Crop Protection 96 (2017) 258–264

Contents lists available at ScienceDirect

Crop Protection

journal homepage: www.elsevier.com/locate/cropro

Lethal scaring – Behavioral and short-term numerical response of greylag goose *Anser anser*

Johan Månsson

Grimsö Wildlife Research Station, Department of Ecology, Swedish University of Agricultural Sciences (SLU), S-730 91 Riddarhyttan, Sweden

ARTICLE INFO

Article history:
Received 5 January 2017
Received in revised form
27 February 2017
Accepted 2 March 2017
Available online 8 March 2017

Keywords:
Birds
Geese
Crop protection
Harvest losses
Management
Preventive measures

ABSTRACT

Lethal scaring is one method used to alleviate crop damage by grazing geese. During lethal scaring, a few geese foraging on growing crops are shot to achieve a deterrent effect on other flock members. An additional aim is to reinforce the effects of non-lethal scaring measures. As the populations of geese increase in large parts of the world, an increased need for tools within the multifaceted area of goose management has been highlighted. Lethal scaring can potentially be one method, but currently little evidence exists about the effectiveness of the method.

In this study, I tested whether grazing greylag geese *Anser anser* show short-term numeric and behavioral responses due to lethal scaring in targeted fields, using a Before-After-Control-Impact (BACI) study design. The study includes 26 fields with lethal scaring and 43 controls (geese were left undisturbed), where the number of birds was counted and the distance between an approaching person and the geese when all individuals have raised their heads and when they escaped were measured - before and after lethal scaring was performed.

On average, 33 geese were shot per trial, which corresponds to 8.9% of the counted geese on the lethal scaring fields before the shooting occurred. The number of geese significantly decreased in the lethal scaring fields after the shooting (63% less) but were also reduced in numbers on the control fields (17% less). This result may be due to the same goose individuals using both control and lethal scaring fields, and when affected at scaring fields they choose another area or habitat for foraging; for example, in wetlands. However, the difference in the number of geese on control fields, both before and after lethal scaring, did not relate to the distance to lethal scaring fields. Moreover, birds did not seem to become more afraid of an approaching person (i.e., a non-lethal scaring tool) after the lethal scaring had been conducted (flight distance before 134 m (±15.3 S.E.) and after 149 m (±14.1 S.E.) in lethal scaring fields).

In conclusion, this study shows that lethal scaring can substantially decrease the number of greylag geese in damage prone fields for at least three consecutive days, hence this method may also work as a tool to reduce crop losses. Practical experience from tools for alleviating crop damage is available from both Europe and North America, but very little has been published. It is therefore important to evaluate the effectiveness of the available tools under controlled conditions to increase our understanding of appropriate preventive tools and provide guidelines for stakeholders involved in the multifaceted area of goose management and crop protection.

1. Introduction

Many geese populations have increased in Europe and North America during the last few decades (Ankney, 1996; Fox et al., 2010), and have also shifted the use of habitats from relatively natural systems to intensively managed agricultural landscapes (Fox et al., 2017, 2005; Gauthier et al., 2005). Increasing populations of geese can have a detrimental effect on vegetation and ecosystems (Abraham et al., 2005a, 2005b) and also bring geese into conflict with farmers as they cause crop damage (Ankney, 1996; Fox et al., 2017). The recent rapid increase in goose numbers presents a monumental management challenge, and applied research is required to increase knowledge about available tools to mitigate impact and harvest losses. Common tools to reduce damage by grazing geese aim to divert geese from economically sensitive crops to alternative feeding areas where they do not cause damage by

E-mail address: johan.mansson@slu.se.

http://dx.doi.org/10.1016/j.cropro.2017.03.001

using scaring and diversionary fields (Conover, 2002; Fox et al., 2017). Practical experience from these tools are available from both Europe and North America, but very little has been published and a strong need for studies under controlled conditions to inform management has recently been highlighted (Fox et al., 2017).

Lethal scaring is a preventive tool used to reduce harvest losses (Conover, 2002). By shooting some of the birds foraging on growing crops, a deterrent effect on other flock members is expected. In addition to instantaneously reducing goose numbers in certain fields, lethal scaring also aims to reinforce the effects of non-lethal scaring measures (Conover, 2002; Smith et al., 2008). The lethal scaring of geese therefore differs from the culling of large carnivores and ungulates where hunting often targets specific individuals (the culprits; Conover, 2002). Lethal scaring also differs from hunting during the open season, as the objective with lethal scaring is solely to prevent damage whereas the objectives during the open season can also be regulation of the population, harvesting food resources and recreation. Lethal scaring is currently permitted and performed during variety of times, including controversial periods (e.g., breeding season), although little scientific support exists regarding its effectiveness. Therefore, lethal scaring is commonly accepted based on a perceived effect rather than scientific evidence of a real effect. However, studies have been conducted on the response of geese and other water birds to hunting as opposed to specifically for scaring. Earlier studies have mostly been focused on conservation perspectives (Madsen and Fox, 1995), while recent studies have acknowledged the increase in goose populations and shifted the questions to how to hunt more efficiently (Jensen et al., 2017, 2016a). These studies showed that geese and other water birds can be frightened by shots fired from 80 m up to a 500 m range (Madsen and Fox, 1995; van den Tempel, 1992). Furthermore, hunting activities can change activity patterns, foraging sites and increase escape distances (Hockin et al., 1992; Madsen, 2001; Madsen and Fox, 1995; McLennan and Hill, 2012). Moreover, many of the commonly used non-lethal scaring devices such as propane cannons, camouflage nets and fire-crackers seem to provoke fear by mimicking hunting (Conover, 2002). Therefore, it can be expected that lethal scaring will affect the distribution and use of specific fields. However, lethal scaring is most often performed outside the open hunting season, and factors that may affect the response of geese such as the energetic need, flock compositions and environmental conditions (Fox et al., 2017; Weiss et al., 2011) may therefore differ from earlier studies on conventional hunting. Moreover, shooting as a tool to decrease damage has been questioned as behavioral shifts may lead to increased damage. For example, it has been suggested that hunting can scare non-targeted geese from areas where they do not cause damage to more sensitive areas. Furthermore, extra energy expenditures by geese due to hunting disturbance may cause prolonged foraging and thereby increased damage risk (Bechet et al., 2003; Duriez et al., 2009; Mooij, 1991; Nolet et al., 2016).

In Sweden, current legislation states that damage caused by wildlife should primarily be prevented by conventional hunting, lethal scaring and other non-lethal preventive measures (SFS, 1987a:259 Hunting act) such as scaring and diversionary fields, i.e., fields cultivated to attract foraging birds (Hake et al., 2010; Vickery and Gill, 1999). In situations where hunting is not a feasible option; for example, if the focal species is protected, damage should be prevented by other means (the European Community Directive on the Conservation of Wild Birds EEC/79/409). In Sweden, compensation and subsidies for preventive measures have increased the last 20 years and summed to approximately 0.8 million € per year over the last five years (Frank et al., 2016). In addition, it is assumed that the extent of unreported damage is also large (Anon, 2015). One consequence of increasing damage levels is a growing conflict between conservation and agriculture, especially at sites where the birds are attracted to protected wetlands (Hake et al., 2010). Areas of conflicts occur in many parts of Sweden (Frank et al., 2016; Hake et al., 2010). The conflicts become particularly evident in cases where birds are protected and where non-lethal preventive tools do not have the intended effect. Moreover, farmers often claim that these preventive measures are ineffective, which may result in applications for lethal scaring permits outside hunting season or for species that are fully protected. For some species (greylag goose *Anser anser* and Canada goose *Branta canadensis*), lethal scaring is allowed year round if the birds are anticipated to cause damage to unharvested crops. When performing lethal scaring of these two species, there are no other restrictions other than the Swedish hunting act, i.e., no set quota or restrictions on the use of decoys. For other species, there is a range of different restrictions. These restrictions range from full protection where landowners/hunters always need permissions for lethal scaring (independent of the season) to specific seasons and sites when and where lethal scaring is allowed without certain permissions (SFS, 1987b:905 Hunting Regulation). The European Community Directive on the Conservation of Wild Birds (EEC/79/409) permits permissions to use lethal scaring if: 1) other preventive measures do not help; 2) there are no other available suitable solutions; and 3) it does not jeopardize the maintenance of a favorable conservation status (SFS, 1987b:905 Hunting Regulation). Moreover, the expected effects of approved measures also need to be considered when deciding appropriate measures. However, even though common knowledge states that lethal scaring reduces the number of geese at specific sites, few, if any, studies have actually evaluated the effect of lethal scaring on geese, especially at times outside hunting season (Fox et al., 2017).

This study aims to disentangle the perceived and real effect by increasing knowledge about whether lethal scaring, as performed by hunters and farmers in Sweden, is decreasing the number of foraging geese in fields where lethal scaring has been performed. From previous studies on hunting of geese and water birds (Jensen et al., 2017, 2016a, 2016b; Madsen and Fox, 1995) it is predicted that: 1) lethal scaring will reduce the number of birds at a local spatial level and therefore decrease damage risk; and 2) the birds will increase escape distance to an approaching man after the lethal scaring. The study will increase our understanding of appropriate methods and may therefore provide important and urgent guidelines for decision makers and stakeholders involved in the complex issue of goose management and crop protection (Fox et al., 2017; Hake et al., 2010; Tuvendal and Elmberg, 2015).

2. Methods

2.1. Study sites and lethal scaring

Lethal scaring trials (n = 18) were performed between 2012 and 2015 from March to early August (i.e., outside open hunting season) in eight different study sites in southern Sweden (Fig. 1). All study sites were dominated by arable land and characterized by one or several shallow wetlands or lakes where the birds find water for drinking, preening and shelter from predators. Each lethal scaring trial includes two repeated culling events performed during one evening and the subsequent morning (4–7 h between the end of the evening lethal scaring event and the start in the morning, i.e., dark hours). The number of people participating as shooters varied between two and eight. The shooters sat in pairs at two to four places in the fields. In some exceptions, shooters sat alone because of practical reasons. Decoys were used to attract the geese to specific parts of the fields. In some of the 18 scaring trials, more than one field was used for lethal scaring and control, respectively (for