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PROPOSAL FOR AN APPROACH TO DEFINE FAVOURABLE REFERENCE VALUES AND SET POPULATION TARGETS FOR BARNACLE GOOSE AND GREYLAG GOOSE POPULATIONS

The 4th Meeting of the AEWA European Goose Management International Working Group is being hosted by Scottish Natural Heritage.

AEWA INTERNATIONAL MANAGEMENT PLANNING WORKSHOP FOR THE BARNACLE GOOSE AND THE GREYLAG GOOSE (NW/SW European population)

19 June 2018, Leeuwarden, the Netherlands

PROPOSAL FOR AN APPROACH TO DEFINE FAVOURABLE REFERENCE VALUES AND SET POPULATION TARGETS FOR BARNACLE GOOSE AND GREYLAG GOOSE POPULATIONS

Background

In line with Paragraph 4.3.4 in Annex 3 of AEWA, International Single Species Management Plans (ISSMPs) are being prepared for all three populations of Barnacle Goose and for the NW/SW European population of Greylag Goose at the request of the AEWA Meeting of Parties (Operative Paragraph 9 of Resolution 6.4).

The aim of AEWA is to maintain or restore each population to Favourable Conservation Status (FCS); defining Favourable Reference Values (FRVs) is an important step in the process. Although, the AEWA Technical Committee adopted a set of guidelines addressing this subject in 2017, the development of a methodology for setting FRVs under the EU Nature Directives is also in progress. As both species are also subject to the EU Birds Directive, it was agreed during the 1st Greylag Goose Management Planning Workshop in October 2017, in Paris, to review the lessons that can be learned from the project on *Defining and applying the concept of Favourable Reference Values* commissioned by the European Commission and from other projects dealing with the subject, including the large carnivores, which represents a similar problem in many respects. On 4 April 2018, a workshop to review various approaches took place in Ede, the Netherlands.

This proposal builds on the techniques presented at the workshop in Ede and follows the step-wise approach outlined in Bijlsma et al. (2018) to define FRVs in the context of the EU Nature Directives. However, it also recognises that FRVs only represent a legal minimum. Management targets should be defined above this legal minimum and the trade-offs with other, often conflicting, interests should also be addressed in this process. This document outlines a proposal on how this process should be taken forward in the context of developing implementation plans for the three populations of Barnacle Goose and the NW/SW European population of Greylag Goose.

Discussions about FCS are often plagued by confusing '*how much is needed'* (FCS) with '*how much we want*' (management targets, Trouwborst et al. 2017). This proposal outlines a two-step process that addresses these sequentially:

1) Define FRVs as our constraints for setting management (population) targets following available guidance;

2) Define management (population) targets above the FRVs that take into account the trade-offs between the various fundamental objectives of the draft International Single Species Management Plans (ISSMPs).

The 2nd AEWA International Management Planning Workshop for the Barnacle Goose and the Greylag Goose (NW/SW European population) is being hosted by the Province of Friesland.

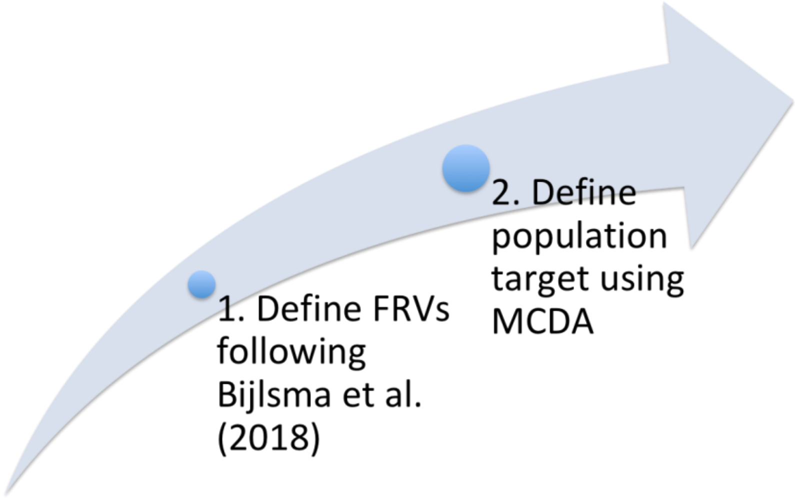

Figure 1. A two-step process involving defining FRVs and setting management (population) targets using methodologies as described further in this paper. Management targets are subject for periodic revisions when the management plans are revised to reflect changing ecological and socio-economic circumstances.

Action requested from the Range States

The Range States are requested to review the proposal for the approach to defining FRVs and management (population) targets for the populations of the Barnacle and Greylag Geese and decide on the use of the suggested methodologies.

List of abbreviations

AEWA	Agreement on the Conservation of African-Eurasian Migratory Waterbirds
BD	Birds Directive
CMS	Convention on Migratory Species
CV	Current Value
DV	Directive Value, i.e. value of population size, range, habitat extent at the time the Birds or Habitats Directive (depending on the species) came into force
EU	European Union
FCS	Favourable Conservation Status
FRP	Favourable Reference Population
FRR	Favourable Reference Range
FRV	Favourable Reference Values
MCDA	Multi-criteria decision analysis
MVP	Minimum Viable Population

1. DEFINING FAVOURABLE REFERENCE VALUES

Legal definition of Favourable Conservation Status

In the case of AEWA Species Action and Management Plans, the definition of Favourable Conservation Status set out in Paragraph 1(c) of the Convention on Migratory Species (CMS) is applicable:

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;

As most of the Range States of these populations are also EU Member States, the provisions of the EU Birds Directive, including Article 2 of the EU Birds Directive is also applicable.

According to Article 2, "*Member States shall take the requisite measures to maintain the population of the species referred to in Article 1 at a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements, or to adapt the population of these species to that level*".

In the interpretation of the European Commission[1], the requirement of maintaining populations in Favourable Conservation Status (FCS) is included into the requirements of Article 2, consequently the concept is also applicable in the context of the EU Birds Directive.

It is important to note, however, the definition of Favourable Reference Population (FRP) of the Habitats Committee that states: "*Population in a given biogeographical region considered the* ***minimum necessary to ensure the long- term viability of the species****; favourable reference value must be at least the size of the population when the Directive came into force*" (European Commission 2005), which is consistent with the approach proposed in this paper.

[1] See footnote 28 of the EU Hunting Guide on page 20

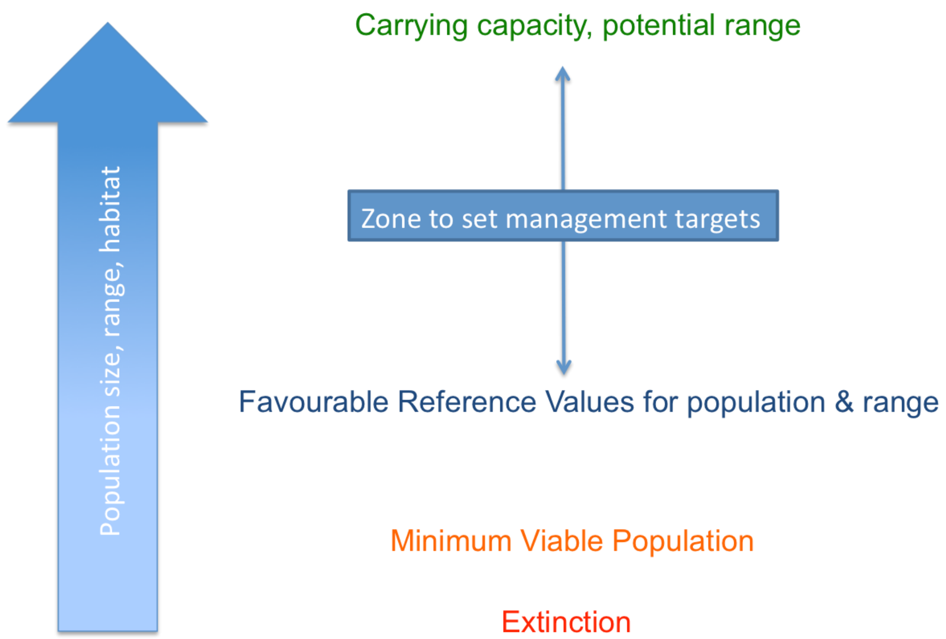

Figure 2. Relationship between extinction, Minimum Viable Population, Favourable Reference Values and carrying capacity. A population is in Favourable Conservation Status when its size and range is equal or larger than the FRVs.

Available guidance

Although the FCS is a key concept in CMS and (a slightly different version) in the EU Habitats Directive (and indirectly also in the Birds Directive), there is little legal and ecological certainty how and at what level FRVs should be set and at what level economic and recreational requirements can also be considered. What is available falls into one of the following categories in order of decreasing regulatory relevance:

1) Non-binding legal guidance from the DG Environment (2017) and AEWA Technical Committee (2017);
2) Technical reports supporting the development of guidance (e.g. Bijlsma et al. 2018);
3) Scholarly legal analysis (e.g. Epstein et al. (2015), Trouwborst et al. (2017);
4) Scientific ecological studies (e.g. Brambilla et al. 2011, Brambilla et al. 2014);
5) Advocacy materials by NGOs (e.g. BirdLife International 2006, BASC 2014).

It is proposed to apply similar standards for the Barnacle Goose and the Greylag Goose as the general principles applicable for defining FRVs for populations under the EU Habitats Directive (DG Environment 2017) which are also adopted for birds (Bijlsma et al. 2018):

1) FRVs should be set on the basis of ecological and biological considerations;
2) FRVs should be set using the best available knowledge and scientific expertise;
3) FRVs should be set taking into account the precautionary principle and include a safety margin for uncertainty;
4) FRV’s should be formulated for population size, range, habitat availability and their future prospect;

5) FRVs should not, in principle, be lower than the values when the [appropriate] Directive came into force (DV), however the distribution (range) and size (population) at the date of entry into force of the Directive does not necessarily equal the FRVs;

6) FRV for population is always bigger than the Minimum Viable Population (MVP) for demographic and genetic viability;

7) FRVs are not necessarily equal to 'national targets': 'Establishing favourable reference values must be distinguished from establishing concrete targets: setting targets would mean the translation of such reference values into operational, practical and feasible short-, mid- and long-term targets/milestones. This obviously would not only involve technical questions but be related to resources and other factors' (European Commission, 2004);

8) FRVs do not automatically correspond to a given 'historical maximum', or a specific historical date; historical information (e.g. a past stable situation before changes occurred due to reversible pressures) should, however, inform judgements on FRVs;

9) FRVs do not automatically correspond to the 'potential value' (carrying capacity) which, however, should be used to understand restoration possibilities and constraints.

Bijlsma et al. (2018) described a step-wise approach to define FRVs (Figure 3).

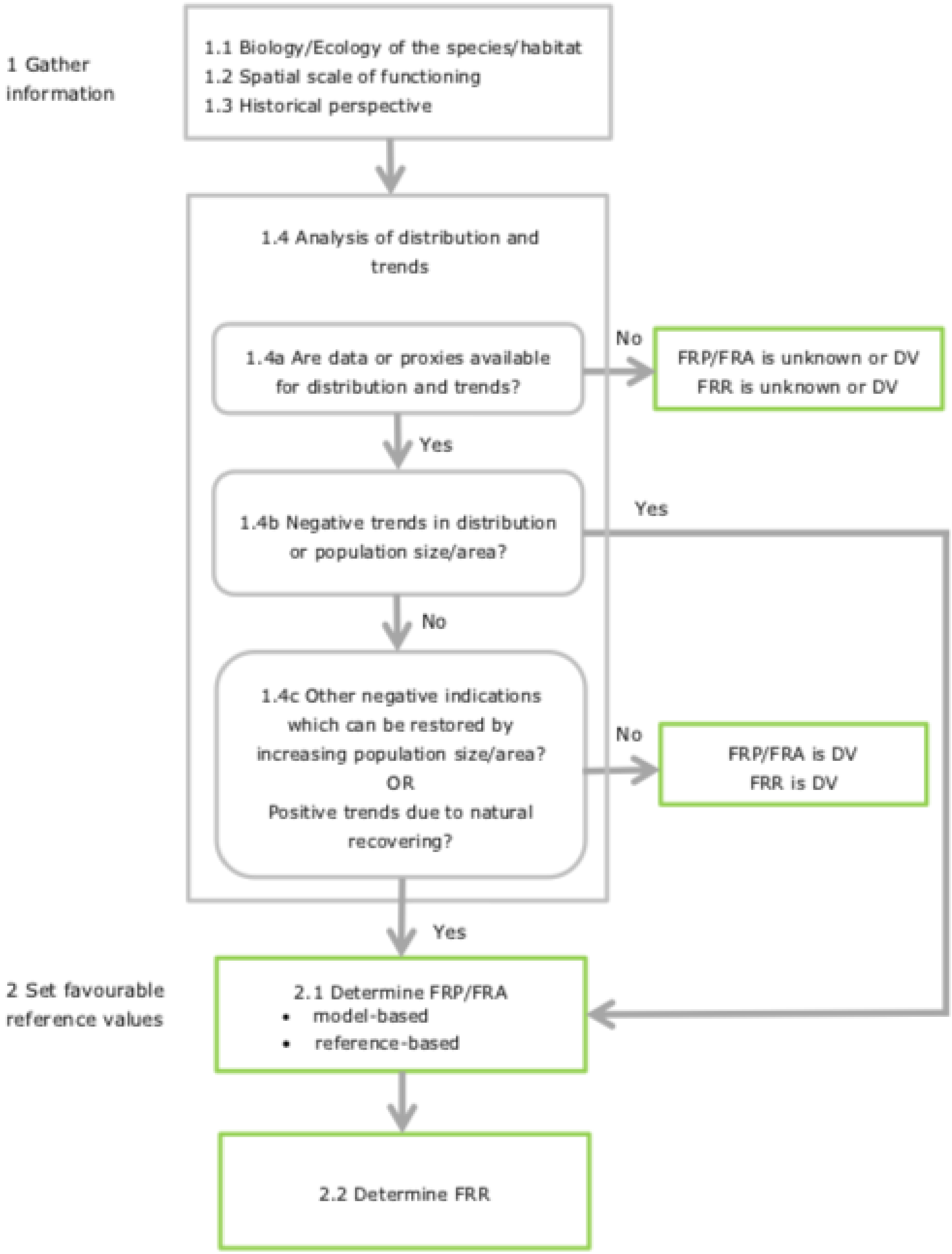

Figure 3. The step-wise approach for setting FRVs for species and habitat types proposed by Bijlsma et al. (2018). DV refers to values at the time the Birds or the Habitats Directive respectively came into force.

Applying the guidance for defining FRVs for Barnacle Goose and Greylag Goose populations

This section follows the steps in Figure 2 and the guidance provided by Bijlsma et al. (2018, in particular Sections 4.2 and 5.4). Page numbers in the footnotes indicate the relevant part of the guidance.

Step 1.1: Biology of the species[2]

Available information on population size, genetic structure of the populations, management units, habitat requirements, existing range are described in Annexes 1 of the two draft International Single Species Management Plans (ISSMPs) (documents AEWA/BG/GG/MPWS/2.3 and AEWA/BG/GG/MPWS/2.4).

Step 1.2: Spatial scale of functioning: how many populations?

With reference to the guidance of the AEWA Technical Committee (2017), Section 5.4.4[3] recommends a three-step approach:

1. **Define and delineate flyway populations.** The authors note that flyway populations are well defined for waterbirds and, among others, they refer to Scott & Rose (1996) and the CSN Tool (http://criticalsites.wetlands.org/en), which are also the recognised sources for defining the flyway populations of Barnacle and Greylag Geese in Table 1 of AEWA and which were followed by the two draft ISSMPs (documents AEWA/BG/GG/MPWS/2.3 and AEWA/BG/GG/MPWS/2.4)). Furthermore, Bijlsma et al. (2018) recognises that truly migratory individuals breeding in the northern parts of the range may mix during migration and wintering with more sedentary individuals in the southern part of the breeding range; but both kind of individuals are considered part of the same flyway population. This is consistent with the AEWA definition of the flyway populations in this management planning process.
2. **Gathering information about the population status of the flyway population.** Available information is presented in documents AEWA/BG/GG/MPWS/2.3 and AEWA/BG/GG/MPWS/2.4) and summarised in section 1.3 below.
3. **Assessment of the FRP & FRR for the different annual cycle stages.** FRR always need to be defined separately for the reproductive and for the non-reproductive seasons (i.e. breeding, staging and wintering ranges). FRPs also should be set for the different stages of the annual cycle. These should be set more-or-less independently for the breeding and non-breeding stages when the breeding or non-breeding ranges of the one population overlaps with others'. However, FRPs set for the different stages should be consistent with one another, especially in case of populations that do not overlap with others.

Step 1.3: What happened to the species?[4]

Understanding the past changes in distribution, population size and trend is important to define FRVs. These are discussed in the draft ISSMPs (AEWA/BG/GG/MPWS/2.3 and AEWA/BG/GG/MPWS/2.4).

Step 1.4: Analysis of distribution and trends[5]

Step 1.4a: Are data or proxies available for distribution and trends?

Step 1.4b: Negative trends in distribution or population size?

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[3] Page 57
[4] Page 37
[5] Page 37

It has to be assessed from an appropriate historical perspective whether negative trends have happened either in the recent past (i.e. within c. 50 years before the BD came into force) or in the historical past (up to two or three centuries). If there were negative trends in the recent or historical past, the process continues with Step 2.1.

Step 1.4c: Other negative indications which can be restored by increasing population size or Is there a case of population recovery?

If no negative trend indications for the recent or historical past, it has to be checked that:

1. Small and isolated populations are viable. If in doubt, the process should continue through Step 2.1.;
2. The situation where range and population show positive trends due recovering needs explicit consideration. If yes, the process should continue through Step 2.1.

Step 2.1: FRP assessment[6]

[Sub]-step 1: Box 4.2[7] in Bijlsma et al. (2018) provides some guidelines how to determine the size of the MVP[8] for reproductive populations:

A. Determine or infer the Minimum Viable Population size (MVP) considering evolutionary potential (‘genetic MVP’)

   a. Perform a Population Viability Analysis (PVA), but even Bijlsma et al. (2018) recognise that PVA-based MVPs have a short temporal validity and are context dependent.

   b. Use MVP estimates from:

      i. Species and context specific literature. Although both species have some PVAs, no MVP has been determined for either species or population;

      ii. Generalised genetic rules to an effective population size Ne ≧ 500;

      iii. Body size relationship described in Section 5.4.2, which suggests an MVP around 500 individuals for heavy birds (>1 kg).

B. Translate MVP-size to FRP level. Bijlsma et al. (2018) proposes[9] using a factor of 10 as a rule of thumb for birds in Section 5.4.2.

C. Determine FRP. Compare the MVP to the DV.

[Sub]-step 2. Considering reference values[10]

Population numbers should not be lower than at the start of the Bird Directive (BD), but this does not necessarily mean that the Directive Value (DV) is a favourable situation for a bird population. The guidance on birds in Bijlsma et al. (2018) presents the following cases:

1. A species' population size might have declined before the BD came into force. In that case the upscaled MVP value always serves as a threshold to prevent setting a FRP that might lead to extinction. If the DV exceeds the MVP, the FRP should be at least equal to DV. A higher FRP value should be set if the species is known to have declined as a result of unnatural conditions that could be reversed given the current human presence and its needs.

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[7] Page 39
[8] Page 54
[9] Page 55
[10] Page 56

2. A species' population size might have been above MVP level when the BD came into force although it was depleted at that time. However, it has shown recovery since, because of restoration of natural conditions. In that case a more recent population level should be set as FRP such as current value (CV) or use an operator and wait till population size has been stabilized.
3. A species' population size can have increased after the BD came into force not as a consequence of restoration/improvement of natural conditions, but due to a substantial increase in artificial habitat. [Bijlsma et al. 2018] suggest setting DV as FRV (if it exceeds upscaled MVP), despite a higher CV in this case. An example is the increase of geese in the Netherlands as a result of agricultural intensification leading to an increase and improvement of foraging habitat.

For non-reproductive ‘populations’, FRP generally cannot be defined for the key areas for wintering or passing[11] using the MVP-based method, and the reference-based method is the only option. However, it should be added that FRP can be derived from MVP for the breeding population in cases when populations do not mix to a large extent because the FRP for the reproductive and non-reproductive areas should be in balance. Targets for wintering must consider the carrying capacity of the (national or supranational) wintering areas using time series over several years from which peak numbers can be used as a proxy for the non-reproductive FRP and a reference value can be derived for the population size in 1980 (DV)[12].

Step 2.2. Considering reference values

Consider the consequences of the decisions on FRP on defining FRR.

[11] Page 54
[12] Page 59

2. USING MULTI-CRITERIA DECISION ANALYSIS TO HELP SET POPULATION TARGETS FOR BARNACLE AND GREYLAG GEESE

Multi-criteria decision analysis (MCDA) (Mendoza and Martins 2006, Huang et al. 2011) is suggested as a framework for deliberations concerning the setting of population goals. Now widely used in natural resource management, MCDA combines scientific information with social objectives to help arrive at a preferred decision alternative. The idea is to clearly define objectives (e.g, minimize agricultural damage) and then use science to predict the consequences of alternative choices for each of those objectives. The best alternative is the one that maximizes the weighted sum of (normalized) consequences across objectives. MCDA explicitly recognizes multiple objectives and inherent trade-offs, and relies on stakeholder input to determine the relative importance of objectives.

Objectives, decision alternatives, and consequences are typically assembled into what is referred to as a consequence table. Elements of the following consequence table are completely hypothetical, and are intended solely to demonstrate the concept of a MCDA. The list of objectives is neither comprehensive nor necessarily reflects the fundamental objectives of the draft management plans. Table 1 is for illustrative purposes only.

Table 1. Example of a consequence table used in the MCDA process

			Alternative population goals (1000s)		
Objective	**Metric**	**Goal**	**500**	**1000**	**2000**
Risk of quasi-extinction	Pr(N<FRP over x years) (%)	minimize	2.0	1.0	0.3
Agricultural damage	# derogation permits	minimize	35	50	60
Culling	# birds culled (1000s)	minimize	25	15	0
Hunting opportunity	# birds harvested (1000s)	maximize	15	15	10
Air safety	ordinal (1=worst)	maximize	3	2	1

Importantly, each social objective is unambiguously defined by one or more measurable attribute (metrics), which the decision maker would like to minimize or maximize. Notice that each of the three alternative population goals have consequences for each of the objectives. For example, the alternative of 500,000 does the best on the objectives to minimize agricultural damage and to maximize (sustainable) hunting opportunity and air safety (green shading), but does worst in terms of minimizing quasi-extinction probability and culling (pink shading). In contrast, a goal of 2 million does best in terms of minimizing quasi-extinction probability and culling, but the worst in terms of minimizing agricultural damage and maximizing harvest and air safety. The population goal of 1 million is expected to provide intermediate consequences. This example demonstrates the trade-offs almost always inherent in decision problems with multiple objectives.

What alternative population goal would be considered the best? The answer, of course, depends on which objectives are more important. Stakeholders can assess the relative importance they place on objectives using a simple technique known as swing weighting (Gregory et al. 2012). First, the stakeholder is asked to imagine a hypothetical alternative that has the worst consequences across all objectives. Then the stakeholder is asked to identify their most important objective and to swing its (and only its) consequence from its worst value to its best to develop a second hypothetical alternative. That alternative is given a rank of 1 (the best). The stakeholder repeats the process swinging one (and only one) consequence from its worst to its best, and ranks those hypothetical alternatives from the second best (2) to the worst (5, in this case). Then the stakeholder assigns 100 points to the hypothetical alternative ranked number 1. They then assign points to the remaining hypothetical alternatives in accordance with how important they are relative to the top ranked one. Finally, the scores are normalized to provide a relative weight for each of the objectives. The first table on the following page demonstrates these steps. In this example, the objective to minimize quasi-extinction probability is of utmost importance, followed by the desire to minimize agricultural damage. Minimizing the culling of birds is less than half as important as minimizing quasi-extinction probability.

How are the weights on the objectives used to identify a preferred alternative? First, all consequence scores are normalized to the interval 0-1 (with 0 being the worst outcome and 1 being the best) for each objective. Then for each alternative, a weighted sum of the (normalized) consequence scores is calculated, using the objective weights established in the swing-weighting exercise. The result is shown in the second table on the following page. In this example, a population goal of 1 million provides the most satisfactory level of trade-off in objectives. However, the population goal of 500,000 scored almost as high. The high scores associated with these alternatives are a direct result of the relatively high weights on agricultural damage, hunting opportunity, and air safety. Changing the weights on the objectives could well change the preferred alternative.

The MCDA for a given species could proceed as follows:

1) Ensure agreement on a set of unambiguous objectives and their associated measurable attributes for each population in question;
2) The EGMP Data Centre would then use empirical information, models, and expert opinion where necessary to predict the consequences of varying population goals on each of the objectives. In some cases, the consequences might be highly uncertain (e.g., the relationship between population size and agricultural damage). We can use the uncertain values and the swing-weighting by stakeholders to assess the risk attitude of stakeholders (Clemen 1996) (more on this later);
3) After preparation by the EGMP Data Centre, a consequence table would be circulated to relevant stakeholders via email with instructions on how to do the swing-weighting exercise. Stakeholders would be asked to identify themselves only as representing a national government, conservation organization, hunting organization, or agricultural organization. This permits an understanding of the variability in stakeholders' perspectives of the objectives, and allows an associated sensitivity analysis (i.e., do the different stakeholder groups vary enough in their respective weights to produce substantive differences in the preferred population goal?);
4) Results would be compiled, circulated, and discussed at the next EGM IWG meeting.

Table 2. Example of swing-weighting of objectives based on the consequences in Table 1. Hypothetical alternatives are developed by swinging one and only one consequence to its best outcome, while leaving the others at their worst. The stakeholder then makes value judgements to rank and score the hypothetical alternatives, and the objective weights then are the normalized scores.

Hypothetical Alternative	Quasi-extinction	Agricultural damage	Culling	Hunting opportunity	Air safety	rank	score	weights	Objective
Base	2.0	60	25	10	1				
A	0.3	60	25	10	1	1	100	0.328	Risk of quasi-extinction
B	2.0	35	25	10	1	2	70	0.230	Agricultural damage
C	2.0	60	0	10	1	5	40	0.131	Culling
D	2.0	60	25	15	1	4	45	0.148	Hunting opportunity
E	2.0	60	25	10	3	3	50	0.164	Air safety
						sums	305	1.000	

Table 3. Example of the consequence table with normalized consequence scores and their weighted averages for each alternative, using the weights from the swing-weighting example. In this case, a population goal of 1 million is provides the most satisfactory trade-off in objectives, while a goal of 2 million provides the worst trade-off.

			Alternative population goals			normalized scores		
Objective	**Metric**	**Goal**	**500**	**1000**	**2000**	**500**	**1000**	**2000**
Risk of quasi-extinction	Pr(N<FRP over x years) (%)	minimize	2.0	1.0	0.3	0.000	0.588	1.000
Agricultural damage	# derogation permits	minimize	35	50	60	1.000	0.400	0.000
Culling	# birds culled	minimize	25	15	0	0.000	0.400	1.000
Hunting opportunity	# birds harvested	maximize	15	15	10	1.000	1.000	0.000
Air safety	ordinal (1=worst)	maximize	3	2	1	1.000	0.500	0.000
					wtd sum	0.541	0.567	0.459

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