

August 19, 2004

## Update #2: Nearshore/coastal marine analysis and site selection

### Introduction

This is the second update in a series that describes the nearshore component of the Northwest Coast ecoregional assessment. The introductory update described the project overview, nearshore marine analytical framework, and alternative scenarios for data analysis (Ferdaña 2004). This report describes the decision support tool used to construct the draft site selection of high priority nearshore conservation areas. In addition, an expert review and verification process is currently underway that will comment on the initial integration of terrestrial and marine analyses and examine the combined final draft selection.

This is directing the organization to systematically identify the array of places around the globe that embrace the full spectrum of the Earth's natural diversity. It is also a framework for developing the most effective strategies to achieve tangible, lasting results, and to work collaboratively to catalyze action at a scale great enough to ensure the survival of entire ecosystems (TNC 2001). Developing a coast-wide analytical framework for identifying high priority conservation areas: 1) gives us a regional picture of marine conservation efforts, needs, and opportunities, 2) allows us to take freshwater and terrestrial factors into consideration and 3) identifies strategies to preserve and increase biodiversity at specific sites.

### Approach to setting priorities

Setting priority areas for conservation often involves a strategic planning approach. The Nature Conservancy's approach is called "Conservation by Design."

The Nature Conservancy (TNC) in Oregon and Washington, USA, and Nature Conservancy Canada (NCC) in British Columbia, Canada, are conducting an ecological assessment of the Northwest Coast ecoregion in order to set conservation priorities. An ecoregion defines an area of similar geologic, oceanographic, hydrologic and biologic properties. This ecoregion spans the coastal range of the Pacific Northwest from southern Oregon to the northern tip of Vancouver Island in British Columbia. We have developed preliminary marine ecoregion study areas in the Pacific Northwest to define nearshore and offshore analyses (Figure 1). The Coastal Forests and Mountains ecoregion - British Columbia portion - defined a marine area where both a nearshore and offshore analysis was conducted (Rumsey et al. 2003). In the Puget Sound, WA, and Strait of Georgia, BC, an intertidal and shallow subtidal analysis identified high priority nearshore areas integrated with terrestrial areas (Floberg et al. 2004). The Northwest Coast ecoregion will be finalized by the fall of 2004, initially completing a coastal analysis with plans to move further offshore in the coming year (Figure 2).

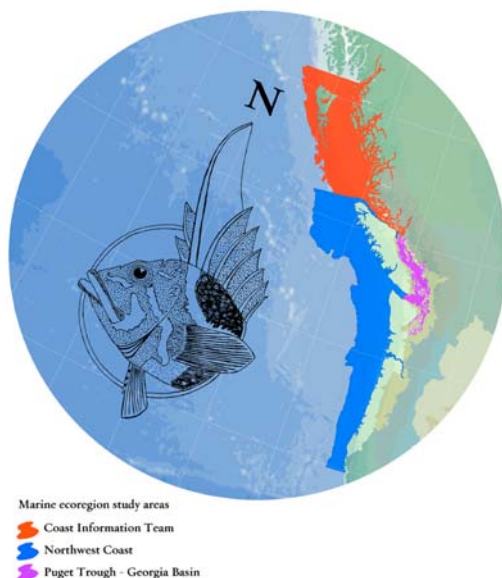


Figure 1. Marine ecoregion study areas

## Decision Support Tools

The objective of ecoregional planning is to identify a portfolio of sites that will conserve the diversity of species, natural communities, and ecological systems characteristic of an ecoregion. Planning methods and analyses for the estuarine, nearshore and offshore components of the assessment identify areas that, if conserved and properly managed, will protect a representative subset of the marine biodiversity of those waters and coastal environments. The three key components to consider during the ecoregional planning process are: 1) conservation targets - ecosystems, habitats, and species that represent the diversity of biotic assemblages in a region, 2) conservation goals - the amount of each target that should be represented in conservation areas across the planning region, and 3) population viability and ecological integrity - an assessment of negative impacts that may affect the persistence of populations of species and examples of ecosystems. This is also called a suitability or cost index. For a more in depth treatment of the planning process see Beck et al. 2003.

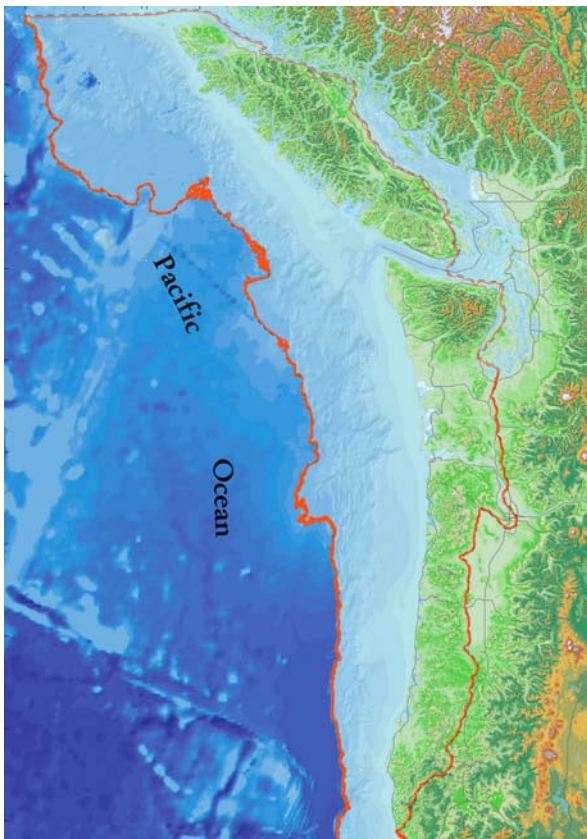


Figure 2. Northwest Coast ecoregion.

Decision support tools such as Marxan (see Possingham et al. 2000) help create an efficient conservation portfolio by minimizing the total area selected while meeting the assigned conservation goals. Marxan uses a simulated annealing algorithm to evaluate alternative site selection scenarios, comparing a very large number of alternatives to identify a good solution. The procedure begins with a random set of assessment units, and then at each iteration swaps assessment units in and out of that set and measures the change in "cost." Cost here does not mean dollars for land purchase, but the amount of area selected in the alternative. The algorithm's objective function is a nonlinear combination of the total area and the boundary length of perimeter of the site selection output (Leslie et al. 2003). A boundary length modifier setting in the algorithm's parameters determines the relative importance placed on minimizing the perimeter relative to minimizing area. There is never just one "optimal" solution (i.e., the definitive set of conservation areas) in regional planning, but it is possible to identify those areas that are both essential and representative as part of an ecological assessment plan. Siting algorithms provide a context for objective representation that is both measurable and spatially explicit.

A scenario in Marxan is a user-defined set of parameters including the desired number of solutions or runs, and the amount of clumping of assessment units. There are two main outputs from Marxan. One is called "summed solution" that adds all of the solutions from a scenario together. What this does is keep track of how often each assessment unit was involved in any solution. This information is a useful way to explore the irreplaceability of assessment units. A "sum of summed solution", or multiple scenarios added together, is also called the conservation utility (Rumsey et al. 2003). We ran nine scenarios with one hundred runs each. We varied the goals across targets (goal ranges of 10 - 30%, 20 - 40%, and 30 - 50%) and amount of clumping or boundary modifier (.01, .05, .125) to produce the conservation utility map (Figure 3). This output is helpful for visualizing the range of values (0 - 900) across the majority of assessment units (units > 0).

The other output is called "best solution" which is the most optimal run in the scenario that best meets the defined parameters. The best solution uses the .01 clumping factor and the 20 - 40% goal range. This single solution was compared to both the conservation utility output and initial expert review in constructing the draft nearshore and estuarine portfolio.

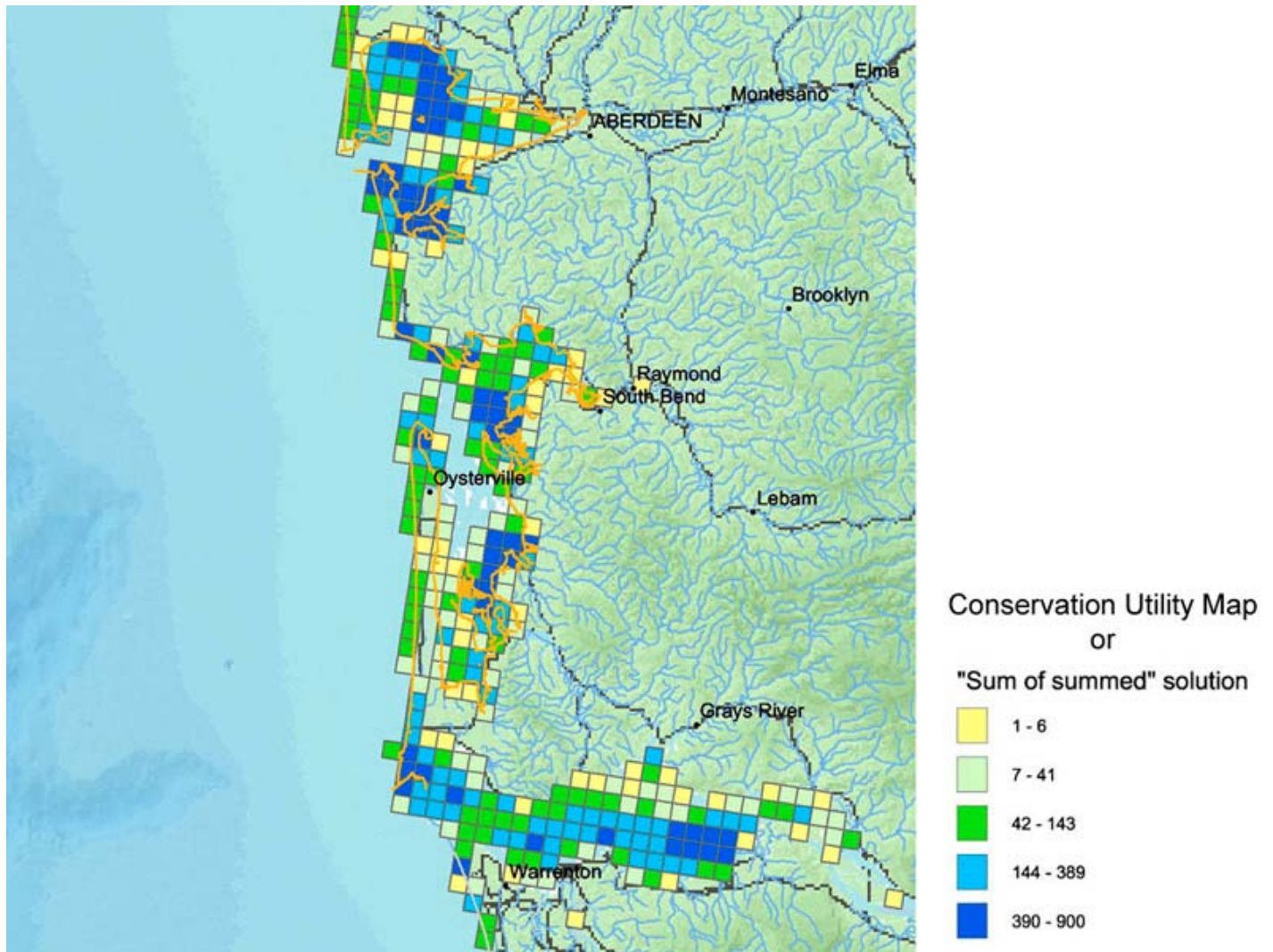
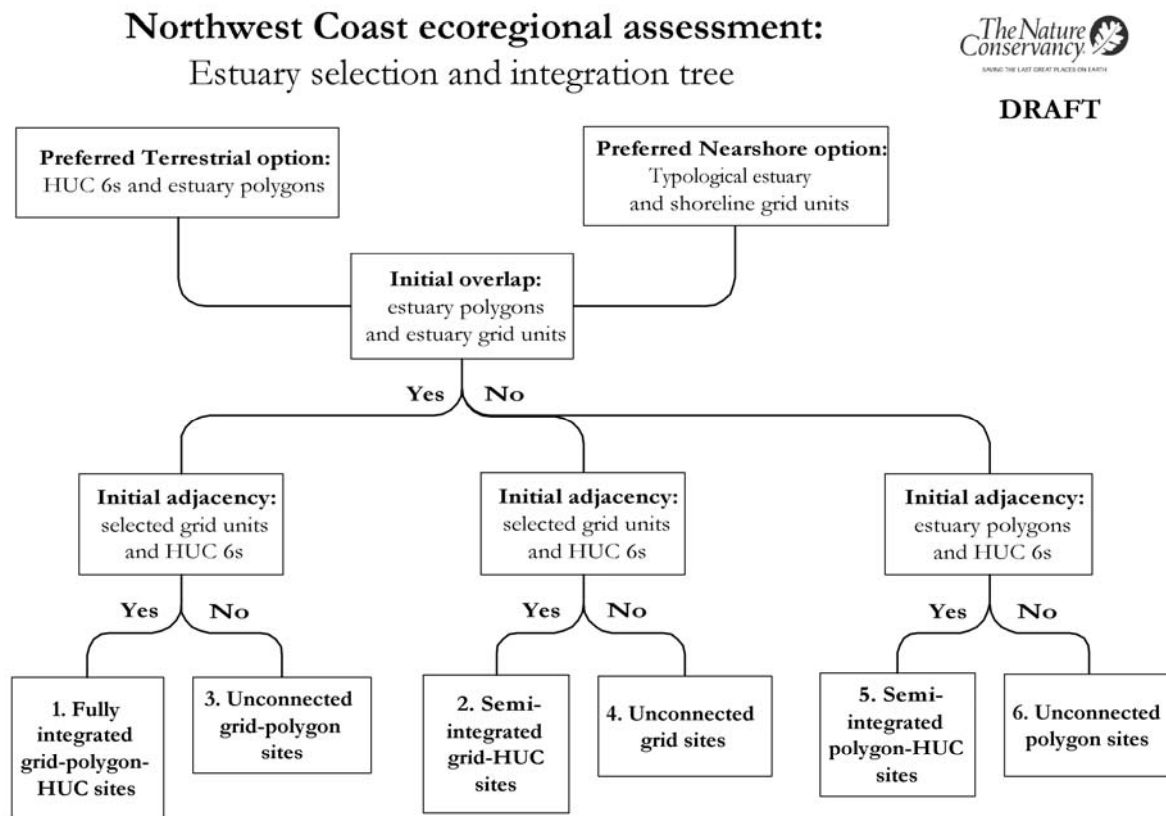


Figure 3. Conservation utility map of nearshore site selection. Grays Harbor, Willapa Bay, and the mouth of the Columbia River, Washington and Oregon.

In parallel with the nearshore a terrestrial analysis examined conservation targets and a suitability index within HUC 6 watersheds and estuary polygon assessment units. This analysis identified estuaries at different scales than the grid assessment units (variable-sized estuary polygons versus uniform 400-hectare grids). In addition, the estuary polygons were analyzed along with the HUC 6 watersheds in order to find efficiencies of site selection between coastal watersheds and their adjoining estuaries. We combined this separate analysis with the draft nearshore and estuary grid selection via an initial integration exercise (Figure 4).

These solutions and initial integration must undergo further expert review. We have come up with a few terms to consider when examining the integrated site selection. Control or reference sites are assessment units verified as important areas for nearshore marine biodiversity by experts. Missed sites are assessment units outside of the integrated selection but identified as ecologically important. Random sites are units in the selection but don't seem to have known ecological importance. And high cost sites are selected units among negatively impact coastal areas verified by experts. This fourth category requires further analysis and ground-truthing to determine whether these areas are of ecological importance within developed areas. This evaluation may help identify high priority restoration sites within the portfolio.



1 - 6: Order of sites/targets applied towards nearshore conservation goals (mid-risk scenario)

Figure 4. Initial integration decision tree combining terrestrial, estuary, and nearshore analyses.

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