SAN FRANCISCO

ESTUARY

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Access to Vessels for Science Sampling Shrinking but Retrofitted Pontoon Offers Touchless Fish Surveys

WATER
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Creeks & Quilts for Climate

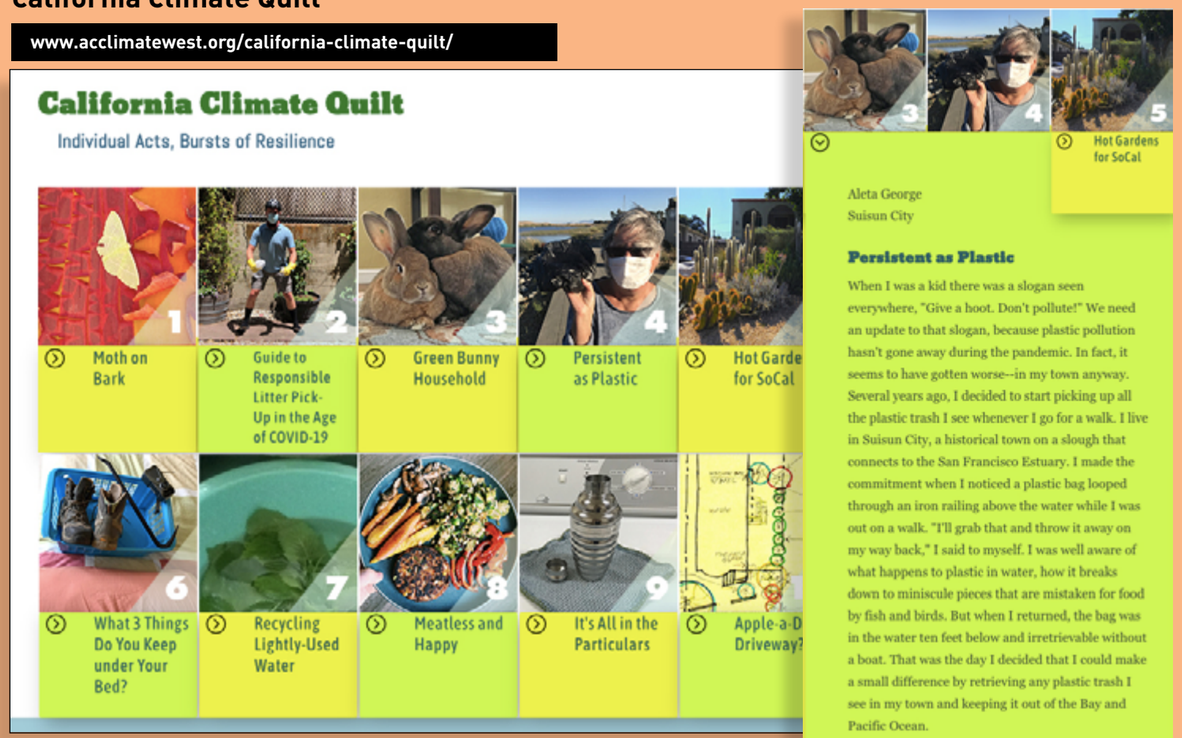
The *Estuary News* team has been working behind the scenes with partners on a cool new build out of our sister Acclimatewest project called the California Climate Quilt. Acclimatewest.org is a pilot storytelling site that gathers stories about creeks, sloughs, and shorelines adapting to sea level rise, describing who lives around them and what concerns they have about their environment, as well as exploring the local natural and human history of the area. At the same time, in a world driven by short attention spans and social media, we realized that you may have a lot of individual stories of resilience or climate adaptation action to share! So this summer we began digitally sewing a California Climate Quilt and issued a Dare — what can you change by 25% now and by 2025 to reduce you carbon footprint? Other initiatives are working on metrics and BTUs – our focus is the people, the story, the action, the photo or art, the sense of community around a quilt of actions!

So get quilting. Send us your story about your individual act of resilience—whether it's how you grow herbs with rinse water or gave up eating meat or planted an orchard in your driveway or abstain from using ziplock bags. Make your own group or school or block or family square of 25 squares! www.acclimatewest.org/stories/dare25by2025/

Help us find creeks that make good stories, introduce us to the people who live there, so we can build local storytelling partnerships.
Email us at acclimatewest@gmail.com.

California Climate Quilt

www.acclimatewest.org/california-climate-quilt/



Daylighting Delta Science on Maven's Notebook

Maven's Notebook, our water news partner, is working with *Estuary News* to bring you more science than ever before from the Delta. Don't miss the notebook's new science pages, which include a growing directory of scientists working in the Delta (submit your profile!), highlights of Delta research, and a new series of podcasts called *Science in Short*. The series brings the voices of researchers working in the San Francisco Estuary to you. Enjoy our first podcast – an interview by *Estuary News* reporter Alastair Bland with PhD student David Ayers on his work exploring the habitat needs of fish.
Stand by for release September 29, 2020.

H E A L T H

Covid Clues from Wastewater

LISA OWENS VIANI, REPORTER

As COVID-19 continues its unrelenting rampage, wastewater plant managers and university researchers are ramping up their efforts to monitor wastewater for SARS-CoV-2, the virus that causes the disease. Their goal is to give public health departments a powerful tool: an early warning system for new outbreaks in communities. In Yosemite Valley, for instance, wastewater testing revealed the presence of the virus in the community before swab testing of individuals showed a problem.

"There's a time delay before cases appear in a community and in the medical system," says Katy Graham, a graduate student at Stanford University who is leading development of laboratory methods that will link trends and concentrations of the virus' RNA (ribonucleic acid) in wastewater to the virus' prevalence and spread in communities. "Individuals can shed the virus for days or weeks before they are aware they have it. Tracking its RNA in wastewater can identify COVID infections in the community more accurately and faster than other types of testing."

Wastewater treatment plants from around the Bay are submitting samples of their untreated waste (influent) to labs at Stanford and other universities. Despite the seemingly hazardous nature of the samples, there have been no instances of virus transmission from the testing process, says Graham. "We are detecting viral RNA, which is not the same thing as infectious or intact viruses. RNA can be detected in a sample without infectious virus present." Although risk of transmission from the samples is low, the Stanford team takes extra precautions, Graham says. "We are very careful, we use lots of PPE and N95 masks and lab coats and biosafety hoods. We socially distance."

The East Bay Municipal Utility District (EBMUD) was one of the first wastewater dischargers to send samples to Stanford. The district first encountered COVID-19 when the Diamond Princess cruise ship arrived in Oakland in March about to overflow with waste. "They called us and said, 'We're desperate, we're at capacity.' We took the wastewater to our [Oakland] plant and treated it after sending some samples to Stanford," says Eileen White, wastewater director for EBMUD. Since then, she has been coordinating the utility district's efforts with public health agencies at the local, state, and federal levels, including the Centers for Disease Control and Prevention (CDC). White says the information gathered through wastewater testing can be used to guide county health officers in making decisions about shelter-in-place orders.

East Bay Dischargers Authority general manager Jackie Zipkin says there have been many different efforts by dischargers and researchers moving in parallel to help track COVID-19. While Stanford's focus is primarily research and model development, UC Berkeley is gearing up to test as many as 100 samples per day, she says. And EBMUD is now building capacity to perform more testing in its own labs. They've also tested their treated effluent before it is discharged into San Francisco Bay. "It does not have COVID — the treatment process kills it," says White. "So if you're a swimmer in the Bay, the answer is 'No, you won't get COVID.'"

A working group of researchers from Stanford and UC Berkeley, public health officials, and treatment plants convened recently to coordinate efforts, says Zipkin. A subset of those leaders has formed a steering committee tasked with framing a regional wastewater monitoring program.

EBMUD employees take samples of untreated wastewater, which will be tested for SARS-CoV-2. Photo: EBMUD

Katy Graham samples for SARS-CoV-2 in Alexandria Boehm's lab at Stanford. Photo: Stanford

But a big challenge for all the labs moving forward is cost. "There's the cost of setting up the lab itself, of performing the analysis, which can cost $200 or more per sample, and the cost to the agencies to collect the samples and ship them off," says Zipkin. She says most wastewater agencies are covering the cost of the labor to take and ship samples to labs as well as to analyze samples. "The perspective of the wastewater community is one of eagerness to help," she says. "I think every agency wants to send samples if they can be useful. We want to see this work moving forward because we all want to do something and feel it has a lot of promise." White says the CDC has promised that funding will be forthcoming.

Zipkin points out that a regional program will help home in on an outbreak: "The more different data sources you have to evaluate trends and try to triangulate an outbreak, the better. [A regional program] presents an opportunity to do that." Wastewater sampling saves resources too, she says. "You can look at a whole neighborhood or building versus testing every individual in the community."

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MONITORING

Match Points in Stormwater Soup

NATE SELTENRICH, REPORTER

Scientists studying environmental pollutants tend to divide them into two distinct groups. One includes "legacy" contaminants that drew attention during the early stages of the environmental movement, like mercury, PCBs, and some pesticides. The other is a much larger class of "emerging" contaminants whose production or monitoring began more recently and about whom less is known; think pharmaceuticals, plastic additives, and flame retardants.

SFEI's Jennifer Sun and Patrick Kim sample water in San Leandro Bay. Photo: SFEI

Effluent from wastewater treatment plants is often seen as the primary source of emerging contaminants in San Francisco Bay. But a report published in July by the Regional Monitoring Program (RMP) challenges that assumption by highlighting the importance of urban stormwater runoff as another major source of some less-studied chemicals in Bay waters.

These include ethoxylated surfactants, traditionally thought of as detergents more likely to be present in wastewater, and other compounds derived from tires and roadways, says senior scientist Rebecca Sutton with the San Francisco Estuary Institute (SFEI), who led the work.

In 2016, SFEI researchers collected water samples at three sites in the Bay, each representing a different contaminant pathway: the middle Napa River (still tidally influenced) for agricultural runoff; the mouth of Coyote Creek for treated wastewater discharge; and San Leandro Bay for urban runoff. The study team also obtained effluent samples from four local wastewater plants.

Instead of searching only for specific contaminants, the researchers wanted to cast a wider net. For this they turned to a relatively new approach known as non-targeted analysis, which uses laboratory techniques called liquid chromatography and mass spectrometry to pick out chemical signatures in samples and then compare them to more than 22,000 signals for known compounds. Matches, or hits, are then further analyzed to confirm their identity with a high degree of confidence.

"Around the beginning of the 2010s, the concept of using advanced analytic chemistry to try to discover new compounds that might be in the Bay that we were not looking for came to be possible," says Duke University's Lee Ferguson, a pioneer of non-targeted analysis who has served on the RMP's Emerging Contaminants Workgroup since 2006 and whose lab analyzed the samples. After a few pilots in the early 2010s, technological advances finally made a full-Bay study possible.

"It's a very powerful technique," Sutton says. "It can reveal things we didn't anticipate."

Sure enough, water samples in the study contained more than 400 unique, water-soluble chemicals including detergents and surfactants, plastic additives, pesticides, pharmaceuticals, and flame retardants.

Predictably, pesticides were the primary contaminant in water from the Napa River. Samples from the Coyote Creek site and four wastewater treatment plants contained plenty of pharmaceuticals — including antibiotics, antiepileptic drugs, antidepressants, hypertension drugs, anticonvulsants, and cardiac treatment drugs — as well as ingredients from cleaning and personal-care products.

But San Leandro Bay, bordered by highly urbanized and industrial sections of Oakland, Alameda, and San Leandro, harbored some surprises. It contained the greatest number of ethoxylated surfactants, potentially harmful chemicals more widely known for their use in products including shampoo, liquid soap, bubble bath, and hair relaxers.

In fact, these chemicals are also used in asphalt and automotive and industrial products. After they are deposited on parking lots, roadways, and other surfaces, rain can wash them to the Bay through creeks and storm drains.

The San Leandro Bay samples also detected compounds used in the production of rubber vehicle tires. Recent studies in Washington's Puget Sound have shown that chemicals leaching from tires can be toxic to coho salmon.

"We keep learning about new contaminants, both in the Bay and the water pollution world in general, and the idea is to identify them as early as possible so that they don't become legacy contaminants of the future," says RMP lead scientist Jay Davis.

Because the research did not quantify contaminant concentrations, it doesn't address whether chemicals are present at levels of concern for aquatic life or human health. That task will fall to follow-up studies to further investigate the prevalence and risk profile of ethoxylated surfactants, so-called tire leachate, and other emerging contaminants in urban stormwater runoff. Some of this work is already underway, initiated soon after results from the non-targeted analysis study first became clear.

"The RMP spends several hundred thousand dollars per year on emerging contaminant work, and we shifted a large portion of that toward stormwater studies," Davis says. "It has become a major focus of our work."

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POLLUTION

The Delta's Blooming Problem

CARIAD HAYES THRONSON, REPORTER

Bright-green blotches of algae have been popping up all over the Delta since early summer, from Discovery Bay to the Stockton waterfront, befouling the air and poisoning the water with toxins that can sicken or even kill humans and animals. Veteran Delta watchers believe that this year's harmful algal blooms may be the worst ever, and worry that some features of Governor Gavin Newsom's recently released Water Resilience Portfolio for California will aggravate the problem.

"We don't have enough data to know if this is the worst year ever, because we haven't been out there every single year for years and years monitoring," says Meredith Howard, and environmental program manager at the Central Valley Regional Water Quality Control Board. "I will say we've seen higher toxin numbers this year compared to the last three or four years."

Although blooms are common in Discovery Bay and Stockton, "What was especially concerning this year is that we saw significant concentrations out in the Estuary as far as Antioch that were connected to the big Delta bloom," says scientist Brian Bergamaschi of the U.S. Geological Survey (USGS).

Delta waterways in the summer can be ideal environments for the cyanobacteria that create harmful algal blooms (HABs). "There are certain areas of the Delta that don't get a lot of flow for long periods of time, usually in the summer when it's really warm. Cyanobacteria love that," says Howard, citing the stagnant waters around Stockton as a particularly

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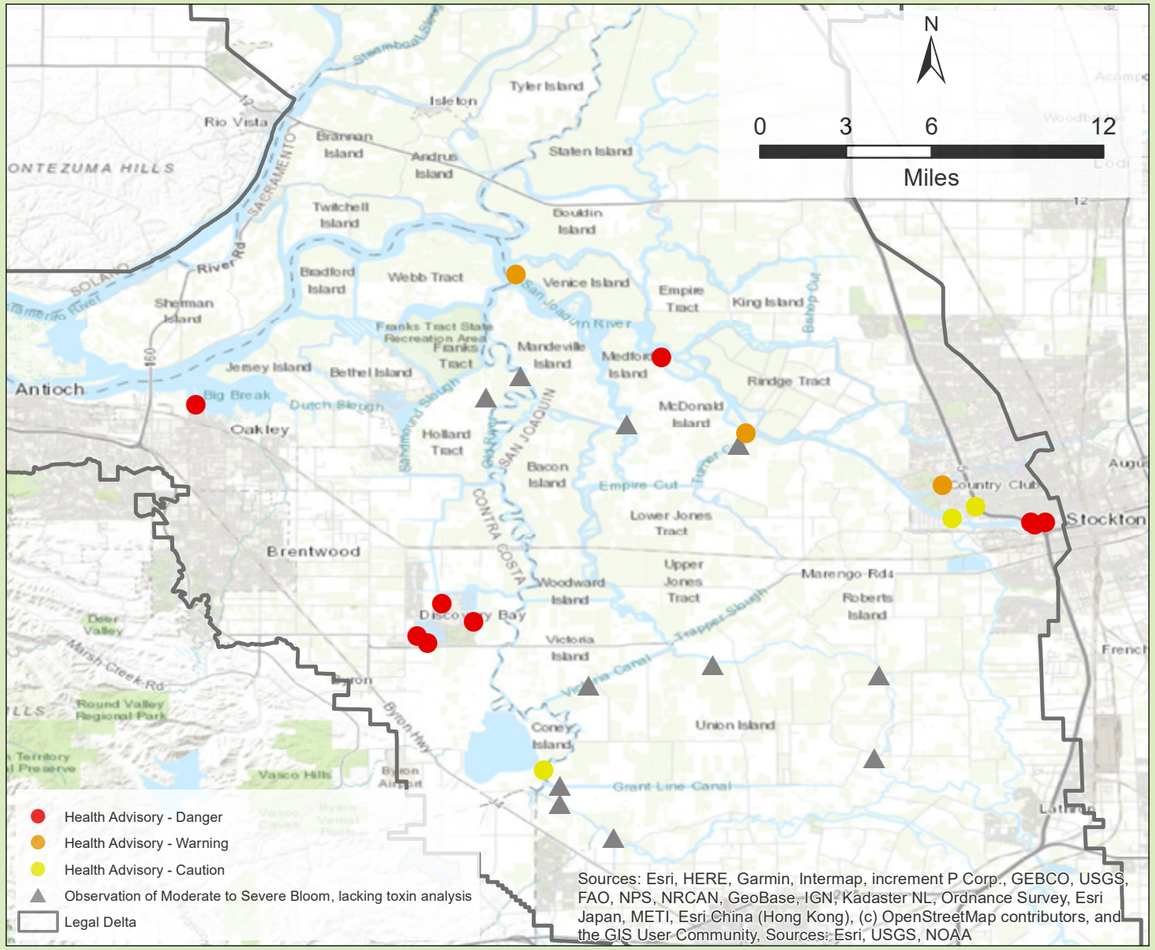
2020 Delta Cyanobacteria Blooms

Cyanotoxin Human/Animal Health Advisories and Visual Bloom Observations



optimal spot for HABs. "Cyanobacteria grow faster in warm water." The nutrients that spill into the Delta from agricultural land and urban runoff also stimulate their growth.

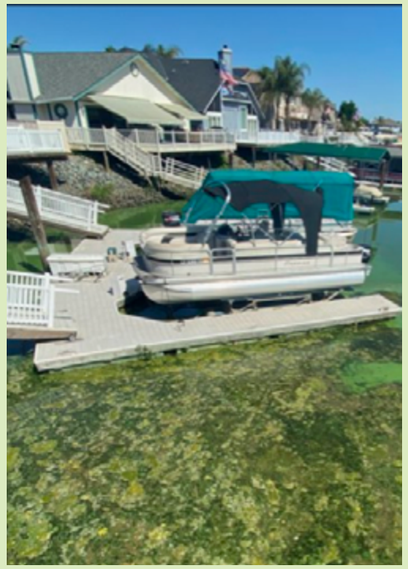
Despite the alarming number of blooms identified this summer, the true extent of the problem is unclear, as there is no formal monitoring program for HABs in the Delta. "HABs are kind of like COVID in that if you don't track it, you don't know what you're really dealing with," says Barbara Barrigan-Parrilla, director of Restore the Delta, which has been raising alarms about HABs since 2014.

In 2019, the governor signed AB 834, mandating a freshwater and estuarine HAB program. "That was supposed to give us a lot of resources starting in July 2020," says Howard, but COVID-related budget constraints took that off the table.

Such a program will be challenging to design and expensive to operate, says Bergamaschi, who is studying the effect of cyanotoxins on Delta aquatic ecology. It can cost upwards of $350 to analyze each water sample for the toxins, not including the costs of "getting people into boats to collect the samples."

Monitoring is also complicated by the fact that not every algal bloom is harmful. "Just because you can see an algae colony doesn't tell you whether or not there are cyanotoxins in the water column," says Bergamaschi's USGS colleague Tamara Kraus. "There are different kinds of algae; some of them are beneficial and some of them are harmful. Some of them have the gene to produce the toxin, and some of them don't. Some that have the gene are not necessarily making the toxin." The conditions that cause the organism to produce the toxin are still unknown.

Although there is no formal HAB monitoring program in the Delta, an informal peer-to-peer scientific network is picking up some of the slack, says Howard. "There's a huge number of groups that do monitoring [of various things] in the Delta. We've started to work with USGS and the Department of Water Resources, and we're trying to get HABs incorporated into more of our regional monitoring programs." In the meantime, the Surface Water Ambient Monitoring System, established in 2016, maintains an online portal that allows anyone to report suspected HABs.



Algal bloom in Discovery Bay, 2020. Photo courtesy Michael Greggens

"There are a lot of active stakeholders who use that resource now," says Howard. "It's gotten to the point where there are actually more reports than we have staff to investigate."

Howard is hopeful that a regular monitoring program will begin in 2021 (implementing AB 834 is one of the priorities identified in the Water Resilience Portfolio). In the meantime, Howard says she is talking with regional board members and stakeholders about developing a HAB mitigation and management strategy for the Delta.

To Barrigan-Parrilla, some solutions are obvious. "There has to be adequate fresh water flowing through the Delta all year round," she says. Number two, we've got to do something about [nutrient-heavy] discharge from the Port of Stockton and agriculture. And number three, we need mechanical recirculation systems [where there are stagnant areas]."

Barrigan-Parrilla and others are worried that several priorities identified in the portfolio will limit the needed freshwater flows. These include the proposed Sites Reservoir, the latest iteration of the Delta tunnel, and reliance on voluntary agreements with water contractors to increase flows and improve conditions for native fish in the Delta.

"What's going to happen when we are deprived of even more flow?" asks Barrigan-Parrilla. "Rather than just saying 'no' to the tunnel, we're saying, let's solve this problem and then talk about the tunnel. But [the Department of Water Resources] just doesn't want to do that. And it's the same with voluntary agreements. Nobody wants to do the hard work about how these issues are interrelated."

New water quality standards for the Delta might go a long way toward resolving these issues, says Kate Poole of the Natural Resources Defense Council. In 2018, the State Water Resources Control Board released its Phase One update to the Bay-Delta Water Quality Control Plan, which set new standards for flows from the San Joaquin River. However, those standards have yet to be implemented. Phase Two, which would address flows from the Sacramento River, is on hold while the state tries to negotiate the voluntary agreements. Earlier this year, negotiations over the agreements dissolved when the parties—including state and federal agencies and water contractors—disagreed over Endangered Species Act requirements.

"The state board needs to get back to work on both the Phase One implementation and the Phase Two standards," says Poole. "If the voluntary agreements come back to life, they can be plugged into that proceeding. But there's urgency around this. We've lost decades already."

Poole says her concern about the Water Resilience Portfolio is that while it includes some laudable initiatives and approaches, "It doesn't connect the pieces, which is what really needs to happen if we're going to deal effectively with these big thorny problems, like restoring the health of the Delta."

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TECHNOLOGY

Retrofitted Houseboat IDs Fish in the Shallows

ISAAC PEARLMAN, REPORTER

On a hazy Delta morning at Isleton's B & W Resort, more than a dozen trucks are already neatly arrayed in the double-long parking spaces with empty trailers facing the boat launch: evidence of fishers and boaters getting an early start on their Labor Day weekend. Randy Mager, sporting a flannel shirt and worn baseball cap, radiates earnest enthusiasm, which for a 20-year state government veteran is as refreshing and rare as a Delta smelt. "I am more excited about this than I have been about pretty much anything else in my career," says Mager, a senior environmental scientist with California's Department of Water Resources (DWR).

The subject of his palpable excitement floats in the water in front of us: a 25-foot long pontoon boat with a soccer-goal-like rectangular array mounted on the front, and a gaping table-size hole cut into the boat's flat floor. Joe Merz, whose company Cramer Fish Sciences designed the boat, issues an invitation aboard from behind a shark-covered facemask, telling us how the vessel was a Lake Shasta houseboat when he bought it in 2015. After years of testing and modifications, the boat has been so radically changed that according to Merz the only remaining original part is the steering console and instrument panel.

Whitney Thorpe, a fisheries biologist at Cramer and the MacGyver-like genius behind much of the boat's transformation, hands out life jackets and efficiently runs us through the boat's safety protocols. "Obviously watch out for the giant hole," she points out with a friendly laugh. "It's painted bright orange so you can't miss it!"

The new monitoring boat is capable of something never done before: combining video technology and DNA analysis from shed molecules in the water to get a clearer picture of what's going on in the Delta's murky depths. "Fish monitoring is limited in the Delta's restored habitats," explains Mager. Net surveys are all but impossible in shallow riverbanks and intertidal wetlands, where dense aquatic plants choke nets and propellers, and levee rip-rap bruises boat bottoms. "You end up with a net full of vegetation and fish that die by the time you take them out," he says. Which poses a problem if some of those species are endangered.

Chute net dragged under the boat. Photo: Isaac Pearlman

With the new method, fish aren't captured — they simply pass through a water-filled chute under the boat, without being pulled from the water or handled. Mager calls the technology a "game changer" and raves about all the new data it collects and questions it can answer, including whether fish prefer a certain type of restored habitat.

As we drift into the south fork of the Mokelumne River, the rest of Joe Merz's crew trails behind us in a second boat. Normally the DNA sampling team would also be on the platform boat, scooping up water samples to hunt for molecules they can use to identify what species have passed through the water column recently. But due to coronavirus protocols the group is split up today, in order to have no more than four people per boat.

Merz pilots us to the first sample site, peppering jokes and friendly banter into his overview of the boat's technology and their research. Meanwhile Thorpe moves in a hyper-efficient blur, rigging up two GoPro cameras and snapping them into a waterproof housing. She belly-flops onto the boat's floor to connect the net that will funnel fish from the wide-mouthed front array through a narrow chute under the boat's platform, where the fish pass in front of the cameras before exiting through gates in the back. The apparent simplicity is deceptive: Merz notes they contracted a company to model the fluid dynamics of the water flow in order to design the system so that fish pass through slow enough and at the best orientation to the cameras for successful identification. "This system has been in my head for 20 years," he says.

We head toward an island of reeds and thick hyacinth in the middle of the river, and Merz uses hydraulics to maneuver the rectangular intake in front of the boat up and down like a bulldozer's blade. A tablet streaming the video feed shows several fish rapidly passing through the chute, almost too fast to see, though Merz can identify them with just a glance: "Bass," he says,

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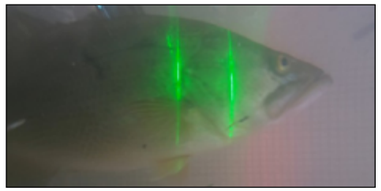
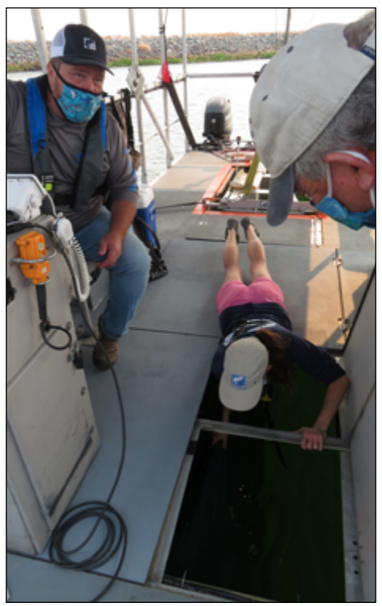


Largemouth bass photo shot by new camera rig. Photo: Cramer Fish Sciences

checking the boat's line then turning back to the screen. "There goes a bluegill." Soon he won't have to, though: the team has developed an algorithm that can automatically identify the fish species from the video. "We're at 95% accuracy for some of the more common Delta species," says Merz, who at this point relies on trained staff to verify and improve the algorithm's recognition. "Our goal is 100%."

As we nose into the green swath of vegetation, the perils of aquatic plants that Mager warned about quickly become evident. Green beards of algae float by on the video screen, and Thorpe uses a small rake to rapidly pull out the thick clumps so they don't block the fish passage or cameras. Eventually the net clogs and Merz lifts a floor panel to unzip the net from the top, pulling out double handfuls of green sludge.



Cramer's Whitney Thorpe attaches the net to the chute through the hole in the bottom of the boat, as Joe Merz (left) and Randy Mager (right) look on. Photo: Isaac Pearlman

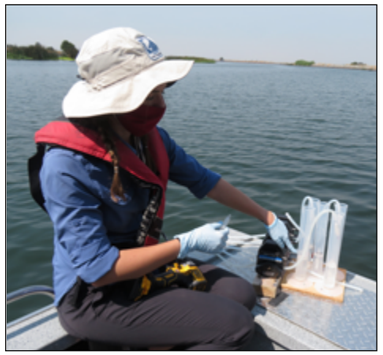
"When you haul up net, you are just getting an average," Mager points out. "You don't know if the fish [you catch in the net] were all in one group, or all at one depth." He explains that Merz's group is collecting real-time data on water temperature, salinity, and more that is time-stamped and matched to the individual fish recorded on the video. This gives a much more detailed, nuanced look than simply lumping together fish caught from throughout the water column in a trawl or seine net under one measurement. "With a trawl survey you could spend an hour picking through the net," says Mager, shaking his head with amazement at how fast Thorpe and Merz have the net cleared and ready.

Merz next demonstrates the vessel's "four-wheeling" capability, piloting the boat close enough to a rip-rapped levee to elicit an astonished curse from Mager. The boat's front intake has wheels on the bottom of the posts, allowing it to act as a fender as it bumps along the shallow river bottom. If it encounters something larger, like a tree stump (or, as the requisite Delta joke goes, a dead body), the array is designed to snap off and easily reattach, rather than bending or breaking.

The DNA sampling crew pull up next to us and show off their finger-length clear plastic capsules of water. From these samples the DNA team will filter and capture molecules that fish have sloughed off from scales, mucus, and feces. Once the specimens, traveling on ice to prevent DNA degradation, reach the lab the team will know within 90 minutes which locations had Chinook salmon DNA and therefore which type of habitat the species may prefer.

"[DNA analysis] isn't new," notes Gregg Schumer, who oversees Cramer's environmental DNA services. He points out that the technique just came slowly to environmental monitoring. "Before it was like doing santeria on the Delta," he laughs, joking that early on his DNA presentation audiences consisted of his mother and one other person. "Now, the rooms are packed."

Mager excitedly rattles off research questions this technology and data could answer next, ranging from nutrient blooms during levee breeches to salinity gradient impact on fish distribution. "It's like we just got a new Lego set," he says. "We could build anything."



Cramer's Katie Karpenko preps vials of shed DNA to send to the lab on ice. Photo: Isaac Pearlman

However, Merz and his crew are seeking bigger prey. With the recent addition of a second camera, they now can measure fish length from video, and are starting to incorporate fish larvae into their video identification algorithm. And though their DNA analysis focuses on migratory salmon for Mager's project, Schumer points out that their treasure trove of samples could be analyzed for a broader sweep of species in order to unveil a more comprehensive picture of the Delta ecosystem.

"We need to monitor the Delta like a patient in a hospital: looking at the big picture," says Schumer, equating traditional monitoring to diagnosing a patient by staring at their pinky. "We are just scratching the surface of the things we can do."

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To see video of the pontoon wonder in action visit Estuary News online.

F I E L D W O R K

A Fragile Fleet

JOHN HART, REPORTER

The naming of boats and ships is a serious matter. Each larger vessel's name starts with a code that tells what it carries, what propels it, or what purpose it serves. If it were your hobby to keep tabs on traffic on San Francisco Bay, you'd see a lot of big UCCs (container ships) and TCHs and TCRs (tankers). You'd see ferries emblazoned with MV, standing for "motor vessel." Before COVID-19, you would have spotted the occasional SS, standing for "single screw" but meaning a passenger liner. And if you looked hard you might see the occasional modest hull labeled RV. RV stands for research vessel. Seeing these letters, you know you're looking at one of the indispensable craft that take scientists and their gear to collect data from the waters and sediments of San Francisco Bay and the Delta.

Watching Bay-Delta science unfold, we take for granted the little armada that keeps it all going. But, like many of the systems that quietly sustain our society, this one is showing signs of strain.

Nobody has a firm count, but it appears there are about 100 vessels supporting research in the Estuary. They range from a few large craft that can work outside the Golden Gate to little "trailerable" skiffs and Adirondack rowboats that ply Delta shallows. Some, like the U.S. Geological Survey's *RV Turning Tide*, belong to federal agencies. Others, like the California Department of Fish and Wildlife's *RV Longfin*, are state-owned. Important ones, like San Francisco State's *RV Questuary*, are university assets and double as floating classrooms. Still others, like Dixon Marine's *RV Lakota*, belong to private companies that lease them out to clients such as the San Francisco Estuary Institute (SFEI), Chevron, and PG&E.

Top: The RV Turning Tide *(53 feet, USGS), underused due to staff limitations; is on the water for two weeks every two years in aid of Regional Monitoring Program pollution studies.*

Bottom: The RV Questuary *(38 feet, SFSU) "is the most capable boat I've seen on the water," says Alex Parker of the California Maritime Academy. Idled for the moment due to lack of crew, it will need replacement, or at least a new engine, in about five years. Photo: Linda Vortman*

About half of this fleet is enrolled with the Interagency Ecological Program, a research cooperative set up in the 1970s to track the effects of water projects and mainly, though not entirely, focused on the Delta. The other half, working largely in the lower Estuary, has not until now had such an organizational umbrella.

Depending on task, research boats need different refinements. Those that tow nets require big A-frame winches to hoist loads in and out of the water. Other boats may make do with lighter "davit" winches. They all need lab space, or at minimum a clean area for filtering and storing water samples. They need various special instruments. And they need crews adept in the special demands of operating a boat for research. "Driving a boat for science is different from driving a boat for other purposes," says Melissa Foley of SFEI.

This under-appreciated support system has been stretched thin for years. Many vessels, or "hulls" in the language of the field, are approaching the end of their useful lives. Like an old car, an old boat starts having problems two and three at a time. Take the case of the *RV Longfin*, launched in 1983 and vital to generations of Bay studies. "It's one thing after the next," says Steve Culberson of the Interagency Ecological Program (IEP). "As soon as you fix the hydraulics, the exhaust manifold goes down. We're using scotch tape and baling wire to hold these things together. You need to buy a couple of 1.5- to 2-million-dollar boats every decade to keep the information coming."

Captains, crews, and maintenance staff are also getting older. San Francisco State's *RV Questuary* rocks at the dock in San Rafael, having lost two captains in succession.

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Now there is a university hiring freeze. Not many young people are mastering the particular skills that make what you might call a research-support mariner.

State and federal environmental budgets are unpredictable and generally shrinking, leading to a kind of hoarding. Boat-owning agencies are less willing and able to lend their craft to projects outside their core missions and to people from other organizations. The informal swaps and mutual favors that have lubricated the machinery — "Oh, you're going to Liberty Island, could you scoop up a couple of liters for our zooplankton work?" — become harder to arrange. At the same time, says Foley, "There's not enough research going on within single agencies to support and pay for individual vessels."

Sharing boats is an obvious solution, but can bring complications. Liability, for instance. "Who's an employee and who is not? Who can use a winch?" asks Karina Nielsen of San Francisco State. "If a $50,000 instrument off the side of the boat gets lost, who's responsible? We are trying to figure that out."

In recent years, such nagging concerns have ripened into a sense of crisis. At one point in 2017, the IEP's *Longfin* missed surveys due to mechanical problems, creating gaps in precious, multi-decade streams of data. By the end of 2017, the IEP had set up a "fleet resilience" team and by August 2018 completed a plan to track the state of the boats and plan for future needs.

It has proven harder than you'd think just to fuse many agencies' information into a common format. "That doesn't look like our list!" people complain. As for new craft, it's unclear who would pay, or how.

The RV Longfin *(42 feet, CDFW), named for the longfin smelt, has been monitoring estuary fish since the 1980s. "It's pretty much at the end of its life," says the agency's Stephanie Fong.*

The six to eight years needed to design and build a boat exceeds the length of the research contracts that structure the program's funding. "It's a struggle," says Stephanie Fong of the Department of Fish and Wildlife.

The IEP has one thing going for it: an ironclad mandate. Without the data it generates, the state and federal pumps that send water south from the Delta would be legally forbidden to function. Even in times of austerity, money for this program's boats is likely to be found — somehow.

Things are less focused but no less urgent in the lower Estuary. In the fall of 2019, SFEI faced the possibility of losing access to all three boats it relies on for certain pollution studies: the *Questuary*, the *Turning Tide*, and the Geological Survey's *Peterson*.

In February of this year, when face-to-face meetings were still the norm, a roomful of worried people sat down at SFEI headquarters to map out a better way for the Bay. Again, the obvious first step was to build an inventory of the vessels, their capabilities, and their maintenance needs. The second, parallel step is to get a grasp of research missions expected in the next couple of years.

And after that? At a minimum, the participants agreed, the issues that hamper sharing the existing fleet must be wrestled down. One concrete suggestion: jointly support a new captain for the *Questuary*.

A longer-term dream is to band together to buy — and staff, and maintain — one or more capable boats for all to share. This would mean creating a new entity, a formal consortium. This option looks even farther off now than it did in pre-COVID days." Any new vessel," Foley says, "is likely to be long delayed."

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The RV Peterson *(67 feet, USGS) bears the name of pioneering Bay researcher David Peterson. It collects Bay water quality data monthly.*

Video of USGS sampling trip: https://www.sfestuary.org/estuary-news-usgs-investigates-50-year-mystery-of-san-francisco-bay/

COMMUNITY

More Grants for Real People

CARIAD HAYES THRONSON, REPORTER

Even as "environmental justice" and "community engagement" have long been watchwords of restoration and resilience efforts, economically disadvantaged communities on San Francisco Bay's shoreline have often felt sidelined by them. But that may be changing: the summer of 2020 saw new initiatives to give communities more power to shape and participate in restoration projects in their own backyards.

In July, the San Francisco Bay Restoration Authority kicked off its new Community Grants Program, allocating $200,000 of its $25 million 2020-21 budget to projects led by community-based organizations in economically disadvantaged bayside communities.

"This program will welcome new voices and partnerships, and work with community leaders to develop projects that empower and benefit communities that historically have been excluded from habitat restoration and the design of parks and trails," says Taylor Samuelson of the State Coastal Conservancy, which provides staff support to the Authority.

The new program is the upshot of work that began shortly after voters approved 2016's Measure AA, a region-wide parcel tax dedicated to Bay restoration. "The Authority's Advisory Committee expressed interest in bringing a stronger environmental justice focus to the Authority and to the way that Measure AA funds are allocated," says Samuelson. The committee convened a panel of environmental justice experts, who recommended that the Authority hire a consultant to study the issue and develop recommendations, a dozen or so of which were adopted by the Authority's board earlier this year.

"One of the main issues that came out of my interviews boiled down to communities not trusting the Authority enough to actually want to engage with them," says the consultant, Nahal Ghoghaie. "So adopting guiding principles that would help establish trust was an important recommendation." Others included scoring criteria that encourage an interdisciplinary approach and making the grant application process accessible to community groups that don't have the technical expertise and staff capacity of larger organizations.

STRAW (Students and Teachers Restoring A Watershed) in the San Pablo Bay National Wildlife Refuge. Photo: Natasha Dunn

"One of the big purposes of the program is to provide more staff support for economically disadvantaged communities," says grant program manager Linda Tong. Applicants to the new program can submit a pre-application letter rather than a full proposal. "If staff determines that project is appropriate for Measure AA funding, we will work closely with the proponent to help develop something that can be brought to our board."

Community visioning is a key thrust of the new program. "Rather than having an agency go to a community after they've come up with a plan for a restoration project, we're going directly to the community to ask them what ideas they have," says Tong. "We want a community-led process, where people are coming up with the ideas for what kind of projects they would want to see along the shoreline near where they live."

Programs that could benefit from the new program include those that grow out of the Oakland Shoreline Leadership Academy, a new program of the West Oakland Environmental Indicators Project. "The idea is that 18 to 20 residents of Oakland shoreline neighborhoods come and learn about vegetation, sea-level rise, planning processes and everything, and then each come up with a project," says the Indicators Project's Phoenix Armenta. "We imagine these would be $5,000 to $10,000 projects. They could include anything from hosting a shoreline music festival to doing a community cleanup day or planting green infrastructure. They'll go through the Academy for six months, and then we will work with them to develop their grant applications so that they can apply to do their own projects."

Critically, all participants in the academy will be paid; Ghoghaie identifies compensation as a vital part of any community engagement process. "If there are any community members involved in a project whatsoever, whether it's specifically an environmental justice project, or a mega-project like the [South Bay] Salt Ponds, they must always be compensated for their time."

The Authority is not alone in sharpening its focus on equity issues. Following a lengthy series of meetings and workshops, the Coastal Conservancy has also developed new Justice, Equity, Diversity, and Inclusion guidelines. Samuelson says these will be presented to the agency's board in September, and she is hopeful they will be adopted.

Ghoghaie sees a growing emphasis on environmental justice since the recent momentum of the Black Lives Matter movement cast new light on the inequities facing disadvantaged communities. "In the past month alone I think I've had three government agencies and two private consulting businesses ask me to do E.J. trainings for them," she says. "I wouldn't be surprised if it eventually leads to more programs that are focused on prioritizing these communities."

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GROUNDWATER

Small Farmers Shortchanged by SGMA?

MICHAEL ADAMSON, REPORTER

When governor Jerry Brown signed the Sustainable Groundwater Management Act (SGMA) into law in September 2014, he said that "groundwater management in California is best accomplished locally." With the first round of plans made available for public comment this year, it appears that, while the state certainly ceded control to local management agencies, those same agencies have prioritized the interests of big agriculture and industry over small farmers and disadvantaged communities. A June 2020 paper from UC Davis published in the international journal *Society & Natural Resources*, as well as work done by the Fresno nonprofit Leadership Counsel for Justice and Accountability, have shed light on the procedural inequities.

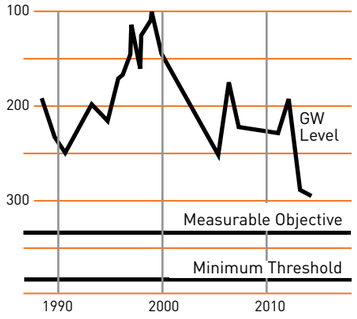
During the 2011-16 drought in California, declining rainfall, snowpack, and availability of surface water led to increased groundwater pumping in farms across the state. This change coincided with many farmers transitioning from row crops to thirsty permanent crops like almonds. A 2016 bulletin published by the California Department of Water Resources noted that 21 groundwater basins in the state were critically overdrafted, up from 11 in 1980.

"Whoever has the access to control how change is made also controls the distribution of harms and goods in society," said UC Davis doctoral researcher Linda Estelí Méndez Barrientos, a co-author of the journal article, on the July 10 episode of *Water Talk*, a University of California podcast. In the SGMA process, that access is exemplified by the existing California irrigation districts, along whose lines many of the Groundwater Sustainability Agencies (GSAs) charged with implementing SGMA in their local basins were formed. Irrigation districts are controlled by farming interests, and GSA boards are dominated by big agriculture. In her research, Méndez Barrientos found that "only 12% of the 260 GSAs have representation from tribal groups, disadvantaged communities, or small farms not affiliated with the irrigation districts."

Madera County is one example of how GSA agendas don't always reflect all local interests, as the governor intended. In the last decade, Madera has seen large agricultural operations increase their planting of water-intensive crops like almonds, causing increasing numbers of domestic wells to run dry. When Madeline Harris, policy advocate for Leadership Counsel, made a public comment to one Madera subbasin GSA suggesting incentivizing crop conversion toward something more suitable to Madera's climate and aquifer condition, the response was not positive. According to Harris, one of the bigger almond farmers on the advisory committee "lashed out and compared that suggestion to Fidel Castro moving Cuba away from tobacco and towards sugar cane. It was hard to move forward meaningful discussion."

WATER LEVEL TULARE GSP

GROUNDWATER SURFACE - DTW



Source: Darcy Bostic, UC Davis

The journal article co-authored by Méndez Barrientos discusses how the "high transaction cost" of participation inhibited many small farmers and disadvantaged communities from participation and proper representation in their respective GSA's planning process. GSA meetings are typically two hours long and occur on a weekly or biweekly basis. "Let's say I'm a mother with two kids and I live in the middle of nowhere in the Central Valley," says Méndez Barrientos. "Going to that meeting is inherently more difficult than if I was a CEO of an enterprise with staff who can go on my behalf."

Ruth Dahlquist-Willard, an advisor with UC Cooperative Extension and another co-author of the paper, facilitated communication with small farmers, including immigrant and refugee farmers, who struggled to keep pace with SGMA's technical backdrop. "The payoff is lower," she says. For farmers who lack the resources to hire experienced staff or consultants to parse the language of a hydrologist or an engineer, "a GSA meeting is not the format that would be helpful for them to understand how SGMA is going to affect their farm."

The Groundwater Sustainability Plans submitted for many of the critically overdrafted basins in California appear to prioritize big agricultural and industrial interests. While the minimum thresholds for groundwater levels set by many plans don't endanger the deeper wells of big farming operations, they threaten to leave shallower domestic wells high and dry. "They're much lower than present-day levels," says Darcy Bostic, research associate at the Pacific Institute, of some proposed minimum thresholds, "indicating that they will likely continue to withdraw water at a rate that isn't equal to the rate of planned recharge projects."

Madeline Harris says that emergency water providers in Madera County are receiving calls from as many as two domestic well owners per week saying that their wells have gone dry. "We're advocating for a more robust and immediate response in terms of implementing demand-reduction strategies," she says.

Protecting water for small farmers and disadvantaged communities may require more state intervention, contrary to Jerry Brown's preference for local control at the time SGMA was signed into law. Méndez Barrientos believes that such intervention is critical if SGMA is to achieve the goals for which it was designed. "In policy, things are path-dependent," she says. "Once they set a course, it is very difficult to trace that back and correct it."

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FISHING

Trolling for Salmon by Kayak

ALASTAIR BLAND, REPORTER

Whales scare us much more than sharks. They erupt from the ocean with a rush of displaced water and a poof of air. A collision could be disastrous.

"Whale – go-go-go!" I shout.

We pedal double-time to dodge the humpback, behind us and approaching from the left. A moment later it surfaces again, with another poof, now off to our right, moving away. We relax and slow back to our standard trolling speed of about 2.5 miles per hour, and we plod forward.

My brother Andrew and I are in a pedal-powered kayak two miles from shore off the Marin County coast, where anchovies so thick they darken the water have attracted birds, porpoises, sea lions, thresher sharks, humpback whales and — our target — Chinook salmon. The daily bag limit is two fish per angler. We have one fish aboard, a 14- or 15-pounder, and we hope to catch three more.

We probably won't. Kayak fishing for salmon isn't easy. The day before, we fished for six hours and caught nothing (while the boat fleet reported catching a fish per rod), and three days before that, we also came back to shore with no fish for our efforts. Indeed, this summer has been particularly tough.

Still, the hope that a fish will strike draws us back repeatedly, and every few days we're at it again. We wake up between 3 and 4 in the morning, and aim to be punching through the surf before sunrise. The boat we use is my brother's, an 18-foot-long battleship of a kayak called the Hobie Tandem Island. It features pedal drives, a rudder, outriggers and, if we wish to use it, a sail. We fish using downriggers and rod-holders that Andrew has placed at strategic points around the boat. It's barely a kayak at all, really, though without a motor, we still face many handicaps that a paddler does — most of all the inability to go anywhere fast.

Fishing from a powerboat would be easier, but I began kayak fishing 22 years ago, after learning to fish on motorboats, and I'm not going back. We still catch more than enough fish most summers, and even on the days when we catch nothing — getting "skunked," as fishermen say — we at least get a workout. I figure that a mile pedaled in a sluggish kayak equals two or three on a bicycle, and sometimes we log 15 or 20 miles by mid-afternoon. Each day begins with a thrilling blast through the breakers, and we end each trip by surfing a wave to the beach.

It's almost impossible not to enjoy kayak fishing, and anglers are discovering this. In the late 1990s, fishing from plastic, motorless boats was a freakish novelty. Powerboat fishers gawked at us in disbelief when we paddled into a salmon fleet, and if we saw another kayaker, we'd often fish together in the spirit of camaraderie. Things have changed. The activity exploded in popularity about a decade ago, and now there are scads of us. Parking areas clog up early, and on the water, we mostly ignore each other like morning commuters on Market Street. The scene gets visibly more congested each summer.

Social media has much to do with the boom. Many kayak anglers record each trip on GoPro cameras, and they post videos on YouTube and reports on Facebook. A few anglers stay tight-lipped when they discover a hot bite, but word always leaks onto the Internet. These days, crowds are almost as much a part of salmon fishing as water, wind, and whales.

The advent of pedal-powered kayaks has also spurred new interest in kayak fishing by making it easier than ever. Anglers can now pedal their boats and steer using a hand lever that controls a rudder at the stern. This allows us to keep our hands almost constantly free for various other tasks, especially handling rods and landing nets.

"I'm on!" Andrew shouts.

His rod, angled outward in its holder, throbs as line peels off his reel. Following our routine, Andrew cranks up his four-pound downrigger weight, which hangs off a spool of wire line and holds the bait at the

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desired depth while we fish but poses a tangling risk once a salmon is on. I leave my line down, hoping for a second hookup, while I steer us slightly to the right to keep Andrew constantly positioned to fight the fish. He cranks the reel and regains some line before the salmon dashes away on a 15-yard run. We do circles around the fish while it tires and draws closer to the boat. Finally, Andrew reels down to the leader and lifts, and the fish glides over the surface. I scoop it up in the net: a solid 10-pounder.

When the salmon is dead and bleeding, we each say, "Thanks fish" — our customary offering to every salmon we catch and kill. We used to say sorry until I pointed out one day a few years ago that we aren't sorry at all when we land a salmon. We treasure these fish, after all. Salmon is my favorite food, and, like my brother, I treat every scrap like a pearl.

I salt the gills and guts in jars to make Roman-style fish sauce, or garum. The fillets go into the fridge and freezer, and the fatty belly meat — the best part — is eaten as an appetizer to dinner. We bake the heads and filleted carcasses and feast on the scrap meat. The bones I boil into a creamy broth, which I sometimes drink for breakfast with some salt and a dash of cayenne. The strained pulp goes into my garden beds.

When we get skunked, we try to joke it off as we wheel the boat up the beach. "At least we don't have to clean any salmon."

"Yuck – I hate cleaning salmon."

"They're the worst."

Our most memorable days have involved great white sharks. In 2018, a 10- or 12-footer cruised alongside us off Daly City, inspecting us as we sought our fourth salmon of the morning. The next summer, off Point Reyes, a great white bumped the bottom of our kayak — a half-attack, you might call it. Twice, we have seen eight-footers leap completely from the water off Pacifica.

We finish the day with the two salmon. In the parking lot, a young man sees the fish and asks what they are. This has happened before, and I can hardly believe there are people who don't know what a salmon looks like. On the other hand, these fish are no longer pillars of our society. Adult Chinook and Coho once outnumbered Californians ten to one. There were millions, and people subsisted on them.

Today, there are 40 million of us and perhaps a half-million spawning salmon in the best years, and their future is bleak. Global warming threatens the cold-water rivers where they spawn, and riverside development plus agricultural water diversions have already destroyed many watersheds. Habitat restoration projects have moved at glacial paces, and, sadly, we have hatcheries to thank for our fish. These facilities release tens of millions of young Chinook each spring into the Bay and ocean, keeping the runs on artificial life support. While the daily Facebook fish reports are happy stories of success, the greater story arc of California's salmon is a tragedy.

But we don't dwell on this when the alarm goes off at 3:30. We pile the gear into the car, cinch down the kayak straps, and, buzzing on excitement, head for the beach. Even the early birds are never guaranteed to catch salmon, but they'll probably find parking.

Reporter Alastair Bland with kayak and catch.

E N D A N G E R E D

Nursing Salmon on Flooded Farms

ROBIN MEADOWS, REPORTER

In 2012 a team of salmon researchers tried a wild idea: putting pinky-sized Chinook on a rice field in the Yolo Bypass, a vast engineered floodplain designed to protect the city of Sacramento from inundation. The team found that rearing fish on farms works better than they had ever dreamed. Salmon in this managed floodplain grew so fast — averaging more than one millimeter per day — that they outpaced young Chinook elsewhere in the region. Now, after nearly a decade of testing fish in fields, a new paper in San Francisco Estuary and Watershed Science outlines lessons learned as well as next steps in managing floodplains for salmon.

California Trout's Jennifer Kronk tosses a net to sample fish food. Photo: Jak Wonderly

"There's some urgency," says lead author Ted Sommer, a native fish expert at the state Department of Water Resources, which manages the Yolo Bypass as a floodway. "There's been a long-term decline in Chinook salmon."

Floodplains once served as nurseries for young salmon migrating from mountain streams to the ocean. Today, however, most of the low-lying land along California rivers is leveed and farmed. "They're one of the more important areas we could improve," Sommer says. "We're looking for creative solutions — can we make farming more fish friendly?" The big question is whether fields that produce rice can also be managed as floodplains.

Basin to bypass

The Yolo Basin was once an enormous wetland along the Sacramento River, covering an area about 40 miles long and up to seven miles wide from what is now Knights Landing to the Sacramento-San Joaquin Delta. Early accounts described the basin as an immense sea during severe winters. As rainstorms swelled the river and local streams, floodwaters overtopped their banks and spread over the basin at depths ranging from as much as 20 feet by the riverbanks to just a few inches farther out. These floodwaters moved slowly in a broad sheet through the wetlands to the Delta, taking so long to drain that the basin was impassable half the year.

Riparian forests thick with cottonwoods, sycamores, and oaks grew on natural streamside berms. The rest of the Yolo Basin was dominated by freshwater marsh filled with dense stands of tule more than 10 feet high. In an 1870 volume called The Western Shore Gazetteer, Yolo County, C.P. Sprague and H.W. Atwell told of "simply immense rushes, which cover the ground with an almost impenetrable thicket."

Herds of tule elk wandered the basin's marshes and grizzly bears abounded. Astonishing numbers of geese and ducks thronged to the basin to feed and rest during their winter migrations along the Pacific Flyway. Lansford W. Hastings recounted the spectacle in his 1945 book The Emigrants' Guide to Oregon and California, describing the innumerable flocks as "at times blackening the very heavens," and their "tumultuous croaking and vehement [squawking]" as almost deafening.

The Yolo Basin was also a paradise for salmon and other fish. Young salmon grew big and fat in the basin's floodplain nurseries on their way down to the ocean, and returning adults swam back up the basin toward their natal spawning grounds. Salmon were so plentiful that people with handheld nets hauled in tremendous catches from the banks of the Tule Canal, an early effort to drain the basin that was built in 1864.

Today much of this historical floodplain is occupied by the 59,000-acre Yolo Bypass. Built about 100 years ago, the bypass is an imposing structure: 40 miles long, two to three miles wide, and bounded by 20-foot earthen levees. Sacramento River floodwaters pour into the bypass at the top and flow out to the Delta at the bottom. The land in the bypass is a mix of private farms and duck clubs and public wildlife areas.

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Fremont Weir, letting Sacramento River Water into the Yolo Bypass. Photo: Jak Wonderly

Managed floodplains

Given these extensive alterations, it's no surprise that biologists assumed the Yolo Bypass was no longer a good place for fish. That perception began to turn around in the late 1990s, when Sommer went into the bypass and saw that many fish species thrive there in wetter winters. "We found that it was a major fish nursery," he recalls. In hindsight, it makes perfect sense because even now the bypass is an expanse of inland sea after heavy rains. That said, it was still a big leap to put young salmon on rice fields. Even Sommer had doubts.

Fish food from the farmfield floodplain. Photo: Jak Wonderly

He knew pesticides wouldn't be a problem in winter-flooded rice fields. These agricultural chemicals are applied in the spring and break down fast in the environment. But he did worry that decomposing rice stubble, which is left on the fields after the fall harvest, would use up oxygen in the water and suffocate the fish. "I was nervous initially — but despite the fact that we're taking about agricultural fields, it's pretty good fish habitat."

Young salmon flourish in winter-flooded rice fields because these managed floodplains are spectacularly rich in tiny crustaceans, informally called "bugs," that make terrific food for little fish. "This is one of the key cool findings," Sommer says. The team learned that building up this abundance of food takes about three weeks. "It's not enough to get the floodplain wet, you have to keep it wet so bugs can grow and the fish can get big," says Jacob Katz, a fish ecologist at California Trout who is a co-author of the paper. "That's the key to survival once they reach the ocean."

The problem is that the bypass is engineered to drain rapidly. While the land there is inundated when it rains a lot, it drains in a matter of days in drier winters. And that, Katz explains, is when managed floodplains can do the most for young salmon. "The bypass is already a good place to be a fish during wet years," he says. "The challenge is that during dry years, there's very little floodplain habitat."

Managed rice fields could create salmon nurseries in the bypass even when rain is scarce. "Passive restoration is not enough," Katz says. "We can use infrastructure to mimic historical floodplains." He envisions augmenting berms to hold floodwater in fields longer, and installing operable gates to drain the fields and release fish.

Dos and don'ts

Actively managing fish on fields requires some finesse, however, as the team learned at the height of the 2012-2016 drought. Their experimental flooded rice field was one of the only wetlands for miles around, drawing cormorants, egrets, and great blue herons that picked off the young salmon. "California's seesaw climate is a challenge for managed wetlands," Sommer says. "I wouldn't recommend them during a historical drought."

Carson Jeffres, an ecologist at the UC Davis Center for Watershed Sciences and another co-author of the paper, chalks this instance of high bird predation up to experience, explaining that we need to understand what works and what doesn't to inform management actions. The lesson he draws is that "if you have the only spot out there, that's not good — but a mosaic of floodplain habitats could work." Boosting the number of flooded fields would give waterbirds more places to hunt, which could lessen the risk of creating predation hotspots.

The team also identified the primary factors critical to the success of managed floodplains. "Flow and connectivity are essential," Sommer says. "Fish are consistently attracted to inflows and outflows so they can't be in a pond — you have to keep flow through the field." In addition, when salmon leave the field, they need a reliable connection to natural habitat so they don't get stuck or eaten. "You need a clear exit corridor that drains well so fish can move out quickly and freely." Getting young salmon off fields safely will require nimble hands-on management.

UC Davis team insert tags in young salmon that grew up in the flooded rice fields to see how they fare after they leave. Photo: Jak Wonderly

The goal is to balance keeping fish on fields long enough to maximize the floodplain benefits with releasing fish while there's still enough water to make it to the Delta. That timing can vary widely depending on the weather, from as early as mid-February in a dry year to as late as early June in a wet year. "Ecosystems are not bound by dates on the calendar," Jeffres says. "You need to look at the system as a whole, track the forecast, and time the migration to conditions." He proposes a salmon czar to oversee and coordinate these logistics, comparing this to the role waterkeepers play for rivers and streams.

Wild fish

So far, all the team's test salmon have been trucked in from hatcheries and poured directly onto flooded fields. Co-author Bjarni Serup would like assurances that wild fish will also benefit from managed floodplains before implementing them on a large scale to the Yolo Bypass. "We'd like to see whether we can get natural-origin fish on and off fields," says Serup, an environmental scientist at the California Department of Fish and Wildlife. Questions include whether wild salmon will swim to rice fields on their own when the bypass floods, and whether growing up in fields increases their odds of survival to the ocean.

Juvenile salmon fattened up in the flooded rice fields. Photo: Jak Wonderly (first published in bioGraphic).

Jacob Katz and Jennifer Kronk from California Trout get ready to monitor fish. Photo: Jak Wonderly

Projects that could help provide answers are underway. A joint California Rice Commission-UC Davis study is fitting field-reared salmon with acoustic tags and tracking their survival after release. Moreover, DWR is installing a 100-foot-wide notch in the Fremont Weir, a two-mile-wide concrete wall at the top of the Yolo Bypass that controls when floodwaters spill in from the Sacramento River. Currently, this happens during big storms and the retrofit will also allow water over the weir during smaller storms. This will flood the bypass more often, and could also make it easier for young wild salmon to swim into the bypass and onto managed floodplains. Construction of the $190 million Fremont Weir notch project is scheduled to begin in 2022.

Another unknown is how to design managed floodplains that work for both young and adult salmon on the Yolo Bypass. "It's like a highway with traffic in two directions," Serup says. "Young fish are swimming downstream and adults are swimming upstream so there's potential for conflict in rice fields — water control structures are just not good for adult fish." Agencies are working to minimize obstacles for migrating adult salmon in the bypass. "They're high-value individuals," Serup says. "They've returned to spawn."

Scaling up

John Brennan, who owns the Yolo Bypass rice farm that hosted most of the team's work over the last decade, is more than ready to move forward on managed floodplains. "The weirs are getting notches, and there's side channel and gravel bed restoration along the Sacramento River from Shasta Dam to Chico," he says. "What's missing is floodplains."

Brennan is all set to create expansive managed floodplains. One reason the bypass drains so speedily is that it slopes five or six feet from the top to the bottom. Brennan proposes building four-foot berms on the low side of farmed lands to keep water from sheeting off, and inundating thousands of acres in the bypass for salmon nurseries. He'd love to see these managed floodplains folded into the Fremont Weir notch project.

"It's going to be fantastic when it all comes together," Brennan says. "The ultimate dream is to ramp down the hatcheries and have wild fish take over."

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Science in Short:
Podcast Interview with PhD student David Ayers on fish habitats. Visit Mavens Notebook.

RESTORATION

Makeover for Delta Weed Patch & Salt Trap?

JOE EATON, REPORTER

What began as a project to convert a submerged Delta island into habitat for endangered native fish has morphed into a multi-benefit package with additional payoffs for water quality and recreation. The collaborative design process for the Franks Tract Futures project brought initially skeptical local stakeholders on board and is being hailed as a model for future initiatives. Yet major uncertainties remain as interested parties explore the challenges of implementing a complex redesign of a big chunk of the Delta.

Photo: Alexander Kraus-Polk

The proposed project would take a big shallow lake full of weeds, deepen some parts, fill in others with new lands and fish habitats, add beaches and recreational amenities, and stanch the spread of salt water from the ocean toward the South Delta export pumps.

Carl Wilcox of the California Department of Fish and Wildlife (CDFW) has taken on many large-scale ventures in his career, but none quite like this one. "This project is unique in my experience because it's in the Delta and it's transformational," he reflects. "You're not just enhancing something that's already there and functions to some degree," Wilcox says. "You're making a large-scale ecosystem change that alters negative ecological and hydrodynamic characteristics resulting from past alteration."

One of the largest and least subsided of the Delta's flooded islands, 3,000-acre Franks Tract, probably named after dredge operator John C. Franks, was drained and converted to farmland between 1902 and 1906. Over the years, the levees around the Tract repeatedly failed. Following a 1938 breach that flooded Franks Tract, no attempt was made to reclaim it.

Little Franks Tract, a 330-acre appendage west of the main Tract, flooded in 1982. After a stint as a Navy bombing range during World War II, the Franks Tract State Recreation Area became a popular boating and fishing destination for Bay and Delta residents, serviced by Bethel Island. Apart from this unincorporated community, there are few roads and little electricity around the edges of Franks Tract.

Over time, submerged aquatic vegetation — invasive species like egeria, water hyacinth, and water primrose — degraded Franks Tract. Boat propellers became tangled in the weeds. Chemical control was expensive and raised alarms about effects on fish. No one maintained the remnant levees along adjoining Piper and Shellmound sloughs. "If those go, waves will break on the Bethel Island shoreline and the marinas," Wilcox says.

Navigable sloughs silted up. Sea-level rise loomed. "There were a lot of trends people were not happy with," recalls UC Davis landscape architecture professor Brett Milligan. It became clear to some local residents that the status quo was unsustainable.

The status quo changed a little more abruptly in 2015 with construction of a temporary barrier across the False River to prevent salt water intrusion from ocean tides into the area of the water export pumps. "The barrier did what it was supposed to do from a water-quality perspective, but it had negative consequences for the Delta boating and fishing community and some of the neighboring island landowners because it changed the hydrology," Wilcox says.

Jamie Bolt manages the Bethel Harbor marina, family-owned since 1972 with 85 in-water berths and dry storage for 400 more boats. "We were affected by the dynamics of water flow with the barrier," she says. "It was inconvenient for our customers to get up to the Sacramento and San Joaquin rivers because of the closure of False River. One of the ways around it, Fisherman's Cut, had such increased flows that it became dangerous. The Jersey Island ferry was caught in the current and damaged."

Retired engineer David Gloski, who bought property on the island in 2000, lives half a mile from the barrier and recalls that it drew him into the planning process for improving Franks Tract. "My job is to keep this area an asset for myself and my neighbors," he reflects. "Why don't we try to figure out the best things we can get out of the whole process?"

Under the aegis of the Delta Smelt Resiliency Strategy, CDFW conducted a feasibility study for a Franks Tract project to improve fish habitat in 2017-18. The resulting proposal, calling for the creation of tidal marsh close to Bethel Island and the closure of False River, drew a strong negative reaction. "We understood why after talking with them," says Wilcox. Part of it was aesthetic, a preference for open-water views from the island over marsh vegetation.

"Marsh habitat was going to be situated in a major boating corridor and aligned along residential areas, bad for property values," Gloski says. For marina operators like Bolt, the design meant loss of access to "fast water," which at Bethel Island means water you can boat through at high speed. Her marina would have been 20 minutes from fast water. "It's as if I ran a ski resort and my family operated the lift and you made me put the lift 20 minutes away from the mountain."

Gloski countered the landscape redesign CDFW had floated with his own "local option," in which the marshes would be moved away from Bethel Island. Wilcox calls Gloski's role "really helpful and constructive — he came up with a concept design addressing concerns about navigation and access, especially the fishing component." While some neighbors resisted the idea of any changes, Gloski recognized the need for action: "The Tract isn't staying the way it is and isn't changing for the better. Something needs to be done if we want it functional and navigable." He calls the positive response to his design "the beginning of an evolution."

Returning to the drawing board, CDFW reconfigured the project development process. The new process combined an agency-heavy steering committee, an advisory committee of local stakeholders (including Bolt and Gloski), a public engagement effort led by Milligan, and an iterative approach to design beginning in 2019. A "no action" alternative — leaving the Tract as it is — was on the table at every stage. Online geospatial surveys let respondents drop a pin on a map to show their locations and current features they liked and disliked. Locals hosted field trips for Milligan's undergraduate students, who helped generate alternative designs.

"There was lot of distrust initially," Milligan recalls. "People were convinced that they weren't going to be heard, wouldn't have a voice in the process, that it was all part of a water grab. That's a legacy in the Delta that has to be undone. The salinity barrier left a bad taste."

The engagement process changed that. "This process was something I had been hoping would show up for a project for years," says steering committee member Michael Moran, supervising naturalist at neighboring Big Break Regional Shoreline, part of the East Bay Regional Park District. "There was something wrong about the way we were trying to do projects, so much resistance to things with good benefits. Try to change anything in the Delta and it's 'Katy, bar the door!'" He remembers some local participants being caught off guard by the agencies' openness, wary of being co-opted. "The project was as much about the process as about the physical changes."

All the resulting designs for Franks Tract moved the marshes away from Bethel Island. "Playing out the 'no action' alternative was a key turning point," says Milligan. "Stakeholders got to see how their interests potentially aligned with the project." Seven initial designs were whittled down to three for the final decision round. At each stage, "no action" lost support: "In the final survey, three-quarters of the responders voted for one of the three designs over 'no action.' That was a major shift," he says.

Local doubts lingered about the connection to a water grab or new tunnels under the Delta, but gradually diminished. Planners insist there is no relationship between the Franks Tract project and any water "conveyance" project. "The project has independent utility irrespective of the tunnel or current operations," says Wilcox.

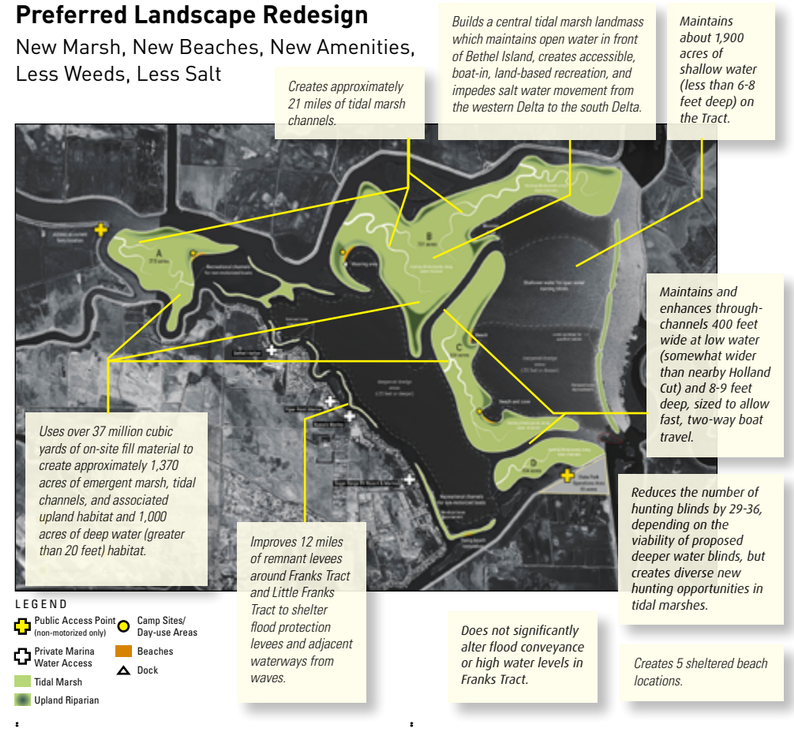
In terms of effects on public trust in the project process, the tunnel concern was always there but slowly evaporated, says Milligan: "At first we got tons of comments about that; in the last survey very few."

The landscape redesign chosen as the Preferred Alternative would use dredged material from within the Tract to build up areas on the northern and eastern sides and in adjoining Little Franks Tract where tidal marsh vegetation could take root, creating 1,150 acres of marsh, intertidal habitat, and tidal channels. Other potential sources of fill, including sediment from tunnel excavations, were ruled out.

continued on next page

Preferred Landscape Redesign

New Marsh, New Beaches, New Amenities, Less Weeds, Less Salt



"The project isn't proposing to use any 'tunnel muck,'" says the project's principal engineer, Michelle Orr of Environmental Science Associates (ESA). "Onsite dredge is the cheapest source of fill and has the benefit of deepening the channels and open water areas." The resulting 1,100 acres of deeper water would improve navigation for boaters and fishers and make the Tract less hospitable to invasive weeds and less prone to harmful algal blooms (see p. 5). Habitat for striped bass would be enhanced, and largemouth black bass might also benefit.

By impeding the movement of water from the western Delta to the south Delta, the new marshlands would also block saltwater intrusion without resorting to hard salinity barriers. The marshes would also mitigate the risk of Delta smelt and juvenile salmon being pulled toward the water project pumps ("entrained") in the south Delta. Little Franks Tract would be set aside for Delta smelt and for kayakers, paddle-boarders, and other non-motorized boaters. Twelve miles of remnant levees would be upgraded. Duck hunters would lose some traditional blinds on the water, although new and diversified hunting sites would be created within and on the edges of the tidal marshes.

"We took Peter Moyle's perspective that the Delta is a novel ecosystem, incorporating native and non-native species," says Wilcox. "You can't put it back the way it was." But some historic functions can be restored. Wilcox sees the plan as an exercise in reconciliation ecology, benefiting native fish as well as "desirable" introduced species like striped bass and largemouth black bass — non-natives with constituencies.

"Delta smelt are very important to CDFW, but that's only one stakeholder; others need to be part of the process," says Orr. "We did look closely at smelt. Little Franks Tract is closest to where smelt are typically found and farthest from the pumps. The new marshes would provide food web support. Preferentially setting aside that area, optimizing it for smelt habitat, works well with non-motorized boating."

The non-native fish, meanwhile, are of greater interest to the Bethel Island community, as black bass fishing is a huge economic driver for the local economy. "Rarely a weekend goes by without a bass tournament, either national or local, with a hundred or more bass boats taking off at 6 o'clock," Gloski observes. Bass like weeds but the latter can slow boats and clog fast water channels.

Wilcox describes tradeoffs for bass anglers: "We're addressing the weed issue through dredging, making the Tract more pelagic, less weed-dominated. We'll still have lots of edge habitat with weeds whatever we do. Arguably it could be better for black bass than it is now, with more linear habitat."

Striped bass, meanwhile, would benefit from the pelagic effect. "Striped bass like velocity gradients, or seams," says Orr. "You have that kind of seam at what hydrologists call the 'nozzle,' where water from False River enters Franks Tract, a great place to fish for striped bass. We added in a few more seams to our design as desirable features for bass."

Along with water quality and fish habitat, recreational use is the third leg of the new design tripod. "Probably the engineering issue we spent the most time on was what kind of channels were required to meet the water quality and navigation goals at the same time," Orr notes. Enhanced navigation is one piece of the project that draws enthusiastic local support, along with proposed beaches and other boat-accessible recreational facilities.

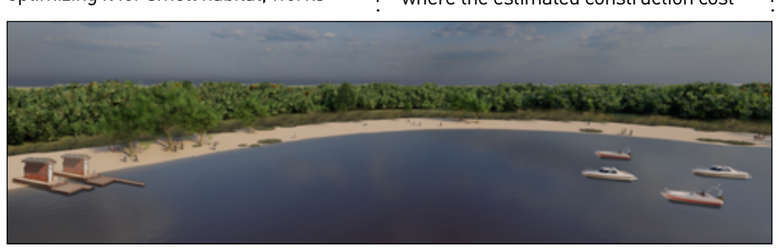
Looking past the construction phase, Gloski and Bolt stress the importance of maintenance. "We're really concerned for how this area gets managed going forward," Gloski says. "It's one thing to implement, but are you just going to walk away and in five years it's a mess?"

Other unanswered questions include where the estimated construction cost of $560 million will come from. "It could be a line item in a bond," Wilcox speculates. In addition to funding and community support, agency involvement will be critical. "There needs to be a champion to keep it going," says Wilcox, noting that CDFW is not likely to be the lead agency going forward.

The California Department of Parks and Recreation owns the Tract. Jim Micheaels, former manager of the State Parks district that includes the Tract and another steering committee member, describes the projected increase in recreational use as "a key concern" of his agency: "Our Department is not funded to operate, maintain, and manage the proposed recreation facilities or features and increased use that would result from the Franks Tract Futures plan," he says. Some kind of co-management between State Parks and the East Bay Regional Park District may be an option.

Despite the questions and challenges lurking in the weeds, the Franks Tract Futures project does offer a bold vision for rearranging a big chunk of the Delta to achieve a variety of common goods, all in one package. Steve Rothert, who heads the Department of Water Resources' newly created Division of Multiple Benefit Initiatives notes pragmatic incentives for addressing multiple societal goals in one effort: "We've learned increasingly that it's almost impossible to do any meaningful project of any significant size and significant benefits alone. Also, given the current economy and the challenging state budget situation, over the next five years or longer we'll be forced to be creative in developing multi-source funding packages to get big projects done. The broader the base of interests who want a project to be implemented, the greater the likelihood that stakeholders will find support among funding entities."

At press time, the Preferred Alternative had just completed a public comment period. Wilcox, retiring from CDFW at the end of September, is trying to drum up support to keep the project going. On Bethel Island, people are waiting with cautious optimism, among other emotions, for what happens next.



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HISTORY

Londons Roam and Feast on the Bay circa 1910

ALETA GEORGE, REPORTER

Jack London usually sailed west whenever he left the Oakland Municipal Wharf, but on December 18, 1913, he headed east — because he could. Although the canal connecting the Oakland Estuary to San Leandro Bay had been completed in 1902, it wasn't until the U.S. Army Corps of Engineers widened and deepened the canal in 1913 that it became navigable.

Aboard the *Roamer*, a 30-foot yawl London bought used in 1910, Jack and his wife, Charmian, approached the Park Street Bridge. "Mate has to hustle for an hour or so to get Park St. Bridge open + we're first boat that it ever opened for," Charmian wrote in her diary. The Fruitvale and High Street bridges also swung open, and the couple completed their sail through the Oakland Inner Harbor Tidal Canal. They anchored off Alameda near the old oyster beds, shot a duck, and ate it with artichokes from an Alameda farm.

Charmian takes the wheel.

From 1910 to 1915, well-known American writer Jack London and his wife Charmian spent at least a month a year on the *Roamer*. Jack wrote most mornings — 1,000 words a day, he claimed — but mostly they sailed and explored the Bay and Delta, or as Jack said, "up Bay and down." Charmian kept a diary of their explorations, and her truncated observations provide a snapshot of the Estuary in the early 19th century.

"They loved being on the *Roamer* because it gave them an escape from Jack's celebrity," says Iris Jamahl Dunkle, who used Charmian's diaries extensively for her new biography, *Charmian Kittredge London: Trailblazer, Author, Adventurer*, released by University of Oklahoma Press this month.

Jack London and the Roamer.

One thing that stands out in Charmian's entries is how well she and Jack ate while on the Bay. They preferred their striped bass raw and their duck nearly so. They ate fish chowder made of "shiners, pike, perch and catfish" from the Delta, and fished for rock cod and netted crabs near Hospital Cove (now Ayala Cove) off Angel Island. One day in October 1914 they caught more than 40 rock cod. Charmian wrote, "Early crab lunch with salmon caviar, stuffed celery, fried clams, cauliflower toast...Soldiers fishing + swimming off Angel Island."

On the water they witnessed the rise of the Panama-Pacific International Exposition grounds in San Francisco; skirted clam-dredges, hay scows, and wheat ships; watched the tides carefully; and executed tricky sailing maneuvers through slender sloughs and southeasters. Occasionally, Jack walked into towns such as Martinez and Pittsburg to read Call of the Wild to schoolchildren.

In October 1913, the pair went to Knight's Landing on the Sacramento River, and drove by car to see the rice fields (see p.15). "First rice we ever saw in Cal," wrote Charmian, adding that the man behind the rice was meatpacking magnate J. Ogden Armour. He was helping to finance Reclamation District 1500 in the Sutter Basin, but work begun that year to build levees was met with resistance and held up in litigation for many more.

Jack London took these photos of the "famous Kanakas" with Charmian (second from left) at the mouth of the Feather River.

In December 1914, they anchored in Benicia "where the Solano + the new Contra Costa ply back + forth." Before the Contra Costa was built and put into service that year, the Solano was the largest railroad ferry in the world, capable of carrying up to 48 cars between Benicia and Port Costa, where the railcars coupled to engines and continued their routes.

One of the defining characteristics of the Bay at the turn of the century — and before — was its vibrant immigrant communities, and Charmian touched on these ethnically diverse populations in her diary several times. The *Roamer* frequently stopped in Walnut Grove on the Sacramento River, where the Londons enjoyed Japanese dinners with sake, and asked Yoshimatsu Nakata, Jack's valet, to bet on the lottery since white people weren't allowed to participate.

continued on page 23

Ferryboat Solano *at Port Costa-Benicia*

PROFILE

Heavy-Lifting for Fish: Ted Frink

JOE EATON, REPORTER

Ted Frink recalls watching Jacques Cousteau's television specials when he was growing up in coastal Orange County. "I envisioned myself as Cousteau," says Frink, a fisheries biologist with the California Department of Water Resources (DWR) now approaching retirement. "My folks encouraged my interest in science. I knew I could be a biologist." That early inspiration sparked a long and varied career, culminating in his work as chief of DWR's Special Restoration Initiatives Branch and his role in mitigating obstacles to salmon and steelhead passage in streams all over the state.

Rafting on the American River.

Frink focused on salmonids and other anadromous fish early on, graduating from Humboldt State in 1984 with a degree in fisheries ecology and a minor in hydrology. His first professional assignment was in Imperial County with what was then the California Department of Fish and Game (CDFG), testing ways to control the exotic waterweed Hydrilla in local canals. "This convinced me I could find a job," he remembers. Then came salmon stream restoration work with the US Forest Service in the Klamath region, collaborating with the Yurok and Hupa tribes. One restoration gig took him to Red Cap Creek, locale of some much-debated 1967 sasquatch footage (the so-called Patterson-Gilman film). Frink didn't encounter any large hairy primates, although there were "funny smells and strange noises in the night."

With federal career pathways less than promising, Frink hired on with the East Coast-based consulting firm Ebasco Environmental. That took him to Superfund sites from Hershey, Pennsylvania, where the discharge ponds smelled like chocolate, to a Denver, Colorado locale full of "chemicals no one in their right mind would put together." He also conducted fisheries and hydrologic studies in support of the Mono Lake Committee's suit against the Los Angeles Department of Water and Power, which led to a landmark court decision requiring restoration of historic lake levels and tributary stream flows. "This is where the Public Trust Doctrine became a mantra in my career as an ecologist," says Frink.

One consulting project proved more adventurous than he had bargained for. In the late 1980s, San Joaquin Valley irrigation districts were planning hydropower dams in the Tuolumne River watershed west of Yosemite National Park, although the river was a candidate for wild and scenic status. During that project Frink originated a technique, still in use, for measuring flows in high-velocity streams using climbing gear to hold the surveyors' boat in position. To get to remote creeks, Frink and his crew flew in a Huey 500. Piloting the Huey, the fastest helicopter available at the time, were Vietnam veterans who had survived being shot down in combat. The pilots had to avoid wire cables that had been strung across the Tuolumne canyon in the mining era, made more visible by colored flags and hanging cable cars. On one trip down-canyon, doing a hundred miles an hour, the copter began to shake violently. Landing safely on a sandbar, the pilot found that one of the main rotor blades had "a giant kink in the middle" from impact with an unseen cable. Frink and his co-workers had to hike five miles to get out of the canyon. Investigators later found that the warning flags and cable car had been moved off to the sides. The responsible parties were never identified, and the dams were never built.

Friends suggested that Frink look for a state job as a fisheries biologist; he applied with both DWR and DFG,

and was hired by DWR in 1991. "I didn't know what to expect," he says. "I knew [how to] work in fisheries but now I had to understand engineers to get things done." He spent five years in the Division of Environmental Services, initially working on protecting fish from entrainment at water diversions but then on fish passage improvement.

Legislation introduced by State Senator Byron Sher had funded DWR to investigate potential new storage reservoir locations while also identifying inoperable, outdated, or dangerous dams that should be removed, or could improve fish passage to and from habitat up and downstream. "We realized it would be a non-starter if we had to call it the Dam Removal Program — too controversial — so it became the Fish Passage Improvement Program," Frink says. A five-year study generated a roster of potential sites.

It's been a long haul, but some dams have come down, or are on their way out like a dam on York Creek in Napa County: "We're getting close to making that project happen, a dam removal that we initiated for a little creek with a steelhead run that flows through St. Helena. Another I'm proud of was the San Clemente Dam on the Carmel River, where the Coastal Conservancy took the lead — a big milestone for me and a great example of collaborative work."

He hopes to see dam removals on the Klamath River in the not-too-distant future as well. Frink also worked on the Fremont Weir in the Yolo Bypass, a bottleneck where migrating salmon, steelhead, and sturgeon were repeatedly stranded. "We finally got a design in the works to build a bigger and better fish passage notch in that flood system weir," he says. (See also "Nursing Salmon" p.15).

Frink has had a hand in a long list of projects and initiatives: partnering with the Winnemem Wintu Tribe and NOAA Fisheries to study options for fish passage over Shasta Dam; helping develop an acoustic sound barrier to guide migrating salmonids at Georgiana Slough on the Sacramento River; restoring tidal wetlands at Dutch Slough; and administering the Urban Streams Restoration Grant Program. Frink recently took on a project at the Salton Sea, creating 4,000 acres of saline pond habitat at the mouth of the New River for fish (including desert pupfish) and migratory waterbirds. The project will replace habitat lost due to Colorado River water transfers and address air quality problems from seabed dust.

Fishing near Bridgeport in the Sierras.

Inevitably there have been frustrations. Searsville Dam, owned by Stanford University, has been in limbo for 15 years. But overall, Frink says his years of experience working collaboratively with multiple entities have paid off, whether it's water districts, tribes, landowners, farmers, or the owners and operators of water facilities. "The biology is straightforward," he says. "The engineering is unique but straightforward. It's always working with others that creates the challenge. It's frustrating at times but rewarding when we actually improve a passage problem."

After retirement, Frink will have more time for the foot and bicycle races he takes on to raise funds for Breathe California and the Leukemia & Lymphoma Society, and for the sustainable community he's helping develop in Costa Rica. "I expect I'll stay involved with fish passage," he adds. "I have a desire to keep moving it forward."

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JACK LONDON, *cont'd from page 21*

At the mouth of the Feather River, they met the "famous Kanakas," wrote Charmian, including a "quaint + loveable old Hawaiian" that had lived there for 22 years. The Kanakas and their wives brought salmon, striped bass, and carp as gifts.

Near Stockton they stopped at what Charmian described as "a God-forsaken Japanese work-place where the baby-eyed young....mother cooks for 40 or 50 men! Such a dreadful life the poor, sweet little 'picture-wives' are lured into!" She didn't mention, however, how federal and state immigration laws had contributed to the existence of these camps. In 1913, California passed a law forbidding immigrant farmers from owning land, even though Chinese and Japanese farmers had farmed the Delta for decades.

The Bay has gone through many changes, and continues to change today, but a constant then and now is Mount Diablo. Seen from Georgiana Slough, Charmian described how the "lovely composition is drawn together by Mt. Diablo. So clear + sharp, + even from here we can see the crinkles!" On another day she noted the "cloudy-sunny-wondrously beautiful Mt. Diablo." On a November cruise she wrote, "Sierras white with snow, Mt. Diablo + its range clear-cut sapphire. Tule glistening laid flat. Spouting surf on lee shores in some places. Big scow aground. Ducks flying low."

Mount Diablo circa 1900s. All photos courtesy The Huntington Library, San Marino, California

Aleta George is at work on a book about Jack London and the San Francisco Bay. The entries quoted here are from the original diaries, JL 215-233, Jack London Papers, The Huntington Library, San Marino, California.

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FEMA To Fund Large-scale Managed Retreat

ISAAC PEARLMAN, REPORTER

In early August the Federal Emergency Management Agency (FEMA) announced $500 million in grants for pre-disaster projects, including for the first time grants for large-scale buyout and relocation of entire neighborhoods in flood zones. The new program arrives on the heels of a similar $16 billion program started by the Department of Housing and Urban Development last summer, and comes as a surprise given the often contentious nature of managed retreat from shorelines and flood zones.

For decades, a variety of disaster reponse reform advocates have pushed FEMA to fix its beleaguered National Flood Insurance Program, which currently heavily subsidizes property owners to rebuild in place after a disaster, rather than using funds for planned relocation out of high risk areas. A 2017 analysis by the nonprofit Natural Resources Defense Council showed that since 2000, for every $100 FEMA spent in disaster recovery only $1.72 was spent helping people relocate. As a result, according to FEMA some 30,000 "severe repetitive loss properties" have been flooded and rebuilt an average of five times.

More funding would appear to be a positive step toward fixing that imbalance. However, managed retreat remains a delicate process fraught with a long history of inequality. Wealthy communities at risk, such as California's Del Mar, Pacifica, and Malibu have strongly — and successfully — resisted calls to retreat and instead opted to hunker down behind fortified seawalls and levees. The United States Army Corps of Engineers' cost-benefit analysis for publicly-funded flood infrastructure has been shown to favor wealthier residents with higher property values, while buyouts are used more often in lower income communities.

Burn on Napa's Atlas Peak (LNU Complex Fire)in August 2020, the same area that burned in 2017. Repetitive loss problems occur in both flood and fire zones. Photo: Amber Manfree

Frontline communities at higher flood risk are disproportionately made up of minority and poor residents, in part because discriminatory housing policies such as redlining forced them into dangerous housing locations in the first place. For those on the water's edge without the political clout or representation to attract federal funding, options are limited: accept a buy-out offer, usually limited by FEMA to 75 percent of a home's assessed value; or face a grim future with increasingly stronger and more frequent weather disasters.

And even that bleak choice may be curtailed soon. Per a New York Times report, the Army Corps recently joined FEMA in aggressively promoting relocation by instructing cities who want federal funds for levees and other flood protection to either employ buyouts or face the threat of eminent domain to seize at-risk properties and force residents to move. Which begs the question — will FEMA's new funding be used as a boost for equitable relocation, or as a hammer on the poor?