



INSTITUTIONEN FÖR BIOLOGI OCH MILJÖVETENSKAP

# **Risk assessment of chemical mixtures in the aquatic environment**

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# **Risk assessment of chemical mixtures in the aquatic environment**

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## **ABSTRACT**

The total chemical production within the European Union amounts to more than 300 million tonnes per year, of which 140 million tonnes are considered as hazardous to the environment. In order to ensure that these chemicals do not have harmful effects under normal use, likely environmental concentrations are compared to assumed environmentally safe concentration, and only if the resulting risk is deemed acceptable is the product or chemical allowed for use. Depending on the use category of the chemical or product, market approval might require authorization from competent authorities, or a registration by the producer/importer. However, neither of the approval systems considers the combined risk from the coincidental mixtures which will be formed when several individually approved substances co-occur in the environment.

This thesis first analyses the hazard from chemicals from different regulatory classes. Thereafter the combined risks from coincidental mixtures detected in the Swedish aquatic environment from three different monitoring programs are estimated.

When using Swedish water quality objectives and a Kaplan-Meier adjustment to account for non-detects, 73% of 1308 samples taken in Swedish agricultural streams were estimated to be at risk. In contrast, using hazard-values calculated specifically per trophic level (algae, aquatic invertebrate and fish) according to the current pesticide guidelines, only 4% of the samples are estimated to be at risk. This demonstrates the risk estimates dependence on how hazardous concentrations are determined, a single substance issue which gets incorporated into the mixture risk assessment. The thesis also demonstrates that despite the Swedish national goal (adopted 1999) of a non-toxic environment, there is no perceivable trend in the estimated risk in the agricultural streams between 2002 and 2013. Similarly, samples taken along the Swedish west coast and analyzed for 172 organic chemicals show exceedances of estimated safe concentration at five out of five locations. Also concentrations measured in fish tissue exceed concentrations thresholds set for human consumption, both for individual compounds and for their mixtures.

The thesis adds to a growing body of literature which demonstrates that chemical concentrations detected in the environment frequently exceeds concentrations perceived as safe. This indicates that the current chemical load in the environment should, at least, be considered during market approval.

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