More than six years ago, Dr. Thomas Parker, a biology professor at San Francisco State University, walked at the southern tip of San Francisco Bay with his colleague John Callaway from the University of San Francisco. As team members on a major project to help restore the area’s damaged plant life, the two skirted several salty ponds near the foot of the Dumbarton Bridge and excitedly discussed the best techniques for the task. They wore black rubber hip boots to protect themselves from the deep tidal mud, and periodically jammed long poles of PVC pipe called “pins” into the soft, salty ground. Parker and Callaway returned every few weeks to check the pins and record how much new sediment had accumulated. Earlier that year (2006), engineers had deliberately breached the levee that for decades had kept Bay water from inundating the ponds. The tide could then wash in and out of the marsh each day and deposit layer upon layer of sediment. This tidal action, in turn, would eventually create a thick-enough zone to support salt-resistant plant life and to form the basis of a healthy and newly restored ecosystem.

Based on Parker’s work, scientists now have important insights on how to restore the plant ecology in both chaparral and wetland environments.

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Chaparral in the Santa Lucia Mts, Arctostaphylos glauca, A. glandulosa and Adenostoma fasciculatum as visual dominants in photo.

Above:
Corte Madera Marsh, with Christina Yunker (left), and Stephanie Bishop (both graduate students in the Parker lab). Both photos by V.T. Parker

Right: Distichlis spicata (salt grass) found in wetlands. Photo by David Hoffman
...California's have destroyed an alarming 90 percent of their marshes, swamps and tidal flats.

Parker’s passion for plants and animals started in childhood. “I grew up in an area where we had a wild creek, and I fell in love with catching animals all the time,” he recalls. His love for biology and other sciences stuck with him throughout school, college, and into professional life and is a leading reason why he works toward ecosystem preservation. His favorite job description is fieldwork. “I like actually physically going into the field, being outside.”

Parker earned his doctoral degree in ecology at the University of California Santa Barbara. By the time he graduated college, he was already on track for a dream job by his definition. He accepted a position at Rider College in Lawrenceville, New Jersey, and became involved with wetlands for the first time. Since 1980, he has been a faculty member in the biology department at SF State. Parker has dedicated most of his research time to studying the conservation and restoration of wetlands, chaparral, and California’s other native environments. He has published three books and over 100 articles and restoration of wetlands, chaparral, and California’s other native environments. He has published three books and over 100 articles.

Above: Sand Mound Slough, Delta, Ellen Herbert (standing, research technician), John Callaway (University of San Francisco), Jessica Van Den Berg (foreground, research technician). Photo by V.T. Parker

Left: China Camp State Park salt marsh, (left to right) Karrie Dies, Yohei Mitsubishi, Drew Potter, Bernhard Warzecha. Photo by V.T. Parker

Dr. Thomas Parker
Department of Biology

Distichlis spicata and Salicornia pacifica in experimental tidal mesocosms. Photo by Stephanie Bishop

After about three years, enough sediment had been deposited in the marsh to support plant species such as Salicornia pacifica (pickle weed) and Distichlis spicata (salt grass). “In 2006 the levee was opened,” says Parker, “in 2008 it was filled, and by 2009 plants had finally invaded.” Today, after several more years, Parker and Callaway can confirm that their project was just one of Parker’s and just a small portion of the marsh ecosystem preservation. His favorite job description is fieldwork. “I like actually physically going into the field, being outside.”

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When imagining “wetlands,” some people picture filthy, foul-smelling, bug-infested lowlands that—for all they know—serve no purpose. While wetlands do have their share of insects and offensive odors, they’re, in fact, among our planet’s most crucial environments. Parker understands in great detail the importance of wetlands and for the past 30 years has researched ways to preserve what little remains of these altered ecosystems.

Wetlands are home to a large variety of fauna and flora, many of which are on endangered species lists. Wetlands also recharge groundwater, produce fresh oxygen, help prevent flooding, and even filter toxins from drinking water. Humans depend on wetlands for these and other reasons, says Parker. However, in an attempt to reclaim land for agriculture and development, Californians have destroyed an alarming 90 percent of their marshes, swamps and tidal flats.

Wetlands face another destructive threat: inundation based on rising global temperatures. In the past century, increasing greenhouse gas emissions have affected global climates, causing polar ice caps to melt and sea levels to rise all over the world. Wetlands everywhere, not just those in the San Francisco Bay Area, will become inundated and eventually, will become part of the ocean itself. Once distinct ecosystems will then cease to exist.

Using satellite images and maps generated by oceanographers, Parker has estimated rising sea levels and projected likely impacts on wetlands. “Historically,” Parker says, “sea level has only risen about one millimeter per year, but that has accelerated since humans have started adding carbon dioxide. We are up to around three millimeters a year.” Although this amount is still less than the thickness of a shoestring, predictions show significant accumulations and a worsening of the phenomenon during the last half of this century.

In order to survive, wetland plants will literally have to stay above the deepening water. Plants have been doing this for 5000 years, says Parker, but at the rate of just one millimeter per year. If the rise in sea level continues to accelerate at its current rate, ecosystem disruption will be inevitable.

“We have lots of sediment in [San Francisco] Bay,” Parker says, and this means that here, at least, “wetlands will be able to keep up for the first 20 or 30 years without a problem.” After this however, plant growth will be unable to keep up with the rising water and the ecosystem faces decimation. These changes are not directly affecting society directly right now, he says. In the future, however, if we ignore the issue, humans will begin to experience consequences such as flooding, species loss, and ground water salinization. Odd as it sounds, one of Parker’s former graduate students, Stephanie Bishop, worked on a wetlands project in the middle of the SF State campus. In the green houses behind Thornton Hall, Bishop set up 55 different “artificial wetlands.” These have “tidal” of different intervals and salinities, and they allowed her to investigate Bay-Delta ecology in a semi-realistic but experimental way. Bishop examined the interaction between tidal submersion and salinity on two salt marsh species, Salicornia pacifica (pickle weed) and Distichlis spicata (salt grass). The state of California’s Cal Fed Fund financed
Rodents provide fire adaptation for Arctostaphylos (manzanita) species

by Dr. Thomas Parker

One of the current projects in the Parker lab investigates the role of rodents in burying seed of chaparral plants. Many chaparral plant species depend on buried seed to survive wildfire and re-establish their populations. About two thirds of manzanita species are killed by fire and they produce these seed banks. The seeds only germinate after wildfire. Rodents are predators of these seed banks. They collect them and hide them in the ground in caches. To keep other rodents from finding them by smell, rodents tend to bury them just deep enough for the seeds to survive the high temperatures of wildfires. Subsequently, the seeds are stimulated by fire and they germinate afterwards. If you walk around a chaparral stand in the spring after a wildfire, you’re likely to see lots of seedling germinating, and many of them in clusters arising from rodent caches. Because the rodents bury them deeper than other methods for seeds to get buried, rodent caches are critical for recovery of plant populations in areas with high intensity wildfires.

Among Parker’s graduate students studying different aspects of manzanitas, Brian Peterson is investigating the ability of manzanita seeds to survive heat. Brian has optimized an oven modified with an infra-red heating block that can generate temperatures over 1000°C (over 1800°F). Brian creates artificial soil seed banks with the seed buried to different depths in soil. He heats the soil with the manufactured “wildfire” and monitors temperatures at different depths. Seeds are tested for viability after each experiment. He is testing for the relationship for depth of burial and ability of seeds to survive. He is also testing whether clusters of seeds (caches) reduce the flow of heat, permitting some of the seeds in the cache to survive.

While rodent burial of seed is interesting by itself, a hypothesis that Parker is investigating is whether rodent caching was essential to the evolution of these fire-stimulated seed banks. Many manzanitas belong to a lineage of genera in the subfamily Arctostaphyloideae of the rhododendron/blueberry family (Ericaceae) and manzanitas are the only group of species in this lineage that have dormant seed. The fruit in the subfamily also have evolved from succulent fruit with thin seed thin seeds as in madrones (Arbutus species) to dry fruit with large seed armored by thickened woody material. Rodent caching provides the perfect mechanism of seed burial allowing seed to survive fire, and would be a critical initial step allowing the evolution of the fruit and seed, and permitting seed dormancy to develop.

Above: Arctostaphylos andersonii seedlings arising from a rodent cache (about 37 individuals); Bonny Doon Natural Research Reserve. Photo by V.T. Parker

Left: Salicornia pacifica (pickle weed) found in wetlands. Photo by Ron Vanderhoff

Parker feels that a critical first step to saving native chaparral plants is to help the seed-burying animals. Based on Parker’s work, scientists now have important insights on how to restore the plant ecology in both chaparral and wetland environments.

State budget cuts have left many California colleges and universities with research shortfalls and their investigators scrambling for any sort of funding for research. The only way to get new financing is from grants, Parker says, and these are “incredibly difficult” to obtain. Parker’s research on wildfire and chaparral environments will progress, he is certain, but considerably more slowly than anticipated. Other agencies and conservation organizations have helped to restore California’s ecosystems by removing invasive plant and animal species. These methods, however, fail to prevent the ongoing destruction of land. Educational institutions need to continue their basic research. Parker is convinced, so they can continue to gather evidence on ways to stop the ecosystems’ actual destruction, not merely to fix the land after damage has occurred.

Recently, Parker was invited to meet with a regional scientific review panel to discuss the conservation of wetlands. The panel is examining ways to preserve the Bay Delta, while also encouraging people to remove some water for agricultural, industrial, and development applications. “It’s not as easy as it sounds” to solve the wetlands puzzle, Parker says. However, he is content to devote the necessary time and research to finding solutions because he loves to learn and values the satisfaction of answering life’s newest curiosities.

To prevent the destruction of California’s coastal environment, scientists must continue to collect field data samples and record sea level changes. With these, they can ascertain clues on the future fate of wetlands. As of now, Parker says, predictions are that wetlands will be self-extincting for another 100 years. What about after that, however? Wetlands are found on every continent and ultimately, affect everyone on earth, directly or indirectly. Collaborating on projects is crucial, and so is communicating findings so that everyone may benefit from them. We are able to find about 50 seeds,” he says, and “the ones buried below an inch are able to survive after a fire.” Parker estimates that such buried seeds account for over half of the seed banks in a chaparral area. This experiment validated his hypothesis that animals form a vital link in the survival of many native plant species after seasonal fires.