Laboratory Evaluation of Effects of Early Life-Stage Exposure to Selenium on Pallid and Shovelnose Sturgeon

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Abstract

Selenium is an essential element at low concentrations, but toxic at slightly higher concentrations. In early life stage (ELS) fishes, its toxic effects appear as terata especially skeletal deformities (Se replaces S in protein) and also edema (distorted cell membranes leading to fluid leakage).

Sturgeon may be vulnerable to Se effects (see abstract) and the early life stage exposed through maternal transfer.

Introduction

Exposure of Platte River, NE sturgeon to Se is of concern:

- Morphological abnormalities consistent w/effects of Se in other fishes
- No effect on weight or length
- Erythrocyte abnormalities most sensitive endpoint
- NOEC 17.5 µg Se g egg-1 SNS
- LC50 16.5 µg Se g egg-1 PLS
- NOEC 7 - 10 µg Se g egg-1 PLS
- LOEC 12 µg Se g egg-1 SNS
- LOEC 13 µg Se g egg-1 PLS
- SNS and PLS similar sensitivity (graphics numbered similarly for some bullets)

Methods

- Experimental Design/Endpoints:
  - 72 embryos, 4 replicates
  - 7 & 17 OFF pathologies evaluated
  - 17 OFF survival evaluated

- Procedure:
  - Wild PLS and SNS from Missouri River
  - Spawned in hatchery
  - Nano-injection of Seleno-L-Methionine into pre-gastrulation embryos

- Post transition to exogenous feeding:
  - 10 larvae, 4 replicates
  - Survival and genotoxicity (erythrocytes) evaluated
  - Weight and length evaluated

Results

Treatments consisted of 4 Se-L-met concentrations, uninjected and carrier solvent (phosphate buffered saline) controls

PLS SNS

Nominal µg/p egg Actual µg/p egg

<table>
<thead>
<tr>
<th>Concentration µg/p egg</th>
<th>PLS</th>
<th>SNS</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>6±1</td>
<td>9±2</td>
</tr>
<tr>
<td>10</td>
<td>7±1</td>
<td>12±3</td>
</tr>
<tr>
<td>18</td>
<td>13±1</td>
<td>17±6</td>
</tr>
<tr>
<td>32</td>
<td>17±6</td>
<td>23±3</td>
</tr>
<tr>
<td>Uninj.</td>
<td>5±1</td>
<td>3±1</td>
</tr>
</tbody>
</table>

Measured by ICP-MS

Conclusions

- Pallid and shovel nose sturgeon appear to be similarly or slightly more sensitive to Se when compared to other species of fish and other sturgeon species. Erythrocyte abnormalities were the most sensitive endpoint, but one that is not commonly evaluated for fish.

- Sources of selenium in the lower Platte river are more likely attributable to coal-fired power plants, irrigation return waters, and run-off from CAPs. Although seleniferous deposits are found in the North Platte basin, two reservoirs upstream of the lower Platte River probably collect the majority of these sediments.

- Effects on ELS sturgeon in this study indicate that current environmental concentrations found in sturgeon eggs in the Lower Platte River are not causing adverse effects on survival or development.

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