



Early Life History Exposures to Cadmium in Fathead Minnows: Effects on Reproduction

Environmental Issue

- Cadmium (Cd) is common in the environment
 - Cd is used in several industrial processes
 - Cigarette smoke is a primary source of Cd, but it can be found in water, air and food.
- Cd may disrupt endocrine function
 - Cd activates estrogen and androgen receptors (Keitt et al., 2004)
- Estrogenic and androgenic compounds can disrupt pattern development
 - Exposure to exogenous estrogens or androgens during development can cause permanent damage to reproductive organs.

Scientific Approach

- Overview: The primary goal of this project is to determine if exposure to Cd during development affects the reproductive success and reproductive physiology of fish. A second objective is to determine which developmental stages are most sensitive to Cd exposure. To achieve these goals, the breeding success of fathead minnows (*Pimephales promelas*) exposed to Cd during various developmental stages will be compared to that of unexposed fish.



- Hypothesis: Exposure to Cd during development impairs the reproductive success and alters the reproductive physiology of fish.

•Research Plan:

- Determine if exposure to Cd during development impairs reproduction*
 - A 21-d breeding study will determine reproductive success (Ankley et al., 2001).

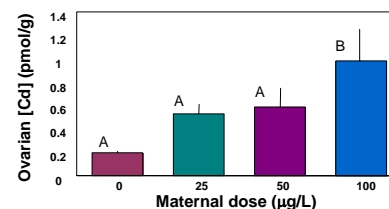
- Determine if exposure to Cd during development alters reproductive physiology*
 - The number of breeding tubercles, intraocular distance and plasma sex steroid concentrations of males will be determined.
 - Gonads will be removed from all fish, gonadosomatic index will be determined and histological analysis can be conducted.

Determine which developmental stages are most sensitive to Cd exposure

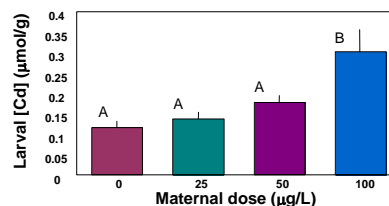
- Fish will be exposed to Cd during critical developmental stages including periods of embryonic development and sexual differentiation.
- Fish will be exposed during embryonic development by way of maternal transfer in which Cd-exposed females transfer Cd to their embryos. Fish exposed during other developmental stages will be exposed to water-borne Cd.

•Preliminary Results:

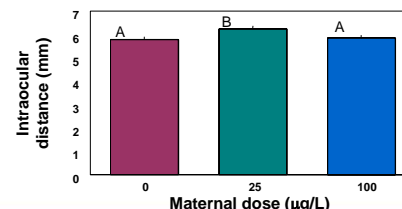
- Cd-exposed females accumulate Cd in their ovaries in a dose-dependent manner.



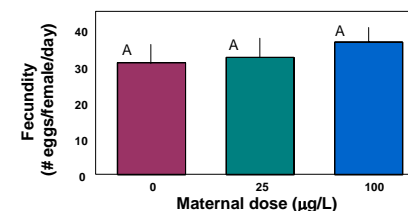
- Cd-exposed females transfer Cd to their offspring in a dose-dependent fashion.



- Exposure to Cd during embryonic development alters the intraocular distance of males.



- Exposure to Cd during embryonic development does not impair reproductive success.



Impacts

- Information from this study will:
 - enhance the current understanding of metal toxicity by showing the ability of Cd to act as an endocrine disruptor
 - identify potential population-level effects of Cd exposures in fish
 - identify developmental stages that are most sensitive to Cd exposures

Citations: Ankley, G.T., K.M. Jensen, M.D. Kahl, J.J. Korte and E.A. Makynen. 2001. Description and evaluation of a short-term reproduction test with the fathead minnow (*Pimephales promelas*). *Environ. Toxicol. Chem.* 20: 1276-1290.

Keitt, S.K., T.F. Fagan and S.A. Marts. 2004. Understanding sex differences in environmental health: a thought leaders' roundtable. *Environ. Health Perspect.* 112: 604-609.

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