

Effects of contaminants on the shovelnose sturgeon as a surrogate for the endangered pallid sturgeon

J. Buckler¹, J. Candri², M. McKee³, D. Papoulias², D. Tillitt², D. Galat¹

¹University of Missouri-Columbia 302 ABNR Columbia, MO, ²USGS, Columbia Environmental Research Center, 4200 New Haven Rd., Columbia, MO, ³Missouri Department of Conservation, 1110 S. College Ave, Columbia, MO

Abstract

Polychlorinated biphenyls (PCBs) continue to be of environmental concern in aquatic habitats even though their production and use has been banned since 1979. Concurrently, shovelnose sturgeon (*Scaphirhynchus platyrhynchus*) and pallid sturgeon (*Scaphirhynchus albus*) populations have been in decline over the past century and contaminants may be a contributing factor. An egg exposure study was performed to determine the effects of PCB 126 on the development of shovelnose and pallid sturgeon. Eggs from shovelnose and pallid sturgeon were exposed to 3,3',4,4',5-pentachlorobiphenyl (PCB 126) in a water bath during water hardening. Percent fertilization, percent hatch, percent survival, and gross pathologies were used to determine effects of PCB 126 on exposed eggs. Additionally, a complementary reproductive assay was conducted to assess the effects of PCBs on sturgeon reproduction. Extracts from the egg samples were isolated to conduct H4IIE bioassays to determine the potency of the extracts. Results of these studies will be used to determine the potential effects of PCB exposures on sturgeon populations and to determine the suitability of using the shovelnose sturgeon as a surrogate for the pallid sturgeon in toxicity testing.

Objectives

- Determine the developmental effects of pure PCB 126 on shovelnose sturgeon and pallid sturgeon via water bath exposure of fertilized eggs
- Determine the sensitivities of shovelnose sturgeon and pallid sturgeon to PCB 126

Methods

- Shovelnose and pallid sturgeon eggs
- Nominal PCB 126 egg concentrations Acetone, 16, 80, 400, 2000 ng/g egg (Table 1)
- Determined percent fertilization, hatch, and mortality
- Recorded pathologies
- Daily dead removal
- Ended at 30 days post fertilization

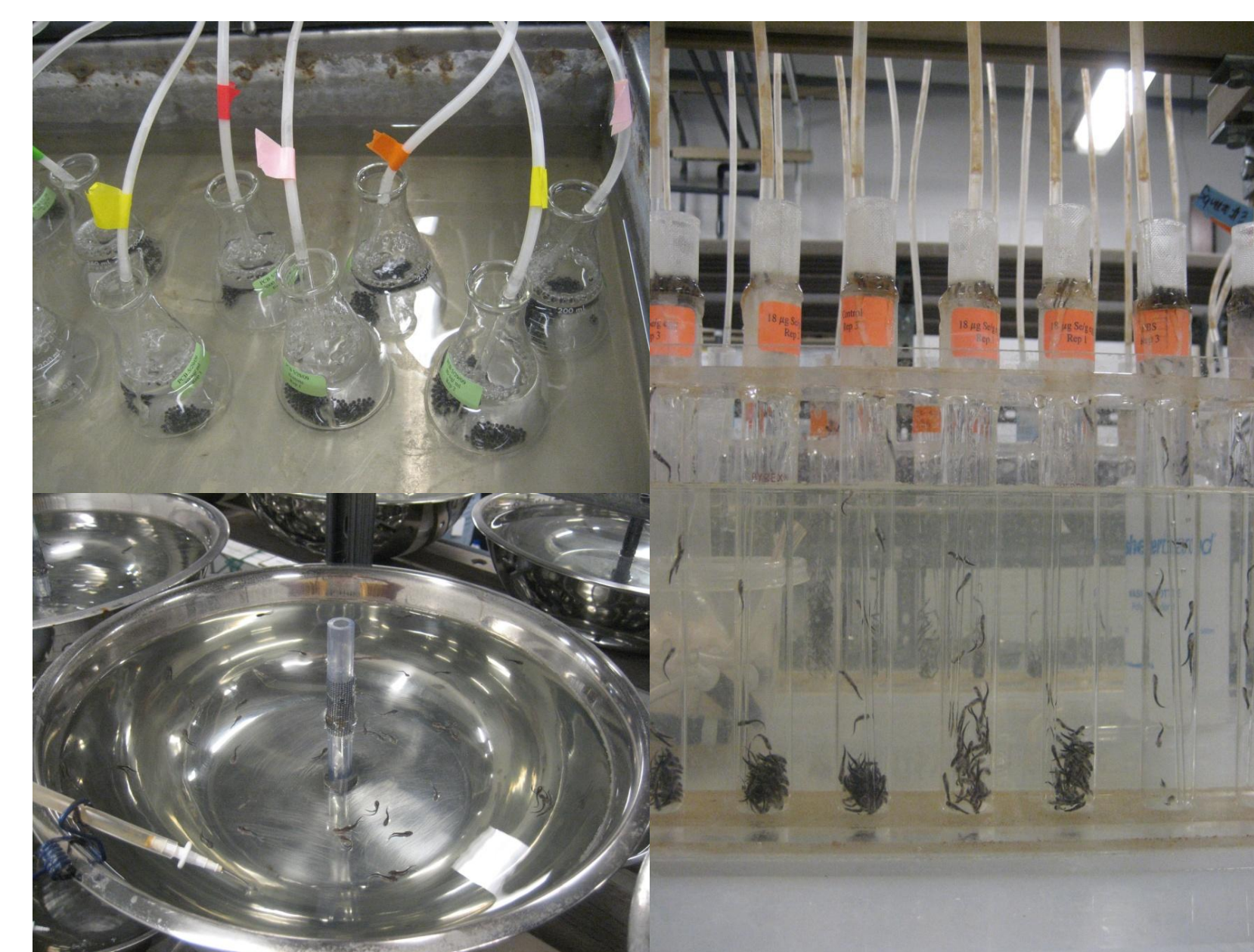


Figure 1. Exposure flasks, hatching tubes, and rearing bowls used during the egg exposure.

Results

Nominal Egg Dose (ng/g egg)	Replicate No.	Shovelnose Sturgeon Measured Egg Dose (ng/g egg)	Pallid Sturgeon Measured Egg Dose (ng/g egg)
A	1	3	0
	2	1	0
	3	1	0
16	1	69	49
	2	104	69
	3	88	62
80	1	176	192
	2	232	225
	3	233	165
400	1	1250	421
	2	1140	363
	3	1040	366
2000	1	1770	685
	2	1960	729
	3	1400	600

Table 1. Dose information from shovelnose sturgeon and pallid sturgeon egg exposures. Measured doses were determined from using a 10 egg sample from each replicate.

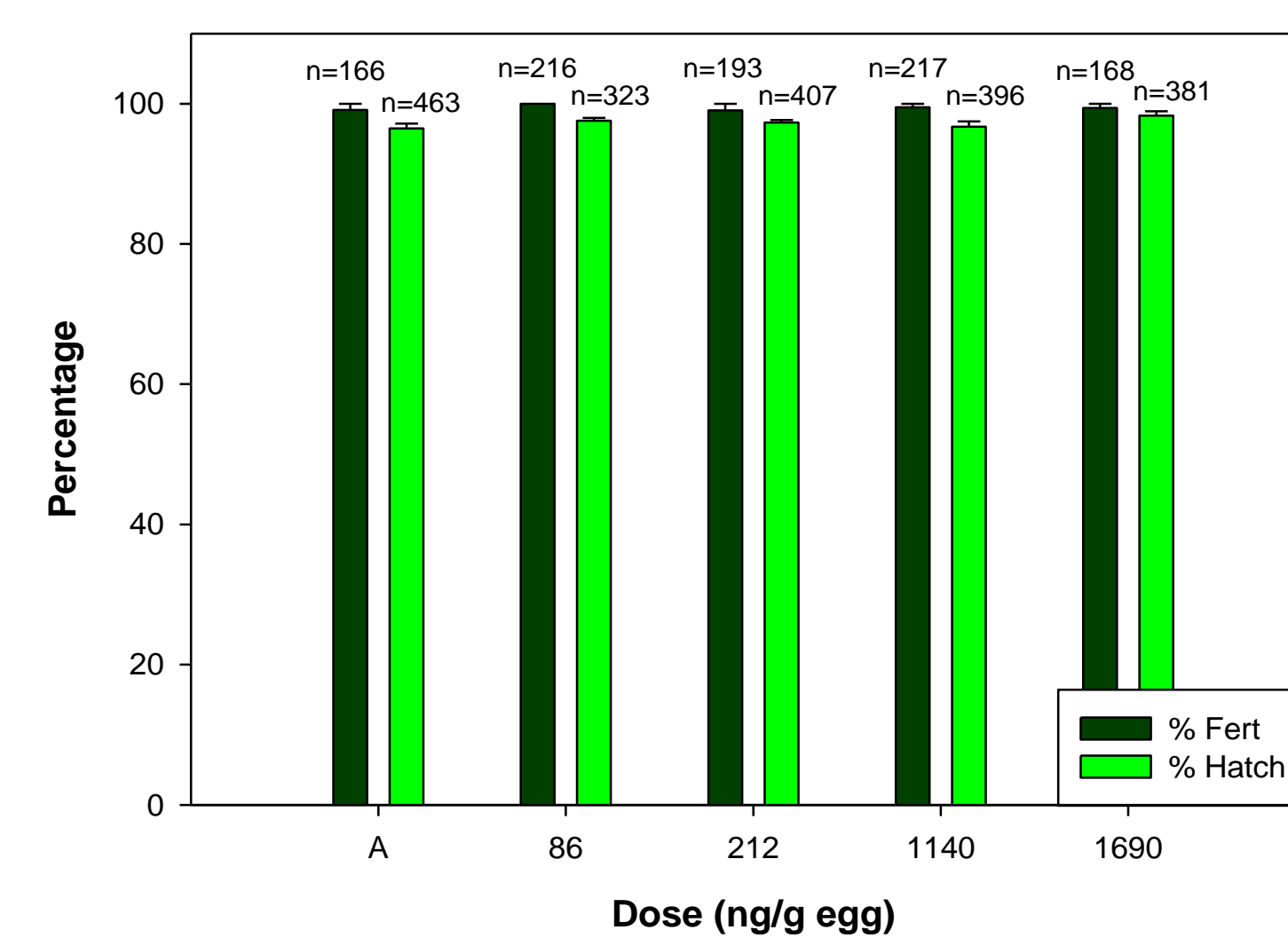


Figure 2. Shovelnose sturgeon fertilization and hatch percentages. No statistical significance exists between doses for fertilization or hatch.

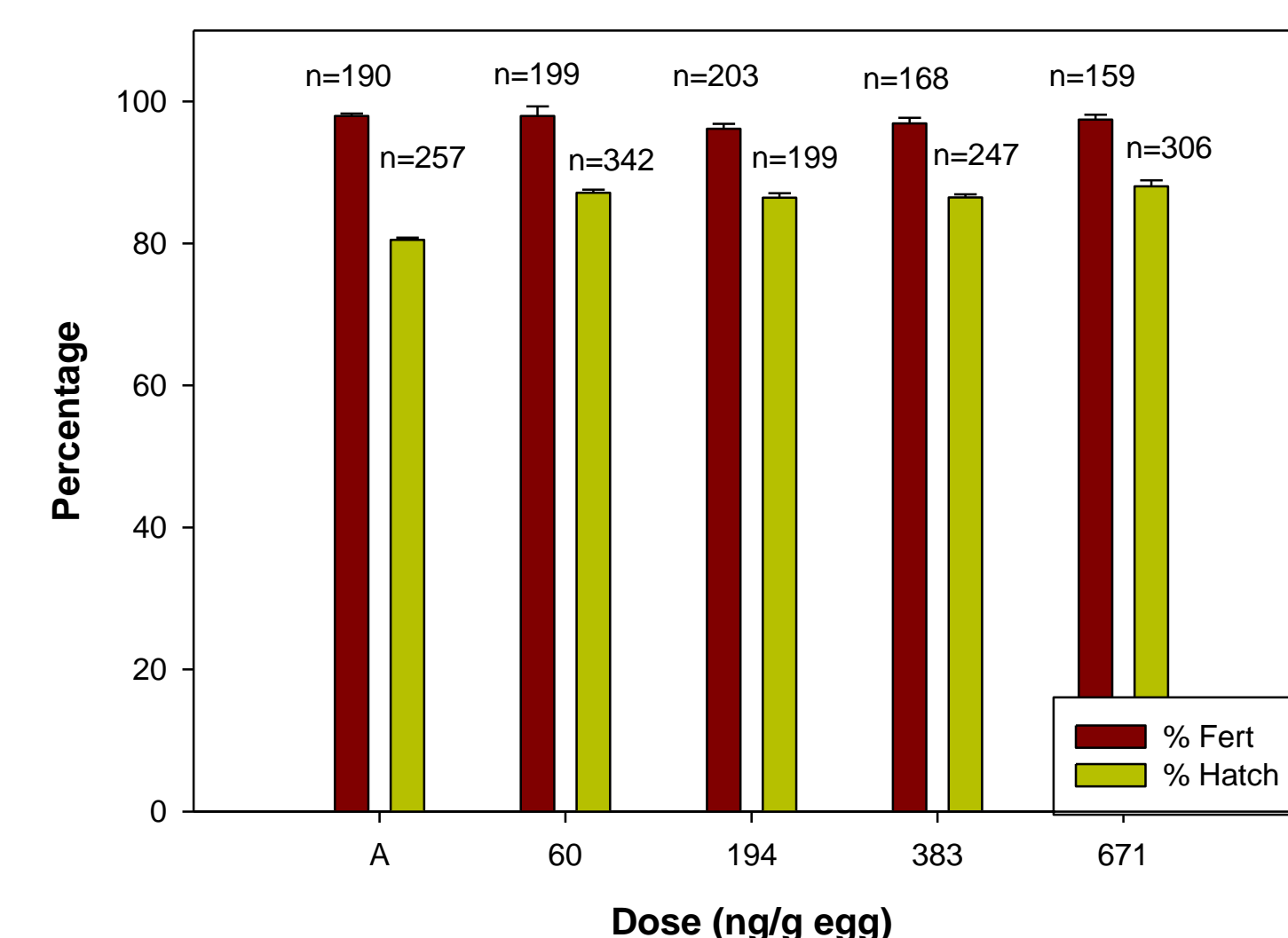


Figure 3. Pallid sturgeon fertilization and hatch percentages. No statistical significance exists between doses for fertilization or hatch.

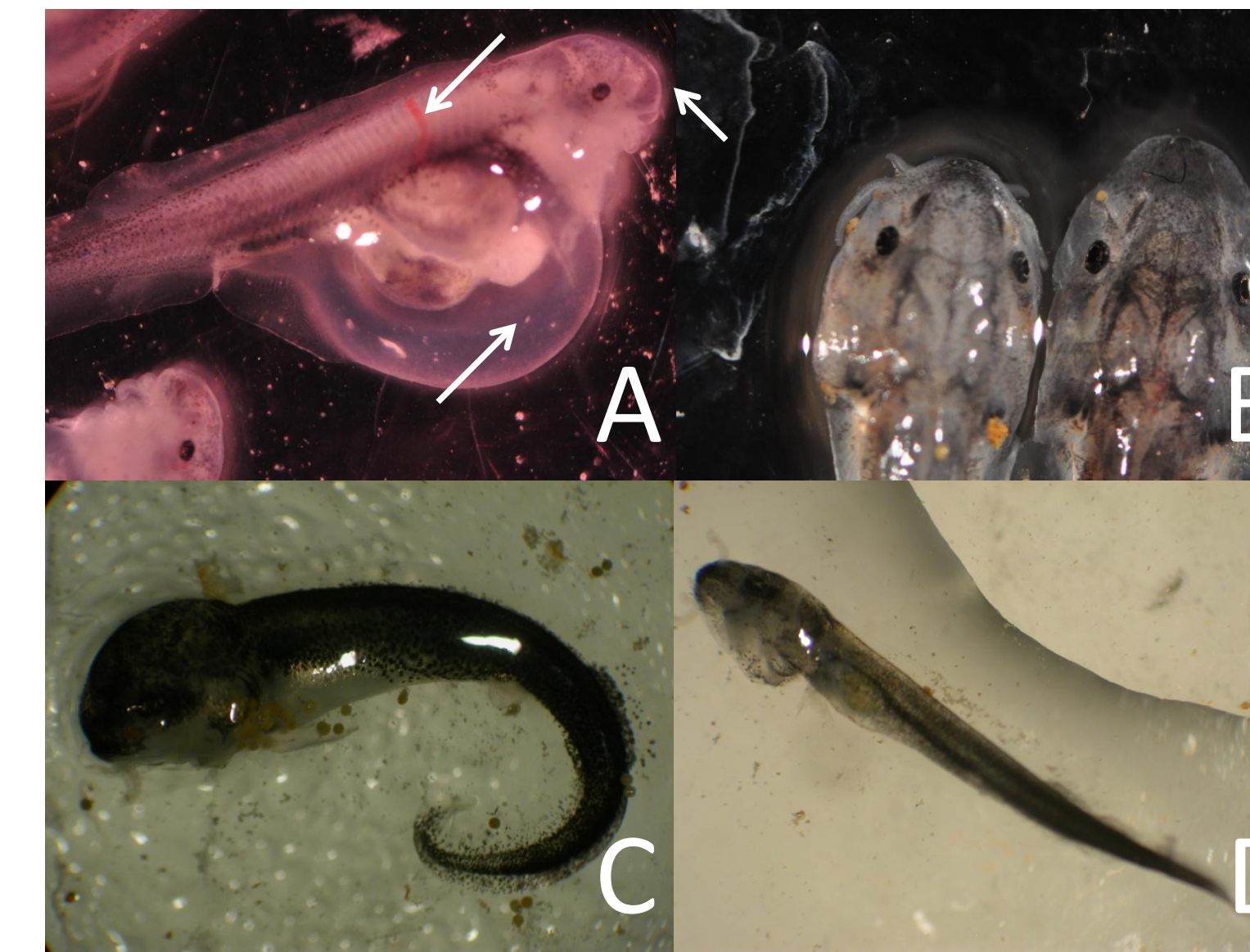


Figure 4. Pathologies in pallid and shovelnose sturgeon from the egg exposure study
A) Pallid sturgeon larvae with pathologies
B) Pallid sturgeon with a shortened snout
C) Shovelnose sturgeon showing craniofacial deformity
D) Control shovelnose sturgeon

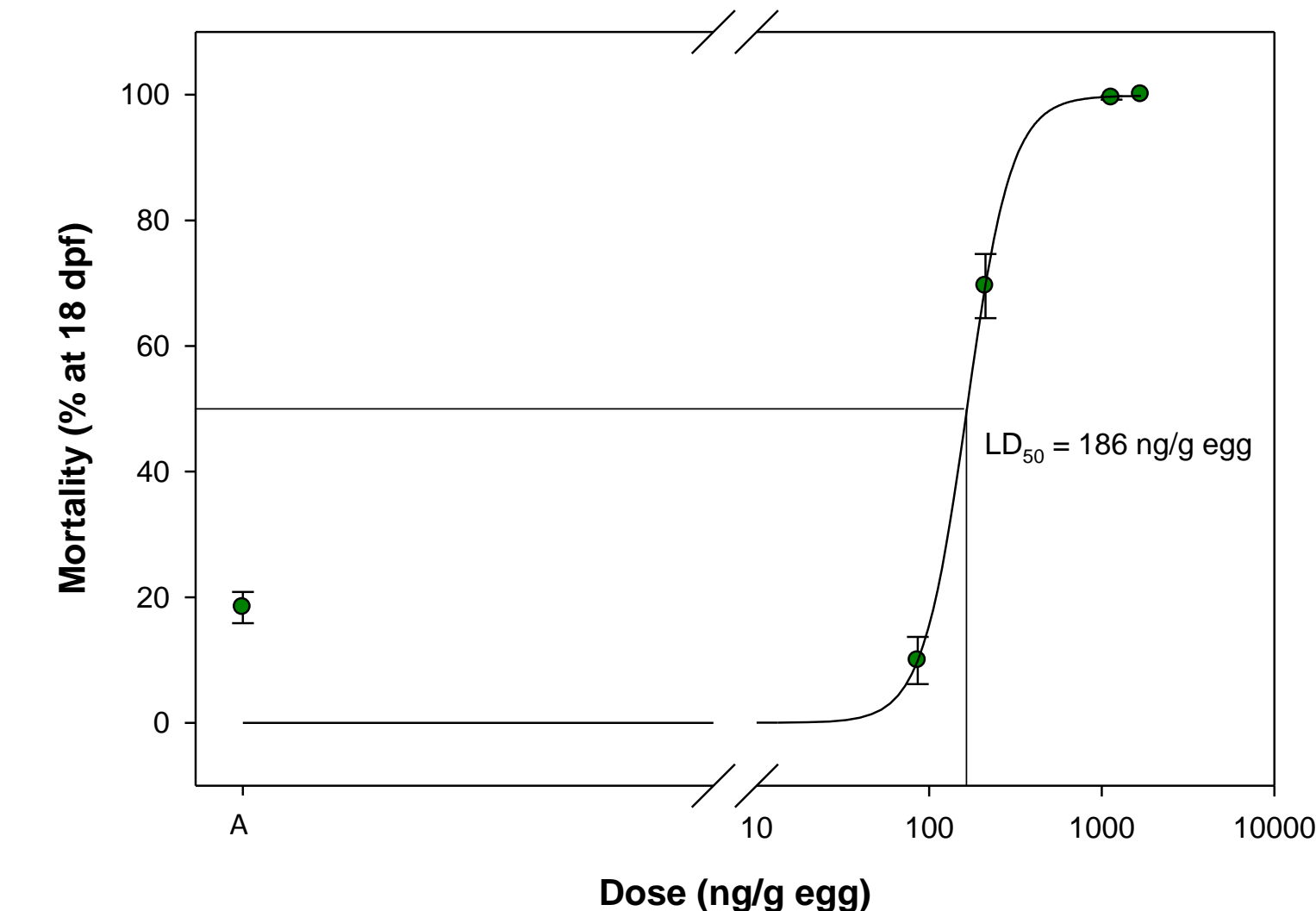


Figure 5. Dose response curve from shovelnose sturgeon egg exposure $r^2 = 0.9550$. Dose reported as measured dose in egg samples. LD_{50} value calculated using TOXCALC software.

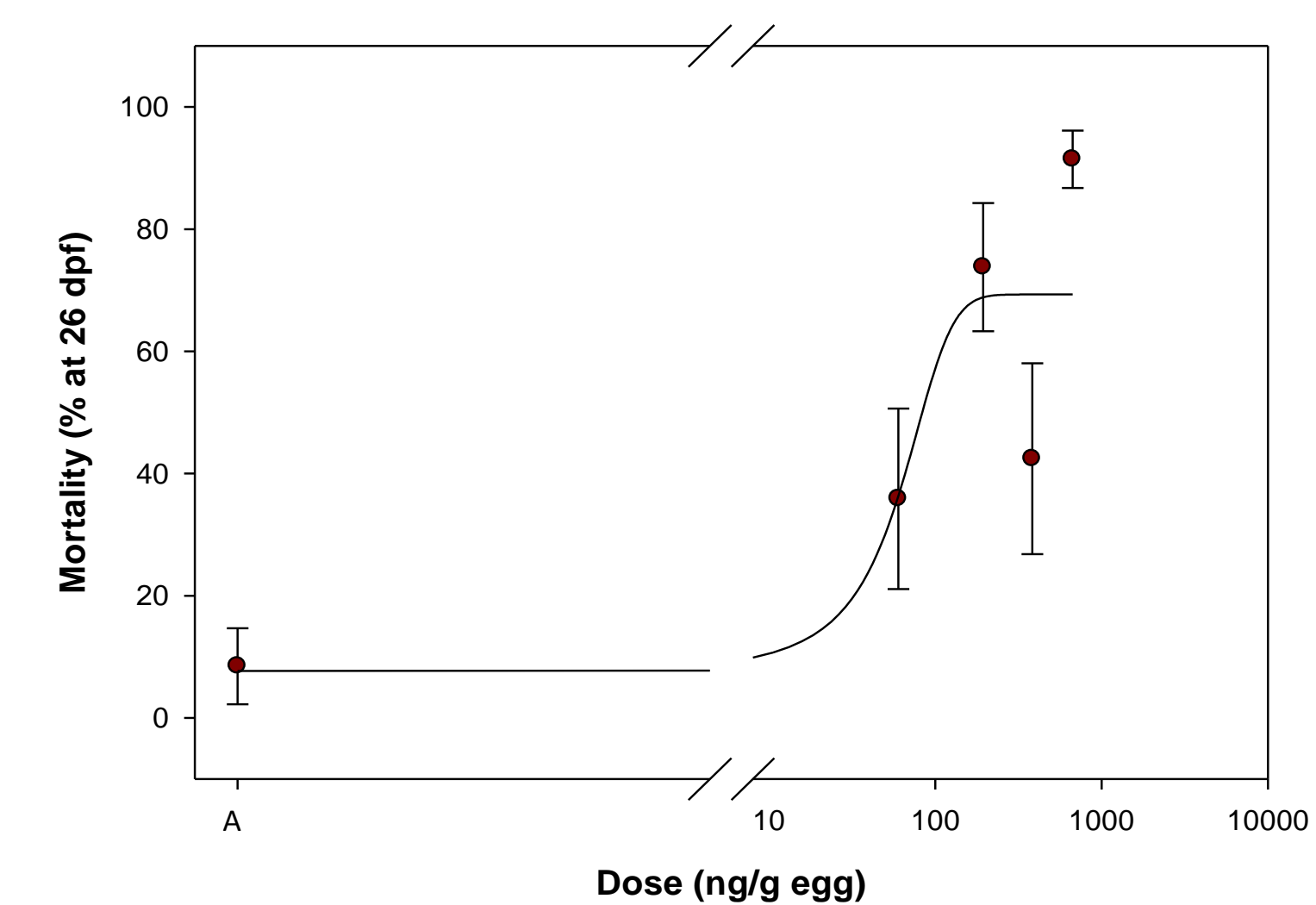


Figure 6. Dose response curve from pallid sturgeon egg exposure $r^2 = 0.7111$. Dose reported as measured dose in egg samples.

Species	LD_{50} (TEF)	Source
rainbow trout (<i>Oncorhynchus mykiss</i>)	0.005	Walker and Peterson (1991)
Japanese medaka (<i>Oryzias latipes</i>)	0.032	Kim and Cooper (1999)
pallid sturgeon (<i>Scaphirhynchus albus</i>)	0.058*	this study
shovelnose sturgeon (<i>Scaphirhynchus platyrhynchus</i>)	0.069	this study

Table 2. LD_{50} reported as TEFs for other test organisms. (*estimated using 12.9 ng TCDD/g egg LD_{50} for shovelnose sturgeon)

Discussion

- No significant differences in fertilization or hatch percentages (Figures 2 and 3)
- Pathologies first seen at day 4 post fertilization
- Edemas and hemorrhaging most common pathologies
- Shovelnose sturgeon measured PCB 126 LD_{50} – 186 ng/g egg (95% CI 86 – 212) at 18 dpf
- Pallid sturgeon measured PCB 126 LD_{50} – 224 ng/g egg (95% CI 186 – 269) at 26 dpf
- Shovelnose and pallid similar in percent fertilization
- Shovelnose and pallid sturgeon similar in sensitivity to PCB 126 (Table 2)
- Similar pathologies in shovelnose and pallid sturgeon species (Figure 4)

Concurrent Research

- Reproduction Assay
- Correlate egg exposure study with wild shovelnose sturgeon reproduction
- Correlate PCB egg concentrations with reproductive parameters
- Correlate H4IIE derived toxicity estimates with PCB concentrations in eggs

Acknowledgements

We thank Travis Moore and Dave Herzog for collecting fish for the reproduction assay, Bruce Drecktrah and staff at Blind Pony, as well as Mandy Annis, Denny Buckler, Rachael Claunch, Robert Gale, John Meadows, Diane Nicks, Lisa Tracy, and Vanessa Velez for their help conducting this study.

Works Cited

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