Pre-harvest Calibration of a Paired and Nested Watershed Study to Evaluate Event-Based Suspended Sediment Export

The Little Creek Study

Swanton Pacific Ranch
Davenport, CA

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Presentation Outline

• Location overview
• Management history
• Little creek monitoring project
  • Goals
  • Study design
  • General timeline
  • Water quality data collected and stat analysis

Management history

Looking Downstream in North Fork ~1910

Looking upstream in North Fork ~2000

Little Creek study goals and current analysis

• Scientifically document water quality and channel conditions before, during, and after single-tree and small group selection harvests.
• Evaluate the effectiveness of current forest practice rules and best management practices for timber harvesting activities in maintaining existing water quality and channel conditions.
• Current analysis
  – Analyze the storm event water quality data from the Little Creek watershed to assess the calibration (pre-treatment phase) of the Little Creek Study.
  – Describe the existing variability
  – Determine the magnitude of change capable of being detected in the post-treatment period.
Paired Watershed Design
• Control watershed: South Fork
• Treatment watershed: North Fork

Nested Watershed Design
• Control Watershed: Upper North Fork
• Treatment watershed: North Fork

Timeline and study design
Calibration period 2001-2008
• Measure existing water quality
Treatment in 2008
• Harvest portion of watershed between the North Fork and Upper North Fork stations
Post-treatment 2008-2011+
• Measure for potential change in water quality

Field data collection – stage and streamflow

Lab Water Quality Testing
• Lab analysis of 1 hour samples
• Turbidity
  • Units: nephelometric turbidity units (NTU)
• Suspended Sediment Concentration (SSC)
  • Units: mg/L

Defining the dataset – Predicting SSC from turbidity
• Need for SSC to be predicted from turbidity
  • Turbidity shown to be a better predictor than flow
• Previous research has indicated SSC versus turbidity is a variable relationship that is best defined on an event basis
• Regression analysis used to establish relationship.
  • Regressions assessed based on $r^2$, p-value, residual plots, and fits
  • Data transformations when necessary
Defining the dataset – storm events

- Minimum storm event size based on turbidity
  - Peak must be greater than 20 NTUs
- Only samples >20 NTUs analyzed for SSC
- Define storm events based on the hydrograph using Hewlett and Hibbard (1967) 0.05 slope method
  - Separates storm flow from base flow
- Storm event ends when turbidity drops below 20 NTUs or the 0.05 slope line intersects the hydrograph

Event load calculation

- Events with complete SSC and flow datasets used for analysis
  - Must have both datasets to calculate loads
- Calculate individual hourly loads to determine event loads
  - High temporal variability requires hourly sums
- Event loads establish the calibration dataset
  - Changes in the relationship used to detect change

Assessing detectable magnitude of change using confidence intervals

- Back-transformation of confidence interval into non-logarithmic numbers not valid
- Generate a synthetic dataset representing percentage increases over the original dataset
- Transform the new dataset, perform regression, and compare new regression line to original confidence interval
New regression line comparison to existing confidence intervals for NF versus UNF

Conclusions

- Suspended sediment versus turbidity relationship has allowed for prediction of suspended sediment data
  - Established on an event basis
- Data thus far has yielded a sufficient number of event-specific suspended sediment loads to enable simple linear regression analysis
  - Nested (NF versus UNF) relationship indicates less variability than paired (NF versus SF) relationship
  - Narrower confidence intervals for magnitude of change detection for nested relationship

Other Little Creek Study Components

- Annual geomorphic surveys
  - Longitudinal profiles and cross sections to detect potential sediment source/sink areas
- LIDAR mapping analysis (Russ White)
  - Stream channel and road features under forest canopy
  - Comparison with conventional surveys

Questions?