FAIRWAY Research Highlights

Use of passive samplers in drinking water catchments

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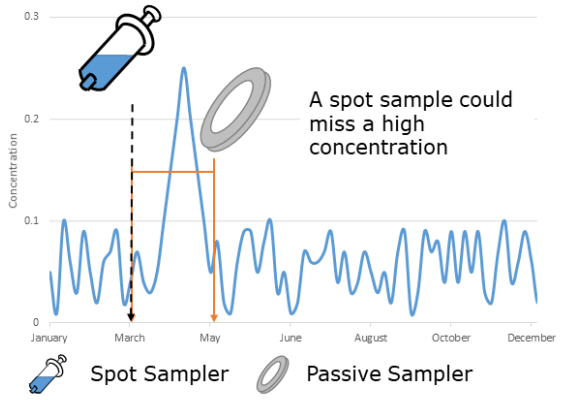
The FAIRWAY project explored the potential of passive samplers to monitor pesticide concentrations in real-world scenarios, both in surface waterbodies and groundwater. This leaflet briefly explores passive samplers and compares their use with that of spot sampling for routine water quality monitoring.

Why Passive Sampling?

The European Water Framework Directive (European Commission Directive 2013/39/EC) requires the implementation of monitoring programmes to measure levels of chemical pesticides in water for evaluation of chemical status.

Spot sampling, coupled with laboratory analysis, is presently accepted as the standard technique for monitoring. However, spot sampling provides only a snapshot of the environment at a specific point in time and may miss episodic changes in pesticide levels in surface and groundwater in the intervals between sampling.



To reduce the non-representativeness of spot sampling, passive sampling techniques are an option. Passive sampling relies on the unassisted molecular diffusion of pesticides through a diffusive barrier onto an adsorbent surface over a prolonged period of deployment. These samplers are designed to maximize the mass of pesticide accumulated in order to detect the generally low levels of pesticide present in water.

Spot samplers may be used to monitor pesticide concentrations in both surface and groundwater, each of which poses technical challenges for deployment and retrieval.

Which Passive Samplers?

POCIS™ and Chemcatcher® passive samplers are considered here, but there are other devices on the market.

Chemcatcher®

- Devices were easy to deploy; only requiring an anchoring point and a sufficient depth of water that the devices remain submerged throughout deployment.
- The greatest challenge was the hydrologically flashy nature of the river. Peak flows made it difficult to identify suitable deployment locations.
- Further information may be found at https://chemcatcher.ie.

POCIS™ passive samplers were deployed in two groundwater wells:

- Devices were easy to deploy; due to the steady nature of the flow, it was easy to get a sufficient depth of water.
- To avoid any bacteriological problems, the device was not set inside the water plant but just outside.
- Further information may be found at https://www.est-lab.com/pocis.php.

Geoscience for a sustainable Earth brgm
https://www.brgm.fr/fr

afbi AGRI-FOOD & BIOSCIENCES INSTITUTE
https://www.afbini.gov.uk

FAIRWAY
Farm systems management and governance for producing good water quality for drinking water supplies
https://www. fairway-is.eu

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La Voulzie Case Study - Groundwater

The La Voulzie catchment area is a large-scale farming dominated catchment to the East of Paris. The table below shows positive detections of pesticides using POCIS™ passive samplers in water taken from two springs (raw water).

Period 2 and Period 3 have the same length, but the number of compounds accumulated is different. The difference in accumulation between deployment periods is influenced by water quality, which is influenced by variations in environmental conditions such as flow rate and the physico-chemical parameters of water (temperature, pH). For instance, atrazine has been banned since 2003 but significant seasonal variations were detected.

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
	09/03-18/05	18/05-08/06	08/06-29/06	29/06-29/07	29/07-17/09	17/09-18/10
Days of sampling	70 days	21 days	21 days	30 days	50 days	28 days
Atrazine	m M	m M	m M	m M	m M	m M
DIA	m M	m M	M	M	m M	m M
Boscalide	M	m M			M	M
Propiconazole	M	m M			M	M

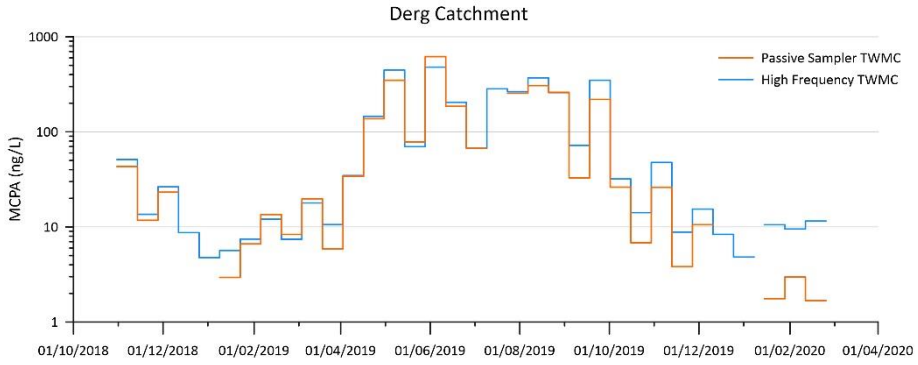
m : Detection by passive sampler in the minor spring ; M : Detection by passive sampler in the Major spring

The results also show that some pesticides, like boscalide, were quantified only during period 2 in the minor spring. **They could have been missed by spot monitoring.**

Derg Catchment Case Study – Surface Water

The Derg catchment is a grassland-dominated catchment in the north-west of the island of Ireland that frequently experiences very high concentrations of the herbicide MCPA (2-methyl-4-chlorophenoxyacetic acid). In this 16 month study a high frequency (7hrs in summer/daily in winter) spot-sampling campaign recorded 37 separate occasions when concentrations exceeded 0.1µg/L. Nearly 70% of these events lasted less than 24 hours.

Chemcatcher® passive samplers were deployed for 29 two-week periods across the study period and the time-weighted mean concentrations (TWMC) for each period were compared with those calculated for the High Frequency sampling (see figure).



Time-weighted mean concentrations determined by both techniques were comparable across a range of time-weighted average concentrations (the Y axis is on a log scale) for this combination of pesticide and hydrologically flashy river.

Conclusion

Passive samplers can offer a cost-effective alternative to high frequency sampling protocols in a number of situations, and they can be used to compliment high frequency sampling exercises.
The use of passive samplers allows for

- The monitoring of pesticide presence/absence in more sites and over longer periods of time, particularly at remote locations where more technological monitoring techniques are not appropriate.
- The qualitative ranking of pesticide loads in different waterbodies and thus the targeting of more intensive monitoring schemes and management approaches.