HOW USEFUL ARE AQUATIC INDOOR MICROCOSMS COMPARED TO OUTDOOR MESOCOSM POND STUDIES FOR RISK ASSESSMENTS?

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Introduction

Micro- and mesocosm studies are useful in risk assessment when lower-tier laboratory studies indicate potential risks of a test substance. Often the question arises as to whether an indoor semi-realistic microcosm test is suitable or an outdoor mesocosm study should be conducted. Aquatic indoor microcosms get closer to reality in respect of greater number of species and trophic levels than standard laboratory studies, but they are more artificial than aquatic outdoor mesocosm ponds due to their smaller volume and the constant environmental conditions in the laboratory. To assess acute and sub-acute toxicant effects on a population and any subsequent population recovery, the important taxa should be continuously present in the test system over a sufficiently long period.

The aim of this study was to compare zooplankton data from microcosm and mesocosm studies with respect to their species composition and their statistical power in detecting effects of toxicants.

Materials and Methods

We analysed zooplankton data sets from two indoor microcosms and seven outdoor mesocosm studies:

<table>
<thead>
<tr>
<th>Volume</th>
<th>Water depth</th>
<th>Sediment layer depth</th>
<th>Light</th>
<th>Temperature</th>
<th>Control replicates</th>
<th>Treatment replicates</th>
<th>Zooplankton samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>19 L</td>
<td>20 cm</td>
<td>2 cm</td>
<td>200 µE m² s⁻¹ (16:8h)</td>
<td>20°C</td>
<td>3</td>
<td>3</td>
<td>1 L</td>
</tr>
<tr>
<td>4900 L</td>
<td>10 cm</td>
<td></td>
<td></td>
<td></td>
<td>10 cm</td>
<td>2</td>
<td>5–20 L</td>
</tr>
</tbody>
</table>

For the microcosms studies, five snails (Lymnaea stagnalis) were introduced into each cos to prevent phytoplankton growth, and twice a week, nitrogen (0.09 mg N/L) and phosphate (0.015 mg P/L) were added to ensure sufficient primary production.

Results and Discussion

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The total numbers of taxa in the microcosms were almost equal in comparison with the outdoor mesocosms (Fig.3), but fewer rotifer taxa could be evaluated (Tab. 1).

The chlorophyll-a concentration of the microcosms was in the range of the outdoor systems (Fig.4).

The MDD for the crustaceans were mostly lower in the microcosms than in the mesocosms, whereas the opposite was found for the rotifers (Fig.2, lower panels).

The lower MDD’s for the dominant crustacean taxa in the microcosms indicate a lower detection limit for test item effects and therefore a higher statistical power than in the mesocosms.

Hence, microcosm studies are a useful tool for examining possible acute and chronic effects of a test substance on zooplankton populations, particularly for crustacean taxa.

Microcosms show further advantages when compared with larger outdoor mesocosms: more replicates can be used due to their smaller size, and the studies can be conducted independently of the current season.

However, microcosms are not appropriate for the additional evaluation of effects on aquatic emerging insects, other macroinvertebrates or aquatic macrophytes.

Conclusions

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