Don't move a mussel: targeting to prevent dreissenid spread in the Missouri River Basin

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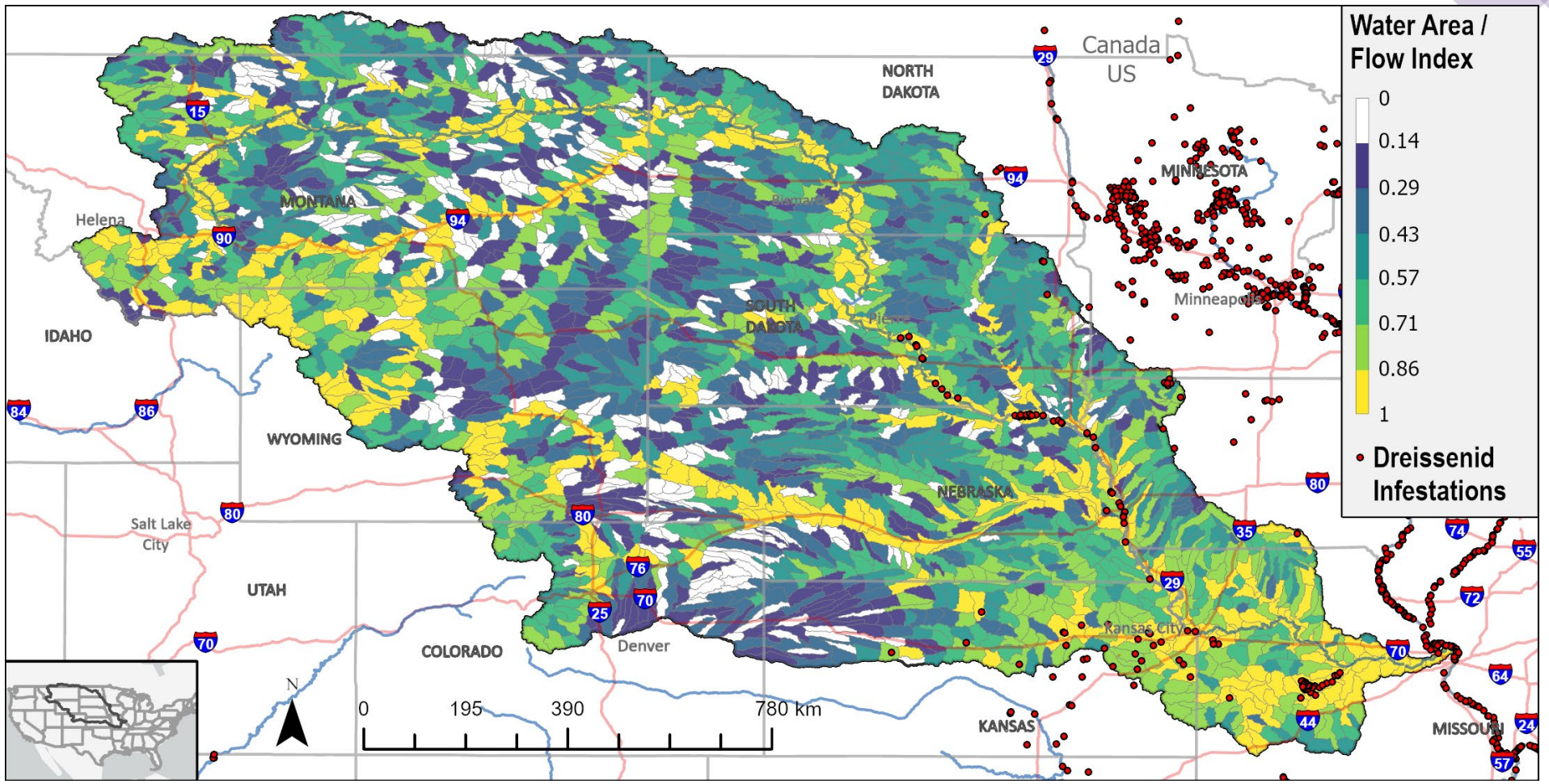
Invasive Dreissenids

- Two invasive freshwater mussel species—quagga and zebra—pose multiple threats to the Missouri River Basin (MRB)
  - But there are several categories of threats
  - Categories may have different weights for various objectives and users
  - Organizing all the information can be daunting for policy makers

- Goal:

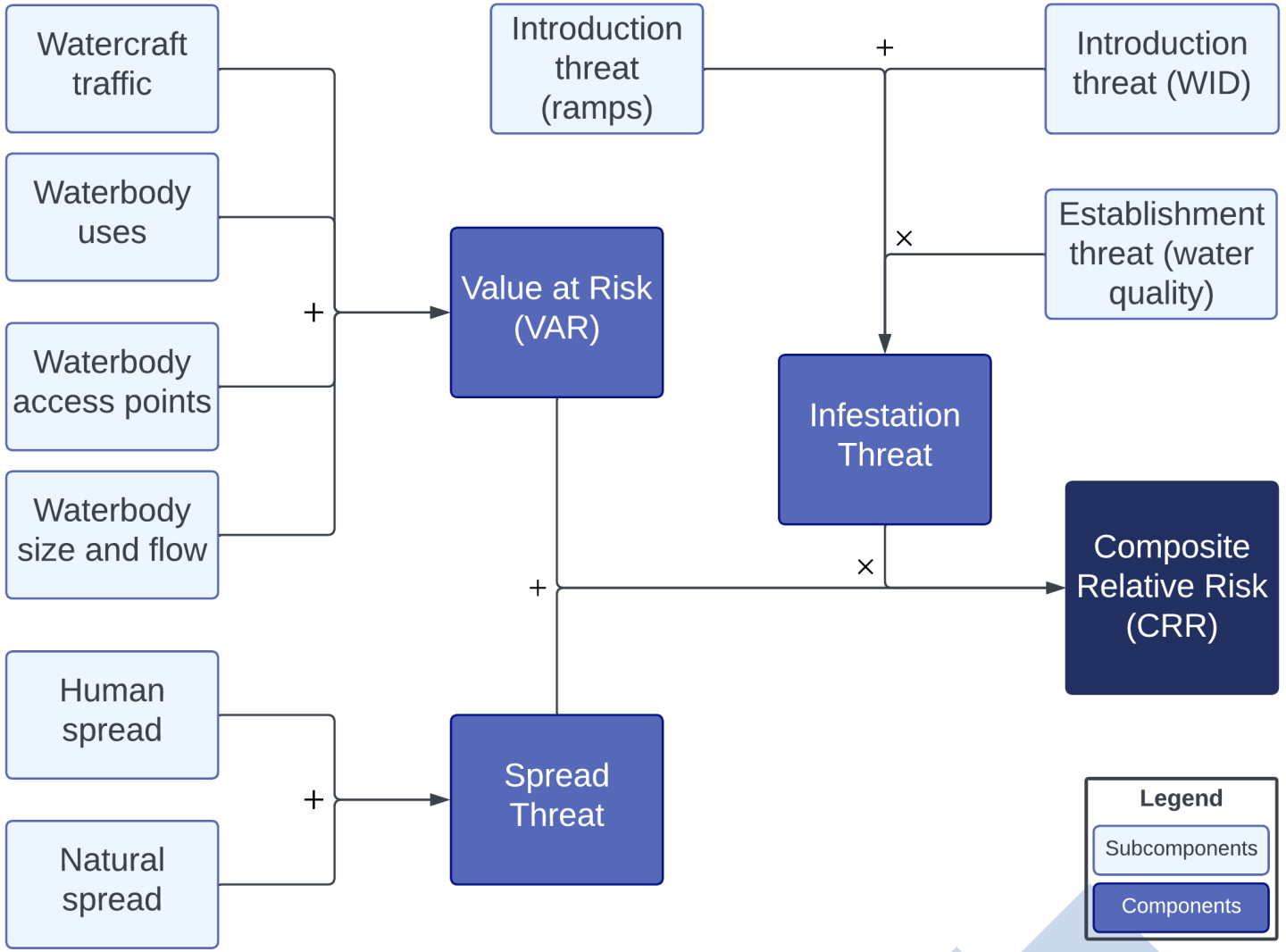
Provide a simplified but flexible means to help prioritize primary threat areas at a HUC 10 level in the MRB

Invasive Dreissenids



Nonindigenous Aquatic Species Database and NHDPlus Data (USGS)

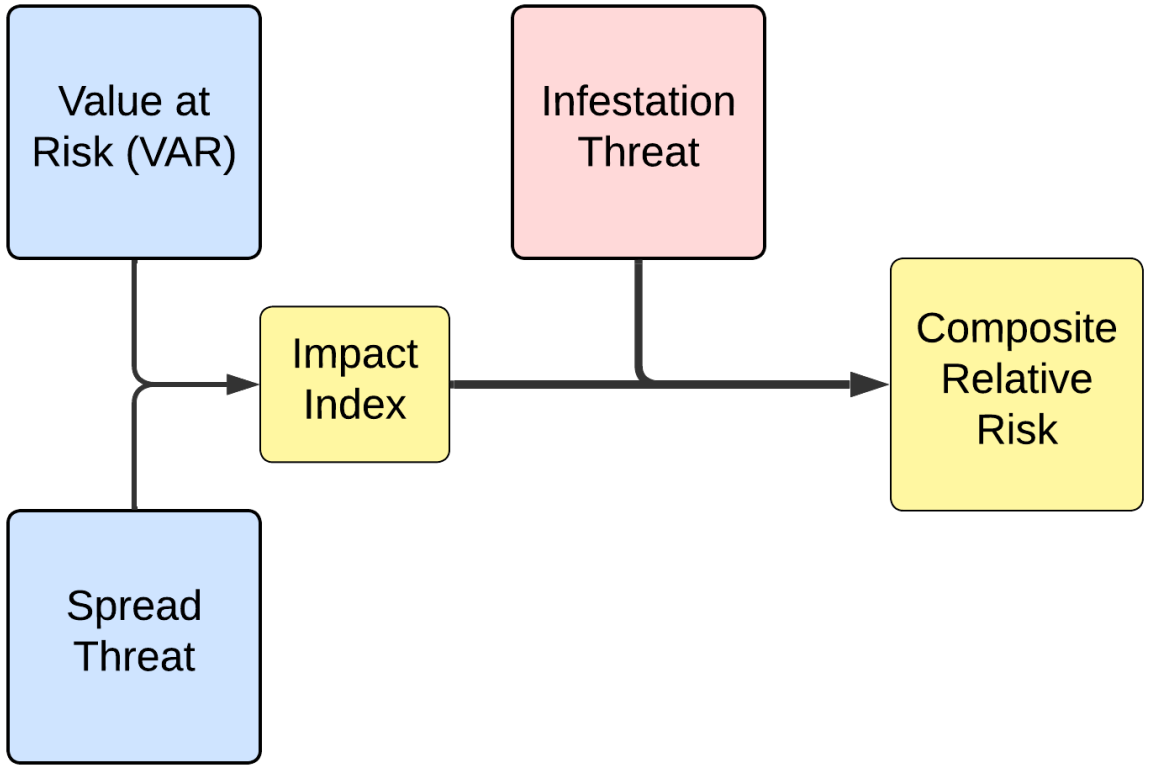
Model: Composite Relative Risk



Data

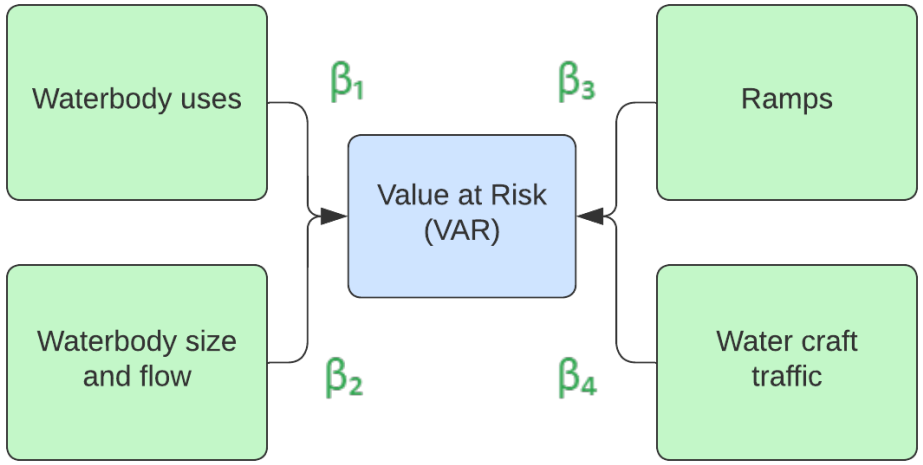
Three primary categories of data

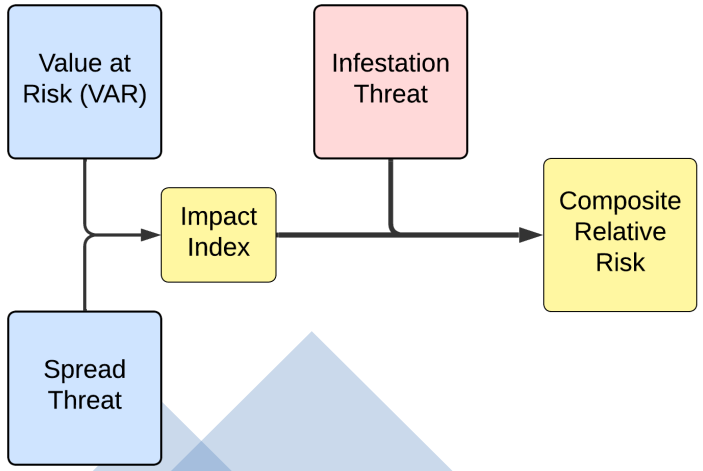
1. Value at Risk (VAR)
   - Direct threat
2. Spread Threat
   - Indirect threat
3. Infestation Threat
   - Introduced multiplicatively
   - Proxy for establishment probability of infestation



Data: Value at Risk

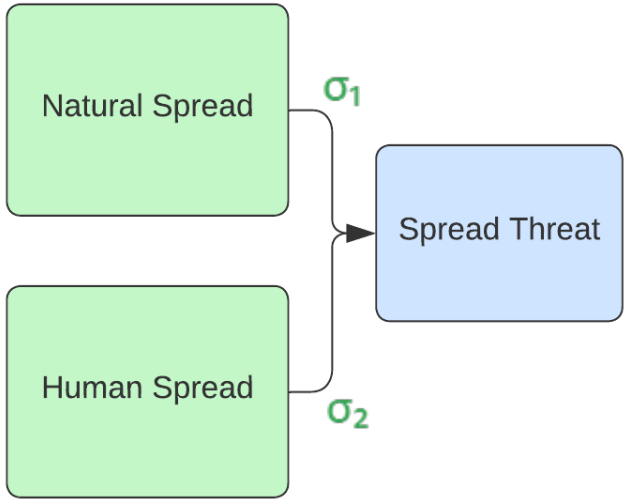
	Weight		Subcomponent Description	Detail
1. Value at Risk (VAR)	0.25	β_1	**Waterbody beneficial use count**	Count of beneficial uses states reported to EPA, plus count of hydropower facilities. Epa 303(b) data set
	0.25	β_2	**Waterbody coverage and flow: HUC 'wetness'**	Two measures for the HU are converted to MRB-wide or state-wide percentiles then averaged: (1) cumulative surface area of lakes/ponds (km^2), and (2) maximum (across streams/rivers in HU) of the mean annual flow.
	0.25	β_3	**Demand: waterbody access point count (boat ramps)**	Count of registered boat ramp locations
	0.25	β_4	**Demand: watercraft traffic level weighted by HUC 'wetness'**	Measure is converted to a rate per unit time (inspections/year) to normalize for time series of different length. HUC wetness weight is given by "Waterbody size" index (defined in this table).

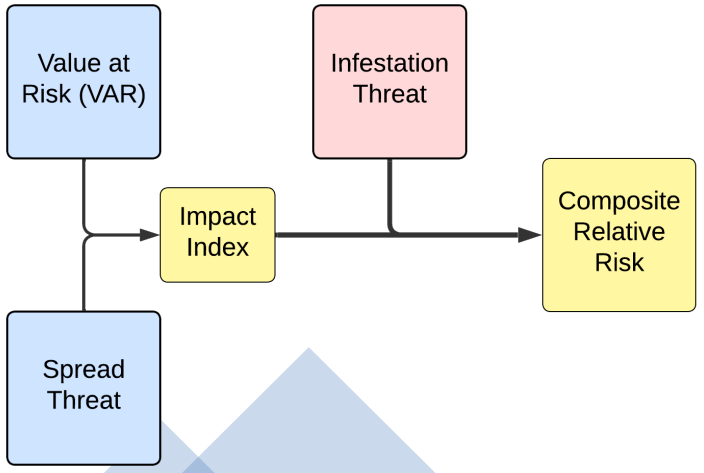




Data: Spread Threat

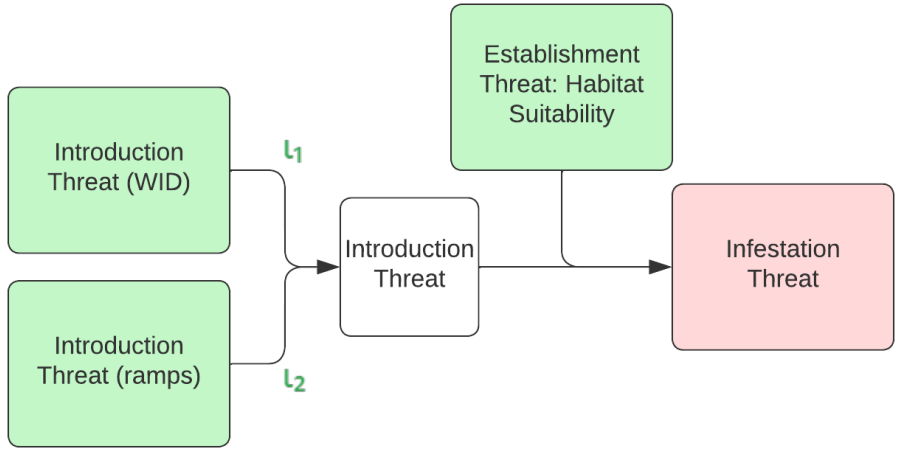
	Weight		Subcomponent Description	Detail
2. Spread Threat	0.5	σ_1	**Natural spread potential: downstream distance**	The downstream distance (km) for each waterbody object to the end of the MRB (at confluence with the Mississippi River), or ``path length'', is calculated and the minimum length (most downstream) within the HU is selected
	0.5	σ_2	**Human spread potential: waterbody access point count**	Count of registered boat ramp locations

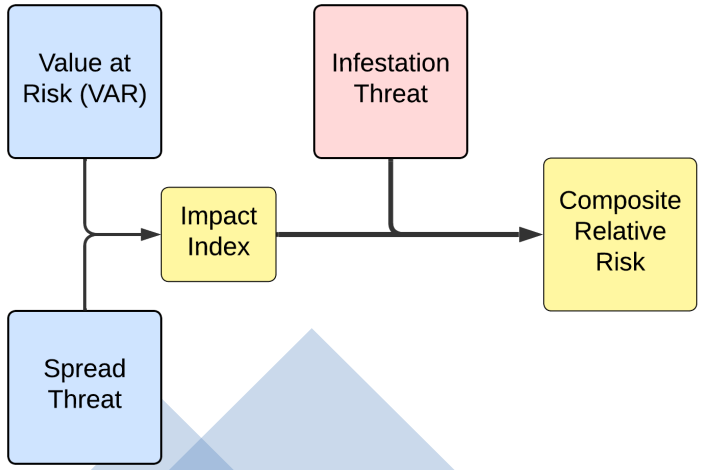




Data: Infestation Threat

	Weight		Subcomponent Description	Detail
3. Infestation Threat	0.5	ι_1	**Introduction threat: distance-weighted sum of waterbody access-points (boat ramps)**	Distance weight for each ramp is equal to one minus the MRB-wide or state-wide percentile of the ramp's distance (km) to the nearest infestation-site.
	0.5	ι_2	**Introduction threat: distance-weighted sum of watercraft inspection and decontamination (WID) stations, then weighted by HUC wetness**	Distance weight for each station is equal to one minus the MRB-wide or state-wide percentile of the station's distance (km) to the nearest infestation-site. HUC wetness weight is given by “waterbody size" index (defined in this table).
	--	--	**Establishment Threat: Habitat Suitability**	Dreissenid habitat suitability (categorical: ``low", ``medium", and ``high“ suitability) is estimated using calcium and pH levels. Converted to number weight using ordinal percentile ranking

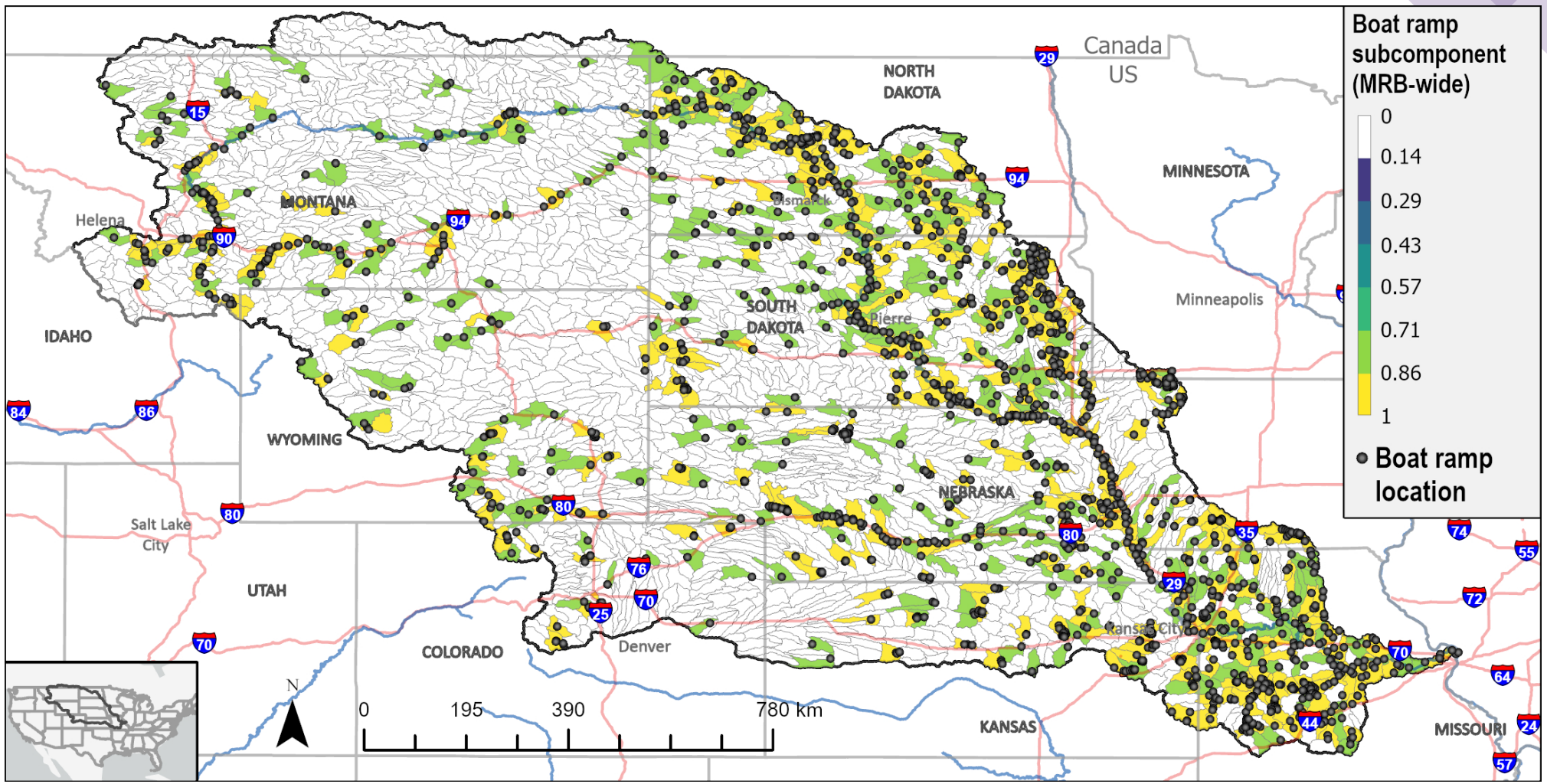




Combining the Data

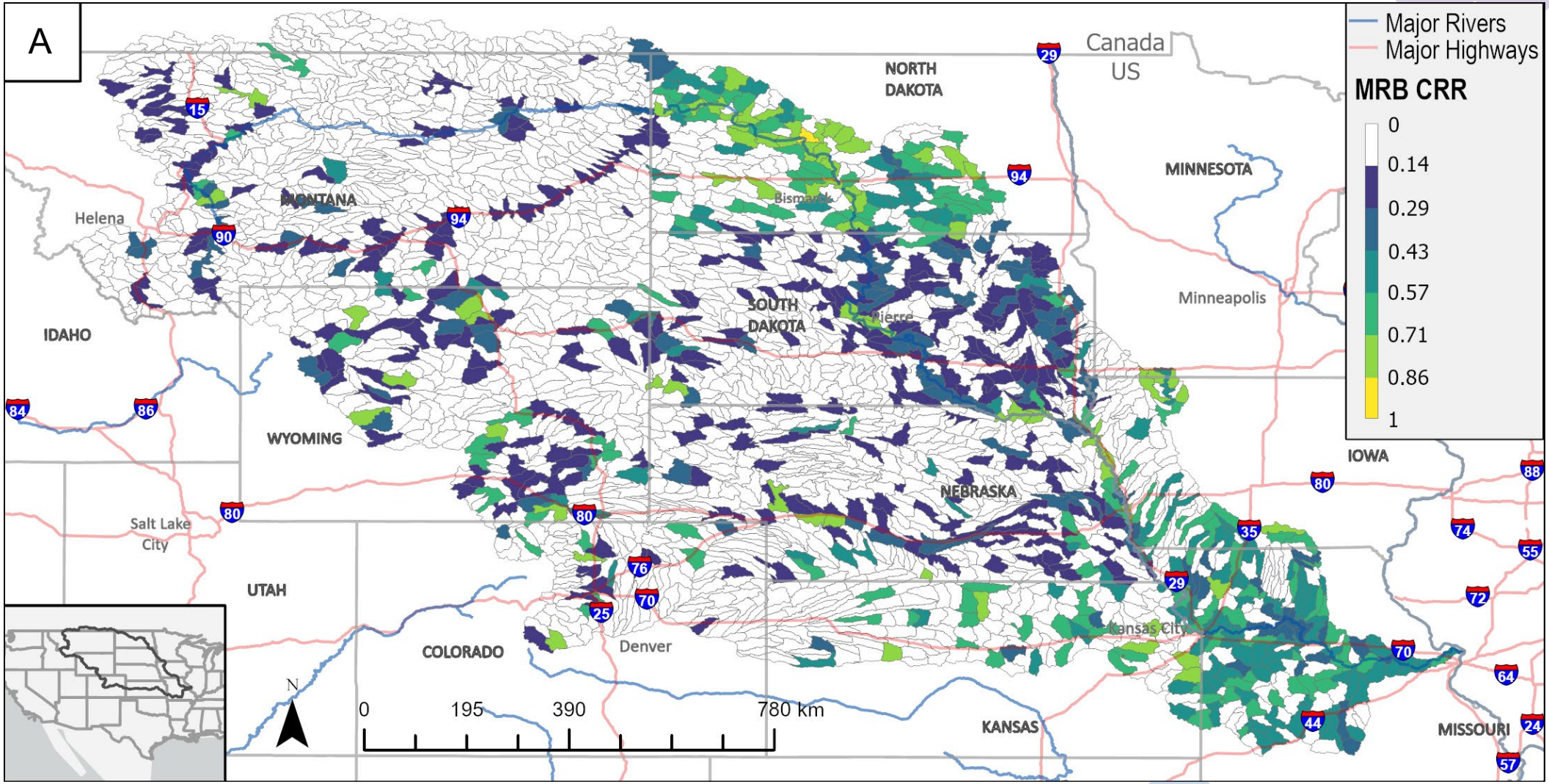
- To combine the subcomponents, first convert to indices using percentile ranking
  - E.g. a HUC containing the 50th percentile number of boat ramps gets a boat ramp subcomponent score of 0.5
- These rankings can be at the entire MRB or at state level
  - State level rankings indicate high threat HUC's only relative to other HUC's in the same state
  - Helps to control for state-level over/under representation in the data
- Subcomponents are then combined using weighted average with adjustable weights

Example of a Subcomponent

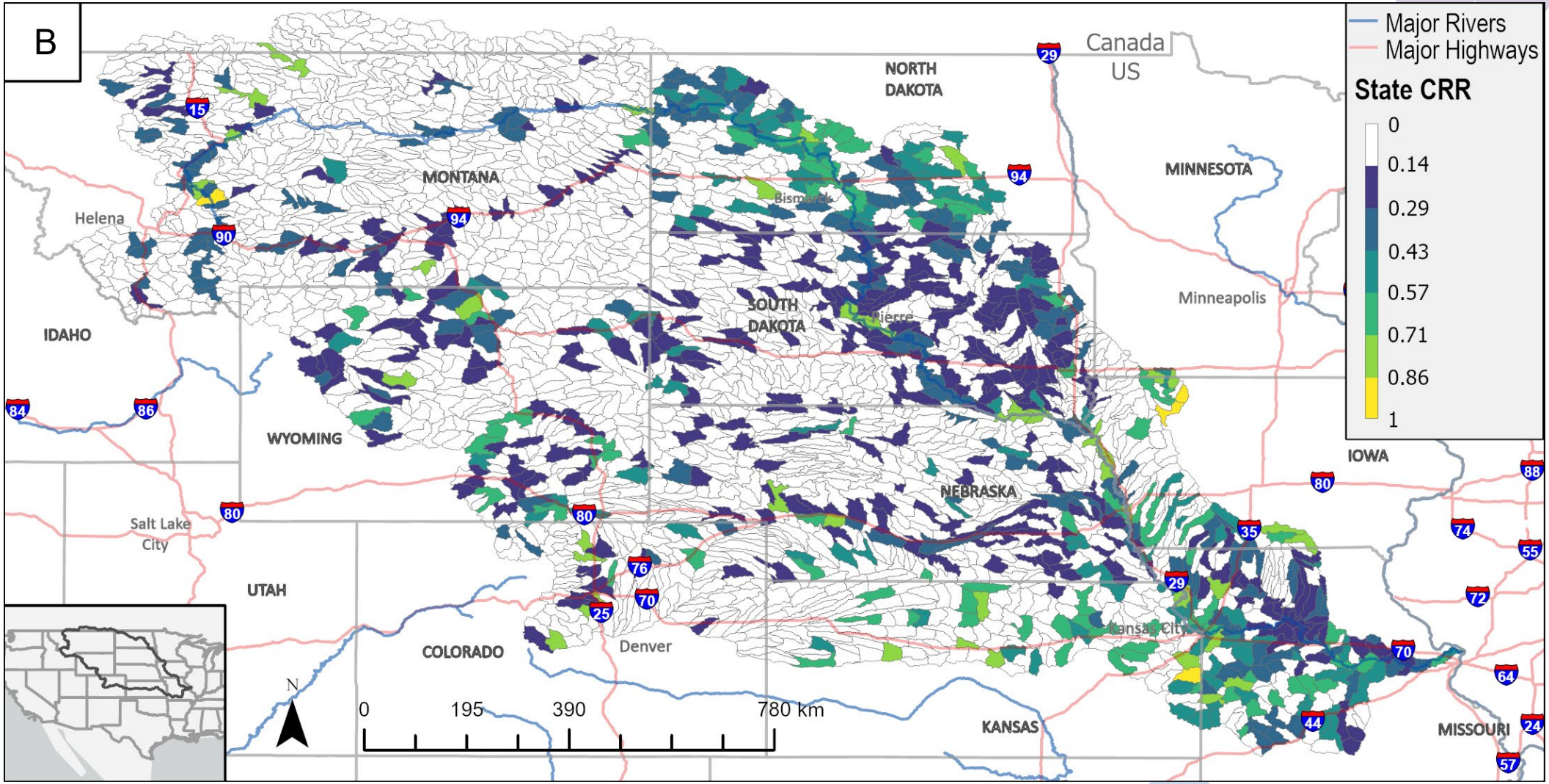


Nonindigenous Aquatic Species Database and NHDPlus Data (USGS)

CRR Maps (MRB-Wide Ranking)



CRR Maps (State-Wide Ranking)



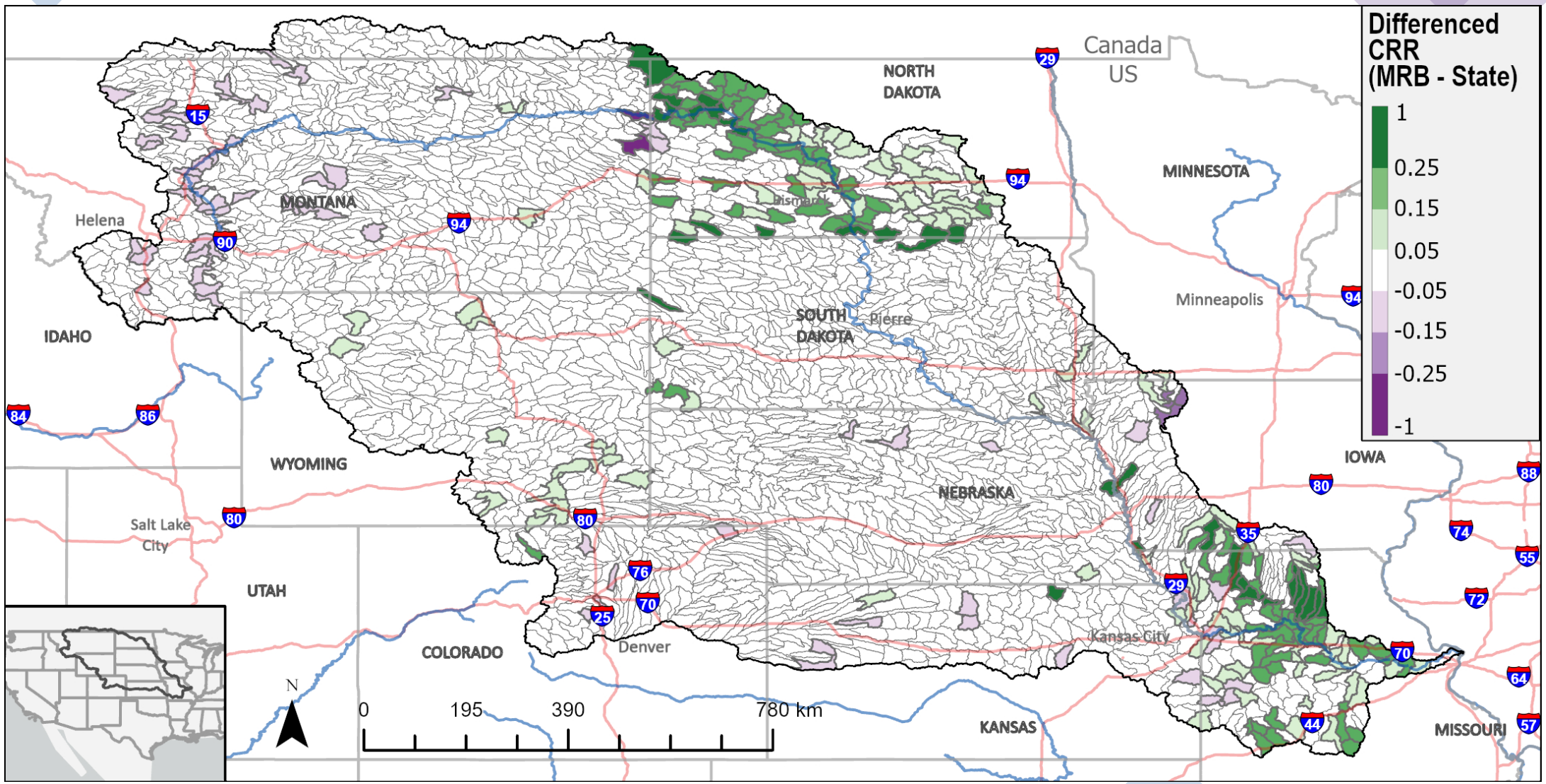
MRB versus State-wide Ranking

- Qualitatively similar
  - The highest threat areas are highlighted in both cases

- Differences between MRB-wide and state-wide can be informative
  - Can indicate high priority HUC's for co-operative prevention and containment efforts

- For example, HUC's in Missouri (shaded green below) regarding containment. May be worth co-operating to contain spread in very infested regions

CRR Maps (MRB-Wide)

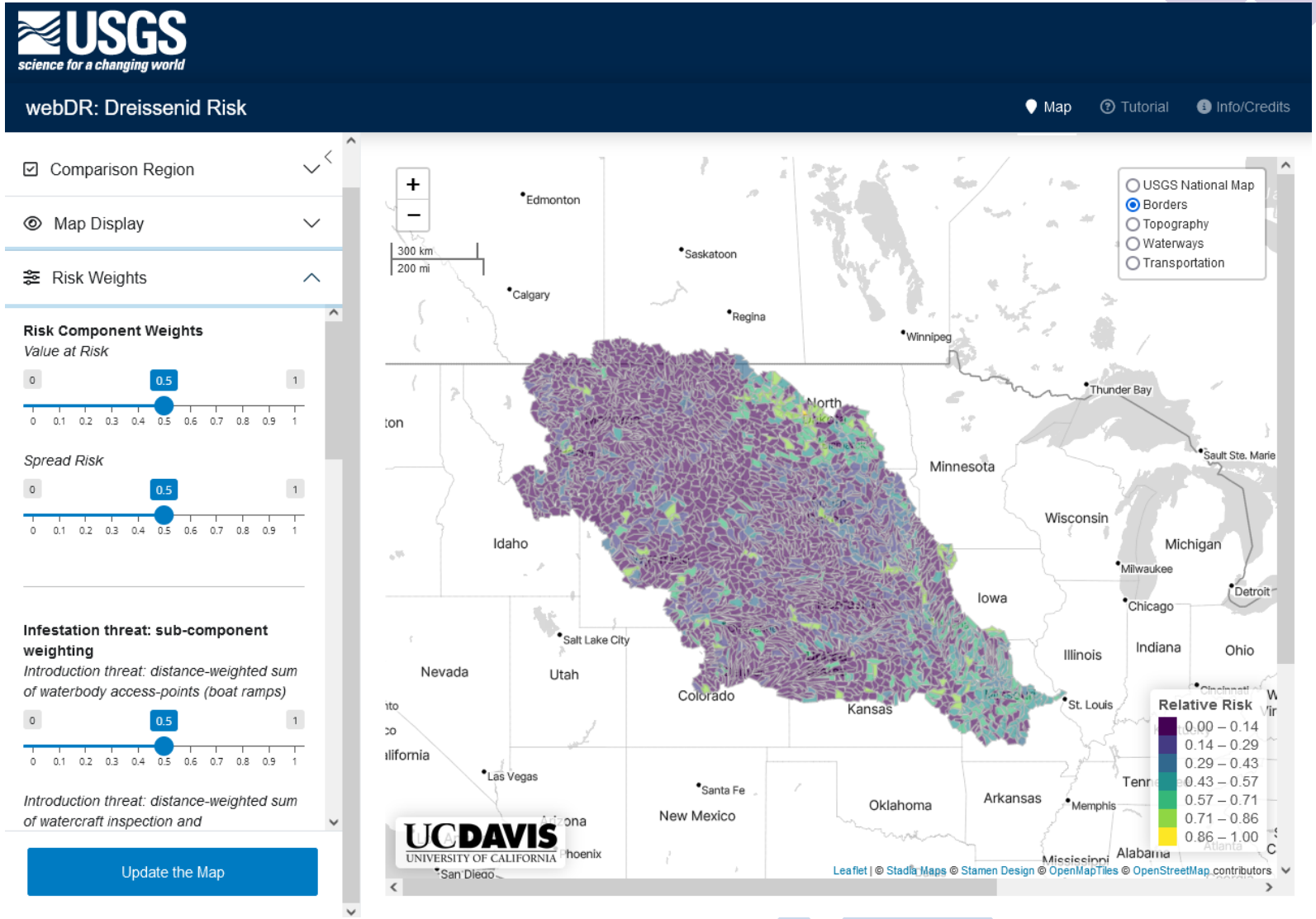


Flexibility and Application

- Weights on the subcomponents and components can be changed
- Can be made to reflect relative importance of factors for individual managers
- Weights could also input the results from other models in the future
- Rshiny Tool to interact with data and adjust weights

Flexibility and Application

- Web tool to interact with data
- Can change weights to see how results change



Thank you

Courtesy: USFWS