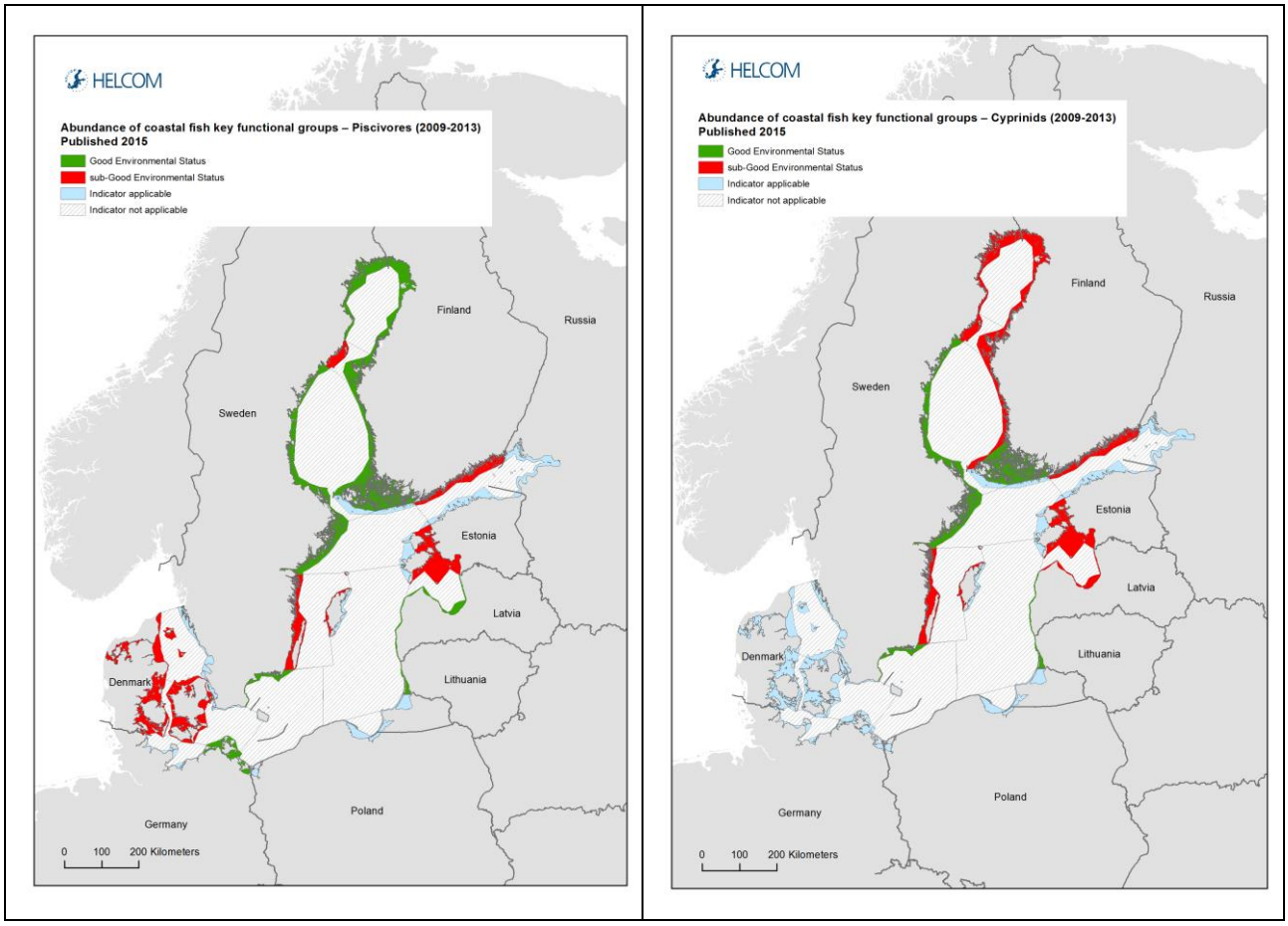
Abundance of coastal fish key functional groups

Key Message

This core indicator evaluates the abundance of selected functional groups of coastal fish in the Baltic Sea. As a rule, Good Environmental Status (GES) is achieved when the abundance of piscivores (i.e. fish that feed on other fish) is high and the abundance of cyprinids (i.e. fish that feed on e.g. benthic invertebrates) is within an acceptable range. The status of functional groups of coastal fish in the Baltic Sea has been evaluated by assessing the status of piscivores and cyprinids during the period 2009-2013.



Key message figure 1: Status assessment results based evaluation of the indicator 'abundance of selected functional groups of coastal fish'. The assessment is carried out using Scale 3 HELCOM assessment units (defined in the HELCOM Monitoring and Assessment Strategy Annex 4). Click to enlarge.

For piscivores, GES is achieved in 27 (out of a total of 47) monitoring locations, and for 15 coastal HELCOM assessment units out of the 24 that were evaluated. For cyprinids, GES is only achieved in half of the 24 monitored locations and thus seven of the 16 evaluated assessment units. In the locations classified

as sub-GES, the abundance of cyprinids was too high in seven out of 12 locations and too low in four Swedish locations and in the only assessed Estonian location.

The environmental status indicated by piscivores is slightly better compared to that indicated by cyprinids. Generally, the status of piscivores is better in more northern areas compared to southern and western areas. For cyprinids, the GES is achieved in coastal waters along the Swedish coast in the Quark, Bothnian Sea, Åland Sea, Northern Baltic Proper and Bornholm Basin, along the Finnish Archipelago Sea coast and along the coasts of Latvia and Lithuania.

The level of confidence of the assessment differs across areas, but is higher in those having the longest data series. Data on cyprinids is lacking from more southern and western areas.

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

Relevance of the core indicator

The state of coastal fish communities reflect the ecological state in coastal ecosystems as well as the effects of recreational and small-scale coastal commercial fishery. Changes in the long-term development of the abundance of functional groups of coastal fish reflect the effects of increased water temperature and eutrophication in coastal areas and/or changes in the level of human exploitation or predation pressure.

Policy relevance of the core indicator

	BSAP Segment and Objectives	**MSFD Descriptors and Criteria**
Primary link	Biodiversity • Natural Distribution and occurrence of plants and animals • Thriving and balanced communities of plants and animals	D1 Biodiversity 1.6. Habitat condition (condition of typical species or communities, relative abundance and/or biomass, physical, hydrological and chemical conditions)
Secondary link	Hazardous substances • Healthy wildlife	D4 Food webs 4.3 Abundance/distribution of key trophic groups and species
Other relevant legislation: In some Contracting Parties of HELCOM potentially also EU Habitats Directive		

Cite this indicator

HELCOM (2015) Abundance of coastal fish key functional groups**.** HELCOM core indicator report. Online. [Date Viewed], [Web link].

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Core indicator report – web-based version October 2015 (pdf)

Extended core indicator report – outcome of CORESET II project (pdf)

Results and Confidence

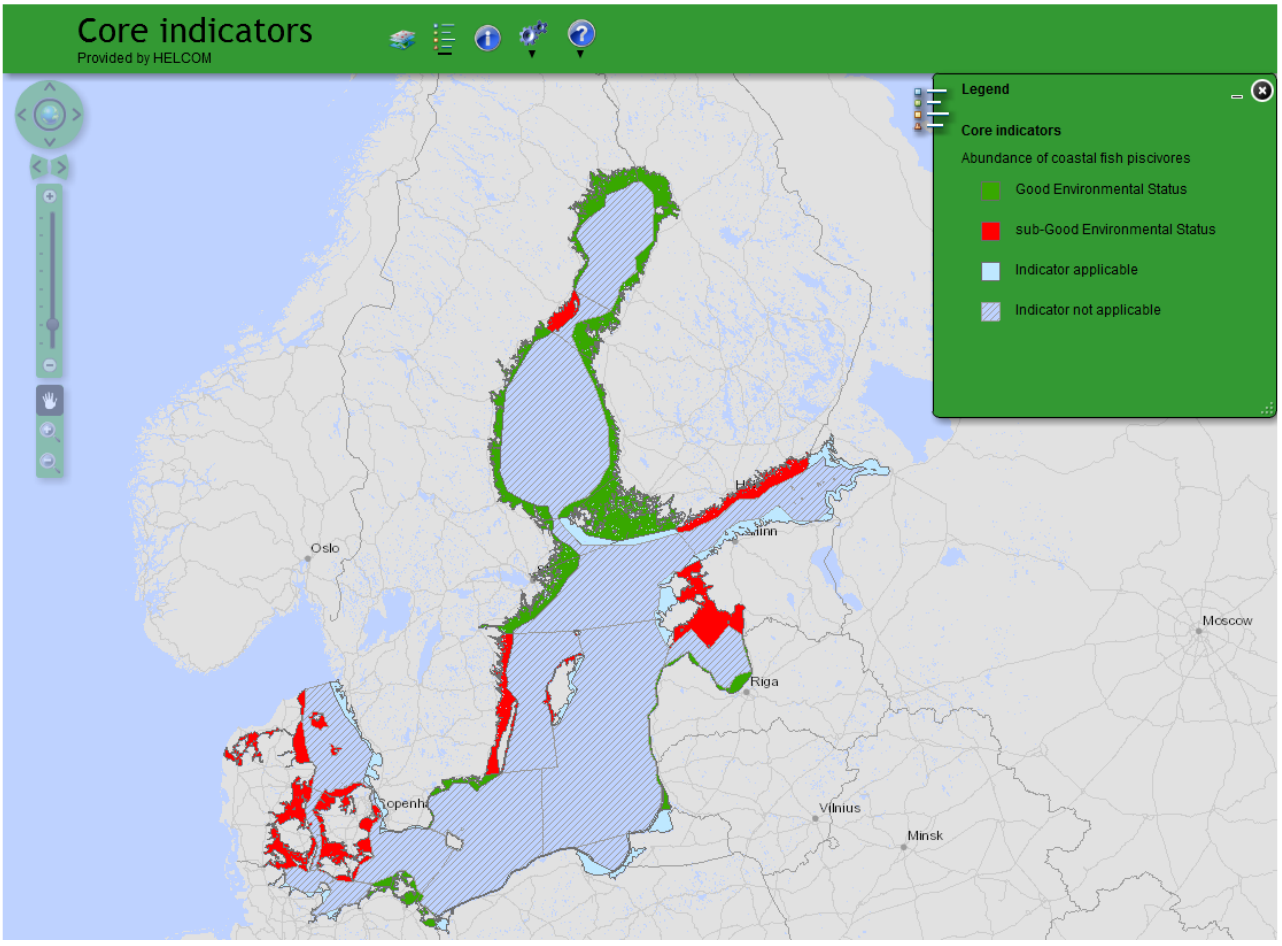
The current evaluation of GES using coastal fish evaluates the period 2009-2013 and uses either a 'deviation from baseline approach' or a 'trend based evaluation' depending on the time series coverage. Evaluations have been carried out for 24 (for piscivores) and 16 (for cyprinids) 'scale 3 HELCOM assessment units'. For more information on assessment units, see the Assessment protocol.

The status evaluation per monitoring location and assessment unit is summarized in the tables below. Only piscivores and cyprinids were evaluated in this indicator due to a lack of data and fully developed indicators for mesopredators.

Piscivores

In more than half of the evaluated monitoring locations (27 out of the total 47 locations) GES is achieved. For a few assessment units there are differing GES classifications in different monitoring locations within the same unit (see table below), likely reflecting differences in the local appearance of coastal fish communities. When summarizing over assessment units, GES is achieved in 15 out 24 assessed units.

Some general patterns suggest that the status depends on the geographic area and the considered species. In the more northern and eastern areas where perch, pike and pikeperch represent the coastal piscivores, the status is generally good, whereas in more southern and western areas where cod and turbot are the dominating piscivorous species, status is worse.



In the northern most parts of the Baltic Sea (Bothnian Bay and The Quark), the status is generally good. In most monitoring locations the relative abundance of perch, pike and pikeperch is high and stable or increasing. Only in one location (Norrbyn) is the catch per unit effort (CPUE) decreasing over time.

Results table 1. Piscivore evaluation results for the assessment period 2009-2013.

Subbasin	Country	Monitoirng area	Period	Coastal water type	Assessmen	Status
Bothnian Bay	Finland	ICES SD 31	1998-2013	Bothnian Bay Finnish Coastal waters	Baseline	GES
Bothnian Bay	Sweden	Råneå	2002-2013	Bothnian Bay Swedish Coastal waters	Trend	GES
Bothnian Bay	Sweden	Kinnbäcksfjärden	2004-2013	Bothnian Bay Swedish Coastal waters	Trend	GES
The Quark	Finland	Rectangle 23 & 28	1998-2013	The Quark Finnish Coastal waters	Baseline	GES
The Quark	Sweden	Holmön	1998-2013	The Quark Swedish Coastal waters	Baseline	GES
The Quark	Sweden	Norrbyn	2002-2013	The Quark Swedish Coastal waters	Trend	subGES
Bothnian Sea	Finland	ICES SD 30	1998-2013	Bothnian Sea Finnish Coastal waters	Baseline	GES
Bothnian Sea	Sweden	Gaviksfjärden	2004-2013	Bothnian Sea Swedish Coastal waters	Trend	subGES
Bothnian Sea	Sweden	Långvindsfjärden	2002-2013	Bothnian Sea Swedish Coastal waters	Trend	GES
Bothnian Sea	Sweden	Forsmark	1998-2013	Bothnian Sea Swedish Coastal waters	Baseline	GES
Åland Sea	Sweden	Lagnö	2002-2013	Åland Sea Swedish Coastal waters	Trend	GES
Archipelago Sea	Finland	ICES SD 29	1998-2013	Archipelago Sea Coastal waters	Baseline	GES
Archipelago Sea	Finland	Finbo	2002-2013	Archipelago Sea Coastal waters	Trend	GES
Archipelago Sea	Finland	Kumlinge	2003-2013	Archipelago Sea Coastal waters	Trend	GES
Northern Baltic Proper	Sweden	Askö	2005-2013	Northern Baltic Proper Swedish Coastal waters	Trend	GES
Gulf of Finland	Finland	ICES SD 32	1998-2013	Gulf of Finland Finnish Coastal waters	Baseline	subGES
Gulf of Riga	Estonia	Hiiumaa	1998-2013	Gulf of Riga Estonian Coastal waters	Baseline	subGES
Gulf of Riga	Latvia	Daugavgriva	1998-2007	Gulf of Riga Latvian Coastal waters	Trend	GES
Gotland basin	Sweden	Kvädöfjärden	1998-2013	Western Gotland Basin Swedish Coastal waters	Baseline	subGES
Gotland basin	Sweden	Vinö	1998-2013	Western Gotland Basin Swedish Coastal waters	Baseline	subGES
Gotland basin	Latvia	Jurkalne	1999-2007	Eastern Gotland Basin Latvian Coastal waters	Trend	GES
Gotland basin	Lithuania	Monciskes/Butinge	1998-2011	Eastern Gotland Basin Lithuanian Coastal waters	Trend	GES
Gotland basin	Lithuania	Curonian Lagoon	1998-2011	Eastern Gotland Basin Lithuanian Coastal waters	Trend	GES
Bornholm basin	Sweden	Torhamn	2002-2013	Bornholm Basin Swedish Coastal waters	Trend	GES
Bornholm basin	Germany	Pomeranian Bay, Outer	2003-2013	Bornholm Basin German Coastal waters	Trend	GES
Bornholm basin	Germany	Stettin Lagoon (German part)	2008-2013	Bornholm Basin German Coastal waters	Trend	GES
Bornholm basin	Germany	Peene river / Achterwasser	2009-2103	Bornholm Basin German Coastal waters	Trend	GES
Bornholm basin	Germany	East of Usedom Peninsula	2008-2013	Bornholm Basin German Coastal waters	Trend	subGES
Arkona basin	Germany	Greifswalder Bodden	2008-2013	Arkona Basin German Coastal waters	Trend	GES
Arkona basin	Germany	Strelasund	2009-2103	Arkona Basin German Coastal waters	Trend	GES
Arkona basin	Germany	Darß-Zingst Bodden chain	2008-2013	Arkona Basin German Coastal waters	Trend	GES
Arkona basin	Germany	Northeast of Ruegen Island	2008-2013	Arkona Basin German Coastal waters	Trend	GES
Arkona basin	Denmark	Præstø Fiord	2005-2012	Arkona Basin Danish Coastal waters	Trend	subGES
Arkona basin	Germany	North of Kühlungsborn city	2008-2013	Mecklenburg Bight German Coastal waters	Trend	GES
Arkona basin	Germany	Wismar Bight and Salzhaff	2008-2012	Mecklenburg Bight German Coastal waters	Trend	subGES
Arkona basin	Germany	Börgerende	2003-2013	Mecklenburg Bight German Coastal waters	Trend	GES
Arkona basin	Denmark	Area south of Zealand (Smålandsfarvandet)	2008-2013	Mecklenburg Bight Danish Coastal waters	Trend	subGES
Belt sea	Denmark	Sejerø Bay	2005-2013	Belts Danish Coastal waters	Trend	subGES
Belt sea	Denmark	Southern Little Belt and the archipelago	2005-2013	Belts Danish Coastal waters	Trend	subGES
Belt sea	Denmark	Århus Bay	2005-2013	Belts Danish Coastal waters	Trend	subGES
Belt sea	Denmark	Fiords of Eastern Jutland	2005-2013	Belts Danish Coastal waters	Trend	subGES
The Sound	Denmark	The Sound	2005-2013	The Sound Danish Coastal waters	Trend	subGES
Kattegat	Denmark	Isefjord and Roskilde Fjord	2005-2013	Kattegat Danish Coastal waters, including Limfjorden	Trend	subGES
Kattegat	Denmark	Northern Kattegat	2005-2013	Kattegat Danish Coastal waters, including Limfjorden	Trend	subGES
Kattegat	Denmark	Northern Limfjord	2005-2013	Kattegat Danish Coastal waters, including Limfjorden	Trend	subGES
Kattegat	Denmark	Hjarbæk Fjord	2005-2013	Kattegat Danish Coastal waters, including Limfjorden	Trend	subGES
Kattegat	Denmark	Venø Bay and Nissum Broad	2005-2013	Kattegat Danish Coastal waters, including Limfjorden	Trend	subGES

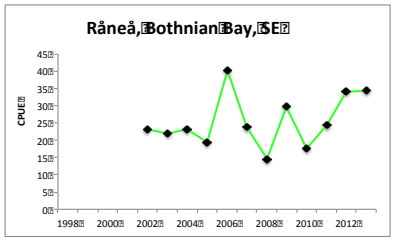
In the northern parts of the Baltic Sea (Bothnian Sea, Åland Sea and Archipelago Sea), the relative abundances of piscivores are generally high and stable, but not increasing (see Results figure 1). In the only location where GES is not achieved (Gaviksfjärden), there is no temporal trend over the relatively short time period covered, but the average abundance of piscivores is more than half of that in the other locations monitored with the same gear (Långvindsfjärden, Lagnö, Finbo and Kumlinge).

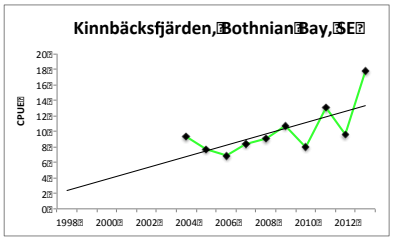
In the central parts of the Baltic Sea (Northern Baltic Proper, Gulf of Finland, Gulf of Riga and Gotland Basin), there are differences in the status across monitoring locations, and GES is only achieved in four out of seven assessment units (see Results table 1). GES is achieved in the Northern Baltic Proper and western part of the Gotland Basin, whereas one of the Gulf of Riga monitoring stations (Hiiumaa), the Swedish locations in the Gotland Basin (Kvädöfjärden and Vinö), and all areas in the Gulf of Finland are classified as sub-GES.

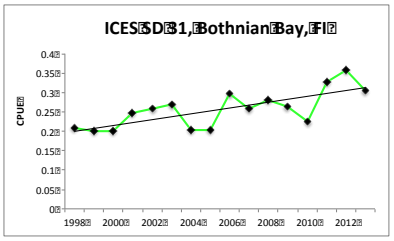
In the more southern parts, GES is achieved in the Swedish locations (Torhamn, Bornholm basin) and in general also in German coastal waters. GES is not achieved in the remaining assessment units or monitoring

locations, mainly in the Danish waters where cod and turbot are the dominating piscivorous species (see Results table 1).

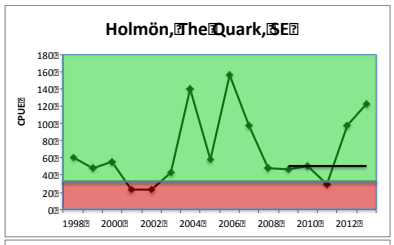
Bothnian Bay

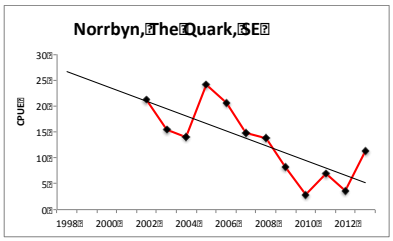


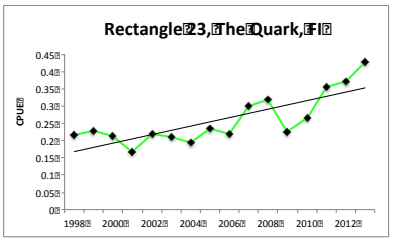


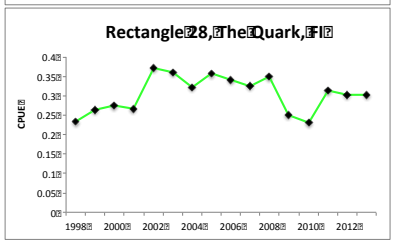


The Quark

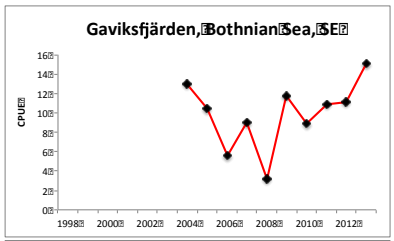


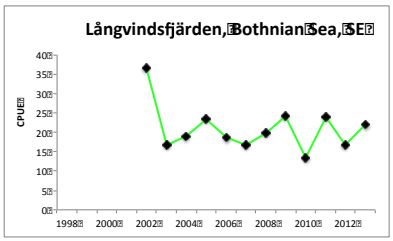


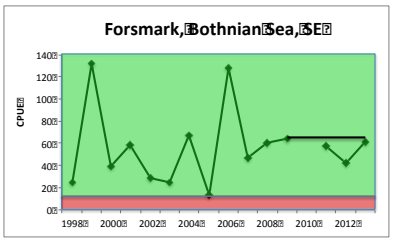


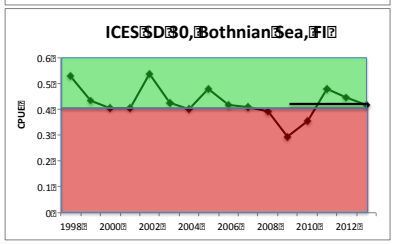


Bothnian Sea

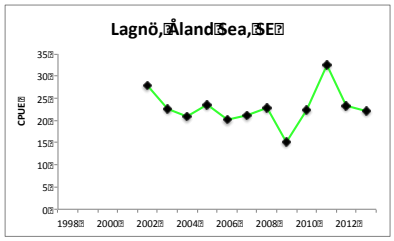




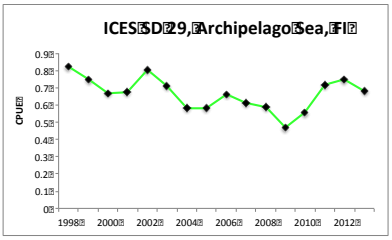


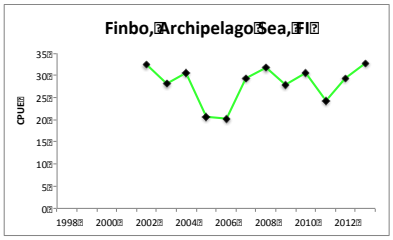


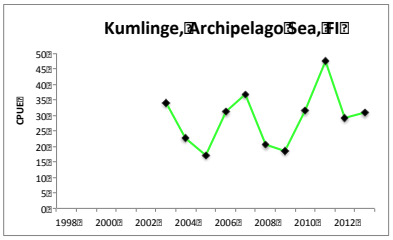
Åland Sea



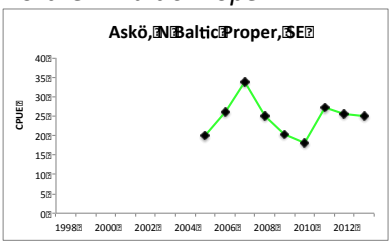
Archipelago Sea



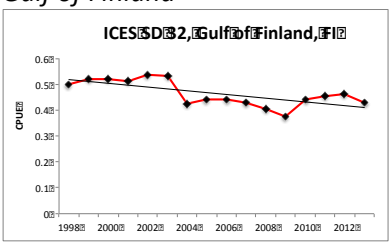




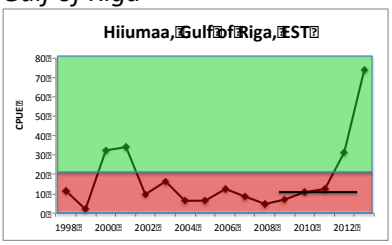
Northern Baltic Proper

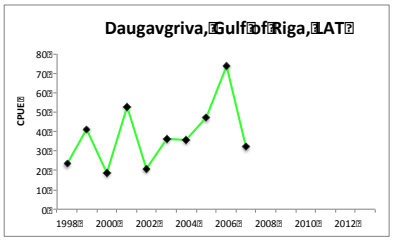


Gulf of Finland

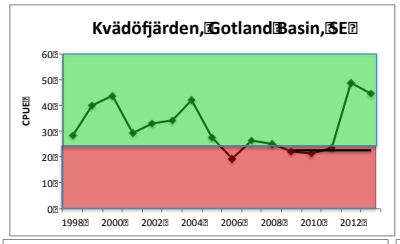


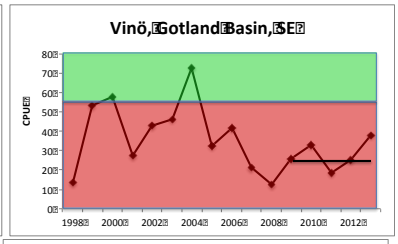
Gulf of Riga

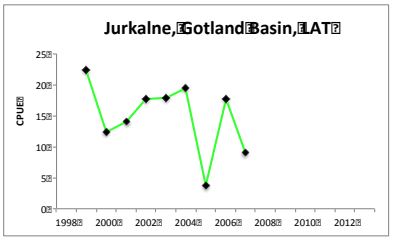


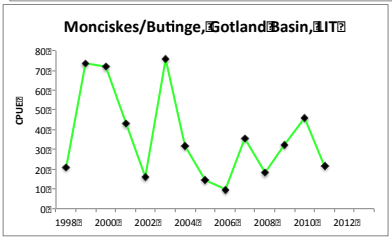


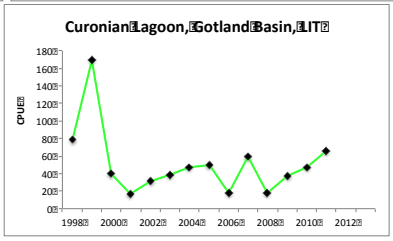
Gotland Basin



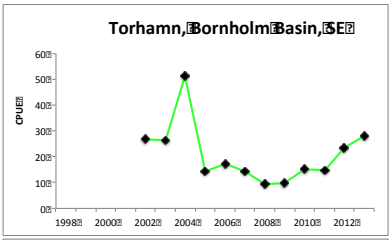


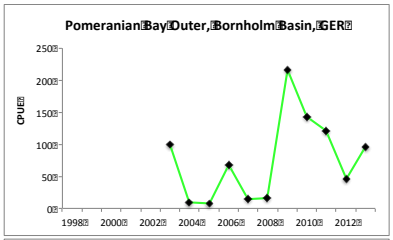


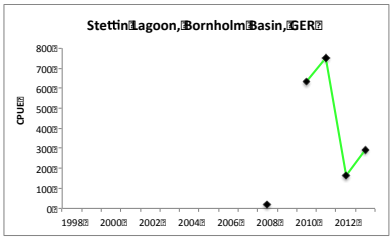


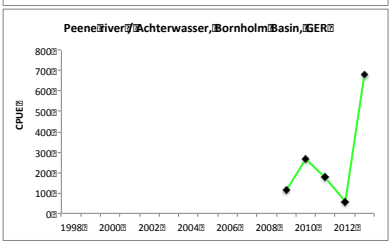


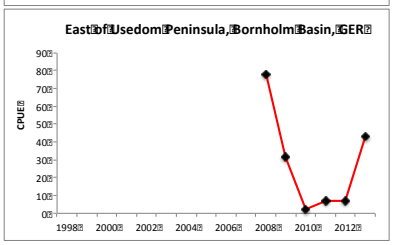
Bornholm Basin



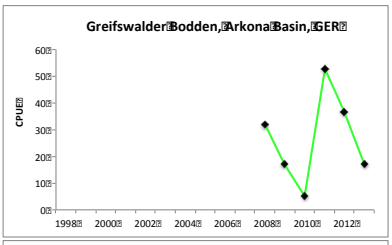


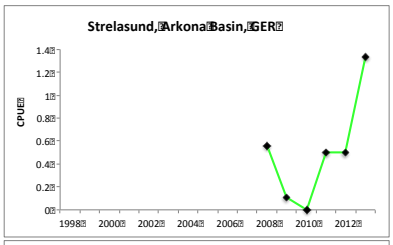


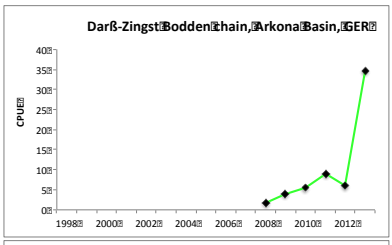


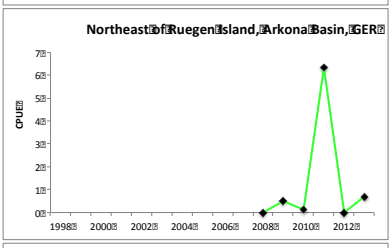


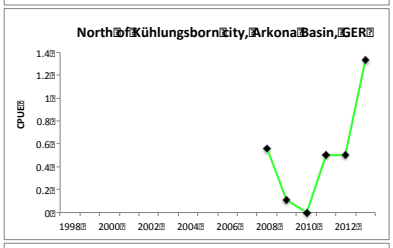
Arkona Basin

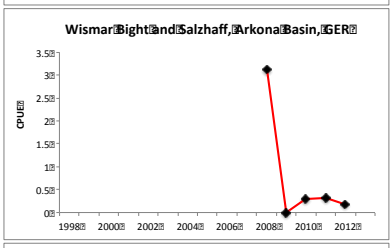


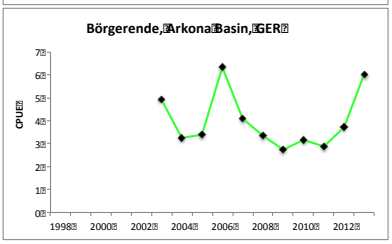


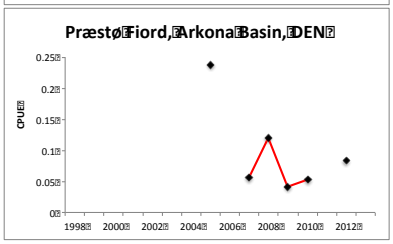


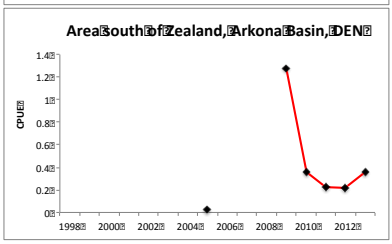




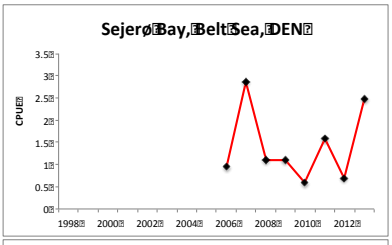


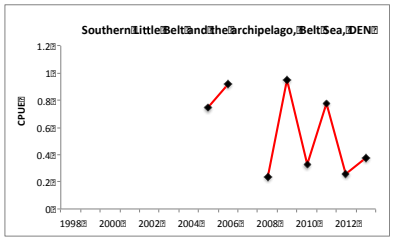


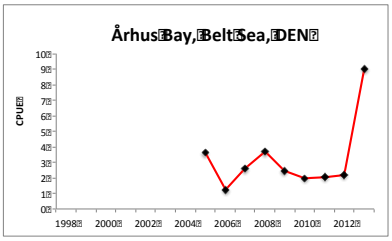


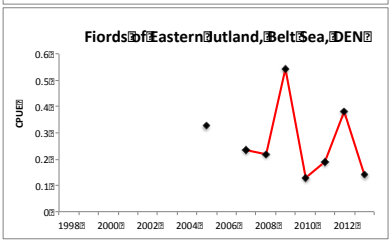


Belt Sea

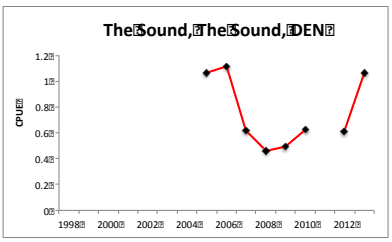




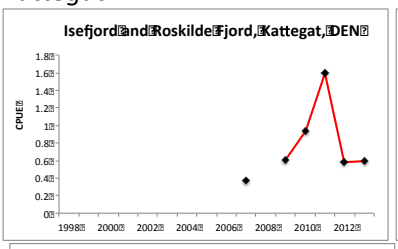


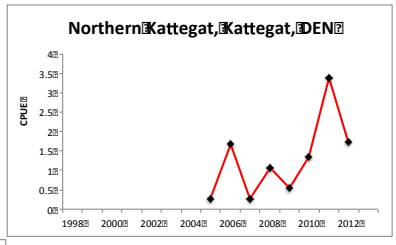


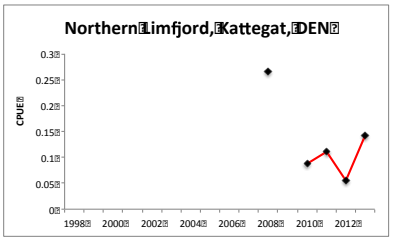
The Sound

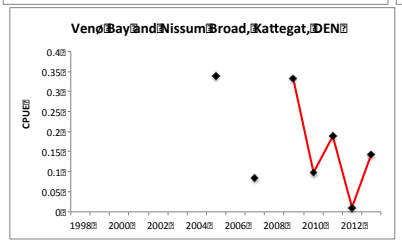


Kattegat





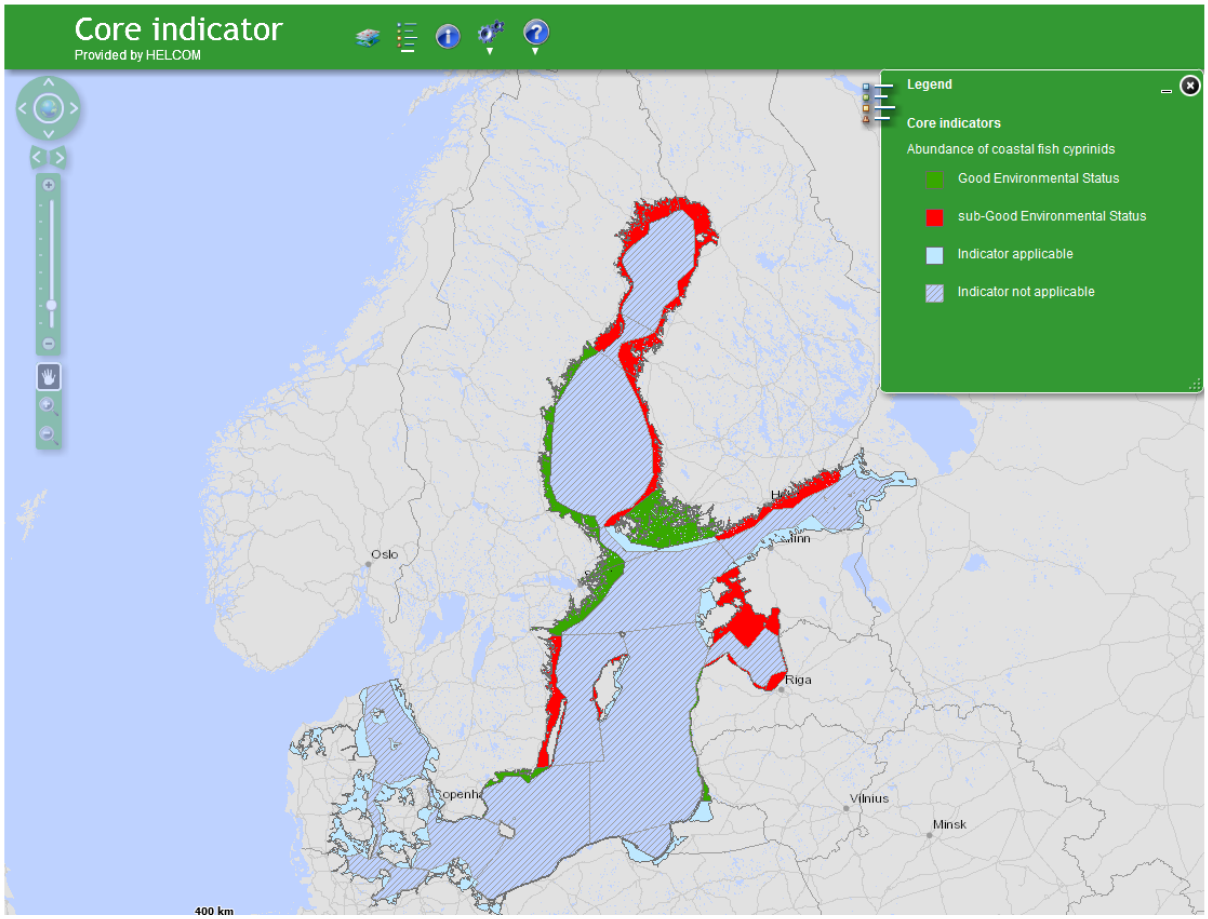




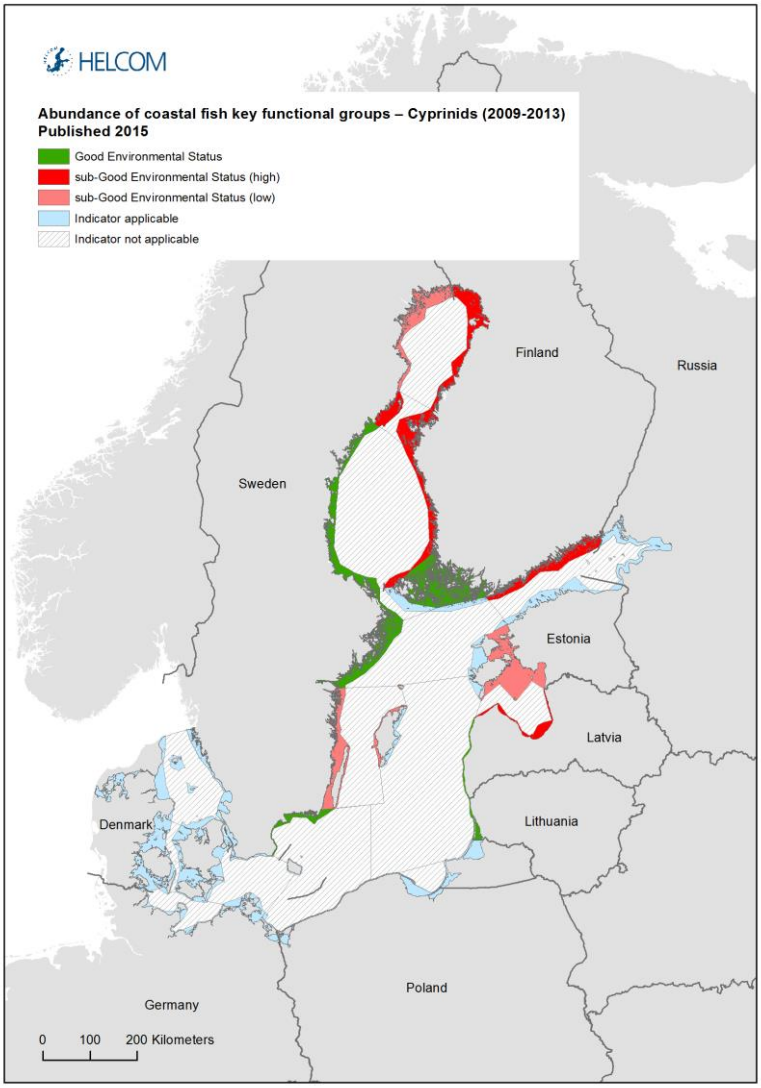
Results figure 1. Piscivore evaluation results. All evaluations are displayed per sub-basin for each monitoring location. In locations where the baseline approach is applied, the GES boundary is displayed as the edge between the green (GES) and red (sub-GES) fields and the evaluation of GES/sub-GES is given for each point in time. The black lines indicate the median of the evaluated period. For assessment units where the available data only allowed for a trend based evaluation, a green line denotes a GES evaluation outcome whereas a red line denotes a sub-GES evaluation outcome.

Cyprinids

The environmental status assessed on the basis of the abundance of cyprinids is generally not good. GES is not achieved in half of the assessed monitoring locations (12 out of in total 24 areas), and only in seven out of 16 assessment units is GES achieved.



In the majority of the locations classified as sub-GES (7 out of 12), the abundance of cyprinids was at too high levels (GES high), however in four Swedish locations (in the Bothnian Bay and Gotland basin), and in the only Estonian location assessed (Hiiumaa), the abundances appear to be too low to reflect GES (GES low) (Results figure 2).



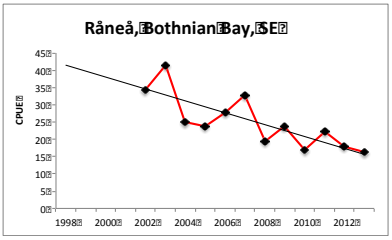
Results figure 2. Spatial representation of the status evaluating, also detailing in if the sub-GES evaluation was due to cyprinid numbers having been considered too high or too low to reflect GES.

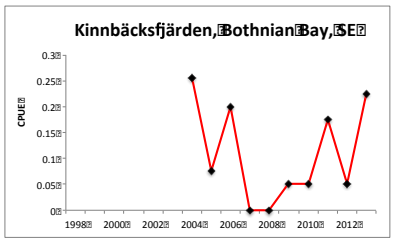
Results table 2. Cyprinid evaluation results for the assessment period 2009-2013.

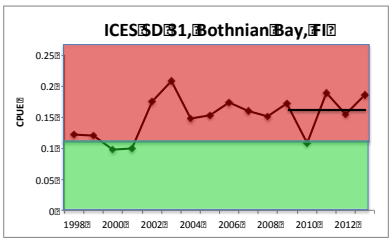
Subbasin	Country	Monitoirng area	Period	Coastal water type	Assessment method	Status	Comment
Bothnian Bay	Finland	ICES SD 31	1998-2013	Bothnian Bay Finnish Coastal waters	Baseline	subGES	High
Bothnian Bay	Sweden	Råneå	2002-2013	Bothnian Bay Swedish Coastal waters	Trend	subGES	Low
Bothnian Bay	Sweden	Kinnbäcksfjärden	2004-2013	Bothnian Bay Swedish Coastal waters	Trend	subGES	Low
The Quark	Finland	Rectangle 23 & 28	1998-2013	The Quark Finnish Coastal waters	Baseline	subGES	High
The Quark	Sweden	Holmön	1998-2013	The Quark Swedish Coastal waters	Baseline	subGES	High
The Quark	Sweden	Norrbyn	2002-2013	The Quark Swedish Coastal waters	Trend	GES	
Bothnian Sea	Finland	ICES SD 30	1998-2013	Bothnian Sea Finnish Coastal waters	Baseline	subGES	High
Bothnian Sea	Sweden	Gaviksfjärden	2004-2013	Bothnian Sea Swedish Coastal waters	Trend	GES	
Bothnian Sea	Sweden	Långvindsfjärden	2002-2013	Bothnian Sea Swedish Coastal waters	Trend	GES	
Bothnian Sea	Sweden	Forsmark	1998-2013	Bothnian Sea Swedish Coastal waters	Baseline	GES	
Ålands Sea	Sweden	Lagnö	2002-2013	Ålands Sea Swedish Coastal waters	Trend	GES	
Archipelago Sea	Finland	ICES SD 29	1998-2013	Archipelago Sea Coastal waters	Baseline	subGES	High
Archipelago Sea	Finland	Finbo	2002-2013	Archipelago Sea Coastal waters	Trend	GES	
Archipelago Sea	Finland	Kumlinge	2003-2013	Archipelago Sea Coastal waters	Trend	GES	
Northern Baltic Proper	Sweden	Askö	2005-2013	Northern Baltic Proper Swedish Coastal waters	Trend	GES	
Gulf of Finland	Finland	ICES SD 32	1998-2013	Gulf of Finland Finnish Coastal waters	Baseline	subGES	High
Gulf of Riga	Estonia	Hiiumaa	1998-2013	Gulf of Riga Estonian Coastal waters	Baseline	subGES	Low
Gulf of Riga	Latvia	Daugavgriva	1998-2007	Gulf of Riga Latvian Coastal waters	Trend	subGES	High
Gotland basin	Sweden	Kvädöfjärden	1998-2013	Western Gotland Basin Swedish Coastal waters	Baseline	subGES	Low
Gotland basin	Sweden	Vinö	1998-2013	Western Gotland Basin Swedish Coastal waters	Baseline	subGES	Low
Gotland basin	Latvia	Jurkalne	1999-2007	Eastern Gotland Basin Latvian Coastal waters	Trend	GES	
Gotland basin	Lithuania	Monciskes/Butinge	1998-2011	Eastern Gotland Basin Lithuanian Coastal waters	Trend	GES	
Gotland basin	Lithuania	Curonian Lagoon	1998-2011	Eastern Gotland Basin Lithuanian Coastal waters	Trend	GES	
Bornholm basin	Sweden	Torhamn	2002-2013	Bornholm Basin Swedish Coastal waters	Trend	GES	

Evaluations were only carried out for cyprinids in the central and northern parts of the Baltic Sea since monitoring and/or fully developed indicators for mesopredatory fish are currently lacking. According to the assessment the whole Finnish coast, with the exception of the Archipelago Sea area, as well as large parts of the coastline of Latvia and Lithuania are characterized by sub-GES. Along the Swedish coast, GES is achieved only in the Bothnian Sea, Northern Baltic Proper and the Bornholm basin.

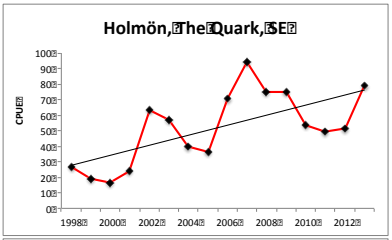
Bothnian Bay

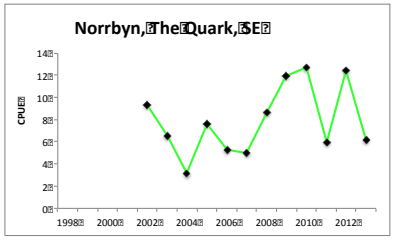


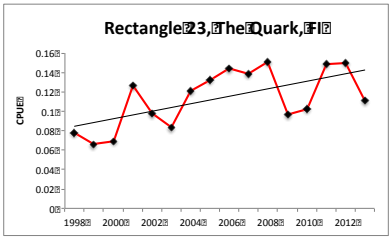


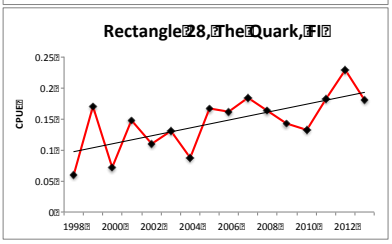


The Quark

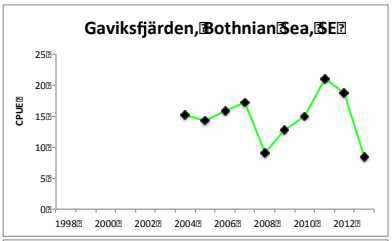


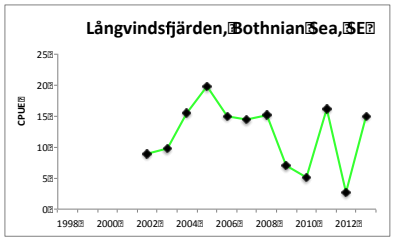


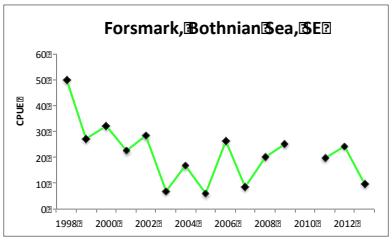


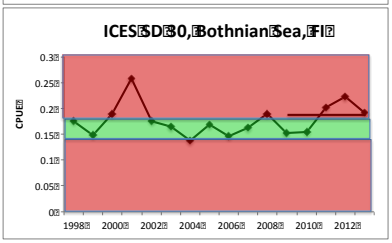


Bothnian Sea

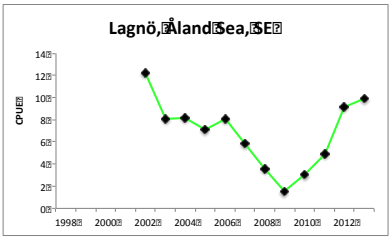








Åland Sea


Lagnö, Åland Sea, SE
CPUE
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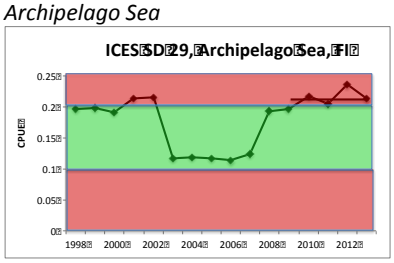
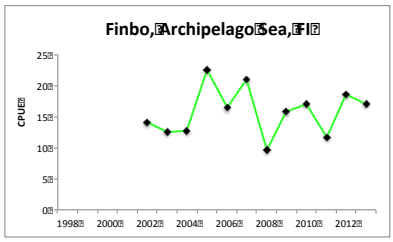
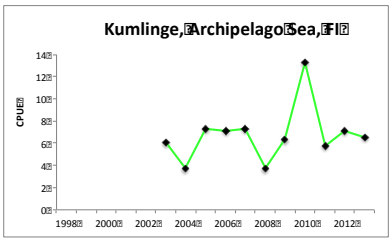
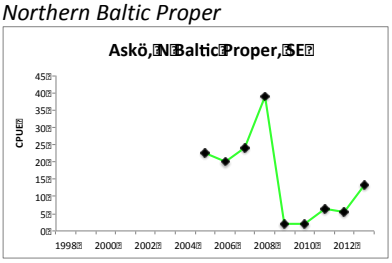
Archipelago Sea



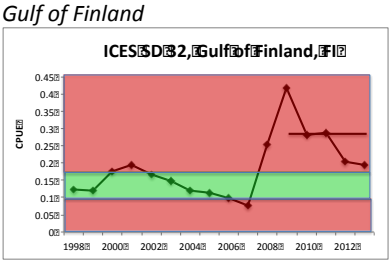




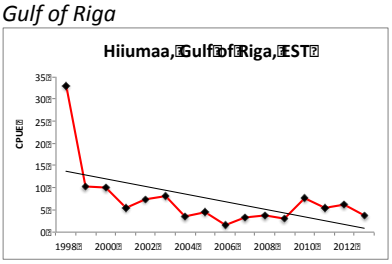
Northern Baltic Proper

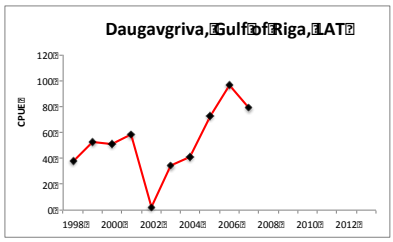


Gulf of Finland

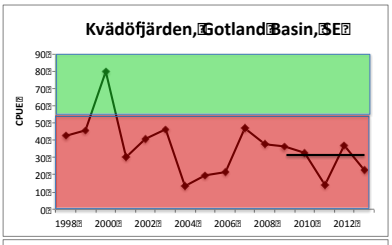


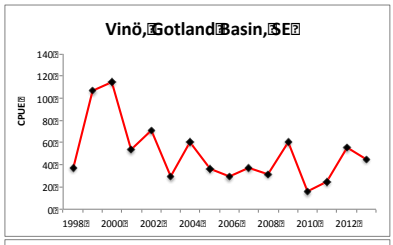
Gulf of Riga

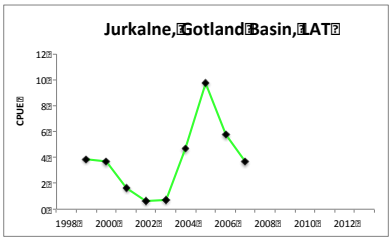


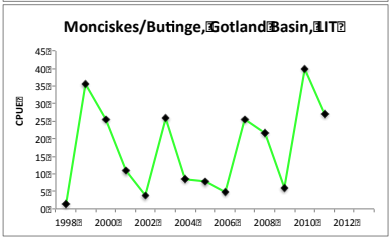


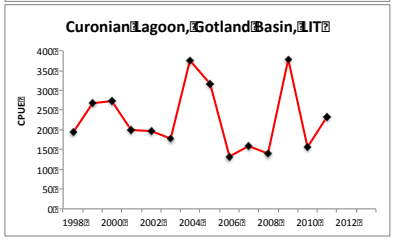
Gotland Basin



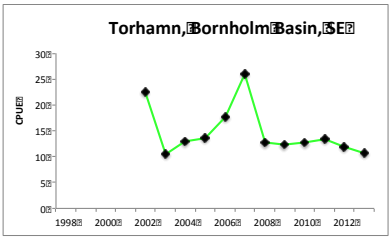








Bornholm Basin



Results figure 3. Cyprinid evaluation outcome. All evaluations are displayed per sub-basin for each monitoring location. In locations where the baseline approach is applied, the GES boundary is displayed as the edge between the green (GES) and red (sub-GES) fields and the evaluation of GES/sub-GES is given for each point in time. The black lines indicate the median of the evaluated period. For assessment units where the available data only allowed for a trend based evaluation, a green line denote a GES evaluation outcome whereas a red line denotes a sub-GES evaluation outcome.

In the northernmost parts of the Baltic Sea (Bothnian Bay and The Quark), the status is generally sub-GES (Results table 2 and Results figure 3). In all but two Swedish locations (Råneå and Kinnbäcksfjärden) the abundance of cyprinids is too high to achieve GES. In some of these locations the abundance of cyprinids appears to increase over time.

In the Bothnian Sea, Åland Sea and Archipelago Sea along the Swedish coast the relative abundance of cyprinids is generally stable (indicating GES), whereas along the Finnish Bothnian Sea coast the abundance is too high, and hence indicating sub-GES (see Results figure 3).

In central parts of the Baltic Sea (Northern Baltic Proper, Gulf of Finland, Gulf of Riga and Gotland Basin) the overall status of the assessed cyprinid fish communities is not good. All but two of the eight monitoring locations (Jurkalne, Latvia and Monciskes/Butinge, Lithuania) are characterized by sub-GES (see Results table 2).

In the southernmost locations (Torhamn, Bornholm basin) the evaluation of cyprinid communities indicate GES.

Confidence of the indicator status evaluation

To date, no approach has been developed for rigorously determining the confidence of the status evaluation for coastal fish indicators. The confidence might vary across assessment units, countries and monitoring locations since the number of years for which coastal fish monitoring has been carried out varies. Generally, the confidence of the evaluation is high in the locations where monitoring started before 1999, whereas it is lower for the locations with data availability for a shorter time period. Moreover, some assessment units cover relatively large coastal areas with few monitoring programmes, making the assessment less confident. Also, a low catch level of the target species (as in Denmark) lowers the confidence of the status evaluation.

Some assessment units cover relatively large coastal areas with few monitoring programmes, making the evaluation of confidence lower. Since coastal fish communities are typically more local in their appearance than the scale of assessment units applied in the indicator, there might be diverging evaluations at different monitoring locations within an assessment unit, hence yielding a lower confidence of the evaluation of

environmental status. On the other hand, the confidence is naturally higher in those assessment units covering rather limited geographical area and that have several monitoring locations with the same status.

As different gears and methods are used in different countries to monitor coastal fish, evaluations are not directly comparable across locations. However, each data point presented is representing an yearly average across several observations (numbers differ across monitoring programmes), and since the assessment of status within each location is based on baseline conditions within that specific location and the specific gear used, the confounding effects from differences in methodology are not likely to substantially lower the overall confidence of the evaluation.

In order to improve the confidence of the evaluation, longer time series are needed in some monitoring locations, and some areas additional monitoring data is needed. Further work is also needed to develop a quantitative approach for determining the confidence of the evaluation as well as principles for aggregating status evaluation across areas and indicators.

Good Environmental Status

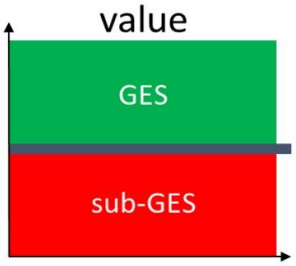
Good Environmental Status (GES) is achieved when the abundance of piscivores is high and the abundance of cyprinids is within an acceptable range. The quantitative boundaries for GES for coastal fish are based on location-specific baseline conditions where time series covering more than 15 years are available (10 year baseline + 5 year evaluation period). In areas where shorter time series are available, a trend based approach (time series covering less than 15 years) is used. The approach used in the different monitoring locations is presented in the Results section.

A baseline needs to be to be defined for determining the GES boundary. The period used to define the baseline needs to cover at least 10 years in order to extend over more than twice the generation time of the typical species represented in the indicator and thus cater for natural variation in the indicator value due to for example strong and weak year classes. For the period used to determine the baseline to be relevant, it must also be carefully selected to reflect time periods with stable environmental conditions, as stated within the MSFD (European Commission 2008). Substantial turnovers in ecosystem structure in the Baltic Sea are apparent in the late 1980s, leading to shifts in the baseline state (Möllmann et al. 2009) and for coastal fish communities substantial shifts in community structure have been demonstrated in the late 1980s and early/mid 1990s (Olsson et al. 2012). In some areas, there have also been minor shifts in fish community structure later (see environmental fact sheet for further background).

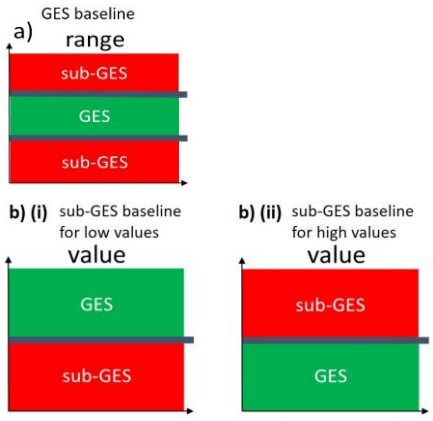
Estimates of the relative abundance and/or biomass are used to determine whether coastal fish key functional groups in the Baltic Sea achieve GES or not. These estimates are derived from fishery independent monitoring, recreational fishermen surveys and/or commercial catch statistics. Since there are strong environmental gradients in the Baltic Sea and coastal fish communities and stocks are typically local in their appearance and respond mainly to area-specific environmental conditions, the evaluations for coastal key fish species are carried out on a relatively local scale.

The evaluation period applied when using the baseline approach should cover five years to cater for natural variability. GES is evaluated based on the deviation of the median value of the indicator during the assessment period in relation to the boundary level (Good environmental status figure 1).

Piscivores

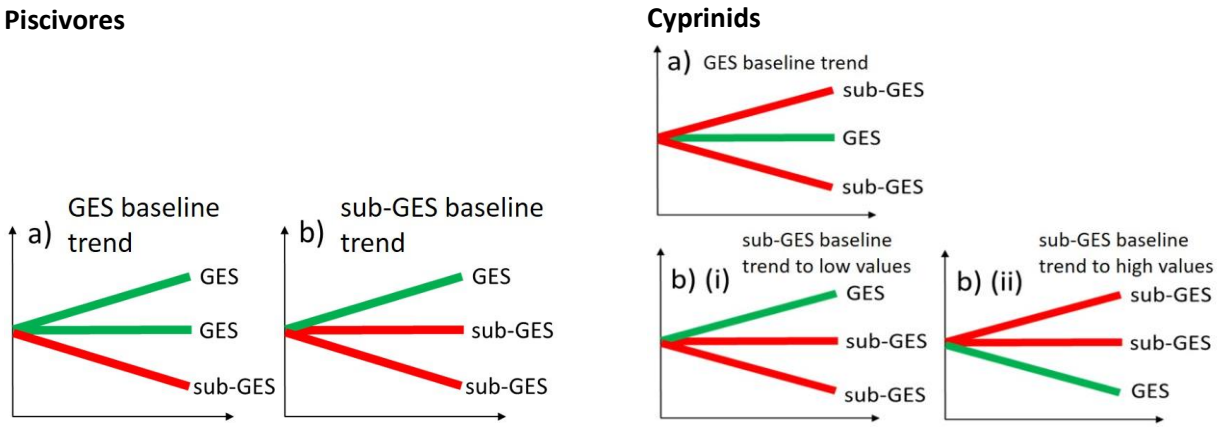


Cyprinids



Good environmental status figure 1. Determination of acceptable deviation from baseline (>15 years) for piscivores (left) and acceptable range from baseline for cyprinids (right). See description in the Assessment protocol.

When using the trend based approach, GES is evaluated based on the direction of the trend of the indicator over the time period considered in relation to the desired direction of the indicator (Good environmental status figure 2).



Good environmental status figure 2. Application of the trend based approach for evaluating environmental status for piscivores (left) and cyprinids (right). GES is defined based on the direction of the trend of the indicator compared to the desired direction of the indicator over time. See description in the Assessment protocol.

Application of the trend based approach for evaluating environmental status where GES is defined based on the direction of the trend of the indicator compared to the desired direction of the indicator over time.

The functional groups used in this indicator are piscivorous fish species and members of the cyprinid family. In areas where cyprinids do not exist naturally, mesopredatory fish species could be used e.g. wrasses (*Labridae*), sticklebacks (*Gasterosteidae*) and gobies (*Gobiidae*). Due to lack of data, only piscivorous fish and cyprinids are included in this assessment. Piscivorous fish coastal fish species are typically represented by perch (*Perca fluviatilis*), pike (*Esox Lucius*), pikeperch (*Sander lucioperca*) and burbot (*Lota lota*) in the less saline eastern and northern Baltic Sea (Sweden, Finland, Estonia, Latvia and Lithuania) and in sheltered coastal areas in Poland and Germany. In the more exposed coastal parts of the central Baltic Sea and in its western parts, piscivores are typically represented by cod (*Gadus morhua*) and turbot (*Scophthalmus maximus*). A similar division can be made for members of the cyprinid family (*Cyprinidae*), e.g. roach (*Rutilus rutilus*) and breams (*Abramis sp.*) are most abundant in the less saline eastern and northern Baltic Sea, whereas mesopredatory fish (sticklebacks, wrasses and gobies) are representative in the more exposed coastal parts of the central Baltic Sea and in its more saline western region.

Assessment Protocol

This indicator uses two different approaches for evaluating whether Good Environmental Status (GES) is achieved. The approach used depends on the availability of data. If there is sufficient data (at least 15 years' time series), then the baseline approach is used. If the criteria for applying the baseline approach are not fulfilled, then the trend based approach is used.

Baseline approach

In order to be able to apply the baseline approach for evaluation of GES, coastal fish datasets must meet certain criteria:

1. The time period used to determine the baseline should cover a minimum number of years that is twice the generation time of the species most influential to the indicator evaluation. This is to ensure that the influence of strong year classes is taken into account. For coastal fish, this is typically about ten years. In this evaluation, the time period used to determine the baseline against which GES is evaluated spans over the years 1998-2008.
2. The dataset used to determine the baseline must not display a linear trend within itself ($n \geq 10$, $p > 0.05$), as the baseline for evaluation should optimally reflect the community structure at stable conditions and not a development towards a change in the environmental status.
3. Before evaluating GES, it should also be decided whether or not the period used to determine baseline reflects a period of GES. This could be done either by using data dating back earlier than the start of the period used to determine the baseline, by using additional information, or by expert judgment. For example, if data preceding the period used to determine the baseline have much higher indicator values, then the baseline might represent sub-GES (in case of an indicator where higher values are indicative of a good environmental state) or GES (in case of an indicator where higher values are indicative of an undesirable state).

Once the baseline status has been determined, GES boundaries are defined as the value of the indicator at the X^{th} percentile of the median distribution of the dataset used for determining the baseline. The median distribution is computed by resampling (with replacement) from the dataset used to determine the baseline. In each repetition, the number of samples equals the number of years in the dataset. In order to improve precision, a smoothing parameter may be added in each repetition. The smoothing parameter is computed as the normal standard deviation of the re-sampled dataset divided by the number of years re-sampled. To evaluate GES during the assessment period the median value of the indicators during the assessment period is compared with the specific GES boundary (see Good environmental status figure 1 and the decision tree in Assessment Protocol figure 1):

For piscivores, in situations where the baseline state reflects GES, the median of the years to be assessed (n=5) should be above the 5th percentile of the median distribution of the dataset used to determine the baseline in order to reflect GES. For cyprinds and mesopredatory fish species, the median of the years to be assessed (n=5) should be above the 5th percentile and below the 95th percentile to reflect GES.

1. For piscivores, in situations where the baseline state reflects sub-GES, the median of the years to be assessed (n=5) should be above the 98^{th} percentile of the median distribution of the dataset used to determine the baseline in order to reflect GES. For cyprinds and mesopredatory fish

species, in order to reflect GES the median of the years to be assessed (n=5) should be above the 98th percentile if the baseline status is indicative of too low abundances, and below the 5th percentil if the baseline status is indicative of too high abundances.

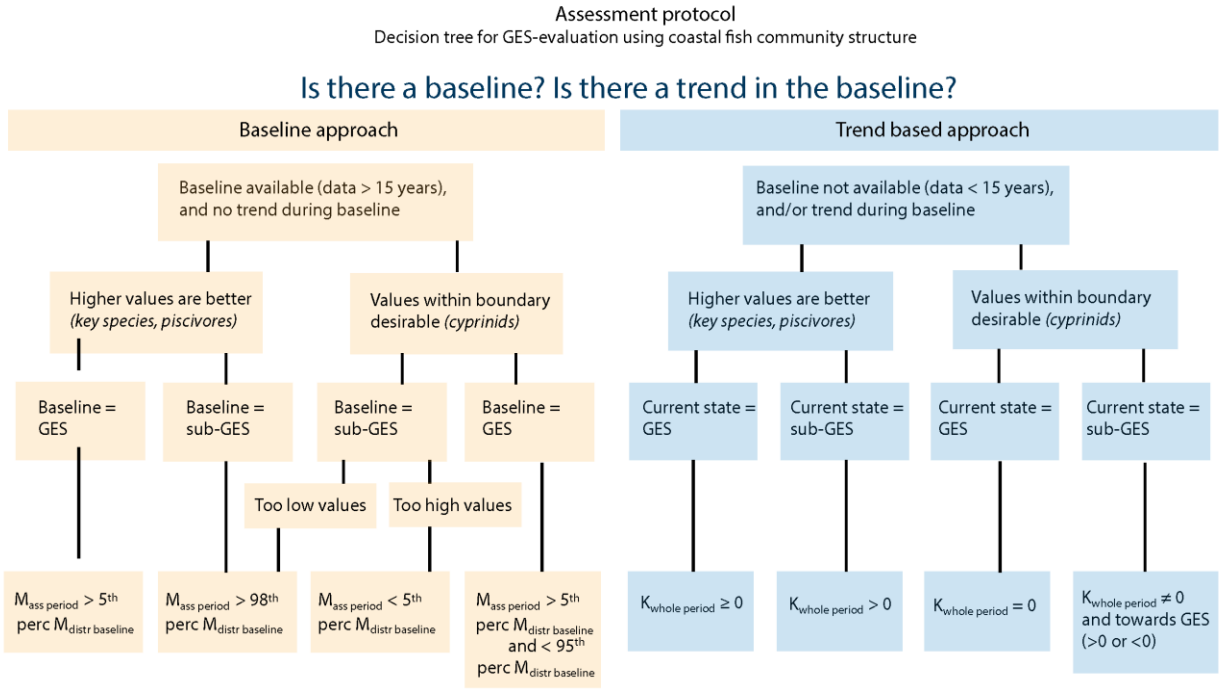
Trend based approach

If the requirements for defining quantitative baseline conditions are not met (e.g. short time series, or a linear development during the period used to determine baseline conditions), then a trend based evaluation should be used. Data should date back to the early/mid-2000s to be included in the evaluation.

In the trend based approach, GES is defined based on the direction of the trend compared to the desired direction of the indicator over time (see Good environmental status figure 2). Where the first years in the evaluated time series represent GES status, for piscivores the trend of the indicator over time should not be negative in order to represent GES. For cyprinids and mesopredatory fish, the trend of the indicator over time should not exhibited any direction in order to reflect GES. If, on the other hand, the first years of the assessed time series represent sub-GES, then for piscivores the trend in the indicator should be positive in order to represent GES, and for cyprinids and mesopredatory fish the trend should be in the desired direction to reflect GES. The significance level for these trends should be p <0.1.

Decision tree for GES evaluation using coastal fish community structure

In this decision tree (Assessment Protocol figure 1) the indicators are abbreviated as follows: *abundance of key fish species* as '*key species*', *abundance of piscivores* as '*piscivores*' and *abundance of cyprinids* as '*cyprinids*'. Baseline refers to the period 1998/1999 – 2008. $M_{ass\ period}$ refers to the median of the assessment period (2009-2013), perc = percentile, $M_{distr\ baseline}$ refers to the bootstrapped median distribution of the baseline period, and K refers to the slope of the linear regression line over the whole time period.



Assessment protocol figure 1. Decision tree for GES evaluation using coastal fish community structure.

Assessment units

Due to the local appearance of typical coastal fish species, status evaluations of coastal fish communities are representative for rather small geographical scales. In this evaluation the HELCOM assessment unit scale 3 'Open sub-basin and coastal waters' has been applied. The indicator is not evaluated for the open sea sub-basins since the species in focus are coastal.

Evaluations for piscivores were carried out for 24 coastal HELCOM assessment units and for cyprinids for 16 assessment units. The number of units evaluated is currently restricted by the monitoring activities. In assessment units with several monitoring datasets the summed status (representing the majority of monitoring locations within the unit) is used to determine the status of the assessment unit. If equal numbers of monitoring locations have GES and sub-GES, then the one-out-all-out procedure is applied.

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

Data analyses

The data used for the evaluations are derived from fishery independent monitoring, recreational fishermen surveys and/or commercial catch statistics.

Fishery independent monitoring

The analyses are based on catch per unit effort (CPUE) data from annual averages of all sampling stations in each area. In order to only include species and size groups suited for quantitative sampling by method, individuals smaller than 12 cm (Nordic Coastal multimesh nets) or 14 cm (other net types) were excluded from the assessment. Abundance is calculated as the number of individuals of the species included in the indicator per unit effort (CPUE).

Commercial catch data

The analyses were based on catch per unit effort data (CPUE) in the form of kg/gillnet day, and each data point represents total annual catches per area. The gillnets used have mesh sizes between 36-60 mm (bar length) and hence target a somewhat different aspect of the fish community in the area. In addition, fishing is not performed at fixed stations nor with a constant effort across years.

The estimates from the gillnet monitoring programmes and commercial catch data are not directly comparable, and only relative changes across data sources should be compared.

Relevance of the Indicator

Biodiversity assessment

The status of biodiversity 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 abundance of selected functional groups of coastal fish, this indicator will also contribute to the next overall biodiversity assessment to be completed in 2018 along with the other biodiversity core indicators.

Policy relevance

The core indicator on abundance of coastal fish functional groups addresses the Baltic Sea Action Plan's (BSAP) Biodiversity and nature conservation segment's ecological objectives 'Natural distribution and occurrence of plants and animals' and 'Thriving and balanced communities of plants and animals'.

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

- ' to develop long-term plans for, protecting, monitoring and sustainably managing coastal fish species, including the most threatened and/or declining, including anadromous ones (according to the HELCOM Red list of threatened and declining species of lampreys and fishes of the Baltic Sea, BSEP No. 109), by 2012' and
- 'develop a suite of indicators with region-specific reference values and targets for coastal fish as well as tools for assessment and sustainable management of coastal fish by 2012'.

The core indicator also addresses the following qualitative descriptors of the MSFD for determining good environmental status:

Descriptor 1: 'Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions' and

Descriptor 4: 'All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity'.

and the following criteria of the Commission Decision:

- Criterion 1.6 (habitat condition)
- Criterion 4.3 (abundance/distribution of key trophic species)

In some Contracting Parties the indicator also has potential relevance for implementation of the EU Habitats Directive.

Role of key functional groups of coastal fish in the ecosystem

Coastal fish, especially piscivorous species, are recognized as being important components of coastal food webs and ecosystem functioning (Eriksson et al. 2009; Olsson et al. 2012). Moreover, since many coastal fish species are rather local in their appearance (Saulamo & Neuman 2005; Laikre et al. 2005; Olsson et al. 2011), the temporal development of coastal fish communities might reflect the general environmental state in the monitoring locations.

Piscivorous fish species in coastal ecosystems generally have a structuring role in the ecosystem, mainly via top-down control on lower trophic levels. Viable populations of piscivorous species are generally considered to reflect an environmental status with few eutrophication symptoms and balanced food webs (Eriksson et al. 2011).

Human pressures linked to the indicator

	General	MSFD Annex III, Table 2
Strong link	Several pressures, both natural and human, acting in concert affect the state of key functional groups of coastal fish. These include climate, eutrophication, fishing, and exploitation and loss of essential habitats. To date, no analyses on the relative importance of these variables have been conducted.	Physical loss - sealing Physical damage -abrasion -selective extraction Inference with hydrological processes -significant changes in thermal regime -significant changes in salinity regime Nutrient and organic matter enrichment -inputs of fertilisers and other nitrogen and phosphorus-rich substances Biological disturbance -selective extraction of species, including incidental non-target catches
Weak link	There might also be effects of hazardous substances on the state of coastal fish key functional groups	Potentially also: Contamination by hazardous substances -introduction of synthetic compounds -introduction of non-synthetic substances and compounds

The state of key functional groups of coastal fish in the Baltic Sea is influenced by multiple pressures, including climate, eutrophication, fishing mortality and exploitation of essential habitats, but also by natural processes such as food web interactions and predation from apex predators.

The functional groups considered in this indicator are generally heavily affected by the impacts of a changing climate (Möllman et al. 2009; Olsson et al. 2012; Östman et al. submitted) including alterations in the food web (Eriksson et al. 2009; 2011), the impact of increased water temperature and, for cyprinids in particular, also lowered salinity (Härmä et al. 2008).

Among pressures related to human activities, exploitation of essential habitats (Sundblad et al. 2014; Sundblad & Bergström 2014) impact both piscivores and cyprinids, whereas fishing generally affects mainly piscivores (Edgren 2005; Bergström et al. 2007; Fenberg et al. 2012; Florin et al. 2013). Coastal piscivorous species, such as perch, pike and pikeperch, are targeted in the recreational fisheries sector and in many

countries to a lesser extent by small-scale commercial fisheries (Karlsson et al. 2014), whereas cod is mainly exploited in the offshore commercial fisheries.

The effect of eutrophication on the state of coastal fish communities does not appear to be of as large importance (Olsson et al. 2012), but it might increase with higher latitude (Östman et al. submitted) and for some cyprinid species (Härmä et al. 2008).

The abundance of piscivorous coastal fish (such as perch, pike, pikeperch and cod) is influenced by recruitment success and mortality rates, which in turn might be influenced by ecosystem changes, interactions within the coastal ecosystem and abiotic perturbations. An increased abundance of piscivorous fish might reflect increasing water temperatures and moderate eutrophication (perch and pike), availability of recruitment habitats (all), low fishing pressure and low predation pressure from apex predators (all), but also high eutrophication (pikeperch) as well as colder and more saline conditions (cod) (Böhling et al. 1991; Edgren 2005; Bergström et al. 2007; Linlokken et al. 2008; HELCOM 2012; Olsson et al. 2012; Östman et al. 2012; Bergström et al. 2013; Östman et al. submitted). As for the majority of coastal piscivorous fish species, exploitation of recruitment areas has a negative impact on the development of perch populations (Sundblad et al. 2014; Sundblad & Bergström 2014).

Cyprinids and mesopredatory fish species typically represent lower trophic levels in being planktivores and benthivores. As such, these groups of species are both impacted by bottom-up mechanisms such as eutrophication (Härmä et al. 2008; Östman et al. in revision) as well as by top-down regulation by piscivorous fish species (Eriksson et al. 2011; Baden et al. 2012; Casini et al. 2012) and apex predators (Östman et al. 2012). Hence, whereas abundant and strong populations of piscivorous coastal fish species are indicative for a functioning ecosystem in good environmental status, high abundances of cyprinids and mesopredators often characterize systems in an undesirable environmental state.

Natural interactions such as predation pressure from apex predators, foremost cormorants (*Phalacrocorax carbo*), could at least locally impact the state of coastal fish communities (Vetemaa et al. 2010; Östman et al. 2012). In some areas the outtake of coastal fish by cormorants exceeds, or is of a similar magnitude, to that of the commercial and recreational fisheries (Östman et al. 2013). The state of groups of mesopredatory fish species such as wrasses, sticklebacks and gobies, and potentially also cyprinids, could be affected by the food web structure in coastal areas and neighbouring ecosystems (Eriksson et al. 2011; Baden et al. 2012; Casini et al. 2012). Especially decreased predation pressure from declining stocks of piscivorous fish species might favour the increase in abundance of mesopredatory fish species.

Monitoring Requirements

Monitoring methodology

The HELCOM common monitoring on coastal fish is described on a general level in the **HELCOM Monitoring Manual in the sub-programme: Coastal fish**.

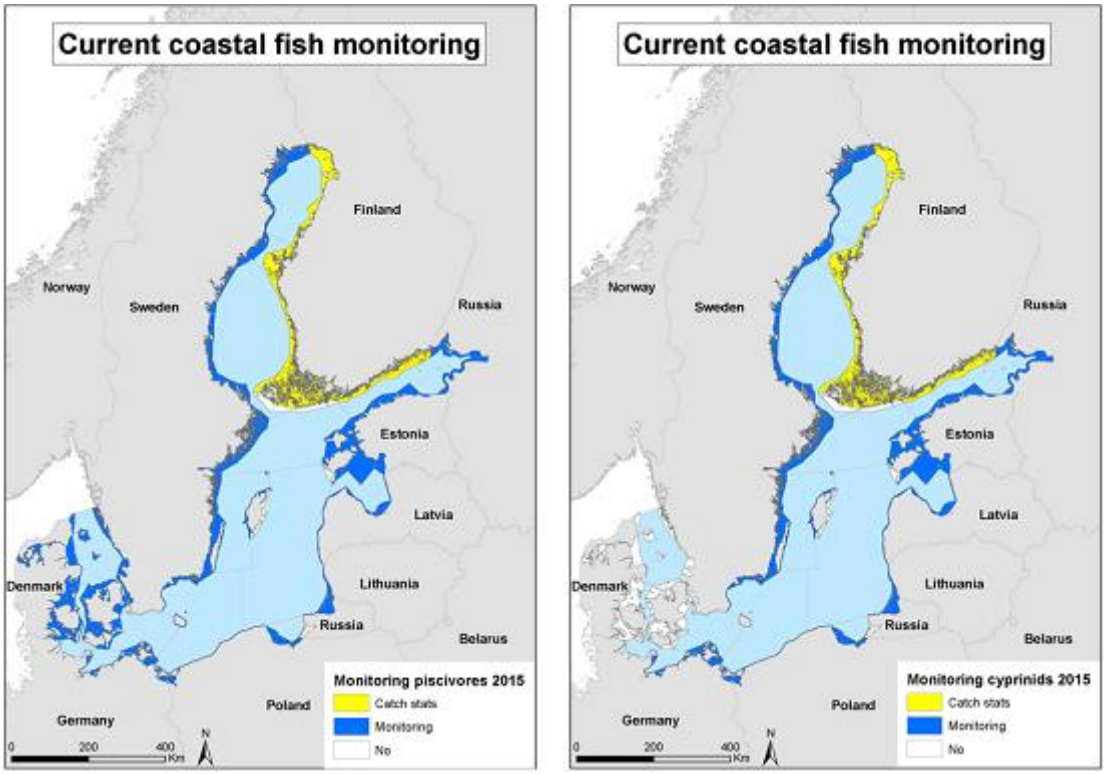
Monitoring guidelines specifying the sampling strategy are adopted and published.

Current monitoring

The monitoring activities relevant to the indicator that are currently carried out by HELCOM Contracting Parties are described in the HELCOM Monitoring Manual in the Monitoring Concepts table as well as in the guidelines for coastal fish monitoring.

Sub-programme: Coastal fish
Monitoring Concepts table

Coastal fish monitoring is rather widespread in the Baltic Sea, and at present covers 34 of the total 42 'scale 3 HELCOM assessment units' (Monitoring figure 1). The current monitoring of piscivores has a good spatial coverage, covering all of the 34 assessment units. For cyprinids, the coverage of monitoring is less extensive (26 assessment units), partly due to the limited occurrence of the species group.



Monitoring figure 1. Coverage of current monitoring of coastal fish by HELCOM assessment unit scale 3 for piscivores (left) and cyprinids (right). Catch stats = commercial catch statistics, Monitoring = fisheries independent monitoring, No = no current monitoring. Click to enlarge.

There are spatial and temporal gaps in the current monitoring and currently, the status evaluations for some areas are based on alternative data sources such as analyses of catch per unit effort (CPUE) data from commercial fisheries. The current monitoring of coastal fish in the Baltic Sea represents a minimum level of effort and serves as a first step for evaluating the status of coastal fish communities.

The current monitoring likely yields insights into major and large scale changes in coastal fish communities in the Baltic Sea, but unique and departing responses in some areas are possible.

Since monitoring and assessments in Latvia ceased in 2007, no indicator updates or status assessments can currently be undertaken for that area. In Lithuania, monitoring is only carried out every third year, so no update since 2011 is available. In Estonia, coastal fish monitoring is carried out at several locations, but the current assessment has only been made for one location (Hiiumaa).

Description of optimal monitoring

Due to the presence of natural environmental gradients across the Baltic Sea, and the rather local appearance of coastal fish communities (and hence their differing structures and responses to environmental change), the spatial coverage of monitoring should be improved in some areas in order to enhance the confidence of the evaluation outcome. When designating new potential monitoring sites, it should be considered that the levels of direct human impact on the coastal fish communities in the existing monitoring areas are low, and future locations should also include more heavily affected areas.

Current monitoring is designed to target coastal fish species preferring higher water temperatures and that dominate coastal areas during warmer parts of the year, typically those with a freshwater origin. Monitoring of species like whitefish, herring and cod that dominate coastal fish communities in more exposed parts of the coast and during colder parts of the year is, however, rather poorly represented. Monitoring of these species and components should be established.

Data and updating

Access and use

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

HELCOM (2015) Abundance of coastal fish key functional groups**.** HELCOM core indicator report. Online. [Date Viewed], [Web link].

ISSN 2343-2543

The indicator output results can be accessed as excel files via the following links:

Piscivores - summary

Piscivores - figures

Cyprinids - summary

Cyprinids - figures

Metadata

Data are typically collected annually in August by national and regional monitoring programmes. Commercial catch statistics in Finland represent total annual catches. See HELCOM (2015) for details.

A few time series of coastal fish monitoring began in the 1970s (Olsson et al. 2012), whereas other were started in the 1980s. The majority of the available time series of coastal fish community structure were, however, initiated in the mid-1990s. In Finland and Sweden a new coastal fish monitoring programme with a higher spatial resolution was established in the early 2000s. For more information, see HELCOM 2012.

Data from 1998 and onwards have been included in the current assessment to cater for shifting baselines, while including as much data as possible.

The raw data which this indicator evaluation is based on, are stored in national databases and extracted for the evaluation. Each country has its own routines for quality assurance of the stored data. No common database currently exists for coastal fish core indicator data. Different options for developing a regional database for the coastal fish core indicators (i.e. not raw data) are currently being investigated. The aim is to clarify options for data arrangements for the purposes of updating the core indicator in the future during 2015.

Data source

Coastal fish monitoring is coordinated within the HELCOM FISH-PRO II expert network. The network compiles data from fisheries independent monitoring in Finland, Estonia, Latvia, Lithuania, Poland, Germany, Denmark and Sweden. Coastal fish communities in the Baltic Sea areas of Russia are to some extent monitored as well. In Poland, a fishery independent coastal fish monitoring programme was established in 2014 and since no time series data exist, data from Poland was not included in the current assessment. In Germany, data are derived from coastal fish monitoring within national projects such as the artificial reef programme outside Rostock/Warnemünde off the summer resort Nienhagen (since 2002), the eel monitoring programme along the coastline of Mecklenburg-Western Pomerania (since 2008), and the coastal trawl survey in the Pomeranian Bay by the University of Rostock (since 2003). None of these three projects have long-term secured funding. In Denmark, there is no coastal fish monitoring programme and the data provided relies on voluntary catch registration by recreational fishermen through the 'key-fishermen' project, which has no long-term secured funding (initiated in 2005). Since the monitoring programme in Finland has limited geographic coverage, the state of coastal fish communities is assessed using estimates of catch per unit effort (CPUE) from the small scaled coastal commercial fishery. There are some additional monitoring locations (see HELCOM 2015) which were not included in this assessment due to lack of funding in some countries for carrying out status assessments.

The institutes responsible for sampling are: Natural Resources Institute Finland (Luke) (Finland), Provincial Government of Åland Islands (Finland), Estonian Marine Institute (Estonia), University of Tartu (Estonia), Institute of Food Safety, Animal Health and Environment "BIOR" (Latvia), Nature Research Center (Lithuania), National Marine Fisheries Research Institute, Gdynia (Poland), Association Fish and Environment Mecklenburg-Vorpommern e.V. (Germany), University of Rostock (Germany), National Institute of Aquatic Resources, Technical University of Denmark (Denmark), Department of Aquatic Resources, Swedish University of Agricultural Sciences (Sweden).

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Archive

This version of the HELCOM core indicator report was published in October 2015:

Core indicator report – web-based version October 2015 (pdf)

Extended core indicator report – outcome of CORESET II project (pdf)

Older versions of the indicator report are available:

2013 Indicator report (pdf)

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