HELCOM core indicator report
July 2017

Abundance of waterbirds in the breeding season

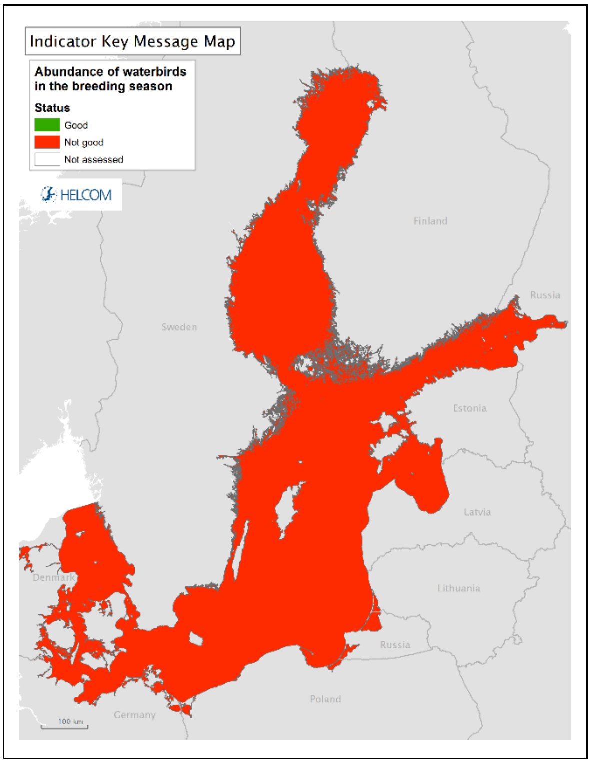
Key Message

This core indicator evaluates the status of the bird species breeding in the Baltic Sea area by assessing fluctuations in abundance. As a rule, good status is achieved when the abundance of 75% of the considered species of a species group does not decline by more than 30% (20% in species laying only one egg per year) compared to a baseline during the reference period 1991-2000.

The indicator performs status evaluations by aggregating annual single species index values for all waterbird species or on the basis of aggregated indices for five species groups (wading feeders, surface feeders, pelagic feeders, benthic feeders, grazing feeders).

The evaluation for the assessment period 2011-2015 showed diverging results for the species groups: While pelagic feeders and grazing feeders achieved the threshold value indicating a good status, surface feeders, benthic feeders and wading feeders failed to achieve the threshold value and do not indicate good status. The results apply to the entire Baltic Sea area.

Future evaluations may be carried out on a finer spatial scale, e.g. on the level of aggregations of sub-basins as recommended by the Joint OSPAR/HELCOM/ICES Working Group on Seabirds (OSPAR/HELCOM/ICES 2017).



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

The confidence of the indicator evaluation is estimated to be **intermediate**.

The core indicator is applicable in the waters of all the countries bordering the Baltic Sea. However, the current evaluation does not include data from Russia, Lithuania and Denmark.

Relevance of the core indicator

Waterbirds are an integral part of the Baltic marine ecosystem. They are important predators, often at a high level in the marine food web. The indicator follows temporal change in the abundance of key waterbird species, which responds to numerous pressures, many of them owing to human activities. Thus, the indicator gives a more general view on the state of marine birds in the Baltic Sea and reflects the cumulative impact of pressures.

Policy relevance of the core indicator

	BSAP Segment and Objectives	**MSFD Descriptors and Criteria**
Primary link	Biodiversity • Viable populations of species • Thriving and balanced communities of plants and animals	D1 Biodiversity D1C2 The population abundance of the species is not adversely affected due to anthropogenic pressures, such that its long-term viability is ensured
Secondary link	Eutrophication • Natural Distribution and occurrence of plants and animals	D1 Biodiversity D1C3 The population demographic characteristics of the species are indicative of a healthy population which is not adversely affected due to anthropogenic pressures D1C4 The species distributional range and, where relevant, pattern is in line with prevailing physiographic, geographic and climatic conditions D4 Food-web D4C1 The diversity of the trophic guild is not adversely affected due to anthropogenic pressures D4C2 The balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures D4C4 Productivity of the trophic guild is not adversely affected due to anthropogenic pressures
Other relevant legislation: EU Birds Directive (migrating species Article 4 (2); pied avocet, Mediterranean gull, Caspian tern, sandwich tern, common tern, Arctic tern, little tern listed in Annex I); Birds Directive Article 12 report, parameter "Population trend"; Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA).		

Cite this indicator

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

Results and Confidence

This indicator is based on the main parameter 'abundance of breeding waterbirds' and also takes into account the supporting parameter 'breeding success'. The abundance parameter follows the OSPAR Ecological Quality Objective (EcoQO) procedure for the status of seabirds in the North Sea (ICES 2008, 2013, OSPAR/HELCOM/ICES 2016), whereas the breeding success parameter is being developed separately.

Abundance

The abundance component of the indicator is based on counts of breeding pairs, nests or individuals belonging to a breeding population. After testing the indicator concept for selected breeding waterbirds in the Baltic earlier (Herrmann et al. 2013), the indicator has now been applied to a broader spectrum of waterbird species for the first time.

The analysis, spanning the reference period (1991-2000) to set the modern baseline and the assessment period (2011-2015), is based on data of 26 waterbird species. The models for two species (common eider, great cormorant) failed when data from the Kattegat were included. Therefore, datasets excluding Kattegat were used for the two species, though that area holds significant numbers of breeding birds of common eiders and great cormorants.

In 17 of the 26 species, the geometric mean of index values in the assessment period (2011-2015) deviated less than 30% (species laying two eggs per year) or 20% (species laying one egg per year) downwards from the modern baseline defined as the average index values in the reference period 1991-2000. These 17 species are estimated to be in a good status. However, nine species deviated more than 30% from the baseline, which indicates that they are not in a good status. According to the indicator concept, waterbirds altogether represent good status when 75% of the species are in good status. As only 17 of the 26 species (65%) were in good status, the threshold for an overall good status of breeding waterbirds was not achieved in the period 2011-2015.

When looking at species groups, the results are diverging. Breeding waterbirds of two species groups achieved the threshold value of 75% of species deviating less than 30%:

- pelagic feeders: 7 out of 7 (100%) species’ index values deviate less than 30% (including razorbill and common guillemot deviating less than 20%), and
- grazing feeders: 2 out of 2 (100%) species’ index values deviate less than 30%.

Three of the breeding waterbirds species groups fail to achieve the threshold value of 75% of species deviating less than 30%:

- benthic feeders: 1 out of 3 (33%) species’ index values deviate less than 30%,
- surface feeders: 4 out of 8 (50%) species’ index values deviate less than 30% and
- wading feeders: 3 out of 6 (50%) species’ index values deviate less than 30%.

Index values of the species included in the assessment are listed in Results table 1 and can be used for national MSFD reporting.

Species failing to keep above threshold level (deviate more than 30%) in the years 2011-2015 were common eider, velvet scoter, Arctic skua, common gull, great black-backed gull, herring gull, pied avocet, turnstone and dunlin.

Species that increased so much that their average index value for 2011-2015 exceeds 130% of the baseline level, which according to the indicator concept are reported as a signal for possible imbalance in the environment, were great crested grebe, great cormorant, common guillemot and Arctic tern. For instance, the increase of common guillemot might be attributed to overfishing of predatory fish (cod) and the resulting abundance and body condition of sprat (e.g. Österblom et al. 2006).

Results table 1 presents trends calculated for the whole period (1991-2015), with details listed in Results table 2 as information to support the interpretation of the status results in a more long-term perspective. Though still indicating good status, four species are significantly declining (Eurasian oystercatcher, goosander, red-breasted merganser and black guillemot). All species not achieving good status in the indicator status evaluation also show significantly declining trends, most strongly in turnstone, dunlin, great black-backed gull and common eider. Out of the 26 species assessed, seven show significant positive and 12 significant negative trends, while six species appear to be stable and for one species the result is uncertain.

Graphs showing index values and trends are provided in Results figure 1.

The method of analysis applied did not give results for barnacle goose, Caspian tern and sandwich tern as their TRIM models were not possible to estimate. Further, results for greater scaup were omitted due to apparent low confidence, because they are based on only five sites and showed very large confidence intervals.

The abundance parameter evaluates data from regular monitoring activities of the coastal countries. If a wider scope would be aimed for, the indicator could be updated using data from additional sites and stemming from various mapping activities outside regular monitoring programmes. Such a filling of gaps in the regular monitoring with additional data sources could improve the confidence and coverage of the indicator evaluation in the future.

Results table 1: Evaluation of the status of breeding waterbirds in the entire Baltic for the period 2011-2015. Index values (single years and mean) are scaled to the average of the reference period (1991-2000, index value set to 1). Good status is shown by green colour, if the threshold level of 0.7 (0.8 in species laying only one egg per year) is met for the geometric mean 2011-2015. If the index value exceeds 1.3 indicating a large abundance increase the status is still considered good but indicated in orange. Red colour means that the species is not in good status. Trends for the period 1991-2015 are shown as ↑ (moderate increase), → (stable), ↓ (moderate decrease) and ↓↓ (strong decrease), with * when p<0.05 and ** when p<0.01 (?: uncertain; for details see Results table 2). Index values for common eider and great cormorant were calculated excluding Kattegat.

group	species	number of sites	index values 2011	2012	2013	2014	2015	mean 2011-2015	good status?	trend 1991-2015
wading feeders	common shelduck	434	1.251	0.950	1.177	0.920	1.034	**1.059**	yes	→
	Eurasian oystercatcher	1177	0.700	0.687	0.757	0.799	0.840	**0.754**	yes	↓**
	pied avocet	44	0.929	0.741	0.633	0.826	0.373	**0.669**	no	↓**
	ringed plover	463	0.847	0.715	0.937	1.023	1.040	**0.904**	yes	→
	turnstone	285	0.263	0.191	0.320	0.347	0.366	**0.290**	no	↓↓**
	dunlin	36	0.179	0.102	0.099	0.061	0.167	**0.113**	no	↓↓**
surface feeders	Arctic skua	166	0.596	0.219	0.230	1.523	0.627	**0.492**	no	?
	common gull	1558	0.644	0.677	0.676	0.595	0.683	**0.654**	no	↓**
	great black-backed gull	1305	0.322	0.338	0.380	0.362	0.331	**0.346**	no	↓↓**
	herring gull	1128	0.519	0.596	0.626	0.574	0.526	**0.567**	no	↓**
	lesser black-backed gull	482	0.831	0.869	1.033	0.843	0.792	**0.870**	yes	→
	little tern	96	0.949	1.050	0.978	0.972	0.807	**0.948**	yes	→
	common tern	886	1.340	0.985	1.397	1.238	1.508	**1.280**	yes	↑**
	Arctic tern	905	2.001	1.794	2.140	3.047	2.617	**2.277**	yes	↑**
pelagic feeders	goosander	706	0.758	0.717	0.886	0.790	0.802	**0.789**	yes	↓**
	red-breasted merganser	1000	0.854	0.891	0.741	0.852	0.963	**0.857**	yes	↓**
	great crested grebe	218	2.266	2.666	3.018	3.488	3.497	**2.947**	yes	↑**
	great cormorant	177	1.276	1.328	1.359	1.664	1.801	**1.471**	yes	↑**
	razorbill (1 egg)	104	1.160	1.050	1.073	1.292	1.145	**1.141**	yes	→
	common guillemot (1 egg)	35	1.205	1.754	1.297	1.638	1.563	**1.477**	yes	↑**
	black guillemot	230	0.647	0.784	0.920	0.711	0.825	**0.772**	yes	↓*
benthic feeders	tufted duck	740	0.945	1.033	1.234	1.475	1.400	**1.200**	yes	→
	common eider	667	0.289	0.300	0.302	0.203	0.189	**0.251**	no	↓↓**
	velvet scoter	518	0.393	0.399	0.450	0.429	0.515	**0.435**	no	↓**
gra-zing fee-ders	mute swan	1269	0.959	1.315	1.454	1.274	1.278	**1.244**	yes	↑**
	greylag goose	566	1.109	1.356	1.123	1.234	1.262	**1.213**	yes	↑**

Results table 2: Trends observed in breeding waterbirds in the Baltic 1991-2015. Trend slopes and standard errors result from TRIM analyses.

group	species	number of sites	trend slope	S.E.	p	status*
wading feeders	common shelduck	434	1.0010	0.0030		stable
	Eurasian oystercatcher	1177	0.9858	0.0016	<0.01	moderate decline
	pied avocet	44	0.9775	0.0071	<0.01	moderate decline
	ringed plover	463	0.9955	0.0025		stable
	turnstone	285	0.9318	0.0042	<0.01	steep decline
	dunlin	36	0.8868	0.0097	<0.01	steep decline
surface feeders	Arctic skua	166	0.9754	0.0169		uncertain
	common gull	1558	0.9757	0.0018	<0.01	moderate decline
	great black-backed gull	1305	0.9451	0.0017	<0.01	steep decline
	herring gull	1128	0.9711	0.0023	<0.01	moderate decline
	lesser black-backed gull	482	0.9871	0.0072		stable
	little tern	96	0.9972	0.0054		stable
	common tern	886	1.0101	0.0034	<0.01	moderate increase
	Arctic tern	905	1.0408	0.0036	<0.01	moderate increase
pelagic feeders	goosander	706	0.9917	0.0026	<0.01	moderate decline
	red-breasted merganser	1000	0.9908	0.0025	<0.01	moderate decline
	great crested grebe	218	1.0615	0.0069	<0.01	moderate increase
	great cormorant**	177	1.0292	0.0078	<0.01	moderate increase
	razorbill	104	1.0071	0.0039		stable
	common guillemot	35	1.0260	0.0046	<0.01	moderate increase
	black guillemot	230	0.9877	0.0048	<0.05	moderate decline
benthic feeders	tufted duck	740	1.0050	0.0032		stable
	common eider**	667	0.9298	0.0023	<0.01	steep decline
	velvet scoter	518	0.9542	0.0036	<0.01	moderate decline
gra-zing fee-ders	mute swan	1269	1.0153	0.0018	<0.01	moderate increase
	greylag goose	566	1.0116	0.0029	<0.01	moderate increase

* The multiplicative overall slope estimate in TRIM is converted into one of the following categories. The category depends on the overall slope as well as its 95% confidence interval (= slope +/- 1.96 times the standard error of the slope) (Pannekoek & van Strien 2001):

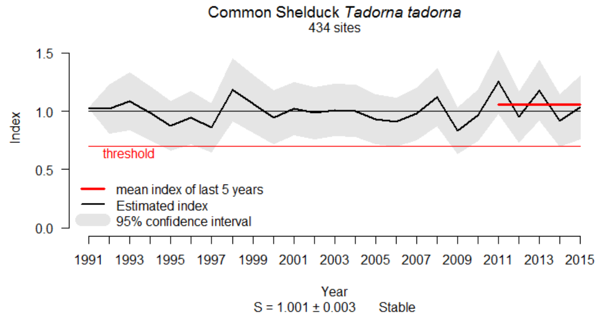
Strong increase - increase significantly more than 5% per year (5% meaning a doubling in abundance within 15 years). Criterion: lower limit of confidence interval >1.05.
Moderate increase - significant increase, but not significantly more than 5% per year. Criterion: 1.00< lower limit of confidence interval <1.05.
Stable - no significant increase or decline, and it is certain that trends are less than 5% per year. Criterion: confidence interval encloses 1.00 but lower limit >0.95 and upper limit <1.05.
Moderate decline - significant decline, but not significantly more than 5% per year. Criterion: 0.95< upper limit of confidence interval <1.00.
Steep decline - decline significantly more than 5% per year (5% meaning a halving in abundance within 15 years). Criterion: upper limit of confidence interval <0.95.

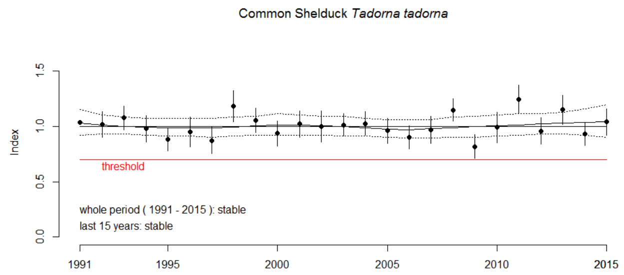
** Without Kattegat.

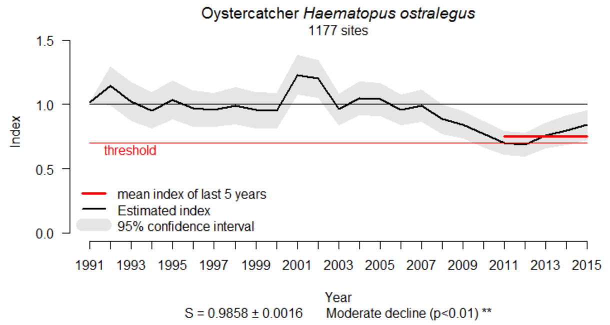
Results figure 1 (left): Index graphs showing annual index values for breeding waterbirds in the entire Baltic (black line) and 95% confidence intervals (grey shading) resulting from TRIM analyses after rescaling the annual indices to reference level where average of index values 1991-2000 is 1 (thin black line). Further shown are thresholds for good status (70% of baseline, 80% of baseline in species laying only one egg per year, thin red line) and the average index values 2011-2015 (geometric mean) used for the evaluation (red line). In addition, trend slopes and s.e. as well as the status of the species are given below the graphs. Index values for great cormorant and common eider were calculated without data from Kattegat.

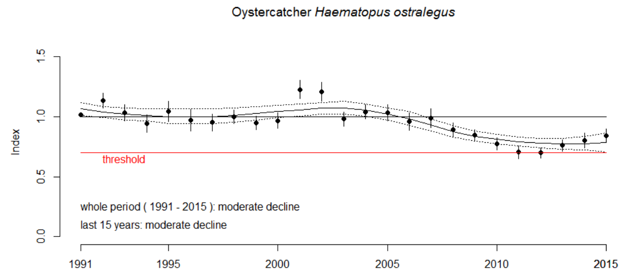
Results figure 1 (right): Trend graphs showing annual index values for breeding waterbirds in the entire Baltic (black dots) and standard errors (vertical lines) resulting from TRIM analyses (after rescaling) as well as smoothed trend lines (thick black lines) and their s.e. (dotted lines)as calculated by the modified MSI-tool. Further shown are baselines (average of index values 1991-2000, thin black line) and thresholds for good status (70% of baseline, 80% of baseline in species laying only one egg per year, thin red line). In addition, the status of the species for the whole period (1991-2015) and for the last 15 years (2001-2015) is given below the graphs. Index values for great cormorant and common eider were calculated without data from Kattegat

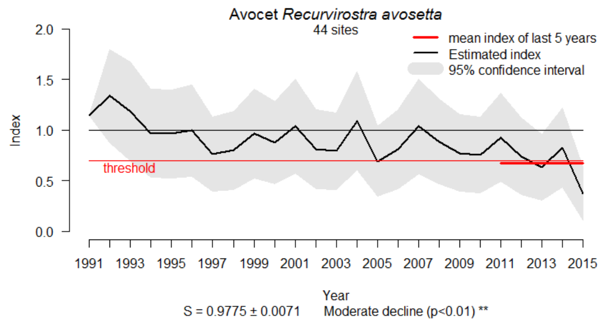
Wading feeders

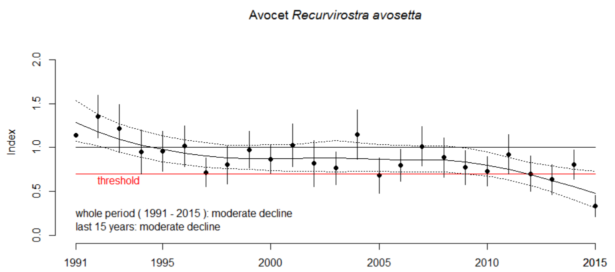


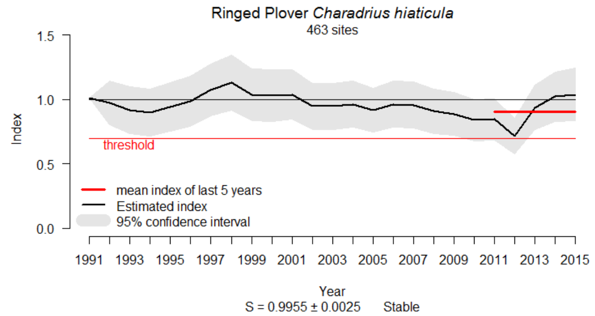


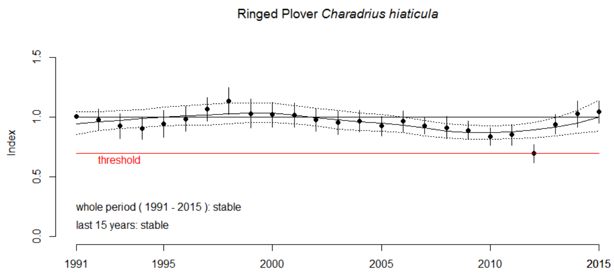


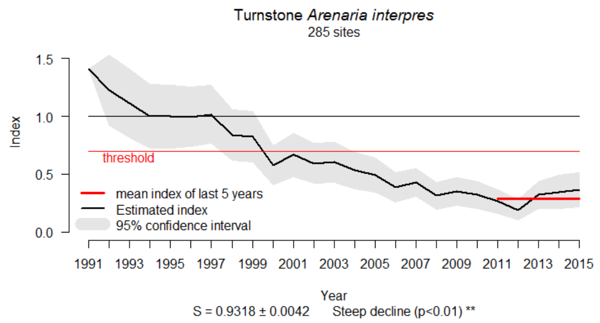


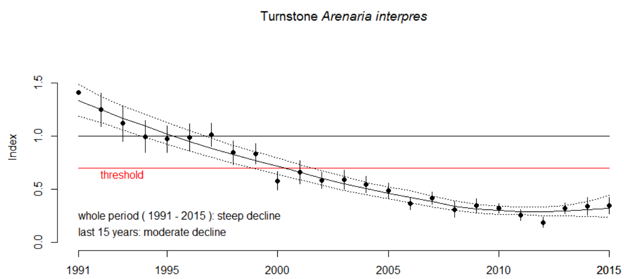


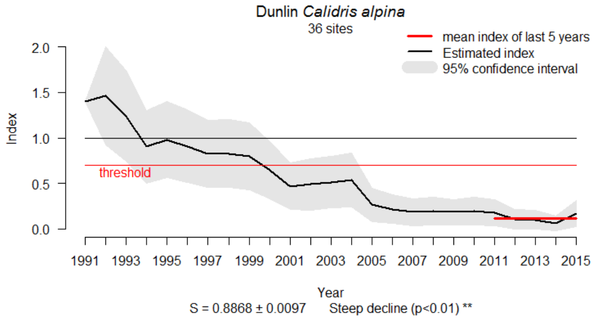


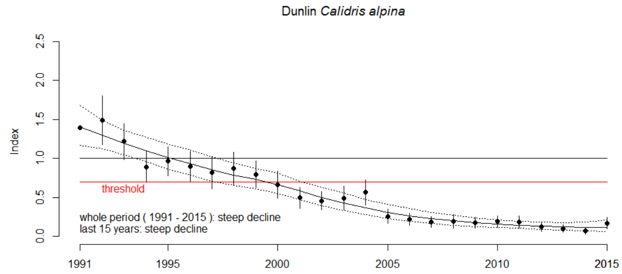




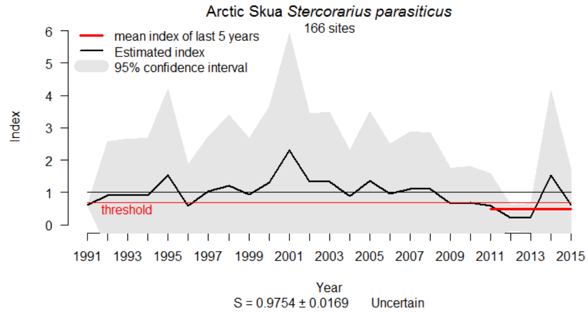


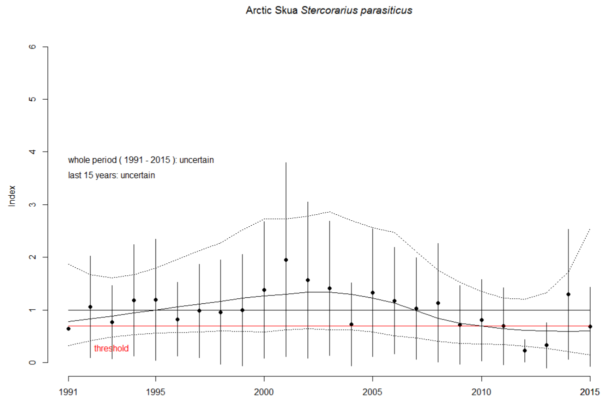


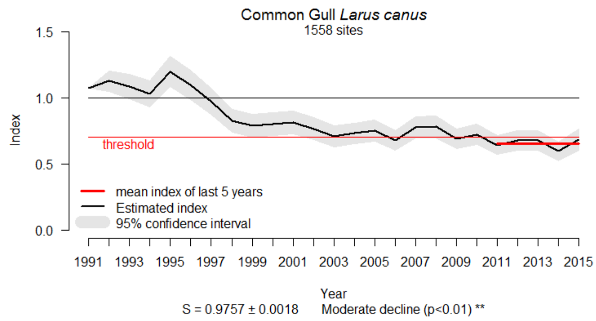


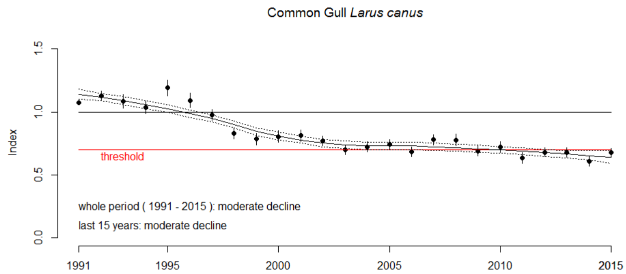


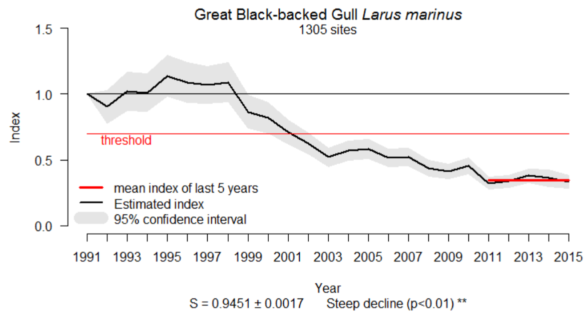
Surface feeders

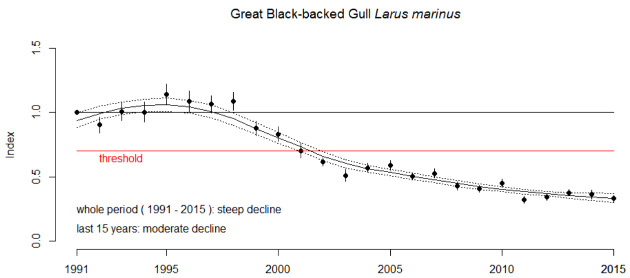


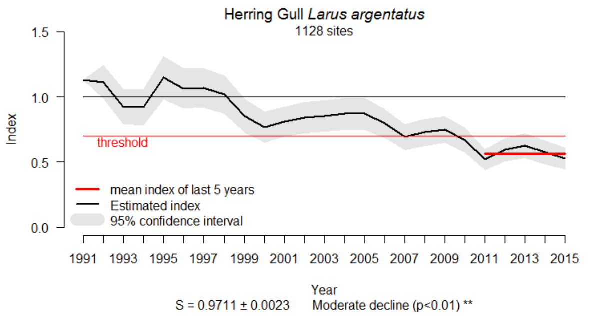


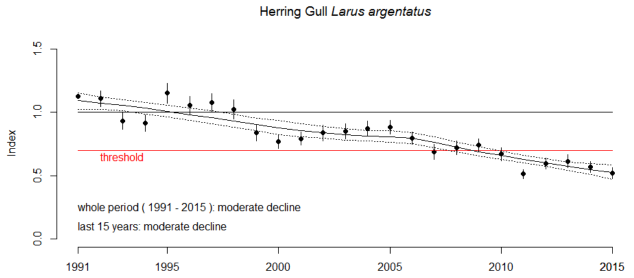


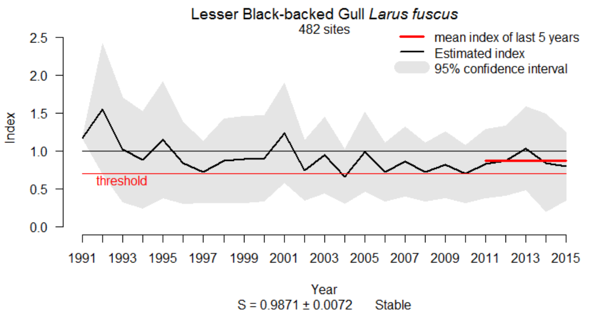


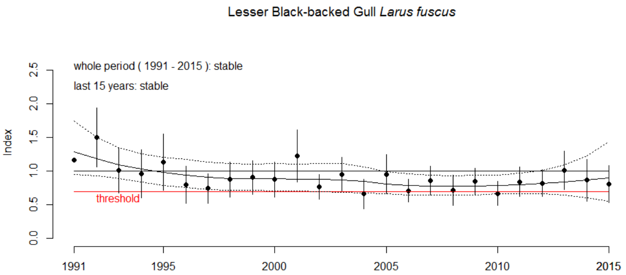


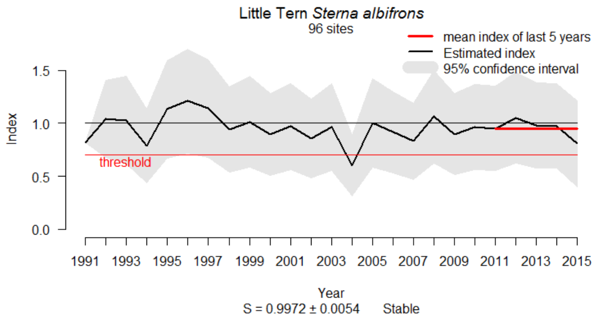


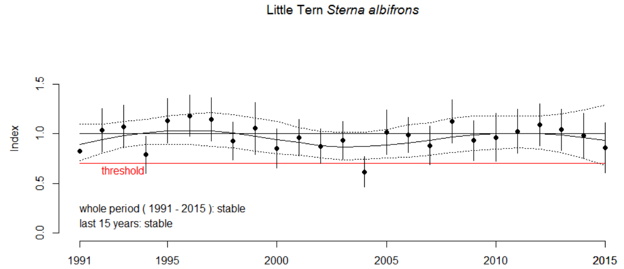

Herring Gull *Larus argentatus*
1128 sites
Index
threshold
mean index of last 5 years
Estimated index
95% confidence interval
Year
S = 0.9711 ± 0.0023
Moderate decline (p<0.01) **

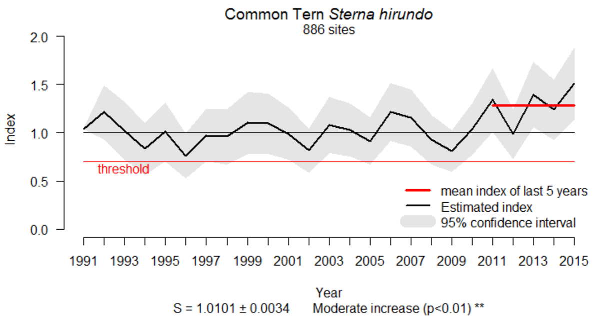

Herring Gull *Larus argentatus*
Index
threshold
whole period (1991 - 2015): moderate decline
last 15 years: moderate decline

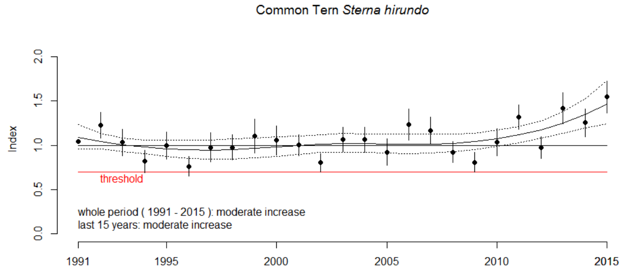

Lesser Black-backed Gull *Larus fuscus*
482 sites
mean index of last 5 years
Estimated index
95% confidence interval
Index
threshold
Year
S = 0.9871 ± 0.0072
Stable

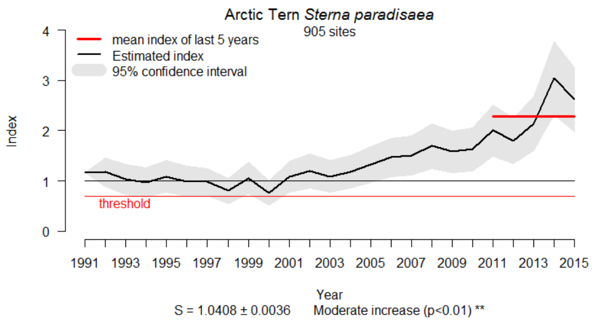

Lesser Black-backed Gull *Larus fuscus*
whole period (1991 - 2015): stable
last 15 years: stable
Index
threshold

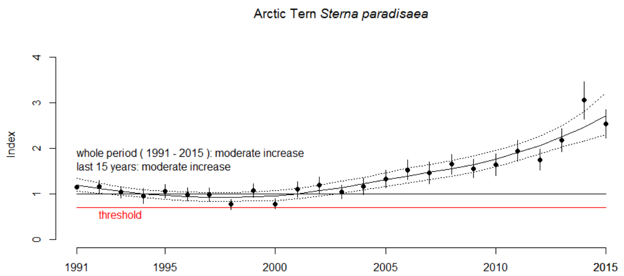

Little Tern *Sterna albifrons*
96 sites
mean index of last 5 years
Estimated index
95% confidence interval
Index
threshold
Year
S = 0.9972 ± 0.0054
Stable


Little Tern *Sterna albifrons*
Index
threshold
whole period (1991 - 2015): stable
last 15 years: stable

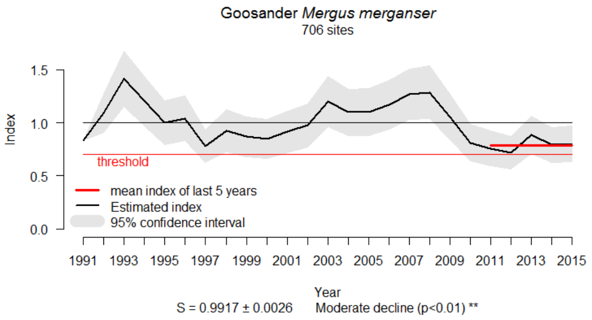

Common Tern *Sterna hirundo*
886 sites
Index
threshold
mean index of last 5 years
Estimated index
95% confidence interval
Year
S = 1.0101 ± 0.0034
Moderate increase (p<0.01) **

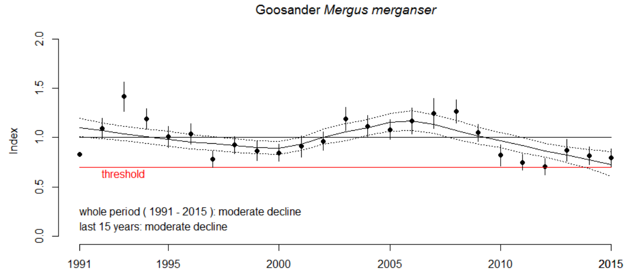

Common Tern *Sterna hirundo*
Index
threshold
whole period (1991 - 2015): moderate increase
last 15 years: moderate increase

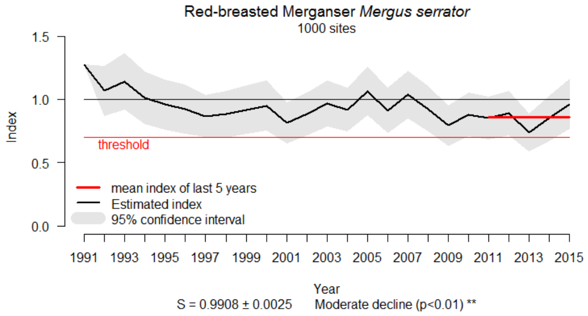

Arctic Tern *Sterna paradisaea*
905 sites
mean index of last 5 years
Estimated index
95% confidence interval
Index
threshold
Year
S = 1.0408 ± 0.0036
Moderate increase (p<0.01) **

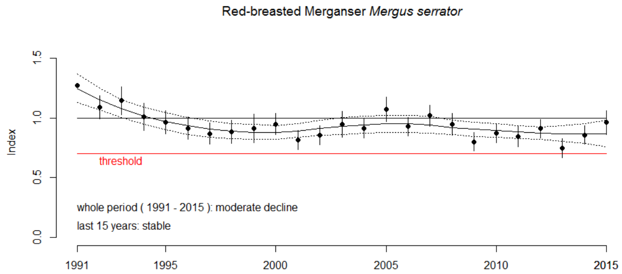

Arctic Tern *Sterna paradisaea*
Index
whole period (1991 - 2015): moderate increase
last 15 years: moderate increase
threshold

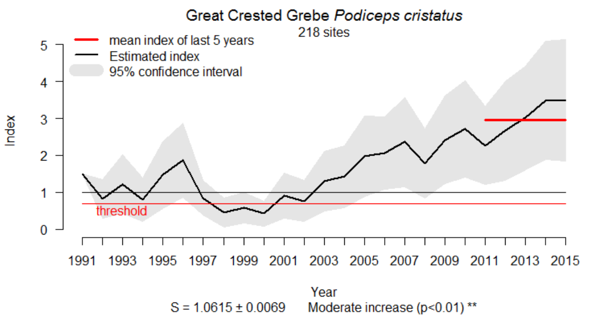
Pelagic feeders

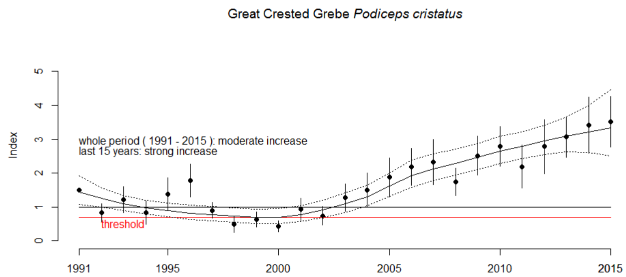


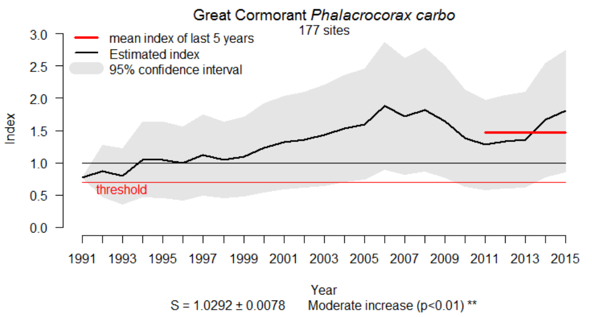


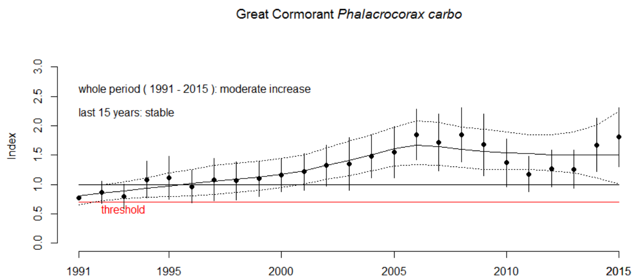


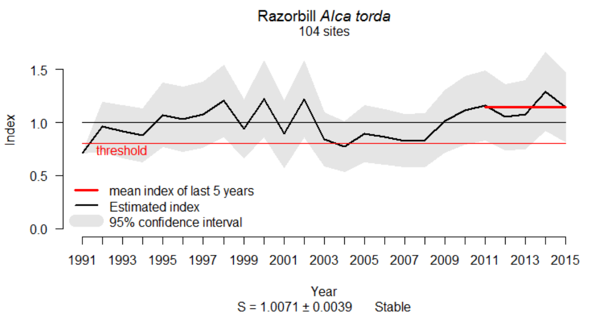


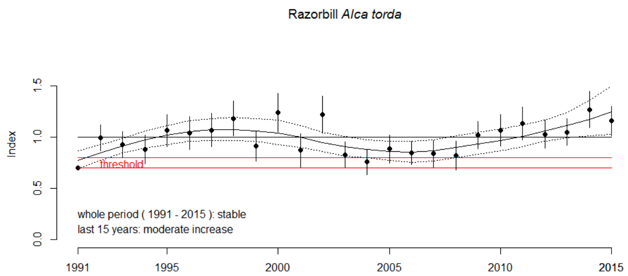


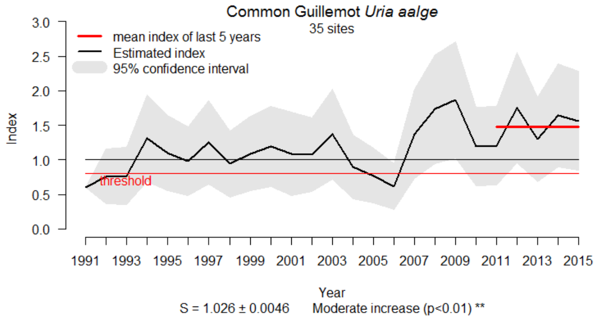


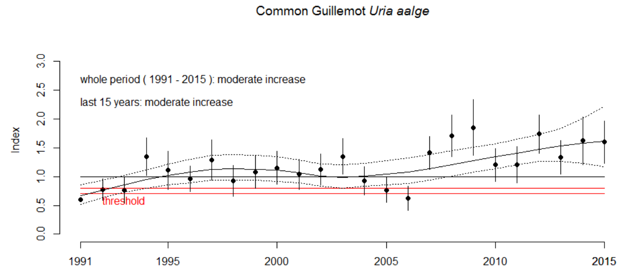


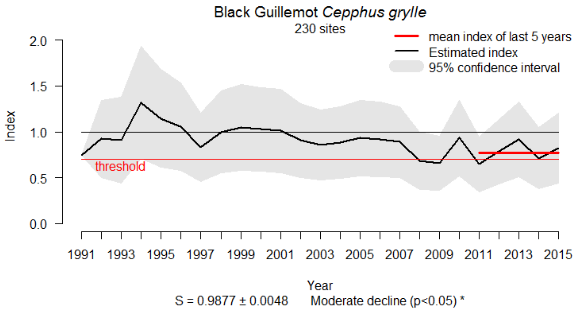


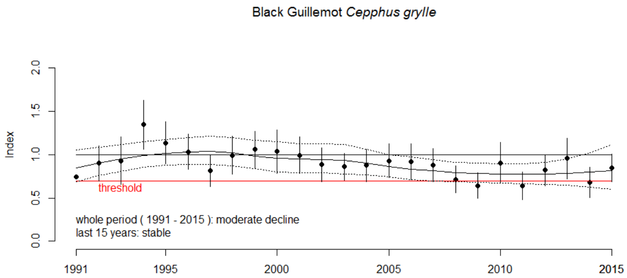




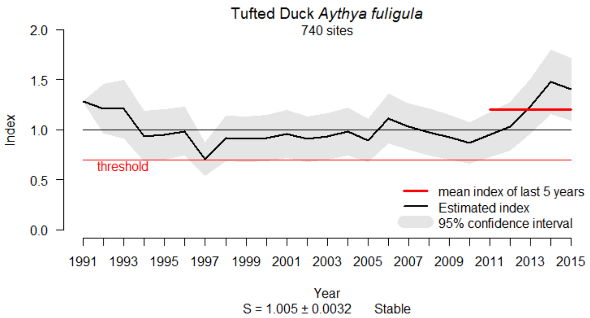


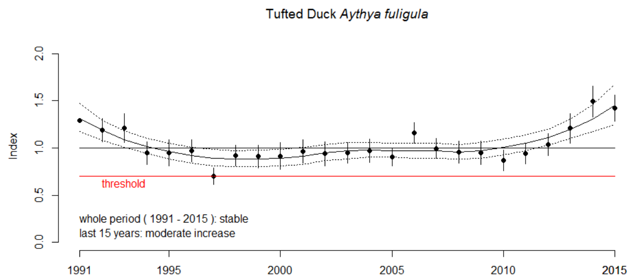


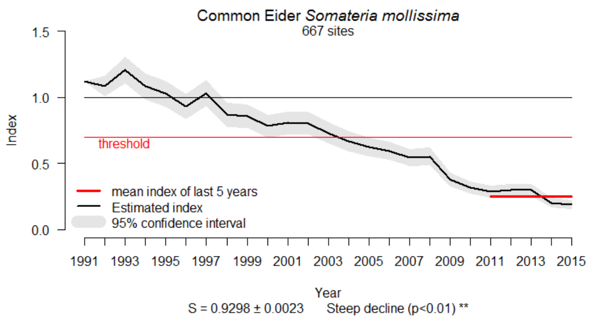


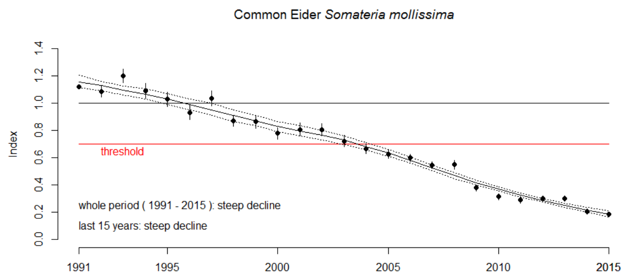


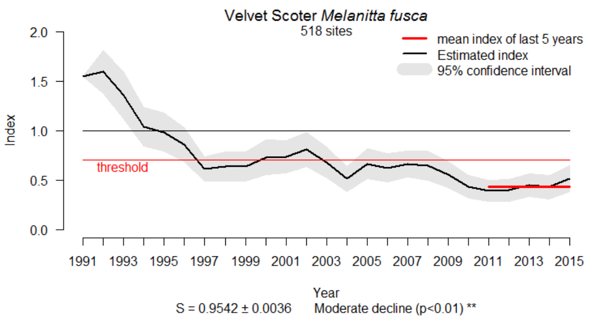
Benthic feeders

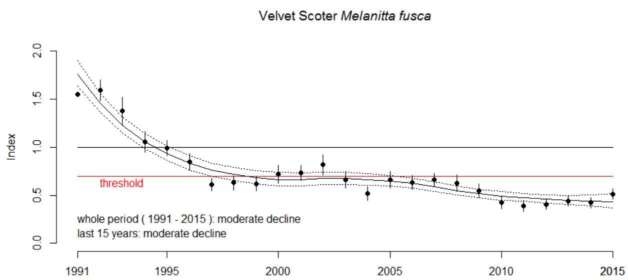




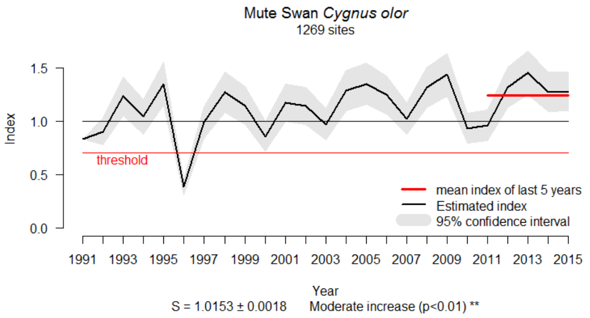


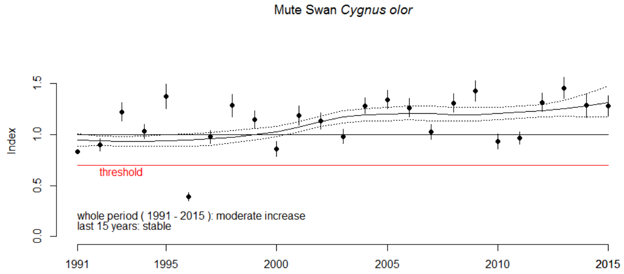


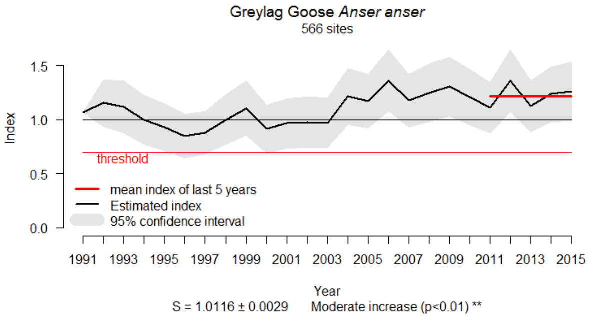


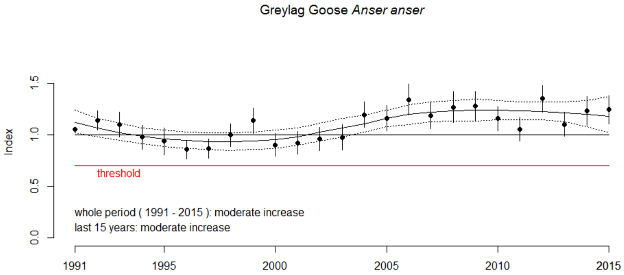


Grazing feeders









Breeding success

The status evaluation based on the breeding success parameter of the indicator is poorly developed. No current results can yet be presented. There is no operational monitoring scheme which could currently supply data for the evaluation, although productivity is observed in several case studies (Herrmann et al. 2013). Therefore, this part of the indicator has been regarded as only providing qualitative support to the status evaluation based on the abundance of breeding waterbirds parameter. If monitoring schemes covering a number of waterbird species are available, it could be relevant to construct the breeding success parameter as an independent indicator with its own threshold value comparable to the operational indicator in the OSPAR region (ICG-COBAM MSFD Indicator B-3 'Breeding success/failure of marine birds').

Breeding success can directly show the suitability of prevailing environmental conditions for the reproduction of waterbirds. Whereas the bird abundance parameter alone may react slowly to changes in the environment owing to the high longevity of the individuals of the population, breeding success reflects short-term changes much better and could potentially act as an “early warning system”. For example, decreased food availability would directly translate into breeding failure as soon as a certain threshold is no longer met. As long as marine food is taken for chick provisioning, the marine ecosystem can thus be evaluated by the reproductive output in relation to reference values. However, breeding failure is often connected to predation. As this mainly involves terrestrial mammals, a breeding success indicator reflects the conditions in the coastal landscape as well. Therefore, evaluations based on measurements of breeding success have to include careful considerations about the reasons responsible for breeding failure.

Confidence of the indicator status evaluation

The overall confidence of the indicator is currently **intermediate**.

Regarding the temporal coverage, the confidence is high because data from all years of the assessment period (2011-2015) are included. However, not all species are monitored in each country annually. Commonly found intervals are three or six years (as adaptation to Natura 2000 reporting cycles, see European Commission 1992, 2010) or even ten years. This results in many missing data for part of the years in the dataset. Although TRIM is designed to handle this by imputing the missing data, the analysis needs a substantial amount of yearly "real" data to calculate reliable imputed values. Missing counts for particular sites are estimated (´imputed´) from changes in all other sites. If there are too few of these "other sites" with "real" data, the obtained estimates for focal sites are strongly influenced by site-specific processes at the sites providing the real data.

The spatial representability is estimated to be low, because this evaluation is lacking information from three Contracting Parties of HELCOM (Denmark, Lithuania, Russia) and contains only fragmentary information from Latvia. Therefore, the current analyses are based on unevenly distributed sites around the Baltic Sea.

The accuracy of the estimate is high, because the results clearly show whether or not the threshold values are met. The reference period (1991-2000) used to define the modern baseline for the indicator is arbitrarily chosen to reflect as early abundance data as possible. The modern baseline does not reflect pristine conditions. In order to enhance the confidence in the overall threshold values, future work to explore the abundance of the baseline period in relation to pristine conditions could be undertaken.

Methodological confidence can be regarded as intermediate. Though there are no HELCOM guidelines for monitoring breeding bird abundance, the methods applied in breeding bird surveys can be expected to meet international agreed standards and to result in data qualities according to at least local standards.

Good Environmental Status

The status is evaluated by examining the proportion of breeding waterbird species for which the abundance deviates more than 30% (20% in species laying only one egg per year) from the abundance in the modern baseline defined by a reference period. This approach can be used for status evaluations i) as a multi-species assessment or ii) for species groups of waterbirds separately. The latter is used in MSFD according to the COM Decision (EU) 2017/848 about criteria and methodological standards on Good Environmental Status. In either case, the threshold value is achieved when 75% of the species deviate less than 25% from the baseline.

This threshold concept follows the concept of the OSPAR Indicator 'Marine bird abundance' (ICES 2013). Upward deviations (>30% above abundance at the baseline) are not considered to reflect a failure to achieve the threshold value indicating good status, however they are reported as possible indications of imbalance in the ecosystem. The applicability of this method in the Baltic Sea has been shown by Herrmann et al. (2013). Good status is possible to achieve also for species identified as being threatened in the Baltic Sea (HELCOM 2013), when the species maintained its population size on a low level or even increased while still being under pressure from anthropogenic influence.

When species groups form the basis of the assessment, the threshold value of 75% of species not being 30%/20% below the baseline level can directly be converted to the number of species included in each group. ICES (2015) has defined terminology and composition of functional species groups, which are defined mainly by the way of foraging (see Good environmental status table 1). OSPAR/HELCOM/ICES (2016) have identified bird species suitable for supporting the breeding waterbird abundance indicator. Thus, this indicator provides five evaluations when applied to

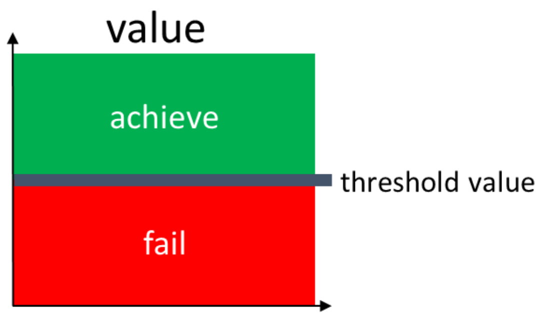
- wading feeders (six species: common shelduck, Eurasian oystercatcher, pied avocet, ringed plover, turnstone, dunlin),
- surface feeders (ten species: Arctic skua, common gull, herring gull, great black-backed gull, lesser black-backed gull, little tern, Caspian tern, sandwich tern, common tern, Arctic tern),
- pelagic feeders (seven species: great crested grebe, great cormorant, goosander, red-breasted merganser, razorbill, common guillemot, black guillemot),
- benthic feeders (four species: greater scaup. tufted duck, common eider, velvet scoter) and
- grazing feeders (three species: mute swan, barnacle goose, greylag goose).

Given the composition of the species groups, the five evaluations are based on a different number of species per group. For example, in surface feeders, eight out of ten species would need to be above the threshold, while in benthic feeders all three species would have to be above the threshold level, because two out of three species would mean that only 67% of the species do not deviate from the baseline too much (but 75% is required).

The selection of species assessed in the indicator was related only to breeding occurrence in Baltic marine habitats and data availability, but independent of threat status.

Good environmental status table 1: Species groups of waterbirds as defined by ICES (2015).

Species group	Typical feeding behaviour	Typical food types	Additional guidance
Wading feeders	Walk/wade in shallow waters	Invertebrates (molluscs, polychaetes, etc.)	
Surface feeders	Feed within the surface layer (within 1–2 m of the surface)	Small fish, zooplankton and other invertebrates	"Surface layer" defined in relation to normal diving depth of plunge-divers (except gannets)
Pelagic feeders	Feed at a broad depth range in the water column	Pelagic and demersal fish and invertebrates (e.g. squid, zooplankton)	Include only spp. that usually dive by actively swimming underwater; but including gannets. Includes species feeding on benthic fish (e.g. flatfish).
Benthic feeders	Feed on the seafloor	Invertebrates (e.g. molluscs, echinoderms)	
Grazing feeders	Grazing in intertidal areas and in shallow waters	Plants (e.g. eelgrass, saltmarsh plants), algae	Geese, swans and dabbling ducks, coot



Good environmental status figure 1. Schematic representation of the threshold value. Determination of acceptable deviation from baseline (condition during the reference period), where the threshold is achieved if 75% of the considered populations are not more than 30% below the baseline level (20% in species laying only one egg per year). Upward deviations (>30% above abundance at the baseline) are not considered to reflect a failure to achieve the threshold, but rather indicate possible imbalance in the ecosystem. No threshold value has currently been developed for the included parameter 'breeding success'.

Owing to both natural and anthropogenic influences, breeding bird numbers have fluctuated over the past decades. Therefore, it is difficult to define 'natural' population sizes, which could serve as reference levels. For practical reasons, a preliminary modern baseline is set based on a reference period as the average abundance during the starting period of data compilation (1991-2000), but future work on the indicator may find more appropriate solutions by setting species-specific reference periods for defining the baseline against which the status is assessed, which reflect the pressures affecting the populations.

Although generally giving more up-to-date information on the situation of bird populations, the parameter breeding success (i.e. the annual reproductive output) cannot be evaluated at present. This is mainly due to the lack of monitoring programmes. If monitoring of breeding success can be implemented in the Baltic Sea region in future, an evaluation method could be developed by either looking at colony failures similar to the OSPAR indicator 'Breeding success/failure of marine bird species', developed by ICG-COBAM (ICES 2013) or relying on more precise measurements of offspring per breeding pair.

Assessment Protocol

The assessment is based on the numbers of breeding pairs of selected waterbird species, counted in breeding colonies or in monitoring plots. Site level raw data are used for each species to calculate the annual indices and trends. The national monitoring programmes provide the breeding bird monitoring data. Each site level data for each species consists of site code, coordinates of the site, year of survey, recorded abundance and the units in which the abundance is expressed (mostly pairs). There is a separate entry for each year the site was visited. Each site is assigned a code indicating to which country and assessment unit it belongs.

To calculate the yearly indices and trends, the classical TRIM framework and software (Pannekoek & van Strien 2001) is used. Models explaining the observed abundance by site effects and year effects while accounting for serial correlation and overdispersion in the data are built for each species. The method is based on loglinear Poisson regression and is able to impute the missing observations (ter Braak et al. 1994, van Strien et al. 2001, 2004). For more details of the procedure, see also http://www.ebcc.info/trim.html and https://www.cbs.nl/en-gb/society/nature-and-environment/indices-and-trends--trim--/background-trim-method-and-indicators. The method produces yearly indices and linear trend estimates (the slope of the regression line through the logarithm of the indices). The year 1991 or the start year of the time series (if later) is used as the point of reference (when the index is 1), but the results are then scaled to a reference period (i.e. the average index values from 1991-2000 are scaled to 1).

The linear trend estimates and their confidence intervals are used to classify the trends into moderate or steep decline, moderate or strong increase, stable or uncertain. For full details of the classification criteria, see http://www.ebcc.info/index.php?ID=615#Box%20Trend%20interpretation%20and%20classification.

The obtained yearly indices and their standard errors were used to calculate the smooth trend and its confidence interval for each species using MSI-tool (Soldaat et al., submitted) developed by Statistics Netherlands. The R code of the original MSI-tool script was modified to rescale the values to reference level where average of index values 1991-2000 is 1.

For the parameter breeding success of Baltic waterbirds, no assessment protocol currently exists.

Further development of the indicator

The indicator is in a state allowing evaluation of the status of breeding waterbirds in the entire Baltic. Beneath efforts to apply evaluations to a finer spatial scale (see section 'Assessment units' below), the aim should be to complete the coverage of waterbird species (though only few had to be left out this time because TRIM models were not possible to estimate). Currently, already all species groups are represented in the indicator results, but the inclusion of barnacle goose (a grazing feeder) and Caspian and sandwich terns (surface feeders) would strengthen conclusions for the respective species groups.

The indicator includes threatened birds (not their threat status) in the status evaluation. According to the indicator concept, a species can have good status even though it is listed as threatened/endangered in the HELCOM Red List (HELCOM 2013), which considers also other criteria in addition to population size. International (e.g. Europe red-list, IUCN red-list) red-listed species should be included in further development of the indicator, and it should be considered how to present the abundance results as to avoid misunderstandings regarding threat status.

Assessment units

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

At the current stage of the indicator development, the assessment unit is the entire Baltic Sea. It is an aim to apply the indicator on a finer geographical scale, for instance on the aggregation of the 17 sub-basins (HELCOM assessment unit scale 2) to seven sub-regions, as recommended by OSPAR/HELCOM/ICES (2017) for the wintering waterbird indicator. Several waterbird species (terns in particular) are known to switch between breeding colonies from year to year, possibly even at distances involving switches between sub-basins, leading to the estimate that HELCOM assessment unit scale 2 is not an appropriate scale.

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 waterbirds in the breeding season, this indicator contributes to the overall biodiversity assessment along with the other biodiversity core indicators.

Policy relevance

The indicator on abundance of waterbirds in the breeding season addresses the Baltic Sea Action Plan (BSAP) Biodiversity and nature conservation segment's ecological objectives 'Thriving and balanced communities of plants and animals' and 'Viable populations of species' as well as the eutrophication segment's ecological objective 'Natural distribution and occurrence of plants and animals'.

The core indicator is relevant to the following action of the 2013 HELCOM Ministerial Declaration:

- 4 (B). WE DECIDE to protect seabirds in the Baltic Sea, taking into consideration migratory species and need for co-operation with other regions through conventions and institutions such as the Agreement on Conservation of African Eurasian Migratory Waterbirds (AEWA) under the Convention on Migratory Species (CMS), and particularly in the North Sea (OSPAR) and Arctic (Arctic Council) areas.

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

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';

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 (European Commission 2017):

- Criterion D1C2 (population abundance)
- Criterion D1C3 (population demographic characteristics)
- Criterion D1C4 (species distribution)
- Criterion D4C1 (diversity of trophic guild)
- Criterion D4C2 (balance of total abundance between trophic guilds)
- Criterion D4C4 (productivity of trophic guild)

The EU Birds Directive (a) lists in Annex 1 barnacle goose, pied avocet, dunlin (Baltic subspecies *Calidris alpina schinzii*), Caspian tern, sandwich tern, common tern, Arctic tern and little tern as subject of special conservation measures and (b) generally covers all migratory species and they have to be reported (European Commission 2010). Thus, all species included in the concept of the indicator are also covered by the EU Birds Directive, which requires conservation of habitats in a way that allows birds to breed, moult, stage during migration and spend the winter.

Furthermore, the Baltic Sea is located in the agreement area of the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA). Contracting Parties (all HELCOM member countries except Poland and Russia) are obliged to undertake measures warranting the conservation of migratory waterbirds and their habitats.

The goals of the BSAP, EU MSFD, AEWA and EU Birds Directive are largely overlapping and the data needed for the indicator are roughly the same as needed for reporting within the framework of the EU Birds Directive.

In order to protect migrating birds in the Baltic Sea region, HELCOM has adopted the Recommendation 34/E-1 'Safeguarding important bird habitats and migration routes in the Baltic Sea from negative effects of wind and wave energy production at sea'. Since some species included in the concept of the indicator are vulnerable to habitat loss caused by wind farms and access to feeding areas of breeding birds may be blocked by wind farms, while others are prone to collisions (e.g. Masden et al. 2010, Furness et al. 2013, Bradbury et al. 2014), the indicator is linked to the intentions of the recommendation.

Role of waterbirds in the ecosystem

Waterbirds are an integral part of the Baltic marine ecosystem. They are predators of fish and macroinvertebrates, scavengers of carcasses and fishery discards and herbivores of littoral vegetation. They can be assigned to functional species groups, meaning that different prey types are taken from different compartments of the marine environment. Most species are specialized in certain species and/or size classes of prey. As they cannot survive without a sufficient food supply, changes in the number of waterbirds reflect conditions in the food web of the Baltic Sea. A high number of breeding waterbirds may not automatically indicate a good environmental status, because for instance piscivorous species benefit from a high availability of small fish, which in turn may points to a disorder of the food web owing to overfishing of large fish species.

As they are predators at or close to the top of the food web, waterbirds accumulate contaminants and their numbers, and even more their breeding success, indicate the degree of contamination. Moreover, several waterbird species are predated by white-tailed eagles, transferring the loads of contaminants to a higher level in the food web.

Some waterbird species are not only breeding, but also wintering in the Baltic Sea region. For several reasons, those species are potentially included in the concepts of both the breeding and wintering waterbird abundance indicators. The intention of the indicators is to support the assessment of environmental status of marine areas rather than the state of bird populations per se. This is most obvious in species that have differing distribution patterns between breeding and wintering seasons (e.g. alcids). In general, the explanatory power of the indicator is constrained by factors acting on the waterbirds in the non-breeding season, either in the Baltic Sea or in staging and wintering areas along the flyways to southern Europe and Africa or even Australia and Antarctica, depending on the migration routes of the respective species.

Human pressures linked to the indicator

	General	MSFD Annex III, Table 2a
Strong link	The most important human threats to breeding waterbirds are predation by indigenous and non-indigenous mammals, contamination by hazardous substances and prey depletion.	Biological pressures: - input or spread of non-indigenous species - disturbance of species (e.g. where they breed, rest and feed) due to human presence - extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities) Physical pressures: - physical disturbance to seabed (temporary or reversible) - physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate) Pressures by substances, litter and energy: - input of nutrients – diffuse sources, point sources, atmospheric deposition - input of organic matter – diffuse sources and point sources - input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) – diffuse sources, point sources, atmospheric deposition, acute events
Weak link	Numbers of breeding waterbirds are additionally influenced by pressures acting primarily in the non-breeding season.	Pressures by substances, litter and energy: - input of litter (solid waste matter, including micro-sized litter) - input of anthropogenic sound (impulsive, continuous) - input of other forms of energy (including electromagnetic fields, light and heat)

The abundance of breeding waterbirds in the Baltic Sea is strongly influenced by a variety of human activities, both directly and indirectly. The effects are cumulative, because pressures exist in the breeding season, during migration and in winter.

In general, waterbirds strongly respond to food availability. Therefore, human activities influencing the food supply of waterbirds are reflected in bird numbers. For fish-eating birds, direct human pressure is posed by the extraction of fish, while physical damage of the seafloor directly affects benthic feeders. On the other hand, overfishing of large predatory fish species increases the abundance of smaller species and thereby improves the food supply for birds. Indirect effects can also occur via human induced eutrophication: in the oligotrophic end of the eutrophication status, the bird populations are limited by the availability of food sources, whereas towards eutrophic conditions plant and zoobenthos biomass increases, which first benefits waterbird populations, but in the extreme end will cause a decrease in food availability.

As their reproduction takes place on land, even waterbirds that live at sea during all other times are prone to predation by non-indigenous mammals such as American mink and raccoon dog, which have been introduced by humans and therefore have to be treated as a human pressure. While many breeding colonies are well protected nowadays, some breeding sites are still under pressure from direct human disturbance, for example from tourism and recreational boating.

Bird losses from drowning in fishing gear, hunting and plumage oiling as well as habitat loss from offshore wind farming, aggregate extraction and shipping are pressures mostly acting in the non-breeding season. At least in those species that both breed and spend the winter in the Baltic Sea, also these human pressures affect the numbers of breeding birds – not only by the elimination of birds from the population, but also in terms of carry-over effects by reducing body condition with effects on survival and reproductive success. Negative impacts on body condition are also obtained year-round from the accumulation of contaminants ingested via the food web.

Monitoring Requirements

Monitoring methodology

Monitoring of breeding waterbirds in the Contracting Parties of HELCOM is described on a general level in the **HELCOM Monitoring Manual in the sub-programme: Marine breeding birds abundance and distribution.**

Specific monitoring guidelines for breeding waterbirds are planned to be included into the Monitoring Manual.

The indicator on breeding waterbirds is primarily based on counts of breeding pairs or nests along the shorelines of the Baltic Sea, i.e. is restricted to coastal landscape (including islands). Many species only breed in nature reserves or other protected sites, which have been monitored using constant methods for decades. In many sites, breeding birds are counted annually, and gaps can be filled by a TRIM analysis.

Breeding success is usually measured as the number of fledged chicks per breeding pair. Methods to observe the reproductive output differ between species. For instance, in Great Cormorants it is possible to count the nearly-fledged juveniles in the nests, whereas in gulls and terns reliable data are available only when movements of the non-fledged offspring are restricted by fencing or when mark-recapture methods are applied.

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.

Sub-programme: Marine breeding birds abundance and distribution
Monitoring Concepts table

There are some differing characteristics in the countries' monitoring programmes, e.g. the species covered and the temporal scaling. Surveys are in most cases conducted annually, but every three or six years (as an adaptation to Natura 2000 reporting cycles, see European Commission 1992, 2010) or even every ten years (e.g. common eider in Denmark) in some cases. Some new monitoring schemes, such as the 2015 spring monitoring scheme in Sweden, will be implemented in the near future, however recent overviews of monitoring of breeding waterbirds are still valid, e.g. the BALSAM metadatabase or the project's interim report (HELCOM 2014).

Description of optimal monitoring

For abundance of breeding birds, the currently operational national monitoring schemes are only partly sufficient to supply the necessary data for the indicator. There are still gaps regarding spatial coverage (lack of monitoring schemes in Russia and Latvia) and coverage of species (not all monitoring schemes include all the species dealt with in the indicator), and an optimal monitoring would have to get these gaps closed. The monitoring methods applied could benefit from international standardization, however, need to take into consideration the varying environmental conditions and species composition of the different regions of the Baltic Sea. As not all species can be monitored in every country, depending on the assessment unit level chosen, it would be wise to coordinate national monitoring schemes in a way that allows for coverage of as many species as possible. For rare species, and those showing higher degrees of inter-annual relocation, coordinated Baltic-wide surveys should be aspired for in order to minimize the effects of data gaps and low site fidelity.

Breeding success is currently not monitored sufficiently to allow for any status evaluation. In order to improve the confidence of the indicator evaluation, breeding success should be included in monitoring activities at least for the key species in the main breeding colonies throughout the Baltic Sea region.

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 (2017) Abundance of waterbirds in the breeding season. HELCOM core indicator report. Online. [Date Viewed], [Web link].

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Metadata

Result: Abundance of waterbirds in the breeding season

Data: Abundance of waterbirds in the breeding season data

Following a data call in March 2016, breeding bird data of 30 species for the years 1991-2015 were supplied by authorities from Contracting Parties of HELCOM, except Russia, Lithuania and Denmark. Breeding bird abundance was reported in numbers of breeding pairs, but Swedish data referred to numbers of males and individuals. The use of different units did not cause problems, because calculations are done on the basis of population indices rather than on population sizes. Data sets consisted of site code, year, species and abundance. Data were supplied for a total of 1920 sites, but each species had different numbers of sites used in the analysis.

Contributors and references

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Archive

This version of the HELCOM core indicator report was published in July 2017:

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

Older versions of the report

2013 Core indicator Report

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