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Exhaustive Trace Pollutant Screening of Waterbodies Using Passive Sampling Techniques.

EXHAUSTIVE TRACE POLLUTANT SCREENING OF WATER BODIES USING PASSIVE SAMPLING TECHNIQUES

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Filling the Monitoring ‘Hole’

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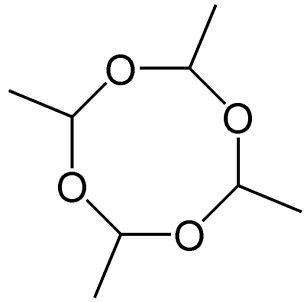
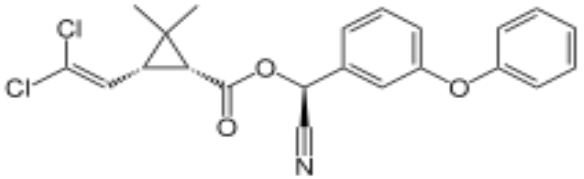
- **Monitoring is fundamental to the work of WRT – we’re constantly looking to expand our ‘arsenal’ of techniques.**
- **Poor ecology within a waterbody not always attributable to ‘gross’ pollution - insidious effects of trace pollutants can be very important.**
- **Better means of assessing on-going impacts of low level contaminants required → Trace Organics Profiling (TOP) project.**
- **Long term aim to develop truly exhaustive trace pollutant profiles for key watercourses.**

Significance of Trace Pollutants

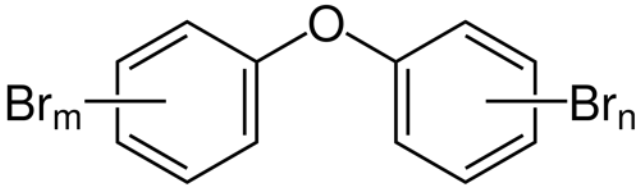
Can adversely affect the ecology of waterbodies and the quality of drinking water, often at very low concentrations (sub-ppb)



Metaldehyde
Molluscicide which is very hard to remove from DW even using advanced treatment processes



Cypermethrin
Low ng/l concentrations can decimate aquatic invert populations



PBDEs
Highly persistent bio-accumulative flame retardants. Numerous suspected impacts on terrestrial & aquatic life forms.

TOP Project Vision!

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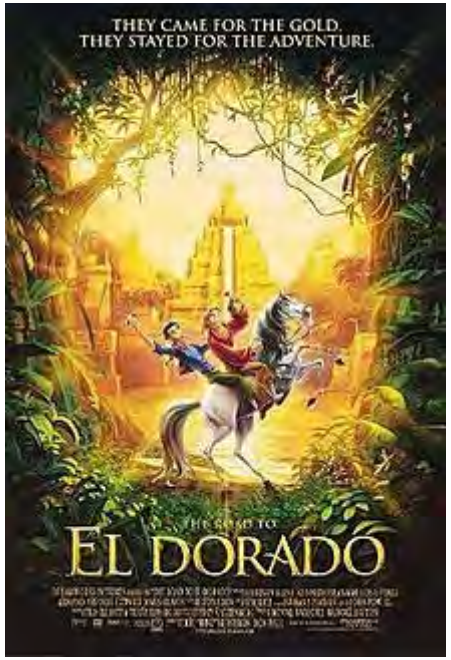

A monitoring procedure which can detect and semi-quantify, at high sensitivity, trace organic pollutants (& heavy metals) spanning the entire polarity range

TOP Method – Fundamental Aspects

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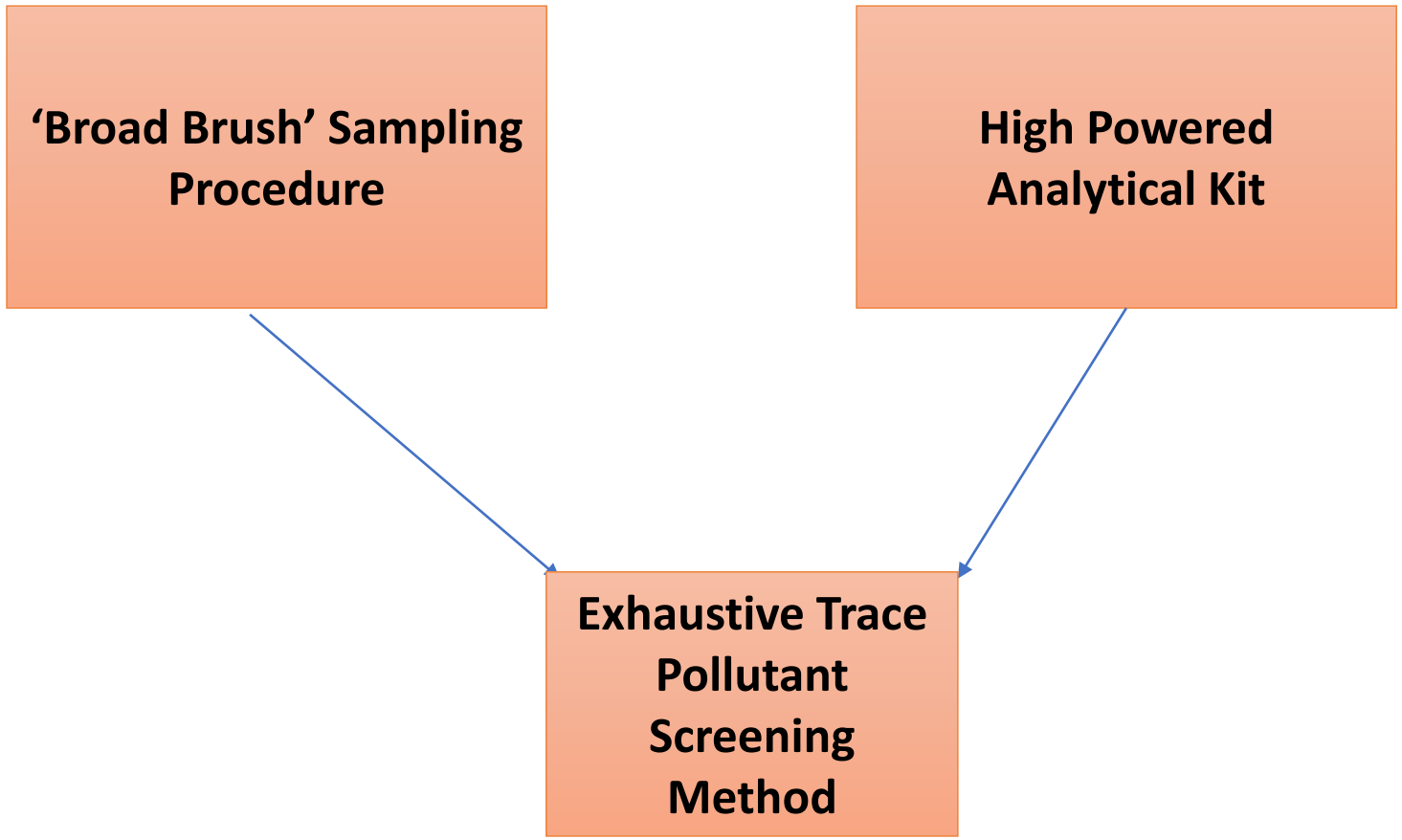

The Analytical Kit Already Exists

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- **Chromatographic techniques (GC & LC) interfaced with various configurations of mass spectrometer for organics & ICPMS for trace metals.**
- **Recent advances in high resolution mass spectrometry and associated data analysis techniques will play a fundamental role.**
- **Analysis for targeted lists of pollutants, ‘known unknowns’ and ‘unknown unknowns’.**
- **Semi-quantitation of detected compounds will reveal trends in pollutant profiles and give access to individual ‘heat maps’ for key watercourses.**

A Key Role for Passive Sampling

- Continuous sampling techniques
- Avoid ‘hit-and-miss’ nature of spot sampling
- Low tech, low cost sampling methods
- Can be used in targeted or screening modes
- Produce time-weighted-average-concentrations
- Various configurations of sampler available

‘Broad Brush’ Sampling

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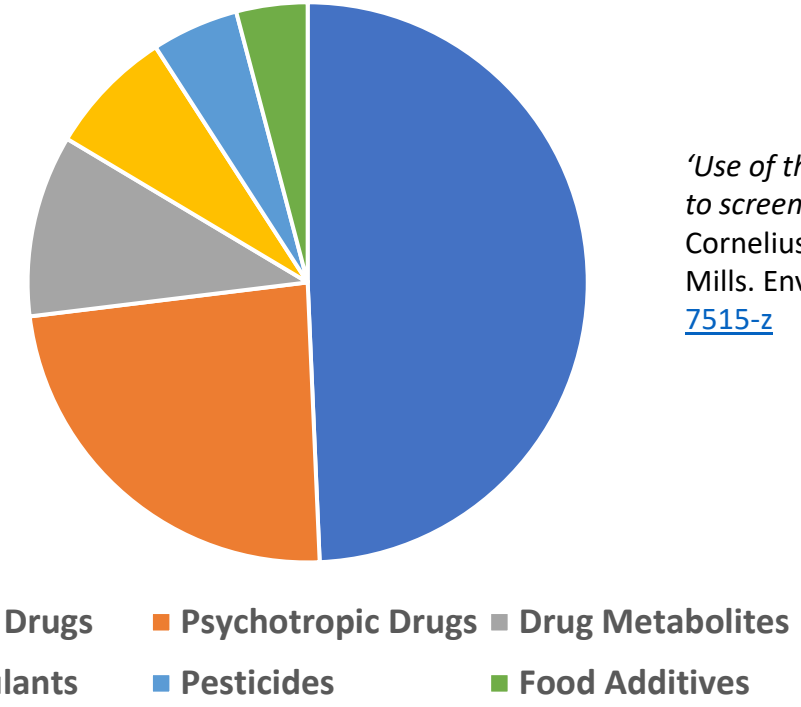
Sampler Type	Receiving Phase	Target Analytes	Analytical Technique
Chemcatchers	a) HLB	Mid-range polarity organics.	LC-MS
	b) Anion Exchange	Acidic organics.	LC-MS
	c) Cation Exchange	Basic organics.	LC-MS
Rubber Sheeting	Silicone Rubber	Non-polar organics.	GC-MS
DGT	Chelating resin	Heavy metals.	ICP-MS

Micro-pollutant Screening – Example Data

- **2017 study in Gauteng Province, South Africa using HLB Chemcatcher-based sampling and LC-QTOF analysis.**

- **Detected 219 trace pollutants in two badly polluted rivers whose ecology has been severely impacted by discharges from poorly functioning STWs.**



'Use of the Chemcatcher® passive sampler and time-of-flight mass spectrometry to screen for emerging pollutants in rivers in Gauteng Province of South Africa'. Cornelius Rimayi, Luke Chimuka, Anthony Gravell, Gary R. Fones, Graham A. Mills. Environ Monit Assess (2019) 191:388 https://doi.org/10.1007/s10661-019-7515-z

TOP Project – Key Requirements

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- **Input of expert collaborators to aid in experimental design and data interpretation & reporting.**
- **Funding for a year long trial of the methodology in a suitable West Country river catchment (up to ~£100K).**
- **Suitable local sampler deployment site(s).**
- **Laboratory capable of supplying fully prepared samplers of all appropriate types and an analytical service to include requisite method development work and the post deployment analysis of all sampler extracts.**
- **Facility to carry out parallel biological sampling to assess aquatic invertebrate populations and give access to Species at Risk (SPEAR) index measurements, potentially providing an indication of the seasonal impact of pesticide inputs.**

TOP Project – Conclusions

- **First example of obtaining a truly exhaustive trace contaminant profile of a watercourse**
- **Includes novel Chemcatcher-based methodology (cation exchange) which has the potential to generate significant commercial income if calibrated for compounds such as glyphosate & AMPA**
- **Acquisition of full scan MS data would allow retrospective screening for emerging contaminants**
- **Evidence of significant interest in the wider water industry**

Thank You

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