

ESTUARY

Thinking like a Beaver

Scanning for Ancient Valleys

Cooking Fish Food in a Ship Channel?

Rethinking Ballparks & the Bay Trail
in View of Climate Change



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I N T E R V I E W

The Coast Whisperer

ARIEL RUBISSOW OKAMOTO
INTERVIEWS SAM SCHUCHAT

Sam Schuchat, outgoing chief of the California State Coastal Conservancy, is one of the most dapper state officials I've ever met. He often wears an elegant hat with a brim and band, no Giants bill cap or REI woolly for the leader of a powerful state agency, one that has done more to ensure that the coast is accessible to all Californians than any other. Of course, Schuchat would say he had a lot of help — partners everywhere, lots of folks willing to give any project involving the Conservancy their best. Schuchat is also quite the politician: he likes to work the room, shake hands, bend ears, and make deals. I can't say I know him personally. But I can say I've seen him everywhere I've gone in my long career writing about the Estuary — at conference podiums, at levee breaches, in deep hallway conversations beside the coffee machine, at plantings for native species and vigils for endangered ones. This guy gets around.

After two decades at the helm of the Conservancy, Schuchat retires on June 25. His replacement is yet to be named. But the emotional and political intelligence he brought to the job will be missed (Estuary News invites your comments at our online post of this interview). In the coming years, Schuchat says he hopes to spend more time riding his bike and playing music, not to mention travelling post shelter-in-place. But he also expects to keep his finger on the pulse of the California coast and to delve more deeply into national climate change work.

ARO: What are three things you hope every Californian knows about the Coastal Conservancy?

SCHUCHAT: I hope they understand that all of the incredible blessings of open space and nature we have here in California, we have because people made them happen. And that the Coastal Conservancy, within its jurisdiction, has been a big part of that. The second thing I hope they understand is that as a government agency, we're an example of the good government can do, and that they



pay for it, they are where the money comes from. The third thing I hope they understand is that we all have to share this natural inheritance with each other. I'm thinking about that because [my last] Coastal Conservancy board meeting is going to be particularly contentious, and a lot of the contention is coming from people who basically don't want to share what they have. Fighting against that is a big part of what we do.

ARO: What big changes have happened in the Conservancy's worldview since you first started your job 20 years ago?

SCHUCHAT: We talk a lot now about restoration, but at the beginning of my career we talked about conservation. That meant keeping things the way they've always been. But it's pretty clear now in the era of climate change, that we can't do that. And also that we can't roll the clock back to some pristine past state of nature that may never have really existed. Before European settlement, native tribes had all kinds of huge impacts on the landscape. Another thing that's changed since the beginning of my career is that, when we used to talk about access to the coast, we were thinking mostly in terms of physical access, making sure there was a trail and parking. But about 10 years ago, we really started thinking about the non-tangible barriers to coastal access, including rac-

ism, not seeing yourself in the coastal picture, and not having the means to get to the coast. We've come up with various new approaches to removing these non-tangible barriers as best we can, but the battle for physical access continues. It's not just about the last 100 feet anymore, about getting from the road to the beach; it's about other things as well. The COVID year has also taught us just how important it is for people to be able to get outside, near their homes, and I hope that sticks.

ARO: If you look at the last two decades, what is one thing you consider a big success and what was the fish that got away?

SCHUCHAT: One of my favorite projects was the removal of San Clemente Dam on the Carmel River, which was the biggest dam removal in the state to date. We'll keep that record until the dams on the Klamath come down, which happily they're going to soon. But we have another obsolete dam in Ventura County, Matilija Dam, and I really wanted to get that sucker down, too.

ARO: Why did you want to get it down?

SCHUCHAT: Once you've taken one dam down, your appetite is whetted. But it's also big and ugly, and taking it down would be an awesome triple play. It's good recreationally; it will restore the steelhead run; and it will restore sediment supply to the beaches down coast of the Ventura River. It's also a climate change adaptation, a classic multi-benefit Conservancy project, deeply supported by the people who live there. At this point, we just need the money.

ARO: What advice do you have for dealing with the complexity of big, ambitious projects like restoring the Hamilton Airfield or the South Bay salt ponds? How do you both hold on to the vision but also let go to get it done?

SCHUCHAT: You can't overthink. The reliance on stakeholder planning processes, while important in the little "d" democratic sense, can drive you into this world of making things a lot more complicated than they need to be. There is a tendency within the environmental community to make the perfect the enemy of the good. People argue that projects are not good enough, that they could be better! There's a danger

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M O N I T O R I N G

Bay Fish Still Not Good Eating

JOE EATON, REPORTER

After decades of efforts to clean up San Francisco Bay, its fish still carry a toxic load that makes them unfit for human consumption. A new Regional Monitoring Program (RMP) report on its 2019 sport fish survey contains some positive news: an overall decline in polybrominated diphenyl ethers (PBDE), hopeful trends in polychlorinated biphenyls (PCBs) and dioxin, and continued low selenium levels. But no downward trend was found for mercury. Then there are per- and polyfluoroalkyl substances (PFAS), which the RMP only began monitoring in 2009 and for which no human consumption advisory levels have been established in California. These chemicals, used in stainproofing, waterproofing, and many other applications, are a new cause for concern.

The 2019 survey was the eighth iteration since 1997, with surveys currently occurring on a five-year cycle. Tissue samples are taken from five core indicator species (striped bass, white sturgeon, shiner surfperch, white croaker, and jacksmelt) selected as most popular for consumption. Supplemental samples from several other species are also analyzed for contaminants. The fish were caught at 13 Bay locations representing popular fishing sites, taken by hook and line, with gill nets and otter trawls, and, in the case of the reclusive monkeyface prickleback, by poke poling.

“The single most significant finding may be the mercury results,” says Jay Davis, co-director of the San Francisco Estuary Institute (SFEI)’s Clean Water Program. “It’s remarkable how flat the concentrations are over a 50-year period.” Mercury is the primary focus of the fish consumption advisories issued by the state Office of Environmental Health Hazard Assessment (OEHHA), a division of the California Environmental Protection Agency.

Davis says legacy mercury from the 19th-century mining era is augmented by atmospheric mercury that’s deposited in the Bay and trapped in sediment. Mercury

in striped bass, the main indicator species, is “right on the threshold for no consumption by sensitive populations,” meaning women ages 18 to 49 and children up to 17. He notes that stripers in the Bay have higher mercury levels than those off the East Coast and in the Gulf of Mexico.

The most encouraging trend Davis sees concerns the flame-retardant PBDEs, showing a sharp decline following manufacturing phaseouts. If that continues, the chemicals may no longer need to be monitored. Dioxin and PCBs appear to be declining at least in white croaker, an important sentinel species because of its high fat content and its mobility within the Bay. Selenium results were amplified by an anomalously high reading in one individual white sturgeon.

The highest levels of another huge class of multi-use chemicals, PFAS, were found in the South Bay, particularly in largemouth bass from Artesian Slough. The survey found levels exceeding thresholds for human consumption set by states other than California. According to Davis, the Bay is still ahead of the curve: “We have the most comprehensive monitoring program for PFAS anywhere.” OEHHA deputy director Sam Delson says the agency has PFAS contamination in its sights as well: “We are currently evaluating the toxicity of PFAS chemicals and may be able to develop ATLs (advisory tissue levels) for one or more PFAS chemicals as we complete the evaluations.” The first step may involve interim fish consumption advice for hotspots like Artesian Slough.

RMP scientists found one particular kind of PFAS that has already been banned, perfluorooctane sulfo-

nate (PFOS), prevalent in the Bay fish samples. High PFOS concentrations have also been found in harbor seals and double-crested cormorant eggs in the South Bay. These chemicals, implicated in several kinds of cancer and developmental abnormalities, accumulate in food webs. Eleven states have PFOS fish tissue advisory thresholds in place.

PFAS chemicals in general remain ubiquitous — used in food packaging, waterproofing and stainproofing, Teflon manufacturing, fire-suppression foams, lithium-ion batteries, insecticides, cosmetics, medical inhalers, and ski wax — and are difficult to remove from wastewater.



Photo: Sierra Garcia

Beyond mercury, selenium, dioxin, PCBs, PBDEs, and PFAS, what else is lurking in the Bay? Rebecca Sutton, who heads SFEI’s emerging contaminants program, says nontargeted analysis may augment the traditional way of screening for specific substances: “You take a sample, detect as many chemical signals as possible, and match them up based on a library of standards. You might find some surprises.” The technique has been used on water samples (see “Match Points in Stormwater Soup,” September 2020) and could be applied to fish tissue.

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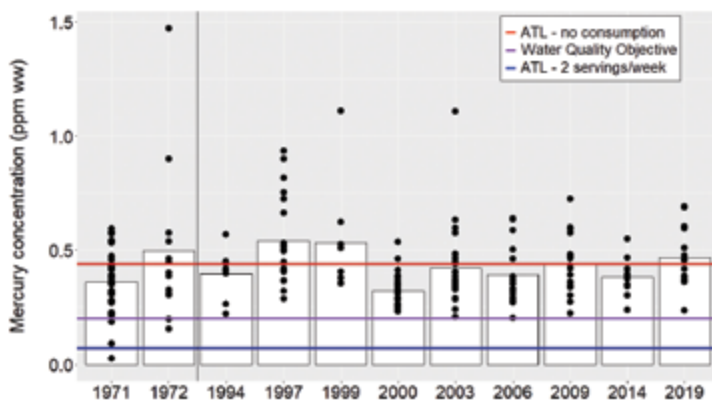
Efforts to keep contaminants out of the Bay encounter the effective limits of regulation. When the use of PBDEs as flame retardants was phased out, manufacturers replaced them with brominated and phosphate-based chemicals that are also toxic; Sutton calls it “a regrettable substitution.” Likewise, some newer PFAS chemicals used in place of older formulations known

to be harmful have turned out to be similar in toxicity and persistence, and may be used in greater quantities because they’re less effective. “There’s a whole slew of contaminants out there,” says San Francisco Baykeeper staff scientist Ian Wren. “It’s a whack-a-mole thing.”

World trade amplifies the toxic impact: while the U.S., Canada, the European Union, and Japan phased

out PFOS, China, India, and Brazil ramped up production. Many of the resulting goods have entered the U.S., and the Bay Area’s waste stream. Atmospheric mercury from coal burned in Asia is deposited in the Bay’s water.

Mercury Concentrations in Striped Bass



Long term trend from 1971-2019 in PPM WW. Source: RMP

Wren sees the persistence of problematic mercury levels, as well as PCBs (which have declined in at least one fish species but not as much as anticipated), as evidence of a failed regulatory strategy: “Since the beginning of the RMP in the early 1990s, water quality has remained relatively stagnant. That puts into question the wait-and-see approach pursued by water quality regulators.” The Bay’s tides and currents don’t appear to be flushing contaminants out, especially in the relatively shallow South Bay. Monitoring has identified persistent hotspots. “Why aren’t we cleaning up the contaminated sediment?” he asks. “It would go a long way toward improving the health of the overall Bay.”

Wren points to successful sediment cleanup campaigns in other coastal regions. He acknowledges such efforts would be expensive, and compelling polluters to pay would be difficult; some of the responsible parties are long gone. “Small groups like Baykeeper don’t have the resources to pursue enforcement actions,” he adds. And he feels regulatory agencies lack the political will.

The human risks are no abstraction. Subsistence fishing is a fact of life for many Bay Area residents, particularly among communities of color, the economically disadvantaged, and the homeless. It’s culturally important for some, a stress reliever for others. Some fishers may be unable to read posted warnings about fish consumption or too hungry to observe them.

Davis says there are anecdotal observations suggesting subsistence fishing increased during the pandemic, but no hard data. To get a handle on who’s eating fish from the Bay, the North Bay environmental justice organization All Positives Possible has surveyed fishers in Carquinez Strait as a pilot project, and hopes to expand it. Ensuring that locally caught fish is safe to eat is an essential first step toward restoring a healthy fishery in San Francisco Bay.

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R I V E R S

Thinking Like Beaver to Aid Yellow Creek

LISA OWENS VIANI, REPORTER

Last fall, the Maidu Summit Consortium, a nonprofit composed of nine Mountain Maidu tribal member groups, installed 73 BDAs—beaver dam analogs—in Yellow Creek, a tributary to the North Fork Feather River and a state-listed heritage trout stream. Swift Water Design and U.S. Fish and Wildlife Service designed the structures, and Mountain Maidu tribal youth worked with Swift Water to build them. The idea behind the structures, which mimic beaver dams, is to slow erosion, catch sediment, and build up the river bottom to reverse the incised channel—without importing soil and other materials or emitting carbon from heavy, diesel-powered equipment.

“Before this project, PG&E had done some pond and plug projects to restore the meadow,” says Trina Cunningham, executive director of the Consortium. “We wanted to try to restore habitat more naturally in a less invasive way.”

In 2019, the 2,300 acre Humbug Valley, known as Tásmam Koyóm to the Maidu, was returned to the tribe as part of PG&E’s land divestiture resulting from their bankruptcy

settlement. The tribe has been working to restore meadow and riparian ecosystems ever since. “We want to see more fish diversity, a more diverse ecosystem,” says Cunningham. “We miss the beaver, porcupine, and other animals that are important to the ecosystem. Compared to pond and plug, if you have beaver doing the work they can restore meadow systems, catch sediment, address head cuts, and stop incision just as good if not better than equipment.”

Pond and plug involves excavating local material to make “plugs” to fill channels to their historic meadow floodplain elevation. The excavated sites fill with water from the stream and groundwater, resulting in “ponds.”

Kevin Swift, founder of Swift Water Design, led the team installing the BDAs in the first of what will be several phases. “It’s process-based restoration rather than using diesel and rock and insisting on imposing a form on the river,” he says. “Instead, we use the power the stream brings us and introduce materials that give the stream something to work with. Those structures drive channel evolution and add roughness



Mountain Maidu youth (Sophia Williams, Harvey Merino, David Washoe, and Maudesty Merino) participated in building the BDAs. Credit: Mountain Maidu Tribe

and complexity—with a small bit of human nudging you can begin to correct structurally starved streams.”

The BDAs are installed strategically, not randomly. “In any given stream, there will be interesting points where evolution or recovery is most likely to occur, and where we might adopt and build three or more structures that interact and support each other there.”

Swift’s BDAs replicate beaver dams as closely as possible. “You build low with a heavy, wide base, a low rise on the front and back, just like a beaver dam and you just sort of needelfelt together all of the materials you find around, making a kind of lasagna.” When the BDA is finished, says Swift, “you should have a big messy pile of mud and sticks like a beaver dam holding water. At base flow you should have water going over the top.” In certain situations, if willow is growing nearby—and “not being used by willow flycatchers”—he’ll add it to the BDA as he builds it. “Those willows will root and sprout and help perennialize the structure.”

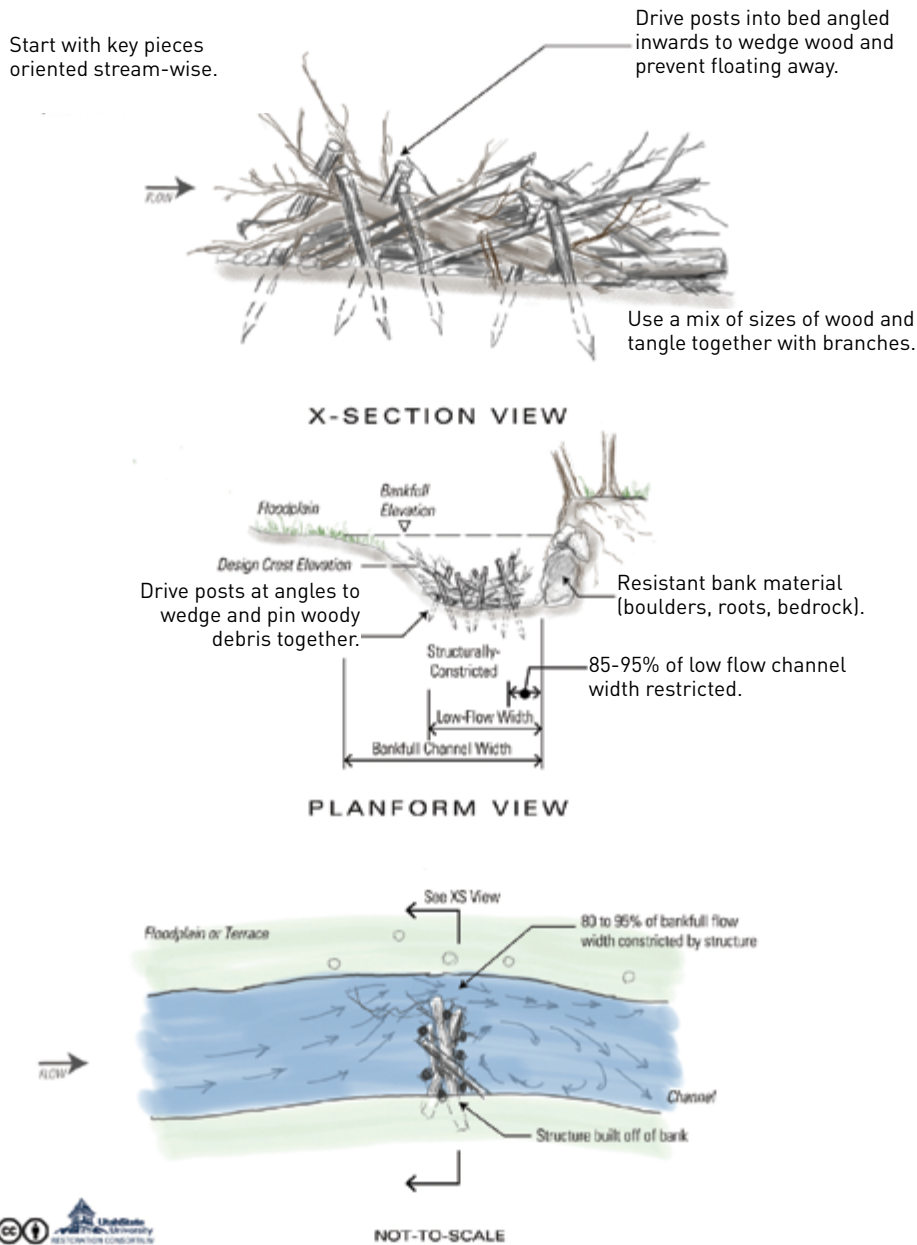
Sophia Williams, a young Mountain Maidu tribal member, says the experience of building the BDAs was rewarding and fun; she hopes to make more. “We found several willow bushes a couple miles from our dam location. Once all the willow was woven we then filled in all the gaps with [more] willow and packed it with mud. Just after an hour of the analogs being built, the stream began to rise.”

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Kevin Swift and his crew designed and installed BDAs on upper Yellow Creek. Photo: Brock Dolman, OAEC.

Beaver Dam Analog Schematics



Type of analog called bank attached PAL which forces constriction jet of flow.
Source: Utah State University

Swift doesn't expect the BDAs to stay exactly as built but instead to evolve and change over time — and even to blow out on rare occasion — just like real beaver dams. "If the stream doesn't like something, you'll get quite a critique," he says. His main goal for the BDAs on Yellow Creek is to raise the groundwater table and reconnect the main stem with its side channels (great habitat for fish) and its floodplain. "I want to get water up and out on the floodplain every year — that's where the magic is, that's the life of the river."

Although the California Department of Fish and Wildlife (CDFW) will not allow people to bring beavers back to the site, the BDAs could attract the furry, long-toothed engineers, say Swift and other consortium members, who would love to see them return: there are beaver present in nearby tributaries, and cattle grazing has been discontinued since the Maidu took over land management, so there is now plenty of willow and other vegetation for beaver.

Kate Lundquist, WATER Institute director with the Occidental Arts & Ecology Center (OAEC), who got involved in the BDA work through a grant from CDFW and developed a planning strategy for recruiting beaver, says, "We need to keep the 'B' in 'BDAs.' We want people to be doing instream structures, but we want to make sure people don't forget the beaver. If you are building them in areas where you have beaver, they will manage and maintain the structures. Instead of being on the hook for maintenance, let the beavers do the work."

Lundquist says that while some state officials have expressed doubt that beaver were native to the Sierra, she and OAEC co-director Brock Dolman have combed through historic accounts and found plenty of evidence of their presence, including a remnant dam carbon-dated to 1,270 years ago and an account from an older resident of the area who remembers a giant beaver dam and the best fishing of his life on a Yellow Creek tributary. "Tásmam Koyóm is ripe for beaver again," says Lundquist.

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H I S T O R Y

Ancient River Channels Could Speed Groundwater Recharge

ROBIN MEADOWS, REPORTER

By the time California finally began regulating groundwater use in 2014, most of the San Joaquin Valley was in critical overdraft. The Public Policy Institute of California estimates that groundwater pumping in the region has exceeded replenishment by an average of 1.8 million acre-feet per year over the last few decades. This imbalance was even worse during our last drought, when overuse shot up to 2.4 million acre-feet per year.

Overpumping puts groundwater aquifers at risk of compaction, permanently reducing their water storage capacity and making surface lands sink. Now, however, San Joaquin Valley groundwater managers must find and implement a fix. The state's Sustainable Groundwater Management Act mandates balancing the region's pumping with replenishment by 2040.

Managed aquifer recharge — diverting excess flood water so it can soak into the ground — is an obvious remedy. But accelerating recharge in the San Joaquin Valley is easier said than done. "Recharge is slow in silt and clay, and these are ubiquitous across the Central Valley," explains

Graham Fogg, an emeritus hydrogeologist at UC Davis.

Fogg and colleagues have found a new way to speed recharge in the Central Valley: ancient river channels where water can shoot underground. The channels are called paleo valleys because they formed 16,000 years ago, during the last ice age when an expanse of alpine glaciers capped the Sierra Nevada. "As the ice melted, glacial streams were flowing hard year-round," Fogg says. This rush of water cut deep, wide channels across Central Valley flats on its way the ocean.

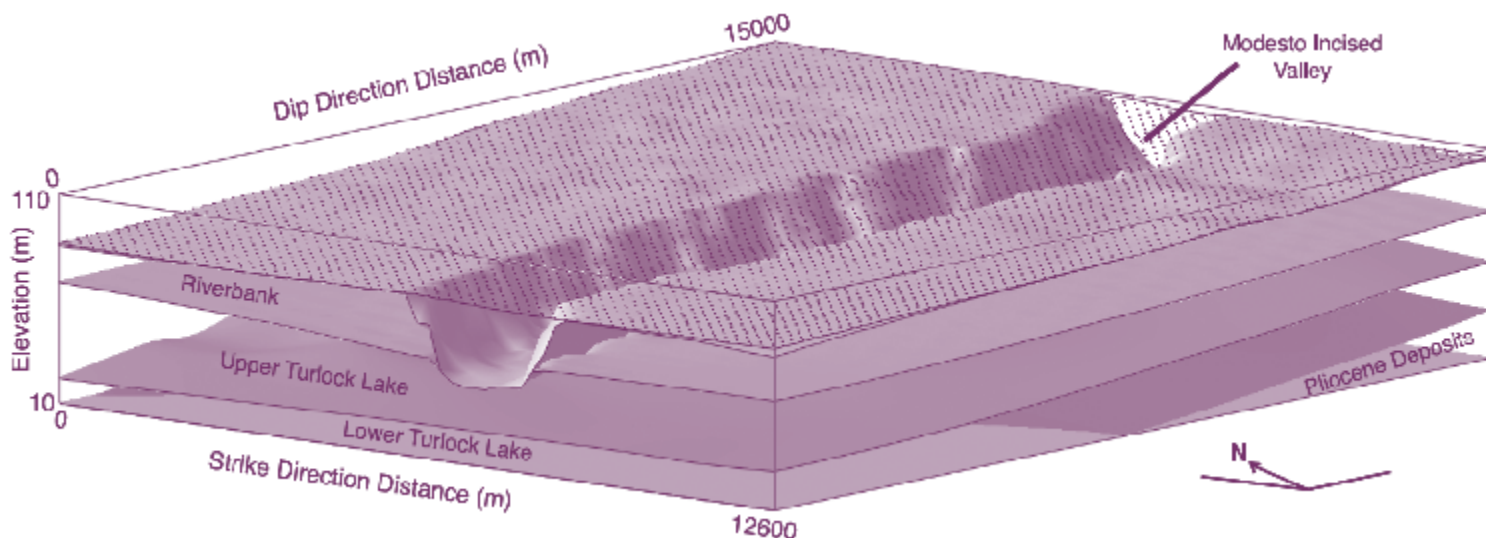
As the glaciers melted away and sea level rose, these channels filled up with sediment. "Paleo valleys are 80 to 90 percent sand and gravel that's extraordinarily coarse," Fogg says. These ancient channels are also enormous at about a mile across and 100 feet deep. All this makes them ideal for groundwater recharge. He estimates that water soaks into them 60 times faster than into the fine silt and clay that pervade the Central Valley. Using paleo valleys for recharge would also be relatively cheap. "It would be orders of magnitude less expensive than building and maintaining more dams," Fogg says.

So why aren't we already taking advantage of these marvels of natural infrastructure? We don't know precisely where the paleo valleys are because the land has changed dramatically. When these channels were first cut, so much of the world's water was still in glaciers that sea level was about 400 feet lower than it is today. That meant the Sacramento-San Joaquin River Delta was much lower too, so the rivers draining the Sierra Nevada cut far into the land. Over the millennia since then, ice melt refilled the seas and sediment built up the land. Today, California's paleo valleys are buried.

Some are just a few feet below the surface, though, and these are the channels best suited for recharge. In the early 2000s, Fogg and then-student Gary Weissmann discovered a paleo valley near the surface on the Kings River in Fresno County. "We said, 'These features have huge potential for recharge — we should find the rest of them,'" Fogg recalls.

It's been 20 years and little progress has been made since then. So Fogg and colleagues decided to try a new way of finding these ancient

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Model of the buried paleo (incised) valley in the Kings River alluvial fan determined with subsurface data from wells (Weissmann 2004). "Modesto, Riverbank, Upper Turlock Lake and Lower Turlock Lake" refer to Pleistocene glacial cycles, with "Modesto" representing the most recent glaciation of the Sierra Nevada that resulted in incision of the ancestral Kings River and backfilling of the paleo valley with very coarse, highly permeable sediments.



Helicopter towing an airborne electromagnetics transmitter loop to survey the subsurface near Fresno. Photo: Rebecca Quist

river channels. Late last year, Fogg teamed up with Rosemary Knight, a Stanford geophysicist, and her research group in a pilot study with an underground imaging technique called airborne electromagnetics. Knight has used this technique over the past five years to map inland groundwater basins as well as salt-water intrusion into coastal aquifers.

Airborne electromagnetics entails flying low to the ground in a helicopter towing a transmitter loop about 60 feet across. "An electric current goes through the loop, which sets up a magnetic field that penetrates the ground surface," Knight explains. This magnetic field generates underground currents that vary with the electrical resistance of the various materials they encounter underground. Resistance is highest in the coarse gravel and sand that fill paleo valleys, and lowest in the fine clay that impedes groundwater recharge. These underground currents then generate their own magnetic fields, which are measured by a receiver mounted on the loop. This gives researchers a picture of what's underground to a depth of about 1,000 feet.

To see if airborne electromagnetics can spot paleo valleys, the researchers flew a helicopter along the Sierra Nevada foothills in Tulare and Fresno counties. This region includes the paleo valley discovered via borehole data two decades ago, and the big question was whether the team could find it with airborne electromagnetics, too.

The land above this paleo valley doesn't look special to the naked eye. But airborne electromagnetics confirmed that it's special underground. "We found the paleo valley — it's super exciting!" Knight exclaims, leaning forward and smiling with delight. "It's a massive coarse-grained feature extending out into the valley." She calls paleo valleys "fastpaths" for delivering Sierra Nevada snowmelt to Central Valley aquifers.

The next step is finding more paleo valleys along the Sierra foothills and Central Valley floor, and Knight is confident that airborne electromagnetics is the way to go. "It's such a stunning signature," she says. Fogg agrees, saying the technique is "probably a perfect way to find paleo valleys."

This pilot project is welcome news for groundwater managers in the San Joaquin Valley. "Everybody knows we have to do more recharge but we don't know where to do it to maximize rates," says project collaborator Kassy Chauhan, a civil engineer who leads the North Kings Groundwater Sustainability Agency in Fresno County. "This proves we can figure out where those prime locations are."

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Cooking Food in the Sacramento Shipping Channel?

BY JOHN HART

The learned doctors attending the bedside of the Sacramento-San Joaquin River Delta agree on one thing: the patient is not doing well. What ails it, many students of the case suggest, is dehydration: the perennial artificial drought induced by withdrawals of water for human use, whether pulled from feeder rivers or extracted from the Delta itself. The obvious prescription — that society moderate its demands — is politically very hard to fill.

Recently, though, attention has turned to what might be called a comorbidity: malnutrition...

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Cooking Food in a Shipping Channel

The learned doctors attending the bedside of the Sacramento-San Joaquin River Delta agree on one thing: the patient is not doing well. What ails it, many students of the case suggest, is dehydration: the perennial artificial drought induced by withdrawals of water for human use, whether pulled from feeder rivers or extracted from the Delta itself. The obvious prescription — that society moderate its demands — is politically very hard to fill.

Recently, though, attention has turned to what might be called a comorbidity: malnutrition. Delta waters simply don't generate enough basic food, in the form of phytoplankton, to sustain the food chains extending to salmon, sturgeon, and smelt. Compared with the problem of thirst, this hunger might actually be a little easier to assuage — if we look for answers in the right, and sometimes unexpected, places.

The diverse floating organisms called phytoplankton build themselves from sunlight and from minerals found in the water. No shortage of solar radiation here. Delta waters have become clearer of late, which was predicted to induce a plankton bloom but did not. The limiting factor, in this part of the world, seems to be nitrogen. Due to upstream dams and agricultural practices, the Sacramento River no longer brings down much of this building-block substance.

Another ingredient in phytoplankton growth is time. Plankton mass may double daily, but the curve rises slowly at first. If nutrients float past too quickly, there's no time to use



Photo: Brett Milligan

them. The modern Delta is a streamlined place, adapted to moving water, not to hoarding it. Whatever nitrogen does find its way in locally, as at the regional sewage treatment plant at Freeport, is hurried out toward San Francisco Bay. (The Bay is thought to have too much of the stuff, but that's another story.)

"The correct amount of nutrients in water bodies is not zero," observes Randy Dahlgren of UC Davis. As a proxy for nutrients, we measure chlorophyll. About 10 parts per billion, Dahlgren says, is a good chlorophyll number, nowhere near the excess called eutrophication. In summer, much of the Delta shows readings of 1-3 ppb.

There are some remoter corners of the system, though, where food is not limiting and phytoplankton grows robustly. Researchers are pondering how to expand these oases and distribute local surpluses to impoverished regions. One such fertile spot, the Yolo Bypass, has been studied in depth for decades now. Another, on researchers' radar for less than ten years, is the Sacramento Deep Water Ship Channel.

The Channel is a paradox. Opened by the Army Corps of Engineers in 1963, it provides a 26-mile shortcut from the river near Rio Vista to the Port of West Sacramento. Thirty feet deep, arrow-straight for miles, steep of bank, roiled by massive vessels carrying rice out and supplies such as fertilizer in, the channel seems the very opposite of an idyllic Delta slough. Yet this utilitarian ditch reproduces some of the

functions of the aboriginal water-scape. It grows plankton. It holds healthily cold water in its depths. And it has proved to be a refuge for Delta smelt. "In the last few years, the channel has been the only place where smelt have been caught in appreciable numbers with any consistency," says Erwin Van Nieuwenhuysen of the U.S. Bureau of Reclamation.

An interesting place. Yet the long-running Interagency Ecological Program ignored it. The California Department of Fish and Wildlife took its first samples for smelt in 2009. The real research effort dates only to 2012, when Van Nieuwenhuysen and his Bureau colleagues, "out of complete curiosity," took their research vessel *Compliance* up the channel for an initial tour.

They found a waterway in three distinct segments. The southern part has strong tidal movements, behaving much like the adjacent river. In a middle section, the tidal rhythm fades and syncopates, stirring up mud and creating a "turbidity maximum"; this is the place to look for smelt. The northern reach was once connected to the upper Sacramento River by a lock for barges, but Stone Lock shut down for good in 2000. Now this segment is like a long, skinny lake, out of reach of the tides but accidentally freshened through a little rift in the bulkhead that was installed above the disused lock structure. The northern tip turns green each spring with algae, making onlookers in West Sacramento think "pollution."

Pollution, to a biologist, is often only chemicals that are out of place. The problem with these blooms is not that they occur. It is that they stay put too long. The organic matter produced here doesn't wash down to the middle reach, where animal species might



Port of West Sacramento, rice ship in Berth 2. Photo: PWS

fatten on it. Instead it sinks to the bottom and decays, using up oxygen and locking up nutrients in bottom muds. (Too little circulation, we see here, can be as bad for plankton as too much.)

This ambiguously promising state of affairs stands to change, as authorities debate plans to reconnect the upper channel with the Sacramento — or to separate the waters forever.

The city of West Sacramento owes its existence to levees. As it stands, the leaky bulkhead is a flaw in the protective ring. The Army Corps of Engineers has offered a plan to fix this chink in the armor, closing the gap with 550 more feet of conventional dike. An application for federal funds, for the specified purpose, is pending.

But the city, which now owns the lock along with a section of channel, seeks to make this spot an attractive recreation site and a hub of urban redevelopment. A permanently stagnant pool behind a levee would be a poor centerpiece. Encouraged by the Bureau of Reclamation, the city has been looking at alternatives that would improve, not eliminate, the connection to the Sacramento. If more than the present trickle were

allowed to pass, this infusion could make the upper end of the channel more appetizing. It could also, food web researchers note, send more phytoplankton downstream.

Before the pandemic interrupted the planning, a consensus seemed to be forming around an alternative that would install four gated culverts allowing flows of up to 700 cubic feet for second. This is enough capacity to allow a careful manipulation of the food supply. “You would let it cook,” says Van Nieuwenhuysse, “and then push it down.”

If and when federal money comes through, a full-dress National Environmental Policy Act (NEPA) study, comparing several options, will ensue. Among those options, ship channel researchers hope, will be a yet more ambitious idea. They would like to see Stone Lock restored to a state in which a much wider range of flows could be allowed to pass into the ship channel. Like the culvert option, this plan would permit phytoplankton management downstream. But it could do more. Bigger pulses of water could push floating foodstuffs clear out of the southern end of the channel and into a wider reach of the western Delta.



Stone Lock. Photo: PWS

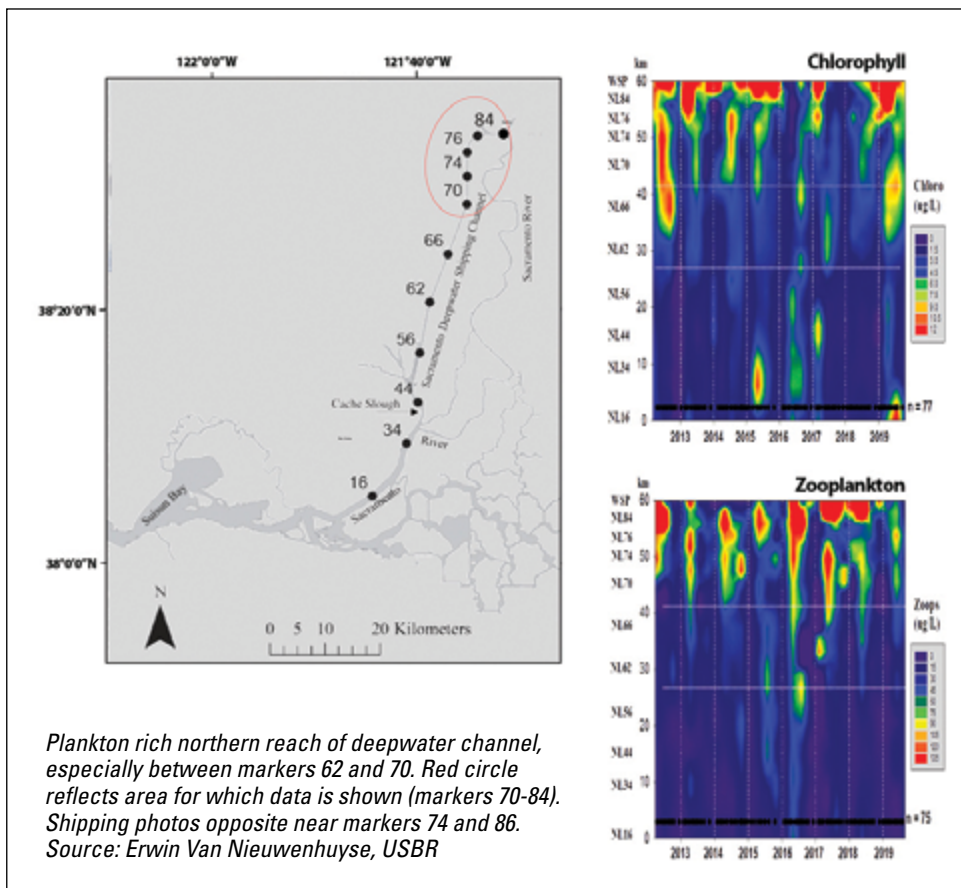
And there’s another tantalizing possibility. A properly restored connection could give green sturgeon and Chinook salmon a new path to and from the sea. Both young fish headed for the ocean and adults bound upstream to spawn might take this route, avoiding what have been called the “death traps” of the Central Delta.

This is a case where local government finds itself the steward of a regional restoration opportunity. Any new plan, observes West Sacramento’s Katie Yancey, “requires full cooperation and advocacy” from the city, the associated but distinct flood control agency, and likely from the independent Port of West Sacramento as well.

Higher level agencies, of course, will also have their say. The State Water Resources Control Board may well treat the reconnection as a new diversion. Arguably, a water right existed when Stone Lock was functioning, but the records that could quantify it are nowhere to be found. “We literally don’t know how they operated or how much water went down there,” Van Nieuwenhuysse says. He calculates that perhaps 50,000 acre-feet a year would be rerouted. Compared with other adjustments proposed to benefit the Delta ecosystem, he argues, this would be a moderate change.

Indeed many questions remain. But any treatment that could even marginally help the long-declining Delta seems worth probing in full.

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P E R S P E C T I V E

One Reporter's View on Fish, Farms, and the Fight over the Delta's Water

ALASTAIR BLAND

As drought parches California, obliterates its snowpack, and reduces rivers to trickles, a familiar feud over water has resurfaced. Farmers want more of it to irrigate their crops, while fishermen and environmentalists want more left in rivers to protect the state's Chinook salmon.

Mainstream news outlets often portray the struggle as one between two groups ravaged by environmental whims and climate change. However, this interpretation weaves a false equivalence through the narrative. Whereas the state's Chinook and coho salmon runs have withered to about a tenth of their historic magnitude, California's agriculture industry has seen steady and soaring growth since its inception 150 years ago. Today,



California's farms occupy millions of acres, use 80 percent of our stored water supply, and produce about \$50 billion in products each year, most of it destined to leave the state. Even in dry years, most of California's farm acreage receives plenty of water, and total farm revenue does not substantially decline.

The deterioration of the Central Valley's aquatic ecosystems as the agriculture sector thrives represents the failure of a particular tenet of state policy known as the coequal goals. The Delta Stewardship Council is tasked with carrying out this objective, which mandates providing a reliable water supply for human users and protecting, restoring, and enhancing the state's natural resources and wildlife. "The coequal goals," the Council's website states, "shall be achieved in a manner that protects

and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place."

John McManus, president of the Golden State Salmon Association, a fishery advocacy group that lobbies for habitat restoration projects and improved flow conditions for salmon, feels the coequal goals initiative has not significantly influenced policy. "It's pretty clear that the coequal goals are only equal on paper," he said in an interview. "In the real world, the big agricultural operations have always gotten more of the state's water than any other community or group."

Drought tends to reveal this inequality. While most irrigated farm acreage receives water even during dry years, rivers tend to shrink away

continued on page 26



Art: Sophia Zaleski

S E D I M E N T

Three Ways to Feed the Marsh

NATE SELTENRICH, REPORTER

Seal Beach is drowning. As a result of sea-level rise, subsidence, and limited sediment supply, much of the 920-acre National Wildlife Refuge in Orange County can no longer keep its head above water. Pacific cordgrass, normally exposed at low tides, is being completely inundated. Rare nesting habitat for the endangered light-footed clapper rail is disappearing at high tides. It's a marsh manager's worst nightmare, and a potential harbinger of things to come later this century for tidal wetlands up and down the state, including those in San Francisco Bay.

The problem at Seal Beach has been building for decades, and by 2016 managers knew they had to act — fast. But options for saving the existing marsh were limited. So on an eight-acre test plot they went for the Hail Mary: a promising yet unproven approach called “thin-layer placement,” which had never before been attempted in a California salt marsh.

The process involved using pipes and hoses to lightly spray sediment from a nearby dredging project onto the project site, which was hemmed in by hay bales and sandbags. Contractors ultimately added eight to ten inches of sandy material across the site, a thickness that project manager Eryan Sloane of the California Coastal Commission says was calculated to strike a balance between gaining as much height as possible and not suffocating existing vegetation.

Though it's been practiced for decades in Louisiana and along the East Coast, thin-layer placement via hydraulic spraying has gained greater interest both nationally and locally in recent years. It's seen as a potentially valuable tool for adding height to existing marshes that lack adequate sediment supply to survive subsidence and sea-level rise. And because it involves the careful application of slurried, or water-suspended sediment, thin-layer placement is thought to mimic the intermittent storm-driven deposition of large vol-



Nozzle used to apply sediment at Seal Beach (note the one pictured is elliptical as recommended for future applications). Photo courtesy USFWS.

umes of mud and sand atop healthy marshes, and thus allow for the natural recovery of existing ecology. How well and how quickly that happens is a matter of ongoing inquiry.

At Seal Beach, things didn't go exactly as planned. Five years on, not only has the net elevation gain diminished to four inches due to compaction and further subsidence, but native wetland plants like pickleweed and cordgrass have not rebounded as rapidly as expected. “We had this idea that after two growing seasons, the site would be revegetated,” Sloane says. “The revegetation has been much slower to recover than we originally anticipated.” She attributes this to a mix of factors, including the thickness and characteristics of the new sediment layer, a low seed bank in the project area, and overly optimistic expectations.

But all is not lost. As an experimental pilot paired with extensive monitoring and active management, the effort has been quite successful. Sloane says it has already generated scores of lessons for future proj-

ects, not only at Seal Beach—where the U.S. Fish and Wildlife Service is already considering another, larger project to build upon the pilot—but throughout California. “I've had conversations with resource managers across the state who have been interested in the project,” Sloane says. “We have a ton of lessons learned.”

In addition to the Seal Beach project, thin-layer placement has also been studied in recent years by the National Estuarine Research Reserve. Through a coordinated project launched in 2017, scientists at eight different marshes nationwide, including Manzanita Marsh in western Richardson Bay near Mill Valley, installed a series of tiny plots measuring 28 inches by 28 inches each, filled them with varying depths and types of sediment, and then monitored them over the course of three years.

Co-principal investigator Kerstin Wasson, who also serves as research coordinator at the Elkhorn Slough National Estuarine Research Re-

continued on next page

serve and is an adjunct professor at UC Santa Cruz, says initial revegetation was fastest in test plots with the least amount of sediment, just 2.75 inches. By the end of the study's three-year time frame, deeper plots with 5.5 inches of sediment had caught up and fared about as well. But no plots with added sediment became as fully vegetated as reference plots.

These findings generally agree with those at Seal Beach: full plant cover may well return after the addition of a layer of sediment to support a drowning marsh — whether that means 10, 5.5, or 2.75 inches — but it won't happen quickly, and could take a decade or more.

"You have trade-offs between long-term sustainability and speed of recovery in the short term," Wasson says. "Are you trying to build the marsh high enough to withstand sea-level rise 100 years from now or to be fully vegetated one year from now?"

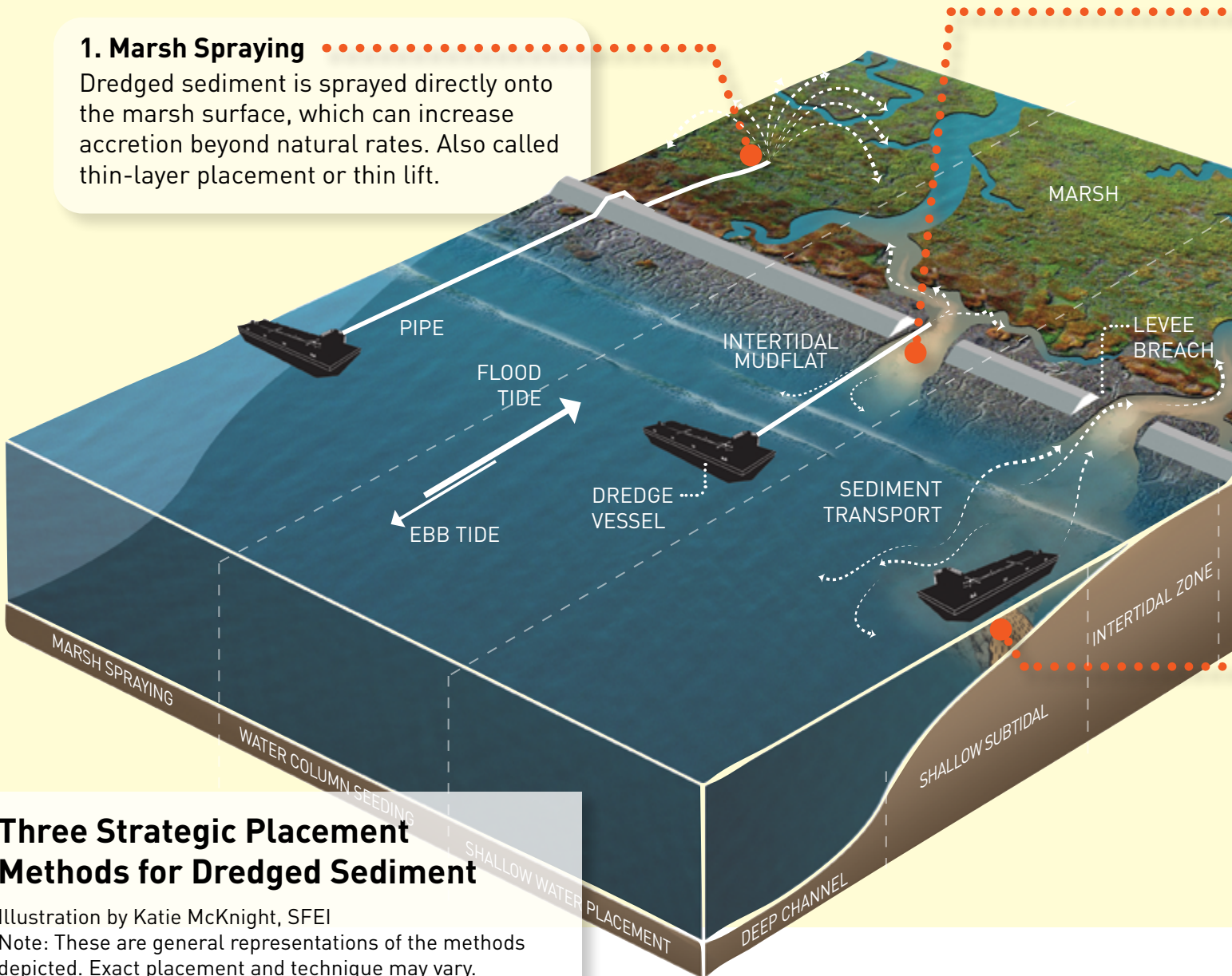
Hydraulic thin-layer placement has been attempted at a more real-world, though still pilot-level scale just once in the Bay Area, near Novato's Deer Island. In 2016, the Marin County Flood Control District placed 12 to 18 inches of re-slurried sediment dredged from Novato Creek onto the adjacent marsh in order to help build its elevation in a manner mimicking natural processes. Though slow and expensive, the work was successful.

"The plants have gone right back through it," says Roger Leventhal, a senior engineer with Marin County Public Works who designed and permitted the project. "It's a good example of flood agencies trying to reuse sediment."

Leventhal has also advocated for using the technique to help restore Marin's Bothin Marsh, next to Manzanita Marsh in Richardson Bay and home to a popular segment of the Bay Trail that is routinely flooded by king tides and storm surges. Thin-layer placement is among a variety of approaches currently being considered by Marin County Parks and Open Space for Bothin, which is one of San Francisco Bay's highest-profile at-risk marshes (see also p. 21).

1. Marsh Spraying

Dredged sediment is sprayed directly onto the marsh surface, which can increase accretion beyond natural rates. Also called thin-layer placement or thin lift.



Three Strategic Placement Methods for Dredged Sediment

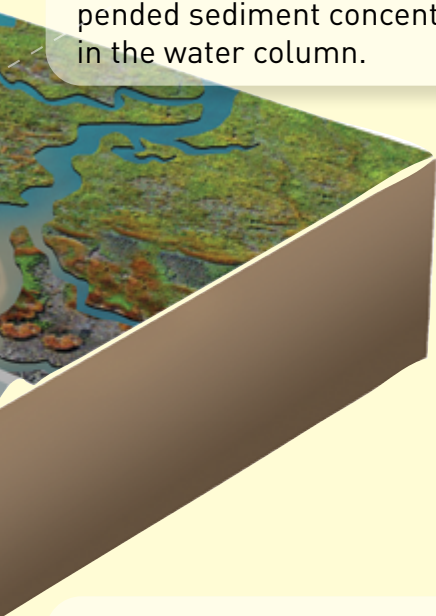
Illustration by Katie McKnight, SFEI
 Note: These are general representations of the methods depicted. Exact placement and technique may vary.

In its recent report *Sediment for Survival*, the San Francisco Estuary Institute highlights a looming shortage in the natural sediment supply needed by marshes and mudflats regionwide to gain elevation as sea level rises. Without successful placement of potentially hundreds of millions of tons of additional sediment sourced from navigation and food-control channels, dams, and upland sources, many existing wetlands will be lost.

Alongside thin-layer placement, two other, even less familiar ways of moving supplemental sediment onto stranded salt marshes are being considered for future use in San Francisco Bay. One, known as shallow-water placement, involves placing dredged sediment into the

2. Water Column Seeding

Sediment is released into the water column at the marsh channel entrance during an incoming tide to increase suspended sediment concentration in the water column.



3. Shallow Water Placement

Sediment is placed offshore to be resuspended by wave and tide action and then transported by tidal currents onto the marshes.

shallow subtidal zone and relying on wind and wave action to move it onto the mudflats and marsh. The other, known as water-column seeding, involves slowly releasing sediment at flood tide into marsh channels so that it is carried in on the tide and gently deposited along channels throughout the marsh system.

Jeremy Lowe, a senior environmental scientist with the San Francisco Estuary Institute, led a study in 2017 evaluating the feasibility of each of these three forms of “strategic placement” to inform future beneficial reuse of dredged sediment in the Bay. Thin-layer placement, he believes, may be ideal for the targeted filling of low spots in a marsh rather than covering tens or hundreds of acres in a blanket of mud. Water-column seeding is likely of even more limited applicability because of the technical challenges involved with getting sediment into a channel at the right time and rate, he says — but may be valuable in specific circumstances.

Shallow-water placement, meanwhile, most closely mimics natural processes and can move sediment over a larger area, but is also the least directed, he says. Since wind and waves do the heavy lifting, results may be unpredictable—with no guarantee that sediment will move into the targeted marsh in the desired quantity. Shallow-water placement may also temporarily increase turbidity in near-shore waters beyond typically allowed levels.

There’s actually one more option, Lowe says: none of the above. In some cases, it may be best to let existing marshes simply retreat and re-shape, he says. “It all fits into what our expectations are for marshes in the long term.”

In others, as *Sediment for Survival* makes abundantly clear, there simply may not be enough mud available. “At some point somebody’s going to have to make some choices,” Lowe says. “Maybe we should not be so extravagant in our designs for fill. We can’t just draw the line and expect to find the fill.”

Much of that fill—and thus the key to the long-term survival of some of our region’s marshes—lies in the



Deer Island. Photo: Roger Leventhal

hands of the U.S. Army Corps of Engineers. Currently, the majority of the material the agency digs up during routine dredging of federal channels is dumped at sea, due in large part to the high cost and technical difficulty involved in the beneficial reuse of dredged sediments. These challenges may be particularly pronounced when it comes to the precision and care required for more strategic placement of sediment onto existing marshes with minimal environmental impact.

Still, informed by Lowe’s report, former San Francisco Estuary Institute senior scientist Julie Beagle is now leading the Corps’ efforts at further pursuing strategic shallow-water placement of dredged materials in San Francisco Bay. The agency is conducting modeling to determine suitable sites in hopes of initiating its first project—ideally near a Corps-dredged channel—within the next couple years.

“There’s lots of ways to get sediment onto marshes, and we know that the Corps and everyone needs to reuse material,” Beagle says. “I think we need all tools possible, and we need the right tool in the right place. Our solutions are going to be different based on the problem and the setting. We need to pilot more of these tools so that as the century progresses, and we start to see the impacts of sea-level rise and the sediment deficit, we’ve got tools that can be deployed at the right time to give our baylands the best chance of survival.”

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P E O P L E

Little Mud, Lotta Work

JACOBA CHARLES, REPORTER

For decades, patches of Creekside Marsh at Hal Brown park in Corte Madera lay barren.

“There wasn’t a single thing growing,” says Sandy Guldman, 80, a recently retired environmental consultant who is also president of the nonprofit group Friends of Corte Madera Creek Watershed. “The soil was all old fill.”

But now, many of the bare patches have filled in with planted and volunteer pickleweed, saltgrass, marsh baccharis, and more. The remainder is at least partially vegetated, thanks to a recently completed restoration project that was — largely single-handedly — managed and maintained by Guldman.

“[This is an example] of the difference that one person can make,” says Darcie Luce of the Estuary Partnership, describing Guldman’s efforts, which included writing the project CEQA documents, securing SEP grand funding, obtaining permits, monitoring, coordinating volunteers, and hopping into her car to pick up donations of pickleweed or saltgrass from the Watershed Nursery whenever they announced that they had extra. Beyond herself, Guldman credits many others: the nursery; the Marin County Parks department, which provided \$800,000 as well as equipment; the Ross Valley Sanitary District; and a handful of volunteers who regularly come out to weed.



Field trip and planting by students from Cal State East Bay. Photo courtesy: Ross Valley Sanitary District.

Beyond improving the soils and planting native tidal marsh species in barren areas, the primary goal of the project was to improve the tidal prism of the park’s wetland areas. The project increased the amount of tidal flow to the marsh by replacing a single failing culvert with three new ones in 2016. Today the marsh is lush, with a broad channel surrounded by mounds of greenery, and spotted here and there with orange snarls of dodder. Snowy egrets regularly stalk through, unfazed by a steady stream of nearby traffic of bicycles and pedestrians.

The project itself was not without hitches. The initial plan was to lower the marsh in order to rapidly achieve greater tidal prism — and thereby improve flood capacity. However, this was soon modified upon learning that a recent survey of marshes around the Bay had deemed Hal Brown marsh to be one of the

most likely to resist drowning due to sea level rise. The plan was revised to replace instead of remove the barren fill soil, but that too was thwarted in part — there wasn’t enough quality bay mud available.

“No one wanted to give us such a small amount [of mud],” said Guldman. “It just wasn’t worth their time.” In the end, only enough mud was available to replace some of the old fill, and the remainder was simply amended with compost and gypsum. That is the area that is still struggling — more so since the water supply to the park sprang a leak and was shut down earlier this spring. Guldman hopes that it will be repaired and turned on soon, as many of the plantings are crisping in the sun.

“I have bird-dogged this,” Guldman said. “One person really can make an impact: find something that you like to do and just do it. I don’t expect people to even notice, really. But I feel gratification at seeing a project like this get done — and that is reward enough.”



Guldman on the bike path adjacent to Creekside Marsh. Photo: Jacoba Charles.

Moonrise over Giant Marsh: New Monitoring Data from Two-Year-Old Supershore Project

BY ARIEL RUBISSOW OKAMOTO

Kathy Boyer is used to getting up in the dark so she can slide across the mudflats into the Bay at first light. But this past May, she got a once-in-a-decade treat. As the professor from SF State's Estuary & Ocean Science Center aimed her boogie board at some two-year-old eelgrass beds growing off the Richmond shoreline, the Super Flower Blood Moon rose in the western sky.

continued next page



Moonrise over Giant Marsh

Kathy Boyer is used to getting up in the dark so she can slide across the mudflats into the Bay at first light. But this past May, she got a once-in-a-decade treat. As the professor from SF State's Estuary & Ocean Science Center aimed her boogie board at some two-year-old eelgrass beds growing off the Richmond shoreline, the Super Flower Blood Moon rose in the western sky.

"It's hard to get up at 4 a.m. but if I wasn't doing this work, I would have missed the eclipse," said Devon Wallace, a student of Boyer's and a recent SF State graduate, who was enjoying the chance to get in some field experience after a year grounded by coronavirus restrictions. Indeed few of members of the field crew complained of the wee-hours wake up required to participate in a low-tide eelgrass planting at Richmond's Giant Marsh. The eelgrass is one ingredient in the region's biggest, most complex experiment in shoreline restoration with climate change in mind to date.

The field crew collected eelgrass growing naturally near the restoration site, transplanted it back to a university lab in Tiburon, prepared it for replanting, then replanted the grass in the mud. The restoration technique, which includes attaching the eelgrass to a paper stick to prevent it from floating away from its intended location, has been used to plant eelgrass in several experimental configurations at Giant Marsh since the project was first constructed in 2019.

As the 200-acre, 22-partner project verges on its second birthday, taking stock of the results has been exciting for researchers. Led by the State Coastal Conservancy, this ambitious effort to build the entire spectrum of shoreline habitats — from subtidal



Pickleweed takes to arbor structure. Oysters growing on the new reef. Photos: SCC

eelgrass beds to oyster reefs to tidal marsh and adjacent uplands — on the East Bay shore is rapidly evolving.

Just a year after construction, more than 400,000 oysters had colonized the newly built oyster reef. This past November, another biologist, Chela Zabin with the Smithsonian Environmental Research Center, also found "gazillions of baby oysters" latched onto the undersides of small test tiles collected from the site. Another sign of success for Zabin were the rock crabs nestling in the shell bags and crawling in and out of holes in reef balls. The bags and balls are just some of the different reef-building substrates the group is experimenting with.

The crabs, the oysters, the growing eelgrass, not to mention the diving birds, are all signs that the human-engineered reef is indeed the ecosystem-builder it was all cracked up to be.

"We just had our full team meeting in April to discuss the physical and biological monitoring data through December 2020, and we've gained lots of excellent insights," says project leader Marilyn Latta of the California Coastal Conservancy.

One immediate insight was that an unusual June heat wave just after the eelgrass planting in 2019 had sucker-punched one of six plots planted at different densities at different dis-

tances from the oyster reef. "To really do our experiment well, we needed to do the replant," says Boyer, lead scientist for the project. "It wasn't recovering, so we were basically missing one replicate of reef-eelgrass relationships."

The heat wave and low tides that June also left another experimental planting, this time of rockweed, high, hot, and dry. *Fucus distichus* is a big-leaved, dark brown seaweed researchers added to the reef structure to help create shady, cooler microhabitats for oysters. "Within a day or two of placement, one batch of the *Fucus* just snapped off the cobbles on which they had been growing. Either they were very brittle, or it was transplant stress, or conditions just weren't favorable," says Zabin.

Zabin noted a die-off of mussels along the California coast around about the same time, backing up her theory about poor conditions. COVID cancelled a planned replant in 2020. Her team finally got back out on the mudflat in January 2021, transplanting in much cooler weather, and packed the *Fucus* more densely into the orifices of the oyster reef.

"It helped retain moisture and reduce wave stress, like having a stand of trees versus one tree," Zabin says. (Related research by one of her interns indicates that when the tide is out, air temperature under *Fucus*

Previous page photo: The May eclipse is called a Super Flower Blood Moon for these reasons: the lunar eclipse turns the moon a coppery shade of red; the event coincides with what is known as a super-moon—where a full moon is particularly close to the Earth due to its oval-shaped orbit; and finally it is called the flower moon because it occurs in the month of May, as opposed to the "harvest" moon that occurs in fall. Photo: Katharyn Boyer

canopy is on average 8 degrees C cooler and relative humidity is 37% higher than on a surface without Fucus.) "It creates a more hospitable microhabitat for oysters than a hot rock," says Zabin.

Already the landscape-scale shoreline experiment — with its varieties of plots, densities, species, elevations, and restoration techniques — is suggesting one important take home: "The best elevation, in terms of oyster density, is around Mean Lower Low Water, or MLLW," says Zabin.

Another emerging result relates to the different densities of the experimental eelgrass plantings. "Planting more densely doesn't seem to have a facilitative effect," says Boyer. "If you stick in more shoots you get more shoots, but dense plantings don't amplify success." She's not surprised: "After doing years of restorations, I've found that no matter the conditions, plants pretty much decide how dense they want to be."

Another observation is more oysters on the north side than the south side of the higher portions of the reef structure, confirming these large bivalves may be limited by heat, and reaffirming Zabin's instinct to add Fucus to the reef. "With climate change there are more hot days and less fog, and thus an increased likelihood that

a low tide will expose oysters to high temperatures and drying conditions. This research with Fucus is one of the avenues we are exploring to develop restoration methods that address climate change," she says.

Researchers are not just experimenting in the shallows of the Bay. The multi-partner restoration team is also building arbors on the shore, using eucalyptus branches trimmed from adjacent parklands. The purpose of these branch "teepees" is to coax some native and rare marsh plants to grow higher. "The arbor technique is working really well for both the endangered California seablite and the common pickleweed; both are climbing the structures. It's a really simple technique that anyone can do," says Kathy Boyer. The resulting mini-mounds of succulents are intended to give marsh mice or rails refuge from high tides.

As waves, storms, and sea level advance, the experimental habitat-complex is also designed to buffer the Giant Marsh shoreline from erosion. Engineers from Environmental Science Associates (ESA) arranged different sizes of reef structures and associated seagrass plantings in a way that accounts for environmental parameters such as water depth and orientation in relation to wind and wave direction to

test what works best in terms of shoreline protection.

Monitoring results show that wave energy is reduced 20 to 30% at low tides, 5 to 15% at mid tides, and minimally at high tides (see charts). "The reefs at Giant Marsh do a better job of wave attenuation the lower the water level," says Damien Kunz, a hydrologist with ESA. Results so far are promising, he notes. "We expect the wave energy reduction will have a positive effect on sedimentation of the nearby mudflat. But I want to see the next round of data before jumping to any conclusions."

On the shore itself, in the intertidal zone, the site is now clean enough to proceed to the next phases of the experiment — planting native cordgrass and creating tidal marsh. Over the last few seasons, the San Francisco Estuary Invasive Spartina Project has been treating the site to remove invasive cordgrass. Plans call for two native cordgrass restoration sites, one paired with the reef and one a control, to go in mud next winter. "We want to see if the reef protects the new cordgrass from high-energy waves, and preserves the marsh scarp face from erosion," says the Conservancy's Marilynn Latta.

In the future, the team will also be adding new sensors around the eelgrass plantings, thanks to a recent grant from the Ocean Protection Council. Eelgrass can change water chemistry (oyster shells don't form when the water is too acid) and the sensors will help measure just how much restoration can contribute to this important function (recent UC Davis research found that some natural eelgrass beds can raise the pH of the water around them). Eelgrass can also store carbon, another research frontier of the Giant Marsh project.

While the scientists scrutinize their results, the birds are making the most of the new food factory offshore. This May, when Boyer was doing her flower moon replant, she saw an osprey catch a bat ray for breakfast. Indeed, so many herons, egrets, terns, and other birds were at the restoration site she felt like she was "in the middle of a wading, diving, feeding frenzy."



"Baby" Fucus (rockweed), an offspring of the 2019 transplant, photographed on the reef this January? 2021. Fucus doesn't spread far, and this youngster occurred away from plantings, a sign of healthy conditions. Photo: Chela Zabin



ESA field staff orient and install a time-lapse camera at the Giant Marsh project site, in order to document wave run-up along the marsh shoreline. Photo: ESA

In view of the eclipse, Boyer couldn't help take stock of the light and dark sides of her work. "If we are going to advance this approach to adaptation, we need ten of these projects going around the Bay, and more people to do the heavy lifting," she says.

Crawling in the mud and planting eelgrass stick-by-stick, not to mention constructing new reefs in the shallows, pushing paper, getting permits, raising money, buying sensors, and handling the dozens of other tasks associated with large-scale field experiments, is daunting.

The region will need an army of the young and strong to carry on this work in the future, and to save our shores the natural way. "We have to build physical capacity to do this work everywhere around the Bay."

The next super blood moon will appear on October 8, 2033. By then, humanity's efforts to invest in adaptation infrastructure may begin to be eclipsed by the advance of icemelt into our Bay. We're on the dark side, and it's going to be bloody, but Giant Marsh is shining a light.

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Arrangement of ESA wave monitoring equipment around the nearshore oyster reef treatment. Source: ESA

D E S I G N

Bay Trail Retreat at Bothin Marsh

ELYSE DEFRANCO, REPORTER

The Bay Trail connecting Sausalito and Mill Valley is a bustling pathway where recreational bicyclists, bike commuters, and pedestrians all mix amidst the bayfront marsh scenery of the Bothin Marsh Open Space Preserve. Around thirty times per year, though, this scene looks dramatically different, as high tides flood the area with seawater, making the path impassable.

Experts say this demonstrates how vulnerable the path and marsh are to sea-level rise, and an ambitious new project is underway to re-engineer the pathway and help the marsh adapt to this future. On June 8, the team working on this “Evolving Shorelines” project announced a final design that moves the Bay Trail to follow the perimeter of the marsh, but the decision didn’t come easy.

“It was evident that the multi-use path is our most-used park asset, and it’s extremely visible to the public,” said Veronica Pearson, ecological restoration planner with Marin County Parks and part of the One Tam team leading the project. “And we wanted to be very conscious about how we develop the plan for adaptation and keep the public in the loop.”

In partnership with Golden Gate National Parks Conservancy, the project team has sought community input and guidance from the start. Indeed, this stretch of the Bay Trail is so popular that addressing its vulnerability to sea-level rise makes a great launchpad for conversations about climate change adaptation and the role of tidal marsh ecosystems. These ecosystems not only provide habitat for wildlife, they also act as natural water-filtration systems between the land and Bay waters and sequester and store large amounts of carbon.

The rising Bay isn’t a concern for the distant future; experts project a foot of increase in Marin by 2030, producing flooding events around 220 days per year. The one-foot increase would submerge the mudflats and shift the high-tide line closer to the road and communities, subjecting businesses and homes along Shoreline Highway to frequent flooding. By the turn of the century, impacts will be far worse.

The project team plans to take on the most urgent adaptations first, such as resurfacing the Bay Trail to maintain functionality for recreation and transportation. Walking or biking along the trail today, one can already

see the corrosive effects of flooding seawater evident in the trail’s pocked surface. Project leaders also plan to create raised marsh mounds and improve connectivity to tidal channels, which will not only preserve quality wildlife habitat but also help the marsh adapt to the shorter-term impacts of sea-level rise up to about two feet. Ultimately, however, planners seek to prepare for up to four feet of rise by 2060.

Although the rich biodiversity of the marsh gives the feeling that it predates the human development surrounding it, the truth is that this area has undergone extensive changes over the last 150 years. In 1851, most of what is now marsh was actually open water. Significant engineering changes began in 1924 in order to support first a railroad bridge, and later a berm. The Bay Trail of today follows the footprint of this old railroad berm. This was followed by a 1960s flood-control project that rerouted Coyote Creek, impacting sediment supply to the marsh from the watershed.

All this engineering means that the natural processes that would sustain the marsh into the future aren’t in place, including a restoring flow of sediment needed to coun-



Bay Trail vision view adjacent to Almonte Boulevard, Bothin Marsh, Marin County. Rendering: ESA/WRT



Bay Trail realignment. Map: ESA/WRT

teract erosive wave action. Despite these human impacts, the marsh habitat has become a vibrant habitat for wildlife and plants, offering views of acrobatic dives of Caspian terns alongside the more slow-moving elegance of Black-necked stilts as they forage in the mudflats.

In October 2020, the project team presented three different trail

alignment options to the public and explained related impacts to Coyote Creek. On June 8 of this year, following community input, the team announced the favored plan, which realigns the Bay Trail to follow the perimeter of the marsh. The design leaves the old trail embankment in place to create new, higher marsh habitat for wildlife and provides a buffer between the shoreline and waves coming from Richardson Bay.

A new raised embankment along the marsh perimeter offers higher ground for the trail, flanked by an ecotone slope (vegetated transitional habitat), as well as a buffer between the road and community and the high tides. Without the bisecting trail in the way, the plan allows the marsh to undergo a more natural adaptation process. The project is still in the planning and permitting stage, with implementation slated for 2025.

As excited as the project team is to tackle such a big challenge and test some of these adaptation techniques, Rob LaPorte, project manager with Golden Gate National Parks Conservancy, emphasized that we can't miss the forest for the trees. "Slowing the pace of sea-level rise is critical to giving the marsh its best chance of survival: the slower the rate, the better opportunity the marsh will have to adapt. It's a good reminder that climate mitigation and reducing carbon emissions are still our biggest tools to reducing impacts to our environment."

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ALTERNATE ADAPTATION CONCEPTS

CONCEPT 1
Raise Trail in Place

CONCEPT 2
Span the South Marsh

CONCEPT 3
Ring the South Marsh



Source: ESA/WRT

F I R E

Trail to a Fire-Safe Watershed

CARIAD HAYES THRONSON, REPORTER

Long insulated from severe risk by mild temperatures and the fog that regularly swaddles the Santa Cruz Mountains, San Mateo County now finds itself — like the rest of the Bay Area — facing the climate-driven prospect of catastrophic wildfire. The threat is leading one of the county's largest landowners to devote unprecedented resources to fire-prevention efforts in the Peninsula Watershed — efforts that will also restore parts of the landscape to an approximation of their historical condition.

"In the last few years, the weather has changed in regards to the relative humidity," says Fire Safe San Mateo County's Denise Enea. "Normally you would go up to [the redwood-forested ridgeline at the edge of the watershed] and it would be kind of cold and misty. Now, you get out of the car and you reach for your sunglasses and your cap because it's hot and it's dry. And we're also seeing much more wind." The upshot, she says, is a noticeable increase in fire ignitions — including one in mid-May, much earlier in the year than normally expected. Thousands of homes occupying the area's wildland-urban interface, including some of the region's priciest properties, would be at risk in the event of a conflagration.

The changed weather, along with more frequent and extended droughts, is leading the San Francisco Public Utilities Commission (SFPUC), which owns approximately 23,000 acres of the upper watersheds of San Mateo Creek and Pilarcitos Creek, to double down on fire prevention efforts. "Last year we did more wildfire risk reduction work than any previous year," says SFPUC's Tim Ramirez, "and this year we're going to do more than last year. We are removing hazardous

trees that have died from drought and plant pathogens, expanding our fuel breaks, and getting at ladder fuels in the understory."

SFPUC is also working with Cal Fire on a new project that would allow the state agency to conduct additional prescribed burns in certain areas of the watershed. Traditionally Cal Fire conducts prescribed burns on San Andreas and Pilarcitos Dams (seven acres total); this year both were conducted on June 9.

Ramirez notes that the heavy tree cover that blankets the watershed's slopes is relatively new; before settlers arrived and began planting trees — many of them not native — on their farms and ranches, the area was largely grassland. To help guide its vegetation work, the SFPUC has

proved a six-mile extension of the Bay Area Ridge Trail. "The ridgeline that runs through the watershed lands is a key connection for the Ridge Trail," says Liz Westbrook of the Bay Area Ridge Trail Council. "We've been working on it with the SFPUC for more than 20 years."

Although new public access to the watershed lands carries some risk — a careless hiker's smoldering cigarette butt could ignite a fire, for example — Ramirez says that overall, the new trail will help protect the watershed. "It's going to give us access to places we haven't been able to get to before for emergency response." He also notes that the docents who will patrol the trail, and the trail users themselves, can help spot and report small fires before they become big ones.



SFPUC and Cal Fire personnel conducting a prescribed burn this June on San Andreas Dam. Photos: SFPUC

commissioned a historical ecology report from the San Francisco Estuary Institute. "It gives us a bit of a glimpse of what the area used to look like," says Ramirez, adding that the intent is not to recreate the past entirely. "But it helps us try to restore the biodiversity of the watershed at the same time we're reducing some of the fuel loading and wildfire risk. We're going to restore some of these grasslands and manage them that way in the future, not let the trees just come back." The report is expected to be completed later this summer.

The SFPUC's work is concentrated along its property boundaries and roadways, including the ridgeline next to Highway 35, which is also where, in May, the Commission ap-

The SFPUC funds and conducts its own work on the Peninsula Watershed, and also supports and coordinates with other agencies, including Cal Fire; local fire protection districts; the Mid-Peninsula Open Space District, which has extensive holdings adjacent to the watershed; and Fire Safe SMC. Governor Newsom's state budget for the year includes \$2 billion for wildfire prevention; roughly half of it will be dedicated to vegetation management, including grants for local agencies to conduct forest health projects.

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S T O R M W A T E R

Ballpark Battlegrounds

MICHAEL HUNTER ADAMSON, REPORTER

In June, Mountain View's Permanente Creek is barely a trickle. Culverts burp water into a concrete channel abutted by schools, houses, and ballparks. A pair of mallards splash through the water, not even up to their ankles. After a dry winter, it's hard to look at these conditions and imagine that gurgle of water rising up over its concrete banks to flood the city, which might explain part of the decade-long push and pull between some residents and flood managers over the adjacent McKelvey Park.

Along Miramonte Avenue, and almost 20 feet below it, sit a couple of baseball fields, both in use on a Saturday afternoon. Parents are in attendance behind home plate, but rather than sitting behind a chain-link backstop at field level, they look

down from bleachers at the top of vertical concrete walls. McKelvey Park's curious design reveals its double use: a 0.7-acre, 18-foot deep basin designed to protect Mountain View from Permanente's next major 50- to 100-year flood.

Flood detention basins like the one at McKelvey Park, according to Afshin Rouhani, an engineering manager in water resources with the Santa Clara Valley Water District, can help solve the problem of urban flooding. Many South Bay creeks like Permanente have been locked into a concrete channel to protect adjacent developments, but in extreme flood events, they can overflow their walls and spill out across the densely populated floodplain. "One solution is to build the channel bigger," suggests Rouhani. "Another is to take the peak off." In other words,

when Permanente floods, peak storm flows are diverted into the McKelvey Park basin. As the basin fills up, the creek level maintains, then drops, and when the flood recedes, the water held in the basin is returned to the channel.

Projects like McKelvey Park are feats of engineering, and come with a commensurate investment of time and capital. Valley Water began planning the project in 2003 and construction was only just completed last year. The detention basin forms a part of a larger flood-protection program along the creek's path from the mountains to the Bay.

Despite the project's dual function of flood protection

for the city and sports complex, the project was not met with universal enthusiasm from the community. Public comments from various Mountain View Voice articles about the McKelvey Park construction include complaints about the costs and inconveniences associated with the construction. Other complaints seem to show a lack of concern for any potential future floods: "Ten million [dollars] to plan for a storm that has a 1% chance of happening each year?" And "Permanente Creek has not flooded since...1959."

Leaving aside the fact that, according to Valley Water, Permanente Creek has experienced major flooding four times since 1959, the scientific understanding of extreme climate events in California in recent years has changed. Scott Dusterhoff, lead geomorphologist with the San Francisco Estuary Institute, suggests that, even if summer is getting longer, hotter, and drier, long-term precipitation numbers may not change much. "If precipitation falls mostly during a few intense storms, then the flood flows could be quite large," says Dusterhoff. "The best available science is telling us that large flood events will be getting larger, even with a drier future."

Lotina Nishijima, project manager of McKelvey Park's construction period for Valley Water, stresses the importance of winning over public support for a project of this scale. "I remember seeing...hundreds of meetings and public workshops," says Nishijima. "We don't own the land along the creeks, so in order to get the right of way to build projects, working with cities and other entities is very important."

McKelvey has been built, but others like it around the Bay Area have not been as successful. In Marin County, similar attempts to build a multipurpose detention-basin/baseball-park have foundered. Most recently, in 2017, a community-organized effort prevented plans of transforming Lefty Gomez Field, at Fairfax's White Hill Middle School. The website saveleftygomez.com mentions multiple drowning victims found at municipal flood-control facilities in Las Vegas and Pearl City Hawaii, and expresses concerns over a potential attractive nuisance in the form of a standing body of water being located on middle-school grounds.



McKelvey Park. Photo by Michael Adamson

3D Rendering of McKelvey Park Detention Basin.
Image: Valley Water



Warren Karlenzig, a Marin resident and president of sustainability consulting firm Common Current, whose work with the Los Angeles Department of Water and Power helped it move to green infrastructure to reclaim stormwater, advocates for a more systemic approach to stormwater management. A flood protection plan “is not just a monolithic structure,” says Karlenzig. “Neighborhoods with rain gardens that channel rain from rooftops into areas that hold water, public works projects, volunteer projects,” all play a role.

The public works and volunteer projects that Karlenzig talks about have already demonstrated success in Marin County. On San Anselmo’s Red Hill Avenue, the Miracle Mile median project can hold one to two acre-feet of water, reducing the impact of localized flooding and droughts while cleaning pollutants from runoff. And at the Fairfax

Pavilion, a parking lot badly eroded by poor stormwater drainage, Karlenzig organized a volunteer effort that, over the course of one weekend, constructed a bioretention system that held one million gallons of stormwater in its first year of use.

Karlenzig sees bioretention working in concert with larger engineering projects to help take some of the pressure off of structures like McKelvey Park. His systemic view is echoed by Rouhani of Valley Water, who talks about how detention basins take a watershed view of flood control. “You have to do things where it makes sense,” he says, “even if the project impact is in a different place than project benefits.”

The neighborhood around McKelvey Park has new baseball fields, and the neighborhoods downstream have flood protection without building unsightly flood walls along the creek channel. It seems like a win-win, but, when looking at the new facility, it’s easier to empathize with the skeptical residents. There’s something severe about the 18-foot concrete walls, and the tall iron fence along the sidewalk where there were once redwood trees. All too often, when it comes to planning for climate change, universally welcomed workable solutions don’t exist.

“I would say that a flood detention basin is the best tool for situations like Permanente Creek,” says Dusterhoff. “You don’t have a lot of options, like turning a floodplain back into a floodplain.” Since its completion, McKelvey Park has been well received, even winning several design awards, and Nishijima believes the praise is well earned. “We learned a lot and there were a lot of challenges,” she says. “It’s hard to make everybody happy.”

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Volunteers build a bioswale at Fairfax Parkade. Photo: Warren Karlenzig

REPORTER'S VIEW, *cont'd from page 12*

when supplies dwindle, often causing disastrous die-offs in fish populations. This year, disease is ravaging Chinook in the Klamath, where trickling flows have warmed to lethal temperatures. A similar crisis is expected in the Sacramento this summer as spawning salmon lay and fertilize their eggs in what environmental advocates fear will be deathly warm outflow from Lake Shasta.

Susan Tatayon, chair of the Delta Stewardship Council, told Estuary News that agencies “are working toward achieving the coequal goals” and that measuring success is complicated. A set of “performance measures,” described at the Council’s website, was introduced several years ago. They address water quality, people and property, river flows, and water exports, among other variables.

“Achieving these coequal goals will be going on for generations,” Tatayon said, adding that finding a sustainable balance in water use “is urgent” as species like Delta smelt and several runs of Chinook salmon decline. She believes coequality between water uses will arrive through “ecosystem-based management,” which looks at entire ecosystems rather than taking a species-by-species regulatory approach.

This spring, Governor Newsom declared the drought a formal emergency. This declaration could ease the way toward waivers on environmental protections that would allow water to be more easily funneled out of the Delta. That’s what happened during the last drought, leading to prematurely drained reservoirs and lethal spawning conditions downstream of Shasta Dam, where sun-warmed outflow killed nearly every Chinook salmon egg laid in the summers of 2014 and 2015.

Farmers also feel the burn of drought. In the Sacramento Valley, rice plantings have been scaled back by 20 percent of average acreage — what headlines have featured as an agricultural disaster. However, it’s a relatively small cut for growers, and as soon as plentiful rainfall returns, those fallowed acres will be farmed again.

In the western San Joaquin Valley, some farmers — especially those with junior contracts for water in years of surplus — are plowing over producing trees for lack of delivered water. But



such growers are the minority, points out Jon Rosenfield, a senior scientist with the organization San Francisco Baykeeper. “These junior contractors do not represent all or even most California farmers, or even all or most Central Valley farmers,” he said.

Most of the state’s orchards will receive the water they need this year to produce profitable crops. “When surface allocations are low, during droughts, farmers often turn to groundwater,” said Peter Gleick, a professor emeritus with the Pacific Institute, an Oakland research thinktank. “That’s one reason why farm income rarely drops very much during droughts.”

In fact, the last major dry spell, though publicized as devastating to farmers, cut a relatively small \$4 billion in sales from the state’s agriculture industry from 2014 through 2016, according to recent reporting by CalMatters.

This year, in spite of cries for more water in the state’s farmlands, California farmers are poised to harvest 3.2 billion pounds of almonds — yet another in a long string of record crops for the booming industry.

To Rosenfield, the plight of the state’s salmon fishing industry illustrates the lopsided version of coequality for which society has settled. “In 2008 and 2009 after the salmon runs collapsed, fishermen were shut down completely, and this year they’ve lost half their season, and based on what’s happening now, it’s possible they’ll get shut down again in three years,” he said. “But if a farmer gets cut by 30 percent, people react emotionally, because God forbid a crop should be fallowed.”

The notion of coequality in California’s water use is an illusion created by drastically shifted ecological baselines. As a society, we have forgotten what it means for a river to be a healthy and productive system. We live in a recalibrated paradigm where anything less than economic growth is a crisis, and endangered listings and depleted stocks are the status quo for native fish species. Allocating even minimal flows of water to keep these creatures from disappearing is controversial when it cuts into farm production.

California leaders talk about restoring rivers and wetlands, but these ecosystems, once destroyed, are rarely fully revived. Recently, a San Joaquin River restoration effort was celebrated when it coaxed a few salmon back to a watershed that once hosted hundreds of thousands. In her 2015 book *The Narrow Edge*, naturalist Deborah Cramer wrote, “We so easily settle for the diminished world around us Unaware of what we have lost, we can’t imagine what we might restore.”

This cultural amnesia continues, drawing us down the slippery slope of progress. Last month, a political figure in the San Joaquin Valley suggested declaring the Delta smelt extinct to ease water-pumping restrictions intended to protect the fish, which Republicans have often pointed out is small and economically worthless. Indeed, California would have a real shot at achieving its coequal goals if some water users just disappeared.

Alastair Bland
(pictured above)

INTERVIEW, cont'd from page 2

and a risk in taking that attitude. That last increment of design perfection can be illusory, and not worth the time and energy to pursue.

I'll give you an example from the San Clemente Dam removal in the Carmel Valley. After moving the river around the dam, leaving the dam to hold the accumulated sediment, we spent a huge amount of time and energy designing, engineering, and then constructing a natural step-pool river, with careful placement of boulders and large woody debris pieces. Then we emerged from the drought and had one of our wettest years. The first couple of big storms came roaring down the canyon and rearranged all of that careful work. In retrospect, we wondered, "Why did we do all that?"



Matilija Dam in Ventura County, the fish that got away for Schuchat. He hopes their South Coast Regional Manager Megan Cooper will continue to carry the torch. Photo: SCC

ARO: What about the creation of the SF Bay Restoration Authority? Was that a paradigm shift for the Conservancy?

SCHUCHAT: It's one of the things in my career I'm most proud of being involved in, and the most fun thing I ever did.

ARO: Why was it fun?

SCHUCHAT: Because I'm a political junkie who likes campaigns and elections and polling and coalition building. Getting the voters to approve the regional tax and authority, that was a great process. And now we have the gift that keeps on giving, half a billion dollars over 20 years. But I don't think it's a paradigm shift in the sense that we know that people in the Bay Area love the Bay, and they're willing to pay for it. Possibly more so than any other place

in the country. But it was a useful demonstration of the willingness of citizens to pay for a big vision. I think it could be replicated elsewhere in California and probably elsewhere in the United States, as long as you have the right sort of institutional framework to be able to do that. And it helps if you have an iconic natural resource that everybody loves. But there's plenty of places in California with that.

ARO: Do you think there's more support now for this kind of taxation than before? Given the political environment and stalemates in Washington, I almost prefer to know my tax dollars are going to something very specific and local.

SCHUCHAT: That's an interesting point. One of the things that we learned from the Measure AA vote itself is that actually, people weren't worried

about how locally the money got spent. The elected officials were, and special interest groups were, because they are all in for particular places and particular things that they want. But you know, 70% of Bay Area voters were perfectly happy to say, "Yes, you can charge me 12 bucks a year, and as long as I'm reasonably sure that the money is being well spent, it's not actually that important to me that you spend

it on my part of the Bay." Individual citizens are actually less parochial than their elected officials.

ARO: Do you think we can use a mechanism like Measure AA to fund climate change adaptation?

SCHUCHAT: We're going to have to. I'm not expecting the federal government or even really the state to bail us out. So we need to have local money. San Francisco voted a few years ago to start paying for their seawall on the Embarcadero and that's an example. They'll get state or federal money, but it probably won't be enough to do what they need to do.



Sand-friendly wheelchairs, some equipment for which was installed and paid for by the Conservancy. Photo: SCC

ARO: How did you get through the last administration?

SCHUCHAT: Despite the outward chaos, our work went on. We got lucky because we had this racist dictator who didn't know how to govern or manage. With no one to run their agencies, they couldn't really implement their agenda. And even in the places where they did hire people, like for the EPA, they hired stupid people who did dumb things that got thrown out by the courts. So over time, we were left to deal with civil service lifers, and they were great! It was also a great time to be a public official in California. The attitude here was Trump hates us not just because we're a heavily Democratic state but also because we're a very diverse state that is making a transition into being a majority minority state. All kinds of diverse people are gaining political power here. That drove the Republicans crazy but made me really proud and happy.

ARO: Going forward, is there one last thing you hope to achieve?

SCHUCHAT: I want to see the South Bay Salt Pond Restoration Project completed in my lifetime. I'd also like to see more progress on the major trail systems that we work on: the Bay Trail and California Coastal Trail and Santa Ana River Trail. Every time I go on the Bay Trail and see how many people are out there, it just makes me incredibly happy. In fact, one great thing about this job is I can go almost anywhere in coastal California and see

continued on back page



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San Francisco Bay and the Sacramento-San Joaquin River Delta comprise one of 28 "estuaries of national significance" recognized in the federal Clean Water Act. The San Francisco Estuary Partnership, a National

Estuary Program, is partially funded by annual appropriations from Congress. The Partnership's mandate is to protect, restore, and enhance water quality and habitat in the Estuary. To accomplish this, the Partnership brings together resource agencies, non-profits, citizens, and scientists committed to the long-term health and preservation of this invaluable public resource. Our staff manages or oversees more than 50 projects ranging from supporting research into key water quality concerns to managing initiatives that prevent pollution, restore wetlands, or protect against the changes anticipated from climate change in our region. We have published *Estuary News* since 1993.

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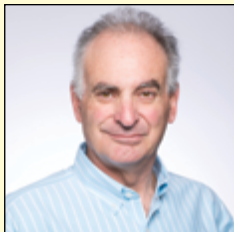
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INTERVIEW, *cont'd from page 27*

things that we did, and people enjoying them. The other day at Stinson Beach I saw somebody using one of the beach wheelchairs, with fat tires, that you can push in the sand. We purchased some of those chairs and put them on the beach! All you have to do is go to a website or call a phone number, get a code, and reserve one.



Seeing our money making it possible for somebody in a wheelchair to get right up close to the ocean makes me incredibly happy. Just this month, I've also been really proud to help move \$12 million worth of fire prevention money out the door. It shows what a well-honed machine we are, and the kind of contacts and connections we have with the local governments and Resource Conservation Districts that are going to be spending the money. We were able to turn out a Request for Proposal for that money in two weeks.

ARO: Speaking as one older, white, privileged environmentalist to another, what should we be thinking about in terms of racism and equity in the conservation world?

SCHUCHAT: I'm really proud that I'm leaving behind a much more diverse staff than I found when I came to the Conservancy in 2001. It looks like we've cracked the code on hiring for

diversity; something like 90% of the people we've hired in last few years, about a dozen, have been people of color. But it's important to remember we all have to keep chipping away at this. There's no silver bullet. One thing we did that worked well was to create a very diverse advisory council for our Explore the Coast program. The program brings

kids from disadvantaged areas to the coast. The advisory council has taught us a lot and helped us better focus on equity in access to the coast.

ARO: So did you just place a premium on hiring people of color or did you do more?

SCHUCHAT: We had to look at how we wrote the job descriptions, and what classifications we were using, and where we were advertising. Most of our past hires of color have been in our business and accounting department, and we wanted to hire more into program management. We realized we had a job classification that required previous experience in conservation work. And if the conservation field is mostly white, and you require previous experience, you're going to get mostly white people applying. So we pivoted to looking for the skills and abilities we need, rather than the experience. And we understand that means that we have to train them. So we've created

a pretty elaborate training curricula that takes 20 weeks. And we had to do all of this within the constraints of the state civil service system, which is Byzantine and incomprehensible. After 20 years, I feel like I really understand how the state budget works but I would not pretend to understand the state human resources system.

ARO: At this change point in your life, is there one last thing you want to say to your colleagues, or to young people, looking forward to the future?

SCHUCHAT: It is very hard to do the work that we do, but the average Californian in the street really loves it and supports it. You've got to keep that in mind. Plenty of people are going to come along and say "Don't do this" or "We can't afford that." But back when I used to fly on airplanes, and somebody would ask me what I did for a living, and I'd tell them about the Coastal Conservancy, their response was always: "Wow, that is so cool!"

For the audio version of this interview go to estuarynews.com online.