

Our Ocean Backyard — *Santa Cruz Sentinel* columns by Gary Griggs, Director, Institute of Marine Sciences, UC Santa Cruz.

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Dealing with a retreating coastline



An entire row of bluff top homes along the Esplanade in Pacifica was destroyed during the 1997-98 El Niño winter as the bluff was attacked by waves.

The beach at Santa Cruz was a 10-mile hike to the west 18,000 years ago at the end of the last Ice Age. As glaciers retreated and ice melted over the following centuries, sea level rose about 400 feet and gradually flooded the edge of California, moving the beach inland. The coast retreated about 300 feet per century during that era of warming and melting. Throughout this 18,000-year period the sea cliffs marching back three feet every year didn't matter much. Although the Ohlones used the coastline, harvesting fish and shellfish and hanging out on the beach, they didn't have permanent dwellings so the precise location of the beach and sea cliff didn't really matter.

Things are different today. The shoreline and sea cliff from San Diego to Santa Barbara is almost completely urbanized. In Santa Cruz County, homes, businesses, roads, parks and parking lots cover the coastline from Manresa to Natural Bridges. It's probably fair to say that California's most valuable real estate is right on the

edge. But that edge is never in the same place for more than a few decades. The shoreline moves back and forth as sea level rises and falls in response to climate change.

Around the Mediterranean Sea, civilizations have dealt with this phenomenon for thousands of years. In California, however, our coastal development and construction history is much shorter. Photographs of coastal bluffs in Santa Cruz County from the late 1800's reveal that people didn't build right at the edge. But today, it's pretty much continuous development of one sort or another.

So how have we dealt with the erosion and retreat over the past 50-100 years and what are we going to do in the future? This is a complex issue involving expensive and difficult questions, and its not going to get any easier in the future.

Historically there have been three basic options for dealing with coastal retreat: 1. retreat or relocation; 2. armor or protection; or 3. beach nourishment. None of these are simple solutions so it will take a few columns to tell the whole story.

Nobody with an oceanfront location is excited about moving back from the edge, but it has happened and will likely happen more and more frequently in the future. On Depot Hill in Capitola, six cliff top apartments were taken down after the Loma Prieta earthquake when foundations cracked and partially failed. Twenty years earlier a house next to the apartments was picked up and moved back several blocks and put on a new foundation.

In other cases, failure to relocate houses led to cliff collapse and homes ending up on the beach below, which is what happened along the Esplanade in Pacifica in 1998. Sea level rise and a more severe storm climate claimed a number of villages along the southeast coast of England during the Middle Ages that are chronicled in a book written a century ago, *The Lost Towns of the Yorkshire Coast*. Perhaps the most expensive relocation to date was the Cape Hatteras lighthouse. The National Park Service moved this 130-year old, 21-story tall structure, which weighs 4830 tons, over a half a mile inland on giant rollers in 1999 at a cost of \$12 million.