowed a small skiff from Monterey to Oahu in 39 days, 9 hours, and 56 minutes, winning them first place in a race against seven other teams as well as a Guinness World Record.

“I said, ‘Never again’ after crossing the ocean the first time,” Derreumaux, now 44, recalls.

But his thirst for pushing the limits quickly returned. He aimed to one-up himself and, notably, legendary waterman Ed Gillet, who kayaked from California to Maui in 1987. “Compared to Ed who used a kite sometimes during his crossing, I will only be using human power,” Derreumaux says.

As the first step in his planned trip, Derreumaux commissioned a boat builder in England to construct a kayak. Rob Feloy, along with partner Ginge Murphy, began work on the craft in November 2019 and finished four months later. The result was a sleek 22-foot-long vessel with space for sleeping and a sealable

chamber where Derreumaux may, if necessary, take shelter during nasty weather. The boat weighs about 140 pounds unmaned and unloaded and can be powered with a pedal-drive system as well as a conventional paddle. Its hull consists of two layers of carbon fiber sandwiched over one of natural cork, making the boat essentially unsinkable.

When occupied and fully loaded, the rig will weigh about 900 pounds — an assemblage Derreumaux guesses he will be able to move at an average of about two miles per hour. He’ll be paddling as well as pedaling — an alternating arrangement he hopes will help him avoid injury and prevent atrophy of his leg muscles. (When Gillet finished his kayak voyage in 1987, he found himself unable to walk once he landed on the beach, so diminished was the strength of his lower quarters.)

“I’d like to maintain the health and integrity of my whole body,” Derreumaux says. “I’ll see how it goes, but most likely I’ll do two hours paddling, two hours pedaling, two hours paddling, two hours pedaling.”





As for sustenance, a solar-powered desalination kit will produce Derreumaux's water, and he has a manual system as a backup. He'll bring some fishing gear, he says, but that's just for emergency purposes. His main sustenance will come from energy bars and freeze-dried meals, of which he plans to eat about 6,000 calories per day. Still, he expects the rigors of the trip to strip 25 pounds from his already athletic frame.

While both boat and athlete are as seaworthy as can be, Derreumaux is prepared for the worst, and should anything go seriously wrong, he will resort to technology. He'll be carrying an emergency position indicating

radio beacon fixed to the boat, a personal locator beacon on himself, two GPS devices, a Garmin tracker, a satellite phone, and a satellite internet connection. He'll also keep himself tethered to the kayak at all times.

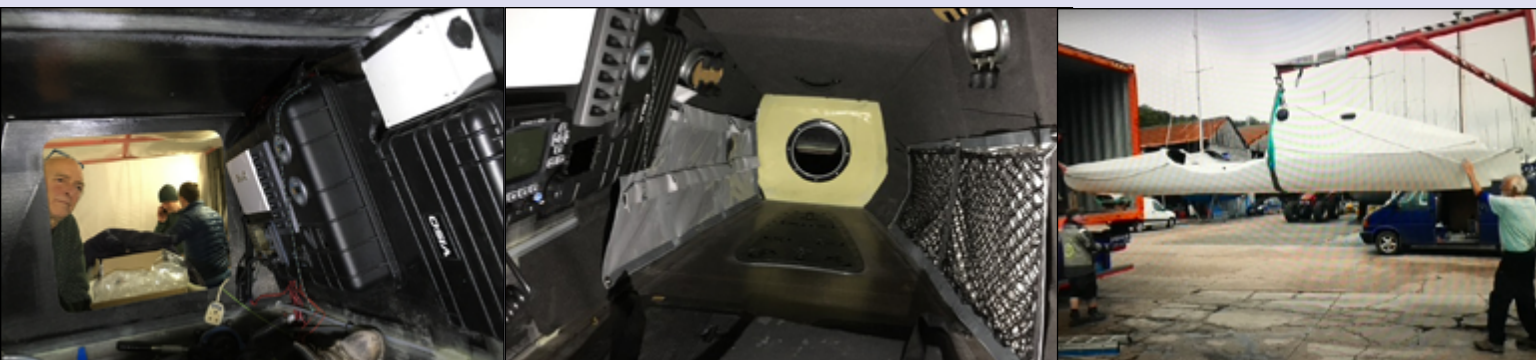
Derreumaux says his fixation on extreme travel is partly about testing his own limits, but it also has much to do with the unique appeal of returning home again.

"Everything we're familiar with on land is so beautiful, and it has so much value — whether you're just going for a walk, or hugging a child, smelling the trees," he says. "These adventures help me recreate and appreciate these feelings."

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English boat builders Rob Feloy and Ginge Murphy built the seaworthy kayak in four months in a large, drafty boat repair shed. Within the shed they also erected a temporary polythene tent with bubble wrap so they could get the temperature up to cure the resins and paint. The boat's carbon fiber structure without any fittings weighs around 45 kilos. Shed photo and strip courtesy Murphy & Feloy.



I N F R A S T R U C T U R E

Fire Sparks Sewer Boon

NATE SELTENRICH, REPORTER

Early on the morning of October 9, 2017, a firestorm roared with unforgiving speed across a swath of northeastern Santa Rosa. The unincorporated community of Larkfield lay directly in its path. One-hundred and sixty homes there burned to the ground.



Three and a half years later, Larkfield is still being rebuilt—in some ways better than ever, thanks in part to an ambitious and innovative program by the Sonoma County Water Agency to bring sewer service to the modest, tight-knit community at the foot of the Mayacamas Mountains.

New homes of all shapes, sizes, styles, and colors, each designed to suit the owner's preference, are interspersed with dozens more in varying stages of construction. On a recent weekday afternoon, building and landscaping crews labored around Larkfield's every bend: installing framing, siding, hardscaping, interiors. Another 25 lots remained bare except for a blanket of bright-green spring grass.

Though they appear heterogeneous from street level, below the surface roughly half of Larkfield's homes are connected for the first time via a hidden network of pipes. Before the fire, the neighborhood largely lacked sewer access, with all but a handful of homes on the perimeter relying instead on septic

systems—where household wastewater is passed through small settling tanks before being dispersed in a backyard “leach field.”

Lots are relatively small in Larkfield, ranging in size from 1/4 to 1/3 of an acre. In the 1950s and '60s, when most of the original homes were built, that was considered big enough for a septic system—but didn't leave room for much else. Nowadays, regulations call for at least half an acre in order to protect both human health and the environment, says Mike Thompson, an assistant general manager with Sonoma County Water Agency, also known as Sonoma Water.

“You have the potential with a relatively tight cluster of septic systems to have an issue with

groundwater contamination in this area,” Thompson says. “There hadn't been monitoring done, but definitely a strong potential existed there.”

If excess nutrients or harmful chemicals from wastewater were to infiltrate nearby Mark West Creek,

which runs to the north of the neighborhood, they could flow from there to the Russian River, which provides drinking water to more than 600,000 North Bay residents.

“The other issue is if the system fails, it becomes a public health and very direct environmental impact” through more localized, surface-level contamination, Thompson says.

By 2017, many of the neighborhood's septic systems were approaching the end of their expected lifespan. A few had already failed. If residents rebuilt with their old septic systems still in place and then they failed, Thompson worried they'd be unable to replace them due to current space requirements.

Better for everyone, he figured, would be to finally connect the neighborhood to the sewer system. Residents would gain an alternative to septic, a likely boost in property value, and greater use of their land, while Sonoma Water would acquire another source of recycled water.

“We saw this as a once-in-a-century opportunity to make a community better than it was before this horrible event,” says Thompson, who helped launch and lead the project. “By being able to bring sewer into this area, and do it while everything else was dug up, there were so many advantages.”

Back when the idea first arose in the weeks after the fire, one of Sonoma Water's main concerns was whether enough property owners would be willing and able to pay the



Backfilling the new sewer trench with a lean concrete slurry, which is stronger and less expensive than backfilling and compacting with soil. Photo: Sonoma Water



Connecting a sewer lateral. In some parts of the Larkfield project, contractors used a technique called trenchless installation to save cost. The technique involves drilling a small tunnel and pulling a long high-density polyethylene hose/pipe behind it. The driller aims the tunnel to a pit several hundred feet away where they connect to a conventional sewer pipe. Photo: Sonoma Water

cost, estimated at about \$50,000 per parcel, of creating a new sewer collection system in the community. Sure enough, during their first community survey, staff learned that only a quarter of residents were interested.

“We saw this as a once-in-a-century opportunity to make a community better than it was before this horrible event”

“It didn’t go very well at first,” says Larkfield resident Chris Mocny, a retired engineering technician with Sonoma County who was already familiar with the local sewer system and liked the idea of extending it to Larkfield. But he was also among those initially discouraged by the expense. “We’re looking at huge costs of rebuilding our homes, and then on top of it you want us to pay for the sewer? So we were very skeptical.”

Then Thompson and his colleagues had an idea: what if the agency offered a deferred loan program to cover the cost, with no payments for ten years? Soon nearly half the residents needing new homes were able to commit. By late 2019, two years after the fire, Sonoma Water was ready to build.

Between January and September 2020, Sonoma Water installed more than a mile and a half of eight- and six-inch PVC sewer main at depths ranging from three to 14 feet, along with 900 feet of narrower-gauge, low-pressure sewer — and 57 manholes. The project’s “extremely fast” timeline was aided by lighter-than-average traffic due to the pandemic along Mark West Springs Road, which bisects the neighborhood.

Looking forward, as more of Larkfield’s existing septic systems fail but cannot be easily replaced, Sonoma Water expects that more property owners will choose to pay to access the sewer system. And decades after the last home connects, the agency will finally recoup all its expenses— with interest. It will also have gained access to tens of thousands of gallons of additional household wastewater per day to treat and reuse for irrigation, industry, environmental restoration, and more.

Along with augmenting recycled water use, the project supports climate resilience in a county that has been hammered by drought, flood, and fire in recent years by freeing up yard space in sewer-connected homes for accessory dwelling units, maximizing housing availability and density in the conveniently located neighborhood. In addition, public sewer systems are generally more resistant to damage from fires and other natural disasters than private septic systems.

“Resilience is more than just building a sewer project,” says Brad Sherwood, Sonoma Water community and government affairs manager. “For Sonoma Water, resilience means investing in infrastructure that will help future generations of Sonoma County residents battle climate change.”

On a recent afternoon, one elderly resident who asked that her name not be used said she has lived in Larkfield for 20 years, and was happy to trade in her old septic system for a sewer connection. The deferred loan made it possible for her, she said.



Standing outside her newly rebuilt home, watering her freshly planted landscaping with a garden hose, she looked across the street. Where her former neighbors once lived, an empty lot sat quiet: a reminder that while Larkfield has come a long way since the fire, recovery continues.

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I N F R A S T R U C T U R E

Uncorking York Creek

DANIEL MCGLYNN, REPORTER

Over the summer, while most of the Bay Area was figuring out how to navigate the COVID-induced shelter-in-place orders, 1,933 heavy truckloads laden with 22,000 yards of material wound their way away from Napa County's York Creek, and were dumped into two nearby landfills. Extracting these spoils was the last step in the York Creek Dam removal project, the culmination of decades of effort by the city of St. Helena to take down a small earthen dam with a big ecological impact. The dam blocked fish from spawning in the creek's 4.4-square-mile-watershed.

Though the project seemed straightforward, no one involved in its conception could have imagined the convoluted path to its completion forty years later, nor just how difficult and expensive it would turn out to be for a small city to tackle a heavily regulated dam removal project and watershed.

Today, York Creek flows freely from its headwaters in the hills above the Napa River, which the creek feeds. The dam site is about



Log sediment structure anchored to tree.
Photo: Daniel McGlynn

two-and-a-half-miles upstream from that confluence and was first constructed in 1900 to create a reservoir for residents of St. Helena and the surrounding vineyards. Amber Manfree, a Napa Valley native and geographer, remembers as a kid in the 1980s that the reservoir still kind of looked like a reservoir.

By the time the dam was removed in 2020, a forest of alder, willow, and invasive ivy had grown in the sediment infill behind the barrier, rendering it useless for water storage. There are hundreds of obsolete, small dams just like York Creek's scattered across California's watersheds. These aging dams show the same issues — they no longer provide water supply, they trap increasingly scarce sediment upstream, and they obstruct fish passage to spawning grounds.

Talk of removing the dam on York Creek first started in 1992, after routine maintenance on the dam's reservoir outlet went wrong and enough fine silts washed downstream to the Napa River to choke the water and cause a noticeable fish kill. The California Department of Fish and Wildlife (formerly Fish and Game) filed a legal complaint. The city studied the prospects of removing the dam but was unable to obtain the necessary federal and state permits.

In 1997, the California Central Coast steelhead was listed as a federally threatened species. That left York Dam blocking access to 1.5 miles of prime steelhead spawning habitat, which only ratcheted up calls for action. In 2001, St. Helena officials started working with a handful of regulators and permitting bodies that would eventually need to stamp the project so it could move forward.

If the funding, design, and actual construction of any infrastructure project are challenging, the number of permits required to move the York Creek project forward were more so. In the end, permits had to be procured from eight agencies, each requiring expensive planning and documentation, including the California Department of Fish and Wildlife, U.S. Fish and Wildlife Service, National

Marine Fisheries Service, U.S. Army Corps of Engineers, San Francisco Bay Regional Water Quality Control Board, State Historic Preservation Office, Napa County Public Works, and Bay Area Air Quality Management District.

The project languished in a permitting quagmire until 2010, when the National Oceanic and Atmospheric Administration started fining St. Helena \$70 a day because of lack of compliance with earlier agreements to remove the dam.

By 2020, the total amount paid by the city in daily fees exceeded \$190,000, wrote consultant Amber Manfree in a California Water Blog post. Permitting issues continued for another decade until a grant funding expiration deadline loomed.

Like the permitting struggles, the price tag of the dam removal project grew over the years.

The York Creek dam removal project was funded by a 2015 \$987,876 grant from the U.S. Environmental Protection Agency's San Francisco Bay Area Water Quality Improvement Fund, which was matched by the same allocation from the city's general fund, and an \$800,000 Proposition 84 Round 2 Integrated Regional Water Management (IRWM) Implementation Grant. (IRWM's role in water infrastructure improvement and cross-jurisdictional action often occurs out of the limelight, but since 2002 the program has allocated a total of \$1.5 billion to many of California's more pressing projects.)

"If you look at the funds spent in 2020 by the city for consultants and contractors for this project it adds up to \$4.5 million, which was 68 percent of the [city of St. Helena's] water department's total budget," says Jenn Hyman, director of engineering at EKI, the Oakland-based engineering firm that took over in the last year of the project and got the final project design approved and completed. "For the city to take this on was immense financially, so the grant funding was really important."

An expiration date on the IRWM grant spurred York Dam forward. "We knew we needed to finish the project, the funds were not going to be available indefinitely," says Natasha Dunn, IRWM grant manager and environmental planner at San Francisco Estuary Partnership.



New creek channel (dam remnant at left). Photo: Daniel McGlynn

The project's lengthy funding and permitting phase brought with it a train of different design consultants over the decades — each offering their own design suggestions to the city. These ranged from minor improvements all the way to a complete reimagining of the creek's channel through the project area. Eventually, the city settled on removing half of the historic sediment deposits and then creating a "notch" to guide the creek through the remaining sediment. The idea is that over time, the creek will gradually transport the sediment to the decades-starved lower reaches of the creek.

"Originally, we were going to take everything out," says Erica Ahmann Smithies, St. Helena's director of public works, city engineer, and York Creek project lead for the past four years. "Then we changed the design to let nature take over." This process will help improve both overall riparian habitat and steelhead-specific habitat. Rather than leave to chance where all of that sediment will end up (the uncertainty was an issue for permitters), 36 logs were strategically slung across downstream locations to catch sediment and create pools. The logs are bolted to trees still growing along the creek's banks — and how best to anchor them (they are connected with long steel bolts) was also a topic of permitting talks.

The vision of trying to keep things simple and use local materials installed in natural forms, like log catchments, was in part informed by the permitting process and in part by a recent high-profile dam removal project on the Carmel River. After years of study and an \$83 million dollar investment, San Clemente Dam (18 miles inland from the coast in Monterey County) was removed in 2015.

A massive fire subsequently swept through the area, followed by winter rains that created 30-year flood type events, wiping out restoration efforts. "They did everything by the book according to the regulators and then had mother nature come in and wipe everything out," says St. Helena's Ahmann Smithies. "So the permitters wanted to take a less aggressive approach with the construction and engineering on this project."

Officially, the York Creek deconstruction began in late June and ended three days before the Glass Fire in September, all of which was within the grant-funded window. The Glass Fire burned 67,484 acres in Napa County and most of the water-

shed, and damaged six of the new log structures. Contractors worked 12-hour days through COVID-induced restrictions in order to hit deadlines. In some regards, working through the pandemic was beneficial because there was less traffic congestion in Napa Valley, which meant trucks removing sediment could move back and forth from the dam site to the dump site relatively easily (traffic concerns were one of the major issues addressed in the project plan). Contractors revisited the site post-fire to fix the log structures, wrapping up by early November.

Today the creek meanders through the newly created channel on its way to Napa River. A team of engineers and biologists contracted by St. Helena will now monitor the restoration efforts, including how the remaining sediment travels through the watershed. And they will be on the lookout for the return of the steelhead.

"It just took too long," says Ahmann Smithies while recounting the history of the project. "Everyone wanted to get to the finish line, but it was like the environmental two-step trying to get everyone to agree that their needs were being met."



Dam outfall before removal. Photo: California Water Audit

B U G S

Fixing a Dysfunctional Marsh

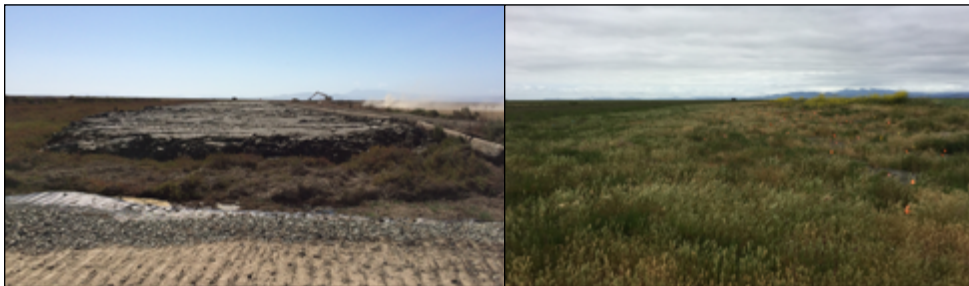
JOE EATON, REPORTER

Restoration projects, like species, evolve. The Sonoma Creek Enhancement Project, originally about mosquito control, has shown itself to be a boon to special-status tidal marsh wildlife as well. More than a decade of adaptive management actions made that happen.

The existing marsh, formed rapidly beginning in the 1960s by deposited sediment, lacked the dendritic channels of a mature marsh. High tides brought in water that pooled in a central basin and didn't drain out, providing breeding habitat for mosquitoes. The disadvantages of chemical treatment prompted land managers to look for alternatives. So in the 2000s, the Marin/Sonoma Mosquito and Vector Control District teamed up with the U.S. Fish & Wildlife Service (the land manager), Audubon California, and environmental scientists Daniel Gillenwater and Stuart Siegel to improve tidal circulation in the dysfunctional marsh.

Their proposed solutions included creating a mile-long mid-marsh channel to improve tidal action and smaller channels to stagnant areas, and, for sea-level-rise resiliency, using dredge material from the channels to build a transition ramp on the land side and mounds on the marsh plain. Placing fill on existing wetland for the ramp complicated the permitting process, but encouraged the San Francisco Bay Conservation and Development Commission to revisit fill regulations and set precedent for future projects. "The Sonoma Creek and Aramburu Island projects broke the mold on that," recalls Gillenwater.

Partial construction in 2015 (Phase 1) improved tidal flushing enough that mosquito treatments could be scaled down. But ongo-



Transition ramp in 2015 and 2019. Photos: Dan Gillenwater.

ing monitoring at the site revealed issues that required tweaking: "We knew the channel wasn't addressing all the drainage problems," Gillenwater says.

In 2018 the District dug 2,000 feet of adaptive-management side channels. That left other unfinished business for a Phase 2 effort: extending the central channel to its full design length and removing Phase 1 construction debris that clogged it. Funding came from mitigation money from PG&E and Tesoro earmarked for use in the local area designated in the recovery plan for the endangered Ridgway's rail. "We had a shovel-ready project," says Meg Marriott, acting manager of the San Pablo Bay National Wildlife Refuge.

With general permits already in place, final Phase 2 design work started last spring, just as the COVID-19 pandemic struck. "We went from concept to construction in six months," explains engineer Melissa Carter of consulting firm Environmental Science Associates. Despite the challenges of the pandemic, which allowed only the use of essential workers, and the wildfires of autumn, construction work was completed in nine days.

As part of Phase 2, the team had to decide what to do with the new material dredged from the channel

extension: extend the ramp or add marsh mounds? Constructability gave the mounds an edge. The Phase 1 mounds, planted with pickleweed from the marsh and other species like gumplant and sea-lavender, provide high-tide refugia for the Ridgway's rail, California black rail, and salt marsh harvest mouse. The gumplant and other plants were grown and planted by Students and Teachers Restoring a Watershed (STRAW) volunteers at the Refuge's nursery.

Wildlife response has been gratifying. Marriott says Ridgway's rails lived near the project area before Phase 1 and may now be colonizing the marsh; a pair was heard calling last year. Harvest mouse populations are stable in a nearby reference area but increasing within the project area. The planted mounds offer vertical structure the mice need to shelter from predators during high tides. The transition ramp, also planted by STRAW volunteers and colonized by native plants, functions as existing habitat as well as a hedge against a future of rising seas and extreme weather events.

With improved drainage and enhanced landscape, the marsh has been transformed. "Before Phase 1 it was a barren, shallowly ponded moonscape with scraggy vegetation and clouds of mosquitoes," says Carter. "Now there's pickleweed as far as the eye can see: knee-high, thigh-high, flourishing." And mosquitoes pose less of a threat to humans and wildlife.

Once again, adaptive management helps work out the bugs.

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Photo courtesy STRAW



Photo: Melissa Carter, ESA

O P I N I O N

Bayshore Breathing Space for All



JESSICA DAVENPORT
DEPUTY PROGRAM MANAGER
SAN FRANCISCO BAY
RESTORATION AUTHORITY



I live just a couple miles from Berkeley Aquatic Park, but it took a shelter-in-place order to get me to go back there after a 20-year hiatus. I had visited the park a couple years after I moved to the Bay Area and found it deserted and a bit gloomy. This time, it was vibrant and full of life, from the bright yellow...

continued next page

OPINION

Jessica Davenport, continued



...this time, it was vibrant and full of life, from the bright yellow gum-plants blooming along the shoreline to the great blue heron feeding in the shallows and shiny-black cormorants diving deep underwater, then returning to the surface to dry their wings in the sun.

And the people! There were kids playing on the playground, cyclists zipping along the Bay Trail, and frisbee golfers politely asking me to move out of the way so they could continue with their game. Along the shore were theater and dance spaces, a bike and boat repair and rental shop, and a place where cyclists with disabilities could get access to adaptive equipment. The lagoon was created by humans, a depression scooped out of the land when the Bayshore Highway was constructed in the 1930s, but that didn't stop it from hosting a range of shorebirds and waterfowl and people of all ages and backgrounds.

The COVID crisis has forced many of us to rethink what it means to have access to parks and trails close to home. Just as the murder of George Floyd and the Black Lives Matter protests that followed led many people to wake up to the injustices of our policing and criminal justice systems, the orders to shelter in place forced a deeper reckoning in the conservation community with the inequities of access to nature and recreational spots in the Bay Area.

Many of the privileged people who led the conservation movement for generations tended to value faraway, pristine cathedrals of nature, such as Yosemite and Lake Tahoe. Over time,

there has been a dawning recognition that our movement needs to be more inclusive and connect people to nature close to home. In 1998, I joined Friends of Five Creeks, a group of volunteers working to clean up local creeks in Berkeley and El Cerrito. We removed trash and invasive plants, planted natives, and advocated for "daylighting" creeks that had been forced underground into culverts to control flooding. For us and hundreds of other members of "Friends" groups around the Bay Area, nature was here, not somewhere you had to drive at least a couple hours to experience.

Within the San Francisco Bay restoration community, there has been a similar shift. While we still focus on restoring large areas of tidal marsh habitat in former salt ponds and hay fields of the North and South Bay to benefit the endangered Ridgway's rail and salt marsh harvest mouse, we now recognize the importance of creating spaces along the shoreline where people, especially people from economically disadvantaged communities, can learn about and participate in nature conservation. As sea level rises, we also recognize the importance of engaging leaders from these communities, including those fighting environmental injustice and gentrification, in nature-based shoreline adaptation planning.

Measure AA, a \$12 annual parcel tax that funds projects administered by the San Francisco Bay Restoration Authority, specifically calls for prioritizing projects that benefit economically disadvantaged communities. Over the past two years, the Authority has grappled with what this means. Some benefits are relatively straightforward, such as providing trails, flood protection, and green jobs to residents of nearby communities. But other benefits are more subtle, such as creating opportunities for leadership development in shoreline restoration planning, and supporting efforts to prevent "green gentrification," the process by which local residents are priced out of their communities as they become cleaner, greener and more desirable to wealthier people.

Also, it is not enough for a restoration-focused agency or organization to decide which benefits to provide — the community needs to weigh in. And for community engagement to be meaningful, project managers must be open to making changes that reflect what community members want. Several of the Authority's current projects, such as the North Richmond Living Levee Project, take steps in the right direction. (See following stories for more examples.) In addition, the Authority recently launched a community



Mardi Gras celebration at 900 Innes, India Basin, San Francisco in March 2020 (see sidebar). Photo courtesy SF Parks Alliance

grants program to provide a simplified pathway to grants for community-based organizations in economically disadvantaged communities (see Deeper Dive, below).

The Black Lives Matter movement is also teaching us that the conservation community has much work to do to make outdoor spaces more welcoming to Black, Indigenous, and other people of color (BIPOC). National attention was drawn to this pervasive problem through the high-profile incidents suffered by Christian Cooper, who was “birding while Black” in New York City’s Central Park, and a group of friends who were “BBQing while Black” at Lake Merritt. Both cases involved white people calling the police on Black people doing harmless things in parks. I thoroughly condemn this type of dangerous harassment, as well as more subtle snubs of Black people in natural places. To combat racism and promote diversity, Black nature lovers have launched #Black-InNature, #BlackBirdersWeek and @BlackAFinSTEM. Just a few of the groups taking action to support BIPOC in the outdoors include Outdoor Afro, Brown Girl Surf, and Latino Outdoors — check them out!

On a recent Sunday afternoon at Point Pinole Regional Shoreline, I noticed that the park was full of a diverse mix of people enjoying the outdoors in their own ways, whether hiking, jogging, birding, picnicking, or just sitting and chatting while enjoying the inspiring vistas of the Bay. As we continue to spend much of our time in isolation, there’s a special joy that comes from connecting with people and nature along the Bay. And that’s something everyone in the region should be able to share.

DEEPER DIVE

LINK: www.sfestuary.org/estuary-news-opinion-davenport-bayshore-breathing-space/

TAXPAYER

Measure AA Projects that Benefit Economically Disadvantaged Communities



Eco apprentices at work in suaeda nursery, a native species adapted to changing shoreline conditions. Photo: LEJ

THE OAKLAND SHORELINE LEADERSHIP ACADEMY aims to empower community leaders to engage in shoreline restoration planning. Led by the West Oakland Environmental Indicators Project, a community-based nonprofit organization with a long history of fighting for environmental justice, the project will provide a six-month training program in shoreline environmental issues. It will also create opportunities to build partnerships with shoreline landowners such as the Port of Oakland and East Bay Regional Park District. Participants will engage in planning processes for ongoing shoreline restoration and public-access projects as well as develop ideas for future projects.

THE 900 INNES REMEDIATION PROJECT, which is also funded by the Authority, provides another model of community empowerment through shoreline restoration. The project — designed in the context of equity — is located in Bayview-Hunters Point neighborhood, one of the last remaining communities with a significant Black population in San Francisco. The community provided feedback on the park

design, including arts enrichment, boatyard park design and elements, and most currently, the playground design, to ensure that the designs remain relevant and reflective of the neighborhood’s priorities.

HERON’S HEAD PARK in San Francisco is a 22-acre open space and restored wildlife habitat that attracts more than 100 bird species every year. The park and its EcoCenter are also used for education and recreation by thousands of birdwatchers, hikers, students, teachers, and other visitors. And the Heron’s Head Park Shoreline Resilience Project will provide even more benefits to both people and wildlife. With funding from the Authority, the Port of San Francisco has partnered with the community-based nonprofit Literacy for Environmental Justice (LEJ) to recruit young residents of the Bayview-Hunters Point community to be Eco-Apprentices. These apprentices will be trained by LEJ and by researchers from San Francisco State University in bay ecology, invasive weed control, native plant propagation and outplantings, and project monitoring.

M O N I T O R I N G

Sediment Paparazzi

ARIEL RUBISSOW OKAMOTO, REPORTER

As the Estuary faces drowning marshes due to rising seas, people want to see action — acres saved, walls built, marsh mice whisked to safety after crawling to the tip of the tallest gumplant.

The urgency has made sediment — the material needed to elevate marshes and buffer zones and build new levees — a local celebrity. It has also made monitoring and modeling sediment movements a magnet for the science paparazzi.

The paparazzi have been busy. The Bay region has a sediment management strategy and a sediment monitoring and modeling strategy, and later this month it will have a new sediment supply and demand analysis, not to mention some specific ideas for coarse sediment reuse. Indeed, six different workgroups of Bay scientists, managers, and regulators are now deeply stuck into studying sediment, how much of it there is in San Francisco Bay, where it comes from and goes to, and more importantly, whether we have enough to elevate our marshes and shorelines above rising sea levels. The advancing Pacific has pushed sediment to top billing on the Bay research marquee; it's the monitoring part, however, that will help us make every grain count.

"The science is telling us the rate of sea-level rise is getting faster, and we probably won't have enough natural sediment in the Estuary to keep up," says Scott Dusterhoff, a geomorphologist with the San Francisco Estuary Institute and lead scientist for the San Francisco Bay Regional Monitoring Program (RMP) Sediment Workgroup.

"We're seeing signs of marshes eroding and drowning right now, not on some future horizon," adds Xavier Fernandez, an environmental scientist with the San Francisco Bay Regional Water Quality Control Board — "so we need to move more sediment onto the marshes right away, otherwise we'll lose them and habitat for species we care about." Estimates suggest the region's marshes and mudflats need 400-600 million tons of sediment in the future to remain ecologically functional

through to the year 2100: now that's a lot of sediment!

And while these alarming facts may seem like the headliner, they're really just the warmup act. The real news is that regional managers and scientists have done their homework and figured out who is doing what in terms of critical research and what our priorities should be to fill the knowledge gaps before it's too late. The RMP sediment workgroup released this homework — a Sediment Monitoring and Modeling Strategy — late last year.

"We don't have a closed sediment budget for the whole Bay for both fine and coarse material," says Lester McKee, one of the Institute's lead sediment researchers, who coauthored the monitoring and modeling strategy with Dusterhoff. "We know how much comes in and from where but we're lacking information on how much is stored or eroded from the Bay bed, and how much is going out the Golden Gate."

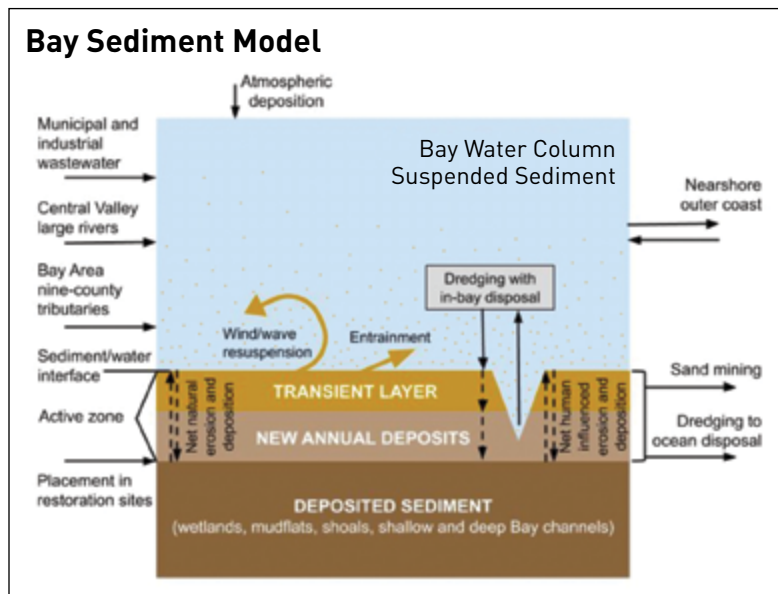
One foundational piece of this research in this puzzle is work currently underway by the U.S. Geological Survey's Bruce Jaffe to update our picture of the state and shape of the bottom of the Bay: its actual bathymetry. Jaffe's last study in the 2000s concluded among other things that

the Bay was eroding in the north and depositing in the far south before the 1980s. Such conclusions may change considerably once he factors in new data from the last 35 years.

"Getting that bathymetry update will be a gamechanger," says McKee. "The old period no longer fits

current conditions or the modern management timeline." At a macro level, this new bathymetry and sediment budget will be more "spatially explicit," providing more detail on specific parts of the Bay that local decision-makers and stakeholders can use to fine-tune their restoration and habitat protection plans, as well as dredging and sand mining permits, he says.

Figuring out how much sediment is going in and out of the Golden Gate is another priority, though it requires sending vessels out after a big storm to measure sediment concentrations in very deep, choppy conditions while dodging container ships and tankers. Estuary News covered this a few years ago, when scientists on the RV Ques-tuary tracked a plume of sediment



Whole system mass balance conceptual model (modified from Krone, 1979).

To get a better handle on research gaps and priorities, the homework involved comparing a variety of management questions about sediment coming from different agencies and activities; as well as summarizing all that is currently known about how sediment in the Bay is impacted by hydrology and geomorphology, dams and flood control channels, rainfall and fault lines in watersheds, and polar and tropical weather patterns affecting coastal processes, not to mention tides, urban development along the shore, and other factors. Among 12 priority recommendations made by the group for study over the next five years, several emerged as needing more detail, more data, or more complex computer modeling sooner rather than later.

released from 2017 flooding the Delta's Yolo Bypass, finding that some of it got stuck in San Pablo Bay and never made it out the Golden Gate. Future studies have to remain reactive to rainfall, but the RMP plans for that, says McKee.

Another gap is understanding exactly how sediment moves around the edge of marshes and mudflats, and what vegetation contributes to this dynamic. Which is partly why the RMP sediment workgroup chose to fund a study by two USGS scientists, Jessica Lacy and Karen Thorne, on that subject first.

For a study site, the two scientists chose Whale's Tail Marsh near Hayward. The marsh is not only in the sediment-rich South Bay, but also surrounded by Eden Landing wetland restoration sites competing for the future sediment supply. More importantly, it's eroding rapidly, with 10 meters of shoreline retreat between 2004 and 2010 according to satellite surveys. The study will help the Workgroup get some real data showing how marshes buffer urban shorelines from waves. "Land managers want to use green methods of shoreline protection but they aren't convinced the data is there yet to show it works," says USGS' Lacy. (Hear more on the study on the new Science-in-Short Podcast *Marsh Mud on the Move*.)

Other recommendations for closing knowledge gaps range from placing sediment monitoring stations in at least two key tributaries within each of the fringing counties to exploring sediment dynamics at key boundaries such as bridges between smaller bays within San Francisco Bay (sub-embayments).

"Sediment science is so darn complicated," says Brenda Goeden, sediment manager for the San Francisco Bay Conservation and Development Commission (BCDC). "It's well studied, but less well understood."

Some of the data collected under the new strategy or pulled from other research is destined to end up in computer models. McKee describes this next generation of models as "more process-based," taking into account erosion and deposition, or system "awakenings" in which long-term calm or dry conditions are interrupted by atmospheric-river downpours or earthquakes or El Niños, releasing sudden pulses of sediment.

It is this combination of strategic data collection and modeling that the strategy describes and that will most

cost-effectively help us to learn more about the Bay. It's just too expensive to measure everything, everywhere, all the time, but models will help fill in some of the remaining gaps in our knowledge, and help teach us where else to focus monitoring efforts.

Lester McKee also describes the evolving models as "higher resolution," and offering a clearer direction for sediment managers trying to choose whether to capture sediment from creek mouths, or place sediment in the shallows to feed adjacent marshes, or import dredged sediment or construction material to raise their shores. They also will need to know when to move it — high tide or low, wet year or dry — and how big the grain size should be for best results.



Mudflat at Eden Landing. Photo: Robin Meadows.

"There are a lot of knobs and dials we can turn to manage sediment in the Estuary," says the Water Board's Christina Toms, science lead for another regional monitoring initiative aimed at tracking wetland health. "We need to know which give us the most bang for the buck."

One place to get more bang is the hundreds of small watersheds draining from the Bay Area hills into the Bay, carrying sediment along the way. "We need to find the sweet spot where we manage watersheds so that we get fine sediment out to baylands but not so much that it causes problems for spawning salmonids," says Dusterhoff.

Another place to get more bang for the work done under the new sediment monitoring and modeling strategy is to answer the questions of those who

are updating regulations. BCDC has already produced a regional sediment management plan (2016) and amended its prohibitions on Bay fill to allow for some placement in the Bay for shoreline adaptation purposes. The Water Board, meanwhile, is working on a basin plan amendment to address a similar disconnect between old rules and new needs, which is due out in 2022.

Both regulators continue to tangle with a longstanding worry that sediments from some sites are contaminated and should never be dumped in a pristine marsh no matter how fast it is eroding.

"We have to rebalance the two risks, the known risk of wetlands drowning from sea-level rise against the potential impacts of contamination from sediments," says the Water Board's Fernandez. "A little higher level of contamination may not have as big an impact on wildlife as loss of habitat."

Fernandez adds "We have to sync up our permitting with ecological processes — keeping something static isn't relevant to current and future conditions."

Climate change is challenging all kinds of regulatory assumptions on many levels. "One thing I really appreciate about the overall sediment strategy is they're beginning to tackle the question of what drier and wetter futures mean for sediment supply and watershed flows," says the Water Board's Toms.

"The RMP is a systematic program that doesn't do things by accident; it goes through periods of hyper-planning that might seem cumbersome but helps us be careful and collaborative about how we use limited resources," says McKee. "When we embark on a new endeavor, we are not just doing people's pet projects. We're choosing to do what's most pertinent to the public at large, maintaining our Bay and shorelines for the community of the future. Plus, if we only did the easy things, we'd be bored."

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DEEPER DIVE

LINK: www.sfestuary.org/estuary-news-sediment-paparazzi-regional-monitoring

H I S T O R Y

Never Again, and Again

JOHN HART, REPORTER

Oil spills in San Francisco Bay are frequent news, but for those old enough to remember there is only one Great Oil Spill, the disaster of January 18, 1971.



Oil spill cleanup in 1971 on San Francisco's Ocean Beach. Courtesy Creative Commons

In a predawn darkness thickened by heavy fog, two small Chevron tankers were maneuvering through the strait. At San Francisco's Pier 45, Coast Guard technicians were just then testing a novel radar system. They watched helplessly as two blips threatened to fuse into one. Frantic calls to the captains failed to get through. The inbound *Arizona Standard* rammed its bow 40 feet into the outbound *Oregon Standard*, releasing more than a million gallons of heavy "Bunker C" fuel mixture — likely the worst spill in Bay history.

The San Francisco Bay Model in Sausalito ran tests predicting, correctly, where the slick would go next: up the Marin County coast. As official response sputtered, a ragtag army of volunteers appeared, determined to help but unsure how. Some capable locals worked through the night to install a boom across the mouth of Bolinas Lagoon, shielding the single most valuable habitat in the spill's path. They did less well dealing with the oiled grebes, scoters, and loons.

"There were dying birds everywhere and no one knew what to do," recalls volunteer Jay Holcomb. "It was as horrible as you can imagine." The Point Reyes Bird Observatory (now Point Blue) estimated the loss of grebes, scoters, and loons at 20,000 birds. Of 7,000 collected, only

300 survived to be released. Effects on other biota — herring, eelgrass — were not even studied.

Weeks later, much of the goo seemed unaccounted for. Chevron asked the advice of John Conomos of the U.S. Geological Survey, who had tracked currents using drifters set at different depths. "Look in San Pablo Bay," Conomos said. The oil was there, in the middle of the water column, trapped between opposing currents on the surface and along the bottom.

Coming less than a year after the first Earth Day celebration, the 1971 spill shocked public opinion, led to new laws and procedures, proved the value of Bay research, and seeded several important environmental organizations.

By early spring, some of the shell-shocked volunteers had incorporated International Bird Rescue, funded by the industry and later directed by Holcomb for a time. It is a leading group in the field to this day.

For its part, the Coast Guard greatly stepped up its supervision of Bay traffic, creating a new Vessel Traffic Service headquartered on Yerba Buena Island; it works like air traffic control though without an airport tower's absolute authority. "Never again," was the slogan of the day.

Of course, the spill of 1971 was neither the last nor the first in a series as old as the petroleum age and often involving fog.

In 1922, the tanker *Lyman Stewart* collided with a freighter in the Gate; its oil clogged the intakes of Sutro Baths near the Cliff House. In 1937, the *Frank H. Buck* was rammed in the Gate by a passenger liner; the SPCA euthanized large numbers of hopelessly oiled gulls.

In 1984, the *Puerto Rican* caught fire and broke up eight miles outside the harbor entrance, shedding about

as much oil as the 1971 disaster, though with less dramatic (or visible) effect. In 1986, the coastal barge *Apex Houston* dribbled oil out of an unclosed hatch cover, killing common murrens from the Golden Gate to Big Sur.

In 1988, Shell's Martinez facility discharged 400,000 gallons of oil into Suisun Bay wetlands. In 1996, the *SS Cape Mohican* spilled 96,000 gallons at San Francisco Pier 70, though most was contained at the site.

Then came November 7, 2007, when the *Cosco Busan* — in touch with Vessel Traffic Service, with bar pilot on board — nevertheless struck a tower of the fogbound San Francisco-Oakland Bay Bridge. The release was a comparatively small 54,000 gallons of heavy oil, but the site and season magnified its effect on birds. Despite advances in bird care and cleanup technology, nearly 7,000 seabirds and shorebirds were killed. Pacific herring suffered as well. A post-mortem report produced another long list of needed improvements, some of them familiar from 1971, and a new round of reforms.

Have things not improved since 1971 or 2007? Of course they have. "California now has one of the best oil spill response, preparation, and prevention systems in the world," says Eric Laughlin of the state Department of Fish and Wildlife. And the relatively trouble-free span since 2007 is the longest yet.

Yet the recurrence of spills — and reported errors in response — reminds us just how difficult this job remains: what an achievement it actually is to move and process billions of gallons of hydrocarbons through and around this busy harbor, in any given year, without significant mishap.

This February, an oil spill was again in the headlines: 600 gallons of mixed water and diesel oil flowed from a punctured pipeline on Chevron's Long Wharf in Richmond. The city issued a public health advisory. Nearby beaches and shorelines were closed. Estimates of spillage grew with each report. San Francisco Baykeeper criticized cleanup efforts as slow off the mark. A report is forthcoming.

Note: footnoted version online.

Beavers Make Good Neighbors

MICHAEL HUNTER ADAMSON, REPORTER

Much like when tech money re-shapes an historical neighborhood, a beaver's move downtown can cause the locals to worry. In Napa, the animals' sprawling waterfront complexes create worrying pools along the riverbank, while the native cottonwoods are whittled down and threaten landowners' roofs. It seems destined that two species known for their environmental engineering would struggle to live in unison. However, municipalities like Napa and Martinez in Contra Costa County have learned to live with their beavers, and the upcoming California Beaver Summit aims to set the record straight.

"Our approach is hands-off," says Jeremy Sarrow, a resource specialist with Napa County Flood Control and Water Conservation District, describing the county's tack toward managing beaver dams built along inhabited waterfronts. This isn't so much to say that they turn a blind eye to conflicts between beavers and concerned landowners, but rather that their position is that there's no need for conflict in the first place.

Sarrow explains that while beaver dams appear to look like they can cause localized flooding, they aren't as permanent as they appear. "When you get a decent flow event, even a one- or two-year recurrence interval, there's typically enough velocity to blow out the dam entirely," he says. Simple underwater structures can also be installed to allow water to flow freely underneath the dam. While beaver-felled trees can cause property damage, Sarrow suggests that a three-foot-high wrapping of hardware cloth (similar to chicken wire but more durable) around the trunk of a

tree is sufficient to deter a beaver.

Furthermore, it's becoming increasingly apparent that beaver habitats have a lasting positive impact on surrounding ecosystems. Emily Fairfax, a scientist and assistant professor at California State University Channel Islands inter-



Photo: Heidi Perryman

viewed by Estuary News last April, has focused her research on beavers' impact on fire resilience. "In severe fires, areas with beaver dams held up pretty well," says Fairfax. Viewed from above, "those areas stayed green."

Recent Bay Area history has also shown that when a beaver moves in, a whole lot of biodiversity follows. In 2007, when one settled into Alhambra Creek in Martinez, Heidi Perryman and other community advocates fought to protect it from government-ordered extermination. "Within a few months, we saw green herons, wood ducks, and river otters returning to the creek," Perryman says. She went on to found the community group Worth A Dam to tell the story of the Martinez beaver and advocate for a similar approach in other urban waterways.

This kind of lynchpin effect is characteristic of a keystone species. Like grey wolves and sea otters in their respec-

tive domains, beavers play a critical role in fostering the health of riparian ecosystems, yet they still struggle for the recognition they deserve.

In May of 2020, the California Department of Fish and Wildlife issued a permit to trap and shoot beavers in eastern Contra Costa County, despite Martinez's precedent. A local news outlet described the controversy that ensued as "a backlash from animal lovers" over "pesky beavers." Despite the growing understanding among both scientists and government agencies, the popular notion of beavers as pest species, not ecological wunderkind, remains indelible.

This enduring misconception stems from the belief that beavers aren't endemic to California. In reality, frontier trappers and traders nearly extirpated beavers from the state. By the time the 49ers came west, beaver sightings were so few that they were perceived as a novelty, not a necessity. "We convinced ourselves that we didn't need them," says Perryman.

To help educate the community and share best practices across agencies and counties, Perryman and others have organized the California Beaver Summit this April 7 and 9. Speakers will clarify beaver history, share the benefits their presence provides, and teach how to interact more responsibly with them. Fairfax, a featured speaker on the second day, will discuss her recent research on beavers and last year's historic fire season.

"It's not about having enough evidence at this point," says Perryman on the value beavers bring to California waterways. "Everybody that drinks water and doesn't want their house burned down should be interested in something that solves both problems."

Author's note: It appears that there is no consensus on how to pluralize "beaver." The author has chosen to use "beavers" (over "beaver") for consistency and clarity's sake, and feels strongly that the summit should have a panel dedicated to getting to the heart of this matter.

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Beaver dam in Napa. Photo: Rusty Cohn



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San Francisco Bay and the Sacramento-San Joaquin River Delta comprise one of 28 "estuaries of national significance" recognized in the federal Clean Water Act. The San Francisco Estuary Partnership, a National Estuary Program, is partially funded by annual appropriations from Congress. The Partnership's mandate is to protect, restore, and enhance water quality and habitat in the Estuary. To accomplish this, the Partnership brings together resource agencies, non-profits, citizens, and scientists committed to the long-term health and preservation of this invaluable public resource. Our staff manages or oversees more than 50 projects ranging from supporting research into key water quality concerns to managing initiatives that prevent pollution, restore wetlands, or protect against the changes anticipated from climate change in our region. We have published *Estuary News* since 1993.

ESTUARY News
MARCH 2021, Vol. 30, No. 1

www.sfestuary.org/estuary-news/

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COVER PHOTO Robin Meadows
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REDALEERT

Mussels Hiding in Moss Balls

JOE EATON, REPORTER

A few weeks ago, someone working in a big-box pet store in the Seattle area informed the U.S. Geological Survey that they had seen suspicious mollusks in ornamental aquarium plants that were being offered for sale. Federal scientists confirmed the presence of zebra mussels tucked away in a clump of *Aegagropila linnaei*, a green alga marketed as moss balls or marimo balls, and issued a warning through the Nonindigenous Aquatic Species Alert System on March 2.

The national Aquatic Nuisance Species Task Force, co-chaired by the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration, swung into action, bringing in regional networks and state wildlife agencies. On March 3, Martha Volkoff at the California Department of Fish and Wildlife in Sacramento, responsible for the detection and monitoring of invasive aquatic species, was notified that one of the most-watched invasives in the West, hitchhiking in aquarium plants being distributed out of Southern California, posed a threat to previously uncolonized areas.

Native to the Black, Caspian, and Azov Seas, the zebra mussel (*Dreissena polymorpha*) reached the North American Great Lakes in the ballast water of a cargo ship and is now widely established east of the Rockies. Zebra mussels are tiny, but their mindboggling numbers can clog the pipes of power plants, water distribution systems, and industrial facilities, degrade dock pilings and other structures, and disrupt aquatic ecosystems. California and other states, organized in a Western Regional Panel, have been working to contain their further spread.

"We had been very focused on watercraft and their movement as the primary vector," says Volkoff. The aquarium trade as a potential pathway wasn't on anyone's radar. Federal and state authorities have dealt with invasive tropical fish and aquarium plants, eradicating the marine alga *Caulerpa* in Southern California, but hadn't considered ornamental plants as a Trojan horse for zebra or quagga mussels.

According to Volkoff, a single Southern California distributor — just one of several suppliers — provided moss balls for 2,800 retail outlets in 49 states, from large chains like PetCo and PetSmart to small independent retailers, under brand names like "Betta Buddy." At press time, inspectors had found moss balls with zebra mussels in stores in 32 states, including California and Oregon.

The chains quickly pulled the product when made aware of the zebra mussel problem, and the U.S. Fish and Wildlife Service and the Pet Industry Joint Advisory Council issued decontamination guidelines for home aquarists. While home aquaria may not be optimal habitat for the mollusks, wildlife managers are advising aquarists to kill any zebra mussels they find in their tanks. At a minimum they should quarantine and monitor their tanks for at least six months after disposing of moss balls.

"I think the response was pretty darn fast," says Karen McDowell, senior environmental specialist with the San Francisco Estuary Partnership and an ex-officio member of the national Task Force. "Once the report had been verified, things happened very quickly."

In a California Department of Fish and Wildlife press release, Volkoff appealed for cooperation: "It is imperative that pet suppliers and aquarists take action to prevent these mussels that have entered the aquarium trade from reaching our waterways."

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