HELCOM INDICATORS

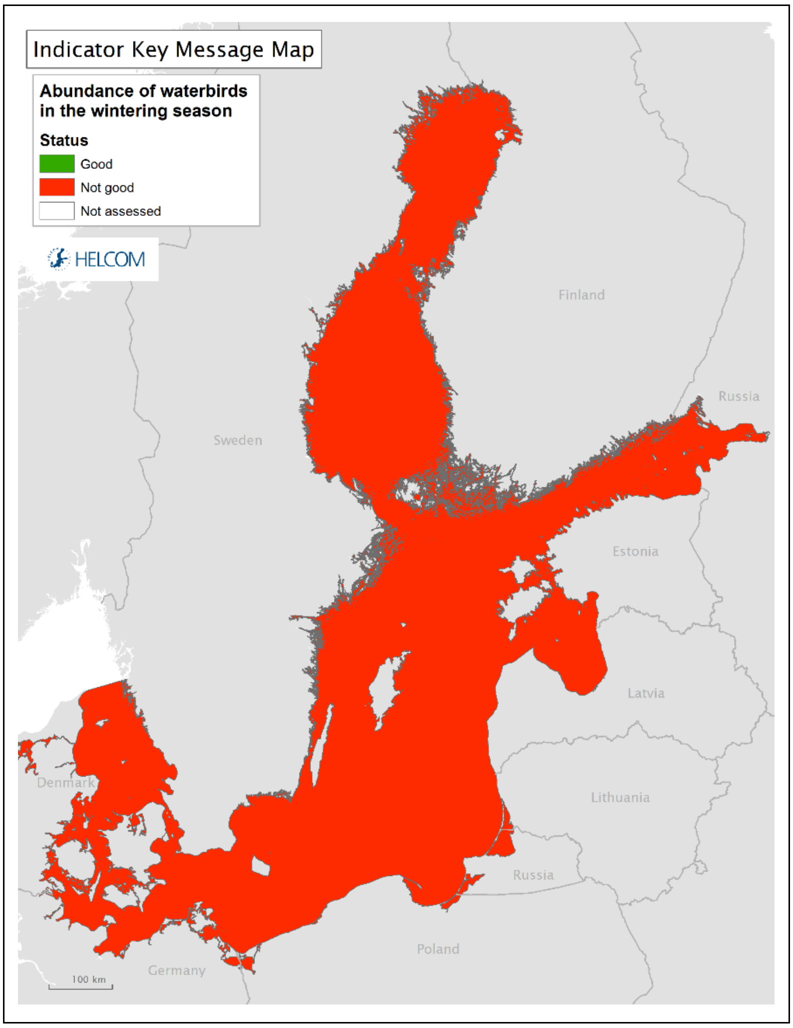
HELCOM core indicator report
July 2017

Abundance of waterbirds in the wintering season

Key Message

This core indicator evaluates the status of abundance of wintering waterbirds in the Baltic Sea region. The wintering waterbirds are considered to reflect good status when at least 75% of the considered species deviate less than 30% downwards (species laying more than one egg per year) or 20% downwards (species laying one egg per year) from the baseline condition during the reference period 1991-2000.

The current evaluation is based on data from coastal surveys of 27 waterbird species for the assessment period 2011-2015. Waterbirds wintering in offshore parts of the Baltic are currently not represented in the indicator due to lacking data, but the inclusion of those birds is under development with the aim to have data from offshore surveys included by 2018.



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

In the period 2011-2015, the abundance of wintering waterbirds in the Baltic Sea was not in a good status, because 74% of the species assessed achieved the threshold value (at least 75% of species meeting threshold value indicates good status). The evaluation could be applied to four species groups of which two groups, namely surface feeders and pelagic feeders, achieved good status (≥75% of species meeting threshold value), whereas benthic feeders and grazing feeders did not reach the threshold value. No evaluation was possible for wading feeders.

The confidence of the evaluations is estimated to be **intermediate**.

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

Relevance of the core indicator

As predators at high levels in the food web, but also as herbivores that may remove large proportions of macrophytes by grazing, waterbirds are an integral part of the Baltic marine ecosystem.

The indicator follows temporal changes in the abundance of key waterbird species, which have functional significance in the marine ecosystem and respond to numerous pressures, many of them caused by human activities. Thus, the indicator gives an overall view of 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 D1C4 The species distributional range, where relevant, pattern is in line with prevailing physiographic 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
Other relevant legislation: EU Birds Directive (migrating species Article 4 (2); red-throated diver, black-throated diver, Slavonian grebe, whooper swan, Steller's eider, smew, little gull listed in Annex I); BD 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

The abundance of wintering waterbirds did not achieve good status in the assessment period 2011-2015, because the result shows that 74% of the species' abundance deviated less than 30% from the baseline, however the threshold value is that 75% of species. The status is thus very close to the threshold level.

The evaluation is based on monitoring data of 27 species, which are collected in the frame of International Waterbird Census (IWC) (Results table 1).

Only 7 of the 27 species assessed did not meet the threshold value in the assessment period 2011-2015, namely red-necked grebe, black-throated diver, common pochard, greater scaup, Steller's eider, Bewick's swan and Eurasian coot. These seven species' index value deviated more than 30% from the baseline value, i.e. the average index value in the ten-year reference period 1991-2000 (Results table 1). The other 20 species that were assessed (i.e. 74%) indicate good status, as the species' index values deviated less than 30% from the baseline value.

In some species, the average index value for the assessment period exceeded the reference value by more than 30%. While still representing good status, the very high results for black-headed gull, smew and Slavonian grebe may indicate imbalance in the environment.

Regarding species groups, the evaluation results are not consistent. Species groups indicating good status, i.e. at least 75% of species deviate less than 30% from the baseline are:

- surface feeders: 4 out of 4 species (100%) indicate good status, and
- pelagic feeders: 7 out of 9 species (78%) indicate good status.

Species groups that did not achieve the threshold value:

- benthic feeders: 3 out of 9 species (33%) indicate good status, and
- grazing feeders: 2 out of 5 species (40%) indicate good status.

Detailed results per species are provided (Results table 1). No assessment was made for wading feeders as no species belonging to this species group were included in the dataset.

In addition to index values, Results table 1 shows trends calculated for the entire period 1991-2015 as supporting information to interpret the status evaluation results for the assessment period 2011-2015. Nine species from all species groups, though still indicating good status, are significantly declining, while eight species are increasing. A strong increase is only seen in common scoter. All the seven species not achieving good status are significantly declining, most strongly Steller's eider. Out of the 27 species assessed, nine show significant positive and 16 significant negative trends, while two species appear to be stable.

Species only marginally wintering in coastal marine areas (three species of alcids: razorbill, common guillemot, black guillemot) are not considered in the indicator, because only a very small fraction of their Baltic Sea winter population is covered by the data which is currently restricted to land-based counts and does not represent birds wintering offshore.

It is important to consider that the results reflect the status of waterbirds along the coastlines (except for some Polish and Finish offshore counts included). In some species, namely Slavonian grebe, red-throated diver, black-throated diver, common eider, long-tailed duck, common scoter and velvet scoter, considerable parts if not the great majority of the Baltic wintering population stay offshore and are poorly represented in the coastal counts. Therefore, results presented for the respective species should not be generalized and extrapolated to the entire marine area of the Baltic. For example, the strong declines reported for red-throated diver, long-tailed duck and velvet scoter in the Baltic (Skov al. 2011) and leading to the classification as endangered species by HELCOM (2013) are not reflected in the indicator results.

Three species of dabbling duck (Eurasian wigeon, Eurasian teal, northern pintail) were reported on by some Contracting Parties of HELCOM in response to the data call for the indicator although the species were not listed. The three species have been excluded from the analysis as the representativety of the data is not certain. The species can be included in the future.

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

Results table 1: Evaluation of the status of wintering 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 by 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 ↑↑ (strong increase), ↑ (moderate increase), → (stable), ↓ (moderate decrease) and ↓↓ (strong decrease), with * when p<0.05 and ** when p<0.01 (for details see Results table 2). In species marked (wt) the GAM was calculated without temperature as a covariate.

Species group	species	number of sites	index values 2011	2012	2013	2014	2015	mean 2011-2015	good status?	trend 1991-2015
surface feeders	black-headed gull	375	1.478	2.802	1.937	2.074	1.294	**1.848**	yes	↑*
	common gull	562	0.609	1.264	0.780	1.121	0.771	**0.877**	yes	→
	great black-backed gull	590	0.703	0.894	0.730	0.952	0.592	**0.763**	yes	→
	herring gull	693	0.650	1.220	0.650	0.884	0.413	**0.716**	yes	↓**
pelagic feeders	smew	841	0.948	1.898	2.185	2.266	1.324	**1.638**	yes	↑**
	goosander	1491	0.621	0.692	1.116	1.313	0.810	**0.874**	yes	↓*
	red-breasted merganser	1070	0.750	1.038	0.758	0.870	0.560	**0.779**	yes	↓**
	great crested grebe	801	0.701	1.269	0.843	1.146	0.809	**0.930**	yes	↑*
	red-necked grebe	275	0.546	0.624	1.169	0.778	0.193	**0.569**	no	↓**
	Slavonian grebe	206	2.810	3.412	2.833	3.972	1.666	**2.824**	yes	↑**
	red-throated diver	356	0.185	2.036	1.021	1.314	0.937	**0.861**	yes	↑*
	black-throated diver	317	0.294	1.135	0.775	1.254	0.378	**0.658**	no	↓**
	great cormorant	1122	0.730	1.417	0.873	1.500	1.085	**1.080**	yes	↑*
benthic feeders	common pochard (wt)	497	0.509	0.565	0.454	0.839	0.303	**0.506**	no	↓**
	tufted duck	1099	0.735	0.765	0.861	0.799	0.750	**0.781**	yes	↓**
	greater scaup	605	0.468	0.586	0.627	0.783	0.468	**0.575**	no	↓**
	Steller's eider (wt)	63	0.355	0.113	0.251	0.525	0.271	**0.270**	no	↓↓**
	common eider (wt)	701	0.657	1.073	1.167	1.174	0.221	**0.734**	yes	↓**
	long-tailed duck (wt)	988	0.581	0.998	0.790	0.868	0.983	**0.829**	yes	↓**
	common scoter	418	0.912	0.992	1.227	1.712	0.606	**1.029**	yes	↑↑**
	velvet scoter	496	0.482	0.396	1.025	0.868	1.013	**0.703**	yes	↓**
	common goldeneye	1503	1.511	1.098	1.153	1.102	0.980	**1.156**	yes	↑**
grazing feeders	mute swan	1461	0.768	0.732	1.083	0.932	0.518	**0.783**	yes	↓**
	whooper swan	941	0.815	1.224	1.213	1.150	0.709	**0.997**	yes	↑**
	Bewick's swan (wt)	93	0.253	11.233	0.284	0.434	0.116	**0.528**	no	↓*
	mallard	1468	0.827	1.069	0.930	0.757	0.538	**0.803**	yes	↓**
	Eurasian coot	698	0.457	0.560	0.542	0.485	0.265	**0.447**	no	↓**

Results table 2: Trends observed in wintering waterbirds in the Baltic 1991-2015. Trend slopes and standard errors result from GAM analyses. In species marked (wt) the GAM was calculated without temperature as a covariate.

Species group	species	number of sites	trend slope	S.E.	p	status*
surface feeders	black-headed gull	375	1.0554	0.0241	<0.05	moderate increase
	common gull	562	1.0088	0.0093		stable
	great black-backed gull	590	0.9961	0.0066		stable
	herring gull	693	0.9876	0.0052	<0.01	moderate decline
pelagic feeders	smew	841	1.0345	0.0041	<0.01	moderate increase
	goosander	1491	0.9893	0.0021	<0.05	moderate decline
	red-breasted merganser	1070	0.9822	0.0021	<0.01	moderate decline
	great crested grebe	801	1.0103	0.0033	<0.05	moderate increase
	red-necked grebe	275	0.9716	0.0083	<0.01	moderate decline
	Slavonian grebe	206	1.0500	0.0160	<0.01	moderate increase
	red-throated diver	356	1.0399	0.0176	<0.05	moderate increase
	black-throated diver	317	0.9727	0.0086	<0.01	moderate decline
	great cormorant	1122	1.0205	0.0035	<0.05	moderate increase
benthic feeders	common pochard (wt)	497	0.9667	0.0035	<0.01	moderate decline
	tufted duck	1099	0.9873	0.0023	<0.01	moderate decline
	greater scaup	605	0.9742	0.0047	<0.01	moderate decline
	Steller's eider (wt)	63	0.9228	0.0107	<0.01	steep decline
	common eider (wt)	701	0.9875	0.0022	<0.01	moderate decline
	long-tailed duck (wt)	988	0.9885	0.0031	<0.01	moderate decline
	common scoter	418	1.0849	0.0067	<0.01	strong increase
	velvet scoter	496	0.9934	0.0031	<0.01	moderate decline
	common goldeneye	1503	1.0082	0.0017	<0.01	moderate increase
grazing feeders	mute swan	1461	0.9908	0.0012	<0.01	moderate decline
	whooper swan	941	1.0098	0.0027	<0.01	moderate increase
	Bewick's swan (wt)	93	0.9234	0.0364	<0.05	moderate decline
	mallard	1468	0.9881	0.0013	<0.01	moderate decline
	Eurasian coot	698	0.9678	0.0022	<0.01	moderate decline

* The multiplicative overall slope estimate calculated by the MSI-tool is converted into one of the following categories, depending 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.

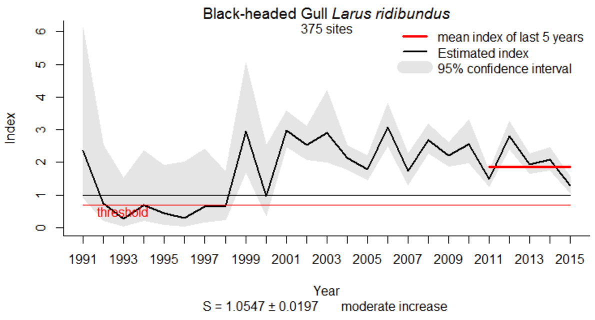
Moderate decline - significant decline, but not significantly more than 5% per year. Criterion: 0.95< upper limit of confidence interval <1.00.

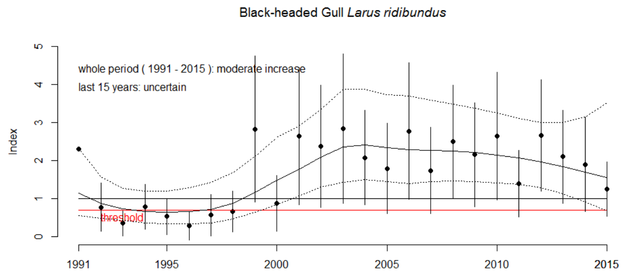
Steep decline - decline significantly more than 5% per year (5% meaning a halving in abundance within 15 years). Criterion: upper limit of confidence interval <0.95.

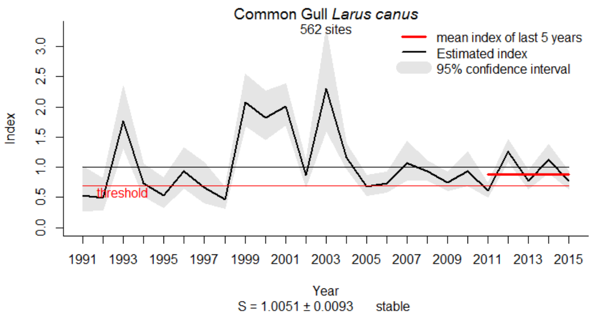
Results figure 1 (left): Index graphs showing annual index values for wintering waterbirds in the entire Baltic (black line) and 95% confidence intervals (grey shading) resulting from GAM analyses with reference level where average of index values 1991-2000 is 1 (thin black line). Further shown are thresholds 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. Models for common pochard, Steller's eider, common eider, long-tailed duck and Bewick's swan do not include temperature as a covariate.

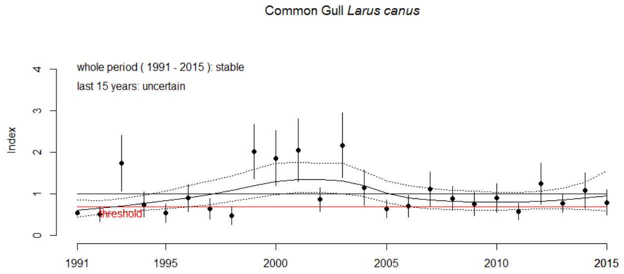
Results figure 1 (right): Trend graphs showing annual index values for wintering waterbirds in the entire Baltic (black dots) and standard errors (vertical lines) as well as smoothed trend lines (thick black lines) and their s.e. (dotted lines) as calculated by the modified MSI-tool. Further shown are 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. Models for common pochard, Steller's eider, common eider, long-tailed duck and Bewick's swan do not include temperature as a covariate.

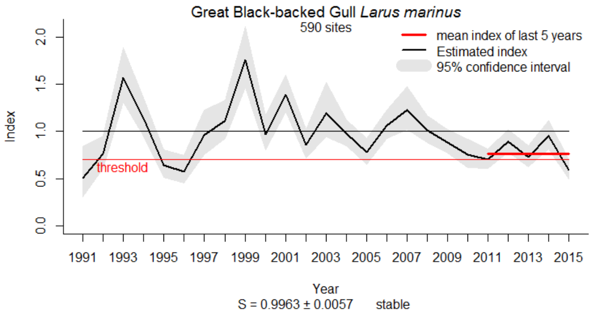
Surface feeders

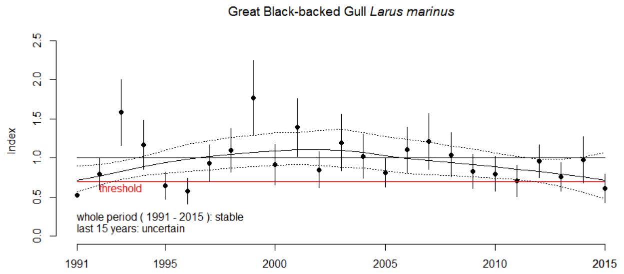


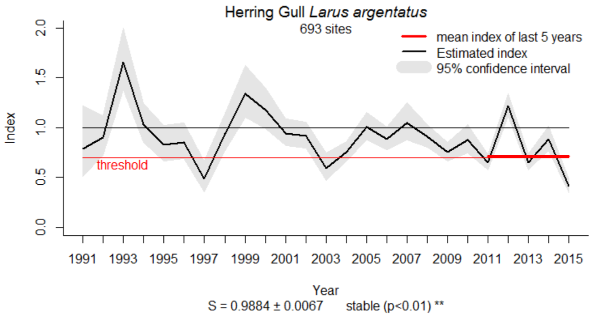


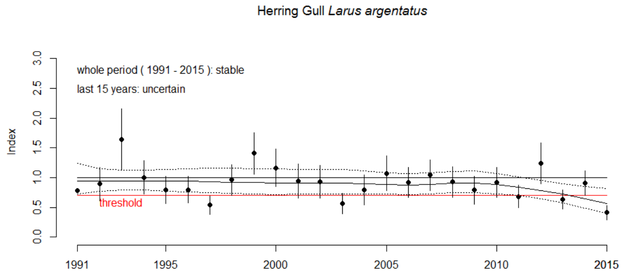




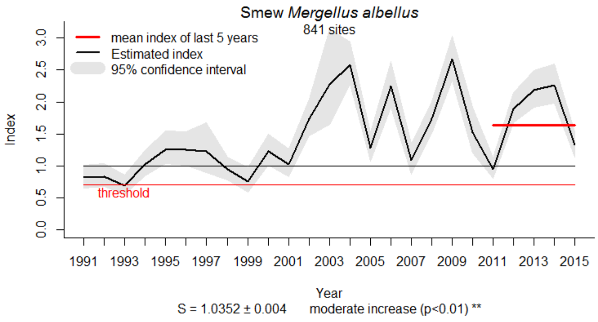


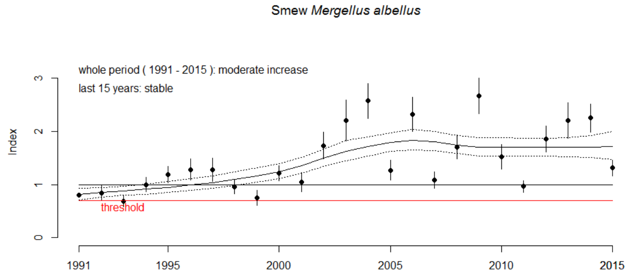


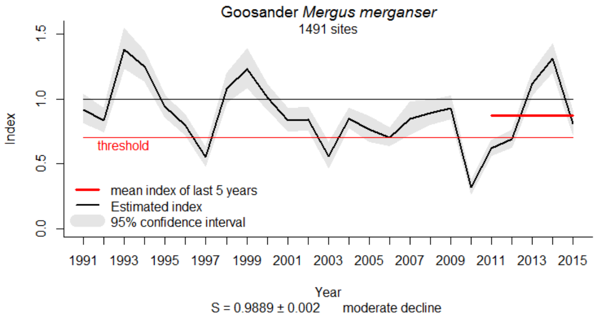


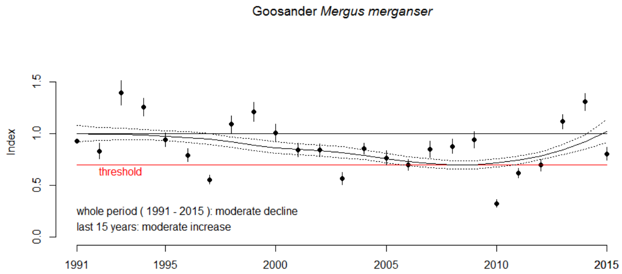


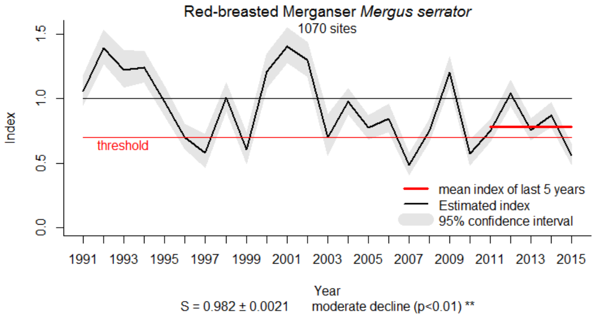
Pelagic feeders

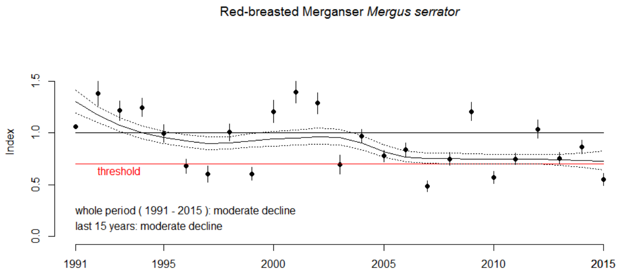


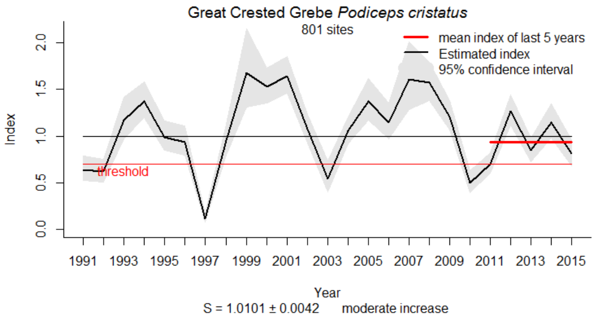


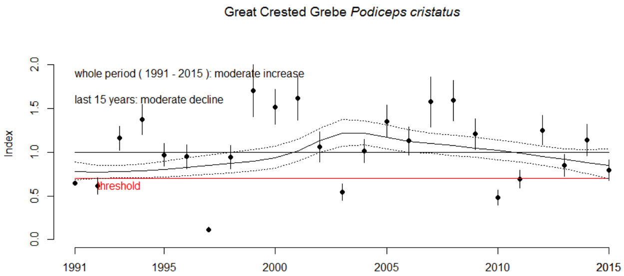

Goosander *Mergus merganser*
1491 sites
threshold
mean index of last 5 years
Estimated index
95% confidence interval
Index
Year
S = 0.9889 ± 0.002 moderate decline

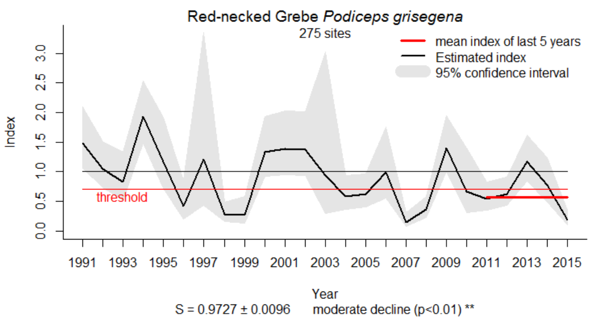

Goosander *Mergus merganser*
threshold
whole period (1991 - 2015): moderate decline
last 15 years: moderate increase
Index

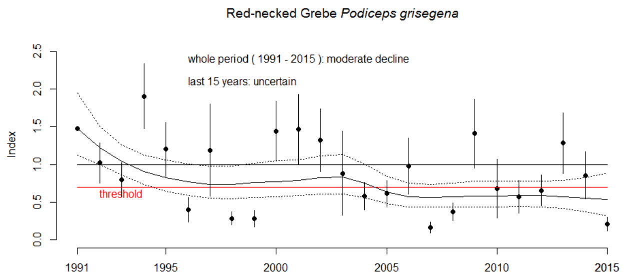

Red-breasted Merganser *Mergus serrator*
1070 sites
threshold
mean index of last 5 years
Estimated index
95% confidence interval
Index
Year
S = 0.982 ± 0.0021 moderate decline (p<0.01) **

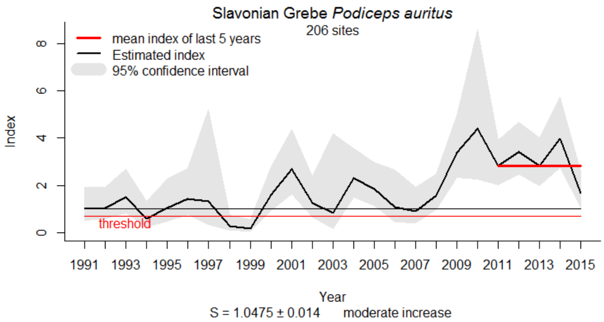

Red-breasted Merganser *Mergus serrator*
threshold
whole period (1991 - 2015): moderate decline
last 15 years: moderate decline
Index

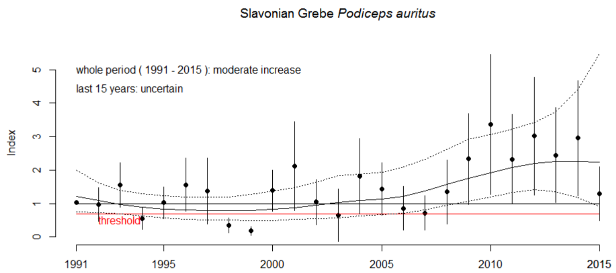

Great Crested Grebe *Podiceps cristatus*
801 sites
mean index of last 5 years
Estimated index
95% confidence interval
threshold
Index
Year
S = 1.0101 ± 0.0042 moderate increase

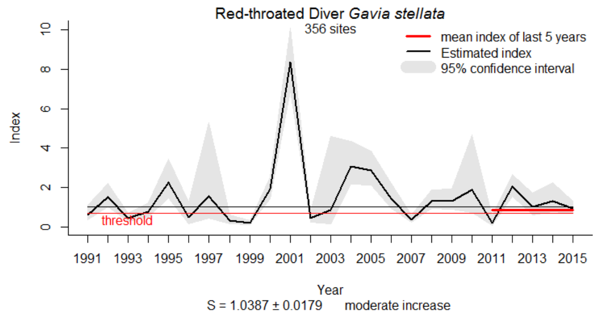

Great Crested Grebe *Podiceps cristatus*
whole period (1991 - 2015): moderate increase
last 15 years: moderate decline
threshold
Index

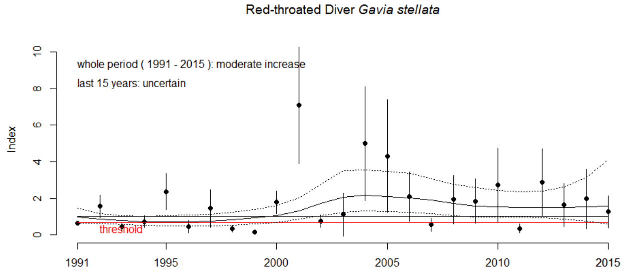

Red-necked Grebe *Podiceps grisegena*
275 sites
mean index of last 5 years
Estimated index
95% confidence interval
threshold
Index
Year
S = 0.9727 ± 0.0096 moderate decline (p<0.01) **

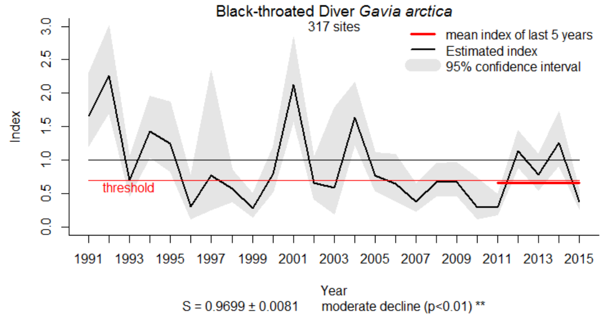

Red-necked Grebe *Podiceps grisegena*
whole period (1991 - 2015): moderate decline
last 15 years: uncertain
threshold
Index

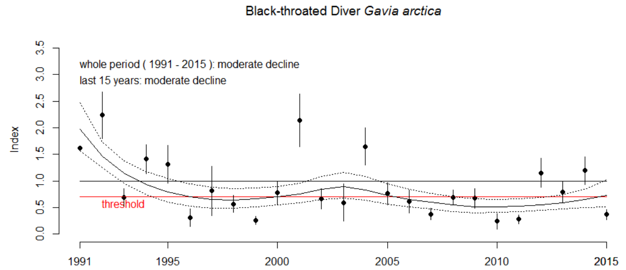

Slavonian Grebe *Podiceps auritus*
206 sites
mean index of last 5 years
Estimated index
95% confidence interval
threshold
Index
Year
S = 1.0475 ± 0.014 moderate increase

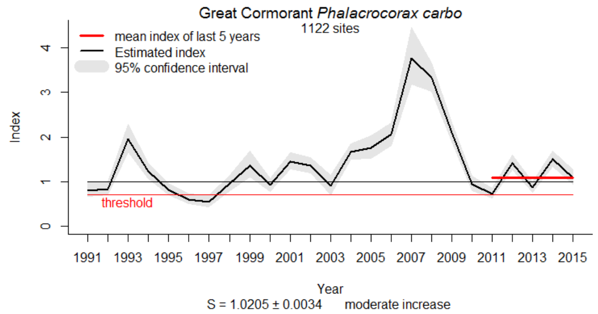

Slavonian Grebe *Podiceps auritus*
whole period (1991 - 2015): moderate increase
last 15 years: uncertain
threshold
Index

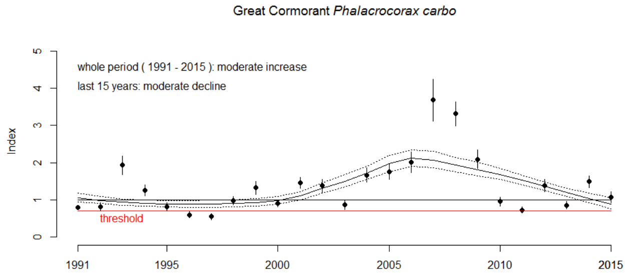




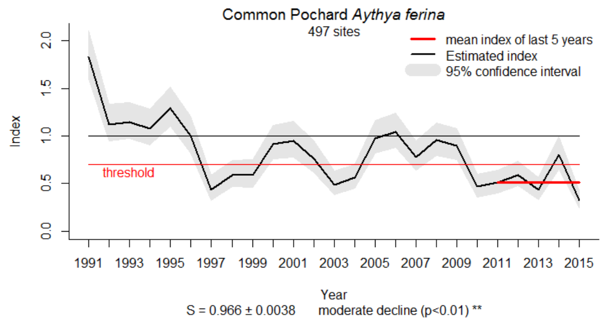


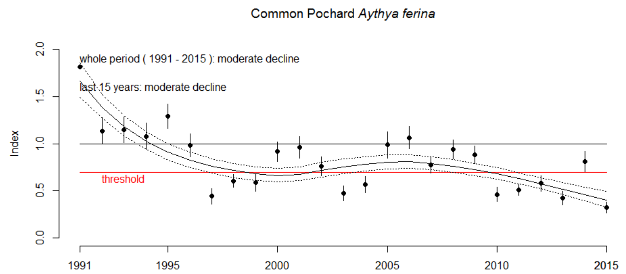


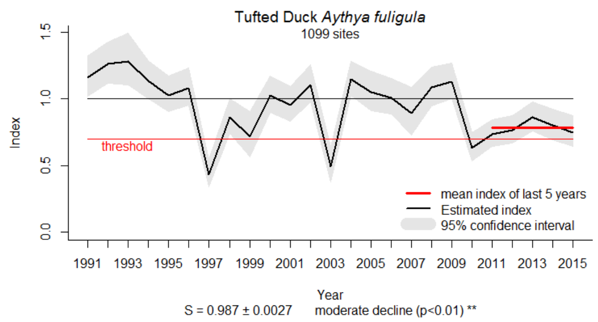


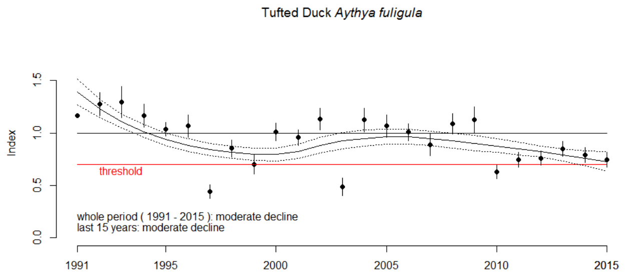


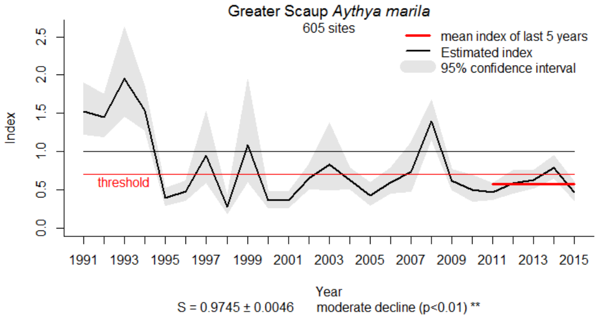
Benthic feeders

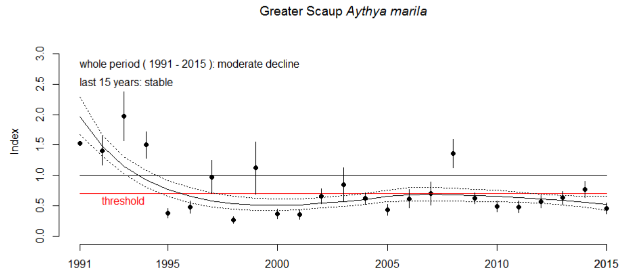


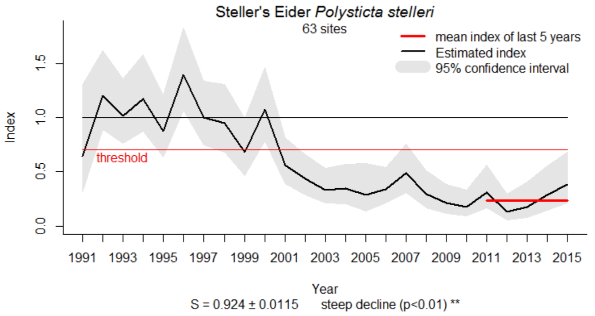


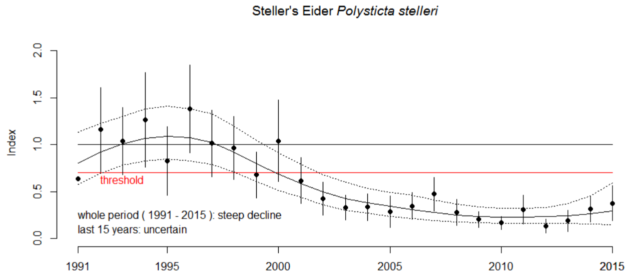


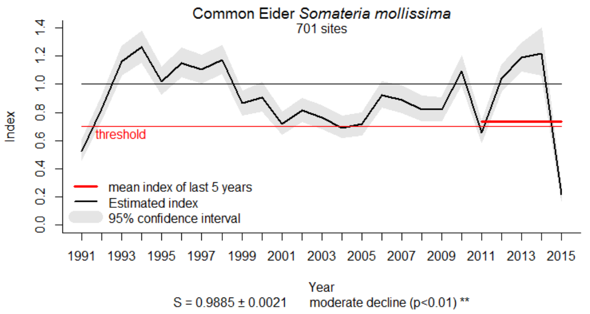


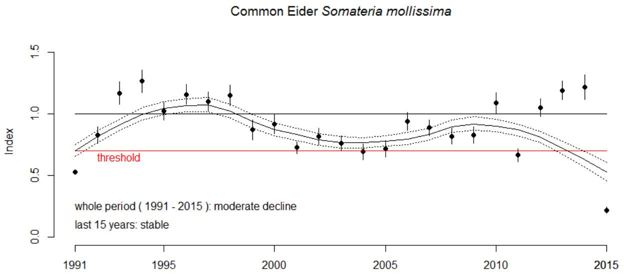

Greater Scaup *Aythya marila*
605 sites
mean index of last 5 years
Estimated index
95% confidence interval
threshold
Index
Year
S = 0.9745 ± 0.0046
moderate decline (p<0.01) **

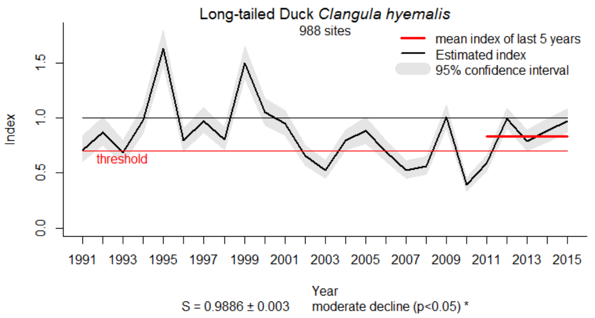

Greater Scaup *Aythya marila*
whole period (1991 - 2015): moderate decline
last 15 years: stable
threshold
Index

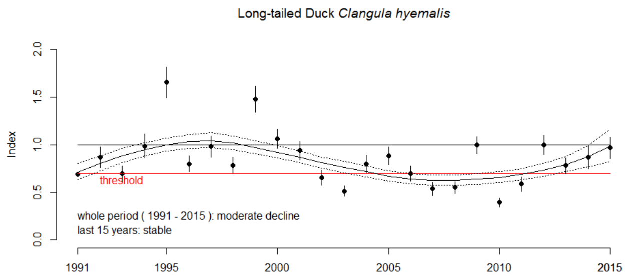

Steller's Eider *Polysticta stelleri*
63 sites
mean index of last 5 years
Estimated index
95% confidence interval
threshold
Index
Year
S = 0.924 ± 0.0115
steep decline (p<0.01) **

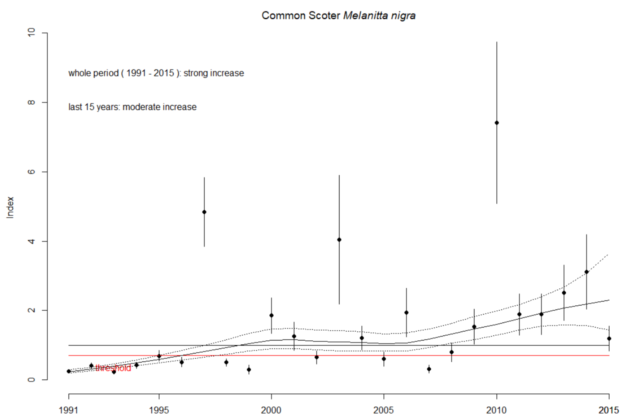

Steller's Eider *Polysticta stelleri*
threshold
whole period (1991 - 2015): steep decline
last 15 years: uncertain
Index

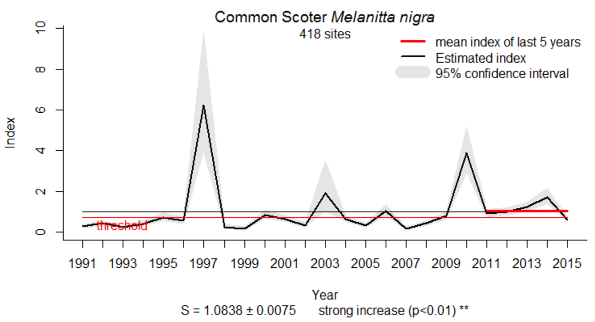

Common Eider *Somateria mollissima*
701 sites
threshold
mean index of last 5 years
Estimated index
95% confidence interval
Index
Year
S = 0.9885 ± 0.0021
moderate decline (p<0.01) **

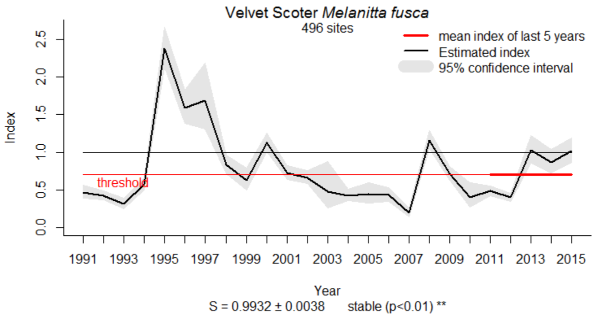

Common Eider *Somateria mollissima*
threshold
whole period (1991 - 2015): moderate decline
last 15 years: stable
Index

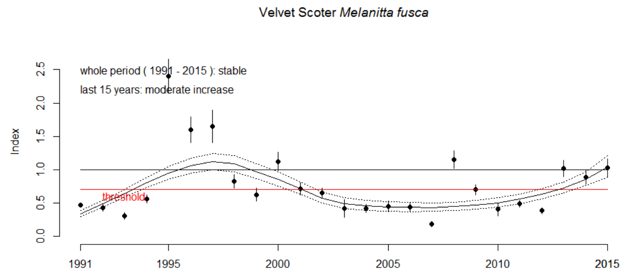

Long-tailed Duck *Clangula hyemalis*
988 sites
mean index of last 5 years
Estimated index
95% confidence interval
threshold
Index
Year
S = 0.9886 ± 0.003
moderate decline (p<0.05) *

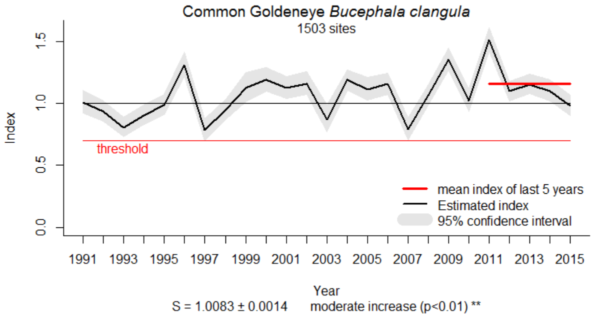

Long-tailed Duck *Clangula hyemalis*
threshold
whole period (1991 - 2015): moderate decline
last 15 years: stable
Index

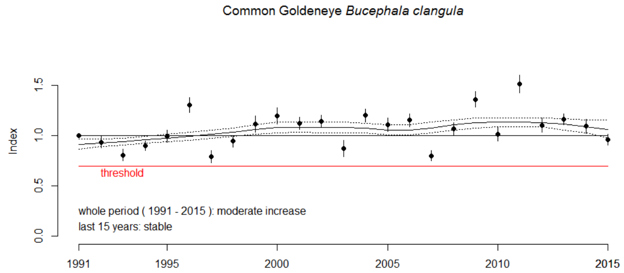

Common Scoter *Melanitta nigra*
whole period (1991 - 2015): strong increase
last 15 years: moderate increase
Index
threshold


Common Scoter *Melanitta nigra*
418 sites
mean index of last 5 years
Estimated index
95% confidence interval
threshold
Index
Year
S = 1.0838 ± 0.0075
strong increase (p<0.01) **

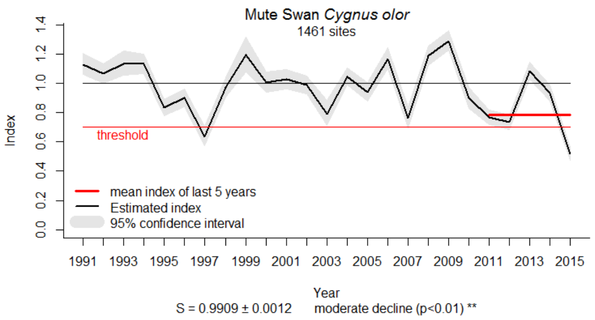


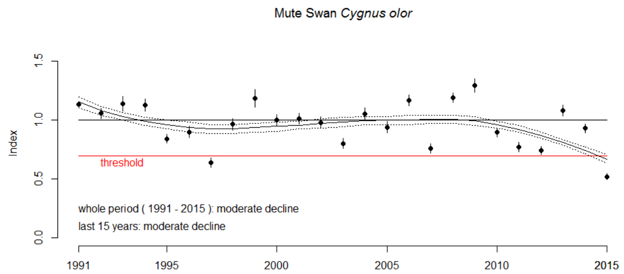


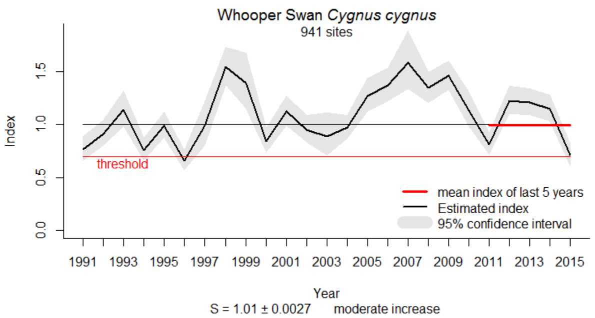


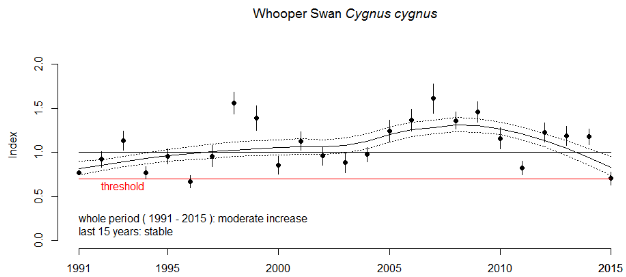


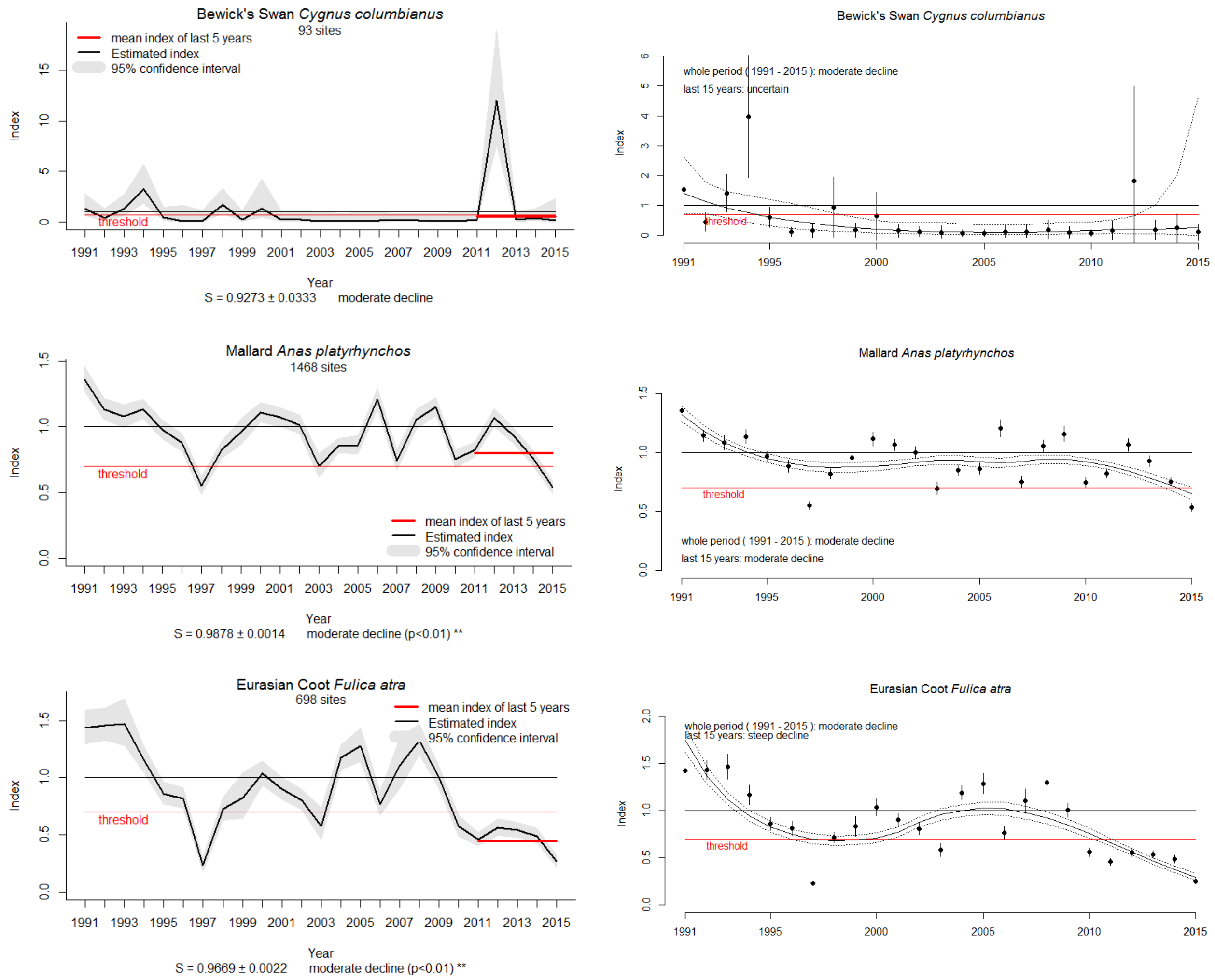
Grazing feeders











Confidence of the indicator status evaluation

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

The temporal coverage is good, as most of the sites were counted annually for the mid-January International Waterbird Census and so far five out of the six-year assessment period (2011-2016) are covered (inclusion of 2016 data is planned for the near future). The spatial representability is low, owing to counting sites often covering long stretches of coastline completely, but currently lacking data from Russia and for some benthic and pelagic feeders from offshore parts of the Baltic. The accuracy of the evaluation is high, because the results clearly show whether the threshold values for good status are met for species groups or all birds. Methodological confidence is intermediate: though IWC data are collected for decades by internationally coordinated methods, these methods are awaiting to be entered in HELCOM guidelines.

Good Environmental Status

The status is evaluated by examining the proportion of wintering waterbird species for which the abundance deviates more than 30% (20% in species laying only one egg per year) from the abundance in the reference period. 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. 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 2017/848/EU about criteria and methodological standards on Good Environmental Status. In either case, the threshold value is achieved when 75% of the species deviate ≤30% (≤20% respectively) from the baseline. The concept is aligned with that of the OSPAR Indicator 'Marine bird abundance', where the same graduation of thresholds is used (ICES 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.

As it is difficult to identify a reference level representing pristine conditions, bird abundances from the beginning of data compilation (typically 1991-2000) are used to define the baseline state as a pragmatic approach. Any single year is prone to random events influencing the number of birds in that year, and therefore the baseline status is defined by the mean abundances of the relevant species during the period 1991-2000. So far, data before 1991 have not been used, because major gaps are very likely to occur in the eastern Baltic owing to only restricted accessibility to large parts of the coast. The use of data before 1991 will be explored in future and may help to define more appropriate species-specific baseline values.

When the status evaluation is based on species groups, 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 species group. For marine habitats in Europe, 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 serving the wintering waterbird abundance indicator, and during the current evaluation it turned out that two more species (Bewick's swan, black-headed gull) could be added to the species set. Thus, this indicator would provide four evaluations when applied to

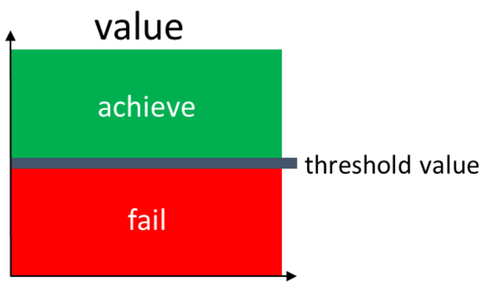
- surface feeders (four species: black-headed gull, common gull, great black-backed gull, herring gull),
- water column feeders (12 species: red-throated diver, black-throated diver, great crested grebe, red-necked grebe, Slavonian grebe, great cormorant, goosander, red-breasted merganser, smew, razorbill, common guillemot, black guillemot),
- benthic feeders (nine species: common pochard, tufted duck, greater scaup, common eider, Steller's eider, long-tailed duck, common scoter, velvet scoter, common goldeneye) and
- grazing feeders (eight species: mute swan, whooper swan, Bewick's swan, Eurasian wigeon, Eurasian teal, mallard, northern pintail, Eurasian coot).

Given the composition of the species groups, the four possible evaluations are based on different numbers of species. For example, in water column feeders, nine out of 12 species would need to be above the threshold value in order to reach good status, while in surface feeders three out of four species would have to be above threshold value, because two out of four species would mean that only 50% 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 occurrence in Baltic marine habitats and data availability, but independent of threat status. The indicator does not assess the species group of wading feeders as no wintering species are assigned to this group (according to ICES 2015 and OSPAR/ICES/HELCOM 2016) are wintering in the Baltic in substantial numbers.

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.

A high number of wintering waterbirds does not automatically indicate a good status. For instance, piscivorous waterbird species benefit from a high availability of small fish, which in turn may point to an imbalance in the food web due to overfishing of large fish species that results in high abundance of small fish. These competitive interactions between fish-feeding birds and large predatory fish affect the setting of a baseline and defining good status for instance with respect to the current long-term management plan of cod, since increased cod stocks would likely affect (negatively) the food availability for birds.

Assessment Protocol

The indicator includes several waterbird species and the assessment approach is sensitive to the number of species represented. In order to evaluate if good status is achieved in the Baltic Sea, all species occurring in the area should be considered. Currently the aim is to include as many representative species for the Baltic Sea environment as possible, however, the species selection process must take into account that some species (e.g. mallard, Eurasian coot, some gull species) exhibit strong connections to other (non-marine) habitats and may therefore not be appropriate to include in an indicator addressing the status of the Baltic Sea. Currently, waterbird species wintering close to the shore have been considered in the indicator. Future expansions of monitoring efforts in offshore areas of the Baltic Sea may allow for inclusion of species wintering offshore.

The approach used for defining good status has been developed by the OSPAR Inter-sessional Correspondence Group on Co-ordination of Biodiversity Assessment and Monitoring (ICG-COBAM MSFD) and used in the OSPAR indicator 'Marine bird abundance' (ICES 2013).

This HELCOM core indicator incorporates further developed aspects of the evaluation method that have been carried out within the EU LIFE project 'Innovative approaches for marine biodiversity monitoring and assessment of conservation status of nature values in the Baltic Sea' (MARMONI; LIFE09 NAT/LV/000238), by correcting the numbers of birds counted for effects of climate change, i.e. winter temperature (Aunins et al. 2013b). The main progress has been to replace the classical TRIM analyses (van Strien et al. 2004) by generalized additive modelling (GAM) which includes winter air temperature as a covariate (Aunins et al. 2013b). This procedure gives yearly single species indices corrected for the temperature and thus - in a long view - for effects of climate change.

Site level raw data was used for each species to calculate the annual indices and trends. The national IWC coordinators of the HELCOM countries provided data for the monitoring sites that were located at the coast, bays and lagoons, and in the case of Poland and Finland also part of offshore habitats. The data was collected according to the Wetlands International field protocol (Wetlands International 2010). Each site level data for each species consisted of site code, coordinates of the site, year of survey and recorded abundance. There was a separate entry for each year the site was visited. Each site was assigned a code indicating to which country and assessment unit it belongs.

Temperature data was obtained from the E-OBS gridded dataset (Haylock et al. 2008), version 13.1 that included data from 1950 to 2012. The data was used to calculate the mean temperature for the week prior to the central IWC counting dates of each year (1991-2015). For each site, where birds had been counted, the temperature values were extracted. The inclusion of temperature data is an important progress, especially with respect to the predicted milder winters (due to the effects of climate change) and subsequent redistributions of sea ice and waterbirds.

To calculate the yearly indices and trends, Generalised Additive Modelling framework (Hastie & Tibshirani 1990; Wood 2006) was used. Models explaining the observed abundance in each site by site, year and mean temperature a week before the counts was created for each species using approach similar to the one suggested by Fewster et al. (2000), but accounting for serial correlation in the data. Inclusion of the temperature data allowed to reduce the variation in observed abundance due to observation conditions. If temperature effects were not significant, the model without temperature in the model formula was calculated.

The mean predicted abundance in the period 1991-2000 was used as the point of reference (when the index is 1). To obtain the index, predicted abundances in each separate year were divided by this reference value. Thus, an index above 1 (or 100%) means population increase compared to the reference and an index below 1 represents a decline. The confidence intervals for each index value were obtained analytically. The geometric mean of index values from 2011-2015 was used to assess the status of a species compared to the reference level.

As the linear trend lines cannot always adequately describe long time series of species abundance, smooth trend lines and their confidence intervals were obtained using MSI-tool (Soldaat et al., submitted) developed by Statistics Netherlands.

These GAM-based indices can serve to calculate the composite indices to get an overall wintering waterbird index (following Gregory et al. 2005) or to aggregate species according to their role in the food web, i.e. by species groups (surface feeders, pelagic feeders, benthic feeders, grazing feeders). Such multi-species indices are calculated as the geometric mean of the single species indices, with every species treated equally and standard errors used to show the variability of data. As an option for the future, such composite indices could serve as assessment tools. It remains to be tested whether the single species approach or the aggregated indices is more robust and better suited to assess good status with respect to population sizes of wintering waterbirds.

The concept of the indicator is well developed, based on long-running monitoring through International Waterbird Census (IWC), i.e. land-based waterbird counts in mid-winter. Further modules, such as monitoring and assessment of waterbirds wintering in offshore sections of the Baltic Sea, can be added in the future.

Further development of the indicator

The main objective of further development in the wintering waterbird abundance indicator is the inclusion of offshore living species and parts of populations, respectively. Currently, the indicator only covers coastal areas, thus inclusion of offshore data would expand its scope and explanatory power. A concept for monitoring waterbirds in offshore parts of the Baltic and a methodology for analyses have been developed by the Joint OSPAR/HELCOM/ICES Working Group on Seabirds and is outlined in more detail in the section 'Description of optimal monitoring'.

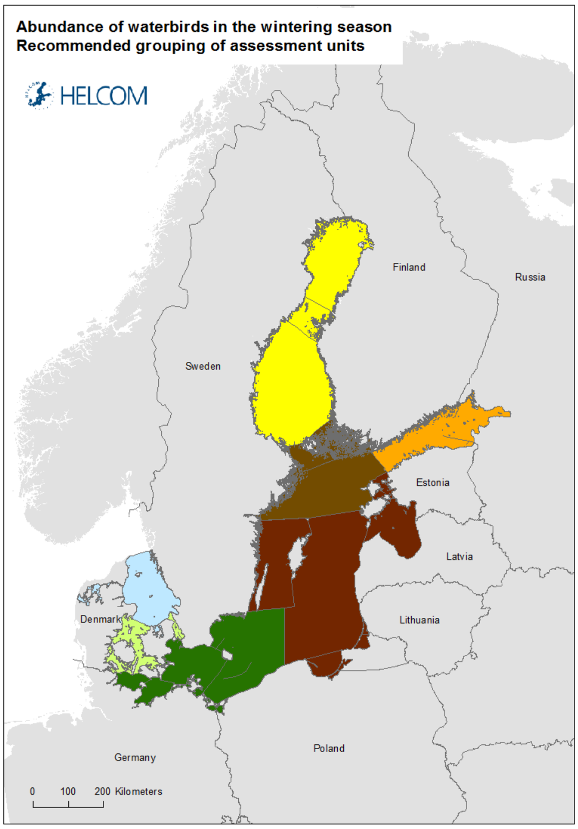
The indicator does not handle threatened birds in the status evaluation and therefore a species can have good status even though the species is threatened/endangered. International red-listed species should be included in further development of the indicator.

Likewise, OSPAR/HELCOM/ICES (2017) recommend to adjust assessment units to a higher spatial resolution by using groupings of sub-basins (see section 'Assessment units').

Assessment units

The current evaluation is made for the entire Baltic Sea using HELCOM assessment unit scale 1. The use of a finer scale is constrained by the high mobility of waterbirds, i.e. movements during a given winter and distributional changes between winters, which may go across the borders of different Baltic Sea sub-basins (17 areas in HELCOM assessment unit scale 2). On the other hand, it would be desirable to assess units smaller than the entire Baltic Sea, because it would be easier to localize problems and to implement necessary regional or local measures to improve the status. For the future, the Joint OSPAR/HELCOM/ICES Working Group on Seabirds recommended to group the 17 sub-basins to seven sub-regions (Assessment units figure 1).

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



Assessment units figure 1: Grouping of 17 sub-basins (HELCOM assessment unit scale 2) to seven sub-regions as spatial units for wintering waterbird abundance evaluations as recommended by OSPAR/HELCOM/ICES (2017).

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 wintering 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 wintering 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 (EU) 2017/848 (European Commission 2017):

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

The EU Birds Directive (a) lists in Annex 1 red-throated diver, black-throated diver, Slavonian grebe, whooper swan, Steller's eider and smew 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 this indicator are vulnerable to habitat loss caused by wind farms and others are prone to collisions (e.g. Furness et al. 2013; Dierschke et al. 2016), the indicator is also 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. Most species are specialized on certain species and/or size classes of prey and their abundance is affected by the availability 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.

As predators at, or close to, the top of the food web, waterbirds accumulate contaminants, and their abundance reflects the degree of contamination. Contaminants ingested in winter may have carry-over effects on breeding success. 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 not only winter, but also breed in the Baltic Sea. For several reasons, those species are potentially included in the concepts of both the breeding and wintering waterbird abundance indicators. First, 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 differing in distribution patterns between breeding and wintering seasons (e.g. alcids). Second, most wintering waterbird species aggregate in suitable feeding habitats, often far from the breeding sites. In addition, there is a turnover of individuals within species, meaning that some individuals of a given species leave the Baltic Sea for wintering in other marine areas, whereas others live in the Baltic Sea only in winter. In general, the explanatory power of the indicator is constrained by factors acting on the waterbirds in the breeding season, either in the Baltic Sea or in other breeding areas in northern Eurasia or as far east as the Siberian Taimyr Peninsula.

Waterbirds use all ice-free areas of the Baltic Sea as a wintering areas and therefore the distribution varies per year depending on ice conditions. The HELCOM supporting parameter 'Ice season' provides insight into the highly variable coverage of ice in the Baltic Sea during the past few centuries.

Human pressures linked to the indicator

	General	MSFD Annex III, Table 2a
Strong link	The most important anthropogenic threats to wintering waterbirds are incidental bycatch in fishing gear (gill nets), prey depletion, oil pollution, intake of hazardous substances and habitat loss owing to offshore wind farms, aggregate extraction and shipping	Biological pressures: - 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		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 status of waterbird populations is affected by several pressures stemming from human activities, including mortality caused by oil spills, incidental bycatch in fisheries, hunting as well as human-induced eutrophication affecting the food web structure and function. Functional groups of species can potentially reflect - in a more specific manner - which pressures are affecting the status.

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 affects benthic feeders. Indirect pressure is caused by eutrophication; in the oligotrophic end of the eutrophication status bird populations are limited by the availability of food sources, whereas towards eutrophic conditions plant and zoobenthos biomass increases, which first benefits seabird populations, but in the extreme end causes decreased food availability.

Among human pressures causing losses of individual waterbirds, drowning in fishing gear (mainly gill nets) is a serious problem. Estimates of the number of birds incidentally caught in fisheries are uncertain, but probably amount to 100,000-200,000 birds annually (Žydelis et al. 2009). In addition, high numbers of seaducks are hunted, with large quotas in particular for common eider and common goldeneye (Mooij 2005, Skov et al. 2011). Though the number of oil spills has decreased, oil pollution causing oiled plumage, hypothermia and finally death still affects waterbirds in the Baltic Sea (Larsson & Tydén 2005; Žydelis et al.

2006). Bird health is constrained also by the intake of contaminants (Broman et al. 1990; Rubarth et al. 2011; Pilarczyk et al. 2012).

Some waterbird species are prone to habitat loss caused by human activities, which perhaps reduce the carrying capacity of certain wintering sites. Avoidance of offshore wind farms has been observed to affect the spatial distribution of divers and long-tailed ducks (Petersen et al. 2011; Dierschke et al. 2016). These species, as well as other seaducks, also avoid shipping lanes (Bellebaum et al. 2006; Schwemmer et al. 2011). For benthic feeders, additional habitat loss is caused by physical damage of the seafloor caused by both fisheries and aggregate extraction.

It is important to note that all the above-mentioned human activities have a cumulative impact on waterbird populations, not only in the wintering season, but also carry over to the breeding season (e.g. affecting breeding success). On the other hand, waterbirds wintering in the Baltic can be influenced by pressures in the breeding areas and during migration (OSPAR/HELCOM/ICES 2017). The cumulative impact on waterbirds has been reviewed by the example of red-throated diver and black-throated diver (Dierschke et al. 2012). This indicator addressing the abundance of wintering waterbirds combines the effects of different pressures.

Monitoring Requirements

Monitoring methodology

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

Guidelines for monitoring methods needed for this indicator have been developed by the HELCOM BALSAM project. The adoption of the guidelines is on-going.

Currently monitoring practices vary and are described for offshore censuses by Camphuysen et al. (2004), Skov et al. (2007, 2011) and Nilsson (2012), whereas for coastal areas census methods are standardized by Wetlands International for the International Waterbird Census (IWC).

The indicator is primarily based on mid-winter counts of waterbirds along the shoreline, carried out as national monitoring, i.e. the indicator is restricted to coastal staging areas. The aim is to expand the indicator by including waterbirds wintering in offshore areas of the Baltic Sea (OSPAR/HELCOM/ICES 2017).

Current monitoring

Monitoring of wintering waterbirds is running in all riparian countries of the Baltic Sea and specifications are provided in the monitoring concepts table in the HELCOM Monitoring Manual.

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

Monitoring of coastal wintering waterbirds (i.e. the IWC) is organized by Wetlands International (Wageningen) and has been carried out annually in mid-January for more than 50 years, with high coverage of the Baltic Sea since 1991.

There is no coordinated monitoring for offshore areas, but national programmes are implemented in several countries and efforts were started to coordinate surveys on a regional level (HELCOM 2014, OSPAR/HELCOM/ICES 2017). The coverage of offshore area monitoring is far from complete, and intervals of monitoring as well as methods and platforms differ between programmes. All past and ongoing offshore surveys are included in a metadatabase developed in the BALSAM project (HELCOM 2014). More details are listed in the HELCOM Monitoring Manual.

Description of optimal monitoring

Concerning coastal waterbirds, the land-based IWC already serves as an optimal monitoring system. It can continue as it is, but future surveys should take into account that the relevance of Bothnian Bay and eastern Gulf of Finland may increase after a few years due to the predicted milder winters as a consequence of climate change.

It would be desirable to include offshore parts of the Baltic in the evaluation of wintering waterbird numbers. Important components of the avian community concentrate in marine areas not covered by land-based surveys, i.e. divers, grebes, seaducks, gulls and alcids. Monitoring of offshore areas requires the use of ships and/or aircrafts as observation platforms for manned transect counts or the use of digital imagery. Currently, offshore monitoring has only been implemented in a few parts of the Baltic Sea, but the Joint OSPAR/HELCOM/ICES Working Group on Seabirds has outlined a strategy for offshore monitoring in northern Europe including the whole HELCOM area and addressing questions of coordination, periods of surveys and methods applied (OSPAR/HELCOM/ICES 2017). International coordination is necessary in order to integrate national monitoring schemes into Baltic-wide surveys. Where reasonable, special programmes such as the visual observation of long-tailed duck migration at exposed sites (Hario et al. 2009) would add valuable information to support the explanatory power of the monitoring results. It has to be noted that so far only two data points for total numbers of waterbirds wintering in the Baltic are available (Durinck et al. 1994; Skov et al. 2011), with another one (based on a coordinated survey in early 2016) awaiting analysis.

Depending on weather conditions and other (e.g. dietary) reasons, the distribution of some species show variability between years, creating a need for simultaneous surveys in all parts of the Baltic Sea. Simultaneous surveys are possible and already carried out in the land-based IWC. Owing to high costs, it has to be further considered if it would be relevant to carry out surveys in the offshore parts of the Baltic Sea with longer intervals, e.g. in one or two years within a six-year reporting cycle of the EU MSFD or Birds Directive. It would therefore be justified to survey the entire Baltic Sea coordinatedly at least every three years. It is further proposed that digital methods for aerial surveys are further developed (OSPAR/HELCOM/ICES 2017).

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 waterbirds in the wintering season. HELCOM core indicator report. Online. [Date Viewed], [Web link].

ISSN 2343-2543

Metadata

Result: Abundance of waterbirds in the wintering season

Data: Abundance of waterbirds in the wintering season data

The current evaluation is based on national monitoring data from coastal mid-winter counts (International Waterbird Census organized by Wetlands International) from all HELCOM Contracting Parties. Data for the years 1991-2015 were supplied by national dataholders following a data call in March 2016. Data sets consisted of site code, year, species and abundance (bird numbers). Data were supplied for a total of 1778 sites, but each species had different numbers of sites used in the analysis.

We acknowledge the E-OBS dataset from the EU-FP6 project ENSEMBLES (http://ensembles-eu.metoffice.com) and the data providers in the ECA&D project (http://www.ecad.eu).

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 Indicator report

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