Stream Quality Index - Outline

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# Introduction

* State of the science for biological assessment
  + Biological indicators are common response endpoints
  + Multiple taxa can be used - macroinverts, fish, algae, etc.
  + Can trigger 303d listing
  + Many states use more than one index, questions regarding how to combine multiple response endpoints - empirically (average, separate) and in regulatory setting (one fails triggers listing, etc.)
* Biological response is a symptom not a cause
  + Biological impairments require remediation
  + Can be achieved through causal assessments to identify stressors impacting biology
  + Causal assessments are effective but labor-intensive, may require new data
  + Rapid screening tools that combine multiple lines of evidence are useful alternatives to prioritize
  + Additional challenges summmarizing complex data that describe environment, biological response
* Methods to integrate biological, chemical, and physical data are needed
  + Should leverage existing data/indices to inform causal assessments,
  + Should aggregate multiple biological indicators
  + Should do so to inform management priorities - actionable results in an accessible format
  + To date, no other studies on holistic stream health indices - currently limited to MMI (integrated index) or functional-based measures (e.g., ecosystem metabolism), i.e., how can multiple indices be simultaneously evaluated?
* The Stream Quality Index
  + This paper presents the SQI as a management tool to jointly evaluate stream quality using biological, chemical, physical data
  + The objective of the SQI is to combine multiple indices to provide actionable information that categorically describes stream quality
  + Goals - provide tiers of information (landscape to in situ), diagnostic information for prioritization
  + Uses biology as an endpoint - empirically links biology to chemical, physical stressors

# Methods

* Backround on study region, SMC program and data collected
* CSCI, ASCI as endpoints - background on both
* Physical, chemical data as stressors - types of data (eutro indicators, conductivity, PHAB, CRAM)
* Modelling approach - what is the probability of biology being impacted given observed stressors
  + Rf models to predict sites as “good”/“bad” biology as a function of chemistry, physical habitat
  + How was biology combined? BCG bins for both indicators, assigned categories based on combination of bins
  + Models produced pChem, pHab for each site, combined to overall pStress
* Model output to SQI scores
  + Defined categories based on good/bad biology, likelihood of stress (need to emphasize how breakpoints chosen)
  + Overall, Biological condition, Stress condition, Stress condition detail
* Online application
  + How to use SQI in practice

# Results

* SMC breakdown, % by catogory, watershed, etc.
* Most common stressors, should link to land use/watershed position, other covariates
* Interesting trends or sites as examples (e.g., ASCI impacted, chemistry stress vs. CSCI impacted, habitat stress)
* Odd-ball categories - Healthy and resilient, Impacted by unknown stress

# Discussion

* Value of the approach
  + Combines multiple lines of evidence to rapidly evaluate stream health
  + Actionable outcomes
  + Linked to common stressors (eutro, conductivity, physical habitat)
  + First to use RF models to combine multiple indices
  + Broad categories to site-level information provided by index, easily accessible with online app
* Drawbacks/limitations
  + Other stressors not evaluated - flow mod, contaminants, climate change
  + Other biota not considered - fish, amphibians, etc.
  + Some expert judgment for breakpoints or index combos (i.e., average BCG between indices, worse BCG, etc.), but note these were at least partically vetted through advisory committees
  + Policy needs not fully integrated because policy has yet to be cleary defined, though in progress
  + Currently does not consider flow regime (ephemeral, perennial)
  + Cursory - not as comprehensive as full-blown causal assessment but could be used to inform where its needed
* Next steps
  + Expansion of toolbox - greater spatial resolution, additional endpoints/stressors
  + Integration with other tools - SCAPE, RSCA, hydromod