Imposex in dog whelks

Scottish Government
Riaghaltas na h-Alba
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Key message

Imposex in dog whelks is an indicator of TBT contamination. This assessment shows that concentrations of TBT in the marine environment are not causing significant harm. However, there is insufficient data to assess all regions in Scotland.

Dog whelks Photo by H. Anderson

Background

Imposex is a condition where female marine snails develop male sexual characteristics, including formation of a vas deferens and growth of a penis. Imposex is caused by exposure to tributyltin (TBT), which was introduced in the 1970s as a biocide in antifouling paint for use on marine vessels. The paint was applied to the hulls of ships and boats but would leach from them into the marine environment. High concentrations of TBT were found in ports and harbours where anti-fouling paint was reapplied to older vessels. Another source of TBT in the marine environment was from treated fish farming netting.

Monitoring for imposex is a very effective and sensitive way to evaluate levels of TBT. The dog whelk (*Nucella lapillus*) (Figure 1) is a suitable coastline species to target for assessment. Low levels of imposex do not cause significant harm. However, at higher levels females can become sterile which can lead to loss of populations.

Figure 1:
The dog whelk (*Nucella lapillus*), a suitable coastline species for imposex monitoring.

The use of TBT-based antifouling paint is now banned from all marine uses, including marine vessels and aquaculture. Since the 1980s, a number of pieces of legislation have been introduced to control this, firstly in yachts and then in larger vessels. A global ban for all ships came into effect in 2008. However, TBT is persistent in the marine environment and is still present in sediment.

For further information on this topic go to: https://marine.gov.scot/sma/assessment/imposex-dog-whelks

Results

Imposex was assessed in dog whelks from four biogeographic regions - Irish Sea (Clyde and Solway), Minches and Western Scotland, Northern North Sea and Scottish Continental Shelf (Figure 2). The data were collected between 2000 and 2018, with surveys completed every 3-4 years.

For regional assessment and trend analysis, only biogeographic regions with a minimum of three suitable stations with a reasonable geographic spread were included. There were insufficient data for regional analysis of the Irish Sea (Clyde and Solway), Minches and Western Scotland and Scottish Continental Shelf regions, although individual sites are discussed in the extended section.

The degree of imposex was categorised by Vas Deferens Sequence (VDS) stages and compared to OSPAR Background Assessment Criteria (BAC) and Environmental Assessment Criteria (EAC). The BAC determines if observed VDS is at background or elevated and EAC identifies if it is causing significant harm. An average VDS below the EAC indicates an acceptable health status.

The level of imposex in the Northern North Sea was above background (Figure 3a) however below the EAC (Figure 3b) indicating that TBT in this area is below concentrations which cause environmental harm.

Trends in imposex were assessed in biogeographic regions where there were at least five years of data (Figure 4). There were sufficient data for trend analysis in the Northern North Sea which concluded that there was a significant downward trend in imposex.

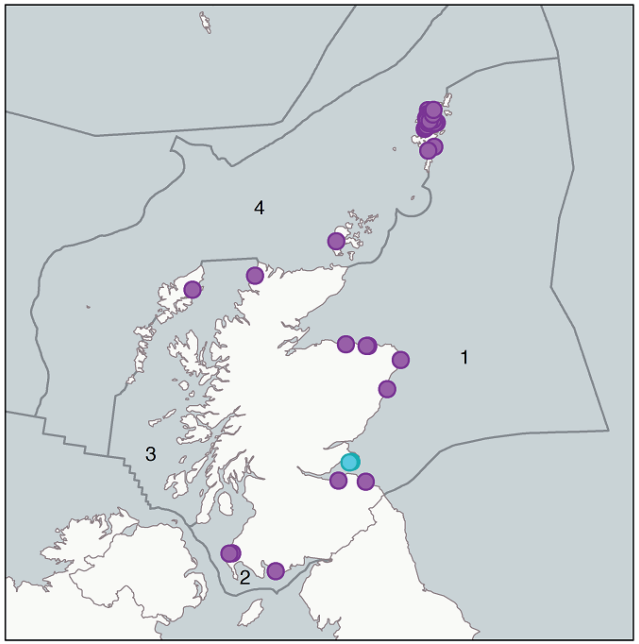


Figure 2:

Monitoring stations included in the imposex status and trend assessments in dog whelk populations per biogeographic region (grey lines). Magenta dots = stations for trend and status assessments. Cyan dots = stations for status assessment only. 1, Northern North Sea; 2, Irish Sea (Clyde and Solway); 3, Minches and Western Scotland; 4, Scottish Continental Shelf.

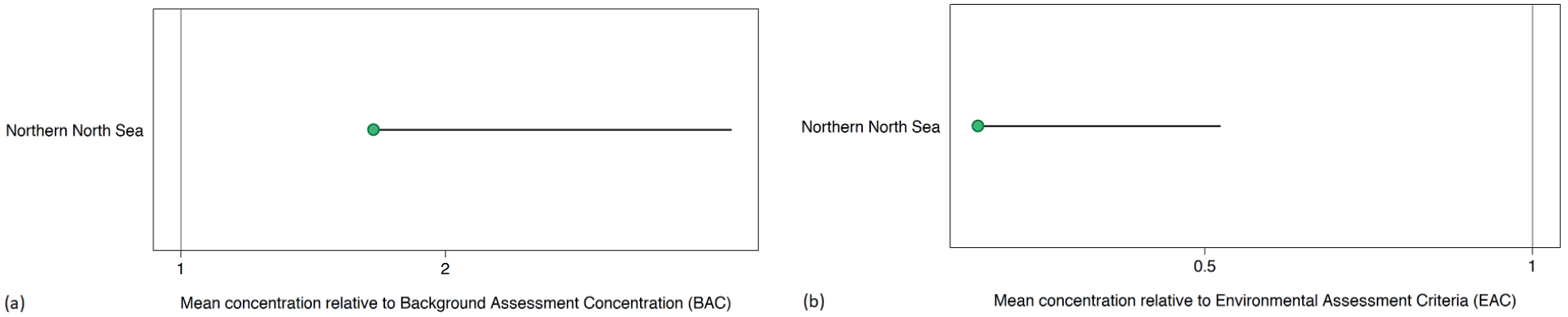


Figure 3:

Status assessment; mean Vas Deferens Sequence (VDS, stage of imposex) in each Scottish biogeographic region relative to the OSPAR BAC (a) or EAC (b) (with 95 % confidence limits) where the BAC/EAC value is 1. The VDS is significantly below the BAC/EAC if the upper confidence limit is below 1. Blue = statistically significantly below the BAC. Green = at or above the BAC but statistically significantly below the EAC. Red = at or above the EAC.

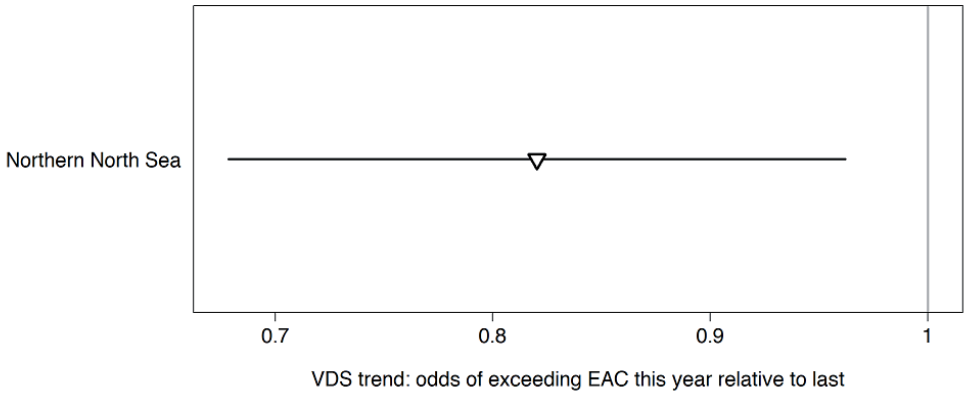


Figure 4:

Trend assessment; the estimated trend for the Vas Deferens Sequence (VDS, stage of imposex) exceeding the EAC in one year relative to the previous year sampled in each Scottish biogeographic region. There is a significant trend if the confidence limits does not cut the vertical line at 0. Upward trends (upwards triangle), downward trends (downwards triangle), no change (circle) and 95 % confidence limits (lines).

Conclusion

Imposex is the biological effect of TBT. This assessment of imposex in dog whelks has only been carried out for the Northern North Sea biogeographic region. The status assessment showed that the level of imposex in this region was elevated above background, however was not at a level that was causing significant harm. The trend assessment concluded that imposex is decreasing in the Northern North Sea. Overall, the assessment indicates that the level of TBT is not causing environmental harm.

There were insufficient data for a regional assessment of status and trends in the other Scottish biogeographic regions. After 2010, the sampling programme was significantly reduced as imposex had significantly decreased across Scotland. Since then sites that had previously failed are the focus of the sampling surveys.

Knowledge gaps

There are a lack of data available in some biogeographic regions. This is due to a reduction in the survey as the level of imposex was declining. To make a regional assessment to confirm this, further monitoring stations are required in the Irish Sea (Clyde and Solway), Minches and Western Scotland and Scottish Continental Shelf.

There are no OSPAR assessment criteria for TBT concentrations in sediment. The Environmental Quality Standard (EQS) proposed by Sweden is being trialled in OSPAR assessments, however these are not agreed yet.

Status and trend assessment

This status and trend assessment is an overall assessment for Contaminants in sediment and biota (PAHs, PCBs, PBDEs and metals in sediment and biota) and Biological effects of contaminants.

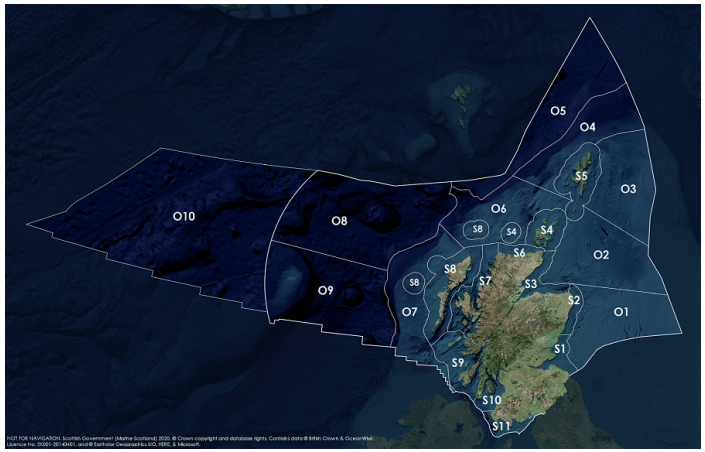
Region assessed	Status with confidence	Trend with confidence	Commets
Northern North Sea			Two stars for confidence in the status is due to lack of suitable assessment criteria for some determinands (metals in biota and some biological effects measurements)

Status and trend assessment legend

Status assessment (for Clean and safe, Healthy and biologically diverse assessments)		Trend assessment (for Clean and safe, Healthy and biologically diverse and Productive assessments)	
	Many concerns		No / little change
	Some concerns		Increasing
	Few or no concerns		Decreasing
	Few or no concerns, but some local concerns		No trend discernible
	Few or no concerns, but many local concerns		All trends
	Some concerns, but many local concerns	**Confidence assessment**	
	Lack of evidence / robust assessment criteria	**Symbol**	**Confidence rating**
	Lack of regional evidence / robust assessment criteria, but no or few concerns for some local areas		Low
	Lack of regional evidence / robust assessment criteria, but some concerns for some local areas		Medium
	Lack of regional evidence / robust assessment criteria, but many concerns for some local areas		High

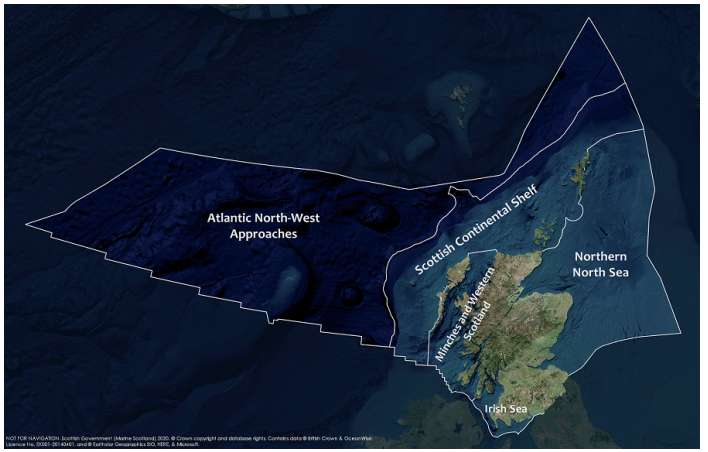
Overal confidence

Assessment regions

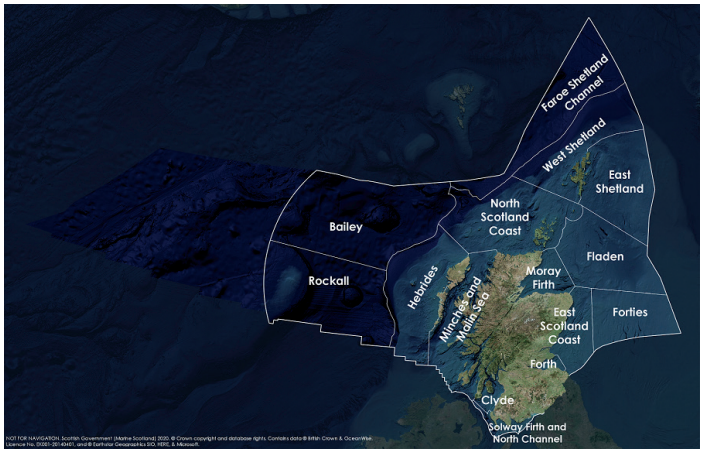


The Scottish Marine Regions (SMRs; S1 – S11) and the Scottish Offshore Marine Regions (OMRs, O1 – O10)

Key: S1, Forth and Tay; S2, North East; S3, Moray Firth; S4 Orkney Islands, S5, Shetland Isles; S6, North Coast; S7, West Highlands; S8, Outer Hebrides; S9, Argyll; S10, Clyde; S11, Solway; O1, Long Forties, O2, Fladen and Moray Firth Offshore; O3, East Shetland Shelf; O4, North and West Shetland Shelf; O5, Faroe-Shetland Channel; O6, North Scotland Shelf; O7, Hebrides Shelf; O8, Bailey; O9, Rockall; O10, Hatton.



Biogeographic, Charting Progress 2 (CP2) Regions. These have been used as the assessment areas for hazardous substances.



Scottish Sea Areas as used in Scotland's Marine Atlas 2011. These are sub divisions of the biogeographic, or Charting Progress 2 (CP2), Regions.

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NatureScot
Scotland's Nature Agency
Buidheann Nàdair na h-Alba

JNCC
Joint Nature Conservation Committee

SEPA
Scottish Environment Protection Agency

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