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Calibration and field evaluation of passive samplers as a new tool for monitoring pesticides in water

Introduction

- The continuous emission of pesticides into the aquatic environment is posing a risk to wildlife and human health (Rodney et al. 2013)
- Conventional methods for monitoring pesticides in the aquatic environment may not fully account for temporal variations due to fluctuation in flow, precipitation, or episodic inputs (Kreuger 1998)
- Passive sampling is a promising tool to determine time-integrated pesticide concentrations at ultra-trace levels and with minimal infrastructure

Objectives

- To characterize five different types of passive samplers in terms of sampling rates (R_s) and sampler-water partition coefficients (K_{pw})
- To compare the passive-sampler derived concentrations against active sampling

Results and discussion

- SR showed a better uptake for the more hydrophobic compounds (log K_{OW} > 5.5), whereas POCIS-A, POCIS-B, and Chemcatcher® SDB-RPS are more suitable for the hydrophilic compounds (log K_{OW} < 0) **(Figure 1)**
- Higher R_s for SR compared to the other samplers **(Table 1)** can be explained by the higher sorbent mass (m_p) of SR compared to the other samplers **(Table 2)**
- Differences between log K_{pw} **(Table 1)** of the samplers can be explained by different surface areas (a_p) **(Table 2)**
- Comparison of TWA concentrations for active and passive samplers in the field showed a good agreement **(Figure 2)**
- Passive samplers detected 38 pesticides which were not detected by the active sampler while there were only 4 pesticides which were only detected by the active sampler

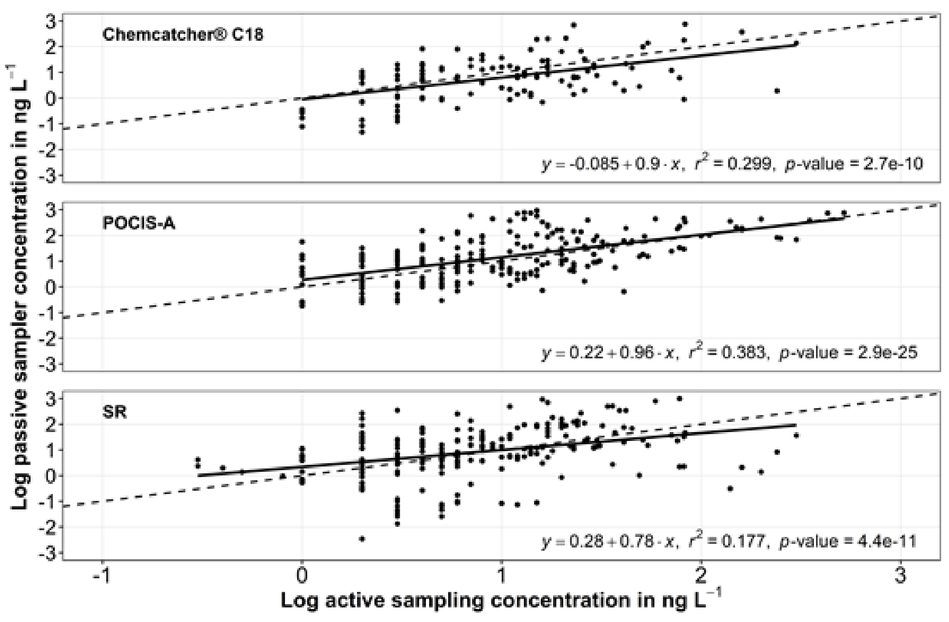

Figure 2. Comparison between active and passive sampling

Materials and methods

- 124 pesticides including herbicides, insecticides, and fungicides were investigated
- The five selected passive samplers included POCIS-A, POCIS-B, SR, Chemcatcher® SDB-RPS, and Chemcatcher® C_{18} **(Table 2)**

Table 2. Overview of the five passive sampling devices

Passive sampler	Characteristics	Sorbent mass (m_p, g)	Surface area, (a_p, cm³)
POCIS-A	Oasis hydrophilic-lipophilic balance (HLB) sorbent	0.22	1.78 x 10^6
POCIS-B	Mixture of Isolute ENV+ and Ambersorb 1500 sorbents	0.22	2.82 x 10^6
SR	Silicone rubber stripes	15.6	457
Chemcatcher® SDB-RPS	Styrene-divinyl benzene Empore™ disk	0.34	35
Chemcatcher® C_{18}	C_{18} Empore™ disk	0.58	35

- An uptake study was conducted in a glass containers filled with water from the Fyris river (Sweden), at constant temperature (20 °C), in the dark, and under turbulent water condition
- To determine R_s, the samplers were removed at time intervals of 0, 5, 11, 20, and 26 days
- Comparison of the time-weighted average concentrations (TWA) for active and passive samplers in the field has been performed for three types of passive samplers, which showed the best performance in the laboratory uptake experiments
- The three samplers (i.e. POCIS-A, SR, and Chemcatcher® SDB-RPS) were deployed at two sampling sites in the southern part of Sweden for one week over six weeks
- In parallel, pesticide concentrations were measured using time-integrated active sampler

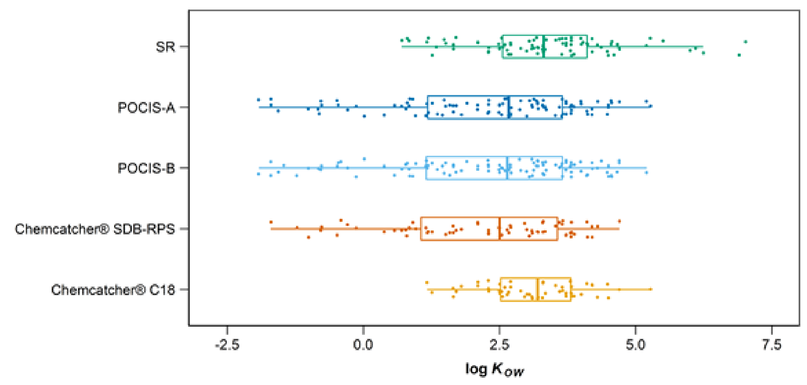

Figure 1. Box-plots for individual pesticides taken up by the five passive samplers in correlation to their octanol-water partition coefficient in the laboratory uptake study

Table 1. Median of R_s and log K_{pw} of the five passive sampling devices (n = 124)

Passive sampler	R_s (L day^{-1})	log K_{pw} (L kg^{-1})
POCIS-A	0.18	4.56
POCIS-B	0.22	4.78
SR	0.86	3.14
Chemcatcher® SDB-RPS	0.05	3.17
Chemcatcher® C18	0.02	2.71

Conclusion

- Passive samplers are suitable for measuring a wide range of different pesticides in water
- Passive sampling is a promising tool by providing time-integrated concentrations, simple application, and high sensitivity
- To apply passive samplers for regulatory purposes, the reliability of the passive sampler-derived TWA concentrations needs to be improved

References

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