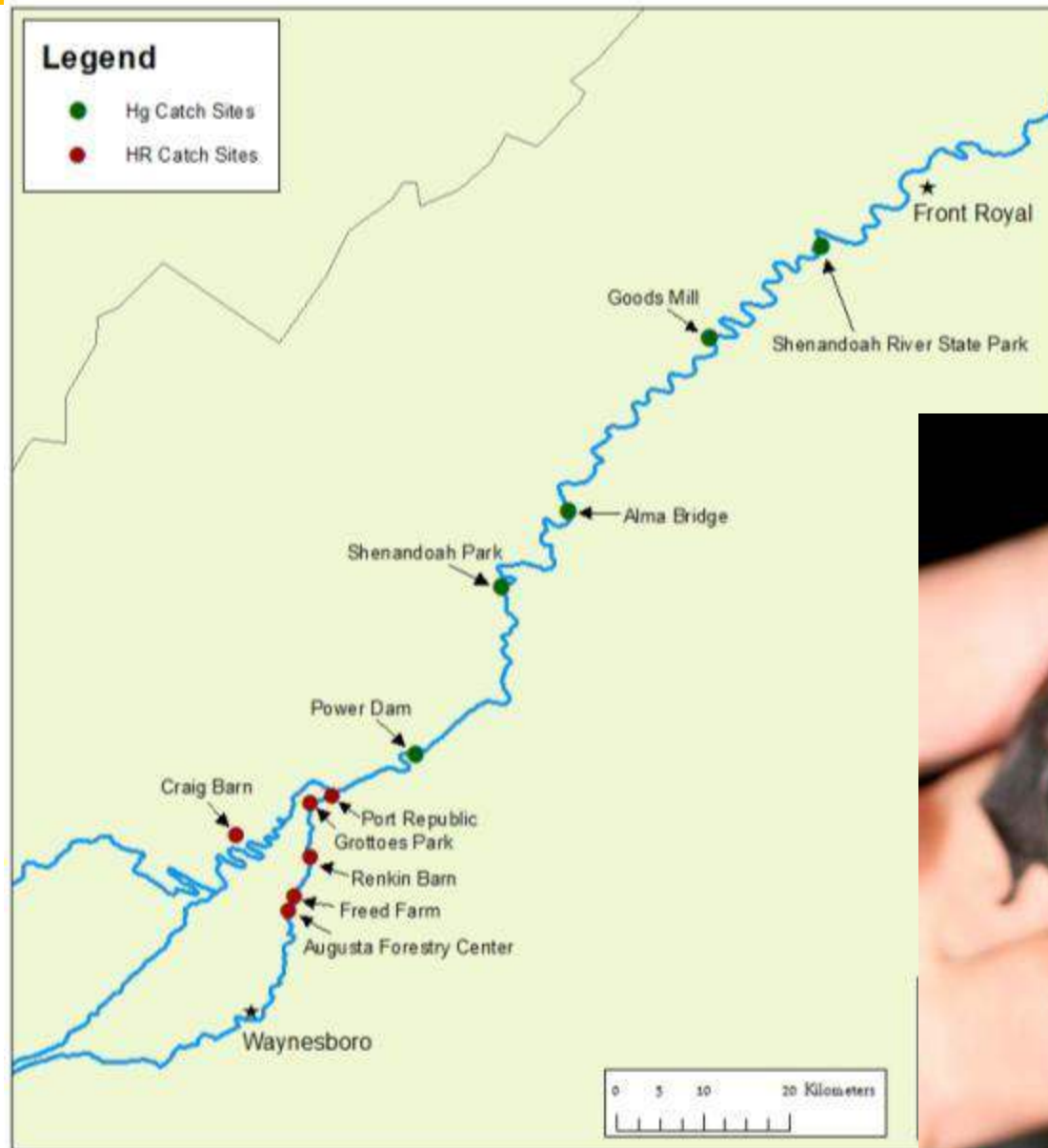


Bio Studies Update

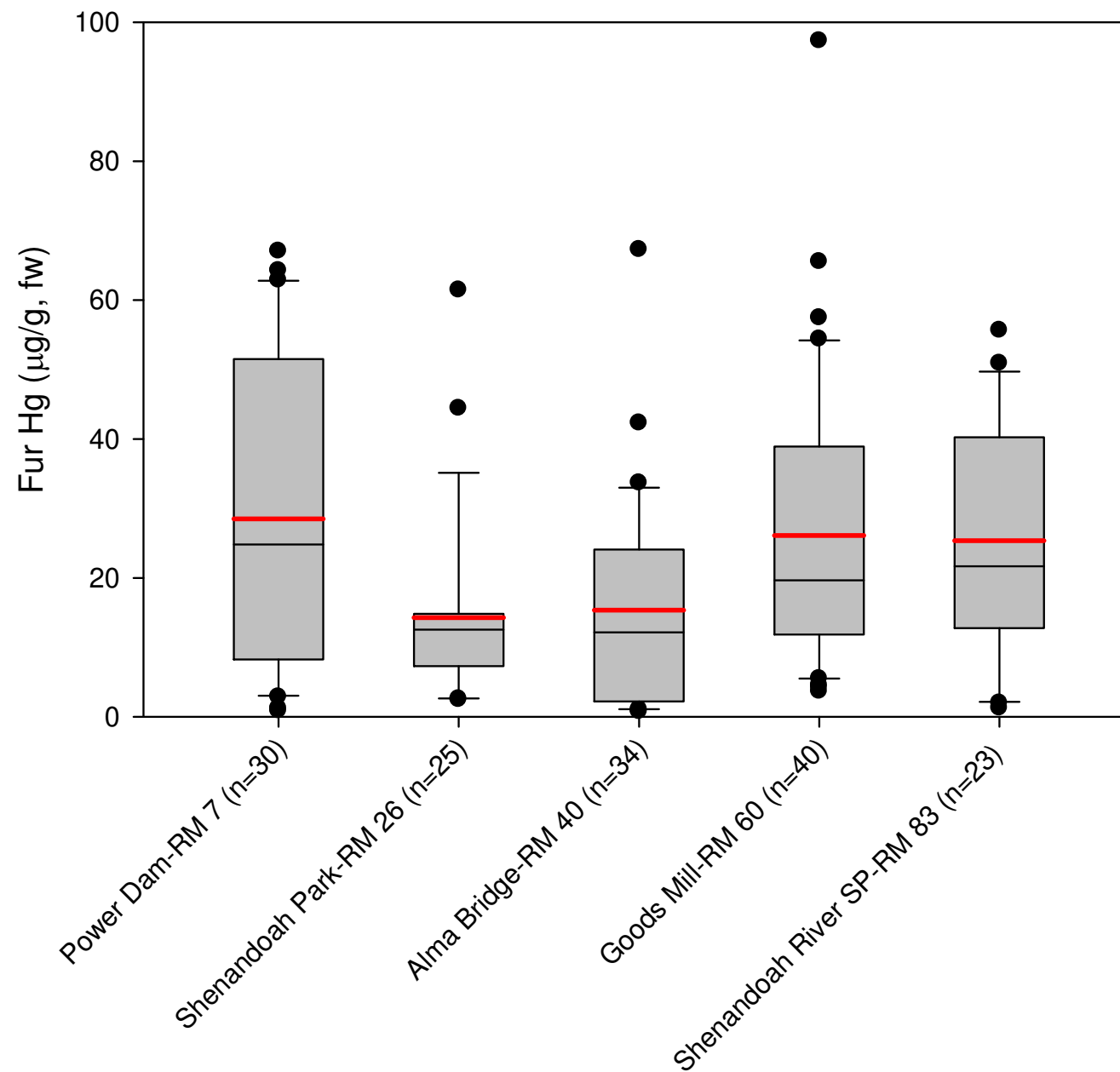
SRST meeting Jan 11, 2011

- Bat 2007-2009
- Toad/Turtle 2006-ongoing
- Bird 2005-ongoing
- Terrestrial trophic model 2009-2010
- Response to expert panel

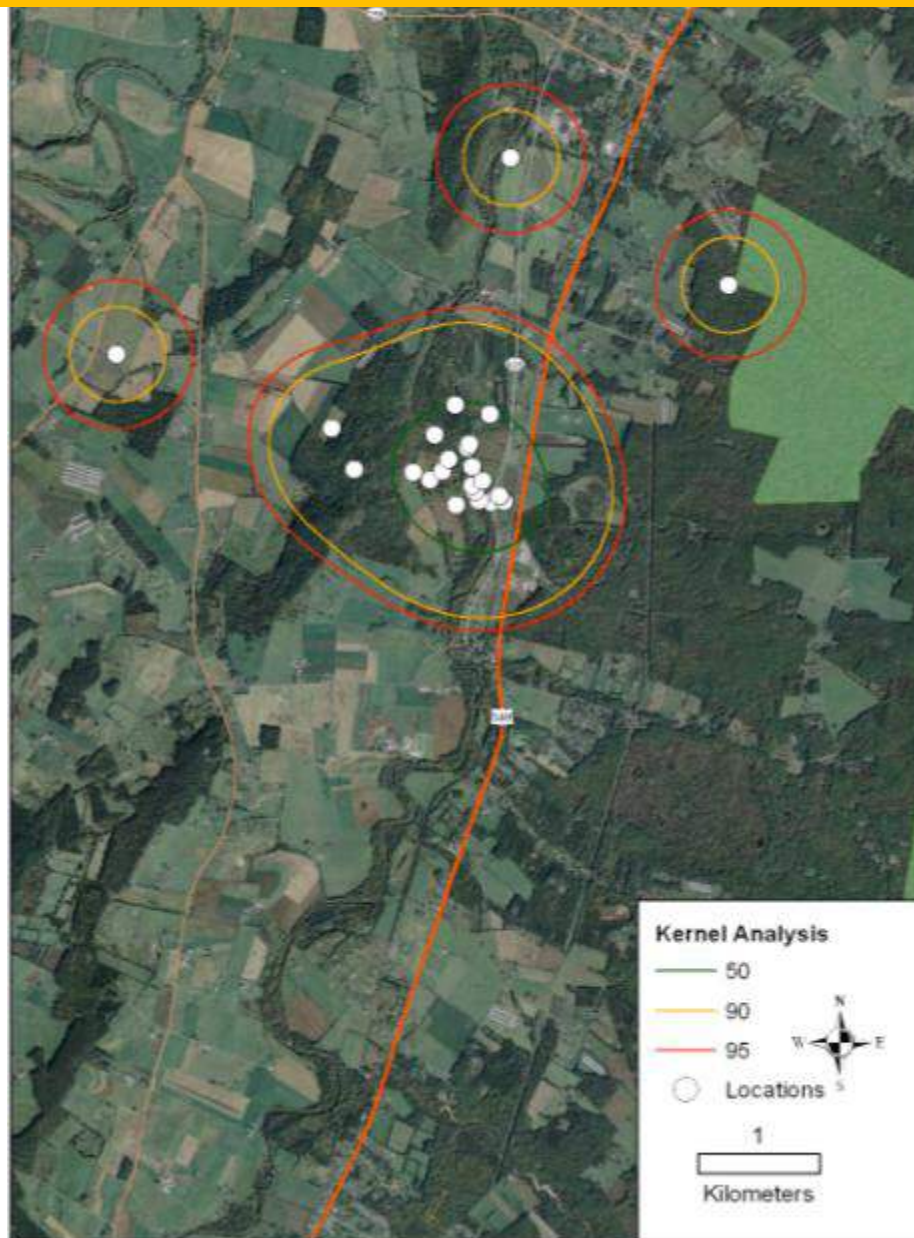
BAT STUDY 2009 – BRI (Dave Yates, Dave Evers)



BAT STUDY 2009 – BRI



BAT STUDY 2009 – BRI



Isopleth (at 50%, 90%, and 95%) with area and perimeter for frequency 151.256 (n=28)

PERCENT	AREA (km ²)	PERIMETER (km)
95	9.71	20.52
90	6.56	15.56
50	1.21	3.91

TURTLE STUDY – VA TECH (Bill Hopkins lab)



Snapping turtle
(*Chelydra serpentina*)



Stinkpot
(*Sternotherus odoratus*)



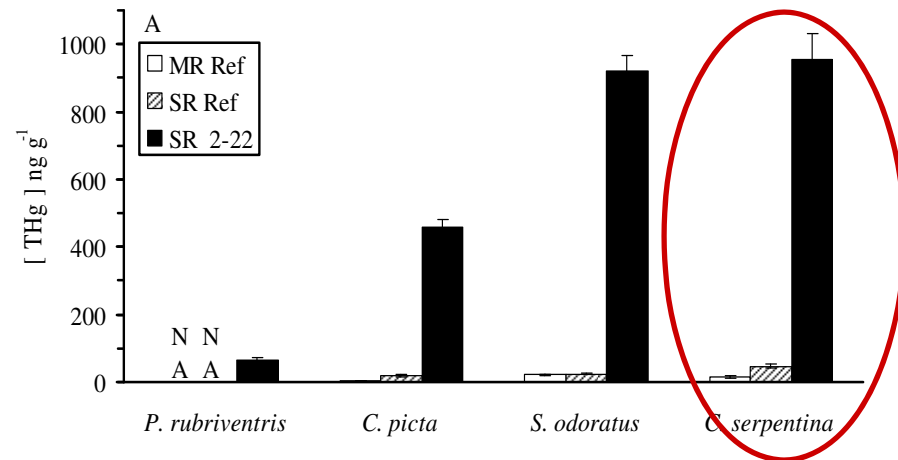
Painted Turtle
(*Chrysemys picta*)



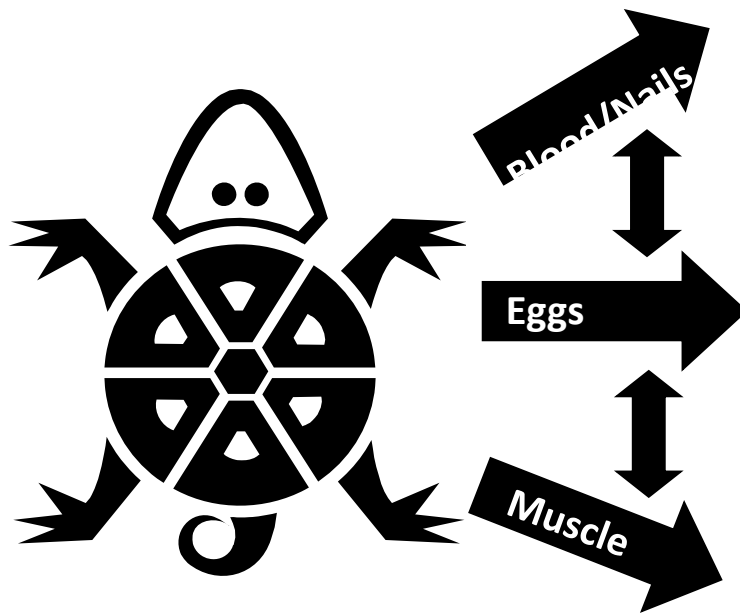
Red Bellied Turtle
(*Pseudemys rubriventris*)

TURTLE STUDY – VA TECH (Bill Hopkins lab)

2006 Project



2010-2012 Project



Female Exposure



Food Web Models

Embryo Exposure
Predator Exposure



Reproductive Effects
& Eco-risk

Female Exposure
Human Exposure



Human Risk Assessment

TURTLE STUDY – VA TECH (Bill Hopkins lab)



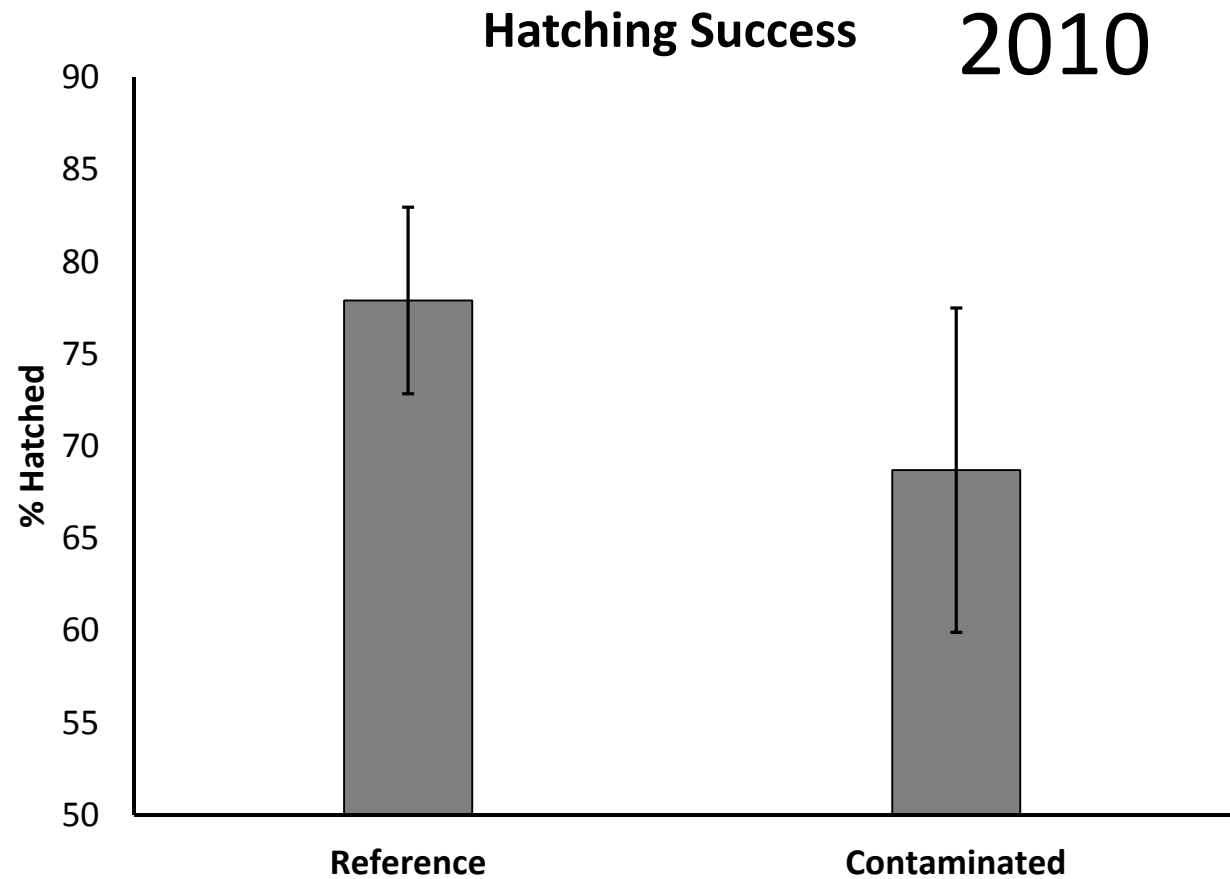
388

175

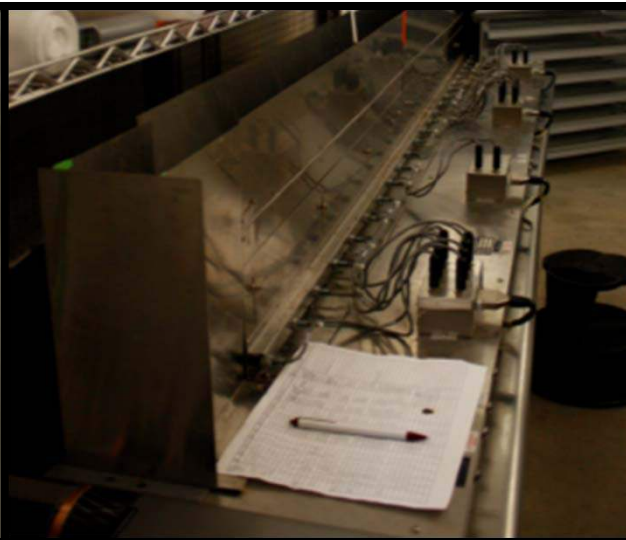
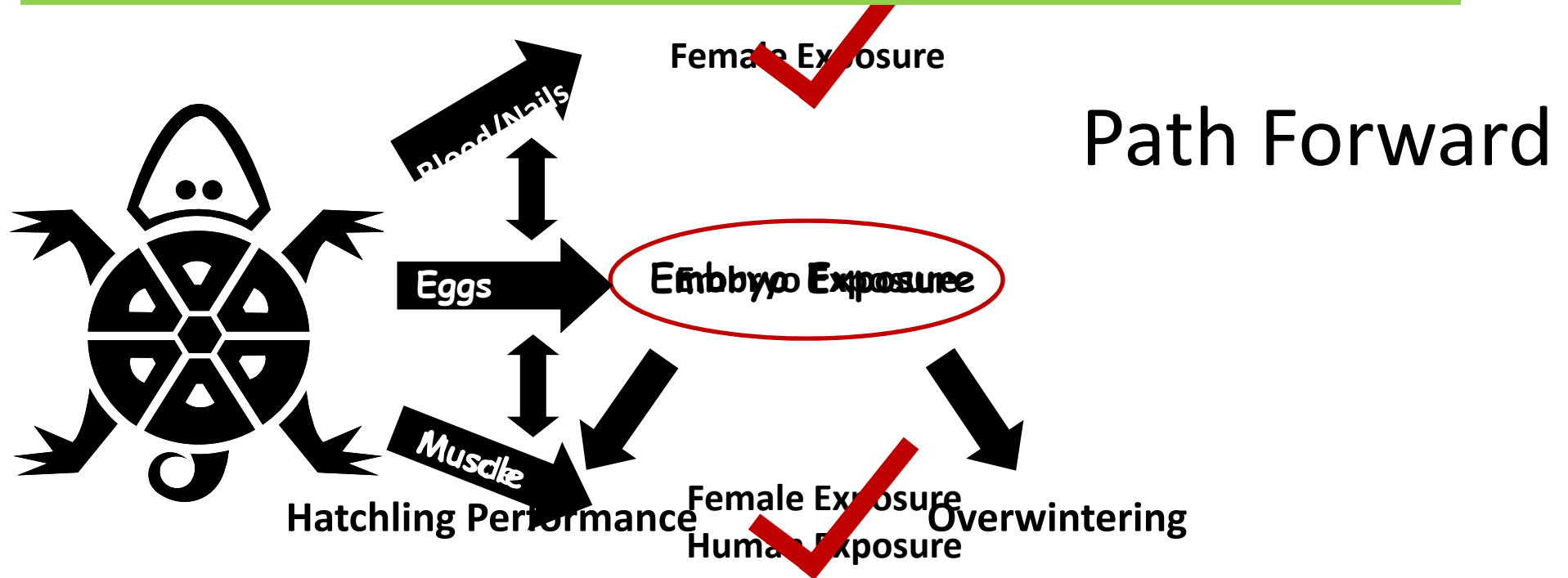
37



1,011

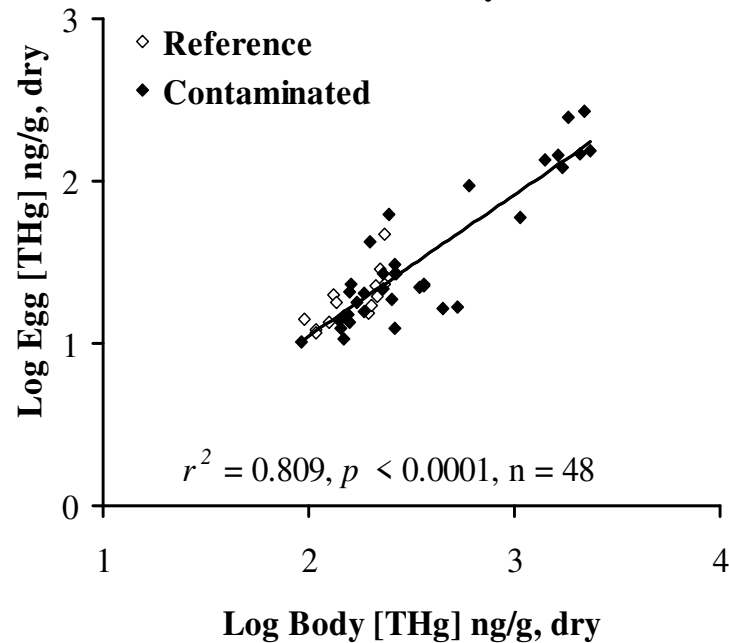


TURTLE STUDY – VA TECH (Bill Hopkins lab)

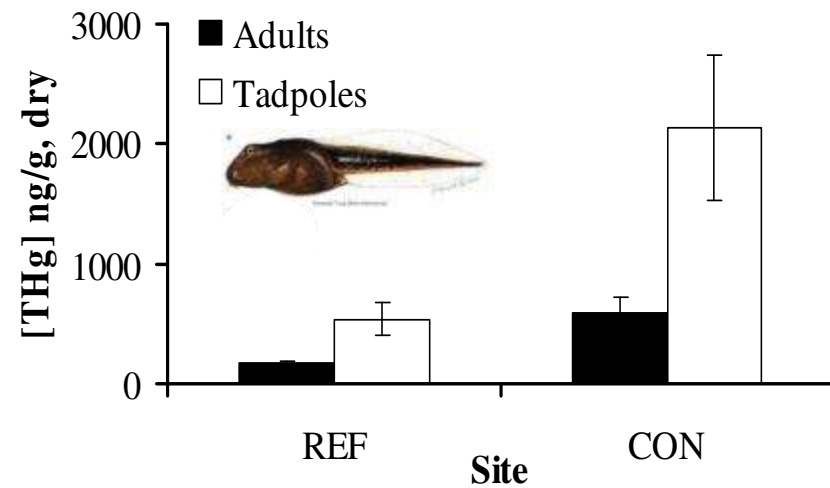


TOAD STUDY – VA TECH (Bill Hopkins, JD Willson)

Maternal Exposure



Dietary Exposure

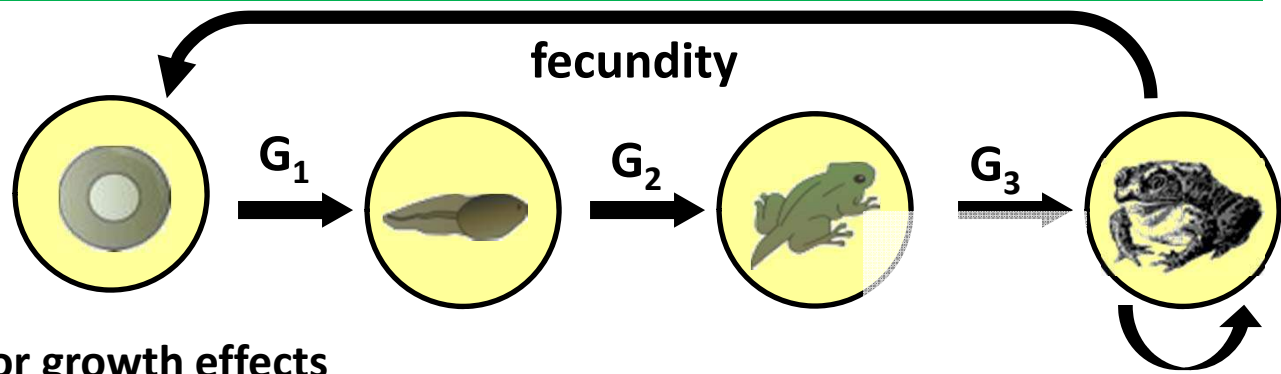


Bergeron et al. (2010) ET&C 29: 989-997

Bergeron et al. (2010) ET&C 29: 980-988

TOAD STUDY – VA TECH (Bill Hopkins, JD Willson)

Individual-Level Effects



- No effects on fecundity
- Dietary Hg alone = minor growth effects
- Maternal Hg alone = growth effects = delayed maturity
- Maternal + Diet Hg + limited food = **↓50% larval survival**

	Clutch Size	Embryonic Viability	Larval Growth	Larval Survival	Juvenile Survival	Juvenile Growth
Maternal	NE	-4% to -39% (annual variation)	-18% (ample food)	+16% to -17% (annual variation)	NE	-8%
Larval Diet	NA	NA	-26% (limited food)	NE	NE	NE
Maternal + Larval Diet	NE	-4% to -39% (annual variation)	-20% to -27% (food-dependent)	-50% (limited food)	NE	-8%

NE = no significant effect; NA = not a valid exposure route

TOAD STUDY – VA TECH (Bill Hopkins, JD Willson)

Prelim Conclusions from Model

- Embryonic effects and delayed maturity have minor effects on populations
- Maternal and dietary Hg *alone*
minor effects on population dynamics
- Larval effects have serious consequences
- Maternal and high dietary Hg *together*
 - ↓ adult density
 - ↑ local extinction
- Minor additional adult effects can be important



TOAD STUDY – VA TECH (Bill Hopkins, JD Willson)

The Path Forward...

Implications for Restoration

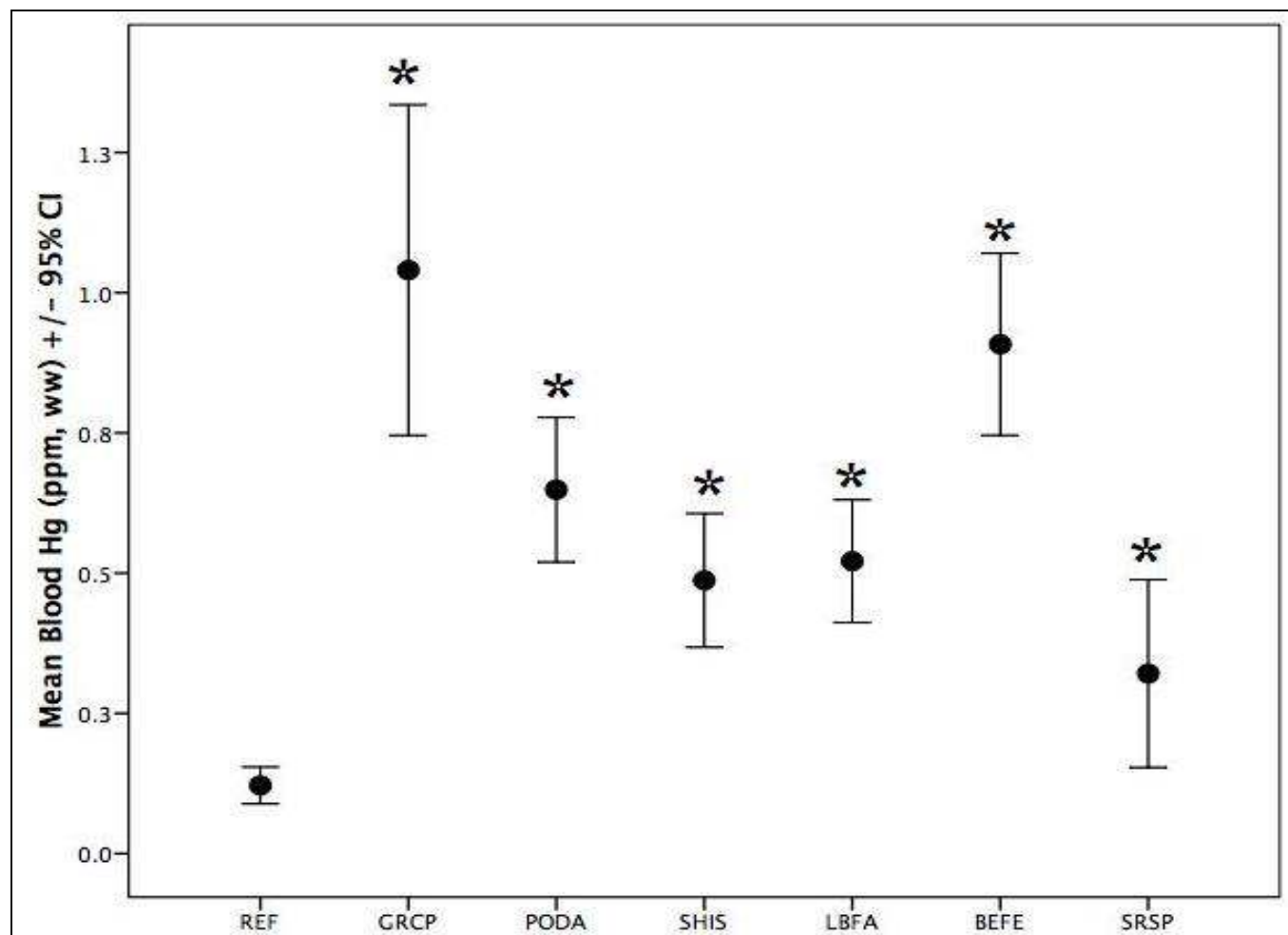
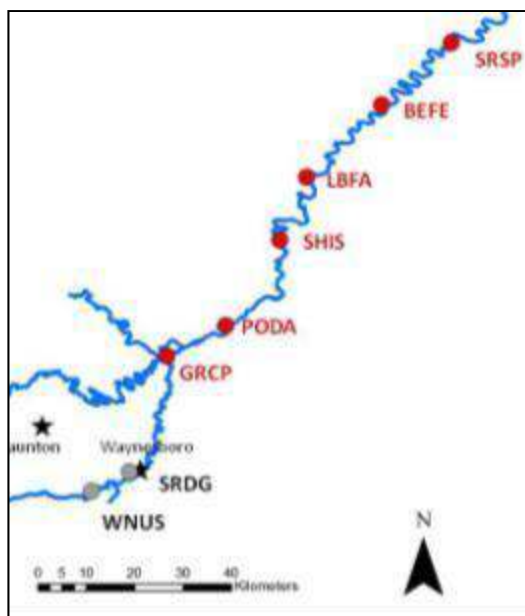
- Larval stage is a good target for restoration
- Reduce Hg exposure through larval diet
- Residual maternal effects have minor effects on abundance or extinction rate



Songbirds 2009 – BRI

Blood Hg in all AHY songbirds

* Indicates significant difference from reference
ANOVA, $P < 0.05$

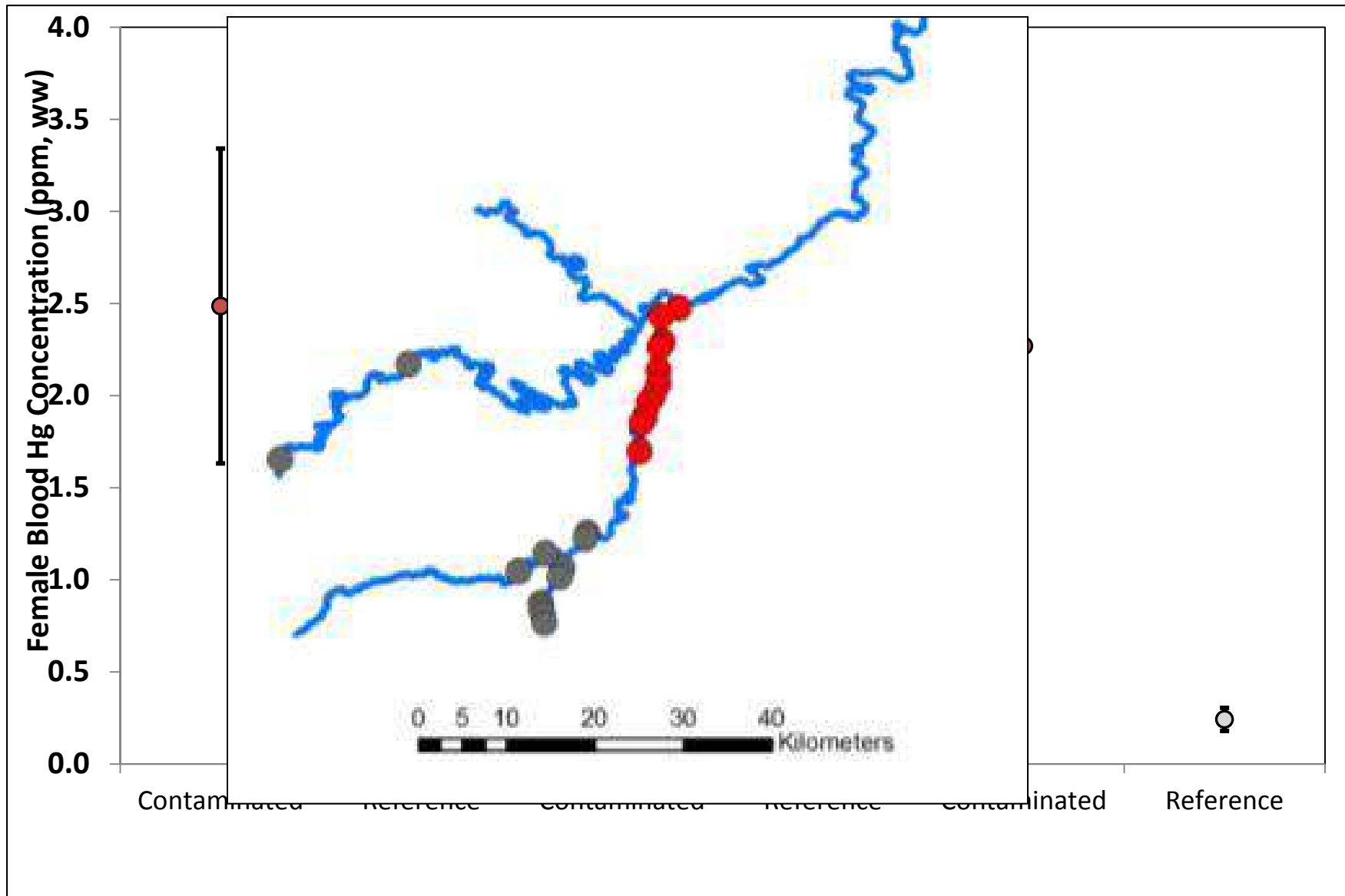


Songbirds 2009 – BRI

Comparison of Target Species

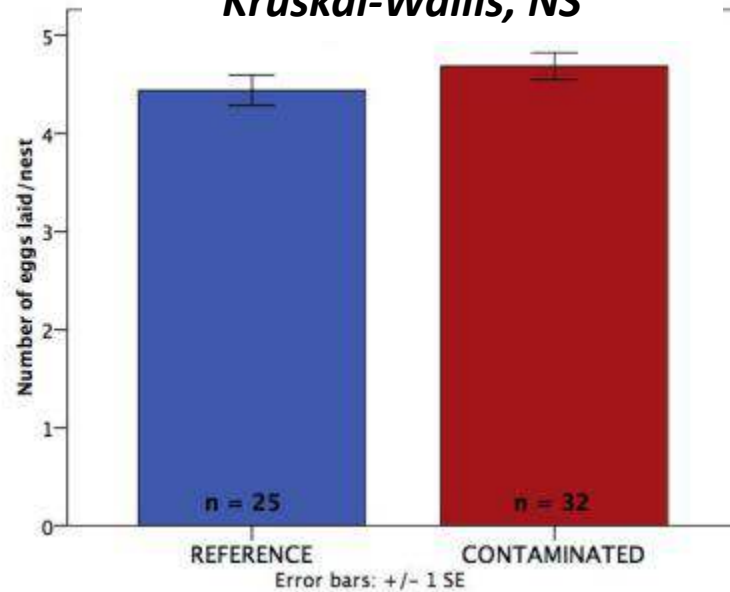


2010 South River Carolina wren study



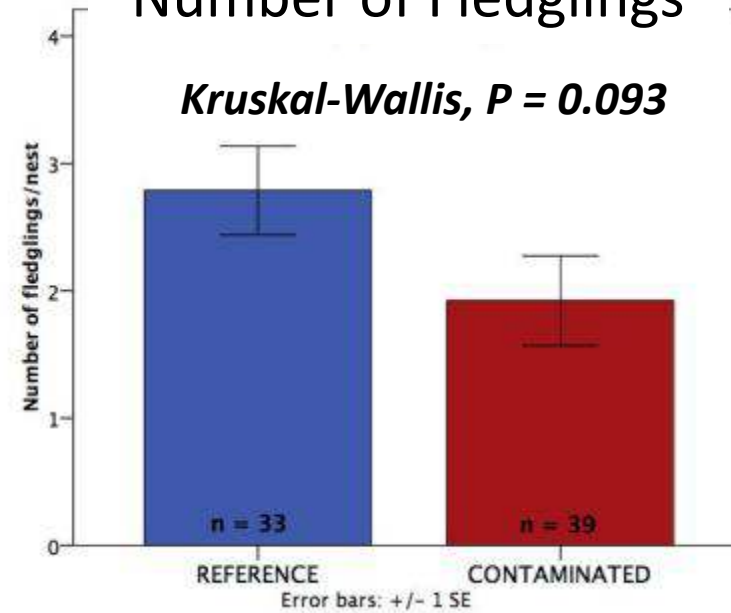
Clutch Size

Kruskal-Wallis, NS



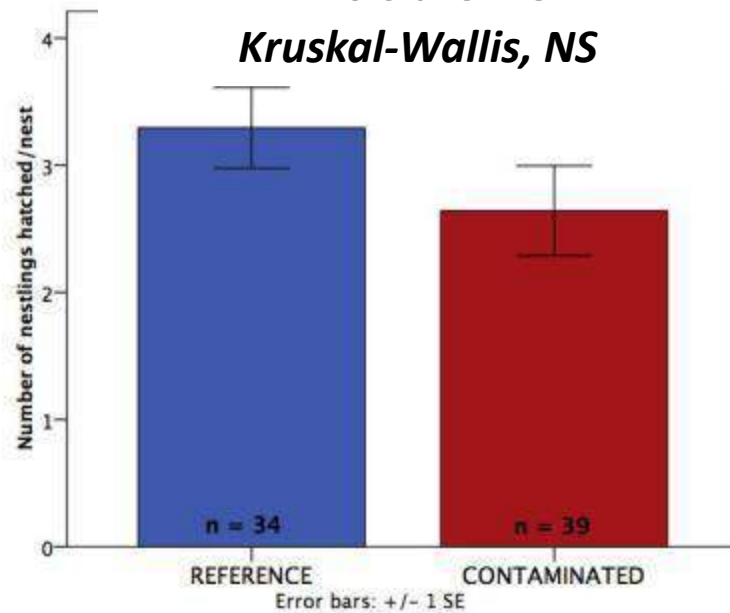
Number of Fledglings

Kruskal-Wallis, $P = 0.093$



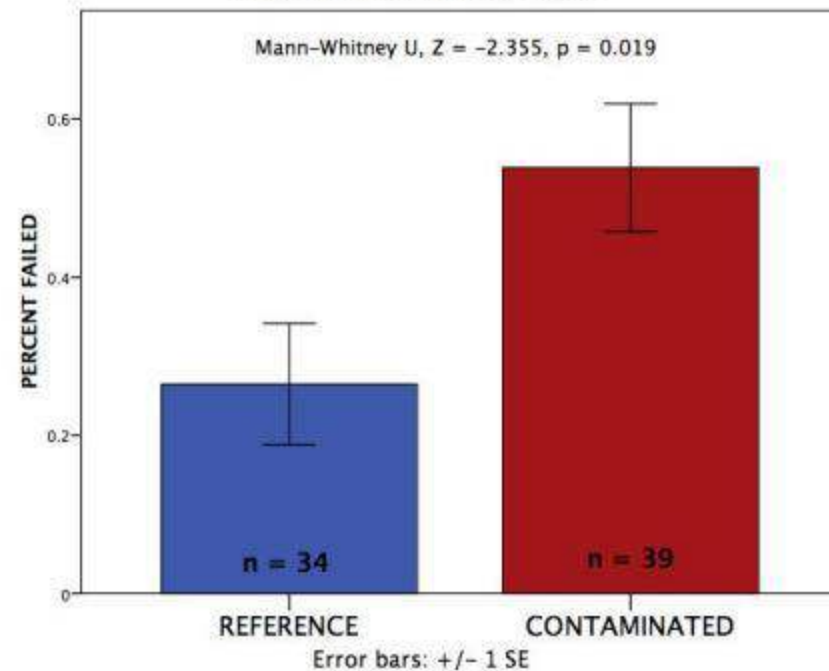
Brood Size

Kruskal-Wallis, NS

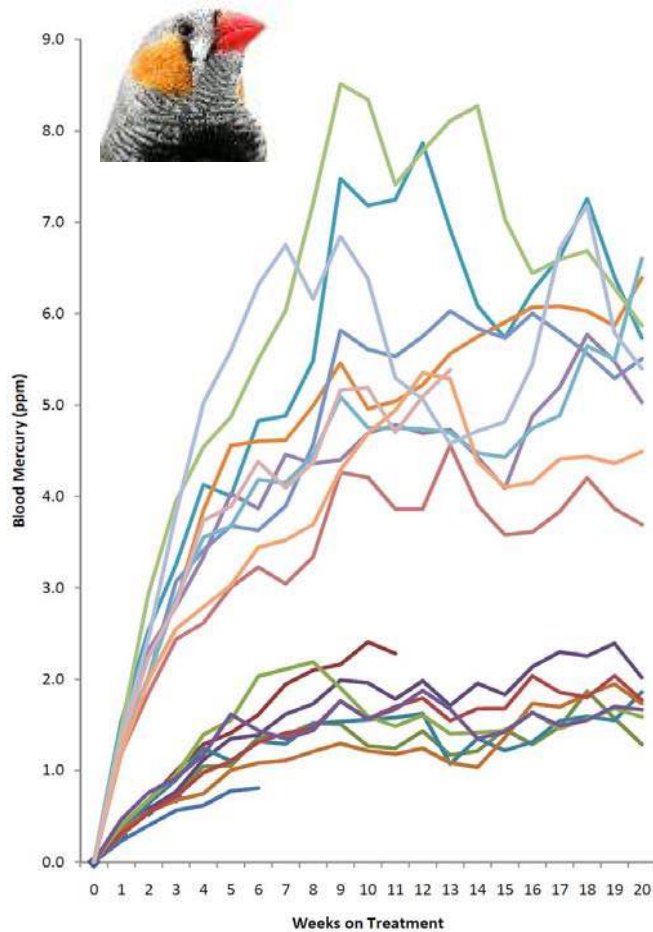


PERCENT OF NESTS THAT FAILED

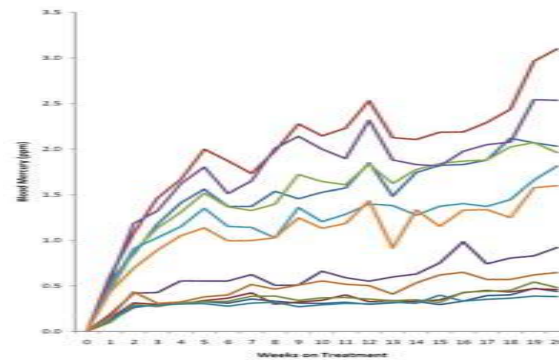
Mann-Whitney U, $Z = -2.355$, $p = 0.019$



Dosing Study—William and Mary, Dan Cristol



Species differ. Starlings fed same amount of mercury had lower levels than zebra finches



0.4 ppm

0.1 ppm

Dosing Study—William and Mary, Dan Cristol

Path Forward - Final round of dosing: January 2011

- MeHgCys only
- Starlings, finches and wrens
- Doses: finch: 0, 0.25, 0.5, 0.75, 1.0
starling: 0, 0.75, 1.0
wren(?): 0, 0.75, 1.0
- Focus on: reproductive success and behavior
endocrine disruption
immune suppression
- Expected completion: August 2012

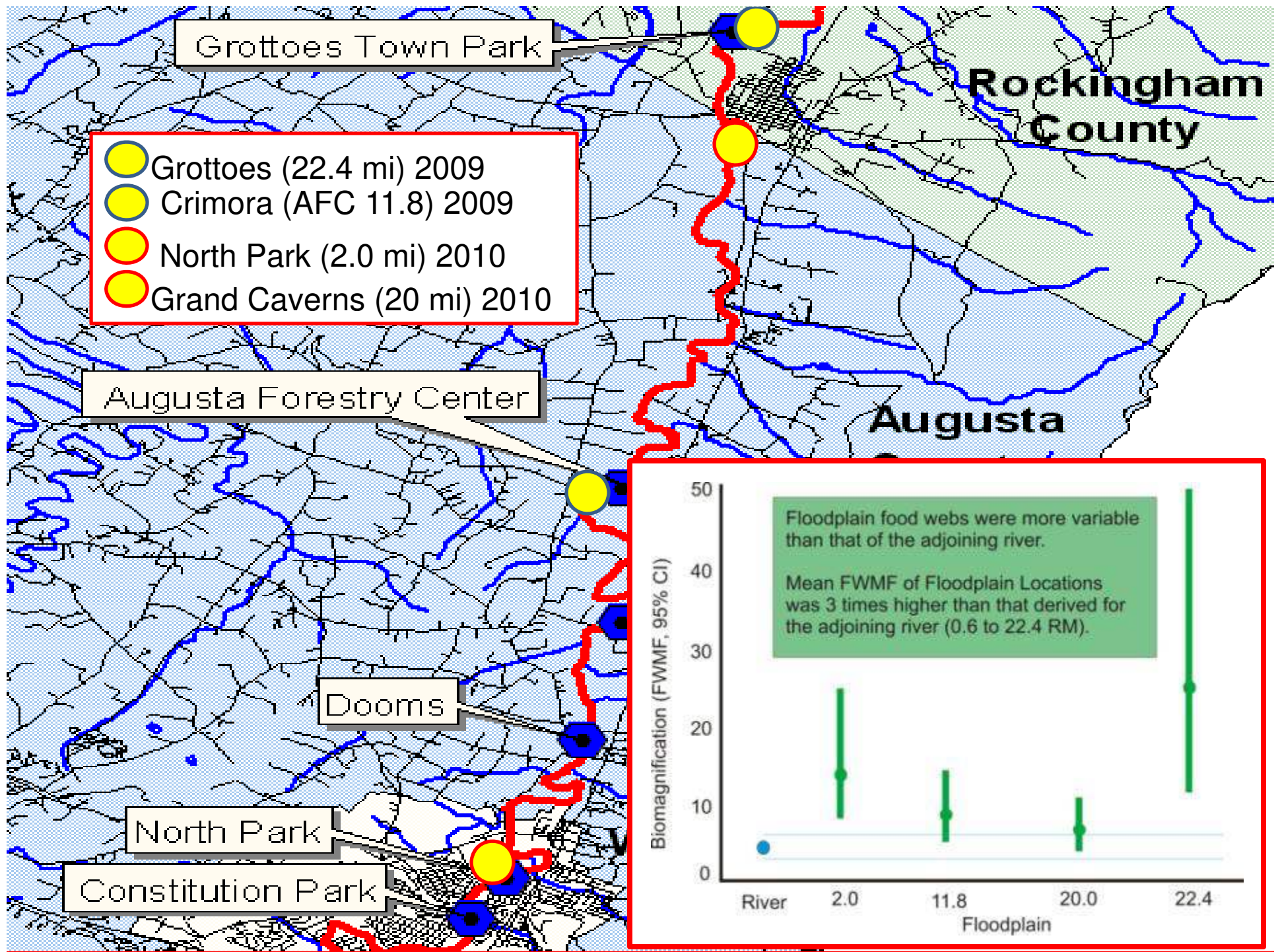
Trophic Model—VIMS, Mike Newman

Goal

Produce tools for predicting mercury movement to at-risk biota (including humans).

Core Premise

**Once mercury enters the biota,
its most important movements to
understand involve trophic
exchange.**



Trophic Model—VIMS, Mike Newman

Overall Conclusions

AQUATIC

- Successful modeling for predicting [Hg] in receptor biota
- Substantial reductions required to resolve endpoint concerns

FLOODPLAIN

- Successful predictive modeling at two of four locations
- Some predictive ability to offer managers at all locations
- High variability as suspected prior to study

COMPARATIVE

- Biomagnification factors higher for floodplain than river food web
 - Includes mammals and birds
 - Differences in available Hg?
 - Thermal conditions?



Expert Feedback

- Source of Hg to terrestrial food webs
- Terrestrial Trophic Models
- Foraging habits
- Other spiders
- Modify restoration per site based on trophic magnification factor
- Methylation
- Modify restoration ?

Expert Feedback

- Effects on amphibians and reptiles
- Continue with the modeling
- Use insights to lessen exposure to avian species
- More collaboration