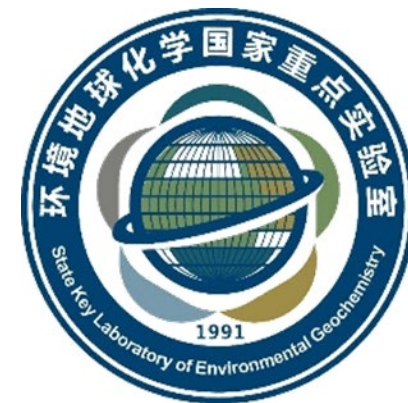




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中国科学院



Elevated MeHg in Forest Riverine Songbirds

-- Mechanisms and Implications



Kang Luo, Wei Yuan, Xun Wang, Xinbin Feng*

Presenter: Dr. Chen Liu

Institute of Geochemistry, Chinese Academy of Sciences

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- 1 Introduction
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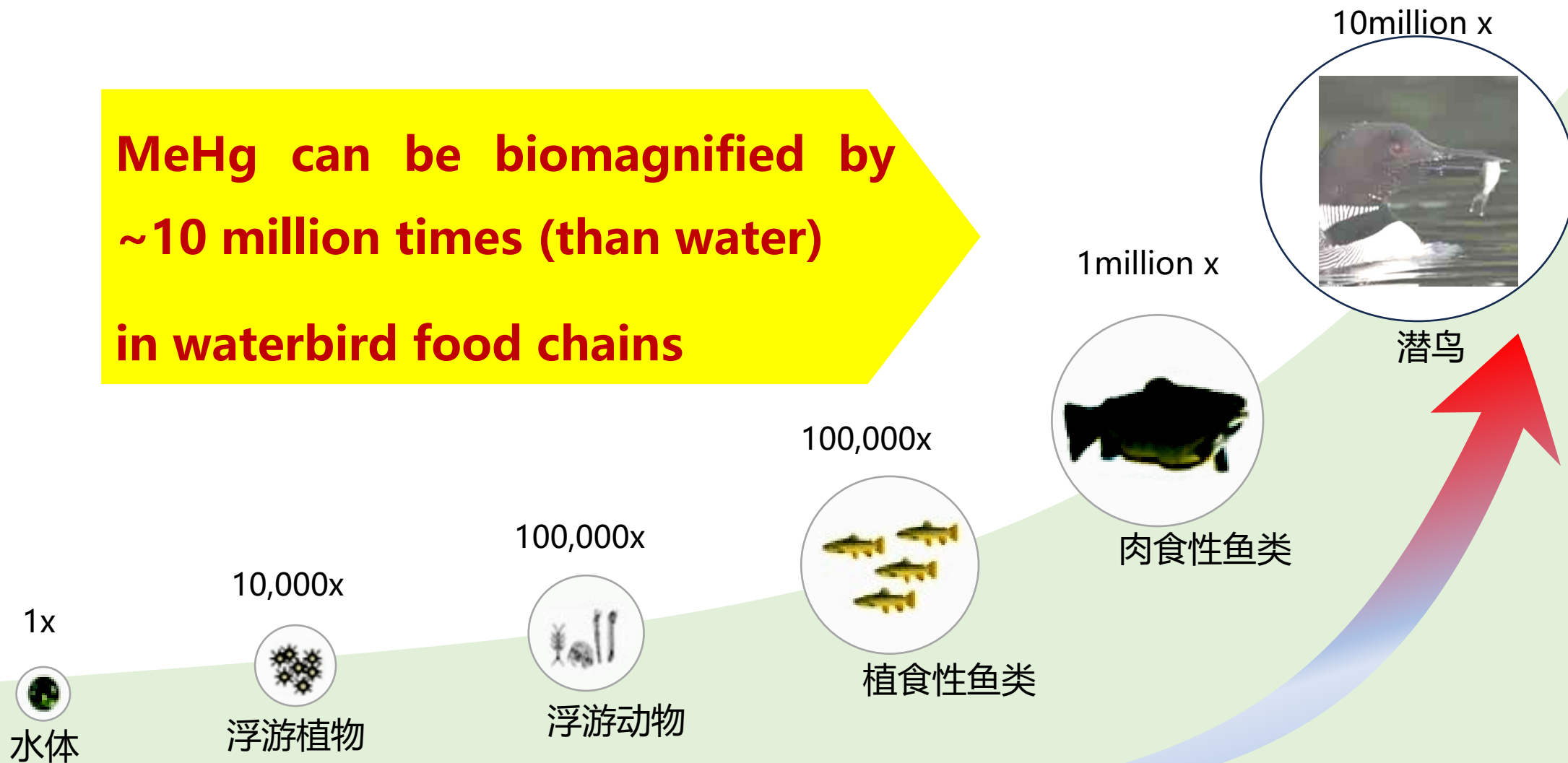


► Introduction--Birds are Bioindicators of MeHg risk

Biomagnification of mercury

Waterbirds/Seabirds

MeHg can be biomagnified by
~10 million times (than water)
in waterbird food chains



US EPA, 2011

► Introduction-- MeHg badly affect birds' fitness

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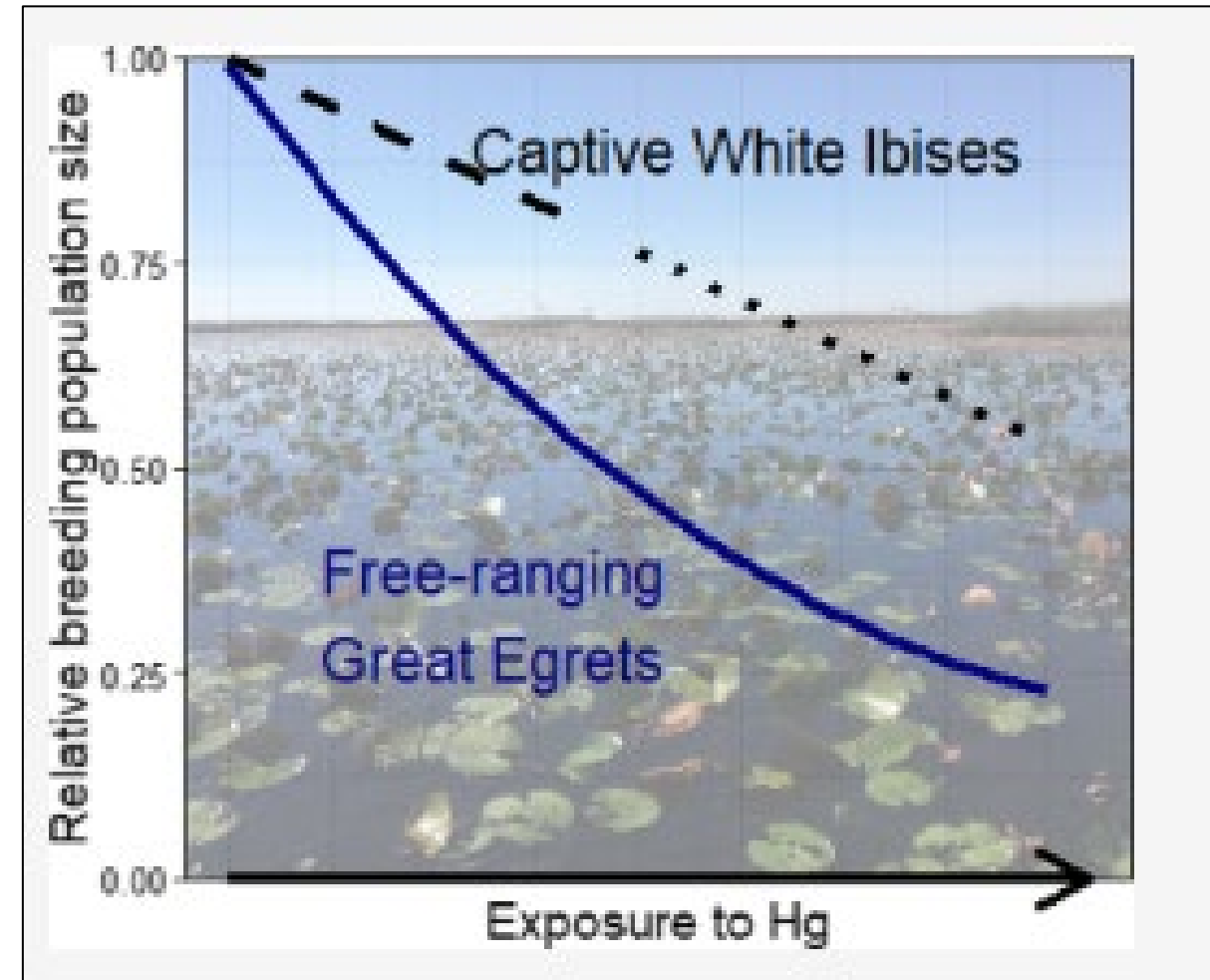
Mercury causes homosexuality in male ibises

[Joseph Milton](#)

[Nature](#) (2010) | [Cite this article](#)

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Environmental pollutant radically changes birds' mating behaviour.



Zabala et al., 2020. ES&T

► Introduction-- Study on MeHg risks of forest birds are scares

A lack of researches on diverse songbirds

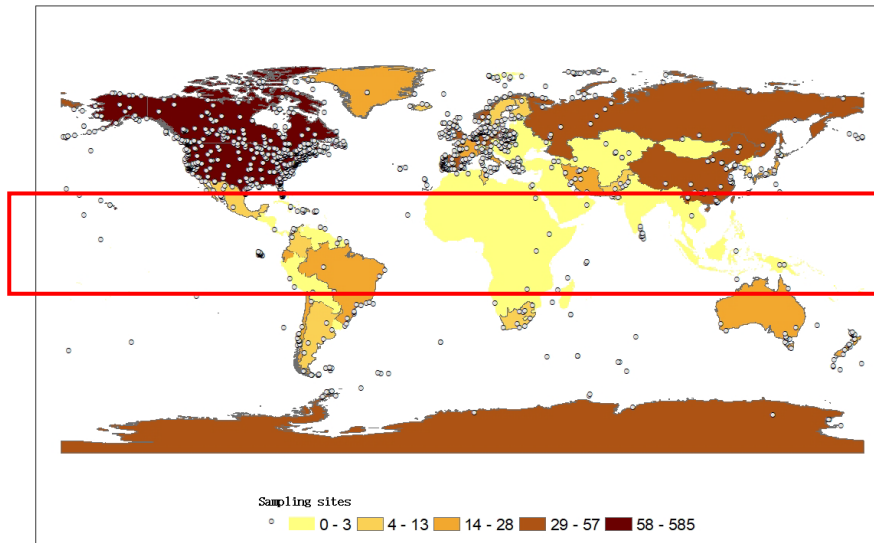
~10,000 bird species in the world, <1,000 being studied, <10%

Waterbirds/seabirds ~1,000 species, >400 being studied, >40%

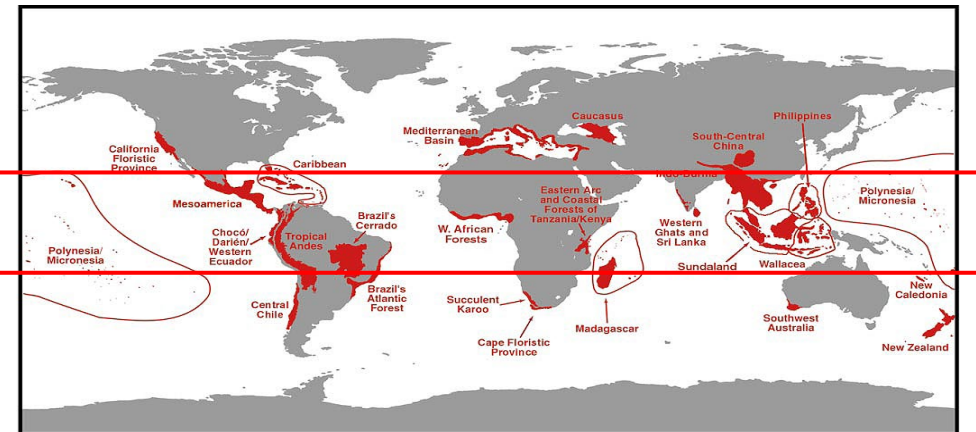
Songbirds ~ 5,400 species, ~300 being studied, < 6%

(Luo et al, unpublished data)

A lack of researches in biodiversity hotspot of tropical/subtropical regions



Sampling locations for Hg studies in birds between 1990 and 2022
(Luo et al, unpublished data)



Global biodiversity hotspots (Myers et al., 2000)

► Introduction-- MeHg risks of forest birds are underestimated



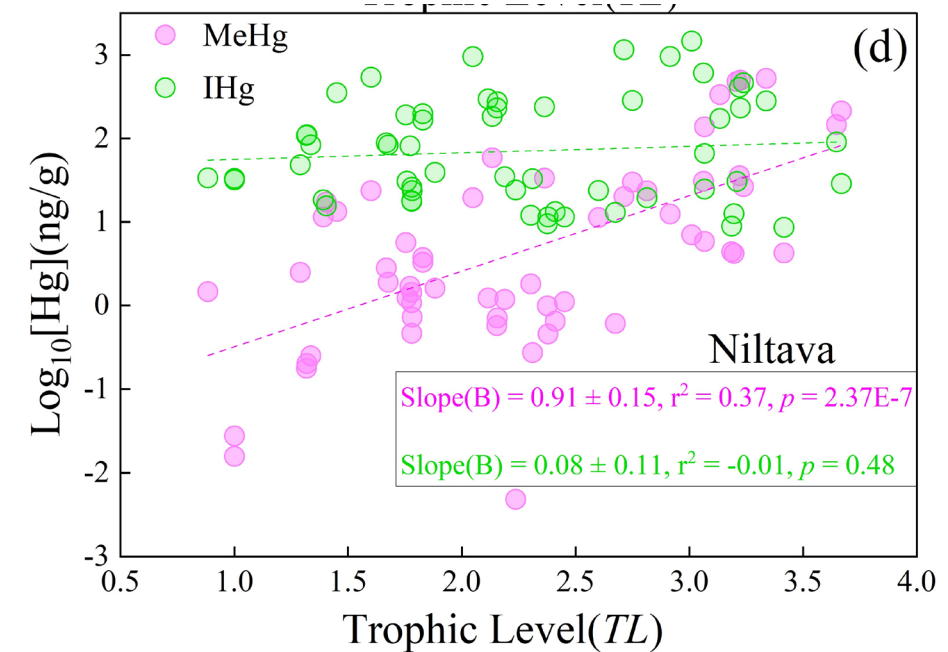
It has been increasingly recognized that remote forest birds may also face serious Hg exposure risks as aquatic ecosystems' (Rimmer et al., 2010; Jackson et al., 2014; Ackerman et al., 2019; Perkins et al., 2020; Stenhouse et al., 2020; Lane et al., 2020) .

The biomagnification and transfer of MeHg in forest bird food chains are remain unclear.

Warrant more case study!!

► New tools 1 —High resolution video recording

High-resolution continuous video recordings offer a unique opportunity to determine the composition of forest bird food(e.g. food provisioning for nestlings) (*Luo et al., 2019; 2020;2024*).



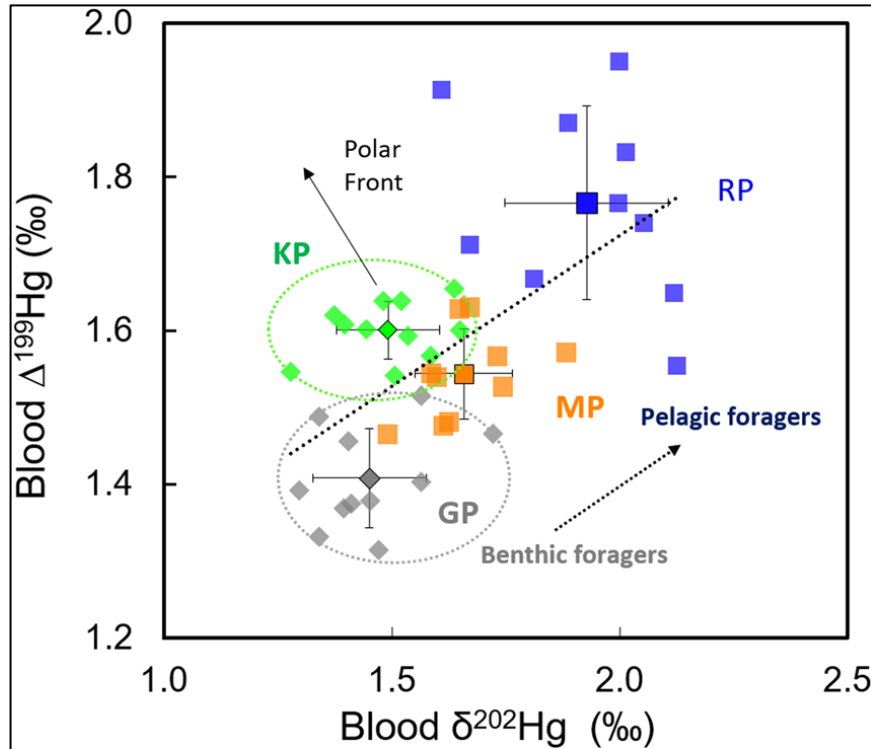
**Morphological Classification
(Video-recordings)**

+

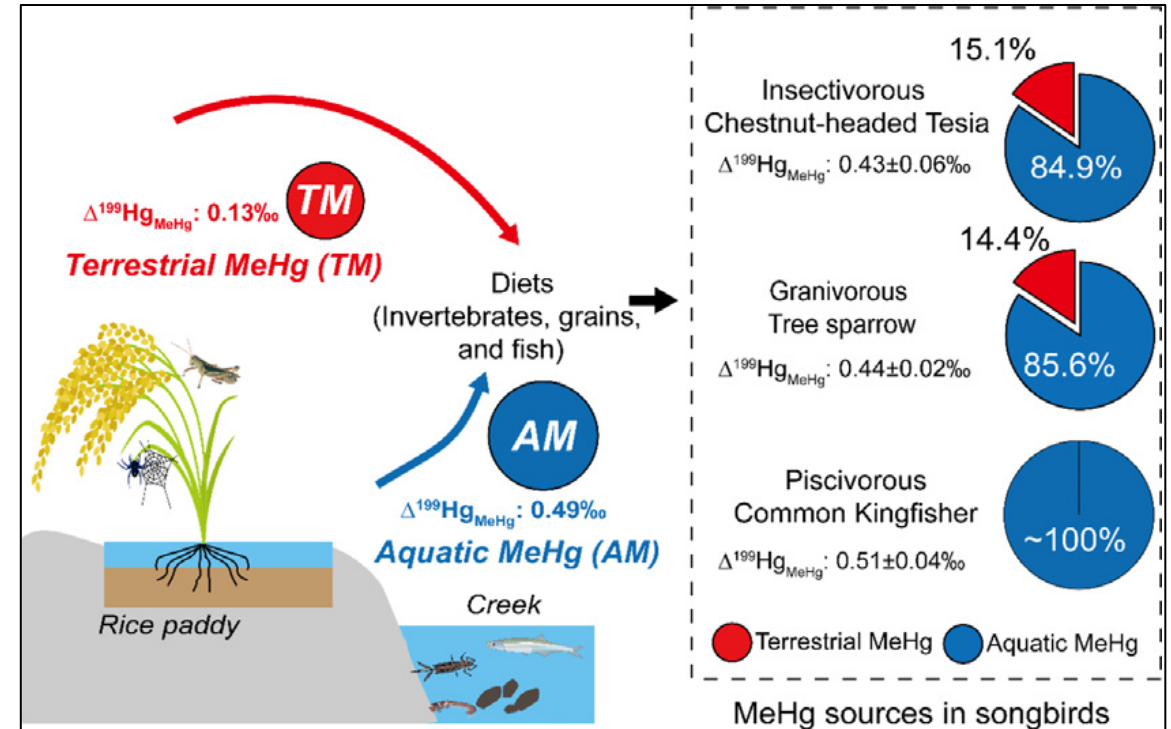
**Traditional C, N
Stable Isotopes Analysis**

► New tools 2- Hg isotopes provides new opportunities

No Hg MIF during its transfer in food chains (*Kown et al., 2012; Zhang et al., 2022*)



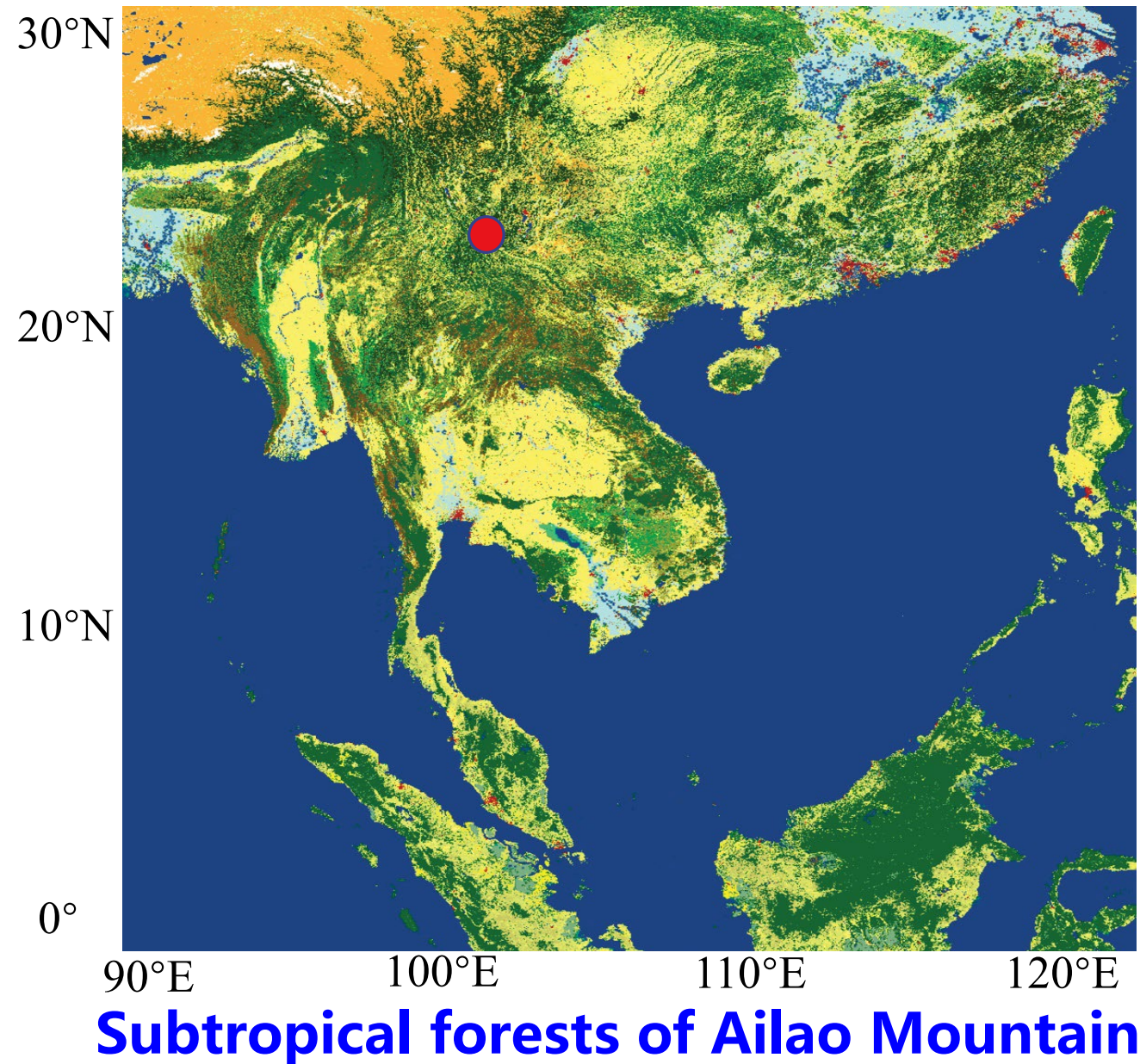
Mercury isotopes revealed the foraging depth of four penguin species (*Renado et al., 2018*)



Hg Isotopes reveals the Hg proportion in birds derived from aquatic and terrestrial sources (*Xu et al., 2023*)

Mercury isotopes have great potential in determining the sources and contributions of Hg in bird food chains.

► Method — Study site



Primary forest , ~68,000hm²

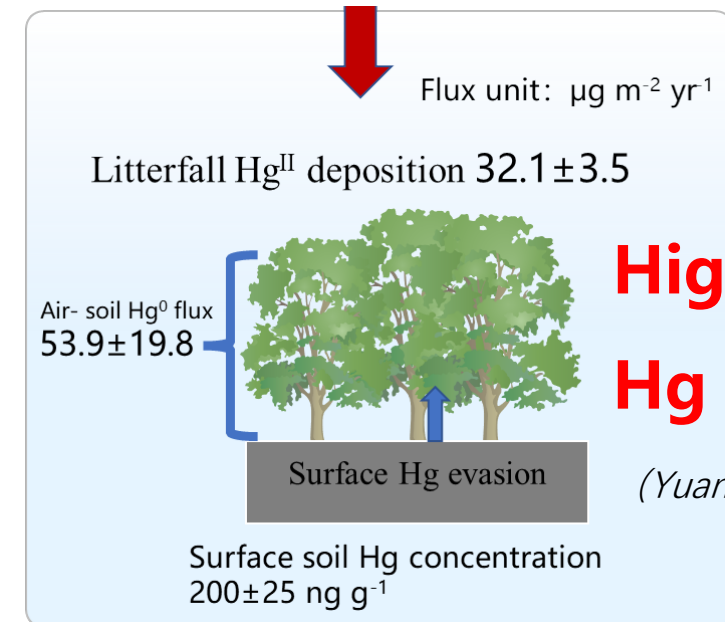
High bird diversity

Important Bird Areas

> 500 Bird species

~ 350 Songbirds

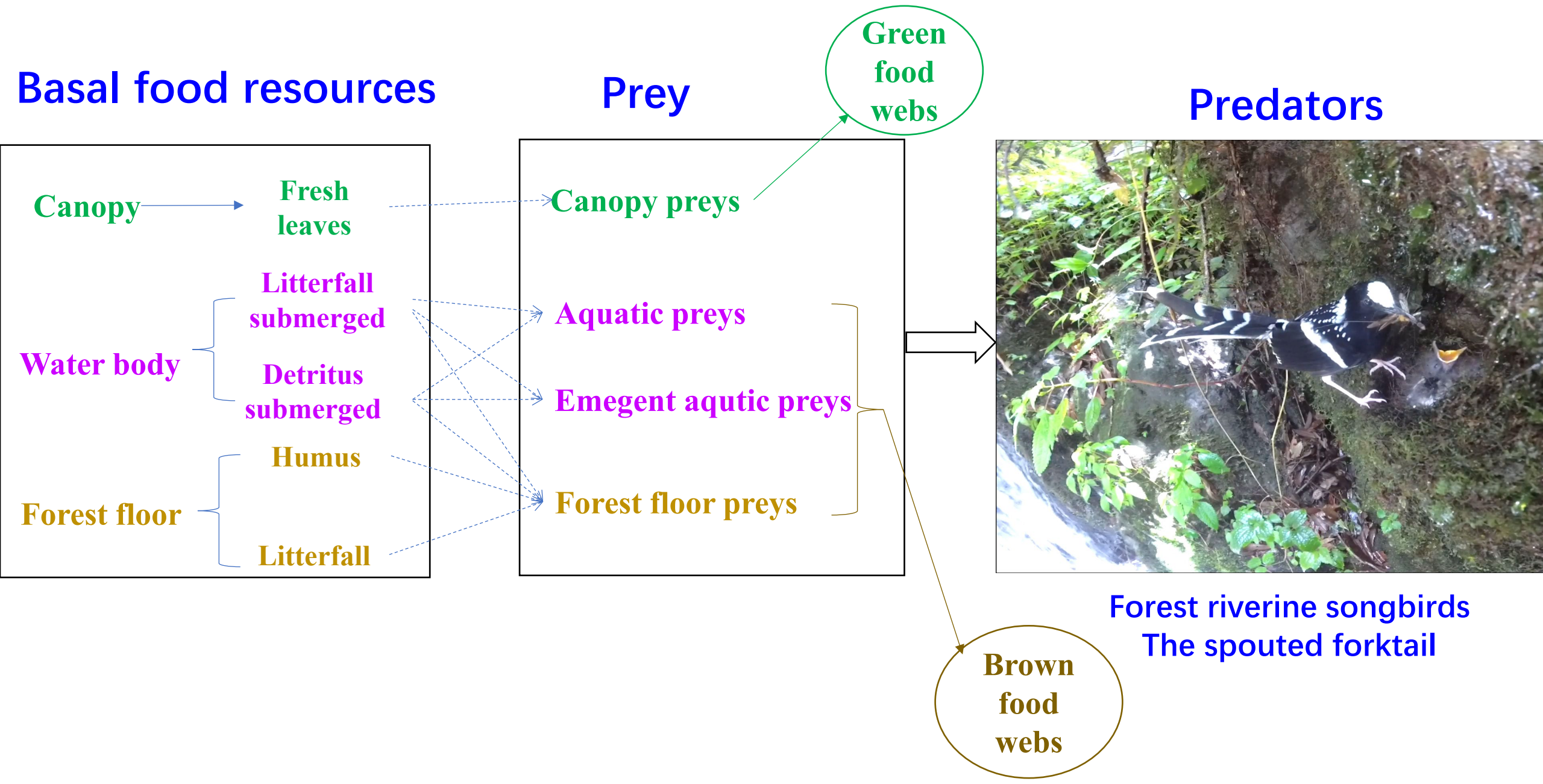
(Birdlife international, 2022;
Luo et al., unpublished data)



High atmospheric
Hg deposition flux

(Yuan et al., 2021; Wang et al., 2022)

►►Method--Sampling



►► Result and discussion- Elevated MeHg in forktails

Adult: 7.1 ± 4.9 ppm, max=15.6 ppm

Legacy Hg contamination site:

Owls : 5.6 ± 2.1 ppm

Woodpeckers : 2.4 ± 1.3 ppm

Sparrow : 2.4 ± 1.0 ppm

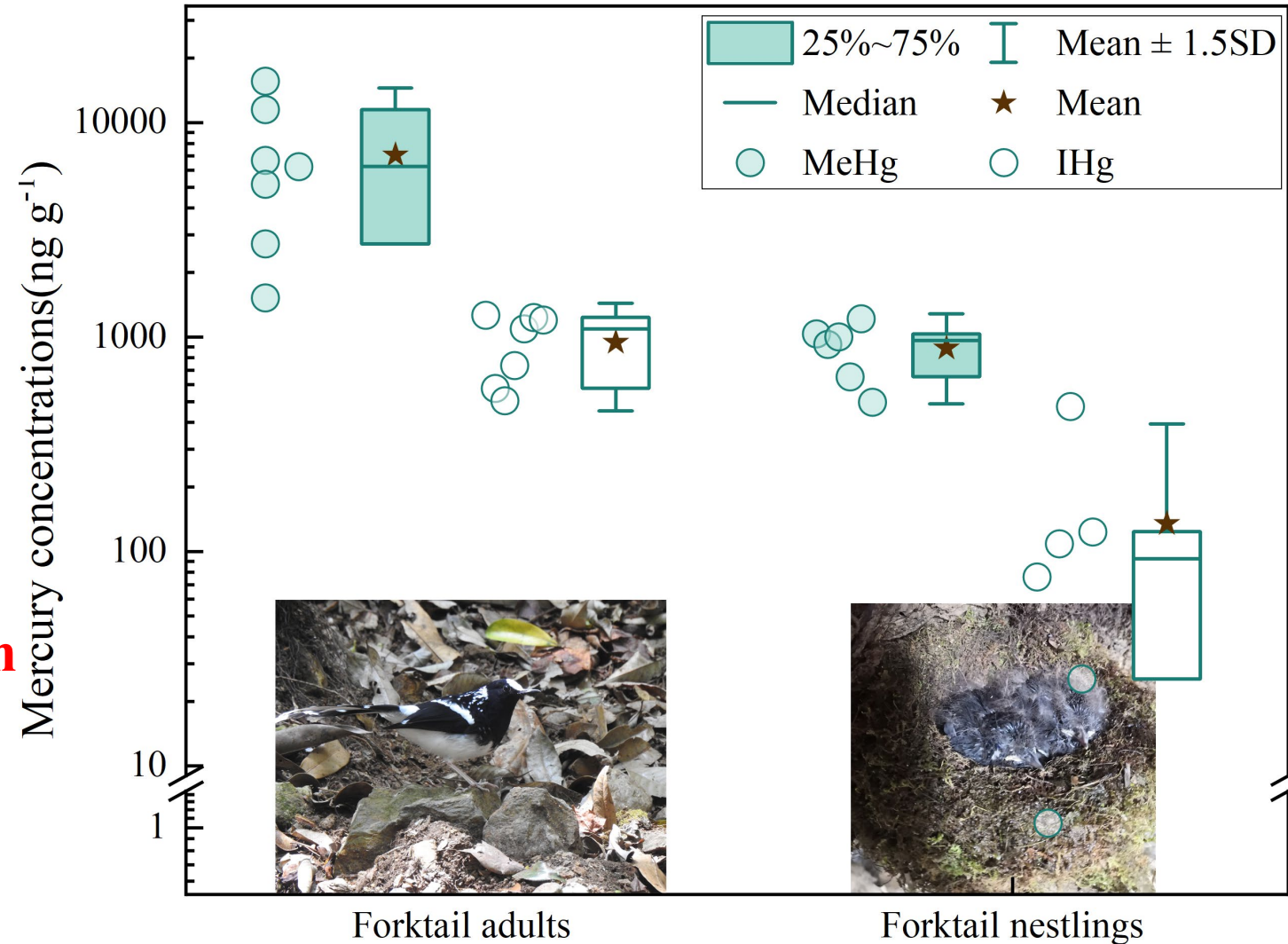
Tits: 7.1 ± 8.3 ppm

Nestling: 0.9 ± 0.3 ppm, max=1.2 ppm

Urban area :

Tits : 0.1 ± 0.03 ppm, max=0.2 ppm

Sparrow: 0.4 ± 0.2 ppm, max=0.7 ppm



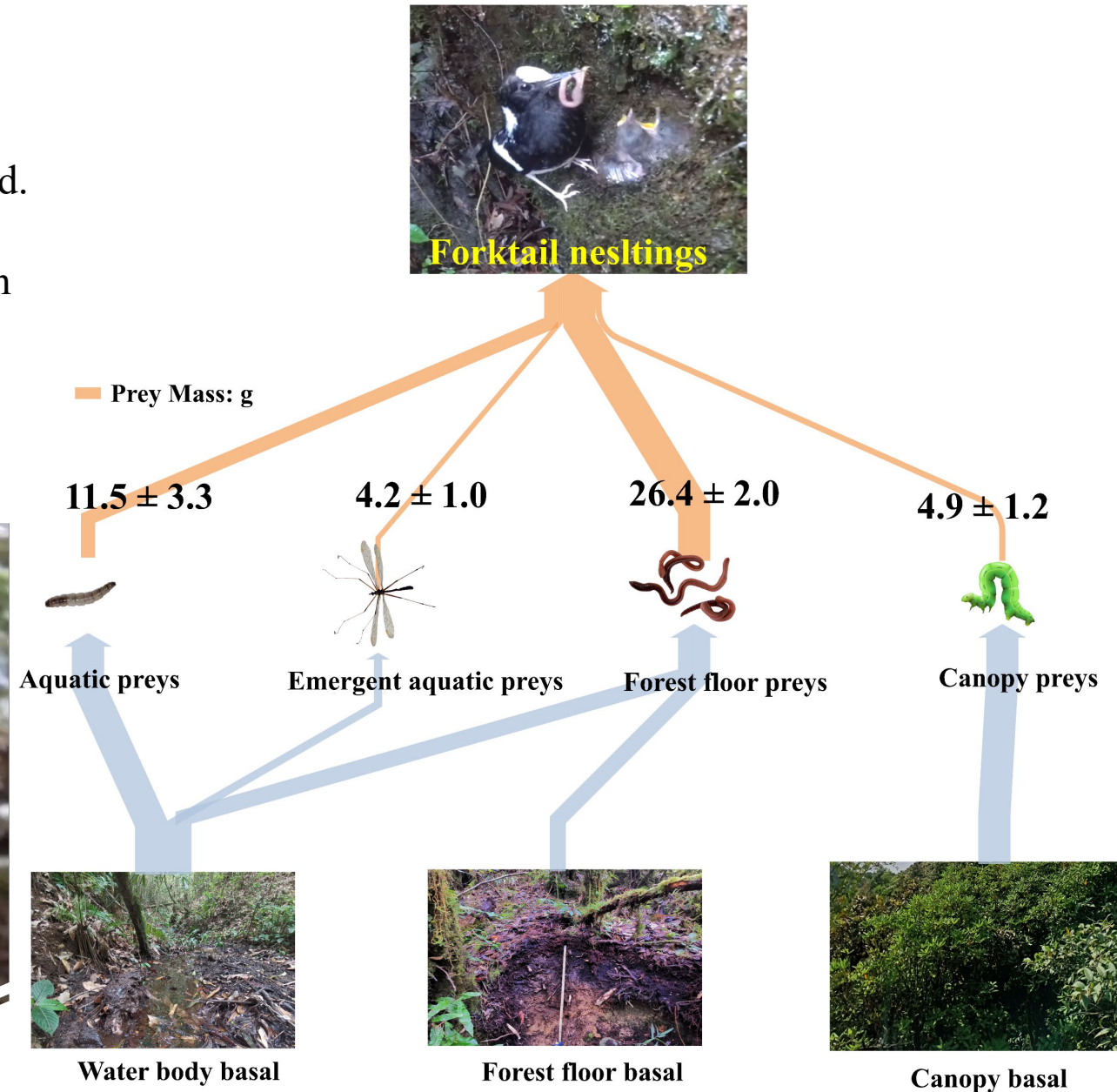
► Result and discussion- Dietary exposure pathways

Dietary composition

Seventy hours of high-definition video recordings were obtained.

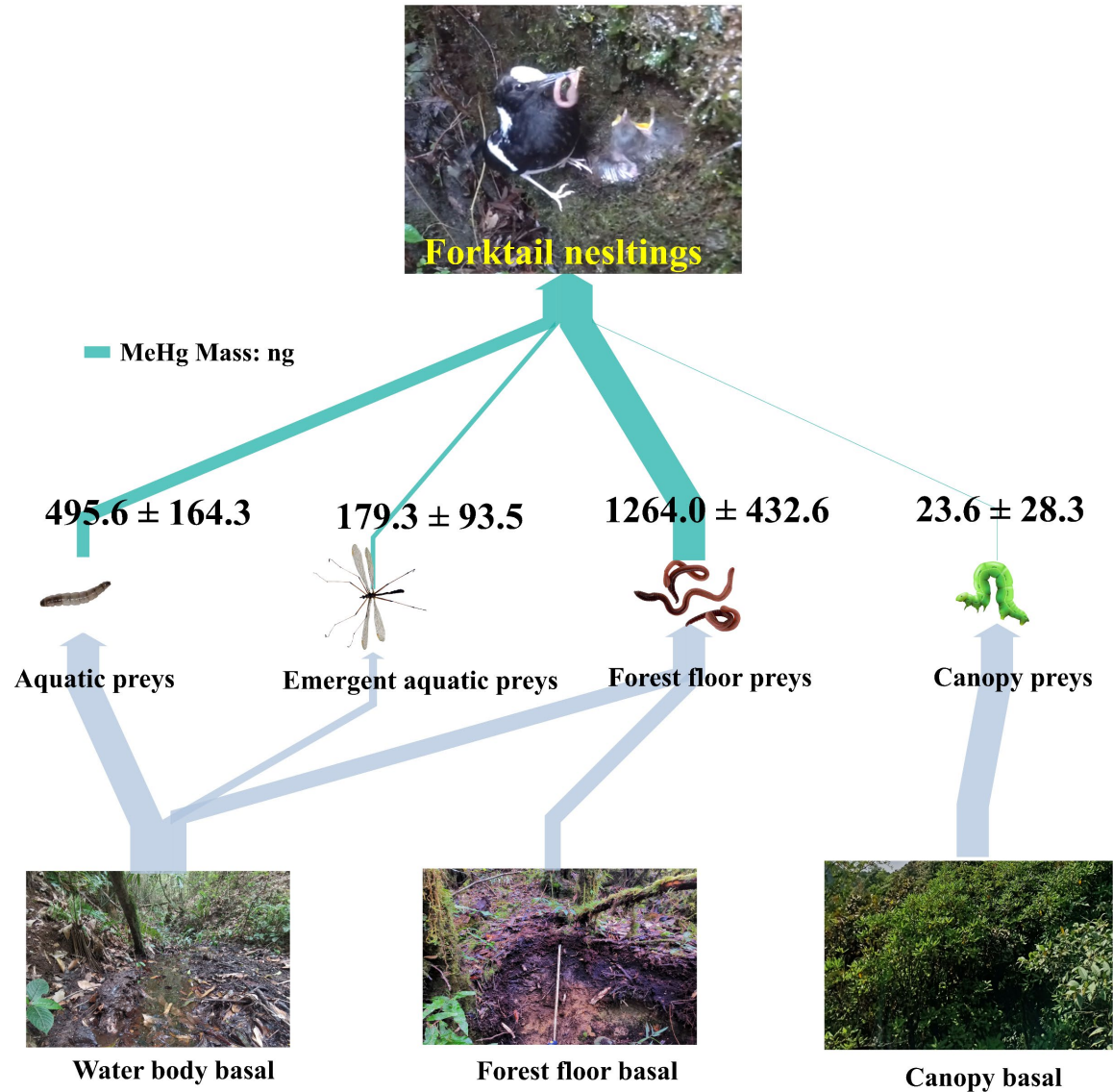
The parent birds returned to the nest to feed 768 times, of which

714 times were identified ,with a total of 46 prey types .

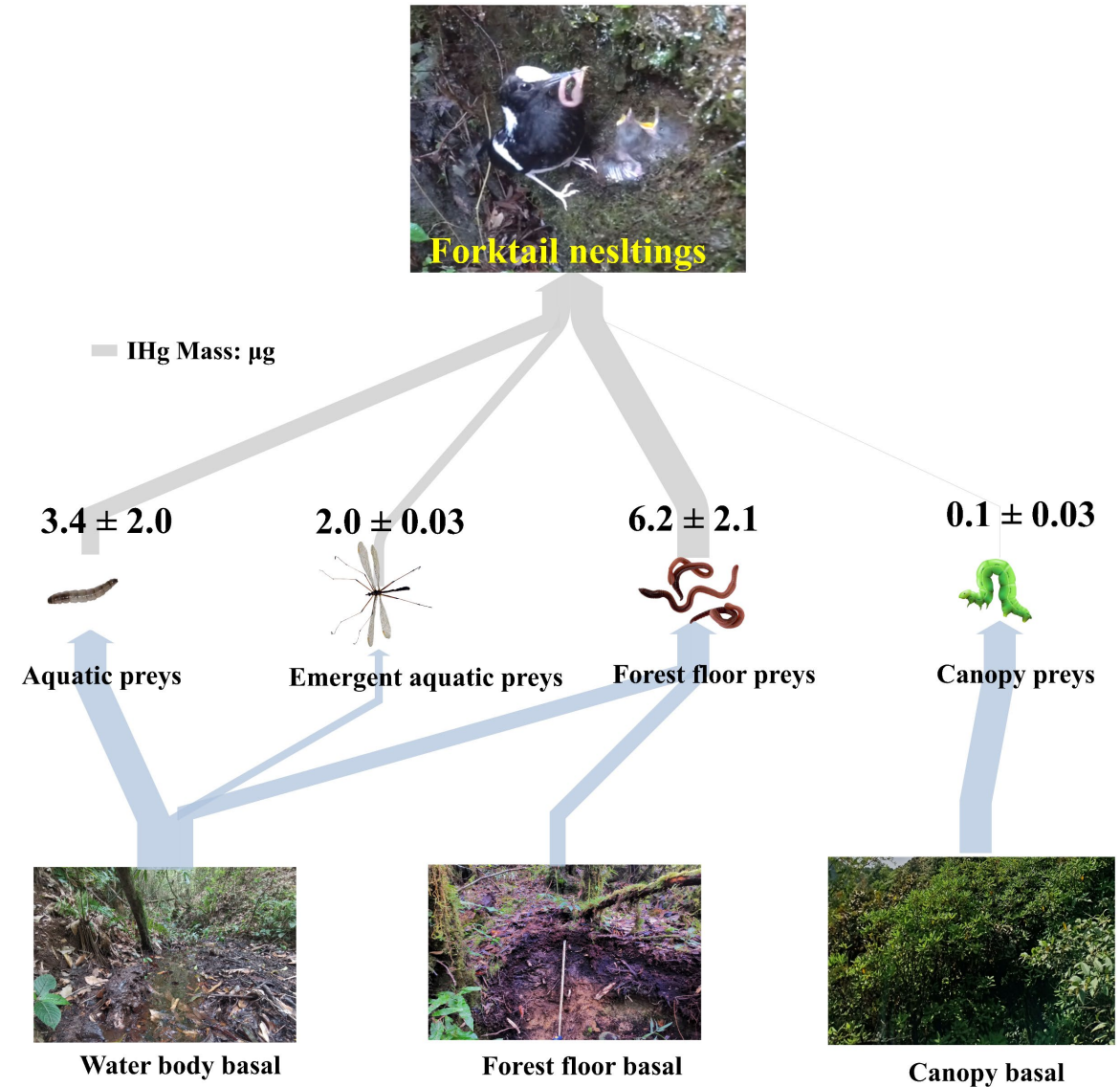


► Result and discussion- Dietary exposure pathways

MeHg transfer

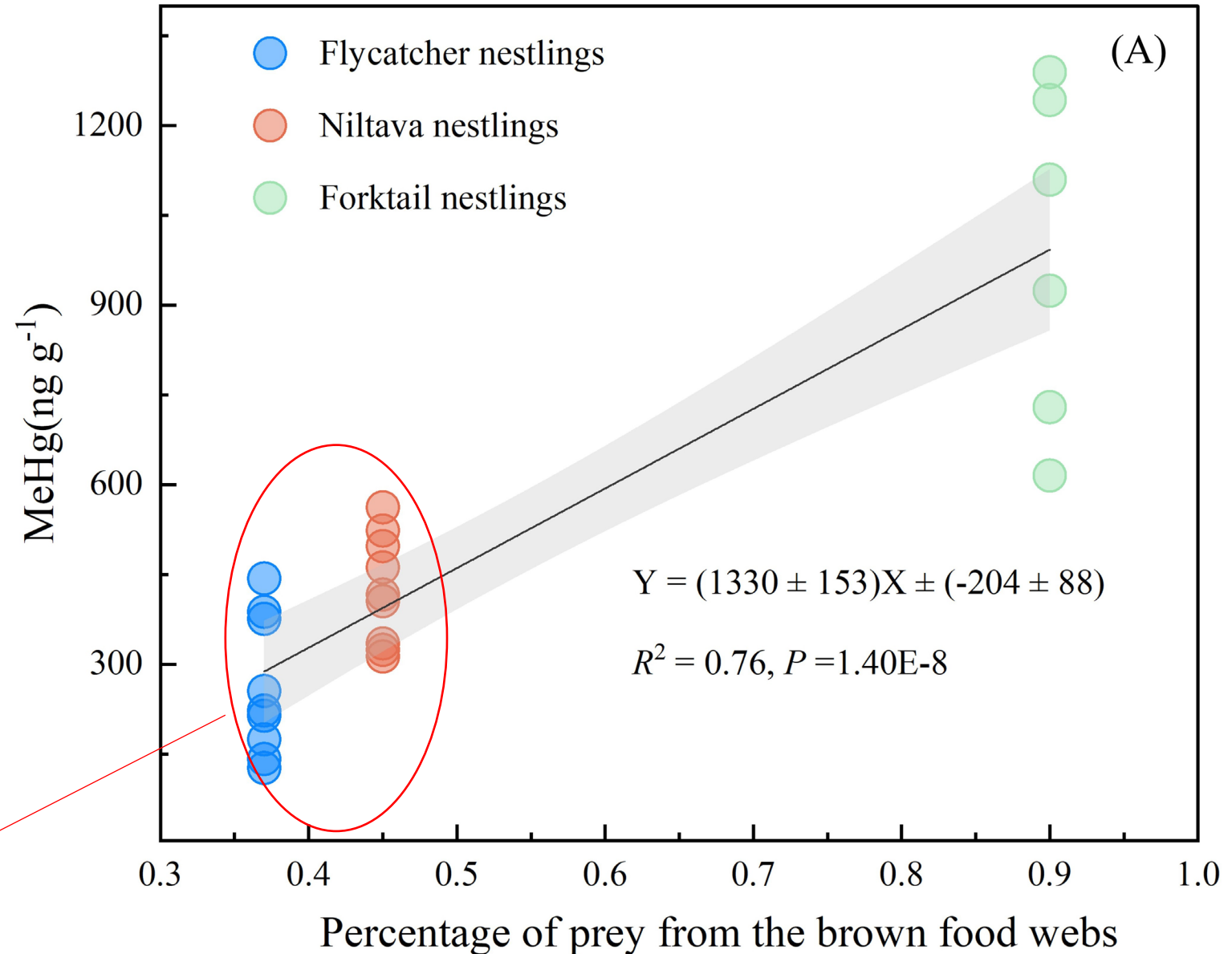


IHg transfer



►► Result and discussion- Dietary exposure pathways

MeHg levels in Forest songbirds positively correlated with their prey items from the brown food webs.

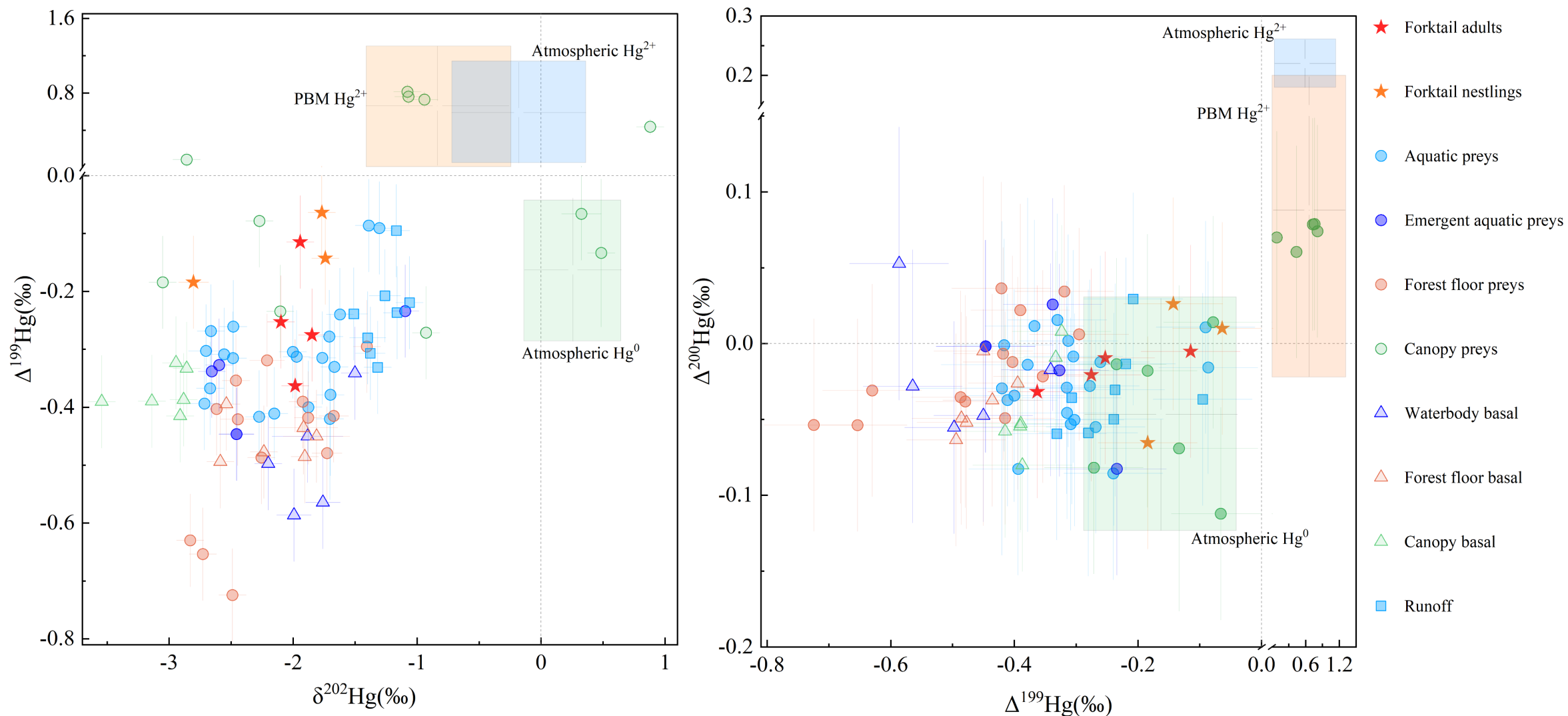


Data from Luo et al., 2024



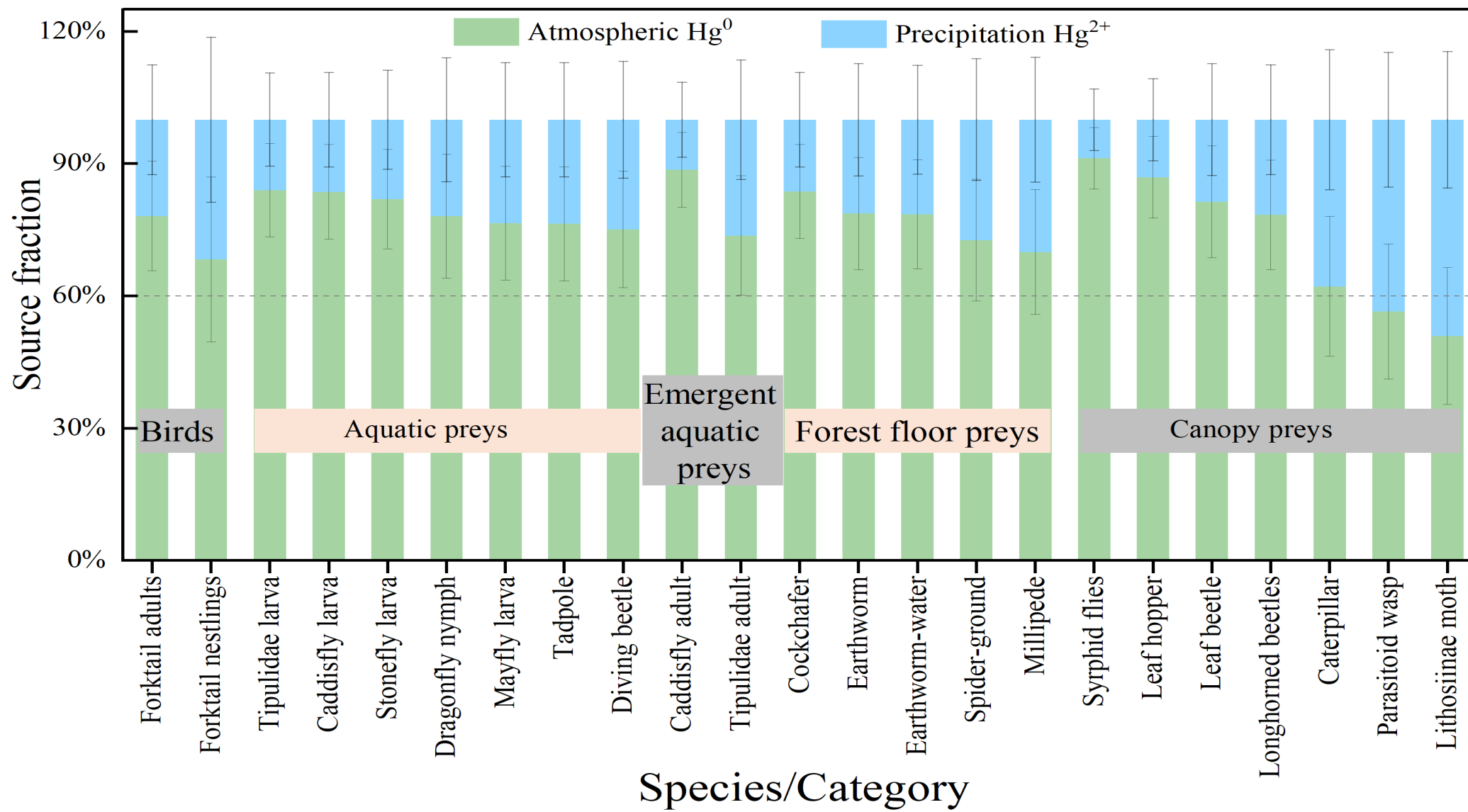
Result and discussion- Hg isotopes in forktail food chain

Hg isotopes in forktail food chain

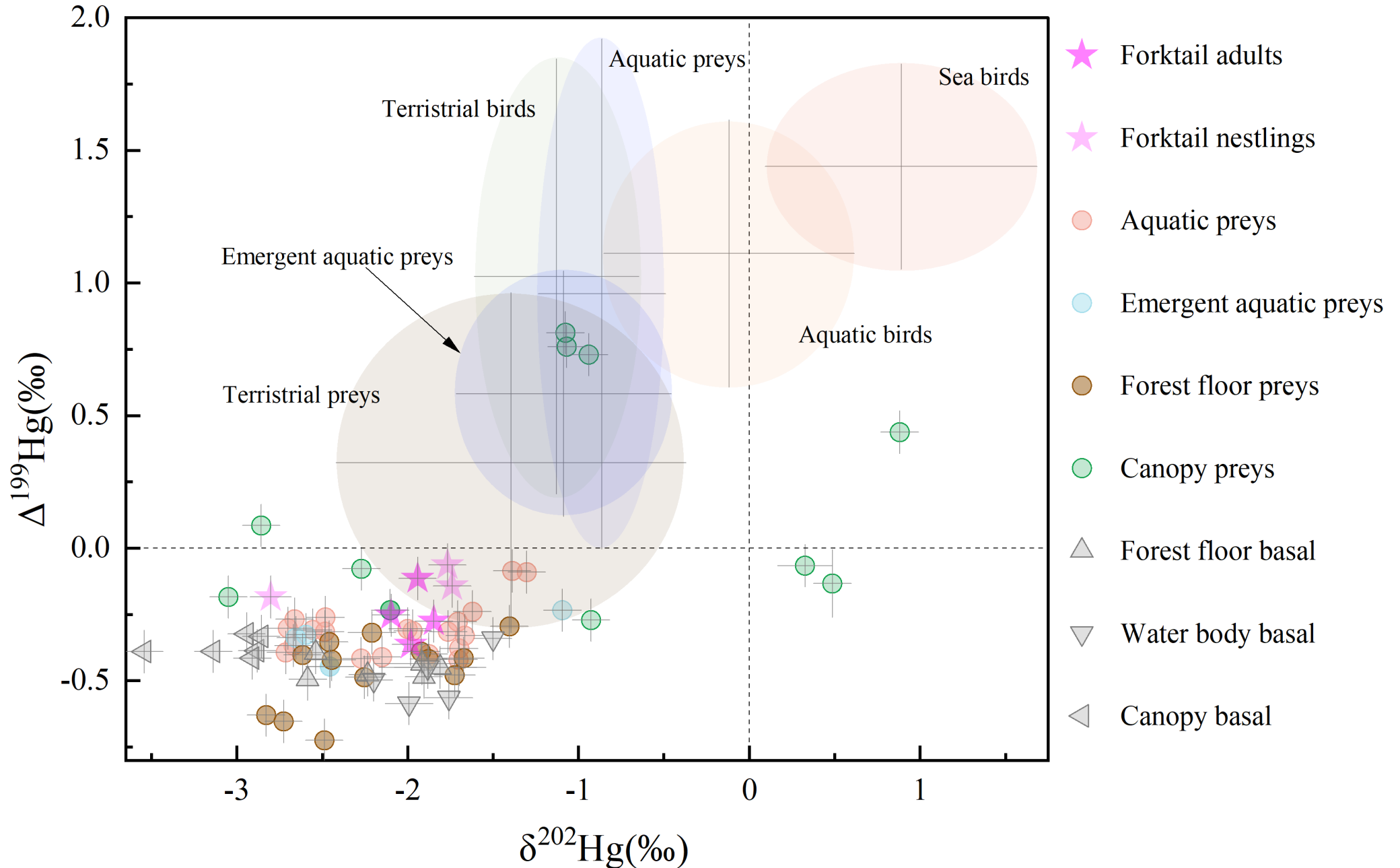


► Result and discussion- Hg isotopes in forktail food chain

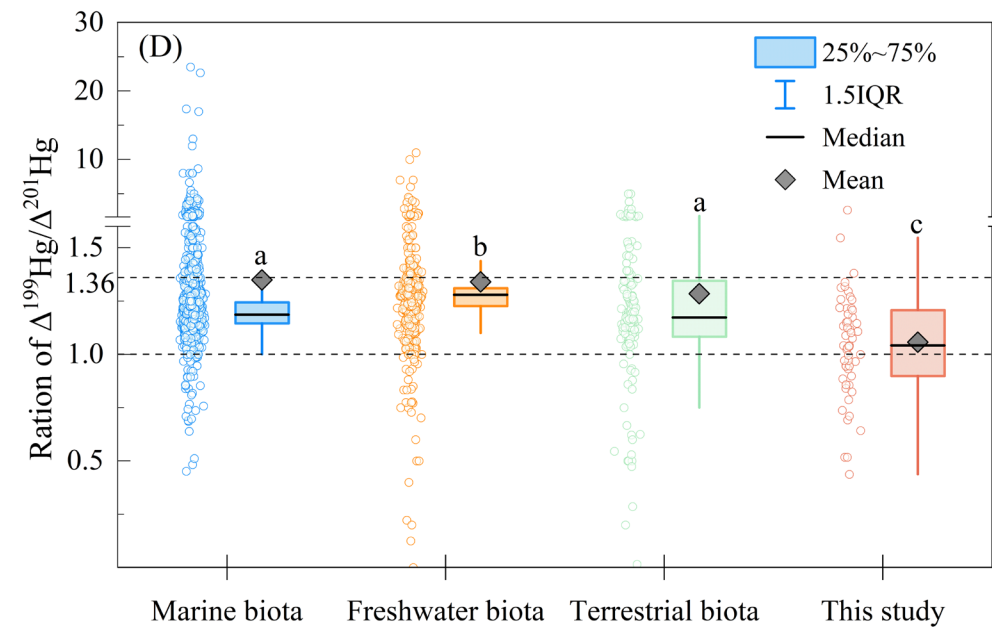
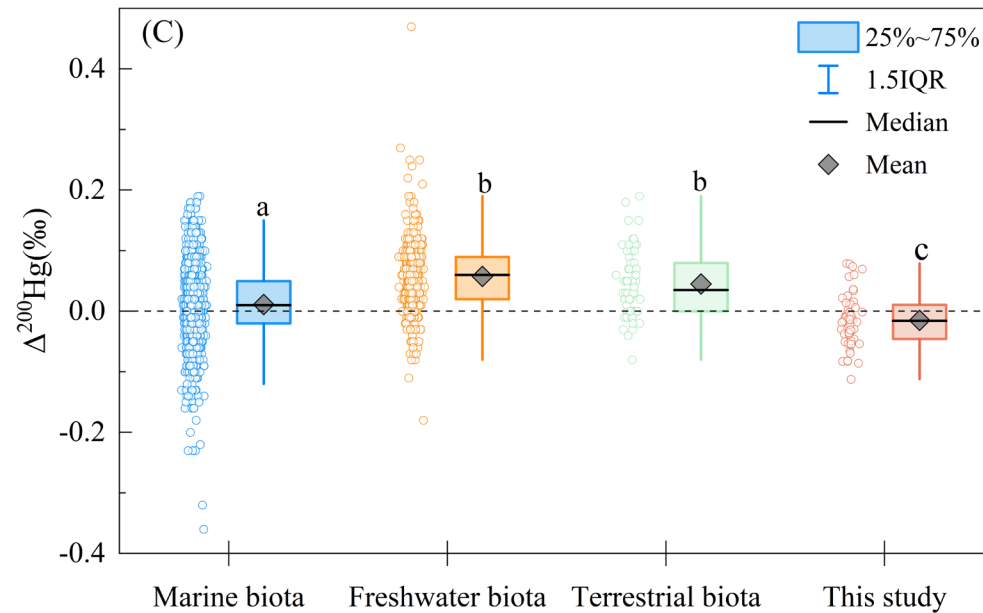
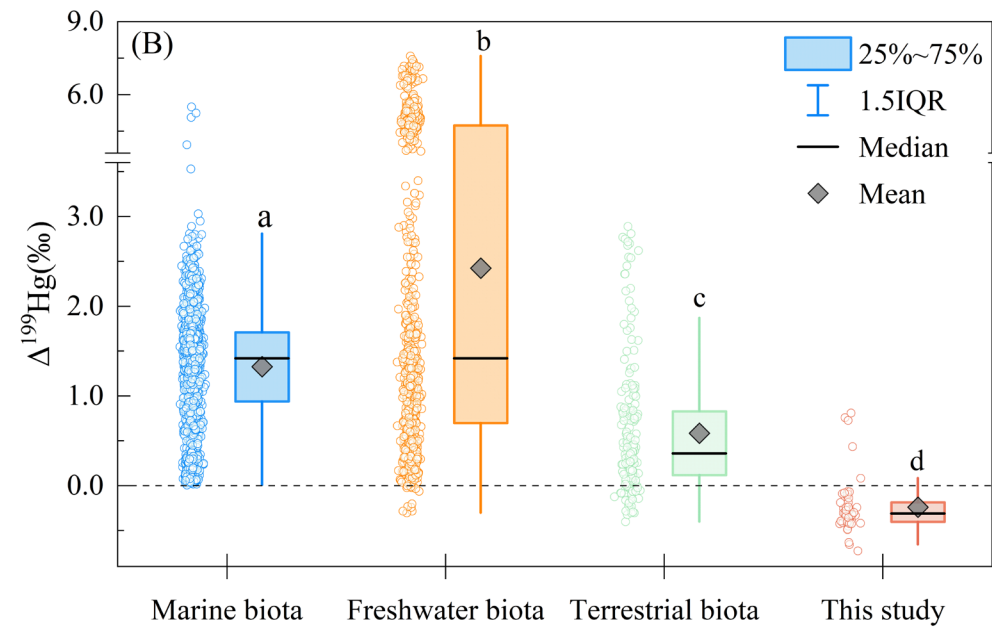
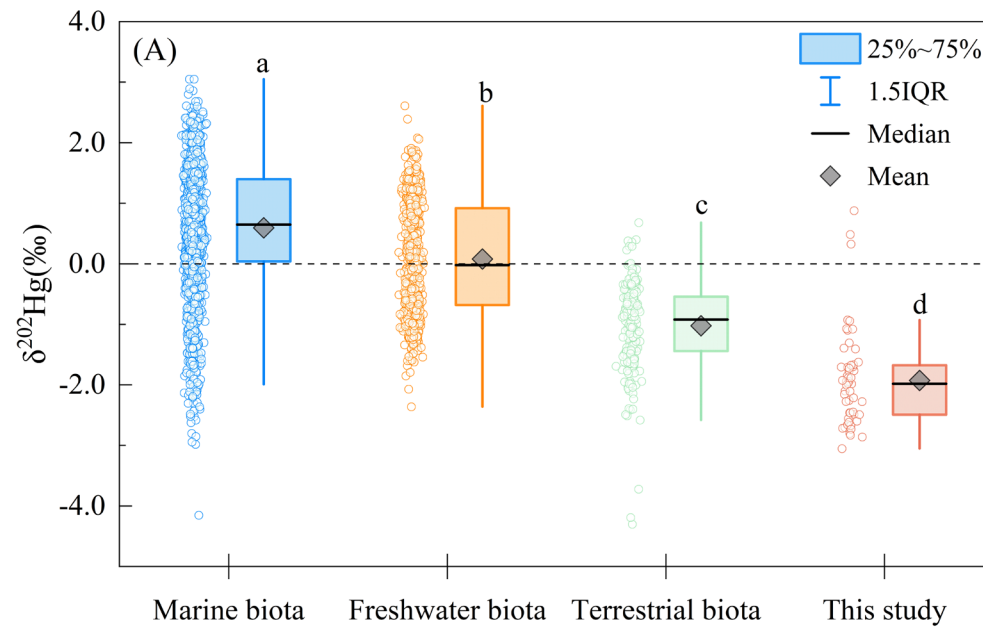
Hg source from even-MIF mix models



► Result and discussion- Comparison with other study

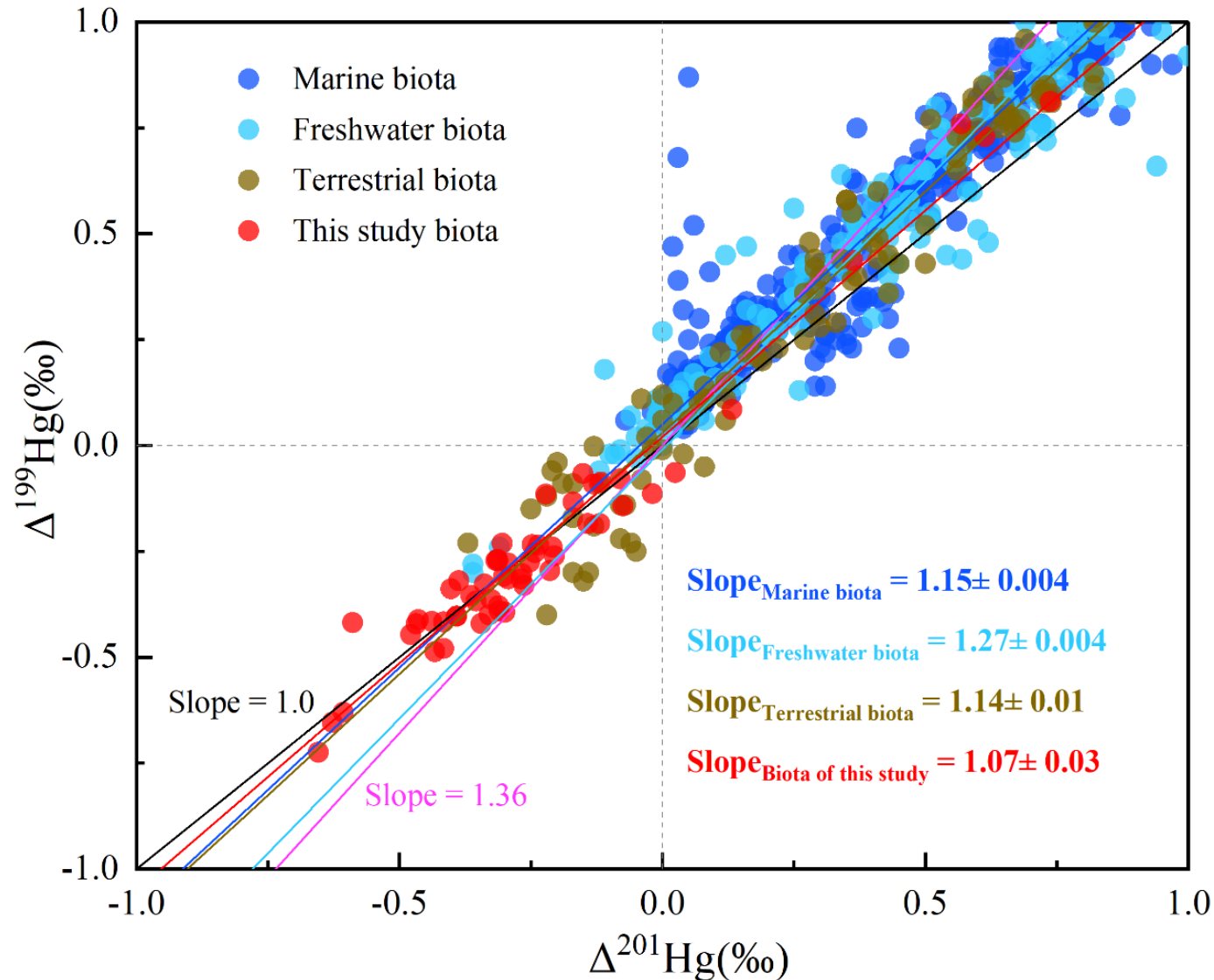


►► Result and discussion- Comparison with other study

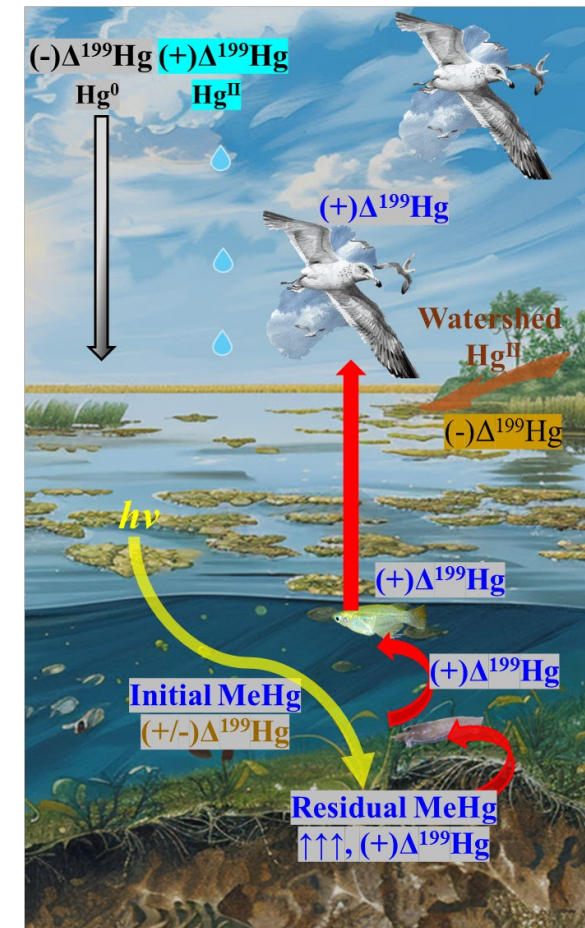
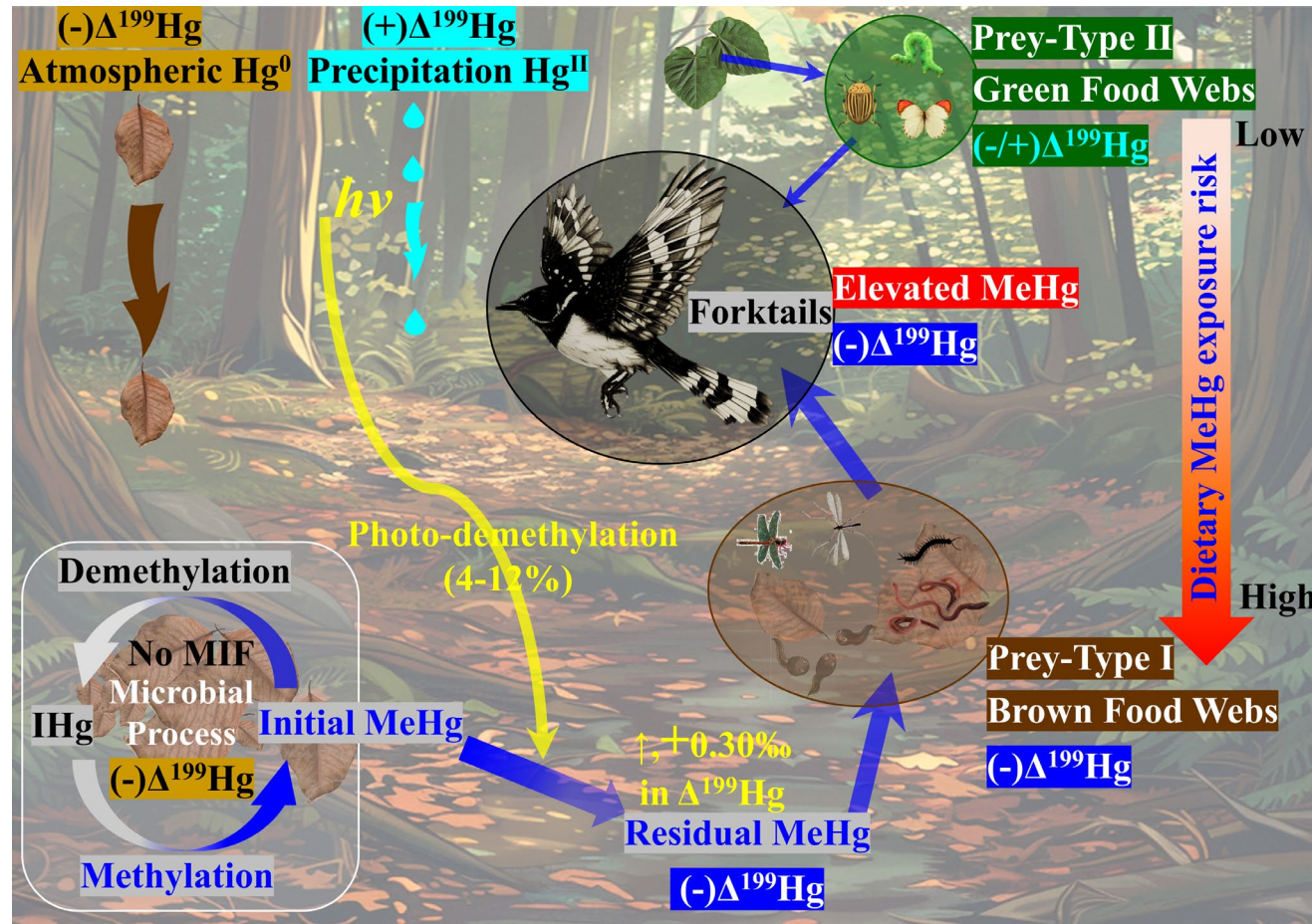


► Result and discussion- Comparison with other study

The difference of 199/201 in this study and others.



► Conclusion—take home message



Elevated levels of MeHg in forktails are sourced from the *in situ* methylation of IHg that comes from atmospheric mercury (Hg^0) through litterfall. It's important to note that the biogeochemical processes of mercury in forest ecosystems differ from those in open aquatic habitats.



Birds are a barometer
for planetary health



Thank You
For Your Listening

