Impacts of Biomass Removal on Flow and Sediment Transport in Forested Streams

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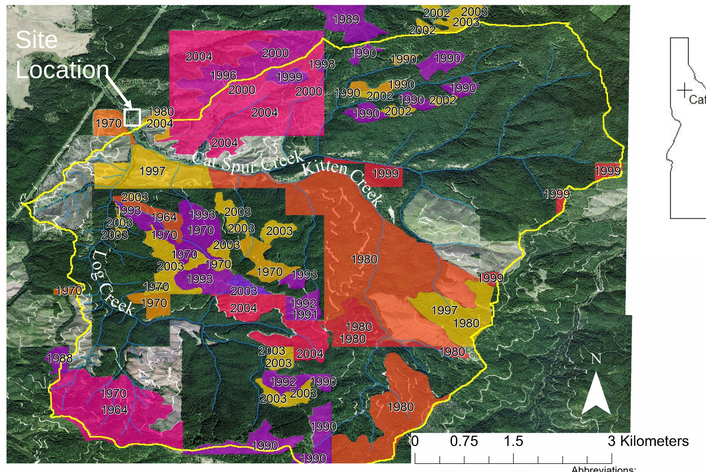
Introduction and Objectives

The project objective is to evaluate the potential impacts of altered hydrologic conditions on flow and sediment dynamics in mountain streams. Specifically, the effects of altered runoff and sediment supply due to biomass removal are being examined. Stream channel aggradation, degradation, bed material size, and sediment transport are being investigated using hydrodynamic and morphological models.

Cat Spur Creek, a harvested watershed located in northern Idaho (Figure 1), was selected to evaluate these effects on stream channels. Cat Spur Creek is a gravel bed stream, with an average flow of 0.3 m^3/s, bank full width of 6 m, and average slope of approximately 0.01.



*Numbers in polygons represent year of harvesting activity

Figure 1: Study Site

Methodology

To determine the stream channel response to biomass removal, an array of possible resulting streamflows and sediment supplies were examined. The flow and sediment were routed through a hydraulic model that determined the output suspended sediment and channel aggradation/degradation as well as changes to the streambed material.

Field Data Collection

Cat Spur Creek was surveyed in July 2014 for channel bathymetry and grain size data. Bed elevation measurements were collected roughly every 20 cm along 35 cross sections, producing the detailed representation of the bed surface shown in Figure 2. Median grain size of the bed material was determined to be 11.8 mm.

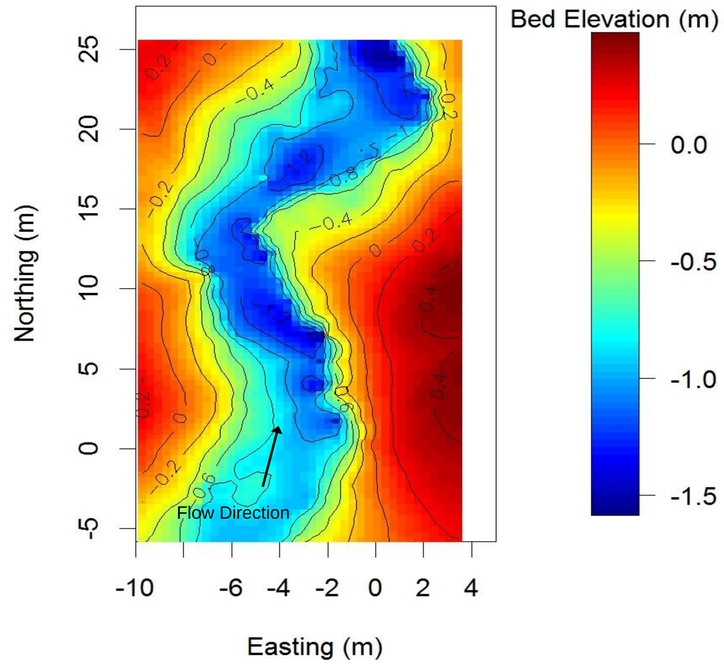


Figure 2: Bathymetric Map of Study Site

Modeling

Modeling was conducted in two stages. The Forest Service, FS WEPP model was used to approximate the increased sediment yield from biomass harvesting. Hill slopes and lengths in the watershed were estimated using ArcGIS. The sediment yields produced by FS WEPP were used to initialize a sediment transport model for a 40 m reach of Cat Spur Creek near the outlet of the watershed. Nays2DH modeling software was used to model hydrodynamics, sediment transport, and channel morphology. A two year return interval flow was used and the model produced estimated bedload transport, as well as, mean bed particle diameter.

Summary of Biomass Removal Impacts to Sediment Yield

Scenario:	Baseline	Harvest	Biomass Removal (5% of Basin Area)		Biomass Removal (10% of Basin Area)	
Annual Return Interval	Sediment Yield (Mg/yr)	Sediment Yield (Mg/yr)	Sediment Increase from Baseline (%)	Sediment Increase from Harvest (%)	Percent Increase (%)	Sediment Increase from Harvest (%)
100	987	2200	181%	26%	211%	39%
50	698	871	49%	20%	66%	33%
20	181	247	81%	33%	104%	49%
10	130	155	53%	29%	96%	64%
5	56	44	-16%	6%	29%	62%

Future Work

Initial modeling has been completed to estimate the effects of biomass removal on the sediment load in small mountain streams. However, additional analysis will be conducted to include more detailed inputs for changes in vegetative cover and stream discharge. Currently, the data and prediction estimates apply only to the Cat Spur Creek watershed. Current work, therefore, is ongoing to upscale and generalize the results.

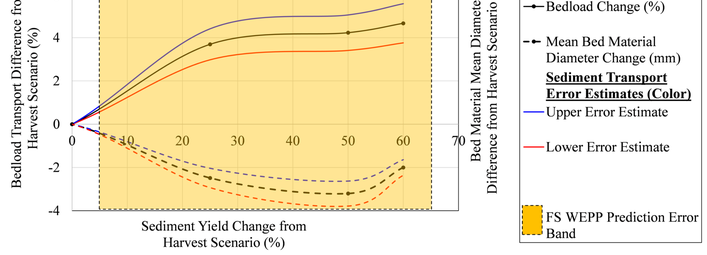


Figure 3: Expected Changes in Bedload Transport Rate and Mean Bed Material Size

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NARA
Northwest Advanced Renewables Alliance

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