HELCOM Eutrophication Assessment Manual

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Contents

1 Introduction

Eutrophication is assessed by HELCOM using regularly monitored data provided by the contracting parties to produce an indicator-based quantitative assessment. The contracting parties are responsible for producing the assessment, with ICES acting in the role of data host.

The experts assigned by the HELCOM Contracting Parties as participants of the eutrophication network are responsible for initiating and following the update of the assessment as well as reviewing and accepting the assessment products. The contact persons for the eutrophication network at the HELCOM secretariat are Ulla Li Zweifel (UllaLi.Zweifel@helcom.fi) and Joni Kaitaranta (Joni.Kaitaranta@helcom.fi).

ICES, as data host, is responsible for the quality assurance and storage of the eutrophication related monitoring data submitted to the ICES database. It is also responsible for producing and visualizing assessment data products for review purposes. The contact person at ICES is Hjalte Parner (Hjalte@ices.dk).

The main purpose of the Eutrophication Assessment Manual is to provide instructions for all parties involved in updating the assessment. It also provides detailed information on assessment protocols for the users of the indicator and assessment products. The manual is a living document, which is updated as needed.

2 Data and work flow

2.1 General description of work flow

In the HELCOM data flow model for eutrophication assessments (Fig. 2.1), **Contracting Parties** are responsible of reporting monitoring data to the COMBINE database hosted by ICES, through regular reporting procedures. After receiving the data, ICES performs QA/QC checking procedures to the data and transfers it to the **ICES database**. For each eutrophication assessment period, data within the ICES database is extracted and is as such drawn into a separate **HELCOM assessment database**, also hosted by ICES. Additional data products, such as validated and pre-aggregated EO- or ship-of-opportunity data, is submitted by the provider directly to the HELCOM assessment database, without entrance to the ICES database. At this stage indicator aggregation and assessment results are produced dynamically using algorithms specified for the individual core indicators and the overall eutrophication assessment based on the HELCOM eutrophication assessment tool (HEAT 3.0). Visualized data products are subsequently brought through a review and acceptance procedure, using workflows in **HELCOM Eutrophication workspace**. The workflow is established on a Sharepoint-based Workspace, where it is possible to task the experts taking part in the assessment process, as well as document the progress. The HELCOM assessment database is being updated continuously until the acceptance at data-, indicator- and assessment levels has been achieved from nominated experts of the Contracting Parties.

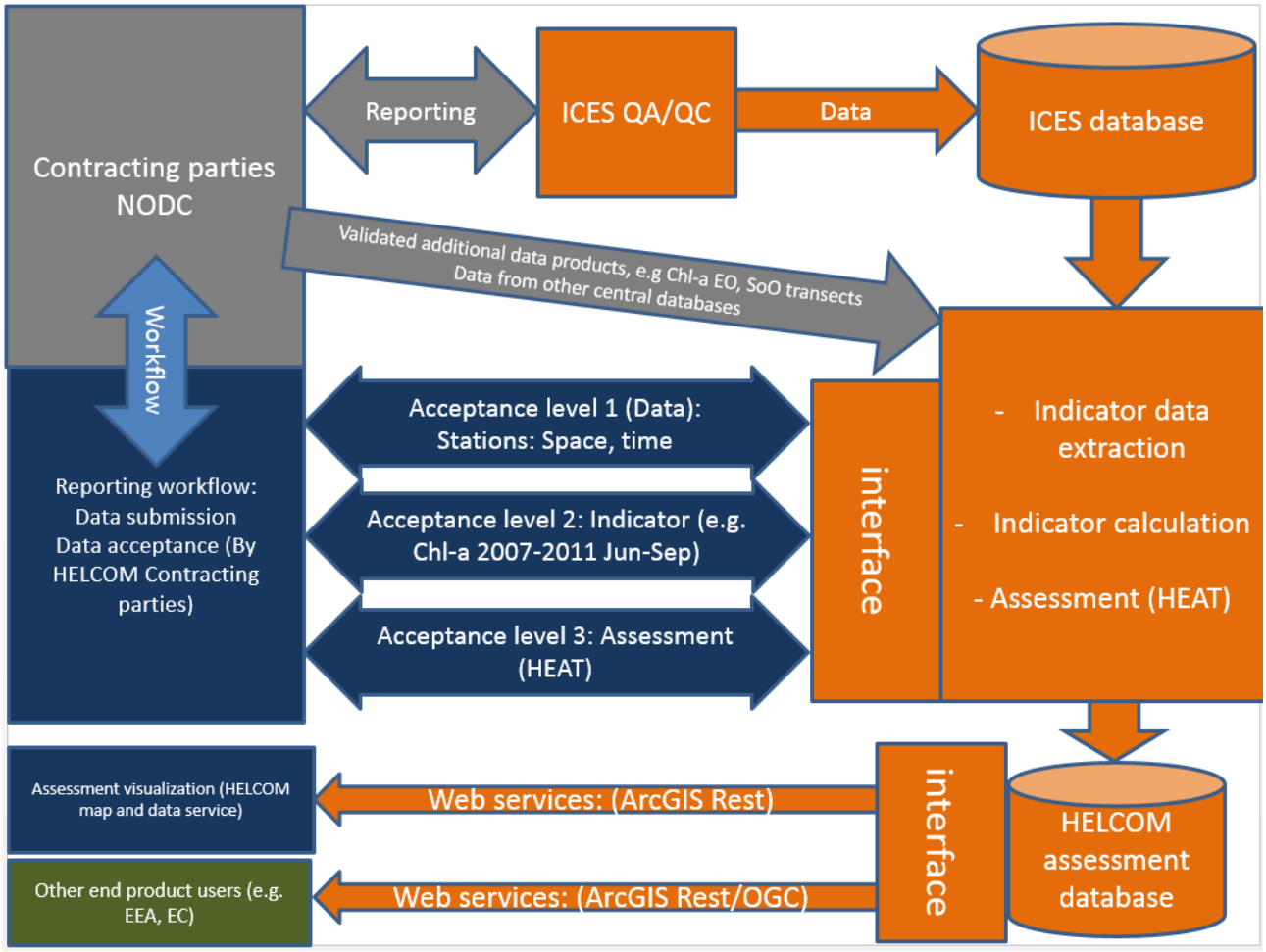


Figure 2.1. Proposal for data and information flow. The color of the items indicate the actor/host: Gray = Contracting Parties, Blue = HELCOM portal (hosted at the Secretariat), Orange = ICES, Green = Other end-users.

Final assessment products, such as indicator maps, are produced and visualized from the database and made available through an interface hosted and maintained by ICES. The HELCOM web portal consists of the HELCOM indicator web reports and the HELCOM Map and Data service. The chart type data visualizations are read from the database visualized in the indicator and assessment web pages. The spatial data (indicator maps) are read from an interface produced with ArcGIS server rest interface, possibly in the future also OGC WMS/WFS compatible web service. The documented interface is open and capable of providing data products to be visualized in data portals and visualization end-points hosted by other actors, e.g. HELCOM Contracting Parties national institutions, EEA and EC.

The roles of Contracting Parties and institutions taking part in the work flow are presented in Table 2.1.

Table 2.1. The roles of Contracting party experts and institutions. 'EUTRO' refers to the HELCOM eutrophication network.

Action	System	When	Outcome	Host	Actor
Submission of national monitoring data: DE	e-mail / ICES portal	Annually	Data submitted to ICES	ICES	IOW
Submission of national monitoring data: DE	e-mail / ICES portal	Annually	Data submitted to ICES	ICES	LUNG
Submission of national monitoring data: DE	e-mail / ICES portal	Annually	Data submitted to ICES	ICES	LNUG (LLUR Flintbek)
Submission of national monitoring data: DK	e-mail / ICES portal	Annually	Data submitted to ICES	ICES	NERI
Submission of national monitoring data: EE	e-mail / ICES portal	Annually	Data submitted to ICES	ICES	EMI/Pärnu Inst.
Submission of national monitoring data: FI	e-mail / ICES portal	Annually	Data submitted to ICES	ICES	SYKE
Submission of national monitoring data: LV	e-mail / ICES portal	Annually	Data submitted to ICES	ICES	LHEI
Submission of national monitoring data: LT	e-mail / ICES portal	Annually	Data submitted to ICES	ICES	EPA
Submission of national monitoring data: PL	e-mail / ICES portal	Annually	Data submitted to ICES	ICES	IMGW
Submission of national monitoring data: PL	e-mail / ICES portal	Annually	Data submitted to ICES	ICES	NMFRI
Submission of national monitoring data: PL	e-mail / ICES portal	Annually	Data submitted to ICES	ICES	GIOS
Submission of national monitoring data: RU	e-mail / ICES portal	Annually	Data submitted to ICES	ICES	SOI
Submission of national monitoring data: SE	e-mail / ICES portal	Annually	Data submitted to ICES	ICES	SMHI
Quality assurance (national monitoring data)	ICES data centre	After data submission	Quality assured data in ICES and assessment database	ICES	
Submission of algaline data & products		Annually	Additional data to assessment database	ICES	SYKE
Submission of algaline data & products		Annually	Additional data to assessment database	ICES	IMGW
Submission of EO data products		Annually	Additional data to assessment database	ICES	SYKE
Extracting data from other databases		Annually	Additional data to assessment database	ICES	ICES data manager extracts data from databases with agreement
Collating assessment data	ICES data centre	Repeatedly?	Assessment database v1	ICES	
Review of assessment data: DE	HELCOM sharepoint	Annually	Acceptance of assessment database v1	ICES	DE-EUTRO-contact
Review of assessment data: DK	HELCOM sharepoint	Annually	Acceptance of assessment database v1	ICES	NERI / DK-EUTRO-contact

Review of assessment data: EE	HELCOM sharepoint	Annually	Acceptance of assessment database v1	ICES	EMI/Pärnu Inst. / EE-EUTRO-contact
Review of assessment data: FI	HELCOM sharepoint	Annually	Acceptance of assessment database v1	ICES	SYKE / FI-EUTRO-contact
Review of assessment data: LV	HELCOM sharepoint	Annually	Acceptance of assessment database v1	ICES	LHEI / LV-EUTRO-contact
Review of assessment data: LT	HELCOM sharepoint	Annually	Acceptance of assessment database v1	ICES	EPA / LT-EUTRO-contact
Review of assessment data: PL	HELCOM sharepoint	Annually	Acceptance of assessment database v1	ICES	IMGW / PL-EUTRO-contact
Review of assessment data: RU	HELCOM sharepoint	Annually	Acceptance of assessment database v1	ICES	SOI / RU-EUTRO-contact
Review of assessment data: SE	HELCOM sharepoint	Annually	Acceptance of assessment database v1	ICES	SMHI / SE-EUTRO-contact
Collating assessment data after review	ICES data centre	Repeatedly?	Assessment database v2	ICES	
Core indicator calculation: DIN	ICES data centre	Repeatedly?	Indicator values produced to assessment database	ICES	
Core indicator calculation: DIP	ICES data centre	Repeatedly?	Indicator values produced to assessment database	ICES	
Core indicator calculation: chla	ICES data centre	Repeatedly?	Indicator values produced to assessment database	ICES	
Core indicator calculation: Secchi	ICES data centre	Repeatedly?	Indicator values produced to assessment database	ICES	
Core indicator calculation: oxygen debt	ICES data centre	Repeatedly?	Indicator values produced to assessment database	ICES	
Review of core indicator: DIN	HELCOM sharepoint	Assessment period	Indicator values produced to assessment database	ICES	EUTRO DIN responsible: IOW
Review of core indicator: DIP	HELCOM sharepoint	Assessment period	Indicator values produced to assessment database	ICES	EUTRO DIP responsible: IOW
Review of core indicator: chla	HELCOM sharepoint	Assessment period	Indicator values produced to assessment database	ICES	EUTRO chla responsible: SYKE
Review of core indicator: Secchi	HELCOM sharepoint	Assessment period	Indicator values produced to assessment database	ICES	EUTRO secchi responsible: SYKE
Review of core indicator: oxygen debt	HELCOM sharepoint	Assessment period	Indicator values produced to assessment database	ICES	EUTRO oxygen responsible: BNI/SMHI
Producing end products open via internet	ICES portal & HELCOM sharepoint	Assessment period	Maps, plots, metadata information, reporting products, products for specific end-users etc.	ICES & HELCOM	

2.2 Instruction for assigned eutrophication experts for checking eutrophication assessment data

To ensure a high quality of the data and the assessment of the eutrophication indicators as well as the overall HEAT assessment a checking procedure has been agreed and will be followed by experts in the HELCOM Eutrophication Network. Each country is responsible for checking their datasets and the assessment of their coastal waters. The open sea assessment is checked following a step-wise procedure (table 2.2). Detailed instructions on the checking procedure can be found in Annex 2A.

Table 2.2. The step-wise acceptance procedure, showing steps, responsible actors and the review parameters to be filled at each step. The levels refer to: 1) data, 2) indicator and 3) assessment.

Step	Responsible actor	Parameters filled in 'National data check-up'
1. Review of assessment products	Level 1: national representatives Level 2, coastal: national representatives Level 2, open: Experts assigned by the HELCOM eutrophication network Level 3, coastal: national representatives Level 3, open: national representatives	*Checked* (yes/no) *Exceptions* (yes/no) *Description of exceptions* (string)
2. Agreement on actions	HELCOM eutrophication network	*Actions* (string)
3. Acceptance	Level 1: national representatives Level 2, coastal: national representatives Level 2, open: Experts assigned by HELCOM eutrophication network Level 3, coastal: national representatives Level 3, open: Experts assigned by HELCOM eutrophication network	*Accepted* (yes/no)

The review is done in the 'Eutrophication data reporting workspace', under 'national check-up'-page (https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Lists/National%20data%20checkup/AllItems.aspx), where experts have been provided with rights to relevant sub-pages (Figure 2.2). The assessment data may be viewed at the 'Dataview' -page, or downloaded for viewing in any selected programme.

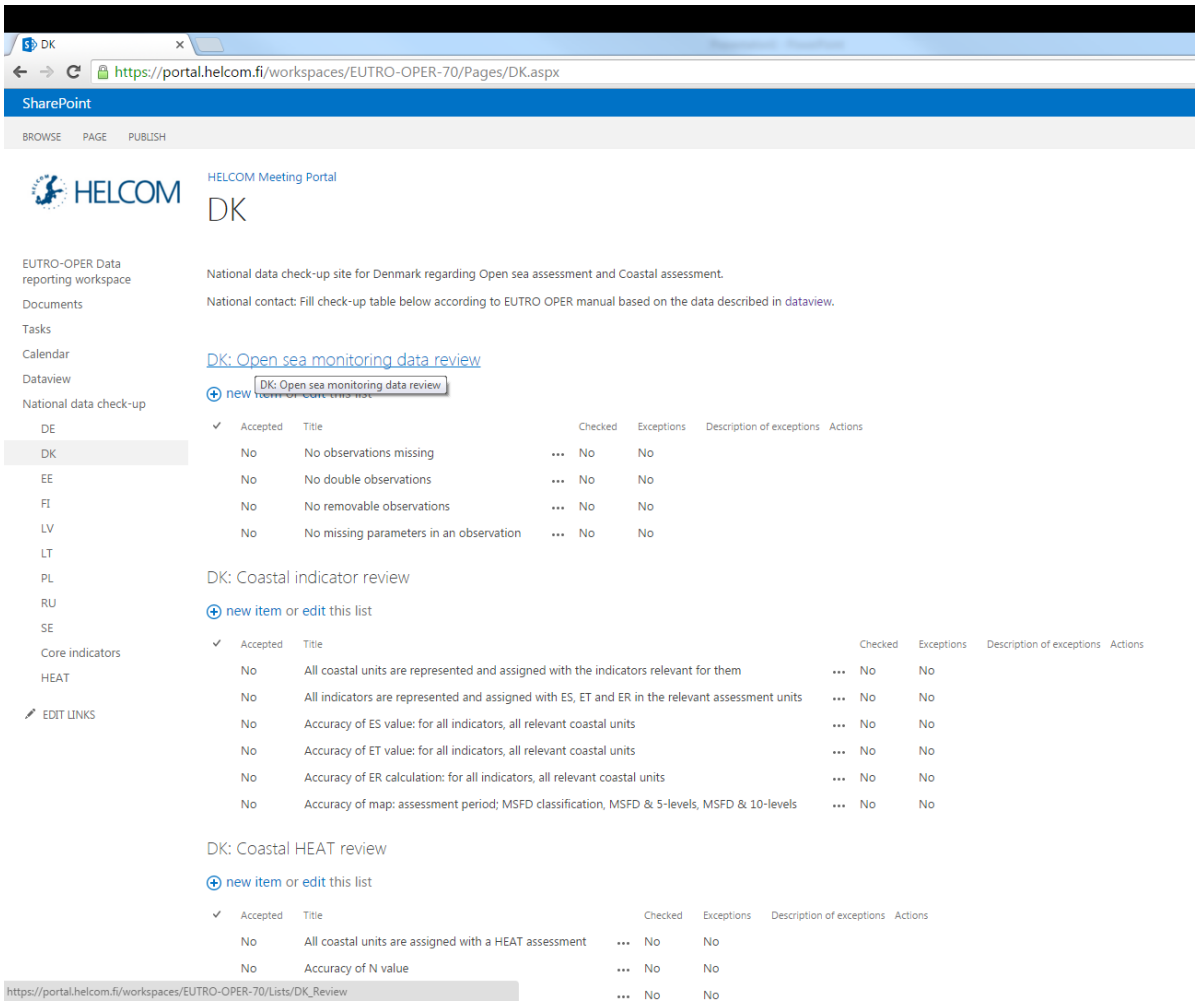


Figure 2.2. The national data check-up page, showing the parameters to be filled under review. (example from DK review page).

2.3 Documentation of work flow

Once acceptance at all three levels has been confirmed and the final HELCOM assessment is produced, the assessment dataset is locked for changes and archived to the HELCOM assessment database in order to preserve the original dataset used in the assessment for documentation purposes.

Reporting review workspace will be also published and locked for editing. The different steps of the review process (checks / comments added by Contracting parties nominated experts and actions carried out) for each review item is stored in the workspace list version history. The version history is also exported to a specific excel sheet for archiving.

3 Data reporting

3.1 Definition of datasets and responsible institutes

The HELCOM monitoring data is reported by Contracting Parties to ICES, using their guidelines and policy for data submission (http://www.ices.dk/marine-data/guidelines-and-policy/Pages/Submitting-data-and-meta-data.aspx). In general, the data formats, guidelines and vocabularies are specific to the data type and monitoring programme. The monitoring data related to the eutrophication core indicators are submitted through ICES oceanographic data submission (http://ocean.ices.dk/submission/). ICES welcomes any data format as long as it well described and structured consistently.

Table 3.1. List of monitoring datasets reported to ICES by Contracting Parties annually.

Country	Monitoring programme(s)	Presently submitted to ICES database (yes/no)?	Available Online?	Can dataset be made available to HELCOM in future (open use / restricted use / not available)	HELCOM open-sea sub-regions (SEA-)	HELCOM coastal sub-regions (yes/no)	Data Holder	Principal Contact	Spatial Data Type	Observation depth (depth /transect)
Denmark	COMBINE	yes			001...011, 013	yes	National Environmental Research Institute (NERI)	Ole Mancher	Point	
Estonia	COMBINE	no			008, 011...013	yes	Estonian Marine Institute (EMI/Pärnu Inst.)	Arno Põllumäe	Point	
Finland	COMBINE	yes			001...017	yes	Finnish Environment Institute (SYKE)	Sirpa Kleemola / Riikka Hietala	Point	
Germany	COMBINE	yes			004...017	yes	Leibniz Institute for Baltic Sea Research (IOW)	Frank Walther (contact person at national database "MUDAB")	Point	
Germany	COMBINE	yes			004...017	yes	Landesamt für Umwelt, Naturschutz und Geologie (LUNG)	Frank Walther (contact person at national database "MUDAB")	Point	
Germany	COMBINE	yes			004...007	yes	Landesamt für Landwirtschaft, Umwelt und ländliche Räume (LLUR, ICES lab code LNUG)	Frank Walther (contact person at national database "MUDAB")	Point	
Latvia	COMBINE	yes			003, 006...010, 012	yes	Latvian Institute of Aquatic Ecology (LHEI)	Dagnija Fedorovicha	Point	
Lithuania	COMBINE	yes			008, 009, 012	yes	Environmental Protection Agency (EPA)	Nailia Bairamova	Point	
Poland	COMBINE	yes			002...017	yes	Institute of Meteorology and Water Management (IMGW)	Neves Sergio	Point	
Poland	WFD	no	no	yes	SEA-007 - SEA - 009	yes	Chief Inspectorate for Environmental Protection (GIOS)	Małgorzata Marciniewicz	Point	0 m, near bottom
Russian Federation	COMBINE	yes	SeaDataNet	restricted use	008...011, 013...015	yes	State Oceanographic Institute (SOI)	Alexander Korshenko	Point	
Sweden	COMBINE, national, article 8, OSPAR	yes	yes	open use?	001...017	yes	Swedish Meteorological and Hydrological Institute (SMHI)	Lotta Fyrberg	Point	

3.2 QA/QC guidelines

The reporting and QA/QC procedures follow common guidelines for HELCOM eutrophication assessment data. They include instructions on basic requirements of reported data, data standards, formats taken, collection and processing details, quality control and documentation, as well as information on the support of the data host ICES.

The QA/QC guidelines for discrete water sample data, EO-based information, Ferrybox flow-through information and ready indicator products are presented in ANNECES 3A-3D.

4 Updating indicators

This chapter describes the indicator set available for eutrophication assessment and how they are assessed in the HELCOM process.

The indicators are divided into three principle classes. HELCOM core indicators are used in offshore waters beyond 1 nm seaward from the baseline i.e. beyond coastal waters as defined the Water Framework Directive (WFD). They have been agreed for use in HELCOM with associated GES-boundaries.

The second class is HELCOM pre-core indicators that are developed towards use in offshore waters but are still not operational or agreed as core indicators. They may also lack e.g. commonly agreed GES-boundaries.

The third class of indicators consists of those used in coastal water assessments under the Water Framework Directive. This indicator group is much more heterogeneous. Some indicators have been intercalibrated between countries through the EU GIG process, but many indicators (and particularly those considered as 'physico-chemical supporting parameters' within the WFD) are based on national work. WFD indicators are used to nationally to assess ecological status under the WFD during a 6 year cycle and are reported to the European Environment Agency (EEA).

Table 4.1. For each indicator, the statistics are calculated in each sub-basin, and include:

Statistic	Abbreviation	Explanation
Indicator value	ES	Indicator value during the period of the assessment, based on information achieved through monitoring
Standard deviation	Std	Standard deviation of data used for calculating ES
GES boundary (or target)	ET	Commonly agreed boundary for Good Environmenal Status (BSEP 143)
Eutrophication ratio	ER	Ratio between ES and ET (for indicators with positive response to eutrophication) and ratio between ET and ES (for indicators with negative response to eutrophication)
Status confidence	ES-Status	Confidence based on the data used for calculating ES
Target confidence	ET-Score	Confidence of target-setting procedure

For open-sea areas, the indicator statistics are produced from data and/or data products submitted and stored at the HELCOM eutrophication assessment data base using the indicator-specific aggregation principles and specifications presented below. Calculations are made both on annual and assessment-period levels. Indicator targets are based on the results obtained in the TARGREV project (HELCOM 2013a), taking also advantage of the work carried out during the EUTRO PRO process (HELCOM 2009) and national work for WFD. The final targets have been set through an expert evaluation process done by the intersessional activity on development of core eutrophication indicators (HELCOM CORE EUTRO) and the targets were adopted by the HELCOM Heads of Delegations 39/2012 (BSEP143).

For coastal areas, there are two optional ways of producing the indicator statistics. The responsibility may be in the hands of the contracting party, who reports ready indicator statistics based on calculations are made in connection with the national Water Framework Directive reporting for those Contracting Parties being also EU Member States. If agreed by the eutrophication network and the contracting party in question, coastal indicator statistics may be alternatively produced from monitoring data submitted and stored at the HELCOM eutrophication assessment data base, in a similar way as for open sea indicators.

4.1 HELCOM core indicators, open sea

Updating indicator status

Core indicators have been agreed for dissolved inorganic nitrogen (DIN) and –phosphorus (DIP) (MSFD D5 Category 1), for chlorophyll-*a* concentrations and Secchi depth (Category 2) and for oxygen debt (Category 3). Tables 4.2 – 4.5 describe the assessment parameters and procedure. Assessment (target) levels for all core indicators are found in Table 4.6.

The open-sea core indicators are updated using data reported by Contracting Parties to the HELCOM COMBINE database hosted by ICES, using the algorithms developed for the eutrophication assessment work flow (see chapter 1). The oxygen debt indicator is currently an exception to this, and reported as ready indicator products. The values are achieved using indicators specifications shown in Table 4.5.

Updating indicator confidence

Indicator confidence is a combination of status- and target confidence.

Indicator status confidences are assigned according to a simple set of rules based on the number of observations. LOW confidence (=0%) is assigned if there are no more than 5 annual status observations during one or more years. MODERATE (=50%) confidence is used if more than 5 but no more than 15 status observations are found per year. HIGH (=100%) confidence requires more than 15 spatially non-biased status observations are found each year.

Chlorophyll-*a* indicators differ slightly from this. Using data from both in-situ and Earth Observation sources, the classification is as below, although an additional "Zero" class has been added, to indicate where there are no status observations. Low status is then set to 20%, moderate to 75% and high to 100% "confidence".

The target confidence was rated based on the uncertainty of the target setting procedure, and is fixed unless targets are adjusted (Figure 4.6). ET-Score was determined HIGH if the target was based on numerous observations made earlier than the 1950's, possibly in combination with hindcast modelling, MODERATE if the target was based on observations made earlier than the 1980's and/or hindcast modelling and LOW if the target was set through expert judgement and/or information from reference sites and/or observations made during or after the 1980's.

Table 4.2. Specifications of the Category 1 core indicators DIN and DIP.

Indicator	DIN	DIP
Response to eutrophication	Positive	Positive
Parameters	DIN = NO2 + NO3 + NH4 concentration (µM)	DIP = PO4 concentration (µM)
Data source	Monitoring data provided by the HELCOM Contracting Parties, and kept in the HELCOM COMBINE database, hosted by ICES (www.ices.dk)	Monitoring data provided by the HELCOM Contracting Parties, and kept in the HELCOM COMBINE database, hosted by ICES (www.ices.dk)
Assessment period (test assessment)	December 2006 – February 2011	December 2006 – February 2011
Assessment season	Winter = December + January + February	Winter = December + January + February
Depth	Surface = average in the 0 – 10 m layer	Surface = average in the 0 – 10 m layer
Removing outliers	No outliers removed	No outliers removed
Removing close observations	No close observations removed	No close observations removed
Indicator level	average of yearly average values	Average of annual average concentrations
Eutrophication ratio (ER)	ER = ES / ET	ER = ES / ET
Status confidence (ES-Score)	LOW (=0%), if no more than 5 annual status observations are found during one or more years. MODERATE (=50%), if more than 5 but no more than 15 status observations are found per year.	LOW (=0%), if no more than 5 annual status observations are found during one or more years. MODERATE (=50%), if more than 5 but no more than 15 status observations are found per year.

	HIGH (=100%), if more than 15 spatially non-biased [to be specified what this means…] status observations are found each year.	HIGH (=100%), if more than 15 spatially non-biased [to be specified what this means…] status observations are found each year.
Indicator target confidence	MODERATE	MODERATE
Indicator confidence (I-Score)	Confidence (%) = average of ES-Score and ET-Score	Confidence (%) = average of ES-Score and ET-Score

Table 4.3. Specifications of the Category 2 core indicator chlorophyll-*a*.

Indicator	Chlorophyll-*a*
Response to eutrophication	positive
Parameters	Chlorophyll-*a* concentration (µg l^{-1})
Assessment period	June 2007 – September 2011
Assessment season	Summer = June + July + August + September
Depth	Surface = average in the 0 – 10 m layer
Removing outliers	No outliers removed
Removing close observations	No close observations removed
Indicator level (ES)	Defined as using multiple data types. The final ES is defined as an average of the annual estimates. Annual ES estimates are defined through (for an example where EO- and *in-situ* data are used for the indicator) $ES_y = \frac{\frac{M(insitu)}{M(insitu+M(eo)} + \frac{SC(insitu)}{SC(insitu)+SC(eo)}}{2 \times ES(insitu)} + \frac{\frac{M(eo)}{M(eo)+M(insitu)} + \frac{SC(eo)}{SC(eo)+SC(insitu)}}{2 \times ES(eo)}$, where *M* = methodological correction factor, agreed by the eutrophication network, values given in table below, and *M(insitu)* + *M(eo)* + *M(fb)* = 1

Sub-basin	$m_{in\text{-}situ}$	m_{EO}	m_{fb}*
SEA-001 The Kattegat	0.55	0.45	0
SEA-001 Great Belt	0.55	0.45	0
SEA-003 The Sound	0.55	0.45	0
SEA-004 Kiel Bay	1	0	0
SEA-005 Bay of Mecklenburg	1	0	0
SEA-006 Arkona Basin	1	0	0
SEA-007 Bornholm Basin	0.55	0.45	0
SEA-008 Gdansk Basin	0.55	0.45	0
SEA-009 Eastern Gotland Basin	0.55	0.45	0
SEA-010 Western Gotland Basin	0.55	0.45	0
SEA-011 Gulf of Riga	0.70	0.30	0
SEA-012 Northern Baltic Proper	0.55	0.45	0
SEA-013 Gulf of Finland	0.55	0.45	0
SEA-014 Åland Sea	0.55	0.45	0
SEA-015 Bothnian Sea	0.55	0.45	0
SEA-016 The Quark	0.55	0.45	0
SEA-017 Bothnian Bay	0.55	0.45	0

* so far m_{fb} = 0, since ferrybox data is not used yet

	in-situ = water sample measurements from HELCOM COMBINE *EO* = daily earth observation on 20K grid *fb* = daily ferrybox observation on 20K grid *SC* = confidence correction factor assigned according to ES-Score, see reasoning described below. For ZERO SC=0, for LOW SC= 0.2, for MODERATE SC=0.75, for HIGH SC=1.0 *ES(in-situ)* = arithmetic average of *in-situ* observations in assessment unit during assessment season during year *y* *ES(eo)* and *ES(fb)* = geometric average of EO/fb grid cell data in assessment unit during assessment season during year *y*
Eutrophication ratio (ER)	ER = ES / ET
Status confidence (ES-Score)	ES-Score will be calculated separately for each data type. The same criteria will be used for all data types, based on their *n*, as described below. n_y*(in-situ)* = number of observations n_y*(EO)*, n_y*(fb)* = the number of 20K grid cells containing data, multiplied with the number of observation days during year *y* ES-Score is classified as described in BSEP 143, but an additional ZERO-class is taken into use. ZERO (0), if there are no status observations LOW (0.2), if no more than 5 annual status observations are found during one or more years. MODERATE (0.75), if more than 5 but no more than 15 status observations are found per year. HIGH (1.0), if more than 15 spatially non-biased [to be specified what this means…] status observations are found each year. To calculate the overall indicator confidence, the indicator ES-Score is calculated using the weighted average of the ES-Scores from the different observation methods. Weighting factors are the methodological correction factors presented above.
Indicator target confidence	MEDIUM; exception: Kattegat LOW
Indicator confidence (I-Score)	Confidence (%) = average of ES-Score and ET-Score

Table 4.4. Specifications of the Category 2 core indicator Secchi depth.

Indicator	Secchi depth
Response to eutrophication	negative
Parameters	Secchi depth (m)
Data source	Monitoring data provided by the HELCOM Contracting Parties, and kept in the HELCOM COMBINE database, hosted by ICES (www.ices.dk)
Assessment period (test assessment)	June 2007 – September 2011
Assessment season	Summer = June + July + August + September
Depth	-
Removing outliers	No outliers removed
Removing close observations	No close observations removed
Indicator level	average of yearly average values
Eutrophication ratio (ER)	ER = ET / ES

Status confidence (ES-Score)	LOW (=0%), if no more than 5 annual status observations are found during one or more years. MODERATE (=50%), if more than 5 but no more than 15 status observations are found per year. HIGH (=100%), if more than 15 spatially non-biased [to be specified what this means…] status observations are found each year.
Indicator target confidence (ET-Score)	HIGH
Indicator confidence (I-Score)	Confidence (%) = average of ES-Score and ET-Score

Table 4.5. At present, the only Category 3 indicator is Oxygen debt, which is operational below the halocline in the central basins of the Baltic Proper (from the Bornholm Basin to the Gulf of Finland). Target values are 7.104 ml/l in the Bornholm basin and 10.54 ml/l in the central Baltic Proper and Gulf of Finland.

Indicator	Oxygen debt
Response to eutrophication	positive
Parameters	Oxygen debt (mg l^{-1})
Data source	Monitoring data provided by the HELCOM Contracting Parties, and kept in the HELCOM COMBINE database, hosted by ICES (www.ices.dk)
Assessment period (test assessment)	June 2007 – September 2011
Assessment season	All months
Depth	Below halocline
Indicator level (ES)	Reported as ready indicator product, according to details documented in BSEP 133
Eutrophication ratio (ER)	ER = ES / ET
Status confidence (ES-Score)	LOW (=0%), if no more than 5 annual status observations are found during one or more years. MODERATE (=50%), if more than 5 but no more than 15 status observations are found per year. HIGH (=100%), if more than 15 spatially non-biased [to be specified what this means…] status observations are found each year.
Indicator target confidence (ET-Score)	HIGH
Indicator confidence (I-Score)	Confidence (%) = average of ES-Score and ET-Score

Table 4.6. GES-boundaries (ie targets) and confidence assessments for the eutrophication core indicators.

	Category 1				Category 2				Category 3	
	DIN		DIP		Chlorophyll a		Secchi depth		Oxygen debt	
	INDICATOR TARGET (ET)	TARGET CONFIDENCE (ET-SCORE)	INDICATOR TARGET (ET)	TARGET CONFIDENCE (ET-SCORE)	INDICATOR TARGET (ET)	TARGET CONFIDENCE (ET-SCORE)	INDICATOR TARGET (ET)	TARGET CONFIDENCE (ET-SCORE)	INDICATOR TARGET (ET)	TARGET CONFIDENCE (ET-SCORE)
SEA-001 The Kattegat	5.00	M	0.49	M	1.50	L	7.60	M		
SEA-001Great Belt	5.00	M	0.59	M	1.70	M	8.50	M		
SEA-003 The Sound	3.30	M	0.42	M	1.20	M	8.20	M		
SEA-004 Kiel Bay	5.50	M	0.57	M	2.00	M	7.40	M		
SEA-005 Bay of Mecklenburg	4.30	M	0.49	M	1.80	M	7.10	M		
SEA-006 Arkona Basin	2.90	M	0.36	M	1.80	M	7.20	M		
SEA-007 Bornholm Basin	2.50	M	0.30	M	1.80	M	7.10	M	6.37	H
SEA-008 Gdansk Basin	4.20	M	0.36	M	1.90	M	6.50	M	8.66	H
SEA-009 Eastern Gotland Basin	2.60	M	0.29	M	2.20	M	7.60	M	8.66	H
SEA-010 Western Gotland Basin	2.00	M	0.33	M	1.20	M	8.40	M	8.66	H
SEA-011 Gulf of Riga	5.20	M	0.41	M	1.65	M	5.00	M		
SEA-012 Northern Baltic Proper	2.90	M	0.25	M	2.70	M	7.10	H	8.66	H
SEA-013 Gulf of Finland	3.80	M	0.59	M	2.00	M	5.50	M	8.66	H
SEA-014 Åland Sea	2.70	M	0.21	M	1.50	M	6.90	M		
SEA-015 Bothnian Sea	2.80	M	0.19	M	1.50	M	6.80	M		
SEA-016 The Quark	3.70	M	0.10	M	2.00	M	6.00	M		

SEA-017 Bothnian Bay	5.20	M	0.07	M	2.00	M	5.80	H		

4.2 PRE-CORE indicators, open sea

Pre-core indicators are not included into the eutrophication assessment. They are still under development, and may lack GES-boundaries, or other elements that would be required for update into core status.

Once accepted as HELCOM Core indicators, open-sea pre-core indicators will be updated using data reported by Contracting Parties to the HELCOM COMBINE database hosted by ICES, using agreed algorithms. In specific cases, they may be reported as ready indicator products, based on documented methodology. The values are achieved using indicators specifications shown in Tables 4.7 – 4.9.

Indicator confidences are assigned according to the same rules as applied for core indicators.

Total nitrogen and total phosphorus

Pre-Core indicators are: total nitrogen and total phosphorus concentrations, spring bloom chlorophyll-*a* as well as for cyanobacterial blooms. At present, the total nitrogen and total phosphorus indicators include alternatives for both the summer period and for the annual mean status. Further harmonization of this indicator is envisaged.

Table 4.7. Specifications for pre-core indicators total nitrogen and total phosphorus.

Indicator	Total nitrogen	Total phosphorus
Response to eutrophication	positive	positive
Parameters	Total nitrogen concentration (µM)	Total phosphorus concentration (µM)
Assessment period (test assessment)	January 2007 – December 2011	January 2007 – December 2011
Assessment season	Annual / Summer (June-September)	Annual / Summer (June-September)
Depth	Surface = average in the 0 – 10 m layer	Surface = average in the 0 – 10 m layer
Removing outliers	No outliers removed	No outliers removed
Removing close observations	No close observations removed	No close observations removed
Indicator level (ES)	average of yearly average values	Average of annual average concentrations
Indicator target (ET)	under development, the aim is to estimate using hindcast model simulations	under development, the aim is to estimate using hindcast model simulations
Eutrophication ratio (ER)	ER = ES / ET	ER = ES / ET
Status confidence (ES-Score)	LOW (=0%), if no more than 5 annual status observations are found during one or more years. MODERATE (=50%), if more than 5 but no more than 15 status observations are found per year. HIGH (=100%), if more than 15 spatially non-biased [to be specified what this means…] status observations are found each year.	LOW (=0%), if no more than 5 annual status observations are found during one or more years. MODERATE (=50%), if more than 5 but no more than 15 status observations are found per year. HIGH (=100%), if more than 15 spatially non-biased [to be specified what this means…] status observations are found each year.
Indicator target confidence (ET-Score)	Expected to be MODERATE, as the targets will be based on model simulations.	Expected to be MODERATE, as the targets will be based on model simulations.
Indicator confidence (I-Score)	Confidence (%) = average of ES-Score and ET-Score	Confidence (%) = average of ES-Score and ET-Score

Chlorophyll-*a*, spring bloom

The chlorophyll a spring bloom intensity is a measure of the magnitude (in terms of chlorophyll a peak concentration) and duration (in terms of number of days above a threshold) of the spring bloom, based primarily upon earth observation data.

Table 4.8. Specifications for pre-core indicator spring bloom chlorophyll-a.

Indicator	Spring bloom chlorophyll-*a*
Response to eutrophication	positive
Parameters	Spring bloom intensity
Assessment period	January 2007 – December 2011
Assessment season	Spring period
Depth	Surface (visible layer)
Removing outliers	On responsibility of data submitter
Removing close observations	No removal
Indicator level (ES)	Average of annual average concentrations (data delivered in 20K grids)
Indicator target (ET)	Under development, the aim is to estimate using model simulations
Eutrophication ratio (ER)	ER = ES / ET
Status confidence (ES-Score)	LOW (=0%), if no more than 5 annual status observations are found during one or more years. MODERATE (=50%), if more than 5 but no more than 15 status observations are found per year. HIGH (=100%), if more than 15 spatially non-biased [to be specified what this means…] status observations are found each year.
Indicator target confidence (ET-Score)	Expected to be MODERATE, as the targets will be based on model simulations.
Indicator confidence	Confidence (%) = average of ES-Score and ET-Score

Cyanobacterial bloom indicator

The Cyanobacterial bloom index is a multiparametric indicator, combining different measurable aspects of the cyanobacterial blooms.

Table 4.9. Specifications for pre-core indicator on cyanobacterial blooms.

Indicator	Cyanobacterial bloom index
Response to eutrophication	negative
Parameters	Cyanobacterial bloom index
Assessment period	January 2007 – December 2011
Assessment season	Summer
Depth	Surface = average in the visible layer
Removing outliers	On responsibility of data submitter
Removing close observations	No removal
Indicator level (ES)	Average of annual average concentrations (data delivered in 20K grids)
Indicator target (ET)	Under development
Eutrophication ratio (ER)	ER = ES / ET
Status confidence (ES-Score)	Estimated by data submitter
Indicator target confidence (ET-Score)	Under development
Indicator confidence	Confidence (%) = average of ES-Score and ET-Score

4.3 Coastal indicators

Indicators used in national coastal waters are those reported under the WFD by those Contracting Parties that are also EU Member States. These indicator results are reported by the Contracting Parties at an aggregated level (status estimate and target for each assessment unit). For assessing the status of coastal waters in HELCOM, some Contracting Parties have chosen to use the water body level which is also used under the WFD, while other Contracting Parties have chosen to use the larger WFD coastal water types as HELCOM assessment units.

Table 4.10. The indicators reported by the Contracting Parties to be used in the eutrophication assessment for their coastal waters. Some of the indicators are expressed in groups, even if the indicators vary nationally. This grouping does not affect the overall eutrophication assessment, which is done separately within the coastal waters of each contracting party, in each coastal assessment unit (water body / water type).

Criteria	Name	Abbreviation	Description	Period	Season	Assessment units
1	Dissolved Inorganic Nitrogen	DIN	Dissolved Inorganic Nitrogen	12-3	Winter	SEA, LAT, POL, SWE
1	Dissolved Inorganic Phosphorus	DIP	Dissolved Inorganic Phosphorus	12-3	Winter	SEA, LAT, POL, SWE
2	Chlorophyll-*a*		Combination of EO and in situ Chlorophyll a	5-9 / 6-9	Summer	SEA, GER, EST, FIN, LAT, POL, SWE, DEN
2	Secchi Depth		Secchi Depth	6-9	Summer	SEA, GER, EST, FIN, LAT, SWE
3	Oxygen Debt		Oxygen	1-12	Annual	SEA, GER, SWE
1	Total Nitrogen	TN	Total Nitrogen	1-12	Annual	GER, POL, SWE
1	Total Phosphorus	TP	Total Phosphorus	1-12	Annual	GER, POL, SWE
3	Oxygen in shallow areas		Oxygen	varying	Summer	DEN, GER, POL
3	Zoobenthos Quality element		Zoobenthos QE (GER, POL, DEN) or ZKI (EST)			GER, POL, DEN, EST
1	Total Nitrogen	TN	Total Nitrogen	6-9	Summer	EST,FIN
1	Total Phosphorus	TP	Total Phosphorus	6-9	Summer	EST,FIN
2	Phytoplankton biovolume		Phytoplankton biovolume	6-9	Summer	EST, FIN, LAT, POL, SWE
3	Benthic macroflora depth distribution		Benthic macroflora depth distribution	7-9	Summer	EST
3	Fucus vesiculosus depth distribution		Fucus vesiculosus depth distribution	7-9	Summer	EST
2	Proportion of perennial species		Proportion of perennial species	7-9	Summer	EST
3	Large inverterbrates FDI	FDI	Large inverterbrates FDI	7-9	Summer	EST
3	Large inverterbrates KPI	KPI	Large inverterbrates KPI	7-9	Summer	EST
3	Macrophytes, sheltered		Macrophytes, sheltered	7-8	Summer	FIN
3	BBI	BBI	BBI	5-6	Summer	FIN
3	Benthic Quality Index	BQI	Benthic Quality Index	5	Summer	LAT, SWE
3	Phytobenthos Ecological Quality Index	PEQI	Phytobenthos Ecological Quality Index	7-9	Summer	LAT

3	Furcellaria lumbricalis depth distribution		Furcellaria lumbricalis depth distribution	7-9	Summer	LAT
2	Chlorophyll a		Chlorophyll a	1-12	Annual	POL
1	Dissolved Inorganic Nitrogen	DIN	Dissolved Inorganic Nitrogen	1-12	Annual	POL
1	Dissolved Inorganic Phosphorus	DIP	Dissolved Inorganic Phosphorus	1-12	Annual	POL
2	Secchi Depth		Secchi Depth	1-12	Annual	POL
3	Oxygen		Oxygen	6-9	Summer	POL
3	Macrovegetation Quality element		Macrovegetation QE (SWE), Macrophytes QE (GER, POL), Macrophyte, open (FIN)	7-9	Summer	SWE, GER, POL, FIN
1	Total Nitrogen	TN	Total Nitrogen	12-2	Winter	SWE
1	Total Phosphorus	TP	Total Phosphorus	12-2	Winter	SWE
2	Chlorophyll a (in-situ)		Chlorophyll a (in-situ)	5-9	Summer	SEA, GER, EST, FIN, LAT, POL, SWE
2	Chlorophyll a (eo)		Chlorophyll a (eo)	6-9	Summer	SEA, GER, EST, FIN, LAT, POL, SWE

At present for all coastal indicators, the indicator level as well as the GES boundary has been assigned nationally for each assessment unit, basing on the methodology agreed during the WFD work (for intercalibrated indicators) or nationally (for indicators not intercalibrated). In cases where indicator information exists only as EQR, it may instead be reported as Ecological Ratios (ER) directly.

5 Producing overall assessment (HEAT 3.0)

5.1 Assessment units

The HELCOM eutrophication assessment is an indicator-based quantitative assessment. The assessment is made separately for 17 open-sea and 138 coastal assessment units (figure 5.1), based on information achieved from regularly updated and commonly agreed indicators, which include estimates of present status as well as targets of good environmental status. The 138 coastal assessment units are based on “water body types” or the larger “water types” as used under the WFD by choice of the Contracting Parties. Commonly agreed HELCOM core indicators are used in open sea, and national indicators are used in coastal areas (see previous chapter). The indicator information is aggregated to form an estimate of overall eutrophication, using the HELCOM Eutrophication Assessment Tool (HEAT 3.0).

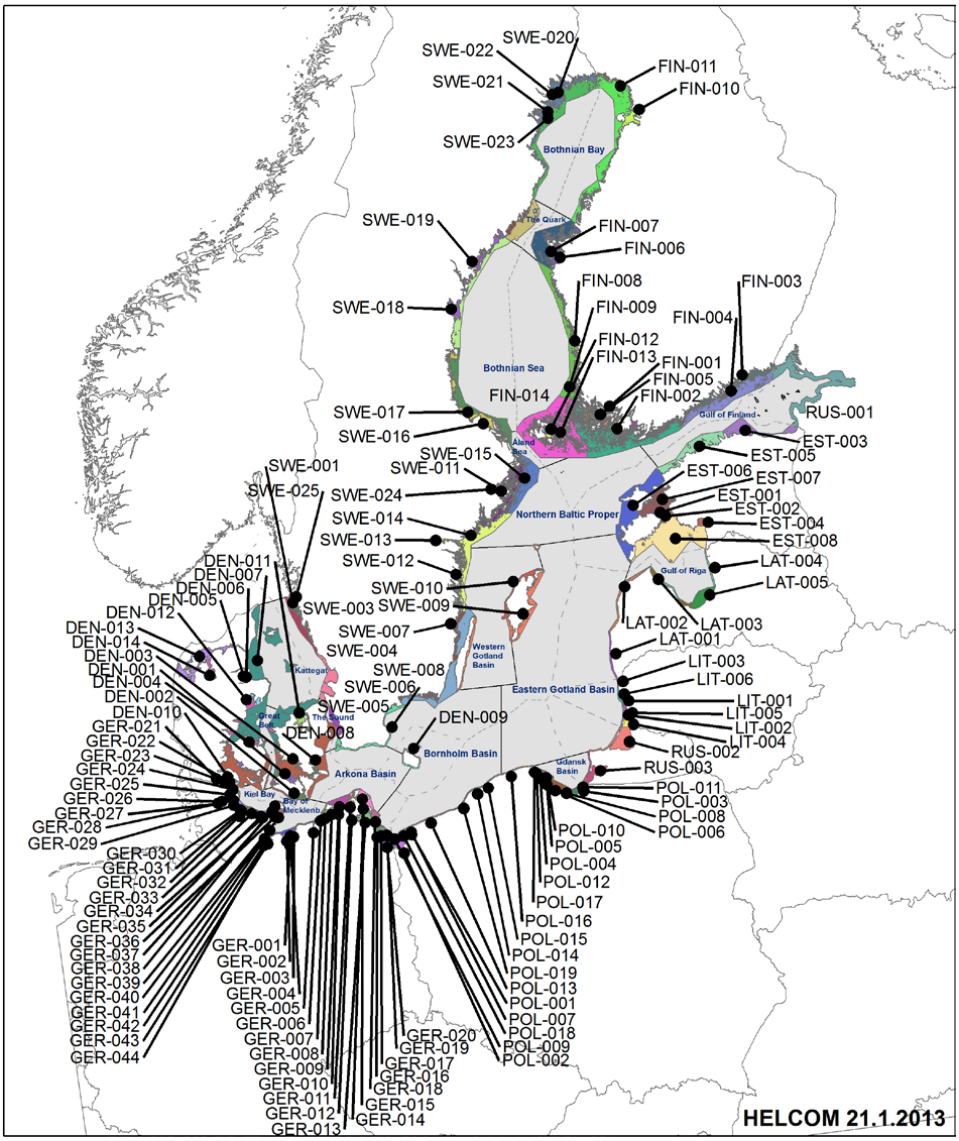
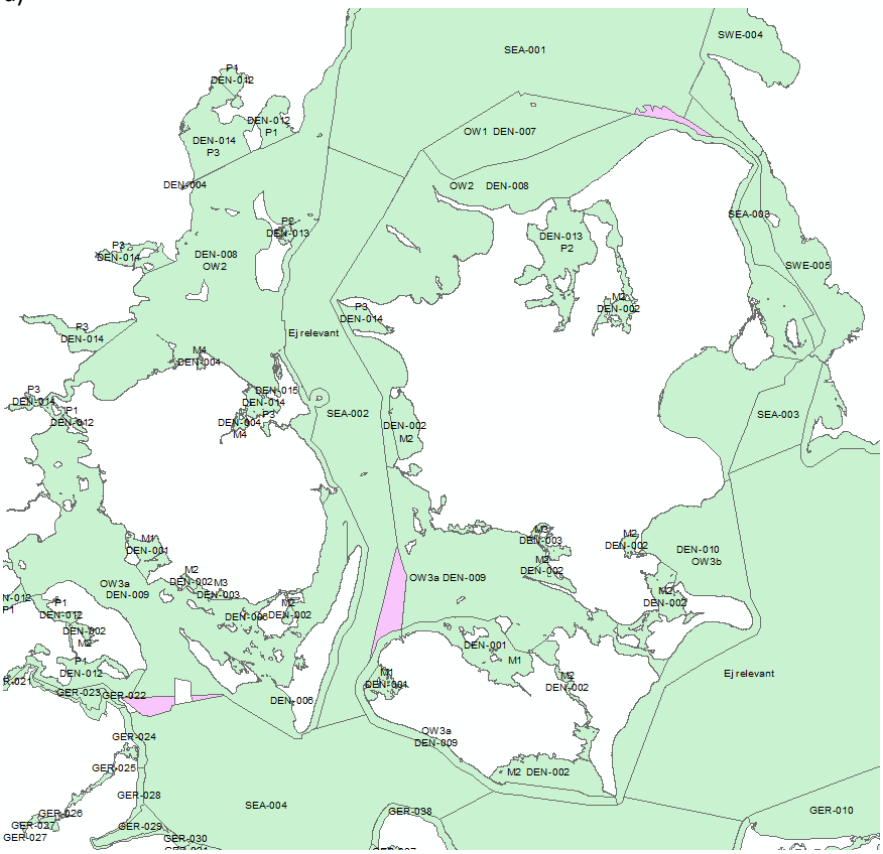


Figure 5.1. A map illustrating the 17 open-sea and 138 coastal assessment units (from HELCOM monitoring and assessment strategy)

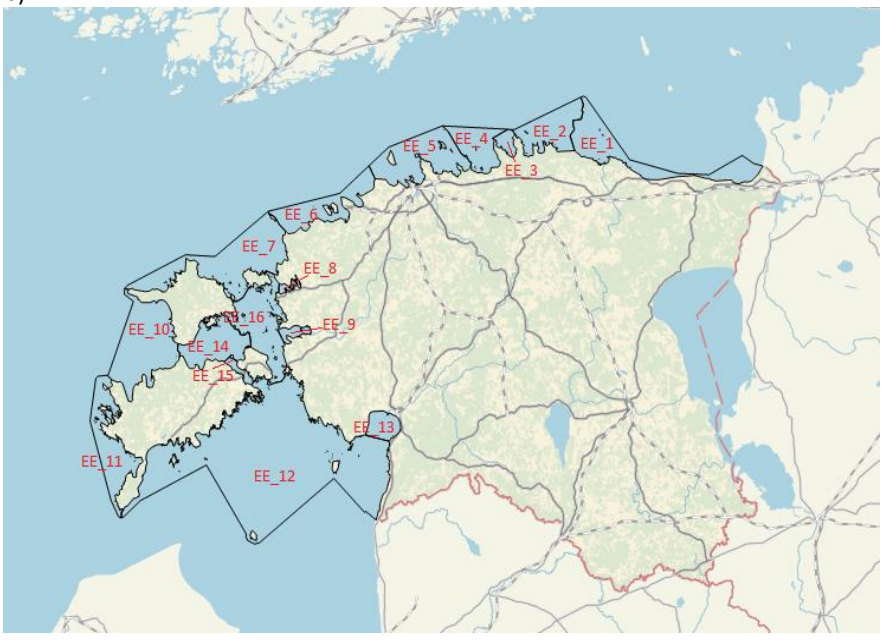
Exceptions to the HELCOM assessment unit division are made in the coastal areas of Denmark, Estonia and Germany (figure 5.2).

Figure 5.2. Exceptions to the coastal assessment unit division in a) Denmark, Germany and b) Estonia.

a)



b)



5.2 HELCOM Eutrophication Assessment Tool (HEAT 3.0)

To produce the overall eutrophication assessment, core indicator results are grouped into three "criteria" as used under the Marine Strategy Framework Directive (MSFD) and described in the Commission Decision (2010/477/EU): 1. Nutrient levels, 2. Direct Effects, 3. Indirect Effects. The criterion 'nutrient levels' comprises of 10 nutrient indicators, though all of them are not used together in any of the assessment units. Direct effects include the indicators chlorophyll-*a* concentration, Secchi depth, phytoplankton biovolume and percentage of perennial macroalgal species. Indirect effects include three shallow water oxygen indicators, deep bottom oxygen debt, nine macrovegetation indicators and seven macrozoobethos indicators.

Eutrophication status assessment

Eutrophication status is assessed by the three criteria described above (figure 5.3). The criteria-specific eutrophication status is calculated as a weighted average of the eutrophication ratio of each indicator within the criteria. The weight is evenly distributed, unless otherwise justified. The lowest criteria-specific eutrophication determines the overall eutrophication status (one-out-all-out approach) of each assessment unit.

Confidence assessment

The eutrophication status assessment is accompanied by a confidence assessment. The method, based on Andersen et al. (2010) and described in detail by Fleming-Lehtinen et al. (2015), estimates Final Confidence Rating (FCR) for each assessment unit. FCR may range between 100% and 0% and is grouped into three confidence classes: high (100–75%), moderate (74–50%) and low (<50%). The confidence class is determined by the availability of data for each indicator and data type separately. The calculation of confidence is done in three steps:

1) Indicator-specific confidence (see chapter 3): ET-Score and ES-Score are combined by averaging the scores to determine the confidence of each indicator, assigning a value of high for 100%, moderate for 50% and low for 0%.
2) Criteria-specific confidence: weighted arithmetic mean of the confidences of the indicators within each criteria.
3) FCR: Arithmetic mean of the criteria-specific confidences, weighing criteria equally, and ignoring those not having any indicators. Additionally:
    - To ensure at least moderate confidence of the overall eutrophication assessment, the classification has to be based on at least two, but preferably three criteria, with ideally no less than two indicators per criterion.
    - A criterion with only one indicator has its criteria-specific confidence reduced by 25%'
    - if the assessment is based on only a single criterion, FCR is reduced by 50%.

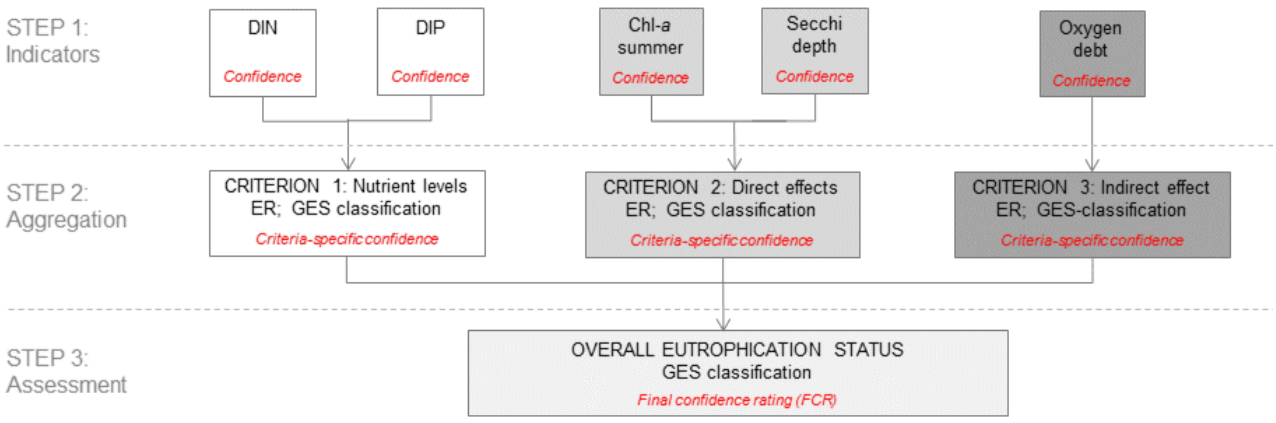


Figure 5.3. Schematic visualization of how the eutrophication status assessment (or primary assessment, in black) and the confidence assessment (or secondary assessment, in red italics) are produced in open-sea assessment units using HEAT 3.0 using core indicators. The

assessments are carried out separately for each assessment unit. Steps 1-3 are described in detail in the Material and methods section. Abbreviations: DIN = Dissolved inorganic nitrogen; DIP = Dissolved inorganic phosphorus; Chl-a = chlorophyll-a; Secchi = Secchi depth; ER = Eutrophication ratio derived from GES-boundary and present level of indicator; FCR = Final quality rating of the assessment; GES = Good environmental status, referring to an acceptable level of eutrophication (figure from Fleming-Lehtinen et al. 2015).

5.2.1 Open sea assessment

Aggregation of indicators into criteria

For the open-sea areas, the core indicators of eutrophication are used, using the following aggregation into criteria (pre-core and candidate indicators are marked in parentheses to show their potential aggregation):

Criteria 1, nutrient levels

- winter DIN
- winter DIP
- (annual or summer total N)
- (annual or summer total P)

Criteria 2, direct effects

- summer chorophyll-*a*
- summer Secchi depth
- (spring bloom chlorphyll-*a*)
- (cyanobacterial bloom index)

Criteria 3, indirect effects

- oxygen debt
- (oxygen consumption)
- (shallow water oxygen indicator)

Indicator weights

In principle, the indicator weights within a criteria are set evenly, unless there is justification to do otherwise. The indicator weights agreed for open-sea areas are shown in table 5.1.

Table 5.1. Assessment unit-specific indicator weights of open-sea core indicators used in the HEAT assessment.

Assessment unit	Criteria 1		Criteria 2		Criteria 3
	DIN	DIP	Chlorophyll-a	Secchi depth	Oxygen debt
SEA-001 The Kattegat	50	50	50	50	
SEA-002 Great Belt	50	50	50	50	
SEA-003 The Sound	50	50	50	50	
SEA-004 Kiel Bay	50	50	50	50	
SEA-005 Bay of Mecklenburg	50	50	50	50	
SEA-006 Arkona Basin	50	50	50	50	
SEA-007 Bornholm Basin	50	50	50	50	100
SEA-008 Gdansk Basin	50	50	50	50	100
SEA-009 Eastern Gotland Basin	50	50	50	50	100
SEA-010 Western Gotland Basin	50	50	50	50	100
SEA-011 Gulf of Riga	33	67	50	30	

SEA-012 Northern Baltic Proper	50	50	70	50	100
SEA-013 Gulf of Finland	50	50	60	40	100
SEA-014 Åland Sea	50	50	50	50	
SEA-015 Bothnian Sea	50	50	60	40	
SEA-016 The Quark	50	50	70	30	
SEA-017 Bothnian Bay	33	67	80	20	

For Secchi depth and chlorophyll-*a* (criterion 2, direct effects), the weight is assigned according to available information on the light absorption by colored dissolved organic matter (CDOM) and the relationship between CDOM absorption and chlorophyll-*a* concentration in the sub-basin (Ylöstalo et al. in prep., Stedmon et al. 2000), respectively. The weight is distributed equally (50% / 50%) for most sub-basins but in the Gulf of Finland and especially in the Gulf of Bothnia chlorophyll-*a* receives a greater weight due to higher absorption of light by CDOM in relation to chlorophyll-*a* (Table 5.2).

Table 5.2. Secchi depth and chlorophyll-*a* have been weighted according to available information on CDOM absorption of light and the relationship between CDOM light absorption and chlorophyll-*a* (chl-a) concentration in the sub-basin.

Basin	Weight Secchi	Weight chla	CDOM light absorption / chlorophyll a (chla)
Kattegat	50 %	50 %	
The Sound	50 %	50 %	Low CDOM absorption (Stedmon et al. 2000)
Great Belt	50 %	50 %	Low CDOM absorption (Stedmon et al. 2000)
Little Belt	50 %	50 %	Low CDOM absorption (Stedmon et al. 2000)
Kiel Bay	50 %	50 %	Assumed similar as in the Belts and Arkona Sea
Mecklenburg Bight	50 %	50 %	Assumed similar as in the Belts and Arkona Sea
Arkona Sea	50 %	50 %	Low CDOM absorption (Ylöstalo et al. 2012), medium in relation to chl-a
Bornholm Sea	50 %	50 %	Low CDOM absorption (Ylöstalo et al. 2012), medium in relation to chl-a
Eastern Gotland Basin	50 %	50 %	Assumed similar as in the Northern Baltic ProperB
Western Gotland Basin	50 %	50 %	Low CDOM absorption (Ylöstalo et al. 2012), medium in relation to chl-a
Gdansk Basin	50 %	50 %	No info
Northern Baltic Proper	50 %	50 %	Medium CDOM absorption (Ylöstalo et al. 2012), medium in relation to chl-a
Gulf of Finland	40 %	60 %	High CDOM absorption (Ylöstalo et al. 2012), medium in relation to chla
Gulf of Riga	30 %	70 %	Extremely high CDOM absorption (Ylöstalo et al. 2012), high in relation to chla.
Åland Sea	50 %	50 %	Interpolated between Bothnian Sea and Northern Baltic Proper
Bothnian Sea	40 %	60 %	Medium CDOM absorption (Ylöstalo et al. 2012), medium-high in relation to chla
Quark	30 %	70 %	Interpolated between Bothnian Bay and Bothnian Sea
Bothnian Bay	20 %	80 %	High CDOM absorption (Ylöstalo et al. 2012), extremely high in relation to chla.

In the Bothnian Bay and the Gulf of Riga, where phosphorus is clearly the limiting element for phytoplankton production, DIN and DIP (criteria 1, nutrient levels) are weighted to increase the effect of the phosphorus using the same proportional weight (33.3% and 66.7%, respectively) as in the previous thematic assessment of eutrophication (HELCOM 2009).

Overall eutrophication

The overall eutrophication status in open sea assessment units is aggregated according to the protocol of HEAT 3.0 (Table 5.3).

Table 5.3. Specifications of the overall eutrophication assessment for open-sea assessment units (HEAT 3.0).

Assessment	Overall eutrophication
Indicators used	DIN, DIP, chla, Secchi, O2

Assessment period	2007 (for DIN&DIP, Dec 2006) – 2011
Criterion 1 weight (C1_W)	33.33%
Criterion 2 weight (C2_W)	33.33%
Criterion 3 weight (C3_W)	33.33%
Step 1, indicators	[for each core indicator, see indicator specifications]
Step 2, criterion status	For each criterion, use core indicators, with aggregation principles given above. Status is the sum of *ER* × *IW* of all indicators within criterion (=weighted average). If criterion has no indicators, the value is na. [for ER and IW, see indicator specifications]
Step 2, criterion status classification	*GES*, if status ≤ 1 *SubGES*, if status > 1
Step 2, Criterion confidence	For each criterion, use core indicators, with aggregation principles given above. Confidence is the sum of *I-Score* × *IW* of all indicators within criterion (=weighted average). If criteria consists of only one indicator, the confidence is reduced by 25%. [for I-Score and IW, see indicator specifications]
Step 2, Criterion confidence classification	*low*, if confidence <50% *moderate*, if confidence 50-74% *high*, if confidence 75-100%
Step 3, overall status classification	The lowest criterion status classification is chosen as overall status classification (one-out-all-out principle) Criteria receiving status = na are ignored.
Step 3, overall confidence	Overall confidence is the sum of *Criterion confidence* × *Criterion weight* for all three criteria. If for 2 criteria, status = na, than reduce the result by 50%
Step 3, final confidence rating (FCR)	*low*, if confidence <50% *moderate*, if confidence 50-74% *high*, if confidence 75-100%

5.3 Coastal assessments

Aggregation of indicators into criteria

In coastal areas, national indicators developed under the WFD process are used. The indicators are set under the following criteria (note that not all indicators are used in all coastal assessment units):

Criteria 1, nutrient levels

- DIN
- DIP
- total N
- total P

Criteria 2, direct effects

- chorophyll-*a*
- Secchi depth
- phytoplankton biovolume
- percentage of perennial species

Criteria 3, indirect effects

- oxygen concentration
- macrophytes
- macrovegetation
- bent.flora_max depth
- F.ves_max depth
- PEQI (macrophytes)
- zoobenthos
- BQI
- ZKI
- FDI
- KPI
- BBI

Indicator weights

In coastal assessment units, idicator weights within criteria are set evenly unless there is justification to do otherwise. The justification should be reported in this part of the manual.

Overall eutrophication

The overall eutrophication status in coastal assessment units is aggregated according to the protocol of HEAT 3.0 (Table 5.4).

Table 5.4. Specifications of the overall eutrophication assessment for coastal assessment units (HEAT 3.0).

Assessment	Overall eutrophication
Indicators	Indicators reported under national WFD
Assessment period	The optimal period is 2007-2011 (identical to open-sea). If reporting is not possible for this period, any period as close as possible is allowable.
Criterion 1 weight (C1_W)	33.33%
Criterion 2 weight (C2_W)	33.33%
Criterion 3 weight (C3_W)	33.33%
Step 1, indicators	[for each core indicator, see indicator specifications]
Step 2, Criterion status	For each criterion, use indicators listed by contracting party, with aggregation principles given above. Status is the sum of *ER* × *IW* of all indicators within criterion (=weighted average). If criterion has no indicators, the value is na. [for ER and IW, see indicator specifications]
Step 2, Criterion status classification	*GES*, if status ≤ 1 *SubGES*, if status > 1
Step 2, Criterion confidence	For each criterion, use indicators listed by contracting party, with aggregation principles given above. Confidence is the sum of *I-Score* × *IW* of all indicators within criterion (=weighted average). If criteria consists of only one indicator, the confidence is reduced by 25%. [for I-Score and IW, see indicator specifications]
Step 2, Criterion confidence classification	*low*, if confidence <50% *moderate*, if confidence 50-74% *high*, if confidence 75-100%
Step 3, overall status classification	The lowest criterion status classification is chosen as overall status classification (one-out-all-out principle) Criteria receiving status = na are ignored.
Step 3, overall confidence	Overall confidence is the sum of *Criterion confidence* × *Criterion weight* for all three criteria. If for 2 criteria, status = na, than reduce the result by 50%

Step 3, final confidence rating (FCR)	*low*, if confidence <50% *moderate*, if confidence 50-74% *high*, if confidence 75-100%

6 Visualization and assessment products

6.1 HELCOM indicator reports and assessment web page

6.1.1 Overall status assessment

The overall eutrophication status assessment is published as a web report, and possibly also a HELCOM report or a BSEP report. This publication provides all necessary information related to the assessment, including brief descriptions of the state of each indicator used in the assessment.

A summary of the status assessment is published at the HELCOM website (http://www.helcom.fi/baltic-sea-trends/eutrophication/latest-status/).

6.1.2 Indicator web report structure

All HELCOM indicators presented in the HELCOM portal share a similar reporting structure. The front page includes the key message and information on the relevance of the indicator. The sub-pages include information on results and confidence, good environmental status (GES), assessment protocol, monitoring requirements, data and updating as well as contributors and references. This structure is described in detail in ANNEX 5A.

The web indicator report is constructed so, that once updating indicator status, it is necessary to update the text and maps only the text on the 'Results and confidence' -page. The maps and figures are updated with products from the assessment work flow, whereas the text is updated by the experts in charge of the assessment. Other pages are updated as needed.

6.2 HELCOM data and map service

The eutrophication assessment and the indicator evaluations are presented in the HELCOM Baltic Sea data and map service. They may be found under 'Sea environmental status' >> 'Eutrophication status'.

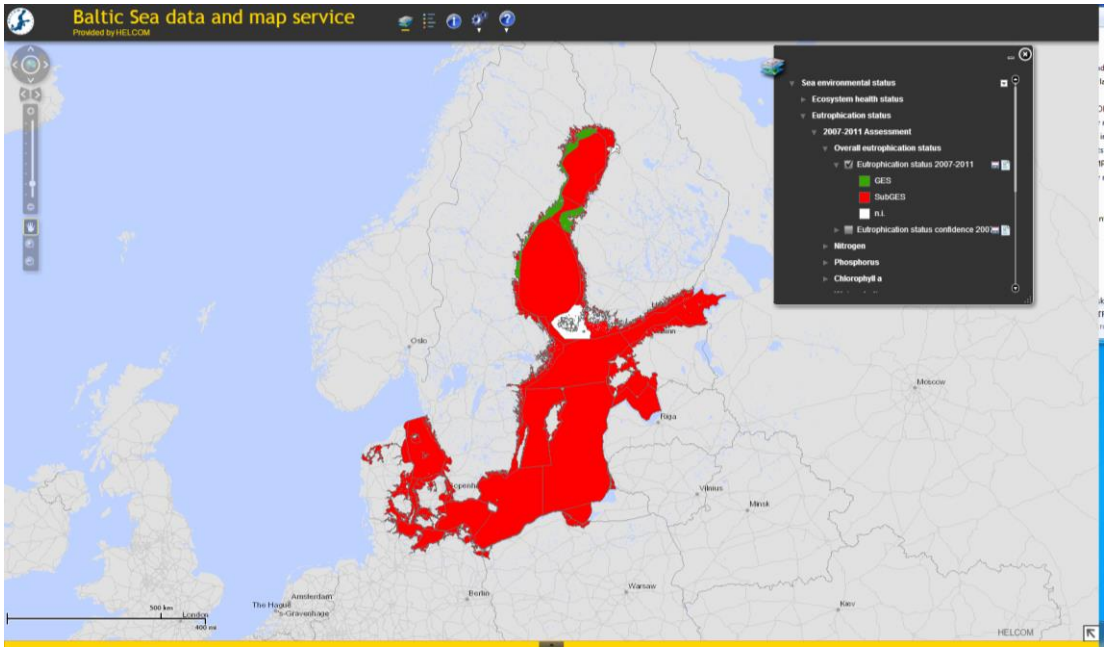
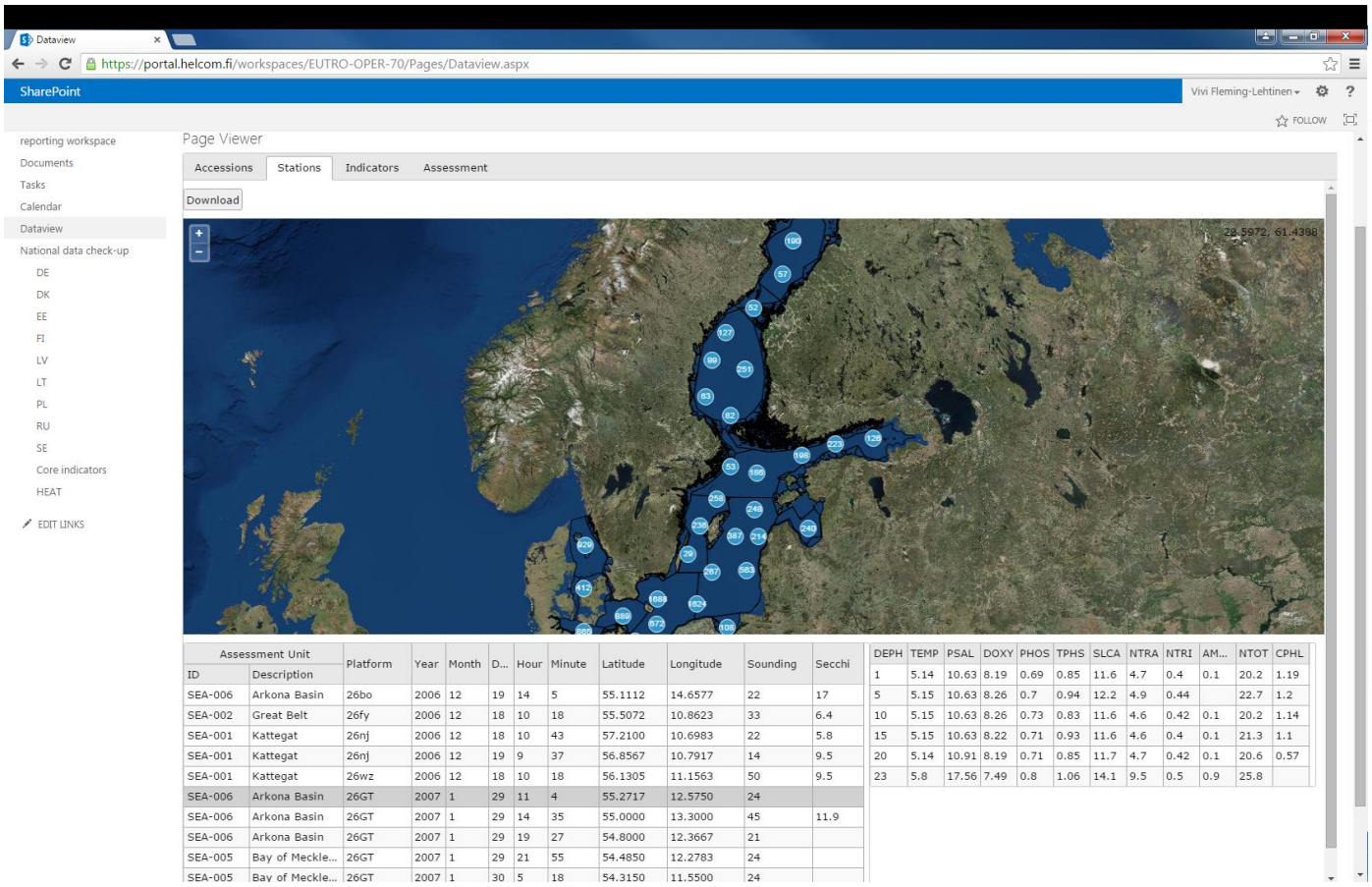


Figure 6.1. A view from the Baltic Sea data and map service, showing overall eutrophication status 2007-2011.

ANNEX 2A: Instruction for data and assessment product review

Review of assessment data

Review item: open-sea data reported by Contracting Parties, to be used for update of indicators; use workspace dataview (https://portal.helcom.fi/workspaces/EUTRO-OPER-70/default.aspx), data leaf 'Stations'. Below the map on the left, you will find the station visits. After choosing a station visit, the observations made on that specific visit are displayed on the right (see figure 2A.1 below).



Assessment Unit		Platform	Year	Month	D...	Hour	Minute	Latitude	Longitude	Sounding	Secchi
ID	Description										
SEA-006	Arkona Basin	26bo	2006	12	19	14	5	55.1112	14.6577	22	17
SEA-002	Great Belt	26fy	2006	12	18	10	18	55.5072	10.8623	33	6.4
SEA-001	Kattegat	26nj	2006	12	18	10	43	57.2100	10.6983	22	5.8
SEA-001	Kattegat	26nj	2006	12	19	9	37	56.8567	10.7917	14	9.5
SEA-001	Kattegat	26wz	2006	12	18	10	18	56.1305	11.1563	50	9.5
SEA-006	Arkona Basin	26GT	2007	1	29	11	4	55.2717	12.5750	24	
SEA-006	Arkona Basin	26GT	2007	1	29	14	35	55.0000	13.3000	45	11.9
SEA-006	Arkona Basin	26GT	2007	1	29	19	27	54.8000	12.3667	21	
SEA-005	Bay of Meckle...	26GT	2007	1	29	21	55	54.4850	12.2783	24	
SEA-005	Bay of Meckle...	26GT	2007	1	30	5	18	54.3150	11.5500	24	

DEPH	TEMP	PSAL	DOXY	PHOS	TPHS	SLCA	NTRA	NTRI	AM...	NTOT	CPHL
1	5.14	10.63	8.19	0.69	0.85	11.6	4.7	0.4	0.1	20.2	1.19
5	5.15	10.63	8.26	0.7	0.94	12.2	4.9	0.44		22.7	1.2
10	5.15	10.63	8.26	0.73	0.83	11.6	4.6	0.42	0.1	20.2	1.14
15	5.15	10.63	8.22	0.71	0.93	11.6	4.6	0.4	0.1	21.3	1.1
20	5.14	10.91	8.19	0.71	0.85	11.7	4.7	0.42	0.1	20.6	0.57
23	5.8	17.56	7.49	0.8	1.06	14.1	9.5	0.5	0.9	25.8	

Figure 2A.1. The stations view, showing observations used in the assessment.

Review responsibility: national experts (see table below)

Review page: National data check-up, under page for specific contracting party (see table below); use rows specified for 'Open sea monitoring data review'

Action	Responsible expert/institute	Review reported at
Review of assessment data reported by DE	DE-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/DE.aspx
Review of assessment data reported by DK	NERI / DK-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/DK.aspx
Review of assessment data reported by EE	EMI, UT/ / EE-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/EE.aspx

Review of assessment data reported by FI	SYKE / FI-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/FI.aspx
Review of assessment data reported by LV	LHEI / LV-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/LV.aspx
Review of assessment data reported by LT	EPA / LT-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/LT.aspx
Review of assessment data reported by PL	IMGW / PL-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/PL.aspx
Review of assessment data reported by RU	SOI / RU S&C-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/RU.aspx
Review of assessment data reported by SE	SMHI / SE-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/SE.aspx

The manual is constructed so, that checking should be done in order from point 1 to 4. You may do the checking either in the workspace, or after downloading the entire dataset. After downloading the dataset, you may use any software you find best suitable (ODV, Excel, etc).

To begin, you may filter out the platforms not relevant for your country. The country is identified by the first two letters/numbers in the platform code, according to:

06 and 07 – Germany
26 – Denmark
34 – Finland
67 – Poland
77 – Sweden
ES – Estonia
LA – Latvia
LT – Lithuania
RU – Russia

OBS! The country code identifies the host of the platform (ship, buoy etc.), not the data reporter!

1. Check that no rows are missing from the assessment dataset
   - to have an overview: zoom in the map and check for obvious missing monitoring stations
   - after overview, check that the total number of observations is not smaller than what should be reported
   - if there are observations missing, check again after filtering by the following parameters one-by-one, to identify the missing observation(s): 1) Year, 2) Assessment Unit, 3) Platform (platform codes: http://vocab.ices.dk/?ref=315), 4) Month, 5) Day, 6) Hour, 7) Minute
   - if missing observations are found: In ***National check-up***, on line ***No observations missing***, tick 'Yes' for *Exceptions*, and mention platform, assessment unit and year under *Description of Exceptions*

2. Check that there are no double or extra observations in the assessment dataset
   - check that the total number of observations is not smaller than what should have been reported (remember to take into consideration the number of possible missing observations found during previous exercise)
   - if there are too many observations, check again after filtering by the following parameters one-by-one, to find where the extra/double observation(s): 1) Year, 2) Assessment Unit, 3) Platform (ship etc.), 4) Month, 5) Day, 6) Hour, 7) Minute

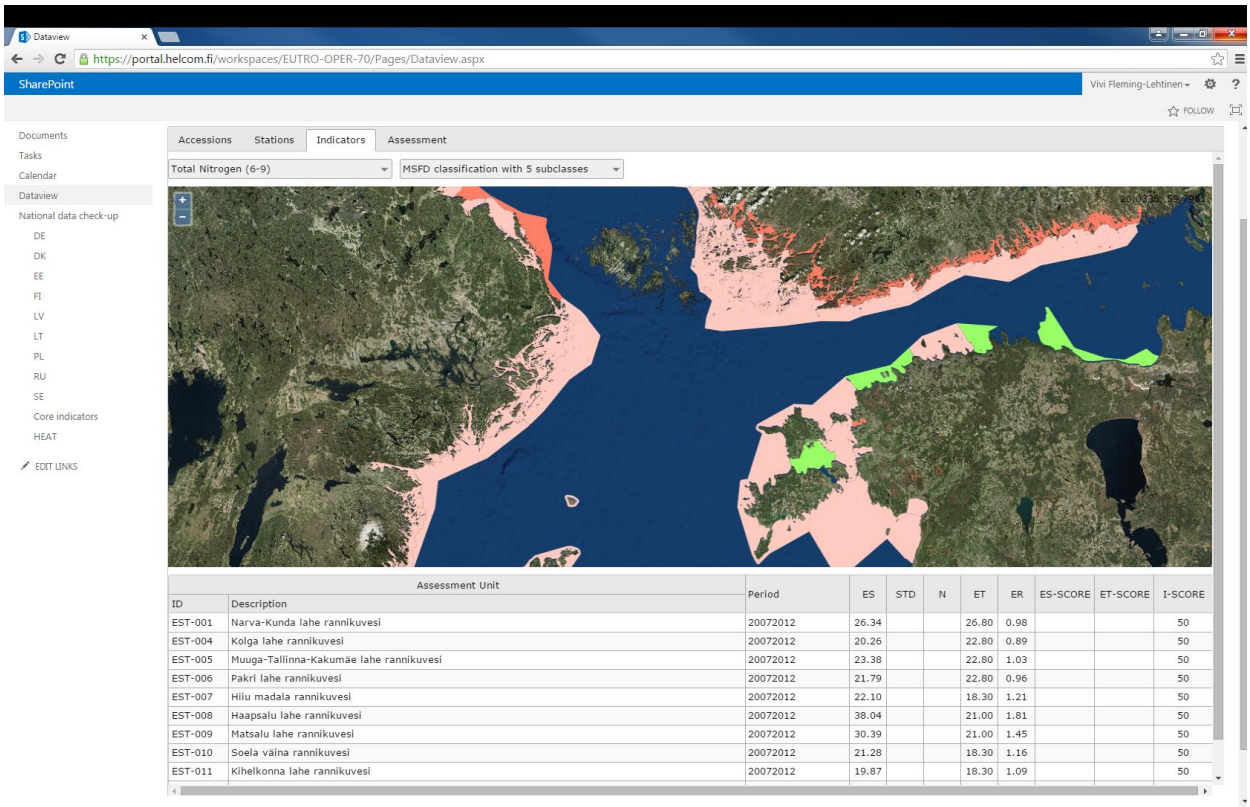
- if extra/double observations are found: In ***National check-up***, on line ***No removable observations***, tick 'Yes' for *Exceptions*, and mention platform, assessment unit and year under *Description of exceptions*

3. Check that there are no missing parameters in the observations
   - for at least five station visits on each of your national platforms, check that all the monitored parameters are assigned a value
   - for at least one of the parameters on these station visits, check that the value is correct
   - if missing rows/parameters or faulty values are found: In ***National check-up***, on line ***No missing parameters in an observation***, tick 'Yes' for *Exceptions*, and mention parameters under *Description of Exceptions*

4. If any missing / extra / faulty station visits or observations were found, submit the corrected data to ICES using the guidelines http://ocean.ices.dk/submission

Review of coastal indicators

Review item: coastal indicators used in WFD, reported by Contracting Parties, to be used in HEAT assessment for coastal assessment units; find data at workspace dataview (https://portal.helcom.fi/workspaces/EUTRO-OPER-70/default.aspx), data leaf 'Indicators'. In the upper left, you may choose the indicator (time-of year in brackets) to be displayed in the map and table below (Fig. 2A.2).



Assessment Unit		Period	ES	STD	N	ET	ER	ES-SCORE	ET-SCORE	I-SCORE
ID	Description									
EST-001	Narva-Kunda lahe rannikuvesi	20072012	26.34			26.80	0.98			50
EST-004	Kolga lahe rannikuvesi	20072012	20.26			22.80	0.89			50
EST-005	Muuga-Tallinna-Kakumäe lahe rannikuvesi	20072012	23.38			22.80	1.03			50
EST-006	Pakri lahe rannikuvesi	20072012	21.79			22.80	0.96			50
EST-007	Hiiu madala rannikuvesi	20072012	22.10			18.30	1.21			50
EST-008	Haapsalu lahe rannikuvesi	20072012	38.04			21.00	1.81			50
EST-009	Matsalu lahe rannikuvesi	20072012	30.39			21.00	1.45			50
EST-010	Soela väina rannikuvesi	20072012	21.28			18.30	1.16			50
EST-011	Kihelkonna lahe rannikuvesi	20072012	19.87			18.30	1.09			50

Figure 2A.2. The indicator view, showing the coastal indicator Total Nitrogen as example.

Review responsibility: national experts (see table below)

Review page: National data check-up, under page for specific contracting party (see table below); use rows specified for 'Coatal indicator review'.

Action	Responsible expert/institute	Review reported at
Review of coastal indicators reported by DE	DE-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/DE.aspx
Review of coastal indicators reported by DK	DK-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/DK.aspx
Review of coastal indicators reported by EE	EE-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/EE.aspx
Review of coastal indicators reported by FI	FI-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/FI.aspx
Review of coastal indicators reported by LV	LV-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/LV.aspx
Review of coastal indicators reported by LT	LT S&C-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/LT.aspx
Review of coastal indicators reported by PL	PL-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/PL.aspx
Review of coastal indicators reported by RU	RU S&C-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/RU.aspx
Review coastal indicators reported by SE	SE-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/SE.aspx

The following protocol should be done for the coastal assessment units of your contracting party; use filtering option on Assessment Unit ID, use 'Show row where' → contains [country part of ID]. The manual is constructed so, that checking should be done in order from point 1 to 7. You may do the checking either in the workspace, or after downloading the entire indicator data. After downloading the dataset, you may use any software you find best suitable (ODV, Excel, etc).

1. All coastal units are represented and assigned with the indicators relevant for them
   - to have an overview: zoom in the map and check that all coastal assessment units for your country are colored
   - for each national coastal indicator, check that it has the right number of assessment units
   - for at least one national coastal indicator, check that it has each assessment unit
   - for at least national coastal indicator, check that no assessment unit occurs twice
   - if missing assessment units are found: In ***National check-up***, on line ***All coastal units are represented and assigned with the indicators relevant for them***, tick 'Yes' for *Exceptions*, and describe briefly the findings under *Description of Exceptions*

2. All indicators are represented and assigned with ES, ET and ER in the relevant assessment units
   - for each coastal indicator, check that all assessment units listed have a value for ES, ET and ER
   - if a value is missing, check whether a value has actually been reported
   - if missing values are found: In ***National check-up***, on line ***All indicators are represented and assigned with ES, ET and ER in the relevant assessment units***, tick 'Yes' for *Exceptions*, and list the indicators with missing values under *Description of Exceptions*

3. Accuracy of ES values
   - for each coastal indicator, check the accuracy of at least two ES values in different assessment units
   - if one ES value is wrong, check also all the other ES values for the indicator in question
   - if faulty values are found: In ***National check-up***, on line ***Accuracy of ES values***, tick 'Yes' for *Exceptions*, and list the indicators with missing values under *Description of Exceptions*

4. Accuracy of ET values
   - for each coastal indicator, check the accuracy of at least two ES values in different assessment units
   - if one ES value is wrong, check also all the other ES values for the indicator in question
   - if faulty values are found: In ***National check-up***, on line ***Accuracy of ET values***, tick 'Yes' for *Exceptions*, and list the indicators with missing values under *Description of Exceptions*

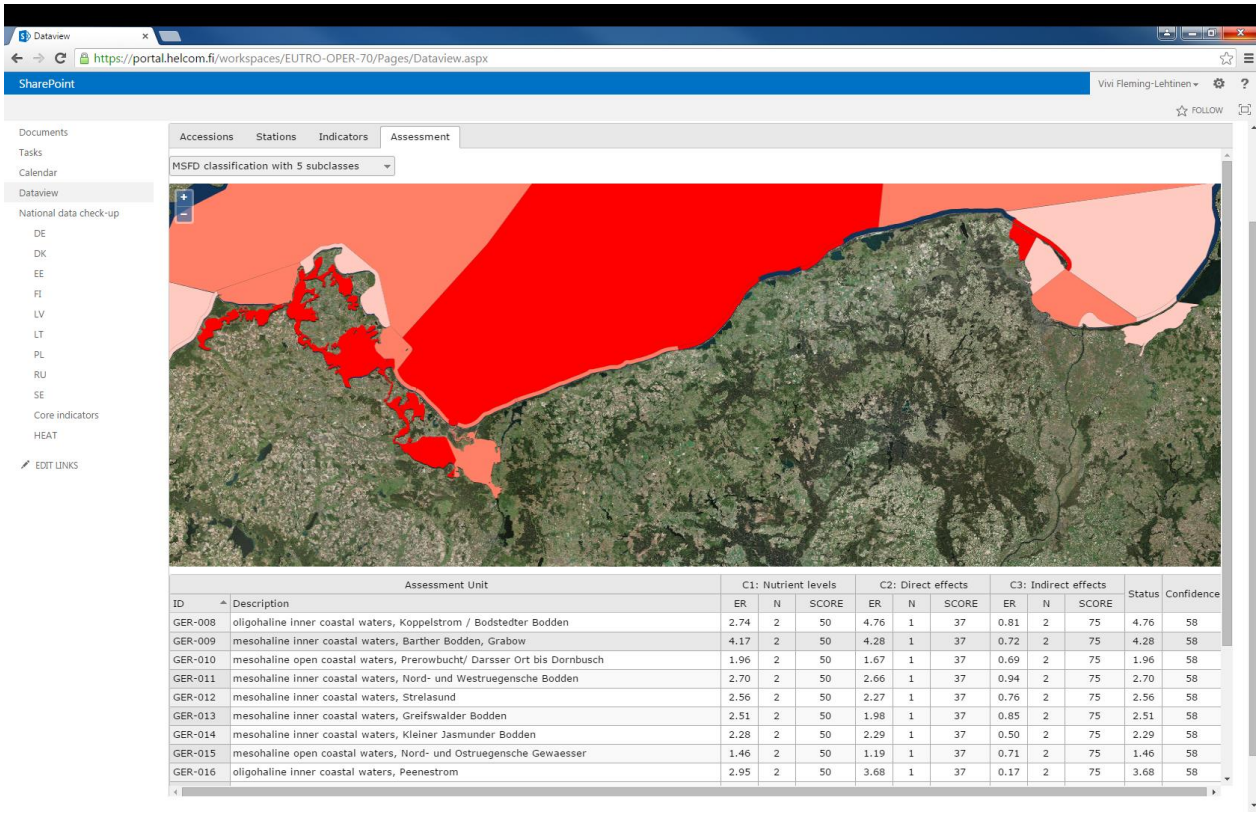
5. Accuracy of ER calculation
   - for overview, zoom in the map and for each coastal indicator, look for any obviously wrong values (use MSFD classification with 10 subclasses when doing this)
   - for each coastal indicator, check the accuracy of at least two ET values in different assessment units
   - if one ES value is wrong, check also all the other ES values for the indicator in question
   - if faulty values are found: In ***National check-up***, on line ***Accuracy of ET values***, tick 'Yes' for *Exceptions*, and list the indicators with missing values under *Description of Exceptions*

6. Accuracy of map
   - for at least one indicator, zoom in the map and check that your assessment unit boundaries appear right
   - if mistakes are found: In ***National check-up***, on line ***Accuracy of map***, tick 'Yes' for *Exceptions*, and describe the findings in *Description of Exceptions*

7. If any missing / extra rows were found, submit the corrected data to ICES, using the EUTRO-OPER '*Questionnaire national WFD indicators_*' assigned for each contracting party. The templates may be found at the data reporting workspace under 'documents' (https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Shared%20Documents/Forms/AllItems.aspx).

Review of coastal HEAT assessment

Review item: HEAT assessment for coastal assessment units; find data at workspace dataview (https://portal.helcom.fi/workspaces/EUTRO-OPER-70/default.aspx), data leaf 'Assessment' (Fig. 2A.3).



Assessment Unit		C1: Nutrient levels			C2: Direct effects			C3: Indirect effects			Status	Confidence
ID	Description	ER	N	SCORE	ER	N	SCORE	ER	N	SCORE		
GER-008	oligohaline inner coastal waters, Koppelstrom / Bodstedter Bodden	2.74	2	50	4.76	1	37	0.81	2	75	4.76	58
GER-009	mesohaline inner coastal waters, Barther Bodden, Grabow	4.17	2	50	4.28	1	37	0.72	2	75	4.28	58
GER-010	mesohaline open coastal waters, Prerowbucht/ Darsser Ort bis Dornbusch	1.96	2	50	1.67	1	37	0.69	2	75	1.96	58
GER-011	mesohaline inner coastal waters, Nord- und Westruegensche Bodden	2.70	2	50	2.66	1	37	0.94	2	75	2.70	58
GER-012	mesohaline inner coastal waters, Strelasund	2.56	2	50	2.27	1	37	0.76	2	75	2.56	58
GER-013	mesohaline inner coastal waters, Greifswalder Bodden	2.51	2	50	1.98	1	37	0.85	2	75	2.51	58
GER-014	mesohaline inner coastal waters, Kleiner Jasmunder Bodden	2.28	2	50	2.29	1	37	0.50	2	75	2.29	58
GER-015	mesohaline open coastal waters, Nord- und Ostruegensche Gewaesser	1.46	2	50	1.19	1	37	0.71	2	75	1.46	58
GER-016	oligohaline inner coastal waters, Peenestrom	2.95	2	50	3.68	1	37	0.17	2	75	3.68	58

Figure 2A.3. The Assessment view, showing an area in the southern Baltic Sea as an example.

Review responsibility: national experts (see table below)

Review page: National data check-up, under page for specific contracting party (see table below); use rows specified for 'Coastal indicator review'.

Action	Responsible expert/institute	Review reported at
Review of coastal indicators reported by DE	DE-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/DE.aspx
Review of coastal indicators reported by DK	DK-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/DK.aspx
Review of coastal indicators reported by EE	EE-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/EE.aspx
Review of coastal indicators reported by FI	FI-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/FI.aspx
Review of coastal indicators reported by LV	LV-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/LV.aspx
Review of coastal indicators reported by LT	LT S&C-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/LT.aspx
Review of coastal indicators reported by PL	PL-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/PL.aspx

Review of coastal indicators reported by RU	RU S&C-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/RU.aspx
Review coastal indicators exported by SE	SE-EUTRO-contact	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/SE.aspx

The following protocol should be done for the coastal assessment units of your contracting party; use filtering option on Assessment Unit ID, use 'Show row where' → contains [country part of ID]. The manual is constructed so, that checking should be done in order from point 1 to 5. You may do the checking either in the workspace, or after downloading the entire indicator data.

1. All coastal assessment units are assigned with a HEAT assessment
   - for overview, zoom in the map and check that all coastal assessment units that should have an assessment value are colored
   - check that the number of coastal assessment units is correct
   - For each criteria, check that all assessment units that should have values are assigned with ER, N, SCORE
   - if missing values are found: In ***National check-up***, on line ***All coastal assessment units are assigned with a HEAT assessment***, tick 'Yes' for *Exceptions*, and list the assessment units with missing values under *Description of Exceptions*

2. Accuracy of N value
   - for at least five assessment units, check that the number of indicators used (N) under each criteria is correct
   - for information on how indicators are to be assigned to criteria, please check the 'Eutrophication assessment manual' under chapter 1.3.4.. (https://portal.helcom.fi/workspaces/EUTRO-OPER-66/default.aspx)
   - if one N value is wrong, you may proceed to check the other N values in the same assessment unit
   - if faulty values are found: In ***National check-up***, on line ***Accuracy of N values***, tick 'Yes' for *Exceptions*, and list the indicators with missing values under *Description of Exceptions*

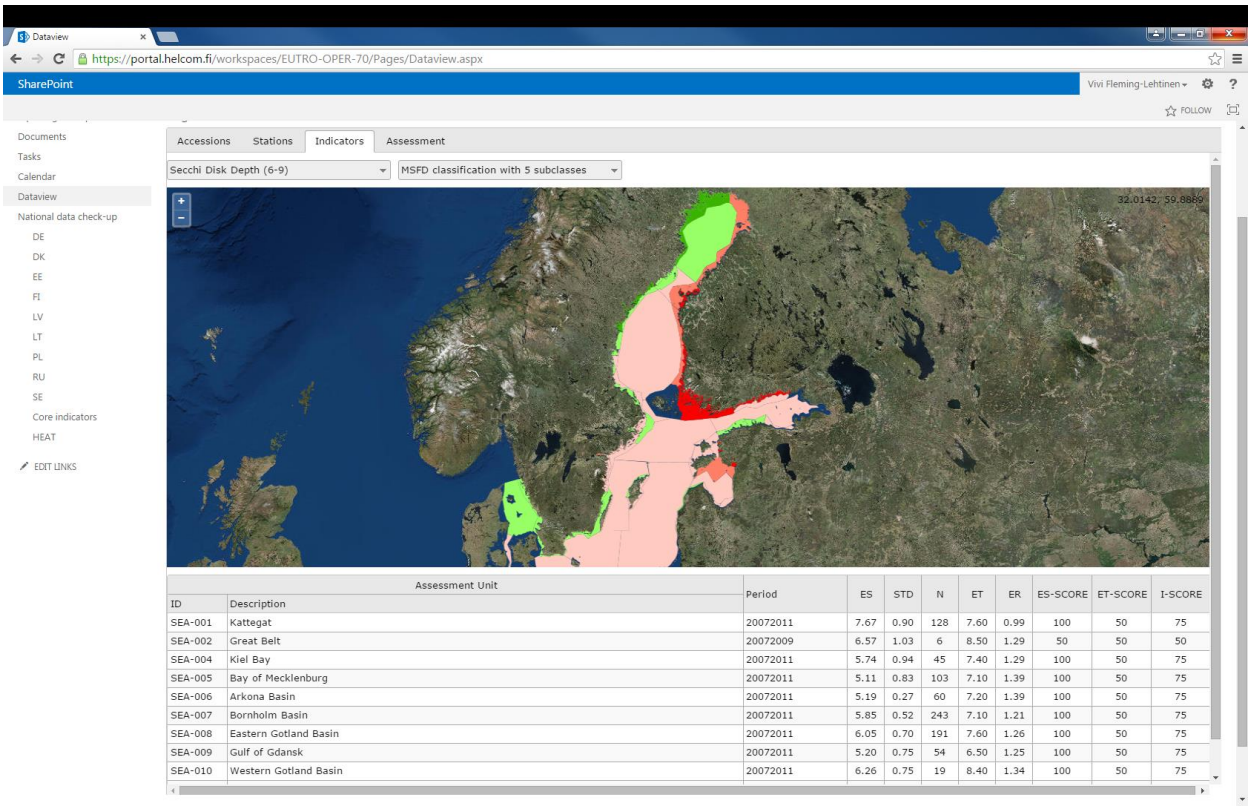
3. Accuracy of ER value
   - for at least two assessment units, check that ER is the average of the ER of the indicators assigned to the assessment unit, under that specific criteria
   - for information on how indicators are to be assigned to criteria, please check the 'Eutrophication assessment manual' under chapter 1.3.4.. (https://portal.helcom.fi/workspaces/EUTRO-OPER-66/default.aspx)
   - if faulty values are found: In ***National check-up***, on line ***Accuracy of ER values***, tick 'Yes' for *Exceptions*, and list the indicators with missing values under *Description of Exceptions*

4. Accuracy of Status value
   - follow same instructions as for ER
   - if faulty values are found: In ***National check-up***, on line ***Accuracy of Status values***, tick 'Yes' for *Exceptions*, and list the indicators with missing values under *Description of Exceptions*

5. Accuracy of map
   - zoom in the map and check that your assessment unit boundaries appear right
   - if mistakes are found: In ***National check-up***, on line ***Accuracy of map***, tick 'Yes' for *Exceptions*, and describe the findings in *Description of Exceptions*

Review of open-sea core indicators

Review item: open-sea core indicators, calculated at the eutrophication assessment database, to be used in HEAT assessment for coastal assessment units; find data at workspace dataview (https://portal.helcom.fi/workspaces/EUTRO-OPER-70/default.aspx), data leaf 'Indicators' (Fig. A2.4).



Assessment Unit		Period	ES	STD	N	ET	ER	ES-SCORE	ET-SCORE	I-SCORE
ID	Description									
SEA-001	Kattegat	20072011	7.67	0.90	128	7.60	0.99	100	50	75
SEA-002	Great Belt	20072009	6.57	1.03	6	8.50	1.29	50	50	50
SEA-004	Kiel Bay	20072011	5.74	0.94	45	7.40	1.29	100	50	75
SEA-005	Bay of Mecklenburg	20072011	5.11	0.83	103	7.10	1.39	100	50	75
SEA-006	Arkona Basin	20072011	5.19	0.27	60	7.20	1.39	100	50	75
SEA-007	Bornholm Basin	20072011	5.85	0.52	243	7.10	1.21	100	50	75
SEA-008	Eastern Gotland Basin	20072011	6.05	0.70	191	7.60	1.26	100	50	75
SEA-009	Gulf of Gdansk	20072011	5.20	0.75	54	6.50	1.25	100	50	75
SEA-010	Western Gotland Basin	20072011	6.26	0.75	19	8.40	1.34	100	50	75

Figure 2A.4. The indicator view, showing core indicator Secchi depth as an example.

Review responsibility: specifically assigned expert for each core indicator (see table below and instructions), with optional comments from national with optional comments from national experts, to be submitted at the Core indicator review page (https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/Core-indicators.aspx) by the commenting dead-line (for EUTRO-OPER test assessment, 31.10.).

Review page: National data check-up, under page for 'Core indicators' (see table below).

Action	Responsible expert/institute	Review reported at
Review of open-sea core indicator DIN	EUTRO DIN responsible: IOW	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/Core-indicators.aspx
Review of open-sea core indicator DIP	EUTRO DIP responsible: IOW	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/Core-indicators.aspx
Review of open-sea core indicator chla	EUTRO chla responsible: SYKE	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/Core-indicators.aspx
Review of open-sea core indicator Secchi	EUTRO Secchi responsible: SYKE	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/Core-indicators.aspx
Review of open-sea core indicator oxygen debt	EUTRO oxygen responsible: SMHI	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/Core-indicators.aspx

The following protocol should be done only for the core indicator you have been assigned responsibility for. Use the upper left drop-down bar to choose the right indicator (months in brackets). The manual is constructed so, that checking should be done in order from point 1 to 10. You may do the checking either in the workspace, or after downloading the entire dataset.

1. All assessment units where indicator is applicable are assigned values for ES, STD, N, ET, ER, ES-SCORE, I-SCORE
   - for overview, zoom in the map and check that all open-sea assessment units that should have an indicator value are colored
   - check that the indicator has the right number open-sea assessment units (SEA-xxx) listed (for the indicators applicable in all open-sea units, the correct number is 17)
   - check that all assessment units listed have a value for ES, STD, N, ET, ER, ES-SCORE and I-SCORE
   - if missing values are found: In ***National check-up***, on line ***All assessment units where indicator is applicable are assigned values for ES, STD, N, ET, ER, ES-SCORE, I-SCORE***, tick 'Yes' for *Exceptions*, and list the assessment units with missing values under *Description of Exceptions*

2. Accuracy of ES value
   - for each of the five assessment years (in EUTRO-OPER test-assessment years 2007-2011), check the accuracy of at least two annual ES values in different assessment units; the checking should be done:
     - against average value of indicator observations (obs. use correct depth and assessment months), calculated from the observation data which can be downloaded from Stations-sheet
     - for EUTRO-OPER test assessment, check against previous assessment published in BSEP143
   - if one ES value is wrong, you may proceed to check the other ES values
   - check for any general comments posted under general check-up comments at the Core Indicator review page (https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/Core-indicators.aspx) after dead-line for commenting (in EUTRO-OPER test-assessment 31.10.), and take these remarks into consideration when you are doing your review
   - if faulty values are found: In ***National check-up***, on line ***Accuracy of ES values***, tick 'Yes' for *Exceptions*, and list the indicators with missing values under *Description of Exceptions*

3. Accuracy of STD
   - follow same instructions as for ES, except that checking at least one annual value is sufficient

4. Accuracy of N
   - follow same instructions as for ES, except that checking at least one annual value is sufficient

5. Accuracy of ET value
   - follow same instructions as for ES, except that checking is done against table of GES-boundaries published in BSEP 143

6. Accuracy of ER calculation
   - follow same instructions as for ES, except that checking is done
     - against ER calculated from ES and ET as reported in the indicator sheet, according to instructions published in BSEP143
     - for EUTRO-OPER test assessment, against previous assessment published in BSEP143

7. Accuracy of ES-Score
   - follow same instructions as for ES
   - for estimating ES score based on availability of monitoring data, use instructions published in BSEP 143

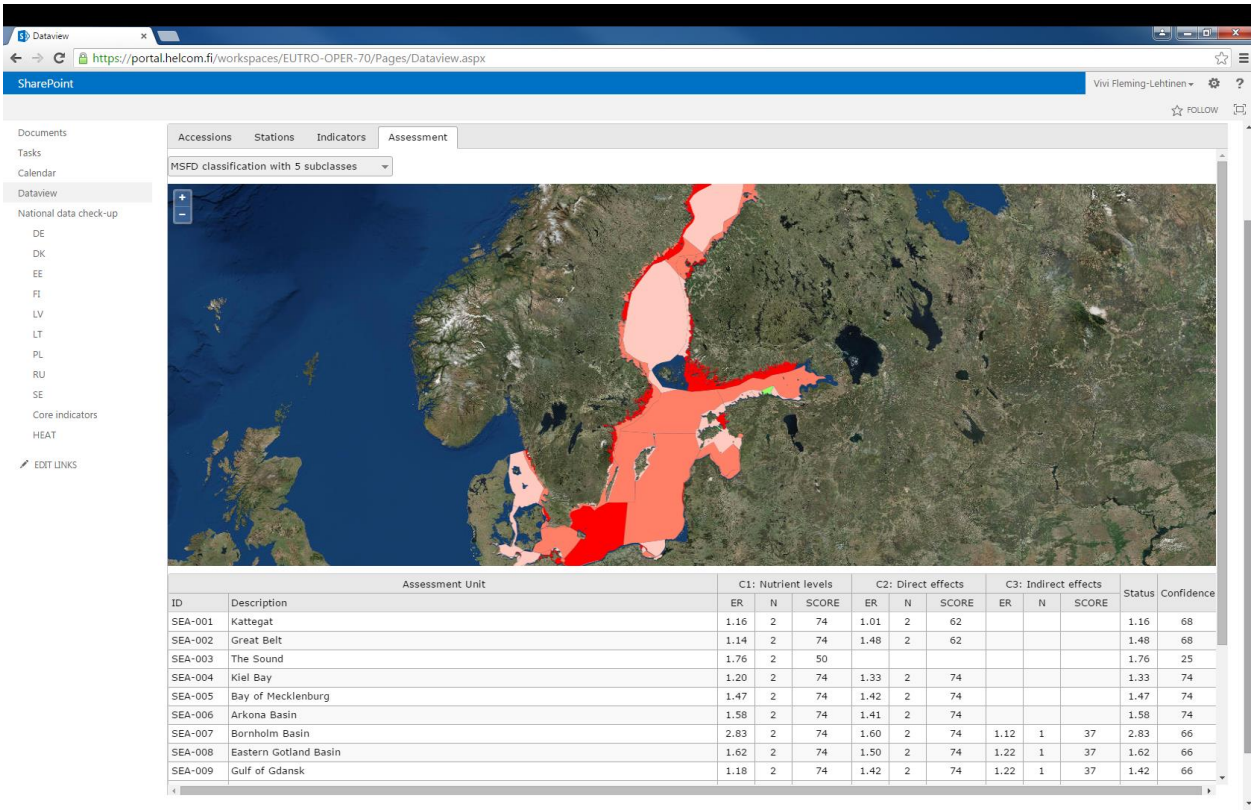
8. Accuracy of ET-Score
   - follow same instructions as for ES, except that checking is done against table of GES-boundaries published in BSEP 143

9. Accuracy of I-Score calculation
   - follow same instructions as for ES, except that checking is done
     - against I-Score calculated from ES-Score and ET-Score reported in the indicator sheet, according to instructions published in BSEP143
     - for EUTRO-OPER test assessment, against previous assessment published in BSEP143

10. Accuracy of map
    - zoom in the map and check that your assessment unit boundaries appear right
    - if mistakes are found: In ***National check-up***, on line ***Accuracy of map***, tick 'Yes' for *Exceptions*, and describe the findings in *Description of Exceptions*

Review of open-sea HEAT assessment

Review item: open-sea HEAT assessment, calculated at the eutrophication assessment database; find data at workspace dataview (https://portal.helcom.fi/workspaces/EUTRO-OPER-70/default.aspx), data leaf 'Assessment'.



Assessment Unit		C1: Nutrient levels			C2: Direct effects			C3: Indirect effects			Status	Confidence
ID	Description	ER	N	SCORE	ER	N	SCORE	ER	N	SCORE		
SEA-001	Kattegat	1.16	2	74	1.01	2	62				1.16	68
SEA-002	Great Belt	1.14	2	74	1.48	2	62				1.48	68
SEA-003	The Sound	1.76	2	50							1.76	25
SEA-004	Kiel Bay	1.20	2	74	1.33	2	74				1.33	74
SEA-005	Bay of Mecklenburg	1.47	2	74	1.42	2	74				1.47	74
SEA-006	Arkona Basin	1.58	2	74	1.41	2	74				1.58	74
SEA-007	Bornholm Basin	2.83	2	74	1.60	2	74	1.12	1	37	2.83	66
SEA-008	Eastern Gotland Basin	1.62	2	74	1.50	2	74	1.22	1	37	1.62	66
SEA-009	Gulf of Gdansk	1.18	2	74	1.42	2	74	1.22	1	37	1.42	66

Figure 2A.5. The assessment view, showing entire Baltic Sea.

Review responsibility: specifically assigned expert for HEAT (see table below and instructions), with optional comments from national experts, to be submitted at the Core indicator review page (https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/Core-indicators.aspx) by the commenting deadline (for EUTRO-OPER test assessment, 31.10.).

Review page: National data check-up, under page for 'HEAT'.

Action	**Responsible expert/institute**	**Review reported at**
Review of HEAT assessment	EUTRO expert network, HELCOM Secretariat	https://portal.helcom.fi/workspaces/EUTRO-OPER-70/Pages/HEAT.aspx

The following protocol should be done for the assessment results. The manual is constructed so, that checking should be done in order from point 1 to 7. You may do the checking either in the workspace, or after downloading the entire dataset.

1. All open-sea assessment units are assigned with a HEAT assessment
   - for overview, zoom in the map and check that all open sea assessment units that should have an indicator value are colored
   - check that the assessment has the right number of open-sea assessment units (17)
   - For each criteria, check that all assessment units that should have values are assigned with ER, N, SCORE
   - if missing values are found: In ***National check-up***, on line ***All open-sea assessment units are assigned with a HEAT assessment***, tick 'Yes' for *Exceptions*, and list the assessment units with missing values under *Description of Exceptions*

2. Accuracy of N value
   - for at least five assessment units, check that the number of indicators used (N) under each criteria is correct
   - for information on how indicators are to be assigned to criteria, please check the 'Eutrophication assessment manual' under chapter 1.3.4.. (https://portal.helcom.fi/workspaces/EUTRO-OPER-66/default.aspx)
   - if one N value is wrong, you may proceed to check the other N values in the same assessment unit
   - if faulty values are found: In ***National check-up***, on line ***Accuracy of N values***, tick 'Yes' for *Exceptions*, and list the indicators with missing values under *Description of Exceptions*

3. Accuracy of ER value
   - for at least two assessment units, check that ER is the average of the ER of the indicators assigned to the assessment unit, under that specific criteria
   - for information on how indicators are to be assigned to criteria, please check the 'Eutrophication assessment manual' under chapter 1.3.4.. (https://portal.helcom.fi/workspaces/EUTRO-OPER-66/default.aspx)
   - if faulty values are found: In ***National check-up***, on line ***Accuracy of ER values***, tick 'Yes' for *Exceptions*, and list the indicators with missing values under *Description of Exceptions*

4. Accuracy of SCORE value
   - follow same instructions as for ER
   - if faulty values are found: In ***National check-up***, on line ***Accuracy of SCORE values***, tick 'Yes' for *Exceptions*, and list the indicators with missing values under *Description of Exceptions*

5. Accuracy of Status value
   - follow same instructions as for ER
   - if faulty values are found: In ***National check-up***, on line ***Accuracy of STATUS values***, tick 'Yes' for *Exceptions*, and list the indicators with missing values under *Description of Exceptions*

6. Accuracy of Confidence value
   - for at least two assessment units, check that Confidence is the average of criteria-specific SCORE values in that specific assessment unit
   - for closer information on confidence is assigned, please check the 'Eutrophication assessment manual' under chapter 1.3.4.. (https://portal.helcom.fi/workspaces/EUTRO-OPER-66/default.aspx)
   - if faulty values are found: In ***National check-up***, on line ***Accuracy of ER values***, tick 'Yes' for *Exceptions*, and list the indicators with missing values under *Description of Exceptions*

7. Accuracy of map
   - zoom in the map and check that your assessment unit boundaries appear right
   - if mistakes are found: In ***National check-up***, on line ***Accuracy of map***, tick 'Yes' for *Exceptions*, and describe the findings in *Description of Exceptions*

ANNEX 3A: ICES QA/QC guidelines for discrete water sample data

(Compiled by ICES December 1999, revised August 2001; June 2006)

In the context of this guideline, discrete water sample data are considered to be any data that result from a single collection of water and so covers a huge variety of parameters. This collection of water must have a specific, identifiable time, position and depth. Such data could originate from a single bottle attached to a rosette or water drawn from a non-toxic supply.

No integrated samples are considered as part of discrete water sample data. Thus, tows that result in integrated data values are not considered in discrete water sample data. Nor are integrated samples from a pumping system or sediment trap.

Receiving Data

The Data Centres require the following information to be supplied by the data supplier together with the data. When receiving data, the Data Centres of the ICES community shall strive to meet the following guidelines.

Data standard

All parameters must be clearly specified and described. If parameter codes are to be used, then the source data dictionary consistency must be specified. Parameter units must be clearly stated. Parameter scales must be noted where applicable. If computed values are included, the equations used in the computations should be stated.

The data should be fully checked for quality and pre-edited or flagged for erroneous values. An explicit statement should be made of the checks and edits applied to the data.

A brief description, or a reference to the data collection and processing methods (e.g. reference to a specific technique or specific project protocols) must be included and should contain information regarding:

- Describe or reference full laboratory methods and procedures
- If sample was sent out for analysis, give laboratory name and accreditation level Describe or reference any internal or external quality assurance procedures (e.g. QUASIMEME, IAPSO)

A brief description of the data processing procedures must be included and should contain information regarding:

- editing/quality control methods
- how are trace values (values below the detection limit) identified
- how are missing values handled (null vs. zero, or “blanks”)
- what is the precision of the methods (e.g. number of significant figures)
- what analyses has been performed (use parameters descriptions as described in the ICES green book)
- what units are used
- whether any duplicate samples were taken
- describe what quality flags are used if any
- comments describing each station
- supply a calibration document

If a cruise/data report is available describing the data collection and processing, this can be referenced. If possible a copy should be supplied with the data.

Format description

Data should be supplied in a fully documented ASCII format. Data Centres are capable of handling water sample data in a wide variety of user-defined and project formats. If in doubt about the suitability of any particular format, advice from the Data Centre should be sought.

Individual fields, units, etc. should be clearly defined and time zone stated. Time reported in UTC is strongly recommended. Ideally all of the data from the single water source should be stored in a single file. The contents of the data and ancillary information should adhere to the

Formatting Guidelines for Oceanographic Data Exchange

(http://ocean.ices.dk/formats/GETADE_Guidelines.aspx) prepared by the IOC's Group of Experts on the Technical Aspects of Data Exchange (GETADE) and available from RNODC Formats.

Often different groups or laboratories will analyse a single water sample for a multitude of parameters. In such cases, it is common for the data from the different groups to arrive at the data centre at different times. The receiving data centre may merge those data from a single water source. Thus it is crucial that the date/time, position and sample identifier accompany the data.

Collection Details

Pertinent information to be included in the data transfer to the Data Centre includes:

- Project, platform, cruise identifier
- Country, organisation, institute, PI
- Station number, site details, sample identifier (or bottle number),), type of station (CTD, CTD(NMMP), continuous flow etc.,
- Analyses performed e.g. salinity and nutrients
- Date and time of the start of the sampling and date of analysis (UTC is recommended) Position (latitude and longitude degrees and minutes or decimal degrees can be used. Explicitly state which format is being used. It is recommended that N, S, E and W labels are used instead of plus and minus signs.)
- Description of operational procedures including (where applicable) sampling rate, detection limits, standard analytic procedures, calibration of equipment, quality control of original data, methods of position fixing (e.g. GPS, DGPS)
- Details of the collection instrument and sensor (e.g. manufacturer, model number, serial number, and sampling rate)
- Sounding (station depth and sample depth) should be included for each station. The method and assumptions of determining the sounding should be included.
- Type of analyses undertaken including any nutrient samples analysed
- Range of data values (desirable)

Any additional information of use to secondary users which may have affected the data or have a bearing on its subsequent use.

For additional information on quality control procedures, metadata requirements for particular parameters and collection instrumentation, see UNESCO (1996).

Value Added Service

When processing and quality controlling data, the Data Centres of the ICES community shall strive to meet the following guidelines.

Quality Control

A range of checks are carried out on the data to ensure that they have been imported into the Data Centre's format correctly and without any loss of information. For discrete water sample data, these should include:

- Check header details (vessel, cruise number, station numbers, date/time, latitude/longitude (start and end), instrument number and type, station depth, cast (up and down) data type /no. of data points, platform identifier)
- Plot station positions to check not on land
- Check ship speed between stations to look for incorrect position or date/time
- Automatic range checking of each parameter (e.g. WOD 1998, Maillard 2000)
- Check units of parameters supplied
- Check pressure increasing or decreasing as appropriate
- Check no data points below bottom depth
- Check depths against echo sounder
- Plot profiles (individually, in groups, etc)
- Check for spikes
- Check for vertical stability/inversions
- Check profiles vs. regional climatology
- Check calibration information available
- Compare parameters for predictable relationships (e.g. parameter ratios) Check for consecutive constant values
- Duplicate detection when comparing to archived data
- Flag suspicious data or correct after consultation with Principal Investigator (PI)

Problem Resolution

The quality control procedures followed by the Data Centres will typically identify problems with the data and/or metadata. The Data Centre will resolve these problems through consultation with the originating PI or data supplier. Other experts in the field or other Data Centres may also be consulted.

History Documentation

All quality control procedures applied to a dataset are fully documented by the Data Centre. As well, all quality control applied to a dataset should accompany that dataset. All problems and resulting resolutions will also be documented with the aim to help all parties involved; the Collectors, Data Centre, and Users. A history record will be produced detailing any data changes (including dates of the changes) that the Data Centre may make.

Request for Support

When addressing a request for information and/or data from the User Community, the Data Centres of the ICES community shall strive to provide well-defined data and products. To meet this objective, the Data Centres will follow these guidelines.

Data Description

The Data Centre shall aim to provide to its clients well-defined data or products. If digital data are provided, the Data Centre will provide sufficient self-explanatory series header information and documentation to accompany the data so that they are adequately qualified and can be used with confidence by scientists/engineers other than those responsible for their original collection, processing and quality control. This is described in more detail below:

- A data format description fully detailing the format in which the data will be supplied

- Parameter and unit definitions, and scales of reference
- Definition of additional quality control
- Flagging scheme, if flags are used
- Data history document (as described in 3.2 below)
- Accompanying data (e.g. CTD data at the time of bottle trip)

Data History

A data history document will be supplied with the data to include the following:

- A description of data collection and processing procedures as supplied by the data collector (as specified in Section 1.1 and 1.3)
- Quality control procedures used to check the data (as specified in Section 2.1)
- Any problems encountered with the data and their resolution and modification date
- Any changes made to the data and dates of these changes

Any additional information of use to secondary users which may have affected the data or have a bearing on its subsequent use should also be included.

Referral Service

ICES member research and operational data centres produce a variety of data analysis products and referral services. By dividing ocean areas into regions of responsibility, and by developing mutually agreed guidelines on the format, data quality and content of the products, better coverage is obtained. By having the scientific experts work in ocean areas with which they are familiar, the necessary local knowledge finds its way into the products. Data and information products are disseminated as widely as possible and via a number of media including mail, electronic mail and bulletin boards.

If the Data Centre is unable to fulfil the client's needs, it will endeavour to provide the client with the name of an organisation and/or person who may be able to assist. In particular, assistance from the network of Data Centres within the ICES Community will be sought.

REFERENCES

Maillard, C. And M. Fichaut. 2000. Medar-Medatlas Protocol, Part I : Exchange Format And Quality Checks For Observed Profiles, IFREMER, June 2000 - R.INT.TMSI/IDM/SISMER/SIS00-084.

UNESCO. 1996. IOC-EU-BSH-NOAA-(WDC-A). International Workshop on Oceanographic Biological and Chemical Data Management Hamburg, Germany 20-23 May 1996, IOC Workshop Report 122.

WOD, 1998. World Ocean Database, Documentation and Quality Control, Version 2, Silver Spring, MD, December 1999.

ANNEX 3B: QA/QC guidelines for EO-based information

In this guideline, EO-based information is considered to be any information derived from satellite images for the use of updating indicators. The observations are in validated form, and may be aggregated temporally and spatially to a specific level.

The data must include a distinct time and position information. In the case of aggregated information, these may represent average values and start and end date of the aggregation period.

Basic requirements of EO-data for use in HELCOM eutrophication assessment

EO-data (Earth Observation, i.e. remote sensing) used in the HELCOM eutrophication assessment and submitted to the eutrophication assessment database must fulfil the following basic requirements.

Data are validated aggregated estimates of a chlorophyll-a estimated using EO data (reflectances). The validation must be based on in-situ monitoring data (ICES). The data submittor is responsible for quality control procedures as described below (value added services), since the database holder will not go through such procedures after receiving the data. These requirements have been described especially for EO chlorophyll-a data but apply also for other parameters such as Secchi disk depth in the future.

The data product may be aggregated at two alternative levels:

1) Large scale
- spatial: HELCOM assessment unit, following the HELCOM sub-division into 17 open sub-basins and 42 coastal areas (shapefile may be retrieved at www.helcom.fi)
- temporal: annual assessment period (eg. summer months)

2) Small scale
- spatial: HELCOM 20K grid (shapefile may be retrieved at www.helcom.fi)
- temporal: daily

On spatially aggregated grids, include statistics per day for each assessment area and 20 km sub-area (HELCOM grid)

- (arithmetic and) geometric mean
- standard deviation
- percentiles (5,25, 50, 75, 95)
- N of observations that were used to derive statistics

The spatial aggregation using HELCOM assessment units (large scale) is particularly suitable for indicator information such as cyanobacteria indicator and spring bloom indicator. The 20K grid size is suitable for chlorophyll-a and forthcoming Secchi disk depth estimates.

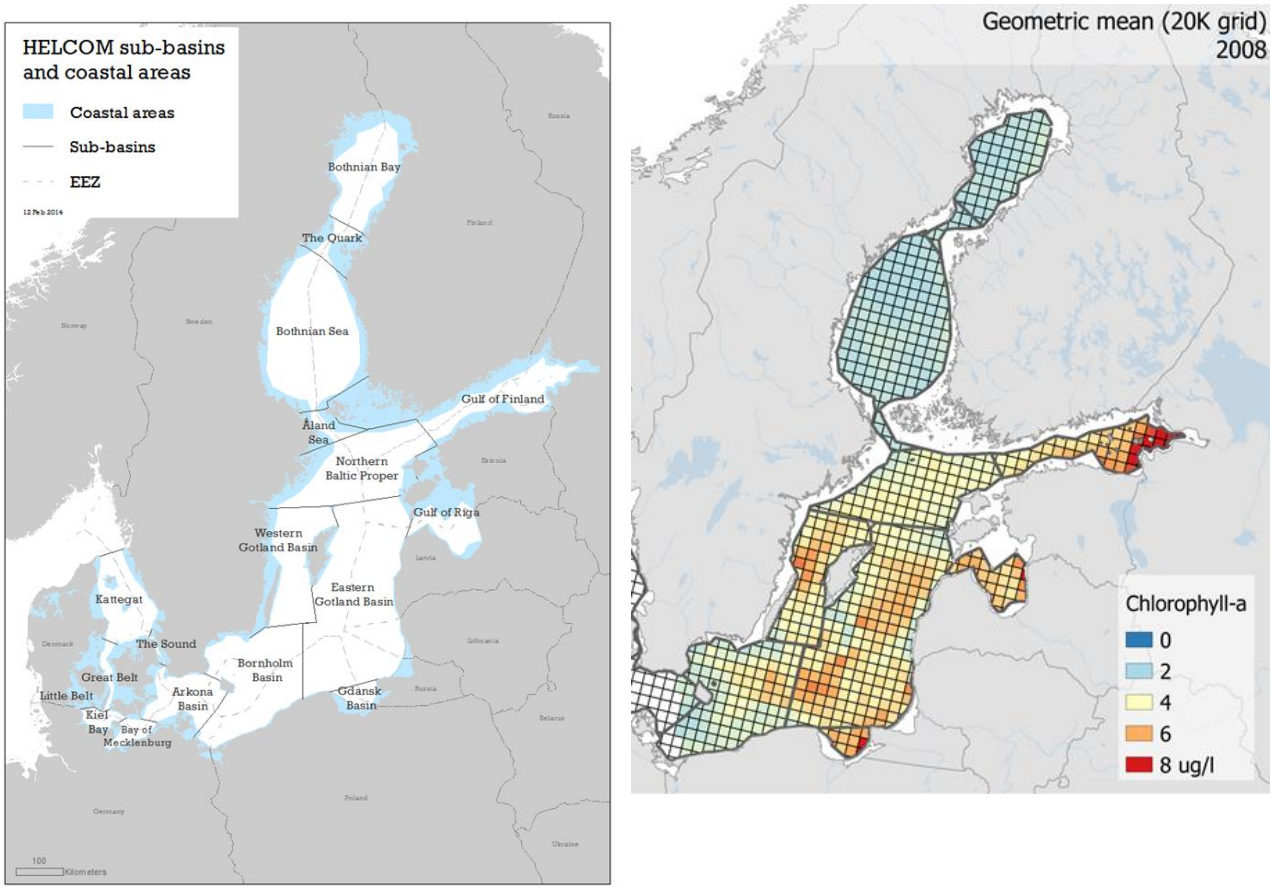


Figure 3B.1. Map illustrating the large (HELCOM assessment units, left panel) and small (HELCOM 20K grids, right panel) spatial scales.

Receiving data

The Data Centres require the following information to be supplied by the data supplier together with the data. When receiving data, the Data Centres shall strive to meet the following guidelines.

Data standard

All satellite-derived products must be clearly specified and described. If product codes are to be used, then the source data dictionary consistency must be specified (e.g. CF Metadata Convention). Product units must be clearly stated, and the algorithms used in the computations should be stated. The data should be fully checked for quality and pre-edited or flagged for erroneous values. An explicit statement should be made of the checks and edits applied to the data. A brief description, or a reference to the data collection and processing methods (e.g. reference to a specific technique or specific project protocols) must be included and should contain information regarding:

- Methods and procedures applied to the analysis of original raw data
- Methods / protocols and dataset(s) used for validation, or refer to their original source
- Internal or external quality assurance procedures (e.g. NASA, ESA protocols, QA4EO guidance[1])

A brief description of the data processing procedures must be included and should contain information regarding:

- editing/quality control methods
- how are trace values (values below the detection limit) identified
- how are missing values handled (null vs. zero, or “blanks”)
- what is the precision of the methods (e.g. number of significant figures)
- what units are used

[1] http://qa4eo.org

- describe what quality flags are used if any
- supply a validation document

If a report is available describing the data collection and processing, this can be referenced. If possible a copy should be supplied with the data.

Format description

EO data and related metadata will be provided primarily via open and standard interfaces (INSIPIRE compatible format). Data format should be documented for example NetCDF-4 or INSPIRE compliant format. If in doubt about the suitability of any particular format, advice from the Data Centre should be sought. Individual fields, units, etc. should be clearly defined and time zone stated. Time reported in UTC is used. The contents of the data and ancillary information should adhere to the convention for CF (Climate and Forecast) metadata (http://cfconventions.org) or equivalent (e.g. Copernicus Marine Service).

Collection and processing details

Pertinent information to be included in the data transfer to the Data Centre includes:

- Processing responsible: country, organisation, institute, PI
- Satellite instrument(s)
- Products derived from satellite data
- Details of the collection sensor
- Resolution of original data
- Algorithm and processing used for deriving product
- Atmospheric correction scheme and cloud masking
- Level of temporal and spatial aggregation used
    - spatial: either HELCOM assessment area or HELCOM 20 km grid
    - temporal: daily or annual assessment period
    - daily aggregation is preferred for chlorophyll-a
- Uncertainties on product estimates
- Date and time of the start and end of the sampling (UTC)
- Position estimate (latitude and longitude degrees and minutes or decimal degrees can be used. Explicitly state which format is being used. It is recommended that N, S, E and W labels are used instead of plus and minus signs.)

Any additional information of use to secondary users which may have affected the data or have a bearing on its subsequent use. For additional information on quality control procedures, metadata requirements for particular parameters and collection instrumentation, see CF Convention (http://cfconventions.org) .

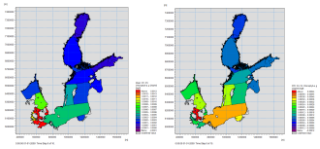
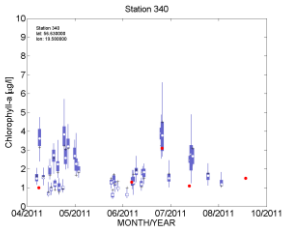
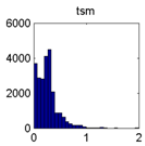
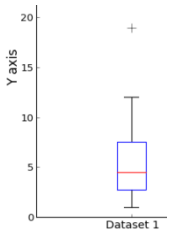
Validation details

Validation is prerequisite to ensure the distribution of quantitative data products and their subsequent application by the user community. Information on the validation process of the provided data should be able to prove the reliability and consistency of satellite-derived products. Pertinent information includes:

- Well documented validation protocol used (as an example see e.g. for ocean colour Mélin and Franz 2014 and MarCoast/CoBiOS validation protocols).
- Detailed characteristics of the validation data, i.e. match-up data sets (in case of direct comparison between satellite product and contemporaneous and co-located in-situ measurements of the same quantity)
- Use of existing database (e.g. AERONET, Zibordi et al. 2006) and especially ICES for the chlorophyll-a.
- Uncertainties associated with field observations in case these are given (e.g. ICES).

- The data used for validation, its temporal and spatial coverage must be described and the validation procedure must be described. The validation must conern the Baltic Sea region.
- Validation metrics/statistics (e.g. number of match-ups between EO and monitoring station data, scatter and systematic difference or bias between the distributions). Table 1 below gives a list of validation metrics . Table 1 is adopted from previous EU/FP7-project CoBiOS deliverable 5.3&5.7.

Table 3B.1. Table of statistical measures used to describe EO validation. Notations: n = number of observations, $\bar{X}$ = mean of variable X, σX = standard deviation of variable X, X = independent (in situ) data, Y = dependent (EO) data, E = Y - X = Error. References L09 = Lehmann et al. 2009, A07 = Allen et al. 2007. Table continued on next page.

Statistical measure	Formula	Scope	Ref.
Descriptive statistics			
Maps of dependent and independent data or and/or time series plots		**Mandatory**	
Time series on station locations		**Mandatory**	
Transects	add example here		
Frequency distributions or boxplots	 or 	Mandatory	
Scale	Linear	**Mandatory**	
Geometric mean (as a tribute to log-normal distributions)	$\left(\prod_{i=1}^{n} a_i\right)^{1/n} = \sqrt[n]{a_1 a_2 \cdots a_n}$	**As needed**	
Regression and correlation			
Regr. and corr. results	A, b, r, r^2, n, p (single sided)	**Optional**	
Error statistics			
Mean absolute error	$MAE = \frac{1}{n}\sum_{i=1}^{n} \lvert Y_i - X_i \rvert$	Mandatory	L09
Bias	$Bias = \frac{1}{n}\sum_{i=1}^{n} (Y_i - X_i) = \bar{Y} - \bar{X}$	**Mandatory**	
Root mean square error (RMSE)	$RMSE = \sqrt{\frac{\sum (y_i - x_i)^2}{n}}$	Mandatory	L09

Statistical measure	Formula	Scope	Ref.
Median error	50th percentile of the error distribution.	Optional	
Skewness of error distribution	$s_0 = \frac{\sqrt{n(n-1)}}{n-2} \frac{\frac{1}{n}\sum_{i=1}^{n}(E_i - \overline{E})^3}{\left(\sqrt{\frac{1}{n}\sum_{i=1}^{n}(E_i - \overline{E})^2}\right)^3}$	**Mandatory**	
Cost function (Normalized bias)	$CF = \frac{1}{n}\sum_{i=1}^{n}\frac{\lvert Y_i - X_i \rvert}{\sigma_X}$	Optional	A07

Value added service

When processing and quality controlling data, the Data Centres of the ICES community shall strive to meet the following guidelines.

Quality control

A range of checks are carried out on the data to ensure that they have been imported into the Data Centre's format correctly and without any loss of information. For discrete water sample data, these should include:

- Check header details / metadata (vessel, cruise number, station numbers, date/time, latitude/longitude (start and end), instrument number and type, station depth, cast (up and down) data type /no. of data points, platform identifier)
- Automatic range checking of each parameter (e.g. WOD 1998, Maillard 2000)
- Check units of parameters supplied
- Flag suspicious data or correct after consultation with Principal Investigator (PI)

Problem resolution

The quality control procedures followed by the Data Centres will typically identify problems with the data and/or metadata. The Data Centre will resolve these problems through consultation with the originating PI or data supplier. Other experts in the field or other Data Centres may also be consulted.

History documentation

All quality control procedures applied to a dataset are fully documented by the Data Centre. As well, all quality control applied to a dataset should accompany that dataset. All problems and resulting resolutions will also be documented with the aim to help all parties involved; the Collectors, Data Centre, and Users. A history record will be produced detailing any data changes (including dates of the changes) that the Data Centre may make.

Request for support

When addressing a request for information and/or data from the User Community, the Data Centres shall strive to provide well-defined data and products. To meet this objective, the Data Centres will follow these guidelines.

Data description

The Data Centre shall aim to provide to its clients well-defined data or products. If digital data are provided, the Data Centre will provide sufficient self-explanatory series header information and documentation to accompany the data so that they are adequately qualified and can be used with confidence by scientists/engineers other than those responsible for their original collection, processing and quality control. This is described in more detail below:

- A data format description fully detailing the format in which the data will be supplied
- Parameter and unit definitions, and scales of reference
- Definition of additional quality control
- Flagging scheme, if flags are used
- Data history document (as described below)
- Accompanying data

Data history

A data history document will be supplied with the data to include the following:

- A description of data collection and processing procedures as supplied by the data
- collector (as specified earlier)
- Quality control procedures used to check the data (as specified earlier)
- Any problems encountered with the data and their resolution and modification date
- Any changes made to the data and dates of these changes

Any additional information of use to secondary users which may have affected the data or have a bearing on its subsequent use should also be included.

References

Allen J. I., Holt J. T., Blackford J., Proctor R. (2007a): Error quantification of a high-resolution coupled hydrodynamic ecosystem coastal-ocean model: Part 2. Chlorophyll-a, nutrients and SPM. Journal of Marine Systems 68, 381–404.

Allen J. I., Somerfield P. J., Gilbert F. J. (2007b): Quantifying uncertainty in high-resolution coupled hydrodynamic-ecosystem models. Journal of Marine Systems 64, 3–14.

Lehmann M. K., Fennel K., He R. (2009): Statistical validation of a 3-D bio-physical model of the western North Atlantic. Biogeosciences, 6, 1961–1974.

Mélin F., and B.A. Franz (2014). Assessment of satellite ocean colour radiometry and derived geophysical products. In G. Zibordi, G.J. Donlon, and A.C. Parr (eds.) Optical Radiometry for Ocean Climate Measurements. Chap. 6.1 Vol. 47 Experimental Methods in the Physical Sciences. Elsevier Inc.

Zibordi G. Et al. (2006). A network for standardized ocean colour validation measurements. EOS Trans. AGU 87: 293-297.

ANNEX 3C: QA/QC guidelines for Ferrybox flow-through information

In this guideline, Ferrybox information is considered to be information derived from automatic flow-through systems implemented on board ships of opportunity. The observations are either original or in validated form, and may be aggregated temporally and spatially to a specific level.

The data must include a distinct time and position. In the case of aggregated information, these may be estimates.

Basic requirements of Ferrybox flow-through data for use in HELCOM eutrophication assessment

Ferrybox-based flow-through data used in the HELCOM eutrophication assessment and submitted to the eutrophication assessment database must fulfil the following basic requirements.

Data are validated aggregated estimates of a core indicator parameter, ie. not raw flow-through observations. The validation must be based on in-situ monitoring data. The data submitter is responsible for quality control procedures as described below (value added services), since the database holder will not go through such procedures after receiving the data.

The data product may be aggregated at two alternative levels:

3) Large scale
- spatial: HELCOM assessment unit, following the HELCOM sub-division into 17 open sub-basins and 42 coastal areas (shapefile may be retrieved at www.helcom.fi)
- temporal: annual assessment period (eg. summer months)

4) Small scale
- spatial: HELCOM 20K grid (shapefile may be retrieved at www.helcom.fi)
- temporal: daily

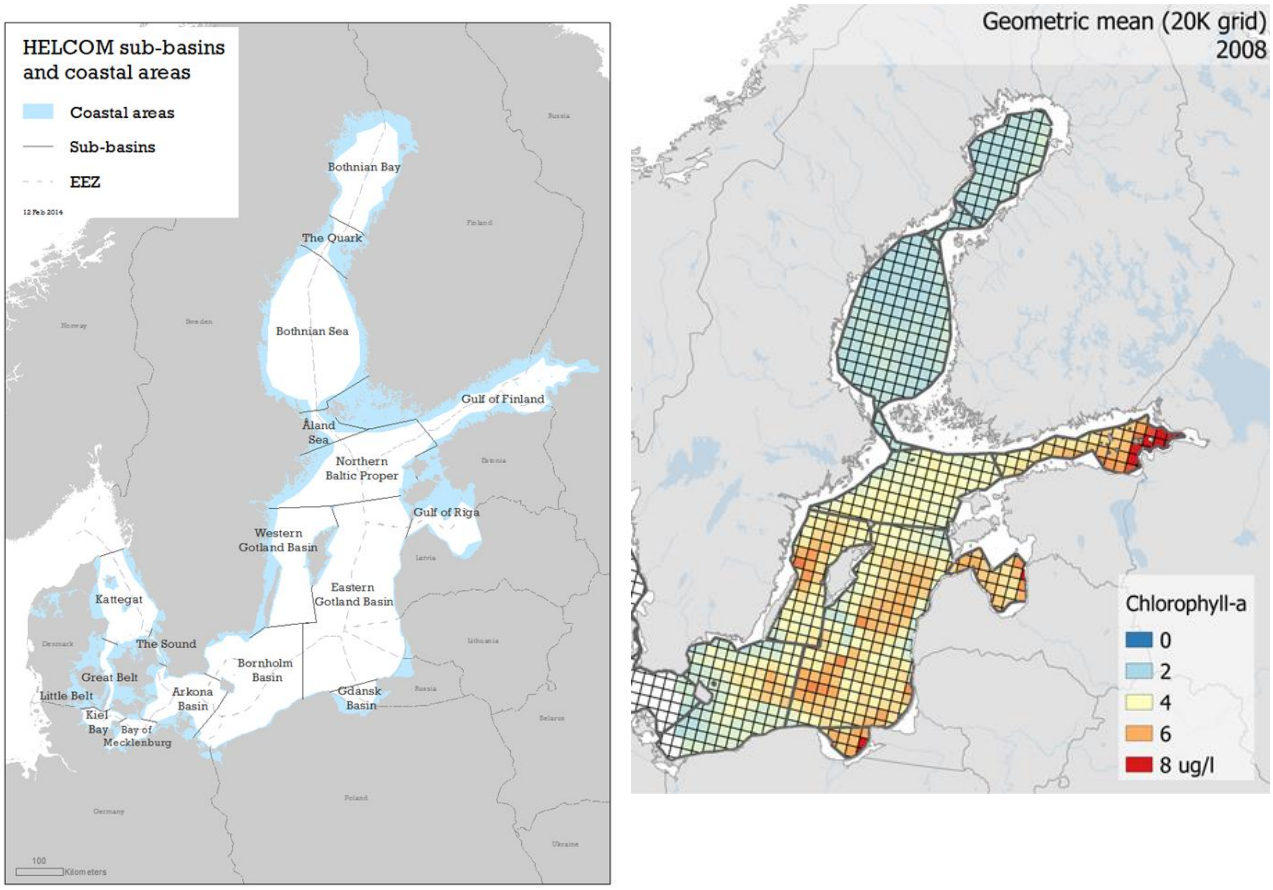


Figure 3C.1. Map illustrating the large (HELCOM assessment units, left panel) and small (HELCOM 20K grids, right panel) spatial scales.

Receiving data

The Data Centres require the following information to be supplied by the data supplier together with the data. When receiving data, the Data Centres shall strive to meet the following guidelines.

Data standard

All parameters must be clearly specified and described. If parameter codes are to be used, then the source data dictionary consistency must be specified. Parameter units must be clearly stated. If computed values are included, the equations used in the computations should be stated. The data should be fully checked for quality and pre-edited or flagged for erroneous values. An explicit statement should be made of the checks and edits applied to the data. A brief description, or a reference to the data collection and processing methods (e.g. reference to a specific technique or specific project protocols) must be included and should contain information regarding:

- Methods and procedures applied to the analysis of raw data
- Methods / protocols and dataset(s) used for validation, or refer to their original source
- Description or reference any internal or external quality assurance procedures

A brief description of the data processing procedures must be included and should contain information regarding:

- editing/quality control methods
- how are missing values handled (recommended as “blanks”)
- what is the precision of the methods (e.g. number of significant figures)
  green book)

- what units are used
- describe what quality flags are used if any
- supply a validation document

If a report is available describing the data collection and processing, this can be referenced. If possible, a copy should be supplied with the data.

Format description

Data should be supplied in a fully documented format (e.g. ASCII, NetCDF). If in doubt about the suitability of any particular format, advice from the Data Centre should be sought. Individual fields, units, etc. should be clearly defined and time zone stated. Time reported in UTC is strongly recommended. The contents of the data and ancillary information should adhere to the Formatting Guidelines for Oceanographic Data Exchange (http://ocean.ices.dk/formats/GETADE_Guidelines.aspx) prepared by the IOC's Group of Experts on the Technical Aspects of Data Exchange (GETADE) and available from RNODC Formats.

Collection and processing details

Pertinent information to be included in the data transfer to the Data Centre includes:

- Processing responsible: country, organisation, institute, PI
- Description of flow-through system and measuring instruments / sensors
- Measured parameters
- Products derived through validation procedures
- Resolution of original data
- Details of validation data
- Conversions used for deriving chlorophyll *a* concentration from chlorophyll *a* fluorescence data
- Level of temporal and spatial aggregation used
    - spatial: either raw data, HELCOM 20 km grid or HELCOM assessment area
    - temporal: either raw data or daily / annual assessment period
- Uncertainties on product estimates
- Date and time of the start and end of the sampling (UTC is recommended)
- Position estimate (latitude and longitude degrees and minutes or decimal degrees can be used. Explicitly state which format is being used. It is recommended that N, S, E and W labels are used instead of plus and minus signs.)
- Description of procedure for checking spikes

Any additional information of use to secondary users which may have affected the data or have a bearing on its subsequent use. For additional information on quality control procedures, metadata requirements for particular parameters and collection instrumentation, see UNESCO (1996).

Value added service

When processing and quality controlling data, the Data Centres of the ICES community shall strive to meet the following guidelines.

Quality control

A range of checks are carried out on the data to ensure that they have been imported into the Data Centre's format correctly and without any loss of information. For discrete water sample data, these should include:

- Check header details (platform, date/time, latitude/longitude, water intake depth).
- Plot measurement positions to check not on land

- Automatic range checking of each parameter (e.g. WOD 1998, Maillard 2000)
- Check units of parameters supplied
- Flag suspicious data or correct after consultation with Principal Investigator (PI)

Problem resolution

The quality control procedures followed by the Data Centres will typically identify problems with the data and/or metadata. The Data Centre will resolve these problems through consultation with the originating PI or data supplier. Other experts in the field or other Data Centres may also be consulted.

History documentation

All quality control procedures applied to a dataset are fully documented by the Data Centre. As well, all quality control applied to a dataset should accompany that dataset. All problems and resulting resolutions will also be documented with the aim to help all parties involved; the Collectors, Data Centre, and Users. A history record will be produced detailing any data changes (including dates of the changes) that the Data Centre may make.

Request for support

When addressing a request for information and/or data from the User Community, the Data Centres shall strive to provide well-defined data and products. To meet this objective, the Data Centres will follow these guidelines.

Data description

The Data Centre shall aim to provide to its clients well-defined data or products. If digital data are provided, the Data Centre will provide sufficient self-explanatory series header information and documentation to accompany the data so that they are adequately qualified and can be used with confidence by scientists/engineers other than those responsible for their original collection, processing and quality control. This is described in more detail below:

- A data format description fully detailing the format in which the data will be supplied
- Parameter and unit definitions, and scales of reference
- Definition of additional quality control
- Flagging scheme, if flags are used
- Data history document (as described below)
- Accompanying data

Data history

A data history document will be supplied with the data to include the following:

- A description of data collection and processing procedures as supplied by the data
- collector / data provider (as specified earlier)
- Quality control procedures used to check the data (as specified earlier)
- Any problems encountered with the data and their resolution and modification date
- Any changes made to the data and dates of these changes

Any additional information of use to secondary users which may have affected the data or have a bearing on its subsequent use should also be included.

References

UNESCO (1996)
WOD 1998
Maillard 2000

ANNEX 3D: QA/QC guidelines for indicator data

In the context of this guideline, indicator data are considered to be ready eutrophication indicator products. Examples of such product would be coastal indicator results, or core indicators not being processed from monitoring observations through algorithms in the HELCOM eutrophication assessment work flow.

The information must be spatially and temporally aggregated to suit the requirements of the assessment. Optimally, the information should be reported in the measuring units of the original indicator parameter. If this is not possible, also information reported as EQR is accepted.

Indicator data is reported directly to ICES (hjalte.parner@ice.dk) and the HELCOM secretariat (joni.kaitaranta@helcom.fi).

Receiving data

Data standard

The data is reported using a specific reporting questionnaire (Manual Table ANNEX_2D Questionnaire indicator data template.xlsx, see table 2D.1).

The indicator data questionnaire includes three types of sheets, which require the following information. Fill in the information only for the relevant assessment units – you may delete the remaining rows. All the information is required, regardless of whether data is reported in original units or eutrophication ratio (ER, see instructions on HEAT assessment for closer information).

1. List of indicator
    - Name of indicator; the commonly used name
    - Applied (yes/no); is the indicator applied in the eutrophication assessment
    - Intercalibrated (yes/no); have the indicator class boundaries been intercalibrated during the WFD process
    - HELCOM target (yes/no); have targets / GES boundaries been agreed for the indicator by HELCOM
    - Description of indicator; short description of the indicator
    - Unit; measurement unit used for indicator parameter; if data is provided in EQR, write “EQR” as unit
    - Response to increasing eutrophication (pos/neg); pos if indicator parameter increases along with increased nutrient inputs, neg if indicator parameter decreases along with increased nutrient inputs
    - Assessment months; the months during which indicator data is used
    - parameters used in indicator; list monitoring parameter(s) used for calculating the indicator

Table 3D.1. The first sheet from the indicator data questionnaire: list of indicators reported.

Indicator no	Indicator name	Applied (yes/no)	Intercalibrated (yes/no)	HELCOM target (yes/no)	Description of indicator	Unit	Response to increasing eutrophication (pos/neg)	Assessment months (1…12)	Parameters used in indicator
1									
2									
3									
…	[add more indicators if needed]								

2. Spatial units
    - includes a map and list of spatial units, based on the HELCOM Monitoring and Assessment Strategy, or additional agreements made in the eutrophication assessment network / EUTRO-OPER project

- if other spatial units are to be used, indicate here, include maps and report a shape-file with the accurate spatial units along with the questionnaire

3. Indicator data sheets
    - HELCOM ID; all spatial units are listed, you may delete the rows with spatial units not reported; if spatial units are missing, indicate that in the spatial unit sheet and send a shapefile along with the reporting
    - Assessment unit name; same as previous
    - Reference condition (if estimated); report in original measurement unit; if indicator is reported in ER, this may be left out
    - Class boundary H/G (if estimated); same as previous
    - Class boundary G/M (if estimated); same as previous
    - Class boundary M/P (if estimated); same as previous
    - Class boundary P/B (if estimated); same as previous
    - HELCOM target (if estimated); same as previous
    - Acceptable deviation (if estimated); same as previous
    - level 2001-2006 (if estimated); provided in the original measurement unit; if indicated in list of indicators to be reported as ER, this may be used as unit

Table 3D.2. The SECOND sheet from the indicator data questionnaire: indicator statistics.

HELCOM-ID	Assessment unit (or water type/water body) name	Reference condition	Class boundary H/G	Class boundary G/M	Class boundary M/P	Class boundary P/B	HELCOM target	Acceptable deviation	level 2001-2006	level 2007-2012
SEA-001	The Kattegat									
SEA-002	Great Belt									
SEA-003	The Sound									
SEA-004	Kiel Bay									
SEA-005	Bay of Mecklenburg									
SEA-006	Arkona Basin									

Format description

Indicator data is reported using the ready indicator data questionnaire (Manual Table ANNEX_2D Questionnaire indicator data template.xlsx, see table 3D.1).

ANNEX 4A: Detailed list of indicators used in coastal waters

Indicators used in Danish coastal waters

Indicator	Applied (yes/no)	Intercalibrated (yes/no)	Description of indicator	Measuring unit	Response to increasing eutrophication	Assessment months (1...12)	Parameters used in indicator
Chlorophyll-*a*	yes			µg/l	pos.	5, 6, 7, 8, 9	Chlorophyll-*a*
Depth limit of eelgrass	yes			m	neg.	6, 7, 8, 9	Depth limit of eelgrass
DKI (zoobenthos)	yes			none (inde:	neg.	3, 4, 5	Species and groups of species

Indicators used in Estonian coastal waters

Indicator	Applied (yes/no)	Intercalibrated (yes/no)	Description of indicator	Measuring unit	Response to increasing eutrophication	Assessment months (1...12)	Parameters used in indicator	Comment
Total nitrogen	yes	No	Summer concentration (µmol l-1) of total nitrogen in seawater. Water samples are gathered 6-7 times during monitoring period from the depths of 1, 5 and 10 meters in every station. totN is analysed on different depths. Assessment value is the average of all measured values.	µmol/l	pos	6...9	1) summer concentration of total nitrogen in seawater.	
Total phosphorus	yes	No	Summer concentration (µmol l-1) of total phosphorus in seawater. Water samples are gathered 6-7 times during monitoring period from the depths of 1, 5 and 10 meters in every station. totP is analysed on different depths. Assessment value is the average of all measured values.	µmol/l	pos	6...9	1) summer concentration of total phosporus in seawater	
Chlorophyll-a	yes	No	Summer chlorophyll a concentration (mg m3) in seawater. Water samples are gathered 6-7 times during monitoring period from the depths of 1, 5 and 10 meters in every station. Chlorophyll a concentration is determined from an integrated sample. Assessment value is the median of all monitored values.	mg/m3	pos	6...9	1) Summer chlorophyll a concentration in seawater	
Phytoplankton biomass	yes	No	Summer phytoplankton wet weight biomass. Water samples are gathered 6-7 times during monitoring period from the depths of 1, 5 and 10 meters in every station. Phytoplankton biomass is determined from an integrated sample. Assessment value is the median of all monitored values.	mg/l	pos	6...9	1) Summer phytoplankton wet weight biomass	
Transparency Secchi disk	yes	No	Summer-time Secchi depth transparency (m). Secchi depth is measured 6-7 times in the monitoring period in every station.	m	neg	6...9	1) Summer-time Secchi depth	
Benthic macroflora depth distribution	yes	Yes	Depth distribution of phytobenthos is measured by visual observations (diving or video). Data on species coverage and appearance is gathered from a transect which is crosswise to the beach. Monitoring is done by 1 meter depth interval to depth where no phytobenthos appears. In every monitoring point 3-4 meter wide seabed area is used to give coverage assessments.	m	neg	7...9	1) coverage of phytobenthos; 2) depth distribution of phytobenthos	
Fucus vesiculosus depth distribution	yes	Yes	Depth distribution of F.vesiculosus is measured by visual observations (diving or video). Data on species coverage and appearance is gathered from a transect which is crosswise to the beach. Monitoring is done by 1 meter depth interval to depth where no phytobenthos appears. In every monitoring point 3-4 meter wide seabed area is used to give coverage assessments.	m	neg	7...9	1) coverage of F.vesiculosus; 2) depth distribution of F.vesiculosus	
Proportion of perennial species	yes	No	Proportion of perennial species in benthic vegetation. Quantitative benthic vegetation samples are gathered by a diver on a transect from 5-7 depths using a 20x20 cm metal frame. 3 dupliacte samples are gathered on each depth. Sampels are analysed in the laboratory to species level and dried at 60 degrees Celsius. Perennial species percentage in an area is determined by perennial species biomass.	%	neg	7...9	1) perennial species biomass; 2) total biomass of erect vegetation	
Large inverterbrates ZKI	yes	yes	The structure of zoobenthos community reacts to different stressors, because there are species in the community which have different physiological tolerance, feeding habits and trophic relations. Zoobenthos species are divided into three sensitivity classes using this information. Index is calculated on the basis of biomass proportions of species belonging to the sensitivity classes and total biomass.	-	neg	5...8	1) zoobenthos species biomass	ZKI in intercalibrated and an improved index is proposed, but because it is not in current regulation, the values from older version of ZKI are presented.
Large inverterbrates FDI	yes	No	Habitat diversity index of phytobenthic zone.	-	neg	7...9	1) benthic species biomass; 2) benthic species abundance	During geographic intercalibration it was concluded that FDI doesn't meet the requirements of
Large inverterbrates KPI	yes	No	Hard bottoms index (KPI).	-	neg	7...9	1) benthic species biomass; 2) sensitive species abundance	During geographic intercalibration it was concluded that KPI doesn't meet the requirements of

Other indicators:								
Indicator	**Applied (yes/no)**	**Intercalibrated (yes/no)**	**Description of indicator**	**Measuring unit**	**Response to increasing eutrophication**	**Assessment months (1...12)**	**Parameters used in indicator**	**Comment**
HPO index		No	HPO index is used for type II waterbody (EST-005) to describe benthic flora. Depth distribution of higer plants (HP) is the maximum depth where higer plants appear. If there are no higher plants on the transect then the value of parameter HP=0. The percentage of opportunistic species is calculated from total biomass of the benthic flora for which the data is collected at the depth of 3 metres. In HPO index the following species are considered as opportunistic: Cladophora glomerata, Cladophora rupestris, Monostroma balticum, Ulva intestinalis, Ulva prolifera, Chaetomorpa linum, Rhizoclonium riparium, Urospora penicilliformis, Ectocarpus siliculosus, Pilayella littoralis. The final value of HPO index results in the averaging of HP EQR and O EQR. HPO index meets all WFD requirements. Percentage of opportunistic species based on biomass data describes abundance. Depth distribution of higer plants describes abundace and the disturbance of sensitive species. There is a statistically relevant relation between EQR value and water transparency. There is a correlation between HPO index and totP.	-	neg		1) depth distribution of higer plants (HP); 2) percentage of opportunistic species in total biomass	Proposed indicator, not described in current regulation therefore values will not be calculated.
PCF index		No	PCF index is used for type V waterbodies (EST-001, EST-002, EST-007). PCF idex assembles perennial species, F.vesiculosus and Charophyta species. To calculate percentage of perennial species (P) quantitative samples are used. Samples are gathered from predefined depths which depend on the length and profile of the transect. Percentage of Charophyta species (C) is calculated from total coverage of benthic flora from depths to 3 meters. F. vesiculosus coverage is calculated from total coverage from the depths 1-3meters. PCF=P+C+F.	-	neg		1) percentage of perennial species of total biomass (P); 2) percentage of Charophyta coverage of total coverage (C); 3) percentage of F.vesiculosus	Proposed indicator, not described in current regulation therefore values will not be calculated.

Indicators in used in Finnish coastal waters

Indicator	**Applied (yes/no)**	**Intercalibrated (yes/no)**	**Description of indicator**	**Unit**	**Response to increasing eutrophication**	**Assessment months (1...12)**	**Parameters used in indicator**
Total N	yes	no	surface water layer (1 m)	µg/l	pos	July to Sept (first	
Total P	yes	no	surface water layer (1 m)	µg/l	pos	July to Sept (first	
Chlorophyll-a	yes	yes (but will be	composite sample (twice the Secchi depth) representing productive surface layer	µg/l	pos	July to Sept (first	
Biovolume	yes	no	composite sample (twice the Secchi depth) representing productive surface layer	mg/l	pos	July to Sept (first	
Secchi	yes	no		m	neg	July to Sept (first	
Macrophyte, sheltered	yes	yes		m	neg	July to August	
Macrophyte, open	yes	yes		m	neg	July to August	
BBI, 0-10 m	yes	yes			neg	Early summer	
BBI, 10+ m	yes	yes			neg	Early summer	

Indicators used in German coastal waters

Indicator	Applied (yes/no)	Intercalibrated (yes/no)	Description of indicator	Measurement unit	Response to increasing eutrophication	Assessment months (1...12)	Parameters used in indicator
TN	yes	no	total nitrogen in water	µmol/l	pos	1...12	total nitrogen in water
TN	yes	no	total phosphorus in water	µmol/l	pos	1...12	total phosphorus in water
Chlorophyll-*a*	yes	partly	Chlorophyll-*a*	µg/l	pos	5...9	Chlorophyll-*a*
Secchi depth	yes	no	Secchi depth (50 cm diameter)	m	neg	6...9	Secchi depth (50 cm diameter)
Oxygen	no	no	oxygen	mg/l	neg	9	oxygen
Macrophytes	yes	yes	complex indicator	EQR	pos		
Zoobenthos	yes	yes	complex indicator	EQR	pos		

Indicators used in Latvian coastal waters

Indicator	Applied (yes/no)	Intercalibrated (yes/no)	Description of indicator	Unit	Response to increasing eutrophication	Assessment months (1...12)	Parameters used in indicator
DIN	yes	no	Sum of winter nitarte, nitrite and ammonium is uzsed	µmol/l	pos	1-3	
DIP	yes	no	Winter phosphate concentration is used	µmol/l	pos	1-3	
Chlorophyll-*a*	yes	in process	Summer chlorophyll a concentration is used	µg/l	pos	6-9	
Phytoplankton biovolume	yes	no	Summer phytoplankton biobvolume is used	mg/m3	pos	6-9	
Secchi depth	yes	no	Summer Secchi depth is used	mg/m3	neg	6-8	
BQI	yes	no			pos	5	
Phytobenthos Ecological Quality Index (PEQI)	yes	in process	Two metrics are used in this indicator: 1) depth distribution of phytobenthos and 2) depth distribution of *Fucus vesiculosus* . For both metrics the deepest occurrence of single attached plant specimen is determined by drop underwater video or diver. The average EQR of both metrics is the final EQR of the assessment method.	average EQR value (from 0 to 1)	negative	from 7 to 9	Abundance, disturbance sensitive taxa.
Depth limit of *Furcellaria lumbricalis*	yes	in process	*Furcellaria* is the most important habitat forming species at the Eastern Baltic Sea coast which overgrowths provide spawning substrate for fish and support the highest biodiversity in the coastal zone. The deepest occurrence of single attached plant specimen is used in this indicator and this is determined by drop underwater video or diver.	m	negative	from 7 to 9	Disturbance sensitive taxa. Indirectly - abundance, diversity.

Indicators used in Polish coastal waters

Indicator	Applied (yes/no)	Intercalibrated (yes/no)	Description of indicator	Unit	Response to increasing eutrophication	Assessment months (1...12)	Parameters used in indicator
Chlorophyll-a(VI-IX)	yes	yes/ongoing		ug/L	pos	6-9	
Chlorophyll-a (a.m.)	yes	no		ug/L	pos	1-12	
Biovolume	no	no			pos		
Macrophytes (SM1)	yes	no		unitless	neg		biomas of perennial macrophytes, total macrophyte biomass
Zoobenthos (B)	yes	ongoing		unitless	neg		abundance class, number of taxa in abundance class, tolerance/sensitivity index
DIN (I-III)	yes	no		mmol/m-3 & mg/L	pos	1-3	
DIN (a.m.)	yes	no		mmol/m-3 & mg/L	pos	1-12	
DIP (I-III)	yes	no		mmol/m-3 & mg/L	pos	1-3	
DIP (a.m.)	yes	no		mmol/m-3 & mg/L	pos	1-12	
TN (VI-IX)	yes	no		mmol/m-3 & mg/L	pos	6-9	
TN (a.m.)	yes	no		mmol/m-3 & mg/L	pos	1-12	
TP (VI-IX)	yes	no		mmol/m-3 & mg/L	pos	6-9	
TP (a.m.)	yes	no		mmol/m-3 & mg/L	pos	1-12	
Secchi (VI-IX)	yes	no		m	neg	6-9	
Secchi (a.m.)	yes	no		m	neg	1-12	
Oxygen (min. VI-IX)	yes	no		mg/L	neg	6-9	

Indicators used in Swedish coastal waters

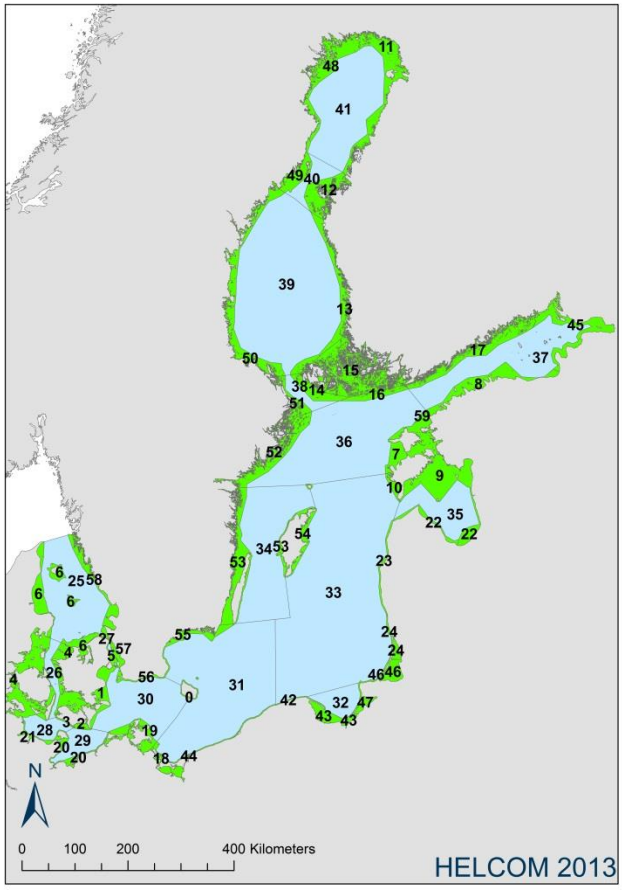
Indicator	Applied (yes/no)	Intercalibrated (yes/no)	Description of indicator	Unit	Response to increasing eutrophication	Assessment months (1...12)	Parameters used in indicator
Chl-a (VI-VIII)	yes	no	SWE-001, SWE-003 -SWE-006, SWE-025, SWE-016 - SWE-023: Mean chl-a concentration from integrated samples (0-10 m) or discrete samples (0,5 m) if water depth is < 12m. SWE-007 - SWE-015, SWE-024: Mean chl-a concentration from 0,5 m. Data from deviating sampling depths can be corrected to represent the above intervals and depths. Reference values for SWE-007, SWE-011 - SWE-013 and SWE-024 needs to be corrected with observed salinity.	μgL^{-1}	pos	6-8	Chlorophyll-a concentration, , salinity
Biovolume (VI-VIII)	yes	no	Biovolume is determined from the biomass of autotrohpic and mixotrophic phytoplankton and expressed as the mean value from integrated samples (0-10 m) or discrete samples (0,5 m) if water depth is < 12m. Data from deviating sampling depths can be corrected to represent the above intervals and depths. SWE-007, SWE-011 - SWE-013 and SWE-024 needs to be corrected with observed salinity.	mm^3L^{-1}	pos	6-8	Biomass of autotrohpic and mixotrophic phytoplankton, , salinity
Macrovegetation	yes	no	A transect shall be classified only if maximal depth distribution of a minimum of three species is included. Each species get a water type specific point. All points within the transect are summarized and averaged and the result is divided with the "reference point" five. Within a water body a minimum of three transects shall be included. The final status for a water body is thus 1-5 points.	points	neg	7-9	Maximal depth destribution [m] of water type specific macroalgaes and angiospermaes.
BQIm	yes	Yes	Status of bottom fauna is classified using the BQIm (Benthic Quality Indices) for soft bottoms. BQI is based on threee parameters: 1) species composition 2)number of species and 3) number of individs (abundancy). These parameters change with an increased input of organic matter to the bottoms. The central feature in the indices is the species sensitivity for disturbance.	-	neg	5-6	BQI is based on three parameters: 1) species composition 2)number of species and 3) number of individs (abundancy).
DIN (XII,I,II)	yes	only biol elements are IC	Mean concentration of DIN 0-10 m in winter. Class boundaries and reference values are related to the observed salinity and are therefor presented as a salinity relation rather than a concentration.	$\mu molL^{-1}$	pos	Water Type specific.	Concentration of DIN = nitrite (NO2-) + nitrate (NO3-) + ammonia (NH4+), salinity
DIP (XII,I,II)	yes	only biol elements are IC	Mean concentration of DIP 0-10 m in winter. Class boundaries and reference values are related to the observed salinity and are therefor presented as a salinity relation rather than a concentration.	$\mu molL^{-1}$	pos	Water Type specific.	Concentration of DIP , salinity.
TN (XII,I,II)	yes	only biol elements are IC	Mean concentration of total nitrogen 0-10 m in winter. Class boundaries and reference values are related to the observed salinity and are therefor presented as a salinity relation rather than a concentration.	$\mu molL^{-1}$	pos	Water Type specific.	Total water concentration of nitrogen, salinity.
TP (XII,I,II)	yes	only biol elements are IC	Mean concentration of total phosphate 0-10 m in winter. Class boundaries and reference values are related to the observed salinity and are therefor presented as a salinity relation rather than a concentration.	$\mu molL^{-1}$	pos	Water Type specific.	Total water concentration of phosphorus, salinity.
TN (VI-VIII)	yes	only biol elements are IC	Mean concentration of total nitrogen 0-10 m in summer. Class boundaries and reference values are related to the observed salinity and are therefor presented as a salinity relation rather than a concentration.	$\mu molL^{-1}$	pos	6-8	Total water concentration of nitrogen, salinity.
TP (VI-VIII)	yes	only biol elements are IC	Mean concentration of total phosphate 0-10 m in summer. Class boundaries and reference values are related to the observed salinity and are therefor presented as a salinity relation rather than a concentration.	$\mu molL^{-1}$	pos	6-8	Total water concentration of phosphorus, salinity.
Secchi (VI-VIII)	yes	only biol elements are IC	Secchi depth from June-August, if these months are missing September may be used. Accuracy shall not be higher than 0.5 m. SWE-007, SWE-011 - SWE-013 and SWE-024 needs to be corrected with observed salinity	m	neg	6-8	Secchi depth, salinity.
Oxygen	yes	only biol elements are IC	There are no general reference values or classification boundaries. Before the water body can be status classified it needs to be determined to what category the water body belongs: 1) Seasonal hypoxia, 2) Perennial oxygen deficiency, 3) Permanent oxygen deficiency, 4) Oxygenated deep waters or 5) Data missing. The categorization is made through a series of tests where the outcome determines how the water body will be treated. The tests, classification procedure, reference values and classification boundaries are described in; EUTRO-OPER document 4-2015_5-8 Assessment of oxygen status in shallower areas of the Baltic Sea – updated.	mlL^{-1}	neg		Oxygen concentration

ANNEX 6A: Structure of the indicator web reports

HELCOM INDICATORS

KEY MESSAGE

- **MAP**
  with HELCOM assessment units, showing where the indicator can be and has been applied and assessment result for each assessment unit (above/below GES boundary)
- short textual description:
  - **status:** 1-2 sentences (GES not achieved in units 1,2,3. GES has been achieved in units 5,6,7)
  - **trend:** 1-2 sentences short- and long-term in the assessment unit
  - **confidence**: high/moderate/low (more details in sub-pages Indicator concept and Description of data)



RELEVANCE OF THE CORE INDICATOR

- aimed at a general public
  - 1-2 sentences, what is the "role" of the assessed element in the ecosystem (e.g. what role does a seal have in the environment – top predator)?
  - 1-2 sentences, what information of the environment does the parameters in indicator describe/estimate (e.g. what does pregnancy rate of mammals tell the reader about the state of the environment) ?

POLICY RELEVANCE OF THE CORE INDICATOR

- description of relevant conventions and other legislation in standardized table

	Primary importance	Secondary importance
BSAP segment and objective		
MSFD descriptor and criteria		
Other relevant legislation		

CITE THIS INDICATOR

[Author's name(s)], [year]. [Indicator name]. HELCOM core indicator report. Online. [Date Viewed], [Web link].

RESULTS AND CONFIDENCE

Current status of the indicator

- detailed text description on how the "key message map" was arrived at
- detailed map, showing indicator ER in five levels (including GES/SubGES)
- plots showing annual averages, standard deviation, period average and target
- table with indicator statistics: ET, ES, ER and status (GES/SubES)

Long-term development

- text description
- time-series plots

Confidence of indicator status

- summary of confidence and how it was estimated
- map showing indicator confidence in the different assessment units

GOOD ENVIRONMENTAL STATUS

- short summary on method and process in estimating GES-boundaries (targets)
- table showing GES-boundaries in open-sea assessment units

ASSESSMENT PROTOCOL

- description of assessment unit division
- how indicator is used in the assessment
- description of methods used in indicator
- weighing of indicator in HEAT

RELEVANCE OF THE INDICATOR

Eutrophication assessment

- description of eutrophication assessment

Policy relevance

- Baltic Sea Action plan
- MSFD
- WFD

Role of indicator in the system

- ecological relevance of the indicator
- hopefully illustration

Human pressures linked to the indicator

- detailed description and background information on the scientific concept/design of the indicator which is summarized on the first page for a non-expert audience, here going into detail
    - what is the "role" of the assessed element in the ecosystem (e.g. what role does a seal have in the environment – top predator)?
    - what information of the environment does the parameters in indicator describe/estimate (e.g. what does pregnancy rate of mammals tell the reader about the state of the environment) ?

MONITORING REQUIREMENTS

Monitoring requirements

- explain what are the minimal requirements for providing an indicator evaluation

Gaps in monitoring

- describe any problems or place for improvement regarding the present monitoring

HELCOM monitoring manual

- link to relevant pages in monitoring manual

DATA AND UPDATING

Metadata

- data source (link to potential excel and underlying database of e.g. COMBINE)
- description of data (coverage spatial & temporal, methodology e.g. in-situ/remote-sensing)
- quality assurance routines

Further work required

- urgent needs for improvement
- anticipated future needs

Arrangements for up-dating the indicator

- description of data-flow (sampling > analyzing > hosting)
- description of long-term updating arrangements
    - how and when is monitored data collected and reported and to what responsible body (e.g. HELCOM group?)
    - what responsible body carries out the analyses required (described above in assessment protocol) in the indicator for updating

View data

- link to indicator values

CONTRIBUTORS AND REFERENCES

Contributors

- list names and institutes of contributors or network responsible for indicator

Archive

- pdf:s of the currently published- and older versions of this indicator

Additional relevant publications

- can be references related to the concept/parameter etc.
- general publications related to the parameter etc.