11th INTERNATIONAL SCIENTIFIC CONFERENCE
RURAL DEVELOPMENT 2023
BIOECONOMY FOR THE GREEN DEAL
26-28th September, 2023, Vytautas Magnus University Agriculture Academy, Lithuania

VYTAUTAS MAGNUS UNIVERSITY AGRICULTURE ACADEMY

Proceedings of the 11th International Scientific Conference Rural Development 2023

Edited by assoc. prof. dr. Judita Černiauskienė

ISSN 1822-3230 (Print)
ISSN 2345-0916 (Online)

Article DOI: https://doi.org/10.15544/RD.2023.041

ASSESSMENT OF DAMAGE CAUSED BY MIGRATING GEESE IN AGRICULTURAL FIELDS

Gediminas BRAZAITIS, Department of Forest Sciences, Faculty of Forest Sciences and Ecology, Vytautas Magnus University, address: K. Donelaičio str. 58, LT-44248 Kaunas, Lithuania, gediminas.brazaitis@vdu.lt *(corresponding author)*
Kastytis ŠIMKEVIČIUS, Department of Forest Sciences, Faculty of Forest Sciences and Ecology, Vytautas Magnus University, address: K. Donelaičio str. 58, LT-44248 Kaunas, Lithuania, kastytis.simkevicius@vdu.lt
Gailenė BRAZAITYTĖ, Department of Forest Sciences, Faculty of Forest Sciences and Ecology, Vytautas Magnus University, address: K. Donelaičio str. 58, LT-44248 Kaunas, Lithuania, gailene.brazaityte@vdu.lt
Dalia KANČAUSKAITĖ, Department of Forest Sciences, Faculty of Forest Sciences and Ecology, Vytautas Magnus University, address: K. Donelaičio str. 58, LT-44248 Kaunas, Lithuania, dalia.kancauskaite@gmail.com
Jolanta STANKEVIČIŪTĖ, Department of Forest Sciences, Faculty of Forest Sciences and Ecology, Vytautas Magnus University, address: K. Donelaičio str. 58, LT-44248 Kaunas, Lithuania, jolanta.stankeviciute1@vdu.lt
Sonata KAZLAUSKAITĖ, Department of Agroecosystems and soil science, Faculty of Agronomy, Vytautas Magnus University, address: K. Donelaičio str. 58, LT-44248 Kaunas, Lithuania, sonata.kazlauskaite@vdu.lt
Liutauras RAUDONIKIS, Lithuanian Ornithological Society, address: Naugarduko 47-3, Vilnius, LT-03208 Lithuania, liutauras.raudonikis@birdlife.lt
Julius MORKŪNAS, Lithuanian Ornithological Society, address: Naugarduko 47-3, Vilnius, LT-03208 Lithuania, julius.morkunas@birdlife.lt

The increasing migrating goose populations seasonally feed in the agricultural fields and grasslands. Annually, farmers encounter and abide the challenges of intense winter wheat and permanent grasslands grazing pressures. In Lithuania, migrating geese caused damages initiate conflicts between farmers, conservationists and hunters. Thus, we aimed to determine the winter wheat and permanent grasslands yield reduction by observing migrating geese grazing intensity and characteristics. In three Lithuanian south-western and central regions we established 15 study areas. During the spring migration geese droppings were counted every 10-15 days. Harvested winter wheat and hay were dried and weighted, wheat ears were counted, grains extracted and weighted. Results proved that migrating geese obviously damage and reduce yield of both winter wheat and permanent grasslands. Grazing reduced winter wheat ear development and grain weight. The high grazing pressure in winter wheat of 7.45 droppings/m^2 reduced yield by 10.8%. In the permanent grasslands geese presence indicator was 10.49±0.43SE droppings/m^2 suggesting high grazing pressure reducing grasslands yield by 15.2%.

Keywords: *migratory geese, spring migration, winter wheat, grasslands, yield*

INTRODUCTION

The migration of geese from the southern wintering to northern breeding areas occurs annually. In Lithuania, during the spring migration agricultural fields become a feeding ground for geese. Often, migrating birds graze in the winter wheat, barley, oat or other crops and permanent grasslands with abundant white clover (*Trifolium repens* L.), perennial ryegrass (*Lolium perenne* L.), red fescue (*Festuca rubra* L.) and creeping bentgrass (*Agrostis stolonifera* L.) cover (Bell, 1988; Keller & Patterson, 1990; Summers & Critchley, 1990; Percival, 1993; Vickery et al., 1994, 1997). Although, geese damage plants not only by pecking, but also by trampling the soil and disturbing natural aeration (Kear, 1970). Migrating geese prefer agricultural fields and grasslands located close to their resting areas, usually no further than 5-10km (Vickery & Gill, 1999). In the first half of the migrating season, geese are more sensitive and prefer the least disturbed fields, while in the second half they tend to graze closer to the source of disturbances and select smaller fields and grasslands (Newton & Campbell, 1973; Owen, 1973; Owen, 1977; Percival, 1993). In addition, selected grazing locations are used repeatedly and frequently by migrating geese (Allport, 1989; Salmon & Fox, 1991; Wilson et al., 1991; Fox et al., 1994; Summers et al., 1996; Gill et al., 1997).

A few methodologies for damage assessment of migrating geese have been established. According to the Bedard and Gauthier (1986) relative geese abundance, impact comparison and damage could be calculated by counting droppings. This method is relative, as on average goose defecates 125 times per day, every 3-5 minutes (Owen, 1971). Other methods include direct counting of the geese and marking their positions on the map (Lorenzen & Madsen, 1986) and recalculating

the counted number of geese for 1 hectare (Madsen, 1985). Analysis of yield is a prominent method for evaluating the crop damage. Harvested winter wheat are assessed by counting average dry mass per grain, average number of grains per wheat ear and total number of wheat ears (Petkov et al., 2017). Summers (1990) suggested a method of calculating dry mass of straws, number of wheat ears, total and 100g dry mass of grains, harvest index and weed biomass. Whereas method of counting 1000 grain mass and bushel (36.4 litres) mass is also practised (Patterson et al., 1989). The yield of permanent grassland is assessed by weighing dry hay matter (Bergiord Olsen et al., 2017; Patton & Frame, 1981), weighing fresh cut material biomass (Bruindering, 1989) or by measuring compressed grass height (Bjerkeet et al., 2021). During the past few decades, the number of migratory geese has gradually increased (Stroud et al., 2017). The high number of migrating geese causes high grazing pressure that reduces the yield of winter wheat and permanent grasslands. Thus, conflicts between farmers for damage and yield reduction, conservationists for preserving important migration areas and protecting species and hunters, as most of the species are hunted, arise. It is important to determine the extent of yield reduction for future development of compensatory mechanisms to compromise between biodiversity conservation and intensive agriculture. Our study aimed to evaluate the intensity and characteristics of migrating geese damage for winter wheat and permanent grasslands yield.

RESEARCH METHODS

Study areas were located in three regions in Lithuania: (1) Nemunas river delta, (2) Žuvintas biosphere reserve and (3) near Raseiniai fishery ponds (Fig. 1). The three regions represent SW and Central parts of the country.

Selected areas were representative of the high feeding pressure during migration in winter wheat and grasslands. In total 15 study areas were observed of which 9 were winter wheat and 6 were permanent grasslands. Field work began during the spring (March-April) migration in 2022 and 2023. Each study area had at least 50 plot replications, of which no less than half were in the control (covered) group. The damaged (available) plots were round shaped with radius of r=1.8m (10m^2). Covered plots were isolated from the impact of geese grazing by establishing 1x1m square grids covered by the net. During the spring migration, geese droppings were counted every 10-15 days from the first appearance to the last observation.

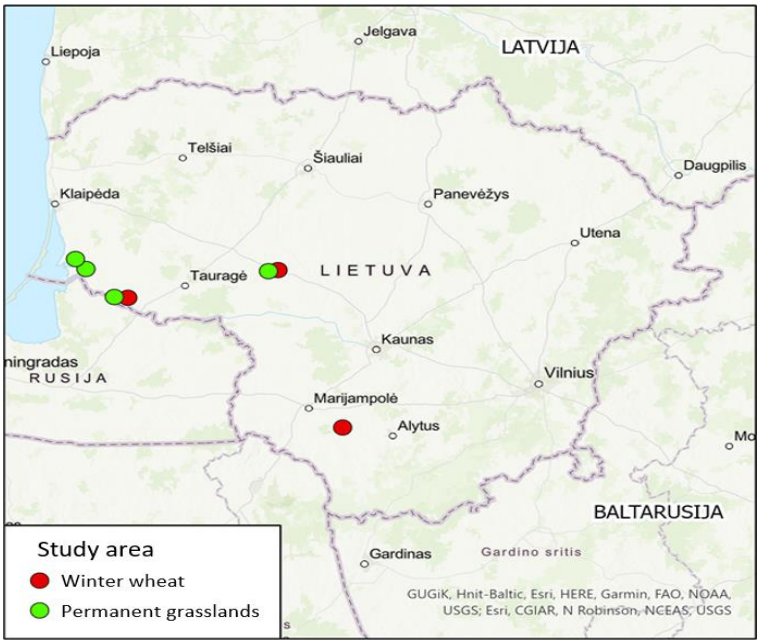

Figure 1. Location of the study areas in Lithuania

Winter wheat was sampled by cutting rows of total 1 m length (2x50 cm) in each plot. Harvested wheat samples were dried for at least 72 hours in 60°C. Wheat ears were separated from the grasses, wheat stems and leaves. In each sample number of developed and undeveloped ears was determined. Grains from the wheat ears were extracted manually and chaff was removed. Each sample was weighted to obtain the grain weight per sample. In the permanent grasslands hay was cut in 0.25m^2 subplots at 1cm height. Collected samples were dried for at least 72 hours in 60°C. Dry matter contents were weighted. Samples were harvested only in the first grasslands growth cycle.

We used ANOVA to compare the data between control and affected study plots. GLMM (Generalized Linear Mixed Model) was applied to eliminate the effects of microrelief and field.

RESEARCH RESULTS

Winter Wheat.

During the spring migration, indicator of geese grazing pressure in winter wheat fields on average varied between 0.2-9.4 droppings/m^2, reaching the maximum count of 16 droppings/m^2. In the intensively grazed fields 15% of the observed plots had no droppings, 55% had 0-5 droppings/m^2 and 93% had 0-10 droppings/m^2.

Grazing by the migrating geese increased the quantity of undeveloped ear (F=4.44; p=0.036) (Fig. 2). The quantity of developed ears per sample between the covered and available for grazing plots were not affected by migrating geese (F=2.0; p=0.16).

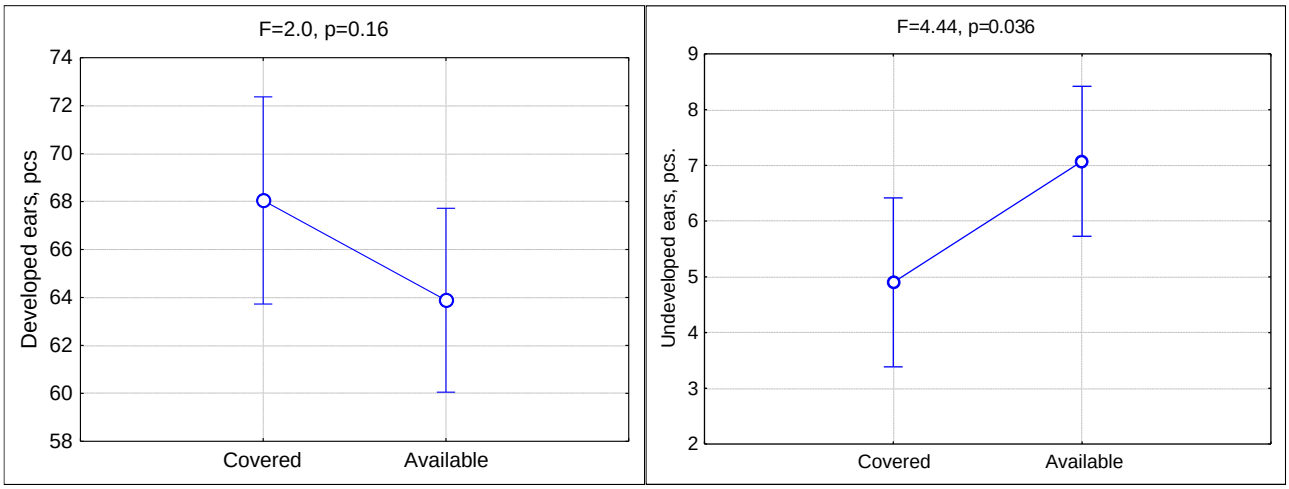

Figure 2. Effects of migrating geese damage on the number of developed (left) and undeveloped (right) ears between covered and available for grazing plots

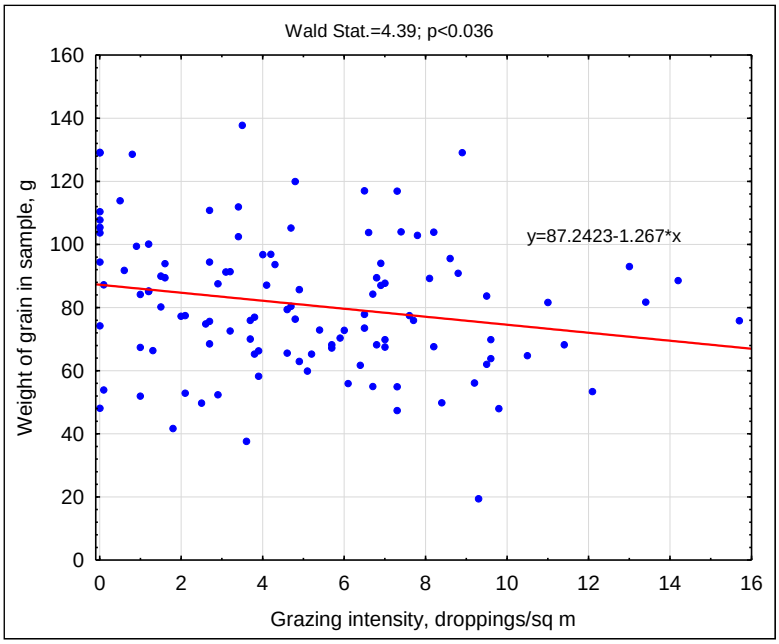

Figure 3. Effects of migrating geese damage on the total grain weight per sample with increasing grazing intensity

The total grain weight per sample significantly decreased with the increasing grazing intensity (F=4.39; p<0.036) (Fig. 3). In the grazed plots with 10 droppings/m^2, weight of the grains was reduced by 12.6g. On average 1 goose dropping/m^2 decreased yield by 1.44% per 1m^2. The moderate intensity grazing in winter wheat was determined to 2.6 droppings/m^2. The moderately grazed winter wheat yield reduced by 3.8%. The high intensity grazing of 7.45 droppings/m^2 reduced winter wheat yield by 10.8%.

Permanent grasslands

Observed grazing intensities in the grasslands demonstrated that 19% of the plots had no geese droppings, 48% had 0-2 droppings/m^2 and 60% of plots had 0-3 droppings/m^2. More than 5 droppings/m^2 were not observed frequently. The highest number of droppings observed per plot were 15 droppings/m^2.

Grazing by the migrating geese had significant biomass yield reduction in the permanent grasslands (F=6.3; p<0.013). Increasing grazing intensity had significant negative correlation to the weight of dry hay (F=23,5; p<0,000002) (Fig. 4). On average 1 dropping/m^2 reduced first growth cycle yield by 2.2% per 1m^2. The second growth cycle that produces 65-80% of forage was unaffected. Combined yield of first and second harvest was calculated to reduce by 1.5% in 1m^2 per 1 observed dropping/m^2.

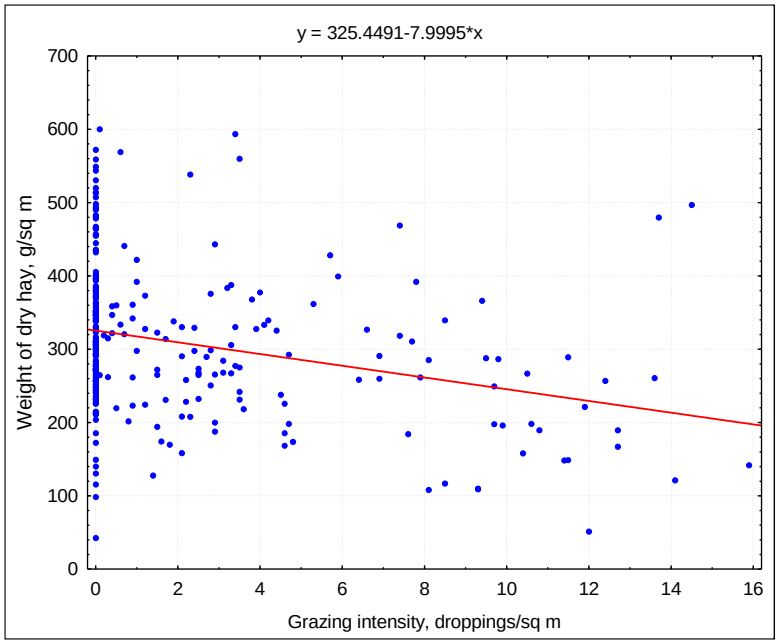

Figure 4. Effects of migrating geese damage on the dry hay weight with increasing grazing intensity

The moderate grazing intensity was estimated to 4,55±0,35SE droppings/m^2. The migrating geese grazing of moderate intensity lowered first and second grasslands yield by 6.6%. Grasslands with the high grazing intensity had 10,49±0,43SE droppings/m^2. First and second harvest of the permanent grasslands with high grazing intensity had yield reduction of 15.2%.

DISCUSSION

In this study, we observed grazing intensity, characteristics and damages of migrating geese for winter wheat and permanent grasslands. We determined that moderate to high intensity grazing significantly reduced yield. Previous studies of damages caused by migrating geese in general provide no consensus for the topic. Although, most of the studies of grasslands focus on the species-specific damages. According to Paterson et al. (1991) Greylag Goose (*Anser anser* L.) in the permanent grasslands reduce yield up to 5%. Brant Goose (*Branta bernicla* L.) reduce harvest of the grasslands by 20% (Summers & Stanfield, 1991), while based on Paterson et al. (1991) damages reach up to 38%. Bean Goose (*Anser fabalis* Lath.) cause a 27% yield reduction (Bjerke et al., 2021). Bergjord Olsen et al. (2017) found that early migration and gathering to larger flocks on average lowers the first grassland harvest by 22.8%.

In Lithuania, migratory goose species that graze in agricultural fields and grasslands are Greylag Goose, Bean Goose, White-Fronted Goose (*Anser albifrons* Scop.), Barnacle Goose (*Branta leucopsis* Bech.) and others, which quite often feed in mixed flocks. Thus, our analysis focused on investigating damages by all migrating geese rather than a selected species. Compared with the available literature, our results showed similar or lower yield reduction. On the other hand, previous research was produced in other European regions providing no evidence for our study areas. Furthermore, observed damages in the winter wheat yield were similar to the findings of a few studies. Based on Kear (1965) yield is reduced by 8.3%, whereas Summers (1990) detected that migrating geese damages reduce yield by 6-10%. It is interesting that a few other authors observe no significant damages for the wheat harvest (van Dobber, 1953; Pirnie, 1954). Although, many provide evidence that winter wheat yield is reduced (Wright & Isaacson, 1978; Deans, 1979; White-Robinson, 1984; Patterson et al., 1989). According to Patterson et al. (1989) geese damages to winter crops are often more substantial on a local scale. Hence, other studies detecting that high grazing pressure reduces wheat harvest by 16-30% (Flegler et al., 1987), by 15% (Patterson et al., 1989) and by 13.2% (Petkov et al., 2017).

As with the permanent grasslands, winter wheat grazing intensity varies between the migrating regions. And although our results showed milder grazing pressure than some of the previous studies, it is important to note that damages were still significant to both permanent grasslands and winter wheat yield. Thus, our study presented important results of previously not researched topic in three Lithuanian regions and provided a foundation for future compensative tools for farmers.

CONCLUSIONS

The migrating geese obviously reduced yield of winter wheat and permanent grasslands during the spring migration. The yield reduction varied based on the grazing intensity.

In the winter wheat fields, the high grazing pressure of 7.45 dropping/m^2 reduced yield by 10.8%. The moderate grazing pressure of 2.6 droppings/m^2 reduced yield by 3.8%. Migrating geese grazing reduced grain weight and decreased wheat ear development.

In the permanent grasslands, the moderate grazing pressure of 4.55±0.35SE droppings/m^2 reduced harvest yield by 6.6%. The high intensity grazing of 10.49±0.43SE droppings/m^2 resulted in harvest yield reduction of 15.2%.

Acknowledgements. The research was initiated and funded by the Lithuanian Ornithological Society during implementation of the project LWfG LIFE CLIMATE LIFE19 NAT/LT/000898 "Providing a climate resilient network of critical sites for the Lesser White-fronted Goose in Europe".

REFERENCES

1. Allport, G., 1989. Norfolk's bean geese and their management. RSPB Conservation Review 3, 59-60.
2. Bell, M.V., 1988. Feeding behaviour of wintering Pink-footed and Greylag Geese in north-east Scotland. Wildfowl 39, 43±53.
3. Bergjord Olsen, A. K., Bjerke, J. W., & Tombre, I. M. 2017. Yield reductions in agricultural grasslands in Norway after springtime grazing by Pink-footed geese. *Journal of Applied Ecology*, 54(6), 1836-1846. https://doi.org/10.1111/1365-2664.12914
4. Bedard, J., & Gauthier, G. 1986. Assessment of Faecal Output in Geese. *The Journal of Applied Ecology*, 23(1), 77.
5. Bjerke, J.W., Tombre, I.M., Hanssen, M., Olsen. A.K.B. 2021. Springtime grazing by Arctic-breeding geese reduces first- and second-harvest yields on sub-Arctic agricultural grasslands. *Science* of the *Total Environment*, 793, 148619, https://doi.org/10.1016/j.scitotenv.2021.148619
6. Bruinderink, G. W. T. A. G. 1989. The Impact of wild geese visiting improved grasslands in the Netherlands. The *Journal of Applied Ecology*, 26(1), 131. https://doi.org/10.2307/2403656
7. Deans, I. R. 1979. Feeding of brent geese on cereal fields in Essex and observations on the subsequent loss of yield. *Agro-Ecosystems*, 5, 283-288, https://doi.org/10.1016/0304-3746(79)90008-8
8. Flegler, E. J., Prince, H. H. & Johnson, W. C. 1987. Effects of grazing by Canada geese on winter wheat yield. *Wildlife Society Bulletin*, 15, 402-405
9. Fox, A.D., Mitchell, C., Stewart, A., Fletcher, J.D., Turner, J.V.N., Boyd, H., Shimmings, P., Salmon, D.G., Haines, W.G., Tomlinson, C., 1994. Winter movements and site-fidelity of Pink-footed geese *Anser brachyrhynchus*, ringed in Britain, with particular emphasis on those marked in Lancashire. *Bird Study*, 41, 221±234. https://doi.org/10.1080/00063659409477222
10. Gill, J.A, Watkinson, A.R., Sutherland, W.J., 1997. Causes of the redistribution of Pink-footed Geese *Anser brachyrhynchus* in Britain. Ibis 139, 497±503. https://doi.org/10.1111/j.1474-919X.1997.tb04665.x
11. Kear, J. 1970. The experimental assessment of goose damage to agricultural crops. *Biological Conservation*, 2(3), 206-212. https://doi.org/10.1016/0006-3207(70)90110-2
12. Kear, J. 1965. The assessment of goose damage by grazing trials. *Transactions of the 6th Congress of the International Union of Game Biologists*, pp. 333-339
13. Keller, V., Patterson, I. J., 1990. Feeding distribution of Pink-footed and Greylag geese around the Loch of Strathbeg SSSI, Grampian. Report to Nature Conservancy Council. Nature Conservancy Council, Aberdeen.;
14. Lorenzen, B. & Madsen, J. 1986. Feeding by geese on the Filso Farmland, Denmark, and the effect of grazing on yield structure of spring barley. *Holarctic Ecology*, 9, 305-311. https://doi.org/10.1111/j.1600-0587.1986.tb01224.x
15. Madsen, J. 1985a. Impact of disturbance on field utilization of Pink-footed geese in West Jutland, Denmark. *Biological Conservation*, 33(1), 53–63. https://doi.org/10.1016/0006-3207(85)90004-7
16. Newton, I., Campbell, C.R.G., 1973. Feeding of geese on farmland in east-central Scotland. *Journal of Applied Ecology*, 10, 781-801, https://doi.org/10.2307/2401869
17. Owen, M., 1971. The selection of feeding sites by White-fronted geese in winter. *Journal of Applied Ecology*, 8, 905-917. https://doi.org/10.2307/2402690
18. Owen, M., 1973. The management of grassland areas for wintering geese. *Wildfowl*, 24, 123-130.
19. Owen, M., 1977. The role of wildfowl refuges on agricultural land in lessening the conflict between farmers and geese in Britain. *Biological Conservation*, 11, 209-222. https://doi.org/10.1016/0006-3207(77)90005-2
20. Paterson, I.W., 1991. The status and breeding distribution of greylag geese *Anser anser* in the Uists (Scotland) and their impact upon crofting agriculture. *Ardea*, 79, 243±251.
21. Patterson, I. J., Jalil, S. A., & East, M. L. 1989. Damage to Winter Cereals by Greylag and Pink-Footed Geese in North-East Scotland. *The Journal of Applied Ecology*, 26(3), 879. https://doi.org/10.2307/2403699
22. Patton, D. L. H., & Frame, J. 1981. The Effect of Grazing in Winter by Wild Geese on Improved Grassland in West Scotland. *The Journal of Applied Ecology*, 18(1), 311. https://doi.org/10.2307/2402498
23. Percival, S. M. 1993. The Effects of Reseeding, Fertilizer Application and Disturbance on the Use of Grasslands by Barnacle Geese, and the Implications for Refuge Management. *The Journal of Applied Ecology*, 30(3), 437. https://doi.org/10.2307/2404184

24. Petkov, N., Harrison, A. L., Stamenov, A., & Hilton, G. M. 2017. The impact of wintering geese on crop yields in Bulgarian Dobrudzha: implications for agri-environment schemes. *European Journal of Wildlife Research*, 63(4). https://doi.org/10.1007/s10344-017-1119-0
25. Pirnie, M. D. 1954. The grazing of dormant winter wheat by wild geese. Michigan Quarterly Bulletin, 37, 95-104
26. Salmon, D.G., Fox, A.D., 1991. Dark-bellied brent geese, Branta *Bernicla bernicla*, in Britain, 1976-1987. Ardea 79, 327-330;
27. Stroud, D. A., Madsen, J., & Fox, A. D. 2017. Key actions towards the sustainable management of European geese. *Ambio*, 46, 328-338.
28. Summers, R. W. 1990. The Effect on Winter Wheat of Grazing by Brent Geese *Branta bernicla*. *The Journal of Applied Ecology*, 27(3), 821. https://doi.org/10.2307/2404379
29. Summers, R. W., & Stansfield, J. 1991. Changes in the quantity and quality of grassland due to winter grazing by brent geese (*Branta bernicla*). *Agriculture, Ecosystems & Environment*, 36(1-2), 51–57. https://doi.org/10.1016/0167-8809(91)90035-V
30. Summers, R.W., Critchley, C.N.R., 1990. Use of grassland and field selection by brent geese *Branta bernicla. Journal of Applied Ecology*, 27, 834-846. https://doi.org/10.2307/2404380
31. Summers, R.W., Underhill, L.G., Howells, R.J., Vickery, J.A., Prys Jones, R.P., 1996. Phenology of migration and use of wintering sites by the increasing population of dark-bellied brent geese, *Branta bernicla bernicla*. *Journal of Zoology*, 239, 197-208.
32. Van Dobben, W. H. 1953. De landbouwschade door wilde ganzen. *Landbouwvoorlichting*, 10, 263-268
33. Vickery, J., & Gill, J. 1999. Managing grassland for wild geese in Britain: a review. *Biological Conservation*, 89(1), 93–106. https://doi.org/10.1016/S0006-3207(98)00134-7
34. Vickery, J.A., Sutherland, W.J., O'Brien, M., Watkinson, A.R., Yallop1, A., 1997. Managing coastal grazing marshes for breeding waders and overwintering geese: is there a confict? Biological Conservation 79, 23-34, https://doi.org/10.1016/S0006-3207(96)00111-5
35. Vickery, J.A., Watkinson, A.R., Sutherland, W.J., 1994. The solutions to the brent goose problem: an economic analysis. *Journal of Applied Ecology*, 31, 371-382, https://doi.org/10.2307/2404551
36. White-Robinson, R. 1984. Effects of grazing by Canada geese and hand clipping on spring cereal crops. Ph.D. thesis, Unversity of Nottingham.
37. Wilson, H.J., Norriss, D.W., Walsh, A., Fox, A.D., Stroud, D.A., 1991. Winter site fidelity in Greenland white-fronted geese, *Anser albifrons favirostris*, implications for conservation and management. *Ardea*, 79, 287±294
38. Wright, E. N. & Isaacson, A. J. 1978. Goose damage to agricultural crops in England. *Proceedings of the Association of Applied Biologists*, 88, 334-338, https://doi.org/10.1111/j.1744-7348.1978.tb00715.x