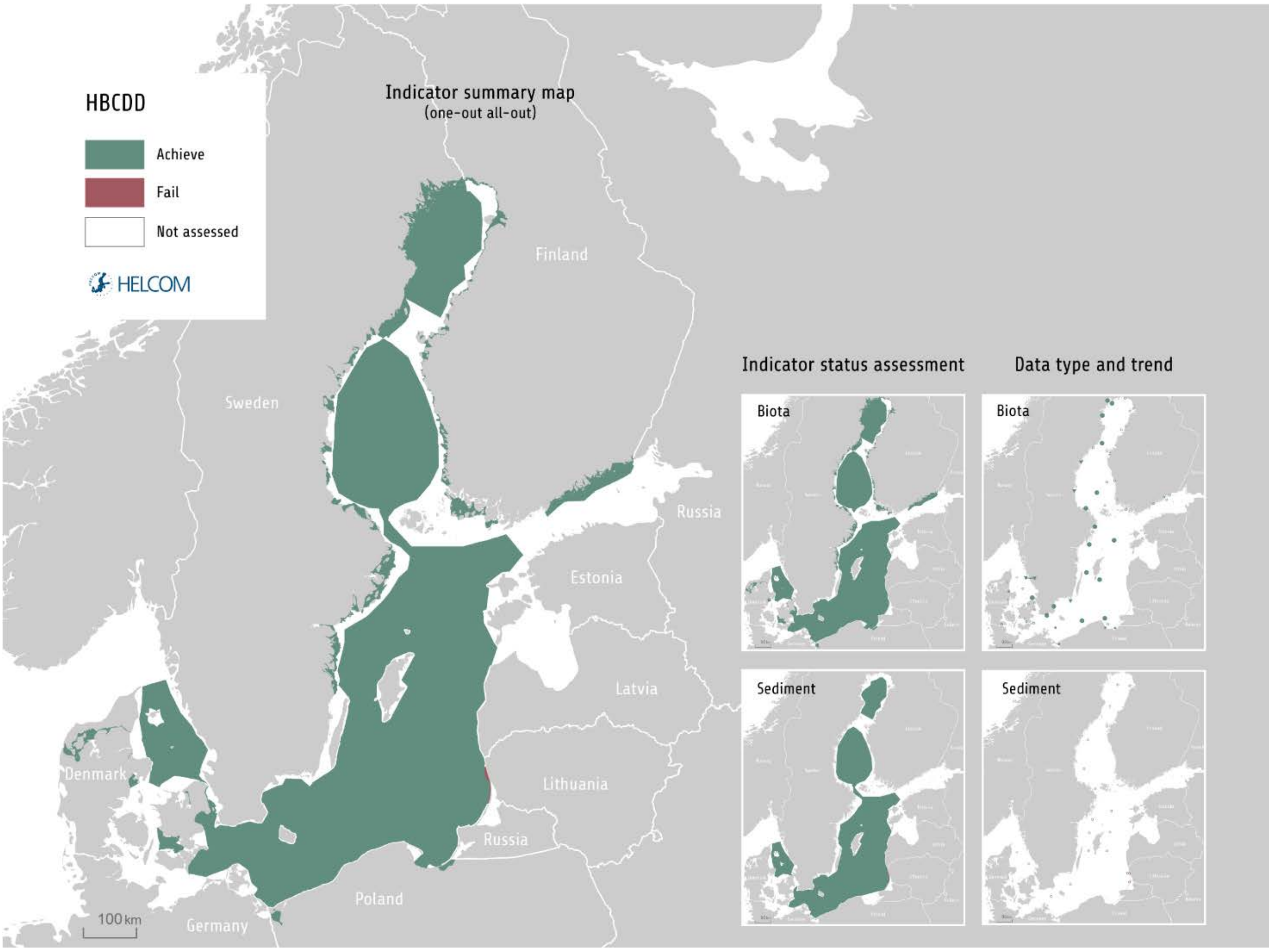
HELCOM core indicator report
July 2018

Hexabromocyclododecane (HBCDD)

Key Message

This core indicator evaluates the status of the marine environment based on concentrations of hexabromocyclododecane (HBCDD) in Baltic Sea fish and sediments. Good status is achieved when the concentrations of HBCDD are below the specific threshold values. The current evaluation is based on data up to 2016, and the status is assessed for the period 2011-2016.



Key message figure 1. Status assessment results based on evaluation of the indicator 'hexabromocyclododecane (HBCDD)'. The assessment is carried out using Scale 4 HELCOM assessment units (defined in the HELCOM Monitoring and Assessment Strategy Annex 4). One-Out-All-Out (OOAO) method (main figure), in biota (upper inset) and in sediment (lower inset). The left map show the assessment of the primary matrix biota, the right map the secondary. **Click here to access interactive maps at the HELCOM Map and Data Service: HBCDD.**

Good status is achieved for biota in all assessed areas since the concentrations of HBCDD in fish are below the threshold value in all monitored areas. For sediments good status is achieved for all assessed areas except for the HELCOM scale 4 assessment units LIT-002 and LIT-006 where short time series data (initial data) contribute to the assessment. However, there are areas where data are absent and thus more measurements are required to enable a status evaluation in the entire Baltic Sea.

Time series of HBCDD levels in biota showed increasing concentrations since the 1980s in the Baltic Proper and Bothnian Sea. However, since the 2000s no increases have been observed and decreasing HBCDD concentrations are seen in fish from the west coast and southern coast of Sweden since the late 1990s.

The confidence of the indicator evaluation results is considered to be **high**. It should also be noted, however, that the majority of the stations are selected as reference stations while potential local problems with HBCDD may occur in areas not included in the current monitoring programmes.

The indicator is applicable in the waters of all the countries bordering the Baltic Sea.

Relevance of the core indicator

HBCDD is a persistent, bioaccumulative and toxic compound with possible impacts on the reproductive and developmental system. The main use of HBCDD is in insulation material in the building industry or as coating for textiles to improve the fire resistance of the materials. Measurements of HBCDD provide information of the contaminant load in the Baltic Sea and the presence of HBCDD in biological samples also reflects the bioavailable part of the contaminant pool. Predators (particularly top predators) and humans are exposed to the contaminant through consumption of the species assessed in this indicator.

Policy relevance of the core indicator

	BSAP segment and objectives	MSFD Descriptor and criteria
Primary link	Hazardous substances • Concentration of hazardous substances close to natural levels	D8 Concentrations of contaminants D8C1 Within coastal and territorial and beyond territorial waters, the concentration of contaminants do not exceed the threshold values.
Secondary link	Hazardous substances • Fish safe to eat	D9 Contaminants in fish and seafood D9C1 The level of contaminants in edible tissues (muscle, liver, roe, flesh or other soft parts, as appropriate) of seafood (including fish, crustaceans, molluscs, echinoderms, seaweed and other marine plants) caught or harvested in the wild (excluding fin-fish from mariculture) does not exceed the threshold values.
Other relevant legislation: The Water Framework Directive and EC regulation No 850/2004 (and its following amendments) and the Stockholm Convention on Persistent Organic Pollutants.		

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Cite this indicator

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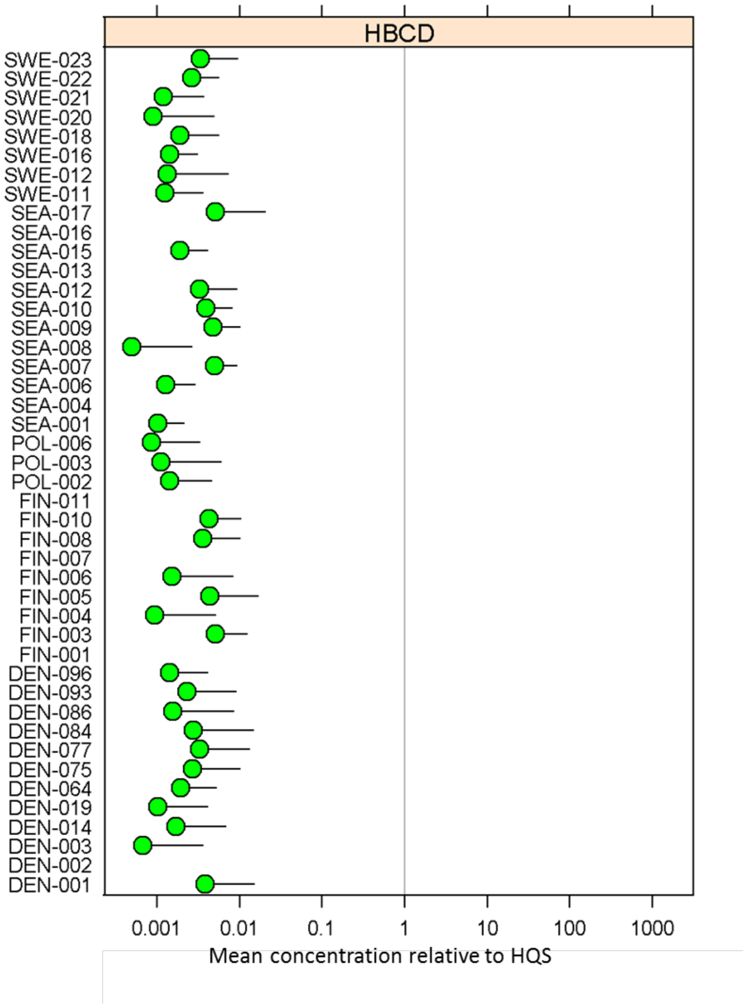
Hexabromocyclododecane HBCDD HELCOM core indicator 2018 (pdf)

Results and Confidence

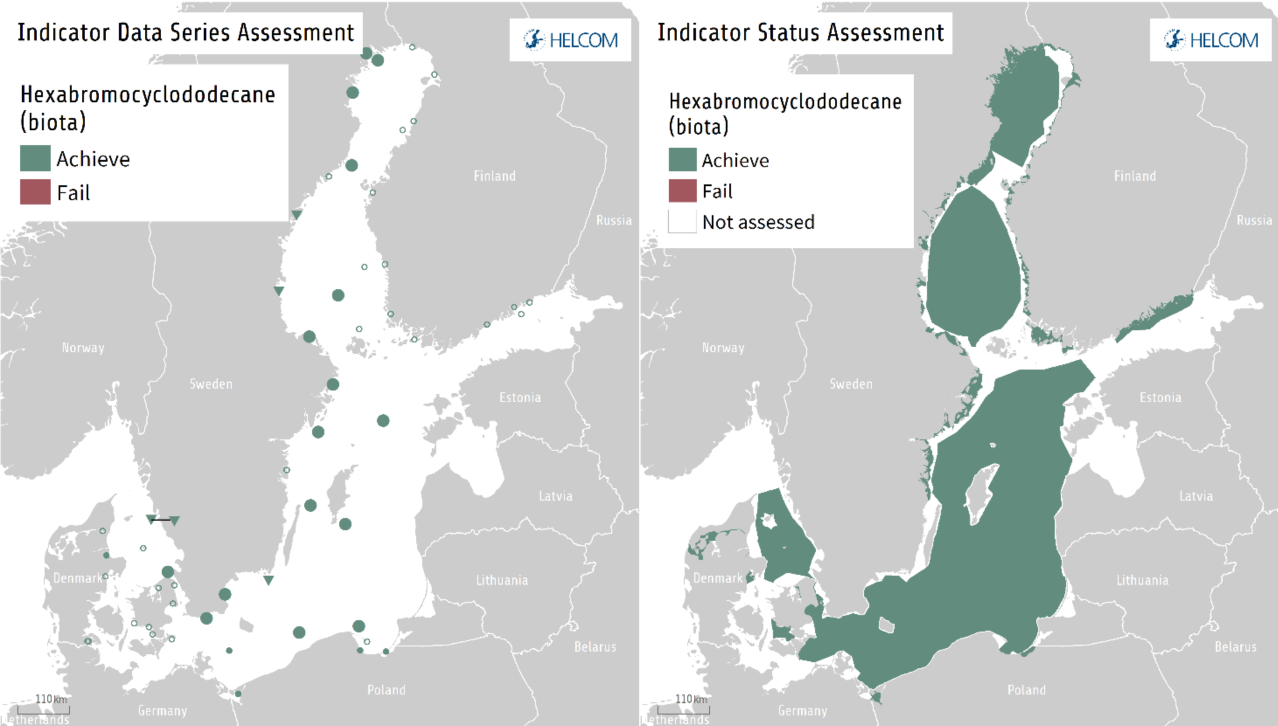
Good status was achieved in terms of concentrations of hexabromocyclododecane (HBCDD) in fish in all evaluated assessment units during the period 2011-2016 as the upper confidence concentrations were below the threshold value of 167µg/kg wet weight (ww) (or 167ng/g ww) (Results figure 1).

The results are based on HBCDD concentrations in different fish species, but also different matrixes, i.e. muscle and liver (Results figure 1). This brings extra variability in the results due to species differences and matrix specific properties.



Results figure 1. Concentrations of HBCDD in fish relative to the threshold value. Filled circles represent a mean value for each assessment unit and the bar represents the upper 95% confidence limit. Green colour indicates that the assessed area is below the threshold value and red colour that the assessed area is above.

Mean concentration of HBCDD in fish from all monitored stations were well below the threshold value (Results figure 2). The lowest values of HBCDD are observed in assessment unit SEA-001 (Kattegat open sea subbasin) with the upper 95% confidence interval of 0.35 ng/g ww in fish and the highest concentrations in assessment unit in SEA-017 (Bothnian Bay open sea subbasin) with upper confidence values of 3.4 ng/g ww in fish. These values are adjusted to a mean lipid content of 5%. The threshold value is about 50 times higher than the maximum upper confidence value detected.

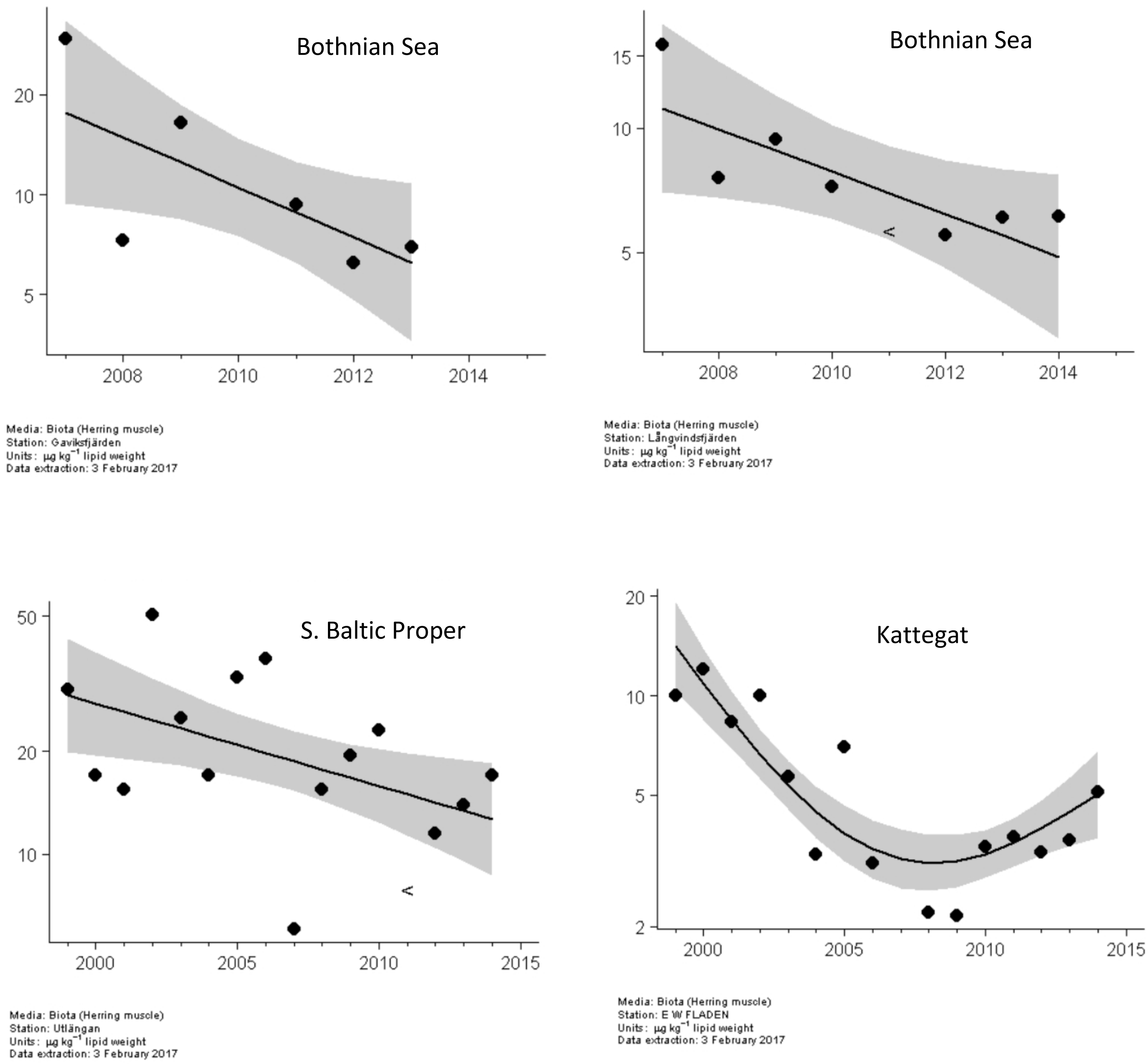


Results figure 2. Spatial variation of the HBCDD sampling stations in biota (herring, cod, perch, eelpout and European flounder) (left) and status assessment by assessment unit in biota (right). Green colour indicates that the upper 95 % confidence interval for HBCDD concentrations are below the threshold value (i.e. good status). Small open circles indicate a status assessment based on only 1-2 years of data (initial data), small filled circles indicate that data is not suitable to assess a trend (treated with initial methodology), large filled circles that no detectable concentration trends can be identified during the whole monitoring period (full data), and the filled arrow indicate that there is a statistically defined upward or downward trend during the monitoring period. **Click here to access interactive maps at the HELCOM Map and Data Service: HBCDD.**

Evaluation of temporal trends

Long term data from biota monitoring stations show increasing HBCDD concentrations from the 1970s and 1980s to the 2000s (Bignert et al. 2017). Cod from south-eastern Gotland show a high increase with concentration values four times higher in the 2000s than in the 1980s.

Since the end of the 1990s, decreasing levels are seen at the Swedish west coast station Fladen for both herring and cod, and the same trend is also detected for herring from Utlängan in the southern Baltic Proper, and in herring from two stations in the Bothnian Sea (Results figure 3 and Bignert et al. 2017).



Results figure 3. Temporal trend of HBCDD concentration (ng/g wet weight) in herring muscle from the Bothnian Sea, the south Baltic Proper and in Kattegat (HQS – threshold level, grey colour- confidence level 95% range (see Assessment protocol).

Evaluation of secondary matrices

Concentrations of HBCDD have also been monitored in sediments by some countries (Sweden, Lithuania, and open sea subbasins of the Bothnian Bay, Bothnian Sea, Åland Sea and Northern Baltic Proper). When these results are assessed against the QS for sediment all assessment units with data show a status below the threshold, except for LIT-002 and LIT-006 where short time series data (initial data) contribute to the assessment (Results figure 4).

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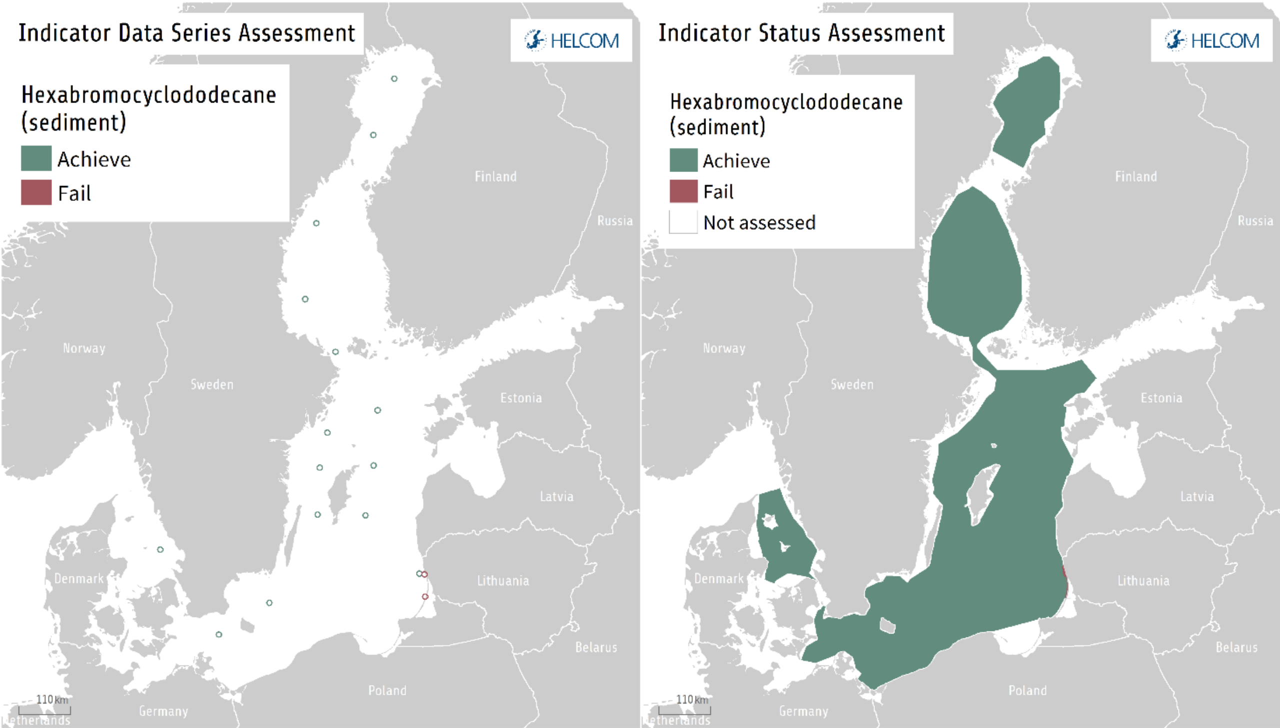


Results figure 4. Status assessment results based on secondary threshold evaluation of HBCDD in sediment. The assessment is carried out using scale 4 HELCOM assessment units (defined in the HELCOM Monitoring and Assessment Strategy Annex 4). **Click here to access interactive maps at the HELCOM Map and Data Service: HBCDD.**

Confidence of indicator status evaluation

The overall confidence of the assessment is **high**.

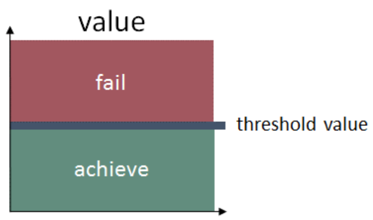
The geographical resolution of the current biota dataset for the whole Baltic Sea is moderate, though low or absent in some assessment units. Monitoring in sediments generally has low spatial and temporal coverage. No detailed geographical studies to investigate the variability in HBCDD concentrations across the region have yet been carried out. However, good status is widely achieved and the distance from the measured concentrations in fish to the current threshold value is large, with the smallest distance observed in SEA-017 (Bothnian Bay open sea subbasin) where the threshold value is 50 times higher than the reported mean value. Therefore the confidence that the observed levels do not exceed the current threshold value is high.

It should also be noted that the majority of the monitoring stations are selected as reference stations and potential local problems with HBCDD may occur in areas not included in the current monitoring programmes.

Thresholds and Status evaluation

Good status in biota is achieved if the concentration of hexabromocyclododecane (HBCCD) is below the threshold value of 167 µg kg^{-1} fish wet weight (Thresholds figure 1).

The threshold value is an environmental quality standard (EQS), derived at EU level as a substance included on the priority list under Directive 2008/105/EC regarding priority substances in the field of water policy (EQSD) (European Commission 2008a). Good status in accordance with the MSFD is defined as 'concentrations of contaminants at levels not giving rise to pollution effects'.



Thresholds figure 1. Good status is achieved if the concentration of HBCCD is below the threshold value of 167 µg kg^{-1} fish wet weight. The threshold value is an environmental quality standard (EQS) derived at EU level as a substance included on the priority list under the Directive on Environmental Quality Standards.

The EQS values are derived from ecotoxicological and toxicological studies to protect freshwater and marine ecosystems from potential adverse effects of chemicals, as well as protection of human health in connection with consumption of drinking water and food from aquatic environments. Quality Standards (QSs) are derived for different protection goals, i.e. pelagic and benthic communities, top-predators in these ecosystems, and human health. The most stringent of these QSs are the basis for the EQS. The EQS boundary for HBCDD is based on the QS set for biota, to protect from secondary poisoning, defined for prey tissue, i.e. fish whole body. For harmonization purposes, the EC Guidance Document No. 32 on biota monitoring (the implementation of EQS_{biota}) under the Water Framework Directive was developed (European Commission 2014). This guidance document recommends that for lipid soluble, biomagnifying compounds such as HBCDD the fish assessed for EQS compliance should be at a trophic level of 4.5 for marine environments with a whole body lipid content of 5%. The aim of the recommendation is to obtain comparable monitoring data. The results in the indicator have been adjusted in order to represent a lipid content of 5 % however no adjustment to a trophic level of 4.5 has been done.

An alternative, secondary threshold value at 170 µg kg^{-1} dry weight (dw) is set for concentrations in sediment. It is derived within the EQS process and is a QS in sediment, set to protect the marine benthic community. The secondary threshold value should only be used when it is not possible to evaluate an area using the primary biota-based threshold value.

The technical HBCDD products consist of three stereoisomers, α-, β- and γ-HBCDD, but the QS and EQS values are derived for the sum of these three stereoisomers. More detailed information concerning the derivation of the threshold value can be found in HBCDD EQS dossier (HBCDD EQS dossier 2011).

Article 3 of the EQSD states that long-term temporal trends should also be assessed for substances that accumulate in sediment and/or biota, such as HBCDD. A trend indicates if the state of the environment is approaching the threshold value or if the state is deteriorating.

Assessment Protocol

Data processing

The data may require transformation into the relevant unit and base for the threshold value which is µg kg^{-1} wet weight. Ideally, the data should be expressed in the same matrix which for the purposes of the indicator evaluation ought to be whole body concentrations in fish at a trophic level of 4.5 with a lipid content of 5%.

The majority of the HBCDD data reported is analysed in muscle tissue. However, the EC Guidance Document No 32 (European Commission 2014) suggests that the assumption can be made that fat soluble compounds would be evenly distributed in the lipid within the whole organism. With this assumption, a whole body concentration would be possible to calculate from any analysed organ as long as the lipid content in the sample is known/analysed. To harmonize the evaluation across the entire Baltic Sea region, it is recommended to calculate the concentrations into corresponding values to a fish with a general fat content of 5%.

Data is to be normalised to lipid content according to the following equation, where $Conc_{norm,\ lipid}$ is lipid normalised concentration, $Conc_{measurement}$ is the original value expressed in wet weight (ww) and lipid $content_{sample}$ is the actual lipid content of the sample:

$Conc_{norm,\ lipid} = Conc_{measurement} x0.05\ /lipid\ content_{sample}.$

In case information on lipid content is absent in the data, general fat content values derived in regional studies for the sampled matrix can be applied.

For this evaluation no adjustment for trophic level has been done but is something that needs to be considered in future assessments according to recommendations below.

The EC guidance document (European Commission 2014) recommends making recalculations so the concentrations are standardized to a fish at a trophic level of 4.5 for marine ecosystems to standardise for the biomagnification effect.

For sediments, the contaminant concentrations are normalized prior to the assessment to account for changes in the bulk physical composition of the sediment such as organic carbon content (5% normalization).

Statistical evaluation

The assessment protocol is structured in three main parts, 1) changes in log concentrations over time are modelled, 2) check for compliance against threshold value and evidence for temporal change of contaminant concentration per station and 3) a spatial aggregation of status per assessment unit.

It should be noted that the assessment protocol makes the assumption that monitoring data stems from the same monitoring stations during consecutive years. The stations used by the protocol are defined in the ICES Station Dictionary. Stations with similar station name are grouped together, but it is also possible to define a group of stations with different names to be defined as the same station in the Station Dictionary. Usually a station is defined in the Station Dictionary with coordinates and a valid box around these coordinates, but coordinates outside of the box will only give a warning when reporting the data, and are not used in the actual data extraction.

Overview

Time series of contaminant concentrations are assessed in three stages:

1. The concentrations are log transformed and changes in the log concentrations over time are modelled using linear mixed models. The type of temporal change that is considered depends on the number of years of data:
    1. 1-2 years: no model is fitted because there are insufficient data ('initial' data)
    2. 3-4 years: concentrations are assumed to be stable over time and the mean log concentration is estimated
    3. 5-6 years: a linear trend in log concentration is fitted
    4. 7+ years: more complex (smooth) patterns of change over time are modelled
2. The fitted models are used to assess status against available threshold value and evidence of temporal change in contaminant levels in the last twenty years
3. The fitted models are also used for spatial aggregation to assess status against available threshold value and evidence of temporal change in contaminant levels on a scale 4 level HELCOM assessment unit.

These stages are described in more detail in the link below. There is also information on how the methodology is adapted when there are 'less-than' measurements (treated as 'initial' data), i.e. some concentrations are reported as below the detection limit, and missing uncertainties, i.e. the analytical variability associated with some of the concentration measurements was not reported.

[Assessment methodology for contaminants in biota, sediment and water]

All initial data is handled in a highly precautionary manner to further ensure that the risk of false positives is minimalised. For all initial data the 95% confidence limit on the mean concentration, based on the uncertainty seen in longer time series throughout the HELCOM area, is used. Applying a precautionary approach, the 90% quantile (psi value, Ψ) of the uncertainty estimates in the longer time series from the entire HELCOM region are used. The same approach is used for time series with three or more years of data, but which are dominated by less-than values (i.e. no parametric model can be fitted). The mean concentration in the last monitoring year (meanLY) is obtained by: restricting the time series to the period 2011-2016 (the last six monitoring years), calculating the median log concentration in each year (treating 'less-than' values as if they were above the limit of detection), calculating the mean of the median log concentrations, and then back-transforming (by exponentiating) to the concentration scale. The upper one-sided 95% confidence limit (clLY) is then given by: exp(meanLY + qnorm(0.95) * Ψ / sqrt(n)), where n is the number of years with data in the period 2011-2016 (HELCOM 2018).

Assessment units

HBCDD is a globally used chemical, widely spread in biological samples and even present in samples from remote places such as the Arctic region. The HBCDD indicator is therefore relevant for the whole Baltic Sea area and can theoretically be applied in all regions.

The core indicator evaluates the status with regard to concentration of HBCDD using HELCOM assessment unit scale 4 (division of the Baltic Sea into 17 sub-basins and further division into coastal and offshore areas and division of the coastal areas by WFD water types or water bodies). This division is applied in order to take into account the different routes by which HBCDD enters the Baltic Sea - via air and via run-off from land, including also potential point sources.

The assessment units are defined in the HELCOM Monitoring and Assessment Strategy Annex 4.

Relevance of the Indicator

Hazardous substances assessment

The status of the Baltic Sea marine environment in terms of contamination by hazardous substances is assessed using several core indicators. Each indicator focuses on one important aspect of the complex issue. In addition to providing an indicator-based evaluation of the status of the Baltic Sea in terms of concentrations of hexabromocyclododecane (HBCDD) in the marine environment, this indicator along with the other hazardous substances core indicators is used to develop an overall integrated assessment of contamination status.

Policy relevance

The core indicator on HBCDD concentrations addresses the Baltic Sea Action Plan's (BSAP) hazardous substances segment's ecological objectives 'Concentrations of hazardous substances close to natural levels' and 'All fish safe to eat'.

The core indicator is relevant to the following specific BSAP commitment:

- Agree by 2009, if relevant assessments show the need, to initiate adequate measures such as the introduction of use restrictions and substitutions in the most important sectors identified by the Contracting Parties and taking as a starting point the HELCOM list of substances or substance groups of specific concern to the Baltic Sea (in which HBCDD is included).

The core indicator also addresses the following qualitative descriptors of the MSFD for determining good environmental status (European Commission 2008b):

- Descriptor 8: 'Concentrations of contaminants are at levels not giving rise to pollution effects' and
- Descriptor 9: 'Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards'.

and the following criteria of the Commission Decision (European Commission 2010):

- Criterion 8.1 (concentration of contaminants)
- Criterion 9.1 (levels, number and frequency of contaminants).

HBCDD is a substance (group) on the revised Water Framework Directive (WFD) Priority Substance list. It has also been identified as a Substance of Very High Concern (SVHC), meeting the criteria of a PBT (persistent, bioaccumulative and toxic) substance pursuant to Article 57(d) in the REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) regulation.

HBCDD is included in Annex XIV of the REACH regulation based on its hazardous properties, the volumes used and the likelihood of exposure to humans or the environment (European Commission 2011). This means that HBCDD cannot be used or placed on the market without first being approved by the European Chemicals Agency, ECHA. According to the harmonized classification and labelling (ATP03) approved by the European Union, this substance is suspected of damaging fertility or the unborn child and may cause harm to breast-fed children.

In December 2009, HBCDD was considered by the Executive Body (EB) of the UNECE (United Nations Economic Commission for Europe) Convention on Long-Range Transboundary Air Pollution (LRTAP) to meet the criteria for POPs, set out in EB decision 1998/2. Since 26th of November 2014, HBCDD is listed in Annex A of the Stockholm Convention, meaning that parties must take measures to eliminate the production and use of the chemical.

Role of HBCDD in the ecosystem

The commercially available brominated flame retardant hexabromocyclododecane (HBCDD or HBCD) is lipophilic, has a high affinity to particulate matter and low water solubility. The technical product consists of three stereoisomers, 70–95 % γ-HBCDD and 3–30% of α- and β-HBCDD, proportions depending on the manufacturer and the production method used. However, HBCDD is known to undergo thermal rearrangement, i.e. a shift in the relative amount of each stereoisomer can be seen if HBCDD, or a material containing HBCDD, is heated above 140°C. This has for instance been shown by Peled et al. (1995) and Heeb et al. (2010). The result of the transformation is that a relative increase of α-HBCDD and a relative decrease of γ-HBCDD could be observed. The transformation rate is dependent on time and temperature. HBCDD in this core indicator refers to the sum of the three diastereoisomers unless otherwise stated.

HBCDD is persistent in air and is subject to long-range transport. It is found to be widespread also in remote regions, and found in e.g. air and biological samples in the Arctic region (de Wit et al*.* 2006, EFSA 2011). The low volatility of HBCDD has been predicted to result in significant sorption to atmospheric particulates, with the potential for subsequent removal by wet and dry deposition. The transport potential of HBCDD was considered to be dependent on the long-range transport behaviour of the atmospheric particles to which it sorbs.

HBCDD has a strong potential to bioaccumulate and biomagnify. Available studies demonstrate that HBCDD is well absorbed from the rodent gastro-intestinal tract. Of the three diastereoisomers constituting HBCDD, the α-form is much more bioaccumulative than the other forms. HBCDD is very toxic to aquatic organisms. In mammals, studies have shown reproductive, developmental and behavioural effects with some of the effects being trans-generational and detectable even in unexposed offspring (Eriksson et al. 2006; Viberg et al. 2006, 2007). Beside these effects, data from laboratory studies with Japanese quail and American kestrels indicate that HBCDD at environmentally relevant doses could cause eggshell thinning, reduced egg production, reduced egg quality and reduced fitness of hatchlings (Fernie et al. 2009). Recent advances in the knowledge of HBCDD-induced toxicity includes a better understanding of the potential of HBCDD to interfere with the hypothalamic-pituitary-thyroid (HPT) axis, its potential ability to disrupt normal development, to affect the central nervous system, and to induce reproductive and developmental effects.

HBCDD has been found in human blood, plasma and adipose tissue. The main sources of exposure to humans presently known is through contaminated food and dust. For breast feeding children, mothers' milk is the main exposure route, but HBCDD exposure also occurs at early developmental stages as it is transferred across the placenta to the foetus. Swedish human breast milk data from 1980 to 2004 show that HBCDD levels have increased since HBCDD was commercially introduced as a brominated flame retardant in the 1980s (Fängström et al. 2008). Though information on the human toxicity of HBCDD is to a great extent lacking, and tissue concentrations found in humans are seemingly low. Embryos and infants are vulnerable groups that could be at risk, particularly to the observed neuroendocrine and developmental toxicity of HBCDD.

Because of the properties of HBCDD as a persistent, bioaccumulating, and toxic compound and in combination of the globally extensive use, HBCDD is considered a relevant substance to monitor in the entire Baltic Sea area. Monitoring species are available, and the substance is expected to be found in the whole area.

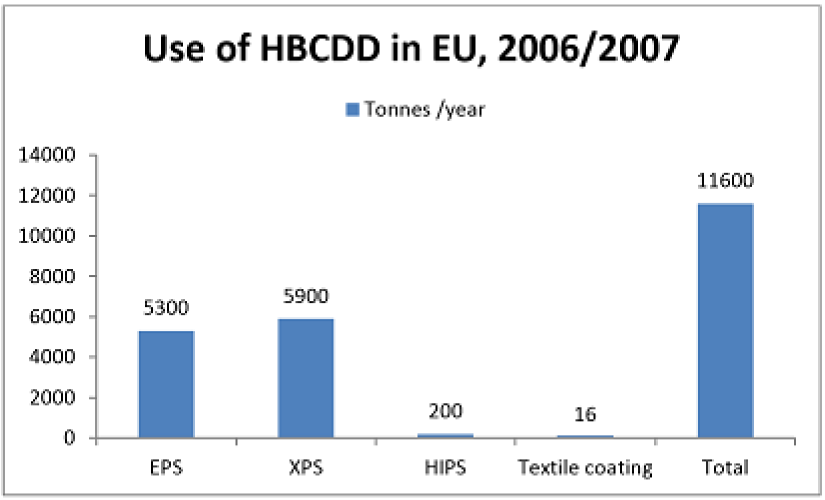
Human pressures linked to the indicator

	General	MSFD Annex III, Table 2a
Strong link	Use of synthetic compounds to increase fire resistance of materials	Substances, energy and litter- Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) – diffuse sources, point sources, atmospheric deposition, acute events
Weak link		

The HBCDD is mainly used in expanded polystyrene (EPS) and extruded polystyrene (XPS) in the construction industry (as thermal insulation), as well as coating of textiles to improve their fire resistance (Marvin et al. 2011; ECB 2008; EFSA 2011). Furthermore, HBCDD is present in a number of different consumer products, mainly packaging material but also polystyrene food containers and foam boards (Rani et al. 2014). The use of HBCDD globally is extensive and the use in EU (not counting imported articles and products containing HBCDD) was estimated to be around 12,000 tonnes in 2006 (Relevance figure 1).

Since HBCDD is used as an additive flame retardant (i.e. not chemically bound to the material) the release of HBCDD occurs by leaching from the material to which it was added (http://chm.pops.int; EFSA 2011). There are a number of studies which identify HBCDD in different media, e.g. in air (EFSA 2011), moss – atmospheric deposition (Schlabach et al. 2002) and soil (Covaci et al. 2009). Furthermore, HBCDD has been shown to be taken up by plants (Li et al. 2011). Covaci et al. (2006) concludes that α-HBCDD is the most commonly occurring diastereoisomer in wildlife.

Estimated emissions within the EU from HBCDD production and handling, associated with micronizing (fine grade grinding) of HBCDD is about 3 kg per year. The estimated release of particles during usage of EPS and XPS has been estimated to 100 g per tonne EPS and 5 g per tonne XPS. This amounts to an estimated release of approximately 560 kg HBCDD per year (of which 530 kg and 30 kg are from the use of EPS and XPS, respectively, assuming a use of 3% HBCDD in both EPS and XPS). This can be compared to a total estimated release of around 3000 kg per year in the EU, including all known sources (ECHA, 2009).



Relevance figure 1: The use of HBCDD in the EU during the years 2006–2007 expressed in tonnes per year. EPS = Expanded polystyrene, XPS = Extruded polystyrene and HIPS = High impact polystyrene, minor sources are not shown as bars. Adapted from ECHA 2009.

The estimated degradation and persistence of HBCDD differs somewhat depending on type of test and experimental setup, but some studies have identified debrominated transformation products, and a shorter half-life has been seen in anaerobic compared to aerobic conditions (EFSA 2011). *In vitro* experiments have shown that mammalian hepatic microsomes can debrominate HBCDD and that γ-HBCDD is metabolized faster than α-HBCDD (MacInnis et al. 2010).

Monitoring Requirements

Monitoring methodology

Environmental monitoring of hexabromocyclododecane (HBCDD) in biota is currently not coordinated in the HELCOM community, implying that national guidelines are applied in the sampling as documented in the **monitoring concepts table** in the **HELCOM Monitoring Manual** under the **sub-programme: Contaminants in biota.**

So far, there are no technical guidelines related to HBCDD monitoring in biota in the **HELCOM Monitoring Manual** and there is a need to develop such common monitoring guidelines.

Current monitoring

The monitoring activities relevant to the indicator that are currently carried out by HELCOM Contracting Parties are described in the **HELCOM Monitoring Manual** in the relevant Monitoring Concept Table.

Sub-programme: Contaminants in biota

Monitoring Concept Table

Presently, only Denmark, Poland and Sweden have permanent monitoring of HBCDD in biota. Germany monitors HBCDD in biota on a project basis, national water monitoring is under development and sediment monitoring is in a planning phase. Finland and Lithuania have results from a few years and are planning to include the substance in their national monitoring programmes. Estonia will include HBCDD analysis (sediment and biota) in coastal areas from 2017. Latvia has only screening data and there is no information from Russia.

Description of optimal monitoring

The performance of existing monitoring should be evaluated in relation to the monitoring objectives, but first there is a need to quantify these objectives. These quantitative objectives need to be specified for each kind of monitoring, e.g. temporal trend-, incident-, geographical (spatial)- and compliance monitoring. For example, for temporal trend monitoring: what statistical power is required, during what time period should a certain trend be possible to detect and with what specified power (with certain one-or two-tailed statistical tests at a specified significant level)? With these definitions at hand it is possible to estimate e.g. required sample sizes and sampling frequencies. It can be shown that for a monitoring period of 12 years or shorter, generally the power to detect trends will decrease substantially if the sampling is carried out every second or every third year compared to annual sampling. For geographical studies the required spatial resolution should be determined. For compliance monitoring, it is imperative to know the distance to target levels (and variance) before sample sizes are estimated.

Time series of HBCDD concentrations in fish are missing or too short to enable evaluation for several sub-basins in the Baltic Sea region. Also biological variables, possible confounding factors (e.g. age, fat content) are often missing (not reported) disabling means to make samples comparable between areas and over time. The geographical resolution is generally too poor to make reliable generalized maps from interpolation of the existing stations using Krieging. No serious attempts to study patterns of variation in fish (coastal-offshore) through variograms have been made that could give guidance to the uncertainty and to the distance between sites required to achieve required confidence in generalized maps.

Some areas of the Baltic Sea have no HBCDD monitoring at present. The eastern parts of the Baltic Sea and the eastern coastline lack reported HBCDD concentrations. Thus increased monitoring is needed to enable both a status and trend evaluation for the entire Baltic Sea.

Data and updating

Access and use

The data and resulting data products (tables, figures and maps) available on the indicator web pages can be used freely given that the source is cited. The indicator should be cited as following:

HELCOM (2018) Hexabromocyclododecane (HBCDD). HELCOM core indicator report. Online. [Date Viewed], [Web link].

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Metadata

Result: Hexabromocyclododecane (HBCDD)

Data: Hexabromocyclododecane (HBCDD) biota data

Data: Hexabromocyclododecane (HBCDD) sediment data

The data used in the assessment is based on HELCOM COMBINE data reported by Contracting Parties as part of regular environmental monitoring activities. The data was extracted in accordance with the HELCOM core indicator extraction table, which specifies the matrix and metadata required.

Contributors and references

Contributors

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Archive

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Hexabromocyclododecane HBCDD HELCOM core indicator 2018 (pdf)

Earlier versions of the core indicator report:

HOLAS II component - core indicator report – web-based version July 2017 (pdf)

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