Insecticides and Their Effects on Amphibians

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Synopsis

Description and a brief history of insecticides.

Introduction to Insecticides

How It Works

Global Declines

Prevalence

Impacts of insecticides on global amphibian populations.

A look into how and why insecticides are being applied worldwide.

Why are insecticides the most important cause of amphibian declines?

What are insecticides?

“An insecticide is a pesticide that is formulated to kill, harm, repel, or mitigate one or more species of insects.”

-National Pesticide Information Center
Brief History

Insecticides have been around since 1000 B.C. Beginning in the 19th century, insecticide use became more efficient and widespread in an effort to feed a quickly growing population and to improve public health.

With the increased efficacy of modern insecticides, spillover effects of these insecticides have become greater.

Impacts

Common Uses:
- Commercial
- Agricultural
- Household
- Public Health

Common Consequences:
- Malformations
- Species Specific Die-off
- Reductions in Overall Diversity
- Developmental Consequences

Case Studies

- Significant reductions in both species richness and individual species abundance.

[Image of graphs and illustrations related to case studies]
Case Studies

- High density ponds were significantly negatively affected from the insecticide carbaryl.
- In high density ponds exposed to carbaryl, larvae metamorphosed much earlier than those that were not exposed.
- Earlier metamorphosis was correlated with less mass at metamorphosis.

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Case Studies

- Time to death varies greatly among populations, but is significantly short.
- Not even incredibly dangerous pathogens such as Bsal or Bd have such short time to death periods.

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Case Studies

- Both low (below normal dose) and high levels of insecticide treatment resulted in more than 25% mortality.
- Any amount of insecticide used resulted in almost 90% of the population developing some sort of malformation.

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Table 1. Effect of density, stressed and normal adults, contact with both Bsal and Bd, and B. thermocijfera on the rate of malformation. Results of Chi-square test and odds ratio calculations to determine significant differences (P < 0.05).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Malformed</th>
<th>No Malformed</th>
<th>Total</th>
<th>Chi-square</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>0.34</td>
<td>0.66</td>
<td>1.00</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Dose A</td>
<td>0.20</td>
<td>0.80</td>
<td>1.00</td>
<td>0.12</td>
<td>0.8</td>
</tr>
<tr>
<td>Dose B</td>
<td>0.10</td>
<td>0.90</td>
<td>1.00</td>
<td>0.00*</td>
<td>0.1*</td>
</tr>
</tbody>
</table>

*Significantly different from untreated controls at p < 0.05.
How much do insecticides impact declines?

- Amphibians represent ⅓ of global biodiversity loss
- Amphibians are heavily reliant on clean air and water sources
- Heavy chemicals in their environment alter their development and overall function
- Defense: predation and disease
- Survival

International Insecticide Usage

Developing countries = developing problems

- Near the equator or in tropical areas
- Areas that amphibians are known to exist in high densities
- Insecticides used to improve developing economies, agricultural industries, and public health

Dichlorodiphenyl… what?

- The most commonly recognized insecticide is DDT (dichlorodiphenyltrichloroethane)
- An organochlorine, used to target vectors of malaria and typhus from the 1940’s - 1970’s
- Currently produced in India, China, and Korea
- Today, roughly 3-4,000 tons produced annually
The biggest challenges are:

- A lack of legislative action and regulations on use
- Poorly trained personnel
- Overuse and improper use of insecticides
- Cheaper option by buying DDT products than compounds like pyrethroid esters
- Aerial application directly impacts adults, larvae, and eggs

Insecticide Prevalence

- Approximately 2.5 billion kg/year are applied worldwide
- Increase in amphibian contact with insecticides
- More agricultural practices taking place
  - Leads to more insecticide use to protect crops

Why are insecticides the most important

- Used globally, especially in areas with high amphibian populations
- Very quickly absorbed through skin
- Increasing effectiveness of insecticides
  - Greater potency to amphibians
- Decreased immune response
  - Leads to increased disease risk
References


