The Coast of Crystal Cove Orange County, California

by

Hany Elwany, Ph.D.

Scripps Institution of Oceanography

Megan Hamilton, M.Sc.

Coastal Environments

Robert Robinson

Dept. of Parks & Recreation

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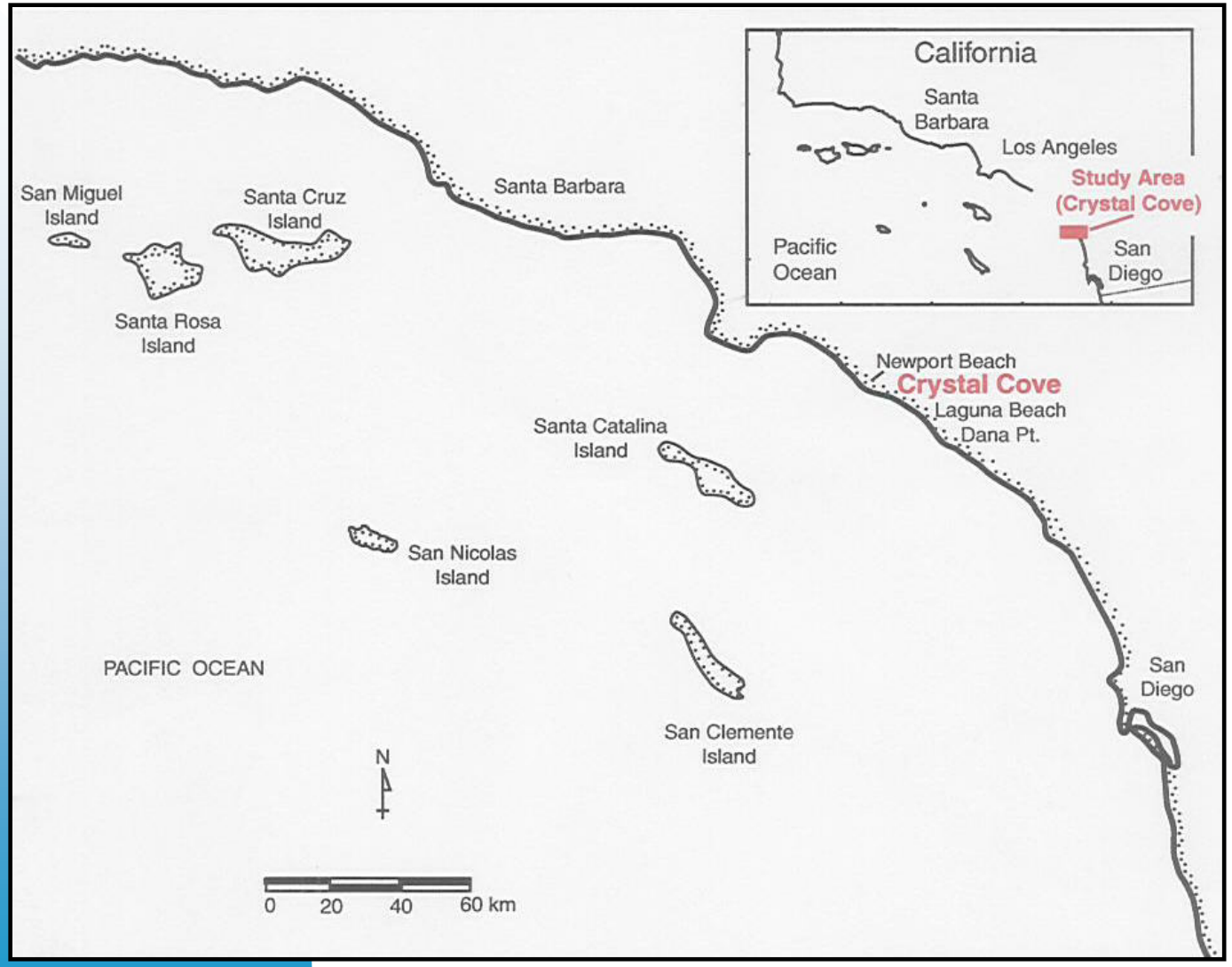
Headwaters to Oceans Conference

Crystal Cove

- History of Crystal Cove Cottages.
- California State Park effort for renovation of the cottages.
- Risks assessment: damages from storm waves and floods.
- Waves, tides, and run-up.
- Sediment transport and budget.
- Beach changes.
- Conclusions.

Location of Crystal Cove



Site History:
Native American Inhabitants

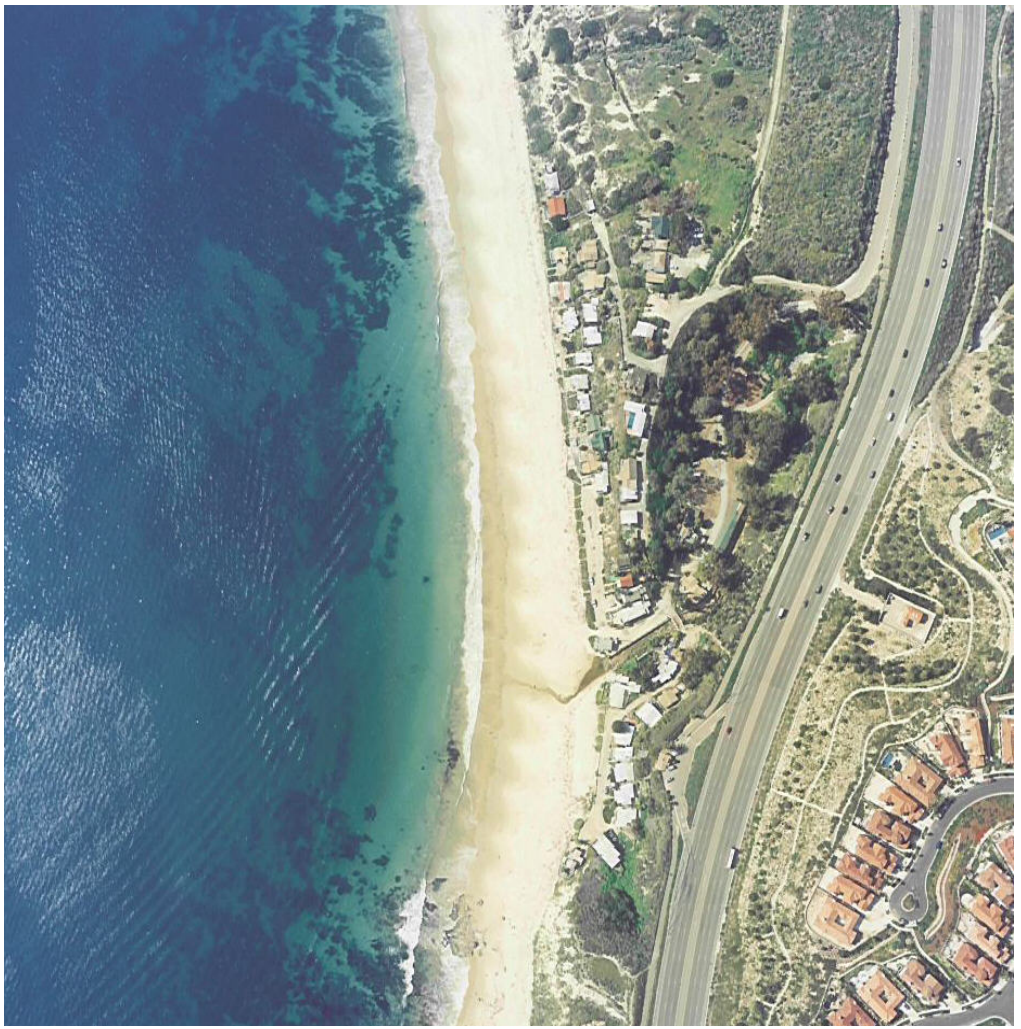
- Site was originally inhabited, in approximately 15,000 BC, by the Hokan tribe.
- The Hokans were overrun by the Shoshone peoples (from the Nevada-Utah Basin) between 500 BC and 500 AD.
- By 1833, the Indian population had been decimated by disease, and its survivors had been incorporated into the Spanish-Mexican mission culture.

Site History: 20th Century

- In early 1900's, site was referred to as Tent City, until tents were replaced by cottages between 1920 and 1940.
- State purchased site from The Irvine Company in 1979.
- In same year, site was placed on National Register of Historic Places.
- California Dept. of Parks & Recreation began managing site in 1984.

Crystal Cove Cottages

- 46 cottages within a 12.3-acre site were placed on the National Register of Historic Places in 1979.
- The first cottage was constructed in 1917. The oldest remaining cottage was built in 1921.
- This is the only remaining California beach community that has virtually unchanged in the past 60 years.



Site Renovation

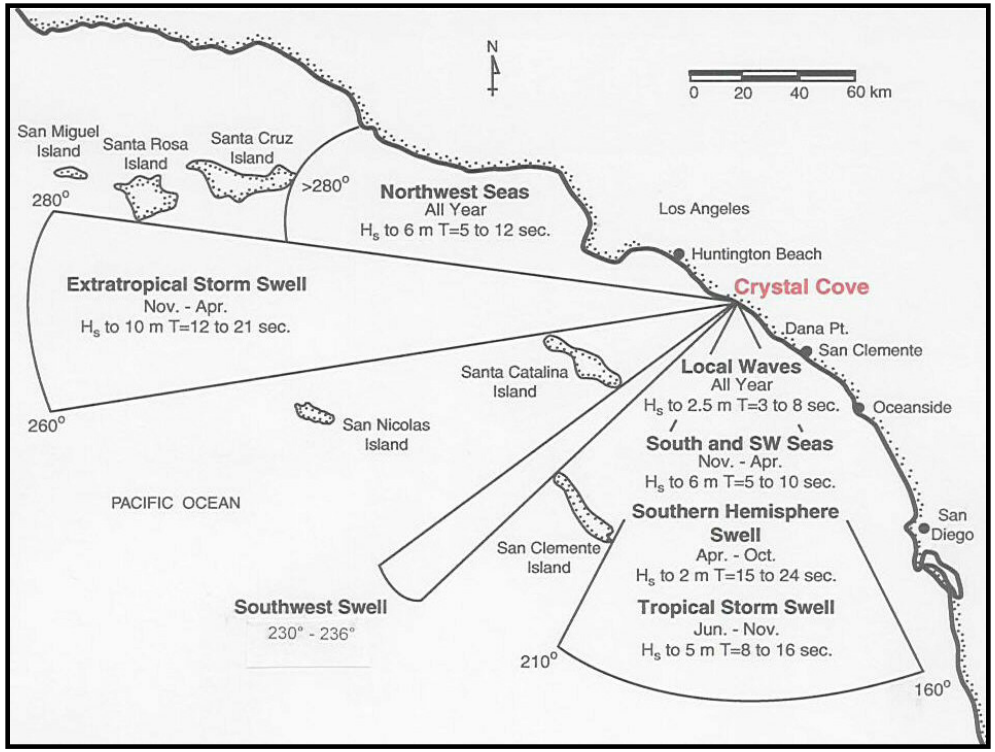
- Department of Parks and Recreation has assumed the responsibility of restoring Crystal Cove Cottages for public use.
- Cost of renovation is estimated at $20 million.
- The project required an assessment of damages by coastal forces before expending funds and evaluating the necessity of providing protective structures to preserve restoration.

Crystal Cove has survived major winter storms during the past 80 years

- Location of the cottages is between two headlands (Pelican Point and Reef Point).
- Location is protected from the western waves by Santa Catalina Island.
- Bottom topography of Crystal Cove differs noticeably from that of Oceanside and Huntington Beach.
- Crystal Cove is fronted by a series of rocky outcroppings that act as a natural submerged breakwater.
- Outcroppings extend from nearshore to –25 ft water depth with a relief of 3-4 ft.
- Sediment budget indicates that sand losses from the area is minimal.
- Near Newport Beach Canyon.

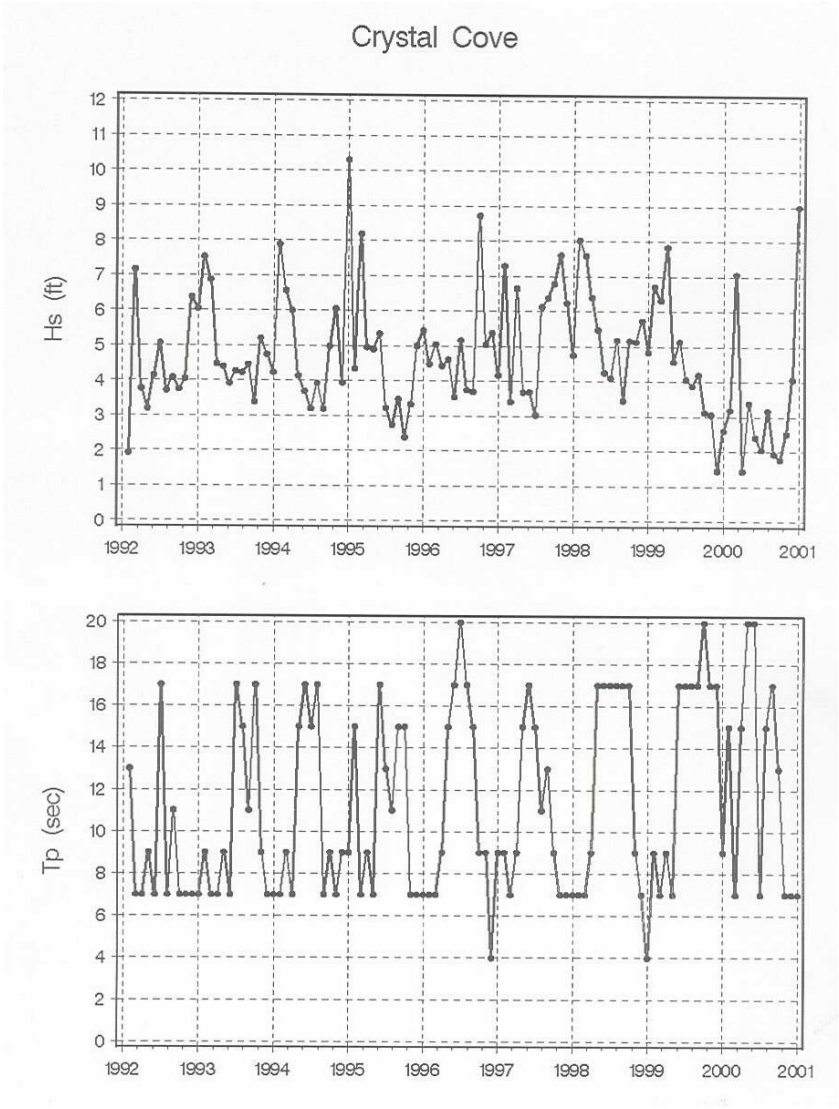
Wave Climate

- Waves in Southern California:
  - Northern & Southern Hemisphere swells and local seas (USACE, 1986).
  - Island shadowing effects from Channel Islands.
  - Nearfield topographic features.

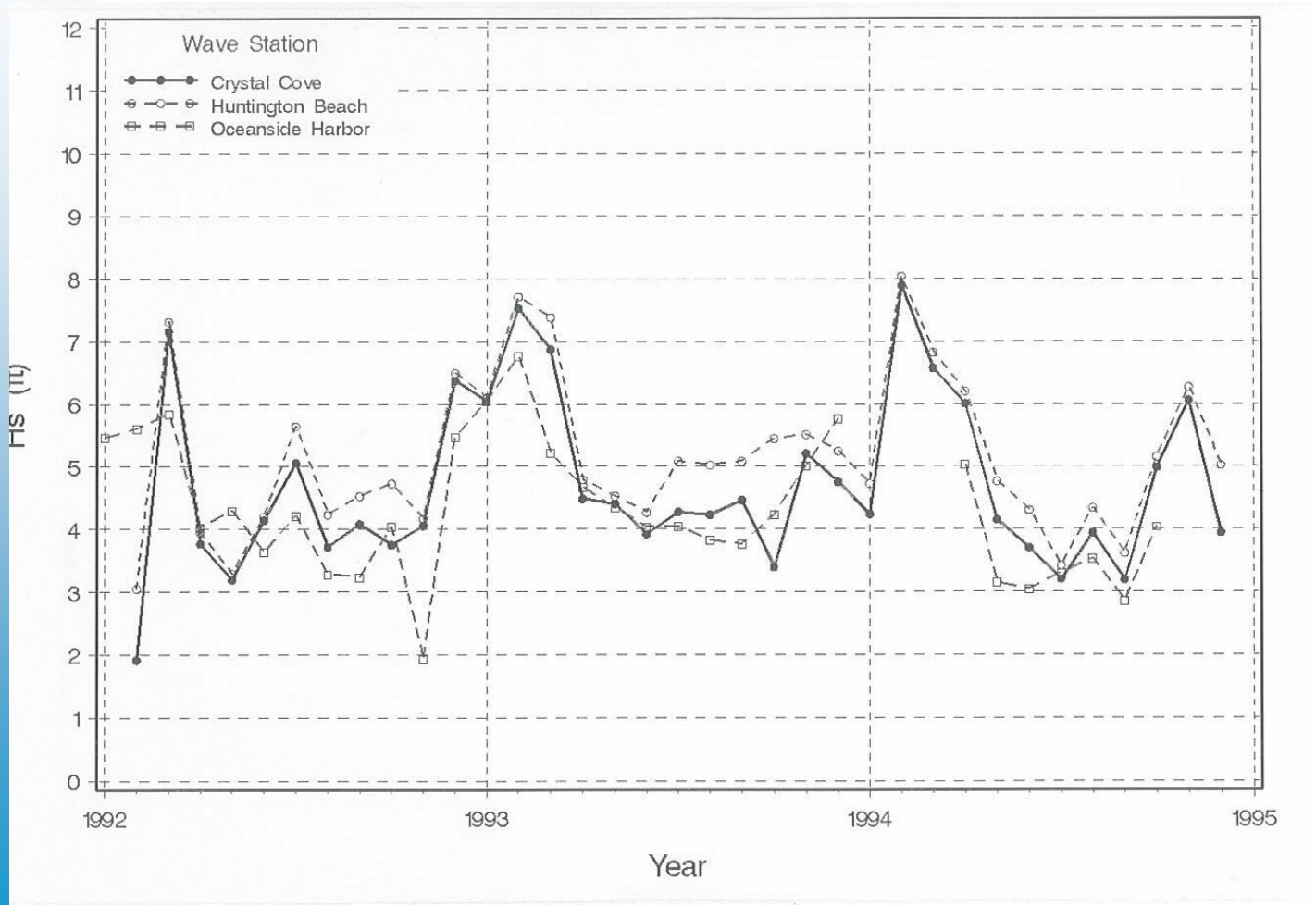


Wave Analysis

- No measured directional wave data in vicinity of Crystal Cove.
- Waves height and period estimated for Crystal Cove using 9-year measured wave data set from Huntington Beach at 11m water depth. Data obtained from CDIP at http://cdip.ucsd.edu

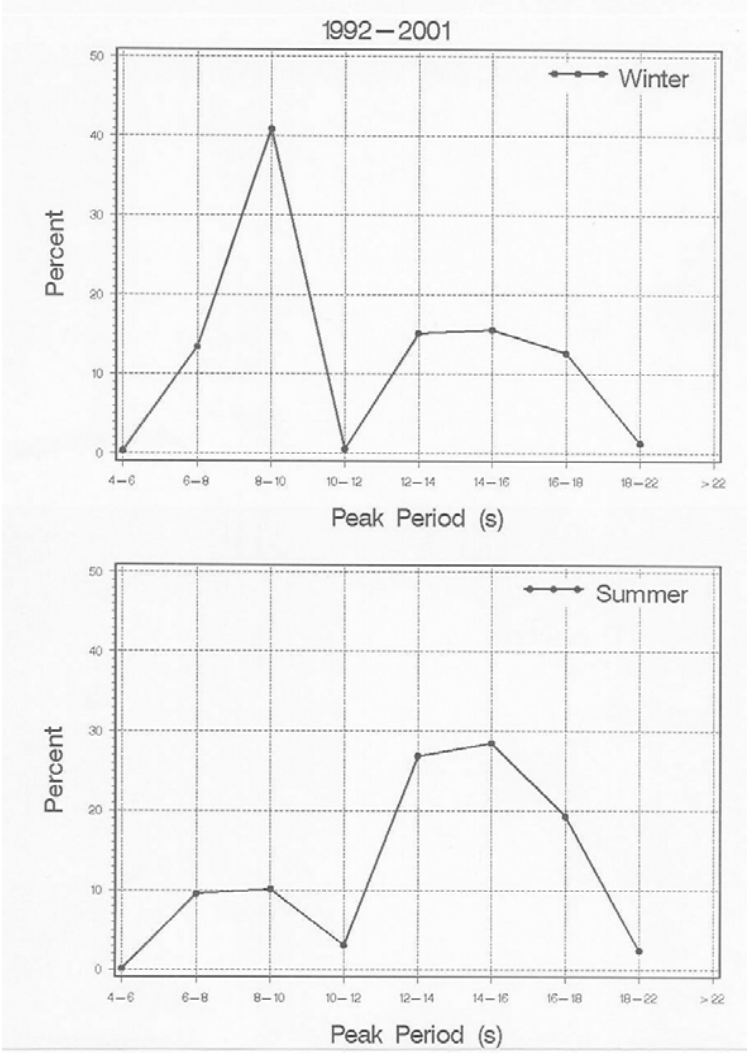


Comparison of Monthly Max Wave Heights at Three Sites at 10 m water depth



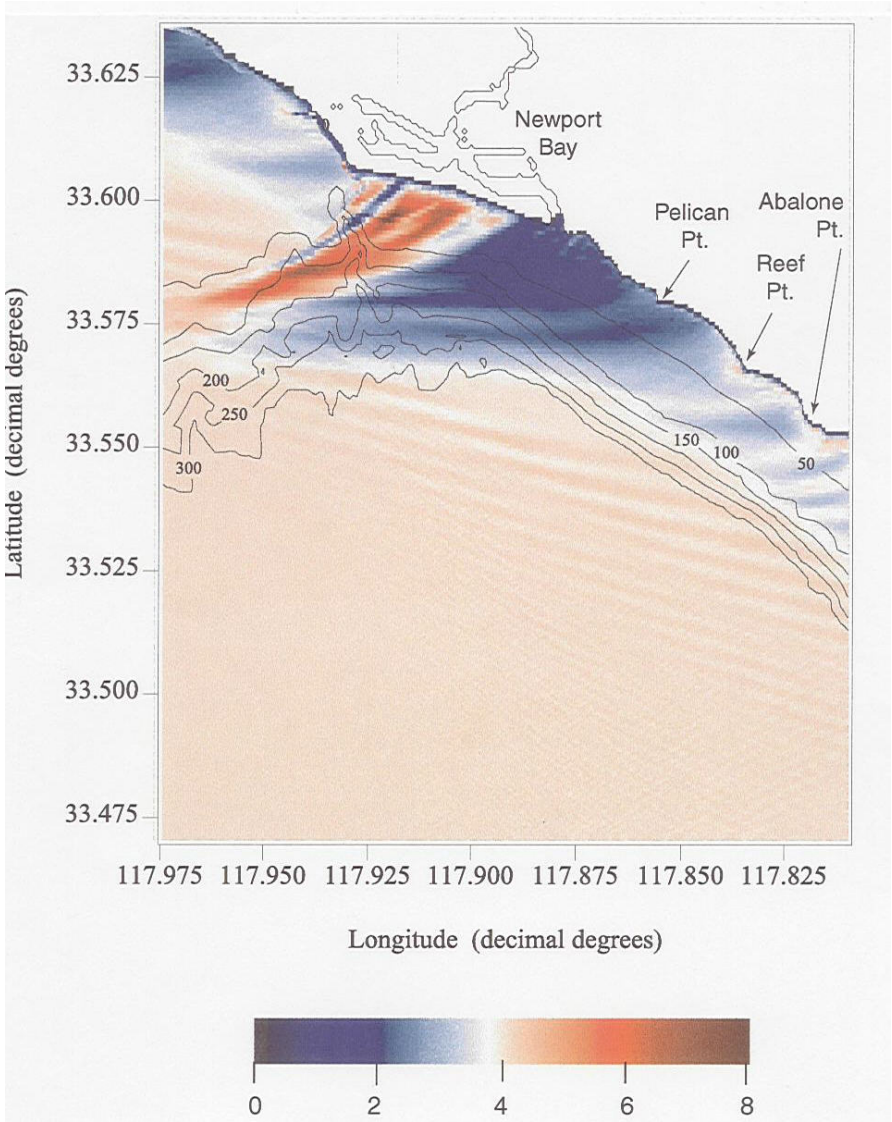
Winter/Summer Comparison of Peak Wave Periods at Crystal Cove

- Wave period generally shorter during winter (8-10 sec.) than during summer (12-16 sec.)



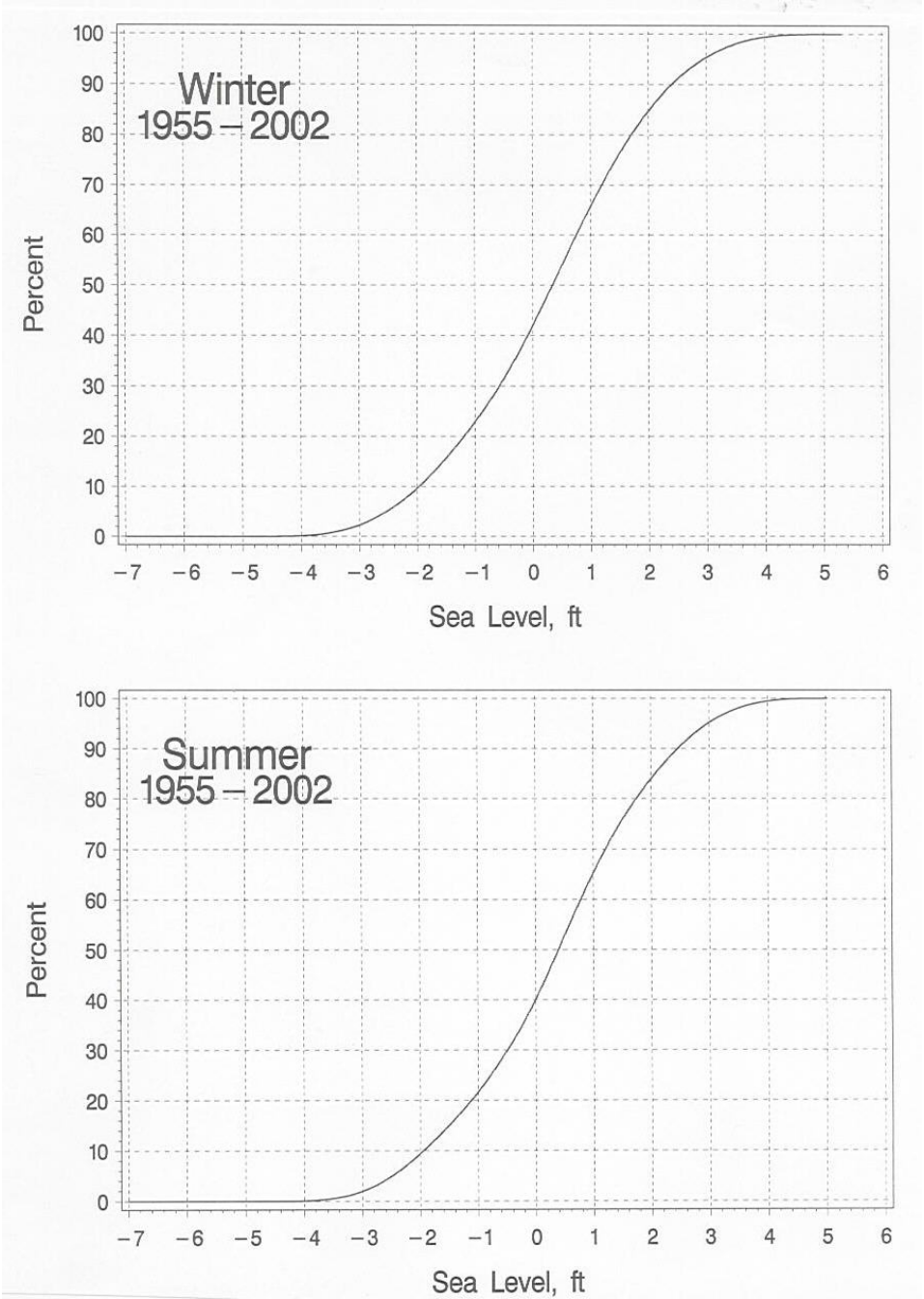
Effect of Newport Canyon on Waves

- Deep water wave height = 4.1m, period = 17s, and direction = 270° (from Jenkins and Wasyl, 2000).



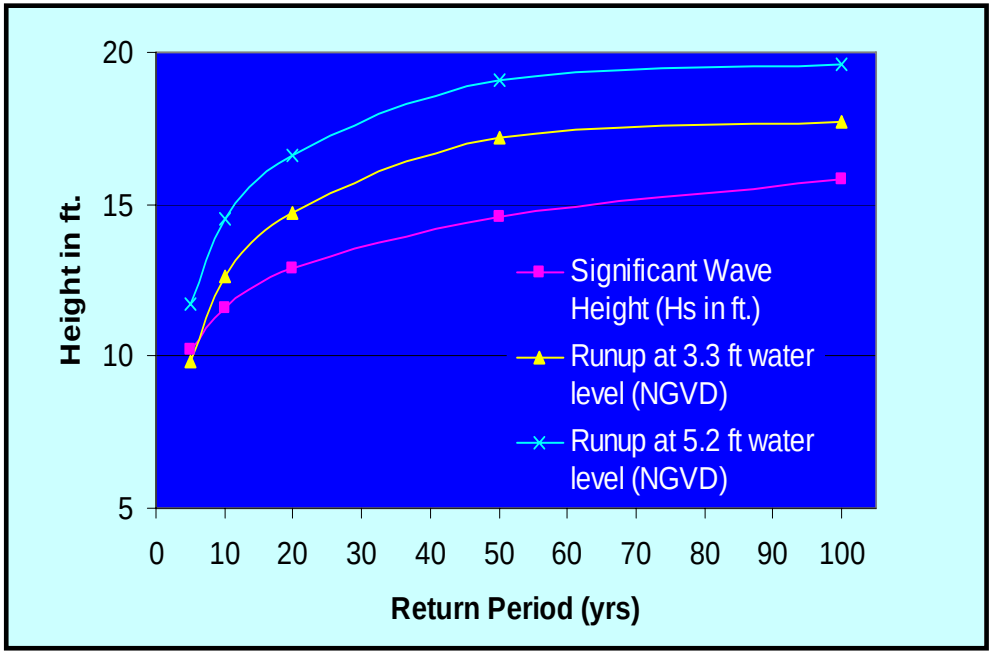
Tide Levels

- Similar tidal regime during summer and winter.
- 95% of the time, tide level is less than 3 ft, above mean sea water level.

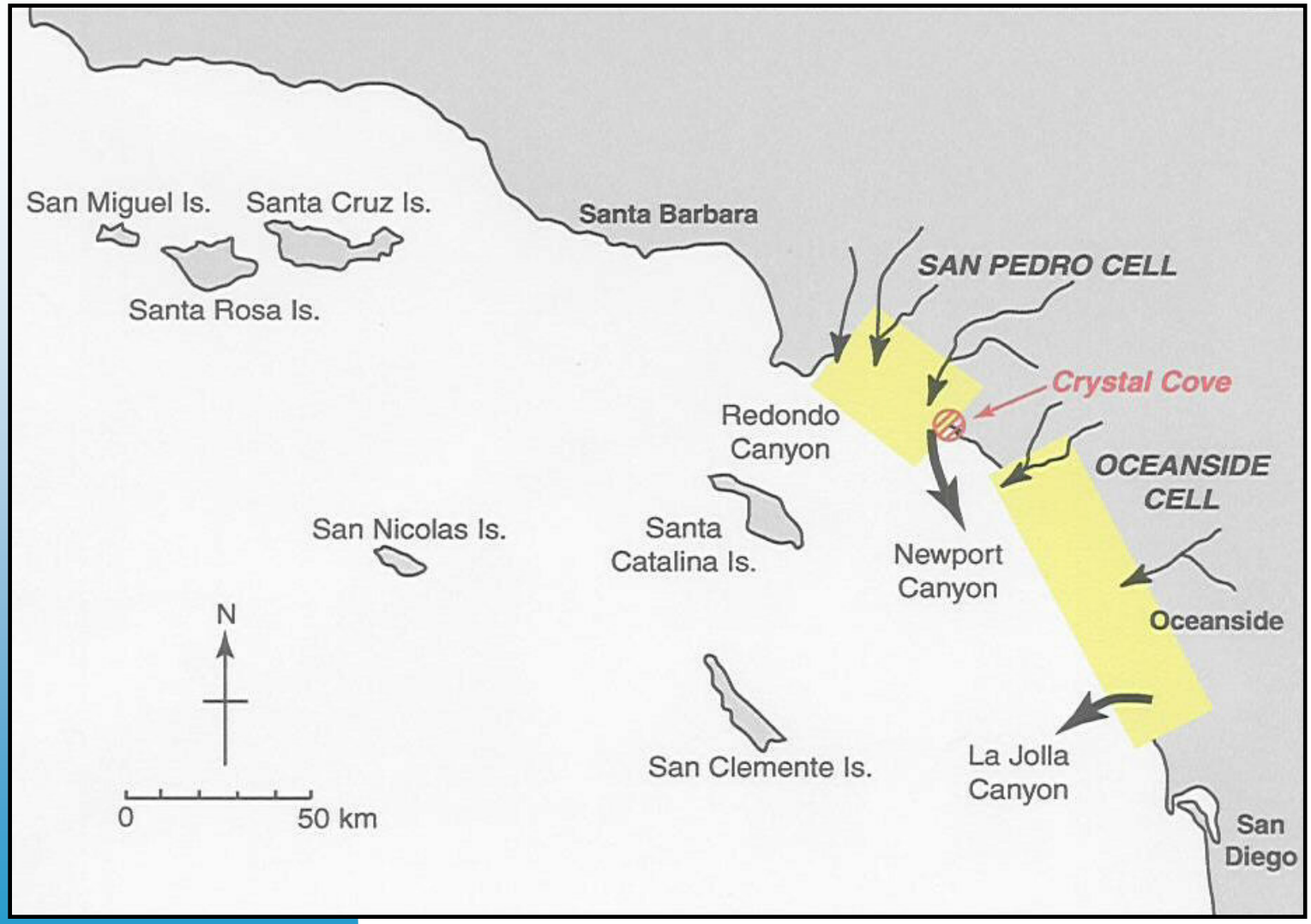


Run-up Analysis for Extreme Conditions

- Run-up/overtopping analysis is based on worst-case scenario of smooth impermeable surface.
- Overtopping may occur for design waves with a return period > 10 years.



Littoral Cells



Littoral Transport and Sediment Budget

- Longshore sediment transport (Crystal Cove and Oceanside Littoral Cells).

Longshore Sediment Transport	Crystal Cove (yd^3/yr)	Oceanside Littoral Cell (yd^3/yr)
Gross Transport	17,000*	700,000 - 1,000,000**
Net Transport	1,300*	50,000 – 200,000**

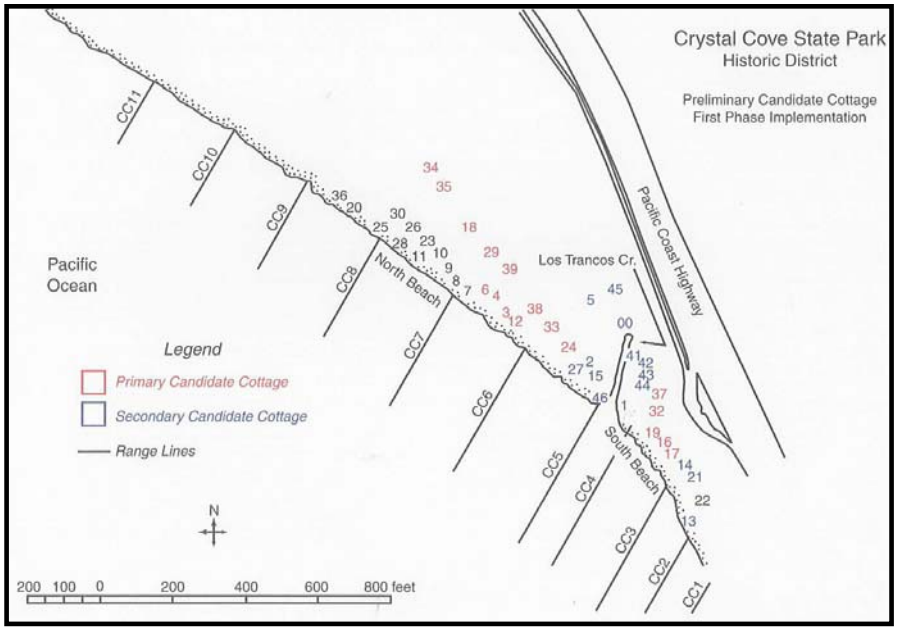
* From Inman et al. (2000)

** From Elwany et al. (1999)

- Inman et al., (2000) estimated littoral cell sediment budget by approximately –1,000 yd^3/yr (losses).
- Net loss of sediment is minimal, leading to relatively stable average beach width.

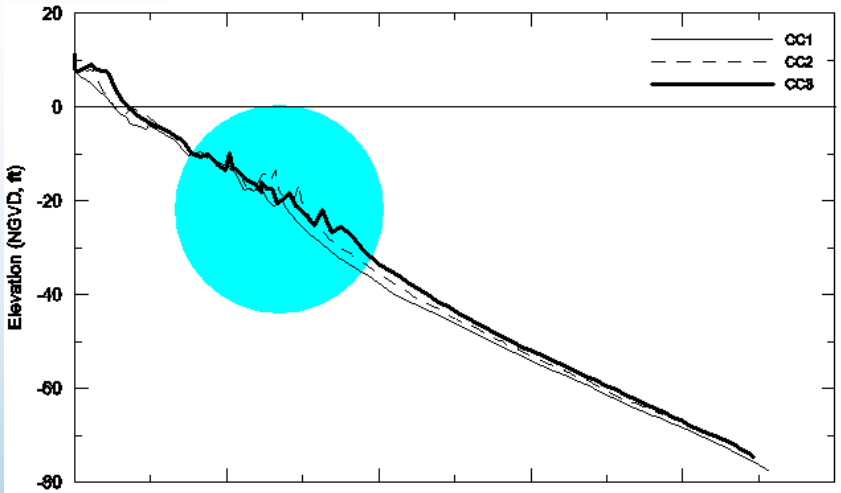
Beach Ranges

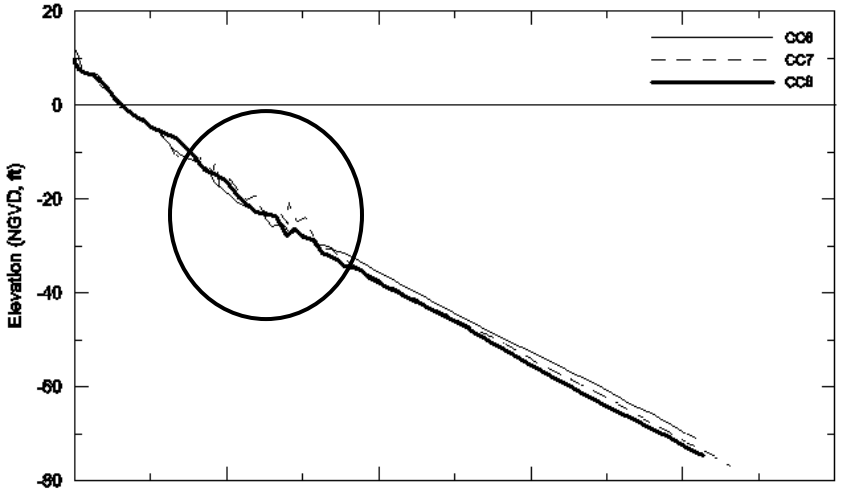
- No long-term beach profile dataset.
- 11 beach profiles surveyed.
- Surveys conducted on 17 July and 12 Sept 2002, before and after a summer tropical storm event.

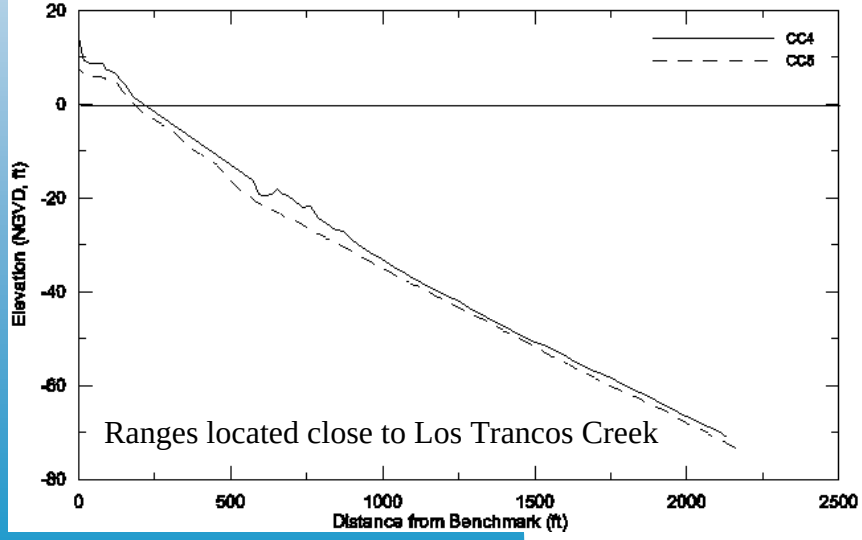


Surveyed by EcoSystems Management Associates, Inc.

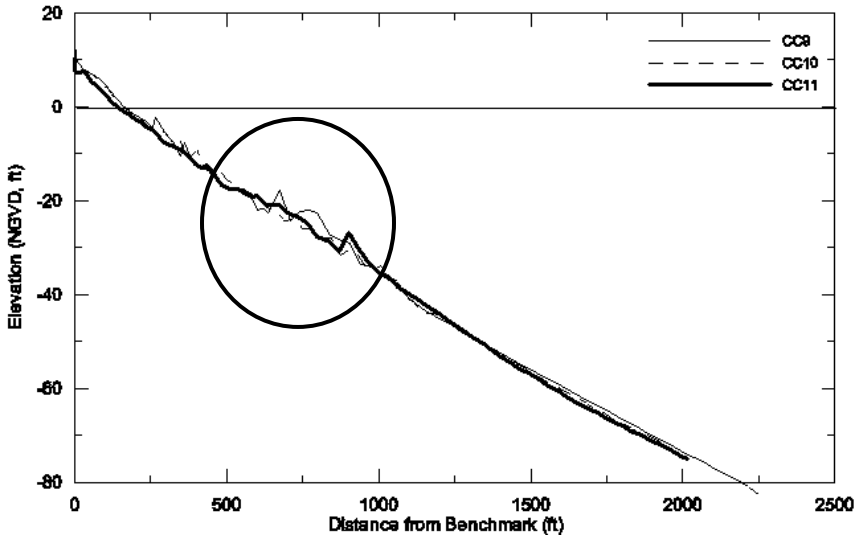
Beach Profiles



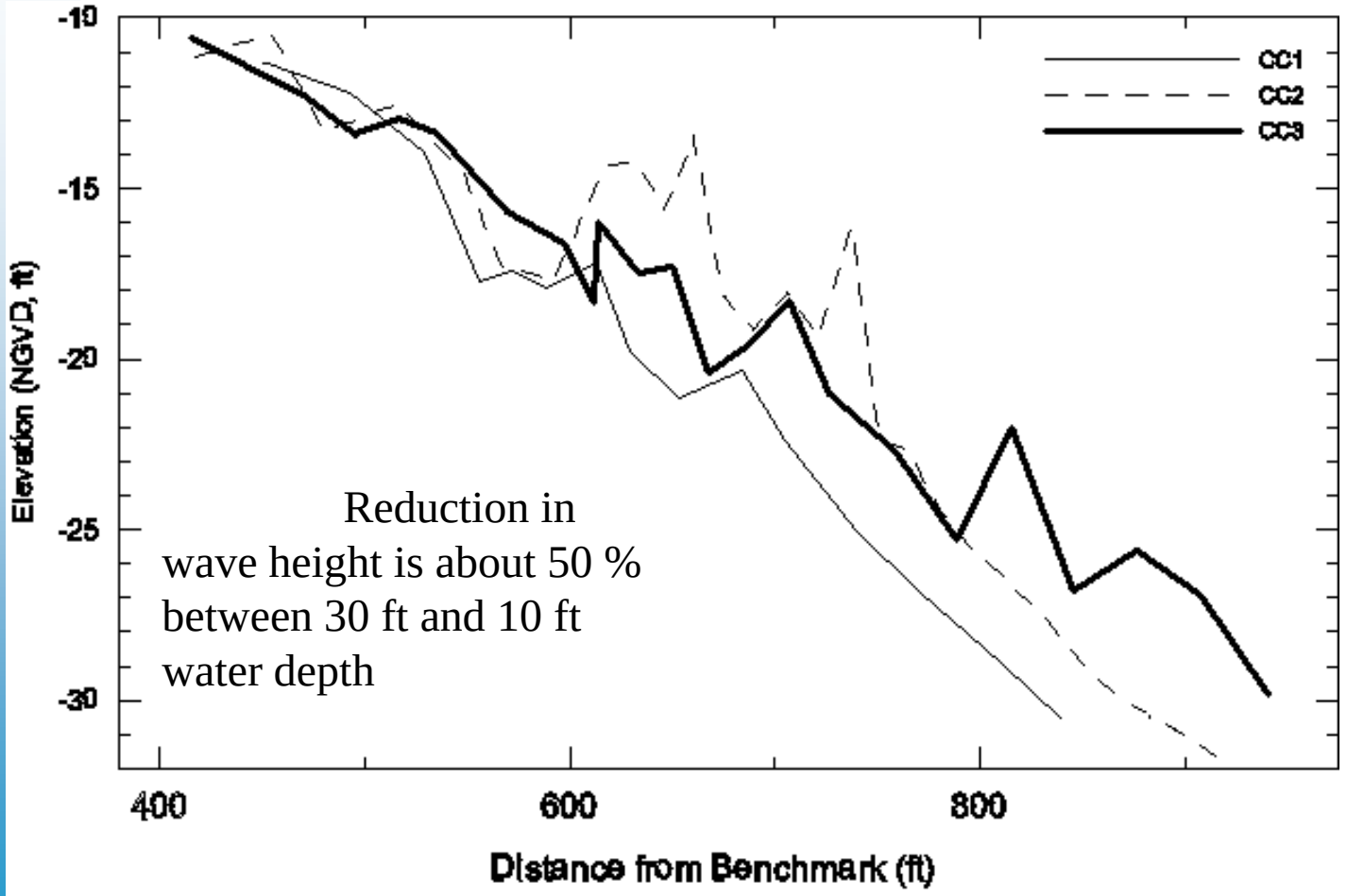




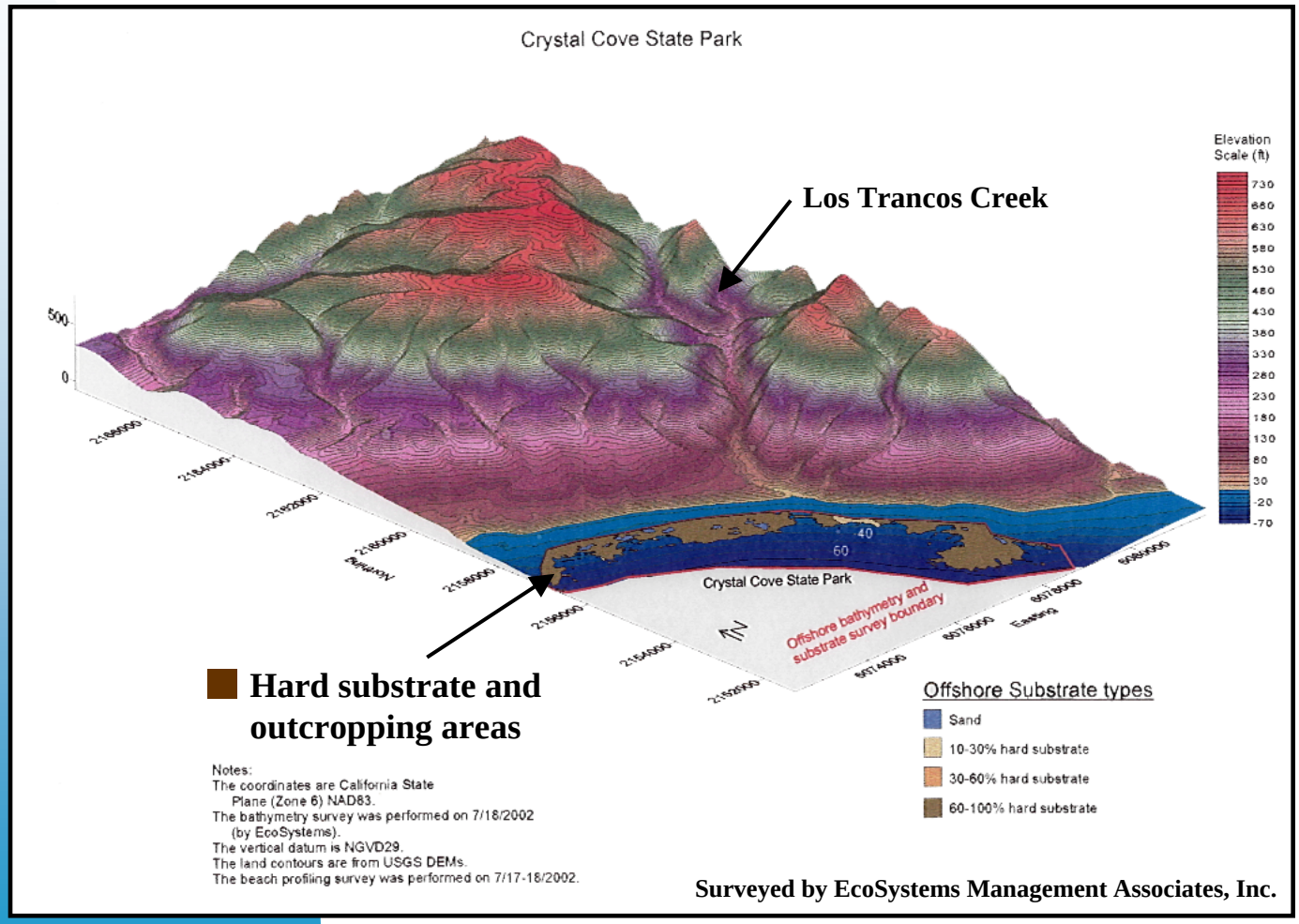
Ranges located close to Los Trancos Creek



Details of Outcroppings along Beach Profiles



Offshore Hard Substrate is Extension for Onshore Topography



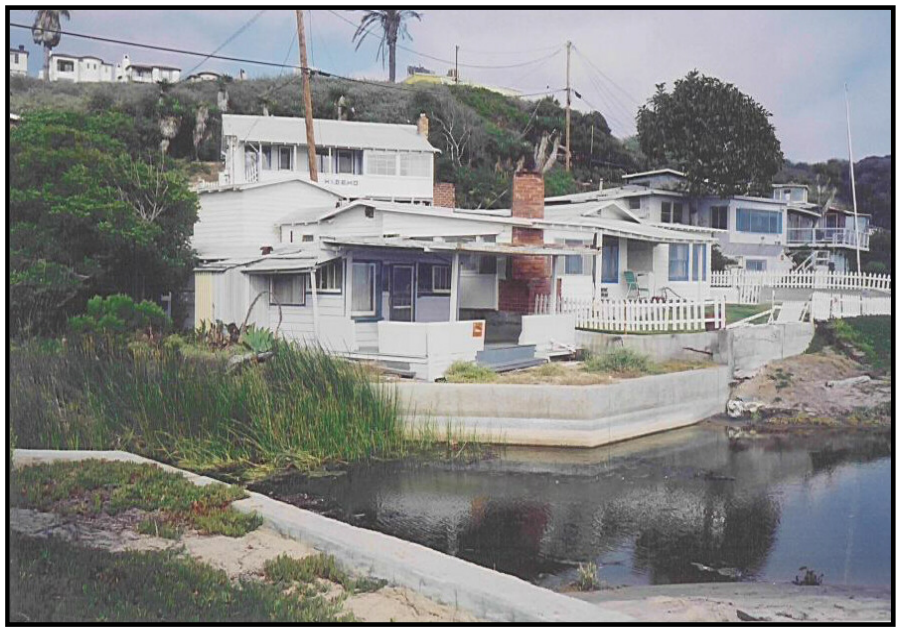
Historic Shoreline Changes

- Analysis of aerial photos from as early as 1927 until the present show little shoreline change (Everts Coastal, 1997; Inman et al., 2000; and Jenkins & Wasyl, 2000).

Notice nearshore hard substrate.

Impacts of Flooding on Cottages

- Topography, watershed, and channel configuration lead to low probability of flooding from the overflow of Los Trancos Creek.



Conclusions

- Crystal Cove cottages have survived over 75 years of the Pacific wave climate and weathered many storms, including the storm of 1939, the 1982-1983 El Niño storms, and the recent significant storms of 1988, 1993, 1995, and 1998, with minor damages.
- Rugged nearshore topography (with reliefs of 3-4 ft) acts as a natural submerged breakwater and provides the cottages with valuable protection during wave storms. They are the extent of the inshore topography.
- Outcropping of Monterey Formation at the headlands (Pelican Point and just south of the cottages) acts as a natural groin to maintain the sand in the front of the cottages.
- The location of Crystal Cove near Newport Beach Canyon provide additional protection from wave storms.
- Run-up and overtopping analysis show that there will be some overtopping with wave conditions having a return period > 10 years. 50- and 100-year design waves could cause some damage to the cottages.