



Status and Trend of Polychlorinated Biphenyls (PCB) in Fish and Shellfish



MSFD Descriptor: 8 - Concentration of contaminants

MSFD Criterion: 8.1 - Concentration of contaminants

Key Message Polychlorinated biphenyls (PCBs) were banned in many countries in the mid-1980s. Since then, while local problems remain, PCB concentrations in shellfish and fish have decreased in most OSPAR sub-regions. With the exception of the most toxic congener (CB118), concentrations in biota are below the level at which they could present an unacceptable risk to the environment

Background

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 synthetic substances.

Polychlorinated biphenyls (PCBs) are man-made chemical compounds that were banned in the mid-1980s owing to concerns about their, toxicity, persistence, and potential to bioaccumulate in the environment. Since the 1980s, global action has resulted in big reductions in releases and remaining stocks have been phased out.

However, despite European and global action, releases continue through diffuse emissions to air and water from building sites and industrial materials. Remaining sources include electrical and hydraulic equipment containing PCBs, waste disposal, redistribution of historically contaminated marine sediments and by-products of thermal and chemical industrial processes.

PCBs do not break down easily in the environment and are not readily metabolised by humans or animals. PCBs accumulate in marine animals, with greater concentrations found at higher trophic levels. PCB compounds are extremely toxic to animals and humans, causing reproductive and developmental problems, damage to the immune system, interference with hormones, and can also cause cancer. A sub-group of PCBs is 'dioxin-like', meaning they are more toxic than other PCB congeners.

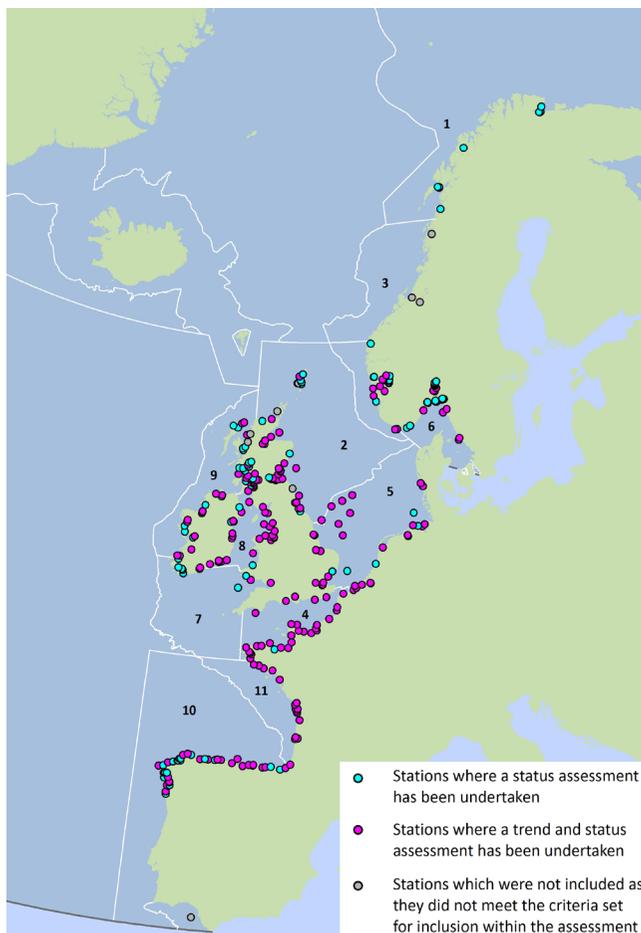


Figure 1: Monitoring sites used to assess PCB concentrations in biota by OSPAR contaminants assessment area (white lines) determined by hydrogeographic principles and expert knowledge, not OSPAR internal boundaries.

Results

Polychlorinated biphenyl (PCB) concentrations are measured in fish liver and shellfish. Samples are taken annually (or every few years) from sites mainly along the coast of the Greater North Sea, Celtic Seas, Iberian Coast and Bay of Biscay and at some coastal monitoring sites in Arctic Waters (**Figure 1**).

The time series used to inform this assessment started in 1995. The data are used to investigate trends in PCB concentration over the period 1995–2015 and to compare concentrations against two sets of assessment values: Background Assessment Concentrations (BACs) and Environmental Assessment Criteria (EACs). Where concentrations are below the EAC they should not cause chronic effects in sensitive marine species and so should present no significant risk to the environment. BACs are used to assess whether concentrations are close to zero for man-made substances, the ultimate aim of the OSPAR Hazardous Substances Strategy.

Status Assessment

Concentrations in biota for six out of seven PCB congeners are below the EAC in all OSPAR sub-regions (**Figure 2**) within the period 1995–2015. However, there are differences between congeners, with concentrations in biota of one of the most toxic PCBs (CB118) close to or above the EAC in eight of the 11 OSPAR sub-regions (Northern North Sea, Norwegian Trench, English Channel, Southern North Sea, Skagerrak and Kattegat, Irish Sea, Iberian Sea and Northern Bay of Biscay), indicating possible adverse effects on marine life in these areas. In three sub-regions (the Celtic Sea, Irish and Scottish West Coast and Barents Sea) CB118 concentrations in biota are below the EAC.

PCBs in biota in most OSPAR sub-regions are still above the BAC. Mean concentrations of CB28 are below the BAC in the Irish and Scottish West Coast, Iberian Sea and Northern Bay of Biscay. Concentrations of other congeners that are below the BAC are CB52 (Irish and Scottish West Coast, and Iberian Sea) and CB180 (Irish and Scottish West Coast).

Trend Assessment

All OSPAR sub-regions assessed still have historical PCB contamination but concentrations in biota are reducing slowly (1995–2014) in nine out of ten, and show no statistically significant change in the other.

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

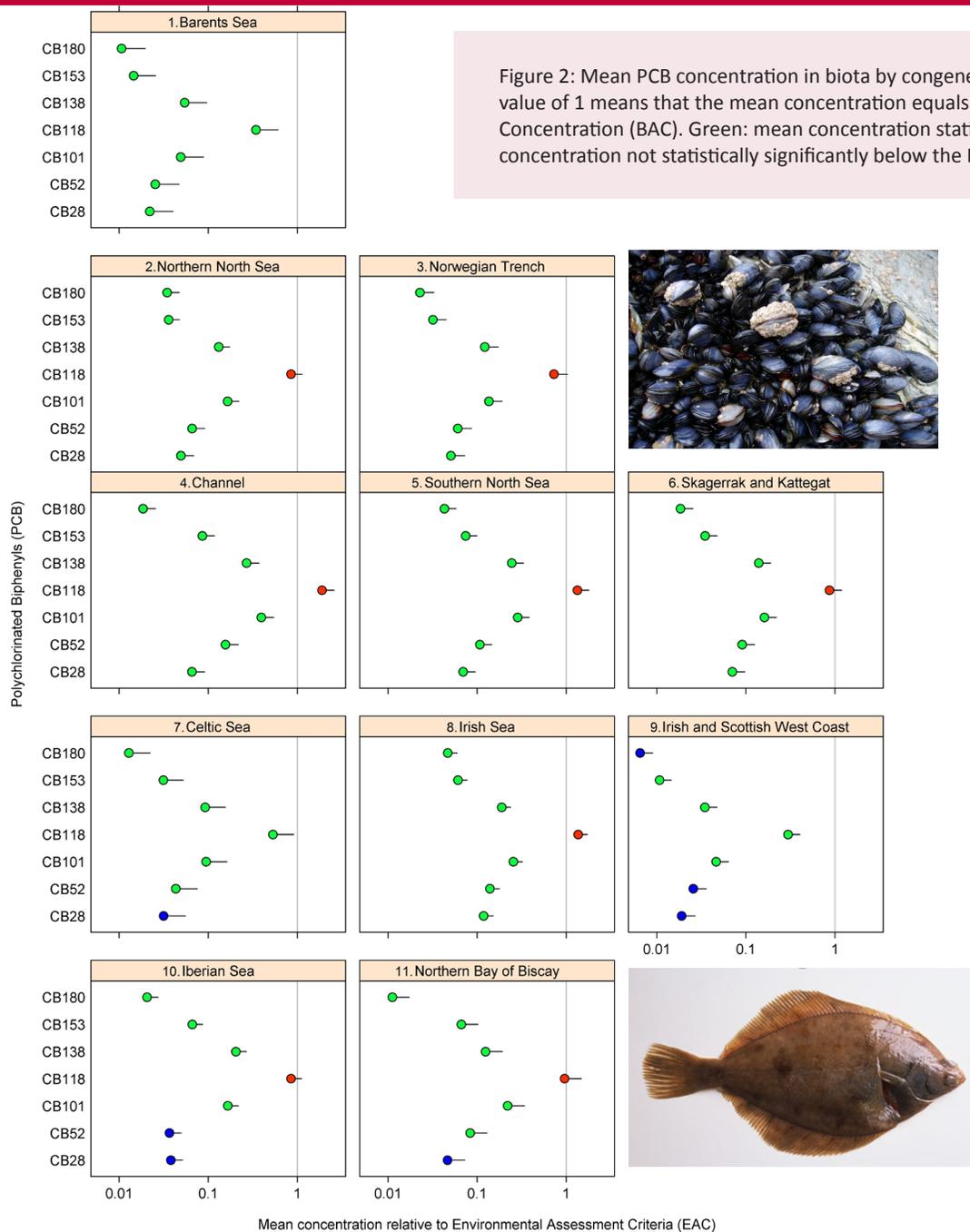


Figure 2: Mean PCB concentration in biota by congener (1995–2015) in each OSPAR sub-region, relative to the EAC (with 95% upper confidence limits) where value of 1 means that the mean concentration equals the EAC. Blue: mean concentration statistically significantly ($p < 0.05$) below the Background Assessment Concentration (BAC). Green: mean concentration statistically significantly above the BAC but below the Environmental Assessment Criteria (EAC). Red: mean concentration not statistically significantly below the EAC



Conclusion

More than 25 years after polychlorinated biphenyls (PCBs) were banned the majority of PCB concentrations in fish and shellfish have decreased to acceptable ecological concentrations in most OSPAR sub-regions. With the exception of the most toxic PCB congener (CB118), the concentrations of PCBs in fish and shellfish are below the level at which they could present an unacceptable risk to the environment. Mean concentrations of CB118 in biota are above this level in eight of the 11 areas assessed (Figure 2), and so adverse effects on marine organisms may still be possible in these areas.

PCBs remain in the sediment for long periods and have the potential to accumulate in biota and biomagnify up food chains. Due to past industrial uses and the persistence of PCBs in the environment, it will take several more decades before concentrations are close to zero, the ultimate aim of the OSPAR Hazardous Substances Strategy.

Knowledge Gaps

Even with discontinued use, it is likely that polychlorinated biphenyls (PCBs) are continuing to enter the environment through secondary sources such as leachate from waste disposal sites. Further research is required to define and quantify diffuse inputs from terrestrial sources. Although secondary poisoning was not considered in the development of the Environmental Assessment Criteria (EAC), because high PCB concentrations have been identified in cetaceans, OSPAR should consider developing EAC for the purpose of protection against secondary poisoning.

Images: Blue mussels (*Mytilus edulis*) © Mark A Wilson
 Common dab (*Limanda limanda*) Wikimedia commons
 Both species are routinely used for PCB monitoring in biota