Riparian Restoration Prioritization on the Shasta River

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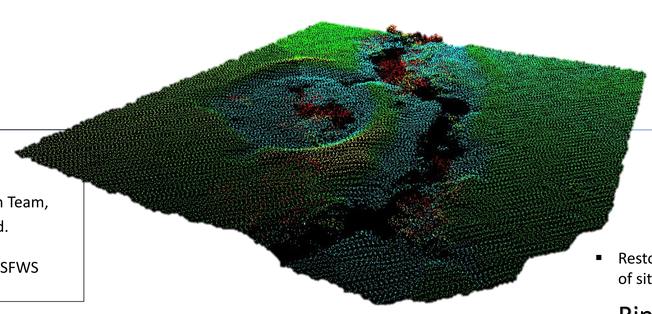
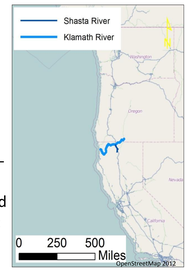


Where?

- The Klamath Basin is a large watershed in Southern Oregon and Northern California
- The Shasta River is in the mid-Klamath, a sub-basin that drains from the feet of Mt. Eddy and Mt. Shasta north to the Klamath River



- The Shasta River is primarily spring-fed
- Modifications to the channel structure and basin hydrology impair resident salmon populations
- Riparian planting is a targeted activity for restoration of habitat value on the river

Who?

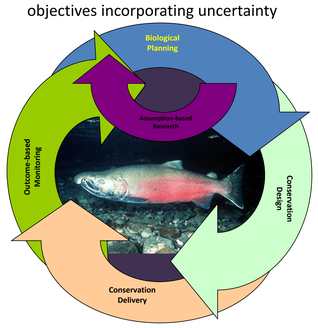
Project Partners:

- US Fish & Wildlife Service:
  - Yreka Fish & Wildlife Office: Partners for Fish & Wildlife
  - Klamath Strategic Habitat Conservation
- Shasta River Riparian Working Group:
  - Yreka Fish & Wildlife Office: Partners for Fish & Wildlife
  - The Nature Conservancy
  - Shasta Valley Resource Conservation District

SHC Overview

Strategic Habitat Conservation…

- Links site-specific restoration work with landscape-scale ecological goals and objectives
- Is about being "smart" about where to work, to improve the efficiency of limited restoration dollars
- Integrates a landscape-scale, adaptive management-based framework for both project- and institutional learning objectives incorporating uncertainty



Problem Statement

Where can we improve riparian conditions by planting willow trees?

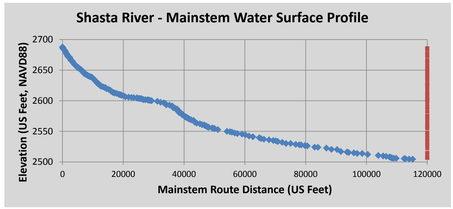
- Where are planted willows likely to succeed?
- What are the current riparian vegetation conditions?
- Where does the planting of trees improve riparian conditions?

LiDAR Derived Components

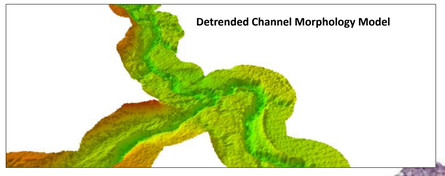
- LiDAR Derived Channel Model – Absolute Elevation NAVD88
- De-trended Riparian Channel – WSE-Normalized Surface
- 3D Polygon Vegetation Objects
- 2D Raster Canopy Summaries

Channel Morphology

- As a rule of thumb, red-laser LiDAR is impacted by water
- Reliable channel bathymetry is only available above the water level at the time of acquisition
- By analysis of the gage hydrograph, the relative stage (flow condition) can be assessed



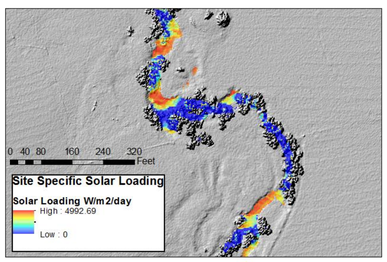
- Examining the LiDAR supports the development of a water surface elevation (WSE) curve for the observed flow



- This WSE is the cornerstone for the detrending and channel structural analysis

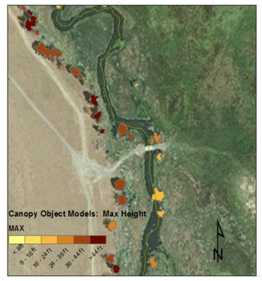
Solar Loading Model

- Temperature is a limiting factor for ecological health and fish populations on the Shasta River
- An inventory of existing vegetation supports modeling the shading contribution of each tree.
- These vegetation objects include information about density and height from LiDAR return data
- Vegetation objects also incorporate information summarized on raster grids (canopy height model)
- Summary of vegetation and canopy as both a continuous surface and discrete objects supports a variety of analyses for landscape prioritization



Data Development

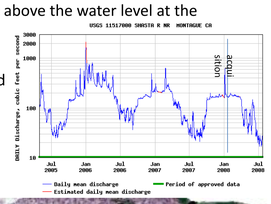
Inventory of Existing Vegetation



- Vegetation density is modeled using LiDAR classification
- Vegetation is extracted and used to create vector vegetation objects
- These vegetation objects include information about density and height from LiDAR return data
- Vegetation objects also incorporate information summarized on raster grids (canopy height model)
- Summary of vegetation and canopy as both a continuous surface and discrete objects supports a variety of analyses for landscape prioritization

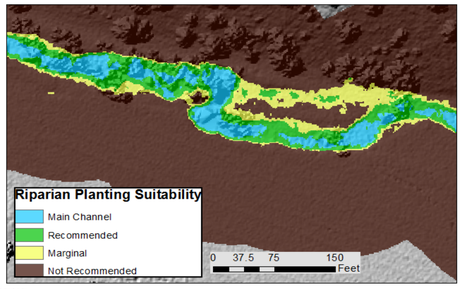
System Hydrology

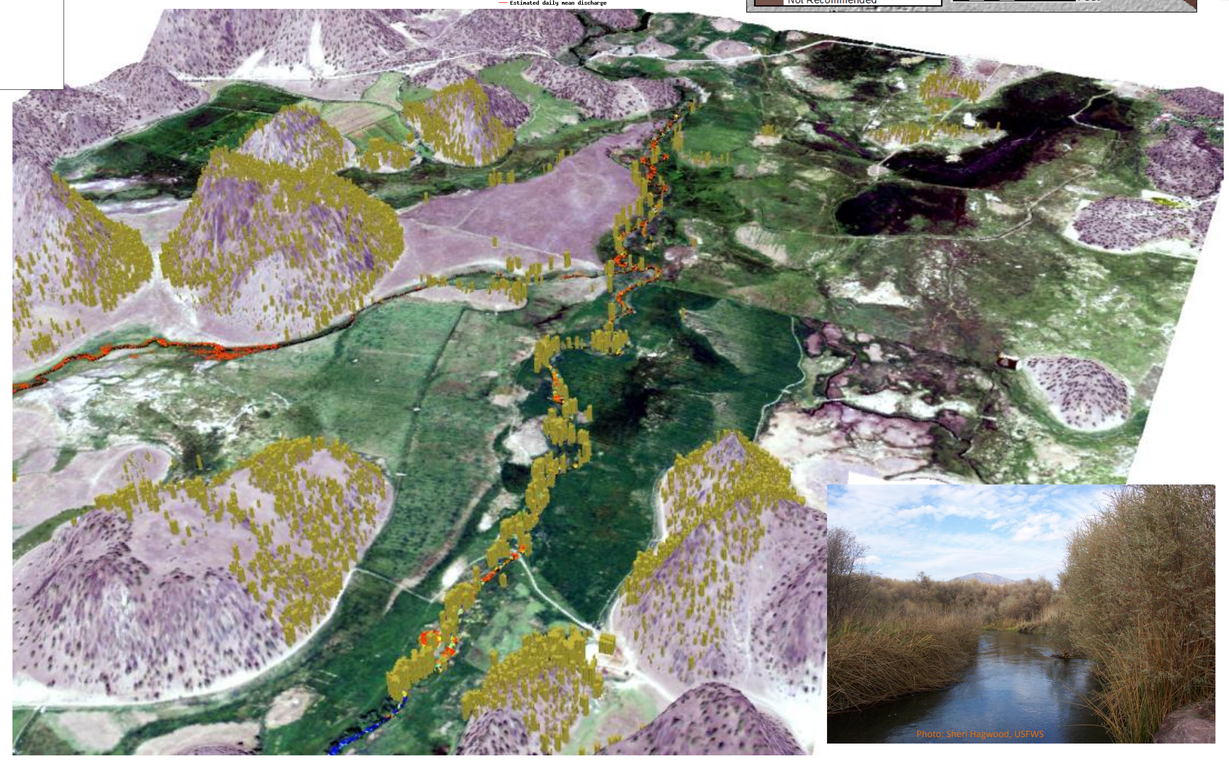
- In general, red-laser LiDAR is impacted (absorbed/diffracted) by water
- Reliable channel bathymetry is only available above the water level at the time of acquisition
- By analysis of the gage hydrograph, the relative stage (flow condition) can be assessed
- Fortunately, this LiDAR acquisition occurred in a dry winter, between storm events
- This discharge at the time of acquisition is very close to a winter base flow



Planting Suitability Model

- The observed WSE is used to develop a groundwater estimator in a narrow ribbon along the river corridor
- This surface is carefully generated to capture the hydraulic connectivity in bends of the river and remnant oxbows
- This surface can then be differenced from the DEM to produce a detrended riparian corridor model
- This riparian corridor model contains much information about channel geomorphology: floodplains, remnant oxbows, and other channel features
- This surface can then be analyzed to show planting suitability in terms of proximity to winter groundwater conditions
- Work is ongoing to map these geomorphological features and incorporate them into the analysis
- KSHC is working with TNC partners to calibrate this critical distance using observed survival in planting efforts

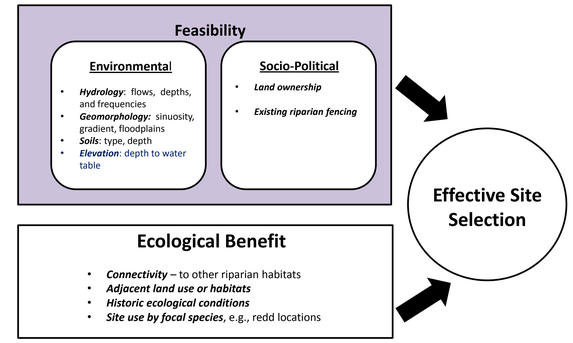




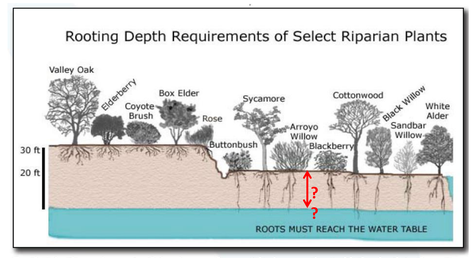
Conceptual Model

- Restoration objectives are set based on the conceptual model of site selection

Riparian Planting Site Selection Criteria



- These physical criteria are then used to define physical (morphological) criteria for survival



Rooting depth requirements of riparian species must be known, along with the depth to the water table across the site, so that planted species will survive and thrive after irrigation is no longer applied.

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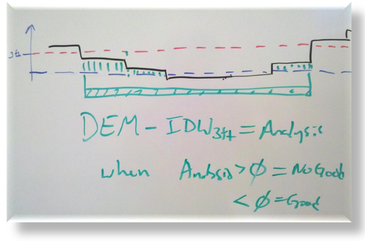
- The rooting depth criterion can be used to define an analytic approach based on surface differencing



Acknowledgments

This work is part of a team effort to conserve natural resources and restore ecological function and in the mid-Klamath basin

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