

Understanding the Impacts of Mercury Contamination from ASGM in Amazonian Wildlife: A Seven Year Case Study from Madre de Dios, Peru

Luis E. Fernandez, Claudia M. Vega Julio Araujo, Jessica N. Pisconte, Shamir Delgado,
Alejandro Portillo, Cesar Ascorra, Miles R. Silman



CINCIA

Center for Amazonian Scientific Innovation
Centro de Innovación Científica Amazónica

Powering Scientific Capacity | Sustainable Innovation | Solutions for Madre de Dios



Reforestation/Restoration/Remediation

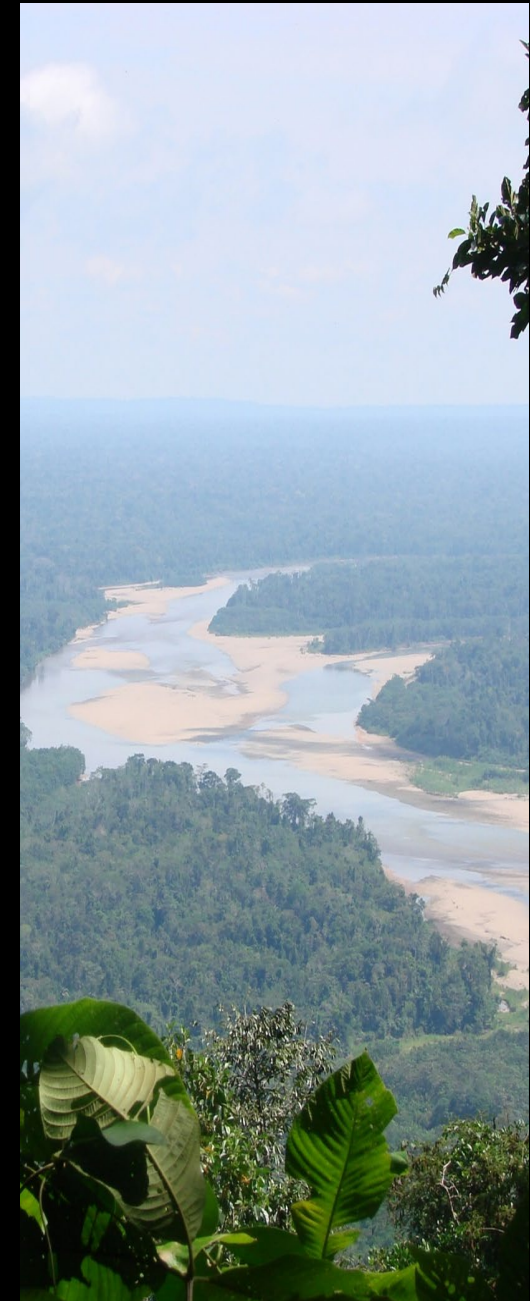
Mercury in the Environment

AI enhanced Satellite/Drone

Policy Intelligence

Education

Madre de Dios







Amazon Landscapes, Hydroscares and Airsheds transformed by Artisanal Gold Mining



ASGM related deforestation in MDD related to the price of gold

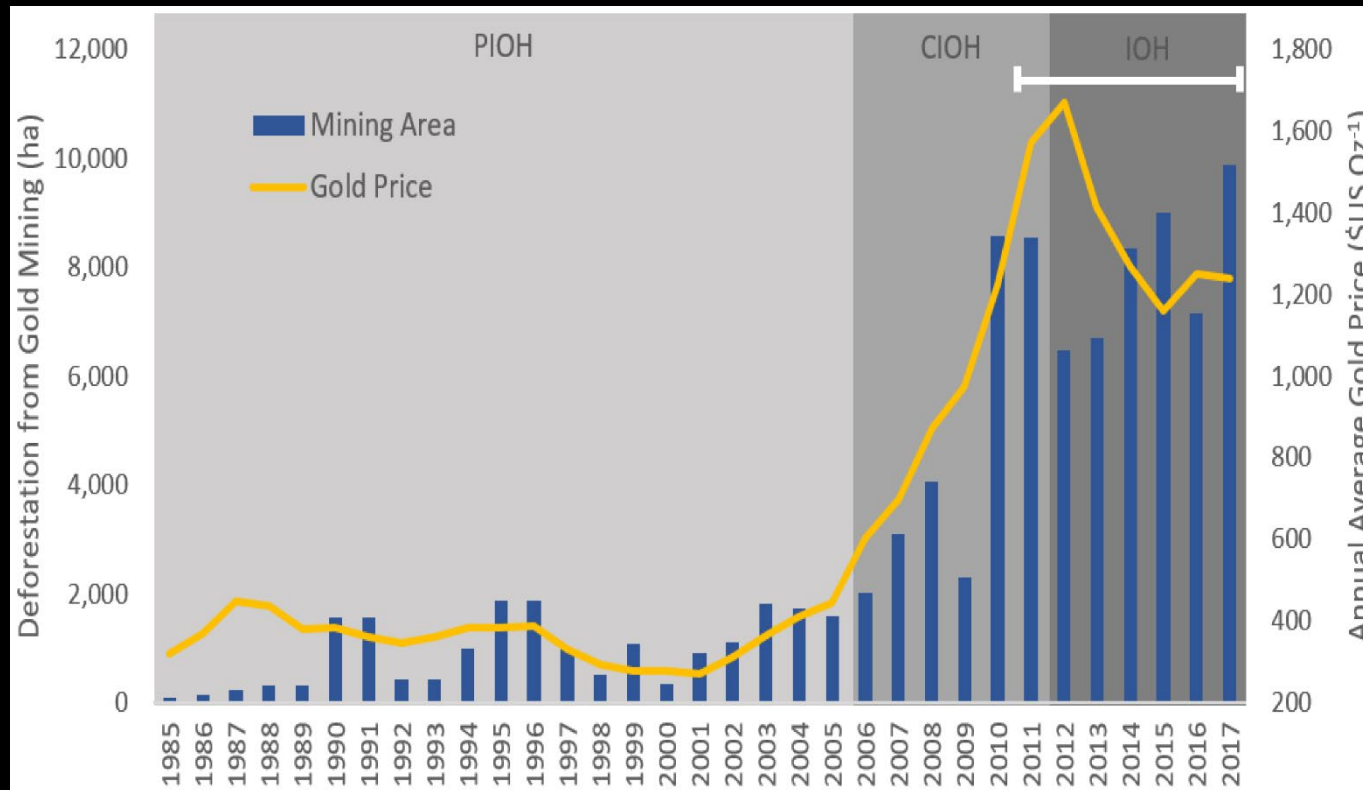


Deforestation and Forest Degradation Due to Gold Mining in the Peruvian Amazon: A 34-Year Perspective

Optical



Landsat



ASGM related deforestation in MDD related to the price of gold

→ Gold price today = \$2404 / oz

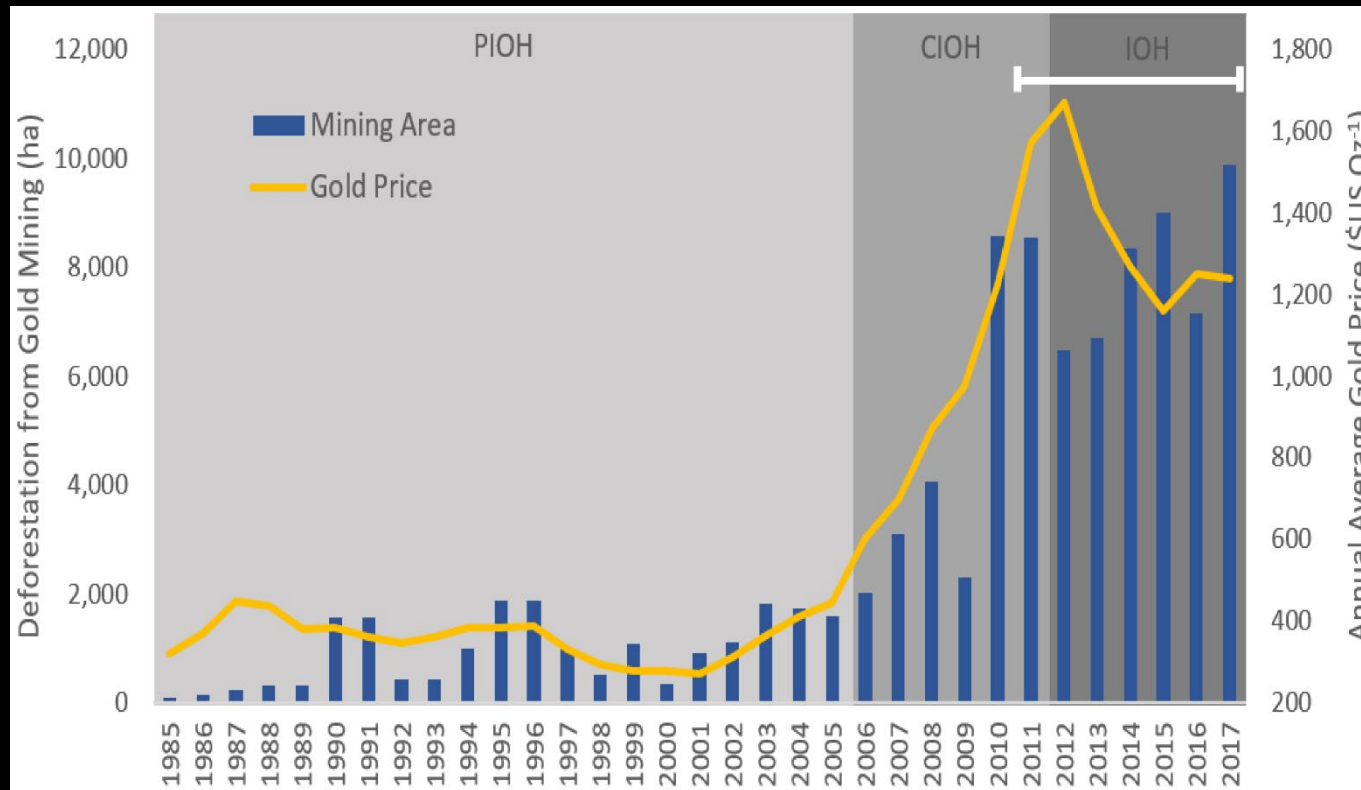


Deforestation and Forest Degradation Due to Gold Mining in the Peruvian Amazon: A 34-Year Perspective

Optical



Landsat



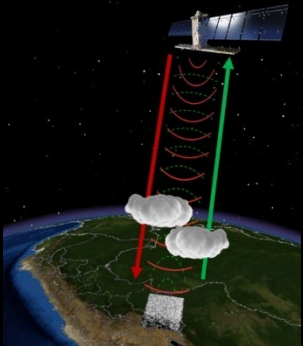
ASGM has been a driver of landscape degradation for more than 40 years in Madre de Dios



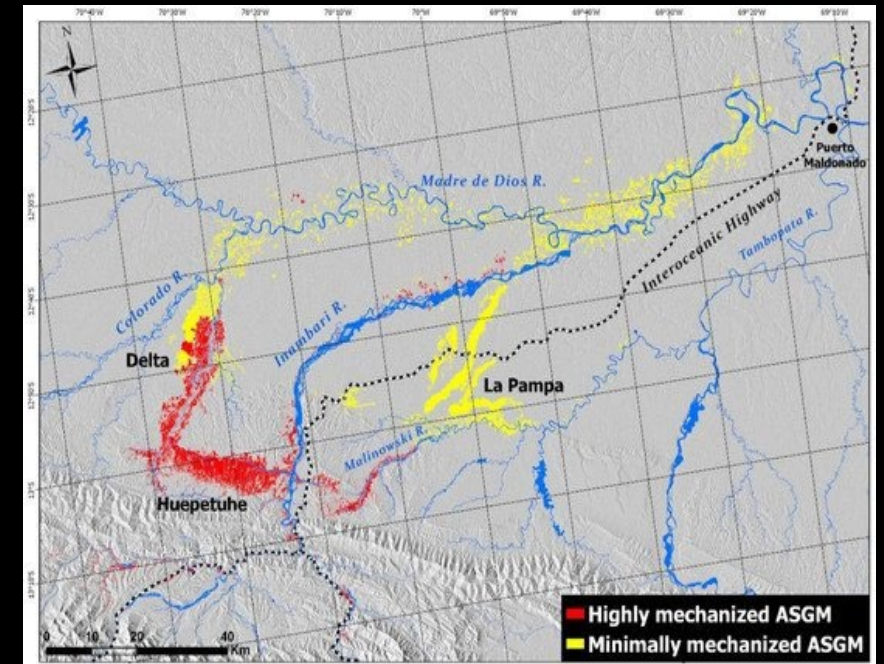
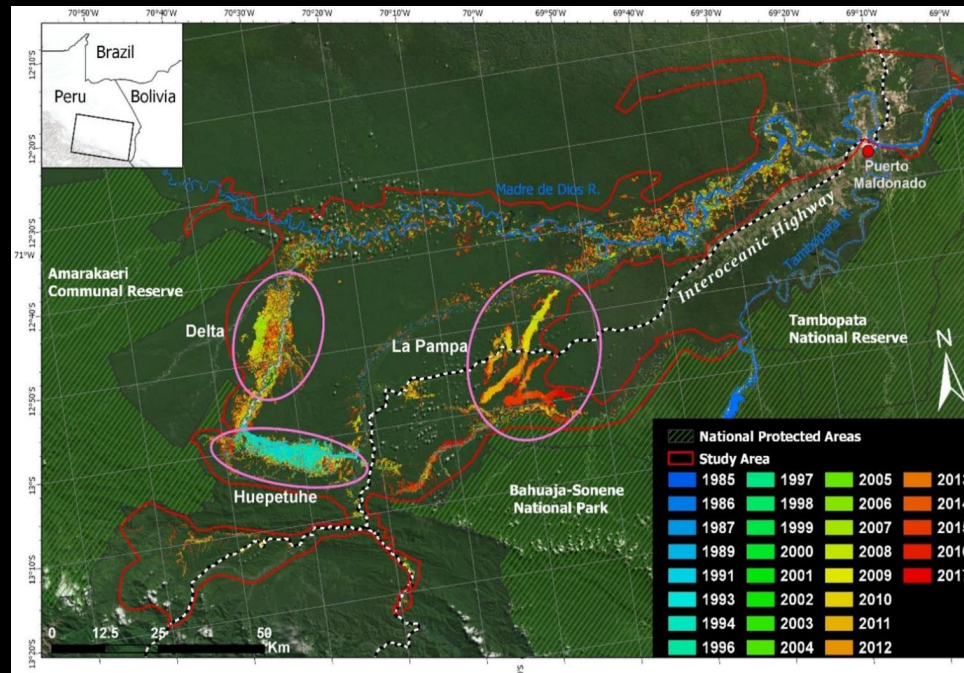
remote sensing

Deforestation and Forest Degradation Due to Gold Mining in the Peruvian Amazon: a 34-Year Perspective

Optical



Landsat

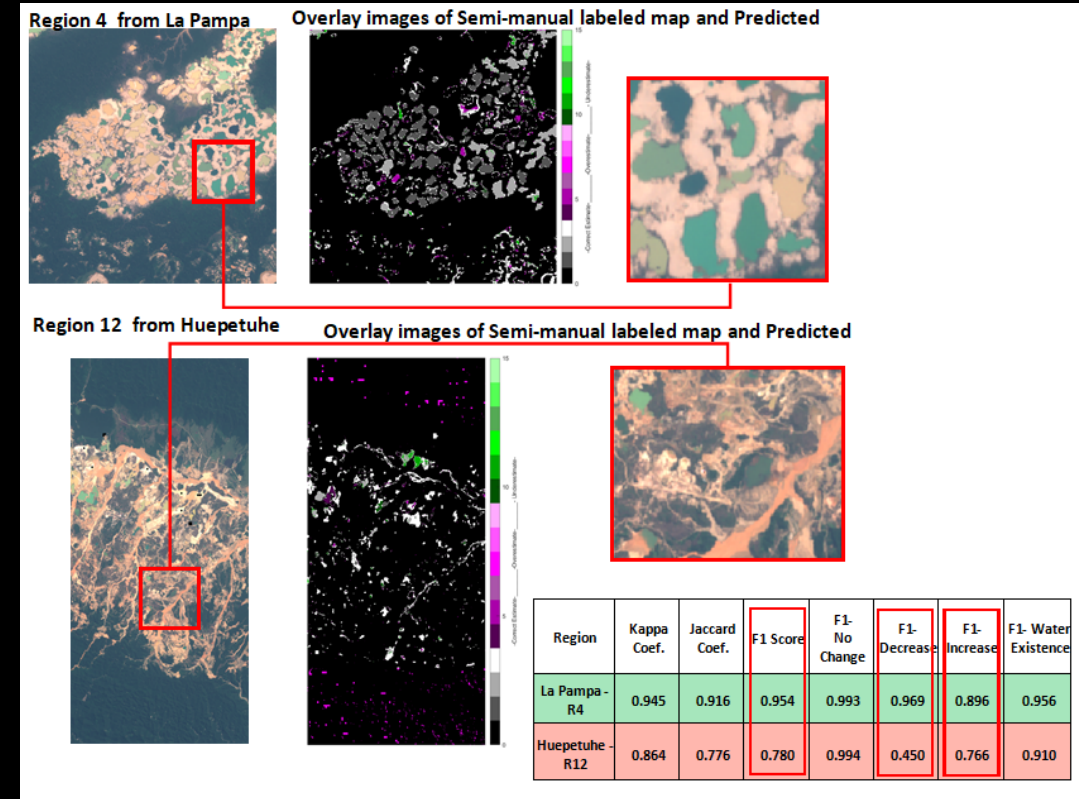
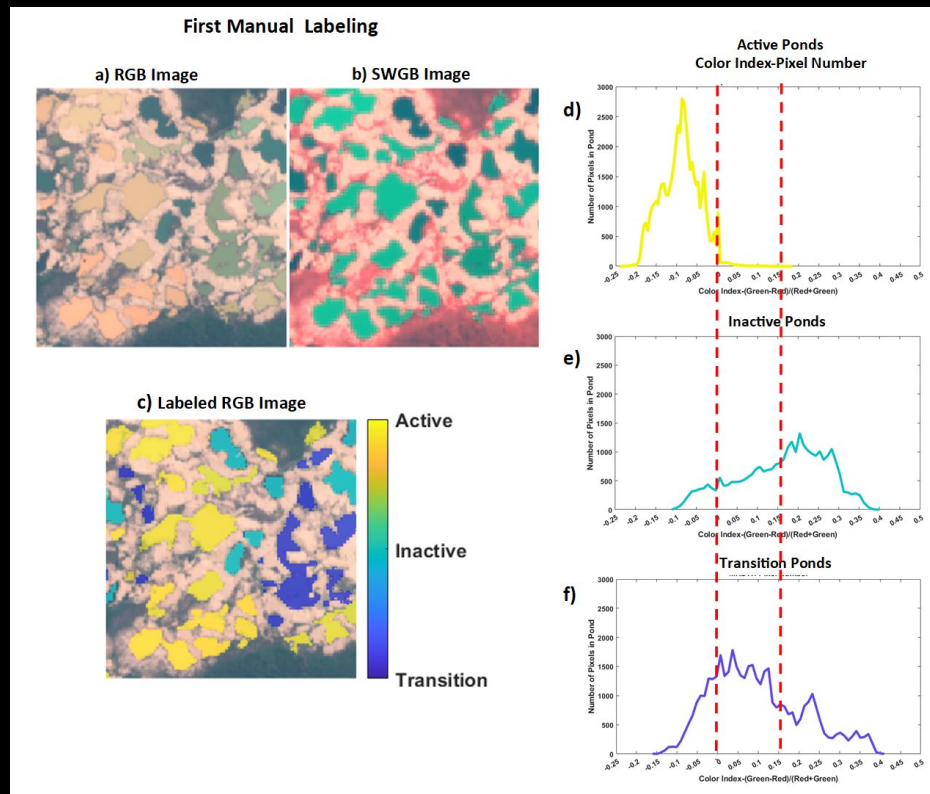


Developed novel AI methods to better characterize the characteristics of ASGM mining ponds at scale using remote sensing

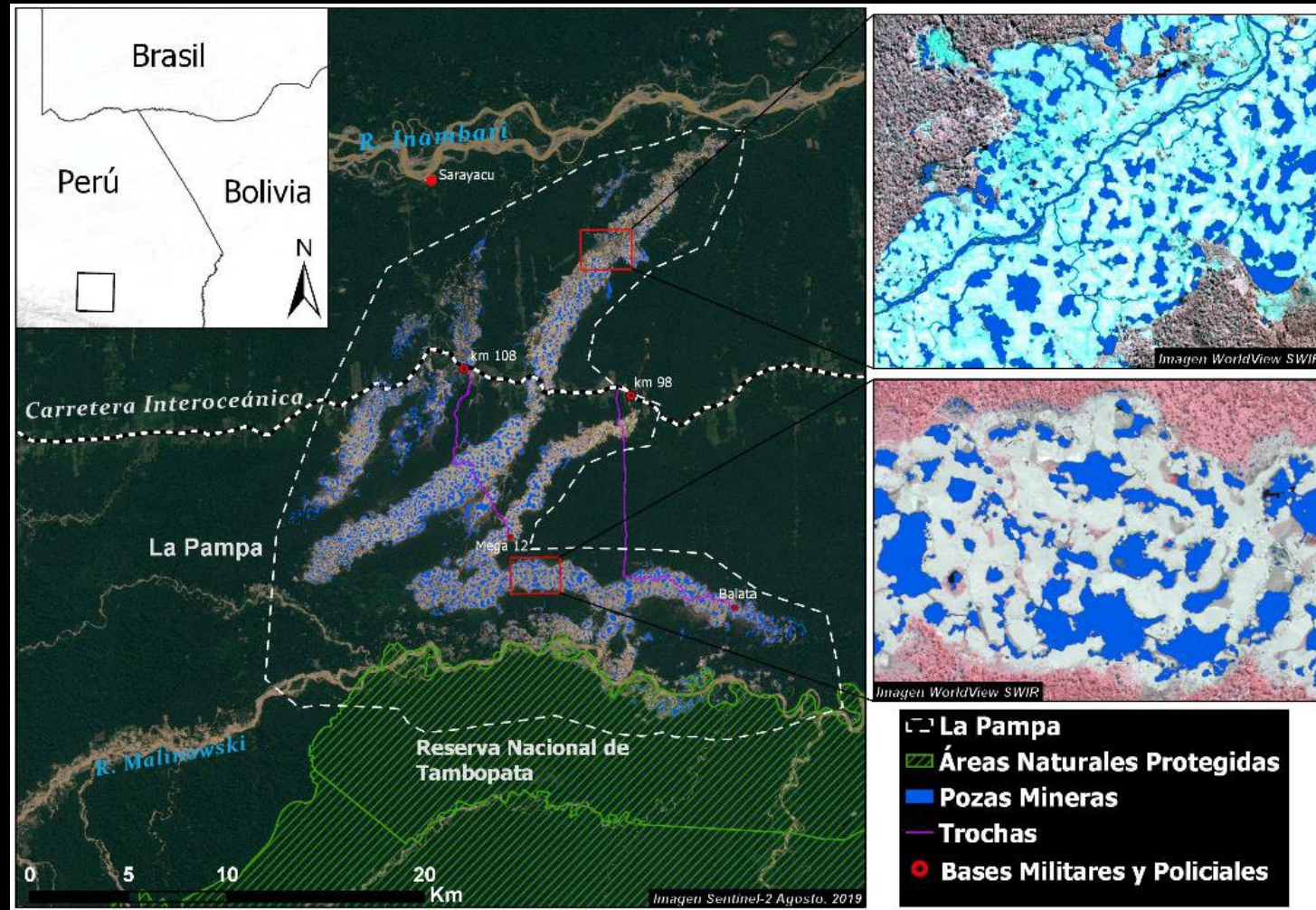


Change Detection of Amazonian Alluvial Gold Mining Sentinel-2 Imagery Using Deep Learning

Radar

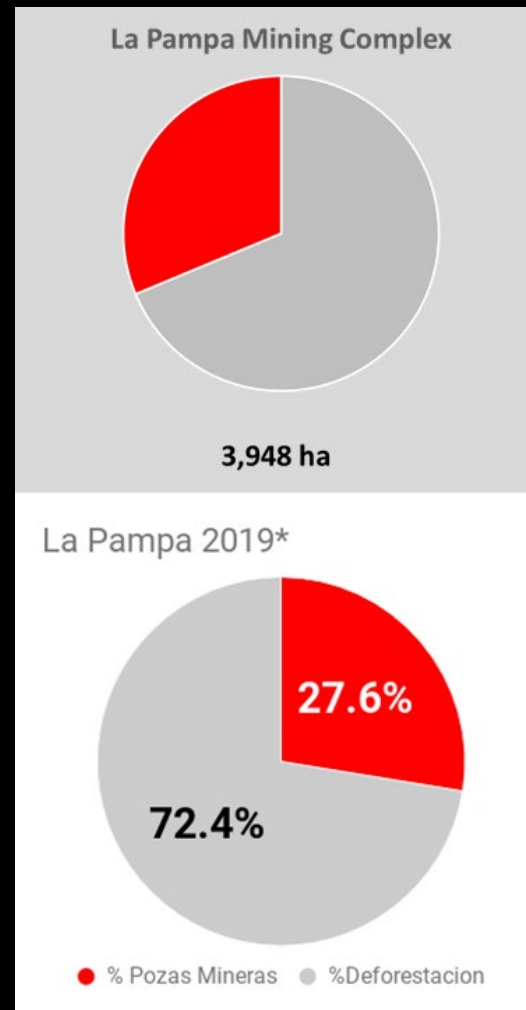
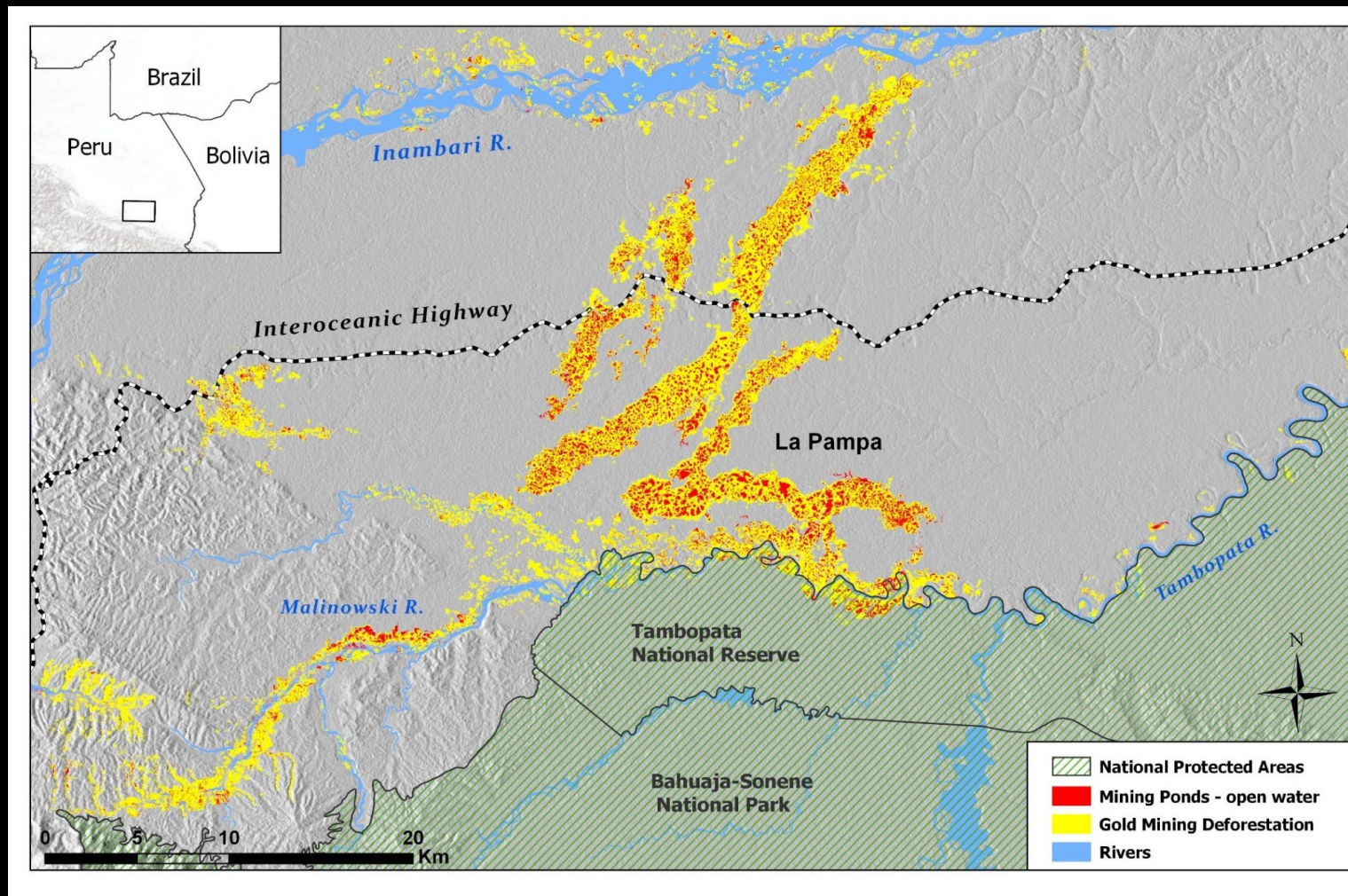


ASGM landscapes in Madre de Dios are extensive, very disturbed and fragmented by mining ponds



Turning Forests to Water

~ 30% of forests lost to ASGM are converted to mining ponds



Mercury dynamics are defined by the Landscapes and Hydroscares created by ASGM



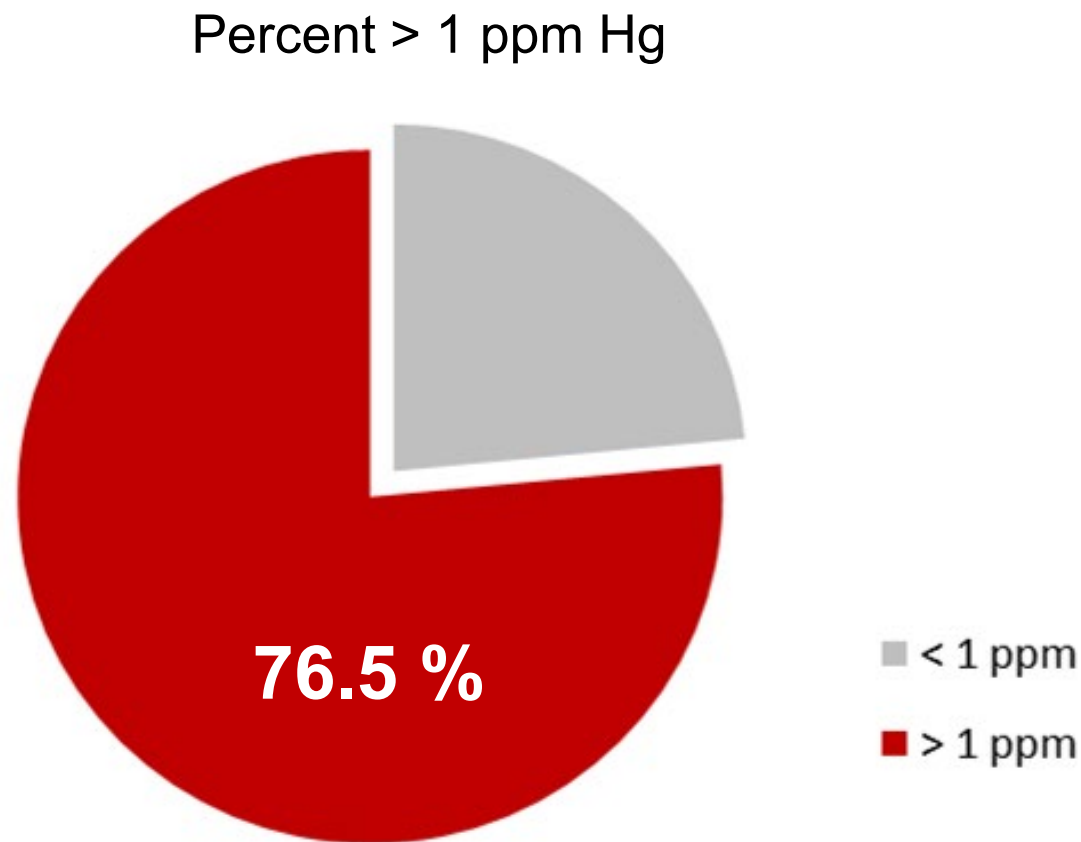
A close-up photograph of a person's hands performing a task in artisanal gold mining. The person is wearing a light brown, textured shirt. Their right hand holds a dark, shallow, bowl-like object, possibly made of wood or metal, which is tilted to pour a silvery, liquid substance (mercury) into a small, white, cylindrical container held by their left hand. The person's left wrist is adorned with a black, multi-strapped bracelet. The background is blurred, showing a natural outdoor setting with green foliage and a body of water under a clear sky.

Artisanal Gold Mining In Madre de Dios

releases
185 tons of mercury
per year

source: *Artisanal Gold Council 2018*

Human hair mercury levels are elevated in Madre de Dios

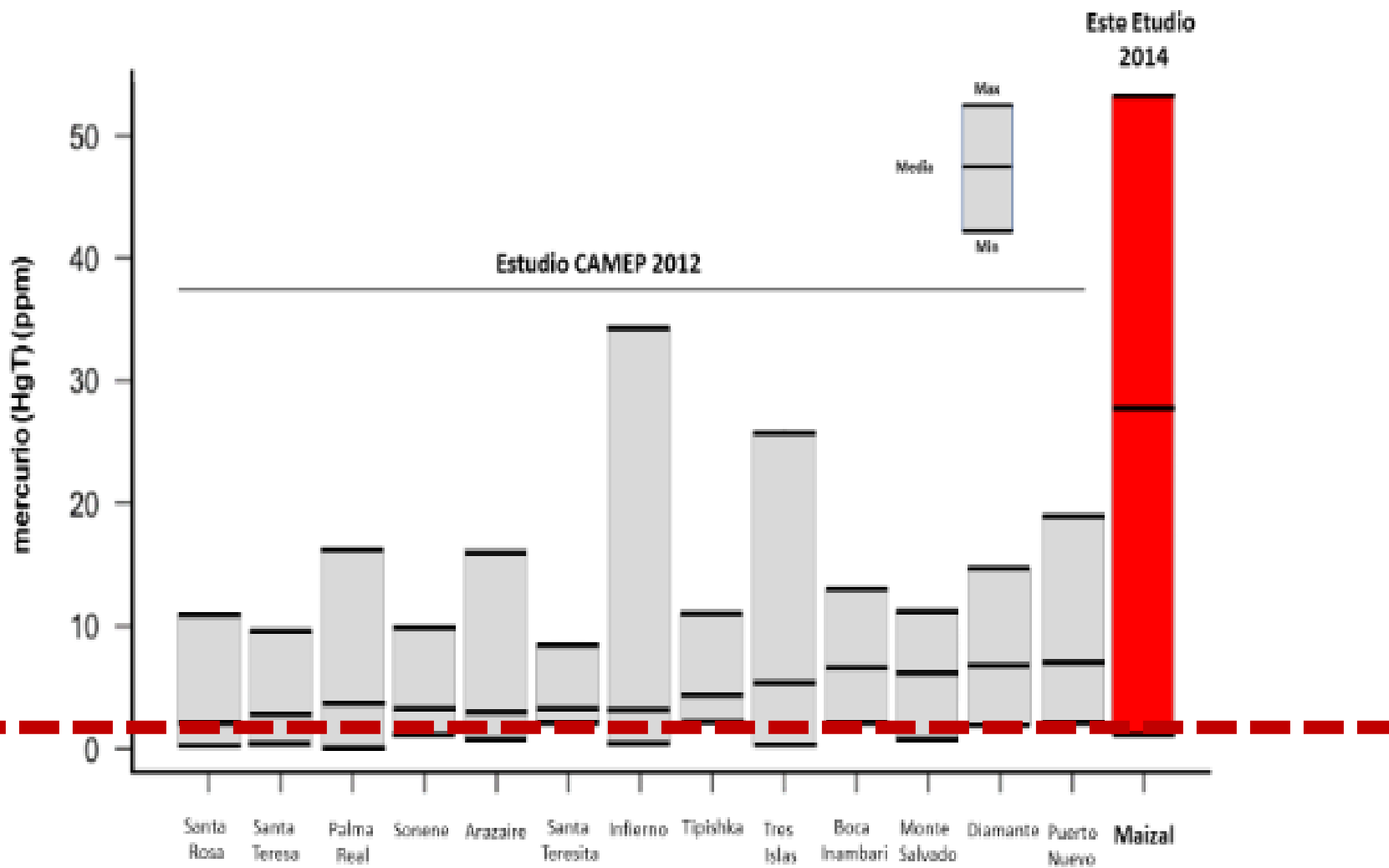


Mean: 2.7 ppm; range: 0.1ppm – 34 ppm;
n = 1029; 24 settlements

US EPA MeHg Reference Human Hair. (EPA RfC): 1 ppm



WHO Reference Level
2.2 ppm





Evaluate mercury impact on terrestrial and aquatic ecosystems using bioindicator species



Plankton



Macroinvertebrates



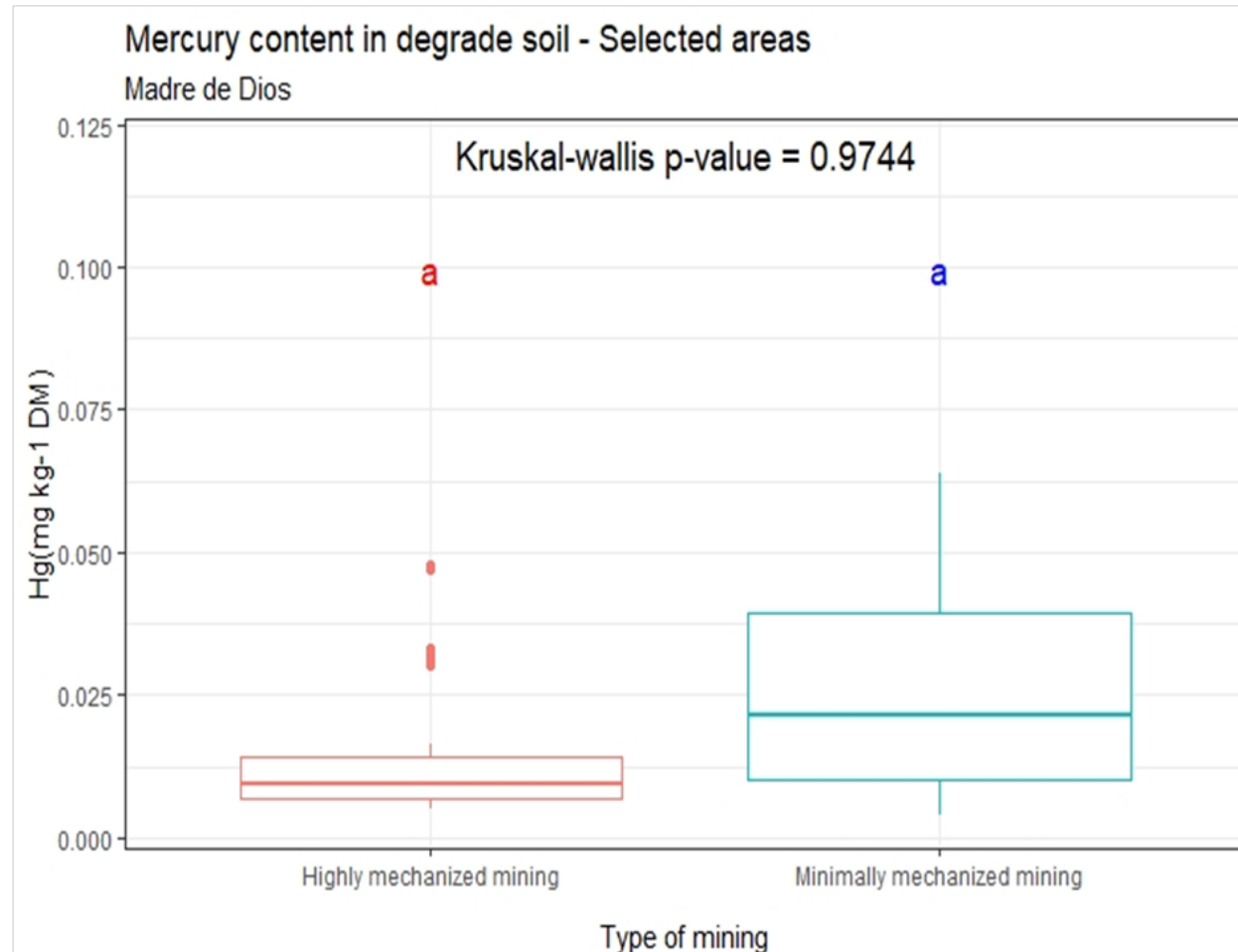
Fish



Sediments

Mercury levels in ASGM soils varies by mining type: minimally mechanized > heavily mechanized

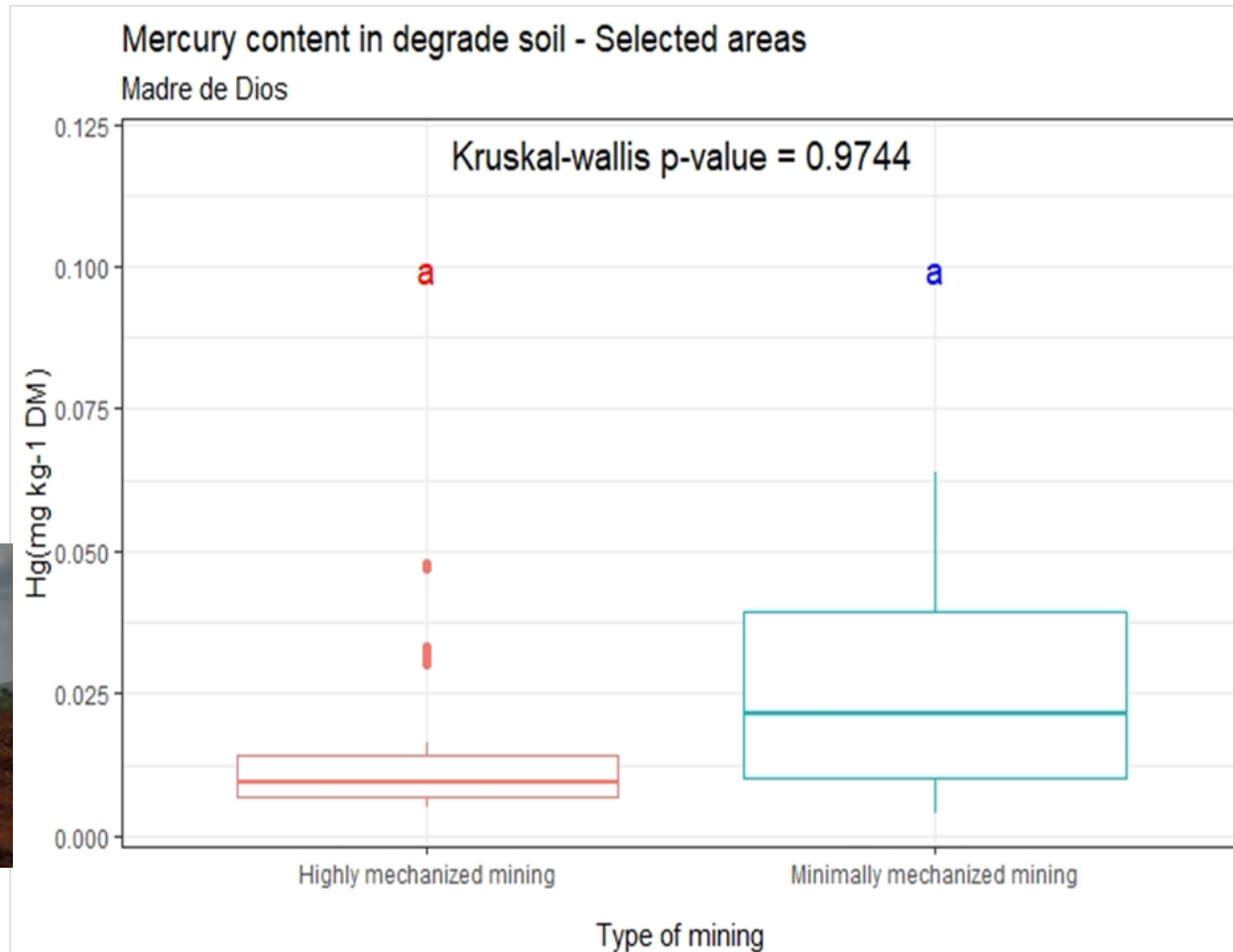
Mercury concentration in ASGM soils by mining type



Soil mercury reference level (mg kg ⁻¹ DM)	
Agricultural soil	
ECA PERU	CEQGs Canada
6.60	6.60^b

Mercury levels in ASGM soils varies by mining type: minimally mechanized > heavily mechanized

Mercury concentration in ASGM soils by mining type

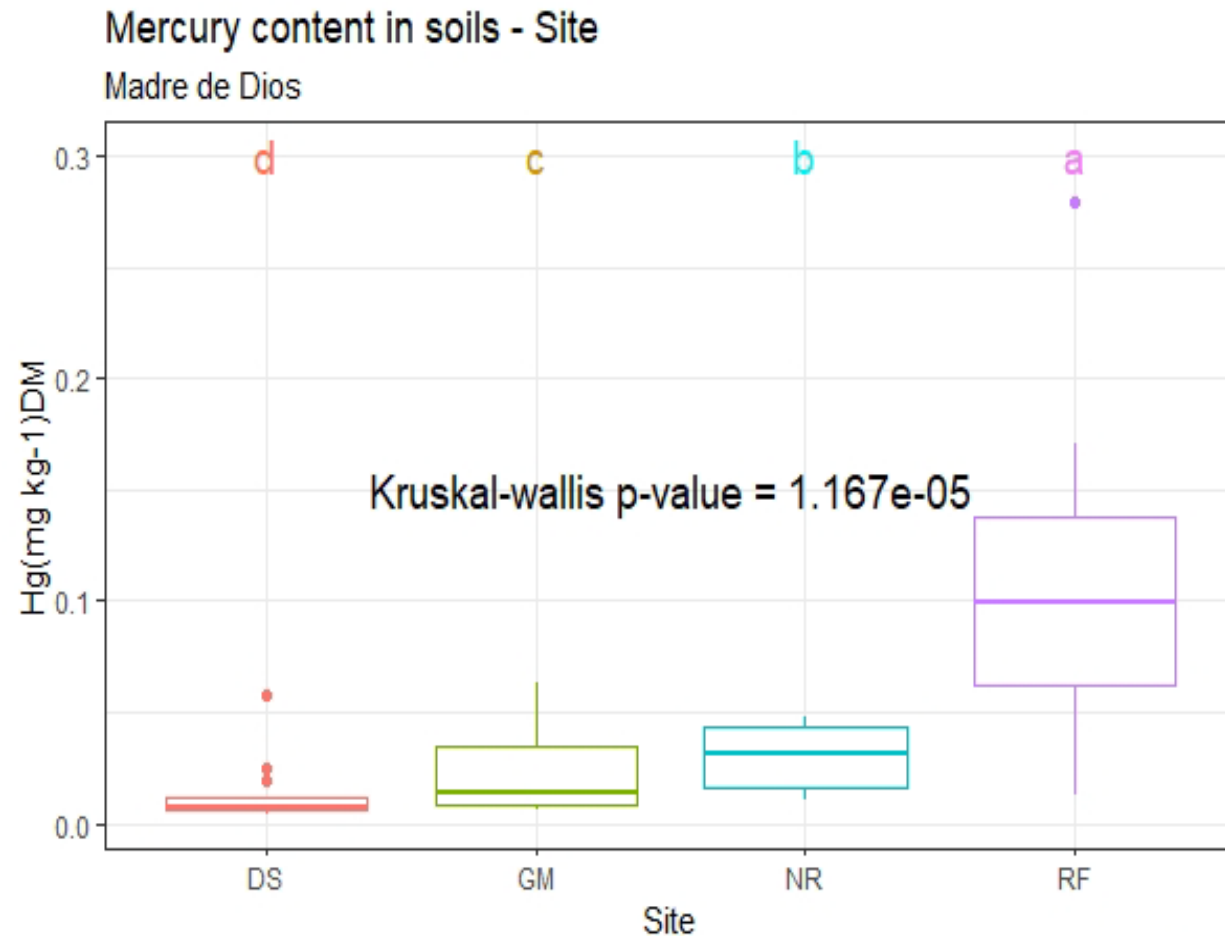


Soil mercury reference level (mg kg ⁻¹ DM)	
Agricultural soil	
ECA PERU	CEQGs Canada
6.60	6.60^b



Mercury levels in ASGM soils are lower than surrounding reference forest soils

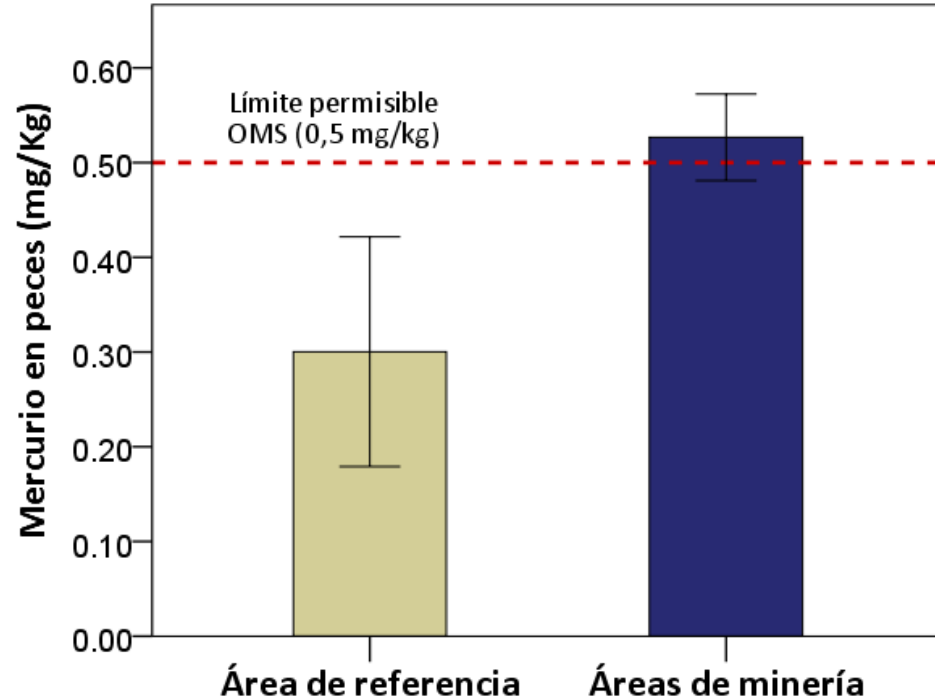
Mercury concentration in ASGM soils by site subclassification



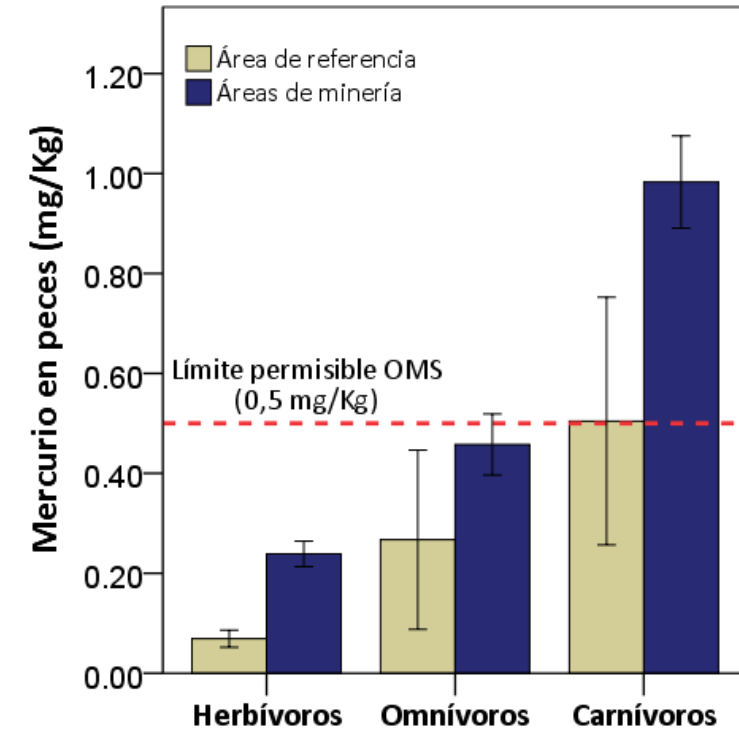
Reference Forest

ASGM sites

Mercury levels in fish from ASGM mining ponds are higher than non-ASGM impacted areas, and Hg is being biomagnified

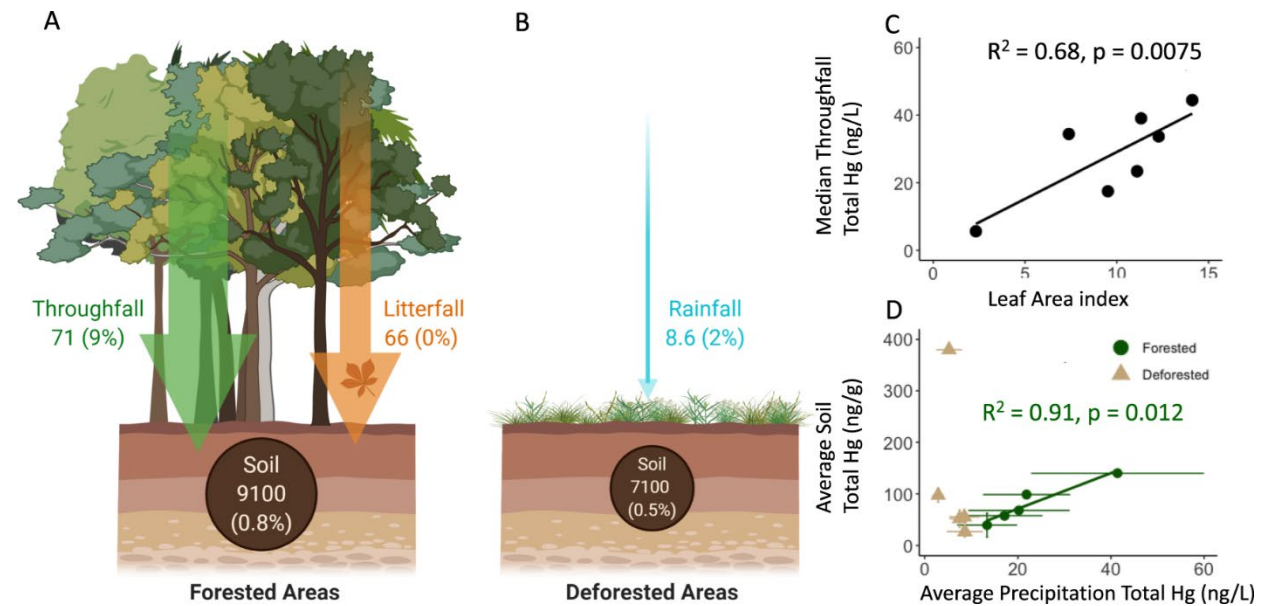
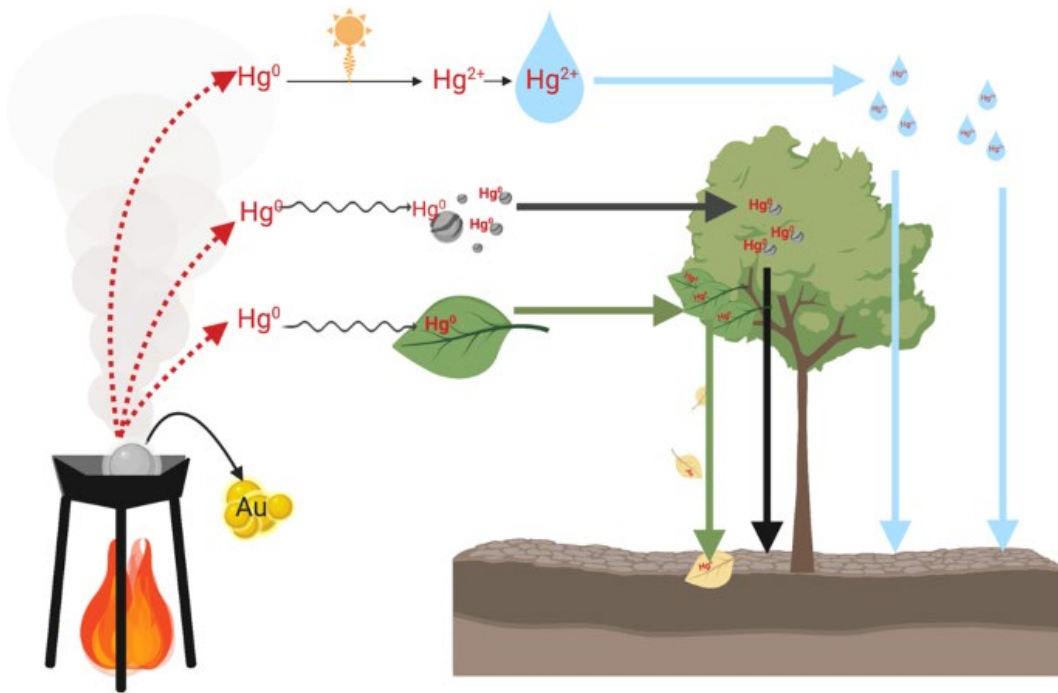


Fish mercury from ASGM sites are higher than non-ASGM impacted areas



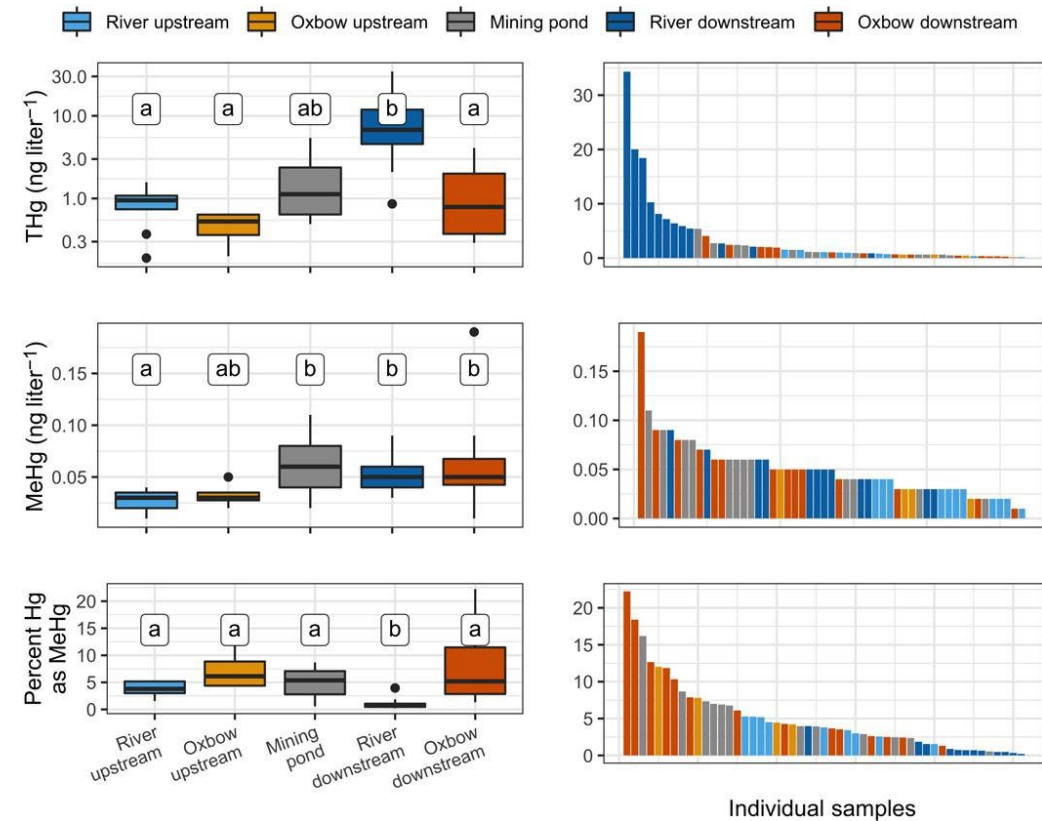
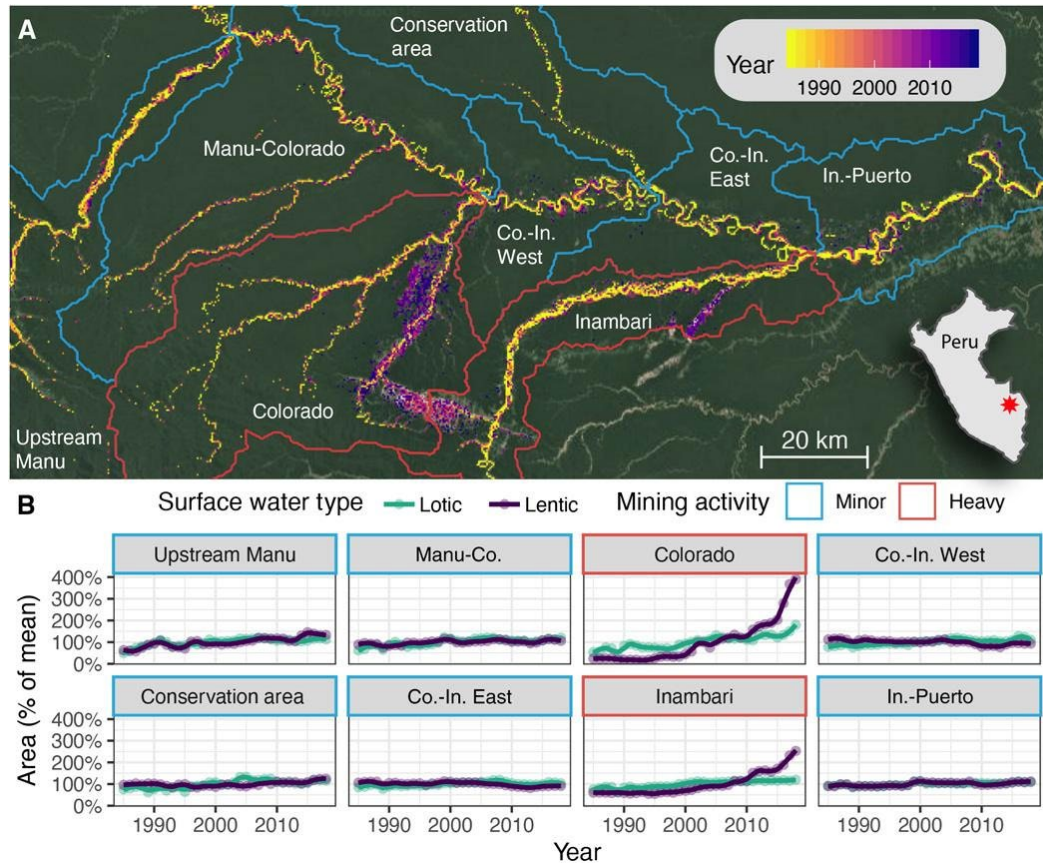
Mercury is biomagnifying in the food webs in ASGM hydroscares

Amazon forests capture atmospheric mercury emission from artisanal gold mining, and bank mercury in forest soils

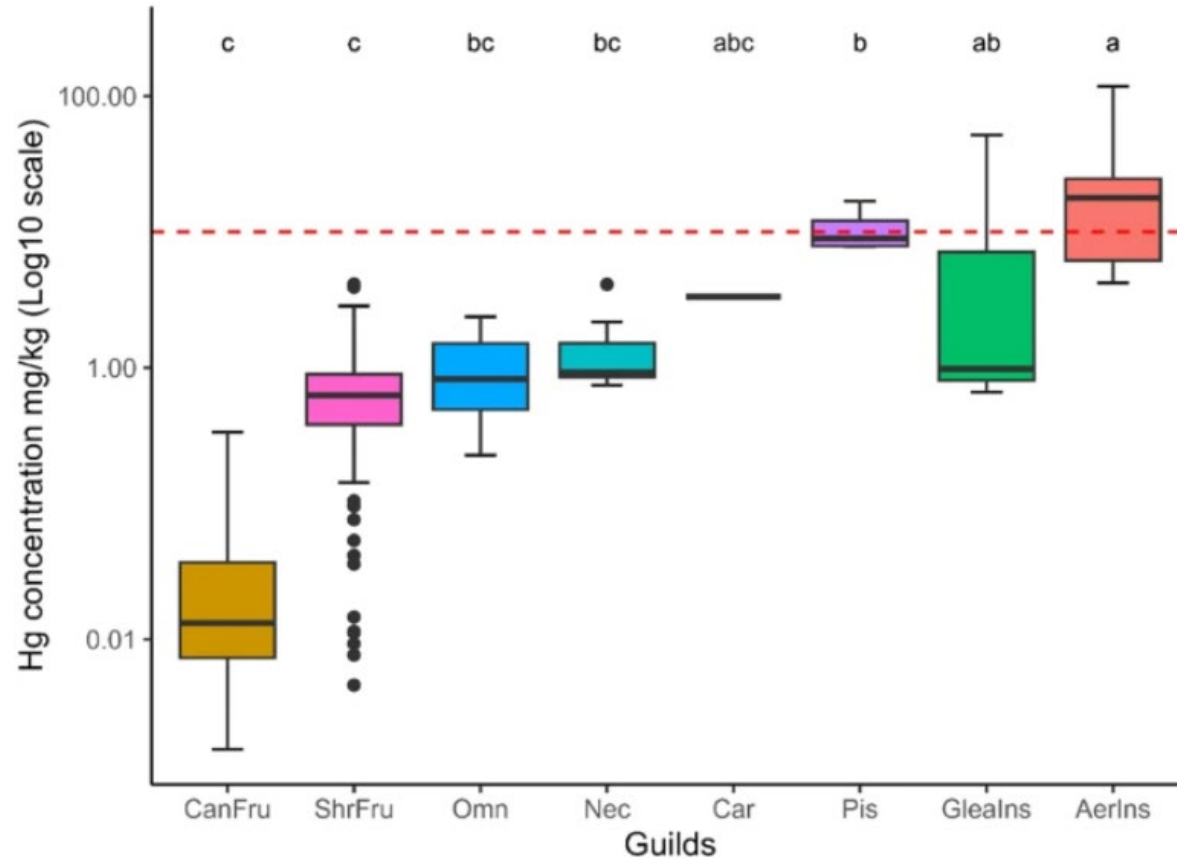


Mining ponds convert mercury into methylmercury at rates 5 - 7 times higher than in rivers

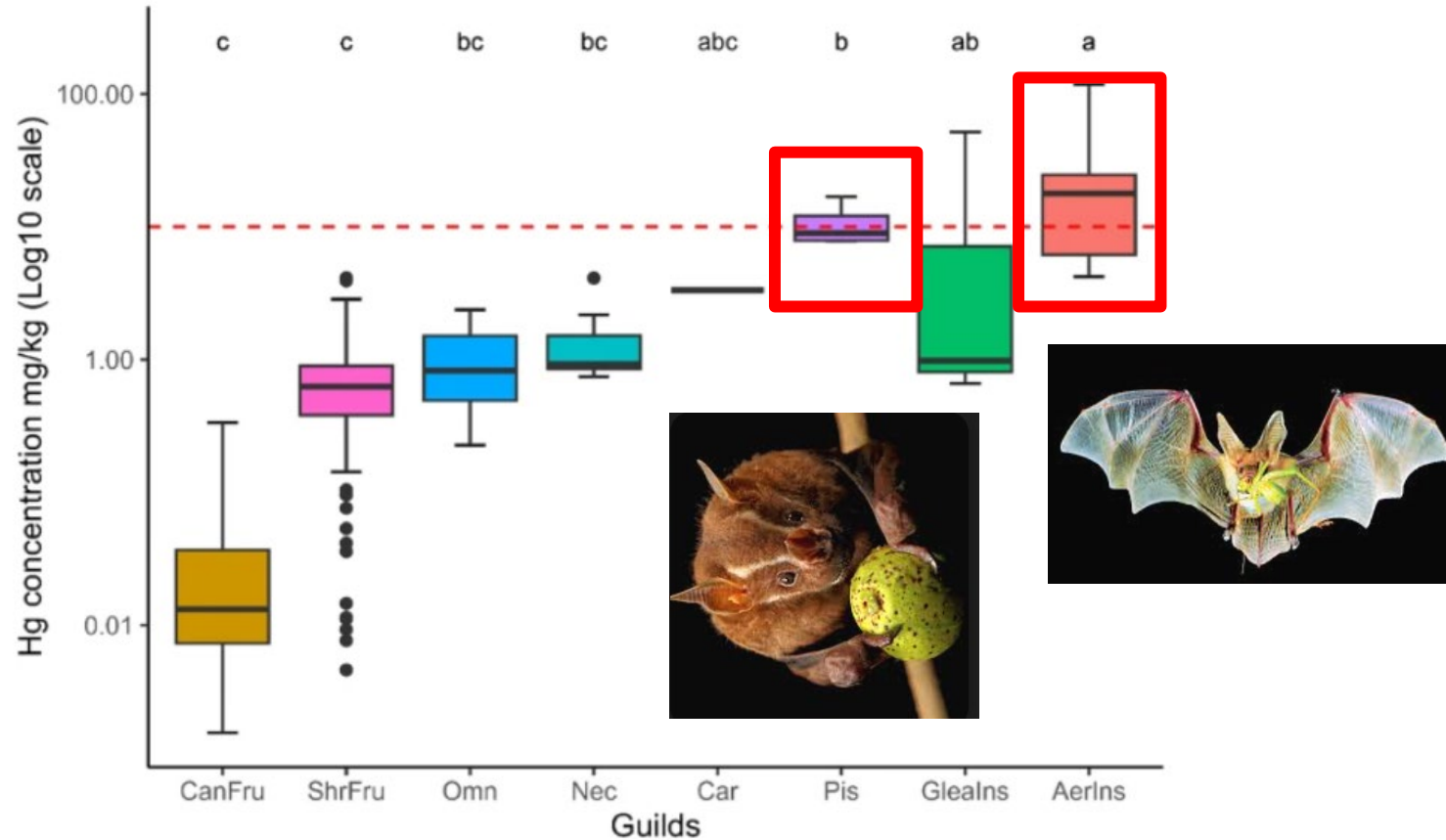
Concentration and distribution of water column total Hg (THg), methyl Hg (MeHg), and percent Hg as MeHg across water bodies upstream and downstream of artisanal gold mining in Madre de Dios, Peru.



Insectivorous & piscivorous bat guilds had highest mercury concentrations



Insectivorous & piscivorous bat guilds had highest mercury concentrations



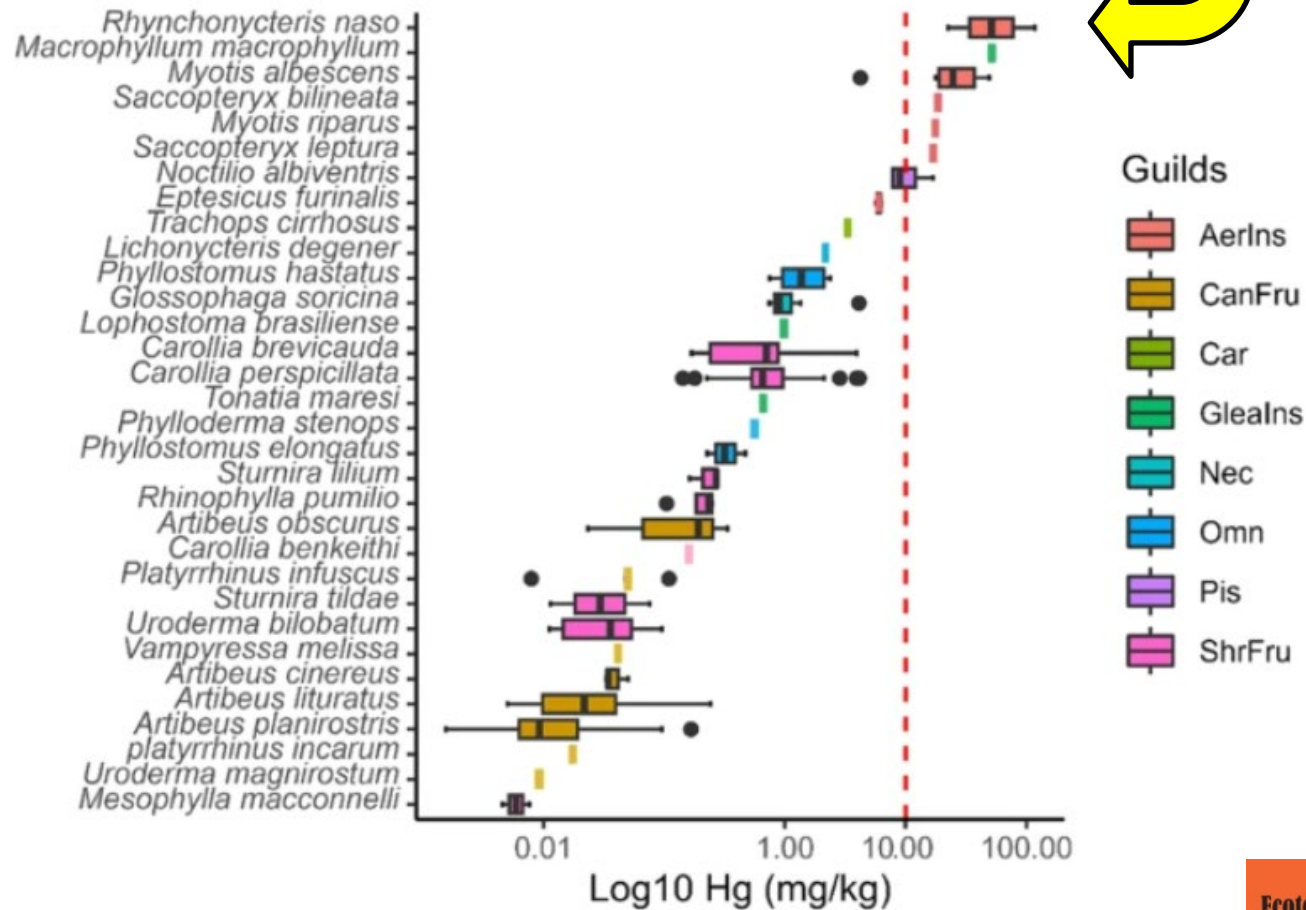
Insectivorous and Piscivorous guilds had highest mercury concentrations

****Observed highest reported Hg value for insectivorous bat - 117 ppm**

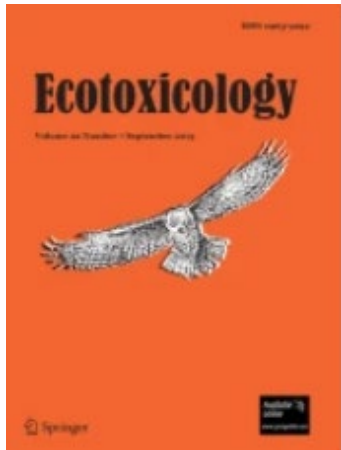


Proboscis Bat (*Rhynchonycteris naso*)

Captured adjacent to a ASGM mining pond
117 ppm



More recent Hg / Biodiversity studies are reported in:



Collection

Special Issue: Assessing Global
Environmental Mercury Exposure in
Biota and Potential Impacts on
Biodiversity

Submission status
Open

Open for submission from
24 October 2022

Submission deadline
Ongoing

Editors



[David Evers](#)



[Paco Bustamante](#)



[Luiz Fernandez](#)



[Manoela Pessoa de Miranda](#)



CINCIA
CENTRO DE INNOVACIÓN
CIENTÍFICA AMAZÓNICA

cincia.wfu.edu

