A Review of Setting Appropriate Reach Length for Biological Assessment of Boatable Rivers

Biological Assessment of Boatable Rivers

• Critical issues: target reach length
• Define data quality objective
  – Reach length should enhance capacity to meet
  – But consider potential secondary uses
• Reach length decision often may be made with insufficient information
Ideally.....

- The effort applied is the minimum that will allow the stated objectives to be addressed
- Question will influence the sampling effort required

\[
\text{Species' Relative Abundance} < \text{Absolute Number of Species}
\]

- Implications for biological assessment programs...

Efficient Sampling Protocols → Potential Cost Savings → Enhance other aspects of study design
What is a reach?

- A length of stream between breaks
  - channel slope
  - local side-slopes
  - valley floor width
  - riparian vegetation
  - and bank material (Frissell et al. 1986)
- Least physically discrete unit in a hierarchical context
- Exceedingly useful scale for describing medium- and long-term effects of human activities on streams
- Bioassessment context – used to describe the area of a fluvial system that samples are collected or other measurements are taken
  - Linear systems – it is quantified as some channel length
Reach Length in Boatable Rivers

- Long reaches (e.g., multiple kilometers)
  - **Advantages**
    - Good for describing the mean condition of a large river section
    - Minimize the influence of
      - Small scale natural conditions
      - Localized impairments
  - **Disadvantages**
    - May mask small scale habitat conditions and impairments.
    - Decreased sensitivity of indicators to detect linkages between
      - Local river conditions
      - Drivers of condition
      - High level of effort
Reach Length in Boatable Rivers (cont.)

- Short reaches (e.g., < 1 kilometer)
  - **Advantages**
    - Sensitive to small scale habitat conditions and impairments.
    - Increased sensitivity of indicators to detect linkages between
      - Local river conditions
      - Drivers of condition
      - Reduced level of effort
  - **Disadvantages**
    - May not be good for describing the mean condition of a large river section
    - May be too sensitive to
      - Small scale conditions
      - Localized impairments
Approaches used for setting reach length

- Best professional judgment
- Past history
- Management objectives
- Response of biological parameters
- Geomorphology (independent of biology)
Setting reach length using biological information

*(Response of Biological Parameters)*

- **Rationale**
  - Aquatic biota as indicators

- **Approach**
  - Over-sampling at series of sites
    - Cover the gradient of conditions
    - Determine reach length when required data quality has been achieved
      - Reach indicator asymptote
      - Level of variability (similarity)
Approaches used for setting reach length
Biological: Framing the reach length based on data

Option 1: Fixed length (Examples: 500m)

• Advantages/Proponents
  – Ease of application
  – Utility in planning

• Disadvantages/Opponents
  – Unequal sampling effort relative to river size
  – May not encompass a sufficient number of habitats
    • Difference detected may be due to habitat differences
    • Could partition out habitats
Approaches used for setting reach length

Biological: Framing the reach length based on data

Option 2: Multiples of the Wetted Width (40X)

• **Advantages/Proponents**
  – As a system gets bigger, habitat units get bigger
  – Effort should increase proportionally

• **Disadvantages/Opponents**
  – Differing amounts of effort are being applied across sites
  – Difficult to apply on impounded systems
Approaches used for setting reach length: Biological Examples…

- Hughes et al. 2002
  - Sampled 45 raftable Oregon rivers reaches for an entire day
  - 85X MWW to collect 95% of the species collected in 100 MWW or 8 hours
  - Collection of all species → 300X MMW on average

- Hughes and Herlihy 2007
  - Sampled 45 raftable Oregon river reaches for an entire day (1-d)
  - 50X MWW, or a catch of more than 120 individuals, produced IBI score that varied <10% of 1-d sample

- Flotemersch and Blocksom 2005
  - Sampled 60 boatable Mid-Western rivers
  - 1 km total shoreline shocked was sufficient for limiting the change in metric scores to 20%
Approaches used for setting reach length

Biological Examples...

- Comparison of 3 studies
  - Began with different reference conditions (100 channel widths vs 2km)
  - different maximum distances (100 channel widths vs 2 km)
  - different values for acceptable variability (5, 10, and 20%)
  - produced 3 different results

- The question(s) being asked and the data quality needs should drive the selection of reach length.

- Issue to consider: How much weight should be placed on secondary uses of data?
Approaches used for setting reach length independent of biology (Geomorphology)

Meander cycles...

- Uses geomorphology of the system
- Origins in work by Leopold et al. (1964)
  - In meandering streams $20 \times MWW = \text{one complete meander}$
    - Fluvial characteristics are repetitive and cyclical
    - Should theoretically include all major habitats types
    - By default, include all resident biota
- Problematic in altered systems - can’t identify meander
  - Highlights value that one meander roughly $= 20 \times MWW$
Approaches used for setting reach length independent of biology

Meander cycles…

Example:

- USGS-NAWQA
  - 20x wetted width (1 meander)
  - Minimum 500m
    - Ensure representativeness of biological data
  - Maximum of 1000m
    - To minimize crew fatigue
  - Used for all indicators
What’s the Correct Answer?

- No single design strategy will allow all research and applied questions to be addressed
- Appropriate reach length…

Intensity of data collection for a particular sampling event

Number of times that sampling can occur

Data quality requirements

Current and projected resource availability
When selecting a reach length, or conducting research for setting reach length…

- Consider…
  - The question being addressed
  - The level of resolution required
    - Precision
    - Accuracy
  - The statistical approach
- Ensure that the reach length is balanced with
  - Available resources
  - Logistical constraints
  - Safety issues
Consider Novel Designs...

• Split-scale design
  – Long sampling reach - estimate broader-scale characteristics
  – Split into several small sub-reaches
    • Generate multiple data points
    • Determine conditions at a smaller scale
    • Estimating spatial variability within the larger scale
    • Reduce minimize risk of crew fatigue
    • Permit use of multiple crews.
Consider Novel Designs...

- 40X-80X
  - In West → response is documented
  - In East → results in too many fish to be feasible
- Option – distribute effort

- Time
- Sample size
Research Needs…

• Boatable rivers (Large and great rivers)
  – Efforts to account for, or partition habitat variability that longer reach lengths seek to encompass
  • Logistically feasible reach lengths
  • Increase the ability to detect habitat specific influences potentially masked by a designs that composites across habitats
What is the minimum significant (p<0.1) change in IBI at a site I can detect 90% of the time for different sample sizes?
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Questions?