Connecting water and people by improving road-crossing infrastructure in the Brazilian Amazon

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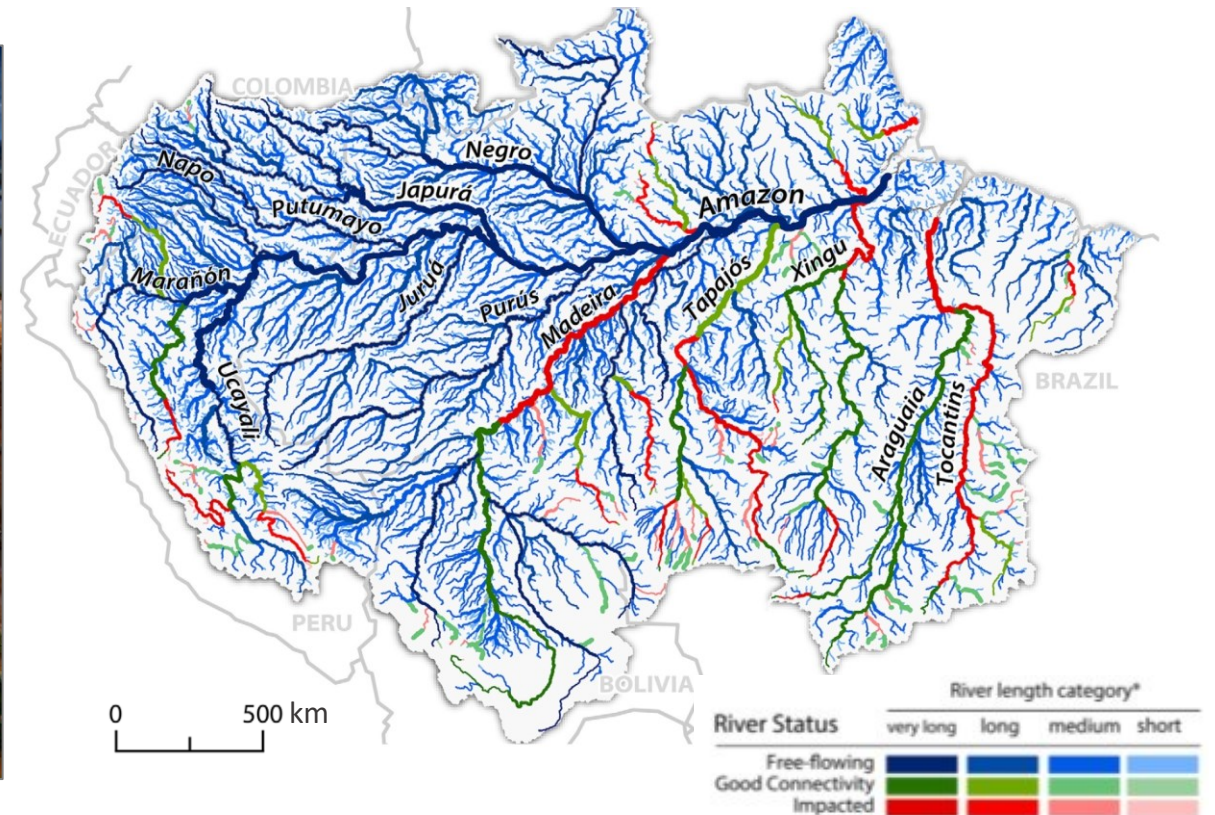
The Amazon Basin

- The world's **largest and most biologically diverse** river system
- Unprecedent **ecosystem change and connectivity loss**

Jirau dam, Madeira River, Brazil

Caldas et al. 2022. Cons Sci Pract

The underappreciated role of small barriers

Road-stream crossing in the Upper Xingu, Brazil

- Smaller infrastructure like farm dams, weirs, culverts

- **High numbers** throughout the Basin

- **Limited regulatory oversight**

- Road infrastructure

Road-stream crossings in the Amazon

- **Inadequate** and **poorly planned infrastructure**

- Predictors of environmental change in **aquatic ecosystems**

- Water **temperature regimes**[1], **GHG emissions**[2], and aquatic **biodiversity**[3].

[1] Macedo et al. 2013. Philos. Trans. R. Soc. B
[2] Macedo et al. in review
[3] Leitão et al. 2018. Ecography

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Risk to people's safety and well-being

BR-319 in Purus-Madeira interfluve, Brazil
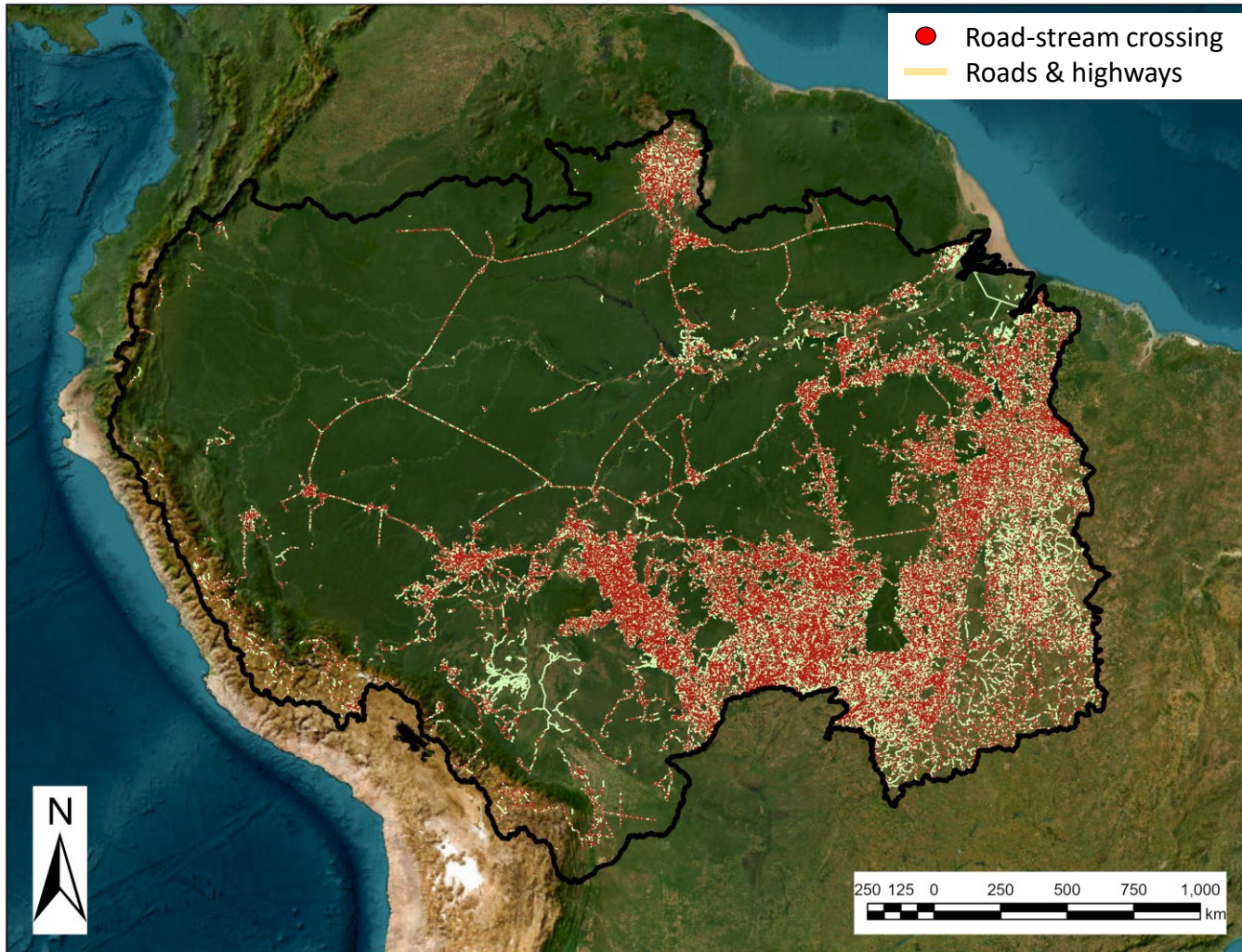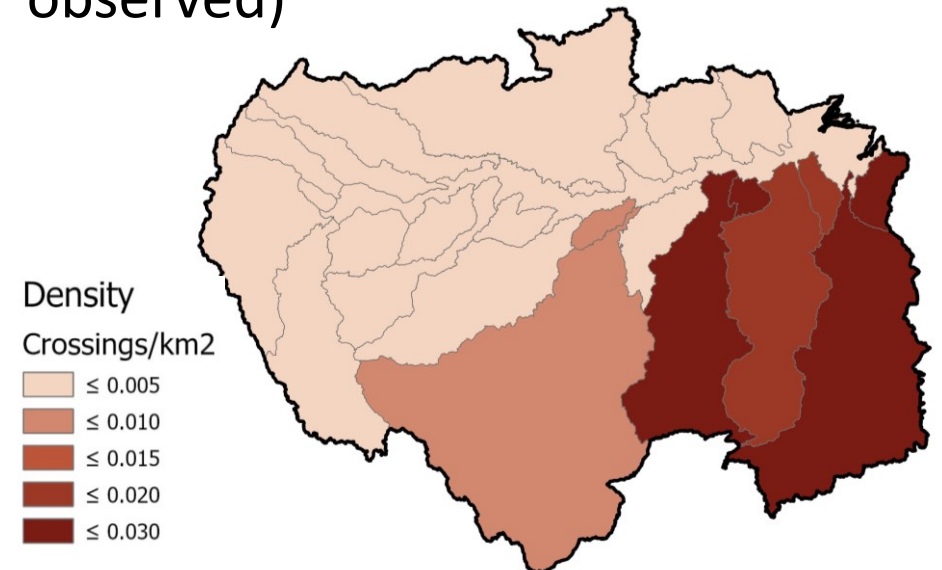

Upper Xingu in Mato Grosso, Brazil

- Local communities pool their own money to **fund infrastructure washed away in previous years**

Scaling the problem

- **63,187 existing road-crossings** (up to 3rd order streams)

- Hydrographic & roads data (SNAPP, CSR-UFMG, gov. databases)

- **Field validation** (70% of observed)

Density
Crossings/km2

- ≤ 0.005
- ≤ 0.010
- ≤ 0.015
- ≤ 0.020
- ≤ 0.030

Road-stream crossing
Roads & highways

The initiative

1. **Map road-crossing infrastructure** & **raise awareness** about the extension and magnitude of the problem.

2. **Propose and test solutions** to restore stream connectivity & **assess ecosystem response**.

3. Promote and support efforts to **scale up connectivity restoration** across the Amazon.

Experimenting solutions

- First **manipulative experiment** that attempts to restore **hydrologic connectivity** in Amazonian streams

- **Removal/replacement** of inadequate or obsolete road infrastructure

- **Before-After Control-Impact (BACI) design** for ecosystem monitoring

BASELINE
(monitoring)

RESTORATION
(intervention)

POST-INTERVENTION ASSESSMENT
(monitoring)
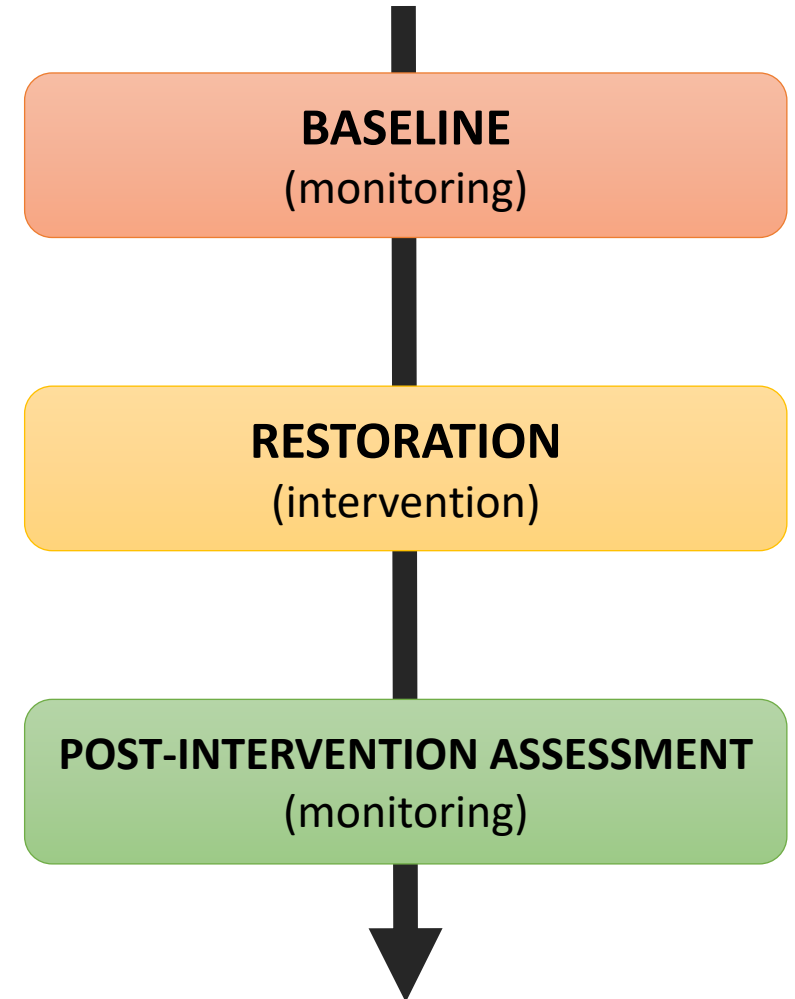
Candidate sites for the experiment

- **Abandoned road infrastructure** in Mato Grosso state, Brazil

- **Low-order streams** draining to the **Upper Xingu**

- **Opportunity**: Assessing benefits of restauration with low levels of conflicts

Assessments of ecosystem response

- **Pre-intervention monitoring** (baseline)

- 15 candidate streams

- Sites **above & below** road-crossings

Physical habitat

Ecosystem processes

Freshwater biodiversity

Developing a model for the Amazon

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Rural area in Santarém, Brazil

- Importance of roads for **rural communities** (health care, education, local economies)

- **Scaling up efforts** to improve road-crossing infrastructure

- Potential for benefiting both **nature and people**

Thank you!

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Funder:

Scaling the problem (projected-future)

- **2,310 expected** from **planned road infrastructure**