

Elevated mercury levels in recently contacted Amazonian indigenous communities in Peru may reveal an undescribed natural mercury hotspot that could represent a significant health risk to these populations

Elevated mercury exposure in Amazonian indigenous populations in Manu National Park, Madre de Dios, Peru

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Background

The Machiguenga are a recently contacted Amazonian indigenous people who resides primarily in the Manu River Basin in four communities located in Manu National Park, a pristine protected area in the Southern Peruvian Amazon (Madre de Dios).

Since 2008, Madre de Dios has experienced an artisanal gold mining boom that has resulted in the declaration of two national states of emergency due to extensive environmental mercury contamination of waterways. Mercury releases from ASGM have been estimated to be 185 tons/year (AGC 2018).

A previous study found that indigenous communities in the mining areas in Madre de Dios have mercury levels 2.3 times higher than non-indigenous communities. (CAMEP 2012).

Though far upstream from the mining zone, concerns by Machiguenga leaders regarding possible mercury exposure of the heavily fish dependent communities prompted a series of studies to assess mercury exposure and risk in Machiguenga communities in 2014, 2017 and 2018.

Methods

Sampling Sites | The study was conducted in three Machiguenga communities located in Manu National Park located 80 km upstream from the nearest mining site: *Maizal* (2014, 2018), *Cachuatal* (2018) and *Yomibato* (2018).

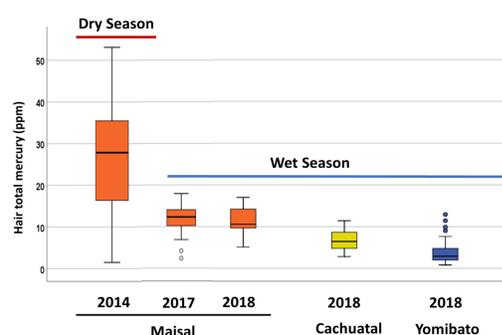
Hair Sample Collection | Scalp hair samples were collected with informed consent from community members. The 2 cm basal segment was analyzed for all cases. For a subset of the 2014 sample set, the entire hair shaft was analyzed in 2 cm segments to determine for historical exposure. A verbal survey on fish consumption was also administered at time of hair collection.

Fish Sample Collection | Fish specimens were collected from community fishing areas in lakes and streams. A dorsal muscle sample was biopsied from each specimen for mercury analysis.

Benthic sediment collection | Benthic sediment samples were collected using Eckman dredges in the water bodies where fish specimens were collected and bagged for Hg analysis.

Mercury analysis | Total mercury (HgT) concentration was measured using EPA Method 7473 on a Milestone DMA-80 mercury analyzer at the CAMEP Mercury Laboratory at Carnegie Institution (2014) and the CINCIA *Laboratorio de Mercurio y Quimica Ambiental* (LAMQA) in Puerto Maldonado, Peru (2018).

Results and Discussion



- **2014 dry season:** Maizal mercury levels were very high (mean: 26.3 ppm, SD:12.8, range 2.5 – 53 ppm, N=68). All samples were above the EPA and WHO reference values.

- **2017 rainy season** Maizal Hg levels were high (mean: 11.9 ppm, SD: 3.19, range 2.3 – 17.9 ppm, N=38). All samples were above the EPA and WHO reference values.

- **2018 rainy season.** All communities are have elevated mean Hg levels Maizal (11.3 ppm), Cachuatal (6.8 ppm), Yomibato (3.8 ppm). Most are above WHO and EPA RfD. Downstream communities have higher mean mercury levels.

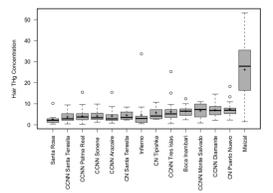
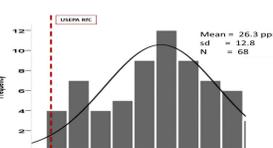
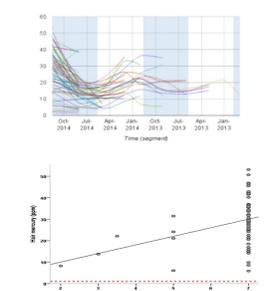
- Hair shaft analysis revealed seasonal variation corresponding to rainy and dry seasons. Community fish consumption was reported as much higher in dry season.

- Hg levels were significantly related to fish consumption rate. Most people reported consuming fish in every meal.

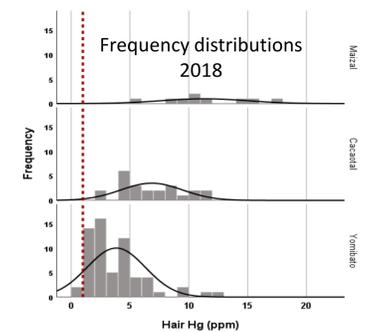
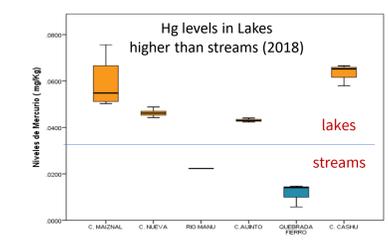
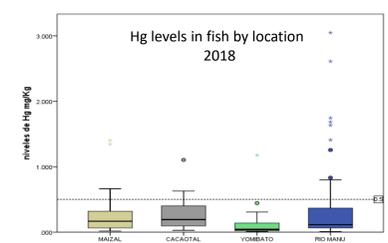
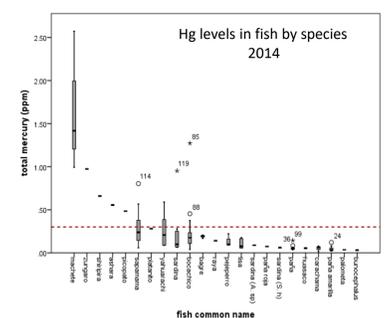
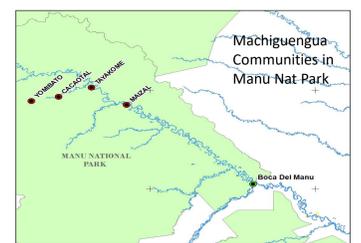
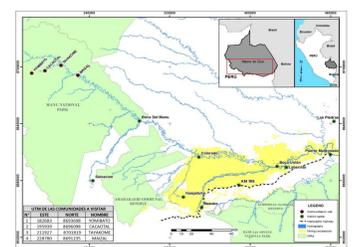
- HgT hair concentrations in Maizal were normally distributed in all 3 years indicating uniform Hg exposure in the population > age 2 yrs.

- Manu River communities have significantly higher levels than those close to the mining zone, suggesting the source is natural.

- Traditional high fish consumption in this high mercury environment may pose a significant and previously unidentified public risk to the Machiguenga people.



Supplemental Information



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