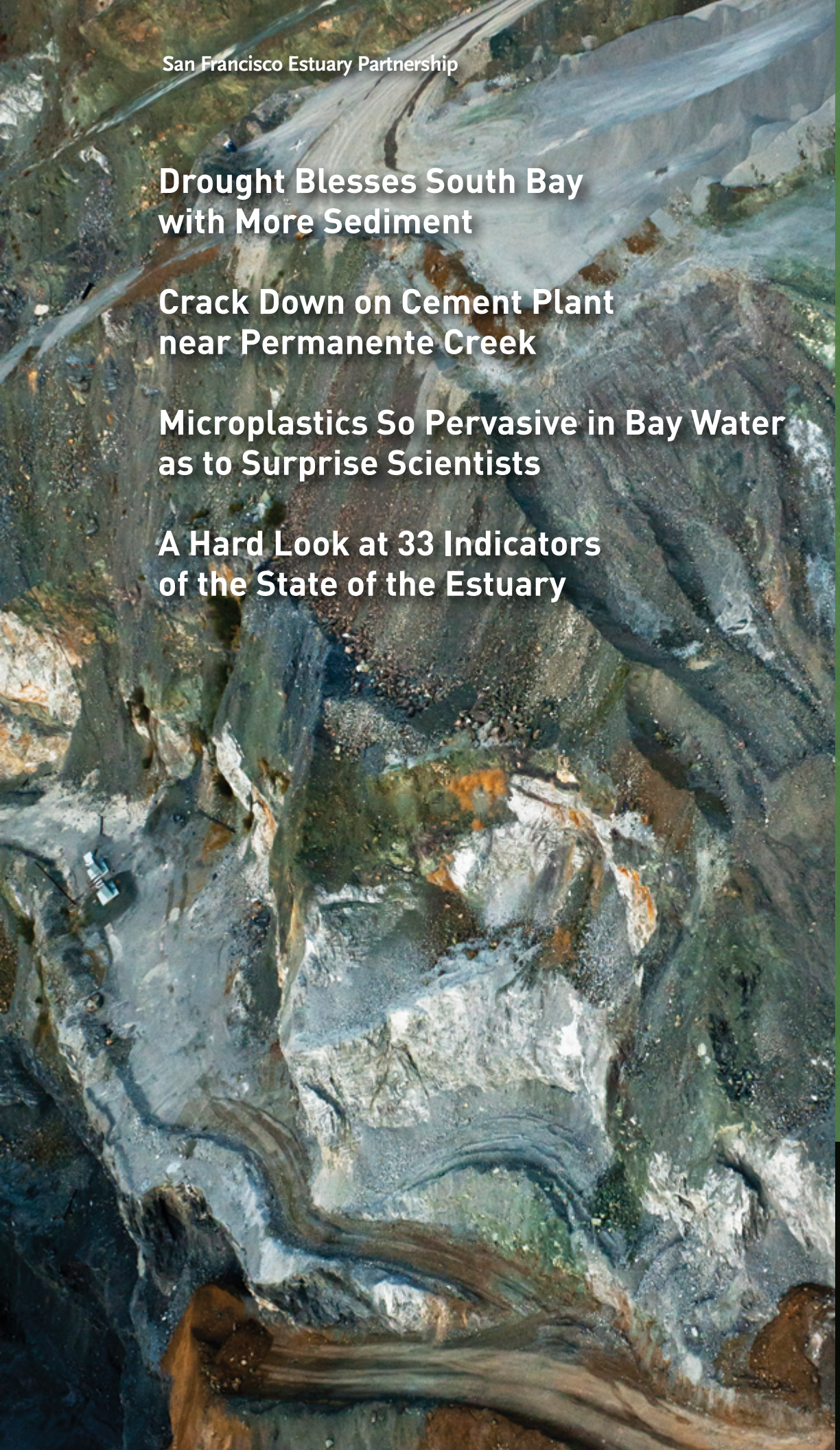

San Francisco Estuary Partnership

Drought Blesses South Bay with More Sediment

Crack Down on Cement Plant near Permanente Creek

Microplastics So Pervasive in Bay Water as to Surprise Scientists

A Hard Look at 33 Indicators of the State of the Estuary

ESTUARY NEWS

SCIENCE • RESTORATION • WATERSHED • POLITICS • SPECIES • BAY

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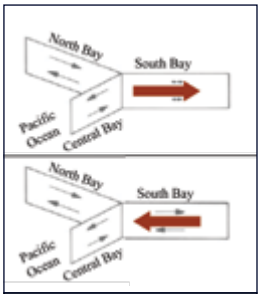
SCIENCE

No Drought of Dirt

With its massive environmental and economic costs, it's hard to see a bright side to the California drought. Consider mud, though. According to US Geological Survey scientist David Schoellhamer, the long dry spell may be giving tidal wetland restoration efforts an unexpected boost by promoting the buildup of sediment in the South Bay where former salt ponds await conversion to tidal marsh.

Since the Gold Rush, San Francisco Bay received sediment churned up by hydraulic mining in the Sacramento and San Joaquin watersheds. That pulse has now mostly spent itself. With the Bay's sediment supply limited, there's concern that tidal plains will be unable to build up fast enough to keep pace with rising sea levels. Restoration planning has turned to reuse of dredged sediment, and trucking dirt from upland construction sites, a costly process.

However, Schoellhamer's data shows a recent increase in suspended sediment in Bay waters near the Dumbarton Bridge. He and his colleagues have deployed underwater monitors that use optical sensing to measure sediment concentration, bouncing infrared light off suspended particles every 15 minutes. For water year 2013-14, their data show concentrations at the Dumbarton double those of the previous 10 years, with levels last seen in the 1990s. They've also found mud overlying shell fragments on the bottom of the Bay and accumulating in backwater sloughs bordering tidal marsh and salt ponds. Sediment concentrations in the rest of the Bay have not increased.



South Bay surface and bottom currents in dry spring 2009 (top) and wet spring 2011 bottom. Source: McCulloch, USGS

Normally, Schoellhamer explains, winds and waves push sediment toward the south end of the Bay. But in years of normal precipitation and snowpack, spring freshwater flows flush salt water out of the South Bay, taking sediment with it. "At the Dumbarton, we have observed sediment actually being pulled out of the South Bay during spring freshets," he says. With greatly reduced freshwater flows, that effect has been muted, resulting in more mud staying in the South Bay.

Schoellhamer says the net landward movement of sediment may increase the accretion of inorganic material on tidal marshes and former salt ponds. Other consequences include increased turbidity, which could limit the productivity of phytoplankton. He points out that USGS monitoring programs are detecting other drought-associated changes in the Bay, including record high temperatures and salinity.

Upstream reservoir management impacts freshwater flows and sediment loads, of course. "Reservoir operators trying to capture the snowmelt before the dry season reduce the spring freshet effect," Schoellhamer adds. "It shows how connected the whole system is, from the Sierra to the reservoirs to San Francisco Bay to the South Bay." **JE**

CONTACT: David Schoellhamer, dschoell@usgs.gov

THIS JUST IN

RAILS, MICE, TERNS RETURN — Although they had seen a single Ridgway's rail over a year ago at South Bay salt pond A21, restored to tidal marsh in 2006, biologists with the Don Edwards Refuge were excited to hear a rail's mating call this past July — a sign that a breeding pair has found the marsh. A few days later, they trapped their first salt marsh harvest mice on the site. Resource managers are thrilled that these delicate species have moved into the area less than 10 years after the pond was breached to let the tides in.

"We always anticipated the return of endangered species into these restored marshes. It's part of the reason we are undertaking this work," says John Bourgeois, director of a massive ecological experiment involving 65 former salt ponds around the Bay. "However, the speed at which the habitat and wildlife is recovering has been very surprising, even to those of us that do this for a living."

Meanwhile, Caspian terns have found and colonized man-made islands in Pond SF2 and Pond A16, lured in by "social attraction"— a sound system and decoys installed by refuge managers. Bourgeois acknowledges that the restored ponds are part of a larger regional effort. "With more wetland restoration projects happening each year, we are definitely on the path toward a healthier San Francisco Bay." **LOV**

CREEK SINKS — A new study by UC Cooperative Extension shows that stream restoration can help mitigate greenhouse gas emissions in the atmosphere. Researchers studied 42 streams across Marin, Napa, and Sonoma Counties, and took soil samples and plant measurements at three plots per site—of the active channel, the floodplain, and upper bank terrace. Restoration project sites ranged from 0 to 45 years post restoration; the mean project age was 15 years. Project length ranged from almost 14,000 feet to 38 feet, with a mean length of almost 3,000 feet.

Both soil and vegetation sequestered carbon. Floodplain vegetation captured the most carbon, followed by channel and upper bank vegetation. Carbon sequestration in the soil was highest in the upper banks and lowest in the channel. The researchers also found that the older the restoration project, the more carbon and nitrogen it stored. A representative 0.6-mile long, 45-year old stream revegetation project could capture enough carbon to offset the energy used by 1,478 homes or the emissions from 3,411 passenger cars in a year.

Marin's *Climate Action Plan* calls for reducing greenhouse gas emissions by an additional 84,160 tonnes CO2e. Just 3.23 miles of stream revegetation could accomplish the same thing, say the study's authors. **LOV**

See http://ucanr.edu/sites/Grown_in_Marin/files/224684.pdf

http://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=19443

INDUSTRY

The Most Under-Regulated Facility

When miners trudged up the northeast slope of Black Mountain in the Cupertino foothills in the late 1800s and began picking away at the rock to get at limestone deposits, they probably weren't thinking about water or air quality. And when Henry J. Kaiser took over the quarry in 1939, turning it into the largest producer of Portland cement in the U.S., the Clean Air Act and Clean Water Act were still several decades away. The Kaiser Permanente Cement Plant (named after nearby Permanente Creek) produced six million barrels of cement to build Shasta Dam, and countless roads, buildings, and bridges. Now known as Lehigh Southwest Cement Company, the quarry and plant still supplies 50% of the Bay Area's Portland cement, and recently earned some intense scrutiny from local regulators.

The local limestone contains mercury, which can pollute both air and water, as well as selenium, which can run off into streams and soil, bioaccumulate in the food web, and cause wildlife defects.

In 2008, a neighbor called the San Francisco Bay Regional Water Quality Control Board to complain about large discharges into Permanente Creek and changes in its flow.

"We discovered that they were discharging their quarry water into the creek in violation of their industrial stormwater permit," says the Water Board's Assistant Executive Officer Dyan Whyte. "I realized that it was one of the most under-regulated facilities we had in the region and that it was time to take a close look at how we regulate not only a quarry but also an enormous cement plant."

In 2010 the Water Board issued a notice of violation stating that the plant needed to cease and desist its discharges into the creek. Water Board investigations also discovered that the plant was discharging water used in industrial processes, says Whyte. In 2011, after Lehigh failed to comply, the Sierra Club sued the company in federal court to stop its illegal discharges and to make them remove thousands of cubic yards of mine wastes in Permanente Creek according to their attorney, Reed Zars.

Photo: Barbara Boissevain

While the Sierra Club lawsuit made its way through the courts, the Water Board began requiring Lehigh to submit information about water flow pathways on the site; report buried waste; and identify all discharge locations and all products used on the site, among other things.

Finally, with a trial looming in 2013, Lehigh agreed with the Sierra Club to a federal court order to construct a $5.2 million pollution treatment facility to stop its illegal discharges. It also agreed to apply to the Water Board for a comprehensive pollution permit and to restore Permanente Creek. As part of their settlement, Lehigh also agreed to post a $12 million bond to ensure that mine waste would be removed from the creek and a functioning, stable channel created that could support aquatic life.

In 2014 the Board put Lehigh under an individual permit (NPDES)

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WATCH DOG

Pier Implosion

With a bubble curtain and a bang, the largest pier holding up the eastern span of the old Bay Bridge crashed into the Bay on November 14. Nearly 600 charges set into the base of the concrete pier caused it to implode into its own hollow core.

Caltrans worked to minimize the blast's impacts on wildlife. The agency arrayed perforated pipes around the pier on the bay floor, and pumped air into them to create a bubble curtain. Engineers estimate the curtain reduced pressure waves from the blast by 80 percent.

The date was chosen with care as well; few salmon, longfin smelt, and other fish of special concern are in the Bay in November, birds tend to nest in other seasons. Just in case, Caltrans used an air cannon to scare avians away before the explosion.

Observers watched for injured or stranded marine mammals such as harbor porpoises and harbor seals for days afterward, but reported no related injuries. Test fish in enclosures as near as 150 feet from the blast also survived.

Prior to the blast, nonprofit watchdog Baykeeper worried that the plume of concrete dust discharged into the water would hurt wildlife. Caltrans responded by adding water quality measures to its environmental monitoring.

Demolishing the pier with explosives rather than by hand "is definitely driven by cost rather than environmental considerations," says Baykeeper staff scientist Ian Wren. "I have not seen results from the monitoring yet so I can't say whether or not the impacts are as minimal as they expected them to be."

Caltrans spokeswoman Leah Robinson-Leach says the monitoring analysis is expected in mid-December. If the implosion proves relatively harmless to Bay life, the agency will likely attempt to remove many of the remaining 21 piers of the old bridge using the same method, eliminating the need years of dismantling work while reducing costs. KW

POLLUTION

Unhealthy Fiber in Bay Diet

Millions of tiny pieces of plastic, each less than five millimeters wide, are flowing into San Francisco Bay each day. This minute debris — known as microplastic — is a growing environmental concern for water bodies worldwide as it evades filtration and mimics food consumed by wildlife.

Now, a recent study found that San Francisco Bay has a higher concentration of microplastic pollution than the handful of other major U.S. water bodies that have been studied, including the Great Lakes and Chesapeake Bay.

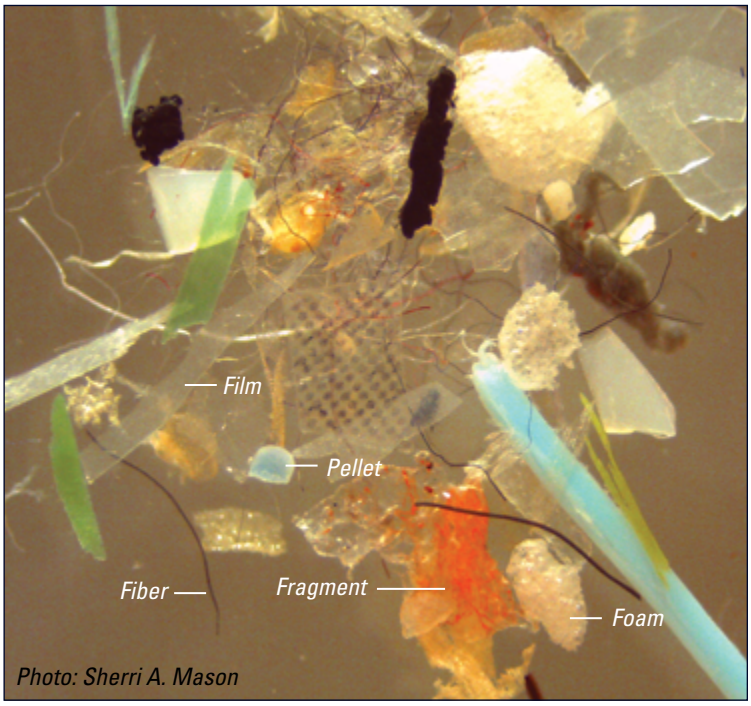


Photo: Sherri A. Mason

"The levels that we found surprised me," says Dr. Rebecca Sutton, a senior scientist with the San Francisco Estuary Institute, who headed up the study. "I did expect to find microplastics, but I didn't expect that our levels would be a lot higher than in other regions."

The reasons for this likely include high population density and the relative size of the Bay, Sutton said.

Microplastic pollution has myriad sources, from tiny beads added to beauty products to the breakdown of larger debris such as plastic bags or Styrofoam. A new California state law will ban the use of cosmetic microbeads starting in 2020, but for now they are still being used in a broad array of products including face wash, toothpaste, and nail polish.

The study tested water from nine sites in the Bay, discharge from eight different wastewater treatment plants, and the stomach contents of nine small fish. Microplastics were found in all samples.

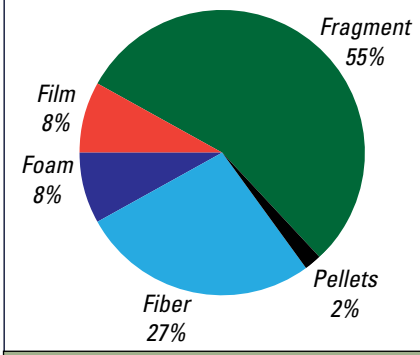
"We were shocked by the results," says Karin North, Watershed Protection Manager at City of Palo Alto, which operates one of the treatment plants sampled in the study. "We have one of the more sophisticated plants in the Bay Area and it's disheartening that we can't remove it."

But retrofitting treatment plants to provide microfiltration or reverse osmosis that would successfully remove microplastics from the waste stream would be prohibitively expensive.

"Upgrading the plants would cost taxpayers billions—multiple billions—of dollars," North says.

Fibers were the single most common type of microplastic found in the treatment plant discharge. These are often created by laundering synthetic fabrics such as polyester or acrylic, among other sources, North said. The tiny, fine hairs break off, get flushed into the treatment plant, and are so small that they slip straight through the filters and into the Bay.

MICROPLASTIC PARTICLES IN BAY SURFACE WATER



Source: SFEI

"We already had microbeads on the radar. But the fiber aspect is something new," North says. "They are so tiny that you can barely see them with the naked eye."

Microplastics of all sorts are worrying because wildlife and other creatures can mistake the tiny particles for food; one study found that corals were starving due to microplastics consumption.

Additionally, microplastics have been found to preferentially absorb toxic pollutants such as pesticides, dioxins, flame retardants, and PCBs, Sutton says. She added that it is also possible that some of those contaminants could move up the food chain.

"Because they float, they tend to collect other chemical pollutants in the water," says Andria Ventura with the nonprofit Clean Water Action. "Those molecules actually glom onto the plastic so they become little poison pills."

Ultimately, the only way to keep microplastics out of waterways is to stop them from entering the waste stream in the first place, North says. While some sources, such as microbeads, can be managed through legislation, it would remain up to consumers to avoid others—such as polar fleece, plastic bags, or take-out containers.

"This is not waste that can be broken down. If you can remove it at the source it's always better than if you try to clean it up at the treatment plant," says North. "It's like going back to being a tree hugger—wearing natural fibers and not using plastics. That really is the message." JC

CONTACT: Dr. Rebecca Sutton, rebeccas@sfei.org

FACT SHEET: sfei.org/microplasticfacts

PERSPECTIVE

Whole Healthy Estuary

Josh Collins, Chief Scientist
San Francisco Estuary Institute

More than twenty years ago I sat in my first meeting about restoring a healthy San Francisco Estuary. We agreed that we needed to first clearly define success as a comprehensive set of compatible health goals based on existing public policies. Then we agreed we needed to find ways to assess conditions relative to the goals, so we could periodically issue public reports on Estuary health.

Most people in that first meeting had the same ideas. They'd already written them into the first *Comprehensive Conservation and Management Plan* for the Estuary (CCMP), backed by EPA's National Estuary Program of the US Clean Water Act.

A year before the CCMP, EPA had published the first *State of the Estuary Report*. It highlighted the State's ecological and economic dependence on healthy physical and biological connections between the ocean, the Estuary, and its watersheds. The report concluded the Estuary had severe environmental problems that were getting worse. The problems justified the CCMP.

Solving the problems has been complicated by political and scientific fragmentation. We cut the problems into pieces along the boundary lines between environmental agencies or their policies. Long before the CCMP, the Estuary was divided into the Bay and the Delta based on the jurisdictions of different pollution control agencies. Both regions have been further fragmented by separate sets of environmental policies governing the ocean, the Estuary bottom and its waters, tidal marshes, rivers and streams, and the rest of watersheds. Each part of the system has a different group of dedicated scientists. There's no Estuary HMO.

The effects of this fragmentation are pervasive. The biggest problems have not been solved and new ones are emerging. Dredged sediment needed for marsh restoration continues to be dumped into the ocean. Runoff continues to degrade local streams. Native wildlife continues to dwindle toward extinction. Novel contaminants are showing up in tide waters. Rapid sea level rise and other aspects of climate change threaten to nullify some health goals.

The biggest plans to fix the problems have taken partial approaches. The *Baylands Ecosystem Habitat Goals* barely touch watersheds and don't extend into the Delta. Despite their names, the Bay-Delta Advisory Council, the Bay-Delta Program of CALFED, and the *Bay-Delta Conservation Plan* barely touched the Bay. There're multiple plans for some watersheds and none for others. The existing plans are poorly coordinated and mostly disconnected from the Estuary or the ocean. The essential component of any estuary is fresh water. Yet after decades of discussions we still lack a comprehensive management plan based on the fundamental fact that the Estuary and its watersheds comprise a single system for freshwater storage, delivery, and use by people and nature. The CCMP remains the only plan with legal standing that pertains to the Estuary as a whole.

Here's some good news. We're making real progress on Estuary health reports. Ten years after the original CCMP, The Bay Institute (TBI) pioneered an *Ecological Scorecard* to report many aspects of Bay health, including the effects of freshwater inflows from the Delta. Six years later, building on TBI's efforts, the San Francisco Estuary Partnership (SFEP) produced a *State of the Bay Report* based on practical health goals. Now, in 2015, SFEP is revising the CCMP to better incorporate the ocean, Bay, Delta, and watersheds. And, it has produced a bone fide *State of the Estuary Report*. As much as possible, the same health indicators are applied to the Delta as well as the Bay, while also focusing on regional health conditions. The new report supports a holistic approach to Estuary health care by providing measures of overall condition and the status of connections between the Estuary and the rest of the greater Golden Gate ecosystem. Now we're able to report on the health of the whole Estuary.

Lasting solutions to the Estuary's health problems will transcend the political and scientific fragmentation. They could require more collaboration than ever before. Perhaps additional political forces will be brought to bear,

continued to back page

Photo: Rick Lewis

W A T E R

Bay Up, Delta Down

Scientists assessing four indicators of ecological health in the Delta and upper Estuary for the *2015 State of the Estuary Report* found a common thread: continued decline. Dr. Christina Swanson of the Natural Resources Defense Council expanded her analysis from past scorecards and the 2011 *State of the Bay Report* to evaluate more of the estuarine interface between Delta and Bay. She examined data on freshwater flows, low salinity and open water habitat in the upper Estuary and Delta, ecological processes such as floods, and the abundance of fish in the upper Estuary over decades. Indicators confirm that the upper Estuary is in poor or very poor condition.

"What struck me compared to the last report and early scorecards is that the Delta is still getting worse but Bay indicators show improvement that reflects our actual, pro-active efforts on the ground to make things better," she says. "We've known the Delta was in disastrous shape for decades, but never did anything to fix it, in a real concrete, substantive science based way, only nibbled at edges. It's either been commitments to do things we don't do, or we do things that prove to be too small and not enough, or we do things for awhile and then stop doing them."

Swanson's four indicators of ecological health in the Estuary are among 33 metrics analyzed in this comprehensive report, ranging from the extent of eelgrass beds in the Bay to the number of egret chicks successfully reared (see insert). In the upper Estuary, several indicators suggest there is less and less food for fish and wildlife. Overall native fish abundance, for example, declined throughout most of the upper Estuary (see map). The quality and quantity of low salinity, open water habitat in the upper Estuary also declined. In the Delta, reverse flow conditions, in which pumping pulls fish toward water export facilities, have become more frequent and severe (see chart).

"Some of these continued declines are being driven by the fact that the last four years have been very dry," says Swanson. "But our existing water quality standards and other commitments to protect the ecosystem were put in place in response to the last drought. We looked at the condition of the ecosystem back then and said 'OMG,' let's never let this happen again. And now we have."

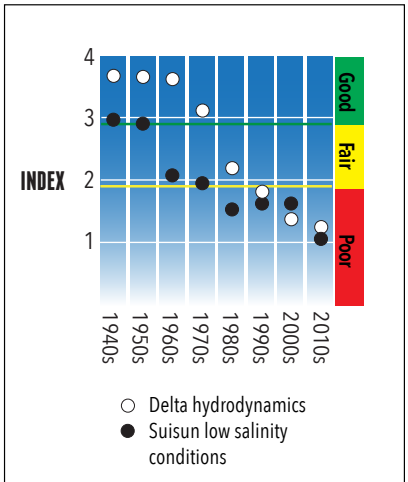
Swanson says part of the problem is that we've never made the hard choices necessary to manage a resource, water, for which there is so much competition. Fish, farms, cities, the ecosystem all need that water. "The way we stall is by calling for more science. We can't keep doing that, we have to take action," she says."

The co-equal goals for the Delta, calling for a balance of water supply and ecosystem health, are still only goals without those hard choices being made. Swanson suggests several steps in response to the findings from her suite of indicators in the *State of the Estuary Report*. First, apply the kind of sophisticated modeling and analysis used to support the ecosystem side of the co-equal goals to the water supply side. "The tool we need to build next is regional water budgets," she says, which would detail available supply and demand region by region around the state. "I want co-equal science for the co-equal goals," she says.

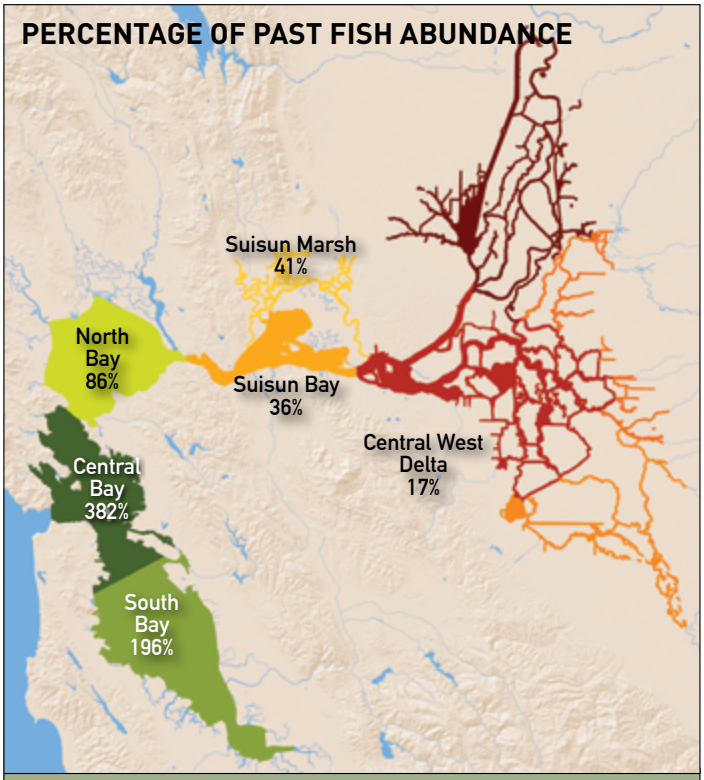
Swanson also thinks there's enough science on the ecosystem side to take real action.

Indeed that is the whole reason for the ongoing investment made by the San Francisco Estuary Partnership and its partners in analyzing the state of the Estuary. "This kind of report is a way to compile, synthesize and compress the science on the system into metrics that allow us to see what's going on and point us in the direction needed to fix it," says Swanson. "My hope is that in the report five years from now, we will be able to detect management changes put in place to restore and enhance the Delta ecosystem." **ARO**

SEE: State of the Estuary 2015, Technical Appendices: www.sfestuary.org/wp-content/uploads/2015/11/0_Comprehensive_TA_Document_SOTER_2015.pdf



Open water habitat in the upper Estuary. *This SOTER index of ecological health measures two things: Delta hydrodynamics and the occurrence of reverse flow conditions; and occurrence of low salinity conditions in Suisun Bay during the ecologically important late winter and spring. Source: State of the Estuary 2015*



Healthy ecosystems support abundant fish populations. Native fish populations have increased in the South and Central Bay but declined substantially in the upper Estuary. In Suisun Bay and the Delta, recent fish abundance levels are just a third of levels measured 30 years ago. This indicator measures the abundance of native fish for the most recent five-year period compared to average abundance from 20 or 30 years ago using data from four different survey programs. Source: State of the Estuary 2015

STATE OF THE ESTUARY 2015
33 Indicators of Health

The *State of the Estuary Report*, published by the San Francisco Estuary Partnership, is the most comprehensive health report ever completed for the Estuary. It uses the best available science and most recent data contributed by over 30 scientists to assess the status of various parts of the ecosystem. The mixed results of this assessment in different areas of the Estuary indicate that we are not doing enough to restore and maintain ecosystem health. A bolder approach will be needed to recover from past and ongoing impacts, especially since future impacts from climate change further jeopardize the ecosystem.

The Upper Estuary will require significant investment in restoring critical physical processes (notably freshwater inflows and floods) and habitats, as well as managing non-native species and preventing new arrivals. Protecting the Estuary will also require much greater efficiencies in human use of the system's fresh water, as well as changes in upstream water management and policy, to make the conserved water available to nourish the Estuary.

The Bay's wetlands are also at risk unless we take a new watershed-based, regional approach to managing sediment and fresh water as essential resources. We must also make room for tidal wetlands to migrate landward. Wildlife conservation efforts should aim to ensure successful reproduction and habitat connectivity over time as climate change alters landscapes. These management actions must all occur in the context of change in the ocean as well, requiring stronger planning for rising seas and more marine conditions in the Bay.

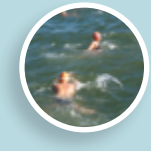
In short, the physical and biological processes that operate at the foundations of estuarine health are deeply damaged and must be fixed if we are to retain the Estuary's native plants and animals, wetlands (and their shoreline protection services), recreational opportunities, and clean water. This assessment of ecosystem health agrees with other regional science reports calling for stronger commitments to a healthier estuary.

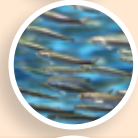
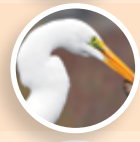
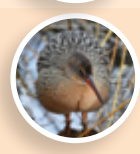
The 92-page *State of the Estuary Report* is available in PDF, print and online. Published in fall 2015, it offers a critical assessment tool along with the *The Pulse,* and with recent reports on how to restore to Bay wetlands, for those currently writing a new management plan for a more resilient Estuary (*CCMP*, early 2016).

LEGEND **STATUS** GOOD FAIR POOR **TREND:** IMPROVING NO CHANGE DETERIORATING MIXED

PEOPLE	BAY STATUS	BAY TREND	DELTA STATUS	DELTA TREND	AT-A-GLANCE
 URBAN WATER USE	FAIR				In the Bay Area, urban water conservation efforts have lowered water use while population has increased. Short-term water use reductions in response to the drought have exceeded State-mandated targets but they may be short-lived.
 RECYCLED WATER USE	FAIR				The Bay Area currently offsets 5% of its urban water demand with recycled water, but lags behind other urban centers in the state.
 TRAIL ACCESS	FAIR				In recent years, public access to Bay and Delta trail systems has steadily increased.

LEGEND **STATUS** GOOD FAIR POOR **TREND:** IMPROVING NO CHANGE DETERIORATING MIXED

WATER	BAY STATUS	BAY TREND	DELTA STATUS	DELTA TREND	AT-A-GLANCE
 SAFE FOR SWIMMING	GOOD				Conditions are excellent at most Estuary beaches most of the time. Conditions have been poor at 7% of beaches in summer, and 27% of beaches in wet weather at times during recent years.
 SAFE FOR AQUATIC LIFE	ESTUARY - WIDE FAIR				Estuary water quality is much better than 40 years ago, but the rate of improvement has slowed. Mercury, invasive species, pesticides, and trash are still problems. Improvement has been achieved for PBDEs and copper. Many potentially harmful chemicals have yet to be assessed.
 FISH SAFE TO EAT	ESTUARY - WIDE FAIR				Limited consumption of most popular Estuary fish species is advised due to contamination from two legacy pollutants (mercury and PCBs). Routine monitoring in place since 1994 has shown no declines in these contaminants.
 FRESHWATER INFLOW	ESTUARY - WIDE POOR				The amounts and variability of freshwater inflow to the Estuary have been substantially reduced, resulting in degradation of habitat conditions and ecological function in the Estuary.
HABITAT					
 OPEN WATER HABITAT	POOR		POOR		In Suisun Bay, good quaiity, low salinity habitat occurs too infrequently, and for too short a time, to support flow-dependent organisms and the estuarine food web. In Delta channel habitats, net downstream flow is too low to support native fish species.
 EELGRASS	POOR				The extent of eelgrass beds in the Estuary has increased, but is highly variable year to-year. The current total acreage is significantly less than the estimated maximum potential extent.
 TIDAL MARSH	FAIR		POOR		Delta marshes have been lost and fragmented to a much greater degree than Bay marshes, despite covering a greater area historically. Restoration efforts have made a significant impact on Bay habitats, but are only just getting underway in the Delta.

WILDLIFE	BAY STATUS	BAY TREND	DELTA STATUS	DELTA TREND	AT-A-GLANCE
 BENTHIC INVERTEBRATES			FAIR		The benthic community at the foundation of the food web still includes many native species, but there are now many non-native species present as well. In some places, most individual benthic organisms are non-native.
 FISH	GOOD		POOR		The fish community differs across the Estuary with increasingly poor conditions toward the upper Estuary. Native fish abundance in the brackish and fresh upper Estuary has declined markedly during the past three decades and is in poor condition.
 HARBOR SEALS	FAIR				Harbor seal numbers in the Bay are relatively stable, but have not increased in tandem with coastal populations.
 WINTER WATERFOWL	FAIR				Wintering dabbling duck populations are strongly increasing across all parts of San Francisco Bay. Wintering diving duck populations are strongly decreasing in Central and North Bays but remain stable in the South Bay.
 BREEDING WATERFOWL			FAIR		Populations of dabbling ducks that breed in the Estuary are mostly decreasing across Suisun Marsh and the Delta. Less common dabblers (non-Mallards) are increasing in the Delta.
 SHOREBIRDS	FAIR				The Estuary's population of large shorebirds is declining, especially in the South Bay. In the Central and North Bay, populations of medium and small shorebirds are stable or increasing, while in the South Bay they are on the decline.
 HERONS & EGRETS	FAIR				Heron and egret nest density is increasing over the long term. Nest success, in terms of fledged chicks, is relatively stable. Subregions reveal more complex patterns.
 TIDAL MARSH BIRDS	FAIR				Tidal marsh bird densities are increasing for two of three species. As restored marshes mature, they are supporting more resident marsh birds.
 RIDGWAY'S RAIL	POOR				In the North Bay, endangered Ridgway's rail populations have rebounded since a 2007-2009 decline. South Bay populations have stabilized at low levels after a similar decline, but not rebounded.

LEGEND **STATUS**: GOOD, FAIR, POOR — **TREND**: IMPROVING, NO CHANGE, DETERIORATING, MIXED

PROCESSES	BAY STATUS	BAY TREND	DELTA STATUS	DELTA TREND	AT-A-GLANCE
MIGRATION SPACE	ESTUARY - WIDE: POOR		NO DATA		Most land around the Estuary available for estuarine habitats to migrate landward, and accommodate higher sea levels, has been developed. Very little of the undeveloped portion is protected.
BENEFICIAL FLOODS	POOR	mixed	POOR	mixed	Flood flow events are now too infrequent, too small and too short in the Estuary to support important ecological processes. Dams, levees and water diversions have cut high volume inflows and beneficial inundation of the Yolo Bypass floodplain.
ZOOPLANKTON AS FOOD			FAIR	mixed	The abundance of zooplankton has decreased in Suisun Bay and the Delta since the 1980s invasion by the clam *Potamocorbula amurensis*, resulting in reduced food availability for fish. In recent years zooplankton populations have been stable.
FISH AS FOOD			FAIR	deteriorating	The abundance of fish varies across the Upper Estuary. In the historically productive marsh and open water zones, small forage fish are declining, but in the Delta beach zone, they are increasing.
CORMORANT CHICKS RAISED	GOOD	no change			The breeding success of Brandt's cormorants in recent years indicates that they are finding enough food in the open waters of the Estuary to feed their young, following a severe decline in success from 2009-2012.
HERON & EGRET CHICKS RAISED	FAIR	mixed			Heron and egret brood size is relatively stable across the Bay.

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Report Editor: Ariel Rubissow Okamoto
Design: Darren Campeau

PEOPLE

Water Portfolio Needs Recycling

There are a few obvious parallels — diversify, plan for future demand, control spending — between the way experts characterize the region's water supply and how personal finance gurus talk about building a bombproof portfolio. With money, the goal is saving for a rainy day; with Bay Area water, it's all about how to save for a prolonged string of dry ones.

According to water conservation and recycling indicators in the 2015 *State of the Estuary Report*, Bay Area residents and municipalities are getting better at conserving. Even against the backdrop of population increases, public education efforts and changing habits have resulted in a 40% per-capita decrease in the past 30 years.

The population of Bay Area will continue to grow, and despite the recent conservation gains (in the last two years region-wide urban water use has dropped by 20% in response to the drought), a search is underway to find other sources of water.

Currently, about 75% of the Bay Area's water supply is imported from watersheds outside the immediate Bay Area primarily from the Delta or from the Mokelumne and Toulumne rivers, which are tributaries of the San Joaquin. Small amounts are also imported from the Russian River and Tomales Bay. Another 10% of the region's water comes from local Bay-draining watersheds, such as the Napa River, and Alameda, Coyote, Los Gatos and San Mateo creeks. The remaining 15% comes from groundwater sources.

"We are so dependent on imported water that if there is a large earthquake or other major disaster, we are going to be in world of hurt," says Peter Vorster, a hydrogeographer with the Bay Institute who conducted the 2015 report analysis. "We are more dependent on imported water than anywhere else in the state."

Importing water might be less of a concern if the source were abundant. But, if last year's record low snowpack is any indication, there is a lot of uncertainty about the future climate.

"Many agencies in the Bay Area are looking at alternative water supplies because they want to be more independent from imported water," says Rhodora Biagtan, a principal engineer with the Dublin San Ramon Services District and a co-chair of the Bay Area Clean Water Agencies' Recycled Water Committee. "There are a lot of communities in the Bay Area where having a local supply would be more sustainable."

One of the most obvious places to increase the homegrown water supply is to recycle the water that is already in the system. But, again according to the 2015 State of the Estuary Report, local water recycling efforts have not kept pace with the larger conservation trends.

Prior to this year's dramatic reductions in use the Bay Area used about 1-million-acre-feet of water a year, with almost half of that amount used for irrigation of urban landscapes and agricultural crops. Current recycling efforts, which include everything from recovering water from wastewater effluent for on-site reuse to gray water and rain catchment amount to less than five percent of the region's total demand.

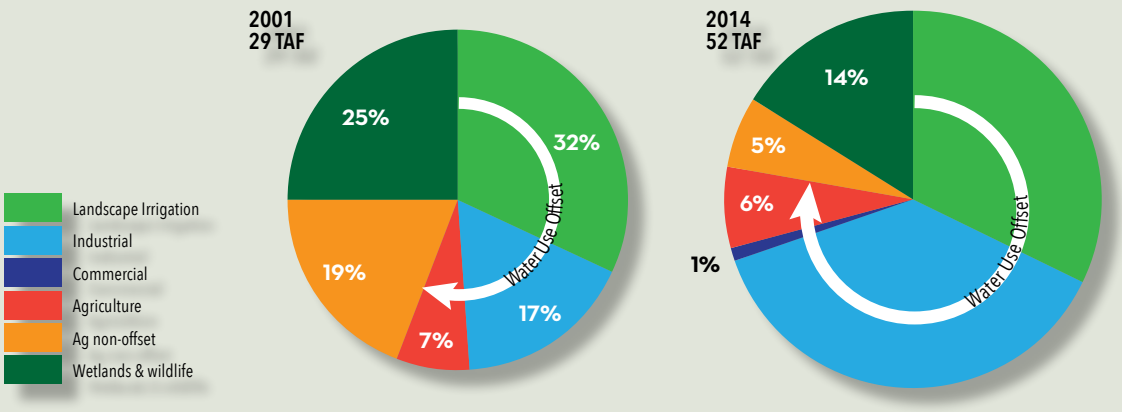
"There are a number of reasons why water recycling is not a bigger part of the picture. There is still the yuck factor. Some people think recycled water is wastewater — it's not. That's one challenge," Biagtan says. "There are a whole bunch of others, including funding and regulations that are still evolving."

In the meantime, water districts are exploring with the best way to use and distribute recycled water, without having to build parallel infrastructure to transport the water separately from untreated wastewater, or treated drinking water.

Bigger projects are already underway, such as a partnership of ten municipal, sanitation, and water agencies, working under the umbrella of the North Bay Water Reuse Authority, to find local solutions to offset potable water demand. Another model is the Silicon Valley Advanced Water Purification Center, which opened last year. The center cleans wastewater with a number of technologies, producing water so clean it can be used to recharge groundwater basins (indirect potable use), or put into reservoirs or the drinking water distribution system (direct potable use).

"We have alternatives, we just need public acceptance, funding, and regulatory approval," Biagtan says. "The drought opened up doors for us, people are realizing the value of water, the public is starting to accept the idea of using recycled water as part of the drinking water supply." **DM**

RECYCLED WATER USE BY CATEGORY
SAN FRANCISCO BAY AREA IN THOUSAND ACRE FEET (TAF)



Source: State of the Estuary 2015

HABITAT

Marsh Metrics Tell Two Stories

Adding indicators of environmental quality for the Sacramento-San Joaquin Delta to those for San Francisco Bay, the new edition of the *State of the Estuary Report* allows instructive comparisons between the Estuary's two components. Consider the report's treatment of tidal wetland loss and restoration. In both regions, much of this vital habitat was drained for agriculture, converted to salt ponds, or filled for urban expansion. For San Francisco Bay, though, restoration of tidal wetlands has become a shared mission. This year, the combined extent of historic and restored wetland hit the halfway point of the 100,000-acre target set 16 years ago by the *Baylands Ecosystem Habitat Goals* project, with more in the pipeline. The Delta, however, has much farther to go to meet even modest restoration goals. The Bay is also in better shape than the Delta in terms of the size of tidal wetland patches. In the Bay, the area comprising patches greater than 500 acres is 88 percent of the historical proportion; the Delta equivalent is only 30 percent. How did this happen, and how can the Delta catch up?

At the beginning of the 19th century, the Bay, including Suisun Bay, had about 190,200 acres of tidal wetland: 55,000 in the North Bay, 14,000 in the Central Bay, 56,000 in the South Bay, 65,000 in Suisun. The Delta had 365,000 acres. Major losses ensued, but by 2009, the year of the previous report, restoration had brought the Bay back to 45,000 acres. Another 6,346 acres were opened to the tides between 2009 and 2015, part of which is expected to evolve into tidal marsh. With the Cullinan Ranch restoration earlier this year, the Bay reached 50 percent of the Baylands Goals objective. Land, permits, and funding have been secured for an additional 14,000-24,000 acres of future tidal wetland for projects over the next 20 to 30 years.

The Delta's tidal wetland, though, covered only 8,000 acres as of 2002, with 259 acres added since then. The state's Cal EcoRestore program would provide another 9,000 acres. But the resulting 17,000 acres would still be far short of a fifty-percent reference value comparable to the Bayland Goals target.

Photo: Rick Lewis

While wetland extent is a self-evident metric of habitat value, patch size requires some context. Sam Safran of the San Francisco Estuary Institute, who assessed the wetland indicators for the report, explains that the report's 500-acre benchmark reflects the requirements of the endangered Ridgway's rail, a San Francisco Bay endemic. "Research suggests their population density increases with marsh area up to approximately 200 hectares, equal to about 500 acres, at which point rail densities in terms of birds per acre plateau," he says. The rail serves as an umbrella species for other tidal marsh organisms, including the California black rail, an inhabitant of both Bay and Delta; song sparrows and common yellowthroats in the Bay; giant garter snakes, tricolored blackbirds, and several rare plant species in the Delta.

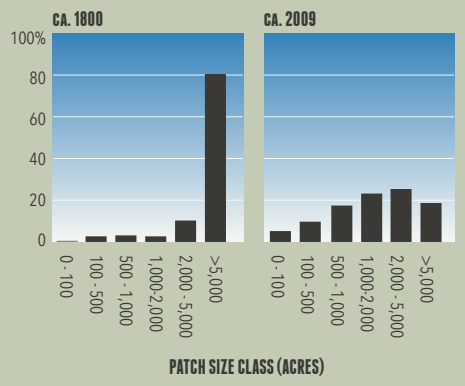
The contrast between Bay and Delta extent and patch size scores reflects a confluence of historic and environmental factors. Wetland restoration has had a Bay Area constituency and institutional infrastructure for decades; the Delta equivalent only began to coalesce after the 2009 Delta Reform Act. In addition, extensive areas of the Baylands were either publicly owned or held by single large landowners when restoration began. "The Delta has lots of smaller parcels and individual landowners, making large-scale restoration a little more challenging," Safran adds. As previously reported here ("Offers They Can Refuse," *Estuary News*, December 2014), some Delta landowners have been unwilling to accept what the quirks of land valuation allow government agencies can pay for restorable land. The oxidation of Delta peat soils, leaving vast areas below sea level, is another complication: "You don't have the big continuous swaths of land in the center of the Delta at an elevation that could support restoration right now," he says. Even so, at least 70,000 acres of diked lands in the Delta are high enough to support tidal marsh vegetation without adding sediment. Under the aegis of the Delta Conservancy, a start has been made on planning and goal-setting for bringing back those lost marshes.

Not that Bay restoration advocates can rest on their laurels. With rising sea levels, increasingly frequent extreme weather events, and a diminished supply of sediment to nourish the marshlands, they'll have to run hard just to stay in the same place, like Lewis Carroll's Red Queen. That's where the *Baylands Ecosystem Habitat Goals Science Update*, released in October, comes in. While the *State of the Estuary Report* shows where we are and how far we've come, the Goals Update, with detailed scenarios and strategies for a range of possible conditions, offers guidance for maintaining resilient wetlands into an uncertain future. **JE**

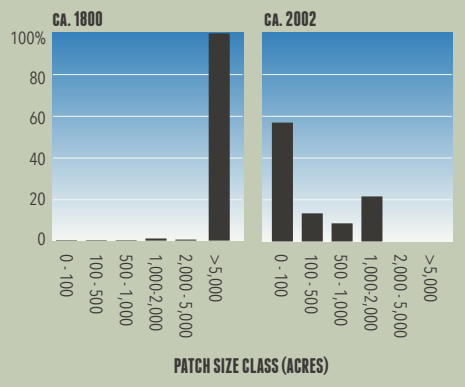
CONTACT: Sam Safran, sams@sfei.org

BAYLANDS GOALS 2015 UPDATE:
baylandsgoals.org/science-update-2015

BAY TIDAL MARSH
PERCENT OF TOTAL AREA BY PATCH SIZE



DELTA TIDAL MARSH
PERCENT OF TOTAL AREA BY PATCH SIZE



Source: State of the Estuary 2015

WILDLIFE

Geese Compete for Crane Grain

Along with the tricolored blackbird and the California black rail, the 2015 *State of the Estuary Report* spotlights the sandhill crane as a potential indicator of the health of Delta wetlands. Since many sandhills roost or forage in farmland, the report notes that their status relates to agricultural practices. Staten Island, managed by the nonprofit Conservation Farms and Ranches for The Nature Conservancy, has become a model of crane-friendly farming, with corn, triticale (a wheat-rye hybrid), alfalfa, and irrigated pasture providing winter forage for the iconic birds. It's a key site for the greater sandhill, state-listed as threatened, and also hosts lesser sandhills, a California species of special concern; its seasonal crane population is one of the best-documented. Ironically, another bird that came off the federal endangered list 11 years ago may now be competing with the cranes for food. The Aleutian cackling goose — "Aleutian goose" for short — once faced extinction. Protective measures helped it rebound, and its burgeoning numbers now pose a challenge for Staten Island's managers.

The Aleutian goose, a mallard-size version of the widespread Canada goose with a higher-pitched voice, evolved on remote, predator-free Alaskan islands. Predation by foxes introduced as a source of marketable fur pushed the geese into a population crash. In the 1940s, with the subspecies near extinction, the US Fish and Wildlife Service began removing the foxes. The goose was federally listed as endangered in 1967, and FWS launched a recovery program in 1975, releasing captive-bred and wild-caught geese into newly fox-free habitat. As numbers built up, migrants returned to California, concentrating in the San Joaquin Valley. Downlisted to threatened in 1990, the Aleutian goose was declared recovered in 2001: an inspiring conservation success story. Around that time, Aleutians began to winter in the Delta, at some point discovering the grainfields of Staten Island.

Now, says conservation program manager Laura Shaskey, tens of thousands descend on Staten every winter. "They've really rebounded — almost too much," she says. Last year's peak count was 30,000, in November. "Aleutian geese tend to prefer foraging in irrigated pasture, in cornfields when waste grain is abundant in the fall, in triticale that has recently been planted, and in alfalfa during some winter periods," she notes. Both greater and lesser sandhill cranes also feed on the waste corn, triticale, and pasture, and lesser sandhills preferentially forage in alfalfa. The drought, forcing some Delta farmers to leave nearby fields fallow or plant alternate crops, may have made Staten more attractive to the geese.

"The large populations of foraging geese are of concern, as they may compete with cranes for food resources," Shaskey explains. Studies of waste grain availability and depletion are under way, but she says it's too soon for definitive answers. In Del Norte County, where the geese stop over on their northward migration, landowners have hazed the flocks to scare them out of croplands. This wouldn't be feasible at the Staten Island refuge, forcing managers to use other options, such as changing farming practices, to cope with the ironic consequences of the Aleutian miracle. **JE**

CONTACT: Laura Shaskey, laura@cfrstaten.com

Aleutian cackling geese. Photo: Sean Wirth

PROCESSES

Blob Lingers Offshore

The waters off California have been aboil with oceanographic anomalies. For more than two years, a peculiar mass of warm water has been lurking offshore between Baja and Alaska. Add to this the upwelling of ultra-low-oxygen waters near shore, and ocean inputs to the Bay have been unusual indeed, according to a recent analysis in the *State of the Estuary Report 2015*.

Up to 2 °C above normal, the mass of ocean water dubbed "the blob" is entirely new to science. "Surely it has happened before but we don't have data on past events," says UC Davis oceanographer John Largier, who says it appears to be related to conditions causing drought. The ridge of atmospheric high pressure that warded off strong arctic storms over the past three winters also caused air temperatures over the ocean to stay relatively warm. Such balmy conditions limited the amount of heat the ocean could lose during those winters.

Whatever its origins, the blob has brought mayhem to California's coastal food webs. Southern California species like pelagic red crabs have been seen far north of their normal swimming spots. They took the places of colder-water fishes that fled further north. The absence of these typical menu items last winter left seals and sea lions on the Farallones hungry.

The blob continues full force this year, returning to coastal waters again in July where it has likely contributed to the closure of the Dungeness crab fishery. The domoic acid toxins ingested by the crabs are produced by algal blooms. These thrive in the extra sunshine and warmer waters between upwelling events in summer. Thanks to the blob, these summer conditions have persisted into fall.

Yet northerly winds still upwelled cold water to the coast on schedule this spring and early summer. In keeping with the trend of oddities, this nutrient-rich water from the depths was unusually low in oxygen.

"We have always had upwelled water, but it's getting more acidic and has even less oxygen than in the past. This seems to have been building for the last few decades," Largier says. "The chemistry of the source water deep in the ocean is changing. This is because greenhouse gas levels have been increasing for decades now, but the upwelled waters could also be coming from deeper down."

Are these ocean anomalies getting through the Golden Gate? Presumably, but scientists haven't yet been able to measure the direct contributions of the blob and anoxic upwelled water on San Francisco Bay conditions. "The temperature of the Bay is due as much to local water inputs and weather as the ocean," says Largier. Low oxygen in the Bay is also an indicator of pollution from farms and cities, making it important to to determine whether the source can be locally managed or is another symptom of global climate change.

Complicating matters further is the powerful El Niño now brewing in the eastern tropical Pacific. Between all these factors, "it's hard to know what will happen this winter," says Largier. "Stay tuned." **KW**

The Marine Mammal Center

Fish Still Favor Bypass

The Yolo Bypass is far more than a flood control channel. Though *2015 State of the Estuary* report metrics indicate that the frequency, magnitude and duration of flooding in the Bypass have been too low to support critical ecological processes in the last five years, two recent Interagency Ecological Program studies in the latest *IEP Newsletter* reinforce its value as fish habitat.

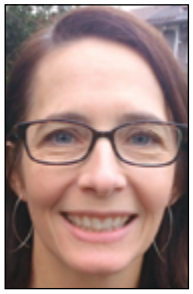
Analyzing survey data since 1998, Brian Mahardja, Naoaki Ikemiyagi, and Brian Schreier of the California Department of Water Resources report that the endangered delta smelt is doing unexpectedly well there. Smelt numbers at several Bypass sampling sites have increased over time, counter to trends in the rest of the Estuary during and after the Pelagic Organism Decline, and remained high even during recent drought years. In addition, both juvenile and adult smelt collected in the Bypass are larger than their counterparts elsewhere. These findings add weight to previous suggestions that the tiny fish are shifting from their usual migratory cycle to permanent residency in freshwater. Since temperatures and other environmental parameters at the Bypass sites haven't changed, exactly what is attracting the smelt and favoring their growth remains unclear.

Delta smelt aren't the only species thriving in the Yolo Bypass during the drought. Earlier work there focused on juvenile Chinook salmon and Sacramento splittail. In a follow-up salmon study in the current *IEP Newsletter*, Schreier and three other DWR scientists — Pascale Goertler, Jared Frantzich, and Ted Sommer — describe surprisingly high counts for juvenile Chinook during the last three dry years. Last year, in fact, their numbers were comparable to totals in 2011, the most recent high-flow year. Although the drought reduced the available rearing habitat in the Bypass and raised water temperatures, densities of the aquatic invertebrates the young salmon feed on remained high. The authors suggest that "the exceptionally productive habitat in the Yolo Bypass may have provided juvenile salmon enough prey to endure the warmer temperatures." That productivity may be linked to the Bypass's natural riparian vegetation and connections to tidal wetlands. **JE**

CONTACT: Brian Schreier, brian.schreier@water.ca.gov

INSIDE

New Leadership



This winter long-time San Francisco Estuary Partnership director Judy Kelly moved on to a new position as executive director of the North Bay Watershed Association. Taking over at the Partnership's helm will be Caitlin Sweeney, who brings over 15 years of experience working on planning and policy issues related to the San Francisco Estuary.

Sweeney joined the Partnership as a Senior Environmental Planner four years ago, where she developed the Watershed Program. She has also overseen various multi-partner collaborative projects on watershed management, wetland restoration, flood protection, and climate change adaptation. Sweeney has also been leading the revision of the *Comprehensive Conservation and Management Plan*, the Partnership's collaborative master plan for the Estuary.

"I will miss Judy's leadership but know we are in great hands with Caitlin. Though they have different styles and strengths, both of these phenomenal women made or will make amazing positive changes for the Estuary."

Amy Hutzel
California Coastal Conservancy

Prior to coming to the Partnership, Sweeney spent 12 years at the San Francisco Bay Conservation and Development Commission, as a planner and ultimately as Chief Deputy Director. During her tenure, she developed enforceable policies on natural resources and sustainable development, including on wetland mitigation, public access, and use of salt ponds. Sweeney has a B.A. in Biological and Environmental Studies from Mills College and a Masters of Marine Affairs from the University of Washington. She resides in Oakland with her husband and daughter.

In the meantime, Kelly says she is looking forward to her new job supporting the board of an Association created to promote stewardship of the North Bay watershed. Member agencies discuss water issues of common interest, explore ways to collaborate on regional water projects, and share information about projects, regulations, and technical issues.

CCMP CORNER

This past November marked the end of the public comment period on the Partnership's draft revision and update of the *Comprehensive Conservation and Management Plan.* "We want to thank everyone who took the time to submit comments," says Partnership director Caitlin Sweeney.

Ongoing work on the revision involves refining CCMPs actions based on comments, and identifying lead entities for all actions, as well as implementing partners. "It's critical to establish 'owners' for each action," says Sweeney, referring to those entities that will have primary responsibility for implementing, or in some cases tracking, progress on actions.

Sweeney has also launched an effort to develop metrics for measuring success of the actions, both in terms of implementation progress and effectiveness in increasing the health of the Estuary. This also involves establishing the linkages between actions and the indicators in the *State of the Estuary Report* where possible. "We want to better understand the results of management actions on specific species and whether we are meeting these and other ecological benchmarks," says Sweeney.

Next steps include development of a new online public interface for reporting CCMP progress, crafting a more detailed implementation schedule, and analyzing how each of the first group of priority actions will be funded.

CCMP:
www.sfestuary.org/ccmprevision/

San Francisco Estuary Partnership
1515 Clay Street, Suite 1400
Oakland, CA 94612

www.sfestuary.org

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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EDITOR Ariel Okamoto

CONTRIBUTING WRITERS
Jacoba Charles
Joe Eaton
Daniel McGlynn
Lisa Owens Viani
Kathleen M. Wong

DESIGN Darren Campeau

COVER PHOTO *Cement quarry*
Barbara Boissevain

CEMENT QUARRY

continued from page 3

and required it to consolidate all of its discharge points into a few for ease of monitoring. In 2015 the U.S. EPA settled a penalty action against Lehigh that resulted in a court order requiring Lehigh to pay $2.5 million in civil penalties. Whyte says Lehigh has installed a pilot treatment system that appears to be removing 93% of the selenium. Lehigh is required to have the treatment plant running at full scale by 2017. The Water Board is also requiring a groundwater investigation, and the plant is still operating under an investigative enforcement order.

Lehigh quarry and Permanente Creek in forested canyon. Photo: Jitze Couperus

Environmentalists and neighbors living near the 3,500-acre plant are not completely satisfied with the settlements and penalties. Kit Gordon, with Permanente Re-Imagined (aka the Permanente Creek Alliance) says the pollution and violations have gone on too long; she asks "Why aren't they just following the rules?" She says the quarry pit has also caused flooding in the area, releasing untreated water during heavy rains. Tired of air pollution, noise, and a layer of dust everywhere from plant emissions, neighbors want the plant gone. But it seems unlikely that will happen. County supervisors say Lehigh has a "vested right" to operate the quarry on the site.

The President of Lehigh Hanson's western region says they are making every effort to comply with the laws: "The water treatment system at the Permanente facility is performing to our expectations to reduce waterborne selenium and other constituents. The cement plant continues to be in compliance with its water management permits. We remain committed to minimizing our environmental footprint at the Permanente facility and throughout the company."

Gordon says a lot has changed since the quarry opened, specifically the number of people living near the quarry and scientific understanding of health impacts from mercury, selenium, and other contaminants. Says Gordon, "Mining at this site releases toxins into the air and water. Would a new facility like this be permitted to operate today? Probably not." LOV

CONTACT:
dyan.whyte@waterboards.ca.gov
reedzars@gmail.com
kitgordona@gmail.com
jeff.sieg@hanson.biz

WHOLE HEALTHY ESTUARY

continued from page 5

with assurances of faster progress. Given the state's economic dependence on a healthy Estuary, and given its critically poor health condition, major businesses heavily invested in the State might contribute their capacities. I wouldn't be surprised. Large infusions of private monies to restore a healthy Estuary can accelerate treatments, but they cannot supplant the need for public oversight based on independent accounts of health conditions. After all, the Estuary belongs to everyone, and everyone deserves to know how the Estuary is doing. Comprehensive, independent, expert monitoring and reporting is a hallmark of accountable health care, for ecosystems as well as people.

More than twenty years ago we began to recruit talented people to help take care of the Estuary. We track conditions, report findings, adapt to changing circumstances. I hoped we wouldn't spend our careers monitoring the ruination of the Estuary. I still have hope.