Literature-based synthesis of nutrient stressor-response relationships to inform assessment, monitoring, and criteria development in rivers and streams

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• Determined by considering relevance to state monitoring and nutrient criteria development
  o Lotic systems, total nutrients, 3 biotic endpoints

• Targeted research questions:
  1. In lotic systems, what is the evidence of the relationships between water column nutrients (TN and/or TP) and:
     - chlorophyll-a?
     - diatoms?
     - macroinvertebrates?
  2. How are these relationships affected by other factors?
Approach

Problem Formulation

Specific research question

Systematic Review

Identify Evidence
- Search academic and unpublished literature
- Screen based on inclusion/exclusion criteria
- Select relevant studies

Evaluate Evidence
- Data extraction
- Quality assessment of individual studies
- Meta-analysis

Evidence Integration

Integrate Evidence
- Rate confidence in bodies of evidence
- Sensitivity analysis to determine robustness
- Develop conclusions

Adapted from Boyles et al. 2016, OHAT/NTP/NIEHS
Cause
(TN, TP)

Effect
(chl, diatoms, macros)
Data Extraction

**Study Design**

**Cause**
- (TN, TP)
- term: measure, trajectory, units, range
- mean/median, standard deviation, transformations

**Effect**
- (chl, diatoms, macros)
- term: measure, trajectory, units, range
- chl extraction & meas., mean/median, standard deviation, transformations

**Documentation**
- response measure value
- response measure type
- response form
- response equation
- transformations

**Study Design**
- CITATION ID
- AUTHOR(S)
- YEAR
- DATASET ID
- SOURCE DATA
- STUDY TYPE
- STUDY DESIGN
- SAMPLE SELECTION
- CONTROL SAMPLES
- CONTROL REPLICATES
- IMPACT SAMPLES
- IMPACT REPLICATES
Data Extraction

**Study Design**

- **Cause** (TN, TP)
- **Effect** (*chl, diatoms, macros*)

**In-stream factors**
- pH
- sediment load
- suspended sediment
- temperature
- alkalinity
- discharge
- flow permanence
- velocity

**Regional/landscape factors**
- light
- canopy cover
- conductivity
- elevation
- habitat
- dominant substrata
- channel width
- DOC
- water depth
- climate
- dominant land use
- latitude/longitude
- stream order
- watershed area
- ecoregion

**Other context**
- state/province
- country
- sample year
- sample month
- temporal extent
- spatial extent

**Modifying/confounding factors**
- sample year
- sample month
- latitude/longitude
- dominant land use
- climate
- channel width
- DOC
- water depth

**Transformations**
- chl extraction & meas.

**Measure**
- response measure value
- response measure type
- documentation
- response equation
- response form

**Measure detail**
- chl extraction & meas.

**Trajectory**
- term
- measure
- units
- range
- mean/median
- standard deviation

**Units**
- term
- measure
- trajectory
- units
- range
- mean/median
- standard deviation

**Range**
- mean/median
- standard deviation

**Response form**
- response measure value
- response measure type
- documentation
- response equation
- response form

**Response equation**
- response measure value
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Results*: Overview

• TP had most relationships (almost double TN)

• Studies cover broad range of nutrient conditions
  
  o Mean TN ranged 0 – 16 mg/L (max 0.1 – 2654 mg/L)
  
  o Mean TP ranged 0 - 67 mg/L (max 0.04 – 163 mg/L)

*based on ~150 papers extracted
  (>2,200 cause-effect pairs)
Chl-a

- Diatoms: 1,493 total
  - Alaska: 1
  - Hawaii: 0

Macroinvertebrates

- Alaska: 8
- Hawaii: 0

- Total: 621

Diatoms

- Alaska: 0
- Hawaii: 0

- Total: 450

*based on ~150 papers extracted (>2,200 cause-effect pairs)
*based on ~150 papers extracted (>2,200 cause-effect pairs, excluding non-reported items)
**Total Phosphorus**

- **Macroinvertebrates**
- **Diatoms**
- **Chlorophyll a**

**Total Nitrogen**

- **Macroinvertebrates**
- **Diatoms**
- **Chlorophyll a**

*based on ~150 papers extracted (>2,200 cause-effect pairs, excluding non-reported items)*
Questions for you

• Are these relationships (TN, TP vs. chl a, diatoms, macroinvertebrates) the most relevant for you?

• What “other” variables are you most interested in?

• What is the most useful way to make our extracted evidence available to you?
  - Accessing the evidence (e.g., via portals, spreadsheets)
  - Filtering the evidence (e.g., geographically, taxonomically)