HELCOM core indicator report

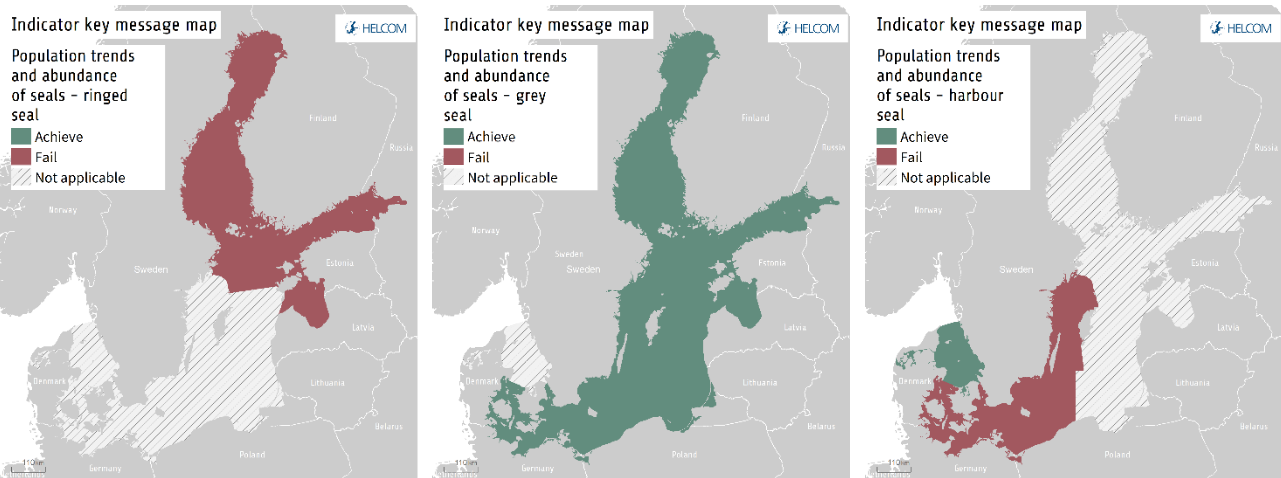
July 2018

Population trends and abundance of seals

Key Message

This core indicator evaluates the status of the marine environment based on population trends and abundance of the three species of seals that occur in the Baltic Sea. Good status is achieved for each species when i) the abundance of seals in each management unit is has attained a Limit Reference Level (LRL) of at least 10,000 individuals to ensure long-term viability and ii) the species-specific growth rate is achieved indicating that abundance is not affected by severe anthropogenic pressures.

The status evaluation is presented separately for the three seal species. The grey seal population of the Baltic Sea is evaluated as a single unit, excluding Kattegat, where the indicator is not applicable for grey seals. The status of ringed seals is evaluated for two management units. The status of harbour seals is evaluated for three management units. The evaluation of abundance and trends of seals are based on data from 2003-2016, and the period 2011-2016 is assessed for current status. Furthermore, in the context of this independent evaluation it has to be taken into account that, utilising different assessment units, national evaluations in the reporting for the Habitats Directive may differ, and in addition that other HELCOM indicators assessing different aspects of seals may show different evaluation results.



Key message figure 1. The overall status assessment results based on evaluation of the indicator 'population trends and abundance of seals' – Ringed seals (left), Grey seals (centre) and Harbour seals (right). The assessment is carried out using Scale 2 HELCOM assessment units (defined in the HELCOM Monitoring and Assessment Strategy Annex 4), using the one-out-all-out approach. Thus, if a seal management unit, in not good status, has a given assessment unit as part of its range, the assessment unit is marked red. However, for harbour seals, the Kattegat assessment unit is marked as good status, although the Limfjord management unit with doubtful status occupies part of the assessment unit (see below). **Click here to access interactive maps at the HELCOM Map and Data Service: ringed seal, grey seal and harbour seal.**

Harbour seals differ from grey seals in their movement behaviour and population structure, with harbour seal in the southwestern Baltic and Kattegat management units appearing to form a metapopulation connected by some degree of movements. Thus, when evaluating the status of the two management units, the LRL is estimated for their combined abundance, whereas their growth rates are estimated and evaluated separately. For some isolated harbour seal units, the LRL of 10,000 individuals may not be achievable. This may be the case for the Kalmarsund and the Limfjord units (degree of reproductive isolation of the harbour seals in the inner Limfjord is being resolved by an ongoing project). For these management units, the abundance criterion will be considered achieved when they have attained carrying capacity, even if it is at a level below the LRL.

The abundance of **grey seals** is above the LRL of 10,000. Grey seals occur in the entire Baltic Sea except for in the Kattegat where the species has not been breeding since the 1930s, except for a few observations from recent years. Grey seals do not achieve good status with regard to population growth rate in the entire Baltic Sea if evaluated against the 7% annual increase during exponential growth. However, they will achieve good status if evaluated against criteria for carrying capacity with population decrease less than 10 % over a 10-year period. When using the latter criteria for population growth rate and the abundance, grey seals overall achieve good status.

Ringed seals occur in the Bothnian Bay (which is considered one management unit) and in the Gulf of Finland, Archipelago Sea, Gulf of Riga and Estonian coastal waters (which are together considered a second management unit). The size of the population exceeds the LRL and achieves good status only in the Bothnian Bay management unit. The sizes of subpopulations in the second management unit add up to only a fraction of the LRL and are stable or declining. The ringed seal population growth rate is below the threshold value for good status (not good status) in both units.

Harbour seals are confined to the Limfjord, the Kattegat (including the Northern part of the Great Belt assessment unit), Southern Baltic Sea (i.e. Bornholm Basin, Arkona Basin, Bay of Meklenburg, Kiel Bay, The Sound and the Southern part of the Great Belt assessment units), and the Kalmarsund.

The Limfjord subpopulation is below LRL, but may nevertheless be approaching carrying capacity since the annual growth rate is fluctuating close to zero. However, at present it is not possible to evaluate the status of the Limfjord population due to limited information about the degree of immigration and interbreeding with the Wadden Sea population.

The growth rate of the core subpopulation in the Kattegat and northern Great Belt is levelling off, which is a sign of that this management unit is approaching its carrying capacity. As no decline exceeding 10% has been detected over the last 10-year period, and the abundance is above the LRL of 10,000 animals, this management unit has achieved good status with regard to both population growth rate and abundance.

The management unit in the Southern Baltic is connected to the Kattegat management unit and thus achieves good status for abundance, but the annual growth rate is just below the threshold value for good status for populations in exponential growth phase. Thus, the overall status of the southern Baltic management unit is not good.

The Kalmarsund population does not meet the criterium for good status with respect to growth rate, and the abundance is well below the LRL, so the status of this population is not good.

Confidence of the indicator evaluation is considered to be **high** for all seal species regarding applicable assessment units, except for harbour seals in the Limfjord, where the connectivity with the Wadden Sea seals is unknown. Similarly, confidence is not high regarding the evaluation that grey seals and the Kattegat-northern Great Belt harbour seal unit are approaching carrying capacity. A longer series of stagnating trends is needed for the confidence to increase.

The indicator is applicable in the waters of all the countries bordering the Baltic Sea since the indicator includes all species of seal that occur in the Baltic Sea, at least one of which occurs in all HELCOM assessment units.

Relevance of the core indicator

The population trends and abundance of seals signal changes in the number of marine top predators in the Baltic Sea. Being top predators of the marine ecosystem, marine mammals are good indicators of the state of food webs, levels of hazardous substances and direct human disturbance.

Distributions of different species during feeding and annual migrations encompass the entire Baltic Sea although no terrestrial haul-out sites occur in Latvia and Lithuania.

Policy relevance of the core indicator

	BSAP segment and objectives	MSFD Descriptor and criteria
Primary link	Biodiversity • Viable populations of species	D1 Species groups of birds, mammals, reptiles, fish and cephalopods 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	Biodiversity: • Thriving and balanced communities of plants and animals Hazardous Substances • Healthy wildlife	D1 Species groups of birds, mammals, reptiles, fish and cephalopods D1C4 The species distributional range and, where relevant, pattern is in line with prevailing physiographic, geographic and climatic conditions. D4 Ecosystems, including food webs 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. D8 Concentrations of contaminants are at levels not giving rise to pollution effects D8C2 The health of species and the condition of habitats (such as their species composition and relative abundance at locations of chronic pollution) are not adversely affected due to contaminants including cumulative and synergistic effects.
Other relevant legislation: In some Contracting Parties also EU Water Framework Directive – Chemical quality, Habitats Directive		

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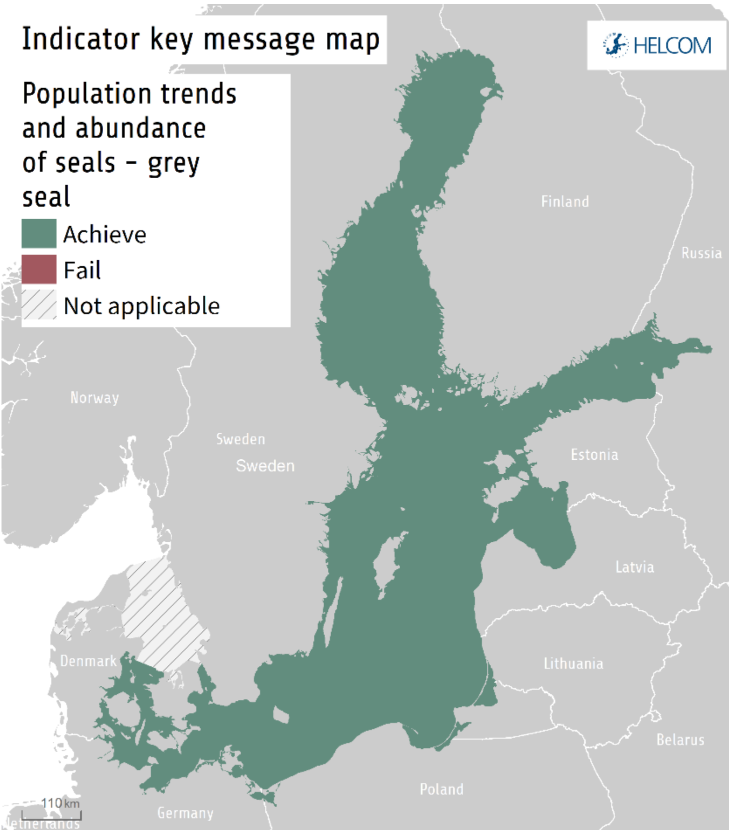
Results and Confidence

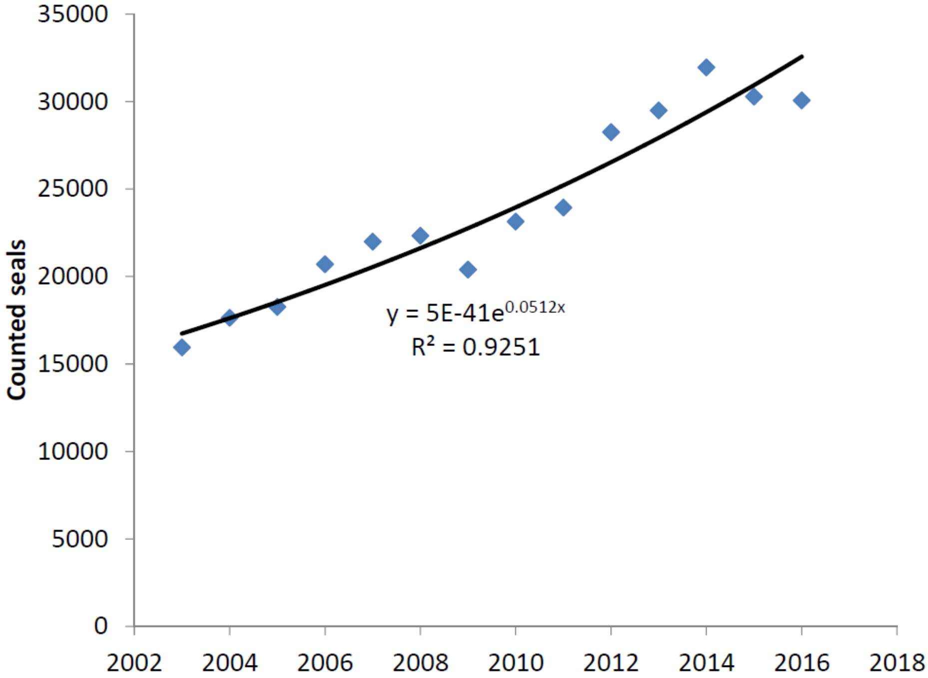
Grey seal

The grey seal population abundance and population growth rate (based on no decrease greater that 10% during a 10-year period) parameters exceed the threshold value, indicating that the grey seal population has achieved good status (Results figure 1). Abundance is considerably above the LRL of 10,000. However, growth rate is below the threshold of 7%. As the population is suggested to approach the carrying capacity, grey seals will achieve good status if criteria for this scenario are used, i.e., no decrease greater than 10% during a 10-year period. Data remain inconclusive (i.e. longer time series are required for full statistical evaluation of carrying capacity) though based on expert opinion good status is assigned to the grey seal in this assessment.



Results figure 1. Overall, Baltic grey seals achieved good status with regard to population growth rate and abundance. Abundance is considerably above the limit reference level of 10,000. Grey seals in the Kattegat originate from both the Baltic and the North Sea populations. Thus this area is not included in the assessment.

For the grey seal a time series of data from 2003 and onwards is used to estimate the population growth rate and its statistical support. The annual population growth rate during the assessment period 2003-2016 was 5.3%. A Bayesian analysis shows 80% support for a growth rate value of ≥4.8% (Results figure 2). Earlier data from the Swedish monitoring programme indicate that the grey seal population was growing at a rate of about 8% per year from the early 1990s in the Baltic Sea (Stenman et al. 2005; Hårding et al. 2007). Although the growth rate is well below the threshold value for good status (7%), the population growth rate seems to level off, which indicates that the population is approaching the carrying capacity. Under this assumption, the observed growth rate should be evaluated against "rate of decrease less than 10% over a 10-year period". The population has thus achieved good status according to the growth rate parameter, and as more than 30,000 animals have been counted since 2014 the population size is also well above the minimum viable population size (i.e. limit reference level (LRL) of 10,000 individuals).



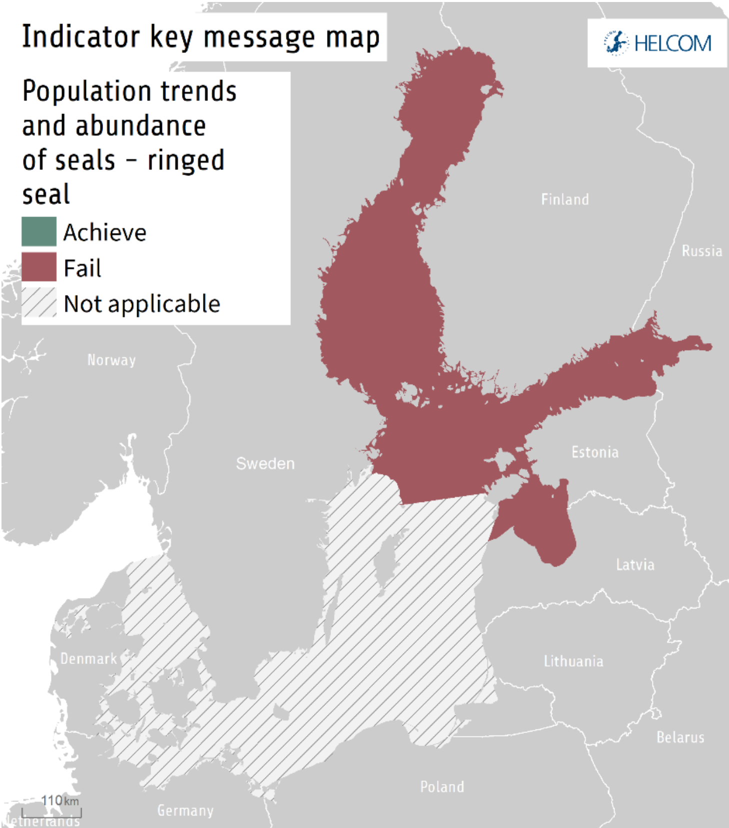
Results figure 2. The annual growth rate of Baltic grey seals during the assessment period 2003-2016 was 5.3 % and the Bayesian analysis shows 80% support for a growth rate ≥4.8%. This is well below the threshold value for good status at 7%. However, population growth rate seems to be levelling off, which indicates that the population is approaching the carrying capacity. Under this assumption, the observed growth is evaluated against "rate of decrease less than 10% over a 10-year period".

Grey seal counts in the Kattegat amount to approximately 100 animals, of which a majority are found at Læsø, Anholt, Bosserne and Varberg, although single animals are seen all along the Swedish west coast. The grey seals here come both from the Baltic Sea and the Atlantic populations (Fietz et al. 2016), and pupping occurs irregularly on Læsø and Anholt but also other sites (Härkönen et al. 2007).

The confidence of the evaluation for the Baltic grey seal is given by <5% support for a growth rate exceeding the threshold value of 7%. Internationally coordinated survey data up to 2016 are sufficient for the analysis.

Ringed seal

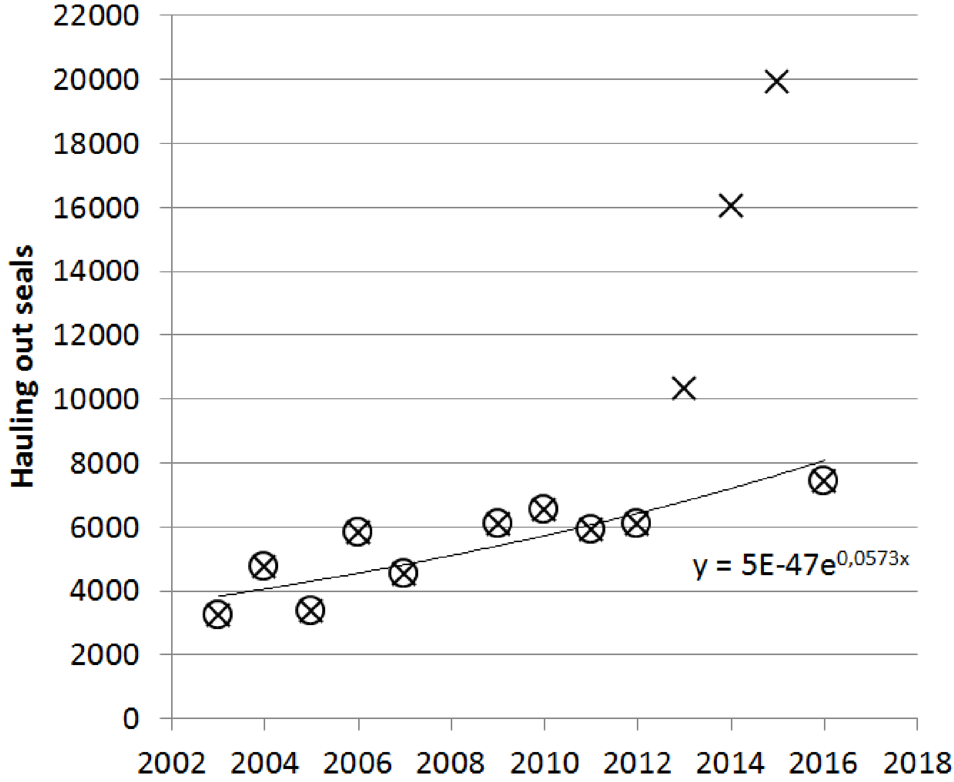
Both ringed seal management units are assigned not good status since the population growth rates are below the threshold value for good status (Results figure 3).



Results figure 3. Ringed seals in the two management units (1 - the Bothnian Bay and 2 - the southern unit encompassing the Archipelago Sea, the Gulf of Finland and the Gulf of Riga including Estonian coastal waters) do not achieve good status.

Due to exceptionally mild winters in recent years, the fast ice (ice attached to land) has started to break up during or before the survey time, which has revealed new features in the hauling out behaviour of ringed seals. In ice conditions where a lot of cracks have appeared to the fast ice cover, more ringed seals enter to the ice forming large groups. This phenomenon was not observed during earlier years when the surveys were carried out in more stable "normal" fast ice conditions. The survey results from the mild years revealed that the population size most probably exceeds 20 000 animals in the Bothnian Bay management unit, which is well above the LRL of 10 000 animals. The proportion of the true population which is available for the survey method in different circumstances still remains uncertain.

The ringed seal population in the Bothnian Bay management unit has been increasing at a rate of 4.5% per year since 1988 (Hårding & Härkönen 1999; Karlsson et al. 2008). During 2003-2016 the growth rate was 5.9 % per year, which is still less than the intrinsic capacity and below the threshold value of 7% (Results figure 4; Karlsson et al. 2008). A Bayesian analysis gives 80 % support for a growth rate ≥4.6 % which is well below the threshold value of 7%. The annual growth rate is based on survey results carried out during the ''normal'' ice conditions. Anomalous survey results from very mild winters (2013, 2014 and 2015) are excluded from the *trend* analysis since they stand out as statistical outliers and since they do not reflect the variation in the true population size, nor sampling bias (Results table 1.), but the exceptional ice-conditions. Further research and relevant quantitative measures for the ice quality are needed to gain a better understanding the haulout behaviour of ringed seals, calibrating the survey results in different ice-conditions and for estimating the true population size. To sum up, the ringed seals in the Bothnian Bay management unit have reached good status for population size but not for growth rate.



Results figure 4. The annual growth rate of ringed seals in the Bothnian Bay during the assessment period of 2003-2016 was 5.9 %, which is below the threshold value of 7 %. For the trend analysis only the comparable data points (circled crosses) were used. The Bayesian analysis shows 80% support for a growth rate ≥4.6 %. Consequently, criteria for good status are not met. Outliers from mild winters (2013-2015) are excluded from trend analysis, see above.

Results table 1. Annual ringed seal survey results from the Bothnian Bay showing the number of observed ringed seals on the survey strips, fraction of the area covered with the survey strips and the number of hauling out ringed seals (calculated from the first two variables).

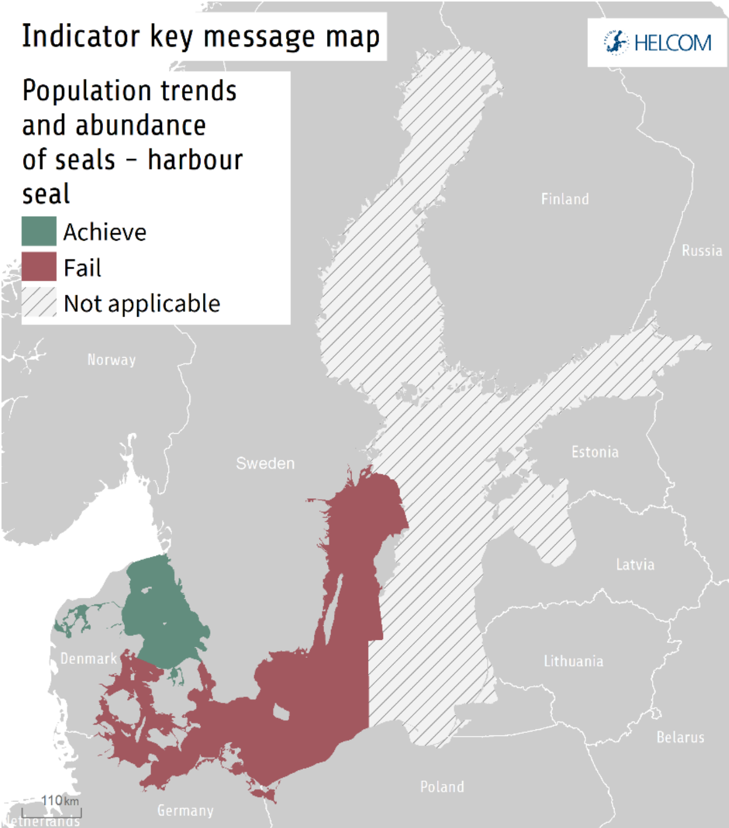
Year	Observed	Sampling fraction	Hauling out
2003	426	13.3	3203
2004	631	13.3	4744
2005	448	13.3	3368
2006	776	13.3	5835
2007	602	13.3	4526
2008			
2009	809	13.3	6083
2010	1740	26.6	6541
2011	785	13.3	5902
2012	3241	53.2	6092
2013	1375	13.3	10338
2014	4222	26.3	16053
2015	3441	17.26	19936
2016	502	6.75	7437

In the Southern ringed seal management unit (i.e. Gulf of Riga, Gulf of Finland and Archipelago Sea) improving trends have not been observed and the population sizes only sum up to a small fraction of the LRL (Karlsson et al. 2008; M. Jüssi pers. com; M. Ahola pers comm.). The ringed seal stock in the Gulf of Finland is decreasing, amounting to about 100 animals (M. Verevkin pers. com), and is considered to indicate a very alarming status. Thus, the Southern ringed seal management unit is clearly below good status in both population size and growth rate.

Although it is important for management to obtain better data from the southern part of the population, in terms of evaluation under this indicator it can be confidently stated that the stock in the Southern management unit is very far from good status both with respect to abundance and growth rate, which is why the confidence of the evaluation is high. The Bothnian Bay management unit clearly exceeds the LRL, but the growth rate is still below good status giving a **high** confidence for the evaluation.

Harbour seal

For the harbour seals in the Kattegat and Southern Baltic, good status has been achieved under the abundance criterion of the metapopulation. However, the population growth rate parameters for the Southern Baltic are below the criteria for good status. The Kattegat management unit is evaluated under the assumption that it is approaching carrying capacity for the area. Under this assumption, it achieves good status. (Results figure 5). The population in the Kalmarsund does not achieve good status for either parameter and the status of the Limfjord population is uncertain as studies are limited with regards to the degree of connection to the Wadden Sea population (which is not evaluated here).

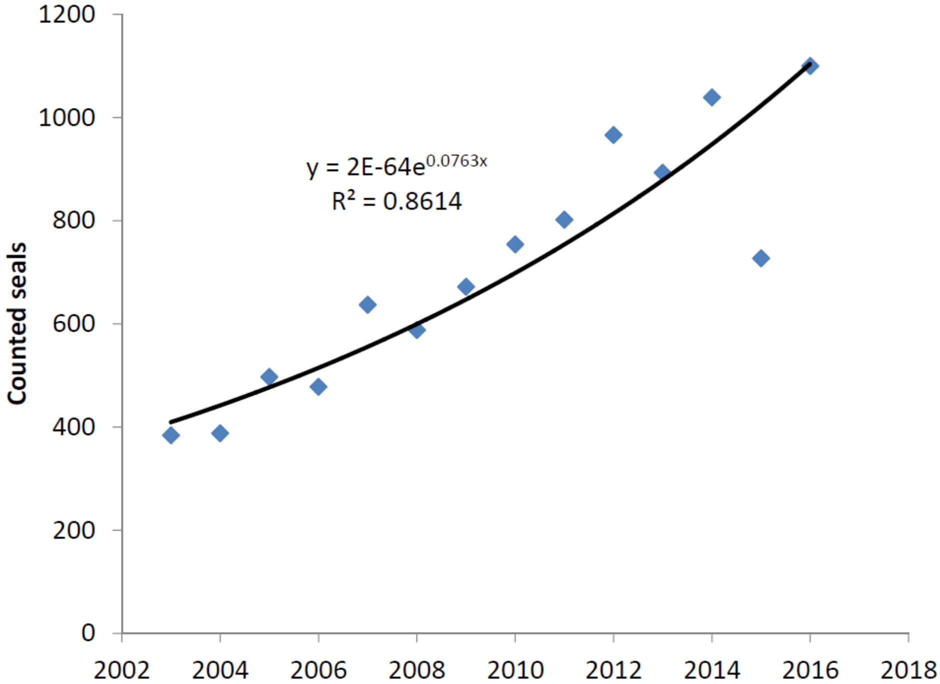


Results figure 5. Harbour seals occur in three management units, where seals in the Kalmarsund do not achieve good status because of population size well below the LRL and a growth rate below the threshold value of 9%. Harbour seals in the Kattegat and Southern Baltic metapopulation do achieve good status with respect to their combined abundance, but the Southern Baltic unit does not achieve good status because the growth rate does not meet the threshold for that. The Limfjord management unit has not been evaluated separately due to limited information about migration and interbreeding with the Wadden Sea population. Limfjord is part of the Kattegat assessment unit in this indicator assessment, hence the indicated result for the Limfjord population is uncertain.

Kalmarsund

The harbour seal population in Kalmarsund is genetically divergent from the adjacent harbour seal populations (Goodman et al. 1998) and experienced a severe bottle-neck in the 1970s when only some 30 seals were counted. Long-term isolation and low numbers have resulted in low genetic variation in this population (Härkönen et al. 2006). The population has increased annually by 9% since 1975 and counted numbers amounted to about 1,000 seals in 2014, see also Härkönen & Isakson (2011).

During the assessment period 2003-2016, the Kalmarsund population has increased on average by 7.9 % per year. A Bayesian analysis of the trend in abundance shows that there is 80% support for a growth rate of ≥6.9%, which is below the threshold value of 9% (Results figure 6). The current population size is well below the LRL of 10,000 individuals, which is why this population does not achieve good status. The confidence of this evaluation is **high** since it is based on sufficient survey data.

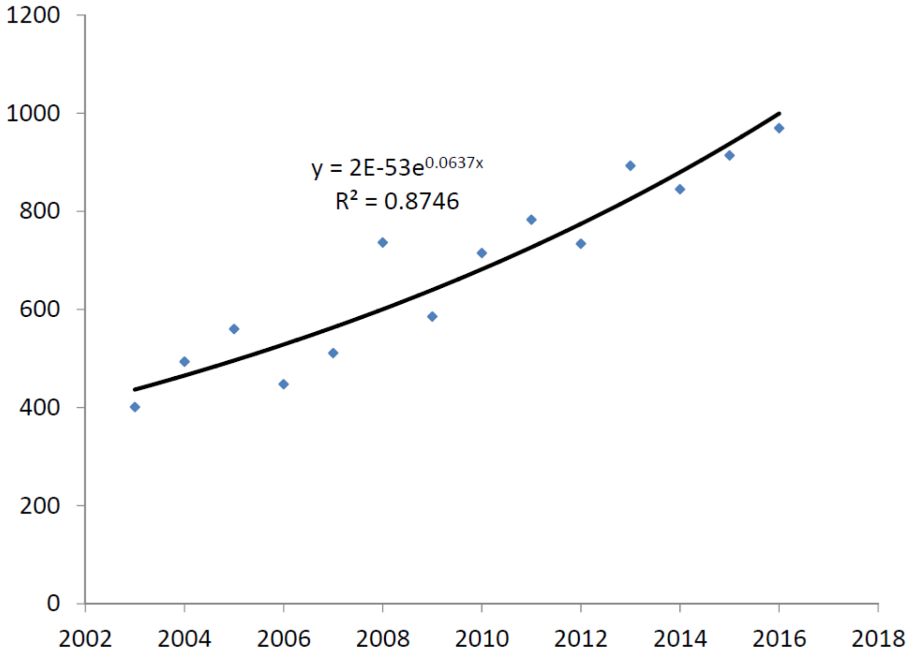


Results figure 6. The annual growth rate of counted harbour seals in Kalmarsund was 7.9% during the assessment period 2003-2016. According to Bayesian statistics there is 80% support for a growth rate ≥6.9%, which is below the threshold value of 9%. The total number of individuals (approximately 1,000 animals) is well below the LRL of 10,000, which means that this population does not achieve good status.

Kattegat, the Danish Straits and the Southern Baltic Sea

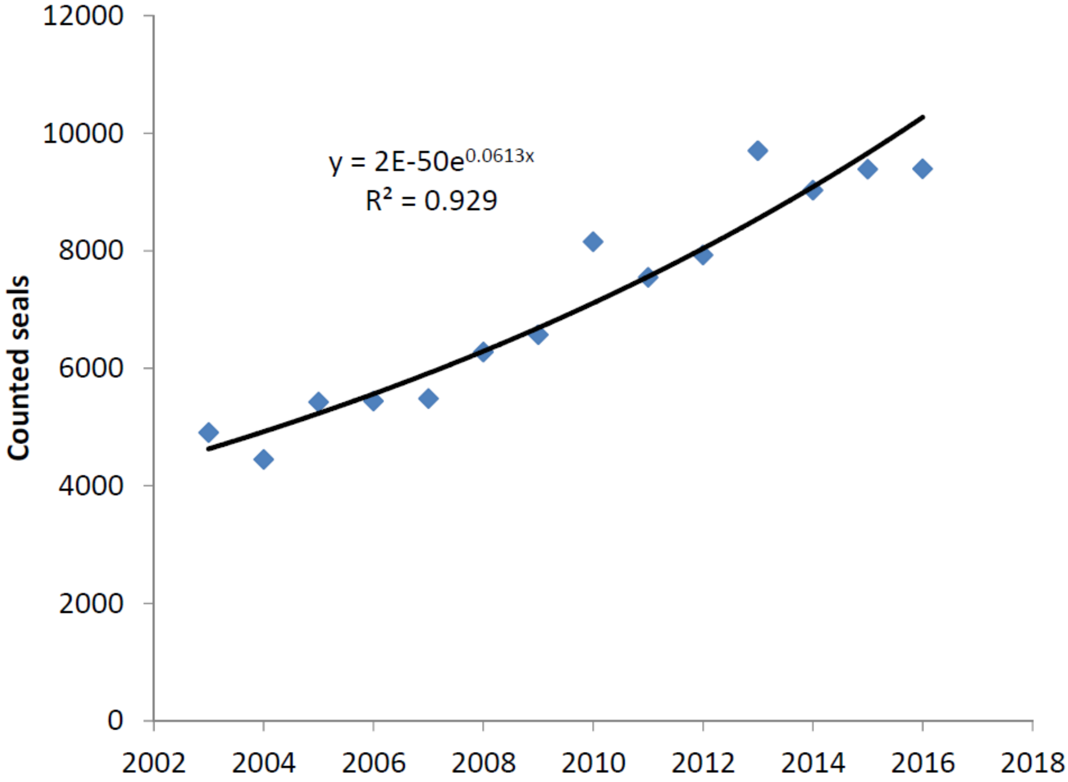
Harbour seals in this area experienced a mass mortality caused by a Phocine Distemper Virus (PDV) epidemic in 2002 which is why the growth rate is analyzed over a period starting after this event. We here show that sub-populations of this metapopulation showed different growth rates, but will also summarise results at the metapopulation level. Thus, while the current evaluation is based on abundance at the metapopulation level, the sub-populations are evaluated independently for abundance trends. It should be kept in mind that the situation can differ among subpopulations, which may have different growth and vital rates. Management actions should take special care when dealing with small subpopulations, ensuring that anthropogenic activities do not jeopardize future persistence of such subpopulations.

In the Southern Baltic, the average annual rate of increase during the assessment period 2003-2016 was 6.6% (Results figure 7). According to the Bayesian analysis there is 80% support for a growth rate ≥5.9%, which is below the threshold value of 9%. Thus, this subpopulation does not achieve good status. Confidence of this evaluation is **high** and based on sufficient survey data.



Results figure 7. The annual growth rate of counted seals in the Southern Baltic harbour seal subpopulation was 6.6% during the assessment period 2003-2016. According to Bayesian statistics there is 80% support for a growth rate ≥5.9%, which is below the threshold value of 9%. The abundance of seals is also well below the set LRL, which means that this subpopulation on its own does not achieve good status.

The harbour seal subpopulation in Kattegat and the Northern Great Belt experienced two dramatic mass mortality events due to PDV when more than 50% of the population died in 1988 and about 30% in 2002 (Härkönen et al. 2006). Unusually large numbers also died in 2007, but the reason for this mortality remains unclear (Härkönen et al 2007). In the spring of 2014, some seals appearing to show signs of pneumonia found in Sweden and Denmark, and also on the North Sea coast. Avian influenza H10N7 was isolated from a number of seals (Zohari et al. 2014). Population surveys in August 2014 showed lower numbers at all seal localities, suggesting a total mortality of approximately 10%.



Results figure 8. The annual growth rate of counted seals in the Kattegat harbour seal subpopulation was 6.3% during the assessment period 2003-2016. There is 80% support for a growth rate ≥5.8%, which is below the threshold value of 9%. The subpopulation is above the LRL and is assumed to be approaching carrying capacity, which is why this subpopulation on its own achieves good status since it meets the criterion “decline not >10% over a 10-year period”.

The rate of increase between the two PDV epidemics was close to 12% per year as in the adjacent North Sea populations (Table 1). This high annual increase is close to the intrinsic rate of increase in harbour seals (Härkönen et al. 2002).

The annual population growth rate in Kattegat and the Danish Straits was close to 12% per year until 2010, but data suggest that it is levelling off, even if the increased mortality in 2014 is taken into account, which is likely to be caused by density dependence, indicating that the subpopulation is approaching carrying capacity. Independent data on somatic growth support that the population is approaching the carrying capacity of the system (Harding et al in prep.). Additional surveys are needed to establish this with high confidence. However, the increase over the period 2003-2016 at 6.3% is significantly lower than the 12% increase during earlier exponential growth (Results figure 8). Bayesian analysis shows 80% support for a growth rate ≥5.8% for the period 2003-2016, which is below the threshold value of 9%. However, the management unit is regarded as approaching the carrying capacity in this assessment and will thus achieve good status since it meets the criterion “decline not >10% over a 10-year period”.

For the Kattegat and Southern Baltic subpopulations combined, the size of the metapopulation is well above the LRL and data on somatic growth indicate that the core of the population in the Kattegat is approaching the carrying capacity. Since no decline has been observed over the past 10 years, the metapopulation meets the criteria for good status. Positive growth rates in subpopulations in the Danish Straits and the

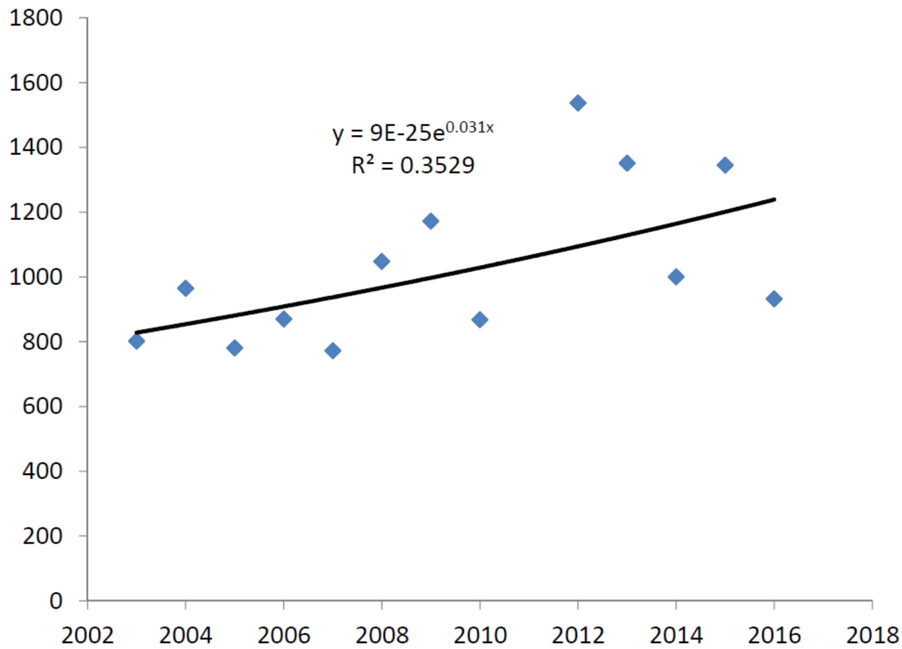
Southwestern Baltic indicate that the metapopulation is expanding. The latter subpopulation might be vulnerable to human activities due to their low numbers and hampered growth rates.

The evaluation is based on sufficient data and the confidence is **moderate** for the Kattegat seals due to uncertainty regarding status relative to carrying capacity and high for the Southern Baltic subpopulation.

Limfjord

The size of the Limfjord harbour seal population appears to have been fluctuating around 1,000 individuals since the early 1990s and appears to have reached its carrying capacity, although an annual increase of 3.2% is suggested by surveys from 2003-2016 (Results figure 9). However, genetic analysis indicates that the seals in the fjord originate from two different populations, (1) the population originally inhabiting the fjord and (2) seals from the Wadden Sea (Olsen et al. 2014). It is not known to what extent the seals from the Wadden Sea use the fjord for other purposes than hauling out and to which extent they interbreed with the native seal population. A proper assessment of the Limfjord harbour seals is contingent on clarification of these issues. Consequently, the status of the Limfjord population is uncertain since immigration may link it to the expanding Wadden Sea population.

The confidence of this evaluation is **low** since the connectivity to the Wadden Sea population is unclear.



Results figure 9. The annual growth rate of counted harbour seals in the Limfjord was 3.2% during the assessment period 2003-2016, and has been fluctuating around 1,000 seals for 25 years. Immigration from the Wadden Sea link it to the latter population, which is why the status of this population is uncertain.

Confidence of the indicator status evaluation

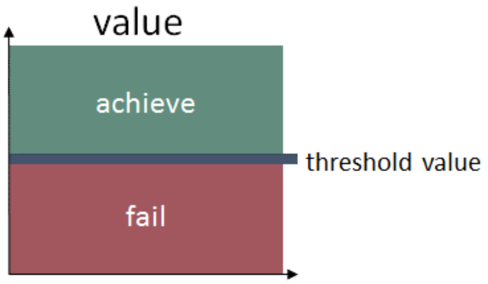
Confidence of the indicator evaluation is considered to be **high** for all seal species regarding applicable assessment units, except for harbour seals in the Limfjord where the connectivity with the Wadden Sea seals is unknown. Similarly, confidence is not high regarding the evaluation that grey seals and the Kattegat-northern Great Belt harbour seal unit was approaching carrying capacity. A longer series of data, particularly for the period abundances have plateaued, is needed for the confidence to increase. For the other management units, the confidence is generally deemed high as observations are available from all years in most relevant assessment units, with no clear temporal or spatial bias. Annual surveys are carried out for all species and management units except for ringed seals in the Archipelago Sea, Gulf of Finland, Gulf of Riga and Estonian coastal waters. Here new methodology is underway since moulting counts on ice are not feasible under currently regular ice free conditions during moulting time which prevail in most moulting seasons. However, confidence of the indicator evaluation is considered high also for this Southern management unit due to very small number of individuals in these areas.

Monitoring activities are currently carried out at a high spatial and temporal frequency. Historical data on population sizes of seals in all management units are available. The main pressures affecting seals, such as hunting and by-catches, diminishing ice fields and effects of contaminants are well known on a qualitative level, but more work is needed to quantify those pressures. Dedicated studies are needed to quantify by-catches on a regular basis, and it is not known why the nutritive condition of Baltic grey seals shows a negative trend. Furthermore, the low population growth rate of ringed seals is not fully understood.

Survey data is available for harbour seals in the Kattegat since 1979, 1972 in the Kalmarsund, 1990 in Southwestern Baltic, since 1988 for ringed seals in the Bothnian Bay and since 2003 for grey seals in the entire Baltic Sea. For grey seals there are also data from Sweden two decades before this time. Ringed seal data in the southern management unit is scarce. Sufficient data collected in the appropriate moulting periods coupled with well-known population ecology processes, rates the confidence of the indicator evaluation as high. Although data are scarce in the southern management unit of ringed seals, this subpopulation is clearly below good status and hence the evaluation of the populations against the set threshold value is deemed to be reliable.

Thresholds and Status evaluation

Good status for the population trends and abundance of seals in the Baltic Sea is determined by comparing population data with threshold values that have been defined based on concepts developed for the conservation of seals, in particular the HELCOM Recommendation 27/28-2 'Conservation of seals in the Baltic Sea area'.



Thresholds figure 1. Good status is achieved when the population growth rate trend and abundance of seals are above the threshold value.

Good status is achieved for abundance of seals in a management unit if the population is above the Limit Reference Level (LRL) with a steady increasing trend towards the Target Reference Level (TRL), where TRL is the level where the growth rate starts to level off and the population asymptotically approaches the current carrying capacity level.

HELCOM set a LRL of 10,000 individuals for all the Baltic seal species for each ecologically and genetically isolated population. For ringed and grey seals, the LRL of 10,000 individuals is the minimum abundance for a species to achieve the threshold value. Harbour seal subpopulations that are connected by migrants should be treated as a metapopulation, where numbers of seals in the metapopulation should exceed 10,000 seals to achieve good status. Harbour seals in the Kalmarsund are isolated and with the current abundance estimate of approximately 1,000 individuals the subpopulation does not reach good status. Harbour seals in the Southern Baltic are considered as a part of a metapopulation including the Kattegat and achieve good status with regard to abundance.

The growth rate aspect of the threshold value is assessed separately for populations at and below the TRL:

- For populations at target reference level (TRL), good status is defined as 'No decline in population size or pup production exceeding 10% occurred over a period up to 10 years'
- For populations below TRL, good status is defined as 3% below the maximum rate of increase for seal species, i.e. 7% annual rate of increase for grey seals and ringed seals and 9% for harbour seals. For good status, 80 % statistical support for a value at or above the threshold is needed. Subpopulations of harbour seal metapopulations are evaluated separately for trends, making different statuses possible for subpopulations of the same metapopulation.

The concept for defining a threshold value for the population size of seals is derived from the general management principle in the HELCOM Recommendation 27/28-2, which states that the population size is to be managed with the long-term objective of allowing seal populations to recover towards carrying capacity.

The limit reference level (LRL) corresponds to the safe biological level and minimum viable population size. HELCOM has set a LRL of 10,000 individuals for grey seals, ringed seals and harbour seals in each of their management units, respectively, understanding that the haul-out fraction during moult surveys is 70%. The LRL of 10,000 implies a population with approximately 5,000 adult seals (and thus 2,500 adult female seals). LRL has been calculated based on estimates of minimum viable population sizes of each seal species based on different extinction risk levels (1, 3, 5 and 10%) for genetically and ecologically isolated populations. The LRL is applicable to Baltic ringed seals, grey seals and harbour seals, corresponding to management units defined in HELCOM Rec. 27/28-2. Some management units of harbour seals (Southern Baltic Sea, Kattegat and possibly the Limfjord) show distinct genetic differences, these populations are affected by immigration/emigration, which is why LRL is not applicable in these units and population sizes of adjacent stocks are included in the evaluation of the LRL. For some isolated harbour seal units, the LRL may not be achievable. This may be the case for the Kalmarsund and the Limfjord units (degree of reproductive isolation of the harbour seals in the inner Limfjord is being resolved by an ongoing project). For these management units, the abundance criterion will be considered achieved when they have attained carrying capacity, even if it is at a level below the LRL.

The approach used for defining the threshold value for population trends is based on the principles of the HELCOM Recommendation 27/28-2 as the population is to increase until it reaches carrying capacity. The 'good status' concept also follows principles applied in Ecological Quality Objectives (EcoQOs) that were developed for marine mammals in the North Sea by the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention). This core indicator is similar to the EcoQO element of the same name used in the ICES and OSPAR frameworks, with the distinction that the two latter EcoQOs include 'No decline in population size or pup production exceeding 10% over a period up to 10 years' for populations 'minimally affected by anthropogenic impacts'. This condition is, however, also deemed appropriate for this core indicator when seal populations are close to natural abundances, i.e. close to carrying capacity.

The OSPAR and ICES frameworks provide some guidance also for populations far below 'natural' or 'pristine' abundances. Applying the term 'anthropogenic influence is minimal' would imply that a population should grow close to its intrinsic rate of increase when not affected by human activities. The theoretical base for this measure is outlined below and compared with empirical data from seal populations.

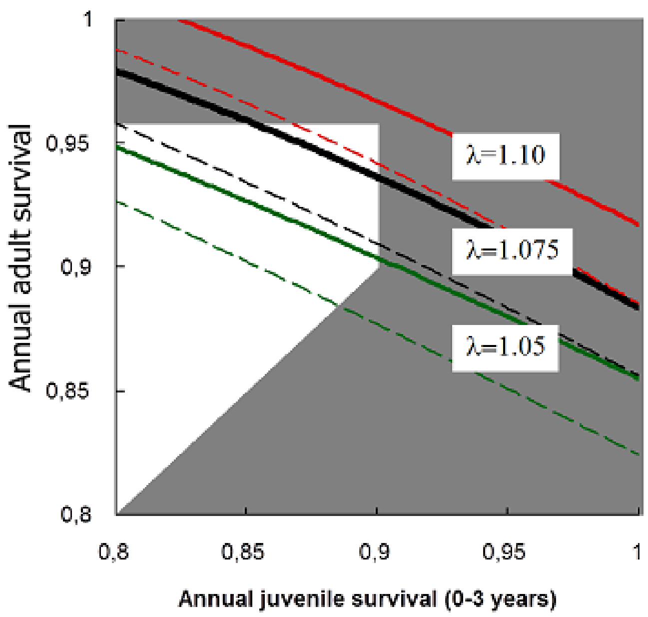
Approach for defining the threshold value for growth rate for populations close to carrying capacity (target reference level)

All growing populations will eventually be affected by density dependent factors (such as decreased availability of food and lack of haul-out sites) and the population size will stabilize at the carrying capacity of the ecosystem. Population sizes of marine mammals can be expected to fluctuate around the carrying capacity due to annual changes in food abundance and other external factors (Svensson et al. 2011). In this situation, the ICES and OSPAR frameworks proposed that good status is achieved when there is 'No decline in population size or pup production exceeding 10% occurred over a period up to 10 years'. The same level is used in the Baltic Sea for the purposes of this core indicator.

Approach for defining the threshold value for growth rate for populations below carrying capacity

Long-term maximum growth rates in seals

The maximum rate of population growth is limited by several factors in grey seals and ringed seals. Females have at most one pup a year, of which 48% are female pups, and first parturition occurs at about 5.5 years of age. It is also evident that not all adult females bear a pup each year, especially not young females (Bäcklin 2011). Of females older than six years, 95.5% ovulate each year (NRM database, Bäcklin et al. 2011), and not all of them will complete a successful pregnancy. An additional limitation for the population growth rate is given by the survival of adults. In most seal species, the highest measures of adult survival are about 0.95-0.96, and for grey seals the best estimate available is 0.935 (Harwood & Prime 1978). An additional constraint is the observation that pup and sub-adult survival is always found to be lower and more variable compared to adult survival in all studied species of seals (Boulva & McLaren 1979; Härkönen et al. 2002).



Thresholds figure 2. Biological constraints delimit the maximum possible rate of increase in populations of grey and ringed seals. The shaded area denotes unlikely combinations of adult and juvenile survival rates. Any given point along the 6 lines shows a combination of adult survival and juvenile survival that produces a given growth rate (λ). The two uppermost lines are for λ=1.10, the two lines in the middle for λ=1.075, and the lowest two lines show combinations that result in λ=1.05. The stippled lines show combinations of adult and juvenile survival rates given that the mean annual pupping rate is 0.95. The bold full lines show the possible combinations given that the pupping rate is 0.75.

These biological constraints impose an upper ceiling of possible rates of long-term population growth for any seal species and can be found by manipulations of the life history matrix (Caswell 2001; Härkönen et al. 2002). Thresholds figure 2 illustrates how fertility and mortality rates known for grey and ringed seals can combine to produce different long-term population growth rates. It is found that growth rates exceeding 10% (λ= 1.10) per year are unlikely in healthy grey seal populations (top stippled line in Thresholds figure 2). Reported values exceeding 10% should be treated sceptically since they imply unrealistic fecundity and longevity rates. Such high growth rates can only occur temporally, and can be caused by e.g. transient age structure effects (Härkönen et al. 1999; Caswell 2001), but are also to be expected in populations influenced by considerable immigration.

The upper limit of individual reproductive rate is reflected at the population level, and gives an upper theoretical limit for the rate of population increase (Thresholds figure 2). The mean values of fecundity and mortality will always be lower than the theoretical maximum, also for populations which live under favourable conditions. Chance events such as failed fertilization or early abortions reduce annual pregnancy rates, and in samples of reasonable sizes, mean pregnancy rates (or rather annual ovulation rates) rarely reach 0.96 (Boulva & McLaren 1979; Bigg 1969; Härkönen & Heide-Jørgensen 1990).

Another factor that will decrease mean pregnancy rates is senescence and pathological changes in the reproductive organs (Härkönen & Heide-Jørgensen 1990). Further, environmental factors reduce fecundity and survival rates. The impact from extrinsic factors may occur with different frequency and amplitude. Environmental pollution and high burdens of parasites can decrease population-specific long-term averages of fecundity and survival (Bergman 1999), while epizootic outbreaks and excessive hunting have the capacity to drastically reduce population numbers on a more short-term basis (Dietz et al. 1989; Harding & Härkönen 1999; Härkönen et al. 2006). Fluctuations in food supply and availability of breeding grounds can cause energetic stress affects survival and fecundity. The type of variation in fecundity and survival rates will determine the demographic structure of a population. In a population with a constant rate of increase (thus no temporal variability), the age- and sex-structures quickly reach stable distributions, where the frequencies of individuals at each age class are constant. Populations with low juvenile survival typically have steeper age distributions compared to populations with higher juvenile survival rates (Caswell 2001). Skewed age structure can cause a temporal flux in the population growth rate.

Harbour seals mature about one year earlier than grey seals and ringed seals, which is why maximum rate of increase in this species is 12-13% per year (Härkönen et al. 2002).

Empirical evidence

With few exceptions, most populations of seals have been severely depleted by hunting during the 20th century. Detailed historical hunting records for pinnipeds are available for the Saimaa ringed seal, Baltic ringed seal, Baltic grey seal and the harbour seal in the Wadden Sea, Kattegat and the Skagerrak. Analyses of these hunting records have documented collapses in all populations, which were depleted to about 5-10% of pristine abundances before protective measures were taken (Heide-Jørgensen & Härkönen 1988; Kokko et al. 1999; Harding & Härkönen 1999). After hunting was banned and protected areas were designated, most populations started to increase exponentially.

Harbour seal populations in the Kattegat and outside the Baltic increased by about 12% per year between epizootics in 1988 and 2002 (Olsen et al. 2010, Teilmann et al. 2010), whereas harbour seals and grey seals in the Baltic showed lower increase compared with exponentially increasing oceanic populations (Wadden Sea Portal). A Bayesian approach (below) is used to evaluate if observed rates of increase close to intrinsic rates are supported. The threshold value for population growth rate is set to a value 3% lower than the maximum rate of increase.

Thresholds table 1. Rates of increase in seal populations recovering after over-hunting. Grey seals from the UK, Norway, and Iceland are not included here since they have been consistently hunted over the years. Canadian grey seals have a life history similar to harbour seals.

Species	Area	Annual growth rate	Period	Reference
Harbour seal	Skagerrak	+12%	1978-1987	Heide-Jørgensen & Härkönen (1988)
Harbour seal	Skagerrak	+12%	1989-2001	Härkönen et al. 2002
Harbour seal	Kattegat	+12%	1978-1987	Heide-Jørgensen & Härkönen (1988)
Harbour seal	Kattegat	+12%	1989-2001	Härkönen et al. 2002
Harbour seal	Baltic	+ 9%	1972-2010	Härkönen & Isakson 2011
Harbour seal	Wadden Sea	+12%	1980-1988	Reijnders et al. 1994
Harbour seal	Wadden Sea	+12%	1989-2001	Wadden Sea Portal

Assessment Protocol

This core indicator evaluates whether good status is achieved by determining the growth rate of the population as well as the population size over a specified time period. The data collected and used in this indicator are based on national aerial surveys described in Galatius et al. (2014).

Each assessment unit is evaluated against two threshold values, for population growth rate and the Limit Reference Level (LRL). The overall status of seals in each management unit only achieves good status if both threshold values are met.

Time series of data for each seal species and each management unit are used as input values in Bayesian analysis with uninformative priors, where it is evaluated whether observed data support the set threshold value. In this process, 80% support for a growth rate ≥ the threshold value is required. If the unit fails to achieve good status, the probability distribution is used to evaluate the confidence of the assessment. The package 'bayesm' in the program R has been used for the analysis. The following is an example of the procedure using survey data on harbour seals in the Southern Baltic Sea over the period 2002-2014:

```
library(bayesm)
year <-
c(2002,2003,2004,2005,2006,2007,2008,2009,2010,20
11,2012,2013,2014)
count <-
c(260,401,494,560,448,511,737,586,715,783,734,893,
845)
y <- log(count)
X <- model.matrix(log(count)~year)
Theta0 <- c(0,0)
A0 <- 0.0000001*diag(2)
nu0 <- 0
sigma0sq <- 0
n.sims <- 5000
Data <- list(y=y,X=X)
Prior <- list(betabar=Theta0, A=A0, nu=nu0,
ssq=sigma0sq)
Mcmc <- list(R=n.sims)
bayesian.reg <- runireg(Data, Prior, Mcmc)
beta.sims <- t(bayesian.reg$betadraw)
sigmasq.sims <- bayesian.reg$sigmasqdraw
apply(beta.sims, 1, quantile, probs = c(0.025, 0.975,
0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35, 0.4, 0.45, 0.5, 0.55,
0.6, 0.65, 0.7, 0.75, 0.8, 0.85, 0.90, 0.95))
```

Which gives the output:

2.50%	0.057402
97.50%	0.104045
5%	0.061368
10%	0.065921
15%	0.069049
20%	0.071529
25%	0.073271
30%	0.074951
35%	0.076557
40%	0.07791
45%	0.079096
50%	0.08053
55%	0.082055
60%	0.08343
65%	0.084957
70%	0.0866
75%	0.088232
80%	0.090172
85%	0.092368
90%	0.095354
95%	0.100053

In this example, there is 80% support for a growth rate ≥0.072 (read at 20%). Thus, the unit does not achieve good status (threshold for harbour seals is 0.09).

Assessment units and management units

This core indicator evaluates the population trends and abundance of seals using HELCOM assessment unit scale 2 (division of the Baltic Sea into 17 sub-basins). The assessment units are defined in the HELCOM Monitoring and Assessment Strategy Annex 4.

The existing management plans for seals operate according to management units that are based on the distribution of seal populations. The management units typically encompass a handful of HELCOM scale 2 assessment units. Evaluations are therefore done by grouping HELCOM assessment units to align with the management units defined for each seal population.

- The Baltic grey seal is evaluated as a single management unit, although genetic data show spatial structuring (Fietz et al. 2013). The total numbers of counted seals in the entire Baltic Sea during moulting surveys since 2014 were above 30,000. The proportion of the population hauled out during moult has been estimated to about 60-80% (e.g. Hiby et al. 2013). Coordinated aerial surveys encompassing the entire Baltic started in 2000, which is why only data after that year are used in analyses.
- The Baltic ringed seal is distributed in the Gulf of Bothnia (first management unit) and the Archipelago Sea, Gulf of Finland and Gulf of Riga (second management unit). This sub-division is justified by ecological data that indicate separate dynamics of the stocks. Since ringed seals from both areas show a high degree of site fidelity, as seen in satellite telemetry data (Härkönen et al. 2008), it is unlikely that extensive migrations occur at current low population numbers, although some individuals may show more extensive movements (Oksanen et al. 2015).
- Harbour seals in the Kalmarsund constitute a separate management unit and is the genetically most divergent of all harbour seal populations in Europe (Goodman 1998). It was founded about 8,000 years ago, and was close to extinction in the 1970s as a consequence of intensive hunting, and possibly also impaired reproduction (Härkönen et al. 2005). The genetic diversity is substantially reduced compared with other harbour seal populations.
- Harbour seals in the southern Baltic (Danish Straits, Danish, German, Polish, and Swedish (Öresund region including Skåne county) waters) form a subpopulation which should be managed separately, although some migrants are exchanged with neighbouring populations, as this stock is genetically distinct from adjacent populations of harbour seals (Olsen et al. 2014). Combined with harbour seals from the subpopulation in the Kattegat, they form a metapopulation. The combined abundance of the two subpopulations is assessed with respect to the LRL threshold, while the abundance trends of the two subpopulations are assessed separately. Thus, different assessments are possible for subpopulations of the same metapopulation.
- Harbour seals in the Limfjord form the third management unit and are genetically distinct from the Kattegat harbour seals, but are influenced by migrants from the Wadden Sea (Olsen et al. 2014).

Relevance of the Indicator

Biodiversity assessment

The status of biodiversity is assessed using several core indicators. Each indicator focuses on one important aspect of this complex issue. In addition to providing an indicator-based evaluation of the population trends and abundance of seals, this indicator will also contribute to the overall biodiversity assessment, along with the other biodiversity core indicators.

Policy relevance

The core indicator on population trends and abundance of Baltic seals addresses the Baltic Sea Action Plan's (BSAP) Biodiversity and nature conservation segment's ecological objective 'Viable populations of species'.

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

- 'By 2015, improved conservation status of species included in the HELCOM lists of threatened and/or declining species and habitats of the Baltic Sea area, with the final target to reach and ensure favourable conservation status of all species'.

The HELCOM Recommendation 27/28-2 Conservation of seals in the Baltic Sea area outlines the conservation goals of seals agreed on at HELCOM. The recommendation is implemented to reach the BSAP goals. The recommendation conservation goals are used as the basis for defining this indicator's threshold value.

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' and

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

Descriptor 8: 'Concentrations of contaminants are at levels not giving rise to pollution effects'

and the following criteria of the Commission Decision (European Commission 2010):

- Criterion 1.1 (species distribution)
- Criterion 1.2 (population size)
- Criterion 1.3 (population condition)
- Criterion 4.1 (Productivity of key species or trophic groups)
- Criterion 4.3 (abundance/distribution of key trophic species)
- Criterion 8.2 (Effects of contaminants)

Marine mammals were recognized by the MSFD Task Group 1 as a group to be assessed.

In some Contracting Parties, the indicator also has potential relevance for implementation of the EU Water Framework Directive (WFD) and Habitats Directive. The WFD includes status categories for coastal waters as well as environmental and ecological objectives. The EU Habitats Directive (European Commission 1992) specifically states that long-term management objectives should not be influenced by socio-economic considerations, although they may be considered during the implementation of management programmes provided the long-term objectives are not compromised. All seals in Europe are also listed under the EU Habitats Directive Annex II, and member countries are obliged to monitor the status of seal populations.

Role of seals in the ecosystem

Being top predators in the Baltic Sea ecosystem, seals are exposed to ecosystem changes in lower trophic levels, but also to variations in climate (length of seasons and ice conditions) and human impacts. These pressures can affect fish stocks, levels of harmful substances as well as direct mortality caused by hunting or by-catch. The vulnerability of seals to these pressures makes them good indicators for measuring the environmental status of ecosystems.

The growth rate of a population is the result of age-specific mortality rates and age-specific fecundity rates. It is therefore a sensitive parameter signalling if mortality or fecundity rates change. Depleted, undisturbed populations are expected to grow by 10% per year (grey and ringed seals) or 12% per year (harbour seals). Significantly lower observed growth rates indicate effects from the environment in form of reduced food availability or impaired health caused by contaminants or diseases. Low growth rates can also be the result of excessive hunting or high levels of by-catches.

All species of marine mammals in the Baltic Sea were severely reduced in the beginning of the 20th century as a result of a coordinated international campaign to exterminate seals. Seal numbers in the Baltic Sea dropped by 80-90% over the period 1920-1945, resulting in extirpation of grey seals in the Kattegat in the 1930s (Heide-Jørgensen & Härkönen 1988) and grey seals and harbour seals along the Polish and German coasts (Harding & Härkönen 1999). Environmental contaminants in the 1960s and 1970s caused infertility in ringed and grey seals, where fertility rates in ringed seals dropped to 17% in the beginning of the 1970s (Helle 1980).

Human pressures linked to the indicator

	General	MSFD Annex III, Table 2
Strong link	The main pressures affecting the abundance and growth rate of Baltic seal populations include hunting, by-catches, and disturbance	Biological disturbance: -selective extraction of species, including incidental non-target catches (e.g. by commercial and recreational fishing)
Weak link	The effects of climate change are a threat to the ringed seal that breeds on sea ice Fishery and food availability	Contamination by hazardous substance: - introduction of synthetic compounds - introduction of non-synthetic substances and compounds

Historically, hunting of seals has been a major human pressure on all the seal species in the Baltic Sea. A coordinated international campaign was initiated in the beginning of the 20th century with the aim of exterminating the seals (Anon. 1895). Bounty systems were introduced in Denmark, Finland and Sweden over the period 1889-1912, and very detailed bounty statistics provide detailed information on the hunting pressure. The original population sizes were about 180,000 for ringed seals, 80,000 for Baltic grey seals and 5,000 for the Kalmarsund population of harbour seals (Harding & Härkönen 1999; Härkönen & Isakson 2011). Similar data from the Kattegat and Skagerrak suggest that populations of harbour seals amounted to more than 17,000 seals in this area (Heide-Jørgensen & Härkönen 1988).

The hunting pressure resulted in extirpation of grey and harbour seals in Germany and Poland in 1912, and grey seals were also extirpated from the Kattegat by the 1930s. Ringed seals declined to about 25,000 seals in the 1940s, whereas grey seals were reduced to about 20,000 (Harding & Härkönen 1999) over the same time period. A similar rate of reduction of harbour seals occurred in the Kalmarsund and the Kattegat (Heide-Jørgensen & Härkönen 1988; Härkönen & Isakson 2011). However, after these heavy reductions, populations appear to have been stable up to the 1960s (Harding & Härkönen 1999).

Then, in the beginning of the 1970s grey seals were observed aborting near full term foetuses, and only 17% of ringed seal females were fertile (Helle 1980). Later investigations showed a linkage to a disease syndrome including reproductive disorder, caused by organochlorine pollution, in both grey seals and ringed seals (Bergman & Olsson 1985). The reduced fertility resulted in population crashes, where numbers of ringed and grey seals dwindled to approximately 3,000 of each species in the beginning of the 1980s (Harding & Härkönen 1999). Increasing numbers of these species were recorded after levels of PCB in biota decreased by the end of the 1980s. Recent samples show that fertility is normal in grey seals, but still impaired in ringed seals (Bäcklin et al. 2011; Bäcklin et al. 2013). The very low numbers of ringed seals in the Gulf of Finland may be caused by impaired female fertility.

Incidental catches of seals in fisheries are known to have substantial effects on the population growth rate in species like the Saimaa and Ladoga ringed seals (Sipilä 2003). The current knowledge on the level of incidental catches of Baltic seal species is limited to a few dedicated studies which suggest that this factor can be substantial. An analysis of reported incidentally caught grey seals showed that approximately 2,000 grey seals are caught annually in the Baltic fisheries (Vanhatalo et al. 2014), but numbers of incidentally caught ringed seals and harbour seals are not known.

Incidentally caught grey seals are significantly leaner compared to hunted seals (Bäcklin et al. 2011), which may suggest that food is a limiting factor for incidentally caught grey seals. It is possible that food limitation is becoming an important factor also for the entire population since data on blubber thickness in Baltic grey seals (also hunted) show a significant decline during the last decade (Bäcklin et al. 2011).

Climate change poses a pressure on species breeding on ice because shorter and warmer winters lead to more restricted areas of suitable ice fields (Meier et al. 2004). This feature alone will severely affect the Baltic ringed seals and the predicted rate of climate warming is likely to cause extirpation of the southern subpopulations (Sundqvist et al. 2012). Grey seals are facultative ice breeders and their breeding success is considerably greater when they breed on ice as compared with land (Jüssi et al. 2008). Consequently, both ringed seals and grey seals are predicted to be negatively affected by a warmer climate. However, effects of climate change should not be included in assessments according to the Habitat Directive.

Most land breeding sites of Baltic seals are protected during critical periods of time, since seals are vulnerable to disturbance during the lactation period. This is especially important for grey seals, where access to undisturbed land breeding sites delimit the expansion of grey seals in the Southern Baltic Sea.

Monitoring Requirements

Monitoring methodology

HELCOM common monitoring relevant for the seal population trends is documented on a general level in the **HELCOM Monitoring Manual** under the **sub-programme: Seal abundance**.

HELCOM monitoring guidelines for seals were adopted in 2014 and currently all monitoring guidelines are being reviewed for inclusion in the Monitoring Manual.

The three regularly occurring seal species in the Baltic Sea, harbour seal (*Phoca vitulina*), ringed seal (*Pusa hispida*) and grey seal (*Halichoerus grypus*) are monitored at their haul-outs during their annual moulting and pupping seasons, with the aim of estimating the abundance and trends (moulting counts) and pup production (pupping counts). Grey seals and harbour seals are counted on their land haulouts during moulting time. Ringed seals are surveyed using transect sampling methodology during moult on the ice. In most areas, the monitoring is performed using aerial surveys, where the seal haul-outs are photographed during the relevant periods in areas where there is a significant occurrence of seals.

Detailed descriptions of the survey methodology and analysis of results are given in the **HELCOM monitoring manual** (Galatius et al. 2014).

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 Concept Table.

Sub-programme: Seal Abundance

Monitoring Concept Table

Current monitoring covers all haul-out sites presently used by seals in the Baltic Sea and is considered to be sufficient to cover the needs of the indicator except for southern ringed seals. See description in the Assessment Requirements of the **HELCOM Monitoring Manual**.

Description of optimal monitoring

The monitoring strategy is optimal for harbour seals which are surveyed three times annually during the moulting period, and increased effort would not significantly improve results (Teilmann et al. 2010). The same is true for ringed seal surveys on ice in the Bothnian Bay, where a minimum fraction of 13% of the ice area is surveyed. Increasing survey effort would only marginally affect the precision of estimates (Härkönen & Lunneryd 1992). Also the coordinated grey seal surveys would be only marginally improved by increased effort. The planned decrease in monitoring frequency for grey seal by Finland might lower the confidence of the evaluation in future years.

However, two management units could benefit from modified methodology:

Limfjord harbour seals

The fjord was separated from the North Sea by land until the 1820s and genetic analyses indicate different populations in the eastern and western fjord, with the eastern fjord being predominantly inhabited by the original population of the fjord and the western fjord predominantly inhabited by immigrants from the North Sea / Wadden Sea (Olsen et al. 2014). A study determining the relative abundances of the two populations, the level of interbreeding and the habitat use of seals with genetic signature is necessary for evaluation in this area.

Southern ringed seals

Since ice cover has been diminishing over the past decades, monitoring of ringed seals on ice in the Archipelago Sea, The Gulf of Finland, and Estonian coastal waters including the Gulf or Riga has only been possible during a few years over the past 20 years. However, before the aerial surveys started, ringed seals were counted on land in August, when they returned to the coast after having spent most of the summer foraging at sea (e.g. Härkönen et al. 2008). Such data is available from the Gulf of Finland, where numbers of counted ringed seals amounted to 300 animals in 1992 (Härkönen et al. 1998), whereas only 100 ringed seals were observed in the same area in 2014 (Verevkin pers. com.). Consequently, the method of surveying ringed seals hauled out on rocks would be an appropriate alternative method for southern ringed seals.

Data and updating

Access and use

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

HELCOM (2018) Population trends and abundance of seals. HELCOM core indicator report. Online. [Date Viewed], [Web link].

ISSN: 2343-2543

Metadata

[Result: Population trends and abundance of seals – Ringed seal]

[Data: Population trends and abundance of seals – Ringed seal]

[Result: Population trends and abundance of seals – Grey seal]

[Data: Population trends and abundance of seals – Grey seal]

[Result: Population trends and abundance of seals – Harbour seal]

[Data: Population trends and abundance of seals – Harbour seal]

The national survey data is compiled annually by the HELCOM Seal Expert Group. A regional database was developed within BALSAM project and has been hosted by the HELCOM Secretariat since 2015. This database will be further developed to also enable evaluation of the Distribution of Baltic seals indicator. This new database will be harmonized with the OSPAR reporting format as a part of tasks given in the Baltic BOOST WP 1.2 by the end of 2016.

This new database will include detailed spatial information and is to be updated annually prior to HELCOM seal expert meetings. The database will be managed by the HELCOM Secretariat having responsibility for updating and storing data provided by the HELCOM Seal Expert Group.

Status assessments are to be accomplished by the Lead and co-Lead countries. The outcome of such assessments will be presented and discussed at the next HELCOM Seal Expert Group meeting.

The first compilations for the database have been completed and an intermediate version of the seal database can be accessed and downloaded as excel file. During 2015-2016 work will continue to operationalize the database, e.g. including further parameters and metadata.

The data collected and used in the indicator are based on national aerial surveys. The survey methodology is described in Galatius et al. (2014). This data covers only haul-out sites and not areas used e.g. as hunting grounds.

Contributors and references

Contributors

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Archive

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

Population trends and abundance of seals HELCOM core indicator 2018 (pdf)

Older versions of the indicator report are available:

Core indicator report - web-based version January 2016 (pdf)

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

2013 Indicator report (pdf)

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