Baltic Marine Environment Protection Commission

Working Group on the State of the Environment and Conservation

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Background

HOD 48-2015 agreed on the core indicator report 'Number of drowned mammals and waterbirds in fishing gear' for publishing noting that the indicator is still at a development stage where only a qualitative evaluation can be made (paragraph 3.63 of the outcome), and taking note of a general study reservation by Germany and Denmark.

HOD 48-2015 agreed on a Lead Country approach to further develop the core indicators (paragraph 3.64 of the outcome). For the core indicator 'Number of drowned mammals and waterbirds in fishing gear' the Lead Country is Germany and Co-Lead Countries Poland and Sweden. The progress made on the indicator development has been communicated to the HELCOM workshop on fish indicators and the FISH 4-2016 meeting held back to back, and to the SEAL 10-2016 meeting as well as to the 2015 JWG Bird meeting.

The indicator development has been hampered by the fact that very little data is available on incidental by-catch of marine mammals and seabirds in fishing gear. The expert work on the indicator has included circulating questionnaires in the Baltic Sea region to identify all available data stemming from monitoring. It has been identified that very little dedicated monitoring takes place in the region as also discussed at FISH 4-2016. As a first step the experts developing the indicator have therefore collated all available information for a subset of species. The information has been collated with the aim to focus on a few representative species for which it is known that incidental by-catch is a relevant source of mortality to assess. The first results for the subset of species are intended as an example of how the incidental by-catch indicator could be operationalized for a larger set of indicators.

This document presents the latest version of the core indicator report. Due to the lack of availability of suitable monitoring-based data, currently only two populations of harbour porpoises, long-tailed duck, common guillemot and greater scaup were included in the assessment. The data basis is from scientific case studies.

The definition of GES applied for the species and populations assessed in this indicator so far are shown i. e. table 1 of the attached report.

Action requested

The Meeting is invited to:

- take note of the progress made, and discuss the developing of the indicator evaluation,
- consider how the data and the assessment could be used in HOLAS II.

Core indicator report:
Number of drowned mammals and waterbirds in fishing gear

Contents

Number of drowned mammals and waterbirds in fishing gear

Key Message

This core indicator evaluates whether the number of incidentally caught and drowned marine mammals and waterbirds are below mortality levels that enable reaching Good Environmental Status (GES). Currently no quantitative targets have been defined for the core indicator for every species concerned. However, concepts for determining the targets based on removal- and conservation targets have been described and are proposed to form the basis of future core indicator target setting activities. Initial removal targets for two populations of harbour porpoises and three species of waterbirds can be derived as indicated in the following table. Available incidental catch estimates are evaluated against these targets which also include other sources of anthropogenic mortality. These have to be refined and further species added as further knowledge is gained.

Key message figure 1: Status assessment results based evaluation on the indicator 'number of drowned mammals and waterbirds in fishing gear'. The assessment is carried out using Scale 2 HELCOM assessment units (defined in the HELCOM Monitoring and Assessment Strategy Annex 4). Click to enlarge. [figure to be exchanged with larger font and colours according to assessment]

Key message table 1. Removal targets for the assessment units of the species to which this assessment applies.

harbour porpoise	Baltic Proper population	zero incidental catch
harbour porpoise	Western Baltic, Belt Sea and Kattegat population	< 1 % incidental catch of the best abundance estimate
long-tailed duck	Western Palearctic population	PBR = 22,600 birds (including oiling and hunting)
greater scaup	Western Palearctic population	PBR = 3,700 birds (including oiling and hunting)
common guillemot	Baltic-breeding population	PBR = 620 birds (including oiling)

For harbour porpoises, increased mortality due to drowning (including death by suffocation) in fishing gears is believed to be the greatest source of mortality to the populations in the Baltic Sea. The number of drowned animals exceeds the tentative removal target for the Baltic Proper population. For the harbour porpoise population in the Western Baltic, Belt Sea and Kattegat, the preliminary incidental catch estimate are in the same range as the removal target. A figure slightly below the target cannot be interpreted as sustainable as there are too many uncertainties in the estimates.

Recent modelling efforts have shown that incidental catch is a relevant source of human induced mortality in grey seals. No recent incidental catch estimates are available for ringed seals and harbour seals.

For waterbirds, drowning in fishing gear is believed to be a significant pressure on the populations of long-tailed duck, scoters, divers and some other waterbird species in wintering areas with high densities of waterbirds. The initial assessment based on case studies reveals that assessment values are exceeded in all three waterbird species included in this assessment. A declining trend in numbers of incidentally caught birds has been detected in the last two decades, however this is generally not believed to be a result of improved fishing practices but due to declining trends detected in the abundance of wintering waterbirds populations (e.g. due to factors such as poor breeding success) which likely contributes to declining incidental by-catch numbers. Also other anthropogenic sources of mortality such as oiling and hunting contribute to declines and must be considered in the indicator assessment. In countries such as Denmark and Sweden where the fishing effort (usually measured in days at sea) has decreased during this time, a change in fishing pressure may also have contributed to the declining trend in by-caught birds. However, it is not known whether the number of gillnets and entangling nets also decreased in the same proportion as days at sea.

Relevance of the core indicator

This core pressure indicator evaluates the number of incidentally caught marine mammals (cetaceans, seals and otters) and diving waterbirds in fishing gears against species specific removal targets. The populations of these highly mobile animals are sensitive to additive mortality caused by fishing gear due to their characteristic slow reproduction rate. The indicator is an important tool for detecting intolerable mortality in key populations of the highly mobile species due to fishing activities.

The distribution and abundance of marine mammal populations is closely linked to healthy fish stocks and influenced by many human activities. For harbour porpoises, incidental catch has been identified as the main known cause of human-related mortality and it is likely to inhibit population recovery towards conservation targets.

Drowning due to incidental catch in fishing gear is a significant pressure on population trends and demography of waterbirds as in vulnerable species the numbers of drowned birds represent a relatively large proportion of the total population size.

Policy relevance of the core indicator

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

	BSAP segment and objectives	MSFD Descriptor and criteria
Primary link	Biodiversity • Viable populations of species • Thriving and balanced communities of plants and animals	Annex III
Secondary link	Eutrophication • Natural distribution and occurrence of plants and animals	D1 Biodiversity 1.1 Species distribution (range, pattern, covered area) 1.2 Population size (abundance, biomass) 1.3. Population condition (demography, genetic structure) D4 Food-web 4.1. Productivity of key species or trophic groups 4.3 Abundance/distribution of key trophic groups/species
Other relevant legislation: In some Contracting Parties also EU Birds Directive, EC Action Plan for reducing incidental catches of seabirds in fishing gears, EU Habitats Directive, Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS) and Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA)		

Cite this indicator

HELCOM (2016) Number of drowned mammals and waterbirds in fishing gear. HELCOM core indicator report. Online. [Date Viewed], [Web link].

Download full indicator report

Core indicator report – web-based version October 2016 (pdf)

Results and Confidence

A complete evaluation of whether Good Environmental Status (GES) is achieved in terms of the number of drowned mammals and waterbirds in fishing gear has not yet been carried out. Due to the lack of availability of suitable monitoring-based data, currently only two populations of harbour porpoises, long-tailed duck, common guillemot and greater scaup were included in the assessment. The data basis is from scientific case studies. For other species, indicative results are presented. Since case studies used for the indicator assessment may be not up to date, the assessment has to be considered preliminary. The confidence of the presented results is low but can greatly be improved once a suitable monitoring scheme is agreed on at Baltic Sea level in the frame of the EU Data Collection Multiannual Programme DC-MAP (European Commission 2016). A time series of incidental catch estimations would best account for uncertainties in the data (see CLA in "alternative target setting approaches", below).

Marine mammals

For harbour porpoises, the risk of incidental catch is highest in various types of gillnets: set gill nets (gear type: GNS), entangling nets (trammel nets, GTR) and driftnets (GND) (ICES 2013a). The latter are banned in the Baltic Sea, but some hybrid nets such as 'semi-driftnets', which are fixed on one end of the net with the other end drifting around this anchor are of special concern.

For seals, in addition to the gear mentioned above, fykenets (FYK) and push-up traps without excluding devices in their entrance are of special concern (ICES 2013a, Vanhatalo et al. 2014). Fykenets might also pose the greatest threat to Eurasian otters (Raby et al. 2011).

Incidental catch of harbour porpoises and seals is difficult to estimate and reliable studies are scarce, but for harbour porpoise the suffocation through incidental catch in fishing gears is believed to be the greatest source of anthropogenic mortality and requires immediate action (ASCOBANS 2009, 2012, 2016b). Not until recently, incidental catch rates have been calculated for the ICES Kattegat and Belts Seas assessment unit (AU)[1] including ICES subdivisions 21, 22 and 23 (ICES 2015, 2016). These are based on collated incidental catch data from net fisheries (Metier level 3) mainly from a Danish remote electronic monitoring project using CCTV cameras on commercial vessels 10 to 15 m long (see below). For ICES subdivision 24 in the Western Baltic, no estimation of harbour porpoise incidental catch has been made. The 95 % confidence interval for the incidental catch numbers applied to the ICES Kattegat and Belts Seas AU is 165-263 calculated for the known fishing effort in 2014 (ICES 2016a). However, there are several sources of uncertainty to this estimate. The fishing effort (with respect to km of net * soak time, see chapter Monitoring Requirements) of the monitored vessels may not have been representative for total fishing effort measured in days at sea only. A possible source of underestimation of the number of incidental catches may be that logbooks are not mandatory for part-time fishermen and recreational fishermen. Another source of uncertainty is that no account has been taken for differences in mesh sizes or other important gear characteristics that may affect the incidental catch rate, or spatio-temporal heterogeneity of fishing effort in relation to harbour porpoise density. It has recently been shown that the combination of both fishing effort and harbour porpoise density produce better predictions of the risk of incidental catch, than one factor only (Kindt-Larsen et al., 2016).

ASCOBANS (2016b) compiled available database and literature information on incidental catch of harbour porpoises in the Baltic Proper. In Latvia, two harbour porpoises were reported as bycaught in 2003 – 2004. In Poland (period 2010 to 2014), one individual incidentally caught in a cod gillnet was reported in 2014.

[1] This ICES assessment unit is not based on population boundaries.

Prior to this (1990-2009) 66 harbour porpoises were reported as incidentally caught, 39% in semi-driftnets, 35 % in cod gillnets, 21 % in other set gillnets, 3 % in pelagic trawls and 2 % in driftnets (banned since 2008).

Based on interviews of fishermen from Sweden, Finland and Estonia, and accounting for the variability in seal abundance and fishing effort and also for underreporting, the annual incidental catch of grey seals in trap nets and gill nets in these countries is estimated around 2,180-2,380 individual seals in 2012, probably representing at least 90% of the total incidental catch in the whole Baltic Sea (Vanhatalo et al. 2014). Annual population growth rates were estimated to be 9.4% (2000-2004) and 3.5% (2004-2009) in Finland (Kauhala et al. 2012) and 7.5% along the Swedish Baltic Sea coast since the 1990s. Related to counted seal numbers (Finnish Game and Fisheries Research Institute 2013), the incidental catch rate would result in 7.7-8.4% which is an overestimation because not all animals are recorded during counts.

Waterbirds

Diving waterbirds are especially vulnerable to set gill nets (GNS), entangling nets (trammel nets, GTR) and driftnets (GND), but incidental catch also occurs in other static fishing gears such as longlines and traps (ICES 2013a, b). Taxonomic groups under high pressure are divers, grebes, cormorants, alcids, mergansers and ducks. High incidental catch numbers are reported from regions of high bird abundance (e.g. wintering birds on offshore banks and in coastal areas, Larsson & Tydén 2005, Žydelis et al. 2009, 2013, Bellebaum et al. 2012). Several studies have shown that the gillnet fishery in the Baltic Sea can in certain places cause high bird mortality. A rough estimate comprised 100,000-200,000 waterbirds drowning annually in the North and Baltic Seas, of which the great majority refers to the Baltic Sea (Žydelis et al. 2009, 2013, Bellebaum et al. 2012). Locally, incidental catch rates have decreased during the last two decades, likely as a result of declined abundance of wintering waterbirds and resulting reduced density at sea (Bellebaum et al. 2012). Areas where waterbirds aggregate are often overlapping with gillnet fishery (Sonntag et al. 2012), thus the incidental catch risk is high when gillnet fishery is exercised in areas with high abundance of foraging waterbirds, which can be present during the breeding period, during migration, for moulting and for wintering.

Confidence of indicator evaluation

Monitoring data on numbers of incidentally caught mammals and waterbirds collected on an annual basis are virtually non-existent. However, limited data from scientific studies and pilot studies can be used for an initial assessment for a few species. Some of these data may not be up-to date and thus have to be related to previous abundance data. So far, the confidence in any previous estimates of the pressure exerted by incidental catch of the relevant populations is low. All estimates are believed to be underestimates or very uncertain because the proportion of unreported cases is likely to be high, or there are serious caveats in the underlying data. Incidental catch numbers for seals and harbour porpoises are either absolute minimum numbers (from reported incidental catches) or estimates from pilot studies. For harbour porpoises there is a high degree of uncertainty both in the estimated numbers of incidentally caught animals and in the estimated removal targets (see chapter 'Targets', below) needed for evaluation of these. For seals, the study by Vanhatalo et al. (2014) has recently increased the knowledge. However for waterbirds, the magnitude of the incidental catch has been sufficiently clarified on the scale of localised case studies (Žydelis et al. 2009). In order to increase the confidence of a GES assessment, annual monitoring data of incidental catches based on a sufficient number of observer days are absolutely necessary.

Targets

Due to the lack of sufficient monitoring data, it has not been possible to set quantitative targets for this core indicator on number of drowned mammals and waterbirds in fishing gear for every species concerned. However, the concepts for determining removal- and conservation targets are described below. Based on this, initial targets for two populations of harbour porpoises and three species of waterbirds can be derived. These have to be refined as further knowledge is gained. Future target setting activities (see sub-chapter 'Alternative target setting approaches') are proposed to obtain the basis of a fully operational core indicator.

The concept to apply targets supported by species specific removal and conservation targets has been developed in other contexts, including ongoing work carried out under the Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS), concluded under the auspices of the Convention on Migratory Species (ASCOBANS 2015a). This approach requires setting species specific conservation targets and defining reference points (removal targets) for the annual incidental catch rate.

Removal targets are based on 'unacceptable mortality levels' for the indicator species. 'Unacceptable interactions' have been defined for harbour porpoises (ASCOBANS 2000, 2006, 2016a, for details see also species specific targets below). Levels of 'unacceptable interactions' are related to the total human induced mortality of which incidental catch is an unknown fraction that may differ regionally. These levels of 'unacceptable interactions' should not be misinterpreted as 'acceptable levels' if the values are below the reference points.

Conservation targets are focused on the state of biological management units (i.e. stocks or populations). A target for a safe human-induced mortality limit (as a consequence from the removal target) is usually the outcome of a simulation over a certain time period using a suitable population dynamic model. During the time period, the conservation target for the stock size is to be reached with a given certainty in a predefined fraction of the simulation time (e.g. at least 95 % likelihood of reaching at least 80 % of carrying capacity within 100 years). In order to set a safe human-induced mortality limit, the time scale of the simulations have to be agreed upon (ICES 2014a, ASCOBANS 2015a). ICES concluded that such human induced mortality limits (or threshold reference points), should account for uncertainty in existing estimates of incidental catch and allow for current conservation goals to be met in order to enable managers to identify fisheries that require further monitoring and those where mitigation measures are most urgently required (ICES 2013a).

In the long-term, mortality in a healthy population must not exceed the birth rate (natality) in order to sustain the population. In seriously depleted populations the human-related mortality must be close to zero to allow for recovery. All the highly mobile indicator species have a slow reproductive rate (K-strategists), and thus the 'unacceptable' mortality due to drowning in fishing gear has to be set at a low level, in order to avoid serious long-term implications for the populations. Due to the fact that the indicator species are affected by several pressures from various human activities, the general aim must be to minimize incidental catch of marine mammals and waterbirds as much as possible.

The use of trend-based targets of the number of incidentally caught animals is not considered appropriate due to the risk of falsely indicating a good status when the target is reached. A slight downward trend may falsely indicate an improvement, as incidental catch is less likely to occur in depleted populations close to regional extinction due to the simple fact that fewer animals occur in the area.

Alternative target setting approaches

For management purposes, interim objectives or short-term and longer-term removal targets have been set for certain species, such as the harbour porpoise. The simplest management approach for setting an interim target is defining a reference point as a fixed percentage of the best population estimate. However, there are uncertainties regarding both values which have to be taken into account. These have been included in more sophisticated approaches (e.g. potential biological removal (PBR) or catch limit algorithm (CLA)) aiming at more conservative targets. Any interim targets (not only for the harbour porpoise) should be applied keeping in mind the general aim of ultimately reducing incidental catches to zero (resolution no. 5- ASCOBANS 2006, 2016a, HELCOM Recommendation 27-28/2 on seals).

The **potential biological removal (PBR)** can be applied for target setting, and is used to set removal targets under the US Marine Mammal Protection Act. The conservation goal is the 'optimum sustainable population' defined as being at or above the population level that will result in maximum productivity (ICES 2014a). For harbour porpoises in the Baltic Sea, Berggren et al. (2002) calculated anthropogenic mortality limits based on minimal demographic information using this approach. For birds, the ICES Workshop to Review and Advise on Seabird Bycatch (WKBYCS) recognises PBR as an initial and rapid assessment tool, which can indicate possible unsustainable mortality levels that would have to be followed by more sophisticated methods for reliable analyses (ICES 2013b). In addition, the workshop pointed out that basic assumptions of the PBR concept need testing and validation before applying to birds.

A **catch limit algorithm (CLA),** based on the principles of the International Whaling Commission's (IWC) revised management procedure (RMP) for commercial whaling, has been used to calculate anthropogenic mortality limits for harbour porpoises in the North Sea (Winship 2009). The next step should be to expand the capability of the model by incorporating multiple areas in the model. Further, a CLA for the Baltic Sea populations still needs to be developed. In the calculations by Winship (2009), the underlying conservation objective has been assumed to be the ASCOBANS interim conservation objective 'to allow populations to recover to and/or maintain 80% of carrying capacity in the long term' (see below).

Since 2009, ICES has advised the European Commission that CLA is the most appropriate method to set anthropogenic mortality limits on harbour porpoise, but this advice still has not been acted upon (ICES 2014a). CLA also is a suitable method for depleted populations such as the harbour porpoise population of the Baltic Proper. It is to be noted that all approaches rely on suitable programmes monitoring population sizes and incidental catches as prerequisites.

Targets for harbour porpoise

Within the frame of ASCOBANS, conservation targets have been agreed for the harbour porpoise and can be applied for the two harbour porpoise management units within the HELCOM area: (1) the Baltic Proper population and (2) the Western Baltic, Belt Sea and Kattegat population. ASCOBANS (2002, 2009, 2012) has adopted an interim goal of restoring (and maintaining) the populations of harbour porpoises to at least 80% of their carrying capacity. ASCOBANS has advised that, to be sustainable, 'the maximum annual anthropogenic induced mortality (including by-catch, but also less conspicuous causes of death such as stress caused by pollutants or noise) for harbour porpoises should not exceed 1.7% of the best estimate of the population size' (Resolution No. 3, Incidental Take of Small Cetaceans, Bristol 2000). It has been reaffirmed in Resolution No. 5, Monitoring and Mitigation of Small Cetacean Bycatch (ASCOBANS 2016a) that "a total anthropogenic removal (e.g. mortality from bycatch and vessel strikes) above 1.7 per cent of the best available estimate of abundance is to be considered unacceptable in the case of the harbour porpoise". Also the intermediate precautionary aim "to reduce bycatch to less than 1 per cent of the best available population estimate" has been reaffirmed. This aim relates to incidental catch explicitly and considers an (unknown) proportion of other causes of anthropogenic mortality. The resolution further states that "where there is significant uncertainty in parameters such as population size or bycatch levels, then 'unacceptable interaction' may involve an anthropogenic removal of much less than 1.7%". To date, there is significant uncertainty in central parameters such as estimations of incidental catch, population size and population growth for both harbour porpoise management units in the Baltic Sea.

PBR analyses based on data from a survey of the southern and western part of the Baltic Proper indicate that for the critically endangered **Baltic Proper population**, recovery towards this goal could only be achieved if the incidental catch was reduced to two or fewer porpoises per year (Berggren et al. 2002). This resulted in the objective (i.e. a removal target) of the ASCOBANS *Recovery Plan for Baltic Harbour Porpoises* (Jastarnia Plan) to 'reduce the number of by-caught porpoises in the Baltic towards zero' (ASCOBANS 2002, 2009, 2016b). The later SAMBAH survey found the distribution range of the Baltic Proper population to only partially overlap with the survey area of Berggren et al. (2002) (ASCOBANS 2016b). However the very low abundance estimate of the Baltic Proper population from the SAMBAH survey confirms the need for reducing the number of incidental catches towards zero. In such a severely reduced population "unacceptable interaction" involves a much lower anthropogenic mortality compared to healthy populations. Thus, the assessment value chosen for the Baltic Proper population is zero. ASCOBANS (2009, 2016b) state that 'as a matter of urgency, every effort should be made to reduce the porpoise by-catch towards zero as quickly as possible'.

For the **population of the Western Baltic, Belt Sea and Kattegat** the removal target chosen as assessment value for this indicator is less than 1% of the best population estimate.

As this limit (as all other target setting options such as PBR and CLA) is applied to the 'best' population estimate, there is a need to better define population boundaries of the population of the Western Baltic, Belt Sea and Kattegat (see Sveegaard et al. 2015 and ASCOBANS 2016b) and estimate the abundance (as well as incidental catch numbers) within these boundaries.

For improved management of the harbour porpoise populations in the Baltic Sea, removal targets in the form of 'safe' human-induced mortality limits (including incidental catch) should be modelled for the distribution range of each population. It would be appropriate to determine targets primarily using the CLA or possibly the PBR approach as these take the uncertainty of data into account. As soon as the results of such simulations are available, the 1% target should be re-evaluated for the population of the Western Baltic, Belt Sea and Kattegat.

Targets for seals

No specific removal targets for seal incidental catch have been formulated to date that could directly be applied for this core indicator. The HELCOM Recommendation 27-28/2 recommends reducing incidental catches of seals to a minimum level and if possible to a level close to zero and to develop efficient mitigation measures.

The conservation target for seals within the HELCOM area is that the populations grows until limited by the environmental carrying capacity of their Baltic Sea habitat. Recovery towards this target will be allowed as a long-term objective. A lower reference limit below which the survival of the population is at risk and a middle reference limit are used for anthropogenic removal licenses. The overall target is to continually improve the situation of the seal species, but no timescale for its achievement is given (Lonergan 2011).

Information about the distribution of Baltic seal species is provided in more detail in the core indicator on distribution of Baltic seals.
No assessment value can yet be given for seals. As a consequence, the three seal species have to be added in the indicator assessment as soon as targets are available. By-catch estimations for grey seals are available from Vanhatalo et al. (2014, see above).

Targets for otters

HELCOM (2013) lists incidental catch in fishing gear, among others pressures, as a major threat to Eurasian otters. However, the extent of the problem is not known. No goals or targets for incidental catch reduction have been formulated yet. As a consequence, otters have to be added in the indicator assessment as soon as better data are available.

Targets for waterbirds

A reduction in the number of incidentally caught waterbirds is needed to reach conservation goals. For the species concerned, analyses of thresholds for unacceptable losses of individuals are lacking, but are urgently desired as soon as data from incidental catch monitoring become available. Among the class of birds with a wide range of patterns of population dynamics, it has to be stressed that many of the waterbirds are species with high longevity, low reproductive rates and late maturity. These characteristics make them vulnerable to the loss of adult individuals in particular (Bernotat & Dierschke 2016). However, knowledge about demographic parameters, such as survival rates, reproductive performance, and delineation of population segments is sparse or unavailable for many of the species affected by incidental catch (Žydelis et al. 2009). One approach using limited demographic information is the PBR approach. The main advantage of the PBR approach is that it relies on those demographic parameters which are easiest to obtain for many bird species.

Removal targets considered as provisional assessment values for this indicator have been derived using the PBR concept in some initial studies. PBR has been calculated for three waterbird species which are known to be incidentally caught in high numbers: long-tailed duck, greater scaup and common guillemot (Žydelis et al. 2009). The use of PBR as provisional targets and assessment values in this indicator will have to be refined at a later stage because this requires further testing and validation before they can be used as a robust basis for target setting (see also Richard & Abraham 2013). So far the ICES Workshop to Review and Advise on Seabird Bycatch (WKBYCS) recognizes PBR as an initial and rapid assessment tool only to indicate possible unsustainable mortality levels (ICES 2013b). For an improved analysis more sophisticated methods may be required in the future of which CLA is one option.

The assessment values for the waterbird species used in this indicator must not be confused with a 'maximum allowable catch'. The concept of 'maximum allowable catch' of seabirds appears not to be consistent with the EU Plan of Action (European Commission 2012) overall objective to 'minimise and where possible eliminate' incidental catch and with Article 5 of the EU Birds Directive, which requires Member States to take measures prohibiting the 'deliberate killing or capture [of birds] by any method'. According to Article 7 of the Birds Directive, exceptions from the prohibition of deliberate killing are allowed in the context of hunting, and some of the species listed in Annexes II/1 and II/2 include species prone to drowning in fishing gear in the Baltic Sea. Also, uncertainties impede the application of PBR in a management context so far to set trigger levels for incidental catch in a population (ICES 2013b).

In northern Europe, the impact of incidental catch on population dynamics has so far only been estimated for three species by applying the PBR approach. CLAs have not been applied to waterbird populations and would require information on population trends currently unavailable for the majority of Baltic waterbirds. Application of PBR and CLA approaches appears to allow for formulation of species-specific removal targets for waterbirds, as soon as reliable estimates of the species specific mortality levels can be obtained through incidental catch monitoring. A prerequisite for the application of PBR and CLA is knowledge about the species specific mortality and population sizes as input parameters, but data are not yet sufficiently available for all species.

An overview of recent estimates for the numbers of waterbirds wintering in the Baltic Sea is given by Skov et al. (2011). Accordingly, the incidental catch problem concerns 8,575 red-throated and black-throated divers, 8,300 great crested grebes, 770 red-necked grebes, 2,890 Slavonian grebes, 54,000 great cormorants, 30,450 common pochards, 476,000 tufted ducks, 127,000 greater scaups, 515,000 common eiders, 2,300 Steller's eiders, 1,486,000 long-tailed ducks, 412,000 common scoters, 373,000 velvet scoters, 174,000 common goldeneyes, 12,600 smew, 25,700 red-breasted mergansers and 66,000 goosanders, but also considerable numbers of common guillemot, razorbill and black guillemot (the latter alcid species not quantified by Skov et al. 2011).

Assessment Protocol

Good environmental status (GES) is achieved if the incidental catch numbers of all assessed species within a given assessment unit are below the removal target threshold (i.e. assessment value) taking also other human-induced mortality into account. A population-specific evaluation is applied to all HELCOM level 2 sub-basins in which i) the population occurs and ii) fishing methods causing incidental catch are spatially overlapping with the distribution of that population.

The GES evaluation for a single sub-basin is done using the 'one-out, all-out' principle, which for instance is applied in the EU Water Framework Directive (European Commission 2000). In this indicator, this means that GES is not reached if incidental catch for a single population contributes to exceeding the pre-defined threshold of human induced mortality for that population (for waterbirds; for harbour porpoises the removal target is related explicitly to incidental catch).

It must be taken into account that not all species are distributed throughout all sub-basins. Consequently, for areas outside the distributional range, no conservation or removal target for the species are needed in the particular sub-basin and the number of species assessed varies among the sub-basins. For the two populations of harbour porpoise and the three waterbird species initially assessed in this indicator the occurrence in the sub-basins is shown in table 1. Table 2 indicates published data on incidental catches per species and sub-basin.

Besides assessing incidental catch on a population scale (see below: assessment units), it may be desirable for management purposes to downscale information in order to implement measures on a smaller scale (e.g. sub-basin, HELCOM scale 2). Difficulties exist both in measuring incidental catch and population size to a sufficiently high degree of accuracy on such a small scale. If this information becomes available, the assessment units may be downscaled for management purposes. In Table 1, some examples of mammal and waterbird distributions are downscaled (not quantitatively) from populations to HELCOM assessment unit scale 2.

Table 1. Distribution of some marine mammals and waterbirds on the level of HELCOM level 2 sub-basins (after Durinck et al. 1994, Skov et al. 2011, Sveegaard et al. 2011, ASCOBANS 2016b).

	Kattegat (DK, SE)	Great Belt (DK, DE)	The Sound (DK, SE)	Kiel Bay (DE, DK)	Bay of Mecklenburg (DE, DK)	Arkona Basin (SE, DK, DE)	Bornholm Basin (SE, DK, DE, PL)	Gdansk Basin (PL, RU)	Eastern Gotland Basin (SE, PL, RU. LT, LV, EE)	Western Gotland Basin (SE)	Gulf of Riga (LV, EE)	Northern Baltic Proper (SE, FI EE)	Gulf of Finland (FI, RU, EE)	Aland Sea (SE, FI)	Bothnian Sea (SE, FI)	The Quark (SE, FI)	Bothnian Bay (SE, FI)
harbour porpoise Baltic Proper population					?	x	x	x	x	x	?	x	?	x	?	?	?
harbour porpoise Western Baltic, Belt Sea and Kattegat population	x	x	x	x	x	x	?										

greater scaup	x	x	x	x	x	x	x	x	x	x	x	x	x				
long-tailed duck	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
common guillemot	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		

Table 2. Indication of published data on incidental catch related to species and sub-basin.

	Kattegat (DK, SE)	Great Belt (DK, DE)	The Sound (DK, SE)	Kiel Bay (DE, DK)	Bay of Mecklenburg (DE, DK)	Arkona Basin (SE, DK, DE)	Bornholm Basin (SE, DK, DE, PL)	Gdansk Basin (PL, RU)	Eastern Gotland Basin (SE, PL, RU. LT, LV, EE)	Western Gotland Basin (SE)	Gulf of Riga (LV, EE)	Northern Baltic Proper (SE, FI EE)	Gulf of Finland (FI, RU, EE)	Aland Sea (SE, FI)	Bothnian Sea (SE, FI)	The Quark (SE, FI)	Bothnian Bay (SE, FI)
harbour porpoise Baltic Proper population					?	?	x	19	19	x	?	x	?	x	?	?	?
harbour porpoise Kattegat/Belt Sea/Western Baltic population	20	20	20	20	20	20	?										
greater scaup	x	x	x	5	13, 14	x	4	8, 9	x	x	11, 12	x	x				
long-tailed duck	1	18	x	5, 6, 18	6	x	4, 7	8, 9	10, 11, 12, 15, 16, 17	x	11, 12	12	12	x	x		
common guillemot	1	18	3	3, 18	3	3	2, 3, 4, 7	3, 8, 9	2, 3, 10, 12, 16, 17	2, 3	11, 12	2, 3	3	2, 3	3		

x = species occurring, number = reference to incidental catch:

1: Oldén et al. 1988: gill nets for cod and herring; 90-95% common guillemot, 3-7% great cormorant, <1% long-tailed duck

2: Lynneryd et al. 2004: Common guillemot in post-breeding season mainly around Gotland, in the Skerries and in the Åland Sea – areas with gillnet fishing. Also common guillemots caught in gillnets with pingers in Hanö Bight.

3: Olsson et al. 2002 and Österblom et al. 2002 (summarzied in Erdmann et al. 2005): map with ring recoveries of common guillemots found in fishing gear (mostly gillnets). Because data are used from 1912 onwards, only sub-basins with many recoveries (i.e. probably including recent ones) are considered.

4: Schirmeister 2003 and Erdmann et al. 2005: Long-tailed ducks very often caught in gillnets off Usedom, to a smaleer amount also greater scaups and common guillemots.

5: Kirchhoff 1982: long-tailed ducks and greater scaups by-caught by gillnet fishery in Kiel Bay.

6: Mentjes & Gabriel 1999: weak to strong bycatch of "ducks" (no species mentioned) west and south of Fehmarn; can be refered to a general bycatch risk for long-tailed ducks in those areas.

7: Kowalski & Manikowski 1982: in gillnets between Dzivnow and Pobierowo (Pomeranian Bay) bycaught birds comprised 53% long-tailed ducks and 0.3% common guillemots.

8: Stemniewicz 1994: in gillnets between Hel, Gdynia and Vistula mouth (Gdansk Basin) bycaught birds comprised 48.3% long-tailed ducks, 7.7% greater scaups and 0.8% common guillemots.
9: Kies & Tomek 1990: in gillnets in Zatoka Pucka (Gdansk Basin) bycaught birds comprised 41% long-tailed ducks, 0.5% greater scaups and 20.5% common guillemots.
10: Dagys & Žydelis 2002: off the Lithuanian coast, the majority of bycaught birds were long-tailed ducks (61%), Alcidae 1%.
11: Urtans & Priednieks 2000: proportions of bycaught birds in the Gulf of Riga: long-tailed duck 35.4%, "diving ducks" 22.9%, auks 5.2%; Baltic Sea (belonging to Eastern Gotland Basin): long-tailed duck 42.5%, "diving ducks" 39.6%. Auks probably include common guillemots and diving ducks probably include greater scaups, although both species are not mentioned in the text.
12: Dagys et al. 2009: Many long-tailed ducks bycaught in Estonian part of Gulf of Finland. There were bycaught long-tailed ducks in other areas of Estonia, and because at least test fishing in the Estonian part of Northern Baltic Proper revealed bird bycatch and the test fishing areas overlap with long-tailed duck distribution (Skov et al. 2011) it can be assumed that this species was actually bycaught there. – Latvia: bycatch occurrence of common guillemot and long-tailed duck in both Gulf of Riga and Eastern Gotland Basin (Latvian parts), greater scaup only in Gulf of Riga. – Lithuania: long-tailed duck 57%, alcids 8% (probably including common guillemot).
13: Bønløkke et al. 2006: report of a greater scaup drowned in fishing net near Rostock (according to German ring recovery database in 1970).
14: Grimm 1985: annual bycatch of 2800 greater scaups in gillnets in Wismar Bay.
15: Larsson & Tydén 2005: incident of 998 bycaught long-tailed ducks on Hoburgs Bank.
16: Žydelis et al. 2006: many beached long-tailed ducks in Lithuania show signs of net entanglement, also some alcids (probably including common guillemot).
17: Bardtrum et al. 2009: turbot gillnet-fishing at east coast of Gotland produces few bycaught common guillemots, and bottom-set gilnnets for cod produced only few bycaught long-tailed ducks on Hoburgs Bank. Two (old?) ring recoveries of greater scaup in fishing gear are reported, but unclear whether east or west of Gotland.
18: Degel et al. 2010: gill net fisheries inverstigated around Aerø suggest that long-tailed ducks and common guillemots are drowing in gillnets in marine areas belonging to Kiel Bay and Great Belt.
19: ASCOBANS 2016b: Puck Bay incidental catch in semi-driftnets, set gillnets and others
20: ICES 2015, 2016a: estimated bycatch number for ICES subdivisions 22,23 and 24 available, bycatch known in all other areas but without estimate

Assessment units

The indicator is applicable in the whole Baltic Sea, as it is known that incidental catches of birds and mammals in fisheries occur in the whole area. The indicator is assessed using HELCOM assessment scale 2 which consists of 17 Baltic Sea sub-basins. The assessment units are defined in the HELCOM Monitoring and Assessment Strategy Annex 4.

Assessments concerning the incidental catch of mammals and birds face the challenge that on the one hand the situation of marine areas needs be assessed on a scale that allows for identification of problem areas where actions should be taken (e.g. within the MSFD framework), but on the other hand the methods available need to be exercised on the level of populations which often additionally are impacted by anthropogenic activities outside the assessment area (especially in migratory waterbirds). Given the high mobility of marine mammals and waterbirds, and the distributional range of populations, assessments will necessarily need to incorporate a scale of the range of a population or management unit, but also needs an adjustment to HELCOM assessment units, with Scale 2 appearing to be an appropriate one.

For example, in the case of the harbour porpoise, two[2] management units exist: 1) the Baltic Proper population and 2) the population of the Western Baltic, Belt Seas and Kattegat. Certain high-density areas (probably representing key habitats) have been identified (Sveegaard et al. 2011; Carlström & Carlén 2016). The preliminary distribution maps produced within the SAMBAH project make it possible to draw a contour around an area where the probability of detecting a porpoise within a given month is e.g. 20% or higher. Based on this, the area around the Midsjö offshore banks south-east of Öland seem to be of crucial importance during the summer months when the Baltic Proper porpoise population is spatially separated from the population of the Western Baltic, Belt Sea and Kattegat. This approach is similar to choosing certain kernel contours based on satellite transmitter data of tagged porpoises (as used in Sveegaard et al. 2011). By-catch risk assessment (BRA) can be made combining this data with available information on fishing effort with gear types known for high incidental catch risk (e.g. gillnets with large mesh size). A BRA was initially developed for cetaceans at an ICES Workshop (ICES 2010) in order to identify areas and fisheries that are likely to pose the greatest conservation threat to by-caught cetacean species, taking into account the uncertainty of the population structure. The BRA highlights areas where the greatest problems occur and enables educated fisheries management decisions. For an area in the Skagerrak, Kindt-Larsen et al. (2016) demonstrated a clear correlation between bycatch risk and the products of porpoise densities and fishing effort (in terms of soak time). A BRA has been carried out for all Swedish waters and the results will be presented in the revised Swedish action plan for harbour porpoises.

The assessment for this core indicator is made using HELCOM assessment units. For the population of the Western Baltic, Belt Sea and Kattegat, the HELCOM open sea assessment units Kattegat, the Sound, Great Belt, Kiel Bay, Bay of Mecklenburg and Arkona Basin should be combined. For the Baltic Proper population, a combination of the assessment units Arkona Basin, Bornholm Basin, Western and Eastern Gotland Basin, Gdansk Basin, Northern Baltic Proper and Åland Sea is necessary (Table 1). More northern and eastern regions may be added as information becomes available if these areas are inhabited by harbour porpoises. In the overlapping area where both populations occur (i.e. Arkona Basin), incidental catches should be assigned to both populations as a precautionary approach.

Some waterbird populations extend into areas outside the Baltic. The assessment is made in sub-basins in which the species is known to occur (Table 1) taking also pressures from outside into account.

Assessment values

The assessment values applied for the species and populations assessed in this indicator are shown in Table 3.

Table 3. Removal targets for the assessment units of the species to which this assessment applies.

harbour porpoise Baltic Proper population	zero incidental catch
harbour porpoise Western Baltic, Belt Sea and Kattegat population	< 1 % incidental catch of the best abundance estimate
long-tailed duck Western Palearctic population	PBR = 22,600 birds (including oiling and hunting, recovery factor = 0.1, explanation see text)
greater scaup Western Palearctic population	PBR = 3,700 birds (including oiling and hunting, recovery factor = 0.1, explanation see text)

[2] A third management unit is the North Sea population which extends into the Kattegat. Due to the comparatively low fraction of its range and porpoise numbers occurring in the area covered by HELCOM, no separate assessment is made here. Instead we refer to OSPAR M6 indicator.

common guillemot Baltic-breeding population	PBR = 620 birds (including oiling)

Harbour porpoise assessment

The population estimate of harbour porpoises in the Baltic Proper assessed by means of 304 acoustic data loggers is 497 animals (95% CI: 80-1091) (ASCOBANS 2016b). The size and trend of the population of the Western Baltic, Belt Sea and Kattegat is unclear, due to the results from different surveys indicating opposite trends in population size and it is not clear whether this reflects real trends in population abundance (ASCOBANS 2015b). A population estimate of 18,495 animals (CV = 0.27, 95% CI: 10,892-31,406) has been provided from ship-based surveys (Sveegaard et al. 2013). However, this population estimate excluded the Sound and the area east of the island of Fehmarn, in which lower densities have been reported from aerial surveys (Gilles et al. 2014). In contrast, a survey including the area from Fehmarn to Cape Arkona estimated 40,475 animals (CV = 0.24, 95% CI: 25,614–65,041) from the same data source (Viquerat et al. 2014). The area in the western and northern Kattegat included in this survey, where high densities were recorded, is currently believed to be also used by animals from the North Sea population (Sveegaard et al. 2013, 2015).

Recently, in the SAMBAH project considerable numbers of harbour porpoises from the Western Baltic, Belt Sea and Kattegat population were estimated in an area east of the Darss Sill and south of the Limhamn ridge in the Sound (ASCOBANS 2016b). Using a different method, the SAMBAH abundance estimation for this area alone is 21390 (95 % CI: 13461-38024) based on C-POD data from 2011 to 2013.

Since no incidental catch estimate is available for the whole area and there is no reliable correction for North Sea population animals in the overlap zone in the Kattegat, the assessment can currently only be made on the basis of ICES sub-divisions 21, 22 and 23 which accounts for the major part of the population range. ICES (2016a) gives a 95% confidence interval for their incidental catch estimate of 165 to 263 porpoises in these ICES sub-divisions. The best geographical fit with these sub-divisions is the abundance assessment by Viquerat et al. (2014) to which the incidental catch estimate has been related. A combined 95 % confidence interval for abundance <u>and</u> incidental catch rate estimates (Buckland 1992) results in 0.3 to 0.9 % which is below the 1 % threshold used as assessment value. However, no confidence interval for the fishing effort has been given by ICES which underlies incidental catch estimates.

For the Baltic proper, the assessment value of zero incidental catch is exceeded by one by-catch in 2014 officially reported (ASCOBANS 2016b). This can be taken as the absolute minimum number as in earlier years incidental catches reported by fishermen to the Hel Marine Station were much higher. The EU driftnet ban in 2008 resulted in the cessation of fishermen reports (Pawliczka 2011).

Waterbird assessment

For waterbirds the potential biological removal (PBR) method is used to compare incidental catch numbers in a population to its size. The level of pressure on a population is considered to be at an unacceptable level if the contribution of incidental catch brings human-caused mortality above the removal target.

For long-tailed duck, greater scaup (including wintering birds in the Netherlands) and common guillemot, the PBR approach has been applied (Žydelis et al. 2009) in order to derive removal targets that can be provisionally considered. PBR values by Žydelis et al. were used as assessment values for this indicator. However, if recent information suggests a sharp decline in abundance, a different recovery factor compared to Žydelis et al. (2009), who suggested stable populations, was used.

In contrast to Žydelis et al. (2009), a recovery factor of 0.1 was applied to long-tailed duck owing to the sharp decrease in population size reported by Skov et al. (2011). The total long-tailed duck incidental catch from available estimates was about 22,000 birds by the time of PBR calculation. Adding mortality by hunting (24,000 birds in EU countries alone, Mooij 2005) and oiling ('tens of thousands', Larsson & Tydén 2005), the assessment value of 22,600 is clearly exceeded. Incidental catch has presumably dropped since then, but so has population size and hence the recent PBR. The assessment should be refined using more recent data as soon as this becomes available.

The PBR limit for greater scaup is 3,700 birds (based on a recovery factor of 0.1 due to the large decline in abundance (Žydelis et al. 2009)[3]) , a value exceeded by losses from fisheries in northern Europe alone and intensified by losses owing to other pressures. Incidental catch is known in the southern Baltic but estimates are not available. However, about 2,000 incidentally caught birds in the Dutch lakes Ijsselmeer and Markermeer alone impact the same population. An unknown number of incidental catches for the southern Baltic contributes to exceeding the pre-defined threshold of human induced mortality for that population which also suffers from hunting and other anthropogenic impacts (the hunting bag is about 2,000 birds). The assessment value of 3,700 birds (valid for the Western Palearctic population) is clearly exceeded.

For the Baltic-breeding common guillemot population, the calculated PBR limit of 620 individuals is more than twice exceeded by the estimated minimum incidental catch for the Baltic Sea (Žydelis et al. 2009). 1,500 incidental catches are estimated from recoveries of ringed birds alone. Oiled birds not taken into account have to be added still. In this population however, immature birds are more likely to die in gillnets than adults. Since PBR assumes that all cases of additional mortality are equally distributed, the PBR chosen is rather conservative.

[3] Žydelis et al. (2009) presents two different PBR calculations using recovery factors of 0.3 and 0.1. Due to a large decline recorded during 1990–2000 and the greater scaup being classified as endangered in EU countries we chose a recovery factor of 0.1.

The overall assessment is shown in table 4.

Table 4. Assessment of incidental seabird catch per species and sub-basin

	Kattegat (DK, SE)	Great Belt (DK, DE)	The Sound (DK, SE)	Kiel Bay (DE, DK)	Bay of Mecklenburg (DE, DK)	Arkona Basin (SE, DK, DE)	Bornholm Basin (SE, DK, DE, PL)	Gdansk Basin (PL, RU)	Eastern Gotland Basin (SE, PL, RU. LT, LV, EE)	Western Gotland Basin (SE)	Gulf of Riga (LV, EE)	Northern Baltic Proper (SE, FI EE)	Gulf of Finland (FI, RU, EE)	Aland Sea (SE, FI)	Bothnian Sea (SE, FI)	The Quark (SE, FI)	Bothnian Bay (SE, FI)
harbour porpoise Baltic Proper population					?	x	x	x	x	x	?	x	?	x	?	?	?
harbour porpoise Western Baltic, Belt Sea and Kattegat population	x	x	x	x	x	x	?										
greater scaup	?	x	?	x	x	?	x	x	?	?	x	?	?				
long-tailed duck	x	?	?	x	x	?	x	x	x	?	x	x	x	?	?		
common guillemot	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
One-out-all-out																	

x = bycatch proven, ? = bycatch mortality remains to be shown (including spatial/temporal overlap of distribution and gillnet fishing)

[Given the large uncertainties in the underlying data (incidental catch and population estimate) for the harbour porpoise population of the Western Baltic, Belt Sea and Kattegat and the small margin between the preliminary assessment and the target, it still has to be discussed with experts whether to fill with green or red colour. It does not change the overall result of the assessment but on the other hand a false positive (green) may open up for the interpretation that incidental catches may not be of concern for this population. A later switch to CLA (as proposed by ICES WGMME) might change the colour of the assessment even without having new data.]

Future Perspectives

All uncertainties identified show that sufficient monitoring of incidental catch, fishing effort, population size, and other sources of anthropogenic mortality is a prerequisite for getting a more reliable assessment. The European Commission has decided to include incidental catch monitoring of protected bird and mammal species in the Data Collection Multiannual Programme DC-MAP (European Commission 2016). Further participation of HELCOM and contracting parties on regional scale is necessary in the implementation process in order to ensure suitable monitoring methods and sufficient coverage as well as effort monitoring in a meaningful parameter (see below, chapter "description of optimal monitoring"). The uncertainty in the fishing effort estimates which underlie the incidental catch estimate needs to be specified by adding a CV or 95 % confidence interval.

It has been stated above that further species are to be added as further knowledge is gained. Also, if up-to-date data becomes available or if assessment values can be derived using a more precise method (such as CLA, see "alternative target setting approaches", above), the assessment should be updated. In this chapter we focus on describing how to overcome uncertainties of this initial assessment or fill data gaps in order to increase the assessment reliability in the near future.

Harbour porpoise

So far, incidental catch estimates can only be assessed against abundance estimates for a similar (not quite the same) area as used in the Viquerat et al. (2014) survey. For ICES subdivision 24, incidental catch estimates must be made available, and also abundance data must be collected covering the relevant area of this subdivision. Thus, in future abundance monitoring the assessment areas should be based on management needs rather than ICES subdivisions or other artificial boundaries. SCANS, SCANS II and Mini SCANS data should then be re-evaluated in order to get a time sequence of abundance data to be fed into CLA calculations.

As outlined above, the population boundaries of the harbour porpoise population of the Western Baltic, Belt Sea and Kattegat must be better defined. Arbitrarily, the northern boundary of the population of the Western Baltic, Belt Sea and Kattegat can be used from Sveegaard et al. (2015). Tissue samples to be taken during incidental catch monitoring would allow assigning specimen to one of the two populations present in the Kattegat through advanced genetic sequencing techniques (such as Genome-wide Single Nucleotide Polymorphism (SNP) analysis). An increasing number of analysed specimen would then allow to more reliably identify the boundaries.

The incidental catch estimate for subdivisions 21, 22 and 23 (which is used in the initial assessment) has been calculated by ICES (2016a) on the basis of an incidental catch rate per day at sea and an estimate of gillnet effort. Table 5 lists 95 % CIs for the parameters used in the assessment and the factor between lower and upper confidence limit.

Table 5. Catch rate, fishing effort total incidental catch and abundance used in the assessment of the harbour porpoise population of the Western Baltic, Belt Sea, Kattegat

	95% CI lower	95% CI upper	Upper/lower
incidental catch rate	0,016	0,025	1,56
Total fishing effort	no CI given	no CI given	-
Estimated total incidental catch	165	263	1,59
Abundance estimate*	25 614	65 041	2,54

* Data from Viquerat et al. (2014)

This overview shows that no uncertainty estimate is available for the estimated total fishing effort because it is based on effort data reported by member states, which is incomplete. Further, the relative range between the lower and upper 95% confidence limits is much bigger for the estimate of abundance than for those of incidental catch rate or total incidental catch, respectively. Thus, the resources for obtaining the most reliable bycatch estimate should focus on investigating whether it is possible to obtain an uncertainty estimate for the total fishing effort which better would be described as km of nets*soak time. In order to obtain a more reliable assessment against targets in the future, the extent of the uncertainty in underlying data (which currently is greatest for the abundance estimate, table 5) should be taken into account. As a priority, a CLA analysis should be developed for this population because the method uses time series of data (both population and incidental catch) and thus decreases the overall uncertainty. A consequence of significant uncertainty in parameters, such as in the population estimate of the harbour porpoise population of the Western Baltic, Belt Sea and Kattegat, is that a much lower removal target may be needed to reach the conservation objectives. As ASCOBANS resolution no. 5 (ASCOBANS 2006 and 2016) states "... if available evidence suggests that a population is severely reduced, or in the case of species other than the harbour porpoise, or where there is significant uncertainty in parameters such as population size or by-catch levels, then "unacceptable interaction" may involve an anthropogenic removal of much less than 1.7 %". Incidental catch again is an unknown fraction of the total anthropogenic removal target. A CLA analysis could produce more reliable targets than this relatively general resolution statement.

The next step in refining incidental catch estimates could be the identification of high-risk areas for incidental catch. The number of harbour porpoises does not only have an effect on the evaluation of the total incidental catch in relation to the total abundance, but the local density of harbour porpoises also affects the incidental catch rate on a temporal and spatial scale. Given the solitary nature of harbour porpoises, the incidental catch rate in a certain fishery is expected to be as dependent on the harbour porpoise density as on the fishing intensity. In other words, if the fishing effort with a certain fishery is doubled in an area, the total number of incidental catches is expected to double as well. Or, alternatively, if the fishing effort is kept constant but the harbour porpoise density is doubled, the total number of incidental catches is expected to double. This relationship is the basis in a recently published paper on identification of high-risk areas for harbour porpoise incidental catch (Kindt-Larsen et al. 2016). All concerns expressed by ICES WGBYC (ICES 2015) on using "imported" observed bycatch rates on fisheries lacking observer data that are quoted in the indicator relate to differences in fisheries parameters, such as vessel size and fishing practices, but never to variation in harbour porpoise density. Even though the "import" primarily is made for fisheries within the same ICES division (e.g. IIId), the spatio-temporal variation in harbour porpoise density may be considerable within these areas. Using the BRA approach, it should be possible to estimate a removal rate that includes the uncertainties of both the incidental catch rate and the abundance by simulating incidental catches from the estimated distributions of both parameters.

Table 6 shows what data may already be available in order to derive CLA values for an assessment.

Table 6. Available data for further development of CLA values for harbour porpoise populations in the Baltic Sea (x = some data available to fill the knowledge gaps)

	Estimates of anthropogenic mortality			Input needed for CLA calculations: Removal limit= $\alpha \times R_{max} (D_T - \beta) \times N_T$		
Species (population)	Incidental catch estimate	Hunting bag	Estimate of other anthropogenic removal (e.g., collision with vessels, detonations etc.)	Population model fit to current population size N_T (time series of population estimates available)	Current status D_T	Maximum population growth rate R_{max}

Harbour porpoise (Baltic Proper)	x	x protected	-	-	-	x
Harbour porpoise (Western Baltic, Belt Sea, Kattegat)	x	x protected	-	(x) to be recalculated from original survey data	-	x

seals and otters

So far, there are no targets for incidental catches of seals and otters. However, existing data would allow the development of PBR or CLA for some seal species to begin with. Demographic and abundance data as well as population boundaries have been quite well examined. For grey seals, an incidental catch estimate is available (Vanhatalo et al. 2014).

Table 7 shows what data may already be available in order to derive assessment values and add further waterbird species to the initial assessment.

Table 7. Available data for further development of PBR and/or CLA values (x = some data available to fill the knowledge gaps)

Species (population)	Incidental catch estimate	Hunting bag	Estimate of other anthropogenic removal (e.g. oiled birds, vessel collision with mammals, detonations etc.)	Minimum estimate of population size N_{min}	Maximum population growth rate R_{max}	Population trend (in order to set the recovery factor in PBR calculations)	Population model fit to current population size N_T (time series of population estimates available)	Current status D_T	Maximum population growth rate R_{max}
Harbour seal (Kalmarsund)	-	x protected	-	x	x	x	x	x	x
Harbour seal (Western Baltic)	-	x	-	x	x	x	x	x	x
Grey seal (Baltic Sea)	x	X	-	x	x	x	x	x	x
Ringed seal (Baltic Sea)	-	x	-	x	x	x	x	x	x
Eurasian otter	-	(x) protected	-						

waterbirds

For the target values in this indicator, so far no own calculations were made. Instead PBR values were derived from Žydelis et al. (2009). It is intended to calculate more PBR values or, in order to account for the large variation between upper and lower confidence levels, to introduce CLA method. For these calculations, preferably recent data on incidental catches and population size is needed as well as some demographic data. Table 8 shows what data may already be available in order to derive assessment values and add further waterbird species to this initial assessment in the near future.

As shown in the chapter "waterbird assessment" (above) it is important to consider other relevant anthropogenic mortality than incidental catch such as from hunting and oiling when applying PBR or CLA values. Hunting bag data is collected in many - but not all - countries on the migration routes of the waterbirds to be considered. National data must be collected either in form of national reports to HELCOM or in scientific projects. Though there are still high numbers of waterbirds dying from plumage oiling (e.g., Larsson & Tydén 2005), a monitoring of oiled birds is lacking in most countries. Scientific studies are required to derive more recent estimates of oil victims per species in areas significantly affected from oil pollution. Recent studies on oiling of waterbirds is available for some coasts of the North Sea which is another overwintering area for some of the waterbirds relevant for this indicator (e.g., Camphuysen et al. 2009).

PBR approach is used in provisional assessments in this indicator because there is data available for three **waterbird** species of concern. It is however acknowledged, that the CLA approach may produce a more reliable assessment because it uses time series of incidental catch and abundance data and thus reduces uncertainties. As in harbour porpoises, priority should be given to develop CLA for the most vulnerable waterbird species. Additional demographic data such as survival rates may be needed for the relevant bird species to improve simulations.

Further demographic modelling and testing of PBR is needed for all species in the future. Whatever approach is used in the assessment, more recent incidental catch and population estimates are needed in order to calculate PBR or CLA values (see chapter Monitoring Requirements). Since these indicate a limit of anthropogenic mortality, also estimates for other causes of mortality (especially oiling and hunting) are needed.

Table 8. Available data for further development of PBR and/or CLA values. Hunting bag data from Mooij 2005. Maximum population growth rate (R_{max}) was calculated from data in Bernotat & Dierschke (2016) preliminarily.

	Estimates of anthropogenic mortality			Input needed for PBR calculations: Removal limit= N_{min} x 0.5 x R_{max} x F			Input needed for CLA calculations: Removal limit= α x R_{max} (D_T - β) x N_T		
Species (population)	Incidental catch estimate	Hunting bag (inluding cripple loss)	Estimate of other anthropogenic removal (e.g. oiled birds, vessel collision with mammals, detonations etc.)	Minimum estimate of population size N_{min}	Maximum population growth rate R_{max}	Population trend (in order to set the recovery factor in PBR calculations)	Population model fit to current population size N_T (time series of population estimates available)	Current status D_T	Maximum population growth rate R_{max}
greater scaup		2,513		154,000[a]	1.36	fluctuating [a]			1.36
long-tailed duck		30,101		1,430,000[a]	1.25	decreasing [a]			1.25
common guillemot				27,280[b]	1.07	stable[b]			1.07
black guillemot 4				31,880[b]	1.14	decreasing[b]			1.14
razorbill				66,400[b]	1.12	increasing[b]			1.12
goosander		20,183		134,000 [a]	1.36	decreasing [a]			1.36
red-breasted merganser		10,771		87,700 [a]		uncertain [a]			

smew				31,500 [a]		fluctuating [a]			
common goldeneye		152,663		375,000 [a]	1.32	stable [a]			1.32
velvet scoter		8,409		322,000 [a]	1.28	fluctuating [a]			1.28
common scoter		7,103		682,000 [a]	1.29	increasing [a]			1.29
common eider		145,374		2,480,000 [a]	1.23	decreasing [a]			1.23
Steller's eider				30,800 [a]		stable [a]			
tufted duck		137,008		1,040,000 [a]	1.58	decreasing [a]			1.58
common pochard		135,821		510,000 [a]	1.34	decreasing [a]			1.34
Slavonian grebe				3,700 [a]		fluctuating [a]			
red-necked grebe				3,700 [a]	1.27	unknown[a]			1.27
great crested grebe				292,000[a]	1.32	fluctuating [a]			1.32
black-throated diver				9,900[a]	1.18	fluctuating [a]			1.18
red-throated diver				42,400 [a]	1.18	increasing [a]			1.18
great cormorant				401,000 [a]	1.16	increasing [a]			1.16

[a] European wintering population (BirdLife International 2015), b Baltic breeding population (BirdLife International 2015).

Relevance of the Indicator

Biodiversity assessment

The level of pressures affecting 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 numbers drowned mammals and waterbirds in fishing gear, this indicator will also contribute to the next overall biodiversity assessment to be completed in 2018 along with the other biodiversity core indicators.

Policy Relevance

The core indicator on number of drowned mammals and waterbirds in fishing gear addresses the Baltic Sea Action Plan's (BSAP) Biodiversity and nature conservation segment's ecological objectives 'Viable populations of species' and 'Thriving and balanced communities of plants and animals' as well as the Eutrophication segment's ecological objective 'Natural distribution and occurrence of plants and animals'. It also addresses the following specific target:

'By 2015 by-catch of harbour porpoise, seals, water birds and non-target fish species has been significantly reduced with the aim to reach by-catch rates close to zero'.

In the BSAP, it was further agreed to set up a reporting system and database for harbour porpoise incidental catch, and competent fisheries authorities were urged to minimize the incidental catch of harbour porpoises.

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

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

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

and the following criteria of the Commission Decision (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)

For the three seal species occurring in the Baltic Sea, the HELCOM Recommendation (27-28/2) adopted in 2006 relating to seals recommends:

- to take effective measures for all populations in order to prevent illegal killing, and to reduce incidental catches to a minimum level and if possible to a level close to zero;
- to develop and to apply where possible non-lethal mitigation measures for seals to reduce incidental catch and damage to fishing gear, as well as to support and coordinate the development of efficient mitigation measures.

Presently, management objectives for all protected species are unclear at the EU level (ICES 2013a). While broad commitments have been made to achieve Good Environmental Status (GES) under the EU Marine Strategy Framework Directive (MSFD), and to Favourable Conservation Status (FCS) under the Habitats

Directive, translating these goals into specific targets on incidental catch limits is as yet unspecified by the EU.

The EU Habitats Directive lists harbour porpoise as a strictly protected species (Annex IV). The harbour porpoise and the three seal species are listed in Annex II, meaning that they are to be protected by the means of the Natura 2000 network. Article 12, paragraph 4 of the Habitats Directive states that Member States shall establish a system to monitor the incidental capture and killing of the animal species listed in Annex IV (a) (European Commission 1992). In the light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned. Member States of the EU are further obliged to develop national programmes for monitoring fisheries, including on board monitoring, under Article 3 of Council Regulation 199/2008, Commission Regulation 665/2008 and the Annex of Commission Decision 2010/93/EU (European Commission 2008b, 2008c, 2009a). These plans include detailed data on fleet capacity and fishing effort by metier and fishing area.

The EU Birds Directive aims to protect, inter alia, habitats of endangered and migratory birds to ensure their conservation in the Europe (European Commission 2009b). This not only refers to birds needing special conservation measures (Article 4 (1)) and listed in Annex I, but also to all migratory species (Article 4 (2)). Therefore, all waterbird species breeding, wintering and staging during migration in the Baltic Sea are covered by this Directive.

EU legislation clearly requires Member States to take measures prohibiting deliberate killing or capture by any method (Article 5 Birds Directive; Article 12 Habitats Directive) which also includes the mere acceptance of the possibility of killing or capture (Case C-221/04 Commission v Spain [2006] ECR I-4515, paragraph 71). Further, the Habitats Directive requires that incidental capture or killing of cetaceans is monitored, and that it should not have a significant negative impact on the species.

As a voluntary instrument within the framework of EU and international environmental and fishery legislation and conventions, the EU Commission has adopted an 'Action Plan for reducing incidental catches of seabirds in fishing gears' (European Commission 2012). It aspires to provide a management framework to minimise incidental catch as much as possible in line with the objectives of the reformed EU Common Fisheries Policy (CFP), i.e. to cover all components of the ecosystem. Among others, proposed action includes the monitoring of seabird incidental catch with a minimum coverage of 10% of the fisheries and mitigation measures.

The Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS) aims to achieve and maintain a favourable conservation status of small cetaceans. Six of the nine Baltic Sea countries are Parties to the Convention (Denmark, Germany, Sweden, Poland, Lithuania and Finland).

All waterbird species occurring in the Baltic Sea are subject of the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA).

Role of the pressure exerted through incidental catch on the ecosystem

There was a substantial increase in gillnet fisheries.

In Baltic Sea fisheries, the use of anchored gill nets has substantially increased in the 1990s and because of the change in stock age composition of cod also in the late 1990’s and early 2000 (ICES 2016b), intensifying the conflict between certain fisheries and bird and mammal species. Waterbirds diving during foraging in order to catch demersal or pelagic fish (divers, grebes, cormorants, mergansers, alcids) and benthic invertebrates (ducks), respectively, are prone to become entangled in various types of nets and to die by drowning. In addition to hunting (Mooij 2005) and oiling (Larsson & Tydén 2005), drowning in fishing gear is a quantitatively important source of mortality for waterbirds living in the Baltic.

The intensification in use of anchored gill nets in the coastal waters of Estonia, Latvia and Lithuania has substantially increased the risk of drowning for the indicator species in the last decades (Žydelis et al. 1990). In other areas, such as Swedish and Danish waters, fishing efforts have decreased in recent years, (Ida Carlén & Finn Larsen, pers. comm.).

In the wide range of population dynamics shown by birds in general, waterbirds belong to those species with high longevity and low reproductive rates. They are therefore vulnerable to the loss, especially of adult individuals, as it takes a relatively long time to compensate for such losses (Bernotat & Dierschke 2016). For waterbirds living in the Baltic Sea, the mismatch between the loss of individuals and the effort to replace them is most pronounced in alcids, whereas ducks may catch up more easily owing to higher reproductive rates and lower ages of first breeding. However, other factors promoting or impeding population growth rates may override this pattern, as currently visible for instance in alcids (increasing owing to favourable food supply; Österblom et al. 2006; Hario et al. 2009), long-tailed duck (declining owing to low reproductive success) and common eider (declining due to reduced mussel stocks; Laursen & Møller 2014).

The same applies to harbour porpoise and seals, which are top predators in the Baltic Sea marine food web and which, due to their population dynamics, are vulnerable to additive mortality (Bernotat & Dierschke 2016). Incidental mortality that exceeds the potential rate of increase will drive a population to extinction. It is thus necessary to keep the sum of all anthropogenic mortality, including incidental catch, below a critical value. From the conservation perspective, immediate management consequences are needed if this critical value is exceeded. In 1991, the Scientific Committee of the International Whaling Commission recommended that incidental mortality should not exceed half of the potential rate of increase (IWC 1991). Furthermore, incidental mortality greater than one fourth of the potential rate of increase should be considered cause for concern (IWC 1996). The figure for the potential rate of population increase for harbour porpoises used for population model simulations by ASCOBANS and the IWC is 4% per annum based on their known life history parameters. Given the high levels of environmental contaminants, including heavy metals and PCBs, of harbour porpoises in the Baltic Sea and impaired immune function (e.g. Siebert et al. 1999, Beineke et al. 2005, 2007a,b, Ciesielski et al. 2006) and the correlation between lower PCB burdens and reproductive failure in UK harbour porpoises (Murphy et al. 2015), the reproductive rate of harbour porpoises in the Baltic Sea may be lower than this generically used rate of increase.

For harbour porpoises, the incidental catch risk is highest in various types of gillnets: set gill nets (gear type: GNS), entangling nets (trammel nets, GTR) and driftnets (GND) (ICES 2013a). The latter are banned in the Baltic Sea, but some hybrid nets such as 'semi-driftnets' which are fixed on one end of the net with the other end drifting around this anchor are of special concern (Skora & Kuklik 2003). In a number of cases, fisheries have tried to circumvent driftnet restrictions of the EU Common Fisheries Policy (CFP) through minor technical modification (Caddell 2010). Due to their properties (one end freely drifting around an anchor), semi-driftnets which are commonly used in Poland may thus attract close attention from the Commission in future years, if they remain widely used on a commercial scale (Caddell 2010). These nets have been reported as GND until 2007, and now (after the ban of GND) are considered GNS (Hel Marine Station, pers. comm.).

The mean longevity of harbour porpoises is only 8-10 years (Read & Hohn 1995; Lockyer & Kinze 2003; Bjørge & Tolley 2009). Stranding data show that only 5% of porpoises live beyond 12 years (Lockyer & Kinze 2003). Sexual maturity is reached late, at the age of 3 to 5 years (Sørensen & Kinze 1994; Adelung et al. 1997; Benke et al. 1998; Lockyer & Kinze 2003). Based on this, it is estimated that a female with a longevity of about 10 to 12 years can deliver only 4 to 6 calves during its life span (Lockyer & Kinze 2003), which would only allow for slow recovery.

Monitoring Requirements

Monitoring methodology

Monitoring relevant to the indicator is described on a general level in the HELCOM Monitoring Manual in the **sub-programme: Fisheries by-catch**.

Current national discard/by-catch monitoring programmes carried out under the EU data collection framework (DCF) do not target marine mammal and bird incidental catches. Monitoring under the EU council regulation 812/2004 protecting cetaceans against incidental catch (European Commission 2004) lays measures concerning incidental catches of cetaceans in fisheries using onboard observers but is limited to larger vessels and hence results in the lowest observer coverage of fisheries posing greatest threat to porpoises and seals in the Baltic Sea (ICES 2013a).

Current monitoring

No regular monitoring activities relevant to the indicator are currently carried out by HELCOM Contracting Parties (see HELCOM Monitoring Manual in the Monitoring Concept Table).

Sub-programme: Fisheries by-catch
Monitoring Concept Table

All HELCOM Contracting Parties which are also EU Member States are obliged to carry out monitoring to provide estimates of population sizes in accordance with the requirements of the Habitats Directive and the Birds Directive.

Contracting Parties currently do not comply with Article 12 Habitats Directive as there is no monitoring in place that gives information that serves the target that incidental capture and killing does not have a significant negative impact on the species. Even more, current monitoring practice led to the unsatisfactory situation that the extent of the incidental catch problem is still not known and as a consequence only minor conservation measures regarding incidental catch (such as the use of pingers in a small fraction of the fishing fleet) are implemented. Some countries have been engaged in developing monitoring based on onboard video cameras recently. To date, it is not clear if this work (from pilot studies) will be extended to a monitoring programme on an annual basis and a representative fraction of the fishing fleets.

A monitoring programme is carried out under the EU Data Collection Framework (DCF). However, fishing métiers under DCF have been selected with respect to fishery data needs rather than bird and mammal incidental catch data needs. It is aimed at monitoring the selectivity of gears with respect to fish discarded and thus incidental catch of marine mammals and waterbirds are not even specifically addressed but rather recorded opportunistically at best. Only adding opportunistic incidental catch data to monitoring programmes focusing otherwise on size and (fish) species selectivity of certain fishing gears does not provide the needed data to enhance the confidence of the indicator. To some minor extent, waterbird incidental catch was monitored in Denmark, Germany, Poland and Sweden, while cetacean incidental catch was monitored under DCF in Denmark, Germany, Latvia, Lithuania, Poland and Sweden (ICES 2013a).

EU Regulation 812/2004 obliges Member States to monitor cetacean incidental catch in gillnets. It has been debated what gears are covered by the Regulation, as gear definitions were not formulated clearly enough for fisheries managers of some Member States (ICES 2010). This is why e.g. some Member States omitted monitoring of trammel nets (GTR) although it is known that porpoises are also by-caught in these nets (Pfander et al. 2012). Further, monitoring under Regulation 812/2004 is not suited to the data needs for this indicator or the original idea behind the Regulation because only vessels >15 m are covered by the observer programme and the majority of Baltic gillnet fisheries is carried out by small vessels which use the same gear. Vessels <15 m are allowed to set 9 km (vessel length <12 m) or even 21 km (vessel length >12 m) of gillnets, respectively, illustrating the high risk of incidental catch even by small vessels.

The Regulation also requires that Member States should design pilot schemes for small vessels; this has often not been done. The idea of scientific pilot studies is to give some indication on incidental catch numbers and provide information on what monitoring method might be suitable for small vessels, although cannot replace monitoring in this large fishing segment.

Only very limited data are collected for protected waterbird taxa under DCF, and it is not possible to estimate effort or coverage. Besides national differences there are large differences in coverage between fishing métiers favouring larger vessels and mainly trawlers. As a result, there are no agreed numbers of by-caught waterbirds and marine mammals for various types of fishing gear (mainly gillnets and entangling nets) in the Baltic Sea, because so far no adequate observer coverage has been achieved with existing monitoring programmes such as DCF and Regulation 812/2004. On the other hand, the results of pilot studies such as interviews are frequently questioned by fishermen and fisheries authorities. Especially in métiers which have been identified by pilot studies as fisheries with a high risk for mammal or bird incidental catch, monitoring is inadequate and a revision of existing monitoring programmes is urgently needed.

Description of optimal monitoring

Monitoring of by-caught marine mammals and waterbirds should enable the estimation of annual (seasonal) mortality from all kinds of specific fisheries to be compared to the population dynamics of the respective species. Besides effort and incidental catch data, data on population size and distribution of species is also needed in order to relate incidental catch numbers to the population. Monitoring results should not only address the problem of incidental catch in general, but should allow to quantify impacts in order to propose management measures such as (temporary) closures of specific fisheries or fishing areas. Optimal monitoring would therefore also provide reliable population size estimates for all species considered from the incidental catch perspective.

The indicator requires estimates of population sizes for those species suffering from incidental catch. While such estimates are available for a number of marine mammals (especially seals) due to target-oriented surveys, they are quite crude for most waterbird species, especially those wintering in offshore areas. Further, uncertainties in population estimates and incomplete knowledge on spatial and temporal distribution patterns have to be addressed. Thus, internationally coordinated surveys need to be organized at least in those marine areas already identified as important for waterbirds (Durinck et al. 1994; Skov et al. 2011) and should be embedded into the respective HELCOM abundance indicators.

The species covered by the indicator are highly mobile and fishing methods differ between sub-regions or even on a local level. Due to the resulting variability in incidental catch risk, a regionally and fishing method differentiated métier monitoring approach that considers fishing activity per spatial unit is recommended. A By-catch Risk Approach (BRA) can be used to identify areas and fisheries that are likely to pose the greatest conservation threat to incidentally caught species, taking into account the uncertainty of their population structure. A BRA was initially developed for cetaceans at an ICES Workshop (ICES 2010). It can also help optimising different methods of monitoring. The BRA highlights areas where the greatest problems occur and enables educated fisheries management decisions such as proactive mitigation measures before incidental catches occur. This is especially important for the critically endangered Baltic Proper harbour porpoise population.

Effort monitoring, as well as incidental catch monitoring, has to be carried out on a fine spatial scale in order to relate incidental catch to both fishing effort and abundance of mammals and birds. Fishing effort must be monitored in a meaningful parameter (length of nets * soak time instead of simply days at sea). The uncertainty in the fishing effort estimates which underlie the incidental catch estimate needs to be specified by adding a CV or 95 % confidence interval.

Appropriate monitoring is needed, so as not to put more burden than necessary on fisheries from management measures to fulfil legal conservation obligations. Monitoring must be able to cover all fisheries and all kinds of vessels. A comprehensive monitoring would use on-board and off-board observers, onboard CCTV cameras (also called Remote Electronic Monitoring, REM, Kindt-Larsen et al. 2012), and possibly additional methods such as interviews (ICES 2013b). In some cases, such as in fisheries with small open boats, self-sampling may be a component of the monitoring programme, but data quality must be verified independently.

Human observers are an important component to sample incidental catch and collect information on composition and number of incidental catch and to deliver specimen to the relevant authorities in order to conduct further examinations regarding age, sex, nutritional state, and injuries. In addition, stomach contents may help to identify in more detail the conflict between marine areas selected by fisheries and habitat demands of mammals and birds. Stranding networks can provide further incidental catch information if collected specimen are examined for net marks and previous injury which could have caused incidental catch. However, limitations in data quality have to be accounted for (e.g. beached bird surveys may indicate incidental catch but never give any information on the type of gear or nationality of the fishing vessel which caused the fatality).

ICES (2013a) has addressed the question of whether it is possible to combine monitoring of protected and endangered species and discard sampling (which will be the main focus of fishery monitoring due to the discard ban) in the same sampling scheme. However, it is unlikely that protected and endangered species will be kept on board or landed since this could infringe on existing national legislation of numerous Member States (ICES 2013a). As a minimum requirement, provisions must be taken that detailed, meaningful photographs of by-caught mammals and birds can be taken if landing is not possible.

It is hoped for that the knowledge on incidental catch of waterbirds and marine mammals will greatly be improved once a suitable monitoring scheme is implemented on regional and national levels within the revised DCF, now termed *EU Data Collection Multi-Annual Programme* DC-MAP: The DC-MAP will guide future fishery monitoring and data collection within the EU, covering a broad range of objectives including the discard ban. It is crucial that in the regional implementation process an adequate sampling coverage plan is developed including mammal and waterbird incidental catch in all relevant fisheries (commercial, part-time and recreational) in the Baltic Sea including all vessel sizes.

Further actions for optimizing electronic monitoring

Pilot studies using cameras for monitoring harbour porpoise and bird incidental catch have shown that these have the potential to be a practical and economic tool for obtaining reliable incidental catch data. Further work is required to demonstrate the potential of the technique to perform consistently with regard to species identification and that all incidents are being detected (ICES 2013b). However, fishermen may reject these systems for personal reasons, hence research and international collaboration is needed on how to create a trustful attitude and to overcome personal reservations against onboard CCTV camera systems.

A main drawback of the onboard camera monitoring of bird and mammal incidental catch is that a large footage has to be viewed to verify the data from fishermen's protocols. In order to further reduce costs of a monitoring programme based on video observation, it may be helpful to computerize the work and view only preselected footage. Thus, the development and validation of reliable automated recognition systems for onboard camera systems is desirable.

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 (2016) Number of drowned mammals and waterbirds in fishing gear. HELCOM core indicator report. Online. [Date Viewed], [Web link].

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Metadata

There is currently no source of monitoring data which specifically compiles and analyses the numbers of by-caught waterbirds and marine mammals in a representative manner. Some information on harbour porpoise incidental catch is taken from the ICES WGBYC database (as presented in the reports ICES 2015, 2016a) which is based on information in Reg. 812/2004 National Reports.

Temporal coverage of monitoring data is poor. Some studies can be used for historical sporadic information on numbers of by-caught waterbirds and mammals. These sporadic data have a very poor spatial coverage (see map in Žydelis et al. 2009).

In the BSAP, it was agreed to set up a reporting system and database for harbour porpoise incidental catch which have not yet been developed.

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Archive

This version of the core indicator report was published in December 2015

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

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

Older versions of the core indicator report are available:

2013 Indicator report

2015 Indicator report

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