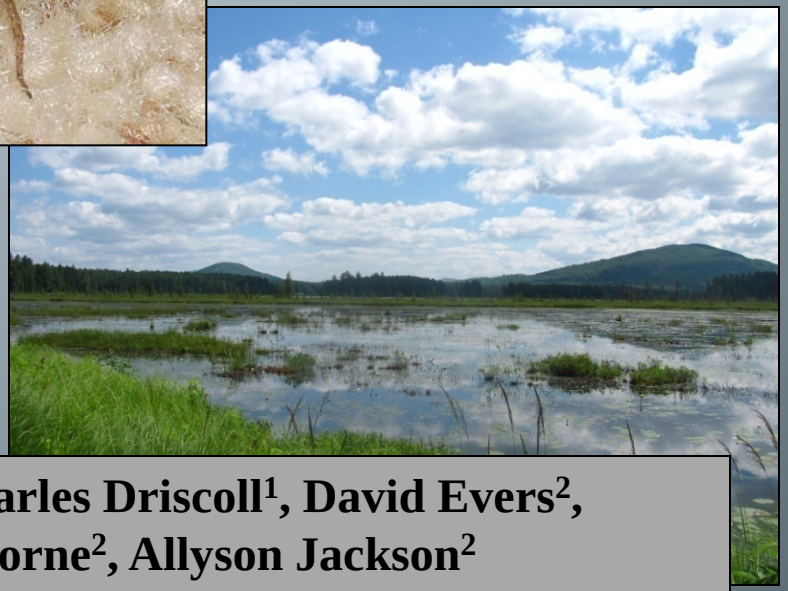
Mercury Bioaccumulation within Terrestrial Foodwebs in the Adirondack Park of New York State



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Appalachian Mountain Mercury Network

Partnering agencies and organizations to gain a better understanding of atmospheric deposition and impacts of pollution on forested ecosystems using thrushes and other songbirds as indicators

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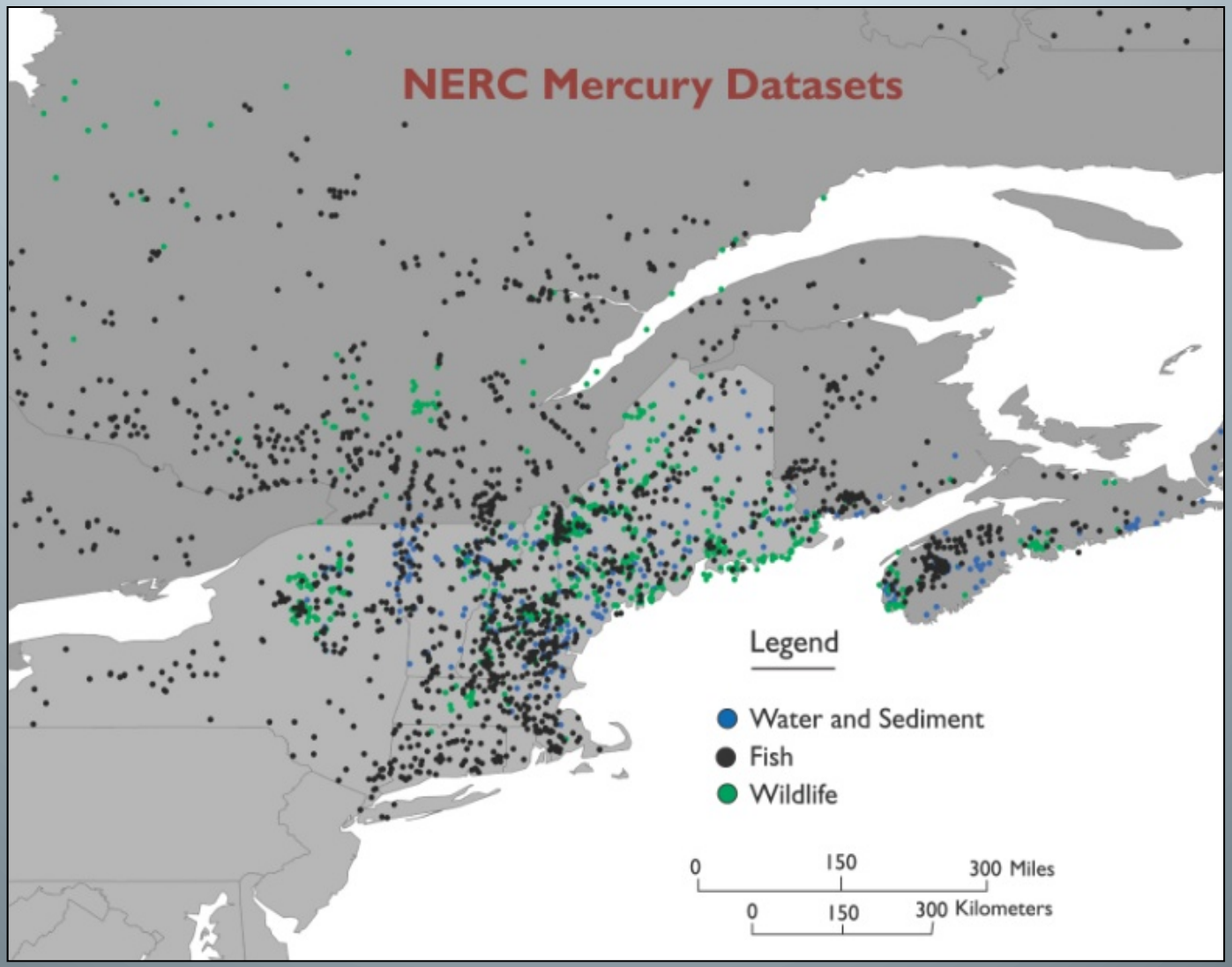
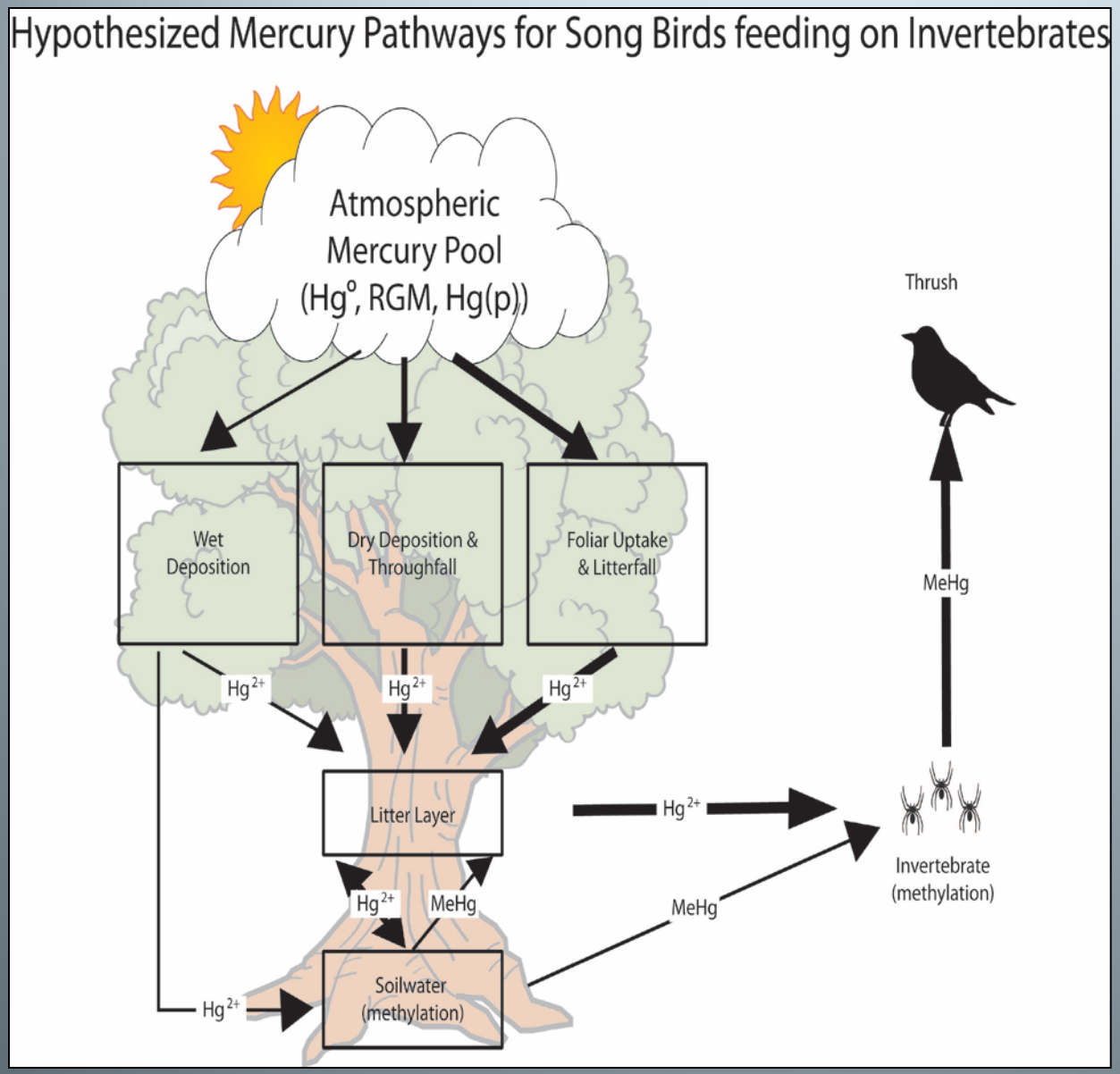
Wildlife Studies



Detrimental impacts have been documented in studies relating to amphibian and songbird communities in the Northeastern United States.
(Bank et al. 2005, 2006, 2007, Evers et al. 2005, Rimmer et al. 2005)

Pathways for Bioaccumulation



Seasonally, songbirds are able to reduce the concentrations of mercury in their bodies through feather growth and egg deposition

With continued ingestion of prey species high in mercury content, individuals may accumulate mercury faster than they can rid their bodies of it through natural processes

Indicator Species for Terrestrial Ecosystems

Red-eyed Vireo

Lincoln's Sparrow

Hermit Thrush

Palm Warbler

Insectivores are widespread across the landscape ~ necessary to understand the role that these species may represent in regards to the health of the surrounding environment

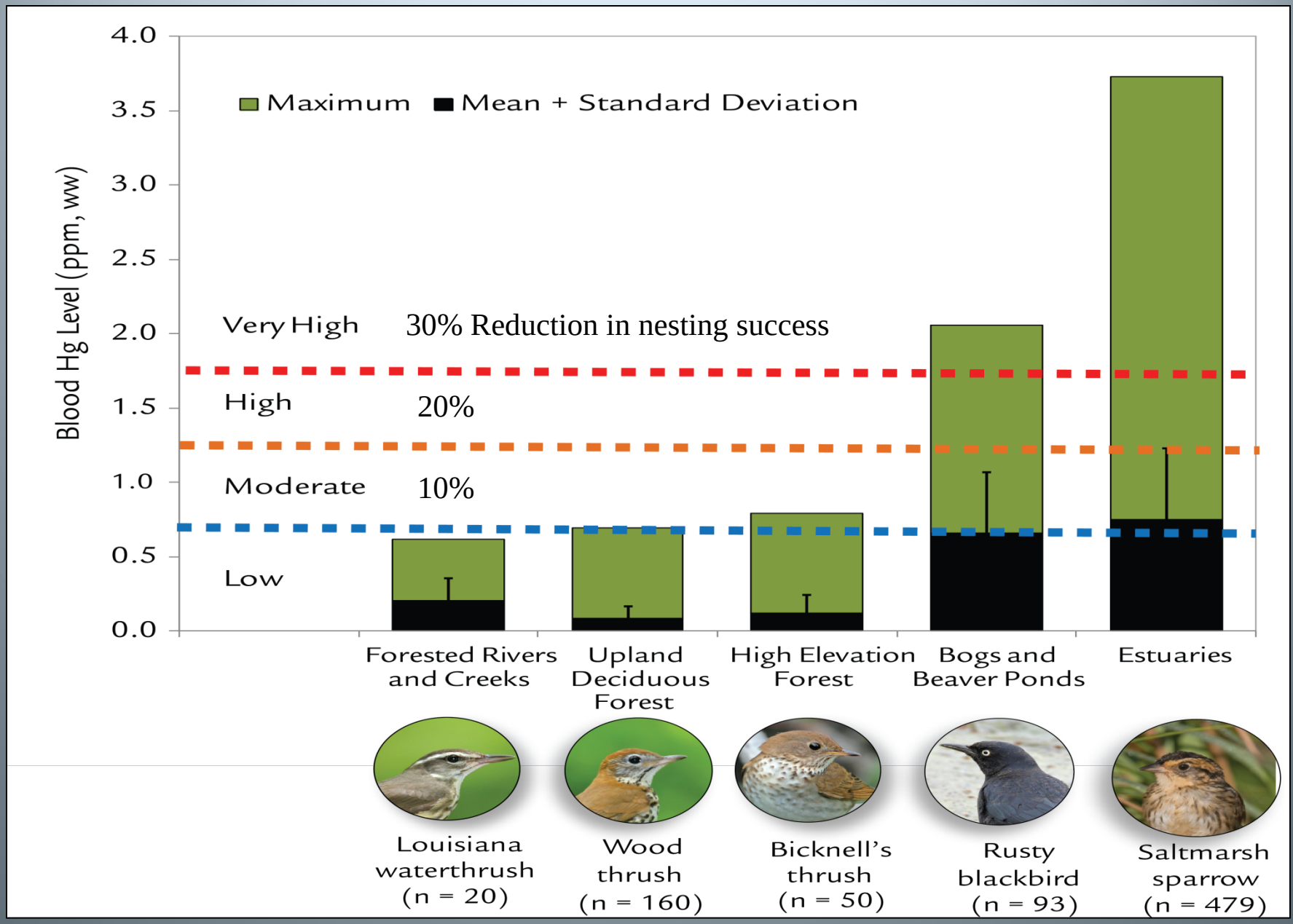
Indicator Species for Terrestrial Ecosystems

- Regional efforts conducted by BioDiversity Research Institute to assess the impacts of Hg on songbird species across 5 terrestrial ecosystems

- Each system has an indicator species that best represents the mercury risk in that particular habitat ~ identify at-risk species and sensitive habitats

Source: Hidden Risks, BRI 2011

Indicator Species for Terrestrial Ecosystems



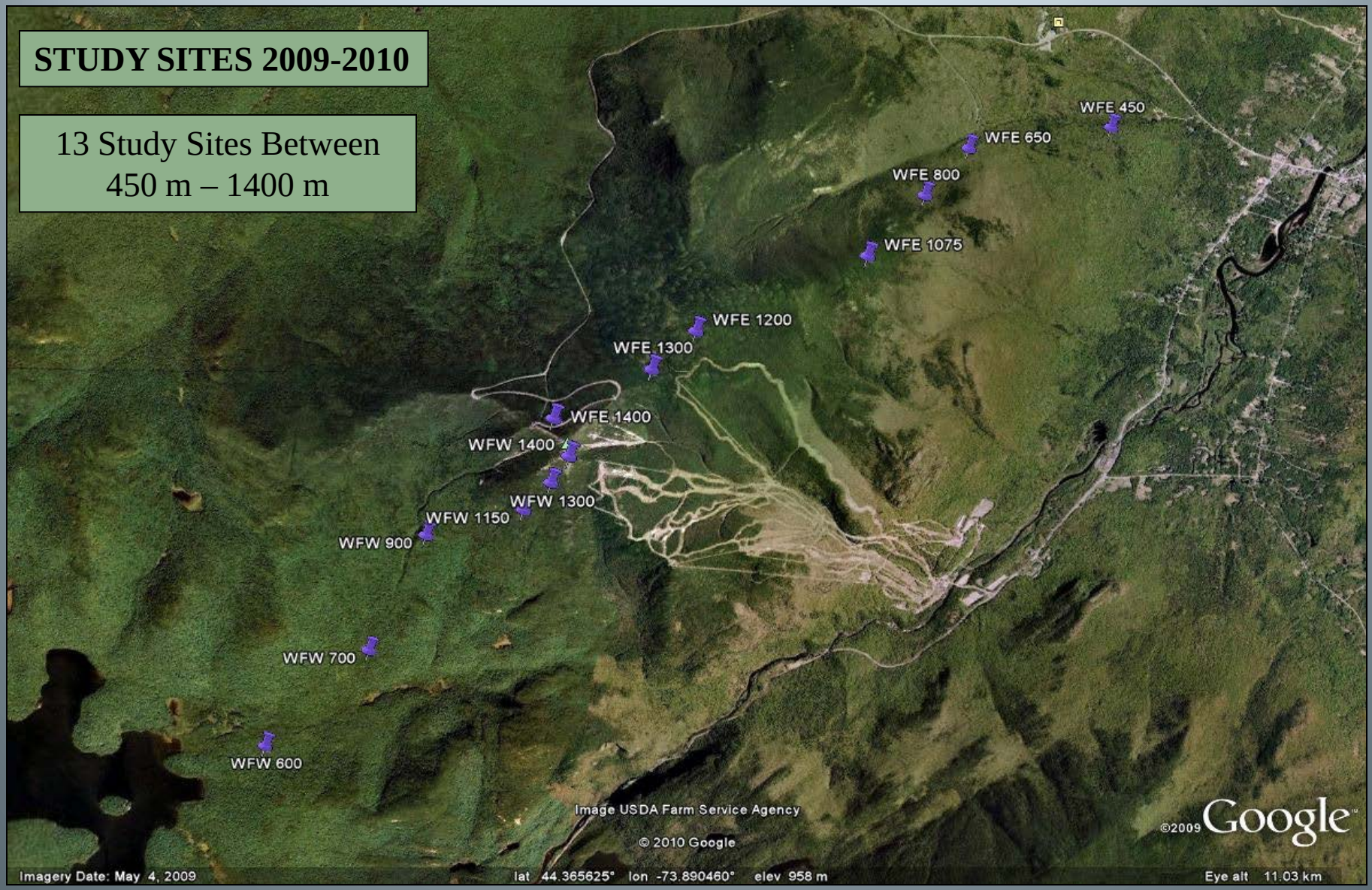
Source: Hidden Risks, BRI 2011

Methylmercury Bioaccumulation within Montane, Terrestrial Foodwebs

- Do mercury concentrations in songbirds and invertebrate, prey species change with respect to elevation, aspect and seasonal variation in high-elevation, terrestrial foodwebs on Whiteface Mountain?

- Mercury deposition 2-5x higher in high-elevation, boreal forests as compared to surrounding low-elevation, hardwood forests
~Miller et al. 2005

Methylmercury Bioaccumulation within Montane, Terrestrial Foodwebs



STUDY DESIGN

Bicknell's Thrush
HIGH ~ ALPINE ZONE ~ 1300 meters

Swainson's Thrush
MID ~ CONIFEROUS ~ 800 meters
Balsam Fir/Red Spruce/Paper Birch

Hermit Thrush
LOW ~ HARDWOOD ~ 450 meters
Beech/Birch/Maple

TEMPORAL PATTERNS

Early Summer (early -June)
Mid Summer (early-July)
Late Summer (early-August)

BIOTIC SAMPLES

Thrush Family
Invertebrates

ASPECT

East vs. West

Elevation Patterns – Mercury Exposure in Thrush Species
Whiteface Mountain: 2009 - 2010

Sharp-Shinned Hawk
2009 - 1.723 ppm
2010 – 1.121 ppm
Red-Tailed Hawk (Captive)
2011 - 0.041 ppm

Coniferous/ Alpine – High Elevation (0.089 ppm)

Bicknell's Thrush (0.094 ppm)

Swainson's Thrush (0.085 ppm)

Bicknell's Thrush (0.088 ppm)

Swainson's Thrush (0.120 ppm)

Hermit Thrush (0.107 ppm)

Coniferous – Mid Elevation (0.109 ppm)

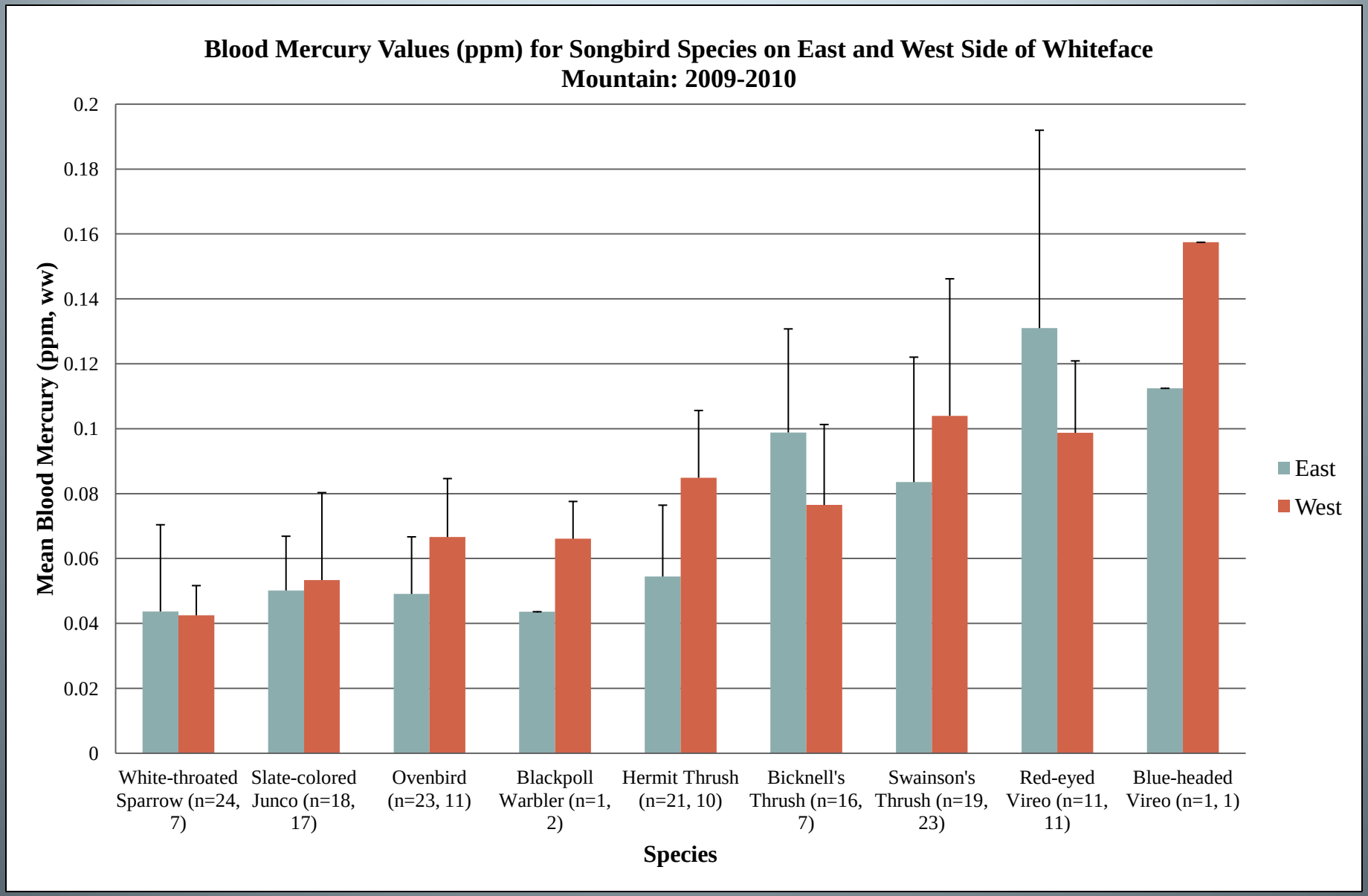
Hardwood – Low Elevation (0.068 ppm)

Hermit Thrush (0.063 ppm)

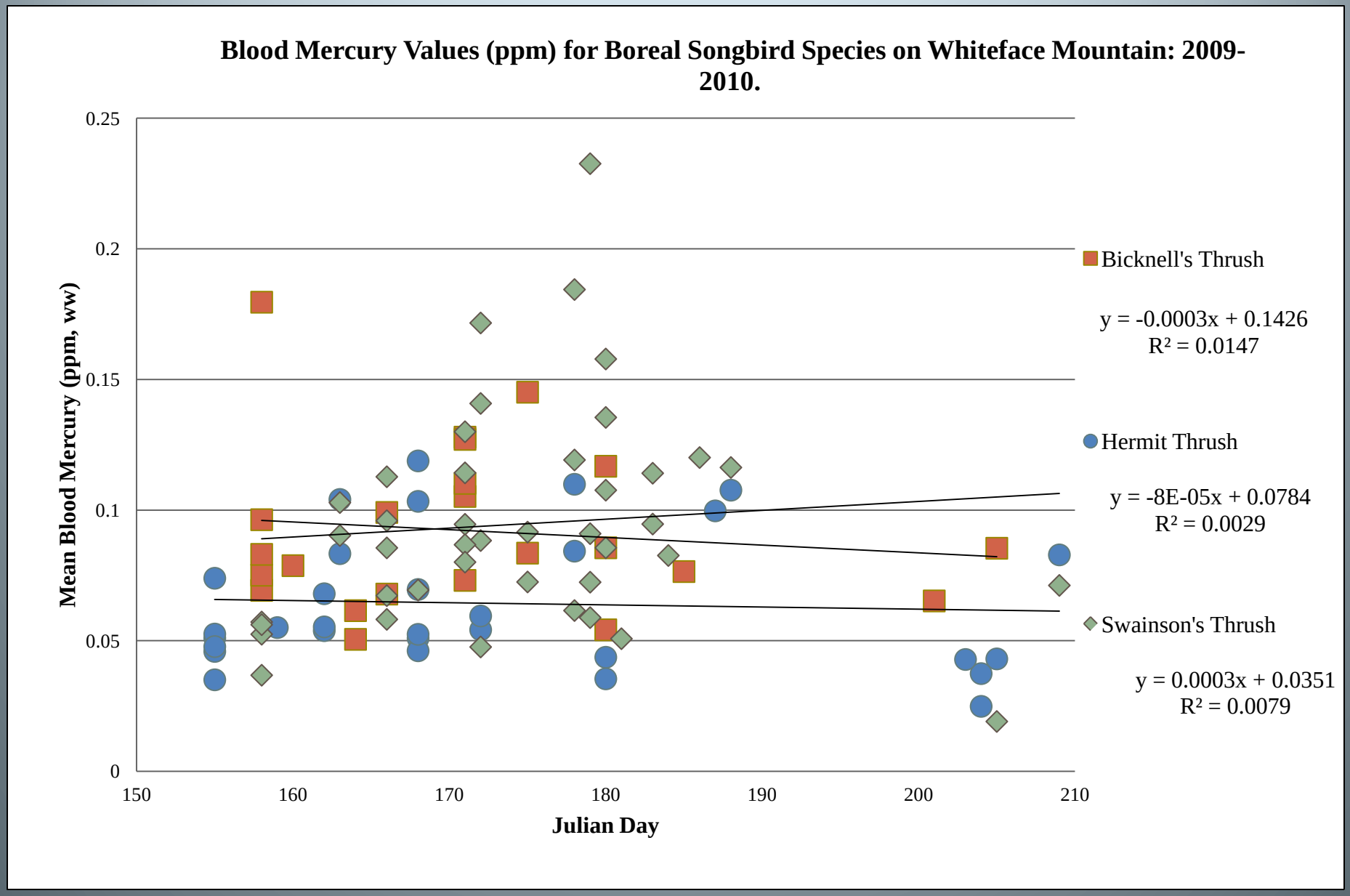
Swainson's Thrush (0.081 ppm)

Within-site Blood Hg Levels

Aspect Patterns- Mercury Exposure in Boreal Songbird Species: Mercury concentrations were higher for all species sampled on the West side of Whiteface mountain, with the exception of Red-eyed Vireo, Bicknell's Thrush and White-throated Sparrow.



Seasonal Patterns - Mercury Exposure in Boreal, Forest Species: Bicknell's and Hermit Thrush show a decrease in Hg concentrations during the field season, while Swainson's Thrush shows a slight increase.



Methylmercury Bioaccumulation within Sphagnum Bog and Northern Hardwood Forest Foodwebs

- How does mercury bioaccumulate from the base of the terrestrial food chain to top predator, songbird species?
- Do mercury concentrations in biota vary between *Sphagnum* bog and adjacent, northern hardwood forests due to differences in mercury cycling?
- Are there detectable seasonal and species-specific patterns within and between study sites?

Methylmercury Bioaccumulation within Sphagnum Bog and Northern Hardwood Forest Foodwebs

Study Sites – 2008, 2009, 2011

Spring Pond Bog
Massawepie Mire
Bloomingdale Bog
Madawaska Flow

Spatial Sampling

Sphagnum Bog vs Hardwood Forest

Temporal Pattern

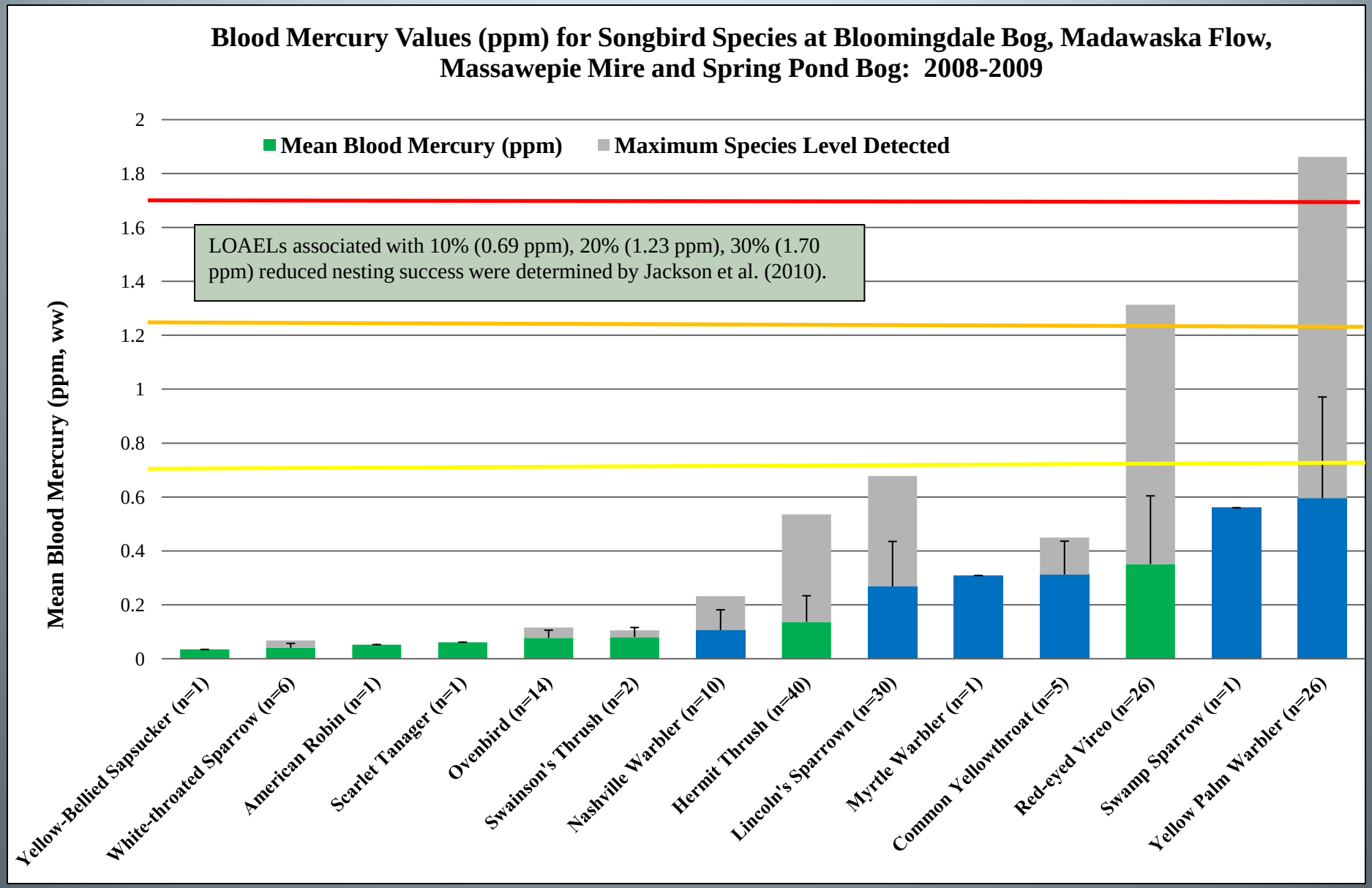
Early Season - Late May
Mid Season – Late June
Late season – Late July

Species Comparisons

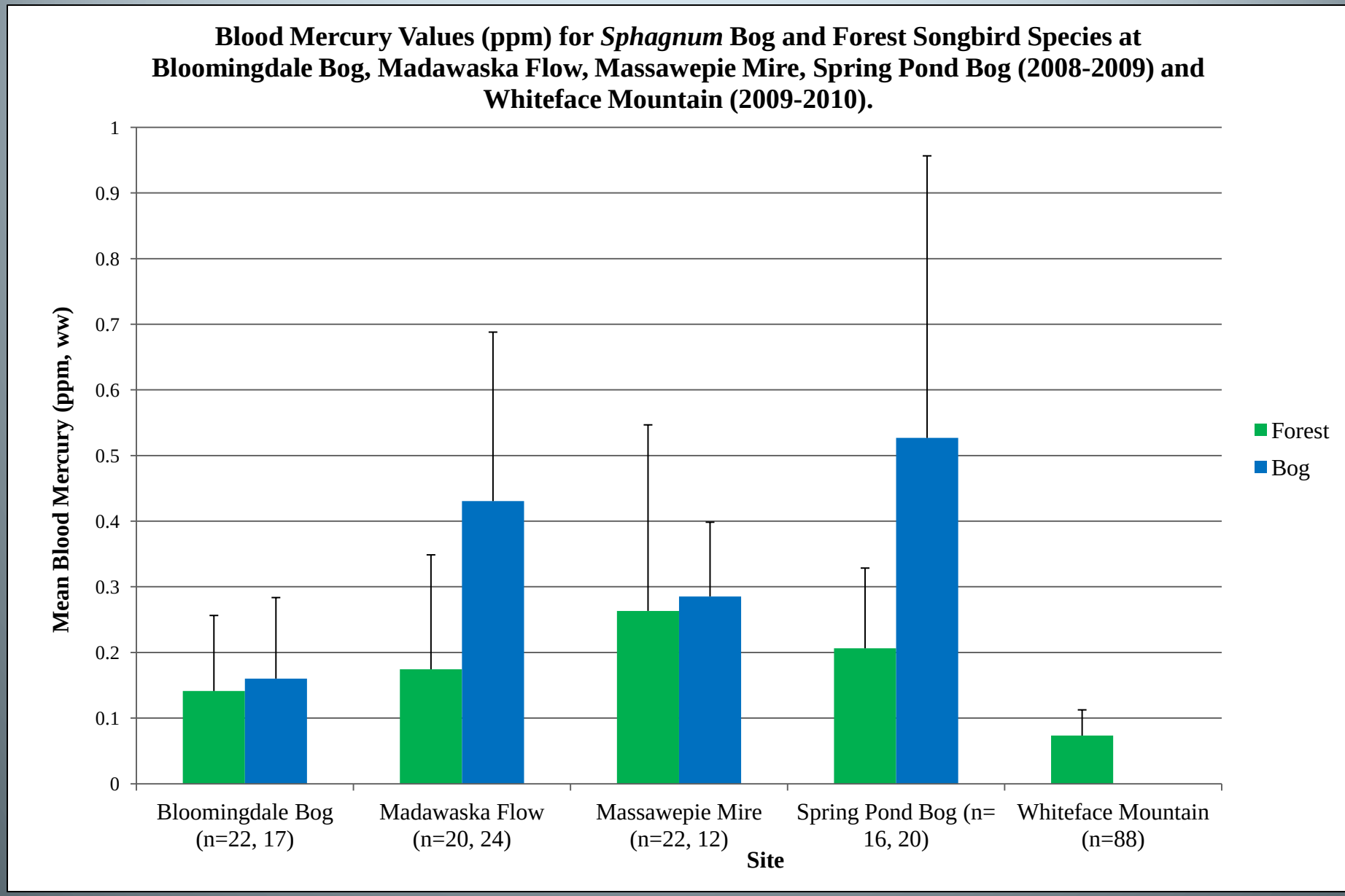
Bog Birds: Palm Warbler, Lincoln's Sparrow, Nashville Warbler

Forest Birds: Ovenbird, Hermit Thrush, and Red-eyed Vireo

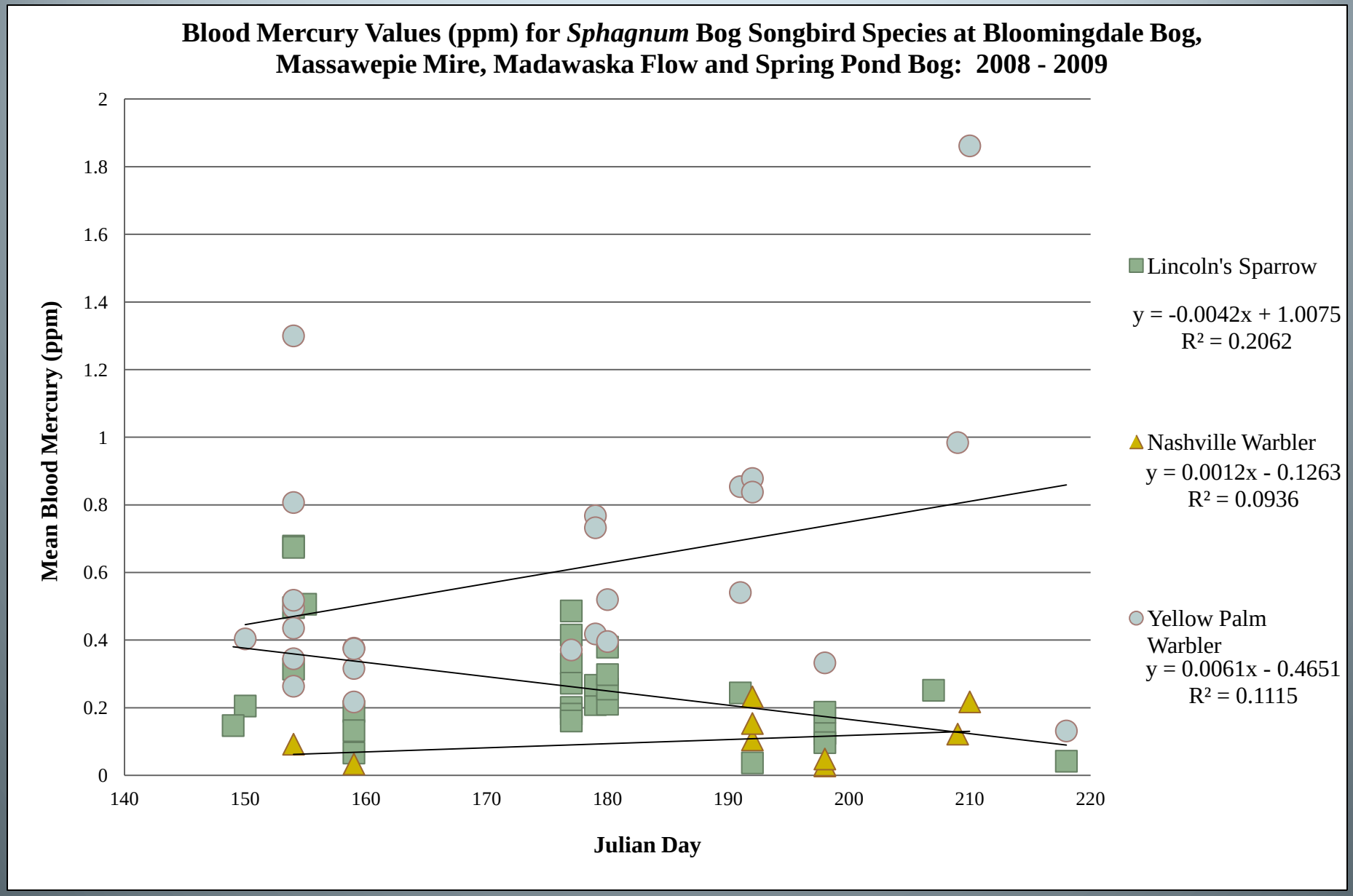
Breeding Songbirds: 2008-2009. Palm warblers and Red-eyed vireos had the highest Hg concentrations compared to other species. These species may be at higher risk to the impacts of Hg contamination than other associated bog and forest species.



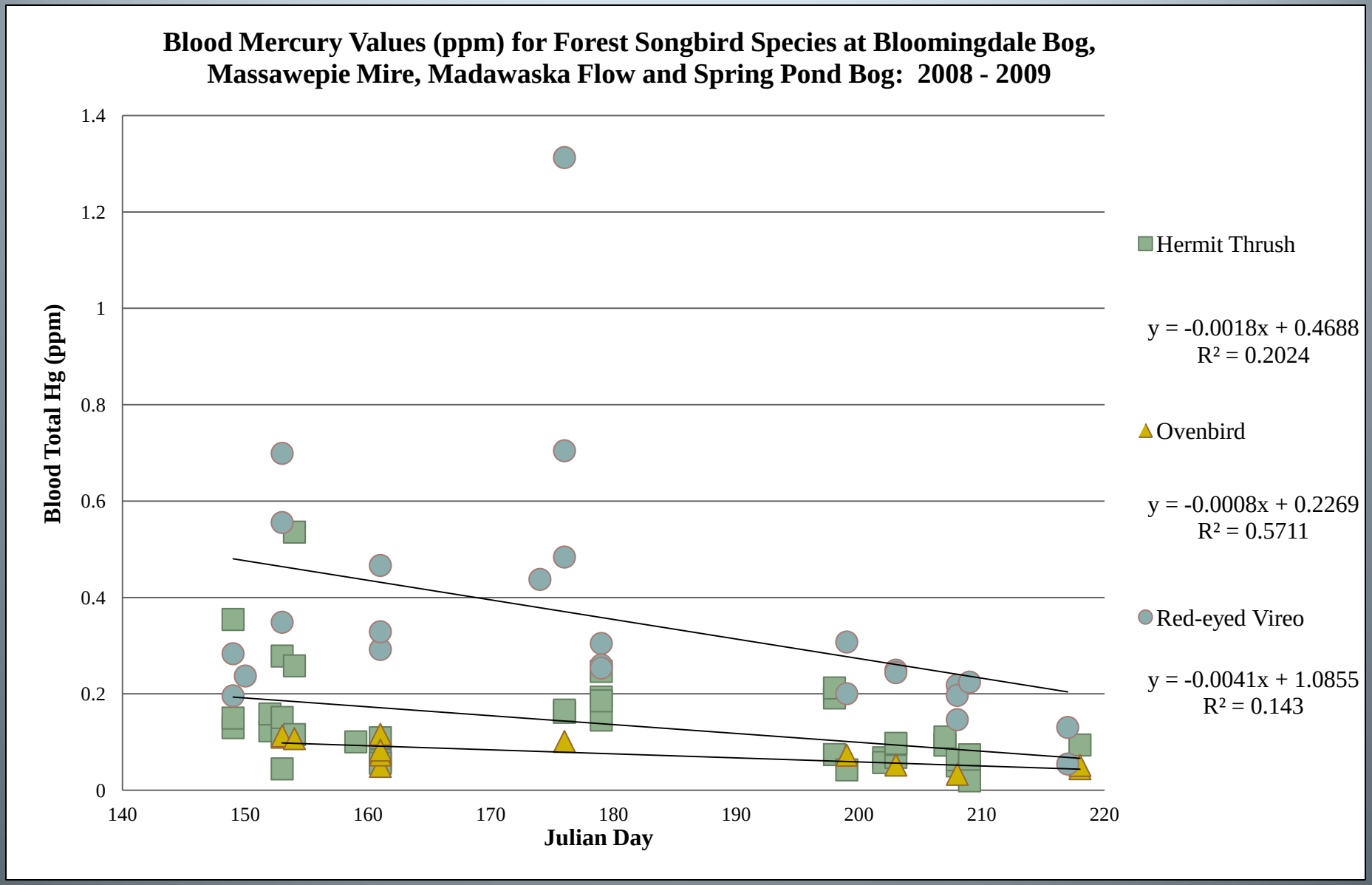
Mercury Exposure by Habitat Type: 2008-2010. At all sites, Bog species were elevated over adjacent, forest species. Hardwood forests adjacent to bog habitats have forest songbirds with higher mercury levels than those documented in the Whiteface study.



Seasonal Patterns - Mercury Exposure in Sphagnum Bog Species: Lincoln's Sparrow show a decrease in Hg concentrations during the field season, while Nashville and Palm Warbler show slight increases.



Seasonal Patterns - Mercury Exposure in Forest Species: All species show decreases in mercury concentrations during the field season, which may be linked to seasonal dietary shifts and mercury concentrations in selected prey species.

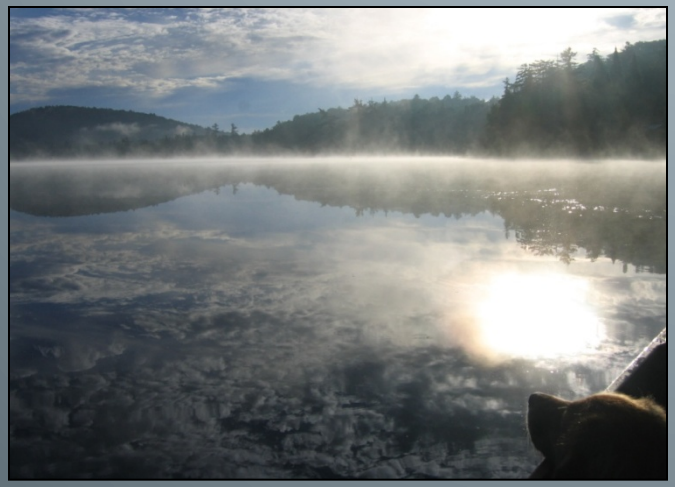


CONCLUSIONS

- **Montane ~** High elevation songbirds had elevated Hg levels as compared to low-elevation songbirds

- **Habitat Type ~** Bog-obligate songbirds had higher Hg levels than nearby forested species. Reinforced by BRI efforts relating high Hg levels to bog habitats

- **Species Patterns** ~All bog and forest sites identified certain species with higher Hg exposure – Yellow Palm Warbler and Red-eyed Vireo



- ***Sphagnum* Bog Influence ~** Elevated Hg levels in forest songbirds suggest that *Sphagnum* bog systems are driving high Hg levels in biota within the immediate and surrounding environment

- Further research needed to better characterize the dynamics of mercury cycling through sensitive, terrestrial foodwebs

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