

# Stable Isotopes and Museum Samples Provide Baselines and Metrics for River Restoration



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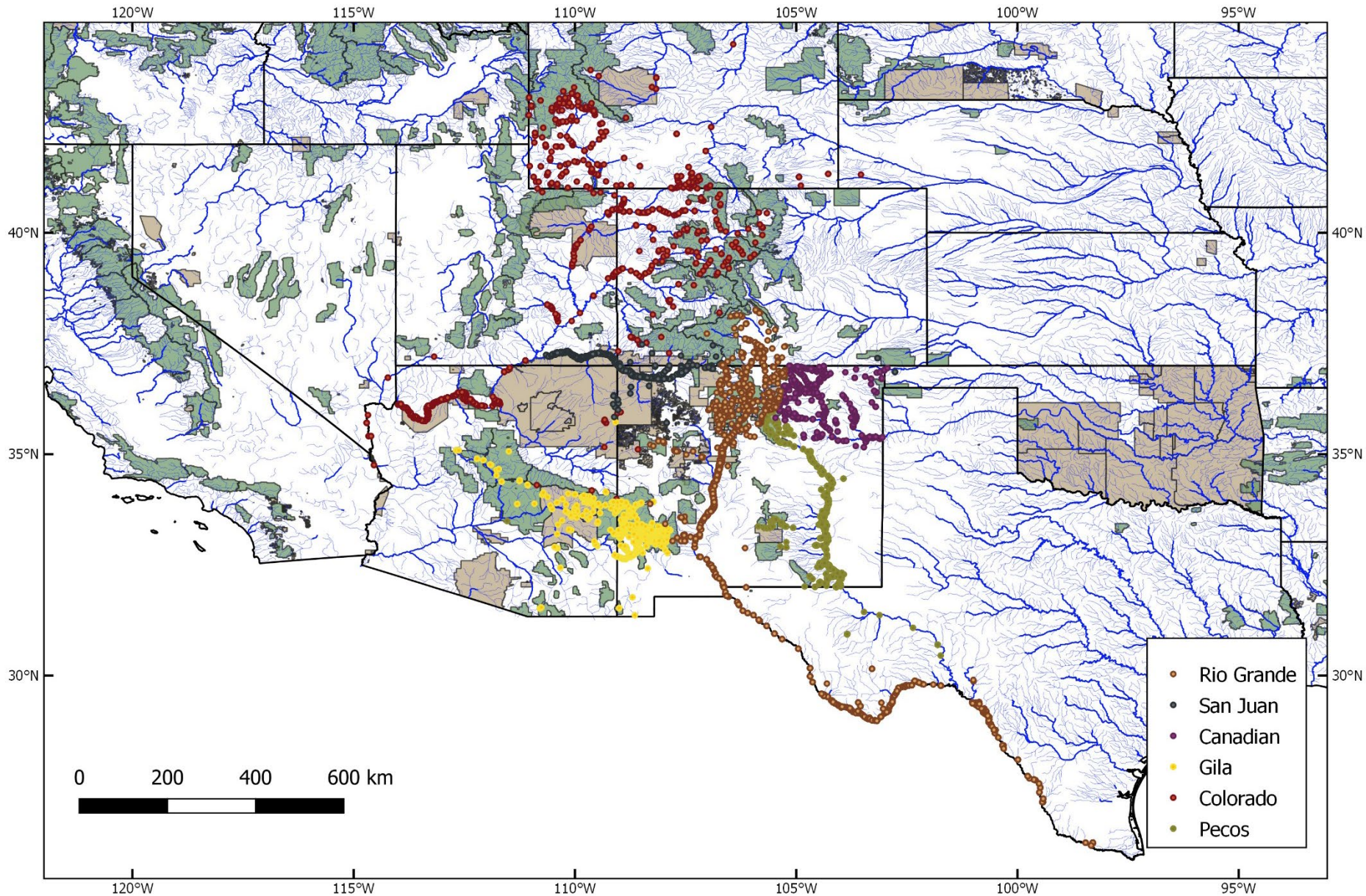
# A Role for Biodiversity Collections in Large River Restoration Ecology

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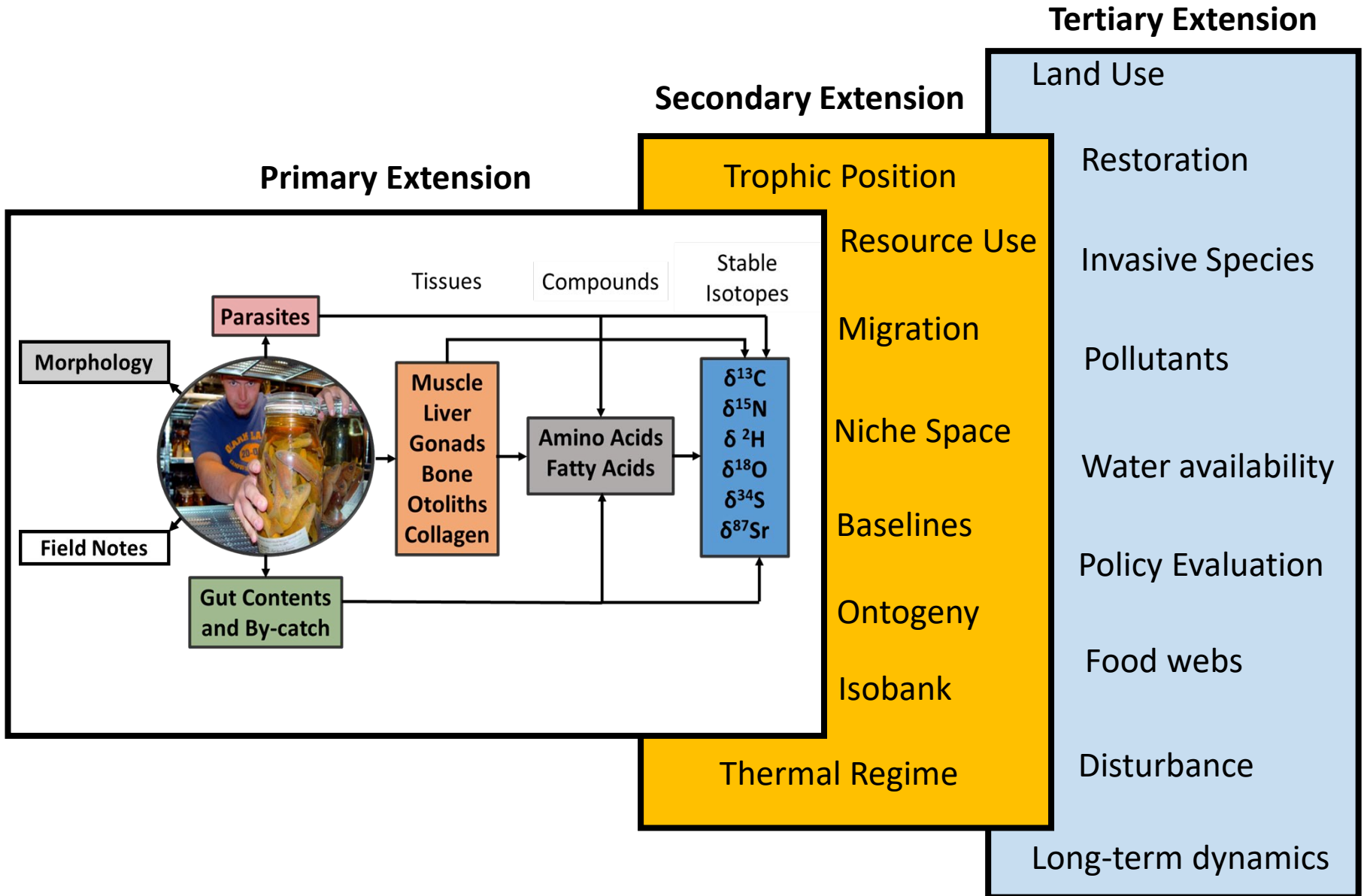
- Radical freshwater ecosystem changes over the last century – coincides with collections growth.
- Stable Isotope Analysis provides a common ‘currency’ to study ecological processes.
- Fish are nearly ubiquitous ‘integrators’ of aquatic food resources and well represented in Biodiversity Collections



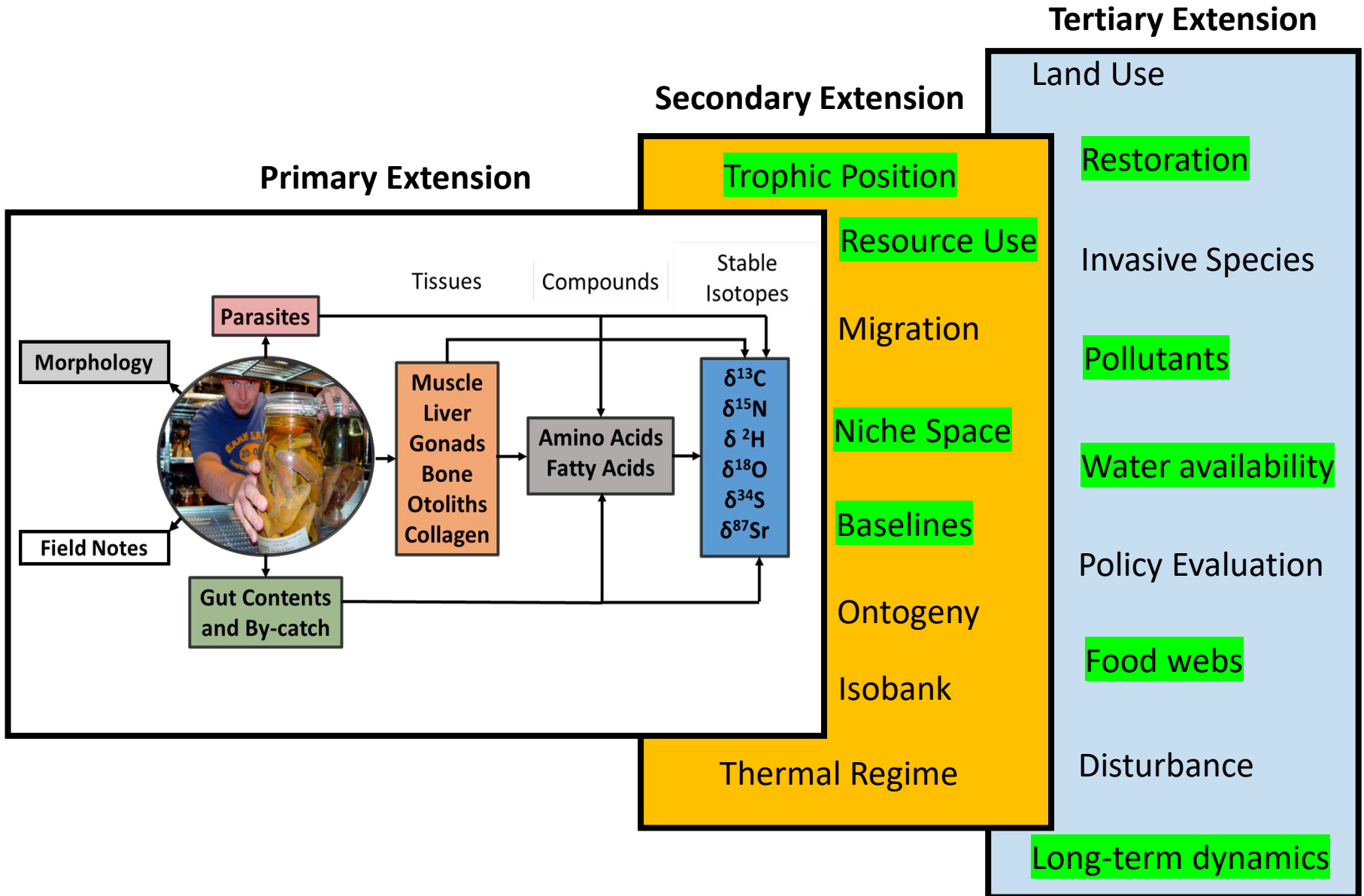
# MSB Georeferenced Localities – Major Southwestern Rivers

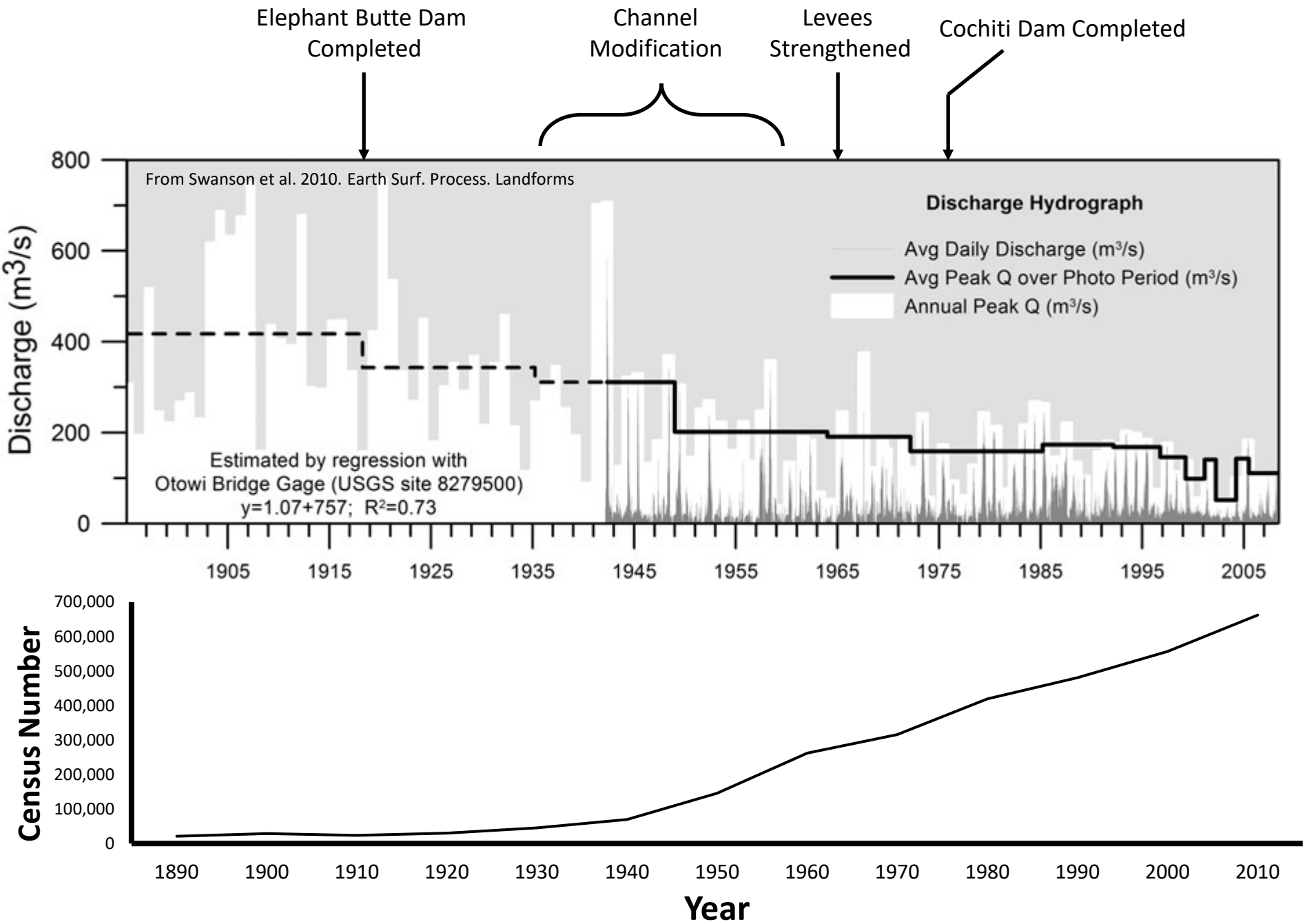


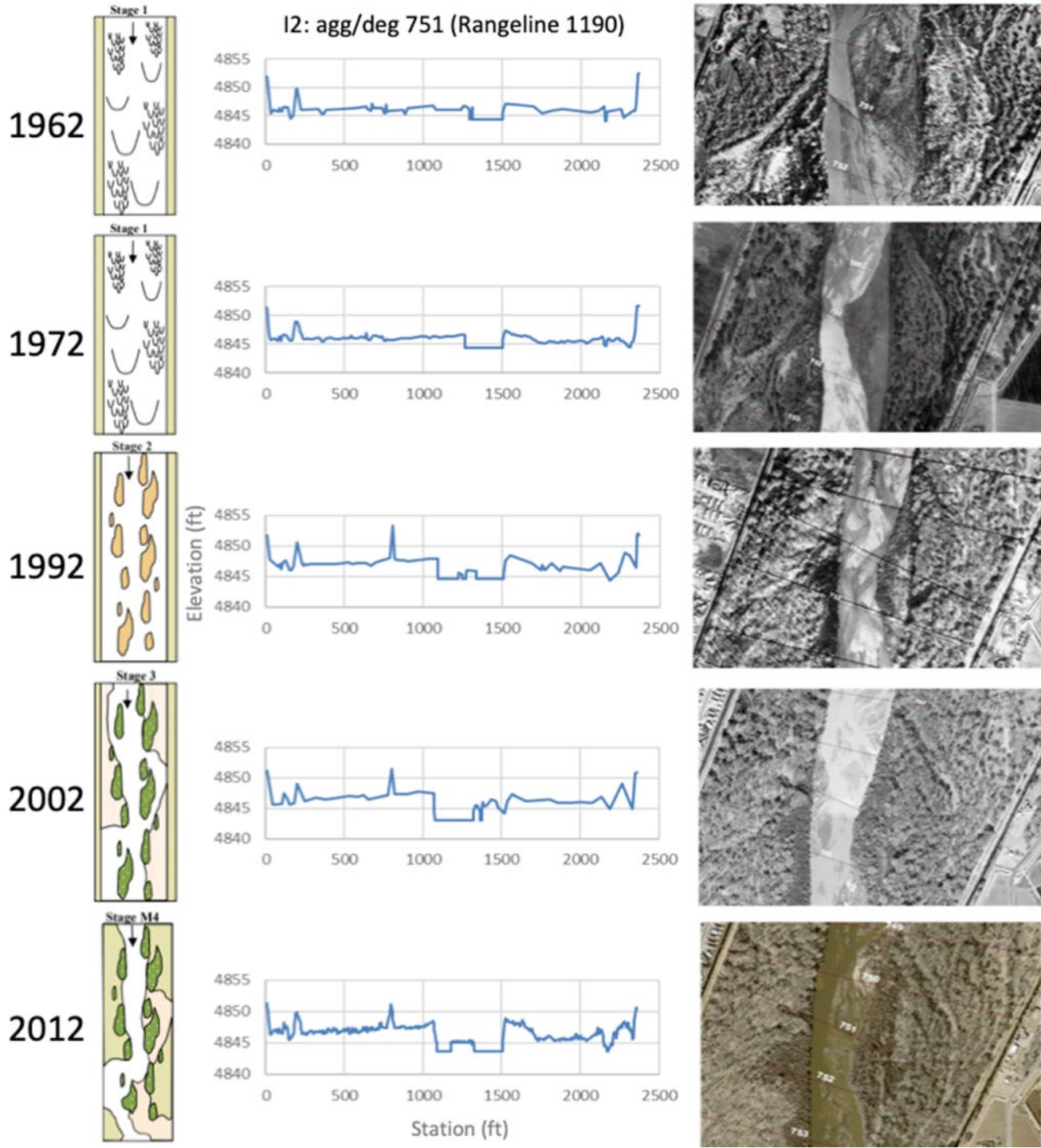
# The 'Extended Specimen' and SIA



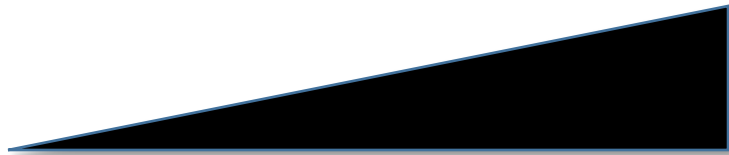
# The 'Extended Specimen' and SIA



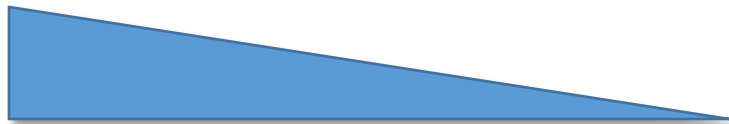




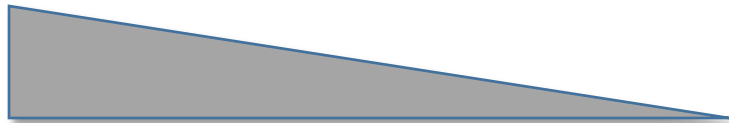
# Predicted Effects of River Regulation



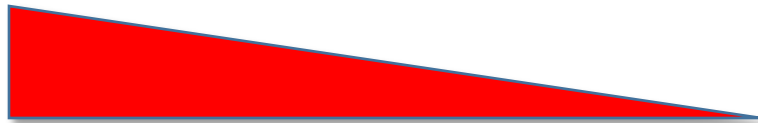
Channel Incision & Flow Regulation



Ecosystem Size & Heterogeneity



Productivity & Energy Inputs

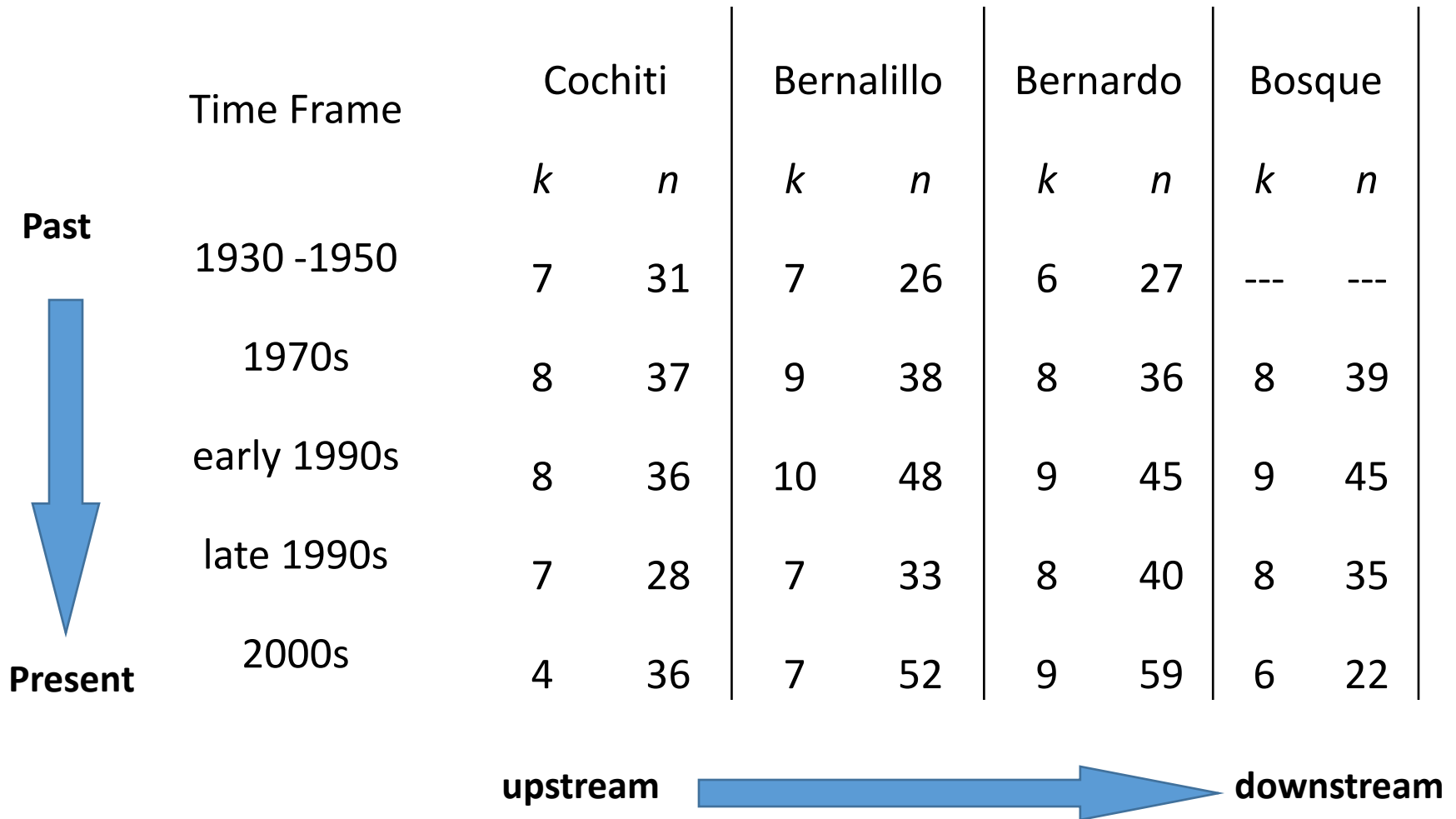


Trophic Complexity & Food Chain Length






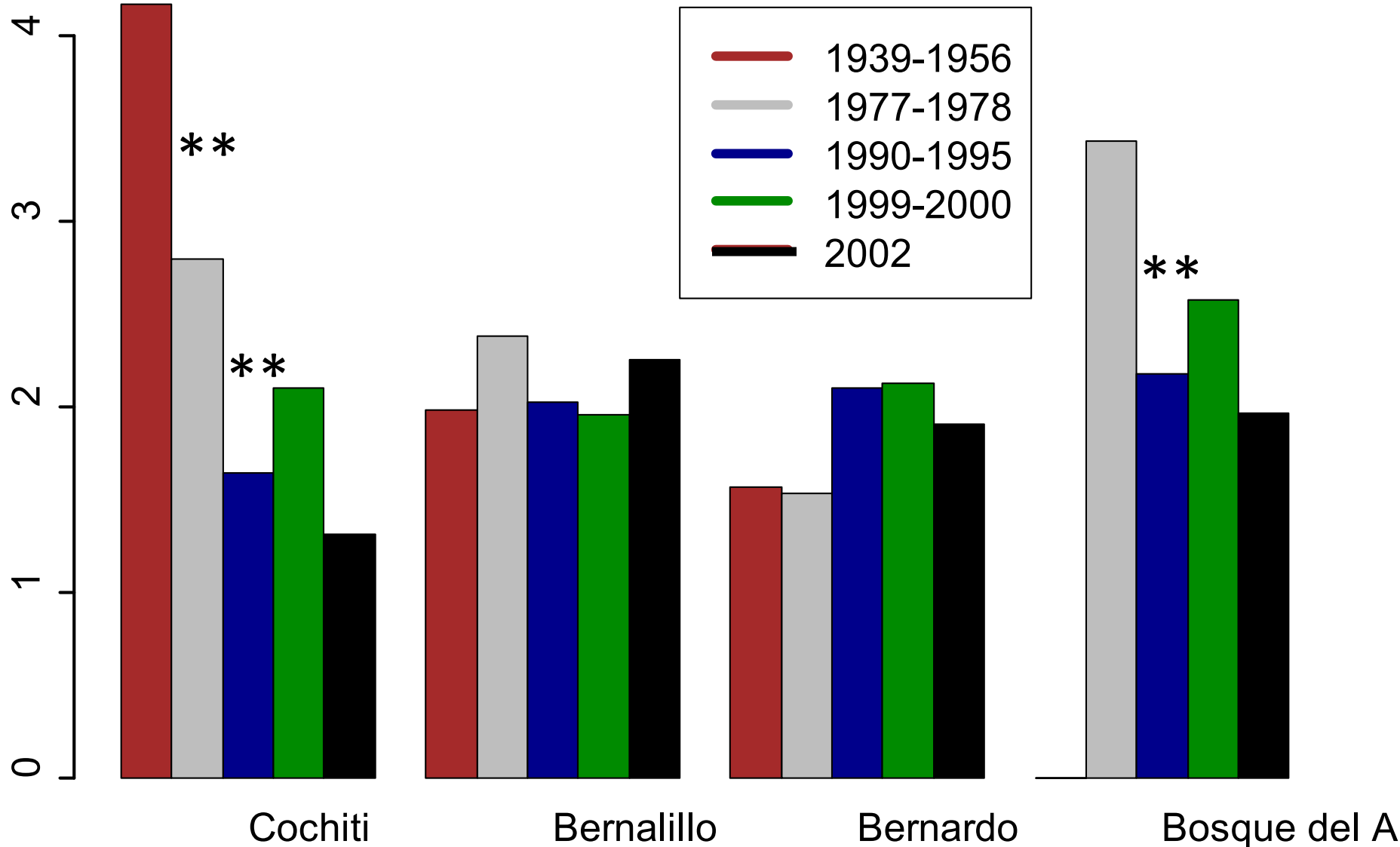
# Rio Grande Fishes Sampling Scheme ( $k_{\max} = 10; n = 713$ )



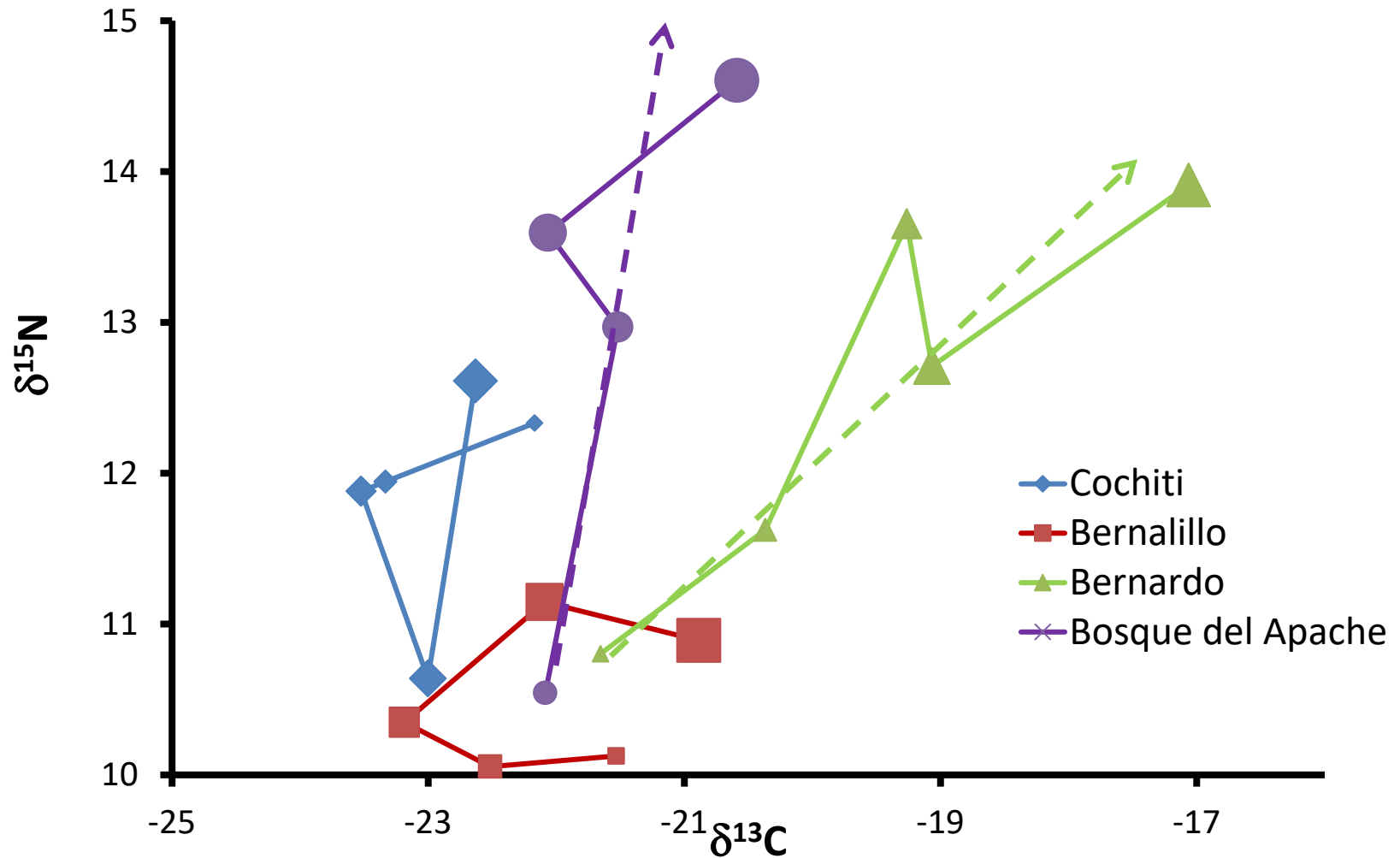
Time Frame	Cochiti		Bernalillo		Bernardo		Bosque	
	<i>k</i>	<i>n</i>	<i>k</i>	<i>n</i>	<i>k</i>	<i>n</i>	<i>k</i>	<i>n</i>
1930 -1950	7	31	7	26	6	27	---	---
1970s	8	37	9	38	8	36	8	39
early 1990s	8	36	10	48	9	45	9	45
late 1990s	7	28	7	33	8	40	8	35
2000s	4	36	7	52	9	59	6	22

upstream  downstream

# Community-wide 'Isotopic Niche' Breadth



# Centroid trajectories over time (late 1930s – 2000s)



Size: Bernardo = Bosque > Cochiti = Bernalillo  
Shape: Bernardo = Bosque  $\neq$  Cochiti  $\neq$  Bernalillo

# Ecological processes are strongly affected by river modification over the last century

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Evidence of significant temporal changes in fish community function in the Rio Grande

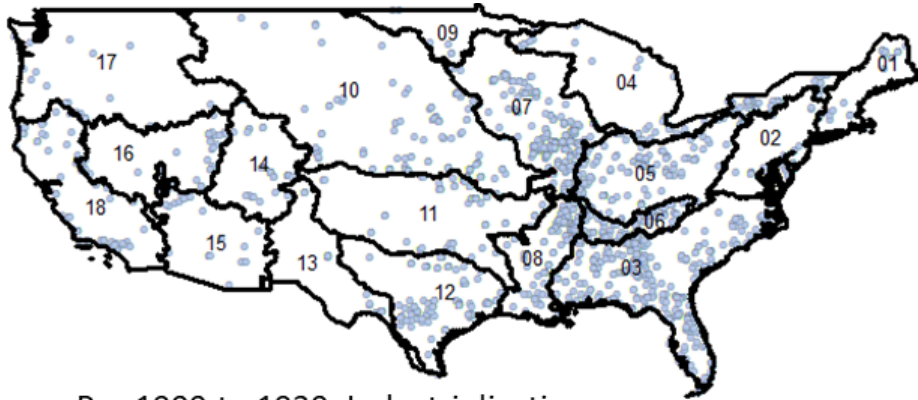
**Isotopic niche collapse** after closure of a major dam and channel modification.

Trajectories of  $^{15}\text{N}$  and  $^{13}\text{C}$  consistent with **point inputs of wastewater**

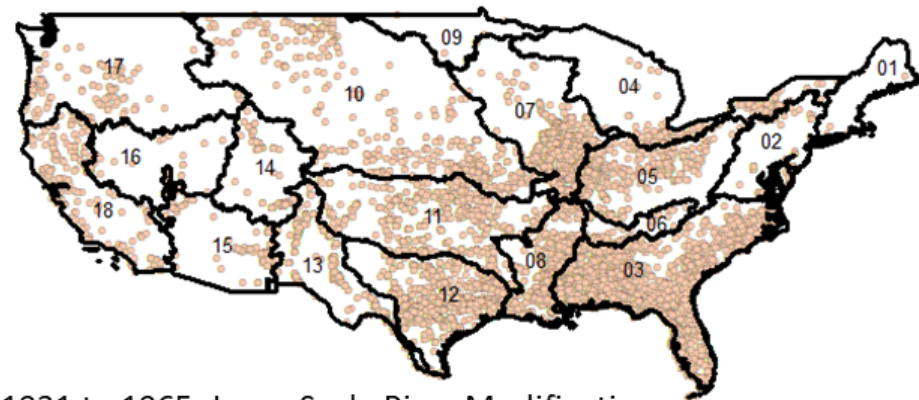
**Two targets for restoration are restoring heterogeneity and reducing nutrient inputs**



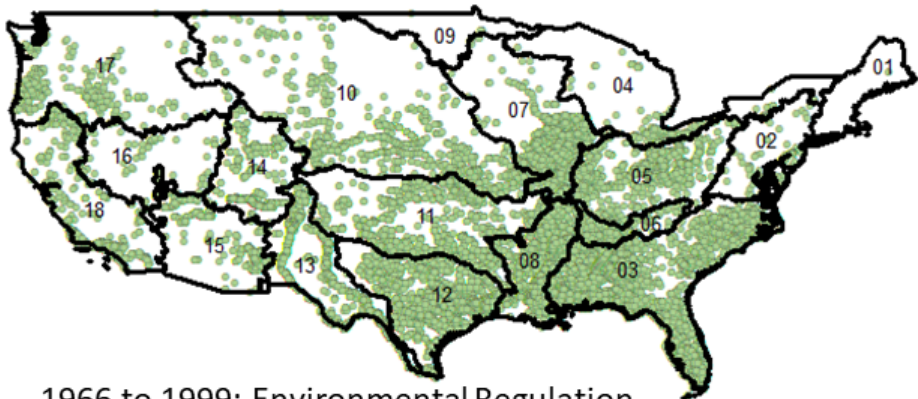
# Scaling up - Freshwater Fish Specimens – US 10 most abundant species by Watershed Area



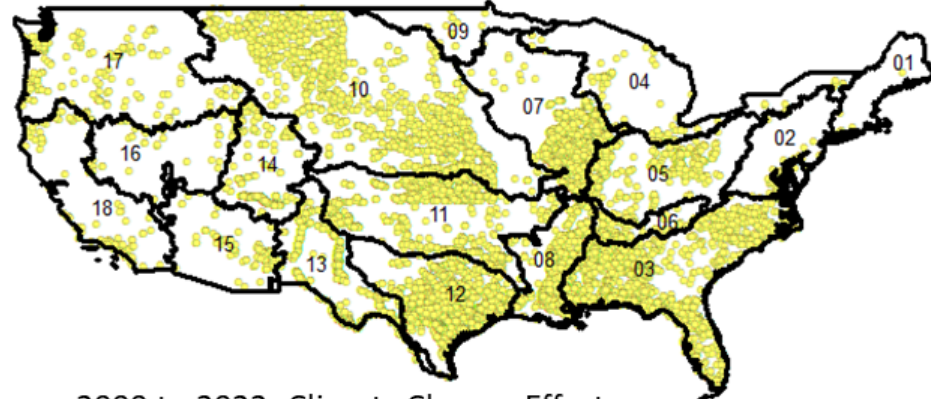
Pre-1900 to 1930: Industrialization,  
Land-Use Transformation



1931 to 1965: Large Scale River Modifications

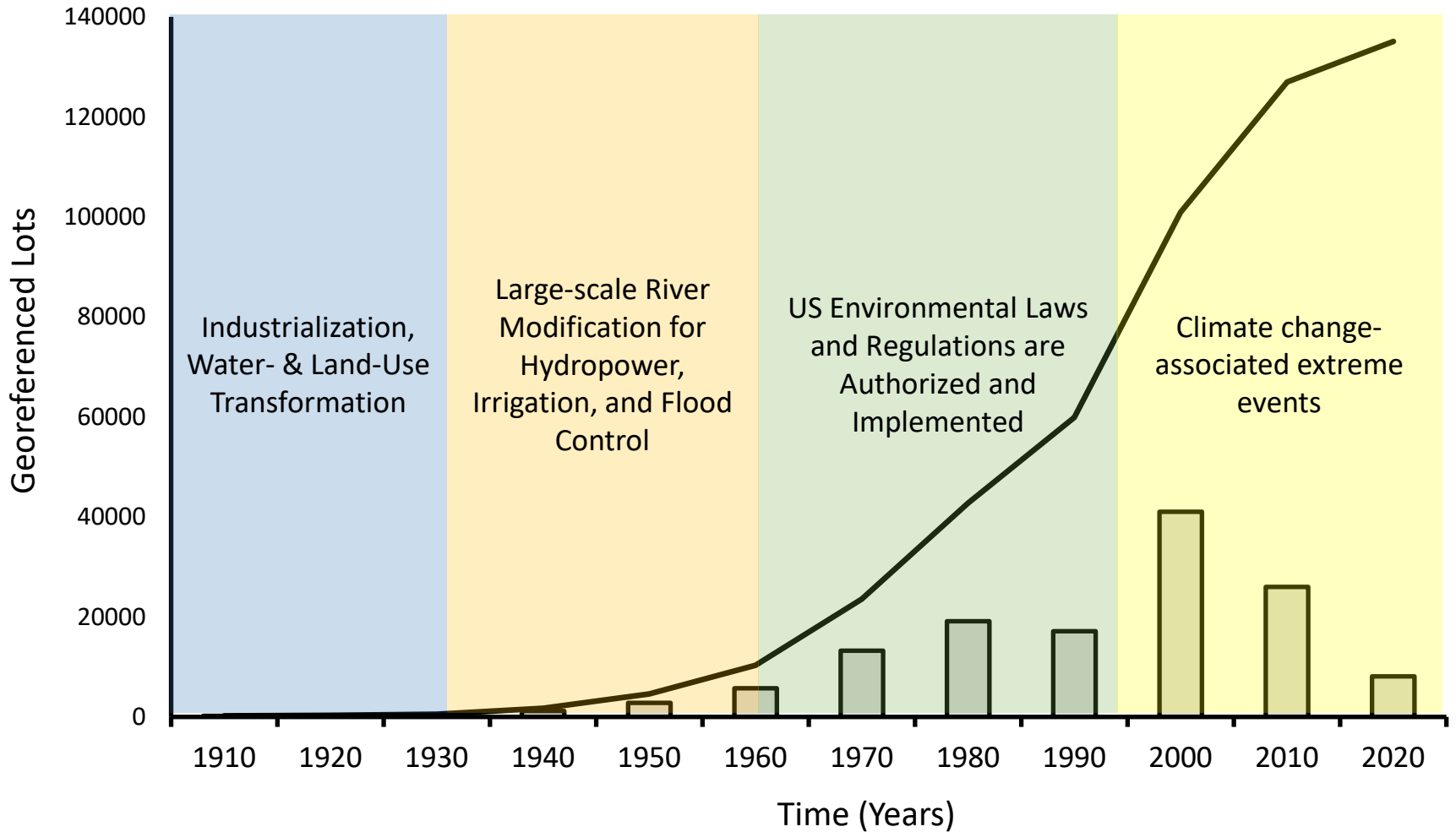


1966 to 1999: Environmental Regulation



2000 to 2022: Climate Change Effects  
Become Acute

# Scaling up in time

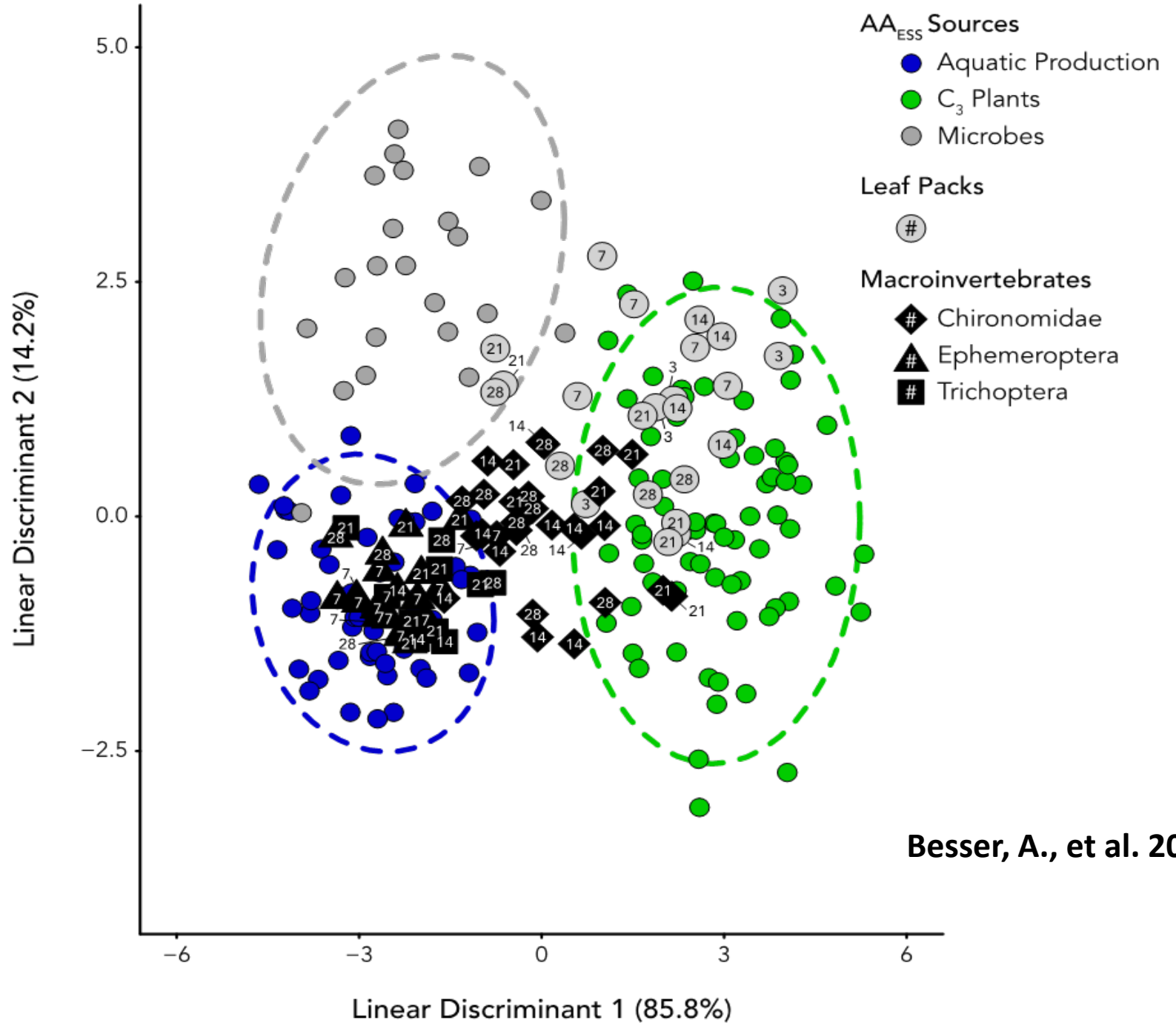


# Challenges and Uncertainties

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- Destructive Sampling
- Preservation Effects – Combinability?
- Visibility/Discoverability - **FAIR**
- Shifting Historical Baselines?
- Sparse and Uneven Records in Time and Space?
- SIA Data/Metadata Aggregator?





Besser, A., et al. 2024.



# Sparse and Uneven Museum Sampling

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- Body size bias
- Pooling samples in time and space
- Interpolation
- Bayesian inference approaches
- New analytic work, e.g., SITA, pseudo-BACI



# SIA Data Availability - Isobank



IsoBank IsoBank Project Datasets Dataset Data Upload My Login Register  
Project Guide Details Statistics List Search Templates Data  
Home



## Latest Updates

- July 1, 2021 - Several updates have been made to the [IsoBank Guide](#) - please start there if you are intending to add data to IsoBank, this page includes various helpful introductory tips, sample templates, and frequently asked questions.
- May 20, 2021 - IsoBank Ingest Workshop at IsoEcol 2021. Several project members led a workshop with 40 participants, describing the IsoBank project, the goals of the infrastructure, and providing a hands-on tutorial on the ingest process. More workshops are planned in the near future, in conjunction with community conferences and as free-floating (and tuition-free) events. Please e-mail us to indicate your interest in future workshops at [isobank@lists.tacc.utexas.edu](mailto:isobank@lists.tacc.utexas.edu)
- March 1, 2021 - IsoBank Production site goes live! This represents the first full implementation of the original vision for IsoBank, with the ability to ingest data based on the community-developed metadata standards, the ability to search for data based on any element in the metadata standards, and appropriate handling for taxonomy and geospatial data. Many features will be added to IsoBank over time but this first production release represents the culmination of many years of work from the community to build towards making IsoBank a reality.



<https://isobank.tacc.utexas.edu/>

# Intersection of SIA, Collections & Environmental Data

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- **River regulation** strongly affects nutrient flow and fish community dynamics in the Rio Grande
- **Effects of regulation** increase in severity over decadal time scales
- **Potential for restoration ecology**
  - Restoration of overbank spring floods
  - Address point-source nutrient loading
  - Anticipate reversal of trajectories we identified
- **Broader role** for Biodiversity Collections for baseline, reference, and post-restoration goal assessment

# Acknowledgements

- Collections and SIA Working Group
- Zach Sharp, University of New Mexico
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- Eliza Gilbert, University of New Mexico
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- Krista Capps, University of Georgia
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- Rachel Bowes, Emporia State University
- Hernan Lopez, University of Michigan



Museum Research Traineeship  
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