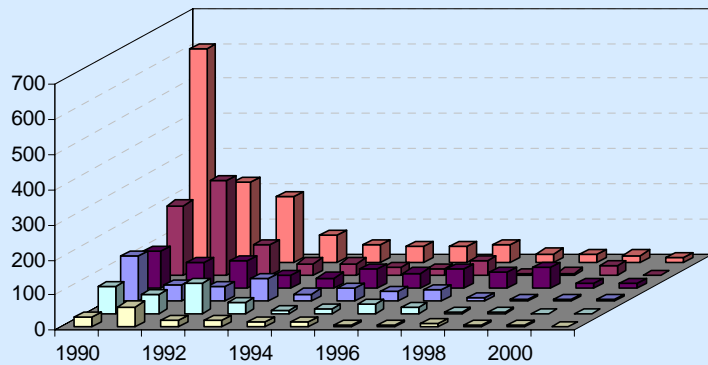


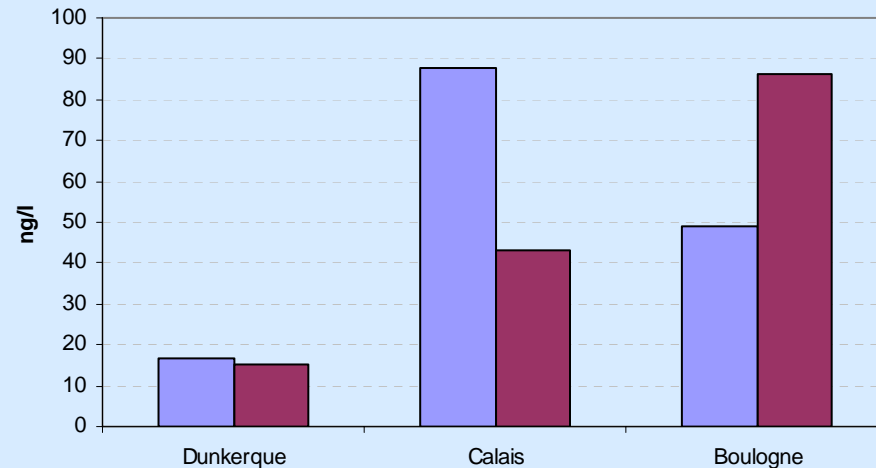
Indicator 17 Pollution by hazardous substances

Concentration of Tributyltin TBT (ng/litre) in water, marinas and harbours Zeeland, 1990-2001 (RIKZ 2003)



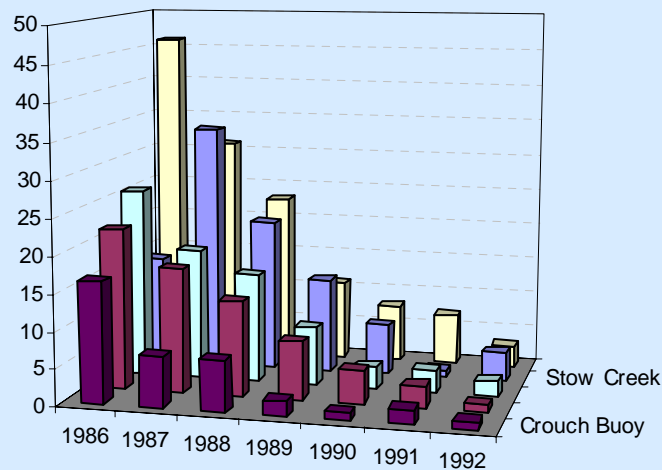
■ Vlieland Marina ■ Colijnsplaat Marina ■ Breskens Marina
■ Harlingen Marina ■ Scheveningen harbour ■ Scharredijke Marina

Concentration of Tributyltin (ng/litre) in water - Nord-Pas de Calais 1997 (Michel and Averty 1999)



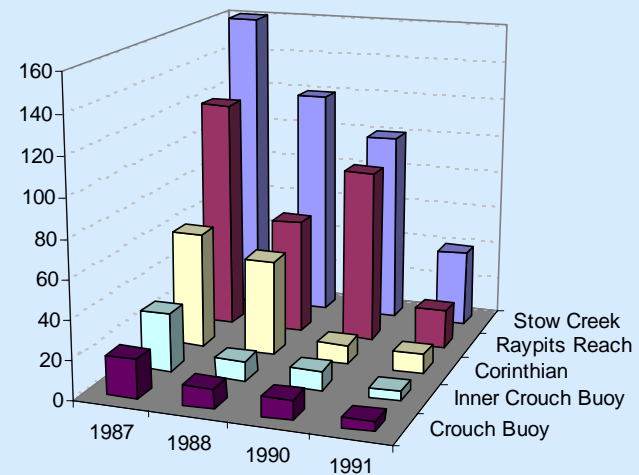
■ marina ■ Commercial & military harbour

Concentration of Tributyltin in water (ng/litre) in the Crouch Estuary Essex, 1986-1992 (Waldock et al. 1999)



■ Crouch Buoy ■ Raypits Reach ■ Inner Crouch Buoy ■ Stow Creek

Concentration of Tributyltin in sediments ($\mu\text{g}/\text{kg}$) in the River Crouch, Essex, 1987-1991 (Waldock et al. 1999)



■ Crouch Buoy ■ Inner Crouch Buoy ■ Corinthian ■ Raypits Reach ■ Stow Creek

- *Concentration of Tributyltin in sediments, water column and biota*
- *Concentrations of Polycyclic Aromatic Hydrocarbons (PAHs)*

Key Message

- High levels of TBT concentrations in marinas and ports have declined considerably since historic peaks in the mid 1980s, after a total ban on the use of TBT paints came into effect in 2003.
- Imposex, a biological effect of TBT, is at least partly responsible for the local decimation of populations of marine gastropods (especially dogwhelks) in the Southern North Sea.
- Concentrations of PAHs are highest in estuaries and coastal waters. Common monitoring programs implemented recently will allow for a larger scale evaluation and provide insights into recovery of pollutant-damaged environments.

Why monitor the pollution of hazardous substances?

Paints containing Tributyltin (TBT) have been widely used on boats as an effective and economical method of antifouling since the late 1960s. TBT is most commonly associated with imposex in marine gastropods, whereby female organisms develop male sexual organs, resulting in a decline and final collapse of local populations. In the Bay of Arcachon in France, a clear link between the failure of oyster culture and the input of TBT from leisure craft provided the basis for immediate action on behalf of the French government. Due to the severe and widespread character of the problem, the International Maritime Organisation (IMO) adopted the International Convention on the Control of Harmful Anti-fouling Systems to phase out the application of TBT paints in 2003 and to remove their presence on ships' hulls by 2008. Organotin compounds are on the OSPAR list of priority compounds that require action. Long-term monitoring of TBT-affected areas will provide insights into recovery of pollutant-damaged environments.

Polycyclic aromatic hydrocarbons are ubiquitous environmental contaminants. Their predominant sources are anthropogenic emissions, including petroleum and its products. PAHs reach the marine environment via sewage discharges, surface run-off, industrial discharges, oil spillages and deposition from the atmosphere. PAHs can be acutely toxic to aquatic organisms. Elevated concentrations may present a risk to humans who eat fish and shellfish.

Where do the data come from?

TBT and the effects of organotin compounds are part of the Coordinated Environmental Monitoring Programme CEMP (OSPAR) since 2003. Participating countries are obliged to measure chemical concentrations of TBT in sediments. They must also implement monitoring of the biological effects (imposex) which will increase the availability of comparable time series. Through an extensive literature search for data previous to 2003, the most relevant time series were selected to present the situation in each of the SAIL sub-regions. In the UK, PAHs have been monitored through a network of coastal monitoring stations from the National Monitoring Plan (NMP) since the 1980s. PAHs and TBT are monitored by RWS/RIKZ in The Netherlands, and by BMM-MUMM (sediments and water) and the Department of Sea Fisheries-ILVO (biota) in Belgium. IFREMER is the responsible authority for monitoring aspects of water quality - including PAHs and TBT - in France.

What does the indicator show?

TBT

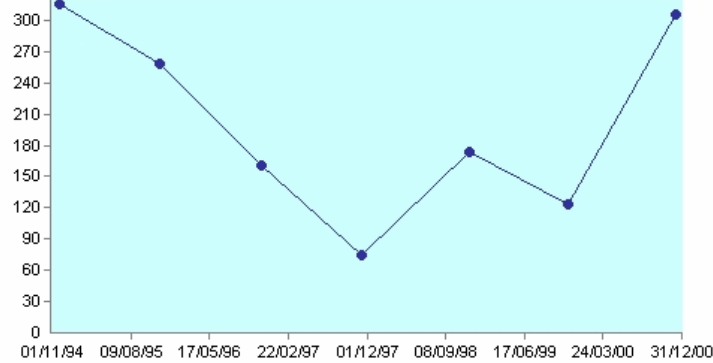
The earliest time series on the presence of TBT in the marine environment are available from the UK, where its use has been banned on small boats since 1987. Highest initial concentrations were found at inner estuary stations in the vicinity of moored yachts, and associated with increased boating activity in spring and summer. Significant decrease in the concentrations of TBT in sediments and water were observed in the Crouch Estuary from 1986 to 1992. Concentrations in sediments at e.g. Stow Creek decreased from 160µg/kg in 1987 to 20µg/kg dry weight in 1991. In 1997 TBT concentrations at these sites were below detection levels. A similar trend was observed in the concentration of TBT in the water column of the Crouch Estuary from 1986 to 1992.

In a study of TBT levels in the water column at marinas and commercial ports in Nord-Pas de Calais, the highest concentration measured in 1997 was 88ng/litre in the Calais marina.

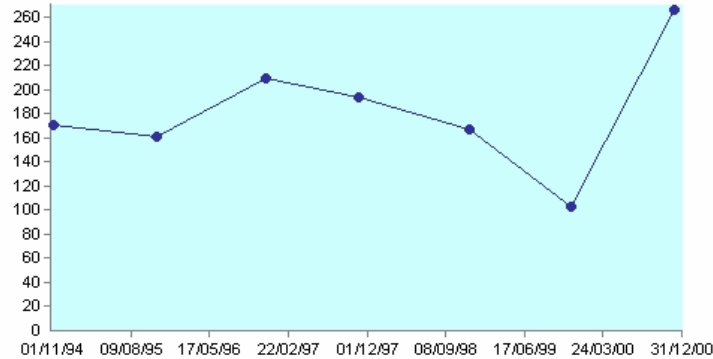
A comparison with TBT levels in French waters in the 1980s show that those of Dutch tidal marinas were at least 6-fold higher, especially for those marinas having a poor water exchange.

**PAH concentration in mussels ($\mu\text{g}/\text{kg}$ dry weight) 1994-2000
Nord-Pas de Calais (IFREMER)**

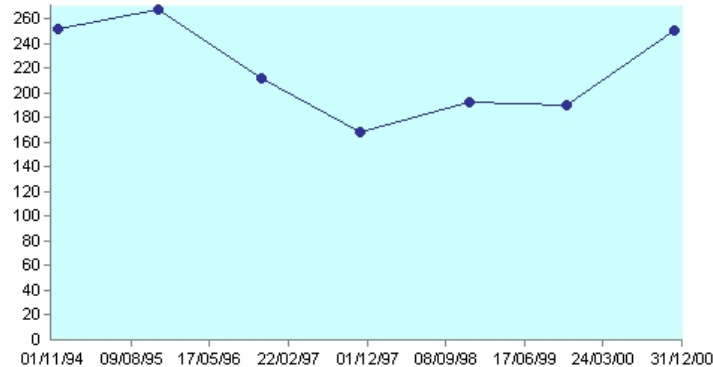
Berck



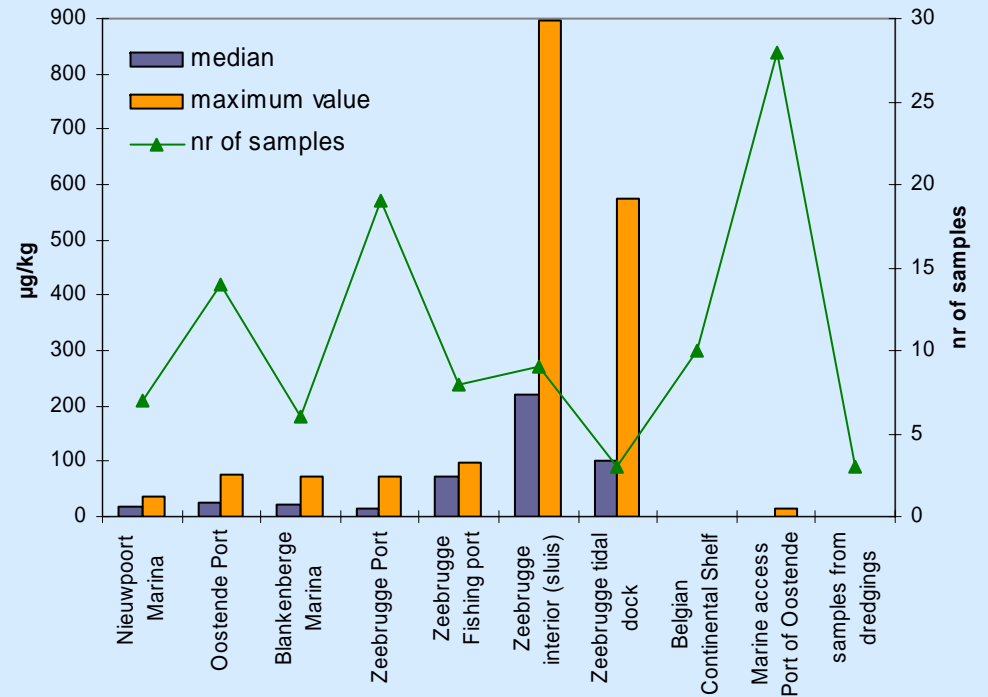
Ambleteuse



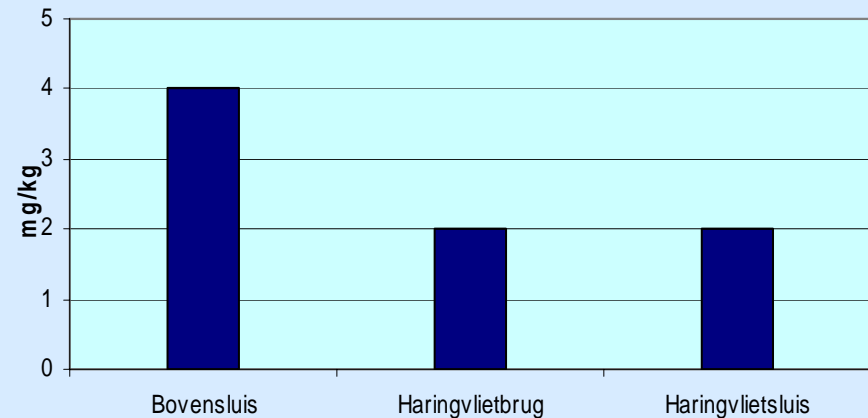
Dunkerque (Oye-Plage)



**Concentration of TBT in sediments ($\mu\text{g}/\text{kg}$ dry weight, Belgian Coast
(Vyncke and Devolder, 1997)**



**Concentration of PAHs (sum) in sediments (mg/kg dry weight)
in the Delta area, The Netherlands (RIKZ, 1989)**



TBT concentrations in water have declined considerably since then - for some marinas from near to 700ng/litre in 1989 to concentrations that are close to detection levels in 2001 (3ng/litre). Even then they may still remain above the Maximal Allowable Level of 1ng/litre.

Maximum concentrations of TBT are found in sediments of intensely navigated areas such as the port of Zeebrugge (895µg/kg dry weight, median 222µg/kg), but median values in sites along the remainder of the coastal marinas and ports are below 100µg/kg d.w. (1997).

In combination with other factors such as damage by fisheries, these high concentrations of TBT are the probable cause of the decline of gastropod populations and the disappearance of dogwhelks along the Belgian coast.

PAHs

Fluoranthene is part of the most toxic fraction of crude oils and is less biodegradable than other PAHs. It is considered representative of chronic contamination by PAHs. Trends in Fluoranthene concentrations (mussels) in Dunkerque (Oye Plage), Boulogne (Ambleteuse) and Berck decreased since the second half of the 1990s but have increased again since 2000. Median values in the three stations are far above the median for the combined sampling at the national level (14µg/kg dry weight in mussels).

Analysis from 45 of the 60 NMP sites around England and Wales indicate total PAH ranging from none detected to 8.5µg/l. The highest concentration of total PAHs in seawater occurs in major estuaries such as the Thames, while PAH concentrations at offshore sites are generally low or undetectable. Total PAH concentrations between 1,000 and 10,000µg/kg were found in sediments at sites in the River Thames.

Coverage of PAH is not exhaustive, and as is the case for evaluation of TBT concentrations and imposex, further developments are ongoing to improve comparability of techniques and methodologies.

What are the implications for planning and managing the coast?

The relation between intensity of navigation and concentration of TBT in biota and sediments has been clearly documented. Since its first description in 1971, imposex has been documented for 150 species of marine snails worldwide. Evidence suggests that there may be effects on the reproduction cycle and immune system of higher taxons. The effect on humans is insufficiently known. The 'TBT story' is another showcase for the importance and the need for integrated planning at all levels, in particular at the coast, where land and sea processes interact. Particular

attention to these interactions is required in areas of intense human use, such as ports and marinas.

The case of Tributyltin also demonstrates the need for an international legal system to address the transboundary nature of marine contamination and set common environmental quality standards to be achieved in all coastal systems. The failure to introduce the Pacific oyster in the 1980s in the UK, due to TBT exposure, lead to control of TBT paints and the setting of Ecological Quality targets. The use of TBT has been banned on small boats in the UK since 1987 and the EC Directive (2002/62) prohibits the application or re-application to all EU ships of TBT compounds as biocides in antifouling systems from 1 January 2003.

Some PAHs - such as benzopyrene - are carcinogenic. Pyrene also has endocrine disruptor impact on marine organisms.

How reliable is the indicator?

The quality of the data is partly defined by the methodology and detection limits of the equipment. Comparability of datasets from national monitoring programmes is defined by inter-calibration in sampling methods and equipment. Uniformity in reporting 'endocrine disruption' and internationally agreed standardized tests for the evaluation of the disrupting activity of chemical compounds are recent developments. So far, data on PAH and TBT are fragmented and discontinuous. PAH are often reported as total aggregated concentrations for a number of individual compounds. Reported levels under detection limit are sometimes considered '0', for others it is considered equal to detection level. This is of importance for the evaluation of impact on biota, where threshold levels apply.

