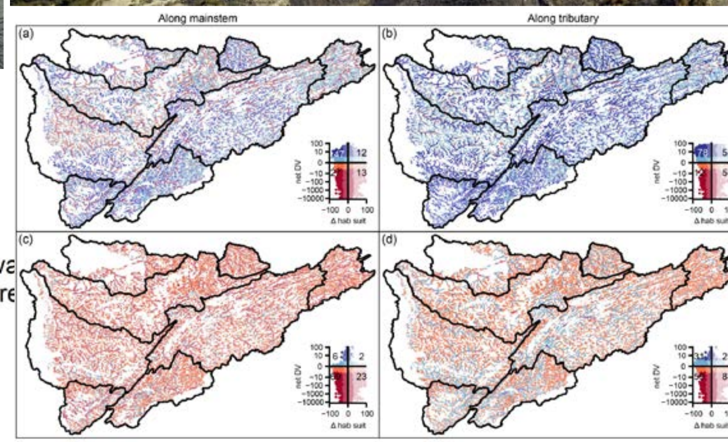
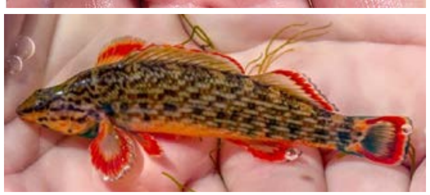
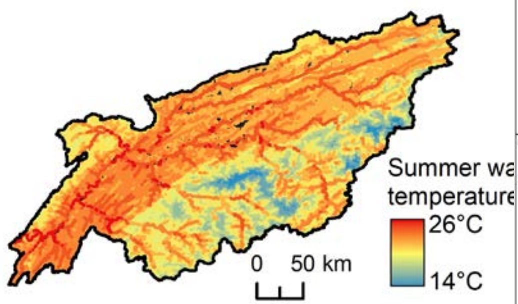
Aquatic Conservation Science and Macroecology in the Giam Lab







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Lab research foci

- Conservation science, mainly focusing on aquatic [stream] systems
    - Other projects include modeling socioeconomic and policy drivers on tropical deforestation, impacts of oil-palm agriculture
- Aquatic macroecology
    - Ecological processes driving regional to continental scale patterns
    - Productivity and body size gradients, mechanisms of community assembly
- Main approaches
    - Collating and analyzing existing datasets from papers, federal and state agencies using statistical approaches from various fields
    - Collaborations with scientists from universities and agencies
    - Experimental and field work

Outline

1. Land-use change and fish in SE Asia; efficacy of riparian buffers
2. Coal-mining impacts on aquatic biodiversity in the US
3. Climate change and fish in the southern Appalachians
4. Examining the diversity-productivity relationship in aquatic systems
5. Expansion of native and non-native fish and their community-level impacts under future climate and land-use change

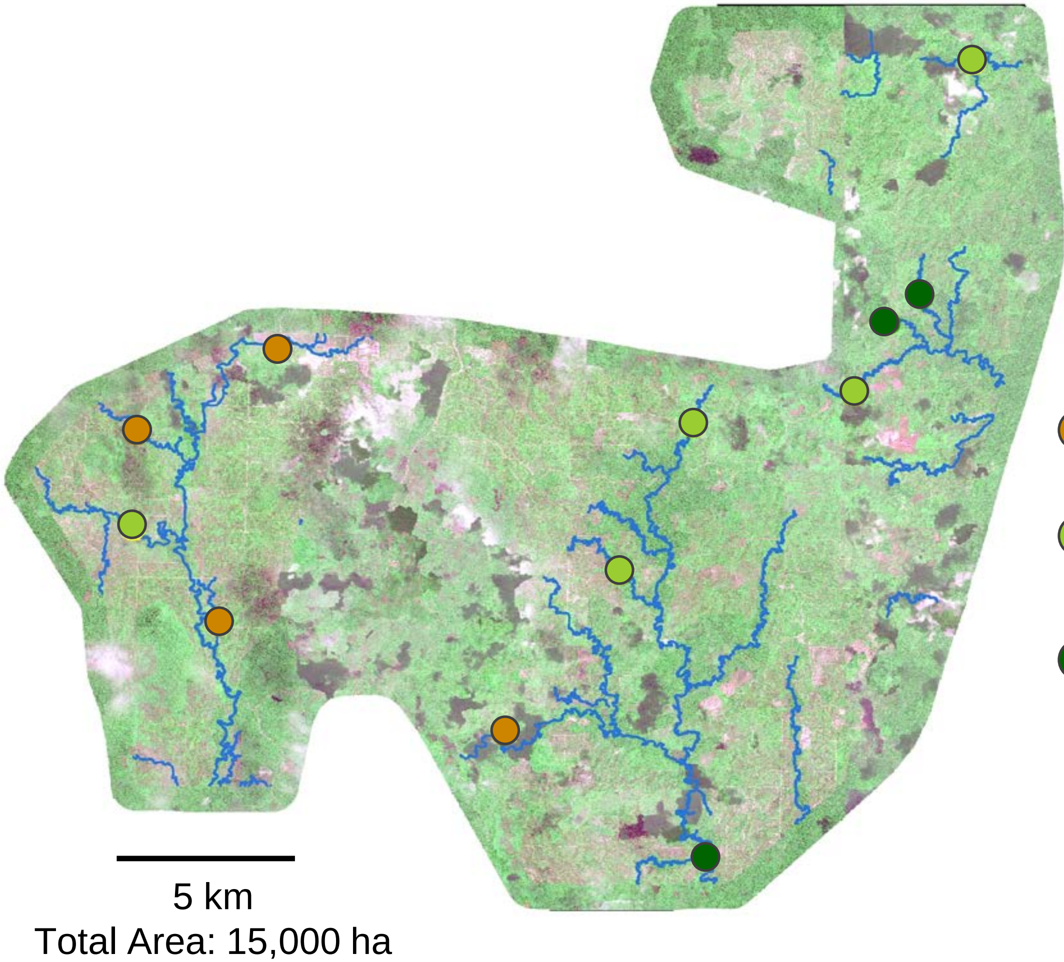
1. Land-use change and fish in SE Asia

Biodiversity-rich forests lost rapidly in the last decade

Malaysia: 16% loss
Indonesia: 10% loss
-Hansen et al. 2013 *Science*


Lowland forests are converted to oil palm monocultures

1. Land-use change and fish in SE Asia

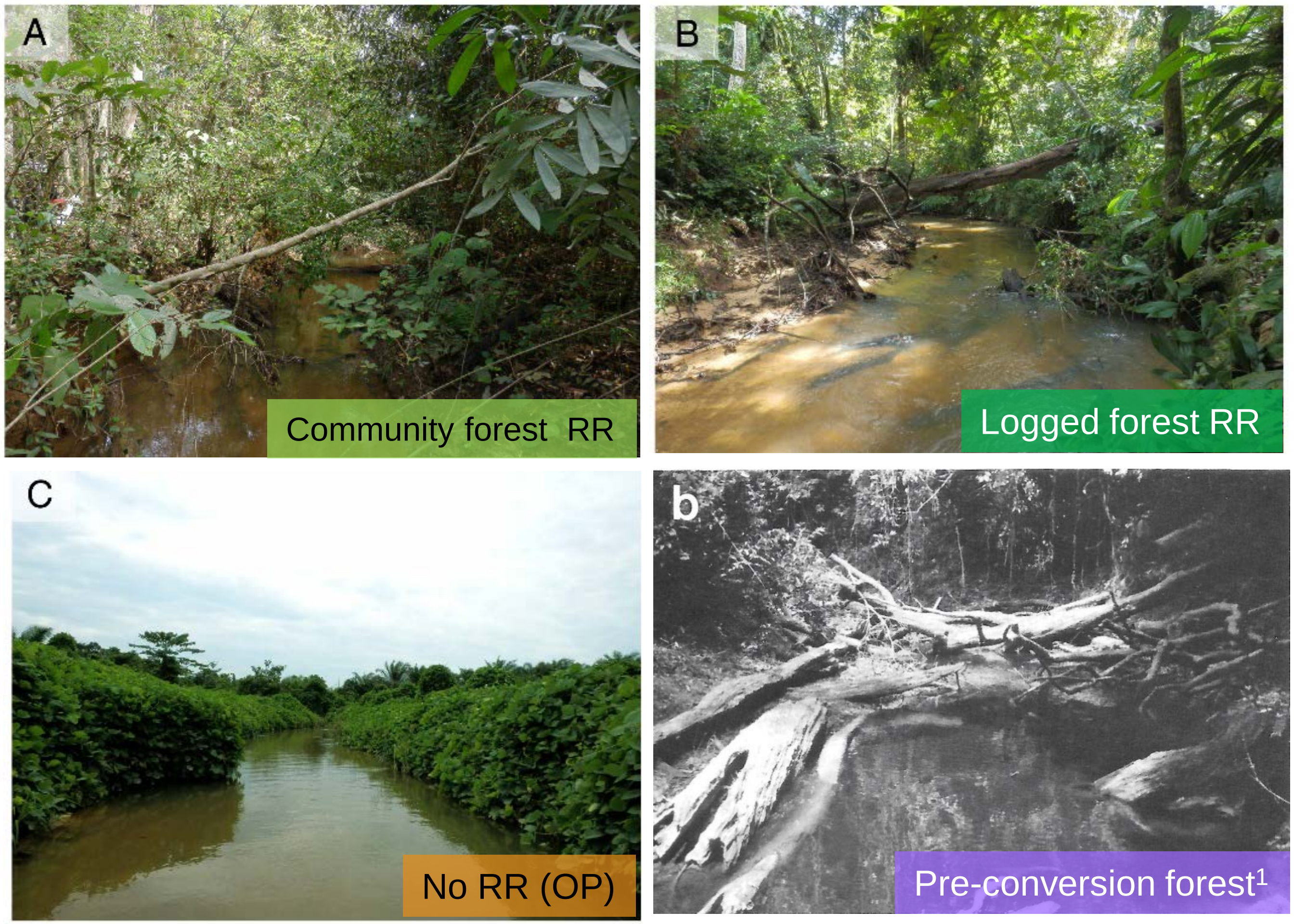


No riparian reserve (OP)

Community forest riparian reserve (RR_{CF})

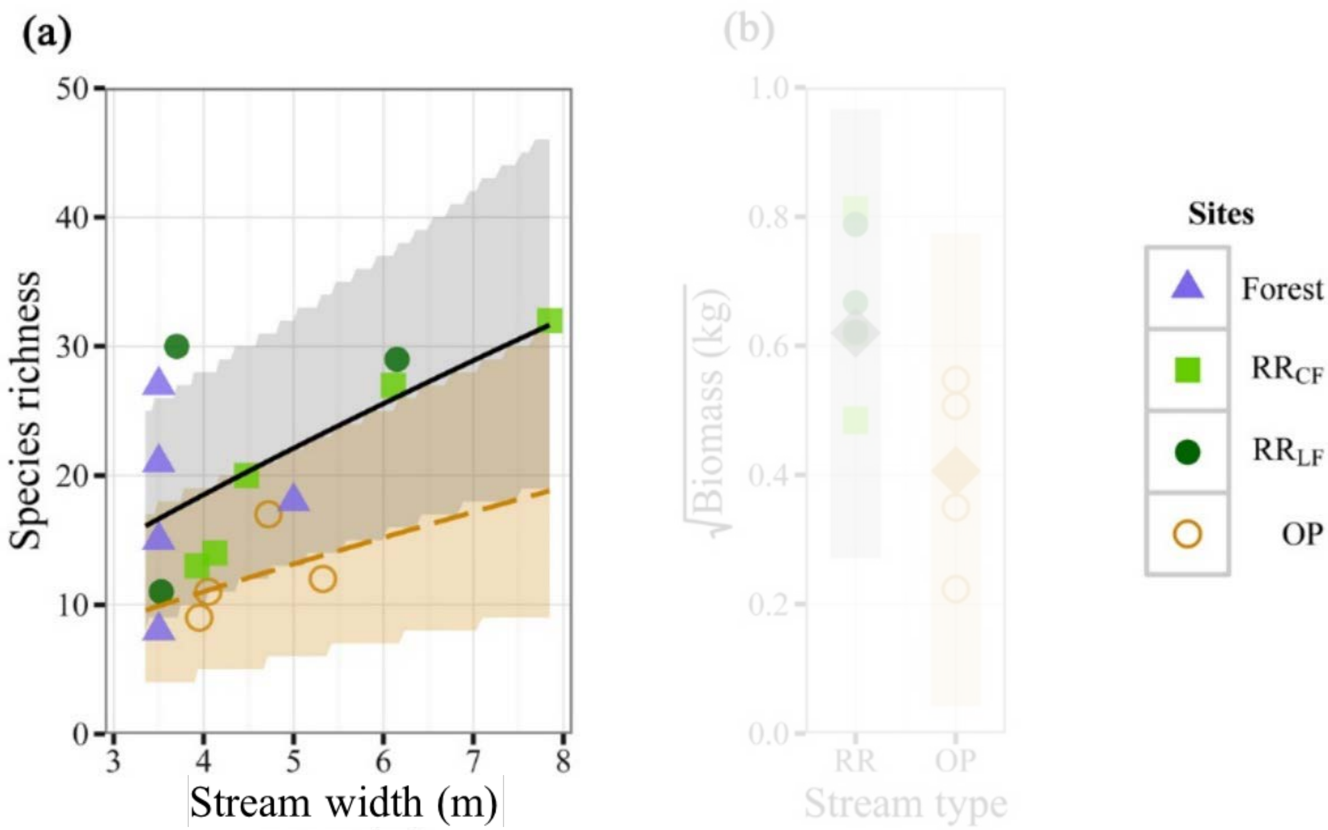
Selectively logged forest riparian reserve (RR_{LF})

Giam et al. 2015 *Conservation Biology*

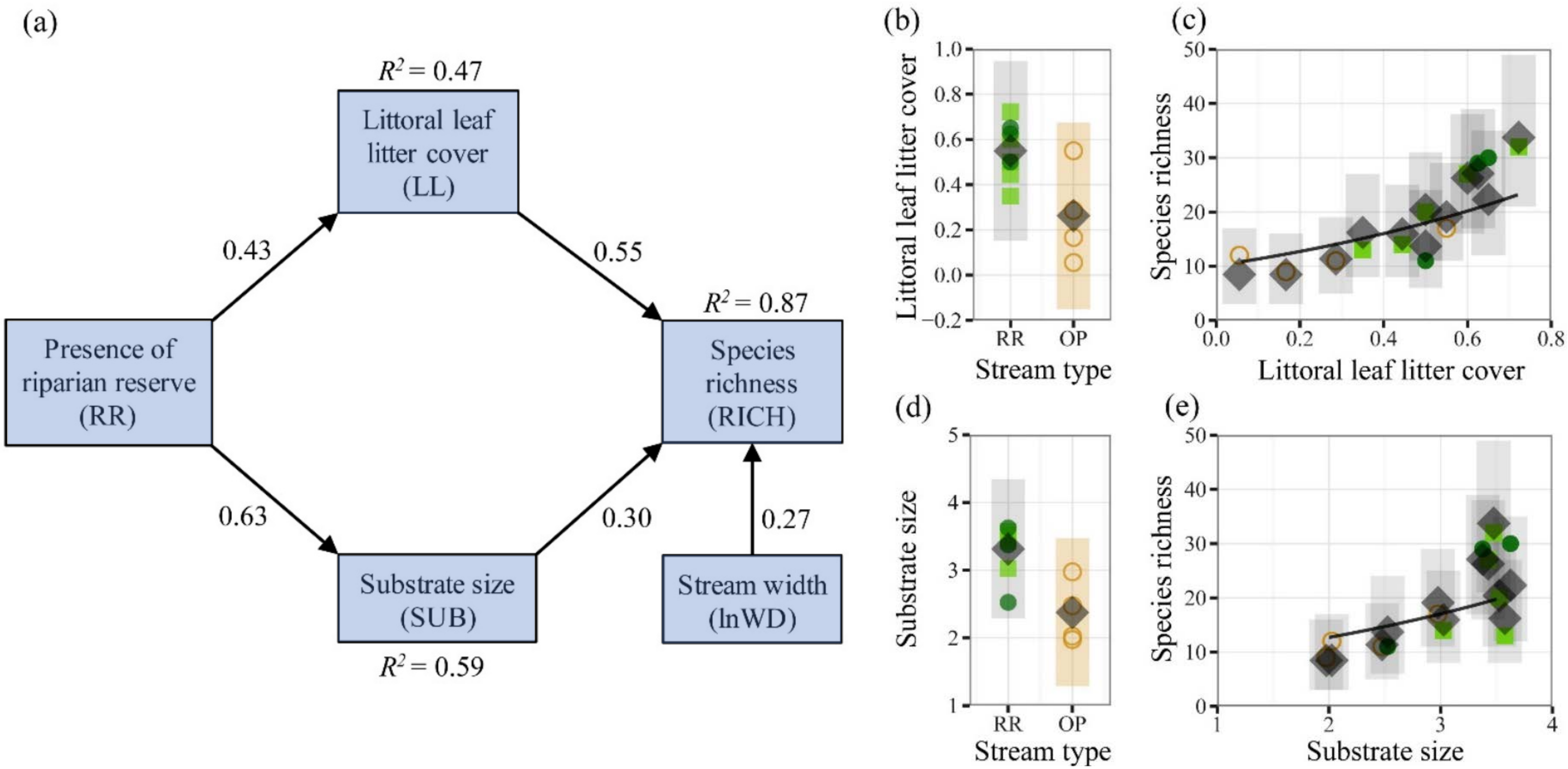


- [1]Roberts 1989 *Mem Cal Acad Sci*

Higher species richness and biomass in riparian reserves

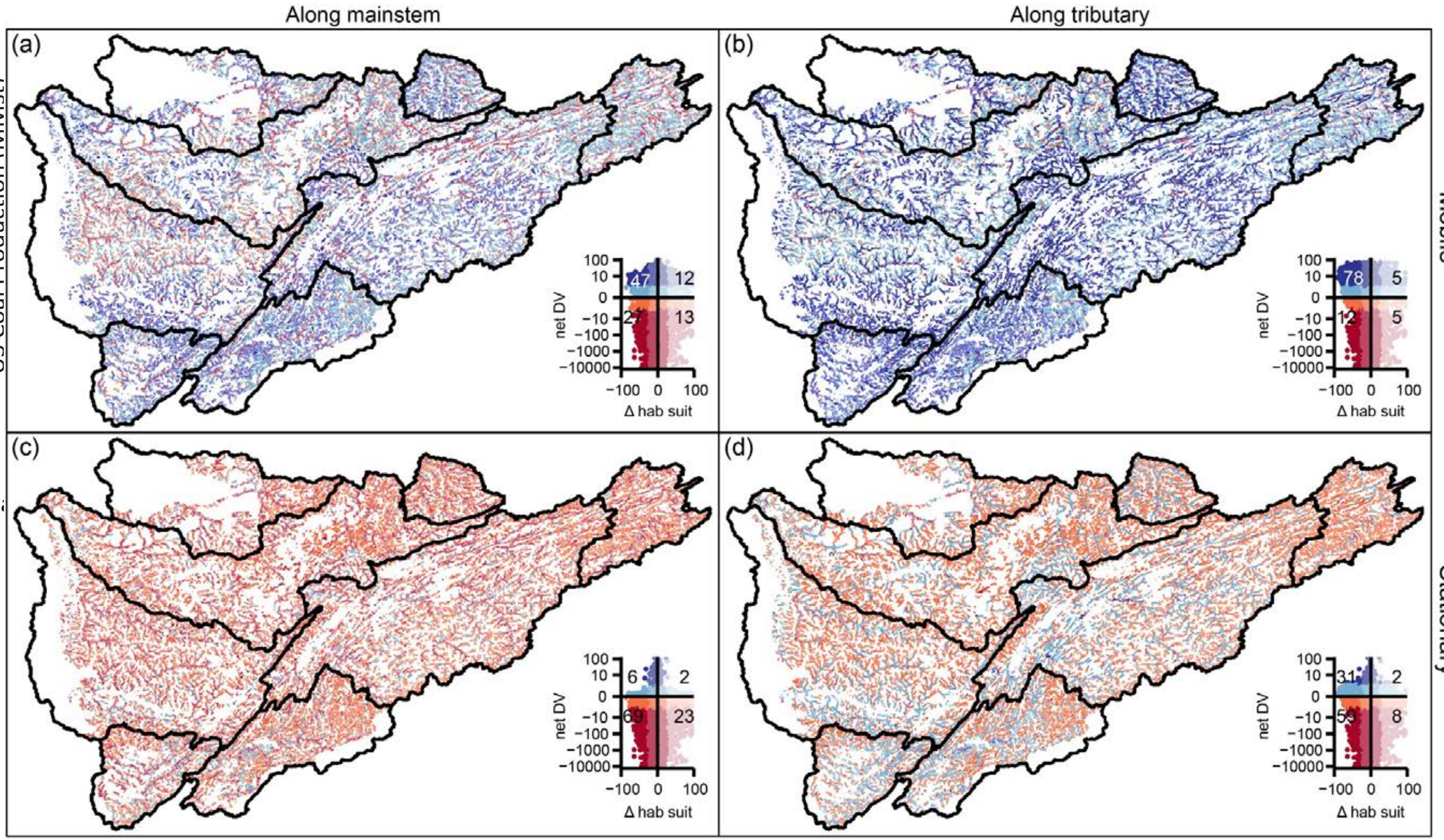


Leaf litter cover and coarse substrate increases richness



2. Coal-mining impacts in the US

US Coal Production (MMst)



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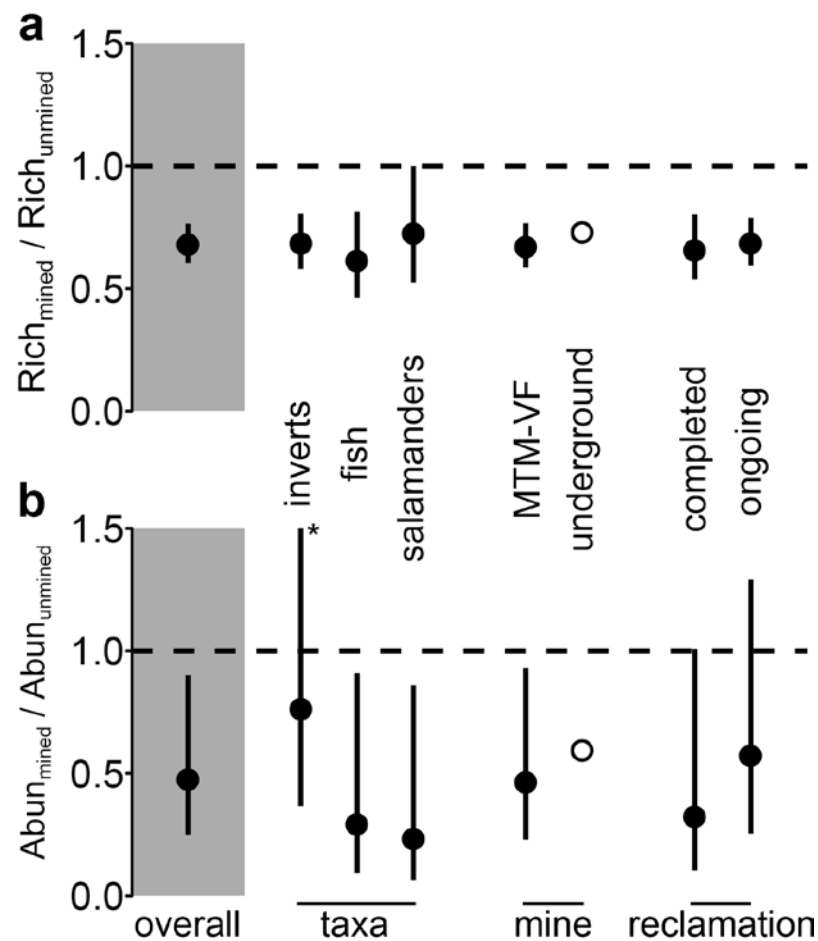
Mining affects both richness and abundance

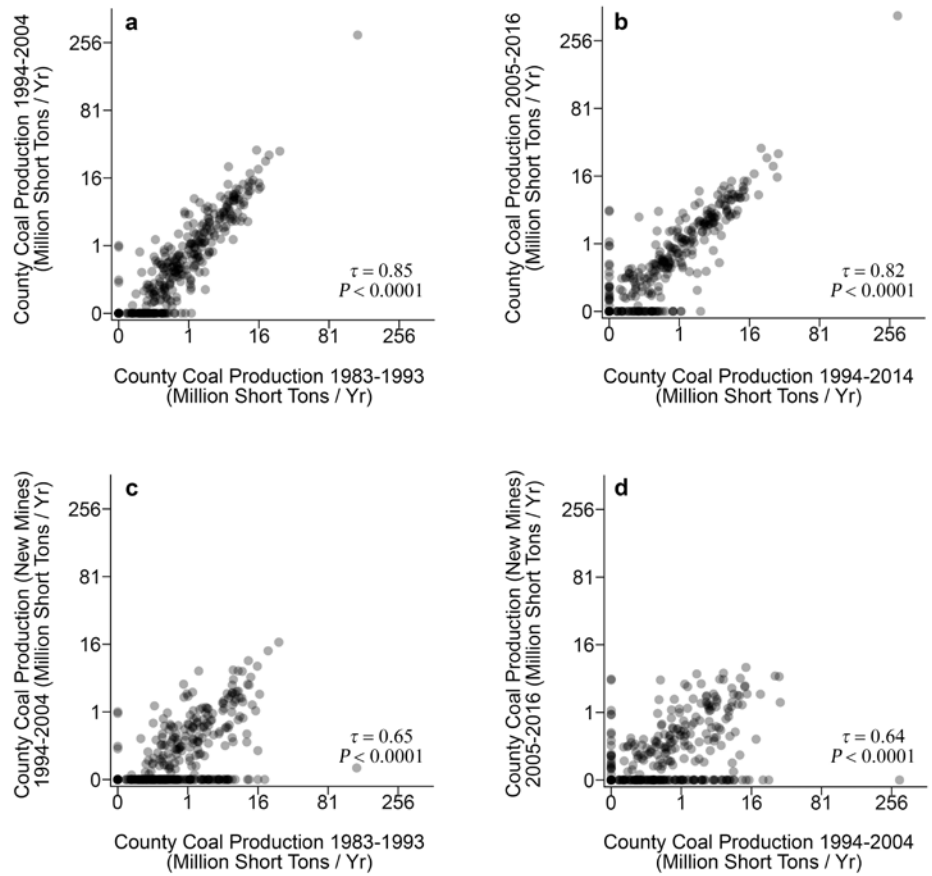
- Mining has negative impacts on both taxa richness and abundance
  - Richness 32% (95% CI: 24-40%) lower in mined sites
  - Abundance 53% (10-75%) lower in mined sites
- Negative effects on richness across all contexts
- Reclamation did not help



Giam et al. 2018 *Nature Sustainability*

Where should we pay attention to impacts?

- Where should we be most concerned about mining impacts?
- We propose: watersheds with the greatest recent coal production and fish richness, accounting for endemism and T&E status
- Assuming: recent coal product = near-future prod.

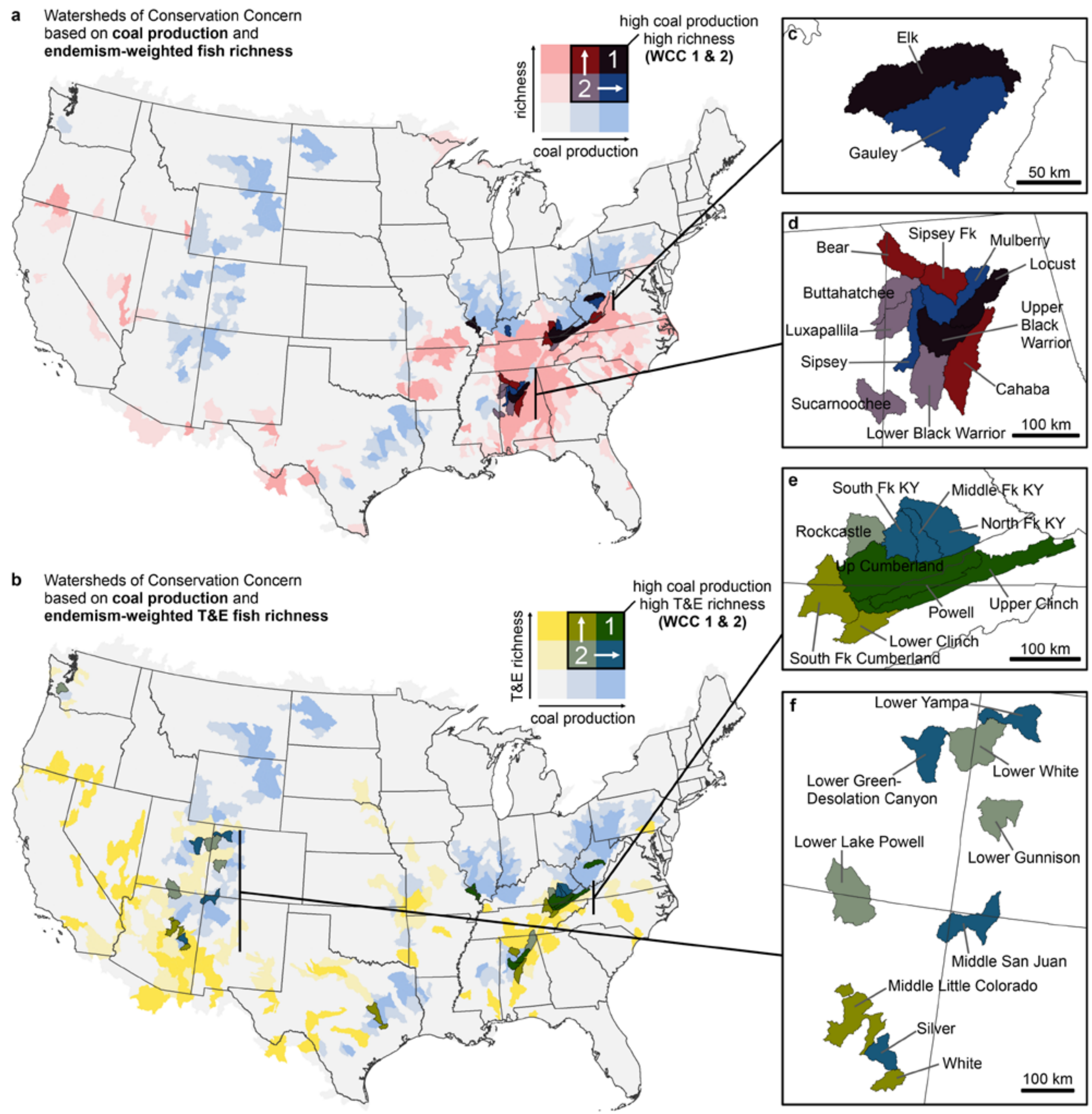


Giam et al. 2018 *Nature Sustainability*

Where should we pay attention to impacts?

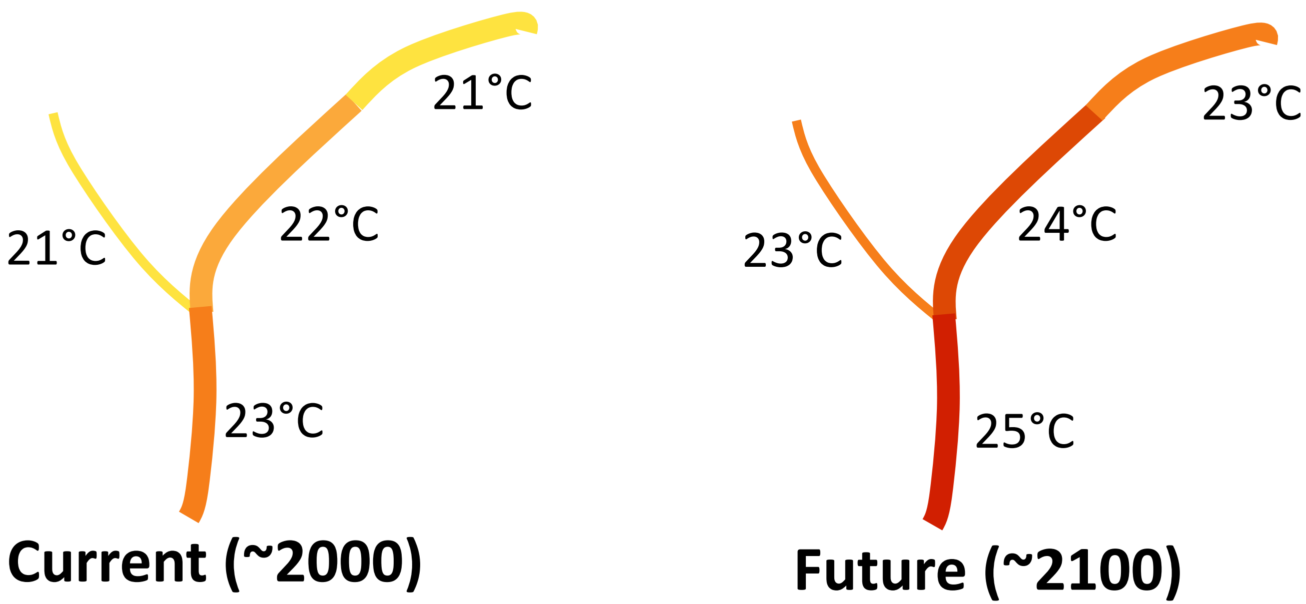
- C/S Appalachian watersheds have high coal prod. and high total as well as T&E richness

- Colorado Plateau: high coal prod. & T&E richness only



3. Climate Change and Fish in the Apps

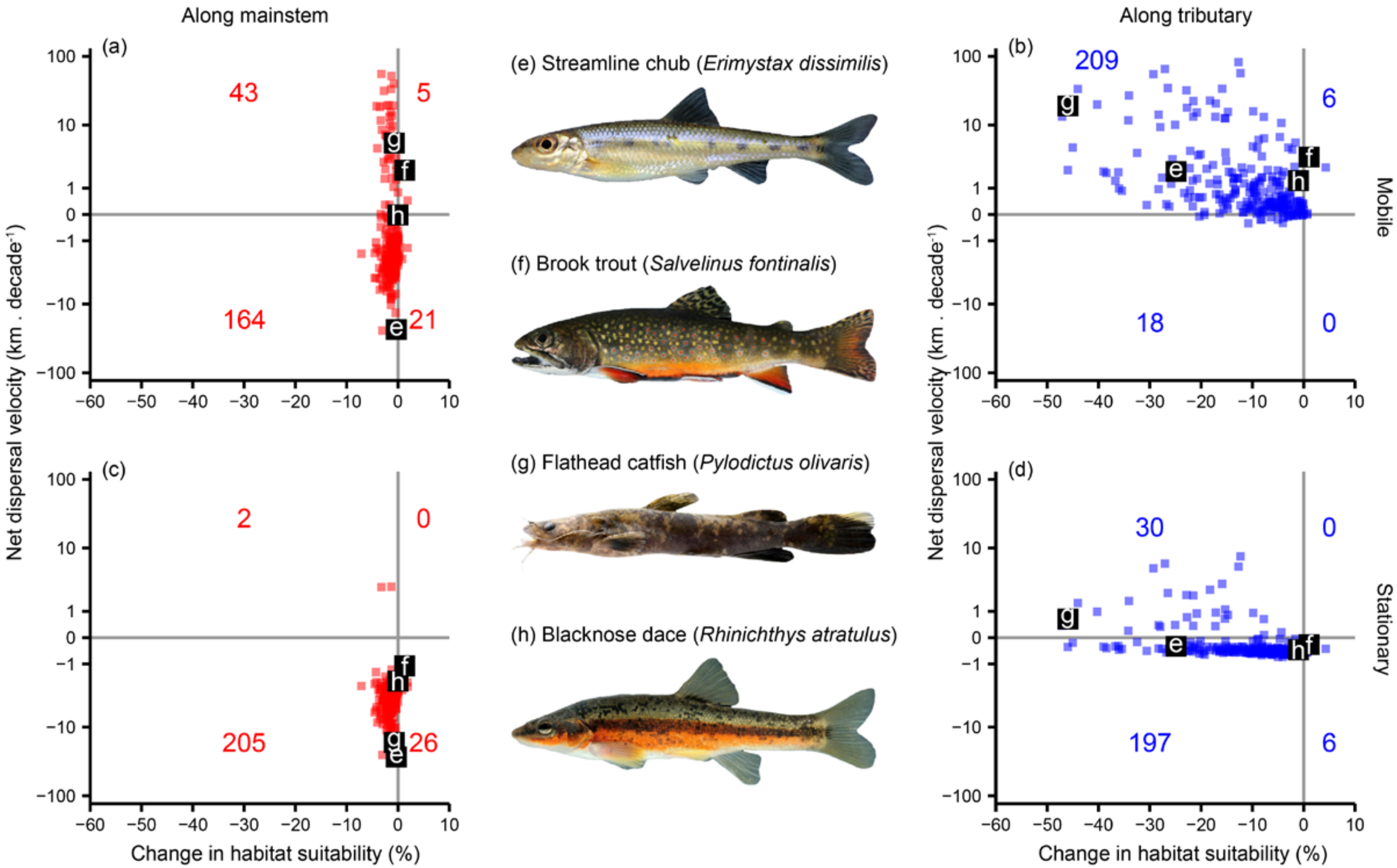
- Can stream fish keep pace with climate change in the Apps?
- Concept of <u>Climate Velocity</u>
  - speed at which an organism would have to move to arrive at a new location with the same climate as its old location



3. Climate Change and Fish in the Apps

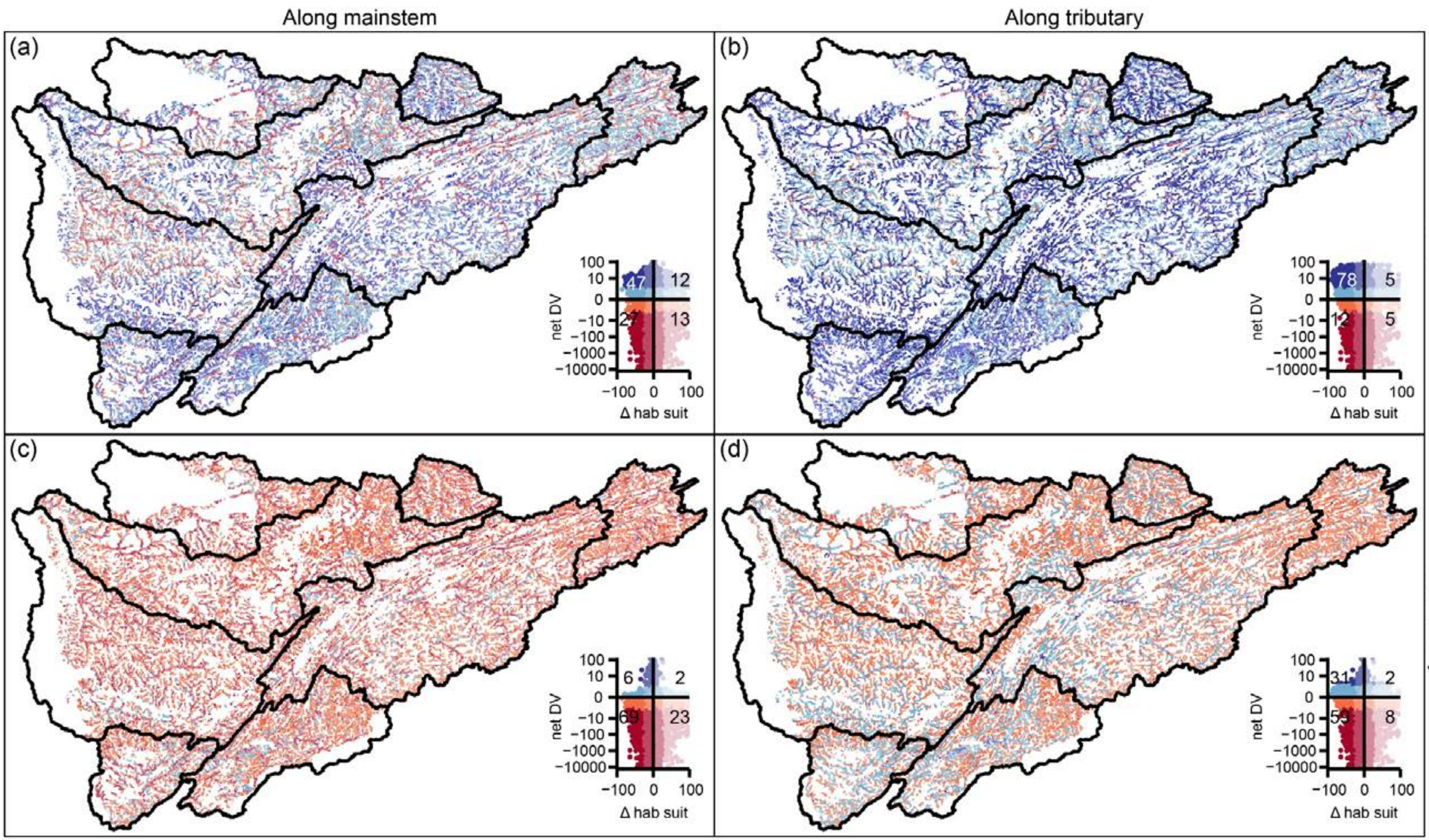
- Concept of <u>Net Dispersal Velocity (NDV)</u>
  - NDV = Dispersal Velocity – Climate Velocity
  - Positive NDV = fish can move faster than needed to reach climatically suitable habitat
  - Negative NDV = fish moves slower than needed to reach climatically suitable habitat
  - Positive NDV = survival by dispersal
  - Negative NDV = death; cannot keep pace with climate change

Tradeoffs between climate refugia and non-thermal habitat suitability



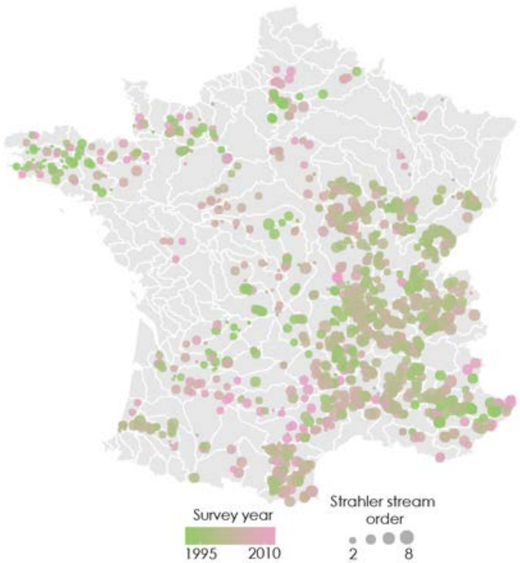
Troia et al. 2019 *Nature Ecology and Evolution*; Troia et al. Author Correction submitted to *Nat Ecol Evol*

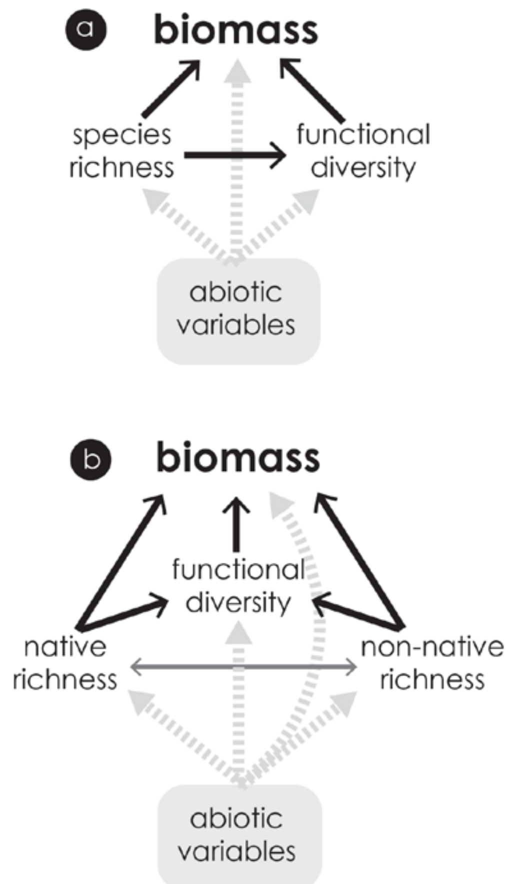
Tradeoffs between climate refugia and non-thermal habitat suitability

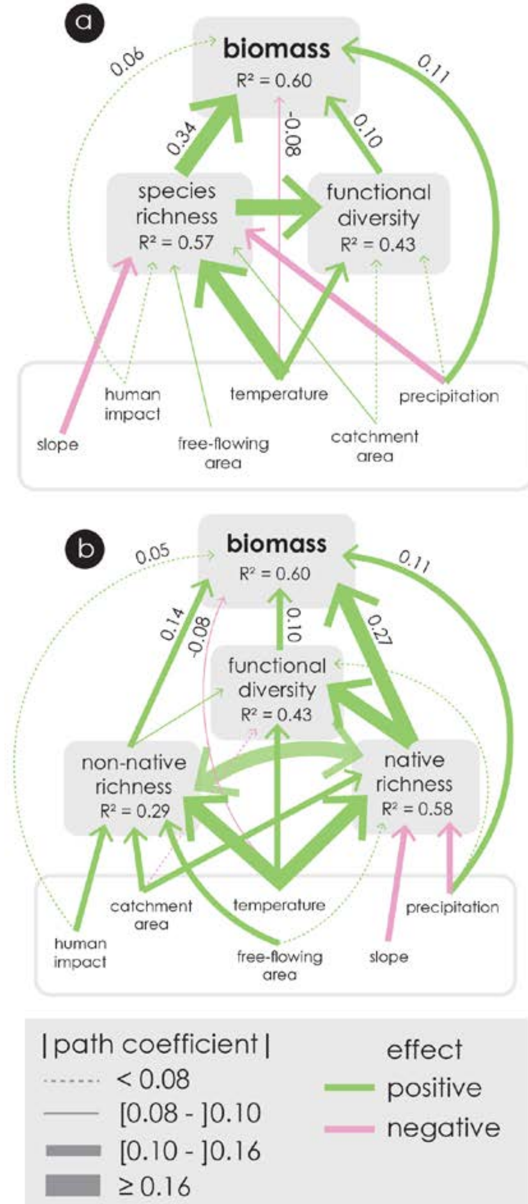


Troia et al. 2019 *Nature Ecology and Evolution*; Troia et al. Author Correction submitted to *Nat Ecol Evol*

4. Diversity-Productivity Relationship







Woods & Giam. *Global Ecology and Biogeography*. In Revision.

5. Fish expansions and impacts under climate and land-use change

- Compilation and analysis of long-term datasets from agencies
    - TVA, TWRA, NCDEQ; collab. with Jen Cartwright and Jacob LaFontaine of USGS and others…
    - Tennessee and Cumberland basins
- Identify expanders: (1) increase in (relative) abundances; (2) increase in number of sites
- Link expanders to environmental changes (e.g., climate, land-use, flow) and traits
- Investigate impacts of expanders on native fish species
- Map current and future habitat suitability of these expanders based on climate, flow, and land-use variables

Thank you!