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EVALUATING THE AEWA SVALBARD PINK-FOOTED GOOSE INTERNATIONAL SPECIES MANAGEMENT PLAN: COSTS, BENEFITS AND PREFERENCES OF STAKEHOLDERS

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AEWA SVALBARD PINK-FOOTED GOOSE INTERNATIONAL WORKING GROUP

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Photo: Pink-footed Geese, Nord Trøndelag, Norway

Report for the:
1st Meeting of the AEWA European Goose Management International Working Group

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EXCUTIVE SUMMARY

The AEWA International Species Management Plan (ISMP) for the Svalbard Pink-footed Goose was initiated in 2012. The ISMP is the first management plan, in Europe, to actively manage a migratory population of waterbirds. The plan was founded on the concept of adaptive management and assimilated key principles of: inclusion, agreed objectives, monitoring, assessment and adjustment of management actions. Annual assessments of its performance have been undertaken, but there was a request, from within its international working group (IWG), to evaluate if the adaptive management process was delivering 'value for money' and set-out a strategy for its longer-term operation. This request highlighted the need to quantify its costs and anticipated benefits in monetary terms. In response, we undertook a rudimentary Cost-Benefit Analysis (CBA) of the ISMP to assess if anticipated gains outweighed its costs.

We compared two scenarios: maintaining the population at the agreed target of 60,000 geese versus 'business-as-usual' where the population was predicted to increase to 134,000 geese by 2022. In this paper we illustrate that the ISMP has the potential to deliver considerable net benefit in avoided crop damage payments in comparison to the operational costs of running the ISMP annual management cycle. However, this is just one tangible benefit of the ISMP, which has multiple objectives and potential management actions. The CBA raised crucial questions about what are valued aspects and outcomes of the ISMP process, as viewed by IWG participants.

We used the Analytical Hierarchy Process (AHP) to derive an order of priorities for the ISMPs objectives, as well as other anticipated outcomes, divided into three overall categories: environmental, economic and social. The collective preferences of IWG members prioritised environmental outcomes above economic or social criteria e.g. maintaining a stable population and the ecological integrity of its habitats. Minimising agricultural losses was the only economic criteria to rank within the top five prioritised ISMP outcomes. In addition, the AHP has indicated that aspects integral to an adaptive management approach were valued.

Hence, coordination, learning, trust-building and compliance were aspects of the ISMP process that were given highest priorities as social outcomes and overall gained similar weightings to economic ones, other than minimising agricultural losses. AHP also indicated that different stakeholder groups prioritise different benefits they anticipate from the ISMP e.g. bird protection representatives prioritised habitat restoration above all other ISMP outcomes. The environmental benefits of a stable population and habitat restoration were not accounted for in the CBA conducted here, but it is recognised that the inclusion of these non-market environmental, as well as social, benefits would derive further value.

Desired ISMP environmental outcomes are measurable objectives and are monitored and assessed as part of the ongoing adaptive management cycle, e.g. population size, extent of arctic tundra degradation and the wounding of shot geese. Potentially, these environmental indicators can be articulated into criteria to evaluate ISMP performance, but crucial questions need to be asked about what are acceptable costs to achieve a desired level of benefit. These will be dependent on the value given to these outcomes and what constitutes success, in the eye of the assessor i.e. what determines 'value-for-money'.

The AHP has established a priority hierarchy for ISMP outcomes and this can be used to weight the value of benefits realized for different stakeholder groups, as well as for the IWG as a collective. This in turn can focus resources on the collection and assessment of data that reflects and is tailored to the priorities of stakeholders enabling a more comprehensive evaluation of the ISMPs performance. It is apparent that both goal-oriented (e.g. stable population target) and process orientated (e.g. learning) outcomes should be considered as benefits in an evaluation of the ISMP. Our mixed analysis demonstrates that the ISMP has the potential to provide outcomes which are highly valued by stakeholders and realizing a broader range of benefits would not have been addressed effectively had it not been for the ISMP process.

The ISMP will now become part of a European Goose Management Platform providing opportunities for cost-efficiencies by integrating individual species management plans into an overarching process to manage multiple goose species across Europe. This will inevitably create a need for a focussed process to ensure the inclusion of stakeholders and the alignment of diverse cultures, management issues, priorities for resources allocation and the value of anticipated benefits. The insights gained from implementing the AEWA ISMP for the Svalbard Pink-footed Goose can inform the development of processes to improve the evaluation of individual species management plans under the EGMP, integrating a broader spectrum of costs and benefits. Critically, mechanisms will be needed to maintain the contribution of diverse stakeholder groups, helping to feedback their preferences, priorities and ultimately how they would evaluate the effectiveness of any plan in achieving their particular prioritised outcomes.

1. INTRODUCTION

Adaptive management is regarded as a valuable management-decision tool in natural resource management, especially where there is uncertainty (Allen and Gunderson, 2011, McFadden et al., 2011, Westgate et al., 2013). Amongst its core components are assessment and learning in an iterative cycle. Much has been written about these aspects in academic literature, although dissemination to broader audiences is deemed lacking (Fabricius and Cundill, 2014). However, there are only a few reported examples of successful adaptive management in practice, particularly those that quantify specific costs, benefits and comparisons to possible alternatives (McFadden et al., 2011, Rist et al., 2013). Within the field of conservation management there has been considerable focus on integrating economic aspects into the evaluation of conservation efforts, particularly biodiversity (Hughey et al., 2003, Naidoo et al., 2006, Murdoch et al., 2007, Laycock et al., 2011). However, it has also been noted that evaluation criteria for conservation programmes should not solely focus on economic measures, but attention must also be paid to explicit ecological and social outcomes and measures (Kleiman et al., 2000). Furthermore, there is a recognised need to broaden the evaluation of management policies and plans to include processes as well as outcomes (Rauschmayer et al., 2009) i.e. evaluation can also be of the quality of the process itself.

Within Europe there are very few applications of adaptive management in natural resource management. One example is the International Species Management Plan (ISMP) for the Svalbard Pink-footed Goose, implemented under the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA). This management plan is the first European test-case to actively manage the population of a migratory waterbird species. The ISMP was developed following the principles of adaptive management, with its participatory approach, requiring stakeholders to set well-articulated and unambiguous management objectives with measurable attributes and range of actions to achieve these. In the case of the ISMP these objectives span environmental, economic as well as social outcomes as incorporated into its stated goal and set of five fundamental objectives (see Box 1, Figure 1).

Assessment of actions and their performance against objectives is an integral part of adaptive management. Initial implementation of the ISMP has been focused on an Adaptive Harvest Management (AHM) strategy, to manage the pink-footed goose population around an agreed level of 60,000 individuals. An international working group (IWG) is responsible for overseeing the annual assessment and adjustment of ISMP management actions, primarily hunting quotas initially (see Box 1). Learning has been an inherent part of the ISMP's implementation to date, gaining better insights about population dynamics of the species as well as operational aspects of implementing its AHM strategy e.g. monitoring, modelling and adjusting hunting regulations. However, there was a desire from within the IWG, chiefly from contributing national statutory authorities, to further evaluate the ISMP by quantifying its costs and benefits. Compared to traditional management plans, the ISMP process has been regarded as relatively resource demanding in terms of organisation, frequency of meetings and reporting. The request was to evaluate if the adaptive management process provides 'value for money' as well as set-out a viable business plan for its longer-term operation. In response to this request, a preliminary Cost-Benefit Analysis (CBA) was undertaken to quantify costs and benefits related to implementing the ISMP, which is outlined here.

The ISMP is only half way through the plans 10 year term and too early for a full assessment of its performance; nevertheless it was important to begin establishing the foundation for an economic assessment. The CBA conducted here is a rudimentary analysis of costs related to running the ISMP adaptive management process and an estimation of one of its tangible benefits, quantifiable in monetary terms, avoided crop damage payments and related to 'minimise agricultural conflicts' a key ISMP objective. The CBA is used to illustrate the potential of the ISMP to deliver 'value for money'. However, it is recognised that this CBA does not take into account the full set of ISMP objectives and anticipated benefits that encompass, environmental, economic and social outcomes. The CBA raised a number of questions about what are valued aspects and outcomes of the ISMP process, as viewed by IWG participants and who they represent e.g. different countries and stakeholder groups. It is known that amongst IWG participants there are different preferences for what the ISMP is expected to deliver (Madsen et al., 2017).

The ISMP has multiple objectives at different levels, with many competing choices and potential management actions for resource allocation. These fundamental and means objectives, many with intangible benefits, are open to subjective evaluation and are problematic to trade-off. What is the importance of each objective, how much more does one objective dominate another in this complex mix of multiple objectives e.g. what is more desirable: to improve habitat management versus increase goose tourism? In order to better understand and quantify judgements about ISMP outcomes and their priorities, preference analysis was undertaken using the Analytical Hierarchy Process (AHP) (Saaty, 1987). This multi-criteria decision making technique was used to establish a hierarchy amongst three top-level *a priori* categories of ISMP objectives (environmental, economic and social) and related sub-criteria representing different potential outcomes of the ISMP. The AHP provided a mechanism to determine: 1) the relative priorities, expressed as scaled weightings, of the IWG as a collective decision-making group for different outcomes expected of the ISMP, 2) differences in the priorities of various participant groups within the IWG e.g. countries and stakeholders and 3) a measure of consensus amongst IWG participants, 4) assess whether preferences and priorities are purely goal oriented e.g. 60,000 population target or if other aspects of the process were important as well e.g. collective learning, coordination, trust building and compliance.

These two pieces of analysis were undertaken as part of a process of critical self- evaluation of the ISMP's adaptive management approach. Two of the authors are actively involved in the ISMP's management cycle. It was considered important to combine and review the results of these analyses to identify preliminary success criteria for the ISMP. The CBA is used to establish the foundation for an economic assessment, explicitly identifying ISMP operational costs, a potential opportunity cost and estimated benefits, in relation to just one of its objectives. This CBA only addresses a very limited number of components that a comprehensive economic value study could estimate (Hanley and Barbier, 2009). A full and comprehensive evaluation of the ISMP is not expected until 2022. However, the AHP has provided a collective hierarchy of priorities, determined by IWG participants, for ISMP outcomes establishing how its overall performance can be evaluated in the long term. This mid-term evaluation is also very timely because new adaptive management plans are currently being developed for other European migratory goose species. Valuable lessons can be learnt from the AEWA Svalbard Pink-footed Goose ISMP, as a first test case, especially where these new plans involve a wide range of stakeholders, who are very likely to have different preferences and priorities in terms of envisaged outcomes for any plan.

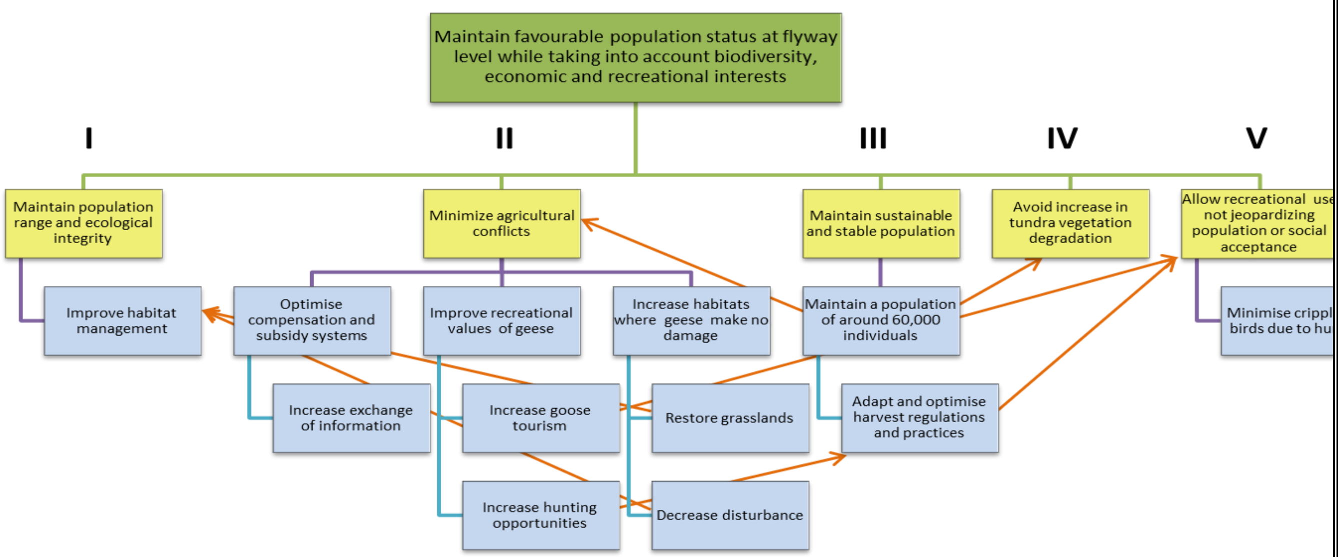
Box 1: Development and implementation of the AEWA International Species Management Plan for the Svalbard Pink-footed Goose

The AEWA International Species Management Plan for the Svalbard Pink-footed Goose was initiated and developed in response to escalating conflicts with agricultural interests, particularly in Norway, and concern about the degradation of vulnerable tundra vegetation in its breeding grounds on Svalbard, as a result of continued increases in the population size of this species. The plan was endorsed at 5th Session of the Meeting of the Parties to AEWA in May 2012 and thereafter an organizstional and procedural framework was created. A key component for its implementation was the formation of a multi-stakeholder working group, set-up to coordinate, review and guide management actions. This group, known as the the AEWA Pink-footed Goose International Working Group (IWG) was set-up to involve a variety of representatives from four range-states that spanned the species flyway (migratory route) in the management process; Norway (including its Svalbard breeding grounds), Denmark, the Netherlands and Belgium,

Participants attending IWG meetings consisted of representatives from national statutory authorities, designated country experts as well as a range of representatives from farmers', hunters', ornithological and nature conservation organisations at international, national and regional levels. Individual IWG country delegations were led by respective statutory authorities, who were ultimately responsible and had the authority to enact IWG recommendations at national levels. IWG recommendations were based on an annual monitoring, assessment and decision-cycle. This culminated in the publication of annual reports assessing the population's development and harvesting of the pink-footed goose, a huntable species in Denmark and Norway only. These assessments were part of an initial 3-year (2012-2015) Adaptive Harvest Management (AHM) strategy, where monitoring data and subsequent IWG recommendations were made publically available on a dedicated website (http://pinkfootedgoose.aewa.info/).

To facilitate and coordinate implementation of the plan and its AHM strategy, IWG meetings were held annually between 2013 and 2015. Composition of the group varied slightly each year, dependant on the availability of representatives to attend these meetings. Nevertheless, broad stakeholder participation in decision-making and management processes was maintained within the IWG. An IWG Coordination Unit was also established to manage the annual management decision cycle e.g. arranging IWG meetings, overseeing monitoring and modelling, as well as reporting (Madsen et al., 2017).

Figure 1: International Species Management Plan, goal (green box), fundamental objectives (I-V yellow boxes) and means objectives/key actions (blue boxes) modified from (Madsen and Williams, 2012).



2. EVALUATING THE ISMP: METHODS

2.1 Cost-Benefit Analysis: setting a baseline

To create a foundation for economic assessment a rudimentary analysis of the costs and anticipated benefits of implementing the ISMP was undertaken. Comparable to a Return-On-Investment (ROI) analysis (Murdoch et al., 2007), this analysis was undertaken to illustrate the ISMPs potential to deliver and represent 'value-for-money'. This analysis was focused on the most tangible benefit expected from the ISMP that could be expressed in monetary terms versus the costs of implementing it, namely crop damages as a result of goose foraging.

The assumption behind setting a population target at 60,000 was that by halting and reversing the continued growth in its population size, crop yield losses (or payments to compensate for damage/subsidies to accommodate geese) could be reduced and minimised to an acceptable level. This was considered a readily identifiable and measurable benefit. Past data was available for compensation and subsidy payments made in relation to goose crop damages from three countries along its flyway. A monetary estimation of this benefit was determined by assessing the relationship between past pink-footed goose population sizes and payments made by authorities to farmers for crop yield losses i.e. subsidies and/or compensation payments.

Regression analysis was used to extrapolate potential payments for crop yield losses based on a predicted population size at the end of the plans term, in 2022. The population was predicted to reach 134,000 birds by this time, see *appendix 1* for simulated population sizes (F.A. Johnson unpublished). For Norway, extrapolations of costs were made on the basis of data presented in Eythórsson, Tombre and Madsen (2017), assuming that the entire population continues to stage in mid-Norway in 2022. For the Netherlands regressions were based on the observed relationship between goose numbers present and payments (Figure S2, appendix 2).

For Belgium, species-specific estimations for crop damages were only available for recent years (2013, 2014; Table S2f, appendix 2). To extrapolate to the 2022 scenario, it was assumed that there is a 1:1 relationship between goose numbers and payments and that the proportion of the population overwintering in Belgium will remain the same. From this analysis an estimation of the ISMP's potential benefit, in terms of avoided costs associated with the agricultural crop damages could be determined in comparison to if no action had been taken i.e. the alternate management action of 'business-as-usual'. Added to this was another monetary benefit of avoided extra administration costs for assessing and distributing compensation and subsidy payments that might be incurred with the predicted increased in population size.

Cost estimates for implementing the ISMP for a single annual management cycle were identified across four operational areas:

1) International Working Group and National Working Group meeting costs. These included costs related to accommodation, travel expenses, preparation and participation time. Standard governmental hourly rates of 67 EUR per hour (503 EUR per day) were used to estimate delegate participation and preparation costs. The participation costs for representatives of non-governmental organisations were also included e.g. farming, hunting and bird protection organisations. These participants were self-funded but it was recognised that their time and travel was an associated ISMP cost, although given freely. International and national travel costs were estimated for all participants.

2) IWG Coordination Unit costs for administrating and coordinating the ISMPs management cycle. This was a fixed budgeted cost.

3) Additional hunting administration costs for Danish and Norwegian authorities for implementing annual IWG recommendations made as part of the AHM strategy e.g. hunting regulation changes. These costs were expressed as administrative days using standard governmental hourly rates.

4) Extra monitoring costs for conducting Pink-footed Goose population estimates. These costs were additional to an annual population count which was undertaken as part of an existing national monitoring programme. Again these costs were expressed as administrative days using standard governmental hourly rates.

Another possible outcome of the business-as-usual scenario (i.e. no ISMP), could be increased hunting opportunities as a result of an increased Pink-footed Goose population expanding into new areas when foraging. This could potentially increase exposure to hunting and additional hunters, in hunting areas where previously Pink-footed Geese had not been shot. Conceptually, this could be of financial benefit generating hunting rental revenues for landowners in new in areas. However, only limited data was available for the value of goose hunting concessions and rental revenue for landowners with geese foraging on their land. This analysis was restricted to Denmark where data on the current number of Pink-footed Goose hunters was available, through the Danish Hunting Bag Statistics.

Unpublished survey data provided an estimate of the average price for rented goose hunting areas within Denmark. Three conditions were evaluated: a 10%, 20% and 30% increase in the number of Pink-footed Goose hunters based on a baseline number of hunters who shot geese in Denmark during the 2013/14 hunting season. These increments were based on expert judgement (J. Madsen) and were only intended as an illustration of a possible alternative monetary benefit. New goose hunters were assumed to be willing to pay the average price for goose hunting areas, generating rental revenues for additional landowners based on these increments. Expansion of Pink-footed Geese into new areas in Norway was considered possible but lack of data precluded estimation of a reliable figure for additional hunting rental revenue.

In implementing the ISMP there was a trade-off, a choice between avoided crop yield losses, due to goose foraging, and possible benefits of increased hunting rental revenue. In this analysis loss of hunting rental revenues was equated to a 'cost' of implementing the ISMP, a sacrifice or benefit forgone by implementing the ISMP. The difference in return between choosing to invest in actively managing the population and limiting it to 60,000 and not managing the population (no population target), was equal to the 'opportunity cost' of forgone hunting rental revenue for landowners and authorities as taxable revenue. This Cost-Benefit Analysis has been a first step for incorporating measurable costs and benefits to evaluate the ISMP and assess its potential to deliver 'value-for-money'. A Return On Investment (ROI) has been estimated, based on the most tangible financial benefits (avoided crop damage payments) versus the operational costs for implementing the ISMP. The ROI is represented as a ratio of the expected financial gains (benefits) of implementing the ISMP divided by its total costs: ROI = (net monetary benefits / total costs).

2.2 Analytical Hierarchy Process: establishing priorities

The Analytic Hierarchy Process (AHP) is a framework for priority-setting and a structured technique for analysing complex (group) decision problems. It helps decision-makers to tackle problems with multiple conflicting and subjective criteria (Ishizaka and Labib, 2011). The AHP requires users to firstly decompose the problem into a hierarchy of sub-problems. Then users can compare two elements of the same level at a time according to their relative importance. The AHP converts these comparisons into numerical values as weights for each element of the hierarchy. The AHP process has been widely applied into different types of group decision problems (Lai et al., 2002, Escobar and Moreno-jiménez, 2007, Dong et al., 2010).

AHP methodology consists of four main steps 1) decision-modelling and hierarchy construction, 2) priority analysis, 3) consistency verification and 4) priority aggregation. The first step was undertaken by the authors, creating a hierarchical set of decision trade-offs related to anticipate outcomes of the ISMP. Three top-level criteria were formulated: 1) environmental, 2) economic and 3) social, each with a number of sub-criteria. These sub-criteria encompassed both goal (e.g. stable population target) and process orientated outcomes (e.g. learning), anticipated as part of implementing the ISMP (see appendix 3).
The subsequent three steps were undertaken using a publically available and licenced MS Excel spreadsheet (Goepel, 2013). This format was considered a convenient, verified and relatively simple mechanism for participants to

complete. Four spreadsheets were sent to 24 individuals who had participated in the IWG as representatives for various stakeholder groups and range state countries, of these 19 responded see Table 1. In each spreadsheet participants were requested to make pair-wise comparisons for the criteria listed and then using judgement scales to evaluate the paired criteria on a standard linear preference scale from 1-9. Using these pairwise comparisons, the relative importance of one criterion over another can be expressed in a matrix and using algebraic mathematical computations and eigenvectors gives the relative ranking of the listed criteria. Priorities for the criteria listed in each input sheet were thus calculated using the row geometric mean method with final priorities calculated using the eigenvector method (Saaty, 1987). However, if respondent judgements were inconsistent in assigning their preferences and scores to create a hierarchy of priorities, respondents were requested to alter highlighted scores, in order to improve their judgements and achieve a consistency ratio (CR) of less than 10%, as recommended by Saaty (Saaty, 1987). Respondents were requested to complete a single spreadsheet giving their priority, expressed as 'weightings', for the three top-level criteria and three separate spreadsheets for the sub-criteria within these categories. AHP example spreadsheets and accompanying instructions sent to participants can be found on-line at http://pinkfootedgoose.aewa.info/.

Results were then consolidated for the IWG as a group (19 respondents), as well as by country and stakeholder groups. Multiple respondent scorings were inputted and grouped in summary spreadsheets. As well as calculating consolidated rankings and weightings these spreadsheets were also able to indicate the degree of consensus between participants within each grouping. This consensus indicator was calculated using Shannon alpha and beta entropy (Goepel, 2013), with a range from 0% (no consensus) to 100% (full consensus). The scores given by each respondent had equal weighting in determining the consolidated criteria weightings and hierarchy. Each participant in the IWG was deemed to have an equal voice and influence; hence the consolidated results do reflect its composition and the number of representatives for each stakeholder group.

Table 1: Responses to the AHP assessment by country and stakeholder groups.

	Authority representatives	Scientific / expert representatives	Farming representatives	Hunting representatives	Bird protection representatives	Total
Belgium	1	1	1	-	1	4
Denmark	1	1	-	2	1	5
The Netherlands	2	-	-	-	1	3
Norway	2	1	2	1	-	6
International	-	-	-	1	-	1
Total	6	3	3	4	3	19

3. EVALUATING THE ISMP: RESULTS

3.1 Cost Benefit Analysis

3.1.1 ISMP implementation costs

Costs of implementing the annual management cycle for the ISMP were assessed across four operational areas. Annual meeting costs for the International Working Group and National Working Groups were estimated to be 67,397 EUR and 44,976 EUR respectively (Table 2; for details see Appendix 2). These costs were based on 24 participants attending the international meeting and 10 participants attending national meetings in Norway, Denmark, Belgium and The Netherlands. The Coordination Unit for the IWG has an annual fixed budget of 60,000 EUR. Additional hunting administration costs for Danish and Norwegian authorities, related to implementing the AHM strategy, were estimated to be 4,024 EUR. Monitoring costs for conducting additional annual Pink-footed Goose population counts were estimated to be 7,035 EUR. These costs totalled 183,432 EUR for a single year.

3.1.2 ISMP opportunity cost

A total of 1,834 Danish hunters shot Pink-footed Geese in the 2013-24 hunting season, as reported in the Danish Hunting Bag Statistics. This figure was used as a base figure to determine the increase in hunters paying rental for new hunting areas, based on expert judgement, in increments of 10%, 20% and 30%. The average annual rental paid for goose hunting areas in Denmark in 2013-14 was 742 EUR per hunting concession. This figure was estimated from a survey questionnaire sent out to Danish goose hunters in 2014 (J.H. Williams, unpublished; n=408). It was assumed that new goose hunters would be willing to pay the average rental price for a hunting area, and a constant price was assumed for existing goose hunting areas. Landowner taxation (c. 38%) was also taken in to account, to estimate the value of hunting rental revenues as a compensation for goose damage. Additional hunting rental revenues were calculated on this basis and included as opportunity costs (forgone hunting rental revenues), shown in Table 2.

3.1.3 ISMP benefits

Compensation and subsidy schemes had been in place in three stopover and wintering regions along the Pink-footed Goose flyway: Nord-Trøndelag and Nordland Countides, Norway, Friesland, The Netherlands and Flanders, Belgium.

In Nord-Trøndelag a subsidy scheme has been in place since 2006. Payment data was obtained from the County Governor of Nord-Trøndelag for the period 2006-20015 (Eythórsson et al., 2017). As almost the whole Pink-footed Goose population stages in Nord-Trøndelag in spring, regression analysis was used to estimate subsidy payments for two anticipated population sizes. These were subsidy payments of 160,200 EUR for a population size of 60,000 birds, the ISMP population target, and 440,300 EUR for a predicted population size of 134,000 birds in 2022. This analysis indicated avoided crop damage payments of 280,100 EUR for Nord-Trøndelag, which was comparable with estimates made using a habitat depletion model that indicated avoided crop damage payments of 269,200 EUR, the latter figure being used (Baveco et al., 2017). Denmark had no compensation or subsidy scheme to compensate farmers for crop damages caused by foraging geese. This is not to say that Danish farmers do not experience losses due to foraging geese, however there was no data available to estimate the level of these losses.

For the Netherlands, historical compensation payments for Pink-footed Goose crop losses were obtained from Faunafonds, a national wildlife funding database, for the period 1995-2014. Again regression analysis was used to estimate the relationship between goose numbers visiting the Netherlands and compensation payments, however only payments made in 1995-2009 were used in this analysis. There was an apparent phase shift in payments made in 2010-2014 which were notably higher than for previous years, the latter (1995-2009) were regarded as more representative of actual crop losses (Fig. S2, Appendix 2). In addition, only a proportion of the Pink-footed Goose population winters in the Netherlands, and autumn peak numbers registered in the Netherlands were used. Regression analysis estimated compensation payments of 50,762 EUR and 89,937 EUR for 30,382 and 62,561 overwintering geese, equivalent to total population sizes of 60,000 and 134,000 geese. This analysis indicated avoided crop damage payments of 39,175 EUR.

Belgium has had a compensation scheme from 2009-2014 for crop losses due to foraging; however only in the last two years have compensation payments been species-specific. (Table S2f, Appendix 2; Flemish Nature & Forest Agency; M. Vandegehuchte pers. comm.). With current numbers of geese, the compensation payments were 47,174 EUR (average for 2013 and 2014). Extrapolated compensation payments were estimated to be 85,859 EUR for the equivalent population size of 134,000 geese. This analysis indicated avoided crop damage payments of 38,684 EUR.

3.1.4 Cost-Benefit Analysis summary

This rudimentary CBA assessment of ISMP cost and benefits indicates a potential net benefit of 171,675 EUR and return for a single year’s annual expenditure of 48% when comparing two anticipated population sizes, the 60,000 ISMP population target and a predicted 134,000 geese in 2022 if no ISMP had been implemented. If the opportunity costs of forgone hunting area rental are included, this ROI ranges from a positive 25% to negative 23%, dependent on the percentage of new hunting concessions realized. These ROIs are equivalent to a net benefit of 87,303 EUR or a net cost of 81,439 EUR, as shown in Table 2.

Table 2: Summary of economic costs and benefits for a single year's management cycle for the ISMP's AHM strategy, comparing managing the population at 60,000 versus a scenario of 134,000 geese in 2022. Full details of supporting estimations and calculations for this cost-benefit analysis can be found in appendix 2.

		% increase in new hunters / hunting concessions		
		10%	20%	30%
Costs	International working group meeting	€ 67,397	€ 67,397	€ 67,397
	National working group meetings	€ 44,976	€ 44,976	€ 44,976
	Coordination Unit	€ 60,000	€ 60,000	€ 60,000
	Additional hunting administration	€ 4,024	€ 4,024	€ 4,024
	Additional population monitoring	€ 7,035	€ 7,035	€ 7,035
	*Sub-total: operation of ISMP annual cycle**	€ 183,432	€ 183,432	€ 183,432
Opportunity cost	Loss of hunting rental revenues**	€ 84,372	€ 168,743	€ 253,114
	Total costs	**€ 267,804**	**€ 352,175**	**€ 436,546**
Benefits	Avoided costs in payments for crop damage/subsidies***	€ 347,059	€ 347,059	€ 347,059
	Avoided compensation / subsidy scheme administration	€ 8,048	€ 8,048	€ 8,048
	Total benefits	**€ 355,107**	**€ 355,107**	**€ 355,107**
Net cost / benefit	Excluding opportunity cost	€ 171,675	€ 171,675	€ 171,675
ROI		48%	48%	48%
Net cost / benefit	Including opportunity cost	€ 87,303	€ 2,932	-€ 81,439
ROI		25%	1%	-23%

*Including NGO voluntary participation costs
**Not including potential Norwegian hunting rental revenues
***Not including potential Danish crop damage payments

3.2 Analytical Hierarchy Process (AHP)

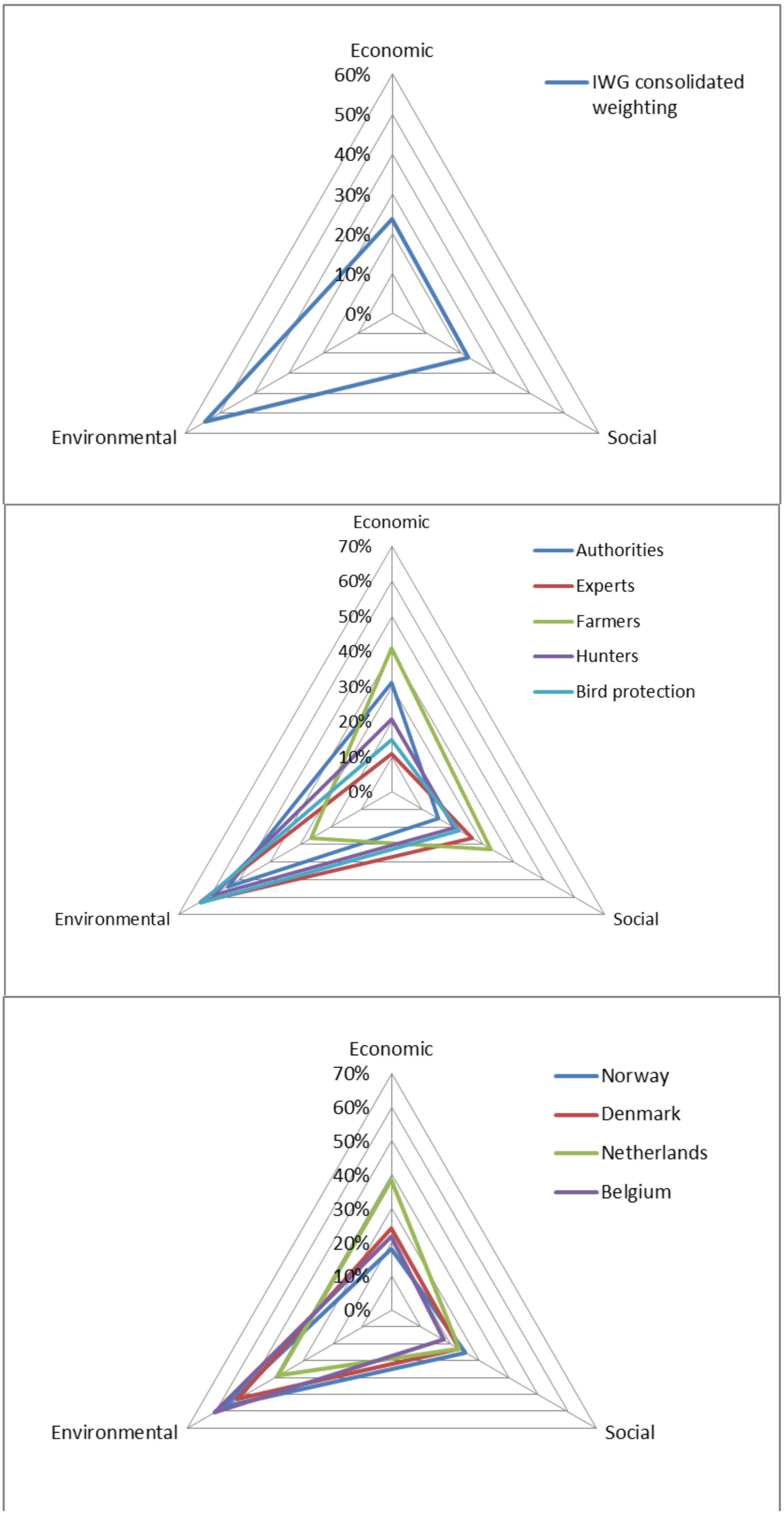
3.2.1 Top-level criteria: environmental, economic and social

Of the three top level criteria ranked by IWG participants, environmental outcomes were valued the most and hence given the highest priority (ranked 1st), with a consolidated weighting of 54%. Almost equal priority was given to economic and social criteria; with consolidated weights of 24% and 22%, respectively (Figure 3). The preference for the ISMP to deliver beneficial environmental outcomes was clearly driven by the desire to maintain a healthy and stable population, as indicated by its weighting given within the environmental sub-criteria. However, there were subtle differences in weightings for the three criteria given by participants representing the various stakeholder groups and countries.

Notably, greater weighting was given to economic criteria by participants representing national statutory authorities (31%) and farmers (41%) in comparison to other participant groups. Farming representatives prioritised economic criteria above environmental (26%) and social (33%). Minimising crop damages were of primary importance within the economic sub-criteria and, understandably, of direct concern to farming representatives. For authorities minimising agricultural losses was also a high priority, within the economic sub-criteria, as compensation and subsidy schemes are a significant cost particularly in Norway, the Netherlands and Belgium.

For Dutch participants environmental and economic criteria were similarly weighted (39% and 38%, respectively) whilst participants from other countries gave greater weighting to environmental criteria. Although there was diversity in weightings given by individuals, particularly between different stakeholder groups, as a collective there was a high degree of consensus in the hierarchical ranking for these three top-level criteria. The group homogeneity of priorities is indicated with a consensus indicator of 78%.

Figure 3: consolidated weightings given by IWG as a collective for the 3 overarching ISMP assessment criteria, as well as consolidated weightings by stakeholder group and country. Each node (end-point) on the radial spokes indicates the consolidated weighting for each of the three top-level criteria.

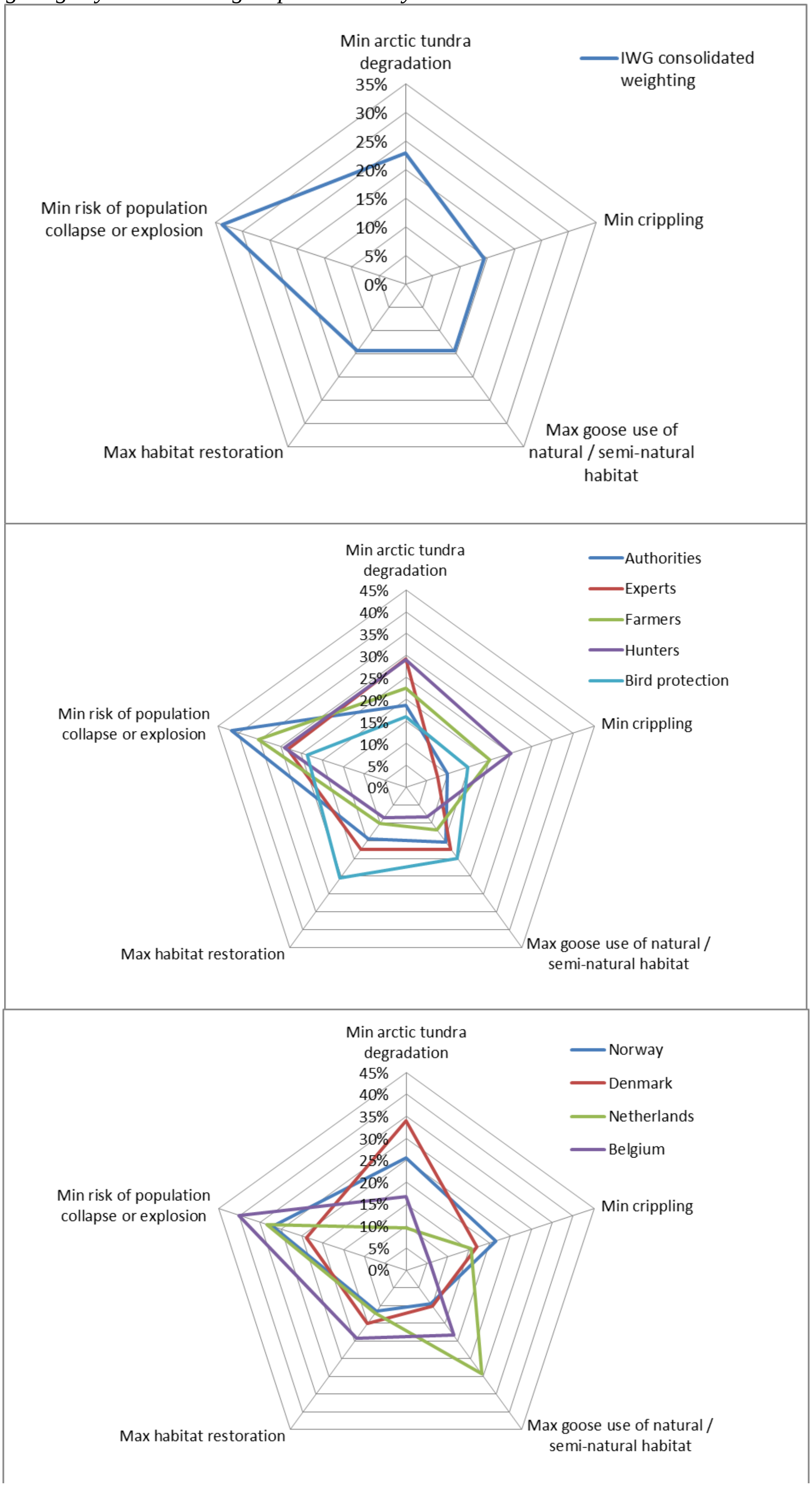


3.2.2 Sub-criteria: environmental

Minimising the risk of a population collapse or explosion was given the highest priority amongst the environmental sub-criteria (consolidated weighting of 34%), followed by minimising arctic tundra degradation (23%), see figure 4. It is not surprising that these two environmental criteria are ranked 1st and 2nd respectively given these are fundamental ISMP objectives. There was a high degree of consensus within the IWG (72%), but this masks subtle differences between countries and representative groups. The northern range states, Norway and Denmark, judged minimising arctic tundra degradation a high priority weighting it 26% and 34% respectively, in comparison to the southern range states, the Netherlands and Belgium, weighting it of 10% and 17% respectively.

The Netherlands indicated a preference, in comparison to other countries, for goose usage of natural / semi-natural habits' as an ISMP outcome giving it a weighting of 29%. Experts expressed a preference for minimising arctic tundra degradation and gave it greater weighting (29%), than other participants. Bird protection participants expressed their preference for habitat restoration, with a weighting of 26%, as well as goose usage of natural / semi-natural habits (weighted 20%), in comparison to other participant groups. Hunters did prioritise minimising tundra degradation, as well as minimising crippling due to shotgun shooting giving these criteria weightings of 29% and 25%, respectively. Farmers' top priority was for a stable population, weighting it at 35%.

Figure 4: consolidated weightings given by IWG as a collective for the 5 environmental sub-criteria, as well as consolidated weightings by stakeholder group and country.

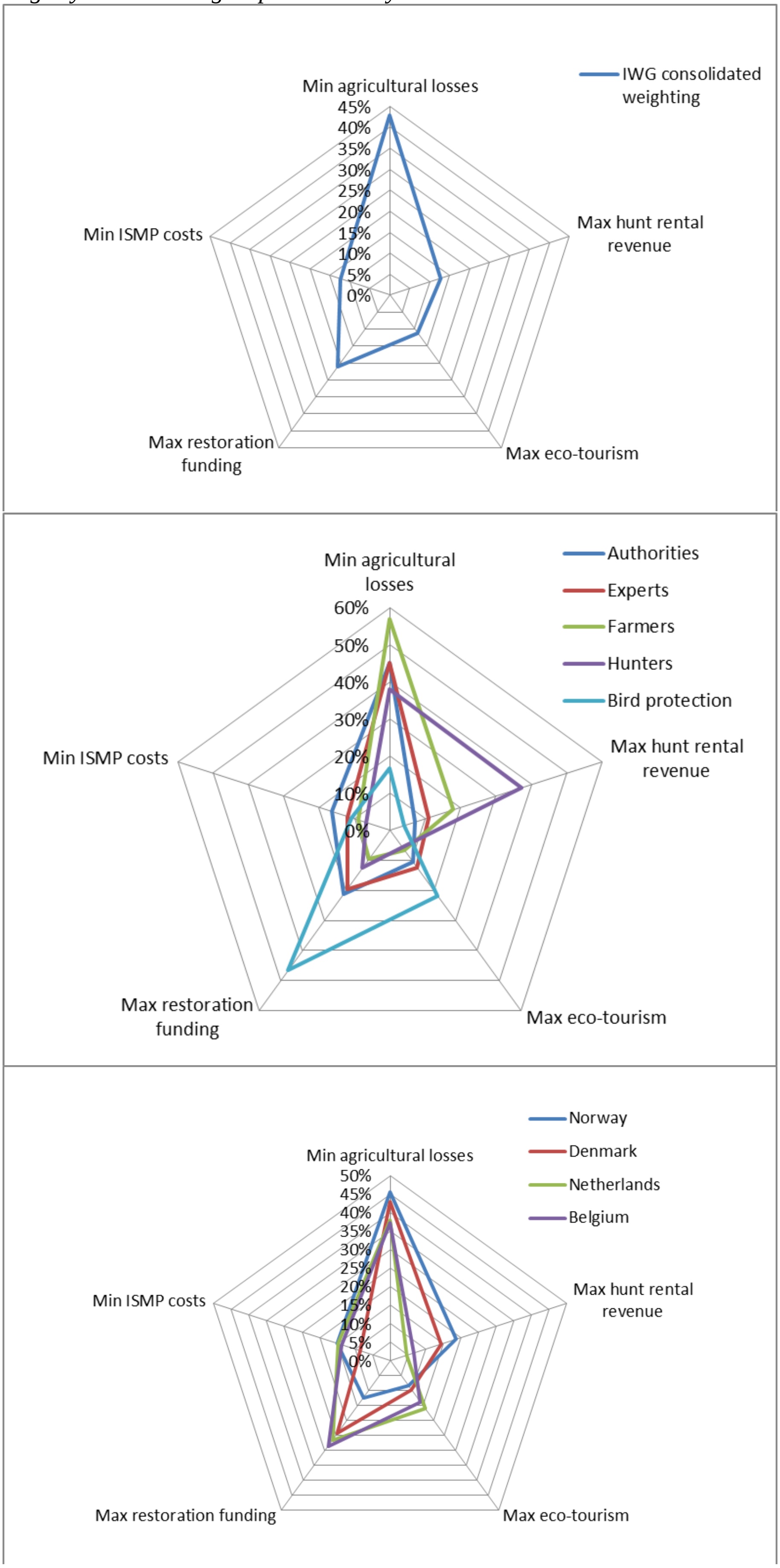


3.2.3 Sub-criteria: economic

Economic priorities for the IWG were focused on minimising agricultural losses and maximising the funding for habitat restoration, with consolidated weightings of 43% and 21%, respectively (Figure 5). Although there was a high degree of consensus within the IWG (69%) certain participant groups clearly had different priorities. Minimising agricultural losses is a fundamental objective and key driver for developing the ISMP. Farming representatives gave it the highest weighting at 57%, and it was the foremost economic priority for all within the IWG, except for bird protection representatives. They favoured, more than other participants, funding for habitat restoration (weighted 46%) and promoting eco-tourism (weighted 22%) to support farmers in tolerating geese on their land.

This is in contrast to hunting and farming representatives who prioritised hunting rental revenue as a means to support farmers (weighted 37 % and 18%, respectively). These differences are also reflected in preferences between the range states, where the northern range states prioritised hunting revenue (Norway 19%, Denmark 14%), whilst the southern range states conversely prioritised eco-tourism revenue (Netherlands 16%, Belgium 14%). It is apparent there was greater interest and priority given to funding habitat restoration going from north to south along the range states. Both The Netherlands and Belgium gave it a high priority (weighted 26% and 29%, respectively). Minimising the costs of implementing the ISMP was not highly prioritised. It was given a similar weighting to maximizing eco-tourism and hunting revenue (consolidated weighting of 12%); however representatives for authorities did give it a higher priority than both these criteria, with a weighting of 16%.

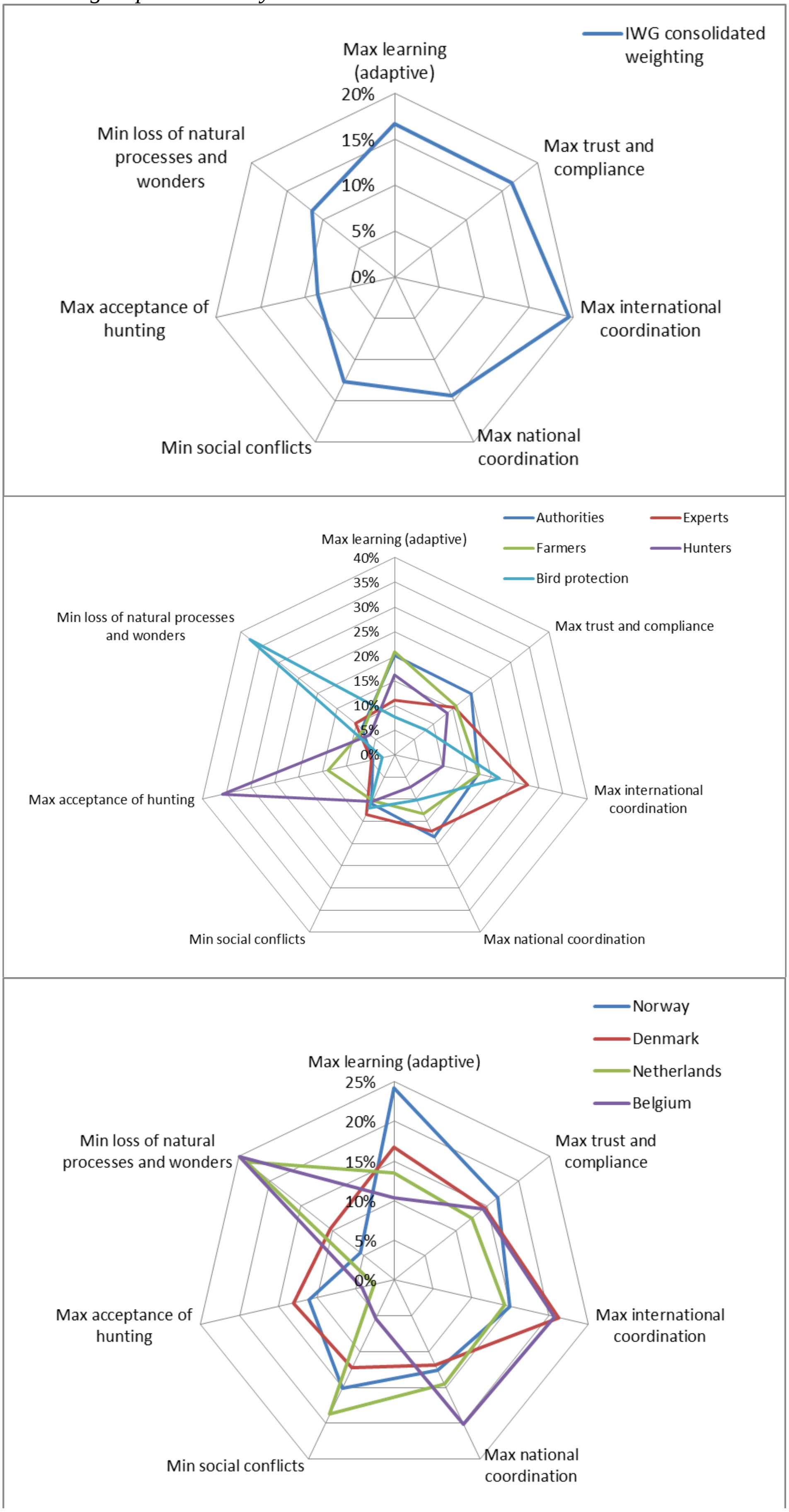
Figure 5: consolidated weightings given by IWG as a collective for the 5 economic sub-criteria, as well as consolidated weightings by stakeholder group and country.



3.2.4 Sub-criteria: social

Preferences within the IWG were broadly distributed across the seven specified social criteria for possible outcomes of the ISMP. It had the lowest consensus indicator (60%), reflecting the diversity of interests amongst participants. The three highest ranked criteria were: international coordination (weighted 19%), collective learning as part of the adaptive process (weighted 17%) and building trust and compliance (weighted 16%), see figure 6. However, there were notable differences between countries with coordination internationally and nationally relatively more important for Denmark (both weighted 21%) and Belgium (weighted 21 and 20%), whilst Norway prioritised learning (weighted 24%) and the Netherlands minimising social conflicts (weighted 19%). Compared to the northern range states, the Netherlands and Belgium also gave greater priority to minimising the loss of natural process and wonders (weighted 24% and 25%, respectively). There were two very clear differences between stakeholder groups with hunting representatives prioritising the acceptance of hunting (weighted 36%) as a beneficial social outcome and bird protection preventatives prioritising minimising the loss of natural process and wonders (weighted 38%).

Figure 6: consolidated weightings given by IWG as a collective for the 7 social sub-criteria, as well as consolidated weightings by stakeholder group and country.



3.2.5 Overall priorities for ISMP outcomes

By combining the priorities of the three top-level criteria with their respective sub-criteria, an overall aggregated rank for all anticipated ISMP outcomes can be derived as shown in Table 3. These weightings indicate the order of priorities for the IWG as a group. The top six criteria reflect the fundamental objectives of the ISMP, with environmental outcomes dominating. There are again slight differences between countries and stakeholder groups and these results can be seen in appendix 4 and tables 1 and 2.

Table 3: sub-criteria, top-level and overall aggregated weights for all anticipated ISMP outcomes

Rank	Criterion	Sub-criteria weighting	Top-level weighting	**Overall weighting**
1	Min risk of population collapse or explosion	34%	54%	**18%**
2	Min arctic tundra degradation	23%	54%	**12%**
3	Min agricultural losses	43%	24%	**10%**
4	Max habitat restoration	14%	54%	**8%**
5	Max goose use of natural / semi-natural habitat	14%	54%	**8%**
6	Min crippling	14%	54%	**8%**
7	Max restoration funding	21%	24%	**5%**
8	Max international coordination	19%	22%	**4%**
9	Max learning (adaptive)	17%	22%	**4%**
10	Max trust and compliance	16%	22%	**4%**
11	Max national coordination	14%	22%	**3%**
12	Min social conflicts	13%	22%	**3%**
13	Max hunt rental revenue	13%	24%	**3%**
14	Min ISMP costs	12%	24%	**3%**
15	Min loss of natural processes and wonders	12%	22%	**3%**
16	Max eco-tourism	11%	24%	**3%**
17	Max acceptance of hunting	9%	22%	**2%**

4. DISCUSSION

By explicitly involving stakeholders, adaptive management requires the development of shared understanding to set collectively agreed objectives. Involving a diverse array of stakeholders in developing and implementing management plans, such as the ISMP, participants not only determine desired outcomes (Newig and Fritsch, 2009) but also how performance might be evaluated. The stated goal and objectives of the ISMP were derived and agreed within the IWG, based on different concerns and expectations of the various participants representing different stakeholder groups.

Utilising the AHP, we have been able to determine and elucidate a hierarchy of expectations and priorities for the IWG as a collective, as well as for different participant groups. Clearly, for the IWG the collective preference overall is for the ISMP to deliver environmental outcomes. Four of the top five ranked outcome criteria are related to ensuring that the Pink-footed Goose population and its habitats are secure for the future; reflective of the ISMPs overall goal. Minimising agricultural losses is the sole economic criteria given sufficient priority to rank within the top five criteria. It was a key driver for the ISMP and one that emerged in public debate and thus gained attention. Nevertheless, these collective priorities do mask subtle differences, particularly between the various stakeholder groups, e.g. national statutory authority representatives prioritise a stable Pink-footed Goose population as do most other participant groups, although for farming representatives minimising agricultural losses is their top priority. Habitat restoration is a top priority for bird protection representatives but they also focus on reducing the wounding of birds, which is a priority they share with hunting representatives. Each of these groups value different aspects of the ISMP and prioritise them accordingly.

How it performs in delivering on those aspects that they regard important will also likely influence how they evaluate its overall success and their continued participation needed to deliver all ISMP objectives. Although national statutory authority representatives are the ultimate decision-makers, we opted to give equal weighting to all participants completing the AHP. The IWG is intended as a platform for stakeholder debate to develop shared understandings and gain majority agreement on desired ISMP objectives and actions.

The Cost-Benefit Analysis outlined here is a first step in identifying and monetizing costs and benefits of the ISMP, to illustrate its potential to deliver 'value-for-money' as requested by the IWG. Having determined the costs of managing the annual adaptive management cycle and assigning a benefit of avoided crop damage payments this CBA has shown that the ISMP can deliver considerable net benefit, or at least provide a break-even return on investment. The CBA, as a formalised assessment, has also provided a structured framework for learning about and incorporating economic measures for evaluating the ISMP (Murdoch et al., 2007). The focus of our CBA was predominantly related to costs and benefits associated with two stakeholder groups, i.e. national statutory authorities and farmers. This raises questions about whose costs should be accounted for and who benefits. The AHP indicated that there are other broad societal and environmental benefits which are highly valued, more than just minimising agricultural losses. To fully evaluate the ISMP, careful consideration should be given to defining the boundaries of an economic assessment, incorporating cost and benefits relevant to the interests of those assessing it. The AHP has helped to derive a clear priority order for ISMPs objectives and other anticipated outcomes, with the highest priorities given by IWG members for environmental outcomes e.g. maintaining a stable population and safeguarding habitats.

What is the value of maintaining a healthy and stable Pink-footed Goose population? For different stakeholder groups the benefits it confers and how these are derived do vary. There is the recreational value of bird-watching and hunting opportunities (market / use value), which can be monetized e.g. generating eco-tourism or hunting rental revenues that could benefit farmers suffering crop damages from foraging geese. In our CBA, the latter was identified as an opportunity cost but there are considerable uncertainties about assigning this as a cost or benefit. Firstly, can hunting rental revenues, and similarly eco-tourism, be considered fair compensation for crop damages? Secondly, revenues are unlikely to be equally shared between countries or even locally. For example, hunting of Pink-footed Geese is not permitted in the Netherlands or Belgium. Thirdly, geese do not necessarily occur in the same areas during the hunting season as they do in spring (Madsen et al., 1999). For IWG participants as a collective these economic aspects of hunting rental and eco-tourism revenue were amongst its lowest priorities (3% weighting, respectively) as outcomes of the ISMP.

The high priority given to maintaining a stable and sustainable Pink-footed Goose population may be associated to its ‘existence value’, the non-market value it holds for participants in its conservation (Alexander, 2000). Statutory authorities are bound by legal requirements to maintain its conservation status, whilst other stakeholder groups may simply take pleasure in knowing it exists and will continue to do so. Determining non-market values is more difficult but there are techniques for assigning monetary estimates e.g. contingent valuation methods / willingness-to-pay. These methods, including CBA, are certainly beneficial and can be used to better integrate economics and account for non-market benefits, enabling the effectiveness of natural resource and conservation management plans to be rigorously evaluated. However “evaluations introduce values into what constitutes success” (Kleiman et al., 2000).

The CBA outlined here raised crucial questions about what are valued aspects and outcomes of the ISMP process, as viewed by IWG participants. Although clear objectives were collectively agreed and set for the ISMP what constitutes its success, to whom and at what cost was not as well articulated. In this study, the AHP has assimilated the values and preferences of IWG participants, by making judgments expressed numerically, to create a hierarchy of priorities for their desired outcomes of the ISMP. In turn this hierarchy can be used to create a framework of success criteria to evaluate the ISMP, focusing resources on actions design to deliver prioritised outcomes, as well measures of performance. ISMP environmental outcomes are measurable objectives and are monitored and assessed as part of the ongoing adaptive management cycle e.g. population size, extent of arctic tundra degradation and the wounding of shot geese.

Potentially, these environmental indicators can be articulated into criteria to evaluate the ISMP performance, but crucial questions need to be asked about what are acceptable costs to achieve a desired level of benefit. Economic assessments to determine costs and quantify benefits are clearly of value and can readily be integrated into an adaptive management learning process. The dynamic nature of long term plans should also be accounted for; priorities can change along with investment costs and anticipated benefits (Naidoo et al., 2006). Furthermore, ultimate goals of natural resource management plans are often not attainable for decades and interim performance indicators should be defined to enable success to be measured in a ‘stepwise fashion’ (Kleiman et al., 2000).

For the ISMP, one of its long term goals is a stable population and interim population targets are an integral part of the AHM strategy, but other ISMP fundamental objectives do not have interim targets specified. Additionally the operational costs related to ISMP meetings, monitoring and reporting will be incorporated into a broader multispecies management platform for geese (Madsen et al., 2017). Fluctuations in crop prices do influence costs of compensation and subsidy schemes and thus any valuation as a benefit of reduced crop yield losses achieved through the ISMP. It is regarded as important to consider these dynamics as well as any associated uncertainties and it is better to accept estimation errors than to exclude cost and benefits in any evaluation (Murdoch et al., 2007).

5. CONCLUSIONS AND PERSPECTIVES

The CBA and AHP in this study have been vital steps in determining the costs and potential benefits of the ISMP, as well as establishing what are important criteria for measuring the success of the ISMP in the long term. In terms of 'value for money', the ISMP has the potential to deliver a considerable net benefit in avoided agricultural crop damage payments in comparison to the 'business-as-usual' scenario, where continued population growth was predicted. The collective preferences of the IWG however, prioritised environmental outcomes above economic or social criteria, e.g. maintaining a stable population and the ecological integrity of its habitats. In addition, it was indicated that aspects integral to an adaptive management approach were valued. Coordination, learning, trust-building and compliance were aspects of the ISMP process that were given highest priorities as social outcomes. The adaptive management approach of the ISMP has been successful in bringing together diverse stakeholder groups to agree a common set of objectives and actions. In addition, with the ISMPs annual cycle of meetings and reports, it has promoted transparency of decision-making, knowledge-sharing (between scientific and local expertise) and collaborative learning (Madsen et al., 2017). These experiences mirror many of the lessons learned in the US in managing waterfowl harvest (Johnson et al., 2015).

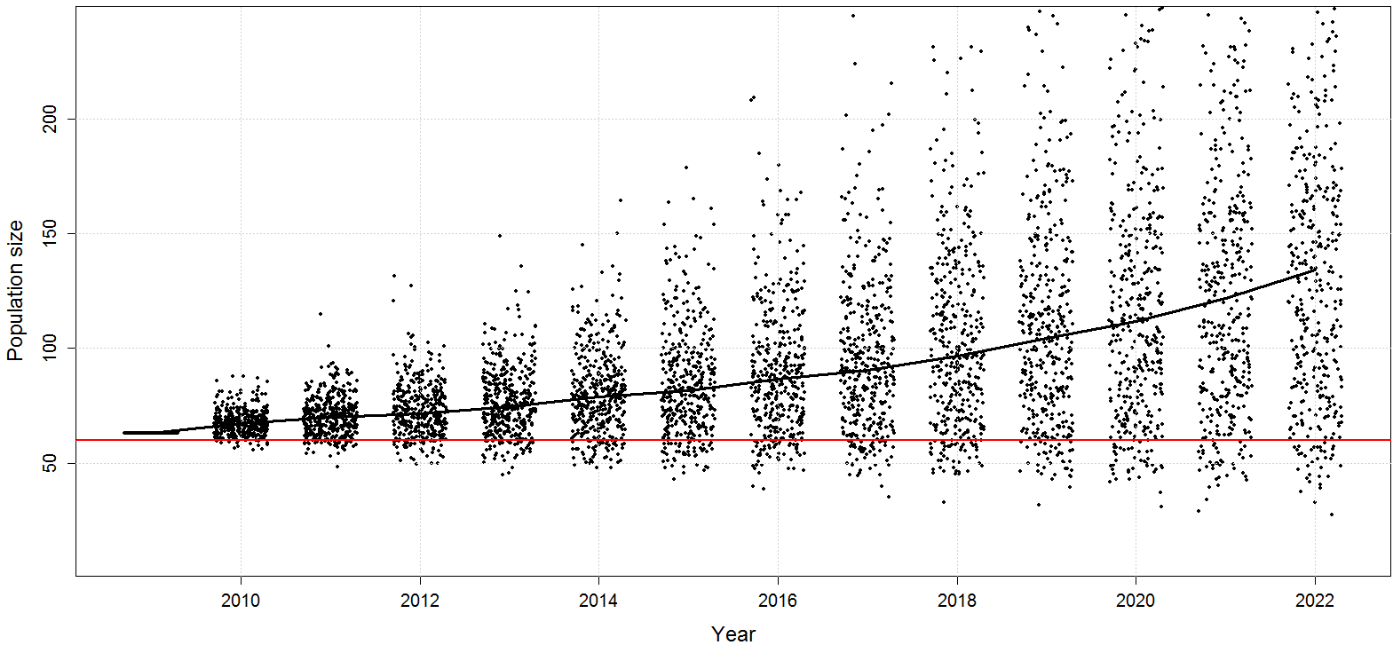
Natural resource management plans are often long term commitments, and similarly it should be accepted that detailed evaluations take time, require resource and leadership but in doing so can provide valuable information to inform decision-makers, as well as a border range of interested parties. In taking an adaptive management approach, the ISMP already embodies these aspects that are conducive for long term evaluation: monitoring, assessment, learning and the involvement of stakeholders. This study emphasises the need to broaden the range of evaluation criteria (both goal and process orientated), as well as how beneficial outcomes of the ISMP are quantified, particularly non-market values that are more difficult to express in monetary terms. The AHP hierarchy of priorities gained here can, in turn, guide resource allocation towards management actions and performance measures that are pertinent to ISMP objectives and outcomes that are valued. Furthermore, AHP indicated that different stakeholder groups do value and prioritise different anticipated benefits of the ISMP. The willingness-to-pay to achieve a desired level of benefit is dependent on its perceived value, and what constitutes success and 'value-for-money' are in the eye of the assessor. Natural resource management plans are increasingly required to balance the interests of multiple stakeholders within society. Our experiences in implementing the ISMP, along with the results detailed here suggest that adaptive management, by engaging in the "delicate process of societal decision making" (Berghöfer et al., 2008), has the potential to deliver many desirable benefits and provide an innovative framework for natural resource management within Europe.

As the ISMP for the Pink-footed Goose will become part of an AEWA European Goose Management Platform (EGMP), this development will provide opportunities for cost-efficiencies by integrating it with several other individual species management plans into an overarching management process. The insights gained from the ISMP for the Pink-footed Goose can inform the development of processes to improve the evaluation of individual species management plans under the EGMP. To fully evaluate the effectiveness of these species plans, objectives and success criteria need to be clearly articulated by quantifying prioritised benefits, setting mile-stones and accounting for related costs. Evaluations of species plans should be inclusive, involving stakeholders to agree success criteria that account for different stakeholder priorities. With multiple-species plans it is likely to be challenging to maintain mechanisms to ensure the continued contribution of diverse stakeholder groups. There will be a need for focussed processes to engage stakeholders at multiple levels (international, national and regional) to feedback their preferences, priorities and ultimately how they would evaluate the effectiveness of any plan. The evaluation of species plans and the continued contribution of different participant groups in their collaborative processes are likely to dependant on whether progress is made in achieving their particular prioritised outcomes. The dynamic nature of long term plans should also be accounted for; priorities can change along with investment costs and anticipated benefits.

Appendices

Appendix 1: Predicted population size in 2022

The ‘Business-as-usual’ scenario: fixed harvest of 7,438 (2007-2009 average). Simulated population sizes using nine models, averaging projections using current model weights (F.A. Johnson unpubl.), 134,000 birds is the projected median population size by 2022 (the time for review of the ISMP) if no action had been taken to control the population size.



Appendix 2: Data used in the economic cost-benefit analysis

Table S2a

Annual ISMP administration costs (in EURO)					
	Days	**No. professionals**	**No. NGOs**	**Rate**	**Costs**
Annual Meeting International Working Group (excl Coordination Unit)					
Length of meeting	1.5	14	10	503	18,090
Travel time for international participants	1	11	8	503	9,548
Travel time for domestic participants	0.5	3	2	503	1,256
Accomodation costs int. participants	2	11	8	100	3,800
Accomodation costs dom. participants	1	3	2	100	500
Per diem international participants	2.5	11	8	60	2,850
Per diem domestic participants	2	3	2	50	500
Excursion					1,000
Travel cost for international participants	1	11	8	267	5,067
Travel costs for domestic participants	1	3	2	133	667
Preparation time	2	14	10	503	24,120
Total Annual Meeting					67,397
Coordination Unit (budget; average 2013-2015)					60,000
National Working Group Meetings (1 meeting in each N, DK, B and NL per year)					
Length of meeting	1	5	5	503	20,120
Travel costs	1	3	5	133	4,256
Preparation time	1	5	5	503	20,120
Per diem for travellers	1	3	5	15	480
Total national meetings					44,976
Additional monitoring activity					
Population survey	1	2	10	503	6,030
Data assemblage	1	2		503	1,005
Grand total					**179,408**
Note: Salaries, accomodation, per diem and travel costs for NGOs included					

Table S2b

Annual harvest regulation administration extra costs (in EURO)				
	Denmark professional time (days)	rate	Norway professional time (days)	rate
Preparation of documents	1	503	1	503
Regulation adaptation	2	503	2	503
Communication	1	503	1	503
Total	4	2,012	4	2,012
Grand total				**4,024**

Table S2c

Compensation/subsidy scheme administration extra costs (in EURO)						
	Norway		Netherlands		Belgium	
	time (days)	rate	time (days)	rate	time (days)	rate
Additional damage assessment	2	503	2	503	2	503
Additional accounts (payment)	2	503	2	503	2	503
Total	4	2,012	4	2,012	4	4,024
Grand total						8,048

Table 2d

Overall increase in agricultural goose damage compensations or subsidies (in EURO)		
Country	EURO	Comments
Norway, Vesterålen	0	subsidies; pink-footed geese have virtually disappeared due to increasing numbers of barnacle geese
Norway, Nord-Trøndelag	269,200	subsidies
Denmark	?	no subsidy/compensation system; costs cannot be assessed
Netherlands	39,175	compensation
Belgium	38,684	compensation
Total	**347,059**	

Table S2e

Dutch compensation payments: 1995 – 2014 (data from Faunafonds)				
Year	Peak No pinkfeet	Paid [€]	Inflation rate	Paid [€] corrected
1995	20.811	37.878	1,69	53.309
1996	24.229	31.647	1,43	44.005
1997	23.449	37.265	1,86	51.284
1998	28.371	11.125	1,77	15.103
1999	32.030	28.859	2,04	38.668
2000	22.708	15.459	2,32	20.398
2001	36.191	27.171	5,11	35.222
2002	27.190	56.911	3,87	70.866
2003	51.233	68.513	2,24	82.661
2004	67.216	63.821	1,38	75.570
2005	47.016	93.204	1,5	109.077
2006	44.411	61.217	1,65	70.724
2007	42.885	65.849	1,58	74.989
2008	44.224	65.291	2,21	73.322
2009	40.861	52.531	0,98	57.831
2010	17.115	101.367	0,92	110.602
2011	23.259	80.376	2,48	86.959
2012	20.332	59.084	2,82	62.458
2013	15.894	86.836	2,57	89.346
2014	12.282	51.666	0,32	51.831

Notes:
Goose numbers provided by F. Cottaar, SOVON (pers. comm).
Inflation rate: http://www.inflation.eu/inflation-rates/the-netherlands/historic-inflation/hicp-inflation-the-netherlands.aspx

Figure S2. Correlation between peak autumn numbers of Pink-footed Geese in the Netherlands and compensation paid for damage caused by Pink-footed Geese, split into two periods: 1995-2009 and 2010-2014. The apparent phase shift in payments between the two periods possibly relate to a change in the organisation of compensation / damage assessment administration. Data from Table S2e with payments corrected for inflation rate. For extrapolation to the future population scenario, the regression line for 1995-2009 was used. To extrapolate the compensation costs to the scenario of 134,000 geese, it was assumed that the proportion of the total population going to the Netherlands remained the same as for the period 2005-2014, i.e. 47%.

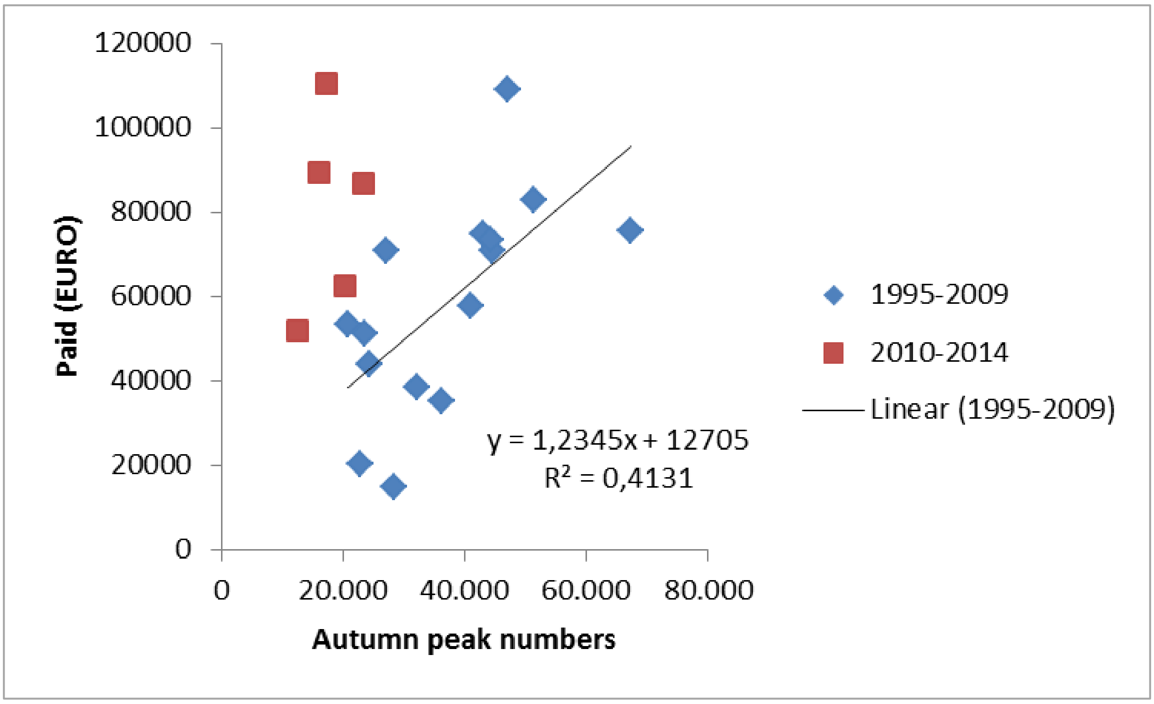


Table S2f

Compensation payments in Flanders, Belgium for crop damage by pink-footed geese			
	Winter		
	2013/14	2014/15	Average
Payments for damage by mixed goose flocks incl. pink-footed geese	€ 41.416	€ 76.013	€ 58.715
Payments for pink-footed geese, assuming 50% contribution in mixed flocks	€ 34.171	€ 60.180	€ 47.176
Peak numbers of pink-footed geese	28.120	27.140	
Total population size	76.000	71.000	
Data sources:			
Compensation payments: Vlaamse Overheid, Agentschap Natuur & Bos, Michiel VanVandegehuchte (pers. comm)			
Goose numbers: E. Kuijken & C. Verscheure (pers. comm)			

Assuming that the proportion of the population going to Belgium remains stable and a 1:1 relationship between goose numbers and compensation payments, the 2022 scenario is that compensation payments will increase to a level of 85,859 EURO.

Appendix 3: ISMP outcome criteria used in AHP

AHP Hierarchy of three top-level criteria with respective sub-criteria

Top-level criteria	**Sub-criteria**	**Relationship to ISMP** (outcome[1] or process)	**Description**
Environment	Minimise arctic tundra degradation	I & IV	Preventing / reducing the risk of further arctic tundra degradation
	Minimise crippling	V	Reducing the wounding / 'crippling' of shot geese.
	Maximise goose use of natural / semi-natural habitats	I & II	Ensuring sufficient natural / semi-natural foraging areas e.g. grasslands to reduce conflicts and crop losses (reducing usage of arable lands)
	Maximise habitat restoration	I & II	The area of restored habitats considered beneficial for geese and biodiversity e.g. traditional grasslands, as well as reducing foraging on venerable crops.
	Minimise risk of population collapse or explosion	III	Maintain a stable and sustainable population that prevents the population collapsing or erupting.
Economic	Minimise agricultural losses (crop damage)	II	Economic costs to farmers and authorities of crop damages / losses caused by geese
	Maximise alternative income: Hunting rental	II & V	Hunting rental that benefits and helps farmers' value geese as source of income.
	Maximise alternative income: Eco-tourism	II & V	Eco-tourism that benefits and helps farmers' value geese as source of income.
	Maximise habitat restoration funding	I & II	Funding for restoration of beneficial habitats for geese and biodiversity e.g. traditional grasslands.
	Minimise costs of operating ISMP process	Process	Costs of monitoring the population, modelling and running IWG meetings etc.
Social	Maximise learning (adaptive management)	Process	Collective learning that leads to better decision making and improved management actions.
	Maximise trust and compliance	Process	Building trust that leads to beneficial agreements, stakeholders abiding by agreements and fulfilling obligations.
	Maximise international co-ordination	Process	Ensuring actions are agreed and co-ordinated between governments.
	Maximise national co-ordination	Process	Ensuring actions are agreed and co-ordinated between government authorities and regional / local stakeholders.
	Minimise social conflicts	II & V	Preventing / reducing the risk of social conflicts arising e.g. farming conflicts about geese.
	Maximise social acceptability of hunting	V	Hunting valued as sustainable, responsible and part of wildlife.
	Minimise loss of natural processes and wonders	III[2]	Valuing natural process and wonders e.g. large flock sizes; letting nature take its own course. Minimum management intervention!

[1] Five fundamental objectives of ISMP considered as outcomes of ISMP process.
[2] For some IWG participants, the concept of setting a population target and actively managing a population size was an ethical dilemma.

Appendix 4: Aggregated AHP results

Table 1: sub-criteria, top-level and overall aggregated weights for all anticipated ISMP outcomes by country

	Criterion	Norway	Denmark	Netherlands	Belgium	Overall
5	Min risk of population collapse or explosion	18%	13%	13%	24%	18%
1	Min arctic tundra degradation	15%	18%	4%	10%	12%
6	Min agricultural losses	8%	10%	15%	8%	10%
4	Max habitat restoration	7%	8%	5%	12%	8%
3	Max goose use of natural / semi-natural habitat	5%	5%	11%	11%	8%
2	Min crippling	12%	9%	6%	3%	8%
9	Max restoration funding	2%	6%	10%	6%	5%
13	Max international coordination	4%	5%	3%	4%	4%
11	Max learning (adaptive)	6%	4%	3%	2%	4%
12	Max trust and compliance	4%	3%	3%	3%	4%
14	Max national coordination	3%	3%	3%	4%	3%
7	Max hunt rental revenue	3%	4%	2%	1%	3%
10	Min ISMP costs	3%	2%	6%	3%	3%
15	Min social conflicts	4%	3%	4%	1%	3%
8	Max eco-tourism	2%	2%	6%	3%	3%
17	Min loss of natural processes and wonders	1%	2%	5%	4%	3%
16	Max acceptance of hunting	3%	3%	1%	1%	2%

Table 2: sub-criteria, top-level and overall aggregated weights for all anticipated ISMP outcomes by stakeholder groups

	Criterion	Authorities	Experts	Farmers	Hunters	Bird protection	Overall
5	Min risk of population collapse or explosion	23%	18%	9%	17%	15%	18%
1	Min arctic tundra degradation	10%	18%	6%	17%	10%	12%
6	Min agricultural losses	14%	5%	23%	8%	2%	10%
4	Max habitat restoration	8%	11%	3%	5%	16%	8%
3	Max goose use of natural / semi-natural habitat	8%	11%	3%	5%	13%	8%
2	Min crippling	5%	5%	5%	15%	9%	8%
9	Max restoration funding	7%	2%	4%	3%	7%	5%
13	Max international coordination	3%	7%	6%	2%	5%	4%
11	Max learning (adaptive)	3%	3%	7%	3%	2%	4%
12	Max trust and compliance	3%	4%	5%	3%	2%	4%
14	Max national coordination	3%	5%	4%	1%	2%	3%
7	Max hunt rental revenue	2%	1%	7%	8%	1%	3%
10	Min ISMP costs	5%	1%	4%	1%	2%	3%
15	Min social conflicts	2%	4%	3%	2%	3%	3%
8	Max eco-tourism	3%	1%	3%	1%	3%	3%
17	Min loss of natural processes and wonders	1%	3%	3%	1%	8%	3%
16	Max acceptance of hunting	1%	1%	5%	7%	1%	2%

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