# Toxicity of Alkylnaphthalenes: Common Environmental Contaminants

Steven J. Rowland, Alan G. Scarlett, Charles E. West, Robert Clough

Petroleum and Environmental Geochemistry Group, Biogeochemistry Research Centre, University of Plymouth, Drake Circus, Plymouth PL4 8AA, U.K.
http://www.research.plymouth.ac.uk/pegg/
Email: S.Rowland@plymouth.ac.uk

## Introduction

- Alkylnaphthalenes (Figure 1) are hydrocarbons commonly detected in the marine environment following spillages of crude oils [1] (Figure 2) and have been widely reported in oil-contaminated sediments [2] and marine organisms [3].

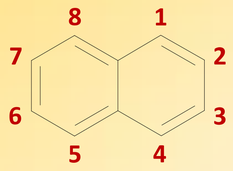


**Figure 1.** Numbering of alkyl position on naphthalene

- Surprisingly, given their widespread occurrence, little information on the toxicity of alkylnaphthalenes to marine organisms has been reported.

- We report the toxicity of a range of commercially-available and specifically synthesised $C_{2\text{-}8}$ substituted non-branched and branched alkylnaphthalenes to the blue mussel (*Mytilus spp*).

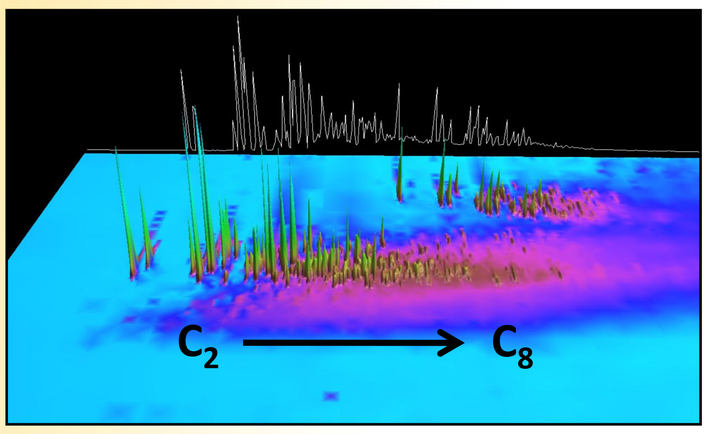


**Figure 2.** GCxGC-ToF-MS mass chromatogram (molecular ions) of $C_2$-$C_8$ alkylnaphthalenes in a crude oil (Alaskan North Slope).

## Materials & Methods

### (1) Alkylnaphthalene Exposure Tests

- Mussels were collected from Trebarwith Sands on the northern coast of Cornwall, UK (N50° 38.720', W004° 45.652') and maintained in filtered seawater at 15°C (± 0.5°C). Mean length was 38.6 mm (standard error = 0.08mm, n= 423).

- Acute (48h) semistatic exposure tests were performed on test solutions (concentration range 0.05 to 2 mg $L^{-1}$) of individual $C_2$-$C_8$ alkylnaphthalenes.

### (2) Measurement of Clearance Rate

- Mussels were placed individually in 400 mL glass beakers containing 350 mL of clean seawater (Figure 3).

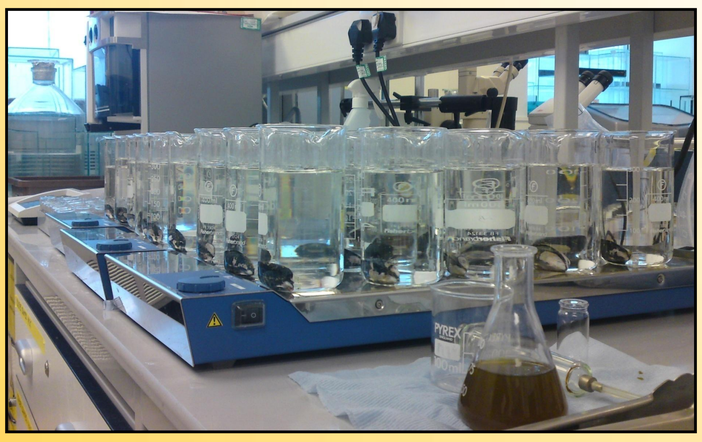

**Figure 3.** Mussel clearance rate apparatus.

- After an acclimation period with slow vortex mixing, 500 µL of *Isochrysis galbana* (Reed Mariculture, Campbell, Ca, USA) algal solution was added to give 25 x $10^3$ cells $mL^{-1}$.

- A 20 mL water sample was removed immediately from all beakers upon addition of the algae and retained in vials for algae enumeration. Further samples were taken after 20 min.

- Algal particles (3-10 µm) were analysed using a Beckman Z2 Coulter particle count and size analyzer (Beckman Coulter, Wycombe, UK).

- From the loss of algal particles during the 20-min period, the clearance rates of the mussels were determined.

## Results

**(A) Concentration response for 2,3,5-trimethylnaphthalene**

**(B) Concentration response for 2-(6'-methylheptan-2'-yl)naphthalene**

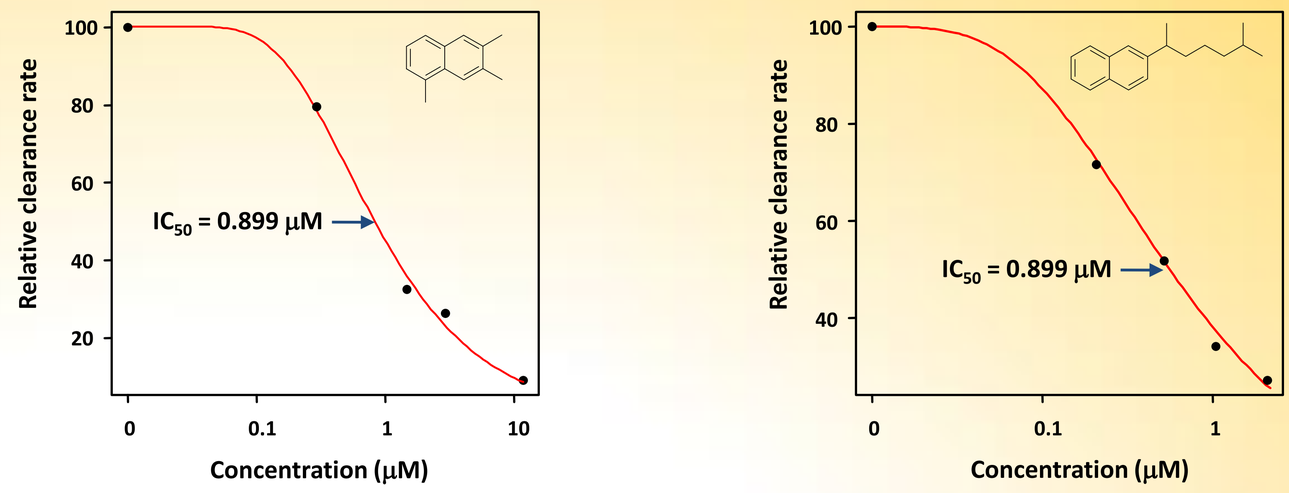


**Figure 4.** Examples of relative clearance rate measurements for mussel exposure tests (n=9) and calculation of $IC_{50}$ values for **(A)** 2,3,5-trimethylnaphthalene ($C_3$) and **(B)** 2-(6'-methylheptan-2'-yl)naphthalene ($C_8$).

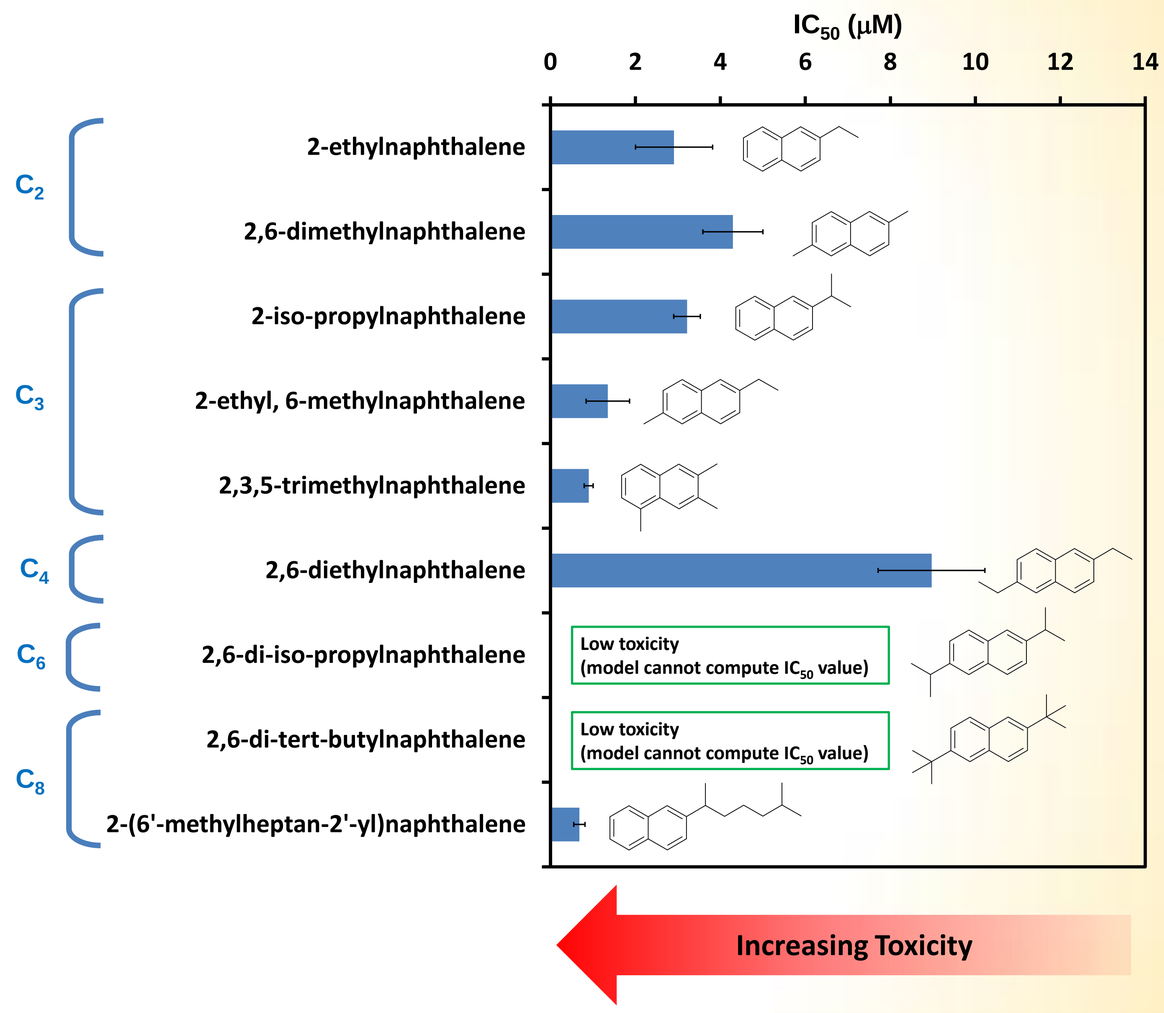


**Figure 5.** Comparison of experimentally determined half maximal inhibitory concentration ($IC_{50}$) values for selected $C_{2\text{-}8}$ substituted non-branched and branched alkylnaphthalenes (error bars = standard error).

## Conclusions

- Branching influences bioavailability and therefore toxicity e.g. some branched $C_8$ alkylnaphthalenes (note: 7,177 $C_8$ isomers are possible) exhibit toxicity comparable to $C_3$ naphthalenes.

- Suggests monitoring of hydrocarbon contaminants in mussels should include an assessment of the concentrations of larger alkylnaphthalenes (>$C_6$) and ideally identification of isomers of branched alkylnaphthalenes.

- Potential for alkylnaphthalenes to accumulate in wild mussel populations resulting in reduction in health status.

## References

**[1]** Wang, Z. and Stout, S.A. (2007) Oil Spill Environmental Forensics: Fingerprinting and Source Identification. Academic Press, London.

**[2]** Franco, M.A., Viñas, L., Soriano, J.A., de Armas, D., González, J.J., Beiras, R., Salas, N., Bayona, J.M., Albaigés, J. (2006) Spatial distribution and ecotoxicity of petroleum hydrocarbons in sediments from the Galicia continental shelf (NW Spain) after the Prestige oil spill. Marine Pollution Bulletin., 53(5-7), 260-271.

**[3]** Booth, A.M., Sutton, P.A., Lewis, C.A., Lewis, A.C., Scarlett, A., Chau, W., Widdows, J., Rowland, S.J.(2007) Unresolved Complex Mixtures of Aromatic Hydrocarbons: Thousands of Overlooked Persistent, Bioaccumulative, and Toxic Contaminants in Mussels. Environ. Sci. Technol., 41(2), 457-464.

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