Retrospective Evaluation of the Acute Fish Toxicity Test for Pesticide Registration

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Highlights

- We conducted a retrospective analysis of acute fish data submitted for pesticide registration to the U.S. Environmental Protection Agency (EPA).
- For most substances, coldwater species were the most sensitive species.
- These results can help inform whether testing with fewer fish species can be used to evaluate potential acute risk to fish from pesticides.

Introduction

- The acute fish toxicity test is used to assess the potential hazard and risk of substances to non-target fish.
- For registration of conventional pesticides in the United States, the test is typically conducted on three different species.
- Evaluating the acute toxicity of one substance can use 200 or more fish.
- We conducted a retrospective data analysis to determine whether the number of species could be reduced while still meeting risk protection goals.

Coldwater: rainbow trout

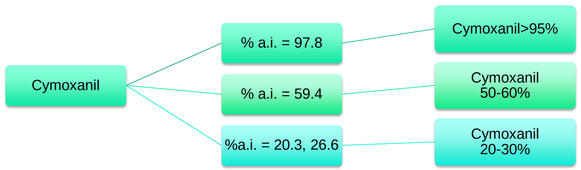
Warmwater: bluegill sunfish

Saltwater: sheepshead minnow

Datasets and Analysis Groups

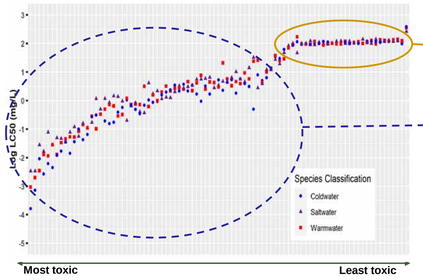
- The initial data set included acute fish toxicity data for pesticide active ingredients (AIs) registered from 1998 to 2016. The 762 studies included:
  - 291 substances (AIs, formulations, and degradation products).
  - 181 pesticide AIs.
- Analysis groups were created by binning substances according to:
  - Percent AI.
  - Specific formulation: e.g., chlorantraniliprole DPX-E245 35WG was binned separately from DPX-E2Y45 20SC.

Creation of Analysis Groups



- Analysis groups were excluded if they did not include an acceptable study on each of the three species.
- The final data set included 87 analysis groups.

LC_{50} Values and Functional Equivalence



Analysis groups were characterized as containing data points that were functionally equivalent, non-functionally equivalent, or unclear.

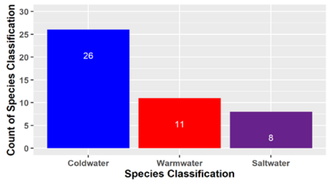
- **Functionally equivalent* (n=33):** for risk assessment purposes, the results from the three species would be considered equivalent because all three produced > LC_{50} values.
- **Non-functionally equivalent (n=45):** the most sensitive species category can be determined.
- **Unclear (n=8):** One or more LC_{50} values made it uncertain which of the three species groups was most sensitive.
  - e.g., LC_{50}s are >89, >90, 95

* The circles in this figure are representative of the general distribution of the functionally equivalent and non-functionally equivalent analysis groups. Each of the three categories are distributed throughout the graph.

Identifying the Most Sensitive Species

- For the 45 analysis groups that were non-equivalent, either a cold or warmwater fish was most often (37/45) the most sensitive species tested.
- For the 8/45 groups where saltwater fish were the most sensitive, the chemicals tended to be of lower toxicity than others in the dataset:
  - In the USEPA classification system, all 8 substances fell into the “moderately toxic” (3/8), “slightly toxic” (4/8), or “practically nontoxic” (1/8).
  - In the Globally Harmonized System’s hazard categorization system, these substances fell into the “toxic to aquatic life” (2/8), “harmful to aquatic life” (3/8), and “not classified” (2/8) categories.

Most Sensitive Species for Non-functionally Equivalent Groups

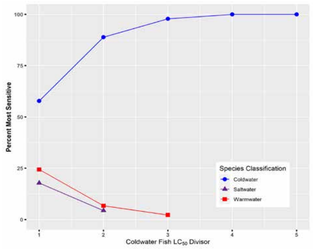


LC_{50} Value Spread

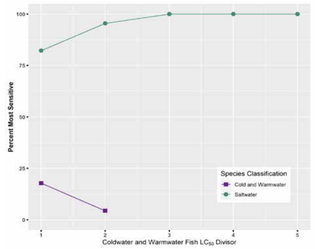
- We evaluated the spread between the LC_{50} values across all the analysis groups to determine:
  - How often the most sensitive species was with 2, 3, 4, or 5X of the coldwater fish LC50 value.
  - We also evaluated whether a similar approach could be applied to coldwater and warmwater fish.

* The y-axes in these figures show the percent of analysis groups where the most sensitive species is included by the divisor.

Coldwater Spread



Cold and Warmwater Spread



Conclusions and Future Directions

- Cold- and warmwater freshwater species were the most sensitive for 37/45 non-functionally equivalent analysis groups.
- We evaluated the effect of dividing coldwater fish data LC50 values by small integer values.
  - Dividing by 3 would make coldwater species the most sensitive for 98% of analysis groups.
  - Dividing by 4 or 5 would make coldwater fish most sensitive for 100% of analysis groups.
- The same approach could be applied to coldwater or warmwater fish data.
  - Dividing by 2 would make warm or coldwater fish most sensitive for 96% of analysis groups.
  - Dividing by 3 or more make warm or coldwater fish most sensitive for 100% of analysis groups.
- These results of these analyses can help inform whether testing with fewer fish species can be used to evaluate potential acute risk to fish from pesticides. Using fewer species could reduce the number of fish required for this testing by up to two-thirds.
- These analyses will be submitted to a peer-reviewed scientific journal for publication.
- Extracted data will be submitted to EPA’s Toxicological Reference Database.

More Information

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- For more information about NICEATM and EPA projects to reduce animal use for acute fish toxicity testing, visit **https://ntp.niehs.nih.gov/go/fishtox**
- Subscribe to the NICEATM News email list: **https://list.nih.gov/cgi-bin/wa.exe?SUBED1=niceatm-l&A=1**