



Status and Trends in the Concentrations of Polycyclic Aromatic Hydrocarbons (PAHs) in Shellfish



MSFD Descriptor: 8 - Concentration of contaminants

MSFD Criterion: 8.1 - Concentration of contaminants

Key Message Although mean concentrations of polycyclic aromatic hydrocarbons (PAHs) in shellfish in all ten assessed areas are above natural background concentrations, they are below levels likely to harm marine species. Mean concentrations are decreasing or show no statistically significant change in the areas assessed in the period 1995–2015

Background

Polycyclic aromatic hydrocarbons (PAHs) are natural components of coal and oil, and are also formed during the combustion of fossil fuels and organic material, for example during activities at an oil refinery. PAHs also occur as a result of natural processes such as forest fires.

PAHs enter the marine environment through atmospheric deposition, road run-off, industrial discharges and as a result of oil spills. PAHs in the marine environment often end up in marine sediment, where they can become trapped in lower layers unless the sediments are disturbed. PAHs also accumulate in shellfish, either absorbed directly from the marine environment or indirectly through food consumption. In contrast fish metabolise PAHs and therefore concentrations in fish are low. The problems caused by PAHs in the marine environment vary considerably from tainting the taste of fish and shellfish to potential carcinogenic effects on humans and animals.

The OSPAR Hazardous Substances Strategy has the ultimate aim of achieving concentrations in the marine environment near background values for naturally occurring substances and close to zero for man-made synthetic substances. Due to their persistence in the marine environment, their potential to bioaccumulate and their toxicity, analyses of PAH concentrations in sediment and shellfish is reported in the OSPAR Coordinated Environment Monitoring Programme (CEMP). Monitoring PAHs in biota across the OSPAR Maritime Area began between 1995 and 1999.

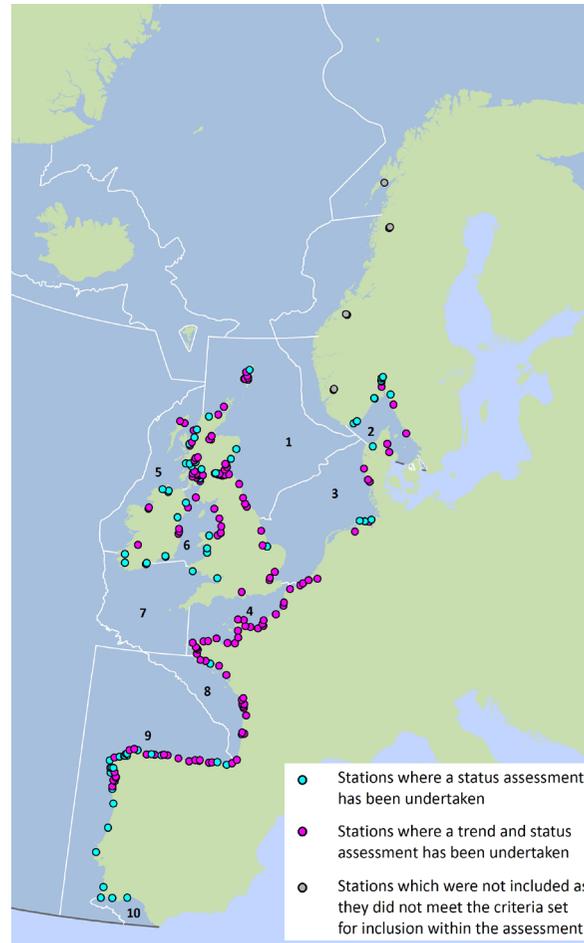


Figure 1: Monitoring sites used to assess PAH concentrations in shellfish by OSPAR contaminants assessment area (white lines) determined by hydrogeographic principles and expert knowledge, not OSPAR internal boundaries.

Results

PAH concentrations were measured in shellfish samples collected between 1995 and 2015 from 188 monitoring sites throughout much of the Greater North Sea, Celtic Seas, and Bay of Biscay and Iberian coast (Figure 1), at frequencies ranging from annually to every three years.

PAH concentrations were compared against two assessment criteria: the OSPAR Background Assessment Concentrations (BACs) and Environmental Assessment Criteria (EACs). Adverse effects on marine organisms are rarely observed when concentrations are below the EAC. BACs are used to assess whether concentrations are near background values for naturally occurring substances, such as PAHs; this is the ultimate aim of the OSPAR Hazardous Substances Strategy.

Mean PAH concentrations in shellfish for each OSPAR sub-region were compared to the EACs. PAH concentrations were below the EAC, but above the BAC in all 10 OSPAR sub-regions (Figure 2). As PAH concentrations in shellfish were below the EAC they are unlikely to cause any adverse effects.

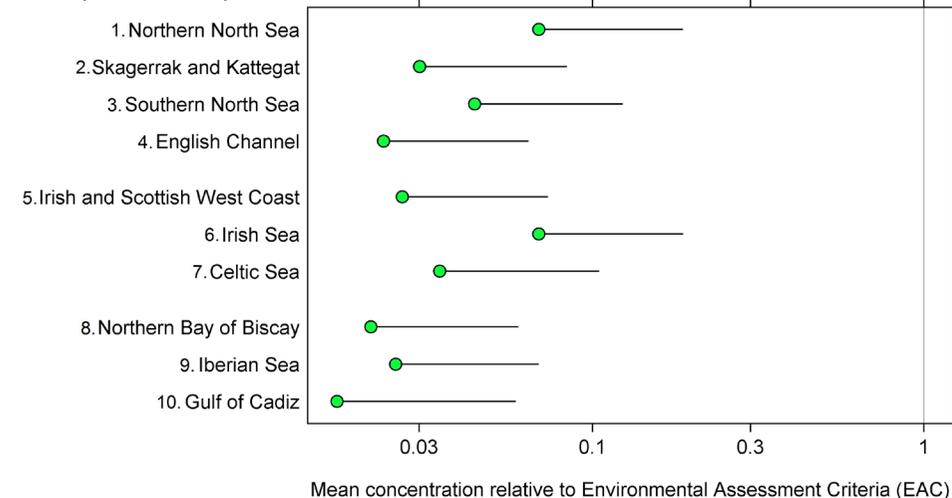


Figure 2: Mean PAH concentration in shellfish in each OSPAR sub-region, relative to the Environmental Assessment Criteria (EAC) (with 95% upper confidence limits), where value of 1 means that the mean concentration equals the EAC. Green: the mean concentration is statistically significantly ($p < 0.05$) below the EAC, but not statistically significantly below the Background Assessment Concentration (BAC)

Results cont...

Temporal trends in PAH concentration in shellfish were assessed in OSPAR sub-regions where at least five years of data were available (Figure 3). Four of the OSPAR sub-regions (Northern North Sea, Skagerrak and Kattegat, Irish Sea, Northern Bay of Biscay) show no statistically significant change in PAH concentrations. Declining PAH concentrations are observed in four OSPAR sub-regions (Southern North Sea, English Channel, Irish and Scottish West Coasts, and the Iberian Sea), with mean annual decreases in concentration of between 6.5% and 3.2%.

There is high confidence in the assessment and sampling methodology and high confidence in the data used.

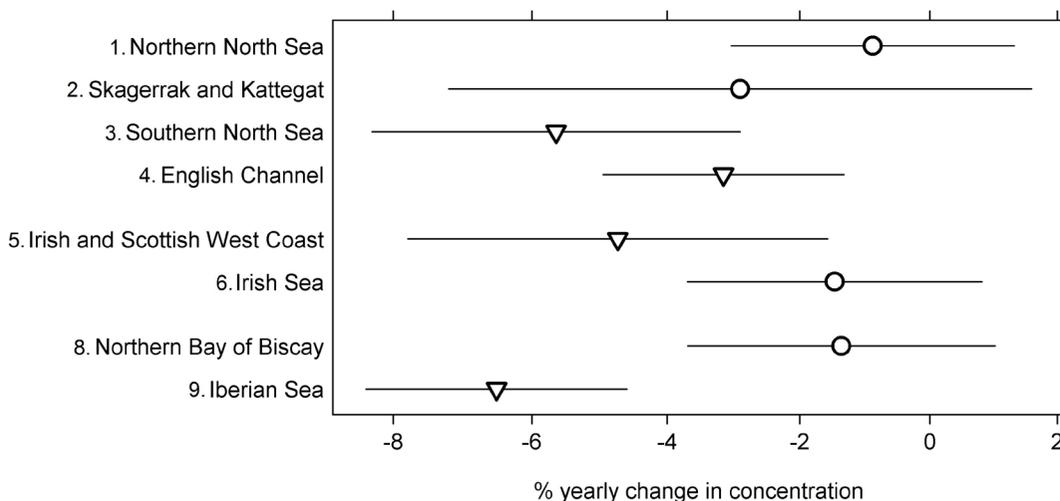


Figure 3: Percentage annual change in PAH concentration in shellfish in each OSPAR sub-region. No statistically significant ($p < 0.05$) change in mean concentration (circle), mean concentration is significantly decreasing (downward triangle). 95% confidence limits (lines)

Conclusion

Mean PAH concentrations in shellfish are above background concentrations in all assessed OSPAR sub-regions. However, concentrations in shellfish are below the Environmental Assessment Criteria (EAC) in all OSPAR sub-regions and therefore are unlikely to cause adverse effects. Temporal trends in PAH concentration in shellfish are either decreasing or show no statistically significant change in all OSPAR sub-regions assessed and no upwards trends are observed.

Whilst PAHs originate from natural sources and will always be present in the marine environment, better use of emission control technology in combustion processes could improve the situation further and reduce concentrations to natural levels.

Knowledge Gaps

There is a lack of monitoring data, particularly in Arctic waters, where there are insufficient monitoring sites with a good geographic spread for a sub-regional assessment of status and temporal trends.

Monitoring of PAH metabolites in fish bile could extend the biota monitoring programme to include open waters. Fish readily metabolise PAHs and so analysis of PAH metabolites in bile will indicate if fish have been exposed to PAH compounds.

Environmental Assessment Criteria (EACs) were used in the assessment of parent PAHs only; there are no assessment criteria for alkylated PAHs. There is a need for EACs to be developed for alkylated PAHs in shellfish. There are currently no data on PAHs in open waters, because shellfish are only found in the coastal zone. The limitations in using EACs and Background Assessment Concentrations (BACs) should be addressed with further research.



Image: Polycyclic aromatic hydrocarbons (PAHs) can accumulate in shellfish, either absorbed directly from the marine environment or indirectly through food consumption ©Jennifer McNew