Voluntary transition by hunters and game meat suppliers from lead to non-lead shotgun ammunition: changes in practice after three years

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DOI: https://doi.org/10.52201/CEJ20/OQWU5273

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SUMMARY

In 2020, UK shooting and rural organisations pledged to achieve a voluntary transition from the use of lead shotgun ammunition to non-lead alternatives for hunting by 2025. The SHOT-SWITCH research project was set up in 2020 to monitor progress towards this aim by examining the proportions of wild-shot common pheasants *Phasianus colchicus* available to consumers in Great Britain that were killed using lead and non-lead shot. In the study's third season, 2022/2023, 94% of pheasants sampled had been killed using lead ammunition. Statistically, this is a significantly smaller proportion than in the preceding two seasons (both > 99% lead), but it remains large. We found no direct evidence of any effect of recent voluntary initiatives to promote the replacement of lead with non-lead ammunition by suppliers and retailers of wild-shot game.

BACKGROUND

On 24 February 2020, nine UK shooting and rural organisations released a joint statement calling for a complete voluntary transition from the use of lead to non-lead shotgun ammunition for hunting within five years 'In consideration of wildlife, the environment and to ensure a market for the healthiest game products' (BASC 2020). In separate additional initiatives, some suppliers of game meat products for human consumption have voluntarily announced their intention to cease supplying game killed using lead ammunition and an assurance scheme has been launched to encourage suppliers and retailers to facilitate the transition.

In this paper, we examine the effectiveness these voluntary actions. We report results from the third year of the SHOT-SWITCH project, which monitors changes in the proportions of wild-shot common pheasants *Phasianus colchicus* available to consumers that were killed using lead and non-lead shot. We also compare the prevalence of lead and non-lead shot in pheasant carcasses obtained from suppliers with varying levels of commitment to providing consumers with lead-free game meat.

ACTIONS

Efforts by shooting and rural organisations to encourage the transition from lead to non-lead ammunition

In 2022, the third year since the five-year voluntary transition was proposed, The British Association for Shooting and Conservation (BASC) provided opportunities to over 3,100 people to try non-lead ammunition across 166 events including for over 2,000 people at the 2022 Game Fair in July in Warwickshire. BASC also distributed over 10,000 information leaflets and provided guidance on their website (BASC 2022). The Game and Wildlife Conservation Trust (GWCT) also provided advice to its members through its guide to practical aspects of the transition (GWCT 2022).

ISSN 1758-2067

Voluntary transition by food retailers and distributors to selling only meat from game killed with non-lead ammunition

UK supermarket chain Waitrose & Partners sells a large volume of food products derived from game meat. In 2019, they announced that they would cease to sell game meat from animals killed with lead ammunition, with effect from the 2020/2021 shooting season (Barkham 2019). Difficulties caused by the COVID-19 pandemic led to a postponement of this intended change until the 2021/2022 season (Waitrose 2020). The commitment not to sell any game shot with lead remained in place for the 2022/2023 season (John Lewis Partnership 2023).

In 2021, the National Game Dealers Association (NGDA), made a commitment to obtain all meat of birds and mammals from lead-free sources from 1st July 2022. This commitment remained in place on the NGDA's website until 6th January 2023, but was removed soon afterwards. It is still referred to on the websites of several shooting and countryside organisations, including a positive joint response published in 2021 by GWCT, BASC, Countryside Alliance, British Game Alliance, the Moorland Association and the Game Farmers' Association (GWCT 2021). A screenshot of the NGDA announcement can be viewed at Wild Justice (2022).

The British Game Assurance (BGA) scheme was set up in 2021 by ten UK shooting and countryside organisations to promote, develop and assure the use of game meat through adherence to BGA 'shoot standards' (BGA 2021). The scheme encourages, but does not require, the use of lead-free ammunition for the shooting of pheasants, except on shoots that elect to join the BGA's Lead Free Register. The Lead Free Register aims to facilitate the sourcing of lead-free game products by game processors, dealers and stockists. Currently, individual consumers cannot check whether the game meat they obtain from a particular BGA-listed stockist is assured by BGA to be lead-free. The Eat Wild website, created by BGA, lists over 150 stockists (food retailers, game suppliers and restaurants) in the UK who supply BGA-assured game meat (Eat Wild 2022).

Our aim was to compare the proportion of pheasants killed using non-lead ammunition between four types of stockists: (1) Waitrose, (2) NGDA members, (3) BGA scheme members and (4) other stockists which were not Waitrose or members of the NGDA or members of the BGA scheme. We therefore attempted to obtain carcasses for analysis from these four stockist types.

Statistical analysis

We compared the results for the 2022/2023 season with those from previous years using 95% Clopper-Pearson exact binomial confidence intervals (CI) for proportions in Epitools (2023) and Fisher's exact test for 2 x 3 tables in Astatsa (2023). We compared results for NGDA and BGA to those from non-scheme members using two-sided Fisher's exact tests on 2 x 2 tables in GraphPad (2023).

CONSEQUENCES

Sampling of pheasants

We obtained 356 whole or oven-ready prepared pheasant carcasses, sold for human consumption, from 66 businesses. Green *et al.* (2021) provides information on how we obtained carcasses, details of the information supplied by vendors and type and location coding used. Table 1 shows the number of carcasses from which at least one shotgun pellet was recovered and the number of businesses from which they were obtained for each of six supplier types we sampled. No information was available about where the bird had been shot for 45 of these carcasses (19%). In those cases, we assumed that the pheasant had been shot in the same region as the location of the supplier, which was the case for 98% (186/190) of the carcasses for which both source and shoot location were recorded.

Table 1. Numbers of common pheasant *Phasianus colchicus* carcasses from which at least one shotgun pellet was recovered for each of six supplier types. The number of businesses of each type that supplied the carcasses is also given.

Supplier type	Number of carcasses	Number of businesses
Butcher's shop	138	41
Farm shop	17	6
Game dealer	38	7
Online retailer	28	7
Supermarket	7	2
Shoot	7	3
All	235	66

Extracting shotgun pellets from pheasant carcasses

Co-workers dissected each pheasant carcass to locate and collect at least one shotgun pellet or large fragment using methods described elsewhere (Green *et al.* 2021; Environmental Research Institute 2023). We recovered between one and 12 shot and/or shot fragments from 235 of the 356 pheasants (66%) and stored them using methods described in Green *et al.* (2021).

Identification of the principal chemical element in shotgun pellets

Laboratory examination and chemical analysis of shotgun pellets were conducted at the Environmental Research Institute, University of the

 ISSN 1758-2067

Highlands and Islands, Thurso, UK as described previously (Green *et al.* 2021; 2022). We carried out qualitative tests to determine whether multiple pellets taken from the same carcass were of the same type; this was true in all instances. Therefore, we selected a single pellet from each carcass to determine its principal metal composition. We attempted to melt each pellet with a soldering iron to identify pellets composed of tungsten powder mixed with a polymer, but found none of these. We next dissolved each pellet in acid and used an Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES; Agilent 5900 with SPS4 autosampler) to estimate the proportion of the mass of each pellet comprised of each metallic element. The methods are described in detail by Green *et al*. (2021; 2022).

Principal chemical element in shotgun pellets collected from pheasants in the 2022/2023 shooting season

Lead was the principal element in 221 of 235 pellets analysed (94.0% of carcasses: mean percentage lead by mass; 93.6%; minimum 77.2%). The four of these shot with the lowest percentage of lead (77.2 - 87.6%) all had metal particles from the shot remaining because the acid had not entirely dissolved them. This metal was not measured by the ICP-OES. We found 10 pellets composed principally of iron (4.3% of carcasses: mean percentage iron by mass; 96.2%; minimum 91.0%) and four pellets composed principally of bismuth (1.7% of carcasses: mean percentage bismuth by mass; 97.2%; minimum 93.2%). Carcasses with shot composed principally of iron were obtained from six businesses located in Wales, Southern England and Northern England. Carcasses with shot composed principally of bismuth were obtained from three businesses in Central England and Northern England (Table 2). The region with the largest proportional increase in non-lead shot (iron and bismuth) was Northern England.

Changes across the 2020/2021, 2021/2022 and 2022/2023 shooting seasons

We compared our results with those from earlier SHOT-SWITCH monitoring (Green *et al.* 2021; 2022) and an earlier study by Pain *et al*. (2010) (Table 3; Figure 1). The proportion of pheasants that contained lead shot in 2022/2023 was slightly lower than in all previous seasons (94% cf. > 99% respectively). The proportions with lead pellets varied significantly among the three SHOT-SWITCH seasons (Fisher's exact test for a 2 x 3 table, two-sided p = 0.001). Shot composed principally of bismuth were recorded for the first time during the SHOT-SWITCH monitoring programme in 2022/2023.

Comparison between results obtained from Waitrose & Partners supermarkets, members of the National Game Dealers Association and British Game Assurance stockists

Co-workers made repeated visits to 15 widely distributed Waitrose supermarkets in October - December 2022, but did not find any oven-ready pheasant carcasses on sale. We were informed by senior Waitrose staff that this product was unavailable because of problems in obtaining a supply sufficiently assured to have been killed using non-lead ammunition. Therefore, we were unable to estimate the proportions of pheasants sold by Waitrose that were killed using lead and non-lead ammunition. For the same reason, this was also the case in the 2021/2022 shooting season (Green *et al*. 2022).

Table 2. Numbers of common pheasant *Phasianus colchicus* carcasses obtained in Great Britain in the 2022/2023 shooting season for which the principal component in a shotgun pellet was identified as one of five elements. Results are shown according to the location of the source of the bird (country or region in which the bird was known or most likely to have been shot; regions are as defined in Green *et al.* 2021). One pellet was analysed from each bird.

	Number of birds with a pellet composed principally of this element					
Source	**Lead**	**Tungsten**	**Bismuth**	**Iron**	**Copper**	**Total birds**
Southern England	73	0	0	1	0	74
Central England	64	0	2	0	0	66
Northern England	26	0	2	8	0	36
Scotland	40	0	0	0	0	40
Wales	18	0	0	1	0	19
Total	221	0	4	10	0	235

ISSN 1758-2067

All shotgun pellets recovered from 57 pheasant carcasses obtained from 11 member businesses of the NGDA were principally composed of lead (Table 4). We recovered pellets composed principally of bismuth from 6.7% (3/45) of carcasses obtained from 10 BGA-listed stockists; the remaining pellets were lead. We recovered pellets composed of non-lead metals (one bismuth and 10 iron) from 7.2% (11/152) of carcasses obtained from non-BGA or NGDA sources (Table 4). Comparing carcasses from NGDA members with those non-participants in either group, we found that NGDA members had a significantly lower proportion of carcasses with non-lead pellets (0% cf. 7.2% respectively; Fisher's exact test for a 2x2 table, two-sided p = 0.038). Comparing carcasses from BGA-listed stockists with those from non-participants in either group, we found no difference in proportions with non-lead pellets (6.7% cf. 7.2% respectively). Note that some sampled businesses were members NGDA and also BGA-listed. Details of numbers of these businesses are given in Table 4.

Table 3. Estimated percentages of wild-shot pheasant carcasses with lead shotgun pellets for those carcasses containing at least one pellet. Results for the 2008/2009 shooting season are from Pain *et al*. (2010), results for the 2020/21 and 2021/22 seasons are from Green *et al*. 2021 and Green *et al*. 2022 respectively. 95% Clopper-Pearson confidence limits (CL) are shown for each estimated percentage.

	Number of carcasses with pellets		Percentage principally lead		
Shooting season	Tested	Principally lead	Estimate	Lower CL	Upper CL
2008/2009	10	10	100.0	69.2	100.0
2020/2021	180	179	99.4	96.9	99.99
2021/2022	215	214	99.5	97.4	99.99
2022/2023	235	221	94.0	90.2	96.7

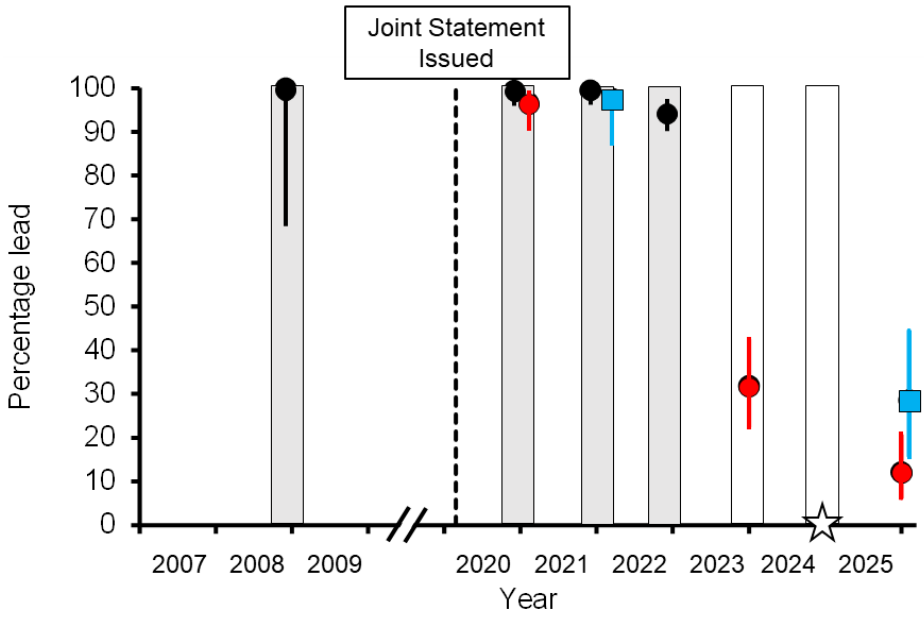

Figure 1. Comparison of the estimated percentages of carcasses of wild-shot common pheasants killed in Great Britain using lead shotgun ammunition (black circles) between a study conducted in the 2008/2009 shooting season (Pain *et al.* 2010) and three recent SHOT-SWITCH studies (Green *et al.* 2021; 2022 and the present study). The vertical lines associated with the black circles are 95% confidence intervals. Grey bars represent the timing of the October – January shooting seasons with existing data on shotgun ammunition types used. White outlined bars denote future seasons remaining within the proposed voluntary transition. The white star represents the intended endpoint of the voluntary complete transition to the use non-lead shotgun ammunition advocated by nine shooting and rural organisations in their joint statement of February 2020. Other symbols represent recorded (2020 and 2021) and projected (2023 and 2025) proportions of gamebird shoots continuing to use lead shot, with their 95% confidence intervals shown by vertical lines, based upon questionnaire surveys by Savills (2021: red circles) and Savills (2023: blue squares).

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Table 4. Estimated percentages of pheasant *Phasianus colchicus* carcasses and stockist businesses from which shotgun pellets composed principally of non-lead metals (iron and bismuth) were recovered. A business from which at least one carcass with non-lead shot was obtained was classed as a stockist of pheasants killed using non-lead shot. Results are shown separately according to whether the stockist business was a member of the National Game Dealers Association (NGDA) only, a stockist listed on the Eat Wild website of the British Game Assurance (BGA) scheme only, or both. Numbers of carcasses and businesses sampled are given in brackets.

Scheme membership		Percentages of:	
NGDA member	BGA stockist	Carcasses	Businesses
No	No	7.2 (152)	14.0 (50)
Yes	No	0.0 (38)	0.0 (6)
No	Yes	11.5 (26)	40.0 (5)
Yes	Yes	0.0 (19)	0.0 (5)

DISCUSSION

Our latest results indicate that efforts made by the shooting and rural organisations to promote the transition to non-lead ammunition are beginning to affect the types of ammunition used by hunters to shoot pheasants for the retail trade. However, this effect has so far been limited, with only about 6% of birds killed in 2022/2023 using non-lead ammunition types. This small change is surprising given that shooting organisations and magazines have communicated positive messages for three years about the efficacy and practicality of non-lead shotgun ammunition. In addition, gamebird-shooting estates surveyed about their current practice and future intentions regarding the use of lead and non-lead shotgun ammunition on their land responded that 3% of shoots were already not allowing the use of lead shotgun ammunition in the 2020/2021 season. Most other shoots planned to phase out lead shot by the end of 2023 or 2025 (Savills 2021). An additional survey of shooting estates in 2022 (Savills 2023) found that a smaller proportion (2%) of shoots did not allow the use of lead shot in the 2021/2022 season than in the previous season. The proportion of shoots intending to prevent the use of lead shot by 2025 was significantly lower (71%) in the new survey than it was (88%) in the previous one (Fisher's exact test for a 2x2 table, two-sided p = 0.027). The results from these surveys indicate that limited progress is being made with regard to shooting estates' transition to non-lead ammunition. These results match those from our study and indicate that considerably more rapid progress will need to be made if a complete transition is to be achieved by the 2024/2025 shooting season (Figure 1).

Our survey suggests that Waitrose & Partners' intended goal of not selling any game killed using lead ammunition is being achieved, but only because Waitrose stores were not selling pheasant meat products. In the 2021/2022 season, before the NGDA's change of policy to supply only game killed by non-lead ammunition was to be implemented, SHOT-SWITCH monitoring found that all pheasant carcasses obtained from the NGDA member businesses sampled had been killed using lead shot (Green *et al.* 2022). This was also the case in the 2022/2023 season, after the change should have occurred. Our results indicate that the 11 member businesses of the NGDA from which we obtained pheasants were all selling game killed using lead ammunition in the 2022/2023 season, despite their stated commitment to cease completely. Our findings are consistent with results from an analysis of pheasant meat obtained from three NGDA members in November 2022 which found high concentrations of lead in meat from most of the carcasses sampled (Wild Justice 2022). Our results suggest that consumers were significantly more likely to purchase pheasants killed using lead ammunition if they obtained them from members of the NGDA than if they bought from vendors who were not members of the NGDA or the BGA assurance scheme. Stockists approved by the BGA's assurance scheme were also selling pheasants killed using lead ammunition and the proportion of carcasses obtained from BGA stockists that contained lead pellets was very similar to that for sources who were neither members of the BGA assurance scheme nor the NGDA.

This paper monitors outcomes for the 2022/2023 shooting season, which is the first since the publication in May 2022 of the UK Health & Safety Executive's restriction proposal dossier for a possible future ban on the use of lead ammunition (HSE 2022). We suggest that progress with implementing both types of voluntary actions intended to increase the proportion of wild-shot pheasants available for human consumption that are killed using non-lead ammunition has been very slow. With just two shooting seasons remaining before the voluntary transition is intended to be complete, our findings suggest that much remains to be done if it is to be achieved.

Annual cost of the SHOT-SWITCH monitoring programme

We estimate the total annual cost of the SHOT-SWITCH project at £25,000. Purchasing pheasant carcasses and posting shot samples cost £2,100 (£6 per sample). Chemical analysis cost £7,050 (£30 per sample) The principal investigators and co-workers

ISSN 1758-2067

donated their time spent acquiring and processing carcasses, recording data, managing the project, analysing data and writing up the results on a *pro bono* basis. The total time spent on these activities was 39 working days. Costing this time at £400 per day gives an additional cost of £15,600.

ACKNOWLEDGEMENTS

We thank Leo Batten, Margaret Breaks, Margot Brownsword, Jacquie Clark, Sophie Green, Shireen Green, Jonathan More O'Ferrall, Alastair Stobart, Matthew Webster and Alastair M. Wilson for assistance with obtaining and processing the pheasant carcasses. Rob Sheldon thanks Wild Justice for funding support. Peter Marshall kindly provided detailed information on the efforts made by BASC to promote the transition to non-lead shotgun ammunition. Roger Draycott (GWCT) and Nicola Buckingham (Savills) helped us to access results from the Savills Game and Conservation Benchmarking Surveys. We thank Ann Thornton, Bill Sutherland and anonymous reviewers for useful comments.

The Royal Society for the Protection of Birds and Waitrose & Partners contributed to the costs of materials and reagents for the study.

This paper is the third publication of results from the SHOT-SWITCH project. More information on the objectives and methods of the project is available on the website of the Environmental Research Institute, University of the Highlands and Islands, Thurso, UK (Environmental Research Institute 2023).

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ISSN 1758-2067