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Olympic Sculpture Park: Results from Year 1 Post-construction Monitoring of Shoreline Habitats

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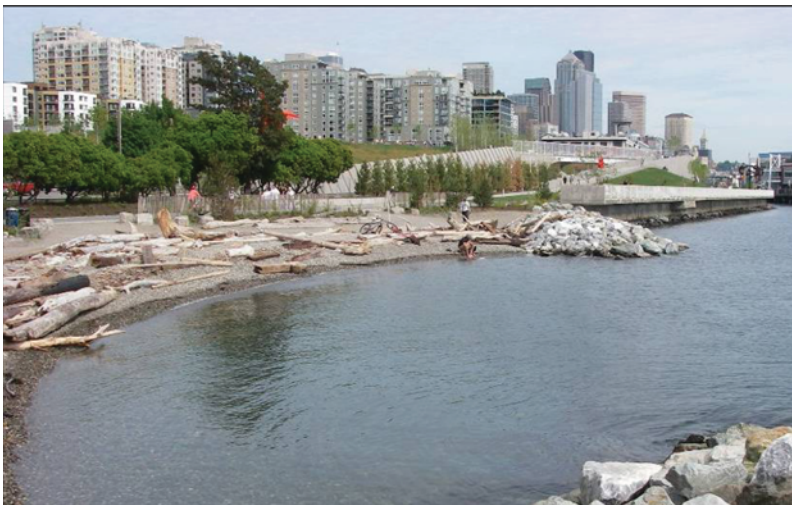

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Executive Summary

The Seattle Art Museum's Olympic Sculpture Park is located on the city of Seattle's urbanized marine shoreline. In order to provide benefits for juvenile salmon and other biota that inhabit the shoreline, a pocket beach and habitat bench were included as part of the public access area along the shoreline. Plantings occurred in the uplands, and gravel and driftwood were placed in the pocket beach. These features replaced relatively unproductive armored seawall and riprap shoreline. It is hypothesized that these created shoreline enhancements will support higher numbers and a greater diversity of fish and invertebrates than the existing urbanized shoreline.

In this study, we report initial post-construction results of monitoring the site for fish, invertebrates, vegetation, algae, and beach profiles at the habitat bench, pocket beach and in the uplands. For biological components, the newly created habitat types were also compared to adjacent seawall and riprap sites.

Overall, Olympic Sculpture Park monitoring results indicate that there has generally been a rapid development of aquatic and terrestrial biota within the newly created habitats. Many of the invertebrate and fish indicators have higher values than baseline conditions measured before construction, or adjacent sections of seawall and riprap. We recommend periodic post-construction monitoring to continue (e.g. 2, 3, 5, 10 years after construction) in order to further assess progression of biological and physical functions as the site develops. Specific monitoring results are highlighted below.

Fish

Fish were sampled to determine abundance and species composition at all of the sites. During snorkel surveys juvenile salmon were common and abundant in shallow water at the pocket beach and habitat bench, suggesting that they have the opportunity to utilize the shallow water habitats that were incorporated in the park construction. The pocket beach provides habitat specific to juvenile salmon at high tide, when they were the only abundant species observed at the beach. Snorkel observations documented high proportions of feeding behavior by juvenile salmon at the habitat bench. Potential fish predators of juvenile salmon were rare at all sites.

Juvenile Chinook salmon netted at the pocket beach consumed mainly amphipod crustaceans, fish, and insects. Chum salmon fed more on planktonic calanoid copepods and less on epibenthic harpacticoid copepods than expected, also feeding on amphipods and unidentified eggs. Coho salmon fed mainly on fish and amphipods.

Epibenthic and Benthic Invertebrates

Epibenthic invertebrates were sampled with a suction pump at 0 to +1' MLLW tidal elevation. Taxa richness increased from pre-construction sampling and was highest at the pocket beach and habitat bench sites. The habitat bench had high densities of harpacticoid copepods and overall epibenthic invertebrates, and the riprap site had high densities of amphipods, all of which are important as juvenile salmon food. The cobble/gravel substrate of the pocket beach at both +12 and 0' MLLW has been

colonized by a diversity of benthic invertebrates, including several taxa of amphipods and polychaete worms that were not present before creation of the pocket beach.

Terrestrial Insects

Terrestrial insects were examined for species composition and number. All of the created habitat types (pocket beach, riparian, and vegetation swath) had significantly higher fallout insect trap densities and taxa richness than some or all of the adjacent modified shorelines (seawall and riprap), and included several taxa that are known to be juvenile salmonid prey items. Insects available to juvenile salmon as potential neustonic prey items on the surface of the water were evenly distributed among the created habitat types, and were similar to that of the adjacent riprap and seawall.

Terrestrial Vegetation and Aquatic Algae

Upland plants and aquatic algae were monitored for percent cover. The performance standard of a 10% increase in cover or a cover value of 40% was met in all backshore vegetation areas, with the exception of the dunegrass area. Changes in vegetation percent cover were greater in the understory than the overstory. SCUBA surveys documented twenty-three species of algae on the created habitat bench. Algae percent cover ranged between 46 to 74%, and kelp beds were firmly established with observed populations of kelp perch and kelp crabs.

Physical Sampling

Beach sediments were monitored for quantity and grain size. Between January 2007 and January 2008, the quantity of sediment on the pocket beach surface experienced an overall small decline. Sediment appears to have been lost due to anthropogenic causes in the summer and wave-driven causes in the fall. Much of the cross-sectional area lost came from the berm and upper foreshore. The berm material is highly mobile, and the driftwood appears to help stabilize local areas and acts as a trap for sediment. The sediment on the upper foreshore is also mobile, as can be observed by the temporary sorting of various sizes of sediment along the beach. On the lower foreshore and bench of the pocket beach, the sediment grain size is significantly coarser, and therefore the profiles are more stable in this region. The coarse, angular and well-packed sediment on the distal habitat bench is relatively invulnerable to transport, but the bench is vulnerable to being covered due to failure and repair of the riprap buttress.

The success of the pocket beach depends on sediment staying at the beach. Peak times of vulnerability to transport occur when extreme high tidal elevation is combined with storm conditions. These conditions, most likely to occur in winter, could result in major reorganization of the beach sediments. In natural systems the impacts of man on shaping beaches by down-slope sediment movement due to foot traffic and sediment removal by throwing is a minor component relative to natural wind and wave-driven transport. Preliminary indications suggest that anthropogenic impacts should be included in consideration of planned maintenance and management concerning physical beach change on the Olympic Sculpture Park pocket beach.

Aerial view of the Olympic Sculpture Park site after construction, showing general sampling locations.