CALIFORNIA DEPARTMENT OF FISH AND GAME
Nearshore Sport Fish Habitat Enhancement Program

Beach Surveys of South Carlsbad State Beach Onshore of Carlsbad Artificial Reef

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Introduction

Long sandy beaches are characteristic of the southern California shoreline. These beaches fluctuate in size and shape, both seasonally and through time. Sand is typically supplied to beaches by rivers, streams, and coastal erosion. Sand deposition and erosion of beaches occurs within geographically definable coastal regions, called littoral cells. A cell is a section of coastline that encompasses a complete cycle of sediment supply, transport, and loss from the coastal system (Habel and Armstrong 1977). In California, littoral cells primarily transport sand southward due to predominant currents and wave direction.

It has been well documented that structures which extend seaward from the coast interfere with currents and littoral cell movements. Natural features (e.g. headlands and submarine canyons) and man-made structures (e.g. harbors, breakwaters, and shore protection devices) interrupt natural littoral flows of sand along the coast (DNOD 1977). These structures typically cause accretion of sediments on the upcoast side of the structure and erosion downcoast. Examples of this phenomenon are common throughout California, one of the most dramatic of which is at Oceanside, in San Diego County.

Oceanside is in the central part of a littoral cell that extends from Dana Point southward to the La Jolla submarine canyon (Inman 1976, Habel and Armstrong 1977). Sediments in this cell are supplied by several ephemeral rivers and streams throughout the

cell, cliff erosion, and an upcoast littoral supply. Sediments are lost when they sink into the canyon.

Sand depletion of Oceanside's beaches began in 1942 with the construction of Camp Pendleton's boat basin. However, serious erosion problems did not develop until 1963, with the completion of the Oceanside small boat harbor. The harbor with its large jetties, the drought, and the violent storms of the 1980s contributed to the depletion of sand south of Oceanside. Because of this, South Carlsbad State Beach (SCSB) is presently California's longest cobble beach (Kuhn and Shepard 1984). Despite efforts to supply the beaches with dredge spoils from Oceanside harbor, the sand continues to erode, leaving only cobbles from years of cliff erosion and remnants of dredge spoils (Inman 1976, Kuhn and Shepard 1984).

Because of the limited sand supply to these beaches, any designs for construction in the nearshore waters of this area must be sensitive to this problem. The planned placement of Carlsbad Artificial Reef (CAR) by the California Department of Fish and Game (CDFG) raised concerns that shallow reef modules might interrupt littoral sand flow. Addressing this concern, CDFG and Tekmarine, Inc. of Pasadena, California, (an oceanographic consulting firm under contract with the City of Carlsbad) conducted studies of nearshore areas off Carlsbad beaches. Based on these studies and information obtained from both the U.S. Army Corps of Engineers and the California Department of Boating and Waterways, Tekmarine concluded that littoral sediment transport occurred primarily within the 30 foot depth contour mean lower low water (MLLW) and

that 30 feet should be the minimum depth for placement of the reef modules (Tekmarine, Inc. 1988). Concern lingered on the part of the California Coastal Commission (CCC), and the CDFG agreed to place the nearshore modules at a depth of 37 feet MLLW and to conduct studies to determine if these modules would affect local beaches.

On 29 May 1991, the construction of CAR was completed. A 12-module complex made of 10,000 tons of quarry rock from Santa Catalina Island, CAR is located 2000 to 2800 feet offshore of SCSB, directly outside Batiquitos Lagoon (Figure 1). The modules were built along three different depth contours: 37, 42, and 57 feet (MLLW).

CAR was designed both as a fishing reef and as a habitat to enhance the survival and growth of fishes that utilize the lagoon. The reef offers shelter, forage, nesting, and nursery areas for reef fishes and provides habitat for invertebrates and algae.

In an effort to determine what impacts the reef may have on sand transport and on the local beaches, CDFG biologists will monitor beach profiles at SCSB down to 0.0 ft. MLLW and measure sand depths surrounding the four 37 foot reef modules.

This report will present the first of three annual beach surveys at SCSB. It will describe the beach profile, structure, and composition of SCSB near Batiquitos Lagoon. Any changes detected by future surveys will be noted and their probable causes addressed.

Materials and Methods

On 17 June 1991, approximately two weeks after the final module of CAR was constructed, beach surveys were conducted at South Carlsbad State Beach. Three parallel transects were positioned across the beach, perpendicular to the shoreline. The transects were placed directly onshore of CAR at: 1) the most northern module; 2) the central modules located directly offshore of the lagoon mouth; and 3) the most southern module. Transects began on the high beach where the supra-intertidal zone (>+7.0 ft. MLLW) interfaced with terrestrial vegetation, then extended down to 0.0 ft. MLLW. Throughout this report, tidal elevations are in units of feet. All other measurements are in units of meters.

The beach profile was surveyed using standard level-transit surveying equipment. Beach elevation was measured at five meter intervals along the transect. Locations of major beach anomalies, such as berms and troughs, were also noted.

The beach face slope was also determined for each transect (Figure 2). To allow for repeatable measurements and comparisons in later surveys, the beach face slope was defined as the slope of a line from the peak of the winter berm down to MLLW.

Beach composition was recorded at each five meter interval. Composition was divided into three categories: cobble (>64mm diameter), pebble (4-64mm diam.), and sand (<4mm diam.). When sand was present, its depth was measured to the nearest centimeter using a brass meter rod. The rod was probed into the sand until solid substrate was felt or a maximum depth of one meter was measured.

Results

The profile and composition of South Carlsbad State Beach near Batiquitos Lagoon were generally consistent throughout the survey area. A shallow trough was present behind a prominent winter berm which extended along the entire section of beach. At the time of this survey, the winter berm had closed off the mouth of the lagoon. The supra-intertidal zone behind the berm was wide and relatively flat. In front of the berm the beach face dropped off steeply to elevations below 0.0 ft. MLLW.

The total length of shoreline along which the three transects were placed was approximately 382m. Distance between the central and north transects was 122m and the distance between the central and south transects was 160m. The width of the beach narrowed toward the south end. Profile lengths for the north, central, and south transects were 43.5m, 40.5m, and 30.5m, respectively (Figure 2).

Elevations were plotted, and the profile shows a relatively flat upper beach, prominent winter berm, and trough (Figure 2). The elevation of these features was nearly the same throughout the length of the beach.

Beach face slope was relatively steep along the length of beach. The steepest part of the beach was near the mouth of the lagoon on the central transect with a slope of -0.30. The southern beach was also relatively steep with a slope of -0.24. The northern beach had the gentlest slope of -0.18 (Figure 2).

Substrate composition was similar among all transects (Figure 3). The upper mid- and high-intertidal beach (above +3.0 ft. MLLW) was composed exclusively of cobbles. The mid- and low-intertidal beach (+3.0 to -1.0 ft. MLLW) was a combination of cobble and pebble which extended below MLLW. Sand did not occur on any transect above MLLW. It was present only below -1.0 ft. MLLW. Sand depths on each transect were similar at equal distances from the sand/pebble interface, and increased farther offshore (Figure 3).

Summary

Results of the beach survey are representative of South Carlsbad State Beach onshore of CAR at Batiquitos Lagoon. The beach was steep, composed of cobbles and pebbles, and devoid of sand. The beach slope and composition were similar to beaches immediately to the north and south of the area; however, those beaches are narrower and backed by steep cliffs. For a cobble-type beach, the profiles at SCSB were not unusual. Cobble beaches are typically steep. In general, the coarser the sediment, the steeper the beach (Inman 1976).

Future surveys will detect changes in beach profile and composition. Because the reef is outside of the littoral transport zone, changes in beach profile and composition due to the reef are not expected. However, normal seasonal fluctuations in beach profiles are expected. For example, in the summer, sediment is deposited and the beach will widen, causing the slope to decrease.

In the winter, sediment is removed and the beach will narrow, causing the slope to increase. Separate sediment monitoring studies of the beach and the benthos around the reef will be conducted, and the fluctuations at these two locations will be measured.

Literature Cited

Department of Navigation and Ocean Development (DNOD). 1977. Study of Beach Nourishment Along the Southern California Coastline. State of California. p. 151.

Habel, J.S. and G.A. Armstrong. 1977. Assessment and Atlas of Shoreline Erosion Along the California Coast. State of California, Dept. of Nav. Ocean Dev. p. 150.

Inman, D.L. 1976. Summary Report of Man's Impact on the California Coastal Zone. State of California, Dept. of Nav. Ocean Dev. p.277.

Kuhn, G.G. and F.P. Shepard. 1984. Seacliffs, Beaches, and Coastal Valleys of San Diego County, California. Univ. of Berkeley Press. Berkeley, Calif. p. 151.

Tekmarine, Inc. [Letter to John Grant, California Department of Fish and Game] 1988 November 8.