# Mercury (Hg) concentrations in raptors across North American flyways

A. Pesano[1], E. Pavlovic[2], F. Nicoletti[2], C. DeSorbo[3], D. Evers[3], L. Brouellette[4], C. Persico[3], H. Yurek[3], M. Etterson[1]

[1] Environmental Protection Agency, Great Lakes Toxicology and Ecology Division, Duluth, Minnesota, USA
[2] Hawk Ridge Bird Observatory, Duluth, Minnesota, USA
[3] Biodiversity Research Institute, Portland, Maine, USA
[4] USFWS, New Jersey Ecological Services Field Office, Galloway, New Jersey, USA

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## Background

- Mercury (Hg) contamination is present world-wide due to release from anthropogenic sources[1].
- Once in the environment, Hg can be transformed into methylmercury (MeHg) which has bioaccumulative properties.
- Apex predators, like raptors, can be a useful biomonitor of Hg contamination across habitats, ecosystems, and at a continental scale.
- Feather THg (total Hg) concentrations represent the MeHg concentrations within a bird when feathers were grown.
- Blood THg concentrations are both a signature of current MeHg concentrations and a redistribution from tissues at the time of collection.

**Objective**: Determine the effect of sex, species, and flyway on THg concentrations in feathers and blood from juvenile raptors across North America.

## Methods

- Feather and blood samples were collected from juvenile raptors of six species across North American flyways. Collection occurred during fall migration between 2009 and 2020.
- Feathers and blood were analyzed for THg concentrations by Biodiversity Research Institute.
- Breast and back feather THg concentrations were correlated (correlation coefficient = 0.95, p-value < $2.2 \times 10^{-16}$); therefore, further analyses were completed with the two feather types combined.
- We used a generalized linear model to predict THg concentrations using the parameters: species, flyway, and sex.
- An ANOVA and Tukey HSD post-hoc test were used to determine statistical differences in feather THg between flyways and species.

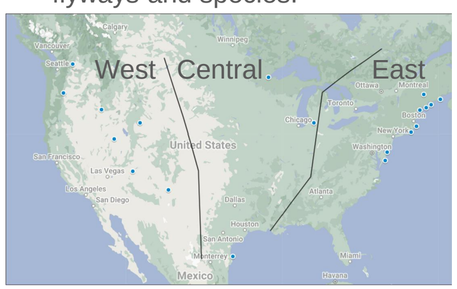


**Figure 1.** Map showing locations of migration banding sites where samples were collected. Lines separate collection sites based on three flyways in North America that were used in this analysis.

**Table 1.** Number of individuals sampled from each species within the flyways.

| | West | Central | East |
|---|---|---|---|
| SSHA | 302 | 385 | 424 |
| COHA | 239 | 107 | 353 |
| AGOS | 73 | 438 | 14 |
| AMKE | 15 | 125 | 256 |
| MERL | 70 | 336 | 403 |
| PEFA | 20 | 234 | 526 |

## Results – Feather THg

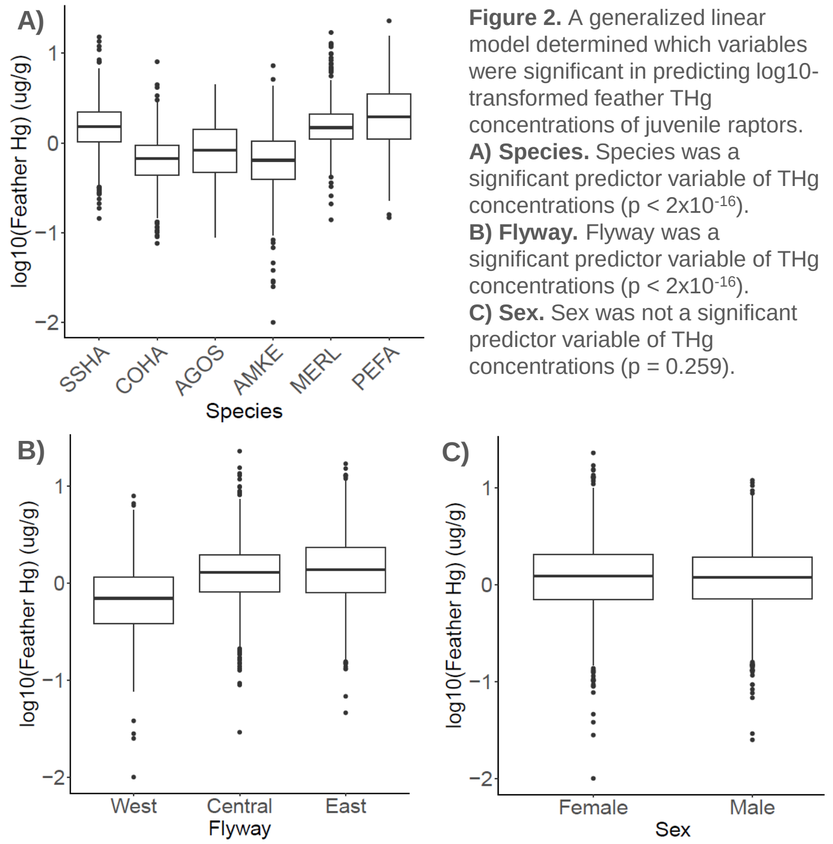


**Figure 2.** A generalized linear model determined which variables were significant in predicting log10-transformed feather THg concentrations of juvenile raptors. **A) Species.** Species was a significant predictor variable of THg concentrations ($p < 2 \times 10^{-16}$). **B) Flyway.** Flyway was a significant predictor variable of THg concentrations ($p < 2 \times 10^{-16}$). **C) Sex.** Sex was not a significant predictor variable of THg concentrations (p = 0.259).

**Table 2.** The ANOVA and Tukey's HSD post-hoc test presented significant pairwise comparisons among **A) Species** and among **B) Flyway**. Significant differences between comparisons are indicated by "Yes."

**A)**

| | SSHA | COHA | AGOS | AMKE | MERL | PEFA |
|---|---|---|---|---|---|---|
| SSHA | – | Yes | Yes | Yes | No | Yes |
| COHA | – | – | Yes | No | Yes | Yes |
| AGOS | – | – | – | Yes | Yes | Yes |
| AMKE | – | – | – | – | Yes | Yes |
| MERL | – | – | – | – | – | Yes |
| PEFA | – | – | – | – | – | – |

SSHA = Sharp-shinned Hawk
COHA = Cooper's Hawk
AGOS = American Goshawk
AMKE = American Kestrel
MERL = Merlin
PEFA = Peregrine Falcon

**B)**

| | West | Central | East |
|---|---|---|---|
| West | – | Yes | Yes |
| Central | – | – | No |
| East | – | – | – |

## Discussion

**Conclusions:**

- Back and breast feather THg concentrations are correlated for juvenile raptors.
- There is no difference in feather THg concentrations between sexes of juvenile raptors.
- Flyway and species both have an effect on feather THg concentrations in juvenile raptors.
  - Increased THg concentration in eastern compared to western North America corresponds to findings of other studies; however, the central flyway was not significantly different than the east flyway indicating that there is not a distinct gradient from west to east.
  - Trophic level differences among species have been found to impact significant differences in Hg concentrations[2].
- Long-term, large-scale data is useful at substantiating impacts of THg concentrations of migrating raptors.

**Future Directions:**

- Preliminary analyses have been performed with blood THg.
  - Blood THg concentrations have been found to correlate significantly with feather THg concentrations.
  - We are currently mitigating power issues in sample size across species and flyway.
- We predict that the same analyses will not hold up for adult raptors as their Hg exposure is more complex.
  - More clear patterns are likely to emerge between sex as females depurate chemicals into their eggs.
  - Adult raptors may be less opportunistic hunters than juveniles, possibly elucidating more clear patterns of trophic level differences across species.

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## Literature Cited

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