

Decision Support Tools to Support Climate Change Vulnerability Assessments



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Goals

- Provide context for decision support tools.
- Describe some potential tools for this assessment.
- Brief case study using tools in conservation planning under uncertainty.
- Resources

Role of “Decision Support Tools”

- Management of uncertainty (Three Stooges Picture)
- Can work towards building consensus on decisions.
- Transparency
- Based on literature, case studies
- Build scenarios.

Types of Decision Support Tools

- Species
- Habitat
- Hydrological
- Process
- Expert Based
- Data Driven
- Models

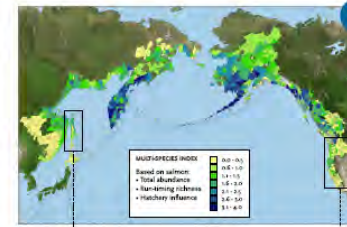
Pacific Salmon Conservation Planning Toolkit at Multiple Spatial Scales



Why Multiple Spatial Scales?

The mission of the Wild Salmon Center is to identify, understand and protect the best wild salmon ecosystems of the Pacific Rim. We devise and implement practical strategies, based on the best science, to protect forever these extraordinary places and their biodiversity.

In order to meet our mission, we must develop decision support tools to help us deal with the inherent complexities of working across such a large geography. Scale is a critical variable as we move from the global to the regional to the local. There are different ecological processes, data availability, and planning units at each scale. Thus, the set of decision support and conservation planning tools must be flexible to meet the planning needs at each scale.



1 North Pacific Scale

Pacific Salmon Conservation Assessment (PSCA)

Conservation Planning Need: Identify river basins throughout wild Pacific salmon range that have the highest conservation value. PSCA facilitates:

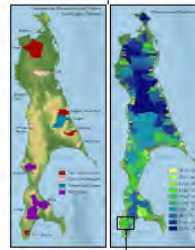
- Identifying Salmon Strongholds with high conservation value
- Creating a network of Salmon Strongholds across the North Pacific
- Assessing ecosystem condition

Data/Tools: PSCA was created for watersheds across the North Pacific that aggregates the best available data for the full range of Pacific Wild Salmon: Abundance, Species richness, Run-Timing, Healthiness, Dem, Protected Areas, Topography, Source & Origins.

Outcomes:

- Data are being used to develop a network of conservation areas using Marmon Dr. Gordon Reaven will present this concept at the Thursday Afternoon Plenary: Bringing the Future into Focus.
- Produced a Salmon Multi-Scale Index for river basins based on abundance, diversity and hatchery influence.
- Provided a foundation for assessing salmon ecosystems at the regional and watershed scales.

2 Regional Scale



Salishan Island Prioritization

Salishan Island Prioritization

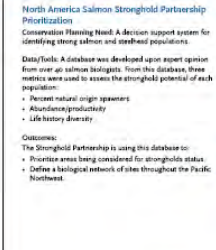
Conservation Planning Need: Identify watersheds that are essential to maintaining healthy salmon populations on Salishan Island.

Data/Tools: WCC created a database incorporating data from government agencies, local experts and organizations, and satellite imagery for 217 watersheds. The following metrics were used to assess the conservation potential:

- Salmonid Species Diversity
- Habitat
- Threats
- Community

Outcomes:

- Watersheds were identified for conservation, restoration, and fishery certification.
- The Langley River was identified as a conservation priority through this process. Since then, two years of field data has been collected and used as the basis for a Conservation Action Plan.



Strong Salmon and Steelhead Population

North America Salmon Stronghold Partnership

Conservation Planning Need: A decision support system for identifying strong salmon and steelhead populations.

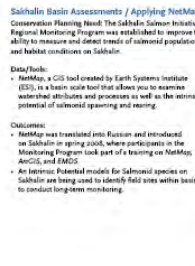
Data/Tools: A database was developed upon expert opinion from over 40 salmon biologists. From this database, three metrics were used to assess the stronghold potential of each population:

- Percent natural origin spawners
- Abundance/productivity
- Life history diversity.

Outcomes:

- The Stronghold Partnership is using this database to:
- Prioritize areas being considered for stronghold status.
- Define a biological network of steel throughout the Pacific Northwest.

3 Watershed Scale



NetMap translated into Russian

Salishan Basin Assessments / Applying NetMap

Conservation Planning Need: The Salishan Salmon Invasive Regional Monitoring Program was established to improve the ability to measure and detect trends of salmonid populations and habitat conditions on Salishan.

Data/Tools:

- NetMap, a GIS tool created by Earth Systems Institute (ESI), is a basin scale tool that allows you to examine watershed attributes and processes as well as the intrinsic potential of salmonid spawning and rearing.

Outcomes:

- NetMap was translated into Russian and introduced on Salishan in spring 2008, where participants in the Monitoring Program took part of a training on NetMap, ArcGIS, and EMS2.
- An Intrinsic Potential model for Salmonid species on Salishan are being used to identify field sites within basins to conduct long-term monitoring.



Decision Support Model for Salmon Ecosystem Viability



Decision Support Model for Salmon Ecosystem Viability

Oregon North Coast Assessment

Conservation Planning Need: Develop a landscape scale snapshot of watershed and salmon condition.

Data/Tools:

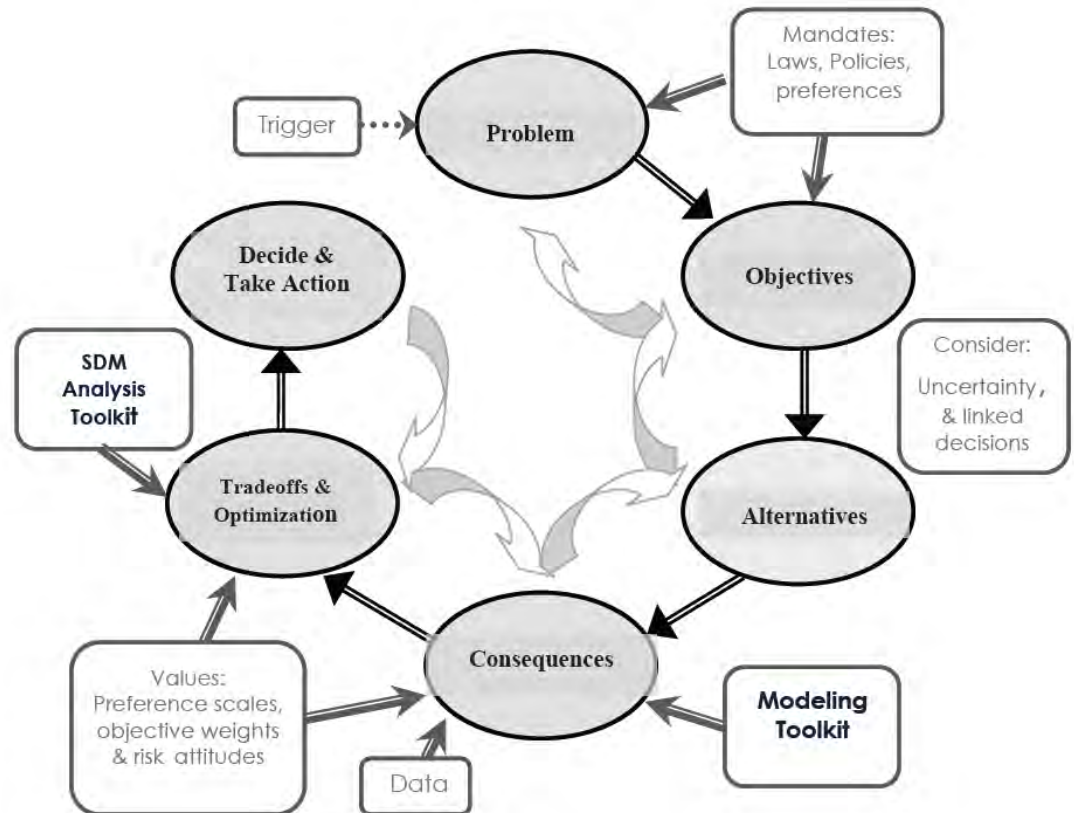
- We used a tool called the Ecosystem Management Decision Support System (EMDSS) system to develop a conceptual model of watershed condition.
- WCC worked collaboratively with GDF, ODFW, Ecotrust, and TNC.

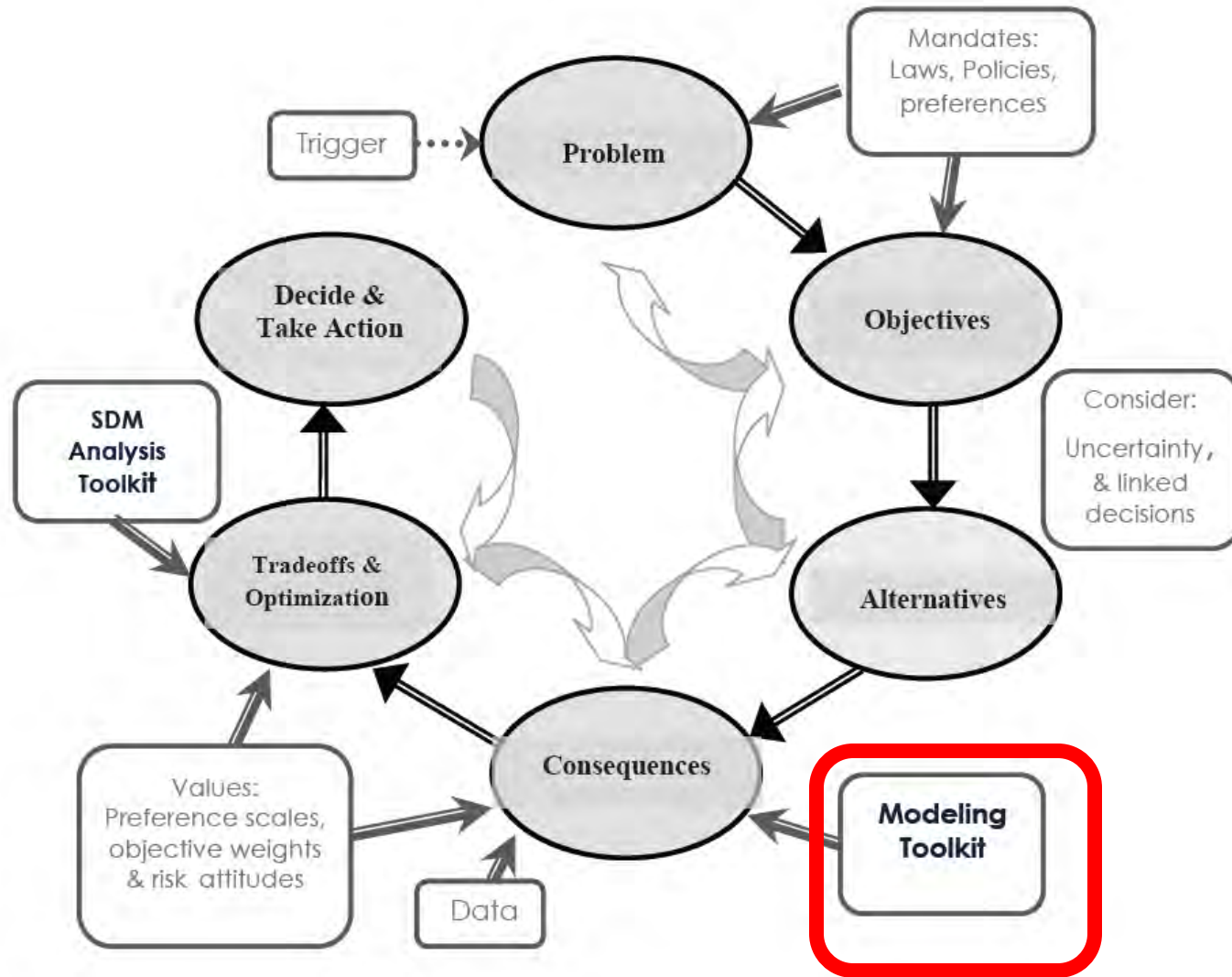
Outcomes:

- Incorporated scientific expertise from partner agencies increased input to the process.
- Developed a watershed condition model that can be used for monitoring.
- Provided supplementary information for the Oregon Board of Forestry in their decision making.

Which Tools to Use?

- Depends on the question.
- Quantitative, Qualitative, mix
- Depends on Resources.
- What exists already?





Trigger

Problem

Mandates:
Laws, Policies,
preferences

Objectives

Consider:
Uncertainty,
& linked
decisions

Alternatives

**SDM
Analysis
Toolkit**

**Tradeoffs &
Optimization**

Values:
Preference scales,
objective weights
& risk attitudes

Data

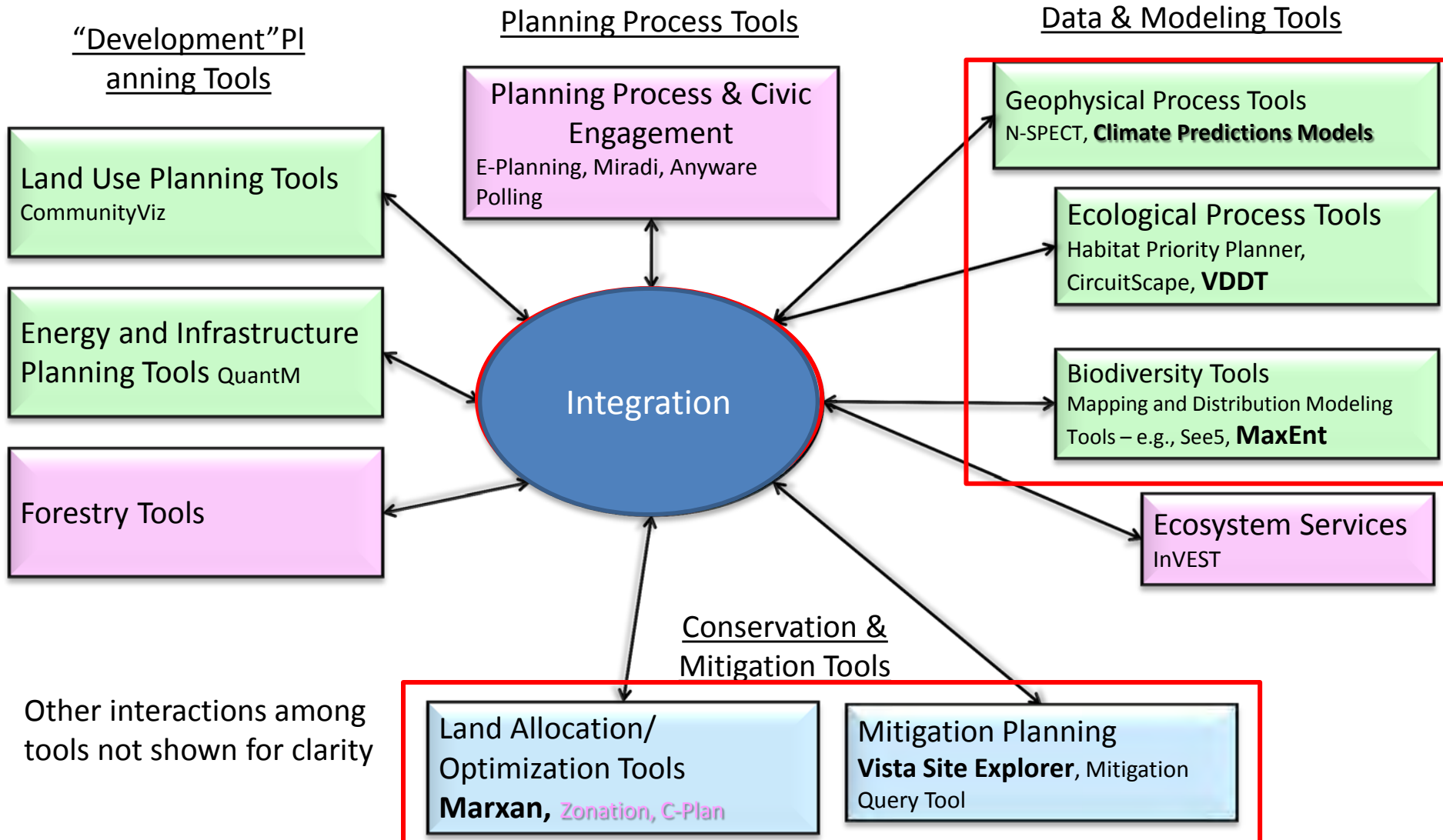
Consequences

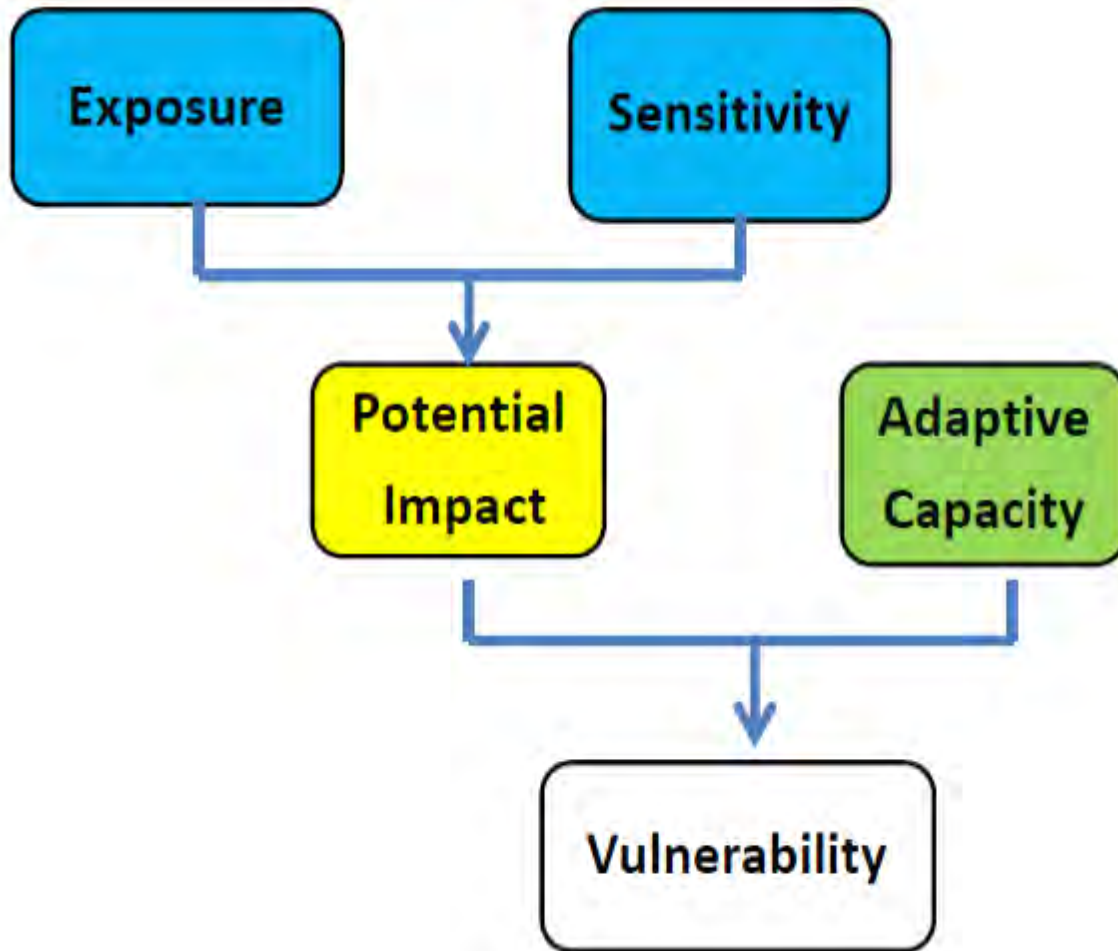
**Modeling
Toolkit**

**Decide &
Take Action**

A Toolkit Approach

- Current Tool Suite
- Demonstrated Tool Interoperability
- Potential tool interoperability





Potentials for Coquille

Exposure

Sea Level
Rise

Decreased
Summer
Flows

Increased
Fire in
Watershed

SLAMM

USFS
data

Fire
Models



FIRE & LANDSCAPES



TOOLS & DATA

LANDFIRE Vegetation Dynamics Development Tool (VDDT)



VIEW LINK: <http://www.essa.com/tools/vddt/>



The Vegetation Dynamics Development Tool (VDDT) is a user-friendly, Windows-based computer tool that provides a state and transition landscape modeling framework for examining the role of various disturbance agents and management actions in vegetation change. It allows users to create and test descriptions of vegetation dynamics, simulating them at the landscape level.

Projecting changes in vegetation structure and composition over time is an important part of landscape-level analyses. Vegetation may change for a variety of reasons, such as human activity, fires, insects, pathogens, mammals, weather, or growth and competition. The interaction of these factors is complex and the combined effects are difficult to predict over long periods.

VDDT provides a common platform for specialists from different disciplines — e.g., entomology, pathology, fire ecology, silviculture, wildlife biology and ecology — to collectively define the roles of various processes and agents of change on landscape-level vegetation dynamics. Moreover, VDDT allows for rapid gaming and testing of the sensitivity of the ecosystem to alternative assumptions. It thus provides a means for learning and communication.

Potentials for Coquille

Exposure

Sensitivity

Sea Level
Rise

Decreased
Summer
Flows

Increased
Fire in
Watershed

Species
Sensitivity

SLAMM

USFS
data

Fire
Models

UW CSD

NatureS
erve

Climate Change Sensitivity Database

Home » Oncorhynchus tshawytscha

Oncorhynchus tshawytscha - Pacific Northwest, focusing on Portland Harbor


April 3, 2012 by Jorge Tomasevic

Author(s) Expertise:

 This species is complete.

Login or register to post comments

Sensitivity Factor	Sensitivity 	Confidence 
Generalist/Specialist	4 Medium-High	5 Very Good
Physiology	6 High	5 Very Good
Life History	2 Medium-Low	5 Very Good
Habitat	7 Extremely High	4 Good
Dispersal Distance	1 Low	5 Very Good
Dispersal Barriers	4 Medium-High	4 Good
Disturbance Regimes	7 Extremely High	5 Very Good
Ecology	5 High	4 Good
Non-Climatic	6 High	5 Very Good
Other (weight)		

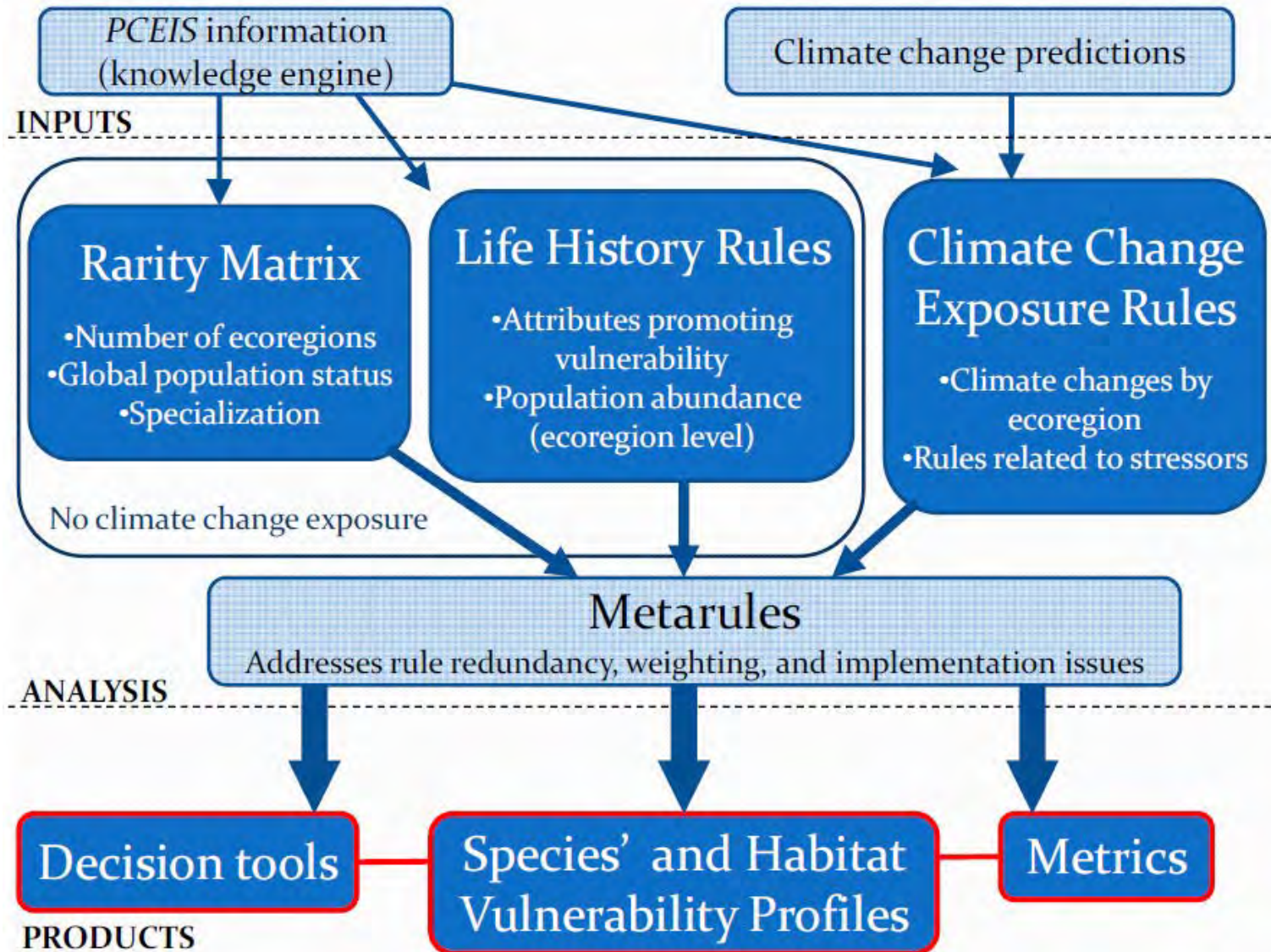
Sensitivity Score : **Extremely High**

Confidence Score : **Good**

Overall User Ranking: **High**

Login or register to post comments

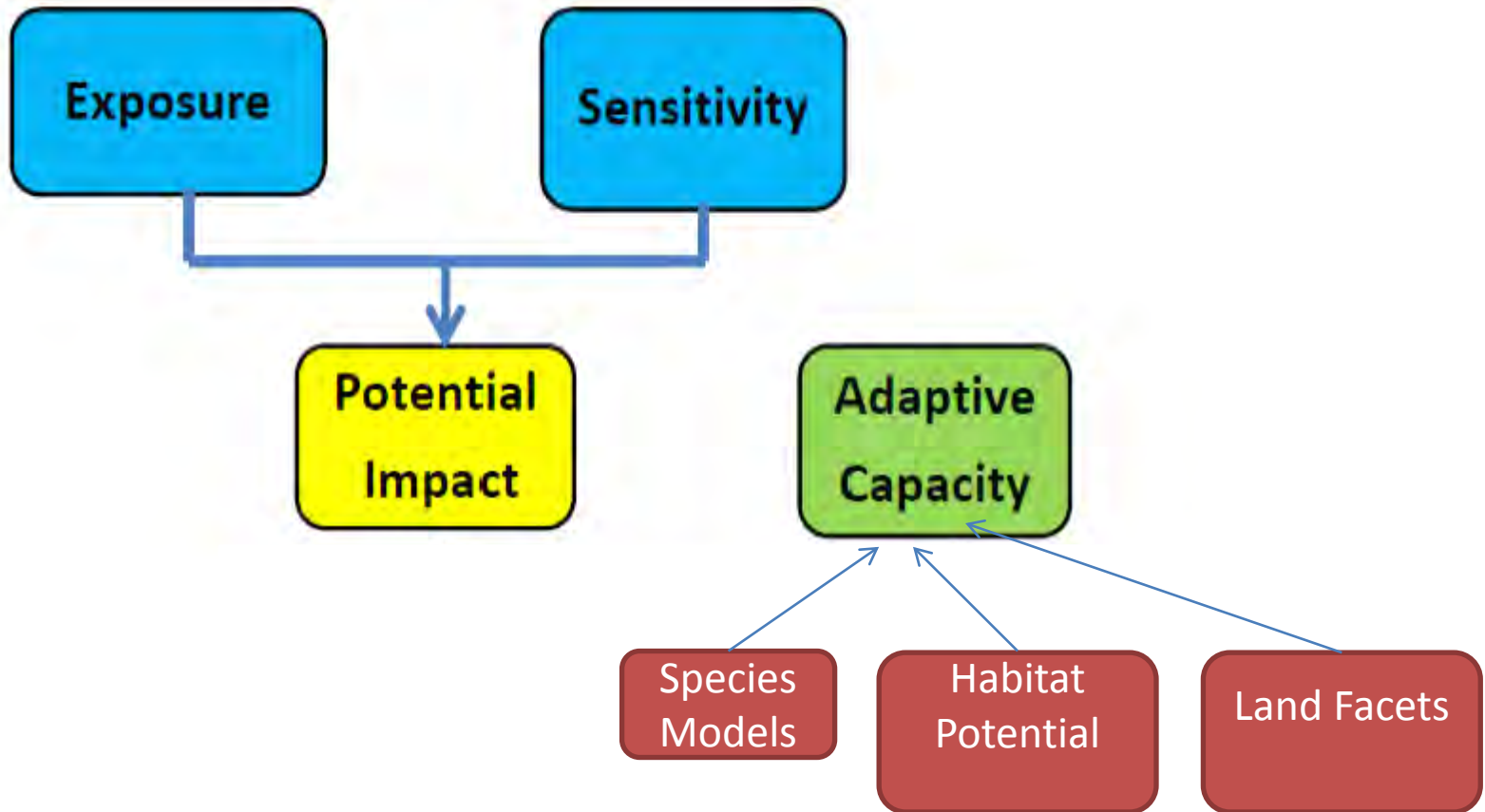
Predicting the vulnerability of nearshore species and habitats to climate change effects, Reusser et al : due 2013



Factors for a CCSI

- Dispersal ability
- Dispersal barriers
- Availability of refuge habitat
- Environmental specificity
- Ecological specificity
- Range size
- Others?

Potentials for Coquille



NetMap: Watershed Template

CLIMATE CHANGE: ASSESSING LANDSCAPE VULNERABILITY
Earth Systems Institute

NetMap
Community Digital Watersheds & Shared Analysis Tools (www.netmaptools.org)

Climate Change: Linking with Other Priorities

Climate change impacts can be considered on their own (impacts of warmer stream temperatures on sensitive fish species) or climate change can be considered in context of other, ongoing management priorities.

Post-Fire Planning (BAER)

Pre-Fire Management Road Analysis/Maintenance

Timber Harvest (riparian mgmt, insects) Watershed Restoration

ESAC/WA

Analysis Approaches

There are options: (1) Cause and effects models can be used to assess singular responses (air or water temperature predictions) or (2) Analysts can use a flexible and exploratory assessment to consider how the pieces of the watershed puzzle fit together.

Fish Habitat

Roads

?

Erosion Potential

Climate

Climate Change and Road Concerns

In this illustrative example in the Boise watershed in Idaho, we perform a "landscape vulnerability" assessment in the context of climate change: a higher chance of winter flooding can pose a risk to the road system & aquatic habitats.

Step 1: Define Vulnerable Habitats

(A) Bull Trout Populations

(B) Bull Habitat

Fig. 1 (A) In the North and Middle Forks of the Boise River, areas of Bull trout populations have been identified at the subbasin scale. (B) A provisional Bull trout intrinsic potential model is constructed using indices of channel gradient, valley floor geology and tributary confluence.

Step 2: Examine Downscaled GCM Predictions

One of the climate change predictions made by the Climate Impact Group (UW) is the difference between the ratio of snowmelt runoff to total runoff between historical and the future (2080 in this example).

Large increases in the ratio of snowmelt runoff to total runoff stem from a lowering of the snowpack in winter.

In certain areas, this implies lower stream flows in the summer and a higher chance of winter flooding (rain on snow) in the winter (Fig. 2). Areas containing vulnerable roads may be at higher risk to winter floods (and streams with lower summer flow may present a risk to fisheries).

Fig. 2. Ratio of snowmelt runoff to total runoff, as percent (2080-historical).

Step 3: Calculate Road Density

(A) Road Density-Basin (km/km²)

(B) Road Density-Segment (km/km²)

Fig. 3 (A) Road density at the basin scale ranges from 0 to 2.5 km/km². (B) Road density at the channel segment-storage wing scale ranges from 0 to more than 100 km/km², allowing better identification of potential risks.

Step 4: Road Drainage Diversion/Surface Erosion

(A) Road Drainage Diversion (m)

(B) Road Surface Erosion

(C) Road Erosion to Streams

Fig. 4 (A) Road drainage diversion can lead to road washouts, gullies and road surface erosion. (B) Road surface erosion depends on road drainage, road gradient, surfacing & road use (WEPP). (C) Erosion is linked to stream channels to US potential risk areas.

Step 5: Roads in Floodplains

NetMap's flexible floodplain tool is used to map the inundation area based on a number of bankfull depths above the channel elevation.

The predicted floodplain surface at 3X bankfull depth is shown in Fig. 5.

Roads that cross floodplains are highlighted using the tool. During large winter floods, these areas could contribute to aquatic impacts.

Fig. 5. Predicted Floodplains.

Step 6: Roads Stability

One of NetMap's erosion parameters 'generic erosion potential' (GEP) is based on a topographic index that combines hillslope steepness and curvature, drivers of gully erosion and shallow failures.

In NetMap, road segments (~10 m) are classified according to the GEP index of the underlying hillside (Fig. 6). This provides an approximation of road failure potential, particularly during storms or following fires.

Fig. 6. Road instability potential.

Step 7: Roads & Debris Flows

Debris flows can be one of the most destructive events following fires or storms, events that could increase with climate change.

NetMap can classify all road - headwater stream crossings by debris flow potential (Fig. 7). Flagged areas could be used to prioritize field surveys and road maintenance programs.

Fig. 7. Road debris flow risk.

Step 8: Putting the Pieces Together

There are numerous ways to put the pieces together to evaluate the risk posed by the road network in the context of climate change.

For example, NetMap's overlap tool can be used to search for locations where threshold values overlap between Bull trout habitat (Fig. 1, B) and debris flow potential (Fig. 8, A) or road density (Fig. 3, B) and habitat (Fig. 8, B).

(A) Debris flow potential (>0.03) & Bull trout habitat (>0.5)

(B) Road density (> 5) & Bull trout habitat (>0.5)

Areas of Concern

Fig. 8. Refer to NetMap Technical Help for relevant citations.

Contact Earth Systems Institute at:
www.earthsystems.net or www.netmaptools.org

Protect the Stage

LAND FACET CORRIDOR DESIGNER

A SUITE OF ARCGIS TOOLS TO IDENTIFY LAND FACET-BASED CORRIDORS BETWEEN FRAGMENTED HABITAT BLOCKS


Jeff Jenness - *Jenness Enterprises*
 Brian Broff - *Northern Arizona University*
 Paul Beier - *Northern Arizona University*

Tools, Manuals, and Literature available from www.corridor-design.org

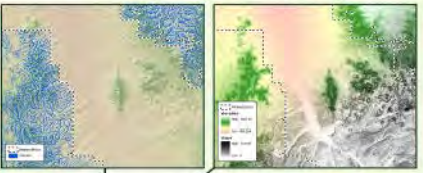
INTRODUCTION

Land Facet Corridor Designer is a geographic approach to designing wildlife linkages that will be useful in the face of impending climate change. This novel GIS-based procedure identifies the geographic portion of a region that maximizes continuity and diversity of landscape units defined by topographic and soil traits (such as high-elevation north-facing slopes with rocky soils, or low-elevation flats with thick soils) that are expected to facilitate wildlife movement.


1 Initial Classification *using our Topographic Position Index (TPI) tool or any classification method you prefer*




2 Define Land Facets for Each Class
Process should be repeated for each class from your initial classification, using only the portion of your landscape within habitat blocks as your sample area. See manual for details.



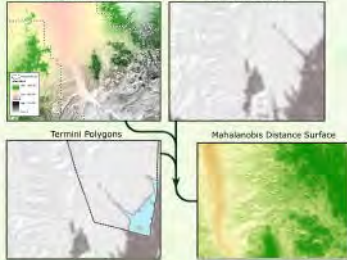
3 Define Density of Each Land Facet
using our Density tool.



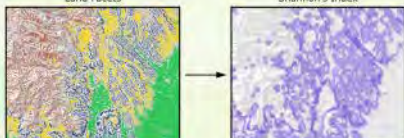
4 Identify Termini Polygons *for each land facet, using the "Density" raster and our Termini tool.*



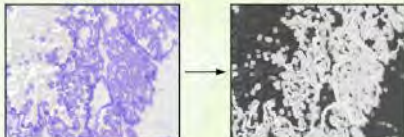
5 Create a Cost Surface *for each land facet, using our Mahalanobis Distances tool to create a statistical similarity raster. See manual for details.*



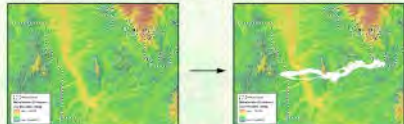
6 Create Land Facet Diversity Raster
using our Shannon's Index Tool. See manual for details.




7 Invert the Diversity Raster *using our Raster Inversion tool. See manual for details.*



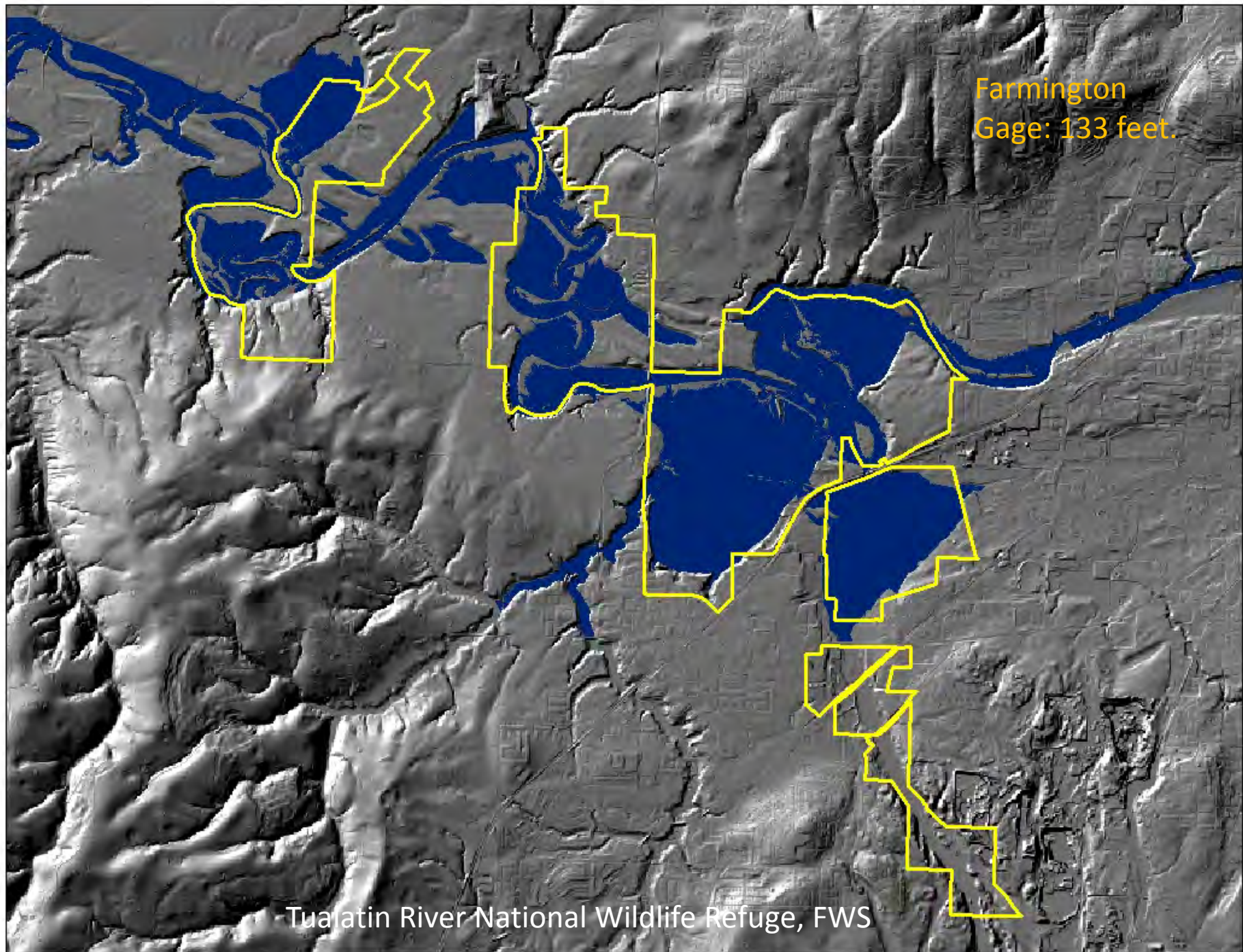
8 Create Corridor Polygons *for each land facet and for the Land Facet Diversity layer, using Corridor Design tools from <http://www.corridor-design.org>*



9 Combine All Corridor Polygons *into a single multi-stranded linkage design.*



Note: We provide several custom ArcGIS and R tools for this step. R is a powerful and free statistical software package.

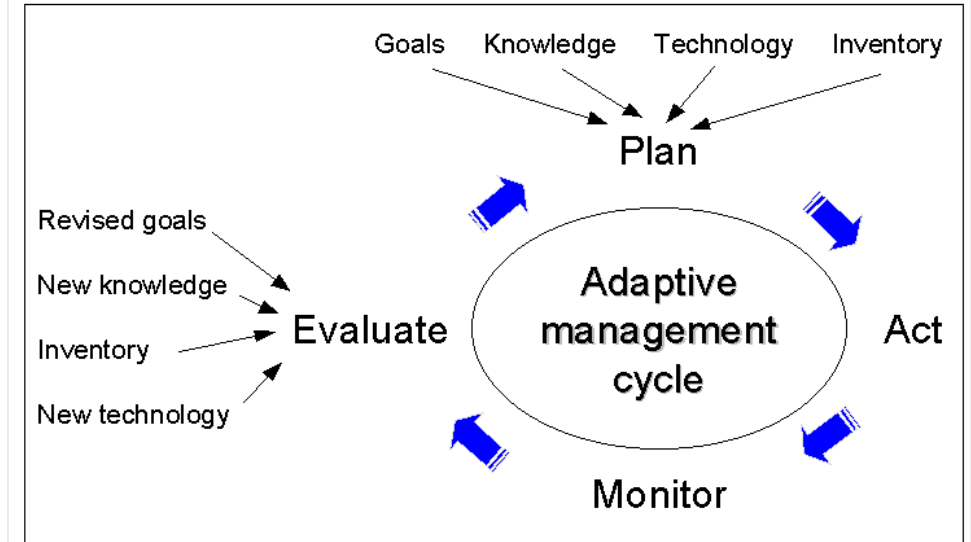


Farmington
Gage: 133 feet.

Tualatin River National Wildlife Refuge, FWS

Decision Support Modeling

- Ecosystem Management Decision Support:
 - NetWeaver Logic Model

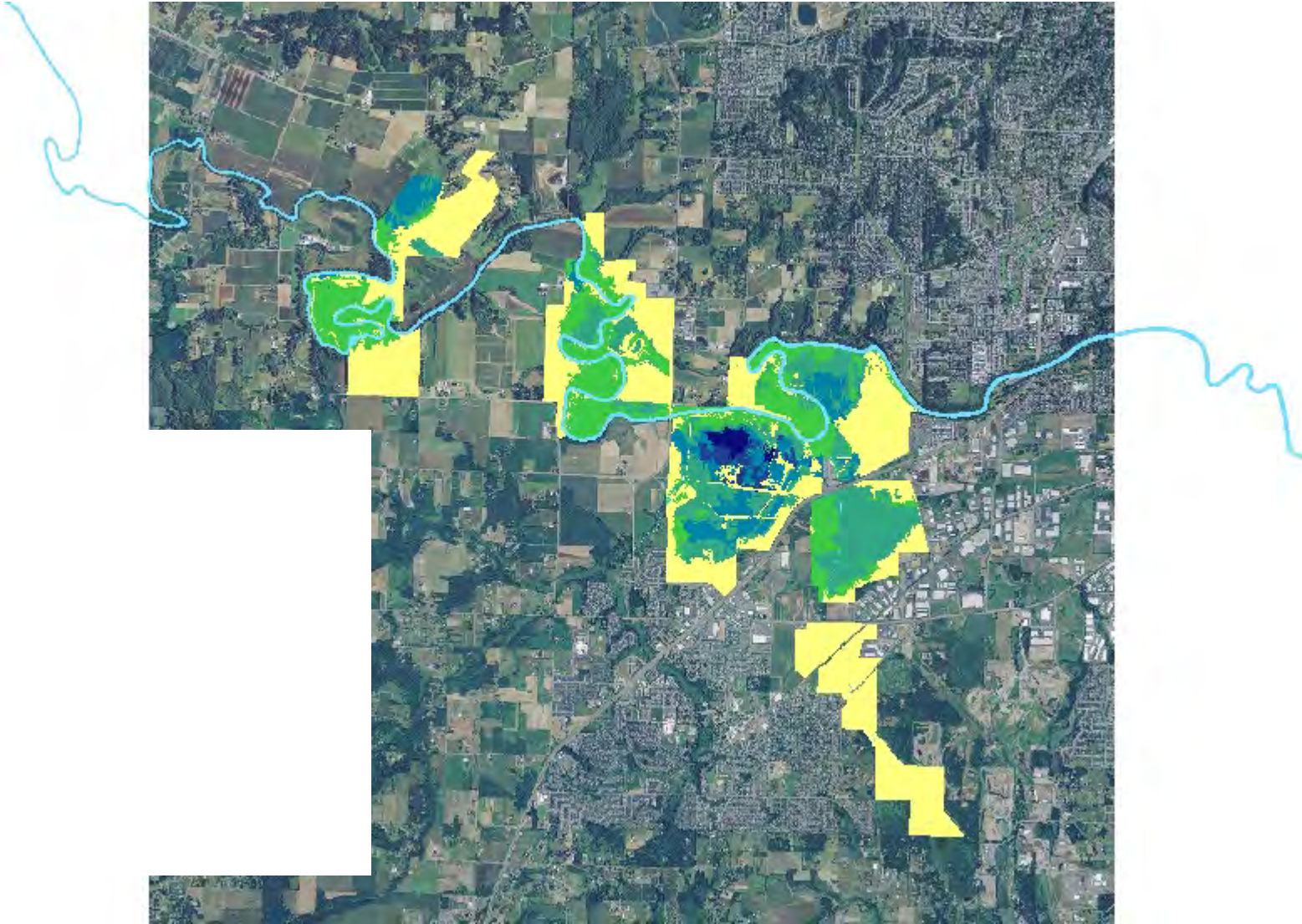


Develop the Support (Evidence)

- Current Vegetation
- Historic Vegetation
- Soils
- Inundation Frequency

- Based upon expert opinion, literature, data.

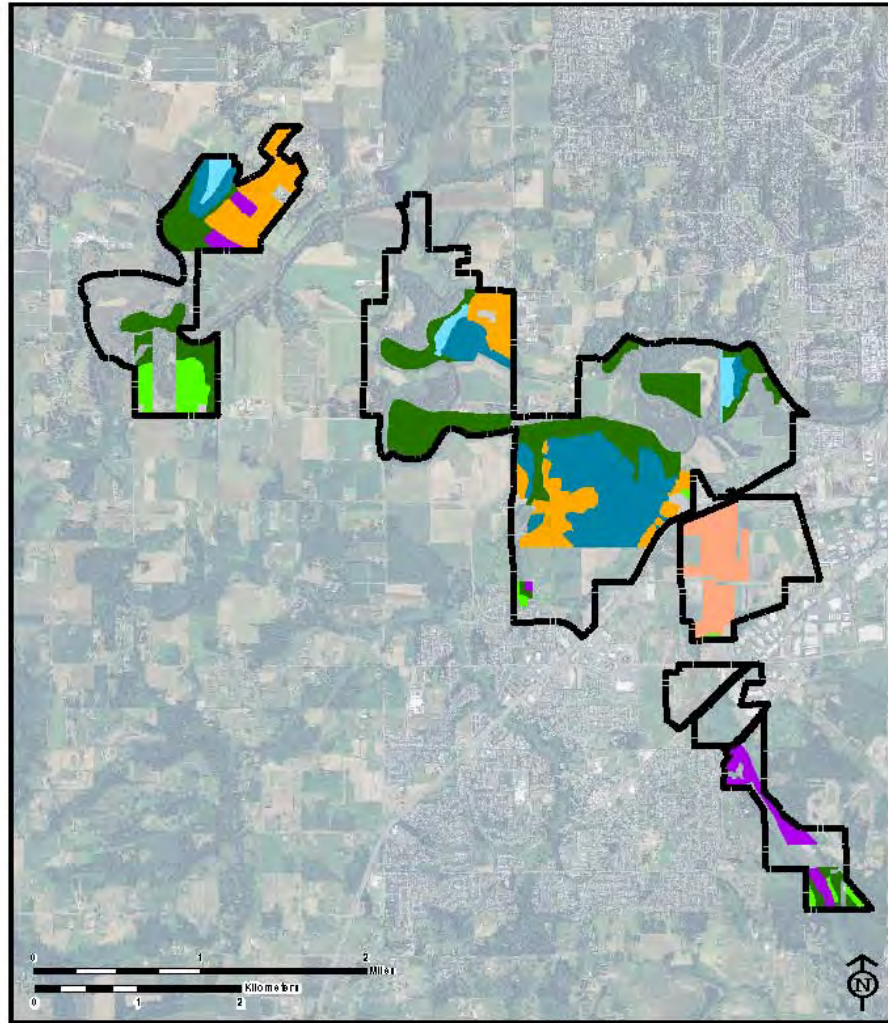
Proposition: Parcel X will develop naturally into Wet Meadow Prairie.



Tualatin River National Wildlife Refuge, FWS

Figure X

Sherwood Units, Habitat Alternative 1



Legend

- | | | | |
|--------------------|---------------|-----------------|--------------------------|
| Cropland | Mixed Forest | Prairie - Wet | Stream |
| Developed | Oak Savanna | Riparian Forest | Approved Refuge Boundary |
| Herbaceous Wetland | Prairie - Dry | Scrub Shrub | |

Map Date: 07/01/2011
Data Source:

Alternatives for Comprehensive Conservation Plan

Matrix of Tools

revised by ICI

Tool Name	Adaptation Database for Planning Tool (ADAPT)	CRISTAL (Community-based Risk Screening Tool – Adaptation and Livelihoods)	NOAA CSC Coastal Inundation Toolkit	NOAA CSC Roadmap	Ecosystem-Based Management Tools Network	Digital Coast	ClimateWizard	Climate Sensitivity Database	DataBasin Climate Center	Northeast Climate Data
Tool Type	Process			Tool Portals			Data portals			
Description	An online database that guides users through ICLEI's 5 Milestones for Climate Adaptation planning framework. ADAPT walks you through the process of assessing your vulnerabilities, setting resiliency goals, and developing plans that integrate into existing hazard and comprehensive planning efforts.	CRISTAL enables local decision makers to assess the impact a project may have on the resources of a community, and modify projects to reduce vulnerability and enhance adaptive capacity by incorporating adaptation methods. This decision support tool is a user-friendly process for planners and managers to identify the links between the livelihoods of locals and climate. CRISTAL steps the user through a series of worksheets for each of these elements from the identification of impacts, through implementation and evaluation of strategies. It also includes example reports or case studies.	This toolkit provides guidance on how to prepare and map inundation estimates for your area. The toolkit was developed by the Digital Coast Partnership Group to help communities understand and address coastal inundation issues. Website components include: Understand basic information about coastal inundation; Identify your county's exposure and examine potential impacts; Map inundation to "see" potential impacts; Assess your community's risks, vulnerability, and resilience; Communicate risk strategies to initiate change; and, Discover how other communities are addressing this issue.	A three hour training designed to help communities characterize their exposure to current and future hazard and climate threats and assess how existing planning and policy efforts may integrate this information to address community issues. After completing this course, participants will be able to: Identify key issues and impacts associated with current and future coastal hazard risks; Identify major elements of community vulnerability; and, Identify strategic "win-win" approaches for reducing risks and vulnerabilities while also addressing other community issues	A Network of tool providers and practitioners that works to bring geospatial and other tools to planning processes. At the EBM Tools Network website, you can find an online database of tools, training resources, webinars, and links to case studies.	Digital Coast is a data and tool portal provide by NOAA Coastal Services Center. The Digital Coast also provides the tools, training, and information needed to turn these data into the information most needed by coastal resource management professionals. Digital Coast is used to address timely coastal issues, including land use, coastal conservation, hazards, marine spatial planning, and climate change. One of the goals behind the creation of the Digital Coast was to unify groups that might not otherwise work together. This partnership network is building not only a website, but also a strong collaboration of coastal professionals intent on addressing coastal resource management needs.	With ClimateWizard you can: <ul style="list-style-type: none"> - view historic temperature and rainfall maps for anywhere in the world - view state-of-the-art future predictions of temperature and rainfall around the world - view and download climate change maps in a few easy steps ClimateWizard enables technical and non-technical audiences alike to access leading climate change information and visualize the impacts anywhere on Earth. The first generation of this web based program allows the user to choose a state or country and both assess how climate has changed over time and to project what future changes are predicted to occur in a given area. ClimateWizard represents the first time ever the full range of climate history and impacts for a landscape have been brought together in a user-friendly format.	Climate changes poses a daunting challenge to natural resource managers and in response the University of Washington has partnered with key collaborators to conduct a climate change sensitivity assessment. This assessment is designed to evaluate the sensitivity of the species and ecological systems of the Pacific Northwest to climate change. This digital database summarizes the inherent climate change sensitivities for species and habitats of concern throughout the Pacific Northwest and will provide resource managers and decision makers with some of the most basic and most important information about how species and systems will likely respond to climate change.	The Climate Center is one of the entryways to Data Basin, the on-line database with data manipulation tools created by the Conservation Biology Institute (CBI). <p>The Climate Center:</p> <ul style="list-style-type: none"> - lists the most recent datasets, maps and galleries with relevance to climate change issues. - provides special features that tell stories around specific datasets available in Data Basin. - provides news briefs about recent publications or observations of change. - highlights climate change-related data providers and climate change experts. - CBI staff are working on developing special tools that will help provide climate change guidance The Climate Center is being built to meet users needs. Let	This database provides projections of changes in temperature, precipitation, relative humidity, and snow cover for the U.S. Northeast that can be expected over the coming century under higher and lower emission scenarios as well as data on these variables for the period since 1961. The data compiled here was generated as part of the Northeast Climate Impacts Assessment, a collaborative research effort between the Union of Concerned Scientists and more than 50 independent scientists from across the Northeast region and beyond. Information can be displayed geographically or as a time series, and can be plotted for the entire region, an individual state, or major cities
Tool Type	Process	Process	Process/Visualization	Process	NA	NA	Climate data access, visualization, analysis	On-line database and index	on line data, collaboration tool	Climate data access, visualization
Complexity	Low	Low	Medium to High	Low	Low	Low	Low	Low-Medium	Low	Low
Developer	ICLEI Sustainable Communities	International Institute for Sustainable Dev (IISD), World Conservation Union (IUCN), SEI-US	NOAA CSC	NOAA CSC	EBM Tools Network	NOAA Central Services Center	C. Zganjar (TNC), E. Givertz (then U. Washington, now TNC), and G. Rober (U. Southern Mississippi)	Univ. Washington / TNC	Conservation Biology Institute	Hayhoe, W'like, Anderson, Liang, Maurer, Zhu, Bradbury, DeGaetano, Stoner and W'ubbles.
Price	Requires membership with ICLEI	Free	Free	Free	Free	Free	Free	Free	Free	Free
Additional Software Needed	NA	NA	ArcGIS, VDatum, or other geospatial models	NA	NA	NA	None	None	None	None
Link	http://www.iclei.org/portal	http://www.cristaltool.org	http://www.csc.noaa.gov/digitalcoast	http://www.csc.noaa.gov/digitalcoast/roadmap	http://www.ebmtools.net	http://www.csc.noaa.gov/digitalcoast/index	http://www.climatewizard.org/	http://www.u.washington.edu/csc/bk/ClimateWizard	http://databasin.org/climate-center	http://www.northeastclimatedata.org

Resources

- Ecosystem Based Management Tools
 - Ebmtools.org
- Climate Adaptation Knowledge Exchange
 - Cakex.org

The screenshot displays the CAKE website interface. At the top, the logo for 'cake Climate Adaptation Knowledge Exchange' is visible, along with navigation links for 'CASE STUDIES', 'VIRTUAL LIBRARY', 'DIRECTORY', 'TOOLS', and 'COMMUNITY'. A search bar is located in the top right corner. The main content area features a map of the Northern Great Plains region, with a red information box overlaid. The box contains the title 'Ocean of Grass: An Ecoregional Climate Change Vulnerability Assessment for the Northern Great Plains', the organization 'World Wildlife Fund', and a brief description of the ecoregion. Below the map, there are sections for 'FEATURED CASE STUDY' and 'WHAT'S NEW'. The featured case study is the same 'Ocean of Grass' assessment, dated April 9, 2012. The 'WHAT'S NEW' section includes 'Coastal Adaptation to Climate Change in New Zealand' dated April 10, 2012. A 'WHAT'S POPULAR' section is also visible at the bottom. On the right side of the page, there are several utility boxes: 'CASE STUDIES' with an 'About the Case Studies' link, a 'Follow New Additions' notification, a 'Search Case Studies' box with a search bar and 'List'/'Map' view options, and a 'Submit a Case Study' button.

Conclusion

- Several different approaches
- Depends upon needs, questions, and resources
- Putting together the necessary tools to answer questions, what are the gaps?
- Understand what is out there already.

“The significant problems we face today cannot be solved with the same level of thinking that we were at when we created them.”

--Albert Einstein