



Spatial and Temporal Analysis of Contaminants of Emerging Concern (CECs) in Dublin Bay: Presenting a Marine Biofilm as New Sampling Device



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INTRODUCTION

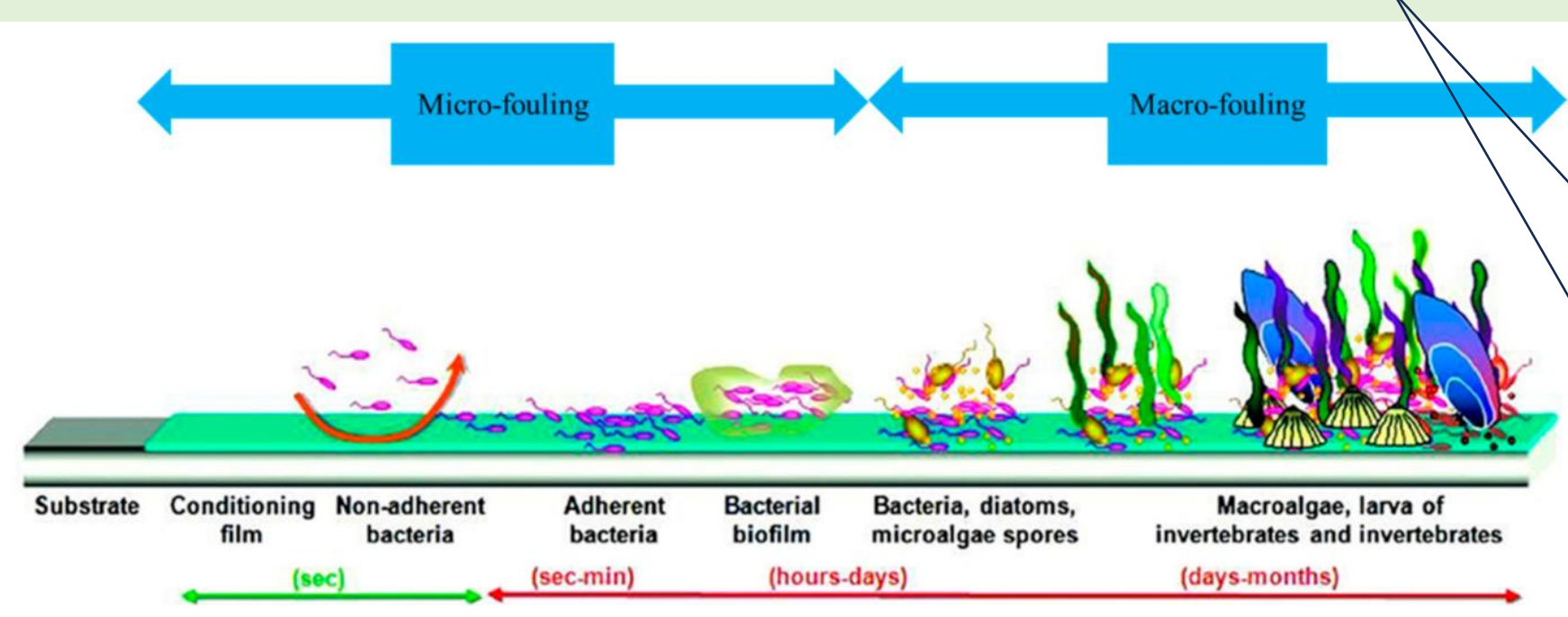
Contaminants of Emerging Concern (CECs) are mainly created by humans and they reach the marine environment mostly directly from land-based sources, but there are cases in which they are emitted or re-mobilized in the marine environment itself. CECs are a concern because of their high levels of human usage, and the biological effects exerted on nontarget organisms [1]. This group of compounds is of great importance being considered in the European Union in the Marine Strategy Framework Directive Descriptor 8, together with the Water Framework Directive and the Regional Sea Conventions [2]. Therefore, the main objective of this study was to determine and quantify existing CECs present along the Dublin coast. This objective was threefold: (i) the use of biofilm as a sampling device, considering micro and macrofouling, using a lobster cage as support for the biofilm; (ii) the determination of CECs in 8 beach locations in Dublin Bay, including a UNESCO Biosphere; (iii) and the measurement of CECs in Poolbeg Marina over 5 days.

METHODOLOGY

USED OF BIOFILM AS A SAMPLING DEVICE

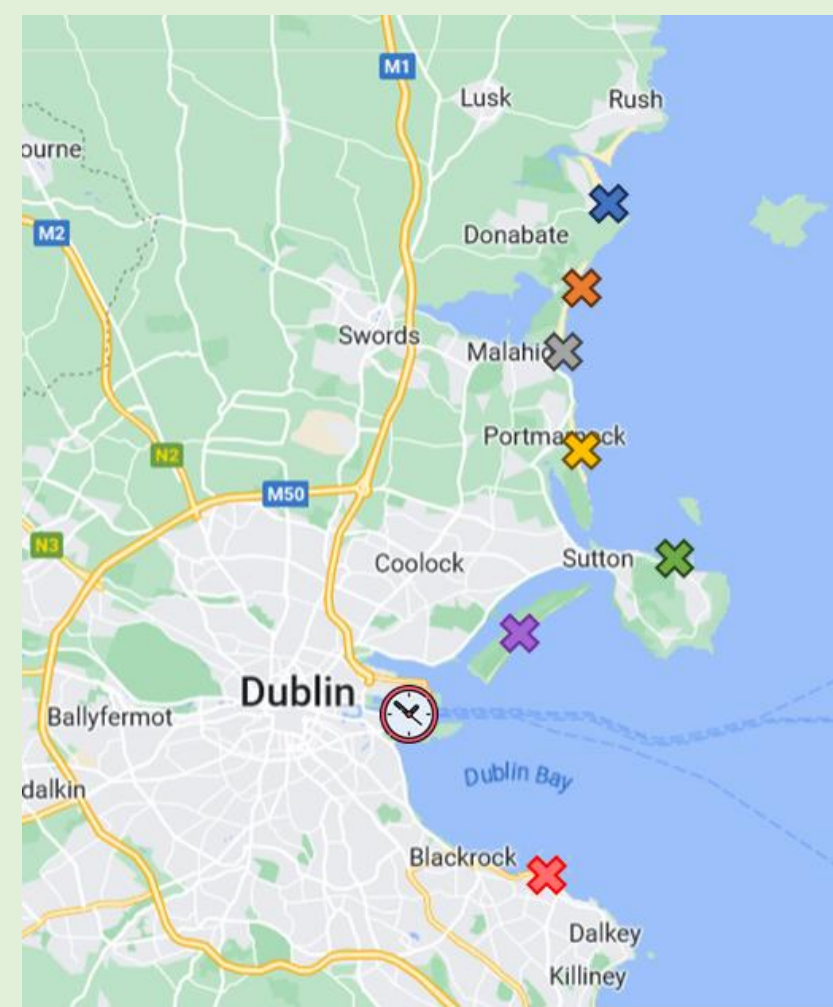


Micro- and macrofouling



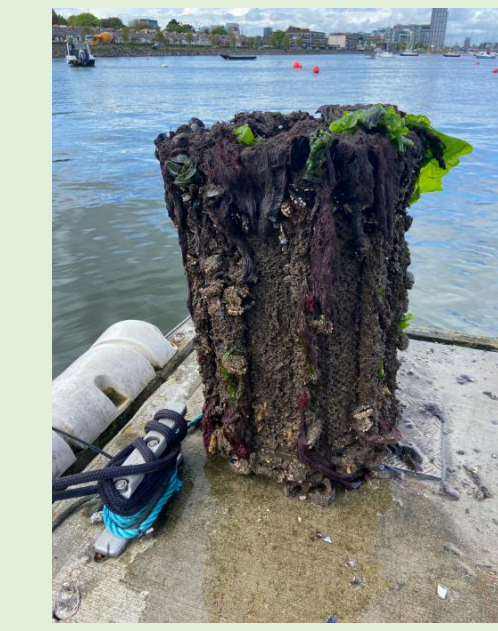
Biofilm was placed in a lobster cage for one year in Poolbeg Marina area. After the year it was recollected and micro and macrofouling was analysed.

SPATIAL AND TEMPORAL (S & T) ANALYSIS OF CECs IN DUBLIN COAST



- Portrane beach
- Donabate beach
- Malahide beach
- Portmarnock beach
- Howth Harbour
- Bull Island
- Don Laoghaire Harbour
- Poolbeg Marina (both)

Areas where sampling were performed. In the case of Poolbeg Marina, a temporal analysis was done, sampling for 5 days to understand the fluctuation of CECs in marine environment.

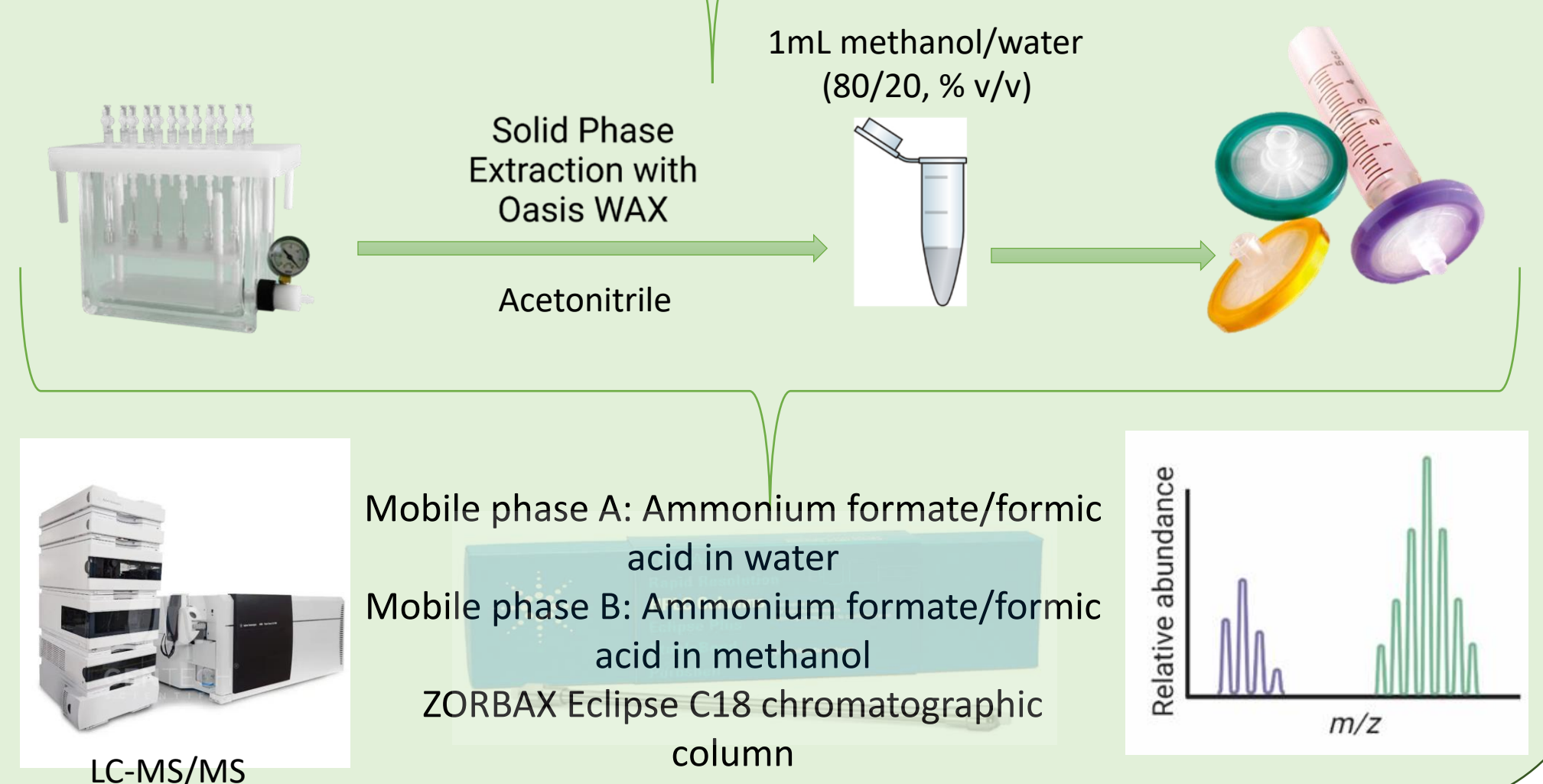


Biofilm samples were:
- Sonicated
- Centrifugated
- Filtered



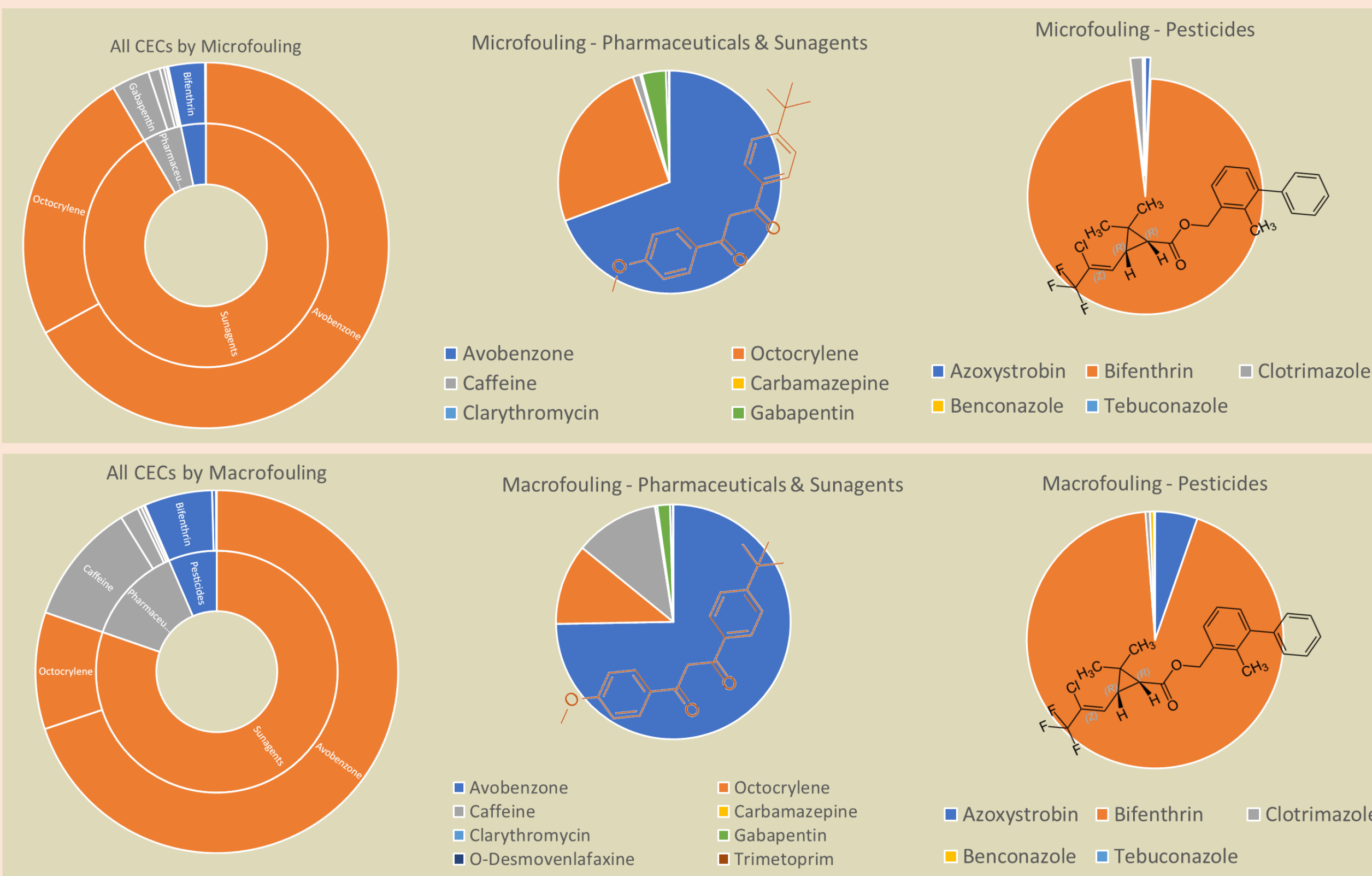
Marine water sample

SPE-HPLC-MS/MS methodology

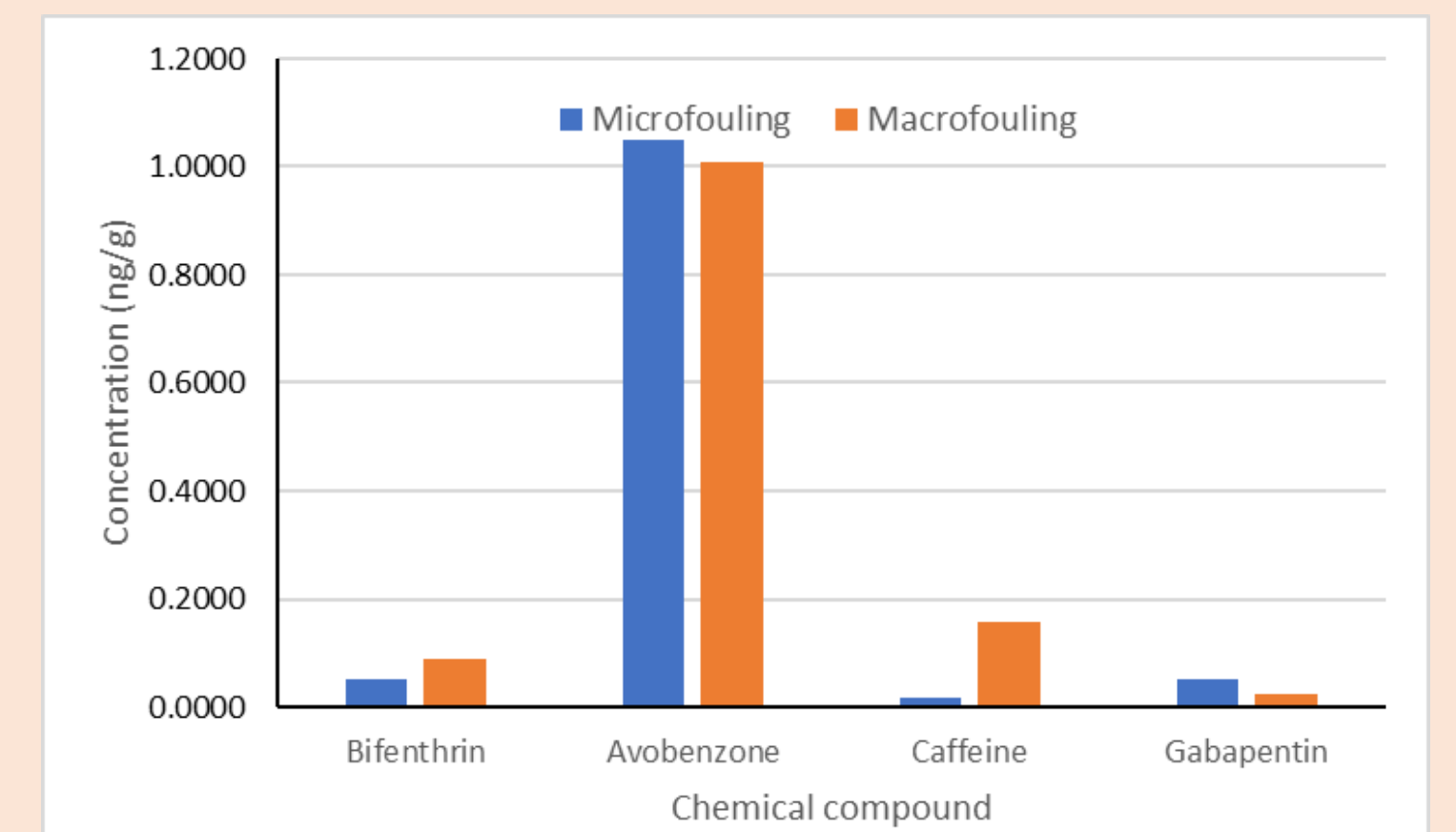
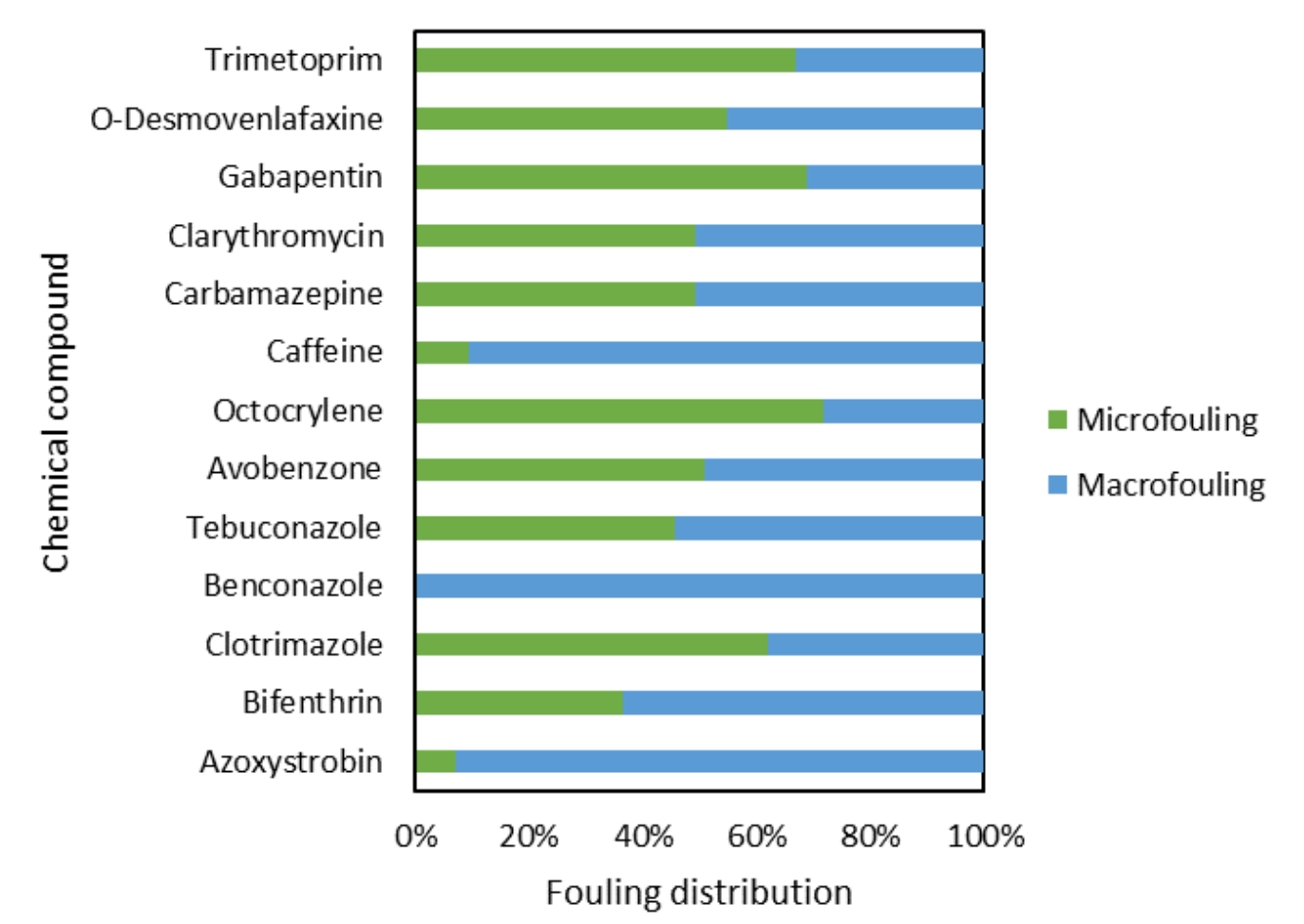


RESULTS & DISCUSSION

BIOFILM RESULTS

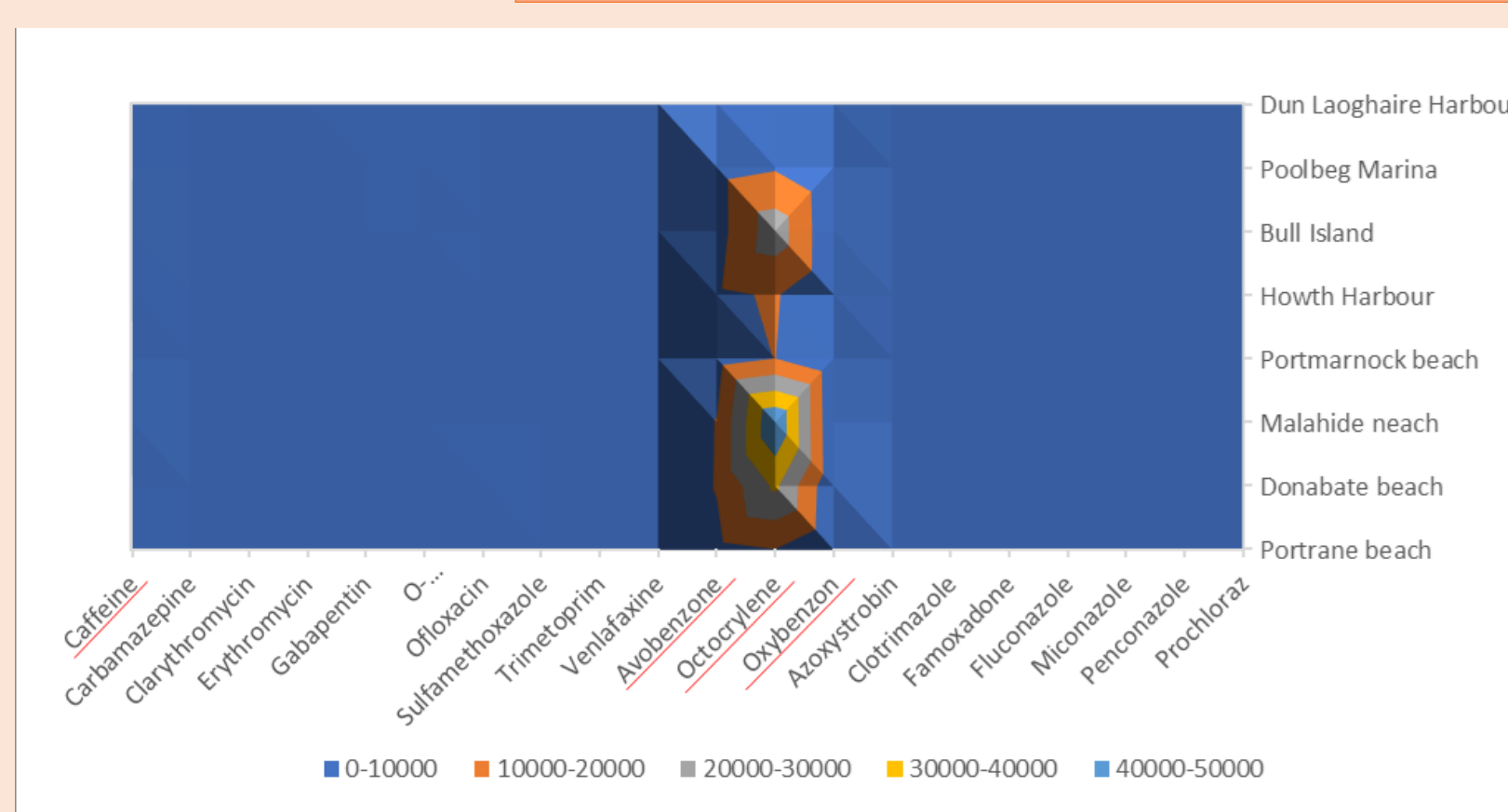


Micro and macrofouling showed the same profile, being the sunagents the compounds that presented the highest concentrations, particularly the avobenzene, whose structure is shown. The pharmaceutical compounds, in general, didn't show significant differences between both methodologies, except for caffeine. On the other hand, several pesticides were searched but only 5 were detected.

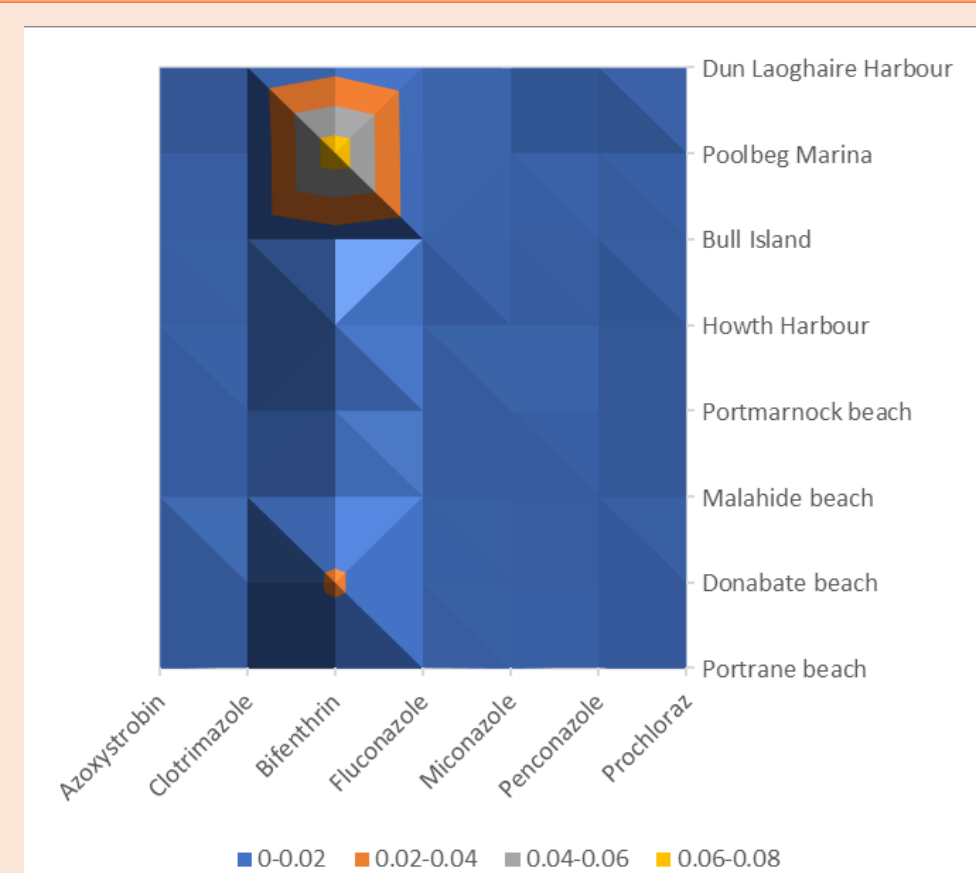


If we represent all the compounds, we can see that some of them, like clarithromycin or tebuconazole, can be equally quantified in both fouling, but there are others like caffeine, octocrylene and azoxystrobin that show differences.

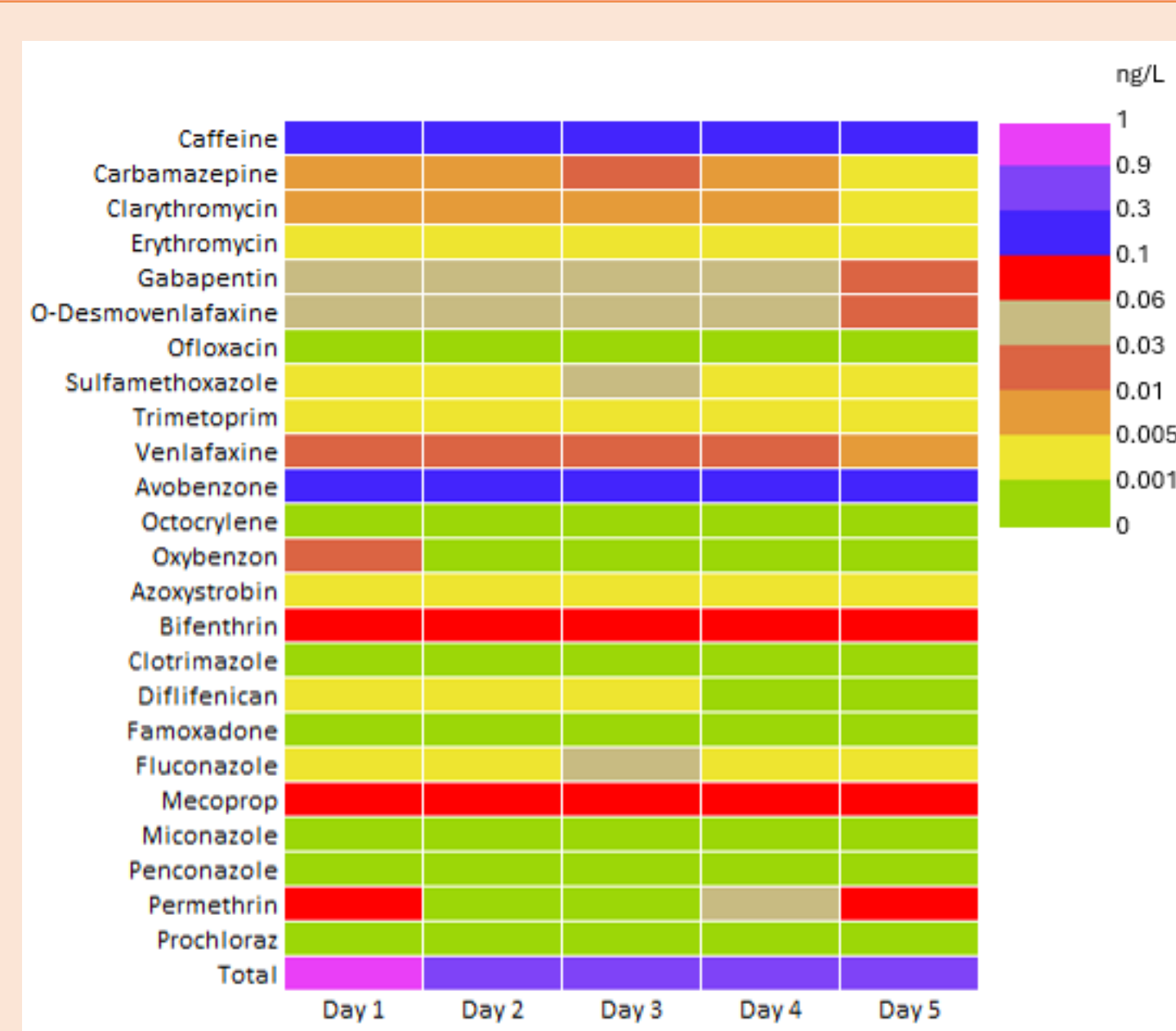
SPATIAL ANALYSIS



Four compounds, caffeine and the three sunagents, represent the biggest proportion of the CECs determined. These data are in agreement with the biofilm experiment, confirming the possible use of biofilm as a new passive sampling device. Of the different location where CECs were detected, Malahide beach presents the highest concentration of these four compounds, between 225 to 10000 ug/L. On the contrary Dun Laoghaire and Howth Harbours presented the lowest concentration of these compounds. If we only consider the pesticides, we can confirm that bifenthrin is the compound most concentrated, and the highest concentration is found in the Poolbeg Marina.



TEMPORAL ANALYSIS



The CECs did not show any trend in the marine environment analyzed, which in itself is a conclusion because it implies that there is a constant concentration of marine pollutants of different kinds that are contaminating the marine environment, highlighting that in this case Dublin Bay has a UNESCO Biosphere. Therefore, we must take into account the possible cumulative effect on the different species that can nest or inhabit that area.

CONCLUSION

Biofilm is a good sampling device where macro and microfouling need to be considered. In swimming areas, the highest contaminants found were the sunagents, whereas in other areas, like harbours, these pollutants are not so concentrated. Pharmaceuticals and pesticides are present in all the samples (biofilm, spatial and temporal) highlighting its distribution in the marine environment. With these results demonstrating a wide range of chemical type and location, it is necessary to consider the possible cumulative effect on the different species that can nest or inhabit the UNESCO Biosphere – near each of the sampling sites.

REFERENCES

- [1] Ada Costa Filho BM, Duarte AC, Rocha-Santos TAP. 2022. Environmental monitoring approaches for the detection of organic contaminants in marine environments: A critical review. Trends Environ. Anal. Chem.
- [2] European Union. 2023. EU Marine Strategy Framework Directive. https://research-and-innovation.ec.europa.eu/research-area/environment/oceans-and-seas/eu-marine-strategy-framework-directive_en. Accessed 17 October 2023.

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