Intertidal Monitoring: Sand Beaches

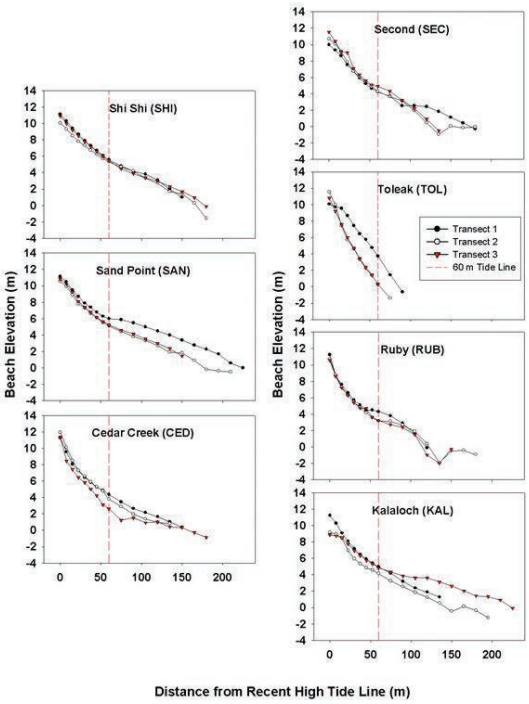
Lewis and Clark, Olympic, San Juan Island

I & M RESOURCE BRIEF

Importance

The North Coast and Cascades Network (NCCN) of parks provide refuge for a vast reservoir of marine resources in the intertidal zone, an area inundated and exposed twice daily by the tide. The hallmark of NCCN intertidal areas is the incredible productivity and diversity of the rocky, cobble and sandy beach habitats, with over 750 species of marine invertebrates and seaweeds and 65 species of intertidal fish. This richness represents the highest diversity of intertidal biota found along the entire west coast of North America. The intertidal zone represents a transition between terrestrial and marine environments. Intertidal and nearshore ecosystems are tightly linked via nutrient cycling, dispersal of organisms and the opportunistic use of intertidal areas by nearshore organisms when it is flooded. The productive nearshore waters of the Pacific Northwest are strongly influenced by oceanographic processes, such as upwelling of deep nutrient-rich water on open coast. Most intertidal organisms have life stages that live and disperse through the nearshore coastal ocean and contribute to its high productivity.

The sand beaches of Olympic National Park are a major intertidal habitat. These beaches make up approximately 30% of the 70 mile Olympic park coastline and play a key role in nutrient cycling and nearshore ocean productivity. Invertebrates living in the sand are important food resources for migrating shorebirds. Sand beach organisms have evolved many adaptations to life in a harsh, wave swept, shifting sand environment. However, sand beach ecosystems are susceptible to the effects of global climate change, including increased warming, increased frequency and magnitude of storm events, sea level rise, and ocean acidification. Direct human impacts, such as shoreline modification and oil spills can also affect sand beach ecosystems.



Status and Trends

Seven sand beaches spanning the length of the Olympic coast are monitored annually as part of the NCCN Intertidal Monitoring Protocol. On each beach the vertical profile, sand size composition, and invertebrate community structure are measured at three different locations. Sampling from the 2010 field season showed that all beaches, with the exception of Toleak beach, were composed of fine sand with shallow beach face slopes. This beach structure dissipates wave energy across the beach face, delivering nutrients and food resources to organisms that live in the sand. These fine sand beaches also had similar animal community structures. Toleak beach was characterized by a steeper beach face composed of sand and gravel. This beach structure reflects wave energy and the coarser sediments create a harsh environment for animals living in the sand. This phenomenon was illustrated in the Toleak beach community structure, which was depauperate relative to the other beaches, with an average of 8.3 taxa present compared to the 11 taxa found on the other beaches.

Opposite, Beach face profiles of Olympic sand beaches. Note that Toleak beach is significantly steeper than the others.

Above Left Olympic National Park sand beach monitoring sites.
Above Right NPS scientists conducting Above beach sampling on Shi Shi beach (OLYM). OLYM/Fradkin

Discussion

The array of similar sand beaches along the Olympic coast allows for the detection of environmental change impacts along a latitudinal gradient. In addition, they comprise a network of comparable sites for use in assessing the impact of oil spills along the coast. Like all of the NCCN marine parks, Olympic is situated along major travel routes for commercial shipping traffic, including oil tankers, bound for the ports of Vancouver (Canada), Seattle, and Portland. Sampling from the 2010 field season provided baseline conditions for this array of beaches. Future work will focus on the analysis of trends in physical and biological structure across time. Toleak beach may be dropped from the monitoring program if it proves consistently different from the other beaches.

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