



# Global and Regional Mercury Threat Assessments

A new tool box to inform strategies for mercury reduction and strengthen links to biodiversity conservation

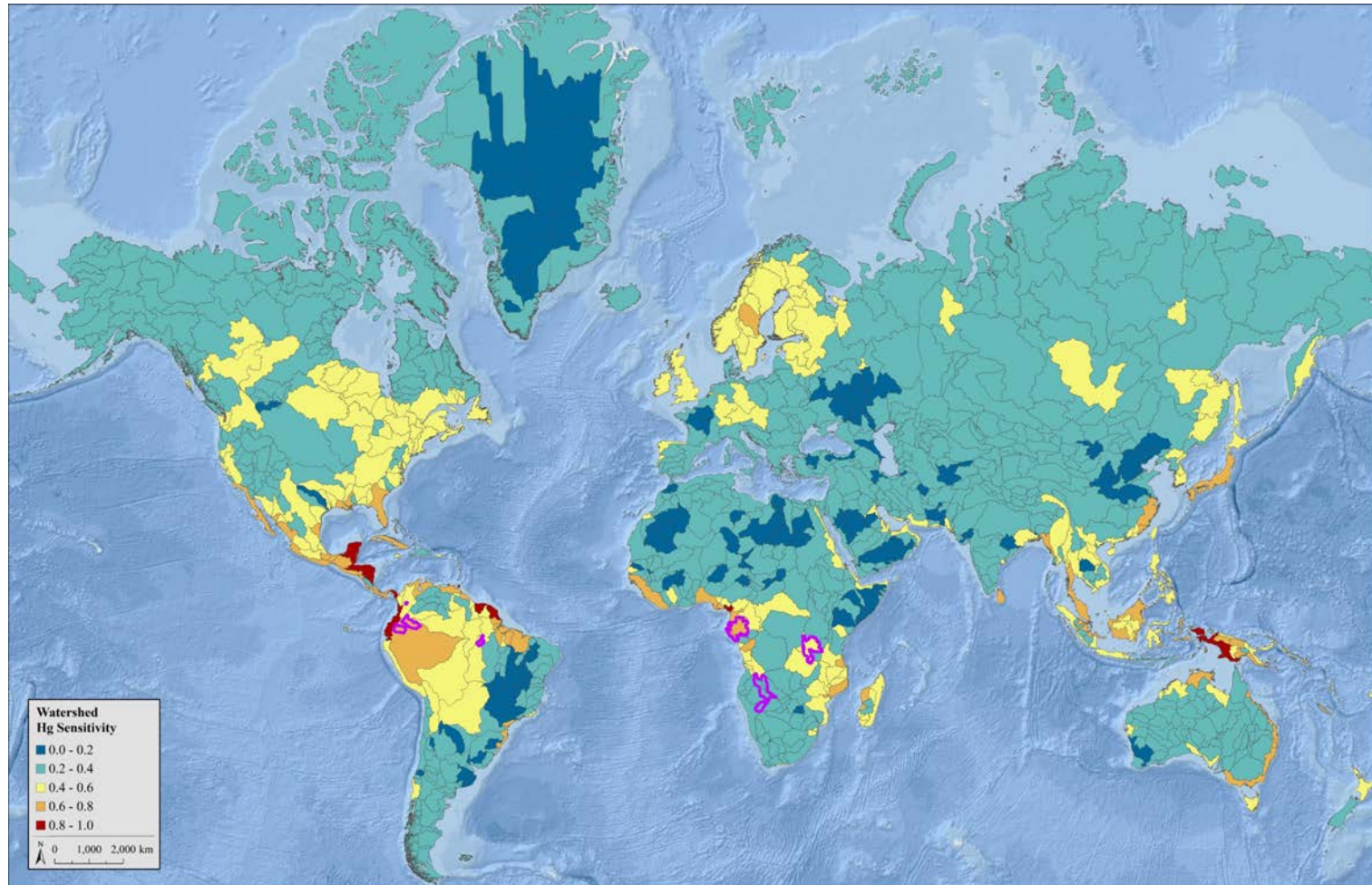
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Biodiversity Research Institute  
Portland, Maine, USA

July 24, 2024 – ICMGP – Cape Town, South Africa

# How do key bioindicators overlap with Hg in the environment?

## First Global Ecosystem Sensitivity Map

Evers and Sunderland 2019



# New Mercury Threat Mapping Toolbox

**Threat** = the potential for negative impacts to people and nature

Map

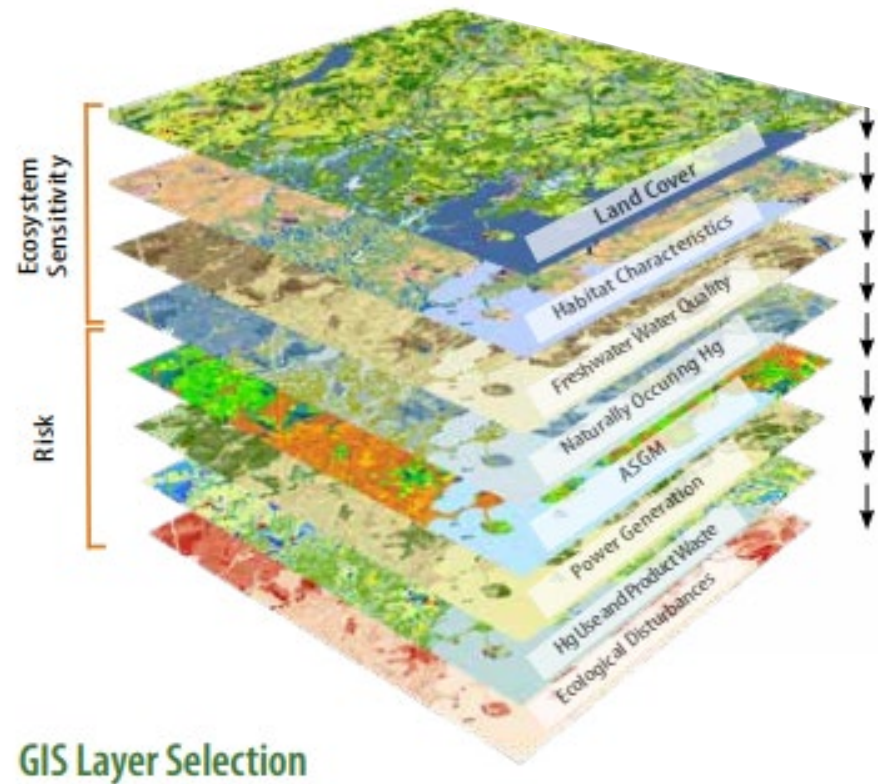
Mercury as a Threat

by combining

Ecosystem Sensitivity

+

Contamination Risk



# Ecosystem Sensitivity

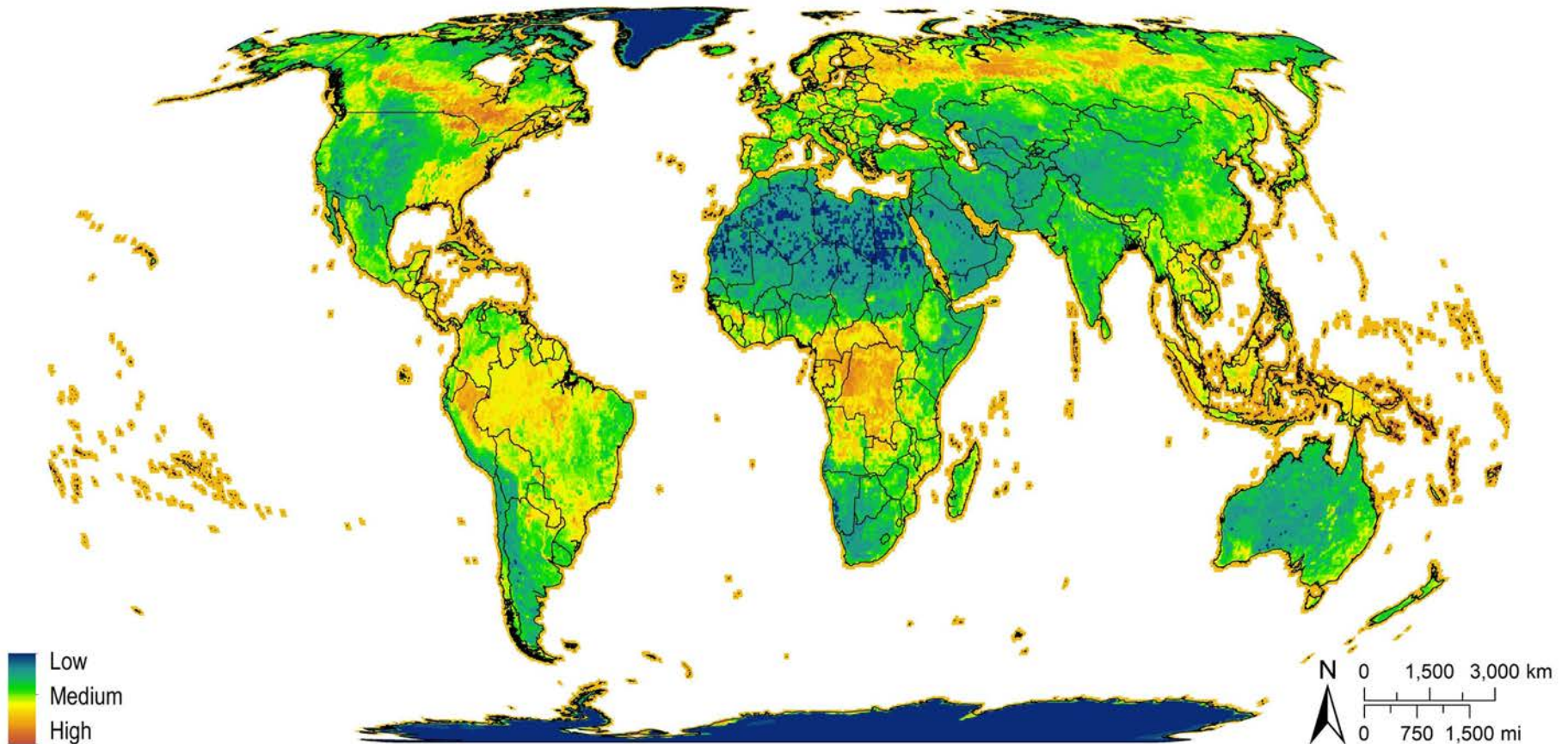
Factors\* included identifying the Sensitivity of Ecosystems to Mercury Methylation:

1. Multiple Land Cover Types;
2. Habitat Characteristics;
3. Forest Integrity;
4. Soil Organic Carbon;
5. Water Quality;
6. Climate Change Disturbance;
7. Naturally occurring mercury

\*Global data must be available



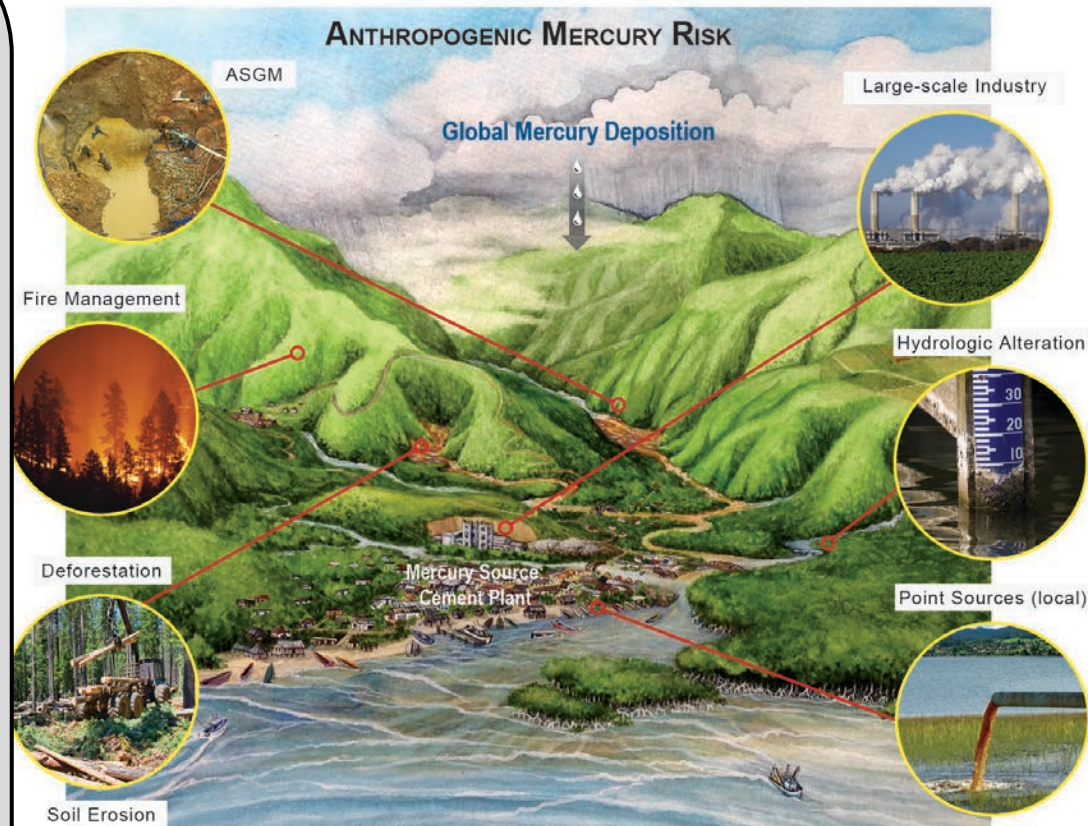
# Tool 1 – Map of Ecosystem Sensitivity



# Risk of Contamination - Anthropogenic Influences

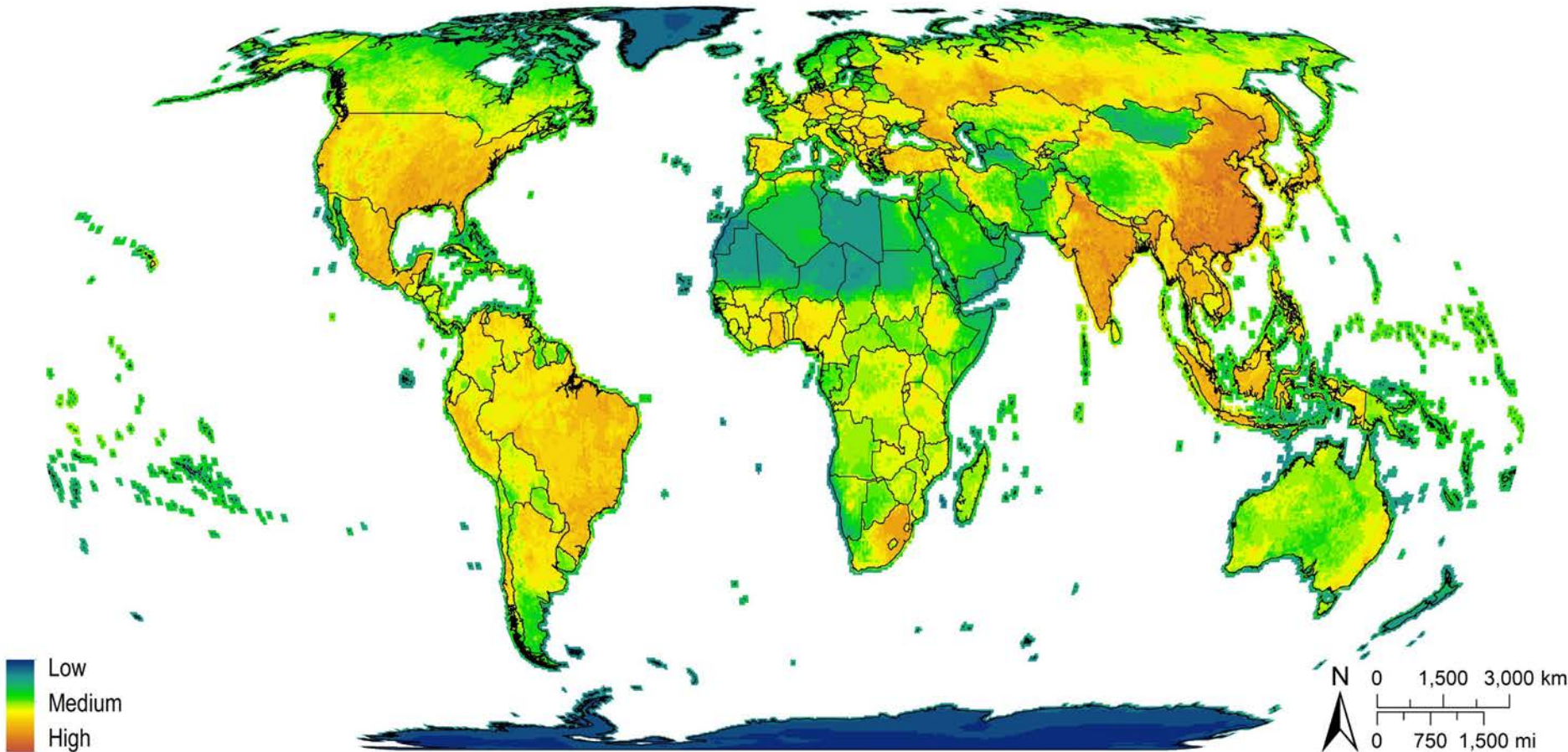
Factors included identifying the **Risk of Mercury Contamination from Anthropogenic Influence/Inputs**

1. ASGM
2. Power Generation
3. Industrial Sources
4. Intentional Use and Product Waste
5. Human-Induced Ecological Disturbance
6. Deforestation
7. Fire Management
8. Hydrologic Alteration
9. Sedimentation



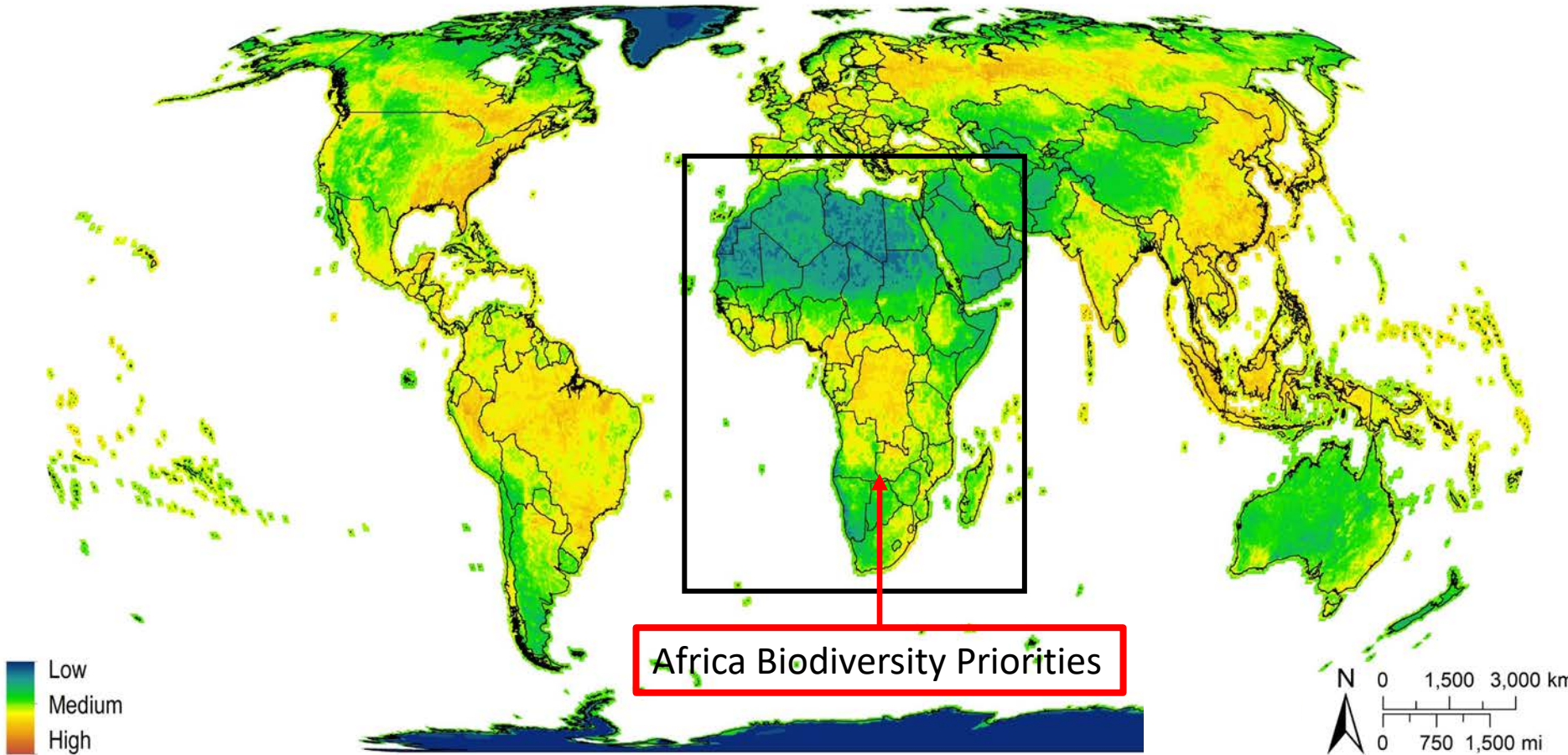
\*All Hg Point Sources -> Moved to Regional/Local Models

# Tool 2: Map of Mercury Contamination Risk



# Tool 3: Global Mercury Threat Assessment (GMTA)

Sensitivity + Risk = Threat



# Tool Use: From Global to Continental – Africa Biodiversity Priority Areas\*

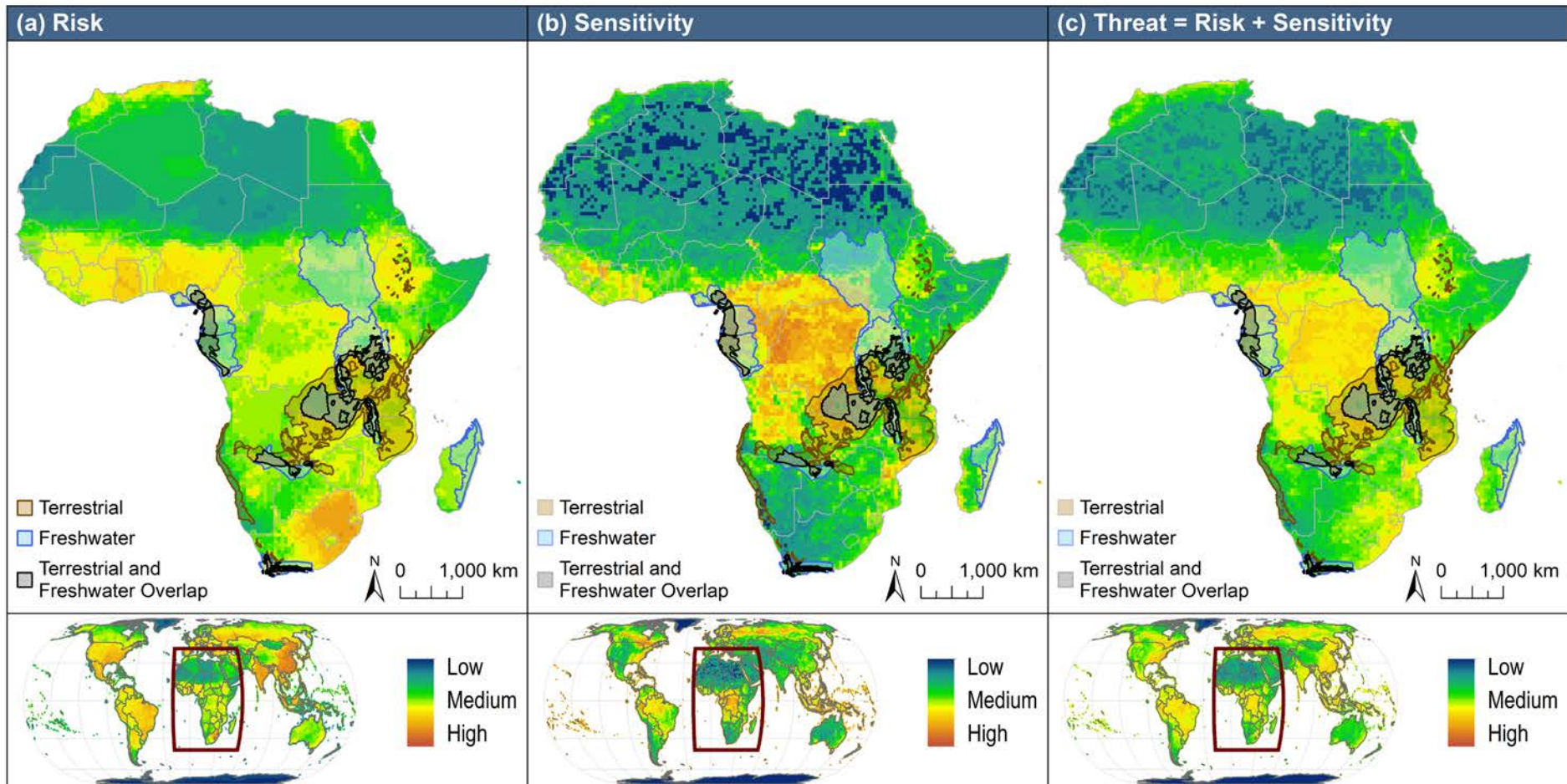
Tear et al. (2014) identified **Continental Biodiversity Priorities** for terrestrial (green) and freshwater (blue) realms

Terrestrial and Freshwater priority areas of overlap (green and blue diagonal lines) were identified as **Global Biodiversity Priority Areas**

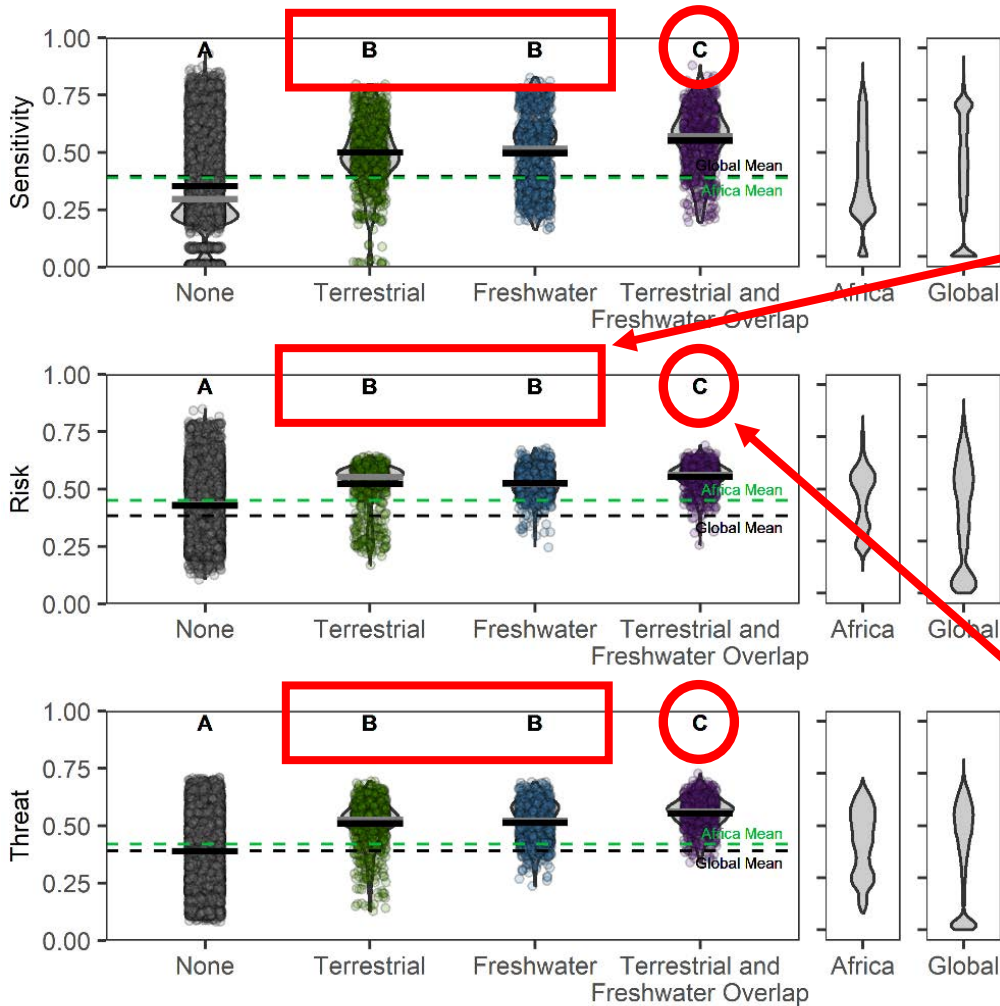


\*Tear et al. 2014

# Continental Biodiversity Priority Areas and the GMTA



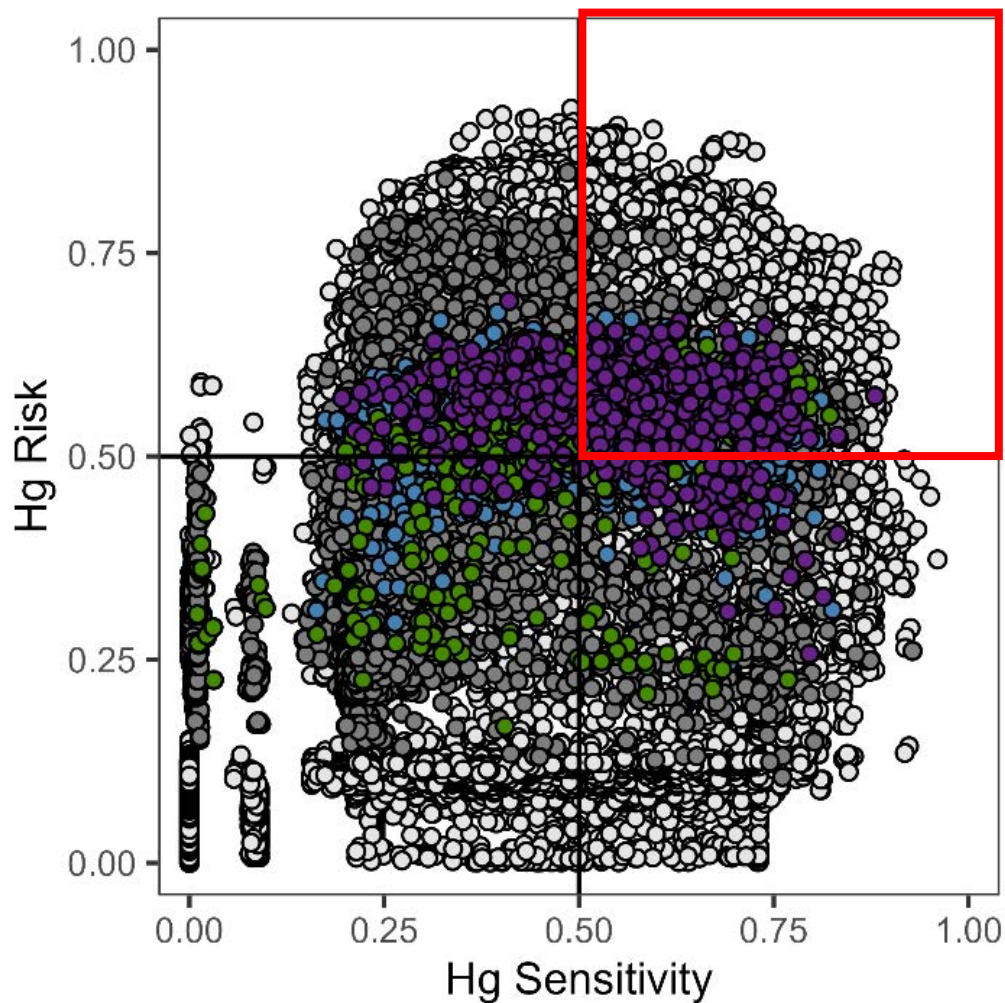
# Tool 4 – Statistical Comparisons of GMTA Outputs



**Continental Biodiversity Priority Areas had significantly higher values than non-priority areas for all mercury indicators**

**Global Biodiversity Priority Areas had significantly higher values than all other areas for all mercury indicators**

# Tool 5 - "Fingerprint" diagram – Africa Biodiversity Priorities

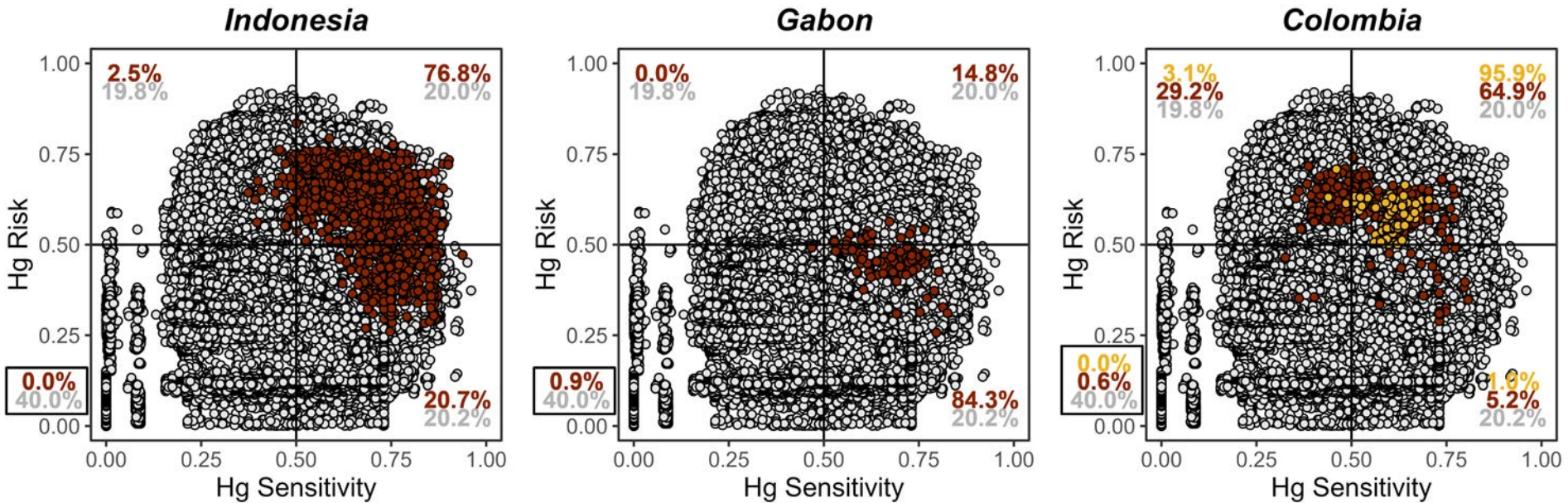


Circles represent scores for each mapping point (pixel) for mercury (Hg) **sensitivity** and **risk**, which are equally weighted to indicate **threat**.

For context, all global (light gray) and Africa (dark gray) scores are shown.

Tear et al. (2014) identified **Continental Biodiversity Priorities** for terrestrial (green) and freshwater (blue) realms, along with **Global Biodiversity Priorities** (purple).

# Tool Use: “Fingerprint” diagrams and Country-level Comparisons

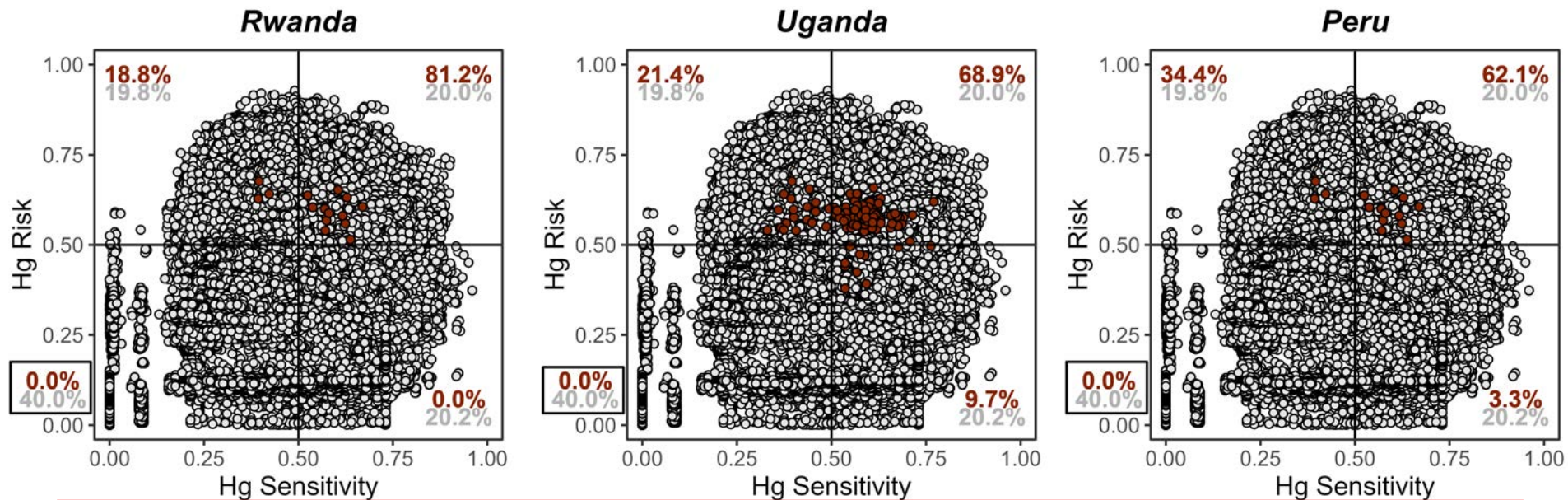


Indonesia has a *very high sensitivity and risk fingerprint*

Gabon has a *higher sensitivity than risk fingerprint*

Colombia has a *higher risk than sensitivity fingerprint*  
while the *Caquetá Division (yellow)* has high risk and sensitivity

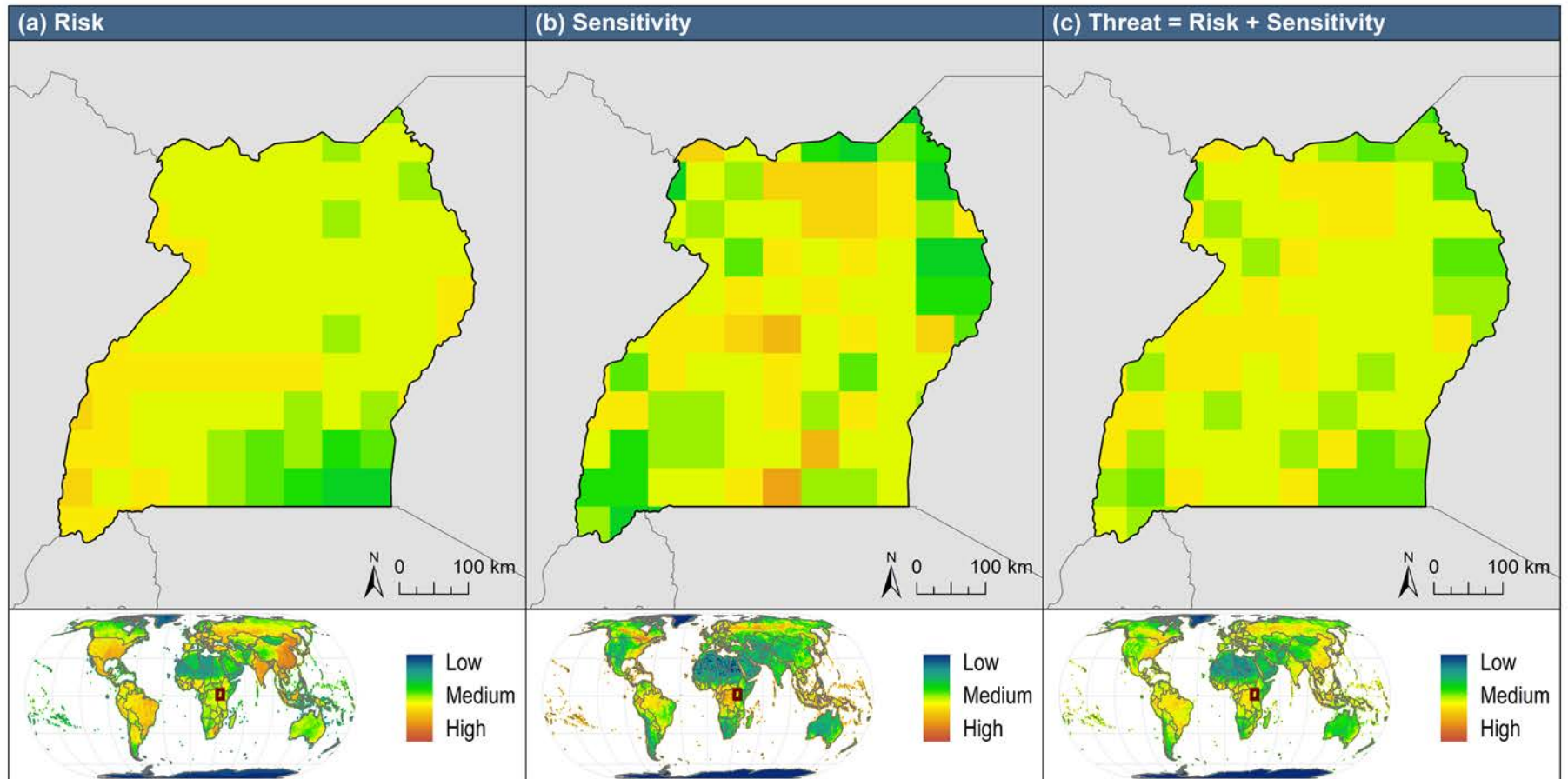
# Tool Use: “Fingerprint” diagram Country-level Comparisons – Countries with less mercury information



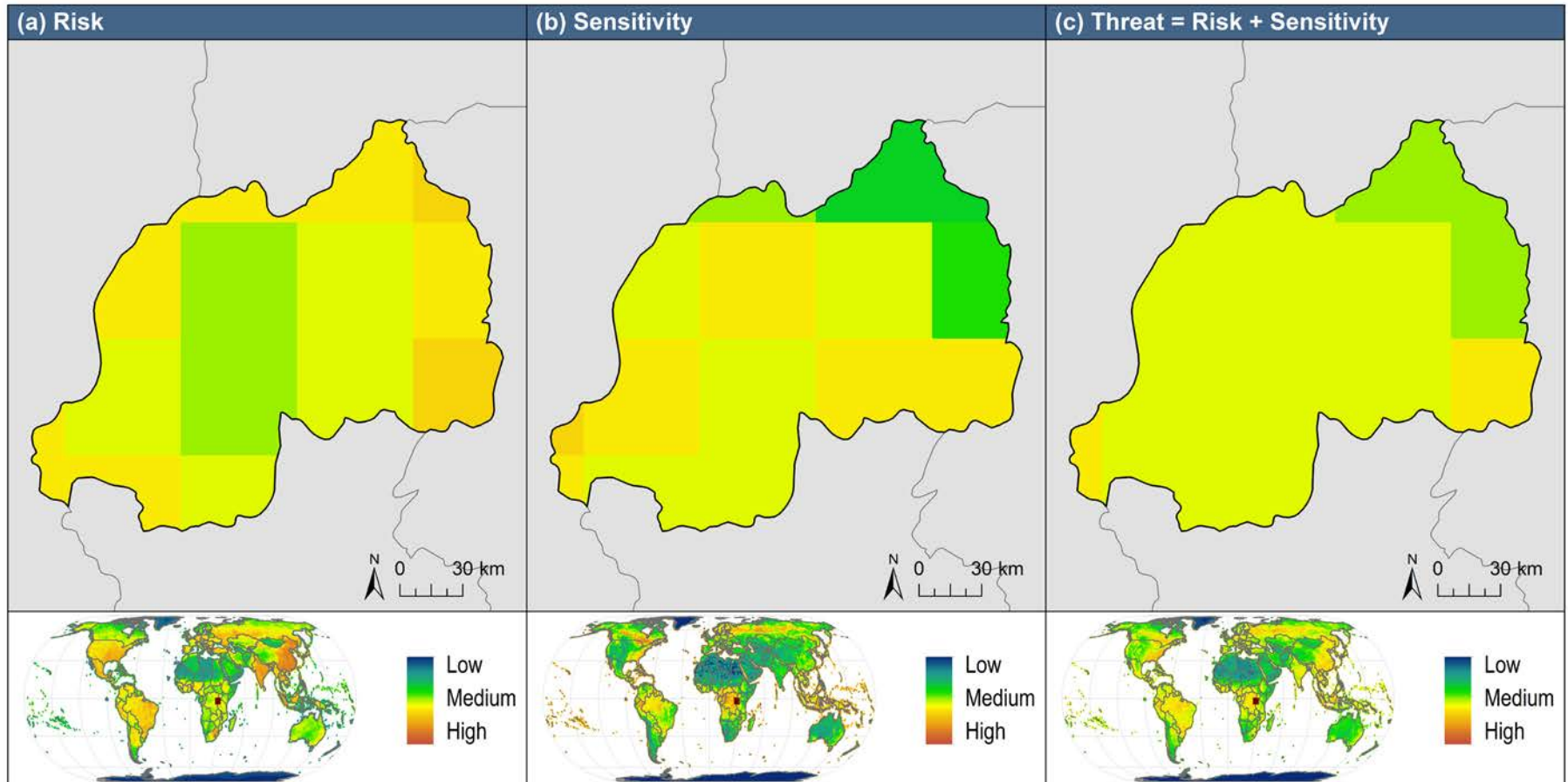
## East African Countries have limited mercury data

- The majority (>60%) of all three countries are in the highest threat category.
- The vast majority (>90%) of all three countries are at high levels of contamination risk.
- Rwanda has highest percent of the country in highest threat category (81%).
- A key research and management question: where in each country do these high levels of risk, sensitivity and threat occur?

# Tool Use: GMTA Maps for spatial assessments Uganda



# Tool 3: GMTA Maps for spatial assessments Rwanda

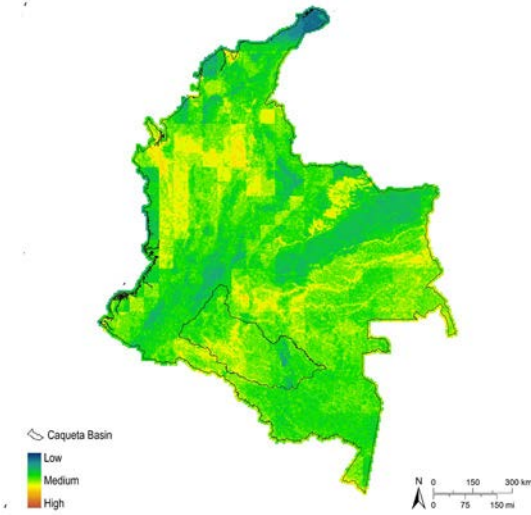


# Transitioning From Global to Regional Threat Assessment

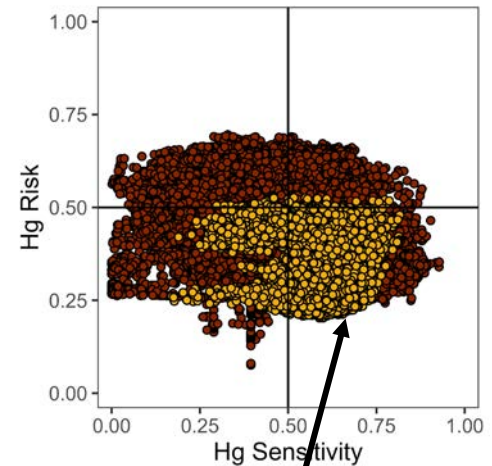


- Uses same risk and sensitivity input layers
- Incorporates finer scale data available at country/project level but not at global scale
- Allows for more site-specific assessments
- Focus in on sub-watersheds
- Case Studies illustrate benefits

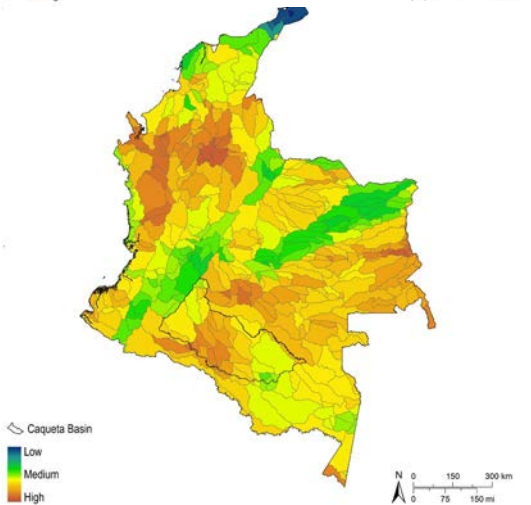
# Case Study: Colombia Maps & Fingerprints



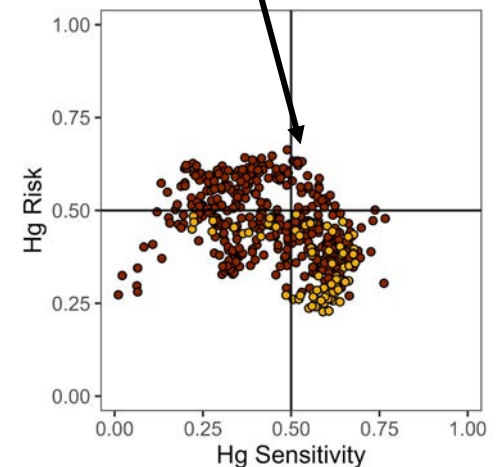
Colombia Hg Threat Map  
by Pixel



Caquetá Department = Yellow dots



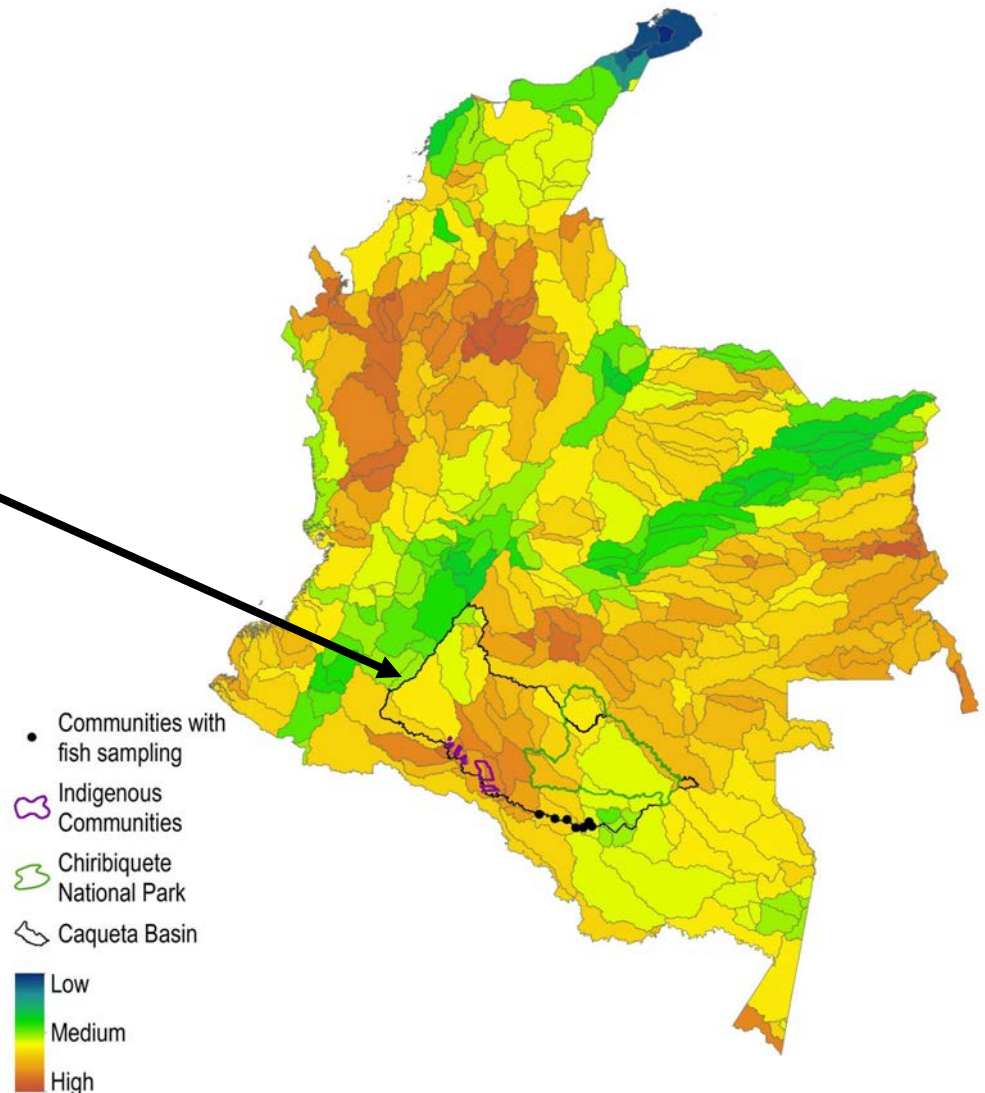
Colombia Hg Threat Map  
by Subwatershed  
(Mean Values)



Within Colombia - the Caquetá Department has high ecosystem sensitivity

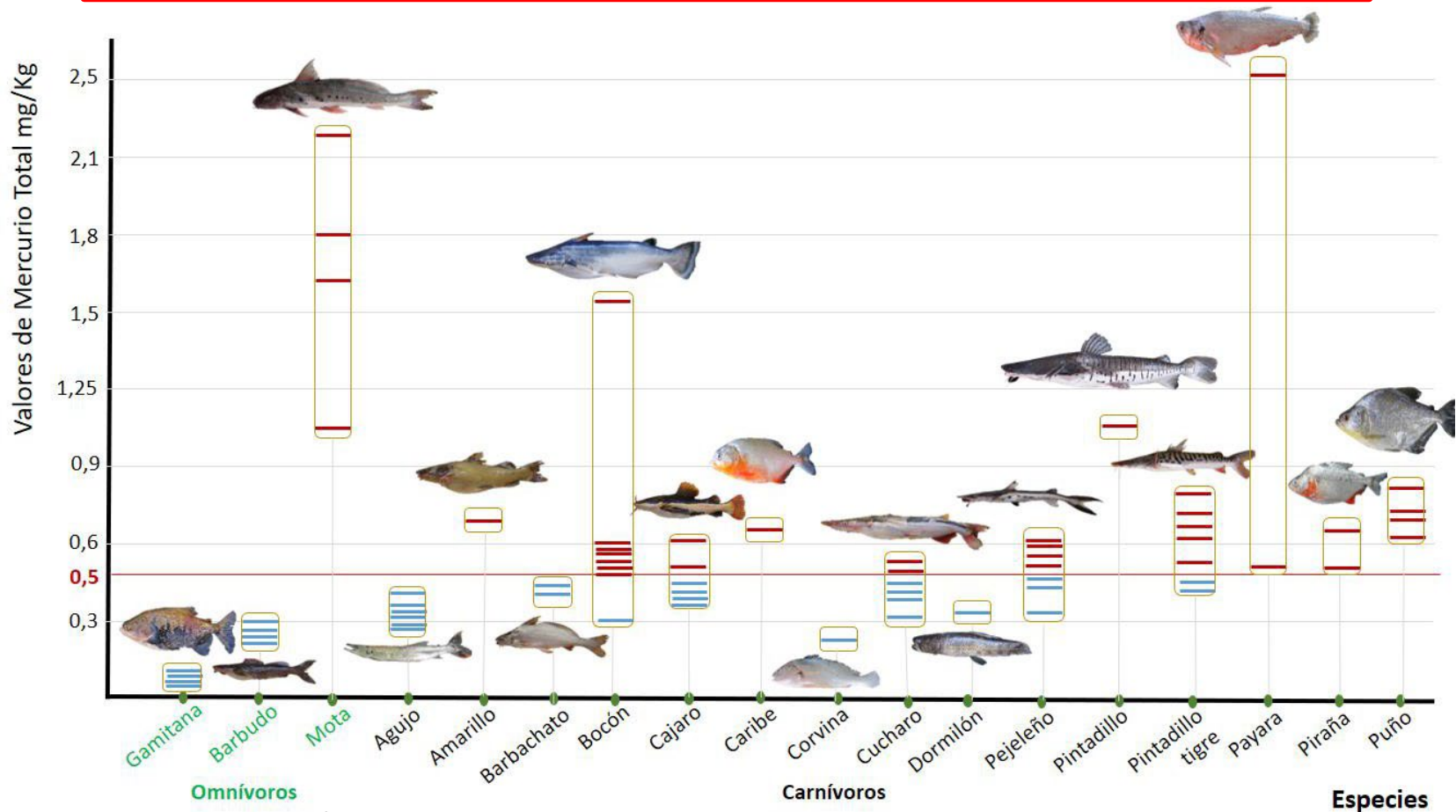
# Case Study: Focal Watershed in Colombia

In the Caquetá Department the Indigenous Communities are *highly threatened* by *mercury contamination* and much of this threat is attributable to *ecosystem sensitivity*



# Case Study: Colombia – Use of local data

In the lower Caquetá District, mercury levels are very high in fish.



Total Mercury values (mg/Kg) detected in each of the specimens collected in the Puerto Zábalo-Los Monos Reserve.

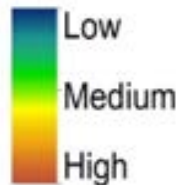
Blue and red lines represent a sample. Blue lines: values below the standard value; red lines: values above the standard value (0.5 mg/Kg) (Ministry of Interior report 2019).

# Case Study: Gabon

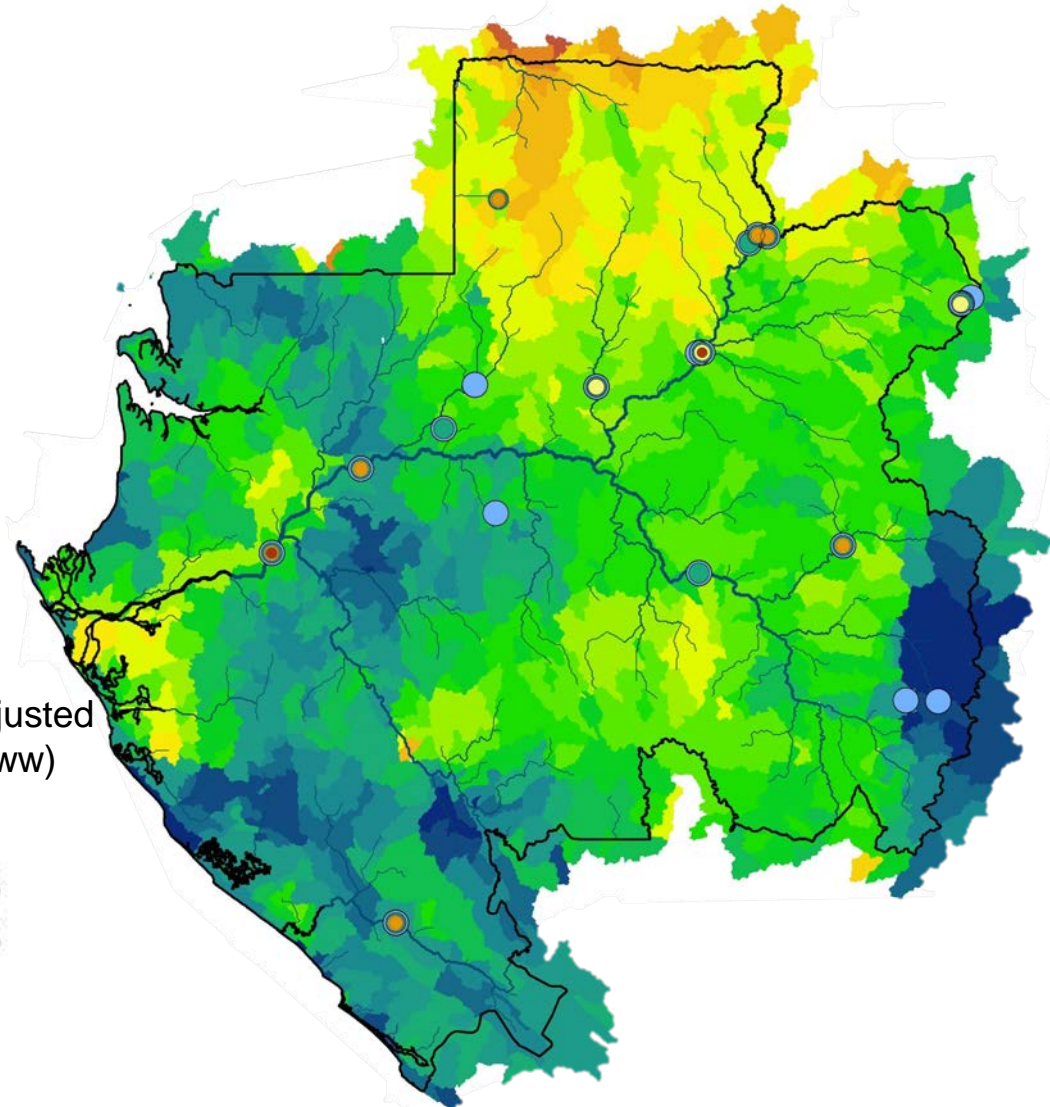
Site specific fish mercury data can be used to test the predictive ability of the mercury threat map

Regional Mercury Threat  
Gabon by Subwatershed  
Compared with  
*Fish Mercury Levels*

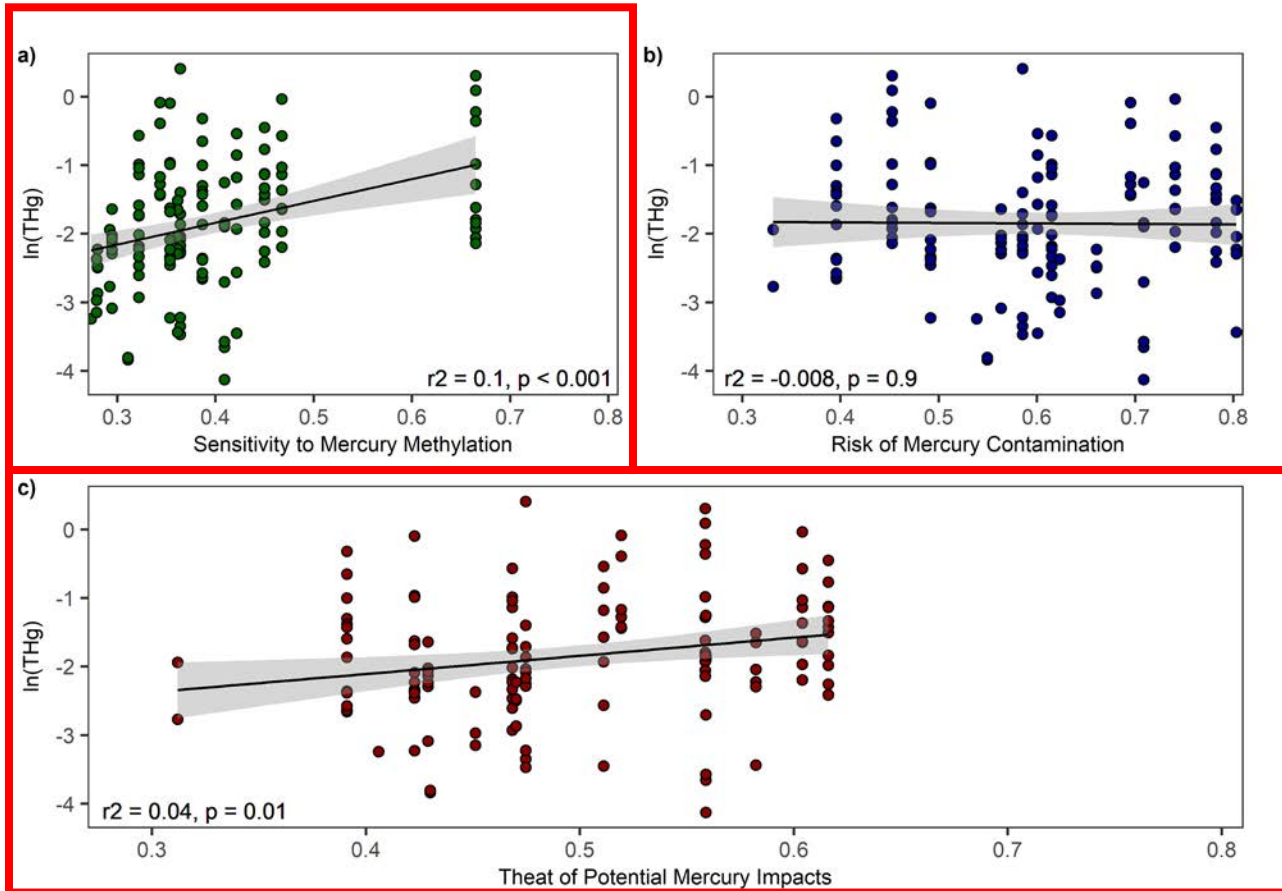
Hg Threat



Genus Length-adjusted  
THg in fish ( $\mu\text{g/g ww}$ )



# Case Study: Gabon statistical analysis



***Ecosystem Sensitivity and Threat* resulted in a *significant positive relationship* to *mercury levels in fish* in Gabon**

# Conclusion – The Global Mercury Threat Assessment Toolbox helps build critical Adaptive Management Feedback Loops

