Historical Change in Puget Sound’s Nearshore Ecosystem Processes

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ABSTRACT
PSNERP Change Analyst quantifies historic change in Puget Sound’s nearshore ecosystems, between 1850s-1880s and 2002-2006, by four types: (1) geomorphic shoreforms; (2) natural wetlands and human structures; and (3) land cover/land use and other human additions within 200 m of the shoreline and (4) within upland areas draining to the shoreline.

INTRODUCTION
Approach & Design
An essential step in PSNERP’s restoration and preservation plan for Puget Sound’s nearshore ecosystems is a comprehensive, spatially explicit assessment of the extent of change to Puget Sound’s shorelines, estuaries, and deltas. The PSNERP Nearshore Science Team (NST) systematically analyzed the historic change between the earliest land surveys of the General Land Office and US Coast and Geodetic Survey between 1850s-1890s and present conditions (2004-2006). We used the PSNERP Geomorphic Classification (see PSNERP Poster #2) to independently classify historic and current shorelines (see panel D). The shoreforms are one of the primary units in a geospatial hierarchy of data (D-O-3) organized in four hierarchical scales: (1) shoreforms, (2) shoreline drainage units, (3) drift cell or delta hydrogeomorphic components, and (4) various larger (“user defined”) scales of shoreline-delta organization, such as large embayments or sub-basins of Puget Sound. We analyzed change data around spatial limits of two dominant nearshore ecosystem “process units” (PU) (2). PUs outline the upland drainage (catchment) area and extend from shore to the 10-m depth contour, and include two types: (1) shoreline process units (SPUs) for beaches associated with littoral drift cells that overlap with each other, and (2) delta process units (DPUs) in large river deltas and drainages organized by different seawater-inlandwater mixing zones. PUs and DPUs may overlap where nearshore drift is active.

Historic change is organized in four hierarchical “tiers” of influence for each PU (9): (1) changes in shoreform composition, (2) changes in historic attributes, such as wetlands, and anthropogenic modifications (9) along the shoreline, (3) anthropogenic changes within 200 m of the adjoining uplands and within the -10 m depth (e.g., - phreatic zone limit) offshore, (4) human changes in the drainage area.

Based on recent applications for restoration and conservation planning (Leslie and McLeod 2007; NAS 2007; Halpern et al. 2008), we adopted the Millennium Ecosystem Assessment’s ecosystem functions, goods, and services (MEA 2005; WR 2005) as an assessment tool to rank the level of cumulative impairment of nearshore ecosystem processes among the shoreline, estuary and delta. Process Units (D).

SUMMARY
Implications for Restoration Planning
The spatial arrangement of various types (tiers 1-4) and levels of change among Puget Sound’s shorelines, estuaries and deltas provides a mosaic of intact (or improved) to impaired process units (D) that can be used for spatially-explicit planning, restoration/preservation along Puget Sound. We will both tabulate and graph the distributions of shoreform transitions and nearshore ecosystem stressors as well as query the comprehensive geospatial database to identify prominent sources of change that account for high impaired nearshore ecosystem processes.

Conversely, we can also identify shoreline segments and areas where shore relative intact, or even “improved” due to the appearance of wetlands, with minimal anthropogenic stress, which may in combination with interconnected restoration be candidates for targeted preservation. In conjunction with a compilation of conservation biology/landscape ecology-based strategies for restoration and preservation to be developed by the NST (see Poster #1), these systematic analyses of the change assessment and impairment assessment database will form the basis for PSNERP’s Strategic Needs Assessment (see Poster #5).

However, change analysis and impairment assessments bring us only to the present condition. The PSNERP restoration plan must also anticipate future development along Puget Sound’s shorelines, estuaries and deltas over the next 50-50 years, when an estimated 1.5 million people are expected to move into the region. Among a variety of tools we have used to forecast alternative futures that could affect PSNERP restoration planning (see Poster #6), we are forecasting additional nearshore ecosystem change that can be incorporated into the same analytical template to systematically assess future risk to restoration and preservation alternatives formulated under current conditions.

REFERENCES

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