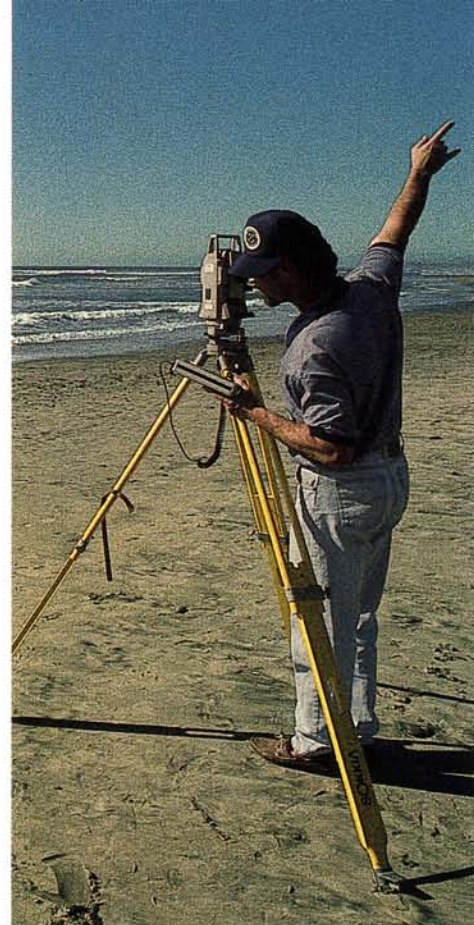




**Sands of Time
RUNNING OUT**

Oceanographer Seeks Solution for California's Dwindling Beaches



Southern California beaches have something for everyone, but it's not just sun and fun. They are a huge factor in the state's economy, generating billions of dollars a year. The problem is that the sand is slowly disappearing.

Ask an old-time surfer about southern California beaches and he'll probably tell you they aren't as wide, pristine, or sandy as they were when he was young. Legends persist of driving cars on the sand from Los Angeles to the Mexican border or finding the beach at Santa Monica a half-mile wide—cowabunga, dude!

In fact, many of the region's beaches are smaller now than they were in the recent past. The truth is that wide, sandy beaches are not usually a natural feature of southern California. Many premier beaches were created, not by nature alone, but largely by human activities. And according to Reinhard Flick, Scripps researcher and oceanographer for the California Department of Boating and

BY CHUCK COLGAN

Waterways, the beaches will be narrower and rockier in the future unless people and governments continue to take action.

"There is a popular misconception that what are narrow, urban shorelines today, under natural conditions would be nice, wide, sandy beaches," Flick explains. "While people have contributed to the loss of some beaches, they also have created many others that are much wider than they were naturally."

During the past 15 years, California's beaches have experienced increasing levels of erosion. State experts say that more than 85 percent of the coastline is now in an "erosional condition." Expanses of sand have disappeared, such as the beaches of San Diego's north county, where, in many places, there is a rocky, cobbled shoreline. In areas with coastal bluffs, once sandy beaches no longer protect cliffs from erosion, putting property and structures at greater risk from storms and high seas.

FACING PAGE: Erosion along north San Diego County beachfront property.
Above right, Scripps researcher Reinhard Flick.

Flick recounts the evolution of southern California's beaches, going back about 25 million years, when the North American continent began lifting up over the Pacific Plate. As the uplift continued, ocean waves cut terraces into the land, creating shelves, some of which are now above water. Over time, sand from riverbeds and eroding cliffs accumulated on

the shelves and was moved offshore by ocean waves.

The natural actions of runoff and erosion continued unchanged until about a century ago, when people began to impact the coastal environment. At first, human intervention seemed disastrous, Flick says.

As southern California grew, so did demand for flood control reservoirs and public water-storage reservoirs. Eventually, dams were built along all of the region's rivers. They greatly curtailed the amount of sand flowing to the shoreline and might have meant doom for beaches were it not, surprisingly, for another human factor—commercial and public development.

Beginning in the 1930s, four decades of massive coastal development provided about 130 million cubic yards (about 100 million m³) of sand that nourished beaches. As a result of this augmented supply, wide sandy beaches devel-

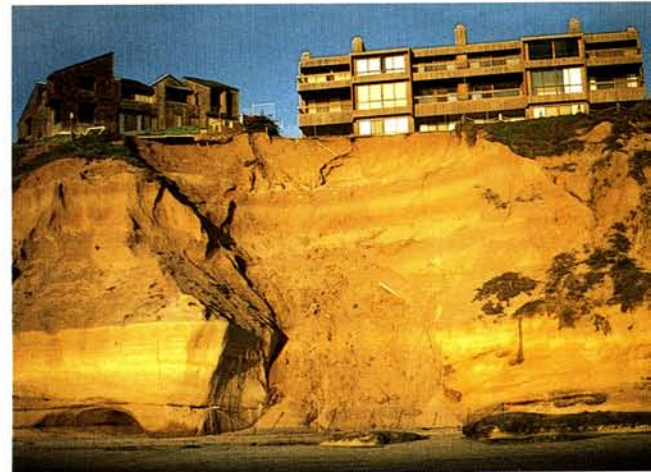
oped, including those at Santa Monica, Laguna Beach, Oceanside, and San Diego. In Santa Monica Bay, for example, nearly all the beach sand is a product of coastal projects.

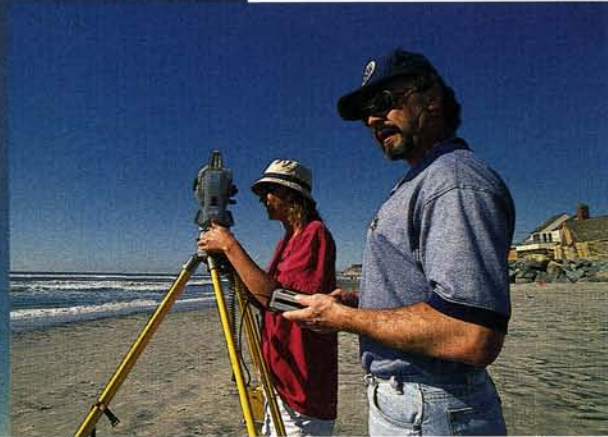
As this sand asset built up from each new harbor, power plant, airport, sewage plant, or other major coastal construction project, it created the impression that wide beaches were natural.

Since the 1970s, however, conditions in southern California have changed greatly, limiting available sand sources. With most rivers dammed or channeled with concrete, their ability to deliver sand to beaches has been reduced by 50 percent or more. The last major harbor was completed in 1969, and no more are planned, or likely, given California coastal protection laws and regulations. And inland sand sources are becoming less available because new development is occurring farther from the shoreline, thus



Storm-driven coastal erosion imperils seaside development in San Diego County.





A team of Scripps researchers led by Reinhard Flick (above at right and middle right) conducts a beach survey of Del Mar, California. Graduate student Megan Hamilton (above at left and middle left) and Thomas Sestak (below) work with Flick.

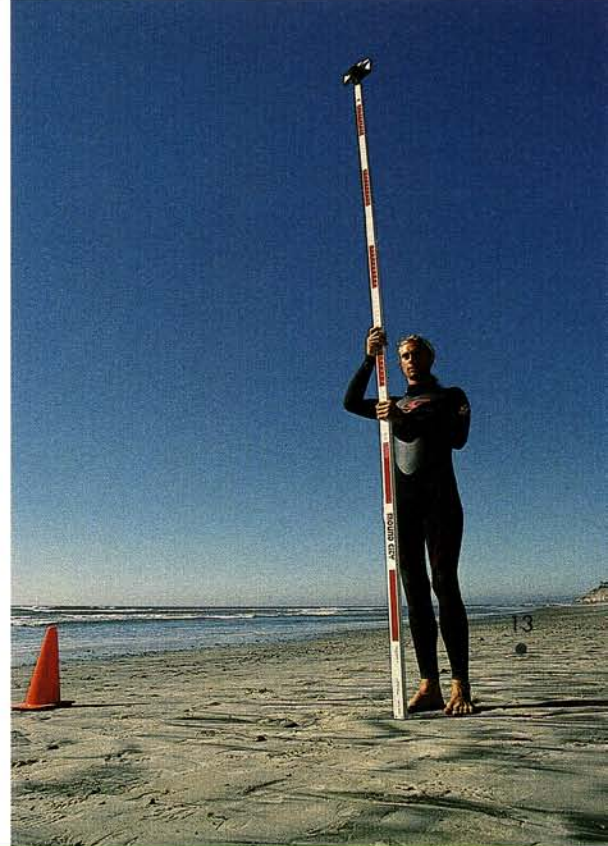
providing less beach-making material.

According to Flick, the result is that today's beaches will, in time, retreat as the consequences of decreased natural sand delivery and reduced sand augmentation take hold. Most locations in southern California face net sand losses in the coming decades. This may happen slowly or in a series of catastrophic events during severe winter storm periods. The latest studies at Scripps confirm an overall imbalance: southern California's beaches are shrinking.

Some people would ask, "So what if the beaches erode; do they have any real worth other

than their aesthetic value or as playgrounds for sun lovers?" They certainly do, declares Flick. Beaches provide the base for two of the state's largest industries, tourism and recreation, and about 500,000 jobs.

"More than 130 million people use southern California beaches annually, and this adds up to a lot of money," he says. "Consider this one statistic: All coastal industries, including oil and gas, transportation, shipping, commercial fishing, the military, tourism, and recreation, have an annual value of about \$17 billion. Of that, more than one-half, or about \$10 billion, comes from coastal tourism and recreation alone.



Without sandy beaches, much of the attraction and money would disappear.”

Beaches also serve as buffers from wave damage for property and coastal infrastructure, particularly during heavy winter storms. It is possible to construct seawalls, which provide very effective protection from erosion, but do nothing to build up or retain beach sand.

Every level of government has responsibilities for curbing beach erosion, Flick reports, but all are faced with problems of priorities and money. Cities and counties have sparse funds for erosion control programs, and the federal government generally focuses such efforts on emergency relief and harbor projects, mostly on the East Coast.

The job of maintaining and restoring healthy beaches falls



primarily to the state, Flick concludes, but a stable source of funding has been elusive. Over the past 16 years, California expenditures on beach erosion control have averaged only \$2 million a year. In 1995 alone, New York appropriated about \$20 million from its general funds, and Florida nearly \$10 million. Some nations also invest heavily in their beaches, with Japan spending \$1.5 billion on beach replenishment since 1990.

“A fundamental question that California residents and politicians need to ask is: Do we want wide, sandy, urban beaches in

southern California?” Flick observes. “If the answer is yes, there is only one way to do it: Bring sand. The good news is that bringing sand to the beaches generally does make them wider, but it’s expensive, and getting people to agree on spending money for such purposes isn’t straightforward.”

Large-scale sand nourishment projects are feasible in southern California, Flick claims. The region’s geology, a long arc sloping eastward from Point Conception to the Mexican border, is generally favorable to beach formation. Also, localized wave energies that can strip sand away are greatly reduced by offshore islands. However, the first requirement is to get more sand to the beaches.

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Top, Collapsed mobile home at El Moro Beach, California. **Above,** Wetsuit-clad researcher holds measuring pole during beach survey. **Right,** North jetties at Agua Hedionda Lagoon, Carlsbad, California.



Early Alert Aids in State's Readiness for

El Niño

When Scripps climate researchers started talking about warm water conditions brewing in the equatorial Pacific that equaled the buildup of the massive 1982-1983 El Niño, which brought California heavy winter storms and \$100 million of damage, Reinhard Flick thought he should let the right people know. It's part of his job.


Flick, a 1978 Scripps graduate, is the staff oceanographer for the California Department of Boating and Waterways, making him the state government's leading authority on beach and shoreline processes and an advisor to government agencies at all levels. He also is a research associate at Scripps's Center for Coastal Studies, where he is able to draw upon the expertise and resources of the institution's scientific community.

Alerted to the impending El Niño, Flick sounded an early warning by organizing a workshop at Scripps in August 1997 for more than 280 local, state, and federal officials to discuss the potential coastal impacts. As a result, many agencies began taking action: making necessary levee repairs; testing emergency management systems; and notifying sheriffs, life-



Scripps researcher and California state oceanographer Reinhard Flick (left) joins Chuck Raysbrook, director of the California Department of Boating and Waterways, in Sacramento.

guards, and swift-water rescue teams. Private property owners were urged to fix roofs, clear trees, and keep emergency supplies and sandbags on hand. No one could stop El Niño storms, but as a result of these activities people were more prepared to face the wild winter as it got under way.

"When you look back to the El Niño conference, you can see that it sparked a lot of public agencies into action well in advance of the winter storms," said Chuck Raysbrook, director of the California Department of Boating and Waterways. "This is just one example of why it is so important to have Dr. Flick on site at Scripps, to move new information from academics to those who can apply it to public issues." 



Carlsbad city beaches represent a supreme effort by state and local agencies to prevent further loss of recreational seaside property. Jetties have been constructed (left), while acres of sand have been pumped in and distributed on the beach (below and bottom) to replace that lost to erosion.

Flick tells of various ideas proposed over the years, including trucking trash from coastal cities to dumps in Arizona and returning with desert sand, which may prove economical if local trash-disposal costs skyrocket.

Inland construction provides opportunities for sand supplies, but trucking sand to the beach can be costly. It could easily take a half million cubic yards of sand, some 25,000 truck loads, to rebuild a small beach, a task that becomes impractical when considering large sections of coastline. The utility of trucking sand, Flick concludes, is limited to maintaining beaches; restoration takes more formidable action.

Dredging provides a more practical approach. Dredges can quickly scoop up or suction large

quantities of sand, which can then be either loaded onto barges or pumped through large pipes to denuded beaches. Such operations have proven successful at a few southern California beaches, but are usually conducted only when harbors or waterways need to be cleared of sediments. These opportunistic sources could never supply enough to build up the region's beaches, Flick asserts, but there are nearby reserves with sand aplenty.

"Just offshore are natural stockpiles of sand sitting in old river channels and other depressions that are the only large, practical sources for beach restoration," Flick says. "No one really knows the amount, but there are hundreds of millions of cubic yards of sand out there."

Some cities south of Long Beach occasionally tap into this submerged supply, dredging offshore sand as needed and depositing it onto local beaches. A similar effort is proposed for San Diego beaches, thanks to problems encountered by the U.S. Navy's project to dredge San Diego Bay for deeper-draft aircraft carriers.

The navy originally planned to dredge up to 11 million cubic yards (8.4 million m³) of bay sand,



barge it along the San Diego coast, and pump it to nine of the county's most severely eroded beaches. The project began in late 1997, with some sand successfully delivered to Oceanside and Del Mar. However, the dredged material turned out to be contaminated with live military munitions and other debris. To avoid obvious dangers, the navy started dumping the sand in deep water miles offshore. This continued until the California Coastal Commission obtained a court order that stopped the operation on the basis that it was wasting valuable state resources.

In February 1998, the situation was resolved when the navy



agreed to trade deep-sixing the bay sand for pumping other offshore sand onto nearby beaches. In April, the U.S. Congress approved funding for the project. Flick describes it as “a significant, large-scale test of this idea for beach restoration.” If successful, it could prove that the method is an economically feasible way to achieve extensive beach building in the San Diego region.

Just bringing sand to a beach is not enough. Flick stresses that replenishment should be accompanied by steps to keep the sand in place, which requires building retention structures, such as jetties, groins, or breakwaters.

However, these are not popular with some beachgoers, who consider them unsightly or fear they may interfere with the surf break. But sand would remain longer, and beaches stay wider, with retention structures, Flick says.

In 1994, Flick joined with Kim

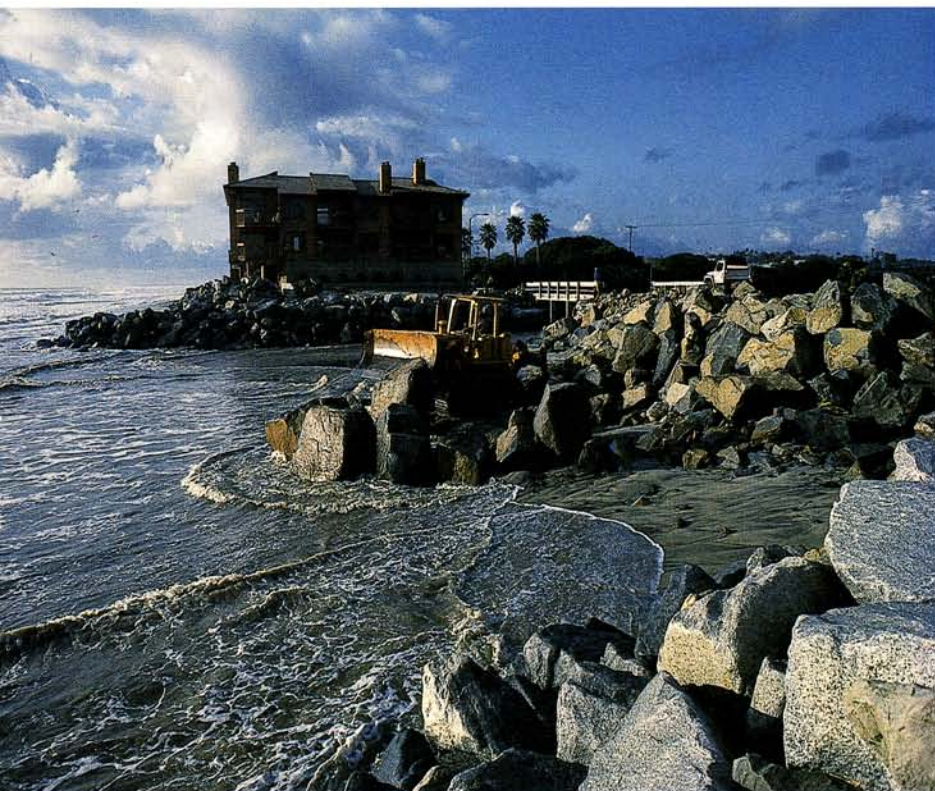
Sterrett of the California Department of Boating and Waterways’ Beach Erosion Control Program and engineering consultant Craig Everts in publishing an assessment of San Diego County beaches, which details how structures could help stabilize the region’s beaches. Such projects, Flick acknowledges, require a lot of money too.

Assemblywoman Denise Ducheny of San Diego’s 79th District is one of the California

legislators taking on the challenge of dealing with long-term beach erosion by proposing additional funding. She is sponsoring a bill that directs 10 percent of the federal money California receives from offshore leases, or about \$3 million annually, to beach building through sand replenishment and to evaluation of protective structures. The bill passed the assembly in June 1997 and is now awaiting hearings by the state senate’s appropriations committee.

The benefits of sandy beaches in southern California are clear—continued recreation, prosperity in the tourist industry, protection of shoreline property, increased public access, and conservation of beach habitats.

“The bottom line,” Flick says, “is that California needs to put more resources into sand nourishment projects and carefully considered sand retention structures. We really don’t have a choice if we want to preserve beaches for ourselves and future generations.”



Countermeasures such as sea walls (top) and rock jetties (left) are under construction throughout southern California in an effort to stem the tide of coastal erosion.