

Mercury in Tropical Songbirds

Evidence from Central Africa

Mercury in the Environment

Through anthropogenic activities, mercury (Hg) is released into the environment at much higher rates than would naturally occur. One of the largest sources of mercury pollution is through emissions. A predominant global source of anthropogenic emissions is artisanal and small-scale gold mining, which is prevalent in tropical regions worldwide.¹

Mercury in the atmosphere may travel long distances before being deposited onto the landscape. When mercury enters aquatic ecosystems, microbes convert it into organic methylmercury (MeHg), a neurotoxin that readily biomagnifies within the food web, and bioaccumulates in long-lived and high trophic-level consumers.

Biodiversity in Central Africa

The Congo Basin Rainforest is the second largest contiguous tract of tropical rainforest in the world.² This rainforest is a significant biodiversity hotspot, hosting over 10,000 species of plants and animals, including over 1,000 bird species; many of those species are endemic and found nowhere else on Earth.^{3,4}

Within the wider Congo Basin, the Atlantic Equatorial Coastal Forest, which spans six countries in the Gulf of Guinea, is among the most biodiverse area of the Congo Basin.⁵

However, these species face a plethora of threats, including habitat degradation and loss, shifts in suitable climate, hunting, and persecution. Heavy metal exposure, especially to mercury, is an under recognized threat to birds and other wildlife in tropical regions but the pervasiveness of mercury in the environment in Central Africa is less well-known than in South America and Southeast Asia.

During the rainy seasons, the tropical forest habitat is potentially at increased risk for enhanced methylation, **likely increasing the risk of methylmercury exposure and mercury sensitivity within the environment (Figure 1).**

At certain concentrations, methylmercury can impact the nervous system causing behavioral, immunological, neurological, physiological, and reproductive impairment in wildlife and humans.⁶

In Central Africa, invertivorous species are consistently highlighted as being the most sensitive to habitat degradation, human disturbance, and other common drivers of decline.⁷ These threats, coupled with bioaccumulation of methylmercury, may further exacerbate population declines among sensitive species.



Burning amalgam to vaporize mercury is commonly used in artisanal and small-scale gold mining and releases toxic mercury vapor into the atmosphere.



The Shining-blue Kingfisher (*Alcedo quadribrachys*) is a common year-round resident found in the Congo Basin Rainforest.

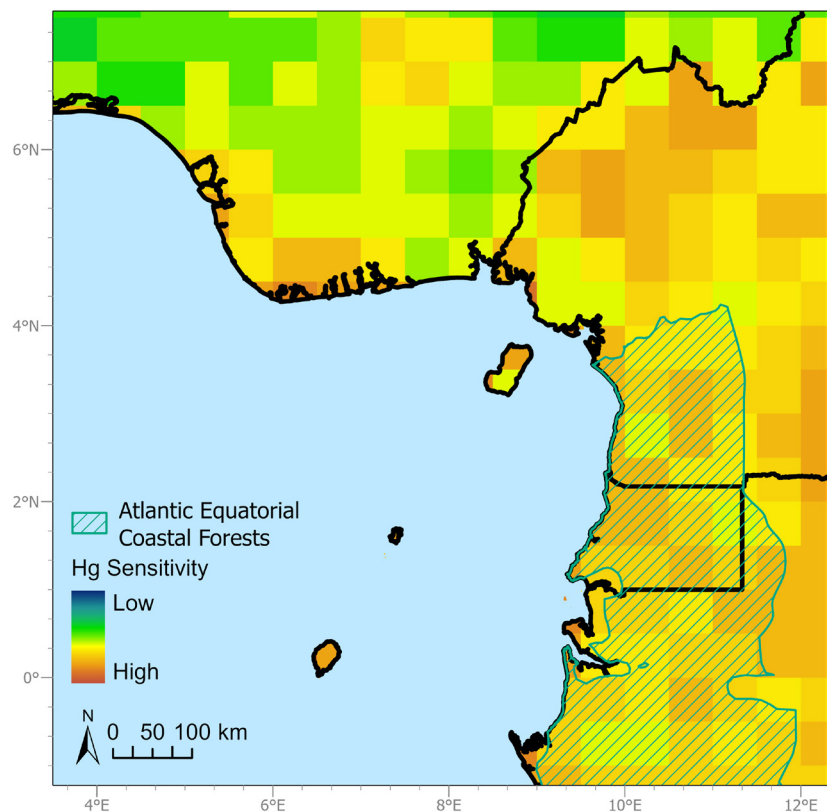


Figure 1. Map of Central Africa mercury sensitivity in the environment with our study area, the Atlantic Equatorial Coastal Forests, overlaid.

Sampling Efforts

BRI researchers undertook a sampling effort in Djibloho Province, Equatorial Guinea, using mist nets, working alongside scientists from Biodiversity Initiative and El Instituto Nacional de Desarrollo Forestal y Manejo del Sistema de Áreas Protegidas (INDEFOR-AP) to quantify mercury concentrations in birds.

This study, likely the first of its kind, helps to paint a bigger picture about mercury in the Gulf of Guinea and wider Congo Basin.

This work formed part of a long-term monitoring program initiated in 2016 by Biodiversity Initiative, which studies understory birds in the ecosystem.



The Brown-chested Alethe (*Chamaetylas poliocephala*) had among the highest levels of feather mercury among the species sampled.

1,530
feather samples

92
taxa represented

35
taxa with elevated levels

Mercury Concentrations in Feathers

Mercury concentrations are presented in terms of total Hg (THg), as it is an established indicator for assessing levels of toxic methylmercury in bird feathers.

Following trends observed in other tropical invertivores, our analysis found **four species to have consistently elevated levels of THg**: White-tailed Ant-Thrush, Fire-crested Alethe, Brown-chested Alethe, and Lowland Akalat, species that are known to occupy primary forest in greater numbers than secondary or degraded forest in Equatorial Guinea.⁸

Effect concentrations (EC) of mercury in songbirds communicate likely impacts to reproductive success, as methylmercury disrupts reproduction. For songbirds, **values above EC10 correspond to a theoretical 10% decline in reproductive success.**

Therefore, all species highlighted in Figure 2 are potentially experiencing at least a 20% decline in reproductive success, with White-tailed Ant-Thrushes and Fire-crested Alethes likely experiencing a decline of more than 40%. Considering how sensitive these species are already to other drivers of population decline, mercury exposure is likely impacting their ability to maintain viable populations.

Furthermore, all these species are ant-following birds, habitually pursuing prey flushed up by raiding predatory *Dorylus* driver ants, a keystone species. Ant-followers are considered an important component of the avian community. Therefore the loss of these species from the ecosystem will likely cause cascading effects as they play central roles in forming and maintaining these flocks.

*elevated levels are anything at or above an Effect Concentration (EC) 10

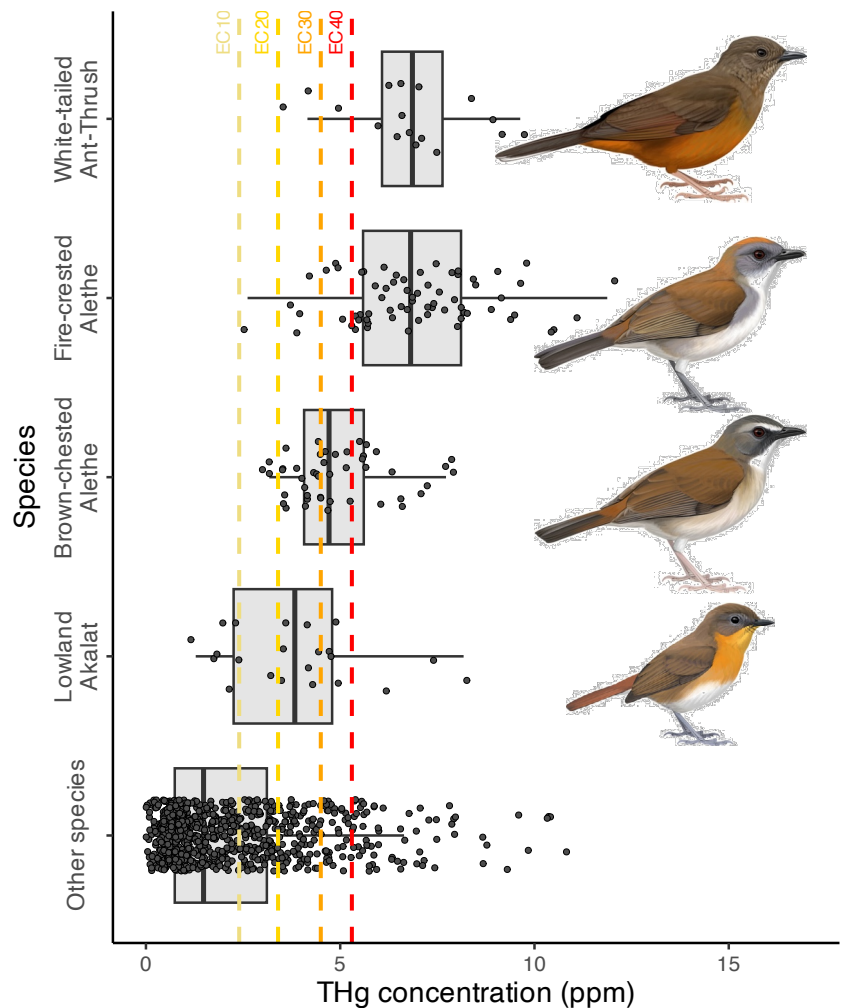


Figure 2. Feather mercury (THg) concentrations (ppm) in four terrestrial invertivorous bird species showing incredibly elevated levels of mercury exposure compared to the overall bird community. Effect concentration (EC) lines indicate THg levels beyond which songbirds demonstrate reproductive declines of 10%-40%. Illustrations by Faansie Peacock.

Variation in Mercury Concentrations

- Several other species showed elevated levels of THg, including kingfishers. The diet of many species of kingfisher in Central Africa is predominantly fish, and globally piscivorous birds show elevated levels of THg, signalling potential impacts to human health for communities consuming fish in those areas.
- Invertivorous bird species show mercury levels comparable to or exceeding those of piscivorous taxa, indicating that mercury exposure can be high across multiple feeding guilds, not just in piscivores.⁹
- Feathers collected from invertivorous birds in Equatorial Guinea are consistently significantly higher in THg as compared to invertivorous birds from Indonesia, Colombia, and Peru.
- In Figure 3, mercury concentrations are presented from sampling in Colombia, Indonesia, and Peru near known point sources, and in Equatorial Guinea away from such sources, therefore atmospheric deposition is elevated enough to create significant adverse conditions within Atlantic Equatorial Coastal Forests.



The Malachite Kingfisher (*Corythornis cristatus*) and other kingfisher species are at a greater risk of mercury poisoning through the process of biomagnification, and declining populations may serve as indicators of elevated mercury levels within aquatic food webs.

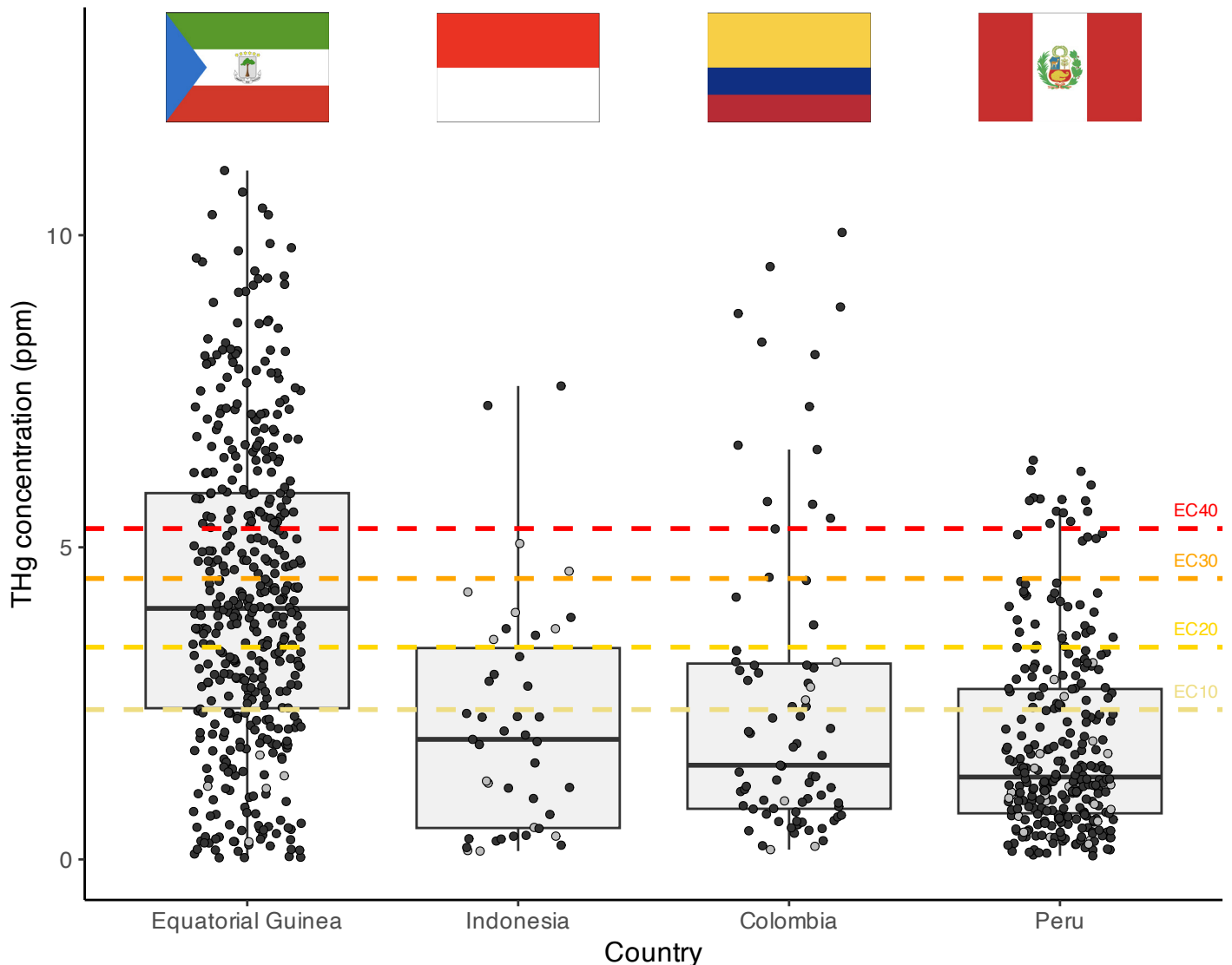


Figure 3. Variation of mercury (THg) concentrations (ppm) from sampling efforts near known point-sources of mercury in the environment in Colombia, Indonesia, and Peru compared to mercury concentrations from sampling efforts in Equatorial Guinea, conducted away from known point-sources. Grey dots represent specialist species and black dots represent generalist species.

Future Research Avenues

Additional work in the region is necessary for understanding the breadth of the impact mercury might be having on wildlife and people from across the region.

Future research that will provide such information includes:

- Collecting additional samples from birds and other animals in different habitat types across the country and in other Gulf of Guinea countries.
- Collecting environmental samples to help establish aspects of the mercury cycle within the region.
- Collecting samples from prey items such as higher-order invertebrates, including spiders and *Dorylus* ants and fish, as well as animals commonly consumed by communities in the region.
- Identify point sources of mercury emissions.

Ongoing Mercury Work in Africa

Beyond tropical songbird research, BRI is helping to establish a regional mercury monitoring network across Central Africa as part of the project "*Facilitating capacity-building with technology assistance and technology transfer for monitoring and managing mercury in Central Africa.*"

Under the Minamata Convention on Mercury, this initiative strengthens local capacity, generates region-specific mercury data, and supports evidence-based mercury management and policy development.

BRI's mercury research also extends to human-related exposures, including studies of mercury-added skin lightening products and other sources of contamination. By linking ecological and human health perspectives, our work advances a comprehensive understanding of the effects of mercury exposure while fostering collaborative solutions at local, regional, and global scales.



BRI scientists Billi Krochuk and Kevin Regan sample tropical songbirds in Equatorial Guinea for mercury exposure.

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Suggested Citation for this Report

Krochuk, B., Regan, K. 2025, Burton M., Evers, D.C. Mercury in Tropical Songbirds: Evidence from Central Africa. Biodiversity Research Institute, Portland, Maine. BRI Science Communications Series 2025-15. 4 pages.

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October 2025