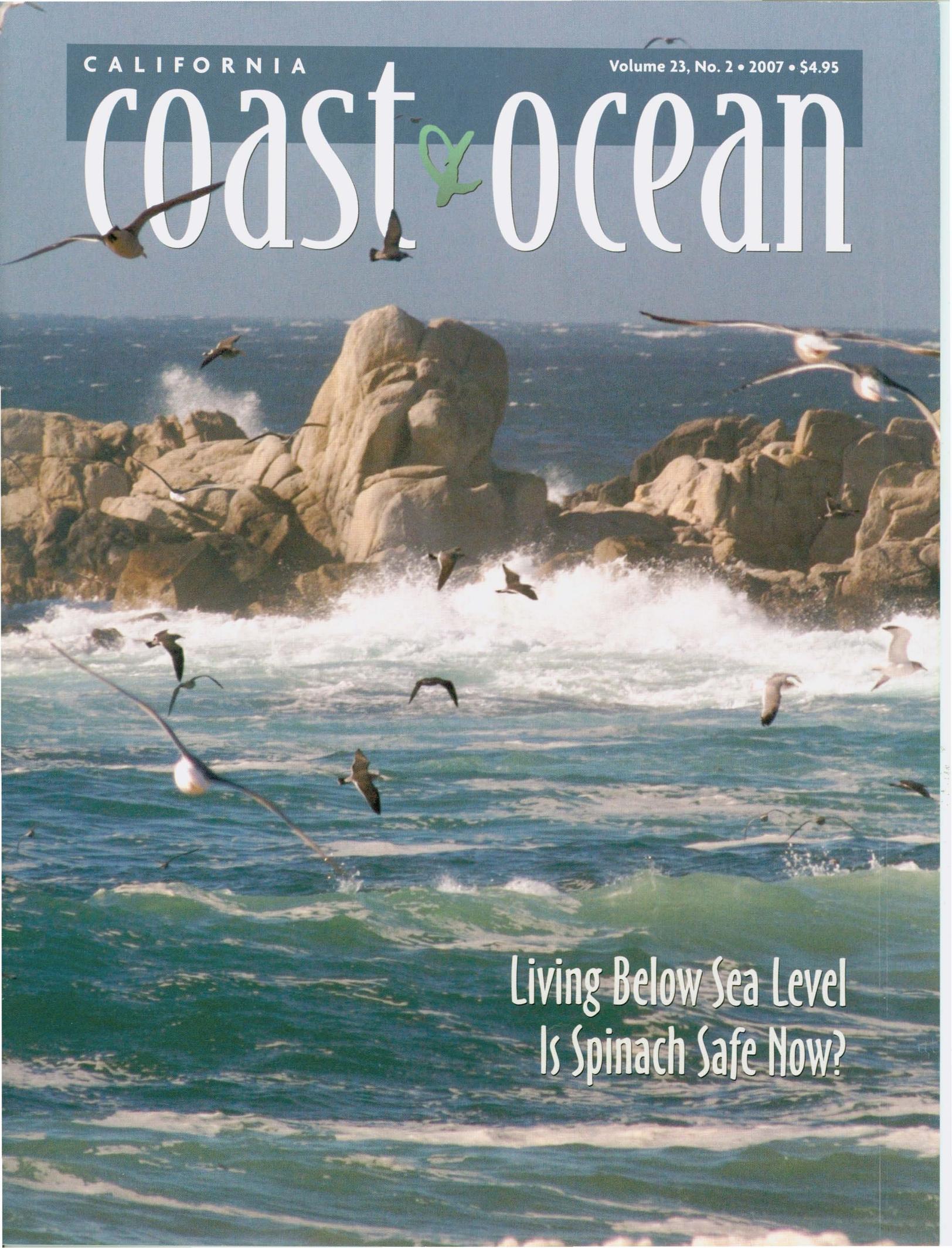


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coast & ocean



Living Below Sea Level
Is Spinach Safe Now?

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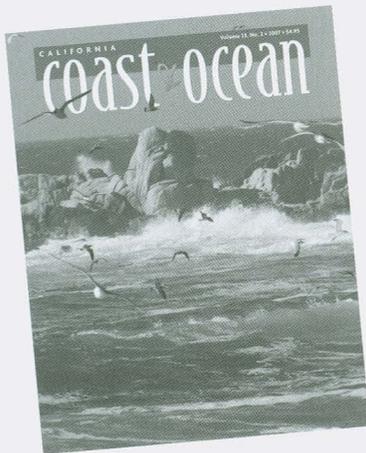
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coast & ocean



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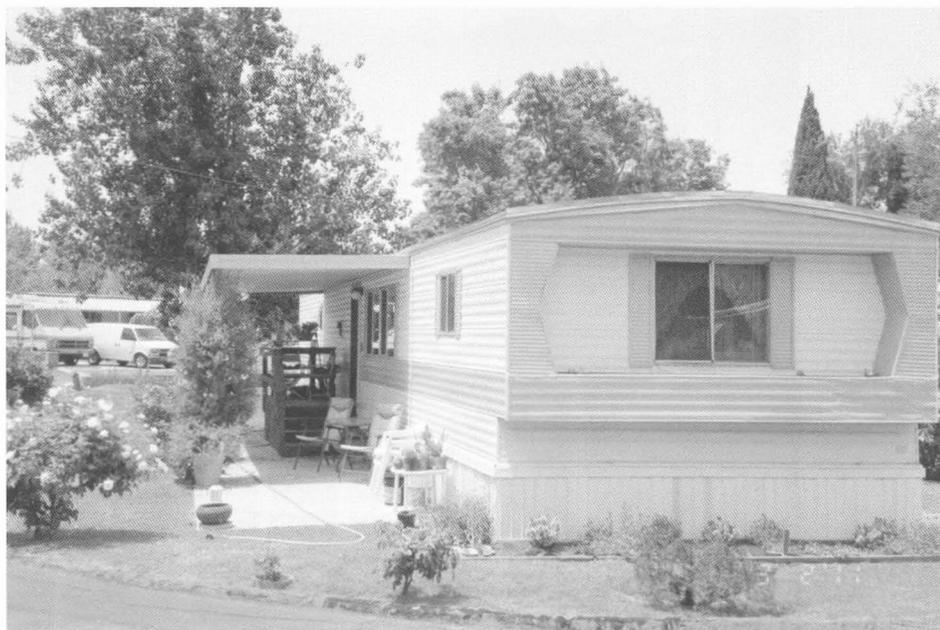
In This Issue

Almost two years after Hurricane Katrina, even as its horrible aftermath continues to unfold, it's eerie to see that in the Sacramento–San Joaquin River Delta developers continue to build homes on man-made islands surrounded by earthen levees. And despite the Delta's long history of levee breaks and floods, and the added risk posed by rising sea level, people are buying those homes—below sea level—and moving in. Why is this being permitted? And why do people choose to invest their savings and their lives in real estate that might be under water before the mortgage is paid?

We asked reporter Shirley Skeel to visit some of these new homeowners and ask the second of those questions. The answers she brought back were of two kinds: “Someone, surely, is making sure this is all right,” and “I hope a disaster doesn't happen, but if it does, well, that's life.”

As in New Orleans, there have been warnings about the Delta's levees. There have been hefty reports and studies. But the economic incentives for development have prevailed. The legislature and the governor have taken steps toward strengthening the levees, but what can be done within the limits of financial resources—and of time—may not be enough. What then?

As I looked at Shirley Skeel's photographs of the happy families in our Delta story, I couldn't help but think of the faces of women and children from the Lower Ninth Ward that I saw in the *New York Times* of July 7, 2007. The story described their bleak lives and prospects. They are quartered in FEMA trailers set among refineries and cane fields, 18 miles from the nearest supermarket, without prospect of jobs or means to get to any work they might find. Separated from the networks of family and friends who used to share in the care of children and the disabled, they are marooned. “We are in storage,” one of the women told reporter Shaila Dewan.



A mobile home in the Sacramento–San Joaquin River Delta

The new homeowners in the Delta may be better off economically than the people in the Ninth Ward were before Katrina, but many of them don't have a lot of choices either. It's hard to argue they should not have moved here when you hear some of their reasons: too much crime, police helicopters, gunfire, industrial pollution where they came from. It's quiet in their new neighborhood, and the children can play outside. They were sure they couldn't afford to buy a home anywhere else. But were they warned? The real estate agents who assured them of safety were trying to make a sale. Scientists are saying something else: The Delta is a disaster waiting to happen.

Also in this issue of *Coast & Ocean*, Carl Nagin examines what has been done to prevent a repetition of last year's deadly outbreak of E. coli in spinach. The source was tracked to pre-washed spinach processed under contract by Natural Selection Foods and grown in a field in San Benito County. How and at what point between field and package the spinach was

contaminated has not been determined. The leafy greens industry has voluntarily reached an agreement to take important preventative measures, though critics question whether these suffice.

In addition to the new agreed-upon standards, some produce buyers and distributors are demanding that growers they buy from do other things that are not only absurd and costly to the farmers but also harmful, such as erecting eight-foot fences around fields, tearing out strips of habitat, and blocking wildlife traffic—undermining years of cooperative restoration and water-quality work.

These articles may alarm you, but they demand public attention. If you find yourself dismayed, do continue in the magazine to the story of George Davidson and the beginning of the U.S. Coastal Survey, which evolved into the National Oceanic and Atmospheric Administration. You will be inspired and energized again. Then have a bit of fun. Go to page 28.

—Rasa Gustaitis

TAMMY MARTINEZ LOOKED around her home set in the sweeping flatlands of the Sacramento–San Joaquin River Delta and felt a buzz of pleasure. It was roomy, tasteful, and best of all, brand new. After the police helicopters and car chases near her family’s old home in the

city of Pittsburg, 15 miles to the west, she relished the tranquility of the Summer Lake community, which was built in 2006 just east of Oakley, in the watery region at the confluence of California’s two biggest rivers, the Sacramento and San Joaquin.

Martinez, 38, would still easily get to her job as a bus driver at Tri Delta Transit in Antioch. Her husband, Roderich, would have a 40-mile commute to Richmond Sanitary District in the East Bay—but that was a small price to pay considering what they now had. She stepped out the back door with her two kids—to gaze at the sky, open fields beyond the

houses and, oddly, an awful lot of sand in the ground . . . as though this had once been the bottom of a lake.

The Martinez family is one among thousands who have bought new homes in residential developments constructed on subsided diked lands in the 1,153-square-mile delta where the rivers meet and flow into San Francisco Bay. Many of these homes are on former wetlands, five feet or more below sea level.

Tammy Martinez knew about New Orleans, of course. She had also heard a lot from the Shea Homes sales agents about the strong four-mile levee that was built last year in a circle around the Summer Lake community. She wasn’t worried—even though her own home is five feet below sea level.

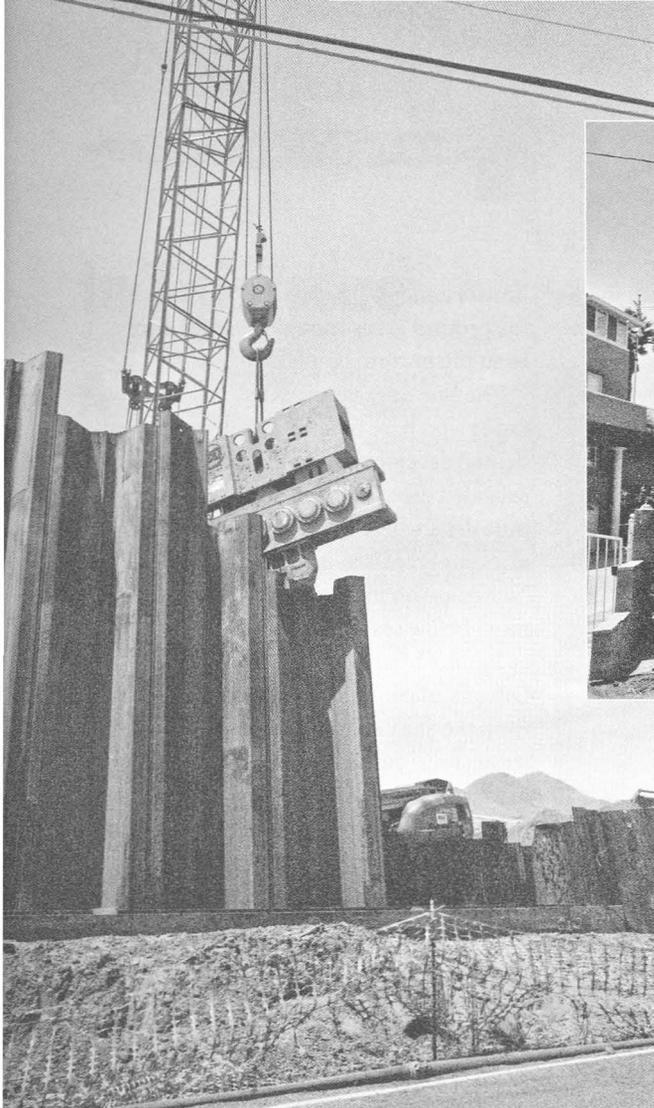
“We feel safe here,” she said. “Everything is inspected. I don’t think they would allow

Living below Sea Level

SHIRLEY SKEEL

Looking up to a road’s end atop a levee on Bethel Island





Top left: Levee construction on Bethel Island

Top right: A house stands on stilts near the water on Bethel Island.



you to live in their community if it wasn't safe. We have a sports club and a canoe club. We love it here."

The Martinez' home is on the Hotchkiss Tract, one of 57 manmade islands surrounded by levees that were built a century or so ago to turn tidal marshlands into farmland. Using picks, shovels, and wheelbarrows,

farmers, former miners, and Chinese laborers constructed 1,100 miles of levees to protect fields of rich peat soil where they planted corn, asparagus, sugar beets, pears, rice, and other crops. Over the years, the peat soil dried and settled. Levees built at five feet were eventually raised as high as 30 feet as the ground kept sinking. Now the Delta is a maze of deep basins and sunken tracts surrounded by earthen dikes. In NASA satellite photos, it looks like a colorful plate of spaghetti. In places where Delta farmland is 25 feet below sea level the islands are actually holes—some of them deeper than San Francisco Bay.

That the Delta is a disaster waiting to happen has been widely acknowledged for a long time. Since 1900, Delta levees have broken 162 times and flooded more than 250,000 acres. Calls for action became more urgent after Hurricane Katrina tore apart the levees in New Orleans and decimated illusions that the laws of nature and physics could be thwarted by piles of dirt and rock. It was not reassuring that the New Orleans levees were built to a higher standard than most of the aging levees in California's Delta.

More than half a million people reside in the triangular Sacramento–San Joaquin River Delta. Many more are being drawn in by the relatively inexpensive homes being built there, within an hour's drive (assuming reasonable freeway flow) from the major population centers of the San Francisco Bay Area and Sacramento.

"In Walnut Creek you'd be paying a million dollars. Here you pay half," said Nicholas Ramirez, 32, who was working on his truck on a hot day in June, but put down his tools to chat with a stranger. He bought a two-story home at Summer Lake a year ago for \$600,000 and moved in from Antioch, where he had lived most of his life, to get away from the noise and congestion. With a 10-year-old daughter and a young fiancée, he wanted a fresh beginning.

"I like that it's quiet here," he said, gazing down the street of picture-perfect houses backed by giant power lines and blue hills. "There's a lot of family people here, a lot of children for my daughter to play with, and not too many people—notice I say not too many people—speeding through here as though it's *The Fast and the Furious*."

Ramirez admitted he "could have done better" checking out the flood threat before buying, but added that most home buyers probably don't probe too deeply. "I think it's mainly because everybody has their own problems and their own concerns with themselves. So until it's actually affecting you, you just wipe it off your shoulder," he said, shrugging. Like the Martinez family, the Ramirezes live five feet below sea level.

The Odds are Scary

“That, in your own backyard there, is the scariest place after New Orleans,” said Nicholas Pinter, a geology professor at Southern Illinois University, Carbondale, in a post-Katrina interview with the *San Francisco Chronicle*. “In California there seems to be large-scale neglect of those levee systems.”

The levees are vulnerable to failure from earthquakes, heavy storms, further subsidence, seepage, erosion, and burrowing by beavers and muskrats, not to mention the threat of flooding as global warming raises sea levels and accelerates seasonal melting of the Sierra snowpack. Geologist Jeff Mount, at U.C. Davis, and Bob Twiss, a levee expert at U.C. Berkeley, estimated that there is a 60 percent chance of multiple, simultaneous levee failures due to an earthquake or flood over the next 50 years. The result could be destroyed homes, roads jammed with panic-stricken residents, disrupted water supplies to much of California, and loss of lives.

John Cain, director of restoration programs at the San Francisco-based nonprofit Natural Heritage Institute and co-author of *Re-envisioning the Delta*, a report produced by U.C. Berkeley's Department of Landscape Architecture and Environmental Planning, said in a recent interview that residential areas being built on the fringe of the Delta are on average five feet below sea level. In the winter flood season, water can rise more than 10 feet above the base of these homes. Many of the levees the residents rely on for protection are 10–30-foot-high unengineered mounds of dirt.

“I think it's incredibly irresponsible and misguided to develop on deep floodplains,” Cain said. “We're not talking about people's living room carpets getting wet every few years. We're talking about whole subdivisions, with houses close together, being inundated up to their eaves. And the odds of that happening are really quite high.” David Mraz, Delta-Suisun Marsh chief flood manager at the California Department of Water Resources, said in a telephone interview that there is undoubtedly cause for concern. He said only about 40 percent of the Delta's levees meet federal standards, though many of the poorer levees are in agricultural, not residential, areas. He also believes that even the federal standard is inadequate today.

“We have a very extensive levee system and . . . it's a problem just waiting to happen,” he said. “The department's pushing for a higher (levee) standard.”

Last year, the City of Oakley annexed the unincorporated East Cypress area, where 4,600 additional homes are planned for Summer Lake and other developments that are yet to be built. The city council, which expects to garner about \$200 million in public improvements, including roads, parks, and water quality and conservation measures, from the four developers at East Cypress, claims that the new development is improving safety for local residents. Rebecca Willis, Oakley's Community Development Director, said by phone that the eight-mile, \$25-million levee system being built by the four developers exceeds federal standards. Money from the developers and the new homeowners will also go toward improving and maintaining the old levee that circles the new one, she said.

However, it is the old levee that currently holds back the water. The new levee sits on dry land inside the old one. Between these two levees are 544 homes that cannot be sufficiently protected because some of them are on top of the old levee, obstructing any engineering work. “These homes don't have (federal standards) protection, and it's not practical to get it to them,” said Willis. “If their levee fails, they may be out of luck (in terms of saving their homes).” Engineers have made it clear, she said, that the space where these 544 homes which stand would fill up with water far faster than it would have before the Summer Lakes development, because the developer's new levee restricts the basin space. That shortens residents' evacuation time from 16 hours to about four hours, she said—not a lot of time if you're asleep when the water surges in.

Friends at Island Park trailer park, Bethel Island: clockwise from top left, David Mariscal, Anthony Klotz, Lloyd Vorum, Tanya Dukacz, Barbie Kelly



However, Willis pointed out, new roads have been built from this threatened area to the new levee, so safe ground is now much closer than it used to be. That, of course, assumes that the new levee holds up.

John Cain believes even residents behind the new levee are not safe. If the old levee was breached, he said, rushing water could pound into the new levee and break through it or under it, because it is built largely from compacted soil and sand, rather than clay. Also, he added, seismologists believe a still-poorly-mapped fault line known as the Midland Fault runs near Hotchkiss Tract.

Don Hofer, a vice president with Shea Homes, disagreed. He said the new extra-wide levee is armored in strategic places with a mix of concrete and dirt to withstand any scouring effect from fast-flowing water. He said the compacted soil and sand provide a solid foundation and structure for the levee. He also insisted that the

company's project is not on a fault line, and that the levee performance during an earthquake would be "very good." Seismic maps, however, show fault lines, including the Midland and Antioch faults, not far from the project.

"If it happens, it happens."

Just north of Hotchkiss Tract, across a canal filled with yachts and dinghies, an old community of golfers, retirees, and commuters has been living behind the dirt levees that encircle Bethel Island. They are linked to the mainland by a single bridge. The sandy island is below sea level and was flooded three times in the early 1900s, but not since.

Tom Culotta, 61, a former flooring contractor now living on a disability pension, moved his mobile home to the Island Park trailer park on Bethel Island to be near his elderly mother. He has lived in the Delta for 40 years and said he's "not really concerned" about flooding, as he can pack up his trailer in half an hour and drive to the top of a levee. Even the New Orleans disaster didn't faze him. "If it happens, it happens," he said. Sitting outside his mobile home with his dog Blanco, he recalled one big storm on Bacon Island near the Delta center in 2004.

"There was a train track ran down the middle of the island on top of the levee, and the levee washed away and flooded the island," he said. "The train fell in the water—it was a cargo train—and made a big mess of things."

Nearby neighbor David Mariscal does worry. He moved in from Brentwood four years ago to be closer to his maintenance job at the Bethel Island golf course. He said he saves on gas and enjoys the friendly community. On a hot day, his home feels serene, standing under tall poplars, amongst potted flowers, patio tables, and pickup trucks. But he said, pointing south, "Look. You come over that bridge. Look how low we are, below the water. And you start thinking about it . . . we're like a sunken island. The only way out of here is over that bridge."

Mariscal hopes that government officials look after the levees sufficiently. Local reclamation districts are largely responsible for maintaining and repairing the levees, with support from the State. Mariscal knows only too well that money is always short, so he revealed his own evacuation plan. "Climb the highest tree," he said, laughing. "There's not an easy way to get out." After the New Orleans fiasco, this was a point brought home to California Governor

Below: A Landsat 7 photo of the Delta

Bottom: A levee-top road runs beside a canal in the central Delta.



Arnold Schwarzenegger. The governor toured the Delta by helicopter, declared a levee emergency, and in 2006 pushed through a \$5-billion flood protection bond that included \$3 billion to improve levees.

To ensure that all levees are safe, however, three times that amount is needed, said David Mraz at the Department of Water Resources.

Should a multi-levee failure occur, the disaster would affect all of California. In *Re-envisioning the Delta*, U.C. Berkeley engineering professor Raymond Seed estimated that any disaster that caused more than ten to 12 levees to fail could knock out the water supply for two of every three Californians for more than a year. Because the Delta is a basin, salt water from San Francisco Bay would be sucked into it, ruining the water quality and stopping the flow of water south.

Earthquakes are a major threat. The Department of Water Resources reported in 2005 that a 6.5-magnitude earthquake in the Delta region—bigger than the 1966 Donner Pass temblor that registered 6.0 on the Richter scale and swayed Sacramento buildings, but less severe than the 1989 Loma Prieta earthquake, which measured at 7.1—could damage more than 30 levees and cause massive flooding. With six major faults nearby, officials are worried. The United States Geological Survey estimates there is a 62 percent probability of a 6.7 or greater magnitude earthquake in the nearby Bay Area in the next 25 years.

A Cheerful Plea of Insanity

Even these statistics seem to bounce off many Delta denizens. Bonnie Brown, 57, a former bartender who has been living in a houseboat on the Middle River in the center of the Delta for 12 years with her dog and five cats, found her last flood experience about five years ago “very exciting.” She said, “The water was just rushing. I mean it was just rushing, fast, fast, fast. I didn’t know if I was going to go off my pylons. That would have been a problem.”

The boat did not break loose then, and Brown’s biggest concern now is the heavy “wave boats” that tear down the river creating large waves for water skiers to jump over. “You get that big three-foot roller coming in. It just rolls and rolls and rolls. It breaks white water on the shore, and it just washes out the levee,” she said.

Brown said she originally came from Reno to help a friend restore his boat. She loved the peace and quiet, and bought her own houseboat, where she now gardens, does stained glass



The San Joaquin River seen from atop a levee

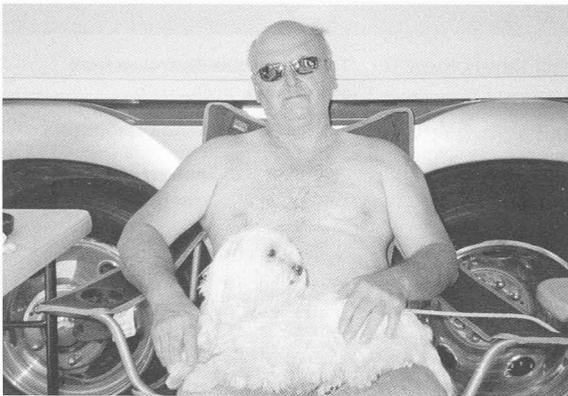
art, and entertains her two grandchildren. Sure, the flood danger is real, she said, but she’s not budgeting. “I guess you just have to be crazier than they are,” she said, smiling and indicating the world at large around her.

This cheerful plea of insanity is not uncommon for old-time residents. Newcomers seem more bemused. Robert Guinan, who bought a house in Mossdale Landing, a new 2,300-home development just east of Lathrop in the southern Delta, laughs at his own rashness. He not only bought in an area protected by old levees, but got in at the top of the housing market prices. After 20 years of living “all over” the East Bay, the 43-year-old government employee moved to Mossdale Landing two years ago with his wife and three children. At the time he felt his investment was solid. As his mother-in-law was also moving to Mossdale, he got a free nanny, too.

These days he sits on his front porch looking at the grand, empty houses for sale around him. The possibility of a flood is only one of the spooks in his life. With the Central Valley property market having swung from boom to slump, as elsewhere, he has lost hope of a quick profit on his home.

“We were hoping to put our kids through college with the profit (from the house). It didn’t turn out that way. These are a bunch of white elephants now,” he laughed wryly.

Guinan said he had been aware the Delta was prone to flooding, but when it came to discussing the final details with the sales agent, the discussion went like this: “That’s just one of those things. Don’t worry, there’s only a hundred pages to sign. Just sign this page and move along. That doesn’t mean anything. Just keep signing. Sign your life away.” Guinan laughed again, throwing his hands up. “I was aware of it. But life is a risk.



Top: Stevie Marzette, Tammy, Roderick, and Savanna Martinez (clockwise from top left) by Summer Lake on Hotchkiss Tract

Above: Tom Culotta and his Maltese dog, Blanco, by their mobile home at Island Park on Bethel Island

It's like driving to the Bay Area every day. You take a risk."

He remembers seeing the giant 1997 flood in the Delta on television. More than 30 levees were breached after heavy winter rains and a substantial snowmelt in the Sierra. Thousands of acres of farmland and hundreds of homes were inundated, with the worst flooding

along a 15-mile stretch of the San Joaquin River, north of where it intersects with Interstate Highway 5. Nine people died. But it was television, Guinan said. It didn't hit home that this could happen to him.

"It's foolish actually," he said. "I haven't seen the flood, only heard about it. If I'd seen it, I would be more apt to say, 'Forget it.' I wouldn't move out here."

Wanting to get into a new home as cheaply as possible, he didn't buy flood insurance. And because Mossdale is officially outside of the Delta flood-zone map, he is not required to. But that could change. The Federal Emergency Management Agency (FEMA) is redrawing the flood-zone map, which in some places is 25 years out of date. City and county officials are scrambling to provide proof that their levees meet the so-called federal 100-year standard. If they don't, the areas behind those levees will be brought within the official flood zone, and homeowners with federally backed mortgages (most mortgages are federally insured, by Freddie Mac or Fannie Mae) will be required by federal rules to buy flood insurance. At Mossdale Landing, the age of the levees and the new FEMA requirement for better-engineered levees casts doubt on the community's future.

The City of Lathrop, which approved the Mossdale development, is working on a submission to provide proof to FEMA that its levees are up to scratch. FEMA spokesman Frank Mansell said the agency expects to present local authorities with the preliminary version of an updated flood zone map this autumn.

Often home buyers who are told their homes are behind a levee built to a standard known as the "100-year levee" feel comforted, thinking the levee was built to withstand floods for at least a hundred years. In fact, the standard means that in any year there is a one-in-a-hundred chance of a flood big enough to breach the levee. FEMA described the 1997 flood as a "typical" 100-year flood, according to the *Stockton Record*. *Re-envisioning the Delta* says that taking into account all residual risks (such as the once-in-200- and once-in-300-year floods), there is a 26 percent chance that over the life of a 30-year mortgage a house protected by a 100-year levee will be inundated by a flood.

That calculation rattles Saphon Hok, a young research scientist who bought a home at Mossdale Landing two years ago. He was not pleased to learn that if FEMA puts Mossdale within the flood zone, he and other local homeowners with federally backed mortgages will be required to buy flood insurance. Flood insurance, which only provides home coverage to a maximum of \$250,000, can cost \$1,400 to \$4,600 a year, according to FEMA. Being in the flood zone could also affect a home's value.

"My wife and I are here for the long term, so we bought a house to live in, not get a return," Hok said. "But I would be concerned if we have to pay extra money for insurance."

Hok moved to Mossdale because he and his wife could not afford to buy in Livermore, where he got a job after graduating from U.C. Davis. Having almost drowned in a flood in Cambodia when he was five years old (his sister plucked him out), he is conscious of the power of large bodies of water. Before buying, he was aware the Delta was vulnerable to flooding, but, he said with a frown, "We took the risk anyway. And let us assume there won't be any flooding in our lifetime."

Although Mossdale has not flooded seriously to date, it is across the San Joaquin River from land flooded in 1997. That giant flood exposed seepage problems in the levee protecting the Mossdale community. In 2002, the U.S. Army Corps of Engineers wrote to the Lathrop City Council expressing concern at the plan to build

homes in Mossdale. The Corps asked for new drains and new engineering work to bring the levee to a higher standard. Lathrop fixed the drains. But as for the engineering work, the Council merely replied that the levee met the federal 100-year standard (albeit from 1989) and left it at that.

John Cain, of the Natural Heritage Institute, said plans for another 11,000 homes in a development called River Islands just across the San Joaquin River could leave Mossdale even more vulnerable. River Islands will be protected by “super levees” along the river. Cain said this could increase the pressure on Mossdale’s aging levees on the other side if the river floods. Lathrop City Council spokesman Mike Esau commented, “Our experts say to their knowledge [the River Islands levees] do not appear to represent a threat at all.”

Council spokesman Esau and Bruce Myers, a vice president with Mossdale’s master developer, Pacific Union Homes, both said in telephone interviews that the levees and the project met all the required standards when the development was approved by Lathrop.

All of this debate was news to Matt Kan, who was peacefully fishing on the river, just over the levee from his Mossdale home on a sunny day in early June. Putting down his rod, Kan said a flood would “be a disaster” for him. He explained that he and his family, including two children, live with relatives during the week in San Jose, where he works as an engineering manager. They could not afford their own home in San Jose, so they bought in Mossdale and stay there each weekend. It is great for the kids, he said.

“It’s a place for them to grow. Everything here is brand new. The school is new. The neighborhood is brand new. People are brand new. It’s a way of looking at a fresh start for my family and myself,” he said.

Kan’s aspirations are shared by thousands of Bay Area families, some of whom could also make their way to the Delta looking for their dream homes, if developers continue to get their way. A growing torrent of protest from scientists, environmentalists, bureaucrats, and some politicians is starting to counteract the fierce lobbying of major developers. Demographer Hans Johnson of the Public Policy Institute, a San Francisco-based nonprofit economic, political, and social research organization, projects that the population of the five counties that share wedges of the Delta will more than double, to 7.5 million, by 2050 if restraints on growth are not put in

place. Already, tens of thousands of new homes are proposed for the Delta region.

Governor Schwarzenegger hopes to curb this growth until the State can be sure the levees are secure. His office is circulating a proposal to require new housing projects in high-risk areas to meet tougher flood-risk criteria. Adam Mendelsohn, the Governor’s communications director, told the *Sacramento Bee* in June that the Governor does not want to shut down construction in the state, and “everything is being debated.” Any bill is likely to face fierce opposition from major developers, who also happen to be big donors to legislators’ coffers.

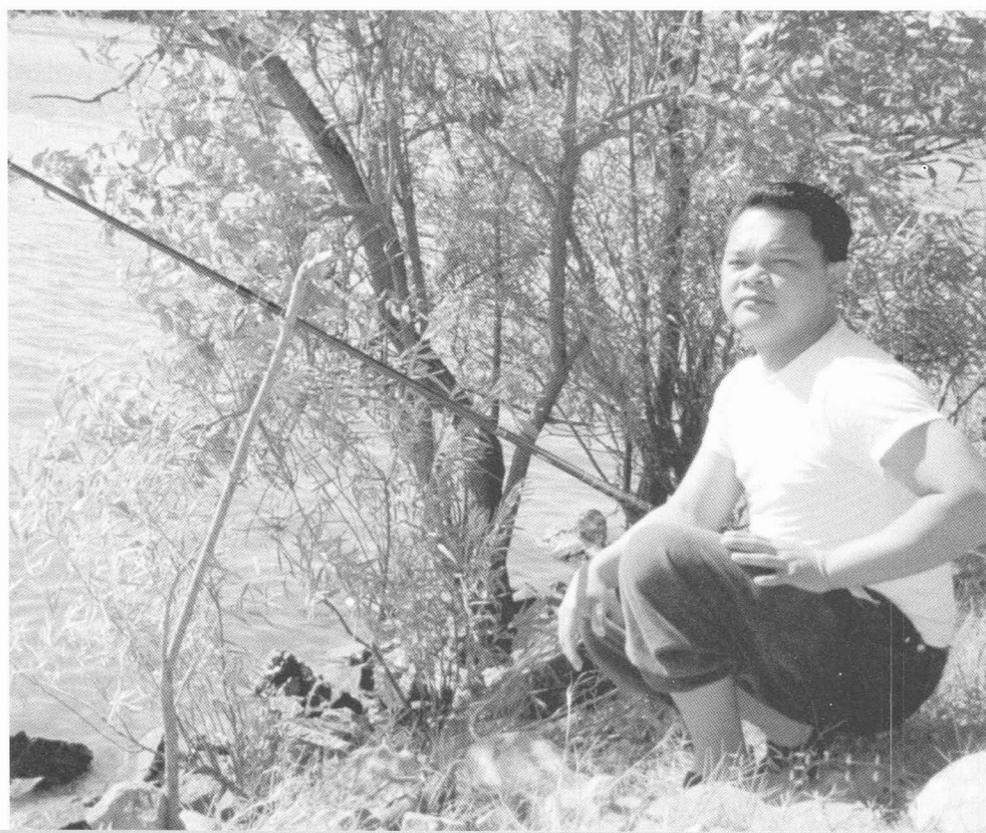
Meantime, Kan says he’s planning to give up some of his fishing time to check out the flood risks. He also aims to finally get around to looking for flood insurance.

“But right now, we’ll just take it as it is,” he said, picking up his rod. “Hopefully it doesn’t happen. Hopefully they fix the levees.” ■

Shirley Skeel, a frequent contributor to Coast & Ocean, is a radio and print reporter who recently moved from the San Francisco Bay Area to the Seattle area.

Below: Living below sea level requires safety precautions.

Bottom: Matt Kan fishing



Tainted Greens

E. COLI PANIC PUTS FARMERS IN THE CROSSFIRE



The combination of cattle and floodwaters can contaminate crops.

CARL NAGIN

LATE IN AUGUST 2006, THE FEDERAL Centers for Disease Control and Prevention (CDC) in Atlanta began investigating cases of severe food poisoning reported by health officials in 26 states and one Canadian province. Over the next six weeks, a rare and particularly virulent strain of *Escherichia coli* 0157:H7 sickened more than 200 people, hospitalizing half of them, some with severe kidney damage, and killing two elderly women and a child. For epidemiologists, the outbreak presented a breakthrough because a DNA-fingerprinting system enabled CDC investigators to trace back the source of the infections from clusters of cases nationwide.



The Salinas River periodically floods parts of nearby fields, which can increase the risk of spreading pathogens.

Bacteria in stool samples of hospitalized patients were genetically matched to pathogens in pre-packaged, “ready to eat” Dole brand spinach that they had recently purchased and consumed. Further, product codes on the bags indicated that the contaminated greens had been processed during one shift on August 15 at a plant then owned and operated by Natural Selection Foods. The company’s records showed that the spinach had been harvested from four fields in Monterey and San Benito counties.

Just how the spinach became contaminated and where in the process from field to package the bacteria originated will probably never be known. An investigative report released last March by the Food and Drug Administration (FDA) could make “no definitive determination” as to “how *E. coli* 0157:H7 pathogens contaminated spinach in this outbreak.”

The consequences of the crisis fell heavily on Central Coast farmers, who are now being pressed by buyers to comply with a conflicting array of new food safety measures, some of which are costly, scientifically unproven, and environmentally harmful. Some violate state regulations, and may even be counterproductive to food safety. But the growers must follow these measures in order to market their crops to the larger contractors or handlers.

The farmers’ predicament is jeopardizing the future of sustainable agriculture and of the habitat and clean water it supports, according to the Nature Conservancy’s Monterey Project Direc-

tor Chris Fischer: “Farmers and conservationists in California have been working together for more than 20 years to develop practices that help protect water quality and wildlife habitat, but since last fall, farmers have been under enormous pressure from their buyers to go the other direction,” she said. “To stay in business, they are being forced to build miles of fences along streams, cut down trees, and bulldoze ponds. Some actions, like creating bare-earth buffers along waterways, may actually increase the risk of contamination downstream.”

Search for the Source

The *E. coli* outbreak of August 2006 was “one of the worst ever reported in produce,” stated a 2006 “Critical Issues” report by the nonprofit Organic Center, which conducts peer-reviewed scientific research on organic food and farming. It prompted investigations by the FBI and FDA and led to one of the largest product recalls in U.S. history: On September 14, 2006, the FDA issued a consumer and retailer advisory not to eat or sell any bagged or fresh spinach. This advisory remained in effect until September 22.

Hank Giclas, vice president for science and technology for Western Growers, a produce industry group, remembered the day the nation’s spinach industry was shut down. “I was in my office, and we were frantically summoned to a conference call with FDA officials. Their advisory took everyone by surprise. It was an unprecedented action. They’d never before issued any



The Salinas River

kind of blanket ‘Do not consume spinach’ warning. The industry ground to a halt.”

Members of Western Growers in California and Arizona grow, pack, and ship nearly half the nation’s fresh fruits, vegetables, and nuts. Giclas estimated that the shutdown cost the spinach industry roughly \$100 million and affected other bagged salad produce as well.

On September 20, five weeks after the Natural Selection Foods plant had processed the spinach for Dole, FDA investigators began taking soil and water samples from four of the ranches where it had been grown and harvested. Samples from one ranch in San Benito County had *E. coli* pathogens indistinguishable from the strain identified by the CDC’s DNA fingerprinting system, PulseNet. These were found in soil, river water, and cow and feral pig feces at Paicines

Ranch, a large grass-fed beef operation that had leased a small amount of its land to a spinach grower. But these *E. coli*-infested samples were found nearly a mile away from the implicated spinach field. None were found on the plot itself.

Whatever the origin and pathways of the outbreak, the washing procedures at the processing plant failed to eliminate the pathogens, and its quality assurance protections failed to detect it after the processing. The FDA report was heavily redacted for “proprietary reasons,” advantageous to Natural Selection Foods’ operators, who were quick to divert attention back to the fields and away from the manufacturing end.

In an October 15, 2006 article in the *New York Times* (“The Vegetable-Industrial Complex”), author Michael Pollan, who has written widely about food and its production, noted that “a

great deal of spinach from a great many fields gets mixed together in the water at that plant, giving microbes from a single field an opportunity to contaminate a vast amount of food. The plant in question washes 26 million servings of salad every week. In effect, we're washing the whole nation's salad in one big sink."

The FDA, which is responsible for safeguarding 80 percent of the nation's food supply, had known about contamination problems in spinach and other Central Coast and Salinas Valley produce for years. Over the last decade, nine other E. coli outbreaks associated with the area's leafy greens had been documented. Prior warnings from the FDA and the California Department of Public Health included letters to Salinas packers, Western Growers, and other industry groups, calling for implementation of safer manufacturing and sanitation practices and, more recently, alerts about wells and irrigation systems contaminated with animal wastes.

However, the FDA has little enforcement authority over the food industry, in contrast with the U.S. Department of Agriculture (USDA), which monitors and regulates meat, poultry, and eggs. The USDA has onsite inspec-

tors at the nation's slaughterhouses with the authority to shut them down if they fail inspections. The FDA's food safety oversight has been the target of intense criticism from congressional critics, including John Dingell (D-MI), chair of the House Committee on Energy and Commerce, and from advocacy groups who complain about its coziness with the produce industry. The FDA's inspection capacity has been decimated by budget cuts in recent years. Between 2003 and 2006, the number of safety tests for U.S.-produced food decreased nearly 75 percent, from 9,748 to 2,455, according to FDA statistics. Last April, Robert E. Brackett, director of the FDA's food safety division, told the *Washington Post* that he believes manufacturers are better equipped to "build safety into their products rather than us chasing after them."

Industry Shapes a Safety Plan

Immediately following the outbreak, prompted by the FDA and California's public health and agriculture departments, Western Growers began developing a Leafy Greens Marketing Agreement, with guidelines that would serve as a standard for certifying the safe handling,

Fields of greens below grazing cattle near the Salinas River



shipment, and sale of produce marketed by its signatories. This agreement would be administered by the California Department of Food and Agriculture (CDFA), which would use a USDA-designed inspection program that has been applied in other states.

The Secretary for Food and Agriculture, A.G. Kawamura, is a past president of Western Growers. Last February, he appointed an advisory board for the marketing agreement composed almost exclusively of representatives from the bigger “handlers”—those who process, package, ship, and distribute leafy green products. Conservation groups and resource agencies that had been working for years with Central Coast farmers had complained from the outset that the Western Growers’ initiative was a closed-door process designed to serve the interests of handlers and big buyers. California Certified Organic Farmers, one of the nation’s oldest and largest certifiers of organic produce, criticized the “lack of transparency in the process.”

When word got out about some of the measures proposed in discussions, such as plowing up riparian buffers, eliminating wildlife, and erecting high fences around fields, alarm spread through the farming, regulatory, and conservation communities.

On October 25, 2006, Roger W. Briggs, executive officer of the Central Coast Regional Water Quality Control Board (RWQCB), aired his agency’s concerns in a letter to Brackett at the FDA, with copies sent to Giclas at Western Growers and other industry groups. The emerging guidelines (known variously as metrics and GAPS—good agricultural practices), “may conflict with the [RWQCB’s] mission to protect water quality and may increase water quality

violations in farming areas,” Briggs wrote. “We are aware of concerns that riparian or on-farm vegetation may attract wildlife that may spread the 0157:H7 E. coli, but are not aware of any research to support those concerns.” He requested a meeting with the FDA and the opportunity “to review any future proposed food safety guidelines or suggested farm practices that may affect water quality.”

Almost three months later, on January 10, 2007, with Briggs still awaiting a response to his letter, the water board’s chairman, Jeffrey Young, wrote to CDFA and Western Growers, noting that 92 percent of the region’s total irrigated acreage—including all the acreage farmed by the large growers of leafy greens—was enrolled in collaborative programs designed to improve water quality. “We know that vegetated conservation practices are among the most effective tools for protecting and improving water quality,” Young wrote. “Millions of federal and state taxpayer dollars have been invested in researching and promoting conservation practices, and in assisting farmers in implementing such practices.” He warned that a “major accomplishment on the part of the agricultural industry” was now at risk.

Not until after Young’s letter, as well as letters from the EPA, the Department of Commerce, and other agencies were fired off, did Western Growers respond to these concerns. It amended an early draft of the marketing agreement to incorporate the conservation concerns and comments of resource agencies, including this language:

Fencing, vegetation removal, and destruction of habitat may result in adverse impacts to the environment. Potential adverse impacts

Salinas Valley, “The Nation’s Salad Bowl!”



CARL NAGIN

include loss of habitat to beneficial insects and pollinators; wildlife loss; increased discharges of sediment and other pollutants resulting from the loss of vegetative filtering; and increased air quality impacts if bare soil is exposed to wind. It is recommended that producers check for local, state, and federal laws and regulations that protect riparian habitat, restrict removal of vegetation or habitat, or restrict construction of wildlife deterrent fences in riparian areas or wildlife corridors.

The Marketing Agreement addresses a wide range of food safety issues, including sanitizing farm equipment; preventing transfer of pathogens from field workers; wildlife encroachments from deer, goats, pigs, cattle, and sheep; soil amendments; and water usage. (See Western Growers' website, www.wga.com, for the June 2007 draft.)

Among those who thought that the agreement fell short of what was necessary was Dr. Charles Benbrook of the Organic Institute, who sent comments to Western Growers, some of which, he acknowledges, were adopted in various drafts of the agreement. But Benbrook found the document remains most seriously flawed with respect to water testing requirements. The required test is based on the wrong organism, and the standard applied to testing for *E. coli* in irrigation water is "unscientific and indefensible," because it relies on "an outmoded recreational water quality risk assessment" from the mid-1980s used by the EPA to test swimming water, he states in a June, 2007 report, "Unfinished Business: Preventing *E. Coli* 0157 Outbreaks in Leafy Greens" (available at www.organic-center.org).

The metrics do not require testing irrigation water specifically for *E. coli* 0157, only for generic *E. coli*, Benbrook states. He concludes: "Water with detectable levels of *E. coli* 0157 should not be used to irrigate leafy greens. Period."

Numerous phone calls to Hank Giclas of Western Growers asking for comment went unanswered.

The Marketing Agreement went into effect last April, and as of June, 111 produce handlers, who process nearly all the leafy greens produced in California, have signed on to it. However, the conflict over ways to ensure safety is far from over, and farmers are hard-pressed in its midst. Some major handlers and contractors who have signed the agreement, including packaged salad giant Fresh Express, are individually demanding



that farmers take additional safety measures, including some that have little science or common sense behind them.

Cattle graze near a field where some contaminated spinach was harvested, January 2007.

No Dogs No Frogs

Fresh Express, purchased in 2005 for \$855 million by Chiquita Brands International, is the nation's top producer of packaged salads, producing 40 percent of those sold in supermarkets. Last year the company processed 1.2 billion pounds of raw lettuce and spinach. Although it signed the Western Growers agreement in April, Fresh Express has its own far more demanding requirements for greens it buys.

Jim Lugg, senior food safety scientist with Fresh Express, has worked with the Salinas-based company since 1963. He said the company supplies growers with its own set of field management guidelines and good agricultural practices, but would not provide me with these, saying they are a "proprietary document protected by copyright." Instead, he referred me to an October 23, 2006 article in *USA Today* ("Fresh Express leads the pack in produce safety") that outlines some general requirements.

According to this article, Fresh Express will not accept produce from fields grown within a mile of a cattle feed lot or dairy operation, or if they are within 150 yards of rivers or habitats that attract wildlife. Fields that show evidence of wild pig visitation cannot be harvested for two years. The company also demands fences and rodent traps every 50 feet around field perimeters.

"If we find animal tracks in a field," Lugg told me, "then we don't believe that the product is safe to harvest." That means, he said, any animals—from frogs to dogs. "We don't like to see animals in a field of lettuce. We don't think people like the

idea.” Asked if this were more about cosmetic issues than food safety, he replied: “What you need to realize is that many more bovine intestines have been studied than mice to see if they are carriers of *E. coli*. Maybe mice and kangaroo rats are just as risky as large animals.” He added that among studies the company has funded is one to examine whether insects are disseminating 0157.

Asked whether he had talked with environmental agencies about the impact of Fresh Express food safety guidelines on riparian habitats in the Salinas Valley, Lugg responded: “It’s not our place to do that. Some public agencies need to do that.”

Steve Church is a co-owner of the Salinas-based Church Brothers, a large grower, shipper, and processing company known for its True Leaf Farms brand. Shortly after the outbreak, Church Brothers announced that it would install six miles of additional fencing around its lots “to prevent any wildlife intrusion into our fields.” In late May, the company announced a price increase of 20 cents per package on all True Leaf and Church Brothers produce. It justified the increase as a cost of its new food safety measures, including fencing. Steve Church is a member of the California Leafy Green Handler Marketing Board, which makes recommendations to the secretary of agriculture and the CDFA on the operation of Western Growers’ Marketing Agreement and the inspection program intended to give it teeth.

I asked Church about the apparent contradiction between the Marketing Agreement and Fresh Express’s more aggressive stance toward fencing and wildlife.

“We [Church Brothers] adhere to Fresh Express guidelines,” he said. “You gotta do that if you want to be a vendor, or not sell to them. If you grow for Fresh Express, you’re more limited in the land you can use. Their recommendations go beyond the agreement.”

Farmers in the Crossfire

Bob Martin, a past president of the Monterey County Farm Bureau, is general manager of Rio Farms, one of the largest growers and employers in King City. These days he spends much of his time trying to make sense of demands imposed in the name of safety by various buyers and handlers who contract for his produce and market it.

“I grow for several different companies, and each one is requiring a different level of compliance,” he said. “They’re fighting for customer

bases in the big box stores, Costco and Wal-Mart. They’re battling for those accounts by saying ‘My product is safer than yours.’”

“I understand we have to get consumers’ confidence back,” he continued. “Spinach sales haven’t recovered. We’re only selling 75–80 percent of our produce, and bagged salads have taken a big hit. But a lot of this is all smoke and mirrors. We need good solid research that will tighten up some of these metrics. How long does the bacterium survive in soil? In water? Are deer really an issue? How far will *E. coli* 0157:H7 travel in the wind? People are looking for answers.”

Last April, speaking at a conference on water quality and food safety in San Luis Obispo, Martin told of farmers being asked to fence their fields and tear out riparian habitat that they have restored to comply with environmental regulations. He pleaded to his audience, which included researchers from the National Science Foundation, the USDA, and the FDA, as well as academic microbiologists, environmental scientists, and crop and food safety specialists: Farmers need help, now. He urged the researchers to talk to industry leaders.

Safeguards or Marketing Ploys?

The crisis has everyone involved in the leafy greens business, especially farmers, on high alert—and nervous. “Maybe some of these things we should have been doing years ago,” said a Salinas Valley grower who asked not to be identified. Keeping cattle pasture a distance away from crops was a good idea, he said. How great that distance should be is another question. Another farmer told of a grower who was asked to remove a grassy waterway to get rid of frogs and rodents. A story is going around that the crop of one field was rejected because crows had been seen flying over it.

Kirk Schmidt, executive director of the non-profit Central Coast Water Quality Preservation, Inc., which is involved in environmental monitoring and helping farmers preserve water quality, believes that the debate over safety measures for leafy greens is being driven by people who work in risk management and the legal departments of the big producers and supermarket chains—people “who don’t understand that crops are grown outside in the dirt.” That’s bad news for water quality and sustainable agriculture in the Central Coast.

Liability, along with branding and creating a positive image for produce, is not a trivial concern for big handlers and packagers like Dole

and Fresh Express, which together control 90 percent of the retail market for packaged salads, according to the Produce Marketing Association. The Seattle law firm Marler Clark successfully represented victims of last fall's E. coli outbreak in lawsuits against Dole. Since 1973, the firm has won settlements and verdicts for food sickness victims totaling \$300 million. That amount is nearly three times the total production value of Monterey County's entire spinach crop in 2006. Monterey County's \$3.5-billion agriculture industry has been turned upside down by the food safety crisis.

Amidst all the distress and anger in the farming community, Martin relies on caution and vigilance. "I look to our work force," he said, "anyone in the field. The awareness of employees is so heightened that I think if it had been at that level before, this wouldn't have happened. They see a deer—they bring it to the managers' attention. They find lettuce with bird poop on it—where before they might have just taken off the leaf, now they drop it."

Fencing the River

In June, I drove with Martin along a stretch of the Salinas River to see first-hand what some of the new, so-called "clean farming" practices imposed by buyers and contractors were all about. (Martin asked that I not identify any of the growers whose fields we observed.) We took a dirt-and-gravel backroad to a field of spring mix planted near the riparian thicket of cottonwoods, willows, and grasses that marks the outer edge of the Salinas floodplain. What was striking about those plots of red and green baby lettuces were the new eight-foot-high chain-link fences installed to guard and tower above them, like some satellite yard of Soledad Prison, 20 miles north. "To keep out the deer," Martin said.

Deer were not implicated in the FDA's March 21, 2007 investigative report on the matter, which focused on cows and feral pigs roaming the ranches close to the suspect spinach plots and on conditions at the processing plant. The fencing I saw going up along river corridors of south Monterey County, much of it visible only from secondary roads, runs about \$5 per foot, Martin said, or \$45,000 per mile. For the bigger growers that can add up to \$150,000 in new costs, not a penny of which will be paid for by their buyers and contractors, who now require it.

A boom in orders for fencing and rodent traps is part of the new world of clean farming around King City, where, as Martin points out, none of



Top: A worker takes a sample of spinach from a harvest machine to test for pathogens.

Above: Collecting spinach from a field for testing

the nine E. coli outbreaks associated with Salinas Valley agriculture in the last decade have occurred. It is hotter here, he explains, and one thing scientists *do* know about E. coli is that, airborne, it's very unstable: It can be irradiated and neutralized by sunlight and hot winds.

Terry Palmisano, a senior wildlife biologist with the California Department of Fish and Game, warns that food safety concerns have the potential to create a 100-mile stretch of fencing on both sides of the river. If that happens, "you lose that as a corridor, a way for wildlife to come down out of the hills and cross the river," she said. "And when it floods, the wildlife can't escape."

On June 7, Martin attended a workshop with the agency's wardens and chief biologists at the Monterey County Agricultural Center in Salinas.



Fencing out wildlife along the Salinas River near King City (in June, before the new fencing ordinance was passed)

Scores of farmers packed the room, along with officials and representatives of industry groups and environmental agencies concerned with what's happening to Central Coast agriculture.

"Buyers are concerned about animal tracks from deer, pigs, cattle, sheep, and goats," Martin told the gathering. "Say you've got a 20-acre block of head lettuce or romaine out there and all of a sudden you're two days from harvest, and you go to the field and there's a lot of animal tracks. The deer came in the night before. They may not have done anything. They just walked through the field. But it's up to the scrutiny of the buyers, who can say: 'You know what? I don't want that deal.' So we're forced to protect our ground from these 'animals of significant risk' and put up fences. You can't [fence around] every little bend [in the river], and you don't want to forfeit a bunch of farmland that you're already using. So you're going to cut some corners in riparian habitat. Nobody wants to talk about this issue. We've never had to be concerned about this before."

Martin was a leader in voicing farmers' concerns to Western Growers as it developed its guidelines, and he now serves as a technical advi-

sor to the organization. Over the years, he has worked with a number of nonprofit organizations and governmental agencies that seek to protect water quality in the Salinas Valley. Like many growers, he finds himself in a crossfire between environmental and food industry interests. He worries that the buyers who are demanding stricter measures are far removed from the realities and consequences of what they are asking.

His views were echoed by many growers at the Salinas workshop, including Benny Jefferson, another member of the Farm Bureau Board and chairman of the Salinas River Channel Coalition. "Anyone from Costco here?" Jefferson asked from the podium. "Wal-Mart? Safeway?" Nobody answered.

Nobody from the industry was there to help the farmers who feel trapped between food safety guidelines they must follow to earn their livelihood and resource agencies' rules they must violate to comply with industry metrics. Nor have Fish and Game or Water Quality Board staff provided clear answers to the farmers' dilemma.

Local regulations prohibited fencing over six feet high along the river until July 10, when the

Monterey County Board of Supervisors, under pressure from processors, passed an “interim urgency” ordinance allowing eight-foot fences. The *Monterey County Herald* noted that the new ordinance waived both 50-foot setback requirements and state environmental regulations.

The pressures on growers are mounting. Vegetation removal in the name of food safety is also a concern for the California Department of Transportation (Caltrans), which has been warning growers about encroachments on land abutting state highways. Caltrans District Director Richard Krumholtz wrote the Monterey County Farm Bureau last spring that his department had observed an increasing number of ranchers and farmers removing plant life “in direct violation of Caltrans vegetation management policies, environmental law and permits.”

It's Counterproductive

“The industry is still in crisis mode, and they are making tremendous errors in standards,” said Kirk Schmidt, a former owner of Quail Mountain Herbs, who represents agriculture on the Monterey Bay National Marine Sanctuary's Advisory Council. “It will take at least a year to undo the screwups before we can talk about restoring environmental requirements to the [food safety] auditing standards. The most important single thing you can do to improve water quality is to keep the sediments on your field, and the second most important thing is keep irrigation on your fields. And that's easier with grassy buffer strips and grass roadways.” Farmers along the Salinas River are being forced by the bigger produce buyers to remove these, according to Schmidt, even though such vegetative buffers mitigate the hazards of toxins, including *E.coli*.

“There's a ton of evidence,” said Dr. Charles Benbrook, “that buffers are effective in filtering out pesticides contained in runoff, and recent studies suggest that 40-foot-wide riparian shrubs and thick grass cover filter out large quantities of *E. coli*.”

That view was supported in a U.C. Santa Cruz research brief published in fall 2006 by the Center for Agroecology and Sustainable Food Systems. Citing more than 80 studies, it noted that removing vegetation-based practices such as filter and contour buffer strips, grassed waterways, vegetative barriers, and constructed wetlands, “would not only reverse progress towards addressing water quality issues, but could also potentially increase the presence and transport of pathogens.” Although food safety and envi-

ronmental protection are interconnected, the research brief argued, they are now on a collision course in the Salinas Valley.

“Millions of dollars of taxpayer money have been invested in helping farmers develop sustainable agriculture and address non-point source pollution,” said Jovita Pajarillo, associate director of EPA's Region 9 water division. “Now we're hearing horror stories about growers going out with bulldozers to remove hedgerows. You can't blame them; they've lost millions. But such practices may result in an enforcement action against them because of water quality concerns.”

Pajarillo works with the California Roundtable, a coalition of environmental groups and agencies that, along with food safety and agricultural industry representatives, is trying to address the conflict. They hope to bring the major buyers to the table and begin a dialogue. So far that hasn't happened.

“I see both sides digging in their heels,” said Michael Payne of the Western Institute for Food Safety and Security at U.C. Davis. “What's needed here is common sense and individualized risk assessment for a particular farm. . . . Some practices are no-brainers, and others we don't have research on.” Payne hopes the money that industry is now pouring into the Institute's research will help it become a meeting ground.

Dr. Benbrook was less enthusiastic about the priorities of the industry-funded research. “Are people being honest about what farmers need to do?” he asked. “I'm not super-impressed with the lack of focus on critical variables such as managing cow manure. There's been a systematic effort to leave the cattle industry out of the dialogue. ‘Let's not look under that rock.’ And that's ridiculous. . . . There's no feral pig lobby, and pigs are a convenient scapegoat for this. Let's learn something new about this bacterium [*E. coli* 0157:H7] and find some different ways to prevent and deal with it.”

The science of how *E. coli* gets into produce is still in its infancy. According to Linda Harris, a U.C. Davis food safety researcher, “It's less than a decade old.” She believes that “we will never eliminate food-borne illness entirely.” Meanwhile, the conflict between food safety and environmental protection has left Central Coast growers twisting in the wind.

If and when the next outbreak occurs, will the onus again be put on them? ■

Carl Nagin is a Berkeley-based reporter whose work has appeared in the New Yorker and on the PBS documentary series Frontline.

“ONCE SEEN, IT WILL NEVER BE FORGOTTEN”

George Davidson and the Point of the Beginning

JOHN CLOUD

IMAGES COURTESY NOAA CENTRAL LIBRARY

ONE MORNING IN 1850, George Davidson and a small survey crew watched the morning fog part to reveal Point Conception, the most dangerous coastal promontory in California. Their small steamship, the *Ewing*, maneuvered past the wave-dashed headlands to leeward, as the crew looked for any small refuge from the booming surf. Their objective was to row to the beach in whaleboats loaded with supplies and two heavy brass telescopes. Davidson and his men were beginning the work of the U.S. Coast Survey in Pacific waters.

It is now 200 years since Congress authorized President Thomas Jefferson to organize a Survey of the Coast. It began on the Atlantic Coast as an exercise and developed into an institution. The Survey of the Coast became the Coast and Geodetic Survey and then the oldest element of the National Oceanic and Atmospheric Administration, or NOAA.

In Jefferson's time, travel by water played a role in human affairs we can now scarcely imagine. There were no railroads, and beyond the East Coast there were not yet many roads. Accurate charts of the coast and sea routes were vital, but also very rare. Jefferson accepted the proposal of a Swiss immigrant named Ferdinand Hassler to survey the coast in a certain way.

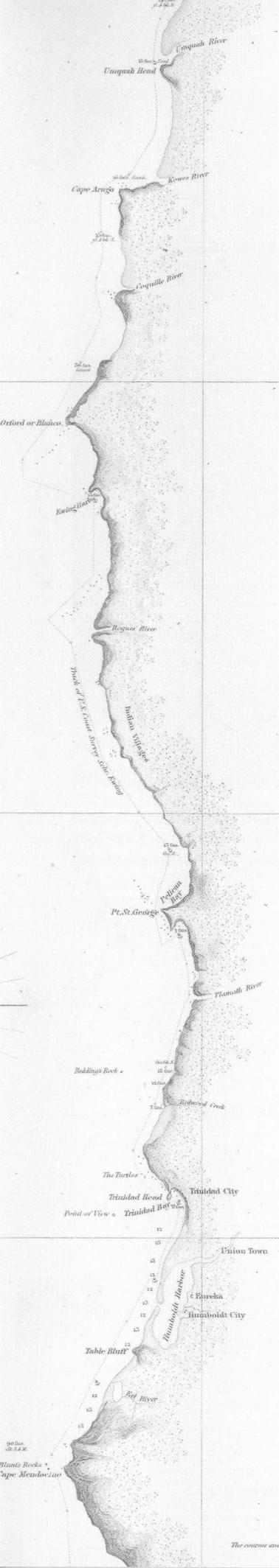
Hassler's survey methodology was such that George Davidson and his men, once ashore,

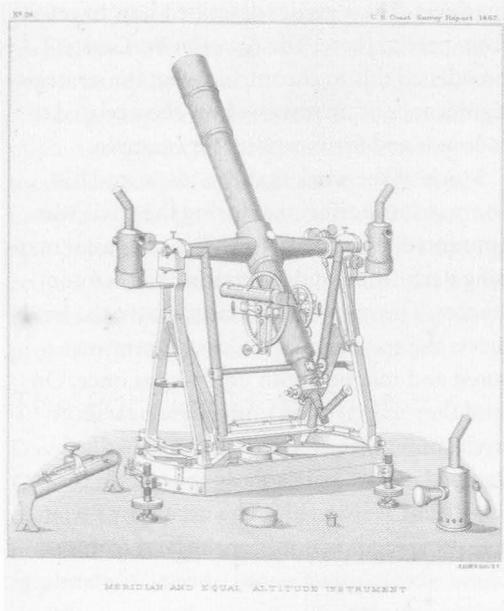
addressed the mighty headland of Point Conception by turning their backs to it. Instead, on a quiet vernal pool as much out of the wind as could be found, they set up a tent, with a hole in the middle, to serve as an observatory. Repeated observations of stars using one of Davidson's two telescopes could yield their latitude, the other their longitude. The near constant wind and fog of the cape required Davidson to wait 50 nights to acquire enough data to determine his position with sufficient accuracy. That spot in a cow pasture near the Coxo anchorage in Santa Barbara County was the POB, the Point of the Beginning, for the Coast Survey on the Pacific coast.

A Twist of Fate

A generation before Davidson, Ferdinand Hassler, a skilled scientist, had left the Old World looking for a better life and a different society. He arrived with a locket from his mother and his own personal iron-bar copy of the French meter, which was then the most precise measure of the length of one meter. The proposal he made to Jefferson for the Survey of the Coast was in another league from the other proposals, and Jefferson the scientist recognized this. Instead of charting the coast immediately, Hassler proposed that the United States develop a geodetic network to accurately locate headlands and capes like Point Conception.

Coastal portion of the 1851 reconnaissance chart from Cape Mendocino to the Umpquah River in Oregon





Davidson Meridian and Equal Altitude Instrument, 1867

Geodesy is the ancient science of the size and shape of the Earth, and the location of specific points on its surface. The flag of the Coast Survey featured a bright red triangle, because the triangle is at the heart of geodesy.

From the Point of the Beginning by Coxo Rancho, Davidson and his men measured a long straight baseline. From both ends of the baseline they measured the angles to a nearby hilltop. Using trigonometry, with two angles and one side they could calculate the lengths of the other two sides of the triangle. From the hilltop they could measure angles to the next hills to create another triangle, and then another. Those triangles marched up and down the Pacific Coast, creating a geodetic skeleton upon which to map the undulations of the coastline and the intricate estuaries and coastal wetlands of California. Then the triangles went inland. Eventually, George Davidson and his crew, including his friend John Muir, scaled peaks in the High Sierra and down into Nevada, marking triangles over a hundred miles on a side, as the Pacific Coast survey marched east to link to the Atlantic survey to become the continental geodetic network.

Like Ferdinand Hassler, George Davidson was an immigrant. He was born in Nottingham, England, in 1825. His family came to Philadelphia in 1832, seeking a fresh start. In 1841 he enrolled at Central High School, a uniquely ambitious scholarly enterprise founded by Alexander Dallas Bache, a great-grandson of



Coxo Anchorage, Coast Survey Chart 614, 1852

Benjamin Franklin. Bache could spot talent, and Davidson had it. Soon he was employed in Bache's astronomical observatory at the school, and then later in Bache's magnetic observatory, the first in the country.

Davidson was a success, and he seemed bound for a scholarly and sedentary career as an astronomer. But in 1843, Ferdinand Hassler of the Survey of the Coast died in action, tumbling off a hill in New Jersey as he tried to protect one of his instruments during a dramatic lightning storm. After some maneuvering, Bache succeeded Hassler as head of the Survey. He brought his best students with him, including Davidson.



George Davidson circa 1880

The constraints of the Survey and its work changed Davidson's life. Instead of building a career at an observatory that doesn't move, he soon became the greatest expert in the Coast Survey on how to turn any given spot anywhere into an observatory for the purpose of determining the latitude and longitude of that specific spot. Originally this required two different instruments for finding latitude and longitude. Eventually Davidson combined them into the Davidson Meridian and Equal Altitude Instrument, a legendary telescope. It was small enough and humble enough to be carried by mules on a trail, but it allowed a Point of the Beginning to be established almost anywhere on earth.

mariners. These guides described how to get from here to there. The *Notes on the Coast* broadened this to encompass what the strategic significance of *there* was—how *there* related to railroads and fortifications, for example.

Much of the work that Davidson and his compatriots performed during the Civil War amounted to ordinary practices of coastal mapping performed under extraordinary circumstances. The coast is, famously, where the land meets the water, and the Coast Survey measured and mapped both domains at once. On land they mapped the immediate nearshore environment, always, and then gradually mapped inland, particularly the terrain that was visible from a ship. The network of triangles provided positions for the land features. These were mapped onto t-sheets, "t" standing for topography.

In the water they mapped hydrography, meaning the water above the shape and composition of the bottom. Their two major tools were, first, another set of triangles, between the survey boat and two flags or signals on shore, and second, a lead weight on a hemp line. By triangulation to the signals they could determine the position of the boat, which they then correlated with the depth of the water gauged by the lead line. They entered this data on a map on the boat, the boat sheet. Once back in camp or on the steamship, the data was corrected and cleaned to produce the smooth sheet. The smooth sheets for the water were combined to make h-sheets (for hydrography) and then merged with the t-sheets to create the master for an engraved chart covering water and land. Especially for the war effort, photographic transfers of simplified versions of the engraved charts were produced rapidly and cheaply by lithography. By the end of the war, Coast Survey personnel were the finest cartographers in the country.

When George Davidson first arrived in San Francisco in 1850, it was a raw and perilous town. By the time he and his wife Elinor returned in 1867, as head of the Survey on the West Coast, San Francisco had become one of the world's

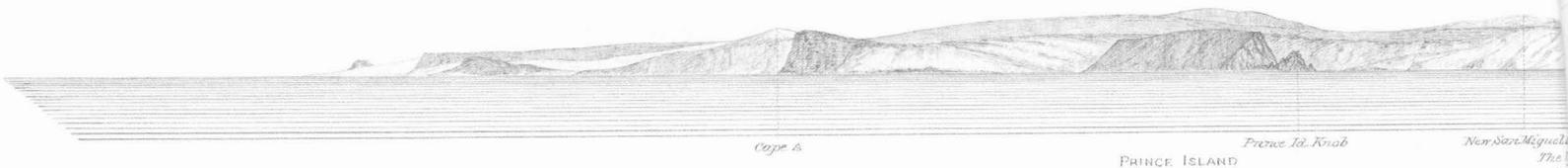
The Coast Survey Goes to War

The Coast Survey was a civil scientific agency, but many of its key staff members were politically liberal or even radical. The native-born American members were Abolitionists, while many of the scientifically trained immigrants were social progressives who quickly took up American causes. Davidson and his compatriots worked vigorously along the West Coast during the 1850s, but when the Civil War loomed, the entire organization decamped for the East to assist the Union in the struggle to come.

The basic Union naval strategy was to impose a blockade on the entire coast of the Confederate states, to prevent movement of ships and supplies. Then the Union armies and navy would fight their way up the Mississippi and other strategic rivers.

Bache was a member of the secret committee in charge of the naval blockade. In preparation for the battles ahead, he had commissioned a set of secret documents to be compiled and published, called the *Notes on the Coast*. The Survey had participated in a long tradition of publishing coast pilots, sailing directions, and notices to

Cuyler's Harbor, San Miguel Island, by Ferdinand Westdahl, 1895



VIEW OF CUYLERS HARBOR, SAN MIGUEL ISLAND, PRINCE ISLAND

SKETCH NO.3

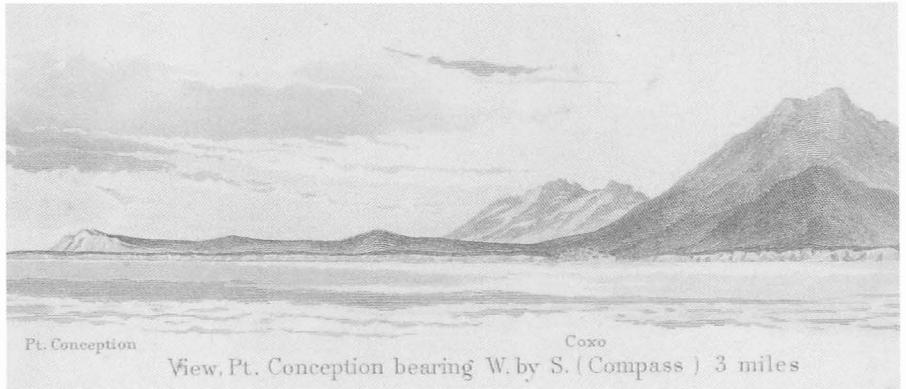
great port cities. It was his home for the rest of his life, but he left it regularly for scientific journeys around the world.

Davidson observed transits of Venus and other astronomical phenomena, including a total solar eclipse in Alaska, a vast region he had played a major role in securing as an American possession. While in Alaska for the 1869 eclipse, he met the distinguished Chilkat leader Kohklux, which led to a major ethnographic project of the Coast Survey (see sidebar).

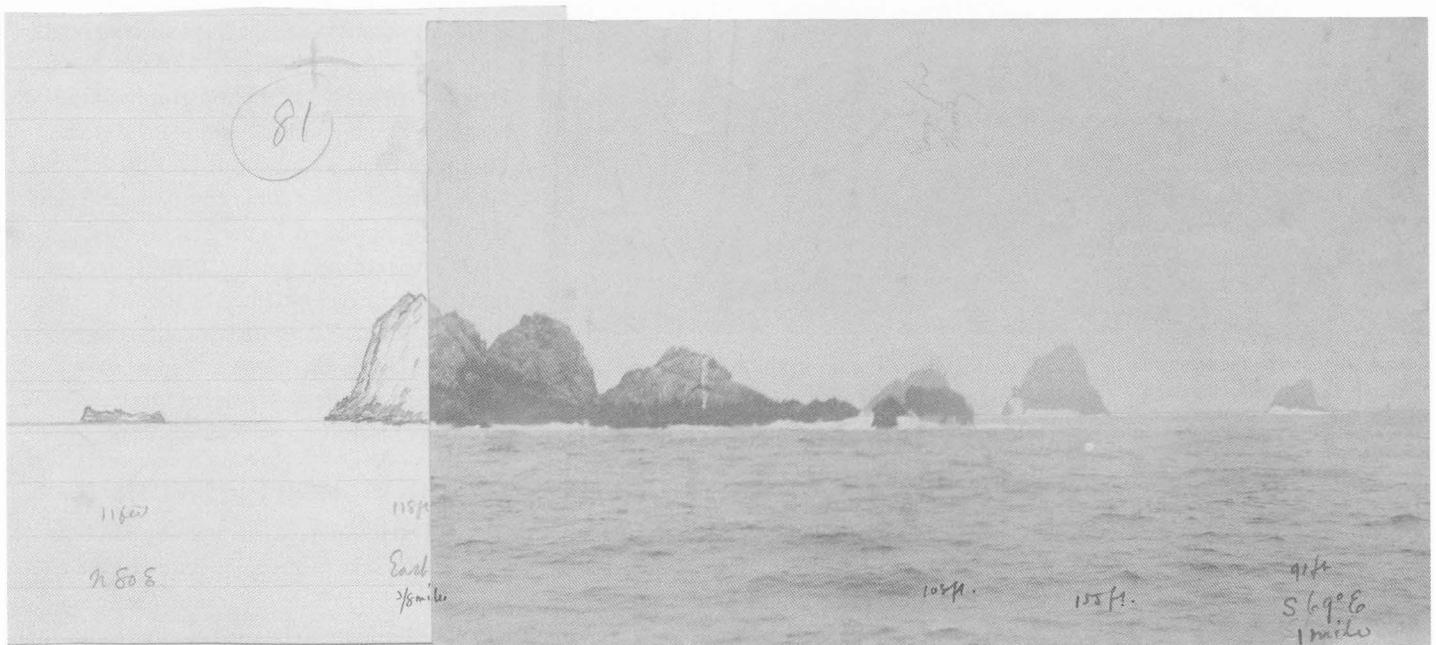
The Pacific Coast Pilot

Davidson's work with Bache on the *Notes on the Coast* during the Civil War had a lifelong impact on him. In 1862 he worked up his travel diary notes and other materials to produce the *Directory of the Pacific Coast*, which was his version of the *Notes*, applied to the Pacific. The rest of his life he continued to update and expand the *Directory*, later called the *Pacific Coast Pilot*. His magnum opus is the fourth revised edition of that book, published in 1889.

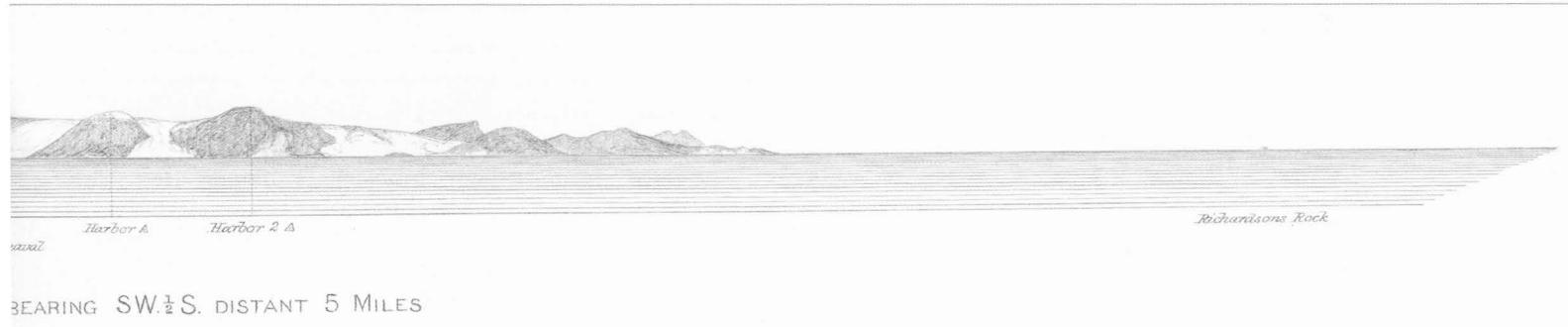
In every edition of the work, he introduces Point Conception this way: "Once seen, it will never be forgotten." The volume distills the knowledge and wisdom of many decades spent sailing the waters along California, Washington, and Oregon. It is voluminous but elegantly written, with a keen eye for the sum of experience of each place, the historical changes Davidson had seen directly, as well as matters like which reefs



Point Conception, by William MacMurtrie, 1853



The Farallones, sketch and photograph composite, George Davidson Collection, the Bancroft Library, U.C. Berkeley





George Davidson on the steamship Spokane, Alexander Archipelago, Alaska, 1907

to avoid, where breaks in the kelp are, and what sailing tack would work under which wind. All told, it is a remarkable achievement for a man who spent most of his life in coastal waters yet never learned to swim.

The *Pacific Coast Pilot* is the last hurrah of an important type of nautical information, coastal views. In 18th-century sailing guides, these began as engravings showing ships under full billowing sail, with generic coastal features to the side and in the background. Over time, the sails billowed less, and real, specific headlands were rendered. The waves and foam diminished, and eventually the ships disappeared entirely.

From the beginning on the West Coast, Coast Survey artists sketched masterful views of specific headlands, such as William MacMurtrie's view of Point Conception published in 1853. Vantages of individual headlands eventually evolved into

“roll-out” coastal views, taking advantage of the fact that on the West Coast the Survey always worked from steam-powered ships that could sail steadily in any wind or current. The steamer maintained a steady speed relative to the coast, and the Survey artist made a series of rapid progressive sketches of the coast looking straight at it from offshore. Later, back on shore, the geodetic framework established by the triangulation network allowed those views to be combined into one continuous drawing that could encompass dozens of miles along the coast.

Davidson supplied many sketches himself, then later commissioned Ferdinand Westdahl, a gifted Swedish immigrant hydrographer. Westdahl had a naturally elegant and spare graphic style, very moderne. In preparation for the 1889 edition of the *Pacific Coast Pilot*, Westdahl completed hundreds of roll-out views, some of which were then reduced and transferred to engraved views published in the book. Westdahl's coastal views are particularly important documents because they display the California coast before it was transformed by roads and modern coastal development.

Davidson and Westdahl also experimented with integrating photography and sketches, as Davidson predicted that photographs of the coastline would eventually supplant sketches. Photography never substituted for the roll-out views; instead, in the 20th century coastal view sketches disappeared. In the 21st century, coastal views have returned, particularly through the remarkable images obtained by the California Coastal Records Project (www.californiacoastline.org). Those sets of images can be usefully compared. (See the next issue of *Coast & Ocean* for a story on the Coastal Records Project.)

A Continental Network

George Davidson lived through the San Francisco earthquake in 1906. He removed the telescope from his private observatory in the city to allow the building to be used as emergency shelter for women and children left homeless by the fire. There were extensive geodetic re-surveys of the primary triangulation network made, to discern earth movements along the San Andreas Fault. One set of measurements supported Davidson in a dispute that went back decades. He had surveyed the peak of Mount Tamalpais in the 1850s. A subsequent survey, in the 1870s, found a discrepancy in his positioning. He asserted that his measurements were accurate,

George Davidson and Native Peoples

George Davidson was unusually sensitive to American Indians and he sought them out as authorities on the history and landscape of the areas the Coast Survey charted. He paid particular attention to Indian names for landscape features, and he insisted these be recorded and used on Coast Survey charts.

Davidson made his first visit to Alaska in 1867, sent there to assess the offer by the Czar to sell "Russian America" to the United States. He returned in 1869 to observe a total eclipse of the sun, and on that trip met Kohklux, a celebrated leader of the Chilkat Indians of southeastern Alaska. Kohklux had had political difficulties with the new American authorities, and Davidson assisted him in various ways. They became firm friends.

Kohklux observed the Survey personnel mapping the coastal area in what is now Glacier Bay National Park and offered to prepare a map of the area deep into the interior, on the route to Fort Selkirk, a long-established headquarters of the Hudson's Bay Company. In 1851, Kohklux had accompanied his father and a band of warriors on an epic overland winter journey to the fort, which they burned down.

Then, several decades later, Kohklux and his two wives spent three days preparing for Davidson a map of the places of that journey, and other adjacent areas they knew from direct experience. The map was their first experience with pencils on paper, and the lines were rather faint. Davidson asked their permission to prepare an ink line overlay on tracing cloth laid over the original map. Once the tracing of features was prepared, Davidson questioned Kohklux and his wives about hundreds of Chilkat place names on the map. The names were written down in a phonetic English version of Chilkat, sometimes with English-language translations. Hence the map preserves the Chilkat name "Lit-ky'-a" for what is now known as Davidson Glacier.

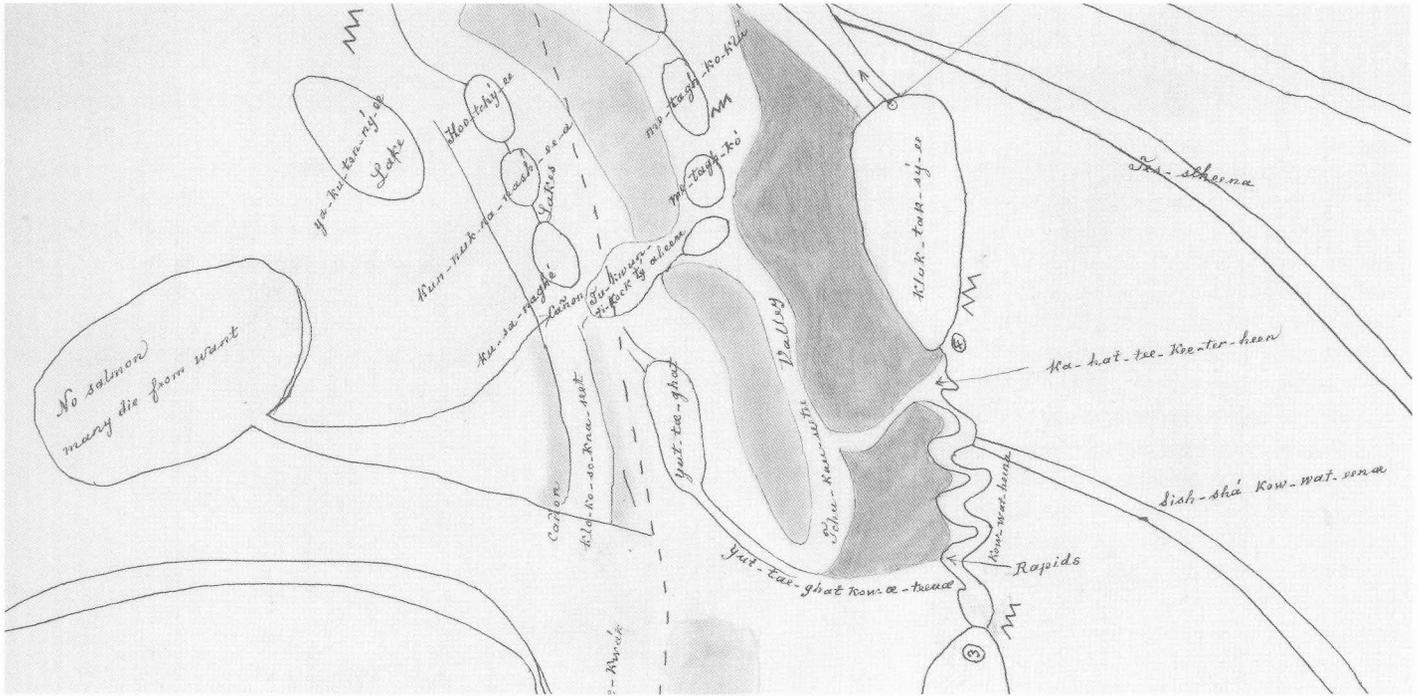
The original map drawn by Kohklux and his wives, and the tracing cloth overlay, were registered as original topography sheet 2268 and enrolled in the Coast Survey Library and

Archives Collection, now in the National Archives II in College Park, Maryland. Davidson's persistence in recording Indian names and perceptions of the landscape led to an important Coast and Geodetic Survey policy document, the *Instructions and Memoranda for Descriptive Reports to Accompany Original Sheets*, published in 1888. It notes:

"Special attention is called to the nomenclature of all points named, especially Indian names. Where the orthography is doubtful, care should be taken to obtain the best authority for the name and spelling used, that confusion and correction upon our printed charts may be avoided and the charts themselves may become the best future historical authority."



Kohklux's map of the territory to the Yukon, topography sheet 2268, 1869.



Detail of Kohklux's map showing native place names and note about salmon

but that the mountain had moved. The re-survey after the 1906 earthquake confirmed that he had indeed been correct.

A hundred years ago, in 1907, Davidson made his last journey to Alaska, exactly 40 years after his initial trip in 1867. He made the first trip because he had been asked to advise Congress whether the nation should purchase Russian America, as it was then called, from Imperial Russia. His favorable report tipped the balance. The United States acquired Alaska, and, of course, the Coast and Geodetic Survey then was given responsibility for charting its coast and islands.

How might he have reflected about his life in his steamship cabin on that last long voyage back to San Francisco? By that point he had received every honor imaginable in California—president of the California Academy of Sciences, regent and professor of the University of California, a member of the state's Earthquake Commission, a senior advisor to the state on water systems and irrigation, and more. From his letters and published writings, however, these matters paled compared to the pride he felt in the quality of the geodetic network he created to describe the state's topography.

All his initial local networks, starting with the tent observatory site at Point Conception, had been corrected and connected into a continental network that, in evolved form, is the framework for all geopositioning today. When we press a

button on a GPS receiver to find out where we are, we do so relative to Davidson's geodetic framework. Davidson also took enormous pride in the visible expression of the network, the many changing editions of the maps and charts produced by the Coast Survey. The coast is the most dynamic environment on the planet, and every chart of it is a complex snapshot of changes continually underway.

Changing Priorities

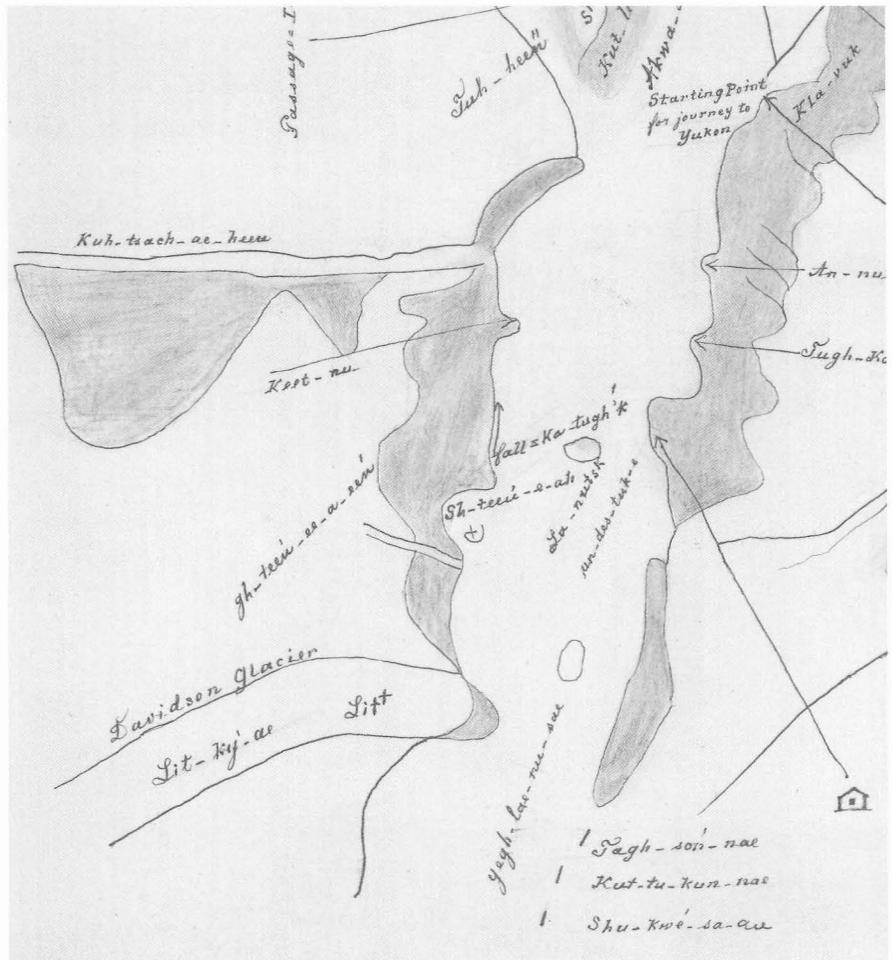
In 1869, Henry Mitchell, who was the chief hydrographic scientist in the Coast Survey, published a treatise on reclamation of tidelands as an appendix to the Survey's annual report. He described the context of change well under way on the Atlantic Coast, but only then beginning in California. In the East, Mitchell said, the rapid development of railroads and wagon roads was changing every aspect of coastal life, previously based exclusively on large and small boats. Estuary channels that had been major thoroughfares became literal backwaters once the villages near them could be reached easily by land. This made for great cultural and ecological stresses, as watercourses began to be seen as potential agricultural land, once the waters were drained away. Rival and incompatible uses of the coast were proposed. Local preferences had also to be balanced with larger constituencies, as draining wetlands in one place could affect flooding in another. As Mitchell noted:

“Were the entire value of a water-course always to be measured by its service, as an avenue for ‘market men,’ the conversion of its territory from commercial to agricultural uses would be generally popular as soon as the bed of a stream became more valuable than its water, and no strife would occur; but in most cases there are other interests involved which are antagonistic to this change, viz: the trade in foreign or distant products, the fisheries, &c. Sometimes, too, an arm of the sea which has ceased to be of use to the residents upon its banks has still a national value as a harbor of refuge or as a thoroughfare.”

The California coast that Davidson and his fellow surveyors found in the middle of the 19th century is now utterly changed, as are human needs and priorities. In the 21st century, the value of watersheds is measured by their capacities for ecological services. Many areas of coastal California now are seen as hugely valuable harbors of refuge for steelhead and salmon if not humans, and as thoroughfares for migrating waterfowl and marine mammals. The patterns revealed by George Davidson and the Coast Survey in the 19th century are among the best templates for ecological restoration and coastal management in California in this new century. In this bicentennial year of the Survey of the Coast, those maps and charts are being brought back to life as digital images for contemporary use in restoration planning.

George Davidson’s achievements are many. He persuaded the wealthy James Lick to endow the great telescope of the Lick Observatory, and also urged Anthony Chabot to endow the Chabot Observatory in Oakland, the first great public observatory on the West Coast, linking him firmly to California astronomy and very big telescopes. But the most important telescope Davidson ever looked through was the first one he set up in a cow pasture by Point Conception, the Point of the Beginning for much of the subsequent history of California and for its potential future. ■

John Cloud is a geographer who received his Ph.D. from U.C. Santa Barbara. He never saw the ocean until he was 18 years old, but is now making up for that with his Adirondack guideboat. He is currently working under contract with NOAA to write the history of the Coast and Geodetic Survey; for this he developed a scanning project to recover Coast Survey treasures now in the National Archives. Many of the original charts, like Kohklux’s map of the terrain from Chilkat to the Yukon, had not been seen for more than a century.



Detail from Kohklux’s map



Exploring the cannery tower

STORY AND PHOTOS
BY ANNE CANRIGHT

MAY 22, 2007—THE DAY WE’VE been waiting for—has dawned glorious. But it’s not the sunshine that fills us with joy. It’s the half-foot minus tide, which means the upper edges of Monterey Bay will be a little less sloshy than usual. It is a perfect morning for a treasure hunt.

I check to make sure that my knapsack is ready, with GPSr (global positioning system receiver), plenty of spare AA batteries, and a Ziploc goody bag full of knickknacks. A camera too—you never know when the hunt will take you somewhere unexpectedly beautiful or interesting. And last but not least, a sheaf of clues.

Our tick-list today features two prominent spots that we’ve been to but have not been able to check out because they are usually under water, or at least wave-swept. We had stored both in the GPSr as latitude-longitude readings

(“waypoints”), and since then have been waiting for a minus tide. Today they will be within our reach. One of them, at the tip of the Monterey Peninsula in Pacific Grove, is usually an island; the second, a crumbling 20-foot-high structure left over from the Cannery Row heyday—perhaps a former pump station—is sometimes at the water’s edge but more often sloshed by waves. Both promise special rewards—assuming our searches prove successful.

What is it we seek? Tupperware and old ammo cans, or, on the “micro” end of the spectrum, test tubes, film cans, and Altoids tins. The containers vary, as does the treasure stashed inside (think shiny colored objects or at the very least a minuscule logbook), but we can always be assured of finding *something*. If, that is, our skills of navigation and observation are up to the task.

The pastime we've become addicted to is called geocaching: *geo-* as in earth (it's a world-wide hobby, with more than 410,000 caches in 222 countries worldwide, and it also takes place out in the world—a definite plus); and *-caching*, as in squirreling something away; and it takes you out into the world on a glorified scavenger hunt among tens of thousands of strangers.

Geocaching is a game made possible by military surveillance, including satellite-enhanced position finding—something that was available to civilians only in an intentionally degraded form until May 2, 2000. On that day, a mythical “great blue switch” was flipped, and in an instant the accuracy of GPS technology improved tenfold as 24 satellites processed new orders and allowed backpackers, boaters, scientists, and other citizen users to join the military in gaining pinpoint positioning accuracy.

The move itself was not entirely unexpected. The White House had earlier declared its intention to cease data degradation eventually—say by 2006. For the “switch” to be pulled six years early—and announced by President Bill Clinton's press secretary just one day before the fact—came as a total surprise. Internet technogeek newsgroup sites immediately sizzled with ideas on how to take advantage of the new capability.

One GPS enthusiast, David Ulmer of Beaver Creek, Oregon, decided to put it to an immediate test. On May 3, 2000, he posted a notice on a GPS users' bulletin board, *sci.geo.satellite-nav*, saying he had stashed a bucket in the woods and its contents were a logbook and pencil, as well as such goodies as videos, software, and a slingshot. He gave these coordinates of his cache, read from his now more powerful GPS device: N45°17.460 W122°24.800. “Take some stuff, leave some stuff,” he invited anyone interested. And so the Great American GPS Stash Hunt was born, redubbed “geocaching” within a few months.

As one wag noted on a keychain we found early on, “We use multimillion-dollar military satellite systems to find Tupperware in the woods. What do you do?”

Liberating Minnie

We decide to hit the cannery tower first. It's near Monterey's Coast Guard Pier, on a beach where SCUBA diving certification tests are often held.

We learned about this cache, called PDH, from the official geocaching website (www.geocaching.com), which provides difficulty ratings,



descriptions, encrypted hints, maps, and visitor logs and photos. The cacher, Touchstone, stashed the hide on December 12, 2005. Out of a possible five, he gave it two stars for difficulty of finding and a stiff four and a half for difficulty of terrain. He then posted a description:

“The cache coordinates will take you to one of the old cannery buildings at the popular and scenic San Carlos Beach. A very busy place on weekends, but don't worry, you should have plenty of coverage to enjoy the site and make your trades in leisure.

“There is a large plaque explaining the cannery operation on the sidewalk above the cache location if you're interested in reading about it.”

The cache name comes from a rating system invented by Jim Bridwell during the 1970s for big-wall rockclimbs in Yosemite. His CRS (Casual Rating System) had four levels: NBD (No Big Deal), NTB (Not Too Bad), PDH, and DFU. Since this is a family magazine, I'll leave it as an exercise for the reader to decipher the last two ratings.

David and I are climbers, so we figure PDH can't be *too* daunting.

Ah, well. This tower is, in point of fact, vertical, as in straight up: 90 degrees. Gravity has a





Left: Minnie!

Right: Tupperware!



certain edge on vertical walls. And the tower is 20 feet tall and seems to grow taller as we gaze up at it. But yes, it is also crumbling: there's texture; there are holds. And—this is the clincher—there's a cache inside.

David puts on his rock shoes—yellow Boreal Ninjas—then steps onto the wall near the tower's edge, grasping a corner up high with his right hand. He steps down. Looks up. "It's hard on the fingers," he mutters. He steps on again, reaches up, moves his left foot high, then frantically grasps for a piece of sheared-off, down-slanting concrete. It's a solid undercling. But what now? He's halfway up. There's nothing to do but dyno—lunge upward and hope he can grab that metal rebar at the top, which fortunately is smooth and of good length. And so he does. He grabs, pulls himself up, teeters a moment, then peers inside.

"Do you see the cache?" I ask.

"I see a ladder. It's rusty. I'll test its sturdiness." He continues to survey the tower's interior. "There's also a lot of junk in here. A rusty camshaft, for one thing. And plants. But at least it's not wet."

"Yes, but do you see the cache?"

"Not yet. There's a pile of driftwood in the corner. Maybe it's under there."

He drops over the side and disappears. I wait. "Take some pictures!" I yell.

A few minutes later, his head pops up over the top lip. He raises his arm in victory. Clutched in his hand is . . . Minnie Mouse? "Found it," he says. "And I've liberated Minnie."

He twists his back to me, dangles his body from the top of the wall, and drops to the damp sand.

Although I had decided the tower was too risky to climb, I am of course consumed by a need to see what's in there. David's shoulders provide a solid platform, and I quickly climb up, over, down, inspect the cache myself (Minnie was the prize, for sure), and climb back up and out.

It's our 64th cache. And by far the hardest.

Travelbugs and Geocoins

After bagging this find, we head south to search for "Kashta's Rock." The cachers, Otter Girl and Keyholelimpet, warn us, "When you see this point on your GPS it may look as though the point is in the water . . . IT ISN'T IN THE WATER. Rest assured, it's on dry land."

Ah yes, low tide is our friend. We cross some coarse sand—which obviously is under water much of the time—and then climb onto a low island. "Yes it's really out there," the cachers

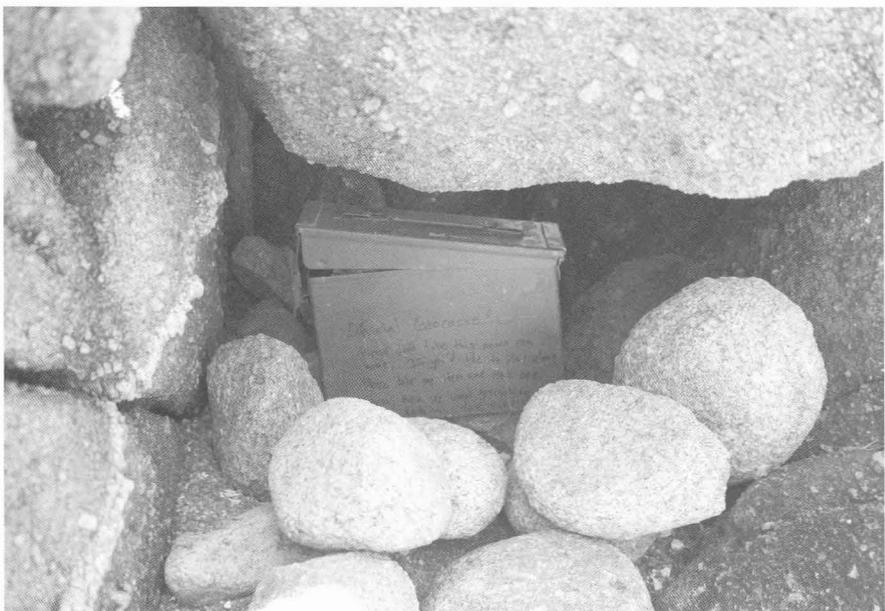
assure in their hint. “Go at low tide; now that you’re there [at the posted coordinates], you’re standing on it.” The GPS switches from tenths of a mile to feet, and the countdown begins: from triple digits—500s, 400s, 300s (ooh, we’re getting close), 200s, 100s—to double digits. We start looking around.

Sometimes, for various reasons—tree cover, power lines, not many satellites overhead—accuracy isn’t truly “pinpoint.” It can be 50 or more feet off. But you learn to use your eyes. Look for a pile of wood that doesn’t seem quite natural, or some mused-up pine needles. Or in the case of Kashta’s Rock, a big stack of medium-sized stones clustered under a large boulder. No way would the sea have deposited them like that.

I start pulling stones out. And there, in the back of the alcove, is an olive-green ammo can. I open it, pull the logbook out from its Ziploc waterproofing, and start to inspect the contents of the container. There’s a travelbug (a TB): Ole One Eye is a little green fellow waving happily at me. A card attached says that he was “released” in Illinois on July 6, 2006, and his goal is “to travel the earth seeing the sights and collecting as much information as possible before I return to my home planet to make a complete report to the BIGEYE.” So far he’s been to Arkansas, Indiana, Iowa, Michigan, New Mexico, Oregon, and California. Since we’re heading to New York in a few weeks, we’ll give him a lift.

Travelbugs, along with geocoins, are “trackable” items that inveterate geocachers have made and assign tracking numbers to; their journeys can then be followed on the geocaching.com website. In my treasure Ziploc, Ole One Eye joins a TB Jeep (green) and a geocoin, created by ShadowAce and Elmosmelmo, that I picked up in Arizona. (“The world is our playground,” as they say.) I will drop them off on our trip out east and, I hope, pick up some new traveling items to bring back home. Being a travel addict myself, I can appreciate the urge to keep on moving.

Geocaching is about a lot of things, including: timing, as in tides, or just in mood; using your senses; and second-guessing (that old GPSr may be 10 times more accurate now than in April 2000, but sometimes it’s still not very close). It can be about puzzles, too, as some caches involve multiple steps, while others require that you sniff out clues or solve problems to determine the correct waypoint coordinates. Even though cache contents are often silly, there’s always that



The island cache

moment when you open the container and look inside: Will there be a travelbug? And it’s fun to read the logbooks, which contain comments of people from all over the world.

In addition to being fun, geocaching can be instructive. A cache called “Snowy Plover,” for example, along the bike trail in Seaside on the Monterey Peninsula, provides a public service announcement on the little bird’s plight along the West Coast, while “Western Sloughs—Global Warming” treats the reader to a 20,000-year history of the area we now know as Elkhorn Slough. Historic buildings, colorful local characters, significant events (were you aware that the last commercial Morse code maritime transmission in the United States was sent from Half Moon Bay on July 14, 1999?)—you never know what you’re going to learn about



Top: Ole One Eye

Above: A paratrooper's insignia marks the end of a multicache hunt.

when you log on for another dose of geocaching.

Sweet Little Secrets

The pleasures are deeper, of course, than uncovering bright little objects or even learning new facts. On one hunt recently in the Huachuca Mountains of southern Arizona, I set out on a 14-mile loop trail that took me through various biomes of that beautiful “sky island” ecosystem. I stopped to photograph alligator cypress, agave, and other plants unique to the area. I looked up and watched hawks soar and songbirds flit. Lizards skittered over rocks and smiled at me. Along the way, I ventured off the trail to explore an old mine site (and locate a cache called “5471 Broadway”) and again to sit on a peaceful rock outcropping, and finally I stopped at an old ranch that has been preserved as a historical site (Brown Canyon Ranch). As a bonus, at several points where I came upon an unsigned fork in the trail (the only map I had was a sketchy one in my head), the GPSr suggested the correct way to go. It is good for practical navigation as well!

At home, too, thanks to geocaching, we’ve discovered luscious hiking spots we never imagined existed, the trailheads being no more than unmarked scuffs on the roadside. We’ve edged out beyond the bluff trail in Pacific Grove onto a jumble of rocks that invited us to sit and watch as cormorants preened, pelicans sailed by, and belly-flopped harbor seals eyed us lazily. At a spot a 10-minute walk from our house, in the Monterey Peninsula Regional Park District’s Frog Pond Reserve, a test-tube microcache is hidden in the struts of a bench in a small grove of redwoods. We walk here often, but now we are more likely to stop a bit and sit on the bench. We don’t need to look at the cache again. It’s just a sweet little secret we enjoy sharing with a bunch of strangers.

Today, we continue to work our way around the peninsula, ending up late in the afternoon at “Kegan’s Cache,” high on a hill in Seaside. We easily find the microcontainer (it holds a log only), and then pause to look out over Monterey Bay. The sun is blinding as it reflects off the water, silhouetting the distinctive topography of the peninsula. We never would have gotten this view without geocaching. ■



Oops

YOU MIGHT SAY THAT THE lead story in this issue of *Coast & Ocean* is about unintended consequences. Farmers in Monterey County, pressed by buyers and distributors and alarmed by the sickness and death from *Escherichia coli* contamination of spinach a year ago, are undoing years of conservation work. Tearing out riparian habitat probably won't protect our food supply from contamination, but it will lead to much greater water pollution and loss of other benefits of sustainable farming.

It is difficult to work in government for any length of time without becoming aware of the law of unintended consequences. Well-meaning, carefully thought-out legislation is passed, regulations are promulgated, and all kinds of unexpected things happen. Of course, we are all living through perhaps the greatest episode of unintended consequences in human history: global climate change.

In the early days of the internal combustion engine there were scattered complaints about its air pollution, and even some gloomy long-term assessments. At the time, though, it seemed like a good deal. After all, unlike horses, cars don't randomly excrete fecal material all over the street. In cities before the automobile this was a major (and disgusting) pollution problem.

At the beginning of the 21st century, we are finally beginning to confront the long-predicted consequences of a civilization based on wanton burning of hydrocarbon fuels. The seas are rising, icecaps and glaciers are melting, the pace of species extinction is increasing, entire island nations will need to be abandoned in the next 50 years, and our oceans are becoming more acid, endangering the ecosystem that makes human life possible.

California faces two major challenges, with a host of associated "lesser" issues. The two big ones overshadow all others. First, we live on the coast: 80 percent of our population lives within 30 miles of the Pacific. An immense amount of critical infrastructure, not to mention people, is located on or near the coast. Already rapidly eroding and geologically active, large parts of our coastline will either be submerged outright or eroded away by the impact of higher water and stronger storms.



engaged in either reducing the carbon emissions that cause global warming, planning for the adaptation we know will be necessary, or both. (If you're interested in reading about what we in state government are thinking about, point your web browser to www.climatechange.ca.gov/documents/index.html.) Here at the Coastal Conservancy and the Ocean Protection Council, we are launching major initiatives to figure out exactly how the coast will be affected by

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The second issue, which Governor Arnold Schwarzenegger's administration is the first to grapple with seriously, is water. California's water system is designed to capture snowmelt from the Sierra, which falls largely in the north of the state, and move it south or out to the coast. The snowmelt is going to go away. California will experience increasingly warmer winters with less snow, higher snow lines, and earlier snow melts. We will have an ever-increasing risk of flooding in the Central Valley and in the Delta, and a water system that must be replumbed to continue to supply drinking water to a state that adds about 500,000 new residents each year.

Every part of state government that deals with resources in the environment is now

sea-level rise, what global warming means for our restoration and acquisition efforts, and how we can reduce our own carbon footprints. I expect these efforts to consume the rest of my professional life, as well as those of my colleagues who are 20 years younger than I. Hopefully we will all be mindful of the law of unintended consequences and carefully choose solutions that do not create their own new problems.

Sam Schuchat is the executive officer of the Coastal Conservancy.

COASTAL CONSERVANCY NEWS

WHEELCHAIR RIDER'S WEB GUIDE

FOLLOWING ON THE SUCCESS OF its wheelchair rider's guides to accessible coastal sites in Los Angeles and Orange County and in the San Francisco Bay Area, the Conservancy approved \$100,000 to Access Northern California to produce a web-based guide to the rest of the coast. The guide will provide essential details about coastal parks, trails, piers, and other recreational areas for people with impaired mobility. Users will be able to search and print the guide, and will be encouraged to provide feedback to help keep the information up to date.

First to be covered will be San Diego, Ventura, and Santa Barbara counties. After that, Access Northern California will cover the North Coast. Information from two books previously published by Coastal Conservancy Publications, *A Wheelchair Rider's Guide: Los Angeles and Orange County Coast* (2001) and *A Wheelchair Rider's Guide: San Francisco Bay and the Nearby Coast* (2006), is already available online at www.scc.ca.gov/Publications/wheel.htm.

HISTORICAL ECOLOGY STUDIES TO HELP IN RESTORATION PROJECTS

THE SAN FRANCISCO ESTUARY Institute (SFEI), a pioneer in the relatively new field of historical ecology, will undertake three studies with the help of \$675,000 approved by the Conservancy in May. This work will enable scientists engaged in habitat restoration work along the coast and on San Francisco Bay to design projects in light of information on how those systems functioned in the past. One of the approved SFEI studies will focus on Ventura County's coastal wetlands and rivers. Another will map and analyze historic coastal wetlands from Point Conception in Santa Barbara County to the Mexican border. The third, under a grant to Contra Costa County, will examine historic habitats in that county.

In Ventura County, which has some of southern California's least developed coastal valleys and watersheds, several major conservation and restoration efforts are under way, led largely by the Conservancy: Santa Clara River Parkway, Ormond Beach Wetland Restoration, Ventura River Parkway, and floodplain restoration projects on lower Calleguas Creek to Mugu Lagoon. The SFEI team, which includes the Southern California Coastal Water Research Project, the California State University Northridge Geography Department, and Stillwater Sciences, will develop a detailed picture of how the rivers and wetlands looked and functioned before they were significantly modified more than a century ago. Researchers will study historical landscape characteristics, including the stability and migration trends of the river channels, the extent of wetlands, the composition and distribution of other habitat types, and the watershed drainage pattern.

For the historical mapping of southern California's coastal wetlands, the team will rely heavily on the U.S. Coast and Geodetic Survey's topographic maps (T-sheets) completed between 1851 and 1893 (see p. 20). They will determine how far inland wetland habitats then extended and how different types of wetlands were distributed along the coast. The digitized maps will allow scientists to calculate more accurately how many total acres of wetlands have been lost, as well as how much of each habitat type, which will help regional planners and land managers set goals for how much of each should be restored.

Contra Costa County's study will provide information on the distribution, type, and size of habitats found in the county over the past 150 years. SFEI will use Mexican rancho documents from the 1840s and 1850s, early aerial photos, and other records from historical societies and city and county archives. This information will be synthesized, analyzed, and aligned with current

known locations and latitude/longitude to create maps and documents describing how habitat patterns and natural physical processes have changed in the county.

Information gleaned from the study will help to guide the East Contra Costa County Habitat Conservation Plan/Natural Communities Conservation Plan, which calls for spending up to \$350 million to acquire and conserve 30,000 acres for 28 rare, threatened, or endangered species. It will also help in the design of individual watershed restoration projects, including those planned for Marsh Creek, Walnut Creek, and Mount Diablo Creek. The Contra Costa Watershed Forum, a partnership of watershed groups, government agencies, and other interested groups and individuals, will use the maps and reports to improve current projects and to foster greater public awareness of creek and watershed issues.

In collaboration with local partners, SFEI has produced detailed views of landscape change throughout San Francisco Bay and along the California coast (see www.sfei.org/HEP). Some of this work was recently featured on KQED-TV's *Quest* and can be viewed at www.kqed.org/quest/television/view/416.

PROGRESS ON THE COASTAL TRAIL

IN MAY, THE CONSERVANCY approved \$1,052,000 for California Coastal Trail projects along the length of the coast. These funds will provide for the building of new trail segments in Humboldt, Sonoma, and San Mateo counties; reconstruction of a stretch of existing trail on the University of California Santa Barbara campus; and for planning and feasibility studies for future segments in Mendocino and San Mateo counties.

In the Lost Coast Headlands of Humboldt County, south of the town of Ferndale, the U.S. Bureau of Land Management (BLM) will build nearly a mile of new trail on 400 acres of former ranchland, enabling

the public to reach a sandy beach. The pathway will begin at a recently constructed parking area and travel along a blufftop and down to the beach near the mouth of Fleener Creek. Along the way, hikers will be able to enjoy extensive ocean views, open grasslands, and several streams that cascade over steep bluffs to the ocean. BLM will use \$75,000 granted by the Conservancy for this project.

The two properties that comprise the Headlands, Lost Coast Ranch and Barri Ranch, were acquired by the Conservation Fund with the help of \$1,970,000 from the Conservancy and transferred to the BLM in 2001 and 2003, respectively. The new Fleener Creek Trail will be designated a spur trail of the Coastal Trail if future acquisitions of public rights make it possible to extend the Coastal Trail through this area.

In Sonoma County, at the southern edge of Bodega Harbor, two popular regional parks will be linked, closing a gap in the Coastal Trail. The Sonoma County Regional Parks Department will use \$305,000 approved by the Conservancy to install a 110-foot prefabricated metal bridge over Cheney Creek Gulch and build 1,654 feet of wheelchair-accessible trail. The bridge will connect Bird Walk Coastal Access Park with popular Doran Beach Park. This project is part of the 2005

County trail plan, which calls for a safe route away from Highway 1 for bicyclists and pedestrians. Eventually the trail will extend south from Salmon Creek, just north of Bodega Bay, to the Marin County border, five miles away.

In San Mateo County, the Peninsula Open Space Trust (POST) will use \$377,000 approved by the Conservancy to build nearly a mile of Coastal Trail, other connecting trails, and a small parking lot with a restroom at Pillar Point Bluff, north of Half Moon Bay. The 119-acre Pillar Point Bluff property was acquired by POST in 2004 with the help of Conservancy funding. It overlooks beaches, tidepools and, much further offshore, the famous Maverick's surf break. The new trails will mostly follow an existing system of former farm roads and informal trails, but will be upgraded to allow fire and emergency access and correct erosion problems. One route from the parking lot to the blufftop will be wheelchair accessible, while another will follow a steeper grade. A boardwalk will be built through the property's seasonal wetlands, and some informal trails that connect the blufftop to the beach through an active landslide area will be closed.

On the U.C. Santa Barbara campus, the student government organization, Associated Students, will use \$175,000 from the

Conservancy to reconstruct the West Campus Bluff Trail, a half-mile Coastal Trail segment that runs from the western edge of Isla Vista to Coal Oil Point Reserve. The trail originated as an unplanned, informal route along the bluffs, but in 1990, the University improved the surface with decomposed granite and added border posts, signs, and benches. Since then, the trail has eroded and deep ruts have formed due to poor drainage and heavy use by joggers, pedestrians, and bicyclists. The Associated Students will improve and upgrade the damaged trail and make it wheelchair accessible, regrading, stabilizing, and resurfacing it with decomposed gravel treated with a binding polymer. In some places the route will be shifted away from the bluff for safety. Informal



RIGHT: POST; FAR RIGHT: SCOTT BULL



Left: Pillar Point Bluff

Above: The eroded West Campus Bluff Trail will be improved.

trails will be closed and planted with native plants. The completed trail will be ten to 12 feet wide, have two-foot shoulders, and will be landscaped to deter off-trail use. Associated Students has raised \$90,000 toward planning and construction, and will assume management of the trail.

The funding approved by the Conservancy in May also included \$90,000 to the County of San Mateo to prepare plans and construction documents for a quarter-mile segment of the Coastal Trail through the Fitzgerald Marine Reserve and a new ramp to Moss Beach Reef; and \$30,000 to the Moat Creek Management Agency for a feasibility study for Coastal Trail access on property between Moat Creek and Arena Cove in Mendocino County.

STEPS TOWARD HUMBOLDT COUNTY ESTUARY RESTORATION

A KEY PIECE OF A PLAN TO RESTORE wetlands and alleviate flooding in Humboldt County's Salt River–Eel River estuary was put into place in July, when the Western Rivers Conservancy acquired the 444-acre Riverside Ranch on the flood plain near the confluence of the two rivers. Eventually much of the former dairy ranch will be inundated, as tidal flow is restored to hundreds of acres of former saltmarsh. In

Left: Tidal flow will be restored to hundreds of acres of former saltmarsh in the Salt River–Eel River Delta.



May, the Conservancy approved \$250,000 to the Western Rivers Conservancy toward purchasing the land. The bulk of the \$2-million purchase price will be funded by the U.S. Fish and Wildlife Service's Coastal Wetlands Grant Program, and by the Wildlife Conservation Board. The Western Rivers Conservancy will transfer the land to the California Department of Fish and Game to own and manage.

The Salt River–Eel River Delta is the fourth-largest estuary in California, although it has shrunk by about 60 percent since the 19th century, when diking, draining, and filling began. Steamships once plied the Salt River; now one can step across the channel. During the rainy season the river tends to flood, inundating farms and communities as well as 600 to 1,000 acres of pasture, dairy waste systems, and several sections of road. The Ferndale wastewater treatment facility has come close to flooding at times, and during high flows, sewage spills directly into the Salt River—and thus to the Eel estuary—are commonplace. In the 1980s the Humboldt County Resource Conservation District (RCD), with a grant from the Conservancy, explored ways to address the situation. At the time, the proposed approaches were deemed infeasible or too costly.

Revisiting the issue in 2003, the RCD began to develop the Salt River Enhancement Plan, which would restore some of

the river's natural hydrologic functions by restoring wetlands, controlling streambank erosion, and related measures. When the owners of Riverside Ranch put it on the market in 2006, the RCD sought to include the property in its enhancement plan.

The ranch is in the flood plain between the Salt and Eel Rivers and can easily be restored to a mix of estuarine habitats. The restored wetlands will mitigate flood hazards and provide habitat for Aleutian cackling geese, migratory songbirds, and salmon and other fish that have historically inhabited the estuary. Areas not prone to flooding will be leased to local ranchers for grazing.

The Salt River originates in the Wildcat Mountains above Ferndale and joins the Eel River about a mile from the ocean. The Eel River estuary is 20 miles south of Eureka.

LETTERS

Editor:

Ed Ueber's identification of the submarine net buoy was correct in its first life. It was reincarnated into a buoy called a revving buoy. You will notice that there is a pipe sticking out to the left of the picking eye at the center of the buoy. That pipe was welded to the buoy at both ends. A cable was threaded through the pipe and connected to an anchor, and the other end of the cable had a loop spliced in it. An anchor barge would grab the loop and pick up the anchor, and the buoy would slide down the cable. So if you were in eighty feet of water, you would wind all the cable on the winch without picking up the buoy.

I have used hundreds of that type of buoy in the suction dredging industry while dredging most of the San Francisco Bay and shipping channels. Shellmaker Dredging Co. had a yard at the entrance of the Petaluma River. We would lose a buoy at night in a storm and it would wash up on the marsh where nobody could find it.

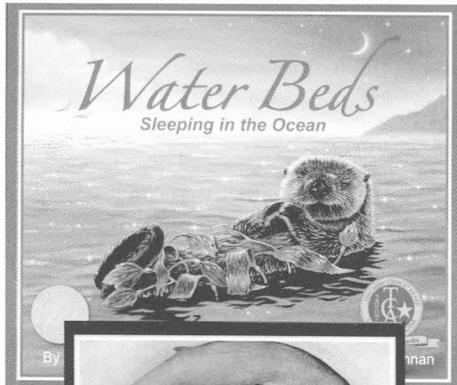
Steve Dougherty, Point Reyes Station



ROUNDUP OF CHILDREN'S BOOKS

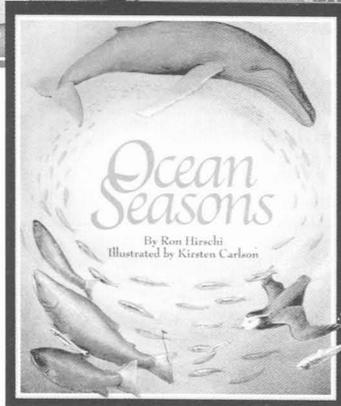
Water Beds: Sleeping in the Ocean,

by Gail Langer Karwoski, illustrated by Connie McLennan. Sylvan Dell Publishing, Mount Pleasant, SC, 2005. 32 pp., \$15.95 (hard cover), \$8.95 (paper). Ages 5–9.



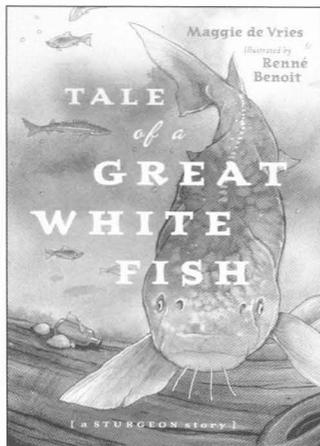
Ocean Seasons,

by Ron Hirschi, illustrated by Kirsten Carlson. Sylvan Dell Publishing, Mount Pleasant, SC, 2005. 32 pp., \$15.95 (hard cover), \$8.95 (paper). Ages 5–9.



Tale of a Great White Fish: A Sturgeon Story,

by Maggie de Vries, illustrated by Renné Benoit. Grey-stone Books, Vancouver, 2006. 44 pp., \$15.95 (hard cover). Ages 6–8.



Uno's Garden,

by Graeme Base. Harry N. Abrams, Inc., New York, 2006. 40 pp., \$19.95 (hard cover).

The Sign of the Seahorse,

by Graeme Base. Harry N. Abrams, Inc., New York, 1992. 40 pp., \$11.98 (paper).

No Room for Napoleon,

by Adria Meserve. Farrar, Straus & Giroux, New York, 2006. 32 pp., \$16 (hard cover). Ages 4–8.

Sandcastles Made Simple,

by Lucinda Wierenga, photographs by Jamey Fountain. Stewart, Tabori & Chang, New York, 2005. 128 pp., \$16.95 (hard cover). All ages.

A NUMBER OF CHILDREN'S BOOKS worth noting have come to us over the past year or so. Because all of them relate in some way to the range of issues covered by *Coast & Ocean*, they might be a good way to pass along some of our—and your—concerns to younger generations. The publishers suggest the age ranges given, but any of these books can be enjoyed by all

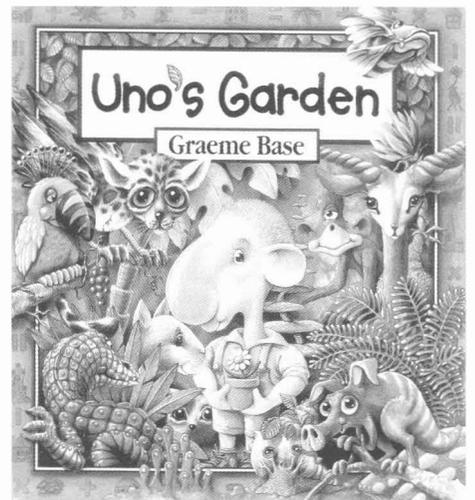
ages. *Water Beds* and *Ocean Seasons* come from a young publisher dedicated to presenting science, math, and nature to children in ways that will excite them and arouse their imaginations. *Water Beds* is a lovely presenta-

tion of the diverse and surprising ways that marine mammals sleep: Dolphins turn off one half of their brains at a time! Elephant seals can stop breathing and sleep underwater! The story should be perfect for bedtime. *Ocean Seasons* is a bit less coherent as a story, and the illustration of “sleeping” seals looks like they’re balanced too precariously to get any rest, but generally the facts are interesting and the pictures are attractive. Each book in this series includes a “For Creative Minds” section with activities to enhance the content of the stories, which can be photocopied or downloaded from the publisher’s website.

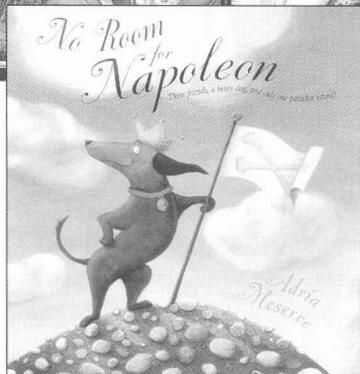
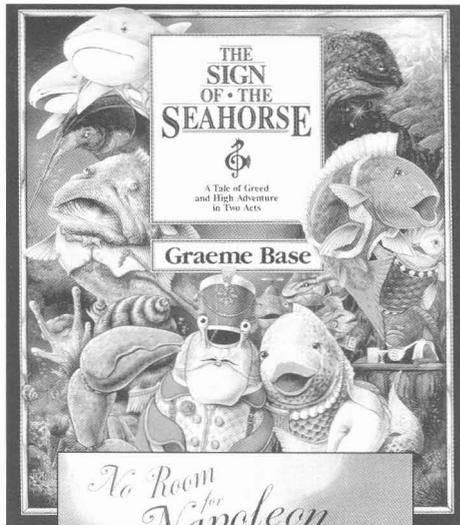
Tale of a Great White Fish follows the long and event-

ful life of a giant white sturgeon, and also gives glimpses of almost 200 years of Pacific Northwest Coast history. This is an engaging tale, well told and charmingly illustrated.

Graeme Base has long been one of my son’s favorite illustrators. Many of his books involve elaborate pictures containing hidden figures or puzzles to solve. *Uno’s Garden* and *The Sign of the Seahorse* have some of those elements, but are more focused on environmental concerns than on brain teasers. Uno, a sort of animal boy, decides to live in the forest among the strange but welcoming flora and fauna of his world. Civilization follows, and as a village grows into a metropolis, the plants and animals gradually disappear, until all that’s left is Uno’s tiny garden. The story goes on, though, as Uno’s descendants are wiser



than those who came before and, over time, help to bring back nature and live in harmony with it. Each page spread gives a tally of plants and creatures to be found in the picture. This book is aimed at younger children than most of Base’s books. *The Sign of the Seahorse* spins a yarn, in rhymed quatrains, of anthropomorphic undersea dwellers. The romance between two young trout, Pearl and Finneus, has to overcome both the greed and malice of the Grouper



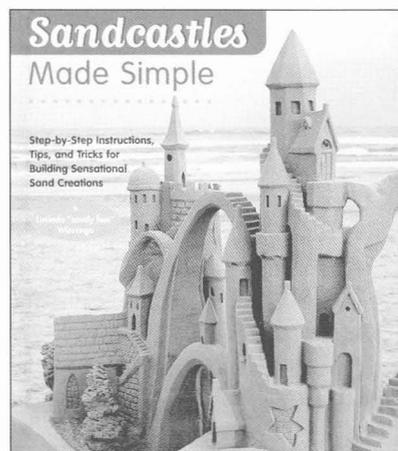
and his henchfish and an arduous journey to locate the source of toxic pollution. The illustrations of fish and other creatures are fanciful, but also realistic enough for species to be recognized.

No Room for Napoleon is a beautifully told story of how selfishness can turn dreams into nightmares—and of how cooperation can set things right. Napoleon the dog seems nice enough when he arrives at a beautiful little island occupied by a crab, a bear, and a bunny, but by the time he's built his dream castle there—his new friends doing most of the work—there's not much of the island left. His unhappy friends decide they must move to another island. It takes a lot of hard work for lonely Napoleon to restore his island to the paradise he'd first found, and convince his friends to rejoin him. Then a cat appears on the horizon. . . .

The title of *Sandcastles Made Simple* is slightly misleading. The methods of construction are presented clearly and simply, but many of them look quite challenging, and would surely require plenty of practice and patience. If you want to build the most impressive castle on the beach, this is the

book for you. You'll learn how to create things from sand that most of us never imagined possible. While not exactly a children's book, this could be a great tool for helping different generations have fun together.

—HMH



WATER, EARTH, AND BUTTERFLIES

Introduction to Water in California, by David Carle. University of California Press, Berkeley, 2004. 276 pp., \$39.95 (hard cover), \$16.95 (paper).

Geology of the San Francisco Bay Region, by Doris Sloan. University of California Press, Berkeley, 2006. 360 pp., \$50 (hard cover), \$17.95 (paper).

Field Guide to Butterflies of the San Francisco Bay and Sacramento Valley Regions, by Arthur M. Shapiro and Timothy D. Manolis. University of California Press, Berkeley, 2007. 359 pp., \$50 (hard cover), \$18.95 (paper).

THESE THREE FRIENDLY LITTLE books together offer a lucid and delightful orientation to the natural world that lies beneath, beyond, and around us in California. Two will be of special interest to residents of the greater Bay Area, the third is a primer for all Californians on a vital resource that is becoming ever more precious. All three are by authors with a deep knowledge of their subjects and a passion to convey what they know to others.

It's not easy to locate ourselves in the natural world when we are most at home in a highly altered built environment. Many residents do not ven-

ture into wild natural places. They enjoy the outdoors along the shore and in orderly parks and open spaces that have clearly marked trails. Many runners and bicyclists are little aware of what they pass while listening to music on their iPods. Unless someone, or something, leads us out and beyond all that, we may never realize what we're missing.

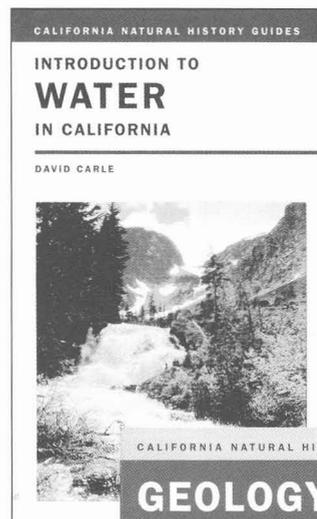
These three guides provide skeleton keys that can let us begin to discover the natural features of California that have been obscured by the noisy modern environment. They invite us to find ourselves in the landscapes that, together, constitute the real California. Each guide, in its own

realm, shows that everything is constantly changing, be it at the pace of geological time, global-warming time, or the fleeting lifetime of a butterfly. Therefore they may also help us to accept change more gracefully.

"Geology is a lens through which we can see the world around us in a new dimension," writes Doris Sloan.

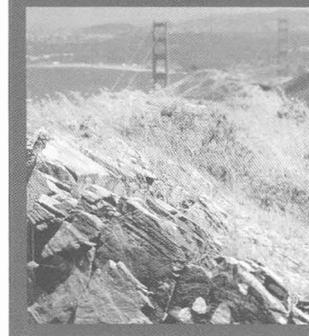
"Knowing the name of a wildflower makes it our friend. Knowing that the bulbous black rock at Point Bonita [at the Golden Gate] was formed in the deep sea and has traveled thousands of miles across the Pacific, makes it part of us." Her *Geology of the San Francisco Bay Region* reveals movement in forms that we generally

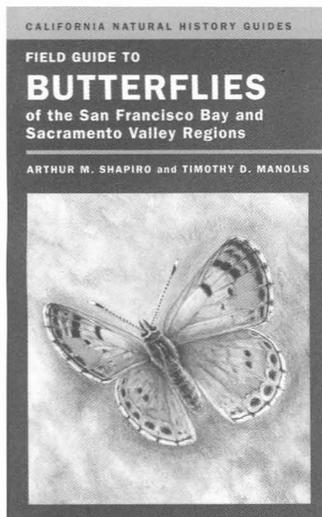
consider stationary or stable. I intend to consult it often.



GEOLOGY OF THE SAN FRANCISCO BAY REGION

DORIS SLOAN
Photography by John Karachewski





Introduction to Water in California, by David Carle, should be in every home, within easy reach, because we all need to understand the basics about water: where it comes from and how it reaches our taps. That's more true than ever now, as global warming leads to an earlier melting of the Sierra snow pack. The state's water delivery system is intricate and amazing, and this lucid little volume draws you right in and shows you the essentials. It's written with the kind of elegant simplicity that only a master of his material can achieve. The illustrations likewise are excellent. Anyone moving to California should get a copy right away.

In his *Field Guide to Butterflies of the San Francisco Bay and Sacramento Valley Regions*, Arthur M. Shapiro introduces us to the evanescent life of butterflies. Our knowledge about butterfly fauna in the region does not go very far back in time. We don't know which ones were here when the European settlers arrived, and we can't expect the butterflies we see now to be here in the future.

"On a time scale of a few thousand years or longer, the much-touted 'balance of nature' is an illusion," Shapiro writes. "The physical environment (especially climate) is constantly changing, and as it does so it reshapes the rules governing biotic interactions." Therefore, he writes, "My advice is

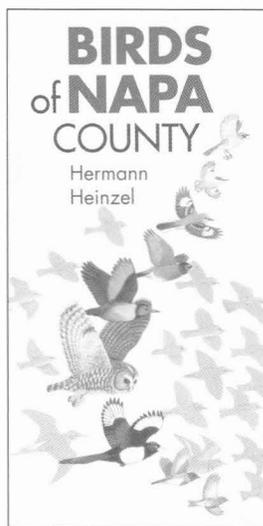
to love and enjoy your butterfly fauna and learn as much as you can so you can approach questions of environmental change and conservation as an informed, responsible citizen." This guide is a great place to begin. Because it's regional, you won't be overwhelmed. I spotted a gorgeous butterfly in my garden and found a picture of it immediately: It was a Red Admiral, not at all unusual, I was a bit disappointed to learn. But I had not known its name before I looked in this guide. And yes, Doris Sloan, it's now a friend.

—RG

Birds of Napa County, by Hermann Heinzel. Heyday Books, Berkeley, 2006. 104 pp., \$12.95 (paper).

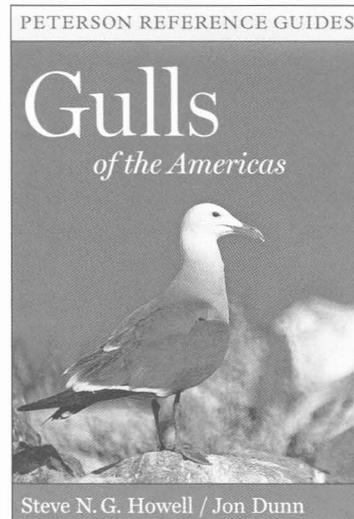
THIS LOVELY FIELD GUIDE IS jam-packed with hand-painted illustrations of over 300 species of birds that live in or pass through Napa County. The descriptions and commentaries are brief but pithy. The paintings of birds in their habitats—flying, perching, swimming, feeding—bring a lively warmth to its pages, avoiding the static feeling of many field guides. Some pages are so crammed with information that connecting text to pictures can be tricky. This sturdily constructed volume includes a checklist, and is well designed for field work.

—HMH



Peterson Reference Guide to Gulls of the Americas, by Steve N. G. Howell and Jon Dunn. Houghton Mifflin, Boston, 2007. 528 pp., \$35 (hard cover).

THIS VOLUME IS THE FIRST of a new series of reference guides that provide far more detail than the long-popular Peterson Field Guides. In fact, the amount of detail it presents on the 36 American gull species is quite overwhelming. The challenge of identifying gulls is demonstrated clearly by its 1,160 color photos of gulls in their many stages of plumage, which can



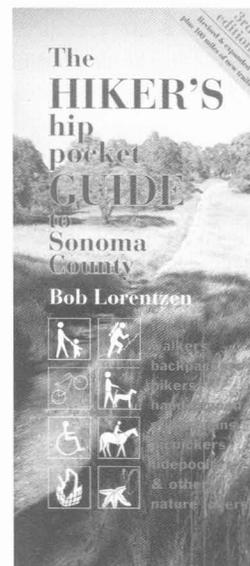
vary dramatically and bewilderingly with age, breeding status, and other factors. Substantial species accounts complete this handsome and impressive volume.

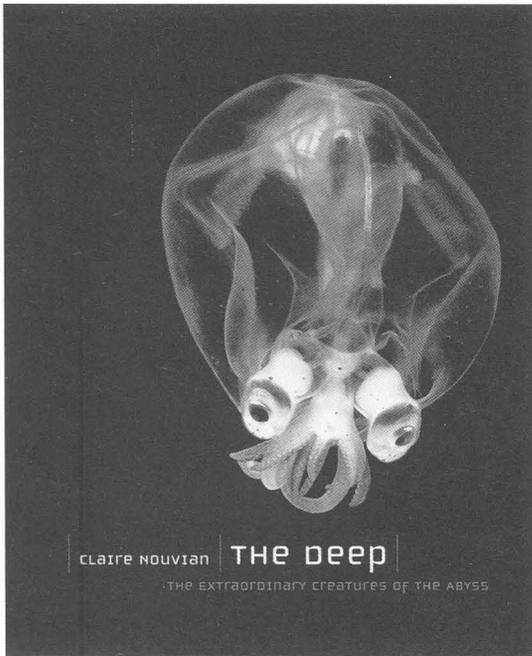
—HMH

The Hiker's Hip Pocket Guide to Sonoma County, by Bob Lorentzen. Bored Feet Press, Mendocino, 2006. 256 pp., \$16 (paper).

FROM ITS ROCKY, windswept coast to its lush forests, rushing creeks, and rolling hills, Sonoma County has an amazing array of natural riches to be explored. This guide, now in its third edition, was one of the first to provide detailed information about the county's parks and trails, and it is still one of the best. Revised and expanded to include 11 new trails, totaling 100 more miles, the guide provides lists of which routes are handicapped-accessible, which allow dogs, and which allow bicycles, and includes suggestions for backpacking and beach walks. Bob Lorentzen has been hiking North Coast trails and writing about them for more than 20 years now, and his knowledge of—and love for—Sonoma's wild, natural places shines through on every page.

—ERE

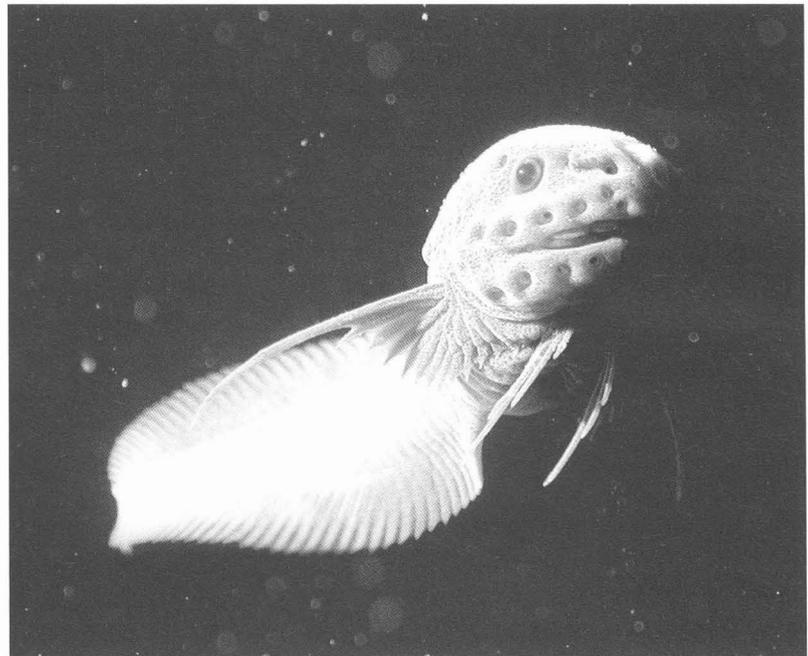




THE DEEP

The Deep: The Extraordinary Creatures of the Abyss, by Claire Nouvian. University of Chicago Press, Chicago, 2007. 256 pp., 250 color plates, \$45 (hard cover).

THESE ARE TWO OF THE MORE than 200 creatures pictured in this astonishing book. It combines articles on the latest scientific discoveries with stunning color photographs of the bizarre and beautiful creatures that occupy the world's largest, and least known, ecosystem—the deep sea and seafloor. The illuminating text by French journalist and filmmaker Claire Nouvian is complemented by essays by prominent ocean researchers. For more information and some color images, see www.thedeepbook.org.

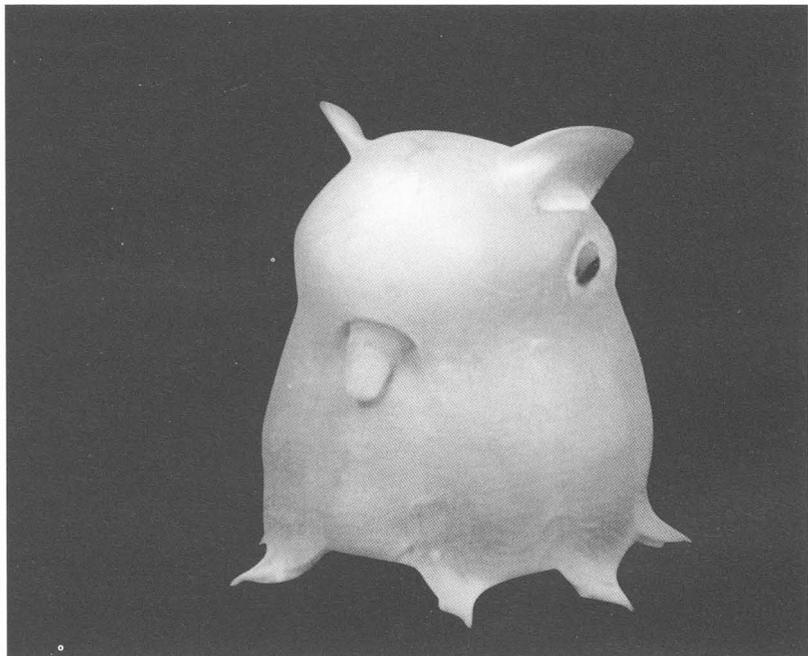


Careproctus longifilis (Threadfin snailfish)

SIZE: 15 cm

DEPTH: 1900 to 2997m

Like a prehistoric tadpole, this fish with a face perforated by large sensory pores seems to confirm the myth of the deep sea as a haven for fossil creatures that have remained unchanged since the dawn of time. Despite its strange looks, the threadfin snailfish is not among the oldest sentinels of our planet, as are the horseshoe crab and the coelacanth, whose fossil records date back more than 250 million years. Photo © 2002 MBARI.



Grimpoteuthis sp. (Dumbo octopus)

SIZE: 20 centimeters

DEPTH: 300 to 5000 meters

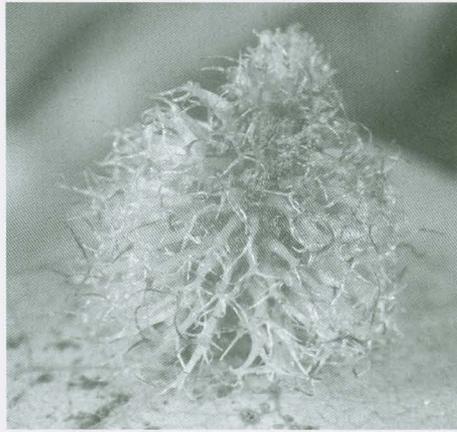
This little octopus almost seems like a character out of a Japanese cartoon. Researchers have already described fourteen species of *Grimpoteuthis*, but beyond the taxonomic description made on the basis of animals captured by trawlers, these octopuses for the most part are still enigmatic. They are most often observed resting on the bottom, with their mantle spread around them. What are they doing there, sitting so quietly in the dark? Nobody knows. Photo © 1999 MBARI.

Back cover

Top left: *Benthocodon* sp.

Bottom right: *Grimpoteuthis* sp.

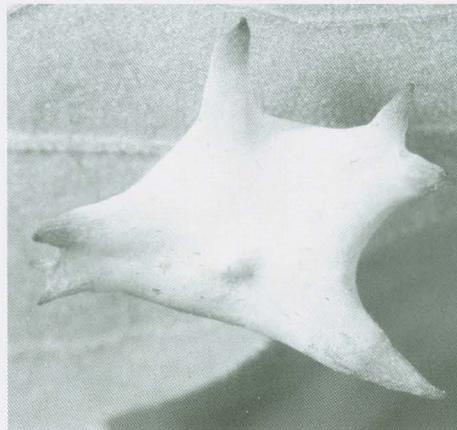
Andricus crystallinus



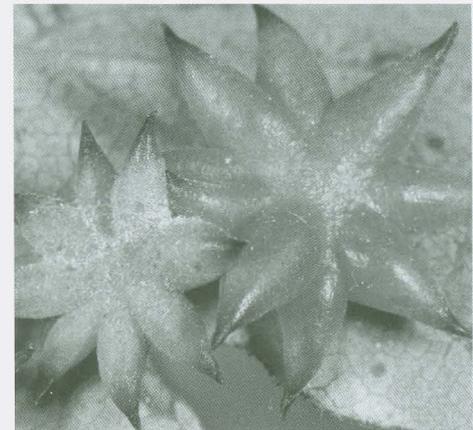
Andricus parmula



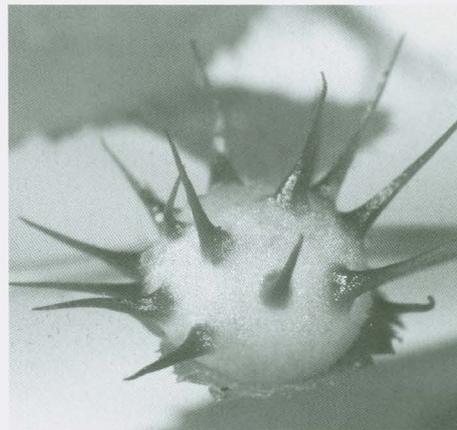
Antron douglasii



Antron douglasii



Diolepis polita



Dryocosmus dubiosus

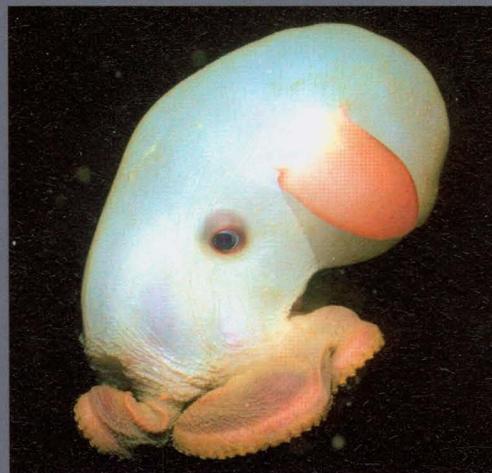
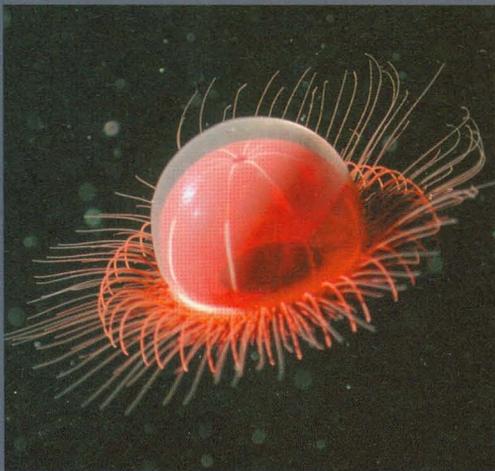


The objects in these photos may look like strange undersea—or otherworldly—creatures, but if you have ever walked through oak woodlands, chances are you have passed some by without knowing. They are galls, or growths, caused by wasps of the family *Cynipidae* and mostly found on the leaves of oak trees (*Quercus* sp.). The galls, which range in size from 1 mm to 6 cm or more and come in many shapes and colors, usually develop soon after the female wasp lays her eggs. It's not fully understood what causes them or determines their shapes, but they do not seem to harm the host plant. Adult cynipid wasps are generally small—1–4 mm long—and species are often easier to identify by looking at their galls than at the insects themselves. These wasps support a community of other insects that feed on them, their galls, and their parasites. *Photos by Joyce Gross.*



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What weird undersea creatures are these? Look inside.