

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

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Natural curves along the shoreline



A satellite view of the coast north of San Francisco revealing three log spiral or hook-shaped bays from space: from north to south: Bodega Head, Point Reyes and Bolinas and Stinson Beach

A high altitude aerial photograph of the California coast reveals some perfectly curved sections of shoreline. Half Moon Bay was named after its smooth curved shape. Bodega Bay, Drakes Bay, Stinson Beach, San Pedro Bay in its pre-breakwater configuration, and the Silver Strand in San Diego are other good examples of shorelines, which have or had a nearly perfect hooked shape, uncoiling or unwinding from north to south.

Monterey Bay is unique in having smooth curved beaches at both ends. The northern end actually has two hooked shaped sections; one begins at Cowells and extends south and east towards Blacks Point, now interrupted by the jetties at the harbor. The second begins along Depot Hill in Capitola and gradually unwinds with a smooth curve extending all the way to Moss Landing. At the southern end

of the bay, the irregular granitic coastline of the Monterey peninsula changes at the Monterey breakwater into a smooth sandy beach that curves gently upcoast all the way to Moss Landing. This curve is interrupted only once, by the bulge of sand at the mouth of the Salinas River.

Each of these bays begins with a tight curve downcoast of a rocky point, and then gradually uncoils proceeding alongshore, just like the shell of an abalone or some other mollusk as it grows. These smooth uncoiling shorelines owe their origin to the process of wave refraction, or the bending of wave fronts as they approach the coastline. They form where rocks occur along the coast that differ in their resistance to wave attack. Where a hard rocky headland occurs along a section of coastline, and there is a dominant direction of wave approach, the stage is set for the formation of one of these uniquely shaped features.

Half Moon Bay is a good example, where Pillar Point stands out as a headland standing some 150 feet above sea level. Under natural conditions, the dominant waves approached from the northwest and then wrapped around Pillar Point and attacked the low-lying and softer sedimentary rocks immediately downcoast. The bending or refraction of the waves as they wrapped around the point spread out or diffused the wave energy in a very regular pattern. The refracted waves gradually eroded the weaker rocks downcoast and behind the point and, over time, the shoreline or beach gradually developed a gently curved or uncoiling shape that mirrored the wave fronts of the refracted waves.

When the Half Moon Bay breakwater was built in 1959, however, the wave energy that was formerly dissipated along the shoreline of this smooth bay was now concentrated at the south end of the new breakwater. The low weak bluffs adjacent to Highway One here are now eroding at about five feet per year and threatening the highway due to the effects of the breakwater in disrupting the natural pattern of breaking waves. In contrast, the construction of the west jetty at the Santa Cruz harbor in 1963 acted as a dam for downcoast sand transport. Seabright Beach, which was originally quite narrow, has been reshaped with the curved shoreline in this instance growing seaward, widening the beach by hundreds of feet.