



Elkhorn Slough possesses a unique beauty and biological richness.

Photo © Paul Zaretsky

# *Dishing up science and stewardship at Elkhorn Slough National Estuarine Research Reserve*

A chemistry professor in college once told students that life was like the plates in the dormitory cafeteria. Remember the plates that were stored in a hole in the counter with a spring at the bottom so that every time you took a plate another one instantly popped up? The plates represented challenges in life, and no matter how many you removed from the top of the stack, there was always another one ready to take its place.

In the world of habitat stewardship, the cafeteria plate lesson has great application.

At the Elkhorn Slough National Estuarine Research Reserve (ESNERR), we are constantly challenged by an endless stack of stewardship plates.

The Elkhorn Slough watershed

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*By Becky Christensen*

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includes a convergence of important habitats: wetlands (saltwater and fresh), grasslands, chaparral, and woodlands. With this diversity comes a bounty of plants,

fish and wildlife. Over 540 species of marine invertebrates, 500 species of plants, 200 species of birds, 80 species of fish, 53 species of mammals, and 29 species of reptiles and amphibians have been identified in the area.

Elkhorn Slough, while providing rich and valuable habitat, is also heavily impacted by many human activities. One of the busiest commercial fishing harbors in California is located at the modified channel opening of Elkhorn Slough. A major railway that carries passengers on



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**Andrea Woolfolk uses a Global Positioning System (GPS) to map habitat and vegetation types throughout the reserve.**



**Uplands and wetlands at**

some trains and toxic substances on others bisects Elkhorn Slough's main channel. The largest electricity-generating power plant in the state stands at the mouth of the Elkhorn Slough. A cluster of automobile wrecking yards sits perched on a hill adjacent to Elkhorn Slough waters. Crops such as strawberries which typically involve intensive use of chemicals are grown in sandy, erodible soil on steep slopes neighboring the waters edge. Well-meaning residents seeking a rural lifestyle bring exotic plants and roaming pets into fragile habitats.

Despite the human influences on the estuary, Elkhorn Slough remains one of the most productive and biologically diverse coastal wetlands in California.

With up to 95 percent of California's wetlands already gone, there is certainly much to protect in the area. Elkhorn Slough is not the only ecosystem facing such threats, and many California resource agencies must address similar issues.

The management approach used at ESNERR involves knowing about the area's past and present ecology, tracking changes over time, and actively conducting research to answer key questions.



Photo © Kenton Parker

**Several automobile wrecking yards sit on uplands above Elkhorn Slough.**

**Site characterization and historical ecology: Knowing yesterday's and today's plates in order to plan for tomorrow**

Answering the question of *how* to protect important habitat is not as obvious as it

might seem. The first step is to characterize the habitats and communities, and to identify the threats to them. To do this, scientists, university students, and trained volunteers collect baseline information about the abiotic (nonliving) factors such as rainfall, temperature, and water salinity, as well as biotic (living) factors such as the



Photo © Paul Zaretsky

Elkhorn Slough.



DFG photo by Becky Christensen.

Dr. Steve Ross conducts an experiment to determine the affects of oxygen variability on the physiology of estuarine fishes.



Photo © Mark Silberstein.

Agricultural erosion on steep lands adjacent to Elkhorn Slough.

through different periods of human history? What animals and plants were present and in what densities? Where did the water flow? How did the distribution and extent of different habitat types change over time and why? These and other elements make up the “historical ecology” of an area. ESNERR staff work to piece together these puzzles using aerial photographs dating back to 1931 and Spanish maps from as early as 1791. Sources such as geologic cores, soil surveys, historic photographs and narratives, and interviews provide valuable evidence of what Elkhorn Slough and its surrounding habitats were like over the last 200 years. Using Geographic Information Systems (GIS), staff then view Elkhorn Slough’s physical features, vegetation, and land uses as they have changed through recent human history.

**Monitoring: Examining the same plates over time**

Another step in “how to manage ecosystems” requires monitoring living and non-living factors over time. Monitoring might be compared to taking a pulse — in this case, of the ecosystem. By recording various parameters at regular intervals over time, scientists can give the system a health check-up, detect rhythms

number of species of plants and animals occupying the habitat, population sizes, and interactions. Collecting this information is no small task. To do this, ESNERR, like the other 25 national estuarine research reserves, is developing a site profile to summarize what is known about its estuarine system.

The past plays an important part in understanding an ecosystem. Habitat restoration decisions are difficult without knowing what the habitat looked like before the various land use changes took place. The present snapshot that we see today tells only a small part of a very large story. What did the ecosystem look like



Researchers sample invertebrates in a restored tide flat.

Photo © Mark Silberstein

and changes, and provide valuable information to land managers and agencies. As an ongoing window into the ecosystem, monitoring things such as water quality, invasive species, or population changes may reveal problems early on and give managers the opportunity to take action.

In 1994, the National Estuarine Research Reserve system instituted the System Wide Monitoring Program (SWMP) to track key elements related to water quality in every reserve. Submerged data-gathering instruments measure parameters such as water temperature, salinity, dissolved oxygen, pH, and turbidity (clarity) every half hour, 24 hours a day, seven days a week. Scientists review the data for quality and then send it to a central data management center in South Carolina where it can be viewed on the web at <http://inlet.geol.sc.edu/cdmohome.html>.

Other projects that help take the biological pulse of Elkhorn Slough include monitoring bird nesting rookeries and nest boxes, shorebird species presence and abundance, and mud-dwelling invertebrates. Monitoring requires a time-intensive, long-term commitment and is often difficult to fund. A one-year grant or short-term work by a Masters' student does not suffice. Volunteers are often recruited to help collect monitoring data, and this can be a good opportunity for citizens to get their hands dirty while assisting with habitat stewardship. This non-glamorous, yet extremely valuable, part of science often goes unnoticed until a major event takes place and we need to understand its significance by comparing monitoring data.

### Research: Where the plates multiply

In conjunction with monitoring, scientific research plays an important role in conservation. How are different species interacting with one another in a given habitat? What are the relationships between one habitat and another? How big does a habitat need to be in order to fully function for the species that depend on it? With every scientific question addressed, many more arise. For scientists, that is the very thing that makes science appealing and exciting – one is never truly finished, another question always begs to be answered.

ESNERR regularly sets research priorities and a whole host of projects are designed to target stewardship decision making. At any given time, about 25



Gaper clam.

Photo © Kenton Parker



Above, yellow mud crab.

Photo © Kenton Parker

research projects are being conducted in and around Elkhorn Slough, coordinated by Dr. Kerstin Wasson. Current research projects include the remote sensing of vegetation and habitat with hyperspectral aerial imagery, examination of the impact of an introduced isopod on bank erosion, investigation of reproductive endocrinology of leopard sharks, documentation of shorebird use of habitats as related to tidal change, evaluation of mussels as bioindicators of metal toxicity, and the development of a nitrate monitoring probe. For interested scientists, a wealth of additional estuarine ecology questions exist that could fruitfully be answered.

"We're always looking for more keen researchers to tackle conservation biology challenges at the Slough," said Dr. Wasson. More information about the ESNERR research program, including additional research project ideas, can be found at

[www.elkhornslough.org](http://www.elkhornslough.org).

Scientific endeavors such as baseline characterization, historical ecology, monitoring, and research support conservation efforts geared toward protecting and restoring habitats. This approach helps to tackle the many "plates" facing the environment in an ever-changing world.

#### How to get involved

Do you have a desire to contribute to the long term health and welfare of California's wildlands? The DFG manages 119 ecological reserves and 106 wildlife areas throughout the state, each with a whole host of habitat stewardship stories to tell. Other state and federal agencies and non-profit organizations also own and manage lands for wildlife habitat. Consider volunteering to help with research, habitat restoration, or public education. Everyone can make a difference by understanding

local conservation challenges and becoming an ambassador for California's lands. For more information about lands near you see:

CA Department of Fish and Game

[www.dfg.ca.gov](http://www.dfg.ca.gov)

CA Department of Parks and Recreation

[www.cal-parks.ca.gov](http://www.cal-parks.ca.gov)

The Nature Conservancy

[www.tnc.org](http://www.tnc.org)

Land Trust Alliance

[www.lta.org](http://www.lta.org)

U.S. Fish and Wildlife Service

[www.fws.gov](http://www.fws.gov)

Bureau of Land Management

[www.blm.gov](http://www.blm.gov)

National Park Service

[www.nps.gov](http://www.nps.gov) 

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## Elkhorn Slough National Estuarine Research Reserve

**E**lkhorn Slough is a seven-mile arm of the Monterey Bay, located halfway between the cities of Santa Cruz and Monterey, with seawater entering and exiting at Moss Landing. It is considered a seasonal estuary, where saltwater and freshwater mix during rainy winter months. The Elkhorn Slough National Estuarine Research Reserve (ESNERR) is owned and managed by the Department

of Fish and Game and operates in partnership with the National Oceanic and Atmospheric Administration, and the private, non-profit Elkhorn Slough Foundation. ESNERR is comprised of 1,400 acres of wetland and upland habitat, located about four miles inland from Moss Landing. There are five miles of hiking trails, a visitor center, and guided walks at 10 a.m. and 1 p.m. on weekends. It is open

Wed. to Sun. from 9 a.m. to 5 p.m. year round, and closed Mon. and Tues. Visit the website for more information about programs and current events. 

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