NATURE-BASED DYNAMIC REVETMENT CONSTRUCTION AT NORTH COVE, WASHINGTON, USA

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INTRODUCTION

A dynamic revetment was constructed at North Cove, Washington, USA in December 2018 along a historically eroding 2-km shoreline reach of coastal barrier at the northern entrance to Willapa Bay (Figure 1a,b). The revetment is composed of poorly sorted angular quarry rock ranging in size from pea gravel to small boulders as well as large wood debris and structures, a dune ridge, and native vegetation integrated with the revetment. The design, aim, and maintenance of the dynamic revetment is to simulate the functions of naturally forming cobble berms along composite beaches in the U.S. Pacific Northwest (Figure 1c,d). The dynamic revetment continues to be adaptively constructed over time, enabling the testing of innovative design approaches and concepts that are rarely possible to do at full-scale in the field. The project provides a unique opportunity to explore nature-based engineering principles and design features.

SETTING

The ocean-ward end of the project is dependent on protection formed by a large shore-connected ebb shoal and broad beach at the juncture between the Pacific Ocean and Willapa Bay. Fine sandy sediment is transported bay-ward by breaking waves along the shoreline, while much greater quantities of sediment are exported by strong ebb currents in the entrance channel just offshore of the coastline. Near the center of the 2-km reach of dynamic revetment is an artificially maintained rocky headland that has resulted from persistent placement of large rock to protect an individual house while the adjacent shoreline (i.e., erosional escarpment) retreated by approximately 175 m on either side. On the updrift side of the headland, sediment is naturally transported toward it to develop a relatively wide beach and more protected dynamic revetment, subject to variations in longshore sediment supply and localized and intermittent reversal of longshore currents near the juncture of the headland with the adjacent coast. The rock-protected headland is of higher elevation than the adjacent downdrift coast and functions as an erosional "feeder bluff" where the large rock of the headland merges with the adjacent dynamic revetment. This transitional zone presents an ideal setting to test the feeding and natural dispersion of cobble material away from an updrift headland point source. At the terminal end of the revetment is a tide gate-controlled drainage ditch bounded at its mouth by updrift sand bars and a downdrift rock revetment along a highway embankment and a groin that extends into the ebb channel. A porous terminal groin constructed of large logs and rootwads on the updrift side of the drainage ditch entrance moderates sediment deposition along the updrift beach fronting the dynamic revetment and across the entrance to the ditch. This condition is critical to reduce the wave setup, infragravity wave propagation, and sediment influx into the drainage ditch.

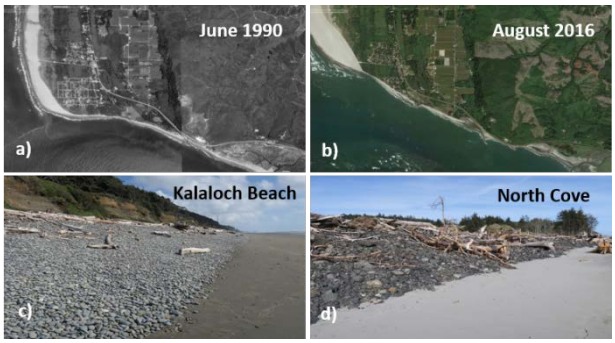

Figure 1 – Top: Aerial imagery of the North Cove shoreline from a) June 1990, and b) August 2016; Bottom: Photos of composite beaches at c) Kalaloch Beach 1 with a natural cobble berm, and d) North Cove with a dynamic revetment.

EVALUATION

To date, the adaptively constructed and managed dynamic revetment has been successful in halting the loss of the barrier uplands that had been rapidly eroding over the past century. The project is being routinely monitored (Weiner et al., 2019) by a variety of techniques including topographic surveys, RFID PIT tags, stationary smartphone photographs, and visual observations. Monitored features include the revetment top and toe positions, revetment slope, beach width, and cobble size. Additional design aspects being evaluated include alongshore and cross-shore cobble transport, cross-sectional volume, beach sediment recovery, effects of large wood and hybrid treatments, backshore dune elevation, material placement and renourishment techniques, functional performance, and maintenance requirements. A synthesis of lessons learned with insights toward design guidance relative to existing conventional practice is in progress.

REFERENCE

Weiner, Kaminsky, Hacking, and McCandless, 2019. North Cove Dynamic Revetment Monitoring: Winter 2018-2019. Shorelands and Environmental Assistance Program, Washington State Department of Ecology, Olympia, WA. Publication #19-06-008. https://fortress.wa.gov/ecy/publications/summarypages/1906008.html