

Mercury and Birds in the Shenandoah Valley

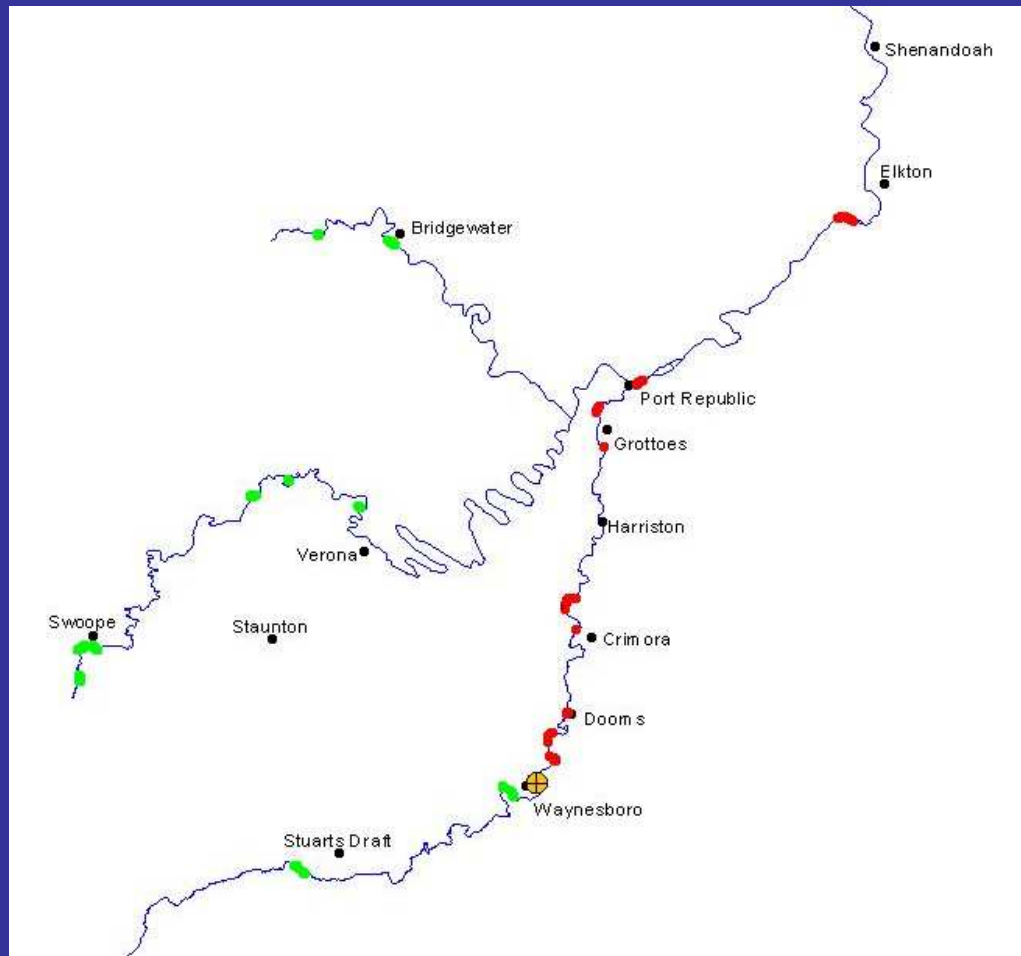
Daniel Cristol et al.

Department of Biology, College of William & Mary



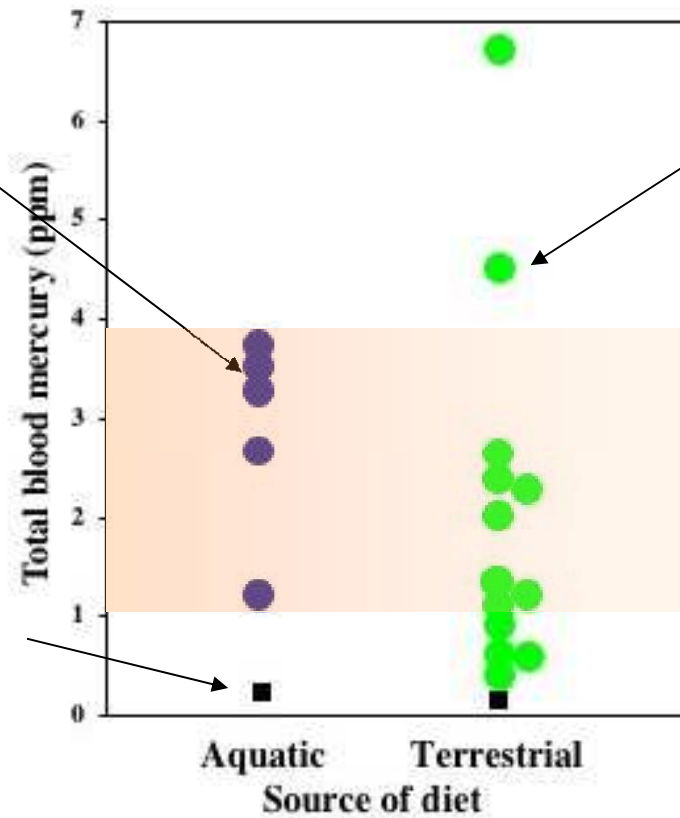
Zebra Finch
The model songbird

South River Mercury Study 2005-2013



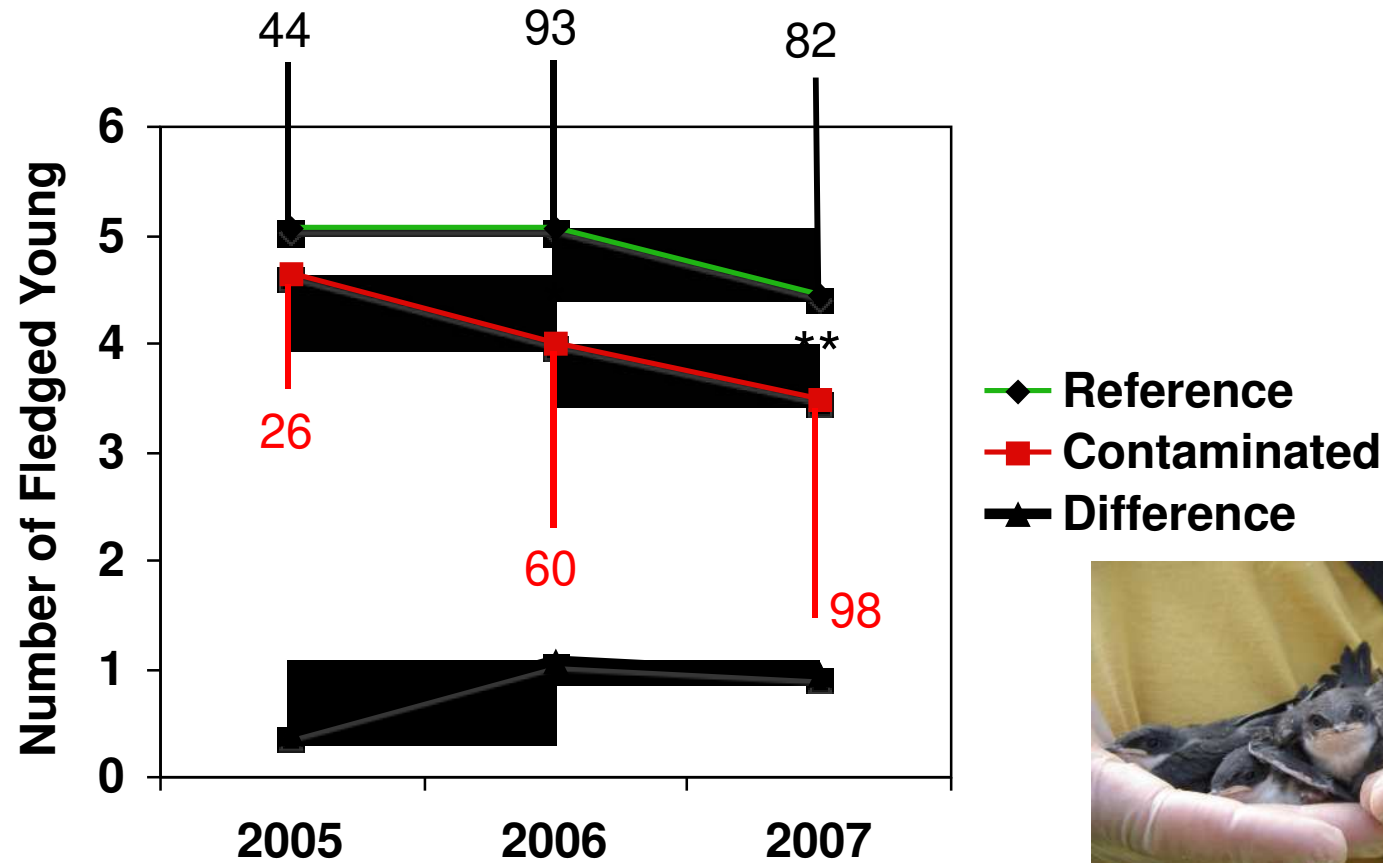


Same species
Same samples sizes
Reference sites



Mercury is not just a problem for aquatic-feeding birds

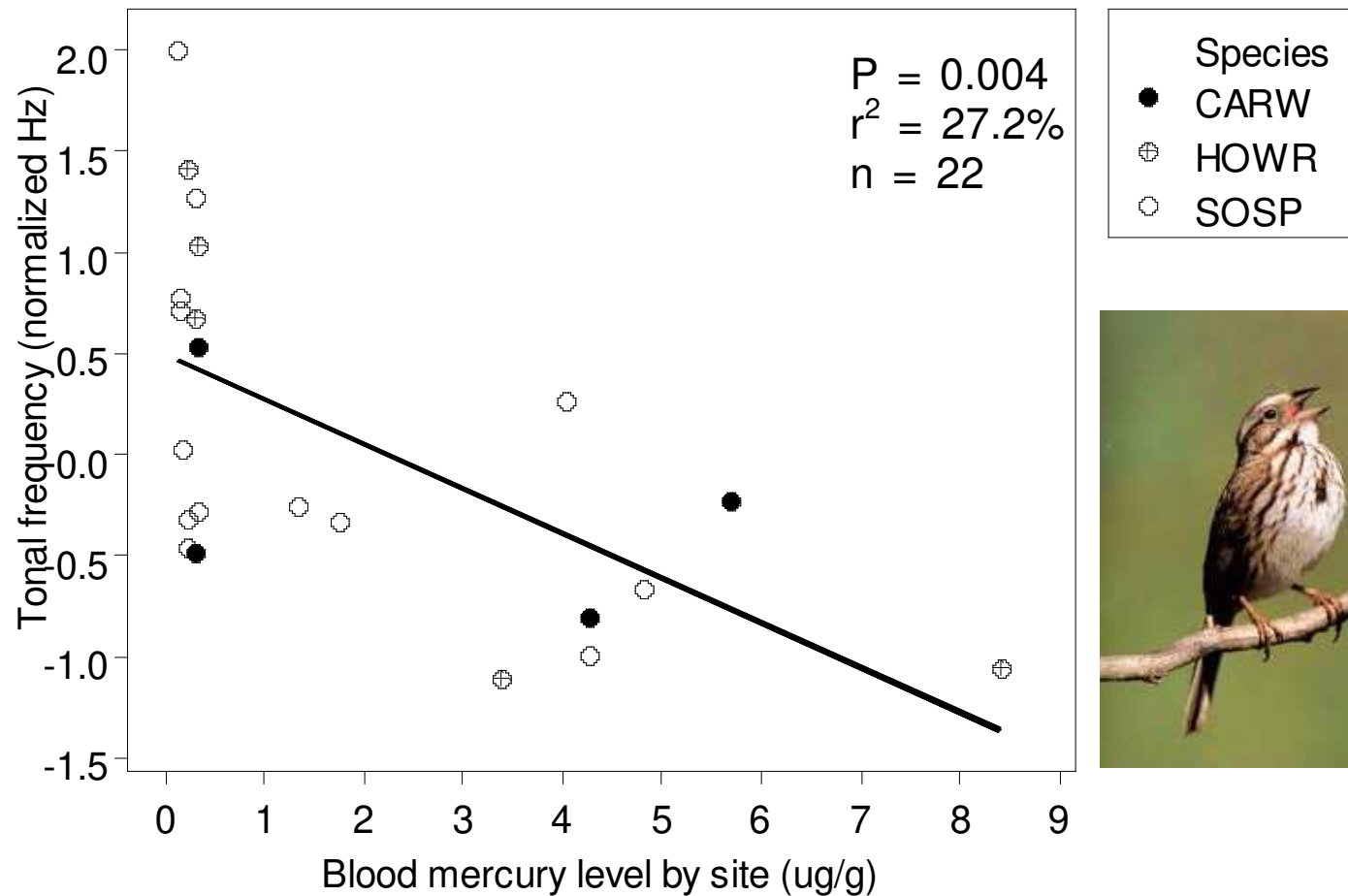
Mean ($\pm$ SD) Fledged Young



Tree Swallows

Contaminated swallows had fewer fledglings

Song pitch and mercury level



Mercury-exposed songbirds sing at a lower pitch

A map of the Eastern United States with Washington, D.C. marked with a star. Migration routes are indicated by arrows originating from D.C. Solid arrows point to Indiana, Ohio, and Virginia. Dashed arrows point to Pennsylvania, New York, New Jersey, Delaware, North Carolina, South Carolina, and Florida. The map includes state names, the Atlantic Ocean, a scale bar (0 to 400 Km / 0 to 300 Miles), and a north arrow.



Cristol et al. 2012, J. Wildlife Management



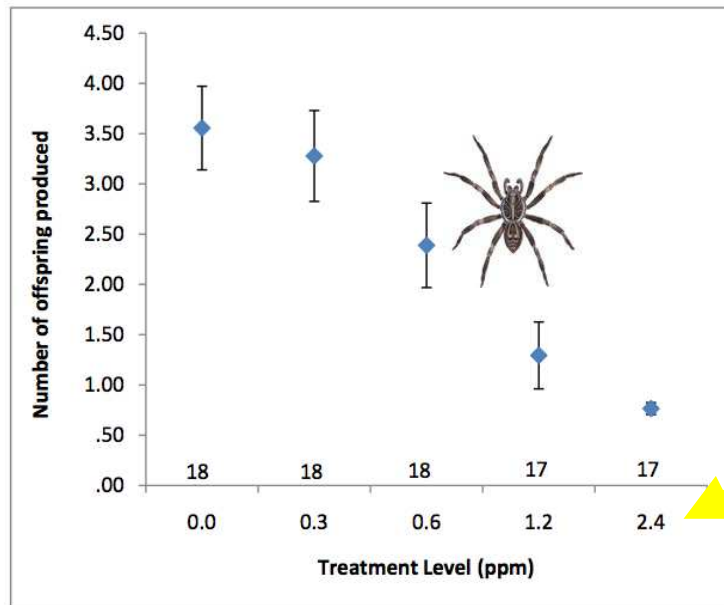
Wolf spiders have the same mercury concentration as fish



Songbirds at mercury-contaminated sites:

- *Fewer fledglings*
- *Altered songs*
- *Skewed sex ratio*
- *Immune suppression*
- *Low corticosterone response*
- *Brighter feathers*
- *Shorter lived*

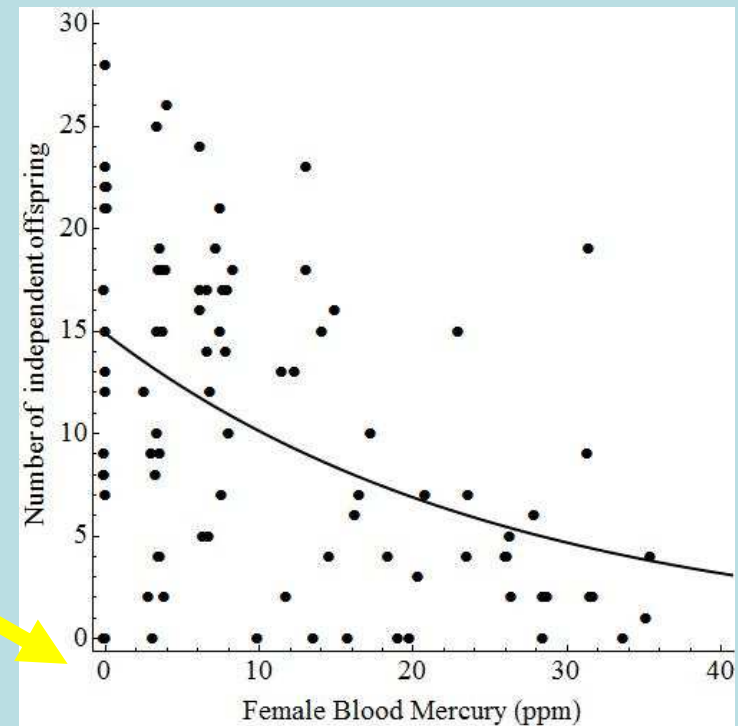




One “breeding season”

Blood mercury level

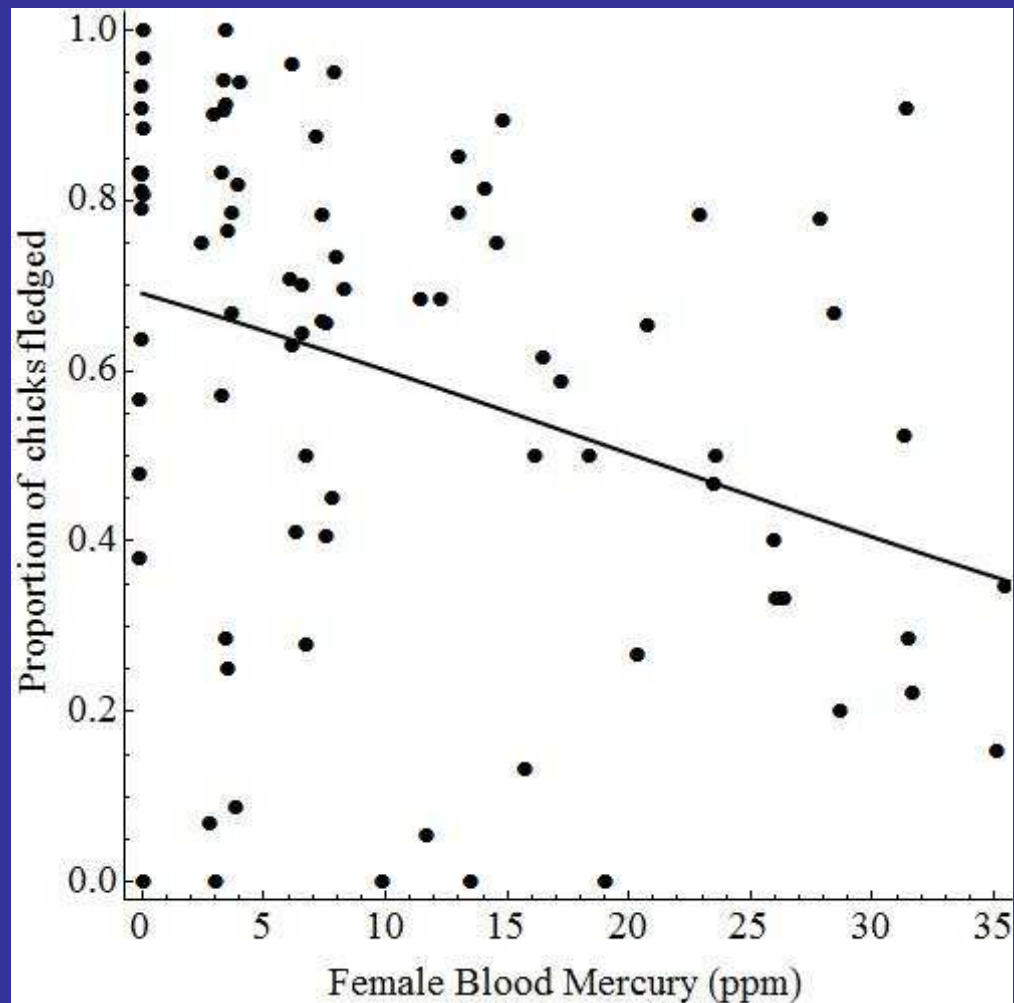
Dietary dose



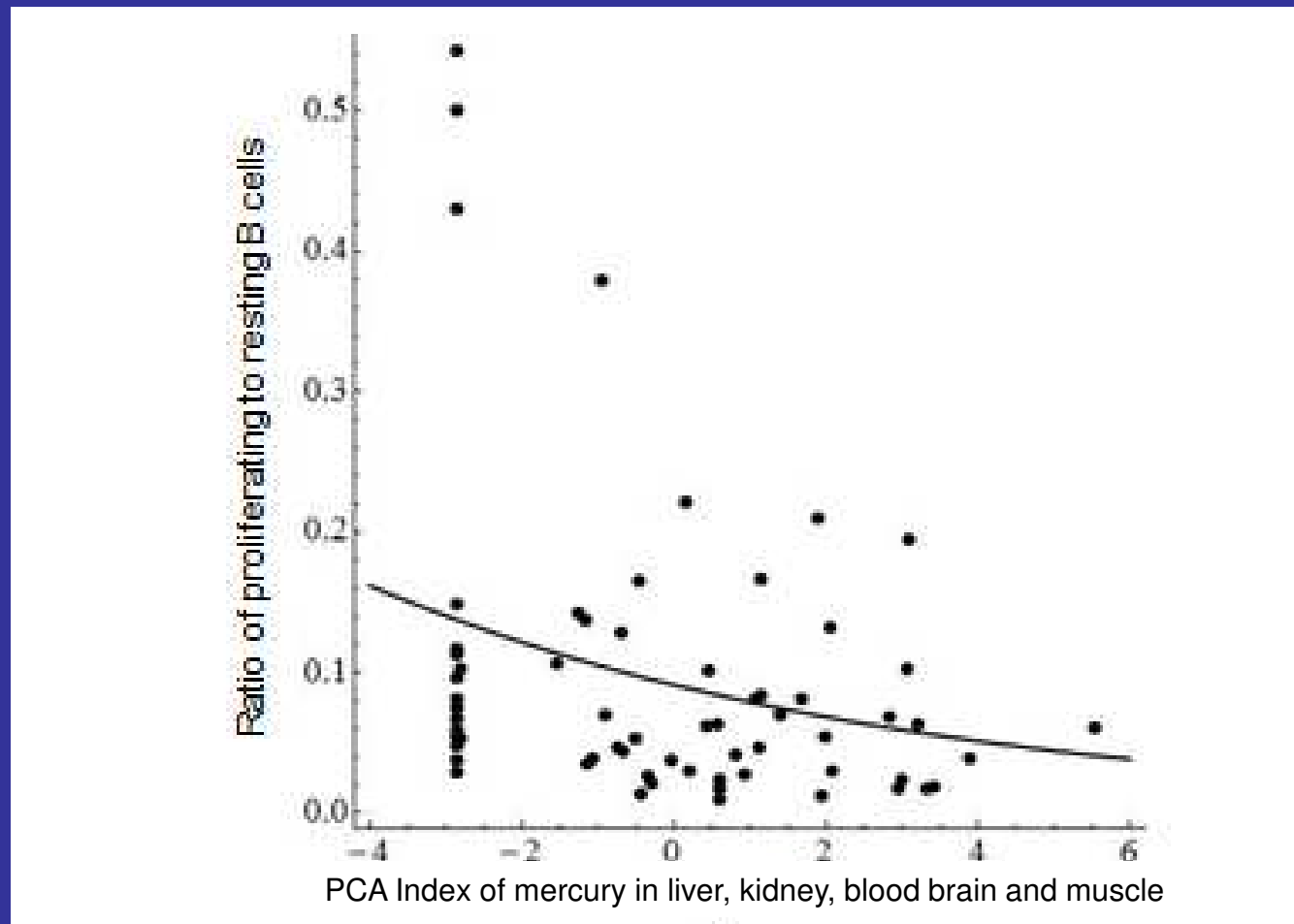
“Lifetime” reproductive success

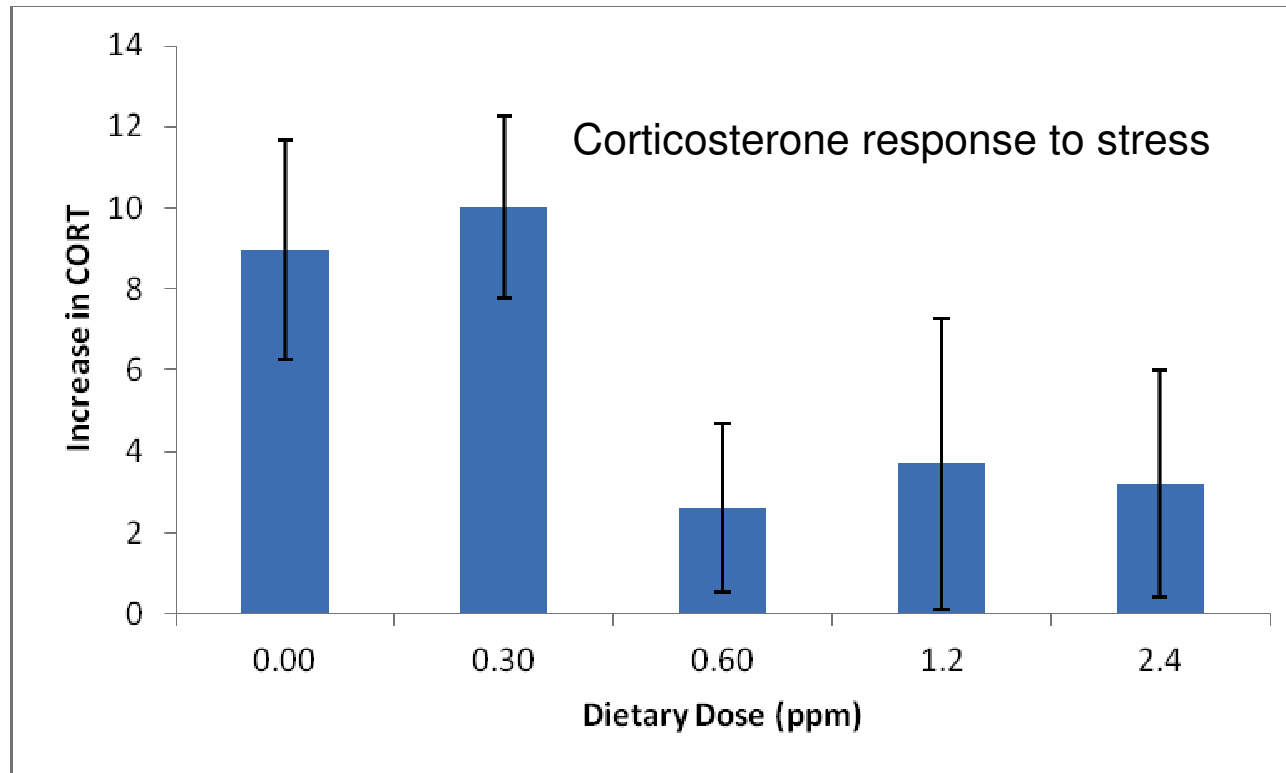


Reproductive loss most pronounced during nestling stage



Immune suppression in zebra finches dosed with 0-1 ppm methylmercury





Field and experimental evidence for effect of dietary Hg on:

- Corticosterone fight-or-flight response
- Song complexity and pitch
- Survival of nestlings to fledging reduced >20%
- Immune response delayed or suppressed

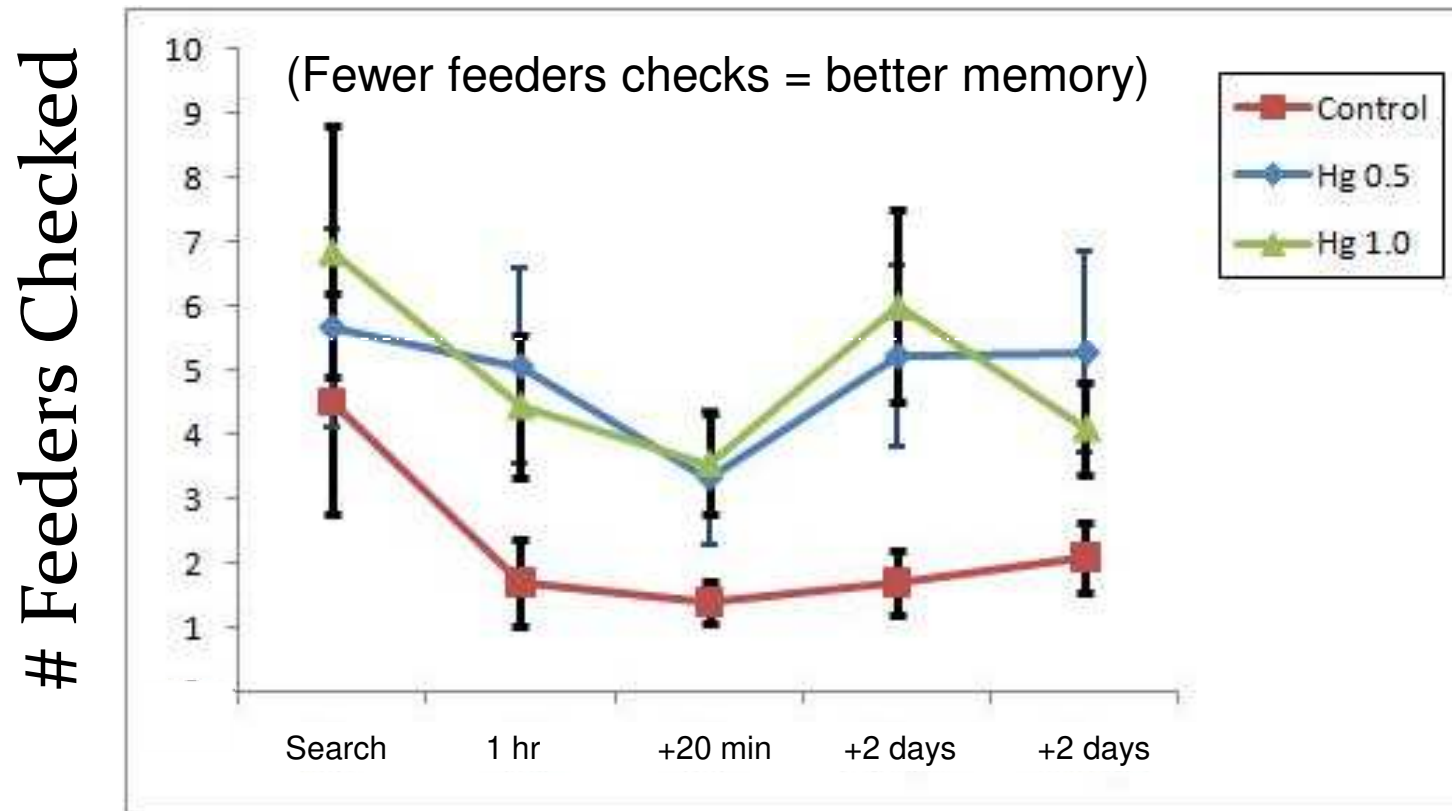
So we can conclude that mercury **CAUSES** these problems

Unpublished dosing studies



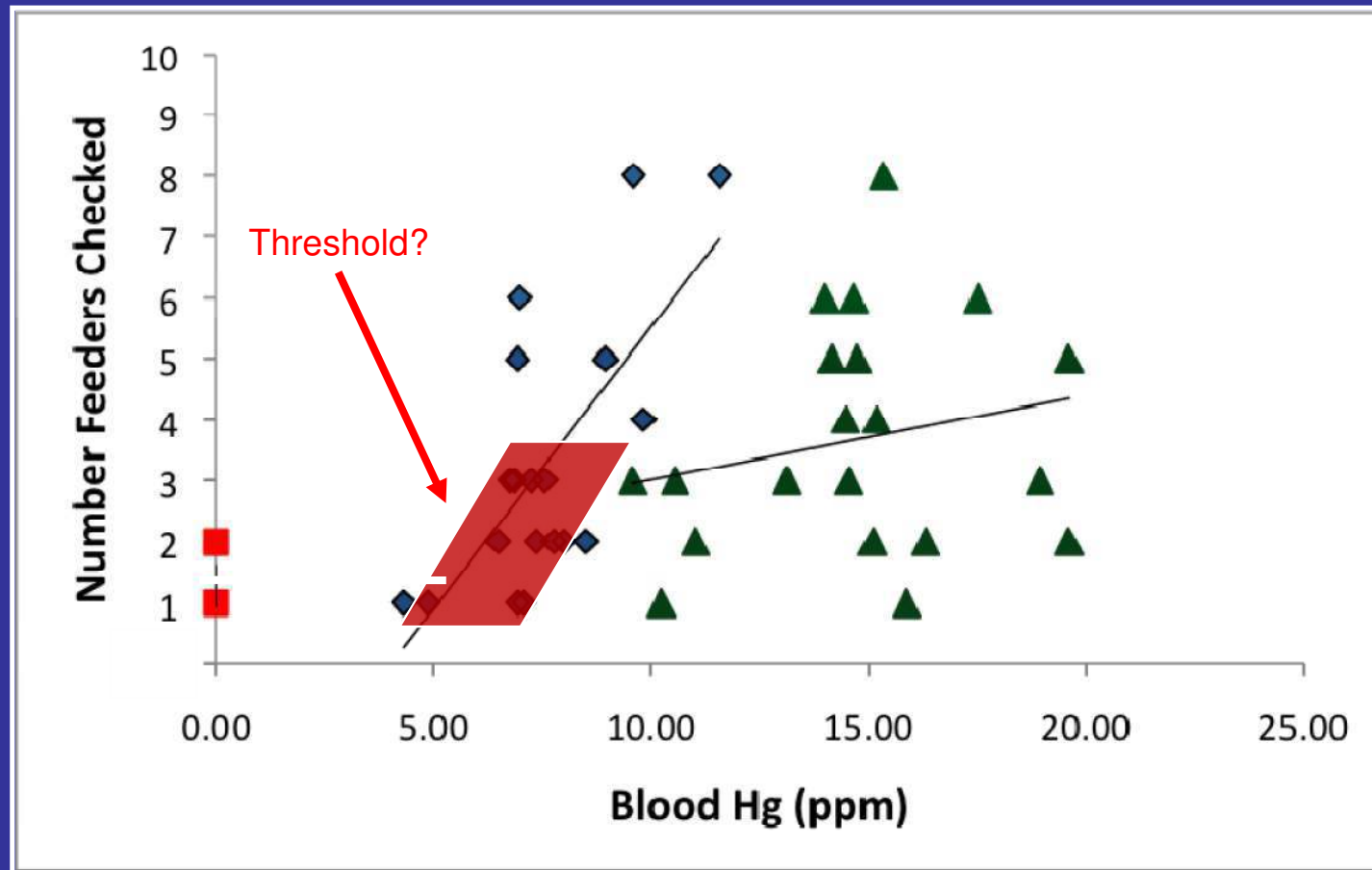
- **Spatial memory severely impaired**
- **Mate choice affected**
- **Development of male coloration altered**
- **Resistance to parasites slightly reduced**
- **Heritability of blood mercury levels**
- **Liver enzymes (glutathione and superoxide dismutase)**
- **Testosterone unaffected**
- **Flight performance reduced**
- **Molt timing sped up**
- **Managing tradeoffs of starvation and predation risks**

Spatial memory test in lifetime exposed finches

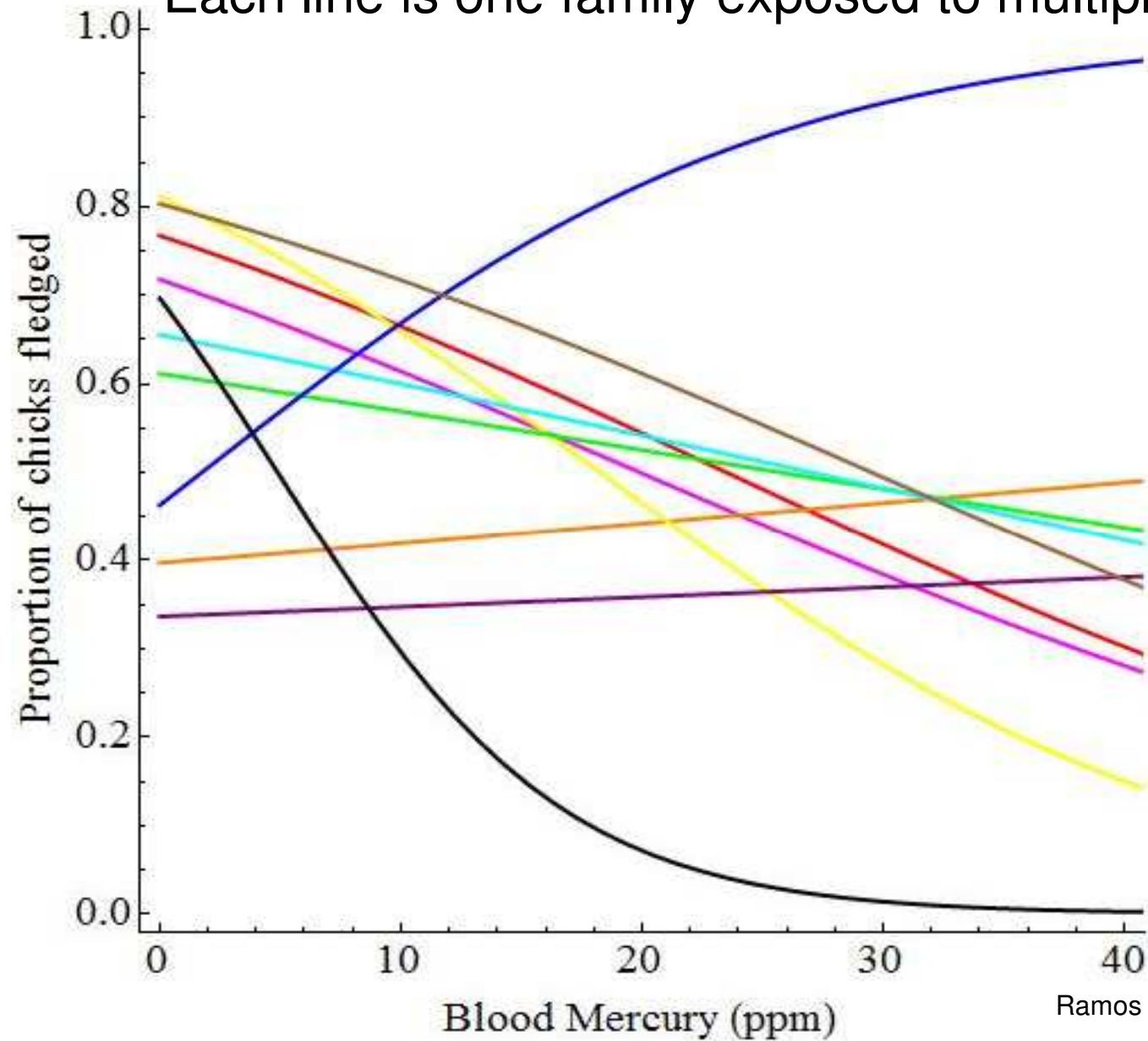


Memory severely impaired in lifetime dosed birds

Individual mercury levels and memory



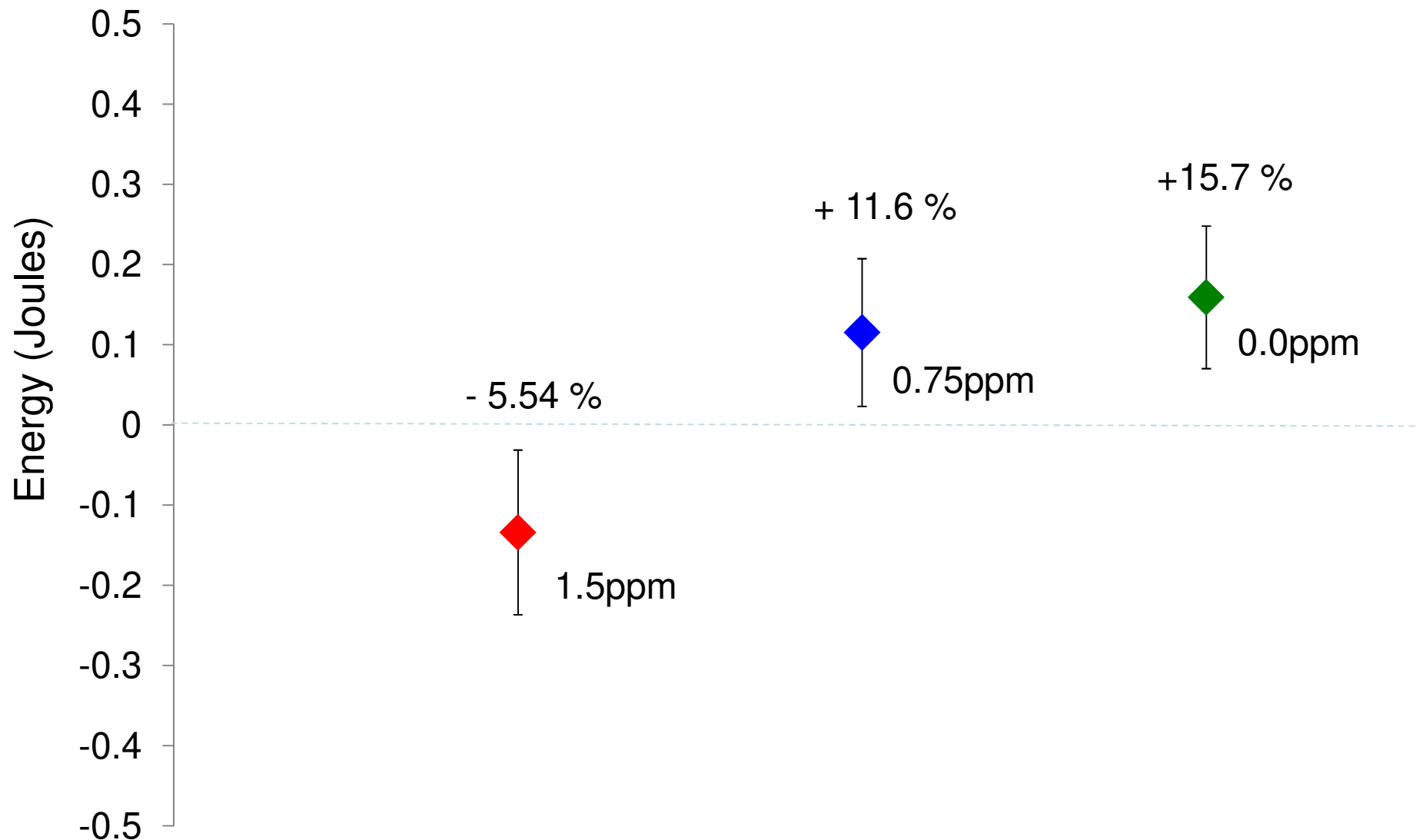
Each line is one family exposed to multiple doses



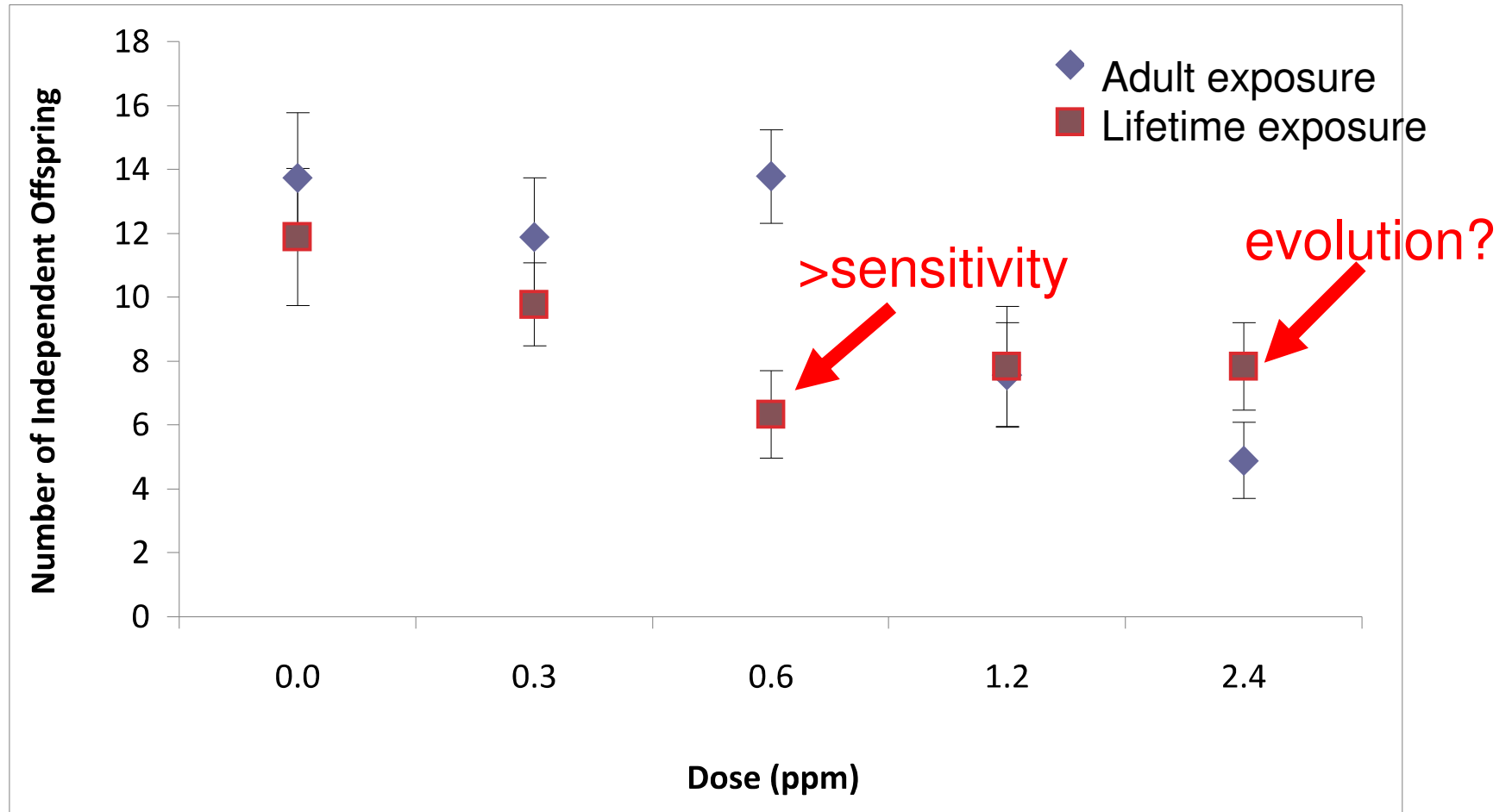
Ramos et al. 2013 Environ. Poll.

Some families not affected by mercury in same way as others

Change in energy invested in take-off by starlings from before dosing to one year later

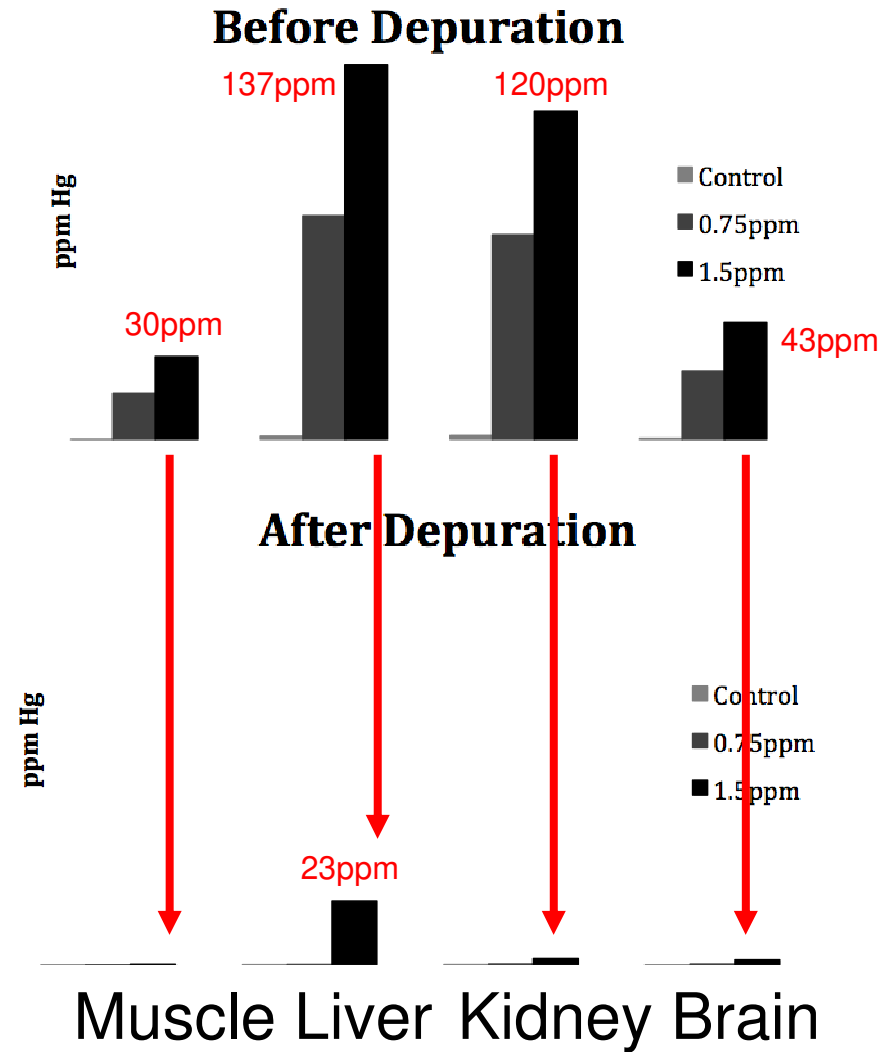


Reproductive success after 1 year of breeding

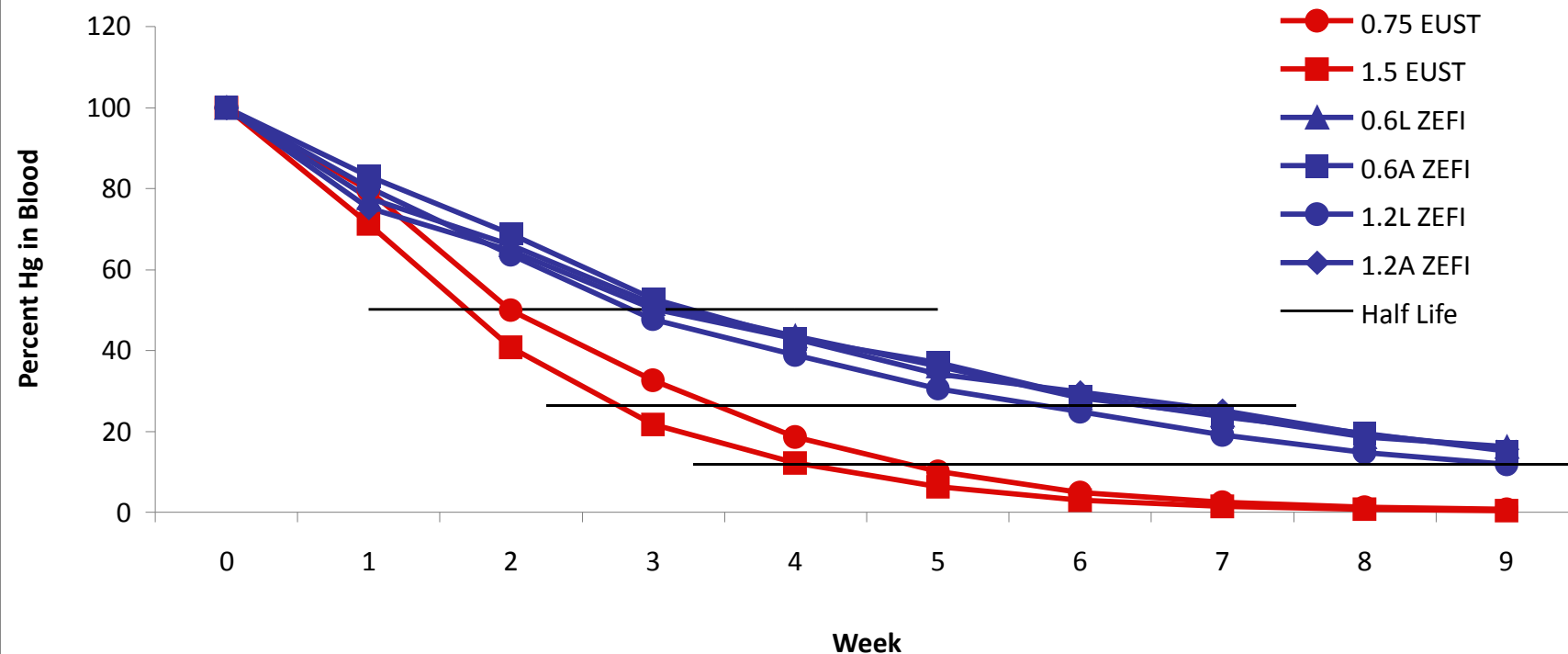


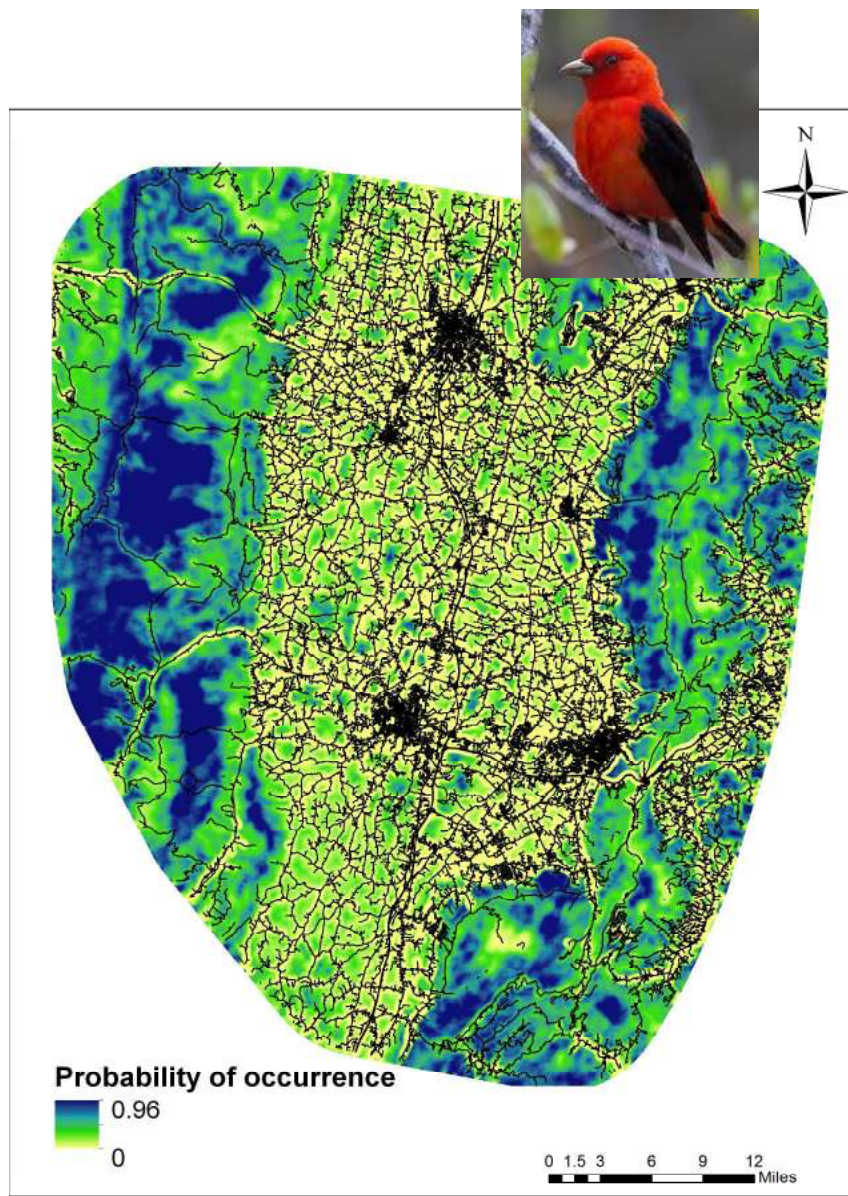
Sensitivity is greater in lifetime exposed birds

Starlings dosed for > 1 year

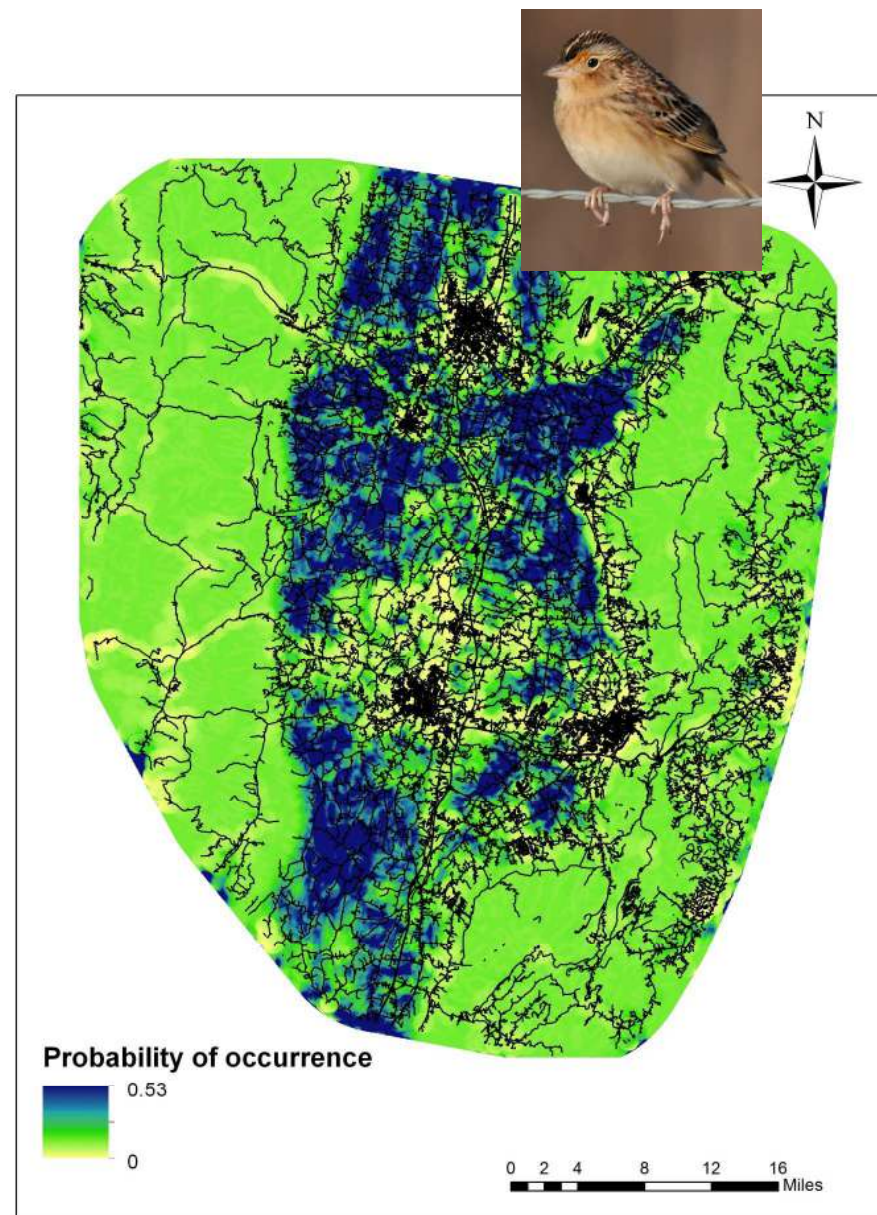


Depuration of Hg from Starlings and Finches





Scarlet Tanager



Grasshopper Sparrow

