Agenda Item 8.2	Projects and Activities Supported by ASCOBANS Small Cetacean Conservation Objectives in Relation to Anthropogenic Removals
Information Document 8.2 / Revision 1	ASCOBANS Conservation Objectives – Draft Technical Guidance Document
Action Requested	Take note
Submitted by	Chair of the Conservation Objectives Workshop

Note: Delegates are kindly reminded to bring their own document copies to the meeting, if needed.

ASCOBANS CONSERVATION OBJECTIVES -

DRAFT TECHNICAL GUIDANCE DOCUMENT

This document aims at giving a background to ASCOBANS/AC28/Doc.8.2 and is to be treated as a living draft document to be later elaborated on. The Chair acknowledges major contributions to this document from Justin Cooke, with additional input on drafts from Sarah Dolman, Ruth Fernandez, Kate Kaminska, David Lusseau, Graham Pierce, Barbara Taylor, and Paul Wade. Note that this document does not necessarily reflect the views or recommendations of all workshop[1,2] participants.

Background

The overall purpose of ASCOBANS as stated in the original Agreement is 'to achieve and maintain a favourable conservation status for small cetaceans in the Agreement area'. Favourable Conservation Status (FCS) is defined in Article 1 of the Bonn Convention (Convention on Migratory Species), under which ASCOBANS was formed and entered into force in 1994. "'Conservation status' [of a migratory species] means the sum of the influences acting on the [migratory] species that may affect its long-term distribution and abundance; 'Conservation status' will be taken as 'favourable' when: (1) population dynamics data indicate that the [migratory] species is maintaining itself on a long-term basis as a viable component of its ecosystems; (2) the range of the [migratory] species is neither currently being reduced, nor is likely to be reduced, on a long-term basis; (3) there is, and will be in the foreseeable future sufficient habitat to maintain the population of the [migratory] species on a long-term basis; and 4) the distribution and abundance of the [migratory] species approach historic coverage and levels to the extent that potentially suitable ecosystems exist and to the extent consistent with wise wildlife management; and d) 'Conservation status' will be taken as 'unfavourable' if any of the conditions set out in sub-paragraph (c) of this paragraph is not met."

While the term FCS is also used within the EU Habitats Directive ((European Directive on the Conservation of Natural Habitats and Wild Fauna and Flora, 92/43/EEC)[3], a number of key features differ between definitions, including the Habitats Directive requiring that 'population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats'. While the 'habitat' is the natural home of an individual, the 'ecosystem' which is denoted in the CMS definition, is the interaction and interrelationships between living organisms and the physical environment. Thus, large populations of species, such as the common dolphin in the NE Atlantic, will have certain roles for maintaining stability within their ecosystems, and it is these roles within ecosystem functioning that would need to be considered.

ASCOBANS has set its conservation objective as "to restore and/or maintain biological or management stocks of small cetaceans at the level they would reach when there is the lowest possible anthropogenic influence." (ASCOBANS Resolution 2.3 on Incidental Take of Small Cetaceans[4], at the 2nd Meeting of the Parties, Bonn, 1997). In the context particularly of bycatch reduction, ASCOBANS seeks to minimise (i.e. ultimately to reduce to zero) anthropogenic removals of small cetaceans. The EU Technical Measures Regulation (2019/1241) likewise aims to ensure that incidental catches of sensitive marine species from fishing are "minimised and where possible eliminated so that they do not represent a threat to the conservation status of these species".

Those are generic policy goals, which further require specific management targets (e.g. keeping anthropogenic removals below a specified limit/threshold) to avoid the risk of the conservation objective **not** being achieved. This applies particularly with respect to bycatch as this is appears to be the primary source of anthropogenic mortality facing small cetaceans that could jeopardise

[1] https://www.ascobans.org/en/meeting/workshop-conservation-objectives-part-1
[2] https://www.ascobans.org/en/meeting/workshop-conservation-objectives-part2
[3] https://www.cms.int/en/convention-text
[4] https://www.ascobans.org/en/document/indicidental-take-small-cetaceans

meeting the conservation objective. It is important to remain aware of, and take into account where possible, other anthropogenic pressures that may affect the demography of the population: those that directly cause mortality such as vessel strike and those that may reduce survival and/or reproductive rates such as habitat alterations, contaminants and underwater noise pollution, prey depletion or disturbance that can affect energy budgets.

Note: *ASCOBANS did not define 'biological units' nor 'stocks', and these terms have been superseded within ASCOBANS by the employment of 'management units' (MUs), defined by the ASCOBANS-HELCOM Small Cetacean Population Structure Workshop (held in 2007) as "a group of individuals for which there are different lines of complementary evidence (e.g. morphometrics, life history parameters, photo-ID, in addition to genetics) suggesting reduced exchange (migration / dispersal) rates over an extended period (low tens of years)". While it was noted that ideally a quantitative target should be set for MUs (e.g. maximum of ten percent migration per generation), for most species we do not have that level of information, nor has the theoretical framework for integration of different evidence bases been fully developed*[5]*.*

The ASCOBANS conservation objective and definition of unacceptable interactions

To achieve the broad aims of ASCOBANS it was necessary to produce clear, well defined conservation objectives from which to develop a programme to try and meet these objectives and to be able to monitor progress[6]. At the most recent Meeting of the Parties, it was agreed in Resolution 8.5 (Rev. MOP9, 2020)[7] that:

> (a) the general aim should be to minimize (i.e. ultimately to reduce to zero) anthropogenic removals (i.e. mortality), and in the short term, to restore and/or maintain biological or management units to/at 80 per cent or more of the carrying capacity;
>
> (b) in order to reach this objective, the intermediate precautionary aim is to reduce bycatch to less than 1 per cent of the best available population estimate;
>
> (c) 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;
>
> (d) 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 bycatch levels, then "unacceptable interaction" may involve an anthropogenic removal of much less than 1.7 per cent.

The population reference level of 80% of carrying capacity had originally been adopted in Resolution 2.3 (MOP2 in Bonn, 1997[8]), and was reaffirmed in subsequent resolutions. Although the choice of the 80% threshold was ultimately a policy decision by the Parties, it took account of recommendations in the literature[9], and some justifications for the choice are noted below. Using the conventional symbol K to denote carrying capacity, the reference level is denoted $0.8K$. The question of how to define K for the purpose of implementing the conservation objective (of maintaining a population above $0.8K$) is also addressed below.

Resolution 2.3 at MOP2 had specified 2% as the threshold for an "unacceptable interaction", but this was revised downward by Resolution 3.3[10], adopted in 2000.

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[5] https://www.ascobans.org/en/document/report-ascobanshelcom-small-cetacean-population-structure-workshop-0
[6] https://www.ascobans.org/sites/default/files/document/Inf06_MOP2_DOC.4.pdf
[7] https://www.ascobans.org/en/document/monitoring-and-mitigation-small-cetacean-bycatch-0
[8] https://www.ascobans.org/en/meeting/MOP2
[9] e.g. Cooke J. & Earle M. 1993. Towards a precautionary approach to fisheries management. *Review of European, Comparative & International Environmental Law* 2(3):252-259.
[10] https://www.ascobans.org/en/document/incidental-take-small-cetaceans

ASCOBANS Resolution 8.5 also emphasised that 'unacceptable interactions' should include all forms of anthropogenic removal, i.e. total anthropogenic removal (e.g. mortality from bycatch and vessel strikes)[11].

The carrying capacity (K), is defined here as the level that a population would reach in the absence of anthropogenic removals (such as bycatch, hunting, vessel strikes, fatal entanglements and other direct kills) and in the absence of anthropogenic effects that negatively impact reproduction such as disturbance, toxic pollutants, habitat destruction and competition for prey. The value of K is constantly affected by natural environmental variation and is difficult to determine directly. Furthermore, both the range and the carrying capacity of most populations are expected to change as the climate changes. Therefore, approaches to achieving the $0.8K$ target do not involve specifying a fixed value for K, but instead aim to ensure that anthropogenic removals are low enough that the population can be expected, under reasonable assumptions, to recover towards, or remain above, the $0.8K$ level.

Relationship of the ASCOBANS population reference level to other population reference levels

Maximum Net Productivity Level (MNPL)

A long-standing management objective, built into several international agreements, has been to maintain populations above the maximum net productivity level (MNPL) or the maximum sustainable yield level (MSYL). The MSYL is the equilibrium population level at which the maximum sustainable yield (MSY) can be taken. The MNPL is the population level at which the net production (excess of growth and reproduction over natural mortality) is maximised. The population levels MSYL and MNPL are equal if yield and net production are measured in the same units (e.g. biomass or numbers of individuals) and a stable population is assumed, i.e. the population is not increasing or declining. While the two terms are equivalent, MSYL tends to be used for commercially harvested species, while MNPL is used for protected species.

Being above MSYL (expressed in terms of spawning stock biomass) is the main population reference level specified in the EU's Good Environmental Status for populations of commercially exploited fish and shellfish. The UN Law of the Sea also obliges states and relevant international management organizations to maintain populations of harvested species above the MSYL.

For marine mammal populations, current approaches to implementing the US Marine Mammal Protection Act (US-MMPA, 1972) assume MNPL = $0.5K$ (see below). The Scientific Committee of the International Whaling Commission uses MNPL = $0.6K$ as its base-case assumption for modelling populations of baleen whales and procedures for managing hunts.

The ASCOBANS $0.8K$ reference level is, therefore, likely to be above MNPL for all or most marine mammal populations. The reasons for choosing a reference level above $0.8K$ include the intrinsic value placed on maintaining cetacean populations at higher levels of abundance, preferably not too far from their natural level. Another reason is that a reference level at MNPL would imply that the full sustainable production of the population is to be taken up by the managed removals. In practice, there are anthropogenic impacts on populations beyond those that can be quantified and managed. To allocate the entire sustainable take of the population to just one sector, such as fisheries, could be a high-risk strategy. It would also leave no room to manage the impacts of other sectors on the marine mammal population. Therefore, precautionary management should aim to limit the managed removals from a sector to just a portion of the maximum possible take that could theoretically be sustained.

[11] https://www.ascobans.org/en/document/monitoring-and-mitigation-small-cetacean-bycatch-0

EU legislative requirements

The ASCOBANS conservation objective of maintaining populations at or above the 0.8*K* reference level is more specific than, but broadly consistent with, other European legislative objectives such as maintaining/restoring to “favourable conservation status" in the EU Habitats Directive. Although it pre-dates the Marine Strategy Framework Directive (MSFD), the ASCOBANS objective is consistent with the MFSD’s objective of restoring/maintaining “good environmental status" (which requires *inter alia* that “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” (Descriptor 4. Food Webs) and “the quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climate conditions” (Descriptor 1. Biodiversity is maintained)).

The EU Marine Strategy Framework Directive (2008/56/EC) establishes a ‘framework within which Member States shall take the necessary measures to achieve or maintain good environmental status (GES) in the marine environment’. In 2017, the EC outlined its decision for laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment (EU 2017/848), which stipulates under Descriptor 1 for primary criteria D1C1 ‘The mortality rate per species from incidental by-catch is below levels which threaten the species, such that its long-term viability is ensured’, and ‘Member States shall establish the threshold values for the mortality rate from incidental by-catch per species, through regional or subregional cooperation’[12].

Within the North-east Atlantic, regional work is being coordinated by the OSPAR Commission. For reporting under the 2023 Quality Status Report, OSPAR’s Marine Mammal Expert Group employed a quantitative interpretation of the ASCOBANS conservation objective when setting thresholds for the M6 indicator ‘Marine Mammal Bycatch’, and where cetaceans are concerned, ‘a population should [be able to] recover to or be maintained at 80% of carrying capacity, with 0.8 probability, within a 100-year period’. OMMEG decided to use 80% probability, as stringent thresholds resulted from using 95% probability at 80% of K[13].

In the context of OSPAR’s Marine Mammal Bycatch Indicator, the threshold value is ‘understood to represent an upper limit to total anthropogenic removals; that is, a limit beyond which the risk of failing to achieve the conservation objectives set by policy makers is unacceptable’. OSPAR will re-review their threshold setting approach following completion of ASCOBANS’ Conservation Objective workshops to ensure that ‘an appropriate precautionary, yet practical and realistic conservation objective’ is employed for their marine mammal bycatch indicator[14].

US legislative requirements

The ASCOBANS conservation objective is also in keeping with the conservation objective of the US Marine Mammal Protection Act (MMPA): "maintaining a healthy population across its range". The MMPA conservation objectives are relevant to Europe in the context of bycatch because the US Marine Mammal Import Rule comes into effect in 2024, requiring countries importing fish into the US to meet the same standards on bycatch that domestic fishers are required to meet. The reference level used in Europe therefore should be at least as stringent as that which is required by the MMPA to ensure fish exports can continue.

[12] https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/marine-mammal-bycatch/
[13] https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/marine-mammal-bycatch/
[14] https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/marine-mammal-bycatch/

Implementing the ASCOBANS population reference level

In order to use the ASCOBANS population reference level as a concrete management goal, it is necessary to specify:

- the criterion for determining when the reference level is met or is predicted to be met;
- the time horizon within which the reference level should be reached; and
- the probability of achieving the reference level over this time horizon.

The carrying capacity, usually denoted *K*, is defined as the level that the population would attain in the absence of anthropogenic removals. The value of *K* is constantly affected by natural environmental variation and is difficult to determine directly. Furthermore, both the range and the carrying capacity of most populations are expected to change as the climate changes. Therefore, approaches to achieving the 0.8*K* reference level do not involve specifying a fixed value for *K*, but instead aim to ensure that anthropogenic removals are low enough that the population can be expected, under reasonable assumptions, to recover towards, or remain above, the 0.8*K* level.

Given the substantial uncertainties typically associated with the estimates of population size and anthropogenic removals, it is usually necessary to conduct simulations to determine how likely it is that the criterion for achievement will be met under any given removal rates. Simulations are conducted for a range of scenarios that span the plausible ranges of the main factors, including population structure, that influence the impact of bycatch and other removals on the population. In some cases, simulations based on quite simple population models may be sufficient, but in other cases more elaborate and realistic models may be called for, including in some cases individual-based models or population viability models.

When computing the ratio of population size to K in a simulation, the following two technical considerations should be borne in mind:

(1) The 0.8*K* reference level is defined in terms of the effective or realizable carrying capacity, which is the population level that would pertain at any given time had there been no anthropogenic removals. Some population models have a parameter labelled *K* that broadly refers to carrying capacity, but which does not correspond exactly to the effective carrying capacity, because the population fluctuates around this nominal *K* even in the absence of anthropogenic removals. In such cases, the realizable carrying capacity implied by the model, rather than the model parameter named *K*, should be used to determine whether the population reference level is reached.

(2) In simulations where the realizable carrying capacity varies naturally, the determination of whether the population reference level is satisfied involves the comparison of two distributions rather than of two-point values. The idea behind the 0.8*K* reference level is that the distribution of population size should not be shifted downwards by more than 20% relative to the case of no removals. Therefore, the ratio of any given percentile of the population size distribution to *K* should be defined as the ratio of population size to the same percentile of the distribution of *K*. It would not be appropriate to compare, for example, the lower 5%-ile of the population distribution under bycatch to the median *K* that would be attained without bycatch.

Time horizon

It is necessary to distinguish between two different time scales:

(i) conservation time frame – e.g. the time required for a population to recover to a population reference level, such as 0.8*K*;

(ii) implementation time frame – e.g. the time required to implement measures to reduce the bycatch or removal rate below a specified threshold.

Regarding the conservation time frame, ASCOBANS explicitly designated the 0.8*K* reference level as a “short-term” aim. Therefore, a 20-year time horizon is recommended for achieving, or satisfying, the population reference level, where possible. That is, the population should reach the 0.8*K* reference level within 20 years or remain above the reference level for at least 20 years (roughly equivalent to the average generation length of a cetacean), as applicable.

The time required for a marine mammal population to recover to a reference level will depend on the current population level and the rate of increase that the species is capable of. The 20-year time horizon may not be achievable for populations that have been severely depleted by past removals, and in an unfavourable conservation status. For such cases, it is recommended that the removal rate be set to the lower end of the range recommended below, so as that the recovery rate is slowed as little as possible compared to the predicted recovery rate without anthropogenic removals

The IWC’s Scientific Committee and OSPAR’s OMMEG, have used 100-year time horizons for simulation purposes. These longer simulations are useful for testing whether a proposed management rule behaves as expected under standardised conditions but are to be understood as *pro forma* scenarios for comparing management approaches rather than necessarily as realistic expectations of the state of populations over the coming 100 years. The large uncertainties arising from climate change and other factors make it hard to specify realistic scenarios that extend so far into the future.

The implementation time frame for measures to reduce bycatch or other removals should normally be of the same order as those for other management measures governing the affected fisheries; this is typically five years or less under the Common Fisheries Policy (CFP). The choice of implementation time frame was beyond the scope of the two workshops, which did not discuss the nature of the concrete management measures that might be adopted to limit bycatch levels or rates. However, it is recommended that simulations assume an implementation delay of up to 5 years for any management measures.

Probability of meeting population reference levels and/or removal thresholds

It is convenient to separate the achievement probability into two components:

(i) the probability that a given removal rate would allow the population reference level to be achieved;

(ii) the probability that a given set of management measures would hold the removal rate below a specified level.

This document is concerned only with the first component, which depends on the nature of the bycaught species. The second component also depends on the nature of the fisheries in which the bycatches occur.

As noted above, simulation studies are usually required to determine the probability with which a given removal threshold or formula allows the population reference level to be met. As a general rule, it is recommended that removal limits should be calculated that imply at least a 95% probability of meeting the population reference level in all scenarios that are considered to be highly likely.

If simulations indicate that it can be hard to achieve the population reference level with 95% probability even in scenarios considered to be highly likely, loosening the probability standard is not recommended. Instead, attention should be paid to ensuring that the simulations are appropriate and realistic, noting in particular the above points concerning the definitions of *K* and the ratio of population sizes to *K*.

Provided that the population reference level is met with 95% probability in those simulated scenarios that are considered to be most likely, a relaxation of the probability requirement or a lowering of the population reference level can be considered for scenarios which are considered less likely, but still sufficiently plausible to merit testing. For example, the IWC Scientific Committee adopted a three-tier categorization of scenarios into high, medium and low plausibility, such that weaker conservation targets are set for medium and low plausibility scenarios than for high plausibility scenarios.

The 20-year time horizon and the 95% probability of achievement are provisional recommendations at this stage. Further analysis and consultation with policy advisers should be conducted to determine the most appropriate values in the ranges 80-95% and 20-100 years.

Implementation of population reference levels – specifying appropriate bycatch limits or thresholds

ASCOBANS anthropogenic removal limits / thresholds

As noted above, ASCOBANS Resolution 8.5 (Rev. MOP9 in 2020) stated 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

The 1.7% figure was calculated by the IWC-ASCOBANS Working Group on the Harbour Porpoise in 1999 as the deterministic bycatch rate that would stabilise the population at $0.8K$ assuming MNPL = $0.6K$ and $R_{max} = 0.04$. R_{max} is the assumed growth rate of the population at 'low' population sizes (i.e. those below the level at which intra-specific competition becomes important). An R_{max} value of 0.04 means that a population at a low level would be expected to grow at the rate of 4% per year in the absence of bycatch or other anthropogenic removals. A population close to its carrying capacity would be expected to grow at a slower rate, on average.

The 1.7% figure takes no account of uncertainty in population size, population structure, bycatch levels, R_{max} or MNPL The figure is also very sensitive to the assumptions. For example, if it is assumed that MNPL = $0.5K$, the corresponding bycatch limit would be 0.8.

For this and other reasons, ASCOBANS Resolution 8.5 called for a re-evaluation of the 1% and 1.7% limits specified in the Resolution. In this context, it is useful to recall that the IWC-ASCOBANS Working Group had recommended further simulation work to: investigate violations of assumptions in the base model; explore sensitivity of the results to variation in certain parameters; and potentially modify the base model to incorporate additional factors, as necessary. The WG further recommend several areas where the base model should be extended for simulation trials, including: seasonal mixing, dispersal, stock sub-structure, age/stage structure, stochastic variability in *R*max and *K*, catastrophic events, value of MNPL, bias in estimated bycatch, variation in monitoring schemes, variation in initial depletion level and long-term, and variation in carrying capacity[15].

US MMPA PBR (Potential Biological Removal)

From the late 1990s, the PBR control rule has been applied by US authorities through the Marine Mammal Protection Act (MMPA) to calculate in each case an annual number of removals that would satisfy the goal of allowing the marine mammal population to recover towards, or remain above, the MNPL. The PBR formula assumes that the MNPL is 50% of carrying capacity ($0.5\ K$). The MNPL is assumed to be achieved by restricting anthropogenic removals to 0.5 times R_{max} times a conservative estimate of population size (N_{min}, - see below). The default value of R_{max} for cetaceans is set to 4% *per annum* in the absence of specific information.

[15] https://www.ascobans.org/sites/default/files/document/Inf32_JointWorkshopReportSupplement%202.pdf-2Supp297_305AnnexO.pdf

The appropriate removal limit is further scaled by a Recovery Factor (F_R), The Recovery Factor (F_R) reduces that allowable anthropogenic mortality for endangered or depleted populations for cases where the status is unknown, to allow for faster recovery. F_R is set to 0.1-0.3 for endangered or decreasing populations, 0.4-0.5 for populations of unknown status, and at most 1.0 for other populations, although all F_R values used to date have been less than 1.0. Formally, the Recovery Factor represents the proportion of population productivity that is removed, instead of contributing to population recovery. It is, therefore, a measure of the extent to which the recovery of a depleted population towards its reference level would be slowed by the allowed take levels. For example, an F_R of 0.1 implies that the rate of recovery would be slowed by 10%, while an F_R of 0.5 implies that the recovery rate would be slowed by 50% relative to the no-take scenario.

The resulting formula for the removal threshold is: $PBR = 0.5\ F_R\ R_{max}\ N_{min}$. Where estimated removals from a marine mammal population exceed the PBR, a process is set in train with the aim of reducing marine mammal deaths. Removals include bycatches and other quantifiable anthropogenic mortalities, such as ship strikes. Injuries which are not immediately fatal are pro-rated on a likelihood-of-mortality basis.

The PBR formula yields annual limits for anthropogenic mortality of 0.2-0.6% (of a conservative estimate of population size) for endangered or decreasing populations and 0.8-1.0% (of a conservative estimate of population size) for populations of unknown status. Higher limits, up to a maximum of 2% of the conservative population size estimate (i.e. where the recovery factor is 1.0), would be recommended only for populations known to be above the assumed MNPL or known to be increasing.

The threshold removal percentages computed using the PBR apply to the so-called N_{min} estimate, which is defined as the lower 20%-ile of the "best" population estimate, where the latter is usually taken to be the most recent one that meets certain quality criteria. The choice of definition of N_{min} was based on simulation studies that showed that this choice ensured that imprecision in the population estimate would not jeopardise achievement of the population reference level. The definition of N_{min} accounts for uncertainty in the estimate of population size. N_{min} is roughly equal to the best population estimate minus one standard error of the estimate.

The practice in the US has been to flag populations for potential management action whenever the known or estimated bycatch levels exceed 50% of the PBR, so that there is time to develop management measures before the problem becomes acute. A comparable "amber zone" should be defined in the European context when known or estimated removals from a population are below the recommended limits but not "far" below. Such an approach, involving triggers for action, was recommended by the 2015 ASCOBANS workshop on 'Unacceptable Interactions Part 1'[16].

A straightforward adaptation of the PBR formula to match the ASCOBANS 0.8*K* conservation objective would be to replace the 0.5 factor in the formula by 0.2. In practice, it has been deemed more convenient to retain the 0.5 factor and instead to use lower values of the Recovery Factor, as undertaken within the OSPAR Marine Mammal Bycatch Indicator (see below). This choice is purely notational; it does not affect the resulting determinations of acceptable mortality rates. However, a consequence is that the nominal Recovery Factor loses its original interpretation.

OSPAR's Modified PBR (mPBR)

The OSPAR Marine Mammals Expert Group (OMMEG) conducted population simulations to determine values of the Recovery Factor that would meet the ASCOBANS population reference level of 0.8*K* with at least 80% probability, over a 100-year time horizon. Based on simulations that covered the same set of scenarios and parameter values as used to test the original PBR formula, the Expert Group recommended modified Recovery Factors of 0.1 for populations which are depleted or of unknown status, and up to 0.35 for well-studied populations with satisfactory status.

[16] https://www.ascobans.org/sites/default/files/document/Expert%20Workshop%20Unacceptabe%20Interactions%20Part%20II%20Bycatch_Report_final_0.pdf

Using the default value of 0.04 for R_{max}, the corresponding maximum removal rates, for comparison, are 0.2% or 0.7% respectively of conservative estimates of population size (N_{min}).

Removals Limit Algorithm

A Removals Limit Algorithm (RLA) was developed for North Sea harbour porpoises by OSPAR, which set a removal limit that can be updated regularly based on estimates of porpoise abundance and past removals[17]. It was adapted from the IWC's Catch Limit Algorithm (CLA) which was developed for the purpose of calculating sustainable catch limits under its Revised Management Procedure (RMP). The removal limit output by this RLA is not a fixed percentage of population size but is calculated on a sliding scale that reduces the percentage if the population estimate decreases. RLAs are subjected to simulation tests in the same way as the PBR or other formulae. RLAs can typically use more data, where available, than the PBR formula, but may or may not actually require the additional data in order to be applied. While the PBR formula can be considered as a simple example of an RLA, the term RLA is usually reserved for more complex procedures. Generally, a highly complex RLA is only to be preferred to a simpler formula such as the PBR if the RLA shows superior performance, or wider applicability, that would justify the extra complexity. Superior performance in this context would mean a higher probability of achieving the conservation objective without invoking removal control measures that are more restrictive on average.

Comparison of previously recommended ASCOBANS bycatch thresholds versus (modified) PBR

The maximum acceptable take levels recommended by ASCOBANS in its Resolution 8.5 are higher than those implied by the US application of the PBR, despite the latter being tuned to a reference level of MNPL = 0.5K, which is well below the ASCOBANS reference level of 0.8K. Furthermore, the ASCOBANS threshold percentages apply to the "best available population estimate" which does not account for estimation error and is typically 15-30% higher than the N_{min} used in PBR calculations. The ASCOBANS take thresholds exceed those implied by the OMMEG recommendations, which are tuned to the ASCOBANS 0.8K reference level, by a greater margin.

The bycatch thresholds of 1% and 1.7% specified by ASCOBANS Resolution 8.5 are, therefore, too high to meet its population reference level, assuming conventional parameter values. As a comparison, expressed as a percentage of N_{min} (a conservative estimate of population size), the thresholds that correspond to the modified PBR calculations recommended by OMMEG (80% of K, 80% probability, 100-year time horizon), range from 0.2% for populations which are depleted or of unknown status to 0.7% for populations in a satisfactory condition. These apply when default values of parameters, such as R_{max}, are used. In specific cases, there may be data available that indicate a higher or lower percentage. It is therefore recommended that the ASCOBANS anthropogenic removal limits / thresholds of 1% and 1.7% be discarded in favour of limits/thresholds based on the modified PBR formula.

Management areas

Application of any formula for specifying maximum acceptable removal rates, be it a fixed percentage, the PBR or an RLA, require the definition of management areas for which the limits are set.

The identity and ranges of marine mammal populations are not always well understood. In situations of high uncertainty with respect to marine mammal population identity, experience with the use of the PBR in US fisheries has shown that population targets/goals are more reliably met when the bycatch thresholds are applied to the estimated abundance of marine mammals **within the respective fishery management area**, rather than to a putative total population size of the marine mammal species in a larger area. In Europe, this could, for example, be applied to common dolphin bycatch within the Bay of Biscay and Iberian Peninsula coast. In cases where local marine mammal

[17] https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/marine-mammal-bycatch/

populations have been identified with ranges smaller than fishery management areas in the US, separate take limits have been set for each local population.

In the case of highly migratory marine mammal species, which spend only part of the year in a fishery management area, the usual practice is to pro-rate the removal threshold by the estimated average proportion of the year which the marine mammal spends in the fishery management area. This ensures that the marine mammal population is adequately conserved even when it is subject to removals in multiple parts of its migratory range.

These general approaches to the designation of management areas are recommended, but variations can be considered where there are specific data and/or simulation studies to show that an alternative approach would meet the specified population targets/goals.