



Ecological Integrity

Integrating Indicators of Ecological Integrity Across
Diverse Ecoregions: Nevada's Proposed Evaluation

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Nevada Division of Environmental Protection

This Is Only Because Of...

- EPA Region 9
- Karen Vargas
 - Numerous bioassessment interns 2006 – 2011
- Beth Vollmer
- Michelle Murdock
 - Tahoe Regional Planning Agency
- Charles Hawkins
- Jake Vander Laan
 - Western Center for Monitoring & Assessment of Freshwater Ecosystems



Bugs *are* Adorable!



Give me your feedback...

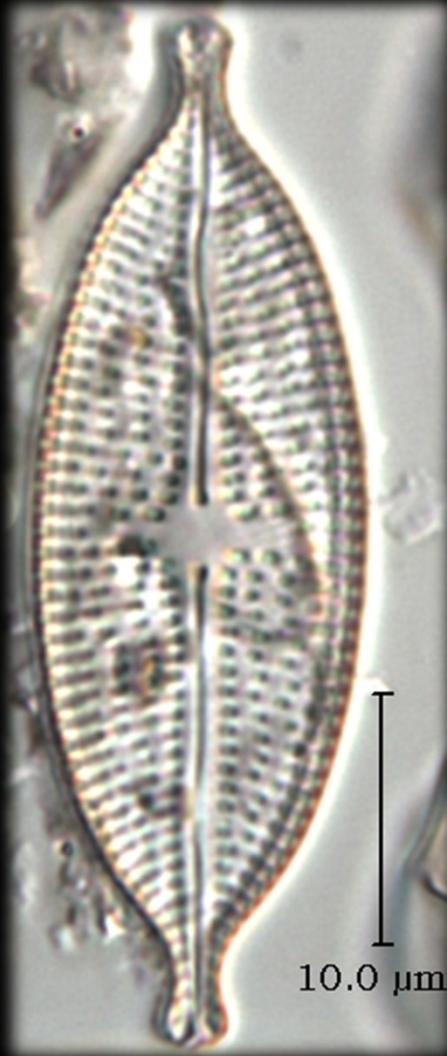
- Write me a note
- Email me
 - dentonm@ndep.nv.gov
- Call me
 - 775.687.9457

So Much To Say!

- I've got some ideas
- I ♥ Nevada, spatially
- Integrate indicators
- Indicate integrity
- Incorporate your ideas



Lofty Goals



Input

- Models
- Indices
- Riparian Habitat
- Chemistry
- Integrate into similar ecosystems

Outcome

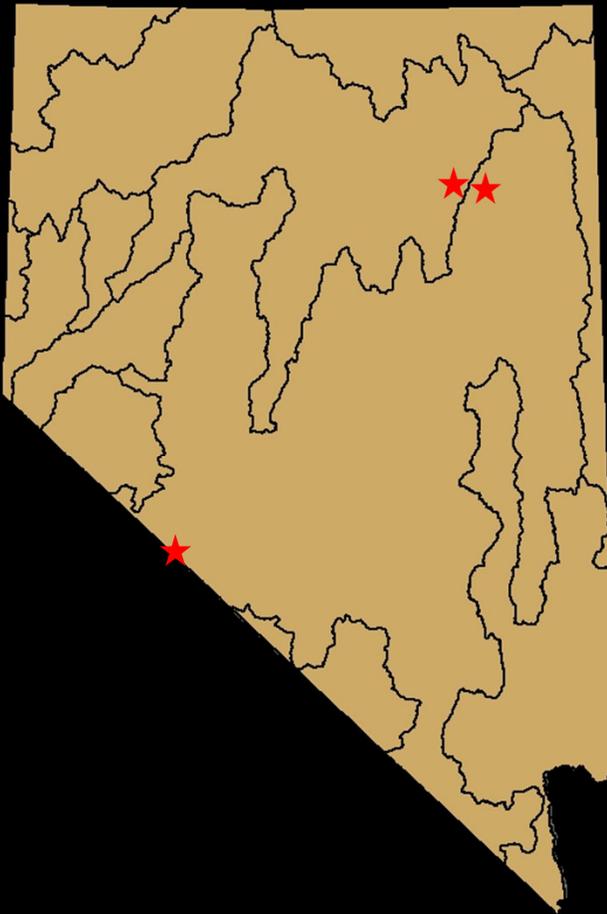
- Simple
- Comparable
- Communicable

Eunotiaticaudatus
 Neoplastia
 Sperchon
 Zaitzevia
 Tryblionella
 Gomphonema
 Turbellaria
 Bavarica
 Limnophyes
 Ironodes
 Heterotrissodadius
 Leptophlebiidae
 Larsia
 Corynoneura
 Coccinellid
 Bezzia/Palpomysia
 Frustulia
 Atractides
 Diamesa
 Parapsyche
 Caloneis
 Baetis
 Simuliidae
 Encyonema
 Protzia
 cinctipes
 Synedra
 laevis
 Doronauria
 Pinnularia
 Geissleria
 Rhopalodia
 Simulium
 Sialis
 Lepidostoma
 Parametricnemus
 Rheocricotopus
 Pistidium
 Achmanthes
 elliptica
 Frustulia
 Atractides
 Diamesa
 Parapsyche
 Caloneis
 Baetis
 Simuliidae
 Encyonema
 Encyonema
 kuetzingii
 salmonids
 doddsii
 Micrasema
 Acari
 Apatania
 Oncorhynchus
 Diademsis
 Cymatopleura
 Pagastia
 Sphaeriidae
 Epithemia
 Geissleria
 Rhopalodia
 Simulium
 Sialis
 Lepidostoma
 Parametricnemus
 Rheocricotopus
 Pistidium
 Achmanthes
 elliptica
 Frustulia
 Atractides
 Diamesa
 Parapsyche
 Caloneis
 Baetis
 Simuliidae
 Encyonema
 Optioservus
 vulgaris
 Cymbella
 Hygrobatas
 grandis
 vofixa
 Chaetocladius
 Thienemannimyia
 Pool
 Periphyton
 Gyrosigma
 Brillia
 Empididae
 Dixa
 Zapada
 Denticula
 Rhyacophila
 Chloroperlidae
 Cinygma
 Placoneis
 Cinygma
 Rhyacophila
 Ptychoptera
 Glossosomatidae
 Fragilaria
 Neophylax
 Heliella
 Orthocladus
 Cyprinidae
 Craticula
 Discostella
 erense
 Diphetor
 Rhyacophila
 Chloroperlidae
 Cinygma
 Placoneis
 Cinygma
 Rhyacophila
 Ptychoptera
 Glossosomatidae
 Fragilaria
 Neophylax
 Heliella
 Ostracoda
 Cyclotella
 Cricotopus
 Perlotidae
 detritus
 Diploneis
 Micropsectra
 hageni
 Fallacia
 capucina
 Malenka
 Ameletus
 gibba
 Prosimulium
 Planothidium
 Paramerina
 DOM
 Aulacoseira
 Sellaphora
 Cinygmula
 Gompheis
 Polypedium
 Detritus
 Capniidae
 autochthonous
 Stempellinella
 brunnea
 Tvetenia
 Pericoma/Telmatoscopus
 Turbellaria
 Bavarica
 Limnophyes
 Ironodes
 Heterotrissodadius
 Leptophlebiidae
 Larsia
 Corynoneura
 Coccinellid
 Bezzia/Palpomysia
 Frustulia
 Atractides
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 Simuliidae
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 kuetzingii
 salmonids
 doddsii
 Micrasema
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 Apatania
 Oncorhynchus
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 Sellaphora
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 Gompheis
 Polypedium
 Detritus
 Capniidae
 autochthonous

Resolution

Hydrologic Basins

14



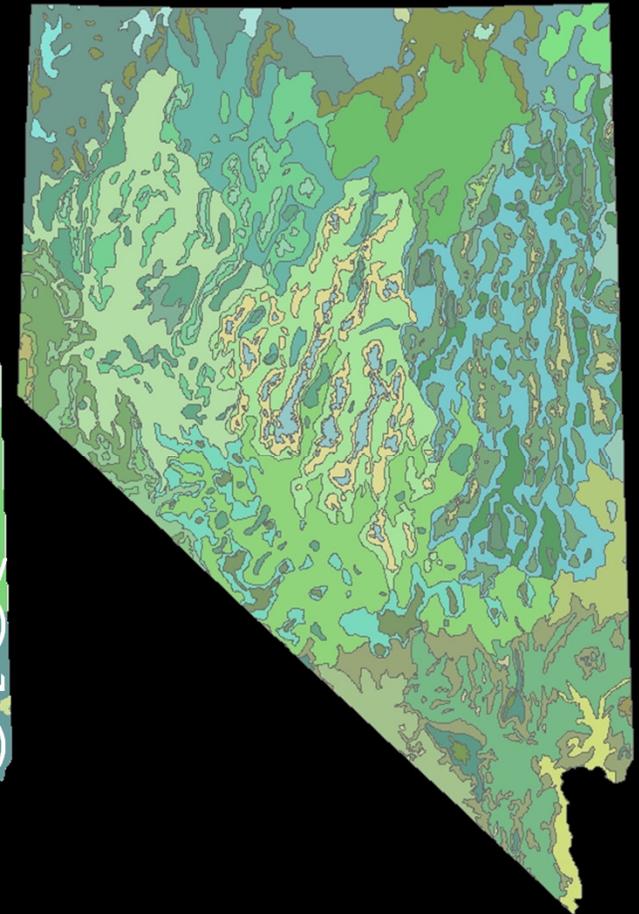
Ecoregion 3

5



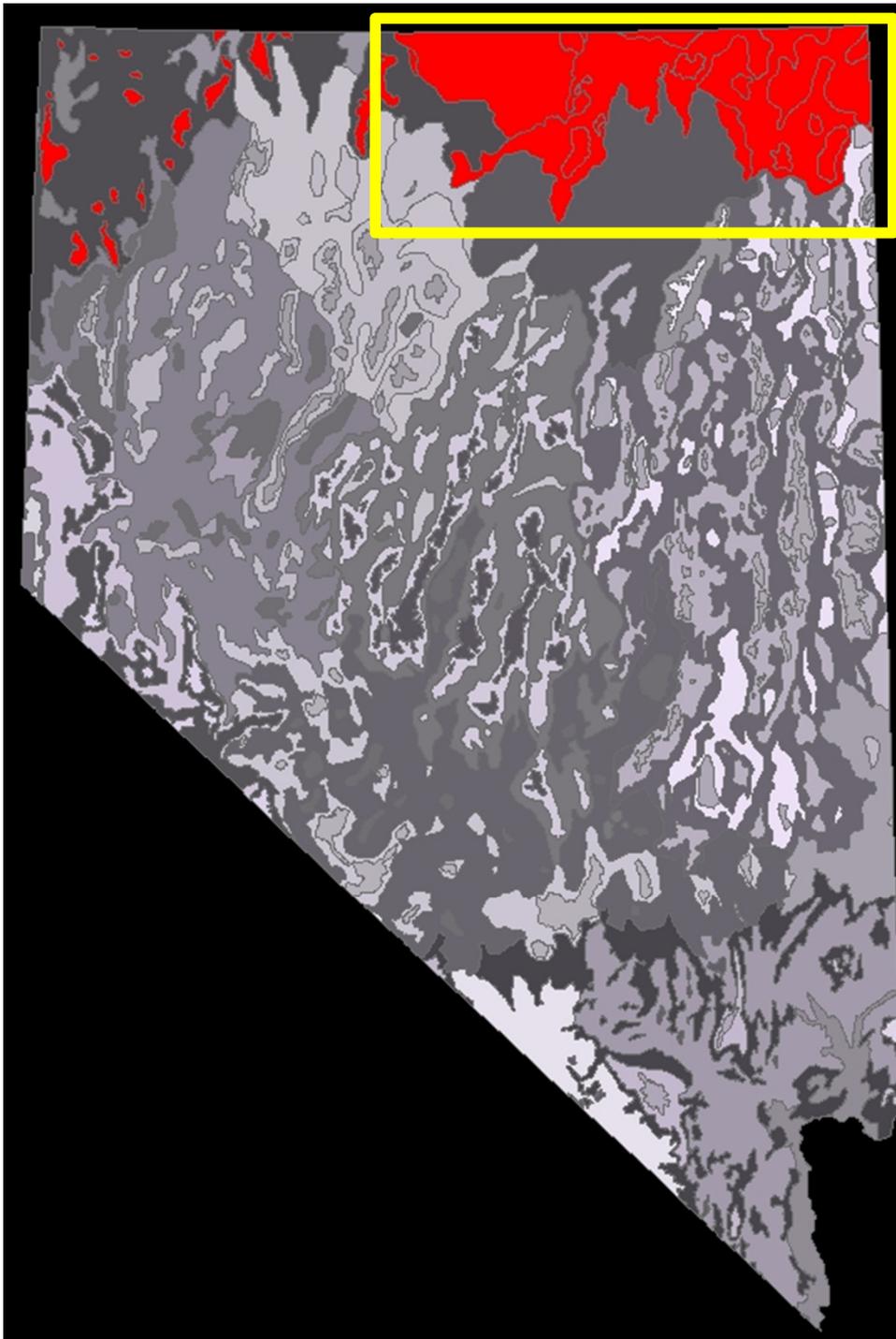
Ecoregion 4

43



Nevada's Basin & Range





Northeast

Hydrologic Basins

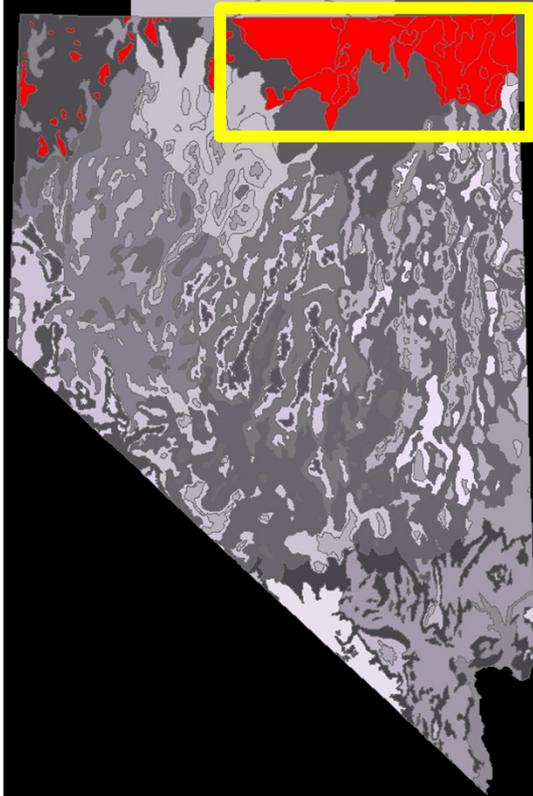
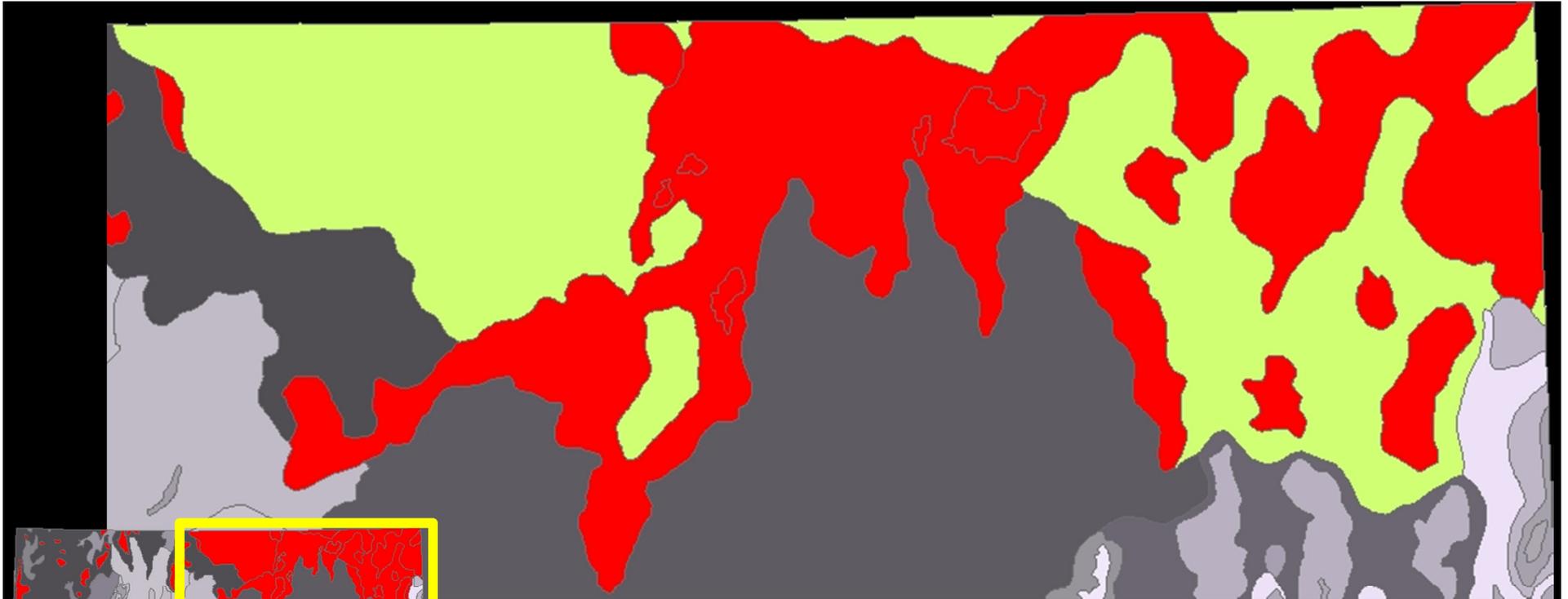
- Snake
- Humboldt
- Great Salt Lake
- Black Rock

Ecoregion 3

- Northern (80)

Ecoregion 4

- Dissected High Lava Plateau
- High Desert Wetlands
- Semiarid Hills & Low Mountains
- Semiarid Uplands
- Partly Forested Mountains

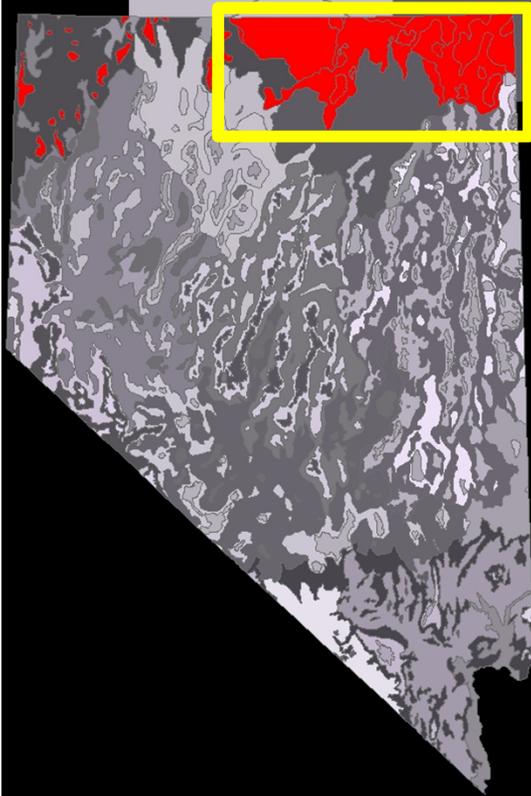
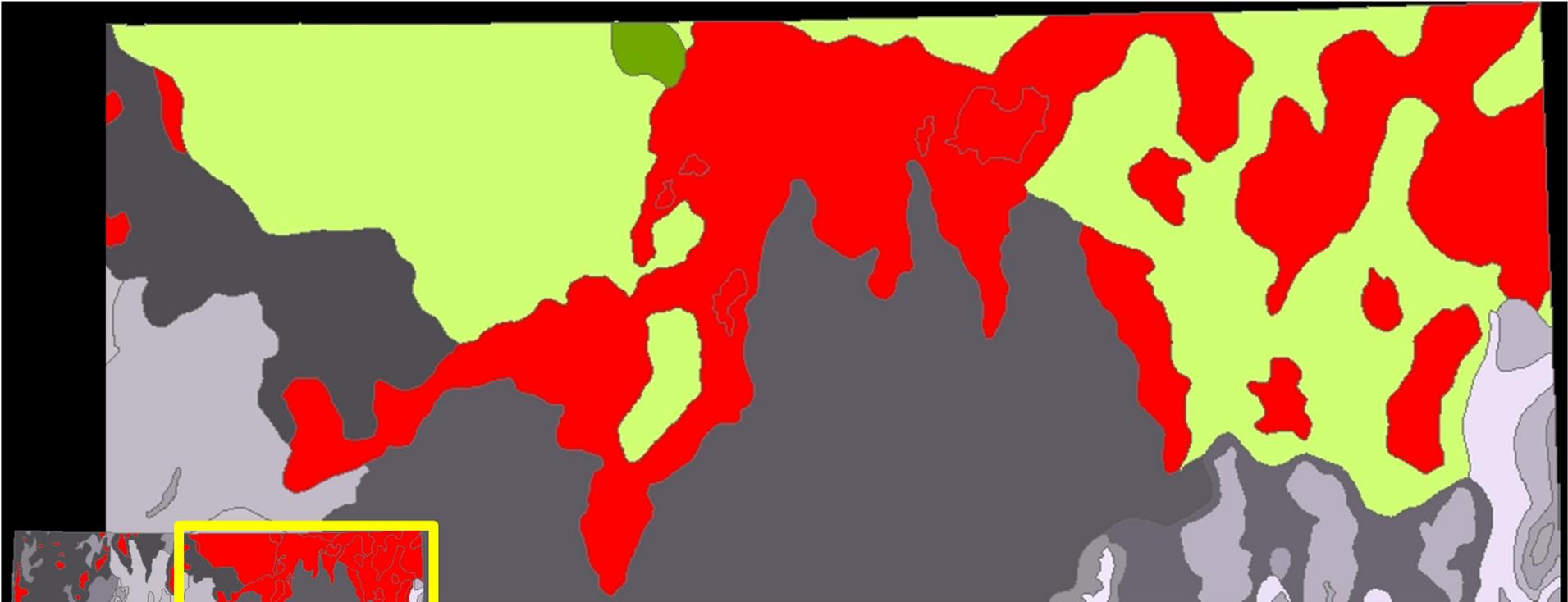


Dissected High Lava Plateau (80a)

Elevation (m) 1490 – 2225

Precipitation (cm) 20 – 40

- Rolling, high volcanic plateaus dissected by deep, shear walled canyons.
- Perennial, ephemeral or intermittent streams, rivers of variable gradients by snow-melt and springs.

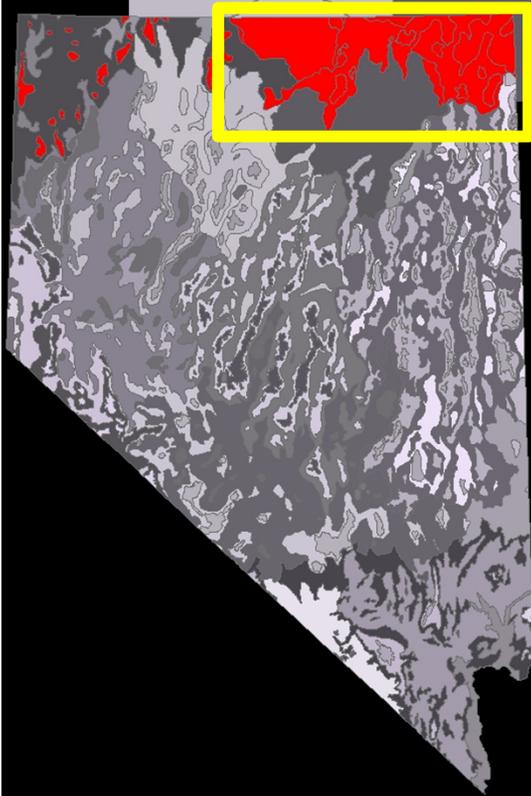
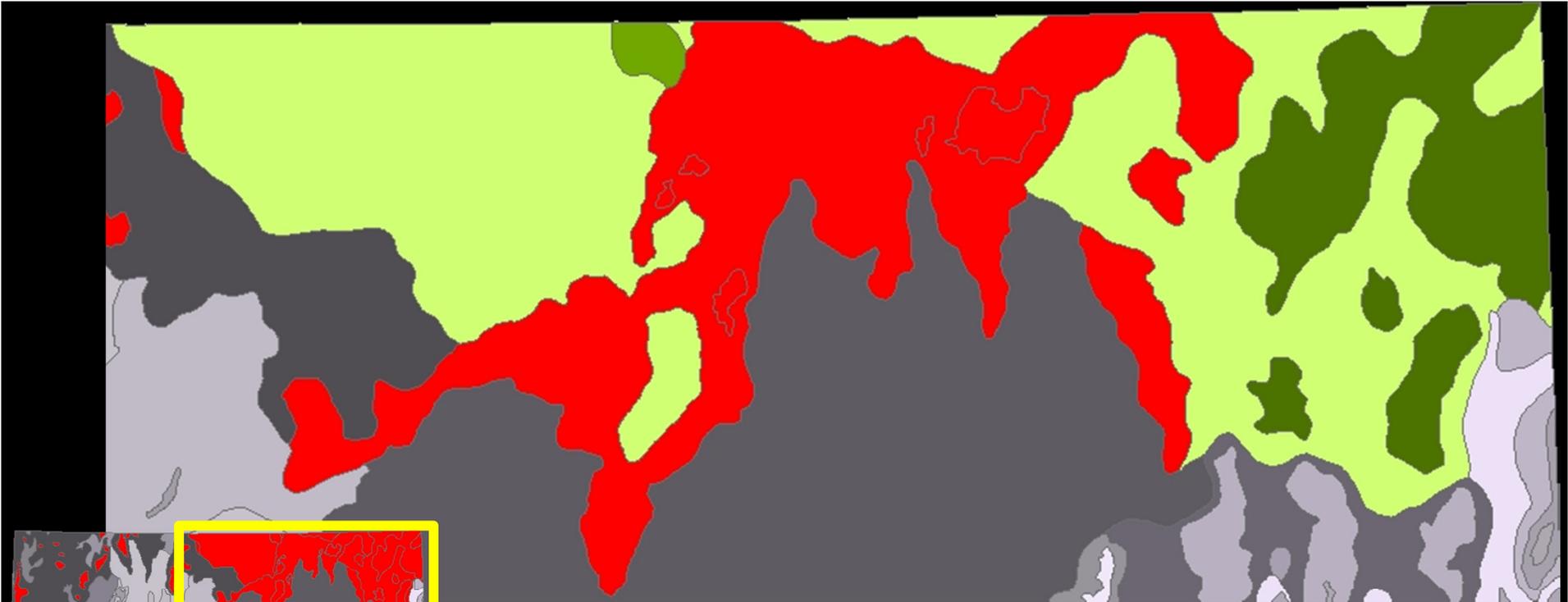


High Desert Wetlands (80e)

Elevation (m) 1615 – 1645

Precipitation (cm) 25 – 40

- Remnant wetlands, floodplains, alluvial terraces, lakes and reservoirs.
- Perennial or ephemeral streams have low- to moderate gradients.

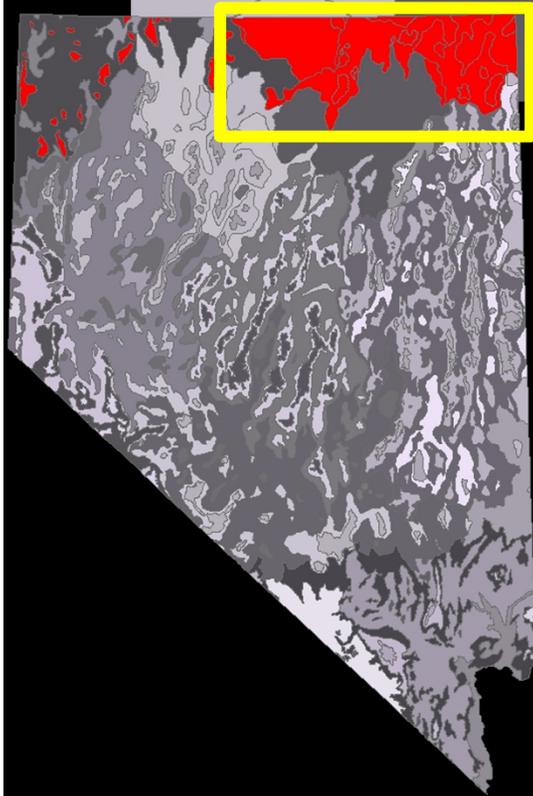
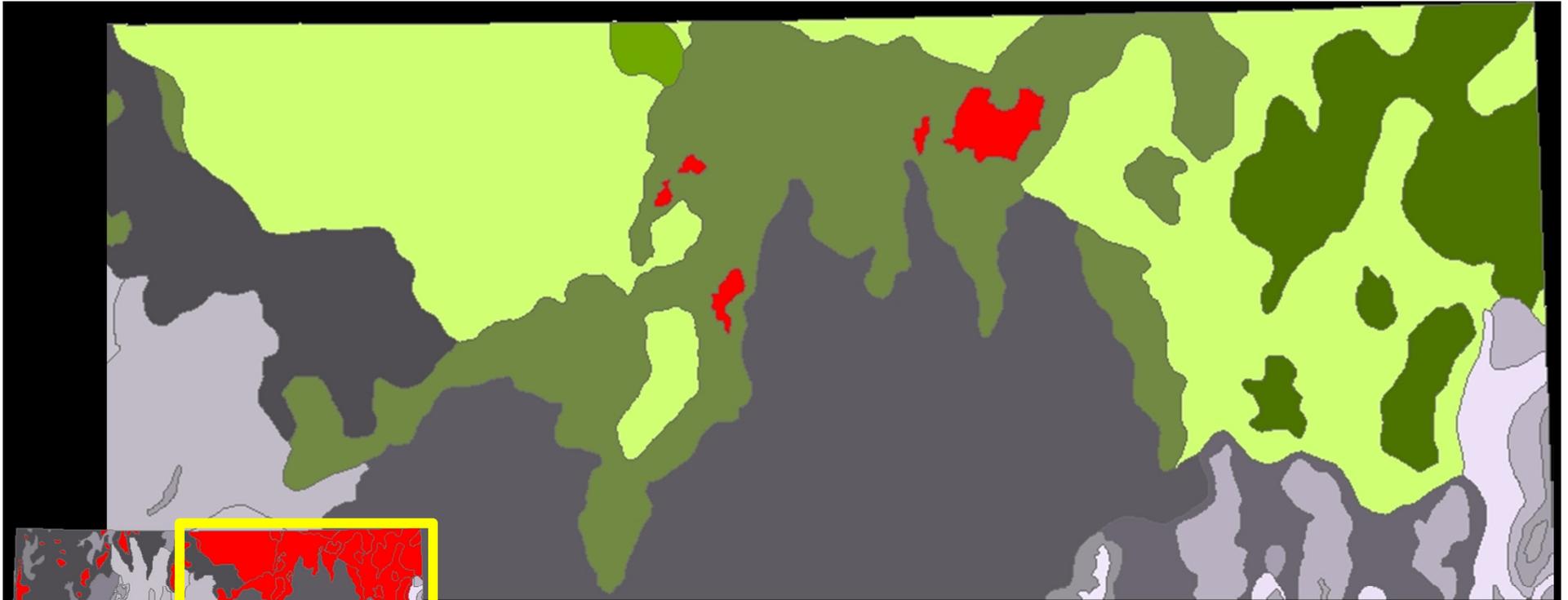


Semiarid Hills and Low Mountains (80b)

Elevation (m) 1760 – 2530

Precipitation (cm) 25 – 50

- Hills, low mountains and alluvial fans.
- Stream flows seasonally variable.
- Low- to moderate-gradient perennial, intermittent and ephemeral streams.

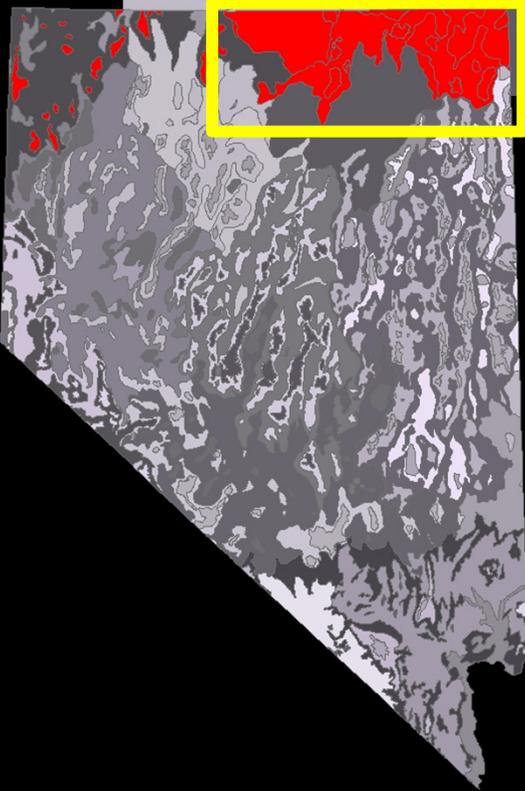


Semiarid Uplands (80j)

Elevation (m) 1760 – 2950

Precipitation (cm) 30 – 45

- Hills, low- and mid-elevation mountain slopes.
- Moderate- to high-gradient perennial, intermittent and ephemeral streams.

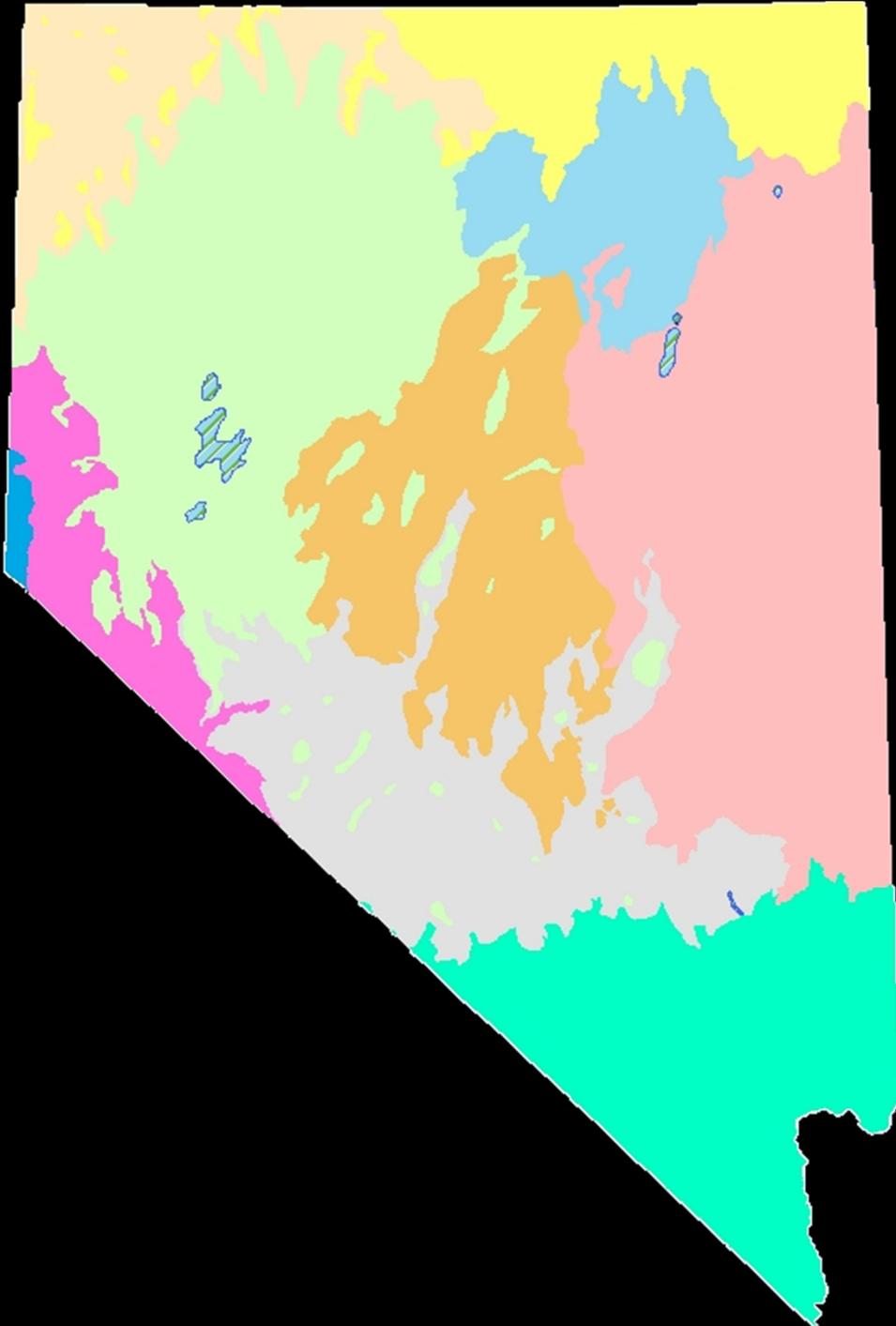


Partly Forested Mountains (80k)

Elevation (m) 2440 – 3320

Precipitation (cm) 40 – 66

- High, rugged mountains with glacial features.
- Perennial or intermittent, high-gradient cold streams are fed by snow-melt and springs.



Eco 3	Eco 3.5	Streams/ Biosites
Northern (80)	Northeast	28/59
	Northwest	37/39
Central (13)	Upper Humboldt	48/49
	Carbonate	24/32
	Central	29/46
	Lahontan	23/68
	East Sierra	37/73
	Tonopah	0/0
	Sierra Nevada	38/95
	Mojave	9/18

Why the Effort?



Northeast

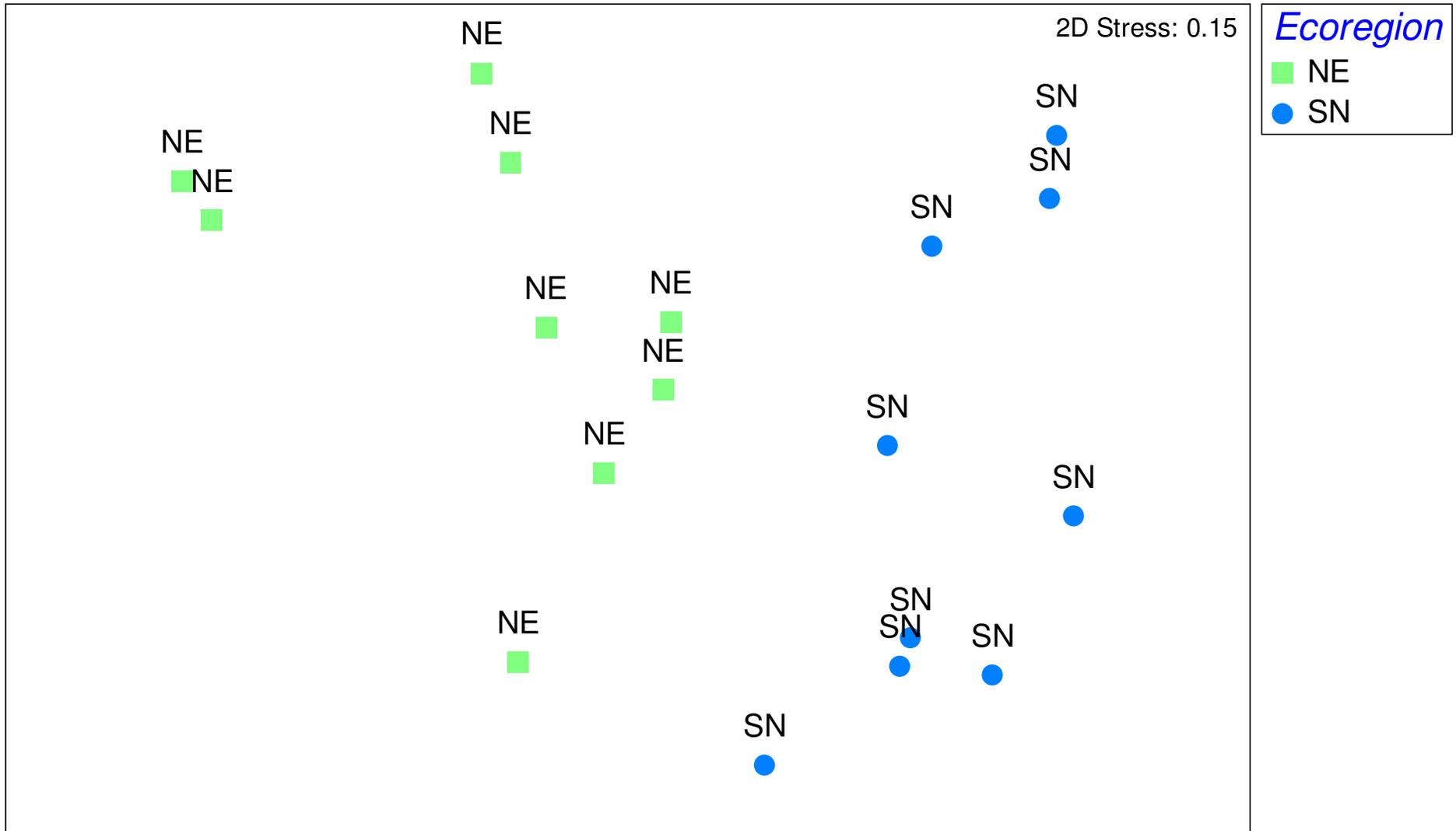
Sierra Nevada

Ecoregion

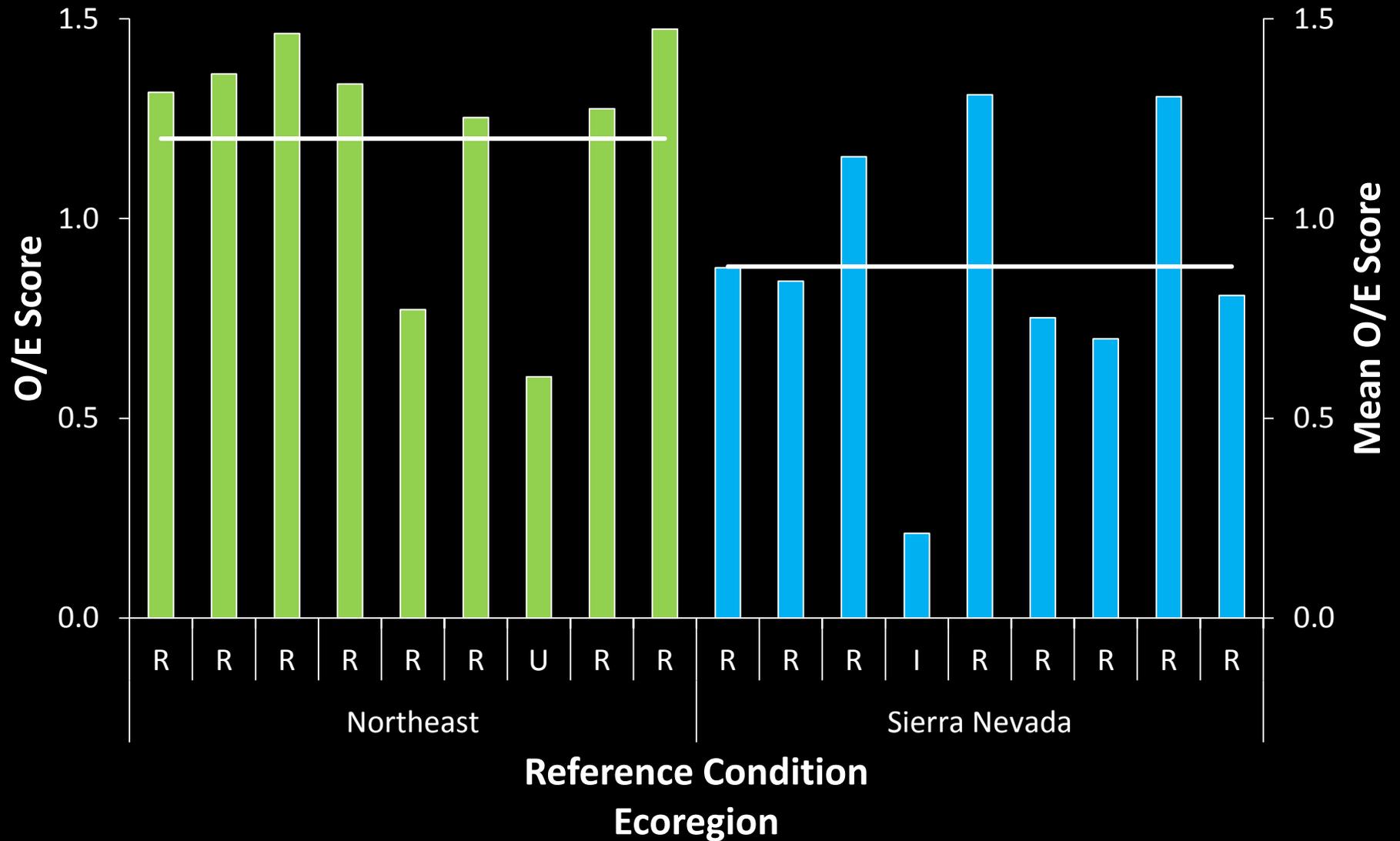
- Nine randomly selected streams from each ecoregion.
 - Across the elevation gradient.
 - Sampled with full EMAP or SWAMP protocols.
 - From previous probabilistic surveys.
- Ecological indicators & stressors.
 - Xeric
 - Western Mountain

Benthic Community Similarity

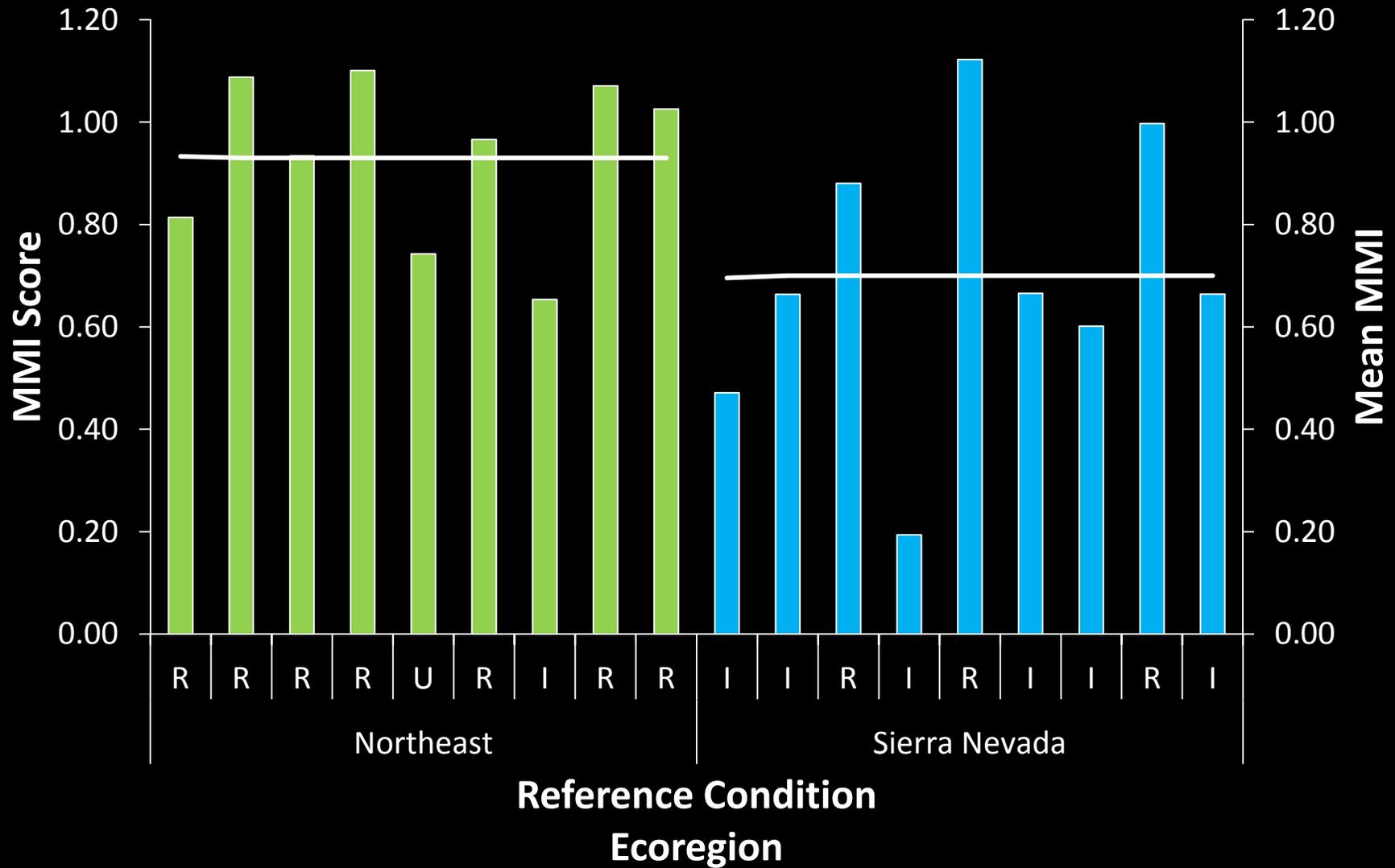
Transform: Log(X+1)
Resemblance: S17 Bray Curtis similarity



Observed/Expected

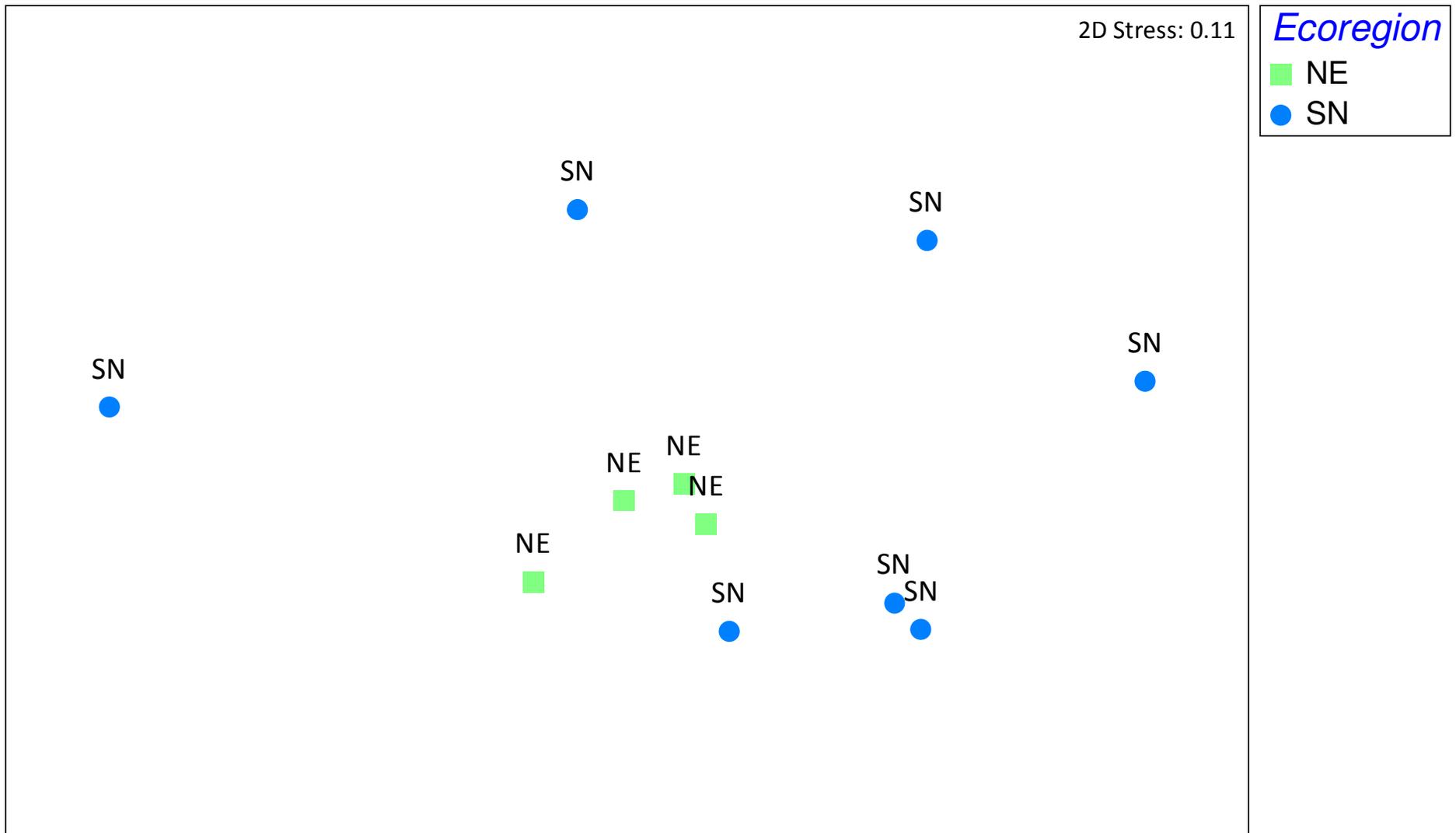


Multimetric Index



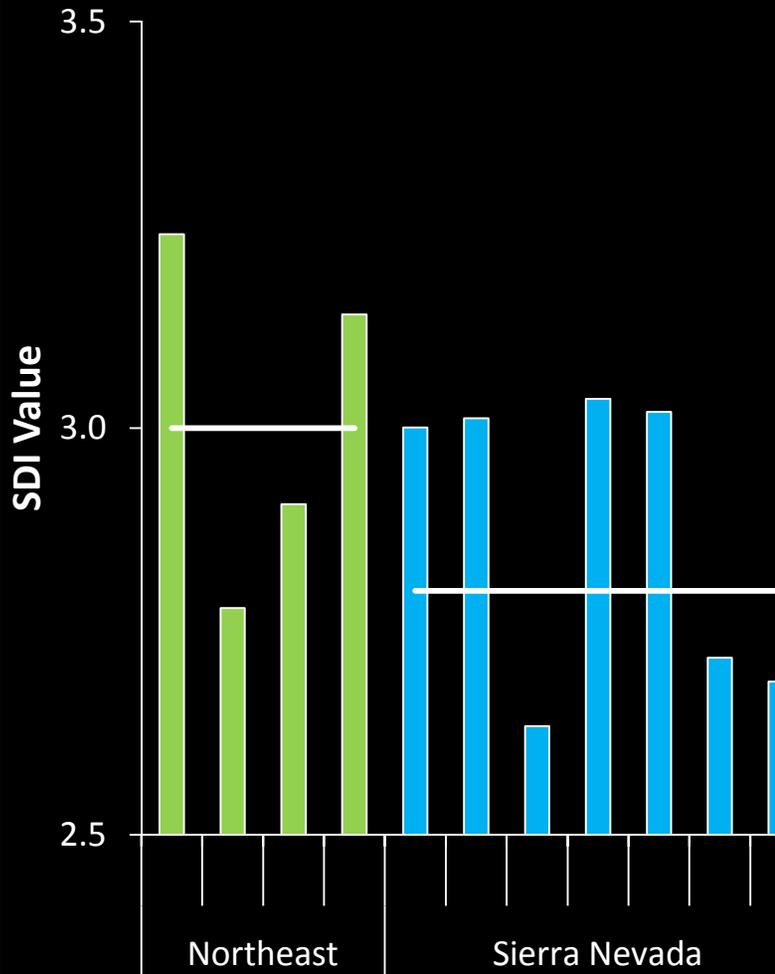
Periphyton Community Similarity

Transform: $\text{Log}(X+1)$
Resemblance: S17 Bray Curtis similarity

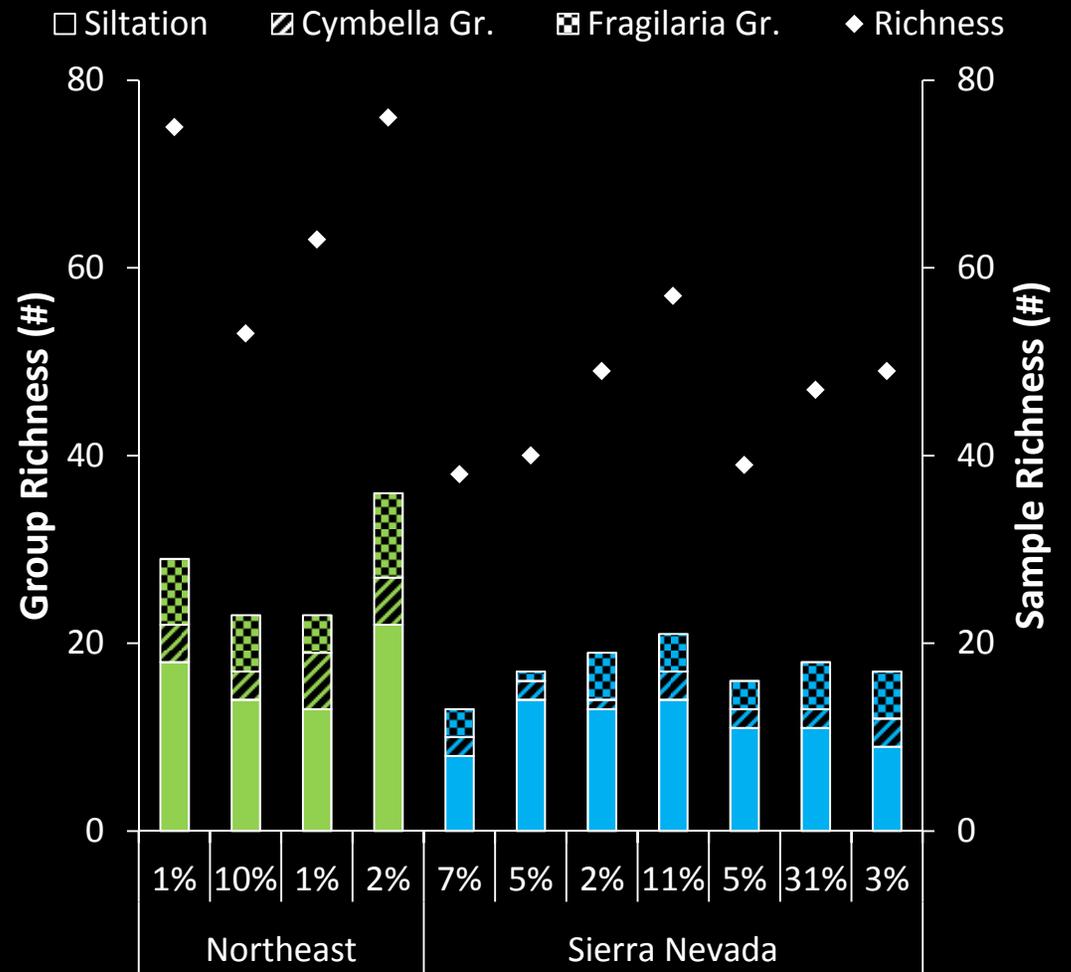


Periphyton MMI Candidates

Shannon (H')

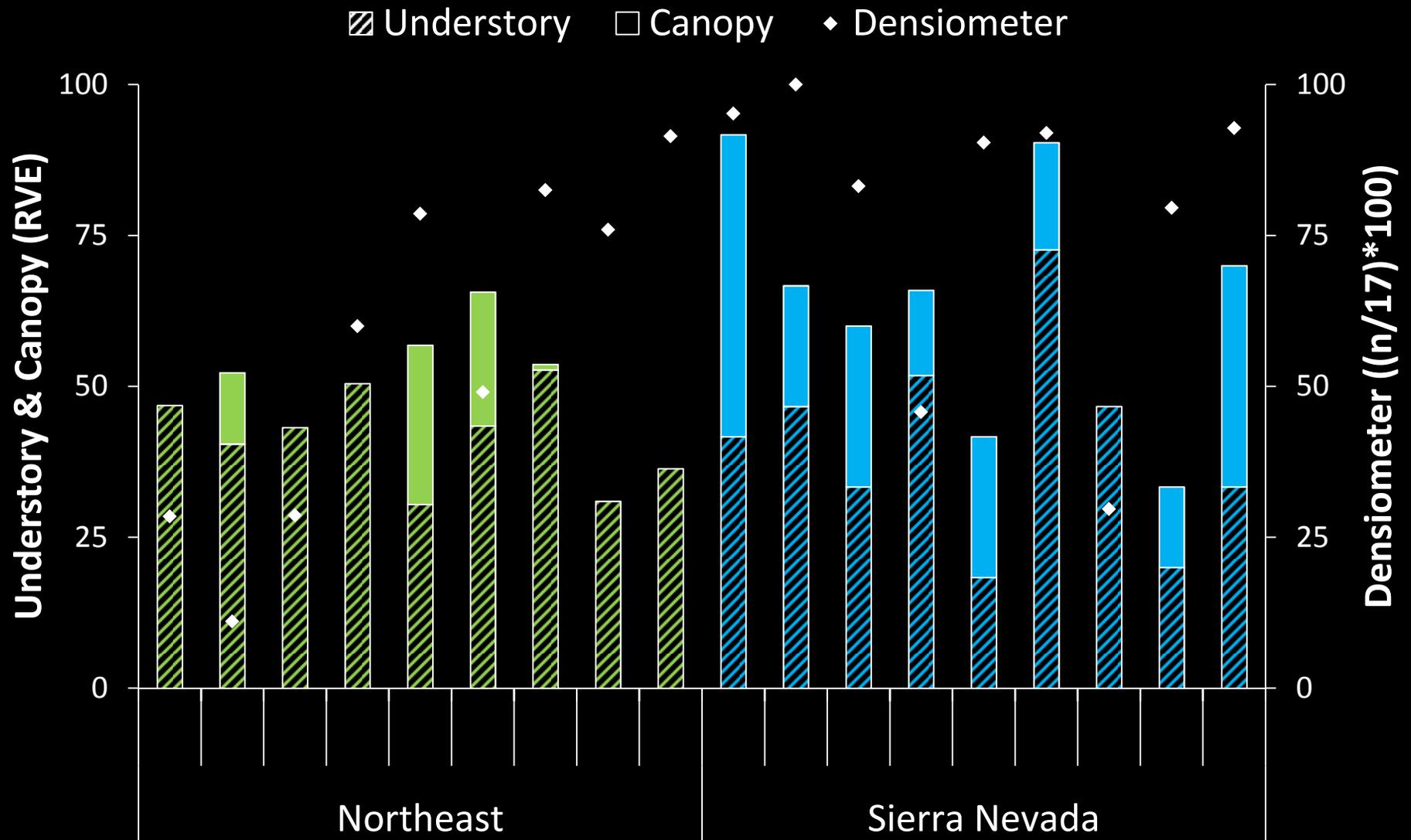


Other



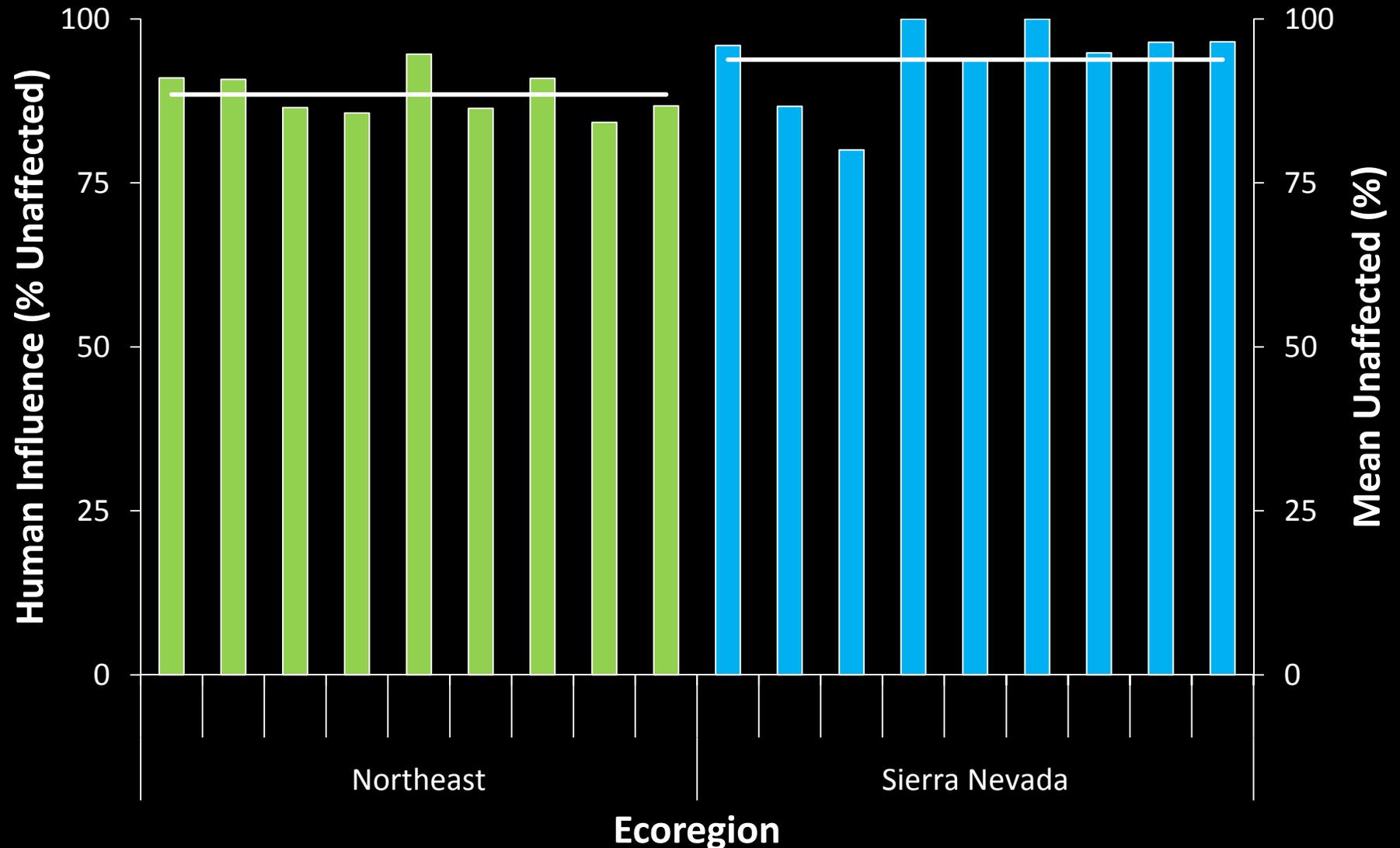
Ecoregion

Riparian Vegetation

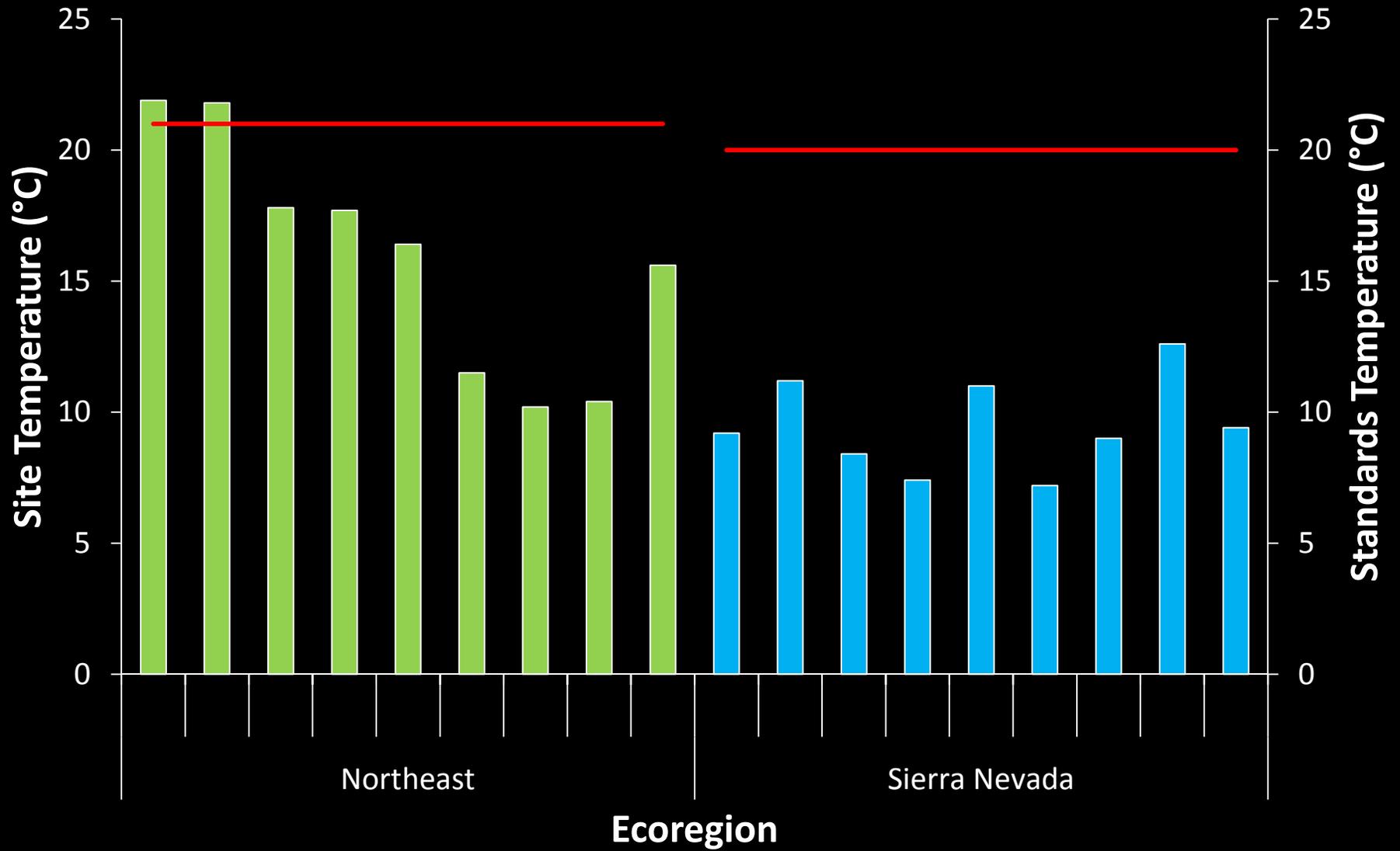


Human Influence

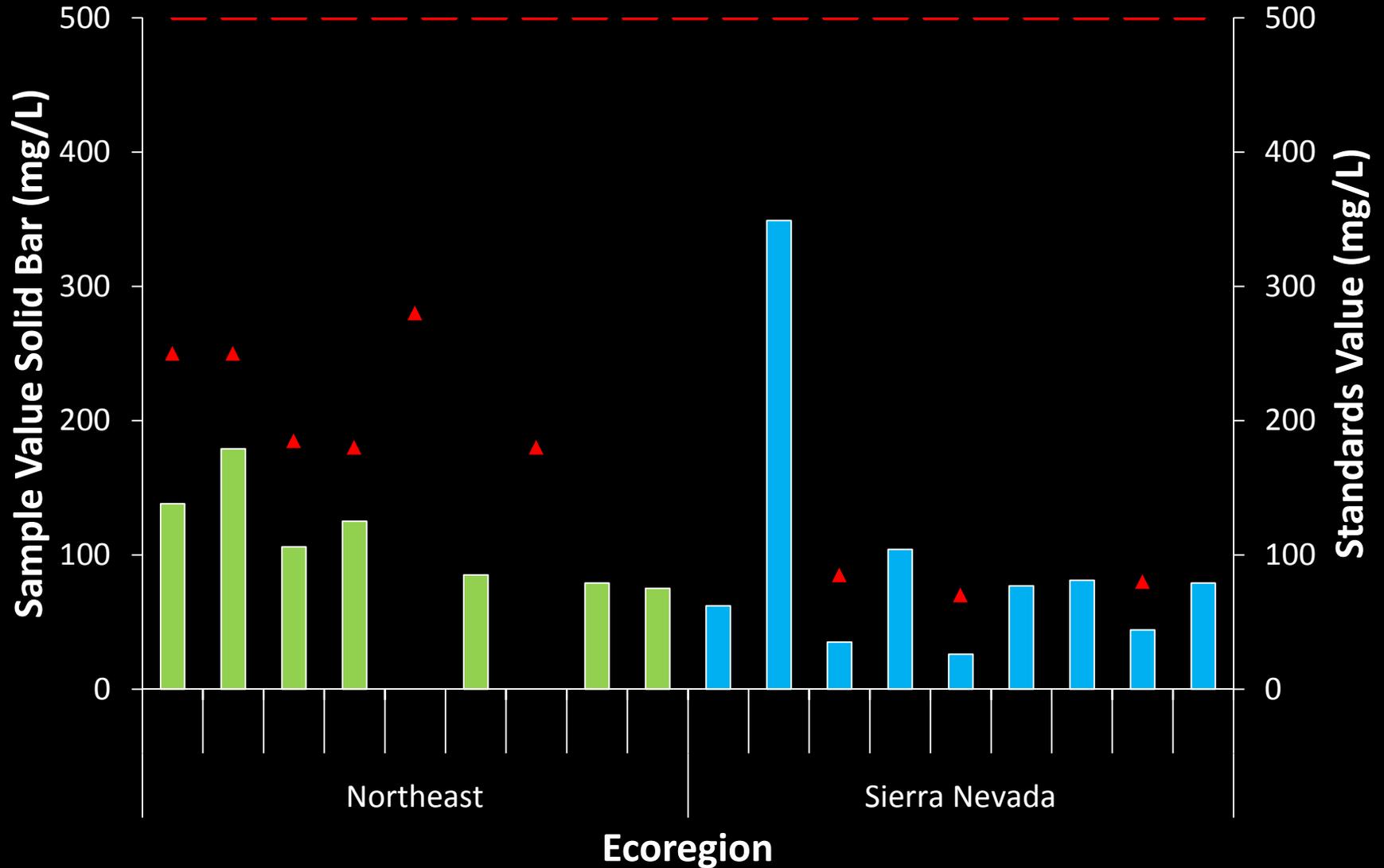
(Unaffected Riparian Visual Estimate & Watershed Activity)



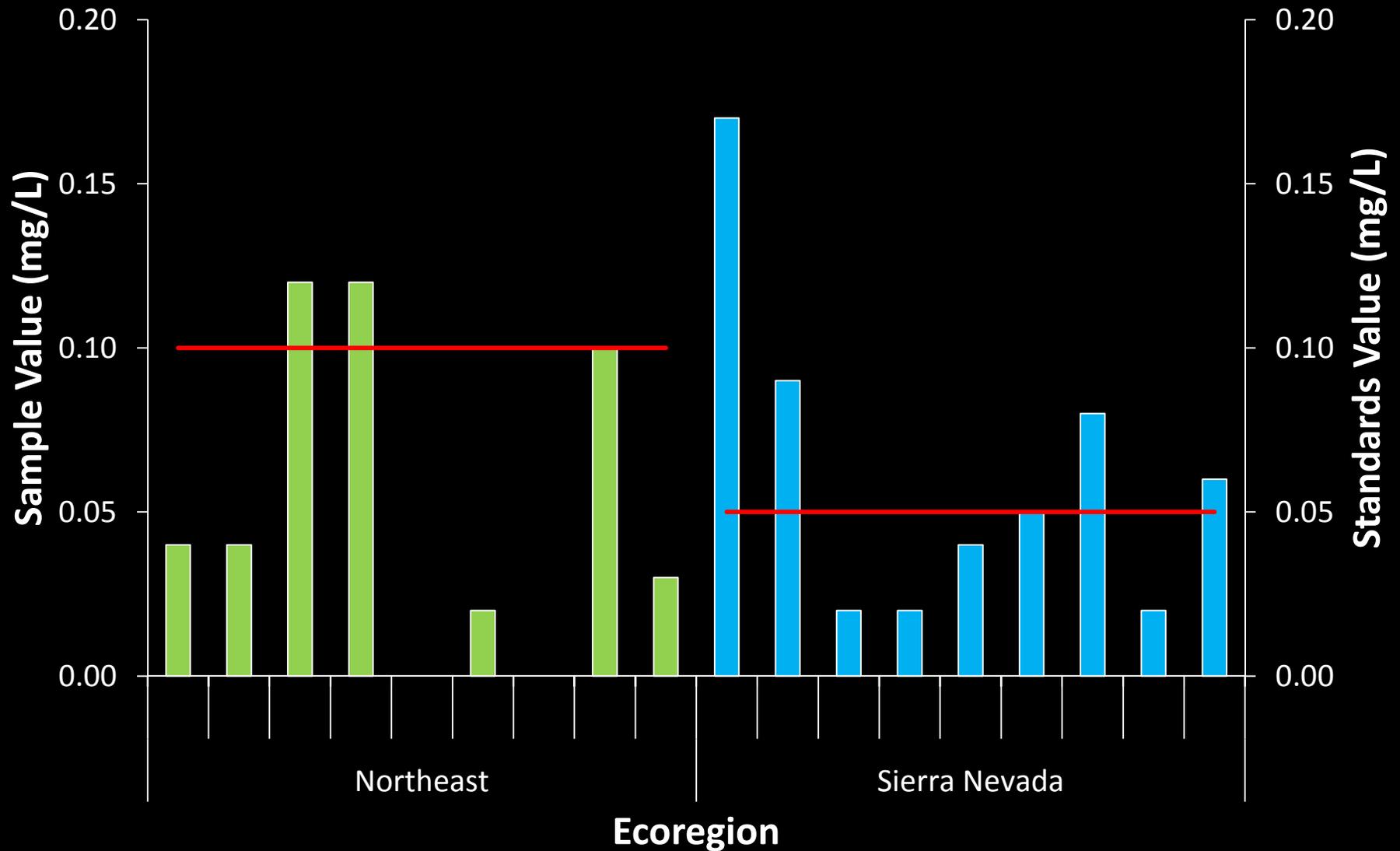
Temperature



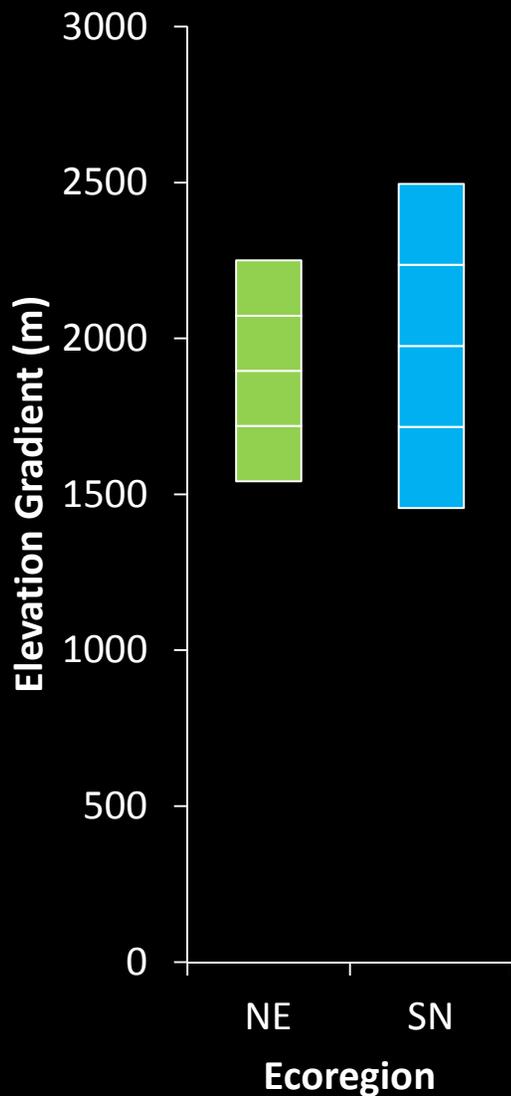
Total Dissolved Solids



Phosphorus

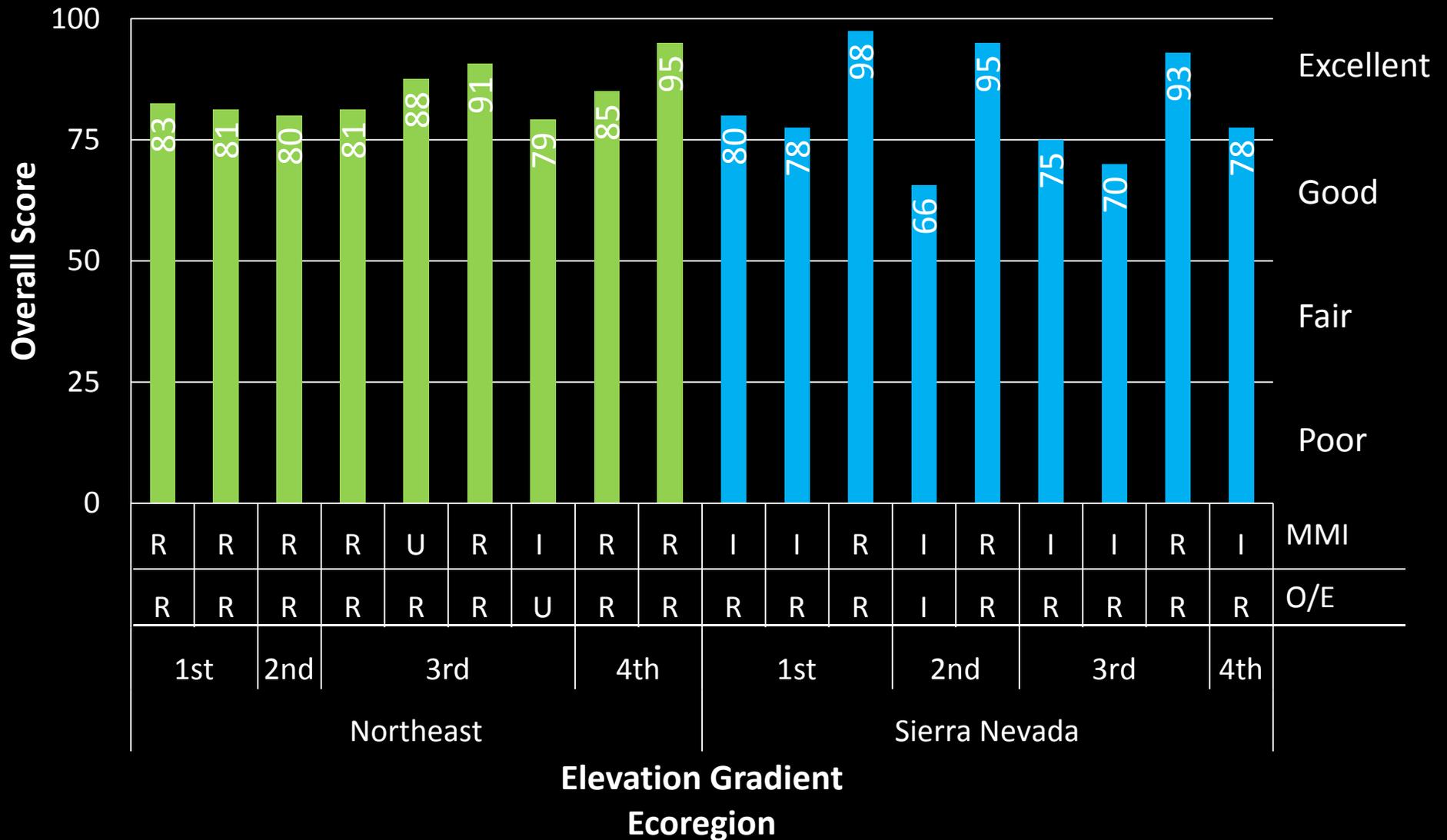


Putting It All Together



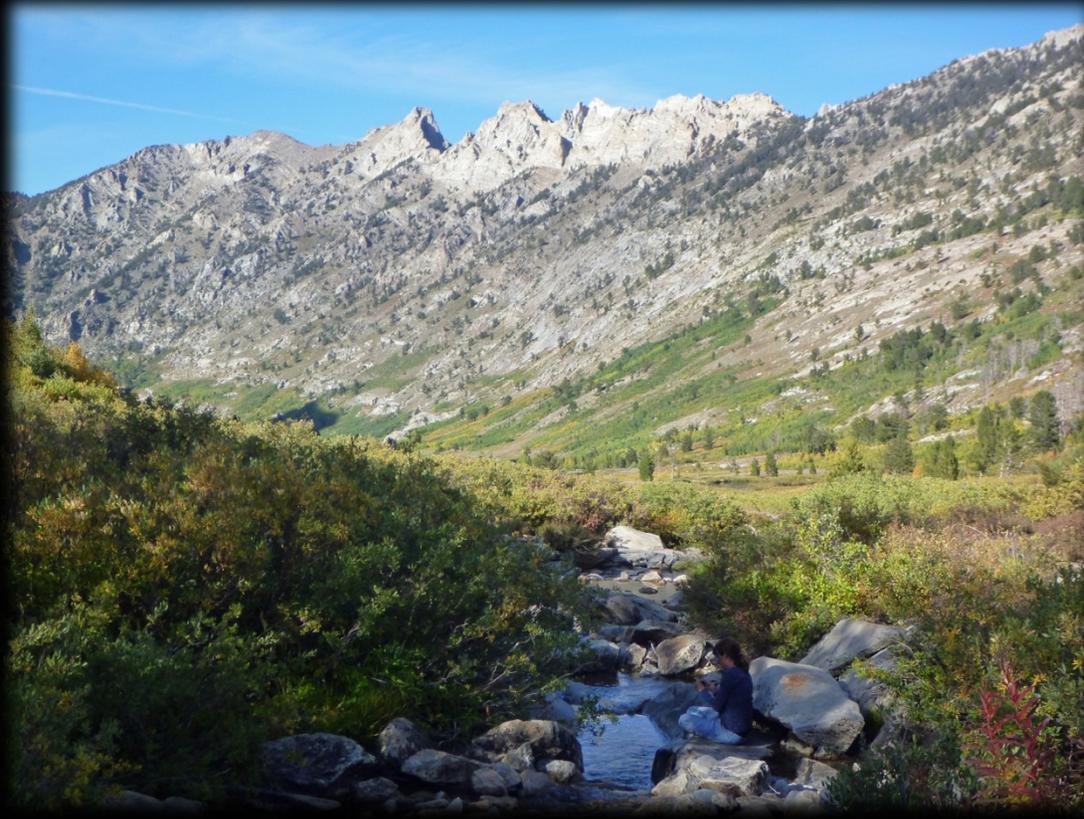
Indicator	Value	Scoring
O/E	0 – 1.0	Converted to a 0 – 100 scale and ranked as quartiles
MMI		
Shannon	0 – 3.5	Converted to a 0 – 100 scale and ranked as quartiles
Future Periphyton MMI		
Riparian Habitat	Values averaged over 11 transects	Converted to 0 – 100 scale and ranked as quartiles
Temperature	In-situ value	Below standard = 4 Exceeds standard = 0
Phosphorus	Laboratory Results	Below standard = 4 Exceeds value to maintain existing higher quality = 2
Total Dissolved Solids		Exceeds standard = 0

Overall Ecological Integrity Score



So now I need to know...

- What indicators best reflect overall ecological integrity?
- Should different indicators be weighed more heavily?
- Should different indicators be weighed differently by Ecoregion 3.5?
- Too much, too little or just right?





Thank you!

WaterbodyName	Watering of Livestock	Irrigation	Aquatic Life	Contact Recreation	Non-Contact Recreation	Municipal or Domestic Supply	Industrial Supply	Propagation of Wildlife	Enhancement Water Quality	O/E	MMI	Ecological Integrity
Salmon Falls			1,2,6	2						R	R	82.5 Excellent
Salmon Falls			1,2,6	2						R	R	81.3 Excellent
Piney										R	R	80.0 Excellent
Walker Gulch										R	R	81.3 Excellent
Snow Canyon						5				R	U	87.5 Excellent
Camp			1							R	R	90.6 Excellent
Meadow										U	I	79.2 Excellent
Deadman's	No Designated Beneficial Uses									R	R	85.0 Excellent
Cadle										R	R	95.0 Excellent
Unnamed trib to Edgewood										R	I	80.0 Excellent
Glenbrook			2					2		R	I	77.5 Excellent
Incline			2,3,4	4				4	2	R	R	97.5 Excellent
Logan House										I	I	65.6 Good
Wood			7							R	R	95.0 Excellent
Secret Harbor										R	I	75.0 Excellent
North Canyon										R	I	70.0 Good
Third			2,3,4,7	4				4	2	R	R	95.0 Excellent
Slaughterhouse										R	I	77.5 Excellent
	1	Temp	Fully Supporting							Reference		
	2	Total P	Not Supporting							Undetermined		
	3	DO	Insufficient Info.							Impaired		
	4	pH	Not Assessed									
	5	TDS										
	6	TSS										
	7	Zinc										