



Trends in Concentrations of Polybrominated Diphenyl Ethers (PBDEs) in Fish and Shellfish



MSFD Descriptor: 8 - Concentration of contaminants
 MSFD Criterion: 8.1 - Concentration of contaminants

Key Message Concentrations of polybrominated diphenyl ethers (PBDEs) detected in biota (fish, mussels, oysters) are declining in the majority of areas assessed. The exception is the Skagerrak and Kattegat where concentrations show no statistically significant change. The lack of assessment criteria means that the environmental significance of the concentrations cannot be assessed

Background

Polybrominated diphenyl ethers (PBDEs) are a group of congeners, mainly used as flame retardants in a variety of materials including plastics, textiles, electronic products, building materials, furnishings and vehicles. PBDEs may enter the environment through emissions from manufacturing processes, evaporation from products that contain PBDEs, recycling wastes and leachate from waste disposal sites (Figure 1). They are widespread and have been detected in air, sediments, surface waters, fish and other marine animals.

PBDEs are toxic, they take a long time to degrade and have the potential to accumulate in fish or shellfish (taken in either directly from the surrounding water or indirectly via food). As a result, some PBDEs were banned or restricted within the European Union starting in 2004. Production of some groups of PBDEs was banned in 2009 by 180 countries that are signatories to the Stockholm Convention.

The spatial distribution of PBDEs in the marine environment is variable. Some PBDE congeners tend to accumulate in fish and shellfish more than others. PBDEs are known to have effects on the nervous, immune and endocrine systems of birds and mammals.

The OSPAR Hazardous Substances Strategy has the ultimate aim of achieving concentrations in the marine environment close to zero for man-made synthetic substances, and PBDEs are included in the group of brominated flame retardants on the OSPAR List of Chemicals for Priority Action. The status of PBDEs in biota is determined but not assessed because there are no OSPAR assessment values developed with which to assess status.

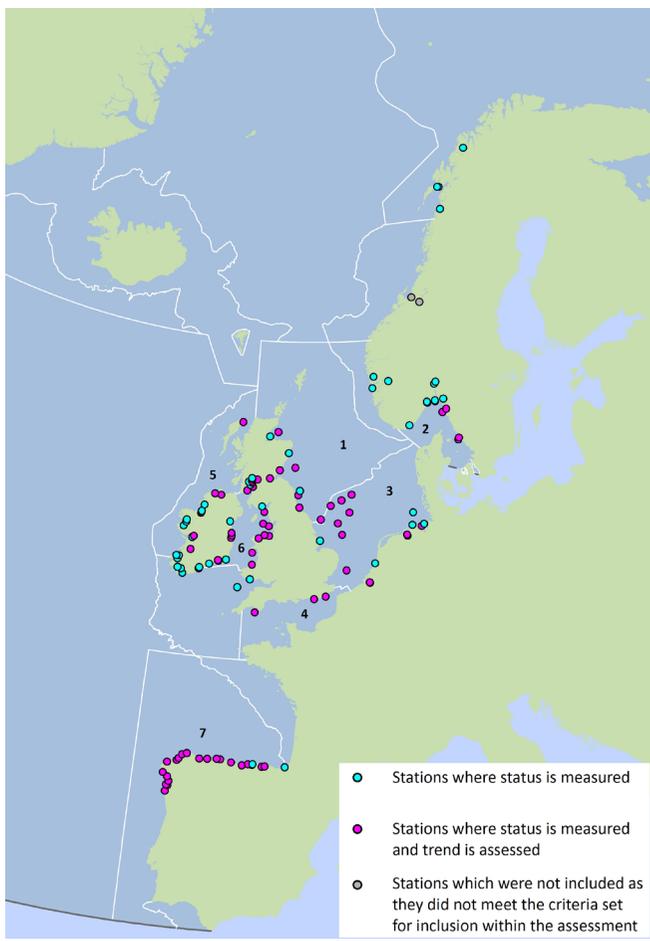


Figure 2: Monitoring sites used to assess PBDE concentrations in biota by OSPAR contaminants assessment area (white lines) determined by hydrogeographic principles and expert knowledge, not OSPAR internal boundaries.

Results

Polybrominated diphenyl ether (PBDE) concentrations are measured in biota (fish, mussels and oysters) taken annually (or every few years) from monitoring sites throughout much of the Greater North Sea, Celtic Seas, and Bay of Biscay and Iberian Coast. A few samples are also taken from Arctic Waters. Monitoring site locations are shown in Figure 2. Data recorded between 2010 and 2015 were used to investigate temporal trends in PBDE concentrations and to compare concentrations and patterns between OSPAR sub-regions. There were too few monitoring sites in Arctic Waters to give sufficient information for a trend assessment for that region.



Figure 1: Land-based waste dumping site with potential leakage of polybrominated diphenyl ethers (PBDEs) from products containing these flame-retardants

Results cont...

Temporal trends in mean PBDE concentrations were assessed in seven OSPAR sub-regions where there were more than five years of data. The results indicate that mean concentrations of PBDEs are decreasing in the majority of OSPAR sub-regions (**Figure 3**). The Skagerrak and Kattegat is the exception, where concentrations in biota show no statistically significant change.

Mean PBDE concentrations are $<1 \mu\text{g}/\text{kg}$ wet weight in ten OSPAR sub-regions. The sub-regions showing the highest mean concentrations of PBDE in biota are the English Channel and Irish Sea. The lowest concentrations are found in the Iberian Sea. However, the species monitored differ between OSPAR sub-regions and this may be reflected in the results. In the Iberian Sea only mussels are analysed, which may explain the low mean concentrations of PBDEs, since mussels across the OSPAR sub-regions show lower concentrations than fish.

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

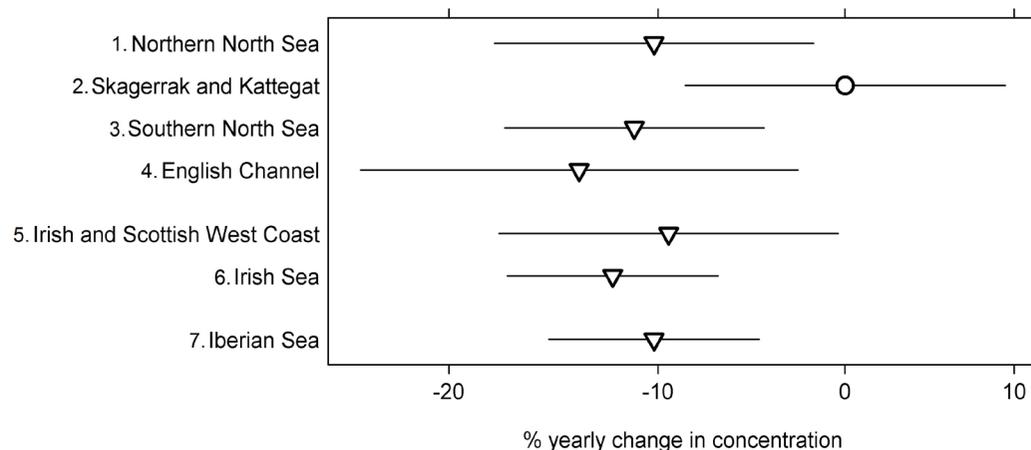


Figure 3: Percentage annual change in overall PBDE concentrations in each OSPAR sub-region. No statistically significant ($p < 0.05$) change in mean concentration (circle), mean concentration is significantly decreasing (downward triangle) 95% confidence limits (lines)

Conclusion

Since PBDEs were regulated, concentrations in fish and shellfish have decreased for the majority of the OSPAR sub-regions.

Temporal trends in polybrominated diphenyl ether (PBDE) concentrations in biota are declining by approximately 10% per year in six of the seven sub-regions assessed. In one sub-region, the Skagerrak and Kattegat, the trend shows no statistically significant change.

PBDE concentrations in biota vary between the OSPAR sub-regions assessed. The highest concentrations occur in the English Channel and the Irish Sea, with the lowest in the Iberian Sea. These differences could reflect the contamination load in the respective sub-regions but could also be influenced by differences in the species monitored. Because there are no assessment criteria available for PBDEs in biota, it is not possible to assess the environmental significance of the concentrations observed.

Knowledge Gaps

There is a lack of monitoring data, particularly in Arctic Waters. Cooperation between OSPAR and the Arctic Council's Arctic Monitoring and Assessment Programme (AMAP) will improve access to data for Arctic Waters.

Assessment values applicable to OSPAR monitoring data for temporal trends and the status of polybrominated diphenyl ethers (PBDEs) in biota need to be developed. A strategy is needed for making data from different monitoring species comparable.

The Environmental Quality Standard (EQS) derived within European Union to protect marine and freshwater ecosystems as well as humans from adverse effects of chemicals in the aquatic environments requires further investigation for use in the OSPAR Maritime Area.