Paper V

Volunteer hunter motivation and engagement to control the invasive alien American mink (Neovison vison) in Norway.

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Abstract

Invasive alien species (IAS) can have widespread negative effects on native biodiversity. We investigated the prospects of engaging hunters in large scale and collaborative efforts to control non-native mink populations in Norway. We made a questionnaire available to all members of the Norwegian Association of Hunters and Anglers (NAHA) to examine the conservation support and the level of efforts to remove mink in relation to wildlife value orientation, hunting motivations and bounty payments. We find that the general level of interest in mink control programs is low, but the few participating believe that mink is a conservation concern and particularly to ground nesting birds. Mink catches were best predicted by municipal bounty payments that caught on average 5.07 more mink than those who did not receive bounty. Contrary to expectations we found that mink hunters that prefer to hunt alone and that had no preference to hunt locally caught on average 2.89 more mink than those that hunted due to social benefits and preferred hunting close to where they lived. The majority of mink hunters prefer governmental-led programs (47%), 33% confer to NGO-led campaigns whereas 20% believe that mink hunting should be self-initiated by individuals or landowners. Their main recommendation is to invest in bounty programs (52%), but more organized efforts were also supported such as raising awareness and recruitment campaigns (33%) and providing equipment and covering costs for mink trapping (29%). Given the low interest in mink removal, we recommend to concentrate efforts around "conservation hotspots" as a start, involving contract operators, bounty payments and awareness and recruitment programs.

Introduction

Invasive species are responsible for the loss of species diversity that in turn can lead to alteration and degradation of ecosystems (Baillie et al. 2004, Poorter et al. 2007, Simberloff et al. 2013) and are estimated to cost Europe at least 12.5 billion euros per year (Kettungen et al. 2008). Invasive alien species (IAS), such as mammalian predators, can exert negative effects via novel predation strategies on native prey species that have not had time to evolve successful predator avoidance strategies, which in many cases eventually have caused local extinctions (e.g. Atkinson 2001, Didham et al. 2005). Signatory states to the Convention on Biological Diversity (CBD) recognize the wider threat of IAS to native species and have adopted a three-stage hierarchical approach to IAS: prevention; early detection and rapid eradication; and finally control and long-term containment of non-native species which are already established (CBD 2002). These CBD guidelines are also supported in the new regulatory framework for member states which are currently under development in the European Union (EU) (Beninde et al. 2014).

Control and eradication campaigns of non-native invasive species have usually been governmental-led and executed by professional conservation staffs (e.g. Bester et al. 2002, Moore et al. 2003, Nordström et al. 2003, Lorvelec and Pascal 2005, Cranswick and Hall 2010). However, time and financial constraints often limit such campaigns to smaller scales. Alternatively, the government may invest in harvest incentives to encourage a broader participation in removal campaign. These may include i) *bounty programs* that give participants monetary rewards based on sufficient evidence of removal; ii) *contract operators* in which public or private organization are directly paid to remove or harvest the invasive species; iii) *recreational harvest* facilitated by training, education and outreach programs or by iv) encouraging harvest of the targeted species by *regulatory modifications* such as changing hunting seasons, licensing practices or bag limits. Finally, governments could also play a role by supporting the development of *commercial markets* for increasing harvests of non-native invasive species. Pasko et al. (2014) show that few studies investigate the use of harvest incentives in invasive species management and best practice for control or eradication of IAS has yet to coalesce.

Inclusion of non-professional volunteers in a coordinated campaign could significantly improve IAS removal on a larger scale (DEFRA 2006, Bremner and Park 2007, Bryce et al. 2011). For example Bryce et al. (2011) successfully organised a campaign including gamekeepers, fisheries staff, wildlife conservation professionals, land managers and local residents to eradicate breeding mink to protect native species in an areas covering 10,570 km^2 in Eastern Scotland. The campaign is now covering larger parts of the Scottish mainland and a recent scoping study shows the potential of including ecotourism tour operators for eradicating mink around seabird colonies in coastal west Scotland (Fraser et al. 2014). Insights from red fox eradication programs in Australia confirm the significance

of a well-organised and coordinated landscape approach for successful control and eradication of IAS (McLeod et al. 2011, Newsome et al. 2014). Bounty programs that are based on shooting, have generally been perceived as an ineffective method for controlling fox populations having suffered from the lack of persistent, planned and collaborative group effort (McLeod et al. 2011, Kirkwood et al. 2014). While such collaborative initiatives could be initiated by local communities, hunters, landowners or other organizations, a review of 34 participatory invasive-vertebrate programs in Australia show that active support from the government is a crucial element in most effective control programs (Ford-Thompson et al. 2012).

Incentives – or voluntary management programs are dependent on the willingness of people to donate time and energy on such initiatives. It is therefore crucial to investigate the motivation of potential participants before choosing the right mechanisms to achieve the goals. Ryan et al. (2001) identified concerns for the environment, personal growth and social learning as important for initial participation in volunteer activities in 148 programs in Michigan. Volunteers did not perceive themselves as free labour, but were deeply engaged in their work and needed to know how their efforts have helped the environment. On the other hand, social benefits such as meeting other people and socialising, may be crucial for volunteer commitment over time and therefore for the continuity of the program (Ryan et al. 2001, Asah and Blahna 2012). Ford-Thompson et al. (2012) found environmental motives as the strongest motivator in IAS programs, but economic effects were the most salient reasons for campaigns initiated by citizens who were typically landowners and agricultural communities. Other studies have shown that place attachment consisting of volunteer work near participant's homes or other areas they feel strongly about ensures a stronger commitment to the program (e.g. Selinske et al. 2015).

Diverse motives may explain the willingness to participate in volunteering, but deeper held beliefs and values may also influence successful IAS management (Sharp et al. 2011, Fischer et al. 2014). Wildlife value orientations may influence the hunting behavior through their impacts on more specific conservation beliefs and attitudes (Fulton et al. 1996) Wildlife value orientation could for instance explain differences in preferences for trapping (e.g. Manfredo et al. 1999) or divergence in views about lethal control in wildlife management (e.g. Manfredo et al. 2009). A difference in wildlife value orientations along a continuum from domination to mutualism appear to exist across western countries and are important for explaining differences in acceptability of lethal control in particular (Jacobs et al. 2014). Based on divergent value orientations we could assume that IAS which involves lethal control and trapping may recruit volunteers with different motives than in other conservation stewardship programs.

The purpose of this study is to investigate the potential for establishing harvest incentive – or volunteer-based mink control programs in Norway. Until recently there have been no coordinated programs for control or eradication of mink except for sporadic captures by recreational hunters or small-scale bounty programs which have been established in some municipalities. As local environmental NGO's are not so prevalent in Norway, a collaborative and coordinated program to remove mink is likely to depend on more organized involvement of recreational hunters, salmon fishers, or coastal populations dependent on fisheries and aquaculture. Hunters and anglers may have the motive for mink removal which may or may not be consistent with the need to protect red-listed species or seabird colonies. However, a targeted program that combines eradication of mink from nature reserves or other hotspot areas by professional staff with recreational hunters and bounty programs could allow for larger scale initiatives on a landscape scale. Potential participants are to a large extent organized by the Norwegian Association of Hunters and Anglers (NAHA) who organize 120,000 of the 190 000 licensed hunters in Norway (Kaltenborn et al. 2012). Understanding hunters' and anglers' motivations and value orientation, as well as their response to bounty programs is a first step for exploring volunteer based control programs.

We start this paper by summarising the government-led mink control programs which have been initiated so far. There are neither previous studies to refer to nor evaluation reports of these initiatives so we base this summary primarily on documents and knowledge acquired by working with this issue for several years. Next, we used a questionnaire to survey the perceptions, motives and value orientations regarding actual removal of mink hunters and trappers in the NAHA, and to examine the support for the leadership of such programs to understand how a collaborative incentive – or volunteer program best could be organised. The questionnaire also included a question regarding whether hunters received bounty payments. Previous studies show that a high percentage of hunters generally express utilitarian wildlife value orientations (Fulton et al. 1996) but Norwegian small game hunters vary extensively both in value orientations and in their motivation to hunt (Kaltenborn et al. 2012). We expected mink hunters with more utilitarian values and who hunt primarily for consumptive reasons to be more oriented towards the protection of fish and game species. Consumptive oriented hunters are also hypothesized to maximise catch to a larger extent than those with more appreciative motives (sensu Kaltenborn et al. 2012). Mink hunters expressing stronger caring beliefs for animals are expected to shoot or trap mink primarily because of biodiversity protection (i.e. red-listed species and protected areas). We also hypothesized that hunters receiving bounty payments would catch more mink than those not receiving bounty payments due to economic reward. Since the retention of hunters is important for long-term mink control we explored whether social benefits or hunting near their homes affects the catch rates and

support to conservation actions. Finally, we discuss our results together with the preferred leadership s and open comments regarding ways to improve mink hunting and compare it to the experiences with large-scale IAS programs elsewhere.

Mink control programs in Norway

As with many countries, state organized hunting bounties were the main method of pest control in Norway during the last century (Pohja-Mykrä et al. 2005). These were disbanded in Norway in 1975, with organisation of bounty and size of economic reward being devolved to individual municipalities. Although payment of bounty for mink hunting varies with municipality, there is no overall knowledge of the number of municipalities involved or the amounts paid. An email survey of coastal municipalities from the 5 highest ranked counties for mink caught revealed that 27.78 % paid bounties ranging from 20 – 400 NOK (€ 2.36 – 47.33). Financial incentives from the Norwegian Environmental Agency were also potentially available to hunters through competitive application for county level distributed funds that were open to all individuals with game management interests. The Norwegian Environmental Agency made efforts to raise the profile of mink hunting within the NAHA by coordinating the production of hunting method manuals, media coverage and a number of written articles. However, no financial or logistical incentives were introduced, or research into understanding the dynamics of mink hunting within the NAHA. There was also no knowledge within the NAHA itself regarding the number of mink hunters in its association.

In 2010, the Norwegian Environmental Agency commissioned a status report of mink ecology and control in Norway and other European countries (Stien et al. unpub.) and began to gather information about mink control initiatives. As part of the information collation, there was a common meeting with participants of a successful citizen initiated mink control program at the World Heritage Site (WHS) on Vega island, in Nordland County and residents interested in mink control in areas adjacent to the WHS. The goal was to hear and report to the Norwegian Environmental Agency their experiences of mink control to protect several colonies of eider that enabled the traditional coastal eider down culture to be maintained, which in turn was the reason for the WHS status. The meeting revealed that the control program was citizen orientated with support from the municipality. The WHS committee had found and hired 2 proficient hunters with tracking dogs who were on call to remove 'problem mink' from eider down colonies i.e. mink not caught by colony owner initiated trapping campaigns. These hunters also undertook in their spare time, independent and fairly systematic mink hunting on the chains of islands to the south and north of the WHS. The hunters were partly motivated by receiving municipal bounty, which in turn had been initiated to aid the success of the WHS but also had a strong desire to eradicate mink in order to aid conservation of ground nesting seabirds. Results from the rest of Norway indicated that few mink control initiatives

existed and that no systematic monitoring of the effect of mink capture on mink numbers or monitoring of sea birds existed. These additional efforts consisted of group citizen initiatives in a few areas in southern Norway and in addition, the contractual operators of the Norwegian Environmental Agency, the Norwegian Nature Inspectorate operated seasonal removal of mink from a small number of nature reserves where mink predation of ground nesting sea birds was observed to be high. This involved hiring a few individual mink hunters with tracking dogs to remove mink from individual reserves before the breeding season began. Otherwise, there were small-scale actions by Norwegian Nature Inspectorate staff including an attempt by staff to recruit local residents to participate in mink control around a nature reserve. Concurrently, county environment protection officials were required to report to the Norwegian Environmental Agency the status of coastal and island nature reserves in terms of threat to breeding seabirds from mink. The Norwegian Environmental Agency drew up a short list of prioritised reserves for mink removal and chose training of professional staff in the Norwegian Nature Inspectorate to undertake the mink removal.

Methods

Survey Sampling and recruitment

Our study was largely exploratory and intended to provide knowledge for the design and elucidation of alternative strategies for a targeted volunteer – and incentive program. As there is no arena for recruiting mink hunters directly, we decided to recruit broadly through the NAHA. We advertised the questionnaire in co-operation with NAHA as a news item in September 2013, on both the organisation's internet home page and monthly magazine with a link to the electronic questionnaire. This was followed 6 weeks later by direct e-mail contact with all NAHA at county level (n=19) and municipality (n=509) groups and further, the 152 municipalities for the five counties with highest mink returns in the 2012 hunting season. The e-mails explained the goals of the project and asked for contact information for potential respondents. The e-mail to NAHA groups also asked for promotion of the survey at county and municipality level. We spent considerable time on the telephone following up contacts and participated in local radio to increase recruitment to our study.

Survey questionnaire

We designed an internet survey in Questback directed to mink hunters. The questionnaire was trialed on a small subset of eight respondents and employees in the NAHA and altered slightly based on their feedback before being available to respondents. The questionnaire consisted of 47 questions and included questions about the number of mink caught-, and general hunting effort in the 2012 hunting season. We included questions to investigate respondents' wildlife value orientations, motivation for

mink hunting and payment of bounty (Fulton et al. 1996) . The variable bounty was collapsed into the 2 categories received or not received. To explore possible forms of leadership of mink control programs we included a question about whom hunters thought should be responsible for mink control. Questions reflecting the motivation to hunt included stating the relative importance of personal, social and environmental benefits for motivating hunters in general (Asah and Blahna 2013). We built on the standardized questions developed to measure wildlife value orientations (e.g. Manfredo et al. 2009) and included a category in subsistence hunting to capture the motivation to hunt for game and fish in Norway. Similar to Manfredo et al. (2009) we used a 7-point scales ranging from −3 (strongly disagree) to +3 (strongly agree) with zero as a mid-point. The utilitarian value orientation was based on four belief items in which 2 reflect priority of humans over wildlife and 2 threats to life and property. We also included two items reflecting caring beliefs. For hunting motivations, respondents were asked to check one or more statements describing why they hunt or fish. We supported these general questions on wildlife value orientations, motivation, and bounty with more specific questions directed to indicate attitudes and intent to participate in conservation aimed at mink control. These included questions about perceived threats of mink to fish, game and red-listed species as well as the importance of removal of mink within protected areas (PA´s). 'Removal from PA's' included nature reserves, national parks, world heritage sites and other specially protected areas. The variable 'red list species of bird' was aggregated for those who checked that mink is a threat for black and white guillemot (*Cephus grylle*), puffin (*Fratercula arctica*), black throated diver (*Gavia arctica*) and common scoter (*Melanita nigra*) according to the Norwegian Species Red List for 2010 (Kålås et al. 2010). The variable 'ground nesting species not red listed' refers to common eider (*Somateria mollissima*) and 'other ground nesting birds'. Finally, we included threat to 'salmon and other salmonids' as a separate variable. Mink hunting behavior was surveyed by three questions (Table 1) to investigate how beliefs, motivations and conservation attitudes affected the number of mink caught and the effort invested in mink hunting. We analysed number of days hunted and intentions to remove mink the next 3 years, but we only retained mink catches in the 2012 season as our analyses showed a significant association among those three variables.

For the purpose of setting up a conservation program targeted towards removing mink we also asked who they thought should be in charge of the program. Since this is the first study targeted towards mink hunters in Norway, we wanted to make sure that we identified a broad range of challenges and alternatives for initiating control programs. We therefore included an open question inviting respondents to contribute suggestions that could improve mink hunting.

The questionnaire and ethics were reviewed and approved by the Norwegian Social Sciences Services (NSD), project number 34676.

Data analysis

Exploratory factor analysis is generally not recommended for small sample sizes, but could be meaningful if interpretable factors can be identified (Pearson and Mundform 2010). We first used principle component analysis and correspondence analysis to investigate the main structure of our data, but decided to use agglomerative hierarchical cluster analyses to classify hunters into groups, which is recommended when sample size is small. Variables were standardized and centralised before conducting Principal Components Analysis (PCA) on belief variables, while Multiple Correspondence Analysis (MCA) was used to explore the categorical data on motivation and leadership variables. We then created classes of the wildlife value orientation, motivation and leadership data by using Hierarchical Clustering on results from the MCA and PCA. Clusters were determined using a Euclidean distance metric for co-ordinate distances and Ward's method to define optimum clusters (Ward Jr 1963, Husson et al. 2010). All of these analyses were carried out in the R package FactoMineR (Husson et al. 2015).

We used generalised linear regression (glm) assuming a poisson error distribution to model the effects of bounty, value orientation and motivation on the number of mink caught. For the categorical data we used cumulative logistic models to predict conservation attitudes and leadership from the wildlife value orientation and motivation using the clm function with a probit link in R package ordinal (Christensen 2015). Best models were chosen using AICc for small sample sizes (Burnham and Anderson 2002).

Results

One hundred and four respondents from 18 counties answered the questionnaire, of whom 96 were NAHA members. While the sample size is statistically small, it represents hunters responsible for a high number of mink caught in Norway. Their total catch of mink was 1053 (mean 12.84, [1 – 80]) which accounts for 19.87 % of the national mink total for the 2012 season (SSB). More than 60% caught less than 5 mink during the 2012 season, which means that a few hunters are catching a large share of the mink in Norway (Figure 1). Most respondents were male (96%), mean age 41.29 [16 – 76] years, lived in coastal municipalities (86 %) and hunted in their residential or neighbouring municipality (91 %, n = 90).

The effect of bounty, belief, motivation and hunting effort on the number of mink caught

Cluster analysis of wildlife value orientations identified one class associated with utilitarian values (28%), one associated with caring beliefs (32%), and one with intermediary values but with higher scores on acceptability to kill wildlife that poses a threat to property or humans (40%)(Table 2). The 3 motivation classes identified are defined by 2 variables: whether they like to hunt with family and friends (social) or if they like to hunt close to where they live (local) (Table 3). The best model for predicting the number of mink caught included the effects of value orientation, motivation and bounty (Figure 2, Appendix Table A1). Significant effects in decreasing order of effect size included a positive effect of receiving bounty, a positive effect of the non-social and non-local hunting class (NSNL), and a negative effect of caring beliefs. Receiving bounty increased the average number of mink caught from the reference value of 6.45 ± 1.08 mink to 11.52 ± 1.10, while hunters that enjoyed hunting alone and not necessarily close to where they lived (NSNL) hunted on average 9.34 ± 1.09 mink compared to the reference value. Hunters with stronger care for animal values caught on average 4.75 ± 1.10 mink, which is slightly less than those who expressed utilitarian orientations. Three outliers that had a large effect on the co-efficient estimates were removed. Inspection of the model residuals indicated that standard deviations were larger than expected when theoretical quantiles were > or < 1. Neither wildlife value orientation nor motivations were significant in predicting conservation attitudes.

Most hunters were interested in removing mink to aid conservation management (Table 4), agreeing strongly that mink was a threat to Norwegian biodiversity and that mink should be removed from PA's. Hunters believed it was more important to remove mink to conserve ground nesting species rather than specific red listed ground nesting species (Table 4). The respondents were divided with regards to protection of Salmonid fishes.

Leadership and recommendations for conservation targeted towards mink control programs?

There was no significant effect of wildlife value orientation or motivation on leadership class. Leadership class was best defined by 3 clusters (Table 5). Cluster one consisted of 47 % of the hunters that had a preference for governmental leadership, cluster 2 indicated a preference for NGO leadership (33 %) and were the most reluctant to municipal leadership and cluster 3 consisted of hunters (20 %) who preferred self-initiated and landowner actions to hunt and were against any hierarchical led actions.

The majority of hunters (86 %) recommended one or more ways that mink hunting could be made more appealing. Recommendations fell into 5 common areas with bounty (52 %) and raising awareness of the negative effects of mink together with recruitment of more mink hunters (36 %)

being common to all leadership classes (S1, Table 1). The recommendation of more logistic and financial support in terms of undertaking mink hunting (29 %) was supported equally by those in favour of governmental and NGO led mink control programs, but not by hunters favouring landowner or self-inititated mink removal (S1, Table 1). The recommendation of organising landowner permissions was only supported by those emphasising governmental-led programs (S1, Table 1). Most recommendations were not explicitly directed to a specific leadership class (S1, Table 2). A third of hunters recommended that bounty should be increased to attract mink hunters.

Discussion

The overall insight gained from this study is that the recruitment to, and interest in mink control programs is low in Norway. The previous attempts to set up such programs and our extensive efforts to recruit participants in our study suggest a low potential for collaborative volunteer programs at present. The few mink hunters that participated in our study accounted for 19.9% of the reported mink catches for the 2012 hunting season, which implies that a few hunters were responsible for a significant part of the mink harvest in Norway. We found support for our hypothesis that mink hunters receiving bounty caught more mink than those that did not. Increasing the bounty payments was also one of the main recommendations provided by hunters to improve mink control programs. Bounty programs may be a way of increasing the number of mink caught. However, increasing number of mink caught per se does not result in successful control due to their high dispersal capacity and probable density dependent response (Einarsson et al. 2006, Bonesi and Palazon 2007, Bodey et al. 2009, Bryce et al. 2011). Indeed, Pasko and Goldberg (2014) indicate that uncoordinated measures have a low success rate for the control of IAS in general, resulting in harvesting, or in some cases conservation of the target species due to changing perceptions of value. Albeit these considerations bounty payments could be a part of a carefully planned programs to control IAS as in the case of the coypu eradication program Gosling and Baker (1989). Bounty was also successfully used in a coordinated landscape approach to red fox eradication in Australia (McLeod et al. 2011, Newsome et al. 2014).

While the mink hunters generally agree that mink is a threat to biodiversity and protected areas, they appear less concerned about the red-listed species that are prioritised by the Norwegian Environmental Agency. Rather the conservation targets of mink hunters appear to be ground nesting birds which are important for recreational hunting (e.g. grouse) or which have previously been economically important (e.g. eider). The willingness to remove mink to protect ground nesting birds is not surprising given the strong support to recreational grouse hunting in Norway (Kaltenborn et al.

2012). Mink on the other hand has no value as food, pelt or for conservation of edible game so that mink hunting for the majority is likely to be a small-scale hobby or by-catch activity rather than a targeted hunting effort. Awareness campaigns that aim at increasing the hunters' interests to harvest mink may be more successful if there is a perceived threat to popular harvestable species such as ptarmigan and salmonid species. The case study from Vega WHS indicates that people living in coastal communities could self-initiate mink removal programs to protect seabird colonies. In Vega, the strong interest in mink removal reflects a strong cultural history as coastal communities were economically substituted by eider down industry up until the 1940's (e.g. Soot-Ryen 1941).

Conservation support to mink control was not clearly reflected by the motivation and value measures included here. We cannot dismiss that the lack of evident relationships are due to the measures used or the low sample size, but literature suggests that hunters and anglers in Norway represents a diversity of interests and values and therefore may deviate from other settings where a more tight relationship between value orientation, conservation beliefs and support to management actions could be found among hunters (Manfredo et al. 2009, Sharp et al. 2011, Jacobs et al. 2014). Appreciative, therapeutic, conservation and consumptive benefits were all expressed as important to hunters and confirms the diverse interest in small game hunting found by Bjerke et al. (2006) and Kaltenborn et al. (2012). The most surprising result is that among a group of hunters there is a distinct class with strong caring beliefs and that invest less in IAS removal.

Many volunteer studies indicate that social benefits are important for being involved in and long-term participation in volunteer conservation efforts (e.g. Ryan et al. 2001, Asah and Blahna 2012). These studies point to a positive relationship between volunteer retention and a sense of belonging either by hunting together with friends and family or by being a member of local cultures and volunteer work near participant's homes (Selinske et al. 2015). We found the opposite for mink hunters. Social benefits and local hunting were among the lowest ranked motivations by mink hunters, and hunters belonging to this class catch more mink than others. Our results also run contrary to what has previously been found for small game hunters (Andersen et al. 2008), and for hunting participation in general. Lack of social motives is further supported by the lack of mentioning of hunting teams in the general recommendation to improve mink control programs, and reflects that there are a few devoted hunters or trappers who have the personal motivation and skills to hunt mink. As much as 43% of the hunters are primarily motivated by social benefits and mink control programs need to encourage also this segment to hunt more. Locally organised control programs may inject a social motivation to hunt and ensure continuity in initiated programs. Such co-ordination may also result in successful control at the landscape scale, even when individual mink hunter catch is low as shown by (Bryce et al. 2011).

Bottom-up initiatives may be easier to facilitate in some cultures and for some conservation purposes than others (Fischer et al. 2014). Conservation volunteer organisations are largely utilised in Britain, the USA and Australia (Silvertown et al. 2013), and most of the examples on volunteer-based programs related to IAS comes from these regions. In Norway, environmental conservation is organised differently, deriving from the corporatist style of governance common to all Scandinavian countries (Dryzek et al. 2002). Organisations are perceived as the arms of the state, and contribute to the formulation of conservation policies as well as the implementation of them by receiving financial and logistic support by the government. It is therefore no surprise that hunters prefer more top-down initiatives led by the government or NAHA rather than citizen or landowner initiated programs. Organising mink control programs as collaboration between the government, municipalities and the NAHA is sensible given the number of local organisations NAHA represents and the financial and the logistic support the government could provide. In comparison, conservation organisations in Norway have fewer members also than the other Scandinavian countries (Dryzek et al. 2002), and are poorly represented at the local level. The crucial role of the government to achieve ecological and social objectives is also confirmed by a review of IAS management programs in Australia (Ford-Thompson et al. 2012). Similarly the hunters in our survey request a more active role by the government for providing infrastructure, bounty, trapping equipment, organize landowner permissions to hunt, and to set up recruitment and education programs to increase participation in mink hunting.

Conclusions and recommendations

We can conclude that there is currently little interest in mink hunting in Norway. The Norwegian Environmental Agency has tried to increase interest in mink hunting through motivating hunters to hunt without supplying economic or logistic support. Whether there has been an increase in mink hunting as a result is not possible to say as the number of mink hunters within the NAHA is unknown. However, the hunting statistics indicate that there has been little change in mink hunted during the 2013 and 2014 seasons. It is clear any future effort involving volunteer mink hunting will require significant investment by the state. This would include provision of finances, direct and/ or facilitation of carefully coordinated plans in collaboration with municipalities, organisation of landowner permissions, and payment of bounty. In addition, the state would need to organise networks of hunters in "conservation hotspots" that can reduce the rate of recolonisation in reserves targeted by state employed professionals. Collaborative efforts involving hunters to control red fox in Norway suggest that effective control of other species could be feasible by combining contractual operators (i.e Statens Naturoppsyn), hunting organizations and bounty payment (which in this case

was remarkably higher than in any mink control programs). Coordinating networks of low catch hunters giving low returns could then complement the effect of relatively few high catch hunters willing and able to catch high numbers of mink over a relatively large area. Furthermore, efforts must be adaptable to cope with changing focus when control results in the decline of mink numbers (e.g. Bodey et al. 2009). Any trial projects should be carefully designed. Not least, the effectivity of mink hunting in such projects must be assessed and should include both an assessment of mink capture on both mink re-colonisation and whether mink catch results in can increase in the target species of conservation.

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Table 1. Variables used in analysis of mink hunter perceptions based on survey questions sent to Norwegian mink hunters regarding the 2012 hunting season.

Variable	Question
Wildlife value orientation	On a scale of 1 to 7, where 1 is total disagreement and 7 is total agreement, how much do you agree with the following statements? 1. Humans should manage fish and wildlife populations so that humans benefit 2. The needs of human should take priority over fish and wildlife protection 3. It is acceptable for people to kill wildlife if they think it poses a threat to their life 4. It is acceptable for people to kill wildlife if they think it poses a threat to their property 5. I care about animals as much as I do about people 6. I value the sense of companionship I receive from animals
Motivation	Check one or more statements that are appropriate for you. I like to hunt or fish because… 1. family or friends hunt (social) 2. it gives me a sense of belonging to a group I wanted to be part of (social) 3. it gives me exciting experiences (appreciative) 4. I think it is important to harvest from nature(consumptive) 5. it increases my knowledge about quarry species (appreciative) 6. I like to eat fresh fish and/ or game that come directly from nature (consumptive) 7. it is an outdoor hobby that is close to where I live (local) 8. it gives me the opportunity to experience impressive nature (appreciative) 9. it is a good form of relaxation (therapeutic) 10. it gives me physical activity (therapeutic) 11. I can contribute to good conservation and/ or management of nature (conservation)
Leadership	Who do you think should lead programs aimed at controlling mink? 1. The Norwegian Environment Agency (national government) 2. The County Government Offices (regional government) 3. The Municipalities 4. Landowners 5. The Norwegian Hunting and Fishing Association / other NGO's 6. Individuals must take responsibility for controlling mink
Bounty	Do you receive funding from the municipality (and how much)? 1. NOK 0 2. 1 – 99 3. 100 – 199 4. 200 – 399 5. 400 – 499 6. > 500
Conservation attitudes	Presence/absence of the following conservation attitudes (combined from several questions as described in the text). 1. Mink is a threat to Norwegian biodiversity 2. It is important to remove mink from protected areas 3. It is important to remove mink to protect red list species of birds

	4. It is important to remove mink to protect ground nesting species
	5. It is important to remove mink to protect salmonid fish
Mink hunting	1. How many mink did you trap or shoot during the 2012 season?
	2. Do you intend to trap or shoot mink during the next three years?
	3. How many days did you hunt during the 2012 season?
Recommendations	Can you suggest some ways to motivate or make it easier for hunters to remove mink?

Table 2. Descriptive values of classes for the beliefs expressed by 104 Norwegian mink hunters. The percentage of hunters in each cluster class is shown in parenthesis. Cluster classes were found by hierarchical agglomerative clustering (see text for details). Values of > 2 for the v.test are significant at the P < 0.05 level with positive sign indicating that the group mean is larger than the overall mean and negative sign indicating that the group mean is smaller than the group mean. The global mean for each variable is indicated in the column MEAN.

Belief variables	Utilitarian (28%) (dominance)			Caring (32%) (mutalism)			Intermediary (40%) (dominance mutualism)			MEAN
	Mean	SD	v.test	Mean	SD	v.test	Mean	SD	v.test	
Humans should manage fish and wildlife populations so that humans benefit	5.17	1.94	-4.26	-	-	NS	6.78	0.55	3.47	6.18
The needs of human should take priority over fish and wildlife protection	3.17	1.44	3.17	1.38	0.73	-4.81	-	-	NS	2.40
It is acceptable for people to kill wildlife if they think it poses a threat to their life	-	-	NS	3.88	1.68	-6.22	6.52	0.82	5.16	5.43
It is acceptable for people to kill wildlife if they think it poses a threat to their property	-	-	NS	2.35	1.23	-6.41	5.21	1.28	6.31	3.91
I care about animals as much as I do about people	2.10	1.26	-6.17	4.94	1.73	2.45	5.02	1.84	3.22	4.21
I value the sense of companionship I receive from animals	3.00	1.28	-6.57	5.41	1.33	2.11	5.71	1.38	3.92	4.88

Table 3. Descriptive values of classes for motivation. The percentage of hunters in each cluster class is shown in parenthesis. Motivation clusters Local = motivated by local hunting, NSNL = non-social and non-local hunting, Social = social motivations for hunting. Cluster classes were found by hierarchical agglomerative clustering using the ward method. Values of > 2 for the v.test are significant at the $P < 0.05$ level with positive sign indicating that the group mean is larger than the overall mean and negative sign indicating that the group mean is smaller than the group mean. N = mean frequency of hunters responding to motivational variable.

Motivation variables	Local (32%)	v.test	NSNL (26%)	v.test	Social (43%)	v.test	N
It gives me exciting experiences	-	NS	-	NS	-	NS	93
I think it is important to harvest from nature	-	NS	-	NS	-	NS	92
It gives me the opportunity to experience impressive nature	-	NS	-	NS	-	NS	91
I can contribute to good conservation and/ or management of nature	-	NS	-	NS	-	NS	88
It is a good form of relaxation	-	NS	-	NS	-	NS	87
It gives me physical activity	-	NS	-	NS	-	NS	84
I like to eat fresh fish and/ or game that come directly from nature	-	NS	-	NS	-	NS	84
It gives me a sense of belonging to a group I wanted to be part of	-	NS	-	NS	-	NS	79
It is an outdoor hobby that is close to where I live	33	3.59	0	-5.19	-	NS	64
It increases my knowledge about quarry species	-	NS	-	NS	-	NS	63
Family or friends hunt	0	-5.23	0	-4.13	44	7.76	44

Table 4. Percentage of conservation attitudes expressed by wildlife value orientation and motivation classes. We found no significant differences among classes.

Conservation values	Utilitarian		Caring		Intermediary		Local		NSNL		Social	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Mink is a threat to Norwegian biodiversity?	25	3	29	3	38	3	28	4	35	1	39	4
It is important to remove mink from protected areas?	24	4	27	5	39	2	31	1	24	2	35	8
It is important to remove mink to protect red list species of birds.	7	21	12	20	13	28	8	24	5	21	19	24
It is important to remove mink to protect ground nesting species	22	6	31	1	25	6	26	6	34	2	28	5
It is important to remove mink to protect salmonid fish	13	15	14	18	22	19	21	11	7	19	21	22

Table 5. Descriptive values of classes for the variable leadership. Leadership clusters Government = state and municipal agencies; NGO = non-government organisation and not municipalities, Individual = individual hunters and landowners. Cluster classes were found by hierarchical agglomerative clustering using the ward method. Values of > 2 for the v.test are significant at the $P < 0.05$ level with positive sign indicating that the group mean is larger than the overall mean and negative sign indicating that the group mean is smaller than the group mean. N = mean frequency of hunters responding to leadership variable.

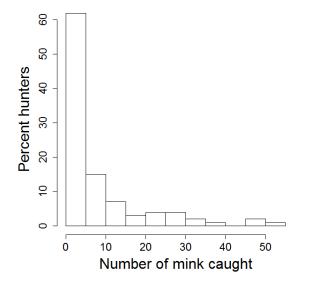| Leadership variables	Government (47%)	v.test	NGO (33%)	v.test	Individual (20%)	v.test	N
1. The Norwegian Environment Agency	33	2.75	-	NS	2	-2.81	57
2. The County Government Offices	23	2.11	-	NS	0	-3.17	40
3. The Municipalities	37	3.24	16	-3.16	-	NS	62
4. Landowners	-	-	-	NS	11	2.25	37
5. The Norwegian Hunting and Fishing Association / other NGO's	0	-5.69	33	7.36	0	-2.75	33
6. Individuals must take responsibility for controlling mink	8	-3.64	-	NS	20	4.97	47

Figure 1. The percentage of hunters catching mink during the 2012 hunting season.
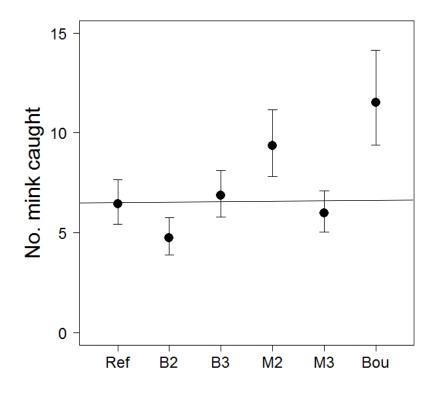
Figure 2. The effects of wildlife value orientation (B), motivation (M) and bounty (Bou) on the number of mink caught by 101 mink hunters during the 2012 hunting season. Ref refers to the reference level given by hunters characterised by utilitarian beliefs, local hunting motivations and no bounty payments and is shown by the horizontal line, B2 = caring beliefs and B3 = intermediary. M2 = non-social and non-local hunters, and M3 = social hunters. Bou = municipal bounty was received. Estimates are given as the exponential of the poisson error regression estimates.

Appendix

Table A1. The three best regression models for the effects of belief, motivation and bounty on the number of mink caught by 104 hunters in the 2012 hunting season ranked according to Akaike's Information Criteria (AICc and ΔAIC) and Akaike's weights (w_i) The ΔAIC values are expressed in relation to the best fitting model. K is the number of parameters in the models.

Rank	Model	K	AICc	ΔAIC	w_i
1	Belief + motivation + bounty	6	1480.66	0.00	1
2	Motivation + bounty	4	1496.67	16.01	0
3	Belief + bounty	4	1505.88	25.23	0

Supplementary Material

Table S1. Recommendations to make mink hunting more appealing displayed by desired leadership class for 86 mink hunters active during the 2012 hunting season.

Recommendation	Leadership Class		
	Government	NGO	Individual
Bounty	19	16	10
Awareness and recruitment	13	12	6
Equipment and costs	12	12	1
Organisation of landowner permission	9	1	1
Changes in law	4	5	2

Table S2. Examples of statements in the 5 recommendation categories made by 86 mink hunters hunting in the 2012 season.

Recommendation	Statement
Bounty	'Bounty for mink would have helped a lot I think'
	'Higher bounty'
Awareness and recruitment	'Local groups buy in traps for young hunters and others interested '
	'Instruction and [the possibility for] increasing skills'
	'Raise awareness what a scourge mink is '
	'More focus on publicising the consequences of mink predation'
	'Increase understanding of the destruction that mink does on natural wildlife that belongs here'
	'Better information regarding where it is possible to hunt'
	'Better information to landowners so that it is easier to get permission'
Equipment and costs	'Easier access to traps'
	'Grant to cover traps and / ammunition'
	'It would have been nice to be given some traps'
	'Economical support and free traps'
	'It would have been nice with economical support…because ammunition and fuel for boats has become so expensive'
Organisation of landowner permission	'Easier to get permission from landowners'
	'Organization of landowners [access]'
	'Landowners that allow access to hunting'
	'That more landowners let us set up traps or hunt'
Changes in existing hunting laws	'It should be possible to shoot from a motor boat'
	'There should be free hunting of mink on uninhabited islands along coast with holms and islands'
	'Remove landowner permission'
	'Lawful to use 22 caliber ammunition as in Sweden'