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Towards the integration of periphyton in pesticide biomonitoring

Ecological impacts on agricultural streams

CONCLUSION

- **Broad range of pesticides detected in periphyton**
- **Distinct pesticide profiles in water vs. periphyton**
- **Periphyton captures more persistent compounds**
- **Useful for assessing pesticide accumulation in biota**
- **Easy and standardized to sample periphyton**
- **Water-only metrics (e.g., toxic units) may underestimate risk**
- **A few compounds dominate overall mixture toxicity**

Why periphyton?

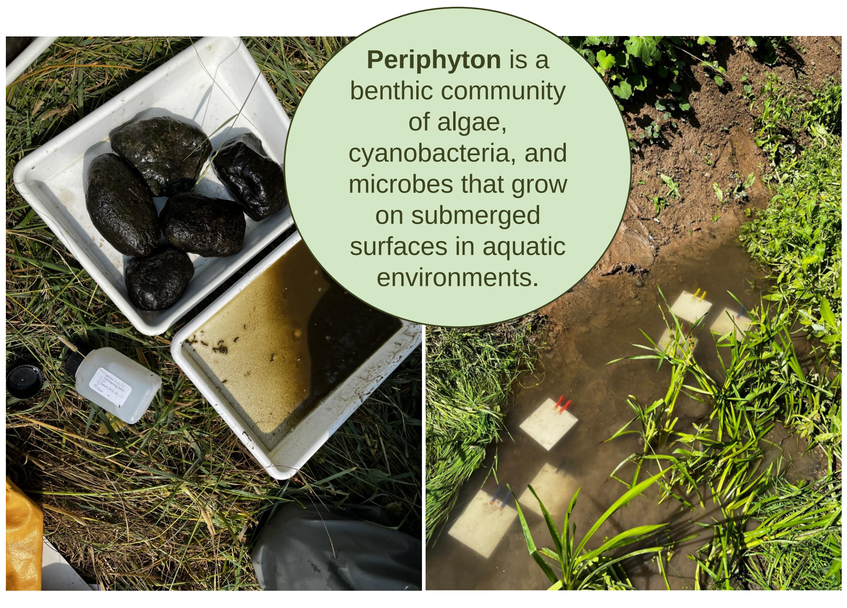
Periphyton is a key primary producer and food source in freshwater systems. It is a well-established indicator of eutrophication, ubiquitous in aquatic habitats, and easy to sample—making it a practical and informative tool for environmental monitoring.

Field study

Study analyzed pesticide accumulation in periphyton (colonized on tiles) and surface water samples from 2022.

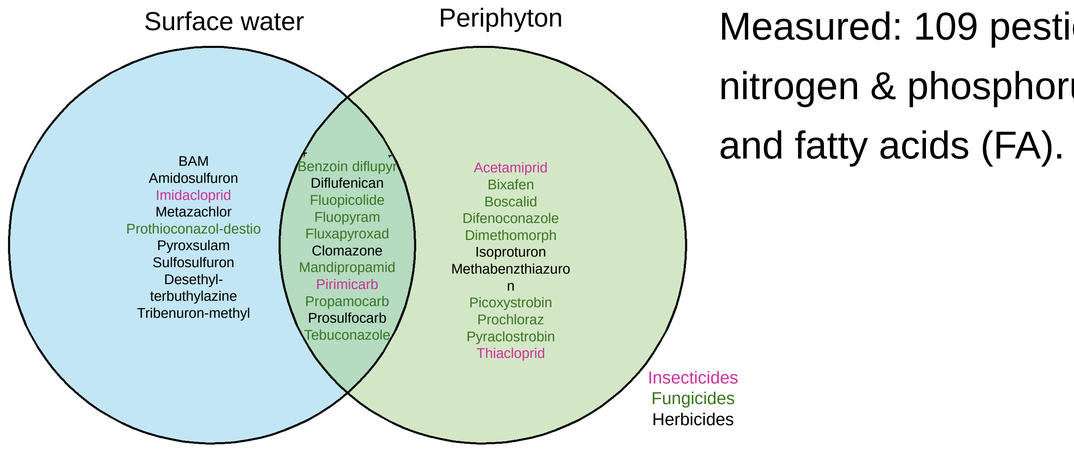
Measured: 109 pesticides, total nitrogen & phosphorus, algal pigments, and fatty acids (FA).

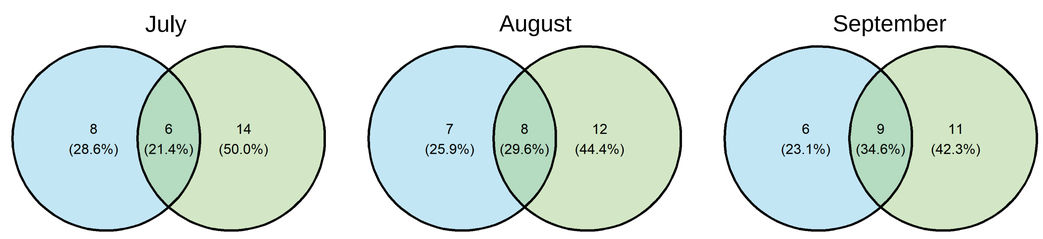
Periphyton is a benthic community of algae, cyanobacteria, and microbes that grow on submerged surfaces in aquatic environments.



Standardized method to collect periphyton from natural substrate (SS-EN 13946:2014).

Periphyton colonization on artificial substrate. Here tiles were deployed for a period of 3 months in three streams in 2022.





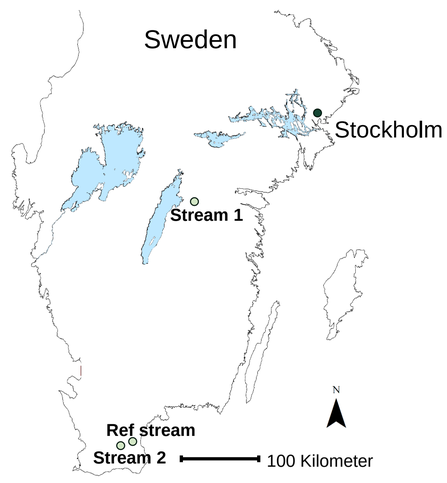


Fig 1. A) Upper graph. Venn diagram showing the overlap of pesticides detected in surface water and periphyton from Agricultural Stream 1 across the three-month sampling period. B) Bottom graphs. Monthly counts of pesticides detected in each matrix (surface water and periphyton) in Stream 1.

RESULTS

- Pesticide profiles varied by site and matrix, but were stable over time
- **Periphyton: up to 30** mainly hydrophobic pesticides detected
- **Surface water:** more hydrophilic compounds and transformation products
- Several pesticides found at high concentrations
- 11 pesticides had BCFs > 5000
- BCFs help identify potential PBT substances
- **Diflufenican** may pose elevated risk due to high bioaccumulation, toxicity to algae, and persistence
- Periphyton functions as a time-integrated **passive sampler**

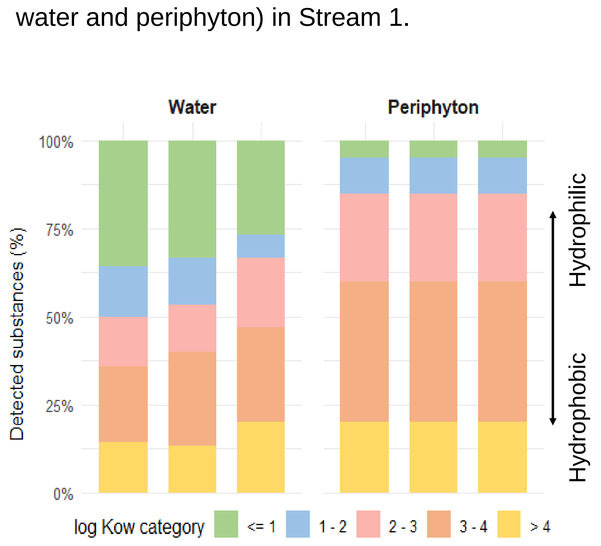


Fig. 2. Number of detected pesticides in water and periphyton normalized and categorized into 4 categories of Log Kow across the three-month period.

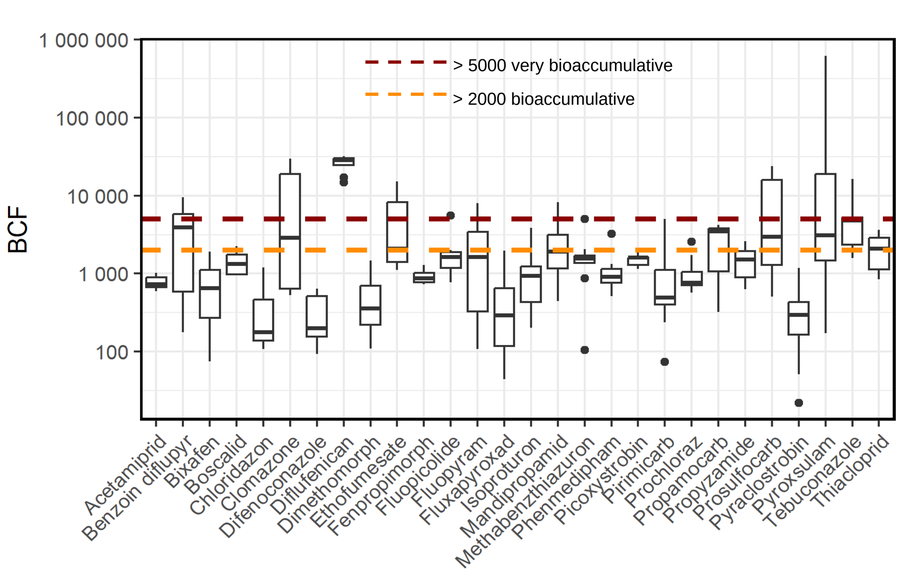


Fig. 3. Bioconcentration factor (BCF in L/kg) of pesticides, calculated as the ratio of pesticide concentration in periphyton to that in surface water.

TOP 5 Pesticides with highest biococentration in periphyton

Pesticide	max_BCF	mean_BCF	log Kow	PNEC_µg/l	Water-sed DT_{50} (d)
Pyroxsulam	626202	147642	-1.01	0.260	NA
Diflufenican	32071	26446	4.20	0.025	175
Clomazone	29900	21272	2.58	5.700	28.4
Prosulfocarb	23895	17522	4.48	4.200	214
Tebuconazole	16465	7170	3.70	1.000	365

Table 1. Pesticides with the highest bioaccumulation potential in periphyton (BCF > 5000), including their toxicity (PNEC) and persistence (water-sediment DT_{50}). Bioaccumulation is one of the three criteria in the PBT (Persistence, Bioaccumulation, Toxicity) assessment framework for chemical substances.

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