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Approach for assessing the (un)sustainability of hunting in the context of the Birds Directive

PURPOSE

The purpose of this document is to provide an approach to allow assessing the (un)sustainability of hunting in the context of the Birds Directive. It provides a definition of sustainability of hunting in the mentioned context, and sets the approach and process for delivering such an assessment in the light of that definition.

BACKGROUND

This technical document is a deliverable of the contract supporting the recovery of bird species of Annex II of the Birds Directive in non-secure conservation status[1]. The European Commission asked the contractor to develop, in cooperation with AEWA, an approach to define and assess the (un)sustainability of hunting of birds, particularly as it applies to species whose populations may be declining, depleted or threatened with extinction[2]. That approach is meant to be applied to the 30 migratory species listed on Annex II of the Birds Directive that are not in a secure status and for which no Adaptative Harvest Management Plan exists[3]. For each of those species, the contractor will collect the necessary data to be able to assess the (un)sustainability of hunting (per population/flyway, if relevant); in particular, survival data, population data, harvest data, and breeding success data where available.

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[1] *Service contract No. 09.0201/2022/886665/SER/D.3 delivered by a consortium of research institutions, led by the Institute for Game and Wildlife Research (IREC) in Spain.*

[2] *The definition of non-secure status comprises species in categories 'Near Threatened' and 'Threatened', according to IUCN Red List criteria, as well as 'Depleted' and 'Declining'; European Environment Agency 2020. State of nature in the EU. Results from reporting under the nature directives 2013-2018. Report 10/2020. Luxembourg: Publications Office of the European Union, 146. doi: 10.2800/705440.*

[3] *The same 30 species are classified under cases 2, 3, 4, or 5 in the review carried out as part of the same contract. Such review is based on the respective role of survival and reproduction in driving the population dynamics, and the importance of hunting with respect to survival.*

In the EU, the definition of hunting needs to be framed within the Birds Directive. Art 2 requires Member States to take measures to maintain bird populations at a level which corresponds to their "*ecological, scientific and cultural requirements*". Any hunting, therefore, must comply with the principles of wise use and ecologically balanced control of the species concerned, and it must not jeopardise conservation efforts in their distribution area. Given that the overall objective of the Directive is the maintenance of bird populations at a favourable conservation status, this should be reflected in the principle of wise use.

The EC guidance on hunting states (§ 2.4.7) that "*in the context of hunting, wise use clearly implies sustainable consumptive use with an emphasis on maintaining populations of species at a favourable conservation status*".

AEWA Agreement's Article II.1 requires its Parties to "take co-ordinated measures to maintain migratory waterbird species in a favourable conservation status or to restore them to such a status." It is by way of exception to the prohibition of taking of birds listed in Column A of Table 1 of the Agreement that hunting may continue on a sustainable basis and only for some specifically marked species' populations (assessed as between around 10,000 and 100 000 individuals). In the context of these exceptions, AEWA describes sustainable use, as "*the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations*". This sustainable use shall be conducted within the framework of an international species action plan, implementing the principles of adaptive harvest management.

For species' populations listed in Column B of Table 1, the regulated taking of birds is equally stringent, since it should ensure "to maintain or contribute to the restoration of those populations to a favourable conservation status and to ensure, on the basis of the best available knowledge of population dynamics…."

SUSTAINABLE HUNTING, POPULATION STABILITY AND RECOVERY

The status and conservation objective of the population being targeted by hunting are key elements to consider in the definition of sustainability. **Hunting of a given species population can be considered sustainable when it occurs at a level** (at the appropriate spatial scale, e.g. flyway for migratory species) **that does not jeopardise the achievement of the conservation objectives set for that population.**

Thus, **for a population that is in a "secure"** or "good" status[4], **hunting is sustainable when it does not lead to population decline.**

For a population that is in a non-secure status (i.e. in "poor" or "bad" status according to IUCN criteria at the appropriate spatial scale[1]), for which the conservation objective is the restoration to a satisfactory level, hunting cannot be considered sustainable if it prevents

[4] *See note 3 above for a list of status categories considered non-secure.*

the population from recovering to a "secure" status. The emphasis here is on improving the population prospects, and a **sustainable hunting level needs to be defined as a level that allows population growth** and is compatible with recovery (see Box 1 for some specific examples). A hunting level that slows down, but does not prevent, the process of recovery to a secure status might also be considered sustainable under some circumstances. For example, when the time frame for achieving full recovery has been defined and agreed, including on the basis of the gravity of the observed decline and/or depletion of the population compared to historical data, taking into account all relevant information to inform such decision[5]. Inevitably, hunting management options should be seen in conjunction with the necessary actions concerning habitat restoration and other conservation measures that, combined, result in population growth at the desired speed.

Therefore, **it is essential to have information on the population status and conservation objective of the specific population in order to carry out an assessment of the (un)sustainability of hunting** (see below). Such status may be identified based on a combination of long-term population trends and population size at appropriate spatial scale[6]. The conservation objective may be identified in qualitative terms (as a "recovery" objective, e.g., to achieve a "secure" status in a given time frame) or in quantitative terms (e.g., to attain a number of breeding pairs in a given time frame, etc).

While the assessment of the status in the EU is carried out at *species* level, the assessment of sustainability of hunting should be done at a lower spatial level, notably the level of the population targeted by hunting (the management unit, e.g., an entire flyway), especially in the context of harvest management. Therefore, it is essential to have information on that specific population in order to make hunting decisions and to carry out assessments of the sustainability of hunting at the appropriate scale.

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[5] *Including the timing for putting in place restoration measures for habitats of wild birds established under the Nature Restoration Law.*

[6] *At the appropriate scale. For migratory species, this is often the flyway scale, but other spatial units can also be used. E.g., the biogeographical populations defined by Wetlands International and AEWA, and specific management units in the context of Species Action Plans and Adaptive Harvest Management mechanisms.*

Box 1 – Sustainable harvest scenarios for stable *vs* declining Annex II species

The Common Moorhen (*Gallinula chloropus*), Eurasian Jackdaw (*Corvus monedula*) and Fieldfare (*Turdus pilaris*) are examples of huntable Annex II species with stable numbers and good conservation status on a European scale (Fig. 1, left). Their current level of harvest is associated with population stability, and it thus seems safe to affirm that it is probably sustainable.

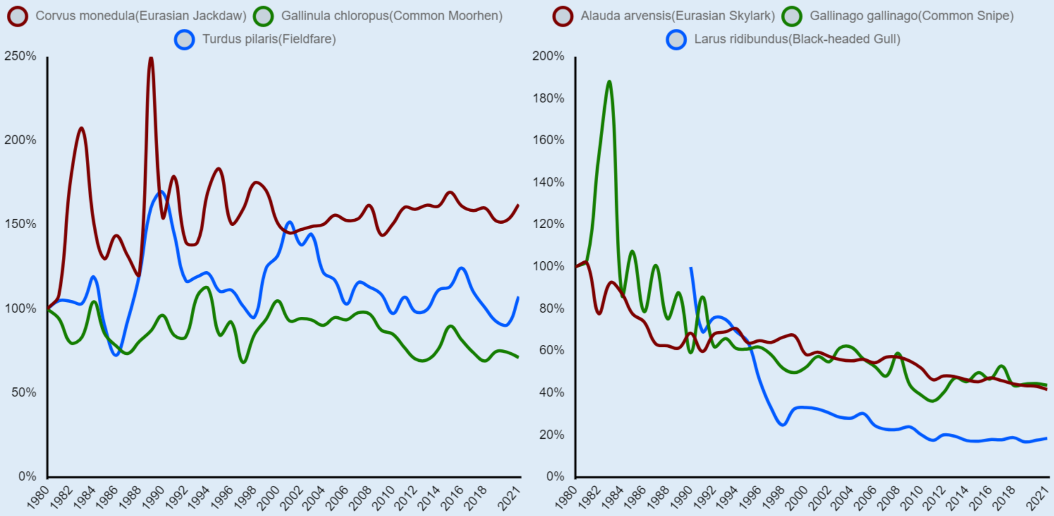

Fig. 1. Left: population trends of Common Moorhen, Eurasian Jackdaw and Fieldfare in Europe, 1980-2021. Right: population trends of Common Snipe, Black-headed Gull and Eurasian Skylark in Europe, 1980-2021. Notice the different scales on the y-axis. Data from PECBMS for European countries (all populations).

In contrast, the numbers of other Annex II species, like Common Snipe (*Gallinago gallinago*), Black-headed Gull (*Larus ridibundus*) and Eurasian Skylark (*Alauda arvensis*), show evidence of long-term declines on a European scale (Fig. 1, right). Their levels of harvest have not been assessed and it is unclear to what extent hunting contributes to the observed population declines. Nonetheless, a sustainable hunting level in this case must seek to recover the populations to a favourable level, rather than simply aim at stabilising them at such low values as the current ones.

CALCULATING SUSTAINABLE HARVEST LEVELS: POPULATION MODELS vs INCOMPLETE DATA

Essentially, there are two alternative approaches to assess the sustainability of harvest and the option will be made depending on the availability of data. When demographic data are sufficient, Population Models are the best option because they provide a good understanding of how the population dynamics operate, and they allow some projections into the future. Where demographic data are incomplete, an initial assessment of hunting (un)sustainability can be done with approaches such as the Demographic Invariant Method (DIM), which is available in the specific software *popharvest* discussed below. It should be noted, though, that popharvest can be a tool to detect cases of unsustainability, but that it cannot properly assess sustainability (cases not detected by the software as being unsustainable may in fact not be sustainable, see below). In the context of this contract, the consortium will develop population models for selected species that have sufficient demographic data. The models will act as a first step in the process of developing Adaptive Harvest Management Mechanisms (AHMM) for those species. For the rest, the (un)sustainability of harvest will be explored following an approach based in demographic invariants (DIM) at the appropriate spatial scale.

Population Models (PM) are usually built using detailed demographic data[7] as well as harvest data and population size estimates[8]. As a consequence, PMs are usually only available for a selection of well-known species. PMs allow calculating population growth rate[9] from actual field data on population parameters, considering uncertainty in the estimation (and also potentially variation across study sites and time). PMs are usually run many times (often >1000), and in each iteration the demographic values used by the model are taken randomly from the distribution of values within empirical data. In situations where a PM can be built, it is possible to "question" the model about the population response (e.g., projected growth rate or size over a given period) to different management decisions and scenarios, including hypothetical levels of hunting including no harvest.

The results of population modelling need to be interpreted in line with the conservation objectives for the species/population in question. For species with secure status and where the objective is for the population to remain stable, harvest scenarios leading to the population growth rate (λ) = 1, or to the population size oscillating within/above certain set limits, will generally be considered sustainable.

However, a harvest scenario leading to the same result (median λ = 1, stability) in case of a population that is in non-secure status or that is at a level below the "population objective" (if the latter is defined in quantitative terms) cannot be considered equally sustainable since **the objective for those populations is to attain population recovery**. In that case, **only those scenarios leading to population growth (λ strictly >1) can be considered sustainable**. Particularly for species in a non-secure conservation status, the concept of sustainable hunting should take into account the population objective (where possible in the form of predefined favourable reference values) and focus on the speed of recovery (how much time is needed to attain the population objective under different scenarios)[10].

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[7] *Including the necessary to allow estimating individual survival of the main age classes (e.g., from capture-mark-recapture programmes), breeding productivity (no. of young fledged per breeding attempt), number of annual breeding attempts (from individual tracking) and age at first reproduction.*

[8] *Although simpler models can sometimes be built with just harvest and abundance data if informative priors exist*

[9] *Population growth* rate *((λ) measures the variation in population size between two points in time . λ=1indicates population stability, λ>1 indicates population growth and λ<1 population decline (λ<1) over a time period.*

[10] *For example, Art. 9.3 of the European Commission COM(2022) 304 final 'Proposal for a Regulation of the European Parliament and of the Council for nature restoration' sets specific recovery targets in the common farmland bird index for each country, to be achieved by 2030, 2040 and 2050.*

For scientific correctness, the estimates obtained through population modelling need to be associated with a measure of uncertainty (error) around the estimated value. Therefore, the debate should also concern which probability around the estimate of population growth rate is acceptable to be below or equal to 1. For example, a population model built for European Turtle-dove (western flyway) indicated in 2021 that, in the “0 harvest” scenario, median population growth rate was positive, but there was a 32 % probability of continued population decline (Fig. 2 below), which was considered excessive risk. This led to a full hunting ban being adopted in the concerned Member States.

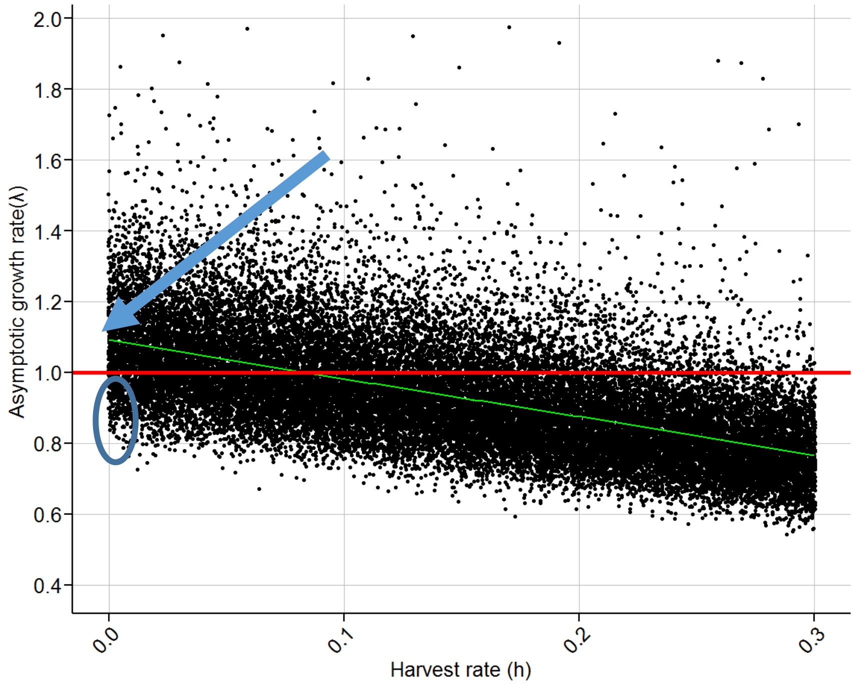

Figure 2. Population growth rate estimated from an Integrated Population Model for European Turtle Dove in the western flyway under varying levels of harvest rate. Green line represents median population growth rate for each harvest rate level. Each black dot represents the growth rate obtained in each of the simulations of the model. The arrow indicates that under zero harvest, median growth rate is positive. However, the blue ellipse highlights that 30% of the simulations under zero harvest rendered negative population growth rates.

Where data are incomplete, the **Demographic Invariant Method** (DIM) allows evaluating potential unsustainability of hunting by calculating a Sustainability Harvest Index (SHI), which is obtained by dividing the volume of actual harvest by an estimated maximum that the population can sustain. There are several approaches to estimating the divisor in that arithmetic operation.

One way is by estimating the annual excess production of new individuals in the population (births minus natural deaths) under optimal conditions and with no limiting factors, i.e., the so called **Potential Excess Growth - PEG**. Using the PEG approach, SHI is calculated as Harvest/PEG.

An approximation to a population´s Potential Excess Growth (PEG) can be calculated by using the formula

$$PEG = N \times (\lambda_{max} - 1) \times f$$

where N is the population size, λ_{max} the maximal annual growth rate expected under optimal conditions[11], and *f* a "recovery factor"[12], a parameter that takes into account the effect of density dependence on demographic performance[13], and that allows considering taking only a proportion of the maximal PEG when performing assessments of sustainability.

In the PEG approach (and under some assumptions[14] about the shape of the density-dependence function), setting *f* = 0.5 leads to calculation of the Maximum Sustainable Yield (MSY)[15], defined as the largest number of individuals that can be extracted from a species' population over an indefinite period in optimal conditions. MSY sets the threshold of sustainability for equilibrium population sizes aiming to remain stable in the long term. Therefore, setting *f* = 0.5 seems appropriate for species or populations with secure status where the aim is to maintain population size at a stable level. Simulations have shown that this *f* value provides sufficient protection against biases in population estimates, maximum growth rates and mortality estimates[16].

For species or populations with lower conservation or population status, including non-secure, the total allowable harvest must be at a level below MSY to allow for some population recovery. Some authors have proposed setting the value of *f* according to the species' IUCN conservation status[17], fixing f = 0.1 for globally threatened species and f = 0.3 for near-threatened ones. In other publications, the value of *f* is chosen from a range of values and is discussed based on the circumstances[18]. This is an important decision, because the value of the "recovery factor" *f* represents the share of the population excess growth that is considered acceptable to harvest. In this sense, setting the value of *f* is based on ecological considerations, but is also a form of social construct, as the choice is not based on empirical data or ecological calculations. Rather, it represents a position in the trade-off between conservation and exploitation. Such a position should consider the legal

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[11] *The rate of growth in the absence of density dependence and harvest, also called intrinsic growth rate*

[12] *Wade, PR. 1998. Calculating limits to the allowable human-cause mortality of cetaceans and pinnipeds. Marine Mammal Science 14: 1-37*

[13] *Niel, C. & Lebreton J-D. 2005. Using demographic invariants to detect overharvested bird populations from incomplete data. Conservation Biology 19: 826-835*

[14] *Specifically, the assumption of linear density dependence*

[15] *Johnson FA, Eraud C, Francesiaz C, Zimmerman GS, Koneff MD. (preprint). Using the R package popharvest to assess the sustainability of offtake in birds. EcoEvoRXiv https://doi.org/10.32942/X21G7D*

[16] *Wade, PR. 1998. Calculating limits to the allowable human-cause mortality of cetaceans and pinnipeds. Marine Mammal Science 14: 1-37*

[17] *Dillingham, P.W. & Fletcher, D. 2008. Estimating the ability of birds to sustain additional human-caused mortalities using a simple decision rule and allometric relationships. Biological Conservation 141 (7): 1783-1792, https://doi.org/10.1016/j.biocon.2008.04.022 and Eraud, C., Devaux, T., Villers, A., Johnson, F.A. & Francesiaz, C., 2021. Popharvest : an R package to assess the sustainability of harvesting regimes of bird populations. Ecology and Evolution 11: 16562-16571.*

[18] *Lormée, H, Barbraud, C., Peach, W., Carboneras C., Lebreton, J-D, Moreno-Zarate, L., Bacon, L. & Eraud, C. 2019. Assessing the sustainability of harvest of the European Turtle-dove along the European western flyway. Bird Conservation International 30: 506-521.*

framework (e.g., the Birds Directive) and it should ideally be agreed with all concerned stakeholders and Member States on the basis of scientific advice and taking into account the conservation status of the species as well as the population status and objective of the concerned population, and other factors, e.g. economic or recreational requirements or, when relevant, public perceptions about the value of the species recovery.

An alternative approach is based on estimating a "**Potential Take Level" (PTL**), defined as the harvest level that allows attaining a predefined management objective. When using PTL approach, the SHI is calculated as Harvest/PTL. The Potential Take Level (PTL) is, in turn, calculated as:

$$PTL_t = F_{obj} \times \left(\frac{r_{max}\theta}{(\theta + 1)}\right) \times N_t$$

where $r_{max}=(\lambda_{max}-1)$, $\theta>0$ is the form of density dependence, N_t is a time-dependent estimate of population size, and F_{obj} is a value between 0 and 1, representing a management objective. Setting $F_{obj} = 1$ in this case implies equating PTL to the maximum sustainable yield (MSY). As specified above, the latter is based on evolutionary life-history characteristics and may not reflect current ecological conditions, so harvests below MSY may still be unsustainable in variable environments or in populations that are at levels lower than their favorable conservation objectives. As with the PEG approach, it is possible to set lower values of F_{obj} to reflect a given population objective; doing so will estimate PTL as fractions of the maximum sustainable yield (MSY). The optimal value of F_{obj} is context dependent and depends on the agreed population objectives. Specifying F_{obj} should explicitly consider current and desired population sizes, based on the recovery objective required by the Birds Directive, taking into account intrinsic and observed population growth rates, the time required to meet management objectives, as well as demographic uncertainty and risk tolerance, with the actual scaling value being established in relation to the population status and objectives (population target and the desired speed of recovery). The value of F_{obj} can be determined once the above-mentioned variables are known[19]. However, it has been noted that both f and F_{obj} values are a social construct, informed by biology and ultimately they are an expression of social values that usually vary among stakeholders[19]. Johnson and colleagues suggest that $F_{obj} = 1$ can be considered for robust (i.e. secure) populations subject to recreational harvest, while $F_{obj} < 1$ might be appropriate for vulnerable populations[19]. It is also important to take into account that the definition of these values should be always considered in the context of the existing legal framework.

Overall, the **DIM** approach provides a relatively easy way to **detect overharvest** (i.e. the **unsustainability** of a certain level of hunting). But it is **important not to consider any SHI < 1 as an indication of current hunting levels being sustainable, particularly for populations/flyways in non-secure status**. In those cases, assuming the already agreed

[19] *Johnson FA, Eraud C, Francesiaz C, Zimmerman GS, Koneff MD. (preprint). Using the R package popharvest to assess the sustainability of offtake in birds. EcoEvoRXiv* https://doi.org/10.32942/X21G7D

general objective of population recovery, it will always be necessary to consider *f* values lower than 0.5 (if calculating PEG) or F_{obj} values lower than 1 (if calculating PTL) to assess sustainability of current harvest as, in those cases, harvest should be lower than MSY to allow population growth, as explained above. Also, given that both PTL and PEG are calculated based on inferred survival values (i.e., not obtained empirically), it would be important, as far as possible, to incorporate uncertainty for the input parameters (including population size and harvest, as well as intrinsic population growth) in the estimation of SHI.

COMPARING THE PEG AND PTL APPROACHES

From a mathematical point of view, the PEG and PTL approaches are comparable, because they include the same parameters: population size, maximum population growth, an indicator of density dependence, and a factor to regulate the relationship between all those variables (i.e., *f* or F_{obj}). Both approaches look at slightly different angles of (un)sustainability and, while PEG aims directly to detect overharvest, PTL can also be used to ascertain the path towards sustainability in a concerted process.

The following table summarises the strengths and weaknesses of the PEG and PTL approaches:

Pros	**Cons**
PEG approach	
• simple to use • detects overharvest (= **un**sustainability) • values of *f* factor fixed *a priori* by user, or agreed • may incorporate level of certainty	• does not allow identifying sustainable levels of harvest • *f* values somewhat arbitrary, as based on criteria that confounds ecological understanding and management objectives or risk tolerance.
PTL approach	
• allows assessing sustainable levels of harvest, once population objectives have been agreed • specifies more clearly the ecological criteria and the management objectives, allowing for more transparent process • values of F_{obj} factor agreed by users and stakeholders • increased ownership of the process • may incorporate level of uncertainty	• part of longer process • requires previous agreement on population objectives and F_{obj} factor • if used with no previous agreement on population objectives, has the same limitations as PEG approach (only detects overharvest, and arbitrary decisions on values of F_{obj} have to be taken)

CONCLUSIONS AND RECOMMENDATION

This exercise applies to 30 species with a non-secure status in Europe, which do not yet have a AHMP, at a time when no previous agreements exist on conservation objectives beyond the already agreed objective of aiming for population recovery. The aim is to try and identify species/populations for which current harvest is likely to be unsustainable (i.e. incompatible with an objective of population recovery), in order to guide stakeholders and Member States to take actions in that respect as soon as possible.

In line with Johnson et al.[20], we recommend using the PTL approach over the PEG. One possible option would be to fix F_{obj}=1, calculate the probability that P(SHI)>=1 for each species/population, and rank them accordingly. Higher rankings (i.e. higher values of P(SHI) >=1) would correspond to the populations in need of most urgent immediate action. However, as mentioned above, when fixing F_{obj} =1, low(er) values for P(SHI)>=1 do not necessarily imply that hunting in those species/populations is sustainable, and there may be situations when the likelihood of unsustainability is also high when taking into account the context of each population (trends, recovery aim, etc.).

Given this, our recommendation is for the alternative option to run popharvest using the full range of F_{obj} values between 0.1 and 1 for each population at the appropriate spatial scale. In each case, there will be 10 values of P(SHI)≥ 1 (one for each F_{obj} value), and a distribution of associated probabilities that SHI>1. Populations in which most values of F_{obj} show a high probability that SHI≥ 1 can be taken as indicative that hunting is clearly unsustainable ('red cases'). Those with few or no values of F_{obj} giving high probabilities of SHI≥ 1 would be less likely to be unsustainable ('green cases') under objectives of population recovery, and those in between would need to be considered more carefully ('orange cases') (see Box 2).

The results would have to be accompanied by information allowing a discussion in the Task Force on the recovery of birds, in view of agreeing on a recommendation to be put forward to NADEG.

In particular, for each species/population in the 'orange cases', the experts in the consortium[21] would clearly indicate a range of F_{obj} values that are plausible, considering the population size and trends and the recovery objective for that species/population. Moreover, the experts would clearly indicate the implications in terms of speed of recovery

[20] *Johnson FA, Eraud C, Francesiaz C, Zimmerman GS, Koneff MD. (preprint). Using the R package popharvest to assess the sustainability of offtake in birds. EcoEvoRXiv https://doi.org/10.32942/X21G7D*

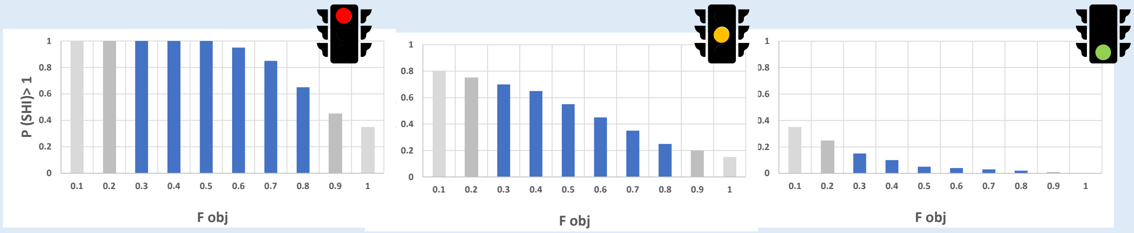
[21] *Service contract No. 09.0201/2022/886665/SER/D.3 delivered by a consortium of research institutions, led by the Institute for Game and Wildlife Research (IREC) in Spain.*

and other relevant parameters of F_{obj} values in the lower part of the range of plausible values, as well as those associated with higher F_{obj} values (in the range of plausible values).

All cases and follow up recommendations would have to be consistent with the approach for the recovery of bird species that are not in secure status (See NADEG Doc Nadeg 21-12-03[22]).

Box 2 – Using PTL with a range of F_{obj} of values.

Given that we aim to assess sustainability of hunting in the absence of an agreed quantitative population objective (i.e. in the absence of agreed Favourable Reference Values), but that for the 30 species being considered (all in a non-secure status), there is an agreed objective of population recovery, we propose using a range of values for Fobj, and estimate the probability of SHI>1 in relation to Fobj. We can then calculate the probability of current harvest being unsustainable to allow population recovery based on that relationship. In all cases, the probability of SHI>1 will increase when using lower values of Fobj, but the shape of that relationship and the actual values will vary. Three hypothetical examples are illustrated in the Figure below.



In the example on the left (RED), overall probabilities of SHI being higher than 1 range between ca. 30% and 100%. This could be interpreted as indicative that the likelihood of current harvest being unsustainable, regardless of the population objective, is high. In the example on the right (GREEN), values range between 0 and 45, which could be interpreted as low likelihood of the current harvest being unsustainable under most population objectives. Some species will fall under patterns showing clearly unsustainable harvest under most circumstances, or clearly sustainable except in extreme conditions. Some other species will fall between both extremes (figure in the middle -ORANGE), which would indicate sustainability if population objective is stability (associated with high values of Fobj), but unsustainability if the aim is to achieve fast population recovery (associated with very low values of Fobj). In all graphs, histograms in blue indicate the F_{obj} values more likely to reflect realistic situations in the management of Annex II species in non-secure status. It should be noted that all Annex II species in secure status (not considered in this exercise) are more likely to be in green.

[22] *https://circabc.europa.eu/ui/group/fcb355ee-7434-4448-a53d-5dc5d1dac678/library/044a1b53-a243-4a5f-a70c-c6c494aaf11c/details*

ANNEX I: STEPWISE PROCESSES TO APPLY THE PTL APPROACH TO ANNEX II SPECIES WITH NON-SECURE STATUS

1. **Define the spatial unit** for management (e.g., for waterbirds, the 'biogeographical populations' identified by Wetlands International and the AEWA Technical Committee, for other species e.g. turtle dove, the flyway).
2. **Compile the necessary input data** for each population. As a minimum, total population size and harvest. Also, to the extent possible, survival in optimal conditions (or, alternatively, body mass) and age at first reproduction, as well as a definition of the species' life-history strategy ('long' or 'short'). In addition to the above, the shape of the density dependence function ('concave or 'convex') must be specified.
3. **Run function PTL in popharvest, specifying uncertainty** by fixing the number of simulations.
4. In a first phase, pending discussion and agreement on quantified conservation objectives and speed of recovery, **the full range of F_{obj} values between 0.1 and 1 will be applied.** Species/populations will be classed in three categories (green, orange, red, see Box 2) according to the distribution of probabilities obtained from those analyses.
5. **Interpret the results.** Outputs include SHI and PTL values. SHI >1 indicates overharvest, but lower values do not necessarily imply that harvest is sustainable (compatible with reaching conservation objectives). The interpretation of the results of species/populations classed as "orange" will be based on a variety of factors, such as the population status (which may influence the importance of taking wrong decisions), the species category (cases 1 to 5, which will speak about the importance of hunting vs other stress factors), as well as the management objective (including desired speed of recovery) (see also point below).
6. **Provide information allowing an informed discussion in the Task Force on the Recovery of Bird species.** In particular, for each species/population in the 'orange cases', the experts in the consortium[23] would clearly indicate the range of F_{obj} values that are plausible, considering the population size and trends and the recovery objective for that species/population, as explained above. Moreover, the experts would clearly indicate the implications in terms of speed of recovery and other relevant parameters of F_{obj} values in the lower part of the range of plausible values, as well as those associated with higher F_{obj} values (in the range of plausible values). Other coexisting factors influencing the speed of recovery, such as economic and recreational interests, the likelihood of investment in habitat restoration, the size and status of the wintering population, etc. will be considered in this step.

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[23] *Service contract No. 09.0201/2022/886665/SER/D.3 delivered by a consortium of research institutions, led by the Institute for Game and Wildlife Research (IREC) in Spain.*

ANNEX II: REPLIES TO FEEDBACK RECEIVED FROM NATIONAL AUTHORITIES AND STAKEHOLDERS

Following circulation to the EU Task Force on the Recovery of Birds (4th meeting, December 2023), several national authorities and stakeholder organisations expressed their support to the approach presented in this document and, at the same time, they provided useful feedback. The ideas expressed in their comments have been incorporated to a new version, as appropriate. However, two lines of reasoning emerge from several responses and deserve being considered and discussed here.

The first argument disapproves the document's exclusive focus on hunting, disregarding the important role of habitat management and other necessary measures to improve the living conditions and, therefore, the conservation prospects of these species. In this respect, it should be noted that this document forms part of a larger set of documents containing proposals for actions contributing to the recovery of species listed on Annex II of the Birds Directive with non-secure status, including on habitat management. In that context, this document contains the definitions and proposed methodology to assess the (un)sustainability of hunting, whilst acknowledging that hunting management is only one component of a wider strategy. Other actions are needed, in most cases, and they are presented elsewhere. The implementation of those actions including habitat restoration could however be used when interpreting the implications of the range of F value. They will provide information allowing an informed discussion in the Task Force on the recovery of bird species in step 6.

The second argument concerns the choice of abundance estimator to assess the status of Annex II species or populations. Some argue that the breeding population size may not be a good indicator for aquatic bird species, and that using the winter population size, which is estimated every year through mid-winter censuses (IWC) coordinated internationally by Wetlands International[24], may be more appropriate. Two powerful reasons supporting that view are that (1), the winter distribution and abundance of certain species in Europe is much higher than their (summer) breeding abundance; and (2), that hunting takes place precisely during the non-breeding season, so it is the monitoring of those populations that will indicate the success of management measures.

Looking at the evidence[25], it emerges that of the 33 migratory bird species listed on Annex II of the Birds Directive with non-secure status, in all cases the EU breeding populations have non-secure status (see table below). As for the winter season, for 15 of the 33 species there is no specific information on their population status (in several cases, because they

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[24] *Mostly through the International Waterbird Census (IWC), organised by Wetlands International. Long-term estimates and trends from those counts are available on the Waterbirds Populations Portal* [*https://wpe.wetlands.org/*](https://wpe.wetlands.org/)

[25] EIONET (2024). Article 12 web tool on population status and trends of 13birds under Article 12 of the Birds Directive. https://nature-art12.eionet.europa.eu/article12/

overwinter in Africa) and for 7 species the EU winter populations also have non-secure status. However, there remain 11 species that have non-secure status during the breeding season but secure status in winter, i.e., their EU winter populations are in a better status than their EU breeding populations (possibly as a result of immigration of individuals from breeding populations outside the EU). For Taiga Bean Goose, Greater Scaup, Northern Shoveler, Eurasian Wigeon and Pintail, their mean winter population is at least 10 times bigger than their average breeding population, strongly suggesting large immigration from outside the EU. Those species are highlighted in bold in the table below.

Breeding pop status	Winter pop status	Species	Winter/Breed. pop ratio	Evidence immigration
non-secure	absent (winter in Africa) or not evaluated	(15) Garganey, Common Quail, European Turtle-dove, Water Rail, Ruff, Common Snipe, Spotted Redshank, Black-headed Gull, Mew Gull, European Herring Gull, Great Black-backed Gull, Rook, Eurasian Skylark, Common Starling, Redwing	n/a	n/a
non-secure	non-secure	(7) Long-tailed Duck, Common Eider, Velvet Scoter, Common Pochard, Eurasian Oystercatcher, Northern Lapwing, Common Redshank	n/a	n/a
non-secure	secure	**(Taiga) Bean Goose**	**37:1**	**strong**
non-secure	secure	Red-breasted Merganser	2:1	none
non-secure	secure	Tufted Duck	5:1	weak
non-secure	secure	**Greater Scaup**	**158:1**	**strong**
non-secure	secure	**Northern Shoveler**	**11:1**	**strong**
non-secure	secure	**Eurasian Wigeon**	**36:1**	**strong**
non-secure	secure	**Pintail**	**22:1**	**strong**
non-secure	secure	Common Teal	5:1	weak
non-secure	secure	Common Coot	3:1	weak
non-secure	secure	Eurasian Curlew	3:1	weak
non-secure	secure	Black-tailed Godwit	4:1	weak

The main questions remain what the interaction between those subpopulations is and whether, given that they form part of the same flyway, they should be treated as part of the same unit. The probability that authorising hunting of a much larger winter population may have a negative effect on the small breeding population should be investigated. In any case, the assessment of (un)sustainability of hunting is to be carried out based on the size of the population in winter, and any considerations of the potential impact on the species population status will be made during the discussion of the results of that analysis.