Salt Marsh Secrets

Who uncovered them and how?

By Joy B. Zedler

An e-book about southern California coastal wetlands for readers who want to learn while exploring

2015

Zedler, Joy B. 2015. Salt Marsh Secrets: Who uncovered them and how?
Tijuana River National Estuarine Research Reserve. Imperial Beach, California
(http://trnerr.org/SaltMarshSecrets).

This e-book records favorite stories about salt marsh secrets that my collaborators and I uncovered while studying southern California coastal wetlands, from the 1970s to date. In 1986, we became the Pacific Estuarine Research Lab.

Please download the files as they appear online and enjoy learning what we learned…and more. You'll meet many "detectives," and you'll be able to appreciate how they learned so much--undeterred by mud and flood. Learn while exploring the salt marshes near you!

Each chapter (1-21) is being posted at the TRNERR as a separate file (PDF).
Chapter numbers precede page numbers (for chapter 1: 1.1...1.14).
Layout by Emily L. Rosenthal. Photos by the author or as noted.

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Conserving tidal marshes

Here's a quick look back to state and national policies and laws that helped people protect the environment:

1970: The National Environmental Policy Act required federal agencies to assess environmental impacts of proposed federal agency projects

1972: California voters approved Proposition 20, which established the California Coastal Commission and six regional commissions. The State began to regulate development along the coast and required permits for development between the State's seaward limit and a boundary that was 1000 yards landward from mean high tide. Peter Douglas wrote much of the proposition and the 1976 Coastal Act. Douglas was the Coastal Commission's Chief Deputy for 10 years, then became its first Executive Director, a leadership position that he held until 2011. Under his guidance, California became a national leader in coastal protection. (Read more at http://www.coastal.ca.gov/pdouglas.html.)

1972: The Coastal Zone Management Act was enacted to protect US coastal zones and encourage restoration, management, public education, research, stewardship and public outreach. This led to the National Estuarine Research Reserve System.

1972: The Clean Water Act was passed to regulate discharges of pollutants to waters of the US. Wetlands are included in those "waters."

1982: Tijuana Estuary became a National Estuarine Research Reserve. It is 1 of 29 nationwide.

I remember when people first noticed that Tijuana Estuary had a new title. Many called it a "national estuarine reserve." I kept saying "research—it's a national estuarine research reserve." It was a totally new concept, and it took a few years for the idea to catch on and for people to appreciate the role of research—"discovering salt marsh secrets" —so that ecosystem management could be science-based.

IF YOU WANT TO STUDY MARSHES, YOU NEED MARSHES TO STUDY. In the mid 1980s, over 90% of California's wetland area had already been lost to drainage or filling. We led the nation in wetland-area loss, with the Midwestern corn-belt states of Iowa, Illinois and Ohio close behind. What did California have in common with these states? Answer: Agriculture and drainage of water-saturated lands to grow crops. For coastal California, however, a major cause of wetland loss was filling to make wet lands into uplands for urban development.

Actual losses of wetland area are uncertain, because ideas about what is a wetland changed over time--the term "wetland" was not even used until the mid 1980s (Zedler et al.1998). A map drawn after a period of drought years would likely show less wetland than a map drawn after several flood years. Dr. Eric Stein has wrestled with these issues in using 1850s maps to quantify early coastal wetland habitats. What we now call the upper or high salt marsh, with infrequent tidal inundation, might not have been mapped as tidal wetland (see early maps in Stein et al. 2010).

Some of the wetland loss occurred decades ago, with construction of roads. After a road bordered or cut through a wetland, adding fill became easier. Along San Diego Bay, there were plenty of sandy spoils dredged up from the bottom of the shipping channels during the Port Authority's maintenance work. Where to dump the spoils? Mudflats and wetlands were handy; they became the dumping grounds. The aerial photo below shows extended land next to transportation corridors in National City and Chula Vista, south of San Diego. More land, more development, less wetland.

That was before the US congress established the Endangered Species Act, the National Environmental Quality Act, and the Clean Water act. These measures were all designed to protect environmental resources and, where possible, to repair some of the historical damages. If you think that made it easy to restore wetlands, read about the battles, below. First however, let's consider why people fight to sustain and restore our wetland heritage.

Why do people care about wetlands?

Let's ask Mike and Patricia McCoy, two of the brightest and best and most indefatigable (untiring) wetland defenders in southern California. Here's what they said in a December 2014 letter:

"The battle to protect the Tijuana Estuary is emblematic of the question that always seems to arise. Why do some people want to protect life and living systems while others do not? Why would any intelligent creature want to destroy their life support system? These questions used to cross our minds continually in this battle and continue even more today."

"Human beings are creatures intelligent enough to utilize their capabilities in remodeling their environment for their own advantage in the short term. They are incapable of anticipating damage their endeavors bring over time. We are taught to use short term linear thought but not interdisciplinary integrative thought processes to address difficult long term issues leading to serious social, economic and ecological problems. This includes interrelationships between and among watersheds, riparian corridors, estuaries and oceans along with the dynamics tying them all together with human civilization."

"We humans have separated ourselves from nature and natural process. We are encapsulated in an unrealistic cocoon dependent upon technology. We seem to believe that technology can resolve all our problems. This gives a sense of detachment from nature. Many people believe we are no longer dependent upon nature for our survival. This thinking has led to the rapid demise of biodiversity leading to massive extinctions, destruction of wetlands, climate change and myriad other ecological catastrophes."

"Restoration of wetland ecosystems is critical to the health of this state and the nation. Climate change is the most serious problem we face as we move into the 21st century. Salt marsh restoration will prove to be important in lowering atmospheric carbon dioxide through carbon capture."

"Programs installed at the Tijuana Estuary and many other ecological reserves in the United States and around the world offer a ray of hope that attitudes are changing. Human understanding and awareness about the magnitude of the impact our species has had on the natural world is significant, unrelenting and must be resolved for life as we know it to continue."

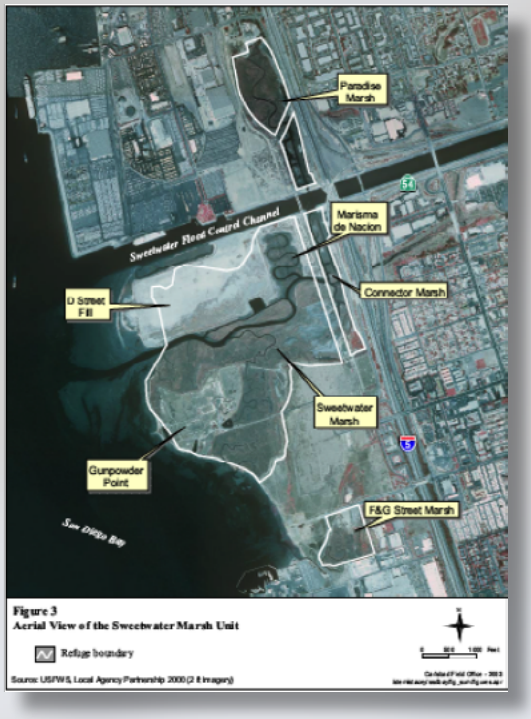
"It is critical that we humans change our thinking and our priorities toward the environment as we move into the future. If we do not, the price we will pay will be astronomical."

"Young people with young minds can grasp new concepts much better than older people, but all people must rethink the way we face current environmental problems and situations."

Battles to protect and restore salt marshes

SWEETWATER MARSH. In Chula Vista, the widening of Freeway 5 was approved under a permit from the US Fish and Wildlife Service (FWS). The permit required several "mitigating" measures, meaning actions to lessen the impact of damaged habitat. One of the actions was to designate the remaining Sweetwater Marsh as a state or regional nature reserve. However, the designation and other requirements were not carried out within the required timeline.

When the League for Coastal Protection learned of the shortcomings, Joan Jackson and the League took legal action; they sued three federal agencies for not following federal law. The highway department (CalTrans), the Army Corps of Engineers (ACE) and the FWS had not met the deadling for mitigating impacts to three federally-endangered species.



While the court case was being considered, researchers and managers accumulated new information about the habitat requirements of the endangered species. After the court decided in favor of the League, the FWS reopened the "consultation period," and mitigation requirements were updated using new knowledge. The agencies had to carry out a new list of mitigating actions. Among the new requirements was that Sweetwater Marsh become a federal reserve. As a result of the lawsuit, Sweetwater Marsh became a National Wildlife Refuge.

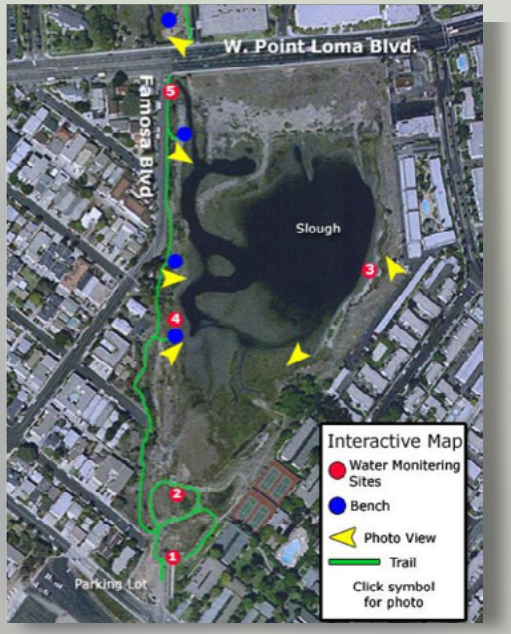
Local developers were part of the battle, too. The City of Chula Vista wanted to create hotels and resort facilities on the upland "island" known as Gunpowder Point. As a young scientist, I attended a public hearing held in Chula Vista and testified that impacts of such developments would be extremely difficult to mitigate. I was one of very few people to testify and the only one objecting, so it was hard to fade into the woodwork.

I didn't know that a lobbyist was listening and planning revenge. He had connections in Washington, D.C., and the next day, I learned that questions were being asked about me and my research in a government office that was funding some of my research. The word was to "find some dirt on Zedler," according to an inside source. How did that happen so fast? I assumed that the lobbyist or a representative contacted the head of the office, who was a political appointee with connections in southern California. I learned about it immediately but I didn't worry, because I knew there was no dirt to find. My projects were on track and within budget, with all required reports provided within deadlines.

My work was safe for the moment, but I was naïve in thinking the matter was closed. My next application for research funding was judged fundable until its "fundable" ranking was suddenly moved to "not fundable." My inside source indicated that the shift in ranking was political, not science-based. So, I appealed to the funding agency for fair treatment. Meanwhile, the proposed hotel site became a FWS wildlife refuge, and new leadership took over the research-funding office. Research was delayed, but eventually funded.

Speaking up and speaking out has its risks, although protecting salt marshes is worth fighting for. Those days were a bit like the "wild west." I hope that kind of foul play has ceased. Salt marshes need research, and requests for research funding need fair and impartial judgments.

FAMOSA SLOUGH. Many years ago, an entrepreneur bought a 20-acre wetland that was disconnected from Mission Bay because it was south of the San Diego River flood control channel. The wetland was called Famosa Slough. The new owner proposed to surround the slough with apartment buildings and call it "The Sanctuary" (ironically). Then the "war of the planks" began, as described by various nearby residents. First, the culvert that muted (reduced) the flow of tidal water into the wetland was blocked with planks. The owner added the planks to prevent tidal water from making his land wet. He claimed that allowing tidal influence created "an illegal wetland." But the planks didn't stay in place very long. Usually at night, planks would be removed, allowing the tide to rewet the slough. The owner complained that vandals were making his property wet when it should be dry. It didn't stop the plank-removal. Then a guard showed up to make sure that the culvert stayed blocked. But water had to flow out after rain, and the crossroad would have flooded if the culvert was always blocked. So the site remained a wetland, despite attempts to "correct" Nature.



When "The Sanctuary" development plan became public, it was obvious that wetland habitat would have to be filled to construct about 200 apartments. And the project's name fueled local objections.

Jim and Barbara Peugh led the opposition and asked for scientific information. It was my pleasure to point out the native plants that indicated the wetland boundary and to suggest where and how to restore some of the more disturbed edges.

The activists formed an organization to protect Famosa Slough and began to advertise trash clean-up activities on weekends. The organization grew as the rewards became obvious—more birds of more kinds used the slough, as did more photographers and more people interested in passive recreation. The Peughs created a newsletter that continues to date. They appealed to the City of San Diego to buy the land. The owner asked for >$3 million, far more than he had paid for it. I was offered jewelry to butt out. Not caring much for jewelry or bribery, I declined.

American avocets
by Karen Straus, Friends of Famosa Slough

Eventually, the City purchased the land, thereby preventing its development. Activist volunteers not only cleaned up the trash but also held work parties to eradicate invasive plants and restore native vegetation. By removing a cluster of exotic trees, the City eliminated use by homeless campers, making neighbors and visitors feel safer. Meanwhile, the waterfowl continued to use the shallow water.

Next, the City installed upstream berms to slow urban runoff and reduce pollutants and settle out sediments and nutrients. The wet soil allowed nitrogen to be denitrified by bacteria. Retaining the urban runoff behind a berm allowed salt water to move further inland. Increased water salinity controlled invasive cattails in the new reserve. Later efforts restored upland vegetation on piles of dirt and debris on land adjacent to Point Loma Blvd. Thanks to local citizens, we can all enjoy the reserve and appreciate the native plants and animals at the corner of Famosa St. and West Point Loma Blvd.

SAN DIEGO RIVER AND ITS DOWNSTREAM SALT MARSH. SDSU Geography Professor Phil Pryde is the hero of this story. He summarized floods and rainstorms in the San Diego River watershed, dating back to the earliest records in 1915. The data made him skeptical about plans to build a concrete-lined channel that would "control" river flows. By 1953, the downstream river had been tamed with riprap levees that prevented freshwater inflows (and sediments) from flowing into both Mission Bay and San Diego Bay.

An even larger project was proposed in 1960—a plan to convert the Mission Valley portion of the river into a concrete ditch, like the Los Angeles River. There wasn't much evidence that the San Diego River needed such a ditch nor that San Diegans wanted one. Regardless, the US Army Corps of Engineers (CoE) presented a plan in 1964 to "improve" the river with a channel up to 250 feet wide and 25 feet deep from the east end of Mission Valley to the Ocean. By Phil's calculations, such a channel could carry the flow of the Columbia River where it enters the US. The "model flow" was certainly more than any flood on record for the San Diego River.

Someone got the US Congress to authorize further planning, and in 1967, the San Diego City Council approved Flood Plain Zoning in Mission Valley. Everything was moving along--until the public hearing in 1971, that is. I think that was my first public hearing, and I have Phil to thank for suggesting that I attend; I had no idea what a momentous occasion it was going to be. About a thousand other people were there, and among them were 4 who spoke in favor and 24 who spoke against the plan, including a County Supervisor. Dr. Pryde was in good company.

Phil's arguments were clear: The size of the flood that the Corps of Engineers estimated was not supportable. Besides, Mission Valley vegetation and wildlife would benefit from a much more natural river—one with a "soft bottom," not concrete. Phil had strong backing from local environmental organizations, and he also had a strong coalition, called the San Diego River Valley Floodplain Technical Council, including several of us from SDSU. We all supported his alternative analysis, that storms in Los Angeles delivered much more water because of nearby mountains. Phil's analysis showed that the "model storm," based on one in 1943 in the San Gabriel Mountains, should not be extrapolated to the San Diego River.

The public hearing with a thousand citizens in attendance, and the rebuttal of potential flood size, had positive effects on the CoE and the City Council. The CoE downsized its flood estimate and began planning a soft-bottom, riprap-lined channel through Mission Valley. It was completed in about 1989. As a result, the downstream salt marsh has a continuous link to upstream wetlands--not natural, but far better than an abrupt boundary with concrete. Bravo, Dr. Pryde! Read the entire story online (http://www.sandiegohistory.org/journal/v57-3/v57-3pryde.pdf).

LOS PEÑASQUITOS LAGOON. It's name means the cobbles, and there were often cobbles at the beach across from the lagoon. Los Peñasquitos Lagoon endured its share of land-use threats, including a proposal for a water park that would have sprawled west from Freeway 5 into the wetland. Where visitors would park their cars was a mystery to me. Sometimes, it seemed that developers thought that "if you build it, parking places will come." While that plan did not go far, continual requests to widen the road along the northeast edge of the salt marsh were eventually granted. And the State Park paved its parking lot.

(photo, trnerr.org).

Thanks to Los Peñasquitos Lagoon Foundation, and particularly its early Chair, Joan Jackson, this site practices science-based management, ensuring that the ocean mouth stays open to tidal flushing to conserve biodiversity.

There was always renegade dumping of horticultural trimmings, and whenever there were persistent rainfalls, the bluffs would lose some of their soil, which eventually moved downhill into the wetland at the bottom of the watershed. Excess sedimentation where the creek flowed into the lagoon became the thesis research project of Keith Greer, working with Dr. Doug Stow at SDSU. Urbanization had increased streamflow and sedimentation, especially during the dry season. Lowered salinity allowed invasion by brackish marsh plants. Using aerial photos from 1928-1999, they showed expanding urban land use, expanding brackish marsh and riparian vegetation, and declining salt marsh and salt pan areas (Greer and Stow 2003).

TIJUANA ESTUARY. The United States' "most southwesterly estuary" is just north of the US-Mexico border. When I first visited it in 1969, there was no reserve, no visitor center, no fence, no marked trails, no bridge, and no limit to the number of off-road vehicle tracks. It was the favorite dumping ground for builders and gardeners to dispose of excess dirt and horticultural trimmings. But there was a plan to make it into a marina with boats and docks in place of the County's finest salt marsh.. The last time I saw that plan, it was framed and hanging on the wall of the visitor center office toilet. A fitting location.

Mike and Patricia McCoy are the heroes of Tijuana Estuary. Without their vigilance and political acumen (sharpness), any plans for a visitor center would be hanging on the wall of a marina toilet. By the time I began visiting Tijuana Estuary in the mid 1970s, Mike and Patricia had already convinced the FWS to buy the land for a national wildlife refuge. But that was just the beginning. Mike and Patricia formed the Southwest Wetlands Interpretive Association (SWIA), which developed broad support for coastal wetlands and obtained National Estuarine Research Reserve status in 1982 .

After achieving NERR status for the estuary, the McCoy team followed with a proposal to recognize the site as a Ramsar Wetland of International Importance. I remember writing letters, letters, and more letters, knowing that Mike and Patricia would make the effort worthwhile. I wondered where Mike found the time; even after retirement, he kept practicing veterinary medicine. He's an amazing man with amazing energies, and Patricia contributes a force that is twice as tall as she. Her devotion and determination are unbeatable. I am privileged to continue to learn from them and to be able to study the salt marshes that they saved from the fate of becoming a marina.

Along Seacoast Drive in Imperial Beach, a small filled real-estate lot was not included in the TRNERR designation. Years later it was finally purchased and added to the reserve. Back in 1974, the narrow lot was the starting point for one of my transects for monitoring vegetation. A lot of disturbance continued, with loads of soil dumped here and there, until one summer, I couldn't locate the first stake that had marked my transect.

No wonder; it was under the landfill. Aerial photos confirmed that slowly but surely, the lot's upland was growing and the wetland was shrinking, with my transect being buried. Next, the real estate sign went up. The price tag also grew, with the NERR as a potential buyer. I was not involved in negotiations to purchase the lot, but I wrote letters about the importance of the land as potential habitat for the endangered salt marsh bird's beak. After the site was purchased, it was great to see the fill excavated and the site restored to salt marsh—with Chris Nordby putting plants in the right places. Another battle won by the McCoy team and SWIA.

BALLONA WETLANDS. People care about our remaining salt marshes. A decades-long battle was to protect and restore the last 300 acres of Ballona Wetlands (just north of LAX--Los Angeles International Airport). You can read about the 1960 conversion of 900 acres of wetlands to Marina del Rey at: www.ballonafriends.org/history.html. Then read how changes in ownership kept conservationists on their toes during the battle to develop versus protect.

In 2003, the protected area totaled ~600 acres. A new tide gate was installed in 2004, increasing tidal influence—at last! Thanks to Marcia Hanscom and her citizen group for endless efforts to get the State to acquire land and manage it for wildlife and human well-being, especially education and passive recreation. Their work tells us how much citizens value the region's remaining green spaces and their precious biodiversity.

Tijuana Estuary

Saving and restoring....the work continues

For more examples of battles, see the web site for Los Cerritos Wetland Land Trust. Check up on plans for Ballona Wetlands and Ormond Beach. The above stories are examples of the local citizen-heroes who kept our salt marshes intact and even expanded some. If I were a historian, I would dig through boxes of correspondence that I left at the NERR and tell more stories. But I'm not. So if you are, or want to be, happy digging!

I remember being asked to evaluate environmental impact statements about many proposed developments and to write letters about many coastal wetlands that needed saving. My team also prepared a management plan for Goleta Slough, next to the University of California-Santa Barbara. We were eager to bring our research findings to bear on real-world issues. Where only 10% of the historical wetland area remains, the challenge is to restore and protect every last square inch, and, wherever possible, to expand tidal marsh area.

Meanwhile, more words of wisdom from Mike and Patricia McCoy:

> "In too many instances agencies cannot do the work they have been trained to do because of political bias. They are overridden by policy and decision makers at the local, state and federal level. For example, species that should be protected and listed as endangered by the US FWS are passed over because of pressure applied from political decision makers influenced by outside interests and money. Listing is seen as disruptive to continuing business as usual. This illustrates the importance of educating and working with legislators and educating the public to elect representatives supporting environmental protection and species at risk."
>
> "Partnership building is needed to resolve the problems. NGO's (nongovernmental organizations) and other private groups can use the courts to resolve conflict and bring pressure to bear on agencies like the US FWS to install correct management decisions and protect resources against disruptive human intrusion. Relationships between NGOs, research and scientific communities are critical. These partnerships enable implementation, protection, restoration and proper management of resources including wetlands."

Even with more area and more restoration effort, the biota are not fully protected. In part, it's because the region's salt marshes have small drainage areas and are small and isolated. The most important driver of diversity and ecosystem services (tidal flushing) is not dependable. Estuary mouths can close due to longshore sand transport. Sustaining tidal influence is a top priority.

The next big challenge is to determine how climate change and sea level rise will further challenge salt marsh conservation. With prolonged droughts (no rainfall), high marsh soils and salt pans do not support annual plants, because they are too hypersaline (>>40 ppt). At this writing, three rainyears have been too dry, and it's not clear that the 2014-2015 rainyear will break the pattern. I consider this challenge again in chapter eighteen.

Corresponding with a student....

What do high school students want to know about salt marsh conservation? I responded to a student's questions in a recent email exchange:

Do any features distinguish southern California salt marshes from others around the world?

Yes. CA coastal watersheds have steep topography and most watersheds are small, compared to other US coasts (although there are notable exceptions, like the Central Valley, which drains into San Francisco Bay). In small coastal watersheds, the downstream/coastal wetlands are small and separate, rather than large and continuous along shorelines such as Louisiana. This makes them very interesting to study, as each wetland is unique in relation to its unique watershed. Also ~90% of the coastal wetland area has been lost to development. This makes them very important to study, so we know what we've lost and how to restore it.

Is there one organism that is most important to salt marsh primary productivity?

Some of my earliest research indicated that the vascular plants and the epibenthic algal mats were about equally productive, unlike salt marshes along the Atlantic and Gulf of Mexico coasts, where one species of cordgrass is highly productive and where algal mats are more shaded and thus less productive.

The Southern CA coastal marshes have more perennial pickleweed than Pacific cordgrass, however, and the pickleweed becomes dominant by being perennial, accumulating a lot of biomass aboveground and sustaining it by growing new branches every year. It's the most widespread species in so. CA salt marshes, but not the most productive per sq. m.

What threatens salt marshes?

Large-scale landscape transformations were common in the past, leading to major reductions of salt marshes in Anaheim Bay, Huntington Beach, Los Angeles Harbor, Long Beach/ Los Cerritos Wetlands, Marina del Rey and Ballona Wetland. San Diego's Mission Bay was once mostly salt marsh; it is now the nation's largest aquatic park with >2000 ac dredged to create boating channels, open water for sailing and water skiing and jet skiing, beaches for swimming and recontoured land for recreation and visitor amenities. San Diego Bay wetlands were largely filled by the late 1900s; in Chula Vista a marina was excavated from dredge spoils around 1980. In all the coastal marshes, there is more sediment due to increased soil disturbance from agriculture and urban development. Mugu Lagoon, for example, lost 40% of its low-tide volume after the 1977-78 winter storms caused flooding that carried sediment downstream from its agricultural watershed.

Smaller scale land uses continue to threaten salt mashres. These include urbanization, polluted runoff (sediments, nutrients and toxic contaminants), filling, dumping of refuse; increased sedimentation rates. In Los Peñasquitos Lagoon; vehicle emissions and "dry deposition" of nitrogen affect vegetation indirectly, while trampling and vandalism have direct negative effects. In addition, invasive plants and animals change the composition of the salt marsh. The encroachment of humans introduces increased lighting, noise, and barriers to movement (buildings, roads).

Climate change, especially rapidly rising sea level, will drown salt marshes---the vegetation cannot migrate inland where cities abut the marshes, and even where there is low-lying land, the plants and animals can't all disperse inland as rapidly as will be needed.

Can salt marshes tolerate pollution and climate change, including variable temperature and salinity?

Because of small size and cumulative impacts of all pollution and climate change, I rate them highly vulnerable. The evidence is the long list of sensitive and endangered species.

What damage do invasive species cause in salt marshes?

Invaders usurp habitat of resident species. Some are predators that eat natives. Others facilitate the invasion of more invaders in what is called an "invasional meltdown." Meghan Fellows and I described how an exotic grass is a "pseudo-host" for the endangered salt marsh bird's beak—the endangered plant roots tap into the grass, but the grass dies before the endangered plant can reproduce.

How can these problems be solved?

Some lost habitat can be regained through ecosystem restoration. But there's not much space between the ocean and the upland that is not already in use. Sometimes the habitat just gets remodeled, i.e., a lagoon with few fish species is dredged and opened to tidal flushing to create deepwater fish habitat (e.g., Batiquitos Lagoon). Sometimes saline lagoons are allowed to become fresh/brackish impoundments (e.g., Buena Vista Lagoon) for waterfowl. Los Peñasquitos Lagoon has threshold conditions which, when reached, trigger permits to bulldoze and reopen the lagoon mouth. Otherwise, managers typically aim to maintain permanent tidal connections (regular tidal flushing) to improve water quality and support more species.

Restoration is not as simple as grading the filled areas and planting species at appropriate elevations. Researchers continue to show that topographic heterogeneity facilitates overall biodiversity. Read about the importance of shallow pools to an annual pickleweed, the use of deeper tidal pools by Killifish, and tidal creeks that give fish both habitat and access the marsh plain.

Who pays for restoration?

Big projects tend to require participation by governmental agencies such as the CA State Coastal Conservancy, NOAA,and US FWS. Big projects also involve many conservation stakeholders, such as nonprofit organizations (The Nature Conservancy, Earth Island Institute, Southwest Wetlands Interpretive Association). Many smaller projects continue through volunteer efforts and local municipalities.