Deschutes River Estuary Restoration Study
Biological Conditions Report

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Thurston Regional Planning Council

Submitted by
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Table of Contents

Executive Summary

This report describes results of two separate studies: the Reference Estuary Study and Biological Conditions Report. In this report we also combine data we collected from southern Puget Sound reference estuaries with a hydrodynamic and sediment transport model, developed by USGS, to predict estuarine communities that could occur in a restored Deschutes Estuary. The overall goal of this suite of studies is to evaluate the feasibility of restoring the Deschutes River Estuary from Capitol Lake, a freshwater impoundment in downtown Olympia, WA.

The Reference Estuary Study consists of field sampling of environmental variables and biological variables in southern Puget Sound estuaries close to Capitol Lake. We sampled 90 sites in five reference estuaries and used multivariate statistics on the data gathered to describe patterns in the expected biological communities and to identify the environmental gradients that structured the communities. We used a geographic information system to combine our analysis of the field data with results from the USGS hydrodynamic and sediment transport model and the Biological Conditions study to describe the communities that will likely develop in the restored estuary.

The Biological Conditions section of this report describes important ecological processes that occur within southern Puget Sound estuaries and their watersheds, primarily gathered from the literature. The aim of this portion of the report was to combine the field and modeling work together in an effort to answer the overarching question of whether an estuarine community, with diverse populations of plants and other organisms can be reestablished in Capitol Lake. The Biological Conditions report also addresses uncertainties in reestablishing an estuary within the current Capitol Lake basin.

The five southern Puget Sound subestuaries selected for characterization in the Reference Estuary Study were Woodard Bay, Ellis Cove, and Mud Bay in Thurston County, and Kennedy Creek and Little Skookum Bay in Totten Inlet in Mason County. At each estuary, sixteen to twenty-one sampling points were located haphazardly. At each sampling point, biological and physical parameters were measured. We collected percent cover of vegetation and sediment types in a 1 m^2 quadrat, measured salinity, temperature, dissolved oxygen concentration, and pH, and measured elevation using a laser level calibrated to established benchmarks at each sampling point. Sediment cores were also collected for later laboratory assessment of bulk density, sediment grain size, and total organic content. Field crews also collected empty/dead invertebrate shells present near the sampling point plot center. The location of each site was also recorded with a high precision global positioning

system. To analyze the field data, we used a combination of cluster analysis and ordination to visualize patterns in our data sets. We then used discriminant analysis to assess factors responsible for the observed patterns in the reference estuaries.

The results of our estuary sampling show that the range of physical conditions predicted by the USGS model for the four Capitol Lake restoration scenarios do occur across the five reference estuaries. Salinities predicted for the restored Capitol Lake and from the reference estuaries ranged from fresh water to polyhaline, while elevations ranged from eulittoral to backshore. Silt loam sediments were the primary predicted sediment types for a restored Deschutes Estuary, and were also the most common in reference estuary sampling.

We used ordination and CLUSTER analysis to create 'habitat bins' from the physical variables measured at our reference estuary sites. We then matched up these 'habitat bins' with biological community data we collected to see how well communities could be predicted from the physical habitat variables. Our ordinations were successful at arranging sample sites, according to their degree of similarity, along principal components analysis axes 1 and 2. Additionally, we mapped sediment types associated with each sample point in ordination space and observed a pattern that grouped sites with similar sediment characteristics. We then used discriminant analysis to match habitat bins with the biological community data we collected. We found, however, that only 52% of the sites were correctly classified. We believe that many of the communities sampled, e.g., diatoms (a type of algae) and filamentous algal mats, were ubiquitous among the habitat types we sampled. Therefore, the discriminant analysis failed to match specific algal communities with the habitat bins we previously defined. We believe that our study would have benefited from a larger number of samples made across a wider range of habitat types and from a more detailed analysis of algal communities. In addition, analysis of benthic fauna, in addition to algae, may have helped discriminate among communities present at the reference estuaries.

Based on the primary variables and modifiers that structure estuarine communities described in the Biological Conditions report, several community types observed in the southern Puget Sound reference estuaries are expected to develop in a restored Deschutes Estuary: high and low salinity marshes, mud flats, mixed (sand and mud) flats, and sandy channels. Shallow areas of the restored Deschutes Estuary will exhibit marsh, mud and mixed flats while the deeper areas will exhibit sandy channels. Other habitats will certainly exist at the periphery of these communities and some blending between these communities is expected. The occurrence of mesohaline and polyhaline vegetated high marsh areas around the peripheries are expected to be limited. Based on observations made at five references estuaries, we believe that the restored estuary will be intermediate to Mud Bay and Kennedy Creek but likely have sandier channels and more mixed sand and mud flats than either of these two reference estuaries.

Undoubtedly, the community types predicted for a restored Deschutes Estuary may not occur, or may occur in different spaces or proportions than expected. There are some key uncertainties associated with these predictions – land use and water management, climate change, native and nuisance species recruitment and management, and human disturbances – that we suspect will also be important in the development of estuarine communities in a restored Deschutes Estuary. Other unknowns, such as the variability of reference estuary salinities and sediments throughout the seasons, stakeholder and community support, and the fact that our reference estuaries were from much smaller watersheds than the Deschutes are considerations beyond the scope of this study. However, based on our experience, the USGS model results, and a review of the literature, we believe that a restored Deschutes Estuary will harbor organisms mainly associated with oligo-mesohaline mud and sand flats, and that areas dominated by vegetated salt marsh communities will be rare.

This study is unique in that reference estuary conditions and modeled site conditions were combined with regional literature to predict what a restored Deschutes Estuary may be. However, the urban setting of Capitol Lake in itself poses some difficult obstacles for achievement of estuarine communities even if tidal flow is reestablished. We believe that with realistic restoration goals combined with active, adaptive management, these uncertainties can be overcome and estuarine communities can be reestablished in the Capitol Lake area.