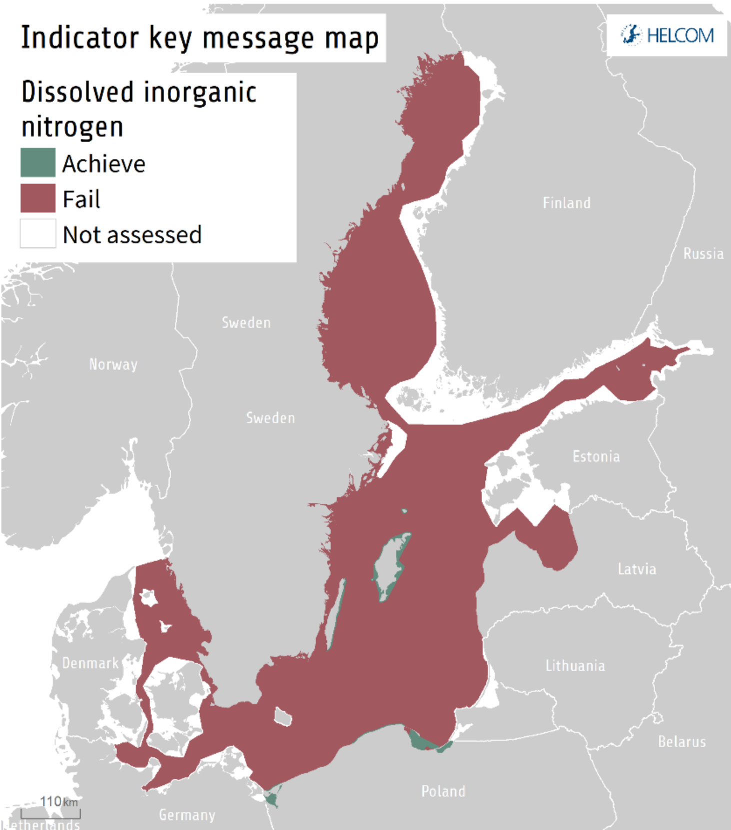
HELCOM core indicator report
July 2018

Dissolved inorganic nitrogen (DIN)

Key Message

The core indicator evaluates average dissolved inorganic nitrogen (DIN) concentration in surface waters (0 – 10 m) during winter (December – February) for the assessment period 2011-2016.

Of the 17 open-sea assessment units none achieved good status (DIN concentration below defined threshold values, which reflect good conditions, Key message figure 1). The winter-time DIN is still at elevated levels in all 17 sub-basins. Decreases in DIN were recorded in the 1990s or the early 2000s, and since this decrease concentrations have generally remained at that level and not decreased further. Of all coastal waters where DIN was assessed, good eutrophication status was only found in Polish coastal waters and around the Swedish islands in Gotland Basin.



Key message figure 1. Status assessment result evaluation of the indicator 'DIN'. The assessment is carried out using Scale 4 HELCOM assessment units (defined in the HELCOM Monitoring and Assessment Strategy Annex 4). See Results section below for details. **Click here to access interactive maps at the HELCOM Map and Data Service: Dissolved inorganic nitrogen.**

The confidence in the indicator DIN status evaluation was only **high** for the Kattegat, Arkona Basin, Bornholm Basin and Gulf of Finland assessment units. In all other open sea sub-basins the confidence was **moderate or low** (see below).

The indicator is applicable in the waters of all countries bordering the Baltic Sea. In coastal waters, total nitrogen may have been assessed instead of DIN (see Total Nitrogen indicator report) in line with the national assessments under the Water Framework Directive and the Russian Maritime Doctrine.

Relevance of the core indicator

Eutrophication is caused by excessive inputs of nutrients (nitrogen and phosphorus) resulting from various human activities. High concentrations of nutrients and the ratios of these nutrients (e.g. N:P stoichiometric ratios) form the preconditions for algal blooms, reduced water clarity and increased oxygen consumption. Long-term nutrient data are key parameters for quantifying the effects of anthropogenic activities and evaluating the success of measures undertaken.

Policy relevance of the core indicator

	BSAP Segment and Objectives	MSFD Descriptors and Criteria
Primary link	Baltic Sea unaffected by eutrophication	D5 Human-induced eutrophication - D5C1 Nutrient concentrations are not at levels that indicate adverse eutrophication effects
Secondary link		D1 Biological diversity of species and habitats Theme: Pelagic habitats -D1C6 The condition of the habitat type, including its biotic and abiotic structure and its functions, is not adversely affected due to anthropogenic pressures. Theme: Benthic habitats -D6C5 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, does not exceed a specified proportion of the natural extent of the benthic habitat type in the assessment area.
Other relevant legislation: EU Water Framework Directive		

Cite this indicator

HELCOM (2018). Dissolved inorganic nitrogen (DIN). HELCOM core indicator report. Online. [Date Viewed], [Web link].

ISSN 2343-2543

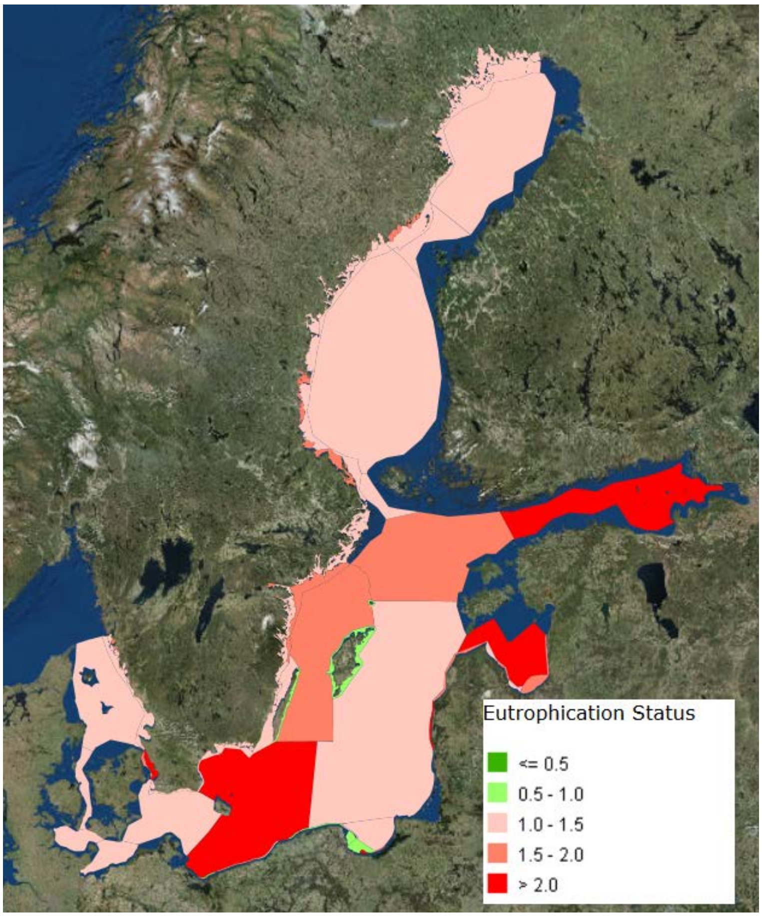
Download full indicator report

Dissolved inorganic nitrogen DIN HELCOM core indicator 2018 (pdf)

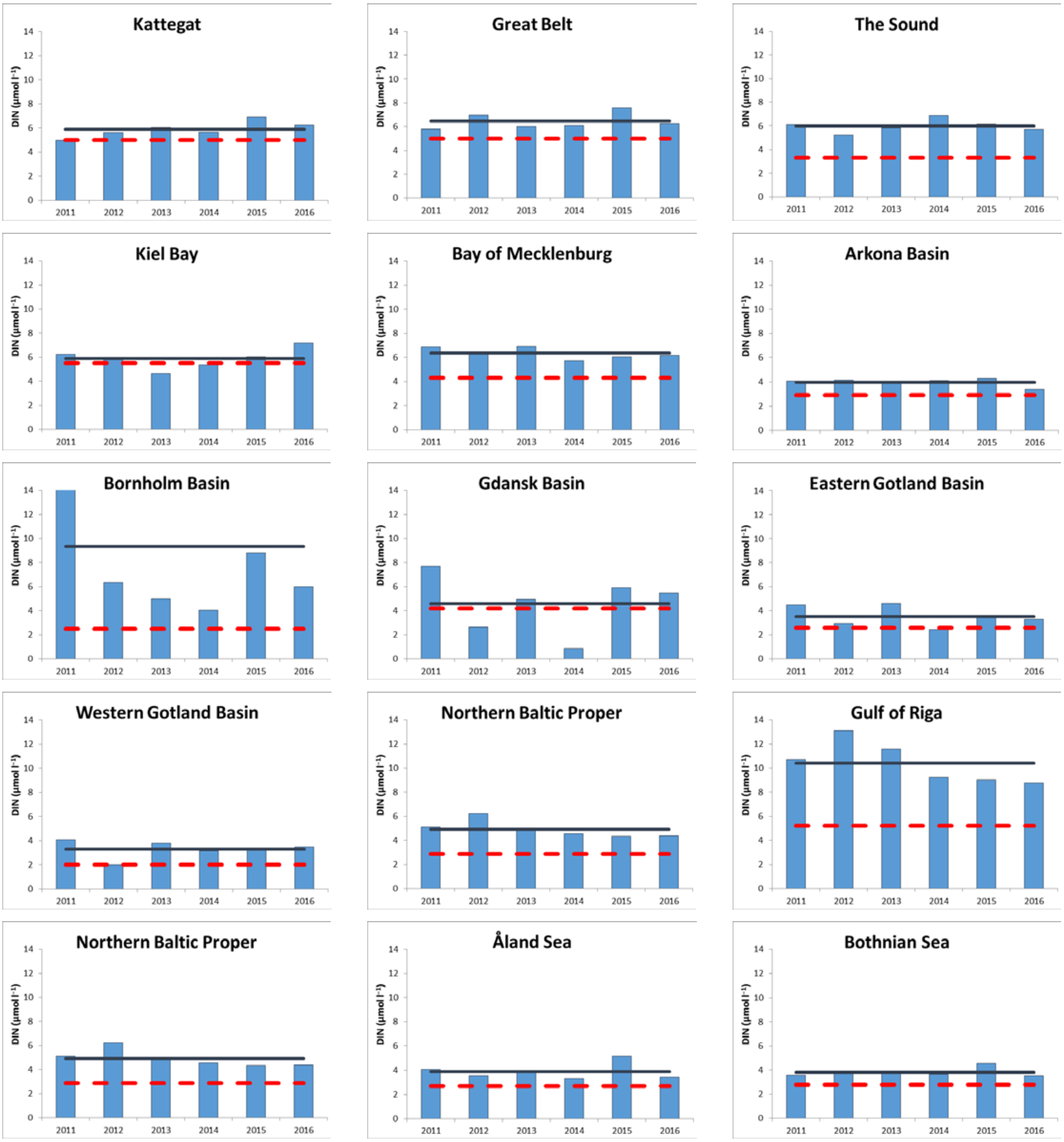
Results and Confidence

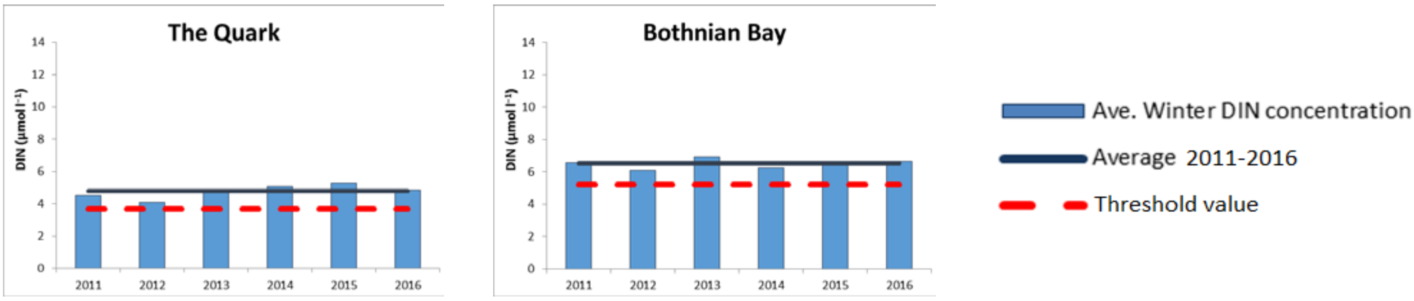
Current status of the Baltic Sea DIN concentration

Good status (concentrations below threshold) for dissolved inorganic nitrogen (DIN) was not been achieved in any of the 17 open-sea sub-basins. Only in a few Polish and Swedish coastal areas (e.g. parts of the Gulf of Gdansk – the Puck bay area) was good status achieved (Results figure 1 and Results Table 2). The sub-basins causing greatest concern (ER values >2) regarding dissolved inorganic nitrogen status were the Gulf of Finland, Gulf of Riga, and Bornholm Basin. The status of Kattegat, Kiel Bay and Gdansk Basin are only slightly above the threshold values (ER < 1.2). Additionally, there has been a steady decrease in DIN in recent years in the Gulf of Riga and in the Northern Baltic Proper (Results figure 2). Some sub-basins showed elevated DIN values in 2015/2016 which might relate to the natural phenomenon of the major Baltic inflow that occurred. This might have contributed additional nitrogen from deeper waters and could have biased DIN concentrations in the Bornholm Basin, Gdansk Basin, Åland Sea and Bothnian Sea.



Results Figure 1. Status of the DIN, presented as eutrophication ratio (ER). ER shows the present concentration in relation to the threshold value, increasing along with increasing eutrophication. The threshold value is ER ≤ 1.00 (achieve good status).


Kattegat
Great Belt
The Sound
Kiel Bay
Bay of Mecklenburg
Arkona Basin
Bornholm Basin
Gdansk Basin
Eastern Gotland Basin
Western Gotland Basin
Northern Baltic Proper
Gulf of Riga
Northern Baltic Proper
Åland Sea
Bothnian Sea
DIN (µmol l⁻¹)
0 2 4 6 8 10 12 14
2011 2012 2013 2014 2015 2016



Results figure 2. Winter DIN concentration on open sea assessment units (solid dark blue line; average for 2011-2016) and threshold values as agreed by HELCOM HOD 39/2012 (red dashed line). It should be noted that the results for Bornholm Basin strongly depend on stations in the open-sea area of Pomeranian Bay, which is influenced by the Odra river plume.

Results table 1. Threshold values, concentration during the assessment period (2011-2016 average), eutrophication ratio (ER) and status of DIN in the open-sea basins. ER is a quantitative value for the level of eutrophication, calculated as the ratio between the threshold value and the assessed concentration – when ER > 1 = threshold value is failed.

Assessment unit (open sea)	Threshold value (µmol l^{-1})	Average 2011-2016 (µmol l^{-1})	Eutrophication ratio, ER	Status (fail/achieved threshold value)
Kattegat	5.00	5.90	1.18	fail
Great Belt	5.00	6.45	1.29	fail
The Sound	3.30	5.99	1.82	fail
Kiel Bay	5.50	5.91	1.07	fail
Bay of Mecklenburg	4.30	6.35	1.48	fail
Arkona Basin	2.90	3.97	1.37	fail
Bornholm Basin	2.50	9.33	3.73	fail
Gdansk Basin	4.20	4.60	1.09	fail
Eastern Gotland Basin	2.60	3.55	1.36	fail
Western Gotland Basin	2.00	3.27	1.64	fail
Gulf of Riga	5.20	10.42	2.00	fail
Northern Baltic Proper	2.90	4.93	1.70	fail
Gulf of Finland	3.80	8.59	2.26	fail
Aland Sea	2.70	3.88	1.44	fail
Bothnian Sea	2.80	3.82	1.36	fail
The Quark	3.70	4.78	1.29	fail
Bothnian Bay	5.20	6.50	1.25	fail

Winter DIN concentrations were only assessed in coastal waters of Latvia, Poland and Sweden (Results table2). In the Polish coastal and transitional waters 77% of the area (km^2) was in good status and 23% failed to achieve good status. In Swedish coastal waters 7% of the area was in good status, 7% was not assessed and 86% failed to achieve good status. In the coastal waters of Latvia 100% of the areas failed to achieve good status. It should be noted that coastal or transitional waters assessed with annual DIN averages have been excluded from this analysis.

Results table2. Results for national coastal DIP indicators by coastal WFD water type/water body. The table includes information on the assessment unit (CODE, defined in the HELCOM Monitoring and Assessment Strategy Annex 4), assessment period (start year and end year), average concentration during assessment period, threshold values, units, and Eutrophication Ratio (ER). The ER is coloured red or green to denote if the status evaluation has been failed or achieved, respectively. *indicates data used are annual, all other data are for the summer season, - indicates only status provided and not raw result value. In Swedish waters only the water bodies that were assessed are shown. ER is a quantitative value for the level of eutrophication, calculated as the ratio between the threshold value and the present concentration – when ER > 1, threshold value has not been reached. Note that the units used in table can be µmol l^{-1} or µg l^{-1} depending on Contracting Party.

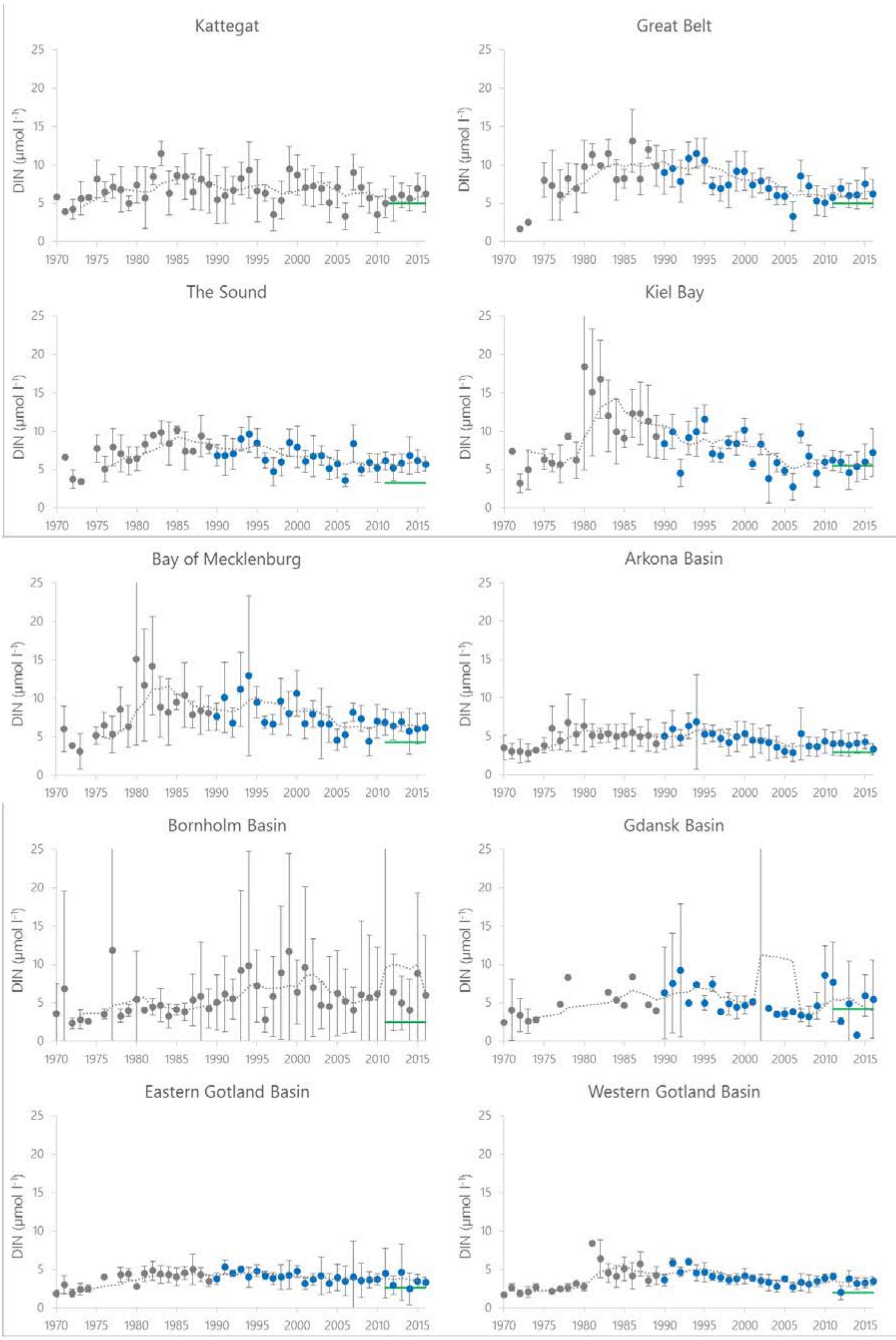
CODE	Period	Average	Threshold value	Units	Eutrophication ratio (ER)
LAT-001	2005-2009	21.90	8.00	µmol l^{-1}	2.74
LAT-002	2005-2009	14.90	8.00	µmol l^{-1}	1.86
LAT-003	2005-2009	12.50	11.00	µmol l^{-1}	1.14
LAT-004	2005-2009	20.30	11.00	µmol l^{-1}	1.85
LAT-005	2005-2009	27.00	14.00	µmol l^{-1}	1.93
POL-001	2011-2016	0.36	1.05	mg l^{-1}	0.34
POL-002	2011-2016	0.44	1.05	mg l^{-1}	0.42
POL-003	2011-2016	0.10	0.38	mg l^{-1}	0.27
POL-004	2011-2016	0.04	0.03	mg l^{-11}	1.38
POL-005	2011-2016	0.12	0.15	mg l^{-1}	0.83
POL-006	2011-2016	0.10	0.15	mg l^{-1}	0.65
POL-007	2011-2016	0.31	0.18	mg l^{-1}	1.72
POL-008	2011-2016	0.81	0.23	mg l^{-1}	3.58
POL-009	2011-2016	0.50	0.32	mg l^{-1}	1.56
POL-010	2011-2016	0.12	0.10	mg l^{-1}	1.23
POL-011	2011-2016	0.28	0.15	mg l^{-1}	1.88
POL-012	2011-2016	0.14	0.10	mg l^{-1}	1.36
POL-013	2011-2016	0.19	0.10	mg l^{-1}	1.85
POL-014	2011-2016	0.37	0.10	mg l^{-1}	3.68
POL-015	2011-2016	0.10	0.10	mg l^{-1}	0.96
POL-016	2011-2016	0.06	0.10	mg l^{-1}	0.63
POL-017	2011-2016	0.07	0.10	mg l^{-1}	0.72
POL-018	2011-2016	0.19	0.23	mg l^{-1}	0.82
POL-019	2011-2016	0.12	0.10	mg l^{-1}	1.17
SWE-001	2011-2016	-	0.67	EQR	1.21
SWE-003	2011-2016	-	0.67	EQR	1.21
SWE-004	2011-2016	-	0.67	EQR	1.40
SWE-005	2011-2016	-	0.67	EQR	2.30
SWE-006	2011-2016	-	0.67	EQR	1.27
SWE-007	2011-2016	-	0.67	EQR	1.04
SWE-008	2011-2016	-	0.67	EQR	1.28
SWE-009	2011-2016	-	0.66	EQR	0.83
SWE-010	2011-2016	-	0.66	EQR	0.78
SWE-011	2011-2016	-	0.67	EQR	1.46

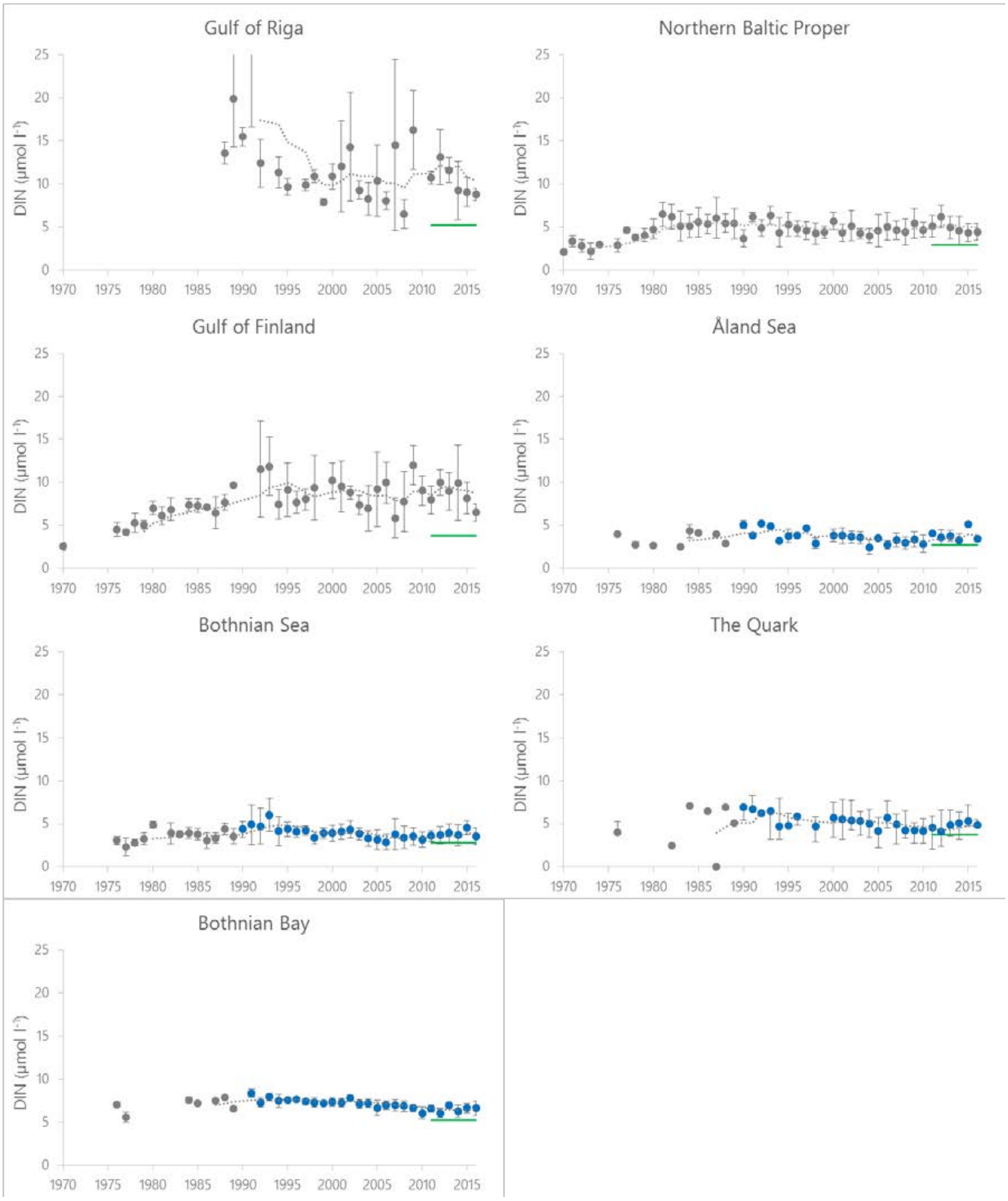
SWE-012	2011-2016	-	0.67	EQR	**1.36**
SWE-013	2011-2016	-	0.67	EQR	**1.74**
SWE-014	2011-2016	-	0.67	EQR	**1.84**
SWE-016	2011-2016	-	0.67	EQR	**1.52**
SWE-017	2011-2016	-	0.67	EQR	**1.04**
SWE-018	2011-2016	-	0.66	EQR	**1.13**
SWE-019	2011-2016	-	0.66	EQR	**1.20**
SWE-020	2011-2016	-	0.67	EQR	**1.59**
SWE-021	2011-2016	-	0.67	EQR	**1.21**
SWE-022	2011-2016	-	0.67	EQR	**1.20**
SWE-023	2011-2016	-	0.67	EQR	**1.21**
SWE-025	2011-2016	-	0.67	EQR	**1.84**

Long-term trends

The long-term trends are provided as additional information and do not influence the status assessment.

Though the wintertime DIN is at elevated levels in all 17 sub-basins, it decreased in the 1990s or the early 2000s in most sub-basins and has since then remained at that level (Results figure 3). Although the pattern is not as distinct as for dissolved inorganic phosphorus (DIP), the DIN concentration showed some disturbance (e.g. elevated concentrations and large error bars) in the concentration in recent years, most visible in the Bornholm Basin (2015 and 2016), Eastern Gotland Sea (2015), Åland Sea (2015) and the Bothnian Sea (2015) (see Results figure 2).

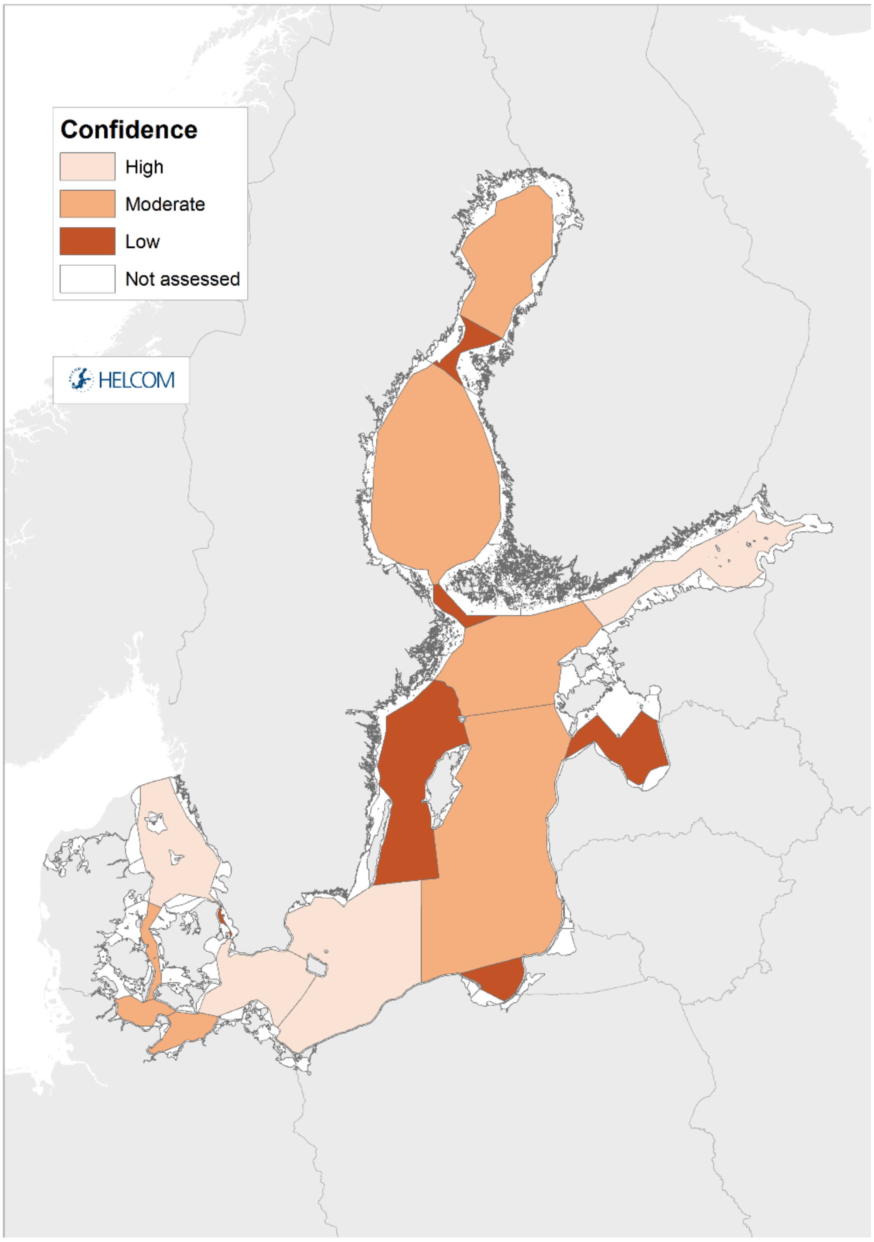

Kattegat
Great Belt
The Sound
Kiel Bay
Bay of Mecklenburg
Arkona Basin
Bornholm Basin
Gdansk Basin
Eastern Gotland Basin
Western Gotland Basin
DIN (µmol l-1)
0
5
10
15
20
25
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015



Result figure 3. Temporal development of winter dissolved inorganic nitrogen (DIN) concentrations in the open-sea assessment units from 1970-2016. Dashed lines show the five-year moving averages and error bars the standard deviation. Green lines denote the indicator threshold. Significance of trends was assessed with Mann-Kendall non-parametric tests for period from 1990-2016. Significant ($p<0.05$) improving trends are indicated with blue data points. No significant deteriorating trends were detected.

Confidence of the indicator status evaluation

The confidence of the indicator status evaluation in open sea areas, based on the spatial and temporal coverage of data as well as the accuracy of the protocol for setting threshold values, was **high** only in the Kattegat, Arkona and Bornholm Basin and Gulf of Finland, while it was **low** in The Sound, Gdansk Basin, Gulf of Riga, Western Gotland Basin, Åland Sea and The Quark. The low confidence was caused by a lack of monitoring data.

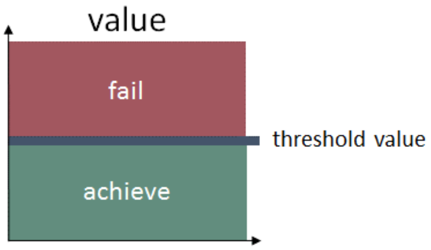


Results figure 4. Indicator confidence, determined by combining information on data availability and the accuracy of the protocol for setting threshold values. Low indicator confidence calls for increase in monitoring.

The indicator confidence was estimated through confidence scoring of the threshold value (ET-Score) and the indicator data (ES-Score). The ET-Score was rated based on the uncertainty of the threshold value setting procedure. The ES-Score is based on the number as well as spatial and temporal coverage of the observations for the assessment period 2011-2015. To estimate the overall indicator confidence, the ET- and ES-Scores were combined. See Andersen et al. 2010 and Fleming-Lehtinen et al. 2015 for further details.

Thresholds and Status evaluation

Status evaluation is measured in relation to scientifically based and commonly agreed sub-basin specific threshold value, which defines the concentration that should not be exceeded (Thresholds figure 1).



Thresholds figure 1. Schematic representation of the threshold values applied in the DIN core indicator, the threshold values are assessment unit specific (see Thresholds table 1).

These indicator threshold values were based on the results obtained in the TARGREV project (HELCOM 2013a), also taking advantage of the work carried out during the EUTRO PRO process (HELCOM 2009) and national work for EU WFD. The final threshold values were set through an expert evaluation process done via intersessional activity to develop core eutrophication indicators (HELCOM CORE EUTRO), and the threshold values were adopted by the HELCOM Heads of Delegations 39/2012.

Thresholds table 1. Assessment unit specific threshold values for the DIN core indicator.

HELCOM_ID	Assessment unit (open sea)	Threshold value (µmol l^{-1})
SEA-001	Kattegat	5.00
SEA-002	Great Belt	5.00
SEA-003	The Sound	3.30
SEA-004	Kiel Bay	5.50
SEA-005	Bay of Mecklenburg	4.30
SEA-006	Arkona Basin	2.90
SEA-007	Bornholm Basin	2.50
SEA-008	Gdansk Basin	4.20
SEA-009	Eastern Gotland Basin	2.60
SEA-010	Western Gotland Basin	2.00
SEA-011	Northern Baltic Proper	5.20
SEA-012	Gulf of Riga	2.90
SEA-013	Gulf of Finland	3.80
SEA-014	Åland Sea	2.70
SEA-015	Bothnian Sea	2.80
SEA-016	The Quark	3.70
SEA-017	Bothnian Bay	5.20

Assessment Protocol

For open sea assessment, this core indicator is 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. The values are achieved using indicators specifications shown in Assessment protocol table 1 (see HELCOM Eutrophication assessment manual).

Assessment protocol table 1. Specifications for the DIN indicator.

Indicator	DIN
Response to eutrophication	Positive
Parameters	DIN = NO2 + NO3 + NH4 concentration (µM/l)
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)	2011-2016
Assessment season	Winter = December + January + February
Depth	Surface = average in the 0 – 10 m layer
Removing outliers	No outliers removed
Removing close observations	No close observations removed
Indicator level	average of yearly average values
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 status observations are found each year.
Indicator threshold value confidence	MODERATE
Indicator confidence (I-Score)	Confidence (%) = average of ES-Score and ET-Score

Assessment units

The core indicator is applicable in the 17 open sea assessment units (at least one nautical mile seawards from the baseline). In the coastal units, the indicator is assessed using comparable indicators developed nationally for the purposes of assessments under the EU Water Framework Directive.

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

Relevance of the Indicator

Eutrophication assessment

The status of eutrophication is assessed using several core indicators. Each indicator focuses on one important aspect of the complex issue. In addition to providing an indicator-based evaluation of the dissolved inorganic nitrogen, this indicator contributes to the overall eutrophication assessment along with the other eutrophication core indicators.

Policy relevance

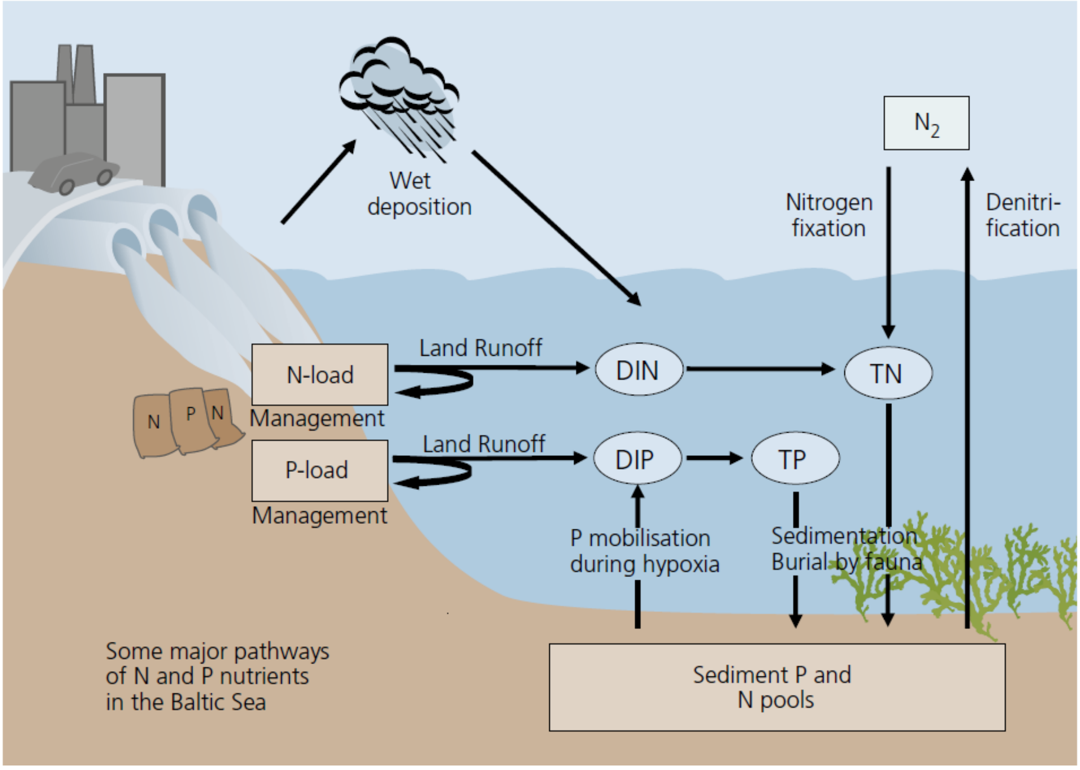
Eutrophication is one of the four thematic segments of the HELCOM Baltic Sea Action Plan (BSAP) with the strategic goal of having a Baltic Sea unaffected by eutrophication (HELCOM 2007). Eutrophication is defined in the BSAP as a condition in an aquatic ecosystem where high nutrient concentrations stimulate the growth of algae, which leads to imbalanced functioning of the system. Nutrient concentrations in the water column are caused by increased anthropogenic nutrient loads from land and air. The goal for eutrophication is broken down into five ecological objectives, of which one is “concentrations of nutrients close to natural levels”.

The EU Marine Strategy Framework Directive (Anonymous 2008) requires that “human-induced eutrophication is minimized, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters” (Descriptor 5). ‘Nutrients in the watercolumn’ (including DIN) are determined as the criteria elements for assessing eutrophication under the criterion ‘D5C1 – Nutrient concentrations are not at levels that indicate adverse eutrophication effects’.

The EU Water Framework Directive (Anonymous 2000) requires good ecological status in the European coastal waters. Good ecological status is defined in Annex V of the Water Framework Directive, in terms of the quality of the biological community, the hydrological characteristics and the chemical characteristics, including nitrogen concentration.

Role of dissolved inorganic nitrogen (DIN) in the ecosystem

Marine eutrophication is mainly caused by nutrient enrichment, leading to increased production of organic matter in the Baltic Sea, with subsequent effects on water transparency, phytoplankton communities, benthic fauna and vegetation, as well as oxygen conditions. Phytoplankton as well as benthic vegetation need nutrients, mainly nitrogen and phosphorus, for growth. DIN is influenced by complex biotic processes like nitrogen fixation in surface waters by cyanobacteria – a DIN source - and microbial denitrification in oxygen depleted environments of deeper waters – a DIN sink (Relevance figure 1).



Relevance figure 1. Simplified conceptual model for N and P nutrients in the Baltic Sea, where DIN = Dissolved inorganic nitrogen, TN = Total nitrogen, DIP = Dissolved inorganic phosphorus and TP = Total phosphorus. Flows along arrows into the blue sea area tend to increase concentrations, and flows along arrows out from the sea act in the opposite direction. Management refers to nutrient load reductions.

Human pressures linked to the indicator

	General	MSFD Annex III, Table 2
Strong link		Substances, litter and energy - Input of nutrients – diffuse sources, point sources, atmospheric deposition
Weak link		

Nutrient concentrations in the water column are affected by increased anthropogenic nutrient loads from land and air.

Monitoring Requirements

Monitoring methodology

Monitoring of nitrogen concentrations by the Contracting Parties of HELCOM is described on a general level in the **HELCOM Monitoring Manual in the sub-programme Nutrients.**

Monitoring guidelines specifying the sampling strategies for nitrate, nitrite and ammonium are adopted and published.

Current monitoring

The monitoring activities relevant to the indicator, as currently carried out by HELCOM Contracting Parties, are described in the **HELCOM Monitoring Manual sub-programme Nutrients monitoring concepts table.**

Description of optimal monitoring

Regional monitoring of dissolved inorganic nitrogen is considered sufficient to support the indicator evaluation. Increased monitoring in certain areas would further improve the confidence in future assessments.

Data and updating

Access and use

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

HELCOM (2018) Dissolved inorganic nitrogen (DIN). HELCOM core indicator report. Online. [Date Viewed], [Web link].

ISSN 2343-2543

Metadata

Result: Dissolved inorganic nitrogen

Data source: The average for 2011-2016 was estimated using monitoring data provided by the HELCOM Contracting Parties, and kept in the HELCOM COMBINE database, hosted by ICES (www.ices.dk). Nominated members of HELCOM STATE & CONSERVATION group were given the opportunity to review the data, and to supply any missing monitoring observations, in order to achieve a complete dataset.

Description of data: The data include the sum of *in-situ* nitrate and nitrite samples, determined using colorimetric methods, as explained in the HELCOM COMBINE manual. In the assessment, only surface water measurements at depths of 0-10 m are reported.

Geographical coverage: The observations are distributed in the sub-basins according to the HELCOM COMBINE programme, added occasionally with data from research cruises.

Temporal coverage: The raw data includes observations throughout the year, during the assessment period 2011-2016.

Data aggregation: The 2011-2016 averages for each sub-basin were produced as an inter-annual winter (December-February) estimates.

Contributors and references

Vivi Fleming-Lehtinen[1], Marina Carstens[2], Wera Leujak[3], Joachim Küss[4], Wojciech Kraśniewski [5], Joni Kaitaranta[6], Laura Hoikkala[6], HELCOM Expert Network on Eutrophication

[1] Finnish Environment Institute, SYKE, Finland
[2] State Agency for Environment, Nature Protection and Geology Mecklenburg-Vorpommern, Germany
[3] German Federal Environment Agency, Germany
[4] Leibniz Institute for Baltic Sea Research Warnemünde (IOW), Germany
[5] Institute of Meteorology and Water Management, National Research Institute, Poland
[6] Secretariat of the Helsinki Commission

Archive

This version of the HELCOM core indicator report was published in July 2018:

Dissolved inorganic nitrogen DIN HELCOM core indicator 2018 (pdf)

Older versions of the core indicator report are available:

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

DIN concentrations 2007-2011 (pdf)

Nutrient concentrations 2003-2007 - HELCOM Core Indicator Report (pdf)

References

Andersen, J. H., Murray, C., Kaartokallio, H., Axe, P. & Molvær, J. (2010). Confidence rating of eutrophication status classification. Marine Pollution Bulletin 60, 919–924.

Anonymous (2008) Directive 2008/56/EC of the European Parliament and of the Council. 17 June 2008. Establishing a Framework for Community Action in the Field of Marine Environmental Policy. Marine Strategy Framework Directive. 22p.

Anonymous (2000). Directive 200/60/EC of the European parliament and of the council of 23 October 2000 establishing a framework for community action in the field of water policy. Official Journal of the European Communities L 327/1.

Carstensen J, D.J. Conley, J.H. Andersen, G. Ærtebjerg (2006). Coastal eutrophication and trend reversal: a Danish case study. Limnology & Oceanography 51:398-408.

Fleming-Lehtinen, V., Andersen, J. H., Carstensen, J., Łysiak-Pastuszak, E., Murray, C., Pyhälä, M. & Laamanen, M. (2015). Recent developments in assessment methodology reveal that the Baltic Sea eutrophication problem is expanding. Ecological Indicators 48, 380–388.

HELCOM (2007) Baltic Sea Action Plan. Baltic Sea Environment Protection Commission. 101p.

HELCOM (2013) Approaches and methods for eutrophication target setting in the Baltic Sea region. Balt. Sea Environ. Proc. No. 133

Additional relevant publications

HELCOM: First version of the 'State of the Baltic Sea' report – June 2017, Baltic Marine Environment Protection Commission – HELCOM, Helsinki, Finland, 197, 2017.

Eutrophication status of the Baltic Sea 2007-2011 - A concise thematic assessment (2014)

Approaches and methods for eutrophication target setting in the Baltic Sea region (2013)

HELCOM core indicators. Final report of the HELCOM CORESET project (2013)

Eutrophication in the Baltic Sea. An integrated thematic assessment of the effects of nutrient enrichment in the Baltic Sea region (2009)

Development of tools for assessment of eutrophication in the Baltic Sea (2006)

HELCOM core indicator report,
ISSN 2343-2543