Migratory geese foraging on grassland: Case study in the region of Flanders (Belgium)

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Abstract
Every winter nearly 100 000 migratory geese visit Northwestern Flanders (Belgium), including several protected species such as the pink-footed goose (*Anser brachyrhynchus*). The geese mainly forage on agricultural grassland, where they remove all the green parts and leave substantial amounts of droppings. In 2009 several farmers' concerns about this phenomenon were thoroughly investigated. The main findings revealed that grass production on grazed parcels is reduced by 450 kg DM/ha on average at the time of the first cut around 1 May. On the same parcels, soil nitrogen addition from goose droppings did not far exceed 10 kg/ha, a small amount in comparison to the farmers' average annual fertilization rate. No negative effect on grass fodder quality was found; even a small but significant increase in crude protein content was observed as well as a decrease in crude fibre content. The results of this study laid the foundation for measuring grass yield losses due to grazing by protected wildlife species, now used in a compensation scheme for farmers.

Key words
Migratory geese, wildlife damage, grass yield, fodder quality, nitrogen addition

Introduction

Every winter, several geese species migrate from their arctic environment, e.g. in Siberia or Svalbard, to western Europe. This includes the coastal regions of Northwestern Flanders, where they were first observed in 1958 (Kuijken *et al*., 2005). Since the mid '90s they are counted systematically, twice a month, during winter (Devos *et al*., 2005). The species observed in the largest numbers are the greater white-fronted goose (*Anser albifrons*) and the pink-footed goose (*Anser brachyrhynchus*), followed by the greylag goose (*Anser anser*). The actual number of migratory geese is hard to assess as the species arrive and leave at different times, but maxima of simultaneous counts over all species are traditionally observed in the months of December and January, reaching about 90 000 individuals in the years between 2001 and 2004 (Devos *et al*., 2005).

Although their presence is enjoyed by many, local farmers can suffer from crop damage caused by large geese numbers foraging on their fields (Van Gils *et al*., 2009). In 2008, the Flemish government started the development of a compensation scheme for yield losses. However, measurement tools and protocols for damage assessment were largely unavailable. This was especially the case for grasslands, the primary goose habitat (Devos *et al*., 2005).

Materials and methods

A selection of five agricultural grassland parcels was made, each with a history of being grazed by migratory geese in winter. Four fenced exclosures of 3m by 6m on each parcel made sure that ungrazed reference plots remained available, with grazed plots of the same dimensions at 1m distance. Within the latter, counts of geese droppings were performed every 10 days to assess grazing intensity, expressed in 'goose days' per ha. One goose day (24hrs) on grassland accounts for 125 droppings. Additionally, dropping counts were performed on

transects crossing the whole parcel, counting within a square frame ($0.25m^2$) placed on the ground every 25m.
Grass yield losses (dry weight) were assessed in spring by harvesting and comparing the grazed versus ungrazed plots. Grass fodder quality parameters – crude protein and crude fiber content – were assessed with NIRS (Near-Infrared Spectroscopy, Shenk *et al.*, 1992).
To assess a possible fertilizing effect of goose droppings, calculations of theoretical nitrogen (N) addition were made, based on chemical analysis of droppings (Groot Bruinderink, 1987) combined with dropping counts.

Results
Grazing intensity of the experimental plots varied greatly, from 112 up to 2 944 goose days per hectare (Table 1). Calculations based on transect counts of droppings were higher compared to those based on plot counts. Grass yield losses at the first cut in spring averaged 450 kg DM/ha.
Grass fodder quality was affected by grazing in winter. Average crude protein content increased from 20.2% in ungrazed plots to 21.2% for grazed plots ($p=0.027$). The opposite trend was observed in crude fiber content, that decreased from 23.5% in ungrazed to 22.6% in grazed plots ($p=0.009$).
Calculations based on transect dropping counts showed that nitrogen additions between 3.6 kg N/ha and 13.7 kg N/ha could be expected (Table 1).

Table 1: Overview of data from five grasslands - mean values of four plots

Field code	GDplot (#/ha)	GDtransect (#/ha)	Yield loss (kg DM/ha)	DCP (%)	DCF (%)	N add (kg N/ha)
Klem03	1 458	2 747	494	+0.3	0.0	12.6
Klem04	2 219	2 944	411	+0.2	-0.5	13.7
Klem05	589	1 248	420	-0.1	-0.2	5.9
Asse03	661	1 422	410	+2.7	-2.2	6.7
Hoek02	112	475	538	+1.8	-1.5	3.6

GDplot: total of goose days per hectare, based on dropping counts in grazed plots
GDtransect: total of goose days per hectare, based on dropping counts on transects
DCP: difference in crude protein content (grazed - ungrazed)
DCF: difference in crude fiber content (grazed - ungrazed)
N add: theoretical nitrogen addition, calculations based on GDtransect

Discussion
To assess grazing intensity, transect counts of droppings probably are more accurate than plot counts, as the first are spread over the parcel, therefore including more spatial variability. Moreover, in this experiment a potential deterring effect from the exclosures in the immediate vicinity (1m) could be expected in the grazed plots.
Farmers' concerns about yield losses due to winter grazing by migratory geese proved to be correct, with an average loss of 450 kg DM/ha. Differences in grazing intensity were much greater than differences in the resulting grass yield losses at the first cut in spring. This could be partially explained by goose behavior and grassland management: grassland is cut to create a short sward before winter (5 to 8cm). The geese can only remove a certain amount of foliage, as they can graze the sward to about 2cm. However, lack of food does not prevent geese from using the terrain as a roosting site, especially overnight. Doing so, they leave significant amounts of droppings, thereby creating a misconception about the term 'grazing intensity' as determined by dropping counts.

Moreover, grass yield losses can be greater in case of wet soil conditions during grazing, with geese trampling and thus sealing the soil, especially on autumn sown grassland. This was reported by farmers but was not noticed during this one year experiment.
Grass fodder quality was slightly positively affected. Probably, swards being grazed in winter have a higher proportion of fresh sprouted foliage in spring. A stronger effect was noticed on parcels that were less intensively managed (Asse03 and Hoek02).
Nitrogen addition due to geese droppings is low compared to the annual input of nitrogen fertilizer in common farming conditions in Flanders: a maximum of 245 kg N available/ha for a management system of grazing combined with cutting.

Conclusions

Migratory geese foraging on grassland in winter are able to cause yield losses at the first cut in spring, in this study estimated to be about 450 kgDM/ha on average. Fodder quality of the sward can be affected in a positive way, with a small increase in crude protein content and a small decrease in crude fiber content. Nitrogen addition by goose droppings is negligible compared to common agricultural practices of fertilizing in the region of Flanders. This study provides useful information for measuring grass yield losses due to grazing by protected wildlife species, that can be used in a compensation scheme for farmers.

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