# Five Years Monitoring the Emergence of Unregulated Toxins in Shellfish in France (EMERGTOX 2018 - 2022)

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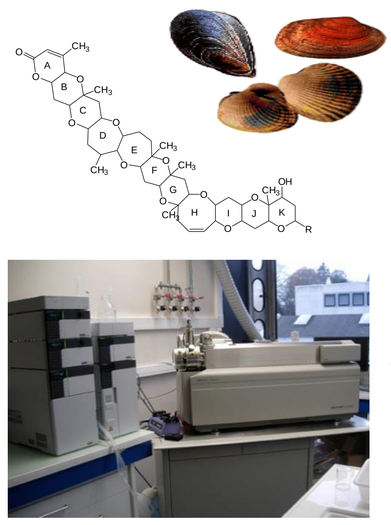
## Context & Objective

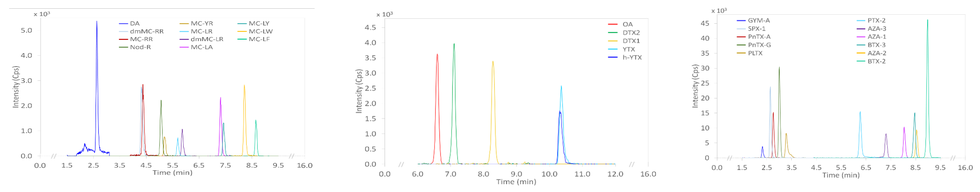
Shellfish accumulate microalgal toxins, which can make them unsafe for human consumption. In France, in accordance with European regulations, three groups of marine toxins are currently under official monitoring of toxic microalgal blooms (REPHYTOX): lipophilic toxins, saxitoxins and domoic acid. Other unregulated toxin groups are also present in European shellfish (e.g., pinnatoxins, brevetoxins, BMAA). One of the main objectives of this work is, therefore, to carry out an inventory of the presence of these unregulated toxins in shellfish in France. The EMERGTOX network has been in place since 2018 to systematically monitor these unregulated toxins throughout the year and highlight emerging toxins in shellfish. It was intended to complement the existing French regulatory monitoring which is dedicated to regulated toxins in Europe. The analytical approach used also allows the monitoring of regulated toxins and consequently the possible identification of hazards related to the presence of these toxins in shellfish outside favorable periods of toxic algal blooms (e.g., winter), as a complement to the official monitoring.

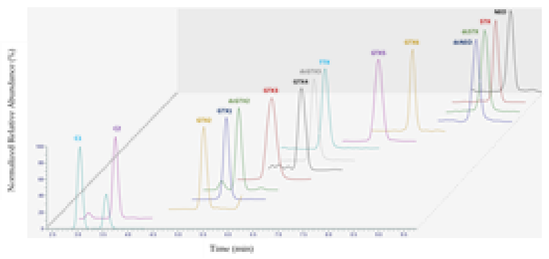
The main objective of the EMERGTOX is to acquire data on the main groups of unregulated lipophilic and hydrophilic toxins listed at the international level in order to contribute to risk assessment.

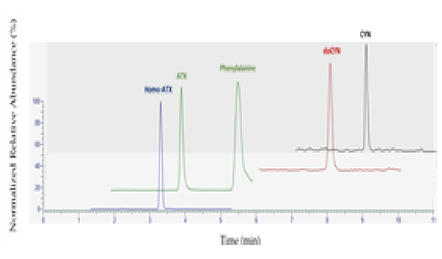
## Methods

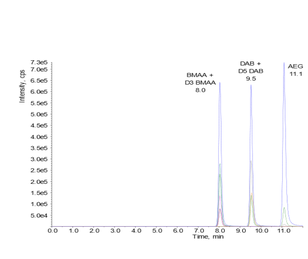


Three analytical approaches using mass spectrometry (LC-MS/MS) were optimized and in-house-validated to monitor, in addition to regulated toxins in Europe, all targeted unegulated toxins groups in Europe: spirolides (SPXs), gymnodimines (GYMs), pinnatoxins (PnTXs), ovatoxins/palytoxins OVTXs/PLTXs), brevetoxins (BTXs), microcystins (MCs), nodularin (NOD), tetrodotoxins (TTXs), anatoxins (ATXs), cylindrospermopsins (CYNs) and β-N-methylamino-L-alanine (BMAA), 2,4-diaminubutyrique acid (DAB) and N-(2-aminoéthyl)glycine (AEG).






## Results

The poster aims to summarize the results btained on unregulated lipophilic and hydrophilic toxins of marine and freshwater origin in shellfish production areas along the French coasts during the period 2018 – 2022.

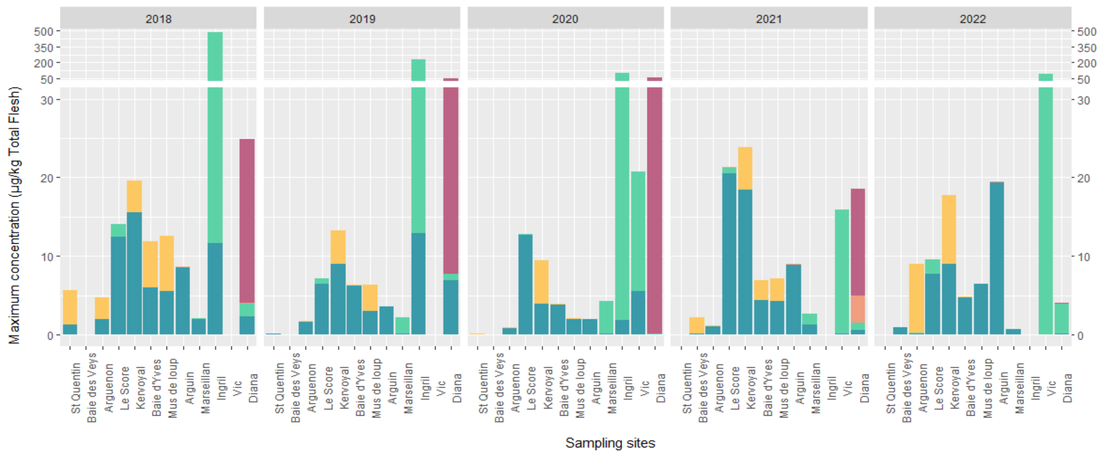



Fig. 1. Maximum concentrations of unregulated toxins found in shellfish at different sites of the EMERGTOX network during 2019–2022 period.

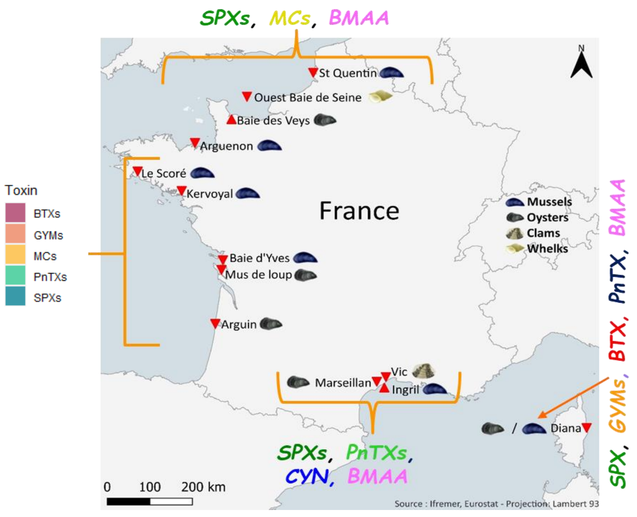



Fig. 2: Toxin profiles of shellfish in 3 coastal regions: English Channel, Atlantic & Mediterranean

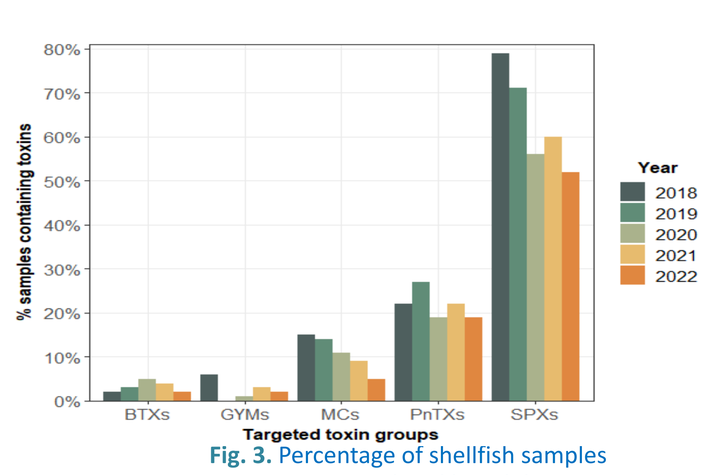


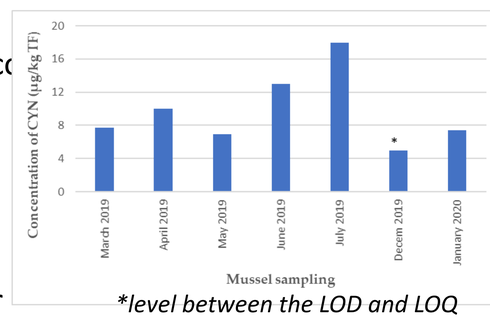

**Fig. 3.** Percentage of shellfish samples containing unregulated lipophilic toxins

► Maximum concentrations of unregulated lipophilic toxins at different sites during 2018 - 2022 period: SPXs, PnTXs, MCs, GYMs and BTXs (Fig. 1 & 2).

- Systematic presence of spirolides (SPX-13-DesMeC, SPX-DesMeD) in all the sampled sites.
- Microcystins (MC-RR or/and dmMC-RR or/and MC-LR) were detected every year in shellfish samples fom the English Channel and the Atlantic co
- Gymnodimine (GYM-A) was detected at two sites: on the Atlantic coast (Le Scoré, Arguin) and on the Mediterranean coast (Corsica).
- Pinnatoxins (PnTX-G or/and PnTX-A) were detected mainly in the Mediterranean.
- Brevetoxins (BTX-2, BTX-3) were detected on the Mediterranean coast (Corsica).

► The annual spatial and temporal evolution of the percentage of each of the targeted lipophilic toxin groups remained generally similar during this period, except for SPXs and MCs, for which there was a decrease of 20% between 2018 and 2022 (Fig. 3).

► Systematic presence of BMAA and DAB in all the shellfish samples, with a maximum in the mussels at Kervoyal on the Atlantic coast (10,000 µg "BMAA+DAB"/kg TF) (BMAA content: 70% - 80% of the total BMAA+DAB) (Fig. 2).




*level between the LOD and LOQ

Fig 4. CYN in mussels collected on the Mediterranean coast

► Recurrent presence of Cylindrospermopsin (CYN) on the Mediterranean coast (Thau Lagoon) between March 2019 and January 2020, with a maximum level of 18 µg CYN/kg TF during the summer 2019 (Fig. 4).

► Except BMAA and DAB, no other toxins were detected in any samples of gastropod (whelk).

## Atypical results for regulated toxins of the Saxitoxin group

Since 2019, recurrent presence in winter of the saxitoxin group (GTX-2, -3; GTX-1, -4; STX) in oysters on the Atlantic coast (Arguin site) (Fig. 5). No known toxic microalga species that produce these toxins was observed *in situ* during this period which was not favorable to algal blooms.

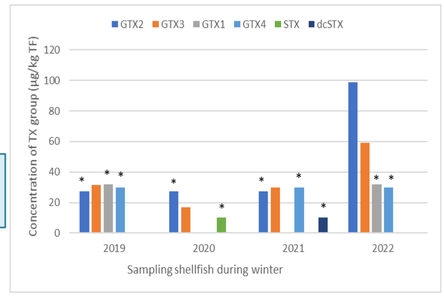



**Fig 5.** Maximum of the saxitoxin group in oysters at the Arguin site during winters 2019–2022.

## For more information, refer to the following references

Amzil Z. et al. (2023). Five Years Monitoring the Emergence of Unregulated Toxins in Shellfish in France (EMERGTOX 2018–2022) . *Marine drugs* , 21(8), 435 (23p.). https://doi.org/10.3390/md21080435,

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