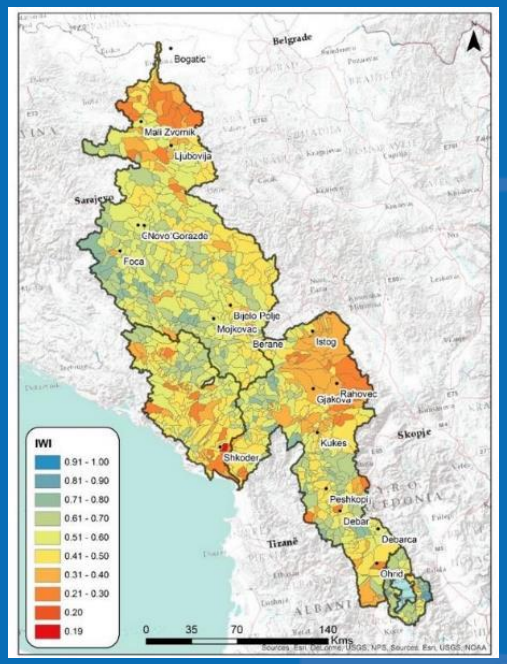
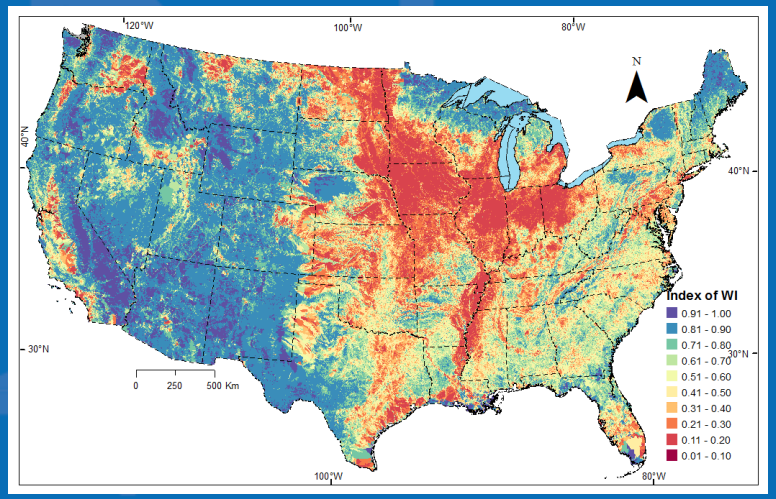
Trans-scale Communication in Large-Scale Watershed Management

Joseph Flotemersch
U.S. Environmental Protection Agency



TE AWA O WAIKATO
RIVER SYMPOSIUM



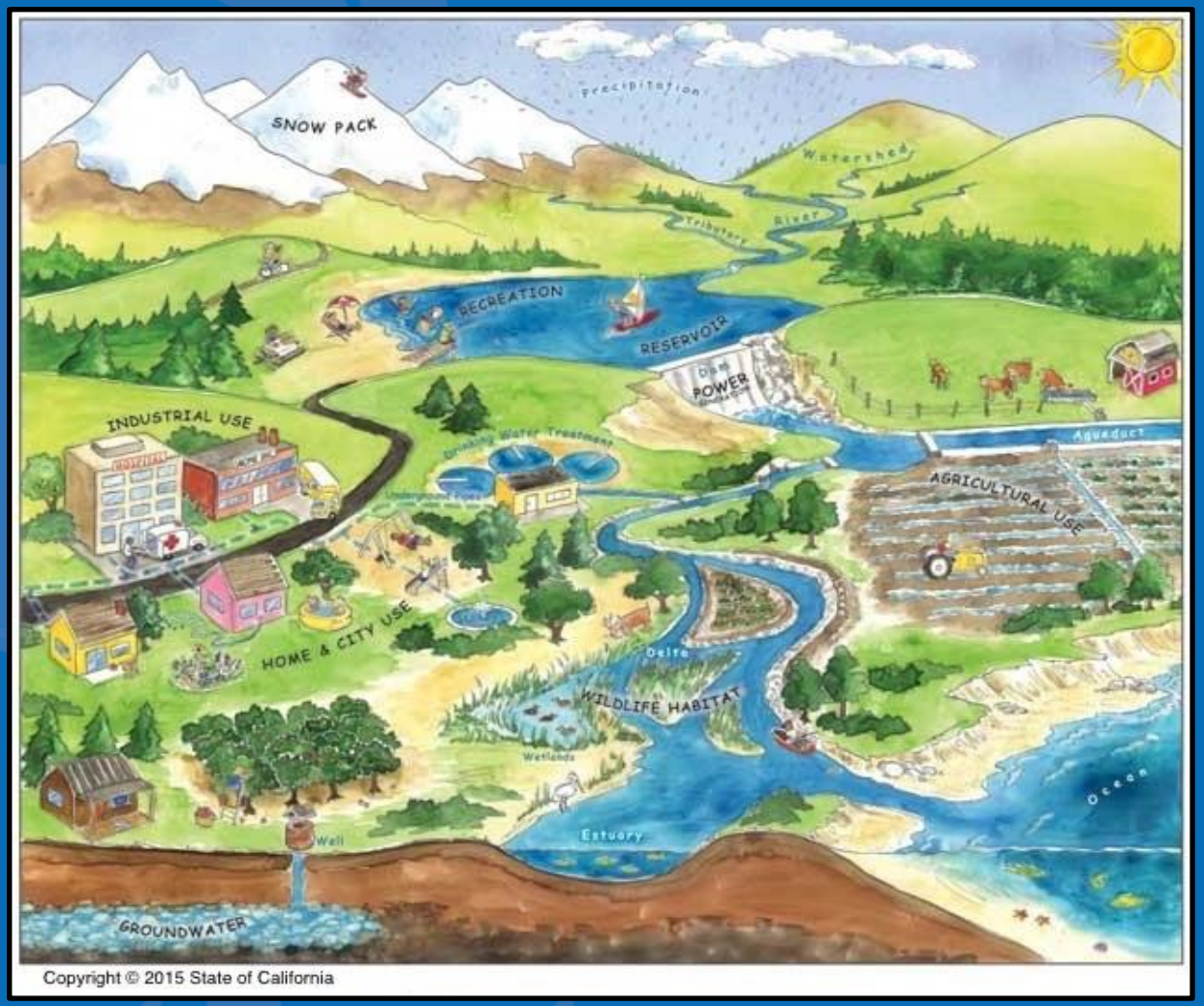
28 - 29 November 2023
HopuHopu, Ngāruawāhia, New Zealand

Office of Research and Development
Center for Environmental Measurement and Modeling

Watersheds are longitudinally-connected ecosystems

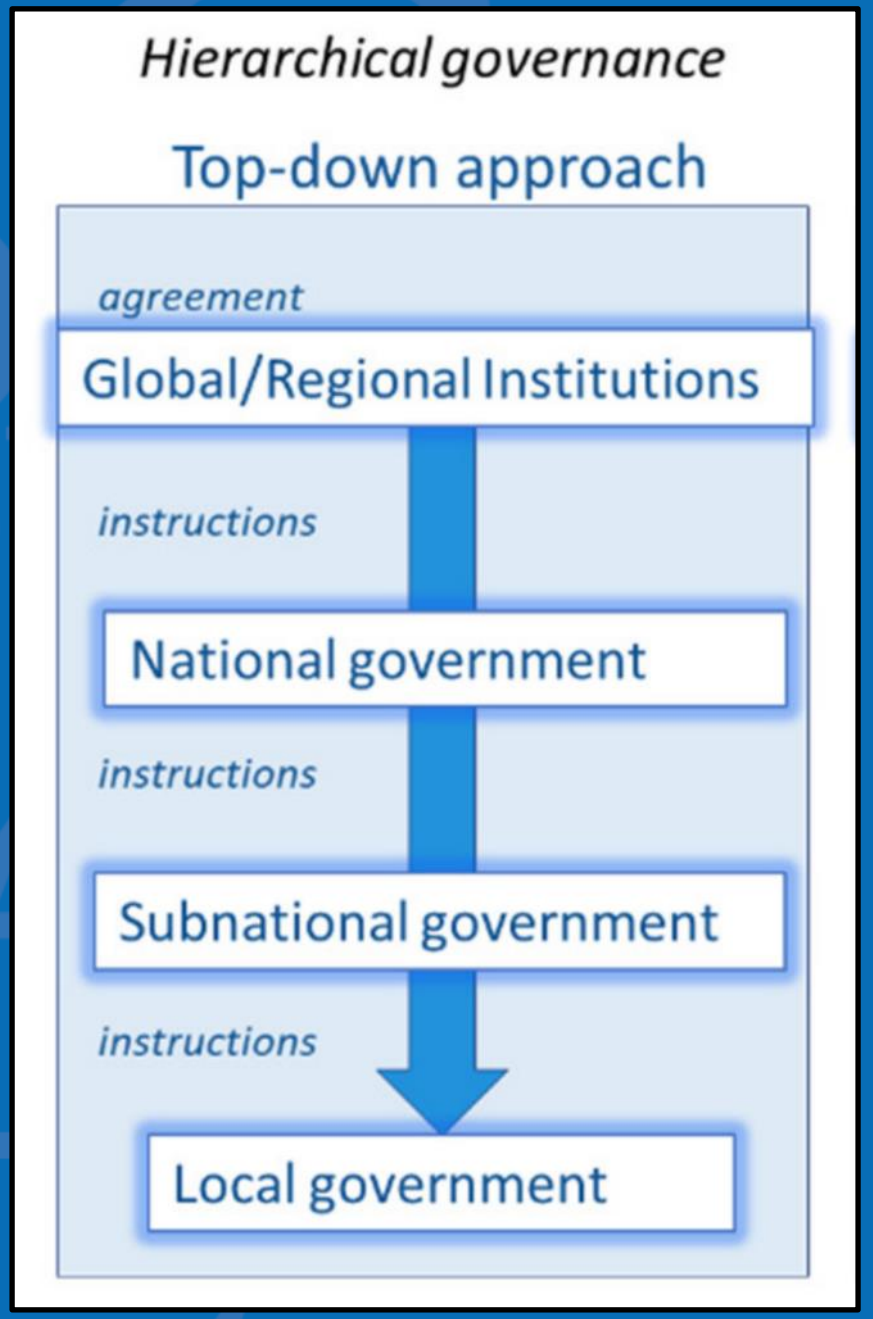
EPA United States Environmental Protection Agency

- Spatially explicit landscape unit
- Contains a range of interacting physical, ecological and social attributes (social-ecological system)
- Provide a range of ecosystem services valued by society
- Ability to provide these services depends on the degree to which they are impaired by human-related activities



EPA United States Environmental Protection Agency

Governance is generally hierarchical



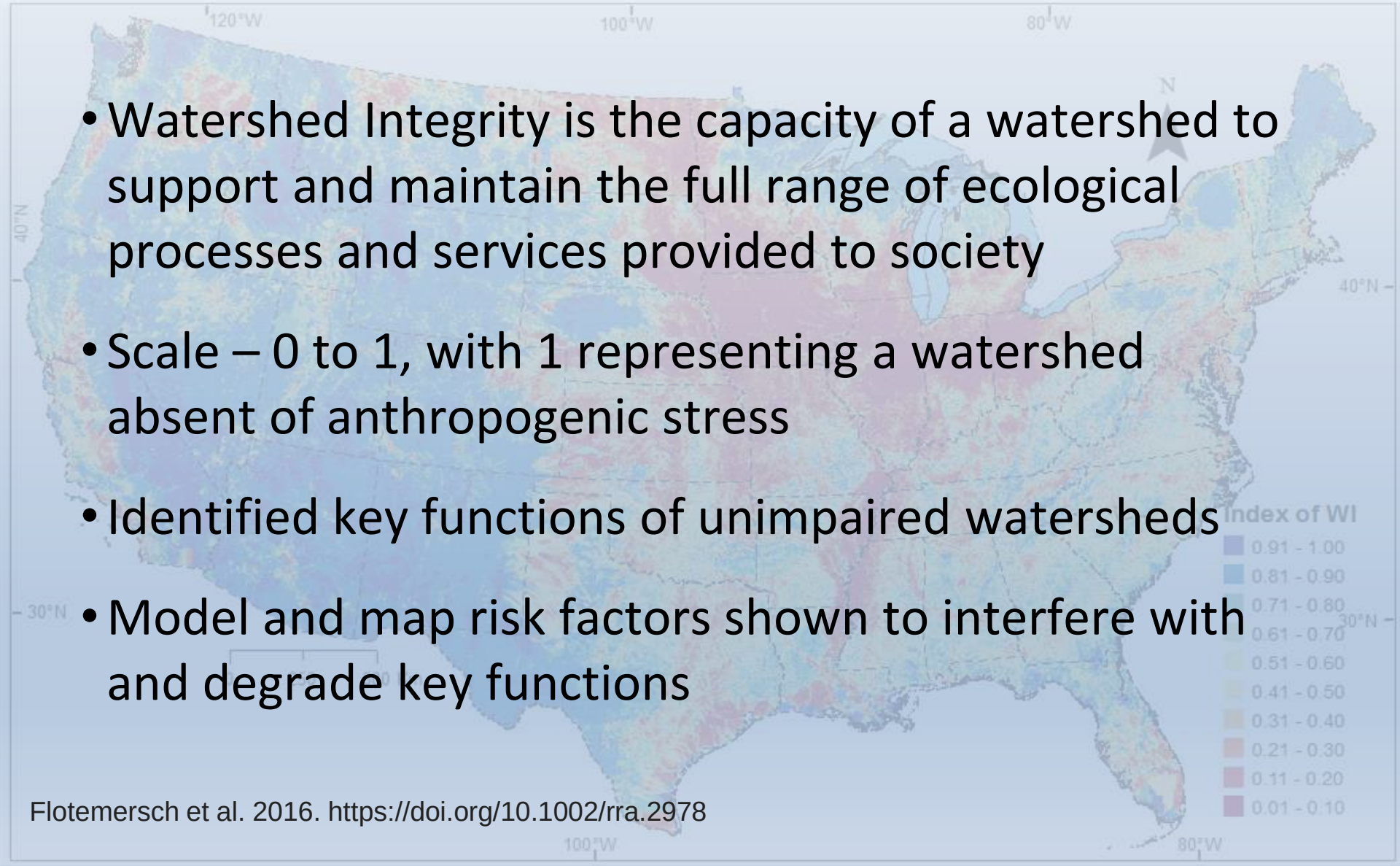
Meuleman 2021 doi.org/10.3390/su13115914

EPA United States Environmental Protection Agency

Efficient basin-scale management requires effective Trans-scale Communication and Management

Communication that facilitates understanding, thinking, and collaborative management across political, geographic, cultural, and conceptual boundaries

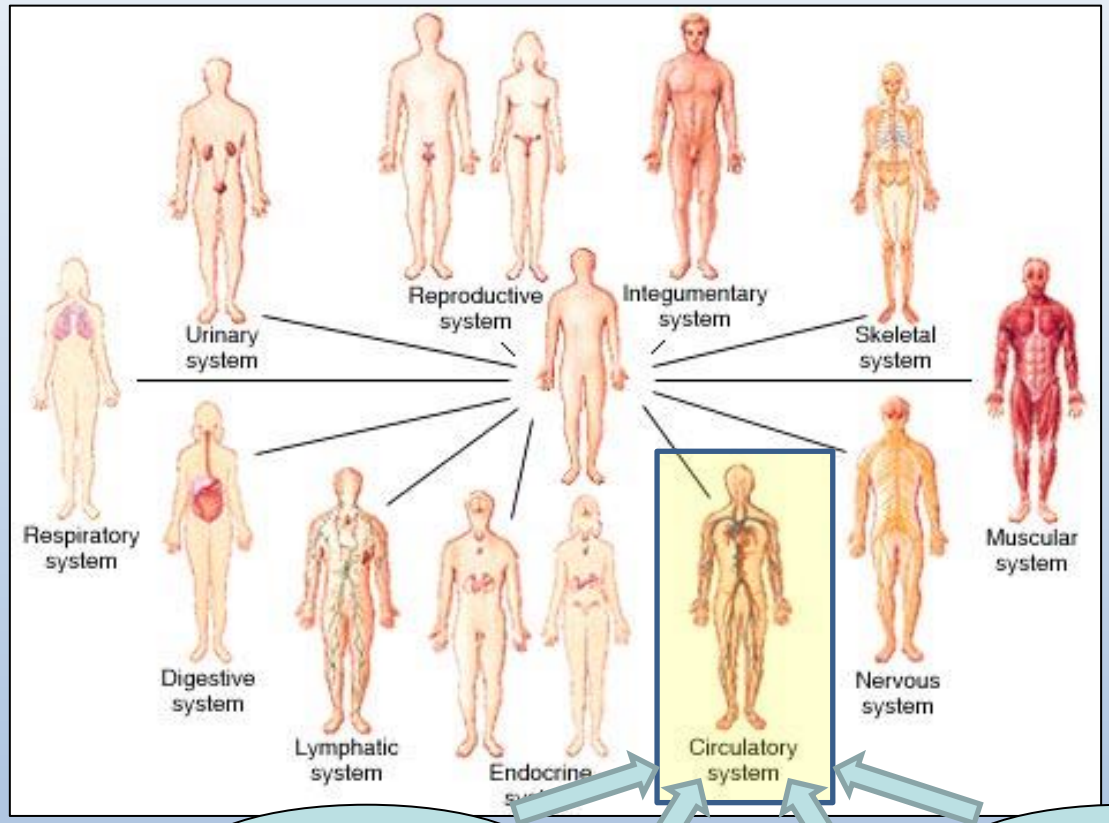
Index of Watershed Integrity



- Watershed Integrity is the capacity of a watershed to support and maintain the full range of ecological processes and services provided to society
- Scale – 0 to 1, with 1 representing a watershed absent of anthropogenic stress
- Identified key functions of unimpaired watersheds
- Model and map risk factors shown to interfere with and degrade key functions

Flotemersch et al. 2016. https://doi.org/10.1002/rra.2978

Human Health Analogy



http://www.stockphotos.sk/image.php?img_id=17762910&img_type=1

Physical activity

Diet

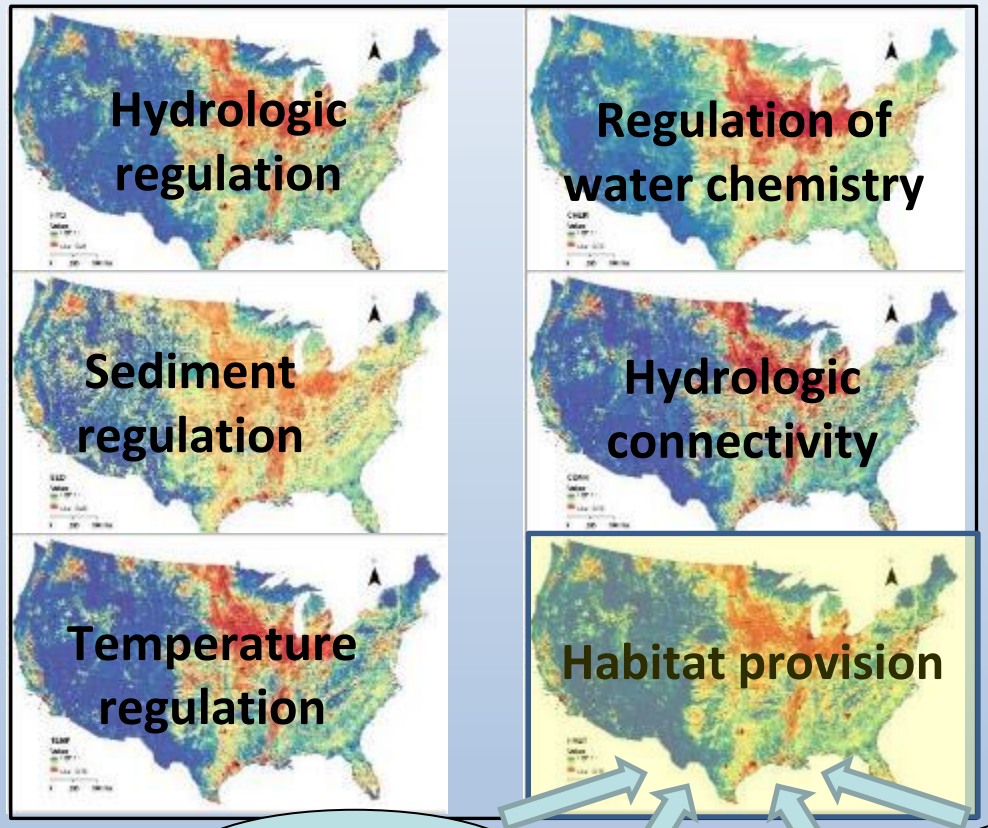
Each system would form a 'layer' in our overall assessment of the integrity of [illegible]ealth

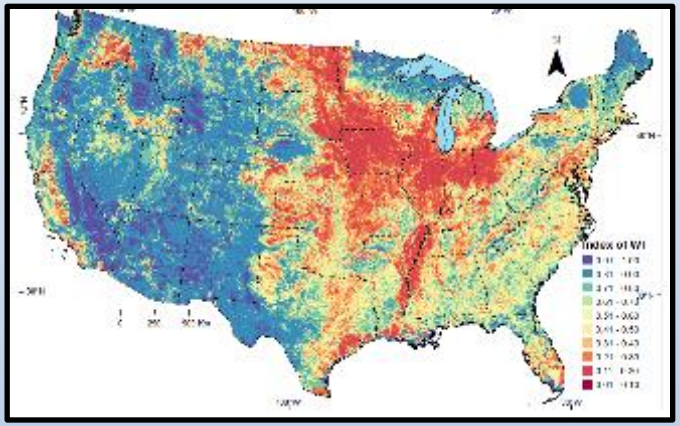
Risk Factors

Obesity

Family history

Watershed Integrity





Thornbrugh et al. 2018. EI

Watershed Integrity

Physical activity

Diet

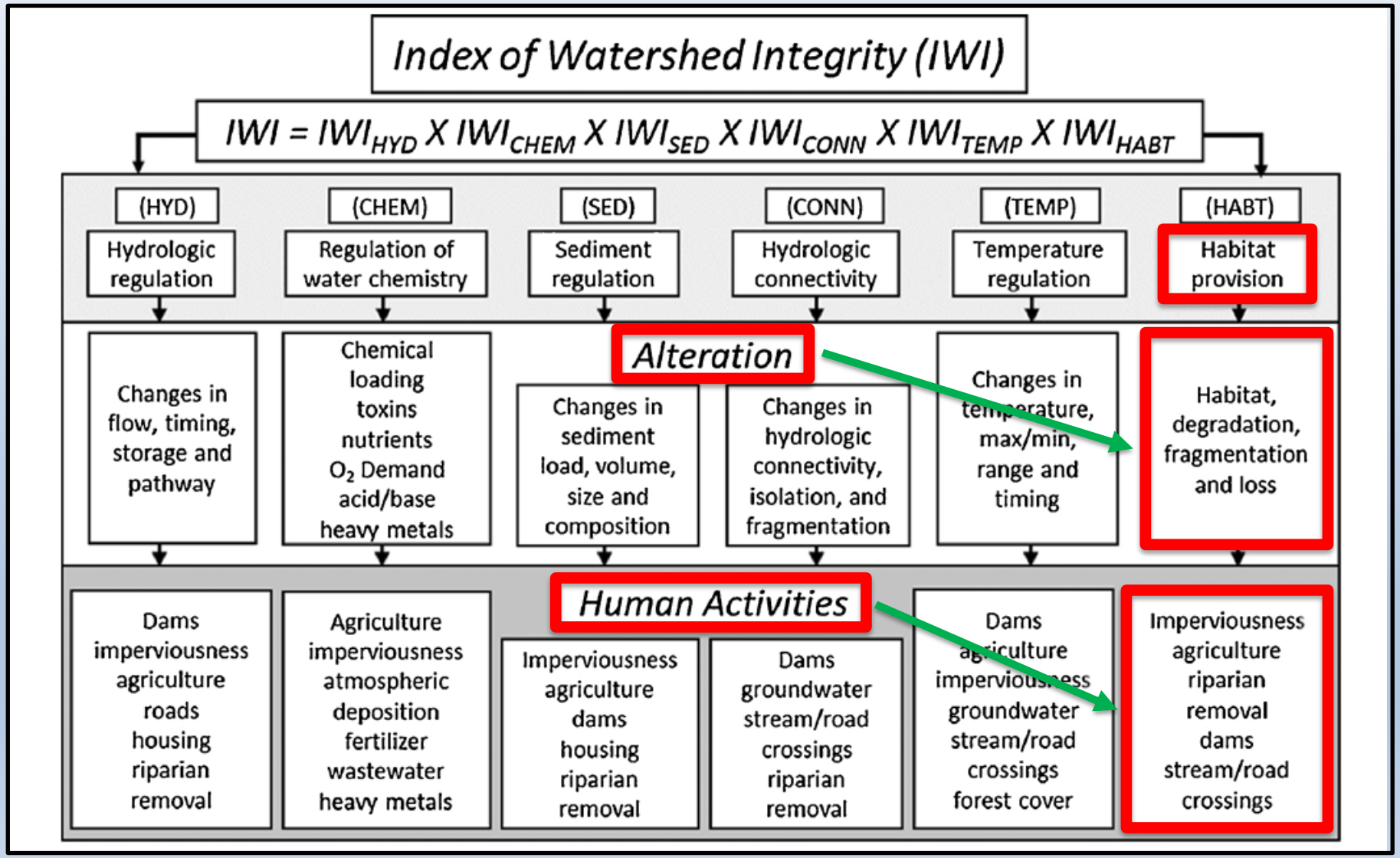
Six key functions must be present for a watershed to ha[illegible] (Flote[illegible]. 2015)

Risk Factors

Obesity

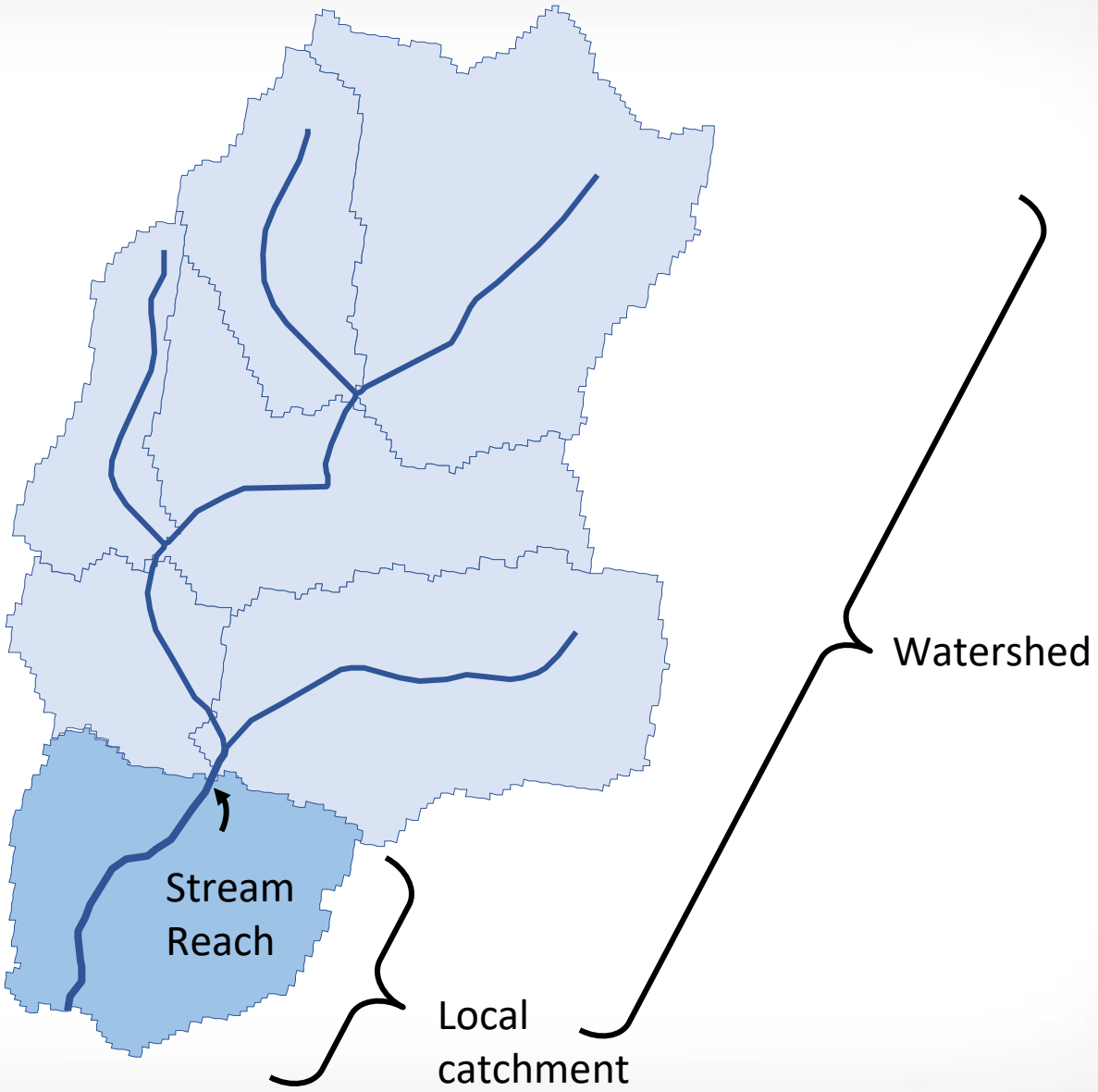
Family history

Model Development



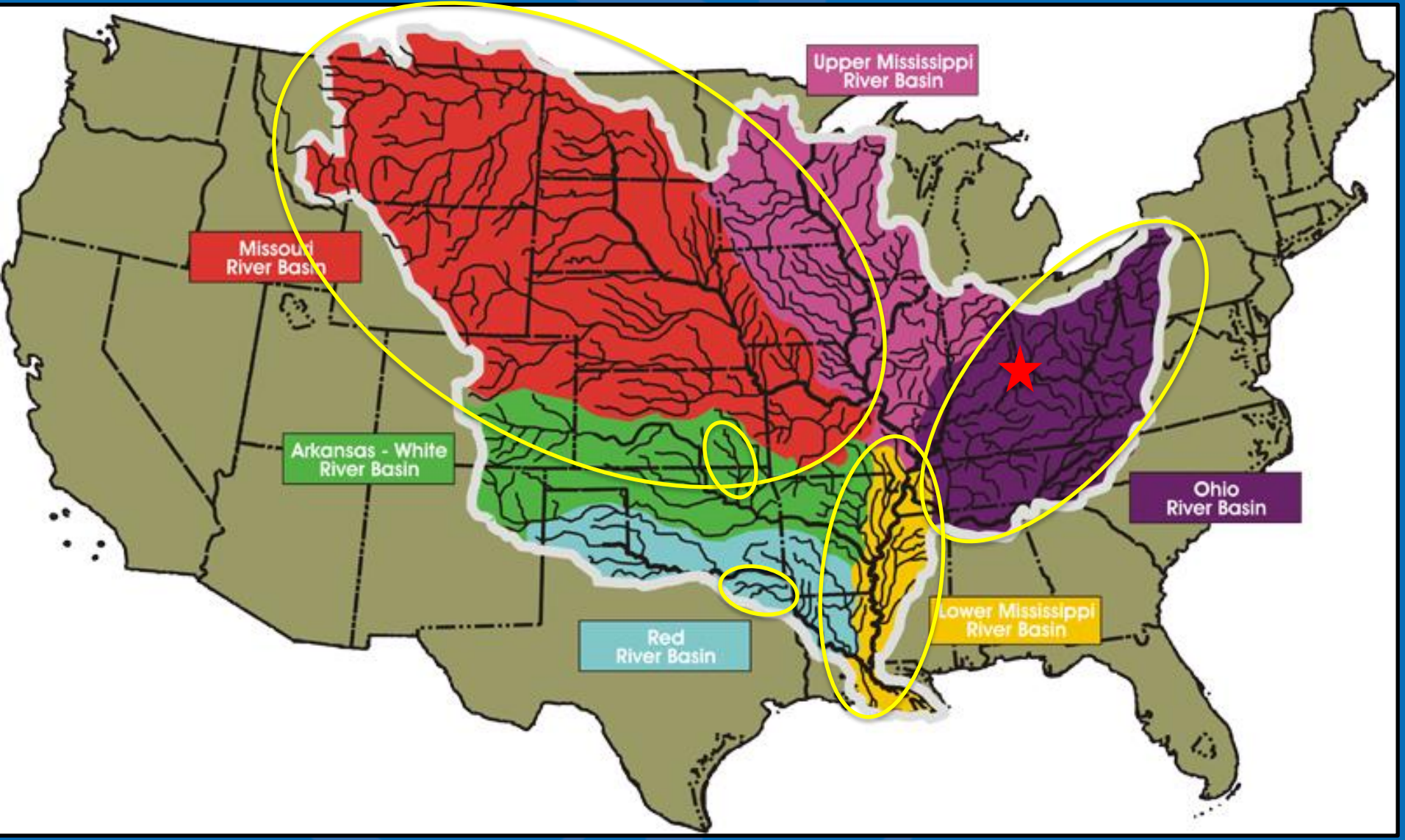
Watershed Integrity =

Hydrology	Chemistry	Sediment	Connectivity	Temperature	Habitat
Surface area of reservoirs	Surface area of reservoirs	Surface area of reservoirs	Surface area of reservoirs	Surface area of reservoirs	Surface area of reservoirs
Stream channelization and levee construction (NA)	Stream channelization and levee construction (NA)	Stream channelization and levee construction (NA)	Stream channelization and levee construction (NA)	Percent of invasive species within riparian vegetation	Percent of invasive species within riparian vegetation
Percent of the watershed comprising agricultural land use	Atmospheric deposition of anthropogenic sources of NH_4 and NO_3	Percent of invasive species within riparian vegetation	Percent of invasive species within riparian vegetation	Percent of watershed composed of agricultural land uses	Density of housing units within the riparian zone
Percent imperviousness of catchment	Percent of watershed composed of urban land uses	Density of industrial facilities	Presence and density of wastewater discharge sites	Percent of watershed composed of urban land uses in the riparian zone (NLCD)	Percent of watershed composed of agricultural land uses
Percent of invasive species within riparian vegetation	Percent of watershed composed of agricultural land uses	Presence and density of wastewater discharge sites	Percent or riparian zone composed of urban land uses	Density of wastewater discharge sites	Density of road/stream intersections
Boundaries, depths, and flows of aquifers (NA)	Fertilizer application rates	Density of mines	Percent of riparian zone compose of agricultural land uses	Groundwater use (NA)	Density of roads within the riparian zone
Total length and density of canals/ditches (NA)	Density of Industrial facilities	Density of roads	Density of ditches/canals (NA)		
Groundwater use (NA)	Presence and density of urban wastewater discharge sites	Soil erodibility	Groundwater use (NA)		
	Density of mines				
	Cattle Density				
	Percent of invasive species within riparian vegetation				
	Chemical constituents of groundwater (NA)				


Stream
Reach
Local
catchment
Watershed

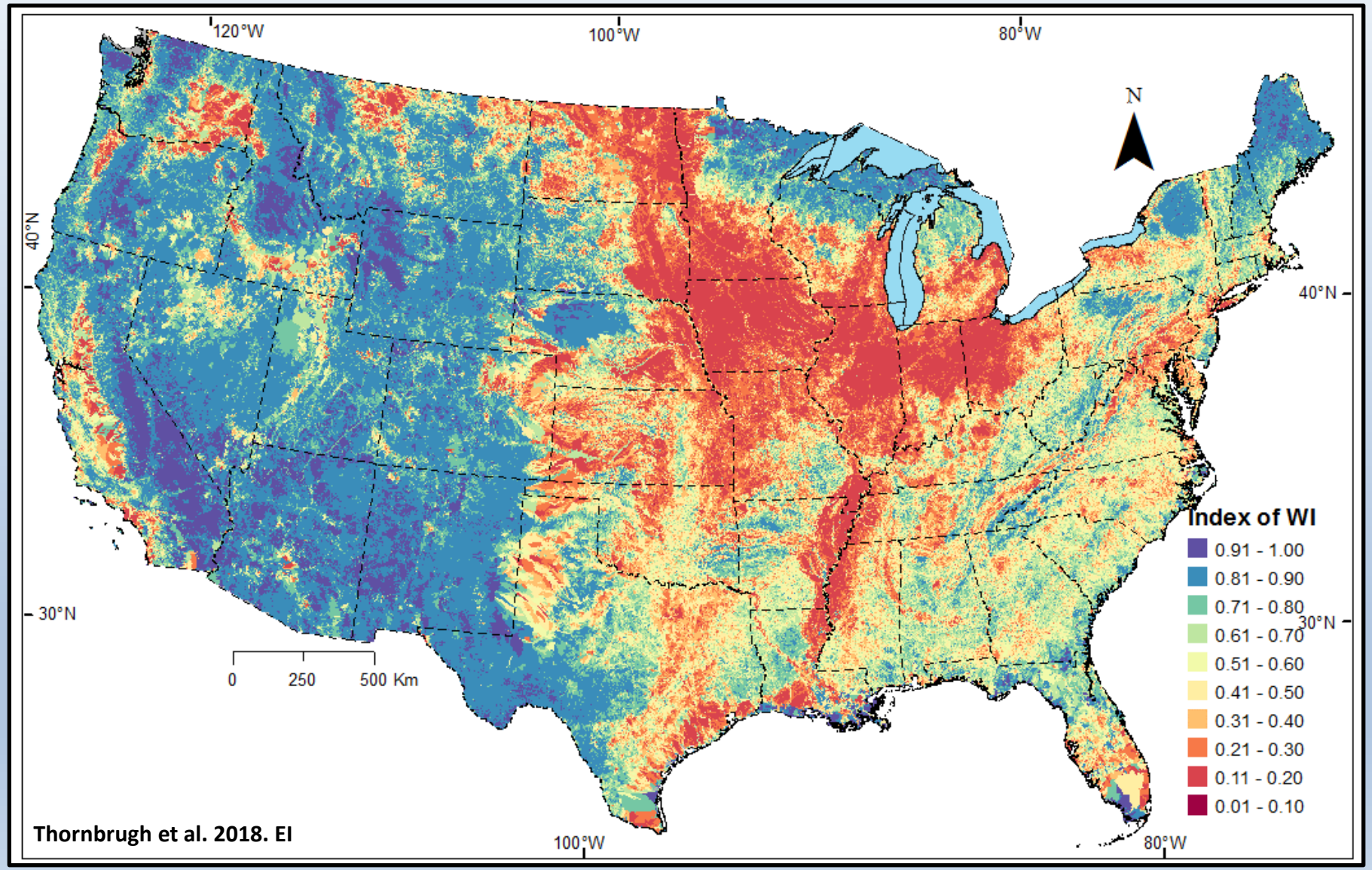
Mississippi River Basin Watershed

United States Environmental Protection Agency

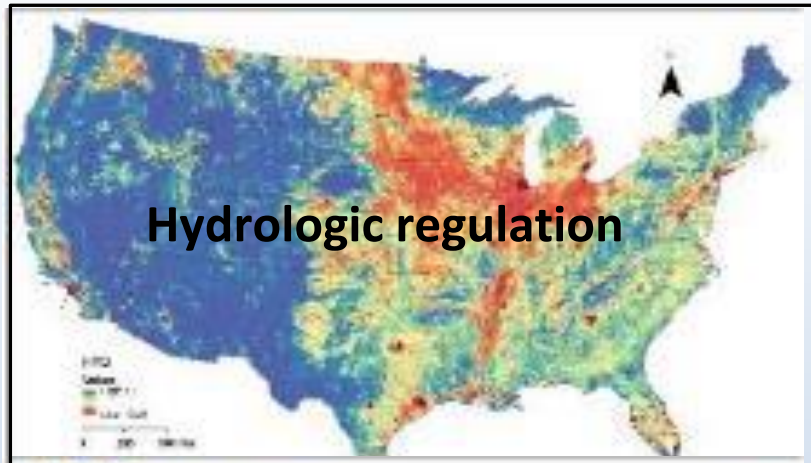


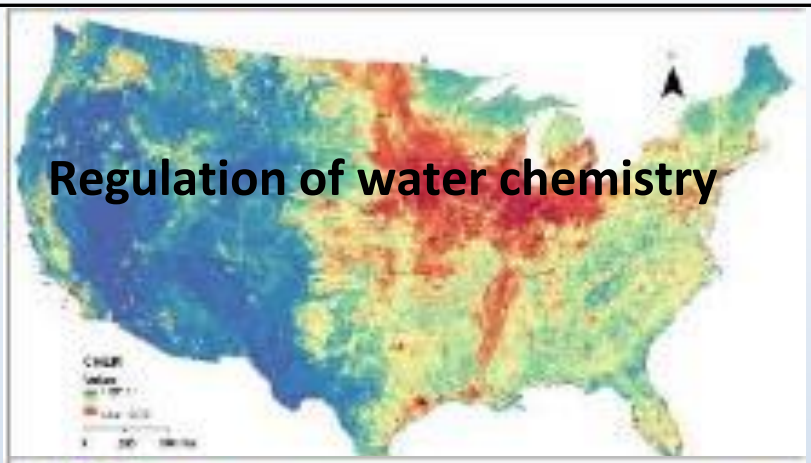
Source: U.S. Army Corps of Engineers, Mississippi Valley Division

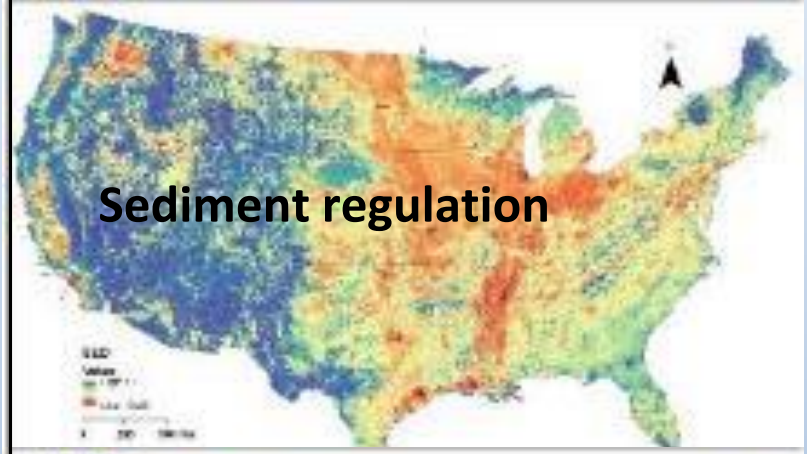
Watershed Integrity

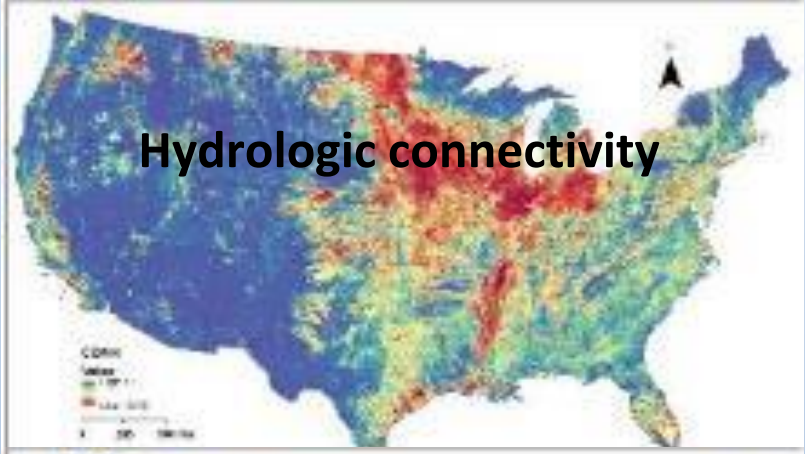


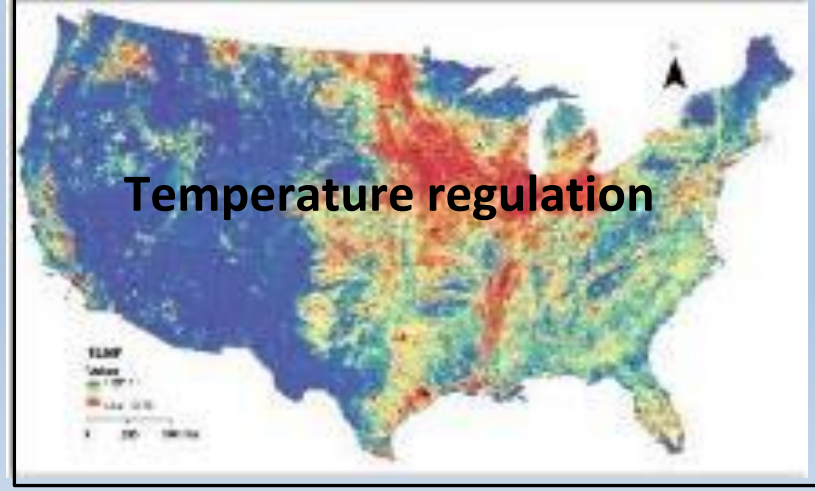
Thornbrugh et al. 2018. EI

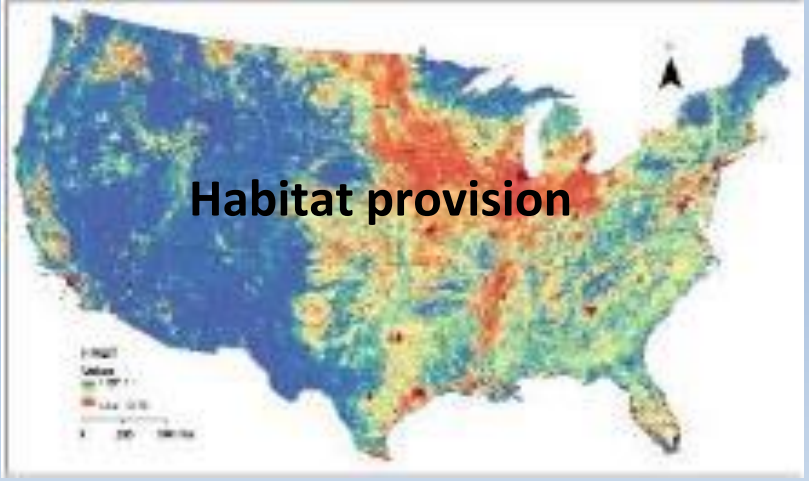

Hydrologic regulation


Regulation of water chemistry

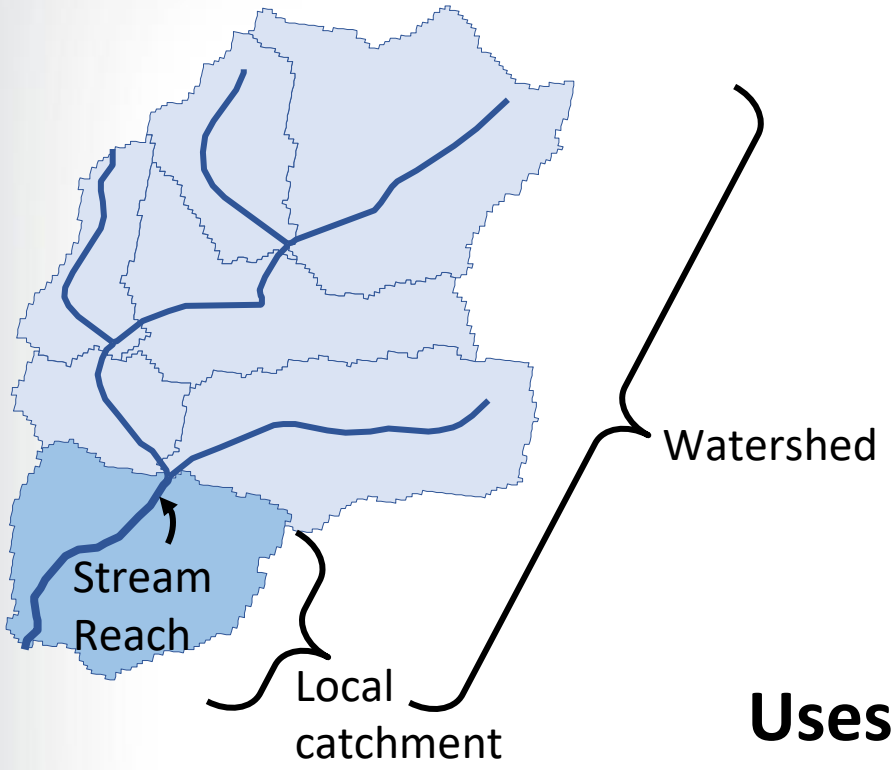

Sediment regulation

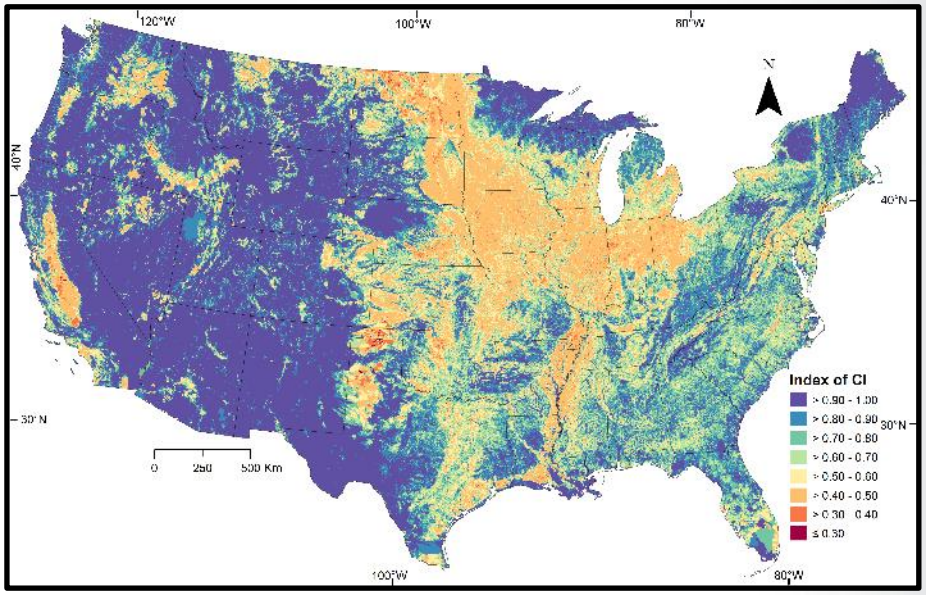

Hydrologic connectivity


Temperature regulation


Habitat provision

Index of Catchment Integrity

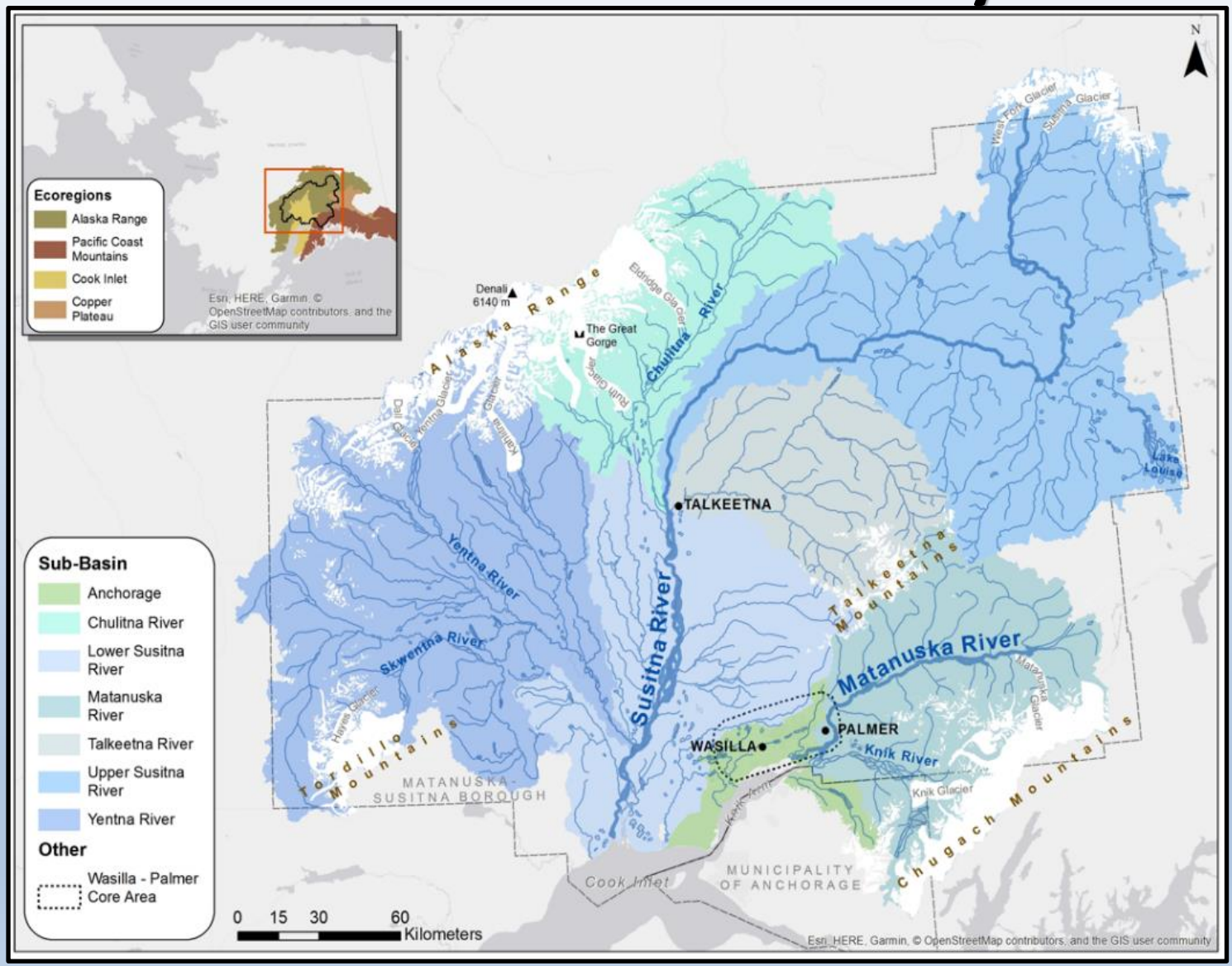




Uses local drainage of individual stream segments (i.e., excludes upstream information)

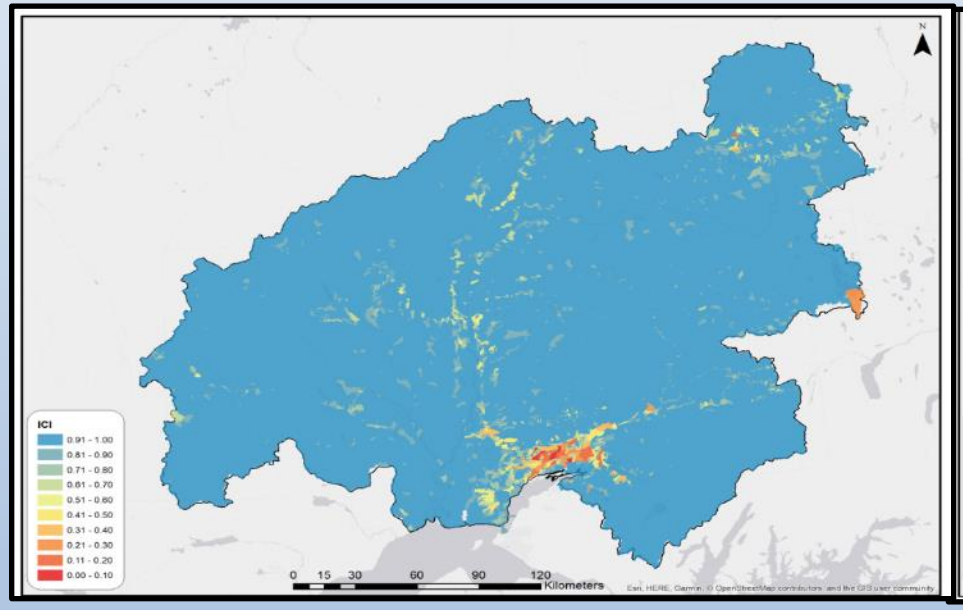
Thornbrugh et al. 2018. https://doi.org/10.1016/j.ecolind.2017.10.070

Matanuska-Susitna Valley IWI



Aho, K.B., Flotemersch, J.E., Leibowitz, S.G., LaCroix, M.A. and Weber, M.H., 2020. Applying the index of watershed integrity to the Matanuska–Susitna basin. *Arctic, antarctic, and alpine research*, *52*(1), pp.435-449.

Mat-Su IWI



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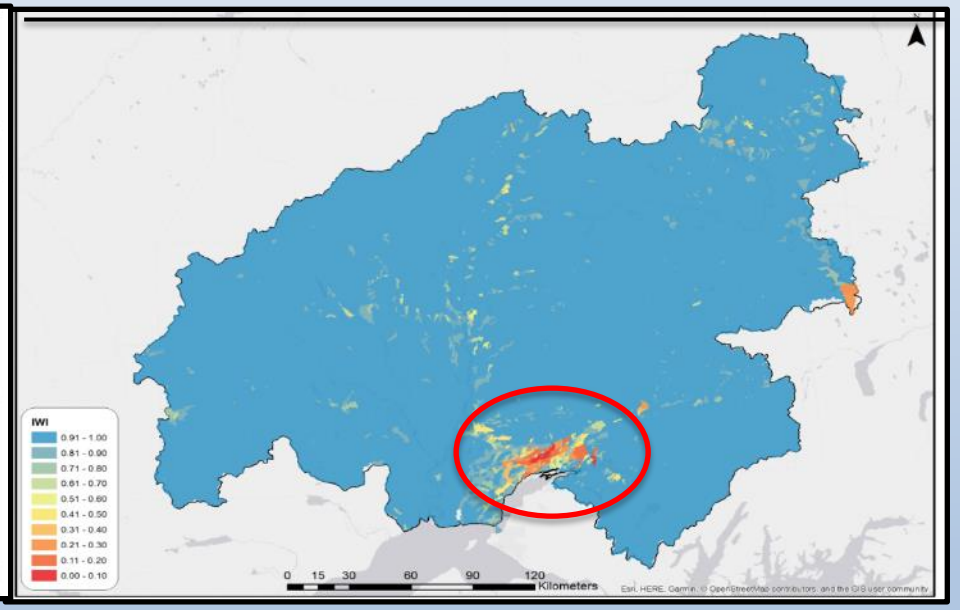

IWI

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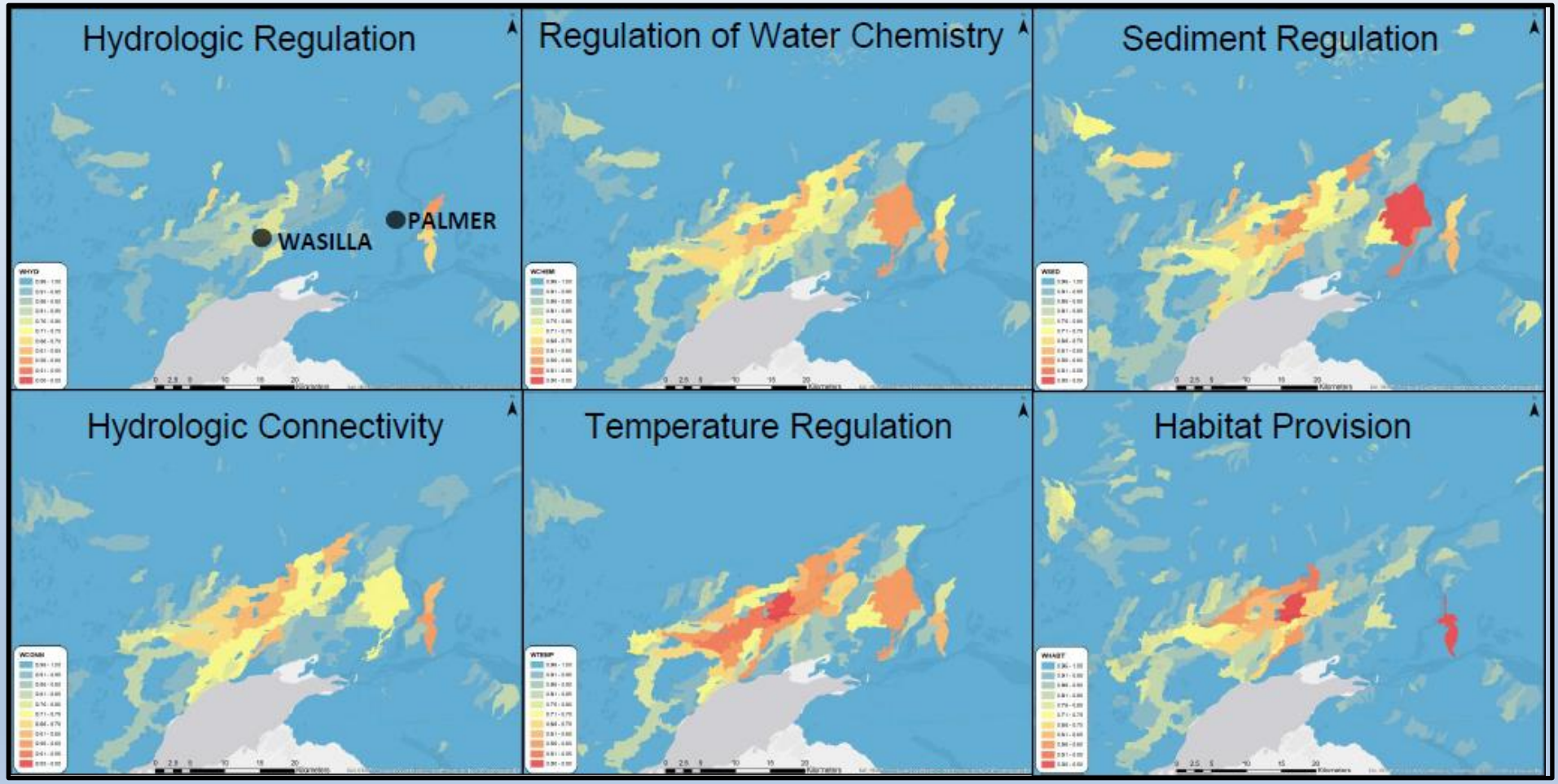

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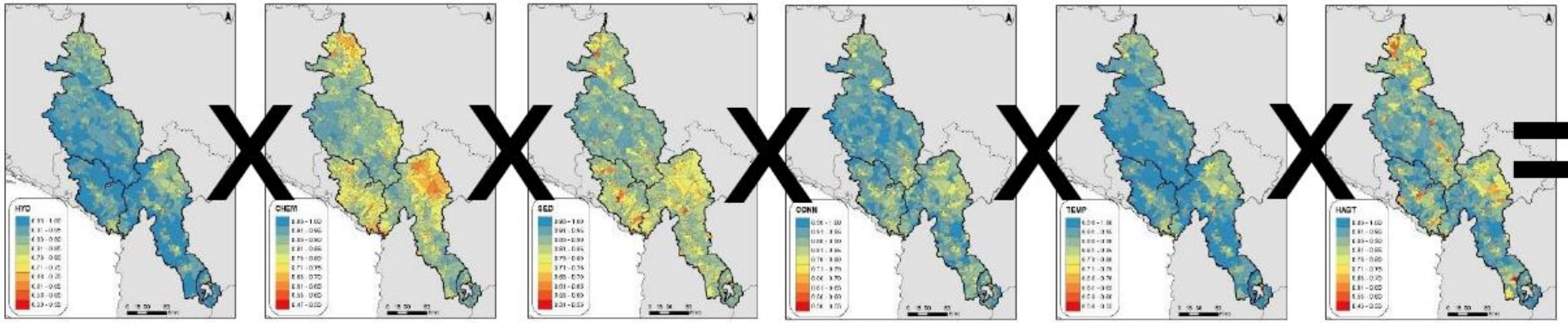
Index of Catchment Integrity

Hydrology | Chemistry | Sediment | Connectivity | Temperature | Habitat



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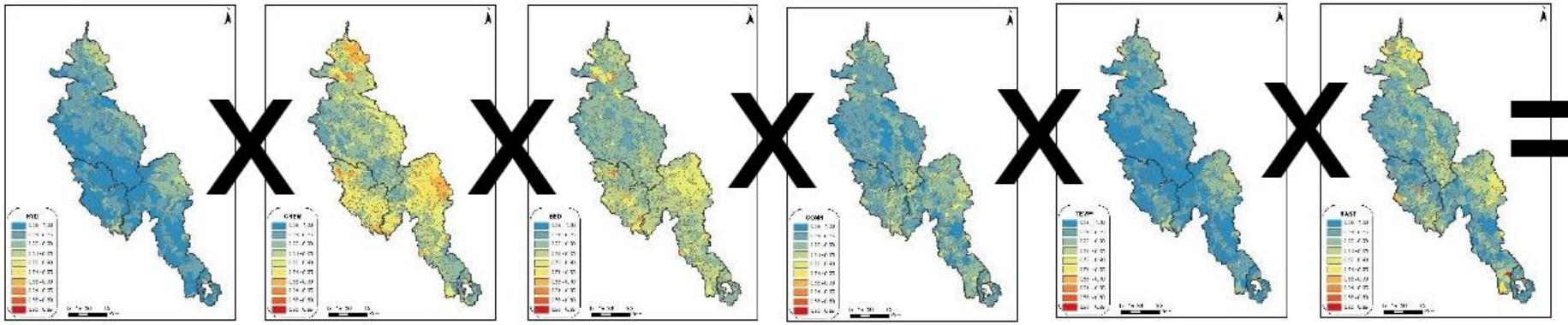
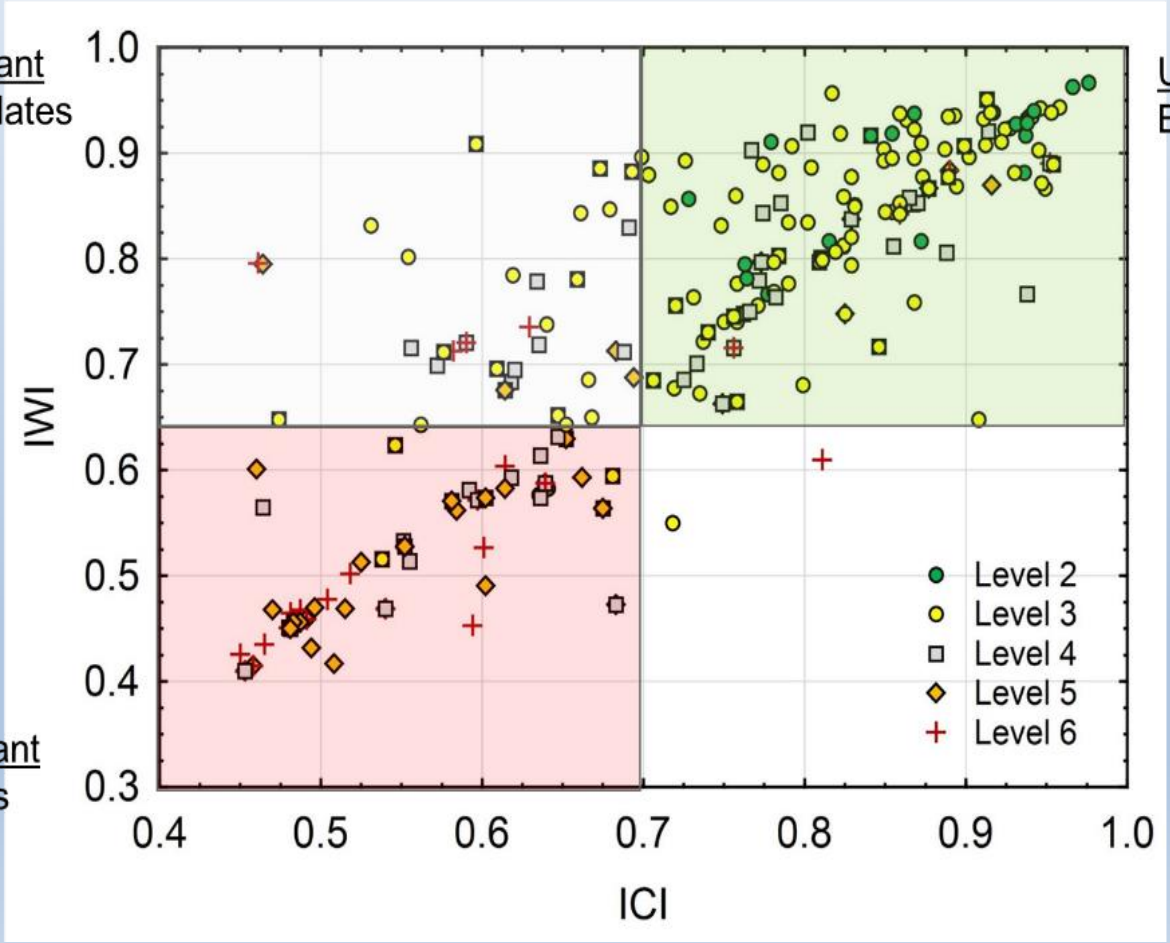


Pacific Northwest Biological Condition Gradient Assessment

Prioritizing sites for restoration and conservation

Upper left quadrant
Next best candidates

Upper right quadrant
Best candidates



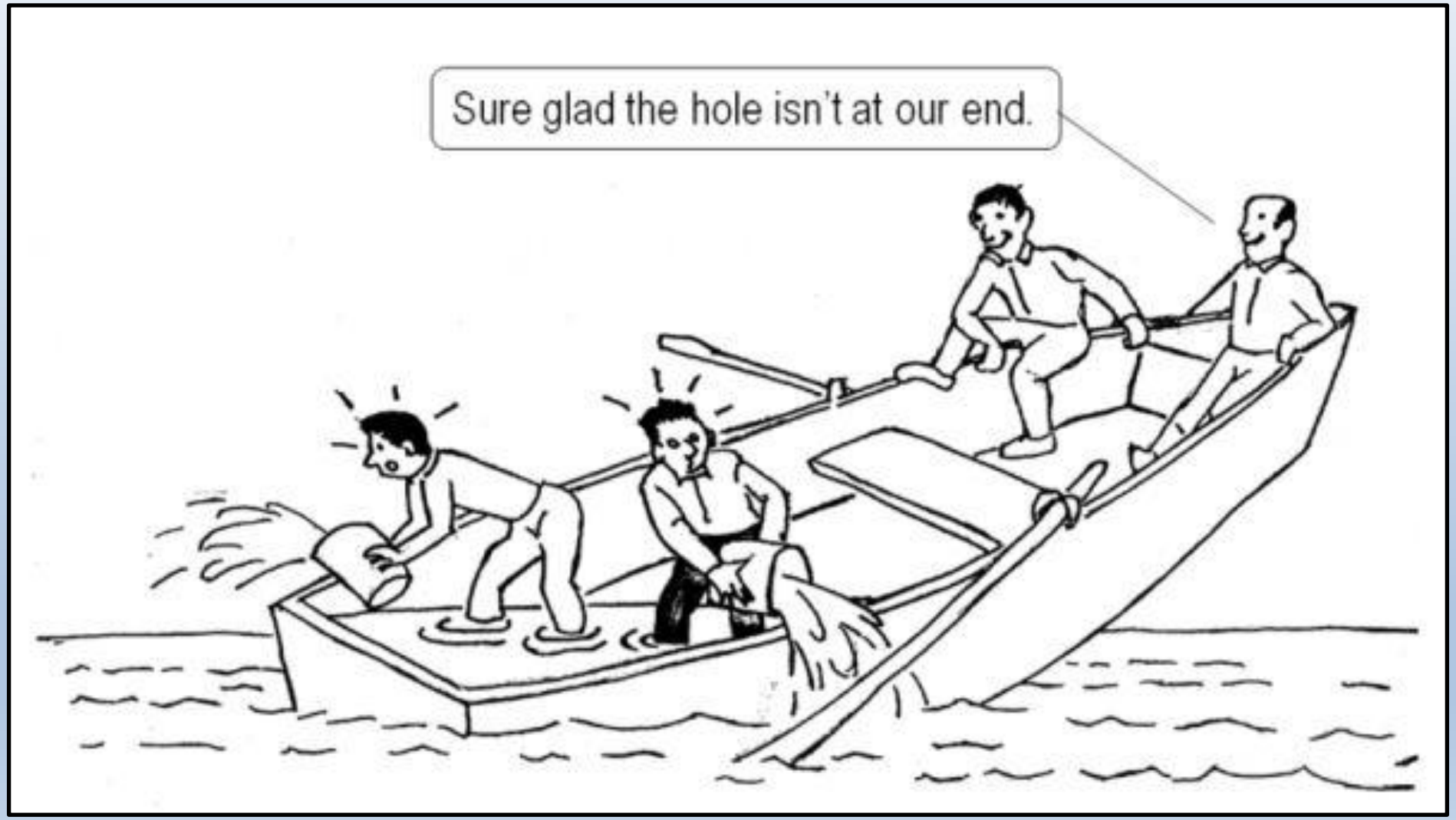
Lower left quadrant
Worst candidates

Stamp et al. in prep

Take home message

- The people you are communicating with often have a perspective that matches their area of responsibility (e.g., community, region, nation).
- Your perception may be bound in a similar way, or by the scale of the issue.
- Other perceptions of an issue may not be trans-scale or trans-boundary.
- Trans-Scale communication helps all involved perceive the issue at the actual scale of the issue in a way that helps the collective conceive and develop realistic solutions.

Trans-scale Communication in Large-Scale Watershed Management



https://www.idahofallsmagazine.com/2020/08/its-not-my-problem