

A photograph of a forest floor with many thin tree trunks and green undergrowth. The text is overlaid on the image.

Mercury as a threat to the Rusty Blackbird: What do we know and where are we going?

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07.05.2006 06:24



Mercury, mercury, everywhere is mercury

- What is the mercury issue all about?
- Where is it a problem?
- What species are at greatest risk?
- How can we track spatial and temporal trends?
- Is songbird diversity being impacted?

The next step: A national Hg monitoring plan

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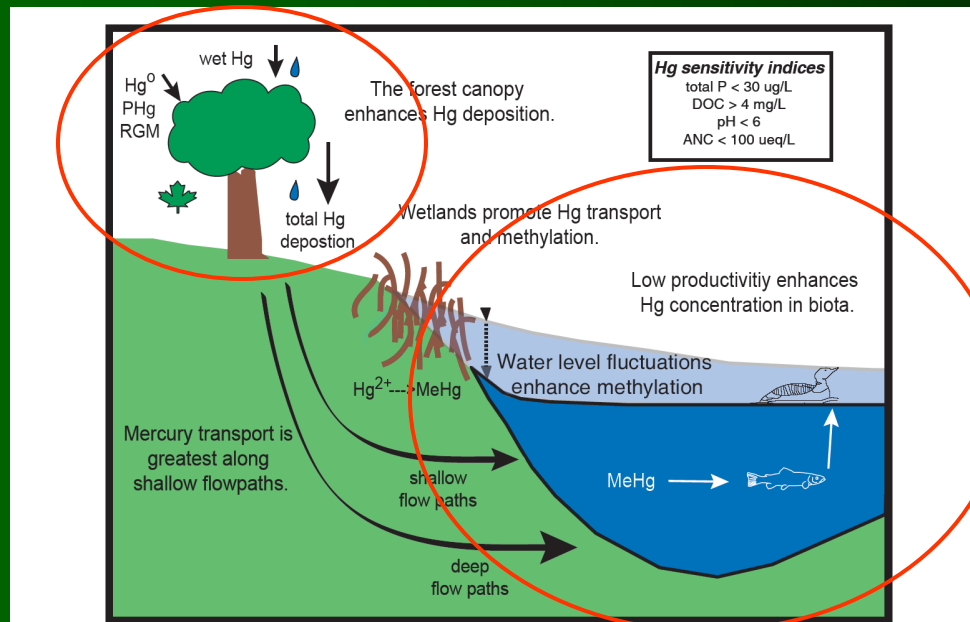
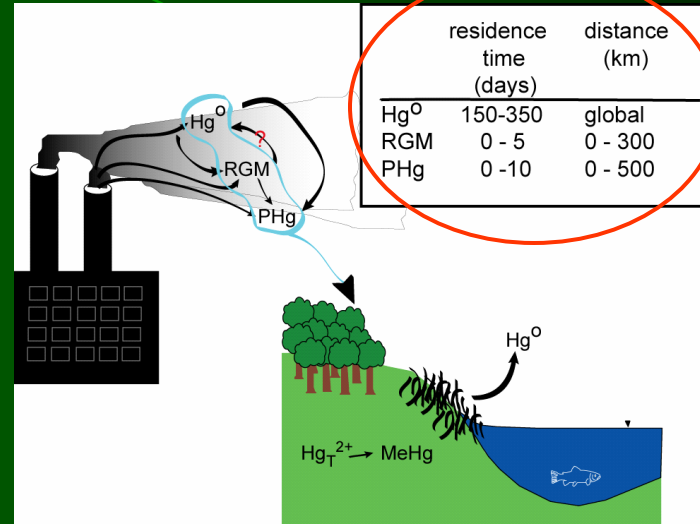
What is the mercury issue all about?

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Too much to cover, but here's a few generalities.....

- There is a finite amount of Hg on earth
- Anthropogenic activities remobilize Hg at rates higher than nature intended
- Current global rates are 3-5x higher than historically, some areas are >15x higher
- Mercury trends in biota are somewhat stable are in some places declining in the Northeast, while increasing in the Arctic (doubling in the past decade in murre eggs; Braune et al. 2006)
- Mercury is generally released through air emissions and effluents into the water
- These releases are of a nontoxic inorganic form....bacteria can convert it into methylmercury.
- Methylmercury is one of the most toxic substances on earth

The mercury cycle is complicated

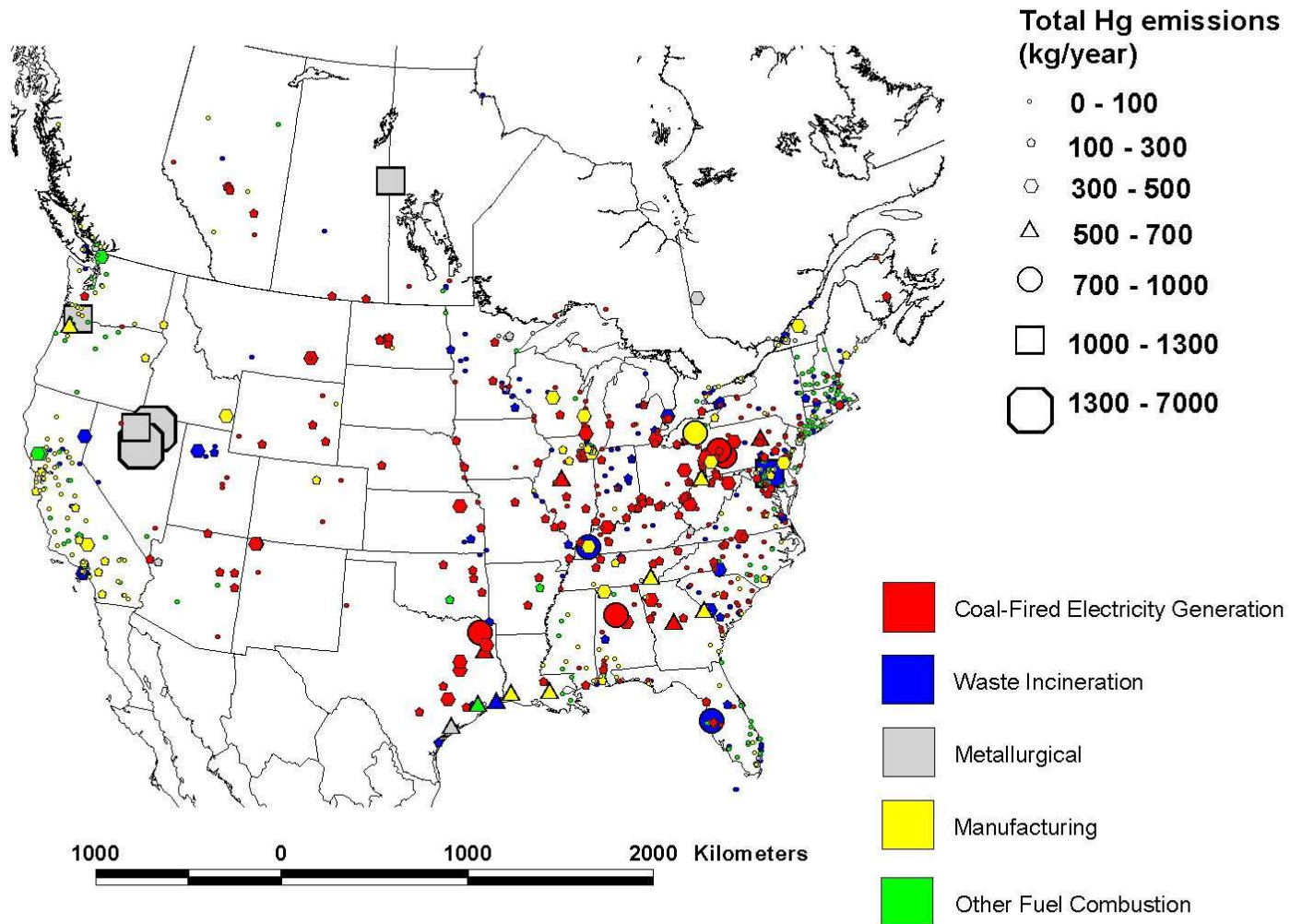


A photograph of a forest floor. The foreground is covered in dense green vegetation, including ferns and other leafy plants. The ground is uneven, with some rocks visible. In the background, there are many tall, thin trees with green foliage, creating a dense canopy. Sunlight filters through the trees, creating dappled light on the forest floor.

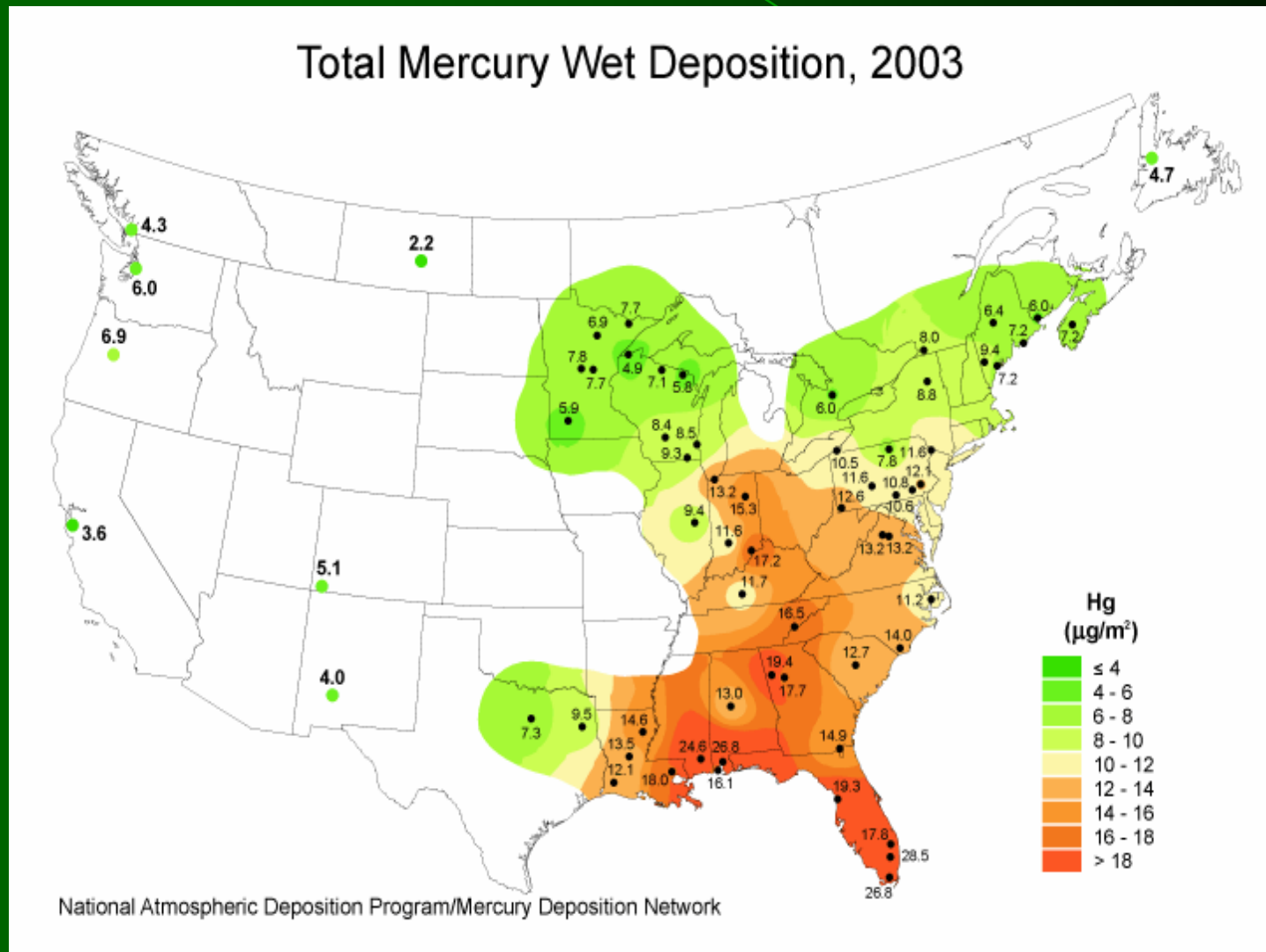
Where is it a problem?

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Current Hg emissions: magnitude and source type



Air Hg monitoring stations (actual measurements with spatial analysis based on kriging)



Air Hg deposition models and areas of deposition concern

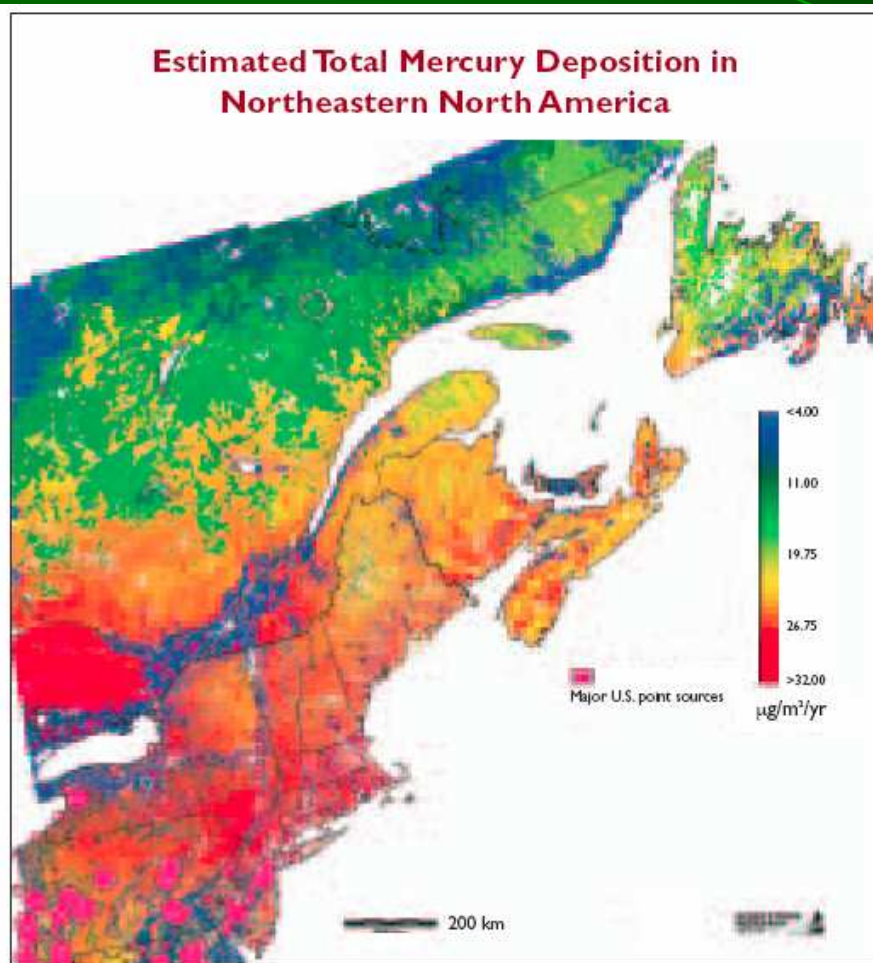
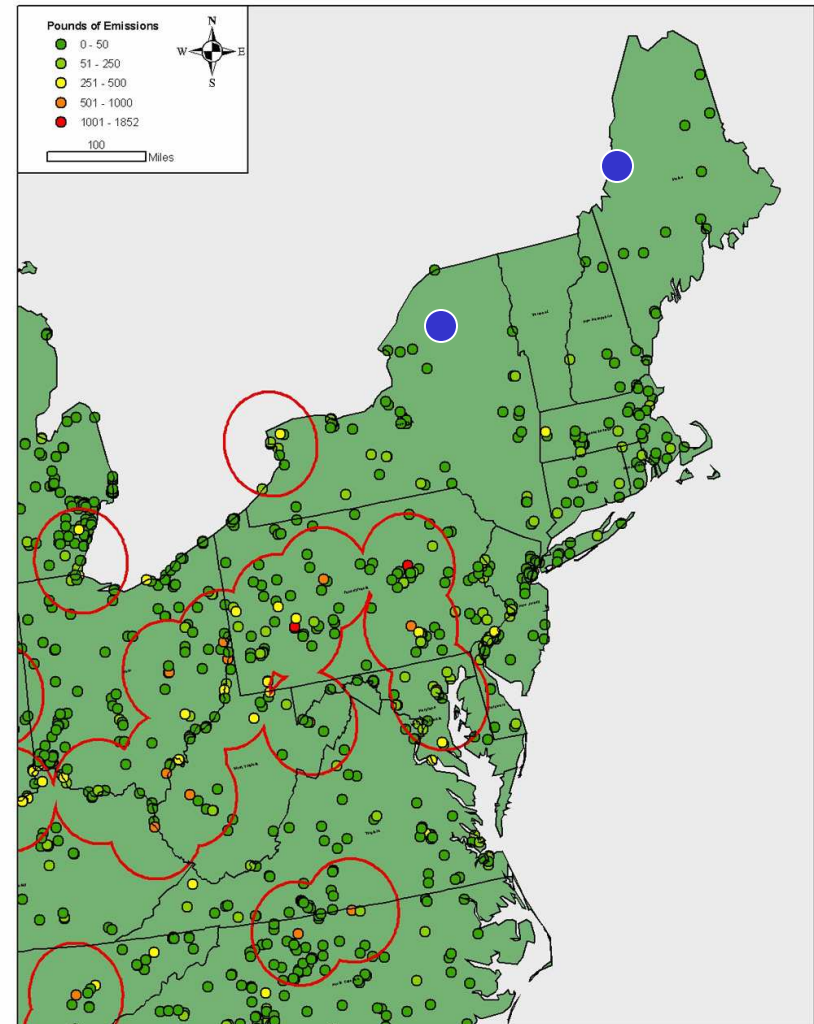


Figure 4: Total mercury deposition based on a new model intended to better depict dry deposition. The model does not fully incorporate the effects of large point sources in the region and those areas are masked in pink.



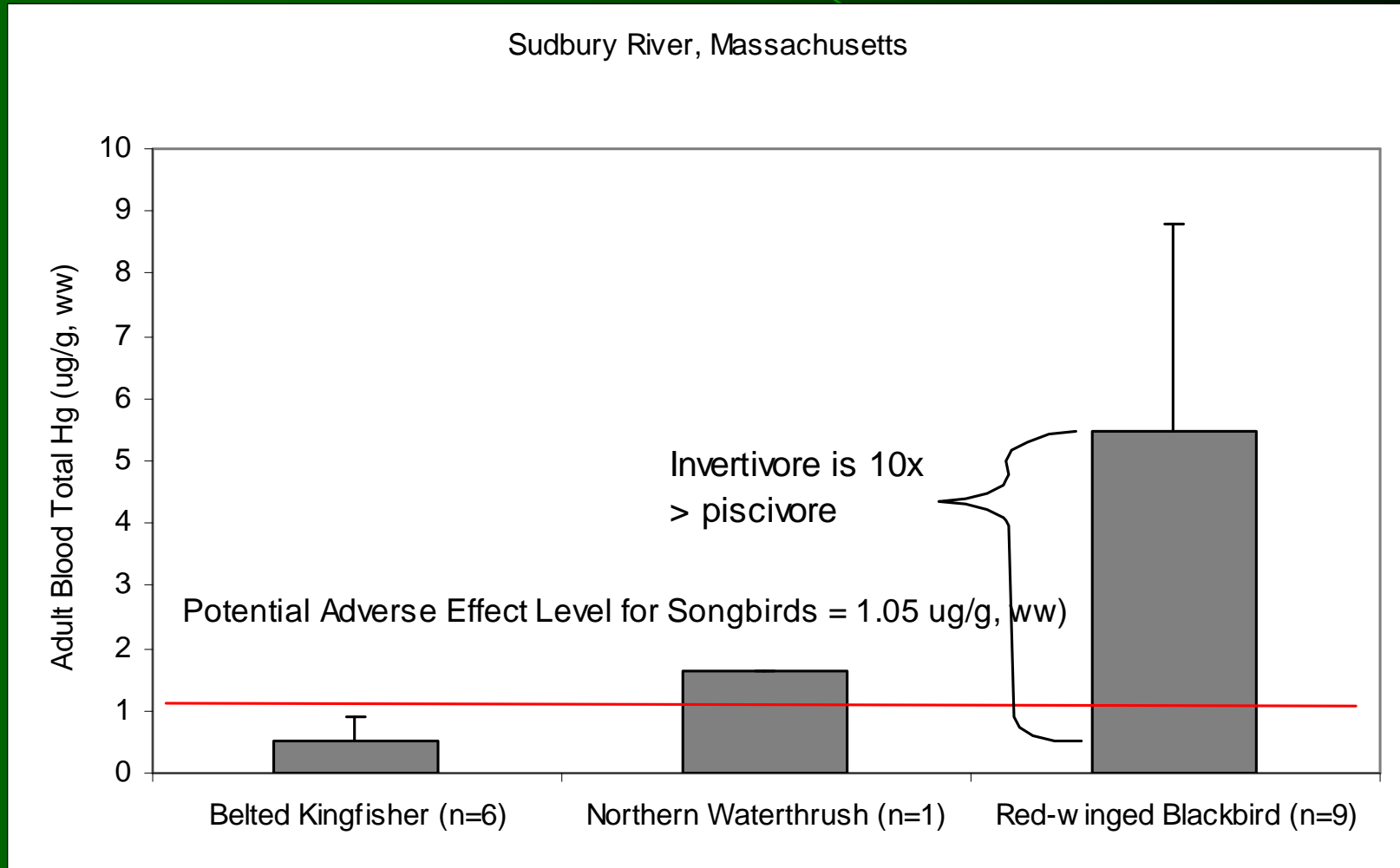
A photograph of a forest floor with many thin tree trunks and dense green undergrowth. The scene is a sun-dappled forest with numerous slender, light-colored tree trunks rising from a thick carpet of green ferns and other low-lying plants. Sunlight filters through the canopy, creating bright patches on the forest floor.

What species are at greatest risk?

Why invertivores vs. piscivores?

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Wetland-foraging invertivores have Hg levels > some piscivores



Different stories
told by different...

Location

Age

Season

Habitats

Body size

Foraging guilds

Figure 11: Mercury in Birds Across the Landscape

Many bird species serve as good indicators of the availability of methylmercury across the landscape. Pictured are preferred indicator species.

Fish-eating birds



Ecosystem:
Natural lake
Indicator:
Common loon
Mercury levels:
0.1 - 8.6 ppm



Ecosystem:
Small river
Indicator:
Common merganser
Mercury levels:
0.7 - 2.4 ppm



Ecosystem:
Reservoir
Indicator:
Bald eagle*
Mercury levels:
0.1 - 1.2 ppm



Ecosystem:
Large river
Indicator:
Belted kingfisher
Mercury levels:
0.1 - 4.6 ppm

*** Note:**
Mercury concentrations are in adult blood, except for the bald eagle and common tern which are in juvenile blood.



Ecosystem:
Nearshore marine
Indicator:
Common tern*
Mercury levels:
0.1 - 1.0 ppm



Ecosystem:
Estuary
Indicator:
Saltmarsh sharp-tailed sparrow
Mercury levels:
0.20 - 1.70 ppm

Insect-eating birds



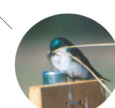
Ecosystem:
High elevation forest
Indicator:
Bicknell's thrush
Mercury levels:
0.10 - 0.80 ppm



Ecosystem:
Riverine forested wetland
Indicator:
Northern waterthrush
Mercury levels:
0.30 - 1.60 ppm



Ecosystem:
Upland forest
Indicator:
Wood thrush
Mercury levels:
0.02 - 0.14 ppm

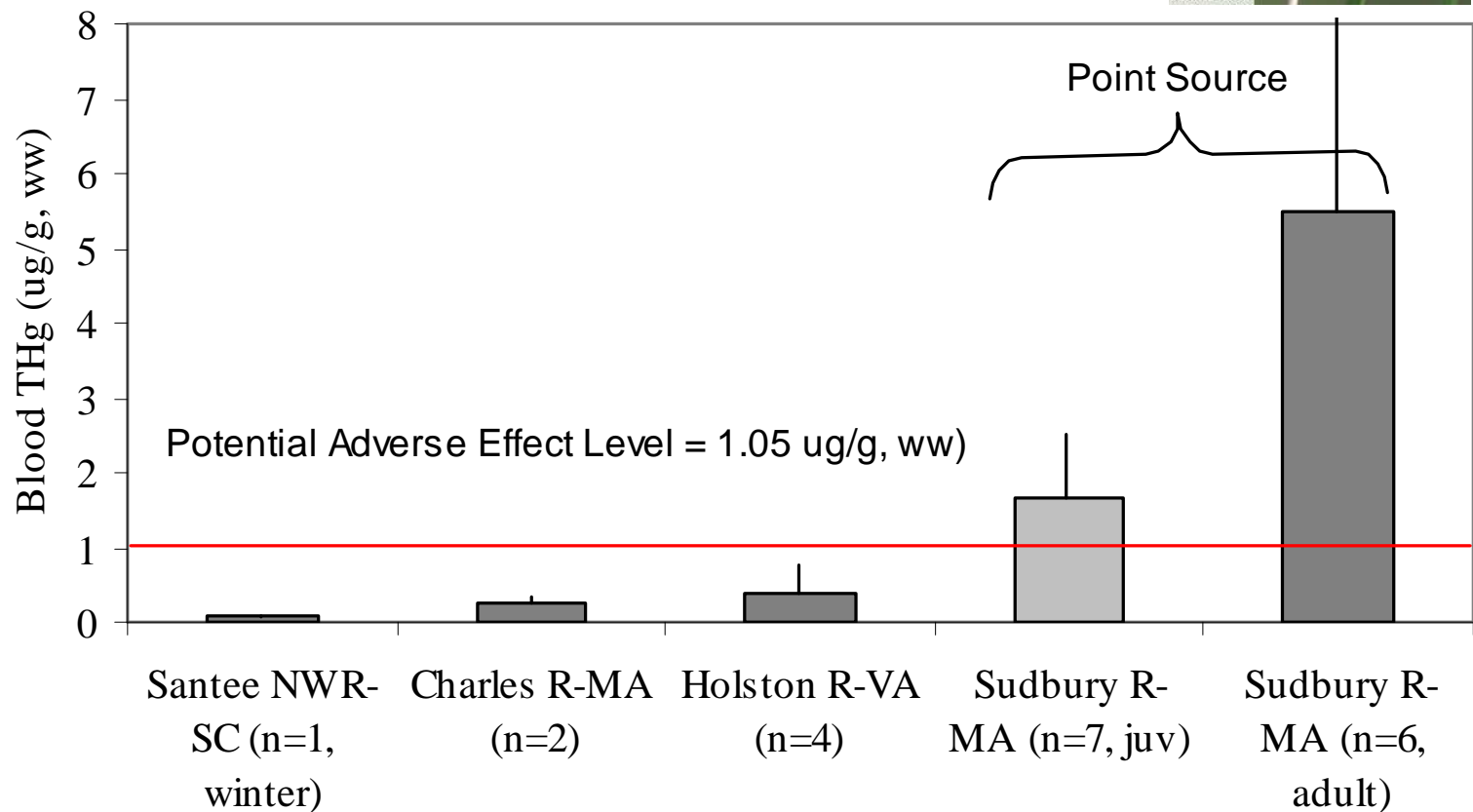


Ecosystem:
Emergent wetland
Indicator:
Tree swallow
Mercury levels:
0.10 - 1.00 ppm

Location and age matters for high risk invertivores



Red-winged Blackbird

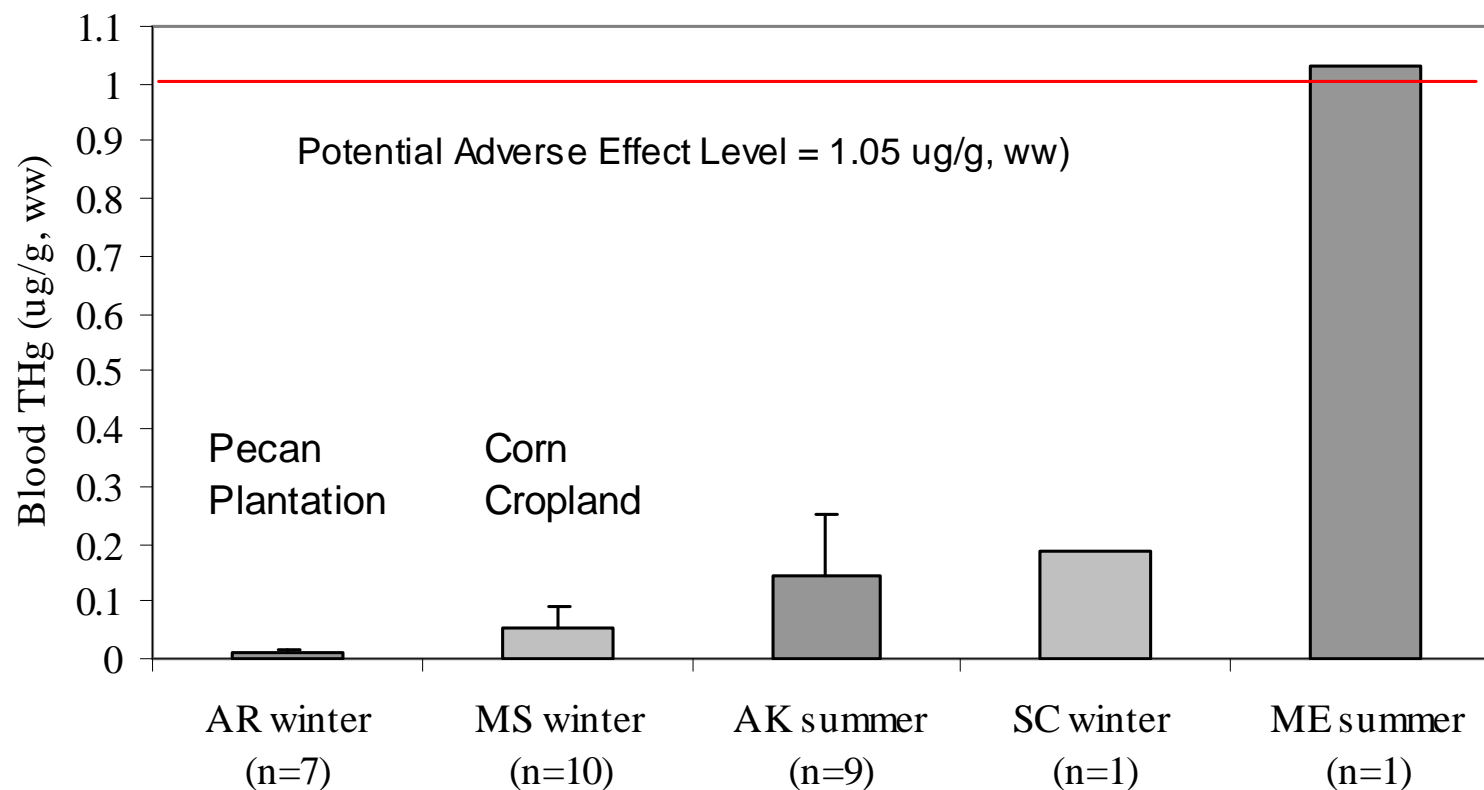


Location and season likely matters



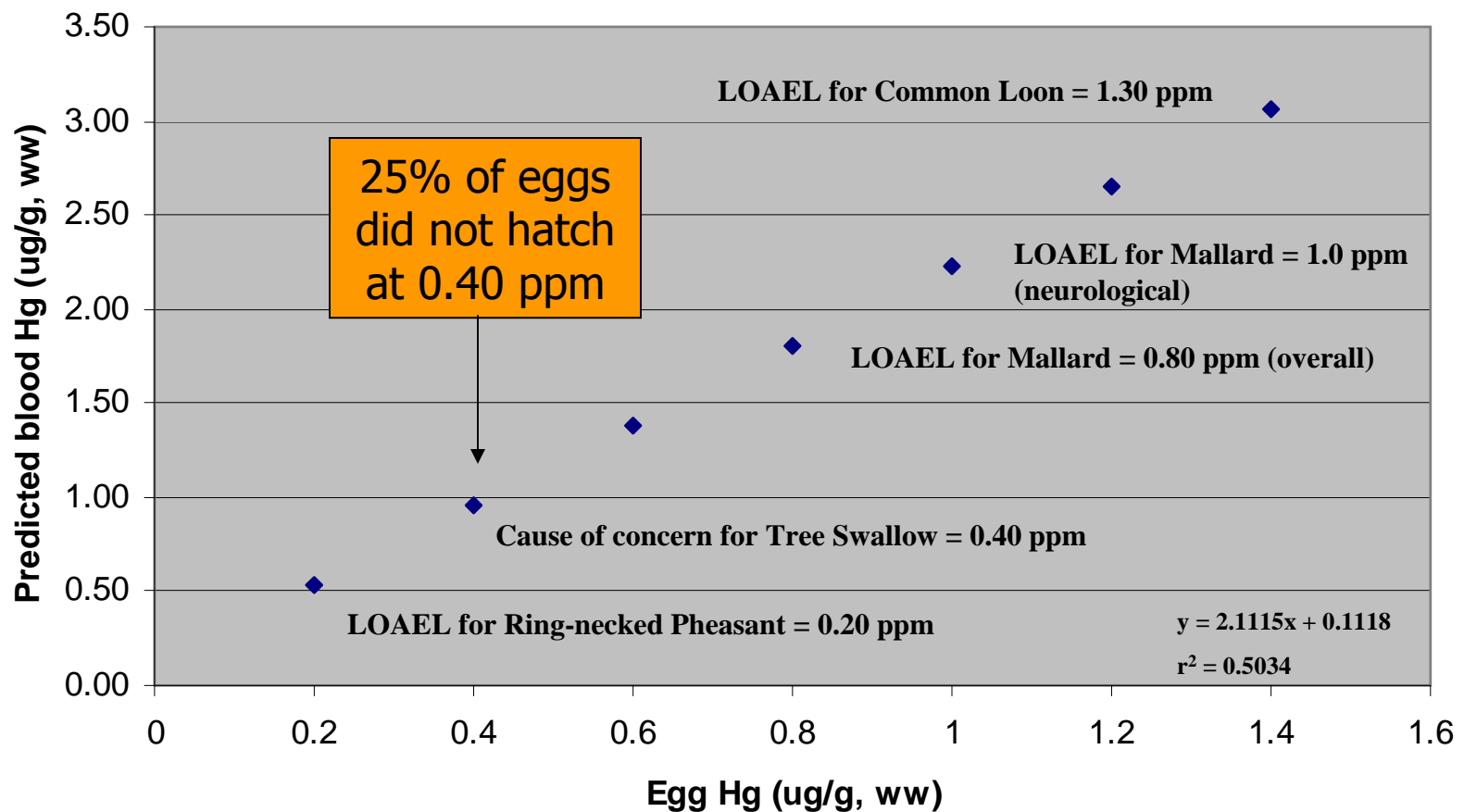
Rusty Blackbird

Atm. Dep.

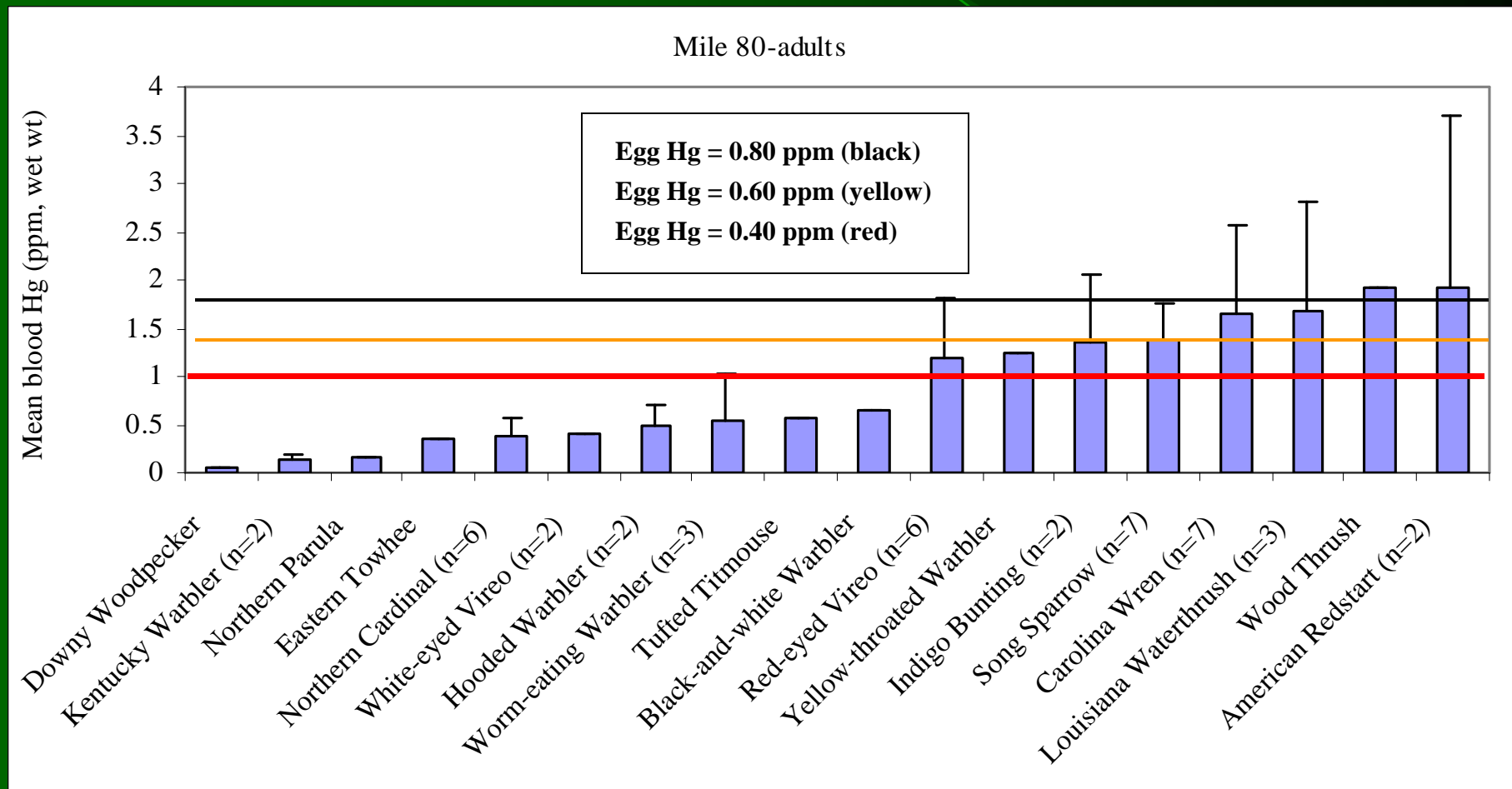


Sensitivities to Hg vary among avian species

(based on several studies including those by G. Heinz, Patuxent Wildlife Research Center)



Songbird blood Hg levels from a river with a 35-year old point source in western Virginia



Invertivores at Risk (species known to have elevated levels with individual or population level impacts)

River Floodplains - Louisiana Waterthrush

Estuaries (East) - Saltmarsh Sharp-tailed Sparrow

Estuaries (West) – California Clapper Rail

Bog/beaver pond wetlands - Rusty Blackbird

Scrub-shrub wetlands – Northern Waterthrush

Montane areas – Bicknell's Thrush

Northern Hardwoods – Wood Thrush



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Expected Risk Profile to MeHg availability: Criteria

RANK	1	2	3	4	5
Forage Guild	Plant/seed/ fruit	Omnivore	Aerial insectivore	Gleaner (upper canopy water's edge add 0.5 pt)	Spider specialist
Body Size	<10g	10-20g	20-30g	30-40g	>40g
Breeding Habitat	Upland grassland (Shrubland add 0.5 pt)	Upland forest (montane add 0.5 pt)	Estuary	Freshwater wetland (forest, shrub, emergent)	Bog
Winter area	Great Plains	Southwest US and northern US	Southeast US and neotropical	Caribbean neotropical	Paleotropical

Add 4 points if a Hg source with ~200 kg/year is within 50 km

Expected Risk Profile to MeHg availability: Ranking (potential range of 4 to 20 points)

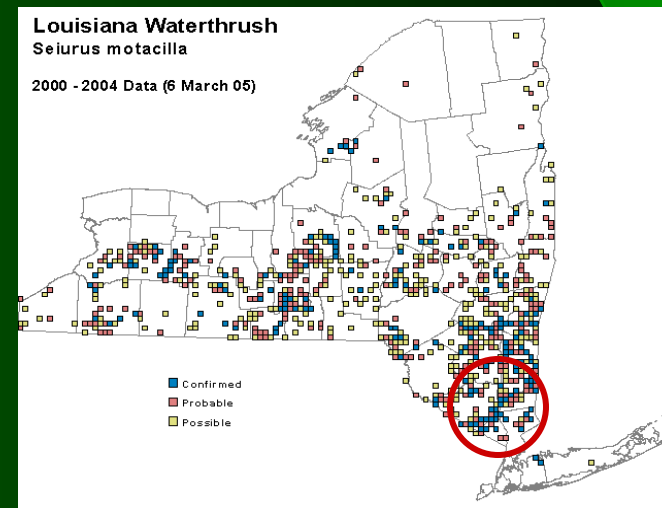
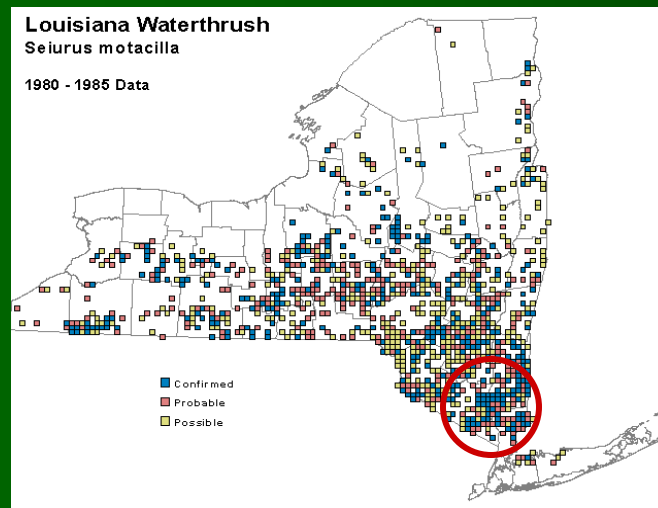
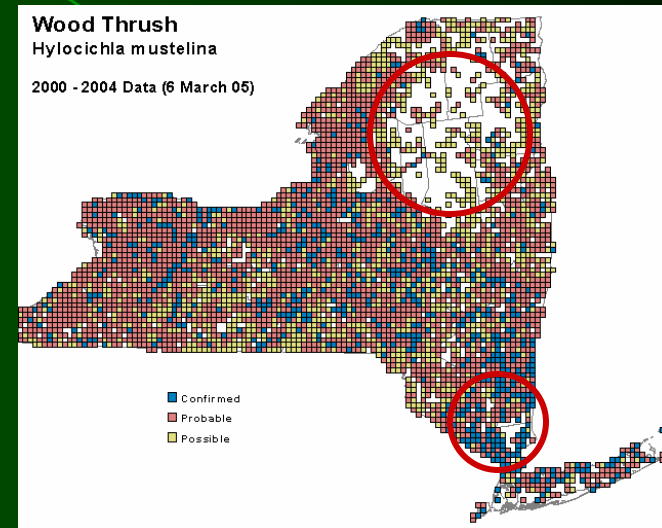
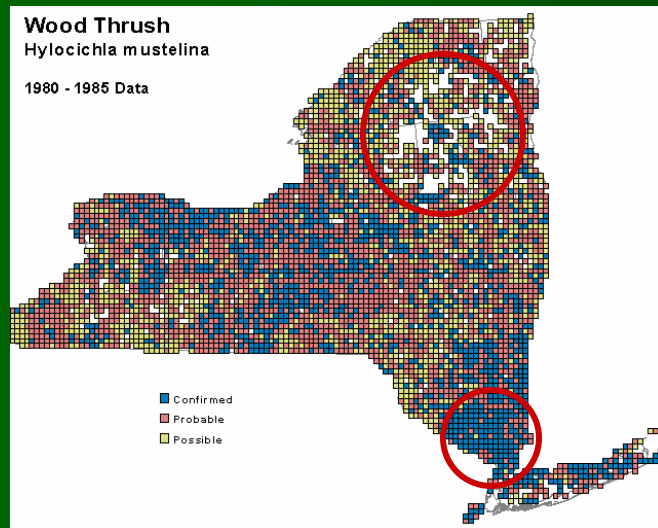
	<p>Species (those underlined have dedicated studies)</p> <p>Rank based on actual data in Black</p> <p>Rank based on estimates in Yellow</p>
High Risk (Rank >13)	<p>16: VIRA, SORA, YERA, GRAJ</p> <p>15: <u>CARW, LOWA, RWBL, RUBL</u>, YWAG</p> <p>14: OSFL, EAPH, <u>NOWA</u>, AMRE, PROW, <u>SSTS, SESP</u></p>
Moderate Risk (Rank 10-13)	<p>13: <u>WOTH, BITH, SWTH, REVI</u>, YTWA, INBU, <u>NSTS</u></p> <p>12: ACFL, VEER, LISP, <u>SOSP</u>, SWSP</p> <p>11: RBWO, <u>TRES</u>, BARS, HETH</p> <p>10: WBNU, HOWA, BLPW, WEWA</p>
Low Risk (Rank < 10)	<p>9: AMRO, TUTI, WEVI, YEWA, BAWA, EATO</p> <p>8: NOPA, KEWA, COYE, NOCA</p> <p><8: DOWO, BCCH, GRCA, CEDW, AMGO</p>



Is songbird diversity and population
viability being impacted by Hg and
other air pollutants?

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Spatial trends over a 20 year period for breeding songbirds



Data from the NY Breeding Bird Atlas



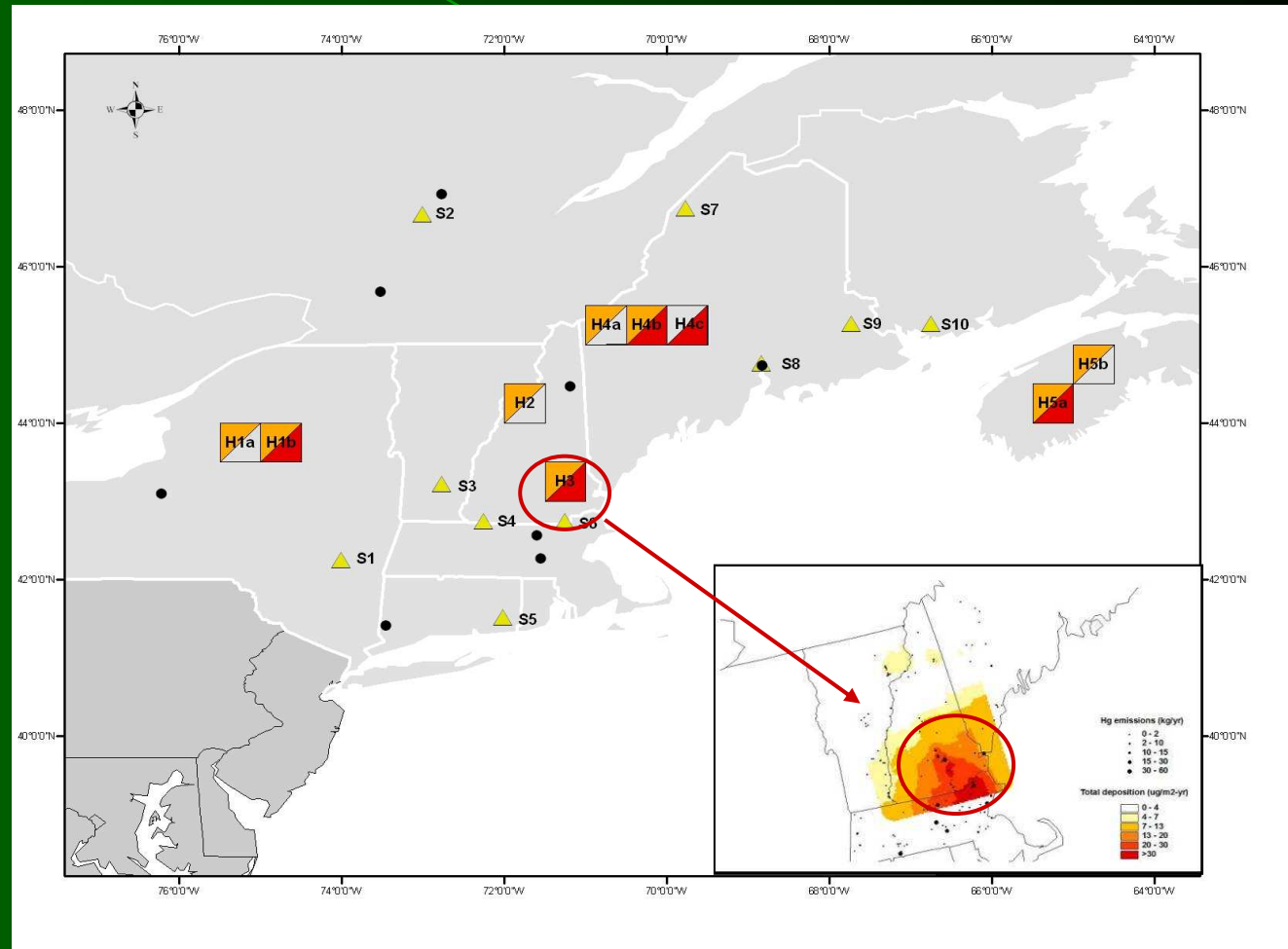
How can we track spatial and temporal trends

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Biological Hg hotspots (based on freshwater piscivores)

Summary

- Perch-loon based
- 5 hotspots
- Area = 22,500 km²
- 10 areas of concern
- Significant finding as the premise of the current US EPA Cap-and-Trade Rule is that hotspots can not be created



Biological Mercury Hotspots (based on invertivores)

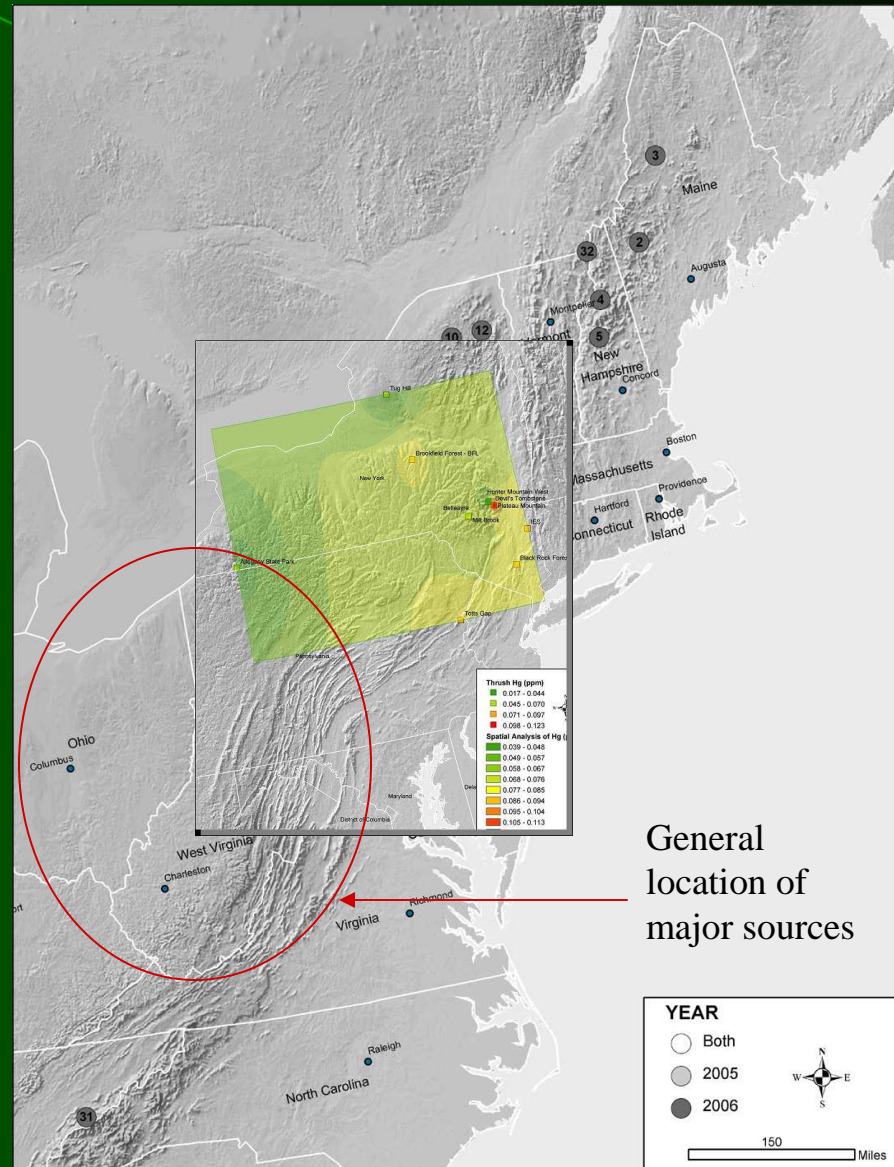
Joint TNC-BRI Project

Two interests:

1. Develop spatial connectivity between major sources and deposition
2. Test hypothesis that synergy of high MeHg and low Ca availability in acidic areas negatively impacts songbird populations

2005-2006 Efforts

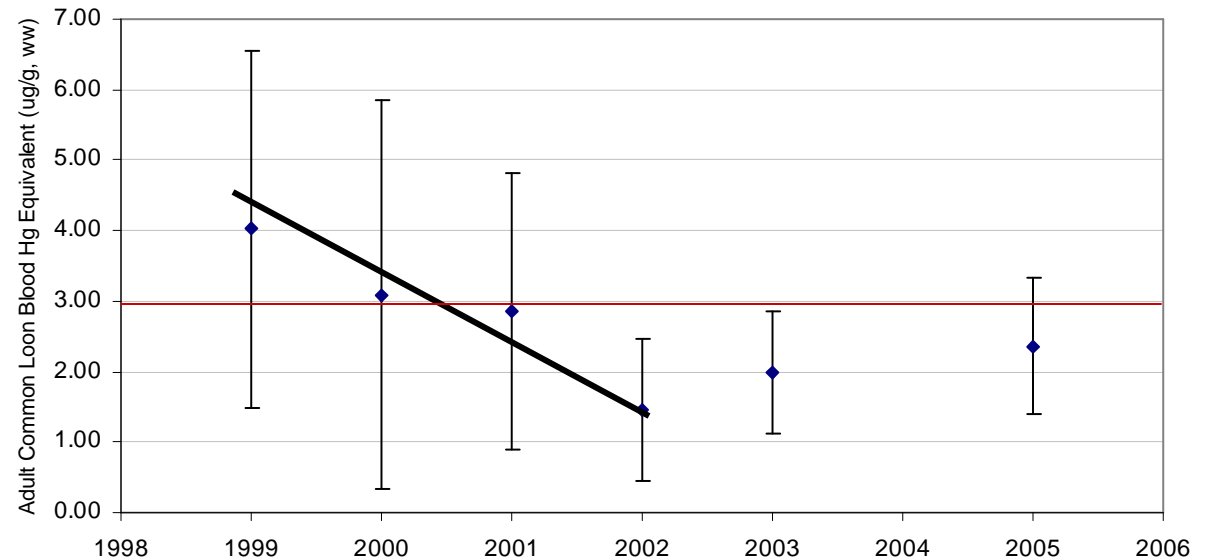
32 sampling stations for Hg and Ca: birds, invertebrates, soil



Demonstration of rapid recovery in biotic Hg levels in New Hampshire



- Area water chemistry and watershed variables do not indicate > normal methylation (i.e., area similar to control)
- Based on 52 individuals on 10 lakes
- 3 ppm (ww) is LOAEL



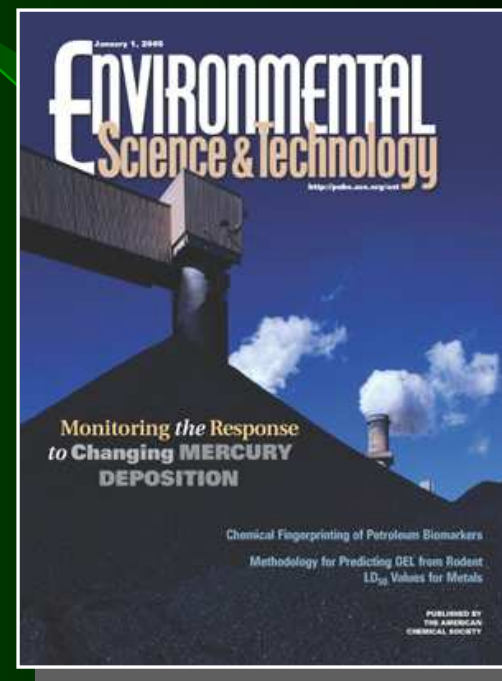
~7,000 lbs of Hg
emitted w/n 100
miles upwind

~6,600 lbs of Hg
removed locally
from 1999-2001

??

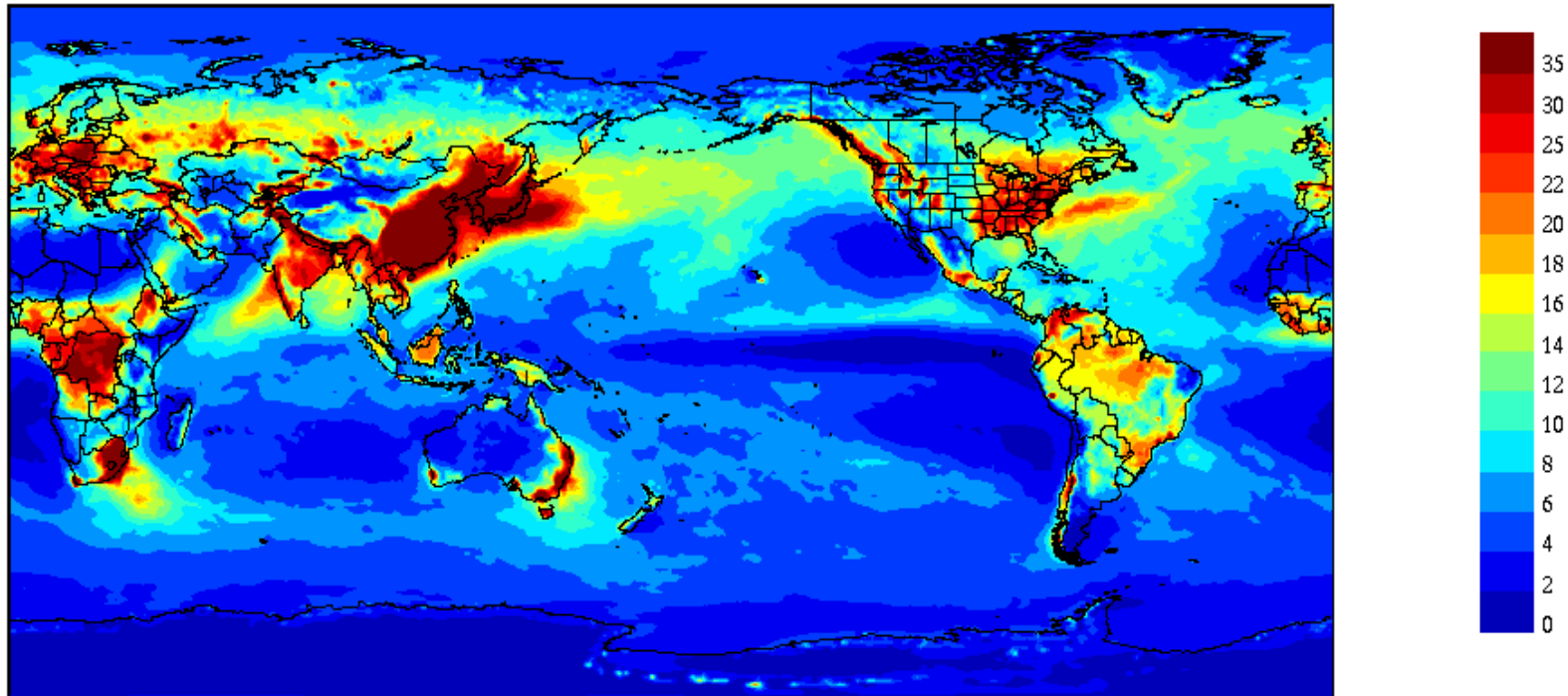
National Mercury Monitoring Plan

- USEPA-sponsored plan recently constructed by external scientists
- Provides a blueprint for tracking spatial and temporal Hg trends
- Starting to understand such trends comes just in time as there are major forces that could enhance environmental Hg loads.....



Mason et al., 2005, 39(1):14A-22A

Dramatically increasing international air emission sources (e.g., Asia) and



From a deposition model developed by Ashu Dastoor, Environment Canada

Continued domestic difficulty for regulations.

