Measuring contaminant Effects in Wildlife From the Genetic to the Population Scale

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Project Team

Project Leader - **R.D Evans, ERS Dept., Trent University**

Students

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With the help of Trapper Organizations in Ontario, Quebec and Nova Scotia

Principal Investigators

Neil Burgess, Environment Canada, Newfoundland
Louise Champoux, Environment Canada, Quebec
Laurie Chan, McGill University
Pierre-Yves Daoust, Atlantic Vet College, UPEI
Brendan Hickie, Trent University
Greg Mierle, ON Ministry of Environment
Mike O'Brien, Fish and Wildlife, NS
Tony Scheuhammer, Environment Canada, Ontario

Outline

- Ontario and Eastern Provinces Hg Studies
- Results of tissue concentrations
  - -Regional differences in Nova Scotia
  - -Limitations to interpretation of concentration data
- Multi-level investigation :
  - -Data suggestive of biochemical level effects
  - -Data suggestive of population effects
- Discuss limitations to current data

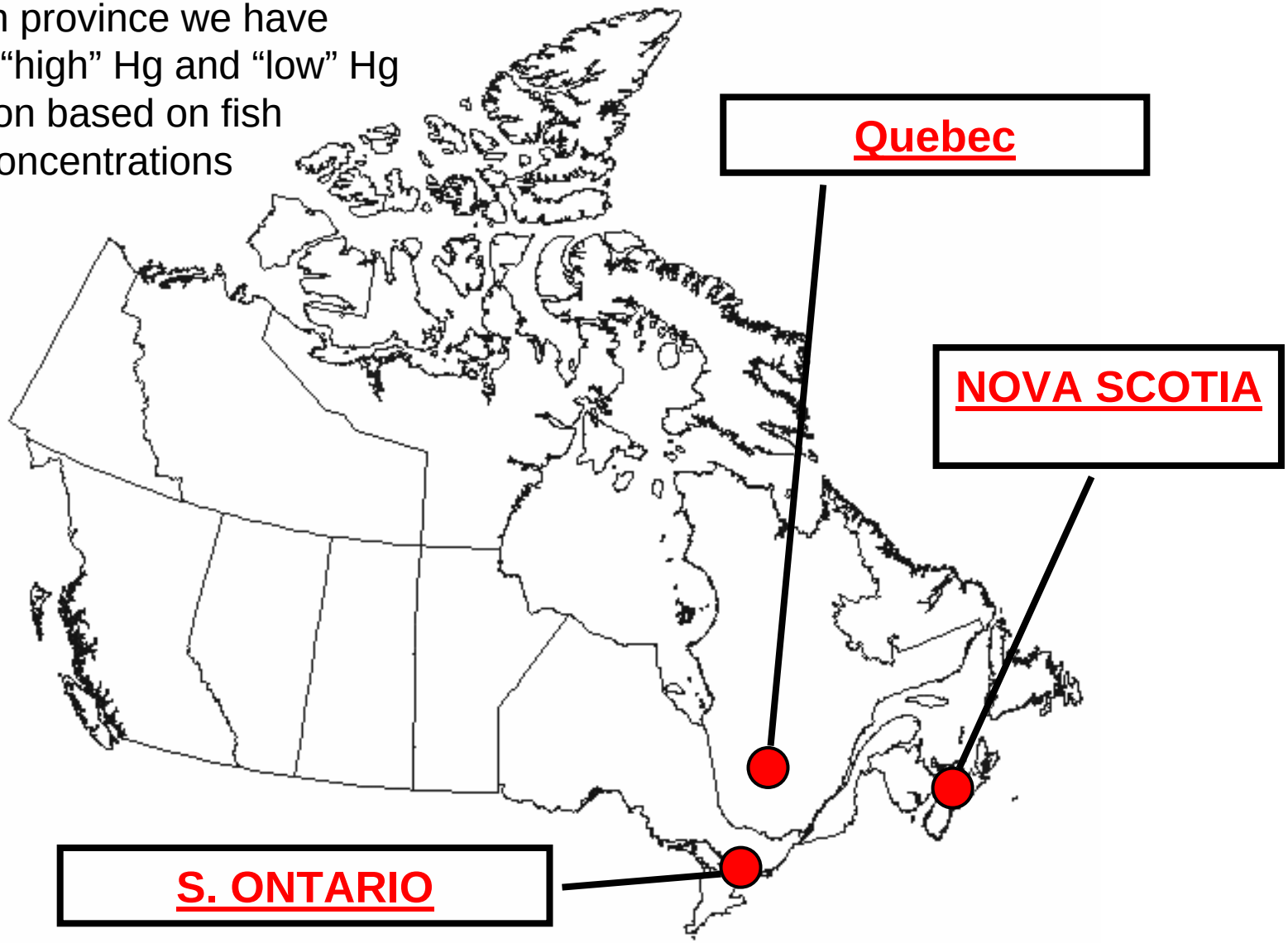
Hg and Piscivorous Wildlife

- **River Otter are piscivorous mammals, obtaining 90% of their diet as fish**

- **Mink also consume large quantities of fish but are more general carnivores**

Study Sites

In each province we have selected a “high” Hg and “low” Hg region based on fish concentrations



Kate Klenavic, M.Sc. student

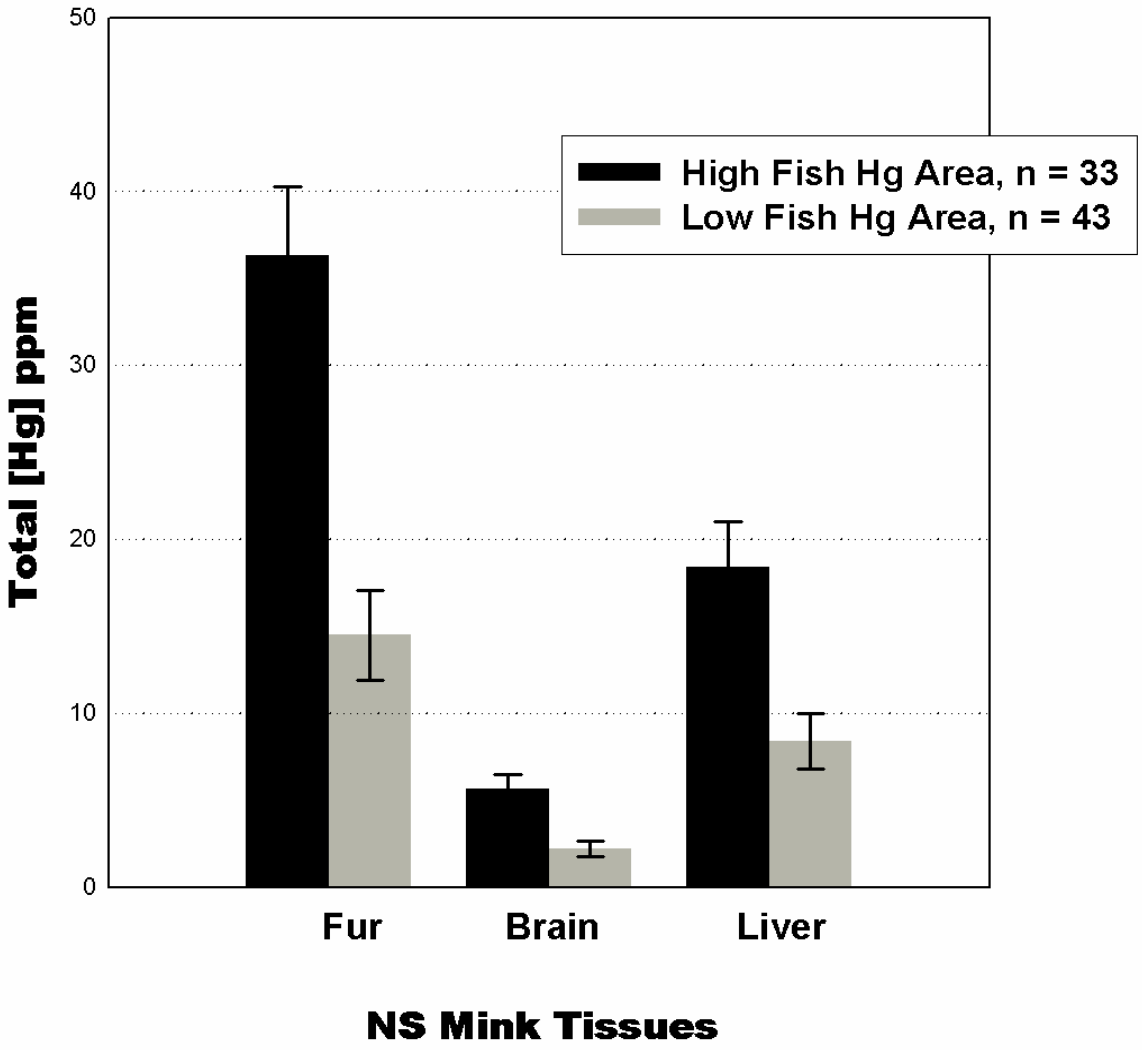
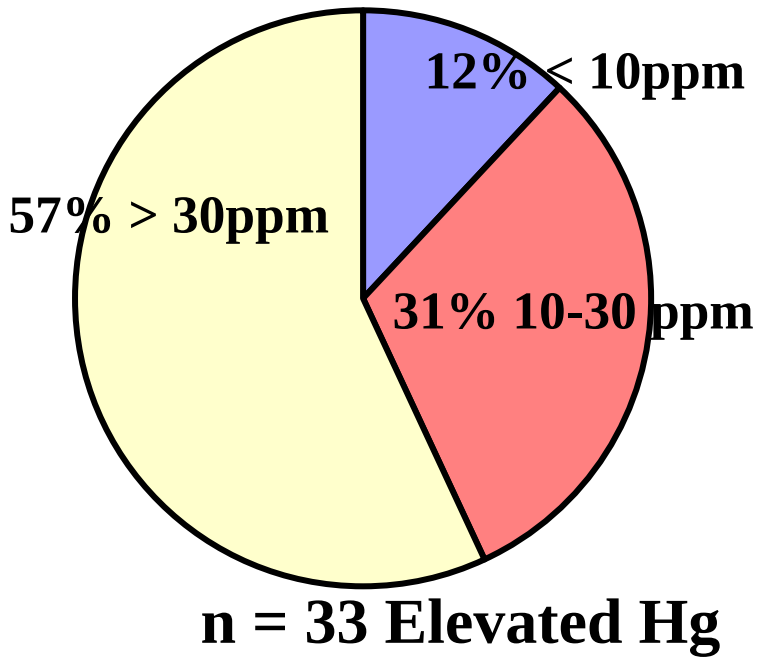


Figure 5. Comparisons of the mean total [Hg] ppm (dry wt.) in various tissues of Nova Scotia mink from two different areas of fish Hg levels. Error bars represent the SE of the mean. Mean concentrations are significantly different from each other within tissues.

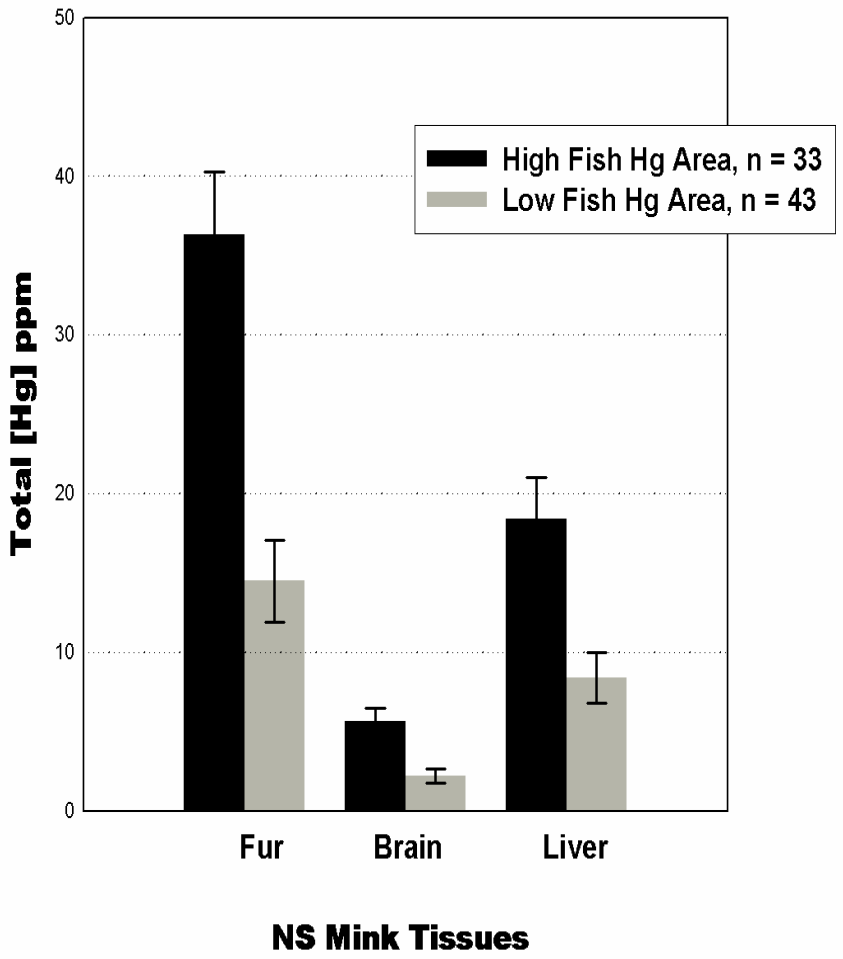
- **Mink/Otter from NS have among the highest Hg concentrations Canada.**
- **Concentrations among organs are correlated.**

-Hg concentrations in the tissues from the “high” populations range from 1.5-78 ppm

- majority of samples (57%) above 30 ppm



Results – Mink



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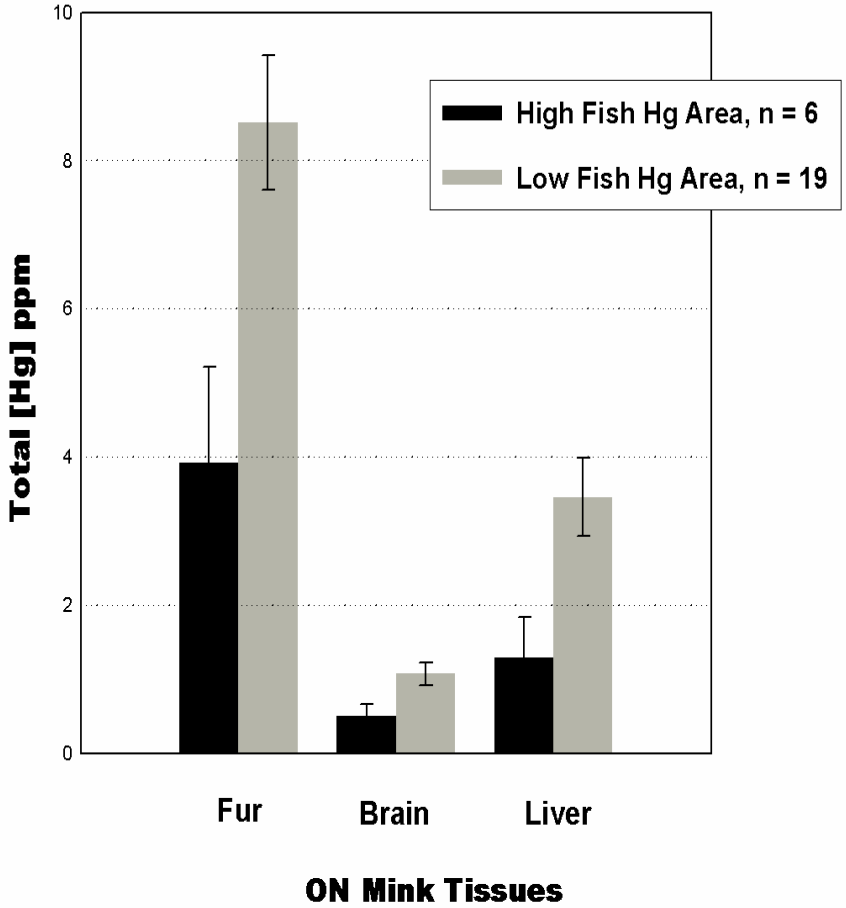

Figure 4. Comparisons of mean [Hg] ppm (dry wt.) in various mink tissues from two different areas of fish Hg contamination in south-central Ontario. Error bars represent the SE of the mean. Mean concentrations within each tissue are significantly different from each other.

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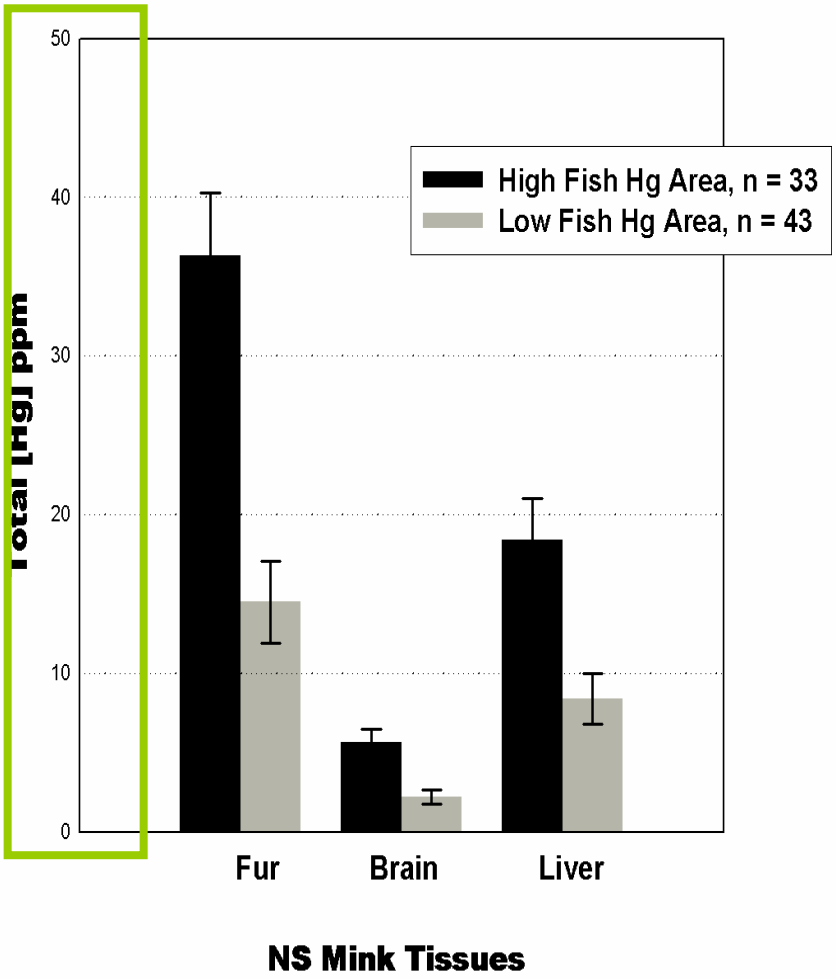

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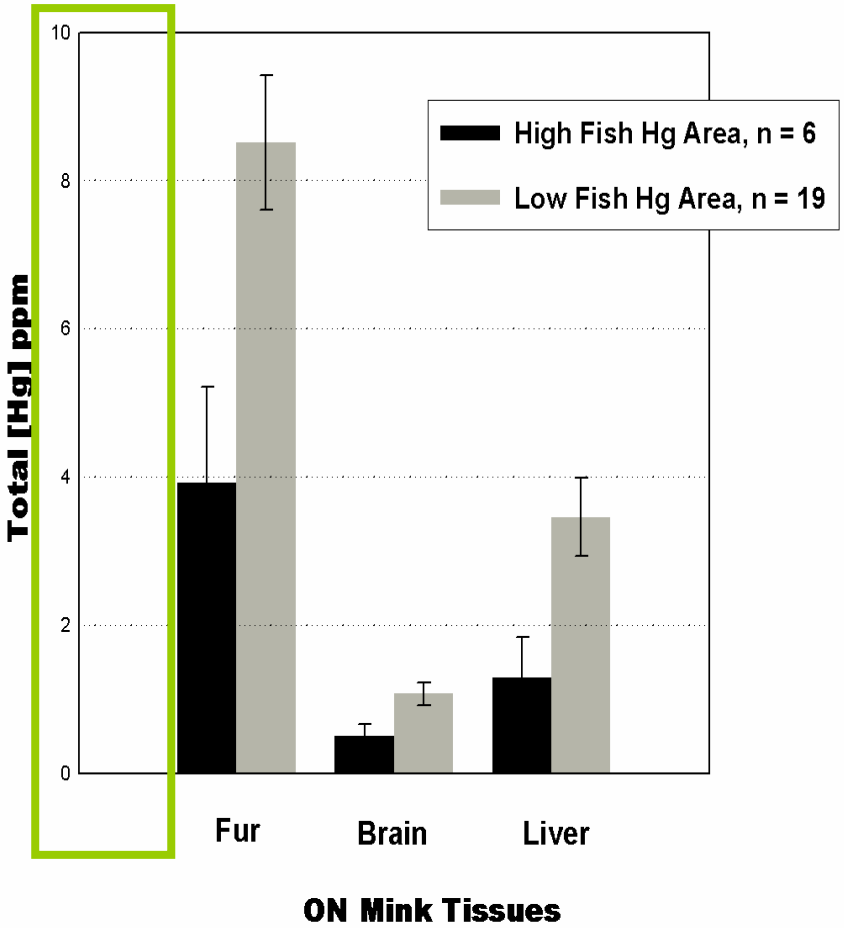

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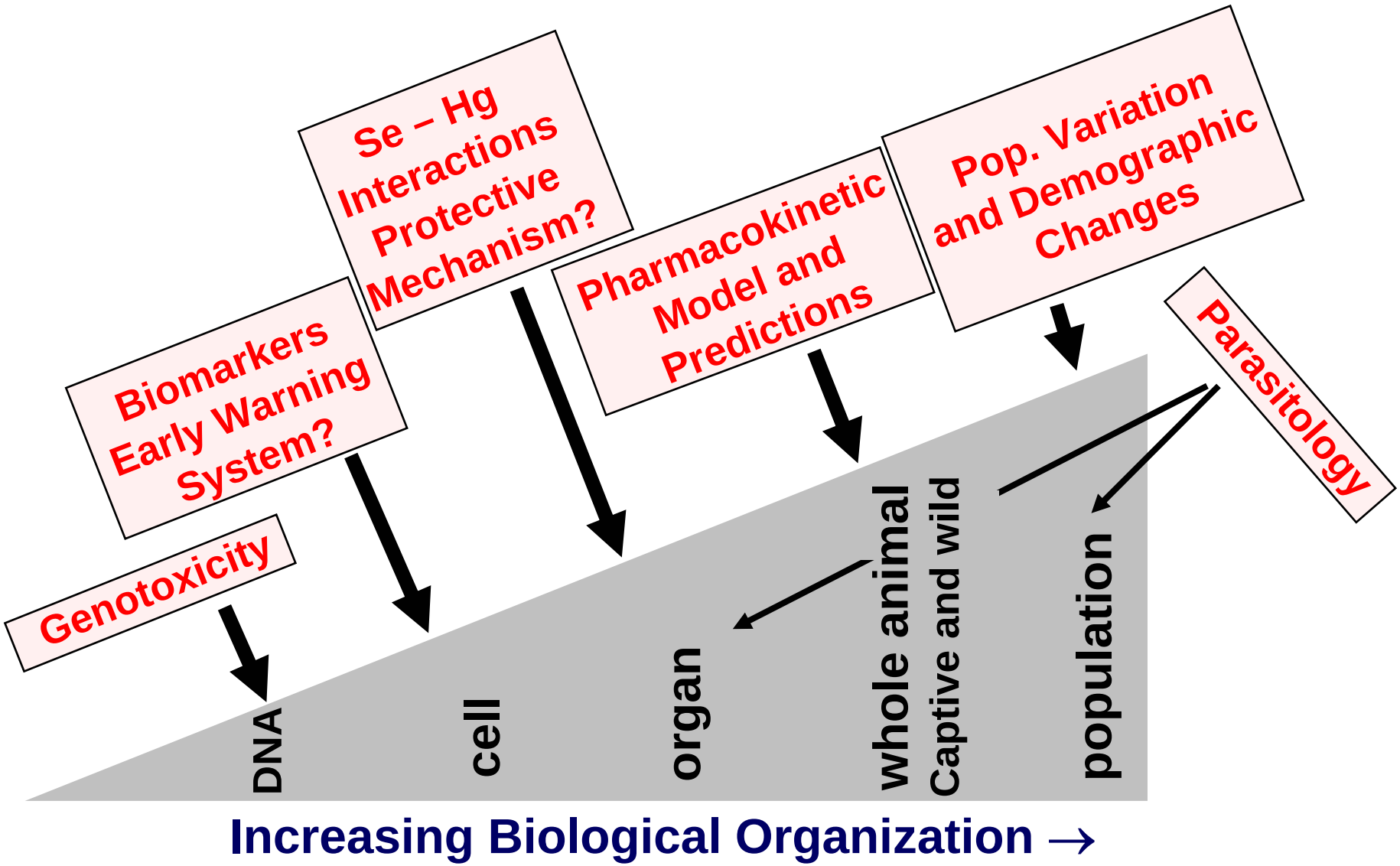
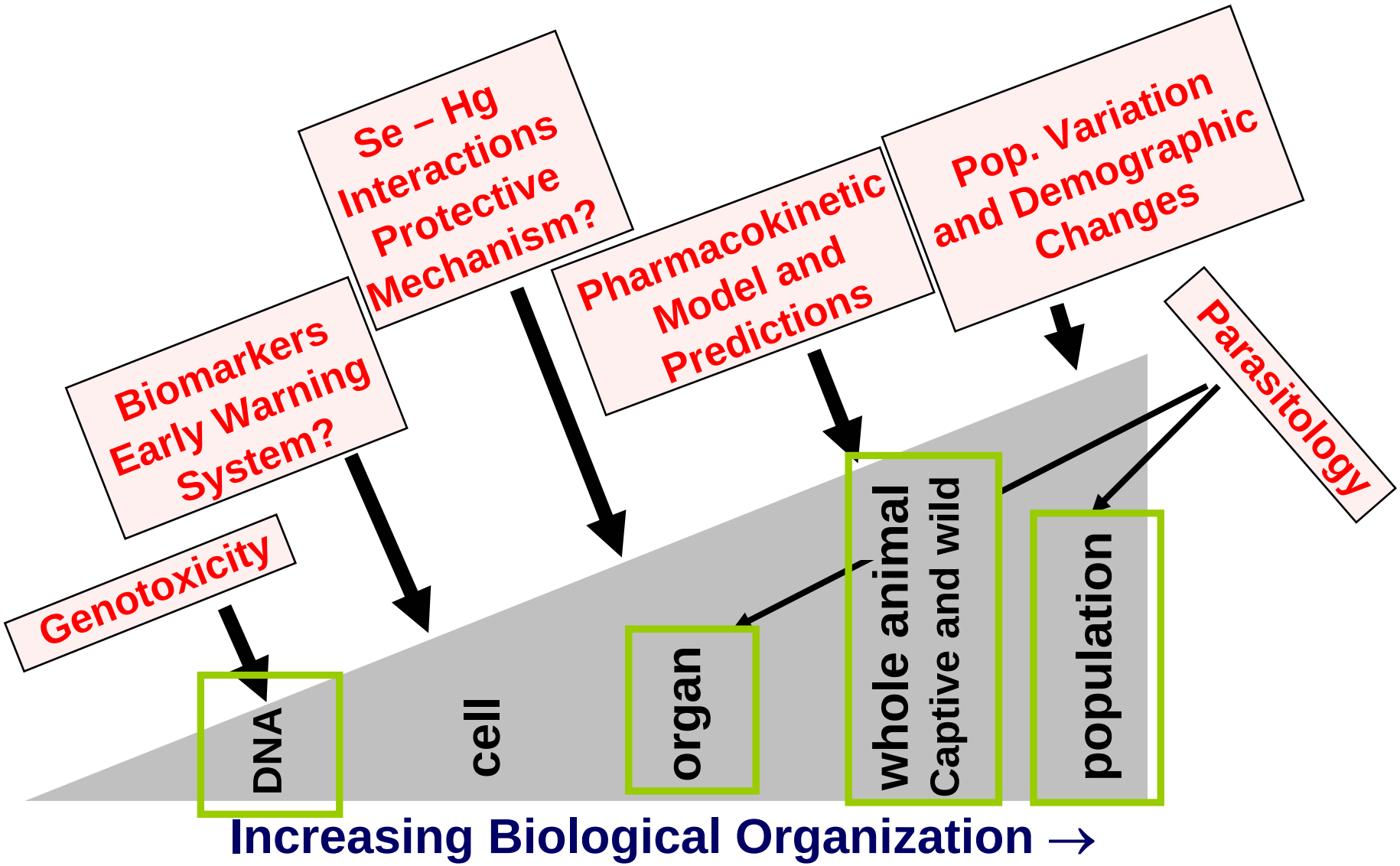
Project Overview



(After Basu, 2003)

Project Overview



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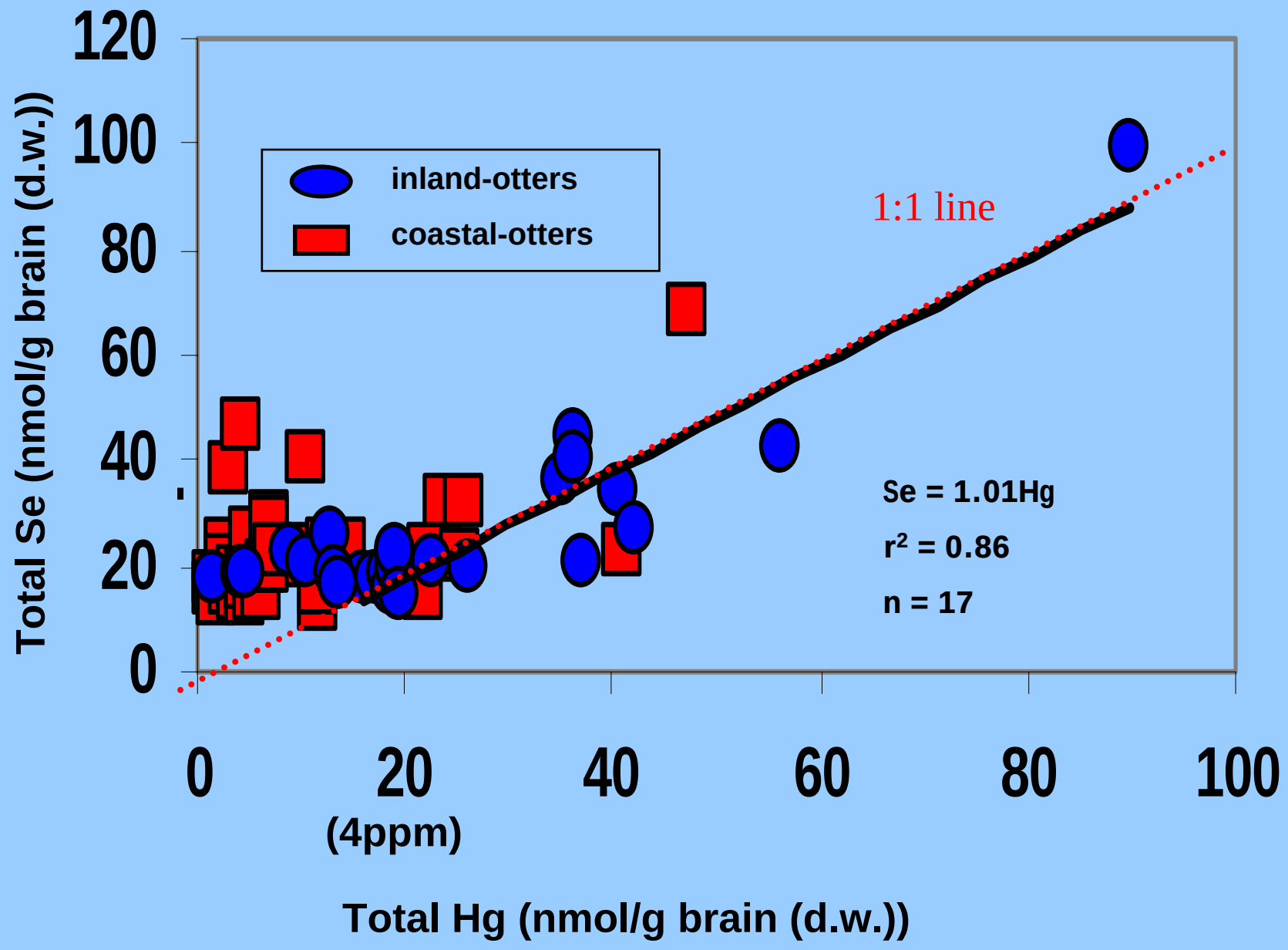
Genetic Markers

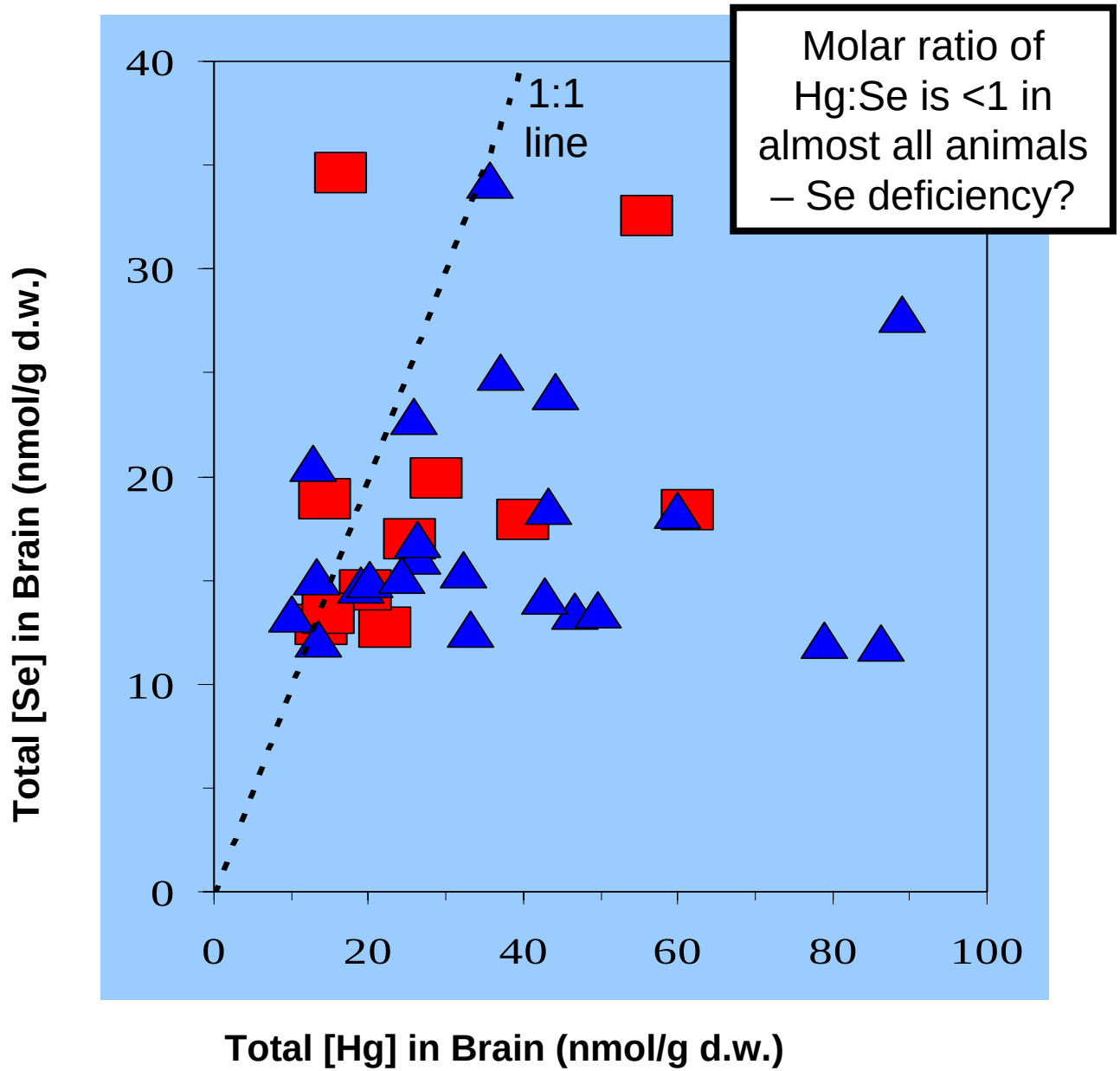
- **Christianne Loupelle – M.Sc. student**
- **Purpose of study is to determine if exposure to Hg results in DNA fragmentation, using comet assay**
- **In vivo studies suggest that such damage occurs, but no good field studies to corroborate**
- **Results indicate that major problem in study is obtaining tissue that is fresh enough for assay. When this can be obtained the assays work well**
- **However, thus far we have not been able to obtain enough high quality tissue to test hypothesis of increasing damage as a function of Hg concentration in wild mink or otter – will test with captive animals**

Se – Hg Interactions

- Kevin Haines – M.Sc. student
- Examine concentrations of Se and Hg in brains
  - Using Nova Scotia animals – large collection prior to COMERN – helps to find animals with high concentrations
  - Test hypothesis of 1:1 between [Se] and [Hg] – which has been reported mostly in feeding studies - in sites where [Se] in food sources should vary – coastal foods high in Se due to marine influence relative to interior sites


120
100
80
60
40
20
0
Total Se (nmol/g brain (d.w.))
inland-otters
coastal-otters
1:1 line
Se = 1.01Hg
r2 = 0.86
n = 17
0
20
40
60
80
100
(4ppm)
Total Hg (nmol/g brain (d.w.))

Hg – Se relationship in NS mink



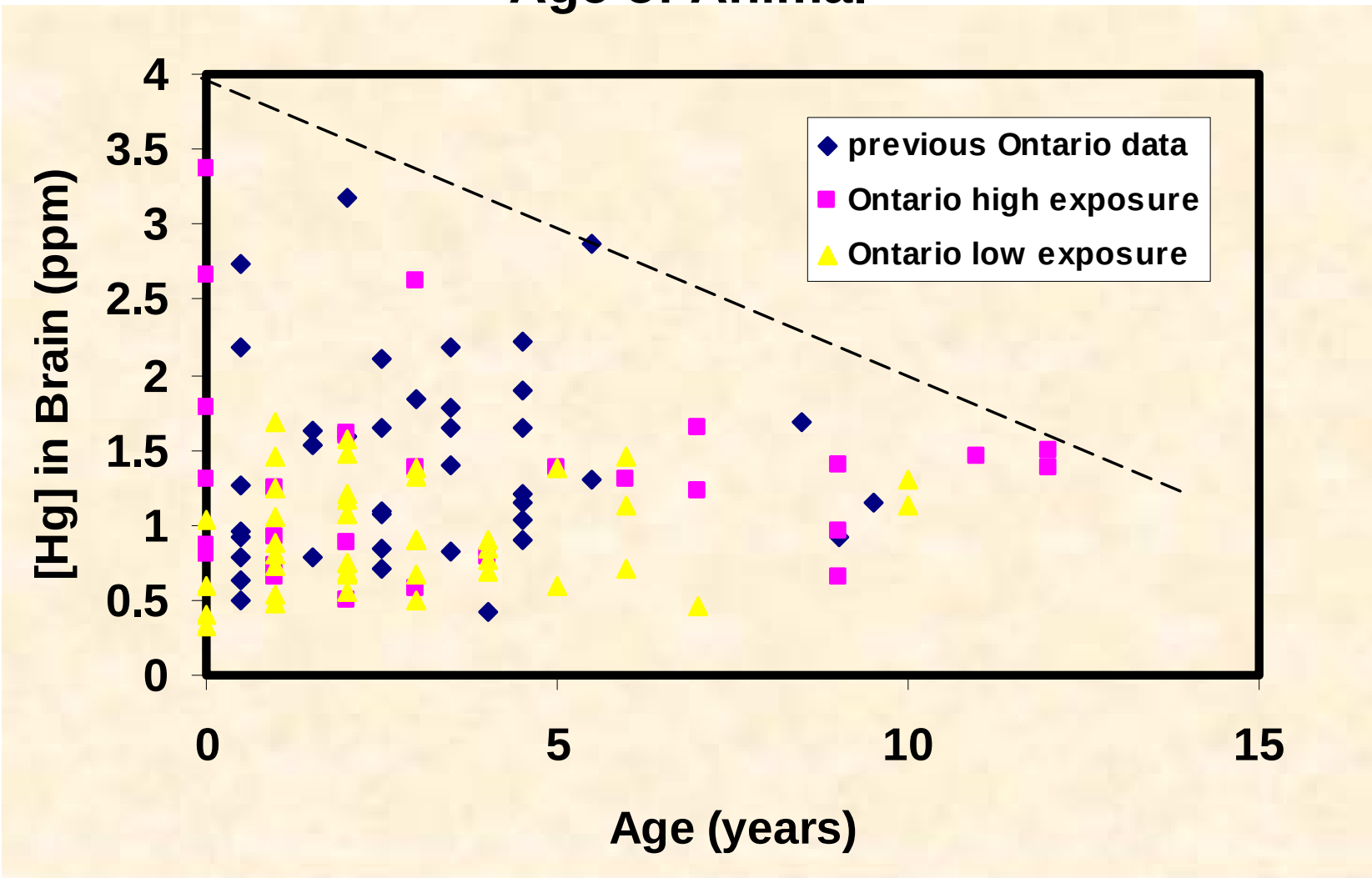
Pharmacokinetic Modeling and Diet Study

- Nicole Grochowina – Trent
- Determine [Hg] in diet of trapped animals – test reliability of fish data bases as food source term for uptake
- Use results from diet study to build pharmacokinetic model - use captive population to test model; model will be scalable and applicable to other mammals - compare with human models
- Major advantage is that we have brain concentration data – missing in human data sets

Population and Demographic Study

- Kate Klenavic, M. Sc, Trent
- Animals collected from two regions in each of three provinces – high exposure and low exposure (based on fish concentrations)
- Test hypothesis that age structure is altered in the presence of Hg exposure

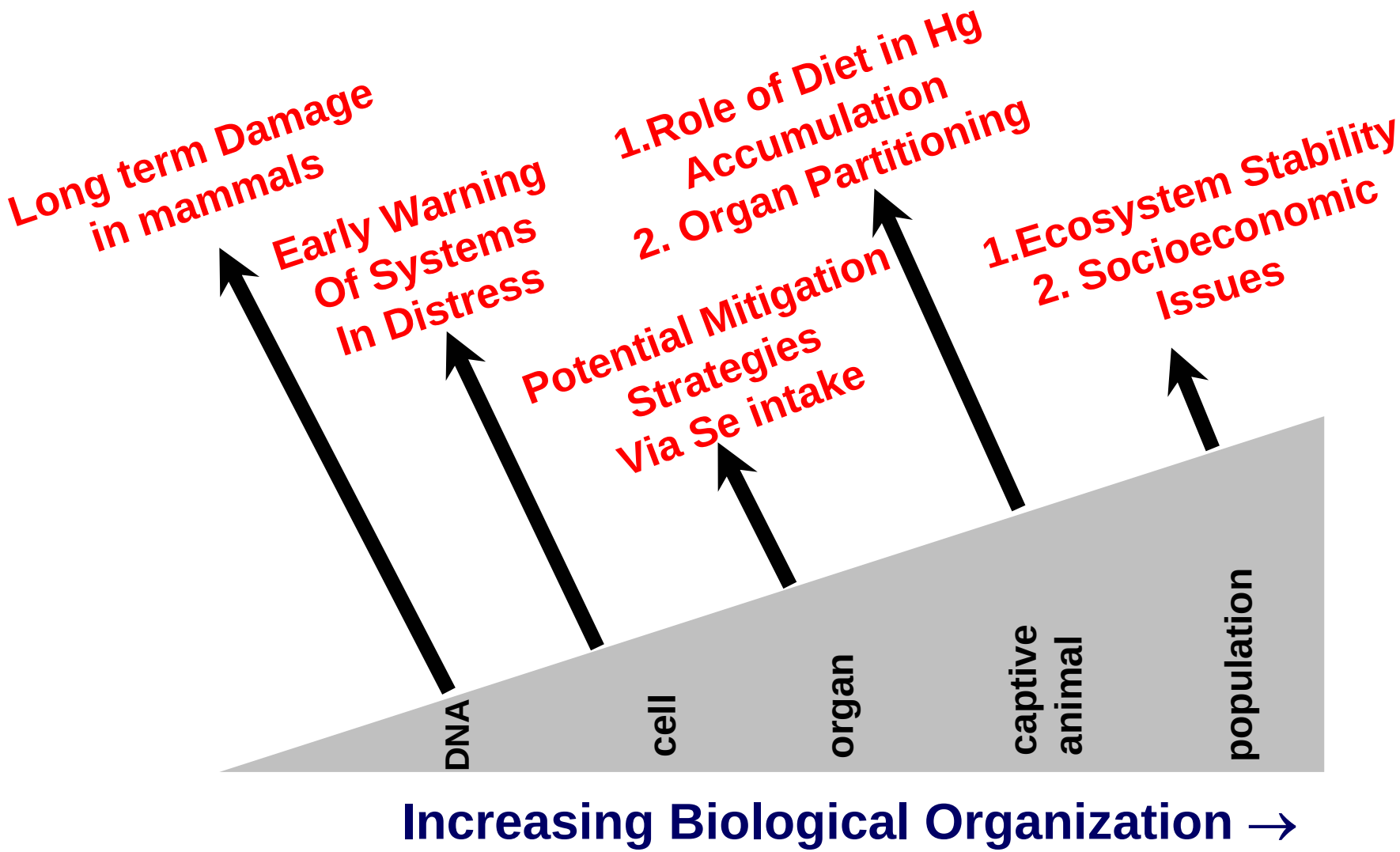
Variation in Brain Hg Concentration with Age of Animal



- Trapped animals are generally most active – more males than females are captured;
- There are many more young animals in the population than old;
- We find a range of Hg concentrations in young animals, but no older animals with high Hg;
- Same pattern was observed in Quebec as in Ontario (NS ages not yet available).

- The results raise the question as to whether young, high Hg individuals survive to old age.

Benefits of Integration Across Levels of Organization



Summary (lessons learned?)

- **Tissue concentrations don't tell the whole story**
- **Several parameters at different levels of organization vary as a function of Hg levels**
- **However, in wild animals there will never be one single stressor – observations could be result of other stressors, or synergistic effects**
- **Captive animal studies can help to isolate relationships for single factors – but not realistic for large mammals**
- **Hopefully small mammals can be a model for larger organisms, including humans**