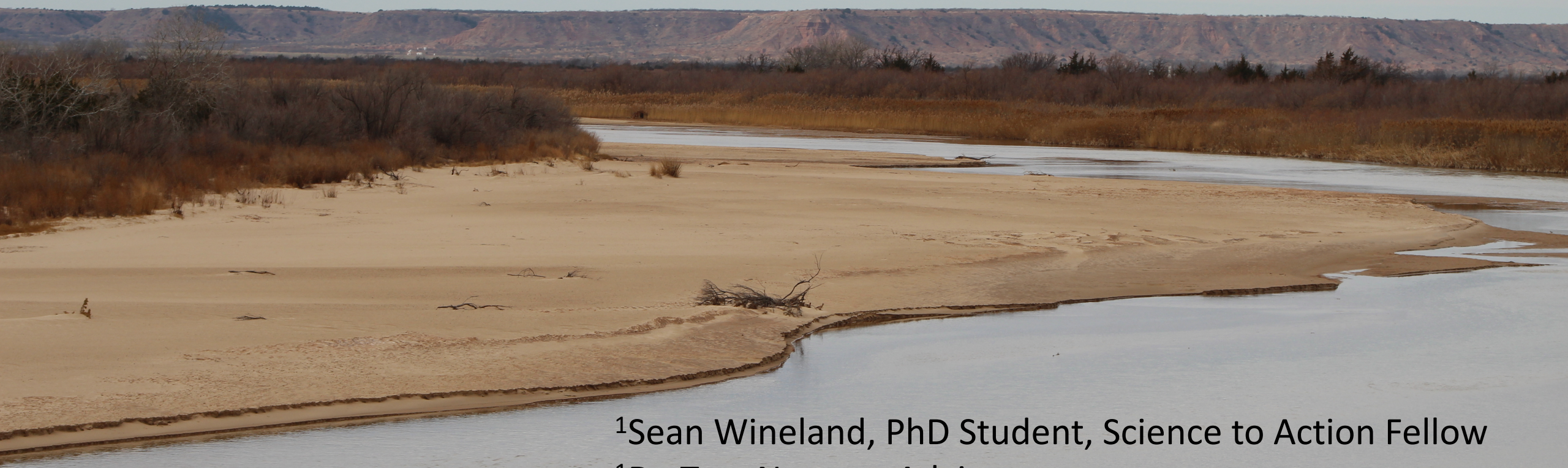
Identifying Conservation Priorities By Combining the Where to with the How to: A Case Study for Implementing Environmental Flows in the Red River Basin

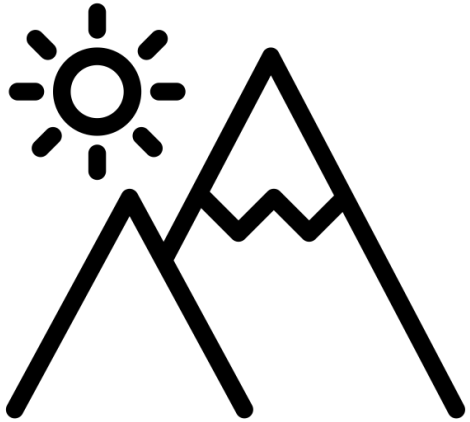


[1]Sean Wineland, PhD Student, Science to Action Fellow
[1]Dr. Tom Neeson, Advisor

[1]Department of Geography and Environmental Sustainability, University of Oklahoma

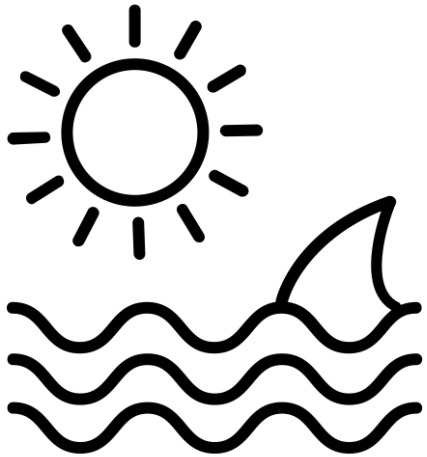
Declining Biodiversity Highlights Need to Accelerate Implementation of Conservation Initiatives

Terrestrial



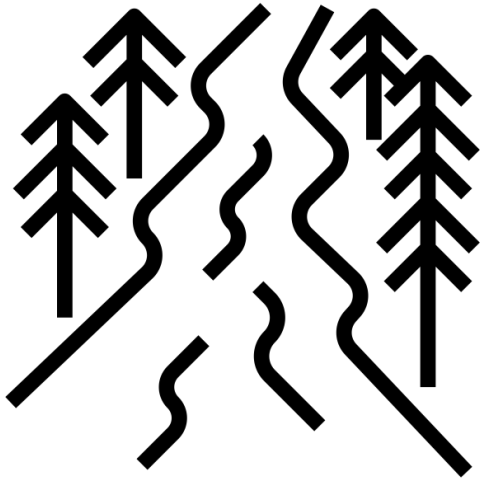
↓38%

Marine



↓44%

Freshwater

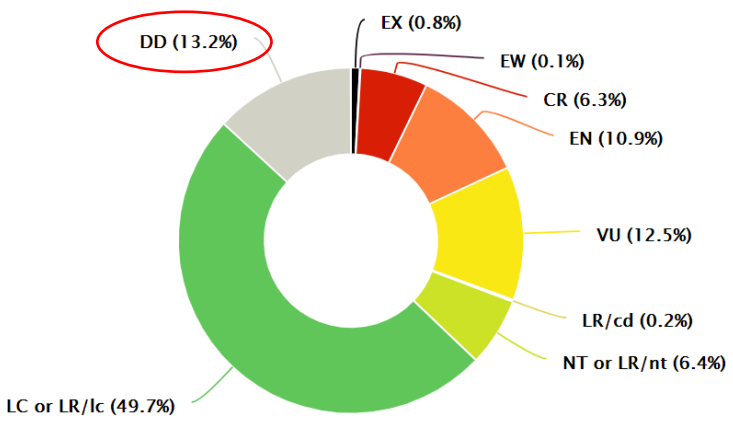


↓81%

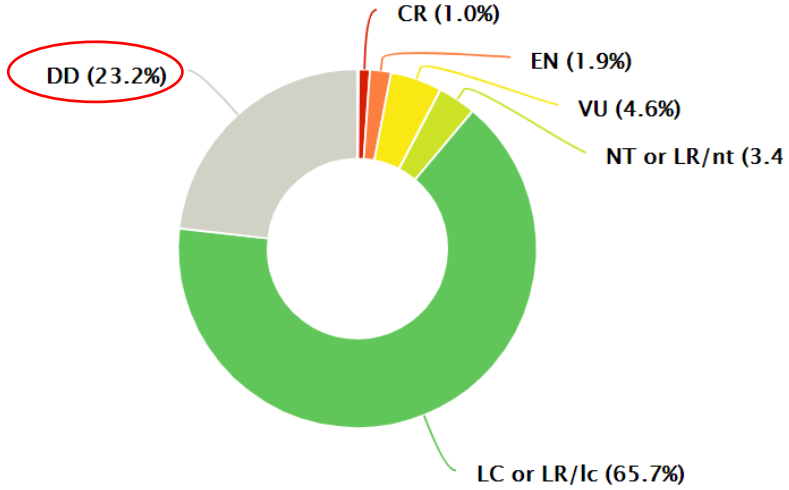
1970-2012 population abundance trends, WWF Living Planet Index

Declining Biodiversity Highlights Need to Accelerate Implementation of Conservation Initiatives

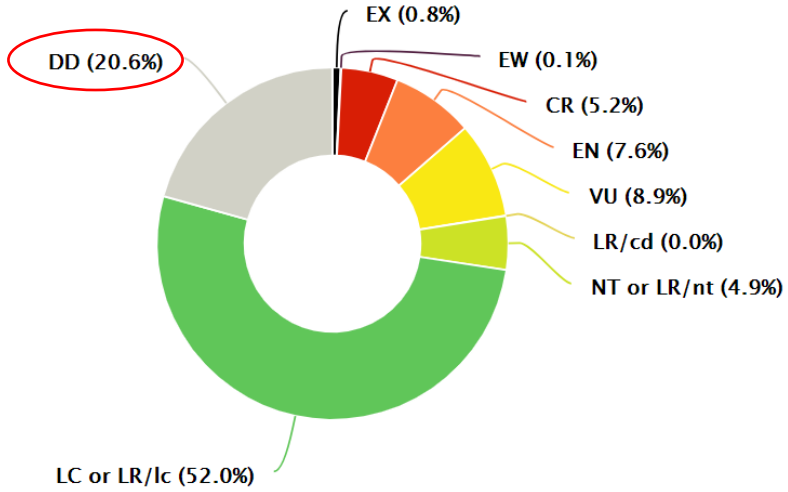
Terrestrial



Marine



Freshwater



- EX – Extinct
- EW – Extinct In The Wild
- RE – Regionally Extinct (regional category)
- CR – Critically Endangered
- EN – Endangered
- VU – Vulnerable
- LR/cd – Lower Risk: Conservation Dependent
- NT or LR/nt – Near Threatened
- LC or LR/lc – Least Concern
- DD – Data Deficient
- NA – Not Applicable (regional category)

IUCN RedList Endangerment Categories by System

Biodiversity: Patterns AND Processes

Patterns

- Distribution
- Abundance
- Occupancy
- Richness
- Diversity
- Rarity

Processes

- Primary production
- Carbon cycling
- Habitat use
- Ecosystem services
- Phenology
- Vegetation dynamics
- Hydrologic dynamics

Question 1:

What are some patterns and processes of biodiversity that you manage or study?

Post them in the chat!

Conservation Prioritization: Where and how to act?

Decision makers/resource managers (you!) might face the difficult challenge of deciding where to allocate increasingly scarce resources for both human and environmental needs under increasingly challenging and uncertain future sociopolitical and environmental climates (how to)

Question 2:

What are some difficult resource allocation problems or tradeoffs that currently face or study, or anticipate in the future?

Post them in the chat!

Conservation Planning

Conservation Prioritization Stages

Research & Assessment Phase

- Scoping and costing the planning process
- Identifying and involving stakeholders
- Describing the context for the conservation initiative
- Identifying conservation goals
- Collecting data
- Identify priority conservation areas
- Setting conservation objectives

Implementation Phase

- Implementing conservation initiative in selected areas
- Maintain and adaptively manage conservation initiative

Knowing But Not Doing: Selecting Priority Conservation Areas and the Research–Implementation Gap

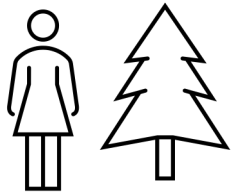
ANDREW T. KNIGHT,*†† RICHARD M. COWLING,* MATHIEU ROUGET,† ANDREW BALMFORD,‡
AMANDA T. LOMBARD,*§ AND BRUCE M. CAMPBELL**

Only 5.7% of conservation plans ever reached implementation!

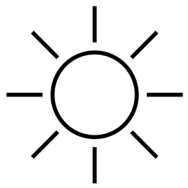
The Implementation Crisis: Why?

1. Conservation initiatives fail to tackle problems from a social-ecological systems perspective

2. Failure to consider important sociopolitical factors



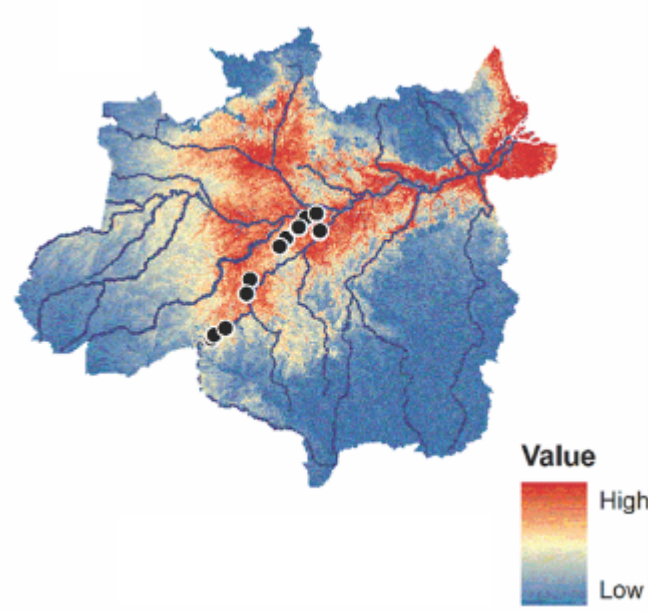
3. Complex tradeoffs between conservation outcomes and human needs



4. Failure to consider climate adaptation and resilience

Prioritizations tend to only focus on the *where to*

Spatial Patterns (i.e., species distribution models)



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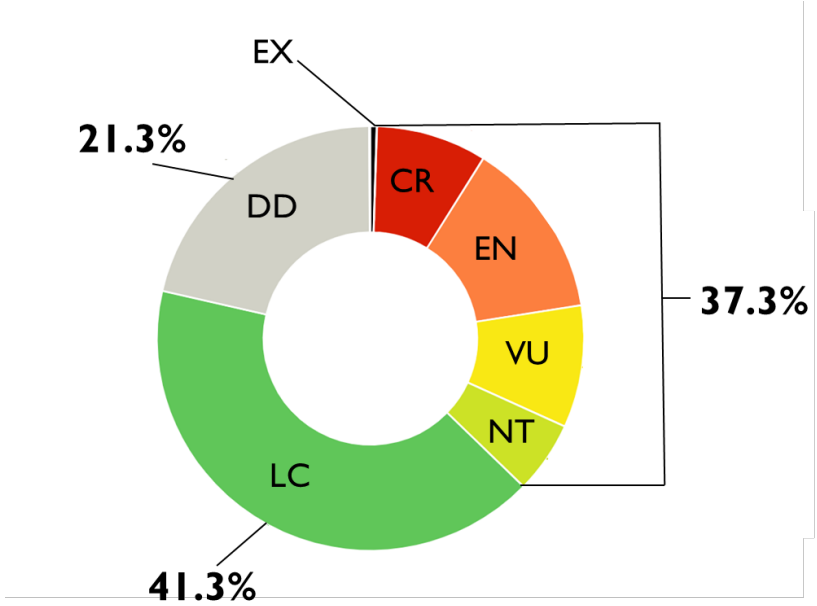
Biodiversity Value



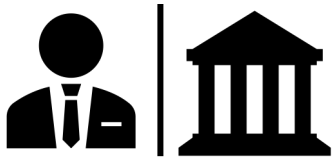
:Hayes et. al. 2018

Prioritizations fail to consider the *how to*

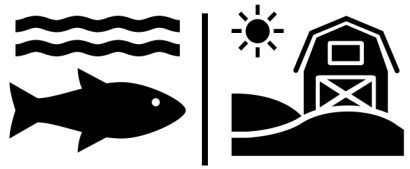
Conservation Feasibility: the sociopolitical factors that contribute to the likelihood of a conservation initiative being implemented and successful

Willingness to participate/sell

Socio-ecological value alignment



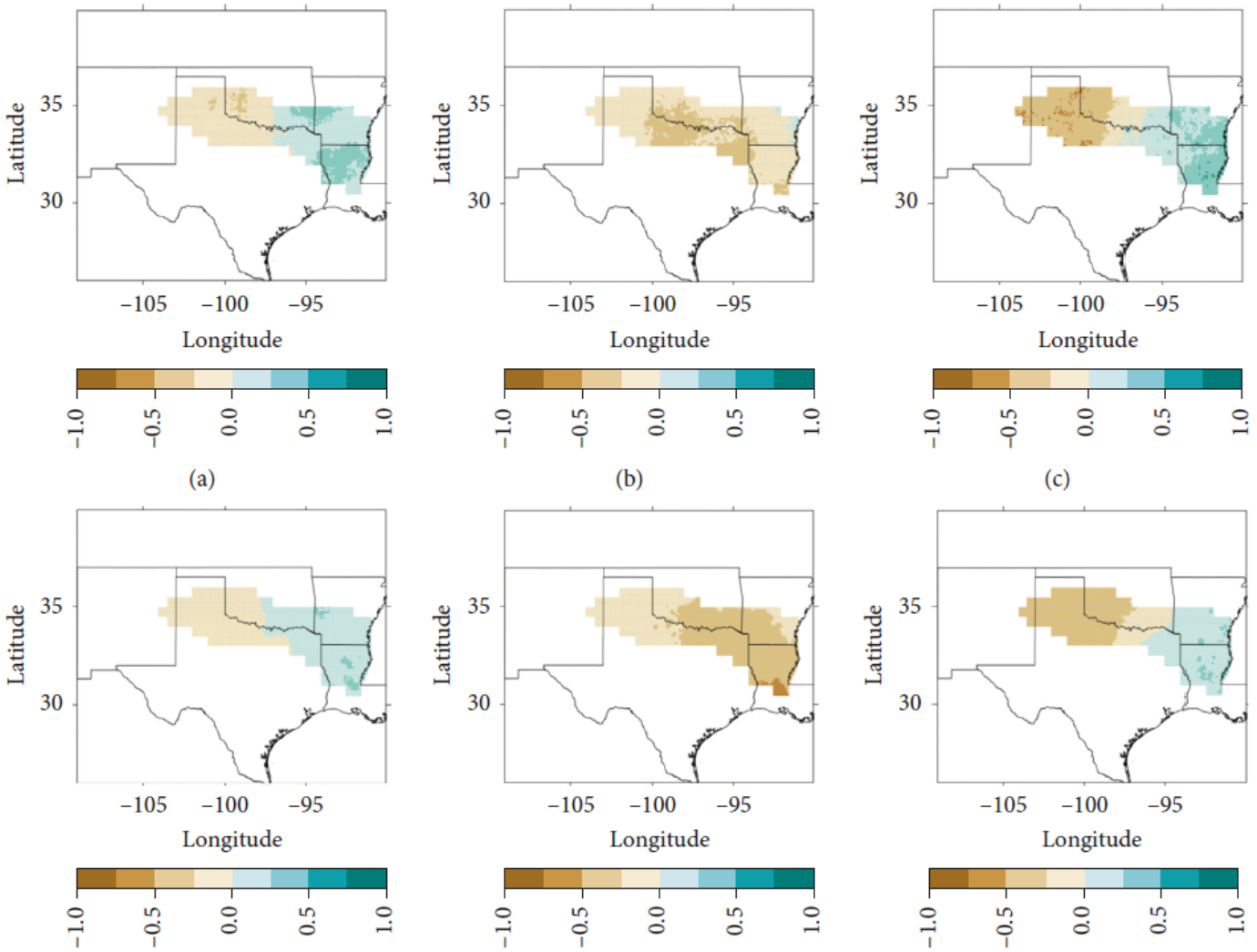
Socio-political/resource governance structures



Shared resource conflicts

Research → Implementation

Prioritizations fail to consider future climate projections



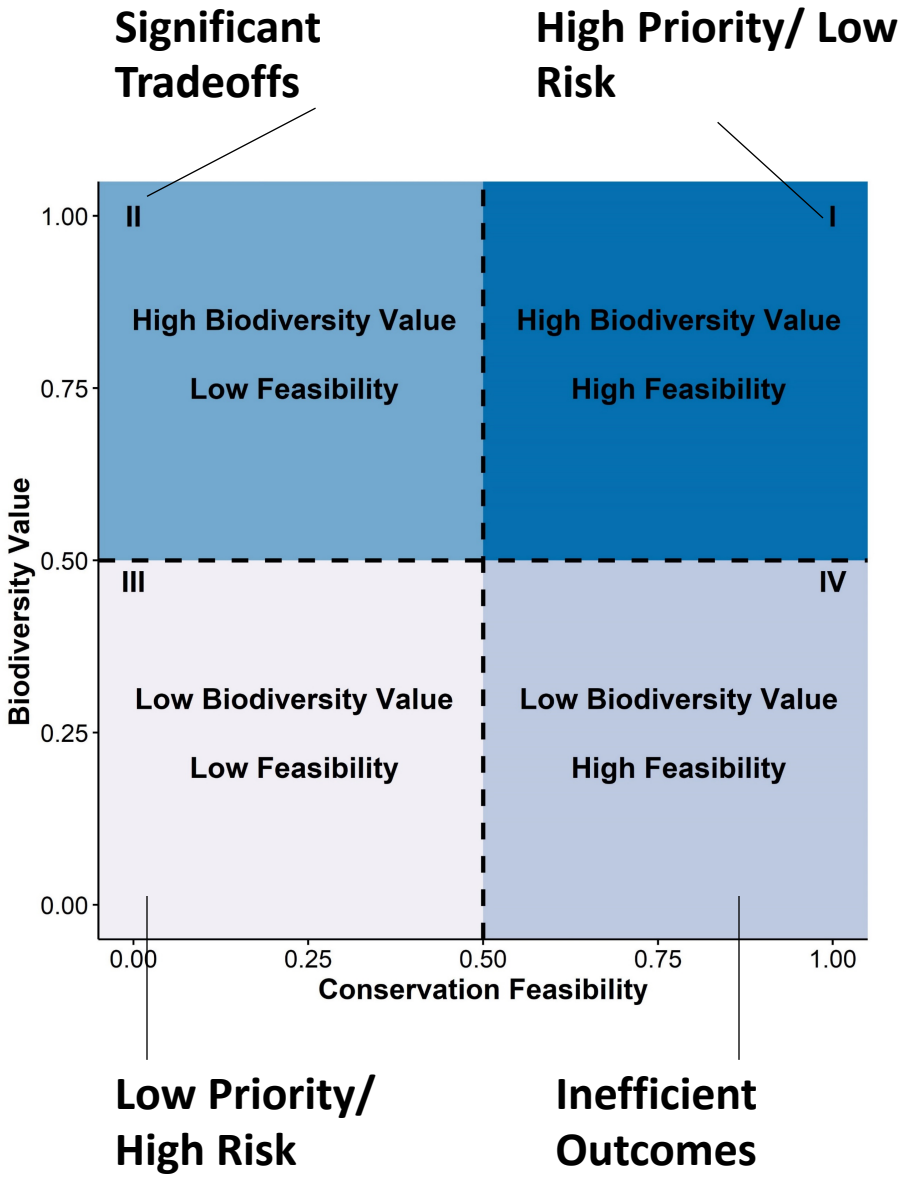
Difference fields for mean daily precipitation (mm/day) between (1981-2005) and (2075-2099)

:Bertrand & McPherson 2019

We developed a simple, flexible conservation prioritization framework

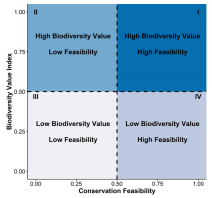
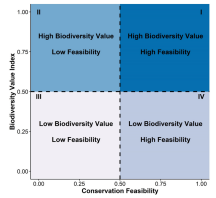
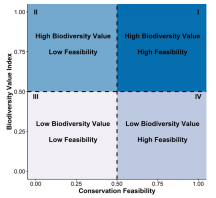
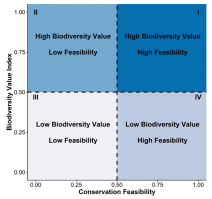
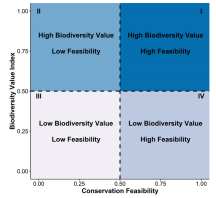
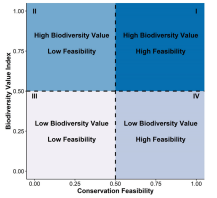
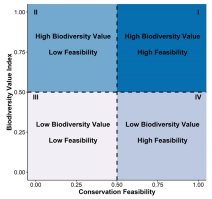
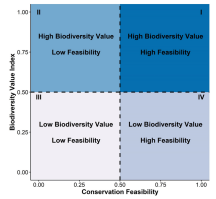
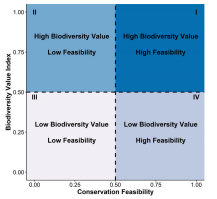
Map the tradeoffs between biodiversity value (where to?) and conservation feasibility (how to?) across future climate scenarios

1. Integrates social and ecological data
2. Identifies key factors that contribute to conservation feasibility
3. Identifies site-level variation in conservation priority
4. Identifies sites resilient to climate change

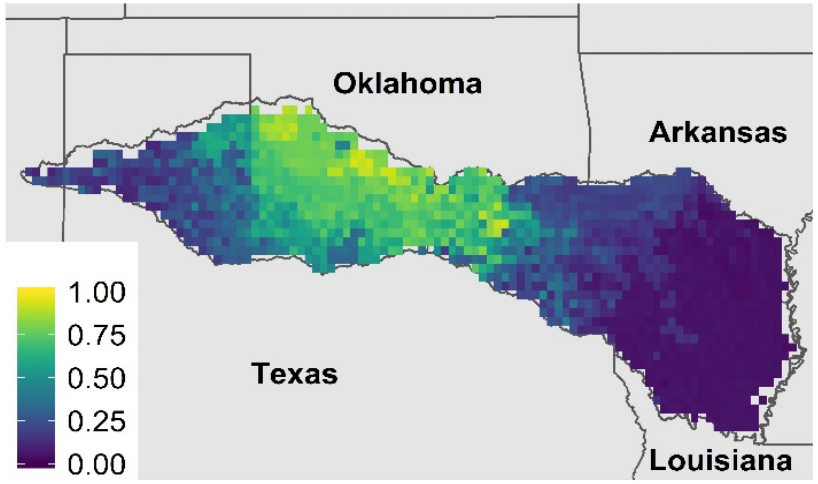


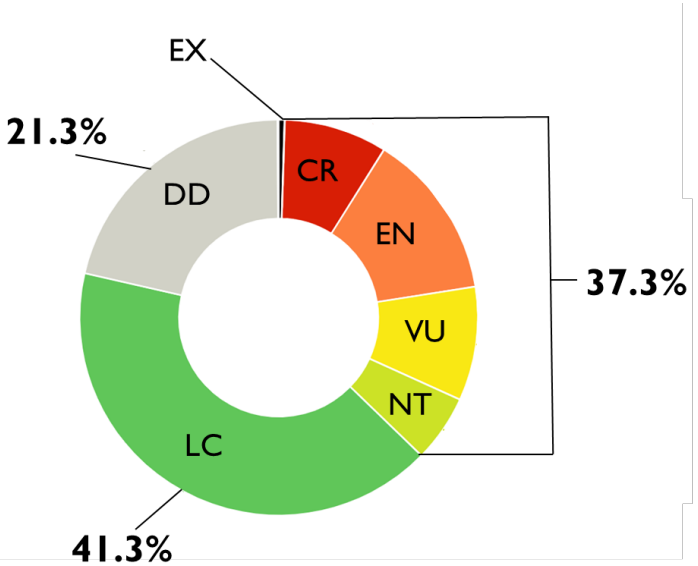
Allow Biodiversity Value and Conservation Feasibility to Vary Independently Across Future Climate Scenarios

General Circulation Model (GCM)

Representative Concentration Pathway (RCP)	CCSM4	MIROC5	MPI ESM LR
2.6			
4.5			
8.5			

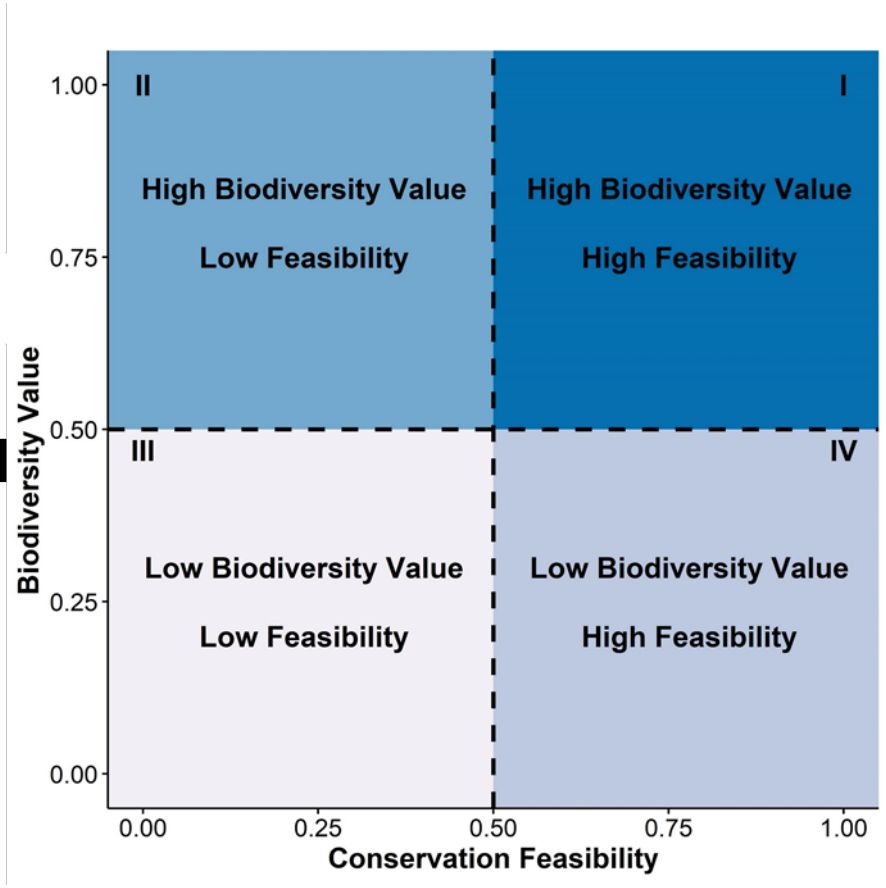
Biodiversity Value Applications





Example Applications:

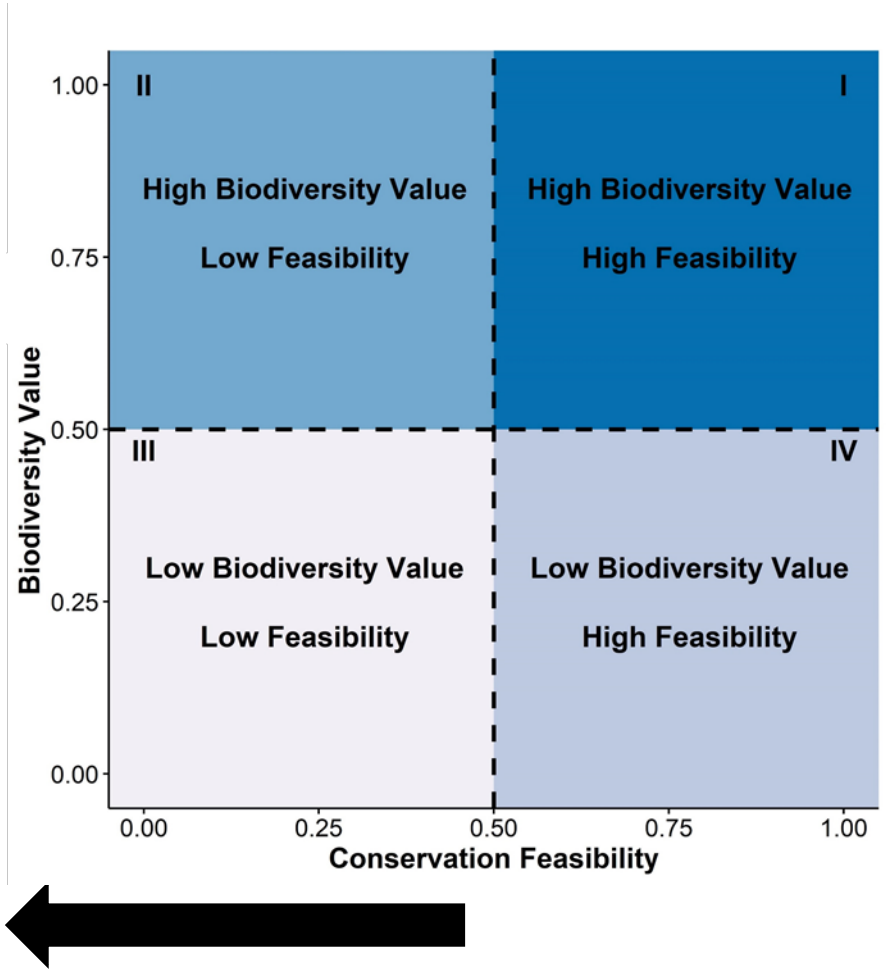
- Distribution, occupancy, abundance, etc. of species of interest
- Ecosystem services provided by species
- Habitat use or suitability
- Risk of endangerment

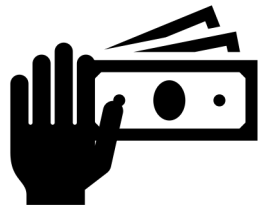


Conservation Feasibility Applications

Example Applications:

- Stakeholder or landowner's willingness to participate in conservation initiative
- Stakeholder or landowner's willingness to sell land or water rights
- Identifying sociopolitical barriers to implementation
- Identifying if public values align with ecological values
- Likelihood of a policy or program to be implemented
- Tradeoffs between shared resources



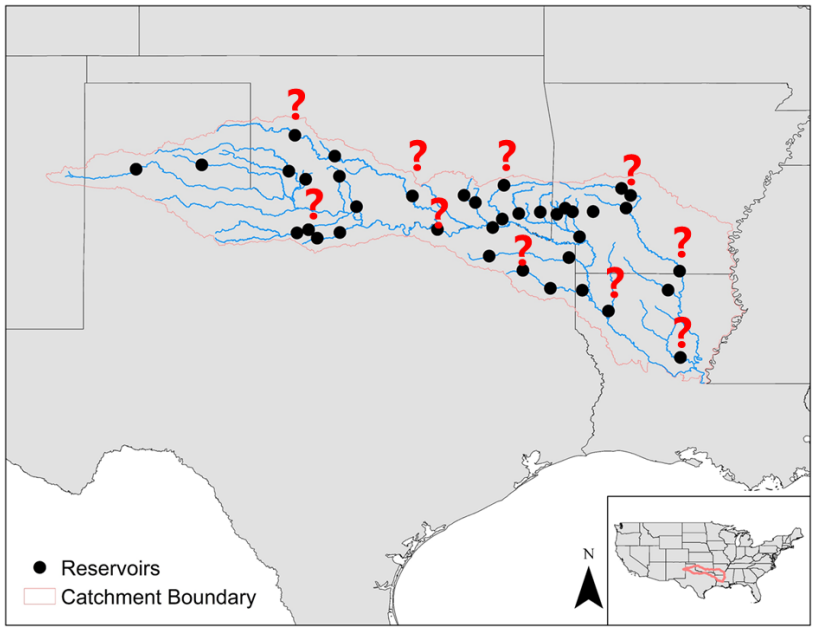


Case Study

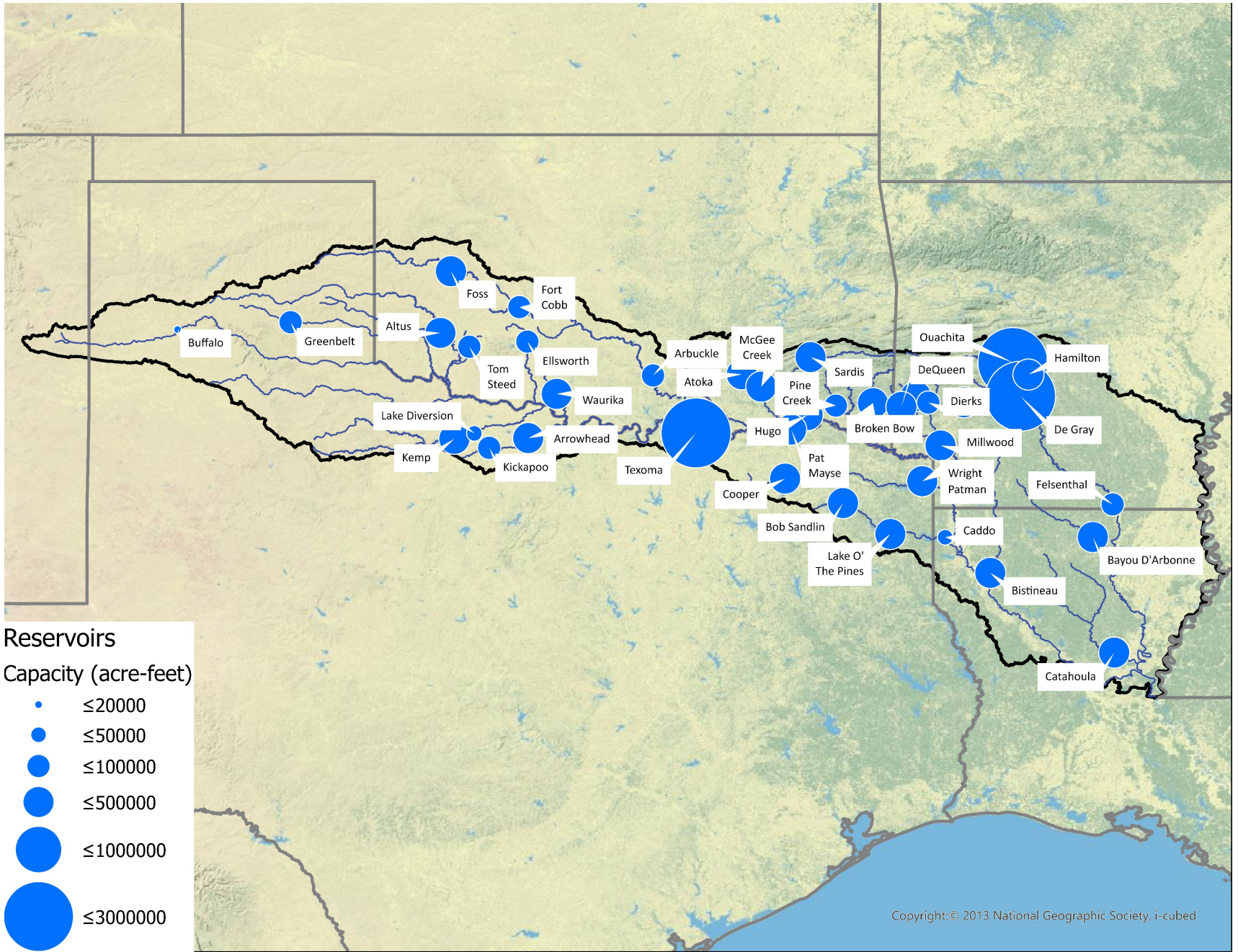
Research Questions:

- Is our prioritization framework effective at identifying site-level variation in conservation priorities?
- Is our prioritization framework effective at identifying sites resilient to climate change?

Application: Where is it most feasible and valuable to implement environmental flows in the Red River basin?



Study Region: 38 major reservoirs



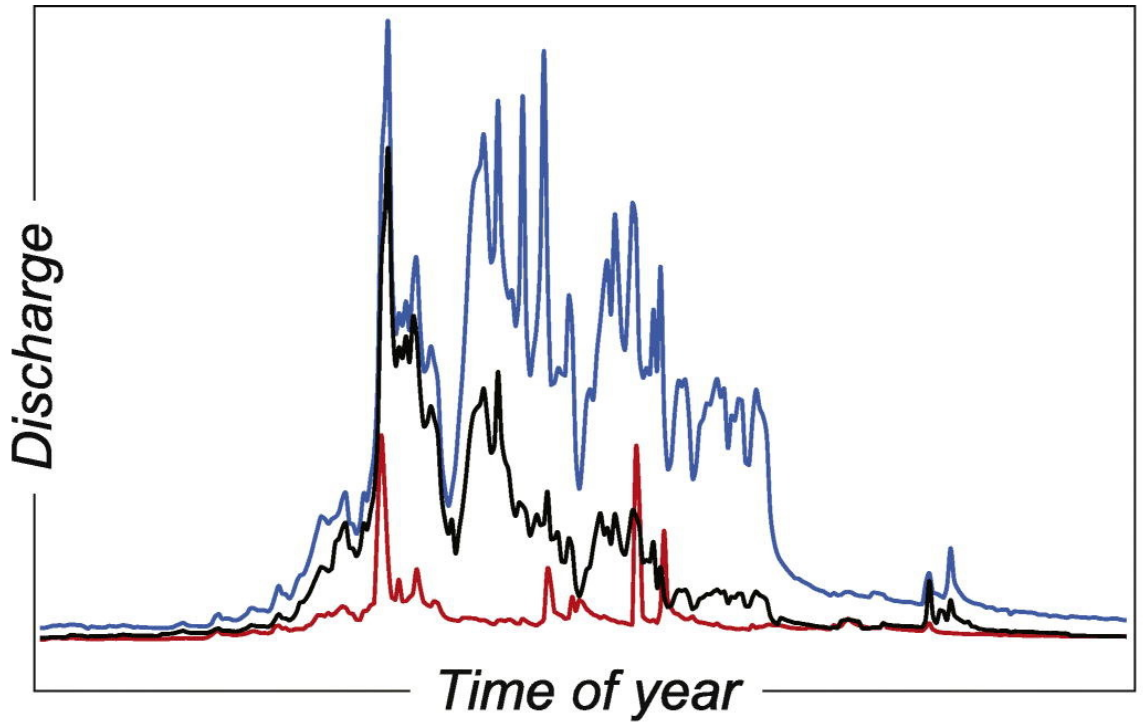
Environmental Flows: What are they?

- Water for freshwater ecosystems and the human livelihoods that depend on them

:WWF

Environmental Flows: What do they do?

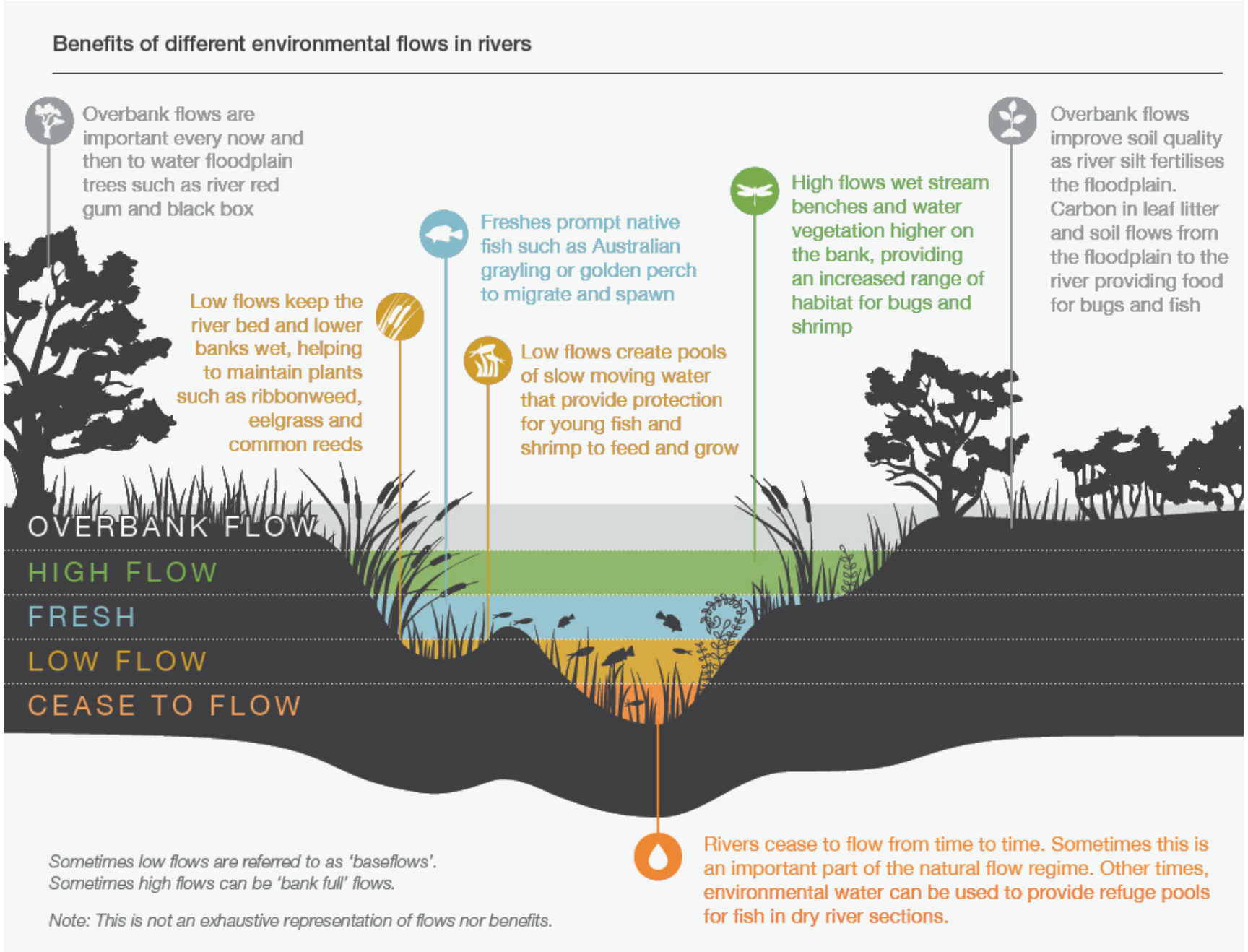
- Mitigate adverse impacts from water diversion and storage
- “Mimic” the natural flow regime – quantity, timing, quality of river flows
- Essential for riverine & floodplain ecosystem structure and function



— *Natural hydrograph,* — *Minimum flow,* — *Functional floodplain flow*

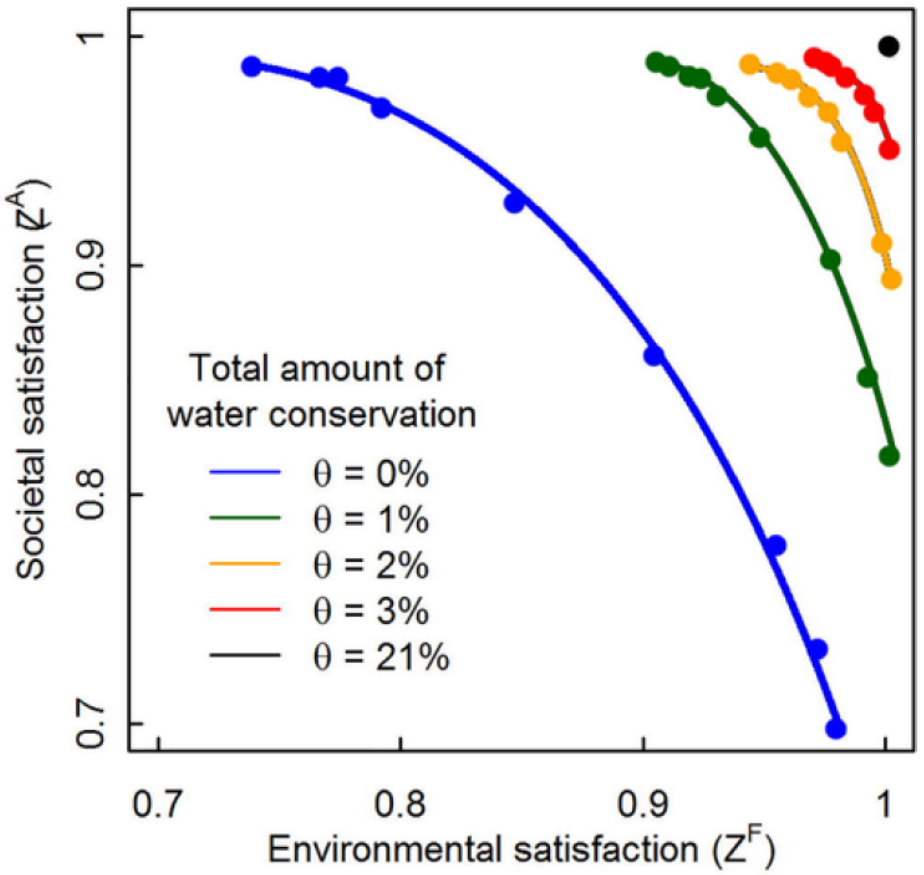
:Hayes et. al. 2018

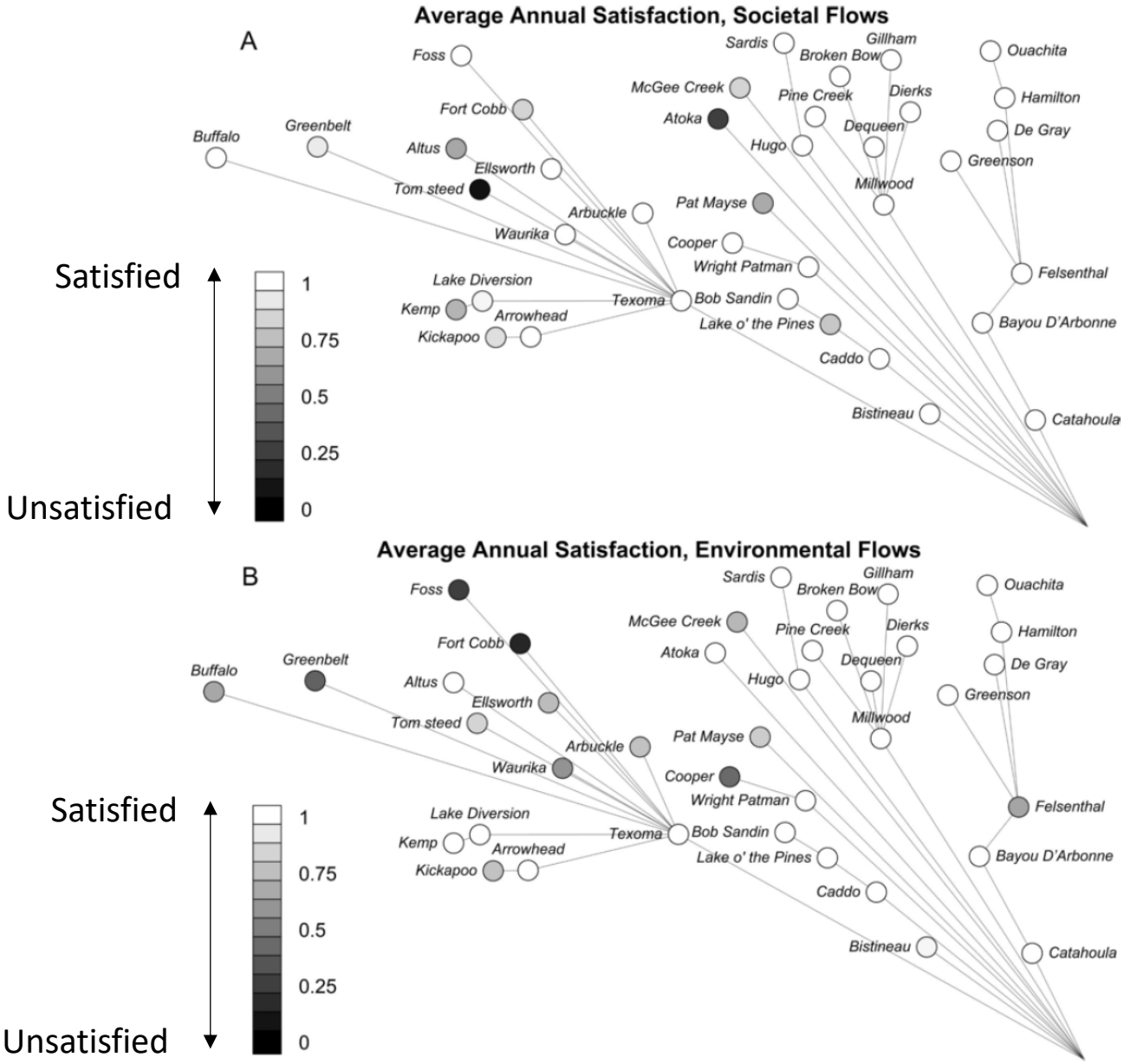
Environmental Flows: Types and Benefits



:VEWH

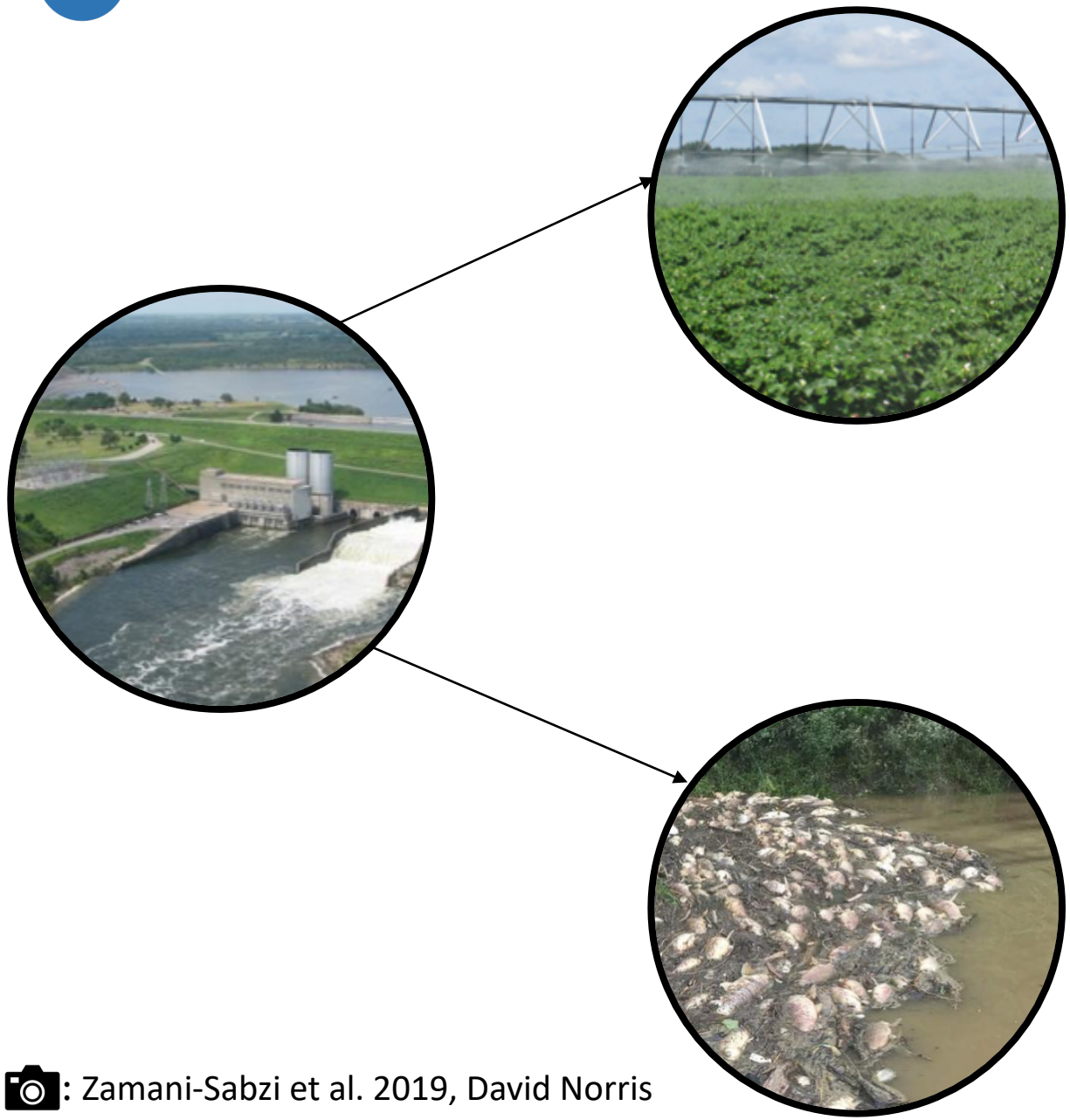
Challenge: Current Water Availability Insufficient for Competing Needs

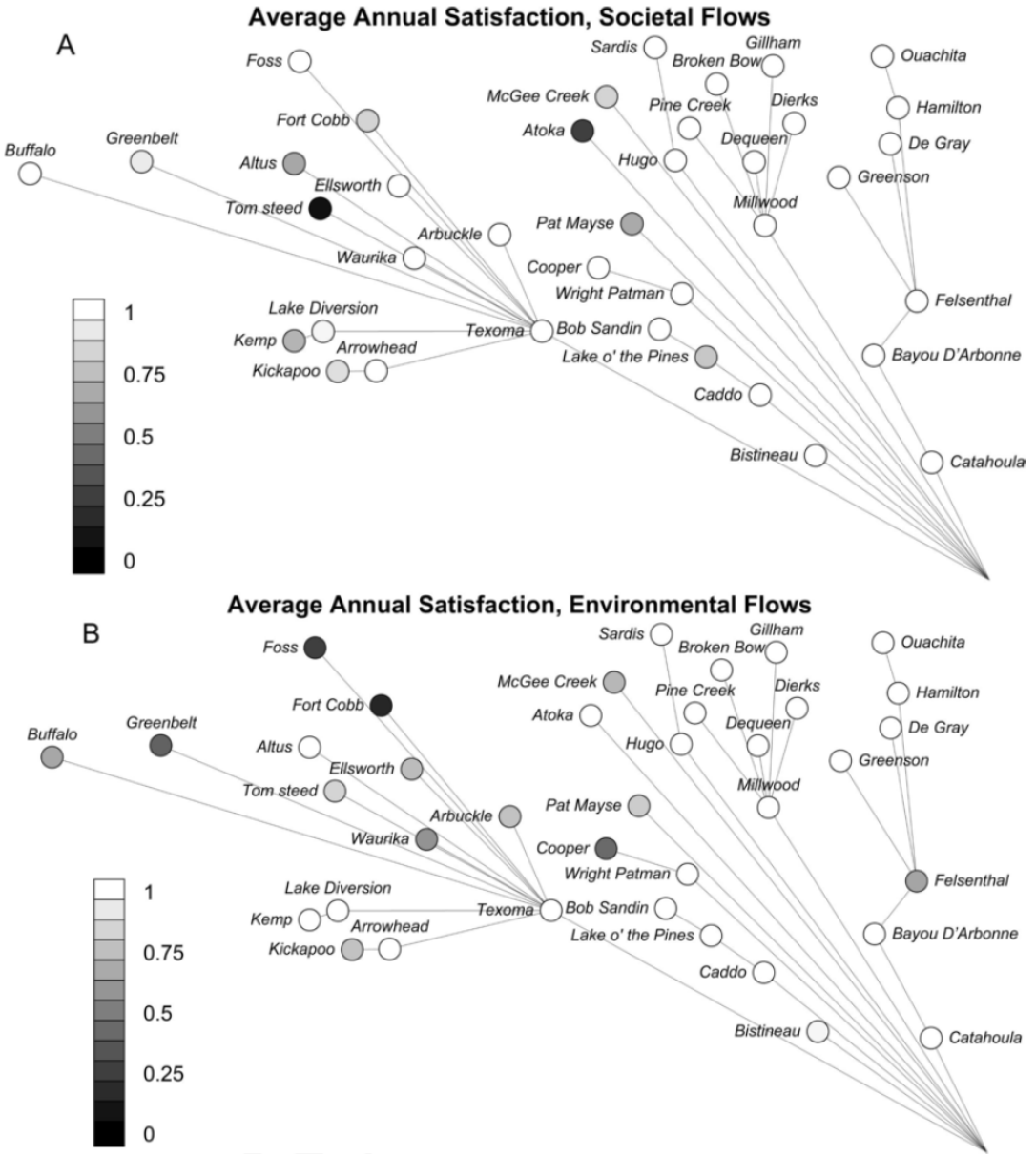




:Zamani-Sabzi et al. 2019

Application: Meeting Environmental Flow Targets (Conservation Feasibility)





: Zamani-Sabzi et al. 2019, David Norris

Environmental Flows for Biodiversity Conservation

Blackspot Shiner (*Notropis atrocaudalis*)
IUCN: Least Concern
Oklahoma: Tier I (Top Priority)

Prairie Chub (*Macrhybopsis australis*)
IUCN: Vulnerable
Oklahoma: Tier I (Top Priority)

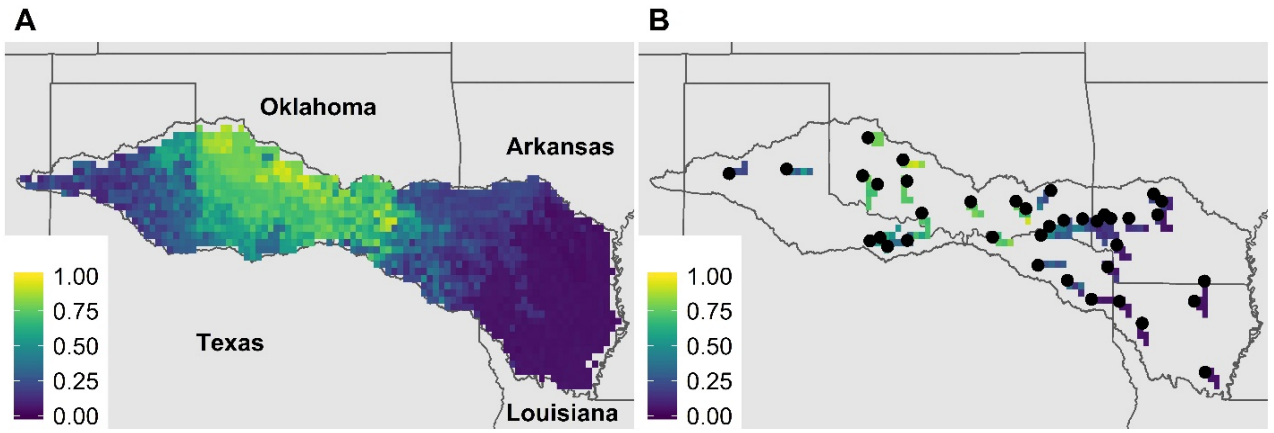
Biodiversity Value

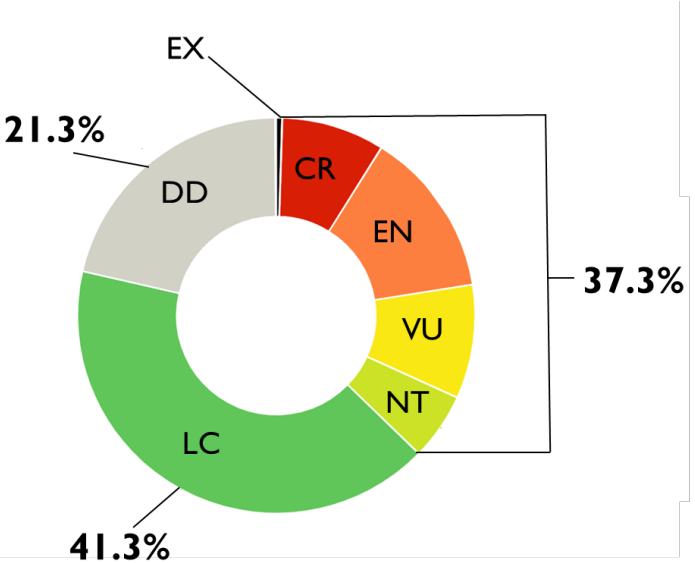
Green Sunfish (*Lepomis cyanellus*)
IUCN: Least Concern
Oklahoma: Not ranked (Low Priority)

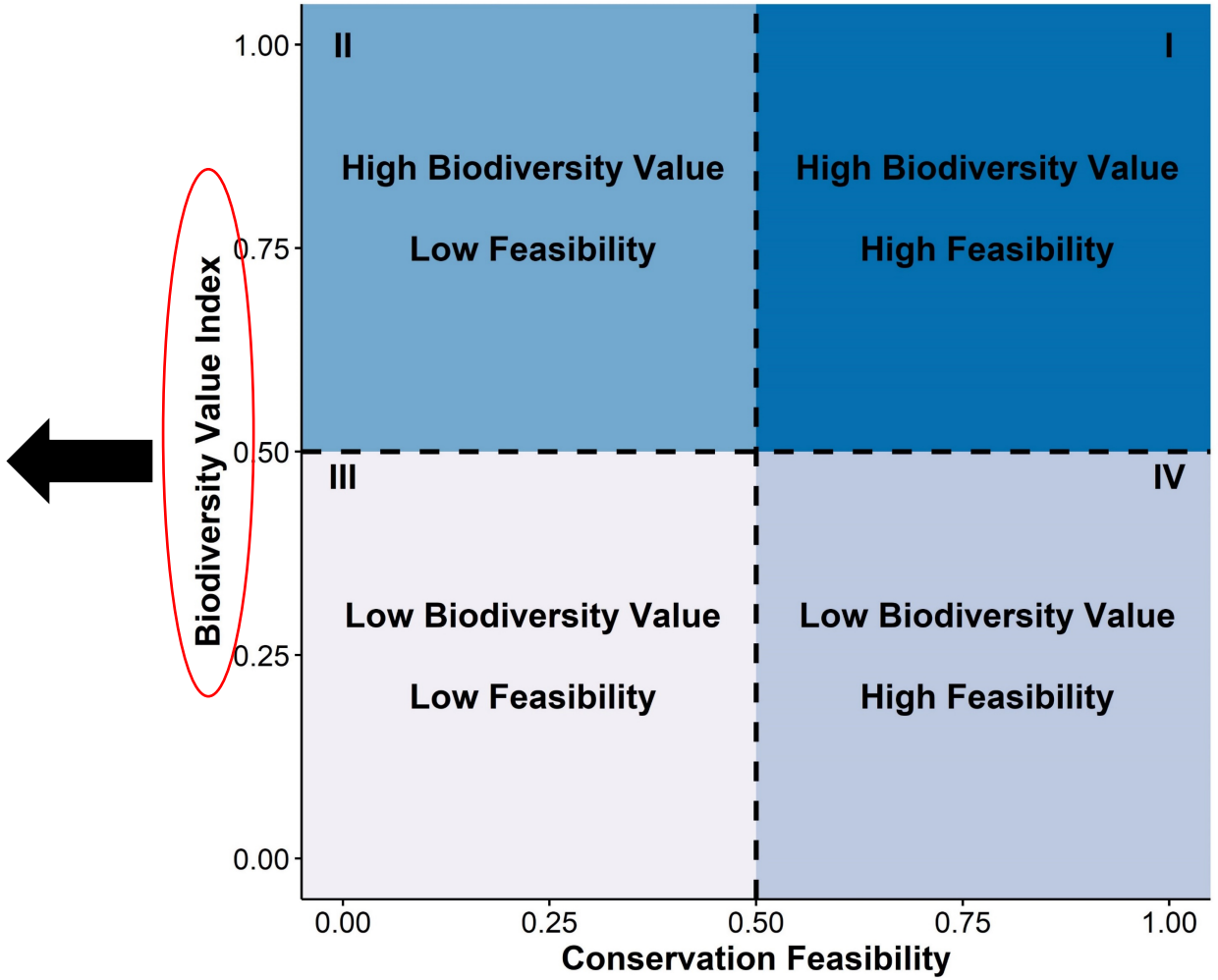
Spotted Bass (*Micropterus punctulatus*)
IUCN: Least Concern
Oklahoma: Not ranked (Low Priority)

:Uland Thomas

Biodiversity Value Index



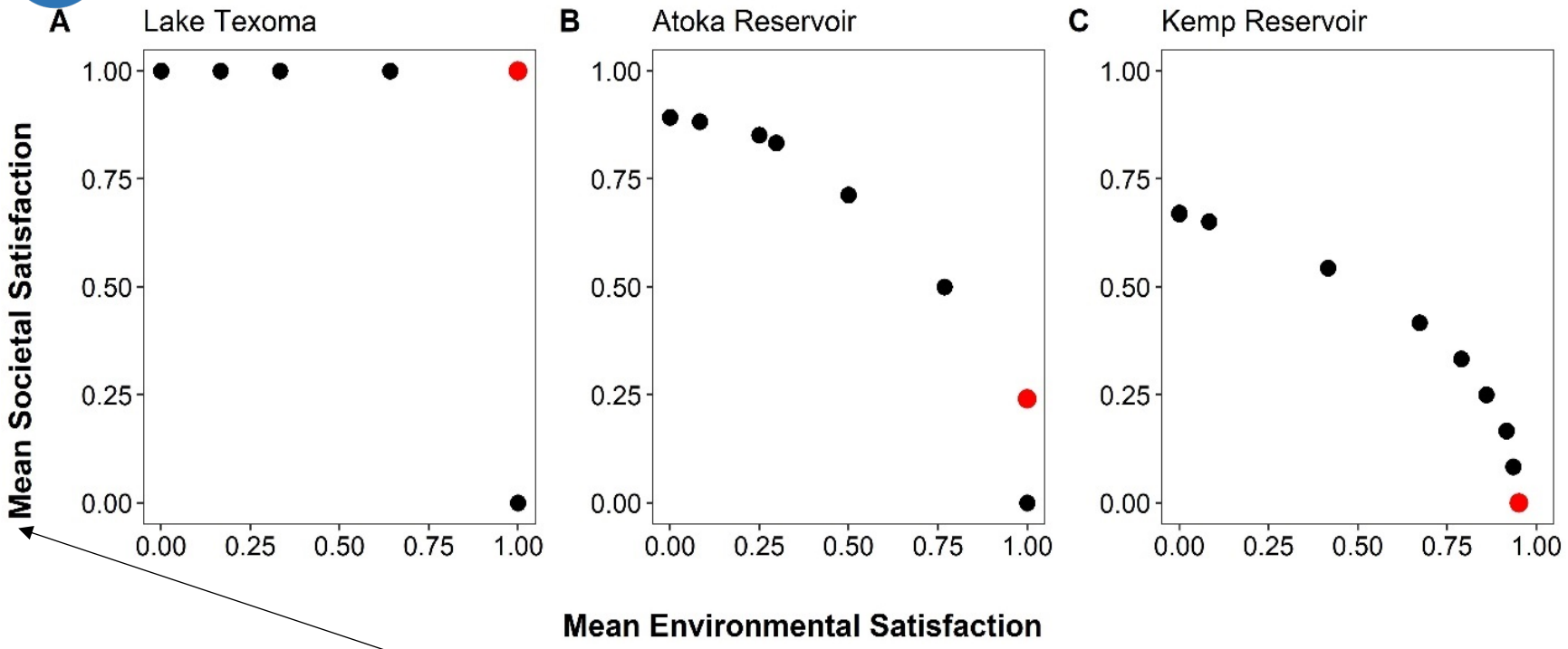


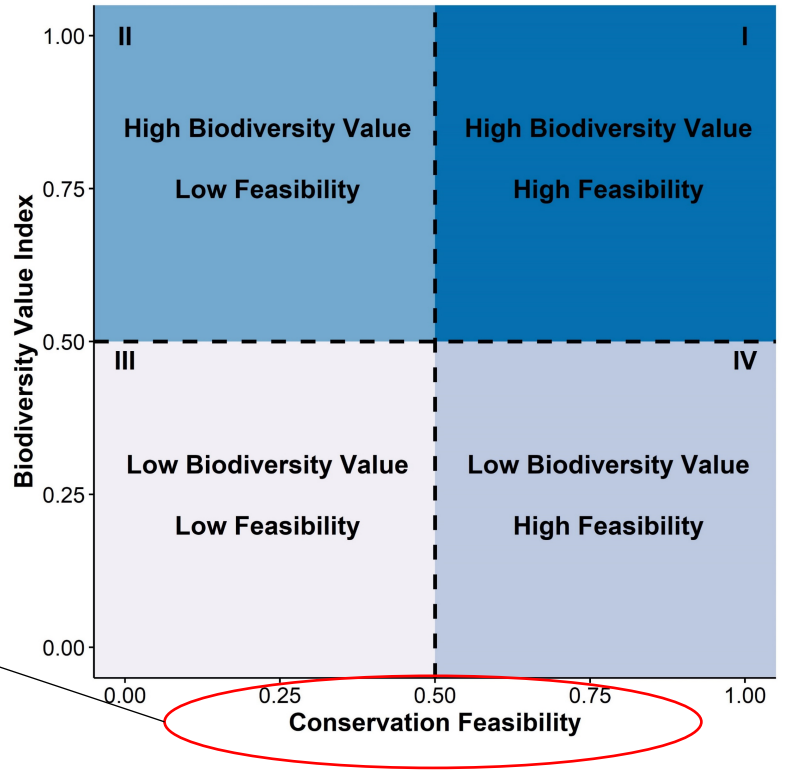


Fish Species Considered

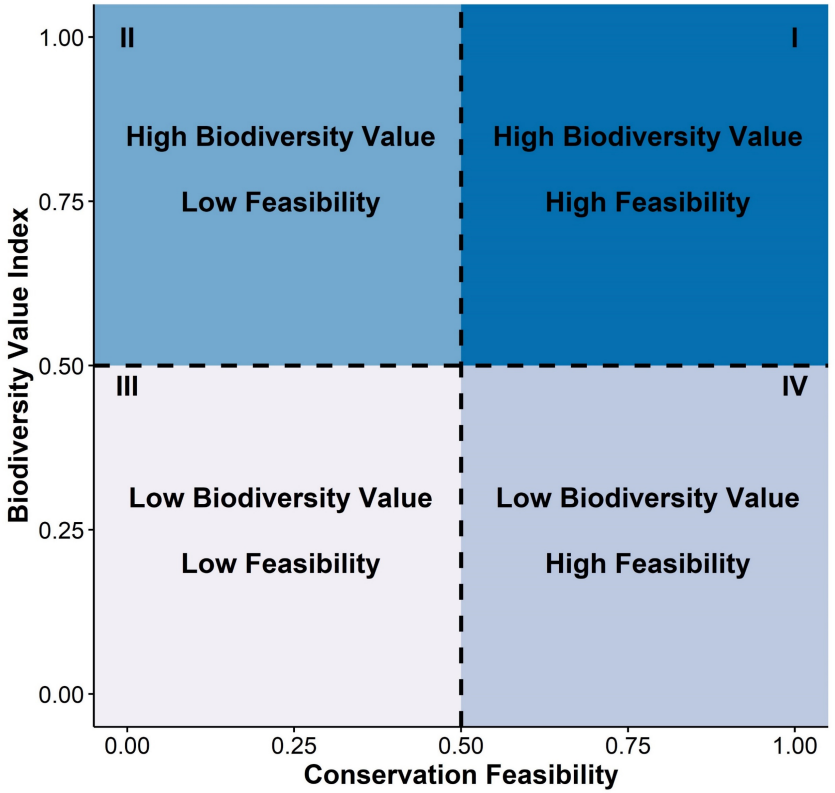
Ameiurus melas	Black bullhead
Cyprinella lutrensis	Red shiner
Cyprinodon rubrofluviatilis	Red River pupfish
Etheostoma collettei	Creole darter
Etheostoma radiosum	Orangebelly darter
Fundulus zebrinus	Plains killifish
Gambusia affinis	Western mosquitofish
Hybognathus placitus	Plains minnow
Ictalurus furcatus	Blue catfish
Lepomis cyanellus	Green sunfish
Lythrurus snelsoni	Ouachita shiner
Macrhybopsis australis	Prairie chub
Macrhybopsis hyostoma	Shoal chub
Macrhybopsis storeriana	Silver chub
Micropterus dolomieu	Smallmouth bass
Micropterus punctulatus	Spotted bass
Micropterus salmoides	Largemouth bass
Morone saxatilis	Striped bass
Notropis atherinoides	Emerald shiner
Notropis atrocaudalis	Blackspot shiner
Notropis bairdi	Red River shiner
Notropis boops	Bigeye shiner
Notropis ortenburgeri	Kiamichi shiner
Notropis perpallidus	Peppered shiner
Notropis potteri	Chub shiner
Notropis stramineus	Sand shiner
Notropis suttkusi	Rocky shiner
Percina copelandi	Channel darter
Percina pantherina	Leopard darter
Phenacobius mirabilis	Suckermouth minnow
Pteronotropis hubbsi	Bluehead shiner

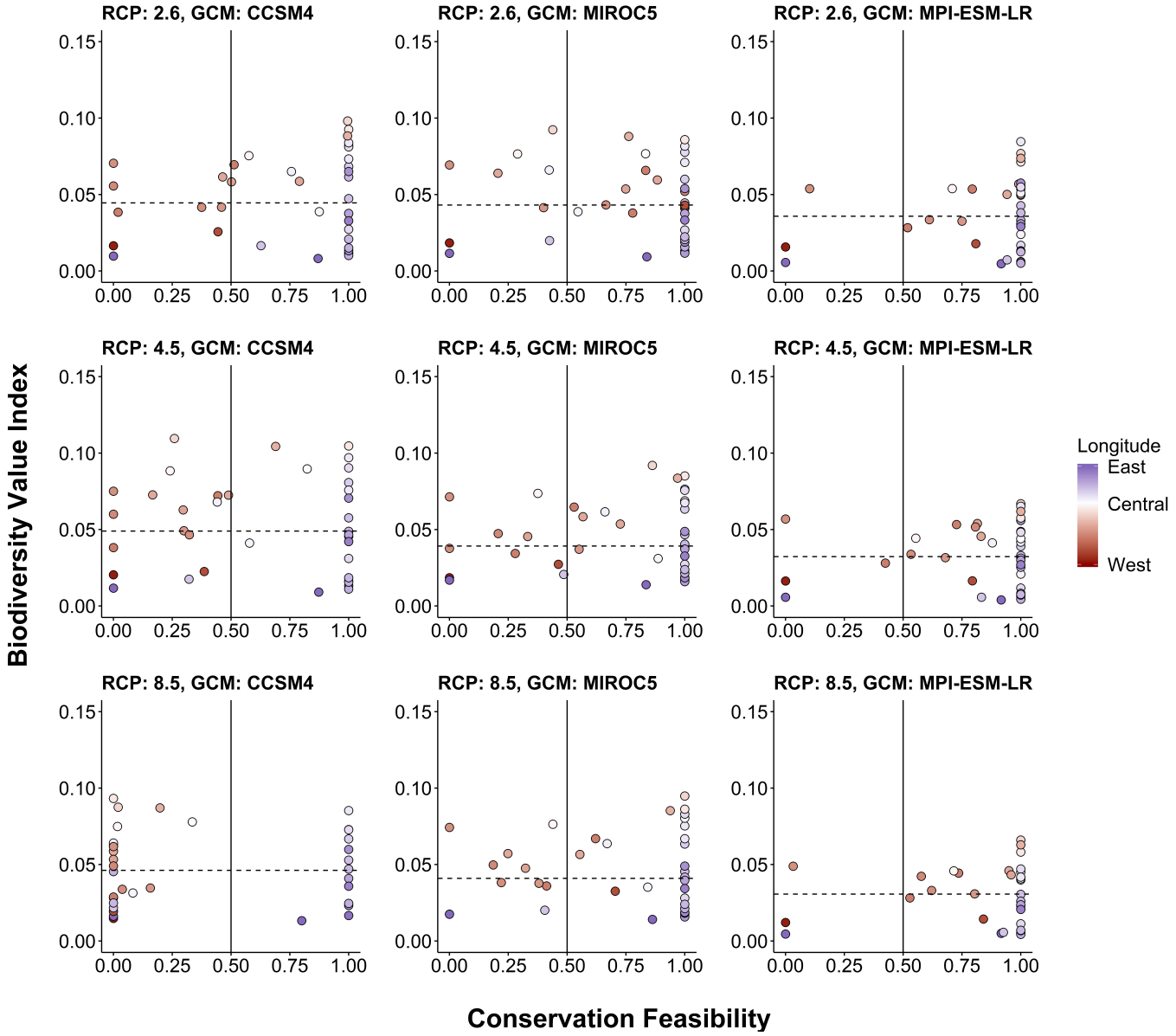
Conservation Feasibility: Sociopolitical Resistance to E-flows





Results: Site Variation Across Future Climate Scenarios





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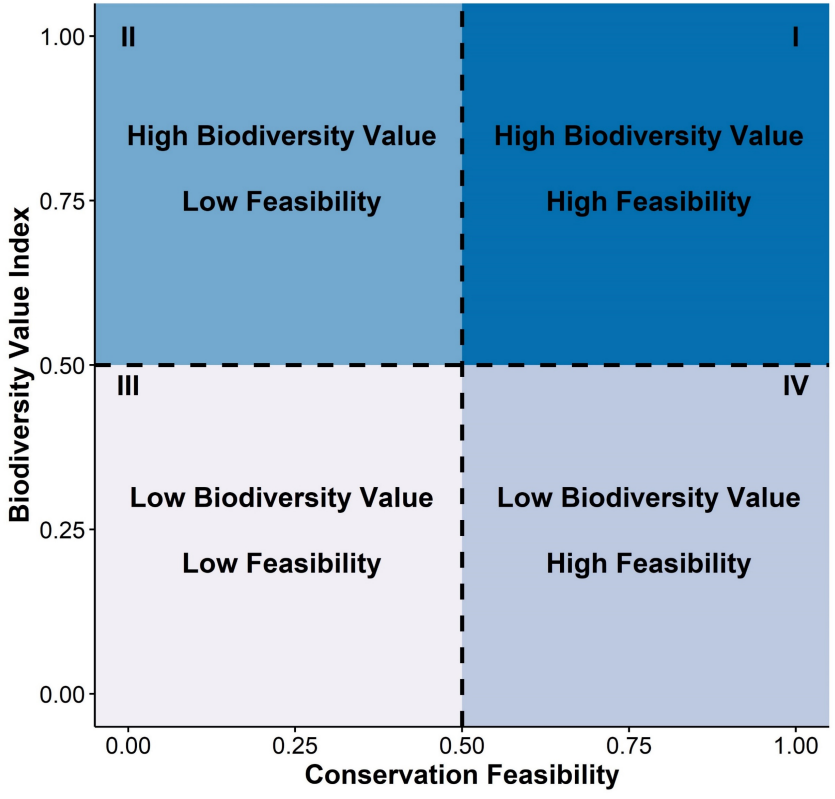
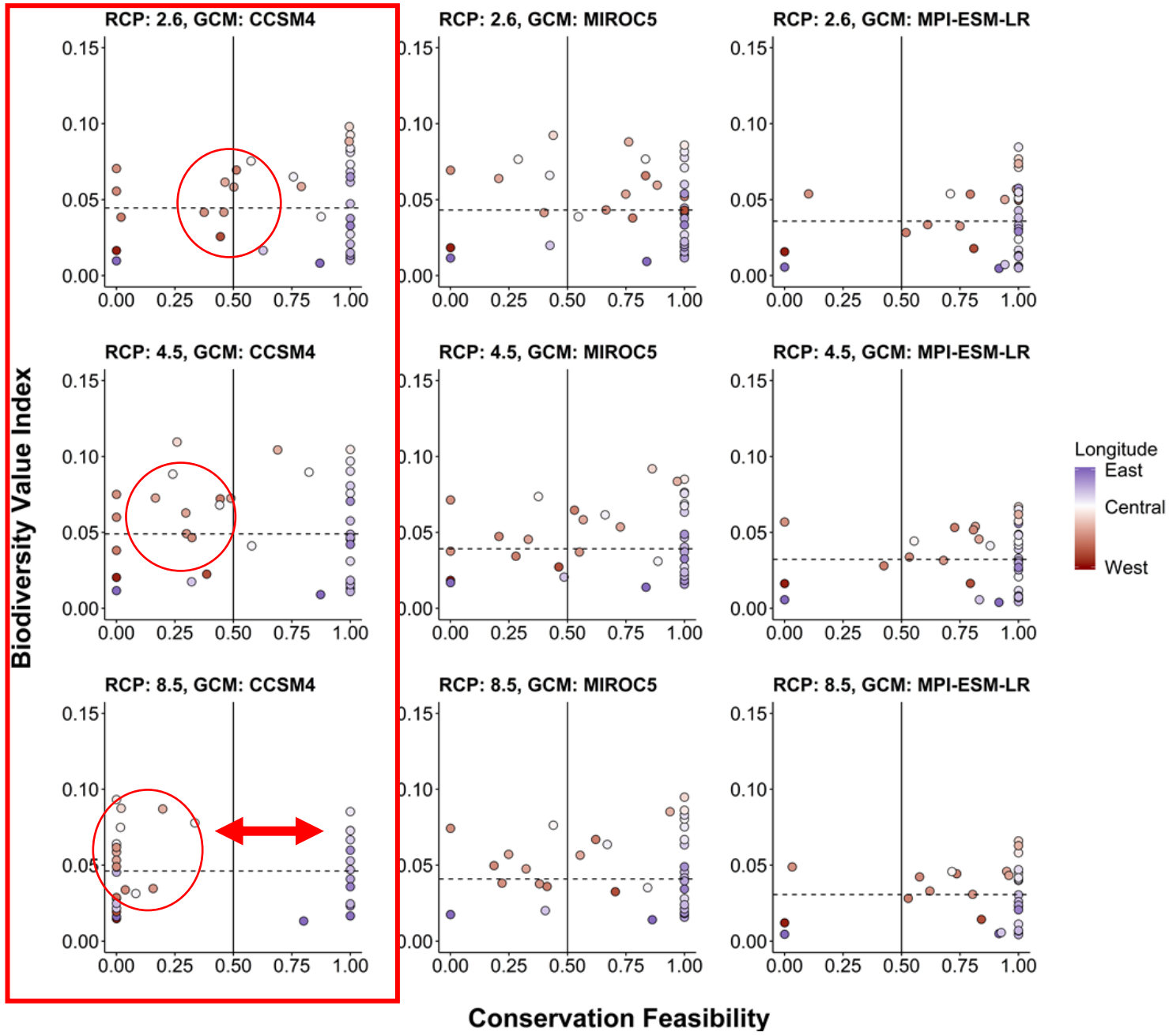
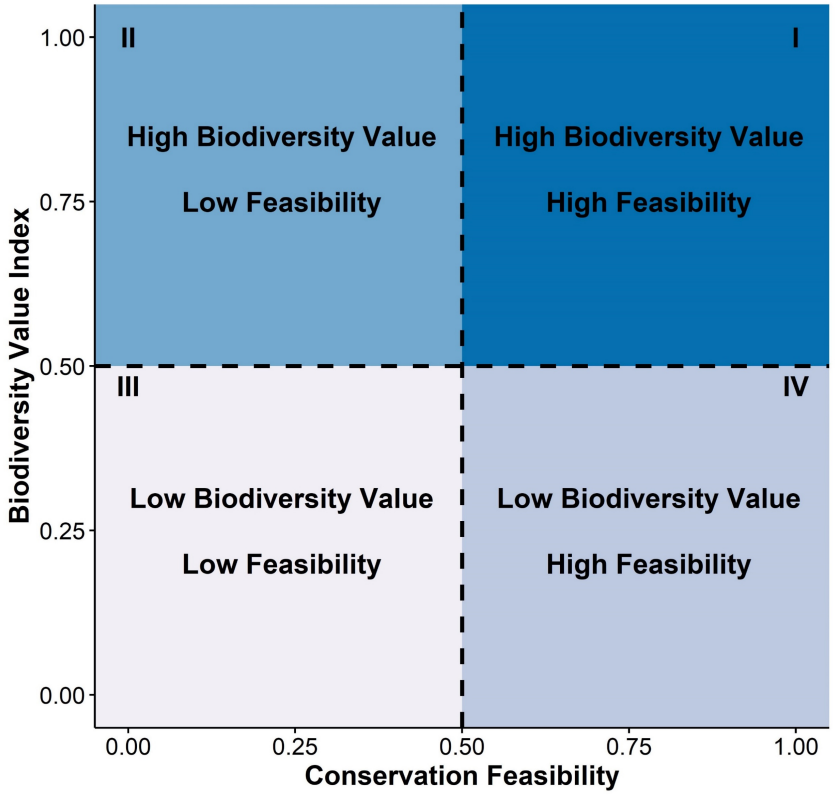
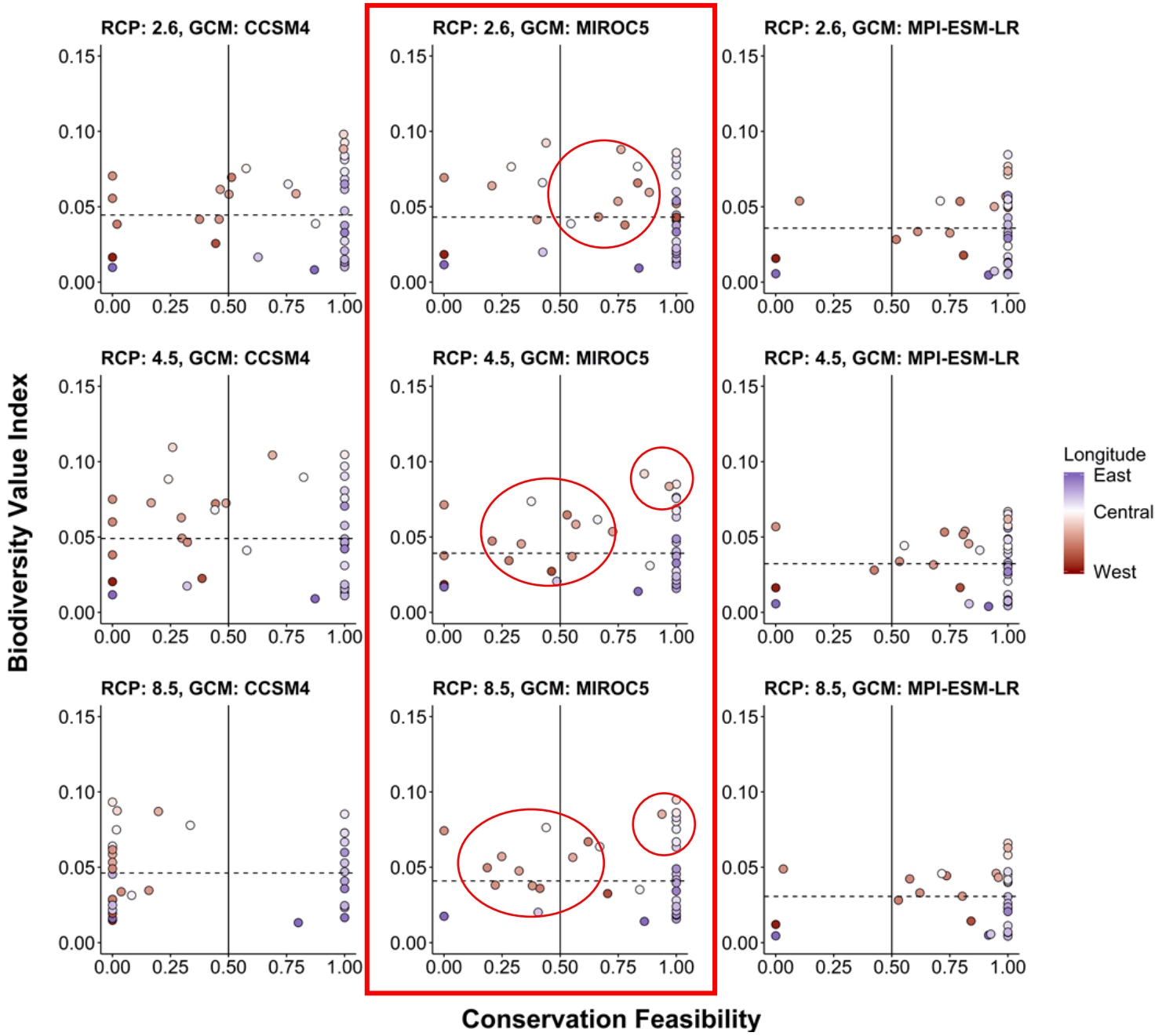


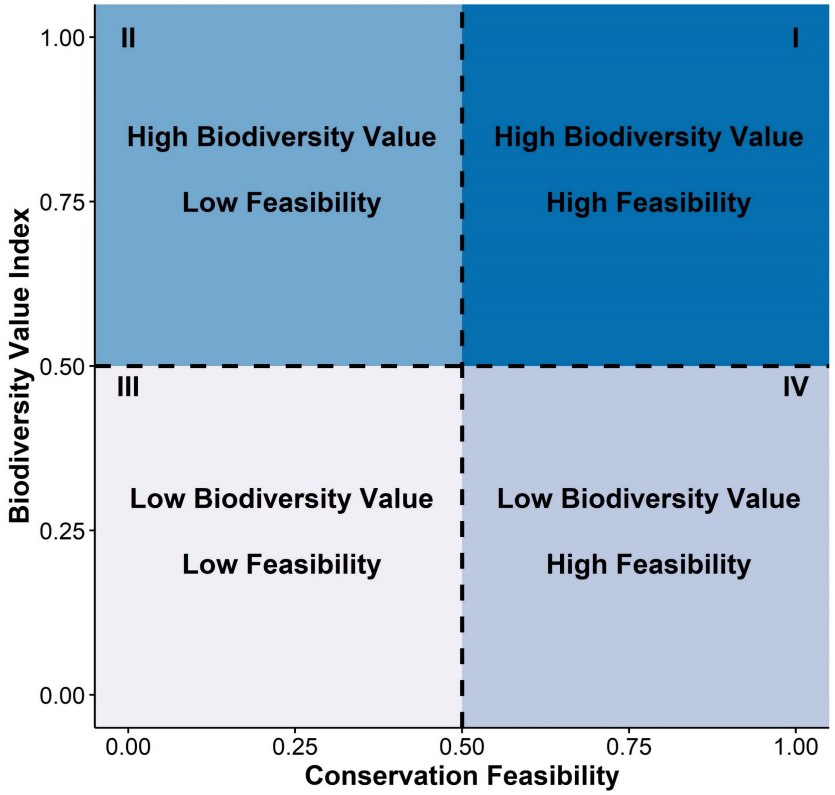


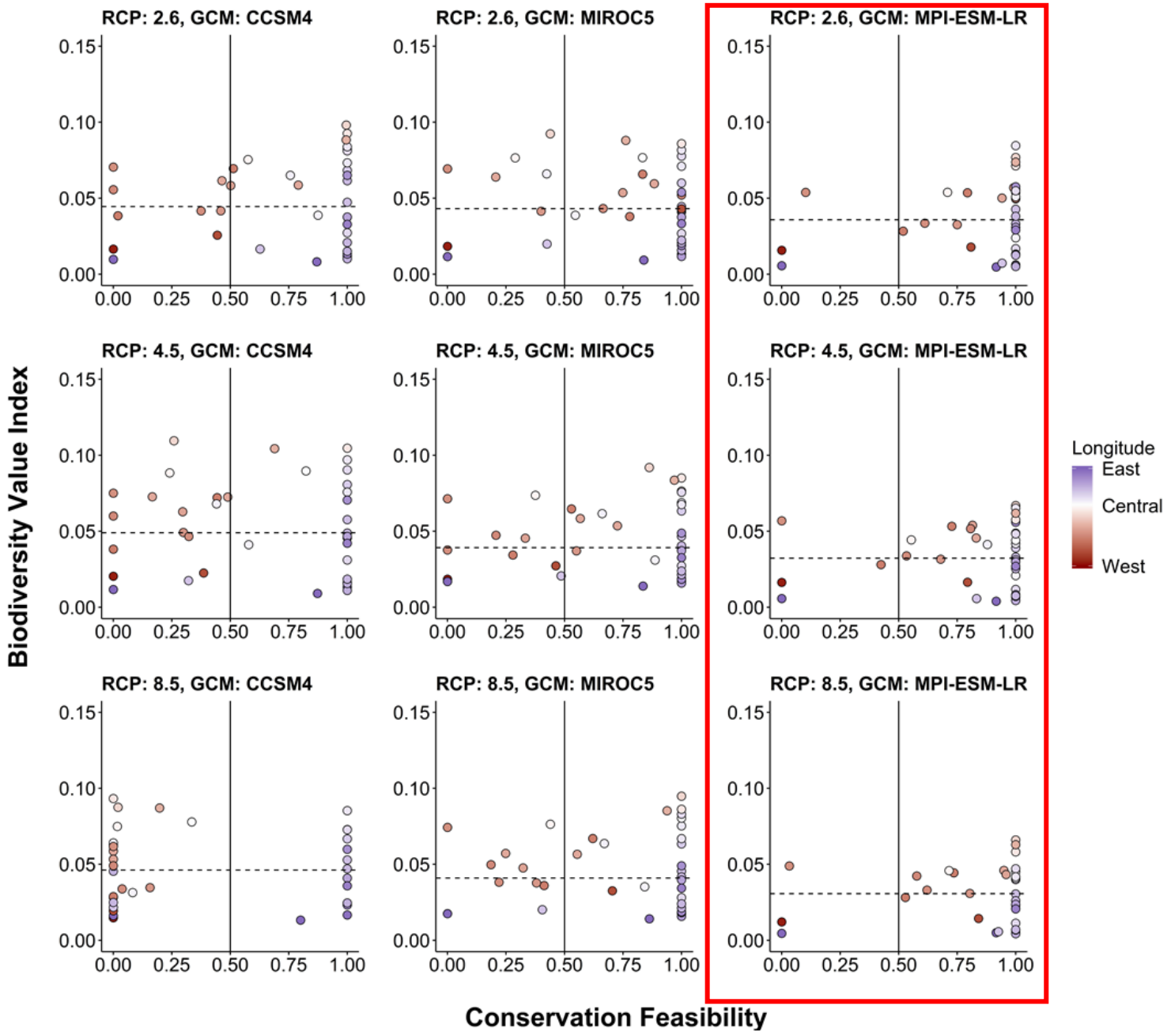
Results: Site Variation Across Future Climate Scenarios



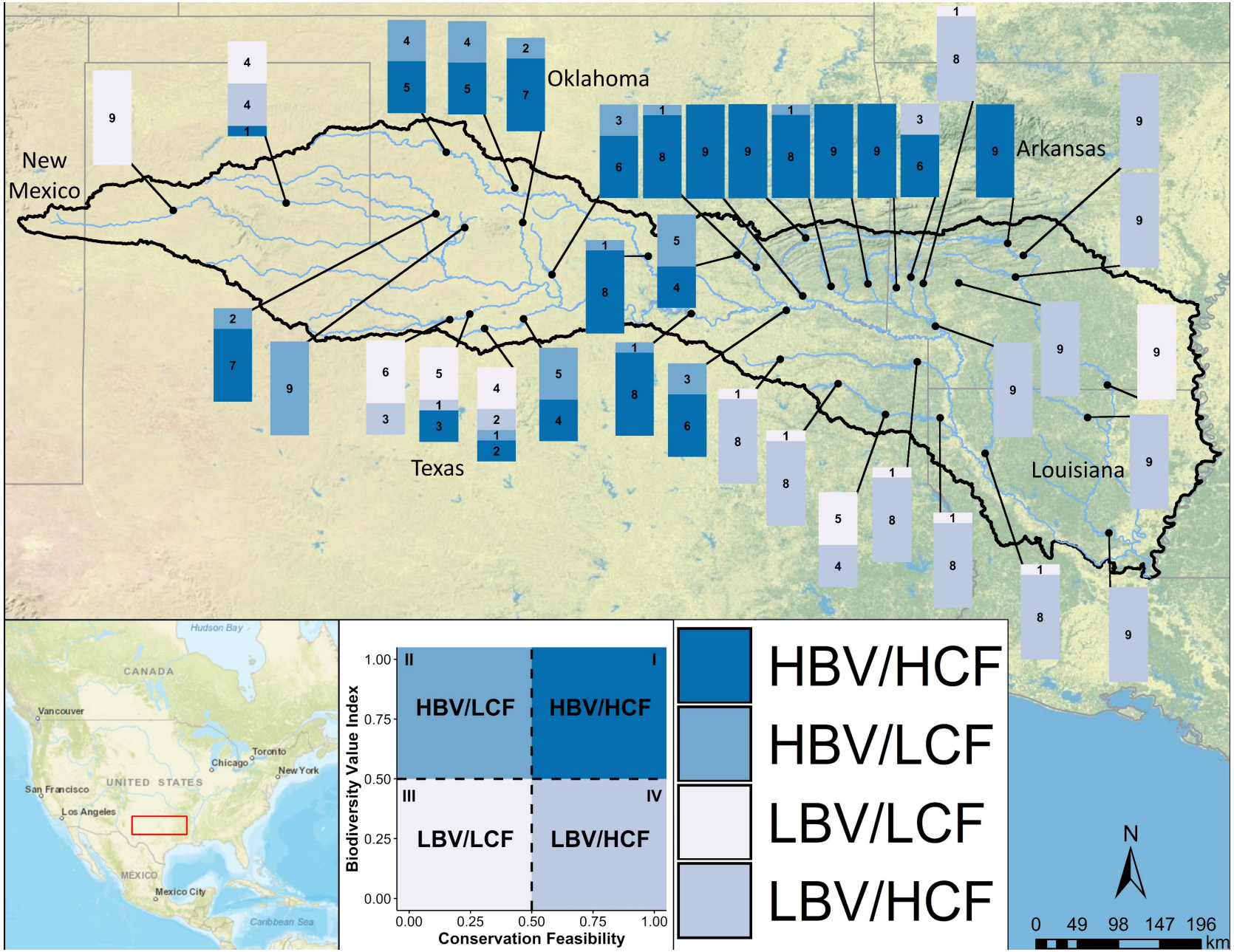


Results: Site Variation Across Future Climate Scenarios

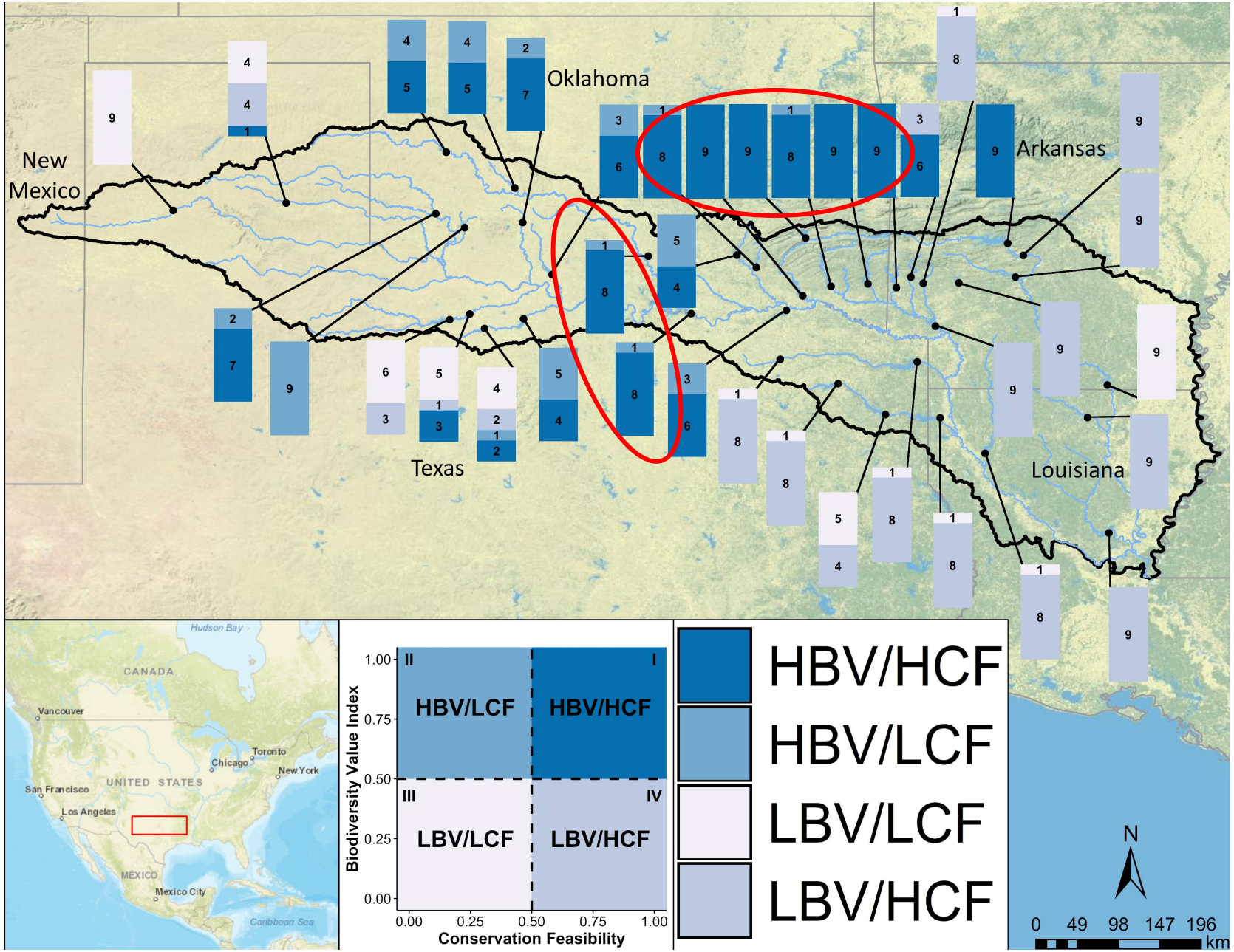




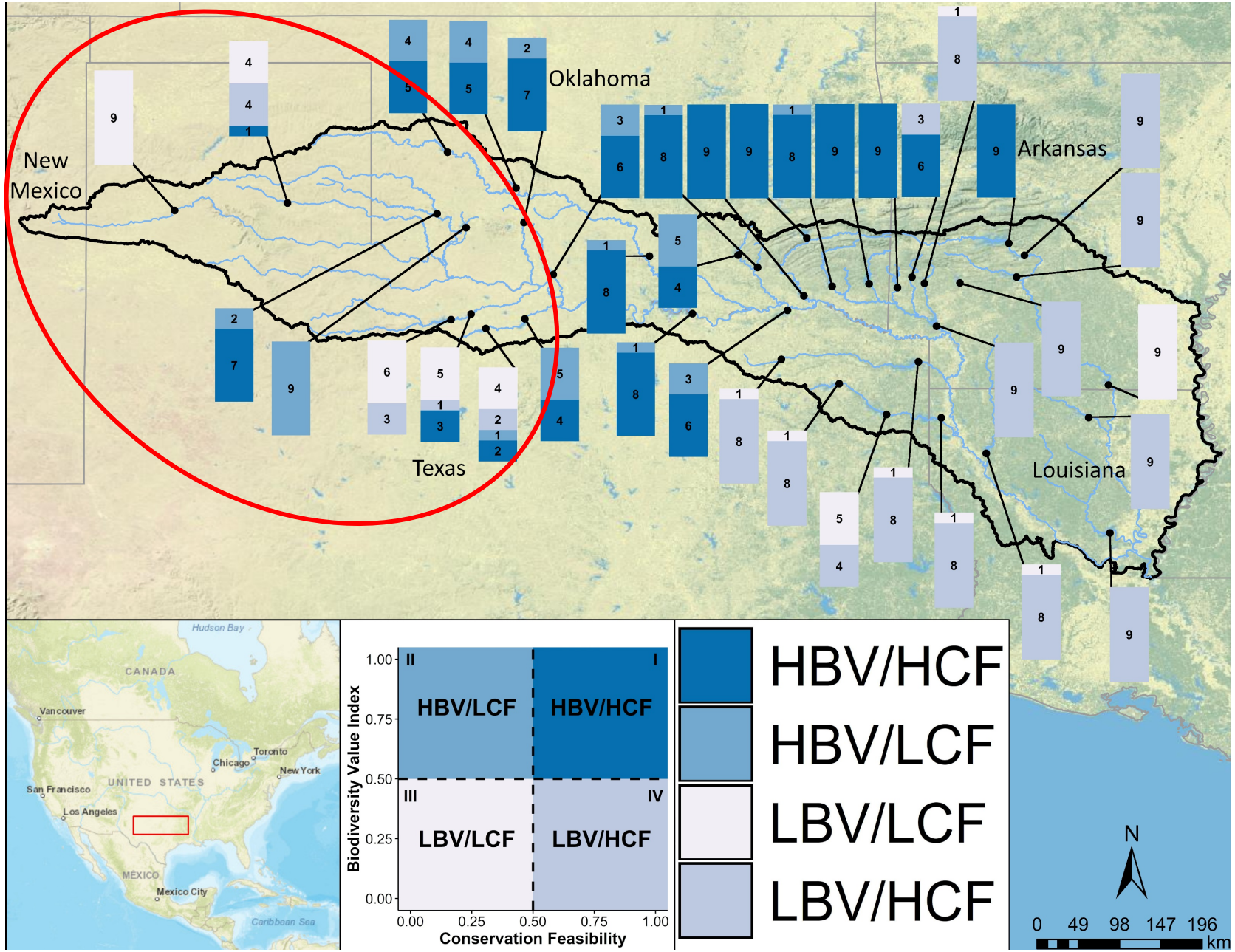
Where are outcomes consistent across future climate scenarios?



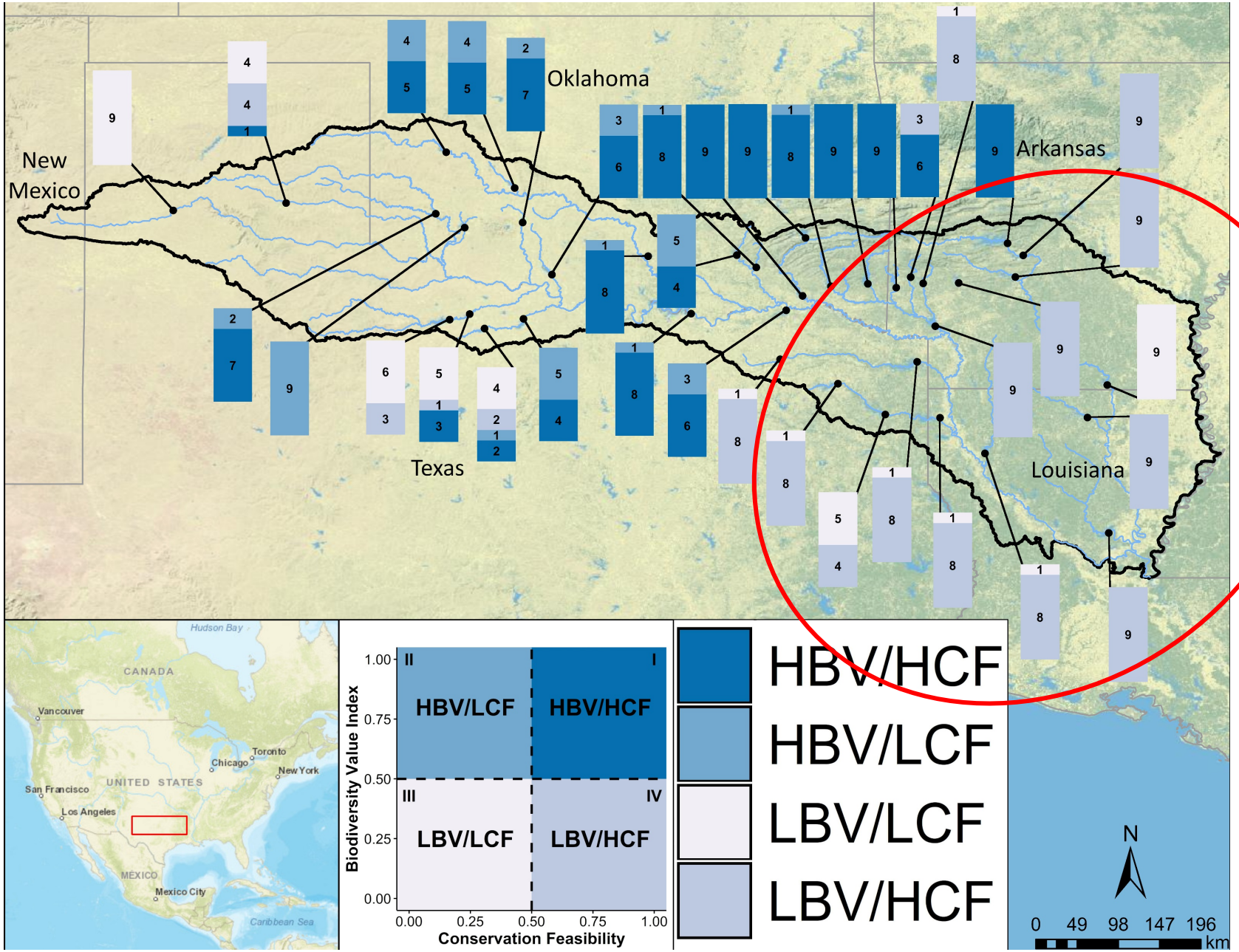
Where are outcomes consistent across future climate scenarios?



High uncertainty in arid western reaches



High Feasibility, Low Biodiversity Value in Eastern Reaches (Why Not?)



Implications

- Coarse-scale tool/framework for identifying high priority climate resilient sites to implement environmental flows
- Use to winnow candidate sites
- Many other factors to consider, but this tool can be used in early stages of planning

Prairie Chub (*Macrhybopsis australis*)

:Uland Thomas, Ricky Porter

Question 3

Can you think of a potential application for this prioritization framework that would be relevant for examining tradeoffs with the resources you manage or study?

Post them in the chat below!

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