Quantifying biological constraints on stream integrity for classification and management priorization

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# Introduction

* Effective stream management can depend on identification and prioritization of locations where activities are expected to have desired outcomes.
  + Difficulty defining priorities one site at a time (or setting priorities without data)
  + Placing bounds on known drivers of change can reduce uncertainty in decisions
  + Understanding effects of landscape on stream integrity is particularly relevant for targeted action
* We don’t have good tools to develop a context of expectation of what’s possible at a site.
  + This can help prioritize management actions.
  + Context can be defined by models, expert knowledge, and/or defined values
  + Stakeholder involvement is critical in this process
* Goal: demonstrate application of a landscape model to classify and prioritize stream monitoring sites using estimated constraints on biological integrity.
  + Statewide application of the model
  + A case study is used to demonstrate how the model can be used to classify and prioritize by watershed using guidance from a regional stakeholder group.

# Methods

### Study area and data sources

* Brief description of CA, stream types and designated uses, PSA regions, management interests (e.g., southern vs. northern CA)
* Data sources
  + Streamcat database used to quantify watershed land use at all sites
  + Streamcat data linked to NHD, reach as individual unit for model output
  + CSCI as measure of biological condition

### Building and validating landscape models

* Development of landscape model using statewide data
* Ag/Urban land in catchment as predictor of constraint
  + Chosen through vetted stakeholder process at the state level
  + Model incomplete by design, goal of explaining portion of biological response from large-scale constraints
* Quantile regression forests and range of model output
* Split between calibration/validation data, evaluation of performance

### San Gabriel River watershed case study

* Overview of SGR watershed, land use, upper/lower watershed, etc.
* SGR management groups and SGRRMP
* General process of involving stakeholders in developing model, identifying priorities
  + Use of interactive application to facilitate

*Figure* SGR watershed

### Reach classification, site performance, and prioritization

* Summary of framework for identifying site priorities for management actions
  + Reach classifciation - all reaches
  + Site performance - all sites
  + Management priorities - by site types, extrapolated to all sites
* Details about classification framework for stream reaches
  + Range of CSCI expectations at a reach relative to a chosen CSCI threshold
  + Likely constrained, possibly constrained, possibly unconstrained, likely unconstrained
* Details about identifying site performance
  + Sites with observed scores above the upper limit of the reach expectation as “over-performing” and sites below the lower limit as “under-performing”, within range as “expected”
  + Identified for each of four reach classications
  + Further identified based on location to CSCI threshold to define “types” to prioritize
* Stakeholder process to assign management priorities by site types

*Figure* flowchart for classification and performance identification

*Table* reach classification, site performance types and categories

*Figure* Site types template figure for prioritization

*Figure* Screenshot of web application

### Sensitivity analyses

* Reach classifications and site performance depend on the range of score expectations and the CSCI threshold
* Sensitivity analysis to evaluate effect of certainty in the model and CSCI threshold (strict, lax) on stream miles by priority category

### Unclassified reaches

* Some reaches were unclassifed if data were insufficient or if a catchment could not be defined
* Latter was more common, particularly in engineered channels or agricultural ditches
* A preliminary approach for assigning biological expectations to unclassified reaches is demonstrated for “typically” urban and agricultural reaches

# Results

### State-wide patterns

* Where does the model perform well, how does performance vary with validation and calibration datasets.
* What is the consistency of patterns? For example, percent stream miles as xyz by PSA.

*Figure* Statewide map.

### Case study

* Extent, classification, prioritization
* Relationships with environmental variables for constrained/unconstrained locations. Maybe apply to hardened/non-hardened reaches in constrained locations.

*Figure* Summary of extent of reach classification, site performance, selected examples

*Tables* Priority table(s) from stakeholder group

### Sensitivity analysis

* Statewide results - reach classification, site performance
* SGR application - where do priorities change? Do overall patterns remain?

*Table* Sensitivity results

### Unclassified reaches

* Extent of typical ag, typical urban statewide
* Framework for assigning unclassified reach to a class
* Statewide patterns, SGR patterns

*Table* Summary by location

# Discussion

* What is the value of identifying constrained channels?
  + Use of more data to develop context of assessment
  + Targeted management for desired outcomes
* What is useful about our approach compared to alternatives?
  + Field-based methods to identify modified channels vs. landscape modelling
  + Related directly to biological condition and regulatory standards
  + Results are widely corraborated by other landscape studies - land use is big determinant of macroinvert assemblage
* What contributed to our success in defining priorities?
  + Stakeholder involvement guided process, contributed to achieving goals
  + An interactive/iterative approach was used - we provided tools to facilitate (web apps) and we did not assume priorities
* Caveats of our aproach
  + What do priorities really mean? Depends on your interests, needs, values, etc.
  + Constrained may not always mean constrained - CSCI vs other biological indicators
  + Site-specific approaches are warranted in certain cases
  + Changing certainty or CSCI treshold - mechanistic effects and implications. Don’t cook the books.
* Future work
  + Link with engineered channels study
  + Priorities statewide, application to larger regions possible (national-scale)

# Supplement

Online application.