The Romberg Tiburon Center in Marin County is not an easy place to find. While running late and driving too fast on the curvy canyon Paradise Drive, I try to recall the Wikipedia search I did on “estuaries” before leaving to meet biology researcher Dr. Matt Ferner at the Center. Key words re-emerge: Salt water. Fresh water. Species-rich. Disappearing. I turn off the radio as it starts to broadcast only loud static. In the silence, I realize the subtle beauty surrounding me on my route.

Deep-green tree-covered hills descend towards a flat marshy zone at the edge of San Francisco Bay. I catch the unmistakable smell of ocean water, marine life, and decomposition. White houses that appear plucked from the early 1900’s sit precariously atop mossy cliffs. The Bay, stretching southward behind the marsh, is a mélange of browns, greens, and blues with white caps rippling like sprinkles on a somber cake. Tugboats and schooners are moored at docks that jet into the Bay like outstretched fingers. Bird calls echo in the distance and then fade. The natural serenity is complete as yellow sun rays blend with the rust-colored towers of the iconic Golden Gate Bridge. During my computer research just hours earlier, I learned that San Francisco Bay is actually one large estuary—from this perspective, a beautiful one—that needs help from both the public and from scientists like Matt Ferner.
He grinned. "I was working on the open coast and a misplaced dam. "It was used to support the gantry cranes originally built for offloading coals. Later, it was used to support the assembly of submarine nets."

Workers also wound some of the cables for the Golden Gate Bridge on the site, he says.

Ferner’s most noticeable characteristic is definitely the brown beard hanging down to his chest. His generous facial hair serves as an accessory, convenience—or inconvenience, and a plaything, he explains. "In Georgia, I had to shave it every year or the mosquitoes and gnats would take up residence. Very unpleasant! Then around Halloween, I would start a new beard for added winter warmth."

"See that big cement thing?" he asks, his long brown beard blowing in the same direction as his pointing finger. He is showing me a huge grey structure that looks like half barn and half aircraft. "That’s Building 36. This is part of the Romberg Tiburon Center’s expansive site."

"It could be your physical geography," he says, "or it could be the people you know, or the people who are connected to who you are." Ferner’s most noticeable characteristic is definitely the brown beard hanging down to his chest. His generous facial hair serves as an accessory, convenience—or inconvenience, and a plaything, he explains. "In Georgia, I had to shave it every year or the mosquitoes and gnats would take up residence. Very unpleasant! Then around Halloween, I would start a new beard for added winter warmth."

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Within an estuary, Ferner learned from Ferner and NERRS educational website ([www.estuaries.gov]), rivers meet and mix with salty ocean water, creating a brackish environment. Bays, lagoons, sounds, and sloughs are all common names for estuaries. Estuaries receive both marine influences, such as tides, waves, and the influx of saline water, and riverine influences, such as flows of freshwater and sediment. NERRS literature describes San Francisco Bay as an area that "once supported 190,000 acres of highly productive tidal marsh, nearly 90 percent of which has been destroyed or altered." As one of the few large estuaries on the West Coast, our Bay plays an extremely vital role, says Ferner. "San Francisco Bay is an important stopping port that big ships can access, not like the rocky cliffs along most of the coast." The Bay also provides "essential nursery habitat for migratory birds," he says, as well as "essential nursery habitat for fish like salmon and herring."

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NERRS supports scientific research of Bay wetlands to improve management and restoration efforts and thus to help create a healthier estuary.

Several significant Bay studies are taking place at, and through, SF State’s Romberg Tiburon Center (RTC). Ferner and colleagues are creating a sort of reference guide of data for their own research and that of other scientists. The "guide" includes information on water quality (salinity, temperature, turbidity, dissolved oxygen), climate, and species of animals found during quarterly monitoring efforts; Photo courtesy of SF Bay NERR.

p.41: Historic fishing pier at China Camp State Park, a component site of the San Francisco Bay National Estuarine Research Reserve (NERR). Photo courtesy of SF Bay NERR.

pp.42-43: Dr. Matt Ferner conducts and coordinates research on the interactions of animals with their physical environment. Clockwise from top left hand corner: Tidal water flows into and out of the marsh through sinuous channels at China Camp State Park, part of the San Francisco Bay NERR; Photo by M. Ferner. Open water habitat offshore of China Camp; Photo by J. Feren. Native Olympia oysters (Ostrea lurida); Photo by A. Hettinger. Freshwater marsh adds to the diversity of habitats within China Camp; Photo by J. Feren. Tidal marsh and channel at Red Ranch, another site within the San Francisco Bay NERR; Photo by M. Ferner. Small research vessel loaded and ready to depart; Photo by M. Ferner. Scientists working within the NERR document the size and species of animals found during quarterly monitoring efforts; Photo courtesy of SF Bay NERR.

San Francisco Bay is an area that "once supported 190,000 acres of highly productive tidal marsh, nearly 90 percent of which has been destroyed or altered."
As a benthic ecologist, Matt Ferner studies processes that determine the abundance and distribution of organisms living on or within estuarine sediments. He is especially interested in how physical attributes of the environment (e.g., habitat structure, water motion) affect abilities of benthic animals to acquire resources. Ferner’s dissertation research in the tidal salt marshes of coastal Georgia focused on the effects of sediment characteristics and hydrodynamics on the strength of predator-prey interactions. A key conclusion from this interdisciplinary work was that environmental factors that benefit one species may be detrimental to another due to differences in the animals’ sensory abilities (Fig. 1). Ferner expanded upon these concepts after moving to UC Davis’ Bodega Marine Laboratory, where he examined the mechanisms of particle capture by small suspension feeding animals. His current research examines effects of water flow on consumer interactions among native and non-native invertebrates in San Francisco Bay. Ferner asserts that understanding how environmental features favor certain species interactions over others can assist decisions about the scale of conservation or restoration efforts, and in some cases may alter previous assumptions about what defines a critical habitat.

**Research Interests**

![Fig. 1. Proportion of slow-moving gastropods (*Busycon canaliculatum*; black bars) that successfully tracked food odors under different flow speeds (U). Blue diamonds indicate percent tracking success by fast-moving crabs (*Callinectes sapidus*) under similar flow and stimulus conditions (data from Weissburg and Zimmer-Faust 1993). When combined with field data these comparative results suggest that olfactory consumers may partition resources along a turbulence dimension according to their relative chemosensory abilities.](image)

**System-Wide Monitoring Program (SWMP)**

Ferner serves as the Research Coordinator for SF Bay NERR where he is responsible for managing the Reserve’s research and monitoring programs. As an integral part of the NERR’s research program, the national System-Wide Management Program (SWMP, pronounced “swamp”) provides researchers, resource managers, educators, and other coastal decision makers with standardized, quantitative measures to determine how reserve conditions are changing in both the short-term and the long-term.

SWMP currently has three major components that focus on: (1) abiotic indicators of water quality and weather; (2) biological monitoring; and (3) watershed, habitat, and land use mapping. By using standard operating procedures for each component across all 27 reserves nationwide, SWMP data helps establish the reserves as a system of national reference sites, as well as a network of sentinel sites for detecting and understanding the effects of climate change in coastal regions.

Abiotic parameters include nutrients, temperature, salinity, dissolved oxygen, water level and marsh elevation, hydrodynamics, and in some cases, contaminants. Biological monitoring includes measures of biodiversity, habitat, species interactions and population characteristics. Watershed and land use classifications provide information on types of land use by humans and changes in land cover associated with each reserve.

In San Francisco Bay, the NERR established and maintains two water-quality stations at China Camp and two water-quality stations and a weather station at Rush Ranch. A second weather station, which will soon be deployed in Richardson Bay, is currently being tested on the pier at the Romberg Tiburon Center. The weather and water-quality instruments automatically collect and store data at 15-minute intervals. The data is freely available through the Reserve, or directly from the internet at www.nerrsdata.org.
A stone crab (Menippe mercenaria) and blue crab (Callinectes sapidus) face off in a bucket in Dr. Ferner’s laboratory in coastal Georgia.

Photo by M. Ferner

“The interior of Building 36, where Ferner maintains his office and additional lab space, is as aircraft-hanger-like as the outside. ‘The lab was recently rebuilt as part of a multi-million-dollar renovation,’ Ferner explains, with NOAA providing over $2.4 million. Along with other monetary sources, SF State was able to open the new Building 36 in 2007. It now houses offices, a seminar room, a library, and laboratories for scientists, students, and staff members funded through RTC and through NERRS projects. Everything inside the building, from the white walls and high ceilings to individual pieces of equipment, looks clean and well cared for, despite constant use. Walking over to a long brown rectangular box, Ferner describes the newly arrived instrument. The still-bubble-wrapped ‘tower’ measures ‘basic�� all sorts of physical and behavioral processes determine what foods or resources a species is able to consume.’ In other words, who eats what, where, how often, how much, and under what types of environmental conditions. ‘By knowing that kind of information,’ Ferner says, ‘we can start to figure out what causes declines in certain species, such as ploceus organisms or delta smelt, or what brings about changes in species composition.’ He is researching how physical processes such as water currents, tides, and wind move among different types of animals to divide up (‘partition’) resources, and thus to successfully coexist.

Outreach is another important aspect of Ferner’s work and a subject he describes with passion. ‘I’ve always felt that it is a really important component of science in general,’ he says, and government funding agencies are now requiring that all scientists have a strong outreach component. ‘Just during the past five years or so, he adds, ‘it has really changed a lot in the bubble-wrapped-tower measures ‘basic searchable data. ‘It’s not just about doing the research and discussing it within our own hallways. It’s about getting our information out so society can benefit from our efforts.’

This is particular true for estuary researchers, he explains, because nonscientific members of the general public are interested in the natural world. ‘The creeks bend and arch where sediments have run off of the surrounding hills. Many of the creeks stop their meandering several hundred feet from the ocean’s edge, however, and run straight. ‘By the end of the Gold Rush,’ Ferner says, the flow of runoff into the marshes was so great that “the channels didn’t have time to make those curves.” The channels that “head out to the water in a straight line formed during the height of the Gold Rush.’”

In his job at RTC, Ferner is constantly examining, learning, and questioning. ‘It’s amazing what the human brain can come up with, he says, ‘We could sit here and brainstorm 50 different really neat research questions and most of them haven’t been asked. In San Francisco Bay, a lot of the research that could think has already been done really hasn’t been. ‘It’s good to know,’ he says, ‘that there’s still a lot to do.’ It’s equally good to know that a scientist and teacher like Ferner, with such a passion for his work, is addressing some of these unanswered questions. “

Photo by M. Ferner

Research technician, Jessica Schnieder, downloads data from the NERR weather station at Rush Ranch.

Photo by S. Ferner

Mesh cages keep predatory masts in place (but not harmed) during an experiment designed to look at how the presence of predatory animals affects prey behavior.

Photo by M. Ferner

change requires grassroots educational campaigns…”

Research technician, Jessica Schnieder, downloads data from the NERR weather station at Rush Ranch.

Photo by S. Ferner

A stone crab (Menippe mercenaria) and blue crab (Callinectes sapidus) face off in a bucket in Dr. Ferner’s laboratory in coastal Georgia.

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