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Mud Shortage Eroding California's Climate Defenses

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By John Upton

OAKLAND, Calif. — As the birdwatchers of Arrowhead Marsh strain through binoculars for glimpses of California clapper rails, they could easily miss the warning signs of an obscure threat to the species' survival.

Grassy banks at the heart of the marsh are sloughing at the edges. With a spike in sea levels looming, chunks of mud are already dissolving into the tidal waterway, shrinking one of the few remaining homes of a species that once nested throughout the marshes that ringed San Francisco Bay's sweeping watershed.

As agencies and nonprofits toil to restore and conserve San Francisco Bay Area marshlands, aiming to defend against rising seas and nurture wildlife, and as voters consider introducing a property tax to support the effort, a bewildering crisis has emerged.

There's not enough mud.

Arrowhead Marsh.
Credit: Ingrid Taylar/Flickr

Marshes capture mud from water to grow and sustain themselves. A worsening shortage of mud floating in San Francisco Bay and its waterways is contributing to erosion. It's threatening plans to block flooding from sea level rise through the restoration of wetlands in the Bay Area, where homes and office buildings are packed into low-lying areas.

Rising Threat to U.S. Coasts

This is the first story in a year-long series by John Upton that will investigate threats from rising seas to American shorelines, and how coastal communities are responding to them.

A state-led science review concluded in October that the effects of climate change mean the marsh restoration plans are more urgent than previously realized.

"The bay is clearing," said Jeremy Lowe, a coastal scientist at the nonprofit San Francisco Estuary Institute. "It's happening at a time when we're thinking we're also going to get accelerated sea level rise."

Seas rose more than 5 inches during the 20th century, pushed upward by global warming, which melts glaciers and ice sheets and expands ocean water. They may rise several more feet this century, triggering existential crises for some low-lying islands and coastal communities.

The sediment shortfall has reached California's vulnerable marshes with suddenness. It doesn't just threaten wildlife. It also leaves homes, roads and coastal power plants vulnerable to inundation.

"The California clapper rail is probably the most endangered bird in San Francisco Bay," said Steve Bobzien, a wildlife ecologist with the parks district that oversees the marsh, which is wedged in an industrial pocket of Oakland between the city's airport and its sports arenas.

Fewer than several thousand of the plump brown birds, which possess the cartoonishly long legs and toes common among wetland dwellers, are thought to survive. "We'll have less potential nesting substrate for the rails in the future if that marsh continues to erode," Bobzien said.

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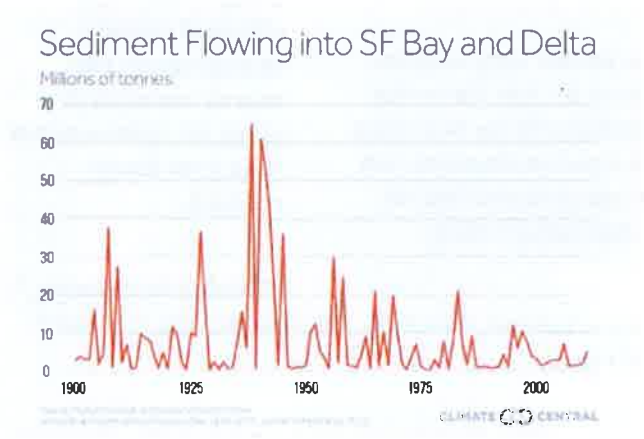
The flow of mud that the clappers rely on has played an important role in California's history. Industrial gold mining of the 1860s in the Sierra Nevada dislodged entire riverbanks upstream of the bay. The pulse of mud that was shaken loose is thought to have snaked its way to San Francisco, until it was exhausted during the past decade or two.

Mud levels increased in San Francisco Bay from the 1850s until the 1950s as sediment flowed into it slowly from the after-effects of gold mining, from eroding riverbanks upstream and from floods, which wash soil from plains into rivers, research has shown. Since the 1950s, the flow of mud has been drying up, and overall the bay's banks have been eroding faster than they have been growing.

Dams, levees and stormwater channels throughout California — and around the world — inadvertently trap sediment or divert it from the floodplains, marshes and shorelines where it's needed.

The problem is most severe in Louisiana, where levees and dams prevent Mississippi River mud from replenishing coastlines. That's driving spectacular losses of coastal land — an estimated 16 square miles a year is being lost. The federal government recently agreed to spend $48 million to relocate a tribe whose land has all but vanished.

Along with sea level rise, sediment shortages and wetland losses have become a global problem. Governments around the world are beginning to turn to marshland restoration projects for protection from the rising seas.



By producing and capturing mud, marshes can grow vertically as seas rise. That gives them a "fierce ability to fight back against sea level rise," said Matthew Kirwan, a coastal ecologist at the Virginia Institute of Marine Science.

The San Francisco Bay Area is embracing the restoration of marshes as a defense against looming flooding.

Bay Area agencies in 1999 published a vision of restoring 100,000 acres of tidal marsh. The region contained an estimated 200,000 acres of marshes in 1800 — a figure that had declined to 30,000 acres by the 1960s as wetlands were torn out, drained or paved over, figures provided by the state show. That left new coastal neighborhoods vulnerable to worsening floods wrought by climate change.

Since 1999, 42,000 acres of marsh has been restored or is being restored, state figures show. Costs from land purchases and restoration work can be staggering. Restoration of marshes at desolate red ponds previously used for salt harvesting in the South Bay alone is expected to end up costing $1 billion over 50 years.

Voters in the nine Bay Area counties in June will consider imposing a new annual property tax of $12 per parcel to reduce water pollution and help fund an acceleration of marsh restorations. Some of the funds could be spent addressing the sediment shortfall. The tax would raise about $25 million a year — "a fraction of what is needed," a Contra Costa Times editorial noted last week.

The newspaper said the sum would be "a good seed-money fund" to help attract further contributions from governments and from private industry. As potential private funders, it singled out successful tech companies that built their Silicon Valley headquarters in areas that "face substantial threats and stand to benefit greatly from wetlands restoration."

A state agency decided in January to put the measure on the ballot, following publication in October of a 266-page report on climate change's impacts on San Francisco Bay. The science report concluded that progress toward restoring the 100,000 acres of wetlands "must be accelerated." It recommended restoration work be well underway in key areas by 2030.

The region's surviving marshes have generally been to able grow quickly enough so far to keep up with rising seas. But this "history of keeping pace with sea level rise" occurred during a "period of relatively low rates of sea level rise as well as high sediment supply," the report said. "This period may have ended."

Even if humanity quickly stopped burning fossil fuels, the long-lasting effects of carbon dioxide pollution mean sea level rise in the 21st century is projected to easily outpace that of the 20th century. Sea level rise this century may be a little less than a foot, or more than 4 feet, depending on energy policies and luck.

Sea level rise is worsening flood hazards against which restored marshes could protect, threatening neighborhoods and critical infrastructure. Higher temperatures, increasing water saltiness and new weeds will worsen dangers for Bay Area wildlife and migratory birds, which rely on marshes for habitat and food.

San Francisco Bay.
Credit: TJ Gehling/Flickr

"Baylands restoration is not a luxury but an urgent necessity," the report said. It described the present time as a "pivotal moment" for the future of shoreline wildlands, "after nearly two centuries of habitat loss and degradation." If "we don't act," it said, the bay will "fundamentally change, with hardened edges and little vegetation."

The analysis warned that without enough sediment, most of the Bay Area's marshes will be damaged or destroyed.

"Sediment supply came out as one of the main constraints to succeeding in having resilient wetlands," said Matt Gerhart of the California State Coastal Conservancy, a government agency that guided the research. "We don't have forever to figure this out."

Research and pilot projects are underway to identify the best ways of boosting mud supplies in the bay, and of feeding sediment from dredging projects directly to marshes without damaging them.

Using pipelines to funnel muddy water over marshes could simulate the nourishing effects of natural flooding, providing sediment without driving machinery over them. Such pipelines are already operating in Louisiana.

"We don't allow the water to flood onto the marshes anymore," Lowe said. "A marsh is a delicate thing. You can't put a dump truck on it."

Some marshes are already being supported using sediment dug up by dredgers. A six-hour drive south of San Francisco, dredging of Huntington Harbour commissioned by Orange County will provide mud to help nourish a marsh in the city of Seal Beach.

In the biggest Californian example so far of "beneficial use" of sediment from dredging projects, marshes at a former Army airfield were built using mud from an Army Corps project that deepened the Port of Oakland. The North Bay site became a sweeping wetland with a hiking trail after it was inundated by breaching a levee in 2014.

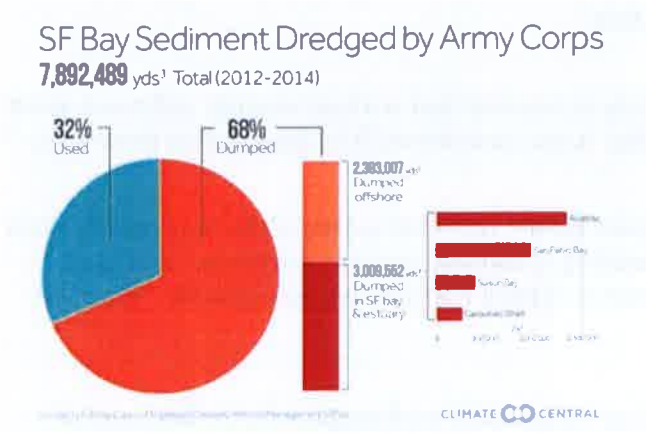
That same year also turned out to be a significant one for the world's climate. That's when a slow-moving and little-understood cycle in the Pacific Ocean called the Pacific Decadal Oscillation switched phases, ending a 14-year slowdown in warming rates at the planet's surface, leading to record-breaking heat in 2014, and then again in 2015.

The same change in the Pacific Ocean cycle may also end a recent run of good fortune for the Golden State's coastlines.

While northeastern states saw seas rise more than 4 inches along their coastlines from 2002 to 2014, sea levels declined slightly during the same period along the West Coast. The change in the PDO had previously been projected to lead to a steep rise in sea levels along the West Coast. Federal data shows tides in San Francisco have risen slightly since 2014.

Even as sea level rise was being masked off the West Coast in recent years by natural factors, it was accelerating on average around the world. That speedup is projected to continue, which will affect Bangladeshis, Sydneysiders and Californians alike in the long run, regardless of the ephemeral effects of ocean phases.

The Bay Area has a unique vulnerability to the problem, because its marsh plants are particularly dependent upon sediment for their growth. Unlike plants native to other regions, California's are poor at producing mud from their own decomposing roots, stems and leaves.



The region's mud shortage is being made more severe by dredging for federal shipping lanes. Bay-floor sediment is constantly flowing down to fill channels that were carved to create ship lanes, requiring ongoing maintenance dredging by the U.S. Army Corps of Engineers.

The shipping industry isn't invoiced for routine dredging needed to keep federal shipping lanes open. That bill is footed by American taxpayers.

That multibillion-dollar annual gift to one of the world's biggest industries is also costing coastal American communities their land, robbing them of the sediment needed to replenish coastlines and stay above sea level.

To protect taxpayer funds, whenever the Army Corps is dredging for routine maintenance, it's required by a federal standard to dispose of the sediment in the cheapest way possible, so long as environmental rules are followed. (For some special projects, such as Port of Oakland's deepening project, sediment dug up at taxpayers' expense has been used to build wetlands.)

In the Bay Area, the Army Corps dumps most of its dredged material as waste in the Pacific Ocean or at a handful of sites near deep channels in the bay. The Army Corps points out that other groups could propose paying the extra costs needed to put dredged sediment to better use at a wetland site.

Confounding that challenge, California law restricts placing of sediment in most parts of San Francisco Bay. The rule is a legislative relic from 50 years ago, after environmentalists rallied to end the rampant filling in of the waterway for development.

The Army Corps dredged nearly 8 million cubic yards of mud and sand from the Bay Area from 2012 to 2014. Piled atop a football field, that would tower nearly a mile into the sky. About one-third of it was used for wetland restorations and other projects, analysis of federal data shows. The rest was dumped.

"We want to participate in beneficial use and put it upland to create new wetlands," Army Corps planner John Dingler said. "We have a real problem justifying that if it's more expensive. It's like our hands are tied."

The dredge disposal sites inside the bay are located along channels that sweep dumped sediments under the Golden Gate Bridge and into the Pacific Ocean. "It doesn't appear to stay in the bay," said Brenda Goeden, a state official who works on sediment management issues.

Goeden, Dingler and Lowe are among a growing ad hoc collection of government and nonprofit planners and scientists loosely collaborating in an attempt to reimagine how California manages its precious mud.

If they succeed, there might yet be a future for California clapper rails — which were recently renamed Ridgway's rails — even as water levels rise around the marshes on which they nest.

"We'll need to restore and create wetlands in upland areas if the species is to persist," said Brent Plater, a conservationist who runs the Wild Equity Institute, a small environmental nonprofit in San Francisco.

It's not all for the birds — or the birdwatchers.

Solving the Bay Area's mud conundrum will be key to meeting the state's wetland restoration goals, scientists have determined. And that's something that could help to protect the more than 60,000 Bay Area homes that are currently less than 3 feet above high tides from muddy floods, even as bay waters rise around them.

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