Status and Trend in the Levels of Imposex in Marine Gastropods (TBT in Shellfish)

MSFD Descriptors 8: Concentration of contaminants
MSFD Commission Criteria: 8.2: Effects of contaminants

OSPAR COMMISSION

Key Message Following bans on tributyltin in antifouling paints there has been a marked improvement in the reproductive condition of marine snails over the assessment period 2010–2015

Background

Antifouling paints are widely used on marine vessels to prevent the growth of marine organisms on the hull. In the 1980s, antifouling paint containing tributyltin (TBT) was used to prevent the attachment of algal slimes and other organisms. By the mid-1980s, the cause of poor growth in oyster stocks was identified as TBT in antifouling paints used on small craft operating in waters near the commercial shellfish beds.

TBT is toxic to many marine organisms at very low concentrations and is unequivocally linked to reduced reproductive performance in several mollusc species.

The OSPAR Hazardous Substances Strategy has the ultimate aim of achieving concentrations in the marine environment close to zero for man-made synthetic substances. Since the mid-1980s, a range of national and international measures has resulted in the phasing out of paints containing TBT in the OSPAR Maritime Area. In 2008, a global ban on TBT in antifouling systems on large vessels came into effect.

Following TBT exposure, some female marine snails (gastropods) develop male sexual characteristics. This is termed 'imposex'. An OSPAR indicator has been developed to measure the extent of imposex within the OSPAR Maritime Area using the Vas Deferens Sequence (VDS). Although TBT ultimately affects many organisms, marine gastropods such as the dog whelk (**Figure 1**), are among the most sensitive, making this an ideal species for monitoring.

OSPAR's Ecological Quality Objective for the North Sea is to reduce the level of occurrence of imposex in dog whelk and other marine gastropods.

Figure 1: Tributyltin affects many creatures, but marine gastropods, such as the dog whelk (*Nucella lapillus*) are among the most sensitive

Results

Imposex, measured as VDS, is currently monitored at more than 200 sites in the OSPAR Maritime Area, on up to three marine gastropod species. At the majority of sites monitored, imposex levels (VDS) are below the level at which harmful effects are first expected to occur. These levels are known as Environmental Assessment Criteria (EAC). In six of the ten OSPAR sub-regions, where there were sufficient data for assessment (over the period 2010–2015), levels of imposex in the three species monitored are significantly below the EACs for each species (**Figure 2**). In three sub-regions (Skagerrak and Kattegat, Celtic Sea and Northern Bay of Biscay) levels are at the EAC and in the Iberian Sea levels are more than five times in excess of the EAC.

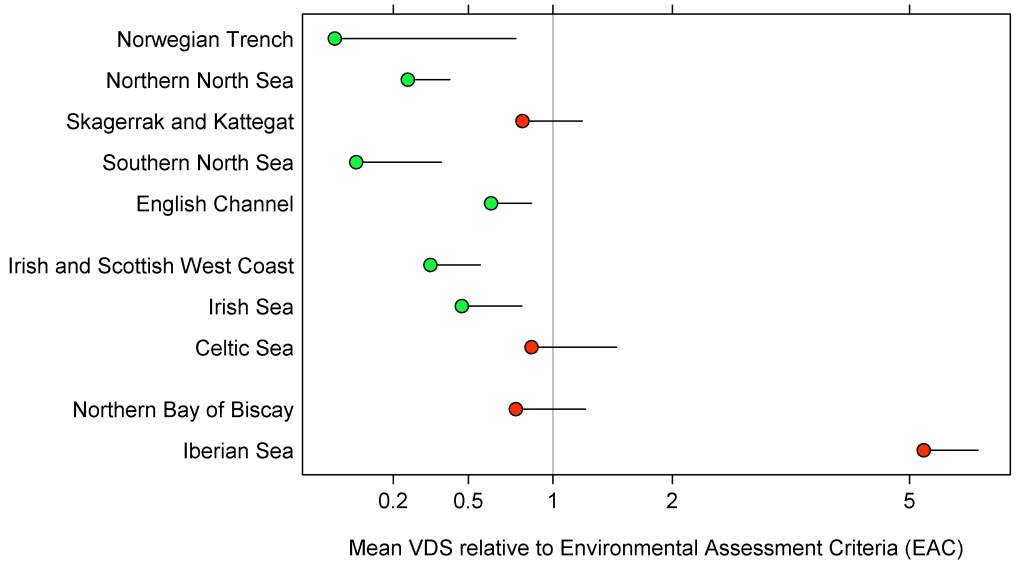

Figure 2: Mean Vas Deferens Sequence (VDS) (2010–2015) in three species of gastropods in each OSPAR sub-region relative to the Environmental Assessment Criteria (EAC) (with 95% upper confidence limits) where value of 1 means that the mean concentration equals the EAC. Green: Statistically significantly ($p < 0.05$) below the EAC. Red: Not statistically significantly below the EAC

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Results cont...

In none of the sub-regions was imposex at levels close to background, i.e. they were not significantly below the Background Assessment Criteria (BAC).

Temporal trends in imposex were analysed at 174 sites using the VDS. Improvement in imposex was detected at 48% of sites, worsening imposex at 0% of locations, and there was no statistically significant change in imposex at 52% of sites (2010–2015). The percentage of improvement in imposex was lowest in the Irish and Scottish West Coasts. Dog whelks are the most common monitoring species, and temporal trends in dog whelk imposex were assessed at 157 (of 174) sites and showed significant improvement at 74% of sites.

When assessed at an OSPAR sub-regional scale, overall improvement relative to the EAC is evident for the nine sub-regions assessed (**Figure 3**).

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

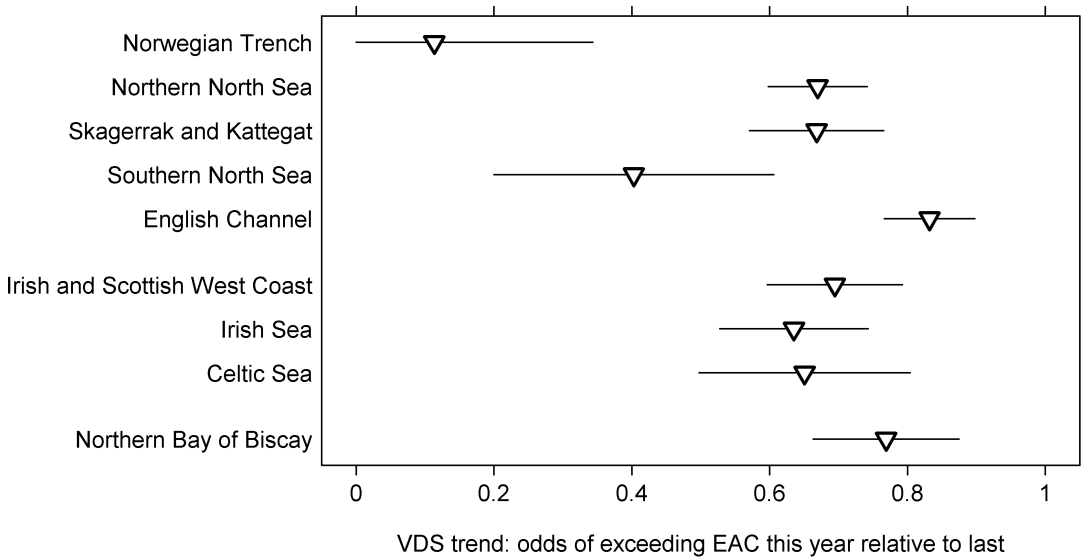

Figure 3: Temporal trends in imposex (Vas Deferens Sequence, VDS) in gastropods (2010–2015) in each OSPAR sub-region; mean concentration is statistically significant ($p < 0.05$) decreasing (downward triangle). 95% confidence limits (lines). The Barents Sea has too few monitoring sites for a regional assessment

Conclusion

Following actions taken to reduce, minimise or ban TBT use within individual countries, the European Union or globally, imposex is decreasing significantly. Compared to the QSR 2010, levels of imposex have markedly improved. In most OSPAR sub-regions, imposex induced by TBT is at or below the level at which harmful effects are first expected to occur and there is also evidence of significant downward temporal trends in the severity of imposex in all sub-regions assessed. Nevertheless, some areas are still subject to high imposex levels. Although levels of imposex are reducing, imposex is not yet at natural background levels in any of the areas assessed.

Ongoing measurement of imposex in marine gastropods is an effective tool for monitoring a contaminant-specific pollution effect. Imposex will continue to provide a good indicator for TBT pollution and will help in identifying illegal use of stocks of TBT-containing antifouling paints or losses of TBT from dockyards, marinas and vessel maintenance activities. Monitoring will identify whether there is any decrease in imposex at sites where imposex levels are not currently declining.

Knowledge Gaps

There could be concern about the potential for environmental harm associated with the substitute chemicals used to replace tributyltin (TBT) in antifouling paints.

The use of copper-based paints, in some cases with the addition of other chemicals, should be monitored to avoid adverse consequences of use of substitute chemicals, i.e. imposex measured as the Vas Deferens Sequence (VDS). TBT present in historically contaminated sediments could be remobilised and enter the water column, representing a potentially long-term issue. Impacts of illegal use of TBT should not be discounted.

This document was published as part of OSPAR's Intermediate Assessment 2017.
The full assessment can be found at www.ospar.org/assessments