

Egg Injections as a Hybrid Field-Lab Technique for Assessing the Embryotoxicity of Methylmercury to Different Birds

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Introduction

Part of the challenge in CALFED mercury research is to use controlled laboratory studies to determine how sensitive aquatic birds, particularly fish-eating species, are to methylmercury. Embryos are the most sensitive life stage in birds, so controlled breeding studies would seem to be the most logical approach. Unfortunately, because of the difficulty in raising aquatic birds in captivity to conduct reproductive studies, no controlled laboratory studies have been done to examine the effects of mercury on the reproductive success of fish-eating or other wild aquatic birds. To fill this gap in our knowledge, we developed a hybrid field-lab approach in which wild bird eggs are collected from the field and injected back in the lab with various doses of methylmercury. This approach bypasses the problems of breeding adults in captivity, while allowing control over the dosing of eggs. Our protocol involves injecting various doses of methylmercury dissolved in corn oil into the air cell of the egg. We discovered that the embryos of different species of birds differ in their sensitivity to methylmercury with some species being more sensitive than the mallards that have, to date, been used as a default species for wild birds.

Methods

Eggs are collected in the field and randomized to injection treatments in the lab. When the eggs have reached the embryological equivalent of a 3-day-old chicken embryo, they are injected with graded doses of methylmercury dissolved in corn oil. Mortality is monitored throughout incubation, and the survival of controls is compared to that of the groups of eggs injected with various doses of mercury.

Drilling eggs



Injecting eggs



Sealing injection site.



Incubating eggs.

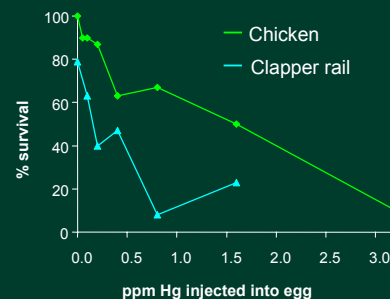


Species tested with egg injections

Order	Species (n = 23)	
Pelecaniformes	Double-crested cormorant	
	Brown pelican	Anhinga
Ciconiiformes	Great egret	Snowy egret
	Tricolored heron	White ibis
Charadriiformes	Herring gull	Laughing gull
	Royal tern	Caspian tern
Galliformes	Chicken	Ring-necked pheasant
Gruiformes	Clapper rail	Sandhill crane
Anseriformes	Mallard	Canada goose
	Lesser scaup	Hooded merganser
Passeriformes	Common grackle	Tree swallow
Falconiformes	American kestrel	Osprey

An Example of Our Findings:

Survival of chicken versus clapper rail eggs injected with methylmercury



What is the Practical Significance of Our Findings?

Our egg injection studies show there are species differences in the sensitivity of embryos to methylmercury, with the embryos of some species being more sensitive to injected methylmercury than are mallard embryos. Because there is very little data from field and controlled breeding studies with wild birds to set harmful effect thresholds of mercury in eggs, the results from controlled breeding studies with mallards have been used for decades as a default threshold to protect the embryos of wild birds. This default approach no longer seems valid -- laboratory-generated data from game farm mallards are inadequate to protect the embryos of the most sensitive wild species. The rankings in embryo sensitivity based on our egg injection studies will allow us to set more realistic thresholds of mercury in eggs to protect reproduction in wild birds.