HELCOM Monitoring Programme topic

Phytoplankton

Programme:

Pigments

Contents

a. Metadata on monitoring strategies and monitoring program on pigments

a.1 Responsible HELCOM subsidiary body

Please indicate the relevant expert group/network if available, otherwise the responsible HELCOM Working Group.

	Permament Groups
☐	Gear – Group on the Implementation of the Ecosystem Approach
☐	Maritime – Maritime Working Group
☐	Pressure – Working Group on Reduction of Pressures from the Baltic Sea Catchment Area
☐	Response – Response Working Group
☒	State and Conservation – Working Group on the State of the Environmental and Natgure Conservation
	Time-limited Groups
☐	Agri – Group on Sustainable Agricultural Practices
☐	Fish – Group on Ecosystem-based Sustainable Fisheries
☐	HELCOM-VASAB MSP WG - Joint HELCOM-VASAB Maritime Spatial Planning Working Group
	Expert Groups
☐	AIS EWG – Expert Working Group for Mutual Exchange and Deliveries of AIS data
☐	EN Hazardous Substances – Expert Network on hazardous substances
☐	EN Marine Litter – Expert Network on Marine Litter
☐	EN Noise – Expert Network on Underwater Noise
☐	ESA – Expert Network on Economic and Social Analyses
☐	EWG OWR – Expert Working Group on Oiled Wildlife Response
☐	EWG SHORE – Expert Working Group on Response on the Shore
☐	Green Technology and Alternative Fuels Platform for Shipping
☐	HELCOM/OSPAR TG BALLAST – Joint HELCOM/OSPAR Task Group on Ballast Management Convention Exemptions
☐	IN Benthic habitat – Intersessional Network on habitat monitoring

☒	IN-EUTROPHICATION - Intersessional Network on Eutrophication
☐	IWGAS – Informal Working Group on Aerial Surveillance
☐	JWG Bird – HELCOM-OSPAR-ICES Joint Working Group on Seabirds
☐	MORS EG – Expert group on monitoring of radioactive substances in the Baltic Sea
☐	PRF Cooperation Platform – Cooperation Platform on Port Reception Facilities in the Baltic Sea
☐	SAFE NAV – Group of Experts on Safety of Navigation
☐	SUBMERGED – Expert Group on Environmental Risks of Hazardous Submerged Objects

a.2 Regional Cooperation (RegionalCooperation)

The monitoring of this programme is:

☒ Fully coordinated

☐ Partly coordinated. Indicate missing component(s):

☐ Coordinated monitoring is under development. Indicate by which group/project and by when a recommendation on coordinated monitoring can be expected.

Common monitoring guidelines. Common quality assurance programme: HELCOM COMBINE manual. Common database: ICES.

b. Monitoring strategies

b.1 Descriptor

The programme supports the following obligatory MSFD Monitoring Srategies. Tick one or more relevant boxes.

☒ **D1**	Biodiversity
☐ **D2**	Non-indigenous Species
☐ **D3**	Commercial fish and shellfish
☐ **D4**	Food webs
☒ **D5**	Eutrophication
☐ **D6**	Seafloor integrity
☐ **D7**	Hydrographical conditions

☐ **D8** Contaminants

☐ **D9** Contaminants in seafood

☐ **D10** Marine litter

☐ **D11** Energy including underwater noise

b.2 BSAP segments

The sub-programme serves the following BSAP segments. Tick one or more relevant boxes.

☒Eutrophication

☐Hazardous substances

☒Biodiversity

☐Maritime activities

b.3 Monitoring strategy description

Monitoring strategy :

Full description in HELCOM COMBINE manual. Detailed information on monitoring frequency and spatial resolution has not yet been collected from all countries but will be added.

b.4 BSAP Ecological objectives

Choose only the most relevant option(s). Tick one or more boxes below.

Eutrophication	☐ Concentrations of nutrients close to natural levels
	☒ Clear water
	☒ Natural level of algal blooms
	☐ Natural distribution and occurrence of plants and animals
	☐ Natural oxygen levels
Hazardous substances	☐ Concentrations of hazardous substances close to natural levels
	☐ All fish safe to eat
	☐ Healthy wildlife
	☐ Radioactivity at pre-Chernobyl levels
Biodiversity	☐ Natural landscapes and seascapes
	☒ Thriving and balanced communities of plants and animals
	☐ Viable populations of species

Maritime activities	☐ No illegal pollution ☐ Safe maritime traffic without accidental pollution ☐ Efficient response capability ☐ No introductions of alien species from ships ☐ Minimum air pollution from ships ☐ Zero discharges from offshore platforms

b.5 Gaps in monitoring

In relation to the GES criteria addressed, indicate when sufficient monitoring was in place or by when sufficient coverage will be in place (Coverage_GEScriteria)

☒ Adequate monitoring was in place in 2014

☐ Adequate monitoring was in place by 2018

☐ Adequate monitoring is in place by July 2020

☐ Adequate monitoring will be in place by 2024

☐ Monitoring is not being put in place for this descriptor due to a low risk

☐ Monitoring for this descriptor is not relevant

Description of the implementation gaps and plans to complete the establishment and implementation of this descriptor monitoring strategy (Gaps_Plans):

Existing coordinated in-situ monitoring does not provide sufficient temporal coverage to achieve high confidence in the core indicator status estimate (BSEP 143). Including Earth Observation and/or Ferrybox monitoring offers means to fill this gap.

c. Monitoring programmes

c.1 Purpose of monitoring

c.1a Assessment purpose in general

The programme supports the assessment of:

Tick the relevant box.

Temporal trends	Spatial distribution	State classification
☒	☒	☒

The **programme** supports the assessment of: (MonitoringPurpose).

Note that the answer to this question will be decisive for whether to answer upcoming questions e.g. upcoming questions on pressures should only be answered if the monitoring is defined as supporting the assessment of pressures.

Tick the relevant boxes.

Environmental state and impacts	Pressures in the marine environment	Pressures at source (land-based, riverine sea-based[1] and atmospheric sources)	Human activities causing the pressures	Effectiveness of measures
☒ If this is selected fill in the following questions: c.1b	☐ If this is selected fill in the following questions: c.1c, d	☐ If this is selected fill in the following questions: c.1c, d	☐ If this is selected fill in the following questions: c.1c, d	☐ If this is selected fill in the following questions: c.1c, d

Give any other monitoring purpose e.g. if the programmes include supporting parameters for other monitoring programmes

Provides input to assessments under WFD and NiD.

For questions 1b-1d, select when applicable for the sub-programme, the link from the Reporting on the 2020 update of Article 11 for the Marine Strategy Framework Directive (MSFD Guidance Document 17, 2020) (Features) to:

- Ecosystem components (relevant for monitoring and assessment for Article 8(1a) for D1C2-C5, D3, D4, D6C3-C5, D7C2)
- Pressures and impacts in the marine environment (relevant for monitoring and assessment for Article 8(1b) for D1C1, D2, D5, D6C1-C2, D7C1, D8, D9, D10, D11)
- Pressure inputs to the marine environment (relevant for monitoring and assessment for Article 10)
- Uses and human activities (relevant for monitoring and assessment for Article 8(1c) and 13)

c.1b • Ecosystem components (Features)

Choose only the most relevant option(s). Tick one or more boxes below.

Theme	Sub-theme	Label feature
Species	☐ Birds	☐ Grazing birds
		☐ Wading birds
		☐ Surface-feeding birds
		☐ Pelagic-feeding birds
		☐ Benthic-feeding birds
	☐ Mammals	☐ Small toothed cetaceans
		☐ Deep-diving toothed cetaceans
		☐ Baleen whales

[1] Sea-based 'Pressures at source' refers to monitoring pressures from sea-based activities where the monitoring is directly at the activity rather than at a distance from or time period after it is generated by the activity (e.g. D1 incidental by-catch when fishing, D2 ballast water discharges, D6 use of bottom fishing gear, D8 contaminant discharges and pollution events from a vessel or pipeline, D11 impulsive sound events from a vessel or platform).

		☐ Seals
	☐ Reptiles	☐ Turtles
	☐ Fish	☐ Coastal fish
		☐ Pelagic shelf fish
		☐ Demersal shelf fish
		☐ Deep-sea fish
		☐ Commercially exploited fish and shellfish
	☐ Cephalopods	☐ Coastal/shelf cephalopods
		☐ Deep-sea cephalopods
Habitats	☐ Benthic habitats	☐ Benthic broad habitats
		☐ Other benthic habitats
	☒ Pelagic habitats	☐ Pelagic broad habitats
		☐ Other pelagic habitats
Ecosystems	☐ Physical and hydrological characteristics	
	☐ Chemical characteristics	
	☒ Ecosystems, including food webs	☒ Coastal ecosystems
		☐ Shelf ecosystems
		☐ Oceanic/deep-sea ecosystems

c.1c • Pressures and impacts in the marine environment (Features)

Choose only the most relevant option(s). Tick one or more boxes below.

Theme	Label: Feature
Biological	☐ Newly introduced non-indigenous species
	☐ Established non-indigenous species
	☐ Species affected by incidental by-catch
Physical and hydrological	☐ Hydrographical changes
	☐ Physical disturbance to seabed
	☐ Physical loss of the seabed
Substances, litter and energy	☐ Eutrophication
	☐ Contaminants - non UPBT substances
	☐ Contaminants - UPBT substances
	☐ Contaminants – in seafood
	☐ Adverse effects on species or habitats
	☐ Acute pollution events

	☐ Litter in the environment
	☐ Impulsive sound in water
	☐ Continuous low frequency sound

c.1d • Pressure inputs to the marine environment (Features)

Theme	Label: Feature
Biological	☐ Input or spread of non-indigenous species
	☐ Input of microbial pathogens
	☐ Input of genetically modified species and translocation of native species
	☐ Loss of, or change to, natural biological communities due to cultivation of animal or plant species
	☐ Disturbance of species (e.g. where they breed, rest and feed) due to human presence
	☐ Extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities)
Substances, litter and energy	☐ Input of nutrients — diffuse sources, point sources, atmospheric deposition
	☐ Input of organic matter — diffuse sources and point sources
	☐ Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) — diffuse sources, point sources, atmospheric deposition, acute events
	☐ Input of litter (solid waste matter, including micro-sized litter)
	☐ Input of anthropogenic sound (impulsive, continuous)
	☐ Input of other forms of energy (including electromagnetic fields, light and heat)
	☐ Input of water — point sources (e.g. brine)

c.1e • Uses and human activities (Features)

Choose only the most relevant option(s). Tick one or more boxes below.

Theme	Label: Feature
Physical restructuring of rivers, coastline or seabed (water management)	☐ Land claim
	☐ Canalisation and other watercourse modifications
	☐ Coastal defence and flood protection
	☐ Offshore structures (other than for oil/gas/renewables)
	☐ Restructuring of seabed morphology, including dredging and depositing of materials
Extraction of	☐ Extraction of minerals (rock, metal ores, gravel, sand, shell)

non-living resources	☐ Extraction of oil and gas, including infrastructure
	☐ Extraction of salt
	☐ Extraction of water
Production of energy	☐ Renewable energy generation (wind, wave and tidal power), including infrastructure
	☐ Non-renewable energy generation
	☐ Transmission of electricity and communications (cables)
Extraction of living resources	☐ Fish and shellfish harvesting (professional, recreational)
	☐ Fish and shellfish processing
	☐ Marine plant harvesting
	☐ Hunting and collecting for other purposes
Cultivation of living resources	☐ Aquaculture — marine, including infrastructure
	☐ Aquaculture — freshwater
	☐ Agriculture
	☐ Forestry
Transport	☐ Transport infrastructure
	☐ Transport — shipping
	☐ Transport — air
	☐ Transport — land
Urban and industrial uses	☐ Urban uses
	☐ Industrial uses
	☐ Waste treatment and disposal
Tourism and leisure	☐ Tourism and leisure infrastructure
	☐ Tourism and leisure activities
Security/defence	☐ Military operations (subject to Article 2(2))
Education and research	☐ Research, survey and educational activities

c.2 Other legislation

The sub-programme links with the following other international legislation (OtherPoliciesConventions). Tick one or more relevant boxes.

☐Bathing Water Directive

☐Common Fisheries Policy and Data Collection Framework

☐Habitats Directive

☐Birds Directive

☒Nitrates Directive

☐Urban Waste Water Treatment Directive

☒Water Framework Directive

☐OSPAR Convention

☐Trilateral Wadden Sea Convention

☐Other, Specify:

c.3 Implementation of Regional Cooperation (RegionalCooperation_implementation)

Indicate the level of implementation by selecting one of the following:

☐Agreed data collection methods

☐Common monitoring strategy (spatial and temporal design of programme)

☒Coordinated data collection (delivered separately by each country)

☐Joint data collection (multinational delivery using same platform and/or algorithms)

c.4 Monitoring concepts

Monitoring concepts table[2]:

Current means of coordination	Features or elements	Parameter	Method	QA/QC	Frequency[3]	Spatial resolution (density) of sampling	Link to HELCOM core indicators[4]	Spatial scope	Monitoring started (year)	CPs monitoring[5]
	Elements (Features) (Features_enum)	Parameters (Parameter) (ParametersOther)	MonitoringMethod (Monitoring Method) MonitoringMethodOther)	(Free text)	MonitoringFrequency	(ProgrammeDescription)	(RelatedIndicator) (RelatedIndicator_name	(SpatialScope)	(TemporalScope)	(CountryCode_Enum)
Regional (COMBINE	Phytoplankton	Concentration of chlorophyll-a	Fixed stations, in situ (HELCOM COMBINE manual, Part C, Annex C4)	National, ICESData TypeGuide and HELCOM COMBINE manual	See map for details	See map for details	Chlorophyll-a (summer)	EEZ	1979	All HELCOM Contracting Parties
National	Phytoplankton	Concentration of chlorophyll-a	Ship-of opportunity, flow-through (ferrybox)	National	Continually	20% (transect)	Chlorophyll-a (summer)	EEZ	1999	EE, FI, SE
National	Phytoplankton	Concentration of chlorophyll-a	Earth Observation, (MODIS,VIIRS)	Other	Continually	100% (1km or 300m resolution grid)	Chlorophyll-a (summer)	EEZ	2003	FI

[2] Needed codelists can be found on 2020 update of Article 11 for the Marine Strategy Framework Directive (MSFD Guidance Document 17, 2020).

[3] The option "Different for each country - see MORE overview" refers to the overview carried out in 2013

[4] Give the name of HELCOM core indicators that are based on the monitoring parameter.

[5] Provide information on the Contracting Partie(s) that are monitoring the parameter.

Current means of coordination	Features or elements	Parameter	Method	QA/QC	Frequency[3]	Spatial resolution (density) of sampling	Link to HELCOM core indicators[4]	Spatial scope	Monitoring started (year)	CPs monitoring[5]
National	Phytoplankton	Concentration of chlorophyll-a	Earth Observation,	Other	Continually		Chlorophyll-a (summer)	EEZ	no dedicated service	PL, EE piloting
National	Phytoplankton	Concentration of phycocyanin	Ship-ofopportunity, laboratory analysis, (HELCOM COMBINE manual, Part C, Annex C4)	National	Weekly	20%	Chlorophyll-a (summer)	EEZ	1999	EE, FI
National	Phytoplankton	Concentration of phycocyanin	~30 fixed stations	National	Yearly	Offshore. See map for details	-	EEZ	2005	FI
National	Phytoplankton	Concentration of phycocyanin (SoO)	Ship of opportunity: flow through	National	FI: Biweekly SE: continually	20% (transect)	-	EEZ	FI: 2005 SE: 2010	FI, SE
National	Phytoplankton	Concentration of phycocyanin	Earth Observation, (MODIS,VIIRS)	National	Daily	100%	-	EEZ	2014	FI
National	Phytoplankton	Surface accumulations of algal blooms	Earth Observation, (MODIS)	Other	Continually	100% (1km or 300m resolution grid)	Summer	EEZ	2002	SE

PARAMETER

Element/Parameter pair
In situ phytoplankton / Concentration of chlorophyll-a

METHOD (MonitoringDetails)

Element/parameter
Water samples from the water column, chlorophyll-a extracted and analysed in laboratory (applies also to monitoring of concentration of phycocyanin in offshore waters). Platform: boat Mode of sampling: fixed station (COMBINE Stations, see map for details). The standard sampling depths are in the upper water column the same as for nutrients: 1 m, 5 m, 10 m, 15 m and 20 m. In COMBINE, the sample from 1 m or an integrated sample (1-10 m) could be analysed. Additional sample(s) should be obtained from chlorophyll maxima present at other depths. At least two samples should be collected. Samples are collected using a rosette sampler which is combined with a CTD system or a cast of reversing water samplers (e.g., Niskin or Nansen bottles) equipped with reversing thermometers. For further details, see: (Part C Annex C4 Chapter 13 in the HELCOM COMBINE manual).

QA/QC

Element/Parameter pair
The quality system is formalized in the quality guidance (Part B Annex B2 in the HELCOM COMBINE manual). Guidance on the interpretation of ISO/IEC/EN 17025 'General'. Requirements for the Competence of Testing and Calibration of Laboratories' (formerly EN 45001 and ISO Guide 25) was given by a joint international EURACHEM/WELAC Working Group (EURACHEM/WELAC, 1992). Specific guidance to Analytical Quality Control for Water Analysis was elaborated by European - CEN/TC 230 (EN 14996) - as well as by international - ISO/TC 147 SC 7 (ISO/TR 13530) - standardization authorities. The analytical requirements are specified, including definition of the type and nature of the sample and its environment, concentration range of interest and permissible tolerances in analytical error (Part B Annex B3 in the HELCOM COMBINE manual). It has been established, by laboratory studies, that the performance characteristics (selectivity, sensitivity, range, limit of detection and

accuracy) of the method meet the specifications related to the intended use of the analytical results (Part B Annex B4 in the HELCOM COMBINE manual).

According to international standard, e.g. ISO 17025, a defined analytical quality has been achieved, maintained, and proven by documentation. The establishment of a system of control charts is a basic principle applied in this context. For further information for control charts refer to ISO/TR 13530 (1997). (Part B Annex B5 in the HELCOM COMBINE manual) The comparability of the data has been ensured through an external quality assessment, such as participation in external quality schemes, ring text and/ or use of external experts (Part B Annex B6 in the HELCOM COMBINE manual).

FREQUENCY

Frequency

Element/Parameter pair
High frequency cruise station sampling should be done >12 times per year during the growing season (basically monthly sampling but weekly in the growing season). In Poland 1 monitoring station is monitored 12 times per year. In Denmark, normaly the frequency is around 24 times per year, with an emphasis on the growth season. In Denmark, normaly the frequency is around 24 times per year, with an emphasis on the growth season. In Estonia 6-12 times per year during the growth season, depending on water body (under WFD). In Poland 1 monitoring station is monitored 12 times per year.

SPATIAL SCOPE

Spatial Scope

Element/Parameter pair
Chlorophyll-a is monitored in the whole Baltic including coastal, transitional water and EEZ. Phycocyanin measured only in offshore areas.

SPATIAL RESOLUTION (DENSITY) OF SAMPLING

Spatial resolution

Element/Parameter pair
Samples are taken on COMBINE stations (listed in Part C Annex C1 of the HELCOM COMBINE manual).

PARAMETER

Element/Parameter pair
SoO flow-through chlorophyll-a / Concentration of chlorophyll-a

METHOD

Element/parameter
Measured in the water column with flow-through fluorometer, 5 m depth to represent mixed layer (applies also to phycocyanin). Platform: In Finland Finnmaid (commercial ship on regular route Helsinki-Travemünde). In Estonia Tallinks Tallinn-Helsinki and Tallinn-Stockholm regular ship-routs are used (ferrybox on 2 ships). Mode of sampling: Sampling is done en route, at constant intervals. Measured at approximately 5 m depth, and represents the mixed surface layer. Flow-through fluoromete. Validation from chlorophyll-a fluorescence, phycocyanine-fluorescence and turbidity with weekly in situ measurements, of water samples with chlorophyll-a extracted and analysed in laboraratory, measurements, using multiple linear regression.

QA/QC

Element/Parameter pair
Fluorometers are calibrated annually in laboratory against standards. In Finland the analysis procedure is audited annually by FINAS laboratory accreditation. Accreditation measures performance characteristics (selectivity, sensitivity, range, limit of detection and accuracy) of the method to the intended use of the analytical results and comparability of data has been ensured through an external quality assessment. In Estonia EN-ISO 17025 laboratory/method accreditation is followed.

FREQUENCY

Frequency

Element/Parameter pair
Sampling is done between March – December, during the ice-free season. Observations are made according to the ship's schedule, with appr. 1-3 day intervals between ship passing a point along it's route. In Estonia laboratorial analyses from ferrybox sampling are done ca 12 times a year.

SPATIAL SCOPE

Spatial Scope

Element/Parameter pair
Chlorophyll-a is monitored in the whole Baltic including coastal, transitional water and EEZ.

SPATIAL RESOLUTION (DENSITY) OF SAMPLING

Spatial resolution

Element/Parameter pair
The spatial resolution of the observations is 200 m along a transect.

PARAMETER

Element/Parameter pair
Earth Observation (EO) chlorophyll-a / Concentration of chlorophyll-a

METHOD

Element/parameter
Remote sensing observations derived from satellite imagery (applies also to phycocyanin). Platform: satellite (current instruments/satellites: MODIS/Aqua and VIIRS/Suomi-NPP, during 2003-2011: MERIS/Envisat; currently Sentinel 2 and 3 are used). Mode of sampling: images are observed daily, timing depends on the overpasses of the satellites. Measurements cover non-cloudy areas with 2000-3000 km wide swath. Current instruments observe images with pixel size (ground resolution) of ~1 km size (historical years 2003-2011: ~300 m pixel size). The sampling represents the mixed surface layer. The observed depth depends on the transparency of the water. Satellite instrument sensors detect reflected signal at several visible and near infrared wavelengths forming an image that covers a 2000-3000 km wide region at one overpass. The ground resolution of the observations depends on the instrument, varying between 300m and 1 km. These observations are transformed to radiances from which Chlorophyll-a is determined using an instrument dependent model. The observations are received from roll-on archives (dependent on the instrument mission) and processed automatically following the procedure: calibration to radiance units, atmospheric correction, cloud detection, rectification. Either a bio-optical or band ratio model is used to derive Chlorophyll-a concentrations [µg/l] from the pre-processed data. For MODIS and VIIRS, an instrument default chl-a determination (OC3, O'Reilly et al., 2000) is utilized with adjusted parameterization for the Baltic Sea. For the Baltic Sea, MUMM

atmospheric correction method (Ruddick et al., 2000) is used instead of standard Gordon and Wang, 1994.

Method of validation carried out by SYKE/Finland, based on the work in EUTRO-OPER (all CP's have been invited to join if they wish): Satellite instrument determinations of chl-a are annually compared against matchups of in situ measurements and Alg@line (water samples and flow-through measurements). Currently, ICES and Finnish national monitoring programme in situ chlorophyll-a are used as reference in situ.

Chl-a algorithm applied on the comparisons is a neural network based bio-optical model that takes into account the humic substances in calculations. The bio-optical module of FUB processor is mainly based on data typical to the European coastal waters. The original training ranges of water constituents in FUB are: 0.05 - 50.0 µg /l (Chl-a), 0.05 - 50.0 mg/l-1 (TSM) and 0.005 - 1.0 m-1 (aCDOM (443 nm)), but it has been found to perform well on circumstances with higher concentrations than the original training ranges. This applies specially for a CDOM that accounts for humic substances in the water. The accuracy of chl-a interpretation has been examined on different parts of the Baltic Sea (comparisons against available monitoring station, Alg@line and ICES data).

QA/QC

Element/Parameter pair
Quality system: The processing steps and the quality of service chain have been described in Marcoast GMES service network Service Provider Validation report (Deliverable N° C6). Comparability: The data is compared annually against in situ and Alg@line-measurements. The quality assessments are reported in ongoing validation deliverables of EU/ESA projects related to operational satellite service chains (at European level). Recent quality assessments have been made in Marcoast II and CoBiOS validation deliverables. Marcoast II project validation and service quality assessment is done under MarCoast Validation Bureau that controls the validation activities within the service chain. MarCoast II ended during 2013.

FREQUENCY

Frequency

Element/Parameter pair
Period of monitoring: from beginning of April to end of October. Data is collected daily. Cloud coverage causes gaps in data collection.

SPATIAL SCOPE

Spatial Scope

Element/Parameter pair
Chlorophyll-a is monitored in the whole Baltic including coastal and transitional waters and EEZ.

SPATIAL RESOLUTION (DENSITY) OF SAMPLING

Spatial resolution

Element/Parameter pair
Spatial resolution depends on the instrument. Currently used MODIS and VIIRS detect with 1km and 750m ground resolution (pixel size), respectively. The image area covers Baltic Sea completely during one day, excluding the cloudy areas. All HELCOM assessment units are covered.

PARAMETER

Element/Parameter pair
SoO in situ chlorophyll-a / Concentration of chlorophyll-a

METHOD

Element/parameter
Measured in the water column, bottle samples taken from ship of opportunity lines. Platform: boat (ship-of-opportunity). Mode of sampling: Sampling is done en route, at fixed longitudes. Sampling is done at appr. 5 m depth, and represents the mixed surface layer. At least two samples should be taken. Water is continuously pumped through a system, taking water samples according to programming (Ferrybox sampling programme). The samples are stored in a dark refrigerator for max. 2 days. For further details of sample analysis, see: (Part C Annex C4 Chapter 13 in the HELCOM COMBINE manual).

QA/QC

Element/Parameter pair
The quality system is formalized in the quality guidance (Part B Annex B2 in the COMBINE manual). Guidance on the interpretation of ISO/IEC/EN 17025 'General Requirements for the Competence of Testing and Calibration of Laboratories' (formerly EN 45001 and ISO Guide 25) was given by a joint international EURACHEM/WELAC Working Group (EURACHEM/WELAC, 1992). Specific guidance to Analytical Quality Control for Water Analysis was elaborated by European - CEN/TC 230 (EN 14996) - as well as by international - ISO/TC 147 SC 7 (ISO/TR 13530) - standardisation authorities.

The analytical requirements are specified, including definition of the type and nature of the sample and its environment, concentration range of interest and permissible tolerances in analytical error (Part B Annex B3 in the HELCOM COMBINE manual).

It has been established, by laboratory studies, that the performance characteristics (selectivity, sensitivity, range, limit of detection and accuracy) of the method meet the specifications related to the intended use of the analytical results (Part B Annex B4 in the HELCOM COMBINE manual).

According to an international standard, e.g. ISO 17025, a defined analytical quality has been achieved, maintained, and proven by documentation. The establishment of a system of control charts is a basic principle applied in this context. For further information for control charts refer to ISO/TR 13530 (1997). (Part B Annex B5 in the HELCOM COMBINE manual).

The comparability of the data has been ensured through an external quality assessment, such as participation in external quality schemes, ring text and/ or use of external experts (Part B Annex B6 in the HELCOM COMBINE manual).

FREQUENCY

Frequency

Element/Parameter pair
Sampling is done between March–December, during the ice-free season. Samples are taken weekly / biweekly / monthly.

SPATIAL SCOPE

Spatial Scope

Element/Parameter pair
Chlorophyll a is monitored in the whole Baltic including coastal, transitional water and EEZ.

SPATIAL RESOLUTION (DENSITY) OF SAMPLING

Spatial resolution

Element/Parameter pair
-

PARAMETER

Element/Parameter pair
Surface accumulations of algal blooms

METHOD

Element/parameter
In Sweden, for monitoring of algal blooms the SMHI system, Baltic Algae Watch System, BaWS, is used, which is a satellite-based observation system for mainly blue-green (cyanobacteria) algal blooms in the Baltic Sea. Analysed satellite pictures provide a graphical presentation of the algae situation throughout the summer at smhi.se.

QA/QC

Element/Parameter pair

FREQUENCY

Frequency

Element/Parameter pair

SPATIAL SCOPE

Spatial Scope

Element/Parameter pair

SPATIAL RESOLUTION (DENSITY) OF SAMPLING

Spatial resolution

Element/Parameter pair

Provide considerations for the scale of aggregation of data for an indicator-based assessment Tick one or more relevant boxes below:

☒HELCOM assessment unit Level 4: Subbasins with coastal WFD division

☐HELCOM assessment unit Level 3: Subbasins with coastal and offshore division

☒HELCOM assessment unit Level 2: Subbasin

☒HELCOM assessment unit Level 1: Baltic Sea

☐MSFD Region

☐EU

☐Other (specify)

☐Unknown

c.5 Monitoring and assessment requirements

Monitoring requirements:

Monitoring is to be carried out to fulfill assessment requirements of HELCOM ecological objectives that are specified through HELCOM core indicators.

The requirements on monitoring can include number of stations, the sampling frequency and replication.

At least 15 observations during the period June-September should be made yearly in each assessment unit is required.

The compilation of observations is expected to be distributed spatially within the assessment unit in a non-biased way.

Adequacy for assessment of GES:

Monitoring should provide adequate data and information to enable the periodic assessment of environmental status, and distance from and progress towards GES as required by MSFD under Article 9 and Article 11.

	Yes	No
Adequate data?	☒	☐
Established methods for assessment?	☒	☐
Adequate understanding of GES?	☒	☐
Adequate capacity to perform assessments?	☒	☐

Assessment of natural variability

Quantitative.

c.6 Data providers and access

From which database the data can be made available? Tick the relevant boxes below:

☒ HELCOM COMBINE ☐ HELCOM PLC ☐HELCOM MORS

☒Other: ICES database, Algabase, SYKE (Earth Observation-data) , EEA

If the previous answer is "Other" please fill in the next questions (In case the answer is a HELCOM database, the HELCOM Secretariat will do it)

Data type Tick the relevant boxes below:

☐Unprocessed/raw Data

☒Processed Data sets

☒Data Products

☐Modelled data

Data management: General description of data management (DataManagement, Free text)

Data in national data centre: Ferrybox raw data data in TalTech Marine System Institute and Estonian Marine Institute of Tartu University; processed data also in Estonian Environment Agency. Data in international data centre: ICES database (HELCOM-COMBINE). To be specified for Ferrybox-data.

What method/mechanism will be used to make the data available? Tick the relevant boxes below and provide location (DataAccess):

☐ Providing URL to view data: Click here to enter text.

☐ Providing URL to download data: Click here to enter text.

☐ Provide location of data in national data centre: Click here to enter text.

☒ Provide location of data in international data centre (e.g. RSC, ICES, EEA, EMODnet): Open access to data (covered by ICES data policy)

When will the data first become available? (DataPublicationDate)

Enter the date of reporting, or even a past date if desired (MM/YYYY):

In situ fixed stations: The data currently available dates back from 2011/2012 and before.

How frequently are the data expected to be updated thereafter? Tick the relevant box below:

☐Every 6 years	☐Weekly
☐Every 3 years	☐Daily
☐Every 2 years	☐Hourly
☒Yearly	☐Continually
☐6-monthly	☒One-off
☐3-monthly	☐As needed
☐Monthly	☐Other (specify) Click here to enter text.
☐2-weekly	☐Unknown

List providing contact points in the Contracting Parties

Contact point to national monitoring programmes will be added

EE: Estonian Environment Agency (Anastassiia.Kovtun-Kante@envir.ee)

Has the data been used or is it planned to be used in HELCOM assessments? Tick the relevant box below:

☒Yes ☐No

E.g. BSEP143 Eutrophication status of the Baltic Sea 2007-2011 - A concise thematic assessment.

Select if data is used in the following Baltic Sea Environment Fact Sheets (BSEF) Tick the relevant boxes below:

Biodiversity

☐Abundance and distribution of marenzelleria species

☐Abundance and distribution of Round goby

☐Abundance and distribution of the Zebra mussel

☐Biopollution level index

☐Observed non-indigenous and cryptogenic species in the Baltic Sea

☐Population development of Great Cormorant

☐Population development of Sandwich Tern

☐Population development of Southern Dunlin

☐Population Development of White-tailed Sea Eagle

☐Temporal development of Baltic coastal fish communities and key species

Eutrophication

☐Bacterioplankton growth

☒Chlorophyll-a concentrations, temporal variations and regional differences from satellite remote sensing

☒Cyanobacteria biomass

☒Cyanobacterial blooms in the Baltic Sea

☒Cyanobacteria bloom index

☐Impacts of invasive phytoplankton species on the Baltic Sea ecosystem in 1980-2008

☐ Nitrogen atmospheric deposition to the Baltic Sea

☐Nitrogen emissions to the air in the Baltic Sea area

☐Phytoplankton biomass and species succession

☐Shifts in the Baltic Sea summer phytoplankton communities in 1992-2006

☐Spatial distribution of the winter nutrient pool

☐Unusual phytoplankton event

Hazardous substances

☐Atmospheric deposition of heavy metals on the Baltic Sea

☐Atmospheric deposition of PCDD/Fs on the Baltic Sea

☐Atmospheric emissions of heavy metals in the Baltic Sea region

☐Atmospheric emissions of PCDD/Fs in the Baltic Sea region

☐Cesium-137 in Baltic Sea sediments

☐Temporal trends in contaminants in Herring in the Baltic Sea in the period 1980-2010

☐Emissions from Baltic Sea shipping

☐Illegal discharges of oil in the Baltic Sea

☐Liquid discharges of Cs-137, Sr-90 and Co-60 into the Baltic Sea

☐Trace metal concentrations and trends in Baltic surface and deep waters

Hydrography

☐Development of Sea Surface Temperature in the Baltic Sea

☐Hydrography and Oxygen in the Deep Basins

☐Ice season

☐Total and regional runoff to the Baltic Sea

☐Water Exchange between the Baltic Sea and the North Sea, and conditions in the Deep Basins

☐Wave climate in the Baltic Sea

C.7 MSFD Criteria (GES Criteria)

Choose only the most relevant option(s). Tick one or more boxes below.

Descriptor 1	☐ D1C1 – Primary: The mortality rate per species from incidental by-catch is below levels which threaten the species, such that its long- term viability is ensured. Member States shall establish the threshold values for the mortality rate from incidental by-catch per species, through regional or subregional cooperation. ☐ D1C2 – Primary: The population abundance of the species is not adversely affected due to anthropogenic pressures, such that its long-term viability is ensured. Member States shall establish threshold values for each species through regional or subregional cooperation, taking account of natural variation in population size and the mortality rates derived from D1C1, D8C4 and D10C4 and other relevant pressures. For species covered by Directive 92/43/EEC, these values shall be consistent with the Favourable Reference Population values established by the relevant Member States under Directive 92/43/EEC. ☐ D1C3 – Primary for commercially- exploited fish and cephalopods and secondary for other species: The population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity, and survival rates) of the species are indicative of a healthy population which is not adversely affected due to anthropogenic pressures. Member States shall establish threshold values for specified characteristics of each species through regional or subregional cooperation, taking account of adverse effects on their health derived from D8C2, D8C4 and other relevant pressures. ☐ D1C4 – Primary for species covered by Annexes II, IV or V to Directive 92/43/EEC and secondary for other species: The species distributional range and, where relevant, pattern is in line with prevailing physiographic, geographic and climatic conditions. Member States shall establish threshold values for each species through regional or subregional cooperation. For species covered by Directive 92/43/EEC, these shall be consistent with the Favourable Reference Range values established by the relevant Member States under Directive 92/43/EEC. ☒ D1C5 – Primary for species covered by Annexes II, IV and V to Directive 92/43/EEC and secondary for other species: The habitat for the species has the necessary extent and condition to support the different stages in the life history of the species. ☐ D1C6 – Primary The condition of the habitat type, including its biotic and abiotic structure and its functions (e.g. its typical species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure

	of species), is not adversely affected due to anthropogenic pressures. Member States shall establish threshold values for the condition of each habitat type, ensuring compatibility with related values set under Descriptors 2, 5 and 8, through regional or subregional cooperation.
Descriptor 2	☐ D2C1 – Primary: The number of non-indigenous species which are newly introduced via human activity into the wild, per assessment period (6 years), measured from the reference year as reported for the initial asessment under Article 8(1) of Directive 2008/56/EC, is minimised and where possible reduced to zero. Member States shall establish the threshold value for the number of new introductions of non-indigenous species, through regional or subregional cooperation. ☐ D2C2 — Secondary: Abundance and spatial distribution of established non-indigenous species, particularly of invasive species, contributing significantly to adverse effects on particular species groups or broad habitat types. ☐ D2C3 — Secondary: Proportion of the species group or spatial extent of the broad habitat type which is adversely altered due to non-indigenous species, particularly invasive non-indigenous species. Member States shall establish the threshold values for the adverse alteration to species groups and broad habitat types due to non-indigenous species, through regional or subregional cooperation.
Descriptor 3	☐ D3C1 — Primary: The Fishing mortality rate of populations of commercially-exploited species is at or below levels which can produce the maximum sustainable yield (MSY). Appropriate scientific bodies shall be consulted in accordance with Article 26 of Regulation (EU) No 1380/2013. ☐ D3C2 — Primary: The Spawning Stock Biomass of populations of commercially-exploited species are above biomass levels capable of producing maximum sustainable yield. Appropriate scientific bodies shall be consulted in accordance with Article 26 of Regulation (EU) No 1380/2013. ☐ D3C3 — Primary: The age and size distribution of individuals in the populations of commercially-exploited species is indicative of a healthy population. This shall include a high proportion of old/large individuals and limited adverse effects of exploitation on genetic diversity. Member States shall establish threshold values through regional or subregional cooperation for each population of species in accordance with scientific advice obtained pursuant to Article 26 of Regulation (EU) No 1380/2013.
Descriptor 4	☐ D4C1 — Primary: The diversity (species composition and their relative abundance) of the trophic guild is

	not adversely affected due to anthropogenic pressures. Member States shall establish threshold values through regional or subregional cooperation. ☐ D4C2 — Primary: The balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures. Member States shall establish threshold values through regional or subregional cooperation. ☐ D4C3 — Secondary: The size distribution of individuals across the trophic guild is not adversely affected due to anthropogenic pressures. Member States shall establish threshold values through regional or subregional cooperation. ☐ D4C3 — Secondary (to be used in support of criterion D4C2, where necessary): Productivity of the trophic guild is not adversely affected due to anthropogenic pressures. Member States shall establish threshold values through regional or subregional cooperation.
Descriptor 5	☐ D5C1 — Primary: Nutrient concentrations are not at levels that indicate adverse eutrophication effects. The threshold values are as follows: (a) in coastal waters, the values set in accordance with Directive 2000/60/EC; (b) beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation ☒ D5C2 — Primary: Chlorophyll a concentrations are not at levels that indicate adverse effects of nutrient enrichment. The threshold values are as follows: (c) in coastal waters, the values set in accordance with Directive 2000/60/EC; (d) beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation. ☒ D5C3 — Secondary: The number, spatial extent and duration of harmful algal bloom events are not at levels that indicate adverse effects of nutrient enrichment. ☒ D5C4 — Secondary: The photic limit (transparency) of the water column is not reduced, due to increases in suspended algae, to a level that indicates adverse effects of nutrient enrichment.

	The threshold values are as follows: (e) in coastal waters, the values set in accordance with Directive 2000/60/EC; (f) beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation. ☐ D5C5 — Primary (may be substituted by D5C8): The concentration of dissolved oxygen is not reduced, due to nutrient enrichment, to levels that indicate adverse effects on benthic habitats (including on associated biota and mobile species) or other eutrophication effects. The threshold values are as follows: (g) in coastal waters, the values set in accordance with Directive 2000/60/EC; (h) beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation. ☐ D5C6 — Secondary: The abundance of opportunistic macroalgae is not at levels that indicate adverse effects of nutrient enrichment. The threshold values are as follows: (a) in coastal waters, the values set in accordance with Directive 2000/60/EC; (b) should this criterion be relevant for waters beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation. ☐ D5C7 — Secondary: The species composition and relative abundance or depth distribution of macrophyte communities achieve values that indicate there is no adverse effect due to nutrient enrichment including via a decrease in water transparency, as follows: (a) in coastal waters, the values set in accordance with Directive 2000/60/EC; (b) should this criterion be relevant for waters beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation. ☐ D5C8 — Secondary: (except when used as a substitute for D5C5): The species composition and relative abundance of macrofaunal communities, achieve values that indicate that there is no adverse effect due to nutrient and organic enrichment, as follows: (a) in coastal waters, the values for benthic biological quality elements set in accordance with Directive 2000/60/EC; (b) beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation.
Descriptor 6	☐ D6C1 – Primary:

	Spatial extent and distribution of physical loss (permanent change) of the natural seabed. ☐ D6C2 – Primary: Spatial extent and distribution of physical disturbance pressures on the seabed. ☐ D6C3 – Primary: Spatial extent of each habitat type which is adversely affected, through change in its biotic and abiotic structure and its functions (e.g. through changes in species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), by physical disturbance. Member States shall establish threshold values for the adverse effects of physical disturbance, through regional or subregional cooperation. ☐ D6C4 – Primary: The extent of loss of the habitat type, resulting from anthropogenic pressures, does not exceed a specified proportion of the natural extent of the habitat type in the assessment area. Member States shall establish the maximum allowable extent of habitat loss as a proportion of the total natural extent of the habitat type, through cooperation at Union level, taking into account regional or subregional specificities. ☐ D6C5 – Primary: The extent of adverse effects from anthropogenic pressures on the condition of the habitat type, including alteration to its biotic and abiotic structure and its functions (e.g. its typical species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), does not exceed a specified proportion of the natural extent of the habitat type in the assessment area. Member States shall establish threshold values for adverse effects on the condition of each habitat type, ensuring compatibility with related values set under Descriptors 2, 5, 6, 7 and 8, through cooperation at Union level, taking into account regional or subregional specificities. Member States shall establish the maximum allowable extent of those adverse effects as a proportion of the total natural extent of the habitat type, through cooperation at Union level, taking into account regional or subregional specificities.
Descriptor 7	☐ D7C1 – Secondary: Spatial extent and distribution of permanent alteration of hydrographical conditions (e.g. changes in wave action, currents, salinity, temperature) to the seabed and water column, associated in particular with physical loss(1) of the natural seabed. ☐ D7C2 – Secondary: Spatial extent of each benthic habitat type adversely affected (physical and hydrographical characteristics and associated biological communities) due to permanent alteration of hydrographical conditions.
Descriptor 8	☐ D8C1 – Primary:

	Within coastal and territorial waters, the concentrations of contaminants do not exceed the following threshold values: (a) for contaminants set out under point 1(a) of criteria elements, the values set in accordance with Directive 2000/60/EC; (b) when contaminants under point (a) are measured in a matrix for which no value is set under Directive 2000/60/EC, the concentration of those contaminants in that matrix established by Member States through regional or subregional cooperation; (c) for additional contaminants selected under point 1(b) of criteria elements, the concentrations for a specified matrix (water, sediment or biota) which may give rise to pollution effects. Member States shall establish these concentrations through regional or subregional cooperation, considering their application within and beyond coastal and territorial waters. Beyond territorial waters, the concentrations of contaminants do not exceed the following threshold values: (a) for contaminants selected under point 2(a) of criteria elements, the values as applicable within coastal and territorial waters; (b) for contaminants selected under point 2(b) of criteria elements, the concentrations for a specified matrix (water, sediment or biota) which may give rise to pollution effects. Member States shall establish these concentrations through regional or subregional cooperation. ☐ D8C2 – Secondary: The health of species and the condition of habitats (such as their species composition and relative abundance at locations of chronic pollution) are not adversely affected due to contaminants including cumulative and synergetic effects. Member States shall establish those adverse effects and their threshold values through regional or subregional cooperation. ☐ D8C3 – Primary: The spatial extent and duration of significant acute pollution events are minimised. ☐ D8C4 – Secondary (to be used when a significant acute pollution event has occurred): The adverse effects of significant acute pollution events on the health of species and on the condition of habitats (such as their species composition and relative abundance) are minimised and, where possible, eliminated.
Descriptor 9	☐ D9C1 – Primary: The level of contaminants in edible tissues (muscle, liver, roe, flesh or other soft parts, as appropriate) of seafood (including fish, crustaceans, molluscs, echinoderms, seaweed and other marine plants) caught or harvested in the wild (excluding fin-fish from mariculture) does not exceed: (a) for contaminants listed in Regulation (EC) No 1881/2006, the maximum levels laid down in that Regulation, which are the threshold values for the purposes of this Decision; (b) for additional contaminants, not listed in Regulation (EC) No 1881/2006,

	threshold values, which Member States shall establish through regional or subregional cooperation.
Descriptor 10	☐ D10C1 – Primary: The composition, amount and spatial distribution of litter on the coastline, in the surface layer of the water column, and on the seabed, are at levels that do not cause harm to the coastal and marine environment. Member States shall establish threshold values for these levels through cooperation at Union level, taking into account regional or subregional specificities. ☐ D10C2 — Primary: The composition, amount and spatial distribution of micro-litter on the coastline, in the surface layer of the water column, and in seabed sediment, are at levels that do not cause harm to the coastal and marine environment. Member States shall establish threshold values for these levels through cooperation at Union level, taking into account regional or subregional specificities. ☐ D10C3 — Secondary: The amount of litter and micro-litter ingested by marine animals is at a level that does not adversely affect the health of the species concerned. Member States shall establish threshold values for these levels through regional or subregional cooperation. ☐ D10C4 — Secondary: The number of individuals of each species which are adversely affected due to litter, such as by entanglement, other types of injury or mortality, or health effects. Member States shall establish threshold values for the adverse effects of litter, through regional or subregional cooperation.
Descriptor 11	☐ D11C1 – Primary: The spatial distribution, temporal extent, and levels of anthropogenic impulsive sound sources do not exceed levels that adversely affect populations of marine animals. Member States shall establish threshold values for these levels through cooperation at Union level, taking into account regional or subregional specificities. ☐ D11C2 – Primary: The spatial distribution, temporal extent and levels of anthropogenic continuous low-frequency sound do not exceed levels that adversely affect populations of marine animals. Member States shall establish threshold values for these levels through cooperation at Union level, taking into account regional or subregional specificities.

d. References

Make a list of cited references and literature for further supportive information.

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