Kauffman-Axelrod and Steinberg (2010)
Tidal Wetland Restoration Prioritization Tools

The Kauffman-Axelrod and Steinberg (2010) Tidal Wetland Restoration Prioritization tool is an ArcGIS ModelBuilder-based approach that prioritizes tidal wetland sites for restoration based on initial spatial data for 530 potential restoration sites in Oregon's Coos estuary watershed. By assessing hydrologic alteration and landscape ecology metrics, nine factors reflecting habitat quality, habitat connectivity, water quality, and restoration feasibility, were combined to determine "restoration priority rankings" for each site. Because the tool is readily manipulated in ArcGIS, and selects priorities based on a set of potential restoration sites for which data are available for the entire state of Oregon, it could readily be reapplied to prioritize sites within other watersheds throughout the state.

OVERVIEW

Lead developer: Jennifer Axelrod, FLO Data and GIS.[1]

Year developed: 2007.[2]

Geographic area: Coos estuary watershed, Oregon.[5]

Resource types: Tidal wetlands.[5]

Restoration/conservation: Restoration only.[3]

Stakeholders: Agencies or organizations seeking wetland restoration opportunities in the Coos estuary.
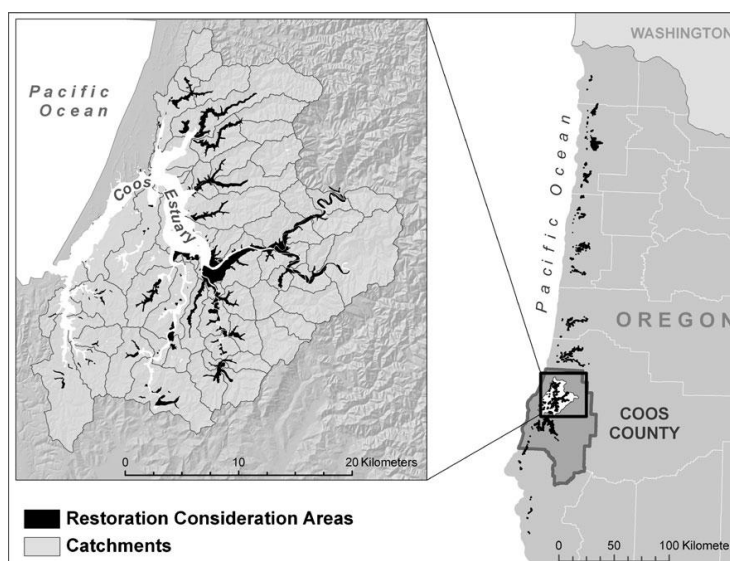

Figure 1. The Coos estuary watershed was the focus of the restoration prioritization analysis described here. Reprinted from Kauffman-Axelrod and Steinberg (2010), used with permission.

Current status: Although the tool was distributed to the Oregon Department of State Lands, the Port of Coos Bay, and the Coos Watershed Association, these prioritization tables, maps, and tools are currently unused.[3]

PRIORITIZATION ANALYSIS

Landscape prioritization tool(s):

Scranton (2004) Tool for Identifying Restoration Consideration Areas: Scranton (2004) identified Restoration Consideration Areas (RCAs) as part of a process to delineate and classify tidal wetlands throughout Oregon by drawing upon a variety of datasets such as National Wetland Inventory (NWI) data, head-of-tide locations, and other data. RCAs are "upland or non-tidal areas that might deserve closer scrutiny as possible candidates for restoration of tidal

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circulation, pending landowner involvement…These are generally lands that are diked or may have been partially filled or ditched for agricultural or commercial purposes." In total, Scranton identified 2264 RCAs throughout the state of Oregon.[4]

Prioritization objectives assessed:
- Feasibility of restoration

Table 1. Scranton (2004) identified RCAs based on the factors and data sources listed below.[4]

Factor used in analysis	Data source(s)
Aerial photography	Various imagery sources and years
Wetland land cover	National Wetland Inventory
Local wetland inventories	Oregon Dept. of State Lands
Hydric soils data	NRCS SSURGO
Estuarine land cover	Oregon Dept. of Land Conservation and Development Estuary Plan Book
Digital elevation models	USGS
Head-of-tide locations	Oregon Dept. of State Lands
Additional resources	Fieldwork, Wetland specialists, Publications

Tidal wetland restoration prioritization tool: This technique prioritizes the suitability of 530 tidal wetlands located in the Coos Estuary of Oregon, originally identified by Scranton (2004), by evaluating nine parameters in custom GIS models. These parameters include both site-specific indicators of hydrologic alteration and ecological functionality as well as landscape prioritization data sources. Factors and data sources underlying each parameter are listed in Table 2.[5]

The model output was standardized on a zero-one scale, with a score of '1' indicating the site with the highest quantity of a given parameter and a score of '0' representing the lowest. A three-tiered weighting system, in which the most important parameters for restoration are given a weight of 3, parameters of intermediary importance are given a weight of 2, and parameters of lower importance are given a weight of 1, was used to combine all nine parameters and generate an overall prioritization score for each site. These scores were then used to establish relative "restoration priority rankings" for each of the Coos watershed's 530 potential restoration sites.[5]

Prioritization objectives assessed:[3]
- Habitat quality
- Water quality
- Feasibility of restoration

Table 2. Factors and associated data sources used to prioritize the 530 potential tidal wetland restoration sites identified by Scranton (2004).[5]

Factor used in analysis		Data source(s)
Hydrologic connection to wetlands	Undiked wetlands: palustrine emergent, scrub-shrub, and forested wetlands	National Wetlands Inventory (US Fish and Wildlife Service-2006)

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	Marine sourced high, marine sourced low, river sourced, and potentially forested wetlands	HGM Tidal Wetlands of Oregon's Coastal Watersheds (Scranton 2004)
	Hydrography (streams)	Regional Ecosystem Office (2007)
Area of adjacent wetlands	Marine sourced high, marine sourced low, river sourced, and potentially forested wetlands	HGM Tidal Wetlands of Oregon's Coastal Watersheds (Scranton 2004)
	Undiked wetlands: palustrine emergent, scrub-shrub, and forested wetlands	National Wetlands Inventory (US Fish and Wildlife Service-2006)
Area of adjacent water	Open water	HGM Tidal Wetlands of Oregon's Coastal Watersheds (Scranton 2004)
Percentage of perimeter adjacent to filled land	Filled lands	HGM Tidal Wetlands of Oregon's Coastal Watersheds (Scranton 2004)
Wetland vegetation composition	Palustrine forested, scrub/shrub, emergent wetlands, estuarine and emergent wetlands, grasslands	Pacific Northwest Landcover, NOAA Coastal Services Center (2000)
Percentage forested in catchment	Deciduous, evergreen, mixed forests, and scrub-shrub	Pacific Northwest Landcover, NOAA Coastal Services Center (2000)
	Catchments (HUC-14s)	USGS Earth Resources Observation and Science (2001) watershed maps
Percentage impervious surfaces and road density in catchment	High, medium, and low intensity developed; open space developed	Pacific Northwest Landcover, NOAA Coastal Services Center (2000)
	Surfaces with >1% imperviousness	USGS Impervious Surfaces (2001)
	Highways and roads	Oregon Bureau of Land Management (2006)
	Catchments (HUC-14s)	USGS Earth Resources Observation and Science (2001) watershed maps
Number of road-stream intersections in catchment	Highways and roads	Oregon Bureau of Land Management (2006)
	Hydrography (streams)	Regional Ecosystem Office (2007)
	Catchments (HUC-14s)	USGS Earth Resources Observation and Science (2001) watershed maps
Number of tide gates in catchment	Tide gates	Oregon Department of Fish and Wildlife Barriers database (2005)
	Catchments (HUC-14s)	USGS Earth Resources Observation and Science (2001) watershed maps

Prioritization products: Tabular data for the top ten priority potential restoration sites in the Coos estuary watershed and map output for the top ten percent of priority potential restoration sites are available in Kauffman-Axelrod and Steinberg (2010).[2] In addition, tabular rankings, parameter values, static maps, and geodatabase outputs, along with any other criteria and metadata, produced for this tidal wetlands restoration prioritization are available upon request.[1,5]
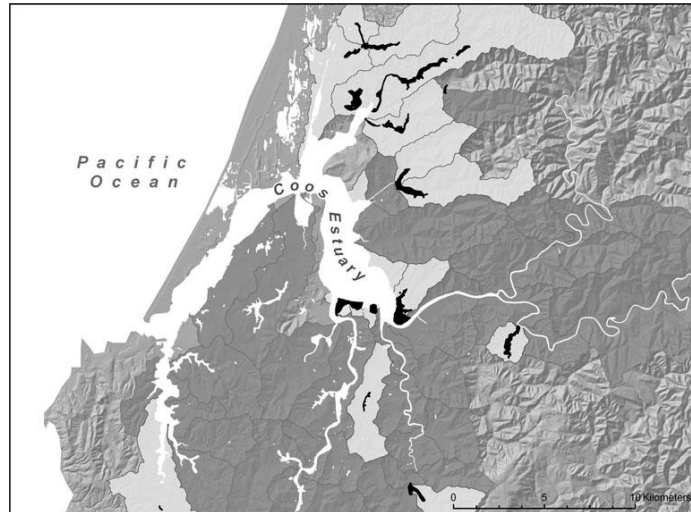

Figure 2. Top 10% of prioritized restoration sites (black) and the catchments in which they reside (light gray). Reprinted from Kauffman-Axelrod and Steinberg (2010), used with permission.

IMPLEMENTATION

Regulatory/non-regulatory programs:
- Section 404 compensatory wetland mitigation.[3]
- Any other regulatory or non-regulatory program for which prioritization of sites for tidal wetland restoration would be useful.[3]

Transferability:
- The tool is based in ModelBuilder in ArcGIS, which is easy for practitioners familiar with GIS to manipulate by changing input parameters and weightings. With limited modification, the tool could readily be reapplied to other areas of the state.[3]
- Prioritization using the tool can be done with limited funding – interested programs would only need to be licensed to use ModelBuilder in ArcGIS.[3]
- The tool uses data sources that are available statewide.[3]
- Because the base data layer for potential tidal wetland restoration sites is available throughout the entire coastal area of the state, the script and ModelBuilder tools used for each parameter in this approach could easily be transferred to other areas of the state. Other states could potentially use the tool but would need to provide a base layer of their own and appropriate GIS datasets.[3]
- Jennifer Axelrod notes that if someone wanted to expand the approach to other parts of Oregon, limited guidance documentation exists for novice GIS analysts as development of a user guide was beyond the scope of the original work. She is available to consult on appropriate modifications to the models and suitable sources of spatial data.[3]

Data gaps:
- No landscape prioritization data sources limit the functionality of the Tidal Wetland Restoration Prioritization Tool. However, calibration, or at least validation, of prioritization maps with rapid assessment or intensive field data would be useful.[3]

Barriers:
- Insufficient funding is a barrier to the adoption and application of these tools to other Oregon tidal watersheds.[3]

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Future goals:
- Expansion of this prioritization effort to all of Oregon's tidal watersheds is a goal for the next five years, if there is sufficient interest from state agencies or other organizations. Since the Coos estuary watershed prioritization was performed entirely with datasets of at least statewide coverage, expansion of these tools to all tidal areas in the state would require relatively little additional effort.[3]

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[1] Jennifer Axelrod. FLO Data and GIS |2001 NW 19th Ave., Portland, Oregon 97209 | 503.413.0375 | flodatagis.com

[2] Kauffman-Axelrod, JL, Steinberg, SJ. 2010. Development and application of an automated GIS based evaluation to prioritize wetland restoration opportunities. Wetlands 30(437) 437-448.

[3] Interview on 12/19/2011 with Jennifer Axelrod, FLO Data and GIS.

[4] The application of geographic information systems for delineation and classification of tidal wetlands for resource management of Oregon's coastal watersheds. Masters Thesis, Marine Resource Management Program, Oregon State University.

[5] These prioritization products can be requested from Jennifer Axelrod, who can be contacted at jennifer.axelrod00@gmail.com.