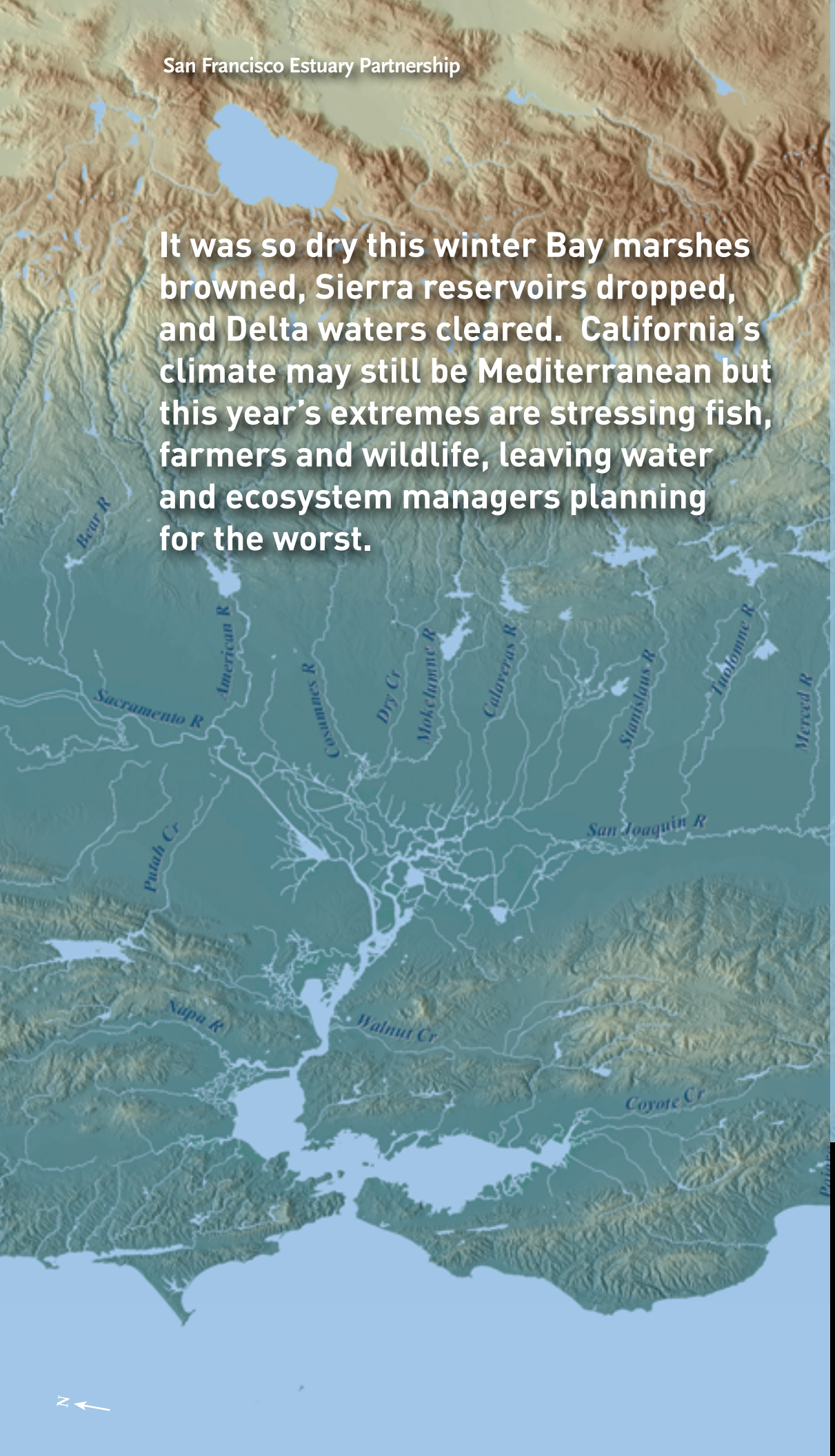
San Francisco Estuary Partnership



It was so dry this winter Bay marshes browned, Sierra reservoirs dropped, and Delta waters cleared. California's climate may still be Mediterranean but this year's extremes are stressing fish, farmers and wildlife, leaving water and ecosystem managers planning for the worst.

ESTUARY NEWS

SCIENCE • RESTORATION • WATERSHED • POLITICS • SPECIES • BAY

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City & County

FLOW FIGHT FOR BAY

Marin became the third California county to adopt a resolution affirming that adequate freshwater inflows are essential for a healthy Bay and Delta this past December. The Contra Costa and Napa county boards of supervisors had already acted. Darcie Luce, coordinating the effort for Friends of the San Francisco Estuary, hopes the remaining Bay and Delta counties will sign on: "We need to show a strong and unified voice on this issue. Some people are still not aware of the important role freshwater flows play in the health of the estuary. It's important to get the word out."

Photo: Brad Jarrett

According to the San Francisco Estuary Partnership's 2011 *State of the Bay* report, "The amount, timing, and patterns of freshwater inflow to the Bay define the quality and quantity of its estuarine habitat... Freshwater inflows also drive key ecological processes... The variability, or changes in inflows over time, trigger reproduction and migration of many species, and high flows transport nutrients and organisms to and through the Bay, and flush contaminants."

Luce says the 2011 report and that year's State of the Estuary Conference galvanized the campaign to secure flows for the Bay. The Association of Bay Area Governments took the lead with its own resolution the following year. That's become the model for the county resolutions.

Luce is helping to tailor each resolution to locally specific concerns — Contra Costa's, for example, focuses more on the Delta than Marin's — while maintaining consistent language across the board. The Marin Municipal Water District's recent resolution supporting the county supervisors' vote was "a welcome surprise," she says. Outreach to other water agencies continues.

Will Washington and Sacramento listen? "We don't have a public vote on the current water planning processes," says Luce. "But the leaders involved should be sensitive to the voice of the public in this part of California." JE

FLUSH WITH DRUGS

The list is long: antibiotics, sex hormones, mood stabilizers — even more benign drugs like ibuprofen, acetaminophen, and caffeine are showing in trace amounts in the Bay.

"Many medications are not fully metabolized by the body, so there is human pass-through, plus improper disposal by flushing down the toilet," says Melody LaBella, pollution prevention coordinator for the Central Contra Costa Sanitary District. "Municipal wastewater treatment plants are not designed to remove diluted concentrations of complex chemicals like pharmaceuticals."

The long-term effects on humans and wildlife of low-grade exposure to a cocktail of medications is still unknown, but the latest Regional Monitoring Program summary of studies of Bay water identified more than 100 different kind of compounds found in prescription and over-the-counter medicines and related products.

In 2008, following a nationwide investigation about pharmaceuticals in water supplies by the Associated Press, the California Association of Sanitation Agencies issued a call to action. Now, most wastewater districts in the region are developing pharmaceutical collection points. "We see the low hanging fruit as unwanted or expired medicines," LaBella says. Since 2009, her district has collected almost 50,000 pounds of drugs and had them incinerated by professional handlers. The program, which operates in partnership with local law enforcement (because legally police are the only agency that can accept narcotics) costs about $100,000 a year.

Other wastewater districts, law enforcement agencies, and cities and counties around the region have launched similar programs. So far, districts and utilities in the East Bay have collected 10,562 pounds of expired or unused medications since 2009, and in San Francisco 30,000 pounds since 2012.

Clean water advocates are also monitoring the progress of SB 727, part of which would require pharmaceutical companies to finance and manage a collection and disposal system for unwanted drugs. LaBella says that the pending legislation also has the support of law enforcement and public health officials who want to see better control of prescription drugs for safety reasons.

In the meantime, the focus around the Bay is on educating the public about proper disposal. "We know we are not getting nearly the amount that is out there," LaBella says. DM

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APRIL EDUCATING & RECREATING

One of the oldest festivals held on the Bayshore is happening again April 12. Berkeley's Bay festival has been inviting the public to the city marina since 1937, offering myriad avenues for getting up close and personal with San Francisco Bay, from dragon boating, tidepooling, and sailing to trolling through many interesting activities and displays sponsored by park districts, yacht clubs, outdoor education organizations, water skiing groups, clean water programs, and more.
For more information:
www.cityofberkeley.info/bayfestival

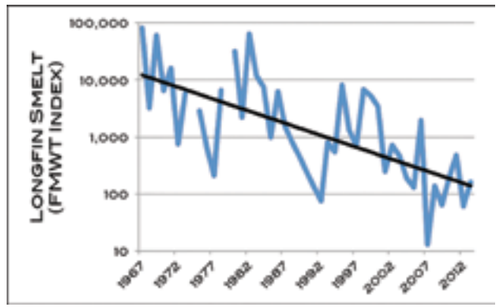
Photo: Paul Kamen

ENDANGERED

The Unsung Smelt

While not as famous as its cousin the Delta smelt, the longfin smelt is just as imperiled locally and — if the drought continues — stands to have one of its worst years ever. "The longfin smelt responds strongly to freshwater flows," explains conservation biologist Jon Rosenfield of The Bay Institute, an environmental nonprofit. "It could really be in trouble."

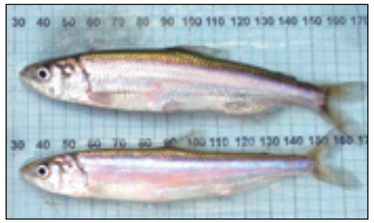
Named for its elegant pectoral fins, the longfin smelt (*Spirinchus thaleichthys*) was once among the most abundant fishes in the San Francisco Estuary. This small, silver fish also has one of the widest ranging habitats. Like salmon, longfin smelt live in both fresh and salt water over the course of their lives: adults live in salty water, swim inland to spawn in fresher waters at about two years of age, and then usually die. Unlike salmon, young longfin smelt track the ever-shifting zone where salt and freshwater meet and mix, riding currents much as turkey vultures soar on thermals. The combination of abundance and its ability to span the Bay-Delta salinity gradient made the longfin smelt ecologically important. "It occurs all the way from the Delta to the nearshore ocean, and all the predatory fish in the Estuary used to eat it," Rosenfield says.



Source: CDFW

We don't know how many longfin smelt are left but we do know they're dropping fast. "The population has gone down 99 percent or more in the last 45 years, a decline bigger than that of the Delta smelt," Rosenfield says. The state assessment, which measures changes in abundance from year to year, peaked in 1967 at nearly 82,000 longfin smelt. But the last decade has seen record lows down in the hundreds and even tens.

Longfin smelt live along the coast from here to Alaska. But the local population is isolated, cut off from the rest by ocean currents, just as mountains and other barriers can isolate land animals. Listed as threatened in



Courtesy NOAA

California in 2009, the longfin smelt is in enough trouble to be listed federally too. But instead it's been on a waiting list since 2012 because the system is backlogged. This is the longfin smelt's second shot at a federal protection. "It should have been listed 20 years ago," says Rosenfield, who helped with the first petition under the Endangered Species Act in the 1990s. "We're lucky it's still here."

He thinks the longfin smelt was saved by the big rains in the 1990s. That's because the population rises and falls mainly with freshwater outflows during the winter and spring. Another major factor in longfin smelt abundance is the number that are old enough to spawn.

"People have been trying to figure out what drives longfin smelt abundance for 40 years," says biologist Randy Baxter of the California Department of Fish and Wildlife, who has monitored the fish at 100-plus stations locally for 25 years. "It's amazing that just two factors account for more than 70 percent of the abundance."

Freshwater outflow is the biggest factor, and the longfin smelt's biggest need is likely more fresh water flowing though the Delta and into the Bay. "The relationship between abundance and flow is strong and extreme," Baxter says. "If you're looking to increase

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MARKET PLACE

Fresh Catch in 48 Hours

Anna Larsen, trained as a classical opera singer, never really planned on becoming a modern-day fishmonger. But a few years ago she was tired of living in LA and the constant hustle required of a performer. She was looking for a new creative outlet and thought it might lie in the food industry.

So she moved to the Bay Area and got a job working in a fish processing and wholesale company, North Coast Fisheries, based in Santa Rosa. The idea of a community supported fishery grew from there.

Modeled after community supported agriculture, where people buy a regular share of a farmer's produce, community supported fisheries aim to connect customers with local fishermen. Dealing in fresh fish is slightly more complicated than dealing in fresh vegetables mainly because of unpredictable weather and sea conditions, layers of regulations, and the general uncertainty inherent in fishing. "There are definitely times of the year when it is hard." Larsen says. "We don't always know what we are going to get. It can be an all or nothing situation."

Undeterred, Larsen started Siren Fish Company in the summer of 2011, two months later. That first summer involved lots of testing and building connections, but the demand for a constant supply of locally caught fish was there.

Larsen calls Siren's customers subscribers and says that there are currently about 400 steady participants. At times that number can climb to about 450. Subscribers sign up on the company's website to receive a share of whatever fish is caught.

Shares range from $20 to $60, depending on the size of the purchase. A half filet is the least expensive, a whole fish is the most expensive. Shares can be purchased weekly or bi-weekly.

Subscribers usually get their fish within 48 hours of it being caught.

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RESTORATION

The Island That Came in from the Cold

For years, Skaggs Island was a tantalizing blank in the map of San Pablo Bay wetlands restoration. Renee Spenst of Ducks Unlimited says it was "one of those places in a strange limbo." Two-thirds of it was owned by the US Navy, which had operated a top-secret listening post there; the rest was privately-owned farmland, where the Haire family grew oat hay. Converting any of the 4,400 acres back to tidal wetland was out of the question. "The agencies doing restoration just had to work around these two parcels," recalls San Francisco Bay Joint Venture coordinator Beth Huning.

Within the last few years, though, these key pieces in the North Bay restoration puzzle have fallen into place. The Navy transferred its property to the US Fish & Wildlife Service in 2011. Then, last December, came what the Sonoma Land Trust's Wendy Eliot calls "the Holy Grail," namely acquisition of the Haire Ranch. In a creative triple play, the US Department of Agriculture's Natural Resources Conservation Service paid the Haire family $7.5 million for a conservation easement; the Land Trust then purchased the land itself for $707,421 (with help from the California Coastal Conservancy and the Gordon and Betty Moore Foundation) and transferred it to the Service. The entire island is now part of the San Pablo Bay National Wildlife Refuge and restoring Skaggs is no longer a pipe dream.

Considered as terra firma, Skaggs Island was the creation of British immigrant John Percival Jones, a gold-seeker turned silver baron whose Pacific Reclamation Company took title to the tract in 1878. It was originally called Camp 6, one of a string of work camps along the Bay. Jones hired Chinese laborers to hand-build levees and drainage ditches; later, clamshell dredgers took over the work. The company planted the drained land in oat hay, which tolerates salinity, and fed the horse population of San Francisco after the 1906 earthquake. During the Great Depression, Pacific Reclamation sold out to grocery tycoon M. B. Skaggs, whose cash-and-carry stores became the nucleus of Safeway. Most of it remained farmland until 1941, when the Navy took over 3,310 acres for the US Naval Radio Station, paying Skaggs $53 an acre. The rest, 1,092 acres, was sold to William Haire. The Navy agreed to keep the Haire property dry and farmable by pumping out water and maintaining levees.

Courtesy Sonoma Land Trust

Through World War II and the Cold War, the Navy's communications and intelligence-gathering base was a self-contained world, with a staff of 400 and a newspaper, post exchange, movie theater, bowling alley, gymnasium, chapel, and bar. Though decommissioned in 1993, the Navy retained ownership. Navy SEAL teams blew holes in the buildings while practicing forced entry. Later, some of the abandoned structures on the remote, unmaintained property became meth labs. "Skaggs Island was a scary place for a while," recalls Eliot. "It was the Wild West, with lots of things happening under cover of darkness."

After prolonged negotiations, the Navy handed over its share of Skaggs to the Fish and Wildlife Service. "They had a fairly large pot of money to do cleanup," says San Pablo Bay refuge manager Don Brubaker. They took down most of the buildings, and removed lead contamination from the firing range. Cleanup also got a boost from Bay Bridge retrofit mitigation funds. Restoration had to wait, though. Because the Service inherited the Navy's maintenance agreement for the Haire property, there was no practical way to bring back wetlands while keeping that parcel dry. The new owner continued to operate the pumps, at an annual cost of $40,000.

Meanwhile on the neighboring parcel, Jim Haire, whose grandfather bought the ranch from Skaggs, was initially reluctant to sell. According to Eliot, the property had been considered as a mitigation site for San Francisco International Airport's runway extension in 2002. After that fell through, Haire still hoped for a price comparable to the $15,000 per acre the airport authority was rumored to have offered. By the time he reconsidered his position, the recession had hit and traditional sources of funding for land acquisition were drying up.

A new possibility emerged when Dean Kwasny, who runs the regional Wetlands Reserve Program for NRCS, joined the Joint Venture's board of directors. At a meeting, someone suggested Skaggs would be a "good fit for my program," he recalls. He agreed to meet with Haire, and that jumpstarted the process: "It was a challenge to work through some of the issues, but nothing was insurmountable." Although most of the reserve program's easements are for private lands, Kwasny explains there are a few California precedents: lands in the Yolo Bypass and San Joaquin Valley, where NRCS has funded easements on parcels owned and being restored by federal and state agencies. The Haire property deal is the first of its kind in the Bay Area, though.

The arrangement gives Haire a year to continue farming on Skaggs, with a possible two-year extension depending on the pace of restoration, and everyone has praised his stewardship. "The San Pablo Baylands could have gone the way of Silicon Valley if not for the farmers," says Huning. "Jim loves the land deeply," Kwasny adds. "He compared selling the property to getting rid of the family dog. He just wanted to know that whatever the outcome, it would be in good hands."

NRCS will fund restoration for the Haire parcel, but the amount has not yet been set. "Our policy is usually a year to obligate restoration funds and three years to spend, though an extension may be possible," says Kwasny. NRCS has already conducted a topographic survey, taken soil samples, and collected historic photographs.

Meanwhile, Brubaker says a hydrologic survey will be arranged through Ducks Unlimited. Then the partners will have to decide what restoration will look like. "One scenario: knock a hole in the levee and let it fill up," he offers. "It's not that simple. All that water will need to go somewhere, and in a hurry. And let's toss storm events and sea level rise into the equation." The tract could be flooded incrementally, or turned into a mosaic of tidal marsh and brackish ponds.

Restoration plans have to take into account that the Haire ranch lies seven feet below sea level, and Brubaker suspects the rest of the island is comparable. Huge quantities of sediment — 60 million cubic yards more or less — could be needed before pickleweed and other marsh plants can take root. Spenst, a veteran of the Napa-Sonoma marsh restoration project, sees opportunities for beneficial reuse of dredged material. As for funding, more will be needed to augment the NRCS pot. Brubaker jokes about car washes and bake sales. A parcel tax proposed for the San Francisco Bay Restoration Authority could make up for dwindling state and federal coffers, if the measure passes. Luckily, Skaggs has no highways or railroad tracks requiring expensive flood protection, unlike other San Pablo Bay projects. But it does have some protected species concerns to address. Wildlife-compatible public access, with hiking and canoe trails and interpretive signage, are in the mix being considered for the new parcels.

"It's going to be fun and interesting," says Brubaker. "We're going to farm clapper rails and salt marsh harvest mice instead of hay, and create nursery habitat for the fish and crustaceans that people like to dip into tartar sauce at Fisherman's Wharf." And it sounds like that would suit Jim Haire just fine. He's told Eliot, Huning, and others that he wants to see the land restored to wetlands within his lifetime. **JE**

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NOW IN PRINT

Suisun Scenarios Outed

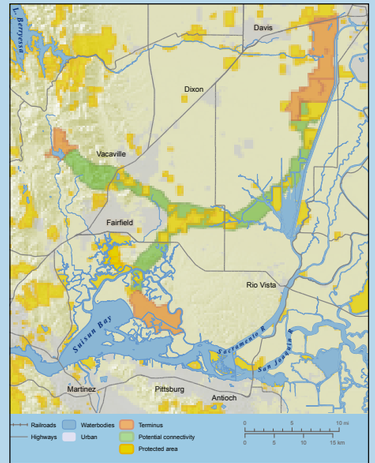
Ever since I began writing about the San Francisco Bay estuary, people have been telling me to pay more attention to Suisun Marsh. But whenver I started in on a story, it was hard to find good information.

Suisun Marsh: Ecological History and Possible Futures puts it all in one place. All the top scientists weigh in on everything from rare plants and elusive butterflies to how floods and droughts shaped this landscape in the past, and promise to do so in the future. Edited by Peter Moyle, Amber Manfree and Peggy Fiedler, the book debuts this spring out of the University of California Press.

For years, Suisun Marsh has been near the top of California's list of places to save. It's in the middle of everything; the biggest, wildest, most open space in the watershed between the Sierra and the sea; the refuge of endangered thistles and voles. It's where fresh meets salt water, where species adapted to extreme swings in conditions thrive, and where engineers and duck hunters have long toiled to attract waterfowl. It's a landscape that has been in and out of the water for millennia, with a long history of human micromanagement.

To explore Suisun's story, the book begins with dry but foundational science chapters on hydrology, sediment, vegetation, climate, and species. It then tells the tale of how the marsh and the water flowing through it have been managed to attract ducks. It also covers how choices were made about building roads, bridges, and infrastructure, and details water quality, salinity, and flow policies governing the marsh.

Closing chapters lay out several scenarios for the future. Some pin their hopes on this marsh as a refuge for endangered species retreating from sea level rise, and others see it as a flood management tool or a vital midpoint in a habitat corridor connecting Bay and Delta. But the authors argue that Suisun Marsh could be much more: a grand experiment, perhaps, in fostering novel ecosystems where aliens and natives, and even a few duck hunters, all flourish. Now that this book is out, those of us writing about how Suisun's future unfurls will have an excellent reference. **ARO**



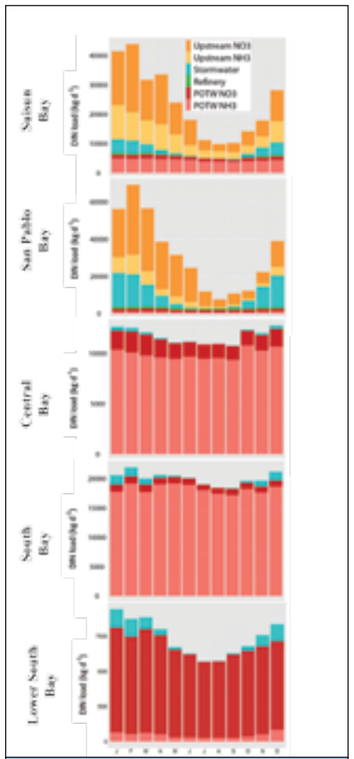
Potential tule elk migration corridors. Data: Patrick Huber. Map: Amber Manfree

POLLUTION

Bay Primed for Pea Soup?

Nutrients could be the next big problem for San Francisco Bay — or make that in the Bay, because they're already here at levels high enough to have caused trouble elsewhere. But despite its excess nitrogen and phosphorus, the Bay has been free of harmful algal blooms and oxygen-depleted dead zones for decades. Indeed, we've been so sure of this immunity to nutrients that most wastewater treatment plants don't even have to remove them before discharging into the Bay. Recent chinks in the Bay's resistance to nutrients are now alerting us, however, to get ready in case there's worse to come.

"The tricky part is the Bay's response to nutrients is changing, but it's not yet clear how best to manage them," says David Senn, a scientist at the San Francisco Estuary Institute (SFEI). Another challenge is that because nutrients haven't been troublesome here, we have a lot to learn about them in the Bay. "It will take a regional collaborative effort to understand how the Bay is changing and what regulatory actions to take," says Naomi Feger, Planning Chief of the S.F. Bay Regional Water Quality Control Board. To accomplish this, the Board drafted a *Regional Nutrient Management Strategy* in 2012 in collaboration with SFEI, the Regional Monitoring Program, wastewater dischargers and other stakeholders. The goal is to develop monitoring and regulations that proactively protect the Bay from nutrient pollution, backed by solid science. Within this major initiative, Senn is coordinating an expert team to outline monitoring and research needs. "It's a first step toward identifying the scientific issues we need to tackle," he says.



Average monthly dissolved inorganic nitrogen (DIN) between 2006-2011. Colors indicate source, see key above. Data: Novick & Senn, 2014

The financial stakes for getting a handle on nutrients in the Bay are high. "It's being called the most costly wastewater issue reorder in the Bay the since 1970s," Senn says. Most of the nutrients come from the 41 wastewater treatment plants which discharge into the Bay, and retrofitting them could cost billions of dollars. In the North Bay, nutrients also come from agriculture and wastewater in the Central Valley and the Delta.

Why haven't all those nutrients pouring into the Bay caused problems? The answer — based on nearly four decades of US Geological Survey work on the Bay's large swings in phytoplankton abundance — is a combination of three things: suspended sediment, tidal mixing, and clams.

Algae needs light to grow but Bay water contains so much sediment that it's murky. "It's like overfertilizing a garden and then covering it with a tarp," Senn says. "The nutrients are there but the other key ingredient, sunlight, is missing." In addition, algae often grows best in estuaries where the entering fresh water floats across the surface. This creates a top layer that concentrates phytoplankton and keeps them near the light. But here, the Bay's strong tides usually break up fresh water layers before algae can bloom. The third factor is large populations of clams and other bottom-dwelling filter feeders that can eat phytoplankton as fast as it can grow.

RMP water quality sensor playing host to animals called hydroids. Photo by Emily Novick, SFEI.

So what's changed? "At least two of the three factors that increase resistance to algal growth," Senn says. Suspended sediment is down by half since the 1990s in the North Bay and South Bay, letting the algae-boosting light shine twice as deep into the water. This trend toward clearer water is expected to continue because excess sediment from the Gold Rush is thought to have finally washed away.

Another change is that clam populations are down sharply in the South Bay, coinciding with a three-fold algae hike in those waters since the 1990s. The drop in clams and other bottom-dwelling algae eaters may be due to a rise in predators like fish and Dungeness crab, which in turn is linked to a shift in large-scale, long-term ocean patterns called the Pacific Decadal Oscillation.

So far there's less concern about the amount of algae than about the pace of change. "Algae levels were low before so it's not like the Bay is pea green now," Senn says. "But it changed at a fast rate."

Other signs of cracks in the Bay's resilience to nutrients include less dissolved oxygen in places where algae is highest. Microbes that eat dead algae also use oxygen, so algal blooms can lead to dead zones in the water. Also troubling was a rare red tide or undesirable algal bloom in the fall of 2004. In addition, small amounts of algae that cause toxic blooms elsewhere are beginning to pop up here too, and recent monitoring has also detected toxins from harmful algae in the Bay. However, Senn stresses that we can't tell if this is related to nutrients — or if it's even a change — because this monitoring has only been underway for a few years.

Besides affecting the quantity of algae, nutrients may also affect their quality. While low algae levels are thought to contribute to the dearth of small fish that larger animals eat in Suisun Bay and the Delta, now a new idea implicating high nutrient levels is being floated. For example, recent studies suggest that high levels of nutrients could dampen the growth of 'good' algae or encourage the growth of 'junk' algae not favored by small fish in Suisun Bay. More research is needed to test this hypothesis, however.

Indeed, more research is needed on just about all aspects of nutrients in the Bay. Right now, we don't know much beyond the facts that algae are rising in parts of the Bay, low levels of potentially harmful algae are common, and algal toxins are detectable. In fact, we don't even know if nutrients are behind what we see. "We need to understand the problem better to help identify the most effective fix," says Senn.

That's where the expert team he coordinates comes in. Their report, due out this month, outlines what we know, what we need to find out, and what a range of plausible scenarios might mean for algae in the Bay. Questions include: Will suspended sediments keep dropping? Do high nutrients really tip the phytoplankton balance toward kinds not favored by small fish? Will clam populations rise again after the next shift of the Pacific Decadal Oscillation? How will the changing climate and changing shoreline affect the nutrient balance? And can we keep nutrients out of the Bay in the first place?

The first step to finding answers is a Bay-wide monitoring program aimed at nutrient pollution. Current monitoring is spotty for key measures like nutrients, kinds of algae, algal toxins, dissolved oxygen, and clams, and also lacks sustainable funding.

Besides being costly, stemming the flow of nutrients into the Bay could take decades. Says Senn, "If problems are on the horizon, starting before they are widely entrenched will give us more flexibility."

"We're taking this seriously," adds Feger, whose agency already has a draft regional permit addressing nutrients in wastewater discharges throughout the watershed out for public review. "We don't want to experience the problems we see elsewhere in the country." RM

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Monitoring: http://sfbay.wr.usgs.gov/access/wqdata/index.html

New Report Due Out Late March: http://www.sfei.org/documents

HOUSE KEEPING

Raising the Dregs

San Francisco Bay's perennial problem with abandoned vessels cluttering and potentially polluting the waters got some uplifting news—literally and figuratively— this winter.

In the finger of water separating Oakland from Alameda, the abandonment situation had become particularly serious in recent years as derelict vessels attracted illegal activity. But thanks to a major cleanup effort by a consortium of more than fifteen agencies and organizations that spent in excess of $4.3 million, the Oakland Estuary is free of potential environmental and navigational hazards.

"It's a huge success," says Brock de Lappe, Harbor Master of the Alameda Marina who in early 2012 brought stakeholders together to address the problem.

The items removed from the estuary include 58 vessels, four dilapidated docks, and some 365 tons of metal, which has been recycled under the direction of the California Department of Resources Recycling and Recovery (CalRecycle). The largest crane on the West Coast (see photo) was brought in to lift up and remove two of the vessels—sunken tugboats measuring between 100 and 160 feet in length—one of which still contained fuel oil. The endeavor amounted to a Bay Area version of raising the *Titanic*.

CalRecycle spearheaded the cleanup, contributing $1.3 million of which $650,000 came from *Cosco-Busan* settlement money administered by the Fish and Wildlife Foundation. USEPA put up much of the remainder. While all consider the cleanup a major accomplishment, it was a unique situation. "It's not a template" for vessel abandonment cleanup, says Peter Pelkofer, senior counsel with the California State Lands Commission. CalRecycle, meanwhile, says it has no plans to take on additional abandoned vessel removal projects.

Dealing with the crafts is not only a financial challenge, but almost inevitably requires the coordination of multiple agencies. "Everyone has some authority, but no one has perfect authority," says Adrienne Klein, enforcement chief for the San Francisco Bay Conservation and Development Commission.

Keeping tabs on questionable vessels typically falls to county or city law enforcement, and in recent years many municipalities have strengthened local anchor-out ordinances to aid officers in citing derelict vessels. But according to de Lappe, Alameda County has not followed suit and suffers from a funding cut to its harbor control unit.

"Now that the cleanup has been done, what's to prevent it from happening again?" de Lappe says. Alameda County Supervisor Wilma Chan's office declined to comment. VS

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HYDRODYNAMICS

Keeping the Salt Field at Bay

As the dry, warm days went on and on and on this winter, two guys intimate with California's Sacramento-San Joaquin River delta shifted gears. One reassigned staff from flood to drought response, and the other lay awake at night imagining barriers across various slough openings. By early February, some Sierra reservoirs were so low, and so close to "dead pool" level, that the water projects stopped pumping and delivering. Farmers had to retrench, communities realized they might only have enough drinking water for the next six weeks, and any salmon that succeeded in spawning upstream had no water to carry them down. Things got scary. The water projects asked state regulators to let them off the hook in meeting various water quality standards, and the governor's state of emergency put the Endangered Species Act on stand by.

While the pundits focused on skin-deep polarizations – in which economy, food supply and farmers trump endangered fish – those with a deeper understanding of California water supply issues were worrying about something else altogether: keeping the salt field at bay. "Salinity is the central management challenge during a drought," says Jon Burau, a senior hydrologist with the U. S. Geological Survey. "People don't realize how much water we 'spend' repelling salinity intrusion to maintain water deliveries."

The water being spent, in this case, is fresh water released from Sierra reservoirs to repel saltwater intrusion from ocean tides into areas of the delta tapped by the water suppliers. In normal or wet years, this expenditure makes sense because the water that repels the salt field is also what makes estuaries biologically rich. But in extremely dry years, like we're facing now, we have to think twice how we spend that scarce fresh water, says Burau.

"If the drought is short-lived, then spend it now. But if you're looking at a protracted drought, you don't want to spend water too early because if Sacramento River flow goes to zero, that's very bad. Under some scenarios, if we don't curtail reservoir releases, we're going to be out of water for the ecosystem and for people by the end of the summer. So instead of burning through the water now, we may want to trickle it out later by making a few extraordinary alterations to the system," he says.

Frank's Tract. Photo: Francis Parchaso

Extraordinary measures may indeed be called for, even with these last few drizzles. "The real question is how do we manage damage to the delta, as a whole, as a result of low flows?" says the Department of Water Resource's Art Hinojosa – who used to work with Burau on interagency teams tasked with overseeing delta water operations. When Hinojosa was in charge of making sure the state water project complied with various permits and standards, he had a lot more water to work with: "It's been very, very, very dry. Even though this last storm was a good shot in the arm, we're still far, far behind where we would normally be."

While Hinojosa's group surveys the snowpack, with the help of a statewide network that produces a new forecast every month, Burau's team tracks what little is left to trickle through the delta, and most of this monitoring is automated. Indeed USGS maintains a network of 38 flow and water quality stations at every significant channel junction and river outlet in the delta, each equipped with state of the art sensors that also monitor salinity. Water managers rely on this network to tell them how many cubic feet per second (cfs) of fresh water is heading downstream, how much the tides are pushing this water around, and where the salt is.

"This latest storm was a bump," says Burau. Before the Pineapple Express arrived, he was measuring flows at less than 6,000 cfs in the Sacramento River. After the storm came through they were up to 25,000 cfs, but that's nothing like the typical peak flow of 60,000 cfs that usually occurs after a big winter storm. After this last storm, Burau also saw a bump in turbidity, but nothing like the first flush after a strong winter storm that can make the water look like chocolate. "Of course reservoirs are holding every drop from these last storms, so delta conditions will return to drought-like within a couple of weeks unless we get more rain," he says.

Another thing that happens in dry years, when rivers are running so low, is that the tides, always the dominant hydrodynamic force in this estuary, have a much greater influence, as Burau found out on January 28, 2014. "We had really low Sacramento River flows, a king tide, and the delta cross channel gates were closed so the tides had nowhere else to go but up the river. These three things created super-reversing flows at our Freeport gauge, 5,000 cfs going upstream, something we've never measured before on the Sacramento River! We had to get crews out on the water to recalibrate all of our north delta stations," he says.

January's constellation of near extreme events lit a fire under Burau's thinking about the salt field. He met with an ad hoc group of equally concerned scientists, modelers and managers to come up with drought mitigation strategies that wouldn't "burn" so much water to keep the salt field at bay. The first steps being explored would be to cut exports, open the cross channel gates and stop operating the Suisun Marsh salinity control gates further downstream – giving tides other places to go. "If we find ourselves back in extremely low flow conditions again, these would be the quickest, least expensive things we could do to save water that would also have the least impact on the ecosystem," says Burau.

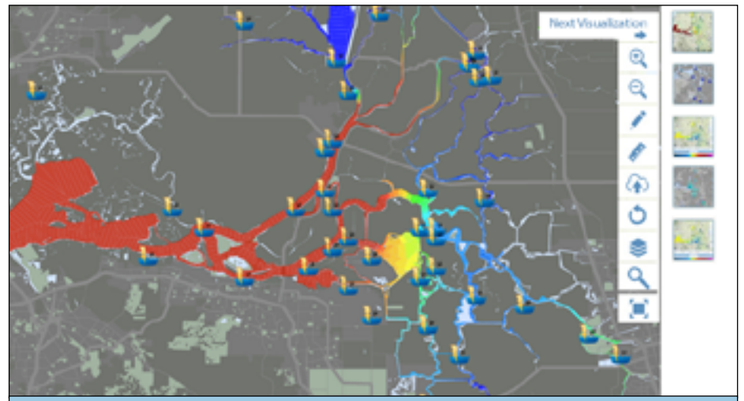
Next steps would be construction of a sequence of temporary rock wall barriers at key channel openings, such as Sutter and Steamboat sloughs, to transfer as much fresh Sacramento River water to the central delta as possible – thereby reducing salinity intrusion into the same area. "They built a number of these same barriers in the 70s," says Burau. "The advantage right now is we can do computer modeling, and see how it works before we build them."

All of these measures, says Burau, are aimed squarely at preventing one thing that seems to be the delta equivalent of a thermonuclear meltdown, at least for water managers: "losing control" of the salt field. Just mentioning it adds a wobble to Burau's usually confident tone. The focal point for this potential meltdown is a 3,500-acre flooded island called Frank's Tract.

"Frank's Tract dominates the hydrodynamic transport landscape in the central delta in much the same way Mt. Shasta creates its own weather, through sheer size. If you let Frank's Tract get salty, the rate of dispersive mixing goes through the roof. Once you've lost Frank's Tract to the salt field, it's right at the pumps, with their strict salinity standards — you don't want to pump salty water onto your farm fields and you certainly don't want to drink it. Once in, pushing the salt field back out of Frank's Tract," he said, "would require a very large volume of fresh water — water we simply don't have or wouldn't want to spend for this purpose."

In sum, rather than letting the entire delta get salty as we slowly run out of water, concerned agencies and scientists have been exploring the pros and cons of a series a temporary barriers that would preferentially allow the north delta to get salty while maintaining what Burau calls a "fresh water corridor" through the central and south delta (see blue on map).

As he and his colleagues mull over and model these kinds of potential drought mitigation measures, Hinojosa's agency hasn't stopped worrying about another kind of emergency that could flood huge islands and change the hydrodynamics of the delta: levee failure. "When we lost Jones Tract, it was a nice spring day in June. So even though there was no high flood threat from river flows or from tidal action with these recent storms, there is always lingering concern that something could go wrong and you could lose a delta island with very little warning, or at least without any other precipitating event," says Hinojosa.



Screen shot of a color–coded visualization of the estuary's salt field on January 25-29 2014. Linear interpolation of real time near-surface electrical conductivity data were used to generate this image from www.BayDeltaLive.com. The cooler colors represent fresh water, the warmer colors salty water. Blue/green region is the approximate "fresh water corridor" discussed in article, and yellow is Frank's Tract. The data used in this image were primarily collected by the USGS and DWR and retrieved from the DWR's California Data Exchange Center (CDEC).

Delta stakeholders will have easier access to this kind of data through a new mapping environment called www.BayDeltaLive.com (sample above) this March. Based on the concept of a "common operating picture" or "dashboards," users will have secure access to visualize, manage, and download data on real time conditions in the water. Initially, this new ecosystem and water management tool will only be available to stakeholder agencies with beta accounts, but developers from 34 North hope to make it more public-friendly soon. For beta accounts contact Amye Osti, amye@34north.com

With weak levees, an unpredictable climate, and fast materializing implications of deeper droughts for the delta, it's no wonder that the flexibility to reroute fresh water around delta hazards stays near the tops of many planners' wish lists.

That flexibility could come, some planners argue, from at last building the 21st century version of the peripheral canal – two twin tunnels taking water from a higher diversion point on the Sacramento River than we do currently, and away from the saltier perils of the central delta.

As the state and stakeholders contemplate whether it's worth the money, Burau sees conditions earlier this year as a clue: "This January, the water was really clear, the turbidity really low, and pumping was near zero, so the residence times of the water in the delta were long. In terms of ecosystem function, this period of unusually low pumping can give us a glimpse of what we might expect with the new tunnels – what things will look like when we don't have the draw of water across the central delta to the pumps as we've had for decades now." Without that draw, the water will remain in the delta longer. As residence times increase, the sediment in the water will settle, and sunlight will penetrate deeper. Such changes in conditions could make algal blooms more prevalent than they have been in the past (see p. 6).

As this issue went to press, Burau was running scenarios and Hinojosa was trying to take a day off with family in between days of being on call to monitor the state of the state's freshwater supply: "When there's less snow and less water, everyone wants to count every drop as soon as it lands. We're all going to be very busy figuring out how to balance the system with the water we have, how to forecast into the future what needs might be and, everytime it rains, how does it change the picture?" he says. ARO

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PEOPLE

Last Watch over Crystal Springs

When Gayle Ciardi looks out at the 23,000 acres of the Crystal Springs Reservoir watershed, a lifetime of memories come to mind. There's the spot where she had her first kiss in the branches of an ancient oak; and the inlet where a rattlesnake bit her as a teenager. There's the dark stand of cypress that her mother dubbed the Enchanted Forest, and the historic house where she grew up hearing stories about this protected landscape from her father and grandfather.

Ciardi knows this land as few others do. Born Gayle Bottimore, she is the fourth generation of her family to watch over San Francisco's water supply. In the 1880s, her great-great-uncle took a job caring for the land and keeping the dams of the Spring Valley Water Company. Her grandfather became a watershed keeper in 1910, and saw the company purchased by the City of San Francisco in 1930. His son, Ephe "Chuck" Bottimore, followed in his father's footsteps. Ciardi herself was raised on the shores of Upper Crystal Springs Reservoir, and spent her childhood riding shotgun with her father as he patrolled for trespassers. She never told her parents she was applying, determined to land the job on her own merit, knowledge, and perseverance.

Ciardi and "Sparkie" on early horse patrol with an East Bay Regional Parks district ranger in the late 1980s.

In 1982, Ciardi realized her dream and was hired as a watershed keeper in the Alameda watershed in Sunol. As the first woman to serve as a watershed keeper for the San Francisco Public Utilities Commission (SFPUC) in the Bay Area, she met a wall of male hostility. "Some of the older guys, the ones in the trades, were horrible. They wouldn't talk to me at all during the day. They'd say, 'You're a woman in a man's job, and there's men with families that need this job'. And when 4 p.m. comes, it's 'Hey, baby, how about I buy you a beer?" Ciardi says. "I used to cry in the car coming home."

After three years of constant hazing, Ciardi triumphed in the end. "One of the auto mechanics, one of the old geezers, says, 'we've pulled every trick on you, everything we could to get rid of you, but it didn't work. You know this job and you do it damn well. From now on, you're one of us."

Having grown up bucking wood and lifting hay bales, Ciardi was strong and capable. She conducted patrols on horseback and assisted local cattle ranchers with roundups. She fixed fences, removed victims of gang shootings and drownings, and battled wildfires until firefighters arrived. She chased trespassers at night, and confronted rifle-toting poachers with more outrage than fear. "I'd go, 'what is the matter with you?' And I'd take their guns," Ciardi says. "Why I didn't get shot I don't know."

Crystal Springs Reservoir, visible from Highway 280, is part of a complex system of dams, reservoirs, pipelines, and tunnels that funnel snowmelt collected in Hetch Hetchy Reservoir near Yosemite into San Francisco via a largely gravity-fed system. In the Bay region, the system's facilities and lands encompass 59,000 acres under the stewardship of the San Francisco Public Utilities Commission.Twenty watershed keepers patrol these landscapes to protect them from fire, trespassers, and other threats to the purity and safety of the water supply of 2.6 million customers around the Bay Area.

After eight years in the East Bay, Ciardi transferred to the Peninsula, eventually moving to the south Crystal Springs cottage where her grandfather lived before her. The Civil War–era house has rooms with original silk wallpaper and views of bald eagles soaring over the reservoir.

From this vantage point, Ciardi has experienced a lifetime of change. Where once she evicted trespassing anglers, she now keeps her eyes peeled for illegal marijuana growing operations. She has witnessed sudden oak death syndrome decimate the forest, an invasion of wild turkeys, the resurgence of mountain lions and a waning interest in nature among local children. "I used to catch kids out here with their gunnysacks looking for snakes or wanting to fish. They were really out here appreciating nature. Then the Internet came, and all the kids are now playing video games. It makes me sad."

She has also seen the duties of her job change to include less security and dam-tending and more serving as an ambassador of the watershed. It's a role in which Ciardi has excelled, says watershed manager Joe Naras. "Gayle can see the good in anybody. She can see how to reach them, particularly among people who might have other notions about the restrictions or the way our land is managed, and she can turn a bad situation into a good one."

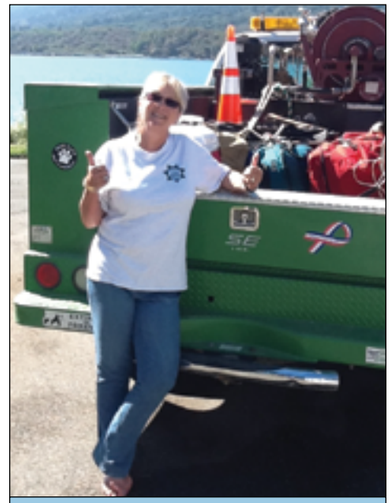
Jim Avant, Peninsula watershed keeper supervisor, recalls a perfect example of how Ciardi defused a potentially ugly standoff. "We chased a bunch of dirt bikers one day on the watershed — there were probably six keepers involved in trying to catch them. They kept running into one of us and turning around and going in another direction. Then they ran into Gayle, and she says, 'Gig's up, boys!' They're like, we give up. Here's somebody we can turn ourselves into. Gayle's combination of charm and authority saved the day."

Now, after 32 years as "the eyes and the ears of the watershed," Ciardi is retiring this February. Her departure spells the end of an era for those charged with keeping the water supply of the San Francisco Public Utilities Commission safe and clean.

"She's a good employee and a good friend. We'll definitely have a hard time filling her shoes," Naras says.

"To give up my truck keys will be horrible," Ciardi says, "but it's time." Luckily, her husband, SFPUC forester Guido Ciardi, who she met on the job, will continue to work on the landscape she loves so much. And although the couple will be moving off the watershed, they have no current plans to go farther than Half Moon Bay.

"I've put my heart and soul into this job, but it's time for the young ones to come in; the job has evolved. It was just a feeling it was time to go," Ciardi says. "I have been so blessed to work with all the people I've worked with—even those guys who made it so tough for me at the beginning. This has been the best job ever." KW



Ciardi sets off from Crystal Springs to help fight the Yosemite Rim Fire of 2013.

OUTSIDE THE BOX

TO BOLDLY GO WHERE NO MAGAZINE IS GOING ANYMORE... PAPER!

You are holding your first 2014 issue of *Estuary News* magazine. We hope you find it as readable and informative as ever. As you remember, we skipped the August issue to regroup and find new funding. Meanwhile the October issue was dedicated to summarizing 20 years of progress implementing the San Francisco Estuary Partnership's Comprehensive Conservation and Management Plan, and the December issue to summarizing the presentations at the 2013 State of the Estuary Conference (online issue only). Both issues provide an unprecedented digest of the state of our efforts to steward, protect, and restore San Francisco Bay and its watershed.

ENERGIZED...

We are delighted to have these major new partners and funders for the next two years, and thank them for their foresight and generosity:

Delta Stewardship Council, Regional Monitoring Program, San Francisco Estuary Institute, and the San Francisco Public Utilities Commission

We also appreciate those who helped last year with small grants, donations and subscriptions: Alameda County Fish & Game Commission, California Coastal Conservancy, ESA Associates, NOAA-NMFS, San Francisco Bay Conservation and Development Commission, and many of our readers like you.

A STILL WORTHY ENTERPRISE...

DONATION LINK: www.sfestuary.org/estuary-news/estuarynewsdonate/

NEXT GENERATION...

In 2014, we plan to publish four paper magazines with PDF versions, coming out in the months of March, June, September, and December. Meanwhile, we are striving to make the magazine more effective, reach a larger audience, collaborate with other Bay-Delta agencies and organizations, and intensify our links to web-based information. If you know of any entities that might give us grant funds to make these much-needed upgrades, or who would share their mailing lists with us, please contact the editor. We also welcome story ideas, photos, interns, and new board members. Engage!

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SAN FRANCISCO ESTUARY PARTNERSHIP
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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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Give to the Coast at Tax Time!

Check your California return for the last page option to make a voluntary contribution of $1 or more to the "Protect Our Coast and Oceans Fund." Money raised supports community and school activities around citizen science, shoreline cleanups, habitat restoration, beach access, and more. http://www.checkthecoast.org.

SIREN, *continued from page 3*

There are pick-up points around the Bay Area and they range from restaurants in San Francisco to private homes in Petaluma. There is even a pickup point in Davis.

It's the tasteable freshness of the fish that keeps subscribers loyal. "People say that we have ruined them on other fish," Larsen says, "There is a pretty big difference in the quality."

The night before delivery, subscribers get an email with details about where and how their fish was caught, complete with information about the boat and its captain. Also included in the email are recipes and preparation instructions particular to that catch. "But all of the background is really secondary to the fact that the fish is really good," Larsen says.

Since the trip from boat deck to dinner table is more direct, community supported fisheries are more efficient from a packaging and transportation standpoint. It's also a little easier to verify the sustainability of the fishing practices involved, "We bought one load of trawl-caught fish once, but I'll never do that again. Now we only buy hook and line, so there is not a lot of bycatch," Larsen says.

In 2013, Larsen says she purchased $130,000 worth of fish from local fishermen who work out of San Francisco, Bodega Bay and Fort Bragg. That is double the amount that the company purchased in 2012. She says Siren pays fishermen slightly higher than market rates. This season the demand has grown so much that Larsen is able to purchase entire hauls from fishermen, which works in both the buyer's and seller's favor. "We are looking to narrow the number of fishermen we work with and buy everything they catch," Larsen says.

Since 2011, when Siren Fish Company started taking on subscribers, other similar community supported fishery operations have opened in the Bay Area and down the central coast. "The word is spreading." Larsen says. "We have helped introduce a demand for local, sustainably caught fish." **DM**

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SMELT, *continued from page 3*

abundance, the biggest knob is the water knob." But ironically, during the driest years when the longfin smelt needs freshwater the most, it gets less. "When water's tight for everyone, we still take what we need," Rosenfield says. This is a double whammy for the smelt because low freshwater flows make it spawn further inland closer to the maws of the Delta pumps.

Plan B for the longfin smelt, proposed in the *Bay Delta Conservation Plan*, is to try one of the smaller knobs: restoring tidal marshes to boost the fish's food. Longfin smelt and the invasive Asian clam (*Potamocorbula amurensis*) compete for the same food, notably the copepod *Eurytemora affinis*, a tiny crustacean that lives on phytoplankton. "The hypothesis is that restoration could help the longfin smelt without increasing freshwater flow," Baxter says.

Will habitat restoration be enough to reverse the longfin smelt's long, steep decline? And if so, will it be in time? If history is any guide, the longfin smelt will need help fast if the drought persists. "There were back-to-back horrendous drought years in 1976 and '77," Baxter recalls. "The population really suffered." Cautions Rosenfield, "If we don't improve freshwater flow, we're fighting with both hands tied behind our back." **RM**

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