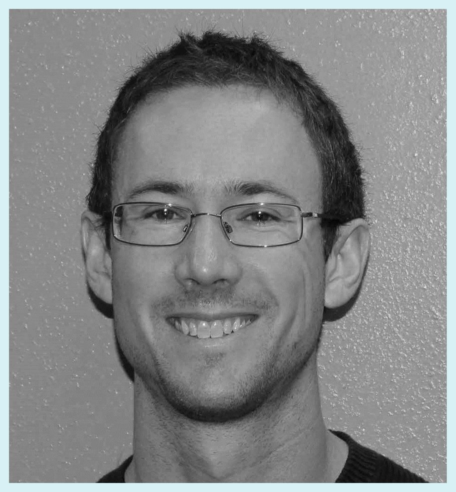
VARIABILITY IN ANALYTICAL APPROACH AFFECTS ACCURACY AND COMPARABILITY OF LANDSCAPE-SCALE AQUATIC ASSESSMENTS

Christian Perry [1], Scott Miller [1,2], and Chuck Hawkins [1,3,4]
[1] Department of Watershed Sciences, Utah State University, [2] BLM/USU National Aquatic Monitoring Center,
[3] Western Center for Monitoring and Assessment of Freshwater Ecosystems, [4] Ecology Center



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Take Home Points

- Data aggregation strategy influences catchment condition scores.
- Managers should be cautious about comparing catchment scores aggregated by different methods.
- To date, there is no agreed upon standard approach to region-wide assessments (RAs), which confounds comparisons among regional assessments.

Problem

- Effective management of aquatic resources requires knowledge of catchment and water body conditions.
- Chemical, physical, and biological data are not available for all stream reaches or other waterbodies.
- Resource managers increasingly depend upon RAs that use catchment-level, GIS-derived surrogates for instream or riparian conditions to inform management practices.
- Lack of a standard, validated approach may affect accuracy and comparability of RAs.

Research Questions

- Do the specific objectives of the RA affect condition scores?
- Does the selection of specific data inputs affect scoring?
- Does the method used to aggregate indicators make a difference?

Methods

1. Reviewed 24 RAs.
2. Listed ways in which assessment objectives, inputs, and methods differ.
3. Determine if differences affect scoring outcomes and RA comparability.

Results

Approaches differed in 3 ways:

1. Scope / Objectives
- RAs targeted condition and vulnerability.
- Geographic extent varied from stream reach to global.

2. Data Inputs
- With few exceptions, most RAs included similar inputs.
- Most data inputs could be placed into 1 of 5 categories: corridor connectivity, land use context, hydrologic regime, water quality, and biotic measures.

3. Approaches to Data Aggregation
- Used either expert opinion or literature sources to establish scoring thresholds and condition categories.
- Scoring methods included fuzzy logic, pre-established rulesets, and presence/absence of threats.
- Most treated each catchment independently, but one allowed threat scores to accumulate downstream.

Case Study: Colorado Plateau Ecoregion

- Three aquatic assessments were conducted recently in the Colorado Plateau Ecoregion that targeted similar endpoints (Figure 1, Table 1).
  1. BLM – Rapid Ecoregion Assessment (BLM-REA)
     Endpoint: Aquatic intactness; score range: -1 to +1.
  2. Trout Unlimited – Conservation Success Index (TU-CSI)
     Endpoint: Habitat condition for wild trout; score range:10-50.
  3. Whittier and Sievert 2014 – Anthropogenic Threat Index (ATI)
     Endpoint: Threats to fish persistence; score range: 0 to 1.
- All approaches aggregated geospatial indicators relevant to aquatic ecosystem condition into categories and assigned total scores to catchments.

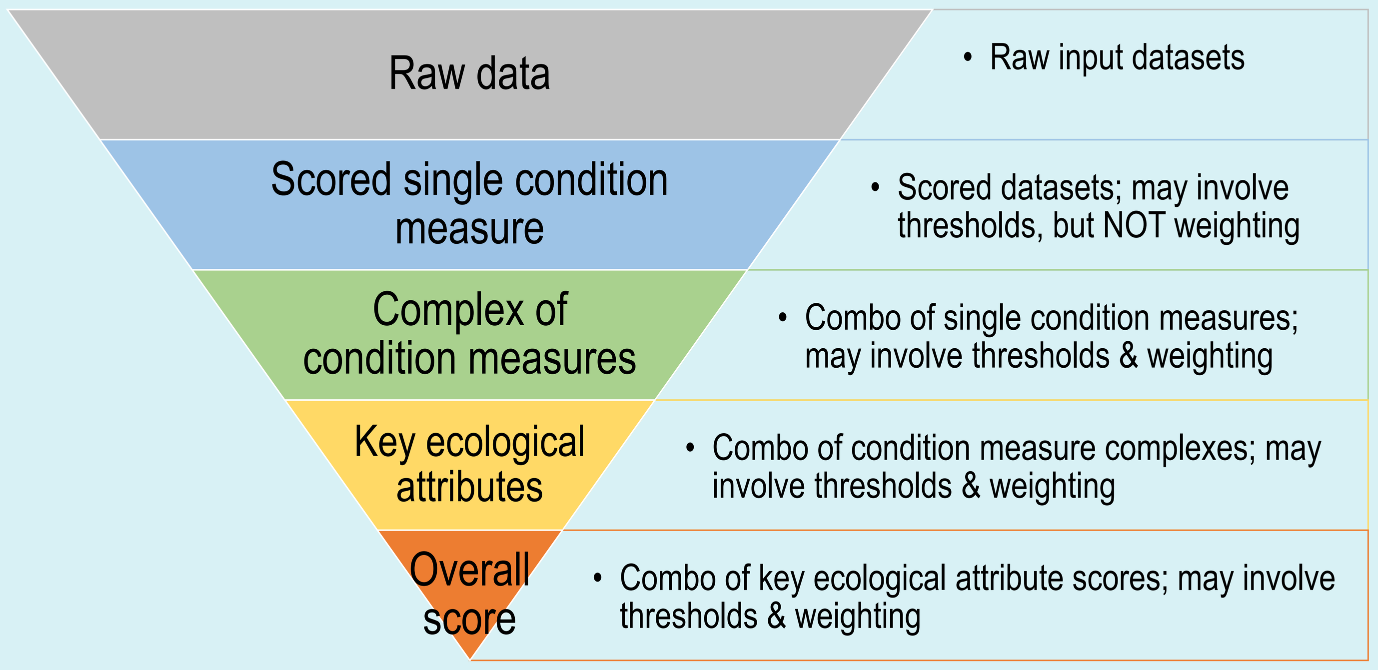

Figure 1: Raw input datasets are scored as single condition measures, then aggregated into complexes of condition measures, key ecological attributes, and finally, overall catchment scores.

Table 1: Level-specific scoring and aggregation differences among three RAs.

	BLM-REA	TU-CSI	ATI
	Scored single condition measure		
Scoring / Aggregation Method:	Iterative adjust. following expert consult.	Pre-established tables	Presence / Absence
Example	% Agriculture	% Agriculture	Agriculture
Range	(-1, +1)	Varies	Absent, Present
	Complex of condition measure		
Scoring / Aggregation Method:	Array of weighting operators	Pre-established tables	N/A
Example	Salinity	Water Quality	N/A
Range	(-1, +1)	(1, 5)	N/A
	Key ecological attribute		
Scoring / Aggregation Method:	Array of weighting operators	Addition	N/A
Example	Water Quality	Habitat Integrity	N/A
Range	(-1, +1)	(5, 25)	N/A
	Overall catchment score		
Scoring / Aggregation Method:	Array of weighting operators	Addition	Addition: (# of all threats upstream)
Example	Aquatic Intactness	CSI Total Score	Total # of Threats
Range	(-1, +1)	(10, 50)	(0, 11)

Case Study Methods

1. Roll up ATI scores to HUC12 polygons (catchments) to match the other approaches.
2. Rescale BLM-REA and TU-CSI scores between 0 and 1: $\left[\frac{(score-min)}{(max-min)}\right]$.
3. Compute mean and SD of catchment scores.
4. Calculate pairwise differences between approaches in catchment scores and map differences.
5. For each difference map, calculate % of catchments where the subtrahend (the approach that is subtracted) is greater than the minuend (the approach from which the other approach is subtracted) and compute mean difference in catchment scores.
6. Determine which indicators and decisions had greatest influence on final scores.

Case Study Results and Interpretation

- The approaches varied considerably in the rescaled scores calculated for each catchment (Figure 2).
  - TU-CSI > BLM-REA in 83% of catchments (Figure 3a); mean = -0.20.
  - ATI > BLM-REA in 93% of catchments (Figure 3b); mean = -0.32.
  - ATI >TU-CSI in 75% of catchments (Figure3c); mean = +0.12.
- The BLM-REA strategy allowed individual indicators with poor scores to override multiple higher-scoring indicators (e.g., 'if one fails, the whole catchment fails').
- The TU-CSI strategy was additive, thus limiting the influence of any single stressor.
- The ATI strategy allowed threat scores to accumulate to downstream catchments. Threats present in any upstream catchment, regardless of density or coverage, contributed to ATI scores.

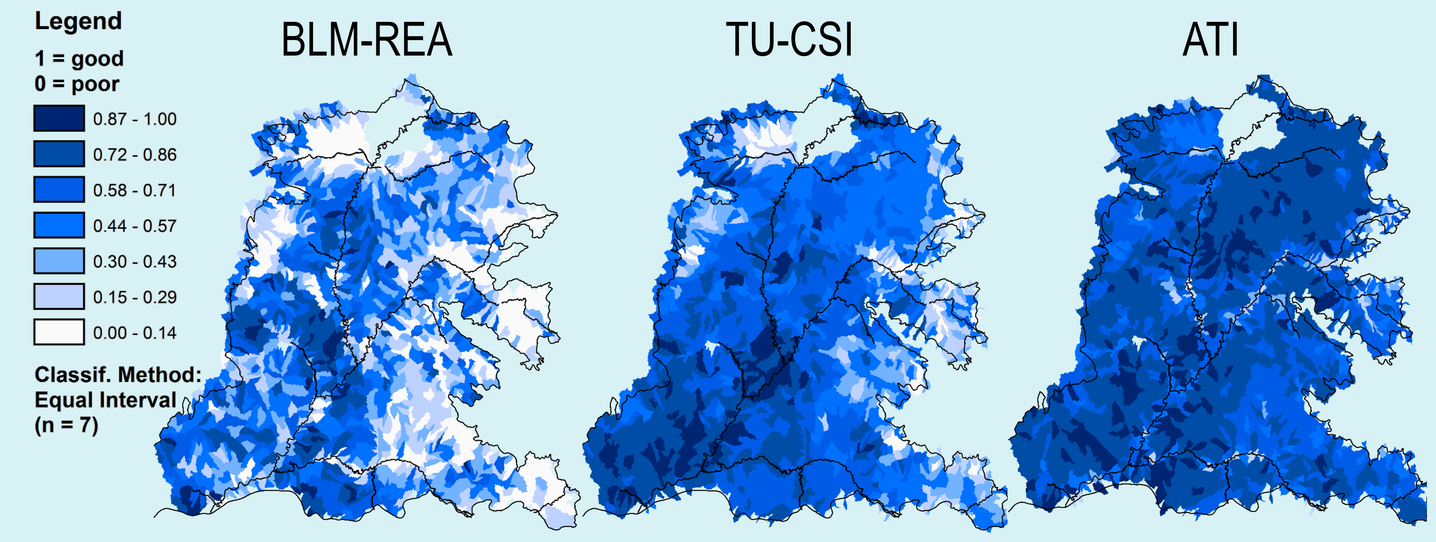

Figure 2: Equal-interval distribution of catchment scores across three region-wide assessments of aquatic condition. (Mean ± SD: BLM-REA = 0.41 ± 0.25, TU-CSI = 0.61 ± 0.21, ATI = 0.72 ± 0.14)

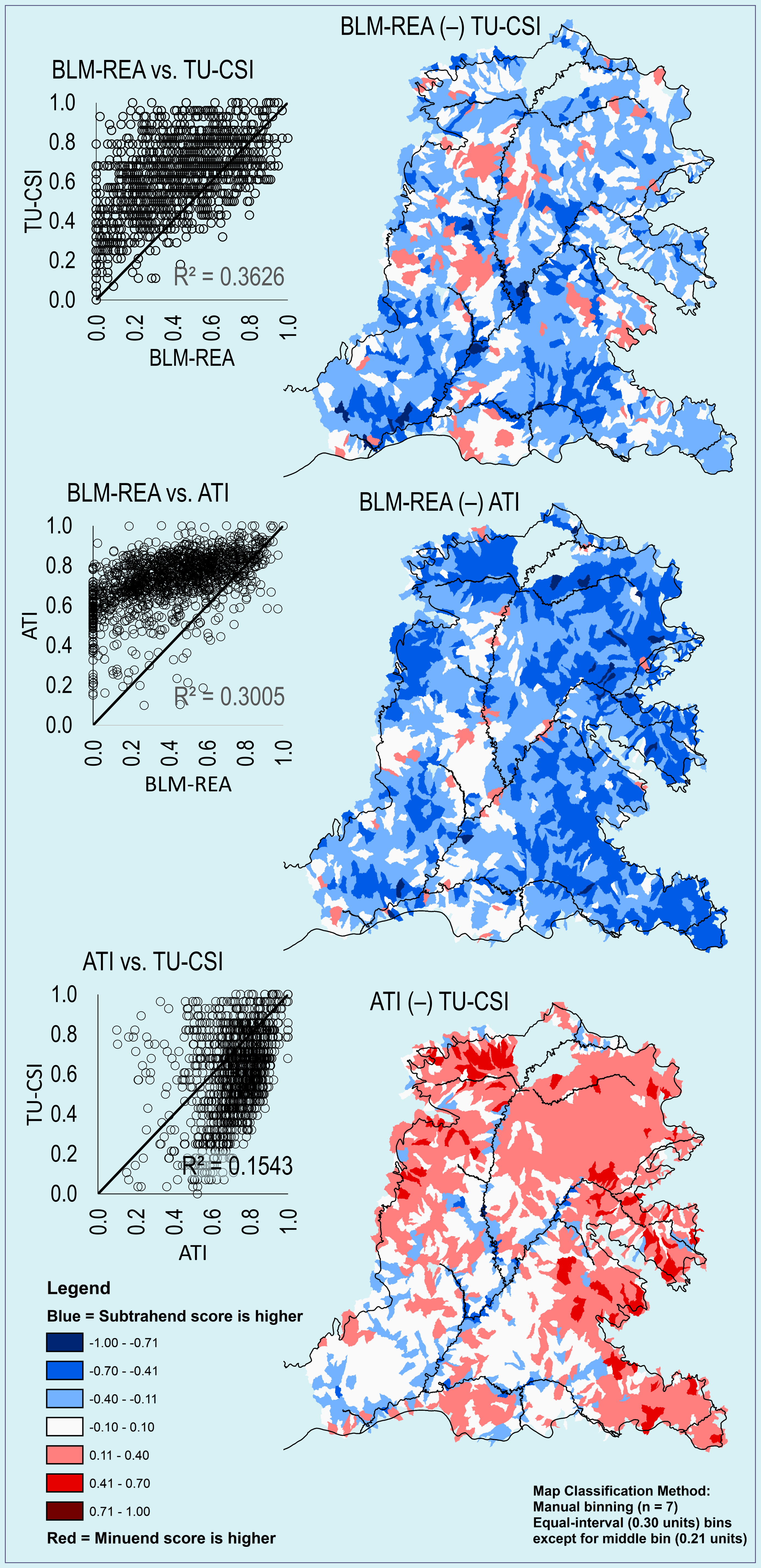

Figure 3: Difference maps among three region-wide assessments of aquatic condition.